

AGENDA

Denver Board of Water Commissioners

Denver Water Administration Building
1600 West 12th Avenue
Denver, CO
Board Room, Third Floor

Wednesday, March 14, 2018 9:00 a.m.

I. INTRODUCTORY BUSINESS

A. Call to Order and Determination of Quorum

B. Public Comment and Communications

At this point in the agenda, the Board may allow members of the public to address the Board on any item of interest within the jurisdiction of the Board, and not on the agenda for action. Speakers wishing to address a specific Action Item will be invited to address the Board when the item is being considered. Three minutes are allowed for each person unless the President determines otherwise.

1. Distributor Communications
2. Citizen Advisory Committee Communications

C. Ceremonies, Awards and Introductions

D. Legislative Update

II. ACTION ITEMS

A. Consent Items

Items listed below are considered routine and may be enacted by one motion and vote. If any Board member desires discussion beyond explanatory questions, or corrections to the Minutes, the President may order that item to be considered in a separate motion and vote.

1. Minutes from February 14, 2018 - Open and Executive
2. Minutes from February 28, 2018 - Open and Executive
3. First Amendment for Barricade Rental Services - Contract No. 501000
4. Moffat Collection System Jim Creek Siphon Rehabilitation – Contract 503052
5. Ratification of Construction Contract Change Orders and Amendments and Professional Services Agreement Amendments

B. Individual Approval Items

- | | | |
|---|-----------------|------------|
| 1. The U.S. Forest Service 2018 Collection Agreement for the From Forests to Faucets Partnership | Christina Burri | 5 minutes |
| 2. The Forest and Land Management Services Agreement with the Colorado State Forest Service Contract No. 503274 | Christina Burri | 5 minutes |
| 3. Amendment No. 3 with AECOM for Northwater Treatment Plant Contract 17101A/501682 | Pete McCormick | 15 minutes |
| 4. Northwater Treatment Plant Site Preparation Package – Yard Pipe GMP 2A - Contract 503212 | Pete McCormick | 15 minutes |
| 5. Amendment No. 1 for Marston Treatment Plant Electrical Upgrades Contract 16942A/501626 | Tom Roode | 5 minutes |

III. POLICY MATTERS

- | | | |
|-------------------------|---------------|------------|
| A. Green Roof Ordinance | Jeannine Shaw | 20 minutes |
|-------------------------|---------------|------------|

IV. EXECUTIVE UPDATE

A. CEO Update

B. CFO Update

C. Operations Update

V. BRIEFING PAPERS & REPORTS

A. Briefing Paper

1. Legislative Update
2. From Forests to Faucets Partnership and Forest and Lands Management Services Agreement
3. Background and Analysis Concerning the City and County of Denver's Green Roof Ordinance: Areas of Interest to Denver Water
4. Summarizing the Northwater Treatment Plant Sizing Decision

VI. ADJOURNMENT

VII. TRUSTEE MATTERS

VIII. EXECUTIVE SESSION

The Board may adjourn the regular meeting and reconvene in executive session on topics authorized by C.R.S. Sec. 24-6-402 or D.R.M.C Sec. 2-34.

- A. Confidential Report § 24-6-402(4)

DENVER BOARD OF WATER COMMISSIONERS

Meeting Date: March 14, 2018

Board Item: II-A-3

First Amendment for Barricade Rental Services Contract # 501000

Action by Consent

Individual Action

Summary:

Denver Water's T&D section requires barricade rental, signage and traffic control services for both planned and unplanned street work. The usage rates for this service have been higher than originally estimated, resulting in an overall shortfall over the three-year duration of the contract.

Budget Information:

Funds for this contract amendment were included in the 2018 budget. This amendment is necessary to cover spending over the original contract period of October 1, 2015 to September 30, 2018. This service is planned for bid over the next few months.

Selection of Business Partner:

Denver Water issued an Invitation for Bid in August 2015 seeking a contractor to provide traffic control services. The IFB was posted on Rocky Mountain E-Purchasing System (BidNet) and sent via direct e-mail to the SBE Bid Hotline list and Denver Water's website. Six vendors submitted bids, with NPL Construction DBA Northern Barricade being the selected vendor. This contract will expire on September 30, 2018 with this first amendment adding \$800,000.00 to the total contract amount.

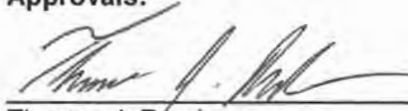
S/MWBE Information:

NPL Construction Company DBA Northern Barricade is neither a SBE nor a certified MWBE. This contract does not meet the criteria of either the O&M Construction Related or the Covered Goods & Services MWBE programs where overall annual participation targets are set.

Recommendation:


It is recommended that the Board approve the First Amendment to Contract 501000 with NPL Construction Company DBA Northern Barricade for barricade rental services for an addition of \$800,000.00 for a total amended contract amount not to exceed \$2,800,000.00.

Approvals:

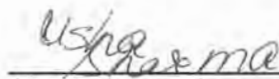


Thomas J. Roode
Chief Operations Maintenance Officer

Respectfully submitted,



James S. Lochhead
CEO/Manager

FOY 

Angela Bricmont
Chief Finance Officer

DENVER BOARD OF WATER COMMISSIONERS

Meeting Date: March 14, 2018

Board Item: II-A-4

Moffat Collection System Jim Creek Siphon Rehabilitation Contract 503052

Action by Consent

Individual Action

Summary:

The Jim Creek Siphon is an 1,800-foot steel, above-ground pipeline in the Moffatt Collection System that was installed in 1936. The original lining material has failed, exposing the steel and allowing corrosion to propagate. To protect the steel from deterioration the lining needs to be replaced. In addition, the existing coating and concrete support piers need various spot repairs. Just upstream of the steel pipeline a new flow control gate will be installed in the canal to facilitate the ease of use of the smaller, buried, bypass pipe in the winter. This rehabilitation scope was selected because the alternative study showed that replacing the lining provides a better cost to benefit ratio than full pipe replacement.

Budget Information:

The work will be completed in 2018. The 2018 Capital Improvement Plan for Moffatt Collection System Jim Creek Siphon Rehabilitation Business Unit does not include sufficient funds for the project, because it was established from an early project estimate. A project budget adjustment in the amount of \$598,810 was previously approved by the System and Program Managers to provide the \$3,211,920 needed for this Contract.

Selection of Business Partner:

Denver Water solicited proposals from three General Contractors listed on the Prequalified Contractor List under the Civil - Pipelines and Industrial Painting and Polymer Professional Coatings disciplines. This Contract was a Quality Based Selection and a restricted proposal process using Instructions to Proposers on the QuestCDN platform. On February 6, 2018, proposals were received from three General Contractors. Proposals were evaluated by a subject matter expert team from Denver Water Engineering and Construction Management on cost, project plan, risk analysis, schedule, team qualifications, and responses to project understanding questions. Western Summit Constructors, Inc. of Englewood, Colorado achieved the highest score, with an associated price of \$3,211,920.

S/MWBE Information:

The Minority and Women Business Enterprise (MWBE) goal established for this construction project is 5% participation. Western Summit Constructors, Inc. achieved 5.27% participation.

Recommendation:

It is recommended that the Board approve Contract 503052 with Western Summit Constructors, Inc. for Moffatt Collection System Jim Creek Siphon Rehabilitation for the contract period March 14, 2018 to October 31, 2018 for a total contract amount not to exceed \$3,211,920.

Approvals:


Robert J. Mahoney
Chief Engineering Officer

Respectfully submitted,


James S. Lochhead
CEO/Manager


Angela Bricmont
Chief Finance Officer

Denver Water aspires to be the best water utility in the nation.
Integrity :: Vision :: Passion :: Excellence :: Respect



DENVER BOARD OF WATER COMMISSIONERS

Meeting Date: March 14, 2018

Board Item: II-A-5

Ratification of Construction Contract Change Orders and Amendments and Professional Services Agreement Amendments

Action by Consent

Action

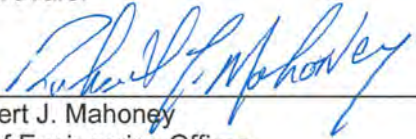
Summary:

The attached are Construction Contracts Change Orders and Amendments and Professional Services Agreement Amendments for Board ratification for January 2018.

Recommendation:

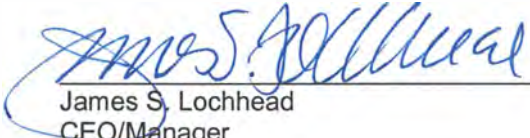
It is recommended that the Board ratify these Construction Contract Change Orders and Amendments and Professional Services Agreement Amendments.

Approvals:



Robert J. Mahoney
Chief Engineering Officer

Respectfully submitted,



James S. Lochhead
CEO/Manager

This list of Change Orders and Amendments is required per the September 13, 2017 resolution which raised the CEO's signing authority to \$750,000. These requirements may be modified by a future Board resolution.

DENVER BOARD OF WATER COMMISSIONERS

Meeting Date: March 14, 2018

Board Item: II-B-1

The U.S. Forest Service 2018 Collection Agreement From Forests to Faucets Partnership Contract # 503257

Action by Consent

Individual Action

Summary:

Since 2010, the From Forests to Faucets Partnership (Partnership) has been a successful collaborative partnership between Denver Water and the U.S. Forest Service (USFS). The goals of the Partnership are to implement forest and watershed health projects to reduce the risk of catastrophic wildfire, and restore forests impacted by catastrophic wildfire events in Denver Water's priority watersheds.

An expanded Partnership program was approved by the Board on December 14, 2016. The program was initiated by a Memorandum of Understanding (MOU) with the USFS, Colorado State Forest Service (CSFS), and Natural Resources Conservation Service (NRCS). Under the expanded Partnership, Denver Water would invest \$16.5 million in forest and watershed health, which would be matched at least dollar for dollar by USFS, CSFS, and NRCS for a total value of the partnership of over \$33,000,000.00 (see Briefing Paper V-A-2). The goal of the program is to treat approximately 40,000 acres within critical watersheds identified as "Zones of Concern."

