

Greeley City Council Agenda

Work Session
Tuesday, January 10, 2023 at 6:00 p.m.

City Council Chambers at City Center South, 1001 11th Ave, Greeley, CO 80631
Zoom Webinar link: <https://greeleygov.zoom.us/j/86148461863>

NOTICE:

City Council Work Sessions are held on the 2nd and 4th Tuesdays of each month in the City Council Chambers. Meetings are conducted in a hybrid format, with a Zoom webinar in addition to the in person meeting in Council Chambers.

City Council members may participate in this meeting via electronic means pursuant to their adopted policies and protocol.

Members of the public are also invited to view Council work sessions in person or remotely. **Work sessions do not include public input in any format. Public comment is only permitted at regular Council meetings on the 1st and 3rd Tuesdays of each month.**

Watch Meetings:



Meetings are open to the public and can be attended in person by anyone.



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For more information about this meeting or to request reasonable accommodations, contact the City Clerk's Office at 970-350-9740 or by email at cityclerk@greeleygov.com.

Meeting agendas, minutes, and archived videos are available on the City's meeting portal at greeley-co.municodemeetings.com/





Mayor
John Gates

Councilmembers

Tommy Butler
Ward I

Deb DeBoutez
Ward II

Johnny Olson
Ward III

Dale Hall
Ward IV

Brett Payton
At-Large

Ed Clark
At-Large

A City Achieving
Community Excellence

Greeley promotes a healthy, diverse economy and high quality of life responsive to all its residents and neighborhoods, thoughtfully managing its human and natural resources in a manner that creates and sustains a safe, unique, vibrant and rewarding community in which to live, work, and play.

City Council Work Session Agenda

January 10, 2023 at 6:00 PM

**City Council Chambers, City Center South, 1001 11th Ave &
via Zoom at <https://greeleygov.zoom.us/j/86148461863>**

1. Call to Order
2. Pledge of Allegiance
3. Roll Call
4. Reports from Mayor and Councilmembers
5. Office of Emergency Management and Disaster Response Overview
6. Overview of the Greeley Downtown Plan Update
7. Water & Sewer Department Updated Design Criteria & Construction Specification
8. Scheduling of Meetings, Other Events
9. Adjournment



Work Session Agenda Summary

Title:

Reports from Mayor and Councilmembers

Background:

During this portion of the meeting any Councilmember may offer a summary of the Councilmember's attendance at assigned board/committee meetings and should include key highlights and points that may require additional decision and discussion by the full Council at this or a future Work Session.

Board/Committee	Meeting Day/Time	Assignment
--Team of 2-- Board/Commission Interviews	Monthly as Needed	Council Rotation
Water & Sewer Board	3 rd Wed, 2:00 pm	Gates
Youth Commission Liaison	4 th Mon, 6:00 pm	Clark
Historic Preservation Loan Committee	As Needed	DeBoutez
Police Pension Board	Quarterly	Clark
Employee Health Board	As Needed	DeBoutez
Airport Authority	3 rd Thur, 3:30 pm	Payton/Clark
Visit Greeley	3 rd Wed, 7:30 am	Butler
Upstate Colorado Economic Development	Last Wed, 7:00 am	Gates
Greeley Chamber of Commerce	4 th Mon, 11:30 am	Hall
Island Grove Advisory Board	1 st Thur, 3:30 pm	Butler
Weld Project Connect Committee (United Way)	As Needed	Butler
Downtown Development Authority	3 rd Thur, 7:30 am	Butler/DeBoutez
Transportation/Air Quality MPO	1 st Thur, 6:00 pm	Olson/Payton
Poudre River Trail	1 st Thur, 7:00 am	Hall
Interstate 25 Coalition	As Needed	Olson
Highway 85 Coalition	As Needed	Gates
Highway 34 Coalition	As Needed	Olson
CML Policy Committee (Council or Staff)	As Needed	Payton/Lee Gates alternate
CML Executive Board opportunity	As Needed	Hall
CML - Other opportunities	As Available/Desired	
Regional Opioid Council	As Needed	Gates



Work Session Agenda Summary

January 10, 2023

Brian Kuznik, Fire Chief

Title:

Office of Emergency Management and Disaster Response Overview

Background:

This presentation serves as follow up to the City Council of October 4, 2022 regarding the City of Greeley's (City) response to disasters and more specifically what the City is doing to lessen the impact of utility service interruptions that are often experienced during a disaster.

Office of Emergency Management - Department Overview:

The City's Office of Emergency Management (OEM) is a citywide function that is currently located within the Fire Department. The OEM's primary responsibilities include:

- the four phases of emergency management, which include mitigation, preparedness, response, and recovery;
- coordinating resources to maintain continuity of operations during major emergencies and disasters; and
- completing regularly scheduled updates to the city's Emergency Operations Plan, along with other critical documents, developing training and exercise programs, leading the city's Incident Support Team, and managing the city's Emergency Operations Center.

Currently, the Fiscal Year 2023 budget includes funding for two full-time positions - an Emergency Manager and an Assistant Emergency Manager. Due to resignations within the Division over the past year, the Emergency Manager position is currently filled on an interim status pending the completion of an organizational and operational assessment conducted by a third-party vendor.

The 2023 priorities for the OEM include the completion of an operational assessment, filling vacant positions, and establishing mitigation and response strategies that are designed to enhance community resiliency.

Summary of Community Hazards:

The Greeley community is susceptible to a wide range of natural, human-caused, and technological hazards. As such, the City has adopted an all-hazards emergency operations plan (EOP) that provides general guidelines and principles for managing and coordinating the

overall response and recovery activities before, during, and after major emergencies and disaster events that affect the City. Furthermore, the City has adopted a continuity of operations plan (COOP) which outlines the essential functions that are necessary for the city to maintain service to the community.

The Greeley community and Weld County region have experienced natural disasters such as floods, wildfires, tornadoes, winter storms, technological emergencies, infrastructure failures, and hazardous material incidents. Greeley continues to be vulnerable to a wide range of hazards.

Partner Agencies:

The City understands the significance that strong partnerships play in preparing for and responding to disasters. As such, the OEM is committed to developing strong working relationships with our many public and private partner agencies. In particular, the OEM works closely with all of our utility service partners such as Atmos Energy, Xcel Energy, Poudre Valley REA, and Verizon Wireless. These agencies work to reduce the loss of service within the community and each are committed to prompt restorative efforts during emergencies.

Strategic Focus Area:

Safe and Secure Communities



Attachments:

PowerPoint

Office of Emergency Management

OEM Update & Disaster Response Overview

January 10, 2023



Office of Emergency Management

The Office of Emergency Management (OEM) is responsible for:

- Activities specific to the four phases of emergency management:
 - Mitigation, Preparedness, Response, and Recovery
- Framework for processes and procedures that ensure critical mission essential functions continue in the event of a disaster, while ensuring resources and personnel are in place to foster recovery and resiliency after an event

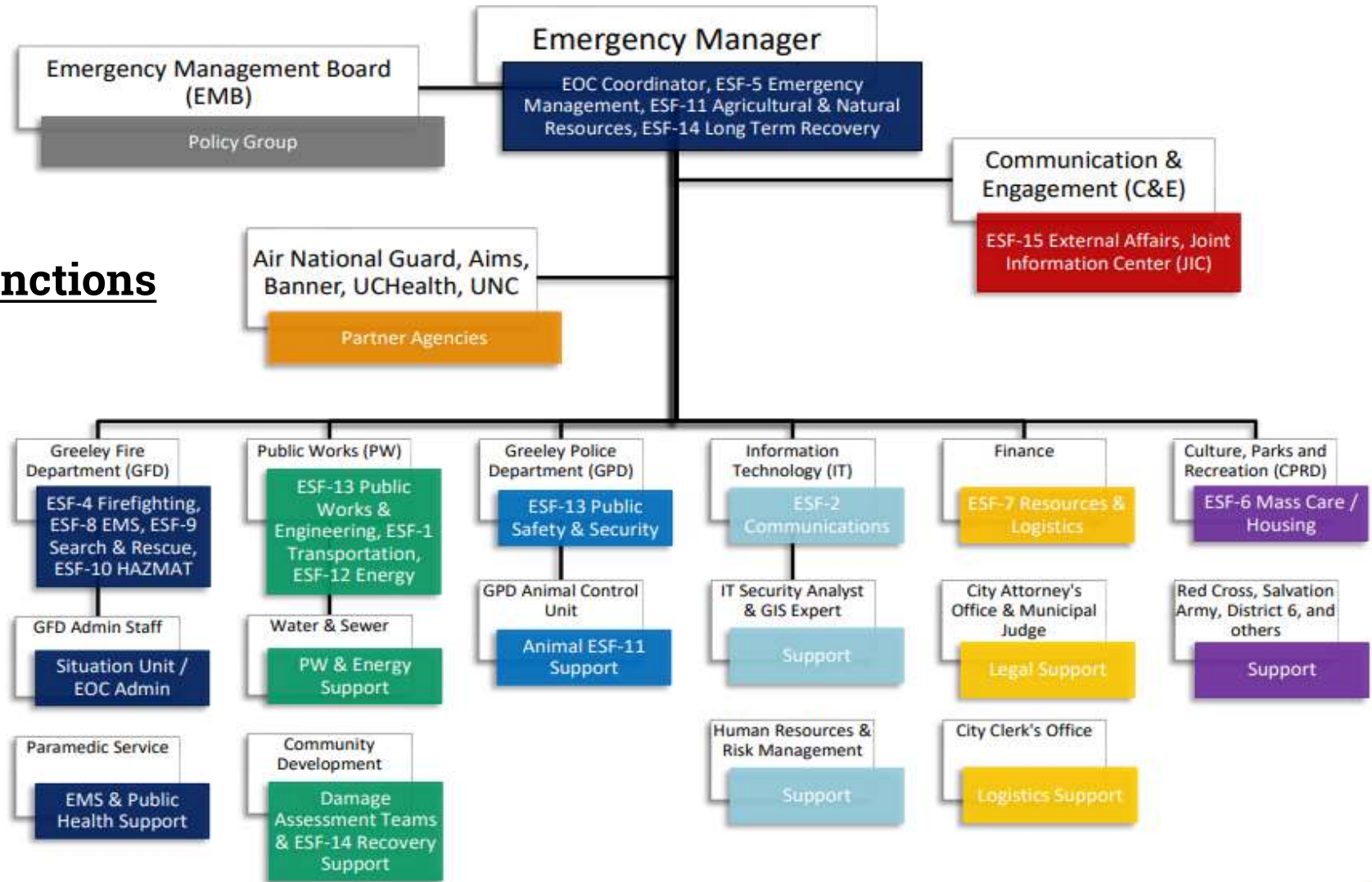
Office of Emergency Management

Crisis Communication:

- Reverse 911: notifying phone numbers associated with a specific address
- Emergency Alerts – CodeRED
 - Requires citizen to opt-in - www.weld911alert.com
- Integrated Public Alert and Warning System – IPAWS
- Employee Emergency Notifications - HipLink

Organization and Assignments

Emergency Support Functions



Office of Emergency Management

Current State of the Office of Emergency Management:

- Two full time positions funded in FY 2023
 - Emergency Manager and Assistant Emergency Manager
- Organizational and Operational Assessment underway
 - Anticipated completion - Spring 2023

Office of Emergency Management

Key Partner Agencies:

- Utility providers, cell service companies, nonprofits, healthcare organizations, higher education institutions, and numerous state emergency management professionals throughout the state of Colorado.



Questions





Work Session Agenda Summary

January 10, 2023

Becky Safarik, Interim Community Development Director

Title:

Overview of the Greeley Downtown Plan Update

Background:

In 2011, the Greeley Downtown Development Authority completed the “Downtown Greeley Investment Strategy”, which provided a vision, analysis of conditions, goals and strategies to help direct downtown investments. In the ensuing decade numerous and significant public and private improvements have been made to advance those redevelopment objectives.

To capitalize on that momentum, take stock of existing conditions, gaps, and opportunities, the City initiated an update of the existing strategic plan. Using another 10-year planning horizon – 2032 – the City contracted with a consultant, P.U.M.A, to undertake this work.

The attached plan was crafted with extensive technical and community engagement and participation over the duration of the study. The updated plan includes a market analysis, capital improvement and urban quality assessments, a vision and core values summary, and a set of action steps to achieve these objectives.

As with the previous plan, it is contemplated that this plan, if approved, would update the plan referenced in the City’s Comprehensive Plan and be used to evaluate future land use proposals. The Planning Commission will conduct a public hearing and formulate a recommendation to Council relative to this proposed plan at its January 10th regular meeting.

Strategic Focus Area:



Business Growth



Community Vitality



Housing for All



Infrastructure and Mobility



Quality of Life



Safe and Secure Communities

Attachments:

Downtown Plan
Slide presentation

Item No. 6.



DOWNTOWN 2032 – THE PATH FORWARD

GREELEY DOWNTOWN PLAN UPDATE

Draft - December 2022

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APPENDIX A: MARKET ASSESSMENT

APPENDIX B: CAPITAL IMPROVEMENT ASSESSMENT

APPENDIX C: URBAN QUALITY ASSESSMENT⁶⁴

APPENDIX D: ONLINE COMMUNITY SURVEY RESULTS

APPENDIX E: PAST PLANS & STUDIES SUMMARY

DRAFT

PLAN SUMMARY

PLAN OVERVIEW

In early 2022, the City of Greeley and the Greeley Downtown Development Authority (DDA) initiated **Downtown 2032 – The Path Forward**, to help guide growth, investments, and improvements in Downtown Greeley over the next decade. Downtown 2032 – The Path Forward provides a roadmap for citywide decision-making and strengthening Downtown’s role as the heart of the region. It also educates the general public about Downtown’s importance to the larger Greeley community and Northern Colorado.

In order to create the roadmap that will guide Downtown investments and improvements for the next decade, the P.U.M.A. Team, City of Greeley, and DDA staff worked collaboratively to chart and complete a Downtown planning process that included an analysis of existing conditions, community outreach, and development of a physical framework and detailed action plan.

EXISTING CONDITIONS

In order to evaluate existing conditions, the P.U.M.A. Team conducted a review of past plans and studies, an analysis of market conditions, and an assessment of physical conditions, including an evaluation of capital improvements and urban quality characteristics. Together, the market, capital improvement, and urban quality assessments serve as the analytical foundation for physical framework and action plan recommendations.

MARKET ASSESSMENT

The **Market Assessment** provides an overview of four market segments - Live (residential), Work (office, manufacturing, and other primary employment), Shop & Dine (retail and restaurants) and Visit & Stay (hospitality and tourism). This Market Assessment is intended to provide baseline data for Downtown Greeley, before and after the beginning of the COVID disruption, when possible, which will inform the community as it continues to transition past the pandemic. The Market Assessment also explores strengths and vulnerabilities in each market segment to ensure subsequent plan recommendations are grounded in economic reality.



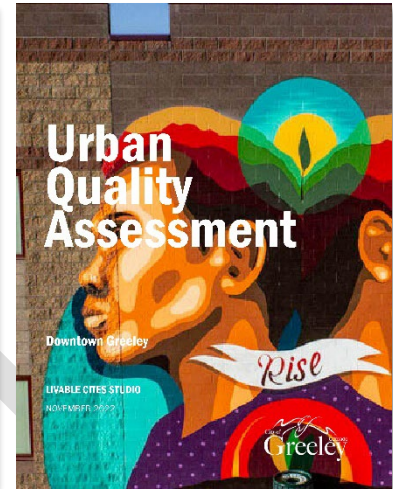
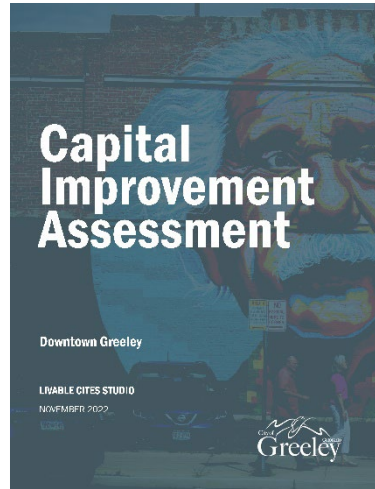
MARKET ASSESSMENT KEY FINDINGS

- The housing market and demand for additional housing remains robust, and will remain a key economic driver in Downtown Greeley moving forward.
- The industrial sector, including manufacturing, and agriculture serve as enduring economic anchors in Downtown. The legacy and continued strength of these sectors offers the potential to define a differential advantage from other downtowns and attract additional anchor employers in these industries.
- Downtown’s office market is likely to remain niche over the next market cycle, though there could be opportunities for small businesses, incubation, and co-working in existing or renovated spaces. The low cost of office space in Downtown offers a lower barrier to entry for entrepreneurs and new businesses compared to peer downtowns.

- Retail continues to strengthen in Downtown. The retail sector could be further bolstered by continuing to build housing and tapping into primary market opportunities like younger and Latinx households and UNC students.
- Connections to UNC remain an underutilized market opportunity.

CAPITAL IMPROVEMENT AND URBAN QUALITY ASSESSMENT

The **Capital Improvement Assessment** is a physical evaluation of the existing streets, plazas, and parks located within the study area boundary. The purpose of the Capital Improvement Assessment is to evaluate the current conditions of the public realm between the curb and edge of the right-of-way, which consists most of the streetscape, to identify gaps and opportunities that can be inform public realm and placemaking recommendations in the Downtown 2032 – The Path Forward Plan.



The **Urban Quality Assessment** is intended to establish a foundation for a high-quality public realm environment by evaluating current conditions in four key areas: existing public spaces, forms of movement, existing street hierarchy, and safety. The Urban Quality Assessment combined with the Capital Improvement Assessment provides a foundation for developing the public realm recommendations found in the physical framework and action plan.

CAPITAL IMPROVEMENT ASSESSMENT KEY FINDINGS

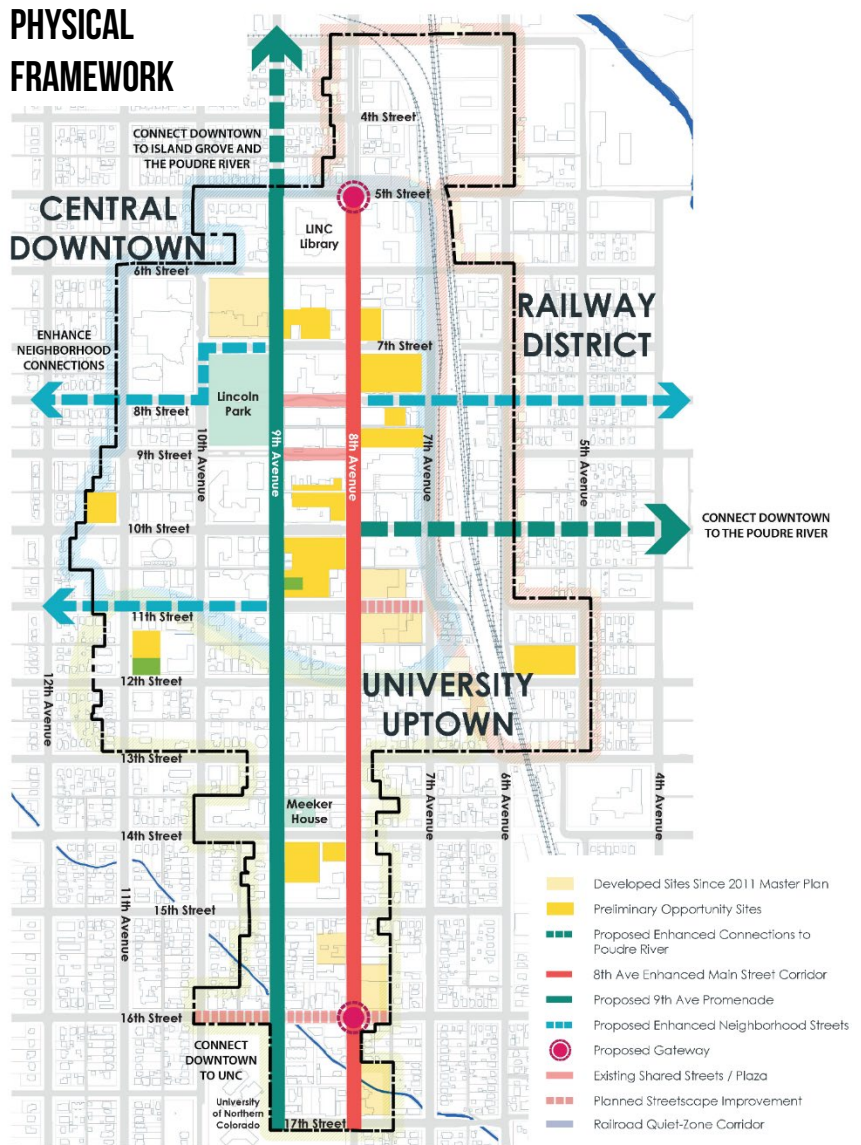
- Areas on the eastern edge of Downtown have the lowest quality public realm, as the majority were ranked as poor and many locations lack basic sidewalks.
- Areas around the Downtown core have a higher ranked capital improvement quality due to additional investment that has occurred on 8th Street, 9th Street, Lincoln Park, 8th Avenue, and surrounding streets.
- The residential areas south of the Downtown core generally have a higher quality public realm with mature trees, lawns, and generous sidewalks.
- 8th Avenue and 9th Avenue have distinctly different but complimentary characters and they generally provide good north to south connectivity through Downtown. These corridors are also supported by 10th Avenue and 11th Avenue that run north-south on the west edge of Downtown.
- In most cases, non-residential areas are fair to poor quality with significant stretches lacking basic sidewalks.

URBAN QUALITY ASSESSMENT KEY FINDINGS

- There is a lack of a distinct public space network and unequal distribution of public spaces throughout the study area geography.
- For an urban core, Downtown has a disproportionate amount of land area dedicated to vehicles, including surface parking lots, wide roads, high volume traffic streets, and on-street parking.
- There is a bicycle infrastructure foundation in Greeley that can be built upon, but that needs to be completed and fully connected to increase bicycling in Downtown moving forward.
- There are pockets of adequate lighting near the core of Downtown, but lighting is lacking in other parts of Downtown.

PHYSICAL FRAMEWORK

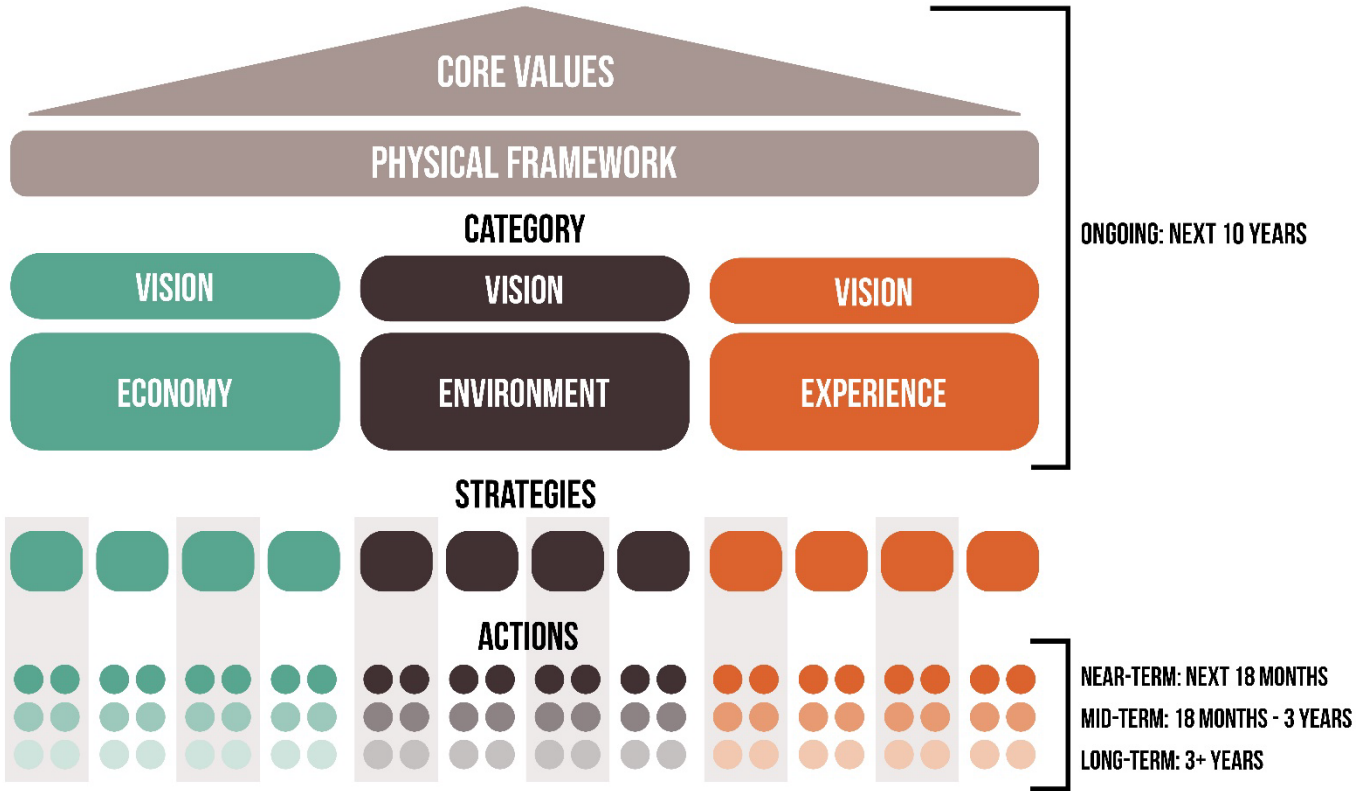
Drawing on the above inputs, the consultant team developed a physical planning framework to guide investments in the public realm that support and enhance market opportunities in Downtown and deliver a Downtown environment that is in sync with community values. The framework maps and descriptions that can be found in Chapter 4: Physical Framework are a key component of this Plan. The Physical Framework includes revised and redefined sub-areas within Downtown, the identification of opportunity sites for future infill development or redevelopment, and transformative projects that can be catalysts for investment and are recommended for priority funding and implementation over the next five to ten years.



ACTION PLAN

Created using the Market, Capital Improvement, and Urban Quality Assessments, and priorities identified through community engagement as building blocks, the Action Plan is intended to provide an implementation roadmap for Downtown Greeley over the next ten years. The Action Plan is guided by the overarching physical framework and core values, and is sorted into three topic areas – Economy, Environment, and Experience – with supporting vision and strategy statements.

The Action Plan is structured by strategies within each topic area, while specific actions can be found in Chapter 5 of the full Plan. The project team developed immediate, short- and mid-term actions for Downtown improvements and investments to guide the City of Greeley, the DDA, the development community, and downtown stakeholders for the next ten-year investment cycle. Responsible parties and illustrative cost are also identified to provide implementation guidance on each of the actions in the full plan.



CORE VALUES AND VISION

CORE VALUES

The Core Values identified below provide an overarching foundation for the Action Plan and are interwoven into all three topic area sections, with each action encompassing one or more of these Core Values.

- Welcoming & Inclusive
- Prosperous & Vibrant
- A Complete Neighborhood
- Accessible & Connected

VISION

The consultant team worked closely with the City of Greeley, the DDA, and the Advisory Committee to synthesize the following vision that forms the basis for the Action Plan recommendations described and illustrated throughout this document.

In 2032..

Downtown Greeley's **ECONOMY** will be robust and diverse, offering residents, employees, students, patrons, and visitors a range of options for jobs, housing, shopping, and dining.

The Downtown physical **ENVIRONMENT** and public realm will be inviting and accessible for people walking or using mobility devices, biking, riding transit, or driving.

The Downtown **EXPERIENCE** will be vibrant, fun, welcoming, and inclusive.

STRATEGIES

ECONOMY

1. Continue to stimulate infill development and redevelopment of underutilized sites.
2. Encourage diverse, vibrant storefront uses throughout Downtown.
3. Continue to diversify the housing base in Downtown.
4. Sustain and attract more primary employers and jobs.
5. Cultivate a Downtown economy that is relevant and welcoming to an array of community stakeholders and visitors.

ENVIRONMENT

1. Enhance connections to the Poudre River north and east of Downtown.
2. Improve connections to the UNC campus.
3. Create new public spaces focused on families, residents, visitors, and the everyday use of inviting and comfortable outdoor spaces, ensuring that each sub-area has an identifiable and destination public space.
4. Unify Downtown's public realm with standards that provide consistency and improve the overall quality.
5. Enhance the quality of the connections to the adjacent neighborhoods around Downtown.

EXPERIENCE

1. Promote local arts and creative experiences in Downtown.
2. Ensure Downtown is clean, safe, and welcoming.
3. Celebrate historic character, charm, and distinctive environment in Downtown.
4. Continue to activate Downtown through programming and events that are relevant and inclusive to Greeley's diverse population.
5. Market existing Downtown assets and amenities to both locals and visitors.

CHAPTER 1: BACKGROUND

PLAN PURPOSE

In early 2022, the City of Greeley and the Greeley Downtown Development Authority (DDA) initiated the Greeley Downtown Plan Update, entitled **Downtown 2032 – The Path Forward**, to help guide the growth and development of Downtown Greeley for the next decade.

After a competitive bid and selection process, the City of Greeley engaged a Denver-based consulting team that included Progressive Urban Management Associates (P.U.M.A.), a firm specializing in downtown organizational and strategic planning and Livable Cities Studio, an urban design and landscape architecture studio focused on improving public spaces and connections to the natural environment.

P.U.M.A. was also contracted by the DDA in 2011 to complete the 2011 Downtown Greeley Investment Strategy, a process that evaluated market conditions and trends, engaged Downtown stakeholders, developed a framework for Downtown that included four sub-areas, and provided an organizational and financing strategy for the DDA to guide investments. This Downtown Plan Update is intended to build on the 2011 Investment Strategy, while identifying new initiatives and priorities looking forward to the next ten years.

HOW TO USE THIS PLAN

Both public agencies and private sector stakeholders will use Downtown 2032 – The Path Forward to guide decisions and actions that affect the form and function of Downtown. The Plan provides a basis for citywide decision-making and strengthening Downtown’s role as the heart of the region. It also educates the general public about Downtown’s importance to the larger Greeley community and the region.

The plan includes an analysis of existing conditions through market, capital improvement and urban quality assessments. More than 1,250 Downtown and Greeley community members provided opinions that shaped plan priorities. The findings from the assessments and community engagement process informed the subsequent structure of the plan, including recommendations for Downtown’s future physical framework, vision, core values, strategies and detailed actions. The Plan’s various sections are outlined, in sequence, below:

In order to evaluate **existing conditions**, the P.U.M.A. Team conducted an assessment of market conditions and an assessment of physical conditions, including an evaluation of capital improvements and urban quality characteristics.

- The **Market Assessment** includes a wide range of data inputs, including primary and secondary sources, that offers a snapshot of existing market conditions Greeley, a Primary Market Area, and Downtown, as well as comparisons between Downtown and downtowns in peer cities. The market assessment provides an overview of four market segments, including Live (residential), Work (office, manufacturing and other primary employment), Shop & Dine (retail and restaurants) and Visit & Stay (hospitality and tourism). This Market Assessment is intended to provide baseline data for Downtown Greeley, before and after the beginning of the COVID disruption when possible, which will inform the community as it continues to transition past the pandemic.
- The **Capital Improvement Assessment** is a physical evaluation of the existing streets, plazas, and parks located within the study area boundary. The purpose of the Capital Improvement Assessment is to evaluate the current conditions of the public realm between the curb and edge of the right-of-way, which consists most of

the streetscape, to identify gaps and opportunities that can be inform public realm and placemaking recommendations in the Downtown 2032 – The Path Forward Plan.

- The **Urban Quality Assessment** is intended to establish a foundation for a high-quality public realm environment by evaluating current conditions in four key areas: existing public spaces, forms of movement, existing street hierarchy, and safety. The Urban Quality Assessment combined with the Capital Improvement Assessment provides a foundation for developing a public realm improvements plan to encourage Downtown Greeley to continue to grow and thrive for years to come.

A summary of the Market Assessment, Capital Improvement Assessment, and Urban Quality Assessment are included in this plan in **Chapter 2: Existing Conditions**, while the full documents are in **Appendices A, B, and C**.

The Downtown 2032 – The Path Forward planning process included a significant community outreach effort that was undertaken by the City of Greeley, the DDA, and the P.U.M.A. team to identify priorities and craft plan recommendations. Additional detail on the methods used to engage the community, key themes from stakeholder engagement, and findings from the online survey can be found in **Chapter 3: Community Outreach**.

Informed by community outreach and an in-depth analysis of existing conditions, the **Physical Framework** section provides an overarching guide for future development, investment, and public realm improvements for Downtown. This section includes an analysis of and recommendations for sub-areas within Downtown, identifies opportunity sites for potential infill development or new public realm amenities, and describes transformative projects that can have a catalytic impact on continuing Downtown’s vitality moving forward. The Physical Framework, including descriptions of its various components, can be found in **Chapter 4: Physical Framework**.

The final section, the **Action Plan**, provides detailed policy and physical improvement recommendations organized into three topic areas; Economy, Environment, and Experience. The Action Plan also provides responsibility centers, illustrative cost, and sequencing for each action. The full Action Plan can be found in **Chapter 5: Action Plan**.

At the back of this document, **Appendices** are included that provide the full assessment of market conditions, the full capital improvement and urban quality assessments, detailed online survey results, and the full summary of past plans and studies.

ACCOMPLISHMENTS SINCE THE 2011 INVESTMENT STRATEGY

Since the 2011 Downtown Greeley Investment Strategy, both the City of Greeley and the Greeley Metropolitan Statistical Area (MSA) have experienced significant growth and development, and the City of Greeley and DDA have accomplished many of the actions recommended in the Investment Strategy. The City and DDA’s role in implementing the Downtown Investment Strategy has continued to strengthen Downtown Greeley’s role as a regional economic and civic anchor. Since 2011, key accomplishments include:

- 16th Street Streetscape and Intersection Improvement Plan
- New 55+ Resort Apartments & Austin’s American Grill
- 8th Avenue Corridor Streetscape Improvements
- 8th Street Complete Street Improvements
- Lincoln Park Improvements
- Greeley Recreation Center Upgrade
- Expanded Public Art Program
- New Syntax Distillery Development
- Parking Management System Implementation

- Establishment of the Greeley Creative District
- New Signature Events Initiated (e.g. Friday Fest, Monster Day, Youth Arts Month, Trick or Treat Street, Oktobrewfest, St. Patrick's Day Parade, etc.)
- Installation of New Downtown Entryway Signage
- New Development of Apartments at Maddie
- New City Center South Municipal Complex
- City Hall Renovation and City Center North Phase 2 Improvements
- New DoubleTree Hotel and Conference Center Development
- New Dutch Bros Coffee Company
- New Fire Station #1
- Firestone Retail
- Rehab of Immaculata Plaza 1 Apartments/Condominiums and Breaking Ground on Immaculata Plaza II New Affordable Housing Development
- Library Innovation Center (LINC) Redevelopment
- New Natural Grocers Grocery Store
- Creation of a Railway Quiet Zone through Downtown Greeley
- The 609 Studio Apartment Building Renovation
- WeldWerks Brewing Co. Adaptive Reuse, Taproom, and Restaurant

HISTORICAL CONTEXT

Beginning more than 12,000 years ago, many of the original inhabitants of the area we now call Colorado were far-ranging people who travelled the southwestern deserts and northern plains, moving with the seasons for the best hunting, gathering, and harvesting. Colorado is just one of the many ancestral lands where the Ute Nation, Apache, Arapaho, Cheyenne, and Comanche grew their culture for thousands of years.

In 1851, the Treaty of Fort Laramie was established between the U.S. government and several local tribes as part of the government's attempt to protect the growing number of settlers moving west and to launch a military presence in the region. Per the treaty, each Native American tribe consented to sovereignty over a bounded territory in exchange for allowing free passage of white migrants as well as the construction of roadways and forts on their land. However, the Colorado Gold Rush of 1858-59 made the treaty obsolete, as settlers moved into the land that was supposedly protected. Renegotiations took place and the Treaty of Fort Wise was signed in 1861, which relegated the tribes to a much smaller tract of land (about one thirteenth the size) in eastern Colorado where they lived under government supervision¹.

Present-day Greeley began as the Union Colony of Colorado, which was established in 1869 by Nathan C. Meeker, an agricultural reporter for the *New York Tribune*, as an experimental utopian farming community "based on temperance, religion, agriculture, education and family values;" it also had the backing of the *Tribune's* editor Horace Greeley, who popularized the phrase "Go West, young man." A committee that included Meeker and former Civil War general Robert Alexander Cameron travelled to Colorado to find a suitable site and purchased 12,000 acres at the confluence of the Cache la Poudre and South Platte Rivers. The site, formerly known as the "Island Grove Ranch," included the area of Latham, an Overland Trail station, and was halfway between Cheyenne, Wyoming, and Denver, Colorado along the tracks of the Denver Pacific Railroad². The name Union

¹ (Treaty of Fort Laramie, 2022)

² (Union Colony of Colorado, 2021)

Colony was later changed to Greeley in honor of Horace Greeley, who had settled in Colorado during the 1859 Pike's Peak Gold Rush³.

Meeker had foreseen Greeley's future as an agricultural hub and future generations would come to find great success in the creation of irrigated farmland for the growth of sugar beet, carrot, alfalfa, potato, onion, and corn. With railroad access and its position at the confluence of two rivers, Greeley was set to flourish. At the turn of the 20th century, the economic boon of agriculture attracted labor-ready immigrants of European, Asian, and eventually Hispanic/Latinx descent, culturally diversifying the Front Range town.

In the late 1930s, as the area's water rights were over-appropriated, the Colorado-Big Thompson River Project was created to provide farming irrigation, diverting water from multiple sources on the east side of the Rockies. Today, the project provides water for 33 cities and towns in the state.

Cattle ranching has always been a part of Greeley's story – but had a global impact starting in the 1930s when Monfort Colorado, Inc., a local family-owned company, modernized the beef industry. The company first introduced the feedlot, changing cattle diet from grass to grain, and later combined feeding, slaughter, meatpacking, sales, and distribution under one roof, revolutionizing the process.

DOWNTOWN'S HISTORY

The first downtown area in Greeley was located on 8th Street between 8th and 9th Avenues. The buildings were adobe, wood frame, or brick structures. By 1879 the area had grown, bounded by the railroad tracks and 9th Avenue on the east and west, and by 7th Street and 9th Street on the north and south. Most of the original commercial buildings have been replaced, mainly with brick buildings. There were several reasons for the use of brick, including that several brick factories operated in Greeley, and that an 1880 fire destroyed a wood frame hotel known as the Greeley House

Greeley's Downtown Development Authority (DDA) was created in 1998. In 2000, the DDA nominated Downtown Greeley as one of Colorado's Most Endangered Places due to threats brought about as a result of economic deterioration, urban growth to the west, businesses' flight to the suburbs, and the high vacancy rate of its downtown buildings. The Downtown Greeley of 1998 stood in stark contrast to that of the mid-1970s, when it was recognized as a thriving urban center that was even made internationally famous by the novel, *Centennial*.

Once Downtown Greeley was added to the Endangered Places list, the Downtown Development Authority, along with the support of the Greeley Historic Preservation Commission, began building a strong support network of business professionals through the Main Street Board. It initially focused on plaza redevelopment, opening them to automobile traffic, as well as removing some of the newer facades to reveal historic storefronts, which in turn began attracting businesses back to the district. Momentum of the preservation of Downtown grew when Greeley became part of Colorado's Main Street program in 2001. Private LLCs purchased and rehabilitated key properties in the Downtown district, which served as a catalyst to demonstrate the potential of older properties and underscore the economic power of historic preservation⁴.

In 2011, Downtown Greeley became the first in the state of Colorado to take advantage of the Common Consumption legislation. Downtown regularly sees thousands of people at its First Friday Fests held throughout the summer months as well as its many other successful events throughout the year. Today, the DDA is very active, employing four champions for Downtown, which is enjoying extremely low vacancy rates, strong business growth, new development, and a positive reputation not only in Greeley but regionally as well.

³ (Virtual Tour, n.d.)

⁴ (Downtown Greeley, 2022)

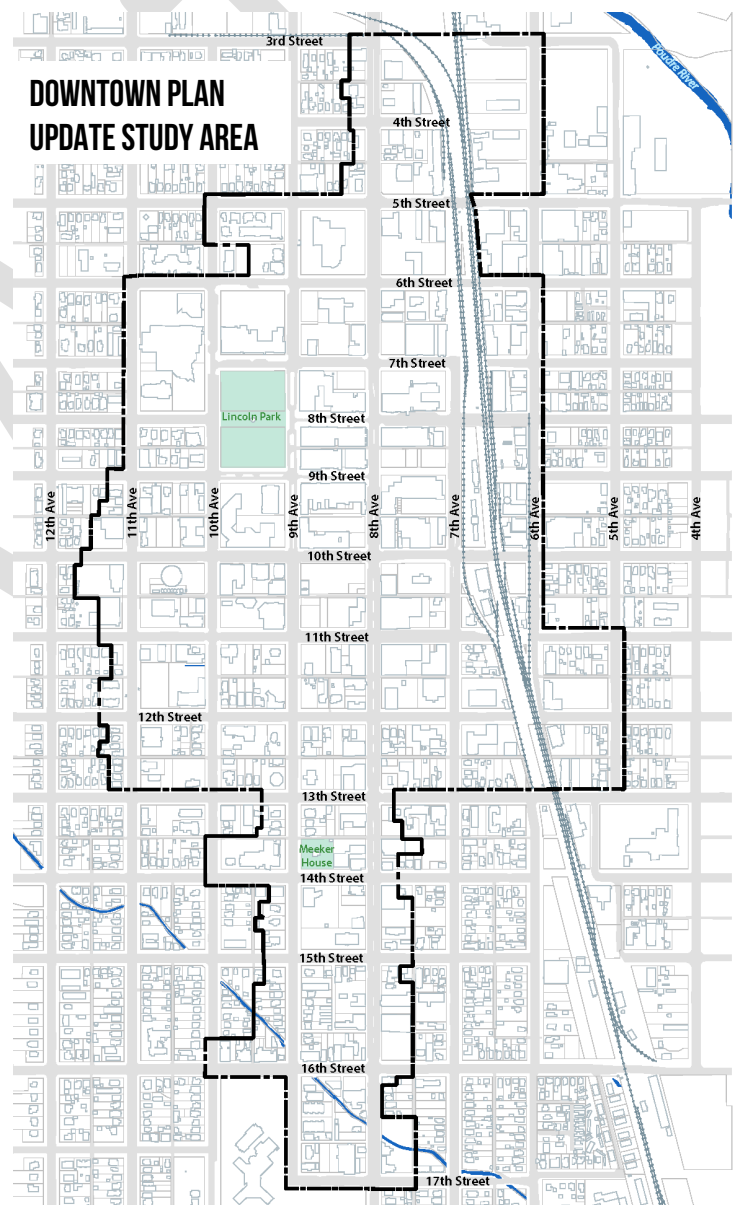
UNIVERSITY OF NORTHERN COLORADO (UNC)

UNC is a public university located in Greeley, adjacent to the southern boundary of Downtown. The university was founded in 1889 as the State Normal School of Colorado and has a long history in teacher education. The institution has officially changed its name four times, but has had its current name since May 1, 1970 reflecting its status as a fully accredited university. Nearly 10,000 students are enrolled at UNC in six colleges, with extended campus locations in Loveland, Denver/Aurora, and Colorado Springs⁵. UNC is currently in the process of becoming a U.S. Department of Education-certified Hispanic Serving Institution (HSI), as 25% of the full-time undergraduate student body is Hispanic, Latino, or Latinx-identifying, in line with the Advancing Educational Equity, Excellence, and Economic Opportunity for Hispanics initiative requirements.

Additional information on Greeley’s history can be found in **Appendix A: Market Assessment**.

STUDY AREA

For the purpose of the Downtown 2032 – The Path Forward planning process, ‘Downtown’ is defined as the area encompassed by the DDA Boundary. The study area as illustrated to the right is roughly bound by 3rd Street to the north, 5th Avenue to the east, 17th Street to the south, and between 11th and 12th Streets to the west. The study area and its context and relationship with adjacent neighborhoods is also acknowledged with this plan.

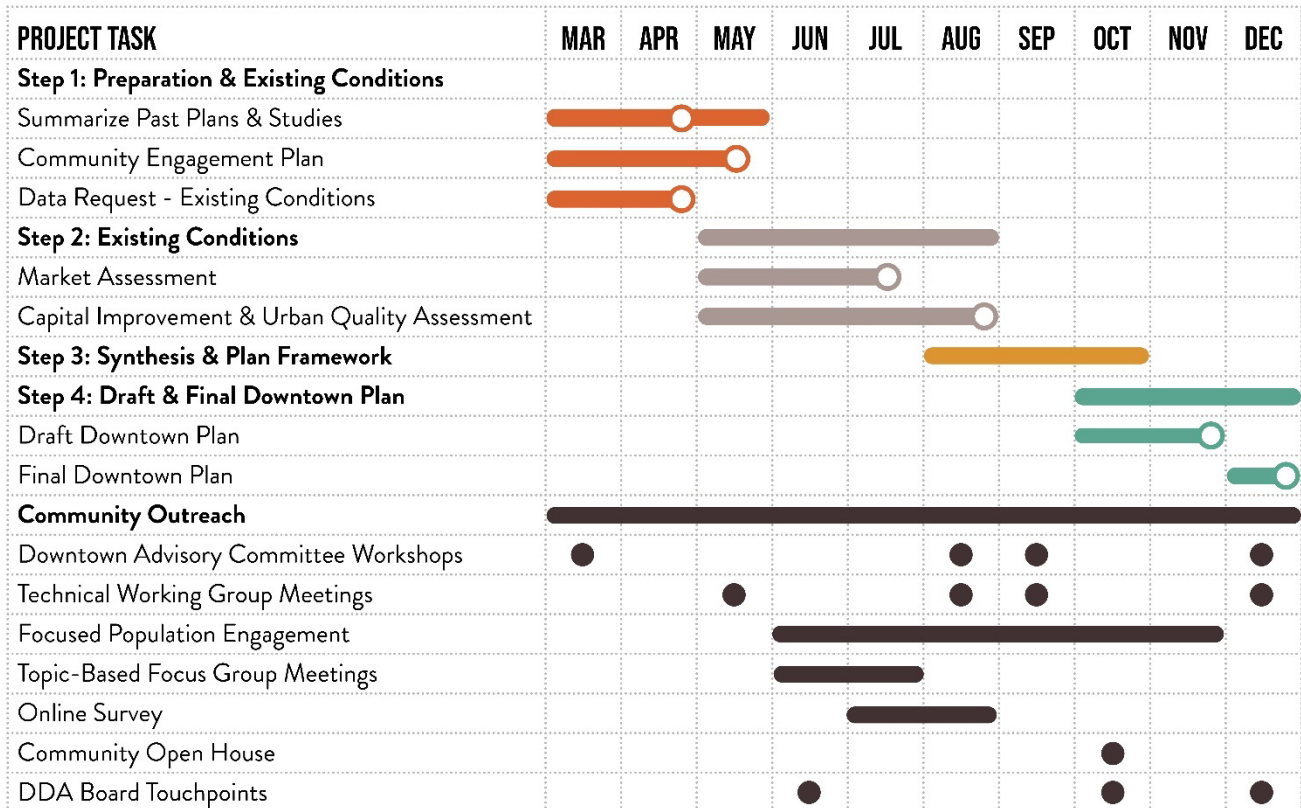


⁵ (University of Northern Colorado, 2022)

PROCESS

The P.U.M.A. Team, City of Greeley, and DDA staff worked collaboratively to chart and complete a downtown planning process with the following major components:

- **Review and analysis of prior plans and studies** conducted in Downtown Greeley over the past 10 years;
- The completion of several foundational assessments of existing conditions for Downtown 2032 – The Path Forward, including **comprehensive market, capital improvement, and urban design evaluations**;
- Extensive **community engagement with Downtown stakeholders**, civic partners such as the City and UNC, DDA board members and the community-at-large that included **nearly 1,250 inputs**;
- Based upon the preceding data and analysis, the plan includes a **physical framework** and **detailed action plan** to guide Downtown Greeley’s evolution over the next ten years.



○ DELIVERABLE

REVIEW OF PAST PLANS AND STUDIES

The City of Greeley and DDA provided the consultant team with all prior and evolving planning efforts that impact Downtown Greeley. The consultant team reviewed all the plans made available in order to ensure that this process would build upon such efforts. Summaries of past plans are included in **Appendix E**. Plans reviewed include:

- Imagine Greeley Comprehensive Plan, February 2018
- Downtown Greeley Investment Strategy, July 2011
- Downtown Greeley Accomplishments, August 2021
- 2022 Annual Growth & Development Projections Report, February 2022

- Greeley Downtown Development Authority 2020 Annual Snapshot, 2020
- City of Greeley Energy Action Plan, 2019
- Master Transportation Impact Study: 8th Avenue Redevelopment, March 2018
- City of Greeley Strategic Housing Plan, 2018
- Market Study & Recommendations: Downtown Apartment Market, April 2017
- Greeley Parks, Trails, and Open Lands Master Plan, May 2016
- Landscape Policy Plan for Water Efficiency, December 2015
- Bicycle Master Plan, May 2015

Greeley citywide plans, particularly the Imagine Greeley Comprehensive Plan, offer a high-level framework to guide and influence decisions that affect the future of the city. They are used as a foundation for the more specific vision, strategies, and actions contained in the Downtown Plan Update. Any future updates to citywide plans should incorporate and refine recommendations from this Downtown Plan.

DRAFT

CHAPTER 2: EXISTING CONDITIONS

KEY TAKEAWAYS: EXISTING CONDITIONS ANALYSIS

MARKET ASSESSMENT

- The housing market and demand for additional housing remains robust, and will remain a key economic driver in Downtown Greeley moving forward.
- The industrial sector, including manufacturing, and agriculture serve as enduring economic anchors in Downtown. The legacy and continued strength of these sectors offers the potential to define a differential advantage from other downtowns and attract additional anchor employers in these industries.
- Downtown's office market is likely to remain niche over the next market cycle, though there could be opportunities for small businesses, incubation, and co-working in existing or renovated spaces. The low cost of office space in Downtown offers a lower barrier to entry for entrepreneurs and new businesses compared to peer downtowns.
- Retail continues to strengthen in Downtown. The retail sector could be further bolstered by continuing to build housing and tapping into primary market opportunities like younger and Latinx households and UNC students.
- Connections to UNC remain an underutilized market opportunity.

CAPITAL IMPROVEMENT ASSESSMENT

- Areas on the eastern edge of Downtown have the lowest quality public realm, as the majority were ranked as poor and many locations lack basic sidewalks.
- Areas around the Downtown core have a higher ranked capital improvement quality due to additional investment that has occurred on 8th Street, 9th Street, Lincoln Park, 8th Avenue, and surrounding streets.
- The residential areas south of the Downtown core generally have a higher quality public realm with mature trees, lawns, and generous sidewalks.
- 8th Avenue and 9th Avenue have distinctly different but complimentary characters and they generally provide good north to south connectivity through Downtown. These corridors are also supported by 10th Avenue and 11th Avenue that run north-south on the west edge of Downtown.
- In most cases, non-residential areas are fair to poor quality with significant stretches lacking basic sidewalks.

URBAN QUALITY ASSESSMENT

- There is a lack of a distinct public space network and unequal distribution of public spaces throughout the study area geography.
- For an urban core, Downtown has a disproportionate amount of land area dedicated to vehicles, including surface parking lots, wide roads, high volume traffic streets, and on-street parking.
- There is a bicycle infrastructure foundation in Greeley that can be built upon, but that needs to be completed and fully connected to increase bicycling in Downtown moving forward.
- There are pockets of adequate lighting near the core of Downtown, but lighting is lacking in other parts of Downtown.

MARKET ASSESSMENT SUMMARY

A comprehensive Market Assessment was completed in the second quarter of 2022 to help inform the Downtown 2032 – The Path Forward planning effort. Data was compiled using primary and secondary sources, including the City of Greeley, Weld County, Esri Business Analyst, the U.S. Census Bureau, real estate research, interviews with local real estate experts and Downtown stakeholders, and other available sources.

It is important to note that the Market Assessment was conducted more than two years into the COVID-19 public health and economic disruption. Given the lag time in data gathering and/or funding to update some databases (typically done on an annual basis), some of the information that follows presents conditions pre-pandemic. This Market Assessment is intended to provide baseline data for Downtown Greeley, before and after the beginning of COVID when possible, which will inform the community as it continues to transition to a new normal.

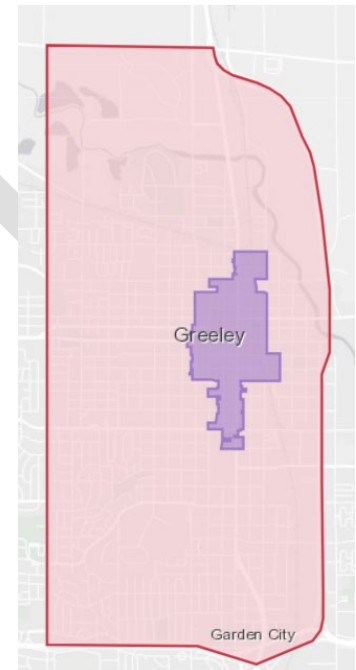
The following summary of the Market Assessment provides an overview of key findings by sector - Live (residential), Work (office, manufacturing, and other primary employment), Shop & Dine (retail and restaurants) and Visit & Stay (hospitality and tourism). The full Market Assessment can be found in **Appendix A**.

MARKET AREAS

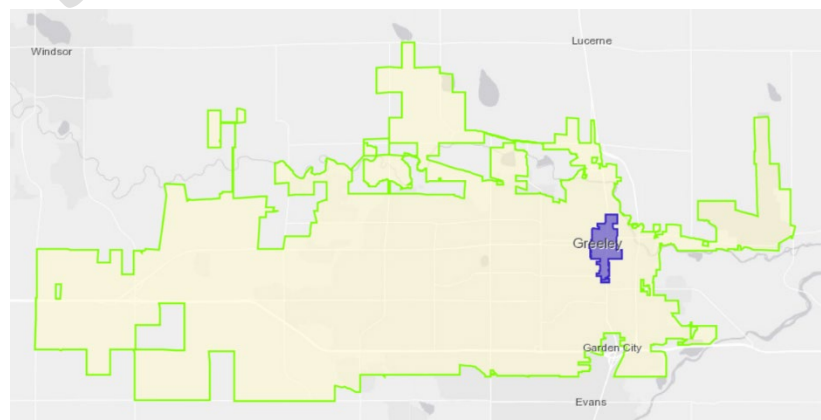
Data was collected, when available, for Downtown Greeley, a Primary Market Area, and the City of Greeley. The Downtown study area is tied to the Downtown Development Authority boundary area shown in the maps below.

The 7.7 square mile Primary Market Area, also pictured below, was defined by the City of Greeley and was also used in P.U.M.A.'s 2011 Downtown Greeley Investment Strategy report. This broader area is used to better understand market opportunities and demand for offerings from within the Downtown boundaries. The Primary Market Area boundary incorporates the Downtown area, as well as adjacent neighborhoods where residents are readily able to access (i.e., with a maximum ten-minute walk or bike ride) and support establishments within Downtown. It is bounded by County Road 64 to the north, U.S. Highway 85 (8th Avenue/Business Rt.) to the east, U.S. Highway 34 to the south, and 23rd Avenue to the west.

The City of Greeley is approximately 49.8 square miles, also shown below, and is a key market and point of comparison for Downtown data. It also offers a wider array of data than the customized, Downtown boundary.



PRIMARY MARKET AREA AND DOWNTOWN



DOWNTOWN WITHIN THE CITY OF GREELEY

PEER CITIES

Peer cities and their downtowns are used as comparisons throughout the Market Assessment. They include Cheyenne, WY; Flagstaff, AZ; Grand Junction, CO; Fort Collins, CO; Idaho Falls, ID; and Ogden, UT. They were selected by Greeley’s Department of Economic Health and Housing Department and verified by P.U.M.A. due to their downtowns being similar in size and other characteristics (i.e., most have universities). Overall, these peer cities share many of the same market dynamics that exist in Greeley today. Boundaries for peer downtowns were set based on Improvement District boundaries or downtown cores as defined in their downtown plans if an improvement district was not present.

DOWNTOWN’S IMPACT ON GREELEY

The “Summary of Impact” table demonstrates that **while its land area is small (~1% of the City), Downtown is one of the most productive and valuable neighborhoods of the community.** It contains a modest proportion of Greeley’s residents (3%), but more **substantial portions of the City’s workers** as well as **dining, drinking and shopping options** (~15% each).

About 3% of the City’s assessed value lies in Downtown land, with **each Downtown acre generating about three times more value** than citywide land in 2021 (see “Assessed Value Per Acre” table).

Summary of Impact

0.48 square miles	→	1% of the city
<i>Meanwhile, Downtown has...</i>		
1,637 residents	→	3% of the city's
7,112 employees	→	14% of the city's
107 restaurants, bars & retailers	→	15% of the city's
\$71.9M in assessed value*	→	3% of the city's

*includes exempt properties

Assessed Value Per Acre, 2021

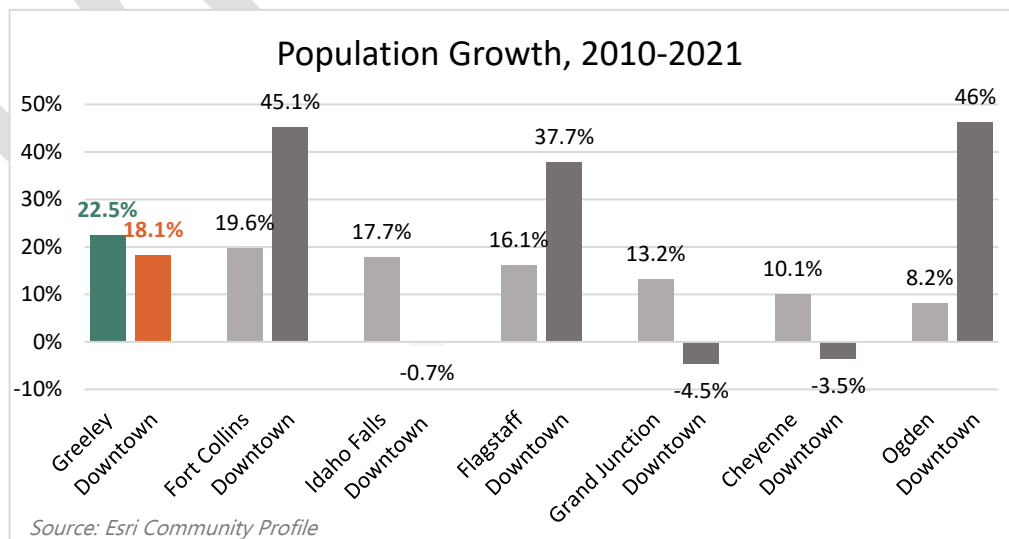
	Acres	Assessed Value	Per Acre Value
Downtown	314	\$71.9 million	\$229.4 thousand
Greeley	31,872	\$2.1 billion	\$64.5 thousand

Source: Weld County Assessor's Office

LIVE

DEMOGRAPHICS

- While Greeley’s citywide population grew more than any of its peer cities during the most recent decade, the population growth of Downtown, as well as the Primary Market Area, has lagged behind the City’s.
- Compared to the Primary Market Area and City of Greeley, in Downtown:



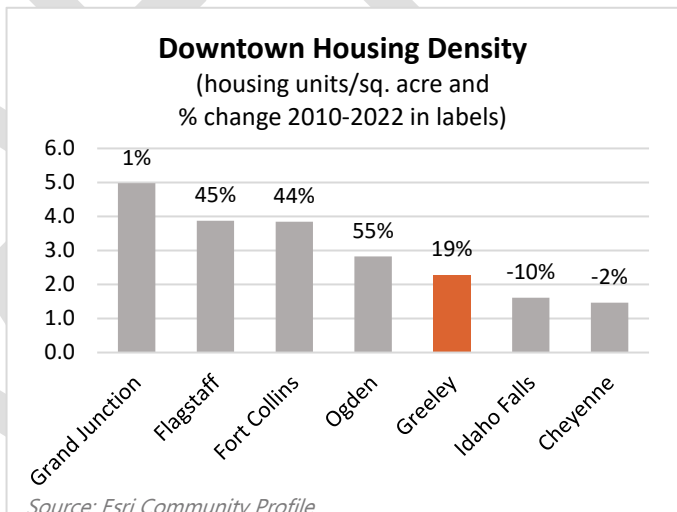
- Households have fewer people than the primary market or City of Greeley, especially children, and many are non-family households containing just one person, which is similar to peer downtowns.
- There is greater diversity, with high proportions of residents identifying as Hispanic.
- Median household income and educational attainment are lower, which is true for peer downtowns and partially explains why Downtown Greeley has historically been associated with higher levels of poverty.
- The white-collar proportion of occupations decreases, while the proportion of blue-collar and services occupations increases; a pattern that is true for about half of peer downtowns in terms of white- and blue-collar workers; all peers examined had higher percentages of service workers living in their downtowns.

Percent of Population that are College Students, 2021	
Flagstaff	37%
Fort Collins, CO	37%
Ogden, UT	33%
Grand Junction, CO	12%
Greeley, CO	7%

- Downtown Greeley is on the low end of population density when compared to its peers.
- Downtown could stand to attract young professional and student residents, especially considering that its university is directly adjacent to Downtown. Greeley's peer cities with universities have much greater proportions of student populations to reside in and/or patronize their downtowns.

HOUSING MARKET

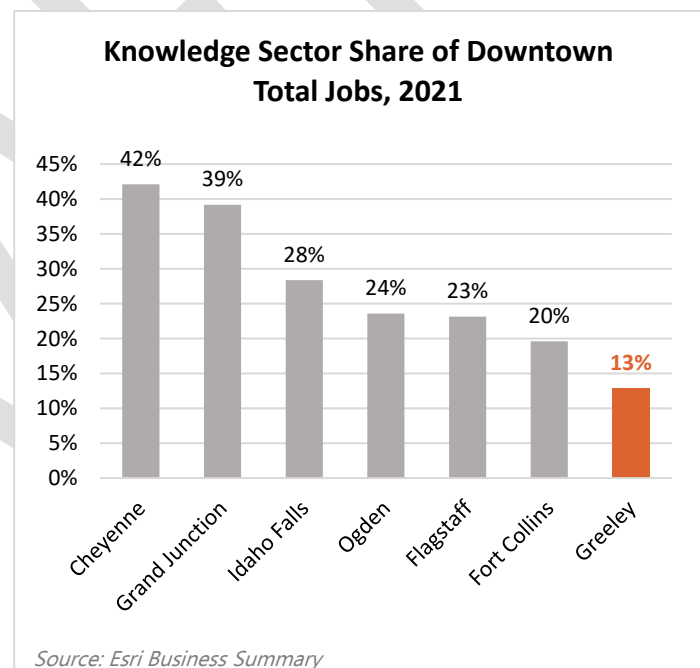
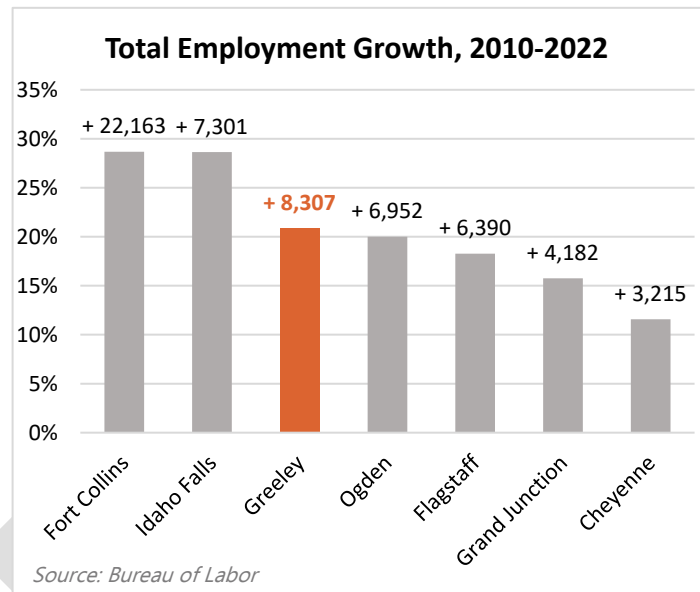
- While Greeley is a desirable place to live, there is little inventory, as making Downtown a residential neighborhood has only recently become a focus.
- Housing is a strong market for Downtown moving forward, and there is healthy demand for more units at all price points.
- Downtown's strongest age segment is 15-34 (~40% of the population) – the “young professional,” Millennial, and student bracket that downtowns and walkable neighborhoods with plentiful amenities are well-positioned to continue to attract.
- Downtown has a high concentration of poverty, as its low rents have historically attracted residents with low incomes and education levels to live Downtown.
- Downtown (and the City) is challenged when introducing density.



WORK

- Healthcare, manufacturing, education, retail, restaurants, and government are the foundations of the Greeley economy. Downtown employment is anchored by manufacturing and government, which together provide over 60% of Downtown jobs.
- Greeley's growing economy gets a lot of recognition by the press, which garners the attention of prospective employers.

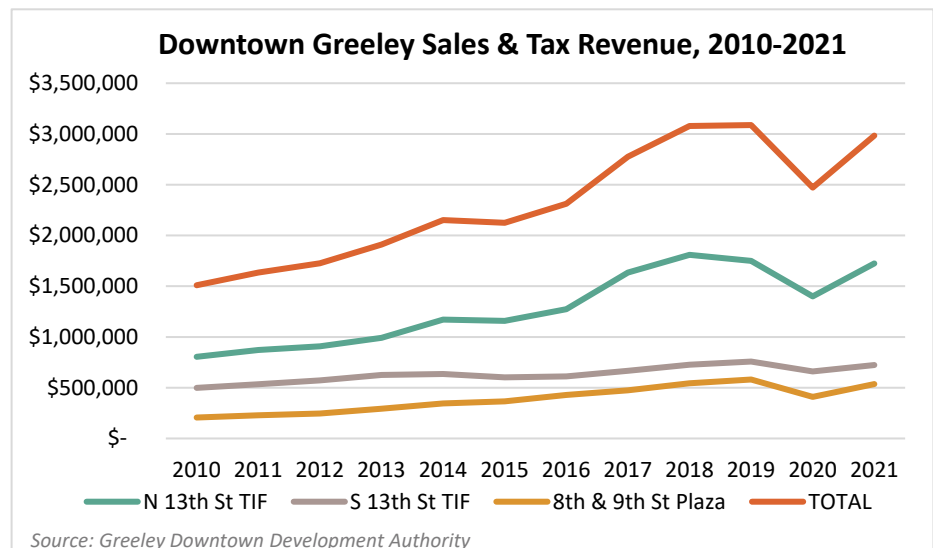
- About 24% of the City’s workers are employed in Downtown. Downtown lacks major private sector employers, which contributes to its below-average number of workers and as well as employees per acre compared to its peers.
- Downtown’s industrial buildings, situated along the railroad tracks, are home to its high concentration of manufacturing jobs, are a welcome fixture are perceived as an asset that positively contributes to the unique character of Downtown, and should be preserved.
- While Downtown’s existing office space might not be particularly appealing to primary employers, its low rents make entry into the market more accessible to Greeley’s small business owners and entrepreneurs. However, there is nearly no (or suitable) office or industrial space available for new or expanding businesses to locate in Downtown.
- Downtown Greeley has little primary employment and few knowledge-based workers, which both trend toward concentrating in downtowns and have high growth potential.
- Greeley’s resident populations are not as well-educated as some, which presents a challenge in attracting both primary and knowledge-based employers.
- There is a high degree of competition from Greeley’s other market areas.
- Nationally, the office sector continues to struggle due to uncertainty around the course of COVID, a potential recession, and the increasing popularity of working from home, which poses complications for a downtown such as Greeley’s that is looking to further develop its employment base and bolster its daytime activities.



SHOP & DINE

- Downtown has a strong mix of street level businesses and services (numbering 331), with 31% dedicated to dining and shopping.
- Since 2016, Downtown’s sales and use tax revenues have increased 29%. The pandemic hit Downtown harder than the rest of the city, causing a decrease of 20% in revenues between 2019 and 2020, but Downtown has made a full and rapid recovery, increasing 21% between 2020 and 2021.
- Downtown businesses are primarily local, independent, and specialty; some, such as the growing number of distilleries and breweries, even build on its manufacturing heritage. This helps to cultivate a distinct character and sense of place, in contrast to many downtowns that have lost some of their local vibe in recent years. Much like the office sector, the low rent structure allows local entrepreneurs to enter the market with unique concepts that further shape the Downtown experience.

- Nationally, food and beverage has been expanding while retail has contracted in most downtown markets. Downtown Greeley is consistent with these trends, having a strong food and beverage market that is on its way to becoming the sector's anchor.
- Greeley (as well as Downtown, the Primary Market Area and neighboring Evans) has a high concentration of Hispanic residents. Downtown can evolve to better welcome and serve this community, both as business-owners, employees, visitors, and cultural contributors.
- Downtown does not have a critical mass of workers or residents to support the addition of substantial amounts of retail currently.
- Despite a low vacancy rate, the high cost of construction and low rents will continue to inhibit the feasibility of building new retail space or rehabbing existing space that is aging and in need of substantial and expensive upgrades.
- The perception that there is insufficient parking that is convenient for accessing Downtown's restaurants and retailers might deter prospective customers, especially as employee and resident populations grow.



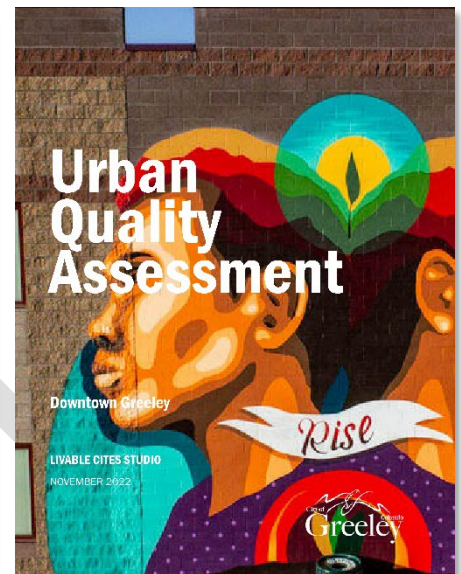
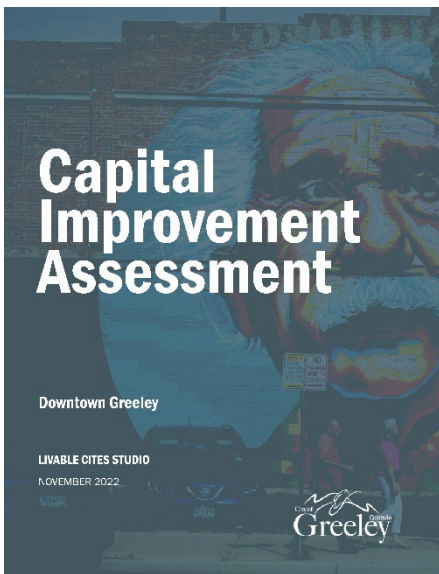
VISIT & STAY

- Tourism has undoubtedly become an important part of Greeley's economy, especially in the last ten years. Its location proximate to other destinations along the Front Range and its comparatively low room prices make it an attractive place to visit. Downtown Greeley has become a destination, with its high concentration of attractions and increasingly popular events that draw residents and visitors alike.
- The City recognizes the importance of its burgeoning art and culture scene and has thus accelerated its cooperative efforts to highlight and grow it in recent years.
- Despite the pandemic setback, its historically limited lodging sector has been maturing over the last decade and has even largely rebounded from its COVID slump in the last year. The recent addition of the DoubleTree hotel, with its modern amenities, has put Downtown on the map as a venue to hold state and regional conferences and events and could pave the way for more national brands to develop hotels in Downtown. Greeley enjoys hotel occupancy rates that are typically higher than the national average as well as that of other communities throughout Northern Colorado, which is another metric of interest to hotel developers.
- So far, Greeley is somewhat unique in that its short-term rental market has not yet posed much of a threat to its traditional lodging market.
- Other Front Range communities such as Fort Collins, Boulder, and Denver still generate a lot of competition for visitors as well as highly-sought after performers and other entertainment draws.

CAPITAL IMPROVEMENT AND URBAN QUALITY ASSESSMENT

SUMMARY

The following summary of the Capital Improvement Assessment and Urban Quality Assessment provides an overview of each report, focusing on key findings from an in-depth analysis of existing conditions in Downtown Greeley's public realm. The full Capital Improvement Assessment and Urban Quality Assessment can be found in **Appendices B and C**, respectively.



CAPITAL IMPROVEMENT ASSESSMENT

The Capital Improvement Assessment is a physical evaluation of the existing streets, plazas, and parks located within the Downtown 2032 – The Path Forward plan area boundary. The existing assets, mostly included in the right-of-way or on City of Greeley owned property, comprise a majority of the occupiable public realm in the plan area boundary, which is intended to create a walkable, safe, attractive, and welcoming user experience within the Downtown area. Capital improvements assist in helping the City of Greeley and DDA pursue their mission to create, support, and promote meaningful Downtown experiences, business growth, and private development in Downtown Greeley. While the DDA has other tools to encourage and support business growth and private development, the Downtown user experience is directly impacted by the various capital improvements that shape the built environment of Downtown. From streets and avenues to alleys, plazas, and parks, the interwoven public realm creates the physical environment that users experience Downtown.

The purpose of the Capital Improvement Assessment is to evaluate the current conditions of the public realm between the curb and edge of the right-of-way, which consists of the majority of the streetscape, to identify gaps and opportunities that can be used to inform public realm and placemaking recommendations in the Downtown 2032 - The Path Forward Plan.

METHODOLOGY

The methodology used for the Capital Improvement Assessment includes an evaluation of the physical condition using a combination of site visits and web-based analysis. Three categories of assets were created for this evaluation: streets, plazas, and parks. Each street, plaza, and park was then ranked using a scoring system of Good, Fair, or Poor conditions. This ranking system assesses the quality of each asset holistically, and then provides some additional notes on each specific streetscape component, including paving, trees/landscape, site furnishings, etc.

STATE OF DOWNTOWN GREELEY PUBLIC REALM

The Capital Improvement Assessment reveals that Downtown Greeley has an average foundation of basic infrastructure and a few areas where the pedestrian has been prioritized, such as 8th Street and 9th Street. However, the evaluation described above indicates there is an overall lack of public realm infrastructure oriented toward the pedestrian and an absence of consistent high-quality public realm experiences throughout Downtown.

The public realm assessment map to the right illustrates the outcome of the overall ranking of Downtown streets, parks, and public spaces at the time of this study. The findings indicate that apart from a few key streets and areas around the Downtown core near Lincoln Park, a majority of the public realm is of fair or poor quality. This indicates that basic assets comprising the public realm need additional improvements, maintenance, or increased inspections to create a public realm that attracts more residents, visitors, and employees.

KEY FINDINGS

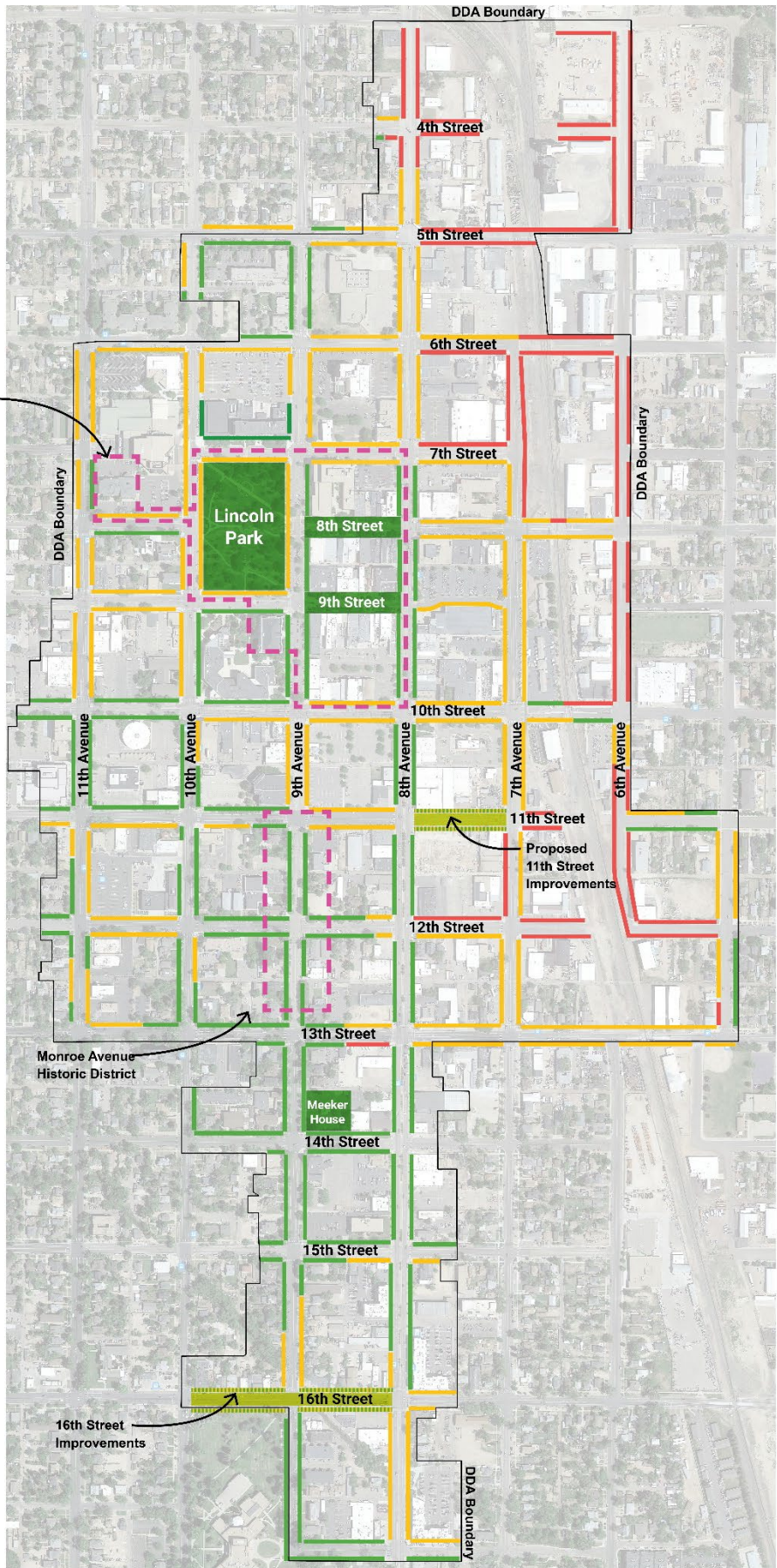
- Areas on the eastern edge of Downtown have the lowest quality public realm, as the majority were ranked as poor and many locations lack basic sidewalks.
- Areas around the Downtown core have a higher ranked capital improvement quality due to additional investment that has occurred on 8th Street, 9th Street, Lincoln Park, 8th Avenue, and surrounding streets.
- The residential areas south of the Downtown core generally have a higher quality public realm with mature trees, lawns, and generous sidewalks.
- 8th Avenue and 9th Avenue have distinctly different but complimentary characters and they generally provide good north to south connectivity through Downtown. These corridors are also supported by 10th Avenue and 11th Avenue that run north-south on the west edge of Downtown.
- In most cases, non-residential areas are fair to poor quality with significant stretches lacking basic sidewalks.

OVERALL CAPITAL IMPROVEMENT ASSESSMENT FINDINGS

Legend

- █ Good
- █ Poor
- █ Fair
- █ Park/Plaza
- █ Planned or Proposed Improvement
- - - Historic Districts
- DDA Boundary

Downtown Greeley Historic District



URBAN QUALITY ASSESSMENT

The Urban Quality Assessment is intended to evaluate the public realm beyond just the public right-of-way. The City of Greeley is fortunate to have a vibrant, successful, and celebrated Downtown that serves as the core of the Greeley community. For decades, Downtown has provided its residents and visitors with businesses, shops, stores, civic buildings, parks, and history that make Greeley the unique place it is today. More recently, new public realm improvements, redevelopment activities, the formation of the Greeley Creative District, and the public art program have brought new life and energy to Downtown. Despite recent improvements, Greeley's streets and public spaces do not do Downtown justice to its lively community. Over time, the balance of streets and public space design has swung too far in favor of cars and functional infrastructure, often at the expense of residents, placemaking, and the environment.

Although the Downtown community and City of Greeley have done a tremendous job addressing this imbalance through previous projects and initiatives, there is still much work to be done. The Urban Quality Assessment aims to address this imbalance by establishing a foundation for a high-quality public realm. By building within the human scale, physical improvements can accommodate the needs of all people and continue to build on previous Downtown place enhancement successes.

METHODOLOGY

The consultant team performed two types of analysis to assess the urban quality. The first type of analysis focused on the core Downtown area near Lincoln Park to evaluate how the public space is experienced by users. The second type of analysis included a comprehensive evaluation of the entire Downtown and focused on sub-areas, forms of movement, street hierarchy, and safety.

To evaluate how the public space is experienced by users, the consultant team visited several locations throughout Downtown and evaluated the quality of each space. The public realm quality rating is based on what fosters successful public spaces, provides protection, offers comfort, and creates interesting experiences for people.

The consultant team evaluated the public realm using the Twelve Quality Criteria method, which is a tool developed by Gehl Architects for researching how public spaces are experienced by their users. More specifically, it is used to evaluate whether different features of a public space are protective, comfortable, and enjoyable for people spending time there.

The thinking behind these three categories is as follows:

1. Without basic protection from cars, noise, rain, and wind, people will generally avoid spending time in a space.
2. Without elements that make walking, using a wheelchair, standing, sitting, seeing, and conversing comfortable, a place won't invite people to stay.
3. Great public spaces tend to offer positive aesthetic and sensory experiences, take advantage of local climate, and provide human-scale elements so visitors don't feel lost in their surroundings.

The comprehensive analysis of Downtown evaluates key areas for future recommendations: **sub-areas within Downtown, existing public spaces, forms of movement, existing street hierarchy, and safety**. The two forms of analysis conducted for the Urban Quality Assessment combined with the Capital Improvement Assessment provides a foundation for developing a public realm improvements plan to encourage Greeley to continue to grow and thrive for years to come.

FINDINGS BY AREA:

SUB-AREAS

- There is a lack of clearly defined sub-areas within Downtown Greeley.
- There is a lack of a sense of place within subareas, as they have no clear edges, destinations, or distinct places.

PUBLIC SPACES

- There is a lack of a legible public space network and unequal distribution of public spaces throughout the study area geography.
- The sub-areas lack recognizable character and identifiable public space.
- Other than the 8th Avenue corridor streetscape improvements over the last ten years extending south, there are no other public spaces south of 9th Street in the Downtown plan study area.
- The eastern portion of Downtown lacks any type of park or public space.

FORMS OF MOVEMENT

- For an urban core, Downtown has a disproportionate amount of land area dedicated to vehicles, including surface parking lots, wide roads, high volume traffic streets, and on-street parking.
- Generally, Downtown Greeley is designed for cars and not people.
- There is a bicycle infrastructure foundation in Greeley that can be built upon, but that needs to be completed and fully connected to increase bicycling in Downtown moving forward.
- There is a complete lack of bicycle connectivity to the eastern portion of Downtown and adjacent neighborhoods to the east in particular.

STREET HIERARCHY

- There is an extensive network of high traffic volume streets in Downtown that are designed for moving cars, making the Downtown environment uncomfortable for pedestrians in many places.
- Major Arterials and Major Collectors create physical barriers in Downtown Greeley, including: 8th Avenue as major vehicle arterial, which may allow 9th Avenue to take on different role looking to the future.

SAFETY

- There are pockets of adequate lighting near the core of Downtown, but lighting is lacking in other parts of Downtown.
- According to available crash data between 2015 and 2019, pedestrian and bicyclist crashes happened mainly on Major Arterial streets without dedicated bike lanes or protections.
- According to available crash data between 2015 and 2019, pedestrian and bicyclist crashes happened mainly on Major Arterial streets without dedicated bike lanes or protections.

CHAPTER 3: COMMUNITY OUTREACH

Inclusive and effective community engagement was vital for the creation of the Downtown Plan Update for the City of Greeley. Early in the process, the consultant team, in partnership with the City and DDA, developed a **Community Engagement Plan (CEP)** to guide outreach efforts throughout the planning process. The CEP laid out the purpose and goals for community engagement during the Downtown Plan Update process, the methods that were used to achieve those goals at each stage of the process, and how input received through this process was incorporated into the final Plan. Through the Downtown 2032 – The Path Forward process, the consultant team, City, and DDA were able to gather **over 1,250 inputs**. This section summarizes key findings from engagement with the community and the methods of outreach that were used throughout the process.

KEY TAKEAWAYS: THE COMMUNITY'S TOP PRIORITIES

The list below is a compilation of the feedback from all community and stakeholder engagement efforts. Understanding community priorities can help the City of Greeley and DDA align their efforts and select actions that fit both the community-wide values and the City's capacity. These themes and priorities form the basis for the Downtown Plan Update and the subsequent opportunities described and illustrated in the following chapter. The common themes and highest rated priorities for improving Downtown Greeley are outlined below:

WELCOMING AND INCLUSIVE

- Ensure that Downtown is reliably safe and welcoming for all residents, students, and visitors.
- Celebrate and support Greeley's diverse communities through holding culturally relevant events, offering a wide variety restaurant and grocery options, and strengthening partnerships between the City, the DDA, and organizations serving diverse populations.
- Improve the marketing and storytelling of Downtown, replacing historic stigma with community pride.

PROGRAMMING AND ACTIVATION

- Consider adding a permanent stage or amphitheater to an existing or new Downtown green space.
- Incorporate family- and child-friendly amenities into the Downtown environment.
- Continue to enhance and activate the public realm, including parks, streetscape, alleys, etc.
- Improve the programmatic synergy with UNC to draw students Downtown.
- Continue to hold events that showcase Greeley's diversity, celebrate Greeley's food scene, and highlight locally-owned small businesses.

STOREFRONT ECONOMY AND CHARACTER

- Fill vacant storefronts, encouraging adaptive reuse of existing buildings where possible.
- Continue attracting a variety of restaurant and retail options, including both affordable and higher-end options, to attract people to Downtown both from within Greeley, and from neighboring communities.
- Continue creating pathways and offering resources to encourage entrepreneurs to enter the Downtown market in an affordable way.
- Encourage small businesses to coordinate and extend hours.
- Retain the historic character that makes Downtown Greeley unique.
- Explore opportunities to diversify restaurant and retail offerings by encouraging multicultural businesses to locate in Downtown.

LIVABILITY

- Diversify the housing stock in Downtown and the neighborhoods adjacent to Downtown.
- Encourage upkeep and maintenance of properties (residential and commercial) in and adjacent to Downtown.
- Work to attract an affordable, full-service grocery store in or adjacent to Downtown.
- Attract more primary employment opportunities so that people who live in Greeley can also work in Greeley, including UNC graduates.
- Improve coordination of services for the unhoused population.
- Work to attract affordable grocery options that are relevant to a wide variety of cultures in Downtown.

INFRASTRUCTURE AND INFILL DEVELOPMENT

- Encourage infill development and redevelopment on underutilized sites in Downtown, such as surface parking lots.
- Improve drainage and stormwater management.
- Optimize the parking experience in Downtown.
- Improve utility capacity and encourage undergrounding utilities in Downtown where possible, particularly as infill development continues.
- Address lack of infrastructure and investment in the eastern portion of Downtown and in the adjacent neighborhoods to the east.

CONNECTIVITY

- Improve physical connections between Downtown and UNC, including creating a more pedestrian- and bicycle-friendly environment, adding more wayfinding signage, and increasing pedestrian lighting to improve feelings of safety.
- Enhance multi-modal connections both within Downtown and to and from the neighborhoods adjacent to Downtown.
- Improve physical connectivity between Downtown and the Poudre River and Poudre River Trail.

STAKEHOLDER OUTREACH METHODS

TECHNICAL WORKING GROUP

A Technical Working Group, comprised of representatives from various City of Greeley departments, was convened to meet with the consultant team at key milestones during the planning process to provide a “sense of reality” into the process and draft plan recommendations.

ADVISORY COMMITTEE

To advise the consultant team, and to develop alignment and consensus among a diverse array of Downtown stakeholders, a Downtown Plan Advisory Committee was created. This Advisory Committee consisted of people representing various facets of downtown Greeley, including key influencers, representatives from the DDA board, other civic partners, residents, property and business owners, and emerging leaders in downtown. The Advisory Committee met throughout the process in a series of meetings and creative workshops to provide creative input and eventual ownership of the Greeley Downtown Plan Update.

TOPIC-BASED FOCUS GROUPS

Early in the process, Topic-Based Focus Group meetings made up of approximately 30 local Greeley leaders and experts in their fields were held that were organized by topics that supported development of the Plan. The intent

of the Focus Groups was to contemplate the variety of issues that are relevant to Downtown, engage a broad cross-section of Greeley's civic leadership, plus offer insight into downtown Greeley's challenges, opportunities, and priorities. Group topics included: 1) Public Realm and Infrastructure, 2) Events and Activation, 3) Economy and Housing, and 4) Real Estate and Development.

DDA BOARD

The P.U.M.A. team met with the Downtown Development Authority Board several times during the Downtown 2032 – The Path Forward planning process. The DDA Board provided input during the initial phase of the plan on strengths, challenges, and priorities for Downtown Greeley moving forward, was consulted as draft plan recommendations formed to provide feedback, and provided an endorsement for Plan adoption to City Council.

POP-UP AT FRIDAY FEST

In order to meet people where they are, the consultant team attended and hosted a pop-up booth at a Friday Fest event in July 2022. This pop-up allowed the consultant team an opportunity to interface with and gather input from community members attending Friday Fest, and to observe Downtown Greeley during a community event.

FOCUSED OUTREACH

Focused population engagement was tailored to understand the needs of underserved or underrepresented groups throughout during the Greeley Downtown Plan Update process. The purpose of focused population engagement was to identify the interests of these historically underserved populations who contribute to economic vitality, staff influential industries, access services, and recreate in Downtown Greeley. Over 20 community leaders were interviewed as part of the process to integrate the perspective of historically marginalized populations into the Downtown 2032 – The Path Forward process.

OPEN HOUSE

During the latter part of the Downtown Plan Update process, an open house was held at the Greeley Recreation Center that gathered nearly 40 community members. This open house served as touchpoint with the broader Greeley community and provided an opportunity to invite individuals who participated in earlier stages of Plan outreach to review and comment on draft plan concepts and recommendations. The workshop was widely advertised through the City's online platforms and social media, sandwich board flyers at key locations in City facilities, and was sent to City and DDA listservs.

ONLINE SURVEY

An online survey was prepared by Progressive Urban Management Associates (P.U.M.A.) as part of the Greeley Downtown Plan Update, *Downtown 2032 – The Path Forward*. This survey was open to the public with the goal of gathering information from a broad audience about their experience and desires for Downtown Greeley for the future. The survey, which was available in both English and Spanish, ran from June 28th to August 15th, 2022. It collected **1,100 responses**.

Demographics: Survey participants represented a cross-section of community stakeholders. Respondents represented a wide variety of age groups (with highest response from 25-44 years old at forty-four percent), were heavily white (87%), and female (63%), and represented a range of household incomes (with 37% of respondent households reporting \$100,000 to \$200,000 in annual income, 35% in the \$50,000 to \$100,000 range). Eleven

- When asked if they would consider living downtown, 69% indicated they would consider living in Downtown Greeley, and the following were the top housing choices: townhouse (ownership), condominium building unit (ownership), and single-family residence with 29%, 28%, and 26% of responses, respectively.
- When asked to select which amenities would make Downtown Greeley a more attractive neighborhood to live in, the top responses were: full-service grocery store (50%), improved sidewalks and bike routes (35%), and more art and cultural options, such as museums and theaters (35%).
- Respondents were asked if they would consider starting or relocating a business to downtown. 26% of respondents answered “yes.”

DRAFT

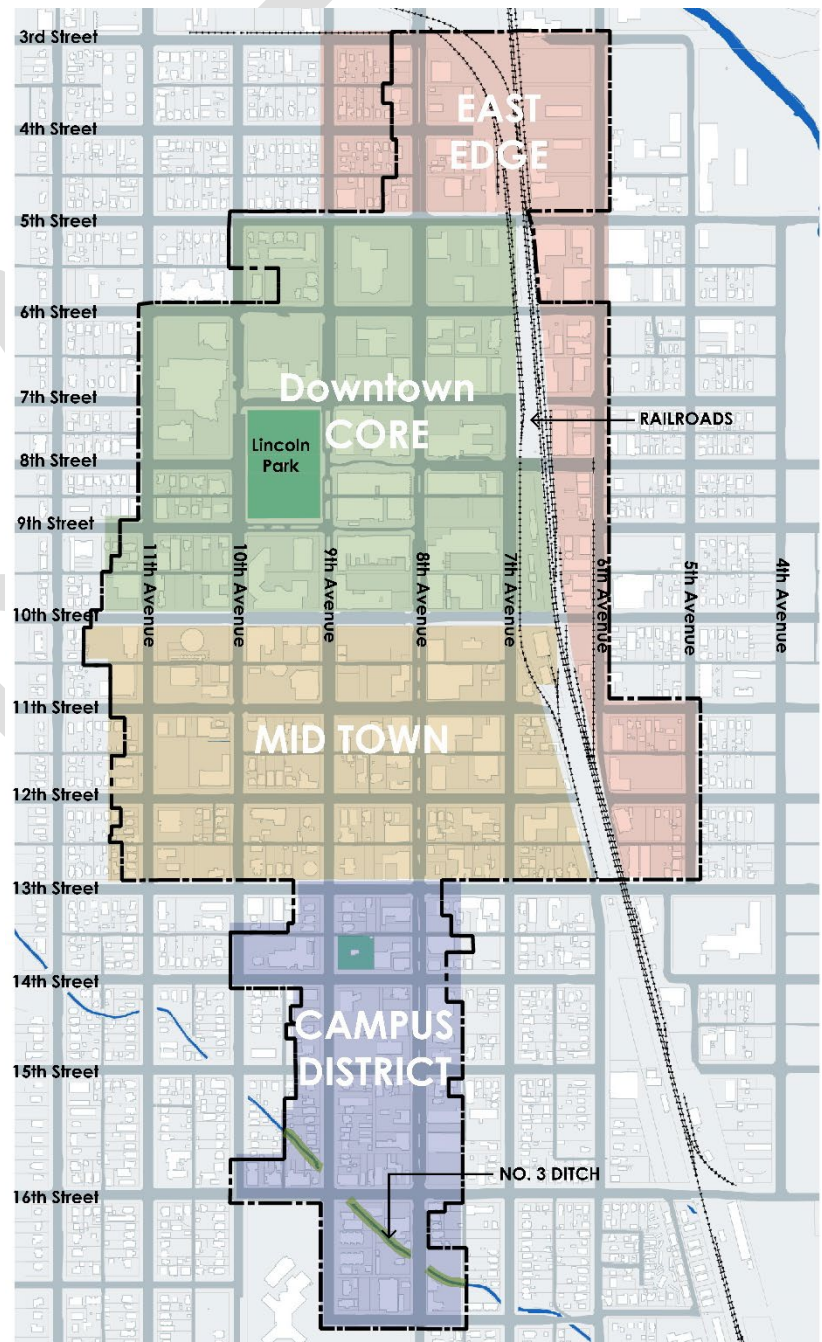
CHAPTER 4: PHYSICAL FRAMEWORK

Building on the key takeaways from the analysis of existing conditions and engagement with the community, the Physical Framework is intended to provide an overall foundation for Downtown Plan Update recommendations. The Framework, consisting of sub-areas, opportunity sites, and transformative projects, lays out a roadmap to guide physical improvements and redevelopment in Downtown Greeley for the next ten years, and provides a basis for the Action Plan found in Chapter 6 of this document.

SUB-AREAS

OVERVIEW OF SUB-AREAS FROM 2011 INVESTMENT STRATEGY

The 2011 Downtown Greeley Investment Strategy identified four sub-areas within Downtown, pictured in the map below; Downtown Core (shown in green), East Edge (shown in red), Mid-town (shown in yellow), and Campus (shown in blue). The 2011 plan was organized around creating strategies to strengthen each of the four subareas, as well as some collective strategies for the entire Downtown area.

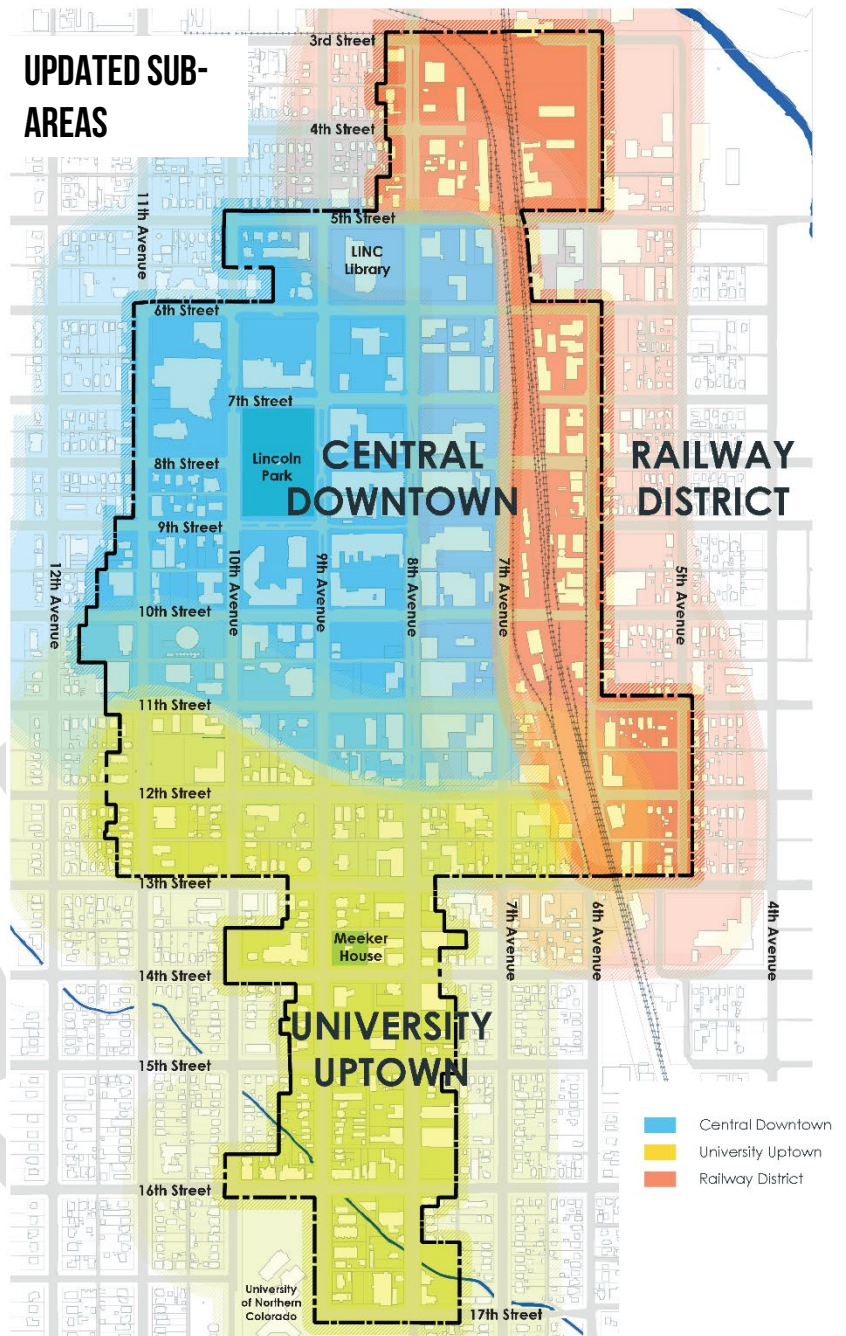


UPDATED SUB-AREAS

Through the consultant team’s analysis and outreach with Downtown stakeholders, it became clear that the four sub-areas included in the 2011 Investment Strategy have evolved with new development and investment, and no longer resonate with community members who regularly interact with Downtown Greeley. The Urban Quality Assessment also revealed that there is currently not a distinct sense of place or identity in each sub-area, as users still perceive Downtown as one larger area, and that each of the sub-areas does not have a distinguishing change in character or hard edge that delineates it from the neighboring sub-area, or from adjacent neighborhoods. Although the sub-areas are differentiated due to a change in current land uses, some architectural character, and/or historic land uses, they lack a distinct sense of place and individuality from the other districts that comprise Downtown. Looking forward, there is an opportunity to better define and leverage strengths of each sub-area, and to create a distinct sense of place within each.

This iteration of the Downtown Plan streamlines sub-areas to three distinct districts within Downtown, eliminating the ‘Mid-Town’ sub-area that was identified in the previous plan, and adjusting the boundaries of the sub-areas to better reflect on-the-ground conditions. The sub-area names have also been adjusted from ‘Downtown Core’ to ‘Central Downtown,’ from ‘East Edge’ to ‘Railway District,’ and from ‘Campus District’ to ‘University Uptown.’

The following sections include a description of existing conditions in each of the sub-areas that was informed by the Urban Quality and Capital Improvement Assessments, the Market Assessment, and engagement with the community, as well as opportunities that exist for each area. Opportunities are sorted by the categories provided in the Market Assessment (Live, Work, Shop and Dine, Visit and Stay), and amenities. These recommendations are carried forward in Chapter 6: Action Plan as more detailed implementation steps, including sequencing, responsibility centers, timing, and illustrative cost.



CENTRAL DOWNTOWN

BOUNDARIES

Central Downtown is the area roughly bounded by 5th Street to the north, between 11th Street and 12th Street to the south, between 11th Avenue and 12th Avenue to the west, and 7th Avenue to the east.

Insert version of the sub-area map zoomed into Central Downtown

EXISTING CHARACTER

Central Downtown is rich in amenities and destination attractions. Together, the amenities abutting or adjacent to Lincoln Park including the DoubleTree Hotel and conference center, Union Colony Civic Center, the Greeley Recreation Center, the Weld County Courthouse, the Greeley Ice Haus, numerous entertainment and event venues, and the Greeley Active Adult Center generate substantial local and regional visitor activity. Lincoln Park itself also serves as a draw, particularly during events and other activations that occur in the park, as do additional events and activities held in other Central Downtown public spaces. Central Downtown is home to a number of locally-owned restaurants and shops that create a vibrant storefront economy, particularly along 9th Avenue, 8th Avenue, 8th Street, and 9th Street. Upon completion, the LINC Library will serve as an additional draw for locals and visitors alike.

Central Downtown also serves as the historic heart of Greeley and has a largely in-tact historical building stock and character. The Downtown Greeley Historic District encompasses Lincoln Park, the old courthouse building, the old Greeley High School, and the blocks between 7th Street and 10th Street and 8th Avenue and 9th Avenue.

Due to investment made by the City of Greeley, the DDA, property owners, the Creative District, and other partners, the public realm in Central Downtown has improved substantially over the last ten years. Streetscape improvements along 8th Avenue, investment in public art throughout Central Downtown, and other key public realm enhancements have created a pleasant pedestrian environment on many key Downtown corridors. Eighth Avenue and 9th Avenue serve as major north-south routes that connect Central Downtown to the UNC Campus and adjacent commercial and residential areas. Fifth Street and 10th Street are major east-west travel routes that serve as gateways and connect Downtown to adjacent neighborhoods.

There is substantial opportunity to build on the energy that already exists in Central Downtown. Market and amenity opportunities for Central Downtown are highlighted in the table below.

MARKET & AMENITY OPPORTUNITIES

Sub-Area	Live	Work	Shop & Dine	Visit & Stay	Amenities
Central Downtown	Higher Density housing: infill development apartments (rent), condominiums (own), mixed-use	Office employers, retail, arts and culture, entertainment	Restaurants, boutique retail	Entertainment (music & private event venues, theaters), community events, recreation (Ice Haus), museums, hotels/convention center, public art	Enhanced bike/pedestrian connections to the Poudre River, dog park, activation of existing parks/public realm, adaptive reuse of historic buildings to retain character, activated alleys, small plazas, or courtyards

RAILWAY DISTRICT

BOUNDARIES

The Railway District is the area roughly bounded by 3rd Street to the north, 13th Street to the south, 7th Avenue to the west, and 6th Avenue and 5th Avenue to the east.

Insert version of the sub-area map zoomed into Railway District

EXISTING CHARACTER

Characterized by grain silos, brick warehouses, wide streets, and the railroad tracks, the Railway District has a distinctive feel to it that pays homage to Greeley’s manufacturing and agricultural heritage. The Railway District has several facilities that embrace this history, including the Colorado Model Railroad Museum, WeldWorks Brewing, Co., the Greeley Chamber of Commerce, and the Greeley Farmers’ Market. Additionally, the under-construction LINC Library is located just outside of the Railway District, and will provide resources, space, and equipment to foster innovation and making, including a woodshop and 3-D printers.

Currently, there is a lack of multi-modal connectivity in the Railway District. Street connections, basic sidewalk and other pedestrian infrastructure, and bicycle infrastructure are missing in many locations throughout this sub-area. Overall, the rail tracks serve as a substantial mental and physical barrier between Downtown Greeley and the area east of the railroad. Additionally, 100-year floodplain has been mapped in the northernmost portions of the Railway District and addressing these physical challenges substantially increases the cost of redevelopment on affected parcels.

The Railway District has the potential to be an even more unique and interesting sub-area where adaptive reuse of the agricultural and railroad buildings should be encouraged. There is also ample opportunity to enhance physical connections to the neighborhoods east of the Railway District to spread needed investment and resources to that area. Opportunities to build on the Railway District’s manufacturing and industrial past can be found in the table below.

MARKET & AMENITY OPPORTUNITIES

Sub-Area	Live	Work	Shop & Dine	Visit & Stay	Amenities
Railway District	Mixed density housing: live/work, affordable multi-family	Primary employers in light industrial or agriculture, maker businesses	Agriculture, bulk, experiential, maker products	Museums, events, public art, destination/experiential businesses, public art	Enhanced bike/ped connections to adjacent neighborhoods to the east, flexible/adaptive streets and plazas, adaptive reuse of agriculture/industrial buildings to retain character

UNIVERSITY UPTOWN

BOUNDARIES

University Uptown is the area roughly bounded by 11th Street and 12th Street to the north, 17th Street to the south, 9th Avenue and 10th Avenue to the west, and 8th Avenue to the east.

Insert version of the sub-area map zoomed into University Uptown

EXISTING CHARACTER

University Uptown serves as the connector between Central Downtown and the University of Northern Colorado campus. North of 13th Street is primarily residential with intermittent commercial activity concentrated primarily along 8th Avenue and 13th Street. 8th Avenue serves as the major vehicular route that connects the UNC to Central Downtown, while the residential Monroe Street Historic District includes a mix of single family and student housing that encompasses 9th Avenue from approximately 16th Street to 11th Street. The University Uptown sub-area overlaps with a portion of the University District that was established in 2009 as a partnership between the UNC and the City of Greeley.

The southern portion of University Uptown along 16th Street is currently a mix of student-focused retail shops and quick-serve restaurants. As this Downtown Plan Update is underway, the City of Greeley Public Works Department is working on the 16th Street Enhancement Project. Improvements being considered through this Enhancement Project will aim to slow vehicular speeds, improve safety, create a walkable environment, revitalize the corridor, maintain as much parking as possible, and increase the connection between UNC and Downtown. The project is working through the design phases with plans to initiate the improvements within the year. Other area redevelopment aspirations in this “Canal Shops” area suggest more public realm and adaptive reuse possibilities.

New development that has occurred along 8th Avenue, such as the Maddie Apartments and Natural Grocers, have worked to spread energy south of Central Downtown into University Uptown. However, there is additional opportunity to continue revitalization and public realm improvements along the 8th Avenue corridor to further enhance connectivity between Central Downtown and the UNC campus. Small parcels and disparate ownership throughout this sub-area present a significant challenge to larger-scale redevelopment, so thoughtful commercial and residential infill may be more appropriate throughout where parcel consolidation is not feasible.

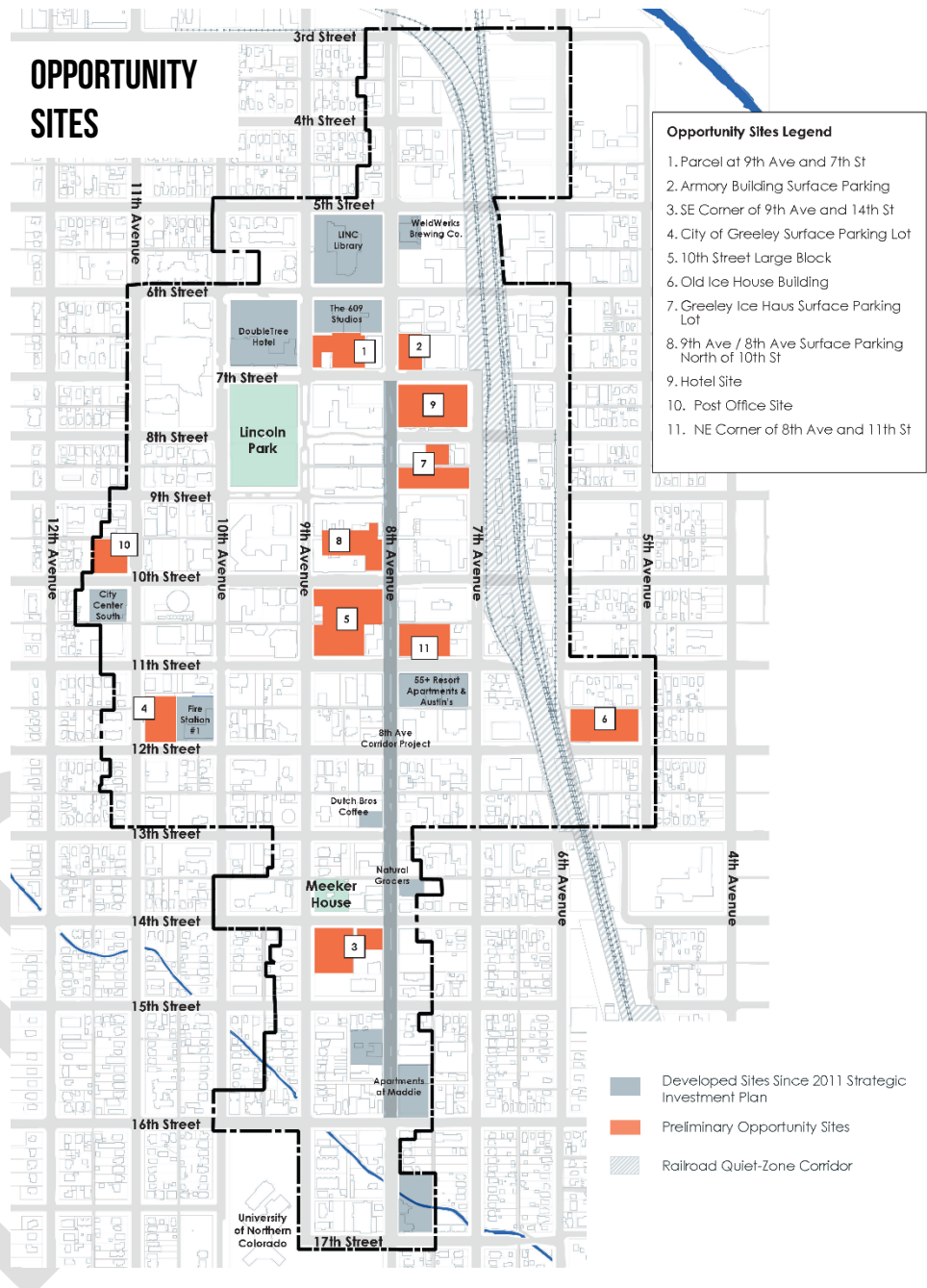
MARKET & AMENITY OPPORTUNITIES

Sub-Area	Live	Work	Shop & Dine	Visit & Stay	Amenities
University Uptown	Enhance existing housing and missing middle housing: townhomes, condos, thoughtful infill with gentle density	Convenience retail, services	Grocery, service- and convenience-oriented retail, restaurants	Public art, museums, synergy with UNC, Bed & Breakfasts	Enhanced bike/pedestrian connections to adjacent neighborhoods and UNC, improved lighting, more green space for daily use of students and families

OPPORTUNITY SITES

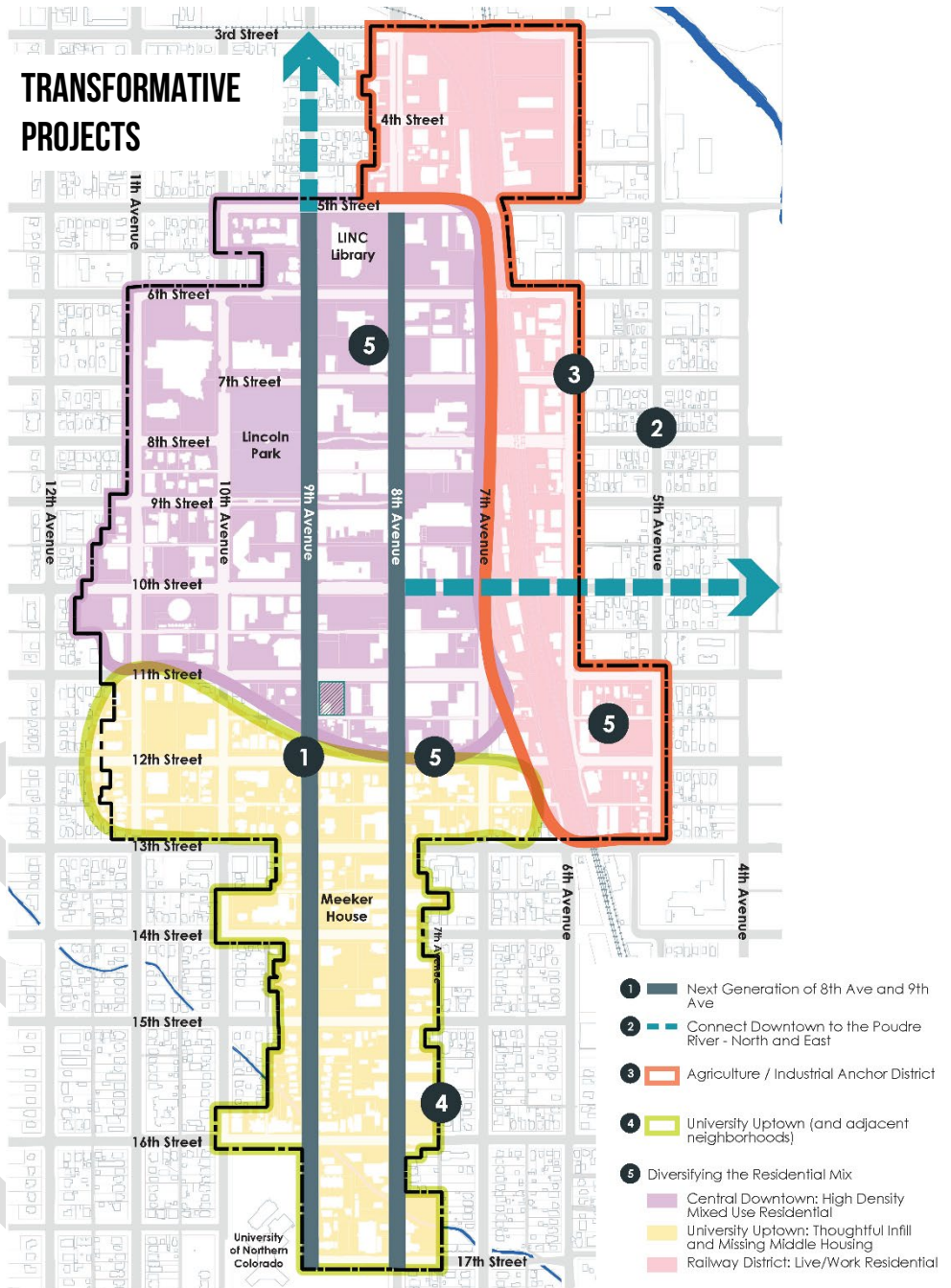
Opportunity sites are areas where redevelopment or new development may occur during the 10-year life cycle of this Downtown Plan Update. A set of three criteria were developed to identify opportunity sites:

- Sites that are currently underutilized, including surface parking lots, at key locations within Downtown that if developed or redeveloped, have the potential to make a positive impact on the overall vitality of Downtown.
- Sites identified in the 2011 Downtown Greeley Investment Strategy and have yet to be developed or redeveloped.
- Sites identified through outreach to Downtown stakeholders and through the community-wide online survey administered during this planning process.



TRANSFORMATIVE PROJECTS

A transformative project is one that has the potential to have lasting positive impacts on Downtown and encourage improvements around it. Most of Downtown property is owned by private entities and improvements are dependent on multiple factors, such as one’s willingness and financial means to redevelop, access to capital, partnerships, existing leases, and more. However, there is publicly owned land downtown as well – some parcels are owned by the City of Greeley or Weld County, and streets, sidewalks, and parks may also offer transformative opportunities. Based on the assessment of Downtown land, property ownership, and property conditions conducted in the previous section on Opportunity Sites and engagement with Downtown citizens and stakeholders described in Chapters 2 through 4 in this Plan, a list of transformative projects was developed. This list, along with ideas and recommendations, should serve as preliminary guidance to get conversations started and hopefully generate excitement about possibilities for the future.



NEXT GENERATION OF 8TH AVENUE AND 9TH AVENUE

8th Avenue and 9th Avenue serve as the primary north-south corridors running through Downtown Greeley, and thus act as gateways in and out of Downtown. These two corridors each have a very different character and feel – 8th Avenue, or CDOT Hwy 85, serves as the primary north-south vehicular route through Downtown and is primarily commercial, while 9th Avenue is generally less auto-centric, and has a mix of residential and civic uses with some commercial interspersed throughout. Looking forward to the next ten years, there is opportunity to embrace and enhance the character that currently exists on each street, while simultaneously strengthening north-south connections between Downtown Greeley and UNC and improving gateways in and out of Downtown.

8TH AVENUE

8th Avenue has historically served as the primary auto-centric commercial corridor connecting Downtown Greeley and UNC, with little cohesion of land uses or appeal to pedestrians, cyclists, or those passing through in a vehicle. In recent years, there has been significant investment in streetscape upgrades to improve the pedestrian experience and overall cohesion along 8th Avenue between 10th Street and 17th Street. Improvements have included the addition of public art, wayfinding signage, medians with trees and plants, widened sidewalks, benches, trash receptacles, and upgraded lamp posts. These investments into the public realm are intended to improve the pedestrian experience between Downtown Greeley and UNC, and to boost the user experience moving into, out of, and through Downtown. The City is continuing to explore ways to provide greater influence on the design and function of the public improvements along this CDOT corridor.

There has also been significant private investment along the 8th Avenue corridor since 2011, including redevelopment and infill development projects like the WeldWerks Brewing Co., Maddie Apartments, Natural Grocers, Dutch Bros coffee shop, the 609 Studio Apartments, and the 55+ Resort Apartments and Austin's American Grill that opened in November 2022.

Looking to the next ten years, it is envisioned that 8th Avenue will continue to serve as the primary north-south commercial corridor in Downtown, building on both the public and private investment that has already been made along the corridor. Although there have been several large-scale development projects along the corridor over the last ten years, the small parcels and disparate ownership of land along 8th Avenue present a challenge to larger-scale development, as consolidation would be required. However, there are ample opportunities for smaller infill residential or commercial projects to continue filling in the frontage along the corridor, or for façade or building improvements to existing structures that would improve the overall look and feel of the corridor. Continued investment in the public right-of-way, particularly in pedestrian infrastructure or other mobility options, will further improve the experience along 8th Avenue.

Add precedent images/case studies of commercial streets with nice design/mix of businesses/etc.

9TH AVENUE

9th Avenue is the second major north-south street running through the center of Downtown Greeley, connecting major destinations such as Lincoln Park, 8th Street, the new LINC Library, and UNC. Unlike the commercial feel of 8th Avenue, 9th Avenue has a predominantly residential character in the southern sections before transitioning to commercial, civic, and mixed-use to the north of 11th Street. The mature tree canopy, generous sidewalks, and tree lawns make it one of the more pleasant, comfortable, and memorable streets in Downtown. The Monroe Avenue Historic District is also located along 9th Avenue from 12th Street to 16th Street, and contains numerous historically significant structures that contribute to the look and feel of the corridor.

Moving forward, 9th Avenue is envisioned as a community amenity that has enhanced facilities that prioritize pedestrians and bicyclists over vehicles. Ninth Avenue does have consistent sidewalks along the length of the corridor that could be extended farther into the right-of-way to offer patio seating for existing and new businesses, or to incorporate other streetscape amenities like benches, additional pedestrian-oriented lighting, or landscaping.

Currently, 9th Avenue does have an on-street bike lane beginning south of 11th Street and north of 6th Street, but these facilities could be upgraded to a protected bike lane or bikeway to make the bicycle experience safer and more accessible, and to better connect Downtown to UNC. There is also an opportunity to extend bike infrastructure (current or enhanced) along 9th Avenue through Downtown between 11th Street and 6th Street to connect the existing bike lanes south of 11th Street and north of 6th Street. There is also an opportunity to highlight bicycle connections and enhance bike infrastructure north of Downtown leading to the Poudre River Trail at Island Grove Regional Park.

In addition to creating an overall environment that prioritizes people over vehicles along 9th Avenue, the feasibility of removing a vehicle travel lane and replacing it with additional public realm amenities, such as a parklet, a dog park, play features for children, or permanent outdoor patios, should be evaluated where possible. There is also an opportunity to better incorporate public art into the physical environment along the entire 9th Avenue corridor, as it is currently lacking south of 9th Street.

The image below provides an illustrative example of what improvements to the 9th Avenue corridor could look like moving forward.



Add images/case studies of a 'next gen' promenade street

CONNECTING DOWNTOWN TO THE POUFRE RIVER

The Cache la Poudre River jogs around Downtown Greeley to the north and east before eventually draining into the South Platte River several miles east of Greeley. Currently, there are primarily commercial and industrial uses

abutting the River where it runs closest to Downtown, while several stretches of the Poudre River outside of Downtown and in neighboring communities have been converted into parks and open space amenities. Island Grove Regional Park is one of those stretches of the River, and is located within the City of Greeley northwest of Downtown. Island Grove Park is located roughly a mile from the northern edge of the Downtown Plan area boundary, and is comprised of 145 acres that embrace the Poudre River adjacency and offer numerous amenities, including pavilions, an events center, play equipment, a trail head for the Poudre River Trail, and many more public facilities.

The Poudre River Trail runs from River Bluff Open Space, located on the east edge of the Town of Windsor, to Island Grove Park in Greeley. The Poudre River Trail extends a total of 21 miles and primarily runs through natural areas and parks along the way. There are plans to extend the Poudre River Trail west to the City of Fort Collins, with the possibility of extension southeast of Greeley to the South Platte River in the future as well.

As the City of Greeley continues to embrace the Poudre River, there are opportunities to better connect Downtown to the Poudre River moving forward, which emerged as a community priority during this Downtown Plan Update process. Downtown is already physically connected to the Poudre River by way of the dedicated bike lanes beginning along 9th Avenue north of 6th Street that connect to Island Grove Park. This connection could be further enhanced through additional signage, improved infrastructure like protected bike lanes, or by eventually creating an off-street path or trail for bicyclists and pedestrians.

If the Poudre Trail extension southeast to the Platte River does come to fruition, there are also opportunities to provide connections to the Poudre River and proposed trail by way of 10th Street east of 8th Avenue. It is approximately a mile from Lincoln Park in Downtown Greeley to where the Poudre River and 10th St meet. Enhanced bicycle and pedestrian infrastructure and clear signage would provide users the opportunity to connect Downtown to not only the river, but a regional trail network as well.

Add images/case studies of river wayfinding/connections

AGRICULTURE AND MANUFACTURING ANCHOR DISTRICT

Greeley's primary industries have always been closely tied to the railroad tracks that through the heart of the community and bisect Downtown, as freight rail was and is the primary means of importing and exporting goods to and from Downtown and the larger Greeley community. Traditionally, uses along the railway have been primarily industrial and agricultural, as these sectors anchor the City's economy and employment base. While Greeley's economy has been diversifying in recent years, it still is and will likely remain reliant on agriculture and manufacturing as key industries looking forward.

The Railway District sub-area is located along the eastern edge of the Downtown Plan study area, and encompasses the railroad tracks that run through Downtown. This sub-area reflects Greeley's agricultural and manufacturing past and present, and offers the opportunity to embrace and celebrate this history while diversifying the types of manufacturing and agricultural activities that happen in areas adjacent to Downtown. While the railroad tracks are often cited as a physical and mental barrier that separates Downtown from the neighborhoods to the east, there is an opportunity to reimagine how the Railway District, and broader Downtown area by extension, interact with the rail tracks. There are already several amenities that celebrate the past and future of what the Railway District is and can be including the Colorado Model Railroad Museum, WeldWorks Brewing, Co., the Greeley Chamber of Commerce, and the Greeley Farmers' Market.

Looking forward, the Railway District can serve as an agriculture and manufacturing anchor district that bridges Greeley's past with its future. This area offers the opportunity to attract primary and knowledge-sector employers that require large-format spaces in industries such as biotechnology. While redevelopment could make sense on

several parcels in the Railway District, the existing building stock offers opportunities for adaptive reuse, expanding on the energy being brought to the area by WeldWerks Brewing Co., the Greeley Farmers' Market, and others. Existing buildings could accommodate uses like breweries, wineries, coffee roasting, a commissary or shared kitchen, chocolate making, live/work spaces, light manufacturing, galleries, or an indoor Mercado or Latino Vendor Market or makers' market. Additionally, many of these uses could include a storefront component that would help in improving street-level activation in the Railway District. There is also an opportunity to embrace the agriculture and manufacturing district identity in the public realm through branded wayfinding, banners, crosswalks and intersection stamps, gateways, themed lighting, and public art.

The image below provides an illustrative example of what improvements to the Railway District could look like moving forward.



Add images/case studies of successful ag/industrial anchor districts

UNIVERSITY UPTOWN AND ADJACENT NEIGHBORHOODS

While both the UNC campus and Central Downtown have distinct identities and senses of place, the area between these two destinations currently lacks a distinct identity. Many participants in the Downtown Plan Update process cited the lack of connectivity between Central Downtown and UNC as a challenge, and identified strengthening physical and programmatic connections between the two places as a key priority.

Over time, the City of Greeley and UNC have been working together to improve connectivity between Downtown and the UNC campus. In 2009, this effort was formalized through the creation of the University District, which intersects with the plan study area between 13th Street to the north, 17th Street to the south, the railroad tracks to the east, and between 9th Avenue and 10th Avenue to the west. The University District has not only reinforced connections between UNC and the City through physical improvements like signage with shared branding, but resulted in the creation of the pilot Home Ownership Program for Employees (G-HOPE) to promote more home

ownership in Greeley’s Redevelopment District and around the University of Northern Colorado campus to UNC students.

There is an opportunity to build on the synergy between the City of Greeley and UNC resulting from the creation of the University District by establishing the University Uptown identity for the area between Central Downtown and the UNC campus, and adjacent neighborhoods. Creating this brand is a key step in fortifying both physical and psychological connections between these two destinations. The University Uptown brand can be utilized in City and UNC marketing and communications, and can also be incorporated into physical improvements in the public realm in the University Uptown area and adjacent neighborhoods. Branded public realm amenities that can reinforce University Uptown as a distinct, unique district include banners, crosswalks and intersection stamps, more signage and wayfinding, and improved lighting. Lighting is particularly key along 9th Avenue and 8th Avenue, as these corridors serve as key north-south connections between Central Downtown and UNC.

16TH STREET ENHANCEMENTS

The 16th Street Enhancement Project is an active project that is currently being led by the City of Greeley Public Works Department. The planned improvements, which encompass 16th Street from 7th Avenue to 11th Avenue, aim to slow vehicular speeds, improve safety, improve and expand the walkable environment, revitalize the corridor, foster the public realm experience with art and amenities, maintain as much parking as possible, and increase the connection between UNC and Downtown. The project is working through the design phases with plans to initiate the improvements in 2023.

Add images/case studies of enhanced wayfinding in university-adjacent neighborhoods

DIVERSIFYING THE RESIDENTIAL MIX

In order to continue cultivating Downtown as a mixed-use neighborhood, additional residential development is needed. The Market Assessment revealed that Downtown Greeley has lower housing density than many of its peer cities, and that residential remains a robust market opportunity for Downtown moving forward. It is recommended that thoughtful residential development continue over the next ten years to strengthen Downtown’s identity as a place where people can live, work, and play. Encouraging a diverse mix of housing throughout Downtown, including both to-own and to-rent options, will continue to build a residential base that accommodates a range of tastes and price points. Each Downtown sub-area has its own distinct character and feel, and thus currently has different types of residential development as well. It is recommended that development of new housing fit the physical look and character of the existing sub-areas where possible, while simultaneously adding to Downtown’s housing stock.

A description of what housing types are recommended for each sub-area moving forward is provided below.

69% of online survey respondents would consider living in Downtown Greeley.

The top 3 desired housing types are:

- Townhouse (ownership) (29%)
- Condominium building (28%)
- Single-family residence (26%)

CENTRAL DOWNTOWN

As the traditional core of the City of Greeley and area that already accommodates density, Central Downtown is a logical place for additional higher density housing types, such as to-own condominiums, to-rent apartment buildings, and mixed-use development with commercial uses on the ground floor and housing above.

Add photo examples of different housing types

RAILWAY DISTRICT

While the Railway District has historically been comprised of commercial and industrial uses, looking to the next ten years, this area could accommodate housing as well. Housing types that would fit with the existing character of the Railway District include live/work and affordable multi-family housing, either as to-own or rental units.

Add photo examples of different housing types

UNIVERSITY UPTOWN

The University Uptown area is already primarily residential, with the exception of commercial uses along segments of 8th Avenue and 16th Street. The housing stock in University Uptown is dominated by single-family units, though there are a number of single-family structures that have been converted to multi-family units. There are also new apartment buildings along 8th Avenue and smaller scale apartment buildings interspersed throughout the sub-area. Moving forward, it is recommended that the existing housing stock be enhanced where possible, either by providing incentives for building improvements, or by enforcing the City's existing building code. Major thoroughfares in University Uptown like 8th Avenue, 9th Avenue, 16th Street, and 13th Street, could accommodate higher density infill mixed-use development, apartments, or condominiums. Along quieter neighborhood streets, it is recommended that thoughtful infill be considered in the form of single-family homes or "missing middle" housing types like townhomes, row houses, multi-plexes, accessory dwelling units, and small-scale apartment or condominium buildings where appropriate. New housing should be encouraged to fit in with the context of the surrounding neighborhood respectful of historic design elements, and should create ownership opportunities when possible.

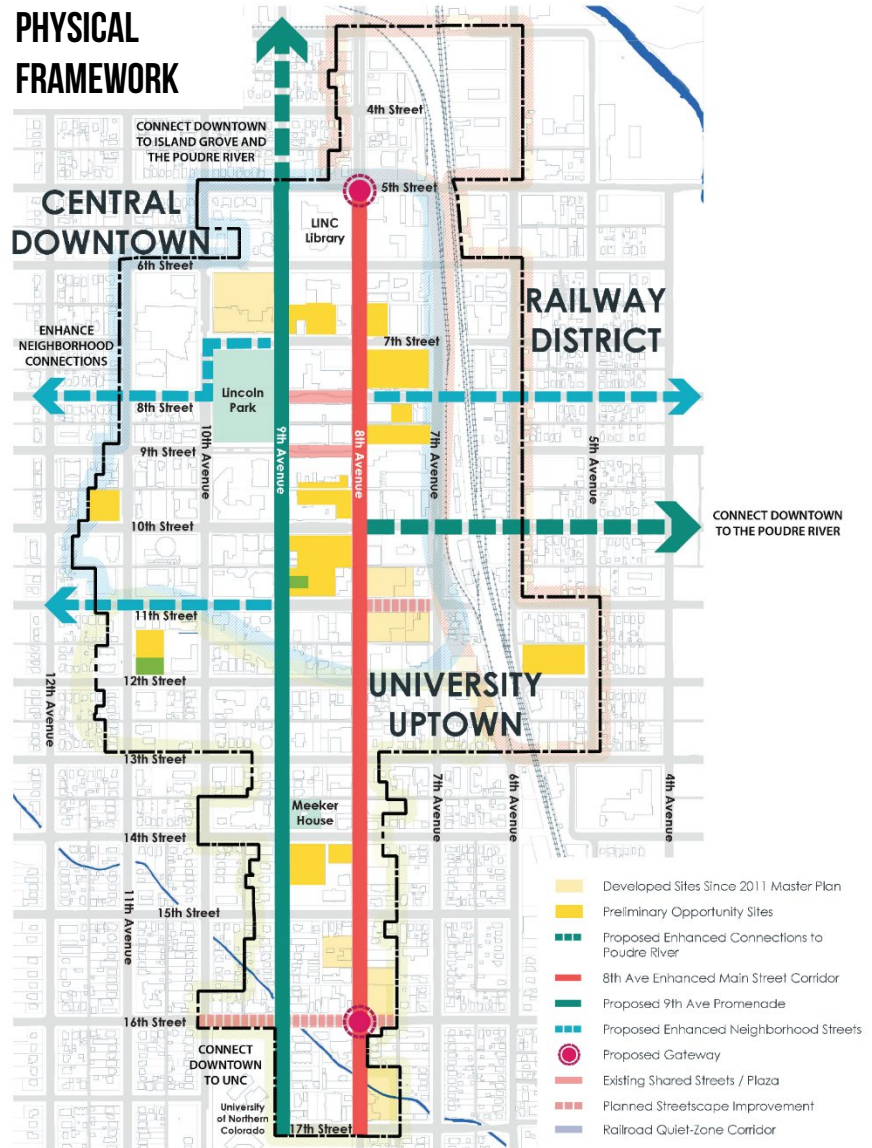
Add photo examples of different housing types

DRAFT

OVERALL DOWNTOWN PHYSICAL FRAMEWORK

Combining all the above pieces (Sub-areas, Opportunity Sites, Transformative Projects) together creates a comprehensive physical framework for Downtown Greeley looking to the future, illustrated in the map to the right. This framework works to build on the energy and work that has been done to improve Downtown over the last 10 years by encouraging additional infill development and public realm enhancements at key locations. This framework also illustrates opportunities for improved east-west and north-south connections both within Downtown and to and from adjacent neighborhoods to address that community priority. This overall physical framework also creates the opportunity to:

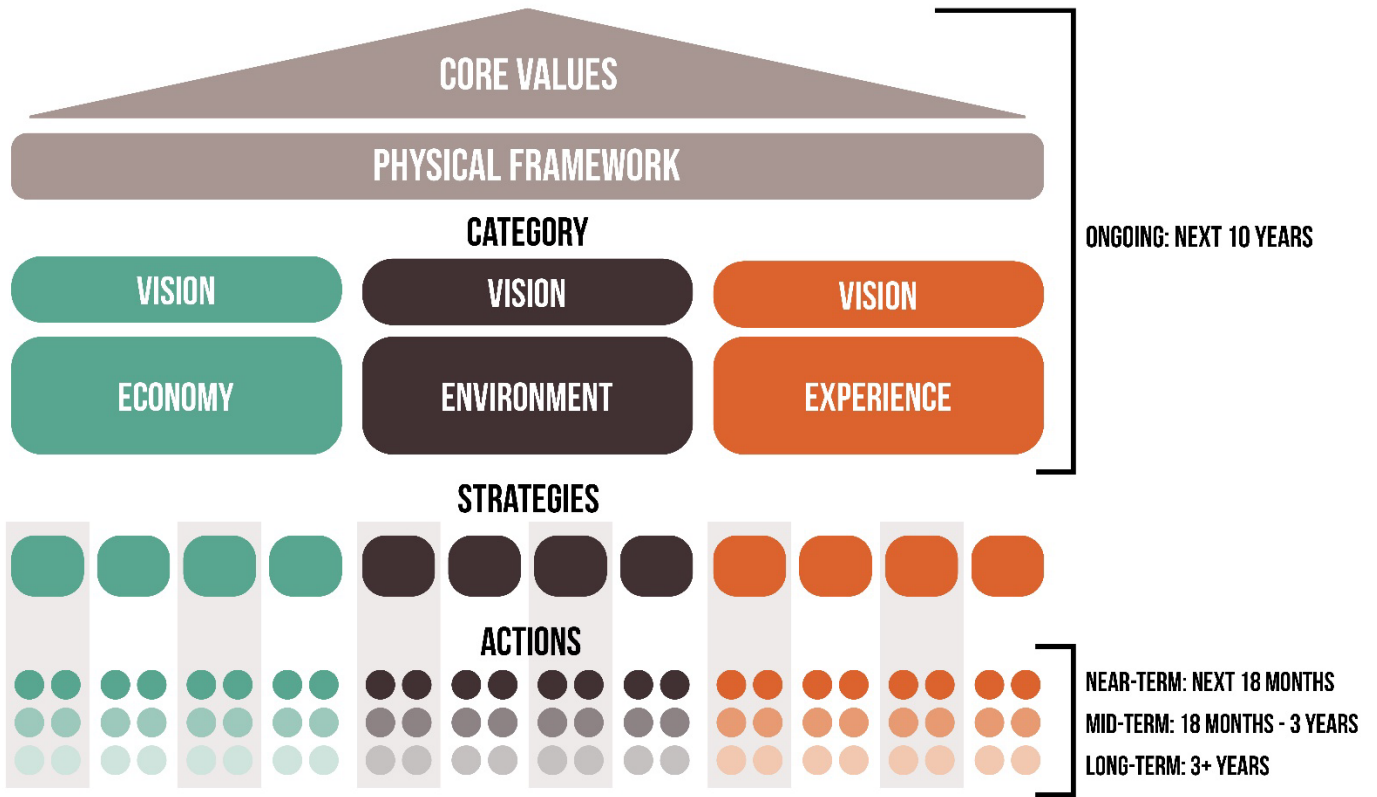
- **Strengthen the north-south spines of 8th Avenue and 9th Avenue**, leveraging the Opportunity Sites and Transformative Projects to create a dual redevelopment corridor connecting amenities within Downtown, and Downtown to UNC and adjacent neighborhoods.
- **Improve key east-west connections through Downtown by enhancing the neighborhood streets of 11th Street west of 9th Avenue, 7th/8th Street jogging around Lincoln Park west of 9th Avenue, and 8th Street east of 8th Avenue.**
- **Create enhanced gateways along 8th Avenue at 5th Street to the north and 16th Street to the south** to welcome people into Downtown. Enhancements could include additional gateway signage, enhanced wayfinding signage, landscaping, public art, and other physical improvements.
- **Continue infill development and redevelopment of Opportunity Sites** throughout Downtown to fill in the urban fabric and improve the pedestrian experience.
- **Create distinct, unique sub-areas** that together form an exciting Downtown experience.
- **Incorporate public space amenities wherever possible** to address the unequal distribution of parks and open space throughout the three sub-areas comprising Downtown.



CHAPTER 5: ACTION PLAN

The Market Assessment, Capital Improvement Assessment, Urban Quality Assessment, extensive community outreach conducted throughout this process, and Physical Framework all serve as building blocks for this Action Plan that will guide investment in Downtown Greeley for the next ten years.

The Action Plan is guided by a vision statement, written by topic area, and an overarching set of core values that is interwoven throughout the actions found in all three topic sections. The Action Plan also contains strategies and set of tactics organized into three topic areas; Economy, Environment, and Experience. This Action Plan provides downtown physical improvements and policies to guide the DDA and City of Greeley, the development community, and downtown stakeholders for the next ten-year investment cycle. For actions and tactics within each of these categories, timelines (short-, mid-, long-term), responsible parties, and illustrative costs are also identified to aid in implementation.



Upon Plan adoption, it is recommended that a **Downtown Plan Implementation Committee** be formed to provide oversight and track implementation of the Downtown 2032 – The Path Forward Plan. The Downtown Plan Implementation Committee should be comprised of representatives from various City of Greeley departments, the DDA, the Creative District, and other key civic partners. It is recommended this group meet quarterly to check-in on Plan implementation progress.

CORE VALUES & VISION

CORE VALUES

The Core Values identified below provide an overarching foundation for the Action Plan and are interwoven into all three topic area sections, with each action encompassing one or more of these Core Values.

WELCOMING AND INCLUSIVE

Downtown Greeley should celebrate its diversity of cultures, building upon this strength to create a place where everyone feels safe and welcome.

PROSPEROUS AND VIBRANT

Downtown's economy should be diversified, robust, and relevant to an array of stakeholders.

A COMPLETE NEIGHBORHOOD

Downtown should not only be a destination where people can work, play, or visit, but a place that offers a range of housing types that meet the needs of diverse age groups, lifestyles, and incomes as well.

ACCESSIBLE AND CONNECTED

Downtown Greeley should continue to be a place that is easy for people of all ages to move around whether by foot or mobility device, bicycle, transit, or car.

VISION

The 1,250 inputs that were gathered from the community throughout this planning process were synthesized into the vision for Downtown Greeley, provided below and organized into the three guiding topic areas of the Action Plan. These vision statements were also vetted through the Advisory Committee and through the broader Greeley community at the Open House. Each of the three vision elements below is interwoven into its subsequent section of the Action Plan.

VISION FOR THE FUTURE: ECONOMY

Downtown Greeley's **ECONOMY** will be robust and diverse, offering residents, employees, students, patrons, and visitors a range of options for jobs, housing, shopping, and dining. Storefronts will be active and offer a variety of restaurant, retail, and creative business options, highlighting the strong local business community. Historic building character will be retained where appropriate, and strategic infill development and redevelopment will continue to diversify residential and commercial options Downtown.

VISION FOR THE FUTURE: ENVIRONMENT

The Downtown physical **ENVIRONMENT** and public realm will be inviting and accessible for all people. There will be multi-modal connections both to destinations within Downtown and to adjacent neighborhoods. Public spaces in Downtown such as parks, plazas, alleys, and sidewalks will be enhanced and activated wherever possible, creating places and opportunities for people to gather.

VISION FOR THE FUTURE: EXPERIENCE

The Downtown **EXPERIENCE** will be vibrant, fun, welcoming, and inclusive. Downtown Greeley will continue to expand on its entertainment, events, and multicultural offerings, and will serve as a regional artistic and cultural hub for a range of creative and unique social offerings that are reflective of the diversity that exists within Greeley. Public art will continue to play an integral role in enhancing the Downtown experience and celebrating the community's assets. Downtown will be clean, safe, and well-maintained, creating an inviting atmosphere for all.

ECONOMY

** = Top community priority identified during the community Open House in October 2022

Sequencing: Short-term (next 18 months), Mid-term (18 months – 3 years), Long-term (More than 3 years)

Strategy	No.	Action	Conceptual Cost	Responsibility	Sequencing
**Strategy 1: Continue to stimulate infill development and redevelopment of underutilized sites.	EC.1.1	Prioritize development and redevelopment of opportunity sites identified through the Downtown Plan process. Explore opportunities to issue RFPs for the development or of redevelopment these opportunity sites.	\$\$	Lead: City of Greeley Support: DDA	Short- to Mid-term
	EC.1.2	Review Downtown policies and programs such as TIF, STIP, Opportunity Zones, and Enterprise Zones, to incentivize investment to specific areas (i.e. Railway District) and types of uses (i.e. attainable/affordable housing, small business incubation and ownership, etc.) that require gap financing.	\$	Lead: City of Greeley Support: DDA	Short- to Mid-term
	EC.1.3	Continue to offer potential investors and developers information, resources, grant opportunities, and contacts at City departments for development and redevelopment opportunities.	\$	Lead: City of Greeley	Short-term
	EC.1.4	Explore resources to demolish, remediate, and redevelop properties that have environmental hazards or other impediments to redevelopment, such as Brownfields.	\$\$\$	Lead: DDA Support: City of Greeley	Mid- to Long-term

Strategy	No.	Action	Conceptual Cost	Responsibility	Sequencing
	EC.1.5	Facilitate mixed-use – in new and existing buildings – with adaptable ground floor spaces that can accommodate a range of tenant types. Identify appropriate locations for ground floor office or small-scale manufacturing use (i.e., non-retail). Explore overlay or other land use tools to support this goal.	\$	Lead: City of Greeley Support: DDA	Mid- to Long-term
	EC.1.6	Explore resetting the Sales Tax TIF base during the DDA renewal process to further stimulate area economic development.	\$	Lead: DDA Support: City of Greeley	Short-term
Strategy 2: Encourage diverse, vibrant storefront uses throughout Downtown.	EC.2.1	Continue to offer technical assistance to entrepreneurs and current and prospective business owners, such as business planning, location assistance, marketing, pathways to property ownership, and assistance in navigating permitting processes.	\$	Lead: City of Greeley Support: DDA, SBDC	Short-term
	EC.2.2	Explore opportunities to bolster UNC's Entrepreneurial Challenge, or E-Challenge , to attract UNC student or graduate businesses to Downtown, such as creating local investment fund financed by Downtown businesses, or exploring angel investor opportunities.	\$\$	Lead: City of Greeley Support: DDA, UNC, SBDC	Short- to Mid-term
	EC.2.3	Proactively tailor business recruitment strategies to each of the sub-areas in Downtown based on needs and character: <ul style="list-style-type: none"> Central Downtown: restaurants, boutique retail, entertainment, hotel/convention center Railway District: maker, destination, manufacturing, and experiential businesses, museums and galleries 	\$\$	Lead: City of Greeley Support: DDA, SBDC	Short- to Mid-term

Strategy	No.	Action	Conceptual Cost	Responsibility	Sequencing
		<ul style="list-style-type: none"> University Uptown: small-format grocery and pharmacy, daily services, neighborhood-serving restaurants, bed and breakfasts 			
	EC.2.4	Nurture and recruit desirable independent businesses to ensure that Downtown continues to be a regional hub for locally-owned enterprises, particularly businesses that reflect the cultural diversity in Greeley.	\$\$	Lead: City of Greeley Support: DDA, Greeley Creative District	Short- to Mid-term
	EC.2.5	Review and update the Redevelopment Resource Guide for high-value businesses that meet the goals of this plan that includes information on receiving pre-approvals for permitting, expedited development review, flexible standards on outdoor seating, flexible approaches to retrofitting compound water taps, etc.	\$	Lead: City of Greeley	Short-term
	EC.2.6	Continue to maintain an inventory of available Downtown commercial spaces to market available properties and match businesses with the appropriate sub-area.	\$	Lead: DDA, Support: City of Greeley	Short-term
	EC.2.7	Explore creating a virtual help desk to invite new and existing businesses to access specialized support.	\$	Lead: City of Greeley	Short-term
Strategy 3: Continue to diversify the housing base in Downtown.	EC.3.1	Facilitate a diversity of housing types in Downtown Greeley that provide options for a range of incomes and lifestyle preferences and proactively tailor housing strategies to each of the sub-areas in Downtown based on needs and character: <ul style="list-style-type: none"> Central Downtown: higher density housing, infill development of apartments (rent), 	\$\$	Lead: City of Greeley	Mid- to Long-term

Strategy	No.	Action	Conceptual Cost	Responsibility	Sequencing
		<p>condominiums (own), mixed-use</p> <ul style="list-style-type: none"> • Railway District: mixed density housing, live/work, affordable multi-family • University Uptown: enhance existing housing and missing middle housing, including ownership opportunities: townhomes, condominiums, single-family, du/tri/quadplexes; thoughtful infill with gentle density 			
	EC.3.2	To reduce the impacts from homelessness, support and encourage intervention, treatment, and outreach services to direct individuals experiencing homelessness and mental health challenges to permanent supportive and/or transitional housing and appropriate services.	\$\$	<p>Lead: City of Greeley</p> <p>Support: DDA, United Way, Weld Trust, Weld County, North Range Behavioral Health</p>	Short- to Mid-term
	EC.3.3	Recognize the opportunity for the City development code to allow housing types that support artists and makers, such as live-work units, particularly in the Railway District.	\$	<p>Lead: City of Greeley</p> <p>Support: Greeley Creative District</p>	Mid-term
	EC.3.4	Facilitate Accessory Dwelling Units (ADUs) in the University Uptown District and adjacent neighborhoods to encourage gentle density and missing middle housing as appropriate and desired.	\$	<p>Lead: City of Greeley</p>	Short-term
	EC.3.5	Invest in amenities and encourage land uses that increase the desirability of Downtown as a neighborhood to live, work, and play in.	\$\$	<p>Lead: City of Greeley</p> <p>Support: DDA</p>	Mid- to long-term

Strategy	No.	Action	Conceptual Cost	Responsibility	Sequencing
	EC.3.6	Explore expanding the G-HOPE pilot program to offer UNC seniors or recent UNC graduates homebuyer down payment assistance to try and entice young professionals in and around Downtown.	\$\$	Lead: City of Greeley Support: UNC	Short-term
	EC.3.7	Explore the feasibility of an overlay district that encourages multifamily homes to meet a minimum maintenance requirement through performance-based zoning.	\$	Lead: City of Greeley	Short-term
Strategy 4: Sustain and attract more primary employers and jobs.	EC.4.1	Work with major regional employers in growing industries, including knowledge sector jobs, to identify new opportunities for establishing a presence in Downtown to continue diversifying the economy.	\$	Lead: City of Greeley Support: DDA, Upstate Colorado	Mid- to Long-term
	EC.4.2	Identify new primary job sectors to attract to the Downtown that build on Greeley's strengths, such as agriculture technology and light industrial, in the Railway District.	\$	Lead: City of Greeley	Mid- to Long-term
	EC.4.3	Incubate and attract small-scale (and creative) craft manufacturers to Downtown Greeley, particularly in the Railway District.	\$\$	Lead: City of Greeley Support: DDA	Mid-term
	EC.4.4	Encourage strong and appealing economic connections between UNC and Downtown. Identify appropriate UNC programming/innovations, such as UNC's E-Challenge, that can be in Downtown, occupy office space, and help spur new jobs, including fostering graduate entrepreneurship.	\$\$	Lead: City of Greeley Support: DDA, UNC	Short-term
	EC.4.5	Enhance the "Bear Biz" program that fosters special promotions by local businesses to the UNC community.	\$	Lead: City of Greeley Support: DDA, UNC	Short-term
	EC.4.6	Facilitate the development of more office and mixed-use space in the Downtown area to	\$\$\$	Lead: City of Greeley Support: DDA	Mid- to Long-term

Strategy	No.	Action	Conceptual Cost	Responsibility	Sequencing
		accommodate a range of tenant types, including flexible co-working space or small-format offices, to meeting existing demand and to invite and accommodate entrepreneurship and diverse economic activity.			
Strategy 5: Cultivate a Downtown economy that is relevant and welcoming to an array of community stakeholders and visitors.	EC.5.1	Continue to build on the Greeley Farmers' Market and recruit businesses that offer household goods and services that are culturally relevant to Greeley's diverse populations to make Downtown a more complete residential neighborhood, such as small-format grocery stores or markets offering a variety of fresh and culturally relevant food options.	\$\$	Lead: City of Greeley Support: DDA	Mid-term
	EC.5.2	Strengthen the relationship between UNC and Downtown Greeley leadership to help ensure that Downtown is relevant, welcoming, and safe to students. This could include creating a professional, part-time, or student internship liaison position at the City of Greeley.	\$	Lead: City of Greeley Support: DDA, UNC	Short-term
	EC.5.3	Proactively engage existing and prospective business owners from Greeley's diverse populations to further promote multicultural entrepreneurship, including exploring a contract with IRC NOCO to provide business resources and services in multiple languages, or creating a bi-lingual business coordinator position at the City of Greeley.	\$\$	Lead: City of Greeley Support: DDA, Immigrant and Refugee Center of Northern Colorado (IRC NOCO)	Short-term
	EC.5.4	Explore opportunities to establish a regular location for a Multi-cultural Vendor Market or Mercado in or near Downtown to serve the Hispanic/Latinx community in Greeley.	\$	Lead: City of Greeley Support: DDA	Short- to Mid-term

Strategy	No.	Action	Conceptual Cost	Responsibility	Sequencing
	EC.5.5	Explore programs and resources to create pathways to property ownership (residential and commercial) to prevent involuntary displacement and gentrification.	\$	Lead: DDA Support: City of Greeley	Short-term

ENVIRONMENT

** = Top community priority identified during the community Open House in October 2022

Sequencing: Short-term (next 18 months), Mid-term (18 months – 3 years), Long-term (More than 3 years)

Strategy	No.	Action	Conceptual Cost	Responsibility	Sequencing
Strategy 1: Enhance connections to the Poudre River north and east of Downtown.	EN.1.1	Invest in streetscape improvements along 10 th Street (east of 8 th Avenue) and 9 th Avenue (north of 7 th Street), that focus on improved pedestrian experience, bicycle facilities, and signage connecting Downtown to the river. Streetscape improvements would entail: <ol style="list-style-type: none"> 1. Corridor Studies 2. Conceptual Design 3. Final Design and Phasing 4. Phased Implementation 	\$\$	Lead: City of Greeley Support: Poudre River Trail Corridor, Inc.	Can be phased to distribute cost.
	EN.1.2	Form a partnership between DDA, City, and Poudre Trail Corridor Board to improve branding, advertising, and physical signage promoting the connection between Downtown and the river.	\$	Lead: City of Greeley Support: DDA, Poudre River Trail Corridor, Inc.	Short-term
	EN.1.3	Consider adding amenities along the Poudre River south of Island Grove as the Poudre River Trail	\$\$\$	Lead: City of Greeley	Long-term

<i>Strategy</i>	<i>No.</i>	<i>Action</i>	<i>Conceptual Cost</i>	<i>Responsibility</i>	<i>Sequencing</i>
		is extended and connections to the river are enhanced.			
Strategy 2: Improve connections to the UNC campus.	EN.2.1	Invest in 9 th Avenue improvements to create an enhanced bicycle and pedestrian experience by repurposing portions of the roadway to non-vehicular uses.	\$\$\$	Lead: City of Greeley Support: DDA, UNC	Mid-term
	EN.2.2	Improve transit/shuttle service from residential housing on campus to key Downtown destinations.	\$\$	Lead: City of Greeley Support: DDA, UNC	Mid-term
	EN.2.3	Create a joint UNC/City/DDA committee to discuss and determine what types of destinations and uses can be added to Downtown to attract students on a daily and weekly basis.	\$	Lead: City of Greeley Support: DDA, UNC	Short-term
	EN.2.4	In cooperation with the Greeley Art Commission, create visual connections throughout the core and to UNC by placing public art displays strategically to guide pedestrians through Downtown.	\$\$	Lead: DDA Support: UNC, City of Greeley, Greeley Art Commission, Greeley Creative District	Mid-term
	EN.2.5	Recognize 10 th Avenue as a direct connector between Downtown and the UNC campus through physical improvements such as enhanced lighting or wayfinding signage.	\$\$	Lead: City of Greeley Support: DDA, UNC	Short-term
**Strategy 3: Create new public spaces focused on families, residents, visitors, and the everyday use of inviting and comfortable outdoor spaces, ensuring that each sub-area has an identifiable and	EN.3.1	Create more kid-friendly activities and amenities in Downtown neighborhoods by adding a collection of small playgrounds, a potential water feature/splash pad, and play elements that appeal to all ages.	\$\$	Lead: City of Greeley Support: DDA	Mid- to Long-term
	EN.3.2	Ensure that resources, including amenities and public realm investments, are equally distributed throughout Downtown and adjacent neighborhoods.	\$\$	Lead: City of Greeley	Long-term
	EN.3.3	Continue to improve alleys in Central Downtown where possible, working with adjacent	\$\$	Lead: City of Greeley Support: DDA	Mid- to Long-term

<i>Strategy</i>	<i>No.</i>	<i>Action</i>	<i>Conceptual Cost</i>	<i>Responsibility</i>	<i>Sequencing</i>	
destination public space.		private property owners and businesses on improvements such as adding paving, managing trash disposal, improving lighting, enhancing maintenance, and exploring undergrounding utilities.				
	EN.3.4	Explore vacating additional alleys in Downtown to reinvent as activated public space, similar to 9 th Street.	\$\$	Lead: City of Greeley Support: DDA	Long-term	
	EN.3.5	Identify locations and amenities for destination public spaces in the University Uptown and Railway District subareas. Consider opportunity sites identified through this process for these public spaces.	\$	Lead: City of Greeley Support: DDA	Mid-term	
	EN.3.6	Plan, design, and implement two new destination public spaces in the University Uptown and Railway District subareas.	\$\$\$	Lead: City of Greeley Support: DDA	Long-term	
	EN.3.7	Explore feasibility of creating a 9 th Avenue Promenade that serves as an open space amenity running through Downtown to and from UNC.	\$\$\$	Lead: City of Greeley Support: DDA, UNC	Mid-term	
	EN.3.8	Explore physical infrastructure upgrades in the Railway District to encourage a greater diversity of uses, enhance pedestrian and bicycle connections, and promote infill development and adaptive reuse of existing structures.	\$\$\$	Lead: City of Greeley Support: DDA	Long-term	
	EN.3.9	Identify small infill sites for Downtown dog park facilities.	\$	Lead: City of Greeley Support: DDA	Mid-term	
	Strategy 4: Unify Downtown's public realm with standards that provide consistency and improve the overall quality.	EN.4.1	Create new design standards and guidelines for Downtown that focus on a consistent treatment to the public realm, streetscape, building frontages, and character.	\$	Lead: City of Greeley Support: DDA	Short-term
		EN.4.2	Revise Public Works roadway standards for Downtown for consistency with new design standards and guidelines.	\$	Lead: City of Greeley	Short-term

<i>Strategy</i>	<i>No.</i>	<i>Action</i>	<i>Conceptual Cost</i>	<i>Responsibility</i>	<i>Sequencing</i>
	EN.4.3	Increase right-of-way inspections in Downtown to monitor compliance with city standards.	\$	Lead: City of Greeley	Short-term
	EN.4.4	Conduct a comprehensive underground utility study to understand stormwater, power, internet, and other utility capacity to understand future capacity for redevelopment and to understand the feasibility of undergrounding utilities.	\$\$	Lead: City of Greeley Support: Xcel, Allo	Short- to Mid-term
	EN.4.5	Conduct an American with Disabilities Act (ADA) accessibility study to evaluate Downtown's current ability to meet ADA standards and identify needed infrastructure improvements needed for compliance.	\$\$	Lead: City of Greeley	Short- to Mid-term
	EN.4.6	Continue enhancing lighting throughout Downtown, particularly along 8 th and 9 th Streets and 8 th and 9 th Avenues.	\$\$	Lead: City of Greeley Support: DDA	Mid-term
	EN.4.7	Conduct a Complete Streets Analysis of 8th Avenue to determine strategies to allow for multi-modal movement along the street, including exploring crossings of 8 th Avenue to improve east/west non-vehicular connections.	\$	Lead: City of Greeley	Short- to Mid-term
	EN.4.8	Work with the City to establish agreed upon standards for Downtown-focused maintenance and support that standard with adequate resources	\$\$	Lead: City of Greeley	Short-term
	EN.4.9	Explore options for a special trash overlay district in the Downtown managed by the City to create a more efficient, effective, consistent and pleasant public realm experience.	\$\$	Lead: City of Greeley Support: DDA	Short-term
	Strategy 5: Enhance the	EN.5.1	Improve pedestrian and bicycle connections across the Union	\$\$	Lead: City of Greeley

<i>Strategy</i>	<i>No.</i>	<i>Action</i>	<i>Conceptual Cost</i>	<i>Responsibility</i>	<i>Sequencing</i>
quality of the connections to the adjacent neighborhoods around Downtown.		Pacific railroad tracks at 5 th and 6 th Street.			
	EN.5.2	Explore 8 th Street Improvements, including: <ul style="list-style-type: none"> Complete the north sidewalk railroad crossing on 8th Street to enhance pedestrian connections. Conduct an 8th Street Enhanced Corridor Study to determine improvements required to enhance connections to adjacent neighborhoods east and west. 	\$\$	Lead: City of Greeley Support: DDA	Long-term
	EN.5.3	Conduct a 9 th Street or 11 th Street enhanced corridor study to determine improvements required to enhance east-west connections to adjacent neighborhoods.	\$\$	Lead: City of Greeley	Mid-term
	EN.5.4	Pursue streetscape improvements on 11 th Street, 8 th Avenue, and 7 th Avenue	\$	Lead: City of Greeley Support: DDA	Short- to Mid-term
	EN.5.5	Complete the planned and designed 16 th Street improvements between 8 th and 10 th Avenues.	\$\$	Lead: City of Greeley	Short-term
	EN.5.6	Utilize public art or other distinct streetscape features to create a sense of arrival at key gateway points, including 5 th Street on the north end of Downtown and 16 th Street at the southern end of Downtown.	\$\$	Lead: City of Greeley Support: DDA, Greeley Creative District	Short- to Mid-term
	EN.5.7	Connect existing bike lanes on 8 th Street and 9 th Avenue by filling in gaps along 10 th Avenue and 7 th Street around Lincoln Park to form a contiguous bicycle network through the center of Downtown.	\$\$	Lead: City of Greeley	Long-term
	EN.5.8	Continue adding wayfinding signs, bicycle signs, light pole banners, and other place enhancements that highlight	\$\$	Lead: City of Greeley Support: DDA	Short- to Mid-term

<i>Strategy</i>	<i>No.</i>	<i>Action</i>	<i>Conceptual Cost</i>	<i>Responsibility</i>	<i>Sequencing</i>
		and direct people to Downtown amenities.			
	EN.5.9	Explore the feasibility of adding branded signage and public art to new Railroad Quiet Zone fencing in the Railway District.	\$	Lead: City of Greeley Support: Colorado Model Railroad Museum, DDA, Greeley Creative District	Short-term

EXPERIENCE

** = Top community priority identified during the community Open House in October 2022

Sequencing: Short-term (next 18 months), Mid-term (18 months – 3 years), Long-term (More than 3 years)

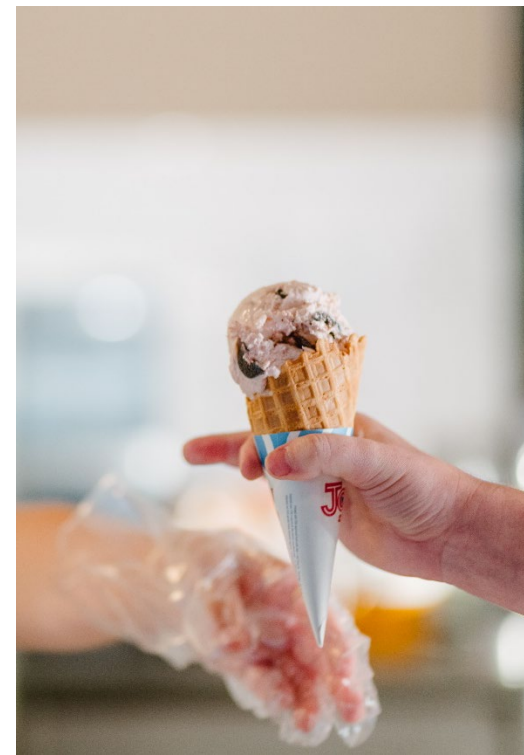
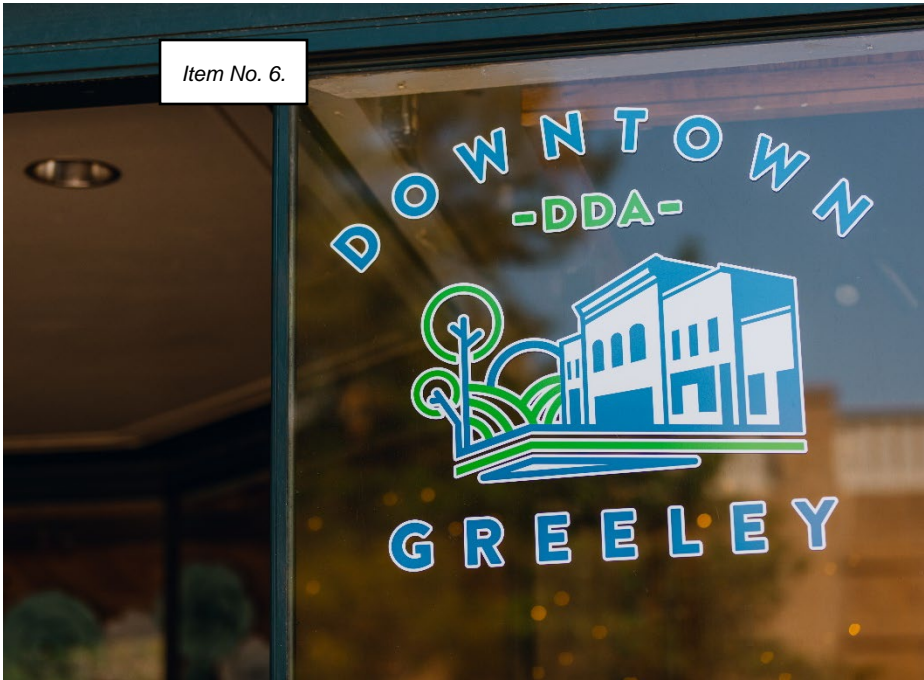
<i>Strategy</i>	<i>No.</i>	<i>Action</i>	<i>Conceptual Cost</i>	<i>Responsibility</i>	<i>Sequencing</i>
Strategy 1: Promote local arts and creative experiences in Downtown.	EX.1.1	Preserve existing and develop or redevelop buildings and spaces that are affordable to artists and creative professionals.	\$\$	Lead: DDA Support: Greeley Creative District	Mid-term
	EX.1.2	Support and consider more widespread promotion of events related to arts and creative experiences in Downtown.	\$	Lead: DDA Support: City of Greeley, Greeley Creative District	Short-term
	EX.1.3	Continue to incorporate art wherever possible throughout Downtown, including permanent and temporary installations.	\$\$	Lead: DDA Support: City of Greeley, Greeley Creative District	Short-term
	EX.1.4	Work with property owners to offer vacant storefronts in the short-term, at low/no costs to local artists as studio and gallery space.	\$	Lead: DDA Support: Greeley Creative District	Short- to Mid-term
	EX.1.5	Work with the Creative District and other local arts partners to continue integrating arts and creative experiences throughout Downtown Greeley.	\$	Lead: DDA Support: Greeley Creative District	Short- to Mid-term
**Strategy 2: Ensure	EX.2.1	Continue to maintain enhanced maintenance standards and	\$\$	Lead: DDA	Short- to Mid-term

Strategy	No.	Action	Conceptual Cost	Responsibility	Sequencing
Downtown is clean, safe, and welcoming.		beautification efforts in the Downtown public realm.		Support: City of Greeley	
	EX.2.2	Support and adopt a holistic approach to addressing real and perceived Downtown safety concerns.	\$	Lead: DDA Support: City of Greeley, Greeley Police Department	Short- to Mid-term
	EX.2.3	Explore hiring a consultant to provide training and strategic planning to City and DDA staff and leadership around diversity, equity, and inclusion issues with the goal of making Downtown welcoming to all.	\$	Lead: City of Greeley Support: DDA	Short-term
	EX.2.4	Connect people experiencing homelessness with resources, and mental health, employment training, and other supportive services.	\$\$	Lead: City of Greeley Support: DDA, Greeley Police Department, North Range Behavioral Services, Frontier House, Lutheran Family Services	Short-term
	EX.2.5	Continue to encourage partnerships, collaboration, and coalition building around Downtown initiatives that represent diverse interests.	\$	Lead: City of Greeley Support: DDA, UNC DEI Leadership, Greeley Creative District, IRC NOCO, Hispanic Women of Weld County	Short-term
	EX.2.6	Designate the City lead department responsible for developing a work program to manage and support the execution of this Plan.	\$	Lead: City of Greeley	Short-term
Strategy 3: Celebrate historic character, charm, and distinctive environment in Downtown.	EX.3.1	Continue to support historic preservation of designated properties in Downtown Greeley by identifying available resources and incentives, and helping property owners obtain grants, tax credits, and other financial tools.	\$\$	Lead: City of Greeley Support: DDA, Historic Preservation Commission	Mid- to Long-term
	EX.3.2	Facilitate adaptive reuse in Downtown that is not limited	\$\$\$	Lead: City of Greeley	Mid- to Long-term

Strategy	No.	Action	Conceptual Cost	Responsibility	Sequencing
		only to districts or structures that meet historic designation criteria, by providing incentives such as historic preservation grants or tax credits, infrastructure investment, regulatory relief, façade grants, or other incentives as appropriate.		Support: DDA, Historic Preservation Commission	
	EX.3.3	Continue to promote events and programs that celebrate Greeley's history, including walking tours, history brown bags, and Historic Preservation Month.	\$	Lead: City of Greeley Support: DDA, Historic Preservation Commission	Short-term
	EX.3.4	Ensure that the portrayal of Greeley's history accurately represents and reflects City's diverse population and storied past.	\$	Lead: City of Greeley Support: DDA, Historic Preservation Commission	Short-term
Strategy 4: Continue to activate Downtown through programming and events that are relevant and inclusive to Greeley's diverse population.	EX.4.1	Encourage events that celebrate the different cultures that exist within Greeley. Work closely with leaders of the Hispanic/Latinx and other communities to help create and plan events that are historically accurate and welcoming.	\$	Lead: DDA Support: City of Greeley, Greeley Creative District, UNC	Short-term
	EX.4.2	Increase the frequency and variety of live music events and festivals, and partner with local institutions and organizations to increase diversity of offerings.	\$	Lead: DDA Support: City of Greeley	Short-term
	EX.4.3	Continue working with UNC to develop events that appeal to college students such as runs, bike rides, music, and UNC celebrations for sports or other activities. These should be offered during times of the week that accommodate UNC student schedules and encourage students to stay in Greeley on the weekends.	\$	Lead: DDA Support: City of Greeley, UNC	Short-term
	EX.4.4	Continue to work with UNC's creative communities, including arts, music, and theatre, to	\$	Lead: DDA Support: City of Greeley, UNC	Short- to Mid-term

Strategy	No.	Action	Conceptual Cost	Responsibility	Sequencing
		showcase student talent in venues Downtown.			
	EX.4.5	Explore ways to improve activation of Lincoln Park including creating a pedestrian-focused environment in and around the park, adding a space for performances, providing regular daily or weekly programming, and creating reasons for people to gather and spend time in Lincoln Park.	\$\$	Lead: City of Greeley Support: DDA, Historic Preservation Commission	Short- to Mid-term
Strategy 5: Market existing Downtown assets and amenities to both locals and visitors.	EX.5.1	Improve communication and marketing of Downtown assets to the UNC community.	\$	Lead: DDA Support: City of Greeley, UNC	Short-term
	EX.5.2	Continue to develop tailored promotions, marketing campaigns, artistic maps and directories, and outreach to institutions and employers, to attract nearby residents and residents from throughout the region, to visit Downtown shops and restaurants.	\$	Lead: DDA Support: Greeley Creative District, City of Greeley	Short-term
	EX.5.3	Build a more distinct brand identify for each of the sub-areas comprising Downtown to improve marketing and promotion of each area.	\$	Lead: DDA Support: City of Greeley	Short- to Mid-term
	EX.5.4	Use technology and QR codes to promote user orientation and awareness of Downtown destinations and amenities.	\$\$	Lead: DDA Support: City of Greeley	Short- to Mid-term
	EX.5.5	Explore ways to attract an additional hotel and/or conference and events center to accommodate larger scale conferences and gatherings.	\$\$	Lead: City of Greeley Support: DDA	Short- to Mid-term

APPENDIX A: MARKET ASSESSMENT



DOWNTOWN GREELEY 2022 MARKET ASSESSMENT

Prepared by: Progressive Urban Management Associates
A component of the *Downtown 2032 – The Path Forward* plan

JULY 2022

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1. MARKET SUMMARY

The following Market Assessment was completed in Q2 2022 to help inform the “Downtown 2032 – The Path Forward” planning effort. Data was compiled using primary and secondary sources, including the City of Greeley, Weld County, Esri Business Analyst, the U.S. Census Bureau, real estate research, interviews with local real estate experts and Downtown stakeholders, and other available sources.

It’s important to note that this Market Assessment was conducted more than two years into the COVID-19 public health and economic crisis. Given the lag time in data gathering and/or a disruption in funding to update some databases (typically done on an annual basis), some of the information that follows presents conditions pre-crisis. This Market Assessment is intended to provide baseline data for Downtown Greeley, before and after the beginning of COVID when possible, which will inform the community as it continues to transition to a new normal.

What follows in this document?

The Market Assessment is organized into two main sections:

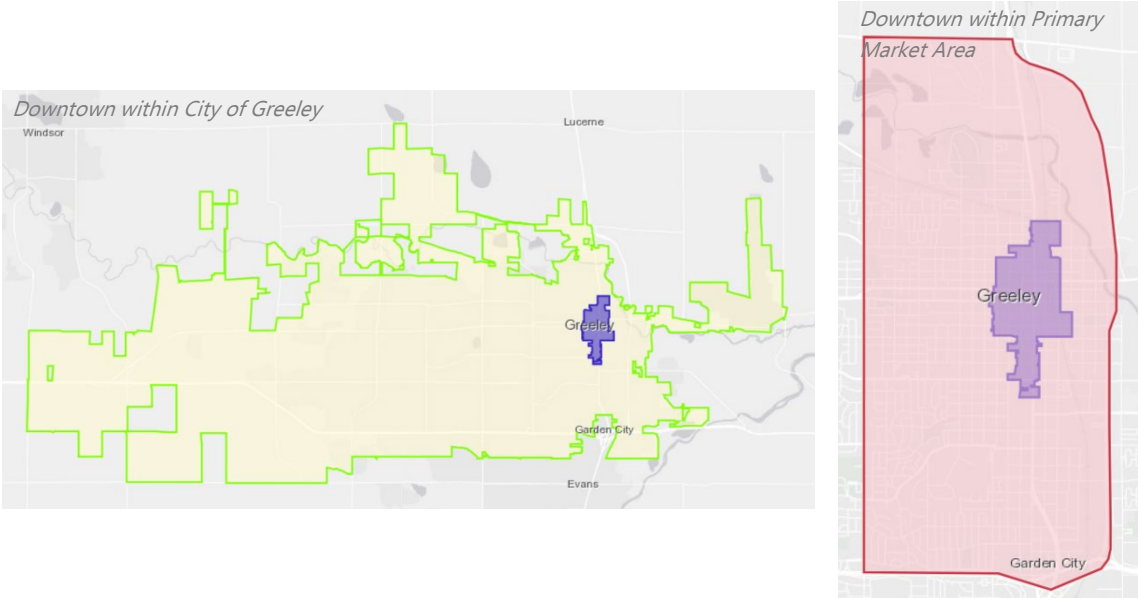
1. The following *Market Summary* provides an overview of key findings by sector. It provides a snapshot of existing conditions – in both Greeley and Downtown – and then an assessment of the relevant real estate sector’s conditions, strengths, and vulnerabilities (i.e., housing, office, industrial, retail, lodging).
2. Detailed supporting research is then provided in four subsequent sections. The *Live* section is an assessment of demographics, psychographics, and housing within Downtown and citywide. The *Work* section is an assessment of the regional economy, the Downtown economy, and the Downtown office market. The *Shop & Dine* section is an assessment of Downtown’s storefront economy. The *Visit & Stay* section is an assessment of Downtown and the region’s visitor attractions, arts and culture, and the lodging sector. When applicable, Downtown Greeley is compared to peer cities throughout these sections to offer new considerations for benchmarking.

Market Areas

Data was collected, when available, for Downtown Greeley, a Primary Market Area, and the City of Greeley. The Downtown study area is tied to the Downtown Development Authority boundary – a 0.5 square mile (approximately 55 blocks) area shown in the maps below. Portions of both U.S. Routes 85 (a.k.a. 8th Ave.) and 34 (a.k.a. 10th St.) run through it, with the greatest extents of the DDA boundary stretching roughly to 3rd Street to the north, 5th Avenue to the east (just beyond the Union Pacific Railroad tracks), 17th Street to the south (excluding the University of Northern Colorado campus), and to 12th Avenue to the west.

The 7.7 square mile Primary Market Area, pictured on the following page, was defined by the City of Greeley and was also used in P.U.M.A.’s 2011 Downtown Greeley Investment Strategy report. This broader area is used to better understand market opportunities and demand for offerings from within the Downtown boundaries. The Primary Market Area boundary incorporates the Downtown area, as well as adjacent neighborhoods where residents are readily able to access (i.e., with a maximum ten-minute walk or bike ride) and support establishments within Downtown. It is bounded by County Road 64 to the north, U.S. Highway 85 (8th Avenue/Business Rt.) to the east, U.S. Highway 34 to the south, and 23rd Avenue to the west.

The City of Greeley is approximately 49.8 square miles, also shown below, and is a key market and point of comparison for Downtown data. It also offers a wider array of data than the customized, Downtown boundary.



Peer Cities

Peer cities and their downtowns are used as comparisons throughout the Market Assessment. They include Cheyenne, WY; Flagstaff, AZ; Grand Junction, CO; Fort Collins, CO; Idaho Falls, ID; and Ogden, UT. They were selected by Greeley’s Department of Economic Health and Housing due to their downtowns being similar in size and other characteristics (i.e., most have universities). On the whole, these peer cities share many of the same market dynamics that exist in Greeley today.

Boundaries for peer downtowns were set based on Improvement District boundaries or downtown cores as defined in their downtown plans if an improvement district was not present.

Peer Cities & Downtowns					
City	2021 Population	University	2021 Univ. Enrollment	Tourism/Recreational Draw	Downtown Size
Ogden, UT	89,694	Weber State University	29,774	Wasatch Mountains	0.79 sq. mi.
Flagstaff, AZ	76,917	Northern Arizona University	28,718	Grand Canyon National Park, Coconino National Forest	0.28 sq. mi.
Fort Collins, CO	173,035	Colorado State University	27,919	Colorado Rocky Mountains, Cache la Poudre River	0.49 sq. mi.
Grand Junction, CO	67,323	Colorado Mesa University	7,824	Colorado Rocky & San Juan Mountains; Colorado National Monument	0.58 sq. mi.
Greeley, CO	112,816	University of Northern Colorado	7,535	Colorado Rocky Mountains, Greeley Stampede	0.49 sq. mi.
Idaho Falls, ID	67,322	n/a - satellite campus or community college only	n/a	Snake River	0.26 sq. mi.
Cheyenne, WY	89,694	n/a - no university	n/a	Colorado Rocky Mountains; Cheyenne Frontier Days	0.37 sq. mi.

Historical Context

NATIVE AMERICAN TRIBES

Long before the terms “Native American”, “Indian”, or “Alaska Native” were created, tribes across the Americas operated as self-governing, independent political communities with varying cultural identities and practices. Tribal sovereignty persists today. Contemporary nations enhance health, safety, and welfare for tribal citizens within tribal territory. There are 574 federally recognized Indian Nations (variously called tribes, nations, bands, pueblos, communities and native villages) in the United States¹. Approximately 229 of these ethnically, culturally, and linguistically diverse nations are located in Alaska: the other federally recognized tribes are located in 35 other states. Additionally, there are state recognized tribes located throughout the United State recognized by their respective state governments.

Many of the original inhabitants of the area we now call Colorado were far-ranging people. They traveled the southwestern deserts and northern plains, moving with the seasons for the best hunting, gathering, and harvesting. In the late 1800s, treaties were used a means to obtain more land for White Settlers. Colorado is just one of the many ancestral lands where the following tribes grew their culture for thousands of years:

- The Ute Nation, or Núchíú which means “the people” lived in Colorado, Utah, New Mexico, and Nevada². Most Ute people still live in these areas today. There are three different Ute tribes today and each tribe lives on its own reservation, which is land that belongs to them and is under their governance. Most Ute people speak English and more than a thousand, speak their native Ute language. The homepages of the [Southern Ute Tribe](#)³, [Ute Mountain Ute Tribe](#), and [White Mesa Community](#)⁴ can be visited by clicking on the hyperlinks.
- The Apache are natives of the Southwest deserts particularly Arizona, New Mexico, Texas, Northern Mexico, and Colorado⁵. The word Apache means “enemy” in the language of their Zuni neighbors. The Apaches’ own name for themselves is *Nde* or *Ndee*, meaning “the people” but they also use Apache. There are thirteen different Apache tribes in the Unites State today: five in Arizona, five in New Mexico, and three in Oklahoma. Each Arizona and New Mexico Apache tribe lives on its own reservation. The Oklahoma Apache’s live on trust land. Almost all Apache speak English today, but many also speak their native Apache language, which is closely related to Navajo. The homepages of the [Jicarilla Apache Nation](#)⁶ and [White Mountain Apache Tribe](#)⁷ provide information about the Apache people from ancient times until today and can be visited by clicking the on hyperlinks.
- The Arapahos call themselves *Hinono-eino* or *Ununa-ina*, which means “our people” but they also use the word Arapahoe⁸. When the Europeans met them, they were living on the Great Plains of Colorado, Wyoming, Nebraska, and Kansas. Eventually the U.S. government deported the Southern Arapaho tribe to Oklahoma where they joined with the Cheyenne. There are two Arapaho tribes today. The Northern Arapahos live on a reservation that they share with the Shoshone⁹. The Southern Arapahos live on trust land together with the Southern Cheyenne tribe.

¹ (Native Languages of the Americas, 2020)

² (Native Languages of the Americas, 2020)

³ (Southern Ute Indian Tribe, 2022)

⁴ (Ute Mountain Ute Tribe, 2020)

⁵ (Native Languages of the Americas, 2020)

⁶ (Jicarilla Apache Nation, 2022)

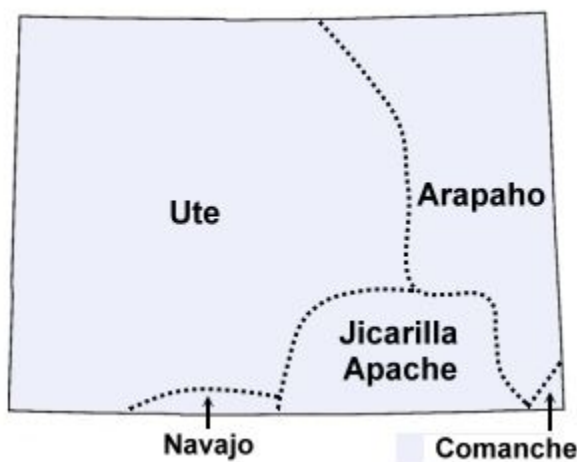
⁷ (White Mountain Apache Tribe, 2022)

⁸ (Native Languages of the Americas, 2020)

⁹ (Native Languages of the Americas, 2020)

- The Cheyenne call themselves Tsitsistas “the people”¹⁰. The Cheyenne people dominated the Great Plains including South Dakota, Wyoming, Nebraska, Colorado, and Kansas. The U.S. government forced the Cheyenne to move to Oklahoma during the 1800s (known as the [Trail of Tears](#)), but some escaped and fled north into Montana¹¹. Today there are two tribes: the Northern Cheyenne tribe of Montana as well as the Southern Cheyenne and Arapaho that live on trust lands in Oklahoma.

Although the nations described above consider themselves kinfolk, each group is politically distinct, they do not all speak the same language, and customs and beliefs vary from band to band. Each political tribal entity has its own government, laws, police, and services, just like a small country. Tribal members are citizens of three sovereigns: their tribe, the United States, and the state in which they reside. Many enrolled tribal members also live in cities and urban settings.



Source: NativeLanguages.org

In 1851, the Treaty of Fort Laramie was established between the U.S. government and several local tribes as part of the government’s attempt to protect the growing number of settlers moving west and to launch a military presence in the region. Per the treaty, each Native American tribe consented to sovereignty over a bounded territory in exchange for allowing free passage of white migrants as well as the construction of roadways and forts on their land. However, the Colorado Gold Rush of 1858-59 made the treaty obsolete, as settlers moved into the land that was supposedly protected. Renegotiations took place and the Treaty of Fort Wise was signed in 1861, which relegated the tribes to a much smaller tract of land (about one thirteenth the size) in eastern Colorado where they lived under government supervision¹².

UNION COLONY

Greeley began as the Union Colony of Colorado, which was founded in 1869 by Nathan C. Meeker, an agricultural reporter for the *New York Tribune*, as an experimental utopian farming community "based on temperance, religion, agriculture, education and family values;" it also had the backing of the *Tribune's* editor Horace Greeley, who popularized the phrase "Go West, young man." A committee that included Meeker and former Civil War

¹⁰ (Native Languages of the Americas, 2020)

¹¹ (Pauls, n.d.)

¹² (Treaty of Fort Laramie, 2022)

general Robert Alexander Cameron traveled to Colorado to find a suitable site and purchased 12,000 acres at the confluence of the Cache la Poudre and South Platte Rivers. The site, formerly known as the "Island Grove Ranch," included the area of Latham, an Overland Trail station, and was halfway between Cheyenne, Wyoming, and Denver, Colorado along the tracks of the Denver Pacific Railroad¹³.

By May of the same year, 500 people had arrived to take up residence in the new colony displacing large groups of Arapahoe and Cheyenne Native American Tribes¹⁴. The name Union Colony was later changed to Greeley in honor of Horace Greeley, who had settled in Colorado during the 1859 Pike's Peak Gold Rush¹⁵.

EARLY HISTORY

Greeley was incorporated as a city on April 6, 1886¹⁶. Greeley was built on farming and agriculture and kept up with most modern technologies as they evolved. Telephones were in town by 1883 and electric lights were Downtown by 1886¹. Automobiles were on the roads alongside horse-drawn buggies by 1910¹. A local Women's Citizens League was established to support female suffrage¹⁷.

In 1922, KFKA became one of the first radio stations to broadcast in the US, and the Greeley Municipal Airport was built in 1928³.

Early residents of Greeley also established Colorado's first teaching college, now called the University of Northern Colorado. It has trained, and continues to train, more educators than any other school in the state¹⁸.

Greeley housed two POW camps in 1943, during World War II³. One was for German POWs and the other was for Italian POWs.

A vote to allow the sale of alcohol passed by a mere 477 votes in 1969, thus ending temperance in the city³.

The Greeley Philharmonic Orchestra was started in 1911³. In 1958, Greeley became the first city to have a Department of Culture³.

WATER LAW

In the dry summer of 1874, when the Cache la Poudre River did not have enough water to supply the irrigators in Greeley and more recent arrivals in upstream Fort Collins, members of local ditch companies began discussions that would lead to the establishment of formal water law in Colorado. By 1888 the colonists had built three major ditches capable of irrigating 90,000 acres of land¹⁹.

AGRICULTURE

Local beef barons pioneered business concepts in Greeley that have influenced meat production worldwide, and the agricultural industries in and around Greeley continue to serve as a magnet for immigrant and refugee workers from as far away as Latin America, East Africa, and Southeast Asia.

ENERGY DEVELOPMENT

In 1870 Greeley's founders very purposefully located their new community near one highly important resource:

¹³ (Union Colony of Colorado, 2021)

¹⁴ (Native American Tribes in Greeley, 2022)

¹⁵ (Virtual Tour, n.d.)

¹⁶ (Brooks, n.d.)

¹⁷ (House of Representatives Committee on the Judiciary, 1934)

¹⁸ (Kroepsch, n.d.)

¹⁹ (Hobbs, n.d.)

water. What they could not have known was that they accidentally placed their community atop another set of resources crucial to the future: oil and natural gas. The area around Greeley, known by energy producers as the Wattenberg Field, is Colorado's most prolific region of hydrocarbon production. More than 20,000 oil and natural gas wells have been drilled in the area since the 1970s.

THE UNIVERSITY OF NORTHERN COLORADO (UNC)

UNC is a public university in Greeley, Colorado. The university was founded in 1889 as the State Normal School of Colorado and has a long history in teacher education. The institution has officially changed its name four times. It was originally known as the State Normal School beginning on April 1, 1889, then the name was changed to Colorado State Teachers College on June 5, 1911, then to Colorado State College of Education at Greeley on February 16, 1935 and then to Colorado State College on February 11, 1957; it's had its current name since May 1, 1970. Nearly 10,000 students are enrolled in six colleges, with extended campus locations in Loveland, Denver/Aurora, and Colorado Springs²⁰.

HISPANIC POPULATION IN GREELEY²¹

Greeley's agricultural industries have been powered by immigrant labor since their inception. The boom in sugar beets at the turn of the twentieth century spurred the construction of large sugar plants in Greeley and surrounding communities, which in turn boosted local beet production as well as demand for laborers in the beet fields. The Great Western Sugar Company recruited German workers from Russia and Japanese workers from the Pacific Coast. Some of these migrant workers saved their earnings and purchased their own farmland in the area. By the 1920s, workers from Mexico and Latin America provided another important source of labor for sugar beet production⁶.

The Great Western Sugar Company, Weld County's largest sugar manufacturer, built colonies where Mexican and Spanish-American workers could live year-round. Anglos thought the Hispanic population would be better off outside city limits. They settled into colonies and neighborhoods that to this day don't feel like the rest of Weld County. People still call those places "Little Mexico"²².

Because of a shortage of workers during World War II, companies recruited more Hispanic people to work American farm fields. Between 1941-1945, Mexico sent 220,000 "braceros" (a word derived from "brazo," the Spanish word for arm) to work on U.S. farms⁷.

Weld County's marginalized Hispanic community began to find solace in the Chicano Movement that swept the nation in the 1970's. In many ways, though, the Chicano Movement's battles still continue.

DOWNTOWN'S HISTORY

The first downtown area in Greeley was located on 8th Street between 8th and 9th Avenues. The buildings were adobe, wood frame, or brick structures. By 1879 the area had grown, bounded by the railroad tracks and 9th Avenue on the east and west, and by 7th Street and 9th Street on the north and south. Most of the original commercial buildings have been replaced, mainly with brick buildings. There were several reasons for the use of

²⁰ (University of Northern Colorado, 2022)

²¹ Hispanic is the term the Census currently uses

²² (Cumming, 2020)

brick, including that several brick factories operated in Greeley, and that an 1880 fire destroyed a wood frame hotel known as the Greeley House²³.

Greeley's Downtown Development Authority was created in 1998. In 2000, the DDA nominated Downtown Greeley as one of Colorado's Most Endangered Places due to threats brought about as a result of economic deterioration, urban growth to the west, businesses' flight to the suburbs, and the high vacancy rate of its downtown buildings. The Downtown Greeley of 1998 stood in stark contrast to that of the mid-1970s, when it was recognized as a thriving urban center that was even made internationally famous by the novel, *Centennial*.

Once Downtown Greeley was added to the Endangered Places list, the Downtown Development Authority, along with the support of the Greeley Historic Preservation Commission, began building a strong support network of business professionals through the Main Street Board. It initially focused on plaza redevelopment, opening them to automobile traffic, as well as removing some of the newer facades to reveal historic storefronts, which in turn began attracting businesses back to the district. Momentum of the preservation of Downtown grew when Greeley became part of Colorado's Main Street program in 2001. Private LLC's purchased and rehabilitated key properties in the Downtown district, which served as a catalyst to demonstrate the potential of older properties and underscore the economic power of historic preservation²⁴.

In 2011, Downtown Greeley became the first in the state of Colorado to take advantage of the Common Consumption legislation. Downtown regularly sees thousands of people at its First Friday Fests held throughout the summer months as well as its many other successful events throughout the year. Today, the DDA is very active, employing four champions for Downtown, which is enjoying extremely low vacancy rates, strong business growth, new development, and a positive reputation not only in Greeley but outside of it as well²⁵.

²³ (Virtual Tour, n.d.)

²⁴ (Downtown Greeley, 2022)

²⁵ (Conversations with the Inspiring Bianca Fisher, 2019)

Downtown's Impact on Greeley

The "Summary of Impact" table demonstrates that **while its land area is small** (~1% of the City), **Downtown is one of the most productive and valuable neighborhoods of the community**. It contains a modest proportion of Greeley's residents (3%), but more **substantial portions of the City's workers** as well as **dining, drinking and shopping options** (~15% each).

Summary of Impact			
0.48 square miles			1% of the city
<i>Meanwhile, Downtown has...</i>			
1,637 residents	→		3% of the city's
7,112 employees	→		14% of the city's
107 restaurants, bars & retailers	→		15% of the city's
\$71.9M in assessed value*	→		3% of the city's

*includes exempt properties

About 3% of the City's assessed value lies in Downtown land, with **each Downtown acre generating about three times more value** than citywide land in 2021 (see "Assessed Value Per Acre" table).

Assessed Value Per Acre, 2021			
	Acres	Assessed Value	Per Acre Value
Downtown	314	\$71.9 million	\$229.4 thousand
Greeley	31,872	\$2.1 billion	\$64.5 thousand

Source: Weld County Assessor's Office

Market Profile Summaries

The following summary provides an overview of key findings for each of the Market Assessment's four main topic areas. It provides a snapshot of existing conditions within each market area and then an assessment of the relevant real estate sector's conditions, strengths, and vulnerabilities. Pre- and post-COVID conditions are discussed when available, and then brief insights are offered into what the future may hold for various segments.

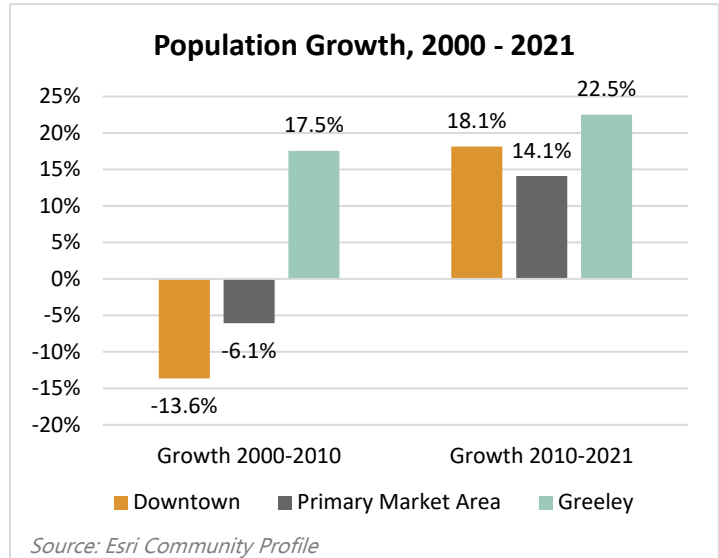
LIVE

POPULATION GROWTH

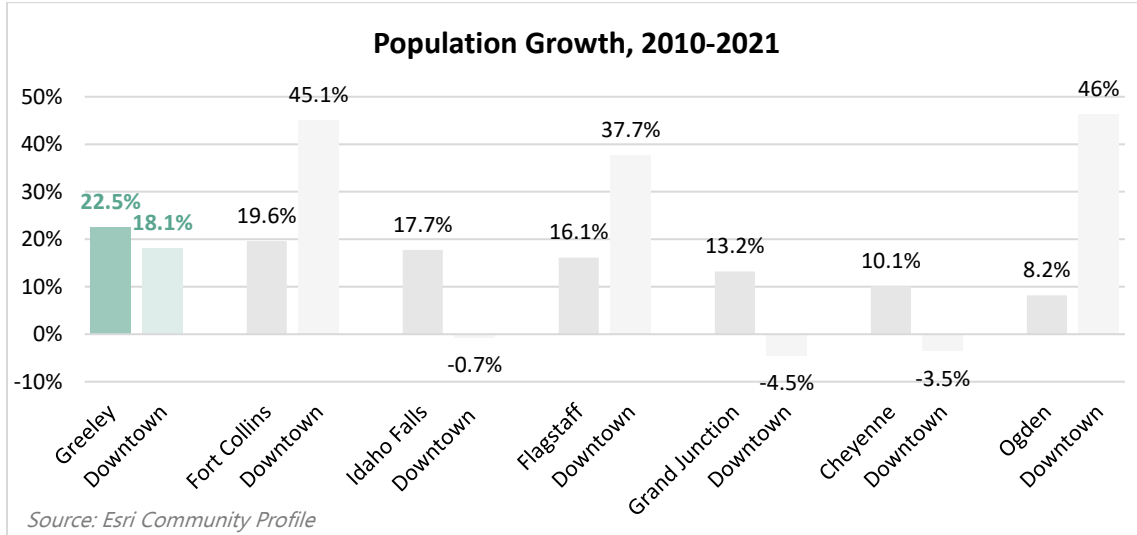
As noted in many recent news articles and reports, the City’s resident **population has boomed over the last two decades, growing 30%** between 2000 and 2021, making it one of the fastest growing cities in Colorado and the country (see “Population Growth, 2000-2021 chart).

Considerable growth occurred during both decades, with the most recent decade outpacing the first; Greeley’s citywide **population also grew more than any of its peer cities** during the most recent decade (see “Population Growth, 2010-2021” chart).

The **population growth of Downtown**, as well as the Primary Market Area, **has lagged behind the City’s**. Populations for these two areas **substantially decreased in the first decade but then rebounded in the most recent decade**, albeit at lower rates that the City’s (see “Population Growth, 2000-2010).



Downtowns across the nation, including a few of Greeley’s peers, have tended to outpace their cities’ rate of growth, which contrasts with what has occurred in Greeley, wherein **most of the growth has been funneled into low density areas outside of Downtown’s boundaries** (see “Population Growth, 2010-2021” chart).



RESIDENT CHARACTERISTICS

The “Demographics Snapshot” table below shows that as the universe of analyzed data contracts, starting with the City boundary, then moving down to the Primary Market Area boundary and then finally to the Downtown boundary, the following trends emerge:

- Households have fewer people, especially children, and many are non-family households containing just one person, which is similar to peer downtowns.

- Diversity increases with high proportions of residents identifying as Hispanic, highlighting the importance of this community in Downtown Greeley.
- Median household income decreases, along with educational attainment, which is true for peer downtowns and partially explains why Downtown Greeley has historically been associated with higher levels of poverty.
- The white-collar proportion of occupations decreases, while the proportion of blue-collar and services occupations increases; a pattern that is true for about half of peer downtowns in terms of white- and blue-collar workers; all peers examined had higher percentages of service workers living in their downtowns.

Demographic Snapshot, 2021²⁶

	Downtown	Primary Market	Greeley
Population	1,309	34,106	114,039 ²⁷
Residents per acre	4.2	6.9	3.6
Households	719	11,438	40,799
Avg. Household Size	1.76	2.52	2.66 ²⁸
One-Person Households*	48.2%	29.8%	26.1%
Median Age	31.1	25.4	32.0
Children (17 & Younger)	17.9%	20.2%	24.1%
Households with Children*	24.1%	32.1%	35.6%
Gender:			
Female	47%	49%	51%
Male	53%	51%	49%
Race/Ethnicity:			
White Alone	61.9%	69.0%	76.3%
American Indian	2.4%	1.6%	1.2%
Some Other Race	22.7%	19.4%	14.4%
Two or More Races	4.8%	4.5%	3.8%
Black	7.1%	3.9%	2.5%
Asian	1.1%	1.5%	1.9%
Hispanic Origin	50.6%	48.4%	38.7%
Income & Education			
Median Household Income	\$23,760	\$41,430	\$59,358
Bachelor's Degree or Higher	15.7%	19.7%	26.7%
Unemployment Rate	10.3%	14.5%	10.0%
Employed Pop. By Occupation:			
White Collar	46.2%	47.5%	56.1%
Blue Collar	31.0%	31.0%	28.5%
Services	22.5%	21.6%	15.4%

*2015-2019 Estimates

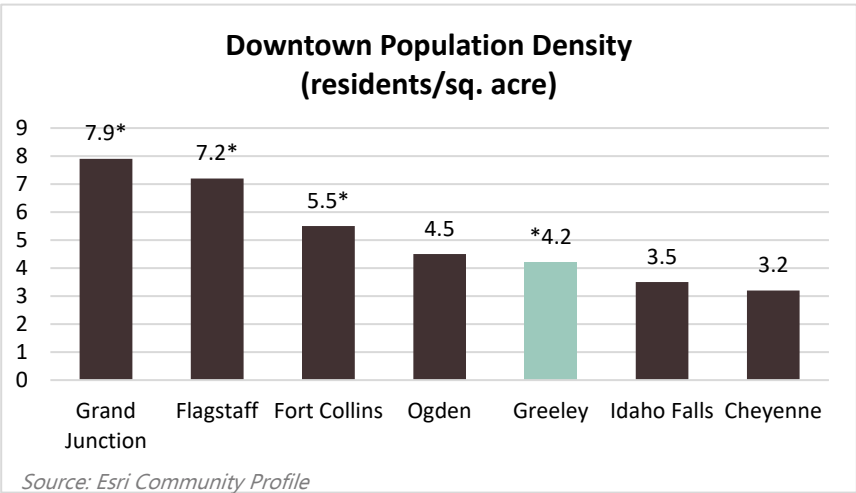
Source: Esri, Community Profile & Population Summary; P.U.M.A.

²⁶ Esri data represents estimates as of July 1, 2021

²⁷ City of Greeley Planning Department based on 2020 Census data states 112,816 as population of Greeley

²⁸ City of Greeley Planning Department based on 2020 Census data states 2.74 as Greeley average household size

All three market areas have **few residents per acre**, with Downtown being only slightly more dense than Greeley as a whole. Typically, downtowns have significantly more residents per acre than their respective cities, but this is only true for half of Greeley’s peers (see “Downtown Population Density” chart; asterisk indicates that the downtown has more residents per square acre than citywide). **Downtown Greeley is on the low end of population density** when compared to its peers.



All three areas have residents that are **fairly young on average**, but Downtown could stand to attract more young professional and student residents, especially considering that its university is directly adjacent to Downtown. Greeley’s peer cities with universities have much greater proportions of student populations to reside in and/or patronize their downtowns. **UNC’s enrollment has diminished 33% in the last decade**, the bulk of which (29%) has occurred since 2019 due to COVID. Despite this trend, students will be **increasingly interested in living Downtown** as safety improves and more student housing options become available.

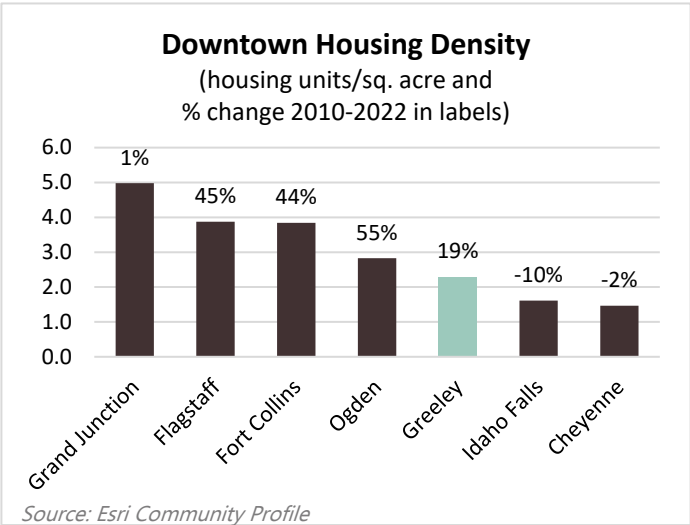
City	Percent
Flagstaff	37%
Fort Collins, CO	37%
Ogden, UT	33%
Grand Junction, CO	12%
Greeley, CO	7%

HOUSING MARKET

Despite historically having one of the most affordable housing stocks in Colorado, **housing prices have risen to record highs**, and, in turn, the City is now faced with an **affordability crisis** much like the rest of the fastest growing cities in the state and the nation. In mid-2022, Greeley’s median home value was \$451,591 (Zillow), which has increased 24.2% in the last year, and its average rent was \$1,260, which has increased ~13.5% in the last year.

There are several dynamics contributing to the City’s affordability woes, including rising construction and labor costs, working-class wages that have not kept pace with the climbing cost of housing, low density development patterns, and the demand for housing far exceeding the supply. These are dynamics that were in play before the pandemic but have been magnified since and show few signs of easing up in the near future.

Many cities, including peers, have been **increasing residential housing density in their downtowns over the last decade to alleviate strains on the market—a trend that was somewhat delayed in Downtown Greeley** (see “Downtown Housing Density” chart). The Downtown rental market has been making great strides in the last couple of years,



increasing its multifamily unit count by ~40% since 2020. While Downtown's vacancy rate is a healthy 5.5% and its market rents are increasing, they are 16% less than the City's on average. Downtown should meet or exceed the City's rents as more newly constructed or renovated units hit the market, as they are fetching rents that are ~50% more than that of the much older, prior-existing units.

With the help of incentives, local real estate developers and investors expect to continue to focus the majority of their downtown activities on the multifamily market sector for the foreseeable future, building and rehabbing units that appeal mostly to younger singles and couples.

STRENGTHS

Greeley is a desirable place to live, and people clearly want to keep moving to Greeley. As the housing options diversify through the construction of new units or updates to existing units that are offered at various price points, more people are wanting to move Downtown.

Housing is a strong market for Downtown moving forward. There is healthy demand for more units at all price points, but especially those on the higher end that will attract more residents with greater incomes that can better support retail as well as begin to dilute the **high concentration of poverty** in Downtown.

Downtown's strongest age segment is 15-34 (~40% of the population) – the "young professional," Millennial, and student bracket that downtowns and walkable neighborhoods with plentiful amenities are well-positioned to continue to attract.

VULNERABILITIES

There is little inventory. Only recently has there been a focus on making Downtown into more of a residential neighborhood. Despite a recent uptick in new unit construction, inventory is still low, and much of it is **old and in need of considerable and expensive upgrades.**

Downtown has a high concentration of poverty. Its low rents have historically attracted residents with low incomes and education levels to live Downtown. As Downtown's prosperity grows, it both increases opportunities for residents to rise above their disadvantaged roots and creates the threat of displacement as property values and rent prices increase.

Downtown (and the City) is challenged when introducing density. Downtown Greeley is among the peer cities with the lowest density of housing units and residents. While Greeley has been experiencing explosive growth in the last two decades, most of the additional residents have failed to flock to Downtown, largely due to the lack of appealing and varying inventory.

Pandemic Impact and Global Trends Affecting Downtowns

*Since 2007, P.U.M.A. has conducted research on trends impacting downtowns across the country. In July 2020, a pandemic update to this research was released that attempted to predict the longer-term impact of the pandemic on downtowns. **The purple boxes found throughout this executive summary offer insights from Global Trends research that are pertinent to Greeley.***

HOUSING SECTOR

Younger demographics will continue to fuel demand for downtown living, although affordability will be more important than ever, as younger generations predisposed to urban living were greatly impacted by the pandemic's economic disruption. Alternative ownership and rental types may be taking root, including group living options, cooperatives, and live-work formats. Real estate segments that have experienced a more permanent impact and closures, such as the office sector, will fuel the need to increase residential populations Downtown, as daytime employee populations are less stable.

WORK

GREELEY OVERVIEW

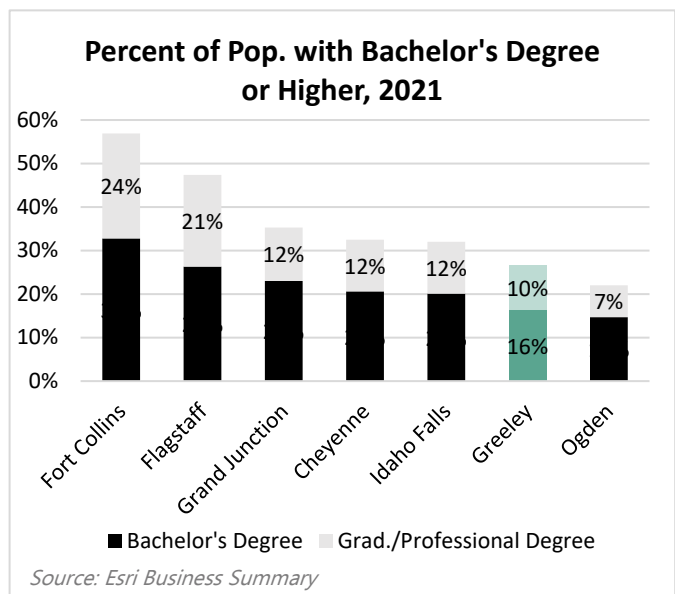
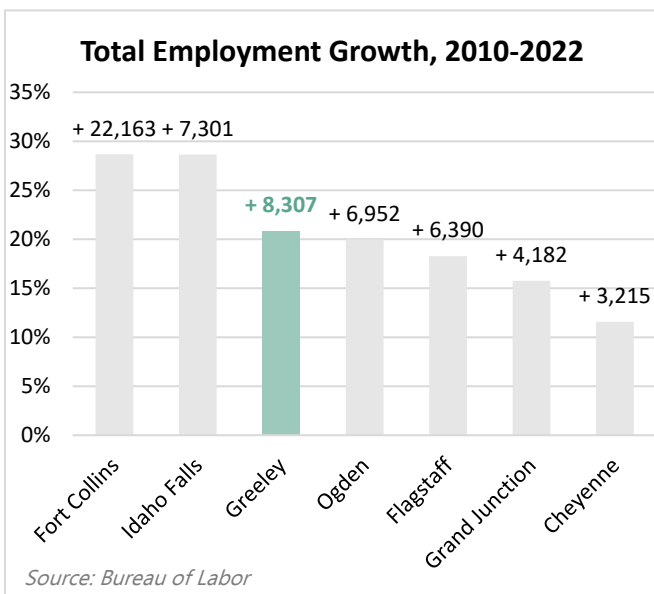
As the **county seat**, Greeley provides many support and processing services for Weld County, which is rich in **agriculture** as well as **oil and gas**. **Healthcare, manufacturing, education, retail, restaurants, and government** are the foundations of the Greeley economy. Greeley’s employment sector is somewhat top-heavy, or **dependent on the continued success of its ten largest employers that provide over a third of its total jobs**.

Since 2010, it has **increased its total employment by 20%**, which is third-highest among its peers (see “Total Employment Growth” chart). Its smaller industries, with wages higher than the Greeley average, are experiencing the most growth, indicating that **its economy is diversifying** and that **affluence is on the rise**.

Greeley’s workforce is not as well educated as some (including most of its peers), which presents a challenge to attracting and retaining employers looking for talent (see “Percent of Pop. with Bachelor’s Degree or Higher” chart).