Every year under this MOU, the USFS submits a collection agreement for the proposed forest health projects. This collection agreement with the USFS for \$3,660,625.00 is from the MOU's committed funds as part of the From Forests to Faucets Partnership and has a term of February 26, 2018 to November 30, 2022. The focus of this agreement is to conduct wildfire risk reduction, watershed restoration and improvements, and maintenance of past and current treatments on approximately 4,197 acres on National Forest System Lands within priority watersheds.

Budget Information:

It is anticipated we will spend \$2,800,000.00 of the total contract amount in 2018, and the remainder of this agreement will be paid in subsequent years as the work is completed. Predicting the timing of billings from the USFS has historically been challenging, therefore the 2018 budget for From Forests to Faucets was set at \$500,000.00. Any variances to the spending against this budget will be reported as an exception on the Quarterly Performance Reports.

Recommendation:

It is recommended that the Board approve contract 503257 with the U.S. Forest Service for forest health and wildfire risk reduction for the contract period February 26, 2018 to November 30, 2022 for a total contract amount not to exceed \$3,660,625.00.

Approvals:



Mike King
Chief of External Affairs



Angela Brimont
Chief Financial Officer

Respectfully submitted,



James S. Lochhead
CEO/Manager

DENVER BOARD OF WATER COMMISSIONERS

Meeting Date: March 14, 2018

Board Item: II-B-2

The Forest and Lands Management Services Agreement with the Colorado State Forest Service Contract # 503274

Action by Consent

Individual Action

Summary:

As part of the Forest and Land Management Services Agreement (FLMSA), the Colorado State Forest Service (CSFS) has been managing Denver Water's lands for over 30 years by implementing fuels reduction, forest health and wildfire risk reduction projects. CSFS renews the agreement on a five-year cycle and is requesting the consideration for approval of \$911,106.00 for the next agreement for 2018-2022.

Budget Information:

The total amount of this contract is \$911,106.00, and the term of the contract is March 31, 2018 through November 30, 2022. Funds for this contract will come from the 2018 budget for the Environmental Planning Business Unit (1005020000), which has sufficient funds to pay the \$148,712.00 estimated to be needed in 2018. The remaining \$762,394.00 will be budgeted in years 2019-2022.

Recommendation:

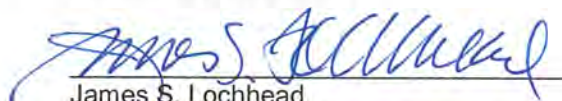
It is recommended that the Board approve contract 503274 with CSFS for forest and land management services for the contract period March 31, 2018 through November 30, 2022 for a total contract amount not to exceed \$911,106.00.

Approvals:

Respectfully submitted,



Mike King
Chief of External Affairs


James S. Lochhead
CEO/Manager

Angela Bricmont
Chief Financial Officer

DENVER BOARD OF WATER COMMISSIONERS

Meeting Date: March 14, 2018

Board Item: II-B-3

Amendment No. 3 with AECOM for Northwater Treatment Plant Contract 17101A/501682

Action by Consent

Individual Action

Summary:

The Northwater Treatment Plant (NTP) is a new 75 million gallon per day (MGD) facility, expandable to 185 MGD, to be constructed on Denver Water's Ralston Reservoir property north of Golden on Colorado State Highway 93. AECOM has been competitively selected and is under contract for Design Package #5 – Architectural and Building Systems work.

This amendment provides AECOM additional scope and a time extension to continue to coordinate elements of the design. Specific elements of the design to be progressed include development of specifications, facilities commissioning and startup activities, and non-process facilities. Additional items of work include ongoing participation in meetings, workshops, and Continuous Improvement events. Scope is also being added to take over elements of the project from other design packages in an effort to reduce coordination risk and place scope with those design packages best positioned to accomplish the work.

Budget Information:

The total amount of this amendment is \$449,516, and the term of the contract has been extended to May 31, 2018. Funds for this service/contract will come from the 2018 budget for the NTP Business Unit, which has sufficient monies for the \$449,516 to be expended in 2018.

Selection of Business Partner:

The initial contract for this Project resulted from a competitive selection.

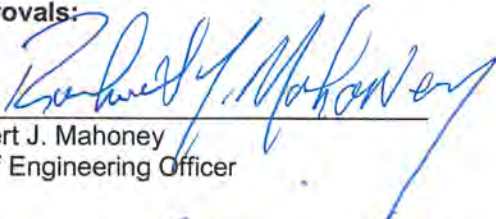
S/MWBE Information:

The MWBE goal for Design Package #5 for Design was 8-12%. The AECOM team has 8.6% MWBE participation for the proposed addition to the 30% design phase.

Recommendation:

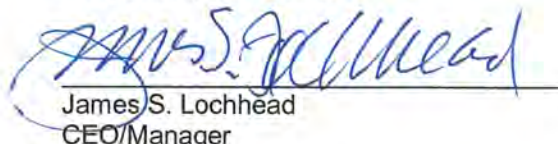
It is recommended that the Board approve the Third Amendment to Agreement No. 17101A/501682 with AECOM for additional design for NTP Architectural and Building Systems work for an extension of the contract period through May 31, 2018 and for an addition of \$449,516 for a total amended contract amount not to exceed \$1,496,330.

Approvals:



Robert J. Mahoney
Chief Engineering Officer

Respectfully submitted,



James S. Lochhead
CEO/Manager



Angela Bricmont
Chief Finance Officer

DENVER BOARD OF WATER COMMISSIONERS

Meeting Date: March 14, 2018

Board Item: II-B-4

Northwater Treatment Plant Site Preparation Package - Yard Pipe GMP 2A Contract 503212

Action by Consent

Individual Action

Summary:

The Northwater Treatment Plant (NTP) is a new 75 million gallon per day (MGD) facility, expandable to 185 MGD, to be constructed on Denver Water's Ralston Reservoir property north of Golden on Colorado State Highway 93. Kiewit Infrastructure Co. has been selected as the Construction Manager-at-Risk (CMAR) for construction of the NTP and is currently under contract for Design Phase Services. A comprehensive CMAR Construction Phase Services Agreement is currently under negotiation and will be presented to the Board for approval upon completion. It is anticipated that future construction work will be contracted under the CMAR Construction Phase Services Agreement, once executed.

This Construction Contract provides the CMAR with necessary scope and budget to conduct critical yard piping construction during a scheduled outage of the Moffat Water Treatment Plant in April and May 2018. Specifically, the work entails construction of a tunneled crossing of Conduit No. 22 on the NTP site. Materials of construction were previously procured under the CMAR's Design Phase Services Agreement.

Budget Information:

The work will be completed in 2018. The 2018 Capital Improvement Plan for Northwater Treatment Plant Business Unit includes sufficient funds for the estimated \$692,891.68 of 2018 expenditures for this work.

Selection of Business Partner:

The initial contract for the CMAR resulted from a competitive selection.


S/MWBE Information:

Due to the specialized nature of the work, no Minority and Women Business Enterprise (MWBE) goal was established for the construction of this portion of the project. It is anticipated that a MWBE goal will be set for the entirety of construction at the time of Board approval of the CMAR Construction Phase Services Agreement.

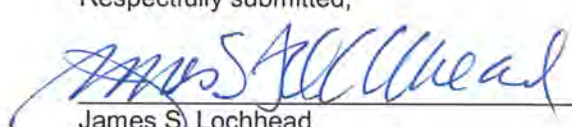
Recommendation:

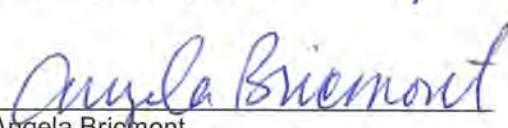
It is recommended that the Board approve Contract 503212 with Kiewit Infrastructure Co. for Northwater Treatment Plant Site Preparation Package Yard Pipe GMP 2A for the contract period March 14, 2018 through June 15, 2018 for a total contract amount not to exceed \$692,891.68.

Approvals:


Robert J. Mahoney
Chief Engineering Officer

Respectfully submitted,


James S. Lochhead
CEO/Manager


Angela Briemont
Chief Finance Officer

DENVER BOARD OF WATER COMMISSIONERS

Meeting Date: March 14, 2018

Board Item: II-B-5
REVISED

Amendment No. 1 for Marston Treatment Plant Electrical Upgrades Contract 16942A/501626

Action by Consent

Individual Action

Summary:

The Marston Treatment Plant (MTP) is located at 6100 West Quincy Avenue, Denver, Colorado 80235, at an elevation of approximately 5,500 feet above mean sea level. MTP was constructed in 1924 and provides up to 200 MGD of treated water capacity to the distribution system. The electrical equipment being replaced in this project has been identified by MTP Personnel as critical to plant operations. The new equipment will increase plant reliability, stability, water quality, maintainability, and safety. Subsequent to initiation of the current project, several flowmeters failed that recently caused flooding and equipment failure. In addition some overdue preventative maintenance work on the electrical system was identified, and Denver Water electricians do not have the expertise to perform.

The MTP is currently in the middle of an outage for the original construction of the Marston TP Electrical Upgrades (Arc Flash Reduction) project which ends April 4, 2018. The original scope of this project was to remove & replace the three main transformers powering the Filter Plant buildings to reduce the danger of an arc flash occurring in the electrical room.

MTP Personnel has requested Engineering install (3) new flowmeters to replace existing failing meters during the Electrical Upgrades project outage and perform preventative maintenance on the electrical gear. The Engineering section mobilized to accommodate this request, completed the design and pre-purchased the flowmeters in 2017 at a cost of \$138,093 for the Settled Water Channel (SWC) flowmeters and \$74,086 for the Disinfection Contact Basin (DCB) flowmeter to have them onsite as soon as possible. The flowmeters have been received by Denver Water. In addition to the flowmeters, it was determined that the contractor would already be onsite testing and commissioning the equipment being modified for the current project and that it would be cost effective to expand the contractor's scope to include the preventative maintenance scope of work.

Budget Information:

The procurement for this additional scope began in 2017 and construction will be completed in 2018. The 2018 Capital Improvement Plan for Marston TP Flowmeters Business Unit includes sufficient funds for the estimated \$625,000 for the project's 2018 expenditures.

Selection of Business Partner:

With the tight outage schedule it was determined that the current project Contractor, Sturgeon Electric would be able to perform this work within schedule, and it was determined that no other contractor could come up to speed fast enough to get the flowmeters installed within the scheduled outage. Sturgeon Electric Company Inc., of Colorado and Denver Water negotiated a price of \$99,809 for the preventative maintenance portion and \$328,776 for the flowmeter addition and replacement, totaling \$428,585.

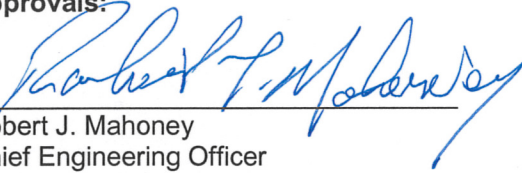
S/MWBE Information:

There was a 6% Minority Women Business Enterprise (MWBE) participation goal required for the construction portion of the project.

Recommendation:

It is recommended that the Board approve Amendment No. 1 to Contract 16942A with Sturgeon Electric Company Inc. for electrical equipment upgrades for the contract period August 9, 2017 to May 31, 2018 for a total contract amount not to exceed \$3,111,968.

Approvals:



Robert J. Mahoney
Chief Engineering Officer

Respectfully submitted,



James S. Lochhead
CEO/Manager



Angela Bricmont
Chief Finance Officer



Tom Roode
Chief O&M Officer

DENVER BOARD OF WATER COMMISSIONERS

Meeting Date: March 14, 2018

Board Item: V-A-1

Briefing Paper for Legislative Update

Strategic Plan Alignment:

Lenses: Customer Centric, Industry Leader, and Long-Term View

GOAL: Play a key role in issues important to our success by advocating the interests of Denver Water in legislative and regulatory matters, specifically by proactively lobbying the Colorado General Assembly.

Summary:

Below is a summary of significant issues and updates:

1. ***HB18-1093 Reclaimed Water Use for Edible Crops*** – This bill passed the House on Second Reading with no objections from any of the Representatives. This is the first of the three reclaimed water bills that we are most interested in. The other two House bills are still awaiting a hearing in the Appropriations Committee.
2. ***SB18-167 Enforce Requirements 811 Locate Underground Facilities*** – Colorado's 811 One-Call program is our state's "call before you dig" service. This bill passed the Senate Finance Committee with one of the three amendments that we have been seeking. This amendment would add a duty to the new Safety Commission to come up with policies and best practices that would ensure efficiencies in the one-call system are found and implemented. Denver Water and others met with Xcel Energy, a proponent of the legislation, to advocate for our remaining two interests; a fix to the definition of local government as it applies to the limited exemption, and a goals based progress report prior to full implementation of the conversion from Tier II to Tier I. ***Recommendation: Oppose unless amended***
3. ***HB18-1215 Safe Disposal Naturally Occur Radioactive Material*** – Technologically enhanced naturally occurring radioactive materials (TENORM) are concentrated in residuals as part of the water and waste water treatment processes. These residuals need to be disposed of and are currently regulated under a guidance. This guidance is overseen by the Colorado Department of Public Health and Environment (CDPHE). The Water Utility Council and the Wastewater Utility Council have worked out amendment language that is agreeable to both communities and have presented it to the bill sponsor, Representative Arndt. ***Recommendation: Oppose unless amended***

Attached is the full bill report which includes a summary table followed by a detailed report on each bill we are tracking. Please refer to this attached report for initial information on all of our bills.

Background:

N/A

Budget Information:

N/A

Alternatives:

N/A

Approach:

N/A

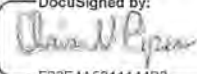
Owner(s):

Chris Piper, Government Relations, External Affairs

Attachments:

Report on 2018 Legislation

Respectfully submitted,

DocuSigned by:


F23E4A5311144B2
Division – External Affairs

DENVER BOARD OF WATER COMMISSIONERS

Meeting Date: March 14, 2018

Board Item: V-A-2

Briefing Paper for From Forests to Faucets Partnership and Forest and Land Management Services Agreement

Strategic Plan Alignment

The From Forests to Faucets Partnership (Partnership) and the Forest and Land Management Services Agreement (FLMSA) is aligned with all three lenses:

Customer Centric Industry Leader Long-Term View

The Partnership and FLMSA support the customer centric lens through excellent operations and strong financials. Through the Partnership and FLMSA, we strategically align our projects to provide the best value to our customers by investing in proactive forest health and wildfire risk reduction projects within Denver Water's priority watersheds. By aligning projects within Denver Water's priority watersheds, known as "Zones of Concern", we are sustaining healthy watersheds and protecting our collection, treatment, and delivery system to provide reliable high-quality water at an affordable rate.

Denver Water's forest health partnerships and agreements support strong financials through a customer centric lens by leveraging many different financial resources. Denver Water has been able to leverage at least a dollar for dollar match from the United States Forest Service (USFS) and Colorado State Forest Service (CSFS). In addition to the Partnership match, we have been able to leverage \$800,000 of corporate contributions from The Nature Conservancy (TNC) for Partnership projects. The Partnership also includes an additional financial commitment of \$400,000 per year by the Natural Resources Conservation Service (NRCS) for forest restoration projects in Denver Water's priority watersheds. Through the Partnership and FLMSA we have been able to sustain a financial plan that supports our strategic objectives and effectively manage our cash reserves to ensure the successful execution of our capital and long-range financial plans.

Denver Water is known as an industry leader for our excellent operations and strong financials in forest health and wildfire risk reduction. Many utilities are now following our lead and entering into partnerships to leverage financial resources for forest health projects. Denver Water has received many international inquiries from utilities in Columbia, Israel, Costa Rica, and Ecuador for how to achieve "payment for ecosystem services" through investments in forest health. Denver Water hosted a tour for the Biennial of the Americas, on September 16, 2017 for international delegates, to showcase Partnership forest health projects in the Pike National Forest. The City of Seattle, City of Boulder, Cheyenne Board of Public Utilities, and City of Steamboat Springs have all inquired this year on how to set up a partnership with the USFS.

The Partnership and FLMSA support the long-term view lens through our proactive approach to reduce our risk of catastrophic wildfires in our watersheds. We are thinking long-term for our customers and our watersheds, in protecting and improving our forests to be more resilient against climate change, insect and disease outbreaks, and increased risk of high-intensity wildfires. We are passionate about our customers and our community, including other stakeholders in our priority watersheds. We know we are a part of something meaningful and larger than our own self-interest by being proactive in protecting our community and our watersheds.

Denver Water aspires to be the best water utility in the nation.

Integrity :: Vision :: Passion :: Excellence :: Respect



Summary

Denver Water is a leader in forest and watershed health and is significantly supporting two programs to protect Denver Water's lands and priority watersheds from catastrophic fires. One program is the From Forests to Faucets Partnership, and the second program is the Denver Water FLMSA with the CSFS. This briefing paper summarizes the two programs and describes Denver Water's approach to moving forward with the three contracts up for consideration:

- 1) **The USFS 2018 Collection Agreement for From Forests to Faucets Partnership:** As part of the Partnership, Denver Water enters into a yearly Collection Agreement with the USFS. Under the 2018 Collection Agreement, the USFS has requested \$3,660,665.00, which is being considered for approval at the March 14, 2018 Board Meeting.
- 2) **The FLMSA with CSFS for Denver Water lands:** As part of the FLMSA, CSFS has been Denver Water's forester for managing Denver Water's lands for over 30 years. CSFS renews this agreement on a five-year cycle and we will be requesting approval for the 2018-2022 agreement in the amount of \$911,106 at the March 14th, 2018 Board Meeting.
- 3) **The CSFS 2018-2021 From Forests to Faucets Agreement:** With the agreed to expansion of the Partnership, CSFS will request approval of a 4-year and \$4 million agreement, as part of the \$16.5 million commitment. We anticipate requesting approval of this agreement at a future Board Meeting in the second quarter of 2018.

Background

The Partnership began in 2010 as a response to the costly impacts from a series of wildfires, including the 1996 Buffalo Creek and 2002 Hayman wildfires, which required expenditures exceeding \$27.7 million for restoration and repairs to Denver Water's collection system. The aftermath of these catastrophic wildfires resulted in the deposit of over one million cubic yards of sediment in Strontia Springs Reservoir. Attempts to dredge the reservoir were costly and only partially successful. Realizing the cost of being reactive to catastrophic wildfires, and understanding the increased risk of catastrophic wildfires in the future, Denver Water partnered with the USFS to take a proactive approach to source water protection.

On December 14, 2016, the Board approved an expansion of the Partnership to include the CSFS and the NRCS, and committed \$16.5 million to the Partnership. The \$16.5 million is matched dollar for dollar by the partners (see budget section below). The Partnership was expanded to include an emphasis on private lands to accelerate strategic and landscape scale forest treatment in our critical watersheds while complimenting and leveraging the restoration achieved since 2010 by the first Partnership. The Partnership will work collectively to design, implement, and monitor forest management projects that result in a cumulative treatment footprint that will meaningfully influence future fire behavior and reduce the potential for detrimental impacts to the watershed and surrounding communities. Our experience tells us that it is critical for Denver Water to reduce the threat of catastrophic fire to protect our source water.