Pandemic Impact and Global Trends Affecting Downtowns: OFFICE SECTOR

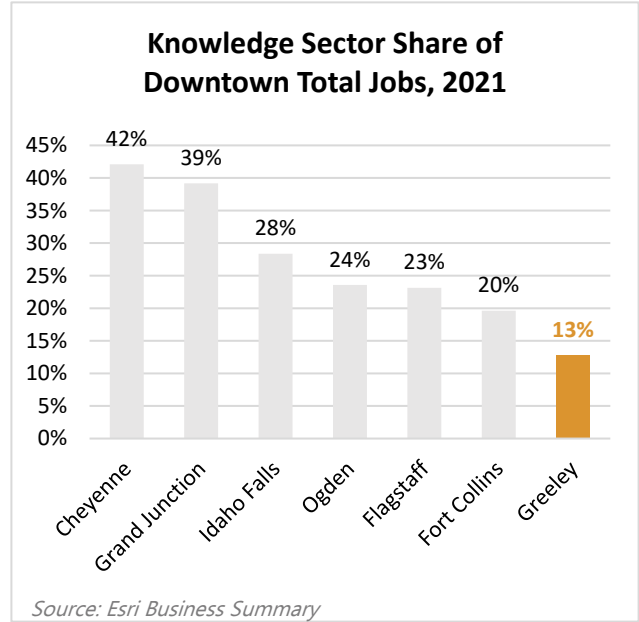
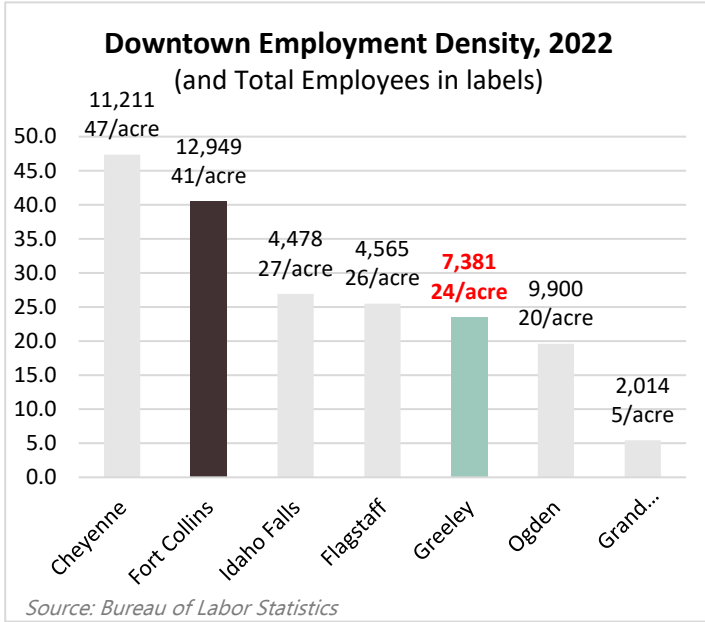
The nature of work was already methodically changing before the pandemic completely disrupted it. COVID-19’s long term impact on conventional office and coworking formats is still being revealed. The trend toward more flexibility in the workplace has accelerated and five-day office work weeks have become less common; however, conventional office formats continue to be an essential part of the equation. Downtowns like Greeley, with institutional anchors such as government, hospitals, and universities within (and adjacent to) their districts will continue to house businesses that service them. The conventional office sector is still in the process of reacting and evolving, however. Fixed and rigid workplaces are becoming less common, as companies are seeking spaces that can more seamlessly host ranging numbers of employees. In the long-term, there may be a rise in demand for a shared/coworking model that offers workers maximum flexibility in their workplace. There is an increased demand for good ventilation and access to the outdoors. Working in commercial real estate’s favor, there are still varying degrees of comfort with COVID, and many workers may continue to demand greater square footage per employee to maintain some level of social distancing when new variants arise. This could help smooth out any hit to demand due to the spike in remote work. Greeley should have an ability to adapt to new demands more swiftly, simply because this sector is largely untapped in downtown, and there isn’t an abundance of conventional office space that many other downtowns may be concerned about keeping occupied.



DOWNTOWN

About **24% of the City’s workers are employed in Downtown**. Downtown **lacks major private sector employers**, which contributes to its **below-average number of workers** and as well as **employees per acre** compared to its peers (see “Downtown Employment Density” chart).

Downtown employment is **anchored by manufacturing** (somewhat unique to Downtown Greeley) **and government**, which together provide over 60% of Downtown’s jobs. Given this, **Downtown’s share of knowledge sector jobs**, which come from industries that are predominately private sector-based, fast-growing, well-paying, and a magnet for talented and well-educated workers, **is the lowest among its peers** (see “Knowledge Sector Share of Downtown Total Jobs” chart).



OFFICE MARKET

The conventional office sector is relatively untapped in Downtown. A majority of Downtown’s workforce is employed in jobs that are not office-based, and furthermore, a majority of the employment that is office-based is made up of City and County workers.

Downtown office space has a vacancy rate of roughly 2%, and fetches the lowest rents in town (\$17.48). Available space is nearly non-existent, which makes it difficult to attract new office tenants, and most space is Class C (or old and requiring major renovations), which is generally not attractive to primary employers but is more affordable for small businesses and entrepreneurs looking to enter the market.

INDUSTRIAL MARKET

Downtown’s industrial buildings, situated along the railroad tracks, are home to its **high concentration of manufacturing jobs and are a welcome fixture in the Downtown ecosystem.** This market is very tight in Downtown as illustrated by its 1.2% vacancy rate, and rents are nearly as high as in the other two market areas.

STRENGTHS

Greeley's growing economy gets a lot of recognition by the press, which garners the attention of prospective employers. **Knowledge-sector jobs (which gravitate toward locating in downtown commercial office spaces) are also on the rise.** If Downtown can find ways to capitalize on this burgeoning interest and growth by accommodating with suitable office space, it should benefit from the densification of knowledge-sector and other office-based jobs. The resulting increase in daytime activity would also pave the way for additional restaurant and retail offerings.

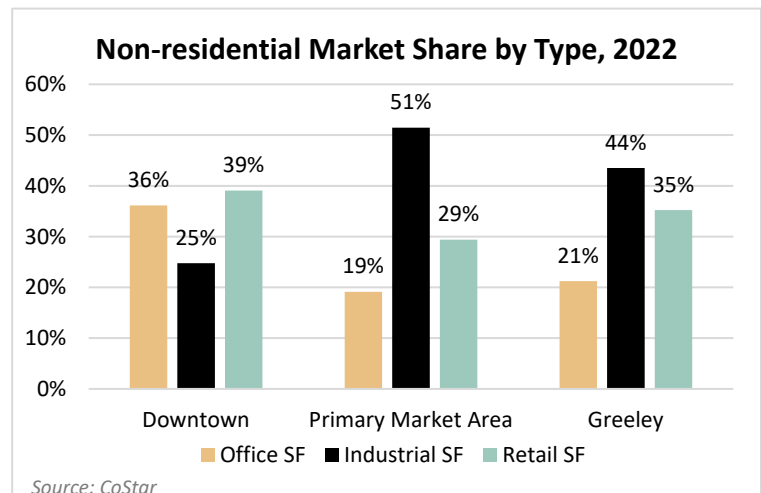
Downtown is surrounded by the Primary Market Area, which contains most of the City's primary employers, which in turn gives Downtown the ability to build on these adjacencies by providing those employers with the supportive professional services they require, as well as by providing workers with restaurant and retail offerings to frequent before, during, and after working hours.

While Downtown's existing office space might not be particularly appealing to primary employers, **its low rents make entry into the market more accessible to Greeley's small business owners and entrepreneurs** (although the problem remains that space is seldom available in such a tight office market).

The government sector, with school district, City, and County presence, **is highly concentrated in Downtown and tends to offer quality jobs that are less vulnerable during tumultuous economic times** (as demonstrated by this industry's 0% rate of change in Greeley between 2016 and 2021).

Another indicator of Downtown enjoying some level of economic resiliency is that it is the **most balanced of all the market areas** when it comes to each non-residential market sector's share of known square footage (see "Non-residential Market Share by Type" chart).

Downtown's **industrial space is perceived as an asset** that positively contributes to the **unique character of Downtown and should be preserved.** Nationally, this market sector has consistently flourished for years, which both helps to ensure the economic stability of its industrial sector and points to the **potential to develop more industrial square footage** along the railroad tracks.



VULNERABILITIES

Downtown Greeley has **little primary employment and few knowledge-based workers**, which both trend toward concentrating in downtowns and have high growth potential. Additionally, Greeley's **resident populations are not as well-educated as some**, which presents a challenge in attracting both primary and knowledge-based employers.

There is **nearly no (or suitable) office or industrial space available for new or expanding businesses to locate in Downtown.** Vacancy rates are very low, meaning that the existing space can't accommodate prospective tenants that want to locate Downtown, and many of the spaces need substantial and expensive upgrades due to

their age. **Employee parking and electrical power infrastructure are greatly lacking** – two elements that are important to prospective primary employers looking to locate in Downtown.

There is a high degree of competition from Greeley's other market areas, as a substantial amount of vacant (and newer) office space needs to be absorbed in the close-by Primary Market Area as well as in west Greeley.

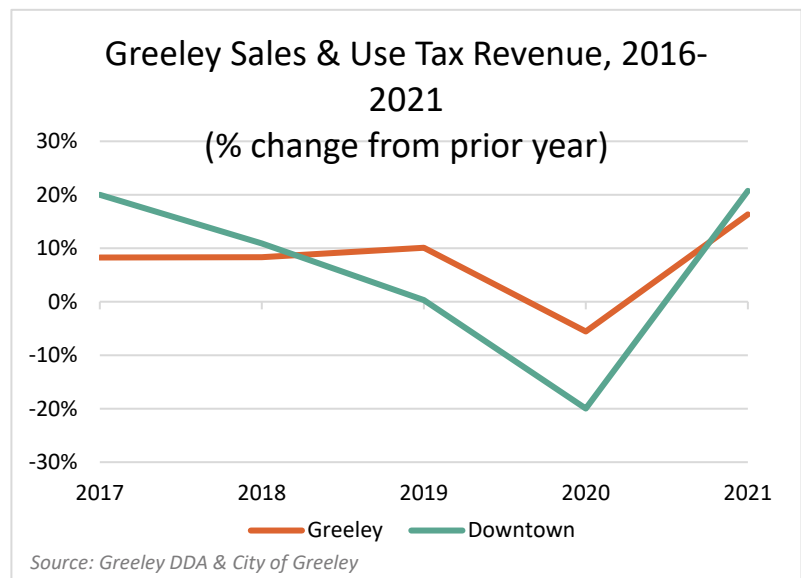
Nationally, the office sector continues to struggle due to uncertainty around the course of COVID, a potential recession, and the increasing popularity of working from home, **which poses complications for a downtown such as Greeley's that is looking to further develop its employment base and bolster its daytime activities.**

SHOP & DINE

GREELEY OVERVIEW

The **retail, food and beverage sectors** are among Greeley's top **five largest industries** in terms of employment. Together, these industries employ over 10,500 workers at approximately 713 businesses throughout the City. The City has **growing resident, employee, and tourist bases to pull from** as potential customers.

Sales and use tax revenues have **increased 42% since 2016** (see "Greeley Sales & Use Tax Revenue" chart). The first pandemic year (2020) was the only year that saw a decline in revenue, and the hit was fairly minimal (~6%). The City made a **full and rapid recovery**, increasing 16% between 2020 and 2021.



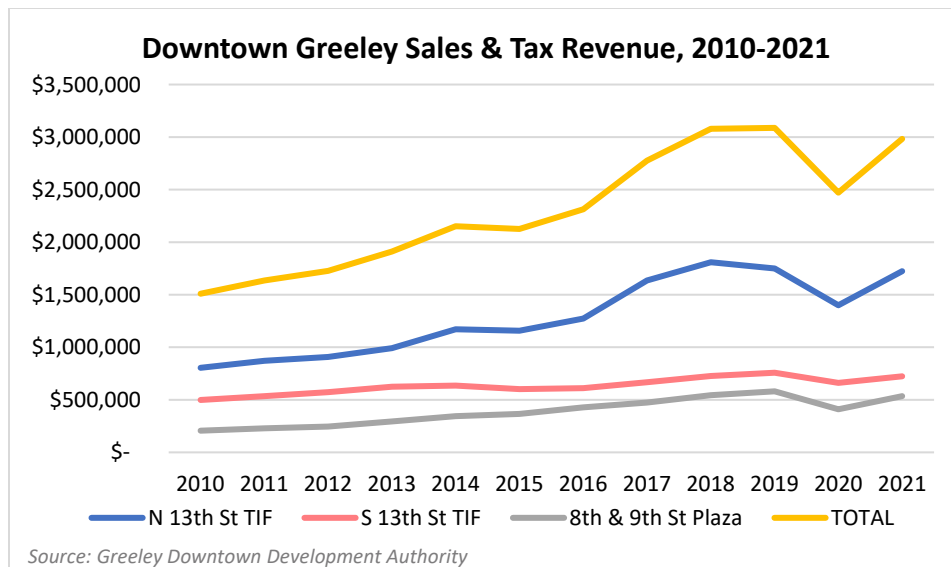
DOWNTOWN

Downtown's storefront economy is critical to its success, driving foot traffic, attracting visitors, and helping maintain vibrancy throughout the day and into the night.

Downtown has a strong mix of street level businesses and services (numbering 331), with **31% dedicated to dining and shopping.**

Downtown's restaurant/bar and retail mix has shifted since the last report was done in 2011, wherein retail establishments greatly outnumbered restaurants. In the last ten years, downtowns have been evolving to trend towards fewer storefront retailers and more restaurants, breweries, cideries, as well as food & wine shops. **Today, while the number of restaurant/bar and retail establishments are equal, Downtown Greeley is beginning to move in the same direction as downtowns nationally**, currently having 46% more eating & drinking establishments and 16% fewer retail sales establishments than there were in 2011.

Since 2016, Downtown's **sales and use tax revenues have increased 29%** (lagging behind the City's 42% growth during the same period; see "Greeley Sales & Use Tax Revenue" chart). The increase is much more dramatic **when looking at the entirety of the last decade, wherein total revenues doubled.** The pandemic **hit Downtown harder** than the rest of the city, causing **a decrease of 20% in revenues** between 2019 and 2020, but **Downtown has made a full and rapid recovery**, increasing 21% between 2020 and 2021. Revenues haven't quite returned to pre-pandemic levels but are just shy of 2019's revenues by a little over \$100K.



RETAIL MARKET

The **retail market** (which includes food and beverage space) **accounts for the most privately held square footage** amongst the three primary non-residential real estate sectors (commercial office and industrial being the other two; see “Non-residential Market Share by Type” chart on page 16).

Downtown has historically had the **highest vacancy rates of the three market areas**, but always within the healthy 10% range. The pandemic caused a spike in the vacancy rate; while vacancy rates have come down again, they have not receded to pre-pandemic levels yet.

Contrary to national trends, Downtown retail space rents are below citywide averages. The average rate in Downtown is approximately \$13 per square foot, which is nearly 30% below the City’s average.

STRENGTHS

While most developers are not currently focusing on developing new retail space in Downtown, their recent **residential mixed-use developments have included ground-floor retail space**, which incrementally adds modest amounts of retail square footage to Downtown and is likely to continue for the foreseeable future.

Downtown businesses are primarily local, independent and specialty; some, such as the growing number of distilleries and breweries, even **build on its manufacturing heritage**. This helps to cultivate a distinct character and sense of place, in contrast to many downtowns that have lost some of their local vibe in recent years. Much like the office sector, **the low rent structure allows local entrepreneurs to enter the market with unique concepts that further shape the Downtown experience.**

Nationally, **food and beverage has been expanding while retail has contracted in most downtown markets.** Downtown Greeley is consistent with these trends, having a **strong food and beverage market** that is on its way to becoming the sector’s anchor.

Greeley (as well as Downtown, the Primary Market Area and neighboring Evans) has a **high concentration of Hispanic residents. Downtown can evolve to better welcome and serve this community, both as business-owners, employees, visitors and cultural contributors.** This is one way the City can strengthen its relationship with this historically marginalized and important community, as well as to offer opportunities for mutual prosperity and enjoyment. Similar efforts should be made to **better welcome and serve UNC students.**

VULNERABILITIES

Downtown does not have a critical mass of workers or residents to support the addition of substantial amounts of retail at this time. Developers are primarily focusing on residential projects in hopes of bolstering existing (and future) retail. **Meanwhile the relatively small number of Downtown residents have the lowest incomes in the City,** which creates the need to pull patrons in from further away areas (a laborious effort).

Despite a low vacancy rate, **the high cost of construction and low rents will continue to inhibit the feasibility of building new retail space or rehabbing existing space** that is aging and in need of substantial and expensive upgrades.

The perception (and/or reality) that there is **insufficient parking** that is convenient for accessing Downtown's restaurants and retailers **might deter prospective customers**, especially as employee and resident populations grow. Additionally, while shopping and dining offerings currently inhabit 31% of storefronts, **they could be more numerous and diverse to attract more patrons.**

VISIT & STAY

GREELEY OVERVIEW

In the last decade, tourism has become much more of an **economic driver** for Greeley. Annually, it sees up to **half a million visitors** who spend nearly **\$30 million.**

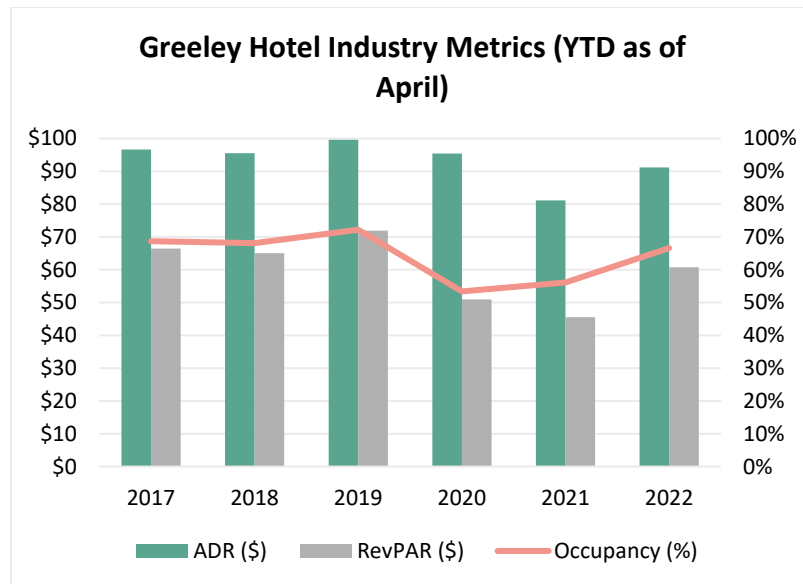
In 2012, Greeley launched the **Greeley Unexpected campaign** (later renamed to **My Greeley**) to rebrand the City from its "cow town" reputation to one that residents could be proud of. As a result, there has been a growing focus on tourism in Greeley. Part of this effort included marketing Greeley as a **"hub and spoke community,"** where visitors can stay in Greeley, but travel to other parts of the Front Range, such as Cheyenne, Fort Collins, Estes Park, and Denver, for day trips.

The City is home to many popular arts and cultural venues including the **Centennial Village Museum**, the **Linn Grove Cemetery**, the **Atlas Theater**, and UNC's **College of Performing and Visual Arts.**

Pandemic Impact and Global Trends Affecting Downtowns: RETAIL SECTOR

Retail has always been one of the most disruptive and fastest evolving real estate sectors. COVID-19 has magnified this dynamic and has hit this sector harder than any other. The pandemic euthanized outdated retail formats that were already declining, including indoor malls, department stores, and several legacy brands. The trend toward online sales has accelerated, although it only accounted for less than 10% of total sales pre-pandemic. Relative to the rest of the sector, downtowns are better positioned for recovery. Local independents and experiential retail will once again distinguish downtowns. Community-driven retail is a growing niche, with a newfound desire to connect with neighbors, demonstrate social impact and influence change amongst retail businesses and entrepreneurs. Downtown Greeley has been driven by specialty retail and local independents that will always benefit from any increase in resident, employee, student, or visitor foot traffic. Its retail sector will struggle to expand until there is a critical mass of residents and employees in Downtown. Business ownership should continue to diversify, particularly to better appeal to Greeley's large Hispanic population.

Much of Greeley's hotel business is **fueled by the oil and gas** activities in town and is somewhat dependent on the state of the energy market, as indicated by coinciding demand changes. The **lodging market in Greeley peaked in 2019** and then slumped as a result of the pandemic; all metrics have been improving since, but none are back to pre-pandemic levels yet (see "Greeley Hotel Industry Metrics" chart).



DOWNTOWN

Downtown Greeley is home to several art galleries, as well as **three museums** and **ten event venues**, including the **Union Colony Civic Center**, the **Moxi Theater**, and the **Greeley Ice Haus**. Since 2014, Downtown has benefited from its state-certified **Greeley Creative District**, which has been credited with gains in creative industry jobs and earnings, new businesses and galleries, as well as new events and increases in visitation.

Many events take place in and near Downtown throughout the year; those that generate the highest number of attendees include its summer **Friday Fest** events, **OktoBrewfest**, the **Greeley Arts Picnic**, the **July 4th Parade**.

320 hotel rooms, about a third of Greeley's total rooms, are located throughout four hotels in Downtown. The **DoubleTree by Hilton** opened in 2017 and was the first national hotel brand to locate in Downtown and offer more sophisticated conference and large event amenities.

STRENGTHS

Tourism has undoubtedly become an important part of Greeley's economy, especially in the last ten years. Its **location proximate to other destinations** along the Front Range and its comparatively **low room prices** make it an attractive place to visit. A lot of work has been done to shift any lingering negative perceptions that might have been deterring visitors. Downtown Greeley has become a destination in its own right, with its **high concentration of attractions** and **increasingly popular events** that draw residents of Greeley, nearby communities, and out-of-town visitors to Downtown.

The City recognizes the importance of its **burgeoning art and culture scene** and has thus accelerated its cooperative efforts to highlight and grow it in recent years. The successful **My Greeley** campaign encourages locals to take pride in and celebrate all that the City has to offer, and the **Greeley Creative District** has become a hub of resources and events to engage creative industries, organizations, businesses, artists, and patrons.

Despite the pandemic setback, its historically limited **lodging sector has been maturing over the last decade and has even largely rebounded from its COVID slump in the last year.** The recent addition of the DoubleTree hotel, with its modern amenities, has put Downtown on the map as a **venue to hold state and regional conferences and events and could pave the way for more national brands to develop hotels in Downtown.** Greeley enjoys **hotel occupancy rates that are typically higher** than the national average as well as that of other communities throughout Northern Colorado, which is another metric of interest to hotel developers.

VULNERABILITIES

While Greeley has been concertedly rebranding to distance itself from its longstanding **cow town image**, it's still overcoming the fact that it **hasn't traditionally been a popular tourist destination.** Its **lodging market is still recovering from the pandemic**, and it has been **fairly reliant on the fluctuating oil and gas industry.** Ideally, its lodging market's visitor profile would become more balanced; a rise in UNC enrollment or a more robust Hispanic scene could drive additional visitors to Downtown, for example.

So far, Greeley is somewhat unique in that its **short-term rental market hasn't yet posed much of a threat** to its traditional lodging market but should be closely monitored to determine when the timing is right to enact **additional regulations.**

Other Front Range communities such as Fort Collins, Boulder and Denver still generate **a lot of competition** for visitors as well as highly-sought after performers and other entertainment draws. Downtown hotels compete with those outside its boundary—primarily corporate brands along the highways that capture travelers passing through.

Pandemic Impact and Global Trends Affecting Downtowns: VISITOR MARKET

For its first few months, the pandemic put a halt to the tourism economy worldwide. Communities that rely on this sector were some of the hardest hit by the economic shutdown. This sector is steadily recovering, but it may continue to fluctuate as new variants emerge. To improve resiliency, Downtowns have been more focused on their local communities and constituents; on way of doing this has been to offer safe, smaller-scale, and culturally-relevant events, some of which are designed for local segments that may not have come downtown as frequently in the past. Downtown environments have also been evolving to become more appealing and inviting to everyone, despite their comfort level with COVID, by converting public spaces to accommodate more outdoor dining and safe gathering spaces. The arts and cultural segment is bring creativity and vibrancy into the reinvention of public spaces and to showcase local heritage, context, and artistic talent.

2. LIVE

Residents

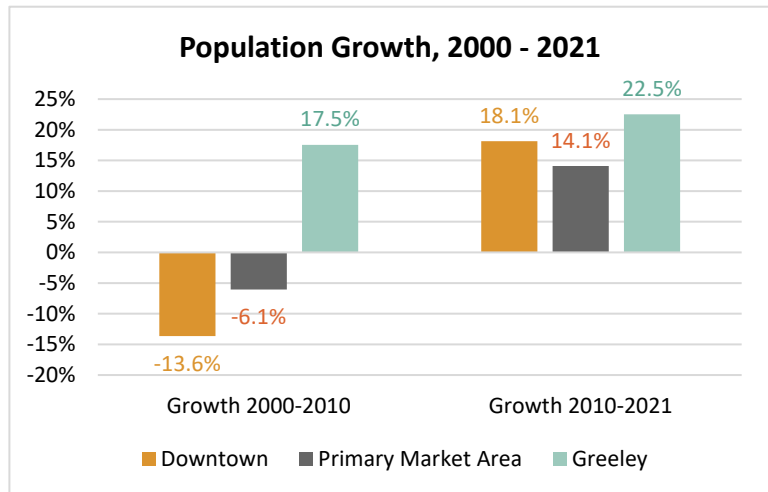
POPULATION GROWTH

- Greeley has added nearly 35,000 residents since 2000 and currently has 112,816 residents³¹. It ranks amongst the fastest growing cities in both Colorado and the country, as many recent news articles and reports have noted. Its population growth since 2010 exceeds Colorado’s (15.5%) as well as all of its peer cities, with Fort Collins not far behind (see “Population Growth, 2010-2021”)³².

	2000	2010	2021
Downtown	1,283	1,108	1,309
Primary Market Area	31,819	29,891	34,106
Greeley	79,192	93,086	114,039 ³⁰

Source: Esri Community Profile

- As of 2021, Downtown contains ~1,300 residents, which is about 1% of Greeley’s total. Greeley is on par with its peers in this regard (1% - Cheyenne, Fort Collins and Idaho Falls; 2% - Flagstaff; 3% - Ogden City; 4% - Grand Junction). The Primary Market Area contains about 30% of all Greeley residents.
- The “Population Estimates” table and Greeley “Population Growth” chart indicate that both the Downtown and Primary Market Area lost residents (a 14% and 6% decrease respectively) between 2000 and 2010; the trend reversed in the last decade and both areas gained residents instead (a 18% and 14% increase respectively). As of 2021, resident numbers are slightly greater than they were twenty years ago – there are 2% (which equates to only about 25) more residents in Downtown and 7% more in the Primary Market Area than there were in 2000.



- The City’s population growth rate has greatly outpaced that of Downtown and the Primary Market Area over the last twenty years, showing a 44% increase between 2000 and 2021. The growth rate over both decades was strong, with the last decade showing a growth rate 5% higher than the first decade (22.5% and 17.5% respectively). For the City’s population growth to outpace Downtown’s is somewhat contrary to what has occurred nationally, as well as for several of Greeley’s peers (see “Population Growth, 2010-2021”). This is an indicator that most of the growth has been funneled into low density areas outside of Downtown’s boundaries. That being said, there is evidence that the most densely populated portion of the population has shifted closer to Downtown in the last decade, which is momentum that can be built upon.

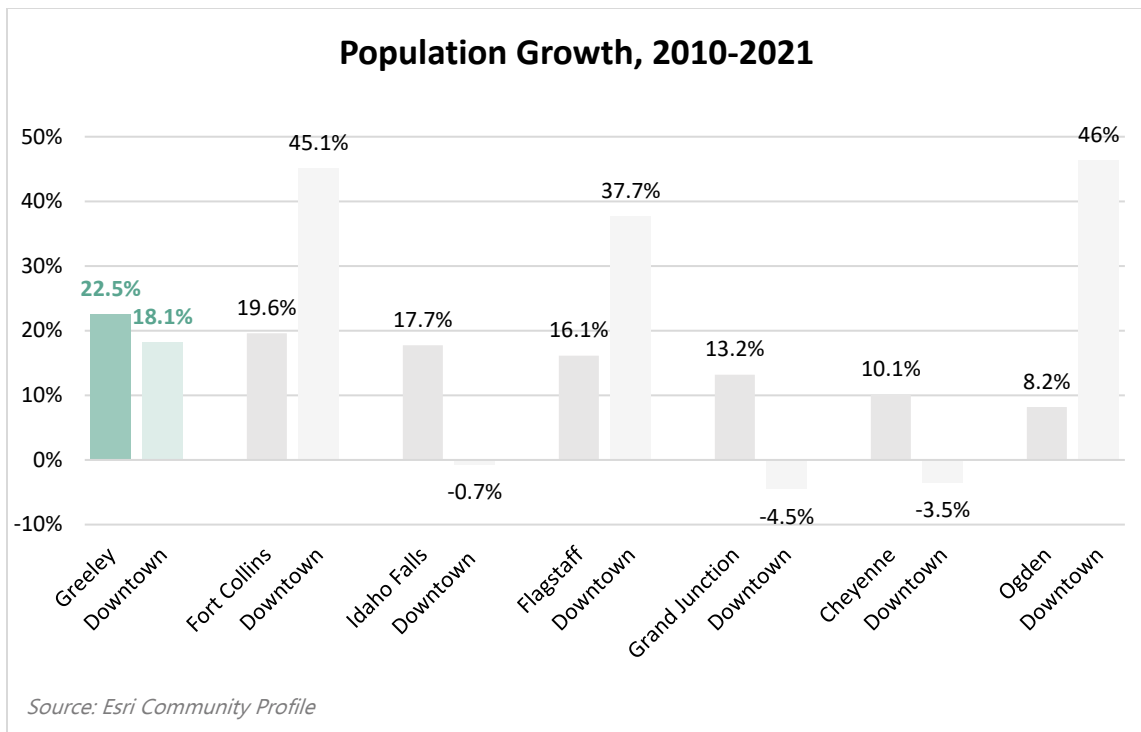
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²⁹ Esri data represents estimates as of July 1, 2021

³⁰ City of Greeley Planning Department based on 2020 Census data indicates the population is 112,816

³¹ City of Greeley Planning Department based on 2020 Census data

³² (Suneson, 2021)



DEMOGRAPHICS

- The "Demographics Snapshot" table below shows that as the universe of analyzed data contracts, starting with the City boundary, then moving down to the Primary Market Area boundary and then finally to the Downtown boundary, the following trends emerge:
 - Average household size decreases
 - One person households increase
 - Population of children decreases
 - Households with children decreases
 - Diversity increases (lower percentages of residents identify as "White Alone" and higher percentages of residents identify as "Hispanic," "Some Other Race," "Black," "American Indian," and "Two or More Races")
 - Median household income decreases
 - Educational attainment decreases
 - Percentage of those employed in white collar occupations decreases
 - Percentages of those employed in blue collar and services occupations increase

Demographic Snapshot, 2021³³

	Downtown	Primary Market	Greeley
Population	1,309	34,106	114,039 ³⁴
Residents per acre	4.2	6.9	3.6
Households	719	11,438	40,799
Avg. Household Size	1.76	2.52	2.66 ³⁵
One-Person Households*	48.2%	29.8%	26.1%
Median Age	31.1	25.4	32.0
Children (17 & Younger)	17.9%	20.2%	24.1%
Households with Children*	24.1%	32.1%	35.6%
Gender:			
Female	47%	49%	51%
Male	53%	51%	49%
Race/Ethnicity:			
White Alone	61.9%	69.0%	76.3%
American Indian	2.4%	1.6%	1.2%
Some Other Race	22.7%	19.4%	14.4%
Two or More Races	4.8%	4.5%	3.8%
Black	7.1%	3.9%	2.5%
Asian	1.1%	1.5%	1.9%
Hispanic Origin	50.6%	48.4%	38.7%
Income & Education			
Median Household Income	\$23,760	\$41,430	\$59,358
Bachelor's Degree or Higher	15.7%	19.7%	26.7%
Unemployment Rate	10.3%	14.5%	10.0%
Employed Pop. By Occupation:			
White Collar	46.2%	47.5%	56.1%
Blue Collar	31.0%	31.0%	28.5%
Services	22.5%	21.6%	15.4%

*2015-2019 Estimates

Source: Esri, Community Profile & Population Summary; P.U.M.A.

- Compared to the other two areas, Greeley has the fewest residents per acre (3.6), the largest households on average (2.66 people), the fewest one-person households (26%), the most households with children (24%), the highest median age (32), the highest median income (\$59,358), the highest level of residents holding a Bachelor's Degree or higher (27%), the most white-collar workers (56%), and is the least diverse (24% of residents do not identify as "white alone," and 39% are of Hispanic origin).
- The Primary Market Area has the most residents per acre (6.9), the youngest median age (25.4) and the highest unemployment rate (15%) compared to the other two areas.
- Compared to the other two areas, Downtown has the smallest households on average (1.8 people), the most one-person households (48%), the fewest households with children (18%), the lowest median income (\$23,760), the lowest level of residents holding a Bachelor's Degree or higher (16%), the most blue

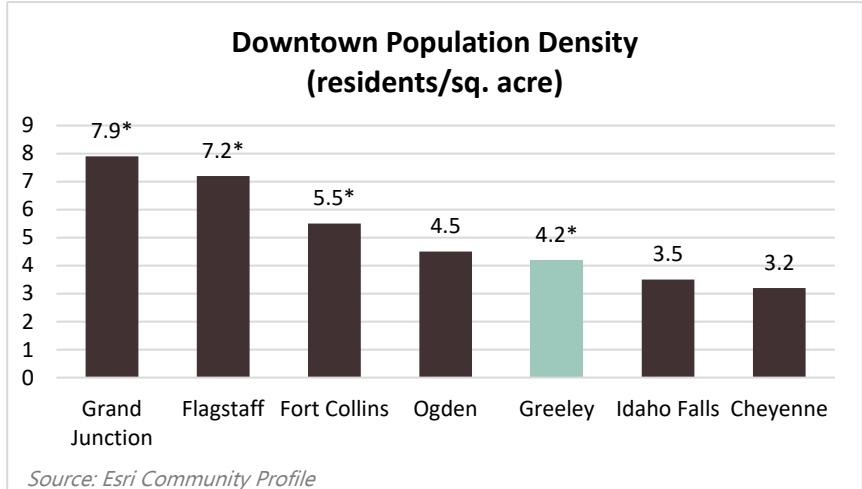
³³ Esri data represents estimates as of July 1, 2021

³⁴ City of Greeley Planning Department based on 2020 Census data states 112,816 as population of Greeley

³⁵ City of Greeley Planning Department based on 2020 Census data states 2.74 as Greeley average household size

collar and service workers (31% and 23% respectively), and is the most diverse (38% of residents do not identify as “white alone” and 51% are of Hispanic origin).

- All three market areas have few residents per acre, with Downtown being only slightly more dense than Greeley as a whole. Typically, downtowns have more residents per acre than their respective cities, but this is true for only half of Greeley’s peers (see “Downtown Population Density” chart; asterisk indicates that the downtown has more residents per square acre than citywide). Regardless, Downtown Greeley is on the low end of population density when compared to its peers.



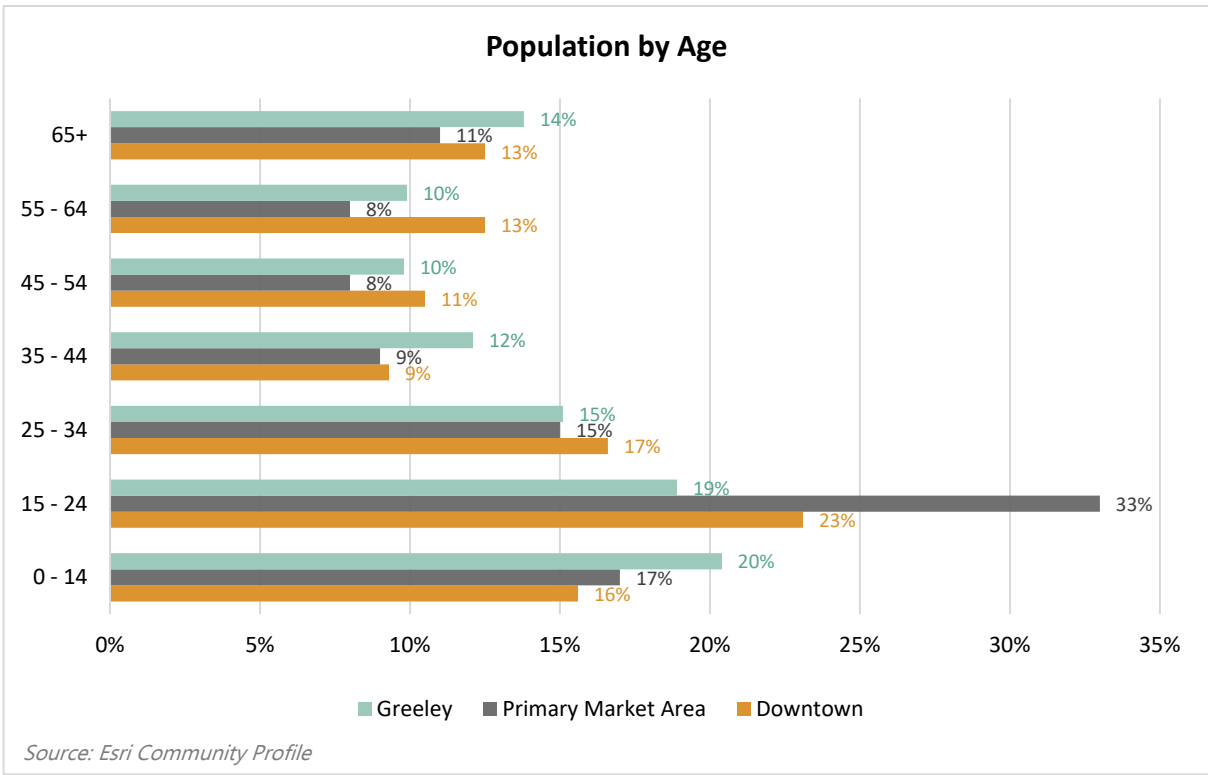
- The median age for all three areas is quite low (25.4 to 32 years), which can be partially explained by the University of Northern Colorado’s presence. As the “Median Age” table indicates, university presence has the same effect in Greeley’s peer cities – of those that have a university, three out of four (Flagstaff, Ogden and Fort Collins) have the lowest median ages (Grand Junction being the one exception). The low median age is also impacted by Greeley’s proximity to major transportation and employment corridors, its easy access to popular recreational areas, its small-town feel and larger-city amenities, as well as its relative affordability compared to many other cities in Colorado.

	Median Age	
	2010	2021
Flagstaff	26.8	28.1
Ogden	29.6	31.7
Greeley	29.8	32.0
Fort Collins	29.6	32.0
Idaho Falls	32.5	34.4
Cheyenne	36.6	38.8
Grand Junction	36.8	39.3

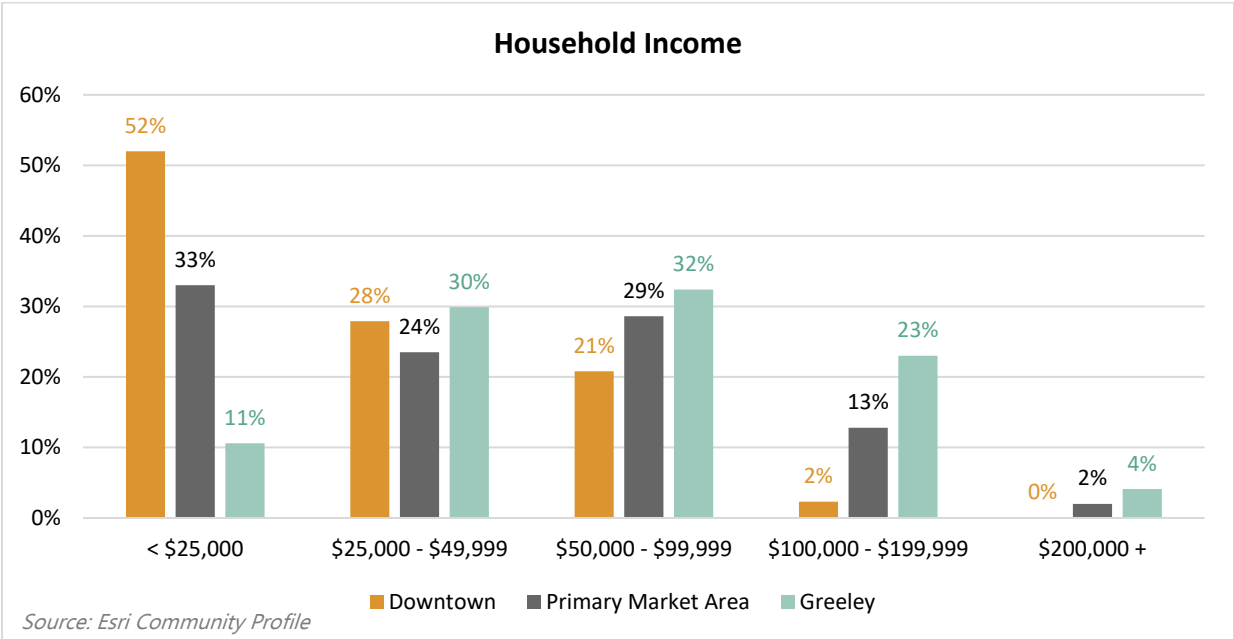
Source: Esri, Community Profile

- The “Population by Age” chart below shows a detailed breakdown of age groups, and compares Greeley, the Primary Market Area and Downtown residents. UNC’s presence drives the fact that the highest percentage of the population for Downtown and the Primary Market Area falls into the 15-24 age bracket (23% and 33% respectively). Approximately 40% of Downtown Greeley residents are aged 15-34—the “young professional,” Millennial, and student populations—which is in line with national trends. This age group tends to seek neighborhoods that are marked by diversity, creativity, culture, walkable areas, transit options, and lots of places to socialize—all elements of a typical downtown³⁶. Downtowns have also been increasingly attracting retirees and empty nesters for similar reasons, and Downtown Greeley appears to be no exception—its 55+ group is the highest out of the three market areas (26%).

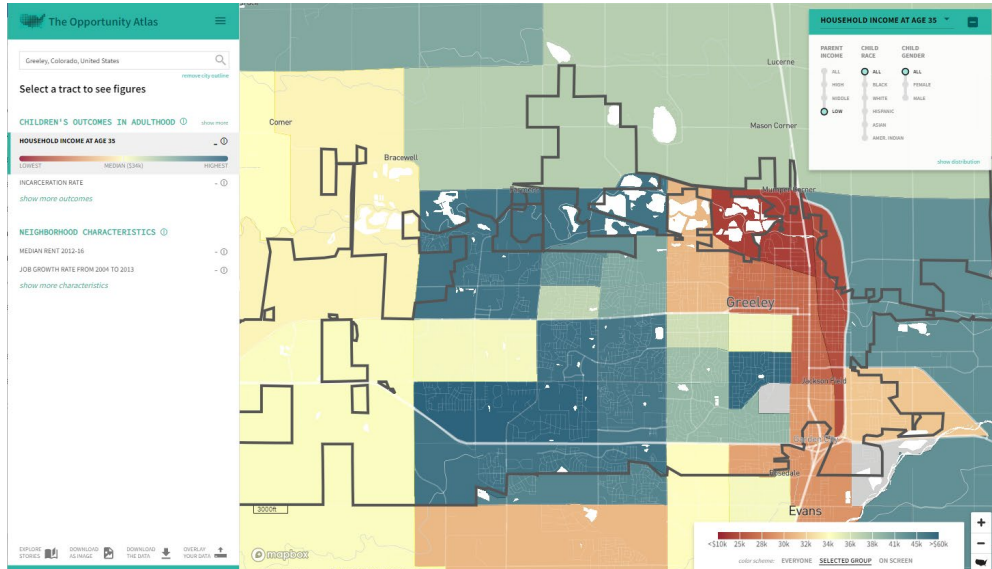
³⁶ (The International Downtown Association, 2019)



- The "Household Income" chart below shows a breakdown comparison between residents of all three areas. Students attending the University of Northern Colorado as well as its relatively high proportions of blue-collar and service workers can partially explain why most households in Downtown (80%) and the Primary Market Area (57%) earn less than \$50K annually. Median household income for peer downtowns together average ~\$36.6K, which is about 54% higher than that of Downtown Greeley (~\$23.8K). This can partially explain why Downtown Greeley has historically been associated with higher levels of poverty.



- The Harvard Opportunity Atlas provides an indicator of how Greeley’s market areas have historically fared in terms of their ability to provide opportunities for upward social mobility in adulthood based on where someone grew up, regardless of whether they still live there³⁷. The map below displays neighborhoods where kids went on to earn lower average incomes at age 35 in red while places where kids grew up to earn more are in blue. The majority of the Primary Market Area and the entirety of the Downtown area are shaded in red, which contrasts with the rest of Greeley that is shaded in yellow or blue. Thus, those who grew up in Downtown and the Primary Market Area have not been as successful in emerging from poverty than those who grew up in other parts of Greeley.



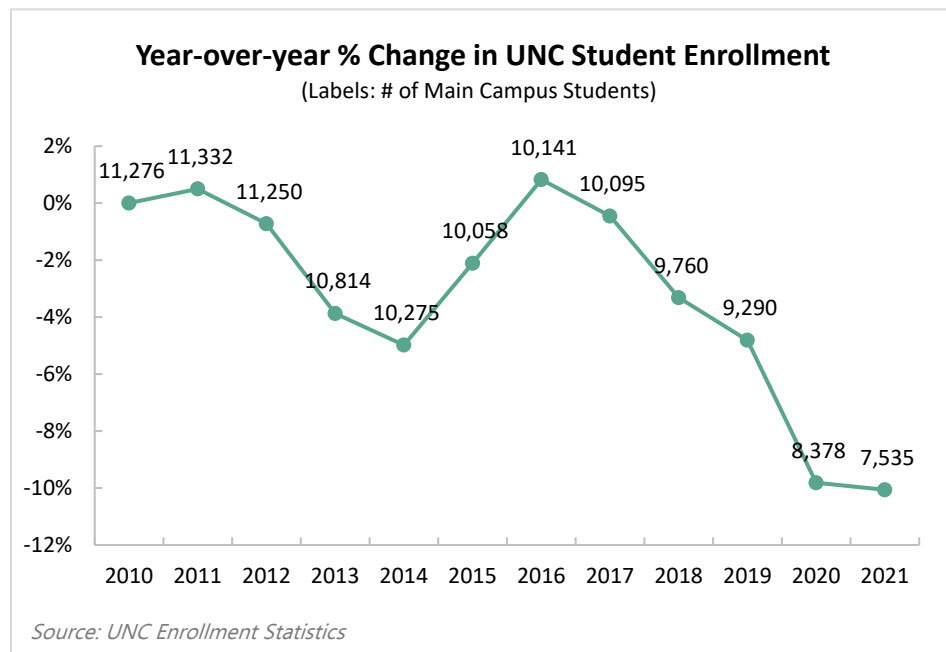
UNC IMPACT ON POPULATION

- The University of Northern Colorado (as well as Aims Community College, but Greeley campus-specific data could not be found) impacts the City’s population, as well as market conditions in the other two areas. Per the “Percent of Population that are Students” table, about 7% of Greeley’s population is made up of UNC students, which is lowest proportion among its peers that also have universities. Students attending universities account for upwards of 30% of some peer city populations, but less than 10% for Greeley.
- UNC’s enrollment was 7,535 as of Fall 2021; 6,416 of these students were undergraduates. The “Peer Cities & Downtowns” table on page 3 shows its enrollment is the lowest of all its peer cities that also have universities.

Percent of Population that are Students, 2021	
Flagstaff	37%
Fort Collins, CO	37%
Ogden, UT	33%
Grand Junction, CO	12%
Greeley, CO	7%

³⁷ (Harvard Opportunity Atlas, n.d.)

- As the “Year-over-year % Change in UNC Student Enrollment” chart shows, enrollment numbers have decreased a striking 33% since 2010, the bulk of which (29%) has occurred since 2019 (the last pre-pandemic year). National higher education enrollment has experienced similar conditions, although to a lesser extent; university enrollment nationally has been



declining every year since 2011. The National Student Clearinghouse Research Center estimates show that enrollment has declined ~21% since 2010; the highest rate of decline occurred as a result of the pandemic, showing a 7% loss in student enrollment since the last pre-pandemic semester of Spring 2020, which is the largest two-year decrease in more than 50 years³⁸. While COVID accelerated the trend, other issues have contributed to the prolonged decline, including a decrease in the number of births since the last recession, the currently favorable labor market, greater public skepticism of the need for higher education, and rising tuition costs³⁹.

- Downtown stakeholder interviews revealed a desire for Greeley to become more of a “college town” versus a “town with a college” through efforts that include growing enrollment numbers and improving upon connections between UNC and Downtown much like Fort Collins has done. One potential way to do this that is being strongly considered and that stakeholders are encouraging is to locate UNC’s future osteopathic medical school Downtown⁴⁰.

PSYCHOGRAPHICS (i.e., LIFESTYLE SEGMENTS)

- While the demographic data discussed above evaluates the characteristics of residents from a more quantitative perspective (i.e., population change, age, income, education), psychographic data focuses on more qualitative aspects by considering lifestyle, behavior, interests, aspirations, and cultural influences of different segments of the population. To better understand this market’s psychographics, Esri’s Tapestry Segmentation system was used, which categorizes all households into over 67 distinct “Tapestry” (or lifestyle) segments (see “Psychographic Segments” table on the next page).
- The *Social Security Set* and *College Towns* segments combined account for 94% of Downtown residents (as a point of comparison, about 1% of U.S. households fall into each of these lifestyle categories).
- The *Forging Opportunity* segment is the most common for both the Primary Market Area and City.

³⁸ (Nadworny, 2022)

³⁹ (Marcus, 2022)

⁴⁰ (Wood & Stahla, 2022)

- **Social Security Set:** this is an older market, with one-fourth of householders aged 65 or older and dependent on low, fixed incomes, primarily Social Security. Many who would have retired early were unable to in the aftermath of the Great Recession, so almost half still earn wages and salary income. Residents are price-sensitive, have limited resources, and live alone in low-rent, high-rise buildings, located in or close to business districts that attract heavy daytime traffic. They choose to live in the heart of the city with its hustle and bustle, with the added benefit of access to hospitals, community centers, and public transportation.
- **College Towns:** about half of these residents are enrolled in college, while the rest work for a college or the services that support it. Most of these residents live in nonfamily households, with many students either living alone or with several roommates. More than three-quarters of these residents rent their housing. This market is bike and pedestrian friendly. On the whole, it has limited income resulting in limited purchasing power, and instead places more value on new experiences, social outlets, and adventure in their lives.
- **Set to Impress:** this group tends to live in multi-unit apartment buildings with lower than average rents. Forty percent are single-person households. Many work in food service while they are attending college and have lower income levels. These consumers value fashion, trends and personal image, but are also price sensitive. They are always looking for a deal and will stock up when the price is right due to a sale. These residents are into the local music scene.
- **Dorms to Diplomas:** this is the youngest market with half of the population aged 20–24. They live alone or with roommates in a mix of dorms, on-campus and off-campus housing that cater to young renters. This market prefers biking and public transportation to get around. They experiment with purchasing various brands and products, having yet to establish preferences. Although school and part-time work take up many hours of the day, the remainder is usually filled with socializing, having fun with friends around town and recreationally, and plugging into the online world.
- **Forging Opportunity:** family is central to this market, which is largely comprised of younger families with children or single-parent households with multiple generations living under the same roof. One in four households is below the poverty level and the rest are very budget-conscious, mostly limiting their spending to necessities bought from discount department stores and the occasional dinner out. Nearly 60% of workers have a high school diploma and are employed in skilled positions across the manufacturing, construction, or retail trade sectors.
- **Bright Young Professionals:** this market is made up of young (median age 33), educated, working professionals living on the urban outskirts. Largely made up of couples, they rent more often than own, and over a third live in multiunit apartment buildings or rowhomes. Median household income, median home value, and average rent are close to the US values. Most have white-collar occupations. Residents of this segment are physically active, keep up on the latest technology, and their purchasing decisions are impacted by their concern for the environment.
- **Metro Fusion:** this is a young, diverse market, with many that do not speak English fluently. They are highly mobile and most live in midsize apartment buildings. Many have young children and a quarter are single-parent families. This is a hardworking market with residents that are dedicated to climbing the

Psychographic Segments	
Downtown	
1. Social Security Set	68%
2. College Towns	26%
3. Set to Impress	2%
Primary Market Area	
1. Forging Opportunity	16%
2. Dorms to Diplomas	14%
3. College Towns	14%
Greeley	
1. Forging Opportunity	9%
2. Bright Young Professionals	7%
3. Metro Fusion	6%

Source: Esri, Tapestry Segmentation Profile

ladders of their professional and social lives. They readily spend money on the latest fashion and electronics, unless they are saving for something specific.

Housing Market

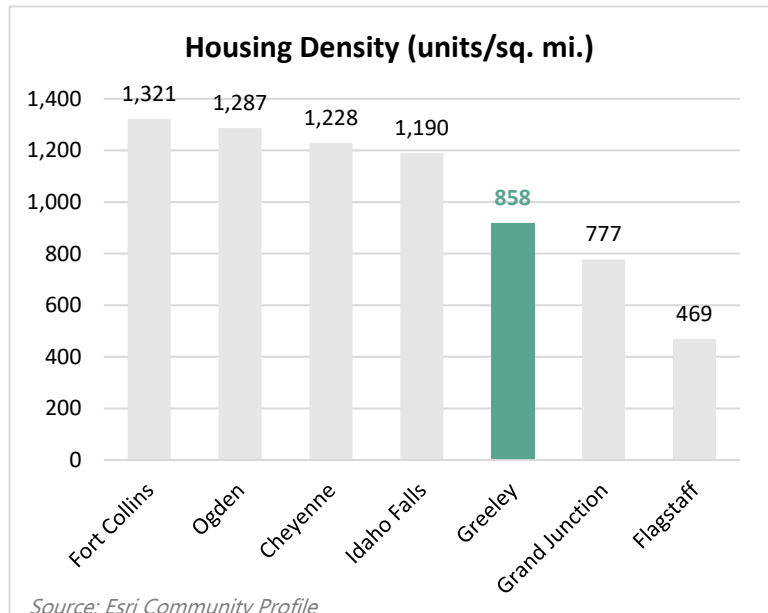
GREELEY MARKET

- Housing has become Greeley’s strongest real estate sector. It has seen housing prices rise to record highs over the last several years. In turn, the City is now faced with housing affordability challenges like the rest of the fastest growing cities in Colorado and the nation.
- Greeley has approximately 43,000 housing units according to Esri estimates (see the “Housing Snapshot” table). Compared to the other two areas, Greeley has the highest percentage of owner-occupied units (38%), the lowest vacancy rates (5%), the highest median home value (\$359,264), the most detached housing units (58%), and the fewest multifamily housing units (47%). There are nearly 20% more owner-occupied housing units than renter-occupied units.
- Compared to its peers, Greeley is on the low end of housing density according to the “Housing Density (units/sq. mi)” chart. While it’s the third largest in area, it is fifth in terms of housing density, illustrating that it has fairly low-density development patterns. Only two peer cities (Grand Junction and Flagstaff) are lower in housing density than Greeley.

Housing Snapshot, 2021

	Downtown	Primary Market Area	Greeley
Inventory (Units)	825	12,630	42,751
Percent of City's Total	1.9%	30%	
Renter-occupied	76%	56%	57%
Owner-occupied	12%	34%	38%
Vacant	13%	9%	5%
Median Rent*	\$673	\$776	\$908
Median Home Value	\$212,500	\$284,812	\$359,264
Detached*	21%	47%	58%
Multifamily*	79%	53%	47%

* 2015-2019 Estimates
Source: Esri, Community Profile



Housing Costs

- There are various tools available to help estimate up-to-date housing costs. For this report, Esri, Zillow, and CoStar were used to reveal trends.

- According to Zillow’s up-to-date estimates as shown in the “Home Values” table (sorted in descending order of 1-year percent change), Greeley’s median home value is approximately \$451,500, which is the third highest among its peer cities, yet 22% less than Colorado’s. Greeley’s housing prices were still under \$300K until as recently as May 2018, which was also true for four of its peer cities (Ogden, Idaho Falls, Grand Junction & Cheyenne).

Home Values

	Esri: Median Home Value, 2021	Zillow: Home Value Index, 2022	Zillow: Home Value Index 1-year % Change, 2022
Flagstaff	\$375,796	\$646,561	35.3%
Ogden	\$239,355	\$399,116	34.2%
Idaho Falls	\$232,337	\$392,215	26.4%
Greeley	\$359,264	\$451,591	24.2%
Fort Collins	\$433,783	\$578,655	23.6%
Grand Junction	\$315,411	\$374,498	22.6%
Cheyenne	\$245,645	\$359,394	15.6%

- Zillow data also reveals that while Greeley’s median home value is the lowest among Colorado’s major front range cities (7%-60% lower), it has increased by a

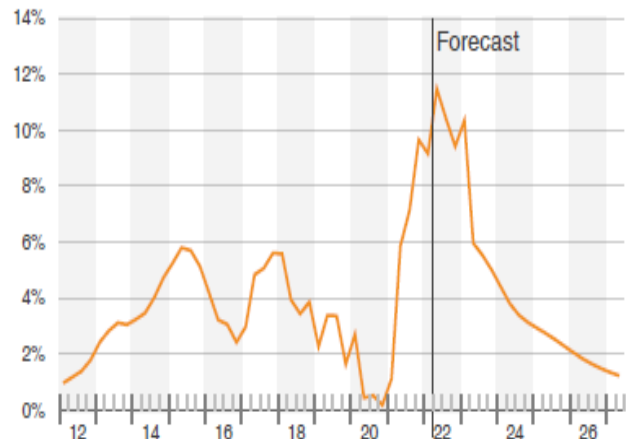
staggering 24.2% in the last year, which is more than some and less than other peer cities, but exactly in line with Colorado’s increase of 24.1%. This has made Greeley (and all Colorado) homes increasingly hard to purchase for first-time buyers and workers (whose wages have risen at a rate that is a fraction of the rate of climbing housing costs⁴¹).

- All of the peer cities analyzed are similarly challenged with escalating for-sale housing costs at varying degrees. According to Zillow, Greeley home values and one-year percent change in values haven’t risen as much as they have in some peer markets, but more than in others (Greeley is 3rd highest and 4th highest respectively).
- Greeley rental prices can be compared to its peers by using Esri’s 2015-2019 and Rent Café’s 2022 estimates as shown in the “Rental Values” table. Similar to home values, Greeley’s rental prices were third highest (behind Flagstaff and Fort Collins) according to both data sources.
- According to CoStar, Greeley’s 2022 average market rent is \$1,260 and has grown over 30% since 2012 (see “Greeley Market Rent Growth (YOY)” chart). Between 2012 and 2019 (pre-COVID), Greeley’s year-over-year market rent increased roughly 3% on average and was trending downward. Rents virtually froze early in the pandemic, but since then, rents have increased at rates much higher than pre-pandemic times (6% in 2021 and ~7.5% so far this year on average, or ~13.5% total).

Rental Values

	Esri: Median Rent, 2015-2019	Rent Café: Average Rent, 2022
Flagstaff	\$1,173	\$1,901
Fort Collins	\$1,273	\$1,755
Greeley	\$908	\$1,374
Ogden	\$749	\$1,148
Cheyenne	\$767	\$934
Idaho Falls	\$648	n/a
Grand Junction	\$802	n/a

Greeley Market Rent Growth (YOY)



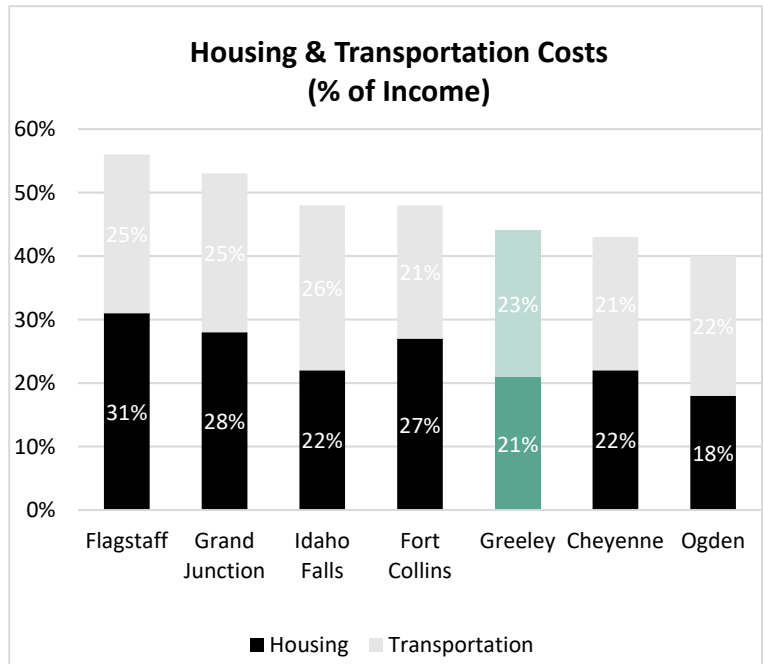
⁴¹ (City of Greeley, 2019)

- The “Pandemic Peer County Rent Growth Rates” table allows a comparison among Greeley’s peers at the county level. A similar high rent growth rate trend since the beginning of the pandemic is apparent; only two of Greeley’s peers have seen rent growth rates that outpace its own⁴².
- One of the reasons for such drastic increases in rent prices is the increase in demand – Greeley was 77 on the list of 100 of the top U.S. cities for renter net migration, gaining 1.6 new renters from elsewhere per renter that moved out in 2021⁴³. Another report puts Greeley as the 4th most popular City among all the nationwide options for people migrating from Denver to Greeley between 2015 and 2019 (netting 3,919 residents)⁴⁴.
- The Housing and Transportation (H+T®) Affordability Index is another tool that can provide a glimpse into a community’s affordability and how cost burdened its households are by measuring local housing and transportation costs as a percentage of income. Compared to its peer cities, Greeley’s households, which spend 44% of income on housing and transportation on average, are more cost-burdened than only two (or 1/3) of its peer cities (Cheyenne and Ogden) and less cost-burdened than four (or 2/3) (Flagstaff, Grand Junction, and Idaho Falls and Fort Collins). Only Greeley, Cheyenne, and Ogden meet the definition of affordable, which requires that no more than 45% of income be utilized for both housing and transportation costs⁴⁵.

Pandemic Peer County Rent Growth Rates

	Change during pandemic (Q1 2020 through Q1 2022)
Weber (Ogden)	22%
Bonneville (Idaho Falls)	13%
Weld (Greeley)	12%
Coconino (Flagstaff)	12%
Laramie (Cheyenne)	8%
Larimer (Fort Collins)	7%
Grand Junction (Mesa)	6%

Source: Washington Post article Apr 22, 2022 citing CoStar data



Market Dynamics

- All of the aforementioned data points are congruent with national trends, with housing costs at an all-time high for a number of reasons, including:
 1. *Demand exceeding supply of new builds* – Greeley has seen explosive population growth (as noted above), but residential construction has not kept pace.

⁴² (Bhattarai, Alcantara, & Van Dam, 2022)

⁴³ (Chantree, 2022)

⁴⁴ (Where people in Denver are moving to most, 2022)

⁴⁵ (1000 Friends of Wisconsin, n.d.)

2. *Rising construction costs* – Construction has become much more expensive in the last decade and especially since COVID. The chief driver of this condition has been increasing material costs due to supply chain issues and increasing labor costs due to a shortage of skilled labor.
 3. *A lower density development pattern* – Peer city research shows that Greeley is on the low end of housing density. Low-density cities, such as Greeley, tend to be ripe for a high cost per unit structure as their population increases.
 4. *Lack of inventory available* – Mortgage interest rates hit record lows to protect the economy during the pandemic, which inspired many to pursue the purchase of a home, creating a great deal of competition over for-sale housing inventory. This rapidly drove home values up, pricing out many would-be home buyers and keeping them in the rental market. This, in turn, caused demand for rental units to rise and turnover to wane, resulting in very low vacancy rates and high market rents. Greeley has not been immune to these dynamics and is quickly becoming an unattainable market to rent in or buy into for households at or below the average income level. While the pace of rent-growth is predicted to ease a bit, it's likely to continue at a rate greater than pre-pandemic levels, which means that housing affordability will continue to be a big challenge⁴⁶.
 5. *Escalating cost of raw water* – The cost per acre foot of municipal water supplied by the Colorado Big Thompson Project has at least tripled in recent years, with most of it currently going toward landscape irrigation⁴⁷.
 6. *Missing homes not built during the Great Recession and Greeley residential downturn* – Financing for any real estate or construction activity was difficult to obtain during the Great Recession. Greeley also experienced a residential downturn from 2016 to 2017. Thus, while Greeley's population was rapidly increasing, few units were built to house them during these times, resulting in a shortage of well over 1,000 units required to keep pace with population growth and setting the stage for this problem to be further exacerbated in subsequent years⁴⁸.
- Greeley is attempting to address this challenge, having completed a strategic housing plan in 2019 that aims to build 5,557 housing units by 2024 at prices all along the spectrum⁴⁹. Greeley issued 2,135 residential permits between 2019 and 2021; if all of those units are built, Greeley will have met 38% of its goal⁵⁰. The plan also outlines the following strategies to alleviate the pressure on housing affordability:
 1. Amend the Development Code
 2. Minimize Infrastructure Costs
 3. Engage Alternative Housing Providers
 4. Improve the Housing Product Mix
 5. Address the Impact of Raw Water Cost on Housing Affordability
 6. Complete Subarea & Neighborhood Plans
 7. Encourage Ownership, Move-up & Executive Housing Options
 8. Encourage Vocational Training & Apprentices Programs
 9. Facilitate Development of Manufactured Home Communities

⁴⁶ (Apartment List Research Team, 2022)

⁴⁷ (City of Greeley, 2019)

⁴⁸ (City of Greeley, 2019)

⁴⁹ (City of Greeley, 2019)

⁵⁰ (McCready, 2022)

Student Housing

- As previously noted, approximately 7,500 students are enrolled in UNC. It’s estimated that around 67% (or ~5,000) of undergraduate and graduate students originate from outside the region, most of whom need housing on or close to the Downtown-adjacent UNC campus⁵¹. According to CoStar, UNC offers about 3,500 dormitory beds, meeting the needs for about 70% of these relocated and retained students, and leaving approximately 1,500 students in need of off-campus housing.
- Monthly costs for dormitories are \$589. Rents for properties that market themselves as student housing range from \$464 to \$796 per month per bed, with \$588 being the median. As with other types of housing, student housing rents have steadily increased over the last decade (58% since 2010), even while occupancy rates have declined to 84.4% since the beginning of the pandemic. Three of the properties, providing 232 beds, are within the Downtown boundary and another 6 properties, providing 430 beds, are within a quarter mile of Downtown. All told, 662 beds are provided by off-campus student housing properties.
- UNC’s contribution to Greeley’s housing affordability problem has apparently been fairly minimal compared to its peers with universities. For now, its enrollment has slowed and dormitory as well as off-campus beds serve the majority of the student housing needs. However, students are still attracted to the prospect of living Downtown, and there is ample opportunity to welcome them as Downtown residents, especially as safety improves and more student housing options become available.

Greeley Student Housing, 2022

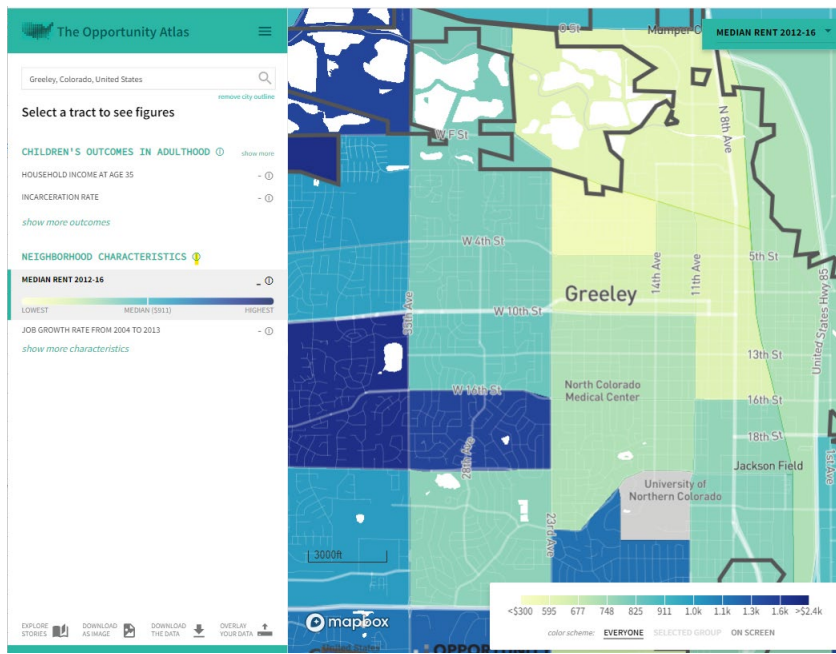
	Beds
2006 9th Ave	5
2007 8th Ave	5
1931 11 th Ave	70
1750 6 th Ave	260
815-919 16th St*	5
724 16th St*	6
2115 8th Ave	6
1424 11 th Ave	84
1640, 1540 & 1521 8th Ave* **	221

**property within Downtown boundary
 **property is 18% students
 Source: CoStar University Report*

DOWNTOWN MARKET

- According to Esri estimates shown in the “Housing Snapshot” table on page 30, Downtown contains 825 housing units, or under 2% of Greeley’s housing inventory (note: these are based on Census estimates and aren’t necessarily reflective of individual developments that have come online recently, such as the Apartments at Maddie).
- Compared to the other two areas (Primary Market Area and Greeley as a whole), Downtown has the highest percentage of renter-occupied units (76%), the lowest percentage of owner-occupied units (12%), the highest vacancy rates (13%), the lowest median home value (\$212,500), the most multifamily housing units (79%), and the fewest detached housing units (21%).
- The median value of Downtown homes is 41% less than that of Greeley and 25% less than that of the Primary Market Area. The same is true for median rent prices, but to a lesser extent, with Downtown rents being 26% less than that of Greeley and 13% less than that of the Primary Market Area. According to Harvard’s Opportunity Atlas (see map below), this has been the case with rent prices for quite some time, which contributes to Downtown’s stigma as having a much higher concentration of poverty than the rest of Greeley:

⁵¹ (University of Northern Colorado, 2022)



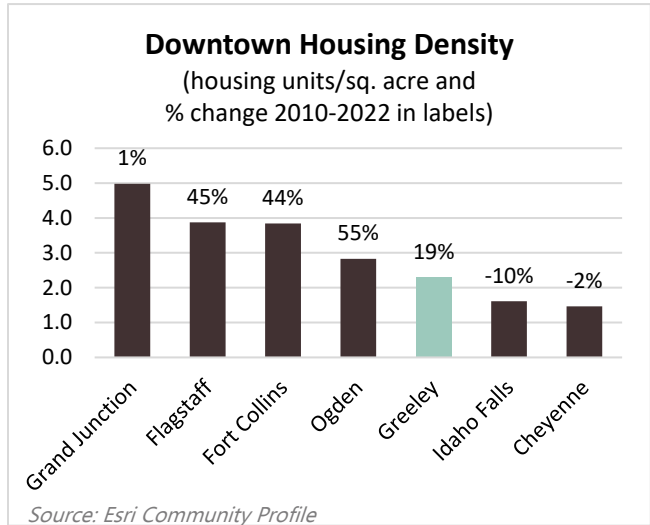
- While Downtown residents have had many barriers to increasing their social mobility, Downtown housing prices have been relatively attainable for households at or below median income levels, including many of those that work in blue-collar and hospitality/service-based jobs that make up large portions of Downtown’s employment base. As Downtown’s prosperity grows, it both increases opportunities for residents to rise above their disadvantaged roots and creates the threat of displacement as property values and rent prices increase.
- Multifamily units greatly outpace detached units in Downtown (79% vs. 21%), while the opposite is true for Greeley as a whole.
- Most of its households (76%) are renter-occupied, which is true across the other two Greeley markets, but to a lesser extent.
- Downtown’s residential vacancy rate of 13% is more than double Greeley’s (5%).
- CoStar drills down to the multifamily rental market and provides an up-to-date picture of conditions, as shown in the “Multifamily Rental Market” table. According to this data, Downtown’s average market rents for multifamily units are ~6% lower than the Primary Market Area’s ~16% lower than the City’s.

Multifamily Rental Market, 2022

	Downtown	Primary Market Area	Greeley
Inventory (Units)	884	3,196	11,020
Vacant Units	49	144	875
Vacancy Rate	5.5%	4.5%	7.9%
Avg. Market Rent per Unit	\$1,089	\$1,023	\$1,260
Studio	\$1,000	\$995	\$986
1 Bedroom	\$1,063	\$1,025	\$1,160
2 Bedroom	\$1,264	\$1,037	\$1,316
3 Bedroom	\$1,010	\$991	\$1,543

Source: CoStar

- Downtown has 884 multifamily units, or 8% of the City’s total.
- Many cities, including peers, have been increasing residential housing density in their downtowns over the last decade to alleviate strains on the market—a trend that was somewhat delayed in Downtown Greeley (see “Downtown Housing Density” chart)⁵². The Downtown rental market has been making great strides in the last couple of years.



- Another 84 units (or 12.3% of all of Greeley’s under construction units according to CoStar) will come online soon when Greeley’s first 4-star rated property (The 55+ Resort Apartments) is completed. When those units are available, ~395 new units (as much as 40% of Downtown’s total multifamily rental units) will have come online since 2020, which indicates a recent, and strong, focus on this market sector (see “Recent Downtown Multifamily Residential Development Activity” table). This was echoed by various area real estate professionals, who report putting the majority of their resources, thanks in part to incentives, into developing and/or renovating multifamily units Downtown, especially of the more upscale variety along the 8th Avenue corridor. According to CoStar data, rents are approximately 50% higher on average for these new units than those that existed prior and had an average year-built date of 1935. Local real estate developers anecdotally supported this data by reporting that their newer, higher end products are fetching the highest rents in town at an average of \$2.25 per square foot.

Recent Downtown Multifamily Residential Development Activity

	Address	Units	Completion
55+ Resort Apartments	1100 8th Ave	84 new	TBD
Apartments at Maddie	1640, 1540 & 1521 8th Ave	221 new	Sep-20
Immaculata Plaza Phase II (affordable; renovation & new)	530 10th Ave	25 reno 29 new	TBD
The 609 Studios (renovation & new)	609 8th Ave	50 reno 61 new	Mar-20

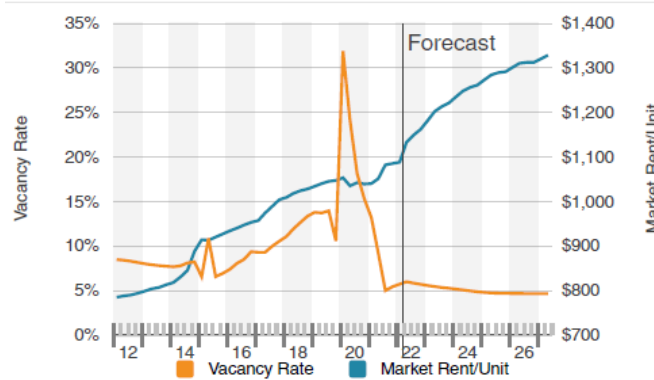
Source: Greeley Downtown Development Authority

- The feeling among local real estate experts is that ~2,000 units are needed (many of which need to serve higher income-earning residents) to reach a critical mass that will meaningfully support a shift to a focus on commercial retail developments.
- As shown in the “MF Vacancy & Market Rent/Unit” charts below, Downtown has historically had higher vacancy rates than the Primary Market Area or City, but they’re trending lower and becoming more in line with the Primary Market Area’s. Today, 5.5% of Downtown’s units are vacant, which is the lowest vacancy rate it’s had in the last decade, save for one slightly lower rate in 2021.
- Compared to the Primary Market Area and the City, Downtown was less stable at the onset of the pandemic; vacancy rates shot up to over 30% in 2020, while the other two area’s rates did not go above 13% during this time. Downtown has proved its resiliency since then, having come back from the highest vacancy rate in Greeley and doing so very rapidly.

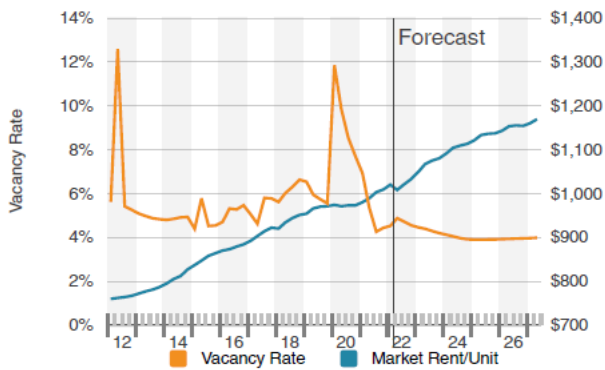
⁵² (The International Downtown Association, 2019)

- National vacancy rates have been trending downward since before the pandemic but have eased since, hitting a low of 4.1% in fall 2021, which indicates yet another force that has contributed to the rise in rental housing costs. National vacancy rates are currently at about 5%, which are in-line with Downtown and Primary Market Area rates, but nearly 3% lower than Greeley's⁵³.
- Trends show that even when the area's vacancy rates remained stable and/or increased over the past decade, market rents continued to increase at substantial rates—a trend that is likely here to stay. Rents have grown somewhere between ~15% and 30% for all the areas examined since 2012, with Downtown experiencing the highest growth rate and the City experiencing the lowest.

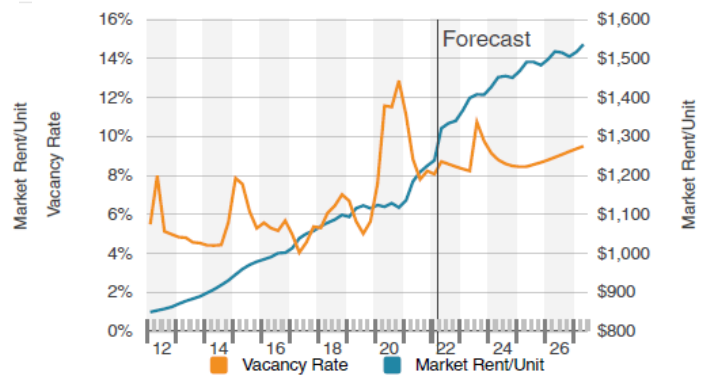
Downtown MF Vacancy & Market Rent/Unit



Primary Market Area MF Vacancy & Market Rent/Unit



Greeley MF Vacancy & Market Rent/Unit



- All told, housing appears to be a strong market for Downtown moving forward. There is healthy demand for more units at all price points, but especially those on the higher end to attract more residents with greater incomes that can better support retail as well as begin to dilute the high concentration of poverty in Downtown. Downtown's housing is also likely to be increasingly attractive to varied users, including UNC students, retirees, and young professionals employed nearby. While Downtown can't solve the City's affordability crisis, it can play an important role in diversifying Greeley's housing stock and adding new units to a strained market.

⁵³ (Apartment List Research Team, 2022)

3. WORK

The Greeley Economy

- Greeley is the support and processing hub for fruitful Weld County, which is the top agricultural producing county in the nation outside of California, as well as home to the largest number of active wells in any county in the United States⁵⁴. Its education sector is 24% more concentrated than the national average and both employs a large percentage of Greeley's workers and offers many post-secondary education programs that turn out skilled talent, especially for two of its key industry sectors—healthcare and construction⁵⁵. Its retail and accommodation & food service industries also employ a robust number of employees.
- According to the Census, Greeley's five largest employment sectors, organized into the standard NAICS codes, are: (1) Health Care & Social Assistance, (2) Manufacturing, (3) Educational Services, (4) Retail, and (5) Accommodation & Food Services (see "Greeley Jobs by Industry" chart on page 42). Together, these five industries account for over half of all jobs in Greeley.

- The ten largest employers in Greeley are shown in the "Largest Greeley Employers" table. Greeley heavily relies on food manufacturing (JBS Swift & Company & Colorado Premium Foods), medical centers (Banner/North Colorado Medical Center & University of Colorado Health Systems), higher education institutions (University of Northern Colorado & Aims Community College), and the public sector (School District, County, and City)

Employer	Employees
1. JBS Swift & Company	4,341
2. Banner/North Colorado Medical Center	3,710
3. Greeley/Evans School District 6	2,200
4. University of Northern Colorado	1,717
5. Weld County	1,615
6. City of Greeley	1,100
7. University of Colorado Health Systems (All Weld)	1,030
8. State Farm Insurance Companies	948
9. Aims Community College	797
10. Colorado Premium Foods (K2D, LLC)	550

Source: Greeley's Department of Economic Health & Housing

- to supply its jobs. These employers alone provide over one third of Greeley's total jobs, indicating a strong reliance on their continued success.
- UNC and Aims Community College are not only two of the City's largest employers, but an anchor of the local economy, with a solid population of students supporting businesses around town, some of which work part-time as well, and a regular infusion of talent in to the local economy through its graduates, which are often coming from programs that compliment some of Greeley's key industry sectors.
- Greeley's key industry sectors (shown in "Greeley's Key Industry Sectors" table), identified by Greeley's Department of Economic Health and Housing, are

Energy & Power
Agriculture & Food
Construction Products & Services
Education
Health Services
Professional Services

Source: Greeley's Department of Economic Health & Housing

⁵⁴ (Site Selection: Key Industry Sectors, 2022)

⁵⁵ (Greeley Economic Development: Industries, 2022)

backed by an analysis below of top employers, location quotients, wages, local post-secondary education programs, jobs and job growth by industry.

- **Energy & power** jobs are classified within the Mining and Oil & Gas Extraction NAICS code, which held Greeley's highest location quotient of 7.63 in 2021 according to Emsi, indicating a very high concentration of employment in Greeley compared to the national average. Census data also indicates that this industry in Greeley has grown more than any of its peers since 2010. While there are no energy & power companies in Greeley's top ten employers list, there are over 2,000 people employed within this sector according to the Census, making it Greeley's 8th largest industry. These jobs provide ~72% higher average wages than the Greeley average according to Emsi. While low oil prices and COVID initially caused the industry to contract with Greeley losing about 20% of these jobs since 2016, it is showing strong signs of recovery. Greeley is the epicenter of Weld County, which is currently responsible for 84% of the state's oil production and 50% of its gas production⁵⁶. While the future of the oil & gas industry is in flux, it's likely that Greeley will continue to be one of the major locations for oil and gas production for the foreseeable future. Greeley is also looking to diversify within this sector, expecting an increase in jobs related to the solar and wind industries⁵⁷.
- Greeley's **Agriculture & Food** jobs mostly involve manufacturing and processing. Manufacturing is Greeley's second-highest employment-generating industry, supplying 12% (~6,000) of all jobs according to the Census. These jobs are largely supplied by two of Greeley's top employers, numbering nearly 5,500 food manufacturing jobs. Manufacturing overall has increased 7% since 2016 according to Emsi, with Cheese Manufacturing (24%), Animal (except Poultry) Slaughtering (8%), and Breweries (101%) showing the strongest gains. Its location quotient of 1.76 also indicates that Greeley has nearly twice the concentration of these jobs compared to the national average.
- While there are no **Construction** products & services employers in the top ten list, and the number of jobs in this category do not make Greeley's top five, they still make up 5% (~2,300) of Greeley's total jobs according to the Census, making Construction Greeley's 7th largest industry. It's also Greeley's sixth-fastest growing industry since 2016 according to Emsi, showing an 18% gain. It's sixth in terms of proportion of Greeley establishments (~7%) according to Esri. The industry has the added benefit of being able to pull local talent from the ten post-secondary education programs offered at Greeley's higher education institutions⁵⁸.
- **Education** is one of the most obvious of Greeley's key industry sectors, as three of its top ten employers fall into this category and it is the third largest industry, supplying 11% (~4,500) of all jobs according to the Census.
- **Healthcare** is another obvious differentiator for Greeley, with two major hospital systems making the top ten employers list, and Health Care & Social Assistance being the top industry, supplying 16% of all jobs according to the Census. Additionally, Esri data suggests that businesses classified in this category (14%) make up the greatest proportion of Greeley businesses. This sector also enjoys the benefits of being able to pull local talent from the ten post-secondary education programs in the area⁵⁹.
- The **Professional Services** sector is necessary to support most of the other sectors, and is the NAICS category that has experienced the second-highest job growth since 2016 of 30% (Emsi).

⁵⁶ (Oil and Gas Energy: June 2022 Production Report, 2022)

⁵⁷ (Fernandez, Greeley's diversifying economy is more than just beef and oil, 2020)

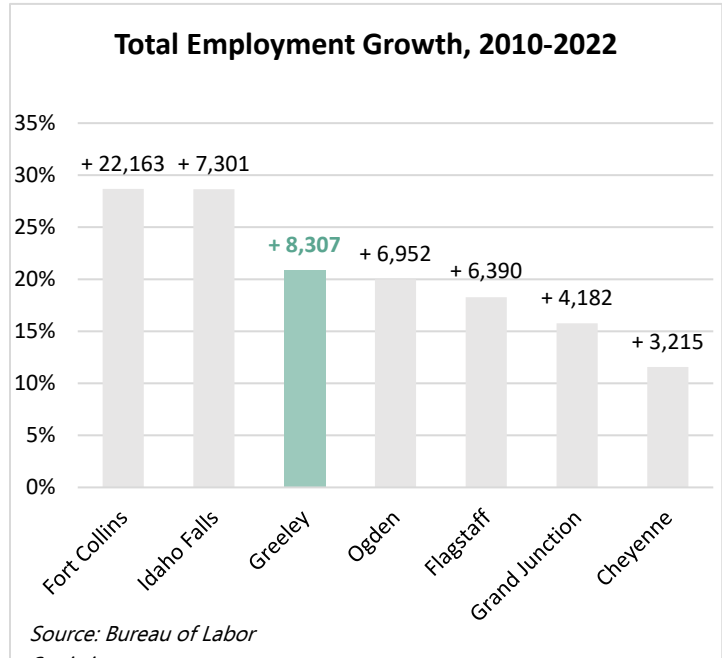
⁵⁸ (Greeley Economic Development: Industries, 2022)

⁵⁹ (Greeley Economic Development: Industries, 2022)

These jobs offer wages ~33% higher than Greeley's average wage. Professional Services businesses also account for 8.3% (or 290) of Greeley businesses, which is the fourth highest number per Esri.

EMPLOYMENT GROWTH

- The Bureau of Labor Statistics indicates that Greeley employs ~49,500 people.
- Greeley has seen strong employment growth over the last decade, adding ~8,300 jobs, which equates to ~20% increase in total employment since 2010.
- Greeley's employment growth is among the fastest of its peers. The "Total Employment Growth" chart shows that Fort Collins and Idaho Falls are the two fastest-growing economies relative to their size, with Greeley being the third-fastest, trailing by about 7% in growth. Greeley has experienced the second-largest increase in actual employment numbers since 2010, with Fort Collins adding over twice as many jobs in the same time period.



- As far as types of jobs, Greeley has grown its Mining and Oil & Gas Extraction and Management of Companies industries more than any of its peers since 2010 (see "Peer Jobs Per Industry" table on the next page). It's also experienced the second-highest growth in its Accommodation & Food Services and Public Administration industries, right behind Idaho Falls for both. Greeley has lost more jobs than any of its peers in the Manufacturing, Finance & Insurance, and Administrative & Support industries.

Peer Jobs Per Industry, % Change 2010-2019

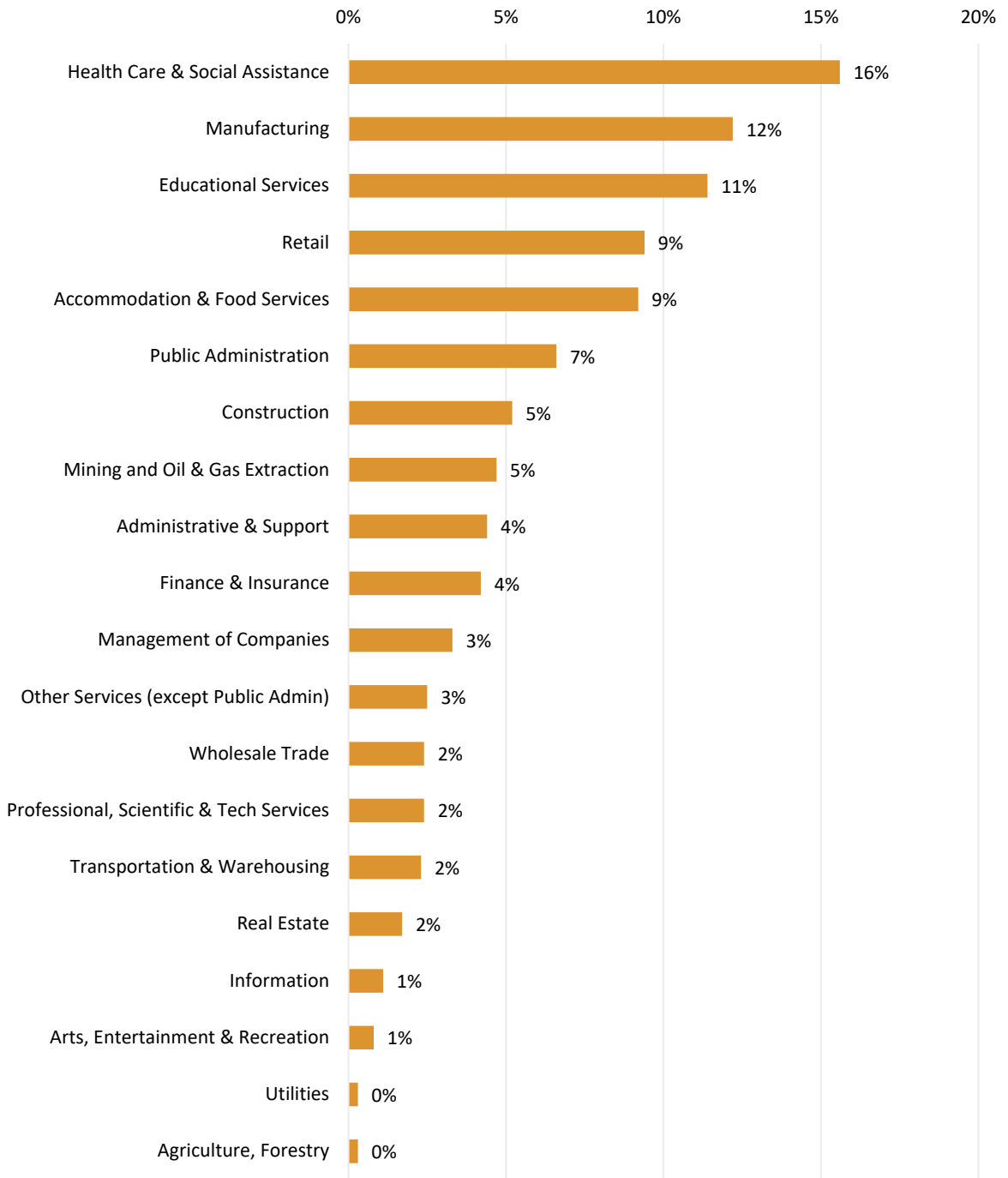
	Greeley	Fort Collins	Cheyenne	Grand Junction	Idaho Falls	Ogden	Flagstaff
Health Care & Social Assistance	4.4%	6.1%	1.2%	6.2%	4.6%	-9.8%	9.3%
Mining and Oil & Gas Extraction	3.9%	0.2%	0.4%	-1.2%	0.0%	0.0%	0.0%
Management of Companies	2.0%	0.3%	-0.1%	-0.2%	0.2%	-0.2%	0.4%
Accommodation & Food Services	1.5%	0.3%	0.2%	0.6%	1.7%	0.1%	-1.5%
Construction	1.2%	0.8%	1.4%	1.6%	0.2%	2.3%	1.2%
Public Administration	0.7%	-1.0%	-2.0%	-2.8%	1.9%	0.0%	0.0%
Real Estate	0.3%	-0.1%	-0.2%	-0.2%	0.1%	-0.2%	0.3%
Transportation & Warehousing	0.1%	0.0%	2.0%	-0.4%	0.0%	0.5%	-1.4%
Utilities	-0.1%	-0.4%	0.0%	-0.2%	0.0%	-0.1%	0.2%
Other Services (except Public Admin)	-0.2%	0.2%	0.0%	0.1%	-0.1%	-0.8%	-0.1%
Arts, Entertainment & Recreation	-0.2%	0.1%	0.4%	0.5%	0.2%	0.6%	-1.1%
Professional, Scientific & Tech Services	-0.3%	-1.9%	0.6%	-0.5%	-1.5%	0.3%	-0.8%
Information	-0.3%	0.5%	-0.4%	-0.9%	-1.5%	-0.4%	-0.2%
Agriculture, Forestry	-0.3%	0.0%	0.0%	0.0%	0.0%	0.4%	0.0%
Administrative & Support	-1.3%	0.7%	0.0%	-0.2%	1.1%	4.8%	-0.4%
Wholesale Trade	-1.6%	0.4%	0.1%	-0.5%	-2.4%	-0.5%	0.4%
Retail	-1.6%	-1.4%	-2.1%	-3.5%	-1.0%	0.5%	-7.0%
Educational Services	-2.0%	-6.0%	-0.9%	1.1%	-0.3%	-0.1%	0.6%
Manufacturing	-3.1%	1.5%	-0.7%	1.2%	0.3%	2.7%	0.7%
Finance & Insurance	-3.1%	-0.5%	-0.1%	-0.7%	0.0%	-0.2%	-0.5%

Source: Source: U.S. Census LEHD; 2019 data (latest available)

TOP INDUSTRIES

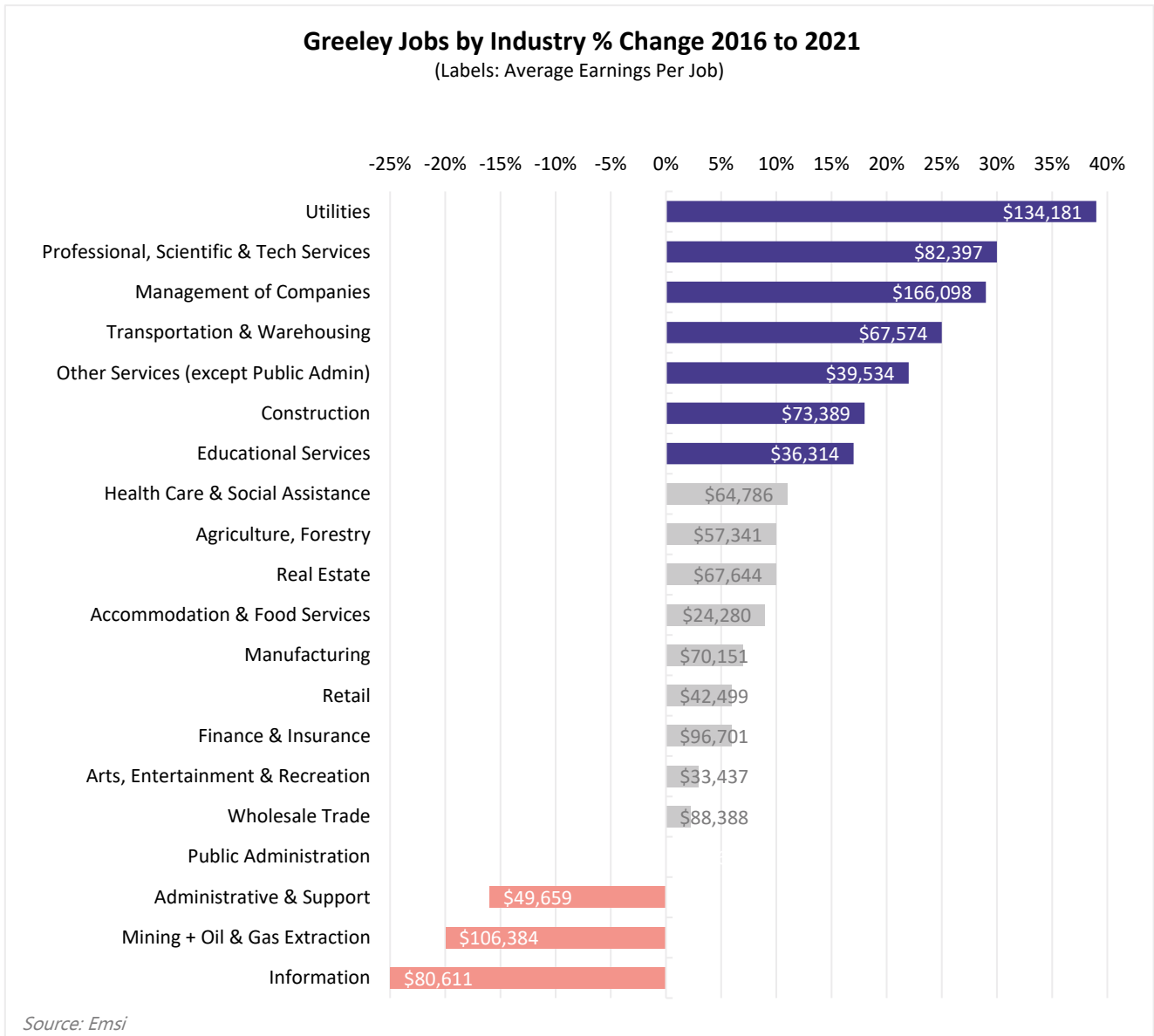
- Jobs by industry data was gathered from the Census' Longitudinal Employer-Household Dynamics (LEHD) program and then sorted by federal NAICS codes to determine Greeley's top industries.
- The "Greeley Jobs by Industry" chart on the next page indicates that Greeley's top employment-generating private-sector industries, accounting for over half of jobs, are Health Care & Social Assistance (15.6%), Manufacturing (12.2%), Educational Services (11.4%), Retail (9.4%), and Accommodation & Food Services (9.2%).

Greeley Jobs by Industry, 2019



Source: U.S. Census LEHD; 2019 data (latest available)

- Emsi data allowed for an examination of recent citywide job gains and losses as well as average earnings. The “Jobs by Industry % Change (Emsi)” chart indicates that all of its major industries, aside from government, have experienced growth since 2016 and that nearly two-thirds of those industries have wages that exceed Greeley’s average earnings per job of \$61,981 in 2021.
- Greeley’s high-growth industries, or those that have expanded more than 20% since 2016, are historically smaller industries for Greeley and include Utilities (39%, which accounts for just 122 additional jobs), Professional Scientific & Tech Services (30%/2,130 jobs), Management of Companies (29%/1,443 jobs), Transportation & Warehousing (25%/1,320 jobs), and Other Services (22%/2,900 jobs). Four of these five have salaries well above Greeley’s average.



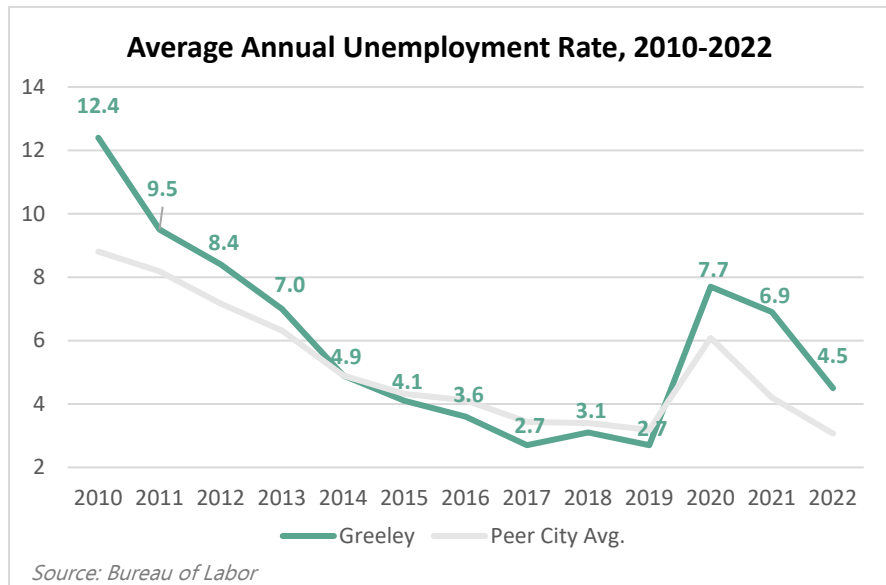
- Two of Greeley’s top employment-generating industries (Health Care & Social Assistance as well as Manufacturing) have experienced growth at a more moderate rate since 2016 (11%/6,703 jobs and 7%/7,492 jobs respectively); these two also have wages above Greeley’s average.

- Only two of the three industries that have contracted between 2016 and 2021 have average earnings above the Citywide average (Information and Mining Oil & Gas Extraction), and neither one is among Greeley’s top ten industries.
- Overall, trends indicate that Greeley’s portfolio of employment-generating industries is diversifying; growth and wage trends also point to a rising level of affluence in the community.

UNEMPLOYMENT

- The “Average Unemployment Rate” chart shows unemployment trends for Greeley and its peer cities since 2010.

- Greeley’s peak rates of unemployment were in 2011 in the wake of the Great Recession, reaching 13.2%, and then in June 2020 due to COVID, reaching 12.1%. Many economists consider a 3% to 5% unemployment rate to be full employment⁶⁰; Greeley’s unemployment rate fell to 5% in May of 2014, and then consistently held low rates of unemployment



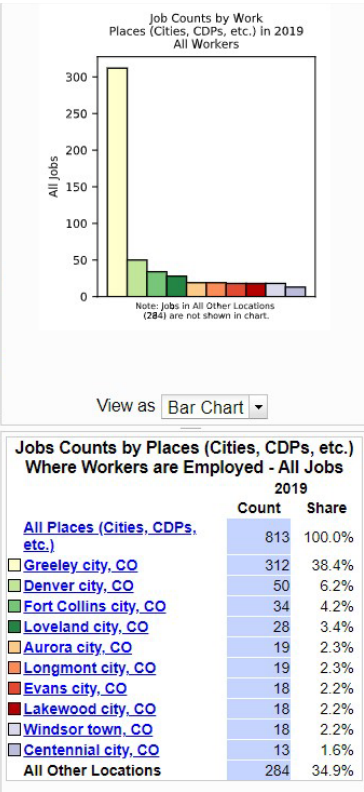
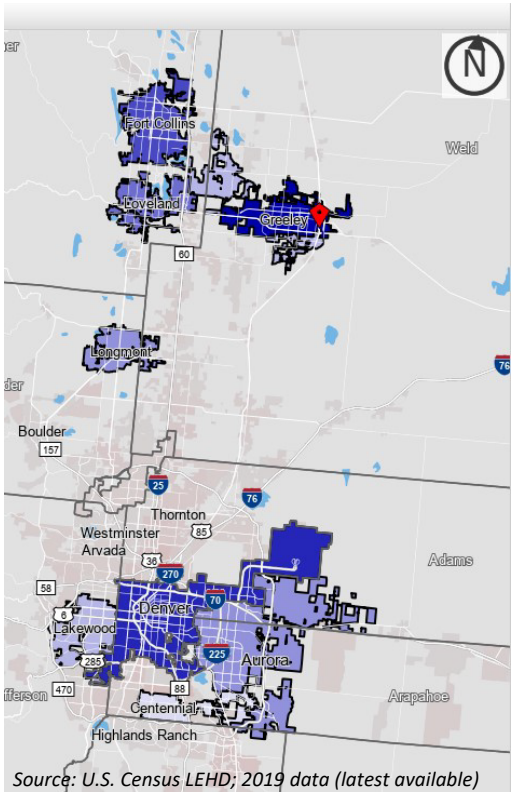
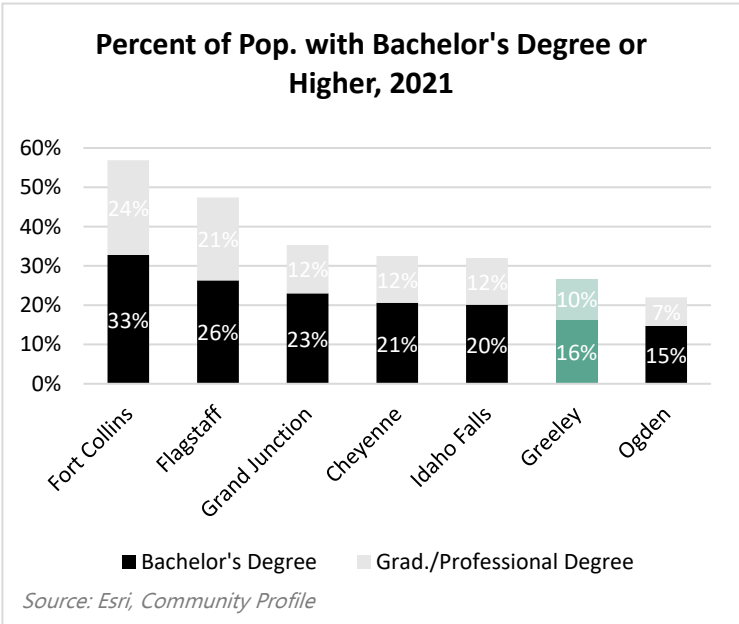
averaging around 3.4% right up to the beginning of COVID in February 2020 when they rapidly rose.

- Before 2014, Greeley’s average annual unemployment rates were higher than its peers, then Greeley enjoyed lower average rates leading up to COVID. Since then, rates have been an average of about 2% higher than its peers.
- Like many of its peers, Greeley’s unemployment rate has recovered fairly quickly, showing rates lower than 5% again by November 2021. It’s currently sitting at 3.7%, which is about 1% higher than pre-pandemic levels, but closely aligned with the state and national rate of 3.6% and Weld County rate of 3.4%.

⁶⁰ (Kagan, 2021)

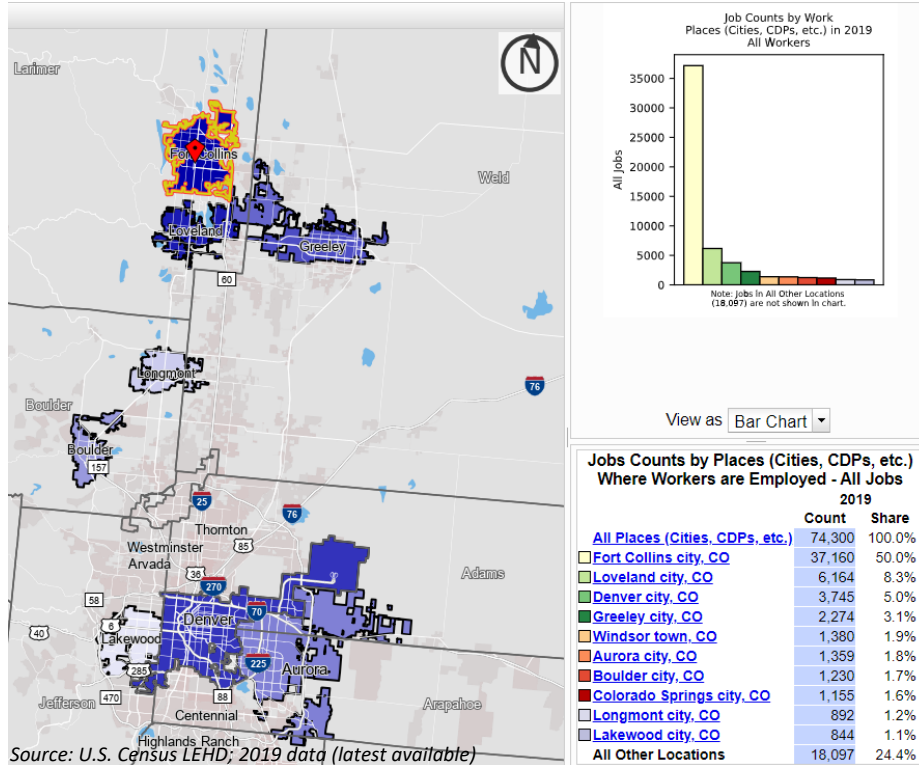
WORKFORCE TALENT & EDUCATIONAL ATTAINMENT

- In today’s economy, jobs and companies follow talent, or resident workforces that are typically highly skilled and educated. Several recent studies have concluded that educational attainment is one of the best predictors of economic success for both individuals and communities. As one study put it, “Talent is the world’s most precious resource” (William Kerr, Brookings Institution).
- Greeley’s residents are not as well educated as all but one of its peers according to Esri, with about 27% of its residents holding a bachelor degree or higher (see “Percent of Pop. With Bachelor’s Degree or Higher” chart). For comparison, its peer cities have between 32% and 57% of its population being highly-educated (with nearby Fort Collins leading by a large margin).
- While UNC has a business school that is recognized as being among the top programs for business administration and accounting, as well as offers many post-secondary programs that generate talent for several of its burgeoning industry sectors, these relatively low higher-education degree numbers suggest that Greeley likely struggles to retain UNC graduates.
- Greeley may struggle to attract and retain employers looking for highly educated talent. This sentiment was echoed by Greeley stakeholders, who indicated that Greeley experiences a lot of brain drain, losing many higher-tech and higher-wage jobs to I-25 corridor cities such as Denver, Fort Collins, and Loveland. Moreover, pre-pandemic data showed that only 38% of Greeley’s residents worked in Greeley, suggesting that it is somewhat of a bedroom community, housing workers that are employed in other nearby cities to a large



extent. It's also highly likely that it's the more educated Greeley residents that are commuting to other areas, including Denver (6.2% of Greeley's workers), Fort Collins (4.2% of Greeley's workers), and Loveland (3.4% of Greeley's workers) for the most suitable jobs (see map below)⁶¹.

- For comparison, Greeley's nearby peer city of Fort Collins maintained about 50% of its residents (12% more than Greeley) as daytime workers in 2019. Other cities that attracted Fort Collins' workers were Loveland (8.3%), Denver (5%), and Greeley (3.1%).



The Downtown Economy

- According to Esri, there are approximately 7,381 employees in Downtown Greeley (see "Employment Snapshot" table). Outside of government employers, none of the top primary employers are within the Downtown boundary.
- Using Esri estimates, Downtown holds 25% of the City's businesses and 24% of its workers, while only making up 1% of the City's land area.
- Downtown's economic productivity, relative to the city, is also illustrated in the per-acre figures shown in the "Employment Snapshot" table. There 1.4 businesses and over 23 employees per acre in Downtown, compared to 0.1 businesses and one employee per acre citywide.

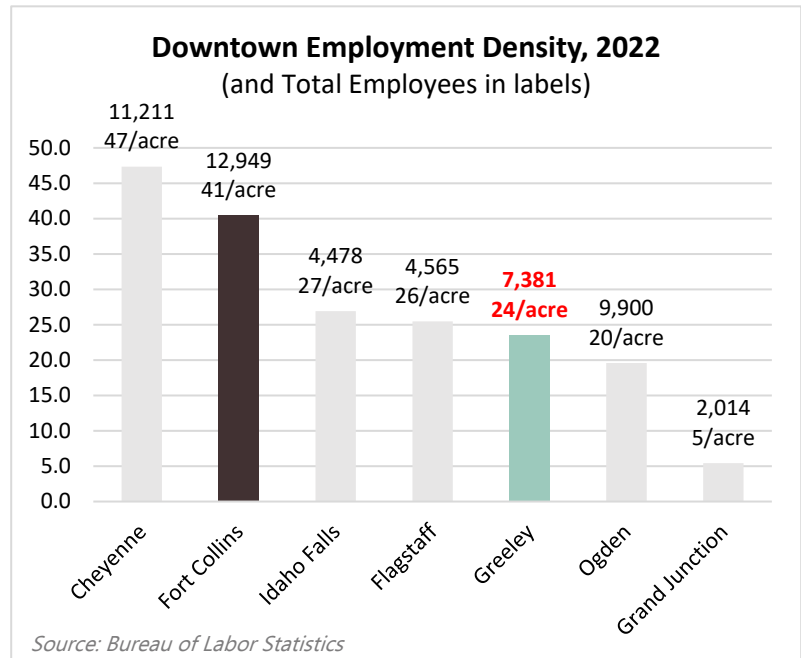
Employment Snapshot, 2021

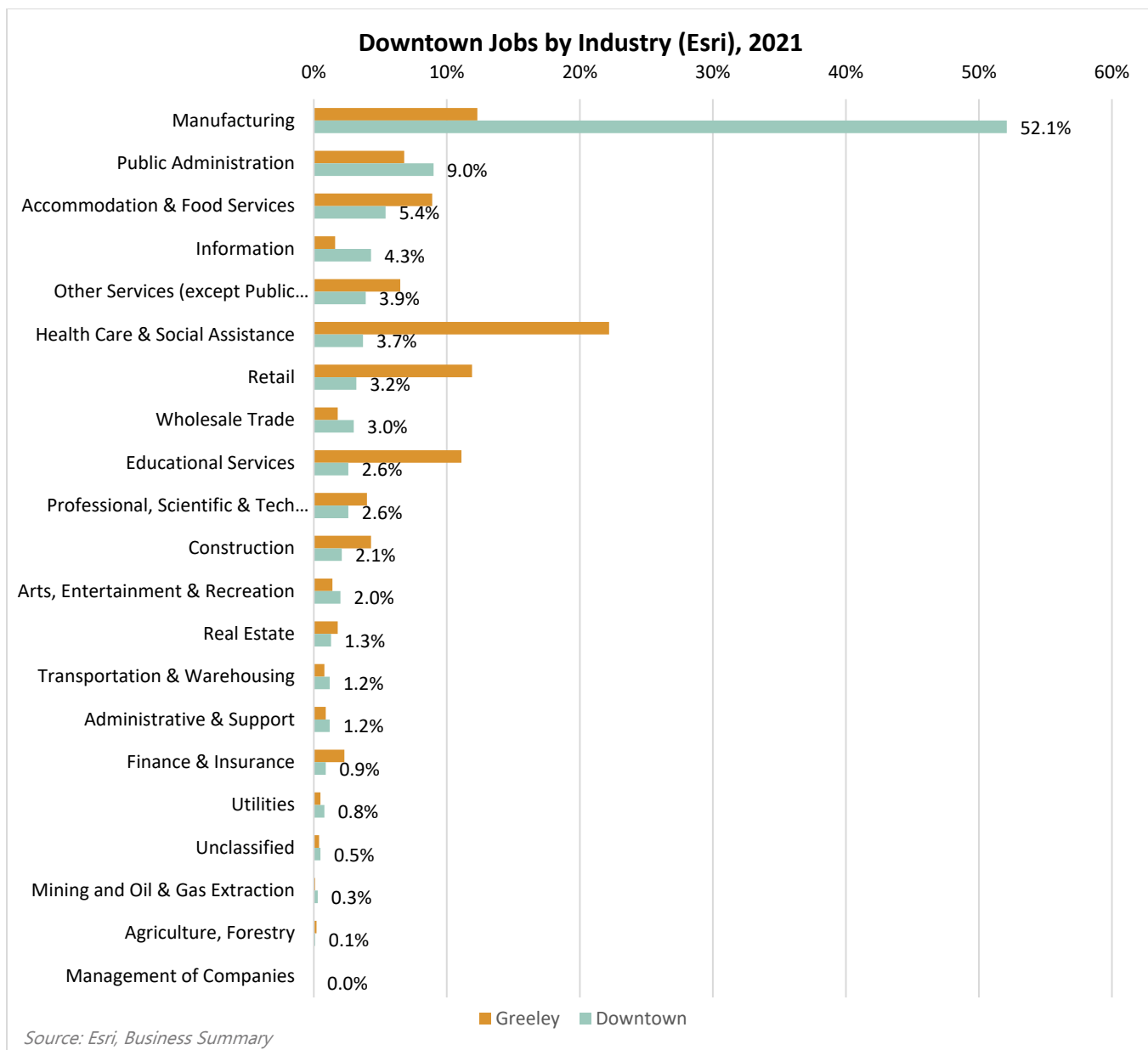
	Downtown	Primary Market Area	Greeley
# of Businesses	448	1,828	1,828
# of Employees	7,381	30,561	30,561
Businesses per Acre	1.4	0.4	0.1
Employees per Acre	23.5	6.2	1.0

Source: Esri, Business Summary

⁶¹ (On The Map, n.d.)

- As the “Downtown Employment Density, 2022” chart illustrates, Downtown Greeley’s total employment is middle-of-the-road when compared to its peer downtowns. It has the third lowest employment density (i.e., 24 workers per acre), while Cheyenne has the highest concentration of employees with approximately double the number per acre, which indicates an opportunity for Downtown Greeley to become a greater employment engine for the local economy.
- Only Esri data allows an examination of Downtown’s industries. As illustrated in the “Downtown Jobs by Industry” chart, Downtown’s economy is largely anchored by Manufacturing (52.1% of Downtown jobs). These jobs are highly concentrated in Downtown, with 60% of the City’s Manufacturing jobs located there. They appear to pay fairly well—around \$71K according to Emsi—which could partially explain why more than half of Downtown’s workers earn good wages as shown in the “Employee Characteristics” table on page 50.
- Public Administration is its second-largest industry (9% of Downtown jobs) and is also heavily concentrated in Downtown, with 19% of the City’s Public Administration jobs located there.
- Downtown also has higher concentrations of the City’s jobs in Information (37%), Wholesale Trade (23%), Utilities (21%), Transportation & Warehousing (21%), Arts Entertainment & Recreation (20%), and Administrative & Support (20%).





KNOWLEDGE-BASED ECONOMY

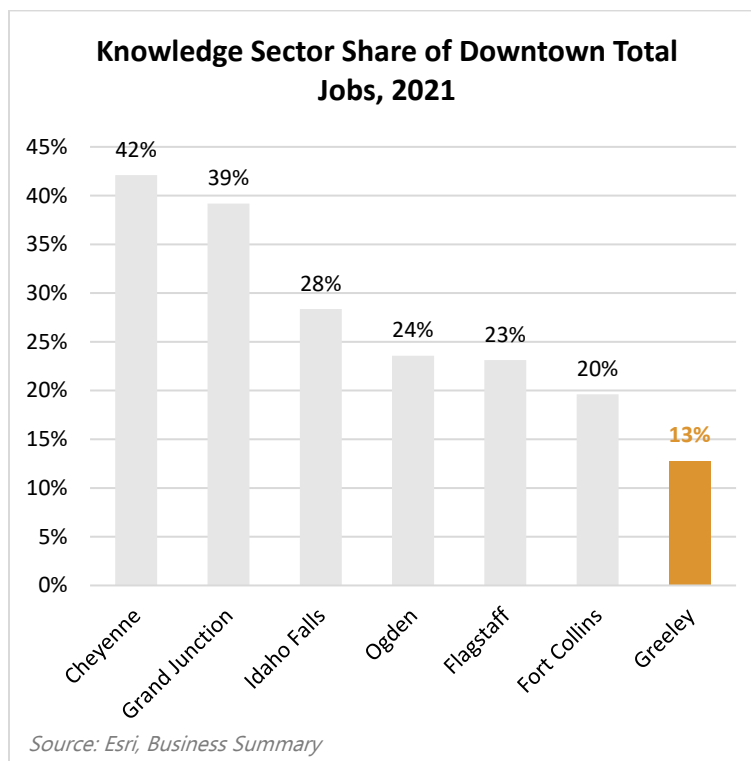
- We live in an increasingly knowledge-based economy. Knowledge sector jobs are a key figure for measuring economic health and growth potential. These industries (listed in the “Knowledge Sector Employment” table) are private sector-based, fast-growing, offer well-paying careers, attract educated talent, and tend to concentrate in downtowns. They also account for a majority of startup businesses and jobs.
- Downtown has an estimated 945 knowledge sector workers, representing ~13% of all Downtown jobs.
- Downtown accounts for only 6% of Greeley’s knowledge sector jobs. This is due in part to the clustering of health care jobs, which make up the greatest proportion of its knowledge sector jobs, outside of the Downtown boundary at its UHealth and Banner Health medical centers.

- The “Knowledge Sector Share of Downtown Total Jobs” chart shows that, compared to its peers, Downtown Greeley rates the lowest when it comes to knowledge-based economy presence, indicating that there is considerable opportunity to cultivate a larger knowledge-based economy in Downtown—one that is more aligned with peers or at least the City’s.

Knowledge Sector Employment, 2021

	Downtown		Greeley	
	#	Share of Total	#	Share of Total
Professional, Scientific & Tech Services	191	2.6%	2,112	4.0%
Health Care & Social Assistance	273	3.7%	11,591	22.2%
FIRE (Finance, Insurance, and Real Estate)	166	2.2%	2,115	4.1%
Management of Companies	0	0.0%	3	0.0%
Information	315	4.3%	847	1.6%
TOTAL	945	12.8%	16,668	31.9%

Source: Esri, Business Summary



- One indicator of a place’s ability to attract knowledge-sector jobs is how well-educated its resident workforce is. As mentioned earlier, Greeley residents are not as well educated as its peers. Downtown is even less educated, having the lowest proportion of residents with bachelor’s degree or higher (15.7%) out of the three study areas. Downtown Greeley contrasts with the average downtown in this way; typically, there is a much higher concentration of highly educated residents (especially for downtowns near university campuses) due to their quality of place as well as their proximity to lots of amenities and suitable jobs⁶².

⁶² (The International Downtown Association, 2019)

- While a highly educated workforce is not yet one of Greeley's most prominent qualities, there are indicators that its knowledge sector is growing. Per Emsi, four of the five industries that make up the knowledge-sector have experienced growth since 2016, with two in the high growth range (i.e., Professional, Scientific & Tech Services at and Management of Companies at ~30% each). Health Care and Professional Services are also two of Greeley's key industry sectors as defined by *Greeley's Department of Economic Health and Housing* and detailed earlier in this chapter, which means Greeley is making a concerted effort to further differentiate itself by cultivating these to become major industries.
- Moreover, Greeley receives a lot of press for its presence on nationwide top-ten rankings and via regional and national awards measuring economic performance. One of the most recent came in 2019, when The Walton Family Foundation awarded Greeley eighth in their "Most Dynamic Metropolitan" ranking, a study that strives to show that a knowledge-based economy sparks economic growth and recognizes cities that have made substantial investments in technology, education, entrepreneurship and commercialization⁶³. These rankings are the result of job growth, per capita income, pay growth, employment ratio and gross domestic product statistics compiled from Census and economic/labor data.
- Greeley will continue to capitalize on this burgeoning interest and growth and Downtown will hopefully be the place for new knowledge sector jobs to locate in the future.

DOWNTOWN EMPLOYEE CHARACTERISTICS

- Downtown employee characteristics are summarized and compared to citywide data in the "Employee Characteristics" table. Downtown's employees, compared to the City's overall, are slightly: older, less diverse, more educated, more likely to be female, as well as have higher annual earnings.

Employee Characteristics, 2019

Age	Downtown	Greeley	Educational Attainment	Downtown	Greeley
29 or younger	21%	25%	Less than H.S.	10%	12%
30 to 54	55%	53%	H.S. or equivalent	21%	20%
55 or older	24%	22%	Some college/Associate degree	26%	24%
Gender	Downtown	Greeley	Bachelor's/Advanced degree	21%	18%
Female	54%	49%	Annual Earnings	Downtown	Greeley
Male	46%	51%	\$15,000 or less	16%	20%
Race & Ethnicity	Downtown	Greeley	\$15,000 to \$40,000	29%	33%
White	94%	91%	More than \$40,000	55%	47%
American Indian	1%	1%	<i>Source: U.S. Census LEHD; 2019 data (latest available)</i>		
Two or More	2%	2%			
Black or African American	1%	3%			
Asian	1%	3%			
Hispanic/Latino	25%	27%			

⁶³ (Fernandez, Greeley's 'dynamic' performance as an economy and community on the rise has city officials beaming, 2019)

Office Market

- The highest percentage of Downtown’s office-based employment is made up of City and County workers (9% per Esri estimates) occupying publicly-owned buildings. Downtown also has privately-held, commercial real estate occupied by office-based private-sector businesses.

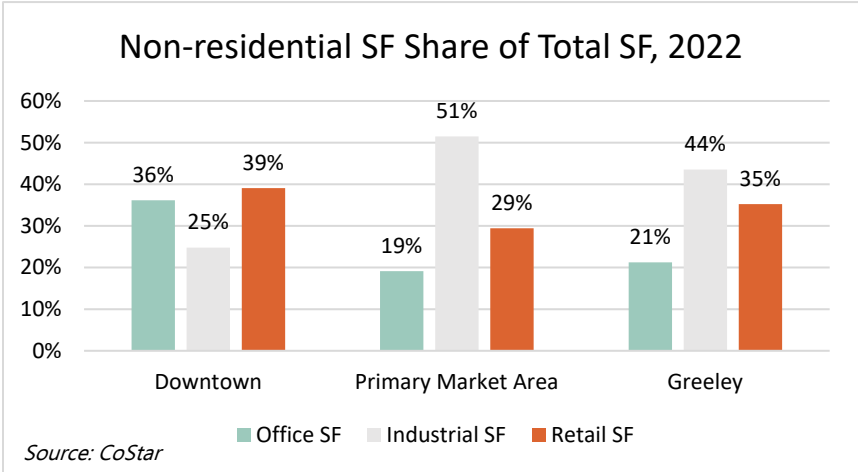
Office Real Estate Market, 2022

	Downtown	Primary Market Area	Greeley
Building Inventory (sf)	782 thousand sf	1.3 million sf	4.1 million sf
Vacancy (sf)	15.2 thousand sf	104 thousand sf	341 thousand sf
Vacancy Rate	1.9%	8.2%	8.3%
Market Rent	\$17.48/sf	\$17.96/sf	\$20.82/sf

Source: CoStar

- The “Office Real Estate Market” table contains CoStar data on Downtown and the Primary Market Area’s commercial office market compared to the City as a whole. Downtown has ~782K SF of space, which is about 19% of Greeley’s total office square footage, that is primarily occupied by that City, County and school district.
- None of Downtown’s office space is categorized as Class A and about 75% of it is Class C with an average year built of 1938, indicating that much of it needs substantial and expensive upgrades. It remains to be seen the extent to which this negatively affects Downtown’s office market, as experts expect a “flight to quality” from tenants, trading up to newer buildings with better ventilations systems, flexible floor plans, and modern (including green) amenities⁶⁴. Interviews with local real estate brokers revealed that some clients have been interested in locating Downtown, but could not find spaces that were updated and did not need a ton of work; even with large budgets of \$130 - \$140 a square foot, tenants cannot make the improvements financially feasible.

- The “Non-residential SF Portion of Total SF” chart uses known non-retail square footage from CoStar to roughly estimate each market type’s proportion of total square footage for each area (there are other types of non-residential space, such as hotel, museum and government) that are not included in the analysis). Office square footage takes up over a third of Downtown’s total known non-residential space and is the area’s second-most prevalent market type (not far behind retail). This is contrary to what is



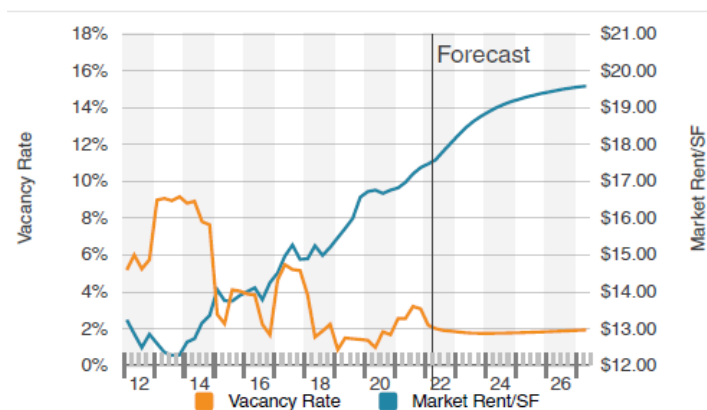
common in many downtown cores nationally, where office is by far the majority of real estate square footage; downtowns were working to better diversify the use of their square footage before the pandemic to become more resilient and will likely accelerate this work due to the deep uncertainty of the office market, in part due to its continuing to lose favor with real estate investors and developers⁶⁵.

⁶⁴ (PwC and the Urban Land Institute, 2022) and (The International Downtown Association, 2019)

⁶⁵ (Badger, 2021) and (PwC and the Urban Land Institute, 2022)

- The Primary Market Area contains about 32% of the City’s inventory of office space; the smallest portion of both the Primary Market Area’s and Greeley’s total non-residential square footage is allotted to office space at 19% and 21% respectively.
- The vacancy rate is significantly (over 6%) lower in Downtown than it is in the Primary Market Area or the City. An ideal vacancy rate in the commercial market is often considered to be near 10% to allow for movement in the market and the ability to house new office tenants in various locations or types of spaces, so both the Primary Market Area and City markets are positioned fairly well to attract new office tenants. Vacancy is nearly nonexistent in Downtown, which likely prevents companies from expanding or relocating there, while there is ample space available outside of its boundaries.
- In Q1 2022, the office sector’s national average vacancy rate was 17.5%⁶⁶. All of the Greeley market areas examined are well below the national average.
- Market rents are approximately \$3 (or 19%) lower in Downtown and the Primary Market Area than they are City-wide, which helps to explain why Downtown has the lowest vacancy rates of all three areas; it can also indicate that there isn’t strong demand for office space in Downtown. Nationally, downtowns tend to have higher rents and lower vacancy rates than their cities, suggesting that businesses will typically pay a premium to be downtown⁶⁷. Low rents also make it hard to financially justify the considerable investment needed to build new space or for landlords to adequately update existing space.
- As shown in the “Office Vacancy & Market Rent/SF” charts below, Downtown’s office vacancy rates were around 9% in 2013 and then were generally on a steady decline, reaching very low rates (around 1%) before COVID. Since then, rates have remained fairly stable, albeit slightly higher. For the other two areas, vacancy rates have been less stable, but have also declined since 2013, reaching rates in the 2-3% range leading up to the pandemic. Primary Market Area and City rates shot up to about 9% in pandemic-ridden 2021 and unlike Downtown, have had a hard time recovering.
- Despite any of the prior-mentioned trends in vacancy rates, office market rents per square foot have steadily increased over time, even since the pandemic. The City has experienced the greatest growth rate in price per square foot at about 33% since 2012, while Downtown and the Primary Market Area’s rate of growth has been approximately 10% less than the City’s. All of the market areas have rents per square foot that are less than half the national average of \$36.5 in Q1 2022⁶⁸.

Downtown Office Vacancy & Market Rent/SF

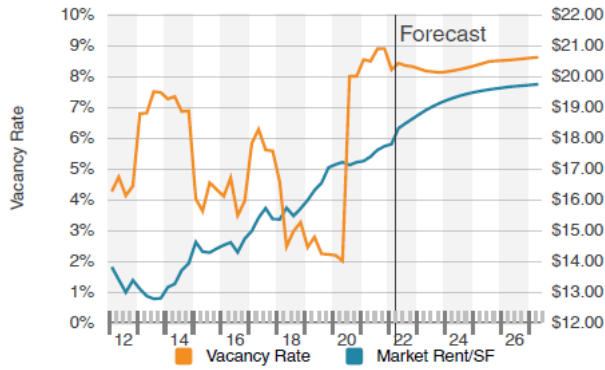


⁶⁶ (Cushman & Wakefield, 2022)

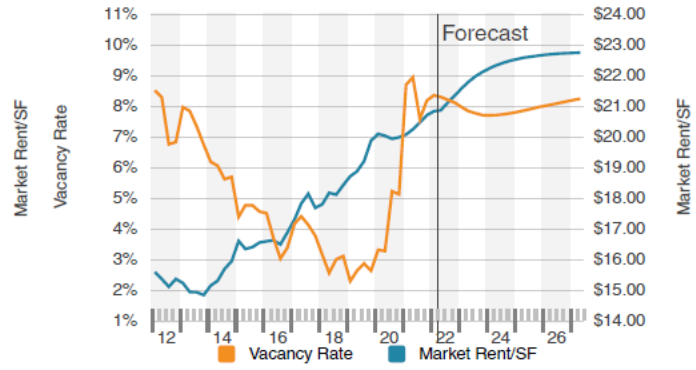
⁶⁷ (The International Downtown Association, 2019)

⁶⁸ (Cushman & Wakefield, 2022)

Primary Market Area Office Vacancy & Market Rent/SF



Greeley Office Vacancy & Market Rent/SF



- According to CoStar, none of the areas have any office square footage under construction. There's a lot of square footage in Greeley (~\$340K) that is vacant, about a third of which is located just outside the Downtown in the Primary Market Area. A lot of the rest was recently built in west Greeley.
- The fact that a lot of office space still needs to be absorbed outside of Downtown, combined with the high cost of construction and low market rent conditions, will likely prevent the development of new office space in Downtown anytime soon. Anecdotal evidence also supports this. Local real estate experts have stated that more private-sector primary employers would have to be recruited to Downtown to warrant any new development, especially of the Class A variety (which would most likely be limited to build-to-suit projects); any recent interest by this caliber of employer has been further thwarted by the lack of ample employee parking and electrical power infrastructure needed to serve such an enterprise. Before the pandemic, there was some interest in developing speculative office space Downtown (most of which would have been Class A), but plans have been on hold ever since COVID and will likely continue to be for the foreseeable future while the market focuses primarily on building residential rooftops in Downtown.
- While Downtown's existing office space might not be particularly appealing to primary employers, its low rents make entry into the market more accessible to Greeley's entrepreneurs (although the problem remains that space is seldom available in such a tight office market). Downtown should support entrepreneurs and small business owners in rehabbing existing spaces in any way possible; incentives (over and above façade improvement grants) to make upgrades more affordable could be one way. Perhaps Downtown can also partner with UNC to help some recent graduates streamline and/or incentivize their entrepreneurial ventures that would be a good fit for Downtown office (or coworking) space.

Industrial Market

- Greeley’s industrial real estate market is summarized in the “Industrial Real Estate Market” table, as well as the “Non-residential SF Share of Total SF” chart.

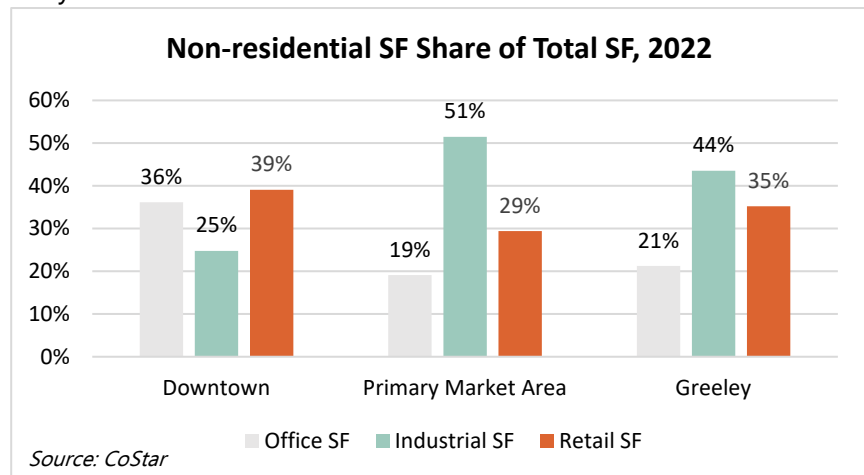
- According to CoStar, Downtown only contains about 6% of Greeley’s total industrial space, mostly located along the railroad tracks on the east side of Downtown, and makes up roughly a quarter of Downtown’s known non-residential market square footage.

Industrial Real Estate Market, 2022			
	Downtown	Primary Market Area	Greeley
Building Inventory (sf)	536 thousand sf	3.5 million sf	8.4 million sf
Vacancy (sf)	189 thousand sf	189 thousand sf	380 thousand sf
Vacancy Rate	1.2%	5.5%	4.5%
Market Rent	\$10.75/sf	\$11.20/sf	\$11.41/sf

Source: CoStar

- A much higher percentage of Greeley’s industrial square footage (42%) resides in the Primary Market Area; the industrial category holds the greatest non-residential market share in the Primary Market Area (51%), as well as the most out of all three areas analyzed. Industrial is also the greatest proportion of non-residential square footage in the City.

- The industrial market is very tight in Greeley, with the highest vacancy rate being 5.5% in the Primary Market Area and the lowest being 1.2% in Downtown.
- The “Industrial Vacancy & Market Rent” charts on the next page show that industrial vacancy rates have generally declined for Downtown and the City since 2012, with the City’s



declining at the highest rate (about an 8% decline from its peak of over 12% in 2012). The Primary Market Area is the only market that has seen an increase in vacancy rates since 2012, the worst of which have occurred since the start of the pandemic. Downtown’s rates have been the most volatile since 2012, oscillating between the range of nearly 7% and 0%; its vacancy rate came down quickly from nearly 5% at the start of the pandemic to 1.2%, which is among the lowest rates it’s enjoyed since 2012. The Primary Market Area and City’s rates are above the national average of 3.1%, while Downtown’s is well below it⁶⁹.

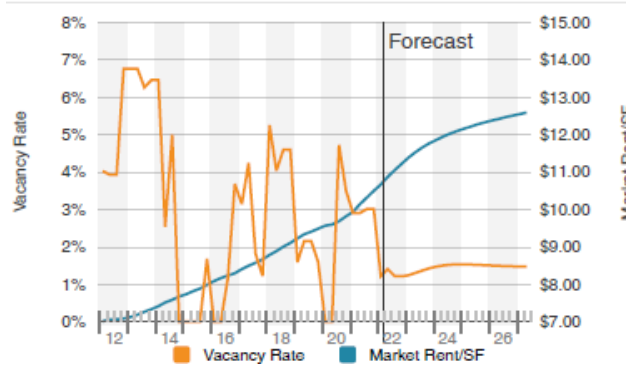
- Regardless of annual average vacancy rates since 2012, industrial rents have steadily risen, with all the market areas experiencing increases of over 50%. Additionally, all of Greeley’s market area rents per square foot are well above the national average of \$8.36⁷⁰.
- Despite robust demand, as indicated by high rents and low vacancy rates, the City is the only market area that is currently constructing additional industrial space – it will add 25.3K square feet in the near future.

⁶⁹ (Cushman & Wakefield, 2022)

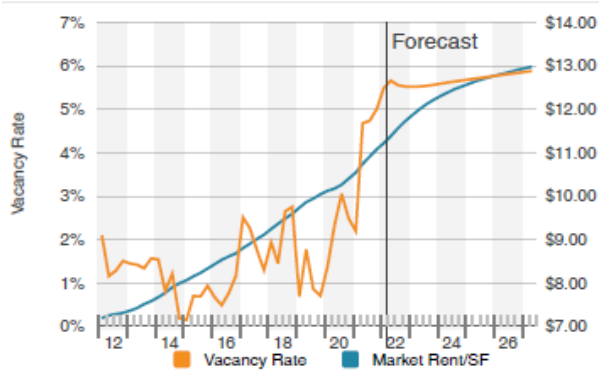
⁷⁰ (Cushman & Wakefield, 2022)

- The future of U.S. industrial/distribution in the near-term looks very promising; as with multifamily, this sector has been flourishing since 2014, showing even more gains during the pandemic and maintaining strong momentum through the recovery, while other sectors have suffered⁷¹.
- Downtown stakeholders see Downtown’s existing industrial space as an asset and would like to see it preserved, insisting that it positively contributes to its distinct character and serves as a reminder of its heritage; the structures have the appearance of being professional and classy, and the large daytime employment base they accommodate is highly valued, especially for its Downtown restaurant and retail patronage.

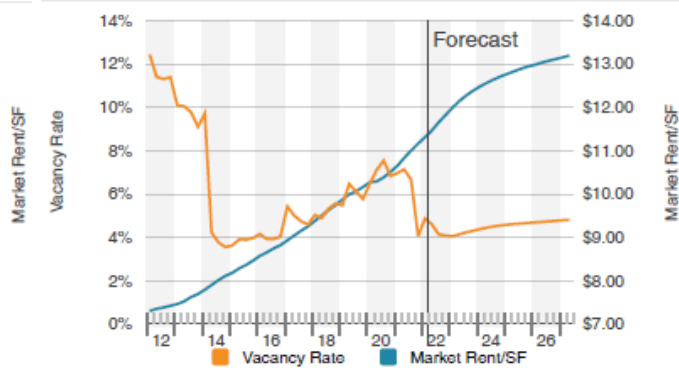
Downtown Industrial Vacancy & Market



Primary Market Area Industrial Vacancy & Market Rent/SF



Greeley Industrial Vacancy & Market Rent/SF



⁷¹ (PwC and the Urban Land Institute, 2022)

4. SHOP & DINE

Downtown Street Level Economy

- The table on the right shows the mix of Downtown’s street level inventory.
- Downtown’s street level (i.e., storefront) economy is critical to its success, driving foot traffic, attracting visitors, and helping maintain vibrancy. The inventory to the right provides a breakdown of all street level businesses by category.
- Downtown has a strong mix of street level businesses and services that draw their patronage from growing residential, daytime employee, and tourist populations.
- In total, there are 331 street level businesses within the Downtown Development Authority boundary.

RETAIL, FOOD AND BEVERAGE

- As with many downtowns, Downtown Greeley’s street level economy is driven by dining and shopping. There are an equal number of storefronts (51) housing eating and drinking establishments (restaurants, bars, cafes, and breweries) as there are for shopping.

Together, they account for 30.8% of total storefronts, or 102 establishments. These categories are shown highlighted in purple in the “Downtown Street Level Inventory” table.

- According to the National Main Street Center, downtowns have been evolving over the last ten years, trending toward fewer storefront retailers and more restaurants, breweries, cideries as well as food & wine shops⁷². Greeley’s ground floor storefronts appear to be filled with equal numbers of retailers and restaurants. However, the “Downtown Restaurant/Bar & Retail Mix” table shows how the mix has shifted since the last study of Downtown was done in 2011; it indicates that Greeley is beginning to move in the

Downtown Street Level Inventory

Type	Establishments	Share of Total
Restaurant/Bar	51	15.4%
Retail	51	15.4%
Entertainment & Recreation	24	7.3%
Automotive	22	6.6%
Construction/Home Improvement	19	5.7%
Health	19	5.7%
Legal Services	18	5.4%
Government	17	5.1%
Media & Visual Arts	13	3.9%
Church/Religious Center	13	3.9%
Banking/Financial Services	12	3.6%
Real Estate Mgmt	11	3.3%
Salons/Spas/Tattoos	11	3.3%
Nonprofit	11	3.3%
Moving & Storage	7	2.1%
Education & Employment	6	1.8%
Energy & Agriculture	6	1.8%
Hotel/Inn	4	1.2%
Insurance	4	1.2%
Manufacturing	4	1.2%
Event Center	3	0.9%
Mail & Print Services	2	0.6%
Funeral	2	0.6%
Dry Cleaners & Laundromats	1	0.3%
TOTAL	331	

Source: Greeley DDA; P.U.M.A.

⁷² (Accordino, 2022)

same direction as what is trending nationally. In the Downtown area, there are roughly 46% more eating & drinking establishments and 16% fewer retail sales establishments today then there were in 2011.

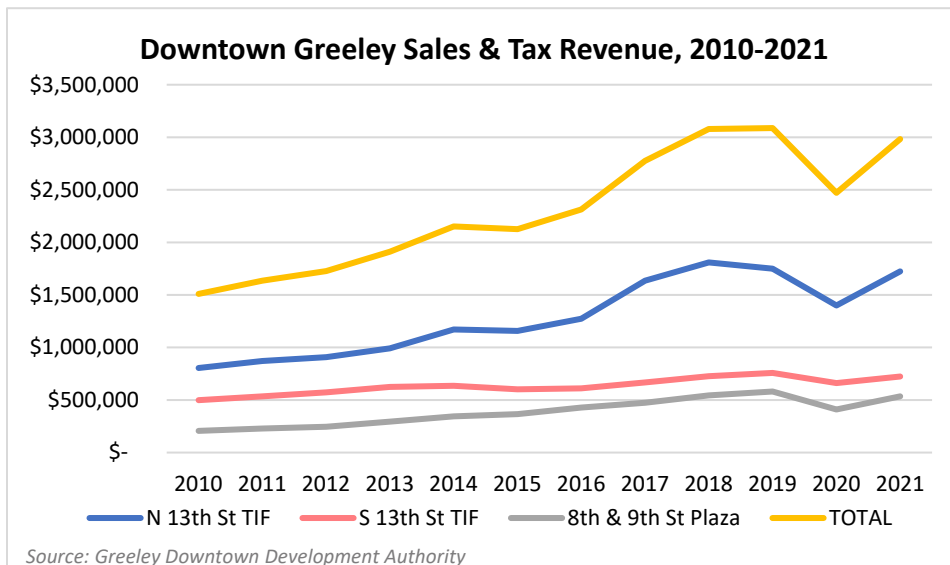
Downtown Restaurant/Bar & Retail Mix

	2011	2022	% Change
Eating & Drinking Establishments	35	51	46%
Retail Sales	67	56	-16%

Source: Greeley DDA, 2011 Downtown Greeley Investment Strategy, PUMA

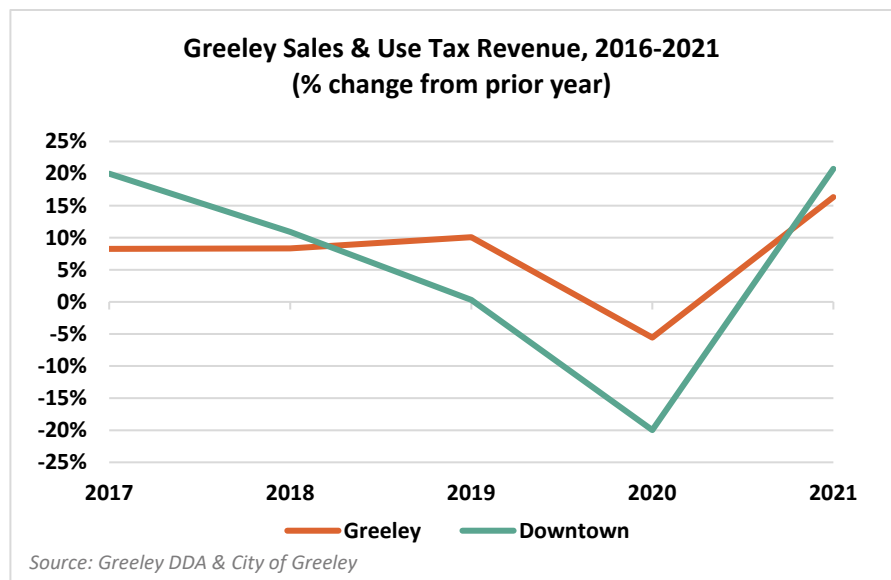
SALES & USE TAX TRENDS

- The “Downtown Sales & Use Tax Revenue” chart shows revenues since 2010 for the whole of the DDA as well as by three geographic subsections:
 - the area north of 13th Street, excluding the 8th and 9th Street plazas;
 - the area south of 13th Avenue, nearest to the UNC campus; and
 - the 8th and 9th Street plazas.



- Since 2010, Downtown’s sales and use tax revenue has doubled. Though voters passed the Keep Greeley Moving Tax in 2016 increasing the tax rate from 3.46% to 4.11%, it can only account for a small portion of this growth.
- Since 2010, all of Downtown’s geographic subsections have experienced tons of growth in sales and use tax revenues, with the most significant increase occurring in the Downtown plaza area (159%), followed by the area north of 13th Street (114%) and the area south of 13th Street (45%). Before the pandemic, revenues experienced positive year-over-year growth, except for 2015 when it decreased by 1.2% for unknown reasons. Growth was particularly strong in 2010 (23%) and 2017 (20%).
- COVID caused a decrease of 20% in Downtown sales and use tax revenues between 2019 and 2020, but Downtown has made a rapid recovery, increasing 21% between 2020 and 2021. Revenues haven’t quite returned to pre-pandemic levels but are just shy of 2019’s revenues by a little over \$100K.
- The City’s sales and use tax revenues were not affected to the same extent by COVID, only decreasing 6% between 2019 and 2020. The City made a full recovery in 2021, increasing 16% between 2020 and 2021 and even growing nearly \$5 million beyond 2019’s pre-pandemic revenues.

- Sales and use tax data for the City is available since 2016. Since then, Downtown has brought in annual sales and use tax revenues ranging between 5% and 7% of the City's total, or an average of 6% a year. From 2016 to 2021, the City's sales and use tax revenue growth of 42% outpaced that of Downtown's (29%; see "Greeley Sales & Use Tax Revenue chart).



Hispanic Community

- Greeley has been putting more emphasis on determining ways to better-include and welcome the Hispanic population in Downtown, both as visitors and business-owners. As mentioned earlier, Hispanics have been a big part of Greeley's history but haven't always received the level of recognition or welcome they deserve. In the U.S., 19% of citizens identify as Hispanic or Latino⁷³; this population is highly concentrated in Greeley, accounting for 39% of the City's residents, 49% of the Primary Market Area's, and 51% of Downtown's. The City of Evans, about a mile south of Downtown and lacking its own central business district, is approximately 43% Hispanic or Latino – a population that could also be served by Downtown Greeley⁷⁴.
- There are opportunities for Downtown Greeley to better include and serve this community in the future, which could even become a differentiator compared to other downtowns that aren't doing a good job of this. Downtown-adjacent UNC is setting a good precedent with its current efforts to become a school of choice for Hispanic students by pursuing a U.S. Department of Education designation as a Hispanic Service Institution (HSI). This designation would mean that 25% or more of the total full-time undergraduate students identify as Hispanic, Latino or Latinx and that infrastructure is in place (all the way down to dining hall selections) that specifically serves and fosters the inclusion of these students, some of whom might be the first in their family to pursue higher education⁷⁵. Anecdotally, UNC staff report that Hispanic students feel that Downtown only values their transactional potential and would like to see a more concerted effort to build a relationship with them, perhaps through creating more multicultural events, recruiting entrepreneurs to establish additional Hispanic-focused restaurants and retail (there are currently less than ten in Downtown), and formally inviting the robust Hispanic food truck scene to the area. These strategies would likely appeal to non-student Hispanic as well.

⁷³ (United States Quick Facts, 2021)

⁷⁴ (Evans city, Colorado Quick Facts, 2021)

⁷⁵ (Delaney, 2021)

Retail Real Estate Market

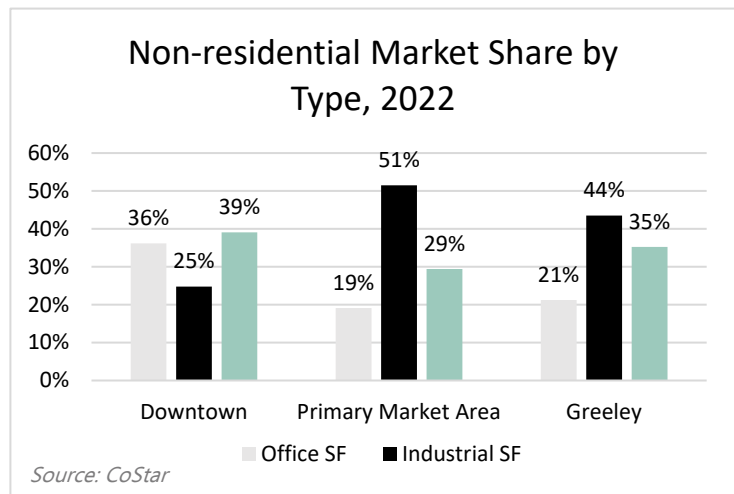
- Retail (which includes food and beverage) has the most square footage allotted to it out of the three non-residential market sectors (office and industrial being the other two).
- The “Retail Real Estate Market” table contains data on Downtown’s retail market compared to the City as a whole; there is 845K square feet of retail square footage in Downtown that comprises 12% of the City’s total. The Primary Market Area contains well over twice that of Downtown and comprises 29% of the City’s total. None of the areas have any retail square footage under construction.

Retail Real Estate Market, 2022

	Downtown	Primary Market Area	Greeley
Building Inventory (sf)	845 thousand sf	2 million sf	6.8 million sf
Vacancy (sf)	35.2 thousand sf	62.4 thousand sf	309 thousand sf
Vacancy Rate	4.2%	3.1%	4.5%
Market Rent	\$12.91/sf	\$13.5/sf	\$16.41/sf

Source: CoStar

- Downtown’s and the Primary Market Area’s market rents per square foot are substantially lower (around \$3) than the City’s (27% and 22% lower respectively), which is counter to national trends that indicate retailers often pay premium rates to locate in downtown⁷⁶. National retail rent per square foot averaged \$22.09 in Q1 2022, which ranges from \$5 to \$10 more per square foot than the Greeley markets⁷⁷.
- The lowest vacancy rates can be found in the Primary Market Area (3.1%). Downtown and the City’s rates are more closely aligned (4.2% and 4.5% respectively). These rates are well below the national average vacancy rate of 6.3% in Q1 2022⁷⁸.
- As shown in the “Retail Vacancy & Market Rent/SF” charts, the vacancy rates over time trends for all the areas examined closely mirror each other. All of the areas currently have low/healthy vacancy rates (i.e. below 10%). Downtown has historically had the highest vacancy rates; they started close to 11% in 2013 and have declined since, reaching below 2% just before the start of the pandemic. Downtown experienced the biggest spike in COVID vacancy rates, reaching about 7% in 2020; rates have come down almost 3%, but are still almost 3% higher than they were just before the pandemic. The worst of the City’s spike was delayed a year, reaching above 5% (an increase over 3%) in 2021 from rates below 2% in 2019. The Primary Market Area has historically had the lowest vacancy rates and have remained below 4% since 2017, even during the pandemic.
- As with Greeley’s other market types (i.e., multifamily, office and industrial), rents have steadily increased despite what was



⁷⁶ (The International Downtown Association, 2019)

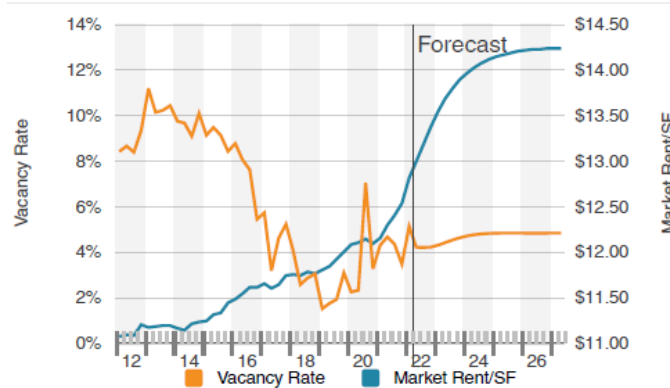
⁷⁷ (Cushman & Wakefield, 2022)

⁷⁸ (Cushman & Wakefield, 2022)

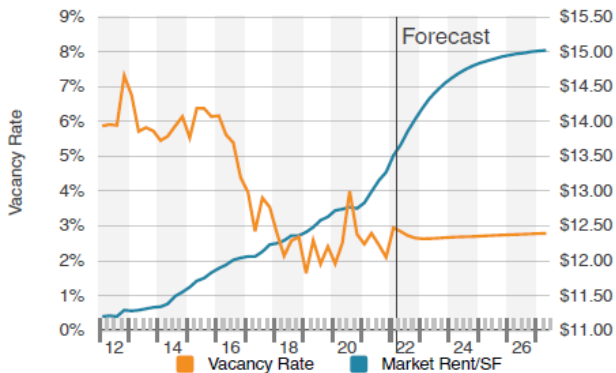
happening with vacancy rates, although the City has enjoyed the greatest rent increase since 2012 (~21%), followed by the Primary Market Area (~17%), and lastly Downtown (~14%).

- As the “Non-residential Market Share by Type” table below indicates, retail is the highest proportion (39%) of non-residential square footage in Downtown. Downtown also has the highest percentage of retail square footage compared to the other two areas, followed by the Primary Market Area (51%) and Greeley (44%).

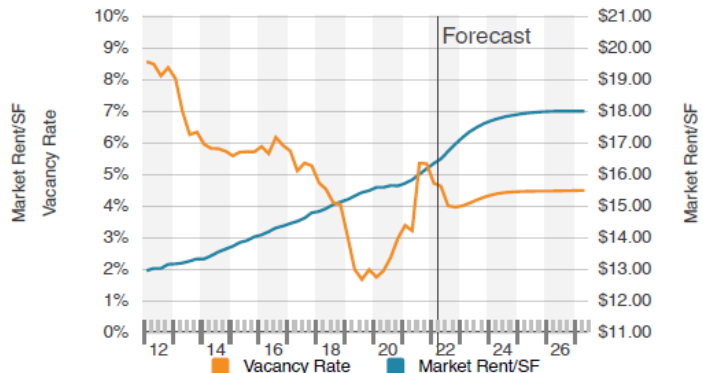
Downtown Retail Vacancy & Market Rent/SF



Primary Market Area Retail Vacancy & Market Rent/SF



Greeley Retail Vacancy & Market Rent/SF



- According to CoStar, none of the areas currently have any retail space under construction and the average year built for existing inventory is 1939. That being said, the “Recent Downtown Retail Development Activity” table on the next page shows that, according to DDA records, nearly 16K square feet of retail space has been added to Downtown since September 2020 with at least 14K coming online soon.
- Similar to what is trending nationally, retail development and investment in Downtown is likely to lag in the near future despite stakeholders’ desire for additional offerings. Local real estate developers report that in the near term, they plan to concentrate on projects in Downtown that are primarily residential until rent prices increase, tenant improvement costs moderate, parking improves, and they feel a critical mass of residents and/or daytime employees has been reached that can support the addition of a substantial amount of retail space of different quality levels to the area. In the meantime, however, any new projects are likely to be mixed-use with ground floor commercial spaces and the low rate structure allows entrepreneurs to pioneer their own retail spaces, which should continue to add modest amounts of retail square footage to Downtown. When the market is ripe for more retail, stakeholders are most interested in

adding more fast-casual restaurants as well as a food hall or other culinary incubator space to build on its rich cultural and burgeoning food truck scene.

Recent Downtown Retail Development Activity

	Address	SF	Completion
Dutch Brothers	1227 8th Ave	919	Nov-21
Firestone Redevelopment (bank + 1-2 retailers or restaurants)	1130 8th Ave	10,431	TBD
Natural Grocers	1320 8th Ave	12,946	Dec-21
Austin's American Grill	1100 8th Ave	4,000	TBD
Apartments at Maddie	1640, 1540 & 1521 8th Ave	2,000	Sep-20

Source: Greeley Downtown Development Authority

5. VISIT & STAY

Greeley Tourism

- Though tourism is not Greeley's biggest industry, hospitality and retail trade are within the top five employment sectors per Census data cited on page 42. Arts, entertainment, and recreation is also an important part of Greeley's identity, despite being one of Greeley's smallest industries in terms of jobs.
- Greeley traditionally hasn't been a popular tourist destination, but the City recognizes its economic importance and has thus been focusing more on tourism in the past decade.
- Part of this focus included marketing Greeley as a "hub and spoke community," where visitors can stay in Greeley, but travel to other parts of the Front Range, such as Cheyenne, Fort Collins, Estes Park, and Denver for day trips⁷⁹. This is complimented by the lower hotel room rates in Greeley than other parts of Northern Colorado.
- Efforts to rebrand Greeley from a "cow town" to a place of pride for residents began in 2012 with the Greeley Unexpected campaign, later renamed My Greeley.
- In 2018, Greeley hosted 436,964 visitors, not including those who attended the Greeley Stampede in late June and early July, who spent nearly \$30 million⁸⁰. This is double the revenue earned from tourism just three years prior and a six-fold increase since 2007⁸¹.

Arts and Culture

- Greeley prides itself on the arts and cultural activities it has, both in and out of downtown. Downtown is home to the **Greeley Creative District**, a hub of resources and events that "exists to highlight the community's distinctive creative identity and increase its economic vitality by uplifting, encouraging, incubating, promoting, and developing the arts and creative businesses in the Greeley Community"⁸². It was fully certified by Colorado Creative Industries in 2014, which qualified it to receive support from the

⁷⁹ (Weaver, Greeley or bust: Greeley is attracting more tourists than ever before, 2016)

⁸⁰ (Otto, 2019)

⁸¹ (Weaver, Greeley or bust: Greeley is attracting more tourists than ever before, 2016)

⁸² (Greeley Creative District, 2020)

state in the form of grant money, resources for technical assistance, as well as prominent placement as a tourist and business destination on state websites⁸³. As an economic driver, it has been credited with gains in creative industry jobs and earnings, new businesses, as well as new events and increases in visitation.

- There are **350** pieces of rotating indoor art and **160** pieces of outdoor art within the Greeley Creative District boundaries, partially funded by its 1% for Arts program, which is a differentiator in that there is a much higher concentration in Downtown Greeley than there is in the average downtown. The district also contains the UCCC and UNC College of Performing and Visual Arts, as well as the Greeley Philharmonic, the Greeley Chamber Orchestra, and the Greeley Chorale.
- The **Centennial Village Museum** includes 35 historical buildings, costumed period actors, and farm animals and offers an opportunity to experience what life was like for the early settlers and Indigenous peoples of the area. The museum hosts its own special events and can also be rented out for private events.
- **Linn Grove Cemetery** was established in 1874, making it one of the oldest cemeteries in Colorado. The 65 acres allow visitors to walk, bike, or drive through the property and the cemetery also provides historical and educational tours about Greeley and Weld County.
- The **Atlas Theater** is an event space for up to 200 people. In addition to hosting weddings, it provides space for theater, dance, and music performances, as well as art shows in the gallery.
- UNC is home to more than 15 Division I sports teams that compete in facilities adjacent to Downtown and draw many visitors (often as alumni) to the area. Additionally, its **College of Performing and Visual Arts** presents dance, music, and theater performances throughout the year both at the Campus Common Performance Hall and at other venues in the community in addition to hosting visiting artists.
- Greeley is a launching point to a multitude of **outdoor recreation** opportunities. 21 miles of the **Poudre Trail** span from Island Grove Regional Park in Greeley to Highway 392 near Windsor. **Pawnee National Grassland** is just 25 miles northeast of Greeley and the **Wild Animal Sanctuary** is 35 miles southeast. **Rocky Mountain National Park** is an easy day trip, accessible with a short hour and a half drive. Greeley is also home to numerous **farm and agritourism** options.

DOWNTOWN VENUES AND MUSEUMS

- Greeley's downtown has three museums and ten event venues (counting event centers as well as theaters and movie venues), four of which have opened since the last report was done in 2011, including: the **State Armory Events Center** - 2014; the **DoubleTree by Hilton Conference Center** -2017; the **Millennium Event Center** - 2018; and the **Moxi Theater** - 2013.
- Annual visitation numbers for a selection of venues and events are summarized in the "Annual Visitation Numbers at Select Greeley Venues" table on the next page (note that COVID likely affected 2021 visitation).

⁸³ (Greeley's creative district draws attention from the state, 2014)

Annual Visitation Numbers at Select Greeley Venues & Events

Venue/Event	Location	Annual Visitation 2011	Annual Visitation 2021	% Change 2011-2021
Recreation Center	Downtown	293,500	n/a	n/a
Library	Downtown	275,000	n/a	n/a
Union Colony Civic Center*	Downtown	137,700	151,130	10%
Senior Center	Downtown	88,900	17,842	n/a
Weld County Courthouse**	Downtown	25,800	42,051	63%
Ice Haus***	Downtown	25,000	115,900	364%
Train Museum	Downtown	10,500	11,726	12%
Greeley History Museum	Downtown	6,600	1,603	-76%
Greeley Arts Picnic	Downtown	30,000	30,000	0%
OktoBrewfest	Downtown	10,000	8,000	-20%
Greeley Blues Jam	Downtown	2,000	2,578	29%
Subtotal within DDA boundary		905,000	380,830	
	County			
Island Grove - Stampede	Complex	234,000	253,802	8%
	County			
Island Grove - all other*	Complex	330,000	n/a	n/a
	County			
Centennial Village Museum	Complex	19,500	3,583	-82%
Subtotal for County Complex		583,500	257,385	
Total for DDA and nearby venues		1,488,500	537,744	

* Includes Jazz Festival and Blues Jam performances at named venue.

** Jurors only. Does not include litigants, attorneys, etc.

*** Does not include parties and group rentals

Source: Visit Greeley

- **Union Colony Civic Center** (UCCC) is Greeley's (and Northern Colorado's) premier indoor performing arts facility. It holds over 100 events per year including Broadway musical shows, plays, concerts, comedy shows, and local dance and school performances. Some of the organizations that the UCCC hosts include the Greeley Philharmonic Orchestra, the Stampede Troupe, The Dance Factory, and District 6 Schools. The facility includes the 1,686-seat Monfort Concert Hall, the 214-seat Hensel Phelps Theatre, and the free Tointon Gallery with ten art exhibits each year.
- The **Moxi Theater** is another one of Downtown Greeley's live music venues, with a capacity of 425 people.
- The **Greeley Ice Haus** is an indoor ice rink that is open year-round and hosts many activities including public skate events, skating lessons, youth and adult hockey leagues and other ice sports like curling and broomball. The **Northern Colorado Eagles**, a semi-pro hockey team, also play their home games there.
- Downtown contains the following museums: the **Colorado Model Railroad Museum**, the **Greeley History Museum**, and the **Meeker Home Museum**, Greeley's first museum which showcases the founding family's house.

DOWNTOWN EVENTS

- Downtown is home to a variety of events annually, several of which are hosted by the DDA. A majority of events take place in the summer, many in downtown or nearby at Island Grove Regional Park. Details are provided in the tables that follow, sorted by size (attendance).

Greeley Annual Event Visitation Numbers, 2021

Events	Total Attendance	Downtown?	Reoccurring?
OktoBrewfest	8,000	✓	
Greeley Arts Picnic	15,000	✓	
July 4th Parade	10,000	✓	
Monster Day	5,000	✓	
Blarney on the Block & Parade	3,000	✓	
Cinco de Mayo	3,000	✓	
MayPlay Fest	3,000	✓	
Trick or Treat Street	3,000	✓	
Greeley Lights the Night Parade	3,000	✓	
Friday Fest	1,500-3,000	✓	weekly June - September
Broncos Carne Asada	1,500	✓	
Holiday Open House		✓	
Greeley Blues Jam		✓	
Weld County Fair			
Potato Day			
Independence Stampede			
Jazz Festival			
Festival of Trees			

Source: Greeley DDA and Visit Greeley

- The tables also include events that take place outside Downtown. Several of these occur nearby, such as at Island Grove Regional Park or the Greeley Stampede Grandstand, and therefore still have a positive impact on downtown businesses. There is an opportunity to attract more of these non-Downtown events into the district more formally as well.
- Downtown's largest, core events include Friday Fest, OktoBrewfest, the Greeley Arts Picnic, the July 4th Parade, and Monster Day.
- Downtown and its surroundings are also home to a variety of medium and smaller events throughout the year, listed in the table above. While they may be smaller in attendance numbers, many are held on a regular basis, providing a popular and consistent stream of visitors into downtown.

Lodging Market

- There are approximately 11 hotels and motels outside the downtown boundary, most of which are national brands that are located by the highways, offering budget options to those driving by car.
- Greeley's hotel business has largely been fueled by the oil and gas industry business in town. During the oil and gas boom of 2013-2014, the industry pushed demand up, accounting for approximately 30% of

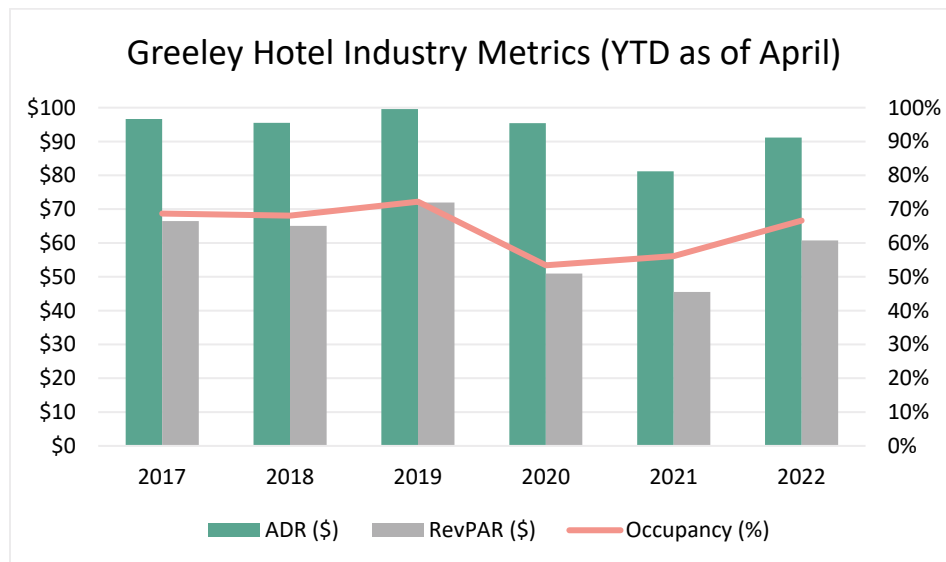
the hotel demand⁸⁴. This dipped between 2015 and 2016 with the end of the boom, but then made a comeback again in 2017 when rig counts doubled from the previous year⁸⁵.

- The Candlewood Suites opened in Greeley in September 2017 to meet oil and gas industry demand. In addition to energy industry and corporate business, the hotel saw occupancy rates of 95% or higher in September and October 2013 due to housing displaced flood victims in Northern Colorado⁸⁶.
- Only city-wide metrics are available. According to Visit Greeley, the average occupancy rate is 67%, which equates to 624 rooms occupied on any given day.
- The “Greeley Hotel Industry Metrics” table and graph below show occupancy rate, average daily rate (ADR), and revenue per available room (RevPAR) for Greeley’s hotels yearly averages as of April each year (YTD) since 2017. All three measures peaked in 2019 at approximately 72%, \$100, and \$72, respectively. Since the onset of COVID in 2020, the market has shown improvement in occupancy rate and RevPAR, though neither are back to pre-pandemic levels. ADR’s trough was in 2021 and has improved since, but is still falling short of pre-pandemic levels.

Greeley Hotel Industry Metrics (YTD as of April)

	2017	2018	2019	2020	2021	2022	% Change (17-19)	% Change (19-20)	% Change (17-22)
Occupancy (%)	69%	68%	72%	53%	56%	67%	5%	-26%	-3%
ADR (\$)	\$97	\$96	\$100	\$95	\$81	\$91	3%	-4%	-6%
RevPAR (\$)	\$66	\$65	\$72	\$51	\$46	\$61	8%	-29%	-9%

Source: CHLA Rocky Mountain Lodging Reports April 2018-2022



- The “U.S. Annual Hotel Industry Metrics” table and charts provided below compare Greeley’s hotel industry metrics to those of the U.S. as a whole. Greeley has a much lower ADR than the country, with the largest pre-pandemic difference of \$34 occurring in 2018. During 2020, the gap shrank to only \$8, but it increased again in 2021. RevPAR follows a similar trend with large gaps before and after 2020, but a narrower margin in 2020. However, Greeley boasts a higher occupancy rate every year since 2017 except

⁸⁴ (Weaver, Greeley hotel occupancy slips with oil and gas industry, 2016)

⁸⁵ (Valzquez, 2017)

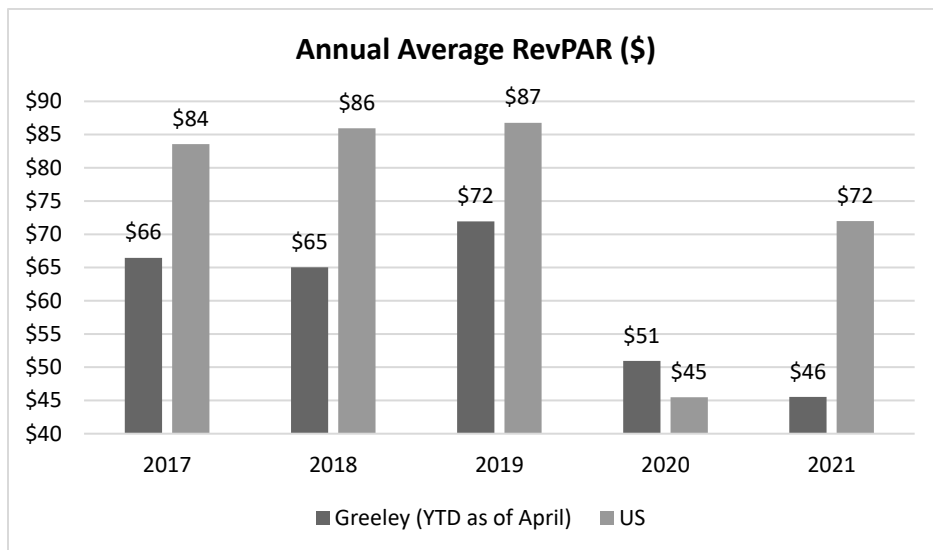
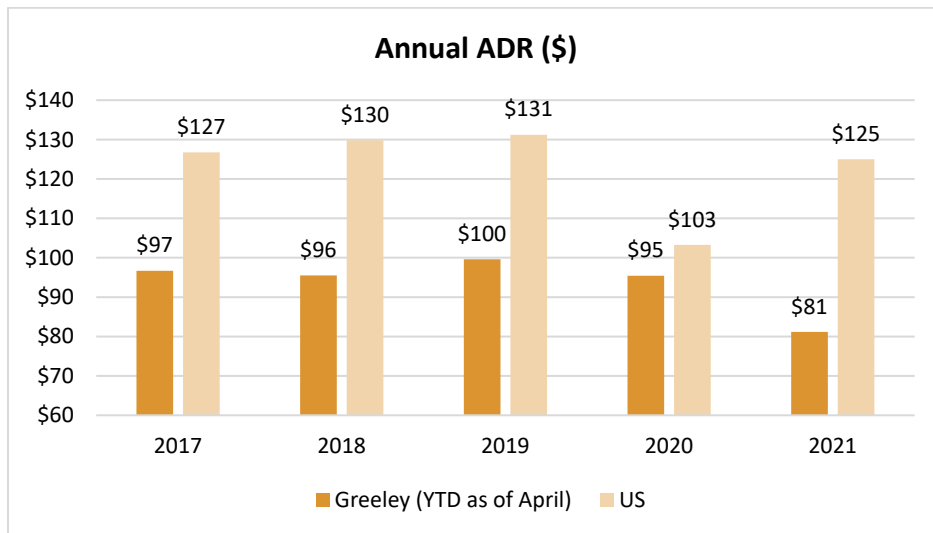
⁸⁶ (Valzquez, 2013)

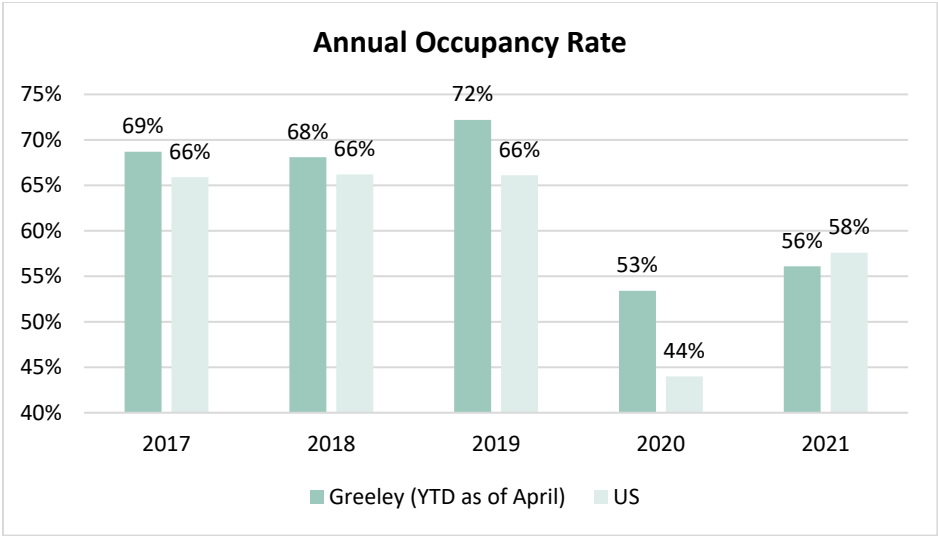
for 2021. This includes the largest gap of nine percentage points in 2020, when both geographies had their lowest occupancy rate.

U.S. Annual Hotel Industry Metrics

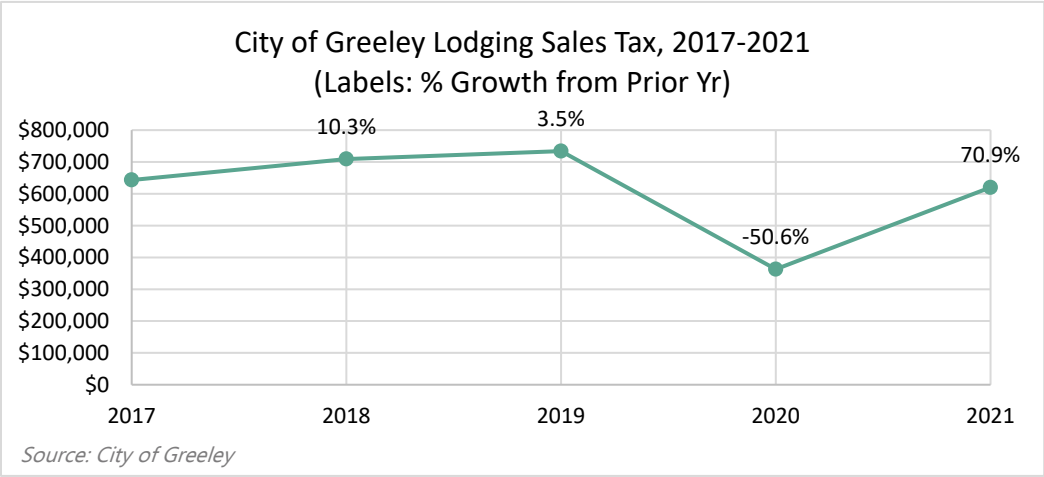
	2017	2018	2019	2020	2021	% Change (17-19)	% Change (19-20)	% Change (17-21)
Occupancy (%)	66%	66%	66%	44%	58%	0%	-33%	-13%
ADR (\$)	\$127	\$130	\$131	\$103	\$125	4%	-21%	-1%
RevPAR (\$)	\$84	\$86	\$87	\$45	\$72	4%	-48%	-14%

Source: STR Global, Hospitality Net via Statista





- The "City of Greeley Lodging Sales Tax" chart below shows trends at the city level. Before the pandemic, growth was steady, increasing 14% in the two-year period between 2017 and 2019. While 2020 showed a huge drop in sales tax revenues, decreasing 50.6%, revenues rebounded strongly in 2021, increasing 70.9%. 2021 revenues are ~\$115K shy of pre-pandemic revenues, representing a net loss of about 15.5% since 2019.



DOWNTOWN LODGING

- Downtown offers four hotels (~27% of the City's), which are listed in the "Downtown Lodging" table. Three are 3-star hotels and one is a two-star hotel. Completed in September 2017, the

	Rating	Rooms
DoubleTree by Hilton Greeley at Lincoln Park	3-star	147
Clarion Hotel and Conference Center Greeley Downtown	3-star	148
Currier Inn Hotel	3-star	10
Greeley University Inn	2-star	15

DoubleTree by Hilton is the newest offering, with 147 rooms, a conference center with seven meeting rooms, and nearly 15,000 square feet of event space.

- Downtown has 320 rooms, or 34% of Greeley's 932 rooms (not including campgrounds or short-term rentals).

SHORT-TERM RENTAL MARKET

- Short-term rental companies, led by Airbnb, have seen explosive growth in recent years. While these rental units play an important role in housing a portion of the visitor market, they also erode the hotel visitor base and chip away at the permanent housing stock in an already strained residential market; currently, Greeley's short-term rental market isn't posing a large threat to either.
- Per AirDNA data, Greeley's short-term rental market is a mix of entire units and private rooms, with slightly more entire unit listings (see "Greeley Short-Term Rental Market" table; note that properties listed are from Airbnb and Vrbo only). Average rental rates are higher than that of local hotels – \$135 per night – and occupancy appears strong as well (71% on average).

Greeley Short-Term Rental Market

Total Listed Rentals	106
Avg. Daily Rate	\$135
Occupancy Rate	71%
Bedrooms	2.4
Guests	5.8
Listing Type	
Entire unit	54%
Private Room	46%

Source: AirDNA; last-twelve-months data as of June 2022; Airbnb and Vrbo only

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APPENDIX B: CAPITAL IMPROVEMENT ASSESSMENT

Capital Improvement Assessment

Downtown Greeley

LIVABLE CITES STUDIO

NOVEMBER 2022



Item No. 6.

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Overview & Purpose

Overview

The Capital Improvement Assessment is a physical evaluation of the existing streets, plazas, and parks located within the Downtown 2032 – The Path Forward plan study area, which is defined as the Downtown Development Authority (DDA) boundary. The existing assets, mostly included in the right-of-way or on City of Greeley owned property, comprise a majority of the occupiable public realm in the plan area boundary, which is intended to create a walkable, safe, attractive, and welcoming user experience within the Downtown area. Capital improvements assist in helping the City of Greeley and DDA pursue their mission to create, support, and promote meaningful Downtown experiences, business growth, and private development in Downtown Greeley. While the DDA has other tools to encourage and support business growth and private development, the Downtown user experience is directly impacted by the various capital improvements that shape the built environment of Downtown. From streets and avenues to alleys, plazas, and parks, the interwoven public realm creates the physical environment that users experience Downtown.

Purpose

The purpose of the Capital Improvement Assessment is to evaluate the current conditions of the public realm between the curb and edge of the right-of-way, which consists of the majority of the streetscape, to identify gaps and opportunities that can be used to inform public realm and placemaking recommendations in the Downtown 2032 - The Path Forward Plan.

Methodology

The methodology used for the Capital Improvement Assessment includes an evaluation of the physical condition using a combination of site visits and web-based analysis. Three categories of assets were created for this evaluation: streets, plazas, and parks. Each street, plaza, and park was then ranked using a scoring system of Good, Fair, or Poor conditions. This ranking system assesses the quality of each asset holistically, and then provides some additional notes on each specific streetscape component, including paving, trees/landscape, site furnishings, etc.

State of Downtown Greeley Public Realm

The Capital Improvement Assessment reveals that Downtown Greeley has an average foundation of basic infrastructure and a few areas where the pedestrian has been prioritized, such as 8th Street and 9th Street. However, the evaluation described above indicates there is an overall lack of public realm infrastructure oriented toward the pedestrian and an absence of consistent high-quality public realm experiences throughout Downtown.

The public realm assessment map to the right illustrates the outcome of the overall ranking of Downtown streets, parks, and public spaces at the time of this study. The findings indicate that apart from a few key streets and areas around the Downtown core near Lincoln Park, a majority of the public realm is of fair or poor quality. This indicates that basic assets comprising the public realm need additional improvements, maintenance, or increased inspections to create a public realm that attracts more residents, visitors, and employees.



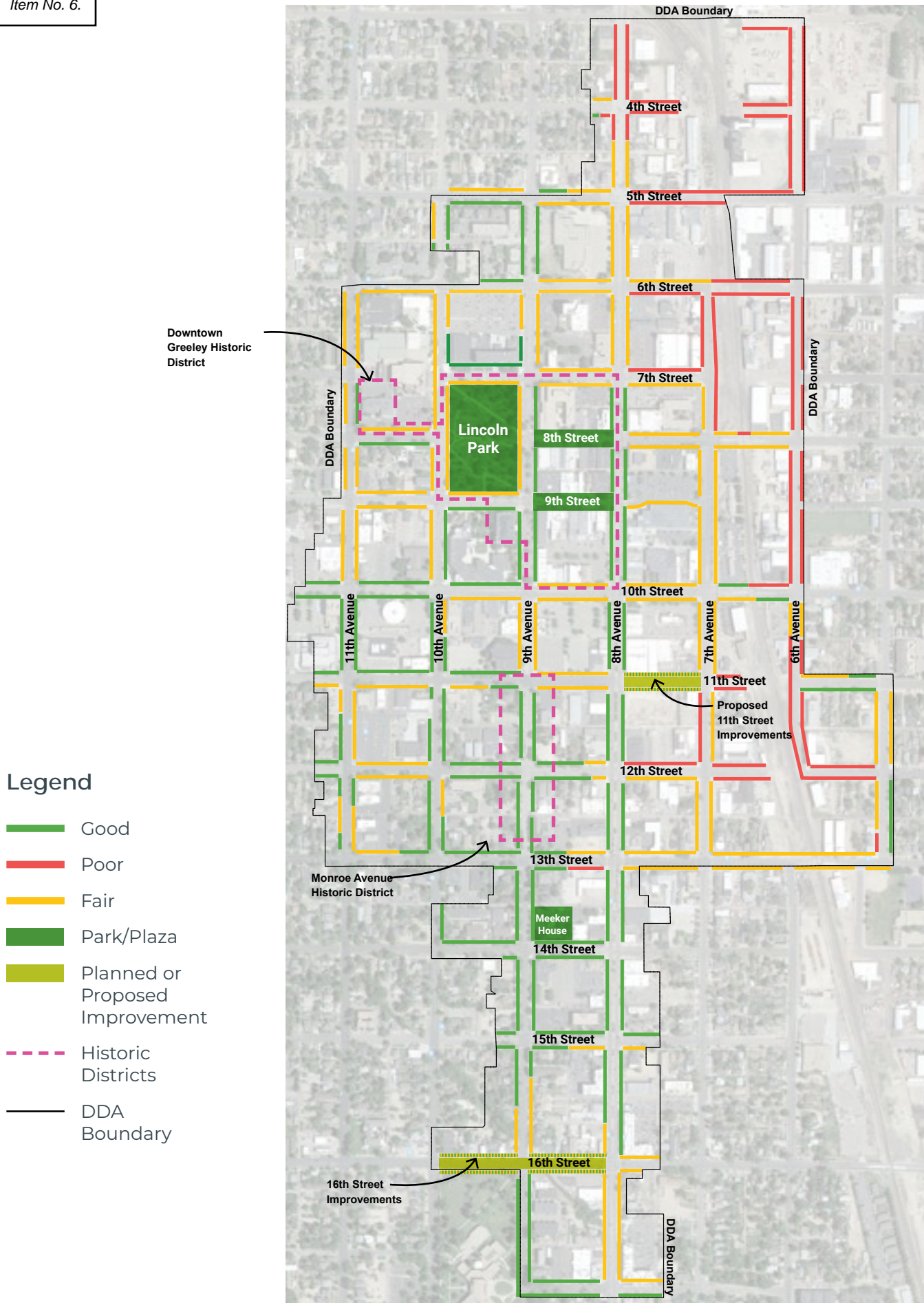
Image of the existing sidewalk near 9th Avenue

Key Findings

- » Areas on the eastern edge of Downtown have the lowest quality public realm, as the majority were ranked as poor and many locations lack basic sidewalks.
- » Areas around the Downtown core have a higher ranked capital improvement quality due to additional investment that has occurred on 8th Street, 9th Street, Lincoln Park, 8th Avenue, and surrounding streets.
- » The residential areas south of the Downtown core generally have a higher quality public realm with mature trees, lawns, and generous sidewalks.
- » 8th Avenue and 9th Avenue have distinctly different but complimentary characters and they generally provide good north to south connectivity through Downtown. These corridors are also supported by 10th Avenue and 11th Avenue that run north-south on the west edge of Downtown.
- » In most cases, non-residential areas are fair to poor quality with significant stretches lacking basic sidewalks.



Image of the streetscape and cafe seating on 9th Street



Analysis of Capital Improvements

Item No. 6.

Public Realm Assets Study



Image of the existing sidewalk along 9th Avenue

Public Realm and Capital Investments for People

As most cities have excellent statistics on traffic flows and parking patterns, issues relating to traffic and parking are generally well represented in planning and capital budgeting processes. Very few cities, however, have information on the quality of the public realm and the areas where capital investments and annual budgeting is required to create and maintain a walkable and rollable Downtown that supports an active business and mixed use environment.

This study assesses the quality of Downtown Greeley's streets and public realm from a pedestrian perspective to provide insight into how Downtown's public spaces function today and the types of improvements required to create a more attractive and comfortable Downtown experience.

Underground Utilities

The focus of the Capital Improvement Assessment is to evaluate the condition of the surface improvements within the public realm. Therefore, an assessment of underground utilities, including water, fiber optic lines, and electrical is not a part of this study. Some addition work, beyond the scope of this assessment, will be conducted to determine the condition and capacity of underground utilities. The stormwater system has been evaluated by the City and is undergoing regular improvements to increase capacity, including the 12th Street Stormwater Outfall project. For additional information, contact the City of Greeley Public Works at 970-350-9881.

Americans with Disabilities Act (ADA) and the Public Realm

This study does not include information related to an ADA evaluation of Downtown's streets and sidewalks. Some information is available through Public Works and a separate analysis may be conducted to further evaluate ADA compliance and accessibility needs in Downtown. For additional information, contact the City of Greeley Public Works at 970-350-9881.

Avenues & Streets

The avenues and streets comprise a vast majority of the Downtown public realm assets. In total, the study area includes over 17 different streets forming an interconnected Downtown grid. The grid includes five north-south avenues between 7th and 11th Avenues, and twelve east-west streets between 5th Street to the north and 16th Street to the south. 16th Street also serves as the boundary between the DDA and the University of Northern Colorado (UNC).

The vast grid of streets includes a variety of physical conditions, with some segments in very good condition and others without any improvements besides basic asphalt. Due to the length of the streets, the assessment demonstrates that physical conditions are inconsistent on each street and can often range from poor to very good within a few blocks.



Image of the existing sidewalk, tree lawn, and mature trees

Downtown Wayfinding & Signage

Improving Wayfinding and Visitor Experience

The DDA recently completed Signage Guidelines (2021) for Downtown, which provide an overall plan and design guidance for various types of signage, including entry monument signs and wayfinding signs. The plan, to be implemented in phases over time, identifies locations for signage throughout Downtown and seeks to improve the visitor and user experience by identifying important destinations and attractions, as well as gateway markers at key entry points. Major gateways have been identified along 8th Avenue at 5th Street and 16th Street, as well as key points east and west on 8th and 10th Streets.

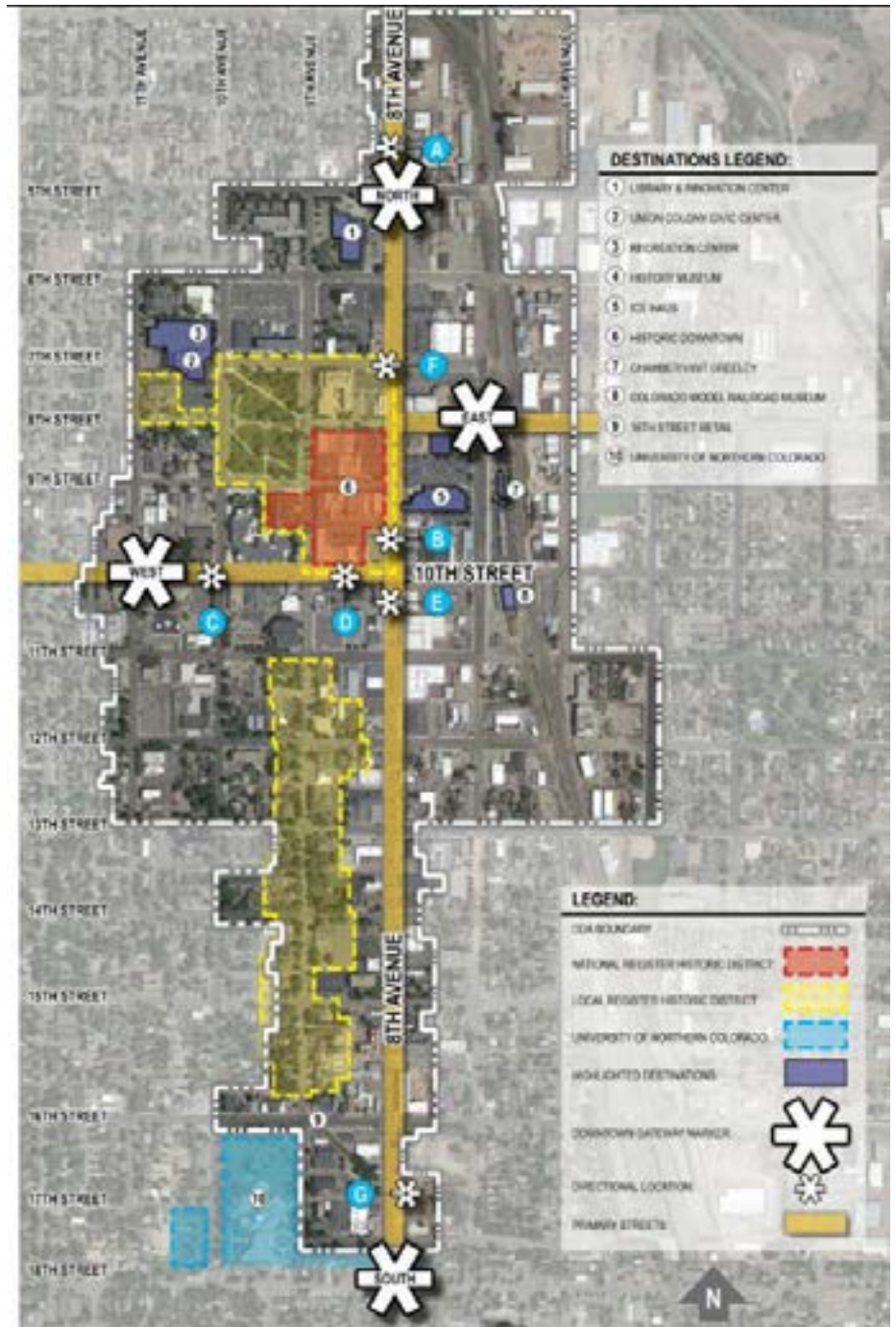
The Wayfinding Signage Content & Location Map on the next page from the Signage Guideline document captures the proposed locations and destinations. The full document can be accessed on the DDA's website.



Image of the new wayfinding signage in Downtown

Wayfinding Signage Content & Location Map

- A Southbound directional:**
 - ↑ Historic Downtown
 - ↑ Ice Haus
 - ↑ History Museum
- B Southbound directional:**
 - ← Colorado Model Railroad Museum
 - ← Chamber/Visit Greeley
 - ↑ University of Northern Colorado
- C Eastbound directional:**
 - ← Historic Downtown
 - ← Union Colony Civic Center
 - ← Recreation Center
- D Eastbound directional:**
 - ↑ Colorado Model Rail Road Museum
 - ← Ice Haus
 - ← History Museum
- E Northbound directional:**
 - Colorado Model Railroad Museum
 - Chamber/Visit Greeley
 - ↑ Library & Innovation Center
- F Southbound directional:**
 - ↑ Historic Downtown
 - ← Union Colony Civic Center
 - Library & Innovation Center
- G Northbound directional:**
 - ← 16th Street Retail
 - ↑ Historic Downtown
 - ↑ Library & Innovation Center



Wayfinding Signage and Location Map (by others)

Avenues & Streets

7th Avenue

OVERVIEW

Located near the eastern edge of Downtown, 7th Avenue straddles one side of the railroad tracks and functions as a transition between the core Downtown area and the industrial uses and businesses located near the rail lines. Other than some improved areas in front of the Train Depot, the historic industrial and commercial uses have created a public realm that lacks many of the basic elements such as sidewalks, trees, and amenity spaces that would make it attractive to pedestrians and bicyclists.

7th Avenue Snapshot



- » Majority fair condition
- » Approximately 25% poor condition
- » Bicycle lanes included south of 8th Street

Legend

- █ Good
- █ Fair
- █ Poor
- • • • Pedestrian Lights



AMENITY AREA

Consistent amenity area treatments between the property line and curb are uncommon. As indicated by the small areas of lawn near the corners of 7th and 10th Streets, when amenity areas are included, they are not very useful or effective. Although there are some improved areas in front of the Train Depot, including improved sidewalks and pedestrian lighting, they lack other amenities such as trees, landscape planting, benches, etc.

EXISTING AMENITIES:

Pedestrian Lighting

- » Only in front of Train Depot and along Ice House frontage

Bus Stops

- » None

Public Art/Murals

- » None

Benches

- » None

Landscape Planters

- » None



Image of the existing sidewalk along 7th Avenue

SIDEWALKS

The inconsistent public realm condition is revealed where there is no sidewalk due to the historic industrial and commercial uses. When sidewalks are present, they are typically an attached condition without any amenity zone or buffer from vehicular traffic.

BUILDING ACTIVATION / FRONTAGE

In most cases, building frontages are oriented to the automobile or service entries, creating an unwelcoming and disconnected public realm environment for people. However, the Train Depot frontage is a wonderful contribution through its detailed architecture, scale, and the location of its building entries.

TREES

The street includes very few street trees located in the right-of-way. With fewer than 10 street trees, they offer very little shading, cooling, or pedestrian comfort.



Image of the existing sidewalk along 7th Avenue

8th Avenue

OVERVIEW

8th Avenue is the primary north-south commercial corridor in Downtown and one of the major destination streets with a variety of restaurants, businesses, and new mixed-use development. Despite it being a CDOT road, it has seen considerable public and private improvements over the years resulting in a pleasant public realm experience between 7th Street and 16th Street, including landscape medians, public art, seating, street trees, amenity areas, and enhanced crosswalks. Although the character still feels vehicular due to the overall width of the roadway and volume of cars, the public realm improvements have created a pleasant place where pedestrians feel safer and more comfortable, and businesses see increased foot traffic and patrons.

8th Avenue Snapshot



- » Over 50% are good condition
- » Northern blocks require the most improvements

Legend

- █ Good
- █ Fair
- █ Poor
- • • • Pedestrian Lights



North Segment
(4th St. - 11th St.)



South Segment
(11th St. to 16th St.)

Proposed
11th Street
Project

AMENITY AREA

The amenity area along 8th Avenue varies, but the segments south of 8th Street include a variety of public art, historic pedestrian lighting, themes, benches, furnishings, street trees, and landscape.

EXISTING AMENITIES:

Pedestrian Lighting

- » Included along majority of the corridor

Bus Stops

- » Seven total bus stops for northbound and southbound bus service

Public Art/Murals

- » Numerous locations of public art

Benches

- » Consistent throughout

Landscape Planters

- » Median landscape treatments
- » Landscaped corners
- » Several potted plants and flowers

SIDEWALKS

A majority of the blocks have nice sidewalks and adequate space for comfortable pedestrian movement. However, the blocks north of 7th Street lack the same character and are fair to poor condition.

BUILDING ACTIVATION / FRONTAGE

Many of the buildings are oriented to create an active building frontage and reinforce the street edge, creating street presence and providing a more inviting sense of place. This is also supported by the elimination of surface parking between the buildings and the public realm, allowing people to window shop and easily enter restaurants and businesses when walking along the street.

TREES

Trees and landscape, often in the form of planted medians and regularly spaced tree wells, help create a consistent feel and character along the street. The public realm improvements are visibly apparent and much more widespread as you travel south from 7th Street towards 16th Street.



Image of a public art piece along 8th Avenue



Image of the streetscape improvements along 8th Avenue

9th Avenue

OVERVIEW

9th Avenue is the second major north-south street running through the center of Downtown, connecting major destinations such as Lincoln Park, 8th Street, the new LINC Library, and UNC.

Unlike the commercial feel of 8th Avenue, 9th Avenue has a predominantly residential character in the southern sections before transitioning to commercial, civic, and mixed-use to the north. The mature tree canopy, generous sidewalks, and tree lawns make it one of the more pleasant, comfortable, and memorable streets in Downtown.

Although there is a need for typical sidewalk repair, replacement, and maintenance, 9th Avenue is one of the most pleasant and enjoyable streets Downtown with great potential to create an enhanced connection between UNC and the center of Downtown.

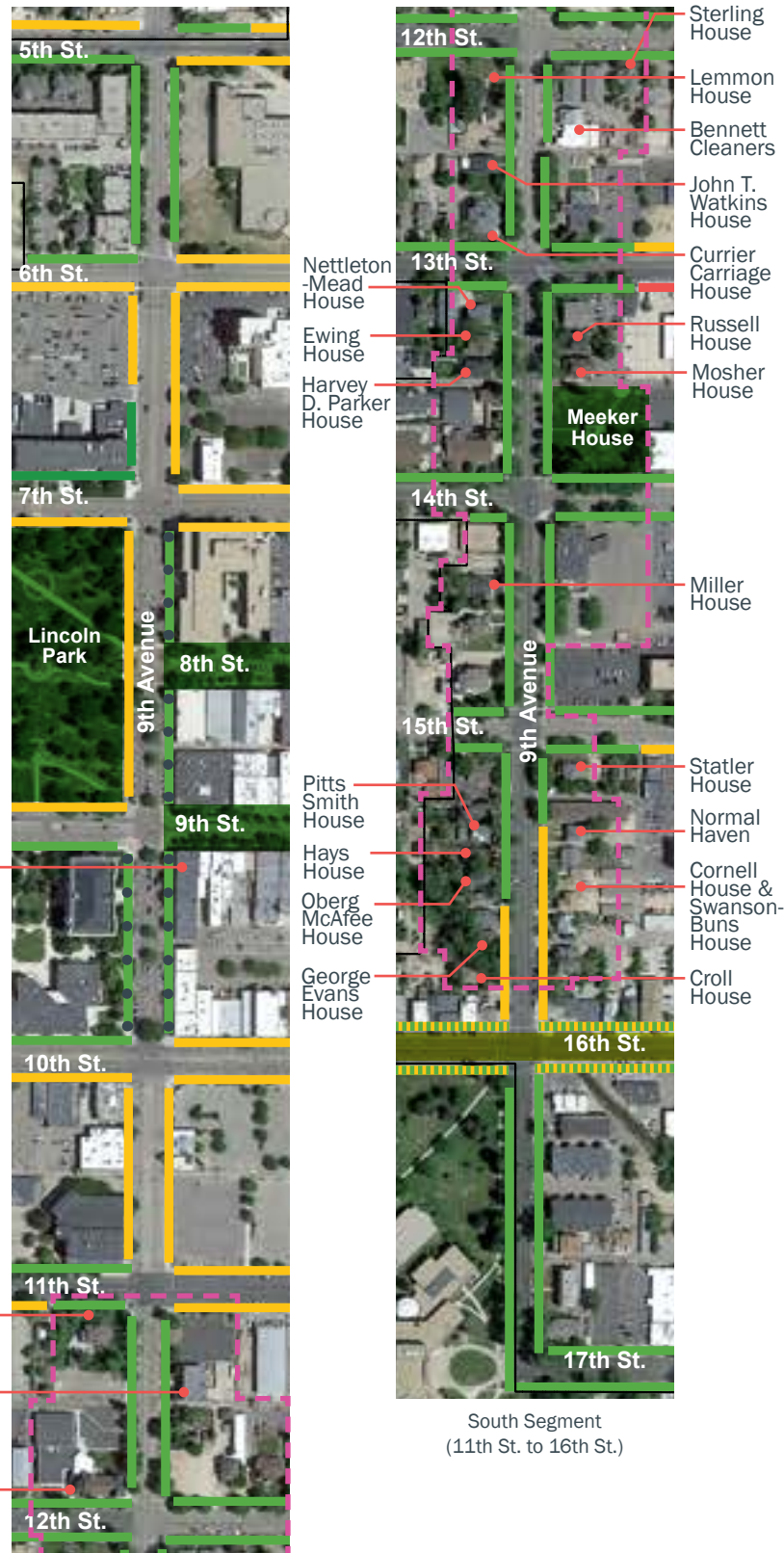
9th Avenue Snapshot



- » Approximately 70% are good condition
- » No poor conditions
- » Bicycle lanes included south of 11th Street

Legend

- █ Good
- █ Fair
- █ Poor
- Pedestrian Lights



AMENITY AREA

9th Avenue includes one of the more consistent amenity areas in all of Downtown with mature trees, wide tree lawns, and mixed hardscape streetscape improvements north of 9th Street.

EXISTING AMENITIES:

Pedestrian Lighting

- » Only included between 10th and 7th Streets

Bus Stops

- » None

Public Art/Murals

- » None

Benches

- » Consistent between 10th and 7th Streets

Landscape Planters

- » Landscape planters between 10th and 7th Streets

- » Nice tree lawns along majority of the street

SIDEWALKS

Continuous sidewalks along both sides of the street run the entire length and create a very comfortable and safe walking environment for residents, students, and visitors to stroll throughout the corridor. The sidewalk condition is in good shape with typical wear and tear needing maintenance or occasional replacement.

BUILDING ACTIVATION / FRONTAGE

Due to the adjacent uses, building activation and street frontage vary along the street. The southern end, south of 12th Street, is much more residential with numerous historic buildings and older residential buildings with wider setbacks, generous front yards, and maintained landscapes. Moving north closer to 11th Street, 9th Avenue transitions to commercial uses, which changes building frontage characteristics and sometimes creates unfriendly adjacencies with blank facades and surface parking lots. The core Downtown blocks include some of the most active and attractive facades with well-crafted architecture, windows, and storefronts.

TREES

Mature street trees are in abundance along 9th Avenue running along both sides of the street for most of its length with the exception of a few blocks near the Downtown core.



Image of the streetscape in front of retail space on 9th Avenue



Image of a historic residential home along 9th Avenue



Image of a blank building facade along 9th Avenue

10th Avenue

OVERVIEW

10th Avenue is one of the two major north-south streets on the western edge of Downtown running from 13th Street to 6th Street and forming the western edge to Lincoln Park, and the front door to City Hall. Although it is similar in character to 9th Avenue, it lacks the same level of quality due to the inconsistent tree canopy, amenity zone, and sidewalk treatment. The inconsistent character of the streetscape and public realm combined with the higher percentage of non-residential uses near the Downtown Core creates a fragmented character and feel.

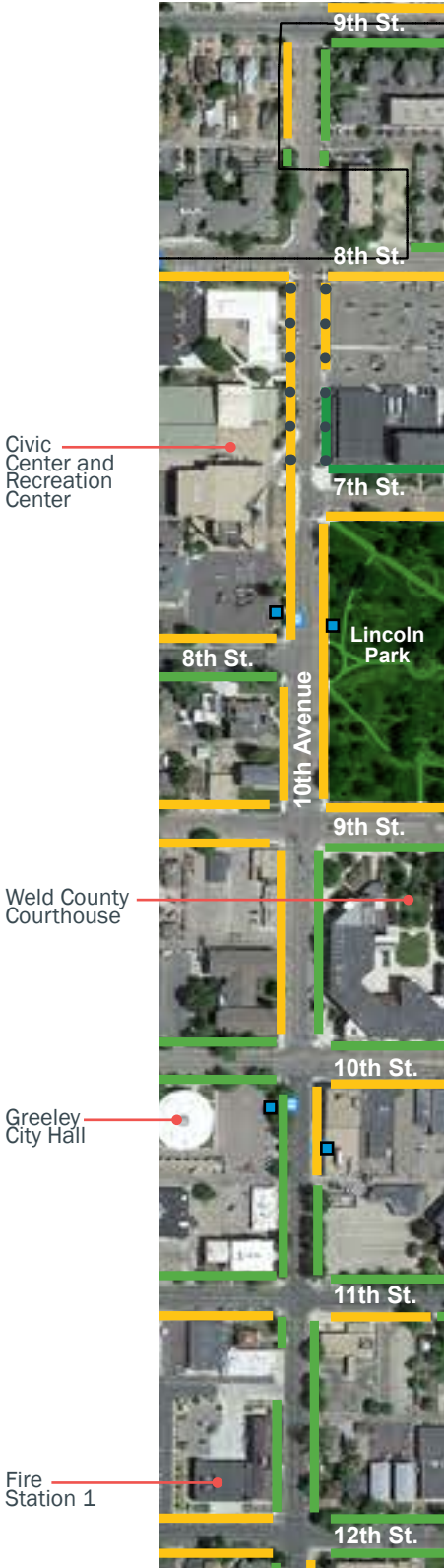
10th Avenue Snapshot



- » Almost equal division between fair and poor conditions
- » No poor conditions
- » Bicycle lanes included south of 11th Street

Legend

- █ Good
- █ Fair
- █ Poor
- • • • Pedestrian Lights



AMENITY AREA

Besides vehicular street lighting, amenities on 10th Avenue are scattered and very infrequent, with an occasional bike rack, as shown in the image to the right.

EXISTING AMENITIES:

Pedestrian Lighting

- » Only included between 6th and 7th Streets

Bus Stops

- » Five bus stops serving Routes 1 and 5

Public Art/Murals

- » Crosswalk murals at 7th Street in front of Civic Center/Rec Center

Benches

- » Only at bus stops

Landscape Planters

- » Enhanced landscape and planters located adjacent to new DoubleTree Hotel

SIDEWALKS

Sidewalks line both sides of 10th Avenue but placement (attached or detached) and quality vary widely depending on the block.

BUILDING ACTIVATION / FRONTAGE

Building uses along 10th Avenue is varied, ranging from major civic buildings to churches and residential properties. The building frontages are inconsistent and range from large blank facades to some areas with more ornate or interesting architecture. In most areas, the street lacks building fronts that activate the street and make it a pleasant area to stroll and linger.

TREES

The street trees are vary in size, placement, and consistent application with some blocks having a healthy and mature tree canopy and others having recently planted trees or missing trees.



Image of the piano crosswalk on 10th Avenue near Lincoln Park



Image of the bicycle lane and varied landscape treatment along 10th Avenue

11th Avenue

OVERVIEW

As the westernmost street, 11th Avenue functions as a transitional street between the commercial and civic/public uses in Downtown to the residential neighborhoods to the west. In many cases, the street functions like a back door or secondary street servicing Downtown and lacking any identifiable character or amenities.

11th Avenue Snapshot



- » Generally fair conditions due to basic sidewalks
- » Lacks many other attributes of higher quality streetscapes

Legend

- Good
- Fair
- Poor
- • • • Pedestrian Lights



AMENITY AREA

11th Avenue is lacking in streetscape amenities, with only one bike rack identified, no benches, trash or other street furnishings.

EXISTING AMENITIES:

Pedestrian Lighting

» None

Bus Stops

» None

Public Art/Murals

» None

Benches

» None

Landscape Planters

» None

SIDEWALKS

The existing sidewalks provide basic pedestrian infrastructure and are well maintained, with a few exceptions near 12th and 13th Streets.

BUILDING ACTIVATION / FRONTAGE

This street features mixed-use, residential, and commercial building frontages. Most residential properties are offset from sidewalks and have private front yards, which ranges in upkeep and maintenance. The commercial and civic properties typically feature surface parking along the street creating an unpleasant pedestrian experiences.

TREES

This street has a variety of tree species, offering some sidewalk character and shading for pedestrians. Some blocks south of 9th Street do not have any trees which creates large gaps and unpleasant walking experience for pedestrians.