Through the Partnership, 94,930 acres in priority watersheds have been treated through forest restoration and fuels mitigation on the Pike-San Isabel, White River, and Arapaho-Roosevelt National Forests, which includes 56,704 acres in Denver Water's Zones of Concern. Lands burned by the Hayman and Buffalo Creek fires in the Pike-San Isabel National Forest surrounding Cheesman and Strontia Springs Reservoirs were revegetated by planting approximately 1.3 million trees, thereby reducing erosion and sedimentation into our reservoirs.

The expanded Partnership includes commitments for monitoring by researchers from Colorado State University's Colorado Forest Restoration Institute (CFRI) to analyze the

effectiveness of forest health treatments and determine a return on investment based on reducing the risk of catastrophic wildfire. CFRI has already performed an analysis on Denver Water's return on investment related to the cost of sedimentation in reservoirs. Their results were published in the *Journal of Environmental Management* 198 (2017), https://cfri.colostate.edu/wp-content/uploads/sites/22/2017/10/Jones-et-al-2017_J-of-Env-Mgmt_ROI.pdf. The results demonstrate that Denver Water is experiencing a positive return on investment with their past and proposed future investments in forest health. Based on this research, which was focused on the Strontia Springs Zone of Concern, Denver Water would experience a return on investment when 17-40% of the watershed area surrounding Strontia Springs is treated. Additionally, CSFS and CFRI analysis have shown that over 30% of the Strontia Spring Zone of Concern has been treated and reduces the risk of a catastrophic wildfire that would inevitably lead to high costs to Denver Water from associated sediment loading into Strontia Springs. Please see attached map with two layout versions: one is a textured map and the other is a color map of the treated areas.

In addition to the Partnership, Denver Water has the FLMSA with CSFS for professional services and management of Denver Water's lands. CSFS has taken great pride and responsibility in being Denver Water's forester for over 30 years. The first formal forest management plan for Denver Water was developed by the CSFS Granby District Office in 1985 because of the mountain pine beetle outbreaks in the late 1970's in proximity to Dillon Reservoir and other high-country reservoirs and priority watersheds in Grand and Summit counties. The first master forestry service agreement for all of Denver Water properties was signed in 1999, which involved all five of the current CSFS Field Offices. This agreement includes a budget and a general five-year plan for projects. The CSFS creates annual operating plans on a yearly basis for specific project details and budgets for Denver Water staff to review, revise, and approve prior to implementation. Most importantly, the fuels reduction and thinning that CSFS performed on Denver Water's lands around Cheesman Reservoir saved our facilities and homes around the reservoir during the Hayman wildfire in 2002 and clearly demonstrates the value of our proactive forest management activities.

Budget

The proposed budget for the FLMSA with CSFS is \$911,106.00 for 2018-2022 on Denver Water lands. For the Partnership, Denver Water will invest \$16.5 million through 2021. Of the \$16.5 million: \$12.5 million will go to the USFS for forest health, monitoring, and maintenance on National Forest lands in our Zones of Concern; and \$4 million will go towards private-lands forest health implementation through CSFS. NRCS is not able to accept external financial contributions as part of the Partnership, but has remained committed by investing \$400,000 per year through 2021 (up to \$1.6 million) in Denver Water's priority watersheds. USFS expenditures are determined each year based on operating plans incorporated into separate collection agreements. For the 2018 USFS Collection Agreement, the USFS is requesting the approval of \$3,660,625.00 as part of the \$12.5 million commitment approved at the December 14, 2016 Board Meeting. The timeframe of the MOU is 2017 through 2021. The projects under this collection agreement will be completed between 2018 and 2021, and paid no later than November 2022. Below is a table outlining the overall Partnership budget commitments under the MOU.

Partner	Denver Water 2017-2021 Investment	Proposed Match	Total
USFS	\$12.5 million	\$12.5 million	\$25 million
CSFS	\$4 million	\$4 million (or more)	\$8 million
NRCS	0	\$1.6 million	\$1.6 million

Total: \$34.6 million

In addition to these investments, TNC has also dedicated \$800,000 to forest health and wildfire risk reduction projects in Denver Water's Zones of Concern in the upper South Platte watershed. This investment is through a collaboration focused on forest health and wildfire risk reduction projects in the upper South Platte watershed, known as the Upper South Platte Partnership (USPP). Denver Water is currently engaged in discussions with TNC to identify additional options for securing more corporate investments to leverage Denver Water's current financial commitments under the Partnership. There is a lot of interest from TNC and its corporate donors (Vail Resorts, Pepsi, Miller Coors, Wells Fargo) to continue funding activities for a landscape scale change and to leverage their funding with partners like Denver Water and the USFS.

Approach

The course of action is the consideration for approval of the USFS 2018 Collection Agreement on March 14, 2018, as part of the \$16.5 million commitment from December 14, 2016. The Board will consider the request for approval for the 2018-2022 FLMSA with CSFS for forest management on Denver Water lands at the Board's March 14th meeting.

The CSFS From Forests to Faucets Partnership Agreement is for \$4 million over the next four years (through 2021) that is part of the \$16.5 million commitment. CSFS already has a plan drafted and will be presented for approval at a future Board Meeting in the second quarter of 2018.

This approach supports our goals of successfully executing the Strategic Plan. Through the Partnership and FLMSA we are supporting and leading excellent operations, strong financials, and inspired people.

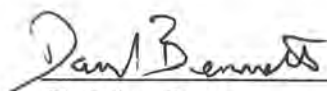
Owner(s)

Christina Burri, Watershed Scientist, External Affairs

Attachments

- Strontia Springs Zone of Concern Textured Map
- Strontia Springs Zone of Concern Color Map
- Timeline for DW forest health programs

Respectfully submitted,

 for CHRISTINA BURRI
Christina Burri
Watershed Scientist


Mike King
Chief External Affairs Officer

DENVER BOARD OF WATER COMMISSIONERS

Meeting Date: March 14, 2018

Board Item: V-A-3

Background and Analysis Concerning the City and County of Denver's Green Roof Ordinance: Areas of Interest to Denver Water

Strategic Plan Alignment

Lenses: Customer Centric Industry Leader Long-Term View

We recognize that the Green Roof Ordinance is a significant policy change in Denver, and that it is largely uncharted territory for our organization, for our customers, and for our community. We are implementing changes and improvements to help ease the administrative burden for all involved, while also contributing expertise on water efficiency and water source options with both the immediate and long-term view in mind.

Summary

Denver voters passed a citizen initiated ordinance ([Initiated Ordinance 300](#)), on November 7, 2017, mandating Green Roofs for any roofs, including new development or a roof replacement for an existing building, if the gross floor area of the building is over 25,000 square feet. Green roofs, or roofs that support vegetated material, have many environmental benefits, but also cannot survive in Denver's arid climate without supplemental irrigation (Tolderlund, 2010). As a major water provider in the West, where water is particularly valuable, Denver Water has a responsibility to be a leader in discussions involving water in our community. The passage of this initiative by Denver voters represents a change in public participation in government, environmental values, and economic development and growth of our community.

Denver Water did not take a position on the Green Roof Initiative during the election, but did follow the discussion closely. Once the initiative passed, leadership assigned a team of staff to write a white paper outlining potential challenges and opportunities for Denver Water and Denver Water customers.

The passage of the initiative arguably caught many organizations by surprise. The implementation timeline was aggressive, with less than two months between passage and effective date. Over the past several months, Denver Water staff participated in discussions intra and inter-agency to address immediate implementation needs and to identify issues that would take more time to address.

Staff will continue to work on outstanding issues, which includes process changes and policy recommendations. Staff will provide an update to the Board later in the year, once the Green Roof Review Task Force recommendations are complete, and when Denver City Council chooses to take up the issue for discussion or a vote on any potential changes.

Background

In this section, staff provides background on the Ordinance, identifies topic areas of interest, corresponding takeaways, outstanding research questions, and potential future policy decisions surrounding the Ordinance. A link to the Ordinance is [here](#), and is also provided as Attachment C.

Ordinance Information

Denver voters passed a citizen initiated Green Roof Ordinance (Initiated Ordinance 300), on November 7, 2017, by a margin of more than 8 percentage points, with a total of roughly 138,000 votes cast.



Denver Election Results on Initiated Ordinance 300

The Ordinance went into effect on January 1, 2018¹ and requires any new building with a gross floor area over 25,000 square feet, or any existing building doing a roof replacement with a gross floor area over 25,000 square feet, to install a Green Roof or Green Roof Combination.²

In Denver, there are initiated ordinances and initiated charter amendments (Denver Elections Division, 2014). In either case, a relatively small number of signatures are required to get an issue on the ballot. Approximately 4,000 signatures were required to get the Green Roof Initiative on the ballot. Article X, Chapter 20 of the Colorado Constitution states that if a ballot measure has any tax implications, a TABOR notice is required. This includes putting information in a voter blue book with the arguments for and against the measure, as well as information on financial impacts. While local governments could require this information for non-tax-related ballot measures as well, in Denver and most other local government elections, it is not required. Voters only see the ballot title and language unless the voter actively searches out the full text of the initiative. Voters saw the following ballot language in November:

Ballot Title- The Denver Green Roof Initiative

"Shall the voters of the City and County of Denver adopt a measure that requires every building and any roof replacement of a building with a gross floor area of 25,000 square feet or greater, or a building addition that causes the building to become 25,000 square feet or greater, constructed after January 1, 2018, shall include a green roof or combination of green roof and solar energy collection; while also requiring proper permits and maintenance plans, establishing construction standards and a technical advisory group, and publishing construction guidelines and best practices; also allowing for exemptions and requiring enforcement with violations and penalties?"

The intention of this Initiative was to make Denver a more environmentally friendly city. There are, however, many unintended consequences that will require collaborative expertise and creativity from citizens, industry and government to find solutions that stick with the intent, and address unintended consequences.

Takeaways

Elected officials in Denver are having preliminary discussions about the potential changes needed in local elections to increase transparency by making the pros and cons of the measure readily available to voters, as well as raising the bar on number of signatures required to get a measure on the ballot.

¹ Applies to projects that submit a site development plan on or after January 1, 2018.

² A Green Roof is a roof that has supports the growth of vegetation. A Green Roof Combination, is a roof that has both vegetation and solar energy collection.

There is some belief that based on the ballot language for the Green Roof Ordinance, voters thought they were voting for 'green roofs,' as in solar panels, not vegetated roofs.

As part of Denver Water's Strategic Plan, we strive for 'Excellent Operations,' which includes the goal of being a leader in the utility industry in environmental stewardship and sustainability. Based on the 2017 customer survey, when asked if "Denver Water makes protecting the environment a priority," there was a 10-percentage point drop from the previous survey in people answering that question favorably. This is something to be aware of as we have discussions regarding Green Roofs, as we want to ensure our reputation of being good environmental stewards remains a strong part of our brand.

When and how could the Ordinance change?

Denver City Council is required to wait at least six months from the effective date of the Ordinance to make any changes. At that time, any changes would require a super-majority of 10 city council member votes for a period of ten years. After the ten years passes, a simple majority could amend the Ordinance. Councilmembers Clark and Susman are formally involved in the city's stakeholder engagement process through the Green Roof Review Task Force.³ City council and the mayor have publicly stated that they will work to honor the wishes of the voters, and insist they will not seek to overturn the entire measure.

In the meantime, the city translated the initiative language into Rules and Regulations for the Ordinance to go into effect January 1, 2018. The Ordinance is in Article XIII, Chapter 10 of the Denver Revised Municipal Code. However, if something was not defined or needed clarification in the initiative language, the city could define or clarify as needed. Anything specifically called out in the language cannot be amended in the Rules and Regulations process.

Takeaways

If a citizen-led measure passes, Denver City Council cannot act right away, and the super majority vote required to make changes stays in place for several terms. The mayoral election is in 2019, and an anti-growth movement is gaining steam in the Denver metro area. How the city responds to this measure may be a good indicator on issues regarding affordability, growth, and the environment.

Stakeholder Comments

The draft Rules and Regulations were made available for public comment as required. At the Denver Planning Board's Public Meeting on January 17, staff observed that opponents were largely made up of the business management and development community, and proponents were largely made up of millennial, grass-roots, environmental organizers. More objective-type comments came from the environmental, solar, and roofing industries. The major themes that staff observed from the public comment session included:

- Definition of "major structural alterations." How this is interpreted will determine when an existing building will be exempt from the Ordinance or not. The requirement for existing buildings is more contentious than the requirement for new buildings.
- Definition of "available roof space." This defines the roof footprint that the Ordinance percentage of Green Roof applies to. While it was defined in the initiative, it lacked clarity. This will determine how large Green Roofs will be and when solar areas are exempt.

³ The Green Roof Review Task Force is separate from the Technical Advisory Committee that was required by the Ordinance.

- Definition and application of “exemption” and “variance.” In the latter, a property owner would be required to pay cash in lieu of not building a Green Roof, in the amount of \$25 per square foot of roof space not getting a Green Roof. Opponents and proponents are concerned about how frequently variances will be granted. The cash in lieu payments go to Denver’s sustainability office, which could be used for incentives to help offset costs of Green Roofs, although how the funds are used are not narrowly prescribed in the Ordinance.
- Opponents were concerned about the narrow, prescriptive nature of the Ordinance and the high cost of installing a Green Roof, which ultimately could have a negative impact on housing affordability, on Denver’s ability to compete with neighboring cities and on overall economic health of the city. These are all unintended consequences that need to be addressed.
- Proponents were concerned about the fast growth-rate of Denver, as well as the lack of sustainability measures being incorporated into the growth happening. While the City of Denver has a sustainability plan, some citizens did not think it went far enough, fast enough. Their response was to put forth the Green Roof Initiative.

Water was not brought up by proponents, other than the positive impacts to stormwater quality. It was brought up by opponents and more neutral parties in the following areas:

- Concern over legality of Ordinance based on water law.
- How existing policies impact Green Roofs in drought or other periods of watering restrictions.
- Concern over increasing water demands in a water-stressed region.

Takeaways

Denver Water should be aware that water may be used as leverage against the Ordinance and that by resolving problems, such as creating exemptions under drought restrictions, this also takes away from opponent’s arguments. The difference in the concept of affordability for developers and affordability for existing residents of multi-family buildings is significant politically, and speaks to new versus existing development.

Areas of Interest to Denver Water

Areas of interest to Denver Water include water rights, protecting public health, understanding the magnitude of impacted buildings, and the impacts to water demand, efficiency and source, drought, connection charges and fees, and intra- and inter-agency responsibilities, coordination and approach. Each of these are outlined in turn below.

Water Rights

The main legal concern is that Green Roofs cannot legally capture more water than what a soil in its natural state would have captured (“incidental capture”) without causing water rights injury or requiring an augmentation plan. The Green Roof Ordinance, mandates Green Roofs or Green Roof Combinations. It is likely that most Green Roofs can be designed in a way to mimic a natural state, avoiding water rights injury or the need for an augmentation plan. However, based on the City’s interpretation of Green Roof Ordinance language, Green Roof Combinations will require developers to adjudicate a court-approved augmentation plan to avoid injuring the water rights of others. The City interprets the Green Roof Ordinance to require water capture from the solar panels; thus, developers who want to build a Green Roof Combination are required to get a letter from the Colorado Division of Water Resources (a.k.a. State Engineer’s Office) granting permission to retain or collect rainfall, which

will not be granted absent an augmentation plan.⁴ Alternatively, in the immediate-term, the city may choose to provide a variance, for developers whose buildings are not exempt.

Green Roofs built pursuant to the Green Roof Ordinance will need an augmentation plan in two instances: (1) Green Roofs that capture rainfall in excess of incidental capture, and (2) Green Roof Combination areas covered by solar installations that capture rainfall, as currently required by Ordinance.

A developer seeking to adjudicate an augmentation plan in the South Platte basin must file an augmentation plan application with the Division 1 Water Court in Greeley. This plan must include a source of augmentation water to replace the water captured from roofs that would have otherwise accrued to the stream. Augmentation plans are detailed and require an applicant to identify each depletion, the amount, time, and location at which the depletion would accrue to the river, and the amount, time, and location at which the augmentation water will be supplied to the river to prevent injury to other water rights holders. §§ 37-92-305(3), (5) & (8), C.R.S. Practically speaking, in context of Green Roofs, a developer would need to identify each roof that is "depleting" the river, the amount of water intercepted, the river to which the intercepted water would have accrued, and the time and location in which this intercepted water would have accrued to the river. This information is usually acquired through a combination of historical weather data (e.g., precipitation, soil composition, etc.) and modeling. Once this information is gathered, the developer would need to prove it can provide augmentation water in the amount, time, and location on the river to which the depletions accrue.

This means that currently, a developer within Denver Water's service area adjudicating an augmentation plan can either supply its own augmentation water or can ask that Denver Water provide augmentation water. If a developer requests that Denver Water supply augmentation water, Denver Water is required to provide it; however, the developer must enter into a water contract and pay the requisite raw water rates and charges, as well as handle any costs or processes associated with filing and adjudicating an augmentation plan.

The transaction costs (e.g., attorney fees, engineering, time, etc.) involved in adjudicating an augmentation plan for Green Roofs are large compared to the amount of water involved. These costs can likely be avoided if a developer builds a Green Roof that does not capture rainfall in excess of incidental capture. However, due to the way this Ordinance is written and currently interpreted, it is less likely Green Roof Combinations are a viable Green Roof option due to required augmentation plan necessary to facilitate rainfall capture.

At the onset of the Operations Complex Redevelopment (OCR) project, Denver Water staff did explore the concept of pursuing a service-area-wide augmentation plan that would not only cover augmentation needs for OCR, but would also allow for the organization to more easily add or cover customers under an umbrella plan. However, staff concluded that it was more prudent to start with an augmentation plan application exclusive to the OCR. In doing so, the organization could get more clarity from Water Court on reuse interpretation, with fewer risks than if we tried this with a service-area-wide approach right out of the gate. This means that augmentation plans for rain water capture on Green Roofs, or any other One-Water-type projects will continue to go through the standard augmentation plan process described above for now⁵.

⁴ Written correspondence between SEO and City of Denver staff in December 2017.

⁵ Water Resource Strategy Division is developing a separate white paper that further explores this issue.

Finally, while there are several statutory augmentation plan exemptions, including for rain barrels (§ 37-96.5-101 et seq.), storm water detention (§ 37-92-602(8)), and post-wildland fire facilities (§ 37-92-602(8)), Green Roofs are not covered by any of these exemptions

Takeaways

How solar is handled in relation to water rights, the definition of available roof space, and variances, are likely going to be the most critical factors in implementation and long-term impacts of this Ordinance as it relates to water rights. Two changes that would make the Ordinance easier for developers to implement, and that would avoid negative impacts to solar because of water law are:

- An Ordinance amendment that clarifies that roofs or portions of roofs covered by solar installations are not required to retain or collect for reuse rainwater.
- A statutory amendment exempting Green Roofs from acquiring an augmentation plan.

Research Questions

- How will the State Engineer determine if a roof captures rainfall in excess of incidental capture?
- Will design criteria be created and vetted to ensure compliance?
- How much would an augmentation plan cost for a single building (water resource engineering fees, attorney fees, water costs, etc.)?

Policy Questions

- Does Denver Water want to interact with the State Engineer's Office directly to understand how stringently the State Engineer intends to enforce Green Roofs?
- How, if at all, should Denver Water participate in the discussion around the Ordinance or statutory amendments discussed above?