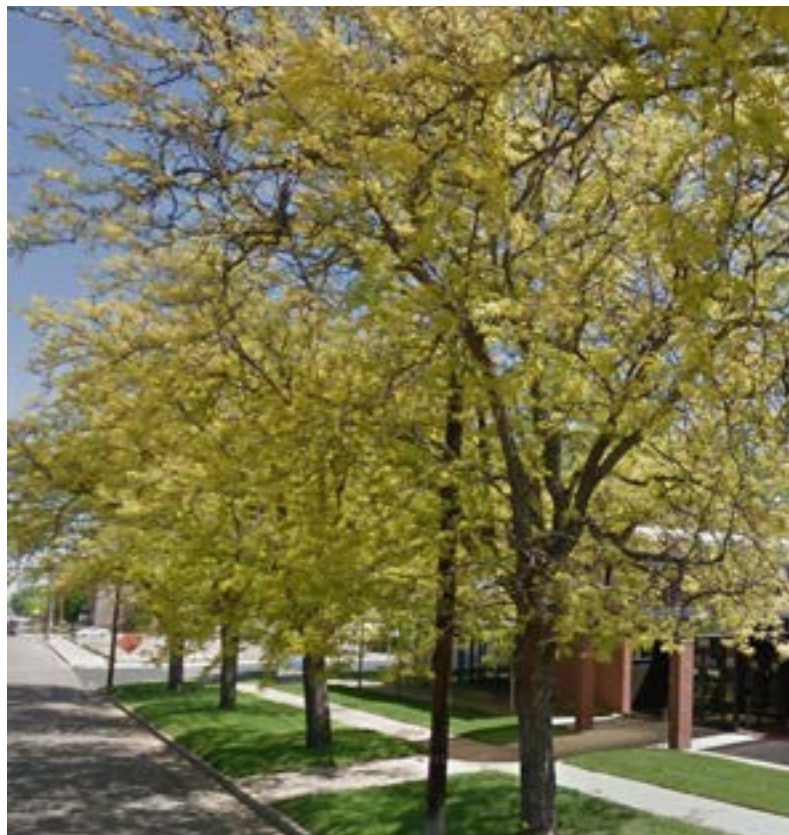


Image of a well maintained sidewalk and amenity area on 11th Avenue



Image of a poorly maintained frontage along 11th Avenue



Image of blocks where the amenity area has been removed to allow for additional travel lanes and parking

4th Street

OVERVIEW

4th Street is the northern most street in the DDA, including a small segment of road on either side of 8th Avenue. The segments within the DDA boundary are mostly unimproved due to its proximity to the railroad tracks and nearby industrial and commercial uses. However, the street does begin to improve as it moves west towards residential blocks.

AMENITY AREA

Other than vehicular street lights, there are no streetscape amenities for pedestrians or bicyclists. Only one small segment includes residential tree lawns west of 8th Avenue.

EXISTING AMENITIES:

Pedestrian Lighting

» None

Bus Stops

» None

Public Art/Murals

» None

Benches

» None

Landscape Planters

» None

SIDEWALKS

Most of the sidewalks are substandard due to the high number of commercial properties where asphalt and parking areas extend to the curb or there is no sidewalk at all. Areas west of 8th Avenue include narrow sidewalks adjacent to residential properties.



Image of dilapidated sidewalk condition on 4th Street

4th Street Snapshot



» Generally very poor conditions



Legend

- Good
- Fair
- Poor
- Pedestrian Lights

BUILDING ACTIVATION / FRONTAGE

Due to the commercial and industrial uses, many buildings along 4th Street create an unfriendly frontage and do not create any non-vehicular street activation. However, the frontage improves in the residential area to the west due to the character and architecture of the smaller-scaled residential buildings.

TREES

There are no standard street trees in this segment of 4th Street other than one single tree at the southeast corner of 8th Avenue.



Image of an asphalt covered amenity area and commercial frontage



Image of the sidewalk and amenity area in front of residential properties

5th Street

OVERVIEW

This segment of 5th Street is near the northern edge of the study boundary and functions as a transitional street with a combination of major commercial, civic, industrial, and residential uses. The varied uses and inconsistent building frontages create an extremely undefined and disconnected public realm. Apart from the improved residential frontage along Meeker Commons, there have been minimal streetscape improvements in recent years. Unimproved conditions are a physical barrier for pedestrians trying to visit the adjacent destinations, including the new LINC Library and WeldWerks Brewing.

AMENITY AREA

Other than vehicular street lights at 5th Street and 8th Avenue, there are no streetscape amenities for pedestrians or bikers. Most of the amenity areas near commercial properties are treated as a functional space with expanded concrete, asphalt, and rock much. Moving west, 5th Street transitions to residential properties and the amenity area begins to include landscaped areas and trees.

EXISTING AMENITIES:

Pedestrian Lighting

» None

Bus Stops

» None

Public Art/Murals

» None

Benches

» None

Landscape Planters

» None

5th Street Snapshot



- » Generally very poor conditions, especially near the railroad tracks
- » Bicycle lanes included west of 8th Avenue



Image of the intersection at 5th Street and 8th Avenue



Image of an undefined sidewalk and amenity area



*Note: The railroad crossing is included as a part of the City of Greeley Railroad Quiet-Zone improvement project along the city's eastern railroad corridor.

Legend

- Good
- Fair
- Poor
- Pedestrian Lights

SIDEWALKS

5th Street has a majority of fair sidewalks, however where 5th Street meets the railroad towards the east, the sidewalks cut off and the area becomes industrial with no sidewalks and undefined areas for pedestrians to walk.

RAILROAD CROSSING

The railroad crossing at 5th Street is unimproved without any sidewalks or formal crossing for pedestrians, including the crossing and approach on both sides. Both sides require basic pedestrian improvements to create a safer and more welcoming crossing from areas to the east.

BUILDING ACTIVATION / FRONTAGE

Other than Meeker Commons, there are significant setbacks that form an unattractive and uncomfortable streetscape. In many cases, service uses, surface parking, or access points line the street edge deterring pedestrians and cyclists from the area.

TREES

The different sides of 5th Street have unbalanced and inconsistent greenery and tree plantings, with very few trees and planting areas on the eastern side.



Image of the sidewalk and amenity area without trees and planting



Image of a well maintained sidewalk and amenity area

6th Street

OVERVIEW

6th Street begins a full transition to the larger commercial uses in the blocks on the northern edge of Downtown making it an uncomfortable area for pedestrians with a lack of consistent streetscape treatments. The varied frontages, street treatments, and setbacks reflect the diverse commercial uses and create an inconsistent feel and character. The street has a large amount of diagonal parking and inconsistent sidewalk treatments, reinforcing its role as primarily a commercial-serving street.

AMENITY AREA

The amenity area along 6th Street is inconsistent and varies from block to block and property to property. There are numerous areas where there are attached sidewalks and no amenity zone, and various amenity zone widths dependent on the layout of diagonal parking and detached sidewalks. The overall character is lacking any consistency and comfort for pedestrians.

EXISTING AMENITIES:

Pedestrian Lighting

- » Between 8th and 9th Avenue on the north side of the street

Bus Stops

- » None

Public Art/Murals

- » None

Benches

- » None

Landscape Planters

- » None

SIDEWALKS

6th Street has basic sidewalks throughout, but varying layout and treatment based on adjacent uses and diagonal parking. 6th Street features detached and attached sidewalks, with neighboring conditions ranging from surface parking to private lawns. Overall sidewalk condition is good, but pedestrian comfort varies.

6th Street Snapshot



- » Generally fair conditions due to basic sidewalks
- » Lacks attributes of higher quality streetscapes

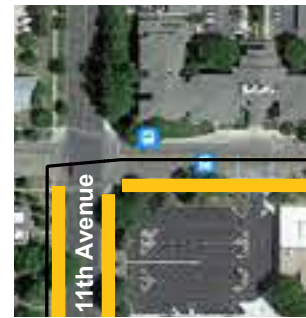


Image of the sidewalk and native landscape next to a repurposed industrial building



Image of an attached sidewalk without an amenity area



*Note: The railroad crossing is included as a part of the City of Greeley Railroad Quiet-Zone improvement project along the city's eastern railroad corridor.

Legend

- Good
- Fair
- Poor
- Pedestrian Lights

RAILROAD CROSSING

Like 5th Street, the 6th Street railroad crossing is also unimproved without any sidewalks or formal crossing for pedestrians. The adjacent industrial uses also have little or no sidewalk improvements. The crossing requires basic improvements to create safer pedestrian connections from areas to the east.

BUILDING ACTIVATION / FRONTAGE

The street lacks any clear building definition and active frontages due to a broad range of commercial uses and large setbacks. Along many blocks, large surface parking lots or building service areas are often located next to the sidewalk, creating a very uncomfortable experience for pedestrians. However, the Housing Authority building at the northwest corner of 9th Avenue does a very nice job creating a welcoming and comfortable frontage.

TREES

This section of 6th Street has little to no trees, severely impacting the streetscape quality. Where trees occur, it is difficult to determine if they are located on private property or if they are within the right-of-way.



Image of the amenity area and sidewalk with pedestrian

7th Street

7th Street Snapshot



- » Better conditions near Lincoln Park
- » Lower quality moving east

OVERVIEW

7th Street begins to shape the main core of Downtown with new improvements at the DoubleTree Hotel, transitioning into Lincoln Park across the street. However, the street begins to quickly lose this sense of a place as it enters the industrial areas east of 8th Avenue.

AMENITY AREA

The amenity area on the main blocks near Lincoln Park and one block east are in good condition with mature trees, landscape areas, occasional bicycle racks, benches, and trash receptacles. Some treatments can be updated but the amenity area shows promise with continued upkeep and maintenance. East of 8th Avenue features poorer conditions due to significantly fewer trees and amenity spaces, attached sidewalks, large road widths, and on-street parking.

EXISTING AMENITIES:

Pedestrian Lighting

- » Only in front of the recently completed DoubleTree Hotel

Bus Stops

- » None

Public Art/Murals

- » None

Benches

- » In front of DoubleTree Hotel
- » Near 8th Avenue

Landscape Planters

- » Pleasant landscape planters near DoubleTree Hotel



Image of a sidewalk and commercial frontage



Image of street furnishings, including a bench and trash receptacle



Legend

- Good
- Fair
- Poor
- Pedestrian Lights

SIDEWALKS

7th Street has continuous sidewalks along each block, but the condition and location vary from block to block, dependent on adjacent uses, parking, and development. Blocks closer to Lincoln Park are of higher quality, while blocks east of 8th Avenue feature increased commercial properties with service access, negatively impacting overall street quality.

BUILDING ACTIVATION / FRONTAGE

Building facades and uses vary on 7th Street from smaller shops to large hotels. Most building frontages are occupied by on-street parking, creating an uncomfortable pedestrian environment. However, there are a few pockets of pedestrian-friendly building frontages and urban murals.

TREES

7th Street includes a large variety of healthy trees near Lincoln park, which decreases as the blocks move east. Blocks east of 8th Avenue have very few trees due to the vehicular-focused commercial and industrial character. Tree sizes and health also vary depending on the tree's planting area, location, and growing conditions.



Image of a blank facade and dilapidated sidewalk east of 8th Avenue



Image of the streetscape in front of the DoubleTree Hotel

8th Street

OVERVIEW

Due to Lincoln Park, 8th Street is the only discontinuous street in Downtown. The interruption influences different character and quality on each side. The west side is characterized by a blend of residential and civic buildings, while the east side is characterized by commercial and industrial buildings. The public realm character and quality ranges from intimate, residential streetscapes to functional, commercial streetscapes.

AMENITY AREA

The amenity area varies from block to block dependent on property use and configuration of on-street parking. The residential blocks include typical tree lawns, while the commercial and civic blocks often replace or alter the amenity zone to create room for diagonal parking, building access, or increased hardscape.

EXISTING AMENITIES:

Pedestrian Lighting

- » None

Bus Stops

- » None

Public Art/Murals

- » One public art piece/mural on Greeley History Museum facade

Benches

- » Benches and bike racks on 8th Street Plaza

Landscape Planters

- » None

SIDEWALKS

Sidewalks are continuous throughout the street. However, their location and configuration change and vary dependent on adjacent uses. The sidewalks in front of the hotel, at the railroad crossing, and the blocks east of the railroad tracks have inconsistent layout and need repair or reconstruction to create a clear sidewalk connection.

8th Street Snapshot

- » Generally fair conditions
- » High block to block variation
- » Bicycle lanes included west of 10th Avenue



Image of an attached sidewalk with diagonal parking



Image of a mature tree and wide tree lawn west of Lincoln Park



*Note: The railroad crossing is included as a part of the City of Greeley Railroad Quiet-Zone improvement project along the city's eastern railroad corridor.

Legend

- Good
- Fair
- Poor
- • • • Pedestrian Lights

RAILROAD CROSSING

As a major east-west roadway, the 8th Street railroad crossing is somewhat up-to-date. The south side of the road features ADA-compliant sidewalks throughout the railroad crossing, but the north sidewalk's western approach terminates just before reaching the crossing, which could be completed to create a second connection on the north side of the street.

BUILDING ACTIVATION / FRONTAGE

8th Street features several uses, including small-scale residential properties, surface parking, and large commercial properties. These contrasting uses and treatments along the street do not provide any consistent building edges that activate the street or establish defined edges.

TREES

Trees where included are healthy and provide a pleasant shade canopy and pedestrian comfort. However, the trees are piece-mealed along the blocks in response to specific constraints and needs of adjacent properties, creating an inconsistent and fragmented feel.



Image of the mural on the Greeley History Museum building



Image of the guest drop off area in front of the Clario

9th Street

OVERVIEW

9th Street is located south of Lincoln Park and fronts major landmark destinations, including the Weld County Courthouse and Greeley Ice Haus. The street has a high volume of vehicular traffic and plays an important role by providing parking and access to nearby major destinations.

Its role of providing access greatly impacts its overall character. 9th street features various uses, so the public realm changes from block to block. There are also many areas that offer substantial on-street parking, which impacts amenity areas and sidewalk configuration.

AMENITY AREA

The amenity area varies from block to block depending on use and configuration of on-street parking. Similar to 8th Street, the residential blocks include typical tree lawns of standard size before transitioning to an attached sidewalk without an amenity area in front of the courthouse. The block east of 8th Avenue in front of the Greeley Ice Haus is more convoluted; the road and sidewalks are organized to primarily serve the needs of the building.

EXISTING AMENITIES:

Pedestrian Lighting

- » A few in front of the Greeley Ice Haus

Bus Stops

- » None

Public Art/Murals

- » None

Benches

- » None

Landscape Planters

- » None

9th Street Snapshot

- » Generally fair conditions
- » High block to block variation



Image of the residential frontages west of Lincoln Park



Image of the attached sidewalk and parking south of Lincoln Park



Legend

- Good
- Fair
- Poor
- Pedestrian Lights

SIDEWALKS

Sidewalks are continuous along the entire street. Similar to 8th Street, their location and configuration change and vary depending on the block and the adjacent uses. The sidewalks on the western block are in moderate condition and separated by a typical tree lawn before transitioning to wider attached sidewalks in front of the park and courthouse. The sidewalks adjacent to Greeley Ice Haus are only located next to the building with a protective railing, creating a tight and slightly uncomfortable feeling for pedestrians.

BUILDING ACTIVATION / FRONTAGE

Similar to 8th Street, varied use impacts the building activation and frontage. 9th Street features a mix of buildings along the western segment from civic uses in front of the park and courthouse to large single-use found at the Ice Haus. All blocks can be improved by providing more visual interest and street activation through facade and edge enhancements.

TREES

Trees where included are healthy and provide a pleasant shade canopy and pedestrian comfort. However, trees are inconsistently placed in response to adjacent property needs, creating an overall inconsistent and fragmented feeling.



Image of the attached sidewalk and protective railing at the Greeley Ice House

10th Street

10th Street Snapshot



- » Generally fair conditions
- » Lacks many attributes found in high-quality streetscapes



Greeley City H

OVERVIEW

10th Street serves as a major corridor for commercial vehicles and a primary route traveling to and through Downtown. Heavy vehicular function and automobile-focused design greatly impacts the public realm, feel, and character. Unlike 8th Avenue which has benefited from streetscape investments, 10th Street remains to have fragmented streetscapes based on adjacent properties and features significant space allocated towards drive lanes and parking.

AMENITY AREA

The amenity area along 10th Street varies from block to block. Most areas are basic without any amenities. The blocks on the north side of the street near 9th and 8th Avenues feature trees, bike racks, planter pots, and trash receptacles.

EXISTING AMENITIES:

Pedestrian Lighting

- » None

Bus Stops

- » None

Public Art/Murals

- » None

Benches

- » None

Landscape Planters

- » Annual flowers in planter pots on the north side of the street near 9th and 8th Avenues



Image of the new public art piece east of the railroad tracks

SIDEWALKS

10th Street has continuous sidewalks throughout, but the condition and location vary from block to block, depending on the adjacent uses. Conditions and widths vary from wider conditions near 9th Avenue to narrower areas with attached sidewalks on other blocks. The overall sidewalk quality is good with typical maintenance required. 10th Street has a gap in sidewalk connectivity along the north side of the road at the railroad tracks.



Image of an existing mature tree near 11th Avenue



*Note: The railroad crossing is included as a part of the City of Greeley Railroad Quiet-Zone improvement project along the city's eastern railroad corridor.

Legend

- Good
- Fair
- Poor
- Pedestrian Lights

RAILROAD CROSSING

The 10th Street railroad crossing is one of the most complete and comfortable crossings in Downtown with well-established sidewalk improvements along the south side of the street, which features public art at the southeast corner. The north side of the street has an improved sidewalk connection from the west, but it currently terminates at the tracks, creating a gap. The northern segment should be completed to connect the northern crossing.

BUILDING ACTIVATION / FRONTAGE

The building activation and frontage treatments vary dramatically from block to block. Some areas near 9th Avenue have exceptional frontages with active storefronts and window displays. Other areas, however, have surface parking lots or completely blank facades, which detract from the pedestrian experience.

TREES

Tree planting and canopy are fragmented and inconsistent along 10th Street. Some blocks maintain existing trees and replace lost trees, but majority of the blocks have no trees due to an attached sidewalk condition.



Image of the sidewalk and mature trees in front of City Hall



Image of the building frontage and streetscape near

11th Street

OVERVIEW

11th Street is a nondescript street lacking any clear identity or foundation of standards as it moves through Downtown. Uses are mostly commercial, which creates varying degrees of building frontages, amenities, and streetscape treatments. However, the lack of identity and consistency may be improved with the 11th Street improvement project proposed on the eastern edge just past 8th Avenue.

AMENITY AREA

The amenity area is mostly treated as a functional area with few pedestrian street amenities. The image to the right shows the one bike rack near 9th Avenue. There are a few blocks with wider amenity areas, but the treatments are limited to mulch. Other blocks do not have any amenity areas due to an attached sidewalk condition and configuration of on-street parking.

EXISTING AMENITIES:

Pedestrian Lighting

» None

Bus Stops

» None

Public Art/Murals

» None

Benches

» None

Landscape Planters

» None

SIDEWALKS

Although there are continuous sidewalks along the street, the location and width vary depending on the adjacent uses and on-street parking configuration. The sidewalk condition deteriorates on eastern blocks due to the transition to commercial and industrial uses with service access and driveway cuts.

40



11th Street Snapshot



- » Varying conditions, with better conditions to the west
- » Bicycle lanes included west of 9th Avenue



Image of a commercial frontage with street trees



Image of a narrow attached sidewalk

Proposed 11th Street Improvements



Legend

- Good
- Fair
- Poor
- Pedestrian Lights

BUILDING ACTIVATION / FRONTAGE

Several building facades are disconnected from the adjacent streetscape, lacking a comfortable and pedestrian-friendly street frontage. Poor sidewalk conditions and deep setbacks also create confusion and an unwelcoming environment.

TREES

11th Street has a decent tree canopy in the central blocks, with some beautiful trees near the historic properties. Moving east from the intersection of 8th Avenue and 11th Street, tree frequency declines and there is little to no canopy or shade. The barren feeling of the public realm discourages pedestrians from walking the street or exploring this part of Downtown.



Image of a wide amenity area and healthy street trees



Image of an attached sidewalk next to diagonal parking

12th Street

OVERVIEW

12th Street, like 11th Street, is a basic street serving Downtown with nicer conditions to the west and very poor conditions on the east. The level of the improvements in the public realm, in most cases, directly reflects the adjacent uses, where the older residential and historic properties have nice trees with mature canopies and sidewalks, and the larger commercial and industrial parcels lack adequate improvements or have dilapidated conditions.

AMENITY AREA

The street amenity options on 12th street are lacking with no benches, bike racks, trash or recycling receptacles, planters, or pedestrian lights. However, blocks near 9th Avenue and the historic district have generous tree lawns with large mature trees.

EXISTING AMENITIES:

Pedestrian Lighting

» None

Bus Stops

» None

Public Art/Murals

» None

Benches

» None

Landscape Planters

» None

SIDEWALKS

Sidewalks are older, very basic, and cracking along 12th street, which will require some repair, upkeep, or replacement in the coming years. Sidewalks are continuous between 11th and 8th Avenues, but then disappear or become very fragmented due to the adjacent commercial uses, parking, and service area needs of industrial buildings.



12th Street Snapshot



- » Better conditions west of 8th Avenue
- » Majority very poor conditions to the east



Image of a block with well maintained trees and landscape



Image of a residential frontage and sidewalk area



Legend

- Good
- Fair
- Poor
- Pedestrian Lights

BUILDING ACTIVATION / FRONTAGE

12th Street has a mix of residential, commercial, and industrial uses, which creates a wide variety of frontages. This mix could lead to an interesting and vibrant streetscape. However, due to a lack of amenities, consistent building setbacks, attractive facades, and architectural character, 12th Street currently has poor street activation.

TREES

A large mature tree canopy exists in the core area between 9th and 10th Avenue, which should be protected and preserved. However, east of 8th Avenue there are no trees, creating a barren and uninviting experience for anyone walking, biking, or rolling.



Image of an attached sidewalk next to a surface parking lot



Image of the sidewalk and amenity area next to multi-unit residential

13th Street

OVERVIEW

13th Street is another basic east-west street in Downtown, transitioning from residential on the west to commercial in the center and industrial on the east. The character of the public realm reflects this transition by changing from better conditions on the west to more challenging conditions to the east. The areas in good or fair condition mostly include basic public realm infrastructure such as sidewalks, mature street trees, and tree lawns, but overall, the street lacks any consistency or distinct character. Some nicer and more recent improvements are located at the intersection of 8th Avenue, which is consistent with the public amenities along a large portion of 8th Avenue.

AMENITY AREA

At 8th Avenue and 13th Street, the intersection amenities for pedestrians are adequate with trash cans, benches, shade, and street planters. This is the only section with higher quality and amenities on 13th Street. The street also includes some very wide tree lawn areas near the historic district closer to 9th Avenue.

EXISTING AMENITIES:

Pedestrian Lighting

» None

Bus Stops

» None

Public Art/Murals

» None

Benches

» Only at 8th Avenue intersection

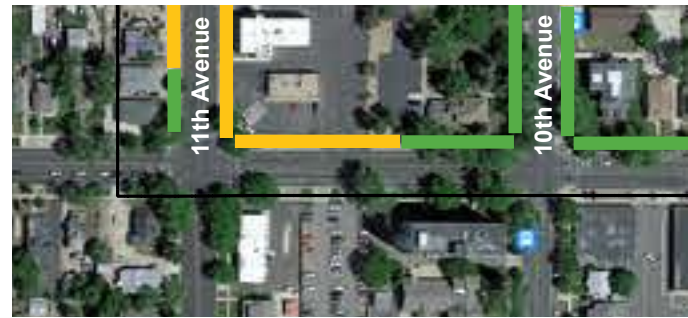
Landscape Planters

» None

SIDEWALKS

Sidewalk quality varies on 13th Street, ranging from very nice buffered sidewalks between 11th and 9th Avenues to fragmented and inconsistent sidewalk treatments east of 8th Avenue. Sidewalks are consistent, but the location, width, and condition vary between blocks.

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13th Street Snapshot



- » Generally fair to good
- » Lacks many high quality streetscape attributes
- » Bicycle lanes included



Image of the streetscape improvements and furnishings at the corner of 8th Avenue



*Note: The railroad crossing is included as a part of the City of Greeley Railroad Quiet-Zone improvement project along the city's eastern railroad corridor.

- Legend**
- Good
 - Fair
 - Poor
 - Pedestrian Lights

RAILROAD CROSSING

The 13th Street has the only complete rail crossing in Downtown with existing sidewalk with ADA compliant truncated domes on both sides. The crossing appears to be regularly maintained.

BUILDING ACTIVATION / FRONTAGE

12th Street has a mix of residential, commercial, and industrial uses, which creates a wide variety of frontages. Frontages near 9th Avenue, including the historic and residential properties, create a nice street edge and add character to the street. However, the commercial and industrial buildings often have blank facades or service access along the street creating unattractive street edges.



Image of the sidewalk and amenity area next to a commercial frontage

TREES

The residential west side of 13th Street features lush trees that help create a very comfortable pedestrian environment, however, moving eastward the tree canopy becomes sparse.

14th Street

OVERVIEW

Although it is a very small segment within the study area boundary, 14th Street has the most successful public realm, featuring mature tree canopy, sidewalks, adequate tree lawns, and building frontages supporting a comfortable public realm.

Other than the Resource Center along the south side, the street has adjacent uses and frontages that create a very comfortable feel and character, making it a pleasant and welcoming section of the street to stroll and enjoy.

AMENITY AREA

14th Street fronts the Meeker House Museum, which is an important historic site and public amenity for residents and visitors. The large and comfortable tree lawns along 14th provide a comforting amenity space that supports the large trees and overall feel of the street.

EXISTING AMENITIES:

Pedestrian Lighting

» None

Bus Stops

» None

Public Art/Murals

» None

Benches

» None

Landscape Planters

» None

SIDEWALKS

Sidewalks are continuous, consistent, and well maintained, providing consistency and setting a standard for all Downtown streets. However, the attached sidewalk condition on the south side of the street just east of 9th Avenue is a noticeable deviation in quality that creates an uncomfortable walking experience.



Image of a generous amenity area without trees and adjacent sidewalk



Image of the sidewalk and tree lawn near 9th Avenue

14th Street Snapshot

- » All good condition
- » Most successful street in Downtown



Legend

- Good
- Fair
- Poor
- • • • Pedestrian Lights

BUILDING ACTIVATION / FRONTAGE

Although a number of the buildings are older, the landscaping connects the facades to the street, providing a comfortable and visually interesting pedestrian experience.

TREES

Trees populate both sides of 14th Street, establishing greenery, shade, and a sense of enclosure.



Image of an area with a well-maintained sidewalk and mature trees

15th Street

OVERVIEW

Another small segment within the study area boundary, 15th Street continues the character and basic quality of 14th with a mature canopy, sidewalks, adequate tree lawns, and some building frontages supporting a comfortable public realm.

Although it has more adjacent surface parking lots than 14th Street, the street has sufficient sidewalks and tree lawns for most of its length. In some areas, the tree canopy is missing which makes sections of the street less comfortable and inviting than others.

AMENITY AREA

The large tree lawns provide a nice buffer from the street and edge to the sidewalk. The amenity zone also benefits from the improvements at the intersection of 8th Avenue, where some amenities contribute to the character of 15th Street, including public art, and elongated/protected crosswalk medians. However, outside the 8th Avenue intersection, there are no other street accessories or amenities.

EXISTING AMENITIES:

Pedestrian Lighting

» None

Bus Stops

» None

Public Art/Murals

» Two public art sculptures at the intersection of 8th Avenue

Benches

» None

Landscape Planters

» None

SIDEWALKS

Sidewalks are in very good condition with well-maintained landscape and tree lawn areas.



Image of the architectural character fronting 15th Street near 8th Avenue



Image of a sidewalk and tree lawn next to an existing surface parking lot

15th Street Snapshot



- » Majority good condition
- » Bicycle lanes included



Legend

-  Good
-  Fair
-  Poor
-  Pedestrian Lights

BUILDING ACTIVATION / FRONTAGE

Building frontages range from standard residential homes with modest facades and front yard treatments to commercial buildings and surface parking lots. The residential buildings provide a pleasant street frontage due to their front porches, scale, and architectural detail. However, the commercial buildings and surface parking lots do not contribute to building activation.

TREES

Trees populate both sides of 15th Street, which offers shading and pedestrian comfort while contributing to neighborhood character.



Image of landscape planting in front of some residential properties



Image of recently planted trees and residential frontage

16th Street

OVERVIEW

The 16th Street Streetscape and Intersection Improvement is currently an active project being led by the City of Greeley Public Works Department. The planned improvements aim to slow vehicular speeds, improve safety, create a walkable environment, revitalize the corridor, maintain as much parking as possible, and increase the connection between UNC and Downtown. The project is working through the design phases with plans to initiate the improvements in 2023.

The plans and images included here were prepared by the City's consultant design team and represent the latest design plans. An overall assessment of the existing conditions along 16th Street were not conducted to due to the anticipated major improvements and changes.



Conceptual illustration of the proposed improvements prepared by the City's design consultant team



Illustrative plan rendering of the proposed improvements prepared by the City's design consultant team



Conceptual illustration of the proposed improvements prepared by the City's design consultant team

Plazas

8th Street Plaza

OVERVIEW

8th Street is one of the two premier public spaces in Downtown oriented toward pedestrians, promoting events, and creating an active retail and restaurant area. The design of the space as a woonerf or shared street creates an overall curb-less and plaza-like atmosphere that prioritizes pedestrians, sitting, and lingering, but also allows vehicles to pass through and park in the space. This blending of uses allows flexibility for the street to be modified for special events, such as Friday Fest, concerts, and festivals.

The transformation of 8th Street from a typical roadway to a pedestrian-oriented shared street and plaza has been a successful example for Greeley and others. It demonstrates the positive response residents and businesses have when the public realm is designed as a place for pedestrians to linger, enjoy public life, and spend time Downtown with fellow community members and visitors.

PAVERS & HARDSCAPE

The pavers and hardscape materials used in the plaza include precast pavers, truncated domes, concrete planters, lower concrete edgers, drainage pans, and grates.

PAVERS

Two primary types of precast pavers cover the surface of the street: 1) Smaller standard pavers in an interlocking pattern in the drive lane and parking spaces, and 2) Larger square and rectangular pavers in the pedestrian areas.

The pavers are generally in good condition but require ongoing resetting, replacement, and repair, especially in higher vehicular traffic areas. This is common with unit pavers; a larger replacement project should be anticipated in about 10-20 years dependent on use and conditions. The larger pedestrian pavers also appear to be in good condition. At the time of a full replacement, there may be a desire to consider smaller interlocking pavers to prevent cracking and chipping of the larger pieces.

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CONCRETE

The concrete areas used to frame the pavers and create edges or frames do have some cracks and chipping, which is to be expected. Full replacement of concrete areas may be required in areas with an abundance of cracks, such as corners and areas susceptible to Colorado's freeze-thaw cycles and unique weather and drainage conditions.



Image of existing unit pavers and colored concrete area on 8th Street needing repair and maintenance



Image of unit pavers in vehicular area, concrete flow line with drain inlets, and streetscape along 8th Street



Aerial image of 8th Street showing the curved roadway, parking, and streetscape

PLANTING & TREES

The landscape includes small lawn areas, landscape planters, trees, and areas for annual plantings in smaller pots or planters.

Trees and planting areas are in very good condition and well maintained. However, a few areas of recently planted trees indicate some loss of species. Maintenance should include periodic removal and replacement, as needed, as well as regular assessment of tree health to determine if more extensive tree replacement is needed.

PLAZA FURNISHINGS

The plaza furnishings include metal benches, bike racks, pedestrian lighting, and movable seating provided by the restaurants and cafes.

The plaza benches, bike racks, and trash receptacles are in good condition with some common maintenance issues associated with regular wear and tear. Most are standard products that can be easily replaced or repaired as needed.

The pedestrian light fixtures are also in good condition and appear well maintained. Unless damaged by a vehicle, light fixtures should only require typical repairs such as bulb replacement and occasional pole touch-ups.



Image of an existing planter pot, trash receptacle, and bench along 8th Street



Image of a colorful and artistic bicycle rack along 8th Street

9th Street Plaza

OVERVIEW

As the sibling to 8th Street, 9th Street is the second of the two premier public spaces in Downtown oriented toward pedestrians, promoting events, and creating an active retail and restaurant area. Therefore, the design is consistent with the placemaking, physical characteristics, and materiality of 8th Street.

The second of the two streets is also constructed using higher quality materials and finishes not seen throughout Downtown. As with 8th Street, the 9th Street Plaza requires a greater amount of regular maintenance.

PAVERS & HARDSCAPE

The pavers and hardscape materials match 8th Street and include precast pavers, truncated domes, concrete planters and, lower concrete edgers, drainage pans, and grates.

PAVERS

Similar to 8th Street, the plaza includes two primary types of precast pavers to cover the surface of the street. The pavers are also in good condition but appear to have some areas where pavers have been damaged and replaced. This includes areas where slight heaving or lifting may occur due to ongoing freeze-thaw cycles or a transition between paving patterns at the edges. Addressing this may include additional analysis to determine if an alternate paver subsurface base may be utilized.

CONCRETE

The concrete areas used to frame the pavers and create edges have some cracks and chipping, which is to be expected. Replacement of damaged areas with asphalt has occurred in select spots. These areas should be evaluated for long-term solutions to avoid the regular asphalt patching.



Image of large planters, trees, and sidewalk in front of existing businesses fronting 9th Street



Image of a large linear planter with trees separating the sidewalk and vehicular area on 9th Street



Aerial image of 9th Street showing the curved roadway, parking, and streetscape

PLANTING & TREES

The landscape matches the landscape material and character of 8th Street.

Trees and planting areas are also in good condition and will require the same maintenance recommendations as 8th Street.

PLAZA FURNISHINGS

The plaza furnishings also match the collection of benches, trash receptacles, lights, and bike racks of 8th Street. They are in good condition and there were no areas of major concern. The 8th Street Plaza maintenance recommendations also apply to 9th Street Plaza.



Image of the existing large planter and furnishings near the corner of 9th Street and 8th Avenue



Image of the wide sidewalk area, furnishings, and large planter with trees fronting commercial buildings on 9th Street

Parks

Lincoln Park

OVERVIEW

Lincoln Park is the largest and most significant park in Downtown Greeley. The historic park is approximately 10 acres and roughly the size of two city blocks.

As the largest Downtown park, it has great historical significance and serves as the center of the community. Lincoln Park offers amenities such as Pioneer Fountain, Greeley's first drinking fountain, a gazebo, a small playground, planting beds, mature trees, benches, and paths for strolling. The park also hosts a variety of events such as the Arts Picnic and holiday events.

EXISTING CONDITIONS

The park is well cared for and maintained, with ongoing regular maintenance, improvements, and enhancements. Over the years, various improvements have been added, which retains the historic character and beauty while offering thoughtful new amenities. Continuing to strike a balance between retaining historic character and updating for current and future needs will continue to be a consideration for Lincoln Park as Greeley continues to grow and change.



Image of the existing gazebo in Lincoln Park



Aerial image Lincoln Park and the surrounding blocks in Downtown

PLANTING & TREES

The planting and trees include a combination of deciduous and evergreen trees with perennial and annual planting beds set within the lawn area. Due to ongoing maintenance and upkeep, the plantings are all in good condition.

EDGES AND ENTRIES

Although the edges and entries to the park are well maintained, the surrounding streets lack an amenity zone and buffer between the sidewalk and parking, making it an uncomfortable transition into the park. This is exacerbated by the large road widths surrounding the park and uncomfortable crossings to the west on 8th Street.

The key gateways along the western edge and major corners help create identifiable entries, but the lack of entries at the northeast and southwest corners limit points of access and does not successfully connect the park to those areas.



Image of the existing gazebo in Lincoln Park



Image of the central garden and gathering space



Image of the existing playground

Glossary of Terms

Item No. 6.

Definitions

AMENITY AREA. A designated area with desirable or useful features typically located between the curb and sidewalk.

BUILDING ACTIVATION/ FRONTAGE. The exterior of buildings in the context of their scale or connection to the street, curbs, sidewalks, and pedestrians.

CAPITAL IMPROVEMENT ASSESSMENT. A physical qualitative evaluation of the existing streets, plazas, and parks as revitalizing assets located within the Downtown Development Authority (DDA) boundary, which is the study area for this Downtown Plan Update.

DOWNTOWN GRID. The typical uniform layout and crossings of Downtown Greeley's streets. The streets meet at right angles in a dense pattern which encourage walkability and create rectangular blocks.

FRAGMENTED. Meaning a break in functioning pattern, quality, or appearance, resulting in a inconsistent layout in the Downtown area.

GATEWAY. A significant point of entry, denoted by signs and purposeful markers.

HARDSCAPE. Any non-living treatments or elements in a designed landscape or streetscape area. Often this is referring to paving surfaces such as concrete, bricks, pavement materials, stone, or wood.

PLACEMAKING. An approach to create distinctive qualities and gathering spaces that form the heart and identity of a community. This shapes people's user experience, perception, and level of enjoyment while interacting within the community or Downtown area.

PUBLIC REALM. Publicly-owned and publicly accessible streets, lanes, plazas, parks, courtyards, and other areas with different scales or purposes. These types of public spaces are enhanced to create distinctive and unique places that invite and encourage activity.

RIGHT-OF-WAY. The area designated for use as a street, including the travel portion of the street, the shoulders, curbs, gutters, sidewalks, utilities, drainage facilities, traffic signs and any other improvements.

SETBACK(S). Referring to the distance between a residential or commercial structure or building to the property line or sidewalk. This is typically a design code that a structure must be in compliance with as defined by zoning or other adopted regulatory standards.

STREETSCAPE. The collective appearance of visuals and interactive elements such as trees, building facades, landscaping, art, sidewalk, street furnishings, and signage on a given street that comprise its character and use.

TRUNCATED DOME. Is ground surface, physically altered pavement, specially placed to indicate street crossing or platform changes for people with low vision or blindness.

WAYFINDING. All of the ways in which people orient themselves in physical space and navigate from place to place. Wayfinding typically consists of signs and markers to help people navigate from one place to another.

WOONERF. A street design that minimizes the separation of space between vehicles, pedestrians, bicyclists through speed reduction, traffic calming treatments with less or flexibility of the curb space.

APPENDIX C: URBAN QUALITY ASSESSMENT

Urban Quality Assessment

Downtown Greeley

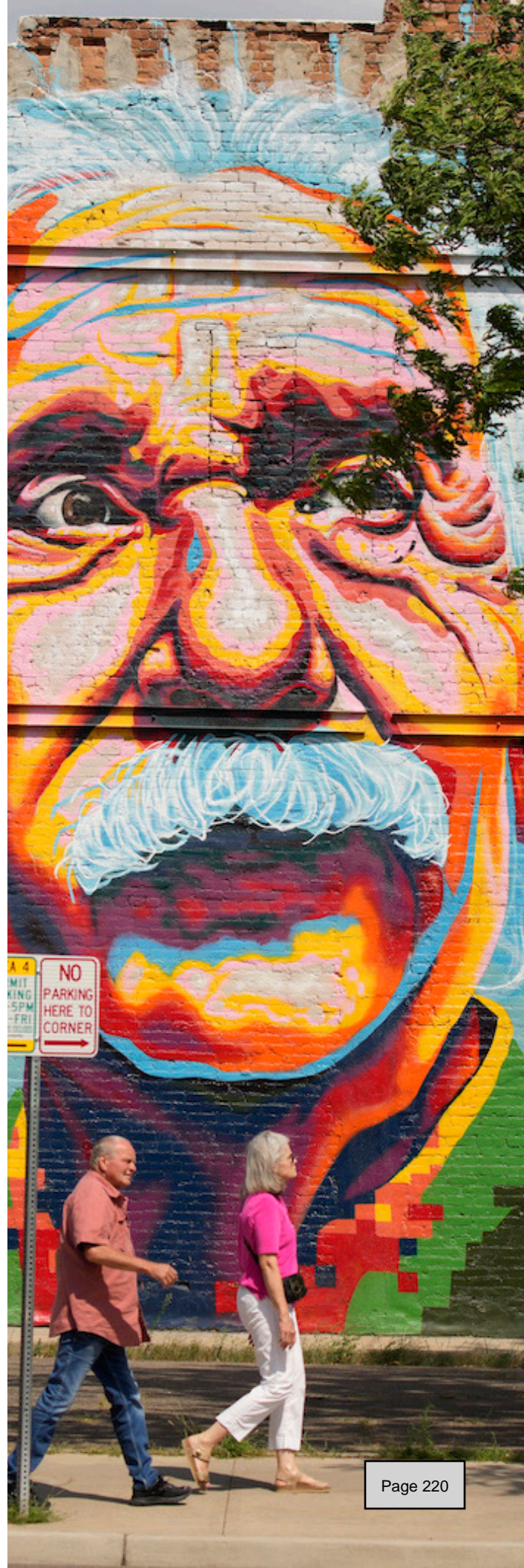
LIVABLE CITES STUDIO

NOVEMBER 2022



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INTRODUCTION

The Urban Quality Assessment is intended to evaluate the public realm beyond just the public right-of-way. The City of Greeley is fortunate to have a vibrant, successful, and celebrated Downtown that serves as the core of the Greeley community. For decades, Downtown has provided its residents and visitors with businesses, shops, stores, civic buildings, parks, and history that make Greeley the unique place it is today. More recently, new public realm improvements, redevelopment activities, the formation of the Greeley Creative District, and the public art program have brought new life and energy to Downtown. Despite recent improvements, Greeley's streets and public spaces do not do Downtown justice to its lively community. Over time, the balance of streets and public space design has swung too far in favor of cars and functional infrastructure, often at the expense of residents, placemaking, and the environment.

Although the Downtown community and City of Greeley have done a tremendous job addressing this imbalance through previous projects and initiatives, there is still much work to be done. The Urban Quality Assessment aims to address this imbalance by establishing a foundation for a high-quality public realm. By building within the human scale, physical improvements can accommodate the needs of all people and continue to build on previous Downtown place enhancement successes.



Image of people gathering Downtown for Friday Fest



Image of existing streetscape along 10th Street

URBAN QUALITY ASSESSMENT

DOWNTOWN CORE AREA SITE VISIT AND EVALUATION

The consultant team performed two types of analysis to assess the urban quality. The first type of analysis focused on the core Downtown area near Lincoln Park to evaluate how the public space is experienced by users. The second type of analysis included a comprehensive evaluation of the entire Downtown and focused on sub-areas, forms of movement, street hierarchy, and safety.

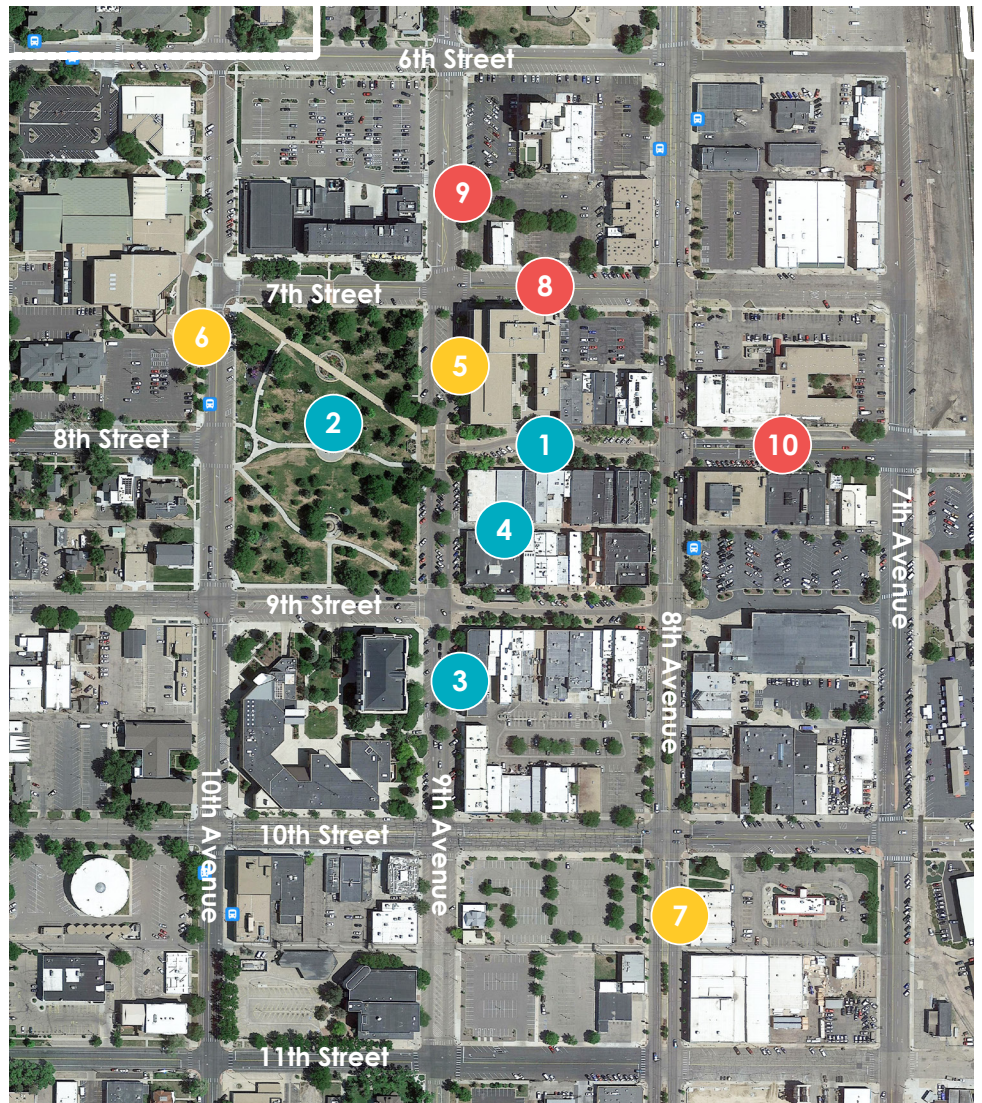
To evaluate how the public space is experienced by users, the consultant team visited the locations indicated on the map to the right and evaluated the quality of each space. The public realm quality rating is based on what fosters successful public spaces, provides protection, offers comfort, and creates interesting experiences for people.

The consultant team evaluated the public realm using the Twelve Quality Criteria method, which is a tool developed by Gehl Architects for researching how public spaces are experienced by their users. More specifically, it is used to evaluate whether different features of a public space are protective, comfortable, and enjoyable for people spending time there.

The thinking behind these three categories is as follows:

Without basic protection from cars, noise, rain, and wind, people will generally avoid spending time in a space

1. Without basic protection from cars, noise, rain, and wind, people will generally avoid spending time in a space.
2. Without elements that make walking, using a wheelchair, standing, sitting, seeing, and conversing comfortable, a place won't invite people to stay.
3. Great public spaces tend to offer positive aesthetic and sensory experiences, take advantage of local climate, and provide human-scale elements so visitors don't feel lost in their surroundings.



Site visit assessment reference map and locations

LEGEND

	Good
	Fair
	Poor

		1	2	3	4	5	6	7	8	9	10	OVERALL SCORE
Protection	Protection against traffic accidents Do people of all ages and abilities safely experience the public realm? Can you safely bike and walk without fear of being hit by a car?	3	3	3	3	2	2	2	2	2	2	24 / 30
	Protection against harm by others Is it perceived to be safe day and night? Is there adequate visibility, activity, and lighting?	3	2	3	2	2	2	2	1	1	2	20 / 30
	Protection from unpleasant sensory experience Is there noise, dust, odor or other pollution? Is there protection from wind, rain & sun?	3	3	3	1	2	1	1	1	1	2	18 / 30
Comfort	Options for Mobility Is the space accessible to all? Are there elements that enhance or limit mobility?	3	3	2	3	2	2	2	1	1	1	20 / 30
	Options to stand and linger Does the space have features to stay and lean on, or facades that invite people to stay?	3	2	3	2	1	1	2	1	1	1	17 / 30
	Options for sitting Are there good public seating options, such as benches, seating walls, or other forms of seating?	2	2	2	1	1	1	1	1	1	1	13 / 30
	Options for seeing Are seating options placed so there are interesting things to look at?	3	2	2	3	1	2	1	2	2	1	19 / 30
	Options for talking & hearing Is it possible to have a conversation here?	3	2	2	3	1	2	1	2	2	1	19 / 30
	Options for play, exercise, and activities Are there options to be active at multiple times of the day, every season, or throughout the year?	1	2	1	1	1	1	1	1	1	1	12 / 30
Experience	Scale Are the public spaces and surrounding buildings at a human scale? If people are at the edges of the space, can they still relate to them as people, or are they lost in the surroundings?	3	1	2	3	1	1	1	1	1	1	15 / 30
	Opportunities to enjoy the climate Are there spaces to enjoy the sun in the winter, shade in summer	3	3	3	1	2	1	1	1	1	1	17 / 30
	Experience of aesthetic qualities and positive sensory experiences Is the space beautiful and appealing? Is it clear that there is good design evident in terms of how the spaces are shaped, detailed, and maintained?	3	2	2	2	2	1	2	1	1	1	17 / 30
TOTAL SCORE		$\frac{33}{36}$	$\frac{28}{36}$	$\frac{28}{36}$	$\frac{25}{36}$	$\frac{18}{36}$	$\frac{17}{36}$	$\frac{17}{36}$	$\frac{15}{36}$	$\frac{15}{36}$	$\frac{15}{36}$	

Site visit evaluation matrix

SUBAREAS/ DISTRICTS

ANALYSIS OF THE 2011 SUB-AREAS

The 2011 *Downtown Greeley Investment Strategy* identified four sub-areas within the Downtown Plan Update study area boundary. An analysis of the sub-areas was conducted to evaluate how successful they are in establishing a sense of place and identity in the various areas of Downtown.

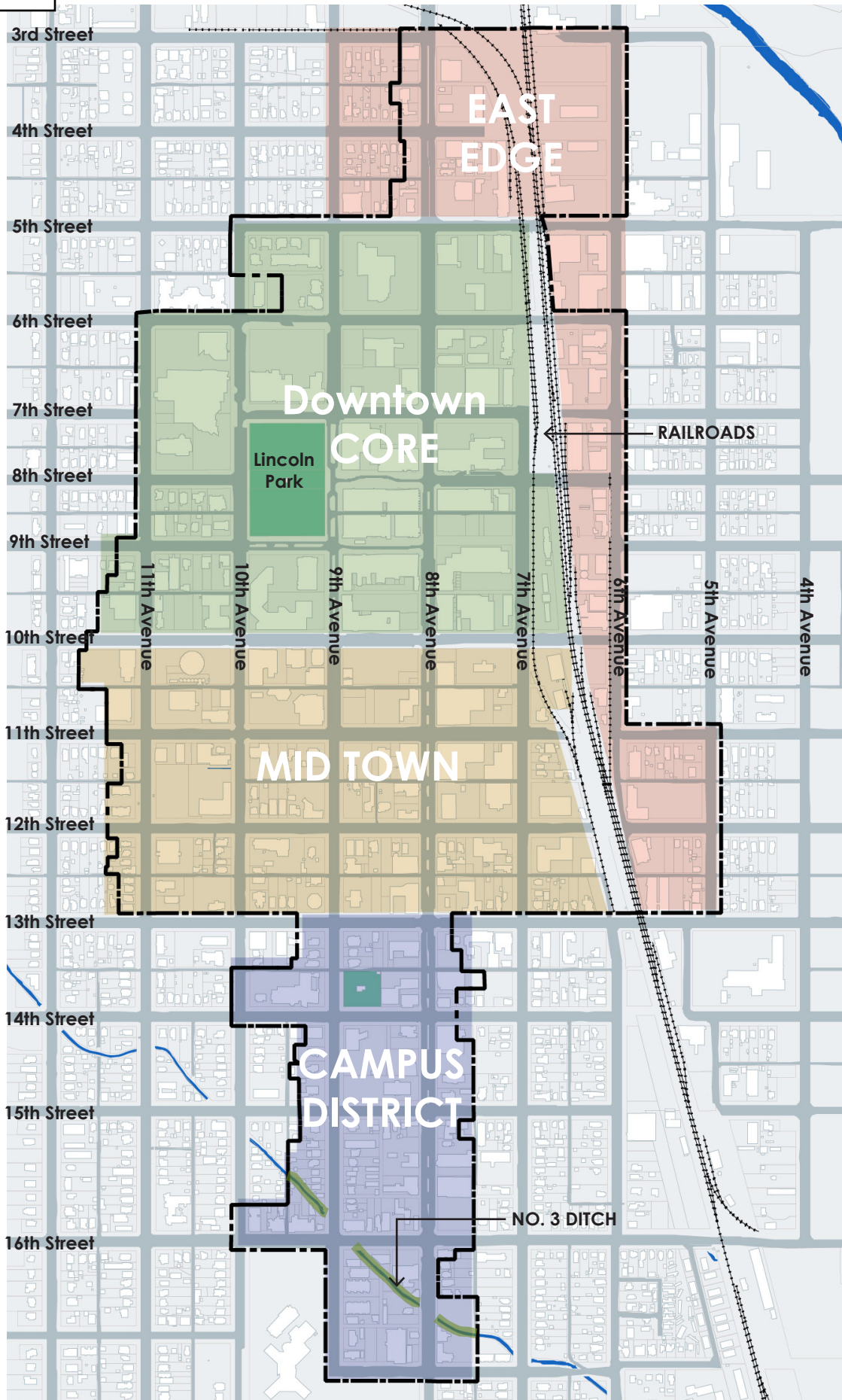
LACK OF CLEAR SUB-AREAS

Within the Downtown sub-areas identified in the 2011 strategic plan, the sense of place and identity of each area is not clear. Users still perceive Downtown as one larger area and tend to not identify with these sub-areas. There appears to be a general understanding between the northern Downtown core and the southern area near the University of Northern Colorado (UNC). The map to the right illustrates the sub-areas, as defined in *Downtown Greeley Investment Strategy*.

LACKING A SENSE OF PLACE WITHIN SUB-AREAS

Although the sub-areas are differentiated due to a change in current land uses, architectural character, or historical land uses, they lack a distinct sense of place and individuality from the other districts. This overall lack of definition and legibility¹ in the public realm is an opportunity to create a network of public space experiences that improve overall legibility while establishing a distinct sense of place within each sub-area.

1. Lack of definition and legibility refers to the lack of a consistent treatment of the physical features of the built environment, including building architecture, materials, and style, building use, and streetscape elements such as furnishings, hardscape, and landscape.



Map of the Downtown sub-areas from the 2011 Downtown Greeley Investment Strategy

PUBLIC SPACES

EVALUATION OF THE DISTRIBUTION OF PUBLIC SPACES

SUB-AREAS / DISTRICTS LACK CLEAR DEFINITION OR PUBLIC SPACE

Although the sub-areas have some identity through similar building uses or architectural character, they lack a distinct sense of place, edges¹, and an identifiable public space² to differentiate between each of them.

The map to the right illustrates the sub-areas identified in the *Downtown Greeley Investment Strategy*. This map shows existing and proposed public spaces to demonstrate unequal distribution in Downtown.

LACK OF LEGIBLE PUBLIC SPACE NETWORK

The locations of the public spaces reveal an unequal distribution and lack of legibility in the Downtown public space network. People often navigate cities from a mental map of known public spaces that are attractive, inviting, and comfortable to travel from one place to another. Downtown Greeley has an opportunity to improve upon its existing parks and plazas to create a more cohesive network of public spaces, reinforce the character of each sub-area, and enhance the overall Downtown experience.

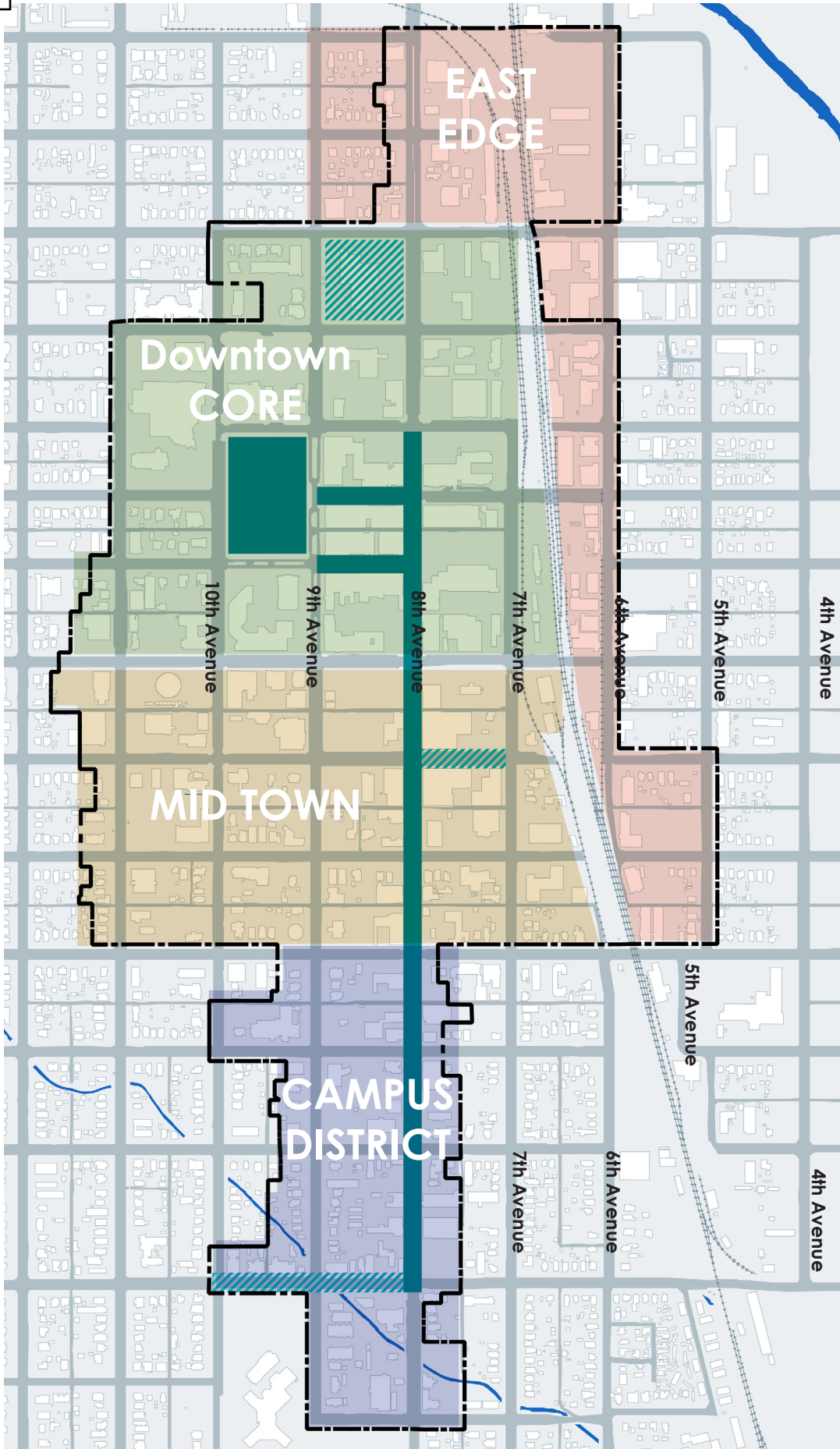
1. Edges in urban districts or neighborhoods are typically defined by a physical feature or character change that informs users they are crossing from one area to another. This can include gateway features, a change in streetscape character/landscape, building architecture, etc.

2. Identifiable public spaces are destination plazas, parks, streets, or recognizable public landmarks where people frequently congregate, socialize, and gather.

LEGEND

-  Existing Public Space
-  Future Public Space

3rd Street
4th Street
5th Street
6th Street
7th Street
8th Street
9th Street
10th Street
11th Street
12th Street
13th Street
14th Street
15th Street
16th Street



Map of the Downtown sub-areas from 2011 and existing public spaces

MOVEMENT

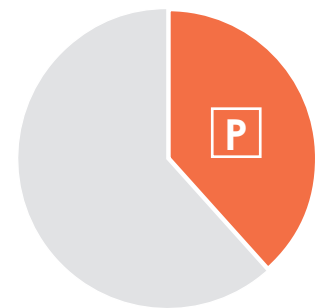
ANALYSIS OF AUTOMOBILES + PARKING

HIGH AMOUNT OF AREA DEDICATED TO VEHICLES AND PARKING

A significant portion of the Downtown area is allocated to automobiles in the form of wide roads, public right-of-way, and expansive surface parking lots. This unequal distribution and orientation towards automobile has resulted in an auto-centric Downtown experience that has limited areas for pedestrians and bicycle facilities. Although some areas feature higher-quality streetscapes, the overall character is inconsistent and lacks a clear focus on pedestrian experience and comfort.

DESIGNED FOR CARS AND NOT PEOPLE

Downtown Greeley's public realm has been historically designed for vehicles to provide easy access and plentiful parking throughout Downtown. The existing public realm prioritized motorists' needs with the exception of key pedestrian-oriented areas such as the 8th and 9th Street Plazas. In most areas, pedestrians often have to navigate uncomfortable sidewalk conditions with incomplete streetscapes. Many areas are missing amenities such as trees, landscape, and street furnishings. The result is a public realm that is fragmented and lacks a consistent treatment focused on pedestrian comfort and experience.



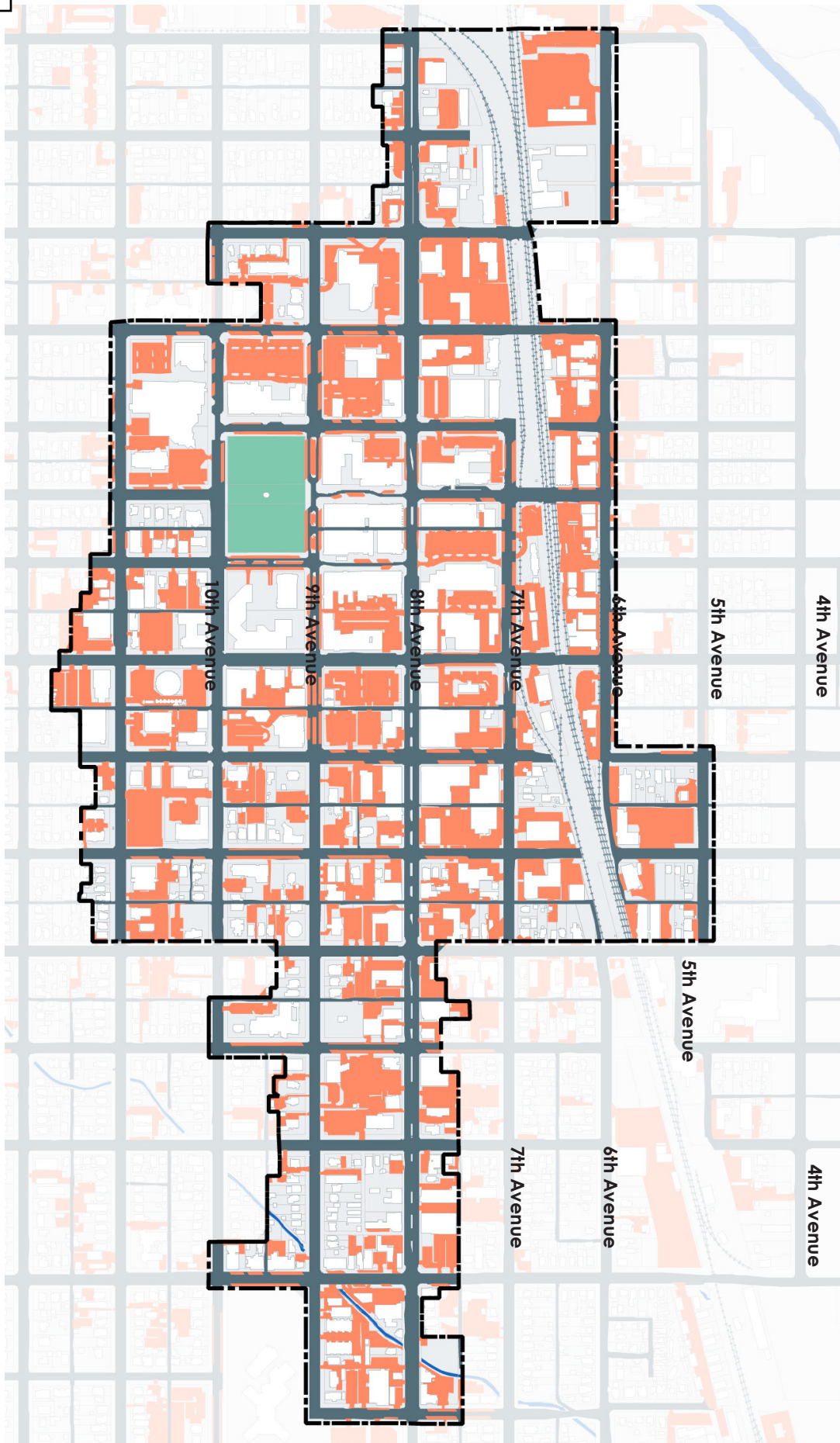
38.83%

of the total area outside the street right-of-way is surface parking

LEGEND

- Surface Parking
- Vehicular Roads

3rd Street
4th Street
5th Street
6th Street
7th Street
8th Street
9th Street
10th Street
11th Street
12th Street
13th Street
14th Street
15th Street
16th Street



Map of the existing surface parking lots outside the public right-of-way and vehicular roads

MOVEMENT

A REVIEW OF THE BICYCLE ENVIRONMENT

GREAT POTENTIAL TO INCREASE BICYCLING

Downtown Greeley is home to a growing bicycling community where students and residents bike Downtown as a part of their daily commute or to visit commercial and civic destinations. Despite Greeley's growing bike community, the existing bicycle network remains incomplete. As the diagram to the right shows, the bicycle network is still fragmented with gaps in the major north-south and east-west streets. While cyclists can move comfortably in some parts of Downtown, other areas are perceived as uncomfortable to bicyclists, especially among young children and families.

IMPROVE FACILITIES FOR BICYCLISTS

Bicycling in Downtown is also complicated by a lack of consistent bicycle facilities (E.g. striped bicycle lanes, buffered lanes, protected lanes cycle tracks, etc.), navigational signage, and protection from vehicles. In many cases, cyclists are sharing the road with vehicles and lack protective buffers, signaling devices to indicate that cyclists are present to drivers, or any other indicators that bicyclists belong in these travel corridors. Recent changes have had a positive impact on the bicycling environment and the available right-of-way in Downtown provides an opportunity for more substantial changes to make bicycling here safe and inviting.



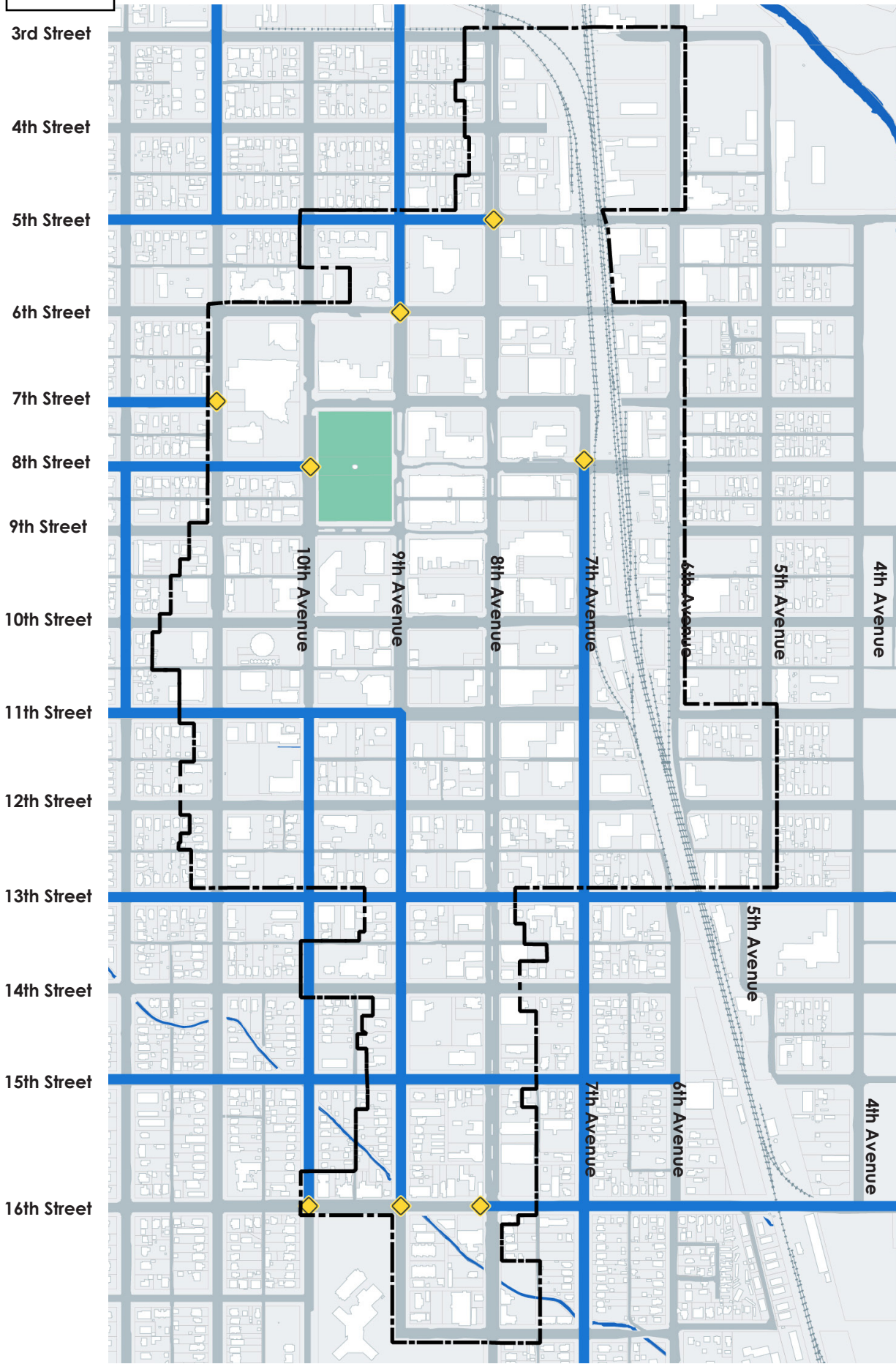
8

locations where bike lanes end without a transition to the connecting streets

LEGEND

 Bike Lanes

 Bike Lanes Ends



Map of the existing bike lanes and locations where the bike lanes terminate

STREET HIERARCHY

ROLE AND DESIGN OF THE STREETS

NETWORK OF HIGH TRAFFIC VOLUME STREETS

Downtown Greeley is impacted by network of arterial and collector streets that are designed to carry high traffic volumes. It is important to consider designing streets for slower modes of transportation, such as pedestrians, bikes, and other micromobility vehicles to make Downtown more inclusive and safe for all modes of transportation.

The information below is a summary of the major street classifications and design criteria.

Major Arterial: streets designed to carry traffic volumes greater than 20,000 vehicles per day.

Minor Arterial: streets designed to carry traffic volumes greater than 15,000 vehicles per day.

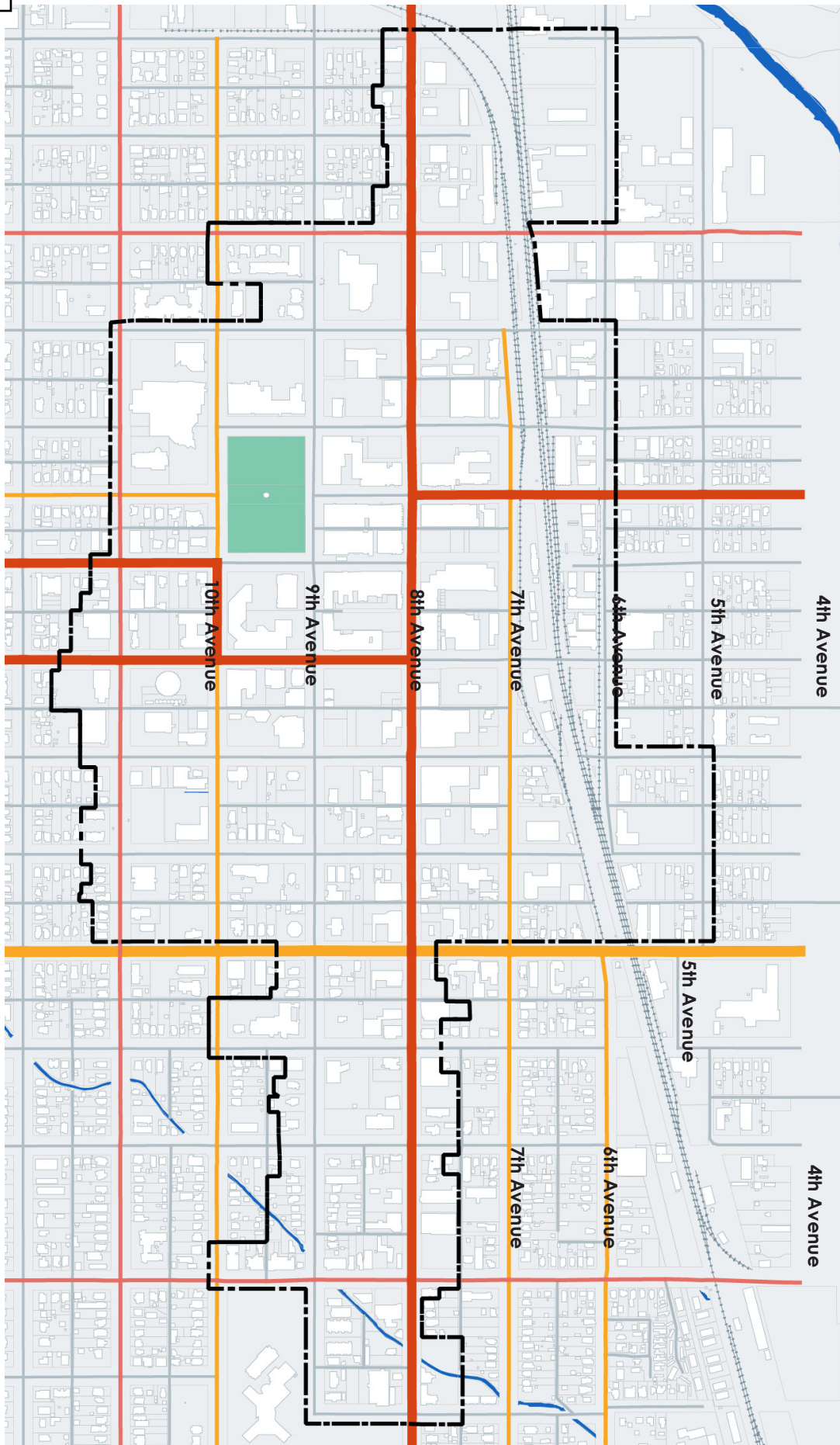
Major Collector: streets designed to carry traffic volumes greater than 10,000 vehicles per day.

Minor Collector: streets designed to carry traffic volumes greater than 3,500 vehicles per day.

LEGEND

-  Major Arterial
-  Minor Arterial
-  Major Collector
-  Minor Collector

3rd Street
4th Street
5th Street
6th Street
7th Street
8th Street
9th Street
10th Street
11th Street
12th Street
13th Street
14th Street
15th Street
16th Street



Map of the existing streets and their roadway classifications

SAFETY

AN EVALUATION OF PEDESTRIAN LIGHTING

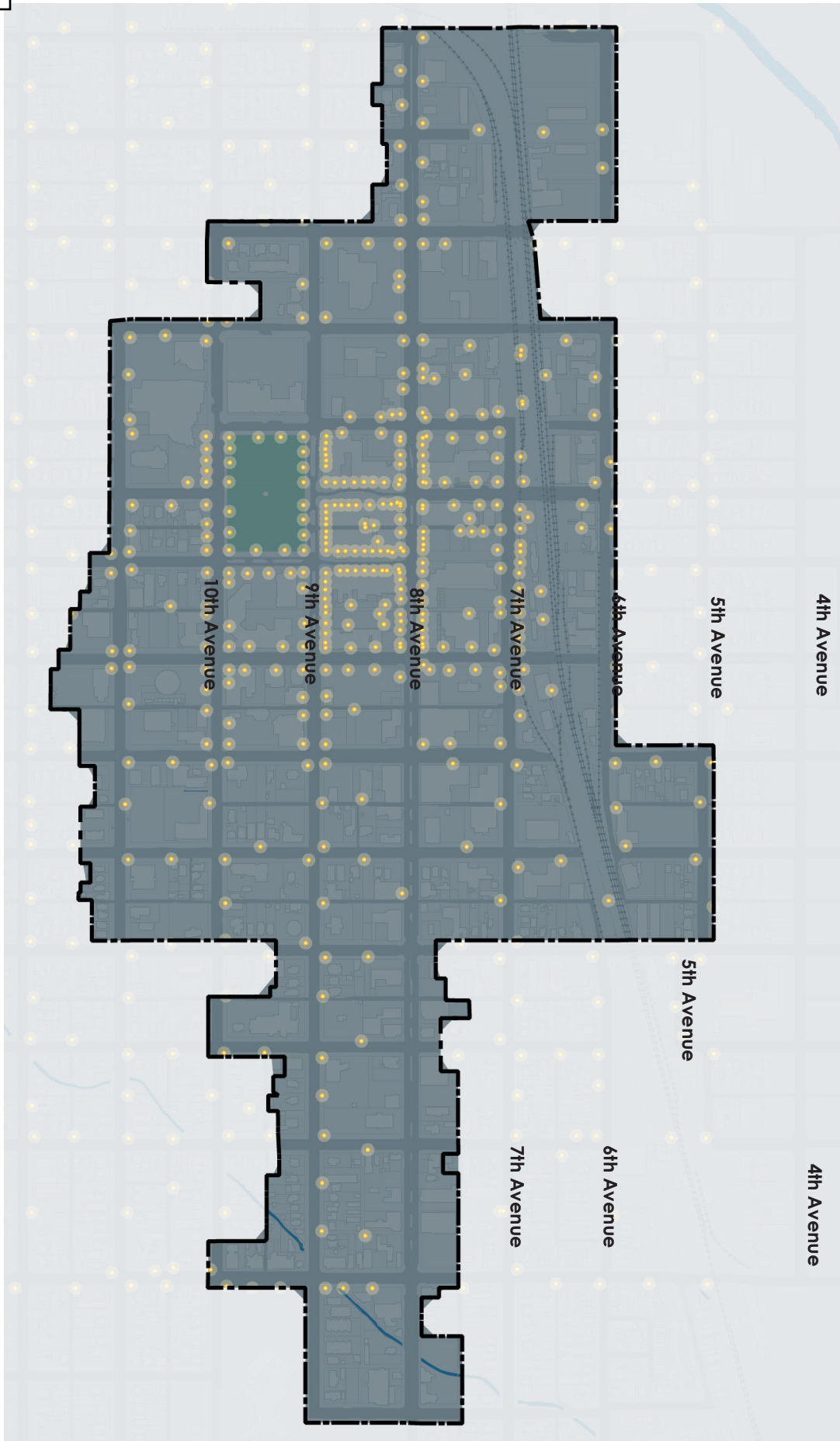
POCKETS OF ADEQUATE LIGHTING

Adequate lighting during the evening hours creates the perception of a safe environment and attracts visitors and residents. The diagram to the right indicates Downtown Greeley has pockets where a greater density of lighting is provided, creating a greater sense of comfort and safety. Outside of the well-lit pockets near 8th and 9th Streets, limited street lighting is evident, which creates an inconsistent feeling of safety throughout. This is especially the case in the southern end of Downtown near the University of Northern Colorado.

LEGEND

 Lighting

3rd Street
4th Street
5th Street
6th Street
7th Street
8th Street
9th Street
10th Street
11th Street
12th Street
13th Street
14th Street
15th Street
16th Street



Map of the existing lighting

SAFETY

UNDERSTANDING PEDESTRIAN AND BICYCLE CRASHES

TRAFFIC CONFLICTS AND SAFETY BARRIERS

Data on pedestrian and bicycle related traffic incidents indicate that major arterial streets such as 8th Avenue and 10th Street remain to create unsafe areas for pedestrians and non-vehicular users. The increased number of accidents along these two corridors indicates the need for additional actions to protect pedestrians and bicyclists from vehicles along these highly used routes. Both 8th Avenue and 10th Street currently represent a safety challenge and interrupt movement by pedestrians and bicyclists between the main core of Downtown and the outlying areas.










23

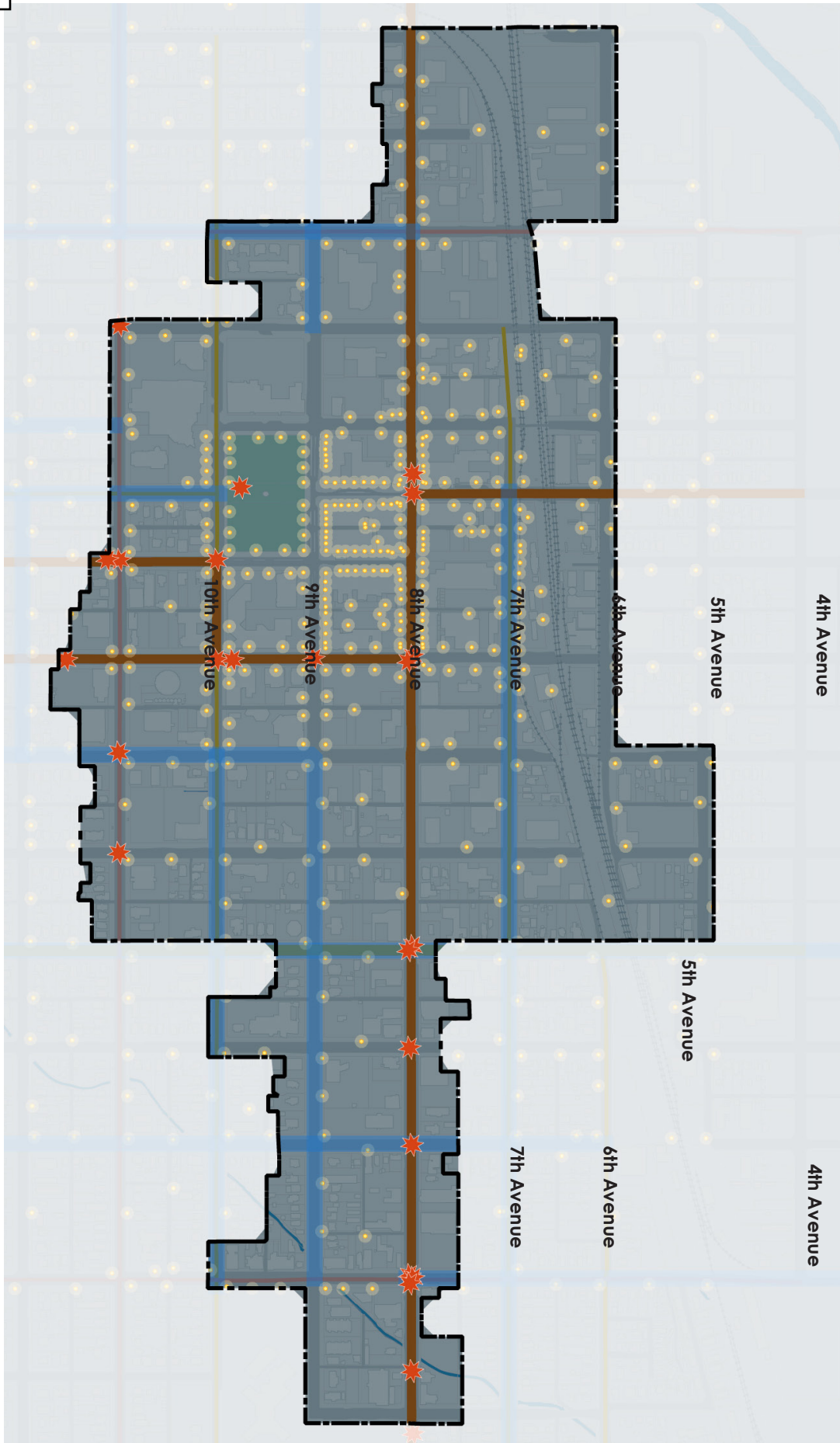
pedestrian and bicyclist related crashes occurred within the Downtown study area¹

¹. Crash data is from 2015-2019

LEGEND

-  Pedestrian & Bicyclist Related Traffic Crashes
-  Lighting
-  Bike Lanes
-  Major Arterial
-  Minor Arterial
-  Major Collector
-  Minor Collector

3rd Street
4th Street
5th Street
6th Street
7th Street
8th Street
9th Street
10th Street
11th Street
12th Street
13th Street
14th Street
15th Street
16th Street



Map of the existing lighting, roadway classifications, and pedestrian and bicyclist related traffic crashes

APPENDIX D: ONLINE COMMUNITY SURVEY RESULTS

DOWNTOWN 2032 – THE PATH FORWARD

ONLINE SURVEY SUMMARY

An online survey was prepared by Progressive Urban Management Associates (P.U.M.A.) as part of the Greeley Downtown Plan Update, *Downtown 2032 – The Path Forward*. This survey was open to the public with the goal of gathering information from a broad audience about their experience and desires for Downtown Greeley for the future. The survey, which was available in both English and Spanish, ran from June 28th to August 15th, 2022. It collected **1,100 responses**.

Demographics: Survey participants represented a cross-section of community stakeholders. Respondents represented a wide variety of age groups (with highest response from 25-44 years old (44%)), were heavily white (87%), and female (63%), and represented a range of household incomes (with 37% of respondent households reporting \$100,000 to \$200,000 in annual income, 35% in the \$50,000 to \$100,000 range). 11% of respondents are Downtown residents and 62% of respondents live outside of Downtown but in Greeley. 50% of respondent live in the 80634 zip code and 35% in 80631. More details on respondent characteristics can be found starting on page 14.

Cross-tabulations: Key survey questions were also cross-tabulated by demographics including interest in Downtown Greeley, age, household income, and race and ethnicity. Key findings from cross-tabulations can be found beginning on page 18.

KEY FINDINGS

Downtown Greeley Today

- **65% of respondents come to Downtown Greeley at least once per week**, with **23%** of respondents visiting downtown on a **daily basis**.
- **Food/beverage and entertainment are significant draws:** 79% of respondents cited restaurants, bars, food trucks, and coffee shops as key reasons they come Downtown. The second most significant amenity that draws people downtown are events and festivals, such as Friday Fest and Oktobrewfest (55%). The third highest answer was entertainment more generally, with 25% of respondents selecting this option.
- While many respondents indicated support for greater bike, pedestrian, and non-vehicle transportation options, **the majority of respondents (90%) typically drive to get Downtown**.

Downtown Greeley in the Future

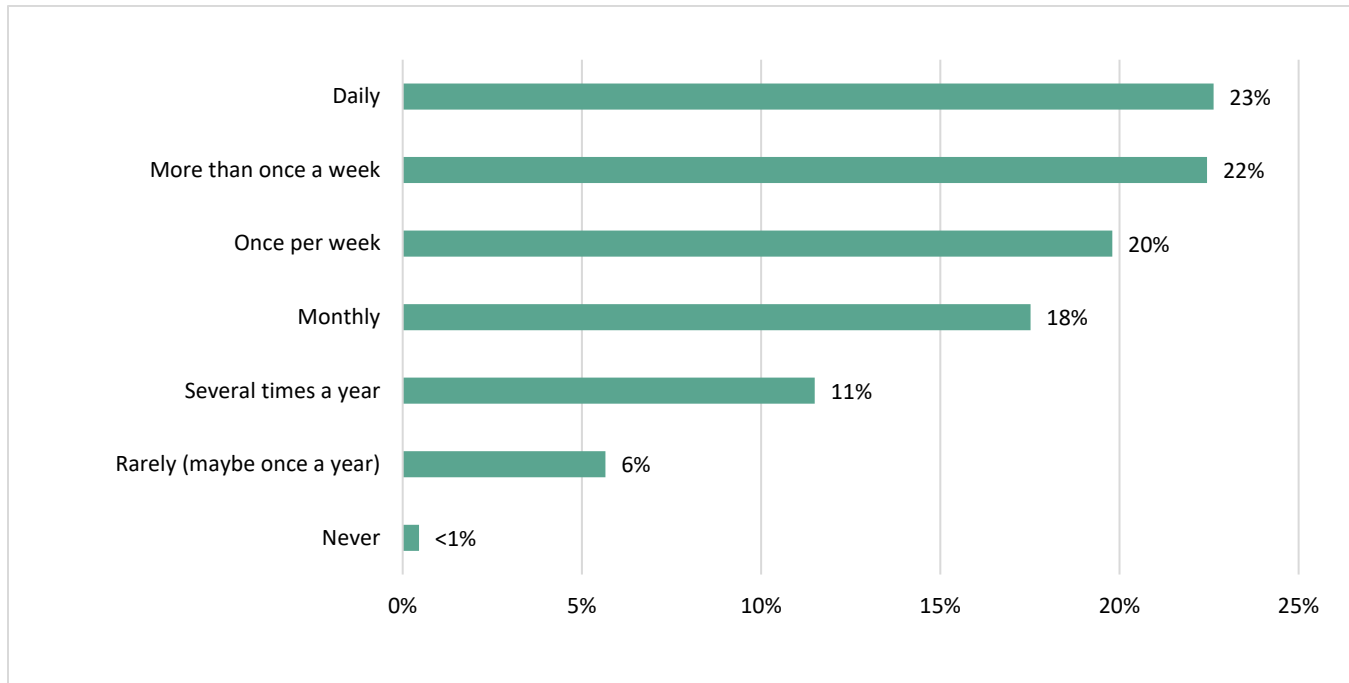
- When asked to provide three words that best capture their vision for Downtown Greeley in the year 2032, the top responses, were **safe, food (& restaurants), clean, and fun**.
- The *physical improvement* answer choices given the most ratings of 'important' or 'very important' to implement in order to achieve respondents' vision for Downtown Greeley were: **redevelop and repurpose underutilized surface parking lots and vacant buildings** (92%), **more beautification** (88%), and **increase lighting in the public realm throughout Downtown** (83%).

SURVEY RESULTS

Question 1: How often do you come to Downtown?

Responses: 1,096

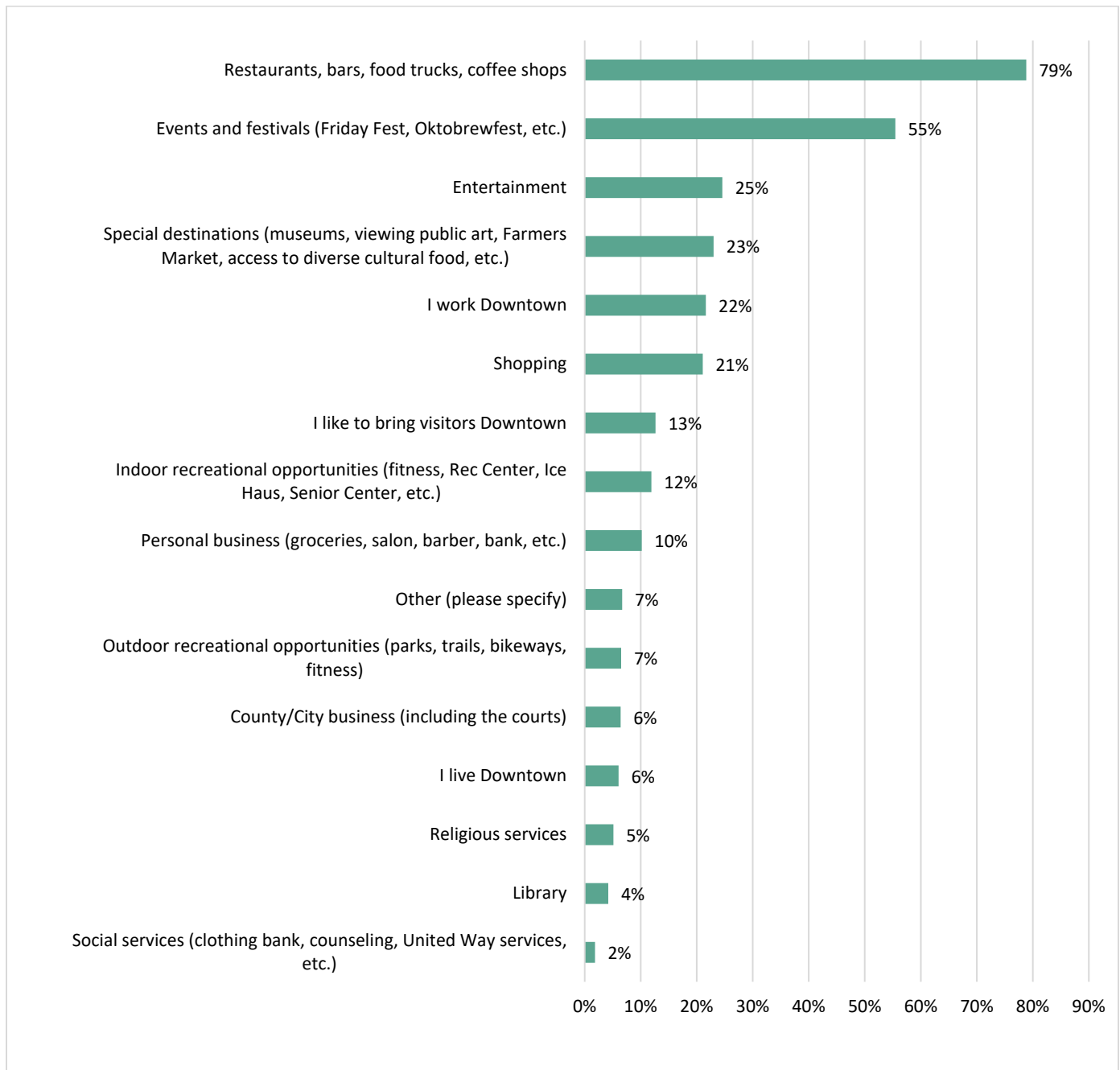
When asked to respond to how often they come to Downtown, most respondents answered that they come **daily**, with **more than once a week** or **once a week** as the next most popular answers. These three responses captured about **65%** of respondents.



Question 2: Please select the top three things that bring you to downtown Greeley.

Responses: 1,094

When asked select what brings them to downtown Greeley most often, **restaurants, bars, food trucks, coffee shops** were by far the top answer in respondents' top three with **79%** of responses. **Events and festivals** and **entertainment** were also in the top three with **55%** and **25%** of responses, respectively. *Note that respondents were allowed to select up to three answer choices, so the graph below exceeds 100%.*



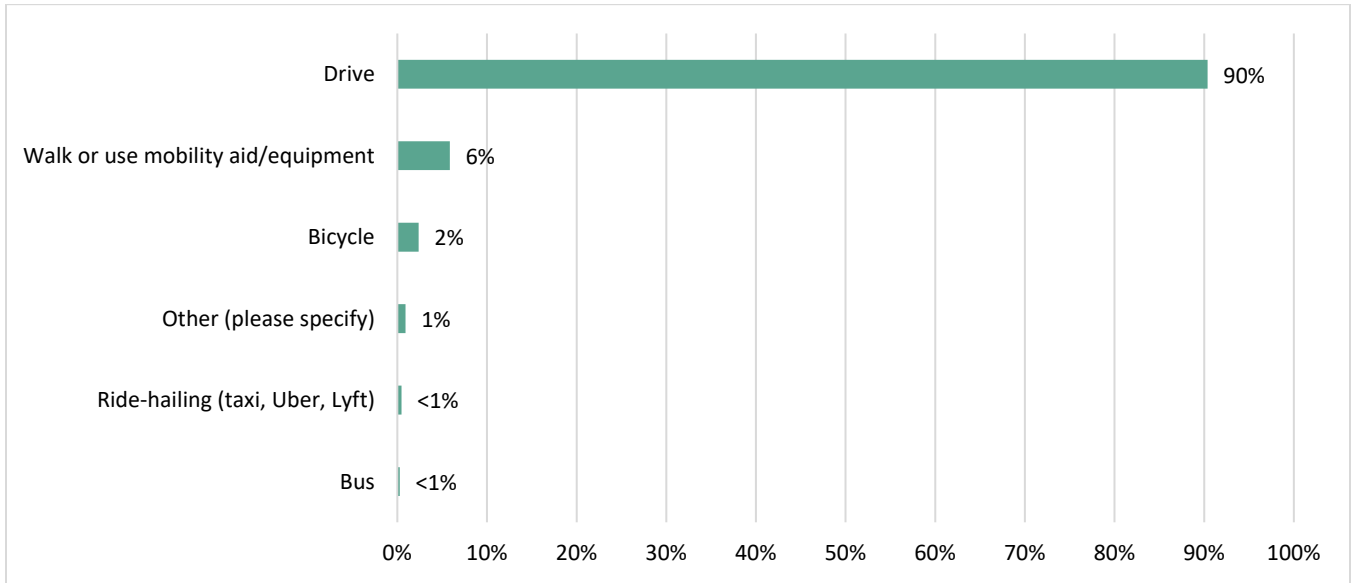
When asked to specify the response of "other" (73 responses), common themes included:

- Visiting specific local businesses, including WeldWerks Brewing Co., Greeley Hatchet House, Natural Grocers
- Many people come downtown for entertainment, including The Kress Cinema & Lounge
- Social events including meetings and volunteering including through organizations including the Greeley Rotary and Chamber of Commerce
- Union Colony Civic Center concerts, art shows, and volunteering opportunities
- Several respondents noted that yoga and dance classes bring them downtown
- Others said they pass through downtown during their commute

Question 3: How do you most often get to Downtown?

Responses: 1,095

Most respondents, **90%**, indicated that they **drive** to Greeley's Downtown. **6%** of respondents answered that they **walk or use mobility aid/equipment**, while **2%** of respondents selected **bicycle** as their primary means of transportation to Downtown. When asked to specify the response of "other", most of the answers included a combination of driving, walking or using mobility aid/equipment, and bicycling.



Question 4: Looking to the future, what three words best capture your vision for Downtown Greeley in the year 2032?

Responses: 787

The word cloud to the right represents the words respondents used to describe their vision for Downtown Greeley in the future. The size of the word indicates how frequently it was used, with the largest words being the ones used most often. The top responses, were **safe** (207 responses), more/improved **food** (& restaurants) (135 responses), **clean** (110 responses), and **fun** (94 responses).



Question 5: To achieve your vision for Downtown Greeley, how important are the following physical improvements over the next 10 years?

Responses: 852

Respondents were asked to rate a series of physical improvements as either 'very important,' 'important,' 'fairly important,' 'slightly important,' or 'not important.' The chart below is sorted according to the action's importance, with the most popular answer choice highlighted for each. All of the improvements were considered by the majority of respondents to be important, but the top three actions considered 'very important' or 'important' were: **redevelop and repurpose underutilized surface parking lots and vacant buildings** (92%), **more beautification** (88%), and **increase lighting in the public realm throughout Downtown** (83%).

	Very Important	Important	Fairly Important	Slightly Important	Not Important
Redevelop and repurpose underutilized surface parking lots and vacant buildings	65%	27%	6%	2%	1%
More beautification (continue public art, additional alleyway enhancements, landscaping and greening, etc.)	58%	30%	7%	3%	2%
Increase lighting in the public realm throughout Downtown (streets, sidewalks, parks, trails, etc.)	51%	32%	12%	3%	2%
Maintain the historic character and authenticity	52%	26%	14%	6%	2%
Enhance Lincoln Park (dog park, covered gazebos, picnic tables, etc.)	37%	32%	20%	8%	3%
Improve the pedestrian and bicyclist experience throughout downtown (east/west connections crossing 8th Avenue and rail tracks, more connected bike lanes, address missing sidewalks, etc.)	37%	30%	16%	11%	6%
Improve gateways in and out of Downtown (better signs, landscaping, lighting, etc.)	33%	32%	22%	9%	3%
Improve traffic flow into and around Downtown (signal timing, conversion of one-way streets to two-way streets, east/west connectivity, etc.)	32%	30%	21%	11%	6%
Improve connections to surrounding neighborhoods	25%	32%	23%	12%	8%
Improve stormwater and wastewater management in Downtown	23%	28%	27%	16%	5%
Increase connections to the Poudre River Trail	28%	23%	23%	16%	10%
Other (please specify below)	32%				

Responses in the 'Other' category include:

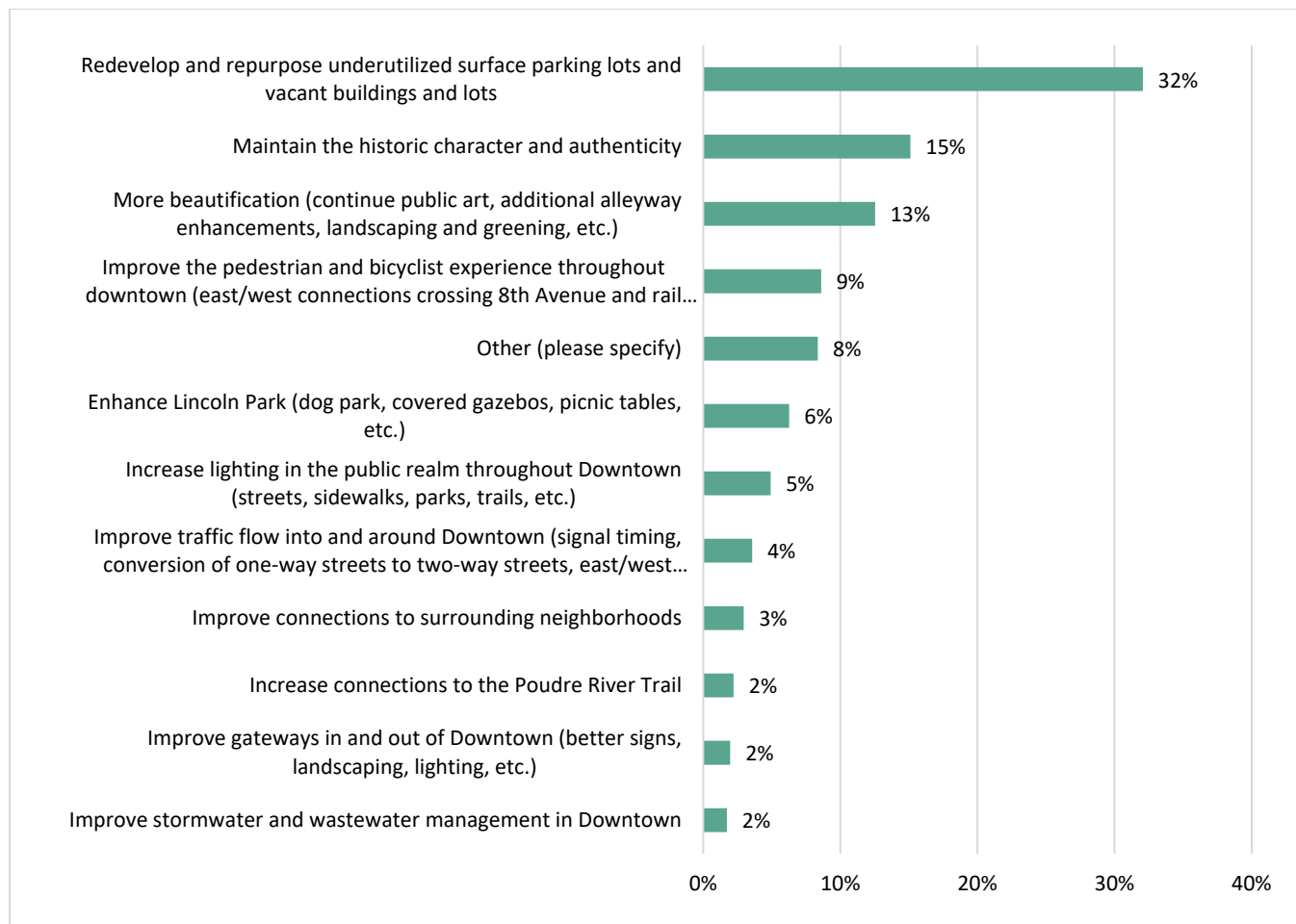
- Lighting in neighborhoods (East Greeley)
- Maintenance standards for residential rentals
- Case study to look at: David Street Station (Casper)
- Climate solutions to reduce emissions
- Interactive art like pianos
- Splash parks/pads

- Permanent space for food trucks, live music
- More mixed used development
- Physical realm should reflect western heritage
- At least 50% of 'Other' answers were about addressing the unhoused population

Question 6: Of the improvements listed in the prior question, which ONE action will be MOST important?

Responses: 816

Respondents were asked to select ONE physical improvement from the previous question's answer choices. The top responses from survey respondents were: **redevelop and repurpose underutilized surface parking lots and vacant buildings and lots** (22%), **maintain the historic character and authenticity** (15%), and **more beautification** (13%).



Question 7: To achieve your vision for Downtown Greeley, how important are the following services over the next 10 years?

Responses: 850

Respondents were asked to rate a series of services in Downtown Greeley as either 'very important,' 'important,' 'fairly important,' 'slightly important' or 'not important.' The chart below is sorted according to the action's importance, with the most popular answer choice highlighted for each. The top three actions considered 'very

important' or 'important' were: **more retail and restaurants** (90%), **enhance public safety** (87%), and **improve property maintenance** (83%).

	Very Important	Important	Fairly Important	Slightly Important	Not Important
More retail and restaurants	65%	25%	8%	2%	0%
Enhance public safety	62%	25%	9%	3%	1%
Improve property maintenance	43%	40%	12%	4%	1%
More arts and cultural facilities, events, and activities for all ages	50%	31%	13%	3%	2%
Provide more services to address the unhoused population	52%	27%	12%	5%	4%
Increase activation of public realm in Downtown (activation of alleys, Lincoln Park programming, increase outdoor dining options, etc.)	38%	37%	19%	5%	1%
Make downtown more welcoming and inclusive to people of all cultural backgrounds	49%	25%	14%	8%	5%
Improve the parking experience	38%	34%	18%	7%	2%
Strengthen surrounding neighborhoods	34%	38%	20%	7%	2%
Make Downtown more friendly to pedestrians and bicyclists	35%	35%	17%	8%	5%
Improve marketing of Downtown Greeley to local and regional markets	34%	34%	22%	8%	2%
More primary employers and job options	26%	33%	27%	9%	4%
Childcare and kid-friendly features and places	25%	33%	24%	13%	5%
More services for daily needs, such as grocery, pharmacy, daycare, doctors' offices, veterinarian, etc.	30%	28%	21%	12%	8%
Create more connections to UNC	25%	29%	23%	13%	10%
Additional hotels and hospitality services (e.g., bed and breakfast, new hotel, etc.)	17%	29%	29%	17%	9%
More housing options	16%	26%	28%	17%	13%
Other (please specify below)	11%				

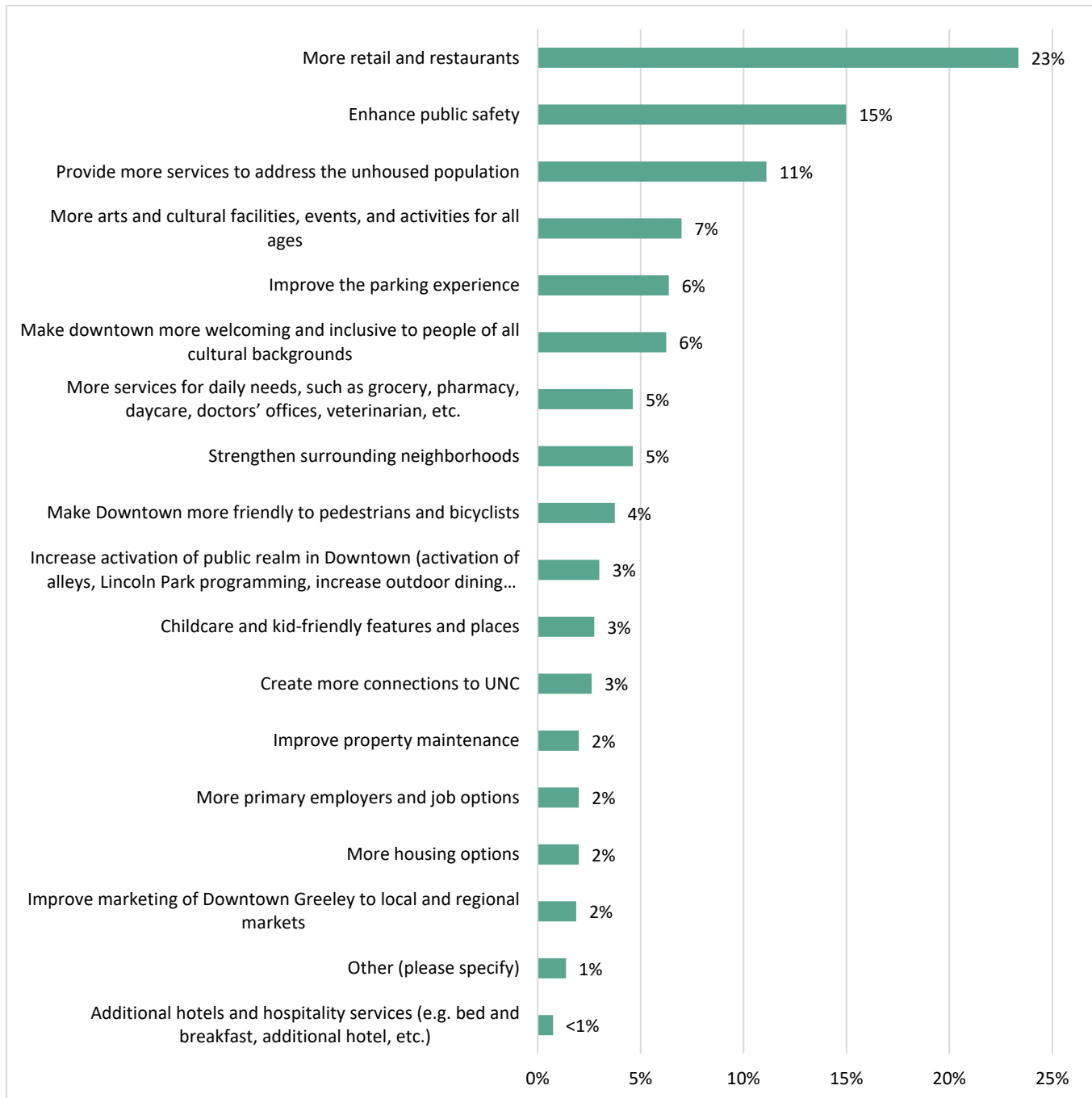
Responses in the 'Other' category include:

- Expand hours of transit service (bus), e.g., evenings and weekends
- More alcohol-free events and entertainment options
- Ensure community development represents diverse interests and cultures
- Increase outdoor dining options
- Support/subsidize small businesses, particularly ground floor retail
- Address the Clarion Hotel site
- Affordable grocery

Question 8: Of the improvements listed in the prior question, which ONE action will be MOST important?

Responses: 804

Respondents were asked to select ONE service from the previous question's answer choices. The top responses from survey respondents were: **more retail and restaurants** (23%), **enhance public safety** (15%), and **provide more services to address the unhoused population** (11%).



Question 9: If you could suggest one additional and specific improvement to enhance Downtown Greeley, not listed above, what would it be?

Responses: 388

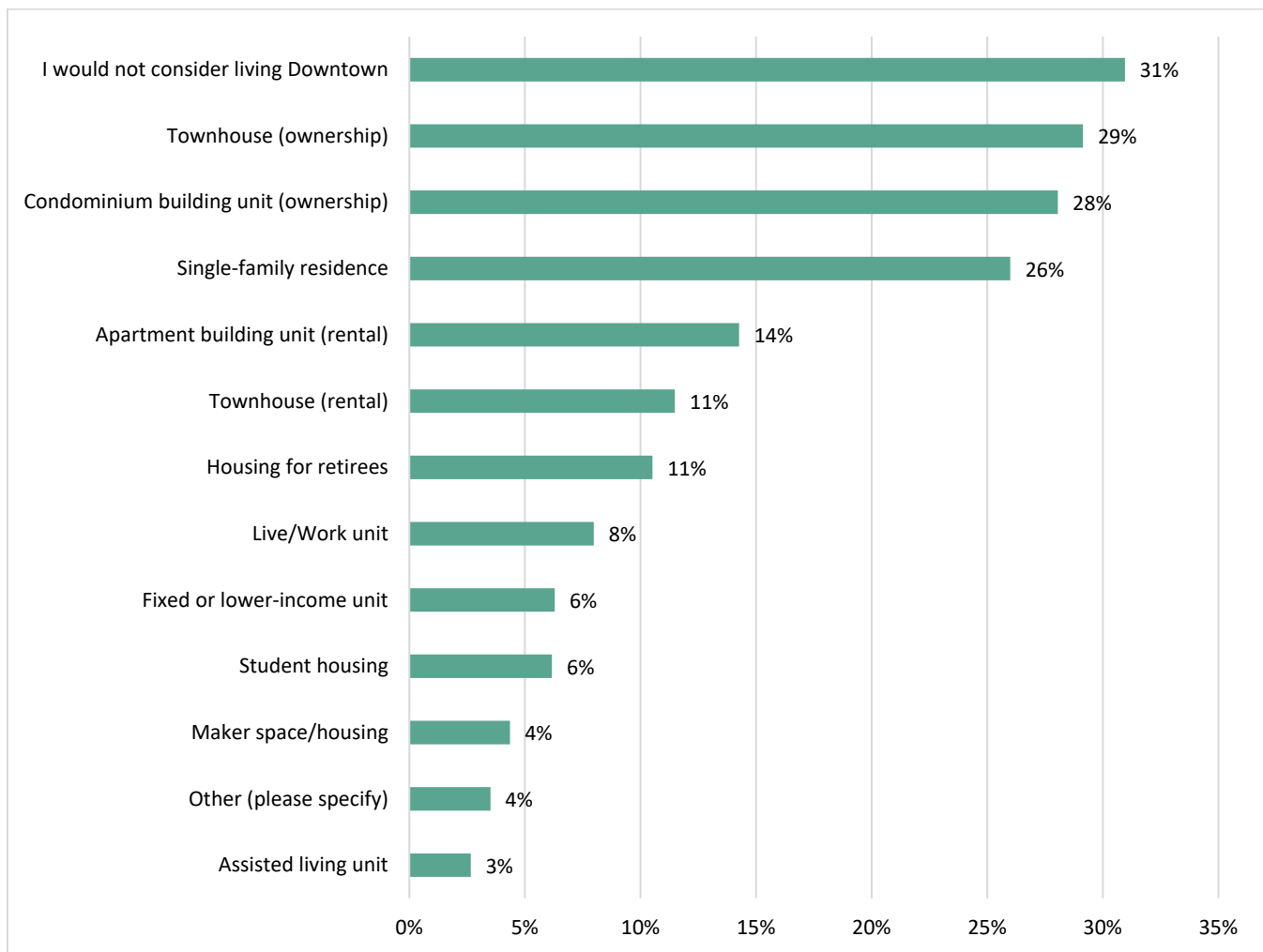
Respondents were asked to provide ideas for additional improvements to Downtown Greeley in an open-ended format. Many respondents elaborated on answer options provided in the prior questions. Specific ideas not included in previous questions include:

- "Anchor" destinations
- Facilitate more opportunities for people to start businesses, such as affordable rental studio space or a commissary kitchen
- Better integrate Lincoln Park and 9th Street (e.g., areas near the courthouse) into downtown – more retail and restaurant activity there
- Outdoor music stage and venues
- Affordable grocery store
- More and better-connected transit
- More multi-cultural events and food
- More parks, dog parks
- Consider the Clarion Hotel site for future redevelopment opportunities
- Outdoor shopping center (like Centerra)
- Ensure shops are open later hours
- More EV charging stations and bike-lock stations
- Outdoor fitness facilities
- Re-establishing the trolley
- Community gardens
- Public restrooms
- Expand the General Improvement District (GID)
- Leave Downtown as it is

Question 10: If you were to consider living Downtown, what type of housing would you most desire? (Please select up to three only)

Responses: 830

Respondents were asked to select which types of housing they would desire if they were to consider living Downtown. The top response was **I would not consider living Downtown**, which **31%** of respondents selected, which suggests that the remaining 69% of respondents would consider living Downtown. Of the housing types, the following were the top choices: **townhouse (ownership)**, **condominium building unit (ownership)**, and **single-family residence** with **29%**, **28%**, and **26%** of responses, respectively. *Note that respondents were allowed to select up to three answer choices, so the graph below exceeds 100%.*



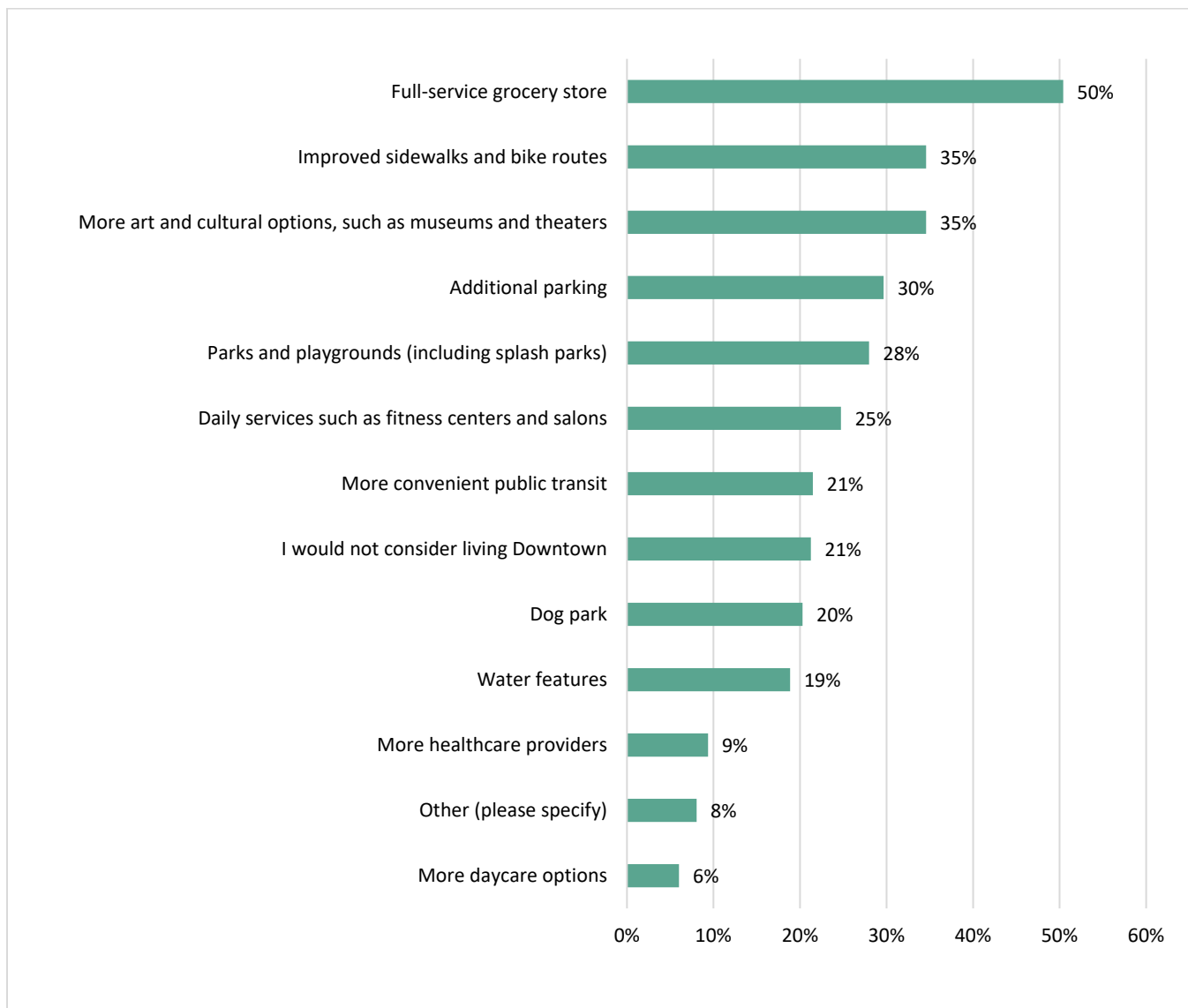
Responses in the 'Other' category include:

- Respondents who already live Downtown
- Affordable units
- Lofts

Question 11: What new amenities would make Downtown Greeley a more attractive neighborhood for you to live in?

Responses: 836

Respondents were asked to select which amenities would make Downtown Greeley a more attractive neighborhood to live in. The top responses from survey respondents were: **full-service grocery store** (50%), **improved sidewalks and bike routes** (35%), and **more art and cultural options, such as museums and theaters** (35%). *Note that respondents were allowed to select all answer choices that apply, so the graph below exceeds 100%.*



Question 12: Would you be interested in starting or relocating a business and/or investing in Downtown?

Responses: 806

Respondents were asked if they would consider starting or relocating a business to downtown. While most respondents (**74%**) answered **no**, over one-fourth of respondents selected 'yes.' Some of the ideas that these respondents shared include the following business types:

- Restaurants, including rooftop and outdoor dining, healthy food, cafes, bakery, ice cream, deli
- Boutique retail
- Wellness industry, including mental healthcare services
- Flea market
- Fitness
- Marketing and arts-related consulting, including video production
- Art studio
- Makerspace

- Pet store
- Massage and beauty
- Creative play spaces
- Art supply
- Plant nursery
- Light manufacturing
- Information technology
- Food truck



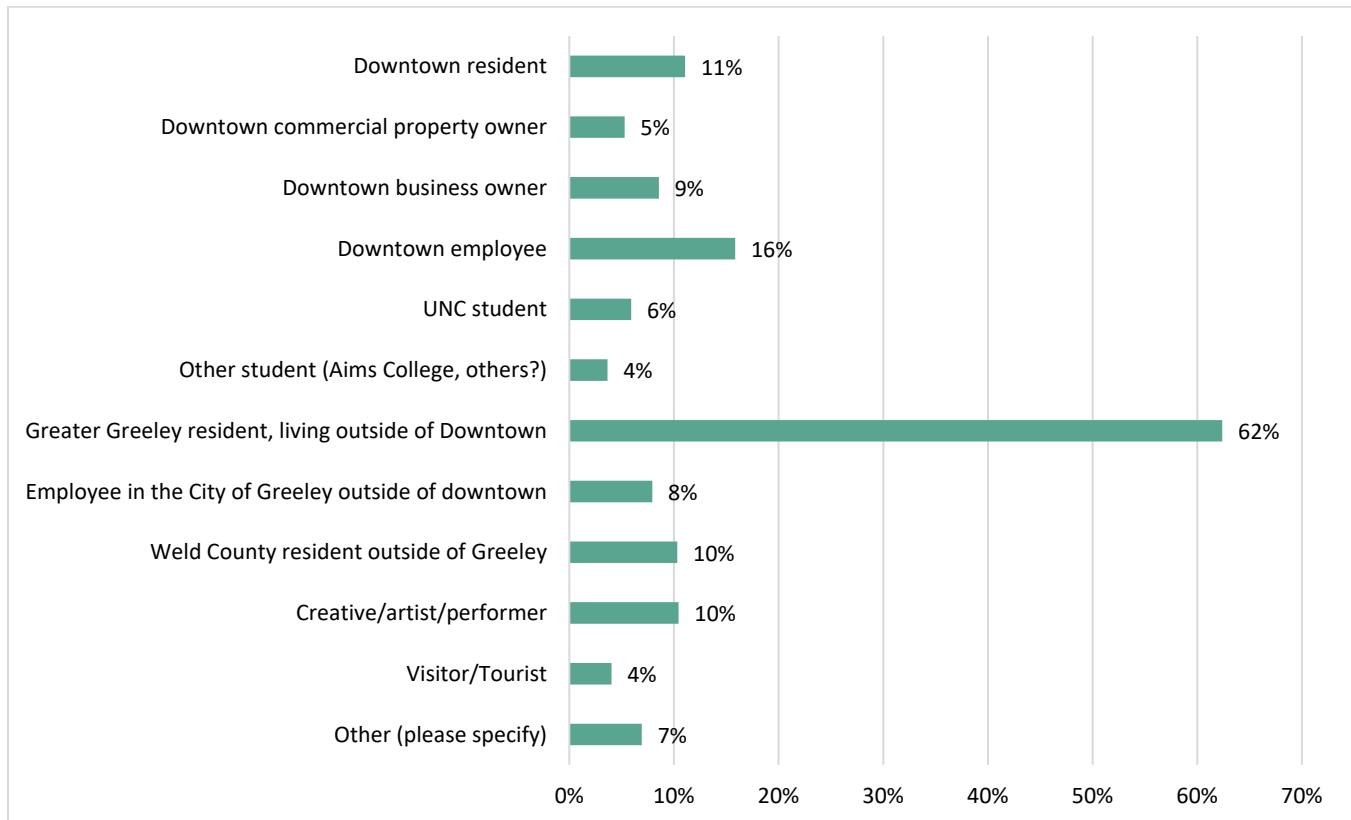
RESPONDENT CHARACTERISTICS

Respondents were asked to provide optional demographic information characterizing their interest in Downtown Greeley, age, gender, ethnicity, race, annual household income, and residential zip code. Graphs summarizing respondent demographics can be found below.

Which of the following best characterizes your primary interest(s) in Downtown Greeley? (Choose all that apply)

Note that respondents were allowed to select all answer choices that apply, so the graph below exceeds 100%.

Responses: 798

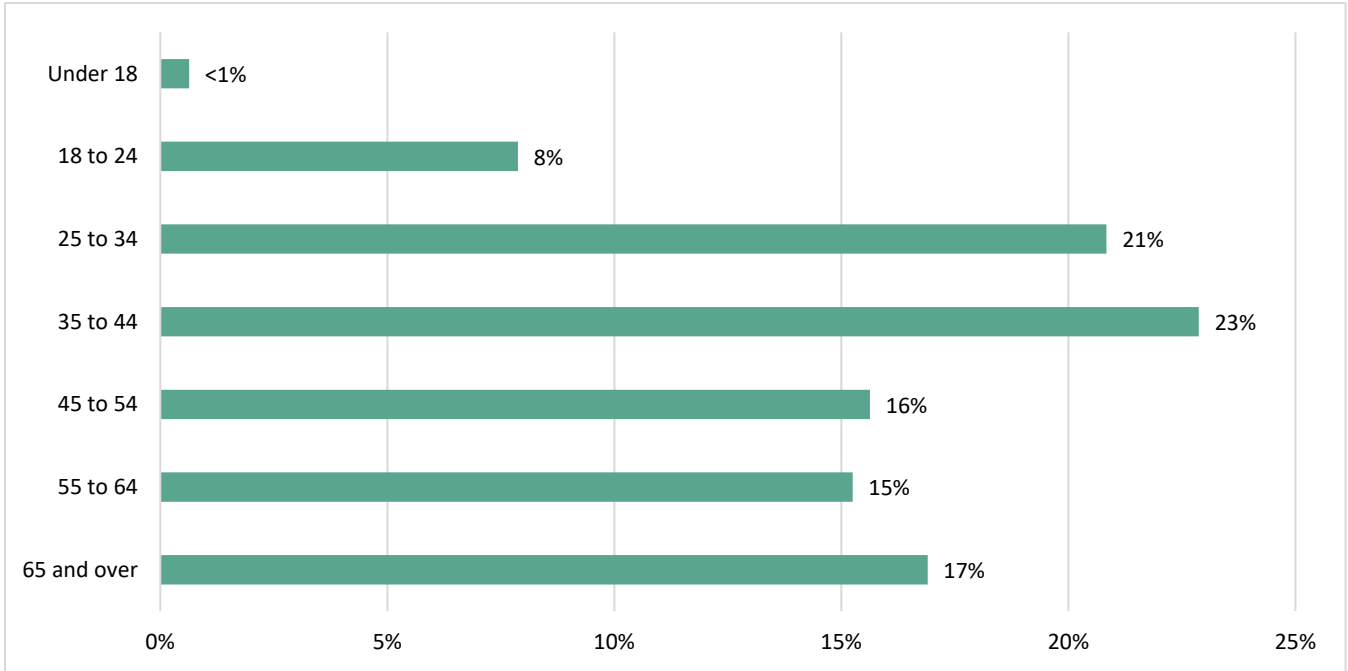


When asked to specify the response of "other", common themes included:

- UNC employees
- Former Greeley/Downtown residents
- Greeley business owners thinking about relocating downtown
- Rental property owners

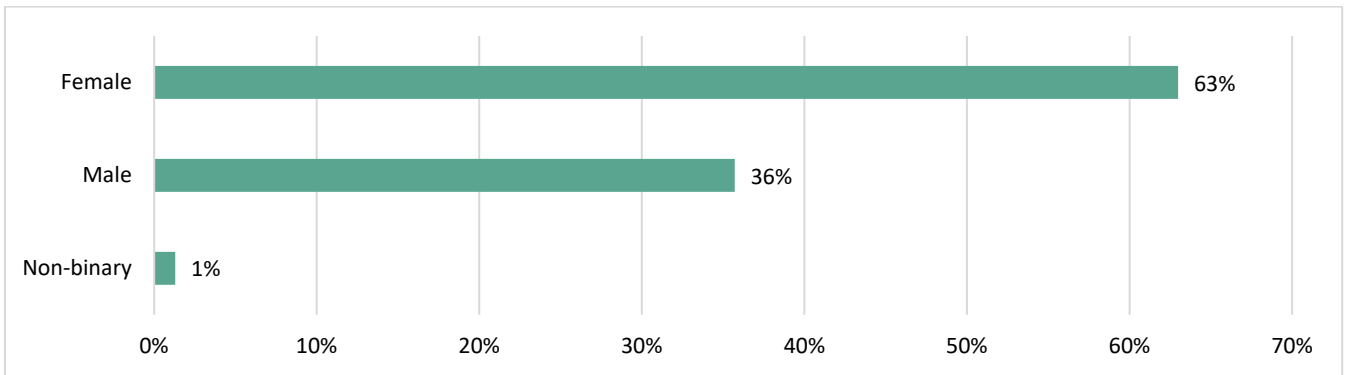
Age

Responses: 787



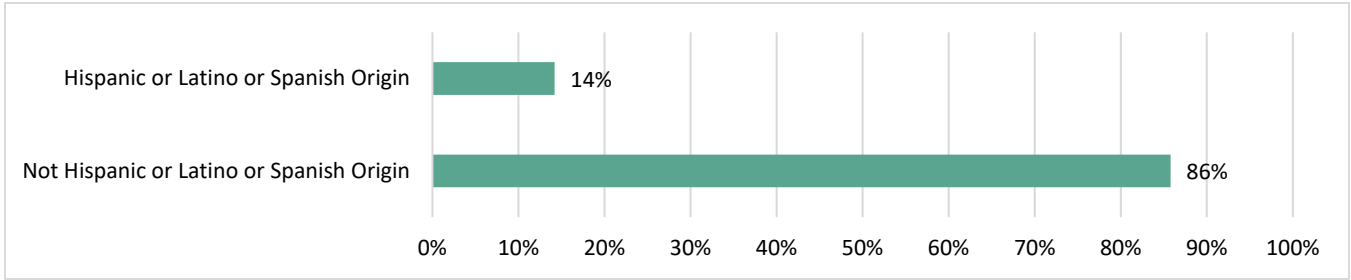
Gender

Responses: 770



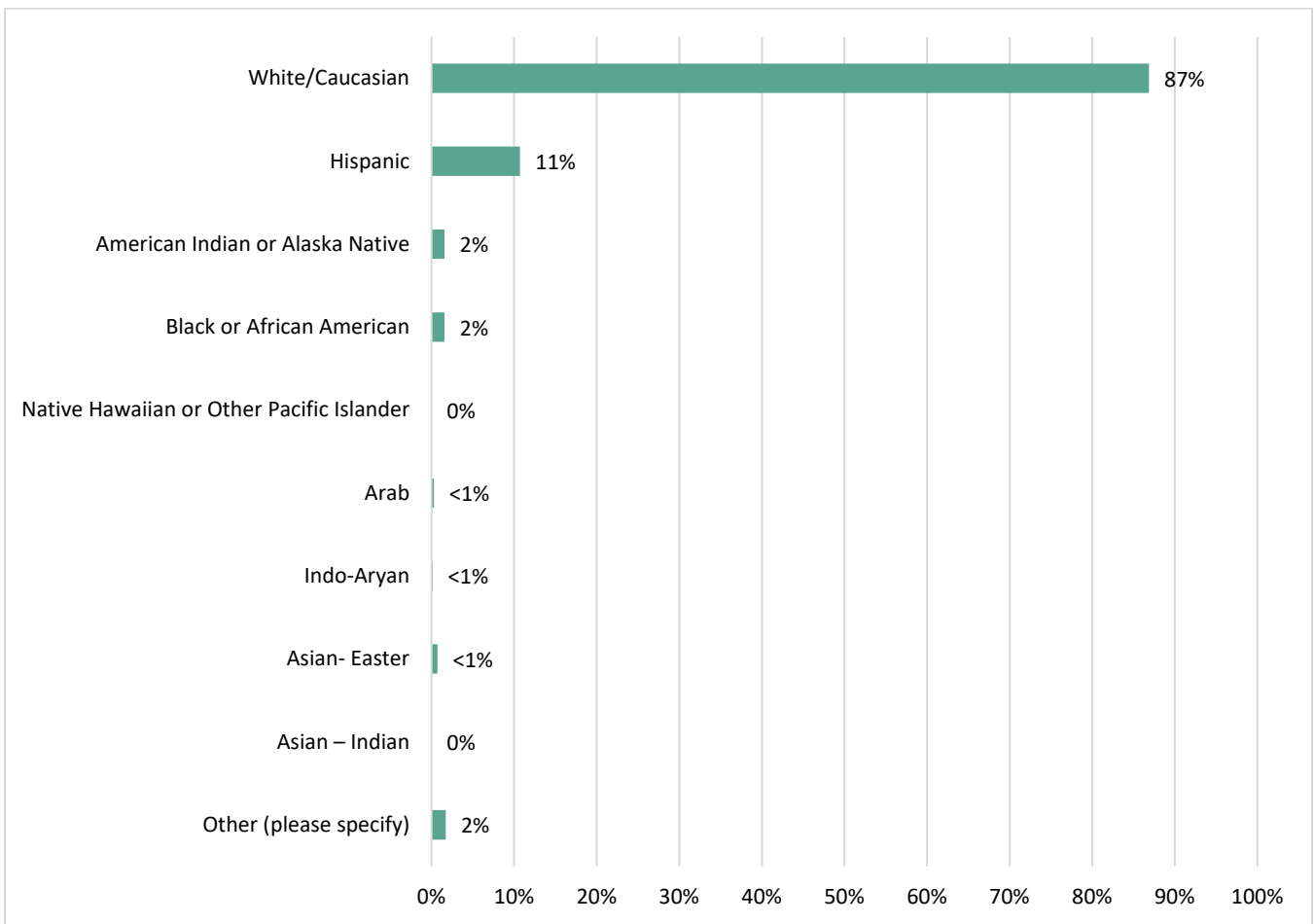
Ethnicity

Responses: 697



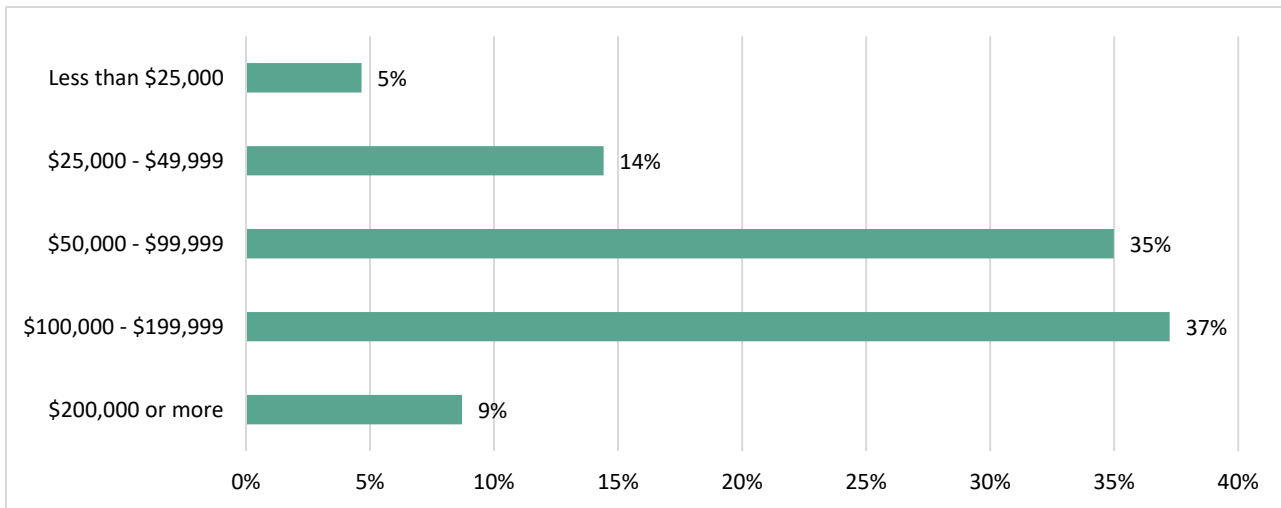
Race

Responses: 700



Annual Household Income

Responses: 666



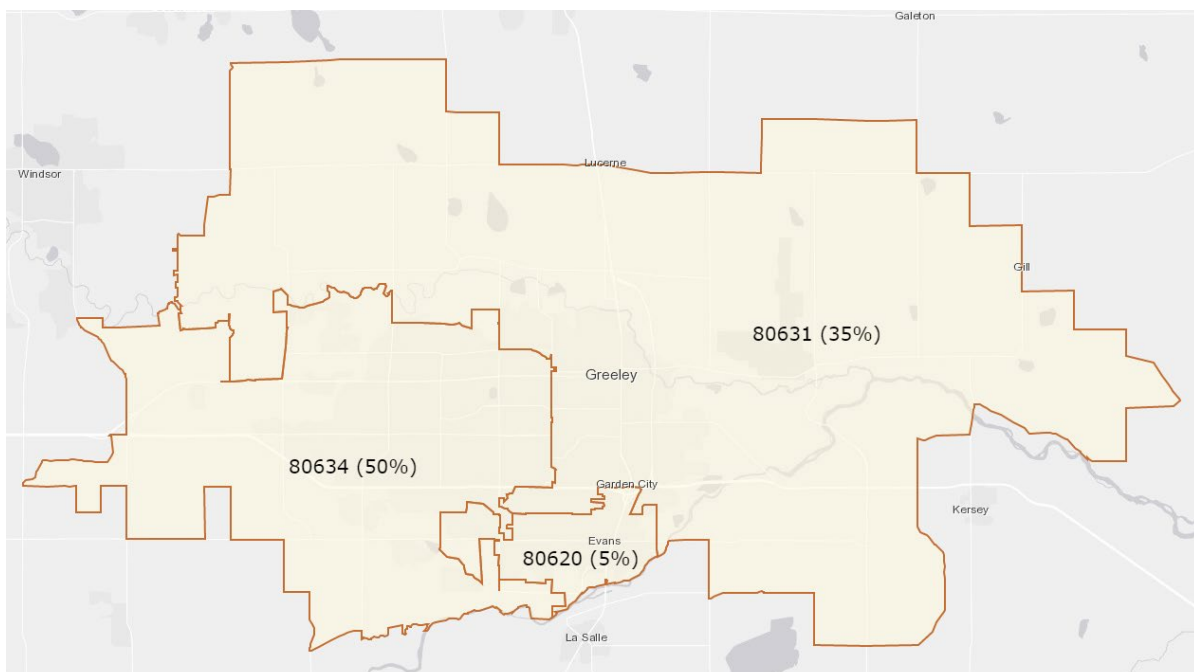
Zip Code

Responses: 559

Survey respondents provided 31 different home zip codes. The zip codes with the most representation in the survey data include (in order of frequency):

1. **80634** (281, 50%)
2. **80631** (193, 35%)
3. **80620** (26, 5%)

Together, these make up **89%** of responses. Other zip codes provided by multiple respondents include 80615 (10, 2%) and 80645 (5, 1%).



CROSS-TABULATIONS

The survey results were cross-tabulated by **interest in Downtown Greeley, age, income, and race and ethnicity**, to see if responses differed based on respondent characteristics and demographics. Survey result variations based on gender were not notably different.

Question 6: “Of physical improvements listed in question 5, which one action will be MOST important?”

Similarities and contrasts between different respondents were analyzed for the results to question 6 (“Of physical improvements listed in question 5, which one action will be MOST important?”). In the following tables, the top responses for each category are highlighted in green, helping to show similarities and differences in priority actions. The top choice for each characteristic is shown in darker green, while any other services or actions receiving 10% or more are highlighted in lighter green. Note: some answer choices are abbreviated from the original survey

Primary Interest in Downtown Greeley – Q6

The table below shows some variation in priorities for physical improvements, based on what the respondent’s relationship to Downtown Greeley is. Some key similarities and differences include:

- There is widespread consensus that redeveloping underutilized parcels should be a clear priority.
- There was less agreement about the importance of maintaining Downtown’s historic character: Students (UNC and Aims College, other) were the groups least likely to consider historic preservation a top priority, with creatives/artists/performers and visitors/tourists representing the groups most likely to rank this action as their top priority.
- More beautification was most highly ranked among students, and least likely to be a #1 priority for visitor/tourists and downtown commercial property owners.
- Students are the group most likely to prioritize the pedestrian and bicyclist experience as the most important physical improvement.
- Downtown business owners, property owners, and visitors/tourists were the groups most interested in increasing lighting in the public realm.

	DT resident	DT comm. property owner	DT business owner	DT employee	UNC student	Other student (Aims College, others)	Greater Greeley resident, living outside of DT	Employ. in the City of Greeley outside of DT	Weld County resident outside of Greeley	Creative/artist/performer	Visitor/Tourist
Redevelop and repurpose underutilized surface parking lots and vacant buildings	33%	21%	37%	37%	46%	24%	33%	32%	38%	30%	25%
Maintain the historic character and authenticity	16%	16%	11%	12%	0%	7%	17%	10%	12%	21%	19%
More beautification	8%	3%	8%	9%	22%	17%	13%	13%	11%	10%	6%
Improve the pedestrian and bicyclist experience	9%	11%	5%	8%	15%	21%	9%	13%	4%	9%	6%
Other (please specify)	11%	24%	13%	12%	7%	10%	6%	11%	11%	9%	9%
Enhance Lincoln Park	3%	8%	8%	5%	0%	7%	6%	6%	5%	7%	6%
Increase lighting in the public realm throughout Downtown	6%	13%	10%	6%	2%	7%	4%	6%	4%	4%	13%
Improve traffic flow into and around Downtown	6%	0%	5%	4%	2%	0%	2%	3%	7%	4%	9%
Improve connections to surrounding neighborhoods	5%	5%	3%	0%	2%	3%	3%	0%	1%	1%	3%
Increase connections to the Poudre River Trail	1%	0%	0%	3%	2%	0%	3%	2%	1%	1%	0%
Improve gateways in and out of Downtown	0%	0%	0%	1%	2%	0%	2%	2%	4%	1%	3%
Improve stormwater and wastewater management	1%	0%	2%	5%	0%	3%	2%	2%	3%	4%	0%

Age – Q6

Survey results were cross-tabulated based on age. Due to the small number of respondents aged 18 or under, that cohort is not included in these results. A few highlights of question 6 responses based on age:

- The answer option with the most age-based variability was ‘maintain the historic character and authenticity of Downtown.’ Nearly 30% respondents aged 65 and over selected this answer, compared to 5% of 18- to 24-year-olds, 7% of 25- to 34-year-olds, and 12% of 35- to 44-year-olds.
- There is consensus across age groups under 65 that the top priority is to redevelop and repurpose underutilized properties downtown.
- Younger responders were just as likely as older respondents to select ‘more beautification’ as their one most important improvement
- 18- to 24-year-olds and respondents 65 and over were the most likely to select ‘improve the pedestrian and bicyclist experience.’

	18 to 24	25 to 34	35 to 44	45 to 54	55 to 64	65+
Redevelop and repurpose underutilized surface parking lots and vacant buildings and lots	39%	35%	32%	41%	28%	23%
More beautification	16%	16%	12%	5%	18%	10%
Improve the pedestrian and bicyclist experience throughout downtown	11%	9%	8%	8%	4%	12%
Other	10%	5%	10%	8%	8%	6%
Maintain the historic character and authenticity	5%	7%	12%	17%	23%	29%
Enhance Lincoln Park	5%	7%	8%	3%	4%	6%
Increase lighting in the public realm throughout Downtown	5%	4%	4%	6%	6%	6%
Improve gateways in and out of Downtown	3%	2%	1%	2%	1%	3%
Improve connections to surrounding neighborhoods	2%	4%	4%	3%	2%	1%
Improve traffic flow into and around Downtown	2%	6%	3%	4%	4%	2%
Improve stormwater and wastewater management in Downtown	2%	1%	1%	3%	3%	1%
Increase connections to the Poudre River Trail	0%	4%	5%	0%	0%	1%

Annual Household Income – Q6

The income categories provided in the survey were less than \$25,000, \$25,000-\$49,999, \$50,000-\$99,999, \$100,000-\$199,999, and more than \$200,000. Key observations and variations across income groups include:

- Respondents with higher household incomes were more likely to rank 'redevelop and repurpose underutilized surface parking lots and vacant buildings and lots' as their top priority.
- 'More beautification' was the most popular physical improvement among respondents with household incomes under \$25,000.
- Respondents with household incomes under \$50,000 were the most interested in improving the pedestrian and bicyclist experience.

	Less than \$25K	\$25,000 - \$49,999	\$50,000 - \$99,999	\$100,000 - \$199,999	\$200,000 or more
Redevelop and repurpose underutilized surface parking lots and vacant buildings and lots	14%	28%	37%	35%	34%
Maintain the historic character and authenticity	7%	15%	10%	18%	14%
More beautification (continue public art, additional alleyway enhancements, landscaping and greening, etc.)	29%	10%	14%	12%	14%
Improve the pedestrian and bicyclist experience	14%	18%	7%	5%	9%
Other (please specify)	11%	8%	7%	7%	7%
Enhance Lincoln Park	0%	5%	10%	4%	2%
Increase lighting in the public realm throughout Downtown	14%	5%	4%	5%	5%
Improve traffic flow into and around Downtown	4%	4%	3%	4%	4%
Improve connections to surrounding neighborhoods	4%	2%	3%	2%	9%
Increase connections to the Poudre River Trail	0%	3%	1%	3%	0%
Improve gateways in and out of Downtown	4%	0%	2%	3%	0%
Improve stormwater and wastewater management	0%	1%	2%	3%	2%

Race/Ethnicity – Q6

The survey asked two optional questions about race and ethnicity. The first, question 16, asked respondents to indicate if 'Hispanic or Latino or Spanish Origin' or 'Not Hispanic or Latino or Spanish Origin' describes their ethnicity. 14% of respondents (or 91 individuals) who answered Question 8 identified as 'Hispanic or Latino or Spanish Origin.'

Question 17 provided ten different options for respondents to select (including, prefer not to answer) to characterize their race/ethnicity. However, the only two respondent categories with notable representation were White/Caucasian (581 respondents for Q8), and Hispanic (69 respondents). The data reveal a few results of note:

- 28% of Hispanic respondents – compared to 12% of White respondents – selected 'more beautification' as their top action.
- 17% of White respondents – compared to 8% of Hispanic respondents – selected 'maintain the historic character and authenticity' as their top action.
- Otherwise, there were not considerable differences in answers based on race/ethnicity.

Question 8: Of the improvements listed in the prior question [“To achieve your vision for Downtown Greeley, how important are the following services over the next 10 years?”], which ONE action will be MOST important?

Similarities and contrasts between different respondents were also analyzed for the results to question 8. In the following tables, the top responses for each category are highlighted in green, helping to show similarities and differences in priority actions. The top choice for each characteristic is shown in darker green, while any other services or actions receiving 10% or more are highlighted in lighter green. Note: some answer choices are abbreviated from the original survey language to better fit the table.

Primary Interest in Downtown Greeley – Q8

The table below shows some variation in priorities for physical improvements, based on what the respondent’s relationship to Downtown Greeley is. Some key similarities and differences include:

- Most groups chose ‘more retail and restaurants’ as their #1 most important action, except for Downtown commercial property owners, business owners, and visitors/tourists.
- The top action among Downtown business owners and commercial property owners was providing more services to address the unhoused population. This action was also tied for #1 among Downtown residents.
- The top action for visitors/tourists was enhancing public safety. This action was also tied for #1 among UNC students.
 - Downtown residents were among the least likely to choose ‘enhance public safety.’
- The only groups that had 10% or more selecting ‘improve the parking experience’ as their top priority were Downtown business owners and Weld County residents living outside of Greeley.
- Downtown commercial property owners had the highest proportion of respondents that chose ‘more housing options.’
- Students, creatives, and visitors had the highest proportion of respondents selecting ‘make downtown more welcoming and inclusive to people of all cultural backgrounds’ as the most important improvement.
- ‘More arts and cultural facilities, events, and activities for all ages’ was most popular (i.e., received over 10% of votes) for Weld County residents outside of Greeley, creatives/artists/performers, visitor/tourists, and employees in the City of Greeley outside of downtown.

	DT resident	DT comm. property owner	DT business owner	DT employee	UNC student	Other student (Aims college, others)	Greater Greeley resident, living outside of DT	Employ. in the City of Greeley outside of DT	Weld County resident outside of Greeley	Creative/artist/performer	Visitor/Tourist
More retail and restaurants	14%	5%	13%	23%	19%	15%	24%	21%	24%	18%	19%
Enhance public safety	12%	13%	13%	19%	19%	7%	13%	20%	12%	11%	32%
Provide more services to address the unhoused population	14%	29%	19%	7%	11%	11%	11%	7%	8%	9%	3%
More arts and cultural facilities, events, and activities for all ages	5%	0%	2%	6%	6%	7%	8%	10%	12%	14%	10%
Improve the parking experience	7%	8%	14%	8%	4%	7%	5%	3%	11%	4%	3%
Make downtown more welcoming and inclusive to people of all cultural backgrounds	7%	0%	2%	3%	13%	11%	6%	7%	5%	13%	10%
More services for daily needs, such as grocery, pharmacy, daycare, doctors' offices, veterinarian, etc.	6%	5%	6%	9%	2%	7%	5%	7%	5%	6%	0%
Strengthen surrounding neighborhoods	7%	5%	3%	3%	0%	4%	5%	3%	1%	4%	10%
Make Downtown more friendly to pedestrians and bicyclists	6%	5%	3%	3%	6%	4%	4%	2%	4%	8%	0%
Childcare and kid-friendly features and places	1%	3%	3%	1%	0%	0%	4%	2%	3%	3%	0%
Create more connections to UNC	5%	0%	0%	3%	13%	11%	3%	3%	3%	5%	0%
Increase activation of public realm in Downtown	4%	3%	5%	4%	2%	0%	2%	7%	3%	1%	6%
More housing options	7%	13%	8%	3%	2%	7%	1%	3%	1%	1%	0%
More primary employers and job options	0%	5%	2%	3%	0%	0%	2%	2%	1%	1%	0%
Improve property maintenance	1%	3%	5%	2%	0%	4%	2%	2%	3%	3%	0%
Improve marketing of Downtown Greeley to local and regional markets	1%	0%	3%	1%	2%	0%	2%	0%	3%	0%	0%
Other (please specify)	2%	3%	2%	2%	0%	0%	1%	3%	1%	0%	3%
Additional hotels and hospitality services (e.g., bed and breakfast, additional hotel, etc.)	0%	0%	0%	1%	0%	4%	1%	0%	1%	1%	3%

Age – Q8

Question 8 survey results were cross-tabulated based on age. Note: Due to the small number of respondents aged 18 or under, that age cohort is not included in these results. A few highlights of the results based on age:

- There is universal consensus across age groups that the top priority is more retail and restaurants, with at least 22% -- and up to 27% -- of each age cohort selecting this action.
- The second highest-rated action, enhance public safety, had support across age cohorts, though 23% of 45- to-55-year-olds selected this action, which is at least six percentage points higher than any other age grouping.
- There was fairly high consistency across respondents in their selection of 'provide more services to address the unhoused population' as a top-three action, with the most support from this action coming from the 18- to 24-year-olds and least support from 45-to-55-year-olds.
- 25- to 34-year-olds selected 'make downtown more welcoming and inclusive to people of all cultural backgrounds' and 'more arts and cultural facilities, events, activities for all ages' than other age groups.
- Respondents over 55 are more concerned in improving the parking experience in downtown than younger age cohorts.

	18 to 24	25 to 34	35 to 44	45 to 54	55 to 64	65+
More retail and restaurants	25%	22%	22%	27%	24%	20%
Enhance public safety	17%	13%	15%	23%	13%	11%
Provide more services to address the unhoused population	14%	10%	13%	7%	12%	12%
Make downtown more welcoming and inclusive to people of all cultural backgrounds	8%	10%	5%	3%	4%	9%
Improve the parking experience	5%	3%	5%	3%	11%	11%
Improve marketing of Downtown Greeley to local and regional markets	5%	1%	1%	3%	2%	3%
More arts and cultural facilities, events, and activities for all ages	5%	11%	7%	8%	3%	7%
Create more connections to UNC	5%	1%	3%	2%	4%	1%
Strengthen surrounding neighborhoods	3%	4%	3%	3%	7%	5%
Improve property maintenance	3%	1%	2%	4%	2%	1%
More services for daily needs, such as grocery, pharmacy, daycare, doctors' offices, veterinarian, etc.	3%	5%	4%	4%	4%	7%
Childcare and kid-friendly features and places	2%	4%	7%	3%	0%	0%
Increase activation of public realm in Downtown (activation of alleys, Lincoln Park programming, increase outdoor dining options, etc.)	2%	3%	6%	3%	4%	0%
Other (please specify)	2%	2%	1%	0%	2%	2%
Make Downtown more friendly to pedestrians and bicyclists	0%	4%	3%	6%	1%	7%
More housing options	0%	4%	1%	2%	2%	3%
More primary employers and job options	0%	2%	1%	0%	6%	2%
Additional hotels and hospitality services (e.g. bed and breakfast, additional hotel, etc.)	0%	0%	1%	1%	1%	1%

Annual Household Income– Q8

The income categories provided in the survey were less than \$25,000, \$25,000-\$49,999, \$50,000-\$99,999, \$100,000-\$199,999, and more than \$200,000. Key observations and variations across income groups include:

- Respondents with higher household incomes were more likely to rank 'more retail and restaurants' as their top priority.
- 'Enhance public safety' was the top priority among respondents with household incomes less than \$25,000 (22%).
- Higher income groups were slightly more likely to select 'provide more services to address the unhoused population' as their top priority.
- Respondents with household incomes less than \$25,000 and over \$100,000 were less likely to choose 'more arts and cultural facilities, events, and activities for all ages' for this question.
- The only income group that clearly prioritized 'improve the parking experience' was \$25,000 to \$49,000.

	Less than \$25K	\$25,000 - \$49,999	\$50,000 - \$99,999	\$100,000 - \$199,999	\$200,000 or more
More retail and restaurants	19%	19%	19%	27%	29%
Enhance public safety	22%	12%	14%	16%	18%
Provide more services to address the unhoused population	7%	12%	12%	11%	13%
More arts and cultural facilities, events, and activities for all ages	7%	10%	10%	5%	2%
Make downtown more welcoming and inclusive to people of all cultural backgrounds	7%	6%	7%	4%	7%
Improve the parking experience	7%	11%	6%	4%	2%
More services for daily needs, such as grocery, pharmacy, daycare, doctors' offices, veterinarian, etc.	7%	3%	6%	5%	4%
Strengthen surrounding neighborhoods	0%	4%	7%	3%	5%
Make Downtown more friendly to pedestrians and bicyclists	7%	7%	3%	3%	2%
Increase activation of public realm in Downtown (activation of alleys, Lincoln Park programming, increase outdoor dining options, etc.)	0%	1%	2%	5%	4%
Create more connections to UNC	4%	2%	3%	3%	2%
Childcare and kid-friendly features and places	0%	2%	3%	4%	0%
Improve property maintenance	0%	3%	1%	2%	7%
More housing options	4%	3%	2%	2%	0%
Improve marketing of Downtown Greeley to local and regional markets	4%	2%	2%	1%	4%
More primary employers and job options	0%	0%	1%	3%	2%
Additional hotels and hospitality services (e.g., bed and breakfast, additional hotel, etc.)	4%	0%	1%	1%	0%
Other (please specify)	0%	0%	2%	0%	2%

Race and Ethnicity– Q8

The survey asked two optional questions about race and ethnicity. The first, question 16, asked respondents to indicate if 'Hispanic or Latino or Spanish Origin' or 'Not Hispanic or Latino or Spanish Origin' describes their ethnicity. 14% of respondents (or 90 individuals) who answered Question 8 identified as 'Hispanic or Latino or Spanish Origin.'

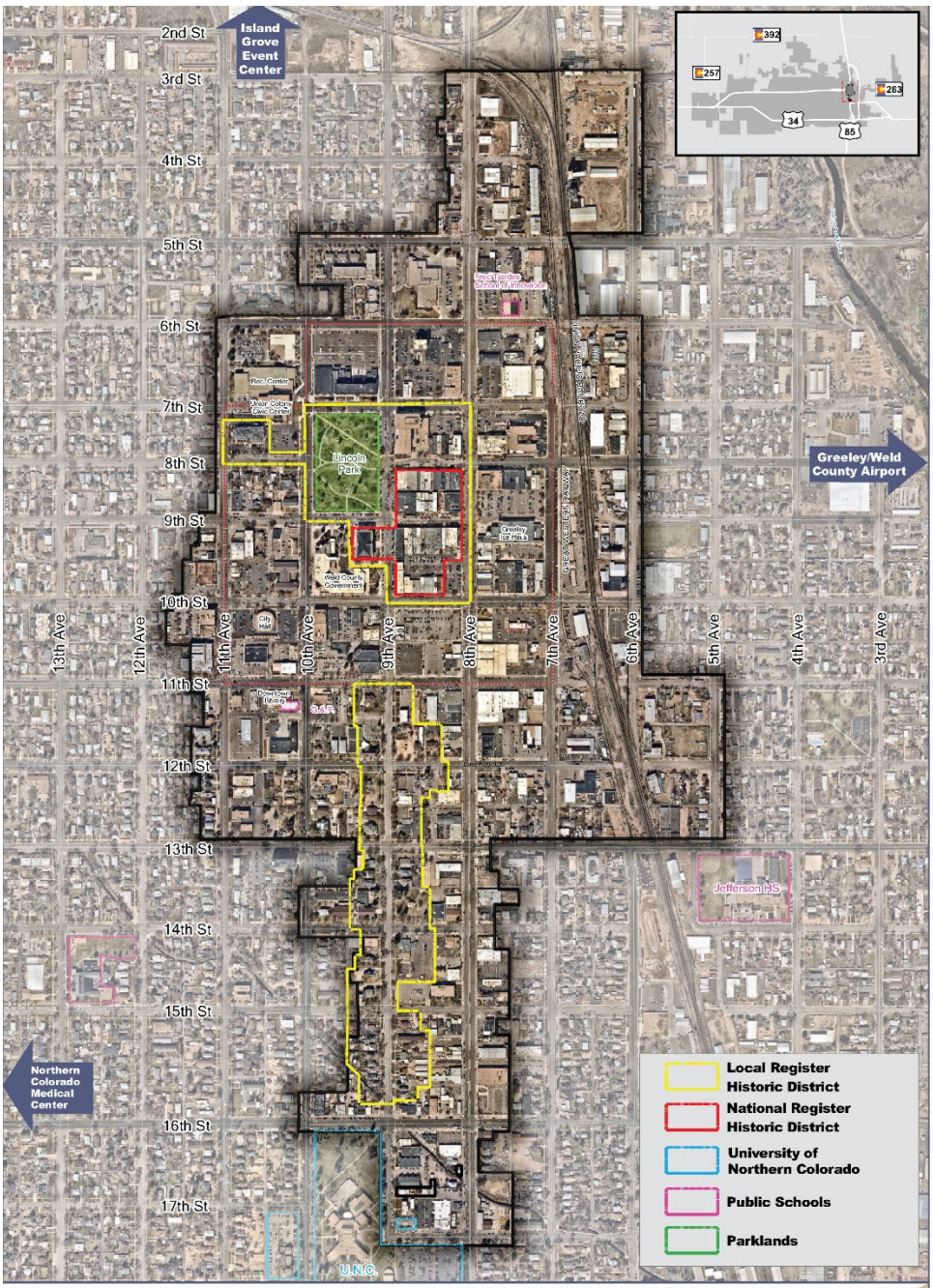
Question 17 provided ten different options for respondents to select (including, prefer not to answer) to characterize their race/ethnicity. However, there were only two significant respondent categories: White/Caucasian (581 respondents for Q8), and Hispanic (69 respondents). While a full analysis was not conducted, the data reveal a few results of note:

- 13% of Hispanic respondents – compared to 5% of White respondents – selected 'make downtown more welcoming and inclusive to people of all cultural backgrounds' as their top action.
- Otherwise, there were not considerable differences in answers based on race/ethnicity.

APPENDIX E: PAST PLANS & STUDIES SUMMARY

GREELEY DOWNTOWN PLAN UPDATE SUMMARY OF EXISTING REPORTS AND DOCUMENTS

APRIL 2022



Downtown Development Authority



In the spring of 2022, the consultant team led by P.U.M.A. reviewed all existing plans, documents and current planning efforts made available by the City of Greeley in order to ensure that this process would build upon such efforts. This document provides a brief summary of these efforts as they relate to downtown Greeley.

PLANNING, ZONING, AND URBAN DESIGN

Plans/Documents Reviewed

- Imagine Greeley Comprehensive Plan, February 2018
- Downtown Greeley Investment Strategy, July 2011
- Downtown Greeley Accomplishments, August 2021
- 2022 Annual Growth & Development Projections Report, February 2022
- Greeley Downtown Development Authority 2020 Annual Snapshot, 2020
- City of Greeley Energy Action Plan, 2019
- Master Transportation Impact Study: 8th Avenue Redevelopment, March 2018
- City of Greeley Strategic Housing Plan, 2018
- Market Study & Recommendations: Downtown Apartment Market, April 2017
- Greeley Parks, Trails, and Open Lands Master Plan, May 2016
- Landscape Policy Plan for Water Efficiency, December 2015
- Bicycle Master Plan, May 2015

IMAGINE GREELEY COMPREHENSIVE PLAN

The Imagine Greeley Comprehensive Plan is an overarching citywide document that provides high-level goals and policies based on different high-priority topics. It was adopted in February of 2018. The plan includes the following sections: Vision Statement, Core Values, Goals, Objectives, and Actions. Below are some key takeaways, as they relate to the city as a whole and the downtown area specifically.

VISION & CORE VALUES

VISION STATEMENT – *Greeley values and respects the diversity of its people, cultures, neighborhoods, and resources in a manner that creates and sustains a safe, unique, united, vibrant, and rewarding place in which to live, work, learn, grow, and play. The community promotes a healthy and diverse economy, and a high quality of life that is responsive to all its residents, businesses and neighborhoods.*

CORE VALUES guiding the vision include:

1. Excellence in actions, attitude, and leadership
2. Proactive, progressive, and balanced economic development
3. Safe, health, and inclusive community
4. Sustainable patterns of growth and development
5. Responsible stewardship of natural resources and the environment
6. Distinctive character and outstanding recreational and cultural amenities
7. High-quality infrastructure and services
8. World-class water resources & management
9. Rich history and diversity of people, customs, culture, and ideas
10. Thriving, connected, and inclusive neighborhoods in all the city
11. Premier educational system and commitment to life-long learning
12. Public/private cooperation to achieve & maintain exceptional community benefits

GOALS & OBJECTIVES

The goals and objectives contained within this chapter provide policy guidance for how the City and community can work towards achieving the vision set forth in the previous chapter.

ECONOMIC HEALTH & DIVERSIFICATION (ED) – *This element deals with topics related to the local economy and focuses on efforts which will encourage job creation and new businesses to locate in Greeley, diversify the mix of businesses and employers, support workforce development, and support ongoing economic development efforts across the City and region.*

Within Greeley, the following industries each contain at least 10% of the total employment: health care, educational services, manufacturing, and retail trade. The energy industry has also been growing in the past 10+ years. Greeley seeks to diversify their employment base *to better cope with a decrease in activities or employment by one of these employers.*

Goals & Objectives

- **Goal ED-1:** Promote a healthy, progressive, and competitive local economy.
 - **Objective ED-1.1:** Attractive Economic Climate
 - **Objective ED-1.2:** Tax base
 - **Objective ED-1.3:** Tourism
 - **Objective ED-1.4:** Economic Diversification
 - **Objective ED-1.5:** Support for Entrepreneurs
 - **Objective ED-1.6:** Climate of Innovation
- **Goal ED-2:** Promote desired economic sectors and a diverse local economy
 - **Objective ED-2.1:** Develop and regularly update a coordinated economic development strategy that:
 - Communicates a clear vision for Greeley’s economic growth;
 - Supports development in priority employment areas (see Objective ED-2.5);
 - Identifies target industries, provides promotional data related to these industries, and creates a business attraction, retention, and creation plan for each;
 - Identifies opportunities for collaboration with state and regional organizations, neighboring local governments, existing businesses, school districts, and institutions of higher learning, and other partners;
 - Provides guidance on promotional, marketing, and other efforts to increase exposure to Greeley
 - **Objective ED-2.2:** Assets and Amenities
 - **Objective ED-2.3:** Incentives
 - **Objective ED-2.4:** Business Attraction
 - **Objective ED-2.5:** Priority Employment Areas
 - **Objective ED-2.6:** Land for Employment Uses
 - **Objective ED-2.7:** Economic Development Capacity
- **Goal ED-3:** Attract and maintain an employed, skilled, and adaptable workforce
 - **Objective ED-3.1:** Diverse Workforce
 - **Objective ED-3.2:** Competency-Based Education
 - **Objective ED-3.3:** Workforce Training
 - **Objective ED-3.4:** Connecting Workers with Employers
 - **Objective ED-3.5:** Barriers to Employment

- **Objective ED-3.6:** Internships and Apprenticeships
- **Objective ED-3.7:** Employee Support
- **Objective ED-3.8:** Promoting Greeley to Workers
- **Objective ED-3.9:** Transportation Options for Workers
- **Goal ED-4:** Facilitate intergovernmental and public/private partnerships that foster successful economic development
 - **Objective ED-4.1:** Regional Collaboration
 - **Objective ED-4.2:** Regional Economic Development
 - **Objective ED-4.3:** Collaboration with Public Institutions

EDUCATION, HEALTH, AND HUMAN SERVICES (EH) – *This element addresses topics related to the health, welfare, and education of Greeley residents, with a focus on promoting and encouraging healthy lifestyles through the use of strategic partnerships and programs, and supporting educational institutions of all levels, including non-traditional learning environments.*

The City of Greeley seeks to work with partners including the school district, the University of Northern Colorado, and Aims Community College *to foster a learning environment that will lead to the success of the students and the general community.*

Goals & Objectives

- **Goal EH-1:** Promote community excellence related to a fully-integrated health care system
 - **Objective EH-1.1:** Health Sciences Education
 - **Objective EH-1.2:** Economic Development Opportunities
 - **Objective EH-1.3:** Cooperation with Partners
 - **Objective EH-1.4:** Health Services
- **Goal EH-2:** Integrate healthy living into community planning and development
 - **Objective EH-2.1:** Community Partners
 - **Objective EH-2.2:** Nutritional Services
 - **Objective EH-2.3:** Active Living
 - **Objective EH-2.4:** Land Use
 - **Objective EH-2.5:** Walkability & Bikability
 - **Objective EH-2.6:** Built Environment
 - **Objective EH-2.7:** Local Food Production and Sales
 - **Objective EH-2.8:** Food Access
- **Goal EH-3:** Ensure that residents are aware of and have access to efficient and effective health and human services
 - **Objective EH-3.1:** Access to Services
 - **Objective EH-3.2:** Advocacy
 - **Objective EH-3.3:** Service Efficiency
 - **Objective EH-3.4:** Early Intervention
 - **Objective EH-3.5:** Customer-Focused Approach
 - **Objective EH-3.6:** Self-Sufficiency
 - **Objective EH-3.7:** Funding for Services
 - **Objective EH-3.8:** Language Barriers
 - **Objective EH-3.9:** Vulnerable Populations
 - **Objective EH-3.10:** Location of Services

- **Objective EH-3.11:** Healthy Lifestyles
- **Goal EH-4:** Support and collaborate with the city’s school districts
 - **Objective EH-4.1:** Impacts of New Development
 - **Objective EH-4.2:** School Siting
 - **Objective EH-4.3:** Land Use and Zoning Changes
 - **Objective EH-4.4:** Safe Routes to School
 - **Objective EH-4.5:** School Resource Officers
 - **Objective EH-4.6:** Student Safety
 - **Objective EH-4.7:** Partnerships
- **Goal EH-5:** Be an education center of excellence
 - **Objective EH-5.1:** Education Facilities Integration
 - **Objective EH-5.2:** Charter and Private Schools
 - **Objective EH-5.3:** Non-Traditional Learners
 - **Objective EH-5.4:** Climate of Innovation
 - **Objective EH-5.5:** Institutions of Higher Education
 - **Objective EH-5.6:** University District
 - **Objective EH-5.7:** Life-Long Learning
 - **Objective EH-5.8:** Educational Strengths

GROWTH & CITY FORM (GC) – *This element deals with growth and addresses how to efficiently manage both new development and redevelopment within Greeley – creating the least impact on the natural environment and enhancing the character of the community. The element also focuses on efforts that prioritize infill development and the revitalization of Downtown Greeley, encourage mixed-use development, and protect and enhance the character of Greeley’s neighborhoods.*

Recent growth in Greeley has taken the form of sprawl, with suburban areas with predominantly single-unit houses and a decrease in population density. The decrease in density has caused residents of Greeley to live farther from the services and amenities they need on a regular basis, while also limiting transportation options. Now, the city looks to promote higher density and more mixed-use development and also increase alternative transportation options.

Goals & Objectives

- **Goal GC-1:** Manage Growth Effectively
 - **Objective GC-1.1:** Growth Management
 - **Objective GC-1.2:** (Compact urban) Form of Growth
 - **Objective GC-1.3:** Adequate Public Facilities
 - **Objective GC-1.4:** Long Range Expected Growth Area
 - **Objective GC-1.5:** Annexations
 - **Objective GC-1.6:** Transitions to Parks and Open Lands
 - **Objective GC-1.7:** Regional Collaboration
 - **Objective GC-1.8:** Data and Trends
- **Goal GC-2:** Promote a balanced mix and distribution of land uses
 - **Objective GC-2.1:** Land Use Guidance Map
 - **Objective GC-2.2:** Jobs/Housing Balance
 - **Objective GC-2.3:** Pedestrian and Bicycle-Oriented Development
 - **Objective GC-2.4:** Mixed-Use and Transit-Supportive Development
 - **Objective GC-2.5:** Neighborhood Centers

- **Goal GC-3:** Promote new development, infrastructure investments, and public improvements that enhance the character of the community
 - **Objective GC-3.1:** Community Character
 - **Objective GC-3.2:** Historic Preservation & Adaptive Reuse
 - **Objective GC-3.3:** Design of Public Facilities
 - **Objective GC-3.4:** Tree City
- **Goal GC-4:** Prioritize infill and redevelopment
 - **Objective GC-4.1:** Priority Infill/Redevelopment Areas
 - This includes the downtown center and downtown neighborhoods
 - **Objective GC-4.2:** Reinvestment/Adaptive Reuse
 - **Objective GC-4.3:** Infill Compatibility
 - **Objective GC-4.4:** Sub-Area and Redevelopment Plans
- **Goal GC-5:** Facilitate the rebirth of Downtown Greeley as a regional multi-use activity area while preserving and promoting the cultural aspects of the area
 - **Objective GC-5.1:** Historic Preservation
 - **Objective GC-5.2:** Design Standards
 - **Objective GC-5.3:** Unique Opportunities
 - **Objective GC-5.4:** Residential Development
 - **Objective GC-5.5:** Community Gathering Place
 - **Objective GC-5.6:** Public Uses
 - **Objective GC-5.7:** Downtown Transportation
 - **Objective GC-5.8:** Downtown Linkages
- **Goal GC-6:** Maintain and enhance the character and interconnectivity of Greeley's neighborhoods
 - **Objective GC-6.1:** Complete Neighborhoods
 - **Objective GC-6.2:** Neighborhood Connectivity
 - **Objective GC-6.3:** Neighborhood Character
 - **Objective GC-6.4:** Historic and Character Districts
 - **Objective GC-6.5:** Neighborhood Reinvestment
 - **Objective GC-6.6:** Neighborhood Retention
 - **Objective GC-6.7:** Neighborhood Infrastructure
 - **Objective GC-6.8:** Neighborhood Plans
 - **Objective GC-6.9:** Suburban Subdivisions
 - **Objective GC-6.10:** Fiscal Impacts

HISTORIC & CULTURAL RESOURCES (HC) – *This element focuses on Greeley's local historic and cultural values with efforts to identify and preserve historically significant elements of Greeley's built environment, celebrate the rich diversity of the community and integrate arts and culture into the everyday life of residents.*

Goals & Objectives

- **Goal HC-1:** Preserve and promote local heritage
 - **Objective HC-1.1:** Identification of Historic Resources
 - **Objective HC-1.2:** Education
 - **Objective HC-1.3:** City-Owned Resources
 - **Objective HC-1.4:** Greeley Museum
 - **Objective HC-1.5:** Historic Registers
 - **Objective HC-1.6:** Preservation Tools

- **Objective HC-1.7:** Heritage and Cultural Tourism
- **Goal HC-2:** Support and celebrate the rich diversity of human experience within the community
 - **Objective HC-2.1:** Cultural Events
 - **Objective HC-2.2:** Promoting Our Diversity
 - **Objective HC-2.3:** Foster Understanding
- **Goal HC-3:** Develop and promote art and culture experiences
 - **Objective HC-3.1:** Greeley Creative District
 - **Objective HC-3.2:** Arts and Entertainment Activities
 - **Objective HC-3.3:** Cultural Resources
 - **Objective HC-3.4:** Art in Public Places
 - **Objective HC-3.5:** Music City, Colorado
 - **Objective HC-3.6:** Coordination with Other Promotional Efforts

HOUSING (HO) – *This element focuses on encouraging the development of a diversity of housing options that adequately serve the needs of all Greeley residents. This diversity includes the types of housing products available and cost of housing for both renters and homeowners.*

In the recent years in Greeley, vacancy rates have decreased while median home value and monthly rent have increased. Residents are spending more money on housing costs than in the past. This trend will need to be offset with a greater availability of housing stock, including affordable options.

Goals & Objectives

- **Goal HO-1:** Improve access to housing for all income-levels, ages, and physical abilities
 - **Objective HO-1.1:** Housing Strategy
 - **Objective HO-1.2:** Special Needs Populations
 - **Objective HO-1.3:** Homelessness
 - **Objective HO-1.4:** Coordinate Support Services
 - **Objective HO-1.5:** Homebuyer Education
 - **Objective HO-1.6:** Universal Design and Visitability
- **Goal HO-2:** Encourage a broad diversity of housing options
 - **Objective HO-2.1:** Diversity in New Development
 - **Objective HO-2.2:** Rental Housing

INFRASTRUCTURE (IN) – *This element recognizes one of the core functions of local government is to provide for a cohesive, efficient, and cost-sustainable physical infrastructure. While civic and social infrastructures are the heart of the city, the physical systems are the skeleton that supports the body politic.*

Looking forward, the city is expecting to expand infrastructure by about 50% to correspond with an estimated population growth of 50%.

Goals & Objectives

- **Goal IN-1:** Ensure developed areas in Greeley are served by adequate public facilities and services
 - **Objective IN-1.1:** Adequate Public Facility Standards
 - **Objective IN-1.2:** Determine Adequacy
 - **Objective IN-1.3:** Fire Service
 - **Objective IN-1.4:** Park Facilities

- **Objective IN-1.5:** Police Service
- **Objective IN-1.6:** Sanitary Sewer Facilities
- **Objective IN-1.7:** Water Facilities
- **Objective IN-1.8:** Storm Water Facilities
- **Objective IN-1.9:** Transportation
- **Objective IN-1.10:** Functional Master Plans
- **Objective IN-1.11:** Costs of Infrastructure Expansion
- **Objective IN-1.12:** Infrastructure Operations
- **Goal IN-2:** Ensure the design, construction, and appearance of City infrastructure and facilities contributes to the character of the community
 - **Goal IN-2.1:** Multi-Functionality
 - **Goal IN-2.2:** Distinctive Design
 - **Goal IN-2.3:** Undergrounding of Utilities

NATURAL RESOURCES & OPEN LANDS (NR) – *This element deals with topics related to the natural environment, efforts to protect and improve the quality of Greeley’s water supply and natural areas; minimizing pollutants and their impacts on the natural environment and public health; energy and resource conservation; and engaging the community in efforts to promote good stewardship of both the built and natural environment.*

Goals & Objectives

- **Goal NR-1:** Protect, conserve, maintain, and improve the quality and quantity of water available to Greeley
 - **Objective NR-1.1:** Anticipate Future Needs
 - **Objective NR-1.1:** Water Source Protection
 - **Objective NR-1.1:** Water Conservation
 - **Objective NR-1.1:** Non-Potable Water
 - **Objective NR-1.1:** Ditches
 - **Objective NR-1.1:** Regional Cooperation
- **Goal NR-2:** Manage emissions, effluents, waste, and other sources of pollution that impact our quality of life and natural environment
 - **Objective NR-2.1:** Air Pollution
 - **Objective NR-2.2:** Outdoor Odors
 - **Objective NR-2.3:** Noise Levels
 - **Objective NR-2.4:** Light Pollution
 - **Objective NR-2.5:** Urban Heat Island Effect
 - **Objective NR-2.6:** Waste Management
 - **Objective NR-2.7:** Stormwater Management
 - **Objective NR-2.8:** Agricultural Uses
 - **Objective NR-2.9:** Groundwater Quality
 - **Objective NR-2.10:** Wetlands
- **Goal NR-3:** Demonstrate stewardship of the environment
 - **Objective NR-3.1:** Protect Natural Features and Viewsheds
 - **Objective NR-3.2:** Public Open Lands
 - **Objective NR-3.3:** Use of Constrained Lands
 - **Objective NR-3.4:** Use of Sensitive Lands
 - **Objective NR-3.5:** Preservation of Natural Areas
 - **Objective NR-3.6:** Resource Extraction

- **Objective NR-3.7:** Urban Forest
- **Objective NR-3.8:** Native Habitats
- **Objective NR-3.9:** Wildlife Habitat
- **Objective NR-3.10:** Coordinated Management
- **Objective NR-3.11:** Oil and Gas Operations
- **Goal NR-4:** Use resources efficiently and sustainably
 - **Objective NR-4.1:** Lead By Example
 - **Objective NR-4.2:** Energy Efficiency
 - **Objective NR-4.3:** Landscaping and Plant Species
 - **Objective NR-4.4:** Renewable Resources
 - **Objective NR-4.5:** Energy Waste Capture
- **Goal NR-5:** Engage all members of the community in the process of supporting the stewardship of our natural and built environments
 - **Objective NR-5.1:** Education
 - **Objective NR-5.1:** Recognition

PARKS & RECREATION (PR) – *This element deals with the planning and maintenance of parks and other recreational facilities with the intended purpose of creating a more inter-connected parks, trails and recreation system that provides better access for residents, creates opportunities for healthy and active lifestyles, and supports the environmental goals of the community.*

Goals & Objectives

- **Goal PR-1:** Develop and maintain an inter-connected system of parks, trails, and recreational facilities
 - **Objective PR-1.1:** Parks & Recreation System
 - **Objective PR-1.2:** Parks, Trails, and Open Lands Master Plan
 - **Objective PR-1.3:** Levels of Service
 - **Objective PR-1.4:** Underserved Areas
 - **Objective PR-1.5:** Trail System
 - **Objective PR-1.6:** Regional Connections
 - **Objective PR-1.7:** Recreational Programs and Facilities
 - **Objective PR-1.8:** Streetscapes and Greenways
- **Goal PR-2:** Ensure the City’s system of parks, trails, and recreational facilities align with and support other community goals
 - **Objective PR-2.1:** Water Conservation
 - **Objective PR-2.2:** Planting and Landscaping
 - **Objective PR-2.3:** Maintenance Practices
 - **Objective PR-2.4:** Stormwater Management
 - **Objective PR-2.5:** Education & Interpretation

PUBLIC SAFETY (PS) – *This element deals with public safety as it relates to crime, natural hazards, and the built environment with focused efforts to prevent and be well-prepared for natural hazards, improve the City’s emergency response services, and create a safe and attractive community.*

Goals & Objectives

- **Goal PS-1:** Minimize loss of life and property from hazards
 - **Objective PS-1.1:** Flood Hazards

- **Objective PS-1.2:** Wildfire
- **Objective PS-1.3:** Steep Slopes
- **Objective PS-1.4:** Hazard Mitigation Planning
- **Objective PS-1.5:** Public Awareness
- **Objective PS-1.6:** Hazardous Materials
- **Objective PS-1.7:** Building and Fire Codes
- **Goal PS-2:** Maintain high-quality public safety and emergency response services
 - **Objective PS-2.1:** Fire Services
 - **Objective PS-2.2:** Police Services
 - **Objective PS-2.3:** Community Policing
 - **Objective PS-2.4:** Emergency Medical Response
 - **Objective PS-2.6:** Coordinated Responses
 - **Objective PS-2.7:** Duplication of Efforts
 - **Objective PS-2.8:** Maintaining Service with Growth
- **Goal PS-3:** Develop and maintain a safe, aesthetically pleasing, and livable community
 - **Objective PS-3.1:** Urban Design
 - **Objective PS-3.2:** Code Enforcement
 - **Objective PS-3.3:** Citizen Responsibility
 - **Objective PS-3.4:** Signage and Language
 - **Objective PS-3.5:** Safe Built Environment
 - **Objective PS-3.6:** Public Perceptions

TRANSPORTATION & MOBILITY (TM) – *This element deals with all modes of travel that make up the city’s transportation system, including automobiles, buses, bikes, pedestrians, trains, and airplanes and efforts to increase safety and efficiency; to provide access to a diversity of transportation options; to coordinate future land use patterns and decisions with those for transportation; and to promote efficient means of moving goods and services through the city and between Greeley and the region.*

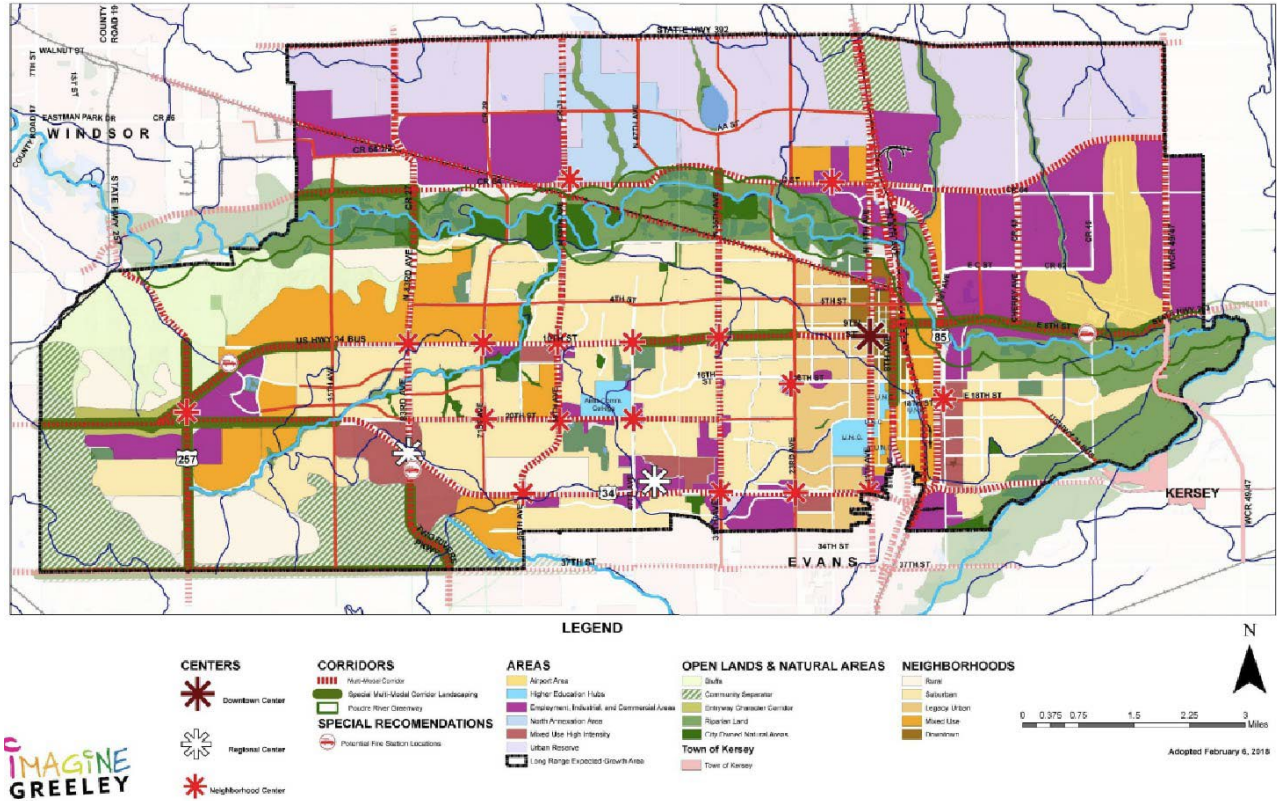
Goals & Objectives

- **Goal TM-1:** Develop and maintain an accessible, integrated, safe, and efficient transportation system
 - **Objective TM-1.1:** Multi-Modal Transportation System
 - **Objective TM-1.2:** Pedestrian Movements
 - **Objective TM-1.3:** Streetscape Design
 - **Objective TM-1.4:** Traffic Calming
 - **Objective TM-1.5:** Emergency Response
 - **Objective TM-1.6:** Transportation Demand Management
 - **Objective TM-1.7:** Parking
 - **Objective TM-1.8:** Functional Classifications
 - **Objective TM-1.9:** Level-of-Service Standards
 - **Objective TM-1.10:** Energy Efficiency
 - **Objective TM-1.11:** System Construction and Maintenance
 - **Objective TM-1.12:** Traffic Enforcement
 - **Objective TM-1.13:** Street Patterns
- **Goal TM-2:** Provide residents with a range of transportation choices and options
 - **Objective TM-2.1:** Complete Streets
 - **Objective TM-2.2:** Bikeway System

- **Objective TM-2.3:** Trail Opportunities
- **Objective TM-2.4:** Residents with Disabilities
- **Objective TM-2.5:** Public Transit
- **Objective TM-2.6:** Regional Transit
- **Objective TM-2.7:** Network Gaps and Barriers
- **Goal TM-3:** Ensure that land use and transportation decisions, strategies, and investments are coordinated and complementary
 - **Objective TM-3.1:** Transportation/Land Use Connections
 - **Objective TM-3.2:** Supportive Development
 - **Objective TM-3.3:** Transit-Oriented Development
 - **Objective TM-3.4:** Balance Impacts
- **Goal TM-4:** Promote the orderly movement of goods and services throughout the city and region
 - **Objective TM-4.1:** Truck Routes
 - **Objective TM-4.2:** Railroads
 - **Objective TM-4.3:** North Greeley Rail Corridor
 - **Objective TM-4.4:** Greeley-Weld County Airport

GROWTH FRAMEWORK

The Growth Framework of the Comprehensive Plan provides an overall vision for how the City of Greeley will grow and evolve in the future. It includes a Land Use Guidance Map, Community Building Blocks, and Annexations. Greeley is expecting to gain at least 50,000 residents in the next 20 years. The city wants to encourage compact and mixed-use development, affordable housing, adequate public facilities, environmentally-sensitive development, and access to parks and open lands.



Land Use Guidance Map

COMMUNITY BUILDING BLOCKS: NEIGHBORHOODS

Neighborhoods are those areas of Greeley where residents live, currently or in the future. The types of neighborhoods are: rural, suburban, legacy urban, mixed use, and downtown. The study area comprises mostly of mixed use and downtown neighborhoods.

Mixed Use Neighborhoods

- Density: generally 4-10 du/acre, but up to 20 du/acre
- Uses: mostly single-unit detached homes; duplexes, town/rowhomes, small-scale apartment buildings, ADUs also allowed
- Small-scale commercial, retail, and service uses allowed, mostly located in neighborhood centers
- Streets: mix of curvilinear and grid pattern with a focus on connectivity (and avoiding dead ends and cul-de-sacs)
- Walkable, blocks no longer than 600 feet long

Downtown Neighborhoods

- Density: 5-20 du/acre
- Uses: mix of housing types and densities; non-residential uses including retail, restaurants, and small-scale office; inclusion of neighborhood amenities such as schools and parks
 - Can be mixed-use or stand-alone uses
- Streets: gridded pattern with alleys, landscaped sidewalks, bike lanes where feasible

- Walkable, blocks no longer than 600 feet long

COMMUNITY BUILDING BLOCKS: AREAS

Areas are locations or districts within Greeley that are not neighborhoods (i.e., are not comprised primarily of residential uses). The types of areas are: airport, education areas, mixed-use high intensity, employment and industrial areas, urban reserve, open lands, community separators, and the north annexation area. The study area comprises mostly of employment and industrial areas.

Employment and Industrial Areas

- Uses: industrial, manufacturing, and other employment uses; commercial and support services (e.g., dining and retail) encouraged
- Streets: mix of gridded and curvilinear/disconnected from larger street network when *focused on serving individual uses or structures within a larger planned development or campus*
- Mobility: mostly concerned with mobility of goods, so access to rail, air, or high-capacity roadways is important; transit priority in areas with a high concentration of employees; encourage connectivity to existing pedestrian and bicycle trains for commuters

COMMUNITY BUILDING BLOCKS: CENTERS

Centers are concentrated nodes of activity within the City of Greeley. The types of centers are: downtown, regional, and neighborhood. The study area includes the downtown center.

Downtown Center

- Density: varies
- Uses: art, entertainment, dining, shopping, community events, civic uses; residential uses present and higher density development is encouraged; infill and redevelopment encouraged
- Streets: gridded with alleys, landscaped sidewalks, bike lanes where feasible, public art features
- Walkable, blocks no longer than 600 feet long

COMMUNITY BUILDING BLOCKS: CORRIDORS

Corridors are generally found along the city's major roadways. The types of corridors are multi-modal corridors and special multi-modal corridor landscaping, both of which are found in the study area.

Multi-Modal Corridors

- Located along major arterial corridors
- Broad mix of high density (including residential) and mixed-use development
- Utilize public transit, pedestrian and bike amenities
- Infill and higher density redevelopment encouraged, especially near transit stops
- Walkable with *an inviting and interesting public realm, wider sidewalks, and by placing parking in the rear of buildings*

Special Multi-Modal Corridor Landscaping

- Incorporate walkways, street trees, bike lanes, and lighting
- Medians, special curb and sidewalk details, sculptural elements, way-finding signage

ACTION PLAN

The Action Plan should be used by City departments in developing annual work plans for staff and to inform the development of the City's budget and Capital Improvement Plan. It should also be used as a reference for community partners who are interested in supporting the implementation of the Comprehensive Plan and wish to collaborate with the City on particular efforts.

The following Implementation Actions (IMPs) relate to Downtown Greeley specifically:

- **Goal GC-5:** Facilitate the rebirth of Downtown Greeley as a regional multi-use activity area while preserving and promoting the cultural aspects of the area.
 - **IMP GC-5.1** Explore expanding existing programs or establishing new programs which encourage the development of attainable housing, particularly “to own” housing, for Downtown workers, such as with the Urban Homesteader program.
 - **IMP GC-5.2** Update the menu of incentives available to Downtown landowners and provide information about such resources in broad formats and in a timely manner.
 - **IMP GC-5.3** Explore regulatory amendments to the Model Traffic Code which would allow for multiple, alternative and special forms of transportation to be allowed in a defined Downtown area, such as Smart cars, horse drawn carriages, trolley, and other similar devices.
- **Goal TM-1:** Develop and maintain an integrated, safe, and efficient transportation system
 - **IMP TM-1.3** Review Development Code standards to evaluate and update parking requirements for various zoning districts to ensure that excessive parking areas are not created, and attractive parking lot design is required.

DOWNTOWN GREELEY INVESTMENT STRATEGY

The Downtown Greeley Investment Strategy was completed by the Greeley Downtown Development Authority (DDA) during the first half of 2011.

OVERVIEW

OBJECTIVES

- *Identify the best ways to invest and leverage tax increment financing to stimulate private investment in Downtown Greeley;*
- *Update the 2002 development plan; and*
- *Help the DDA focus its energies more effectively*

MARKET OPPORTUNITIES

- In-Place Markets
 - ~1 million annual residents and visitors
 - UNC students, faculty, and staff
 - 33,000 residents within a ten-minute walk or bike ride
 - 4,200 employees that work downtown
 - Overnight lodgers at downtown hotels
 - 15,000-45,000 annual room nights
- Neighborhood Profile
 - Lower median income than the city-wide average

- \$33,000 vs. \$43,000
 - Higher percentage of Hispanic/Latino persons than city-wide
 - 47% vs. 36%
 - Psychographic profiles: 21% College Town, 10% NeWest, 10% Great Expectations; 10% Industrious Urban Fringe
- UNC
 - *Student spending is estimated at \$53 million per year*

COMMUNITY PRIORITIES FOR DOWNTOWN

- Lack of identity in Greeley as a whole and downtown
- Immediate economic opportunities from Leprino plant and Niobrara oil and gas
- Improve programming and connection between UNC and downtown
- More options for shopping and dining
- Addition of hotel and conference center
- Increase special events downtown
- Downtown is safer than it is perceived to be
- 8th Avenue is a barrier between Downtown and other parts of the city

Survey Results

- *Top reasons for visiting Downtown: dining (75%), special events (57%), the UCCC (45%), nightlife and entertainment (35%), and shopping (30%)*
- *Top reasons for avoiding Downtown: lack of retail (53%) and restaurants (37%), generally unappealing environment (33%), lack of information on what exists (31%), lack of parking (31%), and safety concerns (29%)*

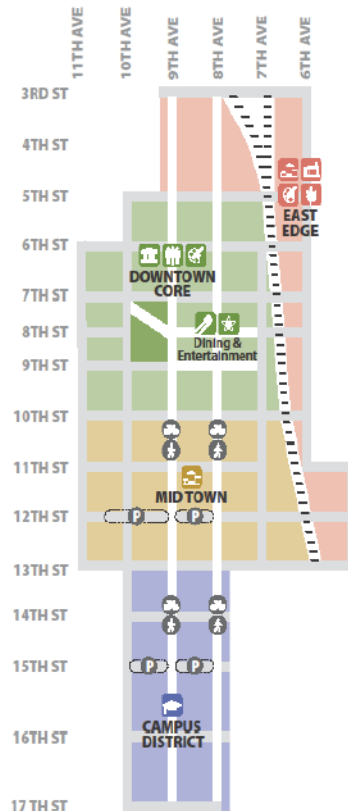
Impressions

The following impressions guide the Downtown Investment Strategy:

- *There is an opportunity to better tap “in-place” markets*
- *Dining and retail are key to the future vitality of Downtown*
- *Creating stronger connections to UNC can elevate the image and cache of Downtown*
- *Downtown can be positioned as Greeley’s authentic and historic destination*
- *There are immediate business development opportunities*
- *The next investment cycle is being led by multi-family residential development*
- *Downtown should concentrate on fortifying its core, connections and amenities*
- *There is an opportunity to create a new market identity and “brand” for Downtown*

SUB-AREA STRATEGIES

By defining four unique sub-areas in and around Downtown, making more logical connections among them, and valuing the history and diversity each has to offer, the DDA can prioritize its investments to make the whole of Downtown a stronger, more cohesive and interesting place to be. The plan recommends four sub-areas: Downtown Core, Campus, Mid Town, and East Edge.



DDA Subarea Map

DOWNTOWN CORE – Dining, Entertainment, Employment & Civic Hub

- Context: employees and residents leave a large, and mostly untapped, market opportunity; includes Downtown Greeley Historic District
- Vision: destination for dining, entertainment and employment; embraces history and culture; strong sense of place; attracting more dining and entertainment options with mixed-use development
- Desired Development: local, independent restaurants and retail; residential development; mixed-use “catalyst” development; hotel; primary employers
- Opportunity Sites: block between 6th and 7th Streets and 8th and 9th Avenues; surface parking lot south of Lincoln Park Branch Library; Armory Building on 8th Avenue and adjacent eastern lot
- Development Challenges: 8th Avenue breaks up sense of continuity and is a perceived and real barrier; 9th Avenue at Lincoln Park contains *long, continuous blank walls that detract from the overall atmosphere of the Core*
- Physical Connections: 8th and 9th Avenues are major north-south routes between Downtown Core and UNC Campus; can be enhanced to provide better accessibility and connectivity to pedestrians and cyclists

CAMPUS SUB-AREA – Mixed-Use with Student-Focused Amenities

- Context: student-focused retail and quick-serve dining; single family and student housing in Monroe Street Historic District; portion of the recently designated *University District*
- Vision: mixed-use with multi-unit housing and ground floor uses with student-serving retail and amenities; well-suited for pedestrian and bike travel

- Desired Development: residential mixed-use development sensitive to single-family homes and existing character; enhanced bike and pedestrian infrastructure
- Opportunity Sites: surface parking lots and retail lacking strong street edge along 8th Avenue and NE corner of 16th Street and 8th Avenue
- Development Challenges: more challenging and lengthy land acquisition process for small parcels that need to be assembled for mixed-use development
- Physical Connections: 8th and 9th Avenues are major north-south connections; need for increased pedestrian and bike safety and comfort to bring students into Downtown

MID TOWN – Mixed-Use Neighborhood Between Core & UNC

- Context: residential with intermittent commercial activity; connection between campus and Downtown Core
- Vision: diverse households; opportunity for new housing, mixed-use development, and increased residential diversity; primarily for-rent with some for-sale units
 - *Neighborhood-focused retail will provide essential goods and services making this a highly desirable, livable and walkable neighborhood.*
- Desired Development: single or mixed-use housing and live/work units; neighborhood-serving retail and services; enhanced bike and pedestrian infrastructure
- Opportunity Sites: Safeway grocery store at 10th Avenue and 12th Street; vacant and underutilized commercial properties both on and off 8th Avenue
- Development Challenges: inconsistent look and feel of businesses; small parcels are difficult for mixed-use and multi-unit development

EAST EDGE – Live/Work, Arts & Light Industrial

- Context: unique feel; embracing agricultural and industrial past; potential for adaptive reuse of agricultural and railroad buildings
- Vision: live/work neighborhood some light industrial manufacturing, agriculture and arts and crafts uses; celebrate history of rail
- Desired Development: live/work units with art and light industrial uses; embrace rail and agricultural history
- Opportunity Sites: existing agricultural and warehouse buildings (preserved and reused when possible); old Ice House building
- Development Challenges: railroad tracks are a physical barrier, noise from train; missing sidewalk segments and road connections; within 100-year floodplain; accessibility for businesses
- Physical Connections: *Better, safer pedestrian and bicycle connections are needed across the railroad tracks, particularly to the Downtown Core*

ACTION PLAN

The actions in this section of the plan are designed to achieve the Sub-area Strategies outlined in the preceding section of the plan. This information is organized into three categories: Economic Development, Experience, and Public Realm. The actions for each section are outlined below.

Economic Development

*Denotes that the recommendation is specifically intended for the Downtown Core.

- ED1: Business and Development Support and Attraction

- ED2: Financial Support
- ED3*: Develop a “Dining and Entertainment Incentive Zone”
- ED4*: Downtown Hotel/Convention Feasibility Study
- ED5*: Catalyst Mixed-Use Development
- ED6*: Mixed-Use Development and Housing
- ED7*: Encourage Adaptive Reuse

Experience

Each recommendation is intended for the entire DDA boundary.

- EX1: Safe & Clean
- EX2: Events
- EX3: Branding and Identity
- EX4: “In-Place” Marketing
- EX5: Embrace UNC
- EX6: Visual and Performing Arts
- EX7: Gateways, Lighting, Banners

Public Realm

*Denotes that the recommendation is specifically intended for the East Edge.

- PR1: Strengthen 8th Avenue Corridor
- PR2: Make the Critical Links
- PR3*: Upgrade Infrastructure

EXISTING BUDGET

DDA 2011 Budget Summary		
Revenue		
Tax Increment Financing	\$ 300,000	52%
Mill Levy	120,000	21%
Dues	50,000	9%
Special Events	62,000	11%
City of Greeley Grant Support	48,750	8%
TOTAL	\$ 580,750	100%
Expenses		
Personnel	\$ 147,000	25%
Marketing & Office Support	43,950	8%
Special Events Expenses	37,300	6%
Capital Improvement Fund	80,000	14%
Economic Development	70,000	12%
Investment Surplus	200,500	35%
TOTAL	\$ 578,750	100%

Program Budgeting Guidelines

- Diversify DDA Program Investments
 - Advance all three programs: economic development, experience, and public realm
- Program Goal

- Annual goal of \$500,000
- Capital Investment Goal
 - Utilize and revolve the DDA's current TIF fund balance of about \$1 million

Other Financial Information

This section also provides information on the following:

- Sample Implementation Budget
- Investment Filter
- Organizational Strategy

APPENDICES

The appendices of this plan include the following:

- Market Profile
 - Summary of Findings
 - DDA Statistics
 - DDA Neighborhood Market Area
 - Population, Age, and Race & Hispanic Origin
 - Income & Poverty
 - Consumer Spending
 - Education
 - Employment and Occupations
 - Housing
 - Housing Vacancies
 - Households
 - Transportation & Commuting
 - Hotel Occupancy
 - UNC Students, Faculty & Staff
- Outreach Summary
 - Methods: DDA Board of Directors, DDA Framework Plan Steering Committee, Focus Groups, Stakeholder Interviews, Community Survey
 - Themes
 - Focus Groups
 - Stakeholder Interviews
 - Online Survey Results
 - Cross-tabulations
- Focus Group Transcript Summaries
 - Tax Increment Financing Committee
 - Steering Committee
 - Greeley Downtown Alliance
- Online Survey

DOWNTOWN GREELEY ACCOMPLISHMENTS

This report summarizes the accomplishments of the strategies/goals identified in the Action Plan section of the Downtown Greeley Investment Strategy. The Investment Strategy was published in July 2011 and this report is from August 2021.

The report lists the status of each goal within the actions for the following three categories that were initially identified in the Investment Strategy: Economic Development, Experience, and Public Realm. The status report categories include: complete, ongoing/in process, needs work, needs research, not necessary/needed (at this point), determine if needed/appropriate, not pursued, alternative, and TBD. For each goal's status, please refer to the report.

2022 ANNUAL GROWTH & DEVELOPMENT PROJECTIONS REPORT

This report summarizes population, housing, income and employment/job growth and development up to and beyond 2022.

POPULATION

- 2021 population of Greeley was 110,787 and is expected to be 123,532 by 2027
 - 11.5% increase in 6 years
- Median household income was reported as \$61,492 in 2019 in Greeley
 - 5.9% increase from the year before

HOUSING

- 768 new residential units are estimated in 2022. This would bring the total number of housing units in Greeley to 46,321.
- A high growth rate of 3.66% would result in 47,181 housing units by 2027
- Greeley issued 915 residential permits in 2021 which was a 236% increase from 2020
 - This was 39.3% more units permitted than Fort Collins, but 45.7% fewer than Windsor
 - Almost two-thirds of the units were single family
- Median home sale price has risen 14.6% since 2020, to \$385,000
 - *A shortage in housing stock has continued to push up the median home sales price.*

EMPLOYMENT, UNEMPLOYMENT, & JOB GROWTH

- In 2021, Greeley had 49,927 jobs which is lower than the 2019 peak level of 51,867 jobs
 - However, unemployment fell from 8% in 2020 to 7% in 2021
- During 2021 (up to November), Greeley gained 1,205 jobs (2.5% increase)
- *Comparing employment growth in Colorado across MSA Regions, Greeley MSA (Weld County area) consistently leads the state and other metro areas.*

INFLUENCING FACTORS ON GREELEY'S GROWTH

- *The Terry Ranch Water Project puts Greeley in a position to support increased demand for residential and commercial development.*
- *The North Weld County Water District's (NWCWD) current moratorium on new tap sales could drive additional development to the City of Greeley, as other nearby cities such as Severance and Eaton impose moratoriums on new building permits in response.*

- *Continued growth in Northern Colorado could lead to increased development pressures on Greeley. Weld County had the second largest percent increase in population (30.1%) between 2010 and 2020, second only to Broomfield (32.6%)*
- *Cost of materials and supply chain issues could temper some of the growth in the City of Greeley and throughout Northern Colorado. Supply-chain issues with construction materials have caused some homebuilders to halt sales of new homes to allow time for supply chain issues to resolve. As mortgage rates continue to rise, delays could lead to higher borrowing costs.*

GREELEY DOWNTOWN DEVELOPMENT AUTHORITY 2020 ANNUAL SNAPSHOT

This report summarizes the accomplishments of the Greeley DDA in 2020 “in spite of the COVID-19 pandemic.”

- 17 new businesses opened
 - 2 restaurants, 4 retailers, 4 entertainment & fitness, and 7 service
- 23 properties sold
 - 15 commercial (\$14.8M) and 8 residential (\$8.9M)
- 3 new residential properties opened
- 2 façade grant projects completed
 - \$83,642 in private reinvestment
- 3 building improvement grant projects completed
 - \$1.4M in private reinvestment
- Promoting a Reimagined Experience
 - “The Place to Be” campaign
 - Pivoted events
 - Expanding the outdoors
 - Art exploration

CITY OF GREELEY ENERGY ACTION PLAN

This Energy Action Plan outlines tangible steps for the City of Greeley to move the community toward its development and energy efficiency goals. Xcel Energy’s Partners in Energy facilitated a series of workshops with the Energy Action Team in the spring and summer of 2019, to develop this plan.

VISION

Greeley promotes a healthy and diverse economy and a high quality of life that is responsible to all its residents, businesses, and neighborhoods. Through Xcel Energy Partners in Energy, the community will create an affordable and reliable energy future based on increased residential, commercial, and industrial energy efficiency and alternative energy opportunities to improve economic health and stimulate growth.

GOALS

- *Encourage 2,700 or more City of Greeley households implement at least one energy efficiency or renewable energy measure annually.*
- *Encourage 270 or more businesses to participate in an energy efficiency or renewable energy program through Xcel Energy each year.*
- *Develop outreach channels to students to increase awareness of and engagement in energy efficiency and renewable energy opportunities.*

- *Complete energy audits in targeted municipal facilities and implement at least one energy efficiency measure in each targeted facility, as recommended by the energy audits.*

FOCUS AREAS & STRATEGIES

- *Residential: the desired behaviors identified included making smart energy choices and improvements at home (i.e., turning off the lights when not in use, upgrading to LED lights, and investing in high efficiency equipment when making upgrades).*
 - Conduct outreach at community events and activities
 - Develop and conduct residential outreach campaigns to under-resourced families, renters, and homeowners
- *Business: the desired behaviors identified included ensuring all equipment upgrades are energy efficient and companies invest in energy efficiency upgrades that make good business sense.*
 - Host an annual Greeley business energy efficiency expo
 - Conduct sector-based small business outreach to restaurants, offices, retail, and eco-friendly companies
- *Educational Institutions: includes not only energy efficiency upgrades to the institution's facilities, but also engaging students to promote energy efficiency and renewable energy.*
 - Engage students in energy efficiency opportunities
 - Complete energy audits and efficiency improvements at targeted facilities
- *Municipal: the desired behaviors identified include ensuring upgrades as well as designs for the construction of new facilities are efficient and increasing the focus of highlighting past successes in efficiency through various media outlets.*
 - Complete energy audits and efficiency improvements at targeted facilities
 - Align processes to integrate energy efficiency and renewable energy information into new construction and development review processes

MASTER TRANSPORTATION IMPACT STUDY: 8TH AVENUE REDEVELOPMENT

In March 2018, Felsburg, Holt, & Ullevig (FHU) prepared this transportation impact study for a new project consisting of 704 residential units and 83,307 square feet of commercial space spanning nine blocks of 8th Avenue, from 10th Street to 17th Street. The following are some of the key takeaways from the report.

- An estimated 11,800 daily trips will be added due to the development, 550 during the morning peak hour and 800 during the afternoon peak hour
- This will result in a noticeable impact with a traffic increase of 14-24% depending on the location, but the existing infrastructure will be able to accommodate it
- FHU recommends a potential land addition at the intersection of 8th Avenue and 16th Street
- No additional traffic signals are recommended
- The developments are planned to have alley access and minimal curb cuts to create a more pedestrian-friendly frontage

CITY OF GREELEY STRATEGIC HOUSING PLAN

Greeley aspires to provide a range of housing to accommodate its diverse and growing population. Diversity in housing would mean both a variety of housing types and a broad range in price. Because communities are largely defined by the type, style, and cost of housing it is important for Greeley to have a clear understanding of current housing conditions with strategies to shape future growth.

KEY CONSTRAINTS TO HOUSING AFFORDABILITY

1. Escalating cost of raw water
2. Rising cost of construction and development related costs
3. Lack of financing
4. Lack of skilled labor
5. Rising costs of existing housing
6. Flat wages
7. Missing homes not built during the Great Recession and Greeley's residential downturn

STRATEGIES

1. Amend the Development Code to Promote Housing Choice
 - a. Correct zoning mismatches
 - b. Accessory dwelling units
 - c. Reduce minimum lot sizes for single family housing
 - d. Provide regulatory incentives for permanent affordable housing
 - e. Encourage complete neighborhoods
 - f. Short-term rentals
2. Minimize Development Costs for Affordable Housing
 - a. Explore new development incentives
 - b. Evaluate having the City front-end major infrastructure
 - c. Support metropolitan districts
3. Engage Alternative Housing Providers to Build Affordable Housing
 - a. Work with community land trusts
 - b. Partner with for-profit and non-profit housing providers
 - c. Work with major employers on shared housing programs
 - d. Work with Habitat for Humanity to expand their role
 - e. Explore land banks
4. Improve the Housing Product Mix
 - a. Encourage diversity in housing types
 - b. Promote housing innovation
 - c. Update the Redevelopment Guide
5. Address the Impact of Raw Water Cost on Housing Affordability
 - a. Implement water smart neighborhood and common area policies
 - b. Develop a water smart policy for individual lots
6. Complete Subarea & Neighborhood Plans
 - a. Complete plans for neighborhoods with housing opportunities
 - b. Large-scale master planning for complete neighborhoods
 - c. Identify under-utilized sites for housing
 - d. Adopt a five-year housing goal
7. Encourage Ownership, Move-up & Executive Housing Options
 - a. Encourage a range in housing choices
 - b. Work with developers to create higher-end developments
 - c. Explore cooperative housing options
 - d. Develop additional home ownership incentive programs
8. Encourage Vocational Training & Apprentice Programs

- a. Support educational institutions involved in skilled trades
9. Facilitate Development of Manufactured Home Communities
 - a. Affordable housing options
 - b. Explore alternative ownership options
 - c. Alternative technologies
 - d. Update regulations

Each of the above strategies actions are listed, along with the priority and who it will be implemented by.