Public Health and Cross-connection Control

One of the concerns that was raised with Green Roofs was related to protecting public health by having sufficient cross-connection control. A cross-connection is a physical connection between a potable (drinking) water supply and a source of contamination or pollution. Cross-connection control, using an appropriate backflow prevention device, is one measure taken to prevent unsafe plumbing conditions from occurring on Green Roofs or other applications where water from a property could inadvertently re-enter the public water supply. In reviewing Denver Water's policies, Chapter 5 of Denver Water's Engineering Standards⁶ and Chapter 11 of Denver Water's Operating Rules⁷ cover potential water quality concerns resulting from cross connection for properties subject to the Green Roof Ordinance.

⁶ 5.05 Cross-connection control and backflow prevention. Denver Water is responsible for protecting its public water system from contamination due to backflow occurrences through residential, multi-family, irrigation, and/or commercial property water service connections (i.e., cross-connections). Denver Water needs the assistance and the cooperation of the public and licensees to ensure this responsibility is met. Denver Water may request access to a property or facility to conduct an on-site cross-connection control audit. Requirements for Approved USC FCCCHR BFPA Installations Based on the Degree of Hazard: A commercial domestic service line tap requires an approved RP or DC to be installed on the domestic water service line 5 feet downstream from the meter pit or immediately upon entry into a heated part of the building 5 feet (maximum) from the wall or floor before any connections based on the degree of hazard.

⁷ 11.01 Protection of Potable Water Quality. Denver Water is responsible for protecting the potable public water supply from contamination or pollution that could enter the Water System through a connection from another water system or by means of

Irrigation systems for Green Roofs have many similarities to standard in-ground irrigation systems. For example, all irrigation systems are required to have an approved backflow prevention device, and are required to be routinely tested and certified as functioning. However, there is a notable difference that warrants additional attention.

Standard landscape irrigation systems either have a separate irrigation tap and meter, or split off the domestic water line and leave the structure to the surrounding property. The city's building code and inspection covers the structure and does not address landscape irrigation; however, Green Roofs are different because the irrigation remains on the structure. The practice of installing and inspecting backflow preventers for irrigation within the building are atypical, and without increased awareness and clearly determining jurisdictional responsibility, compliance may fall through. Currently the responsibility has defaulted to Denver Water and Denver Water will be involved in building code reviews.

Takeaways

The configuration of the water service connection for Green Roof irrigation systems is different from a standard in-ground irrigation system. There are not any known technical barriers for ensuring public health, but rather educational and process barriers.

Research Questions

- What educational resources need to be created or provided?
- What have other cities with Green Roofs experienced regarding cross-connection control?
- How will Denver Water monitor compliance with backflow prevention devices for Green Roofs?

Magnitude of Impacted Buildings

One of the many challenges in working through the potential impacts of the Ordinance is that data on building characteristics, such as gross floor area⁹, square feet of roof space, solar panels, etc. is not readily available. Gross floor area, which specifically includes spaces such as atriums, is one of the determining factors for the percent of Green Roof required for a building. However, gross floor area is not a measurement that the assessor or any other known data source in Denver uses. It may be possible that net area, which is available, may be a reasonable substitute.

As a property owner, Denver Water will need to conduct an inventory of existing and future buildings inside of Denver that would be subject to the Ordinance. The cost of Green Roofs will need to be considered in financial planning and asset management.

Building characteristics greatly influence how impactful this Ordinance will be for any given property. For example, buildings with a gross floor area over 200,000 square feet are required to have 60 percent Green Roof coverage on available roof space. However, as demonstrated below for two buildings that fall into this bracket, the Green Roof requirement ranges from 3 to 35 percent of gross floor area. At a

backflow from a licensee's system. 11.02.2 Backflow Prevention Device Required. Any device connecting an approved system with Denver Water's potable system shall have a backflow prevention device installed and maintained in compliance with the Engineering Standards.

⁹ Gross Floor Area is not the same as calculating floor area for building code. It is specific to the Green Roof Ordinance and includes areas such as atriums.

rate of \$25 per square foot for cash in lieu⁹ of installing a Green Roof, which would require a variance to be granted, the cost for the two examples below would be \$375,000 and \$15 million, respectively.

Xcel Building at 18th and Larimer



- Approximate Gross Floor Area= ½ million sq. ft.
- Available Roof Space = ~25K sq. ft.
- Percentage requirement under Ordinance = 60% of available roof space (15K sq. ft.)
- Supplemental annual water use at 3 GPSF = ~90K gallons or about 0.3 acre-feet

Colorado Convention Center



- Approximate Gross Floor Area = ~1.7 million sq. ft.
- Available Roof Space= ~ 1 million sq. ft.
- Percentage requirement under Ordinance = 60% of available roof space (600K sq. ft.)
- Supplemental annual water use at 3 GPSF = ~1.8 million gallons or about 5.5 acre-feet

Using GIS, and in collaboration with Denver Department of Public Health and Environment (DDPHE), staff began analyzing the potential magnitude of impact in terms of number of buildings and Green Roof space. If all existing buildings get a new roof, are engineered to support a Green Roof, or are replaced by a building with a similar roof size over the next 30 years, approximately three thousand buildings would be impacted and approximately 32.6 million additional square feet of vegetated space.

Count by Building Type (rounded)		
Commercial	Residential	Industrial
1650	330	1030

Green Roof Area by Building Type (millions of sq. ft.)		
Commercial	Residential	Industrial
23.8	2.3	6.5

⁹ \$25/sq. ft. is the estimated cost of installing a Green Roof.

Some of these buildings will certainly receive an exemption or a variance; however, this is a snapshot of potential magnitude based on currently available information. The size of the vegetated Green Roof area has a direct correlation to water demand, which will be explored in greater detail in the next section.

Takeaways

Depending on exemptions, variances, and Ordinance amendments, this Ordinance could drastically change building design and the overall architectural character of Denver. It could encourage anything from developments with minimal amounts of roof space, to a movement to create urban gardens or outdoor amenity space, to increased development outside of Denver's city limits.

Water Demand and Efficiency

The Green Roof Initiative was intended as an environmental measure and it does indeed have environmental benefits ranging from improved stormwater management, air quality, and insulation, to reduction in noise pollution and the heat island effect (EPA, ND). In Denver's climate, however, we know that Green Roofs require supplemental irrigation. Based on current laws and practices, this has historically exclusively come from potable water supplies. Denver Water's water efficiency plan sets out to create benchmarks for efficient water use for a specific sites and types of use. Moreover, the One Water concept seeks to match the right source of water for the right use at the right location.

The amount of water required to support Green Roofs will be impacted greatly by the type of Green Roof implemented. In Denver's climate, an extensive Green Roof typically uses xeric plant material requiring approximately 3 gallons of water per square foot (GPSF) of irrigated area to support the plant material.¹⁰ Conversely, intensive Green Roofs could include anything from trees to urban agriculture, which could use closer to 12 GPSF, Denver Water's benchmark for landscapes in the Water Efficiency Plan, or as much as 18 GPSF annually for the irrigated area.

This means that annual water demand could theoretically increase anywhere between roughly 300 acre-feet on the low end to 1,800 acre-feet on the high-end for the existing building stock because of the Ordinance.

Most existing Green Roofs in the metro area are extensive, not intensive and are lower water use. Given water use and landscape trends, it is more likely to be on the low end of that range. Examples of an extensive and an intensive roof are below; however, the design can vary significantly for intensive roofs.



Extensive Green Roof at EPA Region 8
(EPA.gov, 2018).



Intensive Green Roof at Polo Club Condo
Association (Lime Green Design, 2018).

¹⁰ Information received from Jennifer Bousselot Ph.D., Colorado State University, Department of Horticulture and Landscape Architecture, which is also consistent with Denver Water's estimates for xeric plant material.

Takeaways

Setting benchmarks and measuring performance to inform actions are a cornerstone of water efficiency. To measure and report on water efficiency, whomever is analyzing the information would need to have access to consumption data. Based on current policies and practices, consumption information is not available to Denver Water at a level of detail that would be useful for reporting. Staff would recommend that submetering should be included as a best practice for Green Roof construction.

Research Questions:

- Will Green Roofs largely be the extensive type with xeric plant material or will there be a push for urban agriculture or other intensive Green Roofs with higher water requirements?
- If a developer chooses to make the roof “amenity space” are they still subject to the Green Roof requirement?
- Will Green Roofs offset cooling tower demands and/or plant water requirements, and if yes, by how much?
- How does this change align with IRP scenarios?
- How will the architecture and design community respond?

Policy Questions:

- Would Denver Water want to have policies that influence the type of Green Roofs being installed, or would Denver Water simply promote efficient use of water given the type that is installed (e.g. would we allow high water use turfgrass)? Should drought exemptions influence this?
- The city currently refers to Denver Water’s irrigation and landscape standards for Green Roof requirements. Should this be solely Denver Water’s to develop, or should there be an effort to develop new standards with partners? How far should the standards go in requiring efficient products?
- Should Denver Water be the agency providing water efficiency feedback regarding Green Roofs? If yes, what resources, recommendations or requirements are we willing to put toward that effort?

Water Source

Barring changes in current laws or practices, water required for Green Roofs will likely come from natural precipitation and supplemental potable water from a domestic tap. There are other sources that may be possible to use, albeit somewhat impractical for most people to implement now given the educational, financial and technological barriers.

If the amount of water captured or produced on the site is greater than or equal to the supplemental irrigation requirement, and the quality matches the needed use, it could serve as an option for meeting supplemental irrigation requirements. This would help avoid the need to use potable water for Green Roof irrigation and would promote One Water. If Denver Water wants to increase adoption rates of One Water practices, the organization needs to first better understand the barriers and must determine if and how Denver Water can or will help reduce barriers to implementation.