MARKET STUDY & RECOMMENDATIONS: DOWNTOWN APARTMENT MARKET

In April 2017, Apartment Appraisers & Consultants, Inc. (AAC) prepared this market study and recommendations for Greeley's downtown apartment market. The following are some of the key takeaways from the report.

- Downtown Greeley has many walkable businesses and employers that can make it attractive to live there as well, in turn boosting downtown's economy
 - Though there is also a negative stigma attached to the area due to perceptions of crime, traffic, poor building conditions, etc.
- There is more projected demand for apartments than there is supply in downtown Greeley
 - There may be potential for up to 1,000 additional units "during the next several years"
 - There may be separate demand for condominium development as well
 - "An analysis of the downtown area indicates that it has significant untapped potential"
- AAC recommends that new apartment buildings are built with at least 180, but preferably 200 or more, units to provide "a full range of community amenities," such as community rooms, fitness centers, business centers, and pools/spas
- AAC estimates that the Greeley/Evans market will need to add 330 units per year to keep up with population growth and demand
- There is currently an abundance of older 2-bedroom/2-bathroom units and an undersupply for smaller units
- AAC projects a downtown rent growth of 5% in the first year, 4% in the second year, and 3% in the third year where rents will average \$1,472/month at \$1.77/square foot.

GREELEY PARKS, TRAILS AND OPEN LANDS MASTER PLAN

The primary goals of this master plan update are to ensure the City's parks, trails and open lands meet the needs of a growing community, enhance the quality of life for residents and visitors and add value to all of the ways that Greeley residents recreate and play. This plan update also provides recommendations for funding, policies, operations, services, programming, maintenance and improvements for short and long-term implementation.

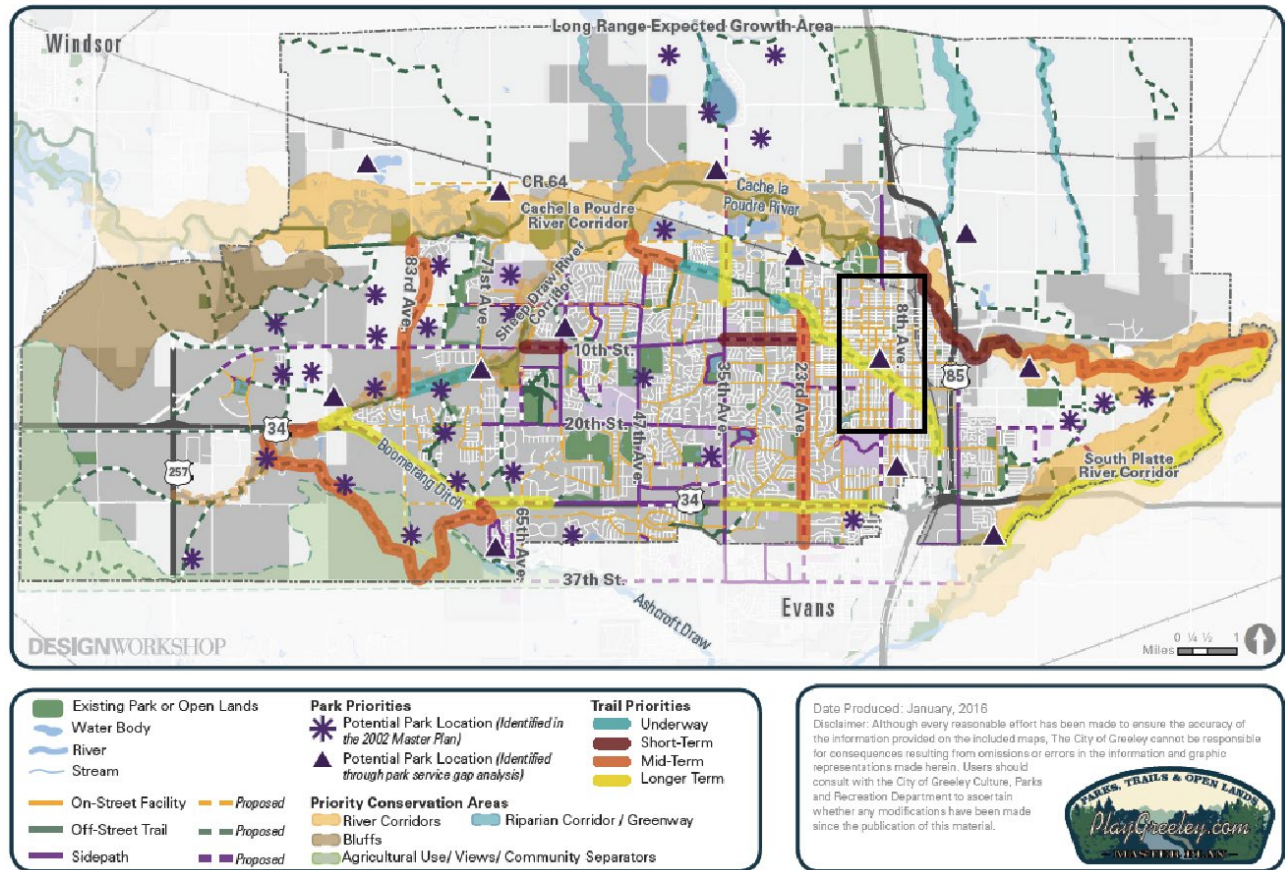
VISION

To be a premier provider of exceptional spaces and experiences for the entire community.

MISSION

To enhance our community through exceptional service and stewardship.

Map 1: Master Plan Recommendations (See Appendix E for Larger Map)



Master Plan recommendations with a rough outline of the DDA boundary in black.

RECOMMENDATIONS

The plan outlines the following recommendations for parks, open lands, trails, facilities, and programs.

PARKS

1. Build new parks to accommodate community needs and growth.
2. Strategically locate new parks.
3. Implement cohesive park design through site-specific master plans.
4. Continue to support water conservation and sustainability goals.
5. Integrate park system additions and design improvements with neighborhood development

OPEN LANDS

1. Strategically conserve open lands to create an interconnected system.
2. Implement the Open Lands Management Plan.

TRAILS

1. Connect and expand the trail system.
2. Expand and diversify Greeley’s recreational trail offerings.

3. Implement trail classification and design standards to create continuity throughout the trail system and accommodate all user types.
4. Enhance safety and usability for trail users.

FACILITIES

1. Satisfy existing and future facility needs as parks are added to the system or renovated.
2. Provide a diversity of facilities to accommodate a variety of group sizes and an increasing number of special events within the community.
3. Provide park access for dogs and their owners.
4. Support youth athletic programs by providing adequate sports fields to accommodate current and future needs.
5. Expand indoor aquatic and outdoor water recreation offerings.
6. Pursue the development of community and neighborhood skate parks to satisfy existing demands and meet future needs.
7. Work with interest groups to establish a site and construct a new disc golf course.
8. In partnership with other entities, provide desired amenities that are not currently a robust part of Greeley's parks and recreation offerings.
9. Enhance park facilities to meet user needs for parking.
10. Create a Recreation Facilities Study.

PROGRAM

1. Continue to provide a diversity of activities in the Core Program Areas being offered (Adult Sports, Aquatics and Youth Sports).
2. Advance the development of supporting programs with high demand that are not meeting current needs and those that are important to the community.
3. Expand Core Program Areas and Supporting Program Areas in an effort to meet growing community needs and keep up with recreation trends.
4. Target youth and senior programming.

IMPLEMENTATION

The plan identifies recommendations for implementation within the following areas: operations and staffing, maintenance, safety, communications, city assets, and funding and budget.

OPERATIONS AND STAFFING

1. Enhance operations utilizing the updated Functional Organizational Structure which responds to the current division of responsibilities.
2. Provide adequate staff and resources to meet existing needs and continue to provide high quality parks, trail and open lands.

MAINTENANCE

1. Document standards for maintenance of quality parks, trails and open lands.
2. Provide adequate maintenance facilities and shops.
3. Ensure continued investment is dedicated to repairing and updating existing amenities and facilities.

SAFETY

1. Maintain minimal security concerns by continually assessing risks and community member perceptions.

COMMUNICATIONS

2. Enhance focused outreach to the following growing demographic groups in Greeley that typically require unique and targeted outreach.
3. Encourage volunteerism and stewardship of existing resources.
4. Apply for/maintain certifications to acknowledge and enhance the quality of the parks system.

CITY ASSETS

- Explore opportunities to utilize city/public assets for recreation and natural lands purposes.

FUNDING AND BUDGET

1. Update the Quality of Life Fund project list 2016-2023 to include capital projects envisioned in the Master Plan.
2. Renew the Quality of Life Tax and blend parks and recreation project funding with other City priorities.
3. Seek funding/support from a variety of sources that have provided funds for past projects (see plan for a list of sources).
4. Explore the feasibility of gaining funding from new sources and developing partnerships to accomplish trail expansion and open lands conservation.
5. Pursue grant opportunities related to Master Plan goals and recommendations.
6. Fund additional programs and departmental resources identified in this Master Plan.

LANDSCAPE POLICY PLAN FOR WATER EFFICIENCY

The purpose of this document is to provide policy direction that strikes the balance between preservation of the lifestyle values of the City of Greeley, and honoring the natural environment by adopting a landscape code that is appropriate for our region.

The City of Greeley has identified four departments to manage water conservation in landscapes: Community Development; Culture, Recreation and Parks; Public Works; and Water and Sewer.

GOALS – the plan identifies the following goals, each with policies and actions.

- **Goal 1:** Maintain Greeley's quality landscapes and urban forest.
- **Goal 2:** Provide adequate information, training, and examples of water efficient landscapes that enable the design, installation, and maintenance of quality landscapes that use landscape water efficiently.
- **Goal 3:** Revise applicable sections of the Municipal Code that address landscaping, irrigation, and soil conditioning to comply with the goals, policies, and recommendations of this Plan.
- **Goal 4:** Explore incentives for water-efficient landscapes.
- **Goal 5:** Ensure that the City of Greeley and its departments continue to lead by example by adhering to landscape practices that may improve irrigation efficiency.

BICYCLE MASTER PLAN

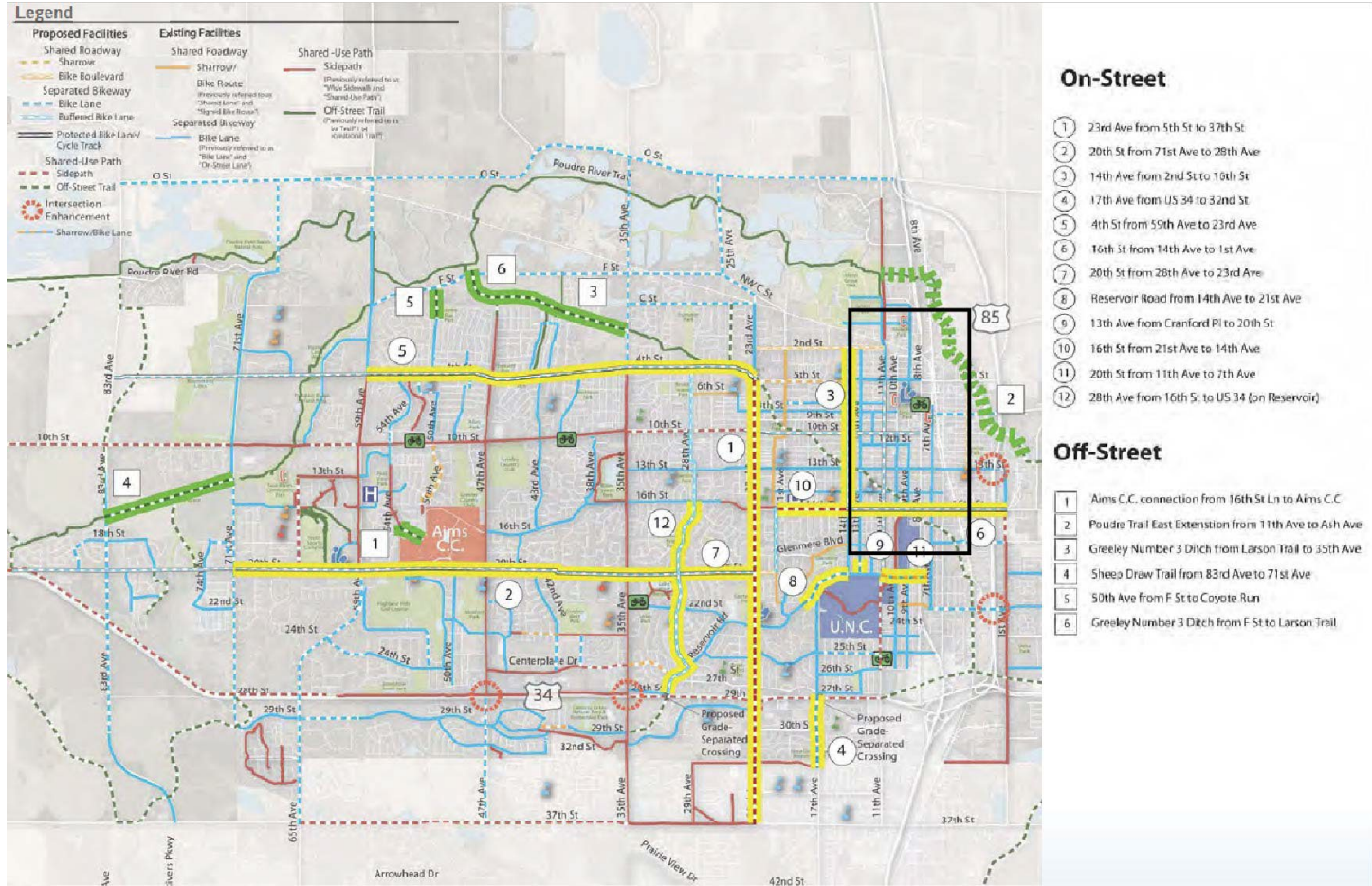
This plan was developed to address the “Five E’s” of bicycling (Engineering, Education, Encouragement, Enforcement, and Evaluation), while providing an action-oriented plan that can quickly be moved forward into implementation.

GOALS – the following goals were identified in the plan:

- Increase bicycle ridership in Greeley.
- Incorporate considerations for bicyclists (facilities, route designation, wayfinding, signage, access, parking, and storage) in all future improvements to the transportation system and to public space.
- Develop design, construction, and maintenance standards for bike facilities.
- Build a safe and efficient bicycling network and support facilities that serve the needs of all types of bicyclists, connecting residential Greeley to the University, recreational trails, downtown, retail centers, and local services.
- Promote bicycling as a healthy and inexpensive transportation alternative, vital to economic development and affordable living choices for Greeley residents.
- Establish a city division under public works to maintain and expand the city bicycle program.

RELEVANCE TO DOWNTOWN GREELEY AND ECONOMY – the following summarizes some of the key points in regard to Greeley’s downtown and economy.

- Downtown is one of the highest areas of bicycle demand, along with the UNC campus, AIMS campus, 10th Street corridor, and the commercial corridor along US-34.
- Bicyclists spend 24% more per month than customers who drive to shop.
- The City estimates that the current potential annual economic benefits that bicycling brings is \$2.68M.
 - The goal of the economic impact when goal bicycle mode share is met is \$8.37M
- Bike-Friendly Business Program: *Greeley’s Bike-Friendly Business Program will recognize businesses that go the extra mile to welcome bicyclists, and encourage business owners to take action to become more bike friendly. It will function as a partnership between the city and businesses where participating businesses receive additional resources from the city, such as educational training.*
- Downtown includes some of the higher, but not the highest, demand areas for bicycling
- The levels of traffic stress downtown vary and include each of the stress categories: suitable for most children, suitable for most adults, suitable for confident adults, and suitable for fearless adults
- Downtown has one of the highest concentrations of bicycle crashes, with many taking place at intersections where there is a bike lane



Priority Project Locations Map with a rough outline of the DDA boundary in black.

Item No. 6.



Plan Overview

City Council Work Session
January 10, 2023

DOWNTOWN 2032 – THE PATH FORWARD
GREELEY DOWNTOWN PLAN UPDATE

Draft - December 2022

Background

- **2011:** the Greeley Downtown Development Authority (DDA) contracted with P.U.M.A. to develop an **area redevelopment and investment strategy**
 - **A decade of public and private investments, events, and activities followed,** including:
 - an improved 8th Ave. corridor & planned 16th Street improvements;
 - a new hotel/conference center, municipal complex & fire station;
 - Lincoln Park & Rec Center upgrades;
 - new apartments, brewpubs, restaurants and shops;
 - parking improvements;
 - signature events such as Monster Day& OktoBrewFest;
 - establishing the State's first 'common consumption' area, complemented with popular summer-long 'Friday Fests'
 - State certification of Greeley's Creative District;
 - expanded public art; and,
 - creation of a Redevelopment Fund to stimulate investment,
- to name a few....

DOWNTOWN GREELEY INVESTMENT STRATEGY



PREPARED FOR THE
**GREELEY
DOWNTOWN DEVELOPMENT
AUTHORITY**

Current Initiative

- To capitalize on this **momentum**, the City Manager designated funding in late 2021 to update the plan to review, update and stimulate continued downtown revitalization; a consultant (P.U.M.A.) was selected and work on the update commenced in early 2022.
- **A planning horizon of 2032** was selected to mirror the previous decade's work and the terminus of the existing Downtown Tax Increment district
- The Plan **evaluated existing conditions** via Market, Capital Improvements, and Urban Quality Assessments to provide the foundation for recommendations
- Extensive **technical review and community outreach** informed core values and priorities that resulted in the proposed strategies and actions

Market Assessment

- Provides an overview of four market segments (Live, Work, Shop & Dine, and Visit & Stay)
- Provides baseline data before and after the Pandemic disruption
- Explores strengths and vulnerabilities in each market segment to ensure recommendations are grounded in economic reality

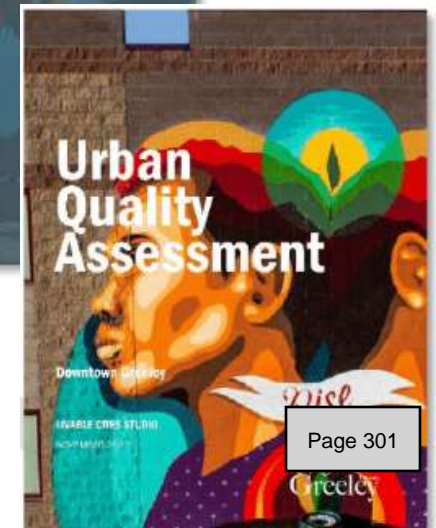


Market Assessment Key Findings:

- Housing market is robust, will remain a key economic driver
- The industrial sector, including manufacturing, are enduring economic anchors that will attract employers and offer distinction from other peer downtowns
- The office market is likely to remain niche over the next market cycle but the low cost of such space offers a lower barrier to entry for entrepreneurs and new businesses
- Retail continues to strengthen Downtown
- Connections to UNC remain an underutilized market opportunity

Capital Improvement/ Urban Quality Assessments

- Evaluated the existing conditions of streets, plazas, and parks in the study area
- Identified gaps and opportunities to support public realm and placemaking recommendations
- Provide a foundation for improvements in four key areas:
 - Public spaces
 - Forms of movement
 - Street hierarchy
 - Safety

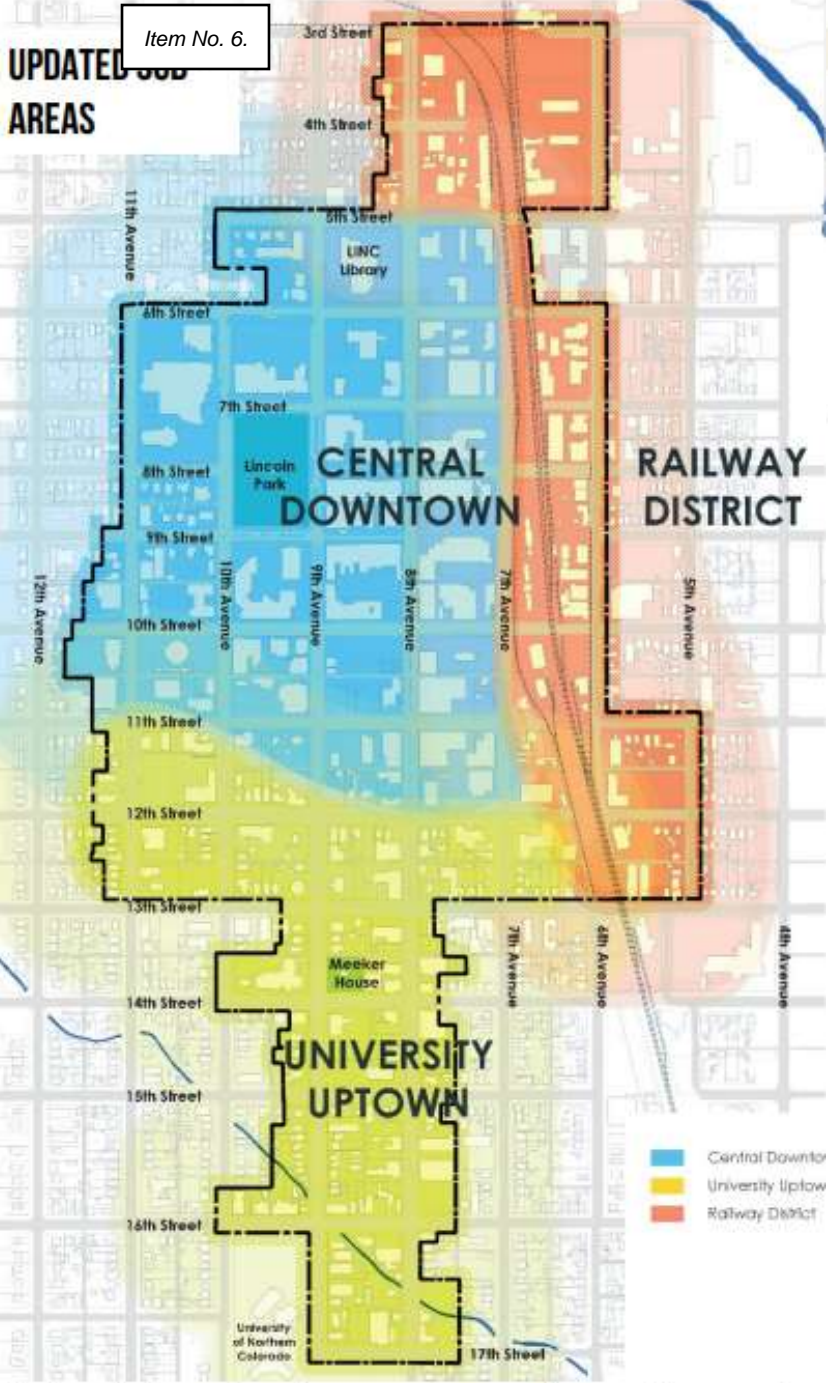


Capital Improvement & Urban Quality Assessments Key Findings:

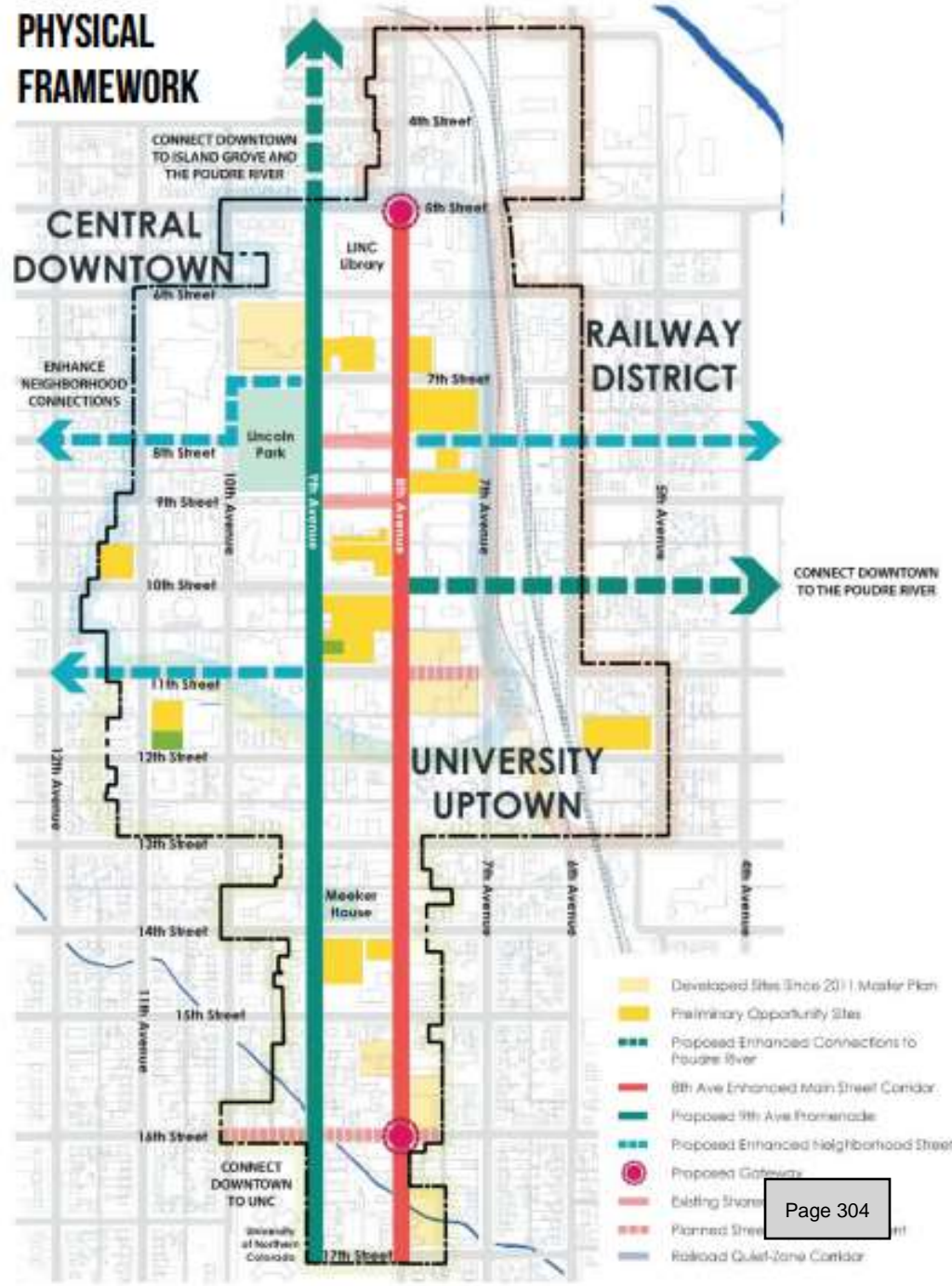
- Eastern edge of Downtown and non-residential areas have the lowest quality public realm space and missing infrastructure (e.g. sidewalks)
- The highest quality public realm space and improvements is in the Downtown core and in the residential areas to the south
- 8th and 9th Avenues have different but complementary characteristics and good north to south connectivity
- A need for a distinct public space network and distribution of public spaces throughout the area
- The area has a disproportionate amount of area devoted to vehicles (parking, road width & capacity)
- The bicycle infrastructure can be built upon for greater use and service to the area
- Lighting near the core of Downtown is adequate but lacking in other areas

Community Engagement

- **Inclusive and broad engagement** was key to the Plan's development that incorporated over **1,250 inputs** and included:
 - Downtown Advisory Committee
 - City Technical Working Group
 - DDA Board
 - Topic-based Focus Groups
 - Community Open House
 - Focused Outreach
 - On-line survey (over 1,100 responses in both English/Spanish)
- **Top priorities** from the on-line survey:
 - **Physical improvements**: repurposing underutilized parking lots, maintaining the area's historic character and more beautification
 - **Services and programs** more retail and restaurants, public safety, offering more services to address the unhoused



Area Context



Key Strategies: Summary

ECONOMY:

1. Continue to stimulate infill development and redevelopment of underutilized sites
2. Encourage diverse, vibrant storefront uses
3. Continue to diversify the housing base
4. Sustain and attract more primary employers and jobs
5. Cultivate a Downtown economy that is relevant and welcoming to an array of community members

ENVIRONMENT

1. Enhance connections to the Poudre Trail
2. Improve connections to the UNC campus
3. Create new public spaces with inviting outdoor spaces distinctive to each sub-area
4. Unify Downtown's public realm with consistent standards that promote a quality setting
5. Enhance the connections to adjacent neighborhoods

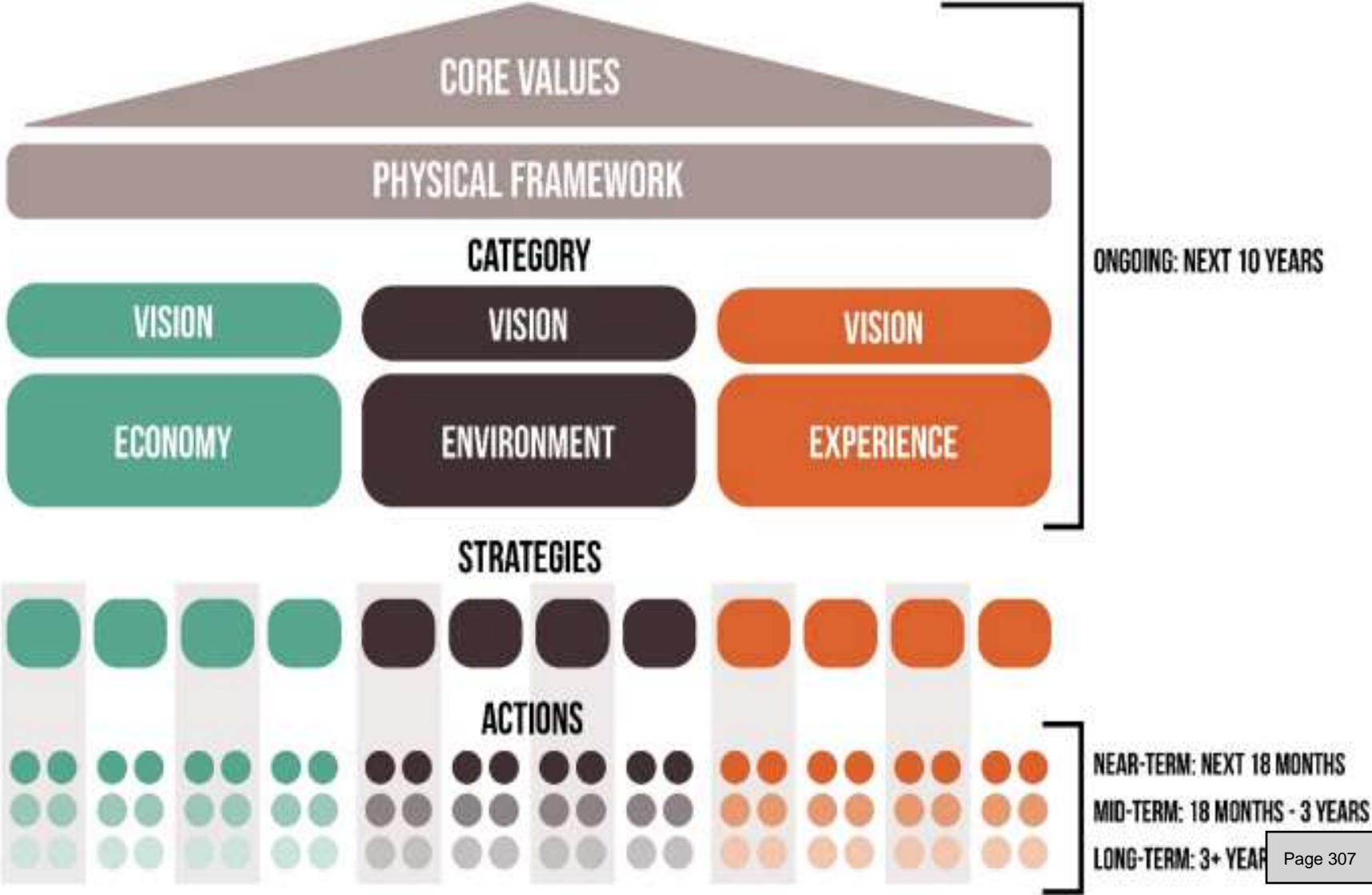
EXPERIENCE

1. Promote local arts and creative experiences in Downtown
2. Ensure Downtown is clean, safe and welcoming
3. Celebrate historic character, charm and distinctive environment in Downtown
4. Continue to activate Downtown through programming and events that are relevant and inclusive of Greeley's diverse population
5. Market existing Downtown assets and amenities to locals and visitors

Actions/Recommendations

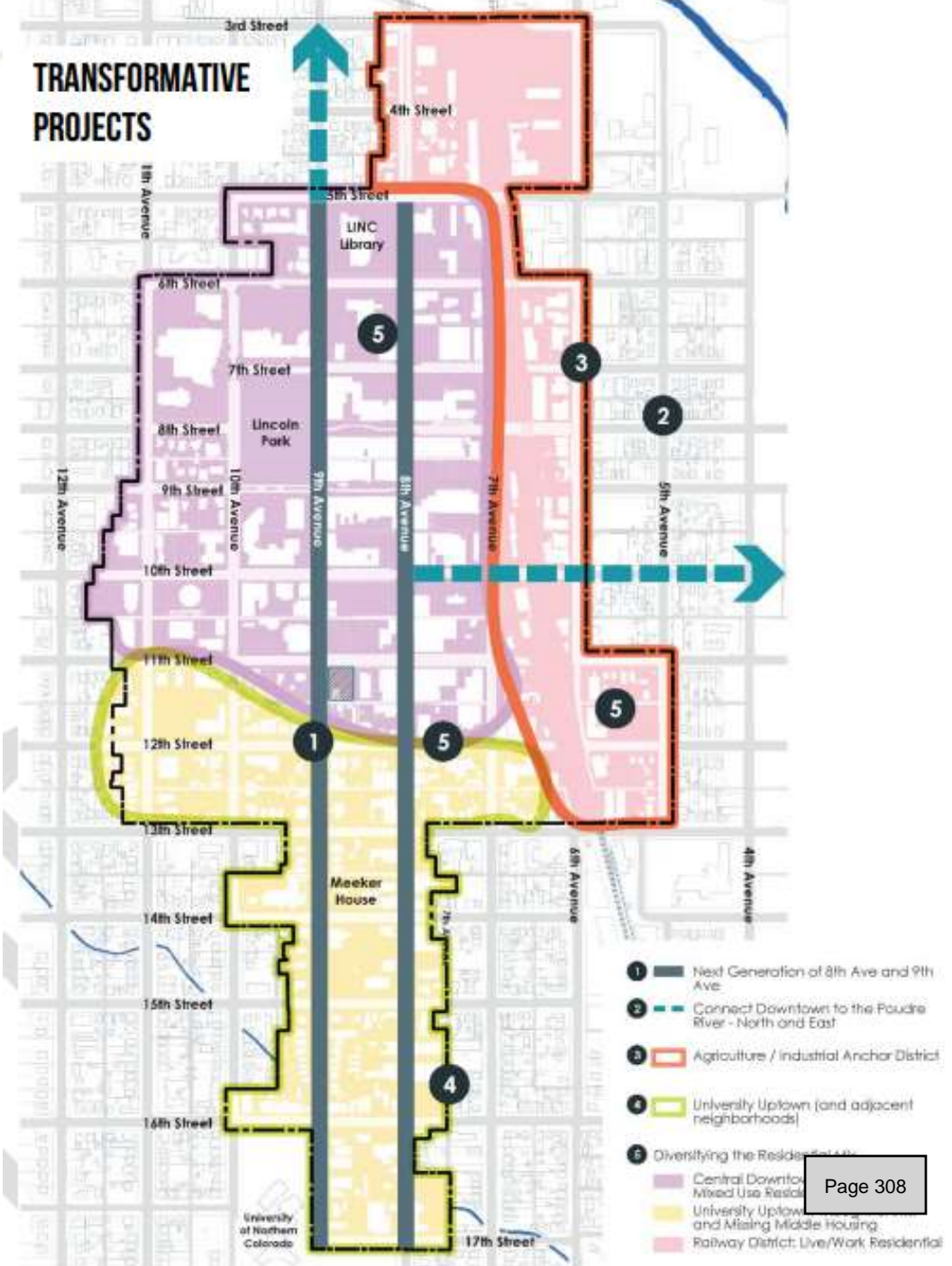
91 specific recommended actions are categorized within three overarching categories.

Key or lead parties for each action are suggested as well as a conceptual cost and general time frame.



Focused Opportunities

- The Plan also invites special focus on actions that have opportunity to be “force multipliers” with broad appeal, return on investment and expanded brand imaging for the greater Downtown area.



Consider the opportunity to activate and brand the Railway District in a distinctive way



Another way to image the multi-use 9th Avenue Corridor connecting Downtown with soft commercial and residential uses via a variety of mobility modes

Key Implementation Action

- While a multitude of interests will each contribute to the success of the 2032 Downtown Plan, it is important to establish who will “own” and orchestrate the key objectives for the success of the recommendations
- Staff recommendation is to incorporate this Plan into the City’s Strategic Work Program and formalize a working relationship with the three ‘anchor’ institutions as the **City. DDA. UNC Partnership**

Review Entities: Recommendations

- **Downtown Development Authority**
 - Reviewed Plan: December 15th
- **Planning Commission**
 - Reviewed Plan/Public Hearing: January 10th
- **City Council Hearing**
 - Scheduled for January 17th



Questions/Discussion



Work Session Agenda Summary

January 10, 2023

Sean Chambers, Water & Sewer Director

Title:

Water & Sewer Department Updated Design Criteria & Construction Specification

Background:

Current Water & Sewer utility design criteria, standards and specification date back to 2008. The updates incorporate new techniques, materials, updated best practices, and revisions required by subsurface utility law. Updating the design standards helps to ensure quality utility infrastructure is installed appropriately to serve the community for generation.

The update incorporates the findings and analysis from recent Water & Sewer Dept. infrastructure master plans covering Non-Potable Water, Sanitary Sewer, and Potable Water Transmission & Distribution. These updates align with the City's development code updates in 2021 and the 2022 Water Efficiency Plan. These updates support maintaining a high level of service reliability for water and sewer customers.

The updated design criteria for the potable water distribution, sanitary sewer collection, non-potable irrigation system, and landscape & irrigation will guide developers and engineers in connecting to the City's utilities. The changes include added guidance and criteria for sewer lift station design, non-potable system design criteria, and updated criteria incorporating recent development code changes. Also included are provisions for compliance with changes to Subsurface Utility Engineering (SUE) law. Lastly, to ensure long lasting community vitality, the criteria have a sixth section that provides guidance on commercial landscape & irrigation design.

The Water and Sewer Department coordinated internal review with other city departments and incorporated feedback through the stakeholder and peer review processes. City Planning and Engineering & Design Review (EDR) staff played a vital role in review and refinement of the updated documents, providing feedback for consistency with other planning documents and city code. Stakeholder workshops with the Builders, Realtors, Developer, Landscape and Irrigation stakeholders were held from July 2021 through December 2022 to collect feedback and apply the insights and wisdom of stakeholder community. The Water & Sewer Dept. tracked comments and questions from private sector engineers, developers, landscape professionals and irrigation stakeholders.

The process has produced a solid and clear set of design criteria, standards, and specifications that meet all regulatory and legal requirements. The updated document provides the building and development community with authorization to utilize updated techniques and materials, many of which are a cost savings over older techniques, and guidance that conforms with Greeley master plans, code and updates to subsurface utility laws.

The Water and Sewer Board, and the Planning Commission have each had extensive reviews and feedback from each have been incorporated into the update. The Water & Sewer Board and the Planning Commission have both formally approved the updated Design Criteria, Standards and Specifications.

The Water & Sewer staff is seeking to inform the Council on this important document and make themselves available to answer questions before the item moves forward for formal action.

Strategic Focus Area:



Community Vitality



Infrastructure and Mobility

Attachments:

- Design Criteria
- Standard Detail Drawings
- Construction Specifications

**DESIGN CRITERIA
AND
CONSTRUCTION SPECIFICATIONS**

VOLUME III

**POTABLE WATER DISTRIBUTION,
SANITARY SEWER COLLECTION,
NON-POTABLE IRRIGATION SYSTEMS,
AND LANDSCAPE & IRRIGATION**



January 2023

DEPARTMENT OF WATER & SEWER

CITY OF GREELEY, COLORADO



FORWARD

The City of Greeley *Design Criteria and Construction Specifications, Volume III, Potable Water Distribution, Sanitary Sewer Collection, Non-Potable Irrigation Systems, and Landscape Irrigation* documents are intended to provide guidance for the design, review, and construction of those public utility improvements pertaining to water in or under the public right-of-way or dedicated easements.

This document represents an attempt to assist those in the design, review, and construction industry to provide quality and long-lasting public utility improvements and facilities. The document also provides for consistency in the areas of design, review, and construction.

This document is not intended to replace or restrict the function of the design engineer or the innovativeness and expertise of developers and contractors. Users of this document are encouraged to submit their ideas and methods of improving this document.

Sean Chambers
Water and Sewer Director

Effective: January 31, 2023

**CITY OF GREELEY, COLORADO
DEPARTMENT OF WATER & SEWER**

**DESIGN CRITERIA
AND
CONSTRUCTION SPECIFICATIONS**

**VOLUME III
POTABLE WATER DISTRIBUTION,
SANITARY SEWER COLLECTION,
NON-POTABLE IRRIGATION SYSTEMS,
AND LANDSCAPE & IRRIGATION**

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**POTABLE WATER DISTRIBUTION, SANITARY SEWER COLLECTION,
NON-POTABLE IRRIGATION SYSTEMS, AND LANDSCAPE & IRRIGATION
DESIGN CRITERIA**

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SECTION 1

GENERAL REQUIREMENTS

1.01 SCOPE

The purpose of the City of Greeley *Design Criteria and Construction Specifications, Volume III, Potable Water Distribution, Sanitary Sewer Collection, and Non-Potable Irrigation Systems and Landscape and Irrigation*, hereafter referred to as the “Criteria”, is to present the minimum design and technical criteria for the analysis and design of potable water distribution, sanitary sewer collection, and non-potable irrigation systems for which City of Greeley acceptance is required. The Criteria may be amended as new technology is developed or a need for revision is demonstrated and proven through experience and use. The Design Engineer shall be responsible for compliance with these Criteria as well as other applicable design and construction standards in the preparation of engineering reports, construction drawings, and specifications for City review and acceptance.

1.02 DEFINITIONS AND ABBREVIATIONS

Wherever the following words, phrases, and abbreviations appear in these specifications they shall have the following meaning:

- A. ac – acre
- B. ac-ft – acre-feet
- C. ANSI – American National Standards Institute
- D. APPROVED PLAN – The latest revised Construction Drawing(s) accepted by the City of Greeley.
- E. APWA – American Public Works Association
- F. AS-CONSTRUCTED DRAWINGS – Drawings reflecting actual conditions and information for the project after construction is completed.
- G. ASME – American Society of Mechanical Engineers
- H. ASTM – American Society for Testing Materials
- I. AWWA – American Water Works Association
- J. CDOT – Colorado Department of Transportation
- K. CDPHE – Colorado Department of Public Health and Environment
- L. cfs – cubic feet per second
- M. CITY – City of Greeley
- N. CONSTRUCTION DRAWINGS – Engineered working drawings including plan, profile, and detail sheets of proposed development and utility improvements accepted by the City.

- O. CONTRACTOR – The individual, firm, partnership, corporation, or combination thereof, private, municipal, or public including joint ventures, which, as an independent contractor, has entered into a contract with the Developer/Owner.
- P. CRITERIA – City of Greeley *Design Criteria and Construction Specifications, Volume III, Potable Water Distribution, Sanitary Sewer Collection, and Non-Potable Irrigation Systems.*
- Q. DESIGN ENGINEER – The partnership, corporation, or individual who is registered as a Professional Engineer, according to Colorado statutes, who is hired by the Developer/Owner to conduct engineering design services and may be empowered by the Developer/Owner to act as his agent for the project.
- R. DEVELOPER – The owner, corporation, association, partnership, agency, or individual who or which shall participate in development, has entered into a development agreement with the City and has entered into an agreement with the Design Engineer and Contractor to perform the development work.
- S. DEVELOPMENT – Any construction or activity which changes the basic characteristic or use of land on which construction or activity occurs, including but not limited to, any non-natural change to improved or unimproved real estate, substantial improvements to buildings or other structures, installation of utilities, mining, dredging, filling, grading, paving, extraction, or drilling operations.
- T. DEVELOPMENT CODE – A section of the City Municipal Code prepared by the City of Greeley Community Development Department which sets forth requirements and standards for land development, land use, and the *Subdivision Regulations*.
- U. DIP – Ductile-iron pipe.
- V. EASEMENT – A right granted by the property owner permitting a designated part or interest of the property to be used by others for specific use or purpose.
- W. EPA – Environmental Protection Agency
- X. ft² – square feet
- Y. ft/s – feet per second
- Z. GEOTECHNICAL ENGINEER – A partnership, corporation, or individual who is registered as a Professional Engineer, according to Colorado statutes, proficient in the area of soil mechanics, and who is hired by the Developer/Owner to conduct subsurface soils investigations and evaluations, ground water assessments, and other related engineering services.
- AA. gpcd – gallons per capita per day
- BB. gpd – gallons per day
- CC. gpm – gallons per minute
- DD. HP - horsepower

- EE. INSPECTOR – Representative of the City of Greeley designated to conduct construction/field observation.
- FF. LAND SURVEYOR – A registered Professional Land Surveyor, according to State of Colorado statutes, who is hired by the Developer/Owner to determine the boundaries and elevations of land and/or a structures and other related surveying services.
- GG. LIVING UNIT - one or more connected rooms, constituting a separate, independent housekeeping establishment for owner occupancy, or rental or lease as a single unit on a monthly basis or longer, physically separated from any other room or dwelling units which may be in the same structure and served by no more than one gas meter and one electric meter.
- HH. MAY – A permissive condition. Where the word “may” is used, no requirement for design or application is intended.
- II. NEC – National Electric Code
- JJ. NFRWQPA – North Front Range Water Quality Planning Association (regional 208 agency)
- KK. NON-POTABLE – Water that is not treated to approved drinking water standards and is not suitable or intended for human consumption, but is produced and delivered for irrigation use.
- LL. OSHA – Occupational Safety and Health Administration
- MM. OWNER – Any person having title or right of ownership in the surface estate of real property or leasehold interest within.
- NN. PGI – PVC Geomembrane Institute
- OO. PLANNING COMMISSION – Appointed members to advise the City Council on land use planning and development and to make decisions on land use matters.
- PP. PLANS – See CONSTRUCTION DRAWINGS.
- QQ. PLC – Programmable Logic Controller
- RR. PROFESSIONAL ENGINEER – An engineer registered with the State of Colorado according to State of Colorado statutes.
- SS. PROFESSIONAL LAND SURVEYOR – A land surveyor registered with the State of Colorado according to State of Colorado statutes.
- TT. psi – pounds per square inch
- UU. PVC – Polyvinyl chloride
- VV. SDC – City of Greeley *Design Criteria and Construction Specifications, Volume I, Streets.*
- WW. SDDC – City of Greeley *Design Criteria and Construction Specifications, Volume II, Storm Drainage.*

- XX. SDR – Standard Dimension Ratio (pipe outside diameter over minimum pipe wall thickness).
- YY. SHALL – A mandatory condition. Where certain requirements in the design or application are described with the “shall” stipulation, it is mandatory that these requirements be met.
- ZZ. SHOULD – An advisory condition. Where the word “should” is used, it is considered to be advisable usage, but not mandatory. Deviations may be allowed when reasons are given which show that the intent of the standard is met.
- AAA. SPECIFICATIONS – The construction specifications portion of the City of Greeley *Design Criteria and Construction Specifications, Volume III, Potable Water Distribution, Sanitary Sewer Collection, and Non-Potable Irrigation Systems*.
- BBB. STRUCTURE - Anything constructed or erected on or in the ground, the use of which requires a more or less permanent location on or in the ground, and, including, but not limited to, walls, retaining walls, fences, parking lots, parking slabs and oil and gas production facilities.
- CCC. STANDARDS – The design criteria portion of the City of Greeley *Design Criteria and Construction Specifications, Volume III, Potable Water Distribution, Sanitary Sewer Collection, and Non-Potable Irrigation Systems*.
- DDD. SUBCONTRACTOR – Any person, firm or corporation, other than the employees of the Contractor, who enters into contract with the Contractor, to furnish labor, materials, or labor and materials.
- EEE. SUBDIVISION REGULATIONS – A section of the Development Code prepared by the City of Greeley Community Development Department, which contains requirements for various land use, land development, and subdivision processes.
- FFF. UNCC – Utility Notification Center of Colorado.
- GGG. UNDERDRAINS – Private line or system that controls or managing any subsurface water on individual foundation lot or lots. No private underdrain systems shall be allow in Water & Sewer easements.
- HHH. UTILITY – City of Greeley Water and Sewer Department.
- III. UTILITIES – Shall mean all utilities, wet and dry, on site prior to the time of any design and development and all utilities proposed with design. Wet utilities shall include, but are not limited to potable water lines, sanitary sewer lines, non-potable irrigation lines, transmission gas lines, storm water lines, ditches and other runoff conveyance elements. Dry utilities shall include, but are not limited to electric lines, telephone lines, gas service lines, fiber optic lines, and cable television lines.
- JJJ. VFD – Variable Frequency Drive
- KKK. WATER AND SEWER DIRECTOR – Shall mean the Director of the City of Greeley Water and Sewer Department or their designated representative.

LLL. WQCD – Water Quality Control Division of CDPHE

1.03 MINIMUM STANDARDS

- A. The City of Greeley’s Community Development Department has Development Code documents that can help define the various processes required for projects within the City.
- B. The City’s review and acceptance will only be to determine if the plans and specifications conform to the City’s requirements. The City’s review and acceptance will not relieve the Developer, Design Engineer and Contractor from responsibility for any variation from the City requirements or adequate design standards. The City’s review and acceptance shall not constitute any assumption of responsibility or liability for the design or construction. It is the intent and purpose of these standards and specifications to obtain high quality construction throughout, with the completed work complying with the City standards and specifications.
- C. All vertical and horizontal control shall be based on the currently adopted City of Greeley vertical and horizontal monumentation. Proposed reference monumentation shall be approved by the City prior to survey. A list of approved monuments may be obtained from the City.

1.04 RELATIONSHIP TO OTHER STANDARDS

- A. Whenever a provision of these Criteria and any other provision in any law, ordinance, resolution, rule, policy, or regulation of any kind contain any restrictions covering any subject matter within these Criteria, the most restrictive standard shall apply.
- B. The provisions of these Criteria and standards are minimum requirements that do not preclude the use of more restrictive standards by the Design Engineer or City.
- C. Adherence to these Criteria does not remove the Developer’s responsibility to investigate and obtain any other regulatory permits or approvals, from either local, regional, state, or federal agencies, that may be required for a particular project.

1.05 REVIEW AND ACCEPTANCE

- A. All potable water, sanitary sewer, and non-potable irrigation construction plans and specifications submitted to the City for review preliminary and final, comment, and acceptance shall be prepared by, or under the direct supervision of a Professional Engineer. Said Professional Engineer shall be responsible for the design, preparation of the construction drawings and reports, determining material specifications, and reviewing the field survey for accuracy.
- B. The construction plan review process for all development as outlined in the *Development Code* shall be followed.
 - 1. The preliminary plan set shall be reviewed by the City for general compliance with these Criteria and the City shall provide comments to the Developer or their agents regarding corrections, additions, and omissions.
 - 2. All submittals to the City shall be done in accordance with the city Development Code.

3. It is the responsibility of the Design Engineer to confirm that submittals are in conformance with these current standards. Any preliminary or final submittal not meeting these criteria may be rejected without review.
 4. After final corrections are made and the plans are accepted, the plans set shall be signed by the Water and Sewer Director or designated representative(s). The signing of the plans will constitute acceptance. The acceptance is qualified in that: ***The plans are reviewed and accepted for concept only and the plan acceptance does not imply responsibility by the Water and Sewer Department or the City of Greeley for accuracy and correctness. The plans acceptance does not imply that quantities of items indicated on the plans are the final quantities required. The plans acceptance shall not be construed for any reason as acceptance of financial responsibility by the Water and Sewer Department or City of Greeley for additional items not shown that may be required during the planning or engineering phase and the construction phase.***
- C. See Section 6 *Landscape and Irrigation Design Criteria* to determine if additional review and supervision by a registered Landscape Architect is required.
 - D. If the Design Engineer responsible for the plans disagrees with any requested changes to the submitted plans that may be required by the City for acceptance, such disagreement shall be brought to the attention of the City, and if required by the City, in writing.
 - E. The Seal of the Design Engineer on plans so corrected and accepted for construction will signify that the Professional Engineer has reviewed, approved, and authorized said corrected plans for construction.
 - F. No construction shall be undertaken without a City accepted and signed set of Construction Drawings and a recorded plat or required potable water, sanitary sewer, and/or non-potable irrigation easements.

SECTION 2

SUBMITTAL REQUIREMENTS

2.01 GENERAL

Requirements discussed in this section are the minimum for potable water distribution, sanitary sewer collection, and non-potable irrigation systems and are not meant to be all-inclusive. Other requirements may be needed for a complete design. The Design Engineer shall consider the maintenance and operational aspects of the potable water distribution, sanitary sewer collection, and non-potable irrigation systems' infrastructure, as well as constructability in their design.

- A. All construction drawings shall be legible and submitted on PDF 22" x 34" or 24" x 36" sheets. Additional sizes may be accepted with prior approval.
- B. A legend describing all line types, symbols, and abbreviations shall be shown either on the cover sheet or each individual sheet.
- C. Each sheet in the Construction Drawings shall be marked "PRELIMINARY, NOT FOR CONSTRUCTION" with the date of submittal. This statement shall be removed on the final City accepted Construction Drawings.
- D. City accepted and signed construction plans are required prior to the City's issuance of construction permits.

2.02 PRELIMINARY CONSTRUCTION PLAN REQUIREMENTS

For Preliminary subdivisions, plans shall be submitted to the City for review and acceptance prior to the preparation of final Construction Drawings. Acceptance of the preliminary submittal shall constitute only a conceptual acceptance and shall not be construed as acceptance of specific design details. The preliminary plans' submittal requirements are outlined below and in the City of Greeley Community Development Department's Construction Plan checklist.

- A. Utility Sheet
 - 1. A general overview of the entire project including, but not limited to, streets (complete with names), alleys, lot and block numbers, all proposed and existing utilities on and within 100 feet of the project site, all existing and proposed easement, rights-of-way on and adjacent to the project site, and storm water facilities.
 - 2. The entire project shall be shown on one (1) sheet unless the project is too large to show sufficient detail. City acceptance must be granted to show the project on more than one sheet and a key map to aid in drawing orientation and locating the sheet construction in relation to the overall project will be required on each sheet.
 - 3. Proposed project phasing for utilities and structures.
 - 4. Proposed point(s) of connection for potable water, sanitary sewer, or non-potable irrigation mains to the existing system(s). All existing potable and non-potable water lines shall be labeled with the pipe diameter, type of material, and year of installation

(available from the City). All existing sanitary sewer lines shall show existing manholes, complete with rim and invert elevations, and pipe diameter.

5. Geotechnical bore locations shall be shown in plan view within the utility plans.
6. Any other information deemed necessary by the Design Engineer or City.

2.03 FINAL CONSTRUCTION PLAN REQUIREMENTS

- A. Final Construction Plans shall contain the same information as indicated in the Preliminary Construction Plan Requirements section 2.02 of these Criteria with additional requirements as outlined below and in the City of Greeley Community Development Department's Final Construction Plan checklist. After one (1) year from the original acceptance date, the City may require resubmittal of the plans for review and acceptance due to revised or updated City design criteria or construction specifications.
- B. City accepted easements or a City accepted final plat must be executed before final Construction Plan acceptance.
- C. One set of 22" x 34" or 24" x 36" plans shall be submitted to the City for acceptance signatures when all known issues have been addressed to the satisfaction of the City. Additional sizes may be accepted with prior approval. Once the plans receive City signatures, the Developer or their agents shall make copies of the signed plans and provide them to the City.
- D. An electronic version, in a format acceptable to the City, of the final Construction Drawings shall be provided to the City at the time of plan signatures.
- E. Potable water, sanitary sewer, and non-potable irrigation main designs shall be provided on separate plan and profile sheets specific to potable water, sanitary sewer, and non-potable irrigation.
- F. The Cover Sheet shall contain a signature line for all Ditch Companies, or end user(s) if the ditch is not controlled by a Ditch Company, that have their facilities impacted or modified by the project.
- G. All utility verifications shall be in compliance with Colorado Revised Statute 9-1.5 as updated.
- H. "Call Utility Notification Center of Colorado (UNCC) at 1-800-922-1987 or dial 811 for utility locates 72 hours prior to any excavation work" shall be put on all drawing sheets.
- I. Conduit Plan
 1. The conduit plan serves to show all proposed utility conduits crossing public rights-of-way and easements. ***The conduit plan may be a separate sheet from the utility plan as requested by the City.***
 2. Provide a general overview of the project including but not limited to street names, street rights-of-way, all proposed and existing utilities, all proposed and existing easements, and lot and block numbers.

3. Show all utility conduits crossing the public rights-of-way and easements and indicate the utility conduit diameter, number of conduits, depth of installation, and name of utility using the conduit.
4. Add the following note to the conduit plan: “All utility conduit crossings of potable water, sanitary sewer and non-potable irrigation lines shall be encased in High Density Polyethylene (HDPE) or fusible C900-16 PVC Pipe, with minimum Standard Dimension Ratio (SDR) 11 across the entire easement or right-of-way width. The encasement joint shall be butt fused. Flexible joints are not allowed.”

J. Construction Plan View

1. Clear distance between utilities shall be outside wall to outside wall.
2. Show and label proposed and existing easements, rights-of-way, and property lines.
3. Indicate the proposed method of connection to existing potable water distribution, sanitary sewer collection, and non-potable irrigation systems.
4. Show all proposed and existing potable water, sanitary sewer, and non-potable irrigation services. Indicate the station of service locations on the potable water, sanitary sewer, and non-potable irrigation mains or include a tabular list of stations.
5. Where the minimum cover over sanitary sewer mains provides less than 10 feet of elevation difference between the top of foundation grade and the top of the sewer main, a note shall indicate the lot is served by a “shallow sewer” and appropriate elevation information shall be provided. Shallow sewer is defined in *Section 4* of these Criteria.

- K. Pothole information of all water or sewer mainlines and impacted services. At critical locations and as determined by City, with date including month and year, elevation, depth and datum.

L. Construction Profile View

1. Show all existing and proposed utility crossings in compliance with Colorado Revised Statute 9-1.5 as updated. Existing utility crossing locations and elevations shall be obtained from the current project design field survey. Existing utilities shall be potholed as required to perform complete and accurate design prior to construction plan acceptance. Field obtained elevations shall be provided on the Construction Drawings complete with when the field information was gathered, the exact location where it was collected, the Firm that performed the potholing and surveying, and the date the survey was conducted.
 - a. Clear distance between utilities shall be outside wall to outside wall.
2. Where the potable water and sanitary sewer mains are within two feet vertically of each other, all water and sewer services that cross a main shall be shown.
3. Provide all pertinent information for existing utilities, refer to checklist for details.
4. Provide pipe slope, manhole inverts in and inverts out (main and service line), and rim

elevations and manhole stationing for proposed sanitary sewer lines.

5. Any other information deemed necessary by the Design Engineer or City.

M. Standard Drawing (Detail) Sheets

1. Include all project applicable City of Greeley Standard Drawings as part of the construction plans set. Water and Sewer Department Standard Drawings are provided in these Criteria. Refer to the Department of Public Works' *SDC* and *SDDC*, latest revision, for other project related details.
2. All City of Greeley Standard Drawings shall contain the City logo in the bottom left corner. If any standard City detail is modified, the City logo shall be removed from the detail and placed on a separate sheet before standard details. All modified detail shall be stamped by design engineer.
3. Where Standard Drawings are not applicable to the work, provide project specific construction details. These shall include construction details of critical connections, atypical crossings, special fittings and appurtenances, and any other details deemed necessary by the Design Engineer or City.

N. Requirements for Changes to Final Accepted Plans

1. Should circumstances warrant changes from the City accepted Construction Plans, acceptance of the changes shall be obtained from the City prior to construction.
2. All modified drawings shall be on 22" x 34" or 24" x 36" sheets. Depending on the extent of the changes, the City will decide if revised plans are required.

O. Wastewater Pumping Station (Lift Station) Final Construction Plans

1. Lift station final construction plan requirements are specific to the design requirements of the lift station in addition to state and regional guidelines. Refer to *Section 4* for lift station requirements.

P. Geotechnical bore logs and groundwater data shall be shown in the Construction Plans.

2.04 FINAL PLAT AND REPLAT REQUIREMENTS

A. Final plats shall adhere to the requirements set forth in the City of Greeley Development Code Chapter 3: *Subdivision Regulations* and the Department of Public Works' *SDC*, latest revision. The following requirements shall also apply:

1. Clearly show, label, and dimension newly dedicated and existing potable water, sanitary sewer, and non-potable irrigation easements.
2. Clearly denote the allocation of any new or existing water dedication credits between the parcels included on the plat.
3. Where minimum cover over sanitary sewer provides less than 10 feet of elevation difference between the finished top of foundation elevation and the invert of the sewer

main, the plat shall indicate that the lot is served by a “shallow sewer”. Shallow sewer is defined in *Section 4* of these Criteria.

4. Where a single service is allowed for multiple buildings on a single lot the plat shall indicate that if the lot is ever subdivided the service and main configuration must be brought into alignment with the current City of Greeley Design Criteria.
 5. All platted lots shall be adjacent to a public potable water distribution and sanitary sewer collection main. No potable water or sanitary sewer services shall cross lot lines.
- B. For all replats where lot lines or street locations change, all existing potable water, sanitary sewer, and non-potable irrigation mains, services, fire hydrants, fire sprinkler lines, etc. shall be relocated to their appropriate location or abandoned. Potable water distribution, sanitary sewer collection, and non-potable irrigation system designs in this replatted area must conform to the current City of Greeley Design Criteria.

2.05 LANDSCAPE PLANS REQUIREMENTS

- A. No plant material with mature growth greater than three (3) feet in height shall be planted within potable water, sanitary sewer, or non-potable irrigation easements.
- B. No shrubs shall be planted within five (5) feet or trees within ten (10) feet of potable and non-potable water meters, fire hydrants, sanitary sewer manholes, or potable water, sanitary sewer, and non-potable irrigation mains and services.
- C. Clearly show and label all proposed and existing potable water and non-potable irrigation meter pits/vaults, mains and services, sanitary sewer mains and services, fire hydrants, and easements on the landscape plans.
- D. Show and label all proposed water taps that will be used for landscape irrigation.
- E. Provide a table summarizing irrigation water use by area per Section **20-254** of municipal code
- F. See Section 6: *Landscape and Irrigation Design Criteria* for additional landscape plan requirements that may apply.
- G. Add sections 2.05-A and 2.05-B of these Criteria as notes on the landscape plans.

2.06 EASEMENTS

- A. When it is not feasible for potable water, sanitary sewer, or non-potable irrigation main installation to be in a dedicated street right-of-way, the installation shall be made within a dedicated easement. The conditions for allowance of such an exception shall be determined for each individual case. The minimum easement width acceptable to the City is as follows:
 1. For a dedicated potable water, sanitary sewer, or non-potable irrigation main easement containing just one (1) main, the width shall be twenty (20) feet or twice the depth to the invert of the pipe, whichever is greater. This easement shall be for the exclusive use by City of Greeley potable water, sanitary sewer, or non-potable irrigation mains. The easement name, which shall be “PERMANENT POTABLE WATER EASEMENT”,

“PERMANENT SANITARY SEWER EASEMENT” or “PERMANENT NON-POTABLE WATER EASEMENT”, and the easement width shall be labeled on the Construction Drawings and plat.

2. For any combination with two utilities, potable water, sanitary sewer or non-potable irrigation main easements, the total width shall be thirty (30) feet or twice the maximum depth to the invert of each utility, whichever is greater. This easement shall be for the exclusive use by the City of Greeley. The easement name and the easement width shall be labeled on the Construction Drawings and plat.
 3. For any combination with three utilities, potable water, sanitary sewer or non-potable irrigation main easements, the total width shall be forty (40) feet or twice the maximum depth to the invert of each utility, whichever is greater. This easement shall be for the exclusive use by the City of Greeley. The easement name and the easement width shall be labeled on the Construction Drawings and plat.
 4. Where pipes of diameters greater than sixteen inches (16”) are installed additional easement width may be required to account for pipe width.
- B. The mains within the easement shall be located as centrally as feasible within the easement while maintaining required separation from other mains and accounting for the depths of mains where necessary.
- C. There shall be no detention ponds, berms greater than three (3) feet, permanent structures, fences, trees, shrubs with mature height greater than three (3) feet, or other obstructions that will impede the ability of the City to adequately maintain and service the main(s) located within the easement.
- D. Easements not dedicated with a plat, shall be dedicated by separate document and recorded prior to City acceptance of the Construction Drawings. Easement dedication by separate document shall include:
1. Easement Dedication Form. An easement dedication form shall be completed by the Developer. Standard easement dedication forms are available in the appendix. The completed easement dedication form must be signed by the property Owner and notarized.
 2. Exhibit Map. An exhibit map (8 ½” x 11”) with sufficient description information to establish the legal boundary of the easement shall be provided. The exhibit map shall show and label all existing easements, property lines, and public rights-of-way. The City may request additional information, not listed here, for the exhibit at the city's discretion.
 3. A Written Legal Description of the dedicated easement boundary.
 4. Funds for Recording. The Developer shall provide cash or a check made out to the **City of Greeley** for the easement recording fees. The City shall provide the recording fee sum once all easement documents are finalized. ***The City does not provide the funds for recording easement documents.***
 5. Once the easement dedication documents are accepted by the City and the recording fees

have been provided in the appropriate amount, the City shall have the easement documents recorded with Weld County.

2.07 HYDRAULIC REPORT – POTABLE WATER & SANITARY SEWER

A hydraulic analysis for the potable water distribution and sanitary sewer collection systems for a given project shall be submitted by the Design Engineer, as a report, to the City for review and acceptance. The report shall be accepted by the City prior to final Construction Drawing acceptance. The hydraulic analysis report will be reviewed by the City, along with the Construction Drawings, in the same review and acceptance process as outlined in *Section 1* of these Criteria. Projects that move forward to final design without a City accepted potable water distribution and sanitary sewer collection system hydraulic analysis report are subject to possible design changes, including but not limited to, pipe re-alignment, upsizing, extensions, and additional stubouts.

The objective of the hydraulic analysis report is to assist the Design Engineer with designing a project's potable water distribution and sanitary sewer collection systems to adequately serve peak demands while adhering to the design requirements set forth in these Criteria. For the potable water distribution system, the hydraulic analysis report serves as a tool for demonstrating the necessary number of connection points to the existing system for adequate water line looping, system reliability and required pipe sizing. For the sanitary sewer collection system, the hydraulic analysis report evaluates peak flow quantities, flow type, pipe capacity, and flow velocity and establishes appropriate pipe sizing.

Non-potable irrigation system hydraulic and design reports are also required for projects utilizing non-potable water for irrigation purposes; however, since non-potable irrigation systems are unique, the non-potable hydraulic and design report requirements have been provided in section 2.08 of these Criteria.

The written hydraulic report shall include the following information:

- A. Title Page
 - 1. Report title.
 - 2. Project name and location.
 - 3. The name, address, and phone number of the Owner, Developer and Design Engineer that prepared the report.
 - 4. Report preparation date.
- B. Engineer Certification Sheet
 - 1. The report shall be prepared by or under the supervision of a Professional Engineer, licensed to practice in the State of Colorado, possessing adequate experience in the design of potable water distribution and sanitary sewer collection systems. The report shall contain a certification sheet with the following statement to be signed and sealed by the Design Engineer:

“I understand the City’s acceptance does not relieve the Design Engineer’s responsibility for errors, omissions, or design deficiencies for which the City is held harmless.

Registered Professional Engineer

(Affix Seal)

- C. Table of Contents
- D. Project Description and Location
 - 1. Clearly state the location of the project. Provide a site vicinity map specifying the project's geographical location and the project area in acres. The project acreage shall be the same as on the project plat.
 - 2. Clearly state the land use zoning, estimated number of residential lots or living units, commercial square footages, and the irrigated acreages.
 - 3. Indicate if the project will be phased. Elaborate on the anticipated timing for each project phase and the phase's associated building and infrastructure construction.
 - 4. For multifamily, commercial, or industrial developments, indicate if potable or non-potable water will be used for landscape irrigation.
 - 5. Identify the locations of all potable water, sanitary sewer, and non-potable irrigation connection points to the existing systems.
 - 6. Provide the pipe diameter, pipe material, and year of installation for the existing potable water, non-potable water, and sanitary sewer lines.
- E. References and Appendices
 - 1. Provide a page referencing all design criteria, resources, and modeling software used in preparing the hydraulic report.
 - 2. Provide appendices as necessary to include modeling result printouts, copies of demand assumption data, and fire flow test results.
 - 3. Hydrant flow tests results may be available from Greeley Fire Department (970-350-9511). Obtained fire flow test pressures will be evaluated for use by the City on a case by case basis.
- F. Potable Water System Report Requirements and Assumptions
 - 1. Provide all used equations, demand assumptions, and essential design requirements, parameters, and constraints.
 - 2. Indicate the software package(s) and version used for the water system modeling.
 - 3. Indicate in which City of Greeley potable water pressure zone the project is located.
 - 4. Provide calculations for estimated population, design flows and velocities, irrigated acreage, irrigation application rates, peaking factors, and any other necessary design

calculations.

5. Provide hydrant fire flow and fire sprinkler system flow requirements.

G. Potable Water System Analysis and Modeling

1. Modeling Scenarios

- a. Static. The static scenario shall establish the available water pressure for the site with no demands on the system and serves to check that pressure requirements are maintained.
- b. Peak hour demand plus fire flow. This scenario shall include peak hour domestic water use¹ demands plus fire flow².
- c. Peak hour demand plus fire flow with one (1) water connection closed. While using the determined potable water demands for the peak hour plus fire flow scenario, each connection to the existing potable water system shall be closed, in turn, and modeled. Fire flow shall be placed at a hydrant nearest to the closed connection. This scenario represents a worst-case water demand condition and shall only serve to demonstrate how the potable water distribution system within the development functions during this condition. It is acceptable to have the potable water system velocity requirements violated in this scenario only. The system must maintain a minimum pressure of 20 psi with fire flow.
- d. Phasing. Water modeling shall be required for the incomplete potable water system as indicated per the planned phasing on the Construction Drawings, in order to demonstrate that peak hour demand plus fire flow can be met for the interim phased condition.

The hydraulic report shall verify that a proposed potable water system can provide the required water demands for a given development, at an acceptable pressure, and meet the overall potable water system design requirements set forth in these Criteria. At the City's discretion all ultimate connections to existing water mains may be required regardless of development phasing. Upsizing water mains within a development as a means to increase water system capacity in lieu of making a connection to another water source, is not permitted.

If the hydraulic water model demonstrates that a larger main is required to serve the phased condition than would be needed for the full build out condition, the Developer is required to install the larger pipe at their expense and is not eligible for pipe oversizing reimbursement from the City when the larger pipe is no longer needed.

- e. Additional scenarios. At the City's discretion, the City may require additional

¹ Domestic water use shall refer to all household and corresponding lot irrigation for single family and applicable multifamily residential potable water use. It shall also refer to all potable water use, including potable irrigation, for commercial and industrial uses.

² Fire flow shall be inclusive of fire hydrant and fire sprinkler flow. Residential, commercial, or industrial developments requiring fire sprinkler systems shall have fire sprinkler demands, in addition to hydrant fire flows, placed in the hydraulic water model at appropriate node locations.

scenarios, adjustments to the fire flow placement, reservoir elevations, and existing system connections, revisions to the pipe and node schematic layout, and other model modifications as necessary to verify that the proposed potable water system will meet the design requirements and potable water demands of the development and the City as a whole.

- f. At the City's discretion, the hydraulic analysis may be required to extend beyond the limits of the project boundary.
- g. Demands for undeveloped parcels shall be calculated based on the higher of the current or anticipated land use or zoning of the property.
- h. Model must be compatible and capable of being integrated with City's hydraulic model developed with InfoWater. Model must be provided to Water and Sewer upon request.

2. Modeling Procedure

- a. Connections to the existing potable water distribution system are typically denoted as reservoirs with the same hydraulic grade elevation. The City shall provide inflow pressure.
- b. Place estimated domestic water, fire sprinkler, and irrigation tap demands at appropriate node locations within the model as they relate within the project.
- c. Locate fire flow demands at hydrant locations according to the modeling scenarios in section 2.07-G of these Criteria. The maximum allowable fire flow provided from any one (1) hydrant shall be 1,500 gpm. If the required fire flow is in excess of 1,500 gpm, the next closest hydrant shall be used until the required fire flow is met.
- d. Depending on the location of the development, existing potable water system performance and reliability in the area, number of available potable water connections, and surrounding land uses, some of the project's proposed potable water connections may require modeling as a demand point or no connection instead of a water source. The City shall provide additional outflow demands for a development on a case by case basis.

H. Potable Water System Report Results

- 1. Provide a schematic layout of the potable water distribution system showing and labeling the reservoir connections, pipe network, and demand nodes as presented and analyzed for each water model scenario.
- 2. Provide a Reservoir Report for the static condition. The Reservoir Report shall include the following information:
 - a. Reservoir Identification Label
 - b. Elevation (ft) per City of Greeley datum
- 3. Provide Pipe Reports for all modeled scenarios. Pipe Reports shall include the following

information.

- a. Modeled Scenario Title
 - b. Pipe Identification Label
 - c. Pipe Length (ft)
 - d. Pipe Diameter (in)
 - e. Pipe Material
 - f. Hazen-Williams Coefficient
 - g. Pipe Control Status (open or closed)
 - h. Pipe Velocity (ft/s)
 - i. Upstream Calculated Pressure (psi)
 - j. Headloss (ft)
4. Provide Junction/Node Demand Reports for all modeled scenarios. Junction/Node Demand Reports shall include the following information:
- a. Modeled Scenario Title
 - b. Node Identification Label
 - c. Node Elevation (ft) per City of Greeley datum
 - d. Node Demand (gpm)
 - e. Calculated Hydraulic Grade (ft)
 - f. Pressure (psi)

I. Potable Water System Design Conclusions

1. Discuss hydraulic analysis results for all modeled scenarios.
2. Confirm that the pipe velocity and pressure requirements during the peak hour demand plus fire flow operating condition are met per *Section 3* of these Criteria.
3. Confirm that the pressure requirements during the peak hour demands plus fire flow operating conditions, with one water connection closed, are met per *Section 3* of these Criteria.
4. Discuss any potable water line oversizing required by the City over and above what is necessary for the development's potable water needs.
5. For phased developments, discuss phased construction of the potable water distribution

system and confirm that potable water pipes are sized and looped appropriately to meet the peak hour, plus fire flow demand velocity and pressure requirements during the interim condition.

J. Sanitary Sewer System Design Requirements and Assumptions

1. Provide all used equations, demand assumptions, and essential design requirements, parameters, and constraints.
2. If a model is required, it must be compatible with the City's InfoSWMM model. Model must be provided to Water and Sewer upon request.
3. Provide calculations for estimated population, design flows, peaking factor(s), hydraulic design, infiltration, flow type, and any other necessary design calculations.

K. Sanitary Sewer Systems Analysis and Modeling

1. If the development is phased, the sanitary sewer system shall be analyzed for full build out. This evaluation shall include the development's sanitary sewer flows and anticipated offsite sanitary sewer flows impacting the sanitary sewer system within the development.
2. Evaluate the development's sanitary sewer sizing for capacity to convey offsite flows.
3. Undeveloped areas shall have sanitary sewer flows calculated based on the higher of the current or anticipated land use or zoning of the property.
4. The City may require additional analysis in order to further verify that the proposed sanitary sewer system will meet the design requirements and needs of the development and the City. The City will evaluate sanitary sewer system hydraulic evaluations on a case by case basis.

L. Sanitary Sewer System Report Results

1. Provide a schematic layout of the sanitary sewer collection system showing and labeling all manholes, design points used for analysis, pipe slopes, and pipe sections.
2. Provide written calculations or printouts of software analysis results for each pipe evaluation including the following information:
 - a. Pipe Diameter (in)
 - b. Material
 - c. Date of installation
 - d. Pipe Slope (%)
 - e. Sub and Super Critical Calculations, when a model is required
 - f. Manning's n Value

- g. Pipe Discharge-(gpm)
- h. Pipe Flow Velocity (ft/s)
- i. Pipe Flow Depth (in)
- j. d/D (depth of flow/diameter of pipe)
- k. Maximum Capacity at d/D of 50% and/or 80% – (gpm) dependent on date of installation

M. Sanitary Sewer System Conclusions

1. Discuss analysis results for all pipe evaluations.
2. Confirm that acceptable pipe velocities and flow depth criteria are met.
3. If design constraints arise and pipe velocity, flow depth, minimum allowable slope per pipe diameter, or any other Criteria requirements cannot be maintained, the Design Engineer shall provide the City written explanation as to why the Criteria is violated, why the non-standard sewer system design should be accepted, and request a variance to the Criteria. Water & Sewer Department acceptance is required for the variance.
4. Discuss any sanitary sewer main oversizing required by the City over and above what is necessary for the development needs.
5. Indicate if the development is served by “shallow sewer.” Shallow sewer is defined in *Section 4* of these Criteria.
6. Discuss potential impacts that future upstream developments may have on the sanitary sewer capacity through the proposed development. Explain the capacity issues within the development and the proposed solutions for resolving them.

N. Supplemental Engineering Calculations

1. These calculations shall include but are not limited to pipe restrained lengths, external pipe load analysis, traffic loadings, casing pipe wall thickness, and air and vacuum release valve sizing.
2. Any calculations deemed necessary by the Design Engineer or City.

O. Wastewater Pumping Stations (Lift Station) Design Report

1. Refer to *Section 4* of these Criteria and CDPHE for lift station design and approval guidelines and lift station design report requirements.

2.08 DESIGN REPORT – NON-POTABLE IRRIGATION SYSTEM

The objective of the non-potable irrigation system design report is to assist the Design Engineer with designing a non-potable irrigation system and storage facility to adequately serve peak season irrigation demands while adhering to the design requirements set forth in these Criteria. Refer to section 2.07 of these Criteria regarding report review and acceptance.

The non-potable irrigation system design report shall include, but is not limited to, the following information:

- A. Title Page, Engineer Certification Sheet, and Table of Contents requirements, refer to section 2.07 of these Criteria.
- B. Project Description and Location
 - 1. Clearly state the location of the project. Provide a site map identifying the project area and location of the non-potable storage facility (pond), pump station, discharges/fill lines, and overflow works.
 - 2. Indicate if the non-potable system will be phased. Elaborate on the anticipated timing of the project phasing and how it will affect the overall design and construction of the non-potable irrigation system.
 - 3. If connecting to an existing non-potable irrigation system, identify locations of pipe connections. Provide the pipe diameter, pipe material, and year of installation of the existing main.
- C. References and Appendices
 - 1. Provide a page referencing all design criteria, resources, and modeling software used in preparing the design report.
 - 2. Provide appendices as necessary to include supplementary information.
- D. Non-potable Irrigation System Report Requirements and Assumptions
 - 1. Provide all used equations, assumptions, design methodologies, essential requirements, parameters, and constraints.
 - 2. Indicate any software package(s) and version used for the non-potable pipe system modeling. The model should be compatible with Innovyze InfoWater for incorporation into the City's model.
 - 3. Provide calculations for determining irrigated acreage, required storage volume, pond design including high and low operating elevations, watering requirements, application rates, and design flow.
 - 4. Provide the number and type of pumps, motor horsepower, system head curves, head computations, discharge pressure, and any other pertinent information for the pump system design.
- E. Discussion Items
 - 1. Discuss specific design features of the non-potable irrigation system and their requirements, including but not limited to, non-potable/potable water sources and means of delivery into the system, the lining and aeration system, pond shoreline treatment, overflow works, and pond design.
 - 2. General design requirements for the pump station, including but not limited to, power

and electrical requirements, control and monitoring systems, and building requirements.

- F. Non-Potable Irrigation System Analysis and Modeling
 - 1. The non-potable irrigation system shall be modeled for the static scenario and the design irrigation demands scenario. Refer to section 2.07 of these Criteria for modeling procedures and report results requirement.
- G. Non-potable Irrigation System Design Conclusions
 - 1. Discuss hydraulic analysis results for all modeled scenarios.
 - 2. Confirm that the pipe velocity and pressure requirements during irrigation demand are met per *Section 5* of these Criteria.
- H. The City may require electronic copies of the hydraulic models be submitted.

2.09 GEOTECHNICAL SOILS REPORT

- A. A geotechnical soils evaluation, prepared by or under the supervision of a Geotechnical Engineer, licensed in the State of Colorado, shall be submitted to the City for review and shall be accepted by the City prior to final Construction Drawing acceptance. The geotechnical soils report shall describe the classifications and characteristics of the soils encountered on the project and include recommended methods of backfilling and compaction. Refer to the Department of Public Works' *SDC*, latest revision, for soils testing and geotechnical soils report requirements.
- B. The Geotechnical Engineer shall evaluate groundwater conditions for the site and provide recommendations for sanitary sewer main groundwater barriers.
- C. The geotechnical soils evaluations shall include information required to determine potential corrosive soils with pH and resistivity, refer to section 3.11 of these Criteria.

2.10 VERIFICATION SURVEY DRAWING REQUIREMENTS

- A. Prior to paving, the Design Engineer shall provide the City with a survey of the installed potable water, sanitary sewer, and non-potable irrigation systems. The purpose of this survey is to verify that the mains and appurtenances were installed per design and within allowable construction tolerances. Once the City has accepted the verification survey, the City shall give the Contractor written notice to proceed with paving construction. ***Verification Survey plans are not As-Constructed Record drawings.*** See section 2.11 of these Criteria for As-Constructed Record Drawing requirements.
- B. The Verification Survey drawing(s) shall be prepared for easy modification and transition to final As-Constructed Record drawings.
- C. The Verification Survey drawings shall be modified from the original construction plan and profile sheets showing the design information as well as the surveyed information. The original design information shall be shown as "lined through" if as constructed conditions differs from approved construction plans. The surveyed information shall be located in the same area as the design information and shall be either "clouded" or made with a heavier line weight than the design information for clear differentiation.

- D. Verifications Survey drawings shall be prepared by a Professional Engineer. Surveyed elevations for the Verification Survey shall be obtained by a Colorado Registered Land Surveyor. The Surveyor shall obtain horizontal locations, surveyed elevations and information for the following: To the same precision and datum as design drawings.
1. Potable and non-potable – Horizontal locations of valves, fire hydrants, blow-offs, air/vacuum release valves, and top of pipe elevations at all valves.
 2. Sanitary sewer – Horizontal locations of manholes, diameter of manholes, sizes of installed pipe, invert elevations of all mainline pipes and services entering and exiting a manhole, distances between manholes, pipe slopes based on the surveyed invert elevations, and proposed manhole rim elevations.
 3. Utilities – Provide horizontal and vertical location of all existing and proposed utility crossings.
 4. For potable and non-potable water lines, provide the proposed final ground elevations at all valve boxes. ***Surveyed top of valve nut and valve nut key extension elevations. This information must be used to calculate top of pipe elevation based on the height of the installed valve bonnet, which varies due to pipe diameter and valve manufacturer.***
 5. Any other surveyed information as required by the City.
- A. Construction tolerances shall be:
1. Water System - Horizontal locations: ± 0.30 feet and Elevations: ± 0.30 feet
 2. Sanitary System - Horizontal locations: ± 0.30 feet and Elevations: ± 0.02 feet
- B. Survey measurement accuracy shall be:
1. Horizontal locations: ± 0.10 feet
 2. Elevations: ± 0.01 feet

2.11 AS-CONSTRUCTED RECORD DRAWING REQUIREMENTS

- A. The Contractor and Design Engineer shall be responsible for recording As-Constructed information on a set of Record Drawings kept at the construction site. A representative of the Developer shall monitor construction to assure that changes in construction (as approved in writing) and other pertinent details, such as horizontal location of fittings and manholes, valves, top of pipe elevations, manhole inverts, service tap locations, pipe sizes, depths, etc. are kept current on the As-Constructed Record Drawings.
- B. Where the construction is phased with a more than 30-day lapse between phases, As-Constructed Record Drawings shall be submitted to the City after each completed phase. The Construction Drawings for all future phases shall also reflect the “As-Constructed” conditions of the previous phases.
- C. At a minimum, the As-Constructed Record Drawings set shall include the following sheets from the original accepted Construction Drawings:

1. Cover Sheet
 2. Utility Plan
 3. All potable water, sanitary sewer, and non-potable irrigation plan and profile sheets.
 4. All construction details and City of Greeley Standard Drawings that were used in the construction of the potable water distribution, sanitary sewer collection, and non-potable irrigation.
 5. Landscape plans.
- D. The As-Constructed Record Drawings shall show the original design information as well as the As-Constructed information. The original design information shall be shown as “lined through”. The As-Constructed information shall be located in the same areas as the design information and shall be either “clouded” and/or made with a heavier line weight as the design information for clear differentiation. The month and year of the construction shall also be noted.
- E. A Colorado Registered Land Surveyor shall certify the As-Constructed horizontal locations and surveyed elevations of all items listed in section 2.10 of these Criteria in addition to:
1. Final sanitary sewer manhole rim elevations and Inverts.
 2. Final top of water valve box elevations, top of pipe.
 3. Construction tolerances shall be evaluated based on original design and City design criteria.
 4. Measurement tolerances shall be:
 - i. Horizontal locations: ± 0.10 feet
 - ii. Elevations: ± 0.01 feet
- F. The project responsible Design Engineer and Land Surveyor shall observe construction, as required, in order to certify the conditions and information recorded on the As-Constructed Record drawings is true and correct.
- G. The General Contractor for the project shall sign each drawing sheet of the As-Constructed Record plans set with the following statement:
- I, _____, hereby state that this project was constructed to City of Greeley accepted Construction Drawings and standards, as designed by the project Design Engineer, and as field staked by the project Land Surveyor. All deviations to the approved Construction Drawings, standards, design, or survey were so noted on field drawings and these were provided to the project Design Engineer for acceptance and inclusion in the As-Constructed Record Drawings.

Construction Company

Address

Authorized Representative

Title

Date

- H. A Professional Land Surveyor shall perform or directly supervise all field survey data collection to verify the As-Constructed conditions and shall stamp and seal each drawing sheet in the As-Constructed Record Drawing set with the following statement:

I, _____, hereby state that this project was field staked for construction per City of Greeley accepted Construction Drawings and standards and in accordance with the project design. I certify that the field survey information obtained for the As-Constructed Drawings was obtained in accordance with City current standards and is accurately represented on these As-Constructed Record Drawings.

Registered Professional Land Surveyor

(Affix Seal)

- I. A Professional Engineer shall review all the As-Constructed information for compliance with the original approved design and standards and shall stamp and seal each drawing sheet in the As-Constructed Record plan set with the following statement:

I, _____, hereby state that I have reviewed the As-Constructed information provided by the project Contractor and project Land Surveyor. I certify that according to the information provided the As-Constructed Record Drawings are in compliance with the City of Greeley accepted Construction Drawings and standards and will function as designed.

Registered Professional Engineer

(Affix Seal)

- J. As-Constructed Record signed and sealed drawings shall be submitted to and accepted by the City prior to issuance of Substantial Completion, in the form of one electronic PDF version and one file package containing GIS spatial data compatible with ESRI ArcGIS using the coordinate system referenced in the most recent City of Greeley Control Points Datasheet. The two (2) year warranty period for the installed potable water, sanitary sewer, and non-potable irrigation systems will begin **after** the Certificate of Substantial Completion has been issued by the City. The request for the Substantial Completion Certificate may be initiated by the City or requested by the Developer, but in all cases is the sole responsibility of the Developer.

- K. The City will compare the certified As-Constructed Record Drawing information with the approved Construction Drawings, previously submitted Verification Survey, and information the City may be aware of during the construction process. Any corrections, additions, or omissions to the As-Constructed Record Drawings shall be provided to the Design Engineer who prepared the As-Constructed Drawings for changes.

- L. The Certificate of Substantial Completion, will NOT be granted until the As-Constructed Drawings for the potable water, sanitary sewer, and non-potable irrigation systems are accepted by the City. (Ordinance 44, 2002)
- M. The Certificate of Final Acceptance occurs at the end of the two year warranty period and final walk through of the project.

2.12 REIMBURSEMENT FOR PUBLIC INFRASTRUCTURE DESIGN AND INSTALLATION COSTS

- A. The City may require the Developer to install a potable water, sanitary sewer or lift station, non-potable irrigation main or non-potable pond and pump station larger than is needed to adequately serve development.
- B. For the installation of mains the City will reimburse the Developer for the materials costs above that required for the development. The difference in materials costs shall only include the difference in pipe materials, manhole materials, valve materials, and fitting materials. Additional materials costs, if any, shall be agreed upon in writing, prior to commencement of construction.
- C. For sanitary sewer collection main oversizing, the City may reimburse the Developer for additional costs due to sanitary sewer main installation excavation depth or width beyond that required for the development.
- D. If the City requested oversizing results in significant change to horizontal or vertical alignment, additional reimbursement may be agreed to prior to construction.
- E. For the installation of sanitary sewer lift stations and non-potable ponds and pump stations the City will reimburse the Developer for the materials costs above those required by the development on a pro rata basis using the portion of the lift or pump station capacity that is not required for the development. The scope of the reimbursement and the reimbursement ratio shall be agreed upon in writing prior to the commencement of construction.
- F. For non-potable pond oversizing, the City may reimburse the Developer for extra excavation and materials costs due to additional depth above that required size for the development.
- G. The Developer shall submit a materials list with unit prices, quantities, and, if appropriate, a cost comparison between the two pipe sizes under consideration. Reimbursement will only be paid after the As-Constructed Record Drawings have been accepted by the City. Copies of material invoices for materials delivered to the development site and used in construction shall be provided along with the Developer's request for reimbursement.
- H. If the Developer is required to design and construct off site potable water, sanitary sewer, or non-potable irrigation mains in order to serve the development, the Developer may be eligible for design and construction cost reimbursements from other developments that connect to that main. Conversely, if the Developer connects to potable water, sanitary sewer, or non-potable irrigation mains constructed by another Developer or the City, the Developer may be required to participate in the design and construction costs of those lines. Refer to the *City of Greeley Charter and Code, Title 20: Public Services*, sections 20-159, 20-160, 20-161, 20-322, 20-323, and 20-324 for additional reimbursement requirements.

2.13 Subsurface Utility Engineering

- A. All new underground facilities, including laterals up to the structure or building being served shall be electronically locatable when installed as required by Colorado Revised Statute 9-1.5-103 as amended
- B. All services including potable water, non-potable irrigation water, and sanitary sewer must be locatable up to the structure using tracer wire. See Water & Sewer standard details for the required tracer wire specifications.
- C. Potable and non-potable irrigation water mains shall be locatable using tracer wire. See Water & Sewer standard details for the required tracer wire specifications.
- D. Sanitary sewer mains do not require tracer wire as they are electronically locatable by other means, including. robots, sonde, and camera systems.

SECTION 3

POTABLE WATER DISTRIBUTION SYSTEM DESIGN CRITERIA

3.01 GENERAL

The purpose of this section is to provide information for the design and layout of a potable water distribution system. Potable water distribution system design shall be in accordance with the City of Greeley *Water Master Plan*, latest revision, and these Criteria.

This section is not intended to be inclusive of all situations and the Design Engineer may be required to use additional engineering judgment to meet the overall design intent for constructability and long-term operations and maintenance. **This Design Criteria typically applies to potable water mains sixteen inches (16”) in diameter and smaller.** The City of Greeley Water and Sewer Director reserves the right to make final determinations of the system design based on the best interest of the City’s system. Refer to standard detail drawings for additional design information.

3.02 DEFINITIONS

A. Potable Water Distribution Mains

1. A potable water distribution main is a water pipe that primarily serves as a delivery conduit to transport potable water from transmission mains or reservoirs directly to individual water services.
2. Potable water distribution mains within the City are eight inches (8”), twelve-inches (12”), and sixteen-inches (16”) in diameter.

B. Potable Water Transmission Mains

1. A potable water transmission main is a water pipe that primarily serves as a delivery conduit to transport potable water directly to the distribution reservoirs and mains.
2. Potable water transmission mains are generally larger than sixteen inches (16”) in diameter.

C. Potable Water Services

1. Potable water services include all piping, fittings, and appurtenances used to convey potable water from the distribution main to the customer.

3.03 DESIGN FLOW

- A. The potable water distribution system shall be designed to transport peak hour plus fire flow demands in accordance with these Criteria.
- B. All water demands used in the design of potable water distribution systems are subject to approval by the City.

C. Design Flow

- The water demand criteria presented in the following table are minimum criteria and the City reserves the right to modify the Criteria, at any time, for the design of specific projects. Potable water demand criteria for uses not provided in the table shall be determined during system design.

TABLE 3-1: Potable Water Design Flow

Residential			
Zoning based on <i>City of Greeley Charter and Code, Chapter 24.401, Zoning</i>			
Use	Units Per Acre*	Occupancy	Peak Hour Demand
R-E	3	3.1 persons	1.9 gpm/unit
R-L	5	3.1 persons	1.9 gpm/unit
R-M	10	2.7 persons	1.7 gpm/unit
R-H	20	1.7 persons	1.1 gpm/unit
R-MH	15	1.7 persons	1.1 gpm/unit
*Use these unit per acre values unless specific unit counts are known			
Commercial			
Where uses are known, use the specific demand values. Commercial demands based on 1000 ft ² of building area unless noted otherwise. Otherwise use the appropriate zoning demand values.			
Use	Average Day Demand without Irrigation		
C-L	1500 gpd per acre		
C-H	3000 gpd per acre		
I-L & I-M	1500 gpd per acre		
I-H	3000 gpd per acre		
Use	Average Day Demand		
Restaurant	500 gpd		
Retail/Office	200 gpd		
Grocery	430 gpd		
Laundry, Dry Cleaning	1000 gpd		
Auto Dealer, Repair/Service	115 gpd		
Car Wash with Water	1500 gpd		
Hospital	380 gpd		
Hotel/Motel	350 gpd		
Retirement & Nursing	350 gpd		
School	12 gpd/student without showers 36 gpd/student with showers		
Religious Building	300 gpd		

Warehouse (Non- industrial)	25 gpd
Irrigation	25 gpm per acre

2. Irrigation is included in the residential water demand, but not included in the commercial water demand. Irrigation demands for commercial uses shall be determined using the provided irrigation demand criteria and the commercial development's estimated irrigated acreage.
3. For residential demands without irrigation flows, a base flow of 60 gallons per capita per day shall be used.
4. Treat Mixed-Use High Intensity Zoning as 50% R-H and 50% C-H and Mixed-Use Low Intensity Zoning as 50% R-H and 50% C-L unless a more detailed breakdown is known.
5. Due to the extreme variation in water consumption amongst the different types of industry, industrial water demands shall be determined during system design when the industrial use is known.

D. Peaking Factor

1. The peaking factor for indoor water use should align with the peaking factor for sanitary sewer in most situations. Instances where the two peaking factors do not align will require approval by the City of Greeley.
2. A domestic peaking factor shall be obtained from ASCE Peak Flow Curve G¹:

$$P_f = \frac{18 + \sqrt{P}}{4 + \sqrt{P}}$$

Where P = Population in thousands (example: P = 2 for population of 2,000)

$$P_f = \frac{18 + \sqrt{\frac{F}{60000}}}{4 + \sqrt{\frac{F}{60000}}}$$

Where F = Flow in gallons per day (based on 60 gpcd in Table 4-1)

E. Fire Flows

1. Contact City of Greeley Fire/Rescue Department (970-350-9510) for the latest adopted fire code and to confirm project fire flow requirements.
2. For design purposes, the maximum allowable fire flow provided from any one (1)

¹ American Society of Civil Engineers (ASCE). 1982. *Gravity Sanitary Sewer Design and Construction. Manuals and Reports on Engineering Practice – No. 60*. Reston, VA: American Society of Civil Engineers.

hydrant is 1,500 gpm. Fire flow may be obtained from more than one (1) fire hydrant providing the additional hydrants are accessible to any possible fire location and meet the spacing requirements and distances from structures as specified in section 3.19 of these Criteria and by the City of Greeley Fire Department.

3.04 PRESSURE REQUIREMENTS

Potable water distribution systems must be designed to provide minimum and maximum system pressures as discussed in the following sections. Water system pressure information for the City’s existing system shall be verified by the City.

- A. The potable water distribution system in all areas shall be designed for a maximum pressure of 125 psi and a minimum pressure of 40 psi at peak hour demands without fire flow.
- B. Twenty (20) psi residual pressure is required at any one (1) hydrant with peak hour demand plus fire flow with one (1) water connection closed.
- C. Pressure zones shall conform to existing City of Greeley pressure zones as provided in the *Water Master Plan*, latest revision. Specific information on the pressure zones or to confirm which pressure zone a development or site is actually located may only be obtained from the City. See Table 3.2 for ground elevation ranges for each pressure zone.
- D. Pressure regulating valves (PRV) or control valves will be required between pressure zones. The final PRV location shall be determined by the City.

TABLE 3-2: Pressure Zone Elevation Ranges

Zone1: 4740’ – 4500’
Zone 2: 4840’ – 4740’
Zone 3: 4940’ – 4840’
Zone 4: 5060 – 4940’

3.05 HYDRAULIC DESIGN

- A. Friction Coefficient
 - 1. Potable distribution mains shall be designed using a Hazen-Williams friction coefficient “C” equal to 120.
- B. Velocity
 - 1. All pipes shall be sized for a maximum water velocity of no greater than five (5) feet per second (fps) at peak hour demand and seven (7) fps at peak hour demand plus fire flow.

3.06 POTABLE WATER MAIN SIZE

- A. Unless specifically indicated in the *Water Master Plan*, sixteen-inch (16") mains are required every mile and twelve-inch (12") mains are required every half-mile. Other distribution mains shall have a minimum diameter of eight inches (8").
- B. Hydrant leads connecting to the potable distribution system shall be six inches (6") in diameter. Other pipe diameters for hydrant leads are prohibited.

3.07 DEPTH OF BURY

- A. The minimum depth of cover shall be five (5) feet and the maximum depth of cover should generally not exceed six (6) feet. Design preference is to minimize lowering which can be challenging to locate and maintain.
- B. When design or constructability constraints are present, deeper or shallower water main installation may be permitted only with acceptance from the City. Additional design and installation considerations may be required by the City depending on the situation. Design considerations should minimize additional fittings and elevation changes where feasible.

3.08 CONNECTIONS TO THE EXISTING POTABLE WATER SYSTEM

- A. Main connections to the existing potable water distribution system shall be made by wet tap or cut in tee. All wet taps and all cut-in tees on mains smaller than 16" diameter shall be made by the Contractor under the direct supervision of the City. It is the Contractor's responsibility to provide all approved tapping materials (tapping sleeves, tapping valves, insulator kit, etc.). Taps for new 8" and 12" main connections to existing 16" or larger mains shall be performed by the City unless otherwise directed.
- B. Connections to the existing transmission mains or distribution mains larger than sixteen-inch (16") shall be limited and must be approved by City.
- C. For wet taps on existing transmission mains or sixteen-inch (16") and larger distribution mains, manufacturer's shop drawings and specifications for the proposed tapping sleeve shall be submitted to the City for review and acceptance prior to installation of the tapping sleeve by the Contractor.
- D. Taps on existing transmission mains or sixteen-inch (16") and larger distribution mains shall require the installation of an insulator kit between the tapping sleeve and tapping valve.
- E. Connection to cast iron mains constructed prior to 1950 may require replacement or non-standard fittings which must be reviewed and approved by City of Greeley Water & Sewer department.
- F. Construction documents shall include a note for all wet taps: "Contractor to reference specifications for approved tapping materials and prior to installation shall contact Distribution for direct supervision of installation by the City."

3.09 LOCATION AND LOOPING OF POTABLE WATER MAINS

- A. Potable water mains shall be located in the center of a dedicated street right-of-way, where feasible, or within a dedicated exclusive easement of appropriate width. If narrow street

sections do not allow the water line to be located in the center of the street right-of-way while maintaining clearances from other utilities and the lip of street gutter, the City may allow the potable water main to be located five (5) feet offset from centerline of the street right-of-way. City approval is required for all other proposed potable water main locations.

- B. The centerline of potable water mains shall not be placed closer than five (5) feet to the lip of street gutter without prior acceptance by the City. Preferred location is to maximize distance from lip of gutter.
- C. Potable water mains serving a cul-de-sac shall be extended to within ten (10) feet of the lip of street gutter at the end of the cul-de-sac and shall have a hydrant assembly placed on the line.
- D. A potable water main serving one (1) lot shall extend all the way across the frontage for that lot.
- E. Where non-compliant or private water mains or service lines exist within or adjacent to a new development, replacement of lines or additional connections to those lines may be required.
- F. Permanent dead-ends are prohibited without prior approval by Water & Sewer. City preference is no dead-end lines and may require additional infrastructure to meet water quality requirements.
- G. Temporary dead-ends with services shall have a fire hydrant or a flushing station with an acceptable discharge point at the end of the line.
- H. Temporary dead-ends with no services shall have a closed valve at the point of connection with the active distributions system and will not require a hydrant or flushing station after the valve.
- I. For temporary phasing, an adequate number of connections to the existing potable water distribution system as determined through hydraulic modeling and approved by the Water & Sewer shall be provided.
 - 1. Potable water mains shall extend to the extremities of the property or the subdivision served. Extensions shall be in appropriate locations to provide adequate water connections and to maintain looping requirements for adjacent, future developments and to facilitate the completion of the grid described in section 3.06 of these Criteria.
 - 2. Water mains shall be extended offsite when required to tie into the existing distribution system for additional water source connections. Appropriately sized easements shall be provided.
- J. In all instances, the City shall determine the potable water system looping, connections, and valving in order to maintain overall water system performance. Ultimately, the required source connections to the existing potable water system shall be solely determined by the Water & Sewer Department.
 - 1. New developments shall have at minimum two separate and distinct connections to the existing system to provide reliability for maximum fire flows in case of pipe failure and

better system circulation to maintain acceptable water quality. Source connections shall be made on opposite sides of the development.

3.10 POTABLE WATER SYSTEM PHASED INSTALLATION AND STUBOUTS

- A. Potable water distribution system phasing, if proposed by the Developer, shall be clearly identified on the overall utility plan. Water plan and profile sheets shall clearly show and label the phasing transitions in the potable water line design.
- B. The proposed potable water system phasing shall maintain looping integrity within the system as described in section 3.09 of these Criteria.
- C. The phased potable water system design shall meet the phased water demands for the development and adhere to all potable water system and hydraulic design requirements provided in these Criteria.
- D. Locate line valves and temporary fire hydrant and flushing station at the end of each phase or stub out, as described in section 3.09 of this criteria. The stubout shall be shown on the potable water plan and profile sheets.
- E. Phased water line or stubout construction shall be extended a minimum ten (10) feet beyond phased street paving to avoid asphalt removal during excavation for future connections.
- F. Phased potable water mains or stubouts intended for future connections shall be valved such that only one (1) valve needs to be closed when the main is extended and no customers are without water service when the line is extended. The valve must be appropriately restrained so it will not “blow off” when the water line is exposed and all thrust blocking is removed for the extension. See section 3.14 of these Criteria regarding pipe restraint.
- G. The maximum length of a stubout shall be fifty (50) feet unless otherwise approved by the City.
- H. Potable water main stubouts not utilized shall be abandoned. Refer to appendix section A3 – *Policies Impacting Design and Construction* for abandonment procedures.

3.11 PIPE MATERIAL

- A. Potable water pipes less than or equal to sixteen-inches (16”) in diameter shall be AWWA C151 cement-lined ductile iron pipe or AWWA C900-16 polyvinyl chloride (PVC) pressure pipe.
 - 1. HDPE pipe and fused PVC may be used with City approval for specifically identified purposes, location and uses such as horizontally bored crossings.
- B. The Design Engineer shall specify the pipe material and class, as required for specific project conditions. The pipe material and class shall be called out on the Construction Drawings.

- C. All ductile iron pipe shall be protected against soil corrosion based on the corrosion level determined from pH and Resistivity levels in accordance with the following table. If the corrosion level is found to be Medium or lower, the pipe shall be wrapped with 8-mils of V-Bio Enhanced Polyethylene Encasement in accordance with AWWA C105. If the Corrosion level is Medium-High or High, then additional Zinc coating of the pipe shall be required.

TABLE 3-3: Corrosive Soil Function of pH and Resistivity

pH	Resistivity (Ohms-cm)	Corrosion
<3.5	Any	High
3.5-4	<4,500	High
	>4,500	Medium-High
4.5-5.5	<4,500	High
	4,500-5,000	Medium-High
	>5,000	Medium
5.5-6.0	<1,000	High
	1,000-5,000	Medium-High
	5,000-10,000	Medium
	>10,000	Medium-Low
6.0-9.0	<1,000	High
	1,000-3,000	Medium-High
	3,000-10,000	Medium
	10,000-20,000	Medium-Low
	>20,000	Low

3.12 VALVES

- A. All valves shall be located in dedicated street right-of-way or within a dedicated exclusive easement of appropriate width. City approval is required for all other proposed valve locations.
- B. Gate Valves
- Gate valves are assigned in the potable water distribution system so that no single accident, break, or repair necessitates shutting down a length of pipe greater than 1,000 feet in all directions or no more than one hundred fifty (150) people are out of service at any one time.
 - At street intersections, gate valves shall be located at the extension of property lines, wherever possible.
 - Gate valves shall be located a minimum five (5) feet away from the edge of concrete cross pans or cutters and away from intersection. This requirement has precedence over section 3.12-B. of these Criteria.
 - Fire hydrant and fire sprinkler line gate valves shall be placed at the main. These gate

valves shall be mechanical joint valves and fasten to a mechanical joint anchor tee (swivel tee) on the main.

5. All potable water line valves shall have a concrete collar around the valve box in accordance with *SDC* Standard Drawings.
6. City may require additional valves to allow for maintenance and control and minimizing service outages. Final valve locations shall be solely determined by the City.
7. Valves shall be provided at both ends of water pipelines where the potential of inaccessibility for repairs may exist, this may include; rivers, ponds, ditches, railroads and highways. Where looping is required, valves shall be located at easement lines or ROW to maintain potable service.

C. Combination Air Valves

1. Sixteen-inch (16") diameter mains shall have combination air valves installed at high points along the main and shall be properly sized by the Design Engineer in accordance with the manufacturer's recommendation. The City shall have final determination on valve size, placement, and type of valve to install.

D. Pressure Regulating Valves

1. Pressure regulating valves (PRVs) control pressures between potable water distribution system and shall be placed at pressure zone boundary. The final installation location shall be determined by City.
2. The standard PRV size is eight inches (8") for all 8" mains unless otherwise approved by the City. For all mains larger than 8", duplex PRVs are required and shall be sized according to hydraulic calculations unless otherwise approved by the City.

E. Blowoffs

1. Any required blowoff location shall utilize a city approved fire hydrant or flushing station.

3.13 PIPE ALIGNMENT

- A. Potable water mains may have a change in alignment or grade to avoid obstructions, within the limits of the pipe joints. If joint deflections is not feasible or permitted by the City, an appropriate bend fitting shall be used.
- B. Allowable Joint Offset for PVC Pipe

TABLE 3-4: Maximum PVC Pipe Joint Deflection or per manufacturers limits whichever is more restrictive

Pipe Diameter (in)	Maximum Joint Deflection (°)
8"	1°

12"	1°
16"	1°

- C. PVC pipe can be joined with High Deflection (HD) Couplings which allow five degrees (5°) of pipe joint deflection per coupling. HD couplings can be used in the place of small bends or where it is undesirable or impossible to joint deflect the pipe.
- D. Allowable Joint Deflection for DIP Pipe

TABLE 3-5: Maximum DIP Pipe Joint Deflection or per manufacturers limits whichever is more restrictive

Pipe Diameter (in)	Maximum Joint Deflection (°)
6"	4.0°
8"	4.0°
12"	4.0°
16"	2.5°

3.14 THRUST BLOCKING AND PIPE RESTRAINT

- A. Concrete thrust blocks or pipe restraints shall be constructed at all mainline bends, tees, dead ends, and valves as shown in the City of Greeley Standard Drawings.
- B. Thrust Blocks
- The thrust block details, as shown in the City of Greeley Standard Drawings, are to be used as minimums only. The Design Engineer shall determine the required size of thrust blocks to use.
 - If for any reason (i.e. temporary dead end line), concrete thrust blocks cannot be used, restrained push-on or mechanical joint restraints shall be required.
- C. Pipe Restraint
- The pipe restraint details, as shown in the City of Greeley Standard Drawings, are to be used as minimums only. The Design Engineer shall determine the required size of thrust blocks to use.
 - For transmission mains, the Design Engineer shall determine the length of required pipe restraint, for the pipe material being used, PVC or DIP, in accordance with AWWA M41 *Ductile-Iron Pipe and Fittings* or AWWA M23 *PVC Pipe – Design and Installation*, latest revision.
- D. In some instances (i.e. fire hydrants, large diameter fire lines, water line lowering's, etc.) thrust blocks may be required in addition to pipe restraint. The design engineer or City shall make such determinations on a case-by-case basis.

3.15 POTABLE WATER MAIN AND SERVICE ENCASEMENTS FOR WET UTILITIES

Wet utilities should be defined as any pipeline that could contaminate the potable water system.

- A. No general statement can be made to cover all encasement conditions, therefore only typical encasement situations are addressed in this section. Encasement requirements shall ultimately be determined by the City on a case-by-case basis.
- B. Refer to construction specification *Section 02445, Casing Pipe – Borings and Encasements* for encasement pipe material, diameter, and wall thickness (if applicable), casing spacers, and standard detail end seals, and installation requirements. No encasements shall be constructed from poured concrete.
- C. The use of “line” or “lines” in this section shall refer to both mains and services.
 - 1. Where sanitary sewer lines cross beneath potable water lines with less than eighteen inches (18”) clearance or any sanitary sewer lines cross above potable water lines, or the ten (10) feet horizontal clearance between potable water lines and sanitary sewer lines cannot be maintained, pipe encasement shall be designed and constructed so as to protect the potable water line.
 - 2. Where non-potable Distribution lines cross above or below potable water lines with less than eighteen inches (18”) clearance, pipe to be center on potable water Main or Fused and shall be designed and constructed so as to protect the potable water line.
 - 3. Pipe encasement shall be placed on the sanitary sewer line or non-potable irrigation line except in situations where the sanitary sewer or non-potable irrigation line is existing. Where the sanitary sewer or non-potable irrigation line is already constructed, the pipe encasement shall be placed on the potable water line. Priority shall be given to encase service lines before main lines.
 - 4. The encasement pipe shall extend a minimum ten (10) feet on either side of the crossing measured from the outside diameter of the crossed pipe. Longer casing pipes may be required depending on the encasement situation.
 - 5. For any atypical encasement sizing situations, the Design Engineer shall size the encasement pipe such that the inside clearance is at least one inch (1”) greater than the maximum outside diameter of the casing spacer runners.
 - 6. Where storm water lines cross above potable water mains, storm water pipe joints shall utilize rubber gaskets and exterior joint wrap a minimum ten (10) feet on either side of the crossed potable water main, measured from the outside diameter of the pipe.
- D. Potable water main crossings under any open irrigation ditch shall have a minimum five (5) feet of cover and shall be encased.
- E. Bored utility crossings shall have a minimum twenty-four inches (24”) of vertical clearance from the outside diameter of the utility casing to the outside diameter of the potable water line if the bored utility crosses above the potable water line and a minimum thirty-six inches (36”) of vertical clearance from the outside diameter of the utility casing to the outside diameter of the potable water line if the bored utility crosses below the water line.

- F. If there are horizontal or vertical clearance conflicts between the potable water line and gravity utilities, the City may require that the potable water main be lowered, raised, or realigned in order to maintain the required clearances.

3.16 POTABLE WATER MAIN BORINGS & ENCASEMENTS REQUIRED BY OTHER AGENCIES

- A. Installation of potable water mains through City of Greeley or another agency's right-of-way, easement, or other, may require a bored casing pipe to facilitate main installation. The type of bored casing material and its properties will be specified by the agency granting permission to cross. Such crossings shall be subject to approval by the City to avoid conflicts in requirements or standards between the City and the agency granting permission to cross.
1. A letter, permit, or approved crossing application from the agency granting permission to cross, must be provided to the City prior to the boring.
 2. The City shall not accept any bored crossings imposed with an annual user or crossing fee from the agency granting permission to cross. All bored crossing fees, if applicable, shall be paid by the Developer prior to the boring.
- B. The minimum requirements for bored casings within the City shall be in accordance with construction specification *Section 02445, Casing Pipe – Borings and Encasements. & standard drawings*
1. The required bore length of casing pipe shall be determined by the Design Engineer and must be accepted by the City.
 2. All bored casing shall have a minimum of twenty-four inches (24") of vertical clearance from the outside diameter of the casing pipe to the outside diameter of the utility line if the bored casing crosses above the utility and a minimum thirty-six inches (36") of vertical clearance from the outside diameter of the casing pipe to the outside diameter of the utility line if the bored casing crosses below the utility, unless more stringent requirements by other utility.

3.17 POTABLE WATER SERVICES AND FIRE SPRINKLER LINES

- A. General
1. Potable water service lines shall not be installed in trenches with other wet or dry conduits/utilities. A service line shall be separated from other conduits a minimum ten (10) feet horizontally and eighteen inches (18") vertically. The only exception will be a fire sprinkler line. In this instance, the horizontal separation may be a minimum of five (5) feet, from outside diameter of the pipe and final determination. This shall be evaluated by the City on a case-by-case basis.
 2. Potable water services and fire sprinkler lines for a given lot must be tapped on the potable water main within the confines of the extended property lines. Certain lots and cul-de-sacs may have the potable water service line or fire sprinkler line located anywhere along the lot frontage but shall be a minimum three (3) feet and preferred location is five (5) feet inside the property line being served.

3. No potable water service taps shall be made on fire sprinkler lines.
4. All taps shall require a tapping saddle or tapping sleeve and valve as shown in standard detail. No direct taps are allowed.
5. Potable water services and fire sprinkler lines not intended to be utilized shall be abandoned. Refer to appendix section A3 – *Policies Impacting Design and Construction* for abandonment procedures.

B. Water Services

1. Refer to construction specification *Section 02514, Water Service Lines, Meters, and Appurtenances*, for service pipe materials and installation requirement.
2. A separate potable water service line and meter must serve each building with individual owners.
3. No potable water service lines shall cross property lines, including irrigation systems, unless otherwise approved by the City for irrigating multiple outlots. Irrigation systems from a single potable water service shall only be allowed for use on that single property. Refer to appendix section A2 – *Compound Tap Exemption Policy for Irrigation of Multiple Outlots*.
4. No compound potable water taps are allowed. Refer to *City of Greeley Charter and Code, Title 20: Public Services, Section 20-253*.
5. Where one or more master meters are allowed for residential units, meters shall be configured to serve contiguous groups of units on one lot with no more than an estimated twenty-five residents served by a single master meter. The master metered system shall also be designed and constructed such that the property owner does not become a public water provider under state or federal regulations.
6. Pressure boosters are prohibited without adequate backflow protection.
7. Potable water services shall be located a minimum five (5) feet inside the property being served.
8. Under no condition is a potable water service to be located under driveways, trees, or other permanent structures.
9. Potable water service taps shall be separated by at least five (5) feet, measured along the potable water main length, including when taps are on opposite sides of the potable water main. Potable water service taps shall also be a minimum five (5) feet from all joints, fittings, or valves.
10. The corporation stop, curbstop, meter, that portion of the service line between the corporation stop and the meter, and five (5) feet past the meter shall all be the same internal diameter.
11. Potable water service curb stops shall be located \pm one (1) foot from the property line or easement boundary and preferred inside the row. Potable water service meter

pits/vaults shall be located as close as possible beyond the curb stop. See City of Greeley Standard Drawings for additional service and meter installation requirements.

12. Potable water service meter pits/vaults shall normally be located after the curbstop in a landscaped area or streetscape. Meter pits/vaults shall not be installed in any street, parking area, driveway, or sidewalk unless otherwise approved by the City. If a meter pit/vault is permitted by the Water & Sewer Department to be located in any traffic area, the pit/vault shall be designed to withstand HS-20 traffic loadings. Curbstops with tracer wire test stations shall be in a valve box.
13. There shall be no major landscaping (trees, boulders, or shrubs with mature growth greater than three (3) feet), buildings, or other permanent structures within ten (10) feet of the meter pit/vault.
14. The maximum allowable number of living units on a single tap may be determined using a fixture analysis per the process outlined in the most recent edition of AWWA Manual of Water Supply Practices M22 – Sizing Water Service Lines and Meters. If no analysis is provided, the maximum values are shown below: Any residential project requesting a domestic tap larger than three inches (3”) shall be reviewed on a case-by-case basis.

TABLE 3-6: Living Units Allowed Per Tap Size

Tap Size (inch)	Maximum Allowable Living Units
3/4”	2
1”	4
1 1/2”	10
2”	25
3”	45

15. Commercial and industrial developments may provide potable water service stubouts, if the end user is known.

C. Fire Sprinkler Lines

1. Fire sprinkler lines two-inch (2”) or smaller shall be type “K” copper. Fire sprinkler lines larger than two-inch (2”) shall be restrained DIP. Restrained DIP fire sprinkler lines require concrete thrust blocking at the main and a gate valve at the main. Fire sprinkler lines are not metered.
2. Fire sprinkler lines must be connected to the potable water distribution system. Connections to non-potable irrigation system are prohibited.

3.18 POTABLE WATER MAINS AND SERVICES IN RELATION TO DRY UTILITIES

Dry utilities shall be defined as any utility pipeline that could not contaminate the potable water system.

- A. Potable water services and distribution mains shall have a minimum ten (10) feet horizontal and eighteen inches (18”) vertical separation from all utilities measured from outside

diameter.

- B. Dry utility crossings shall be encased in high density polyethylene pipe (HDPE), Standard Dimension Ratio (SDR) 11 or approved equal from edge to edge of the easement or right-of-way, or ten (10) feet on either side of the potable water main, whichever is greater. Final determination shall be accepted only by the City
- C. Right angle utility crossings are only permitted above and below the potable water main with adequate clearance. Non-right-angle crossings shall be approved by the City. Parallel installation of other utilities in exclusive water easements are not permitted.
- D. For a potable water line crossing situation not specifically mentioned in this section, the crossing requirements provided in these Criteria shall be applied to that particular situation to the best extent possible.

3.19 FIRE PROTECTION AND HYDRANT SPACING

- A. All fire protection, fire flow, and hydrant requirements are subject to approval by the Greeley Fire Department.
- B. Hydrant Spacing
 - 1. Residential structures shall be no further than 250 feet, fire access distance², from a fire hydrant.
 - 2. In R-L zoned areas, fire hydrant spacing shall be no further than 600 feet measured along the street curb line.
 - 3. In R-M and R-H zoned areas, fire hydrants shall be spaced equal to or less than 500 feet apart, measured along the street curb line. Structures shall be 250 feet or closer, fire access distance, from a fire hydrant.
- C. In commercial and industrial areas, structures shall be 250 feet or closer, fire access distance, from a fire hydrant.
- D. Where potable water mains are extended along streets where hydrants are not needed for the protection of structures, hydrants shall be provided at spacing not to exceed 1,000 feet.
- E. Hydrants shall be located at intersections whenever possible. Hydrants located mid-block shall be aligned with the extension of a property line.
- F. Fire hydrants shall be installed in accordance with construction specification *Section 02516, Water Utility Distribution Fire Hydrants* and City of Greeley Standard Drawings.
- G. A three (3) foot radius in all directions around the hydrant shall be clear of obstructions.
 - 1. Where hydrants are vulnerable to vehicular damage, crash posts shall be provided outside of the three (3) foot radius clearance in all directions from the hydrant and a

² Fire access distance is the distance a fire pumper must travel to lay a standard hose line from a hydrant to the primary access point of a structure. The hose lay distance is not measured over unimproved areas that may be impassable due to weather conditions, obstructions, etc.

minimum of one foot from edge of sidewalk.

2. When hydrants are located less than 4 feet from a vehicular travel path, or not protected by curb and gutter then crash posts shall be provided. Crash posts shall be concrete filled pipes that are four-inches (4") in diameter and a minimum of four (4) feet in height above the finished ground surface with two (2) feet of post below the finished ground surface.
- H. All hydrants must be within dedicated exclusive easements or public rights-of-way. Refer to *Section 2* of these Criteria for easement requirements.

3.20 CROSS CONNECTION AND BACKFLOW PREVENTION

- A. Potable water service lines on any property or inside any building shall have NO physical connection with any pipes, pumps, hydrants, tanks or non-potable irrigation systems that could draw or discharge any unsafe or contaminated water (including steam condensation or cooling water) into the potable water distribution system.
- B. For additional information on cross connection or backflow prevention requirements, refer to appendix section *A1 – Cross Connection and Backflow Prevention Policy*.

SECTION 4

SANITARY SEWER COLLECTION SYSTEM DESIGN CRITERIA

4.01 GENERAL

- A. The purpose of this section is to provide information for the design and layout of a sanitary sewer collection system. Sanitary sewer collection system design shall be in accordance with the City of Greeley Sanitary Sewer Master Plan, latest revision, and these Criteria.
- B. This section is not intended to be inclusive of all situations and the Design Engineer may be required to use additional engineering judgment to meet the overall design intent for constructability and long-term operations and maintenance. **This Design Criteria typically applies to sanitary sewer mains twelve inches (12”) in diameter and smaller.** The City of Greeley Water and Sewer Director reserves the right to make final determinations of the system design based on the best interest of the City’s system. Refer to standard detail drawings for additional design information.

4.02 DEFINITIONS

- A. Sanitary Sewer Collection Mains
 - 1. A sanitary sewer collection main is a sanitary sewer pipe that gathers wastewater flows directly from individual sanitary sewer services or private sewer mains and transports.
- B. Sanitary Sewer Interceptor Lines
 - 1. Sanitary sewer interceptors within the City are fifteen inches (15”), eighteen inches (18”), or twenty one inches (21”) in diameter.
- C. Sanitary Sewer Trunk Lines
 - 1. A sanitary sewer trunk line is a sanitary sewer pipe that collects sewage flows from the collection mains and interceptors and carries those flows to the wastewater treatment facility.
 - 2. Sanitary sewer trunk lines are larger than twenty-one inches (21”) in diameter.
 - 3. All sanitary sewer trunk lines require additional approval through the Colorado Department of Public Health and Environment (CDPHE), and all permitting shall be completed by Developer and Design Engineer and must be approved and signed by City.
- D. Sanitary Sewer Services
 - 1. Sanitary sewer services include all piping, fittings, and appurtenances used to convey sanitary sewage from the plumbing system of a structure to a sanitary sewer collection main.
 - 2. Sanitary sewer services are typically four inches (4”) or six inches (6”) in diameter.

4.03 DESIGN FLOW

- A. The sanitary sewer collection system shall be designed to carry peak wastewater flows plus infiltration/inflow in accordance with these Criteria.
1. Depending on a development's location, consideration of upstream and offsite flow contributions may be required by the City to ensure proper sizing of the sanitary sewer collection mains within the development. This will be determined by the City on a case by case basis.
 2. Depending on the existing capacity of the downstream sanitary sewer collection system, the City may require verification that the downstream sewer system can convey the development's peak flows. If the downstream capacity is inadequate, the Developer may be required to make appropriate downstream sewer system upgrades. This will be determined by the City on a case by case basis.
 3. Any infill or redevelopment project that is an intensification of use shall require the Developer to verify that the downstream sewer system can convey the development's peak flows. If the downstream capacity is inadequate, the Developer may be required to make appropriate downstream sewer system upgrades.
- B. Design Flow
1. The wastewater flows presented in the following table are minimum criteria and the City reserves the right to modify the Criteria, at any time, for the design of specific projects. Wastewater flows for uses not provided in the table shall be determined during system design.

TABLE 4-1: Sanitary Sewer Design Flow

Residential			
<i>Zoning based on City of Greeley Charter and Code, Chapter 24.401, Zoning District Development Standards</i>			
Use	Units Per Acre	Occupancy	Average Day Wastewater Flows*
R-E	3	3.1 persons	0.13 gpm/unit
R-L	5	3.1 persons	0.13 gpm/unit
R-M	10	2.7 persons	0.11 gpm/unit
R-H	20	1.7 persons	0.07 gpm/unit
Commercial			
Use	Average Day Wastewater Flows*		
C-L (not specified)	1,500 gpd/acre (minimum)		
C-H (not specified)	3,000 gpd/acre (minimum)		
Retail/Offices	200 gpd/1,000 SF		
Hotels/Motels	350 gpd/1,000 SF		
Restaurants	500 gpd/1,000 SF		

Bars and Lounges	300 gpd/1,000 SF
Neighborhood Stores	200 gpd/1,000 SF
Department Stores	200 gpd/1,000 SF
Laundry and Dry Cleaning	1,000 gpd/1,000 SF
Banks	300 gpd/1,000 SF
Nursing Homes	350 gpd/1,000 SF
Warehouses	25 gpd/1,000 SF
Car Washes with Water Reuse	1,500 gpd/1,000 SF
Auto Dealer/Repair/Service	115 gpd/1,000 SF
Grocery Store	430 gpd/1,000 SF
Religious Buildings	300 gpd/1,000 SF
Factories	800 gpd/1,000 SF
Hospitals	380 gpd/1,000 SF
Schools (without showers)	12 gpd/student
Schools (with showers)	36 gpd/student
Industrial	
Use	Average Day Wastewater Flows*
I-L (not specified)	1,500 gpd/acre
I-M (not specified)	1,500 gpd/acre
I-H (not specified)	3,000 gpd/acre
*1cfs = 448.33 gpm Average day wastewater flow per capita = 60 gpcd	

- All flows used in the design of sanitary sewer collection systems are subject to approval by the City.

C. Peaking Factor

- A domestic peaking factor shall be obtained from ASCE Peak Flow Curve G¹:

$$P_f = \frac{18 + \sqrt{P}}{4 + \sqrt{P}}$$

Where P = Population in thousands (example: P = 2 for population of 2,000)

¹ American Society of Civil Engineers (ASCE). 1982. *Gravity Sanitary Sewer Design and Construction. Manuals and Reports on Engineering Practice – No. 60*. Reston, VA: American Society of Civil Engineers.

$$P_f = \frac{18 + \sqrt{\frac{F}{60000}}}{4 + \sqrt{\frac{F}{60000}}}$$

Where F = Flow in gallons per day (based on 60 gpcd in Table 4-1)

4.04 INFILTRATION AND INFLOW (I/I)

- A. Infiltration and inflow (I/I) is extraneous water flow that enters the sanitary sewer collection system.
1. Infiltration is water entering the sanitary sewer collection system from the ground through service connections, defective pipes, pipe joints, and manhole connections.
 2. Inflow is unintentional water entering the sanitary sewer collection system from roof drains, underdrains, surface stormwater runoff, and natural drainage. Any direct connections to the sanitary sewer system shall be removed and directed to the appropriate locations.
- B. 200 gallons per day per inch-diameter per mile of pipe shall be added to the peak design wastewater flow as the allowance for I/I.
- C. 500 gallons per day per inch-diameter per mile of pipe located in groundwater shall be added to the peak design wastewater flow as the allowance for I/I.
- D. I/I flows are not subject to a peaking factor.

4.05 HYDRAULIC DESIGN

- A. The required pipe size shall be computed by Manning's Equation below:

$$Q = \frac{1.49}{n} AR^{2/3} \sqrt{S}$$

Where:

Q = Flow (cfs)

n = Manning's Coefficient of 0.013

A = Area of Flow (ft²)

R = Hydraulic Radius (A/P)

Where: P = Wetted Perimeter

S = Slope of pipe (ft/ft)

- B. All sanitary sewer collection mains shall be designed to a maximum depth of flow, depending on age.
1. Half full ($d/D=0.5$) for all mains constructed prior to 2022 due to historical tap locations on the mark.
 2. 4/5 full ($d/D=0.8$) for all new development.

Where:

d = Depth of Flow

D = Diameter of Pipe

- C. Minimum design velocity at peak flow shall not be less than two (2) ft/s or greater than seven (7) ft/s. Where 2 ft/s is not feasible, the minimum slope shall be 1% slope for 8" pipe.
1. Sewer shall be designed for velocities less than seven (7) ft/s whenever possible and for subcritical flows whenever possible.
 2. When conditions require velocity to be greater than seven (7) feet per second, special provisions shall be made to avoid scour and protect against displacement caused by erosion or impact.
- D. When lines are 10" and larger, Developer shall analyze flows for hydraulic jumps and special provisions shall be made to avoid H₂S and protect against its effects.

4.06 SANITARY SEWER MAIN SIZE AND SLOPE

- A. The following table shows the minimum allowable slopes per sanitary sewer main diameter. These minimum slopes may be used provided that the hydraulic design requirements in 4.05 of these Criteria are met.

TABLE 4-2: Minimum Sanitary Sewer Main Slopes (ASCE)

Pipe Diameter (in)	Minimum Slope (%)
8"	0.40%
10"	0.28%
12"	0.22%
15"	0.15%
18"	0.12%
21"	0.10%

- B. The maximum slope for any sanitary sewer collection main shall be 5%
- C. The City requires sanitary sewers to maintain a consistent slope throughout the sewer alignment in order to maintain capacity.
- D. All proposed sanitary sewers shall maintain the same inner diameter (ID) pipe size to match the existing City collection system; no downsizing shall be allowed.
- E. The City may require the Developer to install a sanitary sewer collection main larger than is needed to adequately service the development. Refer to *Section 2* of these Criteria for oversizing reimbursement.

4.07 DEPTH OF BURY

- A. Sanitary sewer collection mains shall have four (4) feet minimum depth of cover from the top of pipe to finished ground surface.
- B. Where grading, existing field conditions, or service constraints demonstrate that a sanitary sewer main must have less than four (4) feet of cover or when sewer main installation is deeper than twenty (20) feet at the invert, refer to section 4.10.
- C. Installation of sanitary sewer mains with depths greater than twenty (20) feet at the invert shall require written approval from Water & Sewer after all reasonable effort is made to keep depths to less than twenty feet.
- D. Where the elevation difference between the top of foundation and the top of the sanitary sewer collection main is less than ten (10) feet, the Construction Drawings and the plat shall indicate the lot is served by a “shallow sewer” and appropriate elevation information shall be given.

4.08 LOCATION OF SANITARY SEWER COLLECTION MAINS

- A. All sanitary sewer collection mains shall be located in dedicated street right-of-ways. Any other sanitary sewer collection mains shall be in a dedicated easement of appropriate width (refer to section 2.06). City approval is required for all proposed locations.
- B. The centerline of sanitary sewer collection mains shall not be placed closer than five (5) feet to the lip of the street gutter without prior acceptance by the City. The sewer collection mains centerline should avoid traffic wheel paths where feasible.
- C. Sanitary sewer collection mains shall extend to the upstream extremities of the property or subdivision being served. Main extensions shall be in appropriate locations to provide adequate sanitary sewer system connections for adjacent, future developments.
 1. A sanitary sewer collection main serving one (1) lot shall extend all the way across the frontage for that lot.
 2. The City may grant exceptions to sanitary sewer collection main extensions if development of an adjacent property is located in a different sewer basin, or if the

property can currently connect to the sanitary sewer system. This will be determined by the City on a case by case basis.

3. Sanitary sewer mains shall be extended offsite when required to tie into the existing collection system.
- D. Sanitary sewer collection mains shall be straight between manholes, both in alignment and slope.
- E. Stormwater and underdrain piping shall be distinguishable by color from sanitary sewer collection mains.

4.09 **SANITARY SEWER COLLECTION SYSTEM PHASED INSTALLATION AND STUBOUTS**

- A. Sanitary sewer collection system phasing, if proposed by the Developer, shall be clearly identified on the master utility plan. Sewer plan and profile sheets shall clearly show and label the phasing transitions in the sanitary sewer main design.
- B. The phased sanitary sewer collection system shall be designed for full build out of the development being served including any additional offsite flows that must be passed through the development. Stub-out shall be designed for future development flows.
- C. Phased sanitary sewer main or stub-out construction shall be extended a minimum ten (10) feet beyond phased street paving to avoid asphalt removal during excavation for future connections.
- D. A stub-out for future connection shall be provided for an adjoining phase or adjacent future developments.
- E. The stub-out design and installation shall maintain both vertical and horizontal alignment in accordance with these Criteria. The stub-out shall be shown on the sanitary sewer plan and profile sheets with the length and end of pipe invert labeled.
- F. The end of the stub-out shall be sealed with a removable watertight plug restrained by half (1/2) a cubic yard of concrete behind the plug until the time of future connection.
- G. The maximum length of a stub-out shall be forty (40) feet unless otherwise approved by the City. If the maximum stub-out length must be exceeded, the sewer main installation shall end at a terminal manhole or be extended to the next upstream manhole.
- H. Sanitary sewer main stub-outs not utilized shall be abandoned. Refer to appendix section A3 – *Policies Impacting Design and Construction* for abandonment procedures.

4.10 **PIPE MATERIAL**

- A. Sanitary sewer collection mains shall be polyvinyl chloride (PVC) SDR 35 pipe suitable for sanitary sewer flows.
- B. Alternative pipe materials shall only be used in the following situations:
 - 1. Where sanitary sewer collection mains are installed less than four (4) feet from the finished ground elevation to the top of pipe, approval by Water & Sewer Department is required.
 - a. The pipe material shall be PVC SDR 26 with flow fill from bottom of trench to one (1) foot above top of pipe, and the full trench width, and manhole to manhole.
 - 2. Where sanitary sewer collection mains are installed deeper than twenty (20) feet at the invert, polyvinyl chloride (PVC) SDR 26 shall be used.
 - a. For alternative pipe material installation situations, external load (earth and live load) analysis is required to verify the minimum alternative pipe material is suitable for the specific project conditions. If the alternative pipe material is unsuitable, the Design Engineer shall specify an acceptable pipe material. External pipe load calculations shall be submitted to the City for review and acceptance.
 - b. The length of alternative pipe material to install shall be called out on the Construction Drawings.
- C. Changes between pipe materials are not permitted along a continuous sewer main. The alternative pipe material shall be installed from manhole to manhole.
- D. To allow new connections to mains that are damaged, the main shall be replaced or rehabilitated per specifications from the upstream to downstream manhole.

4.11 MANHOLE LOCATION AND SIZE

- A. General
 - 1. Manholes shall be installed at every change in direction, slope, or connection with other sanitary sewer collections mains.
 - 2. There shall be no more than three (3) lines designed to discharge into any one manhole. This includes both main and service lines.
 - 3. The Design Engineer shall determine if conditions require an interior protection on the manhole from microbial induced corrosion. Acceptable protections for new construction are polymer concrete, concrete with Xypex Bio-San C500 admixture, or approved HDPE manhole liner systems. Acceptable protections for existing manholes are polymer concrete liner systems or coatings. Water & Sewer Department reserves the right to require additional locations where interior coatings may be required. Locations that require interior manhole protections may include, but are not limited to:
 - a. Locations where hydraulic jump may occur and the next downstream manhole.
 - b. Every drop manhole and the next adjacent downstream manhole.

- c. Any manhole where invert slope exceeds 5% or velocities exceed 5 ft/s or where flows change from supercritical to subcritical.
4. Buoyancy calculations shall be provided for manholes and pipes where groundwater may be encountered, has been identified in the geotechnical report, is located in the floodplain or other water sources are present. The manhole shall be sealed from the outside with an approved seal wrap, where groundwater or other water sources are present.
5. Connection and modifications of existing manholes that are constructed of bricks or show signs of damage shall be replaced or rehabilitated and coated per specifications.

B. Manhole Location

1. All manholes shall be located in dedicated street right-of-way or within a dedicated easement of appropriate width (refer to section 2.06). City approval is required for all other proposed manhole locations.
2. The center of manholes shall not be placed closer than eight (8) feet to the lip of the street gutter without prior acceptance by the City.
3. The edge of the manhole cover shall be located a minimum five (5) feet from the edge of cross pans, wherever feasible.
4. Manholes located outside of the street section shall be located in areas not subject to flooding, stormwater conveyance, ponding or detention.
 - a. If locating manholes in stormwater conveyance areas cannot be avoided, a solid, watertight, bolt down manhole cover with an integral rubber gasket, shall be used.
 - b. Manholes located within the 100-year flood plain shall have a solid, watertight, rubber gasket, bolt down manhole cover. The manhole cover and grade ring shall be bolted to the manhole cone, and all manhole joints and grade rings shall be sealed from the outside with an approved seal wrap.
 - c. Manholes located within groundwater or where other water sources are present, shall have all manhole joints and grade rings sealed from the outside with an approved seal wrap.
5. Manholes outside of road rights-of-way shall be provided with direct access by means of an all-weather road. All-weather road requirements are as follows:
 - a. All-weather roads shall be designed to support City maintenance vehicles up to thirty-five (35) tons with a minimum turning radius of sixty (60) feet.
 - b. At a minimum, all-weather roads shall be ten (10) feet wide with eight (8) inches of compacted aggregate base course. Subgrade preparation, compaction, and aggregate base course shall be in accordance with *SDC* construction specifications.
 - c. If the all-weather road is longer than fifty (50) feet and does not have a public road access from both ends, an appropriately sized turn around shall be provided.

- d. The Design Engineer shall verify that these minimum requirements for the all-weather road are suitable for the specific project conditions.
- e. The all-weather road shall be located in a dedicated sanitary sewer or access easement.

C. Manhole Size and Spacing

- 1. The following table displays the diameter of standard manholes and the maximum manhole spacing for each sanitary sewer pipe diameter:

TABLE 4-3: Standard Manhole Diameter and Spacing

Sewer Pipe Diameter (in)	Manhole Diameter (ft)	Manhole Spacing (ft)
8"	4 ft	450 ft
10"	4 ft	450 ft
12"	4 ft	550 ft
15"	5 ft	550 ft
18"	5 ft	550 ft
21"	5 ft	550 ft

- 2. The following table displays the diameter of inside drop manholes. Use standard manhole spacing from Table 4-3 for inside drop manhole spacing. Inside drop manhole shall only be allowed for utility conflicts and pipe sizes up to eight inches (8"). City approval is required for all other proposed inside drops.

TABLE 4-4: Inside Drop Manhole Diameter

Inside Drop Pipe Diameter (in)	Manhole Diameter (ft)
4" or 6"	4 ft
8"	5 ft

4.12 MANHOLE INVERTS

- A. The minimum elevation drop across a manhole shall be one-tenth of a foot (0.1 ft) except where cast-in-place manholes are to be installed over existing sanitary sewer mains. In such cases, the existing sanitary sewer pipe grade determines the elevation drop across the manhole, by constructing the cast-in-place manhole over the existing, straight sewer main and removing the upper half of the pipe.
- B. Where a smaller sanitary sewer main joins a larger one, the smaller sanitary sewer main crown elevation shall match the crown elevation of the larger sanitary sewer main. This includes sanitary sewer service lines.
- C. Where the invert elevation difference between the invert in and invert out is twenty four inches (24") or more and eight inches (8") or smaller pipe size, an inside drop apparatus

shall be constructed. Refer to City of Greeley Standard Drawings for drop manhole construction.

- D. Sanitary sewer mains and services entering a manhole with less than twenty four inches (24”) but greater than six inches (6”) of elevation difference between the invert in and invert out shall be avoided. If unavoidable, the invert shall have a sloping bench to prevent solids deposition.

4.13 GROUNDWATER BARRIERS

- A. Groundwater barriers shall be installed across the sanitary sewer collection main, ten (10) feet upstream of every manhole, in areas where sanitary sewer collection mains are below groundwater.
- B. Refer to the Standard Drawings and construction specification *Section 02315, Excavation and Fill* for additional information and installation requirements for groundwater barriers.

4.14 SANITARY SEWER MAIN AND SERVICE ENCASEMENTS

- A. Refer to 3.15 of these Criteria and construction specification Section 02445, Casing Pipe – Borings and Encasements for typical sanitary sewer main and service encasement requirements.

4.15 SANITARY SEWER MAIN BORINGS

- A. Refer to 3.16 of these Criteria and construction specification Section 02445, Casing Pipe – Borings and Encasements for sanitary sewer main boring requirements.

4.16 SANITARY SEWER SERVICES

A. General

1. Sanitary sewer service lines shall not be installed in trenches with dry conduits/utilities. A service line shall be separated from other conduits a minimum of five (5) feet horizontally and eighteen inches (18") vertically.
2. Sanitary sewer service lines shall not be installed in trenches with wet conduits/utilities. A service line shall be separated from other conduits a minimum of ten (10) feet horizontally and eighteen inches (18") vertically.
3. Sanitary sewer services for a given lot must be tapped on the sanitary sewer collection main within the confines of the extended property lines. The sanitary sewer service line shall be located a minimum five (5) feet inside the property being served.
4. Sanitary sewer services not utilized shall be abandoned. Refer to appendix section A3 – *Policies Impacting Design and Construction* for abandonment procedures.

B. Sewer Services

1. Sanitary sewer services shall be polyvinyl chloride (PVC) SDR 35 pipe
2. Sanitary sewer services are four inches (4") or six inches (6") in diameter and shall have a minimum slope of 1% (1/8" per foot).
3. The maximum allowable slope for a sanitary sewer service is 8%.
4. If a sanitary sewer service line is required to be greater than six inches (6") in diameter, its design and connection to the existing sanitary sewer system shall be considered as a

collection main. Even though the sanitary sewer service is larger than six inches (6") in diameter, it is still considered private and maintained by the property owner.

5. A separate sanitary sewer service line must serve each structure.
6. No sanitary sewer service lines shall cross property lines.
7. Compound sanitary sewer services shall be avoided where feasible.
8. Sanitary sewer service connections at manholes shall be avoided where feasible.
9. Sanitary sewer services shall be located a minimum ten (10) feet downstream of the potable water service, wherever feasible.
10. Sanitary sewer service connections at manholes shall be avoided where feasible.
11. The sanitary sewer service line shall be electronically locatable and have tracer wire installed per *Section 02534, Sanitary Sewer Service Lines* and Standard Detail Drawings.
12. Tapping new connections to the existing sanitary sewer system shall be completed by City.
13. Sanitary sewer service connections to the sanitary sewer collection main shall be made with a tee or tapping saddle and shall be separated by at least five (5) feet along the

sewer main length, including when connections are on opposite sides of the sanitary sewer collection main.

14. Sanitary sewer service wyes are not allowed on the sanitary sewer collection main except in cul-de-sacs where a manhole or tee connection is not feasible.
15. Sanitary sewer service clean-outs are not permitted in the public right-of-way or sanitary sewer easement.
16. Sanitary sewer service connections to 15", 18" or 21" collection system interceptors or trunk lines are not permitted unless approved by the Water & Sewer Department.

4.17 **SANITARY SEWER MAINS AND SERVICES IN RELATION TO OTHER UTILITIES**

- A. Refer to 3.18 of these Criteria and construction specification Section 02510, Water Utility Distribution Piping for sanitary sewer main and service separation in relation to other utilities requirements.

4.18 **SANITARY SEWER LIFT STATIONS AND FORCE MAINS**

- A. All lift stations with capacities at 2,000 gallons per day (gpd) or greater are subject to Colorado Department of Health and Environment (CDPHE) Regulation 22.
- B. Cost Responsibilities
 1. Design and Construction
 - a. The Developer shall be solely responsible for all costs associated with the design and construction of the lift station and force mains. This includes the cost of any easements, land acquisition, documents associated with permitting approval through CDPHE and North Front Range Water Quality Association (NFRWQPA), and any other cost associated with the project.
 2. Reimbursement
 - a. Where additional service area outside of the proposed development is anticipated, the City of Greeley will require the lift station and associated improvements to provide additional capacity than what is necessary for the initial development. Refer to Section 2.12 of this criteria for additional clarification.
 3. Operations and Maintenance
 - a. Public Facilities: Public lift stations are defined as any lift station serving more than one user and accepted by the Public utility. Operations and maintenance activities shall be the responsibility of the City for all public lift stations only upon completion and acceptance of the proposed improvements. The Developer shall provide an operations and maintenance manual and procedures for all equipment and processes associated with the lift station. The Developer shall coordinate with the City during

the planning and design phases on equipment operations and maintenance requirements.

- b. Private Facilities: Private lift stations are defined as any lift station serving only one user. Operations and maintenance responsibilities for private lift stations are the sole responsibility of the owner or private entity.

C. Planning and Permitting

1. General

- a. Gravity based solutions are preferred to lift stations as it provides the most reliable and lowest cost service for our customers. The use of a lift station and force main shall be evaluated on a case-by-case basis. If there is an appropriate gravity solution, then the developer shall design and construct the proposed improvements meeting the City of Greeley Criteria. Any lift station or force main shall first be approved by the City following proper justification by the Developer. Where a lift station is determined to be required it shall be designed to allow for an eventual connection into a gravity system.
- b. The lift station and force main design shall adhere to state and regional approval processes and the Developer shall keep informed and notify the City of major milestones during the design and approval processes. The Developer shall adhere to the submittal requirements previously stated in Section 2 of these Criteria.

2. Procedures

- a. The Developer shall employ the services of an engineer licensed in Colorado that has successfully designed and permitted at least two lift stations of similar size as proposed, within the State of Colorado. The Developer and the engineer shall adhere to the following procedures through the planning and design phases:
 - i. Coordinate a conceptual project meeting with the City to provide justification for the project and initial design considerations including site location, force main alignments, land acquisition requirements, preliminary design criteria, project schedule, and permitting requirements.
 - ii. Upon initial conceptual acceptance for consideration of the need for a lift station, provide written project justification for the project and design considerations including site location, force main alignments, land acquisition requirements, preliminary design criteria, project schedule, and permitting requirements.
 - iii. Attend follow up meeting following completion of the review of conceptual documents.
 - iv. It is the expectation that the developer keep the City informed of the project's progress from design through construction approval. This includes notifying the City of the major project milestones associated NFRWQPA and CDPHE review and approval process and allowing for City review of major reports and documents. Major milestones include but are not limited to:
 - Site Application submittal to NFRWQPA

- Signed and approved Site Application submitted to CDPHE
 - Basis of Design Report (BDR) submittal to CDPHE
 - Design approval from CDPHE
 - Funding requests
 - Public meetings/outreach
- v. Upon the City’s review and acceptance of the conceptual design, the applicant may proceed with the Lift Station Site Application process in accordance with CDPHE Regulation 22.
- The Site Application shall be submitted to NFRWQPA following review and acceptance by the City
 - Following NFRWQPA and local agencies approval of the Site Application, the applicant shall submit the Site Application and required counterparts in accordance with Regulation 22 to CDPHE for review and approval
- vi. The Lift Station BDR shall be reviewed by the City prior to submitting the BDR to CDPHE for review and approval. The BDR shall include at least a 60 percent design package and shall only be submitted to CDPHE upon City approval of 60 percent design package.
- vii. Prepare and deliver final design plans and technical specifications for the City’s review and approval.
- viii. Applicant shall coordinate with the City through the construction bidding process as necessary.
- ix. Applicant shall coordinate construction inspections with City Inspectors.
- x. Applicant shall submit all construction submittals for review including shop drawings and data and operation and maintenance manuals.
- xi. Applicant shall coordinate with the City for start-up testing and required training.
- xii. Applicant shall submit final record drawings to the City in AutoCAD and pdf format.
3. Colorado Department of Public Health and Environment (CDPHE)
- a. The design and construction of all lift stations and force mains shall adhere to CDPHE’s most recent version of Regulation 22 – Site Location and Design Approval for Domestic Wastewater Treatment Works (The City reserves the right to review all procedures and reports required under Regulation 22 and request revision if necessary. Where CDPHE’s Regulation 22 and the City’s Criteria differ, the more restrictive of the conditions shall apply.
4. North Front Range Water Quality Planning Association (NFRWQPA)
- a. The planning and Site Application process of the proposed lift station and force main shall be in accordance with NFRWQPA wastewater utility plan guidance. The applicant will be required to provide updates to the City’s Wastewater Utility Plan

(WUP) for the proposed lift station and force main as part of the Site Application process.

- b. The process for obtaining lift station approval from the Water Quality Control Division (WQCD) begins with the NFRWQPA (www.nfrwqpa.org). CHPHE *Regulation 22*, latest revision, requires that prior to WQCD final design review and approval, the lift station Site Application must be submitted to the NFRWQPA. Refer to the NFRWQPA website and *Regulation 22* for guidelines and requirements on the lift station site location and design approval process.

5. City of Greeley

- a. The Developer shall coordinate with the following City's departments to ensure all procedures and policies are adhered to.
 - i. Water and Sewer Department
 - ii. Community Development
 - ii-a. Engineering Development Review
 - ii-b. Planning Department
 - ii-c. Building Inspections
 - iii. Other Departments as Required

6. Lift Station Design Criteria

- a. Applicable Codes, Environmental Compliance, and Health and Safety
 - i. Applicable Codes: For work done in the City, work shall be performed in accordance with the codes established by the City's building department.
 - ii. Environmental Compliance: Environmental assessments and/or environmental reviews may be required as a preliminary investigation to determine if a particular parcel of real property is subject to recognized environmental constraints such as, and not limited to the following: floodplain areas, wetlands, endangered species, and hazardous conditions. Should environmental constraints exist as identified above, it is the Developer's responsibility to incorporate mitigation measures to comply with environmental requirements in accordance with applicable and current rules and regulations.
 - iii. Health and Safety: Public lift stations are required to conform to all City and OSHA health and safety requirements. City operation staff safety shall also be considered during the design and construction of the lift station including, but not limited to:
 - Readily accessible equipment placement for maintenance activities
 - Classified areas in accordance with the National Fire Protection Association (NFPA) 820 Regulations
 - Lifting assistance for heavy equipment

- Nonslip floor finishes
 - Handrails
 - First-aid and safety equipment
 - Fall protection
 - Limitation of confined spaces – it is desired by the City to limit confined space entries where possible
- b. Determination of Wastewater Flows
- i. Existing wastewater flows shall be calculated using the calculation methods stated in Section 4.03, 4.04, and 4.05. Should the project area not fit the previously stated design flow estimation methods, applicable and industry-standard calculation methods shall be utilized. Methods include real-time flow monitoring or calculations based on land-use. Methods and calculations shall be included in relevant planning documents and subject to City's review.
 - ii. Proposed and future wastewater flow projections shall be estimated for the build-out conditions of the service area. Estimation methods shall be based on projected land-use. The planning period and projected land-use within the service area shall be coordinated with the City during the planning phases.
 - iii. Organic and other applicable wastewater constituent loadings shall be considered and evaluated based on existing and projected land-use. It is the Developer's responsibility to calculate based on most current available information, flows and constituent loadings for accessing available sewer and wastewater treatment capacities.
- c. Impacts on Downstream Lift Stations or Sewer Capacities
- i. Ultimate peak hour design flows shall be used to determine the impact to downstream collection system infrastructure including treatment facilities, lift stations, and sewers. Existing infrastructure needs to be able to accommodate peak flows and loadings from new lift stations and force mains. The capacity of existing infrastructure to accommodate flows from new lift stations shall be justified to the City as part of the planning and design documents.
- d. Lift Station Capacity
- i. Lift station capacity shall be designed to accommodate existing and future projected peak flows for the entire service area.
 - ii. Hydraulic calculations and system/pump curves require consideration and shall be submitted for review during the planning phases to the City of Greeley and as part of the CDPHE's approval process.
 - iii. Receiving sewers shall be evaluated to ensure adequate capacity to accommodate the ultimate lift station flow.

e. Emergency Storage

- i. The lift station shall be designed for at least 60 minutes of emergency storage at peak hour flow conditions or as required by CDPHE. Emergency storage can utilize volume within the wet well above the high level alarm and upstream collection system piping provided that it is demonstrated that back-up will not occur into any existing or potential future service connections or taps. No future taps shall be constructed within the section of influent sewer or sewers to the lift station designated to provide emergency storage. If a piping connection is required to accommodate emergency storage provisions, the invert of the pipe connecting the wet well to emergency storage shall be above the high level alarm. Additional emergency storage may be required at the discretion of the City based on site location, emergency response time, and potential environmental concerns.
- ii. Emergency storage can be accomplished using an additional storage vault structure. The emergency storage structures shall provide adequate access and floor slope for cleaning and shall be designed with pre-cast concrete, cast-in-place concrete, fiberglass reinforced plastic, or other approved equals. If constructed of concrete, adequate protection (i.e. polymer concrete or concrete admixtures) shall be provided to mitigate corrosion caused by hydrogen sulfide. If used, the emergency storage vault shall be designed to provide flow to and from the wet well to the vault and with adequate access for pumping via vacuum truck or other appropriate method.
- iii. If emergency storage can be accomplished through gravity flow from the lift station to another existing collection system, the City may consider that as an option to meet emergency storage requirements. It shall be demonstrated that the gravity overflow, existing collection system, and downstream facilities be adequately sized to accept increased flow. Additionally, should the collection system be operated by another entity, a legal agreement stating the entity can and shall receive emergency flows shall be coordinated and presented to the City during the design review process.

7. Force Main Design Criteria

a. Materials and Sizing

- i. Force main material shall be AWWA C900-16 with minimum wall thickness of at least DR-25. DR-18 or DR-14 shall be required if pressure or surface loading at any location in the system exceeds the DR-25 pressure rating.
- ii. Force mains shall be minimum 4-inch diameter. Force mains shall be sized appropriately for a minimum fluid velocity of 2 feet per second and maximum velocity of 7.5 feet per second. Sizing shall also conform to CDPHE design requirements, whichever is most limiting. Parallel force mains are strongly preferred by the City for maintenance procedures, emergency conditions, and capacity optimization between existing and build-out flows. If parallel force mains are not considered feasible for a specific installation, it shall be demonstrated that the force main diameter is optimal for existing and build-out flow velocities.

- iii. If force main diameter is such that the wastewater velocity is less than 2 feet per second at initial operating conditions, the design shall include VFDs on the pumps to allow the motors for the pump or pumps to increase frequency to increase the wastewater velocity in the force main to be a minimum of 3 feet per second for a minimum flushing time of 5 minutes. Reference the Electrical and Controls section of this criteria.
- b. Access / Cleaning Stations
 - i. Force main clean-out access shall be provided every 500-feet in situations where the force main is 950-feet or longer. Clean-outs shall provide adequate access to allow for pipeline condition observations via video camera and maintenance.
- c. Protection, Bedding and Compaction
 - i. Pipe bedding and backfill of force mains shall conform to the specifications in Section 02315 of these standards.
- d. Force Main Alignments and Separation
 - i. The minimum buried depth of the force main shall be 48-inches from top of pipe.
 - ii. Wastewater force mains shall adhere to CDPHE and City standards for separation between potable water lines and other utilities. Wastewater force mains shall travel below existing potable water lines meeting the minimum requirements as outlined in Section 4.18. Should minimum separation requirements not be possible, refer to encasement requirements in Section 4.15 of the Criteria.
 - iii. Should the wastewater force main alignment be such that it cannot accommodate these separation requirements vertically or horizontally, provisions shall be provided to safeguard the existing utilities in accordance with the City design criteria and construction standards.
- e. Special Permitting Requirements
 - i. In situations where the force main alignment crosses areas that include wetlands, floodplains, irrigation ditches, railroads, and waterways, the Developer shall be responsible for all permitting during the design phase to ensure that local and state requirements are adhered to. The Developer shall document all required permits with the City prior to proceeding with construction. In all cases, the Developer shall evaluate alternative force main alignments to minimize impact to sensitive areas described herein.
 - ii. Easements required for the force main alignment shall adhere to Section 2.06 of these criteria. All easements required for the force main shall be approved by the City and granted to the City prior to City of Greeley approval of construction documents.

8. Land Acquisition and Easements

- a. All land area requests for the lift station sites shall be submitted and approved by the City prior to starting the land acquisition process. Lift Stations shall be located on property deeded to the City. The minimum size for the lift station site shall allow for adequate equipment access, maintenance activities, and ancillary equipment (i.e. generator, odor control, emergency storage, etc.). In no cases shall the lift station site be less than 2,500 square feet in size. Applicant shall provide preliminary lift station site drawings showing major lift station components, security, buildings, and access for the City to review and determine required site size.
- b. Force main alignments exiting the lift station site up to the point of gravity connection shall be contained within an sewer easement and shall be dedicated to the City per Section 2.06 of this criteria.

D. Lift Station Site

1. Location and Topography

- a. The lift station and site location shall be designed and constructed to limit disturbance to the surrounding properties both aesthetically and during construction activities. The site shall allow adequate access to the site from existing public right of way. The lift station site shall be designed to provide adequate drainage away from the lift station and building and conform to City standards for drainage and storm water management plans. Developer shall perform a geotechnical evaluation of the site to determine soil conditions and hydrology as well as recommendations for lift station construction. Lift station sites shall be located outside of the FEMA 100-year floodplain with the finished floor elevation of the lift station a minimum of 2-feet above the floodplain. All lift station site locations are subject to review and approval by the City and CDPHE Regulation 22.

2. Lift Station Building / Enclosure

- a. The lift station shall be enclosed in a weatherproof structure. The lift station enclosure and lift station pumping components as a minimum shall be accessible without permitting for confined space access. As a minimum the lift station enclosure shall be ventilated and heated and conform to the City's planning and building department requirements and applicable structural and building codes. The size of the building or enclosure shall allow for adequate clearance to maintain pumping equipment, piping, valves, electrical gear and controls. The minimum spacing between pumps shall be 30 inches, spacing around pumps of 36 inches, and electrical panel clearance shall be no less than 48 inches or as required by the National Electrical Code. Building or enclosure entry ways, hatches and overhead doors shall allow for convenient access and equipment removal for maintenance and replacement. All lift station enclosures or buildings must be approved by the City

and applicable architectural committees that are associated with the subdivision or local association.

3. Aesthetics

- a. The lift station shall be subject to the City's Development Review process and applicable development standards. The lift station architecture and aesthetics shall be designed to match the surrounding structures. Landscaping shall be considered and planned to match the surrounding environment with low maintenance and water use. Appropriate screening and other methods shall be utilized to minimize noise and visual impacts.

4. Access

- a. All wastewater lift stations shall be sited to allow access by all-weather surface roads capable of accommodating maintenance trucks from public right of way to the lift station site. The access shall at a minimum support HS-20 loading with a minimum width of 15 feet. The access points and site shall be designed to allow WB-50 trucks to maneuver within the site and exit the site without backing into public right of way. The site layout shall allow for access to the wet well and vacuum/jetter truck to clean out accumulated material in the wet well. All hard or concrete surfaces shall be designed for the expected vehicle and equipment loads.

5. Security Fencing

- a. The lift station site shall contain perimeter security fencing minimum 6' in height. The fencing is subject to the City of Greeley Municipal Code and shall be reviewed and approved by the City.
- b. The lift station site access gate shall have a minimum size full width opening of 18-feet and of lockable type.

6. Lighting

- a. Lighting shall be provided at the lift station site to allow for necessary activities during night and times of low visibility. The lighting system shall be designed to provide illumination best suited for the station layout which may include suspended, wall, or ceiling mounted fixtures and shall be suitable for routine maintenance activities and inspections. Site lighting equipped with photocells shall not be

allowed. Refer to Chapter 18 of Greeley Municipal Code for more information, as applicable.

7. Potable Water

- a. The site shall have access to potable water. Potable water connection, service size, backflow device and meter shall be coordinated with the City. At a minimum, there shall be a frost proof yard hydrant located in the vicinity of the wet well.

E. Lift Station Components

1. Pumping System

- a. Each Lift Station shall have a minimum of 2 pumps. The pumps shall be designed to accommodate existing flows and future flows from fully developed contributing area. Firm capacity of the pump system shall be designed (or phased) to pump ultimate peak flow at maximum computed total dynamic head. Pump operation shall be automatic but fitted with the capability to run the system in manual control.
- b. Lift Stations shall be designed as a duplex system as a minimum. Duplex system for ultimate flow of the service area, shall be designed so that each pump is sized for peak hourly flow. The applicant shall provide a spare pump of the same capacity. Lift stations serving service areas that are phased over several years shall be designed initially as a duplex system as a minimum with room to add additional pumps for meeting the ultimate flow demands of the service area. Lift stations that are designed with more than two pumps shall be capable of pumping peak hourly flows with the largest pump out of service. The applicant shall provide a spare pump matching the size of the largest pump in service.
- c. In all cases pumping systems shall be designed to accommodate existing and build-out flows with adequate redundancy as defined by CDPHE Regulation 22 and in these criteria. If future build-out conditions require pumps (greater than 2) that are not needed for near term flow conditions, the lift station shall be designed to add additional pumps, piping, valves, electrical and controls without the need for a major system shutdown and / or bypass pumping.
- d. Pumping system shall be designed to allow for adequate access between other pumps, piping, and ancillary equipment for maintenance activities including, but not limited to, routine maintenance and inspection and pump removal.
- e. Required Pumping System Type: Above Ground Mounted Self-priming Suction

The pumping system is self-priming suction pumps placed on grade with minimal piping to suction from the wet well. The only accepted manufacturer for the pumping system is Gorman Rupp. Pumping systems shall be site-specific designs or pre-packaged systems meeting site requirements. All designs are contingent upon review and approval by the City.

f. Alternate Pumping System

If the Developer, with approval from the City, determines above ground mounted self-priming suction pumps are insufficient for the application, the Developer can seek a variance to utilize either wet well / dry well or submersible pump configurations. The Developer must adequately prove that the alternative pump configuration is the optimal choice for the application and include evaluations between both dry-pit and submersible configurations.

- i. Submersible Pumps: Where above ground mounted self-priming suction pumps are insufficient, City of Greeley will only consider submersible pumps where the ultimate build out peak hour flow rate is less than 100 gallons per minute. Where submersible pumps are approved by City of Greeley, the pumps must be removable without entering the wet well by providing rail and crane system. Control Panels and associated equipment shall be located within an enclosure of adequate size. The Developer shall provide two spare pumps to the City of Greeley.
- ii. Wet Well/Dry Well: Where above ground skid mounted self-priming suction pumps are insufficient and flow rate is greater than 100 gallons per minute during peak hour flow at full build out, the lift station shall be configured to provide separate wet wells and dry wells. Common walls between wet wells and dry wells shall be water and gas tight. Suitable and safe means of access shall be provided to the dry well for operations staff, maintenance, and removal of all equipment from the dry well. Access shall include separate equipment and access hatches. Access to the dry well shall be provided through stairs. Ladder access is not allowed. Where dry wells are considered, the lift station shall be designed to ensure that surface runoff cannot enter the lift station. Where groundwater may exist above the dry well, adequate measures shall be provided to prevent infiltration of groundwater into the dry well and wet well.

g. Pumping System Components

- i. Each pump shall have a dedicated check valve, plug valve, and air-relief valve on the discharge side of the pump. Pressure gauges shall be provided on both the suction and discharge (prior to the check valve) side of the pump. Pressure gauges shall be provided with a pulsation snubber constructed of 316 stainless steel and an isolation valve. It is preferred that these pump system components are supplied by the pump manufacturer if supplied as a skid-type system to ensure compatibility, performance, and single point of supply.

h. Hydraulics

- i. Pumps shall be designed to accommodate existing and future flows. Pump design calculations shall be included in the design reports and subject to City review. Hydraulic calculations shall include pipe friction losses using appropriate friction coefficients and minor friction losses. Net positive suction head available ($NPSH_A$) and net positive suction head required ($NPSH_R$) shall be considered to ensure pump cavitation will not occur. Control descriptions for the pumps shall consider water levels required to maintain adequate $NPSH_A$ and $NPSH_R$.

2. Station Piping

a. Material and sizing

- i. Station piping shall be 316 stainless steel or ductile iron pipe and sized to accommodate the necessary flow ranges. Flanged header pipe shall be ductile iron complying with ANSI/AWWA A21.51/C115 and Class 53 thickness. Flanges shall be ductile iron class 150, or as required by pumping application and pressures, and comply with ANSI B16.1. Generally, the liquid velocity in the station piping shall be no less than 3 feet per second and no greater than 7 feet per second.
- ii. All ductile iron piping shall be glass lined in accordance with ASTM B1000, use pipe suitable for glass lining with minimum Class 53 thickness.

b. Expansion Joints/Victaulic Coupling

- i. Station piping shall include expansion joints, flanged coupling adaptors and/or grooved couplings to allow for dismantling of station piping for maintenance and parts replacement.

3. Grinders

- a. Grinders may be required, which the City will determine on a case by case basis, depending on expected flows and loading.
 - i. Grinders shall be in-line only.
 - ii. Accepted manufacturers are Franklin-Miller or approved equal.
 - iii. All grinders are contingent upon review and approval by the City.

4. Valves

a. Plug Valves

- i. Isolation valves shall be eccentric non-lubricated plug valves. Each pump discharge shall have a dedicated isolation valve so that each pump can be isolated from the common discharge header. Plug valves shall be of cast iron body, ASTM A126 Class B. Valve plugs shall be cast iron ASTM A126 Class B covered with a Buna-N Rubber compound. The seats are to be a corrosion resistant alloy either 316 stainless steel or nickel. Valve body shall be semi steel with flanged end connections drilled to 150 pounds, or higher as required by application pressures. Valve shall be operated with a single lever actuator providing lift, turn, and reseal action. The lever shall be equipped with a locking device to hold the plug in the desired position. Valves shall be able to pass a spherical solids not less than 3 inches diameter. Accepted manufacturers include DeZurik, Valvmatic, Milliken.

- b. Check Valves (4" or more in diameter)
 - i. Check valves shall be swing check valves capable of passing a 3-inch spherical solid. Check valves shall meet the latest AWWA C508 standard and be of the resilient hinge check valve type. All internal hardware shall be stainless steel. Valve shall be equipped with flanged ends and be fitted with an external lever and spring. Valves shall be equipped with removable cover plate to permit entry or for complete removal of internal components without removing the valve from the line. Valve shall be rated at 175 PSI water working pressure, 350 PSI hydrostatic test pressure. For high pumping head applications (150 feet or greater), the Developer shall submit a type of check valve that will minimize hydraulic surges or slam to the system. Each pump discharge shall have a dedicated check valve. Accepted manufacturers include Val-matic, DeZurik, Victaulic, Golden Anderson.
 - c. Combination Air and Vacuum Valves
 - i. Sewage rated combination air and vacuum valves shall be placed at the discharge of pumps as close to the check valve as possible and at any local high points in the station piping. Route discharge line to sump. Accepted manufacturers include Val-matic and Golden Anderson.
5. Bypass Pumping Assembly
- a. Lift Station Out of Service
 - i. A bypass pumping configuration shall be designed to bypass the lift station should it ever need to be taken offline. The bypass pumping configuration shall include provisions to bypass the entire lift station as well as lift station components including the wet well and pumping equipment and station piping. Bypass connections shall also be included on the common discharge header to the lift station pumps (station piping) as well as the force main (site piping) along with isolation valves. All bypass connections shall be at a minimum 6" camlock.
 - b. Approach Manhole
 - i. An approach manhole shall be constructed upstream of the wet well within the lift station site boundaries. The approach manhole shall serve as a common connection for the gravity sewer or sewers feeding the pump station and shall connect to the wet well by a single gravity pipe.
 - c. Wet well
 - i. Lift Station wet wells shall be Polymer Concrete or concrete with Xypex Bio-San C500 admixture to prevent corrosion on the interior surfaces caused by concentrated levels of H₂S and other corrosive properties of raw wastewater.
 - ii. All wet well penetrations shall be link sealed and grouted to prohibit any leakage from the wet well or groundwater infiltration.

- d. Coatings and Paintings
 - i. All exposed carbon steel or ductile iron surfaces, piping and equipment shall have field-applied protective painting or coating except where material (i.e. PVC, stainless steel, hot-dipped galvanized or aluminum) or factory coating warrants exception. All paint and coatings systems shall be approved by the City and shall adhere to City standards for color coding.
6. Electrical and Controls
- a. Arc Flash
 - i. Study
 - i-a. Provide arc flash study on the electrical equipment per NFPA 70E.
 - ii. Labeling
 - ii-a. Provide labeling per NFPA 70E.
 - b. Electrical Equipment
 - i. All electrical control panels with controls and wiring shall be built in accordance with NEC, UL, NFPA 70E, NFPA 820 and ETL standards. The electrical components and enclosure shall be labeled as a complete UL listed assembly with manufacturer's UL label applied to the door. Developer shall coordinate with City Building Department on applicable codes.
 - ii. Developer shall coordinate with the City for electrical utility providing electrical service. Station shall be provided with a separate utility transformer and meter/main with ground fault protection. Primary power to the station shall be 480-volt, 60 Hz, 3-phase service per utility provider standards. Developer is required to pay permitting, design, and costs for primary power to the lift station site. Secondary power service shall be designed by a certified electrical engineer licensed in the State of Colorado. As a minimum, the station shall include service disconnect panel, automatic transfer switch (ATS), motor control center (MCC) or electrical distribution panel. The service disconnect panel shall be mounted on the exterior face of the lift station building common wall to the indoor electrical switch gear.
 - iii. The ATS shall be provided to switch from normal utility power to standby emergency power upon power outage and switch back to normal power once the power outage is restored. The ATS shall have indicating lights for normal power, emergency power, and a digital panel indicating volts and amps. The ATS shall be mounted inside the lift station building integral to the MCC. The ATS manufacturer shall be compatible and approved by the accepted lift station pump manufacturer, Gorman Rupp. The City's standard for standby emergency power is natural gas-powered engine generators manufactured and provided with the lift station pumps manufacturer, Gorman Rupp. If the lift station pumps are provided by a manufacturer other than Gorman Rupp, the Developer shall

provide the ATS and standby emergency power generator specifications and manufacturer for City review and approval.

- iv. Electrical switchgear (480 volt) shall be mounted in a NEMA 1 MCC with removable buckets within a NEMA 3R wrapper. A step-down transformer shall be included to provide power service to a separate light or power panel rated for 120 / 240-volt service. The light or power panel is required to provide service for interior and exterior lighting, receptacles, ventilation and controls. Switchgear shall be manufactured by Cutler-Hammer, Allen Bradley, Square "D", or approved equal by the City.
 - v. Transient voltage suppression rated at 80 KA minimum shall be provided at the main electrical service panel and shall be installed in accordance with the latest requirements of NEC Article 285.
 - vi. Wiring to any instrumentation shall be multi-conductor shielded cable suitable for Class 2 low voltage controls. Must use Black and red wiring in cable for all class 2 low voltage controls.
 - vii. All wiring that that is running from VFD to motor shall be VFD rated cabling if shared with other VFDs.
 - viii. All wiring from control panels to motors shall be in liquid-tight conduit with copper conductors rated not less than 600 volts AC. All wiring shall follow NEC code and local code.
- c. VFDs and Soft Start and Stop
- i. All motor sizes greater than 20 HP shall be equipped with a reduced voltage solid state start and stop or also known as soft start and stop. The use of variable frequency drives (VFD) for the lift station pumps shall be evaluated on a case-by-case basis. The Developer will be required to demonstrate the advantages for installing VFDs for the ranges of pumped flows. The soft start / stop device and / or VFD shall be mounted adjacent to the MCC. Accepted manufacturers for the soft start / stop and VFD equipment shall be Allen-Bradley, Eaton or Mitsubishi.
- d. Level Controls
- i. The primary level control system used for the lift station to turn pumps on and off and sequence lead and lag operations shall consist of the radar level measurement type. The primary level control system shall have a minimum of five differential level set points including low liquid level, start / stop lead pump, start / stop lag pump, start / stop standby pump (if required), and high water level. The level control shall be equipped with a transmitter device and user interface screen for user set points and display of liquid level in the wet well. Contacts shall be provided for selected alarm outputs for integrating into the SCADA and telemetry system. Accepted manufacturers for level control shall be Endress Hauser or a manufacturer approved by the City.
 - ii. In addition to the primary level control system, the lift station shall be equipped with a secondary level control system for back-up. The secondary level control

shall consist of electro-mechanical float switches for low water cut-off, pump on / off, and high-water alarm. Accepted manufacturers for float switches shall be Siemens Water Technologies Model 9G-EF or approved equal.

- iii. The secondary level control system would be based on a PID loop and use wet well levels to modulate the VFD speed.
 - e. Lift Station Control Systems
 - i. Controls shall provide automatic reset of alarm conditions for normal power fail, high water level, standby pump run, and a common alarm contact. However, alarm conditions shall activate an alarm light that is mounted at the roof line of the lift station building or enclosure. Any pump alarm conditions shall require manual reset and SCADA reset. All lift station alarm outputs shall be transmitted via telemetry system to on-call City operation staff and master SCADA control center.
 - ii. The lift station PLC shall be an Allen Bradley CompactLogix 5069-L320ER. Alternative PLC's must be approved by the City.
7. Control Panel
- a. Each control panel shall contain adequate surge protective devices.
 - b. The PLC control panel shall be sized to adequately contain all PLC and communication equipment and rated for NEMA 4X/12 enclosure.
8. Human Machine Interface (HMI)
- a. Redlion G15C1100
 - b. HMI program shall be unlocked and copy of program given to City of Greeley I&C department after commissioning of Control Panel.
9. PLC (Programmable Logic Controller)
- a. Allen Bradley Studio 5000 Platform
 - b. Compactlogix or Controllogix Series
 - c. IO check to be done after completion of control panel being installed.
 - d. Each PLC shall have a minimum of a 2-hour uninterrupted power supply (UPS).
 - e. Program shall be unlocked and copy of program given to City of Greeley I&C department after commissioning of PLC.
10. Instrumentation
- a. Vibration Sensor must be provided on each motor.
 - i. Acceptable Manufacturer

- i-a. Allen Bradley
 - i-b. Banner
 - b. Radar
 - i. Must install one radar to read the level of the wetwell and also backup floats
 - ii. Only acceptable manufacturer is Endress Hauser
 - c. Backup Floats
 - i. Must be approved by the City.
 - d. Discharge Flow Meters
 - i. Acceptable Flow Meter Manufacturers
 - i-a. Endress Hauser
 - i-b. Rosemount
 - i-c. Must have an approved vendor do a start up on the flow meter.
 - ii. Communication
 - ii-a. Ethernet IP
 - ii-b. Modbus TCP
 - iii. Flow totals must come from the meter and not be calculated in the PLC.
 - iv. The flow meter shall be fitted with grounding rings as required with 150 pound flanged connections.
 - b. Upstream Flow Meters
 - i. Acceptable Flow Meter Manufacturers
 - i-a. ISCO or approved equal
 - i-b. It will need to have a Tienet box in the manhole.
 - i-c. Must have an approved vendor do a start up on the flow meter.
 - i-d. Manufacture: Isco Tienet 360 LaserFlow. Signature Laser flow meter transmitter.
 - ii. Communication
 - ii-a. Ethernet IP
 - ii-b. Modbus RTU
11. Programming

- a. Alarms
 - i. Contact City of Greeley I&C Department for list.
- b. Trending
 - i. All analog signals
- c. PLC (Programmable Logic Controller)
 - i. Communication
 - i-a. PLC to PLC messaging must be done through Ethernet.
 - i-b. PLC to VFD communication must be done through Ethernet.
- d. HMI/SCADA
 - i. Status Colors
 - ii. Motor Status
 - ii-a. Green - Running in Auto
 - ii-b. Red – Off
 - ii-c. Yellow – Running in Hand or Manual
 - ii-d. Red flashing - Faulted
- e. Back-up Power Supply
 - i. Back-up power shall be supplied at the lift station to power the pumps and ancillary equipment in the event of a power outage. The back-up power system shall be natural gas powered. The Gorman Rupp standby engine system is preferred, and the Developer shall determine if that system is suitable for the application. Other back-up power systems will be considered if application is not suitable for the Gorman Rupp system. If not provided by Gorman Rupp, alternate back-up power system will be evaluated and approved by the City on a case-by-case basis. The City's preference for alternate back-up power systems is Cummins for both the generator and ATS.
- f. Telemetry and SCADA
 - i. The Remote Telemetry Unit (RTU) shall communicate by way of Ethernet or Allen Bradley Ethernet. Use approved City of Greeley radio system. Programming of SCADA system must be done by an approved and qualified contractor.
 - ii. Provide 40-foot pole for SCADA radio, which can be integrated into light pole.
 - iii. Required Data and Inputs in SCADA

- iii-a. Intrusion alarm
- iii-b. Wetwell Level - Floats
- iii-c. Wetwell Level - Radar
- iii-d. Wetwell Low Level activated
- iii-e. Wetwell High Level activated
- iii-f. VFD Running Amps from VFD or Softstart
- iii-g. Flow (gpm)
- iii-h. Flow Totalization - must be the totalizer from flow meter
- iii-i. Flow total from yesterday
- iii-j. Pump motor status
- iii-k. Softstart or VFD status “Faulted”
- iii-l. Softstart or VFD status on/off
- iii-m. Power Fail
- iii-n. Amperage for each pump
- iii-o. VFD status on/off
- iii-p. VFD speed (Hz)
- iii-q. VFD Reference
- iii-r. Station common alarm
- iii-s. Generator Running
- iii-t. Generator Switch in Normal or Emergency
- iii-u. Generator common alarm
- iii-v. Runtime for each pump
- iii-w. Pump starts
- iii-x. Control Panel Temperature
- iii-y. Pump Selector Switches status
- iii-z. H2S Monitoring System in wetwell or discharge manhole

- iii-aa. Calculated Inflow (gpm)
- iii-bb. Flood Alarm
- iii-cc. Phase Monitor power status
- iii-dd. Generator battery voltage
- iii-ee. Vibration sensors on motors
- iii-ff. Building or Vault temperature
- g. Alternate Communication
 - i. Provide an option to install fiber from Lift Station to closest City of Greeley fiber pull box.
 - ii. Must use a City of Greeley approved vendor.
- h. H2S Monitoring Systems in Wet well or discharge manhole
 - i. The City may require that the Developer design and install H2S monitoring and mitigation in the manhole the force main discharges into. Factors that may require H2S monitoring in the manhole include pump flow, force main length and location of the discharge manhole.

12. Mechanical

- a. Ventilation
 - i. Adequate ventilation shall be designed in buildings and vaults as required and adhere to all applicable State, NFPA, and OSHA requirements. Ventilating system shall consist of electric or natural gas make-up air units sized to provide a minimum of 6 air changes per hour and shall automatically begin operation upon user selected indoor temperature settings for both summer and winter modes. Supplemental cooling and heating will be required if building temperatures exceed 85 degrees Fahrenheit (F) or fall below 55 degrees F. Ventilation shall be accomplished by the introduction of fresh air in the station and be filtered to remove debris and minimize particles. Ventilation fans shall automatically come on upon entry of the lift station enclosure or building or activated by the light switch adjacent to the entry door.
 - ii. In addition to the make-up air ventilation system, supplemental heat shall be required using electric or natural gas unit heaters to maintain a minimum temperature of 55 degrees F. Unit heaters shall be automatically controlled thermostatically. Heating systems shall be designed based on an outside ambient temperature of negative 20 degrees F.
- b. Air Conditioning
 - i. Air conditioning shall be provided if ventilation system cannot ensure inside air temperate of below 85 degrees F within a reasonable time period of ventilating.

Cooling systems shall be designed based on an outside ambient temperature of 105 degrees F.

- c. Drains
- iii. Lift station enclosures or buildings shall contain no floor drains that connect to the wet well. The enclosure at the level the pumps are located shall include a trench drain which slopes to a sump pit equipped with a duplex submersible sump pump system controlled with weighted float level switches. The sump pump system shall discharge to the top of the wet well with an air gap. The pump system shall be sized based on expected drain flows such as air release valves, maintenance, etc. Each sump pump discharge shall contain a check valve and isolation valve along with a pump removal system. The sump pump system shall be connected to the back-up or emergency power system.
 - iv. Pumps shall be equipped with drains that flow via gravity to the wet well for evacuating wastewater during maintenance.
 - v. The lift station site shall be equipped with a perimeter drain if recommended from the geotechnical study.

13. Odor Control and H₂S Generation

- a. The lift station shall be evaluated for the odor mitigation system and final determination of implementing odor control measures will be reviewed and determined by the City. Supporting data, calculations, or assumptions for hydrogen sulfide generation based on estimated wastewater characteristics and industry standards shall be included in the evaluation. In the absence of supporting data and / or calculations, the Developer shall utilize the latest edition of "Metcalf and Eddy Wastewater Engineering Treatment and Resource Recovery" for medium strength sulfide concentrations in wastewater. Other factors to consider in the evaluation include but are not limited to:
 - Proximity to and use of neighboring properties
 - Wastewater composition (BOD₅, COD, TSS, Sulfides, TKN, Ammonia-N)
 - Wind direction and downwind properties
 - Operation and maintenance requirements of odor control system
- b. If odor control is determined necessary, the type of system shall be selected based on the site-specific needs of the lift station. All ancillary equipment and necessary provisions shall be incorporated into the design of the lift station to provide a functional system. Odor control systems may include but are not limited to the following mitigation technologies:
 - Carbon absorption systems
 - Biological scrubber or filter
 - Chemical scrubber

- c. If odor control is not required, provisions for future addition of odor control facilities (i.e., installation of ventilation ducts and penetration into the wet well for future connections) shall be provided.

14. Force Main Components

a. Connection to Existing Gravity Sewer and Discharge Manhole

- i. Force mains shall connect to a gravity wastewater system at a manhole, or a structure designed to receive pumped wastewater. At a minimum the discharge manhole and the next two downstream manholes shall be polymer concrete, concrete with Xypex Bio-San C500 admixture, or approved HDPE manhole liner systems. The force main discharge shall be designed to minimize turbulence and scour within the connecting structure. The City will determine on a case by case whether odor control is required at the receiving structure.

b. Isolation Valves

- i. It is desired by the City to design the force main to limit required valves along the force main alignment. High points and low points shall be minimized along the pipe alignment.
- ii. If required, isolation valves shall be plug valve type. All direct buried plug valves shall normally remain open (with exception of bypass connection and isolation valves) and be installed with a valve box and lid. Accepted manufacturers include DeZurik, Valvmatic, Milliken

c. Air and Vacuum Relief Valves

- i. High points and low points shall be minimized along the pipe alignment.
- ii. Air relief valves shall be provided on ultimate and local high points throughout the force main alignments. All air relief valves shall be located in an access manhole or vault appropriately sized for the application and maintenance staff access. Air and vacuum relief valves shall be minimized along the pipe alignment and must be approved by City.

d. Fittings

- i. Piping shall be PVC or ductile iron and sized to match the force main size.
 - i-a. PVC force main material shall be in accordance with AWWA C900-16 with minimum wall thickness of at least DR-25. DR-18 or DR-14 shall be required if pressure or surface loading at any location in the system exceeds the DR-25 pressure rating.
 - i-b. All ductile iron piping shall be glass lined in accordance with ASTM B1000, use pipe suitable for glass lining with minimum Class 53 thickness.

15. Testing and Start-up

a. Lift Stations

- i. The Developer shall develop a plan to test and demonstrate successful and flawless performance of all equipment and components of the lift station in manual and automatic mode. The start-up and testing plan shall be submitted to the City for review prior to commencing the start-up. A factory representative for the pumps and controls and City I&C and Operations representatives shall be on site for the start-up operations.

b. Force Mains

- i. Force mains shall undergo hydrostatic pressure testing for at least two hours at two times the working pressure. Test results shall be documented and demonstrate holding pressure within the criteria and specifications described in the City's Design Criteria and Construction Specifications (see Section 01713 Water Distribution System Testing for requirements).

16. Operation and Maintenance Procedures and Warranties

a. Operations and Maintenance

- i. The Developer shall supply the Water and Sewer Department with two (2) complete sets of operation and maintenance instructions, shop drawings, and pump curves. An electronic set on a thumb drive shall also be submitted. Developer and/or manufacturer shall provide one half day training on operations of the lift station for City Staff.
- ii. Operation and maintenance instructions shall be specific to the equipment installed. All non-relevant reference material shall be removed or clearly crossed out using heavy red line.
- iii. All emergency power generation equipment shall have operation and maintenance instructions. Must provide training for operations and maintenance staff. Contractors to verify that generator alarms work in SCADA.

b. Warranties

- i. A two (2) year warranty shall be provided for the lift station system including performance, materials, and installation.
- ii. The date of substantial completion shall be specifically determined, in writing, for the lift station system.
- iii. Any warranties associated with the lift station shall be transferred to the City after final acceptance and construction is complete.

17. Standard Details
 - a. Flow Schematic
 - b. Below Grade Lift Station
 - c. Above Grade Lift Station
 - d. Bypass Pumping Detail

SECTION 5

NON-POTABLE IRRIGATION SYSTEM DESIGN CRITERIA

5.01 GENERAL

The City of Greeley (City) uses non-potable (untreated) water to irrigate both public and private property throughout the City. The City has a network of irrigation ditches for supplying source water for irrigation purposes. The typical irrigation system arrangement is a “hub-and-spoke” layout where irrigation water is diverted from an irrigation ditch to an irrigation water storage pond and then pumped to the distribution system to provide sufficient pressure and capacity to serve many customers. Another arrangement specifically for a small irrigation system is a direct connection between the ditch and pump station excluding the storage pond. The goal of the City is to expand the non-potable water system and reduce the use of potable water for irrigation purposes and improve irrigation practices, which is key to the City’s long-term water conservation plan.

The purpose of this section is to provide information for the design and configuration of a non-potable irrigation system. Non-potable irrigation system design shall align with the City of Greeley’s *Non-Potable Water Master Plan* (Master Plan), latest revision. The City of Greeley Water and Sewer Director reserves the right to make final determinations of the system design based on the best interest of the City’s system. Refer to standard detail drawings for additional design information.

This section is not intended to be inclusive of all situations and the Design Engineer may be required to use additional engineering judgment to meet the overall design intent for constructability and long-term operations and maintenance.

The Design Engineer shall meet with Engineering Development Review (EDR) and Water and Sewer (W&S) Departments to discuss how new developments fit into the City’s overall Non-Potable Water Master Plan to provide non-potable irrigation service at acceptable pressures in both new and existing areas.

The Master Plan shows proposed service area boundaries and conversion areas. These service area boundaries are subject to change during the planning phase based on property boundaries, non-potable water supplies, planned conversion areas, existing system capacities, and other factors. Final service area boundaries shall be determined by the Water & Sewer Department.

The City has the right to oversize the irrigation system to serve customers outside the development’s improvements limits. The City will reimburse the developer for oversizing based on Section 2.12 of these Criteria.

The Design Engineer shall also meet with the ditch company from where the raw water is being diverted. The City will assist in coordinating the meeting and have a City representative present. The purpose of this meeting is to discuss the diversion requirements such as check structures,

head gates, and flow measurement, and determine if there is sufficient capacity within the ditch to serve the new Non-potable Irrigation System.

The non-potable irrigation storage pond and pump station facility shall be located on property deeded to the City. The raw water supply line and its appurtenances between the water source (i.e. ditch) and the storage pond shall be within a utility easement dedicated to the City.

The Design Engineer shall provide supporting calculations, design methodologies, and references documentation used to establish the design parameters. All information shall be included in the Non-Potable Irrigation System Design Report. Refer to Section 2.08 of these Criteria for Non-Potable Irrigation System Design Report requirements and formatting.

The Non-Potable Irrigation System Design Report shall be stamped and certified by a Professional Engineer registered in the state of Colorado. The design report shall verify that the proposed non-potable irrigation system can provide the required irrigation demands for the service area, at an acceptable pressure, and meet the overall non-potable irrigation system design requirements set forth in these Criteria.

The City of Greeley Water and Sewer Director reserves the right to make final determinations of the system design based on the best interest of the City's system.

5.02 DEFINITIONS

- A. Non-potable Irrigation System – The non-potable irrigation system consists of (1) ditch headgate and appurtenances to divert flows, (2) raw water supply line and appurtenances between the water source and storage pond, (3) storage pond, (4) pump station facility, and (5) distribution mains and appurtenances.
- B. Non-potable Irrigation Main - A pressurized pipeline that conveys non-potable water to individual non-potable irrigation services.
- C. Non-potable Irrigation Services – Non-potable irrigation services include all piping, fittings, and appurtenances used to convey non-potable water from the irrigation main to the consumer.
- D. Air Gap – A method of backflow prevention defined as the unobstructed, physical distance of two (2) feet minimum of free atmosphere between the discharge point of a potable water supply line and the highest level of the irrigation storage pond or the FEMA 100-year floodplain, whichever is greater.
- E. Reduced Pressure Zone (RPZ) Backflow Preventer – A device that can be connected to a potable water system to supply water to a non-potable water system and protect the potable

water system from backflow contamination. The device consists of two check valves with a pressure vacuum breaker in the middle. This device can be used in lieu of an Air Gap.

- F. Shoulder month/season – The periods in early spring and late fall where non-potable customers require some irrigation water, but the agricultural ditches are not operational, occasionally resulting in the non-potable water system being supplied by potable water.
- G. Shoulder tap – A connection from the potable water distribution system to the non-potable water system to provide water for irrigation purposes during the early spring and late fall shoulder months.
- H. Service Area – The general geographic area that is served by or expected to be served by an individual non-potable irrigation supply system.
- I. Conversion Area – A previously developed parcel that is currently irrigated by potable water but may consider switching to non-potable irrigation in the future; the amount of irrigated area for this type of customer is typically known.

5.03 DESIGN FLOW

- A. The non-potable irrigation system shall be designed to transport peak season irrigation demands in accordance with these Criteria.
- B. All irrigation demands used in the design of non-potable irrigation systems are subject to approval by the City.
- C. Pump Station Design Capacity
 - 1. The non-potable irrigation demand criteria presented below are the minimum criteria and the City reserves the right to modify the criteria, at any time, for the design of specific projects. The non-potable irrigation application rates includes provisions for evapotranspiration and operational efficiency losses in the non-potable irrigation system.
 - 2. The City's goal is to minimize the size of the pump station by having a balanced system. A balanced system is where half the irrigable areas within a service area are being irrigated on any given irrigation day. Refer to Section 6 *Landscape Irrigation Criteria* for additional information regarding irrigating operational requirements.
 - a. Weekly Irrigation Application Rates:
 - i. Bluegrass turf, arborvitae, willows = 1.9 inches/week
 - ii. Tall Fescue, columbine, potentilla purple coneflower = 1.6 inches/week
 - iii. Buffalograss turf, sedums, succulents, iris, penstemon = 0.9 inches/week
 - iv. Native grasses, yarrow, rabbitbrush = 0.2 inches/week

- b. Daily Watering Window = 8 hours
 - c. Irrigation Days/Week = 6 days (Monday through Saturday)
 - i. Single family residential may irrigate up to three (3) days per week on their assigned days.
 - ii. All other areas including, but not limited to civic and open spaces, common areas for all customer classes, right-of-ways, municipal buildings, multi-family residential, and non-residential areas may irrigate 6 days per week (Monday through Saturday) with half of the area being irrigated on any given irrigation day.
3. Sizing the design capacity of a pump station shall be based on the following equation:

$$\sum Q_{i,ii,iii,iv} = \frac{a}{b} \times \frac{c}{d} \times \frac{e}{f \times g}$$

Where:

Q = Pump Station Design Capacity (gpm)

a = Irrigation Application Rate (inches/week)

b = Number of Irrigation Days per Week (days/week)

c = Total Irrigable Area (acres)

d = 12 inches/foot (conversion factor)

e = 325,829 gallons/acre-foot (conversion factor)

f = Daily Watering Window (hours/day)

g = 60 minutes/hour (conversion factor)

5.04 HYDRAULIC DESIGN

A. Raw Water Supply Pipe

1. The design flow shall be based on the time it takes to replace two (2) full days' worth of storage over a 24 hour period.
2. Pipe size shall be computed by Manning's Equation up to a maximum 80% full and friction coefficient of 0.015, but shall not be less than 12-inches in diameter.

B. Pump Station Intake Pipe

1. The design flow shall be based on the Pump Station Design Capacity.
2. Pipe diameter shall be based on a maximum velocity of 1.0 feet per second (fps) when the pipe is flowing full, but shall not be less than 24-inches in diameter.

3. The intake pipe shall be equipped with a passive intake screen. Refer to 5.21 of these Criteria for additional information.

C. Distribution System

1. Distribution System Pressure

- a. For new developments with no conversion areas within the non-potable pump station's service area, the non-potable irrigation pump station and distribution system within the service area shall be designed for a maximum pressure of 125 psi and a working pressure range of 70 - 100 psi at high points and the furthest service point of application.
- b. For new developments that include conversion areas within the service area, the Design Engineer shall consider potable water system pressures based on fire hydrant static pressures provided by the City when sizing the pump station and distribution system. Static pressures that exceed 90 psi shall be brought to the W&S Department's attention.

2. Friction Coefficient

- a. Non-potable irrigation lines shall be designed using a Hazen-Williams friction coefficient "C" equal to 120.

3. Velocity

- a. All pipes shall be sized for maximum water velocity of no greater than five (5) feet per second (fps) at peak flow.

4. The minimum size of non-potable irrigation mains shall be six-inches (6") in diameter.

5.05 DEPTH OF BURY

- A. The minimum depth of cover shall be four (4) feet and the maximum depth of cover shall be six (6) feet for non-potable irrigation mains.
- B. When design or constructability constraints are present, deeper or shallower main installation may be permitted only with acceptance from the City. Additional design and installation considerations may be required by the City depending on the situation.

5.06 CONNECTIONS TO THE EXISTING NON-POTABLE IRRIGATION SYSTEM

- A. Connections to the existing non-potable irrigation system shall be in accordance with the *Construction Specifications, Section 02510, Water Utility Distribution Piping*.

5.07 LOCATION AND LOOPING OF NON-POTABLE IRRIGATION MAINS

- A. All non-potable irrigation mains shall be located in dedicated street right-of-way or within a dedicated easement of appropriate width. City approval is required for all other proposed non-potable irrigation main locations.
- B. The centerline of non-potable irrigation mains shall not be placed closer than three (3) feet

to the inner edge of concrete gutter without prior acceptance by the City.

- C. A non-potable irrigation main serving one (1) lot shall extend all the way across the frontage for that lot.
- D. Non-potable irrigation mains shall extend to the extremities of the property or the subdivision served. Extensions shall be in appropriate locations to provide adequate connections.
- E. The City shall determine on a case by case basis if non-potable irrigation system looping is required for a development.

5.08 NON-POTABLE IRRIGATION SYSTEM PHASED INSTALLATION AND STUBOUTS

- A. Non-potable irrigation system phased installation and stubouts shall be in accordance with Section 3.10 of these Criteria.
- B. Locate temporary blowoff assemblies at the end of each phase or stubout.

5.09 PIPE MATERIAL

- A. PVC: AWWA C900-16 DR 18 (235 PSI) polyvinyl chloride (PVC) pressure pipe, purple color for direct buried applications only. Refer to construction specification *Section 02513, for Polyvinyl Chloride Pressure Pipe* for additional information.
- B. DIP:
 - 1. ANSI/AWWA C151/A21.51 ductile iron pipe with mechanical joints for direct buried applications only. Refer to Section 3.11 C. of these Criteria for corrosion protection requirements.
 - 2. ANSI/AWWA C115/A21.88 flanged ductile iron pipe with flat faced flanges for exposed applications only.
 - 3. Refer to construction specification *Section 02512, for Ductile Iron Pipe* for pipe additional information.
- C. Steel: AWWA C200 steel pipe for both direct bury and exposed applications. Design Engineer shall determine required thickness for each application. The Design Engineer shall submit proposed interior and exterior coatings for City review and approval.

5.10 VALVES

- A. All valves shall be located in dedicated street right-of-way or within a dedicated easement of appropriate width. City approval is required for all other proposed valve locations.
- B. Gate Valves
 - 1. Gate valves shall be installed in accordance with Section 3.12 of these Criteria and *W&S Standard Drawings*, latest revision.
 - 2. All non-potable water line valves located in paved areas shall have a concrete collar

around the valve box in accordance with *W&S Standard Drawings*, latest revision.

3. Refer to construction specification *Section 02515, Water Utility Distribution Valves* for gate valve requirements.

C. Air/Vacuum Valves

1. Air/Vacuum Valves shall be installed at all high points along the non-potable irrigation main and shall be properly sized by the Design Engineer in accordance with the manufacturer's recommendation. The City shall have final determination on valve size and placement. NOTE: It is the City's preference that the number of high points within the pipeline be minimized.
2. Refer to construction specification *Section 02515, Water Utility Distribution Valves* for Air/Vacuum valve requirements.
3. Reference *W&S Standard Drawings* for installation requirements.

D. Non-potable Blowoffs

1. Non-potable blowoffs shall be installed at the end of all non-potable irrigation mains. The City may also require that non-potable blowoffs be located at low points within the system.
2. Reference *W&S Standard Drawings* for installation requirements.

5.11 PIPE ALIGNMENT

- A. The curved pipe alignment design requirements for non-potable irrigation mains shall be in accordance with Section 3.13 of these Criteria.

5.12 THRUST BLOCKING AND PIPE RESTRAINT

- A. Thrust blocking and pipe restraint requirements for non-potable irrigation mains shall be in accordance with Section 3.14 of these Criteria.

5.13 NON-POTABLE IRRIGATION MAIN AND SERVICE ENCASEMENTS

- A. Refer to Section 3.15 of these Criteria and construction specification Section 02445, Casing Pipe – Borings and Encasements for typical non-potable irrigation main and service encasement requirements.

5.14 NON-POTABLE IRRIGATION MAIN BORINGS

- A. Refer to section 3.16 of these Criteria and construction specification Section 02445, Casing Pipe – Borings and Encasements for non-potable irrigation main boring requirements.

5.15 NON-POTABLE IRRIGATION SERVICES

- A. General
 1. Non-potable irrigation service lines shall not be installed in trenches with other

conduits/utilities.

2. There shall be no physical connections between the non-potable irrigation system and the potable water system unless an approved backflow device is used to prevent non-potable water from entering the potable water system (i.e. RPZ device).
3. Non-potable irrigation services not utilized shall be abandoned. Refer to appendix section A3 – *Policies Impacting Design and Construction* for abandonment procedures.

B. Irrigation Services

1. Non-potable irrigation services 3/4” to 2” in diameter shall be crosslinked PEXa in accordance with AWWA C904 with acceptable manufacturers is Municipex®, Uponor AquaPEX®, or approved equal.
2. The non-potable irrigation service for a given lot must be tapped on the non-potable irrigation main within the confines of the extended property lines unless excepted by the City for the irrigation of multiple outlots under single ownership. Refer to appendix section A2 – *Compound Tap Exemption Policy for Irrigation of Multiple Outlots*. Otherwise, irrigation systems from a single non-potable irrigation service shall only be allowed for use on that single property. Refer to *City of Greeley Charter and Code, Title 14: Public Services*, Section 14.04.200 for compound tap restrictions.
3. Non-potable irrigation services shall not be located under driveways, trees, or other permanent structure.
4. Non-potable irrigation services shall be located a minimum three (3) feet inside the property being served.
5. Non-potable irrigation service taps shall be separated by at least two (2) feet, measured along the non-potable irrigation main length, including when taps are on opposite sides of the non-potable irrigation main. Non-potable irrigation service taps shall also be a minimum two (2) feet from all joints, fittings, or valves.
6. The corporation stop, curbstop, meter, the service line between the corporation stop and the meter, and five (5) feet past the meter shall all have the same equivalent inside pipe diameter.
7. Non-potable irrigation shutoff valves (curb stops and gate valves) shall be placed within one (1) foot of the property line or easement boundary (inside or outside).
8. Non-potable irrigation meter vaults pits/vaults shall normally be located after the curbstop in a landscaped area or streetscape. Meter pits/vaults shall not be installed in any street, parking area, driveway, or sidewalk unless otherwise approved by the City. If a meter pit/vault is permitted by the Water & Sewer Department to be located in any traffic area, the pit/vault shall be designed to withstand HS-20 traffic loadings. Curbstops with tracer wire test stations shall be in a valve box.. See *W&S Standard Drawings* for additional service and meter installation requirements.
9. There shall be no major landscaping (i.e. boulders, and trees, or shrubs with mature growth greater than three (3) feet), and buildings, or other permanent structures within

ten (10) feet of the meter vault.

10. Pressure boosters are allowed if required. Booster pumps must be prefabricated units with variable speed controls. Provide submittal cut sheets for City approval prior to ordering booster pump.

5.16 NON-POTABLE IRRIGATION MAINS AND SERVICES IN RELATION TO OTHER UTILITIES

- A. Non-potable irrigation mains and services shall have a minimum eighteen-inch (18") vertical separation and minimum five (5) feet horizontal separation or twice the depth of the invert of the pipe, whichever is greater from all utilities measured from outside diameter.
- B. Where non-potable irrigation lines cross above or below potable water lines with less than eighteen-inch (18") clearance, pipe encasement shall be designed and constructed so as to protect the potable water line. Note: It is the City's preference to have non-potable waterlines located below potable water lines.
- C. Non-potable irrigation main crossings under any open irrigation ditch shall have a minimum five (5) feet of cover and shall be encased.
- D. Dry utility crossings shall be encased in high density polyethylene (HDPE) pipe, Standard Dimension Ratio (SDR) 11 from edge to edge of the easement or right-of-way, or ten (10) feet on either side of the non-potable irrigation main, whichever is greater. Perpendicular utility crossings are permitted above and below the non-potable irrigation main. Parallel installation of other utilities in non-potable irrigation easements is not permitted.
- E. Bored utility crossings shall have a minimum twenty-four inches (24") of vertical clearance from the outside diameter of the utility casing to the outside diameter of the non-potable irrigation line if the bored utility crosses above or below the non-potable irrigation line.
- F. If there are horizontal or vertical clearance conflicts between the non-potable irrigation line and a utility, the City may require that the non-potable irrigation main be lowered, raised, or realigned in order to maintain the required clearances.
- G. For a non-potable irrigation line crossing situation not specifically mentioned in this section, the crossing requirements provided in these Criteria shall be applied to that particular situation to the best extent possible.

5.17 UNDERGROUND MARKING AND IDENTIFICATION

- A. Underground un-detectable marking tape shall be installed 18-inches above non-potable irrigation mains.
- B. Reference construction specification Section 02315, Excavation and Fill for Marking Tape Requirements.

5.18 NON-POTABLE IRRIGATION WATER STORAGE FACILITIES (PONDS)

- A. General

1. All water to be stored in the non-potable irrigation pond and the pond location shall be approved by the Water and Sewer Department prior to proceeding with facility design.
2. Combining non-potable irrigation storage with storm water detention requires approval by both the Water and Sewer Department and Public Works Department Storm Water Division. A written explanation shall be submitted describing the circumstance as to why a combined pond is needed.
3. The Design Engineer shall determine the high and low operating levels, required design storage volume, and the invert elevation of the pump station intake pipe.
4. The Design Engineer shall design a gravity flow raw water supply pipe from the water source (i.e. ditch) to the irrigation storage pond.
5. There shall be no major landscaping (trees, shrubs) with mature height greater than three (3) feet planted within ten (10) feet of the liner anchor trench.

B. Storage Volume Design

1. Non-potable irrigation ponds shall be sized to accommodate a minimum four (4) days of supply based on the Pump Station Design Capacity. The four day supply volume shall not include the dead storage.
2. Dead storage shall be based on the water level that limits the wet well inflow below 75% of the Pump Station Design Capacity. For example, if the Pump Station Design Capacity is 1,000 gpm, the dead storage begins when the inflow is less than 750 gpm.
3. A minimum freeboard of 12-inches shall be provided for storage ponds not combined with storm water and 18-inches for combined storage ponds.
4. Minimum usable storage volume of an irrigation storage pond shall be based on the following equation:

$$V = \frac{Q \times a \times b \times c}{d}$$

Where:

V = Total Useable Storage Volume (acre-feet)

Q = Pump Station Design Capacity (gpm)

a = Daily Watering Window = 8 hours/day

b = 60 minutes/hour (Conversion Factor)

c = Days of Storage (days) = 4 minimum

d = 325,829 gallons/acre-foot (Conversion Factor)

5. The minimum depth of the pond shall be 8-feet from the full pond surface level to the bottom.

6. Pond side slopes shall include a 4:1 safety bench for 12-feet horizontally and 3:1 slope thereafter to achieve maximum depth of pond. If steeper side slopes are required to meet storage volume requirements due to site constraints, then fencing must be installed around the pond for safety purposes. Fencing materials must match architectural components of development or HOA fencing requirements.
7. The non-potable irrigation pond shall be designed with either an overflow spillway if topography allows or an overflow structure hydraulically connected to storm sewer.
 - a. Spillway or overflow structure shall be designed to convey a minimum of 150% of the pond fill rate based on 5.04 A. 1. of these Design Criteria.
 - b. The Design Engineer shall provide necessary design information and construction details on the Construction Drawing for the irrigation pond overflow/spillway.
8. If the non-potable irrigation pond is intended to also function as a stormwater detention facility, with approval from the City, the Design Engineer shall include the additional detention storage volume over and above that required for irrigation operations. Refer to the *SDDC*, for stormwater detention pond design requirements. In addition, the irrigation source water flow shall be measured and recorded. Refer to 5.22 of these Criteria for additional information.

C. Non-Potable Irrigation Pond Liner

1. All non-potable irrigation ponds shall be designed with an approved liner system. Field conditions, constructability, storage volume fluctuations, costs, warranty, and operation and maintenance shall be considered in the selection and design of the pond liner system.
2. Approved pond liner materials are listed in Section 02666 Pond Liners. A layer of 10 oz/sy. geotextile must be included on top and bottom of pond liner material for protection purposes.
3. The Design Engineer may specify a pond liner alternative depending on the project conditions. The alternative pond liner system is subject to approval by the City.
4. Lining installation in areas where groundwater pressure can occur shall be avoided. The bottom of the liner shall be above the water table to prevent the liner from floating.
5. Additional Pond Liner Information:
 - a. Site structures such as piping, concrete, and drains shall be completed prior to lining installation.
 - b. The design and construction requirements for special liner installations such as anchor trenches, pipe protrusions through the liner, liner vents, batten attachments to concrete structures, seaming methods/testing, subgrade preparation, and cover treatment over the liner shall be in accordance with the manufacturer's specifications and the design shall ensure that the liner warranty is not invalidated. Coordination with and approval by the liner manufacturer is required. The proposed special liner installation details are subject to approval by the City.

- c. Construction details for special liner installation items shall be provided by the Design Engineer to be included on the Construction Drawings.

D. Shoreline Protection Treatment

1. Non-potable irrigation ponds shall be designed with a perimeter shoreline protection treatment to protect against wave action erosion. Due to the numerous shoreline protection treatments available (i.e. riprap, boulders, perimeter concrete walls, geotextile products, riparian plantings) the Design Engineer shall propose a suitable shoreline protection treatment depending on the project conditions. The proposed shoreline protection treatment for erosion protection is subject to approval by the City.
2. The Design Engineer shall make special considerations regarding the selection, design, and installation of shoreline protection treatment to ensure that the liner warranty is not invalidated. Coordination with and approval by the liner manufacturer is required.
3. Areas subject to scouring water velocities, such as at the raw water supply pipe discharge conveyance into the pond or beneath the pond fill line/service, shall be adequately protected against erosion and wash out (i.e. concrete splash pad, grouted riprap, large boulders, or appropriately sized riprap).
4. Appropriate construction details for shoreline protection treatment and erosion protection shall be provided by the Design Engineer to be included on the Construction Drawings.

5.19 AERATION SYSTEMS

- A. The Criteria provided here offer generic guidelines for the design of non-potable storage pond aeration systems. Each aeration system is unique and requires special design, therefore, it is the Design Engineer's responsibility to design a fully operational system for the given conditions and provide necessary construction details and specifications to accompany the design.
- B. Refer to construction specification *Section 11230, Aeration System* for additional non-potable pond aeration system requirements.
- C. Aeration System Design
 1. Coordinate the aeration system design and construction with the non-potable irrigation pump station design. House and incorporate aeration system components within the irrigation pump station building.
 2. Aeration system design components shall include, but are not be limited to, air compressors, aftercoolers, condensate separators, electrical controls, valves, pipe manifolds, flow meters, gauges, aeration pods/diffusers, housing requirements, installation and operational instructions, and recommended maintenance.
 3. The Construction Drawings for the aeration system shall show a typical layout, elevation and plan views, and critical dimension for the aeration system design and construction. The aeration system manufacturer is responsible for the layout and design of the aeration system supplied and any special coordination issues that affect

the critical dimensions, layout or orientation of the aeration system.

4. Aeration system shall be sized to provide four (4) pond volume turnovers per day based on the following equation:

$$X = \frac{V \times b}{c}$$

Where:

X = Number of Fine Bubble Diffusers

V = Pond Volume (millions of gallons)

b = 4 (Turnovers/day)

c = Effective Turnover Rate = d x e / f

Where (numbers below are based a disk aeration module with model ADS LWA-3, other manufactures and models will require calculations changes based on specific equipment):

d = Diffuser Depth (feet)

e = Diffuser Turnover Rate = 3.5 mgd

f = Diffuser Effective Depth = 15 ft

5. Fine Bubble Diffusers shall be spaced to provide even coverage.

5.20 NON-POTABLE IRRIGATION PUMP STATION

A. General

1. All pump station site locations are subject to review and approval by the City.
2. Pump station sites shall be located outside of the FEMA 100-year floodplain.
3. The pump station finished floor elevation shall be a minimum of 2-feet above the storage pond's highest water surface elevation to prevent water overflowing the wet well into the pump station building.
4. The non-potable irrigation pump station location shall allow adequate access to the site from new or existing public right of way. The site shall be designed to provide adequate drainage away from the pump station building, pond, and conform to City standards for drainage and storm water management plans.
5. The building shall be sited to allow access by all-weather surface roads capable of accommodating maintenance trucks from public right of way to the pump station site. The access shall at a minimum support HS-20 loading with a minimum width of 15

feet. The access points and site shall be designed to allow WB-50 trucks to maneuver within the site and exit the site without backing into public right of way. The site layout shall allow for access to the wet well and vacuum/jetter truck to clean out accumulated material in the wet well. All paved surfaces shall be designed for the expected vehicle and equipment loads.