For example, under Colorado HB 13-1044, which Denver Water supported, City and County of Denver adopted an Ordinance allowing graywater to be captured and reused. Depending on the site, graywater may be a viable supplemental water source. Like Denver Water's Operational Campus Redevelopment project, there may be other options such as rainwater harvesting or on-site wastewater treatment. There are significant hurdles for implementing either of those soon.

Takeaways

Adding different water sources to a building's water supply tends to be more challenging both technically and financially for existing buildings, compared to new development. However, the Green Roof Ordinance is a major change for developers and to even get new development to take on any additional work or risk, there will likely need to be significant incentives and minimal barriers. Customers would need an easier way to identify if their buildings are good candidates for using alternative water sources. The timing of pushing these alternatives is important to consider. People are currently overwhelmed and still sorting through the uncertainties of the Ordinance. Until city council addresses the issue, which would be June at the earliest, projects subject to the Ordinance will likely be delayed by the developer if possible. These are long-term investments and large assets and if alternative water systems are not put in place at time of initial construction, the likelihood of them being retrofitted is low.

Research Questions

- What building characteristics are conducive to which alternative water sources?
- What is the cost, and what are some of the barriers for new and existing development?

Policy Questions

- Should Denver Water be the one to provide a tool for developing feasibility of One Water?
- Should Denver Water help develop and/or finance incentives for graywater or other One Water systems?
- Where would Denver Water like to see the cash in lieu funds from the sustainability office go?

Water Conservation and Drought

Chapters 14 and 15 of Denver Water's Operating Plan cover water conservation and drought response, respectively. Type of irrigation (e.g. overhead spray, drip, hand-watering), type of plant material (turf, shrubs, flowers), and type of use (private landscape, public park with heavy use, sports field) are the primary way the frequency and timing of allowed watering is determined, and when drought restrictions apply.

In general, Green Roofs should be able to be installed and maintained in a way that supports healthy plant material, while staying in the bounds of water conservation rules in Chapter 14, with a few exceptions. Three provisions that may conflict with Green Roof installation and operation including:

- Soil amendment requirement- Green Roofs use a different growing media than traditional landscapes and the soil amendment requirement would not be applicable.
- Irrigation of more than one acre- Green Roofs should go through an irrigation plan review, but the Green Roof may be less than an acre.

- Time of day watering restrictions for overhead spray irrigation- in some instances, it is considered a best practice to water a Green Roof in the heat of the day using overhead irrigation to cool the plants quickly and promote evaporative cooling.

Green Roofs should also be able to stay alive during Stage 1 Drought Restrictions, without any additional exemptions required. In Drought Response, Section 15.03, Stage 2 Drought Restrictions, depending on the type of irrigation and site use, Green Roof vegetation could be negatively impacted if further exemptions are not made. Denver Fire Department has expressed significant concern over increased fire risk and public safety if Green Roof vegetation is dry or dead because of lack of water. Given the significant investment and potential for public safety to be impacted, Green Roofs may call for the highest level of exemption or outdoor watering. Additionally, these roofs act as green infrastructure that can with stormwater management and may reduce building cooling loads (EPA, Green Infrastructure, 2018).

Community College of Denver Green Roof



(Denver Green Roof Initiative, 2018).

Takeaways

There is some clean-up in the Operating Rules in Water Conservation Chapter 14 that may be warranted, but the larger question is about time of day watering for overhead spray irrigation in Chapter 14. Additionally, exemptions in Drought Response, Chapter 15 need to be addressed. Green Roofs represent a large investment by building owners and have potential safety implications if not watered properly.

Research Questions

- How can fire risk be measured or quantified? Will watering outside of 10 a.m. and 6 p.m. be the most efficient given the different media? Northern Water's study showed that in some instances water spreads more easily during hotter hours. Could there be other benefits as well?
- How would a water budget exemption be applied?
- How would watering rules be monitored if irrigation is occurring out of sight?

Policy Questions

- Should Green Roofs be further exempt from conservation and drought restrictions, and if yes, to what extent? What are the deciding factors (e.g. safety, level of water use, type of irrigation, etc.).

Connection Charges, Fees, and Plan Review

System development charges (SDCs) for Green Roofs are being determined in the same way any building with irrigation and domestic water use being supplied from the same tap. Denver Water's SDC structure has not been changed in about five years. Rates will begin a study on SDC structure, and will specifically look at concurrent and non-concurrent use, as it relates to peak demand for a given time-period. This could have impacts on cost to any combined taps, not just Green Roofs.

Denver Water is currently piloting an SDC efficiency credit program. In this program, if an eligible customer meets or exceeds certain water efficiency standards, therefore reducing their demand, they may be eligible for a partial credit for their tap. Properties with irrigation have a GPSF requirement they need to be under.

Customers getting a new tap must submit water plans for review by Denver Water. Staff verify many things, such as the ability of our existing water mains to provide for sufficient fire flow protection, pressure, peak demand, compliance with engineering standards, etc. Depending on the size and complexity, different levels of plan review kick in. Green Roofs are currently required to do an irrigation plan review. The irrigation plan review fee is \$450 regardless of size.

Landscape irrigation design and performance plays a significant role in water efficiency. In the case of developments that have more than one acre of irrigated area, Denver Water reviews irrigation plans in accordance with our requirements and guidelines. The city of Denver references those same guidelines for their projects, but does not review any irrigation or landscape plans for private developments. Denver Water's landscape irrigation standards are not tailored to Green Roofs.

The US EPA Region 8 building in Denver was originally installed with a drip irrigation system on top of the extensive Green Roof, but the high UV environment in Denver caused the irrigation lines to degrade and they had to replace the irrigation system with overhead spray irrigation (EPA, Denver Case Study, 2017). It is a best practice to place the drip irrigation system within the subsurface rooting zone, but there are also times where it may be appropriate to have overhead spray irrigation to help facilitate quick cooling of the plants.

Denver Water works closely with Development Services for current plan reviews. However, with Green Roofs, we would start to see new plan review types, such as roofing permits, and would become more involved with the building department. As plan reviews start to come in at an increased rate, this will require additional staff time put towards plan review and could impact multiple sections, such as tap sales and hydraulic engineering.

Takeaways

From a connection charge and fee perspective, Green Roofs will be treated the same as any other irrigation use or plan review. Denver Water continues to work more closely with the city's Community Planning and Development Department. This partnership has proven to be beneficial for providing better customer service, and is an important opportunity to be more involved in land use discussions that can have a significant impact on Denver Water and our customers (e.g. rain gardens, lead service

lines, etc.). Local governments, such as City of Lakewood, have expressed interest in having Denver Water be more involved in their irrigation and landscape plan review as well.

Research Questions

- What amount or flow of water would typically necessitate an increased tap and meter size?
- How much additional staff resources will be required to conduct the increase in plan reviews required?
- How is non-concurrent use verified?

Policy Questions

- Should Green Roof requirements be added to the efficiency tap credit in Denver and what should the gallons per square foot (GPSF) be?
- Does Denver Water want to stay the course of requiring irrigation plan review for Green Roofs? If yes, how will the increase in workload be prioritized and handled once we start to see an increase in submittals?
- How involved in landscape plan review do we need or want to be, given that landscapes are a focus area for water efficiency?

Coordination and Stakeholder Involvement

There are numerous avenues for stakeholder involvement in the Green Roof Ordinance for implementation and future potential changes. These include the promulgation of rules and regulations, a technical advisory group, a stakeholder task force, and the mayor's process improvement initiative for development in the city. These are outlined below.

Rules and Regulations

Between mid-November and mid-December, Community Planning and Development convened numerous city departments, as well as other governmental agencies, such as Denver Water, to develop the draft rules and regulations and the processes that would be required to implement the Ordinance. Denver Water did not submit formal written comments. The city has reviewed public comments and updated the Rules and Regulations, which are in Chapter X of the Revised Municipal Code.

Green Roof Technical Advisory Group

The Ordinance required the city to convene a 10-member technical advisory group, made up of representatives from industries defined in the Ordinance. This group is housed under the umbrella of the mayor's boards and commissions and will provide technical expertise on how to implement the Ordinance *as written*. This group is responsible for periodically reviewing the cash in lieu amount required for variances, as well as providing recommendations on modifications to technical requirements and standards. Denver Water is not participating in this group.

Green Roof Review Stakeholder Task Force

Given the prescriptive nature of the Ordinance-required technical advisory group, and the need for much larger stakeholder involvement, the Denver Department of Public Health and Environment (DDPHE) formed a Green Roofs Review Task Force. This 20-member task force of stakeholders will convene

approximately six to eight times over the next five months and will recommend modifications, clarifications, and improvements to the initiative through a collaborative, consensus-based process. The meetings are open to the public to observe. The first meeting was held on January 19, 2018. Denver Water secured a seat at the table as a task force member and is participating through the lens of water efficiency and One Water. The task force includes city staff, architects, members of the development and management community, energy, solar, and roof specialists, as well as utility providers, such as Denver Water and Xcel Energy. The complete list of members is linked [here](#) and is provided as an attachment.¹¹ Agendas are posted prior to the meetings, and minutes are shared (without names attached to comments). Anyone can sign up to receive updates.

Policy Questions:

- What issues does Denver Water want to be considered as part of the group discussion, and what does Denver Water want to decide on its own or in another venue?
- How much staff resources can the organization dedicate to providing data or expertise that would help with smoother Ordinance implementation?

Development System Performance Steering Committee

Over the past year, Denver Water staff have been participating in one of the mayor's initiatives on improving the customer experience and overall efficiency of the development process in Denver. Through that effort, our agencies recently made plan review process changes that have put us in a significantly better position to more efficiently handle Green Roof plan review more seamlessly. Previously, a developer would submit a formal plan review for city agency review, and if they got the go-ahead to proceed, would then submit those approved plans to Denver Water. Because Denver Water's review happened after the city's review, we were oftentimes able to catch required plan changes to protect public health and safety that had major impacts on a project's viability, and caused the developer to have to go back through the city's plan review process again.