6. Developer shall have a geotechnical evaluation completed of the site to determine soil conditions and hydrology as well as recommendations for storage pond, pump station foundation and wet well construction. Refer to Section 2.09 of these Criteria for Geotechnical Soils Report for additional information.
7. The Criteria provided here offer guidelines for the design of non-potable irrigation pumping systems. Each pumping system is unique and requires special design, therefore, it is the Design Engineer's responsibility to design a fully operational system for the given conditions and provide necessary construction details and specifications to accompany the design.
8. Refer to construction specification *Section 15140, Irrigation Pump Station* for additional non-potable irrigation pump system requirements.

B. Pump System Design

1. The pump system shall be designed with a reinforced concrete one common wet well and multiple vertical turbine pumps to provide irrigation flows at varying demands and constant discharge pressure. Pump redundancy is not required.
2. Each pump shall have a dedicated VFD to control the pump.
3. The bottom of the wet well shall be a minimum 4-feet below the invert of the intake pipe.
4. The wet well shall be designed to prevent vortexes and cavitation which can adversely affect pump performance.
5. Pump efficiency shall be a minimum eighty percent (80%) at the specified operating point.
6. The pump system design shall include a skid assembly to support all pump components during shipping and to serve as the installed mounting base. The base shall be of sufficient size and strength to resist twisting and bending from hydraulic forces and support the full weight of all components (i.e. pumps, motors, filters, piping, valves, etc.).
7. The pump system shall include a pressure maintenance pump for sustaining the pressure in the non-potable irrigation system during non-irrigated times and shall operate no more than every 15-minutes to maximize pump life. If the pressure maintenance pump operates more frequently then allow larger pressure differential (in pump controls) to reduce operating cycles to recover lost water pressure.
8. Pump system design components shall include, but not be limited to, motors, filters, valves, gauges, mounting and support structures, power and electrical equipment,

control systems, operator interface devices, alarms, data acquisition and telemetry, and monitoring devices.

9. Pump discharge piping and filter waste pipe shall be supported 6 to 18-inches off the building floor and exit through the wall before pipe burial.
10. Filter to waste pipe shall discharge into the storage pond a minimum distance of 100-feet from the Pump Station Intake Pipe inlet and liner protection is required.
11. The Construction Drawings for the irrigation pumping system shall show a typical layout, elevation and plan views, and critical dimensions or clearances for the pump system, building, wet well, electrical, etc.
12. The pump system manufacturer is responsible for the layout and design of the pump system supplied and any special coordination issues that affect the critical dimensions, layout or orientation of the pump system.
13. The pump system design is subject to approval by the City.

5.21 PUMP STATION INTAKE PIPE AND INTAKE SCREEN

- A. Intake pipe shall be AWWA C900-16 DR32.5 (125 PSI) polyvinyl chloride (PVC) pressure pipe, color purple or green or ASTM F679 PVC gravity sewer pipe.
- B. The exposed section of the intake pipe shall have intermediate concrete pipe cradles with a stainless steel strap to secure the pipe to the cradle. The maximum length of unsupported pipe shall be 9-feet.
- C. Intake Screen
 1. Intake pipe shall be equipped with a square shaped passive intake screen constructed of 16 gauge, flattened 304 stainless steel, with 3/8 x 7/8 inch openings. The frame shall be constructed of stainless steel.
 2. The intake screen shall be sized such that the velocity through the screen does not exceed 0.25 feet per second (ft/s).
 3. The bottom of the screen shall be a minimum 16-inches above the bottom of the pond. The intake screen shall be supported by and mounted on top of a reinforced concrete block.
- D. Intake Pipe Isolation
 1. The wet well shall be equipped with a slide gate or the intake pipe equipped with a buried gate valve to shut off flow between the storage pond and wet well. Refer to Construction Specification *Section 15140 for Slide Gates and Gate Valves*.

5.22 RAW WATER SUPPLY SYSTEM

- A. Raw water supply pipes shall have a minimum eighteen-inch (18") vertical separation and minimum five (5) feet horizontal separation or twice the depth of the invert of the pipe, whichever is greater from all utilities measured from outside diameter.

1. Pipe Material: PVC, DIP, or RCP. Refer to City of Greeley *Stormwater Design Standards*, Section 6, subsection 9.3.7 for additional culvert information.
- B. The raw water supply line shall be located on the opposite side of the pond as the non-potable pump station intake structure to promote water turnover within the pond and minimize stagnation that leads to water quality degradation.
- C. Flow shall be controlled by a hand wheel operated slide gate (headgate) mounted to a reinforced concrete headwall. The headwall shall be equipped with a steel trash rack anchored to the concrete headwall with stainless steel hardware.
1. Head Gate Manufactures/Models: Refer to Construction Specification *Section 11285, Slide Gates*.
 2. Refer to City of Greeley *Stormwater Design Standards*, Section 9, subsection 9.3.7 for additional trash rack requirements.
 3. The headgate configuration shall be approved by both the City and the associated ditch company.
- D. Flow Measurement
1. A parshall flume shall be used to measure flow in close proximity to the headgate. Construction of the parshall flume shall be dictated by the ditch company.
 2. The flow approaching the parshall flume shall be subcritical and operate under free-flow conditions.
 - a. The parshall flume shall be equipped with an 8-inch diameter stilling well to measure the flow depth using either a stage recorder or a non-contact level radar measurement device with the signal transmitted to the City's SCADA system via the Pump Station's Remote Telemetry Unit (RTU). Power shall be brought from the non-potable pump station to power either unit. Refer to Section 5.2 of these Design Criteria for additional SCADA information.
 - b. Where the Colorado Department of Natural Resources (DNR) requires flow data, a stage discharge recorder shall be mounted on top of the stilling well to compute and log discharge flow and totals.
 - i. Manufacturer and Model: Sutron Corporation, model SDR-0001-4 or approved equal.
 - c. For locations where the DNR does not require flow data, a radar level measuring unit may be used in place of the stag recorder.
 - i. Manufacturer and Model: Endress and Hauser - Micropilot FMR10 or approved equal.
- E. Check Structures

1. A check structure may be required where there is not sufficient depth within the irrigation ditch to provide sufficient head to achieve the raw water supply design flow. If the Design Engineer determines that a check structure is needed, a HEC-RAS model shall be created to compute water surface profiles. The check structure shall not prevent deliveries of water to downstream users.
2. The check structure shall be constructed of reinforced concrete with removable boards.

5.23 PUMP BUILDING

- A. The pump building shall be a precast concrete building sufficiently sized to house all the equipment including but not limited to pump skid, electric and controls cabinets, telemetry cabinet, and aeration system.
- B. There shall be a minimum 4-foot spacing between the building walls and pump skid.
- C. There shall be sufficient space between the pump skid filter(s) and building walls to allow removal of the filter screen for servicing and replacement. Space must be also provided to meet all electrical code requirements.
- D. The minimum wall height shall be 8-feet 6-inches with equipment doors sufficiently sized to be remove and replace electrical and controls panels.
- E. The pump building shall be equipped with two trench type floor drains that run either the width or length of the building and connect directly and perpendicular to the wet well.
- F. Refer to construction specification *Section 15140, Irrigation Pumps for additional requirements.*

5.24 SHOULDER MONTH WATER SUPPLY

- A. All non-potable irrigation systems require a backup potable water tap (shoulder tap) for providing irrigation water when non-potable water is unavailable (“shoulder months”). There is no Plant Investment Fee (PIF) required for a shoulder tap.
- B. Shoulder month water supplies must be approved by the City.
- C. Shoulder month water shall be discharged into the non-potable irrigation system’s water storage facility (pond). A candy cane configured discharge pipe with a minimum two (2) foot air gap shall be provided between the shoulder tap discharge and the maximum operating or overflow elevation of the pond water surface, whichever is greater.
- D. The shoulder tap shall be size based on the maximum water demands during shoulder months or at least four (4) inches in diameter and metered. Only City personnel may operate the shoulder tap.

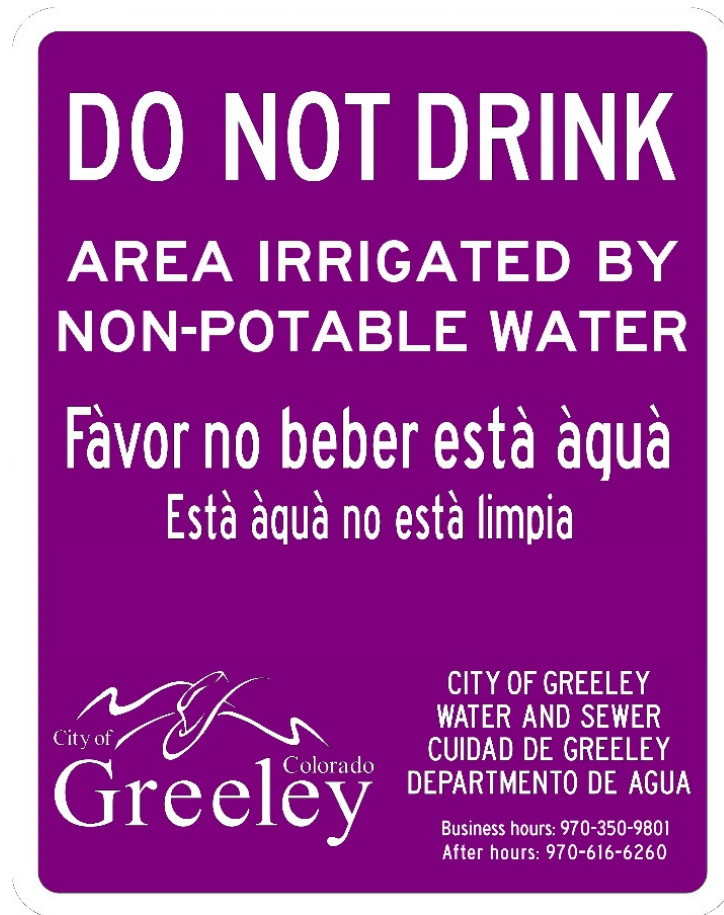
5.25 SCADA

- A. A Remote Telemetry Unit (RTU) shall be provided to communicate with the City's SCADA system. The RTU shall communicate with the City's SCADA via City fiber optic if within 1,500-feet of the pump station. If fiber optic is not available, the RTU shall communicate via XetaWave radios.
- B. The RTU shall communicate with the pump system and instrumentation by way of Modbus serial or Ethernet, or Allen Bradley Ethernet or serial. If there is no ability to communicate with the Control Panel, analog and digital inputs may be utilized.
- C. Refer to construction specification *Section 15140, Irrigation Pumps for additional requirements.*

5.26 SIGNAGE

- A. Signage must be posted at sites where non-potable water is utilized for irrigation. Signs shall be posted near sidewalks and paths that provide access into the non-potable irrigated area(s). Where neighborhoods use non-potable water for irrigating individual homes, all street access points into the neighborhood shall also be posted. Coordinate signage locations with the City of Greeley during design process.
- B. An example of an approved sign is provided below (sign design/layout provided by Area Wide Protective).

- C. Signs shall be 12-inches wide by 18-inches tall. Holes for fastening the sign to post shall not damage nor cover any text.



5.27 WATER DEDICATION REQUIREMENTS FOR NON-POTABLE IRRIGATION

- A. Contact the Water and Sewer Department and refer to *City of Greeley Charter and Code, Title 20: Public Works and Utilities* regarding water dedication requirements.

5.28 WATER SUPPLY WELLS

- A. Under certain circumstances the City may, at its election and in its sole discretion, accept use of a well(s) to meet non-potable needs. In that case, ownership of the well(s) would need to be transferred to the City and the well(s) permit changed to non-exempt irrigation well permit. Depending on the development layout and capacity of the well(s), the well could be used directly for irrigation without filling a storage pond first. The Design Engineer would need to evaluate each system individually and obtain City approval. Sufficient information regarding the well(s) such as condition and sustainable yield will be required to assist in the evaluation.

SECTION 6

LANDSCAPE AND IRRIGATION DESIGN CRITERIA

6.01 GENERAL

The City of Greeley Landscape and Irrigation Criteria and Standards, hereafter referred to as the “Criteria”, is intended to provide information for the design, review, installation and maintenance of landscape and irrigation systems within the City of Greeley to promote the efficient use of water and the reduction of water waste through best management practices. Both landscape and irrigation systems should be designed for non-potable water as outlined in Section 5 of these criteria.

It is the purpose and intent of this Criteria to support the City of Greeley Comprehensive Plan, the Greeley Water Master Plan, and the Landscape Policy Plan for Water Efficiency to:

Promote water conservation

- Reduce or eliminate outdoor water waste
- Reduce peak summer water usage
- Reduce water demand of new construction and development
- Reduce overall per capita demand
- Guide smart development by incorporating land use and water planning principals
- Guide smart development through practices, problem solving, technology and innovation
- Utilize onsite stormwater runoff to supplement landscape irrigation through rainwater harvesting

Support attractive and sustainable landscapes

- Use of low-water plants like native landscapes and xeriscape
- Stormwater and rain garden utilization, such as bio-retention practices, stormwater wetlands, dry wells
- Support an urban canopy by strategically placed trees to reduce heat islands and energy use

These Criteria shall be regarded as the minimum requirements and performance standards for the design, installation and maintenance of landscape and irrigation systems.

Whenever a provision of these Criteria and any other provision of the City of Greeley Municipal Code or any provisions in any law, ordinance, resolution, rules or regulations of any kind, contains any requirements covering any of the same subject matter, the requirements that are more restrictive or impose higher standards shall govern. If there is a discrepancy in the interpretation of these Criteria, the Water and Sewer Director or designee thereof, shall make the final determination of the intent of these Criteria.

Supplemental information including but not limited to forms, checklists, notes, etc. are available on the City of Greeley’s website and shall be referenced or submitted in accordance with the requirements set forth in these Criteria. It is the responsibility of the owner, designer, installer or maintenance contractor to obtain the latest version of any submitted document, as the City will periodically update these items.

- Landscape and Irrigation Criteria Checklists

- Irrigation Performance Audit Guidelines
- Irrigation Performance Audit Form
- Water Budget Chart and Example
- Pressure calculations worksheet
- WaterWise Best Management Practices
- Example of median and right-of-way designs
- Preferred plant list database

6.02 DEFINITIONS

- A. **APPLICATION RATE:** The depth of water applied to a given area and during a specific time, usually expressed in inches per hour or inches per week.
- B. **CHECK VALVE OR ANTI-DRAIN VALVE:** A valve located under or incorporated within a sprinkler head or other location within the system to prevent the system from draining on the lowest head(s) when the system is off.
- C. **COMPOST:** Fully finished, stabilized, and mature product, derived from decomposed plant and organic material that can be added to the soil as an amendment. Compost provides increased nutrient uptake, increased water holding capacity, and improves the soil structure of the site. This is not the same as topsoil.
- D. **CYCLE AND SOAK:** Method of irrigation where water is applied in multiple, short cycles. This allows the water to be applied more slowly, allowed to soak into the soil and prevent run-off, promoting deeper roots and healthier plants.
- E. **DISTRIBUTION UNIFORMITY:** The measure of the uniformity of the irrigation water over a defined area.
- F. **DROUGHT:** Periods or seasons with below average precipitation.
- G. **EMITTERS:** A pressure compensating emitter component of an irrigation system that disperses water to the landscape (i.e., sprinklers, bubblers, micro-sprays, etc.)
- H. **ESTABLISHED LANDSCAPE:** The point at which plants in the landscape have developed roots into the soil beyond the root ball, which promotes long-term health and growth.
- I. **ESTABLISHMENT PERIOD:** The first year after installing the plant in the landscape or the first two years if irrigation will be terminated after establishment. Typically, most plants are established after one or two years of growth. Native habitat mitigation areas and trees may need three (3) to five (5) years for establishment.
- J. **HARDSCAPES:** A non-living landscape feature that is made of any durable material (pervious and non-pervious) such as building, pavement, walkways and parking areas-including those of crushed stone, patios, and decks.
- K. **HYDROZONE:** An area within a landscape where the plant materials require a similar amount of water. For this document, hydrozones are divided into four (4) categories:

- *Very-Low Hydrozone*: Plant materials that require less than one gallon per square foot of area per growing season of supplemental water once established. The plant materials within this zone are typically drought-tolerant natives. This hydrozone is designated by the letter “V” on landscape plans.
 - *Low Hydrozone*: Plant materials that require between one (1) and nine (9) gallons per square foot of area per growing season of supplemental water. This hydrozone shall be designated by the letter “L”.
 - *Moderate Hydrozone*: Plant materials that require between ten (10) and 14 gallons per square foot of area per growing season of supplemental water. This hydrozone shall be designated by the letter “M”.
 - *High Hydrozone*: Plant materials that require more than 14 gallons per square foot of area per growing season of supplemental water. The plant material within this zone is intended for high-pedestrian traffic areas such as sport fields or community gathering spaces. This hydrozone shall be designated by the letter “H”.
- L. **IRRIGATION EFFICIENCY**: The measurement of the amount of water beneficially used divided by the amount of water applied. Irrigation efficiency is derived from measurements and estimates of irrigation system characteristics and management practices. Greater irrigation efficiency can be expected from well designed and maintained systems.
- M. **LOW FLOW IRRIGATION OR DRIP IRRIGATION**: The application of irrigation water at low pressure through a system of tubing or lateral lines and emitters such as point source, pressure compensating compents, dripper lines, micro-sprays and bubblers. Low flow irrigation systems apply small volumes of water, measured in gallons per hour, slowly at or near the root zone of plants.
- N. **MAINTENANCE OR MAINTENANCE OF LANDSCAPING**: Shall mean but not be limited to regular watering, mowing, pruning, fertilizing, clearing of debris and weeds, the removal and replacement of dead plants and the repair and replacement of an irrigation system. Any activity undertaken to prevent the deterioration, impairment, or need for repair of an area, structure, rights-of-way, or land use.
- O. **MASTER SHUT-OFF VALVE**: An automatic valve installed at the irrigation supply point which controls water flow into the irrigation system. When this valve is closed water will not be supplied to the irrigation system.
- P. **MONOCULTURE**: Large planting of the same species or even cultivar.
- Q. **MULCH**: Organic material such as leaves, bark, straw, wood chips or inorganic mineral materials such as rocks, gravel, decomposed granite or pebbles smaller than a half-inch in diameter left loose and applied to the soil surface for the beneficial purposes of reducing evaporation, suppressing weeds, moderating soil temperature, and preventing soil erosion.
- R. **NON-ESSENTIAL AREAS**: A high hydrozone with traditional turf that receives little, if any, use (i.e., the only person who walk on those areas is the person maintaining the turf).

- S. **PREFERRED TURF:** Very-low to low hydrozones grasses such as Buffalo Grass (*Buchloe dactyloides*), Blue Grama (*Bouteloua gracilis*), or other native species.
- T. **REFERENCE EVAPOTRANSPIRATION or ET:** A standard measurements of environmental parameters which affect the water use of plants. ET is typically expressed as the depth of water in inches or the volume of water in gallons used by an irrigated landscape area over a period of time.
- U. **RIGHT-OF-WAY LANDSCAPING** Shall mean landscaping located within the public or private right-of-way adjacent to a privately owned lot, outlot, or tract, including parkways.
- V. **SEASONAL WATERING SCHEDULE:** The programmed schedule set in the Smart Irrigation Controller. The schedule is based on the summation of the water that has been lost to evaporation and that has been used by the plant materials. The amount of water required to meet the needs of the plant materials change with the weather (seasons).
- W. **SMART IRRIGATION CONTROLLER:** A contractor-grade automatic timing device with nonvolatile memory that automatically adjusts the programmed run time or watering frequency based on changes in weather or soil moisture. Smart controllers may have local weather-based (ET) sensors or soil moisture-based sensors directly, or the smart controllers may be linked to a weather station via internet connection or cellular data card. Acceptable controllers must be selected from the Environmental Protection Agency’s WaterSense labeled irrigation controller list. Retail grade controllers are not acceptable.
- X. **SOIL AMENDMENT:** An organic and inorganic material that is added to native soil to improve texture, moisture holding capacity, nutrient capacity, and water and air infiltration.
- Y. **SUSTAINABLE LANDSCAPES:** Landscapes that feature climate-appropriate landscape design and efficient technologies and are maintained through efficient irrigation practices to support community water objectives.
- Z. **TRADITIONAL TURF:** High hydrozones grasses defined as Bluegrass (*Poa pratensis*), genus *Poa* and turf type tall fescue (*Festuca arundinacea*) and cultivars thereof having dense tufts blades and creeping rhizomes.
- AA. **WATER BUDGET:** The water that is applied annually from an irrigation system to an established landscape area. It is based upon the area’s reference evapotranspiration and is adjusted for plant factors and irrigation efficiency, two major influences upon the amount of water that needs to be applied to the landscape.
- BB. **XERIC LANDSCAPING OR XERISCAPE OR WATERWISE:** Shall mean the use hydrozones that are very-low to low-water use in place of plants that typically require more water to survive and include, but are not limited to, plants having a low or very low water requirement.
- CC. **ZONE:** Typically, an area served by a single irrigation control valve, sometimes referred to as a “station.” Zones are comprised of plant materials and soil types with similar water requirements.

6.03 APPLICABILITY

- A. These Criteria shall apply to all landscape and irrigation system designs, installation, and maintenance performed as a requirement of Chapter 8 – Landscape Standards of the Greeley Development Code and any other code, policy or criteria adopted by the City of Greeley. Areas that fall under these Criteria include but are not limited to:
- Civic and Open spaces
 - Common areas for all customer classes (outlots, pocket parks, usable detention, private/on-lot required/usable areas)
 - Right-of-ways
 - Areas not responsible of a single-family and up to four (4) units per lot
 - Municipal buildings
 - Multi-family residential
 - Non-residential (institutional, commercial, and industrial)
- B. Applicability for these Criteria shall follow major development as defined in Chapter 8, Section 24-801(b) – Landscape Standards of the Greeley Development Code.
- C. These Criteria shall govern over privately enforced guidelines or requirements related to landscaping and irrigation (i.e., business association, homeowners association design guidelines, regulations and requirements, etc.).
- D. Exemptions or where these criteria do not apply to:
- Single-family and up to four (4) units per lot
 - Row houses/townhomes individual parcels
 - Ecological restoration projects not requiring a permanent irrigation system
 - Exemptions listed in Chapter 8, Section 24-801(b)(3)- Landscape Standards

6.04 ENFORCEMENT

- A. The City of Greeley shall be provided the opportunity to review all landscape and irrigation plans, site and soil amendments, design, and installation for compliance with these Criteria. The Criteria are enforced by the City or authorized representative.
- B. All landscape improvements, indigenous plant material, and irrigation system components shall meet performance standards and supporting criteria. The City shall review all submittals for general compliance with these Criteria. An approval by the City does not relieve the owner, designer, installer or maintenance contractor from the responsibility of ensuring the design, plans, specifications, construction, maintenance, and record drawings are in compliance with these Criteria.
- C. In the event of Level 3 or 4 drought declared by the Water and Sewer Board, extreme drought water use planting and temporary irrigation may occur at the discretion of the Water and Sewer Director or designee thereof. For drought declarations visit City of Greeley’s website.

6.05 HANDLING OF TOPSOIL

- A. Stripping and stockpiling of native topsoil onsite shall be required during construction. This topsoil shall be incorporated as the final layer of soil for landscaping unless soil contamination has been determined. Stockpiling shall be handled by the Stormwater Management Plan and applicable Best Management Practices- see Stormwater Section 12- Construction Water Quality, as amended. Soil contamination determinations shall be at the discretion of the Public Works Director or his or her designee.
- B. The onsite replacement of topsoil and the addition of soil amendments are critical to successful establishment and ongoing health of plant material and efficient use of water through the life of the project.

6.06 SOIL AMENDMENTS

- A. Soil amendments (organic or inorganic) shall adhere to the Greeley Municipal Code, Section 24-804(e)(3) – Landscape Standards Installation and Maintenance for all properties.
- B. A minimum of four (4) cubic yards of compost per 1,000 square feet of area shall be used for non-native cool season turf.
- C. Per Greeley Municipal Code Chapter 8, Section 24-801(b) and 24-804(e)(3) – Landscape Standards, soil amendment verification documentation and receipts shall be submitted to the Water and Sewer Department, Water Conservation Program prior to installation of plant material, and shall include review of adherence to all criteria and performance standards. Written documentation reflecting approved volume, method of tilling and type of soil amendment is required.

6.07 MULCH

- A. Mulch (organic or inorganic) shall be used in areas used to cover bare ground, reduce evaporation, suppress weeds, moderate soil temperatures, and prevent soil erosion to promote landscape establishment within landscape beds. Seeding for large areas for grasses and naturalized landscape areas do not require mulch.
 - 1. Organic Mulch
 - a. Organic mulch material includes bark, and wood chips. No construction debris such as pallets shall be used.
 - b. Shall be applied at one and a quarter (1.25) cubic yard per one hundred (100) square feet at a depth no less than four (4) inches, and as appropriate to each hydrozone.
 - c. Shall be applied to soil surface, not against the plant stem, or high against the base of tree trunks to minimize disease.

- d. Tree rings of mulch shall be provided for all trees within turf areas subject to mowing operations. Tree rings for evergreen trees shall extend to the dripline of the tree to avoid limbing up of evergreen trees.

2. Inorganic Mulch

- a. Inorganic mulch includes rock, gravel and pebbles (pea gravel) smaller than one and one half-inch (1.5) in diameter for water conservation and weed suppression. Any materials greater than a half-inch is not considered mulch.
- b. Rock mulch shall have a minimum depth of three (3) inches.
- c. Pea gravel shall not be placed adjacent to paved surfaces unless contained by curbing, retaining wall or similar solid structure.

6.08 WEED BARRIER

- A. Black plastic (polyethylene) is not allowed. Woven weed barrier fabrics (polypropylene), recycled rubber, and plastic weed barriers are not allowed with any plant material unless they are used for playgrounds, large-scale vegetable/edible plant production, or areas that are designated as rock greater than one and one half (1.5) inch in diameter (dry creek beds without vegetation).
- B. Ecologically sound biodegradable weed barrier can be used.

6.09 SUSTAINABLE LANDSCAPE DESIGN

- A. Hydrozones
 - 1. For the purposes of this document, hydrozones are broken into the following four categories:

Table 6-1: Hydrozone Category

Hydrozone Category	Water Needs	Landscape Examples
High	>14 gallons/S.F./season	Bluegrass turf, or other non-native cool season turf, arborvitae, willows
Moderate	10-14 gallons/S.F./season	Columbine, potentilla purple coneflower
Low	1-9 gallons/S.F./season	Buffalo grass turf, sedums, succulents, iris, penstemon
Very-Low	<1 gallons/S.F./season once established	Native grasses, yarrow, rabbitbrush

- B. Landscape water budget and plant material

1. Greeley Municipal Code, Chapter 8 – Landscape Standards shall be adhered to.
2. An annual water budget chart shall be submitted for the landscape and irrigation plans. A water budget chart will show the total annual water used, which shall not exceed an average of 15 gallons/square foot for the landscape for all hydrozones per tap.
3. Plants are to be hydrozoned with plants of similar hydrozone (i.e., low with low). Plants of very low hydrozones are not to be planted in moderate to high hydrozones.
4. High hydrozones shall be limited to appropriate high-use areas with high visibility and functional needs. No more than 25% of the design irrigated area shall be high hydrozones. Where commercial and industrial uses include residential or recreational components, such as, but not limited to, assisted living, schools and daycares, picnic grounds, pocket park, outlots, the Water and Sewer Director or his or her designee may approve a greater percentage of high hydrozones. The applicant must demonstrate that the additional high hydrozones (traditional turf grass) areas are being used in high-traffic areas, such as, but not limited to, athletic fields, children's play areas, parks, and courtyards.
5. Preferred turf grass species are not limited in the design.
6. Specifications are found under Stormwater Design Standards, Section 14- Vegetation and Irrigation as amended shall be followed for stormwater detention and retention ponds.
7. Plant material shall be selected from a list of native and other plants determined to be appropriate for and well adapted to the soil and local environmental conditions and solar exposure requirements. The material plant lists can be found under the Water and Sewer Department, Water Conservation's Plant Database and City of Greeley's Forestry Department Front Range Tree Recommendation List. Upon request to the Water and Sewer Director or their designee, additional plants may be added to the list that are appropriate for these criteria.
8. Plant materials should provide an enriched quality of life by providing multi-season interest, color, texture, and diversity in plant material using the City of Greeley's WaterWise Best Management Practices found under Water and Sewer Department, Water Conservation website www.greeleygov.com/wc.
9. Plant material that is banned for use by the City of Greeley, Weld County and/or the State of Colorado shall not be used. This applies to all builders, installers, and owners. See the Colorado Department of Agriculture website for detailed list of restrictions.
10. The following landscape practices are highly recommended:
 - a. Methods outlined in the City of Greeley's WaterWise Landscaping Best Practices created by the Water Conservation program.
 - b. Protection and preservation of native species and natural vegetation.

- c. Plant selection based on water needs, disease and pest resistance.
- d. Implementing stormwater best management practices into the landscape and grading areas to minimize runoff and to increase on-site retention and infiltration.
- e. Rain gardens, water quality ponds, bioswales and other landscape feature and practices that increase rainwater capture and create opportunities for infiltration while adhering to Colorado Statute 37-92-602(8) the water right of less than 72 hours of water retention and Storm Drainage Design Criteria and Construction Specification manual.

6.10 LANDSCAPE PLANS

Landscape Plan requirements shall be used to aid the applicant, designer, installer and maintenance contractor in the analysis, design, installation, and maintenance of landscapes. These requirements presented herein are the minimum necessary for landscape plan submittals and shall be considered in conjunction with the requirements set forth by the City's Community Development Department and Greeley Municipal Code, Chapter 8 – Landscape Standards.

A general landscape plan shall be included with the Site Development Plan submittal and a more detailed landscape and irrigation plan shall be submitted with the Construction Document submittal. All required forms, checklists and plant list can be found online at the City's website (www.greeleygov.com/wc)

All landscape plans shall adhere to the Water and Sewer Department's Design Criteria and Construction Specification-Potable Water Distribution, Sanitary Sewer Collection, and Non-Potable Irrigation System.

- A. The proposed landscape plans shall include:
 - 1. All existing features that may influence landscape design such as prevailing winds, exposures, topography, hardscapes, and existing features like utilities, fences, structures etc. The design shall adhere to local zoning and codes related to utility easements, sight distance requirements, and buffer zones.
 - 2. Design incorporating water efficient techniques described as follows:
 - a. Group landscape material accordingly based upon hydrozones.
 - b. Selected plants shall be well-adapted to the Greeley climate and site conditions. Plants shall be grouped according to water and light requirements.
 - c. Irrigation equipment shall be appropriate to the hydrozone. Water should be applied deeply and infrequently to develop greater drought tolerance.

3. The identification of the landscape function and activities. This includes the overall theme of the site and neighborhood, onsite traffic patterns, and activity and service area needs.
4. Biodiversity in plant material such as trees and shrubs. Monoculture landscapes are not allowed to avoid drastic negative environmental and economic impacts from tree and shrub pests and diseases.
5. A water budget chart that shows the total annual water use, which shall not exceed an average of fifteen (15) gallons/square foot/year for each water tap and percentage of each landscape hydrozone type.
6. Accurate and clear identification of all applicable hydrozones as categorized in Section 6.09 A. and marked as defined in Section 6.02 K.
7. Final landscape design plans shall be stamped by a Colorado registered landscape architect.

6.11 IRRIGATION SYSTEM REQUIREMENTS

Per section Chapter 8, Section 24-804(h)-of the Greeley Municipal Code, an irrigation system design shall be submitted in conjunction with a landscape plan. The irrigation system design shall incorporate the required items set forth below:

A. Irrigation Methods and Layout

1. Provisions shall be made for permanent, automatic irrigation of all plant material, with the following exceptions:
 - a. Very-low hydrozone plantings that do not require supplemental irrigation beyond establishment.
 - b. Trees and other plants placed within the landscape area along residential local street parkways for single-family detached dwellings.
2. The irrigation method shall be selected to correlate the hydrozones shown on the landscape plan and irrigation water type (non-potable versus potable). The following criteria shall be followed during the design of the irrigation system:
 - a. Drip irrigation or bubblers shall be used for trees and shrubs greater than three (3) feet apart.
 - b. Rotors and pop-up heads with rotary nozzles shall be used for turf grass. Spray heads are not allowed unless pressure-compensating and retrofitted with rotary nozzles.
 - c. Only drip irrigation or strip pattern rotary nozzles shall be used to irrigate strips eleven (11) feet wide or less. Spray and rotor irrigation is strictly prohibited in these areas.

- d. Inline emitter driplines are encouraged for higher density of planting.
- e. Each hydrozone shall be irrigated based on a landscape with similar site and soil conditions and plant material with similar water needs. To the extent reasonably feasible, areas with significantly different solar exposures shall be zoned separately.
- f. Traditional turf and non-turf areas shall be irrigated on separate hydrozones.
- g. On steep grades, an irrigation method with a lower application rate shall be used in order to minimize runoff and, to the extent feasible, these areas shall be zoned separately and zoned in lines parallel to the slope rather than in blocks. On steep grades, traditional and preferred turf shall not be allowed on slopes greater than 25 percent where the toe is adjacent or within ten (10) feet to an impermeable hardscape.
- h. All zones are designed with matching heads with matched precipitation rates and full coverage. Drip, micro-sprays, retrofitted spray heads with rotary nozzles, and rotors shall not be combined on the same zone.
- i. Parking lot medians and islands that are surrounded by pavement shall be located in separate zones from other landscape areas.

B. Equipment

- 1. All equipment used in non-potable irrigation systems including but not limited to valves, valve box lids, sprinkler head tops, valve ID tags, and fittings must be clearly identified most commonly indicated by the manufacturer's addition of the color purple to the components.
- 2. Valves
 - a. A backflow prevention assembly shall be installed in accordance per Section 20-191 of the Greeley Municipal Code-Cross-connection control. All backflow assemblies shall be equipped with adequately sized winterization ports downstream of the backflow assembly and must be the same material type
 - b. To reduce water leaks from the irrigation system, a master shut-off valve shall be installed downstream of the backflow device to shut off water to the system automatically when not operating.
 - c. Flow sensors integrated with the Smart Irrigation Controller are required for single or combined point of connection flows of 15 gallons per minute (GPM) or greater and one (1) inch or greater water taps.
 - d. All valves shall have a manual ball valve installed prior to the lateral valve.

- e. One two (2) inch valve ID tag shall be attached to each control valve one-and-one-half (1.5) inches or greater water tap. Each tag must be labeled with controller and station number.
 - f. Valve box lids shall be branded with minimum two (2) inches characters stating the controller and the zone (station) number for all irrigation systems served by a one-and-one-half (1.5) inches or greater water tap.
 - g. For branching or T's of the main irrigation line that are served by a one-and-one-half (1.5) inches or greater water tap isolation valves upstream of the branching or T's shall be required.
 - h. For irrigation mainline distances over 500 feet, upstream isolation valves are required.
3. Submeters for irrigation systems are encouraged to enable the owner and landscape maintenance contractor to monitor water use. The installation and maintenance of the submeter shall be borne by the owner of the property and not by the City. All such submeters shall be installed in accordance with the specifications established by the City.
 4. Irrigation controllers shall be smart controllers as defined in 6.02.V. Taps sized one-and-one-half (1.5) inches and greater water tap shall have a constant data connection via Wi-Fi or cellular data card so weather-based (ET) data can be received by controller. Controllers shall be installed and programmed according to the manufacturer's specifications.
 - a. Post at each smart irrigation controller a data input chart including the precipitation rate from the audit, water budget, and zone descriptions.
 - b. Within thirty (30) days of the installation of new landscaping, the irrigation system Smart Controller(s) shall be reset to the normal seasonal watering schedule. Minor schedule adjustments for establishing the trees, shrubs, and perennials may be necessary.
 - c. Irrigation days of the week shall follow Section 20-226 of the Greeley Municipal Code-Water conservation and use restrictions; drought response along with the current declaration of the City's water supplies.
 5. Sprinklers and nozzles shall meet the following requirements:
 - a. The type of sprinkler and associated nozzles shall be selected to correlate with the size and geometry of the zone being irrigated.

- b. Sprinklers shall be spaced no closer than seventy-five (75) percent of the maximum radius of throw for the given sprinkler and nozzle. Maximum spacing shall be head-to-head coverage.
- c. Coverage arcs and radius of throw for turf areas shall be selected and adjusted to water only turf areas and minimize overspray onto vegetated areas, hard surfaces, buildings, fences, or other non-landscaped surfaces.
- d. Sprinklers, bubblers, or emitters on each zone shall be of the same manufacturer. Multiple manufactures can be used throughout the system if each zone has the same manufacturer.
- e. Sprinkler heads in turf areas shall have a minimum six (6) inch pop-up riser height. A four (4) inch pop-up riser height is permitted when the irrigation head is in line with a curb along a parking space. If pop-ups are installed within a perennial and groundcover beds, a twelve (12) inch pop-up riser shall be used.
- f. Spray nozzles are not allowed.
- g. Nozzles for rotors shall be selected to achieve an approximate uniform precipitation rate throughout the zone.
- h. All pop-up heads s shall be equipped with check valves and pressure-regulating stems in accordance with Colorado House Bill 19-1231.
- i. Rotors shall be equipped with internal check valves and pressure regulation.
- j. Pressure-compensating emitters shall be used for drip irrigation. For sloped areas, check valve(s) shall be installed in the drip line whenever the valve is at a lower elevation.
- k. Drip line shall be parallel to the slope whenever feasible.
- l. Properties with single or combined point of connection flow of 15 GPM or greater for a one (1) inch water tap or greater, shall have a control system capable of providing real-time flow monitoring and the ability to shut down and/or isolate the problem area(s) with isolation valve(s) in the event of a high flow condition.
- m. Emitters shall be set back from foundations in accordance with Chapter 8, Section 24-802- Landscape standards.
- n. Pop-up heads in turf areas shall be matched precipitation nozzles. Variable Arc Nozzles (VANS) are not acceptable for 90-, 180-, and 360-degree applications. High-Efficiency Variable Arch Nozzles (HE-VANS) are allowed in odd shaped areas (non-linear or triangular head spacing) where 90-, 180- and 360- degree nozzles are not applicable.

6. Sleeving shall meet the following requirements:
 - a. Sleeves shall be installed beneath paved areas to route irrigation pipes and wiring bundles. The diameter of sleeve shall be a minimum of twice that of the pipe and wiring bundle but no smaller than a two (2) inch diameter pipe. The ends of the sleeves shall extend past the edge of the curb, gutter, sidewalk, or other hardscape a minimum of eighteen (18) inches.
 - b. The sleeve material beneath sidewalks, drives and streets shall be PVC Class 200 pipe with solvent welded joints.
 - c. For all sleeving located under concrete, the pavement or other hard surfacing shall be notched on both sides to mark the sleeve location, and tracer wires shall be installed on the upper side and both ends of the sleeving.
 - d. Contain no joints when length is less than twenty (20) feet.
 - e. Separate sleeving used for irrigation lines and wiring bundles.

C. Water Pressure

1. The irrigation system designer shall verify the existing available water pressure.

The irrigation system shall be designed such that the point-of-connection design pressure, minus the possible system pressure losses, is greater than or equal to the design sprinkler operating pressure at final build out.

2. All newly installed sprinkler bodies shall operate at the manufacturer's specific optimum performance pressure range, All pop-up bodies retrofitted with rotary nozzles shall operate at no less than twenty (20) psi and no more than forty-five (45) psi.
3. If the operating pressure exceeds the manufacturer's specified maximum operating pressure for any sprinkler body or nozzle, pressure shall be regulated at the zone valve or sprinkler heads.
4. Pressure boosters are allowed if required. Booster pumps must be prefabricated units with variable speed controls.

6.12 IRRIGATION DESIGN PLAN

The purpose of a preliminary irrigation design plans is to provide a general design and annual water allotment for landscapes. The final irrigation design plans build upon the preliminary design with additional details. In accordance with Greeley Municipal Code, Chapter 8, Section 24-804(h) – Landscape Standards, the irrigation plan shall be designed in conjunction with a landscape plan in a manner to maximize irrigation efficiencies:

- A. Preliminary Irrigation Design Plans shall include:

1. Accurately and clearly identify all applicable hydrozones with square footage using the defined four categories in Section 6.10 and using letter marking found in Section 6.2 of these Criteria.
2. Include irrigation methods according to the hydrozones. All heads on a zone shall have matched precipitation nozzles.
3. A water budget chart that shows the total annual water use, which shall not exceed fifteen (15) gallons per square foot over the site.
4. All necessary system components are sized for adequately meeting the highest seasonal landscape demand with a three-day per week watering schedule. Irrigation shall occur within an eight-hour watering window or as allowable by Section 20-226 of the Greeley Municipal Code -Water conservation and use restrictions; drought response.

B. Final Irrigation Design Plans shall include:

1. Same information required for the Preliminary Irrigation Design Plan submittal and;
2. A Smart Irrigation Controller data input chart. Irrigation schedules for landscape establishment period and established planting shall include irrigation frequency, cycles per day, and minutes per cycle, and a note stating that the schedule is a guide only and actual field conditions may require more or less watering time as plants mature. Seasonal adjustment shall be included in the data input chart. The data input chart must provide scheduling for the highest water demand season and fall within the watering window allowable by Section 20-226 of the Greeley Municipal Code- Water conservation and use restrictions; drought response.
3. A pressure calculation worksheet that shall demonstrate the point-of-connection design pressure, minus the possible system pressure losses, is greater than or equal to the design sprinkler operating pressures.
4. A seasonal maintenance schedule beginning on April 15 through October 15 shall be shown on the irrigation plan to establish procedures for optimum irrigation efficiency and preventive maintenance practices that will conserve water resources. The maintenance schedule shall include 6.16- Irrigation System Maintenance
4. Final irrigation design plans must be approved by a licensed Irrigation Association Certified Irrigation Designer (CID).
5. The following General Notes:
 - a. Contractor installing the system including name, address, and phone number
 - b. All irrigation certifications
 - c. All field adjustments or redesign to show “as-built” drawings after installation is complete
6. The owner of the property shall be provided:

- a. “As-built” irrigation drawings
- b. Water budget chart
- c. Smart Irrigation Controller data input chart
- d. Two (2) operating keys for each type of manually operated valves
- e. Two (2) of each servicing wrench or tool needed for complete access, adjustment, and repair of sprinklers.

6.13 IRRIGATION SYSTEM INSTALLATION

Irrigation system installation shall be consistent with approved plans and meet the City’s Criteria prior to issuance of Certification of Occupancy or other City approvals. Release of bonding or surety (if applicable) shall be withheld until approval is given.

Materials, installation, and execution for parks shall follow City of Greeley Design Criteria and Construction Specifications, Section 02810 Irrigation Specifications.

Otherwise the following shall occur for irrigation system installation:

A. Quality Assurance:

1. Irrigation system installation shall be consistent with approved system design and applicable water type (potable versus non-potable systems). For all systems with one and one-half (1.5) inches or greater water tap, it is recommended that the irrigation system be designed and constructed for non-potable water use.
2. Work and materials shall be in accordance with the latest edition of the National Electric Code, the Uniform Plumbing Code as published by the Western Plumbing Officials Association, and applicable laws and regulations of the governing authorities.
3. When contract documents call for material or construction of better quality or larger size than required by the above-mentioned rules and regulations, provide the quality and size required by the contract documents.
4. A Field Supervisor shall review and sign-off on the installation. Field Supervisors shall have at least five (5) years experience in irrigation system installation and be employed by a company that has been established in the green industry for three (3) or more years.

B. Installation

1. Contact the City of Greeley Water and Sewer Department at conserve@greeleygov.com when irrigation construction begins.

2. Installation shall be consistent with approved system design.
3. New and existing tree and shrub locations as shown on the landscape plans take precedence over irrigation equipment locations. Conflicts between irrigation system, planting material and architectural features shall be avoided.
4. Assembling pipe and fittings shall be in a manner recommended by the manufacturer and in accordance with accepted industry practices.
5. Spare wires
 - a. In conventional (or traditional, single, multi-stand) systems, two (2) spare control wires and one (1) spare common wire shall be installed for the entire length of the mainline. At each valve location, a minimum of thirty (30) inches wire loop shall be provided and located in the valve box. End of wires shall be capped with water-proof wire connectors.
 - b. In 2-wire (or decoder) systems, one (1) spare 2-wire shall be installed the entire length of the mainline. The spare 2-wire installed shall be in a different color than the rest of the 2-wire being used. At each valve location, a minimum of thirty (30) inches wire loop shall be provided and located in the valve box. End of all wires shall be capped with water-proof wire connectors.
6. Sprinkler assemblies shall be installed as per the specifications and at the locations of the irrigation plans. All sprinkler assemblies shall be installed for best performance. The City reserves the right to conduct follow-up audits as deemed necessary at the expense of the customer to ensure irrigation system efficiencies. Any deviations in the installation from the irrigation plan must be noted and included in the as-built drawings.

C. Testing

1. The mainline of the irrigation system shall be tested for each segment of mainline made operational and upon final installation completion to ensure it is free of leaks, defects, or deficiencies. The system shall be brought to normal operating pressure with the all valve manifolds and isolation valves open and all other conveying components closed. Any loss of pressure after two hours should be recorded, investigated, and isolated. Identified leaks shall be repaired and the mainline retested prior to testing any individual irrigation zones.
2. All irrigation zones shall be tested upon final installation completion to ensure the zones are free of leaks, defects, or deficiencies. Each zone shall be activated for five (5) minutes, and the water use shall be recorded from the installed flow sensor installed or calculated from start and stop water meter readings. Deviations from the zone application rate listed in the irrigation plan shall necessitate investigating the zone(s) for correct installation, layout, components, and repair. Post-repair zone testing will be required.

3. It is unlawful for any owner or user of water to fail to comply to the prevision of the Section 20-153 of the Greeley Municipal Code – Bills may be sent; process of bill disputes and to waste water through neglect or by reason of faulty or imperfect plumbing or fixtures per Section 20-123 of the Greeley Municipal Code- Failure to maintain; unlawful;notice;turnoff.

6.14 IRRIGATION PERFORMANCE AUDIT

Per Greeley Municipal Code, Section 24-801(b)(5) and 24-804(h)(5) a letter of substantial completion of the landscape plan and an irrigation performance audit must be completed prior to issuance of Certification of Occupancy or other City approvals. Release of bonding or surety (if applicable) shall be withheld until approval is given. Details of the Irrigation System Installation, Performance Audit and Landscape and Irrigation System Maintenance

A. Exemptions

1. Systems with only drip irrigation.
2. Landscape plans and plant installation without any turf areas.
3. Case-by-case as determined per the Water and Sewer Director or designee.

B. Certification

1. The contractor in charge of the irrigation system installation must contract to have an irrigation performance audit completed by a licensed professional independent of the installation contractor. Acceptable auditors are Greeley’s Water Conservation Program personnel, a CLIA, or QWEL:
 - a. Certified Landscape Irrigation Auditor (CLIA) who is certified by the Irrigation Association, a non-profit industry organization dedicated to promoting efficient irrigation
 - b. Qualified Water Efficient Landscaper (QWEL) who is certified by EPA WaterSense
2. The cost of hiring a CLIA or QWEL shall be the responsibility of the contractor in charge of the installation.

C. Performance Audit Guidelines

1. Irrigation zones tested in the audit must be a representative sample of the entire irrigation system, and at a minimum shall include the evaluation of no less than twenty-five (25) percent of overhead irrigation zones, to include a minimum of two (2) zones per overhead sprinkler type. At the discretion of Greeley’s Water and Sewer’s Director or designee, the minimum number of zones may be increased depending on the size and complexity of the irrigation system.

2. The minimum acceptable distribution uniformities shall be seventy (70) percent for rotor and rotary zones.
3. Results below minimum acceptable distribution uniformity will require adjustments and/or repairs made to the irrigation system. These corrections will be noted on the irrigation as-builts and the test area re-audited until acceptable results are produced.
4. A signed copy of the Irrigation Performance Audit shall be submitted to and approved by the Water and Sewer Department, Water Conservation Program Manager before issuance of a Certificate of Occupancy or other City approvals.

6.15 LANDSCAPE MAINTENANCE

Per section 24-804(e) installation and maintenance of the landscape areas of the Greeley municipal code, the developer, owners' association, property managers, property owner and/or tenant, as required by Chapter 8, shall be responsible for maintaining in a healthy condition all on-lot and right-of-way landscaping, buffering, perimeter treatment, and screening improvements. The landscape and irrigation maintenance shall incorporate the required items set forth below:

- A. The Owners' Association, property managers, property owner, and/or tenant shall be jointly and severally responsible for the regular maintenance of all landscaping elements and irrigation system in good condition. All landscaping shall be maintained free from disease, pests, weeds and litter.
- B. Regular maintenance shall be consistent with the needs of the plant material and shall include pruning, mowing, fertilization, mulching and weeding, and plant materials replacement. Replacement materials shall be healthy plants of comparable size and species, meeting the original intent of the approved landscape design.
- C. Preferred turf shall follow the City of Greeley's Natural Areas & Trails Department No-Mow policy.
- D. Best management practices to fix erosion shall be used to maintain landscapes and irrigation systems.

6.16 IRRIGATION SYSTEM MAINTENANCE

- A. Annual maintenance of the irrigation system includes backflow prevention assembly testing, rain sensor testing, controller data or Wifi connection testing, and filter and strainer cleaning/replacement, and all other preventive maintenance practices that conserve water resources.
- B. Leak repair, replacement of damaged system components, head adjustments, application rate adjustments, and all other preventive maintenance practices that conserve water resources shall be on-going through out the irrigation season.

- C. A completed and passing backflow prevention assembly test consistent with the parameters outlined per Section 20-191 of the City of Greeley's Municipal Code- Connection Control is required for irrigation system start-up. Proper assembly operations shall also be verified through passing backflow prevention assembly test when the assembly is taken out of service for maintenance or repair.
- D. All irrigation system elements shall be repaired and replaced to maintain the minimum acceptable distribution uniformities of sixty (60) percent for rotor and rotary zones.
- E. Irrigation controllers shall be seasonal adjusted using a cycle and soak method with no programming to irrigate between the times of 10:00 a.m. to 6:00 p.m.
- F. Irrigation days of the week shall follow per Section 20-226 of the Greeley Municipal Code- Water conservation and use restrictions; drought response.
- G. Subject to Chapter 14.08-Water Rates and Regulation, failure to maintain any plumbing or fixtures of any premises are so defective as to waste any water is unlawful and shall be subject to penalties and/or water shutoff.
- H. Irrigation audits should be conducted every five (5) years following the initial irrigation system installation following Section 6.14- Irrigation Performance Audit to support long-term water efficiency.

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NON-POTABLE

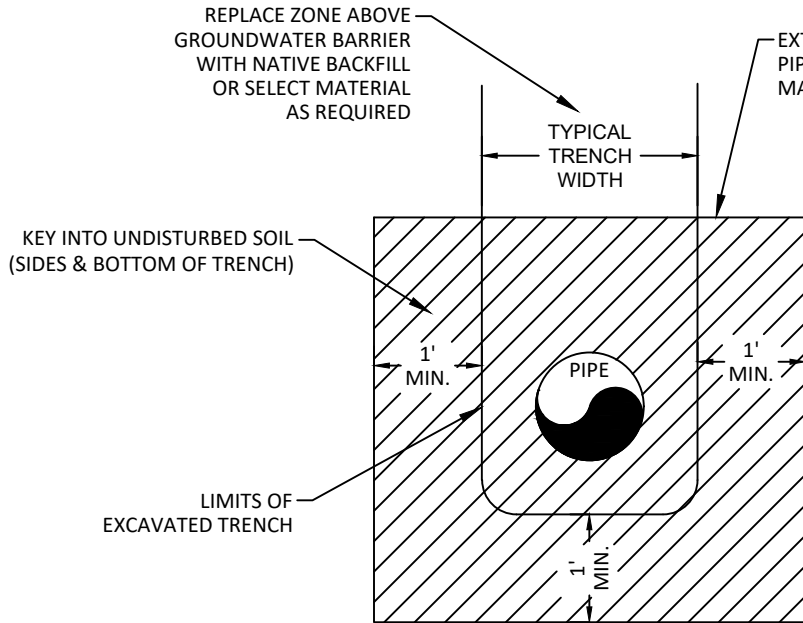
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UTILITY LOCATES

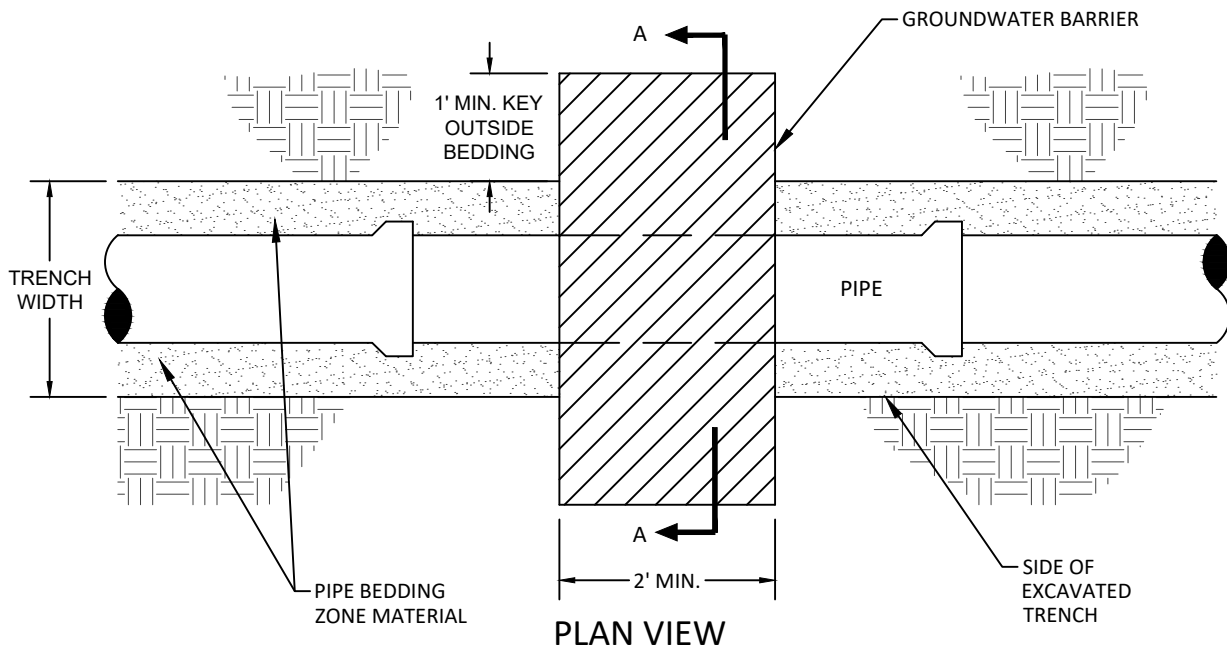
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NOTES:

1. REFER TO WATER & SEWER (W&S) DEPARTMENT CONSTRUCTION SPECIFICATIONS (SPECIFICATIONS) FOR GROUNDWATER BARRIER MATERIAL AND COMPACTION REQUIREMENTS
2. LOCATE GROUNDWATER BARRIERS PER ACCEPTED CONSTRUCTION DRAWINGS AND SPECIFICATIONS.
3. GROUNDWATER BARRIER TO BE CONCRETE, BENTONITE, CLSM CONCRETE, OR OTHER CITY APPROVED MATERIAL. REFER TO SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.

SECTION A-A



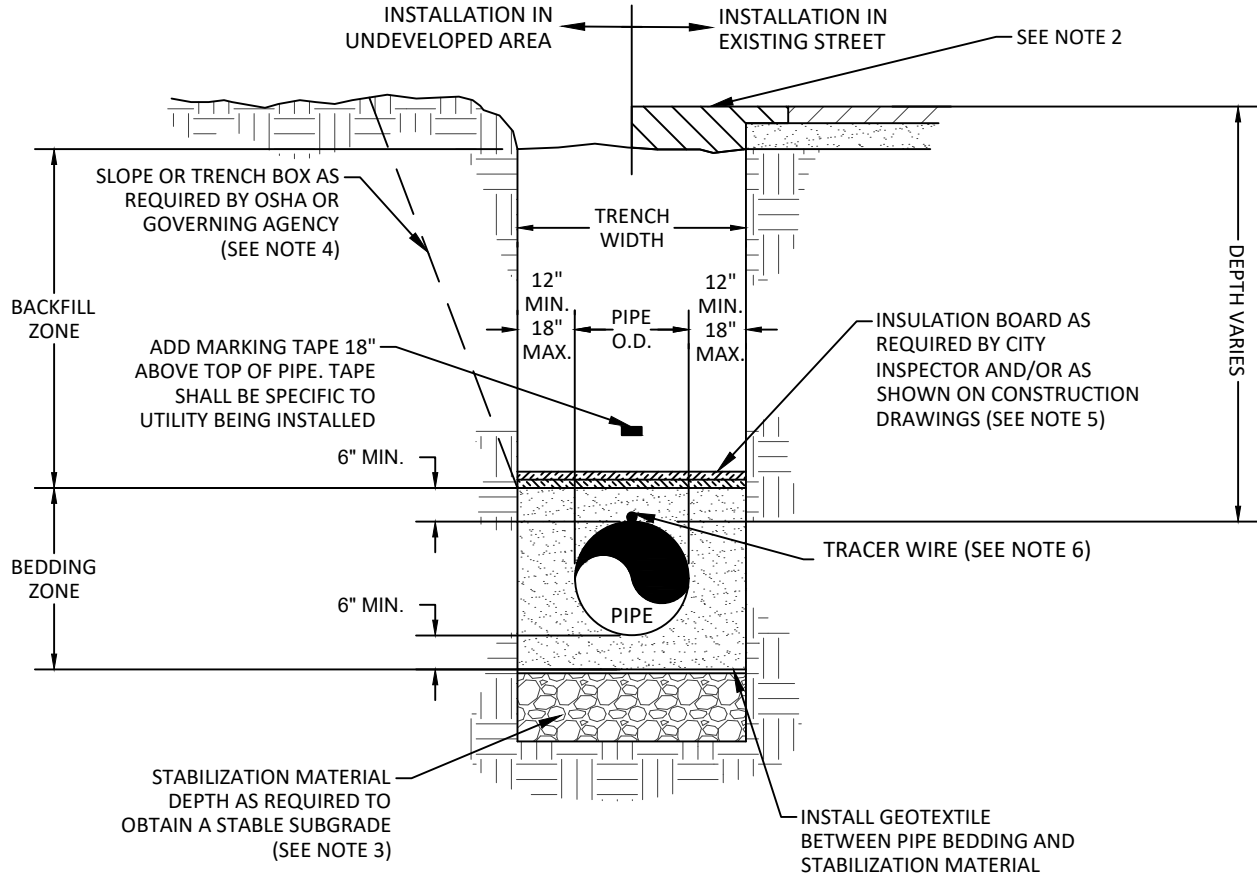
GROUNDWATER BARRIER

DETAIL WS-1



DATE: JANUARY 2023

SCALE: N.T.S.



NOTES:

1. REFER TO WATER & SEWER (W&S) DEPARTMENT CONSTRUCTION SPECIFICATIONS (SPECIFICATIONS) FOR STABILIZATION, GEOTEXTILE, BEDDING, BACKFILL MATERIAL, COMPACTION, AND MARKING TAPE REQUIREMENTS. FOR ANY CONFLICT BETWEEN WATER AND SEWER AND PUBLIC WORKS BACKFILL MATERIAL SPECIFICATIONS AND COMPACTION REQUIREMENTS, THE MORE STRINGENT SPECIFICATION SHALL APPLY.
2. REFER TO STREETS DETAIL S-31 "EXISTING STREET PAVEMENT PATCH DETAIL FOR ASPHALT & CONCRETE", CURRENT VERSION, FOR STREET CUT REQUIREMENTS.
3. AN OVER EXCAVATED TRENCH SHALL BE BACKFILLED AND COMPACTED WITH STABILIZATION OR BEDDING MATERIALS (AS PER SPECIFICATIONS) UNDER THE DIRECTION OF THE CITY.
4. TRENCHES SHALL BE SHORED, BRACED, OR SHEETED PER OSHA REQUIREMENT AND AS NECESSARY FOR THE SAFETY AND PROTECTION OF PERSONNEL AND OTHER UTILITIES.
5. INSULATION BOARD SHALL BE 2" THICK MINIMUM, CONSISTING OF TWO BOARDS (1" MINIMUM PER BOARD) WITH OFFSET JOINTS PLACED ACROSS FULL TRENCH WIDTH. REFER TO SPECIFICATIONS.
6. INSTALL TRACER WIRE ACCORDING TO SPECIFICATIONS AND W&S UTILITY LOCATING ("UL") DETAILS, LATEST REVISION OF EACH.

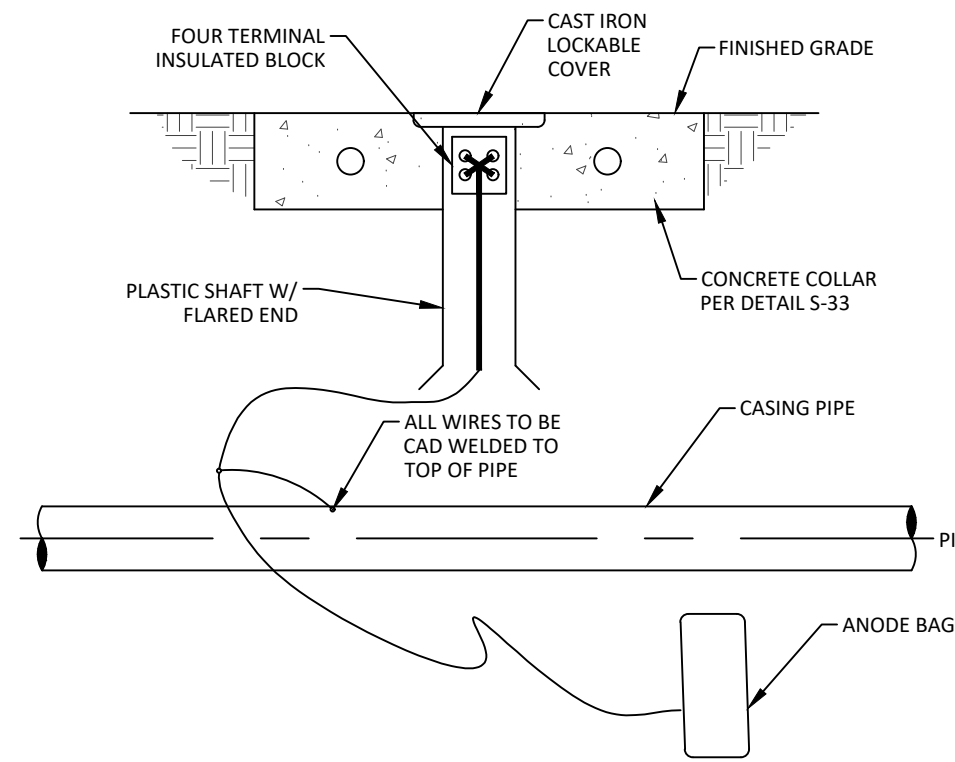


TRENCH CROSS SECTION

DETAIL WS-2

DATE: JANUARY 2023

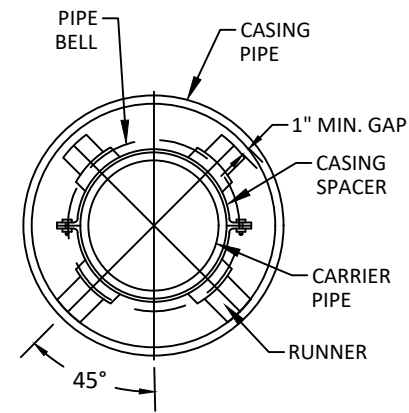
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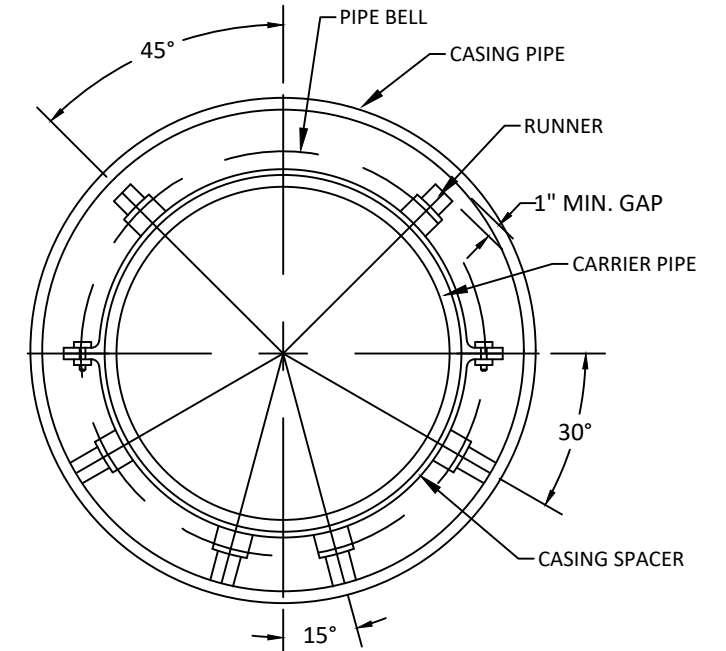
CATHODIC TEST STATION DETAIL

CATHODIC PROTECTION NOTES:

1. CATHODIC PROTECTION SHALL ONLY BE REQUIRED FOR DIP AND STEEL PIPES.
2. INSTALL THE ANODES VERTICALLY OR HORIZONTALLY IN SOIL WITH TOP OF ANODES BELOW THE SPRINGLINE OF THE PIPE. ANODES MUST BE PLACED IN NATIVE SOIL, NOT SELECT BACKFILL SUCH AS SAND, BEDDING, OR CRUSHED ROCK.
3. INSTALL A 17 LB HIGH POTENTIAL MAGNESIUM ANODE BAG ON EACH END OF STEEL CASING PIPES WITH A CATHODIC TEST STATION.
4. STATION TEST WIRES TO BE THHN/THWH.
5. INSTALL A MINIMUM OF 2 FT SLACK AT EACH END OF WIRES.
6. BE CAUTIOUS DURING BACKFILLING. TO NOT DAMAGE OR STRESS WIRES OR CONNECTIONS.



FOR CARRIER PIPES 4"-12"

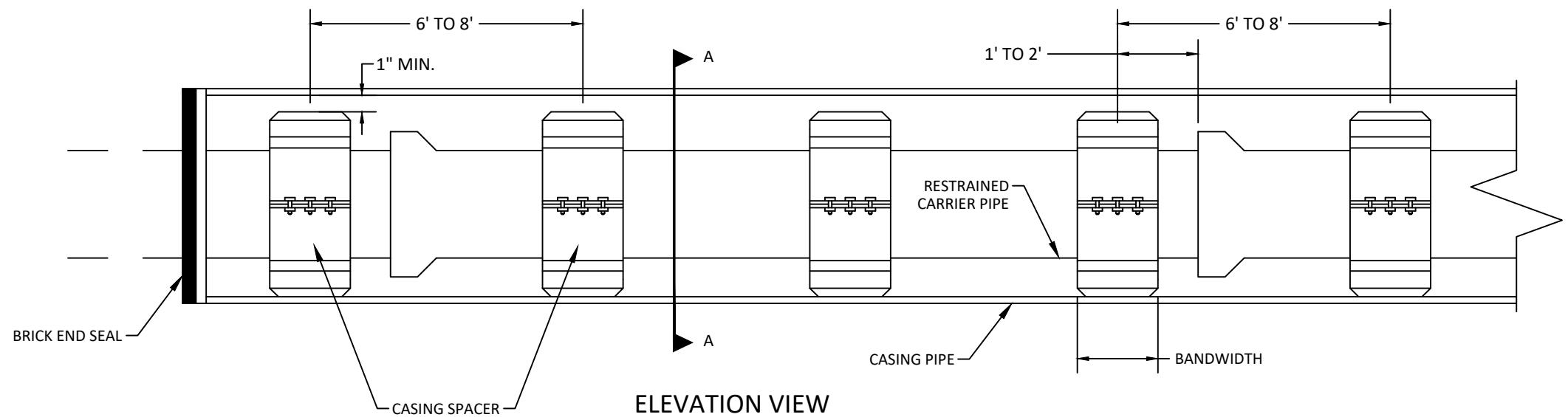


FOR CARRIER PIPES 15" & 16"

SECTION A-A

NOTES:

1. CASING PIPE, CASING SPACERS, AND END SEALS TO BE INSTALLED PER WATER & SEWER (W&S) DEPARTMENT CONSTRUCTION SPECIFICATIONS (SPECIFICATIONS).
2. RECOMMENDED CASING SPACER POSITIONING - PLACE ONE CASING SPACER 1-2 FT ON EITHER SIDE OF THE BELL JOINT AND ONE EVERY 6-8 FT APART THERE AFTER FOR A TOTAL OF 3 CASING SPACERS PER PIPE LENGTH UNLESS OTHERWISE SPECIFIED BY THE MANUFACTURER OR CITY.
3. FOR 12" DIAMETER AND SMALLER CARRIER PIPES, USE 8" CASING SPACER BANDWIDTH.
4. FOR CARRIER PIPES LARGER THAN 12" DIAMETER, USE 12" CASING SPACER BANDWIDTH.
5. CASING SPACERS TO BE IN THE "CENTER RESTRAINED" POSITION.
6. REFER TO SPECIFICATIONS, LATEST REVISION, FOR PIPE CASING SIZES AND MATERIALS.
7. ALL BORINGS & ENCASEMENTS WILL REQUIRE WATERTIGHT END SEALS AS SHOWN AND GROUT FILLED ANNULAR SPACE.
8. RESTRAINTS ARE REQUIRED TO NOT OVER INSERT PIPE AND ALLOWS FOR INSTALLATION OR REMOVAL OF PIPING.



ELEVATION VIEW

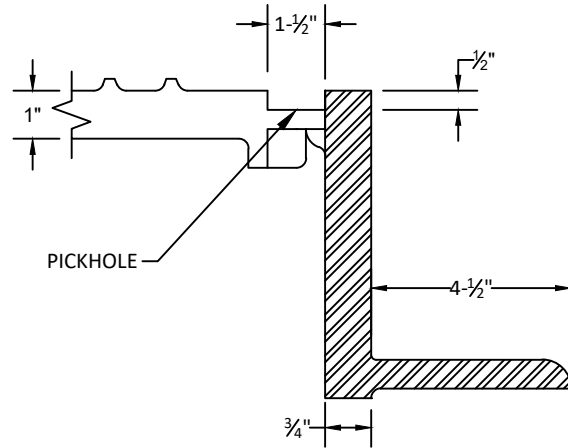
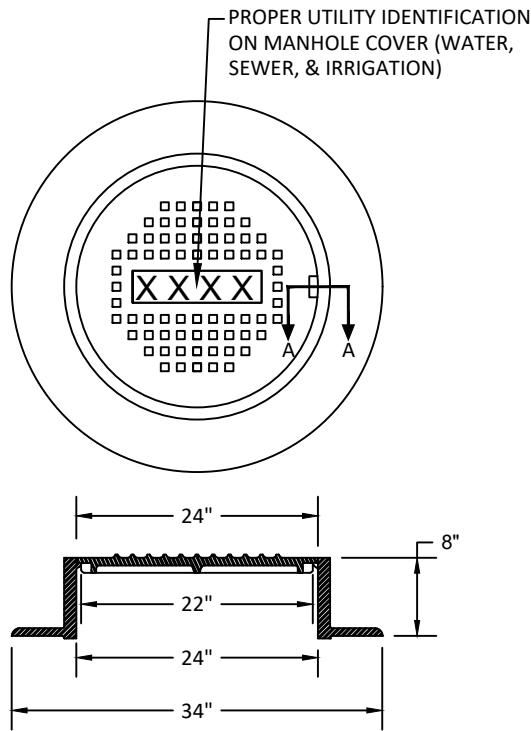


BORING AND ENCASEMENTS

DETAIL WS-3

DATE: JANUARY 2023

SCALE: N.T.S.



SECTION A-A PICK OPENING

NOTES:

1. THE "PROPER UTILITY" DESIGNATION SHALL BE CAST IN THE COVER (WATER, SEWER, IRRIGATION).
2. ALL RINGS SHALL BE A MAXIMUM EIGHT-INCH (8") IN HEIGHT
3. STANDARD IRON RING AND COVERS SHALL BE HS-20 LOADING, CAPABLE CAST IRON CONFORMING TO ASTM A48 CLASS 305B, WITH A BLACK BITUMINOUS FINISH.
 - 3.1. HORIZONTAL BEARING SURFACES OF ALL RINGS AND COVERS SHALL BE MACHINED TO ELIMINATE ANY ROCKING ACTION OR NON-UNIFORM BEARING.
 - 3.2. PICK-HOLE SHALL BE ONE AND ONE-HALF INCH (1-1/2") WIDE BY ONE-HALF INCH (1/2") DEEP.
4. COVERS SHALL BE NON-PERFORATED CHECKER PATTERN WITH MAXIMUM 3/16" "RAISED PATTERN IN NON-PEDESTRIAN TRAFFIC AREAS AND NON-PERFORATED, NON-SKID PATTERN COMPLYING WITH AMERICAN WITH DISABILITIES ACT (ADA) REQUIREMENTS IN PEDESTRIAN TRAFFIC AREAS.
5. MANHOLE COVERS LOCATED WITHIN DESIGNATED 100-YEAR FLOODPLAINS AND AREAS SUBJECT TO WATER INUNDATION SHALL BE THE NON-PERFORATED, WATER TIGHT, SOLID BOLT DOWN, & GASKETED COVER.
6. REFER TO WATER & SEWER SPECIFICATIONS, LATEST REVISION FOR ALL ACCEPTABLE RING AND COVER MANUFACTURERS & MODELS.

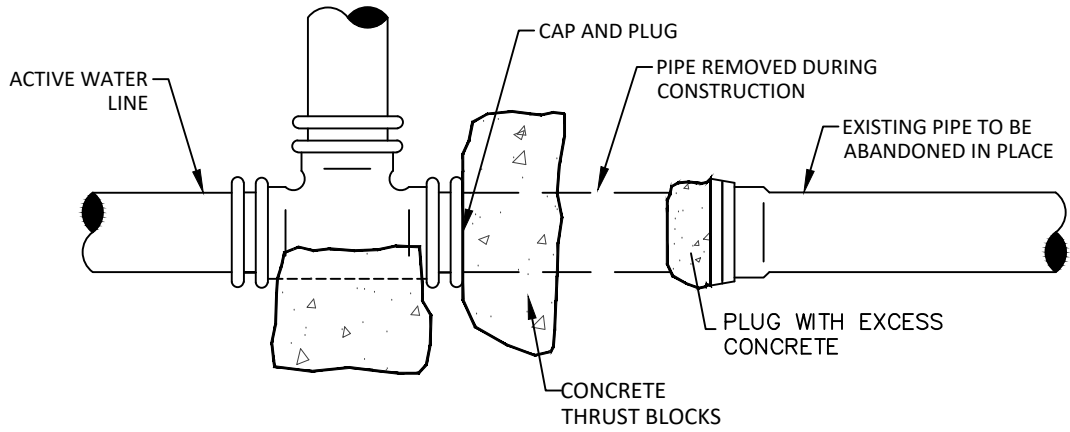


(TYP) MANHOLE COVER

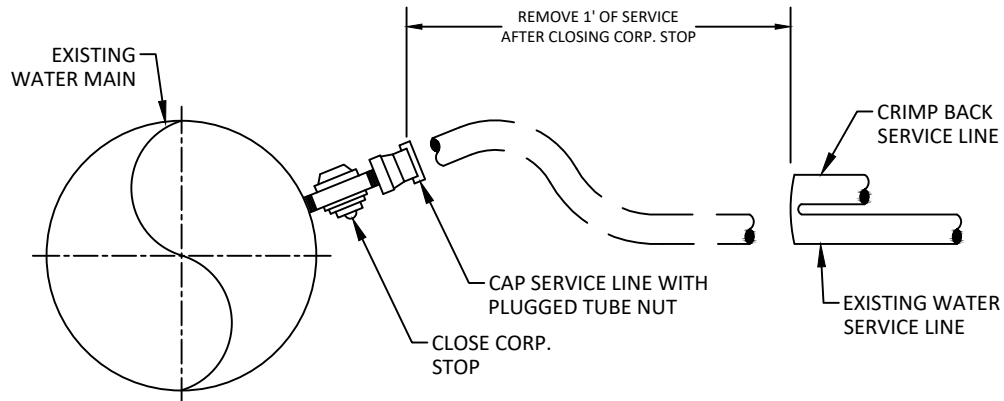
DETAIL WS-4

DATE: JANUARY 2023

SCALE: N.T.S.



EXISTING WATER MAIN ABANDONMENT DETAIL



EXISTING WATER SERVICE ABANDONMENT DETAIL

NOTES:

WATER MAIN ABANDONMENT

1. EXISTING WATER MAINS ABANDONED SHALL BE PLUGGED AND CAPPED AT NEAREST VALVE OR TEE OF ACTIVE WATER LINE AND SHALL HAVE CONCRETE THRUST BLOCK SIZED FOR DEAD ENDS REFERENCED IN DETAILS W-2A AND W-2B.
2. WATER MAIN ABANDONMENT MUST BE SCHEDULED WITH THE CITY 72 HOURS IN ADVANCE AT 970-350-9320.

WATER SERVICE ABANDONMENT

1. EXISTING WATER SERVICES THAT ARE TO BE ABANDONED SHALL BE ABANDONED AT THE MAIN.
2. SERVICE SHALL HAVE THE CORPORATION STOP CLOSED.
3. PLUGGED TUBE NUT SHALL BE INSTALLED NEAREST TO THE CORPORATION STOP.
4. THE END FURTHEST FROM THE CORPORATION STOP SHALL BE CRIMPED BACK.
5. REMOVE CURB STOP AT PROPERTY LINE.
6. IF THE SERVICE TO BE ABANDONED WAS DIRECTLY TAPPED ONTO THE MAIN, THE SERVICE MUST BE ABANDONED AT THE MAIN WITH THE SERVICE PIPE REMOVED AND A STAINLESS STEEL ROMAC REPAIR BAND PLACED OVER THE TAP.
7. WATER SERVICE ABANDONMENT MUST BE SCHEDULED WITH THE CITY 72 HOURS IN ADVANCE AT 970-350-9320.

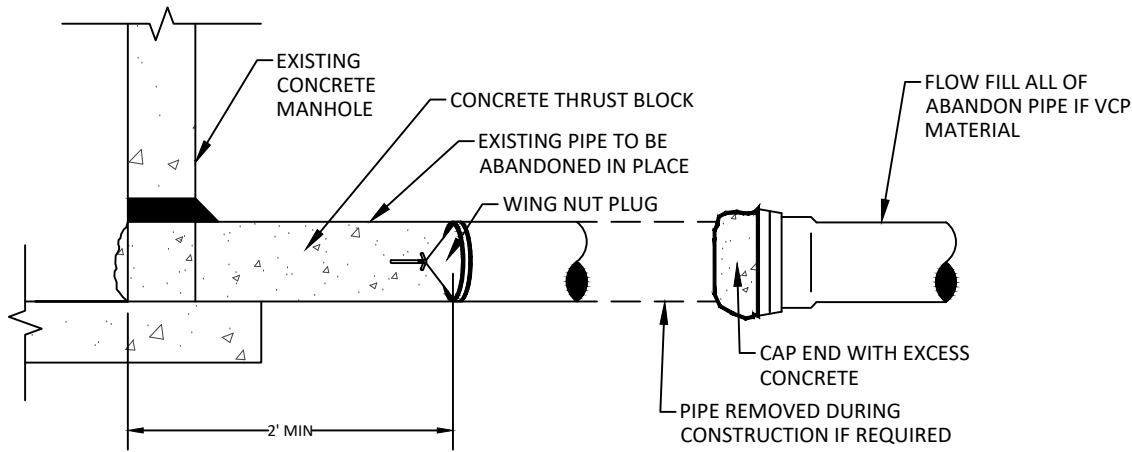


EXISTING WATER SERVICE & MAIN ABANDONMENT

DETAIL WS-5

DATE: JANUARY 2023

SCALE: N.T.S.



EXISTING SANITARY SEWER MAIN ABANDONMENT DETAIL

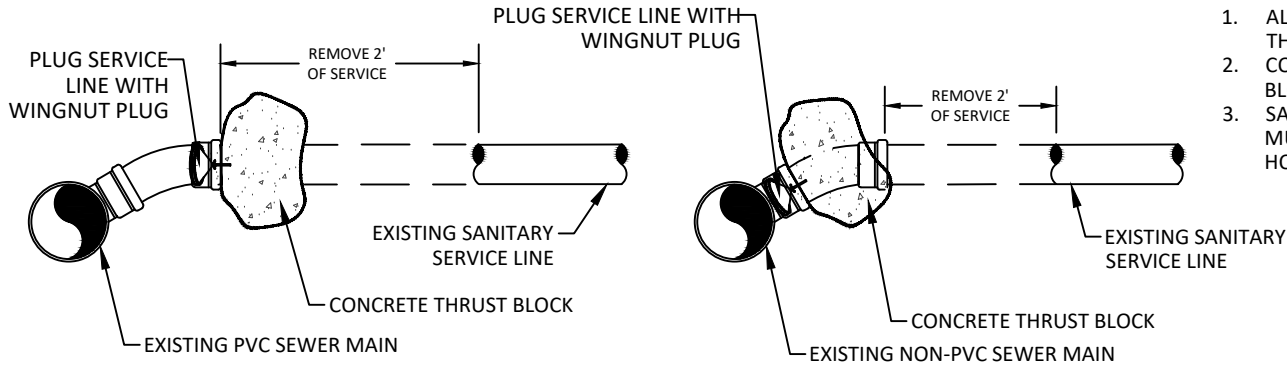
NOTES:

SANITARY SEWER MAIN ABANDONMENT

1. EXISTING SANITARY SEWER MAINS AND SERVICES ABANDONED IN MANHOLES SHALL HAVE A WING NUT PLUG PLACED 2' OUTSIDE OF MANHOLE & HAVE A CONCRETE THRUST BLOCK PLACED FROM INSIDE THE MANHOLE TO THE WING NUT PLUG.
2. ALL ABANDONED MAINS SHALL HAVE BOTH ENDS CAPPED AND ABANDON.
3. ANY EXISTING VITRIFIED CLAY PIPE (VCP) SHALL BE FLOW FILLED COMPLETELY. ALL OTHER PIPE MATERIALS SHALL BE CAPPED ON BOTH ENDS WITH CONCRETE.
4. SANITARY SEWER MAIN ABANDONMENT MUST BE SCHEDULED WITH THE CITY 72 HOURS IN ADVANCE AT 970-350-9322.

SANITARY SEWER SERVICE ABANDONMENT

1. ALL SEWER SERVICES SHALL BE PLUGGED AT THE SEWER MAIN.
2. CONTRACTOR TO INSTALL CONCRETE THRUST BLOCK BEHIND THE WING NUT PLUG.
3. SANITARY SEWER SERVICE ABANDONMENT MUST BE SCHEDULED WITH THE CITY 72 HOURS IN ADVANCE AT 970-350-9322.



EXISTING SANITARY SEWER SERVICE ABANDONMENT DETAIL

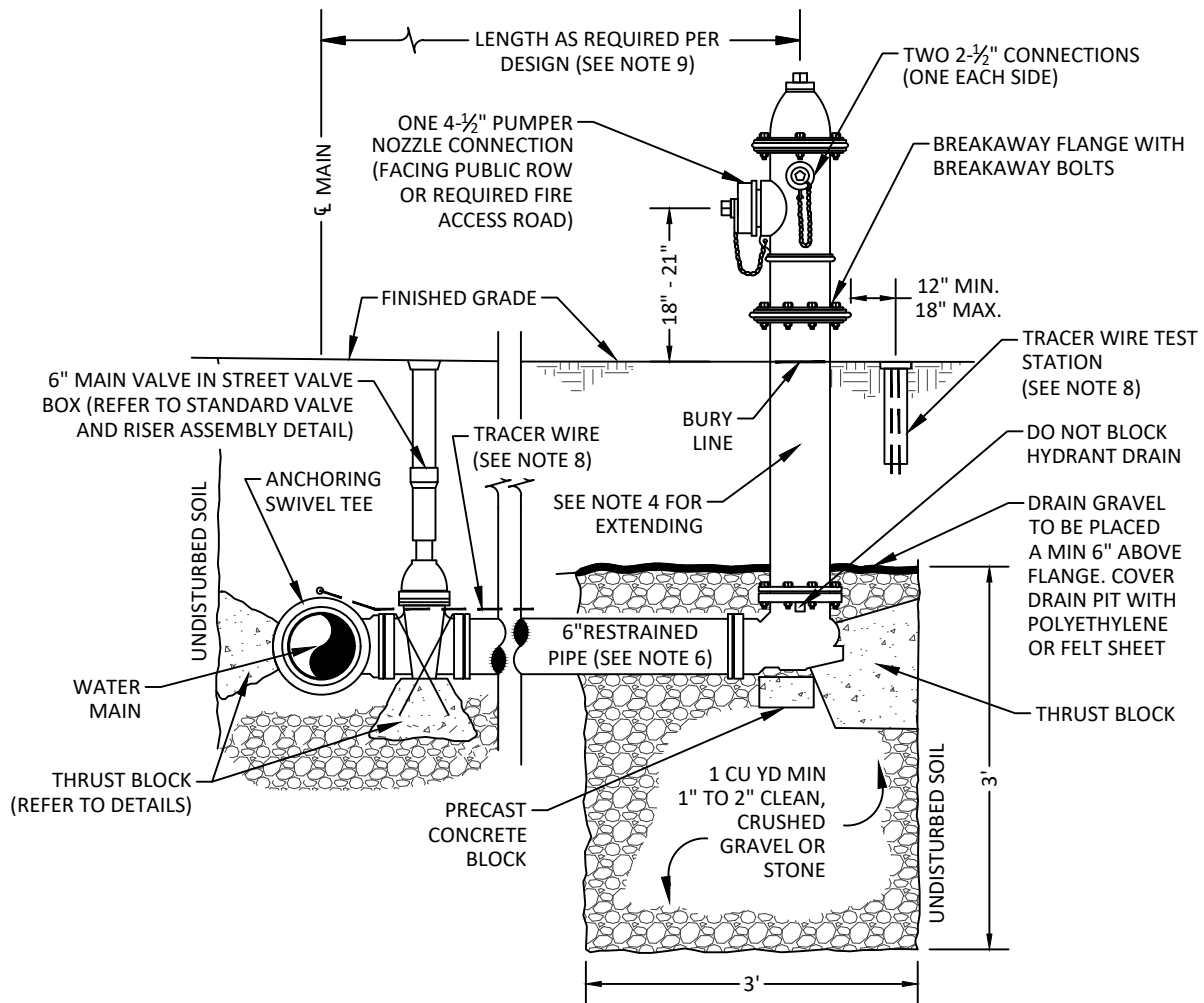


EXISTING SANITARY SEWER SERVICE & MAIN ABANDONMENT

DETAIL WS-6

DATE: JANUARY 2023

SCALE: N.T.S.



ELEVATION VIEW

NOTES:

1. MINIMUM DEPTH OF BURY 5'-6' FROM FINISHED GRADE TO TOP OF PIPE.
2. PROVIDE POLYETHYLENE BOND BREAKER BETWEEN ALL PIPE/FITTINGS AND POURED CONCRETE.
3. FIRE HYDRANTS MUST BE PURCHASED FROM W&S OPERATIONS WITH A MINIMUM 48 HOUR NOTICE. CALL TO ORDER 970-350-9320.
4. ONLY A SINGLE FIRE HYDRANT EXTENSION IS PERMITTED. FIRE HYDRANT EXTENSION MAY BE UP TO 36" (MAX) PER WATER & SEWER SPECIFICATIONS (W&S).
5. GRADELOK EXTENSIONS WILL BE ALLOWED FOR UP TO 2' MAXIMUM ELEVATION ADJUSTMENTS. ANY OTHER EXTENSIONS MUST BE APPROVED BY W&S DEPARTMENT.
6. ALL BURIED VALVES, FITTINGS, AND APPURTENANCES SHALL BE RESTRAINED AND INSTALLED PER W&S SPECIFICATIONS, LATEST REVISION.
7. EITHER D.I.P. OR PVC IS ACCEPTABLE FOR HYDRANT LATERAL PIPE MATERIAL.
8. BEDDING AND BACKFILL SHALL BE PLACED PER W&S SPECIFICATIONS
9. INSTALL TEST STATION AND TRACER WIRE ACCORDING TO W&S SPECIFICATIONS AND UTILITY LOCATING ("UL") STANDARD DETAILS, LATEST REVISION OF EACH.
10. HYDRANT DISTANCE FROM MAIN SHALL BE SUCH THAT THE MINIMUM FIRE FLOW AND PRESSURE MEETS WATER & SEWER DESIGN CRITERIA, LATEST REVISION. THE MAXIMUM DISTANCE A HYDRANT MAY BE FROM THE MAIN SHALL NOT EXCEED 150 FT UNLESS FURTHER HYDRAULIC ANALYSIS IS PERFORMED AND APPROVED BY THE CITY OF GREELEY WATER & SEWER DEPARTMENT.

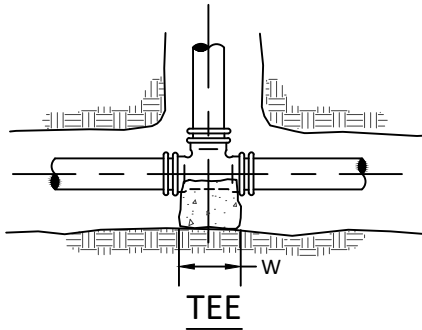


FIRE HYDRANT ASSEMBLY

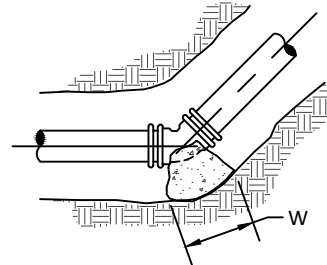
DETAIL W-1

DATE: JANUARY 2023

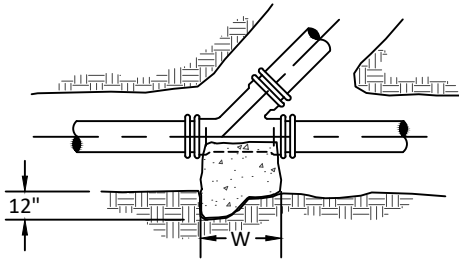
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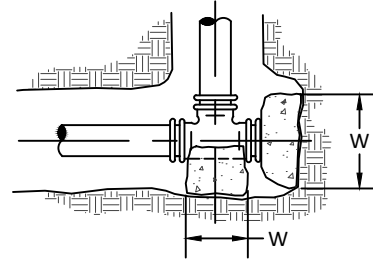
TEE



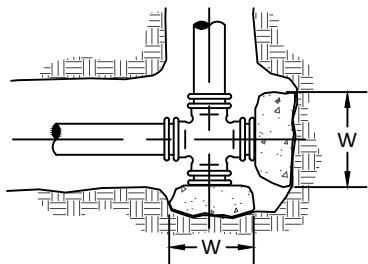
BEND-HORIZONTAL OR
BOTTOM OF VERTICAL



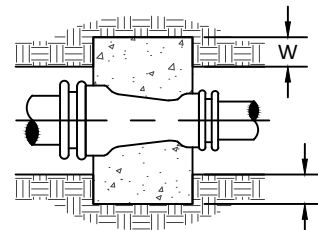
WYE



TEE W/DEAD END ON RUN

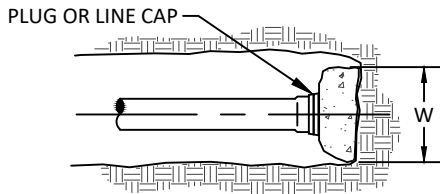


CROSS WITH DEAD END
BRANCHES



REDUCER

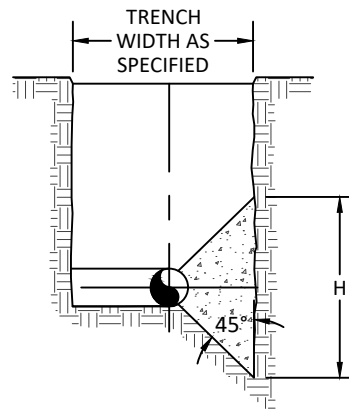
UNDISTURBED
EARTH VARIES
REFER TO
EQUATION ON
DETAIL W-4



DEAD END

NOTES:

1. SEE TABLE ON W-2B OF THRUST BLOCK DETAILS FOR MINIMUM AREA OF CONCRETE TO BEAR ON UNDISTURBED EARTH.
2. POLYETHYLENE BOND BREAKER SHALL BE INSTALLED BETWEEN ALL FITTINGS AND CONCRETE.



SECTION (TYPICAL)



HORIZONTAL THRUST BLOCKS

DETAIL W-2A

DATE: JANUARY 2023

SCALE: N.T.S.

**THRUST BLOCK BEARING AREAS (SQ-FT) FOR INTERNAL STATIC
PRESSURE OF 150 PSI, DIP I.D., SOIL BEARING CAPACITY OF 1000 PSF
AND 1.5 SAFETY FACTOR (S.F.)**

PIPE SIZE	90° BEND	45° BEND	22½° BEND	11¼° BEND	DEAD ENDS, VALVES & TEES, PLUGGED CROSS BRANCHES
4"	3.3	2.5	1.3	0.6	3.3
6"	10.2	5.5	2.8	1.4	7.2
8"	18.3	9.9	5.0	2.5	12.9
12"	39.9	21.6	11.0	5.5	28.2
16"	70.5	38.2	19.5	9.8	49.9
20"	SPECIAL DESIGN REQUIRED				
24"					

UNDISTURBED EARTH [FT²] = W [FT] X H [FT]

THRUST FORCE FOR REDUCERS [LB] = TEST PRESSURE [PSI] X (A_{LARGE} [IN²] - A_{SMALL} [IN²])

∴ GRAVITY BLOCK SIZE FOR REDUCERS [FT²] = 0.225 X (A_{LARGE} [IN²] - A_{SMALL} [IN²])

NOTES:

- POLYETHYLENE BOND BREAKER SHALL BE INSTALLED BETWEEN ALL FITTINGS AND CONCRETE.
- ALL THRUST BLOCKING SHALL BE CAST-IN-PLACE CONCRETE WITH A MINIMUM YIELD 28 DAY STRENGTH OF 2500 P.S.I.
- THRUST BLOCKING SHALL BE CAST AGAINST UNDISTURBED SOIL. FORMS SHALL BE USED AS REQUIRED TO OBTAIN ADEQUATE BEARING AREA AND TO CONFINE THE CONCRETE. THRUST BLOCKING SHALL BEAR ON THE FITTING OR END CAP ONLY AND WILL NOT BE ALLOWED TO SPILL OVER THE JOINT OR AGAINST THE PIPE.
- THE CITY MAY REQUIRE LARGER THRUST BLOCKS THAN SPECIFIED IF SOILS ARE DETERMINED TO PROVIDE LESS THAN 1000 PSF BEARING CAPACITY.
- IN THE ABSENCE OF SOIL BEARING CAPACITY INFORMATION USE 1000 PSF.
- NO LESS THAN 150 PSI TEST PRESSURE SHALL BE USED FOR THRUST BLOCK CALCULATIONS.
- BEARING AREAS FOR ANY PRESSURE AND SOIL BEARING CAPACITY MAY BE OBTAINED BY MULTIPLYING THE TABULATED BEARING AREAS BY A CORRECTION FACTOR "F":

$$F = \frac{(\text{ACTUAL SPECIFIED TEST PRESSURE IN PSI}) / (150 \text{ PSI})}{(\text{ACTUAL SOIL BEARING CAPACITY IN PSF}) / (1000 \text{ PSF})}$$

- EXAMPLE: CALCULATE THE BEARING AREA FOR 8"-90° BEND WITH A TEST PRESSURE OF 200 PSI AND SOIL BEARING CAPACITY OF 3000 PSF.

FROM TABLE BEARING AREA = 18.3 SF

$$F = \frac{(200 \text{ PSI}) / (150 \text{ PSI})}{(3000 \text{ PSF}) / (1000 \text{ PSF})} = 0.44$$

REQUIRED BEARING AREA ON UNDISTURBED SOIL = (0.44)(18.3 SF) = 8.1 SF

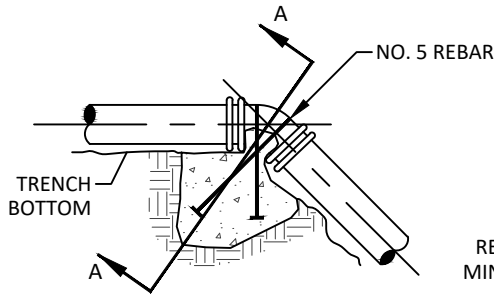


HORIZONTAL THRUST BLOCKS

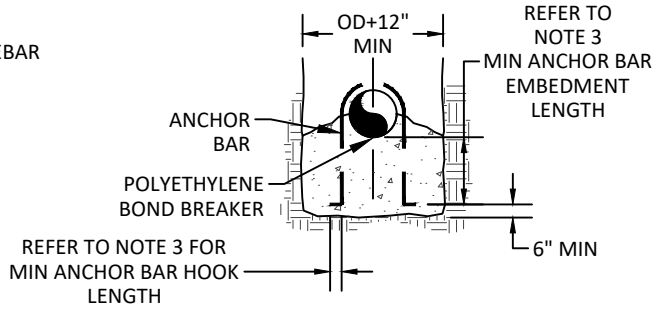
DETAIL W-2B

DATE: JANUARY 2023

SCALE: N.T.S.

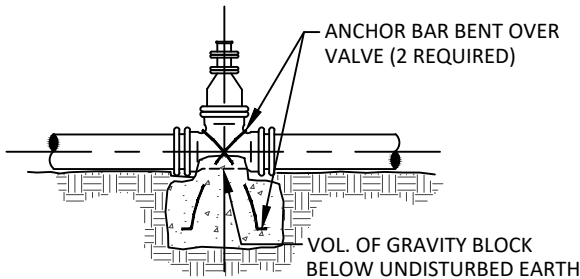


TOP OF VERTICAL BEND

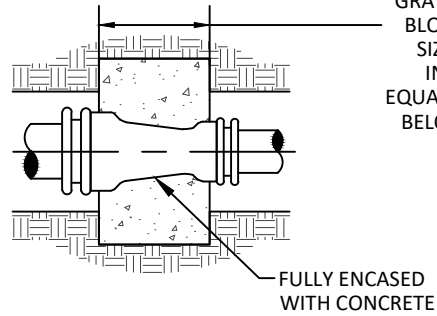


SECTION A-A

VARIES
BASED
ON
GRAVITY
BLOCK
SIZE
IN
EQUATION
BELOW



**VALVE
(GATE OR BUTTERFLY)**



REDUCER

**VOL. OF GRAVITY CONCRETE
BLOCK (CU FT)**

PIPE SIZE	BENDS		
	45°	22 ½°	11 ¼°
4"	16.7	8.5	4.3
6"	36.9	18.8	9.5
8"	65.9	33.6	16.9
12"	144.1	73.4	36.9
16"	254.5	129.7	65.2
20"	SPECIAL DESIGN REQUIRED		
24"			

NOTES:

1. POLYETHYLENE BOND BREAKER SHALL BE INSTALLED BETWEEN ALL FITTINGS AND CONCRETE.
2. ALL ANCHOR BARS SHALL BE EPOXY COATED NO. 5 REBAR AND SHALL BE EMBEDDED IN CONCRETE TO WITHIN 6" OF END OF CONCRETE BLOCK AND SHALL HAVE MINIMUM 6" HOOK LENGTH.

GRAVITY CONCRETE BLOCK SIZES SHOWN IN TABLE ARE BASED ON 150 LB/FT³ DENSITY FOR CONCRETE, 150 PSI TEST PRESSURE, AND A SAFETY FACTOR OF 1.5.

$$\text{GRAVITY BLOCK SIZE [FT}^3\text{]} = \frac{\text{SAFETY FACTOR X THRUST FORCE [LB]}}{\text{DENSITY OF BLOCK MATERIAL [LB/FT}^3\text{]}}$$

$$\text{THRUST FORCE FOR REDUCERS [LB]} = \text{TEST PRESSURE [PSI]} \times (A_{\text{LARGE}} [\text{IN}^2] - A_{\text{SMALL}} [\text{IN}^2])$$

$$\therefore \text{GRAVITY BLOCK SIZE FOR REDUCERS [FT}^3\text{]} = 1.5 \times (A_{\text{LARGE}} [\text{IN}^2] - A_{\text{SMALL}} [\text{IN}^2])$$

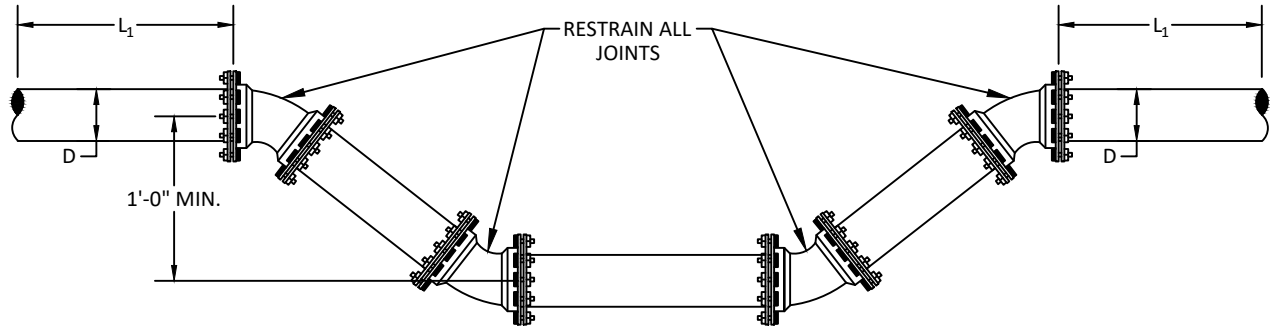


GRAVITY THRUST BLOCKS

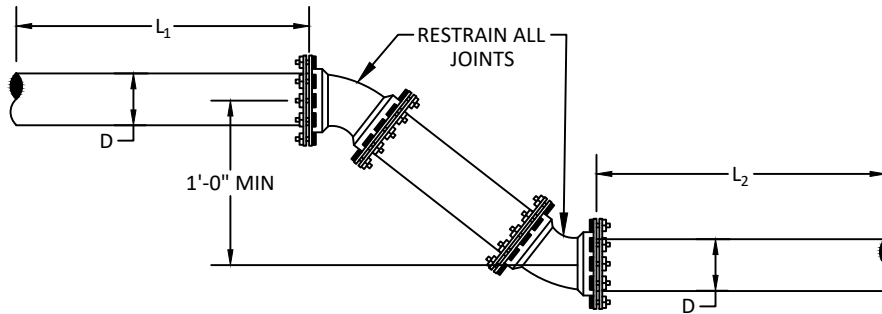
DETAIL W-3

DATE: JANUARY 2023

SCALE: N.T.S.



VERTICAL LOWERING



VERTICAL OFFSET

DI PIPE (POLYETHYLENE-ENCASED): MINIMUM LENGTHS OF RESTRAINED PIPE - IN FEET

PIPE SIZES (D")	VERTICAL BENDS					
	11¼° BEND		22½° BEND		45° BEND	
	L ₁	L ₂	L ₁	L ₂	L ₁	L ₂
4"	5	5	10	5	25	5
6"	10	5	15	5	30	10
8"	10	5	20	5	40	10
12"	15	5	30	10	55	15
16"	20	5	35	10	70	20

NOTES:

1. RESTRAINED LENGTHS SHOWN IN CHARTS ARE MINIMUM LENGTHS.
2. RESTRAINT SYSTEMS ON PIPE LARGER THAN 16-INCH DIAMETER SHALL BE DESIGNED FOR CONDITIONS EXISTING AT INSTALLATION SITE.
3. THE CHARTS ARE BASED ON THE FOLLOWING ASSUMPTIONS:
 - A. 150 PSI TEST PRESSURE
 - B. 1.5 SAFETY FACTOR
 - C. 4-FT BURY DEPTH
 - D. SOIL TYPE: ML, AS DEFINED BY AWWA M23 AND M41
 - E. TRENCH TYPE: #4, AS DEFINED BY AWWA M23 AND M41
4. THE DESIGN ENGINEER IS RESPONSIBLE FOR VERIFYING THE ACTUAL SITE CONDITIONS WITH RESPECT TO THE ASSUMPTIONS LISTED ABOVE.
5. IF LENGTHS CANNOT BE MET FOR DEAD ENDS AND/OR TEES, DESIGN ENGINEER SHALL SPECIFY RESTRAINED LENGTHS OR A COMBINATION OF THRUST BLOCKS AND RESTRAINTS.

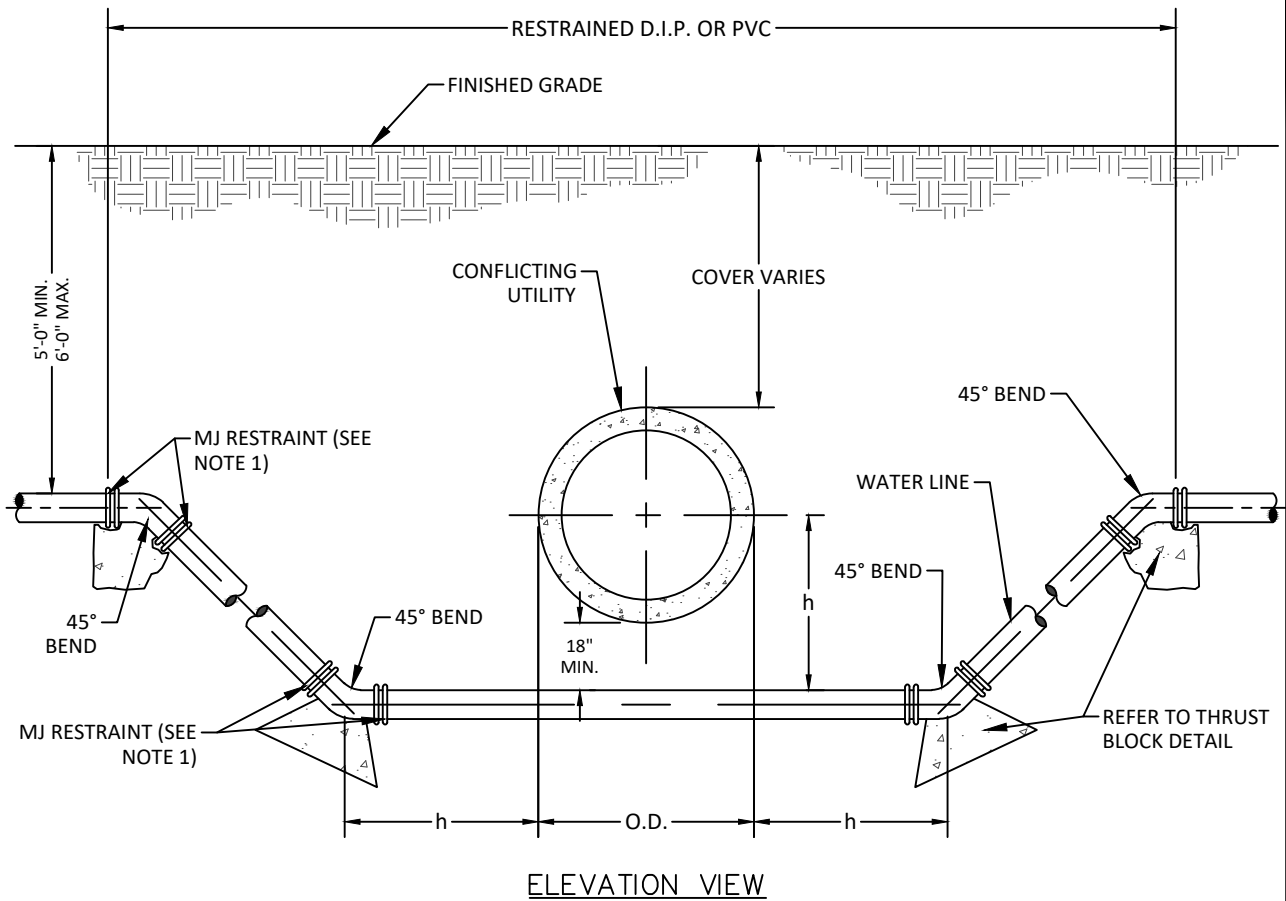


VERTICAL PIPE RESTRAINT

DETAIL W-4B

DATE: JANUARY 2023

SCALE: N.T.S.



NOTES:

1. ALL FOUR VERTICAL 45-DEGREE BENDS SHALL BE RESTRAINED BY MECHANICAL JOINT RESTRAINTS AND THRUST BLOCKS PER THE LATEST REVISION OF W&S THRUST BLOCK DETAILS. ALL BURIED PIPE, FITTINGS, AND APPURTENANCES SHALL BE RESTRAINED AND INSTALLED PER WATER & SEWER (W&S) SPECIFICATIONS, LATEST REVISION.
2. INSTALL TRACER WIRE ACCORDING TO WATER & SEWER SPECIFICATIONS AND STANDARD UTILITY LOCATING ("UL") DETAILS, LATEST REVISION OF EACH.
3. MINIMUM CLEARANCE FROM CONFLICTING UTILITY SHALL BE NO LESS THAN 18 INCHES AT THE NEAREST DIMENSION OR ENCASED PER DETAIL WS-3.
4. INSULATION BOARD ABOVE THE WATERLINE IS REQUIRED IF THE WATER LINE CROSSES WITHIN 4 FEET OF STORMWATER CROSSINGS OR OTHER OPEN-AIR CONDUITS. IN SUCH CASES, INSULATION BOARD SHALL EXTEND 5 FT HORIZONTALLY ON EITHER SIDE OF THE CROSSING CONDUIT. PLACEMENT SHALL BE IN ACCORDANCE WITH THE SEPARATE TRENCH CROSS SECTION DETAIL AND W&S SPECIFICATIONS, LATEST REVISION OF EACH.

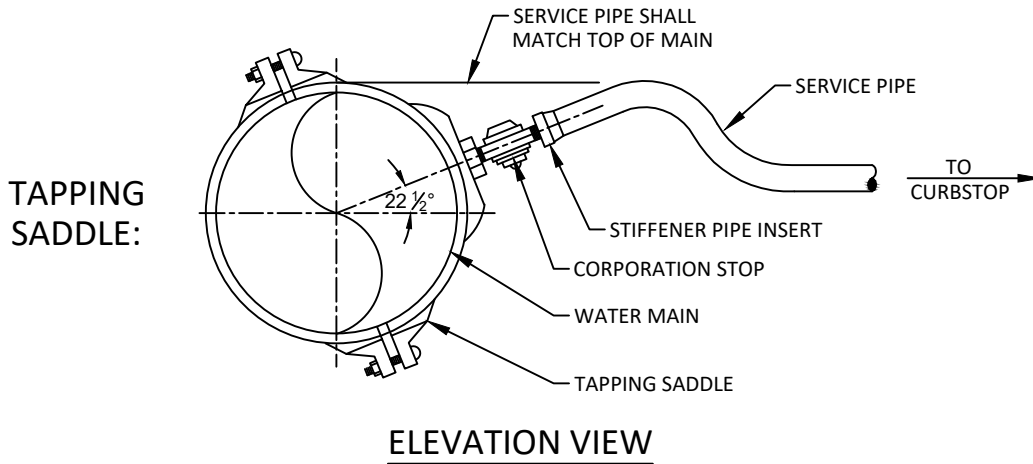


VERTICAL PIPE LOWERING

DETAIL W-5

DATE: JANUARY 2023

SCALE: N.T.S.



TYPE OF PIPE AND SIZE OF TAP												
PIPE SIZE	CAST IRON					DUCTILE IRON					PVC C-900	
	3/4"	1"	1 1/2"	2"	3"&4"	3/4"	1"	1 1/2"	2"	3"&4"	< 2"	> 2"
4"	S	S	NO	NO	TSV	S	S	NO	NO	TSV	S	TSV
6"	S	S	S	S	TSV	S	S	S	S	TSV	S	TSV
8"	S	S	S	S	TSV	S	S	S	S	TSV	S	TSV
12"	S	S	S	S	TSV	S	S	S	S	TSV	S	TSV
16"	S	S	S	S	TSV	S	S	S	S	TSV	N/A	N/A

- "S" - TAPPING SADDLE REQUIRED, ALL SADDLES SHALL HAVE AWWA TAPER THREADS.
- "NO" - NO TAP PERMITTED WITH OR WITHOUT A SADDLE, A TEE CONNECTION MAY BE PERMITTED IF SPECIFICALLY AUTHORIZED BY THE WATER DEPARTMENT.
- "TSV" - TAPPING SLEEVE AND VALVE REQUIRED.
- "N/A" - NOT APPLICABLE.

NOTES:

1. REFERENCE CITY OF GREELEY, WATER & SEWER CONSTRUCTION SPECIFICATIONS, LATEST REVISION, FOR TAPPING SADDLE SPECIFICATIONS.
2. EXISTING STEEL MAINS, TWELVE INCHES (12") IN DIAMETER OR LESS, SHALL BE TAPPED USING A CITY ACCEPTED TAPPING SADDLE.
3. ALL BURIED PIPE, FITTINGS, VALVES, AND APPURTENANCES SHALL BE RESTRAINED AND INSTALLED PER CITY OF GREELEY WATER & SEWER SPECIFICATIONS, LATEST REVISION.
4. INSTALL TRACER WIRE ACCORDING TO CITY OF GREELEY WATER & SEWER SPECIFICATIONS AND W&S UTILITY LOCATING ("UL") STANDARD DETAILS, LATEST REVISION OF EACH.
5. REFER TO CITY OF GREELEY WATER AND SEWER SPECIFICATIONS, LATEST REVISION, FOR PRODUCT AND MFR SPECIFICATIONS.
6. THIS DETAIL ALSO APPLIES TO NON-POTABLE IRRIGATION SERVICE CONNECTIONS TO NON-POTABLE IRRIGATION MAINS.
7. SERVICE TAPS ON WATER MAINS LARGER THAN 16" MAY BE CONSIDERED UNDER CERTAIN CIRCUMSTANCES WITH SPECIAL DESIGN ON A CASE-BY-CASE SCENARIO.
8. FOR ANY NEW WATER SERVICES TAPPING INTO EXISTING MAINS THE CONTRACTOR SHALL NOTIFY THE CITY 72 HOURS PRIOR AT 970-350-9320.

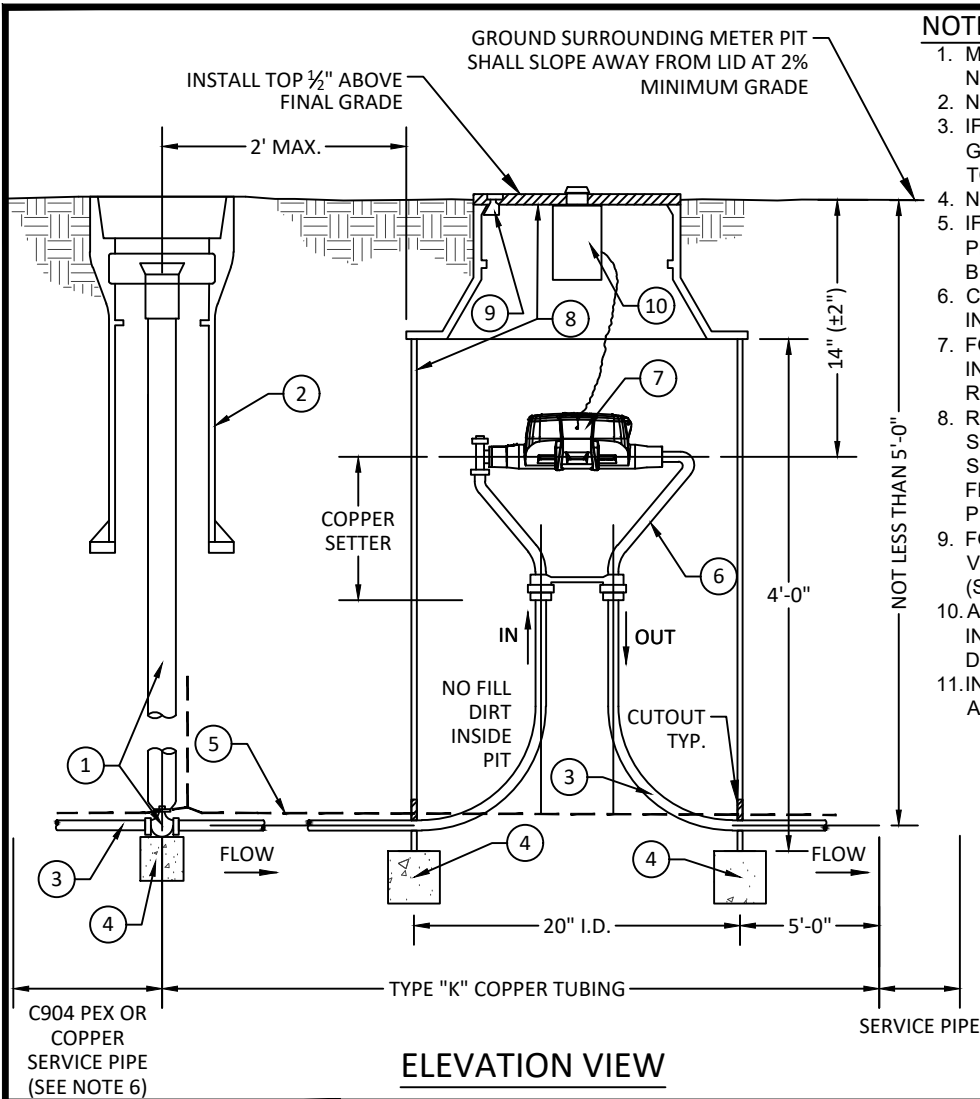


WATER SERVICE CONNECTION

DETAIL W-6

DATE: JANUARY 2023

SCALE: N.T.S.



NOTES:

1. METER MUST BE PURCHASED FROM THE WATER & SEWER (W&S) DEPARTMENT. NO EXCEPTIONS.
2. NOT FOR INSTALLATION IN ROADWAYS, DRIVEWAYS, OR PARKING AREAS.
3. IF SURFACE IS NOT TO FINAL GRADE AT TIME OF INSTALLATION OF METER, OR GRADE CHANGES AFTER INSTALLATION, PROPERTY OWNER MUST ADJUST PIT TO MEET DEPTH AND SPECIFICATIONS.
4. NO CONCRETE FLOOR SHALL BE POURED IN METER PIT.
5. IF PRESSURE REDUCING VALVE AND/OR BACKFLOW DEVICE IS REQUIRED BY PLUMBING CODE, IT SHALL BE INSTALLED DOWNSTREAM OF METER PER BUILDING AND PLUMBING CODE.
6. COPPER SHALL NOT SHOW ANY VISIBLE SIGNS OF CRIMPING AND SHALL BE INSTALLED FROM CURB STOP TO 5 FEET PAST METER PIT.
7. FOR ADDITIONAL METER INSTALLATION REQUIREMENTS, REFER TO METER INSTALLATION NOTES ON CITY OF GREELEY W&S DETAIL W-15, LATEST REVISION.
8. REFER TO CITY OF GREELEY W&S DETAIL W-9 AND CONSTRUCTION SPECIFICATIONS, LATEST REVISION OF EACH, FOR CURB STOP, BOX, AND SERVICE PIPE REQUIREMENTS. IF CROSS-LINKED C904 PEX SERVICE LINE USED FROM CORP STOP TO CURB STOP THE PEX LINE MUST BE UPSIZED TO NEXT PIPE SIZE FROM METER SIZE TO REDUCE LOSS OF PRESSURE.
9. FOR PRODUCT AND MANUFACTURER SPECIFICATIONS, REFER TO CURRENT VERSION OF CITY OF GREELEY W&S CONSTRUCTION SPECIFICATIONS (SPECIFICATIONS), LATEST REVISION.
10. ALL BURIED PIPE, FITTINGS, VALVES, AND APPURTENANCES SHALL BE INSTALLED AND RESTRAINED IN ACCORDANCE WITH WATER & SEWER DEPARTMENT SPECIFICATIONS, LATEST REVISION.
11. INSTALL TRACER WIRE ACCORDING TO CITY OF GREELEY W&S SPECIFICATIONS AND STANDARD DETAILS, LATEST REVISION.

LEGEND	
1	CURB STOP VALVE & SERVICE BOX (SEE NOTE 8)
2	UPPER HALF OF STANDARD VALVE BOX (INSTALLED PER SPECIFICATIONS)
3	3/4" OR 1" SERVICE PIPE (MATCH SERVICE PIPE I.D.) (SEE NOTE 8)
4	BRICK SUPPORT (PLACE ON UNDISTURBED SOIL)
5	TRACER WIRE (SEE NOTE 11)
6	COPPER METER SETTER (MFR PER SPECIFICATIONS)
7	METER UNIT (ORDER FROM CITY OF GREELEY METER SHOP)
8	COMPOSITE DOUBLE LID CONE OR APPROVED EQUAL (MFR PER SPECIFICATIONS)
9	STANDARD FORGED BRASS WATERWORKS PENTAGON HEAD WITH LOCKING SCREW
10	METER ENDPOINT RADIO TRANSMITTER (RT UNIT)
11	TYPE K COPPER MATCHING METER SIZE

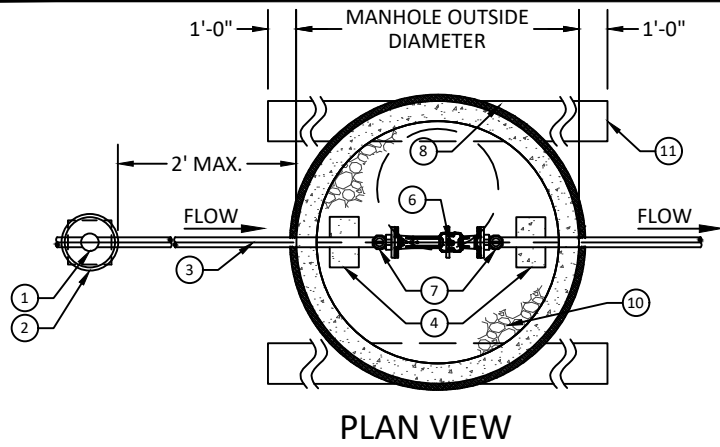


OUTSIDE SETTING FOR 3/4" & 1" POTABLE WATER METER

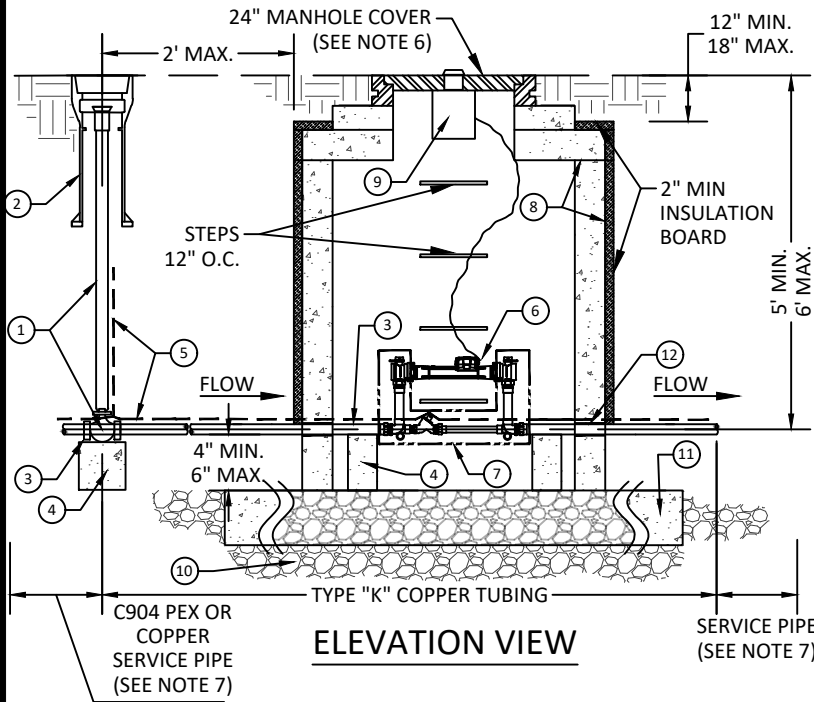
DETAIL W-7

DATE: JANUARY 2023

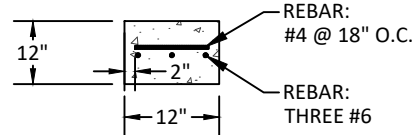
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PLAN VIEW



ELEVATION VIEW



BASE BEAM DETAIL

NOTES:

1. METER MUST BE PURCHASED FROM THE WATER & SEWER (W&S) DEPARTMENT. NO EXCEPTIONS.
2. FOR PRODUCT AND MANUFACTURER SPECIFICATIONS, REFER TO CURRENT VERSION OF CITY OF GREELEY W&S CONSTRUCTION SPECIFICATIONS (SPECIFICATIONS).
3. REFER TO W&S DETAIL W-15, LATEST REVISION, FOR ADDITIONAL METER INSTALLATION AND VAULT REQUIREMENTS.
4. ALL VAULTS, BURIED PIPE, FITTINGS, VALVES, AND APPURTENANCES SHALL MEET CITY OF GREELEY W&S SPECIFICATIONS, LATEST REVISION.
5. NO CONCRETE FLOOR SHALL BE POURED IN METER VAULT.
6. 24" MANHOLE COVER SHALL BE A WORM LOCK LID MARKED "WATER", REFER TO CITY OF GREELEY W&S SPECIFICATIONS, LATEST REVISION, FOR SPECIFIC MANHOLE COVER MFR AND PRODUCT INFORMATION.
7. REFER TO CITY OF GREELEY W&S DETAIL W-9 AND CONSTRUCTION SPECIFICATIONS, LATEST REVISION OF EACH, FOR CURB STOP, BOX, AND SERVICE PIPE REQUIREMENTS. IF CROSS-LINKED C904 PEX SERVICE LINE USED FROM CORP STOP TO CURB STOP THE PEX LINE MUST BE UPSIZED TO NEXT PIPE SIZE FROM METER SIZE TO REDUCE LOSS OF PRESSURE.
8. INSTALL TRACER WIRE ACCORDING TO CITY OF GREELEY W&S SPECIFICATIONS AND STANDARD DETAILS, LATEST REVISION.

LEGEND

1	CURB STOP VALVE AND SERVICE BOX
2	UPPER HALF OF STANDARD VALVE BOX (INSTALLED PER SPECIFICATIONS)
3	1-1/2" OR 2" SERVICE PIPE (MATCH SERVICE PIPE I.D.) (SEE NOTE 7)
4	BRICK SUPPORT (PLACED ON UNDISTURBED SOIL OR 1-1/2" STABILIZATION ROCK)
5	TRACER WIRE (SEE NOTE 9)
6	METER UNIT (ORDER FROM CITY OF GREELEY METER SHOP) (SEE NOTES 10 & 11)
7	COPPER METER SETTER (MFR PER SPECIFICATIONS)
8	48" DIAMETER OR SQUARE CONCRETE MANHOLE (SEE NOTE 4 FOR PRE-CAST)
9	METER ENDPOINT RADIO TRANSMITTER (RT UNIT)
10	6" MIN OF SUBGRADE MATERIAL UNDER GRADE BEAM AND INSIDE VAULT PER SPECIFICATION
11	CONCRETE MANHOLE BASE BEAM (SEE BASE BEAM DETAIL)
12	APPROVED RUBBER SEAL ON PIPE BARREL AT WALL PENETRATION PER SPECIFICATION

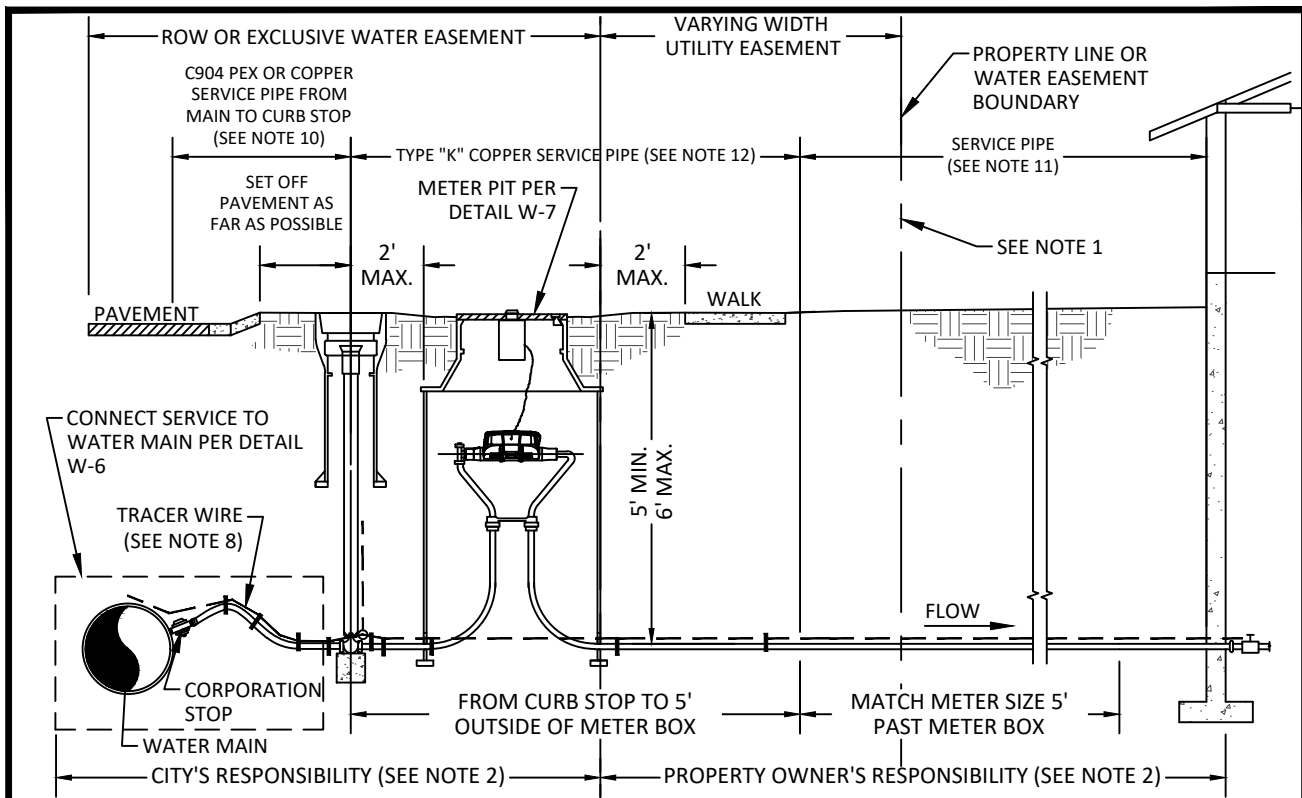


OUTSIDE SETTING FOR 1-1/2" & 2" POTABLE WATER METER

DETAIL W-8

DATE: JANUARY 2023

SCALE: N.T.S.



ELEVATION VIEW

NOTES:

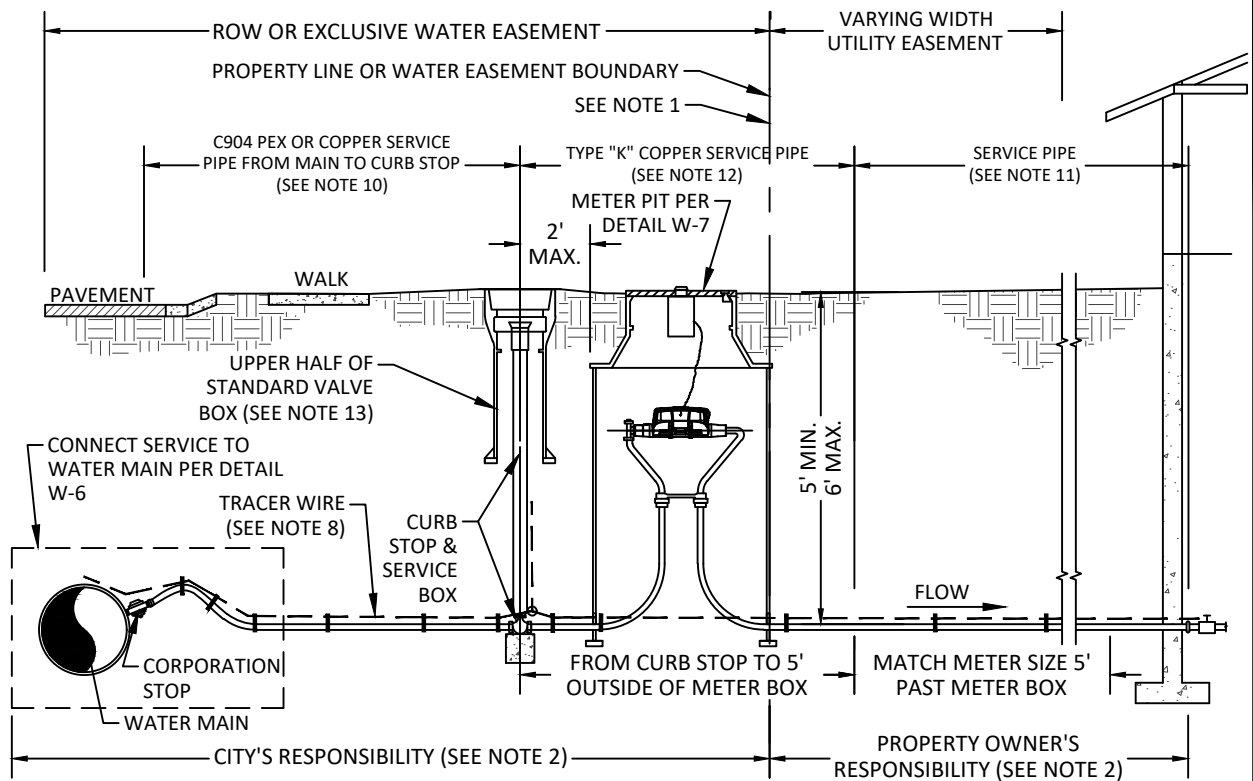
1. PLACEMENT OF CURB STOP SERVICE BOX MAY VARY FROM LANDSCAPE PARKWAY TO A MAXIMUM OF ±1 FOOT OF THE PROPERTY LINE. ANY VARIANCE OF LOCATION OF CURB STOP MUST BE APPROVED PRIOR TO CONSTRUCTION.
2. WATER DEPARTMENT'S RESPONSIBILITY SHALL BE THE WATER MAIN, THE METER INSIDE THE METER PIT, THE CORPORATION STOP, AND SERVICE PIPING FROM THE WATER MAIN UP TO DOWNSTREAM OF METER. PROPERTY OWNER'S RESPONSIBILITY SHALL INCLUDE EVERYTHING DOWNSTREAM OF METER STRUCTURE.
3. SHOULD ANY SITUATION ARISE OTHER THAN SHOWN CONCERNING THE DEPTH OR OBSTRUCTION OF SERVICE LINE OR THE PLACEMENT OF THE METER PIT OR STOP BOX, CALL (970) 350-9317 AND ASK FOR METER SERVICES DIVISION.
4. REFER TO WATER & SEWER (W&S) STANDARD DRAWINGS AND CONSTRUCTION SPECIFICATIONS (SPECIFICATIONS) FOR METER INSTALLATION REQUIREMENTS.
5. POTABLE WATER SERVICE METER PITS/ VAULTS SHALL BE LOCATED IN A LANDSCAPE PARKWAY AREA WITHIN 2 FEET OF THE CURB STOP. SEE DESIGN CRITERIA, LATEST REVISION, FOR METER PIT LOCATION.
6. CURB STOP IS TO BE MINNEAPOLIS PATTERN OR APPROVED EQUAL.
7. CURB STOP MUST BE INSTALLED WITH EITHER PLASTIC OR STAINLESS STEEL PIPE INSERTS TO ENSURE PROPER COMPRESSION FITTING ON C904 CROSS-LINKED PEX PIPE.
8. INSTALL TRACER WIRE ACCORDING TO CITY OF GREELEY W&S SPECIFICATIONS AND STANDARD DETAILS, LATEST REVISION.
9. ALL BURIED PIPE, FITTINGS, VALVES, AND APPURTENANCES SHALL BE INSTALLED AND RESTRAINED IN ACCORDANCE WITH W&S SPECIFICATIONS, LATEST REVISION.
10. COPPER OR C904 CROSS-LINKED PEX SERVICE LINE SHALL BE INSTALLED FROM THE CORPORATION STOP TO CURB STOP. REFER TO W&S CONSTRUCTION SPECIFICATIONS FOR APPROVED SERVICE PIPE PRODUCT AND MFR REQUIREMENTS.
11. FROM 5 FT PAST THE METER PIT ON THE OWNER SIDE UP TO BUILDING STRUCTURE SHALL BE IN ACCORDANCE WITH BUILDING CODE AND DRINKING WATER REQUIREMENTS.
13. TYPE "K" COPPER SHALL BE PLACED FROM THE CURB STOP, THROUGH THE METER PIT, AND UP TO 5 FEET PAST THE METER PIT ON CUSTOMER SIDE.
14. ALL SERVICE PIPE SHALL BE SIZED ACCORDING TO SERVICE TAP INSIDE DIAMETER AND MUST COMPLY WITH AWWA C904. SEE W&S DESIGN CRITERIA, LATEST REVISION.
15. UPPER HALF OF STANDARD VALVE BOX SHALL BE PLACED OVER CURB STOP AND TRACER WIRE TEST STATION LOOP ACCORDING TO W&S SPECIFICATIONS, LATEST REVISION.



POTABLE WATER SERVICE LINE, STOP BOX & METER INSTALLATION (INSIDE LANDSCAPE PARKWAY) DETAIL W-9A

DATE: JANUARY 2023

SCALE: N.T.S.



ELEVATION VIEW

NOTES:

1. PLACEMENT OF CURB STOP SERVICE BOX MAY VARY FROM LANDSCAPE PARKWAY TO A MAXIMUM OF ±1 FOOT OF THE PROPERTY LINE. ANY VARIANCE OF LOCATION OF CURB STOP MUST BE APPROVED PRIOR TO CONSTRUCTION.
2. WATER DEPARTMENT'S RESPONSIBILITY SHALL BE THE WATER MAIN, THE METER INSIDE THE METER PIT, THE CORPORATION STOP, AND SERVICE PIPING FROM THE WATER MAIN UP TO DOWNSTREAM OF METER. PROPERTY OWNER'S RESPONSIBILITY SHALL INCLUDE EVERYTHING DOWNSTREAM OF METER STRUCTURE.
3. SHOULD ANY SITUATION ARISE OTHER THAN SHOWN CONCERNING THE DEPTH OR OBSTRUCTION OF SERVICE LINE OR THE PLACEMENT OF THE METER PIT OR STOP BOX, CALL (970) 350-9317 AND ASK FOR METER SERVICES DIVISION.
4. REFER TO WATER & SEWER (W&S) STANDARD DRAWINGS AND CONSTRUCTION SPECIFICATIONS (SPECIFICATIONS) FOR METER INSTALLATION REQUIREMENTS.
5. POTABLE WATER SERVICE METER PITS/ VAULTS SHALL BE LOCATED IN A LANDSCAPE PARKWAY AREA WITHIN 2 FEET OF THE CURB STOP. SEE DESIGN CRITERIA, LATEST REVISION, FOR METER PIT LOCATION.
6. CURB STOP IS TO BE MINNEAPOLIS PATTERN OR APPROVED EQUAL.
7. CURB STOP MUST BE INSTALLED WITH EITHER PLASTIC OR STAINLESS STEEL PIPE INSERTS TO ENSURE PROPER COMPRESSION FITTING ON C904 CROSS-LINKED PEX PIPE.
8. INSTALL TRACER WIRE ACCORDING TO CITY OF GREELEY W&S SPECIFICATIONS AND STANDARD DETAILS, LATEST REVISION.
9. ALL BURIED PIPE, FITTINGS, VALVES, AND APPURTENANCES SHALL BE INSTALLED AND RESTRAINED IN ACCORDANCE WITH W&S SPECIFICATIONS, LATEST REVISION.
10. COPPER OR C904 CROSS-LINKED PEX SERVICE LINE SHALL BE INSTALLED FROM THE CORPORATION STOP TO CURB STOP. REFER TO W&S CONSTRUCTION SPECIFICATIONS FOR APPROVED SERVICE PIPE PRODUCT AND MFR REQUIREMENTS.
11. FROM 5 FT PAST THE METER PIT ON THE OWNER SIDE UP TO BUILDING STRUCTURE SHALL BE IN ACCORDANCE WITH BUILDING CODE AND DRINKING WATER REQUIREMENTS.
13. TYPE "K" COPPER SHALL BE PLACED FROM THE CURB STOP, THROUGH THE METER PIT, AND UP TO 5 FEET PAST THE METER PIT ON CUSTOMER SIDE.
14. ALL SERVICE PIPE SHALL BE SIZED ACCORDING TO SERVICE TAP INSIDE DIAMETER AND MUST COMPLY WITH AWWA C904. SEE W&S DESIGN CRITERIA, LATEST REVISION.
15. UPPER HALF OF STANDARD VALVE BOX SHALL BE PLACED OVER CURB STOP AND TRACER WIRE TEST STATION LOOP ACCORDING TO W&S SPECIFICATIONS, LATEST REVISION.



POTABLE WATER SERVICE LINE, STOP BOX & METER INSTALLATION (OUTSIDE LANDSCAPE PARKWAY) DETAIL W-9B

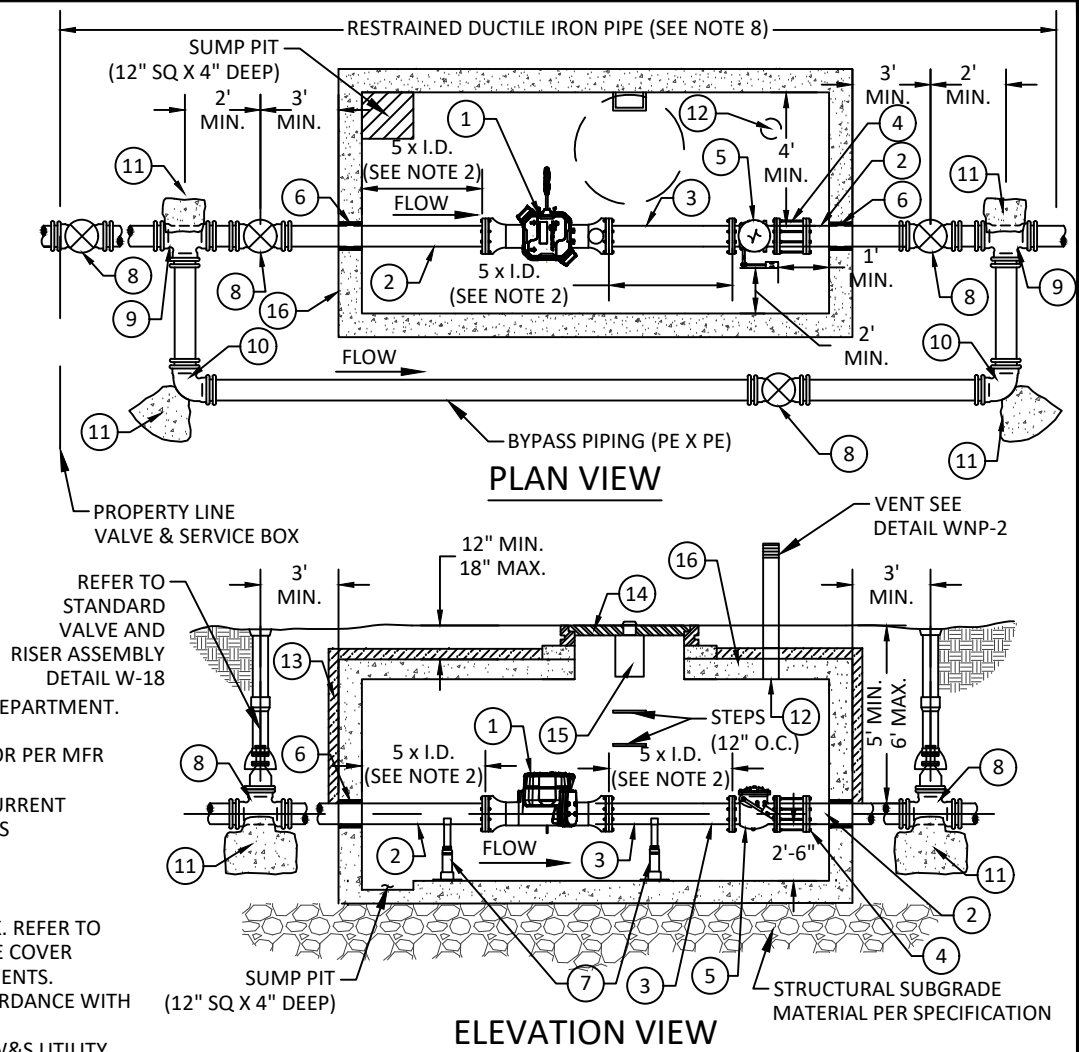
DATE: JANUARY 2023

SCALE: N.T.S.

LEGEND	
1	METER (SEE NOTE 1)
2	FLG X PE SPOOL PIECE WITH WALL RING IN CENTER OF VAULT WALL
3	FLG X FLG SPOOL PIECE (SEE NOTE 2)
4	RESTRAINED FLANGED COUPLING ADAPTER
5	SWING CHECK VALVE
6	APPROVED RUBBER SEAL ON PIPE BARREL AT WALL PENETRATION PER SPECIFICATION
7	ADJUSTABLE S.S. PIPE SUPPORT
8	GATE VALVE (MJ X MJ)
9	TEE (MJ X MJ)
10	ELBOW (MJ X MJ)
11	THRUST BLOCK
12	6" HOLE FOR VENT
13	2" MIN INSULATION BOARD
14	24" MANHOLE COVER (SEE NOTE 5)
15	RT UNIT
16	PRE-CAST CONCRETE VAULT, SIZE AS REQUIRED FOR COMPONENTS SHOWN

NOTES:

- METER MUST BE PURCHASED FROM THE WATER & SEWER (W&S) DEPARTMENT. NO EXCEPTIONS.
- UPSTREAM AND DOWNSTREAM PIPE SPOOL LENGTHS 5X PIPE I.D. OR PER MFR REQUIREMENTS (WHICHEVER YIELDS THE LONGER PIPE LENGTH).
- FOR PRODUCT AND MANUFACTURER SPECIFICATIONS, REFER TO CURRENT VERSION OF CITY OF GREELEY W&S CONSTRUCTION SPECIFICATIONS (SPECIFICATIONS).
- SEE DETAIL W-16 FOR ADDITIONAL METER & VAULT INSTALLATION REQUIREMENTS.
- 24" VAULT COVER SHALL BE A COMPOSITE LID WITH A WORM LOCK. REFER TO W&S SPECIFICATIONS, LATEST REVISION, FOR APPROVED MANHOLE COVER MATERIALS, MANUFACTURERS, MARKINGS, AND OTHER REQUIREMENTS.
- ALL BURIED PIPING SHALL BE INSTALLED AND RESTRAINED IN ACCORDANCE WITH W&S SPECIFICATIONS.
- INSTALL TRACER WIRE ACCORDING TO W&S SPECIFICATIONS AND W&S UTILITY LOCATING ("UL") STANDARD DETAILS, LATEST REVISION OF EACH.



**(TYP) SETTING FOR 3", 4", 6" & 8" POTABLE WATER
METER & VAULT**

DETAIL W-10

DATE: JANUARY 2023

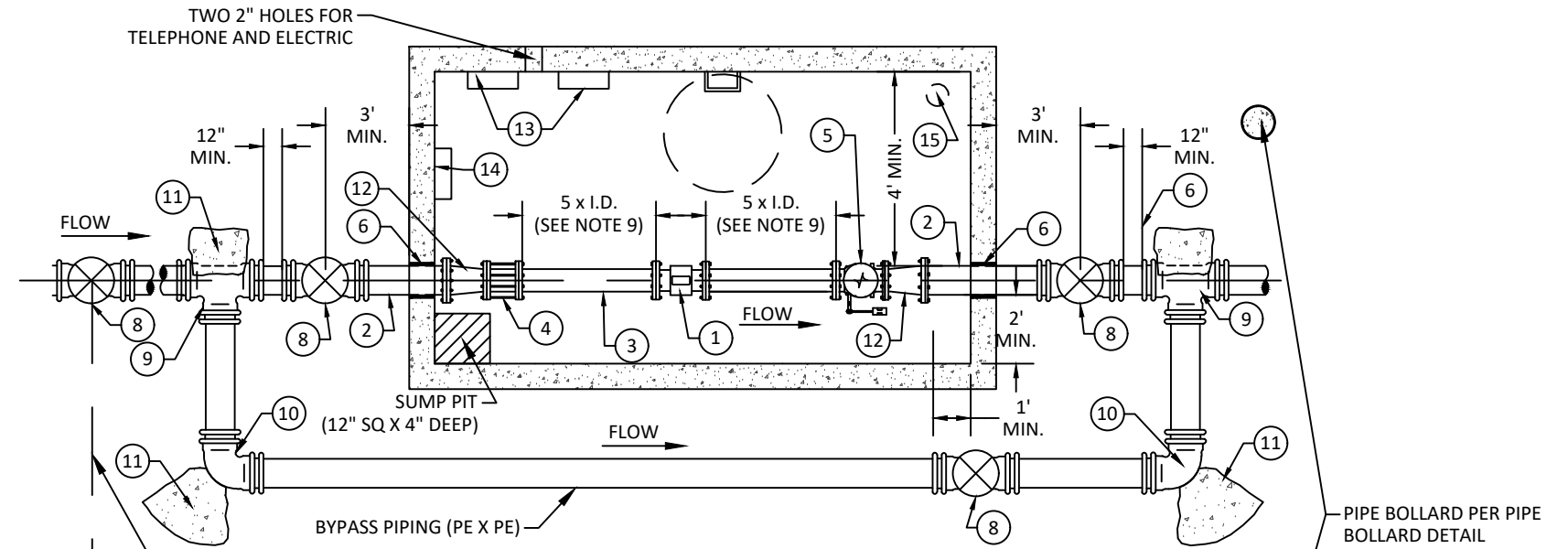
SCALE: N.T.S.



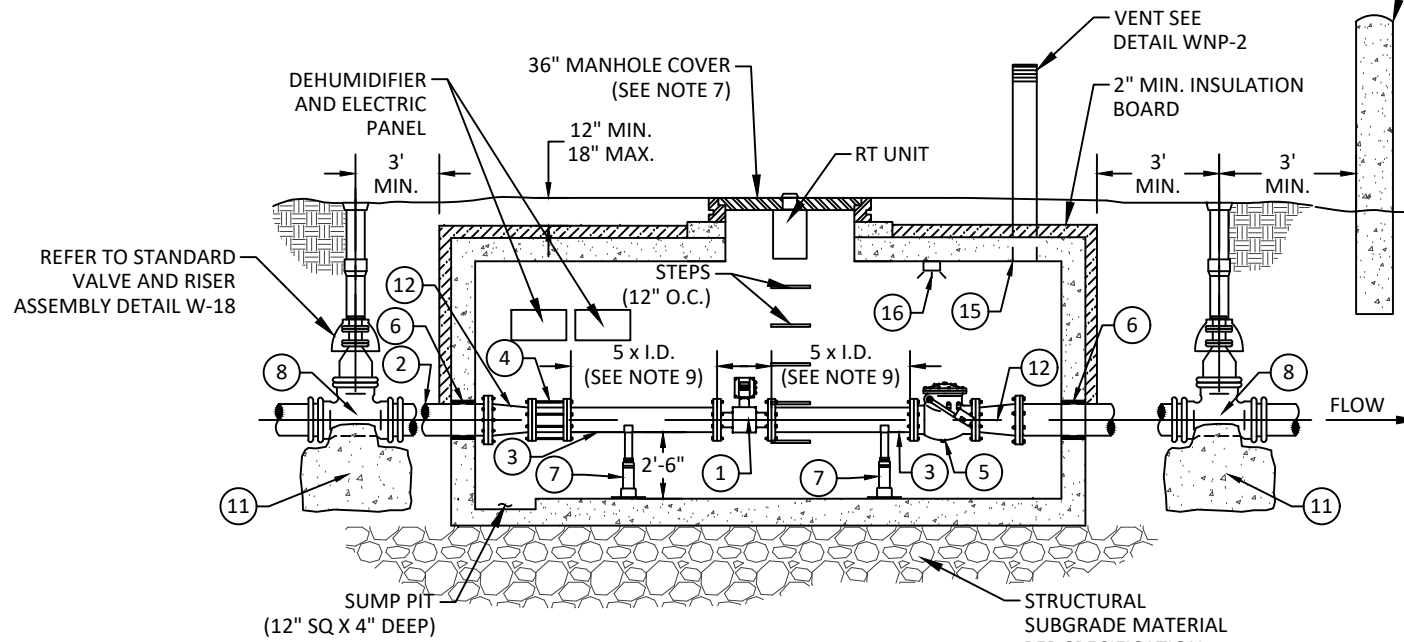
LEGEND	
1	MAG METER (SEE NOTE 1)
2	FLG X PE SPOOL PIECE WITH WALL RING IN CENTER OF VAULT WALL
3	FLG X FLG SPOOL PIECE (SEE NOTE 2)
4	RESTRAINED MECHANICAL COUPLER OR FLANGED COUPLING ADAPTER
5	SWING CHECK VALVE
6	APPROVED RUBBER SEAL ON PIPE BARREL AT WALL PENETRATION PER SPECIFICATION
7	ADJUSTABLE S.S. PIPE SUPPORT
8	GATE VALVE (MJ x MJ)
9	TEE (MJ x MJ)
10	ELBOW (MJ x MJ)
11	THRUST BLOCK
12	CONCENTRIC REDUCER (AS REQUIRED)
13	ELECTRICAL PANEL
14	DEHUMIDIFIER
15	6" HOLE FOR VENT
16	LED LIGHT

NOTES:

1. PURCHASED METER MUST BE BADGER M2000 MAG METER AND/OR COORDINATED THROUGH THE CITY OF GREELEY METER SHOP. NO EXCEPTIONS. CONTRACTOR TO PROVIDE PIPING, COUPLINGS, AND ACCESSORIES AS NECESSARY FOR A COMPLETE SYSTEM.
2. ALL NOTES ON RELATED CITY OF GREELEY WATER & SEWER (W&S) DETAIL NP-3 APPLY TO THIS DETAIL.
3. CONTRACTOR IS RESPONSIBLE FOR PROVIDING POWER AND TELEMETRY TO THE METER AND VAULT.
4. ELECTRICAL/CONTROL PANEL SHALL BE MOUNTED ABOVE GRADE INSIDE A NEMA 4 ENCLOSURE PER W&S SPECIFICATIONS (SPECIFICATIONS), LATEST REVISION.
5. ALL ELECTRICAL WIRE SHALL BE EQUIPPED WITH WATERTIGHT CONNECTIONS ABOVE AND BELOW GRADE.
6. VAULT & MANHOLE COVER SHALL BE RATED FOR HS-20 TRAFFIC LOADINGS.
7. 36" VAULT COVER SHALL BE A WORM LOCK LID WITH A RECESSED TWO-INCH DIAMETER HOLE FOR RT UNIT. REFER TO WATER & SEWER SPECIFICATIONS, LATEST REVISION, FOR APPROVED MANHOLE COVER MATERIALS, MANUFACTURERS, MARKINGS, AND OTHER REQUIREMENTS.
8. SEE W&S DETAIL W-16, LATEST REVISION, FOR ADDITIONAL METER AND VAULT INSTALLATION REQUIREMENTS.
9. UPSTREAM PIPE AND DOWNSTREAM SPOOL LENGTH 5X PIPE I.D. OR PER MFR REQUIREMENTS (WHICHEVER YIELDS THE LONGER PIPE LENGTH).
10. REFER TO CITY OF GREELEY W&S SPECIFICATIONS, LATEST REVISION, FOR PRODUCT AND MANUFACTURER SPECIFICATIONS.
11. INSTALL TRACER WIRE ACCORDING TO CITY OF GREELEY W&S SPECIFICATIONS AND STANDARD DETAILS, LATEST REVISION.
12. PIPE BOLLARD MAY BE OMITTED AT THE CITY OF GREELEY W&S DEPARTMENT'S DISCRETION.



PLAN VIEW



ELEVATION VIEW

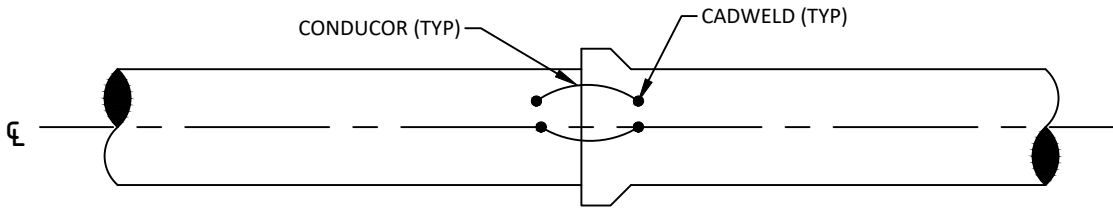
(TYP) SETTING FOR 10" & LARGER ELECTROMAGNETIC (MAG) METER & VAULT

DETAIL W-11

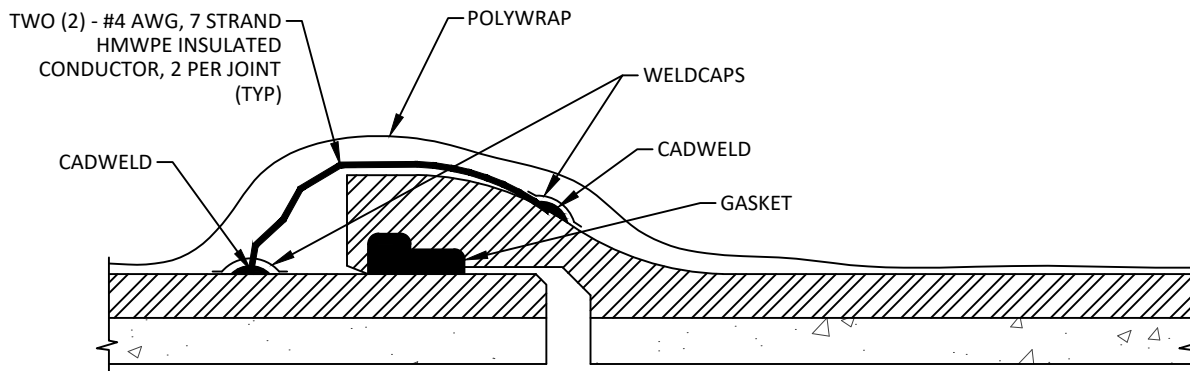


DATE: JANUARY 2023

SCALE: N.T.S.



ELEVATION VIEW



CUTAWAY ELEVATION VIEW

NOTES:

1. CONDUCTOR WIRE SHALL BE RATED FOR DIRECT BURIAL, AND HAVE BOTH ENDS CAD WELDED TO THE PIPE OR BONDING STRAP BOLTED TO PIPE. WIRE SHALL HAVE A MINIMUM OF 2" SLACK.
2. JOINT BONDING SHALL ALSO APPLY TO RESTRAINED AND MECHANICAL JOINT PIPE AND FITTINGS.
3. CONSTRUCT CADWELD CONNECTIONS PER WATER & SEWER CONSTRUCTION SPECIFICATIONS AND DETAILS, LATEST REVISION.
4. ACCEPTABLE ALTERNATIVE TO ANODE CATHODIC PROTECTION IS ZINC COATED D.I.P.



DUCTILE IRON PIPE JOINT BONDING

DETAIL W-12

DATE: JANUARY 2023

SCALE: N.T.S.

GENERAL NOTES:

1. POLYETHYLENE (PE) WRAP MAY BE OMITTED WHEN ZINC COATED D.I.P. IS USED.
2. PE WRAP IS REQUIRED FOR ALL STANDARD (NON-ZINC) DUCTILE IRON PIPE, FITTINGS, AND APPURTENANCES.
3. PE WRAP SHALL BE INSTALLED IN ACCORDANCE WITH THE WATER & SEWER SPECIFICATIONS AND STANDARD DETAILS BELOW, LATEST REVISION OF EACH.
4. REPAIR ANY CUTS, TEARS, PUNCTURES, OR DAMAGE WITH ADHESIVE TAPE. TO PREVENT DAMAGE TO THE PE WRAP DURING BACKFILL, ALLOW ADEQUATE SLACK IN THE TUBE AT THE JOINT. AVOID DAMAGING THE TUBE WHEN USING TAMPING DEVICES.

PIPE-SHAPED APPURTENANCES:

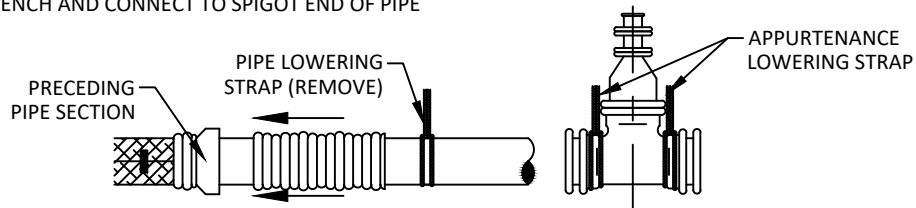
1. COVER BENDS, REDUCERS, OFFSETS, AND OTHER PIPE-SHAPED APPURTENANCES WITH PE IN SAME MANNER AS PIPE ON W&S DETAIL W-13B, LATEST REVISION.

ODD-SHAPED APPURTENANCES:

1. WHEN IT IS NOT PRACTICAL TO WRAP VALVES, FITTINGS, AND OTHER ODD-SHAPED PIECES IN TUBE, WRAP WITH FLAT SHEET OR SPLIT LENGTH OF PE TUBE IN THE FOLLOWING STEPS:

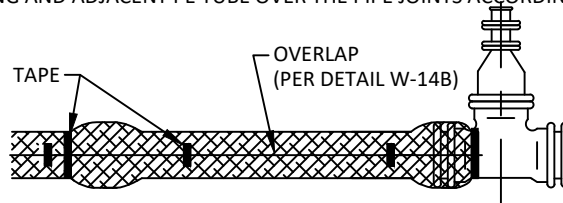
STEP 1

BEFORE CONNECTING THE APPURTENANCE TO THE SPIGOT END OF PIPE, INSTALL THE ADJACENT PIPE AND PE TUBE ACCORDING TO WATER & SEWER DETAIL W-13B, LATEST REVISION. BUNCH THE TUBE IN AN ACCORDIAN- FASHION TO EXPOSE THE SPIGOT END OF THE PIPE. THEN LOWER THE APPURTENANCE INTO THE TRENCH AND CONNECT TO SPIGOT END OF PIPE



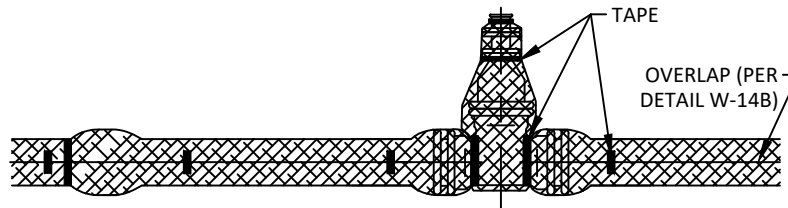
STEP 2

PULL THE PRECEDING AND ADJACENT PE TUBE OVER THE PIPE JOINTS ACCORDING TO STEPS 2 THROUGH 4 IN W-14B.



STEP 3

REPEAT STEP 2 WITH A NEW PIPE ON THE OTHER SIDE OF THE APPURTENANCE. THEN WRAP FLAT PE SHEET OR SPLIT LENGTH OF PE TUBE AROUND APPURTENANCE BY PASSING THE SHEET UNDER THE APPURTENANCE AND BRINGING IT UP AROUND BODY. MAKE SEAMS BY BRINGING EDGES TOGETHER, FOLDING OVER TWICE, AND TAPING DOWN. TAPE PE SECURELY IN PLACE AT VALVE STEM AND OTHER PENETRATIONS.



STEP 4

REPAIR ANY CUTS, TEARS, PUNCTURES, OR DAMAGE WITH ADHESIVE TAPE. TO PREVENT DAMAGE TO THE POLYETHYLENE WRAP DURING BACKFILL, ALLOW ADEQUATE SLACE IN THE TUBE AT THE JOINT. AVOID DAMAGING THE TUBE WHEN USING TAMPING DEVICES.



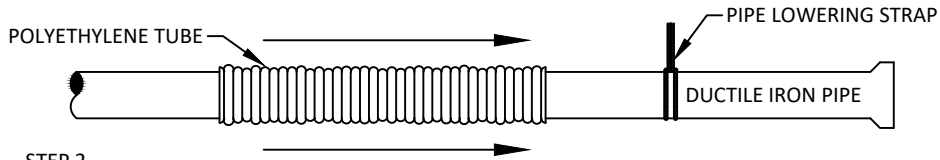
**POLYETHYLENE WRAP INSTALLATION
ON STANDARD DUCTILE IRON FITTINGS
& GENERAL NOTES
DETAIL W-13A**

DATE: JANUARY 2023

SCALE: N.T.S.

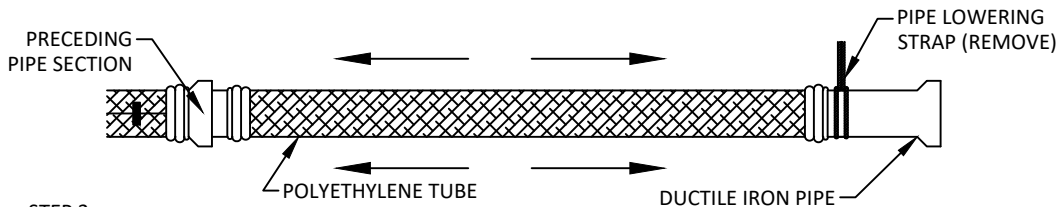
STEP 1

CUT A SECTION OF POLYETHYLENE (PE) TUBE APPROXIMATELY 2' LONGER THAN THE PIPE SECTION. REMOVE ALL DEBRIS FROM THE PIPE SURFACE. SLIP THE TUBE AROUND THE END OF THE PIPE, STARTING AT THE SPIGOT END. BUNCH THE TUBE ACCORDION-FASHION ON THE END OF THE PIPE. PULL BACK THE OVERHANGING END OF THE TUBE UNTIL IT CLEARS THE PIPE SPIGOT END.



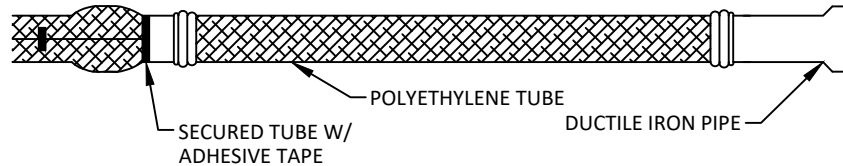
STEP 2

LOWER THE PIPE INTO THE TRENCH AND MAKE UP THE PIPE JOINT WITH THE PRECEDING SECTION OF PIPE. SPREAD THE TUBE OVER THE ENTIRE PIPE BARREL AND REMOVE THE PIPE LOWERING STRAP. MAKE SURE NO DIRT OR BEDDING MATERIAL BECOMES TRAPPED BETWEEN TUBE AND PIPE.



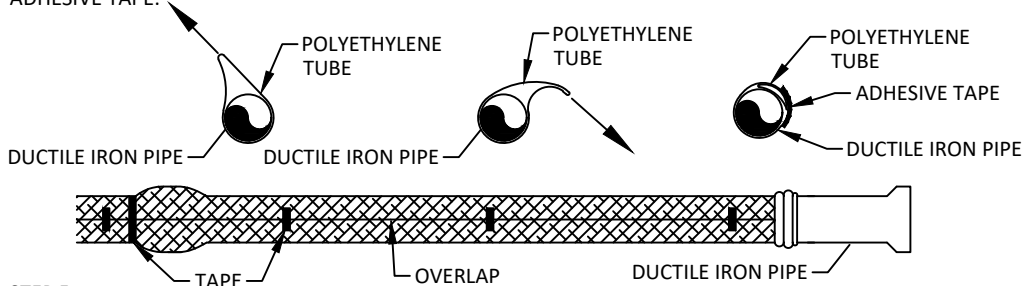
STEP 3

OVERLAP THE JOINT WITH THE TUBE FROM THE PRECEDING LENGTH OF PIPE AND SECURE IT INTO PLACE WITH THREE CIRCUMFERENTIAL TURNS OF 2" ADHESIVE TAPE.



STEP 4

OVERLAP THE SECURED TUBE END WITH THE TUBE END OF THE NEW PIPE SECTION AND SECURE THE NEW TUBE END IN PLACE WITH THE TAPING PROCEDURE IN STEP 3. TAKE UP THE SLACK IN THE TUBE ALONG THE BARREL OF THE PIPE TO MAKE A SNUG, BUT NOT TIGHT, FIT BY FOLDING THE EXCESS TUBE BACK OVER THE TOP OF THE PIPE. SECURE THE TUBE AT 3' TO 5' INTERVALS ALONG THE PIPE BARREL WITH ADHESIVE TAPE.



STEP 5

REPAIR ANY RIPS, TEARS, OR OTHER DAMAGE WITH ADHESIVE TAPE. CAREFULLY BACKFILL PIPE. TO PREVENT DAMAGE TO THE TUBE DURING BACKFILL, ALLOW ADEQUATE SLACK IN THE TUBE AT THE JOINT. AVOID DAMAGING THE TUBE WHEN USING TAMPING DEVICES.

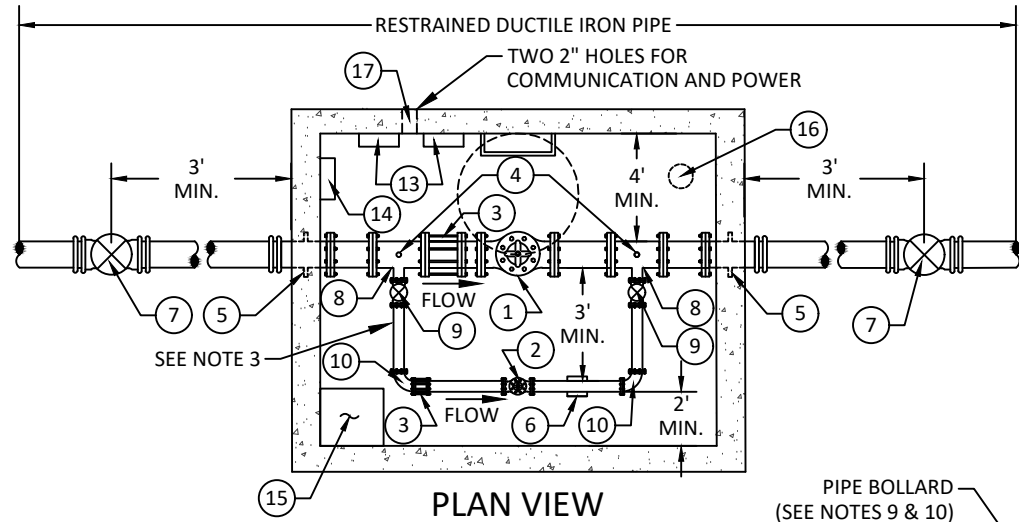


POLYETHYLENE WRAP INSTALLATION ON STANDARD DUCTILE IRON PIPE

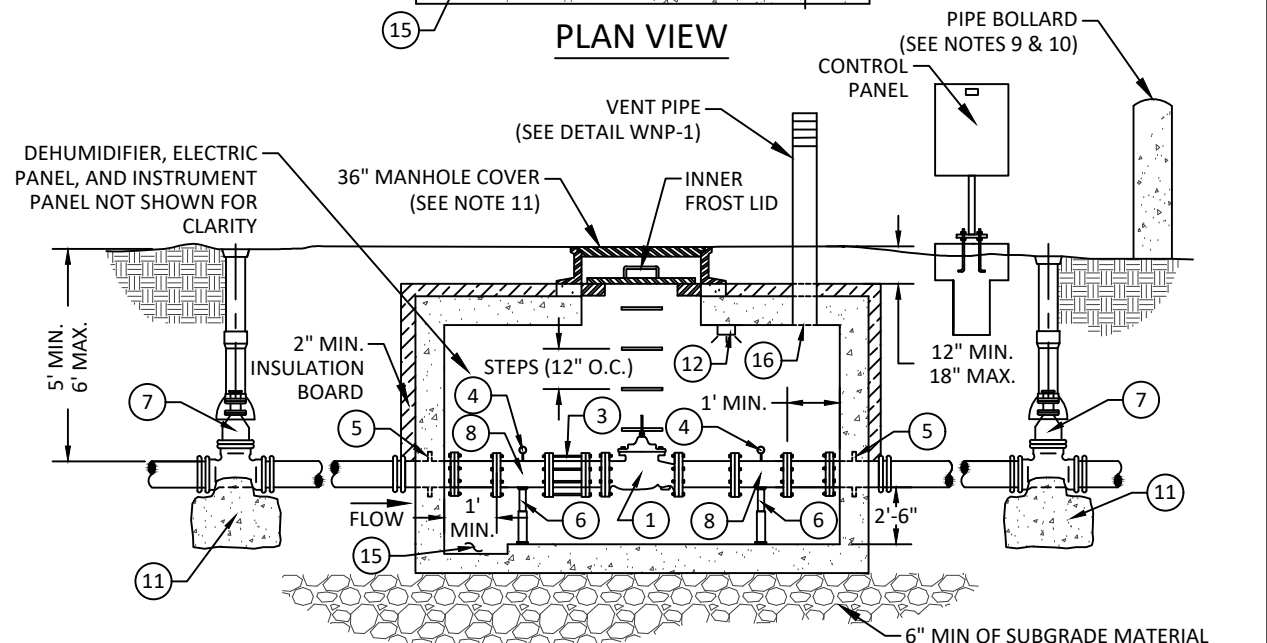
DETAIL W-13B

DATE: JANUARY 2023

SCALE: N.T.S.



PLAN VIEW



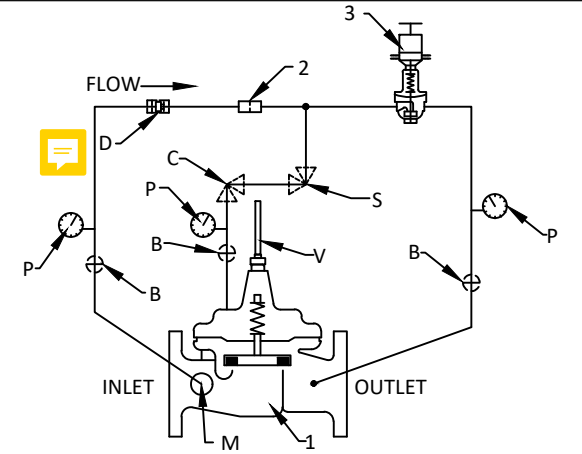
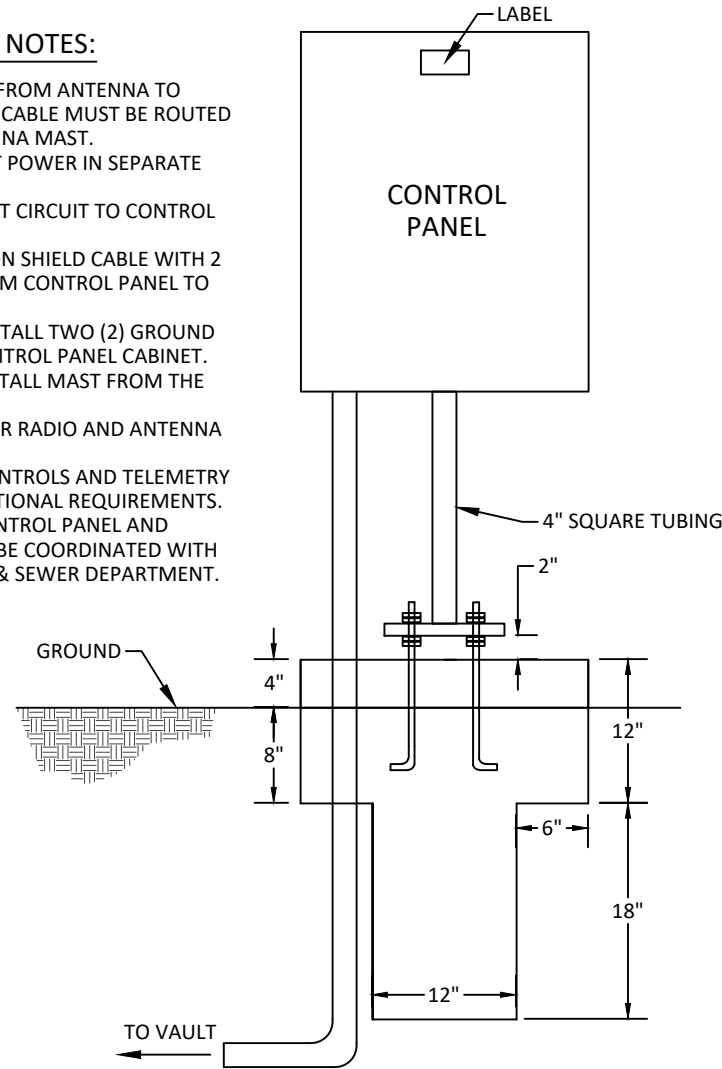
ELEVATION VIEW

LEGEND	
1	8" CLA-VAL 90-01 PRV
2	2" CLA-VAL 90-01 PRV
3	RESTRAINED MECHANICAL COUPLER (MATCH PIPE SIZE)
4	PRESSURE GAGE
5	8" WALL SLEEVE SPOOL
6	ADJUSTABLE STAINLESS STEEL PIPE STAND
7	GATE VALVE (MJ X MJ) AND RISER PER DETAIL W-18
8	8" X 2" REDUCING TEE (FLG X FLG)
9	2" GATE VALVE (FLG X FLG)

10	2" ELBOW (FLG X FLG)
11	THRUST BLOCK
12	LED LIGHT FOR WET CONDITIONS
13	ELECTRICAL JUNCTION BOXES (SEE CONTROLS DETAIL, W-14B)
14	DEHUMIDIFIER
15	SUMP PIT (12" SQ X 4" DEEP) & PUMP
16	6" HOLE FOR VENT (SEE VENT PIPE DETAIL WNP-2)
17	APPROVED RUBBER SEAL PER SPECIFICATIONS

CONTROL PANEL NOTES:

1. ROUTE RF CABLE FROM ANTENNA TO CONTROL PANEL. CABLE MUST BE ROUTED THROUGH ANTENNA MAST.
2. INSTALL 120 VOLT POWER IN SEPARATE CONDUIT.
3. PROVIDE 120 VOLT CIRCUIT TO CONTROL PANEL.
4. PROVIDE 8 BELDON SHIELD CABLE WITH 2 CONDUCTOR FROM CONTROL PANEL TO VAULT.
5. PROVIDE AND INSTALL TWO (2) GROUND RODS AT THE CONTROL PANEL CABINET.
6. INSTALL 30 FOOT TALL MAST FROM THE GROUND.
7. CONTACT CITY FOR RADIO AND ANTENNA SPECIFICATIONS.
8. REFER TO PRV CONTROLS AND TELEMTRY DETAIL FOR ADDITIONAL REQUIREMENTS.
9. LOCATION OF CONTROL PANEL AND ANTENNA SHALL BE COORDINATED WITH GREELEY WATER & SEWER DEPARTMENT.



PRV COMPONENTS SCHEMATIC

PRESSURE REDUCING VALVE COMPONENTS	
ITEM	DESCRIPTION
1	CLA-VAL MODEL 390-02 PRV (100-01 HYTROL MAIN VALVE, SEE NOTE 5)
2	X58C RESTRICTION FITTING
3	CRL-34 ELECTRONIC ACTUATED PRESSURE SUSTAINING PILOT CONTROL (4-20 mA COMMAND SIGNAL)
B	CK2 ISOLATION VALVE
C	CV FLOW CONTROL (CLOSING)
D	CHECK VALVES ISOLATION VALVE
M	X144 E-FLOWMETER (SEE NOTE 4)
P	X141 PRESSURE GAUGE
S	CV FLOW CONTROL (OPENING)
V	X101 VALVE POSITION INDICATOR

NOTES:

1. SEE DETAIL W-15 FOR ADDITIONAL VAULT INSTALLATION REQUIREMENTS.
2. ALUMINUM RING AND COVER TO BE RATED FOR HS-20 TRAFFIC LOADINGS.
3. BYPASS SIZING AND NEED SHALL BE COORDINATED WITH THE CITY OF GREELEY WATER & SEWER DEPARTMENT AND WILL BE EVALUATED BASED ON FLOW AND SITE CONDITIONS.
4. CLA-VAL X144 E-FLOW METER OR APPROVED EQUAL.
5. CLA-VAL 100-01 HYTROL MAIN VALVE SHALL BE CONTROLLED BY ELECTRIC ACTUATOR WITH 4-20 MA CONTROL AND FEEDBACK.
6. ALL BURIED PIPE, VALVES, FITTINGS, AND APPURTENANCES SHALL BE INSTALLED IN ACCORDANCE WITH WATER & SEWER SPECIFICATIONS, LATEST REVISION.
7. ALL VAULT PIPE, VALVES, FITTINGS, AND APPURTENANCES LARGER THAN 3" SHALL BE FLANGED.
8. INSTALL TRACER WIRE ACCORDING TO CITY OF GREELEY WATER & SEWER SPECIFICATIONS AND STANDARD DETAILS, LATEST REVISION.
9. PIPE BOLLARD MAY BE OMITTED AT THE CITY OF GREELEY WATER & SEWER DEPARTMENT'S DISCRETION.
10. IF PIPE BOLLARD IS REQUIRED, BOLLARD SHALL BE INSTALLED IN ACCORDANCE WITH THE WATER & SEWER STANDARD DETAILS AND CONSTRUCTION SPECIFICATIONS, LATEST REVISION OF EACH.
11. 36" MANHOLE COVER SHALL BE A BOLT DOWN LID MARKED "WATER" WITH INNER FROST LID. REFER TO CITY OF GREELEY WATER & SEWER SPECIFICATIONS, LATEST REVISION, FOR SPECIFIC MANHOLE COVER MFR AND PRODUCT INFORMATION.

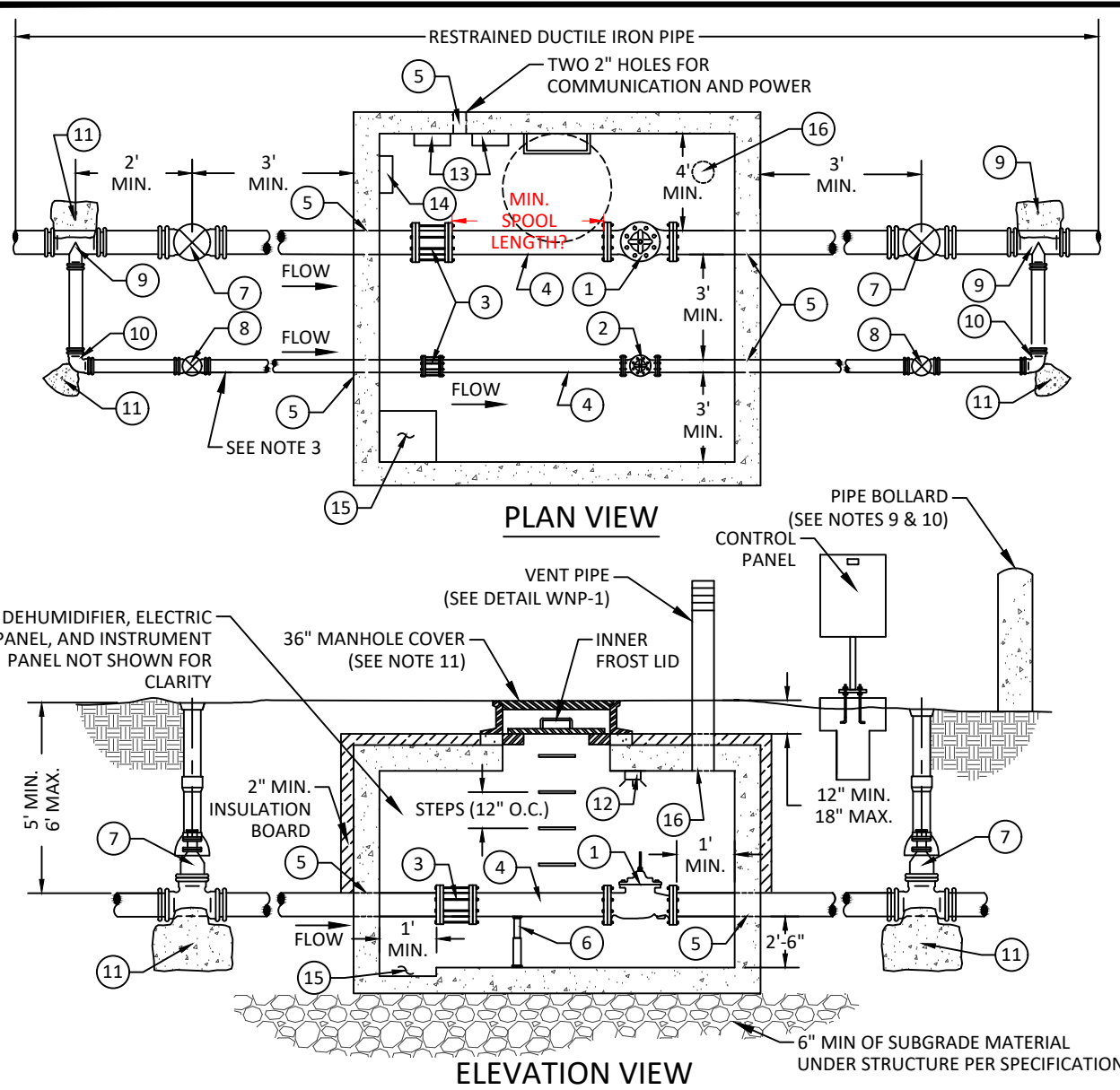


(TYP) 8" PRESSURE REDUCING VALVE & VAULT

DETAIL W-14A

DATE: JANUARY 2023

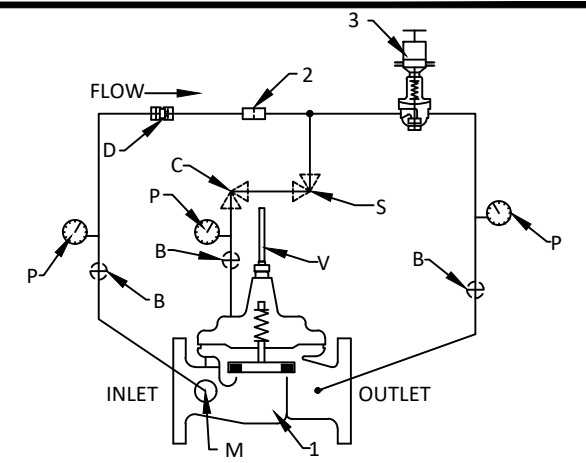
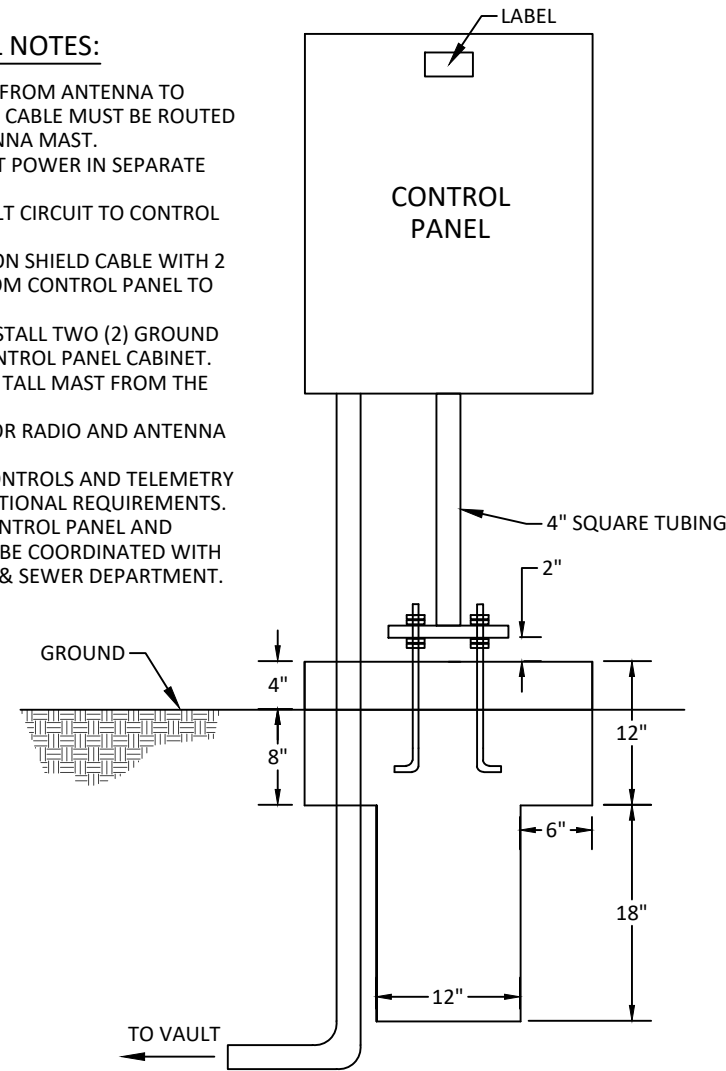
SCALE: N.T.S.



LEGEND	
1	12" CLA-VAL 90-01 PRV
2	6" CLA-VAL 90-01 PRV
3	RESTRAINED MECHANICAL COUPLER (MATCH PIPE SIZE)
4	SPOOL PIPE (MATCH PIPE SIZE)
5	APPROVED RUBBER SEAL PER SPECIFICATION
6	ADJUSTABLE STAINLESS STEEL PIPE STAND
7	12" GATE VALVE (MJ X MJ) AND RISER PER DETAIL W-18
8	6" GATE VALVE (MJ X MJ) AND RISER PER DETAIL W-18
9	12" X 6" REDUCING TEE (MJ X MJ)
10	6" ELBOW (MJ X MJ)
11	THRUST BLOCK
12	LED LIGHT FOR WET CONDITIONS
13	ELECTRICAL JUNCTION BOXES (SEE CONTROLS DETAIL, W-14B)
14	DEHUMIDIFIER
15	SUMP PIT (12" SQ X 4" DEEP) & PUMP
16	6" HOLE FOR VENT (SEE VENT PIPE DETAIL WNP-2)

CONTROL PANEL NOTES:

1. ROUTE RF CABLE FROM ANTENNA TO CONTROL PANEL. CABLE MUST BE ROUTED THROUGH ANTENNA MAST.
2. INSTALL 120 VOLT POWER IN SEPARATE CONDUIT.
3. PROVIDE 120 VOLT CIRCUIT TO CONTROL PANEL.
4. PROVIDE 8 BELDON SHIELD CABLE WITH 2 CONDUCTOR FROM CONTROL PANEL TO VAULT.
5. PROVIDE AND INSTALL TWO (2) GROUND RODS AT THE CONTROL PANEL CABINET.
6. INSTALL 30 FOOT TALL MAST FROM THE GROUND.
7. CONTACT CITY FOR RADIO AND ANTENNA SPECIFICATIONS.
8. REFER TO PRV CONTROLS AND TELEMTRY DETAIL FOR ADDITIONAL REQUIREMENTS.
9. LOCATION OF CONTROL PANEL AND ANTENNA SHALL BE COORDINATED WITH GREELEY WATER & SEWER DEPARTMENT.



PRV COMPONENTS SCHEMATIC

PRESSURE REDUCING VALVE COMPONENTS	
ITEM	DESCRIPTION
1	CLA-VAL MODEL 390-02 PRV (100-01 HYTROL MAIN VALVE, SEE NOTE 5)
2	X58C RESTRICTION FITTING
3	CRL-34 ELECTRONIC ACTUATED PRESSURE SUSTAINING PILOT CONTROL (4-20 mA COMMAND SIGNAL)
B	CK2 ISOLATION VALVE
C	CV FLOW CONTROL (CLOSING)
D	CHECK VALVES ISOLATION VALVE
M	X144 E-FLOWMETER (SEE NOTE 4)
P	X141 PRESSURE GAUGE
S	CV FLOW CONTROL (OPENING)
V	X101 VALVE POSITION INDICATOR

NOTES:

1. SEE DETAIL W-15 FOR ADDITIONAL VAULT INSTALLATION REQUIREMENTS.
2. ALUMINUM RING AND COVER TO BE RATED FOR HS-20 TRAFFIC LOADINGS.
3. BYPASS SIZING AND NEED SHALL BE COORDINATED WITH THE CITY OF GREELEY WATER & SEWER DEPARTMENT AND WILL BE EVALUATED BASED ON FLOW AND SITE CONDITIONS.
4. CLA-VAL X144 E-FLOW METER OR APPROVED EQUAL.
5. CLA-VAL 100-01 HYTROL MAIN VALVE SHALL BE CONTROLLED BY ELECTRIC ACTUATOR WITH 4-20 MA CONTROL AND FEEDBACK.
6. ALL BURIED PIPE, VALVES, FITTINGS, AND APPURTENANCES SHALL BE INSTALLED IN ACCORDANCE WITH WATER & SEWER SPECIFICATIONS, LATEST REVISION.
7. ALL VAULT PIPE, VALVES, FITTINGS, AND APPURTENANCES LARGER THAN 3" SHALL BE FLANGED.
8. INSTALL TRACER WIRE ACCORDING TO CITY OF GREELEY WATER & SEWER SPECIFICATIONS AND STANDARD DETAILS, LATEST REVISION.
9. PIPE BOLLARD MAY BE OMITTED AT THE CITY OF GREELEY WATER & SEWER DEPARTMENT'S DISCRETION.
10. IF PIPE BOLLARD IS REQUIRED, BOLLARD SHALL BE INSTALLED IN ACCORDANCE WITH THE WATER & SEWER STANDARD DETAILS AND CONSTRUCTION SPECIFICATIONS, LATEST REVISION OF EACH.
11. 36" MANHOLE COVER SHALL BE A BOLT DOWN LID MARKED "WATER" WITH INNER FROST LID. REFER TO CITY OF GREELEY WATER & SEWER SPECIFICATIONS, LATEST REVISION, FOR SPECIFIC MANHOLE COVER MFR AND PRODUCT INFORMATION.

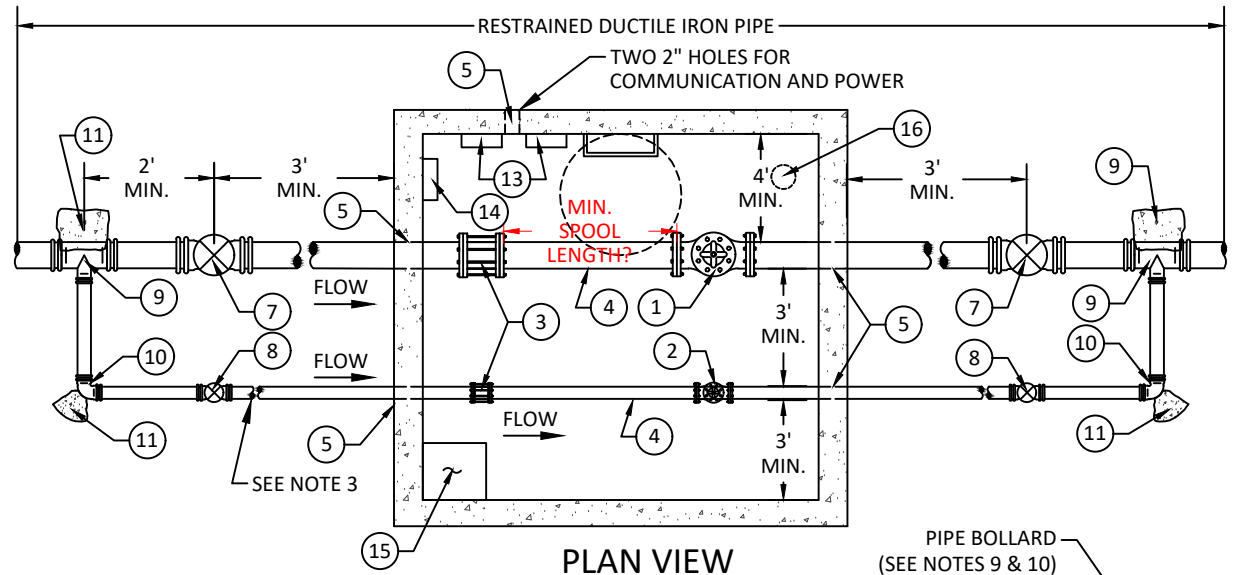


(TYP) 12" PRESSURE REDUCING VALVE & VAULT

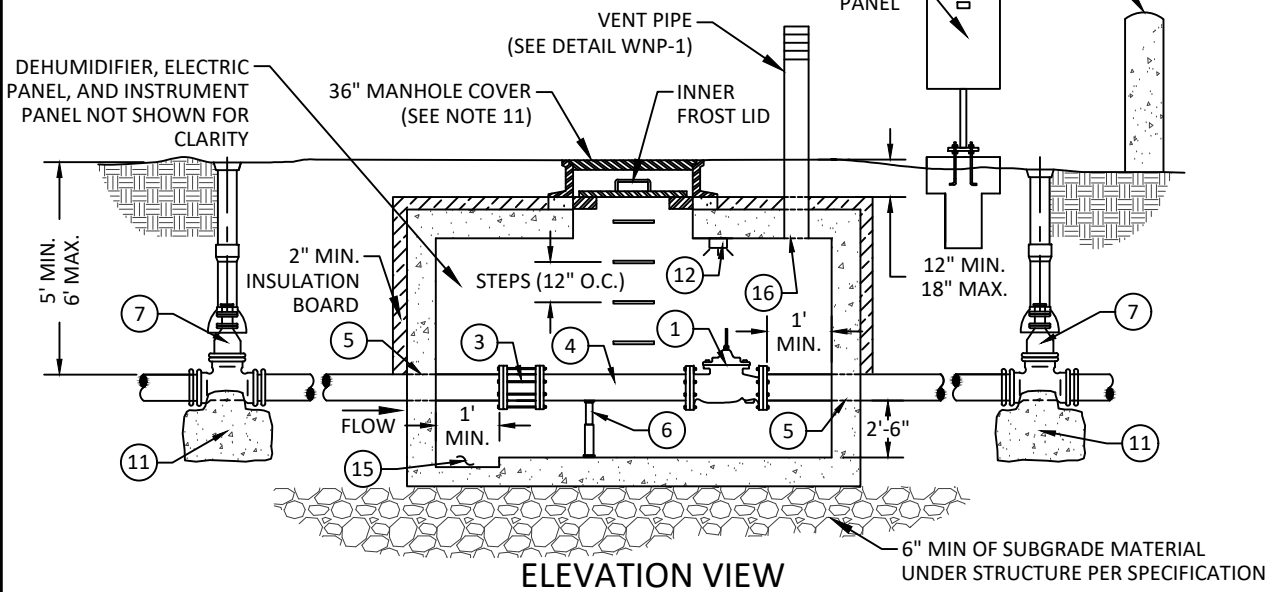
DETAIL W-14B

DATE: JANUARY 2023

SCALE: N.T.S.



PLAN VIEW

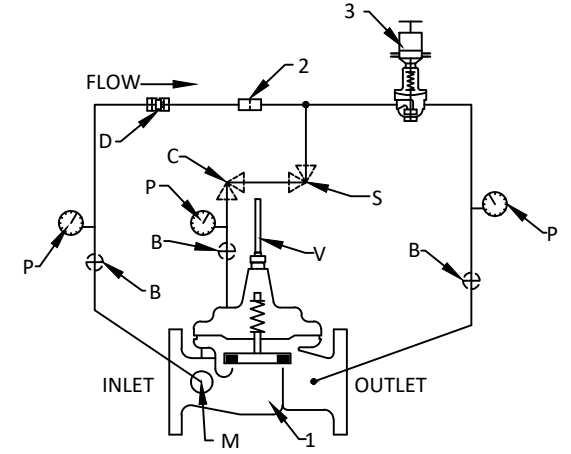
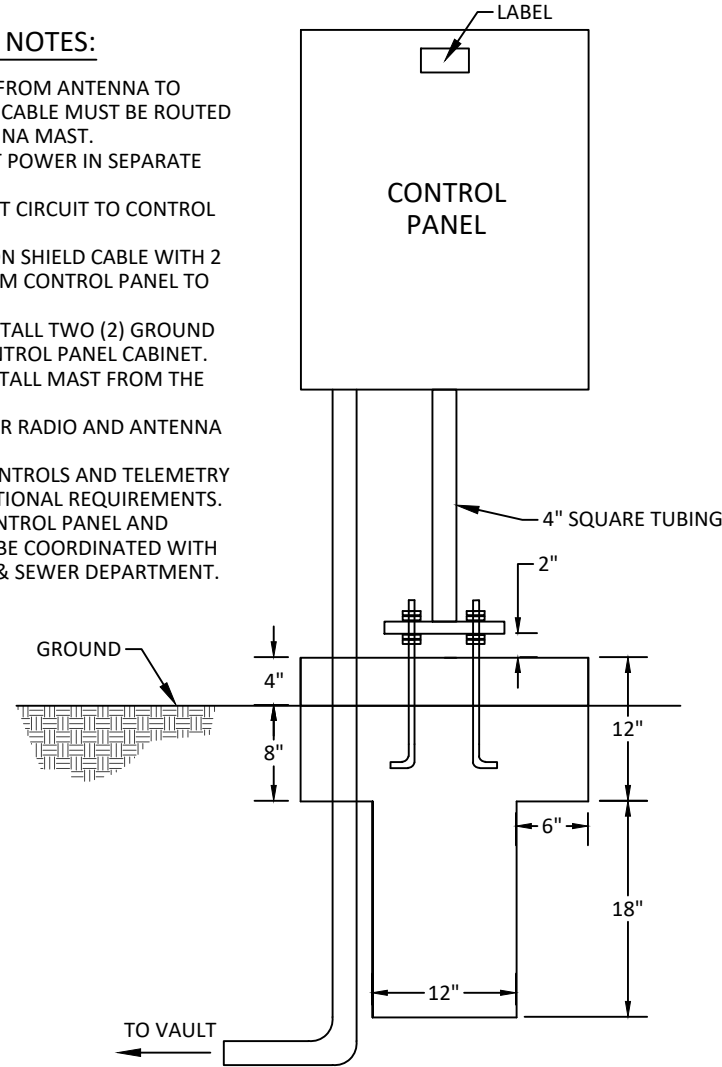


ELEVATION VIEW

LEGEND	
1	16" CLA-VAL 90-01 PRV
2	8" CLA-VAL 90-01 PRV
3	RESTRAINED MECHANICAL COUPLER (MATCH PIPE SIZE)
4	SPOOL PIPE (MATCH PIPE SIZE)
5	APPROVED RUBBER SEAL PER SPECIFICATION
6	ADJUSTABLE STAINLESS STEEL PIPE STAND
7	16" GATE VALVE (MJ X MJ) AND RISER PER DETAIL W-18
8	8" GATE VALVE (MJ X MJ) AND RISER PER DETAIL W-18
9	16" X 8" REDUCING TEE (MJ X MJ)
10	8" ELBOW (MJ X MJ)
11	THRUST BLOCK
12	LED LIGHT FOR WET CONDITIONS
13	ELECTRICAL JUNCTION BOXES (SEE CONTROLS DETAIL, W-14B)
14	DEHUMIDIFIER
15	SUMP PIT (12" SQ X 4" DEEP) & PUMP
16	6" HOLE FOR VENT (SEE VENT PIPE DETAIL WNP-2)

CONTROL PANEL NOTES:

1. ROUTE RF CABLE FROM ANTENNA TO CONTROL PANEL. CABLE MUST BE ROUTED THROUGH ANTENNA MAST.
2. INSTALL 120 VOLT POWER IN SEPARATE CONDUIT.
3. PROVIDE 120 VOLT CIRCUIT TO CONTROL PANEL.
4. PROVIDE 8 BELDON SHIELD CABLE WITH 2 CONDUCTOR FROM CONTROL PANEL TO VAULT.
5. PROVIDE AND INSTALL TWO (2) GROUND RODS AT THE CONTROL PANEL CABINET.
6. INSTALL 30 FOOT TALL MAST FROM THE GROUND.
7. CONTACT CITY FOR RADIO AND ANTENNA SPECIFICATIONS.
8. REFER TO PRV CONTROLS AND TELEMETRY DETAIL FOR ADDITIONAL REQUIREMENTS.
9. LOCATION OF CONTROL PANEL AND ANTENNA SHALL BE COORDINATED WITH GREELEY WATER & SEWER DEPARTMENT.



PRV COMPONENTS SCHEMATIC

PRESSURE REDUCING VALVE COMPONENTS	
ITEM	DESCRIPTION
1	CLA-VAL MODEL 390-02 PRV (100-01 HYTROL MAIN VALVE, SEE NOTE 5)
2	X58C RESTRICTION FITTING
3	CRL-34 ELECTRONIC ACTUATED PRESSURE SUSTAINING PILOT CONTROL (4-20 mA COMMAND SIGNAL)
B	CK2 ISOLATION VALVE
C	CV FLOW CONTROL (CLOSING)
D	CHECK VALVES ISOLATION VALVE
M	X144 E-FLOWMETER (SEE NOTE 4)
P	X141 PRESSURE GAUGE
S	CV FLOW CONTROL (OPENING)
V	X101 VALVE POSITION INDICATOR

NOTES:

1. SEE DETAIL W-15 FOR ADDITIONAL VAULT INSTALLATION REQUIREMENTS.
2. ALUMINUM RING AND COVER TO BE RATED FOR HS-20 TRAFFIC LOADINGS.
3. BYPASS SIZING AND NEED SHALL BE COORDINATED WITH THE CITY OF GREELEY WATER & SEWER DEPARTMENT AND WILL BE EVALUATED BASED ON FLOW AND SITE CONDITIONS.
4. CLA-VAL X144 E-FLOW METER OR APPROVED EQUAL.
5. CLA-VAL 100-01 HYTROL MAIN VALVE SHALL BE CONTROLLED BY ELECTRIC ACTUATOR WITH 4-20 MA CONTROL AND FEEDBACK.
6. ALL BURIED PIPE, VALVES, FITTINGS, AND APPURTENANCES SHALL BE INSTALLED IN ACCORDANCE WITH WATER & SEWER SPECIFICATIONS, LATEST REVISION.
7. ALL VAULT PIPE, VALVES, FITTINGS, AND APPURTENANCES LARGER THAN 3" SHALL BE FLANGED.
8. INSTALL TRACER WIRE ACCORDING TO CITY OF GREELEY WATER & SEWER SPECIFICATIONS AND STANDARD DETAILS, LATEST REVISION.
9. PIPE BOLLARD MAY BE OMITTED AT THE CITY OF GREELEY WATER & SEWER DEPARTMENT'S DISCRETION.
10. IF PIPE BOLLARD IS REQUIRED, BOLLARD SHALL BE INSTALLED IN ACCORDANCE WITH THE WATER & SEWER STANDARD DETAILS AND CONSTRUCTION SPECIFICATIONS, LATEST REVISION OF EACH.
11. 36" MANHOLE COVER SHALL BE A BOLT DOWN LID MARKED "WATER" WITH INNER FROST LID. REFER TO CITY OF GREELEY WATER & SEWER SPECIFICATIONS, LATEST REVISION, FOR SPECIFIC MANHOLE COVER MFR AND PRODUCT INFORMATION.