As of October 2017, Denver Water is part of the same review process stream as all other city agencies for commercial developments. This means that a developer's plan will not get the okay to proceed until Denver Water has reviewed and signed off on the plans. In the last quarter, this change resulted in staff catching the need for water main upgrades at the beginning of three large projects prior to them being approved by the city. As a result, when the developer decided to move forward, they weren't caught off-guard by large, unplanned expenses.

Denver Water's participation in this group has led to improved coordination and has opened opportunities to work on other land use issues. For example, because we were involved in this effort, when the Green Roof Initiative passed, we could build off previous successes and were easily incorporated into the discussion and implementation process.

Internal Coordination

While coordination and outreach to internal staff around the Ordinance has been occurring, staff have developed a more formal internal stakeholder coordination plan based on the issues identified over the last several months. The goal is to make sure others in applicable sections of the organization are informed of the Ordinance, and are engaged in discussions and recommendations for process or policy changes. The coordination is being led by Austin Krcmarik in the Water Efficiency and Reuse team.

¹¹ Austin Krcmarik from Water Efficiency and Reuse is Denver Water's representative on the task force.

Budget

N/A

Alternatives

N/A

Approach

Staff will continue to work on outstanding issues, which include everything from identifying process changes to policy recommendations. Staff will seek any necessary policy guidance and will provide an update to the Board later in the year, once the Green Roof Review Task Force recommendations are complete.

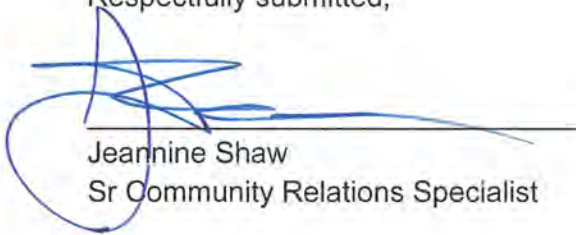
Owner

Jeannine Shaw, External Affairs

Attachments (3)

- A: Briefing Paper References
- B: List of Green Roof Review Task Force Members
- C: Complete Green Roof Ordinance Rules and Regulations

Respectfully submitted,



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Mike King
Chief External Affairs Officer

DENVER BOARD OF WATER COMMISSIONERS

Meeting Date: March 14, 2018

Board Item: V-A-4

Briefing Paper Summarizing the Northwater Treatment Plant Sizing Decision

Strategic Plan Alignment

Lenses: Customer Centric Industry Leader Long-Term View

Executive Summary

Northwater Treatment Plant (TP) was originally planned for a capacity of 150 million gallons per day (MGD). During the week of February 26, 2018, a group of employees from Water Resource Strategy, Engineering, Emergency Management, Operations and Maintenance, and Finance participated in an event to evaluate Denver Water's future treatment capacity needs utilizing a decision-making methodology called Choosing by Advantage (CBA).

The outcome of the process resulted in a consensus by the group to recommend a move from constructing a 150 MGD capacity Northwater TP to instead implementing a combination of treatment system improvements:

- Construct a 75 MGD capacity Northwater TP now and expand as needed in the future;
- Modularize Foothills TP so it will be able to, at times, treat just half of the total 280 MGD capacity;
- Reduce capacity at Marston TP to 150 MGD; and
- Continue Moffat TP operations with the newest train of 60 MGD primary, with the ability to utilize the other trains as needed until the above project elements are completed and significant improvements at Moffat TP make it necessary to abandon (i.e. run to failure).

This alternative reliably provides up to 185 MGD of treatment capacity on the north system.

Reason for Action

Northwater TP was originally planned to treat 150 MGD with two 75 MGD “trains” constructed initially to provide resiliency, also referred to as modularity. A “train” is a unit of treatment that can be operated independently to provide a specific capacity of treated water into the distribution system. Having multiple trains allows for greater operational flexibility while a portion of a TP is out of service. This group was tasked with evaluating whether it is most beneficial to build a smaller (first phase) Northwater TP combined with improvements at Denver Water’s other TPs to enhance resiliency of the entire treatment system.

Target State

Using the CBA decision-making methodology, the goal was to evaluate treatment infrastructure alternatives that will optimize operational flexibility and reliability while meeting three key functions:

- plan deliveries to our customers with full consideration of seasonal factors
- minimize customer outage hours
- accommodate the following max day targets for a 20-year planning window:
 - 400 MGD Summer Demand – May 15th – Sep 15th
 - 135 MGD Winter Demand – Nov 1st – Mar. 31st
 - 400-135 MGD Shoulder Season Demand (varies from winter to summer)

CBA Methodology

The CBA methodology begins with a problem to be solved and establishes factors important for a solution. Alternative solutions are developed evaluated and scored by advantages of those factors. The process then introduces the element of cost by assessing the advantage gained per dollar spent. New alternatives might come about during the process.

Alternatives Summary

Before developing alternatives to evaluate, themes were identified to describe an alternative. Initially, nine (9) alternatives were developed.

Theme: Current Plan (Alternative 1)

Alternative 1 – Construct a 150 MGD capacity Northwater TP with two 75 MGD trains, and abandon Moffat TP.

Theme: Maximize Use of Existing Assets (Alternatives 2 through 5). These alternatives improve the resiliency of existing TPs by fixing the following constraints:

- Distribution System Piping - The existing piping can deliver a maximum of 350 MGD from Foothills and Marston TPs, which is less than the two plants are capable of producing and could deliver full capacity with new parallel piping designed to increase capacity.
- Foothills TP Modularity – Foothills TP is not capable of producing treated water if certain portions of the plant fail, but it could be improved to have two trains.
- Moffat TP consists of 3 trains, ranging in equipment ages of 30 to 90 years. Though the entire facility would need to be reconstructed to reach 150 MGD capacity, the “newer” portions of the TP can be used for a shorter duration.

Alternative 2 – Modularize Foothills TP, complete Distribution System piping improvements to fully utilize capacity at Foothills and Marston TPs and maintain the 60 MGD train (30 years old) and 40 MGD train (60 years old) at Moffat TP.

Alternative 3 – Modularize Foothills TP, maintain the 60 MGD and 40 MGD trains at Moffat TP.

Alternative 4 – Modularize Foothills TP, construct a 100 MGD capacity Northwater TP with two 50 MGD trains and abandon Moffat TP.

Alternative 5 – Modularize Foothills TP, construct a 50 MGD capacity Northwater TP, and maintain the 60 MGD train at Moffat TP.

Theme – Maximize Supply Flexibility (Alternative 6)

Alternative 6 – Modularize Foothills TP, modularize Marston TP, complete Distribution System piping improvements, build conduit W to deliver north system water to Foothills TP, and maintain the 60 MGD train at Moffat TP.

Theme – New Treatment Inputs (Alternative 7)

Alternative 7 – Modularize Foothills TP, construct 50 MGD of Direct Potable Reuse (DPR) and 50 MGD of Aquifer Storage and Recovery (ASR) as new treated water inputs, and abandon Moffat TP.

Theme – Monitor Demand and Wait to Build a New TP (Alternative 8)

Alternative 8 – Modularize Foothills TP, maintain the 60 MGD train at Moffat TP

Theme – Work Towards Two TPs - Foothills and Northwater (Alternative 9)

Alternative 9 – Modularize Foothills TP, construct a 150 MGD capacity Northwater TP with two 75 MGD trains, reduce Marston TP to 150 MGD and abandon Moffat TP.

Factors to Evaluate Alternatives

The group identified the following nine (9) factors to evaluate and score each of the nine alternatives:

Factor 1 - Total available treatment capacity – Treatment assets should meet the predicted capacity needs through 2040.

Factor 2 - Utilization of Existing Treatment Assets – The maximum number of days a TP can run using the average yield of raw water in the north system.

Factor 3 – Treatment Flexibility – Having more treatment trains provides greater flexibility to provide uninterrupted supply to the distribution system in the event of a service outage.

Factor 4 – Total Project Runway – The time required to fully implement the alternative, considering planning, design, permitting, and construction.

Factor 5 – Water Supply Yield Impact – This factor calculates raw water supply loss for various alternatives.

Factor 6 – Sustainability (CO₂ Emissions) – Sustainability advantages were calculated based on relative carbon dioxide (CO₂) emissions, which is based on the amount of power consumed by each alternative and offset by potential generation of hydropower, if any.

Factor 7 – Ability to meet environmental and operational commitments – Fulfill commitments made by Denver Water that rely upon specific operations of our water system, such as the CRCA, Wise Agreement, the 1940s Agreement, Blue River Decree, Moffat Project permits, etc.

Factor 8 – Operational Complexity – The more complex a system is, the more challenging it will be to operate. This factor considered source water quality, the number of TPs, the number of employees needed to operate the plants, TP age, and complexity of the treatment processes.

Factor 9 – System Flexibility – This factor was used to measure the ability of the whole system to perform under various conditions.

Comparison of the Alternatives

Based on these factors, the group evaluated the nine alternatives and scored each alternative's advantages.

Cost Summary and Results

Capital costs were then estimated for each of the alternatives and the alternatives were plotted on a chart to show the amount of advantage gained per dollar invested. During the review of these alternatives, the group discovered a new alternative (Alternative 10 – Preferred Alternative) that would result in a more resilient system at a lower cost than the current plan (Alternative 1) and preserve options for future expansion of the treatment system. Ultimately the group reached consensus that this hybrid should be recommended.

Recommendation – Preferred Alternative (Alternative 10)

Alternative 10 – Modularize Foothills TP, construct first phase of Northwater TP at a capacity of 75 MGD, reduce capacity of Marston TP to 150 MGD, maintain the 60 MGD train at Moffat TP as primary and utilize the other trains as needed until the other project elements are complete and necessary improvements lead to its abandonment. This alternative provides up to 185 MGD of reliable treatment capacity on the north system.

Owners

Respectfully submitted,



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