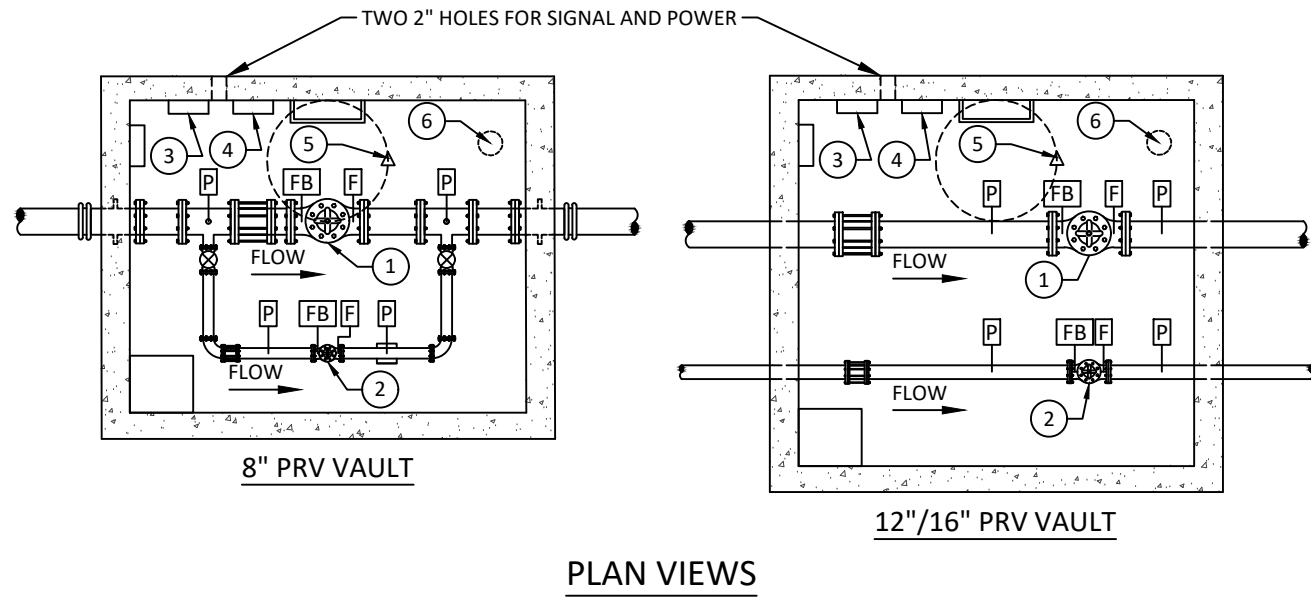


(TYP) 16" PRESSURE REDUCING VALVE & VAULT

DETAIL W-14C

DATE: JANUARY 2023

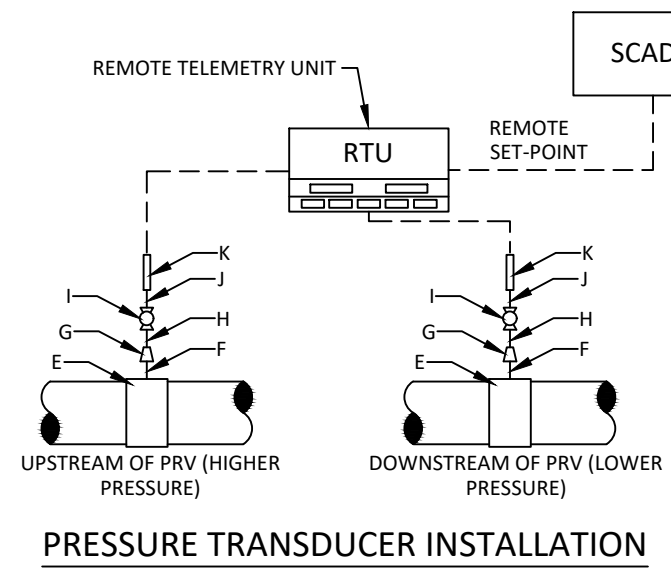
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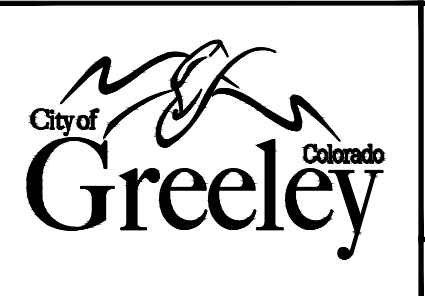
LEGEND	
1	MAIN VALVE (SEE PRV VALVE & VAULT DETAILS)
2	SECONDARY VALVE (SEE PRV VALVE & VAULT DETAILS)
3	SIGNAL WIRING JUNCTION BOX (SEE NOTE 1)
4	120V JUNCTION BOX (SEE NOTE 2)
5	INTRUSION ALARM (SEE NOTE 11)
6	FLOOD ALARM (SEE NOTE 10)
F	X144 E-FLOWMETER (SEE PRV & VAULT DETAIL)
FB	FEEDBACK & SIGNAL
P	PRESSURE TRANSDUCER

- NOTES**
- INSTALL 12x12x6 JUNCTION BOX FOR SIGNAL WIRING. INSTALL TERMINAL BLOCKS FOR SPLICING.
 - INSTALL 12x12x6 JUNCTION BOX FOR 120 VOLT (20 AMP) CIRCUITS:
 - GENERAL OUTLETS
 - DEHUMIDIFIER
 - SUMP PUMP
 - VAULT LIGHTING
 - CONTROL PANEL
 - ELECTRIC HEATER
 - INSTALL WIRING FOR FOUR (4) PRESSURE SENSORS. REFER TO PRESSURE TRANSDUCER INSTALLATION DETAIL FOR MORE INFORMATION.
 - UNIK 5000F GE PRESSURE TRANSDUCER (MODEL#: PTX5032-TA-A2-CA-H0-PF) OR APPROVED EQUAL.
 - INSTALL WIRING FOR PRV MAIN VALVE.
 - INSTALL WIRING FOR FLOW METER.
 - PROVIDE AND INSTALL WIRING FOR 4-20MA FOR CONTROL.
 - INSTALL WIRING FOR 4-20MA FEEDBACK (FB) ON MAIN VALVE.
 - PROGRAM PRV OPEN AND CLOSE TO BE AUTOMATIC OR MANUALLY ADJUSTED FROM SCADA. FEEDBACK TO BE DISPLAYED ON SCADA.
 - INSTALL FLOOD ALARM AND WIRE BACK TO CONTROL PANEL.
 - INSTALL INTRUSION ALARM ON MANHOLE COVER.
 - PROVIDE AND INSTALL ALLEN BRADLEY PLC FOR CONTROLS. USE FIBER OR CONTACT CITY FOR RADIO SPECIFICATION TO COMMUNICATE BACK TO SCADA.
 - SUMP PUMP SHALL BE ROUTED TO STORM INFRASTRUCTURE OR PAN.

PLC INPUT AND OUTPUTS		
FUNCTION	INPUT/OUTPUT	PIN
	DI - 0	0
	DI - 1	1
	AO - 1	2
	AI - 1	3
	AI - 2	4
	AI - 3	5
	AI - 4	6
	AI - 5	7
		8
		9
		10
		11
		12
		13
		14
		15
		16
		17



PRESSURE TRANSDUCER COMPONENTS	
ITEM	DESCRIPTION
E	3/4" BRONZE SADDLE
F	3/4" X 2" NIPPLE
G	3/4" X 1/4" BRASS REDUCER
H	1/4" X 2" NIPPLE
I	1/4" BALL VALVE
J	1/4" X 2" NIPPLE
K	UNIK 5000 PRESSURE TRANSDUCER (SEE NOTE 13)



(TYP) PRESSURE REDUCING VALVE CONTROLS & TELEMETRY

DETAIL W-15

DATE: JANUARY 2023

SCALE: N.T.S.

TYPICAL VAULT NOTES:

1. ALL METER, VALVE, AND VAULT COMPONENTS AND PRODUCT SPECIFICATIONS SHALL BE IN ACCORDANCE WITH APPROVED CONSTRUCTION DRAWINGS ALONG WITH WATER & SEWER (W&S) DEPARTMENT SPECIFICATIONS, LATEST REVISION.
2. PIPING CONFIGURATION IS GENERAL AND INDICATES MINIMUM REQUIREMENTS. CONTRACTOR TO PROVIDE ADDITIONAL PIPING, COUPLINGS, REDUCERS, AND ACCESSORIES AS NECESSARY FOR A COMPLETE SYSTEM. VAULT MODIFICATIONS MAY BE REQUIRED FOR A COMPLETE SYSTEM.
3. METER OR PRV COMPONENTS, INSTRUMENTATION, AND ELECTRICAL SHALL BE INSTALLED PER MANUFACTURER'S RECOMMENDATIONS.
4. CONTRACTOR TO SUBMIT VAULT MANUFACTURER'S SHOP DRAWINGS TO ENGINEERING DEVELOPMENT REVIEW FOR ACCEPTANCE A MINIMUM OF 2 WEEKS PRIOR TO ORDERING AND INSTALLATION.
5. APPROPRIATE LENGTH OF STRAIGHT PIPE SEGMENTS UPSTREAM AND DOWNSTREAM OF METER OR VALVE SHALL BE PROVIDED PER THE METER/VALVE MANUFACTURER'S RECOMMENDATION.
6. FOR INSTALLATIONS LARGER THAN 2", ALL PIPING AND APPURTENANCES WITHIN THE VAULT SHALL BE FLANGED DIP. ALL OTHER EXTERIOR PIPING AND APPURTENANCES, BETWEEN AND INCLUDING THE EXTERIOR TEES AND VALVES, SHALL BE MECHANICAL RESTRAINED JOINT DIP.
7. ALL VAULT JOINTS SHALL BE WATER TIGHT.
8. ALL EQUIPMENT AND PIPING SHALL BE ADEQUATELY SUPPORTED AND ATTACHED TO THE VAULT WALL OR FLOOR USING STAINLESS STEEL FASTENERS AND BOLTS OR APPROVED EQUIVALENT.
9. VAULT COVERS SHALL BE APPROVED MANHOLE COVERS, MARKED "WATER" OR "IRRIGATION" AS REQUIRED, AND INCLUDE AN INNER FROST PROOF LID. REFER TO WATER & SEWER SPECIFICATIONS, LATEST REVISION, FOR APPROVED VAULT COVER MATERIALS AND MANUFACTURERS.
10. FOR VAULTS PERMITTED IN ROAD RIGHT-OF-WAY, VAULT AND RING/COVER SHALL BE RATED FOR HS-20 TRAFFIC LOADING.
11. VAULT LADDER SHALL HAVE OSHA-APPROVED EXTENSION POST INSTALLED.
12. VAULT EXTERIOR SHALL BE COVERED WITH 2" THICK INSULATION BOARD.
13. IF SURFACE IS NOT TO FINAL GRADE AT TIME OF METER VALVE INSTALLATION OR GRADE CHANGES AFTER INSTALLATION, PROPERTY OWNER MUST ADJUST PIT OF VAULT MANHOLE COVER TO MEET SPECIFICATIONS.
14. SLOPE FINAL GROUND SURFACE AWAY FROM PIT VAULT COVER AT A 2% MINIMUM GRADE. MANHOLE LIDS SHALL NOT BE LOCATED IN DRAINAGE AREA OR PAN.
15. SUBGRADE AND SOIL SURROUNDING VAULT SHALL BE BACKFILLED AND COMPACTED IN ACCORDANCE WITH WATER & SEWER SPECIFICATIONS, LATEST REVISION.
16. MANHOLE BASEBEAMS ARE REQUIRED FOR ALL MANHOLE VAULT INSTALLATIONS.
17. ALL PIPING TO BE PRESSURE TESTED PER W & S SPECIFICATIONS, LATEST REVISION.
18. ALL THREADED CONNECTIONS SHALL HAVE TEFLON TAPE OR APPROVED EQUIVALENT TO ENSURE NO LEAKING OCCURS.
19. COPPER SHALL NOT SHOW ANY VISIBLE SIGNS OF CRIMPING.

VAULT ELECTRICAL SPECIFICATIONS:

1. PROVIDE 100 AMP 240/120 VOLT METER LOAD CENTER COMBINATION WITH A MINIMUM 12 SPACES, LOCATED WITHIN 25' OF VAULT.
2. PROVIDE 1-¼" CONDUIT, SCHEDULE 80, FROM LOAD CENTER TO JUNCTION OR PULL BOX IN VAULT WITH ONE SPARE.
3. JUNCTION OR PULL BOX SHALL HAVE 12"X12X8" MINIMUM PANEL LOCATED INSIDE VAULT FOR EXTRA CIRCUIT CONDUIT CONNECTIONS.
4. PROVIDE FIVE 20-AMP BREAKERS FOR LOAD CENTER.
5. PROVIDE OUTLET FOR SUMP PUMP AND DEHUMIDIFIER, 20-AMP 120 VOLT CIRCUIT.
6. PROVIDE LED LIGHTING CIRCUIT: TWO 10-WATT LED LIGHTS WITH OUTDOOR SWITCH LOCATED IN VAULT ON 20-AMP 120 VOLT CIRCUIT.
7. PROVIDE ONE 20-AMP GFI OUTLET FOR SERVICE WORK LOCATED INSIDE VAULT.
8. ALL CONDUIT BOXES, FITTINGS, AND HANGERS SHALL BE PVC, FIBERGLASS, OR STAINLESS STEEL AND SUITABLE FOR OUTDOOR USE.
9. PROVIDE DISCONNECT LOCATED BEFORE METER OR VALVE COMBINATION AS REQUIRED PER ELECTRIC UTILITY IF APPLICABLE.
10. PROVIDE 2" SCHEDULE 80 PVC CONDUITS FROM POLE TO TRANSFORMER TO LOAD CENTER.
11. PROVIDE 240 VOLT SURGE PROTECTION FOR LOAD CENTER.
12. MUST MEET ALL CITY OF GREELEY AND STATE ELECTRICAL CODE REQUIREMENTS.

DEHUMIDIFIER SPECIFICATIONS:

1. DEHUMIDIFIER SHALL BE A LOW TEMP 38 DEGREES OR LOWER AND BE INSTALLED TO MANUFACTURER SPECIFICATIONS.
2. DEHUMIDIFIER SHALL BE INSTALLED A MINIMUM 2' FROM THE VAULT FLOOR.
3. A MINIMUM ½" HOSE SHALL BE INSTALLED FROM DEHUMIDIFIER TO THE SUMP PIT.

METER INSTALLATION NOTES:

1. METER SETTING MUST BE INSPECTED BEFORE BACKFILLING. FOR INSPECTION CALL (970) 350-9317.
2. NO SPRINKLER SYSTEM CONNECTION SHALL BE MADE IN THE VAULT. SPRINKLER PIT SHALL BE MINIMUM 5' DOWNSTREAM FROM THE FINAL VAULT APPURTENANCE (BYPASS TEE).
3. NO MAJOR LANDSCAPING OR STRUCTURES SHALL BE LOCATED WITHIN 10' OF METER VAULT.
4. PRESSURE REDUCING AND BACKFLOW DEVICES SHALL BE INSTALLED INSIDE THE BUILDING SERVED. INSTALL PER CITY OF GREELEY ADOPTED BUILDING CODE.
5. REFER TO W&S SPECIFICATIONS, LATEST REVISION, FOR PRODUCT SPECIFICATIONS.
6. LOCATION OF METER VAULT SHALL NOT BE MORE THAN 2 FEET DOWNSTREAM OF CURBSTOP UNLESS OTHERWISE APPROVED BY W&S.

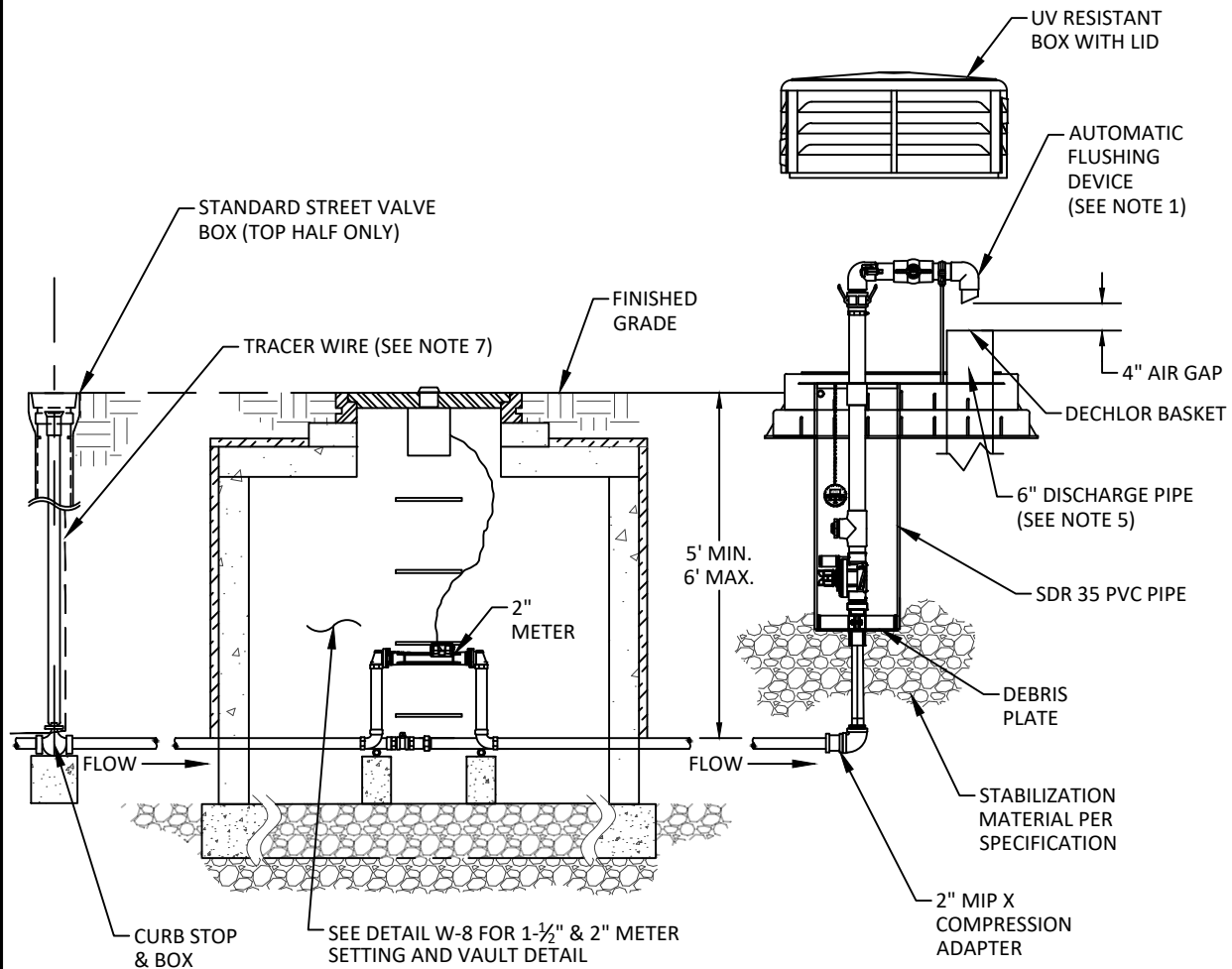


(TYP) VAULT NOTES

DETAIL W-16

DATE: JANUARY 2023

SCALE: N.T.S.



NOTES:

1. FLUSHING DEVICE SHALL BE KUPFERLE #9800 FLUSHING STATION OR APPROVED EQUAL.
2. FLUSHING DEVICE SHALL BE INSTALLED PER MFR REQUIREMENTS.
3. REFER TO WATER & SEWER (W&S) DETAIL W-8, LATEST REVISION, FOR METER INSTALLATION AND LOCATION REQUIREMENTS.
4. FLUSH LINES FREE OF DEBRIS BEFORE INSTALLATION
5. CITY MAY REQUIRE INSTALLATION OF STORMWATER LINE UP TO DISCHARGE POINT TO MANAGE FLUSH WATER.
6. ALL BURIED PIPING SHALL BE INSTALLED AND RESTRAINED IN ACCORDANCE WITH W&S SPECIFICATIONS, LATEST REVISION.
7. INSTALL TRACER WIRE ACCORDING TO W&S SPECIFICATIONS AND STANDARD DETAILS, LATEST REVISION.
8. ALL PIPING SHALL BE 2 INCHES.



AUTOMATIC FLUSHING STATION WITH METER

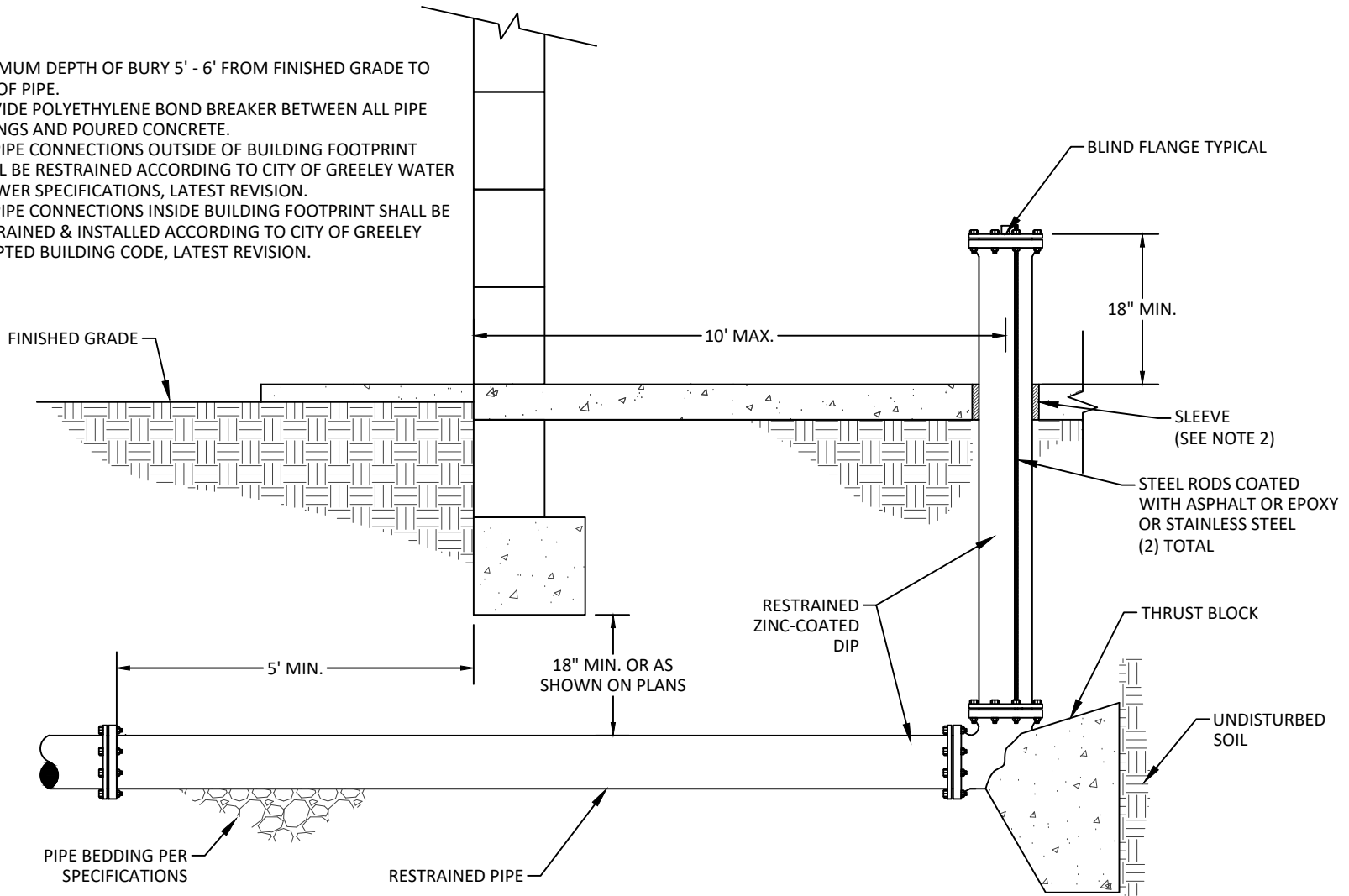
DETAIL W-17

DATE: JANUARY 2023

SCALE: N.T.S.

NOTES:

1. MINIMUM DEPTH OF BURY 5' - 6' FROM FINISHED GRADE TO TOP OF PIPE.
2. PROVIDE POLYETHYLENE BOND BREAKER BETWEEN ALL PIPE FITTINGS AND POURED CONCRETE.
3. ALL PIPE CONNECTIONS OUTSIDE OF BUILDING FOOTPRINT SHALL BE RESTRAINED ACCORDING TO CITY OF GREELEY WATER & SEWER SPECIFICATIONS, LATEST REVISION.
4. ALL PIPE CONNECTIONS INSIDE BUILDING FOOTPRINT SHALL BE RESTRAINED & INSTALLED ACCORDING TO CITY OF GREELEY ADOPTED BUILDING CODE, LATEST REVISION.



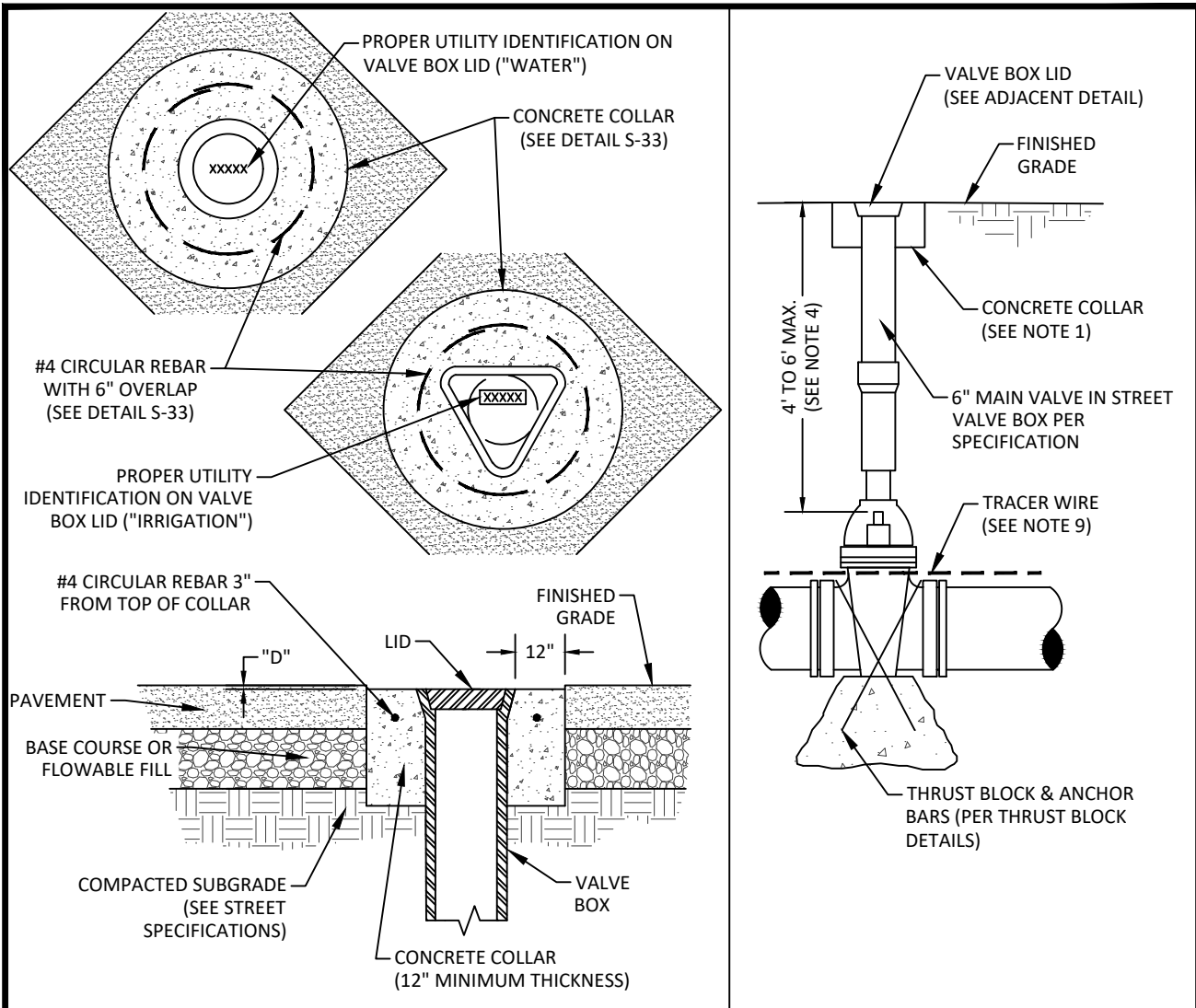
FIRE RISER INSTALLATION

DETAIL W-18



DATE: JANUARY 2023

SCALE: N.T.S.



NOTES:

1. VALVE BOX SHALL BE PLACED IN A CONCRETE COLLAR AT THE SURFACE FOR STABILIZATION. REFER TO STREETS STANDARD DETAILS, LATEST REVISION, FOR VALVE BOXES LOCATED IN PUBLIC STREETS AND ROADWAYS (S-33).
2. VALVE BOX SHALL BE CENTERED & PLUMB OVER THE OPERATING NUT.
3. OPERATING NUT ON BURIED VALVES SHALL BE BETWEEN 4' & 6' BELOW FINISHED GRADE. EXTENSION REQUIRED IF DEEPER THAN 6' TO BRING THE OPERATING NUT TO THE SPECIFIED RANGE.
4. PROVIDE POLYETHYLENE BOND BREAKER BETWEEN ALL PIPE/FITTINGS AND POURED CONCRETE.
5. ALL BURIED VALVES, FITTINGS, AND APPURTENANCES SHALL BE RESTRAINED AND INSTALLED PER WATER & SEWER (W&S) SPECIFICATIONS (SPECIFICATIONS), LATEST REVISION.
6. ALL BURIED VALVES TO BE INSTALLED ACCORDING TO W&S THRUST BLOCK DETAILS AND SPECIFICATIONS, LATEST REVISION OF EACH.
7. BEDDING AND BACKFILL AROUND VALVE SHALL BE PLACED PER W&S SPECIFICATIONS, LATEST REVISION.
8. INSTALL TEST STATION AND TRACER WIRE ACCORDING TO W&S SPECIFICATIONS AND W&S UTILITY LOCATING ("UL") STANDARD DETAILS, LATEST REVISION OF EACH.
9. UNLESS OTHERWISE SPECIFIED, THIS DETAIL ALSO APPLIES TO BOTH POTABLE WATER AND NON-POTABLE IRRIGATION STANDARD VALVES.

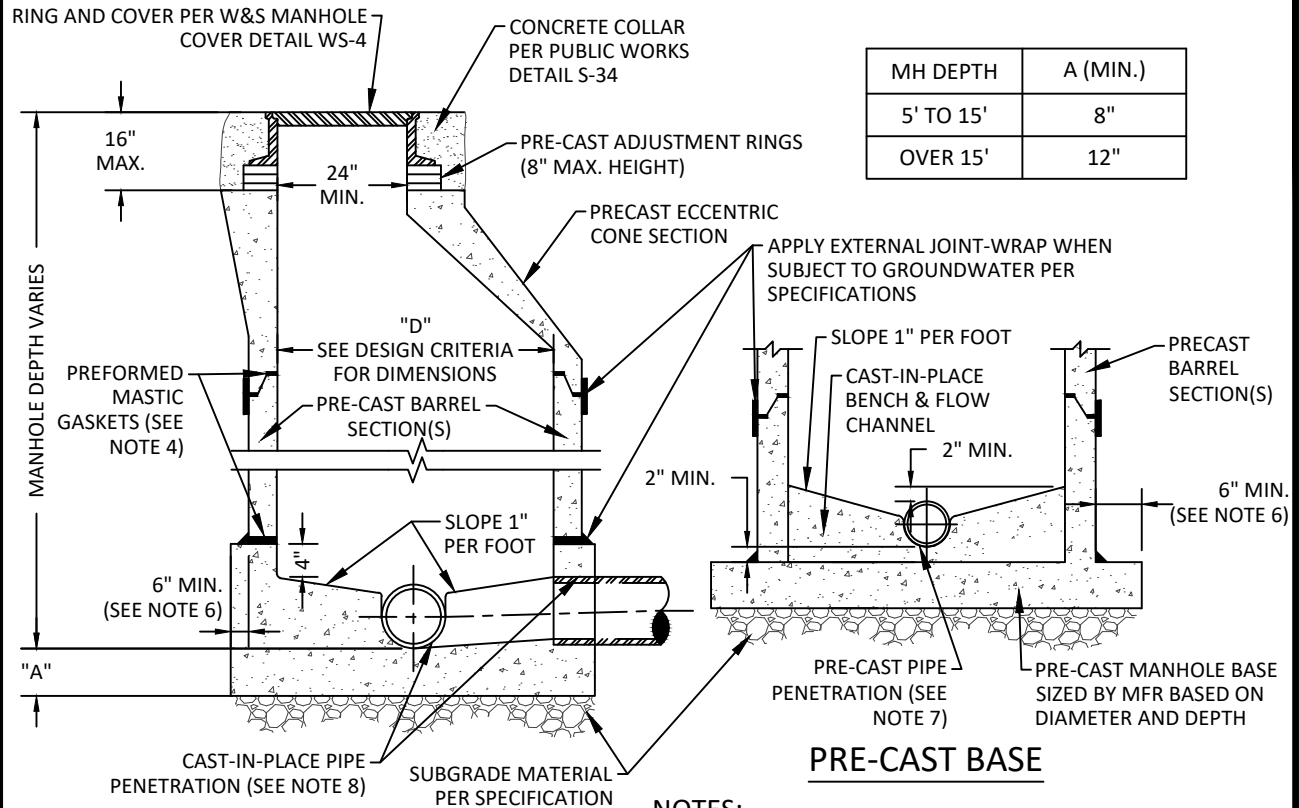


STANDARD VALVE & RISER ASSEMBLY

DETAIL W-19

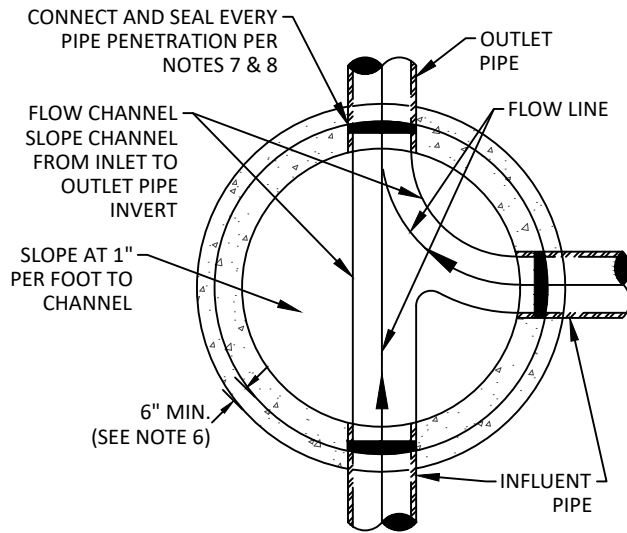
DATE: JANUARY 2023

SCALE: N.T.S.



MH DEPTH	A (MIN.)
5' TO 15'	8"
OVER 15'	12"

CAST-IN-PLACE BASE



PLAN VIEW

NOTES:

1. REFERENCE CITY OF GREELEY WATER & SEWER (W&S) DESIGN CRITERIA FOR MINIMUM MANHOLE DIAMETER (D), AND WATER & SEWER CONSTRUCTION SPECIFICATIONS (SPECIFICATIONS) AND MATERIAL/INSTALLATION REQUIREMENTS, LATEST REVISION.
2. MANHOLES INSTALLED IN GROUNDWATER ABOVE THE BASE SHALL HAVE ALL MANHOLE SECTION JOINTS SEALED PER W&S SPECIFICATIONS.
3. ALL SEWER MANHOLES SHALL BE VACUUM TESTED PER SPECIFICATIONS.
4. SEE W&S SPECIFICATIONS, LATEST REVISION, FOR ACCEPTABLE MFR FOR PREFORMED MASTIC GASKETS.
5. ALL BURIED PIPING SHALL BE INSTALLED IN ACCORDANCE WITH W&S SPECIFICATIONS.
6. BASE SHALL BE AT LEAST 6" WIDER THAN THE BOTTOM PRE-CAST BARREL SECTION AND WIDE ENOUGH TO PREVENT FLOTATION AS DESIGNED BY THE ENGINEER.
7. FOR PIPE PENETRATIONS IN CAST-IN-PLACE BASE, AN APPROVED SWELLSTOP SEAL ON PIPE BARREL SHALL BE USED. SEE SPECIFICATIONS FOR APPROVED MFR AND INSTALLATION REQUIREMENTS.
8. FOR PRE-CAST BASE, PIPE PENETRATIONS SHALL BE INSTALLED WITH A-LOK RUBBER BOOT CONNECTORS OR APPROVED EQUAL.
9. CHANNEL INVERT TO BE FORMED OR SHAPED TO SUIT FIELD CONDITIONS AND MATCH PIPE SIZE, MIN. OF 0.1' DROP ACROSS MANHOLE.
10. ALL PIPES WITH MULTIPLE SIZES MUST HAVE MATCHING CROWNS TO ELIMINATE POSSIBLE SEWER BACKUPS.

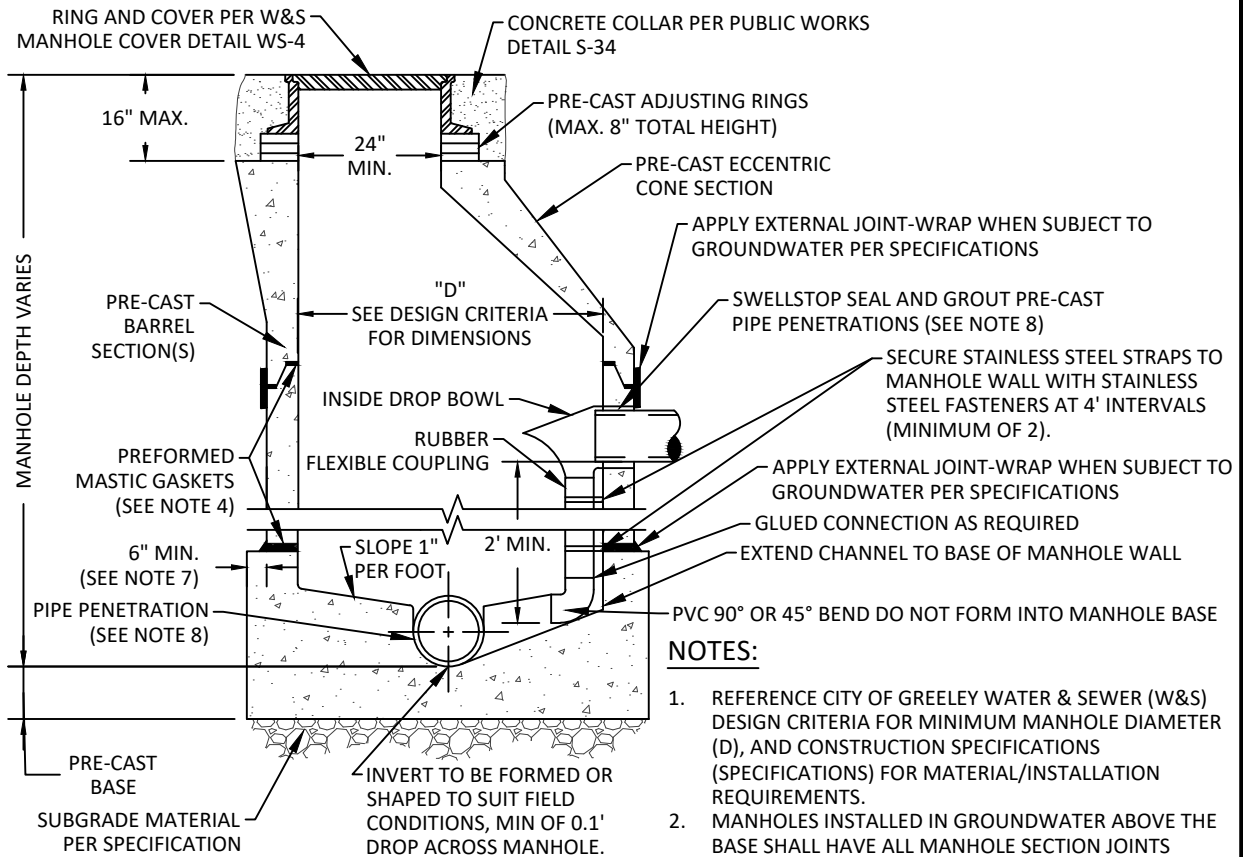


STANDARD SANITARY SEWER MANHOLE

DETAIL SS-1

DATE: JANUARY 2023

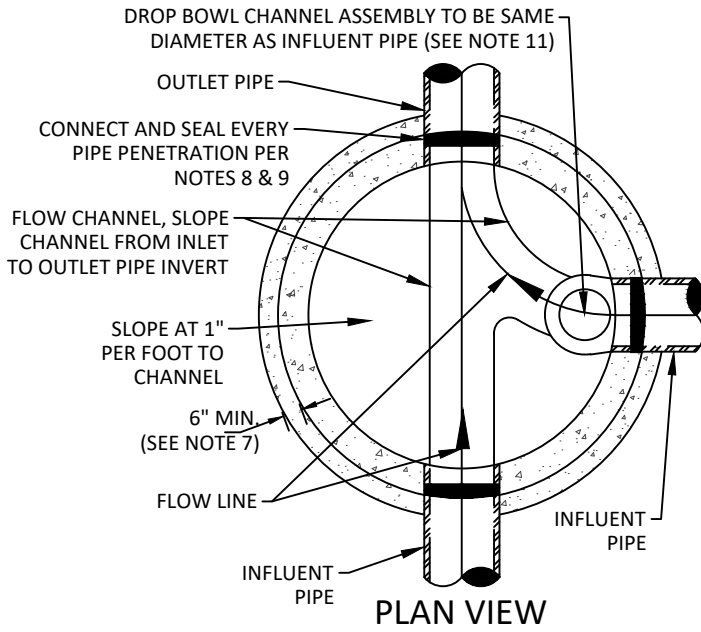
SCALE: N.T.S.



NOTES:

1. REFERENCE CITY OF GREELEY WATER & SEWER (W&S) DESIGN CRITERIA FOR MINIMUM MANHOLE DIAMETER (D), AND CONSTRUCTION SPECIFICATIONS (SPECIFICATIONS) FOR MATERIAL/INSTALLATION REQUIREMENTS.
2. MANHOLES INSTALLED IN GROUNDWATER ABOVE THE BASE SHALL HAVE ALL MANHOLE SECTION JOINTS SEALED PER W&S SPECIFICATIONS.
3. ALL WASTEWATER MANHOLES SHALL BE VACUUM TESTED PER SPECIFICATIONS
4. MANHOLE RETROFITS CAN ROUTE DROP EQUIPMENT PIPING INTO INSIDE FLOW LINE CHANNEL.
5. SEE W&S SPECIFICATIONS, LATEST REVISION, FOR ACCEPTABLE MFR FOR PREFORMED MASTIC GASKETS
6. ALL BURIED PIPING SHALL BE INSTALLED IN ACCORDANCE WITH W&S SPECIFICATIONS.
7. BASE SHALL BE AT LEAST 6" WIDER THAN THE BOTTOM PRE-CAST BARREL SECTION AND WIDE ENOUGH TO PREVENT FLOTATION AS DESIGNED BY THE ENGINEER.
8. FOR PIPE PENETRATIONS IN CAST-IN-PLACE BASE, AN APPROVED SWELLSTOP SEAL ON PIPE BARREL SHALL BE USED. SEE SPECIFICATIONS FOR APPROVED MFR AND INSTALLATION REQUIREMENTS.
9. FOR PRE-CAST BASE, PIPE PENETRATIONS SHALL BE INSTALLED WITH A-LOK RUBBER BOOT CONNECTORS OR APPROVED EQUAL.
10. ALL PIPES WITH MULTIPLE SIZES MUST HAVE MATCHING CROWNS TO ELIMINATE POSSIBLE SEWER BACKUPS.
11. DROP BOWL CHANNEL ASSEMBLY TO BE SAME DIAMETER AS INFLUENT PIPE, OR SIZED TO MEET FULL PIPE CAPACITY OR SPECIFICALLY APPROVED BY W&S DEPARTMENT.
12. ALL SECTIONS OF DROP MANHOLES MUST BE PROTECTED AGAINST MICROBIAL INDUCED CORROSION PER W&S DESIGN CRITERIA AND SPECIFICATIONS.

PRE-CAST BASE



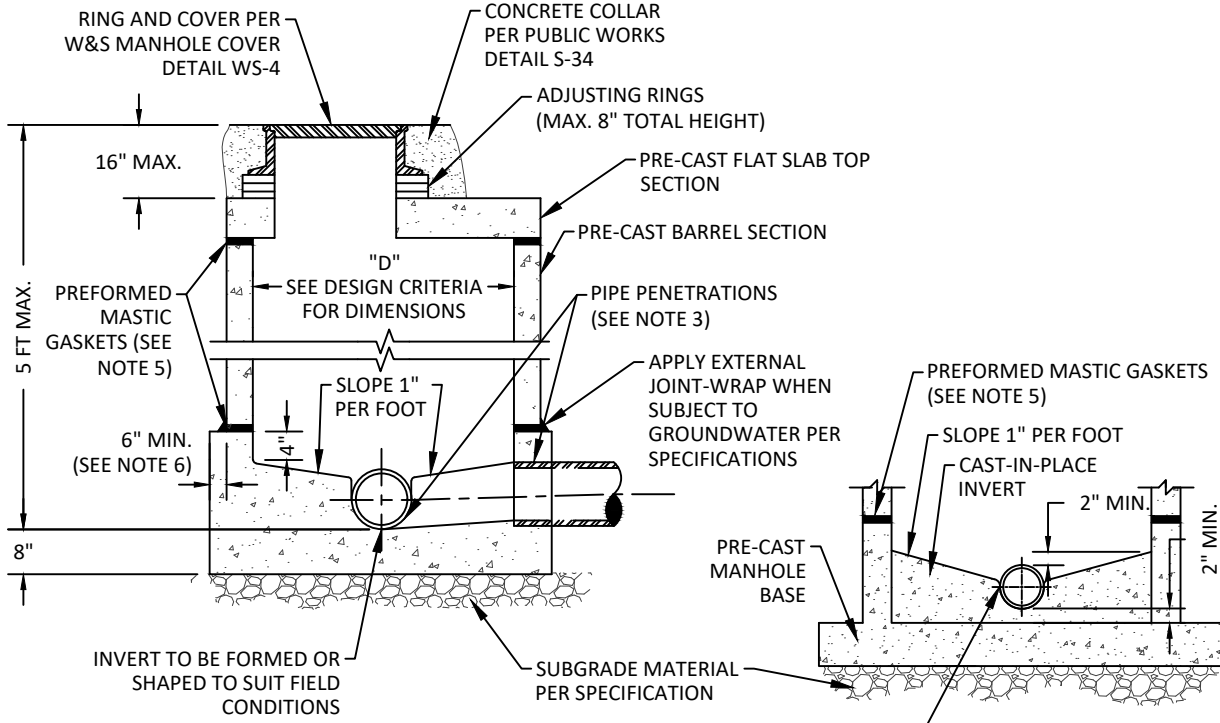
INSIDE DROP SANITARY SEWER MANHOLE

DETAIL SS-2



DATE: JANUARY 2023

SCALE: N.T.S.

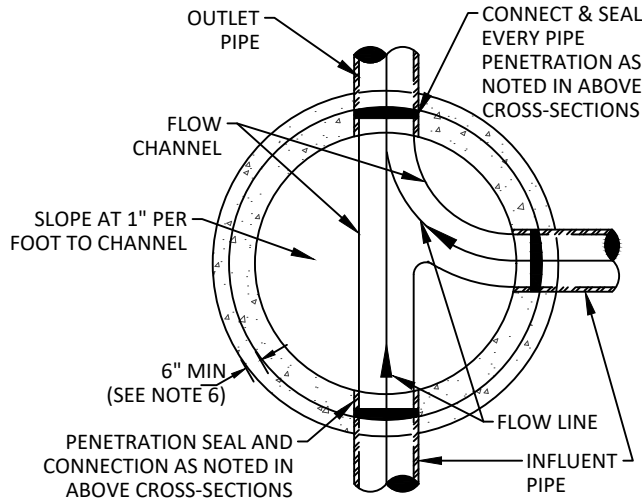


CAST-IN-PLACE BASE

PRE-CAST BASE

NOTES:

1. REFERENCE CITY OF GREELEY WATER & SEWER (W&S) DESIGN CRITERIA FOR MINIMUM MANHOLE DIAMETER (D), AND CONSTRUCTION SPECIFICATIONS (SPECIFICATIONS) FOR MATERIAL/INSTALLATION REQUIREMENTS.
2. FOR PIPE PENETRATIONS IN CAST-IN-PLACE BASE, AN APPROVED SWELLSTOP SEAL ON PIPE BARREL SHALL BE USED. SEE SPECIFICATIONS FOR APPROVED MFR AND INSTALLATION REQUIREMENTS.
3. FOR PRE-CAST BASE, PIPE PENETRATIONS SHALL BE INSTALLED WITH A-LOK RUBBER BOOT CONNECTORS OR APPROVED EQUAL CONNECTORS OR APPROVED EQUAL.
4. ALL SEWER MANHOLES SHALL BE VACUUM TESTED PER SPECIFICATIONS
5. SEE SPECIFICATIONS FOR ACCEPTABLE MFR FOR PREFORMED MASTIC GASKETS
6. ALL BURIED PIPING SHALL BE INSTALLED IN ACCORDANCE WITH W&S SPECIFICATIONS. BASE SHALL BE AT LEAST 6" WIDER THAN THE BOTTOM PRE-CAST BARREL SECTION AND WIDE ENOUGH TO PREVENT FLOTATION AS DESIGNED BY THE ENGINEER.
- 7.



PLAN VIEW

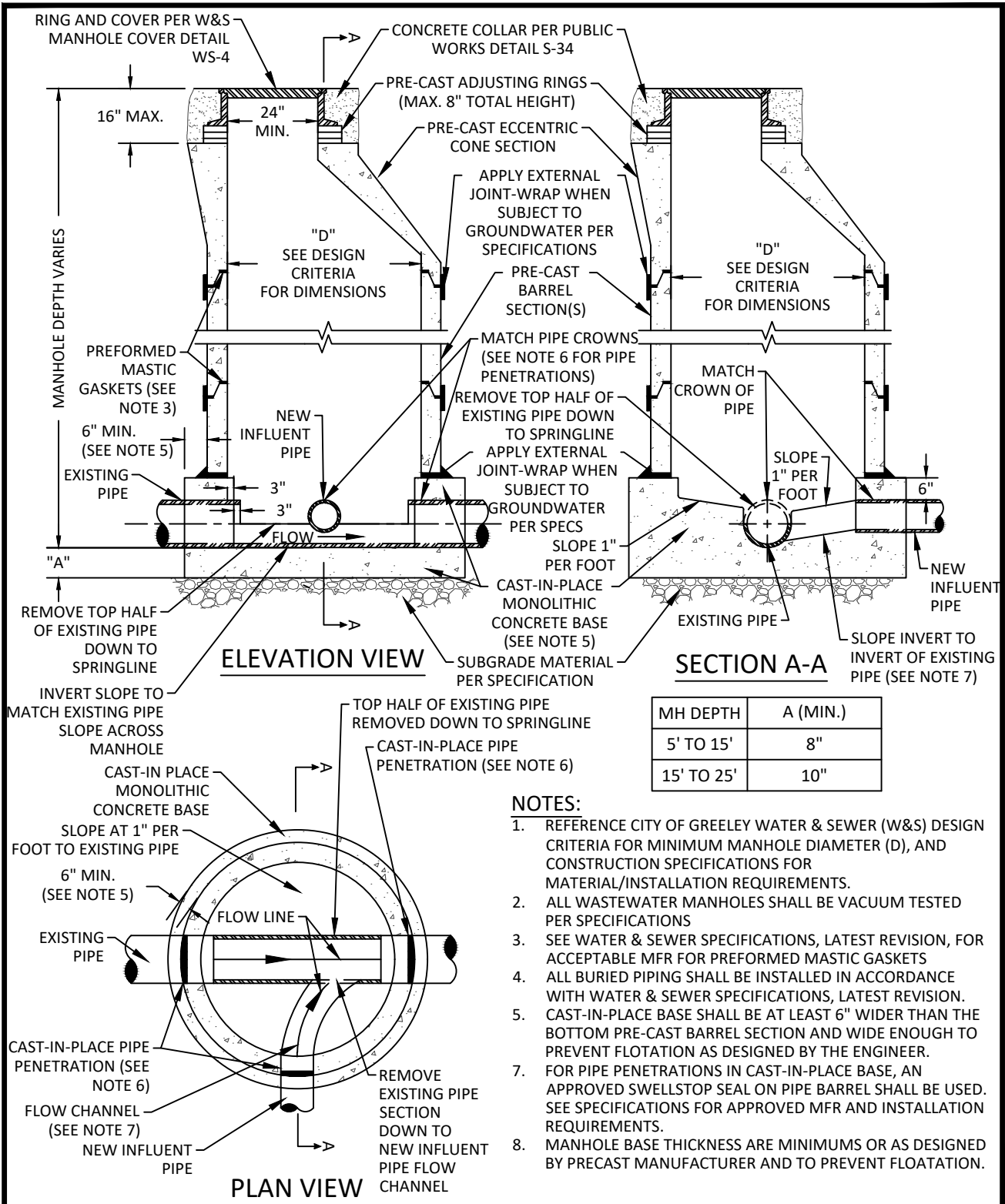


SHALLOW SANITARY SEWER MANHOLE

DETAIL SS-3

DATE: JANUARY 2023

SCALE: N.T.S.

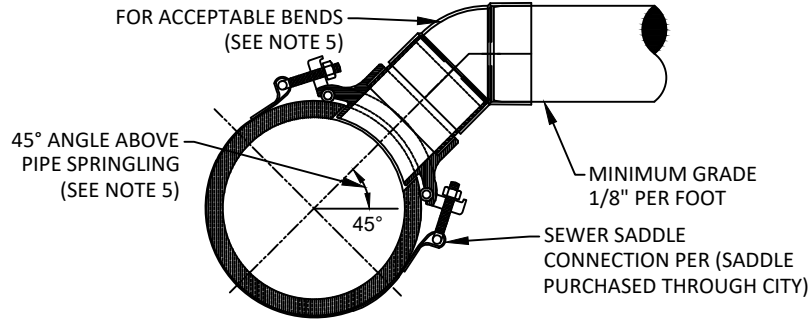


MANHOLE OVER EXISTING SANITARY SEWER LINE

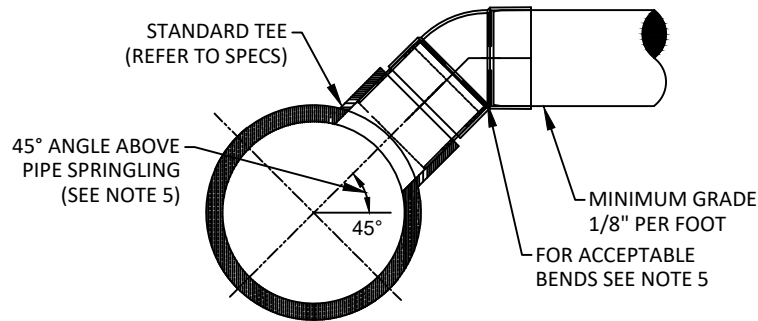
DETAIL SS-4

DATE: JANUARY 2023

SCALE: N.T.S.



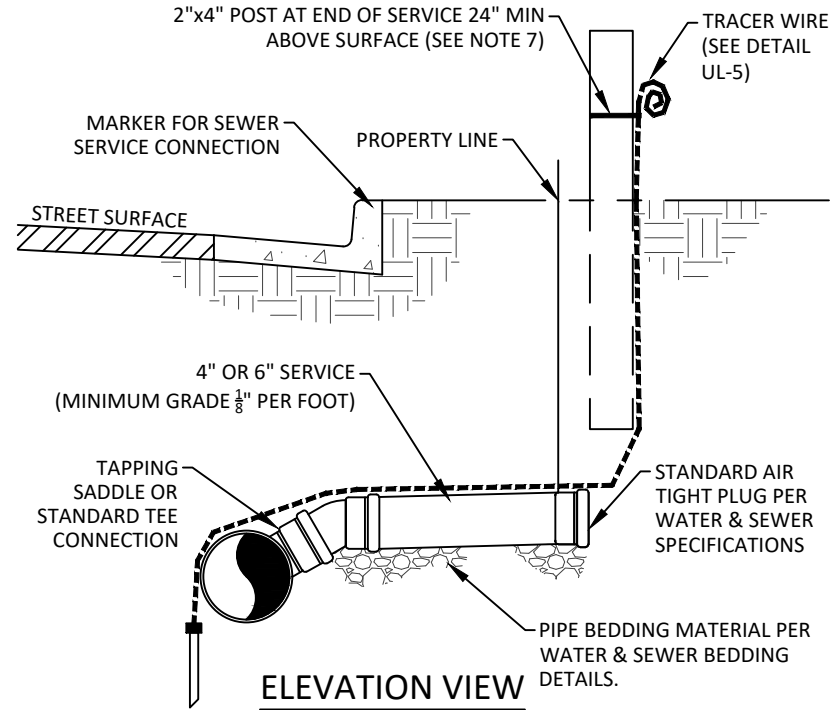
STANDARD SADDLE CONNECTION



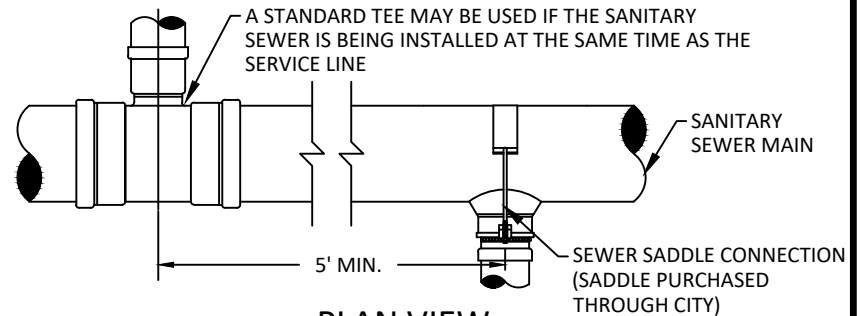
STANDARD TEE CONNECTION

NOTES:

1. IN NO CASE SHALL THE SERVICE LINE PROTRUDE INTO THE MAIN.
2. SERVICES ARE 4" OR 6" IN DIAMETER AND SHALL HAVE A MINIMUM SLOPE OF 1.0% (1/8" PER FOOT) AND A MAXIMUM SLOPE OF 8.0%.
3. SERVICES 8" DIAMETER AND LARGER SHALL BE CONNECTED TO A MANHOLE.
4. SERVICES SHALL EXTEND TO THE PROPERTY LINE UNLESS OTHERWISE SHOWN ON CITY ACCEPTED CONSTRUCTION DRAWINGS.
5. SERVICE CONNECTIONS SHALL BE INSTALLED AT A POSITION 45° ABOVE PIPE SPRINGLINE. ACCEPTABLE BENDS FOR SERVICE CONNECT ARE 45°, 22.5° & 11.25°.
6. INSTALL TRACER WIRE ACCORDING TO CITY OF GREELEY WATER & SEWER SPECIFICATIONS AND W&S UTILITY LOCATING ("UL") DETAILS, LATEST REVISION OF EACH.
7. 2 X 4 POST SHALL BE EXTERIOR GRADE, PRESSURE TREATED, LUMBER.
8. TAPPING OF EXISTING SEWER LINE TO BE SCHEDULED WITH CITY AT LEAST 72 HOURS PRIOR TO CONSTRUCTION (970) 350 - 9322.



ELEVATION VIEW



PLAN VIEW

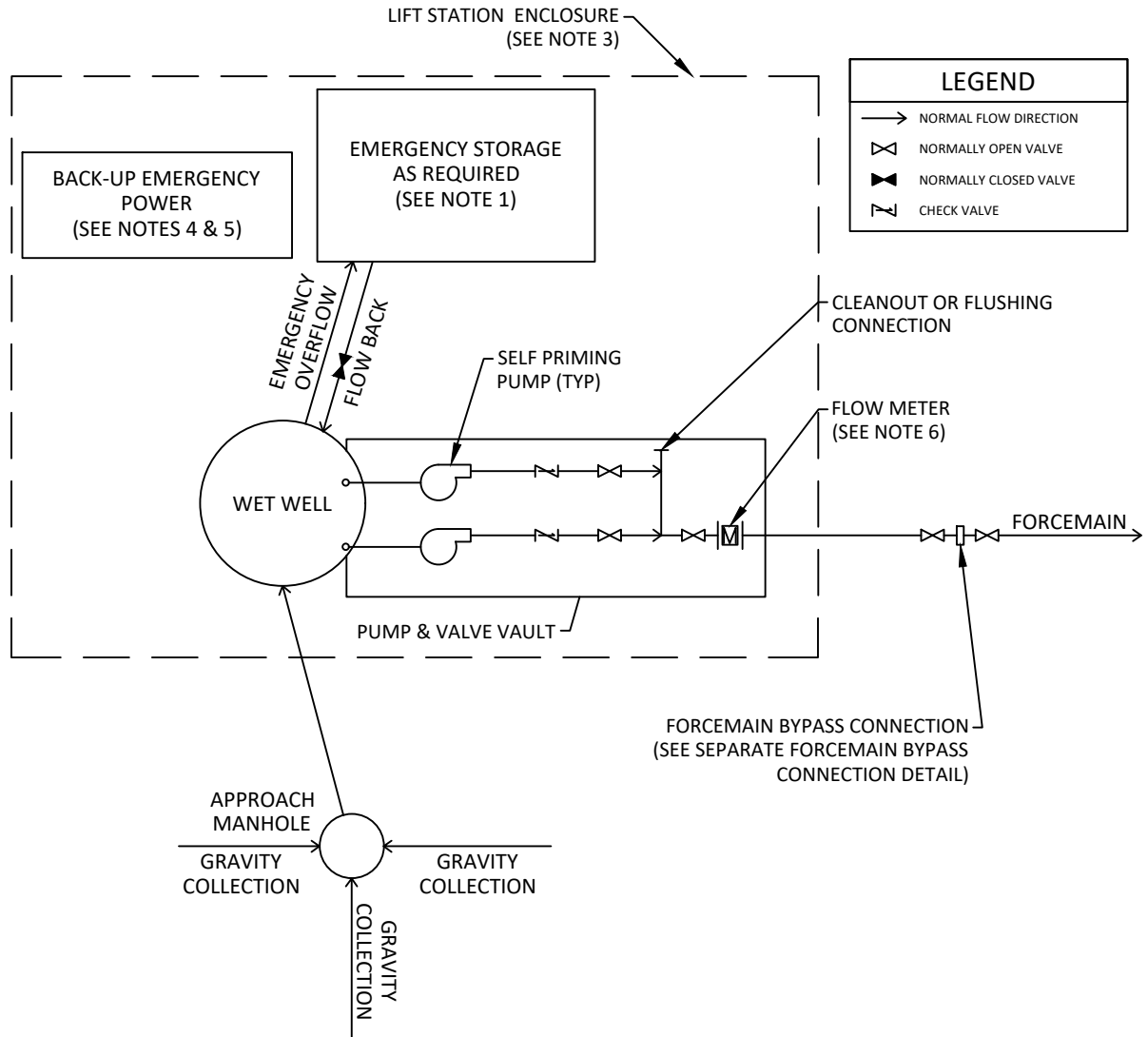
SANITARY SEWER SERVICE CONNECTION

DETAIL SS-5



DATE: JANUARY 2023

SCALE: N.T.S.



NOTES:

1. EMERGENCY STORAGE VOLUME WILL BE BASED ON PEAK HOURLY FLOW AND RESPONSE TIME. STORAGE VOLUME IS SUBJECT TO REVIEW & ACCEPTANCE BY THE CITY AND COLORADO DEPARTMENT OF PUBLIC HEALTH & ENVIRONMENT (CDPHE).
2. LIFT STATION BYPASS CONNECTION IS REQUIRED FOR ALL LIFT STATIONS.
3. FINAL ORIENTATION AND ARRANGEMENT OF LIFT STATION AND FORCE MAIN SUBJECT TO REVIEW & ACCEPTANCE BY CITY.
4. BACK-UP EMERGENCY POWER SYSTEM SHALL BE INCLUDED IN THE STATION BY PUMP MANUFACTURER OR INDEPENDENT GAS GENERATOR.
5. SKID-MOUNTED NATURAL GAS DRIVEN ENGINES INTEGRAL WITH SKID-MOUNTED LIFT STATION PUMP SYSTEM PREFERRED FOR BACK-UP EMERGENCY POWER SYSTEMS.
6. FLOW METER SHALL BE INSIDE DEDICATED METER VAULT PER WATER METER VAULT DETAILS, LATEST REVISION, OR LIFT STATION ENCLOSURE (PREFERRED).
7. REFER TO WATER & SEWER SPECIFICATIONS, LATEST REVISION, FOR ACCEPTABLE PRODUCT AND EQUIPMENT MODELS AND MANUFACTURERS.

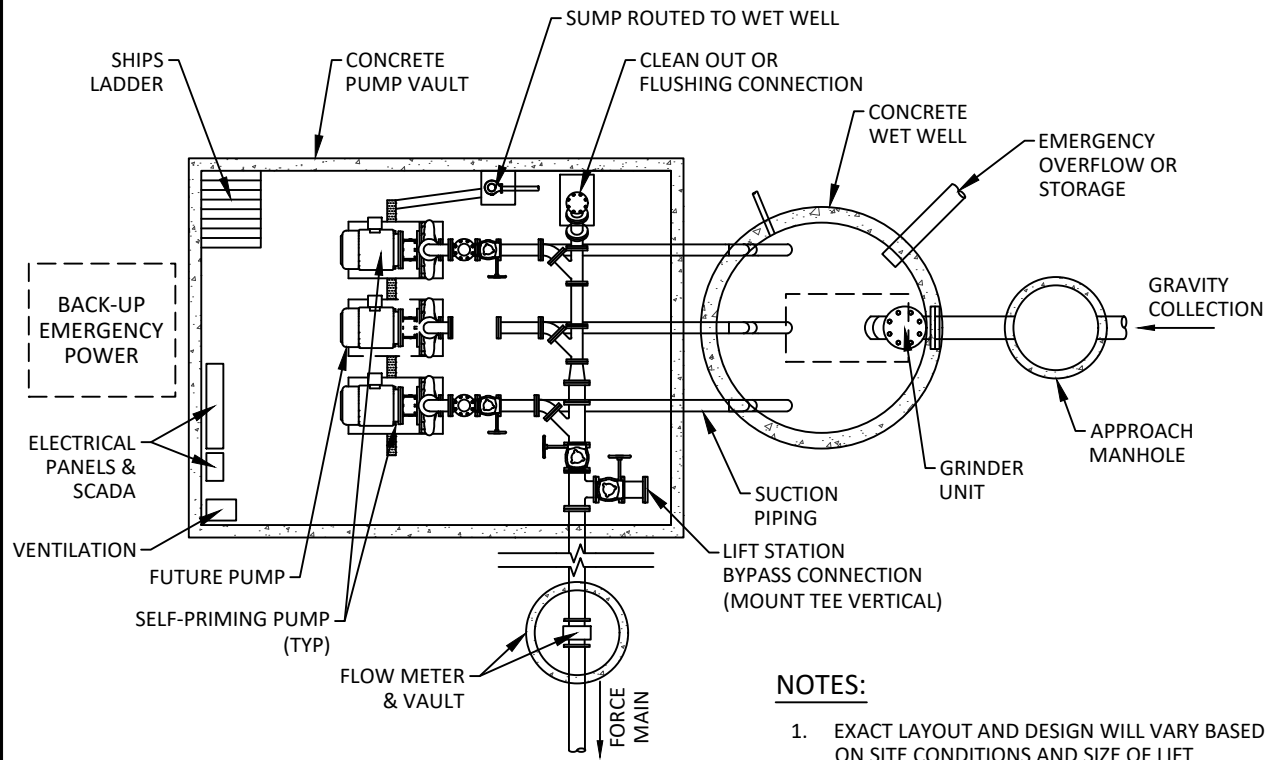


(TYP) LIFT STATION FLOW SCHEMATIC

DETAIL SS-6

DATE: JANUARY 2023

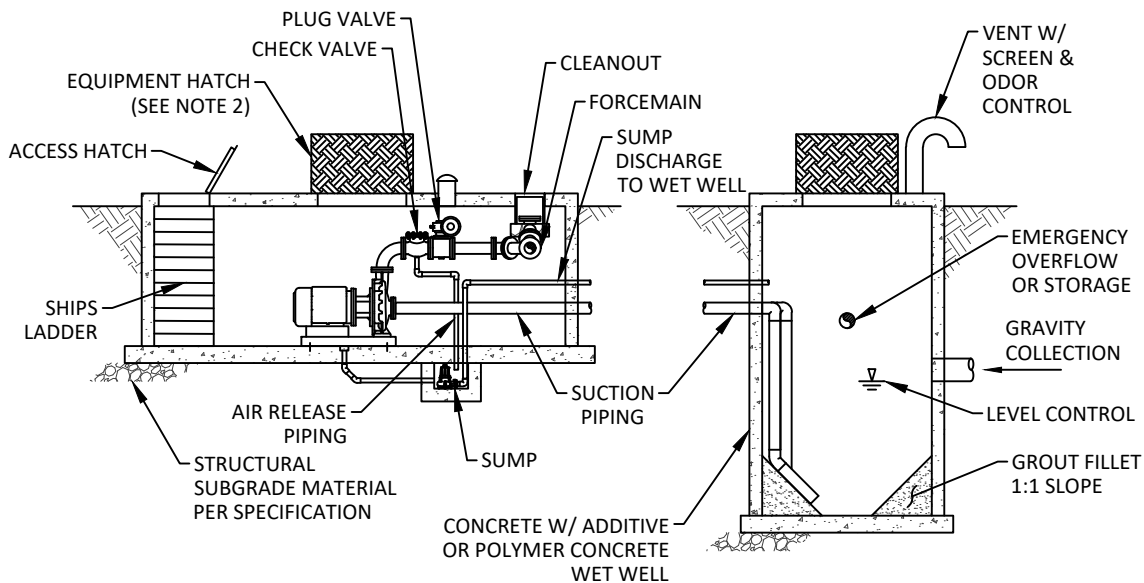
SCALE: N.T.S.



PLAN VIEW

NOTES:

1. EXACT LAYOUT AND DESIGN WILL VARY BASED ON SITE CONDITIONS AND SIZE OF LIFT STATION.
2. EQUIPMENT HATCH SHALL BE OVER ALL EQUIPMENT THAT WILL REQUIRE REPLACEMENT OR MAINTENANCE.



SECTION VIEW

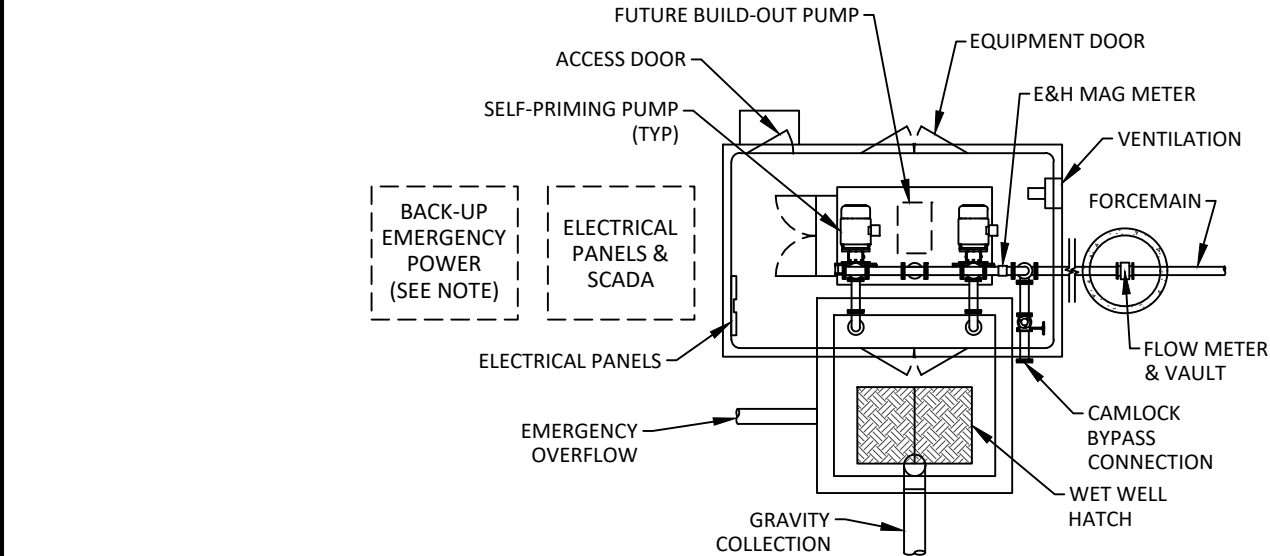


(TYP) BELOW GRADE LIFT STATION

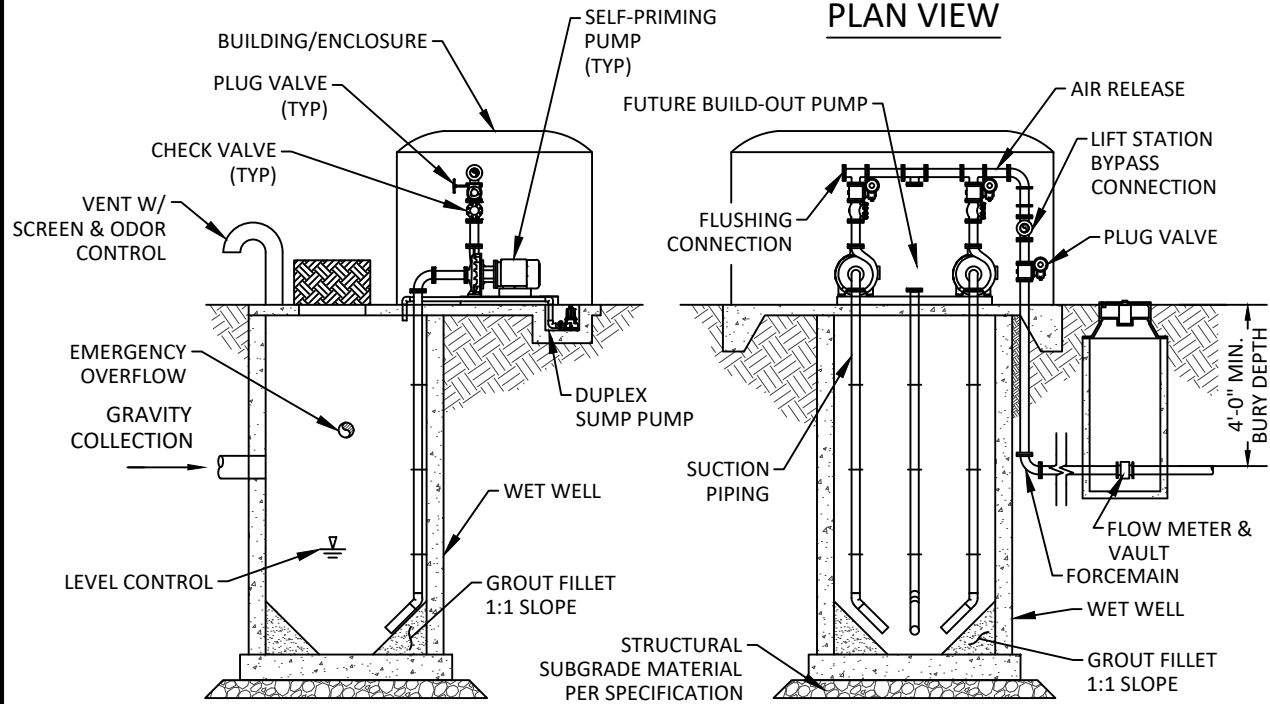
DETAIL SS-7

DATE: JANUARY 2023

SCALE: N.T.S.



PLAN VIEW



ELEVATION VIEW

SECTION VIEW

NOTES:

1. BACK-UP POWER SYSTEMS SHALL BE PROVIDED BY PUMP MANUFACTURER.
2. EXACT LAYOUT AND DESIGN WILL VARY BASED ON SITE CONDITIONS AND SIZE OF LIFT STATION.

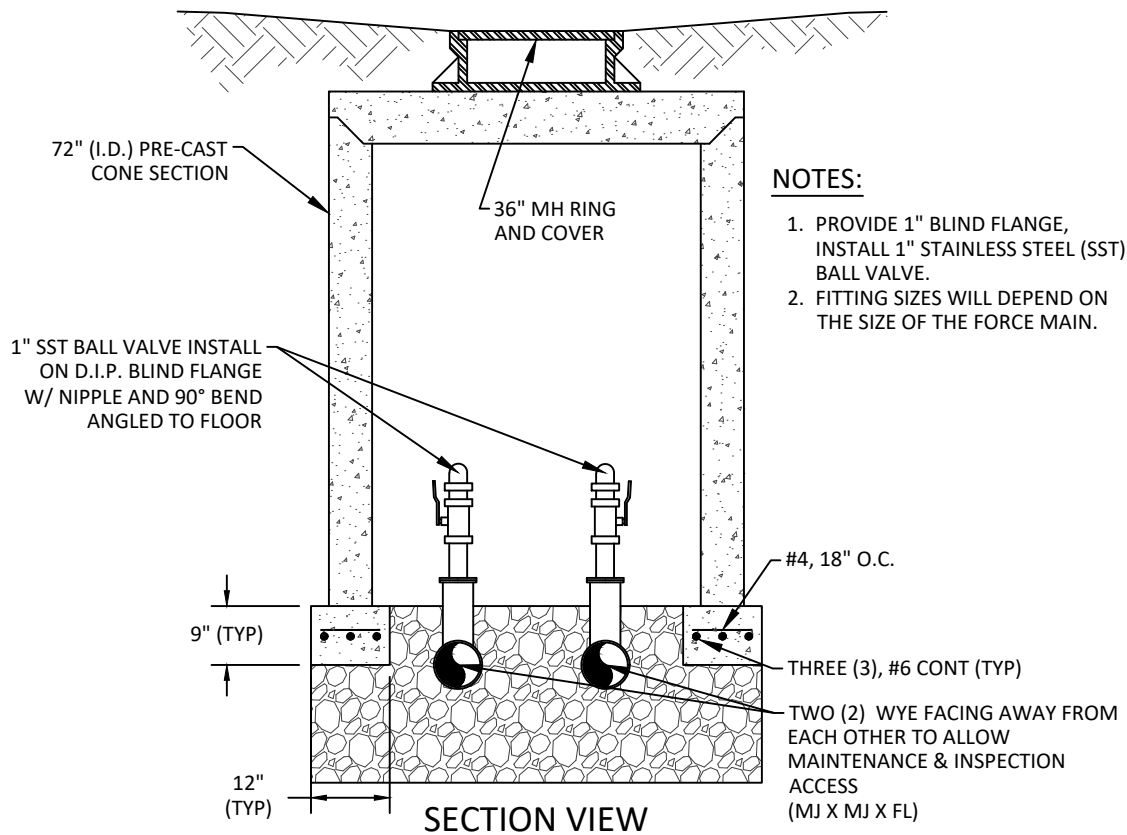
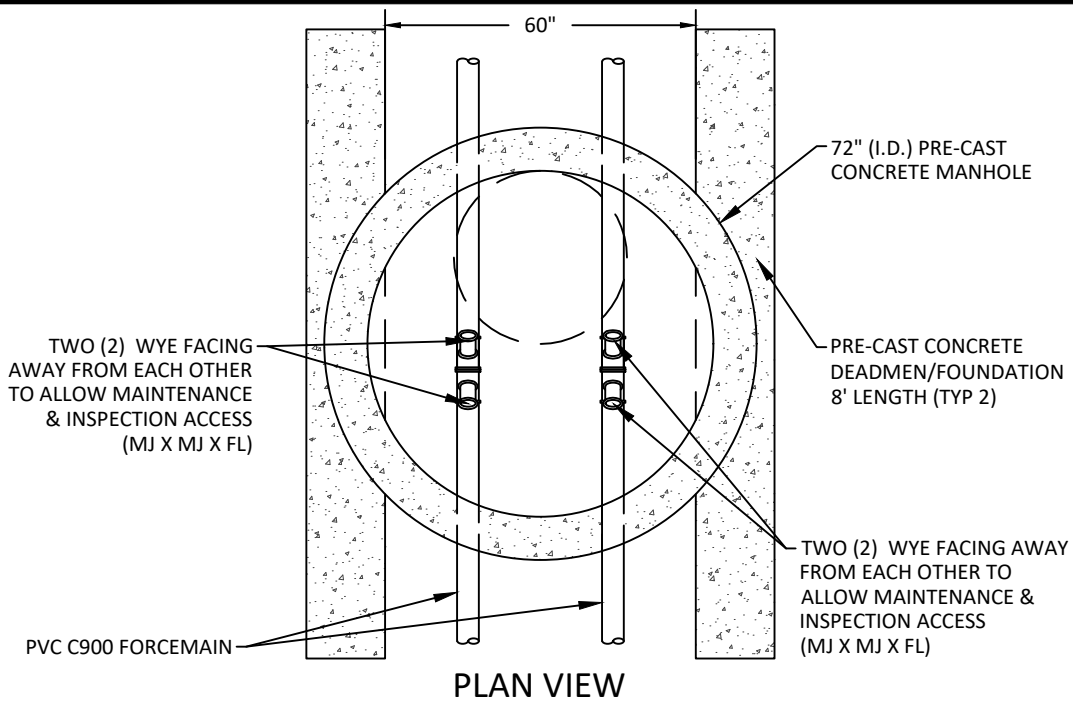


(TYP) ABOVE GRADE LIFT STATION

DETAIL SS-8

DATE: JANUARY 2023

SCALE: N.T.S.



NOTES:

1. PROVIDE 1" BLIND FLANGE, INSTALL 1" STAINLESS STEEL (SST) BALL VALVE.
2. FITTING SIZES WILL DEPEND ON THE SIZE OF THE FORCE MAIN.

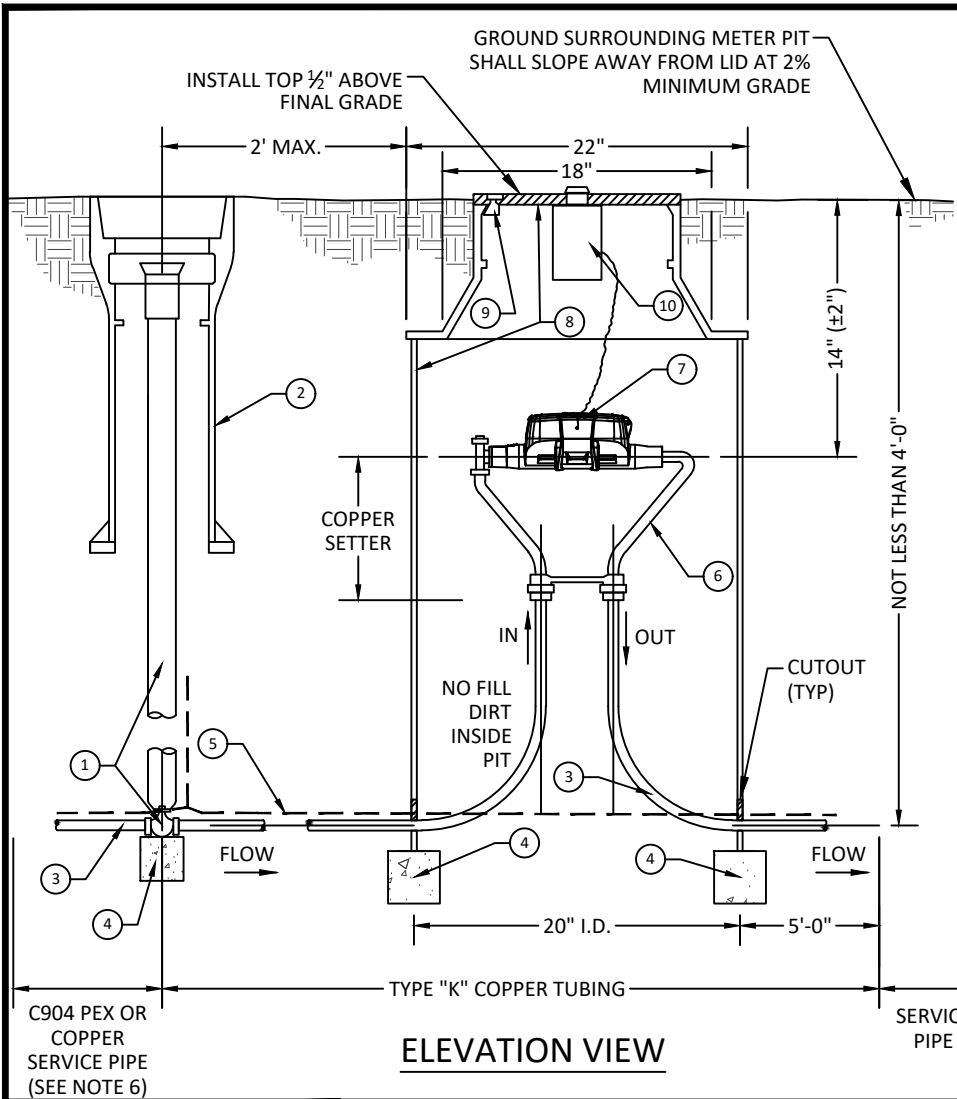
(TYP) FORCEMAIN BYPASS & CLEANOUT CONNECTION

DETAIL SS-9



DATE: JANUARY 2023

SCALE: N.T.S.



NOTES:

1. METER MUST BE PURCHASED THROUGH THE CITY OF GREELEY METER SHOP. NO EXCEPTIONS. CONTRACTOR TO PROVIDE ADDITIONAL PIPING, COUPLINGS, AND ACCESSORIES AS NECESSARY FOR A COMPLETE SYSTEM.
2. COPPER SHALL NOT SHOW ANY VISIBLE SIGNS OF CRIMPING.
3. METER PIT SHALL NOT BE PLACED IN ROADWAYS, DRIVEWAYS, OR PARKING AREAS.
4. PLACEMENT OF CURB STOP BOX MAY VARY FROM A MAXIMUM OF 1' OUTSIDE THE PROPERTY LINE TO A MAXIMUM OF 1' INSIDE THE PROPERTY LINE. PLACEMENT OF CURB STOP BOX OUTSIDE THE PROPERTY LINE IS PREFERRED.
5. METER PIT AND PIPING MUST BE INSPECTED BEFORE BACKFILLING. FOR INSPECTION CALL (970)-350-9264.
6. REFER TO CITY OF GREELEY WATER & SEWER (W&S) CONSTRUCTION SPECIFICATIONS, LATEST REVISION, FOR PRODUCT AND MANUFACTURER SPECIFICATIONS, REQUIRED MARKINGS, AND COATINGS.
7. FOR ADDITIONAL APPLICABLE METER AND METER PIT INSTALLATION NOTES AND REQUIREMENTS, REFER TO CITY OF GREELEY W&S DETAIL W-15, CONSTRUCTION SPECIFICATIONS, AND DESIGN CRITERIA, LATEST REVISION OF EACH,
8. FOR CURB STOP DETAILS, REFER TO CITY OF GREELEY W&S DETAIL W-9, LATEST REVISION.

LEGEND	
1	CURB STOP VALVE & SERVICE BOX (SEE NOTE 8)
2	UPPER HALF OF STANDARD 6" VALVE BOX (INSTALLED PER SPECIFICATIONS)
3	3/4" OR 1" SERVICE PIPE (MATCH SERVICE PIPE I.D.) (SEE NOTE 6)
4	BRICK SUPPORT (PLACE ON UNDISTURBED SOIL)
5	TRACER WIRE (SEE GENERAL NOTES ON RELATED DETAIL NP-2)
6	COPPER METER SETTER (SEE NOTE 6)
7	METER UNIT (SEE NOTE 1)
8	COMPOSITE DOUBLE LID CONE OR APPROVED EQUAL (SEE NOTE 6)
9	STANDARD FORGED BRASS WATERWORKS PENTAGON HEAD WITH LOCKING SCREW
10	METER ENDPOINT RADIO TRANSMITTER (RT UNIT)

ELEVATION VIEW

OUTSIDE SETTING FOR 3/4" & 1" IRRIGATION METER

DETAIL NP-1



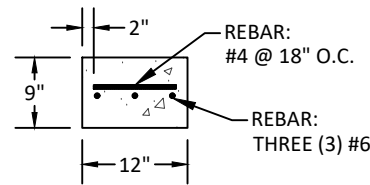
DATE: JANUARY 2023

SCALE: N.T.S.

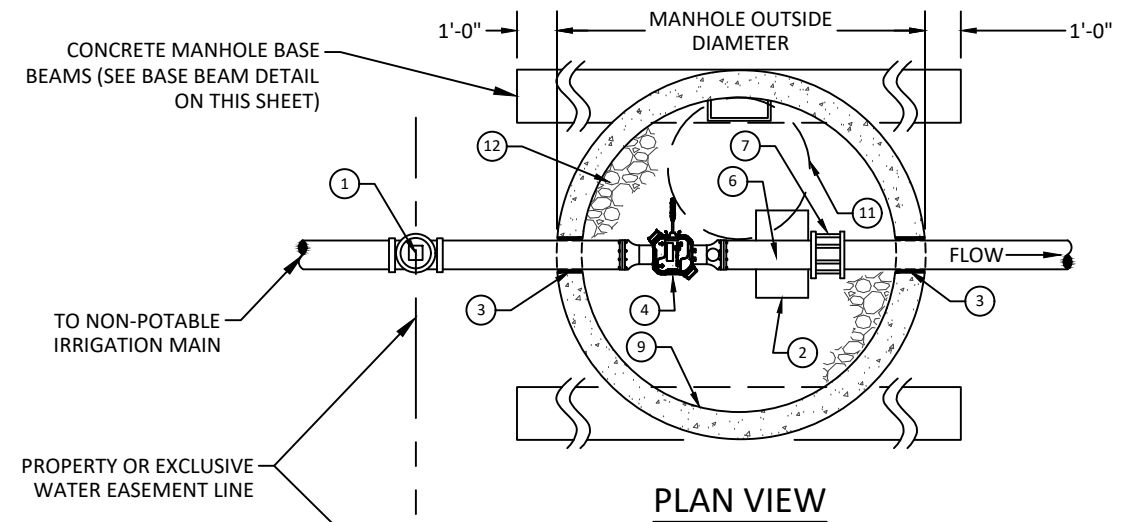
GENERAL NON-POTABLE NOTES:

1. METER MUST BE PURCHASED THROUGH THE CITY OF GREELEY METER SHOP. NO EXCEPTIONS. CONTRACTOR TO PROVIDE PIPING, COUPLINGS, AND ACCESSORIES AS NECESSARY FOR A COMPLETE SYSTEM.
2. LOCATION OF METER VAULT SHALL BE 2 FT DOWNSTREAM OF THE CURB STOP UNLESS OTHERWISE SPECIFIED BY THE WATER & SEWER DEPARTMENT.
3. NO CONCRETE SHALL BE POURED INTO VAULT, UNLESS IN SITUATIONS INVOLVING HIGH GROUND WATER OR OTHERWISE SPECIFIED BY THE CITY. THE WATER & SEWER DEPARTMENT RESERVES THE RIGHT TO REQUIRE A CONCRETE BOTTOM AND BE WATERTIGHT IN AREAS OF HIGH GROUND WATER.
4. ALL EQUIPMENT AND PIPING SHALL BE ADEQUATELY SUPPORTED AND ATTACHED TO VAULT WITH STAINLESS STEEL FASTENERS AND BOLTS.
5. IF SURFACE IS NOT TO FINAL GRADE AT TIME OF METER VAULT INSTALLATION OR GRADE CHANGES AFTER INSTALLATION, OWNER SHALL ADJUST VAULT TO MEET SPECIFICATIONS.
6. VAULT MANHOLE COVER SHALL BE A BOLT DOWN LID. REFER TO WATER & SEWER (W&S) CONSTRUCTION SPECIFICATIONS (SPECIFICATIONS), LATEST REVISION, FOR APPROVED MANHOLE COVER MATERIALS, MANUFACTURERS, MARKINGS, AND OTHER REQUIREMENTS.
7. VAULT MANHOLE COVER SIZE DEPENDS ON METER SIZE:
 - 24" MIN. MANHOLE COVER FOR 1-1/2" AND 2" METERS
 - 30" MIN. MANHOLE COVER FOR 3" AND LARGER METERS
8. METER SETTING MUST BE INSPECTED BEFORE BACKFILLING. FOR INSPECTION CALL (970)-350-9264.
9. PLACEMENT OF CURB STOP BOX MAY VARY FROM A MAXIMUM OF 1' OUTSIDE THE PROPERTY LINE TO A MAXIMUM OF 1' INSIDE THE PROPERTY LINE. PLACEMENT OF CURB STOP BOX OUTSIDE THE PROPERTY LINE IS PREFERRED.
10. SHUTOFF VALVE SHALL MATCH THE SERVICE PIPE INSIDE DIAMETER. REFER TO W&S SPECIFICATIONS, LATEST REVISION, FOR ACCEPTABLE MFR AND MODELS.
 - FOR 2" AND SMALLER SERVICE LINES: SHUTOFF VALVE SHALL BE A STANDARD CURB STOP.
 - FOR 3" AND LARGER SERVICE LINES: SHUTOFF VALVE SHALL BE A STANDARD GATE VALVE (SEE DETAIL W-18).
11. INSTALL UPPER HALF OF STANDARD VALVE BOX AROUND CURB STOP BOX ACCORDING TO THE W&S SPECIFICATIONS, LATEST REVISION.
12. INSTALL TRACER WIRE ACCORDING TO CITY OF GREELEY W&S SPECIFICATIONS AND W&S UTILITY LOCATING ("UL") DETAILS, LATEST REVISION OF EACH.
13. UPSTREAM AND DOWNSTREAM PIPE SPOOL LENGTH 5X PIPE I.D. OR PER MFR REQUIREMENTS (WHICHEVER YIELDS THE LONGER PIPE LENGTH).
14. NO SPRINKLER SYSTEM CONNECTIONS SHALL BE MADE IN THE METER VAULT.
15. NO MAJOR LANDSCAPING OR STRUCTURES SHALL BE LOCATED WITHIN 10 FT OF METER VAULT.
16. REFER TO W&S SPECIFICATIONS, LATEST REVISION, FOR PRODUCT AND MANUFACTURER SPECIFICATIONS.
17. ALL BURIED PIPING SHALL BE RESTRAINED AND INSTALLED IN ACCORDANCE WITH W&S SPECIFICATIONS, LATEST REVISION.
18. SEE WATER & SEWER DETAIL W-15, LATEST REVISION, FOR ADDITIONAL METER AND VAULT INSTALLATION REQUIREMENTS.

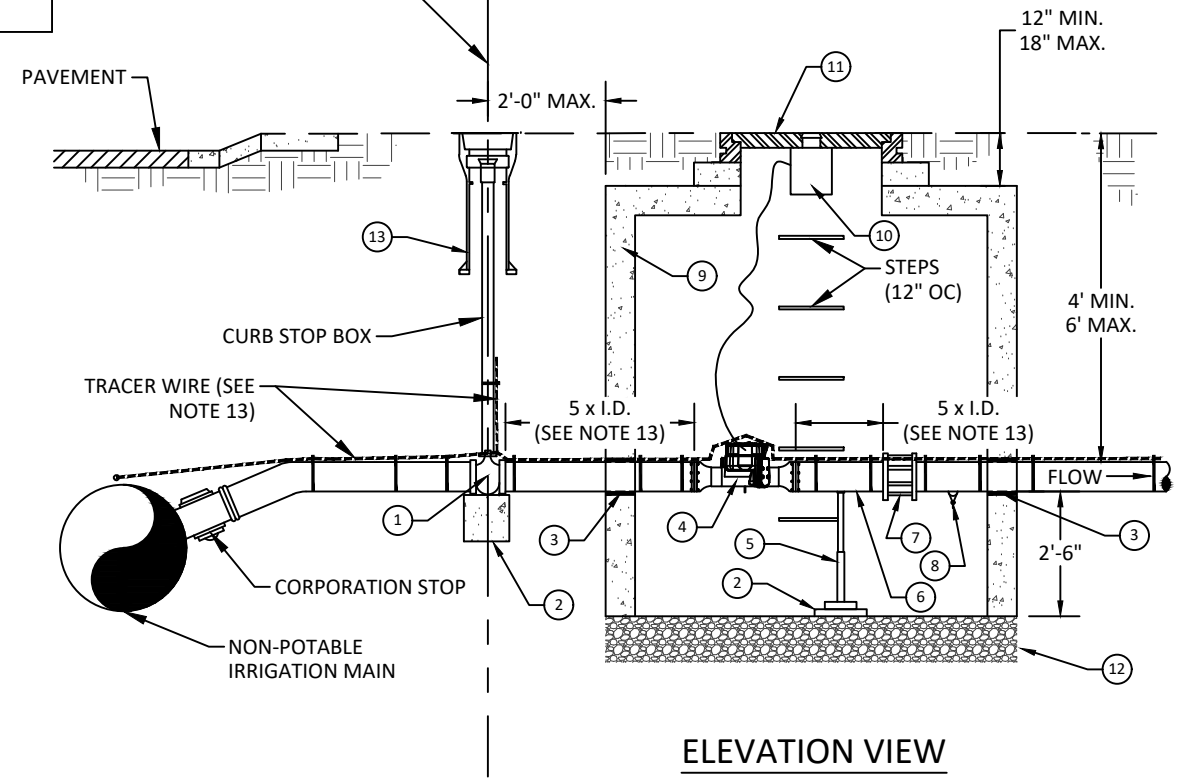
LEGEND	
1	SHUTOFF VALVE WITH 2" OPERATING NUT (SEE NOTE 11).
2	CONCRETE PAVER OR APPROVED EQUIVALENT
3	APPROVED RUBBER SEAL ON PIPE BARREL AT WALL PENETRATION PER SPECIFICATION
4	METER UNIT (SEE NOTE 1)
5	ADJUSTABLE STAINLESS STEEL PIPE SUPPORT AND BASE
6	FLG X PE SPOOL PIPE
7	RESTRAINED FLANGED COUPLING ADAPTER OR COUPLING
8	1" BALL VALVE DRAIN
9	CONCRETE MANHOLE (48" MIN. DIAMETER FOR 1-1/2" AND 2" METERS, 60" MIN. DIAMETER FOR 3" AND 4" METERS, 72" MIN. FOR 6" AND 8" METERS)
10	METER ENDPOINT RADIO TRANSMITTER (RT UNIT)
11	ACCESS FRAME AND APPROVED MANHOLE COVER WITH RECESSED 2" DIAMETER HOLE FOR RT UNIT (SEE NOTES 6, 7, AND 8)
12	6" MIN OF SUBGRADE MATERIAL UNDER GRADE BEAM AND INSIDE VAULT PER SPECIFICATIONS
13	UPPER HALF OF STANDARD 6" VALVE BOX (INSTALLED PER SPECIFICATIONS)



BASE BEAM DETAIL



PLAN VIEW



ELEVATION VIEW

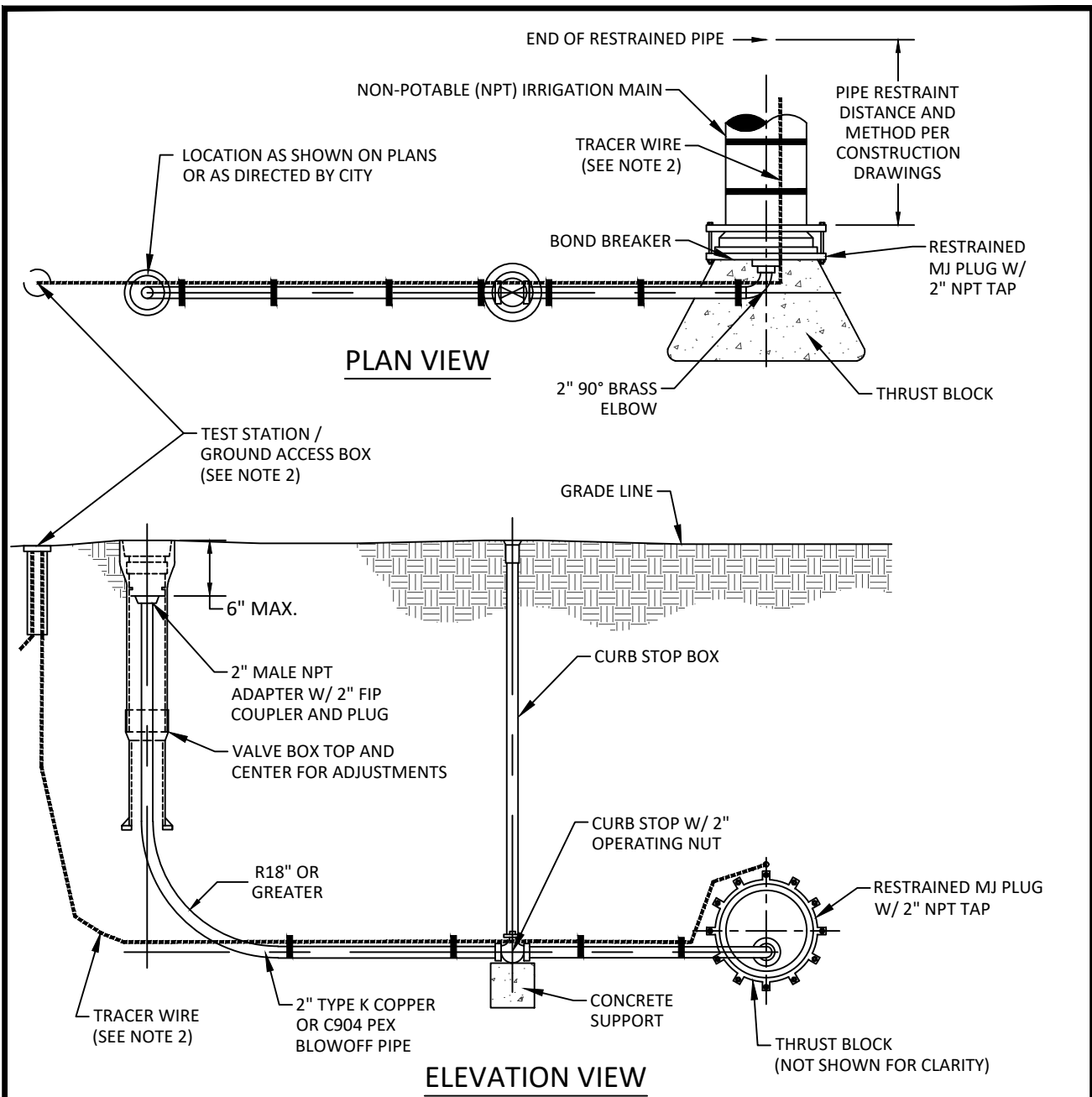


OUTSIDE SETTING FOR 1-1/2" TO 8" IRRIGATION METER & GENERAL NON-POTABLE NOTES

DETAIL NP-2

DATE: JANUARY 2023

SCALE: N.T.S.



NOTES:

1. REFER TO RELATED NON-POTABLE IRRIGATION DETAIL NP-1 AND WATER & SEWER (W&S) DEPARTMENT CONSTRUCTION SPECIFICATIONS (SPECIFICATIONS), LATEST REVISION OF EACH, FOR ADDITIONAL NON-POTABLE PIPE, CURB STOP, AND MISC. VALVE INSTALLATION REQUIREMENTS.
2. INSTALL TRACER WIRE ACCORDING SPECIFICATIONS AND W&S UTILITY LOCATING ("UL") DETAILS, LATEST REVISION OF EACH.
3. ALL BURIED PIPING SHALL BE RESTRAINED AND INSTALLED ACCORDANCE WITH W&S SPECIFICATIONS, LATEST REVISION.

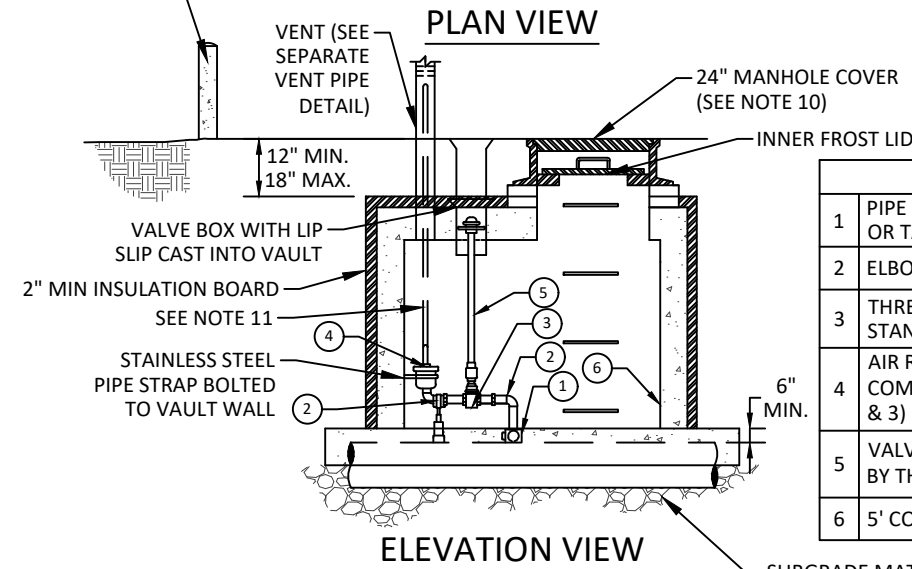
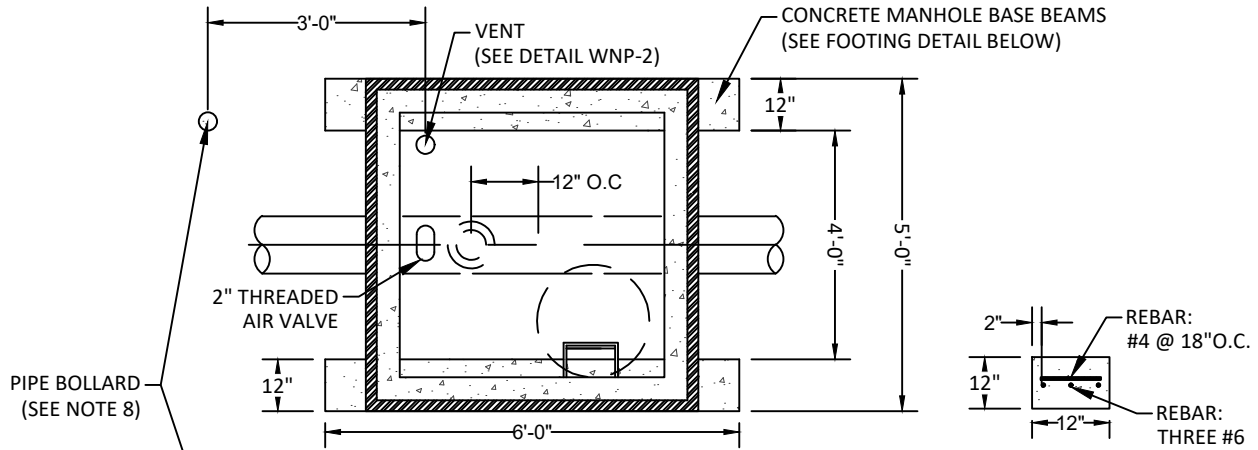


NON-POTABLE BLOWOFF

DETAIL NP-4

DATE: JANUARY 2023

SCALE: N.T.S.



LEGEND	
1	PIPE SADDLE AND CORPORATION STOP OR TAPPING SLEEVE
2	ELBOW
3	THREADED GATE VALVE WITH STANDARD OPENING NUT
4	AIR RELEASE, AIR VACUUM, OR COMBINATION AIR VALVE (SEE NOTES 2 & 3)
5	VALVE STEM EXTENSION (AS REQUIRED BY THE CITY)
6	5' CONCRETE MANHOLE

NOTES:

1. PLACE 6" OF SUBGRADE MATERIAL IN THE BOTTOM OF THE MANHOLE TO THE CROWN OF PIPE ONLY. REFER TO WATER & SEWER (W&S) DEPARTMENT CONSTRUCTION SPECIFICATIONS (SPECIFICATIONS), LATEST REVISION, FOR MATERIAL GRADATION.
2. VALVE TYPE AND SIZE SHALL BE SPECIFIED BY THE DESIGN ENGINEER AND APPROVED BY THE CITY.
3. INSTALL AIR RELEASE, AIR/VACUUM, AND COMBINATION AIR VALVES IN ACCORDANCE WITH MFR SPECIFICATIONS.
4. ALL SUPPORT MATERIALS SHALL BE GIVEN TWO (2) COATS OF RUST INHIBITIVE PAINT.
5. VAULT BOTTOM SHALL SIT 6" HIGHER THAN TOP OF PIPE.
6. VAULT AND MANHOLE COVER TO BE RATED FOR HS-20 TRAFFIC LOADINGS.
7. SEE SPECIFICATIONS AND DETAIL W-15, LATEST REVISION, FOR ADDITIONAL RELEVANT TYPICAL VAULT NOTES.
8. PIPE BOLLARD MAY BE OMITTED AT THE CITY OF GREELEY W&S DEPARTMENT'S DISCRETION. BOLLARD SHALL BE INSTALLED IN ACCORDANCE WITH THE WATER & SEWER STANDARD DETAILS AND SPECIFICATIONS, LATEST REVISION OF EACH.
9. INSTALL TRACER WIRE ALONG MAIN ACCORDING TO SPECIFICATIONS AND W&S UTILITY LOCATING ("UL") STANDARD DETAILS, LATEST REVISION OF EACH.
10. 24" MANHOLE COVER SHALL BE A BOLT DOWN LID MARKED WITH THE APPROPRIATE UTILITY. REFER TO CITY OF GREELEY SPECIFICATIONS, LATEST REVISION, FOR SPECIFIC MANHOLE COVER MFR AND PRODUCT INFORMATION.
11. FOR ALL AIR VACUUM VALVE VAULTS, AIR VALVE INTAKE SHALL BE WATER TIGHT AND PIPED TO THE SURFACE INSIDE THE VENT PIPE WITH SCHEDULE 80 PVC THAT MATCHES VALVE OUTLET SIZE.

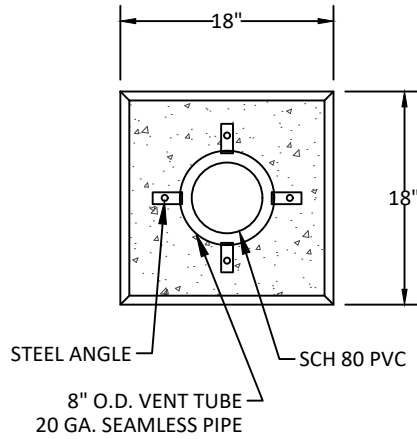


AIR RELEASE/VACUUM & COMBINATION AIR VALVE VAULT

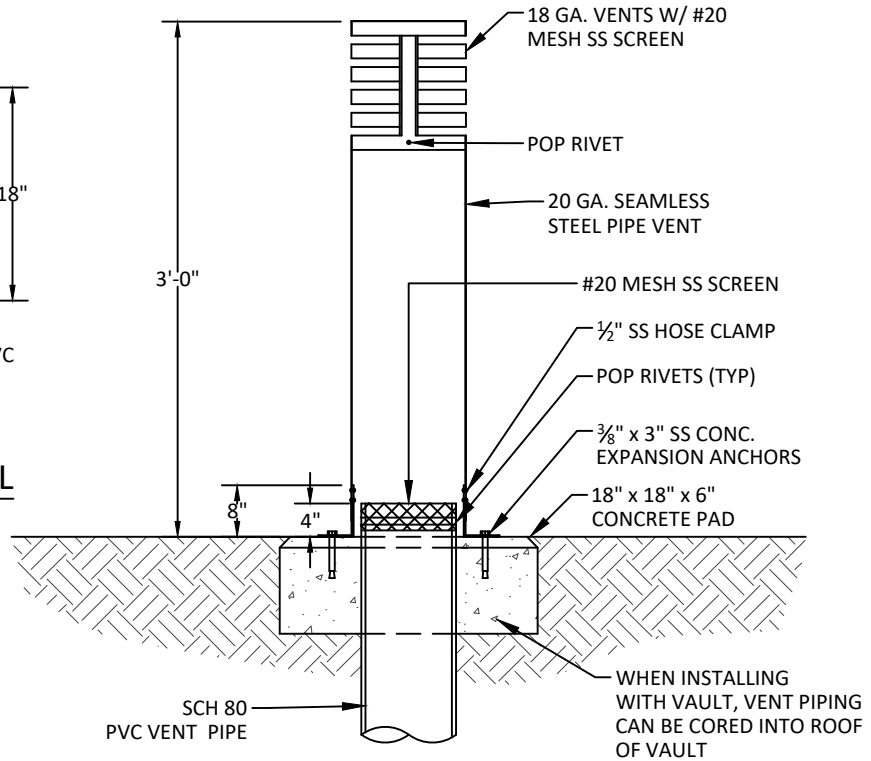
DETAIL WNP-1

DATE: JANUARY 2023

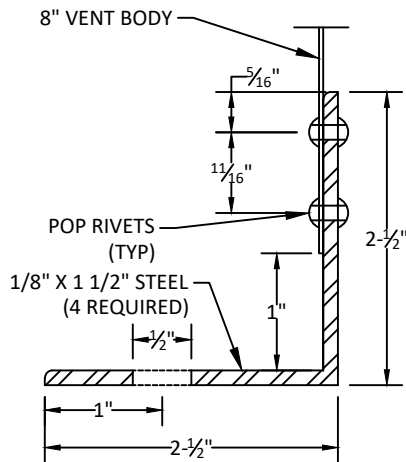
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CONCRETE BASE DETAIL



ROUND VENT SCREEN



STEEL ANGLE DETAIL

NOTES:

1. REFER TO CONCRETE STANDARD SPECIFICATIONS
2. VENT PIPE SHALL BE MANUFACTURED BY CUSTOM METAL MFG OR APPROVED EQUAL.
3. VENT PIPE SHALL BE PRIMED AND COATED ACCORDING TO THE APWA UNIFORM COLOR CODE FOR FOR THE CORRESPONDING UTILITY:
 - 3.A. POTABLE WATER: SHERWIN-WILLIAMS SAFETY BLUE NO. SW4086 OR APPROVED EQUAL
 - 3.B. NON-POTABLE IRRIGATION: SHERWIN-WILLIAMS SAFETY PURPLE NO. SW 4080 OR APPROVED EQUAL.
4. 3" AIR VENT TO BE PVC SCHEDULE 80 WITH GLUED JOINTS BELOW GRADE AND SIZED TO MATCH TO AIR VALVE OUTLET SIZE.
5. WHEN SITE CONDITIONS PREVENT INSTALLING VENT IN ROOF OF VAULT AND PER WATER & SEWER DEPARTMENT'S DIRECTION, SCH 80 PVC MAY PENETRATE VAULT WALL AND RUN HORIZONTAL BEFORE BENDING VERTICAL AT AN ACCEPTABLE LOCATION FOR THE ROUND VENT SCREEN.

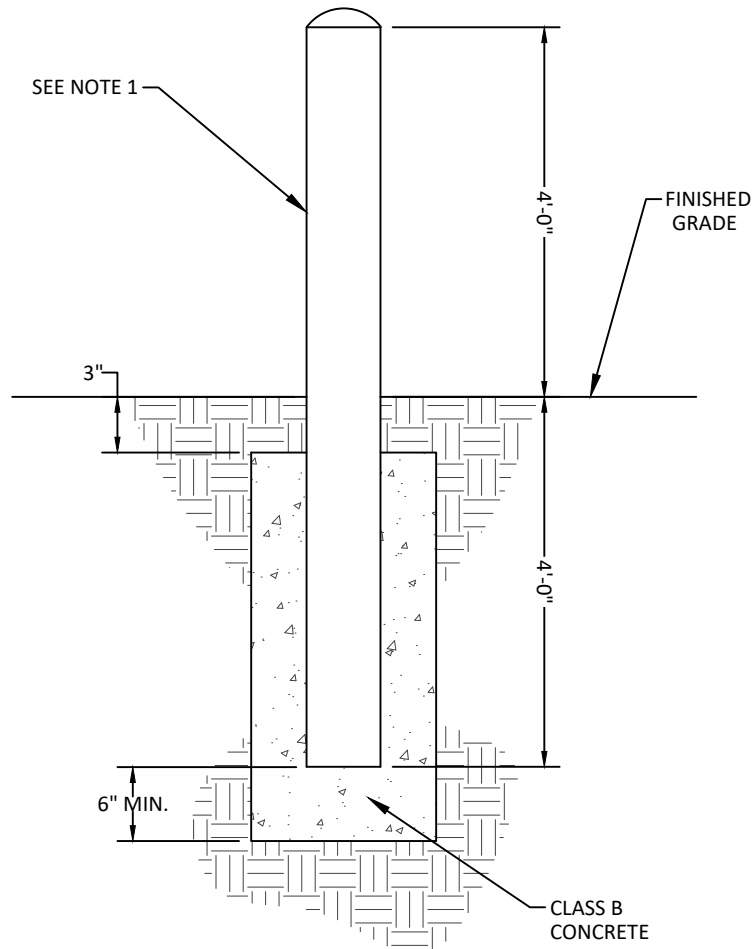


VAULT & AIR/VAC VENT PIPE

DETAIL WNP-2

DATE: JANUARY 2023

SCALE: N.T.S.



NOTES:

1. PROVIDE A 6" MIN SCHEDULE 40 STL. PIPE BOLLARD FILLED WITH CONCRETE WITH ROUNDED TOP, PAINT SAFETY YELLOW.
2. BOLLARD SHALL BE PLACED AT MINIMUM 3'-0" FROM VALVE BOXES, VAULTS, AND CONCRETE STRUCTURES.
3. THE CITY OF GREELEY RESERVES THE RIGHT TO DETERMINE WHERE AND WHEN A PIPE BOLLARD MAY BE REQUIRED OR OMITTED.

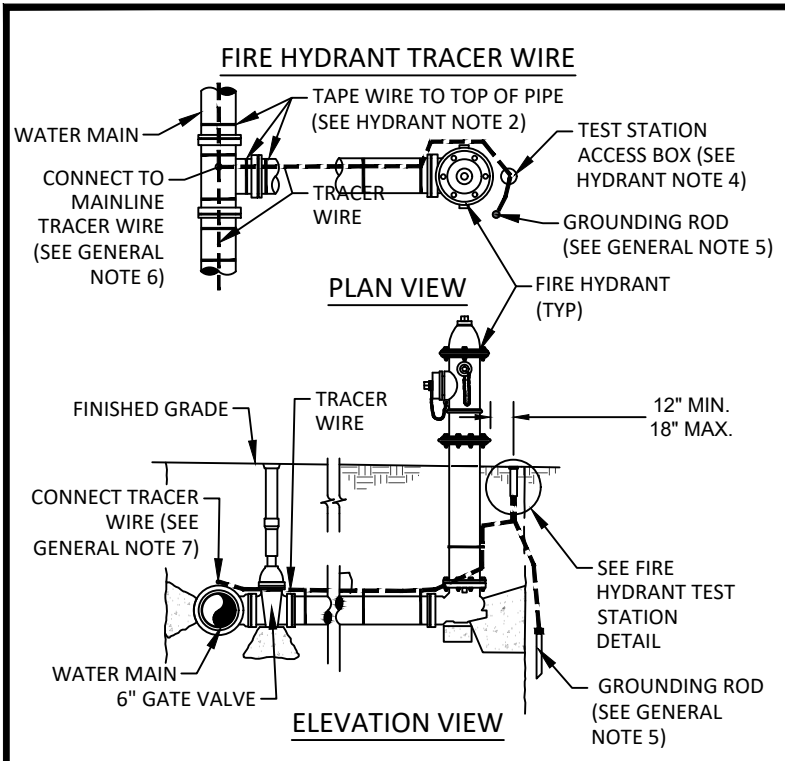


(TYP) CONCRETE PIPE BOLLARD

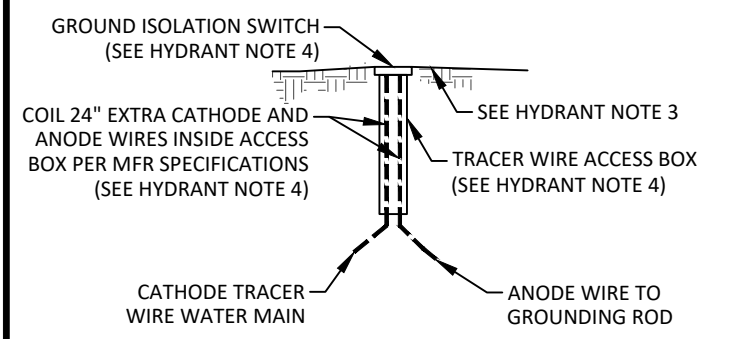
DETAIL WNP-3

DATE: JANUARY 2023

SCALE: N.T.S.



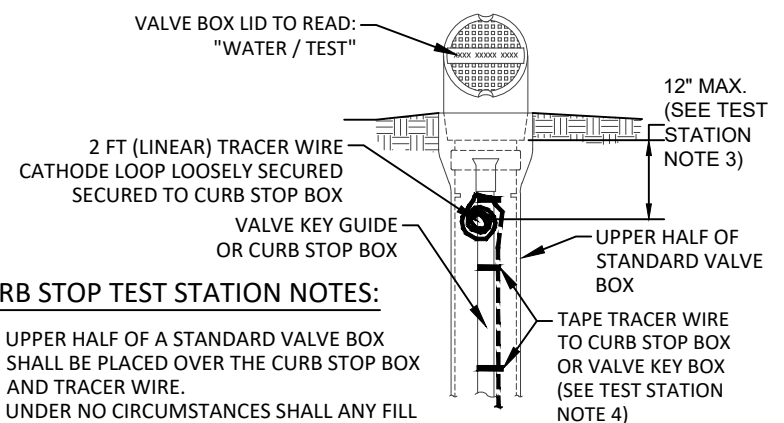
FIRE HYDRANT & STANDARD MFR TEST STATION DETAIL



HYDRANT & STANDARD MFR TEST STATION NOTES:

1. REFER TO RELATED DETAIL FIRE HYDRANT DETAIL, LATEST REVISION, FOR FIRE HYDRANT INSTALLATION STANDARD DRAWING.
2. REFER TO GENERAL NOTES FOR ADDITIONAL TRACER WIRE REQUIREMENTS.
3. GRADE SURROUNDING TRACER WIRE ACCESS BOX SHALL SLOPE AWAY FROM LID AT 2% MINIMUM GRADE.
4. FIRE HYDRANT TEST STATION ACCESS BOX SHALL BE COPPERHEAD SNAKEPIT ACCESS POINT WITH TWO-TERMINAL SWITCHABLE LID OR APPROVED EQUAL.

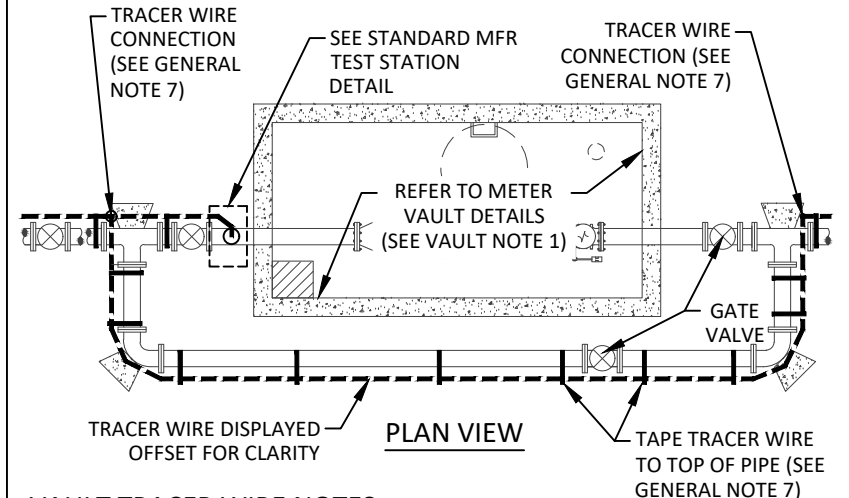
CURB STOP TEST STATION DETAIL



CURB STOP TEST STATION NOTES:

1. UPPER HALF OF A STANDARD VALVE BOX SHALL BE PLACED OVER THE CURB STOP BOX AND TRACER WIRE.
2. UNDER NO CIRCUMSTANCES SHALL ANY FILL MATERIAL BE PLACED INSIDE THE VALVE BOX.
3. SECURE CATHODE LOOP 12" MAX BELOW VALVE BOX COVER INSIDE THE VALVE BOX. FOLLOW SAME TAPING INTERVAL FOR TRACER WIRE ALONG CURB STOP AS TRACER WIRE IS TAPED ALONG PIPE.
4. SECURE CATHODE LOOP 12" MAX BELOW VALVE BOX COVER INSIDE THE VALVE BOX. FOLLOW SAME TAPING INTERVAL FOR TRACER WIRE ALONG CURB STOP AS TRACER WIRE IS TAPED ALONG PIPE.

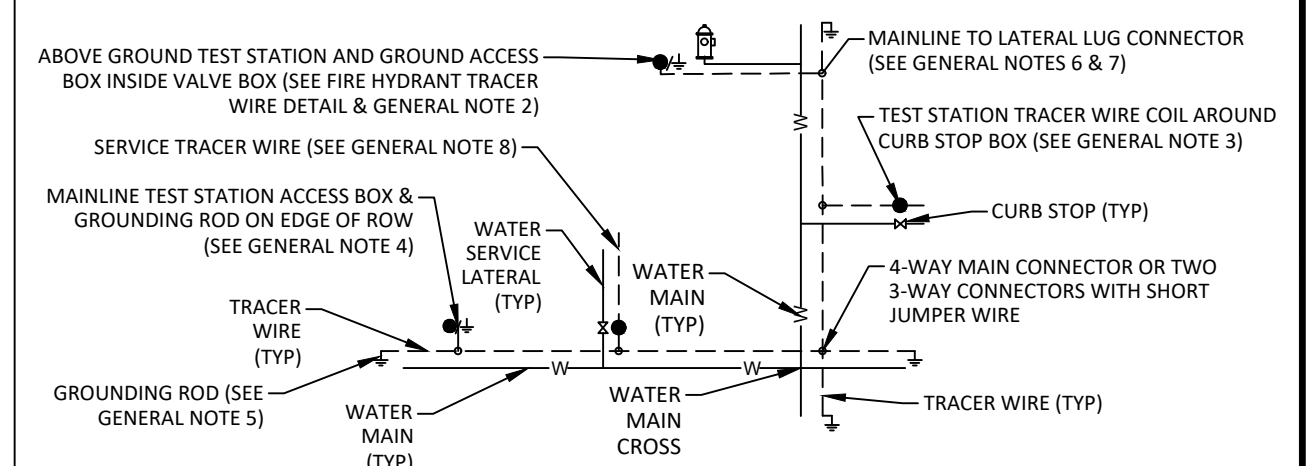
TRACER WIRE AROUND VAULTS



VAULT TRACER WIRE NOTES:

1. REFER TO RELATED DETAILS W-10, W-11, AND W-15 FOR METER VAULT DETAILS AND REQUIREMENTS.
2. REFER TO GENERAL NOTES FOR ADDITIONAL TRACER WIRE REQUIREMENTS.

SAMPLE PLAN OF WATER MAIN TRACER WIRE



LEGEND

- | | | | | | |
|-------|---------------|---|--|---|--|
| — W — | WATER MAIN | ⊕ | DRIVE-IN MAGNESIUM GROUNDING ROD (TYP) | ● | TRACER WIRE ACCESS BOX (LOOSE COIL AROUND CURB STOP FOR ABOVE GROUND ACCESS) |
| - - - | TRACER WIRE | ⊕ | CURB STOP (TYP) | ● | TRACER WIRE ACCESS BOX (ABOVE GROUND ACCESS BOX / GROUNDING ROD) |
| — S — | WATER SERVICE | ⊕ | FIRE HYDRANT (TYP) | | |

GENERAL NOTES:

1. TRACER WIRE DEPICTED OFFSET FROM PIPE FOR CLARITY. TRACER WIRE SHALL BE INSTALLED ON TOP OF PIPE, IN ACCORDANCE WITH THE WATER & SEWER UTILITY LOCATING DETAIL UL-6, AND WATER & SEWER CONSTRUCTION SPECIFICATIONS, LATEST REVISION OF EACH.
2. TRACER WIRE ACCESS IN THE FORM OF A TEST STATION ACCESS BOX FROM A CITY APPROVED MFR MUST BE PROVIDED AND GROUNDED AT EVERY FIRE HYDRANT. REFER TO WATER & SEWER SPECIFICATIONS, LATEST REVISION, FOR PRODUCT AND MANUFACTURER RECOMMENDATIONS AND REQUIREMENTS.
3. TRACER WIRE ACCESS IN THE FORM OF A CATHODE WIRE LOOPED AROUND THE CURB STOP BOX SHALL BE PLACED INSIDE OF A STANDARD VALVE BOX AT EVERY SERVICE LATERAL. REFER TO W&S SERVICE LATERAL UTILITY LOCATING DETAILS UL-3 AND UL-4, LATEST REVISION OF EACH, FOR ADDITIONAL INSTALLATION REQUIREMENTS.
4. FOR LONG RUNS IN EXCESS OF 1,000 FEET WITHOUT SERVICE LATERALS OR HYDRANTS - TRACER WIRE ACCESS MUST BE PROVIDED IN THE FORM OF EITHER AN APPROVED MFR GRADE LEVEL WIRE ACCESS BOX OR A STANDARD VALVE BOX WITH CATHODE WIRE LOOP. EITHER FORM OF ACCESS SHALL BE LOCATED ABOVE THE PIPE OR AT THE EDGE OF RIGHT-OF-WAY AND OUT OF THE ROAD-WAY. TRACER WIRE ACCESS BOX SHALL ALSO BE DELINEATED USING A MINIMUM 48" POLYETHYLENE MARKER POST, COLOR CODED PER APWA STANDARD FOR THE SPECIFIC UTILITY BEING MARKED.
5. TRACER WIRE MUST BE GROUNDED AT EVERY MAINLINE DEAD END/STUB, AND ALONG CONTINUOUS RUNS AT A MAXIMUM OF 1,000 FT INTERVALS WITH A 1.5 LB DRIVE-IN MAGNESIUM GROUNDING ROD PER GROUNDING ROD MFR REQUIREMENTS. PLACEMENT OF GROUNDING ROD SHALL BE INSTALLED IN SUCH A WAY THAT ALLOWS FOR PROPER WIRE LOCATING WITHOUT A LOSS OR DETERIORATION OF LOW FREQUENCY SIGNAL (512 Hz) FOR DISTANCES IN EXCESS OF 1,000 FT. EVERY FIRE HYDRANT TEST STATION SHALL BE GROUNDED PER MFR RECOMMENDATIONS.
6. TRACER WIRE SYSTEMS MUST BE INSTALLED AS A SINGLE CONTINUOUS WIRE, EXCEPT WHERE USING APPROVED CONNECTORS. NO LOOPING OR COILING OF WIRE IS ALLOWED.
7. REFER TO WATER & SEWER SERVICE LATERAL TRACER WIRE DETAIL AND GENERAL TRACER WIRE NOTES ON DETAIL UL-6, LATEST REVISION OF EACH, FOR ADDITIONAL TRACER WIRE INSTALLATION, TAPING, CONNECTION, SPLICING, AND GROUNDING REQUIREMENTS.
8. SERVICE LATERAL TRACER WIRE SHALL EXTEND PAST CURB STOP TEST STATION AND TERMINATE AT STRUCTURE PER SERVICE LATERAL UTILITY LOCATING DETAIL.



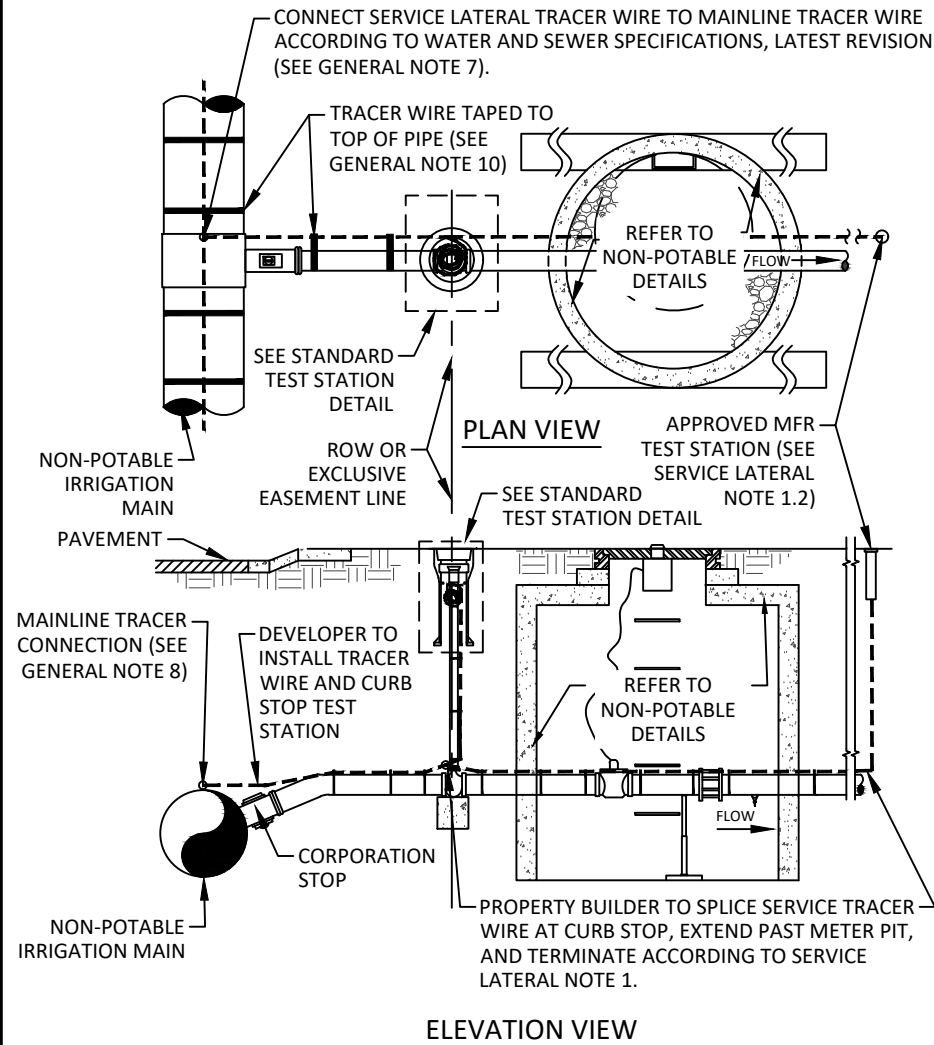
WATER MAIN TRACER WIRE AND UTILITY LOCATING

DETAIL UL-1

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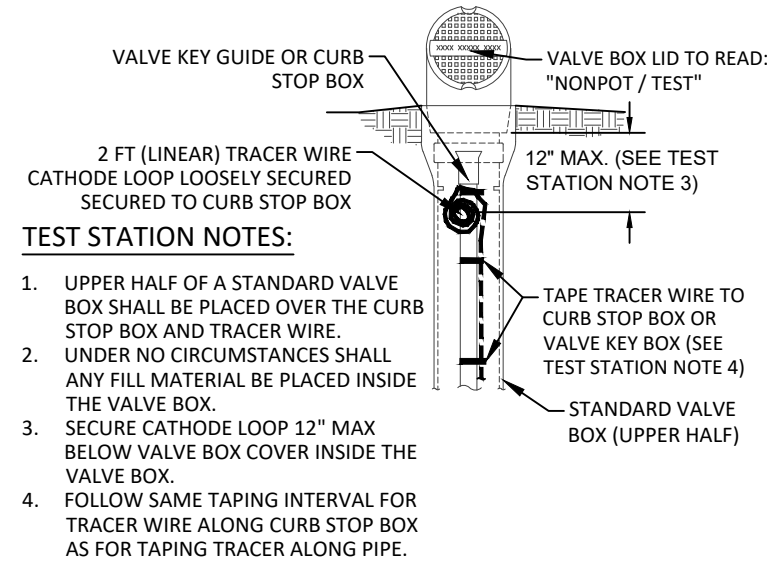
NON-POTABLE IRRIGATION SERVICE LATERAL



NON-POTABLE IRRIGATION SERVICE LATERAL NOTES:

1. TEST STATION AT SERVICE LATERAL FAR END ON OWNER SIDE OF METER:
 - 1.1. SHALL BE A MOUNTABLE OR FLUSH-GRADE ACCESS POINT AND INSTALLED PER MFR SPECIFICATIONS. SEE WATER & SEWER SPECIFICATIONS, LATEST REVISION, FOR APPROVED MFR AND MODELS.
 - 1.2. TEST STATION ACCESS SHALL BE PROVIDED AT TRACER WIRE TERMINATION NEAR THE IRRIGATION CONTROL VALVE BOX OR AS NOTED ON THE DESIGN DRAWINGS.

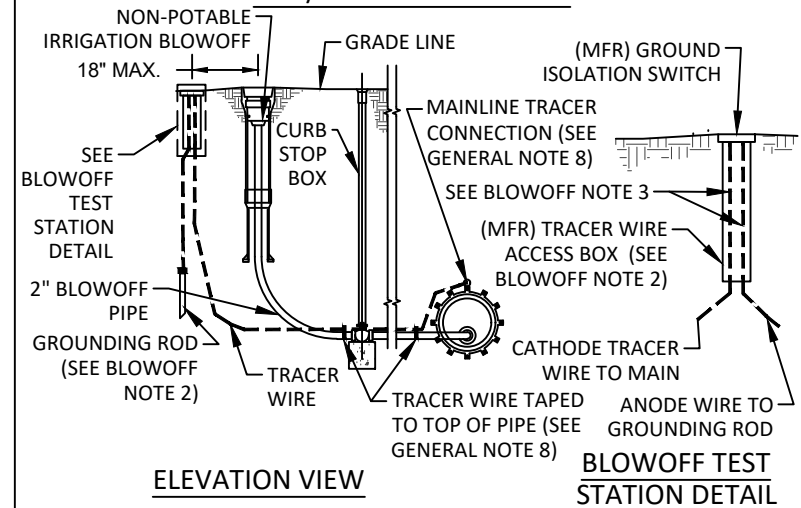
STANDARD TEST STATION DETAIL



TEST STATION NOTES:

1. UPPER HALF OF A STANDARD VALVE BOX SHALL BE PLACED OVER THE CURB STOP BOX AND TRACER WIRE.
2. UNDER NO CIRCUMSTANCES SHALL ANY FILL MATERIAL BE PLACED INSIDE THE VALVE BOX.
3. SECURE CATHODE LOOP 12" MAX BELOW VALVE BOX COVER INSIDE THE VALVE BOX.
4. FOLLOW SAME TAPING INTERVAL FOR TRACER WIRE ALONG CURB STOP BOX AS FOR TAPING TRACER ALONG PIPE.

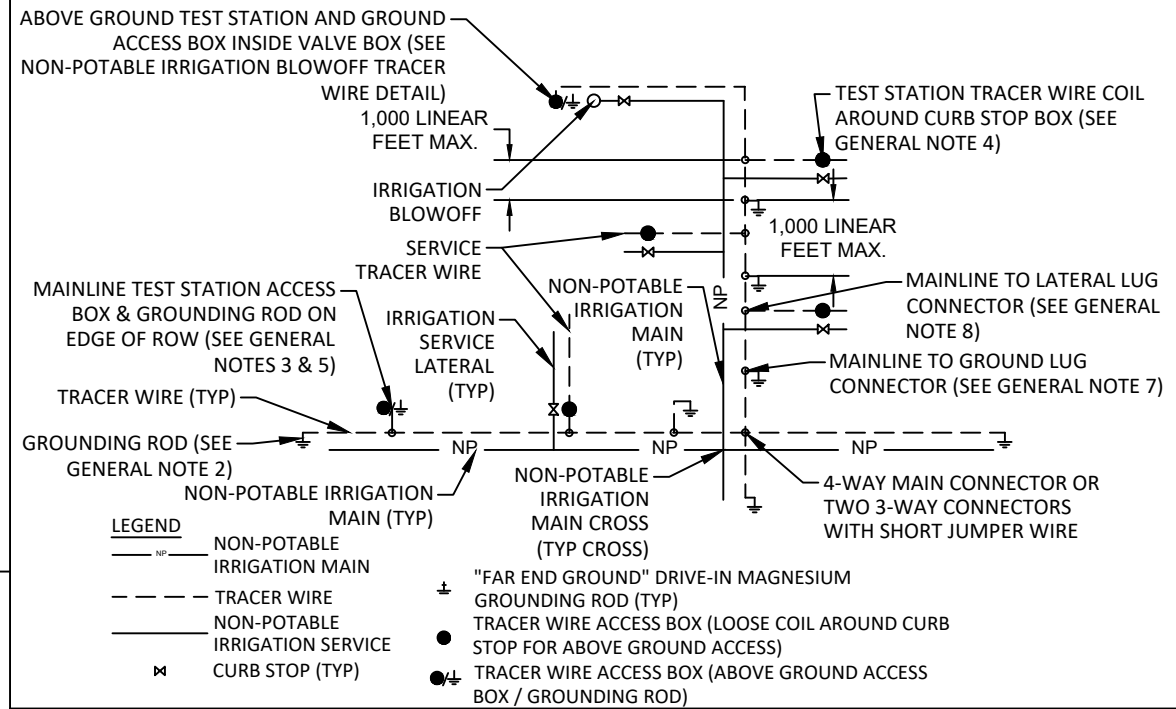
NON-POTABLE IRRIGATION BLOWOFF AND "DEAD END/STUB" TRACER WIRE



BLOW-OFF TRACER WIRE NOTES:

1. REFER TO RELATED NON-POTABLE BLOWOFF DETAIL, LATEST REVISION, FOR BLOWOFF INSTALLATION STANDARD DRAWING.
2. REFER TO GENERAL NOTES FOR ADDITIONAL TRACER WIRE REQUIREMENTS.
3. BLOWOFF TEST STATION ACCESS BOX SHALL BE COPPERHEAD SNAKEPIT ACCESS POINT WITH TWO-TERMINAL SWITCHABLE LID OR APPROVED EQUAL.
4. COIL 24" EXTRA CATHODE AND ANODE WIRES INSIDE ACCESS BOX PER MFR SPECIFICATIONS.

SAMPLE PLAN OF NON-POTABLE IRRIGATION MAIN TRACER WIRE



GENERAL NOTES:

1. TRACER WIRE DEPICTED OFFSET FROM PIPE FOR CLARITY. TRACER WIRE SHALL BE INSTALLED ON TOP OF PIPE, AND INSTALLED IN ACCORDANCE WITH THE WATER & SEWER UTILITY LOCATING DETAILS, AND WATER & SEWER SPECIFICATIONS, LATEST REVISION OF EACH.
2. TRACER WIRE MUST BE GROUNDED AT EVERY MAINLINE DEAD END/STUB, AND ALONG CONTINUOUS RUNS AT A MAXIMUM OF 1,000 FT INTERVALS WITH A 1.5 LB DRIVE-IN MAGNESIUM ANODE GROUNDING ROD PER GROUNDING ROD MFR REQUIREMENTS. PLACEMENT OF GROUNDING ROD SHALL BE INSTALLED IN SUCH A WAY THAT ALLOWS FOR PROPER WIRE LOCATING WITHOUT A LOSS OR DETERIORATION OF LOW FREQUENCY SIGNAL (512 Hz) FOR DISTANCES IN EXCESS OF 1,000 FT.
3. FOR LONG RUNS IN EXCESS OF 1,000 FEET WITHOUT SERVICE LATERALS - TRACER WIRE ACCESS MUST BE PROVIDED IN THE FORM OF EITHER AN APPROVED MFR GRADE LEVEL / IN-GROUND WIRE ACCESS BOX OR A STANDARD VALVE BOX WITH CATHODE LOOP. EITHER FORM OF ACCESS BOX SHALL BE LOCATED ABOVE THE PIPE OR AT THE EDGE OF RIGHT-OF-WAY AND OUT OF THE ROAD-WAY. TRACER WIRE ACCESS BOX SHALL ALSO BE DELINEATED USING A MINIMUM 48" POLYETHYLENE MARKER POST, COLOR CODED PER APWA STANDARD FOR THE SPECIFIC UTILITY BEING MARKED.
4. SERVICE LATERAL TEST STATIONS SHALL BE IN THE FORM OF A CATHODE WIRE LOOP AT THE CURB STOP AND PLACED INSIDE OF A STANDARD VALVE BOX AT EVERY SERVICE LATERAL. REFER TO W&S SPECIFICATIONS AND GENERAL NOTES ON DETAIL UL-6, LATEST REVISION OF EACH, FOR ADDITIONAL INSTALLATION REQUIREMENTS.
5. TEST STATIONS LOCATED AT THE MAXIMUM DISTANCE FROM THE NEAREST GROUND SHALL BE INSTALLED AS AN APPROVED MFR GRADE-LEVEL/ IN GROUND WIRE ACCESS BOX WITH A GROUNDING ROD.
6. GRADE SURROUNDING TEST STATION ACCESS BOX SHALL SLOPE AWAY FROM LID AT A 2% MINIMUM GRADE.
7. "FAR END" GROUNDING RODS WIRE SHALL BE CONNECTED TO MAINLINE TRACER WIRE USING APPROVED LOCKABLE CONNECTORS WITHOUT CUTTING OR SPLICING THE MAINLINE TRACER WIRE.
8. SERVICE LATERAL TRACER WIRE SHALL BE CONNECTED TO MAINLINE TRACER WIRE USING APPROVED LOCKABLE CONNECTORS WITHOUT CUTTING OR SPLICING THE MAINLINE TRACER WIRE.
9. TRACER WIRE SYSTEMS MUST BE INSTALLED AS A SINGLE CONTINUOUS WIRE, EXCEPT WHERE USING APPROVED CONNECTORS. NO LOOPING OR COILING OF WIRE IS ALLOWED.
10. REFER TO GENERAL TRACER WIRE NOTES ON WATER & SEWER DETAIL UL-6, LATEST REVISION, FOR ADDITIONAL TRACER WIRE INSTALLATION, TAPING, CONNECTION, SPLICING, AND GROUNDING REQUIREMENTS.

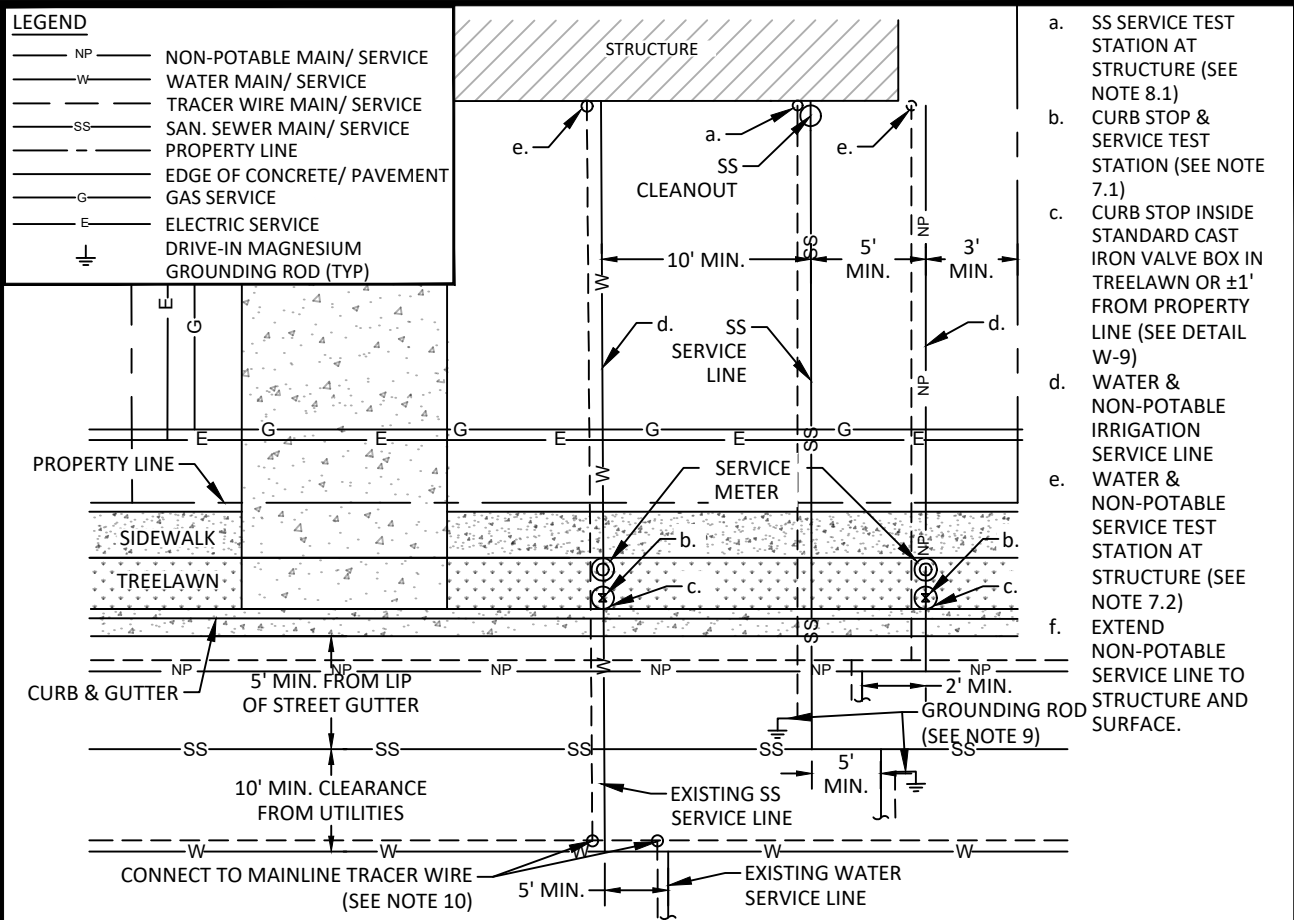


NON-POTABLE IRRIGATION TRACER WIRE AND UTILITY LOCATING

DETAIL UL-2

DATE: JANUARY 2023

SCALE: N.T.S.



NOTES:

1. ALL BURIED PIPE, VALVES, AND APPURTENANCES SHALL BE INSTALLED ACCORDING TO THE CITY OF GREELEY WATER & SEWER DETAILS AND SPECIFICATIONS LATEST REVISION.
2. TRACER WIRE IS REQUIRED FOR ALL SERVICE PIPES (WATER, SEWER, NON-POTABLE).
3. TRACER WIRE IS ONLY DEPICTED AWAY FROM PIPE IN ABOVE DRAWING FOR CLARITY.
4. REFER TO GENERAL NOTES ON WATER & SEWER DETAIL UL-6, LATEST REVISION, FOR ADDITIONAL TRACER WIRE INSTALLATION, TAPING, CONNECTION, SPLICING, AND GROUNDING REQUIREMENTS.
5. FOR FUTURE CONNECTION SERVICE STUBS, DEVELOPER SHALL PROVIDE A MINIMUM OF 2 FEET OF WIRE WRAPPED AND TAPED TO MARKER POST AT PROPERTY LINE (PROPERTY BUILDER SHALL SPLICE TO THIS TRACER WIRE COIL AT LATER DATE).
6. REFER TO WATER & SEWER CONSTRUCTION SPECIFICATIONS, LATEST REVISION, FOR APPROVED TRACER WIRE, GROUNDING ROD, TEST STATION, AND MISC. PRODUCT MFR.
7. WATER & NON-POTABLE SERVICE TEST STATIONS/TRACER ACCESS:
 - 7.1. TEST STATION (AT CURB STOP): TAPE TRACER WIRE TO CURB STOP BOX AND RUN TO SURFACE. SECURE A TWO FOOT (LINEAR) COIL OF TRACER WIRE AT THE TOP OF THE CURB STOP BOX, AND PLACE THE UPPER HALF OF A STANDARD VALVE BOX AROUND THE CURB STOP AND TEST STATION.
 - 7.2. PROPERTY OWNER TEST STATION AT STRUCTURE: TERMINATE TRACER WIRE AT STRUCTURE WITH AN APPROVED TEST STATION ACCESS BOX FROM AN APPROVED MFR, MOUNTED TO STRUCTURE.
 - 7.3. SEE W&S DETAIL UL-4, LATEST REVISION, FOR ADDITIONAL DETAILS.
8. SANITARY SEWER SERVICE TEST STATIONS/TRACER ACCESS:
 - 8.1. PROPERTY OWNER TEST STATION AT STRUCTURE: TERMINATE TRACER WIRE AT STRUCTURE WITH AN APPROVED TEST STATION ACCESS BOX FROM AN APPROVED MFR, MOUNTED TO THE STRUCTURE.
 - 8.2. SEE W&S DETAIL UL-5, LATEST REVISION, FOR ADDITIONAL DETAILS.
9. ALL SANITARY SEWER SERVICE LATERAL TRACER WIRES SHALL TERMINATE WITHIN 2FT OF THE SS MAIN WITH AN APPROVED 1.5 LB DRIVE-IN MAGNESIUM GROUNDING ROD.
10. ALL WATER SERVICE LATERAL TRACER WIRES SHALL BE CONNECTED TO MAINLINE TRACER WITHOUT CUTTING / SPLICING THE MAINLINE TRACER WIRE, ACCORDING TO WATER & SEWER DETAIL UL-6, LATEST REVISION.

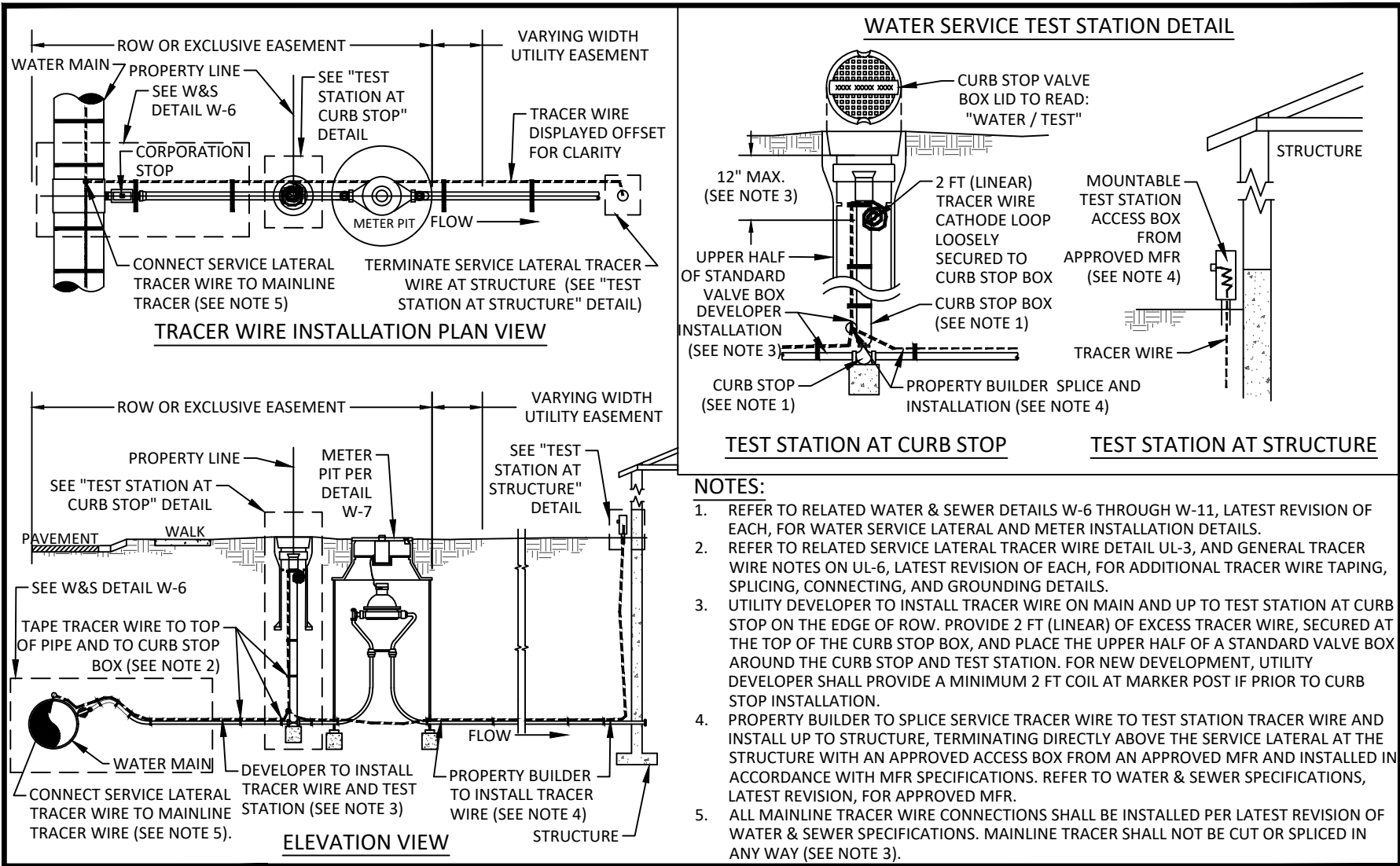


**(TYP) SERVICE LATERAL
UTILITY LOCATING PLAN**

DETAIL UL-3

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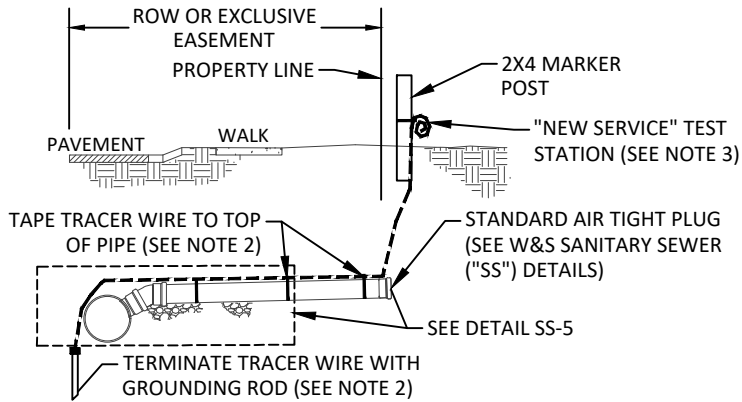
(TYP) WATER SERVICE UTILITY LOCATING DETAIL
SECTION & TEST STATION

DETAIL UL-4

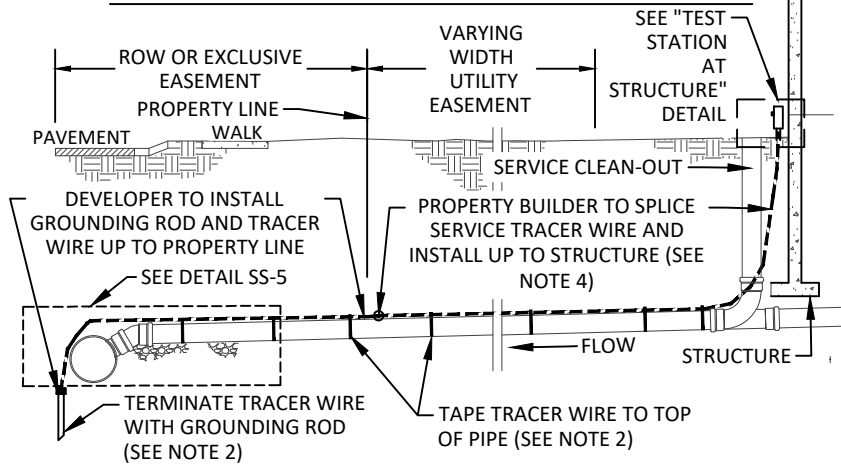


DATE: JANUARY 2023

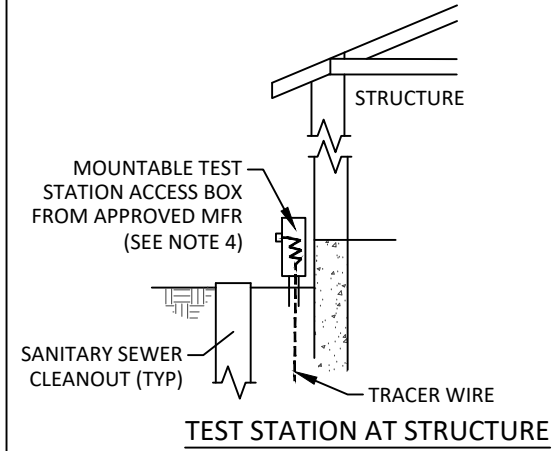
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TRACER WIRE INSTALLATION - NEW CONSTRUCTION



TRACER WIRE INSTALLATION ELEVATION VIEW



TEST STATION AT STRUCTURE

NOTES:

1. REFER TO RELATED DETAIL SS-5, LATEST REVISION, FOR SANITARY SEWER SERVICE LATERAL STANDARD DRAWING.
2. REFER TO RELATED SERVICE LATERAL TRACER WIRE DETAIL UL-3, AND GENERAL TRACER WIRE NOTES ON UL-6, LATEST REVISION OF EACH, FOR ADDITIONAL TRACER WIRE TAPING, SPLICING, CONNECTING, GROUNDING, AND MISC. INSTALLATION DETAILS.
3. DEVELOPER TO INSTALL TRACER WIRE FROM SS MAIN TO THE TEST STATION BOX ON THE EDGE OF ROW. TEST STATION FOR NEW DEVELOPMENT SHALL BE A COIL OF 2 FT (LINEAR) TRACER WIRE, SECURED TO THE SERVICE STUB MARKER POST.
4. PROPERTY BUILDER TO SPLICE SANITARY SEWER SERVICE TRACER WIRE PROPERTY LINE AND INSTALL UP TO STRUCTURE, TERMINATING AT THE SS SERVICE CLEANOUT WITH AN APPROVED MFR TEST STATION ACCESS BOX FROM AN APPROVED MFR. TEST STATION ACCESS BOX SHALL BE MOUNTED TO THE STRUCTURE WITHIN 18" OF THE SS SERVICE CLEANOUT AND INSTALLED ACCORDING TO THE TEST STATION MFR SPECIFICATIONS. REFER TO WATER & SEWER SPECIFICATIONS, LATEST REVISION, FOR APPROVED MFR.



**(TYP) SANITARY SEWER SERVICE UTILITY LOCATING
DETAIL SECTION & TEST STATION**

DETAIL UL-4

DATE: JANUARY 2023

SCALE: N.T.S.

TRACER WIRE NOTES:

1. LOCATING MUST MEET REQUIREMENTS OF SENATE BILL 18-167 OR ANY UPDATE.
2. TRACER WIRE SHALL BE LOCATED ON TOP OF PIPE, TAPED EVERY 3 TO 4 FEET MAX AND EACH SIDE OF EVERY JOINT, FITTING, AND VALVE.
3. TRACER WIRE IS REQUIRED FOR ALL WATER SERVICE LATERALS, NON-POTABLE IRRIGATION SERVICE LATERALS, ALL SANITARY SEWER LATERALS, ALL WATER MAINS, AND ALL NON-POTABLE IRRIGATION MAINS.
4. TWO UNDERGROUND WIRE SPLICES ARE ALLOWED PER SERVICE, SHALL HAVE LOCKABLE CONNECTIONS SPECIFICALLY DESIGNED FOR DIRECT BURIAL, AND DIELECTRIC SILICONE GEL FILLED OR APPROVED EQUAL.
5. REFER TO WATER & SEWER SPECIFICATIONS, LATEST REVISION, FOR TRACER WIRE GAUGE, MATERIAL, AND COATING REQUIREMENTS.
6. TRACER WIRE SYSTEMS MUST BE INSTALLED AS A SINGLE CONTINUOUS WIRE, EXCEPT WHERE USING APPROVED CONNECTORS. NO LOOPING OR COILING OF WIRE AROUND THE PIPE IS ALLOWED.
7. ALL WATER SERVICE LATERAL TRACER WIRES SHALL BE CONNECTED TO MAINLINE TRACER USING AN APPROVED MAINLINE TO LATERAL LUG CONNECTOR WITHOUT CUTTING / SPLICING THE MAINLINE TRACER WIRE.
8. ALL MAINLINE TRACER WIRE BRANCHES SHALL BE MADE WITH AN APPROVED MAINLINE TO MAINLINE LUG CONNECTOR WITHOUT CUTTING / SPLICING EITHER MAINLINE TRACER WIRE.
9. REFER TO WATER & SEWER CONSTRUCTION SPECIFICATIONS, LATEST REVISION, FOR APPROVED TRACER WIRE MFR AND ADDITIONAL INSTALLATION REQUIREMENTS.

TEST STATIONS:

1. TRACER WIRE SHALL BE ACCESSIBLE AT LEAST ONCE EVERY 1,000 FT MAX.
2. TEST STATION SHALL NOT BE FURTHER THAN 1,000 FT FROM AN APPROVED "FAR-END" GROUNDING ROD. THIS GROUNDING ROD MUST MEET WATER & SEWER CONSTRUCTION SPECIFICATIONS AND DESIGN CRITERIA STATED IN THE GROUNDING NOTES.
3. TEST STATION MAY EITHER BE IN THE FORM OF A CATHODE WIRE LOOP ACCESSIBLE FROM FINAL GRADE SURFACE OR AN APPROVED TEST

STATION ACCESS BOX FROM AN APPROVED MFR. EITHER TEST STATION FORM SHALL BE WITHIN THE FAR-END GROUNDING INTERVAL REQUIREMENT, AND MEET WATER & SEWER TRACER WIRE CONSTRUCTION SPECIFICATIONS AND DETAILS, LATEST REVISION OF EACH.

4. GROUND SURROUNDING TEST STATION ACCESS BOXES SHALL SLOPE AWAY FROM LID AT 2% MINIMUM GRADE.

GROUNDING NOTES:

1. ALL SANITARY SEWER SERVICE LATERAL TRACER WIRES SHALL TERMINATE WITHIN 2 FT OF THE SS MAIN WITH AN APPROVED DRIVE-IN MAGNESIUM GROUNDING ROD. SINGLE GROUNDING ROD MAY BE UTILIZED FOR UP TO 3 SEWER SERVICES MAX.
2. MAINLINE TRACER WIRE MUST BE GROUNDED AT EVERY DEAD END/STUB, AND ALONG CONTINUOUS RUNS AT A MAXIMUM OF 2,000 FT INTERVALS WITH A 1.5 LB DRIVE-IN MAGNESIUM GROUNDING ROD PER MFR REQUIREMENTS. PLACEMENT OF GROUNDING ROD SHALL BE INSTALLED IN SUCH A WAY THAT ALLOWS FOR PROPER WIRE LOCATING WITHOUT A LOSS OR DETERIORATION OF LOW FREQUENCY SIGNAL (512 HZ) FOR DISTANCES IN EXCESS OF 1,000 FT.
3. IF GROUNDING ROD IS TOO CLOSE TO A TEST STATION THAT IT INTERFERES WITH PROPER LOCATING, THE GROUNDING ROD MUST BE SWITCH-ABLE IN ORDER TO TEMPORARILY DEACTIVATE THE INTERFERING GROUND SIGNAL IN THE VICINITY. SUCH A TEST STATION SHALL BE IN THE FORM OF A TEST STATION ACCESS BOX FROM A CITY APPROVED MFR.
4. REFER TO WATER & SEWER CONSTRUCTION SPECIFICATIONS, LATEST REVISION, FOR APPROVED GROUNDING ROD MFR AND ADDITIONAL REQUIREMENTS.



TRACER WIRE GENERAL NOTES

DETAIL UL-5

DATE: JANUARY 2023

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**CONSTRUCTION SPECIFICATIONS
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SECTION 01713

SUBMITTALS

PART 1– GENERAL

1.1 SCOPE

- A. This Section includes provisions for Contractor submittals. Additional provisions may be included in specific Specifications Sections.
- B. This Section contains general information pertaining to the processing of submittals. Additional detailed submittal requirements are contained within the individual technical Specifications Sections.
- C. Submittals shall be mailed or emailed as follows:

City of Greeley – Civil Inspections
1100 10th Street
Greeley, Colorado 80631

- D. This Section specifies the general methods and requirements of submissions applicable to the following work-related submittals: Shop Drawings, Product Data, Manuals, Samples, Certificates of Compliance, Statements of Qualifications, Test Results, Survey Data, Calculation's and Construction or Submittal Schedules. Detailed submittal requirements will be specified in the technical Specifications sections.
- E. All submittals shall be clearly identified by reference to Specification Section, Paragraph and Drawing No. or Detail as applicable. Submittals shall be clear and legible and of sufficient size for sufficient presentation of data. The "Submittal Transmittal Form" and the "Certification Statement" to be used with each submittal is included at the end of this Section.
- F. Prepare, maintain, and submit submittal logs as specified herein.

1.2 SUBMIT SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

- A. Shop Drawings
 - 1. Shop drawings include, but are not necessarily limited to, custom-prepared data such as fabrication and erection/installation (working) drawings, design calculations, lists, graphs, operating instructions, scheduled information, setting diagrams, actual shop work manufacturing instructions, custom templates, special wiring diagrams, coordination drawings, individual system or equipment inspection and test reports including performance curves and certifications, as applicable to the work.
 - 2. All details on shop drawings submitted for approval shall show clearly the relation of the various parts of the work and control lines, and where correct fabrication of the work depends upon field measurements such measurements

shall be made and noted on the drawings before being submitted for approval.

B. Product Data

1. Product data as specified in individual Sections include, but are not necessarily limited to, standard prepared data for manufactured products (sometimes referred to as catalog data), such as the manufacturer's product specification and installation instructions, availability of colors and patterns, manufacturer's printed statements of compliance and applicability, roughing-in diagrams and templates, catalog cuts, product photographs, standard wiring diagrams, printed performance curves and operational- range diagrams, production or quality control inspection and test reports and certifications, mill reports, product operating and maintenance instructions and recommended spare-parts listing and printed product warranties, as applicable to the work.

C. Samples

1. Samples specified in individual Sections include, but are not necessarily limited to, physical examples of the work, such as sections of manufactured or fabricated work, small cuts or containers of materials, complete units of repetitively-used products, color/texture/pattern swatches and range sets, specimens for coordination of visual effect, graphic symbols and units of work to be used by the District for independent inspection and testing, as applicable to the work.

1.3 CONTRACTOR'S RESPONSIBILITIES

- A. The CONTRACTOR shall prepare, approve, sign and submit to the City or Engineer of Record any and all Shop Drawings, Manufacturers' Project Data, Certificates, Wiring Diagrams, Operation and Maintenance Manuals and Samples required by the Contract Documents.

NOTE: All references in the Technical Sections under "Shop Drawings" or "Submittal" to the words "approval of" shall mean "reviewed by".

- B. The CONTRACTOR, by preparing, reviewing, approving and submitting the Shop Drawings, Manufacturers' Product Data, Certifications, Wiring Diagrams, Operation and Maintenance Manuals and Samples, represents that the CONTRACTOR has determined and verified all materials, field measurements and filed construction criteria related thereto, and has checked and coordinated the information contained within such submittals with the requirements of the Work, the Project and the Contract Documents.
- C. The CONTRACTOR shall inform the City or Engineer of Record, in writing, of any and all deviations and/or questions regarding the Contract Documents, and shall properly identify these areas of concern in the letter of transmittal of the Shop Drawings, Manufacturers' Product Data, Certification, Wiring Diagram and Samples for proper written disposition respectively by the Engineer of Record. The CONTRACTOR shall provide reproducible Shop Drawings.
- D. All Shop Drawings, Manufacturers' Product Data, Wiring Diagrams, Certifications,

Operation and Maintenance Manuals and Samples submitted, shall be accompanied by a preprinted standard transmittal form with submittal number, and shall be addressed to the City or Engineer of Record to be received and filed.

- E. The Contractor is not relieved of the responsibility for any deviation from the requirements of the Contract Documents, by virtue of Contractor's approval and submittal of the Shop Drawings, Manufacturers' Product Data, Wiring Diagrams, Operation and Maintenance Manuals and Samples to the City or Engineer of Record. All deviations and/or interpretations of the Contract Documents must be approved in writing by the City or Engineer of Record.
- F. The review of the Shop Drawings, Manufacturers' Product Data, Certifications, Wiring Diagrams, Operation and Maintenance Manuals; and Samples by the City or Engineer of Record does not relieve the Contractor of its responsibility from any requirements of the Contract Document, or any errors or omissions in such submittals, or for any failure to perform the requirements and intent of Contract Documents. The Contractor shall be responsible for a fully functional system as intended by the Contract Documents.
- G. The Contractor shall review shop drawings, product data and samples, including those by subcontractors, prior to submission to determine and verify the following:
1. Catalog numbers and similar data.
 2. Conformance with the Specifications.
- E. Each shop drawing, sample and product data submitted by the Contractor shall have affixed to it the following Certification Statement including the Contractor's Company name and signed by the Contractor: "Certification Statement: By this submittal, I hereby represent that I have determined and verified all materials, dimensions, catalog numbers and similar data, and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements." The cover sheet shall fully describe the packaged data and include a listing of all items within the package. Provide to the City or Engineer of Record a copy of each submittal transmittal sheet for shop drawings, product data and samples at the time of submittal of said drawings, product data and samples.
- F. The Contractor shall utilize a 10-character submittal identification numbering system in the following manner:
1. The first two characters shall represents Shop/Working Drawing and other Product Data (SD), Sample (SL), Operating/Maintenance Manual (OM), Certificate of Compliance (CC), Statement of Qualification (SQ), or Test Results/Report (TR).
 2. The next two digits shall be the numbers 01-99 to sequentially number each initial separate item or drawing submitted.
 3. The next character shall be a letter, A-Z, indicating the submission, or resubmission of the same Drawing, i.e., A=1st submission, B=2nd submission, C=3rd submission, etc.

4. The next five digits shall be the applicable Specifications Section Number.

A typical submittal number would be as follows: SD-08-B-13122

SD	=	Shop Drawing
08	=	The eighth initial submittal
B	=	The second submission (first resubmission) of that particular shop drawing
13122	=	Specifications Section

- G. Notify the City or Engineer of Record in writing, at the time of submittal, of any deviations in the submittals from the requirements of the Contract Documents.
- H. The review and approval of shop drawings, samples or product data by the City or Engineer of Record shall not relieve the Contractor from his/her responsibility with regard to the fulfillment of the terms of the Contract. All risks of error and omission are assumed by the Contractor and the City and Engineer of Record will have no responsibility thereof.
- I. No portion of the Work requiring a shop drawing, sample, or product data shall be started nor shall any materials be fabricated or installed prior to the approval or qualified approval of such item. Fabrication performed, materials purchased or on- site construction accomplished which does not conform to approved shop drawings and data shall be at the Contractor's risk. The City will not be liable for any expense or delay due to corrections or remedies required to accomplish conformity.
- J. Project Work, materials, fabrication, and installation shall conform to approved shop drawings, applicable samples, and product data.

1.4 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Work or in the work of any other contractor.
- B. Each submittal, appropriately coded, will be returned within thirty (30) Calendar Days following receipt of submittal by the City or Engineer of Record.
1. Submittal identification number
 2. The date of submission and the dates of any previous submissions.

3. The Project title and number.
4. Contractor identification.
5. The names and telephone numbers of:
 - a. Contractor
 - b. Supplier
 - c. Manufacturer
6. Field dimensions, clearly identified as such.
7. Identification of deviations from Contract Documents.
8. Identification of revisions on resubmittals.

1.5 REVIEW OF SHOP DRAWINGS, PRODUCT DATA, WORKING DRAWINGS AND SAMPLES

- A. The review of shop drawings, data, and samples will be for general conformance with the design concept and Contract Documents. They shall not be construed:
 1. as permitting any departure from the Contract requirements;
 2. as relieving the Contractor of responsibility for any errors, including details, dimensions, and materials;
 3. as approving departures from details furnished by the City, except as otherwise provided herein.
- B. The Contractor remains responsible for details and accuracy, for coordinating the Work with all other associated work and trades, for selecting fabrication processes, for techniques of assembly, and for performing work in a safe manner.
- C. If the shop drawings, data or samples as submitted describe variations and show a departure from the Contract requirements which City or Engineer of Record finds to be in the interest of the City and to be so minor as not to involve a change in Contract Price or time for performance, the City or Engineer of Record may return the reviewed drawings without noting an exception.
- D. The City or Engineer of Record will reject incomplete submittals as not complying with the Contract requirements. Contractor shall provide space for 2.5" by 3.5" review stamp for each submittal.
- E. After receipt of a complete submittal and within the time limits described below, the City

or Engineer of Record will transmit the submittal back to the Contractor marked with one of the following review status:

“Reviewed, No Exceptions Taken”

“Make Corrections Noted, Do Not

Resubmit” “Revised and Resubmit”

“Rejected”

- F. For items marked “Make Corrections Noted, Do Not Resubmit,” the revisions will be marked on the submittal or will be described as comments in the response letter. The submittal will be considered approved without formal revision. The CONTRACTOR shall, within 7 calendar days, submit two (2) corrected record copies of the submittal to the City or Engineer of Record for record purposes.
- G. If the submittal is returned to the Contractor marked “Revised and Resubmit,” the submittal will be transmitted to the Contractor with a statement of the deficiencies. The Contractor shall promptly revise the submittal and resubmit to the City or Engineer of Record.
- H. If the submittal is returned to the Contractor marked “Rejected,” the Contractor shall revise said submittal and shall resubmit the revised submittal to the City or Engineer of Record.
- I. Revisions indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents, Specifications, or Drawings. Submittal revisions shall not be taken as the basis of claims for extra work. The Contractor shall have no claim for damages or extension of time due to any delay resulting from making required revisions to the submittals. The review of submittals by City or Engineer of Record shall in no way relieve the Contractor of responsibility for errors or omissions contained therein nor will such review operate to waive or modify any provisions or requirements contained in the Contract Documents, Specifications, or Drawings.
- J. After approval of submittals, the Contractor shall not deviate from the approved submittal without the prior written consent from the City or Engineer of Record. Commencement of production Work performed in advance of the receipt of approval of submittals shall be entirely at the Contractor’s risk.
- K. Resubmittals will be handled in the same manner as first submittals. On resubmittals the Contractor shall direct specific attention, in writing on the letter of transmittal and on resubmitted shop drawings by use of revision triangles or other similar methods, to revisions other than the corrections requested by the City or Engineer of Record, on previous submissions. Any such revisions which are not clearly identified shall be made at the risk of the Contractor. The Contractor shall make corrections to any work done because of this type revision that is not in accordance to the Contract Documents as may be required by the City or Engineer of Record.

- L. Partial submittals may not be reviewed. The City or Engineer of Record will be the only judge as to the completeness of a submittal. Submittals not complete will be returned to the Contractor, and will be considered "Rejected" until resubmitted. The City or Engineer of Record may at his/her option, provide a list or mark the submittal directing the Contractor to the areas that are incomplete.

- M. Repetitive Review
 - 4. Shop drawings and other submittals will be reviewed no more than twice at the City or Engineer of Record expense. All subsequent reviews will be performed at times convenient to the City or Engineer of Record and at the Contractor's expense, based on the City or Engineer of Record then prevailing rates. The Contractor shall reimburse the City for all such fees invoiced to the City. Submittals are required until approved.

 - 5. Any need for more than one resubmission, or any other delay in obtaining City or Engineer of Record review of submittals, will not entitle Contractor to extension of the time for completion.

- N. If the Contractor considers any correction indicated on the shop drawings to constitute a change to the Contract Documents, the Contractor shall give written notice thereof to the City or Engineer of Record at least seven work days prior to release for manufacture.

- O. When the shop drawings have been completed to the satisfaction of the City or Engineer of Record, the Contractor shall carry out the construction in accordance therewith and shall make no further changes therein except upon written instructions from the City or Engineer of Record.

1.6 DISTRIBUTION

- D. Distribute reproductions of approved shop drawings and copies of approved product data and samples, where required, to the job site file and subcontractors as required or directed by the City.

1.7 SCHEDULES

- D. Provide all schedules required by the requirements of these Specifications.

1.8 GENERAL PROCEDURES FOR SUBMITTALS

- D. Coordination of Submittal Times: Prepare and transmit each submittal sufficiently in advance of performing the related work or other applicable activities, or within the time specified in the individual sections of the Specifications so that the installation will not be delayed by processing times including disapproval and resubmittal (if required), coordination with other submittals, testing, purchasing, fabrication, delivery and similar sequenced activities. No extension of the time for completion will be authorized because of the Contractor's failure to transmit submittals sufficiently in advance of the work.

1.9 QUALITY CONTROL SUBMITTALS

- D. Certificates:
1. Manufacturer's Certificate of Compliance:
 - a. When specified in individual Specification sections or where products are specified to a recognized standard or code, submit prior to shipment of product or material to the Project site.
 - b. City or Engineer of Record may permit use of certain materials or assemblies prior to sampling and testing if accompanied by accepted certification of compliance.
 - c. Signed by product manufacturer certifying that materials, manufacture, and product specified conform to or exceed specified requirements and intent for which product will be used. Submit supporting reference data, affidavits, and certifications as appropriate.
 - d. May reflect recent or previous test results on material or product, but must be acceptable to City or Engineer of Record.
 2. Certificates of Successful Testing or Inspection: Submit when testing or inspection is required by Laws and Regulations or governing agency or specified in the individual Specification sections.
- E. Operation and Maintenance Manual: Submit Operation and Maintenance Manual in accordance with City requirements.
- F. Statements of Qualification: Evidence of qualification, certification, or registration. As required in these Contract Documents to verify qualifications of Engineers, materials testing laboratories, specialty Subcontractors, trades, specialists, consultants, installers, and other professionals.
- G. Written Test Reports of Each Test and Inspection: As a minimum, include the following:

1. Date of test and date issued, Project title and number, testing laboratory name, address, and telephone number, and name and signature of laboratory inspector.
2. Date and time of sampling or inspection and record of temperature and weather conditions.
3. Identification of product and Specification section, location of Sample, test or inspection in the Project, type of inspection or test with referenced standard or code, certified results of test.
4. Compliance with Contract Documents, and identifying corrective action necessary to bring materials and equipment into compliance.
5. Provide an interpretation of test results, when requested by City or Engineer of Record.

1.10 SUBMITTAL LOG

D. The Contractor shall prepare and maintain an accurate submittal log for the duration of the project. The Contractor shall submit initial submittal log within 30 Calendar Days after Notice to Proceed. The Contractor shall submit an updated submittal log once a month and upon request of the City or Engineer of Record. The submittal log shall contain a listing of all submittals required by the Contract Documents and shall include the following.

1. Submittal identification number
2. Specification Section Reference
3. Description of submittal item
4. Projected submission date
5. Actual submission date
6. Date returned by the Engineer
7. Notation of the City or Engineer of Record response
8. Notation if re-submittal or record copy is required

PART 2 – PRODUCTS (NOTUSED)

PART 3 – EXECUTION

3.1 SUBMITTAL TRANSMITTAL/CERTIFICATE FORM

Project Name:

To: City of Greeley – Civil Inspections
1100 10th Street
Greeley, Colorado 80631
Attn:

From: _____

Description:

Submittal #: _____ - _____ - _____ - _____

Type Submittal # Submission Section

Date: _____ Date of Previous Submission: _____ Copies: _____

Supplier: _____ Phone No: _____

Manufacturer: _____ Phone No: _____

Remarks:

Relationship to Critical Features of Work:

Certification Statement: By this submittal, I hereby represent that I have determined and verified all materials, dimensions, catalog numbers and similar data, and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements.

By: _____

Signature

Date

SECTION 01713

WATER DISTRIBUTION SYSTEM TESTING

PART 1– GENERAL

1.1 SCOPE

- A. This section addresses the hydrostatic testing of potable water distribution and non-potable irrigation lines.
- B. The Contractor is responsible for the hydrostatic testing of water lines.

1.2 SUBMITTALS

- A. Testing Plan: Submit prior to testing and include the following:
 - 1. Testing dates.
 - 2. Piping systems and section(s) to be tested.
 - 3. Test type.
 - 4. Method of isolation.
 - 5. Calculation of maximum allowable leakage for piping section(s) to be tested.
- B. Certifications of Calibration for testing equipment, including pressure gauges, that are no more than 6 months old from date of use.
- C. Certified Test Report.

PART 2– PRODUCTS

2.1 PRESSURE GAUGES

- A. Contractor shall supply all pressure gauges used for leakage testing meeting the following requirements:
 - 1. Dial Size: Nominal 2-inch dial size.
 - 2. Accuracy: 2 percent of span.
 - 3. Scale Range: Such that normal operating pressure lays between 50 percent and 80 percent of the scale range.
 - 4. The maximum allowable pressure gauge increment shall be five (5) psi.

PART 3 – EXECUTION

3.1 GENERAL

- A. Testing shall be conducted when:
1. Backfill and compaction has been completed, but before street improvements are installed.
 2. Main has been flushed.
 3. Disinfection may occur after leak testing is completed and accepted or concurrently with the leak testing. Disinfection to follow construction specification *Section 02511, Disinfection of Water Utility Distribution*.
- B. Contractor shall ensure that thrust blocking or other types of restraining systems will provide adequate restraint prior to pressurizing the system.
1. At least seven (7) days shall have elapsed since the last concrete thrust restraint was cast.
 2. A minimum of seventy-two (72) hours shall elapse if high-early-strength cement is used.
- C. The Contractor shall provide all equipment and personnel to perform the hydrostatic test.
1. Test equipment shall be able to maintain a continuous internal pipe pressure required for the test psi and accurately measure leakage from the pipe over a two (2) hour, minimum, test period.
 2. A water meter shall be used to measure the amount of water used in pressurizing the system.
- D. When existing water mains are used to supply the test water, they shall be protected from backflow pressures by temporarily installing a double check-valve assembly between the test and the supply main.
- E. Do not test against the City's existing valves.
1. Provide temporary watertight plugs and temporary thrust restraint until tests pass.
 2. After system passes testing, remove plugs and thrust restraint and connect to existing valve with cut-in sleeve or solid sleeve.
- F. New Piping Connected to Existing Piping:
1. Isolate new piping with grooved-end pipe caps, spectacle blinds, blind flanges, or as acceptable to the City.
 2. Test joint between new piping and existing piping by methods that do not place entire existing system under test load, as approved by the City.

- G. The City shall be notified 48 hours in advance of testing. The City shall witness tests and record times, leakage readings, and pressure over the test period.
- H. A hydrostatic pressure test shall be performed against all new valves at the point of connection to the existing system. This test shall be performed prior to connecting the new system to the existing one.
- I. Only City personnel shall operate existing City owned valves.
- J. Filling the Line
 - 1. Potable water shall be used. An alternative water source will require prior approval from the City.
 - 2. When filling the pipeline, it shall be filled at a rate which will not cause surges nor will it exceed the rate at which the air can be released.
 - 3. Where permanent air release vents are not available, the Contractor shall install corporation stops at high points in the water line in order to evacuate trapped air.
 - 4. All corporation stops, which were installed to facilitate evacuation of air from the water main, shall be removed and plugged with a “cc” threaded brass plug after the water main is filled, and prior to pressure testing.
- K. Pipe shall remain filled with water for a minimum of twenty-four (24) hours prior to the hydrostatic pressure test.
- L. Prior to the tests, inspect valves within the test section to make sure they are fully operational.
- M. Operate all valves in the system in the presence of City personnel.
- N. Prior to test, remove or suitably isolate appurtenant instruments or devices that could be damaged by pressure testing.

3.2 PRESSURE TEST

- A. “Leakage” is the quantity of water that must be added to the pipeline to maintain a pressure within five (5) psi of the specified test pressure after the air has been expelled and the pipe has been filled with water.
- B. Test pressure
 - 1. Test pressure shall be 150 psi or 150% of the operating pressure, whichever is greater, at the highest elevation of the test section.
 - 2. A residual pressure, within five (5) psi of the test pressure, shall be maintained for a minimum two (2) hours.
- C. The maximum allowable leakage for each test section is determined by the following formula and table:

$$L = \frac{SD\sqrt{P}}{148,000}$$

Where: L = maximum allowable leakage, in gallons per hour
S = length of pipe tested, in feet
D = nominal pipe diameter, in inches
P = average test pressure during the leakage test, in psi (gauge)

There will be no additional leakage allowance for valves.

- D. If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.

3.3 PASSING

- A. If the tests disclose leakage greater than that specified, the defective materials and joints shall be located and repaired. The tests shall be repeated until the leakage is less than the maximum allowed.
- B. With the exception of obvious leaks, passing of the pressure test shall be on the basis of maximum allowable leakage per section tested. No leakage is allowed through the bonnet of any valve or appurtenance. Any valve or appurtenance that is tested and leaks will be removed and replaced.
- C. All visible leaks shall be repaired regardless of maximum allowable leakage.

SECTION 01715

SEWER AND MANHOLE TESTING

PART 1 – GENERAL

1.1 SCOPE

- A. This section addresses the testing of sanitary sewer collection mains, manholes, and appurtenances.
- B. All sanitary sewer pipelines shall be air tested per these specifications.
- C. All sanitary sewer manholes shall be vacuum tested per these specifications.
- D. All sanitary sewer collection systems shall be video inspected per these specifications.

1.2 REFERENCES

- A. ASTM International (ASTM)
 - 1. C1244, Standard Test Method for Concrete Sewer Manholes by Negative Air Pressure (Vacuum) Test Prior to Backfill, latest revision.
 - 2. F1417, Standard Test Method for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air, latest revision.

1.3 SUBMITTALS

- A. Video Inspections
 - 1. Flash Drives or USB portable hard drives
 - a. Submit Flash Drive or USB portable hard drives of completed, narrated, color digital videos identified by Project name, street name, right-of-way property name, and manhole numbers.
 - b. Flash Drives or USB portable hard drives become property of the City of Greeley Water and Sewer Department
 - 2. Inspection Logs
 - a. Submit cleaning and television inspection logs of all new installed sewer lines, manholes, structures, and all connections to an existing sewer line.
 - b. Cleaning and television inspection logs shall be submitted prior to request for progress payment, pay applications, or prior to substantial completion. Failure to provide inspections log may result in delay of substantial completion or progress payments.
 - c. Include the following minimum information

- i. Stationing and location of lateral services, wyes, or tees
 - ii. Date and clock time references
 - iii. Pipe joints
 - iv. Infiltration/Inflow defects
 - v. Cracks
 - vi. Leaks
 - vii. Offset joints
 3. Submit specific detailed description of proposed bypass pumping system, including written description of plan addressing schedule, quantity, capacity, and location of pumping equipment.
 4. Submit spill plan to address any spills that might occur.
 5. Field Quality-Control Submittals: Indicate results of Contractor-Furnished tests and inspections.
 6. Qualifications Statement
 - a. Submit qualifications of applicator.
- B. Exfiltration and Infiltration Testing
 1. Submit the following items prior to the start of testing
 - a. Testing procedures
 - b. List of test equipment
 - c. Testing sequence schedule
 - d. Provisions for disposal of flushing and test water
 - e. Certification of test gage calibration
 2. Test and Evaluation Reports: Indicate results of manhole and piping tests
 3. Qualifications Statement
 - a. Submit qualifications for applicator
- C. Vacuum Testing
 1. Submit the following items prior to start of testing
 - a. Testing procedures

- b. List of test equipment
 - c. Testing sequence schedule
 - d. Provisions for disposal of flushing and test water
 - e. Certification of test gage calibration
2. Test and Evaluation Reports: Indicate results of manhole tests
 3. Qualifications Statement
 - a. Submit qualifications for applicator

D. Air Testing

1. Submit the following items prior to the start of testing
 - a. Testing procedures
 - b. List of test equipment
 - c. Testing sequence schedule
 - d. Provisions for disposal of flushing and test water
 - e. Certification of test gage calibration
2. Test and Evaluation Reports: Indicate results of piping tests
3. Qualifications Statement
 - a. Submit qualifications for applicator

E. Mandrel Testing

1. Submit the following items prior to start of testing
 - a. Testing procedures
 - b. List of test equipment
 - c. Testing sequence schedule
 - d. Provisions for disposal of flushing and test water
 - e. Certification of test gage calibration
 - f. Deflection mandrel drawings and calculations
2. Test and Evaluation Reports: Indicate results of piping tests.

PART 2 – PRODUCTS

2.1 VIDEO INSPECTIONS

- A. Flash Drive or USB portable hard drive
 - 1. Description: Digital video formatted files
 - 2. Audio track containing simultaneously recorded narrative commentary and evaluations of videographer, describing in detail condition of pipeline interior.

2.2 EXFILTRATION AND INFILTRATION TESTING

- A. Equipment
 - 1. Plugs
 - 2. Pump
 - 3. Measuring device

2.3 VACUUM TESTING

- A. Equipment
 - 1. Vacuum pump
 - 2. Vacuum line
 - 3. Vacuum tester base
 - a. Compression band seal
 - b. Outlet port
 - 4. Shutoff valve
 - 5. Stopwatch
 - 6. Plugs
 - 7. Vacuum Gage: Calibrated to 0.1 in. Hg

2.4 AIR TESTING

- A. Equipment
 - 1. Air compressor
 - 2. Air supply line
 - 3. Shutoff valves

4. Pressure regulator
5. Pressure relief valve
6. Stopwatch
7. Plugs
8. Pressure Gage: Calibrated to 0.1 psi

2.5 MANDREL TESTING

- A. Equipment
 1. Properly sized rigid ball or “go, no go” mandrel
 2. Pull/retrieval ropes

PART 3 – EXECUTION

3.1 GENERAL

- A. Testing shall be conducted when:
 1. Backfill and compaction has been completed, but before paving and curb gutter improvements are installed.
 2. Line and manholes have been thoroughly cleaned of all foreign material.
- B. The Contractor shall furnish all equipment, labor, and incidentals necessary to perform tests. The pressure gauge shall be capable of indicating pressure to the nearest 0.1 pounds per square inch (psi) increment.
- C. The City shall witness tests and record times, leakage readings, and pressure over the test period. Contractor shall provide the City a minimum forty-eight (48) hours advance notice of any tests.

3.2 ALIGNMENT TEST

- A. Lamp testing shall be on an as needed basis at the City’s discretion.
- B. Lamp each section of sanitary sewer between manholes to determine whether any displacement of pipe has occurred.
- C. Lamping shall be done after pipe trench is compacted and brought to grade or pavement subgrade.
- D. “Full moon” shall be visible for vertical grade alignment. No less than “half moon” shall be visible for horizontal alignment.
- E. Repair poor alignment, displaced pipe, or other defects discovered at the city’s discretion.

3.3 PIPE DEFLECTION TEST

- A. Mandrel testing shall be completed on an as needed basis at the City's discretion.
- B. Each section of sanitary sewer shall be tested for deflection by an independent testing firm as hired by the Contactor prior to City acceptance and as deemed necessary within the warranty period by the City.
 - 1. The maximum allowable deflection for City acceptance is 5% of the base internal diameter.
 - 2. The maximum allowable deflection at the end of the warranty period shall be 5% of the base internal diameter.
 - 3. Mandrel outside diameters in inches are as follows:

TABLE 3.3-A: Allowable Pipe Deflection – Mandrel Test

Pipe Size (in)	Base I.D.	5% Deflection Mandrel
8"	7.665	7.282
10"	9.563	9.085
12"	11.361	10.793
15"	13.898	13.203

- C. Sections of the pipe which fail the deflection test shall have the defects repaired and the test repeated.

3.4 AIR TESTING SANITARY SEWER MAINS

- A. Conduct tests in conformance with ASTM F1417 and these specifications.
- B. All pressures in this section assume no groundwater back pressure, if groundwater is present, increase test air pressures to compensate for the back pressure. Each foot of groundwater produces approximately 0.433 psi back pressure. For groundwater in excess of five feet (5') above the pipe crown, an infiltration test shall be used in lieu of air testing.
- C. Preparation for tests:
 - 1. Flush and clean the sewer line prior to testing in order to wet the pipe surfaces and produce more consistent results.
 - 2. Provide a relief valve on the pressuring equipment to avoid over-pressurizing and damaging an otherwise acceptable line. Set relief valve at 5.0 psi.
 - 3. Plug and brace all openings in the main sanitary sewer line and the upper connections. Check all pipe plugs with a soap solution to detect any air leakage. If leaks are found, release the air pressure, eliminate the leaks and start the test procedures over again.

D. Test Procedure:

1. Add air until internal pressure of the sewer line is raised to approximately 4.0 psi gage. Maintain the air pressure between 3.5 psig and 4.5 psig until the air temperature in the pipe is stabilized with the pipe/ground temperature.
2. Disconnect the air supply and reduce the air pressure to 3.5 psig before starting the test.
3. If the groundwater is higher than the top of the pipe, the test pressure shall be adjusted to account for the higher groundwater. The test pressure shall be increased by 0.433 psi per foot of ground water up to five (5) feet of groundwater. For groundwater over five (5) feet in depth, an infiltration test shall be conducted in place of the air test.
4. Determine the time required for the air pressure to drop from 3.5 psig to 2.5 psig.
 - a. The time elapsed shall not be less than:

$$T = 0.085 \frac{DK}{Q}$$

Where: T = shortest time(s) allowed for the air pressure to drop 1.0 psig.

K = 0.000419DL but not less than 1.0

Q = leak rate in cubic feet/minute/square feet of internal surface

=

0.0015 CFM/SF

D = measured average inside diameter of pipe (in)

L = length of test section (ft)

- b. Example calculation for an eight-inch (8") diameter sanitary sewer pipe with a test section 400 feet long:

$$T = 0.085 \left[\frac{8in(0.000419)(8in)(400ft)}{0.0015CFM / SF} \right]$$

T= 608 seconds or 10 minutes 08 seconds (10:08)

- c. The following table contains the test durations for pipe diameters between eight-inches (8") and fifteen inches (15"), for pipe lengths up to 500 feet.

**TABLE 3.4-D: Specified Test Duration for Length of Pipe Indicated
(Duration indicated in min:sec)**

Pipe Diameter (in)	Pipe Length (feet)						
	0-	200	250	300	350	400	500
8	7:34	7:34	7:34	7:36	8:52	10:08	12:38

10	9:26	9:26	9:53	11:52	13:51	15:49	19:45
12	11:20	11:24	14:15	17:05	19:56	22:47	28:26
15	14:10	17:48	22:15	26:42	31:09	35:36	44:26

5. If lateral or service lines are included in the test, their length may be ignored for computing required test time if the test time requirements are met. If the test section fails, time shall be recomputed to include all the lateral lengths using the following formula:

$$T = 0.085 \left[\frac{D_1^2 L_1 + D_2^2 L_2 + \dots + D_n^2 L_n}{D_1 L_1 + D_2 L_2 + \dots + D_n L_n} \right] \frac{K}{Q}$$

Where:

T = shortest time(s) allowed for the air pressure to drop 1.0 psig.

K = 0.000419(D₁L₁ + D₂L₂ + ... + D_nL_n) but not less than 1.0

Q = leak rate in cubic feet/minute/square feet of internal surface = 0.0015
CFM/SF

D₁, D₂, etc. = measured average inside diameter of pipe (in)

L₁, L₂, etc. = length of test section (ft)

If the recomputed test time is short enough to allow the section tested to pass, then the test section meets the requirements of this specification.

- E. Sections of the pipe which fail the air test shall have the defects repaired and the test repeated.

3.5 EXFILTRATION TEST

- A. Exfiltration testing may only be completed upon approval from the City.
- B. Contractor shall provide a pre-approved device capable of measuring flow in the pipe in fifteen (15) minute intervals and providing a total flow at the end of the testing period.
- C. Flow measurement shall be twenty-four (24) hours minimum and shall be conducted before backfill and trench/area dewatering operations are complete.
- D. The maximum allowable exfiltration for sanitary sewers shall not exceed 50 gallons per day/inch nominal diameter pipe/mile (0.95 gpd/inch/100ft).

3.6 INFILTRATION TEST

- A. If groundwater exists in excess of five feet (5') above the pipe crown an infiltration test for leakage shall be used.
- B. Contractor shall provide a pre-approved device capable of measuring flow in the pipe in fifteen (15) minute intervals and providing a total flow at the end of the testing period.
- C. Flow measurement shall be twenty-four (24) hours minimum and shall be conducted only after backfill and trench/area dewatering operations are complete, and groundwater has

returned to normal elevations.

- D. The maximum allowable infiltration for sanitary sewers shall not exceed 50 gallons per day/inch nominal diameter pipe/mile (0.95 gpd/inch/100ft).

3.7 VACUUM TESTING MANHOLES

- A. Manholes shall be tested before the ring and cover and grade adjustment rings are installed, and after backfill and compaction is complete.
- B. Conduct tests in conformance with ASTM C1244 and these specifications.
- C. Preparation for tests:
 - 1. All lift holes, joints, and other imperfections shall be filled with an approved non-shrink grout, to provide a smooth finish appearance.
 - 2. All pipes entering the manhole shall be temporarily plugged, taking care to securely brace the pipes and plugs to prevent them from being drawn into the manholes.
- D. Test Procedure:
 - 1. The test head shall be placed at the top of the manhole in accordance with the manufacturer's recommendation.
 - 2. A vacuum of ten-inches (10") mercury shall be drawn in the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off.
 - 3. The time shall be measured for the vacuum to drop to nine-inches (9") mercury.
 - 4. The manhole shall pass if the time for the vacuum reading to drop from ten-inches (10") mercury to nine-inches (9") mercury meets or exceeds the values indicated in the following table:

TABLE 3.6-D: Manhole Vacuum Testing Durations

Depth * (ft)	Diameter (in)		
	48	60	72
	Time (seconds)		
8	20	26	33
10	25	33	41
12	30	39	49
14	35	46	57
16	40	52	67
18	45	59	73
20	50	65	81
22	55	72	89
24	59	78	97
26	64	85	105
28	69	91	113
30	74	98	121
* Round actual depth of manhole to next depth up (ex. 11 foot deep manhole, use depth of 12 feet)			

- E. If the manhole fails any test, necessary repairs shall be made by an approved method and the manhole shall be retested until a satisfactory test is obtained.

3.8 TELEVISIONING SANITARY SEWER MAIN

- A. All sanitary sewer lines shall be televised prior to final acceptance and three (3) months prior to the end of the warranty period or as deemed necessary within the warranty/construction period by the City. The televising shall be made by the Contractor or a Sub-consultant to the contractor and the recording shall be submitted to the City for review and acceptance. The individual completing the video recording shall be NASSCO trained and certified.
 - 1. The recording shall be made using a color camera, self-propelled or other, having sufficient light to show detail of problem areas and joints.
 - 2. Camera shall have a swivel head capable of looking up each service connection.
 - 3. Camera speed shall not exceed three (3) ft/s.
 - 4. If problem area or concerns are seen by the operator, then the camera shall be backed up and an extended look at the area will be recorded.
 - 5. All recordings will have location (i.e., manhole # to manhole #), time, date, and footage displayed.
 - 6. All recordings will include an evaluation of the manholes.
- B. The warranty period for the sanitary sewer collection system WILL continue to be in

effect for the time specified in these specifications or until the Water and Sewer Department has received and approved the video recordings, which ever is longer.

SECTION 01785

PROJECT RECORD DOCUMENTS

PART 1 – GENERAL

1.1 SCOPE

- A. This section addresses the requirements for Project Record Documents.
- B. Reference *Section 2* of these Criteria for supplementary information to this specification.

1.2 RECORD DOCUMENTS

- A. Quality Assurance:
 - 1. Furnish qualified and experienced person, whose duty and responsibility shall be to maintain record documents.
 - 2. Accuracy of Records:
 - a. Coordinate changes within Project Record Documents, making legible and accurate entries on each sheet of Drawings and other documents where such entry is required to show change. Project Record Documents may be kept digitally but must be backed-up daily.
 - b. Purpose of Project Record Documents is to document factual information regarding aspects of the Work, both concealed and visible, to enable future modification of the Work to proceed without lengthy and expensive Site measurement, investigation, and examination.
 - c. Field verify all as-built dimensions and materials.
 - 3. Make entries within 48 hours after receipt of information that a change in the Work has occurred.
 - 4. Prior to each request for progress payment, pay application, or when a field change is requested or made, the Engineer of Record, Project manager, Chief Construction, or City may request review and approval of current Redline Drawings. Failure to properly maintain, update, and submit Redline Drawings may result in a deferral of the whole or any part of Contractor's Application for Payment, either partial or final, and substantial completion may be delayed. The City reserves the right to review Redline Drawings throughout the project.

PART 2 – PRODUCTS

SECTION NOT USED

PART 3 - EXECUTION

3.1 MAINTENANCE OF DOCUMENTS AND SAMPLES

- A. Do not use Project Record Documents for construction purposes.
- B. Store documents in Contractor's field office apart from documents used for construction. Protect Project Record Documents from deterioration and store in a secure location. Updated Project Record Documents shall be scanned and saved as a PDF monthly.
- C. File documents and samples in accordance with the specification's section numbers.
- D. Maintain documents and samples in a clean, dry, legible condition and in good order.
- E. Documents shall be made available for inspection by the City upon request. Additionally, most recent PDFs must be provided upon City request.

3.2 RECORDING DURING CONSTRUCTION

- A. Label each drawing "REDLINE DRAWING" in neat large-printed letters.
- B. Mark whichever drawing is most capable of showing "field" condition fully and accurately, however, where shop drawings are used for mark-up, record a cross reference at corresponding locations on the Redline Drawings.
- C. Mark drawings legibly with a pen or pencil. Ink shall not be water based or subject to easy smearing. Use other colors to distinguish between variations in separate categories of work as follows:
 - 1. Red – Incorporated items (added)
 - 2. Green – Deleted items
 - 3. Blue – Comments for information only, not to be added to drawings (black shall not be used since it does not show well on black and white drawings)
 - 4. Yellow – Items marked as "correct"
 - 5. Orange – Items addressed by drafting (pickups) to check your own work
- D. Date entries.
- E. Call attention to entry by "cloud" drawn around area or areas affected.
- F. Record information concurrently with construction progress.
- G. Record new information that was not shown on the Construction Drawings or shop drawings. Give particular attention to concealed work which would be difficult to measure and record later.
- H. Record all field dimensions, elevations, details, deviations in sizes, locations, materials, or other features of the Work. It shall be possible, using these Redline Drawings to correctly and easily locate, identify, and establish dimensions of work features which will be concealed in finished work or underground.
- I. Establish locations of concealed and underground work, utilities and appurtenances, with

accurate horizontal and vertical dimensions. Horizontal locations shall be referenced to a minimum of two (2) permanent surface improvements. Vertical element locations shall be in relation to the project vertical datum.

- J. Do not backfill, cover, place or proceed with any work until necessary Redline Drawings information is obtained.

3.3 REDLINE DRAWINGS AND SUBMISSION

- A. Contractor shall submit Redline Drawing information to the Engineer of Record and City on a monthly basis or prior to each request for progress payment, pay application, or when a field change is requested or made for review and approval.
 - 1. The Engineer of Record and City shall review the submitted Redline Drawing information and any corrections, additions, or omissions identified shall be incorporated into the Redline Drawings by the Contractor prior to approval.
- B. Accompany the submittal to the Engineer of Record and City with a transmittal letter containing:
 - 1. Date
 - 2. Project title and number
 - 3. Contractor's name, address, and telephone number
 - 4. Index containing title and number of each Record Document
 - 5. Signature of Contractor or his authorized representative
- C. Redline Drawings shall be submitted and approved by the Engineer of Record and City prior to issuance of Substantial Completion.

3.4 FINAL AS-CONSTRUCTED RECORD DRAWINGS AND SUBMISSION

- A. Engineer of Record shall incorporate changes from approved Redline Drawings to produce final As-Constructed Record Drawings. As-Constructed Record Drawings shall be submitted to the City for review and approval within 2 months of the Engineer of Record receiving the approved Redline Drawings.
 - 1. The City shall review the submitted As-Constructed Drawing information and any corrections, additions, or omissions identified from the comparison to the approved Redline Drawings shall be incorporated into the As-Constructed Record Drawings by the Engineer of Record prior to approval.

- B. Engineer of Record shall submit approved As-Constructed Record Drawings to the City as noted below within 1 month of City approval of As-Constructed Record Drawings:
 - 1. 22" x 34" blueline or blackline form.
 - 2. Electronic PDF format
 - 3. AutoCAD per the most current version of "Electronic Data Submittal Standards (EDSS)"
 - 4. GIS shape files per the most current version of "Electronic Data Submittal Standards (EDSS)"

SECTION 02240

DEWATERING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Provide all material, equipment, and labor to install and maintain all pumps, piping, drains, well points, and other facilities required to effectively control, collect, and dispose of groundwater or surface water to permit safe and proper completion of the Work. Use appropriate equipment and methods for dewatering based on existing site conditions.
- B. Maintain the foundations and other portions of the Work free from water as required for constructing each part of the Work.
- C. Comply with all applicable environmental protection laws and requirements in operation of the dewatering system.
- D. Must obtain all permits as required by State and Local regulations.
 - 1. Colorado Department of Public Health and Environment (CDPHE) requires permits for dewatering operations.
 - 2. Discharge of water from dewatering operations may need additional approvals based on water quality and location of discharge.
- E. Remove all components of the dewatering system after it is no longer required.

1.2 SUBMITTALS

- A. Submit in accordance with Section 01330: Submittals.
- B. Dewatering Plan: Submit a Dewatering Plan prepared by a qualified dewatering specialist, with experience in design, installation, and operation of dewatering installations. The Dewatering Plan shall be prepared by a Licensed Professional Engineer in the State of Colorado and include the following:
 - 1. Details regarding the anticipated types and locations of various dewatering facilities and design calculations required substantiating the Dewatering Plan.
 - 2. Superintendence plan and schedule, indicating who will be responsible for observing the dewatering system and the proposed schedule describing when personnel will be on site to observe and maintain the system.
 - 3. Coordination with other work including schedule, dewatering and diversion methods as well as operations, erosion and sediment control measures, equipment, and location and elevation of pumps, pipes, and any other features planned for use in the dewatering plan.
 - 4. Provide type and sizes of filters, if used.

5. Identify proposed alignment, support, and protection for discharge pipe. Identify location of discharge and provide details for that location. For pipes discharging into manholes, provide details of pipe entry at manhole.
6. Final recommendations for dewatering.
7. If the Contractor purchases, rents, installs, or mobilizes to the site any elements of the dewatering system before approval of the dewatering submittal, the Contractor does so at its own risk, and will not be due any additional compensation from the Owner if such elements are not subsequently used for the work.
8. Approval of the dewatering system proposed by the Contractor will only be with respect to the basic principles of the methods the Contractor intends to employ. Approval does not relieve the Contractor of full responsibility for adequacy of the dewatering system.

C. Well construction logs. Include:

1. Descriptions of actual materials encountered.
2. Construction details.
3. Well development procedures and results.
4. Deviations from original design.

D. Qualifications:

1. Dewatering contractor.
2. Dewatering design engineer.
3. Testing laboratory.

E. Permit for permanent groundwater monitoring wells.

1.3 DEFINITIONS

A. Definitions

1. Dewatering: Removing water by single or multiple stage wellpoints, deep wells, ejector wells or sumps, as approved based on the Contractor's submittals.
2. Hydrostatic Groundwater Level: The groundwater level at any location during construction and before dewatering.
3. Sump: A depression excavated or constructed, from which water is pumped as part of dewatering.

1.4 AVAILABLE DATA

- A. Logs of test borings and groundwater observations at the time of drilling may be included on the Drawings or Baseline Report.

- B. If available, the Contractor may refer to the boring and test pit logs on the Drawings, but shall draw their own conclusions as to the applicability of the information contained therein. The Contractor may choose to perform additional investigations to develop their dewatering plan. It is the Contractor's responsibility to evaluate site subsurface conditions with respect to required dewatering facilities.
- C. The subsurface conditions and groundwater observations from the test pits and borings apply only to the locations of the test pits and borings and at the time of the explorations and measurements. The subsurface conditions at the site may be different at the time of construction as compared to when observations were made and recorded, and the groundwater level can be expected to fluctuate. These factors should be appropriately considered in developing the Contractor's Dewatering Plan.

1.5 QUALITY ASSURANCE AND QUALITY CONTROL

- A. Dewatering operations shall be adequate to assure the integrity of the finished project and shall be the responsibility of the Contractor.
- B. Regulatory requirements:
 - 1. Obtain required water discharge permits.
 - 2. Obtain permanent groundwater monitoring well permits.

PART 2- PRODUCTS

2.1 DEWATERING SYSTEM

- A. The dewatering system may be single- or multiple-stage wellpoints, deep wells, ejector wells, sumps, or approved alternatives used for dewatering and which fulfill the dewatering requirements specified in this Section. The materials and construction of the dewatering wells will be selected by the Contractor and the Contractors' dewatering specialist.

PART 3- EXECUTION

3.1 GENERAL

- A. Design, furnish, install, maintain, and operate a dewatering system that prevents loss of fines, boiling, quick conditions, or softening of foundation strata and maintain stability of bottom of excavations so that every phase of the work can be performed in a dry, safe, and stable environment. Operate dewatering systems such that excavation bottoms are firm, suitably dry, and free from standing water at all times.
- B. Locate elements of the dewatering system such that interference with excavation and construction activity is minimized. Locations are subject to approval by the Engineer.
- C. The responsibility for conducting the dewatering operation in a manner which will protect adjacent structures and facilities rests solely with Contractor.
- D. At all times during construction, provide ample means and devices to remove promptly, and dispose of properly, all water entering excavations and keep the bottoms of excavations firm and free of standing water until structures to be built thereon are completed and/or backfill to be placed therein is placed. Conduct pumping and dewatering operations such that no

disturbance to foundation subgrade materials or to fill materials supporting any other work will result. Discharged water shall be piped to an approved area.

- E. Install silt barriers or other discharge control measures at dewatering discharge locations, to control and prevent siltation. Provide suitable discharge controls in accordance with applicable federal, state, and local permit regulations, and Section 01570: Sediment and Erosion Control. Do not allow dewatering discharge to cause siltation or other negative environmental impact on natural waterways or other property.

3.2 INSTALLATION AND OPERATION

- A. Operate the dewatering system to lower water levels as required and then operate continuously 24 hours per day, 7 days per week until all facilities and structures affected by the dewatering have been satisfactorily constructed, including placement of fill materials.
- B. Maintain groundwater levels low enough to fulfill the requirements of this Section and do not allow the water level to rise until constructed facilities are complete, so that the water can be allowed to rise without damaging facilities, their foundations, or surrounding areas and structures.
- C. Provide superintendence in accordance with the approved plan during all periods of dewatering. Superintendence means providing qualified Contractor personnel knowledgeable in operation and maintenance of dewatering system(s). The Contractor is responsible for any damage resulting from failure to maintain the dewatering system.
- D. Provide complete standby equipment and power sources available for immediate operation as may be required, to adequately maintain the dewatering on a continuous basis in the event that all or any part of the dewatering system becomes inadequate or fails. Provide an automatic switchover system to the standby power source to ensure uninterrupted power supply to pumps in an emergency. Spare pumps shall be automatically engaged if primary pumps fail for any reason.
- E. When the dewatering system does not meet the specified requirements, and as a consequence, loosening or disturbance of the foundations strata, instability of the slopes, or damage to the foundations or structures occurs, the Contractor is responsible for supplying all materials and labor and performing all work for restoring foundation soils, slopes, foundations, and structures, to the satisfaction of the Engineer, and at no additional cost to the Owner.
- F. When failure to provide adequate dewatering and drainage causes disturbance of the soils below design foundation or excavation grade, provide adequate dewatering and excavate and re-fill the disturbed areas with approved, properly compacted fill material. Such work shall be at the Contractor's expense and at no additional cost to the Owner.
- G. Properly dispose of discharge water in accordance with Federal, State, and local requirements and permits. For discharge of water into holding tanks or infiltration ponds, include a means of overflow protection that is acceptable to the Engineer.
- H. Control release of groundwater to its static level to prevent disturbance of natural foundation soils, or compacted backfills and fills and to prevent flotation or movement of structures, pipelines, or other facilities.

3.3 REMOVAL

- A. Obtain written approval from the Engineer before discontinuing operation of any portion of the dewatering system(s).
- B. Remove all elements of the dewatering system(s) from the site at the completion of dewatering work.

SECTION 02275

RIPRAP AND RIPRAP BEDDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Furnish all labor, equipment, and materials necessary for placing boulders, riprap, riprap bedding, and grouting in conformance with the Construction Drawings and Specifications.

1.2 RELATED SECTIONS

- A. Section 02240—Dewatering.

1.3 REFERENCES

- A. Where reference is made to any standard, the version in affect at the time of bid opening shall apply.
- B. Colorado Department of Transportation
 - 1. Standard Specifications for Road and Bridge Construction.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Certification: Submit certification stating both source of stone and that materials for all types of riprap will meet requirements of this Section.
- C. Product Data: Descriptions of all materials to be provided under this Section. In addition, provide sample of angular stone.
- D. Riprap Bedding
 - 1. Gradation test results for each type of riprap bedding shall be submitted.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Riprap Bedding
 - 1. Imported bed course material for slope protection, or riprap filter blanket, shall be a porous free draining material consisting of sand, gravel, crushed stone or other approved free draining material. This material shall meet the following gradation requirements:

GRADATION FOR GRANULAR BEDDING

Sieve Size	% by Weight Passing
	Type I
3/8"	100
#4	95-100
#16	45-80
#50	10-30
#100	2-10
#200	0-2

B. Riprap

- Imported riprap stone shall be rough, fractured to sub angular, and have a specific gravity of at least 2.65. Riprap shall consist of individual angular rock fragments which shall be unweathered, dense, hard, sound, and resistant to abrasion; shall be free from cracks, seams, and other defects that would tend to unduly increase their destruction by water and frost action. Boulder and riprap stones shall be nearly cubical as possible, with neither breadth nor thickness of a single stone less than one-third of its length. Thus, slab type stones, flaking rock, rounded stones, asphalt, broken concrete, concrete slabs, or other materials not classified as rock will not be allowed for use as boulders or riprap material. Riprap shall be clean, free of fines, and shall meet the following requirements:

CLASSIFICATION AND GRADATION OF RIPRAP

Riprap Designation	% Smaller Than Given Size by Weight	Intermediate Rock Dimension (inches)	D50* (inches)
Type VL	70 – 100	12	6
	50 – 70	9	
	35 – 50	6	
	2 – 10	2	
Type L	70 – 100	15	9
	50 – 70	12	
	35 – 50	9	
	2 – 10	3	
Type M	70 – 100	21	12
	50 – 70	18	
	35 – 50	12	
	2 – 10	4	
Type VH	100	42	24
	50 – 70	33	
	35 – 50	24	
	2 – 10	9	

* D50 = Median Particle size.

C. Grout

1. Concrete for the grout shall be an approved batch meeting the following requirements:
 - i. All concrete shall develop 4,000 psi compressive strength within 28 days.
 - ii. The cement shall be Type V.
 - iii. The stone aggregate shall have a maximum diameter of ½ inch.
 - iv. The slump shall be within a range of 3 inches to 6 inches.
- b. Use of a stiffer mix or other measures as approved by the City for steeper slopes or for vertical joints.
- c. The water/cement ratio shall not exceed 0.48.
- d. Add 1.5 pounds per cubic yard of synthetic fiber reinforcement per manufacturer's instructions.
- e. The grout shall contain both an air entraining admixture and water reducing agent. The job site air content be 6.5% +/- 1.5% by volume. A water reducing agent shall be used.
- f. The Contractor shall submit a mix design in writing to the City for approval prior to the placement of any grout.

PART 3- EXECUTION

3.1 GENERAL

- A. No riprap bedding or riprap shall be placed until the subgrade has been prepared, dewatered and properly compacted, or otherwise prepared in accordance with the provisions of the Specifications and as specified on the Drawings. No material shall be placed until the subgrade has been checked and approved by the Engineer in writing.

3.2 PLACEMENT OF RIPRAP BEDDING

- A. All riprap bedding shall be placed uniformly under all placed riprap material, including replenished riprap materials, to a minimum thickness of 6 inches, and shall not account for the minimum thickness of riprap as shown on the Drawings. Uniform spreading of all riprap bedding shall be done using approved devices and machinery. Excessive rutting of the finished bedding surface shall be avoided. Riprap bedding shall be kept clean and free of other soils. If the riprap bedding is contaminated with other soils or deleterious material, it shall be removed and replaced by the Contractor immediately. Where compaction is required, the bedding shall be compacted to 65% relative density (ASTM D4253).

3.3 RIPRAP PLACEMENT

- A. Riprap shall be placed with a maximum drop height of 3 feet to reduce segregation of particle sizes. Placing in layers or by dumping into chutes or similar methods which may cause segregation are specifically prohibited. The riprap shall be placed, in one preparation,

to the line, grade, and thickness as shown on the drawings, without undue displacement of the granular filter bedding underneath.

- B. Riprap shall be placed to grade in a manner to ensure that the larger rock fragments are uniformly distributed and the smaller rock fragments serve to fill the spaces between the larger rock fragments in such a manner as will result in a well-keyed, densely placed, uniform layer of riprap of the specified thickness. Consolidation of the riprap by backhoe or other means will be necessary to ensure interlocking of rock fragments. Placed riprap shall be uniform and free from bulges, humps, or cavities. Hand placing will be required only to the extent necessary to secure the results specified above.

3.4 GROUTED RIPRAP

- A. The subgrade shall be excavated and any unstable material shall be removed. Approved material shall be placed and compacted in a maximum of 4-inch lifts to 95" of Maximum Standard Proctor Density (ASTM D698) to re-establish the subgrade.
- B. The top of the riprap shall be as indicated on the Drawings.
- C. The riprap shall be placed as described in Section 3.3. Placement shall be approved by the City prior to grouting.
- D. Prior to placing the grout, any type of debris, fines, smaller rock, or silt shall be removed from around the riprap.
- E. Dewatering shall be implemented to guarantee that the grout will not be placed in water and for a period of 24 hours the grout has been placed.
- F. Keep riprap receiving grout wet at all times prior to receiving grout.
- G. The concrete grout shall be placed by injection methods by pumping under low pressure, through a 2-inch maximum diameter hose to ensure complete penetration of the grout into the void area as detailed on the Drawings.
- H. Grout will be placed up to 6 inches from the top of the riprap, or as directed by the Engineer. The operator shall be able to stop the flow and will place grout in the voids and not on the surface of the rocks.
- I. Grout should be troweled out and finished to minimize visibility.
- J. Clean and wash any spillage before the grout sets. The visual surfaces of the riprap will be free of grout. If washing does not clean off grout residue, the Contractor shall wash off any grout residue with muratic acid and water using a brush to scrub off the residue.
- K. A pencil vibrator shall be used to make sure all voids are filled between the riprap. The intent is to fill all voids from the subgrade level around the riprap to a depth as shown on the Drawings. The pencil vibrator may be used to smooth the appearance of the surface but the Contractor shall use a wood float to smooth and grade the grout around the boulders.

3.5 TOLERANCES

- A. Thickness: Minus 10 percent to plus 20 percent as shown on Drawings.

SECTION 02315

EXCAVATION AND FILL

PART 1– GENERAL

1.1 SCOPE

- A. This section covers excavation and trenching, including but not limited to dewatering, preparation of subgrades, pipe bedding, backfilling, compacting, groundwater barriers, materials testing, and finish grading for underground pipelines and appurtenances.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO)
1. T26, Standard method of Test for Quality of Water to be Used in Concrete, latest revision.
 2. T99, Moisture–Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop (Method A), latest revision.
- B. American Concrete Institute (ACI)
1. 305, *Hot Weather Concreting*, latest revision.
- C. ASTM International (ASTM)
1. C33, *Standard Specification for Concrete Aggregates*, latest revision.
 2. C94, *Standard Specification for Ready-Mixed Concrete*, latest revision.
 3. C150, *Standard Specification for Portland Cement*, latest revision.
 4. D422, *Standard Test Method for Particle-Size Analysis of Soils*, latest revision.
 5. D448 (AASHTO M43), *Standard Classification for Sizes of Aggregate for Road and Bridge Construction*, latest revision.
 6. C618, *Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete*, latest revision.
 7. D698, *Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))*, latest revision.
 8. C1012/C1012M, *Standard Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution*, latest revision.
 9. D1556, *Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method*, latest revision.

10. D1557, *Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kn-m/m³))*, latest revision.
11. D2487, *Standard Test Method for Classification of Soils for Engineering Purposes*, latest revision.
12. D4318, *Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils*, latest revision.
13. D4254, *Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density*, latest revision
14. D4832, *Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders*, latest revision.
15. D6023, *Standard Test Method for Unit Weight, Yield, Cement Content, and Air Content (Gravimetric) of Controlled Low Strength Material (CLSM)*, latest revision.
16. D6024, *Standard Test Method for Ball Drop on Controlled Low Strength Material (CLSM) to Determine Suitability for Load Application*, latest revision.
17. D6938, *Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)*, latest revision.

D. Colorado Department of Transportation (CDOT)

1. (CDOT) Specifications for Road and Bridge Construction

E. (National Electrical Manufacturers Association (NEMA))

1. Z535.1, *Safety Color Code*, latest revision.

F. Occupational Safety and Health Administration (OSHA)

1. 29 CFR Part 1926, *Safety and Health Regulations for Construction*, latest revision.

G. City of Greeley Design Criteria and Construction Specifications Streets Volume I (SDC)

1.3 SUBMITTALS

A. Dewatering

1. Water Control Plan: Submit for review by the City prior to start of any field work. At a minimum, the Water Control Plan shall include the following:
 - a. Descriptions of proposed groundwater and surface water control facilities including, but not limited to, equipment; methods; standby equipment and power supply, discharge locations to be utilized, and dewatering pollution control BMPs.

- b. Drawings showing locations, dimensions, and relationships of elements of each system.
- c. Design calculations demonstrating adequacy of proposed dewatering systems and components.
- d. Surface water control and drainage installations and related pollution control BMPs.
- e. Locations and types of monitoring systems.
- f. Proposed methods and locations for disposing of the removed water.
- g. Any treatment system in place to meet discharge quality criteria if applicable.
- h. If the system is modified during installation or the operation, revise or amend and resubmit the Water Control Plan.

- 2. Statement of Qualifications for Dewatering Specialist: Provide a summary of project experience and references for designer of dewatering systems.
- 3. Well Permits: Submit to City before start of field work.
- 4. Discharge Permits: Submit to City before start of field work and keep onsite for the duration of the work.

B. Fill and Backfill

- 1. Results of particle size testing of proposed offsite source material in accordance with ASTM D422.
- 2. Results of Atterberg limit testing of proposed offsite source material in accordance with ASTM D4318 (fine-grained material only).
- 3. Results of Standard proctor testing (ASTM D698) or Modified proctor testing (ASTM D1557) of proposed offsite source material as appropriate based on compaction requirements stated herein.
- 4. Certified test results from independent testing agency.

C. Trench Backfill

- 1. Shop Drawings: Manufacturer's descriptive literature for marking tapes.
- 2. Samples: Submit samples of materials proposed to be used in the Work to demonstrate material conformance with these Specifications.
 - a. Samples to be provided include:
 - i. Trench stabilization material.

- ii. Bedding and pipe zone material.
 - iii. Granular drain.
 - iv. Granular backfill.
 - v. Earth backfill.
 - vi. CLSM.
 - vii. Geotextile.
3. CLSM: Certified mix designs, certified laboratory performance of mix designs, and strength test results provided by a certified laboratory.
- a. Include material types, weight per cubic yard, and 2 and 28-day unconfirmed compressive strengths for each component of CLSM mix.
 - i. Form a minimum of six test cylinders with proposed materials to confirm design strength and mix design in accordance with ASTM D4832. Break four of the cylinders at 7 days in conformance with applicable concrete cylinder specifications and provide test results to City for review. Break the remaining two cylinders at the discretion of City. Complete mix design and cylinder breaks at least 21 days prior to use of the material in the Work. Final mix approval and use of the material will not occur prior to confirmation for strength by the cylinder breaks.
 - ii. Determine the materials and proportions used to meet the requirements of these Specifications. Continuously monitor soil composition. Perform sieve analysis and adjust CLSM mix if general composition changes or as directed by City. Modify CLSM mix as necessary to meet the strength, flowability, pumpability, and set time requirements for each individual pour.
 - iii. Do not place CLSM until City has approved the mix design. City's approval of the mix design indicates conditional acceptance. Final acceptance will be based on tests conducted on field samples and conformance with these Specifications.
4. Catalog and manufacturer's data sheets for compaction equipment.
5. Certified Gradation Analysis: Submit not less than 30 days prior to delivery for imported materials or anticipated use for excavated materials, except for trench stabilization material that will be submitted prior to material delivery to Site.
6. Credentials of certified labs.
7. Description and location of proposed sources of imported material. Include documentation that imported materials are free of hazardous substances.

8. Test for conformance and submit certification and test records of materials showing that they meet the applicable requirements prior to commencing permanent placement of the materials for the Work. Tests, certification, and test records of materials will be performed within 6 months of submittal.
9. Submit a description of material testing work plan and program including as minimum onsite and offsite soils/materials laboratory testing facility location, facility details, testing certifications, experience of testing personnel, frequency of testing regarding material quality and material placement.

1.4 CONSTRUCTION STAKING

- A. Construction staking shall be performed under the direct supervision of a Professional Land Surveyor licensed in the State of Colorado.
- B. Adequate staking shall be provided to establish acceptable horizontal and vertical control.
- C. Offsets shall be staked so that the City Inspector may check vertical and horizontal alignment.
- D. All survey notes and construction staking notes shall be entered into bound, hard cover field books, kept at the construction site for the duration of the project, and shall be made available to the City upon request.
- E. All survey data, which is developed by the Contractor or the Engineer in performing surveys required by the work, shall be available to the City for examination and reproduction throughout the construction and warranty periods.
- F. The City Inspector shall be informed of all field changes to the City accepted Construction Drawings. Approval for the changes shall be required from the City prior to the changes being made in the field.

1.5 FIELD CONDITIONS

- A. Drainage and groundwater.
 1. Keep excavations and trenches free of water during construction. Divert surface runoff and utilize sumps, gravel blankets, well points, drain lines or other means of dewatering, as necessary.
 - a. Dewater the excavation or trench until the structure, pipe, or other, to be installed therein, is completed to the extent that no damage from hydrostatic pressure, floatation, or other cause will result.
 - b. Water shall be removed from the trench to the extent necessary in order to provide a firm subgrade and dry conditions for pipeline installation.
 2. The pipeline being constructed shall not be used for dewatering.
 3. The piping used to dewater the trench shall not be left in the trench when backfilled.

4. For trenched installations, groundwater barriers shall be installed if groundwater is encountered or expected. Groundwater barriers shall be installed as shown on the drawings and, as necessary, every 400'. Refer to the City of Greeley Standard Drawing for additional installation requirements.
 5. Prior to beginning dewatering operations, the Contractor shall obtain all necessary permits and appropriate authorization to start dewatering. If groundwater will be discharged or drained into an irrigation ditch, pond, stream or waterway, a CDPHE Dewatering Permit will be required.
 - a. The Contractor is required to complete and process the Discharge Monitoring Report (DMR) that is typically a part of the Dewatering Permit.
 - b. Upon completion of the work, the Contractor shall be responsible for completing a CDPHE Discharge Termination Notice.
- B. Blasting is not permitted within the jurisdiction of the City unless otherwise authorized by the City. If authorized, permitting and requirements associated with blasting are the responsibility of the Contractor.
- C. Sequencing
1. Backfill shall be completed, at the end of each day, to the extent that no damage from hydrostatic pressure, flotation, or other causes will result.
 2. Where excavation is a hazard to automotive or pedestrian traffic, the amount of open trench and the time duration of that opening shall be minimized. The City shall direct the amount of open trench that is acceptable for the condition encountered.
 3. During construction, maintain access to private residence and businesses.
- D. Underground Obstructions
1. It is the Contractor/City's responsibility to call for utility locates. Call UNCC at 1-800-922-1987 or dial 811 for locates.
 2. Depending on the required subsurface utility engineering (SUE) quality level, the Contractor shall be prepared to expose and verify the size, location, and elevation of underground utilities and other obstructions, sufficiently in advance of construction to permit changes to be made to the Construction Drawings in the event there is a conflict with the proposed and existing utilities. In the event there is a conflict, the Contractor shall notify the City, and affected utility company immediately.
 3. Protect and support utilities, appurtenances, structures, etc., by shoring, bracing or other means necessary.
- E. Weather

1. Do not install pipe or place pipe bedding on frozen soil in the trench bottom.
2. Do not place frozen materials, snow or ice in backfill, fill, or embankments.
3. Do not deposit, tamp, roll or otherwise mechanically compact backfill in water.

1.6 Quality Assurance

A. Preparation of Subgrade

1. Notify City when subgrade is ready for compaction or proof-rolling or whenever compaction or proof-rolling is resumed after a period of extended inactivity.

B. Excavation

1. Provide adequate survey control to avoid unauthorized overexcavation.

C. Fill and Backfill

1. Notify City when:
 - a. Structure or pipeline is ready for backfilling, and whenever backfilling operations are resumed after a period of inactivity.
 - b. Soft or loose subgrade materials are encountered wherever embankment or site fill is to be placed.
 - c. Fill material appears to be deviating from Specifications.

1.7 Soil and Bedrock Conditions

- A. A geotechnical investigation may have been performed for the project in order to obtain relative data concerning the character of material in and upon which the project is to be built. If an investigation has been performed, the information will be available to the Contractor for information purposes only, and is not to be considered a part of the Contract Documents. The Contractor shall satisfy himself as to the kind and type of soil and/or rock to be encountered and any water conditions that might affect the construction of the project.

PART 2– PRODUCTS AND EQUIPMENT

2.1 GENERAL

- A. All material shall be free from frozen matter, stumps, roots, brush, other organic matter, cinders, corrosive material, debris, broken asphalt and concrete, and any other objectionable material that is not suitable in the opinion of the City.
- B. If job excavated material is not sufficient or suitable, suitable material shall be imported. Reference *SDC* construction specifications for import fill requirements.

2.2 DEWATERING

- A. Refer to construction specification *Section 02240, Dewatering*, for dewatering products & requirements.

2.3 MARKING TAPE

- A. Non-detectable:
1. Material: Solid colored non-detectable polyethylene.
 2. Thickness: Minimum 4 mils.
 3. Width: 3 inches.
 4. Identifying Lettering: Minimum 1-inch high, permanent black lettering imprinted continuously over entire length.
 - a. Potable water lines: “CAUTION: BURIED WATER LINE BELOW”
 - b. Non-potable water lines: “CAUTION – BURIED NON-POTABLE WATER LINE BELOW” or “CAUTION – BURIED RECLAIMED WATER LINE BELOW”
 - c. Sanitary and Storm Sewers: “CAUTION: BURIED SEWER LINE BELOW”
 5. Manufacturers and Products:
 - a. Emedco
 - b. Presco
 - c. Approved equivalent.
- B. Color: In accordance with APWA Uniform Color Code for Temporary Marking of Underground Facilities.

Color*	Facility
Red	Electric power lines, cables, conduit, and lightning cables
Orange	Communication alarm or signal lines, cables, or conduit
Yellow	Gas, oil, steam, petroleum, or gaseous materials
Green	Sewer and drain lines
Blue	Potable water

Purple Reclaimed water, irrigation, and slurry lines

* As specified in NEMA Z535.1, Safety Color Code.

2.4 SUBGRADE MATERIAL BELOW STRUCTURES

- A. At minimum, the top six-inches (6") of in-situ soil below structures shall be removed and replaced with an approved structural fill material. If deemed necessary by the City, more than six-inches (6") of material from the trench bottom may require removal and replacement with a stabilization material.
- B. Subgrade material below structures shall be crusher-run angular rock per ASTM 4253 and ASTM 4254, compacted 65-70% or 95% standard proctor dry density, and conforming to CDOT #357 (ASTM D448, AASHTO M43) in table below or approved equivalent.

TABLE 2.4-B.1: Subgrade Material Below Structures – CDOT #357

Size (inch)	Percent (%) Passing
2 ½"	100
2"	95-100
1"	35-70
½"	10-30
#4	0-5

- C. Structures consist of but not limited to vaults, sewer manholes, equipment pads, etc.

2.5 STABILIZATION MATERIAL

- A. In the case of poor soil conditions, subgrade stabilization may be required to adequately support structural foundations and utility pipelines. If deemed necessary by the City, more than six-inches (6") of material from the trench bottom may require removal and replacement with a stabilization material.
- B. Stabilization material shall be crushed concrete and natural aggregate with at least two fractured faces, conforming to CDOT Vehicle Tracking Pad (VTP) (ASTM D448, AASHTO M43)

TABLE 2.5-A.1: STABILIZATION MATERIAL – CDOT VTP

Size (inch)	Percent (%) Passing
3"	100
2"	0-25
¾"	0-15

- C. Geotextile fabric shall be used in conjunction with stabilization material unless approved otherwise by the City. Geotextile fabric shall conform to Colorado Department of Transportation, Division of Highways, State of Colorado “*Standard Specifications for Road and Bridge Construction*”, Section 712.08, Class A Table 712-2, latest edition.
1. Acceptable geotextile fabric manufacturers are:
 - a. TenCate – Mirafi 500X
 - b. Webtec, Inc. Geosynthetics – TerraTex GS
 - c. Or approved equivalent.

2.6 CONTROLLED LOW STRENGTH MATERIAL (CLSM)

- A. The CLSM facility shall be certified by the National Ready Mixed Concrete Association. Mixing times shall conform to the requirements of ASTM C94, Specification for Ready-Mixed Concrete. Hand mixing is not allowed. The production facility shall supply a load ticket with the actual batch weights of the component materials.
- B. Thoroughly mix all water added at the project site in accordance with the recommendations stated in ACI 305, Hot Weather Concreting. Measure all water added to the mix. The water cement ratio as stated in the CLSM mix design approved by the City is not to be exceeded. Do not add water after discharge of the CLSM from the mixer begins.
- C. Place CLSM within the 90 minutes after the addition of cement or fly ash to the mix. The City reserves the right to reduce the allowable time for placement to account for adverse weather conditions or other factors that may accelerate the stiffening of the mix.
- D. Select and proportion the ingredients to obtain an unconfined compressive strength at 2 days to be a minimum of 50 psi, an unconfined compressive strength at 28 days a maximum of 125 psi, and an air content between 7 and 13 percent. Determine compressive strength in accordance with ASTM D4832, Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders. Determine air content in accordance with ASTM D6023, Standard Test Method for Unit Weight, Yield, Cement Content, and Air Content (Gravimetric) of Controlled Low Strength Material (CLSM).
- E. Materials:
 1. Portland Cement: Cement Type I or Cement Type II as defined by ASTM C150, Specification for Portland Cement including Table 1, 2, and 4.
 2. Aggregate: Conform to all requirements for fine aggregate as defined by ASTM C33, Specification for Concrete. Keep the aggregate materials moist for 24 hours before use in the mixture.
 3. Fly Ash (if used): Conform to requirements of Class F fly ash as defined by ASTM C618, Specification for Coal Fly Ash and Raw or Calcined Natural Pollolan for Use as a Mineral Admixture in Concrete, except as modified herein:

- a. Test in accordance with ASTM C1012/C1012M to verify that the sulfate resistance is acceptable.
4. Water: All water used in the CLSM mixture shall meet the requirements of AASHTO T26, Quality of Water to be used in Concrete. Obtain such water from a source approved by the City.

2.7 BEDDING ZONE MATERIALS

- A. The bedding zone shall extend six-inches (6") below the invert of the pipe to six-inches (6") above top of pipe.
- B. Bedding material for sanitary sewer pipe shall be 57/67 rock or City approved equal

TABLE 2.8-B.1: Bedding Material – 57/67 rock

Size (inch)	Percent (%) Passing
1 1/2"	100
1"	95-100
3/4"	90-100
1/2"	25-60
3/8"	20-55
#4	0-10
#8	0-5
#200	1 max

- C. Bedding material for potable and non-potable water pipe shall be either ASTM C33 Sand or Squeegee Fine Sand.

TABLE 2.8-C.1: Bedding Material – ASTM C33 Sand

Size (inch)	Percent (%) Passing
3/8"	100
#4	95-100
#8	80-100
#16	50-85
#30	25-60
#50	5-30
#100	0-10
#200	0-3

TABLE 2.8-C.2: Bedding Material – Squeegee

Size (inch)	Percent (%) Passing
3/8"	100

#4	85-100
#8	30-70
#16	5-40
#30	0-15
#50	0-10
#100	0-5
#200	<1

- D. Or approved equal.
- E. Groundwater Barrier shall meet the following soil classification:
1. Soil Classifications
 - a. Minimum thirty-percent (30%) fines.
 - b. Minimum plasticity index of 10.
 - c. Material shall not be lumpy or hard but shall be finely divided, suitable, and free from stones.
 2. Or CLSM in conformance with *SDC* construction specifications.

2.8 INSULATION BOARD

- A. Insulation board shall be installed above the bedding zone when the depth of cover over the water line is less than five (5) feet.
- B. Insulation board shall be high density and rated for high compressibility of a minimum of 100 psi.
- C. Insulation board shall be a minimum two-inches (2") thick. Acceptable insulation board manufacturers are:
1. Dow Chemical Company - Styrofoam™
 2. Owens-Corning
 3. Or approved equivalent.

2.9 TRENCH BACKFILL MATERIAL

- A. Trench backfill material shall be placed from a point six-inches (6") above the top of pipe exterior to six-inches (6") below the ground surface, or bottom of topsoil layer, or bottom of the pavement subgrade, whichever is applicable. Trench backfill shall conform to *SDC* construction specifications.

PART 3– EXECUTION**3.1 PREPARATION**

- A. Topsoil shall be stripped from areas which are to be disturbed by construction and stockpiled.
- B. Topsoil shall be segregated from non-organic trench material and debris.

3.2 SUBGRADE PREPARATION

- A. General
 - 1. Keep subgrade free of water, debris, and foreign matter during compaction or proof-rolling.
 - 2. Bring subgrade to proper grade and cross-section and uniformly compact surface.
 - 3. Do not use sections of prepared ground surface as haul roads. Protect prepared subgrade from traffic.
 - 4. Maintain prepared ground surface in finished condition until next course is placed.
- B. Compaction
 - 1. Under Earthfill and Exposed Cut Surfaces: Compact upper 8 inches to minimum of 90 percent relative compaction as determined in accordance with ASTM D1557 or 93 percent relative compaction as determined in accordance with ASTM D698.
 - 2. Under Structures Including Slabs, Tanks and Other Miscellaneous Structures: Areas shall be overexcavated to such an extent so as to provide a minimum of 6 inches of granular fill on prepared subgrade. Scarify and compact the upper 8 inches of subgrade to minimum of 95 percent of standard proctor compaction as determined in accordance with ASTM D698.
- C. Moisture Conditioning
 - 1. Dry Subgrade: Add water, then mix to make moisture content uniform throughout.
 - 2. Wet Subgrade: Aerate material by blading, discing, harrowing, or other methods, to hasten drying process.
- D. Testing
 - 1. Proof-roll subgrade with a fully loaded tandem-axle dump truck or similar vehicle to detect soft or loose subgrade or unsuitable material. Proof-roll shall be conducted prior to scarifying/recompaction to identify soft or loose subgrade or unsuitable material. City shall be notified 2 days in advance of proof-rolling

activities and will be present to examine and approve subgrade before backfilling begins. City shall approve proof-roll prior to backfill.

2. Contractor shall provide an independent testing laboratory to conduct in-place density tests in accordance with ASTM D6938 at a minimum rate of one test per every 5,000 square feet of prepared subgrade.

E. Correction

1. Soft or Loose Subgrade:
 - a. Adjust moisture content and recompact, or
 - b. Over excavate as specified in Section 3.3 of this specification, and replace with suitable material from the excavation. If unsuitable soil is encountered at a depth of 3 feet below planned subgrade, excavation shall be halted and the City notified immediately.
 - c. In the event the unacceptable material is encountered at the 3-foot overexcavation, a geogrid shall be provided and placed, and overlain with a geotextile. The overexcavation shall be filled to plan grade with stabilization material. Stabilization material shall be placed in lifts not more than 10 inches thick and shall be compacted to the satisfaction of the City.
2. Unsuitable Material: Over excavate as specified in Section 3.3 of this specification and replace with suitable material from the excavation.

3.3 EXCAVATION

A. General

1. Excavate to lines, grades, and dimensions shown in the drawings and as necessary to accomplish work. Excavate to within tolerance of plus or minus 0.1 foot, except where dimensions or grades are shown or specified as maximum or minimum. Allow for forms, working space, granular base, topsoil, and similar items, wherever applicable. Trim to neat lines where concrete is to be deposited against earth.
2. Do not over excavate without written authorization of City.
3. Remove or protect obstructions as shown in the drawings.

B. Unclassified Excavation

1. Excavation is unclassified. Complete all excavation regardless of the type, nature, or condition of the materials encountered.

C. Trench Width

1. Minimum Width of Trenches: As specified in Section 3.6 of this specification.

2. Maximum Trench Width: Unlimited, unless otherwise shown or specified, or unless excess width will cause damage to existing facilities, adjacent property, or completed Work.

D. Pipe Bedding Grooves for Nonperforated Drain Lines

1. Semicircular, trapezoidal, or 90-degree-V.
2. Excavated or plowed into trench bottom. Forming groove by compaction will not be acceptable.

E. Embankment and Cut Slopes

1. Shape, trim, and finish cut slopes to conform with lines, grades, and cross-sections shown in the drawings, with proper allowance for topsoil or slope protection, where shown.
2. Remove stones and rock that exceed 3-inch diameter and that are loose and may roll down slope. Remove exposed roots from cut slopes.
3. Round tops of cut slopes in soil to not less than a 6-foot radius, provided such rounding does not extend offsite or outside easements and rights-of-way, or adversely impacts existing facilities, adjacent property, or completed work.
4. Temporary earthen slopes or benching shall meet current OSHA requirements or be designed by a Professional Engineer in the State of Colorado.

F. Stockpiling Excavated Material

1. Stockpile excavated material that is suitable for use as fill or backfill until material is needed.
2. Post signs indicating proposed use of material stockpiled. Post signs that are readable from all directions of approach to each stockpile. Signs should be clearly worded and readable by equipment operators from their normal seated position.
3. Confine stockpiles to within easements, rights-of-way, and approved work areas. Do not obstruct roads or streets.
4. Do not stockpile excavated material adjacent to trenches and other excavations, unless excavation side slopes and excavation support systems are designed, constructed, and maintained for stockpile loads.
5. Do not stockpile excavated materials near or over existing facilities, adjacent property, or completed Work, if weight of stockpiled material could induce excessive settlement.

G. Disposal of Spoil

1. Dispose of excavated materials, which are unsuitable or exceed quantity needed for fill or backfill, offsite.

2. Dispose of debris resulting from removal of underground materials, organic matter, trash, refuse, junk, and other materials in accordance with local and federal governmental regulations.

3.4 DEWATERING

- A. Refer to construction specification *Section 02240, Dewatering*, for dewatering requirements.

3.5 FILL AND BACKFILL

A. General

1. Keep placement surfaces free of water, debris, and foreign material during placement and compaction of fill and backfill materials.
2. Place and spread fill and backfill materials in horizontal lifts of uniform thickness, in a manner that avoids segregation, and compact each lift to the specified densities prior to placing succeeding lifts. Slope lifts only where necessary to conform to final grades or as necessary to keep placement surfaces drained of water.
3. During filling and backfilling, keep level of fill and backfill around each structure and pipeline even.
4. Do not place fill or backfill if fill or backfill material is frozen, or if surface upon which fill or backfill is to be placed is frozen.
5. If pipe, conduit, duct bank, or cable is to be laid within fill or backfill:
 - a. Fill or backfill to an elevation 2 feet above top of item to be laid.
 - b. Excavate trench for installation of item.
 - c. Install bedding, if applicable, as specified in Section 3.6 of this specification.
 - d. Install item.
 - e. Backfill envelope zone and remaining trench, as specified in Section 3.6 of this specification, before resuming filling or backfilling specified in this section.
6. Tolerances:
 - a. Final Lines and Grades: Within a tolerance of 0.1 foot unless dimensions or grades are shown or specified otherwise.
 - b. Grade to establish and maintain slopes and drainage as shown. Reverse slopes are not permitted.

7. Settlement: Correct and repair any subsequent damage to structures, pavements, curbs, slabs, piping, and other facilities, caused by settlement of fill or backfill material.

B. Backfill Under and Around Structures

1. Under Structures:

- a. Overexcavate and prepare subgrade as specified in Section 3.2 of this specification, or fill on prepared subgrade with earthfill to within 6 inches of bottom of structure.
- b. Earthfill shall be placed in 8-inch maximum lifts and compacted at moisture content of optimum plus or minus 2 percent. Each lift of moisture conditioned earthfill shall be compacted to a minimum 95 percent of standard proctor compaction as determined in accordance with ASTM D1698
- c. Place a minimum 6 inches of stabilization material below structures and slabs. Stabilization material shall be compacted and tested in accordance with ASTM D4254 to a minimum relative density of 65 percent.
- d. Backfill with cohesive material to lines and grades shown, with proper allowance for topsoil thickness where shown. Place in lifts of 8-inch maximum thickness and compact each lift to minimum 90 percent relative compaction as determined in accordance with ASTM D1557 or 93 percent relative compaction as determined in accordance with ASTM D698.

2. Other Areas: Backfill with earthfill to lines and grades shown, with proper allowance for topsoil thickness where shown. Place in lifts of 8-inch maximum thickness and compact each lift to minimum 90 percent relative compaction as determined in accordance with ASTM D1557 or 93 percent relative compaction as determined in accordance with ASTM D698.

C. Fill

1. Outside Influence Areas beneath Structures, Tanks, Pavements, Curbs, Slabs, Piping, and Other Facilities: Unless otherwise shown, place earthfill as follows:
 - a. Allow for 6-inch thickness of topsoil where required.
 - b. Maximum 8-inch thick lifts.
 - c. Place and compact fill across full width of embankment.
 - d. Compact to minimum 90 percent relative compaction as determined in accordance with ASTM D1557 or 93 percent relative compaction as determined in accordance with ASTM D698.

- e. Dress completed embankment with allowance for topsoil, crest surfacing, and slope protection, where applicable.

D. Site Testing

1. Gradation:

- a. One sample from each 1,500 tons of finished product or more often as determined by City, if variation in gradation is occurring, or if material appears to depart from Specifications.
- b. If test results indicate material does not meet Specification requirements, terminate material placement until corrective measures are taken.
- c. Remove material placed in Work that does not meet Specification requirements.

2. Atterberg Limits:

- a. One sample from each 1,500 tons of finished product or more often as determined by City, if variation in gradation is occurring, or if material appears to depart from Specifications.
- b. If test results indicate material does not meet Specification requirements, terminate material placement until corrective measures are taken.
- c. Remove material placed in Work that does not meet Specification requirements.

3. Contractor shall provide an independent testing laboratory to conduct in-place Density Tests: In accordance with ASTM D1556 or D6938. During placement of materials, test every 500 cubic yards, but no less than two tests per day for each day material is being placed, and no less than two tests per lift.

E. Replacing Over Excavated Material

1. Replace excavation carried below grade lines shown or established by City as follows:

- a. Beneath Structures: Granular fill.
- b. Beneath Fill or Backfill: Same material as specified for overlying fill or backfill.
- c. Trenches:
 - i. Unauthorized Over excavation: Either trench stabilization material or granular pipe base material, as specified in Section 3.6 of this specification.
 - ii. Authorized Over excavation: Trench stabilization material, as specified in Section 3.6 of this specification.

- d. Permanent Cut Slopes (Where Overlying Area is Not to Receive Fill or Backfill):
 - i. Flat to Moderate Steep Slopes (3:1, Horizontal Run: Vertical Rise or Flatter): Earthfill.
 - ii. Steep Slopes (Steeper than 3:1):
 - ii-a. Correct over excavation by transitioning between overcut areas and the designed slope adjoining areas, provided such cutting does not extend offsite or outside easements and right-of-ways, or adversely impacts existing facilities, adjacent property, or completed work.
 - ii-b. Backfilling over excavated areas is prohibited, unless in City's opinion, backfill will remain stable, and over excavated material is replaced as compacted earthfill.

F. Placing Fill Over Geosynthetics

- 1. General:
 - a. Place fill with sufficient care so as not to damage the geosynthetic.
 - b. Place fill only by back dumping and spreading only.
 - c. Dump fill only on previously placed fill.
 - d. While operating equipment, avoid sharp turns, sudden starts or stops that could damage geosynthetics.
- 2. Hauling: Operate hauling equipment on minimum of 3 feet of covering.
- 3. Spreading:
 - a. Spreading equipment shall be track mounted D 6 or lighter.
 - b. Operate spreading equipment on minimum of 12 inches of fill over geosynthetics.
 - c. Spread fill in same direction as unseamed overlaps to avoid separation of seams and joints.
 - d. Never push fill downslope. Spread fill over sideslopes by pushing up from slope bottom.
 - e. Correct wrinkles in geomembranes as required by manufacturer.
 - f. Maintain proper overlap of unseamed geosynthetics as required by manufacturer.
 - g. Avoid overstressing geosynthetics and seams.

4. Compaction: Compact fill only after uniformly spread to full thickness shown.
5. Geosynthetic Damage:
 - a. Mark punctures, tears, or other damage to geosynthetics, so repairs may be made.
 - b. Clear overlying fill as necessary to repair damage.
 - c. Repairs to geosynthetics shall be made by respective installers as specified in respective specification section for each geosynthetic.

3.6 TRENCHING

- A. Do not drop backfill directly upon any structure or pipe. Do not place backfill around or upon any structure until the concrete or CLSM has attained sufficient strength to withstand the loads imposed.
- B. Place backfill after water is removed from the excavation as specified in Section 3.4 of this specification, and the excavation bottom or surface upon which backfill is to be placed is firm and has been dried to a moisture content suitable for scarifying and recompaction. Remove water in a manner that minimizes soil erosion from trench sides and bottom. Provide continuous water control until trench backfill is complete.
- C. Excavate trenches by open cut methods, except where a boring is indicated on the Construction Drawings, required by jurisdictional agencies, or desired by the Contractor and approved by the City.
- D. Do not use mechanical equipment in locations where its operation would cause damage to trees, buildings, culverts, utilities, structures or other property above or below ground. In all such locations, hand-excavating methods shall be used.
- E. Use mechanical equipment designed and operated so the rough excavated trench bottom elevation can be controlled with uniform trench width and vertical sidewalls from an elevation one (1) foot above the top of installed pipe to the bottom of the trench. The trench alignment shall be sufficiently accurate to permit pipe to be aligned properly between the pipe and sidewalls of the trench. Do not undercut the trench sidewall to obtain clearance.
- F. Contractor shall follow the most current regulations concerning excavations set forth by OSHA: 29 CFR Part 1926.
- G. Excavation in Rock
 1. When rock is present, over-excavate a minimum of six-inches (6") below the bottom of the required trench bottom.
 2. Backfill to required trench bottom with compacted bedding material.
- H. Preparation of Trench Bottom

1. Grade trench bottom uniformly to provide clearance for each section of pipe and bedding material.
2. Remove loose materials, water and foreign objects.
3. Provide firm subgrade suitable for placement of bedding material.
4. Wherever unstable material is encountered in the bottom of the trench, over-excavate such material to a depth suitable for constructing a stable subgrade or as determined by the City. Backfill over-excavation with stabilization material and compact. A geotextile fabric layer shall be placed between the stabilization material and the bedding material.

I. Stockpiling Excavated Materials

1. Pile suitable material for backfilling in an orderly manner a sufficient distance from trench banks to avoid overloading and to prevent slide or cave-ins.
2. Do not stockpile excavated material against existing structures or appurtenances.
3. The Contractor shall follow the most current OSHA regulations concerning excavations.

J. Trench Widths

1. Trench width shall be maintained to within three-inches (3") of that specified on the City of Greeley Standard Drawings unless otherwise specified by the City.

3.7 PIPE BEDDING

A. Placement and Compaction

1. Distribute, grade, and compact bedding material to provide uniform and continuous support beneath the pipe at all points between bells and pipe joints.
2. Bell holes shall be dug deep enough to provide a minimum two-inches (2") of clearance between the bell and bedding material. The pipe shall not be supported by the pipe bell.
3. Deposit bedding material and compact uniformly and simultaneously on each side of the pipe to prevent lateral displacement.
4. Compact granular bedding material by vibrating, slicing with a shovel, or bent tee-bar. Care shall be taken to not damage the pipe during compaction. Hand-held equipment shall be used to compact material immediately adjacent to the pipe.
5. All utility trenches within the street right-of-way (including service lines) must be mechanically compacted to not less than 95% of maximum density within \pm two percent (2%) of optimum moisture content as determined by AASHTO T99. Alternatively, utility trenches can also be backfilled with CLSM to the bottom of the new pavement.

6. Trench backfill in utility easements within 20 feet of right-of-way shall be mechanically compacted to 95% maximum density or backfilled with CLSM to within one foot of finish grade.
7. Trench backfill in utility easements beyond 20 feet from right-of-way shall be compacted to 90% maximum density.
8. Place pipe bedding in accordance with the City of Greeley Standard Drawings.

3.8 MARKING TAPE INSTALLATION

- A. Marking tape to be installed in accordance with City of Greeley Standard Drawings. Marking tape shall meet APWA Uniform Color Code specifications. Continuously install marking tape along centerline of all buried piping, at eighteen-inches (18") above pipe. Coordinate with piping installation drawings.

3.9 TRACER WIRE AND TEST STATIONS

- A. Refer to the proper construction specification and the standard drawings ("UL" section) for the utility specific tracer wire and test station requirements.
 1. For water distribution tracer wire, refer to construction specification *Section 02510, Water Utility Distribution Piping*.
 2. For water distribution test stations at fire hydrants, refer to construction specification *Section 02516, Water Utility Distribution Fire Hydrants*.
 3. For sanitary sewer service tracer wire and test stations, refer to construction specification *Section 02534, Sanitary Sewer Service Lines*.
 4. For non-potable irrigation tracer wire and test stations, refer to construction specification *Section 15140, Non-Potable Irrigation System*.

3.10 GROUND WATER BARRIERS

- A. Ground water barriers shall be constructed in such a manner to impede the passage of water through the bedding material and shall be installed when high groundwater conditions exist or as directed by the City.
- B. Ground water barriers shall be keyed at least one (1) foot into the trench wall and bottom, and spaced ten (10) feet upstream of each manhole for gravity sanitary sewers or every 400 feet on water lines and sanitary sewer force mains.
- C. At a minimum, ground water barriers shall extend one (1) foot above the bedding material.
- D. Refer to City of Greeley Standard Drawings for additional installation requirements.

3.11 INSULATION BOARD

- A. Insulation board, if preapproved by the City, shall be installed above the bedding zone wherever the depth of cover over the water main is less than four (4) feet.

1. Insulation board installation shall consist of two (2) overlapping boards, one-inch (1") minimum thickness per board, with off-set joints.
 2. Insulation board shall be placed across the full trench width.
- B. Refer to City of Greeley Standard Drawings for additional installation requirements.

3.12 BACKFILLING AND COMPACTION

- A. Backfill trench promptly after completion of pipe bedding, but only after the City has inspected the work.
- B. Backfilling and compaction operations and requirements shall be in accordance with the *SDC*.
- C. Use backfilling and compaction methods and equipment appropriate for the backfill material. Do not use equipment or methods that will transmit damaging shocks to the pipe.
- D. Do not perform compaction by jetting or water settling.
- E. Rock and bedrock encountered in the excavation shall not be used in backfill.
- F. For areas not receiving surface improvements after construction, return the final grading to the depth of stripping over all areas disturbed by construction operations and replace topsoil.
- G. All surface cuts shall be, as a minimum, restored to a condition equal to, or better than, that prior to construction. All gravel or paved streets shall be restored in accordance with the regulation and requirements of the agency having control or jurisdiction over the street, roadway or right-of-way.
- H. Controlled Low Strength Material:
1. Maintain stability of pipe and conduit throughout CLSM placement and curing. Anchor pipe as needed to prevent movement of the pipe caused by flotation or lateral displacement. If any movement occurs, remove the CLSM material and place the pipe back on line and grade. Remove sloughed material or other debris from top of previously placed CLSM.
 2. Place in lifts as necessary to prevent uplift (flotation) of new and existing facilities.
 3. Fill entire trench section to pavement finish grade for a temporary driving surface in traveled areas, and screed off excess and finish with a float.
 4. In other areas fill the trench section to top of trench backfill zone.
 5. Allow CLSM to set before placing backfill. Prior to placing backfill over CLSM, achieve an indentation diameter less than or equal to 3 inches as determined by ASTM D6024.

3.13 MATERIALS AND QUALITY CONTROL TESTING

- A. The Contractor is responsible for quality control testing and the testing shall be performed by an independent testing agency employed by the Contractor.
- B. For backfill compaction and moisture requirements and the required materials testing, frequency of tests, and standard testing methods, reference the *SDC*.
- C. The following requirements shall also apply:
 - 1. Groundwater Barriers
 - a. Compaction – 95% (ASTM D698)
 - b. Moisture – $\pm 2\%$
 - 2. Bedding Material
 - a. Compaction – 65% of relative density (ASTM D4254)
 - 3. CLSM:
 - a. Provide adequate facilities for safe storage and proper curing of CLSM test cylinders onsite for first 24 hours, and for additional time as may be required before transporting to test lab.
 - b. Provide CLSM testing of air content and for making cylinders from the point of discharge into forms. When CLSM is pumped, Samples used shall be taken from discharge end of pump hose.
 - c. Specimens shall be made, cured, and tested in accordance with ASTM D4832, Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.
 - d. One set of test cylinders shall be tested per each 100 cubic yard of CLSM placed, but no less than one set per day. Frequency of testing may be changed at discretion of City.
 - e. Reject CLSM represented by cylinders failing to meet strength and air content specified.
- D. Services
 - 1. Water services shall have a minimum of one (1) moisture/density test per service.
 - 2. Sanitary sewer services shall have a minimum of two (2) moisture/density tests per service or at the City Inspector's discretion.
 - 3. Moisture/density tests in the vicinity of vaults, valve boxes and manholes shall be performed at a minimum of one (1) foot away from the edge of vault/manhole sections or valve boxes.

- a. Tests shall be performed in random directions from the vault, manhole, or valve box, on separate lifts.
 - b. A minimum of one (1) test shall be performed, on opposite sides of the vault, manhole or valve box, for every two (2) feet of backfill material.
4. The Contractor shall keep copies of all quality control test results in a notebook at the job site for the duration of the project. Test results shall be made available to the City at all times.

3.14 COMPACTION TEST FAILURE

- A. If the required compaction and moisture is not obtained, it shall be the responsibility of the Contractor to recompact or rework the material to the required state of compaction and moisture.
- B. In cases where there is a failure to achieve the required compaction or moisture, the City may require that the backfill be removed and recompactd or replaced entirely with suitable materials.
- C. Water line and sanitary sewer line/manhole testing may be required after recompaction if the testing had been performed prior to recompaction.
 1. Water line testing shall be performed between valves on both sides of the recompactd area.
 2. Sanitary sewer line testing shall be performed between manholes on both sides of the recompactd area.
 3. Sanitary sewer manhole testing shall be performed if recompactd occurs in the vicinity of the manhole.

SECTION 02445

CASING PIPE – BORINGS AND ENCASEMENTS

PART 1– GENERAL

1.1 SCOPE

- A. This section addresses the installation of a casing pipe by boring (or jacking) or as an open trench encasement and includes the acceptable products, materials, and construction practices.
- B. The specifications provided in this section are the minimum City requirements for casing pipe borings and encasements.
- C. The Design Engineer may be required by the City to provide additional design and installation considerations depending on the situation.
- D. The requirements included in this Section shall be superseded by other regulators if the other regulators requirements are more stringent. Other regulations could include CDOT, railroad, county, etc.

1.2 REFERENCES

- A. American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - 1. C206, *Field Welding of Steel Water Pipe*, latest revision.
 - 2. C150/A21.50, *Thickness Design of Ductile-Iron Pipe*, latest revision.
 - 3. C151/A21.51, *Ductile-Iron Pipe, Centrifugally Cast, For Water*, latest revision.
 - 4. C900, *Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In., For Water Distribution*, latest revision. (Both slip joint and fusible)
- B. ASTM International (ASTM)
 - 1. A139, Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over), latest revision.
 - 2. D3350, Polyethylene Plastic Pipe and Fittings Materials, latest revision.
 - 3. F714, Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter, latest revision.
- C. American Water Works Association (AWWA)
 - 1. C901, *Polyethylene (PE) Pressure Pipe and Tubing ½ inch through 3 inch*, latest revision.

2. C906, *Polyethylene (PE) Pressure Pipe and Fittings, 4 inch through 63 inch*, latest revision.
3. M23, *PVC Pipe – Design and Installation*, latest revision.
4. M41, *Ductile-Iron Pipe and Fittings*, latest revision.

1.3 DESIGN CONSIDERATIONS

- A. The Design shall specifically design each casing pipe boring (or jacking) installation.
 1. Casing pipe thicknesses specified in this section are based upon superimposed loads and not upon the loads which may be placed on the casing pipe as a result of jacking operations.
 2. Provide increased casing pipe strength as necessary to withstand jacking loads.
- B. The Design shall size the casing pipe such that the inside clearance is at least one-inch (1”) greater than the maximum outside diameter of the casing spacer runners.
- C. The design and construct all Shafts in accordance with the Contract Documents and promote construction using Contractor’s proposed tunneling means and methods.
- D. Shafts shall be of sufficient size to install the Casing Pipes in accordance with the Contract Documents.
- E. The design shall determine the Shaft footprint size, methods of excavation, ground control, ground support type, and allowable excavation slopes needed to perform the work and provide safe access for tunnel construction subject to the limitations specified herein and elsewhere in the Contract Documents.
- F. Ground support for Shafts and excavations shall stay within established easements.
 - a. Abide by the requirements of existing permits obtained by others, and obtain additional permits or approvals as needed.
- G. Where excavations are undertaken near any structure or facility including but not limited to buildings, railroads, highways, streets, or utilities, the construction shall not alter, damage, impair, or interfere with the operation of the structure or facility.

1.4 REQUIREMENTS OF REGULATORY AGENCIES

- A. The type of casing pipe material and its properties will normally be specified by the agency granting permission to cross. Such crossings shall be subject to approval by the City to avoid conflicts in requirements or standards between the City and the agency granting permission to cross.
- B. The Contractor shall provide a letter, permit, or an approved crossing application to the City from the agency granting the crossing approval. Copies of all documents required to be sent to the regulating agency shall be provided to the City.

- C. The Contractor shall obtain the necessary bonds, insurance or indemnity required by the crossing permit for protection against damage, interference with traffic, or service that may be caused by the construction activities.

PART 2 – PRODUCTS

2.1 CARRIER PIPE

- A. The carrier pipe shall be the same nominal diameter as the system main on either side of the casing pipe.
- B. In situations where one (1) pipe joint falls within the casing pipe, the carrier pipe material shall be consistent with the pipe material being used for the rest of the project.
- C. For situations where more than one (1) pipe joint falls within the casing pipe, the carrier pipe shall be restrained through the casing and the carrier pipe material shall be:
1. Potable Water Distribution System and Non-Potable Irrigation System – Restrained ductile iron pipe (DIP) in accordance with construction specification *Section 02512, Ductile-Iron Pipe*.
 2. Sanitary Sewer System – Restrained gravity sewer C-900 PVC (green in color) in accordance with construction specification *Section 02533, Polyvinyl Chloride (PVC) Non-Pressure Pipe*. Restrained gravity sewer PVC shall extend from manhole to manhole on either side of the casing pipe.
 3. Or other approved equivalent.

2.2 CASING PIPE

- A. Material
1. AWWA C900 Polyvinyl Chloride (PVC) Pipe
 2. Steel Pipe
 - a. The casing pipe shall be new, smooth steel conforming to ASTM A139, Grade B (no hydro.)
 - b. Minimum Yield Strength – 35,000 psi
 - c. Exterior Coating – Not required.
 3. AWWA C901 Polyethylene (PE) Pressure Pipe and Tubing
 4. AWWA C906 Polyethylene (PE) Pressure Pipe and Fittings
- B. The following table indicates what casing pipe diameter and material to use in relation to the carrier pipe diameter. It also provides steel casing pipe minimum wall thicknesses and specifies when to use casing spacers and end seals.

TABLE 2.2-B: Casing Pipe Specifications

2.3

approved equivalent.

ACCESSORIES

A.

Carrier Pipe Diameter (in)	Casing Pipe Diameter (in)	Borings and Encasements	Steel Casing Pipe	Encasements Only
		Casing Pipe Materials	Thickness (in)	Casing Pipe Materials
2" or less Water Services	4"	Welded Steel, Fusible C900 PVC	0.250	C900 PVC
4"	8"	Welded Steel, Fusible C900 PVC or HDPE	0.322	C151 DIP, C900 PVC, HDPE, Welded Steel
6"	12"	Welded Steel, Fusible C900 PVC or HDPE	0.375	C151 DIP, C900 PVC, HDPE, Welded Steel
8"	16"	Welded Steel, Fusible C900 PVC or HDPE	0.375	C151 DIP, C900 PVC, HDPE, Welded Steel
10"	20"	Welded Steel	0.375	Welded Steel
12"	24"	Welded Steel	0.375	Welded Steel
15"	30"	Welded Steel	0.500	Welded Steel
16"	30"	Welded Steel	0.500	Welded Steel

ng Spacers

1. Casing spacers shall be in a "centered-restrained" configuration in the casing pipe.
2. Casing spacers shall be sized such that the height of the risers and runners have no less than one-inch (1") clearance from the inside wall of the casing pipe.
3. Band
 - a. Casing spacers shall be constructed of circular stainless steel bands that bolt together to form a shell around the carrier pipe.
 - b. Material – T-304 stainless steel
 - c. Minimum Thickness – 14 gauge
 - d. Use an eight-inch (8") band width for carrier pipes twelve-inches (12") in diameter and smaller, unless otherwise recommended by the manufacturer.
 - e. Use a twelve-inch (12") band width for carrier pipes larger than twelve-inches (12") in diameter, unless otherwise recommended by the manufacturer.
4. Liner
 - a. Material – Polyvinyl Chloride (PVC)

- b. Minimum Thickness – 0.090-inches
 - c. Hardness-Durometer – 85-90
 - d. Electrical Properties – 1,380 V/min
5. Risers (Support Structures)
- a. Material – T-304 stainless steel
 - b. Maximum Thickness – 10 gauge
 - c. Reinforced over six-inches (6”) in height
 - d. MIG welded to band
6. Assembly Hardware
- a. Bolts – 5/16” - 18 x 2 ½” T-304 stainless steel or plated
 - b. Nuts – Hex, 5/16”
 - c. Washers – 5/16” SAE 2330
7. Runners
- a. Material - Glass Filled Polymer or Ultra High Molecular Weight (UHMW) Polyethylene
 - b. Minimum Width – Two-inches (2”)
 - c. Runners shall be mechanically bolted to the risers.
8. Manufacturers
- a. Cascade Waterworks Mfg.
 - b. PSI Pipeline Seal & Insulator, Inc.
 - c. CCI Pipeline Systems
 - d. Or approved equivalent.
- B. Casing Pipe End Seals
- 1. Material - Seamless neoprene rubber
 - 2. Minimum Thickness – 1/8”
 - 3. Type – Pull on
 - 4. Bands and clamps – T-304 stainless steel

5. Size shall be specific to the casing-carrier pipe combination.
6. Manufacturers
 - a. Cascade Waterworks Mfg. – Model CCES
 - b. PSI Pipeline Seal & Insulator, Inc. – Model C
 - c. CCI Pipeline Systems – Model ESC
 - d. Or approved equivalent.
- C. Grout
 1. Grout shall consist of one (1) part Portland Cement and three (3) parts sand.
- D. Anode Bags
 1. 17-pound high potential magnesium anode bags.
- E. Connections
 1. Connections shall be made with Perma-lock.

PART 3 - EXECUTION

3.1 CARRIER PIPE INSTALLATION

- A. Carrier pipe shall be installed at the elevations and grades shown on the Construction Drawings.
- B. Install the carrier pipe in accordance with the pipe material's specification.
- C. Restrain the carrier pipe within the casing pipe, as required in accordance with this specification.
- D. Install casing spacers one (1) to two (2) feet on either side of the bell joint and one (1) every six (6) to eight (8) feet apart thereafter, for a total of three (3) casing spacers per pipe length unless otherwise specified by the manufacturer or City. Casing spacers are required on all carrier pipes except for two-inch (2") diameter or less water services.
- E. Seal the ends of the casing pipe with casing pipe end seals. End seals are required on all casing pipe installations.

3.2 CASING PIPE INSTALLATION

- A. General
 1. All excavations shall meet the requirements set forth in the construction specification *Section 02315, Excavation and Fill*.

2. Vertical and horizontal offset staking shall be provided at both ends of the casing pipe.
3. Casing pipe shall be installed to the grade and alignment shown on the approved Construction Drawings. Grade and alignment shall not deviate more than 0.3 feet horizontally and 0.1 foot vertically from that shown on the Construction Drawings.
4. Open trench excavation shall not be permitted where boring or jacking is specified.

B. Polyvinyl Chloride (PVC) Casing Pipe

1. AWWA C900 Polyvinyl Chloride (PVC) casing pipe shall be installed in accordance with construction specification *Section 02513, Polyvinyl Chloride (PVC) Pressure Pipe*.

C. Smooth Steel Pipe

1. Provide adequate equipment to ensure a smooth, continuous, and uniform casing with no exterior voids.
2. Joints shall be butt welded in accordance with AWWA C206. Weld each section of pipe around the entire circumference of the joint to form a continuous conduit capable of resisting all applied stresses, including jacking stresses.
3. A seventeen (17) pound high potential magnesium anode shall be installed at each end of steel casing pipes with a cathodic testing station as shown in the Standard Drawings.

D. High Density Polyethylene (HDPE)

1. Installed per manufacturers standards.
2. Minimum SDR-17

E. Grouting (As required)

1. Fill all spaces between the casing pipe and the earth with grout.
2. Plug each hole after pumping through the casing has stopped to prevent backflow of grout.

SECTION 02510**WATER UTILITY DISTRIBUTION PIPING****PART 1 – GENERAL****1.1 SCOPE**

- A. This section addresses the installation of potable and non-potable water distribution mains from four-inch (4") to twenty-four inch (24") diameter and includes the acceptable products, materials, and construction practices that may be used in installation.

1.2 REFERENCES

- A. American National Standards Institute/American Water Works Association (ANSI/AWWA)
1. C104/A21.4, *Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water*, latest revision.
 2. C111/A21.11, *Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings*, latest revision.
 3. C151/A21.51, *Ductile-Iron Pipe, Centrifugally Cast, for Water*, latest revision.
 4. C153/A21.53, *Ductile-Iron Compact Fittings for Water Service*, latest revision.
- B. ASTM International (ASTM)
1. A536, *Standard Specification for Ductile Iron Castings*, latest revision.
 2. B170, *Standard Specification for Oxygen-Free Electrolytic Copper—Refinery Shapes*, latest revision.
 3. B227, *Standard Specification for Hard-Drawn Copper-Clad Steel Wire*, latest revision.
 4. B910, *Standard Specification for Annealed Copper-Clad Steel Wire*, latest revision.
 5. B1010, *Standard Specification for Copper-Clad Steel Electrical Conductor for Tracer Wire Applications*, latest revision.
 6. D1248, *Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable*, latest revision.
 7. F3125/F3125M, *Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength*, latest revision.

1.3 SUBMITTALS

- A. Shop Fabricated Piping:
 - 1. Detailed pipe fabrication or spool drawings showing special fittings and bends, dimensions, coatings, color, and other pertinent information.
 - 2. Layout drawing showing location of each pipe section and each special length; number or otherwise designate laying sequence on each piece.
- B. Hydraulic Thrust Restraint for Restrained Joints: Details including materials, sizes, assembly ratings, and pipe attachment methods.
- C. Dissimilar Buried Pipe Joints: Joint types and assembly drawings.
- D. Pipe Corrosion Protection: Product data.

1.4 JOB CONDITIONS

- A. Pipe delivered for construction shall be strung so as to minimize entrance of foreign material.
- B. All openings in the pipeline shall be closed with watertight plugs when pipe laying is stopped at the close of the day's work or pipe laying is not in progress.
- C. Do not allow debris, tools, clothing, rags, or other materials to enter the pipe. Precautions shall be taken to protect the interiors of pipes, fittings, and valves against contamination.
- D. Use effective measures to prevent uplifting or floating of the pipeline prior to completion of backfilling operations.
- E. Protect pipe and appurtenances against dropping and damage. Damaged pipe and appurtenances that are rejected shall be marked and removed from the site.
- F. Do not install pipe when the trench contains water or when the trench bottom is unstable as determined by the City. Water that is encountered in the trench shall be removed to the extent necessary to provide a firm subgrade, permit connection to be made in dry conditions, and to prevent the entrance of water into the pipeline.
 - 1. Surface runoff shall be diverted as necessary to keep excavations and trenches free from water during construction.
 - 2. The excavation or trench shall be kept free from water until the structure, or pipe, to be installed is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.
 - 3. The pipe shall not be used to dewater the trench.

1.5 LOCATION AND LOOPING

1. All mains shall be located in dedicated street right-of-way or within a dedicated exclusive easement of appropriate width. City approval is required for all other proposed main locations.
2. The centerline of mains shall not be placed closer than three (3) feet to the lip of street gutter without prior acceptance by the City.
3. A main serving one (1) lot shall extend all the way across the frontage for that lot.
4. Mains shall extend to the extremities of the property or the subdivision served. Extensions shall be in appropriate locations to provide adequate connections.
5. The City shall determine on a case by case basis if system looping is required for a development.

PART 2 – PRODUCTS

2.1 PIPE

- A. The same type of pipe material shall be used for each size pipe. Pipe material shall not be interchanged, except where another type of pipe material is specifically indicated.
- B. Reference construction specifications *Section 02512, Ductile-Iron Pipe* and *Section 02513, Polyvinyl Chloride (PVC) Pressure Pipe*.

2.2 VALVES

Reference construction specification *Section 02515, Water Utility Distribution Valves*.

2.3 FIRE HYDRANTS

Reference construction specification *Section 02516, Water Utility Distribution Fire Hydrants*.

2.4 BLOW-OFFS

Reference City of Greeley Standard Drawings.

2.5 SERVICE LINES, METERS, AND APPURTENANCES

Reference construction specification *Section 02514, Water Service Lines, Meters, and Appurtenances*.

2.6 TAPPING SLEEVES AND TAPPING VALVES

- A. Tapping sleeves and valves are required for connections to existing distribution mains unless otherwise indicated on the approved Construction Drawings.
- B. Tapping sleeves for PVC and ductile iron pipe shall have a cast iron or ductile iron body. Tapping sleeves for steel pipe shall be a weld-on type or fabricated steel.

- C. Accepted manufacturers are:
 - 1. ROMAC
 - 2. Ford
 - 3. Smith Blair
 - 4. JCM Industries, Inc.
 - 5. Or approved equivalent
- D. Tapping sleeves shall be rated at 200 psi, minimum, working pressure.
- E. Tapping sleeves shall provide a 100% leak-tight seal.
- F. Prior to ordering tapping sleeve, manufacturer's shop drawings and specifications shall be submitted to the City for review and acceptance.
- G. For tapping valves, reference construction specification *Section 02515, Water Utility Distribution Valves*.

2.7 TRACER WIRE AND TEST STATIONS

- A. General
 - 1. All system components, including tracer wire, connectors, ground rods and access points, must be compatible. The component parts of the Copperhead® Complete Utility Locating System™ have been designed and engineered for compatibility to ensure end-to-end conductivity for the purpose of detecting and protecting underground utility assets.
 - 2. All tracer wire and tracer wire components shall be manufactured in the USA.
 - 3. All tracer wire shall have HDPE (High Density Polyethylene) insulation for direct bury, color coded per APWA standard for the specific utility being marked.
- B. Tracer wire and insulation
 - 1. Tracer wire shall conform to the following ASTM standards as applicable:
 - a. B1010/B1010M – Standard Specification for Copper-Clad Steel Electrical Conductor for Tracer Wire Applications
 - b. B910/B910M – Standard Specification for Annealed Copper-Clad Steel Wire
 - c. B227 – Standard Specification for Hard-Drawn Copper-Clad Steel Wire
 - d. B170 – Standard Specification for Oxygen-Free Electrolytic Copper-Refinery Shapes

e. D1248 – Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable

2. Documentation verifying that tracer wire is 100% made in the USA.
3. If tracer wire manufacturer has not completed a 5-year corrosion test, a 5-year warranty must be provided.
4. Open Trench / Open Cut - Tracer wire shall be Copperhead® copper-clad steel 12-AWG High Strength, high carbon with minimum 450 lb. break load, minimum 30 mil HDPE insulation (1230*-HS-**).
5. Directional Drilling/Boring - Tracer wire shall be Copperhead copper-clad steel 12-AWG Extra High Strength with minimum 1,150 lb. break load, minimum 45 mil HDPE insulation (1245*-EHS-**).
6. Pipe Bursting - Tracer wire shall be Copperhead 7x7 stranded copper-clad steel SoloShot™ Xtreme Strength with 4,700 lb. break load, minimum 50 mil HDPE insulation (PBX-50*-**).
7. Acceptable Manufacturers:
 - a. Copperhead Industries, Inc.
 - b. Approved equivalent.

* denotes color

** spool size (500', 1000', 2500')

C. Connectors

1. All mainline tracer wires shall be interconnected at intersections, at mainline tees and mainline crosses. At tees, the three wires shall be joined using a single, three-way SnakeBite™ Locking Connector (LSC1230C). At crosses, the four wires shall be joined using two, three-way Copperhead SnakeBite™ Locking Connectors (LSC1230C) with a short jumper wire between them.
2. Direct bury wire connectors shall include three-way lockable Copperhead SnakeBite™ Locking Connectors (LSC1230C) and Copperhead Mainline-to-Service Connectors (3WB-01) specifically manufactured for use in underground tracer wire installation. Connectors shall be dielectric silicone filled to seal out moisture and corrosion and shall be installed in a manner as to prevent any uninsulated wire exposure.
3. Non-locking, friction fit or taped connectors are prohibited.

D. Grounding

1. Tracer wire must be properly grounded at all dead-ends/stubs.

2. Grounding of tracer wire shall be achieved by using a Copperhead 1.5-lb, drive-in, magnesium Ground Rod (ANO-12) with a minimum 20-feet, #12 red HDPE insulated copper-clad steel wire connected to the rod specifically manufactured for this purpose.

E. Termination/Access

1. All tracer wire termination points must provide a direct connection point to the tracer wire by a utility locate transmitter (above ground or at grade) specifically manufactured for lite duty, concrete/driveway, or roadway applications.
2. All at-grade access points shall be appropriately identified with “water” on the cap and be color coded per American Public Works (APWA) standards.
3. All two-terminal tracer wire access points must include a manually interruptible conductive/connective link between the terminal for the tracer wire connection and the terminal for the ground rod wire connection.
4. All two-terminal tracer wire access points must have external direct connection points to both the tracer wire and ground rod wire from top of lid.
5. All at-grade access points shall include an encapsulated magnet molded into the top portion of the tube, to allow for detection by a ferrous metal detector.
6. All at-grade access points shall be supplied with anti-corrosion wax/gel to protect wires.
7. Service laterals on public property – Tracer wire shall terminate at an approved at-grade access point located at the edge of the road right-of-way, and out of the roadway. Approved at-grade access points shall be a two (2) foot linear cathode-wire loop within the specified grounding interval or a grounded two-terminal externally switchable lid, where there is a direct connection point for a locate transmitter and an external switch to turn “ground” on and off from the top of the lid. Acceptable access points with two-terminal, externally switchable lids include Copperhead’s SnakePit® Lite Duty (LD14*2T-SW), Lite Duty Adjustable (LD14*2T-ADJ-SW), Lite Duty XL (LDXL36*2T-SW), or Concrete/Driveway (CD14*2TP-SW).
8. Service laterals on *private* property – Tracer wire shall terminate at an approved Copperhead® single-terminal access point (when grounding isn’t required) affixed to or near the building exterior directly above where the utility enters the building, or at a two-terminal access point (when grounding is required) located within two linear feet of the building being served by the utility.
 - a. Single-terminal access points may include:
 - i. Above-grade, Cobra™ Access Point (T1-*)
 - ii. Above-grade, SnakeSkin™ Access Point (SNSK-*-01)

- iii. At-grade, SnakePit® Lite Duty (LD14*TP), Lite Duty Adjustable (LD14*TP-ADJ), Lite Duty XL (LDXL36*TP), or Concrete/Driveway (CD14*TP) Access Point
 - iv. Equivalent single-terminal access point from an approved manufacturer.
- b. Two-terminal access points may include:
- i. Above-grade, Cobra™ Access Point (T2-*)
 - ii. At-grade Two-terminal Switchable SnakePit® Lite Duty (LD14*2T-SW), Lite Duty Adjustable (LD14*2T-ADJ-SW), Lite Duty XL (LDXL36*2T-SW), or Concrete/Driveway (CD14*2T-SW) Access Point
 - iii. Equivalent two-terminal access point from an approved manufacturer.
9. Hydrants – Tracer wire shall terminate at an approved above-grade
- a. Copperhead Cobra™ Access Point properly affixed to the hydrant-grade flange (T2-* -FLPKG). Affixing with tape or plastic ties shall not be acceptable. Tracer wire may also terminate at an approved at-grade Copperhead SnakePit® Lite Duty (LD14*2T-SW), Lite Duty Adjustable (LD14*2T-ADJ-SW), Lite Duty XL (LDXL36*2T-SW), or Concrete/Driveway (CD14*2TP-SW) Access Point.
10. Long-runs, more than 1,000 linear feet, without service laterals, hydrants, or any other access points – Tracer wire access must be provided utilizing an approved at-grade Copperhead SnakePit® Access Point or approved equal. All dead-ends shall be grounded utilizing a 1.5-lb., drive-in, magnesium Copperhead Ground Rod (ANO-12).

* denotes color

F. Prohibited Products

- 1. The following products shall NOT be allowed or acceptable:
 - a. Non-American-made products
 - b. Uninsulated tracer wire
 - c. Stainless steel tracer wire
 - d. Tracer wire insulations other than HDPE
 - e. Tracer wire not domestically manufactured
 - f. Brass or copper ground rods

- g. Brass fittings with tracer wire connection lugs
- h. Wire connections utilizing taping or spray-on waterproofing

2.8 MECHANICAL COUPLINGS

- A. All mechanical couplings shall be of a gasketed, sleeve-type, with diameter to properly fit the pipe. Tolerance on pipe and coupling, together with proper bolt and gasket arrangements, shall be sufficient to ensure permanent watertight joints under all conditions.
- B. Materials used in the manufacture of these couplings shall be new and shall conform to AWWA C219.
- C. Couplings shall be sufficiently wide, so that each type of pipe joined will have as much pipe end inserted in the coupling as is provided by the standard push-on mechanical joint for the pipe size and type involved.
- D. Acceptable manufacturers and styles of couplings are:

TABLE 2.10-D: Couplings

Straight Couplings		
Romac	Style XR501	4" through 12"
Romac	Style ALPHA	4" through 16"
Romac	Style 400	16" and larger
Smith-Blair	Style 441	all sizes
Insulating Couplings		
Romac	Style IC501	4" through 12"
Romac	Style IC400	16" and larger
Smith-Blair	Style 416	all sizes
Reducing Couplings		
Dresser	Style 62	all sizes
Romac	Style RC501	4" through 24"
Romac	Style RC400	16" through 60"
Smith-Blair	Style 415	all sizes
Transition Coupling		
Dresser	Style 162	all sizes
Flange Coupling Adapters and Restrained Couplings		
Smith-Blair	Style 913	all sizes
Smith-Blair	Style 923	all sizes

Romac	Restrained Flanged Coupling Adapter (RECA)	all sizes
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Or approved equivalent.

2.9 FITTINGS

- A. All fittings shall be manufactured in accordance with AWWA C104, C110, and C111.
- B. All fittings shall have either mechanical joint or flanged joint connections.
- C. All fittings shall be made of either gray-iron or ductile-iron, and have a minimum working pressure rating of 350 psi for four-inch (4") through twenty-four inch (24") diameter and 250 psi for larger than twenty-four inch (24") diameter.
- D. All sizes of ductile and gray iron fittings shall be furnished with a cement –mortar lining of standard thickness or fusion-bonded epoxy coating in accordance with AWWA C116.
- E. Iron used in the manufacture of fittings for these specifications shall have:
 - 1. Minimum tensile strength – 60,000 psi
 - 2. Minimum yield strength – 42,000 psi
 - 3. Minimum elongation – 10%

PART 3 – EXECUTION

3.1 GENERAL

- A. All materials used in the construction of potable water distribution shall be new.
- B. Construction Staking
 - 1. Reference construction specification *Section 02315, Excavation and Fill*.
 - 2. Tolerances:
 - a. Joint Deflection: Maximum of 75 percent of manufacturer's recommendation.
 - b. Horizontal alignment shall not deviate from the City accepted Construction Drawings by more than 0.3 feet.
 - c. Vertical alignment shall not deviate from the City accepted Construction Drawings by more than 0.3 feet as measured from the top of pipe.
- C. The minimum effective area of thrust blocks shall be as specified in City of Greeley Standard Drawings, latest revision.

3.2 INSPECTION

- A. Pipe barrel and fittings shall be free of dirt or other foreign objects prior to installation.
- B. Pipe and fittings shall be inspected for cracks, dents, abrasions, or other flaws prior to installation.
- C. Damaged or flawed pipe or fittings shall be rejected, marked, and removed from the site.
- D. Operational Inspection: At the completion of the project and in the presence of the City, the Contractor shall operate all valves to ascertain that the entire facility is in good working order, all valve boxes are centered and valves are open, all hydrants operate and drain properly, all curb boxes are plumb centered and water is available at all curb stops. Any valves or hydrants that do not meet these requirements shall be satisfactorily repaired as directed by the City or removed and replaced with working and properly installed valves or hydrants at no expense to the City.

3.3 PREPARATION

- A. Trenching, Backfilling, and Compaction
 - 1. Reference construction specification *Section 02315, Excavation and Fill*.
- B. Existing Utilities
 - 1. The horizontal and vertical location of existing utilities shall be field verified prior to start of construction.
 - 2. Any deviation from what is shown on the approved Construction Drawings shall be reported to the City immediately and documented on the As-Constructed Record Drawings.

3.4 CONNECTIONS TO EXISTING SYSTEM

- A. When connecting to the existing potable and non-potable water distribution system, ONLY City Water and Sewer Department personnel shall operate existing system valves. The Contractor shall provide at least forty-eight (48) hours notification prior to needing any valve operated, except in the case of emergencies.
- B. At locations where connections to existing mains are to be made, the Contractor shall locate the existing mains both vertically and horizontally and verify their exact size and material in advance of the time scheduled for making the connections.
 - 1. Prior to connecting to existing mains, the Contractor shall have all labor, materials, and equipment ready to connect the fitting to the existing main, so as to keep the shutoff time to a minimum.
 - 2. The Contractor shall notify the City of Greeley 48 hours in advance to examine the existing pipe or appurtenance and specify any necessary adjustments in line, grade, or connection requirements to accomplish the connection. Contractor to make corrections as directed by the City.

3. Use effective measures to prevent contamination to existing potable water lines.
 4. Refer to construction specification *Section 02511, Disinfection of Water Utility Distribution* for more information on disinfection prior to connecting to existing waterlines.
- C. The City shall not be responsible for valve water tightness on existing facilities. If existing valves leak, the City Water and Sewer Department may assist in reducing the influx of water, but the Contractor must use methods at his own disposal to dewater the trench and complete any required testing and disinfection of the potable water line.
- D. All connections shall have valves installed to separate new construction from the existing system. New construction shall not be connected to the existing system until the new system has been tested, disinfected, and accepted by the City.

3.5 PIPE INSTALLATION

- A. Pipe Laying
1. Exercise care when lowering pipe into trench to prevent twisting or damage to pipe.
 2. Measure for grade at top of pipe.
 3. Excavate trench bottom and sides of ample dimensions to permit visual inspection and testing of entire flange, valve, or connection.
 4. Lay pipe with the bells pointing in the direction the work is progressing.
 5. Deflect pipe at joints for pipelines laid on a curve using unsymmetrical closure of spigot into bell. If joint deflection of standard pipe lengths will not accommodate horizontal or vertical curves in alignment, provide:
 - a. Shorter pipe lengths.
 - b. Special mitered joints.
 - c. Standard or special fabricated bends.
 6. After joint has been made, check pipe alignment and grade.
 7. Place sufficient pipe zone material to secure pipe from movement before next joint is installed.
 8. Take effective measures to prevent opening of joints during bedding and backfilling operations.
 9. Complete the joint in accordance with the applicable pipe material specification and adjust the pipe to the correct line and grade as each length of pipe is placed in the trench. Make adjustments in line and grade by scraping away or filling pipe bedding under the entire length of the pipe, except at bells, and not by wedging, blocking, or mounding up the pipe or bells.

10. Secure the pipe in place with the specified bedding tamped under and around the pipe except at the joints. Do not disturb the pipe after the jointing has been completed.
11. Install the pipeline so that a positive or negative grade is maintained between high and low points.
12. The minimum depth of cover for potable water and non-potable water mains shall be five (5) feet and four (4) feet respectively, .
13. When constructability constraints are present, deeper or shallower main installation may be permitted only with acceptance from the City. Additional design and installation considerations may be required by the City depending on the situation.
14. No water pipe may be covered or backfilled until inspection of pipe and bedding has been made or City Inspector has given approval.
15. Tracing wire shall be installed with PVC pipe and ductile iron pipe (DIP) according to the Standard Drawings, latest revision.
16. Install underground marking tape in accordance with City of Greeley Standard Drawings. Tape installation shall be continuous along the pipe

B. Underground Marking Tape and Identification Signs

1. Reference construction specification *Section 02315, Excavation and Fill for Marking Tape Requirements*.
2. Approved signs shall be posted bearing warning of buried pipelines.
 - a. Potable water lines: “CAUTION – BURIED WATER LINE BELOW”
 - b. Non-potable water lines: “CAUTION – BURIED NON-POTABLE WATER LINE BELOW” or “CAUTION – BURIED RECLAIMED WATER LINE BELOW”.
 - c. See the City of Greeley Standard Details an example of an approved sign. Coordinate signage requirements with the City of Greeley during design process.

C. Separation of Water Mains and Services in Relation to Other Utilities

1. Potable water services and distribution mains shall have a minimum ten (10) feet horizontal and eighteen-inches (18”) vertical separation from all utilities measured from outside diameter.
2. Where sanitary sewer lines cross beneath potable water lines with less than eighteen-inches (18”) clearance, sanitary sewer lines cross above potable water lines, or the ten (10) feet horizontal clearance between potable water lines and sanitary sewer lines cannot be maintained, pipe encasement shall be provided in

accordance with construction specification *Section 02445, Casing Pipe – Borings and Encasements*.

3. Where storm water lines cross above potable water mains, storm water pipe joints shall be grouted a minimum ten (10) feet on either side of the crossed potable water main, measured from the outside diameter of the pipe.
4. Potable and non-potable irrigation main crossings under any open irrigation ditch shall have a minimum five (5) feet of cover and shall be encased.
5. Dry utility crossings shall be encased in high density polyethylene pipe (HDPE), Standard Dimension Ratio (SDR) 11 from edge to edge of the easement or right-of-way, or ten (10) feet on either side of the potable water main, whichever is greater.
6. Right angle only utility crossings are permitted above and below the potable water main. Parallel installation of other utilities in exclusive water easements is not permitted.
7. Bored utility crossings shall have a minimum twenty-four inches (24") of vertical clearance from the outside diameter of the utility casing to the outside diameter of the potable water line if the bored utility crosses above the potable water line and a minimum thirty-six inches (36") of vertical clearance from the outside diameter of the utility casing to the outside diameter of the potable water line if the bored utility crosses below the water line.
8. If there are horizontal or vertical clearance conflicts between the potable water line and a utility, the City may require that the potable water main be lowered, raised, or realigned in order to maintain the required clearances.
9. For a potable water line crossing situation not specifically mentioned in this section, the crossing requirements provided in these Criteria shall be applied to that particular situation to the best extent possible.

3.6 TRACER WIRE & TEST STATION INSTALLATION

A. Non-Potable Water System

1. Refer to Water & Sewer Standard Drawings for installation and grounding requirements specific to Non-Potable.

B. General

1. Tracer wire locating system must meet requirements of Senate Bill 18-167 or any update.
2. Tracer wire installation shall be performed in such a manner that allows proper access for connection of line tracing equipment, proper locating of wire without loss or deterioration of low frequency (512 Hz) signal, and without distortion of signal caused by more than one wire being installed in close proximity to one another.

3. Tracer wire systems must be installed as a single continuous wire, except where using approved connectors. No looping or coiling of wire is allowed.
4. Any damage occurring during installation of the tracer wire must be immediately repaired by removing the damaged wire and installing a new section of wire with approved connectors. Taping and/or spray coating shall not be allowed.
5. Mainline tracer wire shall not be connected to existing conductive pipes. Treat as a mainline dead-end ground using an approved waterproof connector to a Ground Rod driven into virgin soil beneath and in line with the utility.
6. Tape to top centerline of pipe every three (3') to four (4') feet with adhesive tape or plastic tie straps such that wire remains in place during embedding of pipe.
7. Tracer wire shall be installed and grounded per City of Greeley Standard Drawings, latest revision.
8. All service lateral tracer wire shall be a single wire, connected to the mainline tracer wire using a three-way mainline-to-service connector, installed without cutting/splicing the mainline tracer wire.
9. In occurrences where an existing tracer wire is encountered on an existing utility that is being extended or tied into, the new tracer wire and existing tracer wire shall be connected using approved connectors.
10. Tracer wire on all service laterals/stubs must terminate at an approved tracer wire access point located directly above the utility, at the edge of the road right-of-way, but out of the roadway.
11. One foot of excess/slack wire is required in all tracer wire access points after meeting final elevation.
12. Tracer wire must be properly grounded as specified.
13. At all mainline dead-ends, tracer wire shall go to ground using an approved connection to a 1.5-lb., drive-in, magnesium ground rod.
14. When grounding the tracer wire at dead-ends/stubs, the Ground Rod shall be driven into virgin soil directly beneath and in line with the utility.
15. Ground rod wire shall be connected to the ground rod terminal on the two-terminal SnakePit® Access Point Lid or to the bottom terminal on the two-terminal Cobra™ Access Point.
16. Where the Ground Rod wire will be connected to a tracer wire access point, one foot of excess/slack wire is required after meeting final elevation.

17. Test Station

- a. Tracing wire shall be brought to the surface in a two (2) foot cathode loop at every service curb stop. Place upper half of standard valve box over curb stop and cathode loop per City of Greeley Standard Drawings.
- b. Fire hydrant test station access boxes shall be installed according to manufacturer specifications.

C. Water System

1. A mainline tracer wire must be installed, with all service lateral tracer wires properly connected to the mainline tracer wire, to promote tracing/locating capabilities from a single connection point.
2. Lay mainline tracer wire continuously, by-passing around the outside of valves and fittings on the north or east side.
3. A single tracer wire only shall be installed on all water service laterals and must terminate at an approved tracer wire access point, color coded blue and located directly above the service lateral at the edge of road right-of-way.
4. Tracer wire access points will be installed at all fire hydrants.
5. All conductive and non-conductive service lines shall include tracer wire.

D. Prohibited Installation Methods

1. The following methods shall NOT be allowed or acceptable:
 - a. Looped wire or continuous wire installations that have more than one wire laid side-by-side or in close proximity to one another
 - b. Tracer wire wrapped around the corresponding utility
 - c. Wire terminations within the roadway in valve boxes, cleanouts, manholes, etc.
 - d. Connecting tracer wire to existing conductive utilities

E. Testing

1. All new tracer wire installations shall be located using typical low frequency (512 Hz) line tracing equipment, witnessed by the contractor, engineer and facility owner as applicable, prior to acceptance of ownership.
2. This verification shall be performed upon completion of rough grading and again prior to final acceptance of the project.
3. Continuity testing in lieu of actual line tracing shall not be accepted.

3.7 THRUST RESTRAINT

A. Anchorage and Blocking

1. Reference City of Greeley Standard Drawings.
2. Concrete thrust blocks and anchors for preventing movement shall be provided at all mechanical joint plugs, tees, crosses, reducers, valves, bends, and changes in direction of 11-¼° or more.
3. The minimum size of thrust blocks and thrust anchors shall be determined from the table provided on the City of Greeley Standard Drawings.
4. The concrete thrust block-bearing surface shall be excavated into undisturbed soil.
 - a. All loose soil shall be disposed of, and the location where the thrust block is to be poured shall be carefully shaped to provide a uniform bearing surface of the required size.
 - b. The concrete thrust block bottom shall be flat, and sides shall be vertical.
 - c. If soil is to be disturbed, making a concrete thrust block or thrust anchor unusable, alternate restraining systems must be approved for use by the Water and Sewer Department prior to pipeline installation.
5. The concrete thrust block shall be formed to provide access to fittings, valves, and hydrants. Care shall be taken not to block outlets or to cover bolts, nuts, clamps, or other fittings to make them inaccessible.
6. The concrete thrust block shall be extended from the fitting or valve to be blocked to undisturbed earth. Concrete thrust blocks shall be constructed so that joints and drain holes are clear and accessible.
7. Concrete shall be separated from fittings, valves, and hydrants by eight (8) mil polyethylene film.
8. The City shall be notified a minimum twenty-four (24) hours prior to concrete being placed.

B. Restraining Devices

1. If concrete thrust blocks cannot be used for any reason, or if otherwise required, push-on and mechanical joints may be restrained with mechanical restraint systems.
2. The City shall determine the length of pipe to be restrained for each situation where mechanical restraint systems are to be installed. Refer to Construction Drawings or coordinate with City as necessary for location.
3. Reference construction specifications *Section 02512, Ductile-Iron Pipe* and *Section 01513, Polyvinyl Chloride (PVC) Pressure Pipe*.

3.8 INSTALLATION OF PIPELINE APPURTENANCES

- A. Install valves, hydrants, blow-offs, and other pipeline appurtenances at the locations shown on the Construction Drawings or as designated by the City to accommodate field conditions.
- B. Horizontal and vertical record measurements of the actual location of fittings, valves, and appurtenant equipment prior to backfill and record for the As-Constructed Record Drawings.
- C. All dead-end potable water lines will have a hydrant blow-off at the end of the. Dead-end potable water lines that will be extended in the future shall have a valve which controls that section of potable water line left in the off position. The valve shall be positioned so no service will be left without water when the line is extended in the future.
- D. Non-potable appurtenances not available from the manufacturer in the purple color (ie. valves, fittings) shall be identified in the field by securing marking tape to the surface of the item. Reference construction specification *Section 02315, Excavation and Fill for Marking Tape Requirements*.

3.9 PROTECTION OF METAL SURFACES

- A. Protect supplied material including coatings that have been damaged.
- B. For polyethylene encasement, reference construction specification *Section 02512, Ductile-Iron Pipe*.
- C. Apply two (2) coats of coal tar paint to ferrous metal rods, rebar, clamps, bolts, nuts and other accessories which are subject to submergence or contact with earth or fill material. Apply first coat of coal tar paint to a dry, clean surface. Allow first coat of coal tar paint to dry before the second coat is applied.

3.10 DISSIMILAR METALS AND INSULATOR KITS

- A. Whenever it is necessary to join dissimilar metals, a City approved insulated joint shall be installed.

3.11 FIELD QUALITY CONTROL

- A. Pipe Leakage Tests.
 - 1. Reference construction specification *Section 01713, Water Distribution System Testing*.
- B. Tracer Wire Testing.
 - 1. Pass current through wire and demonstrate that wire is capable of locating the pipe.
 - 2. If wire will not pass current, locate break in circuit and test until tracer wire works in accordance with its intended use.

C. Soil Compaction.

1. Reference construction specification *Section 02315, Excavation and Fill.*

3.12 PIPELINE DISINFECTION

- A. Reference construction specification *Section 02511, Disinfection of Water Utility Distribution.*

SECTION 02511

DISINFECTING OF WATER UTILITY DISTRIBUTION

PART 1– GENERAL

1.1 SCOPE

- A. This section addresses the filling and disinfection of potable water distribution lines.
- B. The Contractor is responsible for the disinfection and testing of water lines.

1.2 REFERENCES

- A. American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - 1. B300, *Hypochlorites*, latest revision
 - 2. C651, *Disinfecting Water Mains*, latest revision.

1.3 SUBMITTALS

- A. Procedure and plan for cleaning, disinfection, and testing of system. Plan shall include:
 - 1. Plan describing and illustrating conformance to appropriate AWWA standards and this Specification.
 - 2. Proposed locations within system where Samples will be taken.
 - 3. Type of disinfecting solution and method of preparation.
 - 4. Method of disposal for highly chlorinated disinfecting water.
- B. Certification that employees working with concentrated chlorine solutions have received appropriate safety training.
- C. Certification that independent testing agency is qualified to perform bacteriological testing in accordance with AWWA standards, agency requirements, and this Specification.
- D. Certified Bacteriological Test Results confirming area tested is free from coliform bacteria contamination. Forward results directly to City.

1.4 QUALITY ASSURANCE

- A. Independent Testing Agency: Certified in the State of Colorado with 10 years of experience in the field of water sampling and testing. Agency shall use calibrated testing instruments and equipment and documented standard procedures for performing specified testing. The City may choose to self-perform the testing.

PART 2– PRODUCTS

2.1 WATER FOR DISINFECTION AND TESTING

- A. Clean, uncontaminated, and potable.

2.2 DISINFECTANT

- A. Hypochlorite - Reference AWWA B300. Hypochlorite for use in swimming pools is not allowed.

PART 3– EXECUTION

3.1 GENERAL

- A. Perform disinfection after completion of leakage testing and acceptance of results. If pre-approved by the City, leakage test and disinfection can be completed at the same time.
- B. The Contractor shall disinfect all pipe and fittings which will be installed between the new main and the existing mains, which will not be subjected to the standard chlorination procedure. The Contractor shall notify City of Greeley a minimum of 48 hours prior to the disinfection so the City can be onsite to observe.
- C. The Contractor shall flush and satisfactorily disinfect new water lines prior to acceptance of the lines by the City and placing them in service.
- D. New water lines shall not be connected to existing lines until the new lines have been flushed, tested, disinfected, and accepted by the City.
- E. Under NO circumstances shall a non-disinfected potable water main be connected to an existing disinfected potable water main without prior acceptance by the City.
- F. As soon as possible after making the connections, the Contractor shall flush the connection so as to prevent contamination of the existing facilities. The Contractor shall take every precaution necessary to prevent dirt or debris from entering the main.
- G. Complete flushing and disinfection in accordance with AWWA C651, except as modified in these Specifications.
- H. Contractor to furnish chemicals and equipment, such as pumps and hoses, to accomplish disinfection.
- I. Water used to fill pipeline may be supplied using a temporary connection to existing distribution system. Provide protection against cross-connections and appropriate backflow preventer assembly as required by AWWA C651.
- J. Disinfect items installed or modified under this Project, intended to hold, transport, or otherwise contact potable water.

3.2 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Reference the Forwards to AWWA B300 and AWWA C651.

- B. Exercise extreme care in handling hypochlorites, as they may be dangerous to health.

3.3 GROUNDWATER OR SURFACE RUNOFF CONTAMINATION

- A. If it is not possible to keep the pipe and fittings dry during installation, every effort shall be made to assure that any of the water that may enter the pipe joint spaces contains an available chlorine concentration of approximately 25 mg/L. This may be accomplished by adding calcium hypochlorite granules to each length of pipe before it is lowered into a wet trench.
- B. If the main is flooded during construction, it shall be cleared of the flood water by draining and by flushing with potable water until clean. The section exposed to the flood water shall then be filled with chlorinated potable water which at the end of a twenty-four (24) hour holding period shall have a free chlorine residual of not less than 25 mg/L. The chlorinated water may then be drained or flushed from the main. After construction is completed, the main shall be disinfected using the continuous feed or slug method.
- C. If dirt and debris enters the pipe that, in the opinion of the City, will not be removed by the flushing operation, the interior of the pipe shall be cleaned by mechanical means and then shall be swabbed with a 1% hypochlorite disinfection solution. Cleaning with the use of a pig, swab, or “go-devil” should be undertaken only when such operations will not force mud or debris into pipe joint spaces.

3.4 FILLING PIPE

- A. Only City personnel shall operate existing City owned valves to prevent disinfecting solution from flowing back into the line supplying the water.
- B. Where permanent air release vents are not available, the Contractor shall install corporation stops at high points in the water line in order to evacuate trapped air.
1. All corporation stops shall be installed using an approved tapping saddle. No direct taps will be allowed.
 2. All locations for corporation stops shall either be shown on the City accepted Construction Drawings or as directed in the field by the City.
 3. All corporation stops, which were installed to facilitate evacuation of air from the water main shall be removed and plugged with a brass “cc” threaded plug after the water main is filled, and prior to pressure testing. All tap locations shall be shown on the As-Constructed Record Drawings.
- C. Refer to specific method of disinfection in this Specification for maximum filling velocity.
- D. Water supplied from a temporary, backflow protected connection to the existing distribution system or other approved supply source, shall flow at a constant measured rate into the newly installed water main.
- E. Prior to application of disinfectants, clean all pipelines of loose and suspended material. If continuous feed method or slug method of disinfection, as described in AWWA C651,

are used flush pipelines with potable water until clear of suspended solids and color. Provide hoses, temporary pipes, ditches, and other conduits as needed to dispose of flushing water without damage to adjacent properties.

- F. Flush service connections and hydrants. Flush distribution lines prior to flushing hydrants and service connections. Operate valves during flushing process at least twice during each flush.
- G. Allow freshwater and disinfectant solution to flow into pipe or vessel at a measured rate so chlorine-water solution is at specified strength. Do not place concentrated liquid commercial disinfectant in pipeline or other facilities to be disinfected before it is filled with water.

3.5 METHODS

A. General

1. The City, in accordance with AWWA C651, shall approve the chlorinating agent and method of application. The City has the authority to restrict the method of disinfection on a case by case basis.
2. The City shall sample and test water from the pipe system extremities until clear, potable water is obtained.
3. The Contractor shall properly and legally dispose of flushing and heavily chlorinated water. Do not allow flow into a waterway without neutralizing disinfectant residual. See appendix of AWWA C651 for acceptable neutralization methods.
4. Operate new valves and other appurtenances while the lines are filled with heavily chlorinated water.

B. Tablet Method

1. The tablet method consists of placing calcium hypochlorite tablets in the water main as it is being installed and then filling the main with potable water when installation is complete. This method may be used only if the pipes and appurtenances are kept clean and dry during construction.
2. Placing Calcium Hypochlorite Tablets
 - a. During construction, 5-gram calcium hypochlorite tablets shall be placed in each section of pipe. Also, one tablet shall be placed in each hydrant, hydrant branch, and other appurtenance.
 - b. The number of 5 gram tablets required for each pipe section shall be

$$0.0012d^2L$$

rounded to the next higher integer, where d is the inside pipe diameter, in inches, and L is the length of the pipe section, in feet. Reference Table

2, AWWA C651 for commonly used sizes of pipes.

- c. Tablets shall be attached to the top of the pipe by a food-grade adhesive.
- d. The adhesive shall be only on the broadside of the tablet attached to the surface of the pipe.
- e. If the tablets are attached before the pipe section is placed in the trench, their position shall be marked on the section to indicate that the pipe has been installed with the tablets at the top.

3. Filling and contact

- a. Introduce water into the pipes at a velocity no greater than one (1) foot per second (fps).
- b. The chlorinated water shall be retained in the lines for a minimum of twenty-four (24) hours. If the water temperature is less than 41° F, the water shall remain in the pipe at least forty-eight (48) hours.
- c. Detectable chlorine residual of not less than 10 mg/L shall be found at each sampling point after the twenty-four (24) hour or forty-eight (48) hour period.

C. Continuous-Feed Method

- 1. The continuous-feed method of disinfecting water mains consists of completely filling the main to remove all air pockets, flushing the completed main to remove the particulates, and filling the main with potable water.
- 2. Chlorinated water shall be introduced into the water lines at a point not more than ten (10) feet downstream from the beginning of the new main. Water entering the new main shall receive a dose of chlorine fed at a constant rate such that the water will have not less than 25 mg/L free chlorine.
 - a. The entire main shall be filled with the chlorine solution.
 - b. Reference Table 4, AWWA C651 for required chlorine amounts.
 - c. Prior to and during the disinfection process, valves shall be positioned so that the chlorine solution in the newly constructed main will not flow into water mains in active service.
- 3. The chlorinated water shall be retained in the main for a minimum of twenty-four (24) hours, at which time the treated water in all portions of the main shall have a free chlorine residual of not less than 10 mg/L.

D. Slug Method

- 1. The slug method consists of placing calcium hypochlorite granules in the main during construction, completely filling the main to eliminate all air pockets, flushing the main to remove particulates, and slowly flowing through the main a

slug of water dosed with chlorine to a concentration of 100 mg/L.

2. Placing Calcium Hypochlorite Granules
 - a. Calcium hypochlorite granules may only be used with prior written approval by the City.
 - b. During construction, calcium hypochlorite granules shall be placed at the upstream end of each section of pipe and at the upstream end of each branch main.
 - c. The quantity of granules used shall be as shown in Table 1, AWWA C651.
3. At a point not more than ten (10) feet downstream from the beginning of the new main, water entering the new main shall receive a dose of chlorine fed at a constant rate such that the water will not have less than 100 mg/L free chlorine.
4. The chlorine shall be applied continuously and for a sufficient period to develop a solid column, or “slug” of chlorinated water that will, as it moves through the main, expose all interior surfaces to a concentration of approximately 100 mg/L.
5. The free chlorine residual shall be measured in the slug as it moves through the main. If the free chlorine drops below 50 mg/L, the flow shall be stopped, chlorination equipment moved to the head of the slug, and as flow resumes, chlorine shall be applied to restore the free chlorine in the slug to not less than 100 mg/L.
6. Flow rate shall be set so that all interior surfaces are exposed to a chlorine concentration of approximately 100 mg/L for a minimum of three (3) hours.

3.6 PIPE AND FITTING INSTALLED AFTER CHLORINATION

- A. All pipes and fittings which will be installed after the pipe has been chlorinated or installed at connections to existing mains, which will not be subject to chlorination, shall be disinfected:
 1. The ends of the existing pipe shall be thoroughly cleaned both inside and outside before any new parts are installed.
 2. The ends of the existing pipe shall be sprayed with a concentrated chlorine solution (min. of 100 parts per million chlorine), both inside and outside. The inside of the pipe shall be sprayed as far back into the main as possible.
 3. All inside surfaces of any new material that will have contact with potable water shall be cleaned and sprayed with a concentrated chlorine solution (minimum of 100 parts per million chlorine). This includes middle rings and gaskets for mechanical couplings, punch joints, mechanical joints, and split sleeves.

3.7 FINAL FLUSHING

- A. After the applicable retention period, the heavily chlorinated water shall be flushed from the water lines until chlorine measurement show that the concentration in the water leaving the main is no higher than that generally prevailing in the system, or less than 1 mg/L.
- B. The Contractor shall be responsible for all necessary permits and to ensure that no environmental damage occurs from the flushed water line. Reference Appendix B of AWWA C651 for a list of neutralizing chemicals.

3.8 BACTERIOLOGICAL TESTS

- A. The Testing Agency shall collect water samples to test for bacteriological quality to show the absence of coliform and heterotrophic organisms in the pipeline. Testing shall be done after final flushing and disinfection procedures. Under no circumstances shall the main be put in service prior to bacteriological testing.
- B. The Contractor shall schedule with the Testing Agency for sample collection and bacteriological testing. The Contractor shall notify City of Greeley a minimum of 48 hours prior to the testing so the City can be onsite to observe.
- C. The Testing Agency, based upon AWWA C651, shall determine the number and frequency of samples.
- D. All test results shall be sent to the City for review and approval.
- E. Water mains shall not be placed in service until written release is obtained from the City.

3.9 REPETITION OF PROCEDURE

- A. If the initial disinfection, or subsequent disinfections, fails to produce satisfactory samples, the main shall be reflashed and resampled. If the samples are still not satisfactory, the continuous-feed or the slug method of chlorination shall be used to rechlorinate the main until satisfactory results are obtained.

SECTION 02512
DUCTILE IRON PIPE

PART 1 – GENERAL

1.1 SCOPE

- A. This section is a minimum guideline for furnishing and the installation of ductile-iron pipe (DIP) and fittings for water lines.
- B. Pipe shall be furnished complete with all fittings, flanges, specials, and other accessories.
- C. Refer to *Section 02510, Water Utility Distribution Piping*, for additional requirements.

1.2 REFERENCES

- A. American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - 1. C104/A21.4, *Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water*, latest revision.
 - 2. C105/A21.5, *Polyethylene Encasement for Ductile-Iron Pipe Systems*, latest revision.
 - 3. C110/A21.10, *Ductile-Iron and Gray-Iron Fittings*, latest revision.
 - 4. C111/A21.11, *Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings*, latest revision.
 - 5. C115/A21.15, *Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges*, latest revision.
 - 6. C116/A21.16-03, *Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service*, latest edition.
 - 7. C150/A21.50, *Thickness Design of Ductile-Iron Pipe*, latest revision.
 - 8. C151/A21.51, *Ductile-Iron Pipe, Centrifugally Cast, for Water*, latest revision.
 - 9. C153/A21.53, *Ductile-Iron Compact Fittings for Water Service*, latest revision.
 - 10. C219, *Bolted, Sleeve-Type Couplings for Plain-End Pipe*, latest revision.
 - 11. C600, *Installation of Ductile-Iron Water Mains and Their Appurtenances*, latest revision.
- B. American Society of Mechanical Engineers/American National Standards Institute (ASME/ANSI)

1. B16.1, *Cast Iron Pipe Flanges and Flanged Fittings*, latest revision.

C. ASTM International (ASTM)

1. A153/A153M, *Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware*, latest revision.

2. A536, *Standard Specification for Ductile Iron Castings*, latest revision.

3. F3125/F3125M, *Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength*, latest revision.

D. American Water Works Association (AWWA)

1. M41, *Manual of Water Supply Practices, Ductile-Iron Pipe and Fittings*, latest revision.

1.3 SUBMITTALS

A. See *Section 02510, Water Utility Distribution Piping* for Submittal Requirements.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. All DIP shall be supplied by one manufacturer.

B. Handling

1. Use slings, pipe tongs or skids.

2. Do not drop pipe or fittings including dropping on cushions.

3. Do not skid or roll pipe into pipe already on the ground.

4. Do not damage pipe coating or lining.

5. Do not use hooks.

6. Care must be taken to prevent damage to the pipe and fittings by impact, bending, compression, or abrasion.

C. Storage

1. Store and use pipe lubricants in a manner which will avoid contamination.

2. Pipe, gaskets, and all other installation materials shall be stored in accordance with the manufacturer's specifications.

3. Pipe shall be stored on a surface that provides even support for the pipe barrel. Pipe shall not be stored in such a way as to be supported by the bell.

4. Do not exceed maximum stacking heights listed in AWWA C600, Tables 6.

PART 2 – PRODUCTS

2.1 GENERAL

- A. Materials in contact with potable water shall conform to NSF 61 acceptance.
- B. Pipe manufacturer shall submit certification that source manufacturing facility has been producing ductile iron pipe of the specified diameters, dimensions, and standards for a period of not less than 10 years. Testing of pipe required by AWWA A21.51 shall be conducted in testing and laboratory facilities located in the USA and operating under USA laws and regulations. Pipe shall be handled during manufacture and shipped without nesting (without insertion of one pipe inside another).

2.2 DUCTILE-IRON PIPE – SLIP JOINT

- A. General
1. This specification shall cover slip joint DIP in four-inch (4”) through twenty-four inch (24”) nominal diameters.
 2. DIP shall be manufactured in accordance with AWWA C151.
- B. If corrosion level is Medium-High or High, all DIP shall be zinc coated in accordance with ASTM A153/153M.
- C. Pipe joints shall be “push-on single gasket” type conforming to applicable requirements of AWWA C111.
- D. DIP shall have normal laying lengths of either eighteen (18) feet or twenty (20) feet. Random pipe lengths are not acceptable.
- E. Iron used in the manufacture of DIP for these specifications shall have:
1. Minimum tensile strength – 60,000 psi
 2. Minimum yield strength – 42,000 psi
 3. Minimum elongation – 10%
- F. DIP shall have standard thickness cement mortar lining in accordance with AWWA C104.
- G. DIP shall have a bituminous coating, minimum one (1) mil thick, on the pipe exterior, unless otherwise specified.
- H. As shown in AWWA C151, slip joint DIP shall conform, at a minimum, to the following pressure classes:

TABLE 2.1-G: Pressure Class and Wall Thickness – Slip Joint DIP

Diameter (inch)	Pressure Class (psi)	Nominal Wall Thickness (inch)
4	350	0.25
6	350	0.25
8	350	0.25
12	350	0.28
16	350	0.34
20	300	0.36
24	300	0.40
Higher pressure class pipe will be required when the W&S Dept determines that excessive dead loads, pressures, or other conditions warrant increased wall thickness.		

2.3 DUCTILE-IRON PIPE – MECHANICAL JOINT

- A. General
1. This specification shall cover mechanical joint DIP in four-inch (4”) through twenty-four inch (24”) nominal diameters.
 2. All DIP shall be manufactured in accordance with AWWA C151.
- B. If corrosion level is Medium-High or High, all DIP shall be zinc coated in accordance with ASTM A153/153M.
- C. Pipe joint shall be “mechanical single gasket” type conforming to applicable requirements of AWWA C111.
- D. DIP shall have normal laying lengths of either eighteen (18) feet or twenty (20) feet.
- E. All mechanical joint glands shall be sized and drilled in accordance with AWWA C111.
- F. Iron used in the manufacture of DIP for these specifications shall have:
1. Minimum tensile strength – 60,000 psi
 2. Minimum yield strength – 42,000 psi
 3. Minimum elongation – 10%
- G. DIP shall have standard thickness cement mortar linings in accordance with AWWA C104.
- H. DIP shall have a bituminous coating, minimum one (1) mil thick, on the pipe exterior, unless otherwise specified.
- I. As shown in AWWA C151, mechanical joint DIP shall conform, at a minimum, to the

following pressure classes:

TABLE 2.2-H: Pressure Class and Wall Thickness – Mechanical Joint Pipe

Diameter (inch)	Pressure Class (psi)	Nominal Wall Thickness (inch)
4	350	0.25
6	350	0.25
8	350	0.25
12	350	0.28
16	250	0.30
20	250	0.33
24	250	0.33

Higher pressure class pipe will be required when the W&S Dept determines that excessive dead loads, pressures, or other conditions warrant increased wall thickness.

- A. Bolts and nuts for all fitting, mechanical joints, and appurtenances
1. All other applications shall be corrosion resistant, high strength, low-alloy steel (blue bolts) in accordance with ASTM A242 and ANSI/AWWA C111/A21.11 (latest version). Bolts shall meet or exceed ASTM A588, Grade A and nut shall meet or exceed ASTM A563 Grade, C3. Coating shall be Xylan 1424 top coat colored coded blue and zinc plating base coat. Acceptable bolts and nuts are:
 2. Romac Industries, Inc
 3. Or approved equivalent.

2.4 MECHANICAL JOINT RESTRAINTS

- A. General
1. Mechanical joint restraints shall be used for restraining fittings, valves, hydrants, and fire sprinkler lines.
 2. All mechanical joint pipe restraints shall be incorporated in a follower gland and shall include a restraining mechanism which, when actuated, imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. Twist-off nuts, sized same as tee-head bolts, shall be used to ensure proper actuating of restraining devices.
- B. Glands shall be manufactured of ductile-iron conforming to ASTM A536, grade 60-42-10. Restraining devices shall be of ductile-iron heated to a minimum hardness of 370 BHN. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee-head bolts conforming to AWWA C153.
- C. Mechanical joint restraint devices shall have the following minimum working pressures

and shall not be less than piping working pressure ratings:

1. 350 psi with a minimum safety factor of 2:1, for four-inch (4") through twenty-four inch (24") diameter.
2. 250 psi with a minimum safety factor of 2:1, for larger than twenty-four inch (24") diameter.

D. Acceptable manufacturers and styles are:

1. Mechanical Joint Restraint
 - a. EBAA Iron, Inc. – MEGALUG, SERIES 1100
 - b. Uni-Flange Corp. – SERIES 1400
 - c. Romac Industries, Inc.
2. Slip Joint Restraint
 - a. EBAA Iron, Inc. – MEGALUG, SERIES 1700
 - b. Uni-Flange Corp. – SERIES 1450
3. Romac Industries, Inc.

2.5 DUCTILE-IRON PIPE – FLANGED JOINT

A. General

1. This specification shall cover flanged joint DIP in four-inch (4") through twenty-four inch (24") nominal diameters.
2. DIP shall be manufactured in accordance with AWWA C151.

B. Pipe joints shall be "flanged single gasket" type conforming to applicable requirements of AWWA C111.

C. All pipe flanges shall be sized and drilled in accordance with ASME B16.1, Class 125.

D. Iron used in the manufacture of DIP for these specifications shall have:

1. Minimum tensile strength – 60,000 psi
2. Minimum yield strength – 42,000 psi
3. Minimum elongation – 10%

E. DIP shall have standard thickness cement mortar linings in accordance with AWWA C104.

F. DIP shall have a bituminous coating, minimum one (1) mil thick, on the pipe exterior,

unless otherwise specified.

- G. As shown in AWWA C115, flanged DIP shall conform, at a minimum, to pressure class 250:

TABLE 2.3-G: Pressure Class and Wall Thickness – Flanged Joint DIP

Diameter (inch)	Pressure Class (psi)	Nominal Wall Thickness (inch)
4	250	0.32
6	250	0.34
8	250	0.36
12	250	0.40
16	250	0.43
20	250	0.45
24	250	0.47
Higher pressure class pipe will be required when the W&S Dept determines that excessive dead loads, pressures, or other conditions warrant increased wall thickness.		

- H. Bolts and nuts for all fitting and appurtenances
1. All buried applications shall be corrosion resistant, high strength, low-alloy steel (blue bolts) in accordance with ASTM A242 and ANSI/AWWA C111/A21.11 (latest version). Bolts shall meet or exceed ASTM A588, Grade A and nut shall meet or exceed ASTM A563 Grade, C3. Coating shall be Xylan 1424 top coat colored coded blue and zinc plating base coat. Acceptable bolts and nuts are:
 2. In all other applications shall be manufactured to the dimensional specification of ASME B18.2.1 and B18.2.2 and conform to ASTM F593 and F594 Type 316 stainless steel with minimum tensile strength of 75,000 PSI in accordance with ANSI/AWWA C111/A21.11 (latest version).
 - a. Romac Industries, Inc
 - b. Or approved equivalent.

2.6 DUCTILE-IRON PIPE – RESTRAINED JOINT

- A. General
1. This specification shall cover restrained joint DIP in four-inch (4”) through twenty-four inch (24”) nominal diameters.
 2. DIP shall be manufactured in accordance with AWWA C151.
- B. Pipe joints shall be “restrained push-on single gasket” type conforming to applicable requirements of AWWA C111.

- C. Restrained ductile-iron pipe shall have normal laying lengths of either eighteen (18) feet or twenty (20) feet. Random pipe lengths are not acceptable.
- D. Iron used in manufacture of DIP for these specifications shall have:
1. Minimum tensile strength – 60,000 psi
 2. Minimum yield strength – 42,000 psi
 3. Minimum elongation – 10%
- E. DIP shall have standard thickness cement mortar linings in accordance with AWWA C104.
- F. DIP shall have a bituminous coating, minimum one (1) mil thick, on the pipe exterior, unless otherwise specified.
- G. As shown in AWWA C151, restrained joint DIP shall conform, at a minimum to the following pressure classes:

TABLE 2.4-G: Pressure Class and Wall Thickness – Restrained Joint DIP

Diameter (inch)	Pressure Class (psi)	Nominal Wall Thickness (inch)
4	350	0.25
6	350	0.25
8	350	0.25
12	350	0.28
16	350	0.34
20	300	0.36
24	300	0.40
Higher pressure class pipe will be required when the W&S Dept determines that excessive dead loads, pressures, or other conditions warrant increased wall thickness.		

- H. Acceptable manufacturers for boltless, restrained joint pipe are:
1. U. S. Pipe - TR FLEX
 2. Pacific States Pipe - TYTON AND FASTITE RESTRAINED JOINT
 3. American D.I.P - FLEX-RING or Lok-Ring
 4. Clow Corp. – Super-Lock
 5. Or approved equivalent.

- I. Bell type restrained joint pipe shall incorporate a mechanical joint type socket with a mechanical joint restraint.

2.7 MECHANICAL JOINT RESTRAINTS

- A. Reference construction specification *Section 02510, Water Utility Distribution Piping* for additional requirements for mechanical joint restraints.

2.8 TRACER WIRE AND TEST STATIONS

- A. Reference construction specification *Section 02510, Water Utility Distribution Piping* for additional requirements for tracer wire and test stations.

2.9 MECHANICAL COUPLINGS

- A. Reference construction specification *Section 02510, Utility Distribution Piping* for additional requirements for couplings.

2.10 FITTINGS

- A. Reference construction specification *Section 02510, Utility Distribution Piping* for additional requirements for fittings.

2.11 GASKETS

- A. Gaskets in contact with potable water shall be NSF 61 certified.
- B. Gasket pressure rating to equal or exceed the system hydrostatic test pressure.

2.12 POLYETHYLENE ENCASEMENT

- A. All buried ductile-iron pipe and fittings shall be encased in V-Bio polyethylene in accordance with AWWA C105, Method A.
- B. Polyethylene encasement shall be eight (8) mil minimum thickness.

PART 3– EXECUTION

3.1 INSPECTION

- A. Examine pipe and fittings for cracks, flaws, broken or loose lining, dents, abrasions, and other defects. Damaged or flawed pipe shall be rejected, marked, and removed from the site.
- B. Verify size, material, joint types, elevation, horizontal location, and pipe service of existing pipelines to be connected to new pipelines.

3.2 PREPARATION

- A. Trenching, backfilling, and compaction.
 - 1. Reference construction specification *Section 02315, Excavation and Fill*.

- B. Inspect pipe and fittings before installation, clean ends thoroughly, and remove foreign matter and dirt from inside.
- C. Cutting the pipe.
 - 1. Cut pipe smooth, straight and at right angles to the pipe axis.
 - 2. Do not damage the pipe or cement lining.
 - 3. Cut pipe with milling type cutter, rolling pipe cutter, or abrasive blade cutter. Do not flame cut.
 - 4. Grind cut ends and rough edges smooth.
 - 5. Dress cut ends as required for the type of joint to be made, as recommended by pipe manufacturer. Bevel the cut end for push-on joints.

3.3 INSTALLATION

- A. Install buried pipe in accordance with these specifications, City of Greeley accepted Construction Drawings, and AWWA M41.
- B. Join pipe and fittings in accordance with manufacturer's instructions, unless otherwise shown or specified.
- C. Pipe Laying:
 - 1. See *Section 02510, Water Utility Distribution Piping* for information on pipe laying.
- D. Tolerances:
 - 1. See *Section 02510, Water Utility Distribution Piping* for allowable tolerances.
- E. Field Joints
 - 1. Use push-on joints for buried pipe except where indicated otherwise on the Construction Drawings.
 - 2. Use flanged joints at unburied locations unless indicated otherwise on the Construction Drawings.
 - 3. All joints shall be watertight and free from leaks.
 - 4. Use Mega-Lug, or approved equivalent, retainer gland on all exposed mechanical joints for restraint.
 - 5. Block, anchor, or harness all mechanical couplings, push-on or mechanical joints.
 - 6. Install concrete blocking against undisturbed earth in a manner to allow access to joints.

F. Polyethylene Encasement

1. Repair rips, punctures or other damage with adhesive tape or with a short length of polyethylene encasement wrapped around pipe and secured in place.
2. Maintain a sealed encasement on pipe with the polyethylene. Tape to existing lines and the ends of encasement sections.
3. Use loose polyethylene encasement at all buried locations including fittings with flanged or mechanical joints.
4. Polyethylene encasement shall be installed per City of Greeley Standard Drawings.

G. Curves in Trench Alignments

1. See *Section 02510, Water Utility Distribution Piping* for allowable joint deflection.

3.4 JOINT INSTALLATION

A. Push-On Joints

1. Remove all dirt, oil, grit, excess coating and other foreign matter from the inside of the bell and the outside of the spigot.
2. Insert the gasket.
3. Apply a thin film of pipe lubricant to either the inside surface of the gasket, the spigot end of the pipe or both.
4. Do not permit the joint surfaces to come in contact with the ground.
5. Make sure the pipe is marked with a depth mark before assembly to ensure that the spigot is inserted to the depth mark according to manufacturer's recommendations.
6. Do not stab pipe.

B. Mechanical Joints

1. Remove all dirt, oil, grit, excess coating and other foreign matter from the inside of the bell and the outside of the spigot.
2. Insert the gasket.
3. Apply a thin film of pipe lubricant to either the inside surface of the gasket, the spigot end of the pipe or both.
4. Do not permit the joint surfaces to come in contact with the ground.
5. Make sure the pipe is marked with a depth mark before assembly to ensure that

the spigot is inserted to the depth mark according to manufacturer's recommendations.

6. Do not stab pipe.
7. Tighten nuts alternately on opposite sides of the pipe to produce equal pressure on all parts of the gland.
8. Use a torque limiting wrench with the following ranges:

TABLE 3.4-B: Torque Wrench Ranges

Pipe Diameter	Bolt Diameter	Torque (ft-lb)
4"-24"	¾"	75-90

9. Holes in mechanical joint bells shall straddle the top (or side for vertical piping) centerline.

C. Flanged Joints

1. Extend pipe completely through screwed-on flanges.
2. Machine finish the pipe end and flange face in a single operation.
3. Eliminate any restraints on pipe that would prevent uniform gasket compression or cause unnecessary stress in the flanges.
4. Do not assemble mechanical connections until all flanged joints have been tightened.
5. Alternately tighten bolts spaced on opposite sides of the pipe to assure uniform gasket compression.
6. Holes in flanges shall straddle the top (or side for vertical piping) centerline.

3.5 FIELD QUALITY CONTROL

- A. Reference *Section 02510, Water Utility Distribution Piping*.

3.6 PIPELINE DISINFECTION

- A. Reference *Section 02511, Disinfection of Water Utility Distribution*.

SECTION 02513

POLYVINYL CHLORIDE (PVC) PRESSURE PIPE

PART 1 – GENERAL

1.1 SCOPE

- A. This section includes materials and installation procedures for polyvinyl chloride (PVC) pressure pipe for potable and non-potable water distribution.
- B. Pipe shall be furnished complete with all fittings, specials, and other accessories.
- C. Refer to specification section 02510 Water Utility Distribution Piping, for additional requirements.

1.2 REFERENCES

- A. American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - 1. C900, *Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In., For Water Distribution*, latest revision.
- B. ASTM International (ASTM)
 - 1. D1784, *Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds*, latest revision.
 - 2. F477, *Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe*, latest revision.
- C. American Water Works Association (AWWA)
 - 1. M23, *Manual of Water Supply Practices, PVC Pipe: Design and Installation*, latest revision.
- D. National Sanitation Foundation (NSF)
 - 1. Standard No. 61 – *Drinking Water System Components – Health Effects*, latest revision.
- E. Plastic Pipe Institute (PPI)
 - 1. TR-3 – *Policies and Procedures for Developing Hydrostatic Design Basis (HDB), Pressure Design Basis (PDB), Strength Design Basis (SDB), and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe*, latest revision.

1.3 SUBMITTAL REQUIREMENTS

- A. See *Section 02510, Water Utility Distribution Piping* for general submittal requirements.
- B. Additional submittal requirements for PVC include:
 - 1. Pipe Manufacturer
 - 2. Pipe Class / Pressure Rating
 - 3. Color
 - 4. Recommended Minimum bending Radius
 - 5. Recommended Maximum Safe Pull Force (For Fusible PVC)
 - 6. Fusion Technician qualifications indicating conformance with this specification.
(For Fusible PVC)

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. All PVC pipe shall be supplied by one manufacturer.
- B. Handling.
 - 1. Use wide fabric choker slings.
 - 2. Do not drop pipe or fittings including dropping on cushions.
 - 3. Do not use hooks.
 - 4. Polyvinyl chloride (PVC) pipe has reduced flexibility and impact resistance as temperatures approach and drop below freezing. Extra care should be used in handling and installing PVC pipe during cold weather.
 - 5. Care must be taken to prevent damage to the pipe and fittings by impact, bending, compression, or abrasion.
- C. Storage.
 - 1. Store and use pipe lubricants in a manner that will avoid contamination.
 - 2. Pipe shall be stored in accordance with the manufacturer's specifications.
 - 3. Pipe, gaskets, and all other installation materials shall be stored in accordance with the manufacturer's specifications.
 - a. Pipe shall be stored on a surface that provides even support for the pipe barrel. Pipe shall not be stored in such a way as to be supported by the bell.

- b. No pipe stored outside and exposed to sunlight shall exceed the manufacturer's recommended exposure time. This time shall begin from the date of manufacture.
- c. If the exposure time will be greater than the manufacturer's recommended time, the pipe shall be covered with an opaque material. Air circulation shall be provided under the covering.
- d. Pipe that exhibits excessive ultraviolet deterioration and cracking, which in the opinion of the City degrades the pipe quality, shall not be used.

PART 2– PRODUCTS

2.1 GENERAL

- A. Materials in contact with potable water shall conform to NSF 61 acceptance.
- B. Pipe manufacturer shall submit certification that source manufacturing facility has been producing PVC pipe of the specified diameters, dimensions, and standards for a period of not less than 10 years. Testing of pipe required by AWWA C900 shall be conducted in testing and laboratory facilities located in the USA and operating under USA laws and regulations. Pipe shall be handled during manufacture and shipped without nesting (without insertion of one pipe inside another).

2.2 POLYVINYL CHLORIDE (PVC) PIPE – SLIP JOINT

- A. General.
 - 1. This specification shall cover slip joint PVC pipes in 6-inch (6”) through 24-inch (24”) nominal diameters with cast iron equivalent outside diameters.
 - 2. All PVC pipe shall be manufactured in accordance with AWWA C900-16.
 - 3. Pipe shall be blue in color for potable water mains and purple for non-potable water mains.
 - a. Purple PVC pipe markings shall include the designation “CAUTION NON-POTABLE WATER” OR “CAUTION RECLAIMED WATER” in addition to the standard factory labeling required by AWWA.
- B. Pipe joints shall be made using an integral bell with elastomeric gasket push-on type joint or using machined couplings of a sleeve type with rubber ring gaskets and machined pipe ends to form a push-on type joint.
- C. All sizes of pipe under these specifications shall be pressure class as shown on the City accepted Constructed Drawings. Pressure Class 235 (DR-18) shall be the minimum pipe class accepted.
- D. Each length of pipe shall be a standard laying length of twenty (20) feet. Random lengths are not acceptable.

- E. Polyvinyl chloride (PVC) pipe materials shall be made from Class 12454A of 12454B virgin compounds as defined in ASTM D1784. All compounds shall qualify for a rating of 4000 psi for water at 73.4°F (23°C) per the requirements of Plastic Pipe Institute (PPI), *TR-3*, and complies with the National Sanitation Foundation Standard, *No. 61*, for water service.
- F. Elastomeric gaskets shall conform to ASTM F477.

2.3 POLYVINYL CHLORIDE PIPE (PVC) – RESTRAINED JOINT

- A. General.
 - 1. This specification shall cover restrained joint PVC pipe in 6-inch (6”) through 24-inch (24”) nominal diameters with cast iron equivalent outside diameters.
 - 2. All PVC pipe shall be manufactured in accordance with AWWA C900.
 - 3. Pipe shall be blue in color for potable water mains and purple for non-potable water mains.
 - a. Purple PVC pipe markings shall include the designation “CAUTION NON-POTABLE WATER” OR “CAUTION RECLAIMED WATER” in addition to the standard factory labeling required by AWWA..
- B. Pipe joints shall be non-metallic restrained joint design by utilizing precision-machined grooves on the pipe and in the coupling. When aligned, a nylon spline is inserted, resulting in a fully circumferential restrained joint that locks the pipe and coupling together. A flexible elastomeric seal (o-ring) in the coupling provides a hydraulic pressure seal.
- C. All sizes of pipe under these specifications shall be pressure class as shown on the City accepted Constructed Drawings. Pressure Class 235 (DR-18) shall be the minimum pipe class accepted.
- D. Each length of pipe shall be a standard laying length of twenty (20) feet. Random lengths are not acceptable.
- E. Polyvinyl chloride pipe materials shall be made from Class 12454A of 12454B virgin compounds as defined in ASTM D1784. All compounds shall quality for a rating of 4000 psi for water at 73.4°F (23°C) per the requirements of Plastic Pipe Institute (PPI), *TR-3*, and complies with the National Sanitation Foundation Standard, *No. 61*, for water service.
- F. Elastomeric gaskets shall conform to ASTM F477.
- G. Acceptable restrained joint PVC manufacturers are:
 - 1. Certain Teed – CERTA-LOK C900/RJ
 - 2. Or approved equivalent.
- H. Acceptable high deflection restrained joint PVC manufacturers are:

1. Certain Teed – HD (High Deflection)
2. Or approved equivalent.

2.4 POLYVINYL CHLORIDE (PVC) PIPE – FUSED

A. General.

1. This specification shall cover slip joint PVC pipes in 6-inch (6”) through 24-inch (24”) nominal diameters with cast iron equivalent outside diameters.
2. All PVC pipe shall be manufactured in accordance with AWWA C900.
3. Pipe shall be blue in color for potable water mains and purple for non-potable water mains.
 - a. Purple PVC pipe markings shall include the designation “CAUTION NON-POTABLE WATER” OR “CAUTION RECLAIMED WATER” in addition to the standard factory labeling required by AWWA.

B. All sizes of pipe under these specifications shall be pressure class as shown on the City accepted Constructed Drawings. Pressure Class 235 (DR-18) shall be the minimum pipe class accepted.

C. Each length of pipe shall be a standard laying length of twenty (20) feet or more. Random lengths are not acceptable

D. Polyvinyl chlorine (PVC) pipe materials shall be made from Class 12454A of 12454B virgin compounds as defined in ASTM D1784. All compounds shall qualify for a rating of 4000 psi for water at 73.4°F (23°C) per the requirements of Plastic Pipe Institute (PPI), TR-3, and complies with the National Sanitation Foundation Standard, No. 61, for water service.

E. Fusion Technician

1. Fusion Technician shall be fully qualified by the pipe supplier to install Fusible PVC of the type(s) and size(s) being used. Qualifications shall be current as of the actual date of fusion performance on the project.

F. Fusion Joints

1. Unless otherwise specified, fusible PVC pipe lengths shall be assembled in the field with butt-fused joints. Contractor shall follow the pipe suppliers written guidelines for this procedure. All Fusion joints shall be completed as described in these specifications.

2.5 MECHANICAL JOINT PIPE RESTRAINTS

- A. Refer to construction specification *Section 02510, Water Utility Distribution Piping* for additional requirements for mechanical joint pipe restraint.
- B. Acceptable manufacturers for PVC pipe are:

1. Mechanical joint Restraint:
 - a. EBAA Iron, Inc. – MEGALUG, SERIES 2000 PV
 - b. Uni-Flange Corp. – SERIES 1500 Slip joint restraint:
 - c. EBAA Iron, Inc. – MEGALUG, SERIES 1500
 - d. Uni-Flange Corp. – SERIES 1390
 - e. ROMAC Industries, Inc

2.6 TRACER WIRE AND TEST STATIONS

- A. Reference construction specification *Section 02510, Utility Distribution Piping* for additional requirements for tracer wire and test stations.

2.7 FITTINGS AND COUPLINGS

- A. Reference construction specification *Section 02510, Utility Distribution Piping* for additional requirements for fittings and couplings.

PART 3– EXECUTION

3.1 INSPECTION

- A. In addition to any deficiencies covered by AWWA M23, PVC pipe which has any of the following visual defects will be rejected:
 1. Pipe which is sufficiently out-of-round to prohibit proper joining or be able to pass a mandrel test.
 2. Improperly formed bell and spigot ends.
 3. Fractured, cracked, chipped, dented, abrasions, or otherwise damaged pipe.
 4. Pipe that has been damaged during shipment or handling. Acceptance of the pipe at point of delivery will not relieve the Contractor of full responsibility for any defects in material of the completed pipeline.
- B. Damaged or flawed pipe shall be rejected, marked, and removed from the site.

3.2 PREPARATION

- A. Trenching, backfilling, and compaction.
 1. Reference construction specification *Section 02315, Excavation and Fill*.

3.3 FUSION PROCESS

- A. General

1. Fusible PVC pipe to be handled in a safe and non-destructive manner before, during and after the fusion process and in accordance with this specification and the pipe's supplier's guidelines
2. Fusible PVC pipe will be fused by a qualified fusion technician, as documented by the pipe supplier
3. Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine
4. Only appropriately sized and outfitted fusion machines that have been approved by the pipe manufacturer shall be used in the fusion process. Fusion machines must incorporate the following elements:
 - a. Heat Plate – Heat plates shall be in good condition with no deep gouges or scratches. Plates shall be clean and free of any debris or contamination. Heater controls shall function properly; cord and plug shall be in good condition. The appropriately sized heat plate shall be capable of maintaining a uniform and consistent heat profile and temperature for the size of pipe being fused, per the pipe supplier's guidelines.
 - b. Carriage – Carriage shall travel smoothly with no binding at less than 50 psi. Jaws shall be in good condition with proper inserts for the pipe size being fused. Insert pins shall be installed with no interference to carriage travel.
 - c. General Machine – Overview of machine body shall yield to obvious defects, missing parts, or potential safety issues during fusion.
 - d. Data Logging Device – An approved data logging device with current version of pipe supplier's recommendation and compatible software shall be used. Datalogging device operation and maintenance manual shall be with the unit at all times. If fusing for extended periods of time, an independent 110 V power source shall be available to extend battery life.
5. Other equipment specifically required for the fusion process shall include the following:
 - a. Pipe rollers shall be used for support of the pipe to either side of the machine
 - b. A weather protection canopy that allows full machine motion of the heat plate, fusion assembly and carriage shall be provided for fusion in inclement, extreme temperatures, and / or windy weather, per the pipe supplier's recommendations
 - c. An infrared (IR) pyrometer for checking pipe and heat plate temperatures.
 - d. Fusing machine operations and maintenance manual shall be kept with the fusion machine at all times.

- e. Face blades specifically designed for cutting fusible PVC pipe shall be used.

B. Joint Recording

- 1. Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine. The fusion data logging and joint report shall be generated by software developed specifically for the butt-fusion of fusible polyvinyl chloride pipe. The software shall register and / or record the parameters required by the supplier and these specifications. Data not logged by the data logger shall be logged manually and be included in the Fusion Technician's joint report.

3.4 FUSION PIPE INSTALLATION

A. General Installation

- 1. Installation guidelines from the pipe supplier shall be followed for all installations.
- 2. The fusible PVC pipe will be installed in a manner so as not to exceed the recommended bending radius.
- 3. Where fusible PVC pipe is installed by pulling in tension, the recommended Safe Pulling Forces established by the pipe supplier shall not be exceeded.

B. Connections to Existing and New Piping Systems

- 1. Approximate locations for existing piping systems are shown in the construction documents. Prior to making connection into existing piping systems, the contractor shall:
 - a. Field verify locations, size, piping material, and piping system of the existing pipe.
 - b. Obtain all required fittings, which may include saddles, sleeve type couplings, flanges, tees, or other as shown in the construction documents.
 - c. Allow all piping that has been installed to relax for a period of 24 hours or longer before making final connections.
 - d. Have installed all temporary pumps and / or pipes in accordance with the established connection plans.
- 2. Unless otherwise approved, new piping systems shall be completely assembled and successfully tested prior to making connections into existing pipe systems.

C. Cutting the pipe.

- 1. Cut pipe smooth, straight and at right angles to the pipe axis with saws or pipe cutters designed specifically for the material.

2. Remove burrs and wipe off all dust from the jointing surfaces.
3. Bevel the cut end in accordance with manufacturer's recommendation.
4. Do not disturb previously installed joints during cutting operations.

D. Field joints.

1. Use push-on joints for buried pipe except where indicated otherwise on the Construction Drawings.
2. Dirt, oil, grit, and other foreign matter shall be removed from the inside of the bell and the outside of the spigot.
3. A thin film of lubricant shall be applied to the inside surface of the gasket and the spigot end of the pipe, per the manufacturer's recommendation.
4. The lubricated joint surface shall be kept clean until joined.

E. Bending

1. Bending of pipe can be up to 75% of manufacturers recommendation.

3.5 INSTALLATION

A. Reference construction specification *Section 02510, Water Utility Distribution Piping* for additional requirements for installation of pipe.

B. Install buried pipe in accordance with these specifications, City of Greeley accepted Construction Drawings, and AWWA M23.

C. Joints.

1. The pipe shall be joined to the tolerances recommended by the manufacturer (i.e. home line).
2. Stabbing of the pipe shall not be allowed.
3. Previously completed joints shall not be disturbed during the jointing operation.
4. All joints shall be watertight and free from leaks.
5. Test all pipe under concrete and asphalt construction prior to placing concrete to asphalt.
6. Install concrete blocking against undisturbed earth in a manner to allow access to joints.

D. Curves in Trench Alignment.

1. PVC pressure pipe may be curved to change alignment or grade or to avoid obstructions. The allowable joint offset for PVC pressure pipe is provided in the table below:

TABLE 3.3-D: Maximum PVC Pipe Joint Deflection (or per manufacturer's limits which ever is more restrictive)

Pipe Diameter (in)	Maximum Joint Deflection (°)
8"	1°
12"	1°
16"	1°
HD Couplings	5.0°

2. In making the pipe conform to the curve, the pipe lengths should first be assembled in a straight line and then curved as they are lowered into the trench.

3.6 FIELD QUALITY CONTROL

- A. Reference construction specification *Section 02510, Water Utility Distribution Piping* for additional requirements for field quality control.

3.7 PIPELINE DISINFECTION

- A. Reference construction specification *Section 02511 Disinfection of Water Utility Distribution* for additional requirements for pipeline disinfection.

SECTION 02514**WATER SERVICE LINES, METERS, AND APPURTENANCES****PART 1 – GENERAL****1.1 SCOPE**

- A. This section is a minimum guideline for furnishing and installation of corporation stops, service lines, meters, meter setters, and meter pits.
- B. Service lines are from the water main to the meter box.
- C. All services shall be metered with the exception of fire sprinkler lines.

1.2 REFERENCES

- A. American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - 1. C800, Underground Service Line Valves and Fittings, latest revision.
 - 2. C904, Cross-Linked Polyethylene (PEX) Pressure Tubing, latest revision.
- B. ASTM International (ASTM)
 - 1. F876, *Standard Specification for Crosslinked Polyethylene (PEX) Tubing*, latest revision.
 - 2. F2080, *Standard Specification for Cold-Expansion Fittings with Metal Compression-Sleeves for Crosslinked Polyethylene (PEX) Pipe and SDR 9 Polyethylene of Raised Temperature (PE-RT) Pipe*.
 - 3. B88, Standard Specification for Seamless Copper Water Tube, latest revision.

1.3 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. The products shall be handled, stored and protected in a manner that will prevent damage to materials, coatings, and finishes.
- B. All material shall be kept free from dirt, oil, and grease.
- C. All material shall be new.

1.4 INSTALLATION OF SERVICES

- A. All water services 1 ½-inch (1 ½”) and 2-inch (2”) shall be fitted with an approved backflow prevention device.
 - 1. Any case where a cross-connection potential exists, all taps must be fitted with a backflow prevention device.

2. Backflow prevention devices shall be installed according to the Colorado Department of Public Health and Environment (CDPHE), Water Quality Control Division's Cross-Connection Control Manual, latest edition, and tested upon installation and every year thereafter by a certified cross-connection control technician.
 - a. Product information sheets for proposed backflow prevention devices shall be submitted to the Water and Sewer Department for acceptance during the building review process and prior to requesting building permits.
 - b. Test reports shall be forwarded to the Water and Sewer Department.
 - c. The Water and Sewer Department reserves the right to enhance the requirements of the CDPHE based on City requirements.
- B. There shall be no physical connection between any potable water service line, inside or outside of any property or building, and any pipes, pumps, hydrants, or tanks, whereby any unsafe or contaminated water (including steam condensation or cooling water) could be discharged or drawn into the potable water system.
- C. Pressure reducing valves may be required according to the plumbing regulations.
- D. No pressure booster shall be allowed unless adequate backflow protection is used.

PART 2 – PRODUCTS

2.1 TAPPING SADDLES

- A. 1-inch (1") inclusive through 2-inch (2") tapping saddles shall be constructed of materials in accordance with one of the following descriptions.
 1. Bronze body.
 2. Nuts, bolts, and accessories shall be in accordance with the manufacturer's specifications.
 3. Acceptable manufacturers and models of 1-inch (1") inclusive through 2-inch (2") tapping saddles are:

TABLE 2.1-A: 1" – 2" Tapping Saddles

Manufacturer	Model	Pipe Material
Mueller	BR 2 B CC	DIP, CIP
Mueller	H-13000 CC	C900 PVC
Ford	Style 202B CC	DIP, CIP
Ford	Style S90 CC Hinged	C900 PVC

Or approved equivalent.

- B. 4-inch (4”) and larger taps on new construction shall use tees.
- C. 4-inch (4”) and larger taps on existing water mains may be tapped with approval from the City.
 - 1. Tapping saddles shall be a cast-iron or ductile iron mechanical joint tapping sleeve with totally confined end gaskets.
 - 2. Reference the City of Greeley Standard Drawings for tapping sleeve requirements.
 - 3. Acceptable manufacturers and models of 4-inch (4”) and larger tapping saddles are:

TABLE 2.1-C: 4” and Larger Tapping Saddles

Manufacturer	Model
Mueller	H-615 for centrifugal CI, DI, PVC
Mueller	H-616 for pit cast CI pipe

Or approved equivalent.

2.2 CORPORATION STOPS

- A. All corporation stops shall conform to AWWA C800 and be capable of operating at a working pressure of 150 psi.
 - 1. All corporation stops shall be full opening plug type and constructed of no-lead brass.
 - 2. Corporation stop inlet threads for tapping saddles shall be “cc” type only.
 - 3. All corporation stop outlets shall use a compression connection.
- B. Corporation stops shall be used for all taps which are 2-inch (2”) and smaller.
- C. Tap sizes shall match line sizes, i.e., 1-inch (1”) corporation tap with a 1-inch (1”) line.
- D. Acceptable manufacturers and models of corporation stops are:

TABLE 2.2-C: Corporation Stops

Manufacturer	Model
Mueller	H-15013
Ford	F1000

No substitutions allowed.

2.3 SERVICE LINES

- A. 2-inch (2") and smaller service lines shall be cross-linked polyethylene (PEX) pressure tubing that conforms to AWWA C904 or Type K Copper conforming to AWWA C800. From water main to the curb stop shall be cross-linked PEX (service line shall be one size larger than the tap side or matching ID) or Type K copper. From curb stop to meter-setter shall be Type K copper. From meter-setter to 3 feet (3') past the meter pit, Type K copper shall be installed with a copper setter. No PEX shall be allowed in the meter pit. Ensure service lines are the same types of materials noted or they may require an appropriate insulator to be installed at the junctions of any dissimilar metals.
- B. Acceptable manufacturers for service lines include:
1. Municipex®
 - a. The pipe shall be Municipex® SDR 9 Pipe only, conforming to ASTM F2080
 - b. All connections shall be Municipex® compression only.
 2. Uponor
 - a. The pipe shall be Uponor AquaPEX® conforming to ASTM F876
 - b. All connections shall be Uponor ProPEX® compression only.
 3. Copper Water Tube
 - a. Type K standard Copper tube produced in accordance with, ASTM B88, NSF 61 approved, and UNS C12200.
 - b. Copper tubing shall be made in the United States.
- C. 4-inch (4") and larger service lines shall be C900 PVC pipe or ductile iron pipe and conform to construction specification *Section 02513 POLYVINYL CHLORIDE (PVC) PRESSURE PIPE* or *Section 02512, Ductile-Iron Pipe*. 3-inch (3") service lines shall use a 4-inch (4") tap/tee and reduce to 3-inches (3") immediately after the tap/tee.
- D. Fire service lines shall be a minimum of 4-inch (4") diameter and shall be restrained C900 PVC pipe or ductile iron pipe and conform to construction specification *Section 02513 POLYVINYL CHLORIDE (PVC) PRESSURE PIPE* or *Section 02512, Ductile-Iron Pipe*.

2.4 COUPLINGS

- A. All couplings shall be compression x compression only.
- B. Acceptable manufacturers and models of couplings are:

TABLE 2.4-B: Couplings

Manufacturer	Model
Mueller	H-15433
Ford	C44

No substitutions allowed.

2.5 CURB STOPS

- A. Curb stops 1-inch by 3/4-inch (1" x 3/4") inclusive to 2-inches (2") shall conform to AWWA C800.
1. All curb stops shall have compression connections at both ends.
 2. Curb stops shall be plug type, full opening, Minneapolis pattern.
 3. Acceptable manufacturers and models of 1-inch (1") curb stops are:

TABLE 2.5-A.3: 1" Curb Stops

Manufacturer	Model
Mueller	H-10228
Ford	Z11-333 or Z11-444

No substitutions allowed.

4. Acceptable manufacturers and models of 1 1/2-inch (1 1/2") and 2-inch (2") curb stops are:

TABLE 2.5-A.4: 1 1/2" and 2" Curb Stops

Manufacturer	Model
Mueller	H-10228

No substitutions allowed.

- B. Curb stops 3-inches (3") and larger shall be gate valves and conform to construction specification *Section 02515, Water Utility Distribution Valves*.

2.6 CURB STOP BOXES

- A. Curb stop boxes are required with all curb stops.
- B. Curb stop boxes at tracer wire test stations shall be in street valve box and conform to construction specification *Section 02515, Water Utility Distribution Valves*.
- C. Acceptable manufacturers and models of 1-inch (1") curb stop boxes are:

TABLE 2.6-B: ¾" and 1" Curb Stop Boxes

Manufacturer	Model
Mueller (1")	H-10300-99002 (6 ft)
Ford	EM2-50-47-42R or EM2-55-46-48R (6 ft)

Or approved equivalent.

- D. Acceptable manufacturers and models of 1 ½-inch (1 ½") and 2-inch (2") curb stop boxes are:

TABLE 2.6-C: 1 ½" and 2" Curb Stop Boxes

Manufacturer	Model
Mueller	H-10300-99002 (6 ft)
Ford	EM2-50-57 (6 ft)

Or approved equivalent.

- E. Curb stop boxes for 3-inches (3") and larger shall be in street valve box and conform to construction specification *Section 02515, Water Utility Distribution Valves*.

2.7 METERS

- A. All water meters, sizes ¾-inch (¾") through 8-inch (8") shall be Badger E-Series and purchased from the Water and Sewer Department. No exceptions.

2.8 METER SETTERS

- A. Meter setters to be installed as shown in the City of Greeley Standard Drawings.
- B. All ¾-inch (¾") and 1-inch (1") meter setters shall have a meter stop inlet valve with a lockwing. Note that the lay lengths listed do not account for gasket thickness. The acceptable manufacturers and models of meter setters are:

TABLE 2.8-A: ¾" and 1" Meter Setters

Meter Size	Setter Manufacturer	Setter Model	Total Lay Length (in)
¾" x ¾" Meter	Ford	VV-83W-22-33- NL	9 3/8"
¾" x ¾" Meter	Mueller	H-1489N	9 3/8"
1" Meter	Ford	V84-10W-22-44- NL	11 1/8"
1" Meter	Mueller	H-1489N	11 1/8"

No substitutions allowed.

- C. All 1 ½"-inch (1 ½") and 2-inch (2") meter setters shall have a meter stop inlet valve with a lockwing, and a built-in locking by-pass. Note that the lay lengths listed do not account for gasket thickness. The acceptable manufacturers and models of meter setters are:

TABLE 2.8-B: 1 ½" and 2" Meter Setters

Meter Size	Setter Manufacturer	Setter Model	Total Lay Length (in)
1 ½" Meter	Ford Meter	VBB76-12B-44-66-NL	13 3/8"
1 ½" Meter	Mueller	H-1423N	13 1/4"
2" Meter	Ford Meter	VBB77-12B-44-77-NL	17 3/8"
2" Meter	Mueller	H-1423N	17 1/4"

No substitutions allowed.

2.9 METER PITS AND VAULTS

- A. ¾-inch (¾") meters and 1-inch (1") meters:
1. Meter pits shall be 20-inches (20") in diameter and shall be constructed of rigid High-Density Polyethylene (HDPE).
 2. Meter pit covers shall be constructed of rigid HDPE with cap type top lid with a 3-inch (3") deep plastic inner frost lid, or fiberglass lid with a 3-inch (3") deep plastic inner frost lid. All lids shall be traffic rated.
 - a. The minimum allowable opening for meter pit covers shall be 11-inches (11") diameter.
 - b. All meter pit covers shall have a 27/32-inch worm-lock with a Standard Waterworks pentagon head.
 - c. Meter pit covers shall be capable of withstanding minus 40 °F to 190 °F and shall be resistant to ultraviolet light degradation.
 - d. Meter pit covers shall have a pre-installed, recessed, 2-inch (2") hole for the meter endpoint radio transmitter (RT Unit). Fiberglass lids do not need a hole.
 3. Reference City of Greeley Standard Drawings.
- B. 1 ½ -inch (1 ½") and 2-inch (2") meters:
1. Meter vaults shall be 48-inches (48") diameter.
 2. Meter vaults shall be a pre-cast concrete manhole in accordance with construction specification *Section 03400, Precast Concrete*. All vault openings shall have modular sealing units and be grouted with non-shrink grout between

the modular sealing unit and the vault inside and outside wall.

3. Meter vault rings may be an aluminum or Fiberglass manhole ring, and cover with a 24-inch (24") diameter opening unless approved otherwise, in writing, by the City Water and Sewer Department. Aluminum lids shall have a 2-inch (2") recessed hole for endpoint. Fiberglass lids do not need a hole. Frost lid not required. All potable meter vault covers shall have the word "WATER" cast in the lid.
 4. Reference City of Greeley Standard Drawings.
- C. 3-inch (3") and larger meters:
1. Meter vaults shall be a pre-cast concrete in accordance with construction specification *Section 03400, Precast Concrete*.
 2. All vault openings shall be link-sealed.
 3. All joints shall be watertight.
 4. Meter vault covers shall be aluminum ring and lid, or fiberglass ring and lid. 3-inch (3") through 8-inch (8") meter vault lids shall be 24-inch (24") diameter. 10-inch (10") and larger meter vault lids shall be 36-inch (36") diameter opening, unless approved otherwise by the City. All potable water meter vault covers shall have the word "WATER" cast in the lid. Aluminum lid shall have a 2-inch (2") recessed hole in lid for endpoint. Fiberglass lid does not need hole. Frost lid not required.
 5. Include gravel sump
 6. Reference City of Greeley Standard Drawings for vault size and layout.

2.10 TRACER WIRE AND TEST STATIONS

- A. Reference construction specification *Section 02510, Water Utility Distribution Piping* for tracer wire products, manufacturers, and requirements.

PART 3– EXECUTION

3.1 GENERAL

- A. Only those Contractors licensed and bonded with the City of Greeley will be permitted to install water service connections.
- B. The Contractor shall make all taps on new lines, with approved equipment, and install the service line to the curb stop prior to disinfection and pressure testing of the water main.
- C. The Contractor shall adjust meter pits to the horizontal location and to the final grade as determined by grade stakes.
 1. Grade stakes shall be placed a minimum five feet (5') from the location of the meter pit.

2. The grade shall be determined from the top of sidewalk elevation to top of building finished floor.
 3. Grade stakes shall not be disturbed prior to service inspection by the City.
- D. The Contractor shall mark the location of water services and fire sprinkler lines with a stamped “W” and “F”, respectively, 4-inches (4”) high, 3-inches (3”) wide into the face of the curb and gutter.

3.2 TRENCHING, BACKFILLING, AND COMPACTION

- A. Reference construction specification *Section 02315, Excavation and Fill*.

3.3 TAPS

- A. Unless prior approval is given by the City, only City personnel shall make service taps on mains which have been accepted by the City. Contractor to bolt everything prior to the City personnel making the service taps.
- B. The Contractor shall not make any taps without permission from the City.
- C. All taps shall be made with a tapping saddle in accordance with these specifications and the manufacturer’s recommendations.
- D. Connections to the existing potable water distribution system shall be made by wet tap or cut in tee. All wet taps and all cut-in tees on mains smaller than 16” diameter shall be made by the Contractor under the direct supervision of the City. It is the Contractor’s responsibility to provide all approved tapping materials (tapping sleeves, tapping valves, insulator kit, etc.).
- E. Taps for new 8” and 12” main connections to existing 16” or larger mains shall be performed by the City unless otherwise directed.
- F. Connections to the existing transmission mains or distribution mains larger than sixteen-inch (16”) shall be limited and must be approved by City.
- G. For wet taps on existing transmission mains or sixteen-inch (16”) and larger distribution mains, manufacturer’s shop drawings and specifications for the proposed tapping sleeve shall be submitted to the City for review and acceptance prior to installation of the tapping sleeve by the Contractor.
- H. Taps on existing transmission mains or sixteen-inch (16”) and larger distribution mains shall require the installation of an insulator kit between the tapping sleeve and tapping valve.
- I. Connection to cast iron mains constructed prior to 1950 may require replacement or non-standard fittings which must be reviewed and approved by City of Greeley Water & Sewer department.

- J. Construction documents shall include a note for all wet taps: “Contractor to reference specifications for approved tapping materials and prior to installation shall contact Distribution for direct supervision of installation by the City.”
- K. Service taps on mains will be made only under the direct supervision of the City. The Contractor shall give seventy-two (72) hours advance notice to the City before any taps are made.
- L. The City reserves the right to make taps in lieu of the Contractor and the right to deny permission for any main to be tapped.
- M. Tapping equipment shall be of good quality, used for the purpose intended, and used in accordance with the manufacturer’s instructions.
- N. Taps shall not be made within two feet (2’) of any joint, fitting, or valve.
- O. Taps shall be separated by at least two feet (2’), measured along the pipe length, even when taps are made on opposite sides of the pipe.
- P. Taps shall be made at the 2:00 or 10:00 location on the pipe circumference. Taps that are made on the same side of the pipe and within ten feet (10’) of each other, measured along the pipe length shall be staggered by fifteen degrees (15°).

3.4 SERVICE LINES

- A. All water service lines, and fire sprinkler lines shall be a minimum five feet (5’) and a maximum six feet (6’) below the final grade unless otherwise approved by the City.
 - 1. Water Service
 - a. There will be a maximum of one (1) coupling per service, between the main and the curb stop. The coupling shall be used only for repair situations and not for utilizing short pieces of tubing during construction. Couplings shall be compression x compression for services 2-inches (2”) and smaller.
 - b. Service lines shall be uniform in size from the corporation stop to five feet (5’) past the meter pit.
 - c. The expansion loop shall not be installed higher than the top of the main being tapped. When backfilling the service trench, bedding shall be used under and 6-inches (6”) above the expansion loop at the service connection to the main.
 - 2. Fire Service
 - a. Fire sprinkler services shall be uniform in size from the main to the structure being serviced.
 - b. Fire Sprinkler lines shall be a minimum of 4-inches (4”) in diameter.
 - c. A resilient seat gate valve the same diameter as the fire sprinkler service

pipe shall be installed at the main and restrained back to the mainline tee by use of restrained joint pipe or mechanical joint restraint.

- d. Fires sprinkler lines are not metered.
- B. A 2-inch by 4-inch (2" x 4") wooden post, pressure treated and exterior grade, shall be placed at the end of the future service line.
 - 1. All wooden posts shall extend from the end of the service to a point two feet (2') minimum, above the ground surface and shall be painted blue.
 - 2. Locator balls/rings or adequate steel to be located by a ferrous metal detector should be placed at the end of the service at an adequate depth so it will not be disturbed by grading and construction operations.
 - 3. Maintenance of the marker posts shall be the responsibility of the Contractor until the City accepts the project. After acceptance by the City the maintenance of the marker posts shall be the responsibility of the property owner.
 - C. Service trenches shall be subject to compaction specifications. Reference construction specification *Section 02315, Excavation and Fill*.
 - D. Where a water service or fire service line crosses another utility or any underground structure, the service shall preferably pass above the other utility or structure.
 - a. In no instance shall there be less than 18-inches (18") clearance between the water service or fire service line and any other utility or structure.
 - b. The space between the water or fire service line and the other utility or structure shall be backfilled with compacted bedding material or flow-fill concrete.

3.5 CURB STOPS

- A. Reference City of Greeley Standard Drawings for curb stop location.
- B. The Contractor shall adjust the curb stop box to ½-inch (1/2") above final grade prior to final inspections.
- C. Curb stop boxes shall not be placed in driveways or sidewalks.
- D. Curb stop boxes shall be plumb.
- E. Curb stop boxes at tracer wire test stations shall be installed inside a standard valve box and installed in accordance with the City of Greeley Standard Drawings, latest revision.
- F. Contractor shall demonstrate to the City that curb stops are operable prior to City acceptance.

3.6 LANDSCAPE SPRINKLER SYSTEMS

- A. Underground sprinkler systems shall be designed in strict conformance with the City of

Greeley Building Inspection guidelines for the installation of underground sprinkling systems and shall receive approval by permit prior to start of construction. The sprinkler system installer shall be responsible for the submittal of a permit application and the scheduling of inspections prior to installation and operation. A copy of the guidelines is available at the City of Greeley Building Inspection Department.

- B. Each irrigation system shall have appropriate backflow protection.
- C. With the exception of single family houses, all sprinkler irrigation systems shall have their own separate irrigation services and meters.

3.7 METER PITS AND VAULTS

- A. Meter pits or vaults shall not be installed in any street, parking area, driveway, or sidewalk unless prior written permission is obtained from the Water and Sewer Department. If a meter pit or vault is permitted to be located in any traffic area, the pit/vault shall be required to be designed to withstand HS-20 traffic loading.
- B. There shall be no major landscaping (trees, boulder, shrubs over three feet (3') in mature height, etc.) or structure (retaining wall, etc.) within ten feet (10') of the meter pit or vault. All shrubs less than three feet (3') in mature height shall be located no closer than five feet (5') to a meter pit or vault.
- C. The finished ground around the meter pit or vault shall slope away from the lid at a minimum grade of two percent (2%).
- D. There shall be no plumbing connections inside the meter pit or vault.
- E. All tees, connections, and couplings shall be a minimum of five feet (5') from the meter pit or vault wall and be on the outlet side.
 - 1. There shall be no tees, connections, or couplings installed between the curb stop and the meter setter or meter horn.
 - 2. All pipes coming into any meter vault or pit 3-inches (3") or larger shall be flanged pipe only.
- F. The meter pit or vault shall be adjusted to ½-inch (1/2") above final grade if the surrounding grade is changed.
- G. Reference Greeley Standard Drawings, latest revision, for additional meter pit/vault installation requirements.

3.8 TRACER WIRE AND TEST STATIONS

- A. Reference construction specification *Section 02510, Water Utility Distribution Piping*, and City of Greeley Standard Drawings, latest revision of each, for tracer wire and test station installation along water service lines.

3.9 INSPECTION

- A. The Contractor shall ensure that the curb stop, corporation stop, and any couplings

remain exposed until after inspection and the City gives the approval for backfill.

- B. All tap and service inspections shall be scheduled with the City a minimum forty-eight hours (48) prior to desired time of inspection.
- C. The water shall be turned on at the curb stop by the Water and Sewer Department, only after the service line, curb stop, stop box, and meter setter are installed.
- D. Contact the City of Greeley Meter Shop a minimum forty-eight hours (48) prior to requesting final meter pit inspection. Refer to City of Greeley Standard Drawings.
- E. Meter pits and stop boxes shall be at finished grade at time of acceptance of subdivision improvements. If the stop box or meter pit is damaged, bent, or otherwise unacceptable to the City, the builder will be responsible for replacing the damaged stop box or meter pit prior to issuance of a Certificate of Occupancy.

SECTION 02515

WATER UTILITY DISTRIBUTION VALVES

PART 1 – GENERAL

1.1 SCOPE

- A. This section covers water system valves, valve operators, valve boxes, and other valve appurtenances.

1.2 REFERENCES

- A. American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
 - 1. B16.1, Grey Iron Pipe Flanges and Flanged Fittings, latest revision.
- B. American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - 1. C207, Steel Pipe Flanges for Waterworks Service – Size 4 in. through 144 in., latest revision.
 - 2. C500, Metal-Seated Gate Valves for Water Supply Service, latest revision.
 - 3. C508, Swing-Check Valves for Waterworks Service, 2-in. Through 24-in., latest revision.
 - 4. C509, Resilient-Seated Gate Valves for Water Supply Service, latest revision.
 - 5. C512, Air Release, Air/Vacuum, and Combination Air Valves for Waterworks Service, latest revision.
 - 6. C550, Protective Interior Coatings for Valves and Hydrants, latest revision.
- C. ASTM International (ASTM)
 - 1. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings, latest revision.
 - 2. B62, Standard Specification for Composition Bronze or Ounce Metal Castings, latest revision.

1.3 SUBMITTAL REQUIREMENTS

- A. Information to be provided should include:
 - 1. Valve Manufacture
 - 2. Valve Pressure Rating

3. Valve Construction Materials

- B. Two (2) sets of Shop Drawings for each valve size and type shall be furnished to the City for acceptance prior to start of construction.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Take precautions so as not to damage materials during delivery or storage.
- B. Store valves off the ground and away from materials that could contaminate water systems.
- C. Take precautions to keep joints and internal parts clean.

PART 2 – PRODUCTS

2.1 GENERAL

- A. All water distribution valves shall open clockwise (right). (Valves on water transmission lines open counter-clockwise (left)).
- B. All valves shall be the same size as the main unless approved otherwise by the City.
- C. Valves shall be either mechanical or flanged joint as required.
 - 1. Exposed locations shall use flanged joints.
 - 2. Buried locations shall use mechanical joints.
- D. The interior and exterior of all buried valves shall be epoxy coated in accordance with AWWA C550.
- E. All buried valves shall have a two-inch (2”) square-operating nut. The manufacturer shall paint all open right operating nuts red.
- F. The operating nut on buried valves shall be between four (4) feet and six (6) feet below the finished grade. If, in order to achieve the operating nut depth, it is necessary to use a riser stem, the riser shall be double pinned. The riser stem shall be a solid stem coated to prevent corrosion.
- G. All exposed valves that are not equipped with motorized or pneumatic actuators shall be equipped with a handwheel.

2.2 GATE VALVES

- A. General
 - 1. Four-inch (4”) through twelve-inch (12”) diameter gate valves shall be designed for a minimum working pressure of 200 psi and a test pressure of 400 psi. Sixteen-inch (16”) diameter gate valves shall be designed for a minimum working pressure of 150 psi and a 300 psi test pressure.

2. Sixteen-inch (16") bonnets shall be set vertically.
3. Water distribution line gate valves shall be resilient seat gate valves.

B. Resilient Seat Gate Valves

1. Resilient seat gate valves shall be manufactured in accordance with AWWA C509.
2. Valve stems shall be non-rising.
3. Stem seals shall be provided with two (2) o-ring type stem seals in accordance with AWWA C509.
4. Valves shall be facility tested in compliance with ANSI/AWWA C509.
5. Proof-of-design test certification shall be submitted in compliance with ANSI/AWWA C509.
6. Acceptable manufacturers of resilient seat gate valves are:
 - a. Mueller
 - b. Kennedy
 - c. American AVK Company
 - d. Clow

2.3 VALVE BOXES

- A. Valve boxes for potable water applications shall be cast-iron or ductile iron, buffalo type, two (2) piece boxes with round bases.
1. Valve boxes shall have a five and 1/4-inch (5-1/4") screw type shaft suitable for depth of cover as required.
 2. Valve boxes shall be capable of future adjustment for street overlays.
 3. Model 6850 series with drop lid
 4. The word "WATER" shall be cast into the box lid for potable water and "WATER/TEST" into box lids for potable water valves with test stations.
 5. Acceptable manufacturers of valve boxes are:
 - a. Castings, Inc
 - b. Tyler
 - c. Or approved equivalent.

- B. Valve boxes for non-potable irrigation water applications shall be cast-iron or ductile iron, triangular top and cover, two (2) piece boxes with round bases.
1. Valve boxes shall have a five and ¼-inch (5-¼”) screw type shaft suitable for depth of cover as required.
 2. Valve boxes shall be capable of future adjustment for street overlays.
 3. Model 4TCI and compatible with 6850 series bottoms
 4. The word “IRRIGATION” shall be cast into the box lid for non-potable irrigation water and “IRR/TEST” into box lids for non-potable irrigation water valves with test stations.
 5. Acceptable manufacturers of valve boxes are:
 - a. Castings, Inc
 - b. Or approved equivalent.

2.4 AIR RELEASE, AIR/VACUUM, AND COMBINATION AIR VALVES

- A. Air Release (AR) valves, Air/Vacuum (A/V) valves, and combination air valves shall be manufactured in accordance with AWWA C512.
- B. Air Release and Air/Vacuum Valves
1. All AR and A/V valves shall be rated a minimum working pressure of 150 psi and a hydrostatic test pressure equal to 150% of the actual rated working pressure of the valve.
 2. The working parts and seat of the AR and A/V valves shall be brass, stainless steel, or other non-corroding material unless otherwise approved by the City.
- C. Combination air valves shall have features of both the AR and A/V valve.
- D. The size of the AR valve, A/V valve, or combination air valve shall be as noted on the approved Construction Drawings.
- E. Acceptable manufacturers of Air Release, Air/Vacuum, and Combination Air Valves are:
1. ¾-inch (¾”), one-inch (1”), and two-inch (2”) Combination Air Valve – A.R.I. D-040
 2. Two-inch (2”) to ten-inch (10”) Combination Air Valve – A.R.I. D060-C HF
 3. Or approved equivalent.

2.5 SWING CHECK VALVES

- A. All swing check valves shall be manufactured in accordance with AWWA C508.

- B. Swing check valves shall have an epoxy coated interior in accordance with AWWA C550.
- C. Swing check valves shall be ductile-iron, of the resilient-to-coated seat construction, have a resilient hinge arm, and be of the clear waterway design.
- D. The closure assembly shall assume the closed position by gravity under no-flow conditions.
- E. Swing check valves shall be designed for a minimum working pressure of 200 psi and 400 psi test pressure for check valves with diameters of four-inch (4") through twelve-inch (12"). Sixteen-inch (16") diameter check valves shall be designed for a minimum working pressure of 150 psi and 300 psi test pressure.
- F. Acceptable manufacturers of swing check valves are:
 - 1. Mueller
 - 2. American Flow Control
 - 3. M & H
 - 4. Clow
 - 5. Kennedy
 - 6. Or approved equivalent.

2.6 PRESSURE REDUCING VALVES

- A. The function of the Pressure Reducing Valve (PRV) is to reduce an existing high pressure to a pre-adjusted lower downstream pressure for varying rates of flow without causing shock of water hammer on the system.
- B. The PRV shall be hydraulically operated with a free-floating guided piston having a seat diameter equal to the size of the valve.
- C. Materials and Construction
 - 1. Flanges and covers shall conform to ASTM A126, Class B.
 - 2. The PRV shall be fully bronze-mounted with bronze castings or parts conforming to ASTM B62.
 - 3. All PRVs shall be furnished with flanged ends sized and drilled in accordance with ANSI/ASME B16.1, Class 125 specifications.
 - a. Flanges shall be machined to a flat face with a finish of 250 micro inches, or machined to a flat surface with a serrated finish in accordance with AWWA C207.
 - 4. The PRV shall be purchased from the manufacturer as an assembly and shall

include a main valve, electronic actuated pressure sustaining pilot control system which controls operation of the main valve, and other operational components.

- a. The pilot valve shall be a single seated, diaphragm operated, spring loaded type.
 - b. The pilot valve shall be attached to the main valve with piping and isolation valves arranged for easy access to make adjustments and for its removal from the main valve while the main valve is under pressure.
5. PRV shall include an intergraded flow meter and fully functional with City SCADA system to monitor and control the PRV valve.,
 6. All PRVs shall be rated a minimum working pressure of 150 psi and a hydrostatic test pressure equal to 150% of the actual rated working pressure of the valve.
 7. Allow sufficient room around the PRV for assembly and to make adjustments and for servicing.
 8. The standard PRV size to match pipe size unless otherwise approved by the City.
- D. Refer to PRV Standard Drawing for acceptable manufacturers of pressure reducing valve manufacturers and various appurtenances.
- E. Acceptable manufacturers of pressure reducing valves are:
1. Cla-Val
 2. Or approved equivalent.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Valves and valve boxes shall be examined for cracks, dents, abrasions, and other flaws prior to installation.
- B. Damaged or flawed valves shall be rejected. marked, and removed from the site.
- C. Proof-of-design test certification shall be submitted to owner in compliance with ANSI/AWWA C509.

3.2 INSTALLATION

- A. Valves
 1. With the exception of tapping valves, flanged valves shall not be buried.
 2. Valves shall be installed in such a manner that the operating nut is perpendicular to the pipe.

3. Operating nut shall be accessible between 4 FT and 6 FT below finished grade. Extensions may be required for any operating nut that is deeper than 6 FT.
4. Buried valves shall be supported on concrete as shown in the City of Greeley Standard Drawings.

B. Tapping Valves

1. Tapping valves shall be installed per the manufacturer's recommendation.
2. Tapping valves and sleeves are to be hydraulically pressure tested to 150 psi for twenty (20) minutes, with no leakage, prior to proceeding with a wet tap.
3. Tapping valves and sleeves shall be equipped with a threaded test hole.

C. Valve Boxes

1. All buried valves shall be provided with a valve box, including fire hydrant valves, unless indicated otherwise on the approved Construction Drawings.
2. Install the valve box so that no stress is transmitted to the valve.
3. Set the valve box plumb and directly over the valve's operating nut. Valve operators that are mounted to one (1) side of the valve shall be located to the south or west of the valve.
4. The soil around the valve box shall be carefully compacted around the barrel, with hand equipment, to minimize misalignment and settling of the backfill.

D. Air Release, Air/Vacuum, and Combination Air Valves

1. AR, A/V, and combination air valves shall be installed at the locations shown on the Construction Drawings.
2. Air relief and vacuum relief valves shall be installed in accordance with City of Greeley Standard Drawings.

E. Swing Check Valves

1. Swing check valves shall only be used in four-inch (4") or larger service meter settings and shall be installed downstream of the meter.
2. Swing check valves shall be installed in a horizontal, level setting.
3. Swing check valves shall be installed in accordance with City of Greeley Standard Drawings.

F. Pressure Reducing Valves

1. PRVs shall be installed as shown on the Construction Drawings, per the manufacturer's recommendations, and in accordance with City of Greeley Standard Drawings.

3.3 OPERATION

- A. Prior to requesting water system acceptance, the Contractor shall operate all valves in the presence of City personnel.
- B. Only City personnel shall operate valves that have been accepted by the City.

SECTION 02516**WATER UTILITY DISTRIBUTION FIRE HYDRANTS****PART 1 – GENERAL****1.1 SCOPE**

- A. This section is a minimum guideline for furnishing and installation of dry-barrel fire hydrants.

1.2 REFERENCES

- A. American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - 1. C502, *Dry-Barrel Fire Hydrants*, latest revision.

1.3 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Fire hydrants shall be handled, stored, and protected in such a manner as to prevent damage to materials, coatings, and finishes.
- B. All fittings and joints shall be kept free from dirt, oil, and grease.

PART 2 – PRODUCTS**2.1 FIRE HYDRANTS**

- A. Fire hydrants shall be of the following, approved manufacturer:
 - 1. Kennedy Valve, Guardian K-81D
 - 2. American AVK, 2780 Nostalgic
 - 3. City approved equal
- B. Specifications for fire hydrants are as follows:
 - 1. Type and Size of Hydrant
 - a. Dry-barrel type manufactured in accordance with AWWA C502.
 - b. Main valve opening size – 5 ¼-inch (5 ¼")
 - c. Three-way type with one (1) pumper nozzle and two (2) hose nozzles all located on the same horizontal plan.
 - 2. Design and Testing
 - a. Minimum rated working pressure – 150 psi.

- b. Minimum factory test pressure for assembled hydrants – 300 psi in both the open and closed positions.
 - c. Under test conditions, leakage through drain valve not to exceed five (5) fluid ounces (fl. oz.) per minute. No leakage allowed through the castings, main valve, joints, or stem packing.
3. Pumper Nozzle
- a. Size – 4 ½-inch (4 ½”) in diameter.
 - b. Threads – left handed, six (6) threads per inch (1”), National Standard threads.
4. Hose Nozzle
- a. Size – 2 ½-inch (2 ½”) in diameter.
 - b. Threads – left-handed, National Standard threads.
5. Nozzle Cap
- a. Contains a synthetic rubber gasket installed in a retaining groove.
 - b. Dimensions and shape of the nozzle cap nut are the same as the operating shaft nut.
 - c. Attached to the hydrant with non-kinking type steel chains.
6. Operating Nut and Shaft
- a. Nut material – bronze.
 - b. Nut shape – pentagon and tapered.
 - c. Nut size – 1 5/16-inch (1 5/16”) from point to flat base of the nut; 1 ¼-inch (1 ¼”) at the top.
 - d. Nut height – not less than 1-inch (1”).
 - e. Nut operation – Right turn (clockwise direction). An arrow on top of hydrant bonnet designates the direction of opening.
 - f. Hydrants contain an oil reservoir that provides permanent lubrication of the operating nut threads.
 - g. “O” rings protect operating mechanism from the waterway.
7. Barrel
- a. Component connections – bolted flange type

- b. Ground line connection – manufactured to allow positioning of the top section at increments not greater than fifteen degrees (15°).
- 8. Hydrant Base (Shoe)
 - a. Four (4) mil minimum, epoxy lined, including lower valve (plant) and retainer.
 - b. Inlet provided with a mechanical joint to accommodate six-inch (6”) diameter DIP.
- 9. Drain Valve/Openings – One (1) or more provided.
- 10. Traffic Features – breakaway traffic flange.
- 11. Color – Orange
- 12. Certification – An affidavit of compliance shall be provided to the City of Greeley Water and Sewer Department from the hydrant manufacturer stating that all fire hydrant standard and supplemental specifications have been met.

2.2 EXTENSIONS

- A. No more than one (1) six-inch (6”) or one (1) twelve-inch (12”) hydrant extension section may be used.
- B. The extension manufacturer shall be the same as the fire hydrant manufacturer.
 - 1. Kennedy Hydrant, K-8150
 - 2. American AVK Hydrant, 2780 Nostalgic
- C. For extensions greater than twelve-inches (12”), a grade adjustment fitting shall be used. Acceptable manufacturers are:
 - 1. Assured Flow Sales, Inc. – GRADELOK®
 - 2. Or approved equivalent.
- D. Extension sections must be available to allow the fire hydrant to be raised to a new grade without shutting off the water.

2.3 FIRE HYDRANT LATERAL – PIPE AND MAIN CONNECTION

- A. Fire hydrant lateral piping shall be restrained DIP or PVC. Pipe shall be restrained by either restrained joint pipe or mechanical joint restraints.
- B. The hydrant tee on the potable water main line shall be a swivel tee. Tapping sleeves are acceptable when connecting to an existing potable water distribution main.
- C. Reference construction specification *Section 02512, Ductile-Iron Pipe* and *Section 02513 Potable Polyvinyl Chloride (PVC) Pressure Pipe* .

2.4 FIRE HYDRANT LATERAL – MAIN VALVE

- A. The main valve on the fire hydrant lateral shall be a six-inch (6”), resilient seat gate valve located at the main.
- B. The valve shall be provided with a H-20 traffic rated valve box.
- C. Reference construction specification *Section 02515, Water Utility Distribution Valves* for valve installation.

2.5 DRAIN GRAVEL

- A. Fire hydrant drain gravel shall be 1 ½-inch (1 ½”) washed rock.

2.6 TRACER WIRE AND TEST STATIONS

- A. Test Station:
 - 1. Test station section to be four-inch (4”) inside diameter with an eighteen-inch (18”) long flared plastic shaft to prevent removal from an approved manufacturer.
 - 2. Test station lid shall be a lockable two-terminal lid and include a ground switch.
 - 3. Cover shall be lockable, cast iron, with “WATER / TEST” cast in the cover
 - 4. Approved Test Station:
 - a. Copperhead Industries Snakepit® Access Point
 - b. Approved equal.
- B. Grounding Rod: 1.5-lb magnesium anode grounding rod from Copperhead Industries, or approved equal.
- C. Tracer Wire and Connectors: Reference construction specification *Section 02510, Water Utility Distribution Piping* for product information and installation.

PART 3- EXECUTION**3.1 INSPECTION**

- A. Examine fire hydrants and all appurtenances, including valves and piping, for cracks, dents, abrasions, and other flaws.
- B. Mark defective pipe and fittings and store on site at a separate location from work until after City acceptance at which time it shall be removed from the site.

3.2 PREPARATION

- A. For trenching, backfilling, and compaction, reference construction specification *Section 02315, Excavation and Fill*, and Trench Cross Section Standard Drawing.

- B. Reference construction specifications *Section 02512, Ductile-Iron Pipe*, and *Section 02513, Potable Polyvinyl Chloride (PVC) Pressure Pipe*, for pipe installation preparation.

3.3 INSTALLATION

- A. All fire hydrants shall stand plumb and be installed in accordance with City of Greeley Standard Drawings.
- B. The minimum depth of bury shall be five feet six-inches (5'-6") and the maximum depth of bury shall be six (6) feet for restrained DIP fire hydrant laterals.
- C. All fire hydrants shall be connected to the potable water distribution main by a six-inch (6") restrained DIP lateral line. A six-inch (6") main valve shall be installed in the lateral line and be restrained back to the main line tee by use of restrained joint pipe or mechanical joint restraints.
- D. All fire hydrants shall be supported on a minimum of one (1) cubic yard of compacted drain gravel with a concrete thrust block.
 - 1. The concrete thrust block, with a minimum bearing area of 4.5 square feet (sq. ft.), shall be placed behind the hydrant base (shoe) against undisturbed soil.
 - 2. A sheet of eight (8) mil polyethylene film shall be placed between the hydrant base (shoe) and concrete thrust block, and the barrel shall be polywrapped up to final ground line.
 - 3. After the concrete thrust block is poured and has ample time to cure, drain gravel shall be placed a minimum six-inches (6") above the lower buried flange per City of Greeley Standard Drawings. The concrete thrust block shall cure enough so that the drain gravel will not penetrate the concrete.
 - 4. Cover the gravel drain pit with polyethylene film or a City approved felt material.
- E. Keep hydrant drain holes free of obstructions.
- F. Fire hydrants that are placed in pavement areas, shall maintain twelve-inches (12") of horizontal clearance between the concrete and the hydrant barrel. The twelve-inch (12") space between the concrete and the barrel shall be filled with drain gravel.
- G. After fire hydrant installation is complete, the oil reservoir shall be checked to ensure that it is full. If it is necessary to fill the reservoir, it shall be filled with the oil that is specified by the hydrant manufacturer.
- H. Tracer wire and test station box shall be installed per City of Greeley Standard Drawings, latest revision.

3.4 LOCATION

- A. All hydrants shall be field staked for both vertical and horizontal location.
- B. Vertical

1. The vertical distance from any finished surface to the centerline of the pumper nozzle shall not be less than eighteen-inches (18") or greater than twenty-one-inches (21")
2. If a hydrant is raised, no more than one (1) six-inch (6") or one (1) twelve-inch (12") extension section may be used. If the extension is greater than twelve-inches (12"), a grade adjustment extension fitting shall be used.
3. Extensions shall be installed per manufacturer's recommendations.

C. Horizontal

1. Fire hydrants shall be located at least one (1) foot outside of the property line and shall conform to one of the following conditions:
2. When placed behind the curb when no sidewalk is to be installed, the hydrant barrel shall be set so that no portion of the pumper or hose nozzle cap will be less than twenty-four inches (24") or more than thirty-inches (30") horizontal distance from the gutter face of the curb.
3. When placed in a landscaped area between the curb and the sidewalk or between the sidewalk and the property line, no portion of the hydrant or nozzle cap shall be within six-inches (6") of the sidewalk or greater than eighteen-inches (18") from the sidewalk.
4. A three (3) foot radius in all directions of the hydrant shall be clear of obstructions, which shall include, but is not limited to, posts, fencing, vehicles, trash, storage, shrubs, trees, or other plants with mature growth greater than one (1) foot in height.

3.5 OPERATION

- A. Only City personnel shall operate fire hydrants and associated valves that have been accepted by the City unless written permission from the Water and Sewer Department is obtained. If written permission is received, an approved backflow prevention device and water meter shall be installed on the hydrant per City of Greeley Water and Sewer Department requirements.

SECTION 02517

WATER PRESSURE REDUCING VALVES

PART 1 – GENERAL

1.1 SCOPE

- A. This specification covers the design, manufacture, and testing of 1 in. through 16 in. Pressure Reducing Valves (PRV). The Pressure Reducing Valve shall maintain a constant downstream pressure regardless of changing flow rate and/or inlet pressure.
 - 1. Standard products - use the same manufacturer for multiple units of same type.

1.2 REFERENCES

- A. American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
 - 1. B16.1, Grey Iron Pipe Flanges and Flanged Fittings, latest revision.
- B. American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - 1. C207, Steel Pipe Flanges for Waterworks Service – Size 1/2 in. through 48 in., latest revision.
 - 2. C512, Air Release, Air/Vacuum, and Combination Air Valves for Waterworks Service, latest revision.
 - 3. C550, Protective Interior Coatings for Valves and Hydrants, latest revision.
- C. ASTM International (ASTM)
 - 1. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings, latest revision.
 - 2. B62, Standard Specification for Composition Bronze or Ounce Metal Castings, latest revision.

1.3 SUBMITTAL REQUIREMENTS

- A. Information to be provided should include:
 - 1. Valve Manufacture
 - 2. Valve Pressure Rating
 - 3. Valve Construction Materials
 - 4. Pilot Control and Trim Materials

SECTION 02517
WATER PRESSURE REDUCING VALVES

1

- B. Two (2) sets of Shop Drawings for each valve size and type shall be furnished to the City for acceptance prior to start of construction.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Take precautions so as not to damage materials during delivery or storage.
- B. Store valves off the ground and away from materials that could contaminate water systems.
- C. Take precautions to keep joints and internal parts clean.

PART 2 – PRODUCTS

2.1 GENERAL

- A. The Pressure Reducing Valve shall automatically throttle to reduce a higher incoming pressure and maintain an accurate and constant lower downstream pressure without causing shock of water hammer on the system regardless of changing flow rate and/or inlet pressure. If downstream pressure increases above the pilot spring setting, the valve shall close.
- B. The primary PRV size to match pipe size unless otherwise approved by the City.
- C. The PRV shall be hydraulically operated with a free-floating guided piston having a seat diameter equal to the size of the valve.
- D. All PRVs shall be rated for a minimum working pressure of 150 psi and a hydrostatic test pressure equal to 150% of the actual rated working pressure of the valve.
- E. Allowable PRV size combinations of primary and secondary valves are as follows.

Primary PRV Size	Secondary PRV Size
8"	2"
12"	6"
16"	8"

2.2 MATERIALS

- A. Material Specification for the Pressure Reducing Control Valves Main Valve as follows:

Component	Material
Body & Cover	Ductile Iron-ASTM A536
Main Valve Trim	Stainless Steel
Seat	Stainless Steel
Stem, Nut and Spring	Stainless Steel
Seal Disc	Buna-N® Rubber
Diaphragm	Nylon Reinforced Buna-N® Rubber
Internal Trim Parts	Stainless Steel
End Detail	Flanged (2" – 16")
Pressure Rating	Class 150 lb. (250psi Max.)
Temperature Range	Water to 180°F
Any other wetted metallic parts	Stainless Steel

Coating	Fusion Bonded Epoxy Coating (Interior and Exterior); ANSI / NSF 61 Approved / AWWA coating specifications C116-03.
Additional Components	Valve Position Indicator, Limit Switch, Opening & Closing Speed Controls, E-Flowmeter, Pressure Gauges, Restriction Fitting, Isolation Valve, Opening and Closing Flow Controls, Check Valves Isolation Valve,

Commented [AP1]: What are the costs of these options, do we need and could prevent water hammer?

2.3 MANUFACTURE

A. Main Valve:

1. The main valve shall be hydraulically operated, single diaphragm actuated, globe pattern. The valve shall consist of three major components; the body with seat installed, the cover with bearing installed and the diaphragm assembly. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating the operating pressure from line pressure. Packing glands, stuffing boxes and/or rolling diaphragm technology will not be permitted and there shall be no pistons operating the main valve or pilot controls. No fabrication or welding shall be used in the manufacturing process. Y-pattern valves shall not be permitted. Main valve shall comply with NSF/ANSI 61 and certified lead free to NSF/ANSI 372 as a safe drinking water system component.

B. End Connections:

1. End Connections for control valve shall be flanged per ASME/ANSI B16.42, Class 150 (2" thru 16").

C. Main Valve Body:

1. No separate chamber(s) below the diaphragm shall be allowed between the main valve cover and body. No fabrication or welding shall be used in the manufacturing process.
2. The valve shall contain a resilient, synthetic rubber disc with a rectangular cross-section contained on three- and one-half sides by a disc retainer and forming a tight seal against a single removable seat insert. No O-ring type discs (circular, square, or quad type) shall be permitted as the seating surface. The disc guide shall be of the contoured type to permit smooth transition of flow and shall hold the discs firmly in place. The disc retainer shall be of a sturdy one-piece design capable of withstanding opening and closing shocks. It must have straight edge sides and a radius at the top edge to prevent excessive diaphragm wear as the diaphragm flexes across this surface. No hours-glass shaped disc retainers shall be permitted, and no V-type or slotted-type disc guides shall be used.
3. The diaphragm assembly containing a non-magnetic stainless-steel stem; of sufficient diameter to withstand high hydraulic pressures and shall be fully guided at both ends by a bearing in the main valve cover and an integral bearing in the valve seat. The valve seat shall be a solid, one-piece design and shall have

a minimum five-degree taper on the seating surface for a positive, drip-tight shut off. No center guides shall be permitted. The stem shall be drilled and tapped in the cover end to receive and affix such accessories as may be deemed necessary. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating the operating pressure from the line pressure. No bolts or cap screws shall be permitted for use in the construction of the diaphragm assembly.

4. The flexible, non-wicking, FDA approved diaphragm shall consist of nylon fabric bonded with synthetic rubber compatible with the operating fluid. The diaphragm's center hole for the main valve stem must be sealed by the vulcanized process or a rubber grommet sealing the center stem hole from the operating pressure. The diaphragm must withstand a Mullins Burst Test of a minimum of 600 X per layer of nylon fabric and shall be cycled tested 100,000 times to insure longevity. The diaphragm shall not be used as the seating surface. The diaphragm shall be fully supported in the valve body and cover by machined surfaces which support no less than one-half of the total surface area of the diaphragm in either the fully opened or fully closed position. Bellofram type rolling diaphragms shall not be permitted.
5. The main valve seat and stem bearing in the valve cover shall be removable. The cover bearing and seat in the 6" and smaller size valve shall be threaded into the cover and body. The valve seat in the 8" and larger size valves shall be retained by flat head machine screws for ease of maintenance. The lower bearing of the valve stem shall be contained concentrically within the seat and shall be exposed to the flow on all sides to avoid deposits. To ensure proper alignment of the valve stem, the valve body and cover shall be machined with a locating lip. No "pinned" covers to the valve body shall be permitted. Cover bearing, disc guide and seat shall be made of the same material. All necessary repairs and/or modifications other than replacement of the main valve body shall be possible without removing the valve from the pipeline. The valve shall be designed such that both the cover assembly and internal diaphragm assembly can be disassembled and lifted vertically straight up from the top of a narrow opening/vault. Y-pattern valves shall not be permitted. The seat shall be of the solid one-piece design. Two-piece seats or seat inserts shall not be permitted. Packing glands and/or stuffing boxes shall not be permitted.

D. Pilot Control System:

1. The pressure reducing pilot control shall be a direct-acting, adjustable, spring-loaded, normally open, diaphragm valve designed to permit flow when controlled pressure is less than the spring setting. The pilot control is held open by the force of the compression on the spring above the diaphragm and it closes when the delivery pressure acting on the underside of the diaphragm exceeds the spring setting. The pilot control system shall include a strainer and a fixed orifice closing speed. No variable orifices shall be permitted. The pilot system shall include an opening speed control on all valves sizes 3" and smaller as standard equipment. The pilot control shall have a second downstream sensing port which can be utilized to install a pressure gauge. A full range of spring settings shall be available in ranges of 0 to 150 psi. Pilot to be manufactured by control valve

manufacture. Pilot shall comply with NSF/ANSI 61 and certified lead free to NSF/ANSI 372 as a safe drinking water system component.

E. Material Specification for Pilot Control

<u>Component</u>	<u>Material</u>
Body & Cover	Stainless Steel
Pilot Trim	Stainless Steel 303
Rubber	Buna-N®
Connections	FNPT
Pressure Rating	150 psi Max.
Temperature Range	Water to 180°F Max.
Control Tubing	Flexible Braided Stainless Steel
Control Fittings	Stainless Steel

F. Factory Assembly:

1. Each control valve shall be factory assembled.
2. The Quality Management System of the factory shall be certified in accordance with ISO 9001: 2008.
3. For all control valves, the factory assembly shall include the complete main valve, pilot valve(s), and all associated accessories and control equipment.
4. During factory assembly the control valve manufacture shall make all necessary adjustments and correct any defects.

G. Nameplates:

1. Each Control Valve and associated pilot(s) shall be provided with an identifying nameplate.
2. Nameplates, depending on type and size of control valve, shall be mounted in the most practical position possible, typically on the inlet side of the valve body.
3. Nameplates shall be brass and a minimum of 3/32" thick, 3/4" high and 2-3/4" long.
4. Pertinent control valve data shall be etched or stamped into the nameplate. Data shall include control valve Catalog number, function, size, material, pressure rating, end-connection details, type of pilot controls used and control adjustment range.

H. Factory Testing:

1. Each control valve shall be factory tested.
2. The Quality Management System of the factory shall be certified in accordance with ISO 9001: 2008
3. Tests shall conform to approved test procedures.

SECTION 02517
WATER PRESSURE REDUCING VALVES

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4. Shell Test: Control valves and pilot valves in the partially open position with both ends closed off with blind flanges (valves) and pipe plugs (pilots) shall be subject to an air pressure test. The applied pressure shall be 200 psi minimum. The pressure shall be applied for a minimum of 15 minutes. No visible leakage is permitted through the pressure boundary walls of the valve or pilot body or valve cover or the body-cover joint.
5. Seat Test: Control valves and pilot valves shall be subjected to an air pressure seat test and held for a minimum of 15 minutes.

2.4 PRODUCT DATA

- A. The following information shall be provided:
 1. Control Valve manufacturer's technical product data.
 2. Control Valve manufacturer's Installation, Operation and Maintenance manual (IOM).
 3. Control Valve manufacturers certified Shell and Seat test results.
- B. Provide specific information on all optional features specified above and confirm that these items are provided.
- C. The valve manufacturer shall be able to supply a complete line of equipment from 1" through 16" sizes and a complete selection of complementary accessories and equipment.
- D. The control valve manufacture shall provide a computerized cavitation analysis report which shows flow rate, differential pressure, and percentage of valve opening. Cv factor, system velocity, and if there will be cavitation damage.

Commented [AP2]: ?????

2.5 CONSTRUCTION

- A. Flanges and covers shall conform to ASTM A126, Class B.
- B. All PRVs shall be furnished with flanged ends sized and drilled in accordance with ANSI/ASME B16.1, Class 125 specifications.
 1. Flanges shall be machined to a flat face with a finish of 250 micro inches or machined to a flat surface with a serrated finish in accordance with AWWA C207.
- C. The PRV shall be purchased from the manufacturer as an assembly and shall include a main valve, electronic actuated pressure sustaining pilot control system which controls operation of the main valve, and other operational components.
 1. The pilot valve shall be a single seated, diaphragm operated, spring loaded type.
 2. The pilot valve shall be attached to the main valve with piping and isolation valves arranged for easy access to make adjustments and for its removal from the main valve while the main valve is under pressure.

- D. PRV shall include an intergraded flow meter and fully functional with City SCADA system to monitor and control the PRV control valve.
- E. Allow sufficient room around the PRV for assembly, and to make adjustments and for servicing.
- F. Refer to PRV Standard Drawing for acceptable manufacturers of pressure reducing valve manufacturers and various appurtenances.
- G. Acceptable manufacturers of pressure reducing valves are:
 - 1. Cla-Val
 - 2. Or approved equivalent.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Valves and valve boxes shall be examined for cracks, dents, abrasions, and other flaws prior to installation.
- B. Damaged or flawed valves shall be rejected. marked, and removed from the site.
- C. Proof-of-design test certification shall be submitted to owner in compliance with ANSI/AWWA C509.

3.2 INSTALLATION

- A. PRVs shall be installed as shown on the Construction Drawings, per the manufacturer’s recommendations, and in accordance with City of Greeley Standard Drawings.
- B. **Final location of vault and control panel shall be determined by Water & Sewer Department.**

3.3 FIELD TESTING

- A. A direct factory representative shall be made available by the equipment supplier for start-up service, inspection, and necessary adjustments.

3.4 WARRANTY

- A. The Control Valve manufacturer shall warrant the valve to be free of defects in material and workmanship for a period of two-years from date of shipment provided the valve is installed and used in accordance with all applicable instructions. Electrical components shall have a two-year warranty.

3.5 OPERATION

- A. Prior to requesting water system acceptance, the Contractor shall operate all valves in the presence of City personnel.
- B. Only City personnel shall operate valves that have been accepted by the City.

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WATER PRESSURE REDUCING VALVES

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SECTION 02530**SANITARY UTILITY SEWERAGE PIPING****PART 1– GENERAL****1.1 SCOPE**

- A. This section addresses the installation of sanitary sewer collection mains and includes the acceptable products, materials, and construction practices that may be used in the installation of sanitary sewer collection systems.

1.2 SUBMITTALS

- A. Shop Fabricated Piping:
1. Pipe Manufacturer.
 2. Pipe Size.
 3. Pipe Dimensions.
 4. Pipe Class / Pressure Rating.
 5. Color (For PVC).
 6. Manufacturer's Recommended Joint Deflection.
 7. Recommended Maximum Safe Pull Force (For Fusible PVC).
 8. Fusion Technician qualifications indicating conformance with specification *Section 02533, Polyvinyl Chloride (PVC) Non-Pressure Pipe* (For Fusible PVC).
 9. Detailed pipe fabrication or spool drawings showing special fittings and bends, dimensions, coatings, and other pertinent information.
 10. Layout drawing showing location of each pipe section and each special length; number or otherwise designate laying sequence on each piece.
- B. Dissimilar Buried Pipe Joints: Joint types and assembly drawings.
- C. Pipe Corrosion Protection: Product data.

1.3 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Pipe shall be handled and stored per manufacturer's recommendations.
- B. Handling
1. Use wide fabric choker slings when lifting pipe.

2. Do not drop pipe or fittings including dropping on cushions.
3. Do not use hooks or bare cable.
4. Polyvinyl chloride pipe has reduced flexibility and impact resistance as temperatures approach and drop below freezing. Extra care should be used in handling and installing PVC pipe during cold weather. Do not install pipe when temperature is below 40 degrees F.
5. Care must be taken to prevent damage to the pipe and fittings and coating and lining (when applicable) by impact, bending, compression, or abrasion. If damage does occur due to manufacturers handling recommendations not being followed, Contractor is to replace the damaged piece(s) at no cost to the City.

C. Storage

1. Store and use pipe lubricants in a manner which will avoid contamination.
2. Pipe, gaskets, and all other installation materials shall be stored in accordance with the manufacturer's specifications.
3. Pipe shall be stored on a surface that provides even support for the pipe barrel. Pipe shall not be stored in such a way as to be supported by the bell.
4. Cold Weather Storage: Locate products to prevent coating from freezing to ground.

D. Pipe delivered for construction shall be strung to minimize entrance of foreign material.

E. All openings in the pipeline shall be closed with watertight plugs when pipe laying is stopped at the close of a day's work or for extended periods at inspectors' discretion.

F. Do not allow debris, tools, clothing, or other materials to enter the pipe. Precautions shall be taken to protect the interior of pipes against contamination.

G. Use effective measures to prevent uplifting or floating of the pipeline prior to completion of backfilling operations.

H. Protect pipe and appurtenances against dropping and damage. Damaged pipe and appurtenances that are rejected shall be marked and removed from the site.

I. Do not install pipe when the trench contains water. Water that is encountered in the trench shall be removed to the extent necessary to provide a firm subgrade and to prevent the entrance of water into the pipeline.

1. Surface runoff shall be diverted as necessary to keep excavations and trenches free from water during construction.
2. The excavation or trench shall be kept free from water until the structure and/or pipe to be installed is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

3. The installed pipe shall not be used to dewater the trench.

PART 2 – PRODUCTS

2.1 MANHOLES

- A. Reference construction specification *Section 02535, Sanitary Utility Sewerage Manholes, Frames, and Covers.*

2.2 PIPE

- A. Reference construction specification *Section 02533, Polyvinyl Chloride (PVC) Non-Pressure Pipe.*

2.3 SANITARY SEWER SERVICE LINES

- A. Reference construction specification *Section 02534, Sanitary Sewer Service Lines.*

PART 3 – EXECUTION

3.1 GENERAL

- A. All piping shall be supplied by one manufacturer.
- B. All materials used in the construction of gravity sanitary sewer collection systems shall be new.
- C. Construction Staking
 1. Reference construction specification *Section 02315, Excavation and Fill.*
 2. Horizontal alignment shall remain uniform between consecutive manholes and shall not deviate from the City accepted Construction Drawings by more than 2-inches.
 3. Vertical alignment shall remain uniform between consecutive manholes and shall not deviate from the City accepted Construction Drawings by more than ¼-inch, as measured from the pipe invert.
 4. Joint Deflection: Maximum of 75 percent of manufacturer's recommendation.

3.2 INSPECTION

- A. Pipe barrel and manholes shall be free of dirt or other foreign objects prior to installation.
- B. Pipe and manholes shall be inspected for cracks, dents, abrasions, or other flaws prior to installation.
- C. Damaged or flawed pipe or manholes shall be rejected, marked, and removed from the site.
- D. Operational Inspection: At the completion of the project, in the presence of the City, and

as required by the City, the Contractor shall open all manholes and lamp all lines to ensure that no debris is left in the lines/manholes and the lines are not plugged.

3.3 PREPARATION

A. Trenching, Backfilling, and Compaction.

Reference construction specification *Section 02315, Excavation and Fill*.

B. Existing Utilities

1. The horizontal and vertical location of existing utilities shall be field verified prior to start of construction.
2. Contractor to protect all existing utilities and all damaged items shall be repaired or replaced to the satisfaction of the City at the Contractor's expense.
3. Any deviation from what is shown on the approved Construction Drawings shall be reported to the City immediately for approval and documented on the As-Constructed Record Drawings.

3.4 CONNECTIONS TO EXISTING SYSTEM

- A. Main connections to the City's existing sanitary sewer collection system shall be made at an existing manhole or by setting a new manhole on the existing line. A watertight plug shall be installed in the new line and secured to the manhole to prevent any material or the plug from entering the existing system until the City accepts the new system.
- B. At locations where a connection to an existing sanitary sewer collection main is to be made, the Contractor shall locate the existing main both vertically and horizontally and verify its exact size and material prior to start of construction. Report any difference from the design to the City and engineer to verify suitability of design.
- C. The Water and Sewer Department personnel will examine the existing pipe or manhole. Any necessary adjustments in line, grade, or connection requirements to accomplish the connection shall be reviewed and accepted by the City prior to making the connection.

3.5 PIPE INSTALLATION

- A. The only acceptable methods for laying sanitary sewer lines shall be with a laser.
- B. Pipe Laying
 1. Pipe shall be installed per manufacturer's recommendations.
 2. Pipe installation shall begin at the lowest elevation and proceed upstream to the highest unless prior written approval is obtained from the Water and Sewer Department.

- a. Pipe shall be installed so that the bells are pointing uphill.
 - b. Lay pipe true to line and grade.
3. Take effective measures to prevent opening of joints during bedding and backfilling operations.
 4. Complete the joint in accordance with the applicable pipe material specification and adjust the pipe to the correct line and grade as each length of pipe is placed in the trench. Make adjustments in line and grade by scraping away or filling pipe bedding under the entire length of the pipe, except at bells, and not by wedging, blocking, or mounding up the pipe or bells.
 5. Secure the pipe in place with the specified bedding tamped under and around the pipe except at the joints.
 - a. Do not disturb the pipe after the jointing has been completed.
 - b. Do not use mechanical compacting equipment in the zone above the horizontal centerline of the pipe and below a plane one (1) foot above the top of the pipe.
 6. Do not walk on pipe or otherwise disturb pipe after the jointing has been completed.
 7. PVC piping placement:
 - a. Do not lay pipe when temperature is below 40 degrees F, or above 90 degrees F when exposed to direct sunlight.
 - b. Shield ends to be joined from direct sunlight prior to and during the laying operation.
- C. Sewer Crossing
1. Where sanitary sewer lines cross beneath potable water lines with less than eighteen-inches (18") clearance, sanitary sewer lines cross above potable water lines, or the ten (10) feet horizontal clearance between potable water lines and sanitary sewer lines cannot be maintained, pipe encasement shall be provided in accordance with construction specification *Section 02445, Casing Pipe – Borings and Encasements*.

3.6 MANHOLE INSTALLATION

- A. Reference construction specification *Section 02535, Sanitary Utility Sewerage Manholes, Frames, and Covers*.
- B. Manholes shall be installed at the location and to the elevation shown on the approved Construction Drawings or as approved by the Water and Sewer Department to accommodate field conditions.

- C. Measurements of the actual location and elevation of sanitary sewer inverts and rim shall be made for the As-Constructed Record Drawings.

3.7 SANITARY SEWER SERVICE CONNECTIONS

- A. Reference construction specification *Section 02534, Sanitary Sewer Service Lines.*

3.8 FIELD QUALITY CONTROL

- A. Pipe Deflection Tests

- 1. Refer to construction specification *Section 01715, Sewer and Manhole Testing.*

- B. Pipe Leakage Tests

- 1. Refer to construction specification *Section 01715, Sewer and Manhole Testing.*

- C. Soil Compaction

- 2. Reference construction specification *Section 02315, Excavation and Fill.*

SECTION 02533**POLYVINYL CHLORIDE (PVC) NON-PRESSURE PIPE****PART 1 – GENERAL****1.1 SCOPE**

- A. This section is a minimum guideline for furnishing and the installation of polyvinyl chloride (PVC) pipe and fittings for lines without hydraulic pressure.
- B. Pipe shall be furnished complete with all fittings, specials, and other accessories.
- C. Refer to specification *Section 02530 Sanitary Utility Sewerage Piping*, for additional requirements.

1.2 REFERENCES

- A. American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - 1. C900, *Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In (100 mm Through 1,500 mm)*, latest revision.
- B. ASTM International (ASTM)
 - 1. D1784, *Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds*, latest revision.
 - 2. D3034, *Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings*, latest revision.
 - 3. D3139, *Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals*, latest revision.
 - 4. D3212, *Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals*, latest revision.
 - 5. F477, *Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe*, latest revision.

PART 2 – PRODUCTS**2.1 POLYVINYL CHLORIDE (PVC) PIPE - GASKETED**

- A. All PVC pipe shall be manufactured from components which conform to ASTM D1784.
- B. All four-inch (4”) through fifteen-inch (15”) PVC non-pressure sewer pipe and all fittings shall be manufactured in accordance with ASTM D3034.

- C. The standard dimension ratio (SDR) of PVC non-pressure sewer pipe shall not exceed 35.
- D. The maximum pipe length shall be twenty (20) feet and no shorter than twelve feet, six inches (12'-6"), except at service tees and closure pieces.

2.2 POLYVINYL CHLORIDE (PVC) PIPE – SLIP JOINT

- A. General.
 - 1. This specification shall cover slip joint PVC pipes in 6-inch (6") through 24-inch (24") nominal diameters with cast iron equivalent outside diameters.
 - 2. All PVC pipe shall be manufactured in accordance with AWWA C900.
 - 3. Pipe shall be green in color.
- B. Pipe joints shall be made using an integral bell with elastomeric gasket push-on type joint or using machined couplings of a sleeve type with rubber ring gaskets and machined pipe ends to form a push-on type joint.
- C. All sizes of pipe under these specifications shall be pressure class as shown on the City accepted Constructed Drawings. Pressure Class 235 (DR-18) shall be the minimum pipe class accepted.
- D. Each length of pipe shall be a standard laying length of twenty (20) feet. Random lengths are not acceptable.
- E. Polyvinyl chlorine (PVC) pipe materials shall be made from Class 12454A of 12454B virgin compounds as defined in ASTM D1784. All compounds shall qualify for a rating of 4000 psi for water at 73.4°F (23°C) per the requirements of Plastic Pipe Institute (PPI), TR-3, and complies with the National Sanitation Foundation Standard, No. 61, for water service.
- F. Elastomeric gaskets shall conform to ASTM F477.
- G. If bury depth is shallower than four (4) feet, pipe shall be manufactured in accordance with AWWA C900 or city approved equal.
 - 1. Bedding design is to be submitted per manufacturers requirements.

2.3 POLYVINYL CHLORIDE (PVC) PIPE – FUSED

- A. General.
 - 1. This specification shall cover slip joint PVC pipes in 6-inch (6") through 24-inch (24") nominal diameters with cast iron equivalent outside diameters.
 - 2. All PVC pipe shall be manufactured in accordance with AWWA C900.
 - 3. Pipe shall be green in color.
- B. All sizes of pipe under these specifications shall be pressure class as shown on the City

accepted Constructed Drawings. Pressure Class 235 (DR-18) shall be the minimum pipe class accepted.

- C. Each length of pipe shall be a standard laying length of twenty (20) feet or more. Random lengths are not acceptable
- D. Polyvinyl chloride (PVC) pipe materials shall be made from Class 12454A of 12454B virgin compounds as defined in ASTM D1784. All compounds shall qualify for a rating of 4000 psi for water at 73.4°F (23°C) per the requirements of Plastic Pipe Institute (PPI), *TR-3*, and complies with the National Sanitation Foundation Standard, *No. 61*, for water service.
- E. Fusion Technician
 - 1. Fusion Technician shall be fully qualified by the pipe supplier to install Fusible PVC of the type(s) and size(s) being used. Qualifications shall be current as of the actual date of fusion performance on the project.
- F. Fusion Joints
 - 1. Unless otherwise specified, fusible PVC pipe lengths shall be assembled in the field with butt-fused joints. Contractor shall follow the pipe suppliers written guidelines for this procedure. All Fusion joints shall be completed as described in these specifications.

2.4 JOINTS

- A. For pipe manufactured in accordance with ASTM D3034 joints shall be of the push-on bell and spigot type and shall be manufactured in accordance with ASTM D3212.
- B. For pipe manufactured in accordance with AWWA C900 joints shall be of the push-on bell and spigot type and shall be manufactured in accordance with ASTM D3139.
- C. All gaskets shall be of an o-ring type in accordance with ASTM F477.
- D. All bells shall be formed integrally with the pipe and shall contain a factory installed elastomeric gasket, which is positively retained.
- E. Only lubricant that is specified by the pipe manufacturer shall be used.
- F. Solvent cement joints are strictly prohibited.

PART 3 - EXECUTION

3.1 INSPECTION

- A. In addition to any deficiencies covered by ASTM D3034 and AWWA C900, PVC pipe which has any of the following visual defects will not be accepted:
 - 1. Straight pipe, measured from the concave side, shall not deviate from straight greater than 1/16-inch per foot of pipe length.

2. Pipe which is sufficiently out-of-round to prohibit proper joining or be able to pass a mandrel test.
 3. Improperly formed bell and spigot ends.
 4. Fractured, cracked, chipped, dented, abrasions, or otherwise damaged pipe.
 5. Pipe that has been damaged during shipment or handling. Acceptance of the pipe at point of delivery will not relieve the Contractor of full responsibility for any defects in material of the completed pipeline.
- B. Damaged or flawed pipe shall be rejected, marked, and removed from the site.

3.2 PREPARATION

- A. Reference construction specifications *Section 02315, Excavation and Fill*.
- B. Cutting Pipe
1. Cut pipe smooth, straight and at right angles to the pipe axis with saws or pipe cutters designed specifically for the material.
 2. Remove burrs and wipe off all dust from the jointing surfaces.
 3. Bevel the cut end in accordance with manufacturer's recommendation.
 4. Do not disturb previously installed joints during cutting operations.
- C. Joints
1. Dirt, oil, grit, and other foreign matter shall be removed from the inside of the bell and the outside of the spigot.
 2. A thin film of pipe lubricant shall be applied to the inside surface of the gasket and the spigot end of the pipe, per the manufacturer's recommendation.
 3. The lubricated joint surface shall be kept clean until joined.

3.3 INSTALLATION

- A. Sanitary sewer pipe construction shall be done in accordance with these specification section, City of Greeley accepted Construction Drawings and construction specifications *Section 02530, Sanitary Utility Sewerage Piping* and *Section 02315, Excavation and Fill*.
- B. No sanitary sewer pipe may be covered or backfilled until inspection of pipe and bedding has been made or City Inspector has given approval.
- C. Joints
1. The pipe shall be joined to the tolerances recommended by the manufacturer (i.e., home line).

2. Stabbing of the pipe is not allowed.
3. Previously completed joints shall not be disturbed during the jointing operation.
4. All joints shall be watertight and free from leaks.
5. Test all pipe under concrete and asphalt construction prior to placing concrete or asphalt.
6. Support and block pipe as necessary to prevent flotation in high groundwater.

3.4 FUSION PROCESS

A. General

1. Fusible PVC pipe to be handled in a safe and non-destructive manner before, during and after the fusion process and in accordance with this specification and the pipe's supplier's guidelines
2. Fusible PVC pipe will be fused by a qualified fusion technician, as documented by the pipe supplier
3. Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine
4. Only appropriately sized and outfitted fusion machines that have been approved by the pipe manufacture shall be used in the fusion process. Fusion machines must incorporate the following elements:
 - a. Heat Plate – Heat plates shall be good condition with no deep gouges or scratches. Plates shall be clean and free of any debris or contamination. Heater controls shall function properly; cord and plug shall be in good condition. The appropriately sized heat plate shall be capable of maintaining a uniform and consistent heat profile and temperature for the size of pipe being fused, per the pipe supplier's guidelines.
 - b. Carriage – Carriage shall travel smoothly with no binding at less than 50 psi. Jaws shall be in good condition with proper inserts for the pipe size being fused. Insert pins shall be installed with no interference to carriage travel.
 - c. General Machine – Overview of machine body shall yield to obvious defects, missing parts, or potential safety issues during fusion.
 - d. Data Logging Device – An approved data logging device with current version of pipe suppliers recommendation and compatible software shall be used. Datalogging device operation and maintenance manual shall be with the unit at all times. If fusing for extended periods of time, an independent 110 V power source shall be available to extend battery life.

5. Other equipment specifically required for the fusion process shall include the following:
 - a. Pipe rollers shall be used for support of the pipe to either side of the machine
 - b. A weather protection canopy that allows full machine motion of the heat plate, fusion assembly and carriage shall be provided for fusion in inclement, extreme temperatures, and / or windy weather, per the pipe suppliers recommendations
 - c. An infrared (IR) pyrometer for checking pipe and heat plate temperatures.
 - d. Fusing machine operations and maintenance manual shall be kept with the fusion machine at all times.
 - e. Face blades specifically designed for cutting fusible PVC pipe shall be used.
- B. Joint Recording
1. Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine. The fusion data logging and joint report shall be generated by software developed specifically for the butt-fusion of fusible polyvinyl chloride pipe. The software shall register and / or record the parameters required by the supplier and these specifications. Data not logged by the data logger shall be logged manually and be included in the Fusion Technician's joint report.

3.5 FUSION PIPE INSTALLATION

A. General Installation

1. Installation guidelines from the pipe supplier shall be followed for all installations.
2. The fusible PVC pipe will be installed in a manner so as not to exceed the recommended bending radius.
3. Where fusible PVC pipe is installed by pulling in tension, the recommended Safe Pulling Forces established by the pipe supplier shall not be exceeded.

B. Connections to Existing and New Piping Systems

1. Approximate locations for existing piping systems are shown in the construction documents. Prior to making connection into existing piping systems, the contractor shall:
 - a. Field verify locations, size, piping material, and piping system of the existing pipe.

- b. Obtain all required fittings, which may include saddles, sleeve type couplings, flanges, tees, or other as shown in the construction documents.
 - c. Allow all piping that has been installed to relax for a period of 24 hours or longer before making final connections.
 - d. Have installed all temporary pumps and / or pipes in accordance with the established connection plans.
2. Unless otherwise approved, new piping systems shall be completely assembled and successfully tested prior to making connections into existing pipe systems.
- C. Cutting the pipe.
1. Cut pipe smooth, straight and at right angles to the pipe axis with saws or pipe cutters designed specifically for the material.
 2. Remove burrs and wipe off all dust from the jointing surfaces.
 3. Bevel the cut end in accordance with manufacturer's recommendation.
 4. Do not disturb previously installed joints during cutting operations.
- D. Field joints.
1. Use push-on joints for buried pipe except where indicated otherwise on the Construction Drawings.
 2. Dirt, oil, grit, and other foreign matter shall be removed from the inside of the bell and the outside of the spigot.
 3. A thin film of lubricant shall be applied to the inside surface of the gasket and the spigot end of the pipe, per the manufacturer's recommendation.
 4. The lubricated joint surface shall be kept clean until joined.
- E. Bending
1. Bending of pipe can be up to 75% of manufacturers recommendation.

3.6 FIELD QUALITY CONTROL

- A. Refer to construction specification *Section 02530, Sanitary Utility Sewerage Piping*.

SECTION 02534

SANITARY SEWER SERVICE LINES

PART 1 – GENERAL

1.1 SCOPE

- A. This section addresses the furnishing and installation of sanitary sewer service lines, clean-outs, and other appurtenances.
- B. Reference construction specification *Section 02530, Sanitary Utility Sewerage Piping*.

PART 2 – PRODUCTS

2.1 PIPE

- A. Reference construction specification *Section 02533, Polyvinyl Chloride (PVC) Non-Pressure Pipe*.
- B. Piping shall be a minimum of 4” diameter. Pre-approval from the City required for 3” diameter.

2.2 SANITARY SERVICE SADDLE

- A. City to supply service saddle for connection to existing sewer mains.
- B. Contractor to supply service saddle for connection to new sewer mains.
- C. Acceptable manufacturer is:
 - 1. Geneco Sealtite

2.3 FLEXIBLE COUPLINGS

- A. Flexible coupling may be used when bell and spigot pipe joints cannot be made.
- B. Acceptable flexible coupling manufacturers are:
 - 1. Fernco – Strong Back
 - 2. Or approved equivalent.

2.4 TRACER WIRE AND TEST STATIONS

- A. Reference construction specification *Section 02510, Water Utility Distribution Piping* for tracer wire products, manufacturers, and requirements.

PART 3 – EXECUTION

3.1 GENERAL

- A. Only those Contractors licensed and bonded with the City of Greeley will be permitted to install sanitary sewer service connections.
- B. Sanitary sewer service connections shall be installed at locations designated on the City accepted

Construction Drawings.

3.2 The Contractor shall mark the location of the sanitary sewer service with a stamped “S”, four-inches (4”) high, three-inches (3”) wide into the face of the curb and gutter.

3.3 TRENCHING, BACKFILLING, AND COMPACTION

A. Reference construction specification *Section 02315, Excavation and Fill*.

3.4 TAPS

- A. Unless the City gives prior approval, only City personnel shall make service taps on existing mains that have been final accepted by the City. Tapping of existing sewer line to be scheduled with City at least 72 hours prior to construction at (970) 350-9322.
- B. The Contractor shall not make any taps without permission from the City.
- C. Wyes and bends shall not be permitted for service connections unless previously approved in writing by the City.
- D. Taps shall not be made within five (5) feet of a manhole.
- E. The spring line of the service connection shall be a minimum one-inch (1”) above the spring line of the sanitary sewer collection main and no closer than three (3) feet to the bell or spigot of the pipe.
- F. Reference City of Greeley Standard Drawings.

3.5 SERVICE LINES

- A. All sanitary sewer services shall be extended at a constant grade from the tap on the collection main to the building.
- B. Sanitary sewer service lines shall be uniform in size from the tap to the building.
- C. Sanitary sewer service trenches shall be subject to compaction specifications. Reference construction specification, *Section 02315, Excavation and Fill*.
- D. The end of all sanitary sewer services will be plugged with an airtight cap or plug.
- E. The end of all sanitary sewer services shall be marked with a 2-inch by 4-inch (2” x 4”) exterior grade, pressure treated, lumber wood post.
 - 1. All wooden posts shall extend from the end of the service to a point two (2) feet, minimum, above the ground surface and shall be painted green.
 - 2. Adequate steel that can be located by a ferrous metal detector should be placed at the end of the service. The steel shall be installed at an adequate depth so it will not be disturbed by grading and construction operations.
 - 3. Maintenance of the marker posts shall be the responsibility of the Contractor until the sanitary sewer system has been accepted by the City. After the system has been accepted by the City, the Owner or Developer shall be responsible for maintaining the marker posts until the service line is completed to a structure.

F. Tracer Wire

1. Reference construction specification *Section 02510, Water Utility Distribution Piping* for tracer wire product and installation specifications as applicable.
2. Tracer wire shall be installed per Water & Sewer Standard Drawings.

G. Test Station

1. Test stations shall be installed per Water & Sewer Standard Drawings, latest revision.
2. Test stations to be installed by builder at service cleanout near structure.

SECTION 02535**SANITARY UTILITY SEWERAGE MANHOLES, FRAMES, AND COVERS****PART 1– GENERAL****1.1 SCOPE**

- A. This section addresses sanitary sewer manholes and includes the acceptable products, materials, and construction practices to be used in the construction and installation of manholes.
- B. Manholes shall be furnished with all accessories, including base, cone section, gaskets, and ring and cover.

1.2 REFERENCES

- A. American Concrete Institute (ACI)
 - 1. 350-06, *Code Requirements for Environmental Engineering Concrete Structures & Commentary*, latest revision.
 - 2. 440.1R-15, *Guide for the Design and Construction of Structural Concrete Reinforced with Fiber-Reinforced Polymer (FRP) Bars*, latest revision.
 - 3. 548.6R-96, *Polymer Concrete-Structural Applications State-of-the-Art Report*, latest revision
- B. ASTM International (ASTM)
 - 1. A48, *Standard Specification for Gray Iron Castings*, latest revision.
 - 2. A615, *Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement*, latest revision.
 - 3. A996, *Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement*, latest revision.
 - 4. A1064, *Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete*, latest revision.
 - 5. B108, *Standard Specification for Aluminum-Alloy Permanent Mold Castings*, latest revision.
 - 6. B179, *Standard Specification for Aluminum Alloys in Ingot and Molten Forms for Castings from All Castings Processes*, latest revision.
 - 7. C33, *Standard Specification for Concrete Aggregates*, latest revision.
 - 8. C144, *Standard Specification for Aggregate for Masonry Mortar*, latest revision.

9. C150, *Standard Specification for Portland Cement*, latest revision.
10. C207, *Standard Specification for Hydrated Lime for Masonry Purposes*, latest revision.
11. C443, *Standard Specification for Joints for Concrete Pipe and Manholes Using Rubber Gaskets*, latest revision.
12. C478, *Standard Specification for Circular Precast Reinforcement Concrete Manhole Sections*, latest revision.
13. C497, *Standard Test Method for Concrete Pipe, Manhole Sections, or Tile*, latest revision.
14. C579, *Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic, Surfacing, and Polymer Concretes*, latest revision.
15. C580, *Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes*, latest revision.
16. C857, *Standard Practice for Minimum Structural Design Loading for Underground Utility Structures*, latest revision.
17. C923, *Standard Specifications for Resilient Connectors between Concrete Manholes Structures and Pipe*, latest revision.
18. C990, *Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants*, latest revision.
19. D648, *Test Method for Deflection Temperature of Plastics Under Flexural Load in Edgewise Position*, latest revision.
20. D1248, *Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable*, latest revision.
21. D 2584, *Test Method for Ignition Loss of Cured Reinforced Resins*, latest revision.
22. D4101, *Standard Specification for Polypropylene Injection and Extrusion Materials*, latest revision.
23. D4976, *Standard Specification for Polyethylene Plastics Molding and Extrusion Materials*, latest revision.
24. D6783, *Standard Specification for Polymer Concrete Pipe*, latest revision.

1.3 SUBMITTAL REQUIREMENTS

- A. Conform to bid document requirements
- B. Submit manufacturer's data and details of following items for approval:

1. Shop drawings of manhole sections, base units and construction details, jointing methods, materials, and dimensions
 2. Summary of criteria used in manhole design including, as minimum, material properties, loading criteria, and dimensions assumed. Include certification from manufacturer that polymer concrete manhole design meets or exceeds the load and strength requirements of ASTM C478 and ASTM C857, reinforced in accordance with ACI 440.1R-15.
 3. Frames, grates, rings, and covers
 4. Materials to be used in fabricating pipe drop connections
 5. Materials to be used for pipe connections
 6. Materials to be used for stubs and stub plugs, if required
- C. Submitted sealed drawings by a registered Professional Engineer in the State of Colorado

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Manholes shall be delivered, handled, stored, and protected in such a manner as to prevent damage to materials. Rubber gaskets shall be stored in a clean area away from grease, oil, ozone producing electric motors, heat and direct rays of the sun.
- B. All joint surfaces shall be free from dirt, oil, and grease at the time of installation.

PART 2 – PRODUCTS

2.1 GENERAL

- A. AASHTO HS-20 design, or as required loading applied to manhole cover and transition and base slabs

2.2 PRECAST CONCRETE MANHOLES

- A. Precast manhole bases, barrels, and cone sections shall be manufactured in accordance with ASTM C478 and shall be made with Type I/II cement. All cone sections shall be the eccentric type with the exception of shallow (flat top) manholes
- B. Concrete and Reinforcing Materials
 1. All reinforcing materials shall conform to ASTM A1064, ASTM A615, and ASTM A996.
 2. Reference construction specifications *Section 03400, Precast Concrete*.

2.3 MICROBIAL INDUCED CORRSION PROTECTION FOR NEW MANHOLES

- A. POLYMER CONCRETE
 1. Polymer Concrete Manholes

- a. Provide polymer concrete manhole sections, monolithic base sections and related components referencing to ASTM C 478. ASTM C 478 material and manufacturing is allowed compositional and dimensional differences required by a polymer concrete product
- b. Provide base riser section with monolithic floors, unless shown otherwise
- c. Provide riser sections joined with bell and spigot / ship-lap design seamed with butyl mastic and or rubber gaskets (ASTM C990) so that on assembly, manhole base, riser and top section make a continuous and uniform manhole structure
- d. Construct riser sections for polymer concrete manholes from standard polymer concrete manhole sections of the diameter indicated on drawings. Use various lengths of polymer concrete manhole sections in combination to provide correct height with the fewest joints
- e. Design wall sections for depth and loading conditions with wall thickness as designed by polymer concrete manufacturer
- f. Provide tops to support AASHTO HS-20 loading or loads as required and receiving cast iron frame covers or hatches, as indicated on drawings
- g. Acceptable manufactures:
 - i. Armorock LLC
 - ii. Or approved equivalent.

2. Polymer Manhole Design Criteria

- a. Polymer Concrete Manhole risers, cones, flat lids, grade rings and manhole base sections shall be designed by manufacturer to meet the intent of ASTM C 478 with allowable compositional and sizing differences as designed by the polymer concrete manufacturer.
 - i. AASHTO HS-20 design or as required loading applied to manhole cover and transition and base slabs
 - ii. Polymer manholes will be designed based upon live and dead load criteria in ASTM C 857 and ACI 350-06
 - iii. Unit soil weight of 120 pcf located above portions of manhole, including base slab projections
 - iv. Internal liquid pressure based on unit weight of 63 pcf
 - v. Dead load of manhole sections fully supported by polymer concrete manhole base

3. Polymer Manhole Design

- i. Polymer Concrete Manhole risers, cones, flat lids, grade rings and manhole base sections shall be designed by manufacturer to meet loading requirements of ASTM C 478, ASTM C 857 and ACI 350-06 as modified for polymer concrete manhole design as follows:
- ii. Polymer Concrete Mix Design shall consist of thermosetting resin, sand, and aggregate. No Portland cement shall be allowed as part of the mix design matrix. All sand and aggregate shall be inert in an acidic environment
- iii. Reinforcement – Shall use acid resistant reinforcement (FRP Bar) in accordance with ACI 440.1R-06 as applicable for polymer concrete design
- iv. The wall thickness of polymer concrete structures shall not be less than that prescribed by the manufacturer’s design by less than 95% of stated design thickness
- v. Thermosetting Resin - The resin shall have a minimum deflection temperature of 158° F when tested at 264 psi (1.820 mPa) following Test Method D 648. The resin content shall not be less than 7% of the weight of the sample as determined by test method D 2584. Resin selection shall be suitable for applications in the corrosive conditions to which the polymer concrete manhole structures will be exposed
- vi. Each polymer concrete manhole component shall be free of all defects, including indentations, cracks, foreign inclusions and resin starved areas that, due to their nature and degree or extent, detrimentally affect the strength and serviceability of the component part. Cosmetic defect shall not be cause for rejection. The nominal internal diameter of manhole components shall not vary more than 2%. Variations in height of two opposite sides of risers and cones shall not be more the 5/8 inch. The under run in height of a riser or cone shall not be more than ¼ in/ft of height with a maximum of ½ inch in any one section
- vii. Marking and Identification - Each manhole shall be marked with the following information - Manufacturer’s name or trademark, Manufacturer’s location and Production Date
- viii. Manhole joints shall be assembled with a bell/spigot or shiplap butyl mastic and/or gasketed joint so that on assembly, manhole base, riser and top section make a continuous and uniform manhole. Joint sealing surfaces shall be free of dents, gouges and other surface irregularities that would affect joint integrity
- ix. Minimum clearance between wall penetrations and joints shall be per manufacturer’s design

- x. Construct invert channels to provide smooth flow transition with minimal disruption of flow at pipe-manhole connections. Invert slope through manhole is as indicated on drawings. All precast base sections to be cast monolithically. Polymer bench and channel are to be constructed with all polymer concrete material. Extended ballast slab requirements for buoyancy concerns can be addressed with cementitious concrete material
- xi. Provide resilient connectors conforming to requirements of ASTM C 923 or other options as available. All connectors are to be watertight. Install approved resilient connectors at each pipe entering and exiting manholes in accordance with manufacturer's instructions

B. ANTIMICROBIAL CRYSTALLINE WATERPROOFING ADMIXTURE

- 1. Acceptable manufactures:
 - a. Xypex Bio-San C500
 - b. Or approved equal
- 2. System Performance Requirements
 - a. Testing Requirements: Antimicrobial crystalline waterproofing system shall have been tested in accordance with the following standards and conditions and as per the manufacturer's dosage range, and the testing results shall meet or exceed the performance requirements as specified herein.
 - b. Independent Laboratory: Testing shall have been performed by an accredited independent laboratory meeting the requirements of ASTM E329 or other applicable international standard for certification of testing laboratories.
 - c. Indicator: The Admixture shall include an indicator that visually identifies concrete that includes Xypex Bio-San C500.
 - d. Antimicrobial Effect: Independent testing shall be performed according to ISO 22196 (Mod.) "Measurement of Antibacterial Activity on Plastics and other Non-Porous Surfaces". Treated and non-treated control concrete samples shall be tested, and a definite anti-microbial effect shall be evidenced by a significant reduction in formation of Thiobacillus Novellus / Starkeya Novella bacteria on the treated samples versus the non-treated samples.
 - e. Concrete Corrosion Rate: Treated and non-treated control concrete samples shall be tested in a live wastewater environment with high concentrations of H₂S. Treated samples shall show at least 9 times less mass loss after 10 years as compared to control samples.

- f. Long-term Antimicrobial Action and Efficacy: The antimicrobial admixture must show long-term antimicrobial action and efficacy as demonstrated by minimal bacterial concentration on the treated concrete after 10 years exposure to an elevated H₂S live wastewater environment.
 - g. Crystalline Formation: Crystallizing capability of waterproofing system shall be evidenced by independent SEM (Scanning Electron Microscope) photographs showing crystalline formations within the concrete matrix.
 - h. Permeability 1: Independent testing shall be performed according to a U.S. Army Corps of Engineers CRD-C48 (Mod.) "Permeability of Concrete". Concrete samples shall be pressure tested to 150 psi (350-foot head of water) or 1.05 MPa (106 m head of water). After 5 days the untreated samples shall leak, and the treated samples shall exhibit no measurable leakage.
 - i. Permeability 2: Independent testing shall be performed according to EN 12390-8. Treated samples shall be exposed to water with a pressure of 0.5 MPa for 72 hours. Treated samples must exhibit a reduction in permeability coefficient of at least 80% when compared to control concrete. Control samples must have a depth of penetration of at least 50 mm.
 - j. Sulfuric Acid Resistance: Independent testing shall be performed to determine "Sulfuric Acid Resistance of Concrete Specimens". Treated concrete samples dosed at 3% shall be tested against untreated control samples. All samples shall be immersed in 7% sulfuric acid and weighed daily until a control sample reaches a mass loss of 50%. On final weighing the percentage mass loss of the treated samples shall be significantly lower than the control samples.
 - k. Sulfate Resistance: Independent testing shall be performed to determine "Sulfate Resistance of Concrete Specimens" treated with integral crystalline admixture. Treated and untreated samples shall be immersed in a concentrated sulfate solution for at least 4 months. On final weighing the percentage mass loss of the treated samples shall be significantly lower than the control samples.
 - l. Compressive Strength: Concrete samples containing the antimicrobial crystalline waterproofing additive shall be tested against an untreated control sample of the same mix. At 28 days, the treated samples shall exhibit equal or increased compressive strength over the control sample.
- 3. Xypex Bio-San C500 must be added to concrete mix at batch plant.
 - 4. The antimicrobial crystalline powder shall be added to the concrete mix at 1% by weight of the cementitious material content

C. PERFECT LINED MANHOLE SYSTEM

- 1. Perfect Lined Manhole System

- a. Provide Perfect Lined Manhole System components which include monolithic base, risers, conical tops or flat lids and grade rings designed and manufactured in accordance with ASTM C478.
 - b. Monolithic concrete base section shall be lined with prefabricated one-piece homogeneous fiber reinforced polymer (FRP) compound with a minimum thickness of 0.197-in (5mm).
 - c. The sanitary sewer baseliner shall include:
 - i. Full flow channels with side walls to the crown of the pipe(s).
 - ii. A non-skid pattern on inner bench surfaces.
 - iii. Pipe connections with specified invert elevations and slopes for incoming pipes.
 - iv. The standard vertical side wall (skirt) height above the bench shall be 2-in minimum.
 - v. Other skirt heights, as agreed upon between the purchaser and the manufacturer.
 - d. Riser sections to be lined with HDPE Perfect Liner sheets with a minimum thickness of 0.065-in (1.65mm).
 - e. Manhole flat lids and cones to be lined with FRP.
 - f. Manhole joints shall be assembled with a bell and spigot with SDV seal gaskets per ASTM C443. Joint sealing surfaces shall be free of dents, gouges, and other surface irregularities. The joints and complete assembly shall pass vacuum test per ASTM C1244.
 - g. The minimum clear distance between two wall penetrations shall be 6 inches. Minimum clear distance between penetrations and joint seams shall be 3 inches.
2. Basis of Design
- a. Concrete sewer manholes shall be manufactured from self-consolidating concrete (SCC) with a minimum compressive strength of 4,000 PSI conforming to material and performance standards of ASTM C-478.
 - b. Cement for the manholes shall conform to ASTM C-150, Type II-V. All sand and aggregate shall be nonreactive in an acid environment.
 - c. Perfect Manhole system to support AASHTO HL-93 or HS-20 loads.
3. Joints
- a. Elastomeric gasket material shall be produced from EPDM 5055 rubber and

- b. manufactured by D+S SDV Seal.
 - c. B. Installed joints shall be capable of holding constant internal pressure of 30 PSI.
4. HDPE Lining
- a. The interior of the manhole risers shall be lined with a High-Density Polyethylene (HDPE) concrete protective liner (CPL) with a minimum thickness of 1.65 mm. The CPL shall have a minimum of (94 qty) anchors per square foot extruded as one homogeneous piece.
 - b. All edges of the HDPE CPL shall be covered with a EPDM liner clip manufactured by D+S Sealants.
 - c. HDPE CPL shall be capable of resisting groundwater pressure up to 30 PSI.
5. FRP Lining
- a. The interior of the manhole base section and flow channels shall be coated prior to casting with a FRP factory spray coating a minimum of 0.197-in (5 mm) thickness.
 - b. FRP coating shall have spray bonded embeds on the back side of the base liner section.
 - c. When monolithically cast into the base shell the structure the FRP liner shall be capable of resisting groundwater pressure up to 30 PSI.
 - d. At the discretion of the manufacturer the FRP coating may be used in all or part of the liner fabrication for the cone.
6. Acceptable manufactures:
- a. Geneva Pipe and Precast
 - b. Or approved equal
- 7.

2.4 CAST-IN-PLACE MANHOLES

- A. All fine and coarse aggregate shall conform to ASTM C33. Fine aggregate shall be clean, sharp, natural sand. Coarse aggregate shall be clean, strong crushed gravel or stone.
- B. All deformed reinforcing bars shall conform to ASTM A615 or ASTM A996. All bars shall be Grade 60.
- C. All welded steel wire fabric shall conform to ASTM A1064.

- D. Concrete used in cast-in-place manholes shall develop a minimum compressive strength of 3,500 psi after 28 days. Concrete shall have a maximum allowable water/cement ratio of 0.50, by weight.
- E. Reference construction specification *Section 03300, Cast-in-Place Concrete*.

2.5 GRADE ADJUSTMENT RINGS

- A. Precast grade adjustment rings shall be manufactured in accordance with ASTM C478 and shall be made with Type I/II cement.
- B. Grade adjustment rings shall be a maximum of 8-inch (8”).
- C. High Density Polyethylene (HDPE) grade adjustment rings shall be manufactured in accordance with ASTM D4976. Acceptable manufacturers are:
 1. LADTECH, Inc.
 2. Or approved equivalent.

2.6 GROUT – CONCRETE MANHOLE

- A. Grout shall be pre-mixed or job-mixed non-shrink and non-metallic.
- B. The acceptable types and manufacturers for pre-mixed, non-shrink, non-metallic grout are:
 1. QUIKRETE® - Hydraulic Water – Stop Cement #1126
 2. DAYTON Superior – Re-Crete 20 Minute Set
 3. Or approved equivalent.

2.7 GROUT – POLYMER MANHOLE

- A. All materials needed for grouting and patching will be a polyester mortar compound provided by the manufacturer or an approved equal by the manufacturer

2.8 RING AND COVER

- A. All rings shall be maximum eight-inch (8”) in height and have an internal diameter of twenty-four inches (24”).
- B. Standard iron ring and covers shall be HS-20 load capable gray iron conforming to ASTM A48 Class 305B, with a black bituminous finish.
 1. The word “SEWER” shall be cast in the cover.
 2. Horizontal bearing surfaces of all rings and covers shall be machined to eliminate any rocking action or non-uniform bearing.
 3. Pick-hole shall be one and on-half inch (1 ½”) wide by one-half inch (½”) deep.

4. Acceptable rings and covers are:
 - a. Castings, Inc. – MH-250-24 CI
 - b. Or approved equivalent.

- C. For manholes in traffic areas, covers shall be HS-20 load capable and meet the same criteria listed above. For non-pedestrian traffic areas, covers shall be non-perforated checker pattern with maximum 3/16 inch (3/16”) raised pattern. For pedestrian traffic areas, manhole covers shall also have a non-skid pattern, complying with American with Disabilities Act (ADA) requirements.
 1. Covers shall be bolt down and not rock under traffic.
 2. Acceptable ADA covers are:
 - a. Castings, Inc. – MH-310-24CI
 - b. Or approved equivalent.

- D. Manhole covers located within designated 100-year floodplains and areas subject to water inundation shall meet the criteria listed above for standard iron ring and covers as well as the following:
 1. Cover shall be the non-perforated, solid, bolt down, gasket type cover.
 - i. Gasket shall be 1/8”x3/4” Rubber
 - ii. Or approved equivalent.

 2. Ring and covers shall be HS-20 load capable gray iron conforming to ASTM A48 Class 30, with black coat finish.
 3. The word “SEWER” shall be cast in the cover.
 4. Acceptable manufacturers are:
 - a. Castings, Inc.
 - b. Pamrex
 - c. Rexus
 - d. Or approved equivalent.

2.9 MANHOLE ENCAPSULATION SYSTEM

- A. Manhole encapsulation is required when groundwater is present or expected to be present in the area.

- B. Heat-shrinkable sleeves shall be high shrink irradiated and cross-linked polyethylene impermeable backing, coated with protective heat activated adhesive.
- C. A separate closure seal shall be provided to secure the sleeve in place during installation and seal overlap area.
- D. Approved sleeve manufacturers are:
 - 1. WrapidSeal™
 - 2. Or approved equivalent.
- E. Approved primer manufacturers are:
 - 1. WrapidSeal™ “G” Primer
 - 2. Or approved equivalent.

2.10 STEPS

- A. Steps in manholes shall not be installed unless approved otherwise by the Water and Sewer Department.

2.11 PREFORMED MASTIC GASKETS

- A. All preformed mastic gaskets shall conform to Federal specifications SS-S-00210 (210-A). Type I, rope form.
- B. The diameter of the preformed mastic gasket shall be 1.5 inches (1.5”).
- C. The application temperature range shall be between 40°F and 110°F.
- D. Gasket is to be pliable.
- E. Approved gasket manufacturers are:
 - 1. Hamilton-Kent Manufacturing Co. – Kent Seal
 - 2. Con Seal – CS-202
 - 3. RAM-NEK – RN101
 - 4. Or approved equivalent.

2.12 MODULAR SEALING UNITS

- A. Link-Seal®
- B. Or approved equivalent.

2.13 DROP MANHOLE BOWL

- A. Reliner®
- B. Or approved equivalent.

2.14 INTERIOR MANHOLE COATING

- A. See construction specifications *Section 02957 A, Sewer Manhole Rehabilitation* and *Section 02957 B, Sewer Manhole Coating* for additional information.

2.15 MANHOLE PIPE PENETRATION SEALS

- A. For pipe penetrations in a cast-in-place manhole base, an approved expanding hydrophilic waterstop/swellstop seal on pipe barrel shall be used. Approved swellstop manufacturers are:
 - 1. Sika – Strip Applied Waterstops (Swellstop)
 - 2. Aquafin – Waterstop-strip
 - 3. Or approved equivalent.
- B. For pipe penetrations in a pre-cast manhole base, an approved rubber boot connector seal on pipe barrel shall be used. Approved rubber boot connector manufacturers are:
 - 1. A-LOK – Boot Connectors
 - 2. Or approved equivalent

PART 3– EXECUTION**3.1 INSPECTION**

- A. Manholes and accessories shall be inspected for cracks, abrasions, or other flaws prior to installation.
- B. Damaged or flawed manholes and accessories shall be rejected, marked, and removed from the site.

3.2 PREPARATION

- A. Reference construction specification *Section 02315, Excavation and Fill*.

3.3 MANHOLE INSTALLATION

- A. Manholes shall be installed in accordance with Standard Drawings and be constructed in accordance with the approved Construction Drawings.
- B. Flat-top manholes are required whenever the distance between the finished ground surface and the manhole barrel section does not allow room for a cone section.

1. Access holes for flat-top manholes shall be offset from center.
 2. If the distance from the manhole cover to the invert of the sanitary sewer line main is less than 3 feet, the access hole shall be centered.
- C. Cast-In-Place Concrete Base
1. Invert channels shall be smooth and semi-circular in shape conforming to the inside of the adjacent sanitary sewer pipe section.
 2. Form inverts directly in the concrete of the base, or for a straight through manhole with no other inlets the channel may be constructed by laying a full pipe section through the manhole and cutting out the top half of the pipe after the surrounding concrete has hardened.
 3. Changes in direction of flow shall be made with a smooth curve having as large a radius as the manhole will permit.
 4. The floor of the manhole outside of the channels shall have a smooth trowel finish and shall slope toward the channels at one-inch (1") per foot.
 5. Pipe size changes shall be accomplished by matching the pipe crowns and forming the channel to accommodate the pipe size differential.
 6. Where shown on the approved Construction Drawings, a piece of pipe of the proper size shall be built into the manhole where future laterals may be connected. The stub-out shall be sealed with a plug at its outer end and an invert shall be built into each manhole for such lateral connections.
 7. Manhole bases shall be thoroughly bonded to the barrel of the pipe.
 - a. Install an approved rubber gasket on the pipe barrel.
 - b. All connections with the pipe shall be made without projections or voids.
 - c. Inverts must meet the requirements of the City.
- D. Manholes shall be constructed at the location and to the elevation indicated on the accepted Construction Drawings, or as stated by the City to accommodate field conditions.
1. Reference construction specification *Section 02530, Sanitary Utility Sewerage Piping*.
 2. All buried manhole covers shall be referenced to a minimum of two (2) permanent surface references and recorded on the As-Constructed Record Drawings.
- E. The manhole shall be set plumb.
- F. Manhole sections shall be joined to each other using preformed flexible plastic gaskets on both interior and exterior shiplaps. The manhole section shall be joined to the base using a double row of preformed flexible plastic gaskets.

1. All joint surfaces shall be kept clean and dry during installation.
 2. Gaskets shall be pliable at the time of installation.
 3. Primer shall be used on both section/base surfaces unless otherwise directed by the City.
- G. Adjustment rings, and ring covers shall be joined to the manhole section and to each other using flexible plastic gaskets.
1. All joint surfaces shall be kept clean, dry, and warm during installation.
 2. Manhole section shall be grouted to ring and covers on the inside.
- H. All lifting holes, joints, and other imperfections shall be filled with non-shrink grout, to provide a smooth finished appearance.

3.4 CONNECTIONS TO EXISTING MANHOLES

- A. Construct in such a manner that the finished work conforms to the requirements specified for new manholes.
- B. Connections shall be made by core-drilling as small a hole as necessary to insert the new pipe and modular sealing unit. Chipping or breaking out manhole walls is not allowed. Use of a rotary hammer is not acceptable.
- C. Grind the existing manhole base to the cross-section of the new pipe and finish with grout to form a smooth continuous invert. Chipping or breaking out the manhole base is not acceptable.
- D. Seal the annular space between the pipe and existing manhole wall with a modular sealing unit and smooth finish inside the manhole wall with non-shrink grout.
- E. Flow is to be maintained through temporary pumping. Prior approval of the proposed pumping plan shall be obtained from the City.

3.5 MANHOLE TESTING

- A. Testing to be completed in compliance with construction specification *Section 01715, Sewer and Manhole Testing*

SECTION 02666**NON-POTABLE POND LINERS****PART 1 - GENERAL****1.1 SCOPE**

- A. This specification covers pond liners using High Density Polyethylene (HDPE), Linear Low Density Polyethylene (LLDPE), Ethylene Propylene Diene Monomer (EPDM), and Polypropylene (FPP) flexible polypropylene liner, Nonwoven Geotextile, seams, gaskets, metal battens, bolts, embed channels, clamps, and sealant.

1.2 REFERENCES

- A. ASTM International (ASTM)
1. C33/C33M, *Standard Specification for Concrete Aggregates*, latest revision.
 2. D5199, *Standard Test Method for Measuring the Nominal Thickness of Geosynthetics*, latest revision.
- B. American Water Works Association (AWWA)
1. C652, *Disinfection of Water-Storage Facilities*, latest revision.

1.3 ABBREVIATIONS

- A. HDPE – High Density Polyethylene Geomembrane
- B. LLDPE – Linear Low Density Polyethylene Geomembrane
- C. LLDPE-R – Reinforced Linear Low-Density Polyethylene Geomembrane,
- D. EPDM – Ethylene Propylene Diene Terpolymer Geomembrane
- E. FPP – Flexible Polypropylene Geomembrane
- F. FPP-R – Reinforced Flexible Polypropylene Geomembrane

1.4 SUBMITTALS

- A. Product Data: For each type of product.
1. Include construction details, material descriptions, and accessories for geomembrane liners.

- B. Shop Drawings: Include panel layout, seams, penetrations, perimeter anchorage, and methods of attachment and sealing to other construction. Differentiate between factory and field seams and joints.
- C. Samples: For each exposed product and for each color specified. Include one 12-inch (300-mm) seam length for factory-bonded sheets and one 12-inch (300-mm) seam length for field-bonded sheets.
- D. Qualification Data: For Installer.
- E. Product Certificates: For each type of geomembrane liner.
- F. Product Test Reports: For each geomembrane sheet, for tests performed by a qualified testing agency.
- G. Source quality-control reports.
- H. Field quality-control reports.
- I. Sample Warranty: For manufacturer's special warranty.
- J. Maintenance Data: For geomembrane liner to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. All flexible membrane installations shall be certified by the installer or manufacturer as meeting the material and installation requirements of the plans and specifications.

1.6 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace geomembrane liner that fail(s) in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Leaks in geomembrane liner.
 - b. Defects in seams.
 - c. Cracks and holes in floating cover.
 - 2. Warranty Period: twenty-five (25) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain geomembrane liner, accessories, and required seaming materials, solvents, and adhesives from single source.

2.2 PERFORMANCE REQUIREMENTS

- A. Provide geomembrane liners that prevent the passage of water.
- B. Anchor liners to pre-vent uplift due to wind or slippage down the side slope.
- C. Subsurface conditions such as soil type and groundwater levels will dictate the direction and scope of the design of the drainage and venting system beneath the geomembrane liner. An inadequate drainage and venting system may result in floating of the geomembrane liner. Hydrostatic pressures from fluctuating groundwater levels or leakage through the liner may cause the liner to float. Gas production and buildup beneath the liner due to the presence of organic material in the soil or leachate leakage through the liner may cause “whales” or bubbling of the liner.
- D. If the groundwater level may be near the invert elevation of the pond, groundwater monitoring should be conducted during the site investigation to verify the expected water table location. In some situations, it may be necessary to install groundwater monitoring wells for a year or more to determine the ground water levels and gather enough information to properly determine the required flow capacity of the drainage system. If high water tables could adversely affect the proper functioning of the structure, interceptor or relief-type drainage systems shall be included to control uplift pressures. Leakage through the liner due to liner damage should also be considered.

2.3 LINER MATERIALS

- A. Flexible membrane liner materials shall have a nominal thickness as specified in the following table:

Minimum Geomembrane Thickness Criteria	
Type	Minimum Thickness
HDPE	40
LLDPE	40
LLDPE-R	36
EPDM	45
FPP	40
FPP-R	36

B. Liner Properties

1. The liner shall be uniform in color, thickness, and surface texture. The liner shall be resistant to fungal or bacterial attack and free of cuts, abrasions, holes, blisters, contaminants, and other imperfections.
2. HDPE and LLDPE—The HDPE or LLDPE liner shall be manufactured from virgin polymer material and shall meet the property values specified in Tables 521A-1 through 521A-4 as applicable.
3. EPDM—The EPDM liner shall be formulated from virgin compounding materials and shall meet the property values specified in Tables 521A-5 and 521A-6 as applicable. Regrind, reworked, or trim materials shall be from the same manufacturer and the same formulation as the liner. Recycled materials shall not be allowed.
4. FPP—The FPP liner shall be manufactured from virgin polymer material and shall meet the property values specified in Tables 521A-7 and 521A-8 as applicable. A reinforced FPP liner shall consist of one ply of reinforcing polyester (scrim) between two sheets of FPP. The polyester scrim shall be of an open weave that permits strike-through of the FPP.

Table 2.3-1 Requirements for smooth HDPE Liner

Property	Test Methods	Requirements ¹		
		Nominal Thickness (mils)		
		30	40	60
Density, g/cc	ASTM D 1505	0.940	0.940	0.940
Tensile Properties	ASTM D 6693			
Yield Stress, lb/in	(type IV at 2 in/min)	63	84	126
Break Stress, lb/in		114	152	228
Yield Elongation, %		12	12	12
Break Elongation, %		700	700	700
Tear Resistance, lb	ASTM D 1004	21	28	42
Puncture Resistance, lb	ASTM D 4833	54	72	108
Carbon Black Content, %	ASTM D 1603	2-3	2-3	2-3
Carbon Black Dispersion	ASTM D 5596	Cat 1-2	Cat 1-2	Cat 1-2
Seam Properties	ASTM 6392			
Shear Strength, lb/in		60	80	120
Peel Strength ² , lb/in		39/FTB	52/FTB	78/FTB
<ol style="list-style-type: none"> 1. All values, unless specified otherwise, are minimum average roll values as reported for the test method. 2. Film tear bond: A failure of one of the bonded sheets by tearing prior to complete separation in the bonded area. 				

Table 2.3-2 Requirements for Textured HDPE Liner

Property	Test Methods	Requirements ¹		
		Nominal Thickness (mils)		
		30	40	60
Density, g/cc	ASTM D 1505	0.940	0.940	0.940
Tensile Properties	ASTM D 6693			
Yield Stress, lb/in	(type IV at 2 in/min)	63	84	126
Break Stress, lb/in		45	60	90
Yield Elongation, %		12	12	12
Break Elongation, %		100	100	100
Tear Resistance, lb	ASTM D 1004	21	28	42
Puncture Resistance, lb	ASTM D 4833	45	60	90
Carbon Black Content, %	ASTM D 1603	2-3	2-3	2-3
Carbon Black Dispersion	ASTM D 5596	Cat 1-2	Cat 1-2	Cat 1-2
Seam Properties	ASTM D 6392			
Shear Strength, lb/in		60	80	120
Peel Strength ² , lb/in		39/FTB	52/FTB	78/FTB
<ol style="list-style-type: none"> All values, unless specified otherwise, are minimum average roll values as reported for the specified test method. Film tear bond: A failure of one of the bonded sheets by tearing prior to complete separation in the bonded area. 				

Table 2.3-3 Requirements for Smooth LLDPE Liner

Property	Test Methods	Requirements ¹		
		Nominal Thickness (mils)		
		30	40	60
Density, g/cc	ASTM D 1505	0.915	0.915	0.915
Tensile Properties	ASTM D 6693			
Break Stress, lb/in	(type IV at 2 in/min)	114	150	228
Break Elongation, %		800	800	90
Tear Resistance, lb	ASTM D 1004	16	22	33
Puncture Resistance, lb	ASTM D 4833	42	56	84
Carbon Black Content, %	ASTM D 1603	2-3	2-3	2-3
Carbon Black Dispersion	ASTM D 5596	Cat 1-2	Cat 1-2	Cat 1-2
Seam Properties	ASTM D 6392			
Shear Strength, lb/in		44	58	90
Peel Strength ² , lb/in		37/FTB	50/FTB	75/FTB
<ol style="list-style-type: none"> All values, unless specified otherwise, are minimum average roll values as reported for test method. Film tear bond: A failure of one of the bonded sheets by tearing prior to complete separation in the bonded area. 				

Table 2.3-4 Requirements for Textured LLDPE Liner

Property	Test Methods	Requirements ¹		
		Nominal Thickness (mils)		
		30	40	60
Density, g/cc	ASTM D 1505	0.915	0.915	0.915
Tensile Properties	ASTM D 6693			
Break Stress, lb/in	(type IV at 2 in/min)	60	80	120
Break Elongation, %		350	350	350
Tear Resistance, lb	ASTM D 1004	17	22	33
Puncture Resistance, lb	ASTM D 4833	33	44	66
Carbon Black Content, %	ASTM D 1603	2-3	2-3	2-3
Carbon Black Dispersion	ASTM D 5596	Cat 1-2	Cat 1-2	Cat 1-2
Seam Properties	ASTM D 4437			
Shear Strength, lb/in	(1 in wide at 2 in/min)	40	53	79
Peel Strength ² , lb/in		33/FTB	44/FTB	66/FTB
<ol style="list-style-type: none"> All values, unless specified otherwise, are minimum average roll values as reported for test method. Film tear bond: A failure of one of the bonded sheets by tearing prior to complete separation in the bonded area. 				

Table 2.3-5 Requirements for Non-Reinforced EPDM Liner

Property	Test Methods	Requirements ¹	
		Nominal Thickness (mils)	
		45	60
Specific Gravity	ASTM D 792	1.1	1.1
Tensile Properties	ASTM D 882		
Break Stress, lb/in	(type IV at 20 in/min)	50	50
Break Elongation, %		400	400
Tear Resistance, lb	ASTM D 1004	9	11
Puncture Resistance, lb	ASTM D 4833	35	60
Low Temperature Brittleness, °F	ASTM D 1790	< -45	< -45
Seam Properties	ASTM D 413/4437		
Shear Strength ² , lb/in	(NSF modified 20 in/min strain rate)	35	35
Peel Strength ³ , lb/in		14	14
<ol style="list-style-type: none"> 1. All values, unless specified otherwise, are minimum average roll values as reported for the test method. 2. At 200 percent strain. 3. Cohesive bond mode. 			

Table 2.3-6 Requirements for Reinforced EPDM Liner

Property	Test Methods	Requirements ¹
		Nominal Thickness (mils)
		45
Specific Gravity	ASTM D 792	1.1
Tensile Properties	ASTM D 751 Method A	125
Tear Resistance, lb	ASTM D 5884 Method B	130
Puncture Resistance, lb	FTMS 101C Method 2031	45
Ply Adhesion, lb/in	ASTM D 413 Machine Method	7
Low Temperature Brittleness, °F	ASTM D 1790	< -45
Seam Properties		
Shear Strength ² , lb/in	ASTM D 751	35
Peel Strength ³ , lb/in	ASTM D 413	14
<ol style="list-style-type: none"> 1. All values, unless specified otherwise, are minimum average roll values as reported for the test method. 2. At 200 percent strain. 3. Cohesive bond mode. 		

Table 2.3-7 Requirements for Unreinforced FPP Liner

Property	Test Methods	Requirements ¹		
		Nominal Thickness (mils)		
		30	40	60
Specific Gravity	ASTM D 792	0.90	0.90	0.90
Tensile Properties	ASTM D 638			
Break Stress, lb/in	(type IV at 20 in/min)	60	72	130
Break Elongation, %		600	600	600
Tear Resistance, lb	ASTM D 1004	9	11	16
Puncture Resistance, lb	ASTM D 4833	28	35	65
Carbon Black Content, %	ASTM D 1603	2-4	2-4	2-4
Carbon Black Dispersion	ASTM D 5596	Cat 1-2	Cat 1-2	Cat 1-2
Low Temperature Brittleness, °C	ASTM D 1790	< -40	< -40	< -40
Seam Properties	ASTM D 6392, D 6214, D 4437 ³			
Shear Strength, lb/in		35	45	55
Peel Strength ² , lb/in		20/FTB	30/FTB	40/FTB
<ol style="list-style-type: none"> All values, unless specified otherwise, are minimum average roll values as reported for test method. ASTM D 6392 shall be used for thermally welded seams, D 6214 for chemically welded seams, and D 4437 for all other types. Film tear bond: A failure of one of the bonded sheets by tearing prior to complete separation in the bonded area. 				

Table 2.3-8 Requirements for Reinforced FPP Liner

Property	Test Methods	Requirements ¹	
		Nominal Thickness (mils)	
		36	45
Specific Gravity	ASTM D 792	0.90	0.90
Tensile Properties	ASTM D 751 Method A	225	225
Tear Resistance, lb	ASTM D 5884 Method B	55	75
Puncture Resistance, lb	FTMS 101C Method 2031	200	250
Ply Adhesion, lb/in	ASTM D 413 Machine Method	20	20
Carbon Black Content, %	ASTM D 1603	2-4	2-4
Carbone Black Dispersion	ASTM D 5596	Cat 1-2	Cat 1-2
Low Temperature Brittleness, °F	ASTM D 2136	< -40	< -40
Seam Properties			
Shear Strength, lb/in	ASTM D 751	160	200
Peel Strength ² , lb/in	ASTM D 413	20/FTB	20/FTB
<ol style="list-style-type: none"> 1. All values, unless specified otherwise, are minimum average roll values as reported for the test method. 2. Film tear bond: A failure of one of the bonded sheets by tearing prior to complete separation in the bonded area. 			

Table 2.3-9 Requirements for Non-Woven Geotextiles

Property	Test Methods	Material ¹
Mass per Unit Area, oz/sy ²	ASTM D 5261	10
Grab Tensile Strength, lb	ASTM D 4632	230
Grab Tensile Elongation, %	ASTM D 4632	>50
Trapezoidal Tear Strength, lb	ASTM D 4533	95
Puncture (pin) Strength, lb	ASTM D 4833	120
Puncture (pyramid) Strength, lb ⁴	ASTM D 5494	300
Puncture (CBR) Strength, lb ⁴	ASTM D 6241	700
Puncture (CBR) Elongation, in ⁴	ASTM D 6241	1.5
UV Resistance 500 hr Exposure ²	ASTM D 7238	70
Apparent Opening Size (AOS)	ASTM D 4751	As specified ³ , max #100
Permittivity, 1/seconds	ASTM D 4491	0.70 min.
<ol style="list-style-type: none"> 1. All values are minimum average roll value except UV resistance which is a minimum value. 2. Evaluation to be on 2.0 inch strip tensile specimens after 200 lt. hours exposure. 3. U.S. Standard sieve analysis. 4. Alternative puncture test methods to be considered in place of Pin Puncture, ASTM D 4833. 		

2.4 MISCELLANEOUS MATERIALS

- A. Gaskets: Gasket material shall be neoprene, closed-cell medium, 0.25 inch thick, with adhesive on one side, or other gasket material as approved by the liner manufacturer.
- B. Adhesives: Provide types of adhesive primers, compounds, solvents, and tapes recommended in writing by geomembrane liner manufacturer for bonding to structures (if required), for sealing of seams in geomembrane liner, and for sealing penetrations through geomembrane liner.
- C. Penetration Assemblies: Provide manufacturer's standard factory-fabricated assemblies for sealing penetrations. Include joint sealant recommended in writing by geomembrane liner manufacturer and compatible with geomembrane liner, containment conditions, and materials.
- D. Battens Strips:
 - 1. Long-length strips of material indicated, size as indicated on Drawings. Fabricate battens with sharp projections removed and edges eased and then predrilled or punched for anchors. Provide stainless steel anchors and bolts, or other type of attachment, of type and spacing recommended in writing by geomembrane liner manufacturer for attaching geomembrane liner system to substrate and as indicated.
 - 2. Batten strips are normally used to secure geomembrane liner materials to concrete substrates. Verify compatibility of manufacturer's recommended sealant, usually silicone or butyl rubber, with containment conditions and materials.
 - 3. Batten Material: Stainless Steel
 - 4. Minimum Dimensions: 0.25-inch-thick by 2-inch-wide.
- E. Sand: ASTM C33/C33M; fine aggregate, natural or manufactured sand.
- F. Cover Soil: Cover soil may be used on other liners but is not required unless essential for the proper performance, protection and durability of the installation. Cover soils shall not contain sharp, angular stones or any objects that could damage the liner. Maximum allowable particle size of soil cover material shall be 3/8-in for geomembrane liners unless the liner is protected by a 10-oz/sq yd or heavier non-woven geotextile cushion material. Cover materials shall be stable against slippage down the slope under all operational and exposure conditions, such as rapid drawdown or saturation by precipitation or snowmelt.

2.5 FABRICATION

- A. Fabricate geomembrane liner panels from sheets in sizes as large as possible with factory-sealed seams, consistent with limitations of weight and installation procedures. Minimize field seaming.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for soil compaction and grading; for subgrade free from angular rocks, rubble, roots, vegetation, debris, voids, protrusions, and ground water; and for other conditions affecting performance of geomembrane liner.
- B. Examine anchor trench excavation or concrete perimeter, where geomembrane liner will be secured, for substrate conditions indicated above and for correct location and configuration.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Subgrade preparation shall conform to manufacturer recommendation and applicable state regulations. Subgrade materials shall not contain sharp, angular stones or any objects that could damage the liner or adversely affect its function unless a cushion layer is used.
- B. Cushion. A cushion layer shall be placed beneath the liner if the subgrade particles contain sharp angular stones that could damage the liner or particles greater than 3/8-inch for geo-membrane liners. The cushion may be a 10-oz/sq yd or heavier non-woven geotextile or a layer at least 6 inches thick of soil meeting the particle size and shape requirements of the subgrade. Geotextile cushion material shall meet the requirements of GRI Test Method GT12(a). Follow the manufacturer's recommendations for any additional protective measures.
- C. Provide temporary ballast, until edges are permanently secured, that does not damage geomembrane liner or substrate, to prevent uplift of geomembrane liner in areas with prevailing winds.
- D. Prepare surfaces of construction penetrating through geomembrane liner according to geomembrane liner manufacturer's written instructions.
- E. Remove curing compounds and coatings from concrete surfaces to be sealed to geomembrane liner.

3.3 INSTALLATION

- A. General: Place geomembrane liner over prepared surfaces to ensure minimum handling. Install according to Shop Drawings and in compliance with geomembrane liner manufacturer's written instructions. Begin placing geomembrane liner at Project's upwind direction and proceed downwind. Install geomembrane liner in a relaxed condition, free from stress and with minimum wrinkles, and in full contact with subgrade. Do not bridge

over voids or low areas in the subgrade. Fit closely and seal around inlets, outlets, and other projections through geomembrane liner. Permanently secure edges.

- B. **Field Seams:** Comply with geomembrane liner manufacturer's written instructions. Form seams by lapping edges of panels 2 to 4 inches (50 to 102 mm), unless instructions require a larger overlap. Wipe contact surfaces clean and free of dirt, dust, moisture, and other foreign materials. Use solvent-cleaning methods and grind geomembrane seam surfaces if recommended by geomembrane liner manufacturer. Proceed with seaming at required temperatures for materials and ambient conditions. Continuously bond sheet to sheet to construct single or double seams of width recommended for method of seaming used. Seal or fuse free seam edges. Inspect seams and reseal voids.
 - 1. **Adhesive Bonding:** Apply bonding cement to both contact surfaces in seam area and press together immediately, or use other seaming methods as instructed by geomembrane liner manufacturer. Roll to press surfaces together, to distribute adhesive to leading edges of panels, and to remove wrinkles and fishmouths. Remove excess adhesive.
- C. **Installation in Anchor Trench:** Install geomembrane liner in trench according to manufacturer's written instructions. Backfill and compact to lock liner into trench.
- D. **Attachment to Concrete:** Use manufacturer's standard system to suit Project conditions. Support adhesive and geomembrane on minimum 8-inch- (200-mm-) wide concrete substrate unless otherwise indicated.
 - 1. Install batten strips over geomembrane liner as indicated on Drawings.
- E. **Liner Repairs:** Repair tears, punctures, and other imperfections in geomembrane liner field and seams using patches of geomembrane liner material, liner-to-liner bonding materials, and bonding methods according to geomembrane liner manufacturer's written instructions. Apply bonding solvent or weld to contact surfaces of both patch and geomembrane liner, and press together immediately. Roll to remove wrinkles.
- F. **Cover soil** shall be placed within 24 hours after placement of the liner to minimize the potential for damage from various sources, including precipitation, wind, and ultra-violet exposure.

3.4 FIELD QUALITY CONTROL

- A. **Testing Agency:** Contractor to engage a qualified testing agency to perform tests and inspections.
- B. **Nondestructive Testing:** Follow the testing requirements as indicated by the manufacturer to maintain warranty coverage. Record locations of failed seams and patches. Individually number and date occurrences and details of leak and remedial action. Repair leaking seams and patches.
- C. **Destructive Testing:** Follow the testing requirements as indicated by the manufacturer to maintain warranty coverage. Record locations of sample locations and failed seams.

Individually number and date occurrences and details of leak and remedial action. Repair leaking seams and patches, and test sample locations.

- D. Prepare test and inspection reports.

3.5 PROTECTION

- A. Protect installed geomembrane liner according to manufacturer's written instructions. Repair or replace areas of geomembrane liner damaged by scuffing, punctures, traffic, rough subgrade, or other unacceptable conditions.
- B. Before initial filling of pond or placement of earth cover, inspect seams and patched areas to ensure tight, continuously bonded installation. Repair damaged geomembrane liner and seams and reinspect repaired work.

SECTION 02957 B**SEWER MANHOLE COATING****PART 1 - GENERAL****1.1 SCOPE**

- A. Manhole coating with cementitious liner including preparation, build back and corrosion protection. Manhole coating shall follow any miscellaneous manhole rehabilitation work associated with *Section 02957 A, Sanitary Sewer Manhole Rehabilitation*.

1.2 REFERENCES

- A. ASTM International (ASTM)
1. C94/C94M, *Standard Specification for Ready-Mixed Concrete*, latest revision.
 2. C109/C109M, *Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in or [50 mm] Cube Specimens)*, latest revision.
 3. C267, *Standard Test Method for Chemical Resistance of Mortar, Grout, and Monolithic Surfacing and Polymer Concrete*, latest revision.
 4. C348, *Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars*, latest revision.
 5. C496/C496M, *Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens*, latest revision.
 6. C596, *Standard Test Method for Drying Shrinkage of Mortar Containing Hydraulic Cement*, latest revision.
 7. C666/C666M, *Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing*, latest revision.
 8. C882/C882M, *Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete by Slant Shear*, latest revision.

1.3 SYSTEM DESCRIPTION

- A. Manhole lining under this specification shall govern all work, materials, and equipment required for the following:
1. Substrate rehabilitation for the purpose of eliminating infiltration, providing corrosion protection, repair of voids, and restoration of the structural integrity of the substrate as a result of the applying a monolithic fiber reinforced structural/structurally enhanced cementitious liner to the wall and the bench surfaces of brick, concrete, or any other masonry construction material.

- B. Manhole lining shall be applied by an applicator who is approved and trained by the manufacturer of the lining system materials. All aspects of the installation shall be in accordance with the manufacturers recommended and per the following specification.
- C. Manhole lining as referred to on the Drawings and specified herein shall include:
 - 1. The removal of any loose unsound materials.
 - 2. Cleaning of the area to be sprayed with high pressure water.
 - 3. The repair and filling of voids.
 - 4. The repair and sealing of the pipe seals, pipe invert, and benches.
 - 5. The elimination of active infiltration prior to making the application.
 - 6. The spray application of a cementitious mix to form a structural/structurally enhanced monolithic liner.

1.4 SUBMITTALS

- A. Work Plan: Prior to the pre-construction conference, the Contractor shall submit a work plan for review and acceptance by the City. The following items shall be addressed in the work plan, as a minimum:
 - 1. Written description of construction procedures, including bypassing pumping sewage flow and reconnection of service laterals.
 - 2. The locations, dimensions, and number of equipment staging areas and working areas.
 - 3. Product data for review by City. Detailed and complete data pertaining to the manhole lining products and installations
 - 4. Applicator shall provide to City 3 references from Municipal projects completed in the last 12 months.
 - 5. Certificate of “Compliance with Specifications” for the manhole rehabilitation material and installation.
 - 6. Certificates for each applicators experience with installation of the proposed product from the manufacturer of the manhole lining product.
 - 7. Manufacturer’s certifications indicated in Section 1.6.
- B. Manhole rehabilitation product testing reports which shall include but not be limited to:
 - 1. Compressive strength
 - 2. Bond Strength
 - 3. Tensile Strength

- 4. Flexural Strength
 - 5. Shrinkage
 - 6. Freeze/Thaw
- C. Manhole acceptance testing reports

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with manufacturer's instructions.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum ten years documented experience.
- B. Applicator: Material manufacturer shall provide owner with current written certification that applicator's current employees have been trained and approved in handling mixing and application of the product to be used.
- C. Applicator shall initiate and enforce quality control procedures consistent with applicable ASTM, NACE and SSPC together with the manufacturer's recommendations.
- D. Applicator shall have completed and follow all OSHA confined space regulations along with having completed all hazard communication training.
- E. Contractor shall provide to City 3 references from Municipal projects completed in the last 12 months indicating successful application of products to be used by application method generally used for the product.
- F. Equipment: Certification that the equipment to be used for applying the products has manufacturer approval and applicator personnel have been trained and certified for proper use of equipment by manufacturer.

1.7 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings.

PART 2 - PRODUCTS

2.1 PRODUCTS

- A. Manhole Lining Products: Products shall be manufactured by SewperCoat or City preapproved equal. Labor, equipment, and materials, including the machinery specially designed for the application, shall be provided by the applicator.
- B. Patching Material: A quick setting corrosion resistant cementitious material shall be a used as a patching material, and is to be mixed and applied according to manufacturer's recommendations, and shall have the following minimum requirements:
 - 1. Compressive Strength ASTM C109 >1800 psi, 1 hr.

shall be volume stable and have a minimum 28-day compressive strength of 250 psi.

2. If pressure grouting is required the material shall be:

- a. Avanti A-220, Deneef
- b. City-Approved Equal.

E. Liner Material: A cementitious product shall be used to form a structural/structurally enhanced monolithic liner covering all interior substrate surfaces. The liner material shall be applied with machinery specially designed for the application, and shall have the following minimum requirements at twenty-eight (28) days:

Compressive Strength	ASTM C109	>7000 psi
Tensile Strength	ASTM C496	>700 psi
Flexural Strength	ASTM C348	>1300 psi
Shrinkage @ 90% R.H.	ASTM C596	0.07%
Bond	ASTM C882	>2000 psi
Density, when applied		151 +/- 4 lbs./ft3 pcf
Freeze/Thaw	ASTM C666	300 previous cycles no visible damage

1. Liner material shall be the following:

- a. SewperCoat
- b. City Approved Equal

F. Water: Water used to mix product shall be clean and potable. A laboratory shall test questionable water in accordance per ASTM C-94 procedure. Potable water need not be tested.

G. Other Materials: No other material shall be used with the mixes described above without prior approval or recommendation of the City.

PART 3 - EXECUTION

3.1 MANHOLE LINING

A. Equipment Application equipment shall be as recommended by materials manufacturer.

B. Application:

1. Preparation:

- a. Provide means, labor and equipment to dam, plug, and/or divert or bypass the flow from services entering the manhole.
- b. Place covers over invert to prevent extraneous material from entering the sanitary sewer. Adequately sized pumps shall be provided and used by the Contractor continuously to protect the work.

- c. All foreign material shall be removed from the manhole wall and bench using a high pressure water spray (minimum 3,500 psi). Loose and protruding brick, mortar, and concrete shall be removed using a mason's hammer and chisel and/or scraper. Detergent water cleaning and hot water blasting may be necessary to remove oils, grease or other hydrocarbon residues from the manhole surface. Cleaned surface shall be a sound uniform neutralized and are not excessively damaged.
 - d. Fill any large voids with patching material as specified herein. Submit proposed method of discovering voids and proposed product to fill voids.
 - e. A mild chlorine solution may be used to neutralize the surface to diminish microbiological bacteria growth unless it is not acceptable to the manufacture of the product to be supplied. Provide manufacturer's acceptance.
 - f. Surface preparation shall produce a cleaned, abraded and sound surface with evidence of laitance, loose concrete, brick or mortar, contaminants or debris, and shall display a surface profile suitable for application of liner system.
 - i. If required, sandblasting or abrasive blasting may be used to create a roughened surface.
 - g. Active leaks shall be stopped using infiltration control material according to manufacturer's recommendations. Some leaks may require weep holes to localize the infiltration during the application. After application, the weep holes shall be plugged with infiltration control material prior to the application of the final coat. When severe infiltration exists, drilling may be required in order to pressure grout using a cementitious grout or chemical grout, as specified herein for grouting material. Manufacturer's recommendations shall be followed when pressure grouting is required.
 - h. All manhole steps shall be removed and the wall repaired prior to lining.
 - i. Structure to be lined shall be wetted per the manufacturer's recommendations prior to applying lining material.
 - j. Manhole frames and covers that are shifted or are not flush with pavement elevation shall be reset.
 - i. Center the manhole frame and cover over the manhole opening
 - ii. Adjust the frame and cover top elevation to City standards.
2. Invert, pipe seal, and bench repair:
- a. After all preparations have been completed, remove all loose material and wash wall again.

- b. Any bench, invert, pipe seal and/or service line repairs shall be made at this time using patching material and shall be used per manufacturer's recommendations.
- c. Invert repair shall be performed on all inverts with visible damage or where infiltration is present, or when vacuum testing is specified. After blocking through the manhole, and thoroughly cleaning invert, the patching material shall be applied to the invert in an expeditious manner. The material shall be troweled uniformly onto the damaged invert at a minimum thickness of ½ inch at the invert extending out onto the bench of the manhole sufficiently to tie into the structural/structurally enhanced monolithic liner to be applied. The finished invert surfaces shall be smooth and free of ridges. The flow may be reestablished in the manhole within thirty (30) minutes after placement of the material.

3. Mixing:

- a. Mixing shall be done in strict accordance with the material manufacturer's instructions.
- b. Addition of water to the mix shall be in strict accordance with the manufacture's recommendations.
- c. Re-mixing or tempering shall not be permitted. Rebound material shall not be reused.
- d. The mixer shall be cleaned to remove all adherent materials for the mixing valves and from the drum at regular intervals.

4. Spraying:

- a. The surface shall be clean and free of all foreign material and shall be damp without noticeable free water droplets or running water, but totally saturated, just prior to application. Materials shall be spray applied up to one (1) inch thick in one or more passes from the bottom of the frame, however, minimum total thickness shall not be less than ½ inch to insure that all cracks, crevices, and voids are filled and a relatively smooth surface remains after light troweling. The light troweling is performed to compact the material into voids and to set the bond.
- b. Bench application: The covers shall be removed at this time and the bench sprayed with materials mixed as specified in Part 2 and spray applied in such a manner that a gradual slope is produced from the walls to the invert with the thickness at the edge of the invert to be no less than 1 inch. The wall/bench intersection shall be rounded to a uniform radius the full circumference of the intersection.
- c. Operations: Manufacturer recommended equipment shall control the actual amounts of material applied.
- d. Surface Defect Repair:

- i. Continual inspection during coating application shall be maintained
- ii. Any imperfections shall be removed and replaced with sound material.

C. Curing:

1. Care should be taken to minimize exposure of applied product to sunlight and air movement. At no time should the finished product be exposed to sunlight or air movement for longer than fifteen (15) minutes before covering or closing access. In extremely hot and arid climates, manhole should be shaded while application is in process. Contact manufacturer for curing compound recommendations.
 - a. The application shall have a minimum of four (4) hours cure time before being subjected to active flow.
 - b. For traffic areas, calcium aluminate based products shall be used. Traffic shall be deferred for a maximum of six (6) hours.

D. Weather: No application shall be made to frozen surfaces or if freezing is expected to occur within the substrate within twenty-four (24) hours after application. If ambient temperatures are in excess of 95 degrees F, precautions shall be taken to keep the mix temperature at time of application below 90 degrees F. Mix water temperature shall not exceed 85 degrees F. Chill with ice if necessary.

E. Product Testing: Four two inch cube specimens shall be cast each day or from every fifty (50) bags of product used and shall be properly packaged, labeled, and returned to manufacturer for testing in accordance with the Owner's or manufacturer's directions for compression strength testing as described in ASTM C109.

F. Acceptance Testing: Contractor shall test rehabilitated manholes as follows:

1. Visually verify the absence of leaks. Visible leaks shall be corrected immediately.
2. Vacuum tests in accordance with construction specification *Section 01715, Sewer and Manhole Testing* shall be conducted on all manholes
3. Visual inspection shall be made by the Owner. Any deficiencies in the finished liner system shall be marked and repaired according to the procedures set forth by the Manufacture.

SECTION 02960

TEMPORARY SANITARY SEWER BYPASS PUMPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Temporary sanitary sewer bypass pumping to maintain sanitary sewer service during construction.

1.2 RELATED SECTIONS:

- A. All Sections.

1.3 SUBMITTALS

- A. Submittals shall conform to requirements of Section 01300 – Submittal Procedures.
- B. Submit Temporary Sanitary Sewer Bypass Plan for review by the Engineer and Owner prior to start of any fieldwork. A Professional Engineer licensed by the State of Colorado shall sign the Plan. The Plan shall include the following:
 - 1. Names and qualifications of equipment suppliers and installation subcontractors. The Contractor shall document at least 5 years of experience and verifiable history of projects requiring bypass pumping.
 - 2. A description of the proposed temporary bypass systems indicating arrangement, location, capacities of system components, installation details and criteria, and operation and maintenance procedures. This description shall also include the following information:
 - a. Bypass pumping phasing plan with exhibits and descriptions for each phase, including a schedule for installation and maintenance of bypass pumping system, and staging areas for pumps.
 - b. Bypass pump sizes, capacity, number of each size to be onsite, and power requirements.
 - c. Size, length, material, location, and method of installation for suction and discharge piping.
 - d. Standby power generator size and location.
 - e. Method of noise control for each pump and/or generator.

- f. Design calculations demonstrating adequacy of the proposed systems for intended applications. Calculations shall include flow and head calculations including friction loss for the length and type of pipe and static head.
 - g. Bypass pump curve(s) showing pump operating range.
 - h. Daily operations of the pump(s) and the maintenance of the pump(s) during the non-working hours.
 - i. Calculation of available time between pump failure and flooding, backups, etc.
- 3. Diagrams indicating the location of all system components, including, but not limited to, pumps, pipes, catch points, and discharge points. Include road crossing details.
 - 4. Name and telephone number for the Sewer Flow Control Supervisor who is to be on call 24 hours per day while pumps are in operation.

1.4 ENVIRONMENTAL REQUIREMENTS

- A. Comply with Colorado Department of Public Health and Environment (CDPHE) guidelines.

PART 2- PRODUCTS

2.1 EQUIPMENT AND MATERIALS

- A. Contractor shall provide all labor, materials, and equipment necessary to provide adequate sanitary sewer bypass during construction of the Project without causing damage to public or private property or allowing unauthorized discharges of sanitary sewer flows.
- B. The Contractor is responsible for determining the capacity of the sanitary sewer bypass system. The Contractor shall consider the “full pipe” capacity of the sewer system being bypassed when determining the capacity of the bypass system. Based on City of Greeley modeling data, the peak hourly flow rate is expected to be approximately 1,550 GPM through the 18-inch diameter pipe, and the peak hourly flow rate is expected to be approximately 176 GPM through the 12-inch diameter pipe. Equipment and materials to provide this range of flow capacity are at the option and risk of Contractor.
- C. Temporary Bypass Pumping System: All bypass pumping system materials shall be suitable for contact with domestic sanitary sewage. The bypass pumping system shall include the following components:
 - 1. Bypass pump(s) with sufficient capacity to bypass sanitary sewer flows without causing damage to public or private property.

2. Backup pump(s) on site to provide 100% redundancy; backup pumps shall be isolated from the primary system by a valve.
 3. Bypass pumping control system.
 4. Bypass pumping system failure alarm(s).
 5. Discharge piping with leak-free joints.
- D. Temporary Pumps: Pumps utilized in the bypass pumping system shall be self-priming and non-clog type capable of passing a non-compressible four-inch (4") sphere, designed for pumping domestic sewage containing solids and stringy materials. Pumps shall not require the use of foot valves or vacuum pumps in the priming system. All pumps used must be constructed to allow dry running for long periods of time to account for the cyclical nature of effluent flows. The pumps may be electric, or diesel powered. Engine exhaust shall be invisible, without objectionable fumes, smoke, oil mist, or carbon particles. Provide equipment of sufficient capacity to handle peak flow rates.
- E. Discharge and suction piping sizing shall be determined according to flow calculations and system operating calculations.
- F. High Density Polyethylene (HDPE): Piping shall be homogenous throughout, free of visible cracks, discoloration, pitting, varying wall thickness, holes, foreign material, or other deleterious faults. Pipe shall be assembled and joined on site using coupling, flanges, or butt-fusion method to provide leak proof joints. Thread or solvent joints are not acceptable. Pipe fusion shall be carried out by personnel certified as fusion technicians by manufacturer of HDPE pipe and/or fusing equipment. Butt-fusion joints shall be true alignment and uniform roll-back beads resulting from use of proper temperature and pressure.
- G. Flexible Hoses and Associated Couplings and Connectors: Flexible hose and couplings shall be abrasive resistant and suitable for the intended services (i.e., fire hoses are not permitted). They shall be rated for external and internal loads anticipated including test pressure. External load design shall incorporate anticipated traffic loadings, including traffic impact loading where applicable. When subjected to traffic loading, the system shall be composed of traffic ramps and covers maintaining an H-20 loading requirement while in use or as directed by the Engineer.
- H. All rigid or hard piping shall be constructed with positive restrained joints.
- I. Under no circumstance will aluminum irrigation type piping or glued PVC pipe be allowed.
- J. Unmanned Bypass Pumping: All unmanned bypass pumping operations shall be fitted with an auto-dialer feature to monitor the operation of the pump and notify the Contractor in the event of a pump failure or overflow situation.
- K. Noise Control: Bypass pumping system components shall not have excessive noise levels and shall be restricted to a maximum of seventy decibels (70 dB) at a distance of 100

feet. If pumping is required on a 24-hour basis, engines shall be equipped in a manner to keep noise to a minimum.

PART 3- EXECUTION

3.1 TEMPORARY BYPASS PUMPING

- A. Sanitary sewer bypass shall be completed in such a manner that there is no damage to public or private property. Repair and reparations for damage caused by or associated with sanitary sewer flows are the sole responsibility of the Contractor to fix, repair, clean and make whole.
- B. Sewage Spills: Violations of any state or federal laws caused by sewage spills shall be the sole responsibility of the Contractor. Should any liquid or solid matter from the sewer collection system be spilled, discharged, leaked, or otherwise deposited to the open environment as a result of the bypass operations, Contractor shall be responsible for all cleanup and disinfection of the affected area and all associated costs. The Contractor shall also be responsible for notifying the Owner, sewer system operating personnel, and appropriate regulatory agencies and performing all required cleanup operations at no additional cost to the Owner.
- C. Install, operate, and maintain temporary bypass systems in accordance with the Temporary Bypass Plan. Notify Engineer in writing of any changes made to accommodate field conditions and changes to the Work. Provide revised drawings and calculations with such notification.
- D. In the event of accidental spill or overflow, immediately stop the overflow and take action to clean up and disinfect spillage. Promptly notify Engineer so that required reporting can be made to the Colorado Department of Public Health and the Environment (CDPHE).
- E. Flow shall not be transferred to any new or modified facilities until the Owner has inspected and accepted the work.

3.2 FIELD QUALITY CONTROL AND MAINTENANCE

- A. Testing: Contractor shall perform leakage and pressure tests of the bypass pumping discharge piping using clean water prior to actual operation. The Owner will be given 24 hours' notice prior to testing.
- B. Inspection: Contractor shall inspect bypass pumping system every two hours to ensure that the system is working properly.
- C. Maintenance Service: Contractor shall ensure that the temporary pumping system is properly maintained.
- D. A Sewer Flow Control Supervisor is required to be on call 24 hours per day and be physically located within 30 minutes of the project site at all times while the pumps are in

operation. The Sewer Flow Control Supervisor shall be knowledgeable in the operation of the sanitary sewer bypass system and shall have the authority to purchase replacement parts as needed to repair the sanitary sewer bypass system.

E. Extra Materials:

1. Spare parts for pumps and piping shall be kept on site as required.
2. Adequate hoisting equipment for each pump and accessories shall be maintained on the site.

3.3 PREPARATION

A. Precautions:

1. Contractor is responsible for locating any existing utilities in the area the Contractor selects to locate the bypass pipelines. The Contractor shall locate their bypass pipelines to minimize any disturbance to existing utilities and shall obtain approval of the pipeline locations from the Owner. All costs associated with relocating utilities and obtaining approvals shall be the responsibility of the Contractor.
2. During all bypass pumping operation, the Contractor shall protect the pumping station and main and all local sewer lines from damage inflicted by any equipment. The Contractor shall be responsible for any physical damage to the pump station and mains and all local sewer lines caused by human or mechanical failure.

B. Notifications:

1. Contractor shall notify property owners, residents, and business managers in writing prior to plugging, bypassing, or otherwise affecting a sewer service. This notification shall be provided a minimum of 72 hours in advance, but no more than 144 hours in advance prior to plugging or bypassing a sewer service. Contractor shall not plug a sewer service for more than 4 hours without providing additional accommodations.

3.4 INSTALLATION AND REMOVAL

- A. Contractor shall remove manhole sections or make connections to the existing sewer and construct temporary bypass pumping structures only at the access location indicated on the Drawings and as may be required to provide suction conduit.
- B. Plugging or blocking of sewage flows shall incorporate primary and secondary plugging devices. When plugging or blocking is no longer needed for performance and acceptance of Work, it is to be removed in a manner that permits the sewage flow to slowly return to normal without surge, to prevent surcharging, or causing other major disturbances downstream.

- C. When working inside a manhole or force main, the Contractor shall exercise caution and comply with OSHA requirements for working in the presence of sewer gases, combustible oxygen-deficient atmospheres, and confined spaces.
- D. The installation of bypass pipelines is prohibited in all saltmarsh/wetland areas. The pipeline must be located off streets, sidewalks, and on shoulders or the roads. When the bypass pipeline crosses local streets and private driveways, where roadway ramps cannot be used, the Contractor must place the bypass line in trenches and cover with temporary pavement or plates.
- E. Upon completion of the bypass pumping operations, and after the receipt of written permission from the Owner, the Contractor shall remove all piping, restore all property to pre-construction condition, and restore all pavement and roadways. The Contractor is responsible for obtaining any approvals for placement of temporary pipelines from local agencies.

SECTION 03300**CAST-IN-PLACE CONCRETE****PART 1 – GENERAL****1.1 SCOPE**

- A. This section addresses cast-in-place concrete for thrust restraints, sanitary sewer manhole bases, and cut-off walls, including forms, reinforcing steel, finishing and curing, and other appurtenant work.
- B. All other concrete work shall conform to the Design Criteria and Construction Specifications Streets Volume I (SDC).

1.2 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. 117, *Specifications for Tolerances for Concrete Construction and Materials*, latest revision.
 - 2. 301, *Specifications for Structural Concrete*, latest revision.
 - 3. 305.1, *Hot Weather Concreting*, latest revision.
 - 4. 306.1, *Cold Weather Concreting*, latest revision.
 - 5. 309, *Guide for Consolidation of Concrete*, latest revision.
 - 6. 350.1, *Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures*, latest revision.
- B. ASTM International (ASTM):
 - 1. A185, *Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete*, latest revision.
 - 2. A615, *Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement*, latest revision.
 - 3. A996, *Standard Specification for Rail-Steel and Axle –Steel Deformed Bars for Concrete Reinforcement*, latest revision.
 - 4. C31/C31M, *Standard Test Practice for Making & Curing Concrete Test Specimens in the Field*, latest revision.
 - 5. C33, *Standard Specification for Concrete Aggregates*, latest revision.
 - 6. C39/C39M, *Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens*, latest revision.

7. C94/C94M, *Standard Specification for Ready-Mixed Concrete*, latest revision.
8. C143/C143M, *Standard Test Method for Slump of Hydraulic Cement Concrete*, latest revision.
9. C150, *Standard Specification for Portland Cement*, latest revision.
10. C157/C157M, *Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete*, latest revision.
11. C231, *Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method*, latest revision.
12. C260, *Standard Specification for Air-Entraining Admixtures for Concrete*, latest revision.
13. C494/C494M, *Standard Specification for Chemical Admixtures for Concrete*, latest revision.
14. A1064, *Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete*, latest revision.
15. C618, *Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete*, latest revision.
16. C1218/C1218M, *Standard Test Method for Water-Soluble Chloride in Mortar and Concrete*, latest revision.
17. C1260, *Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)*, latest revision.
18. C1315, *Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete*, latest revision.
19. C1602/1602M, *Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete*, latest revision.

1.3 SUBMITTALS

- A. Submit batch tickets for each load at the time of delivery indicating the following:
 1. Identification name and number.
 2. Date.
 3. Quantity delivered.
 4. Mix design.
 5. Mix time.
 6. Time at which the water was added.

7. Amount of water added at job site.
8. All quantities of mix ingredients in batch.
9. Amounts of admixtures added to mix.

B. Mix Designs:

1. Submitted to the City for review and approval not less than two (2) weeks prior to first concrete placement.
2. Concrete mix designs shall contain proportions of materials and admixtures to be used on work, signed by mix designer.
3. Documentation of average strength for each proposed mix design in accordance with ACI 301.
4. Letter of Certification that Concrete Producer has verified compatibility of constituent materials in design mix.
5. Test Reports:
 - a. Cement: Chemical analysis report.
 - b. Supplementary Cementitious Materials: Chemical analysis report and report of other specified test analyses.
 - c. Water-Soluble Chloride-Ion Content in Hardened Concrete: Unless otherwise permitted, in accordance with ASTM C1218 at an age between 28 and 42 days.
 - d. Shrinkage Test Results: In accordance with ASTM C157 as modified herein.
6. Aggregates:
 - a. Gradation for coarse aggregates. List gradings and percent passing through each sieve.
 - b. Gradation for fine aggregates. List gradings and percent passing through each sieve.
 - c. Percent of fine aggregate weight to total aggregate weight.
 - d. Deleterious substances in fine aggregate per ASTM C33, Table 1.
 - e. Deleterious substances in coarse aggregate per ASTM C33, Table 3.
 - f. Manufacturer's Letter of Certification that the aggregate conforms to the specified class designation for coarse aggregate.
 - g. Test Reports:

5. Curing methods (including use of evaporation retardant).
 6. Procedures for measuring and recording concrete temperatures.
 7. Procedures for preventing drying during dry, windy conditions.
- F. Manufacturer's application instructions for bonding agent and bond breaker.
- G. Manufacturers' Letter of Certification of conformance to specified standards:
1. Portland cement.
 2. Fly ash.
 3. Aggregates.
 4. Admixtures.
 5. Bonding agent.
 6. Bond breaker.
- H. Statement of Qualification:
1. Batch Plant: Certification as specified herein.
 2. Mix designer.
 3. Installer.
 4. Testing Agency.
- I. Field test reports.
- J. Results of tightness tests.
- K. Concrete Delivery Tickets:
1. For each batch of concrete before unloading at Site.
 2. In accordance with ASTM C94/C94M, including requirements 14.2.1. through 14.2.10.
 3. Indicate amount of mixing water withheld, and maximum amount that may be permitted to be added at Project site.
 - a. Document all water added on site during or prior to placement.
 4. Indicate all components included in the concrete mix and any admixtures.
- L. Curing

1. Manufacturers' data for the following products:
 - a. Evaporation retardant.
 - b. Curing compound.
 - c. Clear sealer.
 - d. Clear floor hardener.
2. Curing methods proposed.
3. Curing Compound
 - a. Manufacturer's Certificate of Compliance showing moisture retention requirements.

M. Submittal Drawing

1. Submitted to the City for review and approval not less than two (2) weeks prior to placement and must include information on steel placement, sizing, compressive strength, and grade of steel reinforcement. Steel placement and sizing are to meet the City of Greeley Standard Drawing.

1.4 QUALITY ASSURANCE

- A. See the quality assurance requirements in the City of Greeley Design Criteria and Construction Specifications Streets Volume I.

PART 2- PRODUCTS

2.1 CEMENT

- A. All cement shall be Portland Cement. No other cement shall be used without prior written permission of the City.
- B. Portland Cement shall conform to ASTM C150, Type I/II.

2.2 AGGREGATES

- A. Unless otherwise permitted, furnish from one source for each aggregate type used in a mix design.
 1. Normal-Weight Aggregates:
 - a. In accordance with ASTM C33, except as modified herein.
 - i. Class Designation: 4S unless otherwise specified.
 - b. Free of materials and aggregate types causing pop outs, discoloration, staining, or other defects on surface of concrete.

- c. Alkali Silica Reactivity: See Article Concrete Mix Design.
- 2. Fine Aggregates:
 - a. Clean, sharp, natural sand.
 - b. ASTM C33.
 - c. Limit deleterious substances in accordance with ASTM C33, Table 1 and as follows:
 - i. Limit material finer than 75- μ m (No. 200) sieve to 5 percent mass of total sample.
 - ii. Limit coal and lignite to 0.5 percent.
- 3. Coarse Aggregate:
 - a. Natural gravels, combination of gravels and crushed gravels, crushed stone, or combination of these materials containing no more than 15 percent flat or elongated particles (long dimension more than five times the short dimension).
 - b. Limit deleterious substances in accordance with ASTM C33, Table 3 for specified class designation.

2.3 WATER

- A. Mixing water for concrete shall be potable. Alternative sources of water may be permitted with prior approval from the City.
 - 1. If approved by the City, water from alternative sources shall comply with requirements of ASTM C1602/C1602M, and the concentration of chemicals in combined mixing water shall be less than:
 - a. 1,000 ppm chloride content.
 - b. 3,000 ppm sulfate content as SO₄
 - c. 600 ppm alkalis as (Na₂O + 0.658 K₂O).
 - d. Total solids by mass less than 50,000 ppm.

2.4 ADMIXTURES

- A. Admixtures shall be certified to be compatible with each other.
- B. Admixtures shall not contain calcium chloride.
- C. Air-Entraining Admixture

1. An air entraining agent shall be used in all concrete. All air entraining agents shall conform to ASTM C260.
 2. Total air content: 5% to 8%
- D. Water Reducing Admixture
1. A water reducing admixture may be used, if approved by the City.
 2. A water reducing admixture shall conform to ASTM C494 for Type A or Type D chemical admixture.
 3. The water reducing admixture shall be compatible with the cement being used and shall not contain any calcium chloride (CaCl_2).
- E. Accelerators shall conform to ASTM C494 and ACI 306.
- F. Fly Ash
1. When fly ash is used in concrete, the cement replacement shall not exceed 20%.
 2. Fly ash shall conform to ASTM C618, Class C or F. Class C fly ash will not be permitted where sulfate resistant concrete is required.
- G. Antimicrobial Crystalline Waterproofing Admixture
1. Xypex Bio-San C500
 2. Xypex Bio-San C500 must be added to concrete mix at batch plant.
 3. The antimicrobial crystalline powder shall be added to the concrete mix at 1% by weight of the cementitious material content
- H. Any admixture including air entraining agents, accelerators, and retarders must be approved by the City.

2.5 REINFORCING MATERIALS

- A. All deformed reinforcing bars shall conform to ASTM A615 or ASTM A996. All bars shall be Grade 60.
- B. All welded steel wire fabric shall conform to ASTM A1064 and ASTM A185.
- C. Reinforcement supports and spacers shall be plastic coated steel or heavy duty plastic of design and strength to hold reinforcement accurately in place before and during placement of concrete.

2.6 FORMWORK

- A. Forms

1. Forms shall be designed to produce hardened concrete having the shape, lines, and dimensions shown on the approved Construction Drawings.
2. Plywood shall be PSI, waterproof, resin-bonded, exterior type, Douglas Fir.
3. Lumber shall be straight, uniform width and thickness, free from knots, offsets, holes, dents and other surface defects.
4. Form oil shall be light colored paraffin oil or other non-staining material.
5. Forms shall be coated with a form releasing agent before the form or reinforcement is placed in final position. The coating shall be used in accordance with the manufacturer's instructions.
6. Commercial formulation form coating compounds shall not bond with, stain, nor adversely affect the concrete surface's bond or adhesion, and shall not impede wetting of surfaces to be cured with water or curing compounds. Surplus coating on form surfaces and coating on reinforcing steel and construction joints shall be removed before placing concrete.

B. Form Ties

1. Commercially manufactured, removable or snap-off metal form ties designed to withstand applied stresses, prevent spreading of forms during concrete placement, and prevent concrete from spalling upon removal.
 - a. Form ties shall be submitted for approval by the city prior to use.
2. For water holding structures, form tie shall have integrated water stops.
3. Use of wire ties is prohibited.

2.7 MIX DESIGN

- A. Concrete shall develop a minimum field compressive strength of 4000 psi after 28 days, unless otherwise specified by the City (i.e. thrust blocks).
 1. Exception: Concrete utilized for thrust blocks shall develop a minimum field compressive strength of 2500 psi after 28 days. Contractor may utilize standard concrete plant mix design for exterior use and air entrainment.
- B. The water/cement ratio shall not exceed 0.50 by weight.
 1. The water/cement ratio may be increased to 0.56, by weight, if a water reducing agent is used.
 2. High early or rapid set concrete may be allowed in high traffic situations.

2.8 Curing Compound:

- A. Water-based, high solids content non-yellowing curing compound meeting requirements of ASTM C309 and ASTM C1315.

1. Moisture Loss: 0.40 kg/m²/72 hours maximum.
 2. Capable of meeting moisture retention at manufacturer's specified application rate.
- B. Manufacturers and Products:
1. BASF; Masterkure.
 2. Euclid Chemical Co.; Super Diamond Clear VOX.
 3. WR Meadows, Inc.; VOCOMP-30.
 4. Vexcon Chemical, Inc.; Starseal 1315.
 5. Dayton Superior.
- C. Water: Clean and potable, containing less than 500 ppm of chlorides.

PART 3– EXECUTION

3.1 TESTING CONCRETE

- A. Testing procedures and testing frequency shall be in accordance with the *SDC*.
- B. Making and curing concrete cylinders, ASTM C31.
- C. Testing concrete cylinders, ASTM C39.
- D. Slump, ASTM C143.
- E. Slump Tolerance, ACI 117
- F. Air content, ASTM C231.

3.2 MIXING AND TRANSPORTING READY-MIXED CONCRETE

- A. In accordance with ACI 301, except as modified herein.
- B. The maximum elapsed time from the time water is added to the mix until the concrete is in place shall not exceed 1 ½ hours when concrete is transported in revolving drum truck bodies.
- C. The temperature of the concrete shall never exceed 90° F.

3.3 PROTECTION

- A. Cold Weather Concrete
 1. Concrete shall not be placed unless the air temperature adjacent to the concrete placement is 30° F and rising, unless prior written acceptance for cold weather concrete operations is obtained from the City.

2. If cold weather concrete operations are accepted by the City, when daily low temperatures are below 40° F or when temperatures are predicted to be below 40° F within three (3) days of concrete placement, comply with ACI 306.1.
3. Water shall not be heated to a temperature greater than 150° F.
4. If hot air heaters are used, cover exposed surfaces of concrete with impervious sheet material or curing compound to prevent dehydration of concrete.
5. Do not place concrete against frozen ground or against surfaces with frost or ice present.
6. Provide maximum and minimum temperature sensors placed on concrete surfaces spaced throughout the work to allow monitoring of concrete surface temperatures representative of the work. Unless otherwise permitted, record surface temperature of concrete at least once every 12 hours during the specified curing period.

B. Hot Weather Concrete

1. Concrete shall not be placed if the daily high temperature exceeds 90° F unless otherwise accepted by the City.
2. When daily high temperature is 90° F or above, or hot weather conditions exist that would impair quality and strength of concrete, comply with ACI 305.1.
3. Temperature of concrete immediately before placement in forms shall be between 50° F and 90° F.
4. Provide for windbreaks, shading, fog spraying, sprinkling, ice, wet cover, or other means as necessary to maintain concrete at or below specified temperature.
5. To facilitate the placement of concrete in hot weather, the aggregate or the water may be cooled.

3.4 FORMS

- A. Brace or tie forms to maintain desired position, shape and alignment before, during, and after placement.
- B. Do not remove or disturb forms until the concrete has attained sufficient strength to safely support all dead and live loads.
- C. Remove forms with care to avoid surface gouging, corner or edge breakage, and other damage to the concrete.

3.5 REINFORCING

- A. Prior to placing concrete, accurately place reinforcing steel. Maintain in proper position while concrete is being placed and vibrated.

3.6 CONCRETE PLACEMENT

- A. In accordance with ACI 301, except as modified herein.
- B. Batch ticket shall indicate amount of mixing water withheld, and maximum amount that may be permitted to be added at Project site. Any water added must be document and amount provided to City. Any additional water above noted maximum amount shall be rejected and removed from the Project site.
- C. Convey concrete to the point of final deposit by methods which will prevent the separation or loss of concrete components.
- D. Height of concrete freefall shall be limited to four (4) feet.
- E. During and immediately after placement, concrete shall be thoroughly consolidated by mechanical vibrating equipment supplemented by handspading, rodding or tamping worked around reinforcements and embedments, and worked into all corners of the forms. Use equipment and procedures for consolidating concrete in accordance with ACI 309.
- F. Notify City at least 1 full working day in advance before starting to place concrete.
- G. Hot Weather Placement:
 - 1. Prepare ingredients, mix, place, cure, and protect in accordance with ACI 301, ACI 305.1, and as follows:
 - a. Maintain concrete temperature below 95 degrees F at time of placement, or furnish test data or provide other proof that admixtures and mix ingredients do not produce flash set plastic shrinkage, or cracking as a result of heat of hydration. Cool ingredients before mixing to maintain fresh concrete temperatures as specified or less.
 - b. Provide for windbreaks, shading, fog spraying, sprinkling, ice, wet cover, or other means as necessary to maintain concrete at or below specified temperature.
 - 2. Cure concrete as specified in Section 3.8, Concrete Curing.
- H. Cold Weather Placement:
 - 1. Unless otherwise permitted, shall be in accordance with requirements of ACI 306.1 and as follows:
 - a. Cold weather requirements shall apply when ambient temperature is below 40 degrees F or approaching 40 degrees F and falling.
 - b. Do not place concrete over frozen earth or against surfaces with frost or ice present. Frozen earth must be thawed to the acceptance of the City.

- c. Unless otherwise permitted, do not place concrete in contact with surfaces less than 35 degrees F. This requirement is applicable to all surfaces including reinforcement and other embedded items.
- d. Provide supplemental external heat as needed when other means of thermal protection are unable to maintain minimum surface temperature of concrete as specified in ACI 306.1.
- e. Maintain minimum surface temperature of concrete as specified in ACI 306.1 for no less than 3 days during cold weather conditions.
- f. Cure concrete as specified in Section 3.8, Concrete Curing. Protect concrete from freezing until the end of the curing period and until the concrete has attained a compressive strength of 3,500 psi (or the design compressive strength if less than 3,500 psi).

3.7 FINISHING UNFORMED SURFACES

- A. Screed and give an initial float finish as soon as concrete has stiffened sufficiently for proper working.
- B. Initial floating shall produce a surface of uniform texture and appearance.
- C. Follow with a second floating at the time of initial set. This floating shall produce a finish of uniform texture and color.
- D. In areas where concrete is to remain exposed, the final finish shall be obtained with a light brooming.
- E. Manhole inverts shall be true to line and grade and smooth.

3.8 CURING

- A. Finished concrete shall be cured by protecting it against moisture loss, rapid temperature change, precipitation, flowing water, and mechanical injury for a minimum of seventy-two (72) hours after placement.
- B. Concrete shall be maintained at a minimum of 50° F during the curing period.
- C. Curing compound shall be used on all flat exposed surfaces.
- D. The Contractor shall be responsible for protecting the concrete from traffic and the elements.

3.9 CARE AND REPAIR OF CONCRETE

- A. The Contractor shall protect all concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance by the City.
- B. All concrete structures shall not have backfill placed against them until the concrete has reached sufficient strength so as not to have any damage caused by the backfill or backfill operations.

- C. Any concrete found to be damaged, or that may have been originally defective, or that becomes defective after any time prior to the final acceptance of the completed work, or that departs from the established line or grade, or that, for any other reason, does not conform to the requirements of the City shall be satisfactorily repaired as directed by the City or removed and replaced with acceptable concrete at no expense to the City.

3.10 FIELD QUALITY CONTROL

A. General:

1. Provide adequate facilities for safe storage and proper curing of concrete test specimens onsite for first 24 hours, and for additional time as may be required before transporting to test lab.
2. Unless otherwise specified, sample concrete for testing for making test specimens, from the point of delivery.
3. When concrete is pumped, sample and test air content at point of delivery and at the point of placement.
 - a. For Each Concrete Mixture: Provided the results of the air content tests for the first load of the day are within the specified limits, testing need only be performed at the point of delivery for subsequent loads of that concrete mixture except that testing should be performed at the point of placement every four hours.
4. Evaluation will be in accordance with ACI 301 and Specifications.
5. Test specimens shall be made, cured, and tested in accordance with ASTM C31/C31M and ASTM C39/C39M.
6. Frequency of testing may be changed at the discretion of City.
7. Pumped Concrete: Take concrete samples for slump (ASTM C143/ C143M) and test specimens (ASTM C31/C3 IM and ASTM C39/C39M) and shrinkage specimens (ASTM C157/C 157M) at placement (discharge) end of line.
8. If measured air content at delivery is greater than the specified limit, a check test of air content will be performed immediately on a new sample from delivery unit. If check test fails, the concrete has failed to meet requirements of Contract Documents. If measured air content is less than the lower specified limit, adjustments will be permitted in accordance with ASTM C94/C94M, unless otherwise specified. If the check test of the adjusted mixture fails, the concrete has failed to meet requirements of Contract Documents. Concrete that has failed to meet requirements of Contract Documents shall be rejected.

B. Concrete Strength Test:

1. Unless otherwise specified, one specimen at age of 7 days for information, and two 6-inch diameter or when permitted three 4-inch diameter test specimen at age of 28 days for acceptance.

2. If result of 7-day concrete strength test is less than 50 percent of the specified 28-day strength, extend the period of moist curing specified in Section 3.8, Concrete Curing, by 7 additional days.
3. Provide a minimum of one spare test specimen per sample. Spare cylinder shall be tested as directed by City.

C. Shrinkage Tests:

1. When required to conform to shrinkage limits, collect actual concrete materials being batched and before liquids have been added to the mix. Mix sampled material in a laboratory at proportions matching the batched concrete. Test shrinkage characteristics every 5,000 cubic yards of concrete used on job and every 3 months during construction when compression test cylinders are made.
2. Concrete Shrinkage Limits: Test in accordance with ASTM C157/ C157M, with the following modifications:
 - a. Prisms shall be moist cured for 7 days prior to the 28-day drying period.
 - b. Comparator reading at the end of the 7-day moist cure shall be used as the initial length in the length change calculation.
 - c. Reported results shall be the average of three prisms.
 - d. If drying shrinkage of any specimen departs from the average of that test age by more than 0.004 percent, disregard results obtained from that specimen.
 - e. Results at the end of the 28-day drying period shall not exceed 0.040 percent if 3-inch prisms are used, or exceed 0.038 percent if 4-inch prisms are used.
 - f. If the 7-day or 14-day shrinkage tests results exceed the shrinkage limits established by the design mix testing, furnish an additional 14 days of water curing beyond the original curing period, for concrete surfaces of hydraulic structures represented by prisms. Modify the concrete mix design to reduce shrinkage prior to casting additional concrete for the work.

D. High Range Water Reducer (Superplasticizer) Admixture Segregation Test: Test each truck prior to use on job.

1. Segregation Test Objective: Concrete with a 4-inch to 8-inch slump must stay together when slumped. Segregation is assumed to cause mortar to flow out of mix even though aggregate may stay piled enough to meet slump test.
2. Test Procedure: Make slump test and check for excessive slump and observe to see if mortar or moisture flows from slumped concrete.
3. Reject concrete if mortar or moisture separates and flows out of mix.

E. Cold Weather Placement Tests:

1. During cold weather concreting, cast cylinders for field curing as follows. Use a method that will produce a greater number of specimens:
 - a. Six extra test cylinders from the last 100 cubic yards of concrete.
 - b. Minimum of three specimens for each 2 hours of placing time or for each 100 cubic yards.
2. These specimens shall be in addition to those cast for lab testing.
3. Protect test cylinders from weather until they can be placed under the same protection provided for the concrete structure that they represent.
4. Keep field test cylinders in the same protective environment as the parts of structure they represent to determine if specified strength has been obtained.
5. Test cylinders in accordance with applicable sections of ASTM C31/ C31M and ASTM C39/C39M.
6. Use test results to determine the specified strength gain prior to falsework removal or for prestressing.

F. Tolerances:

1. Slab Finish Tolerances and Slope Tolerances:
 - a. Floor flatness measurements shall be made the day after the floor is finished and before shoring is removed to eliminate effects of shrinkage, curing, and deflection.
 - b. Support 10-foot-long straightedge at each end with steel gauge blocks of thicknesses equal to specified tolerance.
 - c. Compliance with the designated limits in four of five consecutive measurements is satisfactory, unless defective conditions are observed.

G. Liquid Tightness Tests:

1. Purpose: To determine integrity and liquid-tightness of finished exterior and interior concrete surfaces of liquid containment structures.
2. All liquid-containing concrete structures are to be tested for liquid-tightness as specified, unless otherwise noted on the Drawings.
3. Water for the initial tightness test shall be from a city approved source. Contractor shall provide means to transport water to the structure to be tested. If additional tightness tests are required due to failure to meet criteria, the Contractor shall provide water for the subsequent tests.

4. After testing has been completed, dispose of test water in a manner approved by the City. Requirements for Liquid-Tightness Test:
 - a. Perform tightness tests in accordance with ACI 350.1 and as specified herein.
 - b. Do not place backfill, coatings, or other work that will cover concrete surfaces until tightness testing has been completed and approved.
5. Measure water surface at two points 180 degrees apart when possible where attachments, such as ladders exist, at 24-hour intervals.
6. Acceptance Criteria:
 - a. Volume loss shall not exceed 0.050 percent of contained liquid volume per 24-hour period, adjusted for evaporation, precipitation, and temperature
 - b. Acceptance that the structure has passed the tightness test shall be based on the total volume loss at the end of the specified test period.
7. Repairs When Test Fails: Dewater structure; fill leaking cracks with crack repair epoxy or polyurethane material that is specific to the type of repairs and meets manufacturer requirements. Patch areas of damp spots previously recorded, and repeat water leakage test in its entirety until the structure successfully passes the test.
 - a. Contractor has one attempt at fixing the leaking of the structure. Any subsequent repairs shall be performed by a City approved structural leak repair expert.

3.11 PROTECTION OF INSTALLED WORK

- A. After curing as specified in Section 3.8, Concrete Curing, and after applying final floor finish, cover slabs with plywood or particle board or plastic sheeting or other material to keep floor clean and protect it from material and damage as a result of other construction work.
- B. Repair areas damaged by construction, using specified repair materials and approved repair methods

SECTION 03400
PRECAST CONCRETE

PART 1– GENERAL

1.1 SCOPE

- A. This section addresses precast concrete products (manholes, vaults, etc.).

1.2 REFERENCES

- A. American Concrete Institute (ACI);
1. 304R, *Guide for Measuring, Mixing, Transporting, and Placing Concrete*, latest revision.
 2. 350, *Environmental Structures: Code Requirements*, latest revision.
- B. ASTM International (ASTM)
1. C31, *Standard Practice for Making and Curing Concrete Test Specimens in the Field*, latest revision.
 2. A36, *Standard Specification for Structural Steel*, latest revision.
- C. Precast/Prestressed Concrete Institute (PCI)
1. MNL-117, *Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products*, latest revision.
 2. MNL-120, *Design Handbook for Precast and Prestressed Concrete*, latest revision.

1.3 SUBMITTALS

- A. Sealer for Exterior Surfaces
1. Product data with mixing/application instructions.
- B. Calculations and Technical Data
1. Proposed details and design calculations for stresses in all critical sections of precast members for all loading conditions including transportation, handling, and erection.
- C. Precasting Manufacturers

1. Experience record on production of precast concrete as shown, with information on precasting plant, that will indicate capability to satisfactorily perform the work.
 2. Evidence of current PCI plant certification.
- D. Certificate of Compliance
1. Certify admixtures and concrete do not contain calcium chloride.
- E. Test Reports
1. For precast manufacturer's concrete test cylinders.
 2. Inspection of installed panels.
- F. Submittal Drawing
1. Submitted to the City for review and approval not less than two (2) weeks prior to placement and must include information on steel placement, sizing, compressive strength, and grade of steel reinforcement. Steel placement and sizing are to meet the City of Greely Standard Drawing.

1.4 QUALITY ASSURANCE

- A. Qualifications of Precasting Manufacturers:
1. Precast Concrete: Product of manufacturer with a minimum of 3 years' experience producing precast concrete products of quality specified.
 2. Precast Plant: PCI certified plant with current certification.
 3. Calculations shall be stamped by an engineer registered in the State of Colorado.

PART 2- PRODUCTS

2.1 MATERIALS

- A. Reference construction specification *Section 03300, Cast-In-Place Concrete*, for precast concrete minimum requirements for mix design (cement, aggregate, water, admixtures, and reinforcement).
- B. Formwork:
1. One-piece, full length and without seams.
- C. Embedded Items:
1. ASTM A36 steel.

2. Anchor Studs: Headed anchor studs (HAS), deformed bar anchors (DBA), or threaded studs as manufactured by Nelson Stud Welding Co., Lorain, OH.
 3. Furnish inserts for lifting precast slabs, and as otherwise required.
- D. Sealer for Exterior Surfaces:
1. Silane Sealer: One-component penetrating sealer, hydrophilic (isopropyl alcohol as a carrier) with 40 percent active ingredients.
 2. Manufacturers:
 - a. Master Builders Co.
 - b. Euclid Chemical Co.
- E. Antimicrobial Crystalline Waterproofing Admixture
1. Xypex Bio-San C500
 2. Xypex Bio-San C500 must be added to concrete mix at batch plant.
 3. The antimicrobial crystalline powder shall be added to the concrete mix at 1% by weight of the cementitious material content

2.2 DESIGN REQUIREMENTS

- A. Structural Precast Members
1. Meet applicable sections of PCI MNL-120.
 2. Design for all loading conditions including transportation, handling, and erection.
 3. Minimum reinforcing steel cover to be 2 inches conforming to ACI 350.
 4. Any structure to be installed in a roadway shall be designed for an AASHTO HS-20 loading.

2.3 FABRICATION

- A. Comply with PCI MNL-117.
- B. Reinforcing Steel: Place in position before concrete is cast and keep clean and free from form oil or other substances harmful to bond.
- C. Concrete: Deposit, vibrate, finish, and cure in accordance with recommended practices of ACI 304R.
- D. Sealer:

1. Apply to precast panels at precast plant site after sandblasting panels, in accordance with manufacturer's instructions.
2. Protect surface until installed in the Work.
3. Repair damage as approved by manufacturer.

2.4 SOURCE QUALITY CONTROL

- A. Prepare minimum three standard concrete test cylinders for each 50 cubic yards or fraction thereof of concrete placed in the precast work in accordance with ASTM C31.
- B. Test and record concrete strengths.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine each precast section upon arrival to the job site for cracks and other unsightly imperfections or structural defects. Record location and condition of damaged sections.
- B. Resolution:
 1. Repair damage to satisfaction of City.
 2. Remove panels with damage or repairs not acceptable to City and install new acceptable panels in place of those removed.
 3. Perform reinspection and obtain acceptance by City.

3.2 INSTALLATION

- A. Set precast sections in accordance with the manufacturer's erection drawings.

3.3 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle all materials to ensure installation in sound and undamaged condition.
- B. Do not deliver precast sections to the job site until the concrete has attained at least 80% of specified design strength.
- C. Precast concrete members shall be lifted and supported during manufacturing, stockpiling, transportation, and erection operations only at the lifting or supporting point, or both, as shown on shop drawings.
- D. Transportation and on-site handling shall be performed with acceptable equipment and methods, as well as by qualified personnel.
- E. Care shall be taken to avoid tensional stresses during transportation.

- F. Place units so that identification markings are discernible.
- G. Stack so that lifting devices are acceptable and undamaged.

3.4 CLEANING

- A. After installation, clean soiled precast concrete surfaces with detergent and water, using fiber brush and sponge. Rinse thoroughly with clean water immediately after using cleaner.
- B. Use extreme care to prevent damage to precast concrete surfaces and to adjacent materials.

3.5 FIELD QUALITY CONTROL

- A. Inspection:
 - 1. Inspect panels with City for cracks or damage. Record location and condition of damaged panels.
 - 2. Any structure that requires liquid tightness shall be leak tested prior to acceptance. Refer to Liquid Tightness Test in *Section 03300, Cast-In-Place Concrete*.
- B. Resolution:
 - 1. Repair damage to satisfaction of City.
 - 2. Remove panels with damage or repairs not acceptable to City.
 - 3. Install new acceptable panels in place of those removed.
 - 4. Perform reinspection and obtain acceptance by City.

SECTION 11230**NON-POTABLE POND AERATION SYSTEM****PART 1 - GENERAL****1.1 SCOPE**

- A. It is the intent of this specification to describe the construction of an automatic pond aeration system for a raw water irrigation ponds. All components of the aeration system including compressors, electrical controls, valves, prefabricated pipe manifolds, flow meters, gauges, pond aeration tubing and modules, and all other items necessary for the proper assembly and operation of the system must be provided by a single supplier as a "knocked down" aeration system. The intent is to provide sole source responsibility for the materials, installation, and warranty of the system.
- B. Furnish all labor, materials, supplies, equipment, tools, and transportation, and perform all operations in connection with and reasonably incidental to the complete installation of the aeration system, and guarantee/warranty as shown on the drawings, the installation details, and as specified herein. Items of work specifically included are:
1. Procurement of all applicable licenses, permits, and fees as required by local codes and utilities.
 2. Connection of electrical power supply to the aeration system.
 3. Installation of compressors, electrical controls, piping, valves, aeration feeder / distribution tubing, aeration modules, and appurtenances necessary for the complete operation of the aeration system.
 4. Coordinating installation of aeration mechanical system with the installation of the pump system concrete mounting pad, conduit penetrations, building walls, doors, vents, and other equipment in the building.
 5. Testing and start-up, and adjustment of aeration system.
 6. Start-up, testing, adjustment of aeration system, training, and demonstration of performance to the City's Representative.
 7. Maintenance period.

1.2 DISCREPANCIES:

- A. It is the intent of these plans and specifications that the aeration system be complete and workable. It is the Contractor's responsibility to make sure that the equipment furnished is compatible and adheres to all regulations. Any discrepancies should be noted immediately and should be reported to the City's Representative for clarification.

1.3 SUBMITTALS:

- A. Deliver all submittals under provisions of Section 01300.

- B. Materials List: Include pipe, valves, flow meters, fittings, compressors, control system components, and electrical equipment. Quantities of materials need not be included.
- C. Manufacturers' Data: Submit manufacturers' catalog cuts, specifications, and operating and maintenance instructions for all equipment supplied.
- D. Maintenance Manual: Submit in all manufacturer's data listed above and recommended operating procedures, adjustments, system trouble shooting, and preventive maintenance procedures.
- E. Shop Drawings: Submit shop drawings of compressor system, electrical controls, and flow meter control unit installation. Show products required for proper installation, their relative locations, and critical dimensions. Note modifications to the installation drawings.

1.4 RULES AND REGULATIONS:

- A. Work and materials shall be in accordance with the latest edition of the National Electric Code and applicable laws and regulations of the governing authorities. When a discrepancy exists between the national and local codes, the local codes shall prevail.
- B. When the contract documents call for materials or construction of a better quality or larger size than required by the above-mentioned rules and regulations, provide the quality and size required by the contract documents.
- C. All electrical control panels with controls shall be built in accordance to N.E.C.,
- D. U.L. and E.T.L. standards. The electrical components and enclosure shall be labeled as a complete U.L. listed assembly with manufacturer's U.L. label applied to the door. All equipment and wiring shall be mounted within the enclosure and labeled for proper identification.

1.5 SYSTEM PERFORMANCE

- A. Refer to Section 5 Non-Potable Irrigation System Design Criteria.

1.6 TESTING:

- A. Notify the City's Representative three days (72 hours) in advance of testing.
- B. On completion of assembly, the aeration system piping shall be hydrostatically tested at a pressure not less than 50 PSI.
- C. Control and safety shut off devices shall be tested and verified operational.
- D. Flow and discharge pressure shall be verified with specified values.
- E. All costs, including travel expenses and site visits by the City's Representative, for any re-testing that may be required due to non-compliance with the Construction Documents shall be the sole responsibility of the Contractor.

1.7 REVIEWS:

- A. The purpose of on-site reviews by the City's Representative is to observe the Contractor's interpretation of the construction documents and to address questions with regards to the installation.
 - 1. Scheduled reviews such as those for testing should be scheduled with the City's Representative as required by these specifications.
 - 2. Impromptu reviews may occur at any time during the project.
 - 3. Final review will occur at the completion of the aeration system installation and As-Built Drawings.

1.8 GUARANTEE/WARRANTY AND REPLACEMENT:

- A. The purpose of this guarantee/warranty is to insure that the City receives aeration system materials of prime quality, installed and maintained in a thorough and careful manner.
 - 1. The manufacturer shall warrant the aeration system to be free of defects and product malfunctions for a period of two years from date of start up or 30 (thirty) months after shipment, whichever occurs first.
 - 2. Failures caused by lightning strikes, power surges, vandalism, flooding, or operator abuse are excluded from warranty coverage.
 - 3. Repair damage to the premises caused by a defective item. Make repairs within seven days of notification from the City's Representative.
 - 4. Contract documents govern replacements identically as with new work. Make replacements at no additional cost to the contract price.

PART 2 - MATERIALS

2.1 QUALITY:

- A. Materials used in the system shall be new and without flaws or defects of any type, and shall be the best of their class and kind.

2.2 SUBSTITUTIONS:

- A. Make complete submittals of all manufacturer's data showing compliance with the Contract Documents.
- B. In making a request for a substitution, the Contractor represents that they:
 - 1. Has investigated the proposed substitution and found that it is the same or better quality, level, capacity, function, or appearance than the specified product, and can demonstrate that to the City's Representative.
 - 2. Will coordinate the installation and make all modifications to the work that may be required for complete installation and operation of the system.

- C. The City will determine acceptability of the proposed substitution and will notify Contractor of acceptance or rejection.
- D. Pipe sizes referenced in the construction documents are minimum sizes, and may be increased at the option of the Contractor upon approval by the City's Representative.

2.3 GENERAL REQUIREMENTS:

- A. The complete aeration mechanical system and related equipment shall be designed to function in an outdoor environment exposed to all of the elements. Furnish protective enclosures and covers as required for proper operation of the system.
- B. The prefabricated aeration system shall have a capacity as shown in the drawings.
- C. The aeration system includes one oil-less compressor, one air-cooled aftercooler, one corona discharge unit, flow meters, gauges, fittings, valves, and piping as required and as shown on the drawings and details.
- D. Completely assemble and operate all components of the aeration system prior to shipment to insure proper fit, assembly and operation on the job site.
- E. Construction shall include a fabricated steel skid assembly to support all components during shipping and to serve as the installed mounting base.
- F. Connection of the aeration system to 240 or 480 three-phase, 460 volt, 60 hertz power supply to service control panel for compressor and air cooler.
- G. All system components shall be supplied and be the responsibility of one manufacturer, even though some components were manufactured by others.
- H. The aeration system and related equipment shall meet all the general and technical specifications; shall be designed, fabricated and installed in a workmanlike manner; and shall be delivered within schedules negotiated between Contractor and manufacturer.
- I. Furnish shop drawing for approval prior to installation.
- J. Provide a factory-trained technician to supervise the installation of the aeration system.

In addition to the time required for installation supervision, the technician shall provide a minimum of 1 day of training for the City's staff in the operation, maintenance, and programming of the aeration system. Notify the City's Representative one week in advance of training to schedule with City.

K. Acceptable Manufacturers:

- 1. Aqua Sierra, Inc.

Contact: Bill Logan, Aqua Sierra, Inc., 8350 South Mariposa Drive, Morrison, Colorado, 80465, (303) 697-5486, FAX (303) 697-5069.

- 2. Keeton Fisheries, Inc.

Contact: Jim Keeton, Keeton Fisheries, Inc., 300 Lincoln Court, Fort Collins, Colorado, 80524, (303) 493-4831, FAX (303) 493-4921.

3. City Approved Equivalent.

2.4 COMPRESSOR SYSTEM:

- A. Furnish "oil-less" air compressor designed for continuous duty operation as main aeration compressor.
 1. Manufactured by Powerex or approved equivalent, having the capacity and operating discharge pressure as shown in the drawings.
 2. Constructed with motor mounted 840 RPM, 460 volt, 3-phase, 60 HZ, electric motor, and all electrical controls.
 3. Equipped with air inlet filter and silencer.
 4. Furnish ventilation and sound suppression enclosure and components to reduce sound level by 7 dBa.
 5. The control system shall include NEMA motor starter with overload protection, 120V transformer, HOA switch, pressure switch, pressure gauge and runtime hour meter, and 24-hour field programmable time clock.
 6. Furnish automatic drain valve, safety relief valve, pressure gauge, and necessary brass valves and copper piping.

2.5 AIR COOLED AFTERCOOLER:

- A. Furnish air-cooled aftercooler with 1/12 HP fan, and copper tube, aluminum fin heat exchanger designed for continuous duty operation.
 1. Speedaire Model 5Z757 rated for 20 CFM at 100 PSI or approved equivalent.

2.6 CONDENSATE SEPARATOR:

- A. Furnish condensate separator with automatic drain valve.
 1. Wilkerson Model WSA-04-FM0 or approved equivalent.

2.7 PIPING:

- A. Compressor Piping: Furnish Type L rigid copper pipe, brass fittings, and components necessary for the complete installation of the aeration mechanical system. Submit shop drawing for approval prior to construction. Show pressure gauges, flow meter, filters, valves, etc.
- B. Air Distribution Tubing: Furnish 100 PSI 1/2-inch high density flexible PVC connecting pond aeration modules to discharge pipe from compressor assembly.
 1. Use non-leaded, self-weighted high density flexible PVC air feeder tubing from compressor assembly discharge to aeration modules.

- C. Pond Aeration Modules: Furnish stainless steel disk aeration modules for installation on the bottom of the ponds.
 - 1. Furnish Model as shown in the drawings as manufactured by Air Diffusion Systems, Lake Bluff, Illinois, 60044, (847) 615-0044.
 - 2. City approved equivalent.
- D. Piping Hardware: Furnish stainless steel clamps, fittings, nylon ties (cable ties), supports, and gaskets as required for all piping and tubing connections.

2.8 VALVES:

- A. Check Valves: Furnish bronze check valves downstream of each compressor.
- B. Isolation Valves: Furnish bronze ball valves for isolation of compressors.
- C. Regulating Control Valves: Furnish 1/2-inch bronze ball valves where indicated on aeration flow diagram detail.

2.9 GAUGES:

- A. Furnish 2.5-inch diameter liquid filled or vibration/pulsation dampened pressure gauges. Install ball valves to provide total isolation of pressure gauges.

2.10 FLOW METERS:

- A. Furnish flow meters, located on each lateral pipe, for each pond aeration module. Label each flow meter with the associated module and location of the module in the pond. Provide a diagram of the modules showing location and label to match the flow meters.

2.11 ELECTRICAL:

- A. Enclosures:
 - 1. Mount the aeration system electrical controls in a self-contained NEMA 3S enclosure with drip lip, fabricated from not less than 14 gauge steel. Furnish door gasket seals constructed from neoprene sponge, sufficient to protect interior components from weather and dust.
 - 2. Furnish operating handle for main station power disconnect located on the front of the panel. Provide dust and weatherproof enclosures for all external operating devices.
 - 3. Mount all internal components of the enclosures on removable back panels. Do not mount components on the panel enclosure with screws that protrude from enclosure.
- B. Compressor Motor Starters, Disconnect, and Electrical Switch Gear:
 - 1. Furnish compressor motor starters contained within a single NEMA 3S enclosure with a single access door and main disconnect. Each starter shall be protected on

each power leg by a time delay fuse of the appropriate amperage. Motor starter coils shall be 120 volt operated.

2. Use ambient-compensating type overload relays installed on each power leg set to trip at 105% of motor full-load current rating.

C. Electrical Control Panel:

1. The electrical control panel shall be NEMA 3S enclosure equipped with a gasketed enclosure door. Isolate the incoming power by means of a circuit breaker or fused disconnect.
2. The operation of the compressors shall be controlled by an industrial grade, field programmable, and timer.
3. All starting circuits, stations safety shutdown circuits and any optional equipment control circuits shall have an operating voltage not exceeding 120 volts. All time delay control relays shall be plug-in type for easy replacement.
4. Switches: The control panel shall be equipped with a flow switch to disconnect the electrical power in the event of the main compressor failure. An indicating lamp on the control panel will alert the maintenance person as to the failure.

D. Aeration System Wiring:

1. All wiring from control panel to compressors shall be in liquid-tight conduit with copper conductors rated not less than 600 volts AC and of proper size to carry the full load amperage of the motors without exceeding 70% capacity of the conductor. A grounding cable shall be included in the liquid-tight conduit. Splices between the motor starters and the motor connection boxes are not allowed.
2. Furnish multi-conductor shielded cable suitable for Class II low voltage controls for wiring to flow sensors.

E. Lightning Arrestor:

1. The main power supply feeding the aeration system station shall be equipped with a 3 phase secondary lightning arrestor having a breakdown current rating of not less than 60,000 amps at 14,000 volts discharge. Power supplies, 300 volts and less, shall use 300 volt rated arrestor with an 800 volt spark-over voltage. Power supplies 301-600 volts shall use 600 volt rated arrestor with a 1,000 volt spark-over voltage.

F. Standards:

1. All wiring shall conform to the National Electrical Code Standards.
2. Flexible conduit sections shall be less than 5 feet in length to meet code. All conduit to devices shall be attached securely to avoid trip hazards.
3. A wiring schematic shall be provided by the manufacturer for approval prior to manufacture. The schematic shall show all devices, connections and wire numbers. Furnish a laminated copy of the schematic attached to the interior door of the panel.

4. All controls and electrical equipment shall be thoroughly inspected and tested before shipment.

2.12 PAINTING:

- A. Painting of the entire unit shall consist of a multi-step coating system which includes metal preparation, rust inhibitive prime coat, and a two-part catalyzed acrylic finish having a total dry film thickness of not less than 4 mils. Paint aeration system components with the manufacturer's standard color. Paint all electrical enclosures and accessory panels with a minimum thickness of 3 mils and baked at 160-180 F.

PART 3 - EXECUTION

3.1 INSPECTIONS AND REVIEWS:

- A. Site Inspections:
 1. Verify site conditions and note irregularities affecting work of this section. Report irregularities to the City's Representative prior to beginning work.
 2. Beginning work of this section implies acceptance of existing conditions.

3.2 AERATION SYSTEM INSTALLATION:

- A. Shipping, off-loading and the technical start up shall be furnished by the aeration system manufacturer. Location and mounting details shall be furnished to the Contractor by the aeration system manufacturer.
- B. Coordinate the installation of the aeration system with the installation of the irrigation pumping system and the construction of the concrete floor slab referenced in other sections of the specifications.
- C. Install the system as recommended by the manufacturer and as shown in the drawings. Make all connections and adjustments necessary for the proper operation of the aeration system.
- D. Install compressors, filters, coolers, flow meters, valves, pressure gauges, and pipe including copper manifolds, sleeves, air distribution pipe, pond aeration tubing, and pond aeration modules.
 1. Install pond aeration tube as shown on plans
 - a. Tie all self-weighted feeder / distribution tubing together at the bottom of the pond with a maximum distance of 20-ft between ties.
 - b. Install ties no closer than 30-ft to the pond aeration module to allow for surfacing and removal of the module.
 2. Make connection between air distribution feeder pipe and pond aeration modules where shown on plans and as recommended by the manufacturer.

3. Install sleeving where indicated on the drawing. Coordinate the installation of the pond edge sleeves with the installation of the trench wall and the pond liner and seal all penetrations as recommended by the manufacturer.

E. Technical start up procedures by the aeration system manufacturer shall include the following:

1. Provide detailed start-up procedure to City's Representative for review, one week prior to start-up.
2. System start up and pressurization of aeration piping system.
3. Pressure, flow, and balance adjustments.

3.3 INSTALLATION OF ELECTRICAL COMPONENTS:

- A. Install electrical control panels and disconnect on wall of mechanical enclosure as recommended by manufacturer and as shown on drawings.
- B. Install all conduit and wiring as recommended by the manufacturer and as necessary for the proper operation of the system.

3.4 PAINTING:

- A. Paint all bare metal surfaces to match paint as applied by pump system manufacturer. Touch up all dings and scratches as required.

3.5 OPERATION AND MAINTENANCE MANUALS:

- A. Furnish System Operation and Maintenance manuals to City's Representative prior to project completions. Furnish four copies of single, bound manual.

3.6 OTHER ITEMS:

- A. Tools and Spare Parts:
 1. Prior to Substantial Completion of the Work, supply to the City operating keys, servicing tools, test equipment, and any other items indicated on the drawings.
 2. Prior to Substantial Completion, supply to the City one complete set of gaskets for the compressor, and one filter (replacement) cartridge for each filter assembly.
 3. Furnish other spare parts indicated on the drawings.
- B. Other Materials: Install other materials or equipment shown on the drawings or installation details to be part of the aeration system, even though such items may not have been referenced in these specifications.

3.7 PROJECT AS-BUILT DRAWINGS:

- A. Submit As-Built Drawings in accordance with Specification Section 01785.

- B. Record pipe system alterations. Record work that is installed differently than shown on the construction drawings.

3.8 MAINTENANCE:

- A. Upon completion of the Work (installation of aeration system and irrigation pond filled with water), maintain system for a duration of 30 calendar days. Make periodic examinations and adjustments to aeration system components as necessary.
- B. Following completion of the Contractor's maintenance period, the City will be responsible for maintaining the system in working order during the remainder of the guarantee/warranty period, and for performing necessary routine maintenance.

3.9 CLEANUP:

- A. Upon completion of work, remove from the site all machinery, tools, excess materials, and rubbish.
- B. Contractor shall clean all surfaces and touch up scratches with factory paint to match original.

SECTION 11285

SLIDE GATES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Furnish all materials and services necessary for the slide gate system as shown on the Contract Drawings and as specified in accordance with provisions of the Contract Documents, and completely coordinated with work of all other trades. Although such work is not specifically shown or specified, furnish all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure and complete installation.
- B. Furnish all materials and services necessary for the installation of the handwheel on the dissipation structure.

1.2 RELATED SECTIONS

- A. Section 03300—Cast-In-Place Concrete

1.3 REFERENCES

- A. Where reference is made to any standard, the version in affect at the time of bid opening shall apply.
- B. American Society for Testing and Materials International (ASTM):
 - 1. A36: Standard Specification for Carbon Structural Steel
 - 2. A126: Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
 - 3. A307: Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod
- C. American National Standards Institute / American Water Works Association (ANSI/ AWWA):
 - 1. C560: Cast-Iron Slide Gates
- D. The Society for Protective Coatings/National Association of Corrosion Engineers (SSPC/NACE):
 - 1. SSPC SP 10/NACE No. 2 – Near-White Blast Cleaning

1.4 SUBMITTALS

- A. General:
 - 1. Submit under provisions of Section 01330—Submittals.

2. Prior to manufacturing any of the components for the installation of the slide gate and appurtenances, detailed shop drawings shall be submitted to the Engineer for approval.
3. Manufacturer drawings shall be certified as meeting ANSI/AWWA C560 Standards for dimensions, construction, and materials used for all parts of the slide gate and manual slide-gate actuator mechanism.

1.5 SYSTEM WARRANTY

- A. Defects in material or workmanship of new system components shall be repaired or replaced at no cost to the Owner for a period of two (2) years from date of final completion as determined by the Engineer and Owner.

PART 2- MATERIALS

2.1 GENERAL

- A. The slide gate shall be installed on the outlet end of the non-potable water pipe at the dissipation structure.
- B. The slide gate shall be designed for totally submerged silty conditions.
- C. The slide gate handwheel shall be installed on the dissipation structure at the top of the ditch in accordance with the Drawings.
- D. The slide gate shall be rated for 20 feet of seating head and 10 feet of unseating head.
- E. Use of slide gates within the non-potable pump station shall require specific design and specification for each application.

2.2 SLIDE GATE MATERIALS

- A. Seat – Cast Iron – ASTM A126, Class B
- B. Slide – Cast Iron – ASTM A126, Class B
- C. Cross Bar – Cast Iron – ASTM A126, Class B
- D. Cross Bar Bolt & Nut – Steel, Plated – ASTM A307, A164
- E. Wedge – Cast Iron – ASTM A126, Class B
- F. Wedge Fasteners – Steel, Plated – ASTM A307, A164
- G. Side Angle – Steel, Galvanized – ASTM A36
- H. Stem Support – Steel, Galvanized – ASTM A36
- I. Head Bar – Steel, Galvanized – ASTM A36
- J. Head Bar Fasteners – Steel, Plated – ASTM A307, A164

- K. Stem – Steel – ASTM A108, Grade 1045
- L. Keeper – Cast Iron – ASTM A126, Class B
- M. Keeper Bolts & Nuts – Steel, Plated – ASTM A307, A164
- N. Lift Nut – Brass – ASTM B584, Alloy 844
- O. Stop Nut – Brass – ASTM B16
- P. Handwheel – Cast Iron – ASTM A126, Class B
- Q. Handwheel Set Screw – Steel, Plated – ASTM A307, A164
- R. Stem Supt., Bolts/Nuts – Steel, Plated – ASTM A307, A164

2.3 Manufacturers

- A. Series 6400 as manufactured by Fresno Gates.
- B. Series C-20 as manufactured by Waterman USA.
- C. Approved equal.

PART 3- EXECUTION

3.1 TESTING

- A. Field Leakage Test:
 - 1. A field leakage test shall be performed by the Contractor after installation of the slide gate.
 - 2. The manufacturer shall be notified of the test in sufficient time to enable manufacturer to have a representative present for that test.
 - 3. After all adjustments have been made and the mechanisms properly lubricated, each gate slide shall be run through three complete cycles as a final check on proper operation before starting the leakage test.
 - 4. Seating and unseating heads shall be measured from the top surface of the water to the center of the gate.
 - 5. At the design seating head, the leakage shall not exceed 0.1 gpm per foot of seating perimeter.
- B. Manufacturer's Representative:
 - 1. The system manufacturer shall provide a field representative for a minimum of one (1) day of field time as required to inspect, test, or approve all aspects of the installation.

SECTION 15140

NON-POTABLE PUMP STATION

PART 1 – GENERAL

1.1 SCOPE

- A. This section addresses the installation and manufacture of non-potable irrigation pumping stations including factory assembled pump system and buildings. The pump station shall automatically deliver water to the turf irrigation system. It shall include vertical turbine pumps; submersible pressure maintenance pump; variable frequency drives; controls, alarms, sensors, displays, valves, and other devices as specified below; and all interconnecting piping and wiring. All equipment shall be fabricated, mounted on a structural steel base.
- B. Furnish all labor, materials, supplies, equipment, tools, and transportation and perform all operations in connection with and reasonably incidental to the complete installation of a non-potable irrigation pumping station and guarantee/warranties.

1.2 REFERENCES

- A. ASTM A523, *Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless*, latest revision.
- B. ASTM A234, *Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service*, latest revision.
- C. ANSI/AWWA C200, *Steel Water Pipe – 6 in. (150mm) and Larger*, latest revision.
- D. ANSI/AWWA C206, *Field Welding of Steel Water Pipe*, latest revision.
- E. ANSI/AWWA C207, *Steel Pipe Flanges For Waterworks Service – Sizes 4 in. Through 144 in. (100 mm Through 3,600 mm)*, latest revision.
- F. ANSI/AWWA C208, *Dimensions for Fabricated Steel Water Pipe Fittings*, latest revision.
- G. ANSI/AWWA C213, *Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines*, latest revision.
- H. ANSI/AWWA C218, *Coating the Exterior of Aboveground Steel Water Pipelines and Fittings*, latest revision.
- I. NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilation Systems*, latest revision.

1.3 DEFINITIONS

- A. ETL ETL Testing Laboratories, Inc.
- B. Hz Hertz

- C. IBC International Building Code
- D. lbs Pounds
- E. LCD Liquid Crystal Display
- F. PLC Programmable Logic Controller
- G. NEC National Electric Code
- H. NEMA National Electrical Manufacturers Association
- I. NFPA National Fire Protection Association
- J. PM Pressure Maintenance Pump
- K. PTFE Teflon
- L. RPM Revolutions Per Minute
- M. SCADA Supervisory Control and Data Acquisition
- N. UL Underwriters Laboratories Inc.
- O. VFD Variable Frequency Drive
- P. HMI Human Machine Interface

1.4 QUALITY ASSURANCE

- A. The pump equipment shall be furnished by a single supplier, who shall be solely responsible for the design and fabrication of the equipment. The supplier shall be regularly engaged in the design and fabrication of such equipment.
- B. List of references for similar pump station installations.

1.5 PROVISIONS FOR LOSS PREVENTION

- A. The complete pump station shall be UL and ETL Listed. The pump station control panel(s) shall be UL listed and labeled. UL listing and labeling of individual electrical components only shall not be acceptable.

1.6 SUBMITTALS

- A. The Contractor shall deliver four (4) copies of all submittals to the City a minimum two (2) weeks prior to ordering materials.
- B. Pump Equipment
 - 1. Materials List: Include piping, valves, fittings, pumps and motors, control system components, and electrical equipment. Quantities of materials need not be included.

2. **Manufacturer's Data:** Submit manufacturers' catalog cut sheets, pump performance curves, specifications, startup manuals, and operating instructions for equipment shown on the materials list. Submit complete instructions for installation, operation, and recommended maintenance of the pump system.
3. **Shop Drawings:** Submit shop drawings of the proposed pump system. Show products required for proper installation, their relative locations, and critical dimensions. Submit technical data sheets, electrical/wiring schematics showing all devices, connections and wire numbers, sequence of operation, and UL listing authorization form.
4. **Operation and Maintenance (O&M) Manual:** Include operating procedures, adjustments, and preventative maintenance procedures. Include a guide for troubleshooting operational problems with the pump system and complete documentation for programming (i.e. recommended settings, adjustments). Deliver the O&M Manual to the City prior to pump system start-up. Provide an unlocked, unencrypted electronic backup copy of all programming and equipment settings for all programmable equipment on a USB drive that can be used to reprogram a replacement component in the event of a memory loss or failure.
5. **Electrical Studies:** Include complete Arc Flash Study including load flows, short circuit calculations and coordination study of all overcurrent protective devices down to each disconnecting means of each branch circuit. Studies to be completed using SKM per the IEEE 1584-2018. Entire SKM Project File is to be provided to the City of Greeley, including all subfolders, reports, tables, and settings files to allow for future updates of study. SKM Project File to be unlocked and unencrypted delivered via USB flash drive. Study to be based upon actual installed cable length and conduit types in addition to actual equipment and protective devices installed.

C. **Pump House:**

1. **Materials List:** Include pipe, fittings, mechanical, and electrical components. Quantities of materials need not be included.
2. **Manufacturers' Data:** Submit manufacturers' catalog cuts, specifications, and operating instructions for all equipment supplied.
3. **Shop Drawings:** Submit shop drawings of building and other drawings called for in the installation details or specifications. Show products required for proper installation, their relative locations, and critical dimensions. Note modifications to the installation detail.

1.7 **WARRANTY**

A. **Pumping System:**

1. A two (2) year warranty shall be provided for the non-potable irrigation pump station system including performance, materials, and installation.

2. The date of substantial completion shall be specifically determined, in writing, for the non-potable pumping system.

B. Building:

1. For a period of two year from commencement of the formal maintenance period, guarantee/warranty materials, equipment, and workmanship against defects. Fill and repair depressions. Restore landscape or other components damaged by the building installation. Repair damage to the premises caused by a defective item. Make repairs within seven days of notification from the Owner's Representative.
2. Contract documents govern replacements identically as with new work. Make replacements at no additional cost to the contract price.
3. Guarantee/warranty applies to originally installed materials and equipment and replacements made during the guarantee/warranty period.

1.8 PERMITTING

- A. Obtain permits for the precast building, electrical within and outside of building, and all other necessary permits required for this Work.

1.9 DISCREPANCIES

- A. It is the intent of the plans and specification that all equipment installed in the pump building be complete and operational. It is the Contractor's responsibility to make sure that the equipment furnished is compatible and adheres to all regulations. Any discrepancies should be noted immediately and should be reported to the Owner's Representative for clarification.

1.10 RULES AND REGULATIONS

- A. Work and materials shall be in accordance with the latest edition of the International Building Code, the International Electric Code, the International Plumbing Code, and applicable laws and regulations of the governing authorities.
- B. When the contract documents call for materials or construction of a better quality or larger size than required by the above-mentioned rules and regulations, provide the quality and size required by the contract documents.
- C. If quantities are provided either in specifications or drawings, these quantities are provided for information only. It is the Contractor's responsibility to determine the actual quantities of all material, equipment, and supplies required by the project and to complete an independent estimate of quantities and wastage.

1.11 CONTROL FEATURES

- A. A pressure start time delay, a stop time delay, and a minimum run timer with automatic and manual time out; shall be provided for each pump. Flow ON and OFF sequencing set points and a 100 percent speed start time delay shall be provided for each main pump.
- B. "Double successive" automatic alternation shall be provided for the main pumps to prevent short cycling while limiting equal wear. Time delayed automatic "sequence shifting" shall be provided to ensure that all operating pumps will sequence properly when one or more of them have been disabled due to a motor overload or a manual shutdown.
- C. An auto-pressurizing mode with adjustable settings that gradually restores system pressure with the VFD main pump shall be provided to protect the irrigation piping at station startup and after extended station shutdowns.
- D. An energy saving mode with adjustable settings shall be provided to reduce the system pressure at low flow rates when friction losses in the system are lower.

1.12 OPERATION

- A. During non-irrigation times, the pressure maintenance (PM) pump will cycle ON and OFF as required to maintain irrigation system pressure. The cycling pressures shall be user selected and set substantially below normal set point pressure, if desired.
- B. If the PM pump cannot maintain the desired pressure, then the programmable logic controller (PLC) will start the first main pump and will gradually ramp the pressure up to desired irrigation pressure to meet small demands.
- C. If the first main pump cannot maintain the desired pressure, the PLC will start the second main pump and will gradually ramp the pressure up to the desired irrigation pressure, and so on and so forth until all pumps are operating to maintain the desired pressure.
- D. Pump speeds will be modulated to hold a constant discharge pressure regardless of flow. As the flow rate increases and the main VFD pump can no longer maintain pressure while at maximum speed, the next sequential pump will be started and the VFD drive pump will accordingly reduce its speed and modulate.
- E. An algorithm shall be included for accurately reducing the VFD pump speed as the next sequential pump is started so that no pressure surges are generated during the transition (even with across the line starting). Algorithm shall apply to all transitions between pumping states.
- F. As the flow continues to increase, pumps will sequentially be started until all pumps are operating. As the flow begins to decrease, pumps will be sequentially turned off until only a single VFD driven pump is operating. When a no flow condition occurs, the last pump in operation shall be turned off.

PART 2– PRODUCTS

2.1 GENERAL

- A. Materials used in the system shall be new and without flaws or defects of any type and

shall be the best of their class and kind.

- B. Pumping stations shall have a capacity and discharge pressure as shown on the Construction Drawings.
- C. Prefabricated pump skids shall be completely piped, wired, hydraulically and electrically tested before shipment to the construction site. The pump station and related equipment shall meet all the general and technical specifications and shall be designed, fabricated, and installed in a workmanlike manner.
- D. All components of the pumping system shall be designed to function within an indoor environment. Furnish protective enclosures, covers, and HVAC system as required for proper operation and maintenance of the system.
- E. Construction shall include skid assembly to support all components during shipping and to serve as the installed skid base. Skid base shall be of sufficient size and strength to resist twisting and bending from shipping, installation, and hydraulic forces and support the full weight of the pumps and motors.
- F. A trained representative or technician from the pump manufacturer shall supervise the installation of the pump skid. The pump manufacturer's representative shall also provide a minimum two (2) days for the startup and training to City personnel in the operation, maintenance, and programming of the new pumping system.
- G. All pump skid components including but not limited to pumps, self-cleaning filters, steel piping, valves, fittings, and pump controls and magnetic flow meter shall be supplied by one (1) manufacturer, even though others manufactured some components. Refer to 2.2, 2.5, and 2.8 for items to be supplied by pump skid manufacturer.

2.2 PREMANUFACTURED PUMP SKID

- A. Vertical Turbine Pumps:
 - 1. Furnish variable frequency drive (VFD) vertical turbine pumps, electric motor driven, complete with the required length of threaded column assembly. Surfaces in contact with water shall be epoxy coated or stainless steel.
 - 2. Pump discharge head shall be surface mounted and have 125 class, 200 psig rated, discharge flange of the same size as the pump check valves. Discharge head shall be cast iron.
 - a. A check valve assembly consisting of two 3/4-inch swing type, 125 class, 200 psig rated, brass or bronze, check valves shall be mounted vertically on each main pump discharge head. The check valves shall be placed in series, in opposite directions, and modified to quickly release air from a main pump when it starts, and to slowly allow air to return when it stops. Each check valve assembly shall remain closed when its pump is running.
 - 3. The pump discharge head shall include a stuffing box and be provided with a drain for the stuffing box wastewater to drain to the wet well.

4. Suction strainers shall be of the basket type and have total inlet areas of at least four times those of the suction bells.
5. Pump efficiency shall be minimum 80% at the specified operating point. The performance curve of each pump selected shall be continuously rising as it approaches shutoff.
6. Bowl assemblies including the suction, intermediate, and discharge bowls shall be furnished with epoxy coating or stainless steel flanged connections. Furnish bronze, dynamically balanced, impellers that are vertically adjustable by a hex nut located at the top of the pump motor.
7. Line shafts shall be supported by bearings no further than 10 feet apart.
8. Column pipe sections shall be no longer than 10 feet and joined together using threaded couplings.
9. Furnish each pump with a flanged, cast iron discharge head complete with a cast iron adjustable packing gland, gland plate, grease seal, packing bushing, packing and water slinger.
10. Provide a continuous bypass flush line from the stuffing box of each pump to the wet well.
11. All bowl bearings shall be constructed of bronze, all column bearings shall be fluted rubber. Each pump shaft, column line shaft, and pump motor shaft shall be turned, ground and polished 416 stainless steel, sized to transmit full nameplate HP of the motor. Minimum acceptable shaft size is one-inch (1").
12. All shaft couplings shall be threaded and machined from 300 series stainless steel. Furnish two (2) piece head shaft assembly. All shaft couplings shall have left hand threads that tighten during pump operation.
13. Each motor shaft shall be removable and couple to the pump head shaft between the bottom of the motor and the packing gland with sufficient clearance to allow removal of the packing gland assembly without motor removal.
14. Materials List

Item	Material
Pump Bowls	Cast Iron with Enamel Lining
Suction and Discharge Cases	Cast Iron with Enamel Lining
Pump Discharge Head	Cast Iron
Impeller	Bronze
Suction and Discharge Case Bearing	Bronze
Intermediate Bowl Bearing	Bronze
Column Bearing Retainer	Bronze
Packing Follower	Bronze
Packing Bushing	Bronze
Motor Shaft Hex Nut	Bronze

Column Bearings	Fluted Rubber
Pump Shaft and Motor Shaft	Polished 416 Stainless Steel
Line Shaft	416 Stainless Steel
Line Shaft Couplings and Motor Shaft Couplings	300 stainless steel
Column Piping and Couplings	Steel
Packing Material	Graphite Impregnated
Water Slings	Rubber
Pump Suction Strainers	Zinc Plated or Stainless Steel

B. Vertical Hollowshaft Pump Motors

1. Vertical hollowshaft pump motors shall be premium efficiency squirrel cage induction type motors with WP-1 enclosures and Class F insulation, manufactured in the United States, rated for continuous inverter duty and designated NEMA MG 1, Part 31.
2. A thrust bearing sized to carry the weight of all rotating parts plus the hydraulic thrust of the pump at shutoff shall be incorporated into each motor.
3. Motors shall be rated for continuous inverter duty, VFD rated, and shall be sized to drive the pump at any point on its operation curve without exceeding motor HP nameplate rating. All motor shall have a 1.25 service factor rating.
4. All motor bearings shall be rated for at least five years of continuous operation.
5. Pump shaft connections shall be made through a bolted coupling at the top of each motor.
6. Motors shall be equipped with non-reverse ratchets and space heaters.
7. All vertical turbine pump motors shall be 1800 RPM nominal.
8. All motors shall be coated with the motor manufacturer's original paint only.
9. Furnish motor thrust bearings of ample capacity to accommodate the weight of all rotating parts plus the hydraulic thrust of the pump at shutoff conditions. Furnish motor bearings rated for a minimum service life not less than five (5) years continuous operation at the design rating point.
10. Furnish motors manufactured in the United States.
11. Acceptable motor manufacturers are:
 - a. Nidec/US Electrical Motors
 - b. Or approved equivalent
12. Miscellaneous:
 - a. Install vibration sensors on each motor.

- b. All motors shall have shaft grounding systems. Grounding systems shall be installed per manufacturer recommendations.

C. Pressure Maintenance Pump (PM Pump)

1. Furnish a PM pump, with a multistage, submersible type, well pump.
2. Pump shall be equipped with a motor shroud for proper cooling of submersible motor and stainless steel suction screen.
3. The pump discharge connection and all riser pipe couplings shall be threaded steel.
4. The submersible pump, riser pipe, riser pipe support plate, and discharge connection shall be removable as a single unit by unbolting the riser pipe support plate from the skid base.
5. Materials

Item	Material
Pump Suction Interconnector	416 Stainless Steel
Inlet Screen	416 Stainless Steel
Pump Shaft	416 Stainless Steel
Check Valve Housing	416 Stainless Steel
Check Valve	416 Stainless Steel
Diffuser Chamber	416 Stainless Steel
Top Bearing	416 Stainless Steel
Split Cone	416 Stainless Steel
Impellers	416 Stainless Steel
Couplings	416 Stainless Steel
Straps	416 Stainless Steel
Cable Guard	416 Stainless Steel
Priming Inducer	416 Stainless Steel
Check Valve Seat	NBR Rubber and Stainless Steel
Intermediate Bearings	NBR Rubber, Bronze or Stainless Steel
Riser piping and couplings	Galvanized Steel

6. The motor leads shall be strapped to the riser pipe on three foot maximum centers with a 12" service loop.
7. Manufacturer: The pump and motor shall be as manufactured by Grundfos or approved equivalent.

D. Skid Base

1. The skid base shall be constructed from structural steel channel, cross members, a 3/4 inch solid steel pump mounting plate, and 3/16 inch steel "diamond" plate. Angle iron shall be used only to support open areas of the deck. The skid base shall completely cover the wet well. A wet well access hatch or flap shall be

provided.

E. Piping

1. All piping 3-inches and larger shall be Schedule 40, black steel, ASTM A120 or A53 Grade B, electric resistance welded pipe.
2. All welded flanges shall be forged steel with slip-on or welding neck type. All welding fittings shall be seamless, conforming to ASTM A234, with pressure rating not less than 150 psi.
3. All fabricated piping shall conform to AWWA standards.
4. All piping smaller than 3 inches shall be schedule 40, galvanized steel, ASTM A120 Grade B, continuous welded pipe.
5. All threaded pipe fittings shall be galvanized, malleable iron, 150 class, ASTM A126 Grade B.
6. All pressurized tubing material shall be Impolene polymer.

F. Valves

1. Pressure Relief Valves
 - a. Furnish a hydraulically operated, pilot controlled, diaphragm-type pressure relief valve and bypass piping to the wet well installed on the discharge piping. Size the pressure relief valve to bypass sufficient water to avoid operating pumps at or near shut off head conditions. The valve size shall be based on at least 50 percent of the total station capacity:
 - i. 2.5 inch - 670 GPM,
 - ii. 3 inch - 1000 GPM, and
 - iii. 4 inch - 1800 GPM
2. The relief valve discharge shall be piped to the wet well through a diffuser tube assembly. The assembly shall be the same size as the relief valve and shall extend into the wet well to a depth of 3 feet below the normal water level. Relief valves discharging directly into the wet well, without diffusing it below the water line, is not acceptable. The portion of the assembly above the skid decking shall be constructed with steel pipe, a steel support plate, and 150 class steel flanges at the relief valve and the diffuser tube.
3. The diffuser tube shall be made of schedule 40 PVC pipe, fittings, and end cap. The tube shall have 3/4 to 1-inch diameter holes drilled around the bottom one to two foot section of the tube. The total area of the holes shall be at least 4 times the area of the diffuser tube diameter.
4. Pilot controls shall include an adjustable 20 to 200 psig rated, pilot valve with a bronze body, a stainless steel stationary seat, and a buna-n resilient seat. An

adjustable needle valve closing speed control shall be provided. The inlet connection to the pilot system shall be on the discharge piping with an isolation ball valve and a wye-strainer strainer. The inlet connection to the pilot system shall not be permitted on the body the pressure relief valve itself. An air release cock shall be provided at the cover tip connection of the relief valve.

5. A brass hose bib shall be provided at the inlet side tapping of the pressure relief valve.
6. Pressure Relief Valve shall be a model CRL-60 as manufactured by Cla-Val or approved equivalent.

G. Check Valves

1. Provide check valves on each pump mounted directly to its pump head's discharge flange and one on the discharge end of the Automatic Self-Cleaning Filter.
2. Check valves shall be of the spring loaded, center guided, silent wafer type.
3. Valve bodies shall be cast iron. Valve internals shall be bronze and stainless steel with buna-n seats. The valves shall have a compound sealing action: metal to metal, and metal to buna-n rubber.
4. The valves shall be 400 psig W.P.
5. Velocities shall be limited to 10 fps, and pressure drops shall be limited to 2.5 psig.
6. Check Valve shall be as manufactured by Val-Matic.

H. Pump Discharge Isolation Valves

1. Each pump shall have a discharge isolation valve. Valves shall be of the lug body, butterfly type rated at no less than 200 psig working pressure.
2. Valves 6-inches and under shall have a 10 position, locking, lever handle. Valves 8-inches and over shall have a hand wheel / gear operator with position indicator.
3. Each valve body shall be ductile or cast iron with an aluminum bronze disc, a 416 stainless steel shaft, bronze shaft bushings, and an EPDM rubber seat.

I. Pressure Relief Valve Inlet Isolation Valves

1. Provide an isolation valve on the inlet of the Pressure Relief Valve. The isolation valve shall be the same as the Pump Discharge Isolation Valves.

J. Station Discharge Isolation Valve

1. Provide an isolation valve at the end of the meter run pipe. The isolation valve shall be the same as the Pump Discharge Isolation Valves

K. Air/Vacuum Valves

1. A 1-inch air-release valve shall be located on the discharge manifold. The valve shall be capable of releasing air while the pumps are running at any flow rate or delivery pressure. The valve shall open under a vacuum to allow air to enter when the station is drained. Its exhaust port shall be tubed back to the wet well. The valve shall have a cast iron body, stainless steel trim and float ball, a Viton seat, and a minimum pressure rating of 200 psig.

L. Ball Valves

1. Provide ball valves to isolate the following items:
 - a. Air Release Valve
 - b. Each pilot assembly connection of the System Relief Valve
 - c. Pressure transducer sensing line connection
 - d. Drain connections
 - e. Pressure gauges
2. Each isolation valve shall be a full port ball valve, rated for 200-psig minimum, with a brass body, a chrome plated brass ball, and a Teflon seat.

M. Drain Valves

1. Drain valves are to be provided at any possible low point in the system and are to consist of 1/4" brass angle valves unless otherwise noted.
2. Provide a drain valve in the pump discharge manifold between the pump check valve and control valve.
3. Provide a 3/4" brass hose bib in the discharge piping to function as a wash down connection and a drain.

N. Gauges

1. All gauges shall be isolated from electrical switch gears and control panels.
2. Provide a pressure gauge near the inlet of the pressure relief valve. The gauge shall be 2-1/2-inch, glycerin filled, and have an accuracy of ANSI Class B or better.

O. Drain Tubes

1. Drain lines shall be provided from packing drain area of each pump discharge head, from the packing gland bypass connection of each pump, from the air-in/air-out check valve assembly on each pump, from the exhaust port of the air/vacuum valve, all drain valves. All of these drain connections shall discharge into the wet well.

P. Automatic Self-Cleaning Filter

1. Provide an appropriately sized automatic backwash filter, with a self-cleaning mechanism, driven by an electric motor.
2. The filter shall have a 300 micron stainless steel mesh screen.
3. An additional pressure gauge shall be provided so that up & downstream filter pressures can be read.
4. The filter shall be operated by the pump system control panel. A filter selector switch, filter flush totals, 4 flushing modes, and 6 diagnostic alarms shall be provided with the PLC and HMI programming.
5. Manufacturer:
 - a. Amiad SAF Series
 - b. No equivalent allowed.

Q. Painting

1. The entire station, with the exception of the control panel, motors, and the underside of the skid base, shall be machine cleaned and painted with a multipart coating system having a total dry-film thickness of not less than 8 mils. One coat of white, polyamide, epoxy primer shall be applied to a dry film thickness of not less than 4 mils. Two coats of Mayan Green, gloss, aliphatic, acrylic, polyurethane, finish shall be applied to a dry-film thickness of not less than 4 mils. A 1-quart can of the finish paint shall be shipped with the station for job site touch up.
2. The underside of the skid shall be coated with a black, polyamide, epoxy lining, not less than 10 mils thick. The control panel and the motors shall retain their manufacturer's original coatings.

R. Electrical and Controls

1. Refer to Section 2.5.

S. Acceptable Pump Skid Manufacturers are:

1. SyncroFlo, 6700 Best Friend Road, Norcross, GA 30071, www.syncroflo.com
 - a. Local Representative: Cascade Industries, 970-402-3252
email: cascadeindustrieslimited@gmail.com
 - b. Or approved equivalent.

2.3 PIPE SUPPORT STANDS

- A. Furnish manufactured steel pipe support stand as shown on the Construction Drawings or City of Greeley Standard Drawings.

- B. Support must be capable of supporting 500 lbs dead load and be adjustable within the range shown on the pump piping detail.
- C. Approved pipe stands are:
 1. Material Resources – Standon S89, Flanged Adjustable Pipe Support
 2. Material Resources – Standon S92, Adjustable Pipe Saddle Support
 3. Or approved equivalent.

2.4 DISCHARGE “Z” PIPING

- A. A welded steel pipe with two 45 degree steel bends (Z-Pipe) shall be provided for installation between the pump station discharge valve located inside the pump station building and the buried irrigation main line. The Z-pipe shall have a welded steel flange for connection to the discharge valve, an underground welded steel thrust plate, and a plain end for connecting to the buried irrigation main piping. The Z-Pipe outside diameter shall be compatible with AWWA C-900 and C-905.
- B. A 2-inch threaded steel outlet shall be welded to the top of the Z-pipe located at the top of the pipe outside the pump building for a winterizing connection. A 2-inch steel threaded plug shall be provided.
- C. Steel: AWWA C200 steel pipe for both direct bury and exposed applications. Submit proposed interior and exterior coatings for City review and approval.

2.5 PUMP SKID ELECTRICAL AND CONTROLS

- A. General
 1. All electrical control panels with controls and wiring shall be built in accordance with NEC, UL, and ETL standards. The electrical components and enclosure shall be labeled as a complete UL listed assembly with manufacturer’s UL label applied to the door.
 2. All equipment and wiring shall be mounted within the enclosure and labeled for proper identification.
 3. The power supply to the pump station shall be three (3) phase, 480 volt.
 4. All wiring from control panels to motors shall be in liquid-tight conduit with MTW or THWN, stranded copper conductors rated not less than 600 volts AC. All wiring shall follow NEC code and local code. All wiring from the control panel to the motors shall be sized according to NEC requirements based on motor full load current. A grounding cable shall be included in the liquid-tight conduit. There shall be no splices between the motor starters and the motor connection boxes, except for the submersible pump motor.
 5. Wiring to flow sensors and pressure transducer shall be multi-conductor shielded cable suitable for Class 2 low voltage controls. Must use Black and red wiring in

cable for all class 2 low voltage controls.

6. All control wiring carrying more than 24 volts, shall be 16-gauge minimum with wire numbers at all termination points. The wiring to all devices outside the control panel shall be contained in metal lined, liquid-tight conduit.
7. All secondary control components shall be powered with 120 VAC or 24 VDC. All control relays shall be plug in type for easy replacement. No 120 VAC powered components shall be allowed on the door of the control panel, just 24 VDC components are permitted on the door.
8. Primary and secondary circuit breakers shall be provided for the control power transformer. A circuit breaker shall also be provided for the motor space heater circuits.
9. Provide full alarms and safety features needed to protect equipment and piping.

B. Enclosures

1. The pumping station electrical controls shall be mounted in a self-contained UL Type 4 or 12 (NEMA-4 or 12) enclosure.
 - a. The enclosure shall be mounted on the pump skid or placed on a concrete maintenance pad.
2. Door gasket seals shall be neoprene sponge, sufficient to protect interior components from weather and dust. The electrical panel doors shall be constructed from 12-gauge steel with integral locking screws and latches.
3. All internal components of the enclosures shall be mounted on removable back panels.
4. All internal wiring within, and interconnecting between, the panels shall be complete and no field wiring within the panels shall be permitted. Wiring troughs and cable raceways shall be self-contained within the enclosures and no external cable trays or wiring troughs are permitted.
5. No pressure gauges, pressure switches, water activated devices, or water lines of any sort shall be installed in any electrical control panel.
6. All adjustments and maintenance shall be capable from the front of the control enclosure. A complete wiring circuit and legend with all terminals, components, and wiring identification shall be provided. Main disconnect shall be interlocked with door.
7. All electrical starter and control panels in the pump system shall be assembled from components that are UL listed.
8. A closed type cooling system shall be included to cool the enclosure and reject heat from the VFD. Open type cooling systems allowing outside ambient air to enter the panel are not acceptable.

9. Adjustable, ambient temperature compensated, bimetallic, inverse time, UL class 10 thermal overload relays or motor circuit protectors shall be provided for each motor.
10. Provide complete instrumentation and controls to automatically start, stop, and modulate pump speeds for efficient and reliable pump flow rates, at a constant discharge pressure.

C. Power Monitor

1. The main power supply in the pump station shall be equipped with a 3-phase power monitor. It shall detect low voltage, phase loss, reversal, shift, or improper sequence. A voltage adjustment, status light, and a plug-in base shall be provided.

D. Surge Protection Device

1. The main power supply in the pump station shall be equipped with a 3 phase, 480 volt rated, UL 1449 surge protected device (SPD). The SPD shall be mounted external to the main cabinet. The SPD shall have a current rating of not less than 10,000 amps, an SCCR rating 200,000 amps, and shall include a green OK status light. The SPD shall be connected to the power distribution block immediately downstream of the main circuit breaker, so it can be isolated for replacement. The SPD shall include an event counter and an audible alarm in the event of SPD failure.

E. Variable Frequency Drive

1. Must have Ethernet/IP communication capabilities with Allen Bradley PLCs and manufacturer supported Add On Instruction for AB PLC programming integration. Preference given to drives that interface to Allen Bradley PLC with AB supported Add On Profile and Automatic Device Configuration. Provide sample code and AOI for non-AB drives.
2. Provide suitable drive input impedance to prevent damage due to power system transients.
 - a. For drives without built-in inductors – add line impedance whenever the transformer kVA is more than 10 times larger than the drive kVA, or the percent source impedance relative to each drive is less than 0.5%. • For drives with built-in inductors – add line impedance whenever the transformer kVA is more than 20 times larger than the drive kVA, or the percent source impedance relative to each drive is less than 0.25%. Or follow tables in publication Drives-IN001 for Allen Bradley VFDs.
 - b. Alternate requirements for the inclusion of added input impedance will be evaluated if the requirements are product specific and within manufacturer published documents. The inclusion or omission of devices shall be documented with a reference to the source publication.

3. Provide Harmonic reduction devices as needed to prevent interference and impaired function of other equipment connected to the source transformer. Requirement is based upon IEEE 519. Distortion of voltage should be less than 5%. Suitable harmonic mitigation can be decided based on the size of the main power transformer. Contractor to verify if harmonic mitigation is needed and provide required harmonic mitigation.
 - a. Preferred solution is the use of Active Harmonic Filter (AHF) sized to expected loads. If requirement 2 (above) does not indicate need for reactor and the AHF can be sized without input reactors, it is allowed to provide the drives without input reactor. Adding a 3% input reactor to all drives can reduce the size of AHF requirement and is suggested best practice.
 - b. Passive Harmonic Filters (PHF), provided with each drive are acceptable means of harmonic mitigation. When provided, they shall be provided with means to disconnect internal capacitance when the VFD is running at low power level or not running.
 - c. Active Front End (AFE) VFDs are acceptable when they are provided with isolating impedance and background distortion is lower than 3%. AFE drives shall have settings as needed for multiple input types such as utility power and backup generator. It is not recommended to mix and match different vendors of AFE drives or put drives on power systems that have unfiltered 6-pulse drives.
 - d. Document using a harmonic calculation tool that the harmonics levels will meet requirements.
 - i. Results/calculation output provided by a manufacturer provided tool such as those from drive and filter manufacturers is acceptable. (Does not have to be provided by a professional engineering tool.)
4. When using an AHF, contact the manufacturer for their recommendations on active harmonic filters sizing and suitability.
 - a. Preferred manufacturer is Mesta/Hammond
 - b. Include documentation of sizing provided by manufacturer.
5. Provide long lead length protection as needed to prevent motor failures. Follow drive manufacturer instructions on lead length recommendations. Mitigation/protection shall be manufacturer specific and shall follow published guidelines. Application must consider if the motor meets inverter rated duty and use minimum voltage rating of the inverter motor standard (1488V). If the motor does not meet inverter duty rated standards, apply suitable devices to protect the motor.
 - a. Allen Bradley 7-class drives 3-300 HP do not require any output devices when powering inverter duty rated motors at distance up to 300 feet. For

distance from 300 to 600 feet it is preferred to use AB motor terminator (connects at motor) so that drive enclosure can be kept small. It is acceptable to use an output reactor for distance up to 600 ft. For distance above 600 feet it is allowed to use a dV/dT or Sine filter. Note that other AB drives and other manufacturers do exactly follow the previous recommendations. See publication drives-in001.

- b. Use of reactors/terminators/filters shall follow the published guidelines of their respective manufacturer. The inclusion or omission of devices shall be documented with a reference to the source publication.
6. VFD cable shall be installed on the output of the VFD to the Motor to assure suitable insulation rating, protection against noise interference and to help mitigate bearing failures and other common mode related problems. Grounding practice and wire type and composition must follow manufacturer guidelines.
 - a. Document the source publication(s) used as reference.
 - b. For Allen Bradley drives the best practice document is Publication Drives-IN001. It also covers lead length and input impedance. The publication 750-IN001 also covers some drive specific guidelines for installation of 750 class drives.
 7. Complete schematic, wiring and interconnection diagrams showing connections to both internal and external devices:
 - a. Include terminal number and wire numbers.
 8. Complete single-line and 3-line diagrams including, but not limited to, circuit breakers, motor circuit protectors, contactors, instrument transformers, meters, relays, timers, control devices, and other equipment comprising the complete system:
 - a. Clearly indicate device electrical ratings on the drawings.
 9. The VFD manufacturer shall be responsible for start-up of the VFDs in the presence of the equipment suppliers, Contractor, Engineer, and Owner.
 10. Approved manufacturers are:
 - a. Allen Bradley
 - b. Eaton
 - c. ABB
 - d. No equivalent allowed.

F. Pressure Transducer

1. Standardize with GE UNIK5000UK 0-150 PSI Part # PTX5032-TA-A2-CA-HO-PF.

2. No equivalent allowed.

G. Wet Well Monitoring

1. Wet wells shall be equipped with an E&H radar sonic liquid level indicator probe and level transmitter.
2. Low level cut off switch (float) shall be provided to send a discrete signal to the PLC to shut down the pumps on low wet well level.

H. Programmable Logic Controller

1. Provide a programmable logic controller (PLC) to control all functions of the station. Relays may be used for interface purposes only. The PLC shall include non-volatile EEPROM memory (no battery needed) that prevents loss of program or settings during power failures; POWER, RUN, BATTERY, ERROR, and I/O status lights; a Modbus TCP or Ethernet port for SCADA communications; an Ethernet port for HMI communications, 2 amp rated dry contact relay outputs (solid state outputs are not allowed); 24 VDC inputs standard and high-speed digital inputs; analog inputs; and an analog output. The PLC shall be rated for locations where electro-magnetic noise, voltage spikes, high temperature, humidity, and mechanical shock exist.
2. All logic for system control, timing, and control of VFD speed shall be handled by the PLC. No external relay logic or timers are permitted. A separate set point controller is not acceptable.
3. The City shall be provided with an unlocked PLC program.
4. Approved PLC manufacturers are:
 - a. Allen Bradley Studio 5000 Platform
 - b. Mitsubishi.
 - c. No equivalent allowed.

I. Human Machine Interface

1. A UL Type 4 rated, 24 VDC powered color touch screen operator interface shall be provided. 120 VAC powered interfaces are not acceptable. The interface shall be a high resolution, backlit color, LCD touch screen. Should the interface fail, a signal shall be sent to the PLC, and the station will continue to run normally. The interface shall also provide protected access to changing all operational settings as well as a re-load factory settings function.
2. HMI program shall be unlocked and copy of program given to City of Greeley I&C department after commissioning of pump station.
3. Approved HMI manufacturers are:
 - a. Redlion G15C1100

- b. Maple Systems
 - c. Or approved equivalent.
4. Human Machine Interface screen shall provide access to operator controls, alarms, and system data such as:
- a. Operator set points.
 - b. Pump HAND-OFF-AUTO selector switches.
 - c. An inverter TEST-OFF-AUTO selector switches.
 - d. An inverter SETUP MODE button.
 - e. A DISABLE-ENABLE switch to prevent the low system pressure and high flow rate alarms from shutting down the station.
 - f. An ALARM RESET push button.
 - g. An ALARM LIGHT TEST button.
 - h. Flood Alarm. Provide flood alarm sensor to detect a flooding in the building.
 - i. Irregular Power.
 - j. Runtime for each pump. – Reset yearly.
 - k. Runtime for each filter. – Reset yearly.
 - l. Count of filter back flushes.
 - m. Total pump starts.
 - n. Flow Rate.
 - o. Total Gallons Pumped – YTD.
 - p. Total Gallons Pumped – Previous day total.
 - q. System Efficiency (Watts/Gallon) including trending.
 - r. System Pressure.
 - s. Filter inlet and outlet pressure.
 - t. VFD/Pump speed for all pumps.
 - u. VFD/Pump feedback speed for all pumps.
 - v. VFD/Pump current draw for all pumps.

- w. VFD/Pump Voltage for all pumps.
- x. On/Off control of pump station.
- y. Vibration sensors on motors.
- z. Provide VFD speed reference and speed feedback.
- aa. ON/OFF/faulted/manual/auto status of VFDs/soft starters and motor starters.
- bb. Ability to change pumps in manual or auto.
- cc. Pond level.
- dd. Wet Well level.
- ee. Alarms page. Show existing and acknowledged alarms.
- ff. Valve positions.
- gg. Password protected.
 - i. Operator level
 - ii. Admin level

J. Alarms and Shutdown

- 1. Pumps shall be shutdown with the appropriate alarm whether they are operating in HAND or AUTO mode.
- 2. Alarms:
 - a. A power failure alarm with trip delay, manual and delayed automatic reset.
 - b. An irregular power alarm with trip delay, manual and delayed automatic reset.
 - c. A leak detection alarm with manual reset.
 - d. low pressure alarm with trip time delay and manual reset.
 - e. A high-pressure alarm with trip time delay and manual reset.
 - f. A high flow rate alarm with trip delay and manual reset.
 - g. A low-level alarm with trip delay and manual reset.
 - h. A high panel temperature alarm trip delay.

- i. A manual and automatic reset.
 - j. An individual motor overload alarms with manual reset.
 - k. A contactor fault alarms with manual reset.
 - l. A pressure transducer failure alarm with manual reset.
 - m. A level transducer failure alarm with manual reset.
 - n. A flow meter failure alarm with manual reset.
 - o. An inverter (VFD) fault alarm with a two-attempt automatic reset,
 - p. A third trip lockout function with timed rollover, and manual reset.
 - q. A PLC failure alarm with automatic reset, and display failure alarm with automatic reset,
 - r. A low battery alarm with automatic reset, an input failure alarm with automatic reset.
3. The following specific alarm conditions along with procedures for correction will be displayed in English on the HMI:
- a. Low discharge pressure (with override switch)
 - b. High discharge pressure
 - c. Low wet well level (Attempts restart)
 - d. Phase loss (Attempts restart)
 - e. Low voltage (Attempts restart)
 - f. Phase unbalance (Attempts restart)
 - g. Individual motor overload/phase loss (indicates which individual motor was shut down)
 - h. VFD fault (shutdown VFD pump only and attempts restart)

2.6 SCADA

A. General

- 1. Coordinate SCADA requirements with the City of Greeley I&C Department. The City shall be provided with an unlocked the PLC program. Programming of SCADA system shall be done by an approved and qualified controls contractor. Use approved City of Greeley radio system.
- 2. Provide 40-foot pole for SCADA radio antenna. Alternatively, the SCADA radio

antenna can be integrated with light pole. Ground antenna mast according to NEC guidelines and provide lightning protection isolators on all cables between antenna and control panel. Install conduit from antenna pole and SCADA control panel.

3. A SCADA radio shall be mounted in the control cabinet. A 15 amp 120 Volt AC circuit shall be made available to power up the SCADA radio.
4. If mounted on the exterior wall, install mast through the pump station building wall and then overhead or under floor to the pump control panel.
5. 120 Volt AC outlet for chemical feed pump. Outlet to be on if main pumps are on.
6. Contractor to build and test SCADA screens before starting up the pump station. Provide one workshop to review design of new SCADA screens.
7. Contractor to setup and test SCADA alarming and program SCADA phone to call out.

B. Radio Equipment

1. Provide and install the following radio equipment.
 - a. Cambium - 3 GHz 450b High Gain, Single Radio - Requires High Gain Antenna Assembly (PN # C030045B032A)
 - b. Cambium - 3 GHz 450b High-Gain Antenna Assembly (PN # N030045D001A)
 - c. Cambium - PoE Gigabit DC Injector, 15W Output at 30V, Energy Level 6 Supply (PN # N000900L001D)
 - d. Cambium - AC US Line Cord, C5 Connector (PN # N000900L001D)
 - e. Radio can't be power up until coordinating with I&C department. Contractor to support alignment of radio.
 - f. Must use outdoor rated, shielded, gel or gel tape CAT6e cable
 - g. Radio can't be power up until coordinating with I&C Staff. Contractor to support alignment of radio.
 - h. Install Cat6e cable from SCADA control panel to radio
 - i. Install moxa ethernet switch in control panel.

C. Contractor to verify with COG I&C department that we have align of sight from existing radio tower to new radio.

1. Controls, Alarms & Data.

- a. Flood Alarm. Provide flood alarm sensor to detect a flooding in the building.
- b. Irregular Power.
- c. Runtime for each pump. – Reset yearly.
- d. Runtime for each filter. – Reset yearly.
- e. Count of filter back flushes.
- f. Station Flow Rate GPM.
- g. Total Gallons Pumped – YTD.
- h. Total Gallons Pumped – Previous day total.
- i. System Pressure.
- j. VFD/Pump speed for all pumps.
- k. VFD/Pump feedback speed for all pumps.
- l. VFD status - ON/Off status bits for all pumps.
- m. On/Off control of pump station.
- n. Wet Well level.
- o. Pond level.
- p. Vibration sensors on motors.
- q. VFD faulted. – On all VFDs.
- r. Building temp.
- s. Remotely Start and Stop Pump Station.
- t. VFD amperage for all VFDs and soft-starts.
- u. Low discharge pressure alarm.
- v. High discharge pressure alarm.
- w. Low and high wet well level alarms.
- x. Phase loss alarm.
- y. Low voltage alarm.
- z. Phase unbalance alarm.

- aa. Individual motor overload/phase loss alarm.
- bb. VFD Voltage – on all VFDs.
- cc. VFD/Pumps Efficiency (Watts/Gallon).
- dd. Flume level in inches.
- ee. Flume flow in GPM.
- ff. Flume Total Gallons.
- gg. Flume Yearly total in Gallons x 1,000.
- hh. Wet well level in feet
- ii. Pump runtimes in hours
- jj. Building Temperature in degrees F°
- kk. Total number of pump starts and number of pump start for yesterday; twenty-four (24) hour period.
- ll. Total filter runtime and total filter runtime for yesterday; twenty-four (24) hour period.
- mm. Control Panel Main Power Voltage
- nn. Control Panel Main Power Current
- oo. Instantaneous Efficiency – (Voltage * Current) / Flow Rates – Sampled (15) seconds and stored 24 hours.
- pp. Average Efficiency – (Average Voltage * Average Current) Average Flow Rates – Averaged for 15 min intervals stored 30 Days.

2. Common alarms:

- a. Pump run status
- b. Low level well
- c. High level well
- d. Filter fault alarm
- e. Irregular power
- f. High panel temperature alarm
- g. Station in remote shutdown

- h. Filter run status
 - i. Reset station alarms
 - j. Station shutdown
 - k. Station restart
 - l. Flow totals should be messaged via Ethernet.
 - m. HMI shall indicate if the pump station is in shutdown mode due to SCADA input.
3. SCADA historical data.
- a. Flow data
 - b. Pressure sensor data
 - c. Vibration sensor data
 - d. Start and Stop Pump Station.
 - e. VFD or soft-starts feedback speed.
 - f. VFD Voltage
 - g. VFD/Pump Current
 - h. VFD/Pump Efficiencies (Watts/Gallon)
 - i. Wet Well level.
 - j. Pond level
 - k. System Pressure
4. Status Colors
- a. Motor Status
 - i. Green - Running in Auto
 - ii. Red - Off
 - iii. Yellow – Running in Hand or Manual
 - iv. Red flashing – Faulted
 - b. Valve position
 - i. Green – Open and Auto

- ii. Yellow – Open and Manual
- iii. Red – Closed in Auto
- iv. Red Flashing - Faulted

5.

2.7 MISCELLANEOUS ELECTRICAL COMPONENTS

- A. Pump Station should have an arc flash study and labeled per the NEC and NFPA 70E. Labels shall be designed to meet the NFPA 70E.
- B. Pump Station shall meet the NEC standard for electrical equipment work space clearances.
- C. Lightning Arrestor
 - 1. The main power supply feeding the pumping station shall be equipped with a three (3) phase secondary lighting arrestor having a breakdown current rating of not less than 60,000 amps at 14,000 volts discharge.
 - 2. Power supplies, 300 volts and less, shall use 300 volt rated arrestor with an 800 volt spark-over voltage.
 - 3. Power supplies 301-600 volts shall use 600 volt rated arrestors with a 1,000-volt spark-over voltage.
 - 4. Main Station Disconnect
 - a. The disconnect shall conform to the requirements of the NEC and applicable local codes.
 - b. The main station disconnect shall have an operating handle on the front of the panel.
 - 5. Secondary Control Circuit Fuses

Single-pole secondary distribution fuses with appropriate ratings shall supply power to each pump starter coil circuit, the control system, and to other circuits as required.

2.8 FLOW SENSOR

- A. Provide a meter readout on OID for monitoring the flow rate, totalizing gallons used, and for shifting the flow sequencing set point range. Total gallons for previous day.
- B. Adjustable settings for pipe diameter, and analog outputs shall be provided. The totalizer shall be capable of counting to two (2) billion gallons and it must be resettable. Both settings and the gallons total shall be held in non-volatile memory (no battery required) and protected by a user defined password with a hidden override key.

- C. The flow sensor shall have the following requirements:
 - 1. Liner Material – PTFE
 - 2. Ethernet or Modbus TCP. Must be able to get flow and flow totals off of the flow meter.
 - 3. Flow Measurement – as low as 6.0 micromhos/cm
 - 4. Empty pipe detection
 - 5. Bi-directional flow sensing/totalization
 - 6. Automatic zero point stability
 - 7. 1% repeatability or better
 - 8. Sensor or remote wall mount

- D. Acceptable flow sensor manufacturers are:
 - 1. E&H Magnetic flow meter
 - 2. Rosemount Magnetic flow meter
 - 3. No equivalent allowed.

2.9 BUILDING

- A. The structure shall be designed by a Colorado licensed Architect in accordance with currently adopted building code. Building specific construction specifications (ie. building materials, electrical) shall be provided. Considerations of the building design shall include the following:
 - 1. Concrete floor with floor drains connected to the wet well.
 - 2. Roof hatches or scuttle located directly above each vertical turbine pumps and wet well slide gate for removal and placement
 - 3. LED interior lighting with minimum lighting levels within the building of 30fc with a 90CRI.
 - 4. LED exterior lighting to operate under an automatic day/night switch, photometric study compliant with municipal code is required with submittals.
 - 5. Exhaust fans and louvers for ventilation
 - 6. Electrical heaters controlled by remote, wall mounted thermostat
 - 7. Vandal-proof hardware on exterior
 - 8. Precast Concrete Building

9. Wet well equipped with LED light, vapor proof with minimum 4000 lumens and located for easy maintenance and replacement.
- B. Provide materials required by local codes for installation of the pump building.
1. Minimum inside dimensions as shown on the drawings.
 2. Sealed exposed aggregate concrete finish, clear coated with graffiti guard, and welding plates.
 3. Provide entry doors as indicated on plans. Door handles to be Best Lock. Include hydraulic arms to each door intended for slow closing and providing means to keep doors open.
 4. Provide roof hatch per the drawings and installation details.
 5. Precast concrete roof and walls with cast out openings for fans, louvers, conduit and piping as shown in the details. Thicken roof slab at seam and slope roof slab away from the seam. Piping penetrations to be core drilled and sealed per the plans.
 6. Wall Penetration Seal: Use hydraulic cement.
 7. Manufacturers:
 - a. Stresscon Corporation
 - b. Wells Precast Innovations
 - c. Approved equal.
- C. Electrical Components:
1. Refer to Electrical drawings and specifications.
 2. Fan: Refer to drawings and installation details.
 3. Louver: Refer to drawings and installation details.
 4. Heater: Refer to drawings and installation details.
 5. Conduit:
 - a. Use galvanized, rigid or flexible, conduit in the pump building.
 - b. Use PVC type, approved waterproof conduit for buried underground installations.
 - c. All conduit which conforms to Underwriters Laboratories specifications.
 - d. Furnish inert plastic yellow warning tape, minimum 3-inches wide, imprinted with "CAUTION: BURIED ELECTRIC LINE BELOW"

above all direct buried conduit.

2.10 SUBSTITUTIONS

- A. Make complete submittals of all manufacturer's data showing compliance with the Contract Documents.
- B. In making a request for a substitution, the Contractor represents that he:
 - 1. Has investigated the proposed substitution and found that it is the same or better quality, level, capacity, function, or appearance than the specified product, and can demonstrate that to the City and the Design Engineer.
 - 2. Will coordinate the installation and make all modifications to the work, which are required for the complete installation and operation of the system.
- C. The Design Engineer and City will determine acceptability of the proposed substitution and will notify Contractor of acceptance or rejection.

PART 3 - EXECUTION

3.1 PUMPS AND MOTORS

- A. Shipping, off-loading, mounting details, and the technical start up shall be furnished by the pump station manufacturer. City of Greeley I&C Department representative shall be onsite for startup.
- B. Affix pump system to concrete mounting pad and complete all piping connections prior to startup and operation of the pump system.
- C. Electrical connection shall consist of a single conduit from three (3) phase, 480 volt, 200 amp disconnect to the pump station main disconnect.
- D. Pump electrical connections shall use an Insulated Multitap Connector.
 - 1. Manufacturers.
 - a. Polaris insulated Multitap connector.
 - b. Or approved equivalent.
- E. Technical startup procedures by the pump station manufacturer shall include the following:
 - 1. Station start up and pressurization
 - 2. Pressure and flow
 - 3. Programming adjustments
 - 4. Monitoring of irrigation cycle

- F. A manufacturer's representative/technician will instruct City personnel as to the operation, adjustment and maintenance of the pump station.
- G. Provide the detailed start-up procedures from manufacturer to the City, a minimum two (2) weeks prior to start-up. City of Greeley I&C Department representative shall be onsite for start and review start-up procedures.

3.2 PRECAST CONCRETE BUILDING AND COMPONENTS

- A. Precast Concrete Building: Construct precast building as shown in drawings. Submit shop drawings of proposed building prior to construction.
 - 1. Compacted subgrade, slab and foundation per soils report.
 - 2. Install buried conduit prior to building slab installation.
 - 3. Install building per manufacturer's instructions. Seal all joints and penetrations. Use caulking consisting of 1 part urethane sealant.
 - 4. Install galvanized vandal proof screens for all louvers. Paint screens to match building exterior.
- B. Concrete Building Floor/Slab: Refer to Structural drawings and specifications.
 - 1. Coordinate location and installation of building welding plates with building manufacturer prior to construction.

3.3 INSTALLATION OF PIPING COMPONENTS

- A. Wall Penetration Seal:
 - 1. Install hydraulic cement where indicated on drawings.

3.4 INSTALLATION OF ELECTRICAL

- A. Refer to Electrical drawings and specifications. All installation of electrical components shall be performed by a licensed electrician (Colorado) and conform to the National Electric Code and all local building codes.
- B. Conduit:
 - 1. Install a continuous run of warning tape, placed in the backfill 6-inches above all direct buried conduit.

3.5 INSTALLATION OF OTHER COMPONENTS

- A. Tools: Prior to substantial completion, supply to the Owner operating keys, servicing tools, test equipment, and any other items indicated on the drawings.
- B. Other Materials: Install other materials or equipment shown on the drawings or installation details to be part of the pump building and mechanical system, even though such items may not have been referenced in these specifications.

3.6 TESTING

- A. Notify the City two (2) week in advance of testing.
- B. Pump System:
 - 1. On completion of assembly of the pumping stations, all discharge pipe and valves shall be hydrostatically tested at 150% of the maximum pump shutoff head.
 - 2. Test, verify, and demonstrate to the City the proper operation of all control and safety shut off devices.
 - 3. Verify flow and discharge pressure from the pump system and demonstrate to the City system performance based on the specified values.
 - 4. Coordinate availability of water with the City.
- C. Building:
 - 1. Operate fans, heaters, outlets, and building lights.
 - 2. Adjust, move, repair system components to correct deficiencies. Repeat the test until the Owner's Representative approves the test results.
 - 3. Cement or caulking to seal piping leaks is prohibited.

3.7 OTHER ITEMS

- A. Prior to the pump start-up, the City shall be supplied with operating keys, servicing tools, test equipment, and any other items required for proper operation and maintenance of the pump station.
- B. Install all materials or equipment shown on the Construction Drawings to be part of the non-potable irrigation pumping system, even though such items may not have been referenced in these specifications.
- C. At the completion of project construction, As-Constructed Record drawings shall be submitted to the City in accordance with construction specification *Section 01785, Project Record Documents*.

3.8 PROJECT RECORD (AS-BUILT) DRAWINGS

- A. Maintain on-site and separate from documents used for construction, one complete set of contract documents as Project Documents. Keep documents current. Do not permanently cover work until as-built information is recorded including photos of work as performed.
- B. Record pipe and wiring network alterations. Record work which is installed differently than shown on the construction drawings. Record accurate reference dimensions, measured from at least two permanent reference points.

- C. Prior to Final Review, obtain from the Engineer a reproducible copy or CAD files of the drawings. Using pen or CAD, duplicate information contained on the project drawings maintained on site. Label each sheet "Record Drawing". Completion of the Record Drawings will be a prerequisite for substantial completion.
- D. Provide copy of all Record Drawings for Electrical and Instrumentation Controls wiring diagrams and programming information within a SCH 40 PVC conduit, large enough to hold documents, painted "SAFETY ORANGE" capped on both ends and labeled with 2" tall blocked black letters "RECORDS DRAWING" securely mounted to the wall inside the building, located in easily accessible and visible location adjacent to electrical equipment. Include CAD AND PDF versions of the drawings on a flash drive attached to a lanyard attached to the top cap of the container. Both ends shall have screwed on caps, not plugs, for easy removal and to shed water.

3.9 MAINTENANCE

- A. Upon completion of Final Review, maintain the pump building mechanical system for a duration of 30 calendar days. Make periodic examinations and adjustments to the system components so as to achieve the most desirable operating conditions.

3.10 CLEANUP

- A. Upon completion of work, remove from the site all machinery, tools, excess materials, and rubbish.
- B. Remove all debris and foreign material from the construction area and pump building prior to operating the system.

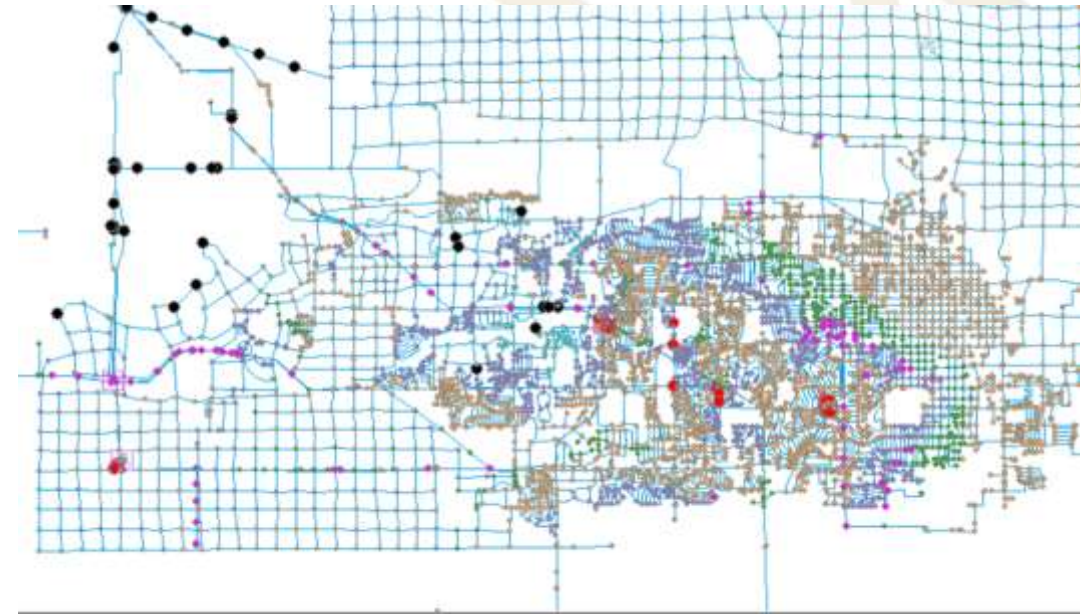
Water and Sewer Department: Updated Design Criteria Standards and Specifications

City Council Work Session
January 10, 2023

City of Greeley Water & Sewer Utilities Department
www.greeleygov.com/water

Goals

- Alignment with:
 - 2021 Water and Sewer Master Plans
 - 2022 Water Efficiency Plan
 - Other City Plans, Policies, and Procedures
- Updated technology and equipment standards
- Potential cost savings
- Comprehensive and easy to follow
- Conformance with new statewide Subsurface Utility Engineering (SUE) Laws

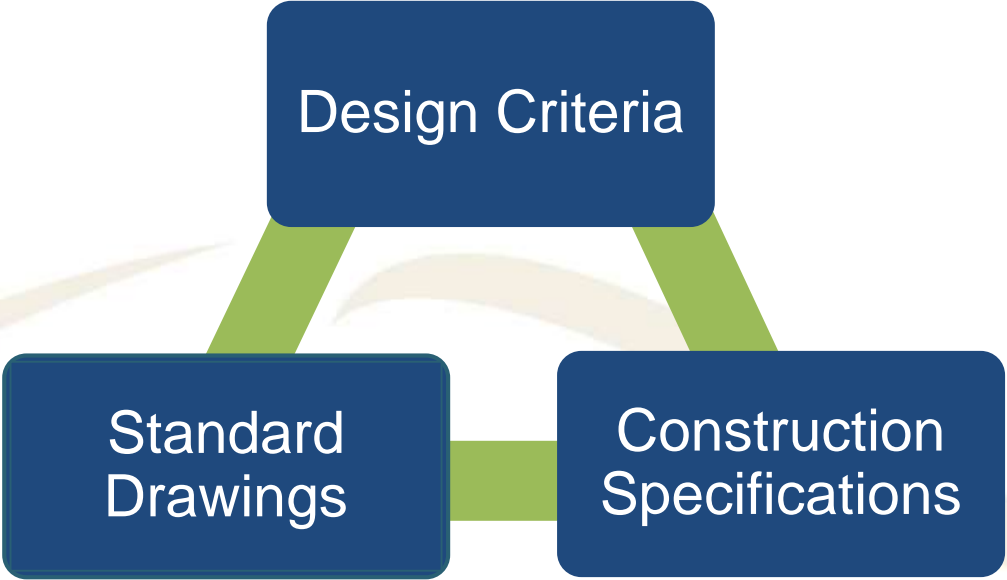


Public Outreach & Engagement



- ✓ **City Water and Sewer Board 4/20/22, 7/20/22, & 11/16/22**
- ✓ **Planning Commission 3/8/22, 8/10/22, 11/8/22 & 12/13/22**
- ✓ **City Department Reviews (2020-current)**
 - ✓ **Engineering Development, Planning, CPRD & Civil Inspections**
- ✓ **Targeted local business & development community stakeholders**
 - ✓ **Builders, Realtors, & Developers Workshops-
7/19/21, 3/2/22, 3/3/22, & 4/29/22**
- ✓ **Engagement and Feedback (December 2021-December 2022)**
- ✓ **Landscape & Irrigation stakeholders 3/2/22, 3/3/22, 4/29/22, 9/30/22,
11/8/22 & 12/5/22**

Design Criteria Standards & Specifications



- Section 1: General Requirements of Development
- Section 2: Submittal Requirements
- Section 3: Potable Water
- Section 4: Sanitary Sewer
- Section 5: Non-potable water
- Section 6: Commercial Landscape and Irrigation

Sections 1-2



Section 1: General Requirements of Development

- Minor updates and streamlined with Engineering Development Reviews

Section 2: Submittal Requirements

- Consistent modeling
- Better survey verifications and as-built drawings
- More details for reimbursement of oversized public infrastructure

Sections 3-4

Section 3: Potable Water

- Demand management per development type
- Ensure flows are more accurately calculated
- Updated connections standards, details and specifications
- Aligns with wastewater for consistency

Section 4: Sanitary Sewer

- Flows per development type
- Updated connection standards, details and specifications
- Detailed lift station criteria
- Aligns with potable water for consistency



Section 5: Non-Potable Water

- Aligns with 2021 Non-Potable Master Plan
- Regional systems and oversizing
- Consistency of systems
- Ensure flows are calculated consistently
- Conservation strategy
 - Reduces energy, chemical & water demands on potable water infrastructure



Section 6: Commercial Landscape & Irrigation

Goals

- Provides long-range water wise planning
- Support attractive and sustainable landscapes

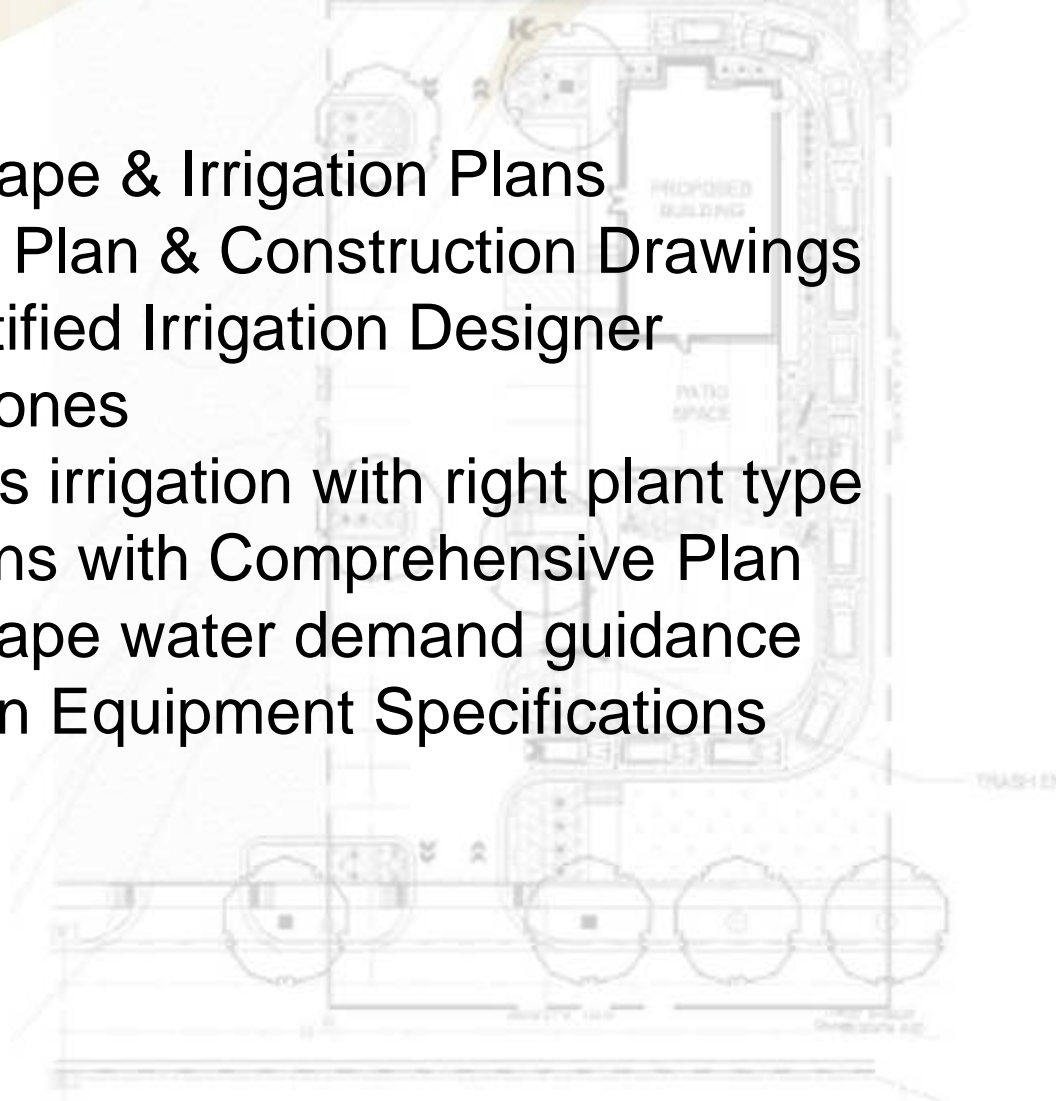
Applicable to:

- Common areas
- Right-of-ways
- Municipal buildings
- Non-residential (commercial/industrial)
- Multi-family residential



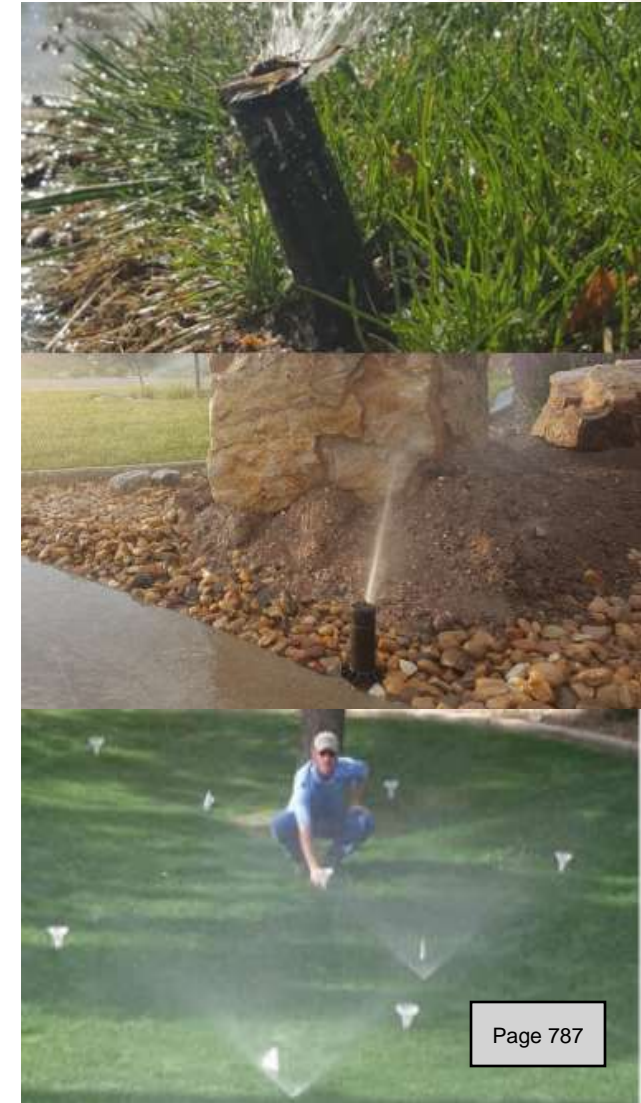
Section 6: Commercial Landscape & Irrigation

- Landscape & Irrigation Plans
 - Site Plan & Construction Drawings
 - Certified Irrigation Designer
- Hydrozones
 - Pairs irrigation with right plant type
 - Aligns with Comprehensive Plan
- Landscape water demand guidance
- Irrigation Equipment Specifications



Section 6: Commercial Landscape & Irrigation

- Irrigation System Installation Specifications
- Irrigation Performance Verifications
- Maintenance (irrigation)
 - Leak repair obligations that align with code
 - Recommends adjustments to sprinkler heads and controllers
 - Suggested checkups
 - Free performance audits by City staff



Standard Drawings & Construction Specifications



CONCRETE FOUNDATION

ELEVATION VIEW

NOTES:

1. MINIMUM DEPTH OF SLAB 1'-4" FROM FINISH GRADE TO TOP OF RISE
2. PROVIDE PROTECTIVE BOND BREAKER BETWEEN ALL REINFORCING AND FORMS (SEE SHEET 1241-10000)
3. PROVIDE MINIMUM 2" CLEARANCE BETWEEN ALL REINFORCING AND FORMS (SEE SHEET 1241-10000)
4. ONLY 1" DIA. 4" HIGH AND 1" DIA. 1" HIGH. PROVIDE MINIMUM 2" CLEARANCE BETWEEN ALL REINFORCING AND FORMS (SEE SHEET 1241-10000)
5. PROVIDE PROTECTIVE BOND BREAKER BETWEEN ALL REINFORCING AND FORMS (SEE SHEET 1241-10000)
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9. PROVIDE PROTECTIVE BOND BREAKER BETWEEN ALL REINFORCING AND FORMS (SEE SHEET 1241-10000)
10. PROVIDE PROTECTIVE BOND BREAKER BETWEEN ALL REINFORCING AND FORMS (SEE SHEET 1241-10000)

FIRE HYDRANT ASSEMBLY

DETAIL W-1

SCALE: N.T.S.

DATE: JANUARY 2023

Greeley

CONCRETE FOUNDATION

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CONCRETE FOUNDATION

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DATE: JANUARY 2023

Greeley

AIR RELEASE/VACUUM & COMBINATION AIR VALVE VAULT

ELEVATION VIEW

NOTES:

1. PLACE 1" OF SURFACE MATERIAL IN THE BOTTOM OF THE MANHOLE TO THE BOTTOM OF THE ONLY HOPE TO WATER & OTHER
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AIR RELEASE/VACUUM & COMBINATION AIR VALVE VAULT

DETAIL WNP-1

SCALE: N.T.S.

DATE: JANUARY 2023

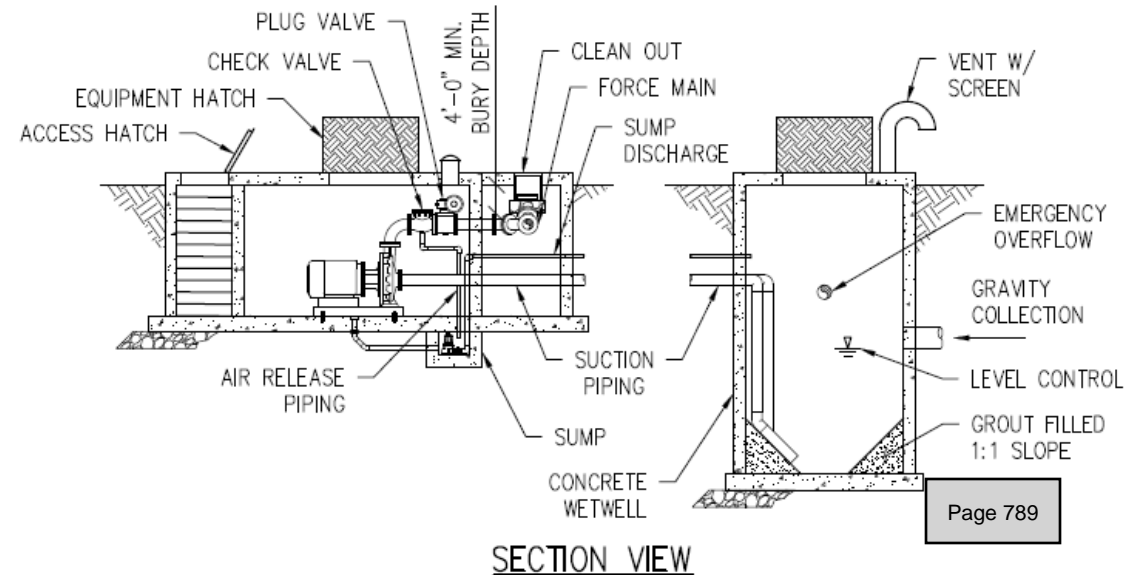
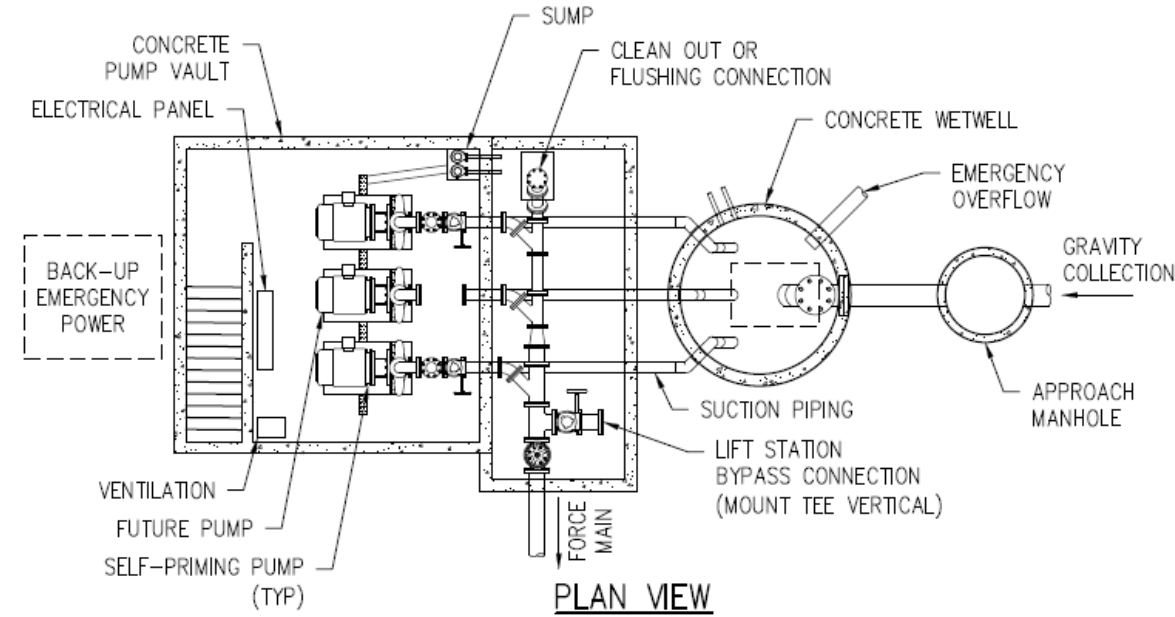
Greeley



Standard Drawings: Section 1-5

Key Updates

- Details with current material & equipment
- Standard lift station drawings to the sanitary sewer drawings
- Utility locating details in accordance with the new SUE law in Colorado (SB 18-167)



Questions?

City Council Approval

- First Reading- 1/17/23
- Second Reading- 2/7/23

DESIGN CRITERIA
AND
CONSTRUCTION SPECIFICATIONS

VOLUME III

POTABLE WATER DISTRIBUTION,
SANITARY SEWER COLLECTION,
NON-POTABLE IRRIGATION SYSTEMS,
AND LANDSCAPE & IRRIGATION



January 2023

DEPARTMENT OF WATER & SEWER

CITY OF GREELEY, COLORADO





Work Session Agenda Summary

Title

Scheduling of Meetings, Other Events

Summary

During this portion of the meeting the City Manager or City Council may review the attached Council Calendar or Work Session Schedule regarding any upcoming meetings or events.

Attachments

Council Meetings and Other Events Calendar

Council Meeting and Work Session Schedule

Status Report of Council Initiatives and Related Information

January 9, 2023 - January 15, 2023

January 2023

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

February 2023

Su	Mo	Tu	We	Th	Fr	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28			

Monday, January 9

Tuesday, January 10

 **6:00pm - City Council Worksession Meeting** (Council Chambers and via Zoom) - Council Master Calendar 

Wednesday, January 11

Thursday, January 12

 **6:30pm - 8:00pm Highway 85 Coalition/Mayors Bullseye Meeting** (Changes with each meeting) - Council Master Calendar 

Friday, January 13

Saturday, January 14

Sunday, January 15

January 16, 2023 - January 22, 2023

January 2023

Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

February 2023

Su	Mo	Tu	We	Th	Fr	Sa
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28				

Monday, January 16

Tuesday, January 17

6:00pm - City Council Meeting - Council Master Calendar ↻

Wednesday, January 18

7:30am - Visit Greeley (Butler) ↻

2:00pm - 5:00pm Water & Sewer Board (Gates) ↻

Thursday, January 19

7:30am - 8:30am DDA (DeBoutez/Butler) ↻

10:00am - 11:00am Register for Jan 19th Northern Colorado Refugee Quarterly Community Consultation (Microsoft Teams (Link will be Received After Registration)) - Council Master Calendar

3:30pm - 4:30pm Airport Authority (Clark/Payton) ↻

Friday, January 20

Saturday, January 21

Sunday, January 22

January 23, 2023 - January 29, 2023

January 2023

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

February 2023

Su	Mo	Tu	We	Th	Fr	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28			

Monday, January 23

- 11:30am - 12:30pm Greeley Chamber of Commerce (Hall) ↻
- 6:00pm - 7:00pm Youth Commission (Clark) ↻

Tuesday, January 24

- 6:00pm - City Council Worksession Meeting - Council Master Calendar ↻

Wednesday, January 25

- 7:00am - 8:00am Upstate Colorado Economic Development (Gates/Hall) (Upstate Colorado Conference Room) - Council Master Calendar ↻
- 5:00pm - 6:00pm GPD Annual Awards Ceremony (Greeley Recreation Center, Room 101) - Council Master Calendar
- 5:30pm - Scholarship Dinner to honor our Colorado Farm Show Scholarship winners (RSVP by noon Friday, January 13, 2023) (Room C of the Island Grove Events Center located at 425 N. 15th Ave., Greeley, CO (Bring Hard Copy Letter Provided with Mail at January 3 Council Meeting)) - Council Master Calendar

Thursday, January 26

Friday, January 27

Saturday, January 28

Sunday, January 29

January 30, 2023 - February 5, 2023

January 2023

Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
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22	23	24	25	26	27	28
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February 2023

Su	Mo	Tu	We	Th	Fr	Sa
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5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
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Monday, January 30

Tuesday, January 31

Wednesday, February 1

Thursday, February 2

- 7:30am - Poudre River Trail (Hall) ↻
- 3:30pm - IG Adv. Board (Butler) ↻
- 6:00pm - 8:30pm North Front Range MPO Meeting (Olson/Payton) ↻

Friday, February 3

Saturday, February 4

Sunday, February 5

City Council Meeting Scheduling 2023

1/4/2023			
This schedule is subject to change			
Date/Type	Description	Sponsor	Placement/Time
January 17, 2023 Council Meeting	Proclamation - Black History Month	Mayor	Intro
	Introduction of Chief Human Capital Officer	Winna MacLaren	Intro
	Minutes Approval (1/3/23 Council Meeting; 1/10/23 Council Work Session)	Heidi Leatherwood	Consent
	Intro & 1st Rdg Ord - W&S Design Criteria Standards and Specifications	Sean Chambers	Consent
	PH - Resolution to Adopt Greeley Downtown Master Plan Update	Becky Safarik	Regular
	PH & 2nd Rdg Ord - 13th Street Apartment Rezone	Becky Safarik	Regular
	PH & 2nd Rdg Ord - 1603, 1611, 1613, 1619 7th Ave Rezone	Becky Safarik	Regular
	PH & 2nd Rdg Ord - 123 N. 9th Avenue Rezone	Becky Safarik	Regular
	PH & 2nd Rdg Ord - Development Impact Fees	John Karner	Regular
	Boards & Commissions Appointments	Heidi Leatherwood	Regular
Executive Session - Fire Negotiations	Noel Mink		
January 24, 2023 Council Work Session	Development Code Update Overview	Becky Safarik	
	2021 COG Audit Review	John Karner	
February 07, 2023 Council Meeting	Proclamation - Youth Art Month	Mayor	Intro
	Minutes Approval (1/17/23 Council Meeting; 1/24/23 Work Session)	Heidi Leatherwood	Consent
	Intro & 1st Rdg Ord - Development Code Amendments	Becky Safarik	Consent
	Intro & 1st Rdg Ord - Grant Approval limits	John Karner	Consent
	PH & 2nd Rdg Ord - Updated W&S Design Criteria Standards and Specifications	Sean Chambers	Regular
Executive Session - City Manager Performance Review	Noel Mink		
February 14, 2023 Council Work Session	Potential Cancellation		

Greeley City Council

Status Report of Council Initiatives

Initiative No.	Council Member Initiating	Council Request	Council Meeting or Work Session Date Requested	Status or Disposition (After completion, item is shown one time as completed and then removed.)	Next Steps & Schedule	Anticipated Deliverable & Date (Report, Council Presentation, etc.)	Assigned to:
15-2021	Olson	Formation of a committee for implementation of a funding strategy for the 35th and 47th interchanges.	December 7, 2021 Council Meeting	Councilmember Olson will be following up with Manager Lee and Director Trombino on next steps	Pending outcome of federal grant application submitted	Report to Council early 2023	Paul Trombino
09-2022	Butler	Review traffic and safety surrounding 15 acre open area between 71st Avenue and 8th Street	June 7, 2022 Council Meeting	Requested that Public Works review the traffic and to improve safety in this congested area.	Additional signage installed for traffic and parking. Staff worked with School District, builder and GPD to ensure road is passable for school buses. GPD will focus enforcement times to ensure compliance with posted speed limit. Staff developing neighborhood safety improvement options and working with School District on transportation issues to improve coordination and support related to safety and infrastructure around school sites.	Anticipate providing report to Council on Improvements in early 2023	Paul Trombino
10-2022	Butler	Review costs and strategies to live stream Planning Commission and Water Board meetings for public and Councilmembers	June 7, 2022 Council Meeting	Asked staff to investigate the cost of live streaming Planning Commission and Water and Sewer Board meetings and return to Council with findings	Additional technology costs ~ \$15,000. Parts are backordered, eta approx. mid-January. Anticipate additional operation costs to include 1 add'l staff at each B&C meeting to accommodate hybrid meeting. Assessing costs related to staffing, overtime expenses or other flexible staff options. Some testing has occurred for broadcasting of meetings. Additional equipment testing will be done once equipment is received. Staff will identify long-term operational impacts at that time.	Anticipated report to Council 1st Qtr 2023	Kelli Johnson
12-2022	Butler	Varying Boards & Commissions meeting times	September 6, 2022 Council Meeting	Asked staff to research the ability for alternative meeting times for Boards & Commissions to increase community engagement and recruitment	CCO survey to Boards due back 12/16. Gathering feedback and will work with CMO on how to deliver to Council.	Report to Council/January 2023	City Clerk's Office
15-2022	Hall	Concerns regarding aftermath of natural disasters	October 4, 2022 Council Meeting	Requested update from Greeley's emergency management team to lessen the aftermath effects from a natural disaster, i.e. water and sewer, electricity, phone services, etc.	OEM update to Council	Work Session report 1/10/2023	Brian Kuznik
16-2022	Clark	Concerns over the increase in incidents and safety in the tunnel under Hwy 34 in the Hillside/Farr Park neighborhood	November 1, 2022 Council Meeting	Requested staff study implementing a closure of the tunnel entrance between the hours of 10:00 PM and 7:00 AM over safety concerns	Neighborhood meeting scheduled for 1/25/23 5:30 - 7:00 pm at Jackson Elementary.	Report to Council early 2023.	Paul Trombino/Becky Safarik
17-2022	DeBoutez	Expressed concern about neighborhood issues, i.e. speeding and noise violations.	November 15, 2022 Council Meeting	Requested GPD and PW research technologies available for traffic calming, speed/red light cameras and decibel measuring devices to improve safety, wellbeing and quality of life in Greeley.	CMO recommendation - Do we invest in additional technology tools and structure to combat neighborhood issues? PW/GPD provide report on technologies available, cost of such technology, and how different technologies are used in other communities and the results of implementing such technology.	Work Session report/CMO recommendation	Adam Turk/Paul Trombino

Item No. 8.

01-2023	Butler	Costs and feasibility study of translation services for agendas and meetings	January 3, 2023 Council Meeting	Request staff research the costs and feasibility of translating the agenda, agenda packet and live streamed meetings in other languages? Is Spanish the predominant language for translation or are other languages also appropriate?		Work Session Report	City Clerk's Office/ Communication & Engagement
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