WESTMINSTER

EXECUTIVE SUMMARY
2015 WATER TREATMENT FACILITIES MASTER PLAN

The 2015 Water Treatment Facilities Master Plan provides the City direction on:

- The quantity of potable water required to meet future demands
- The future of the Semper Water Treatment plant

The key recommendation of the master plan is to retire Semper and build a new facility at a new location (location not yet determined). As a placeholder, this new treatment plant is often referred to as the Standley Lake Water Treatment Plant throughout the technical memorandums. In reality, Standley Lake is just one of many locations in a siting study that will be independently conducted outside of this Master Plan. Construction of the new facility should be done using a phased implementation approach over the next 25 years. Initial construction is scheduled to begin in 2023 with the first phase online by 2025. Highlights of the master plan, methods used, and costs are listed below.

Existing Facilities

- The City owns and operates two potable water treatment facilities that supply water to customers. These are the Semper Water Treatment Facility (Semper) and the Northwest Water Treatment Facility (Northwest).
- Semper uses a conventional treatment technology known as standard sand filtration. Northwest uses membrane filtration treatment. Membrane technology is especially good at treatment of challenging water quality events.
- Semper is 47 years old with a significant number of its assets at or beyond their predicted useful lives.
- Semper requires approximately $4M per year for near- and long-term repairs. These repairs are needed to maintain quality utility services.
- Northwest is 15 years old and is in better condition than Semper.
- Northwest requires approximately $1M per year to maintain the plant. This reinvestment is needed for basic upkeep. Significant changes to the plant are not anticipated.
- Together the Semper and Northwest treatment facilities serve have served the City well. The plants provide high quality potable water. Absent of equipment failures, these plants provide water in the quantity needed to meet all potable water demands.
- A recent citizen survey reported water quality as a primary concern. Water produced by the City's plants meets citizen quality expectations.

Problem Statement Associated with Existing Facilities

- The City's plants do not have the firm capacity to meet established reliability goals, which require that maximum day potable water demand be met with the largest treatment train out of service. Additional treatment redundancy is needed to meet these goals now and in the future.
- The Semper campus is too small to build new facilities without taking existing processes out of service. Taking processes out of service would reduce capacity to unacceptable levels.
- Treatment challenges with the City's source water are rising. The Semper plant cannot treat the projected quality of source water under future potable water demands.
- In an emergency, the City cannot meet quantity and quality goals with the Semper plant. Emergencies include a fire in the watershed or long-term use of canal water (i.e., during times when Standley Lake or the outlet works must be taken off-line).

The Master Plan for Meeting the City's Potable Water Treatment Goals

- Retire Semper and build a new facility at a new location. Implementation will be phased over 25 years. Begin initial construction in 2023 with the first phase placed in service by 2025. The Northwest facility is maintained in its current condition.
- A new plant at a new location has the highest benefit to the City. Six non-monetary criteria determined the benefits.
- A new plant at a new location has the lowest life-cycle cost.
- A new plant at a new location has the best cash flow near- and long-term. The favorable cash flow comes from phased implementation and using Semper as long as reliably possible.
- Phasing the new plant provides use of the full value of the Semper plant. The City will continue to use Semper for many years until reliability is an issue. At that time, the plant will be retired.
- When it is retired, the Semper land will be repurposed in alignment with the new Downtown vision.
- A sensitivity analysis was performed on cost estimates and the benefits. These efforts confirmed that a new plant at a new location is the best master plan alternative (see Figure 1).

Key Next Steps for the City to Implement

- Move forward with planning for the new water treatment facility.
- Perform a siting study in 2018 for the specific best location of a new plant.
- Pilot test in 2019 to confirm the best treatment processes for the new plant and appropriate design criteria.
- Continue annual repairs at Semper to keep it running successfully for 25 years. No improvements to Semper will be made.
- Perform utility financial planning consistent with this Master Plan. The financial plan should target the cash flow shown in Figure 2.

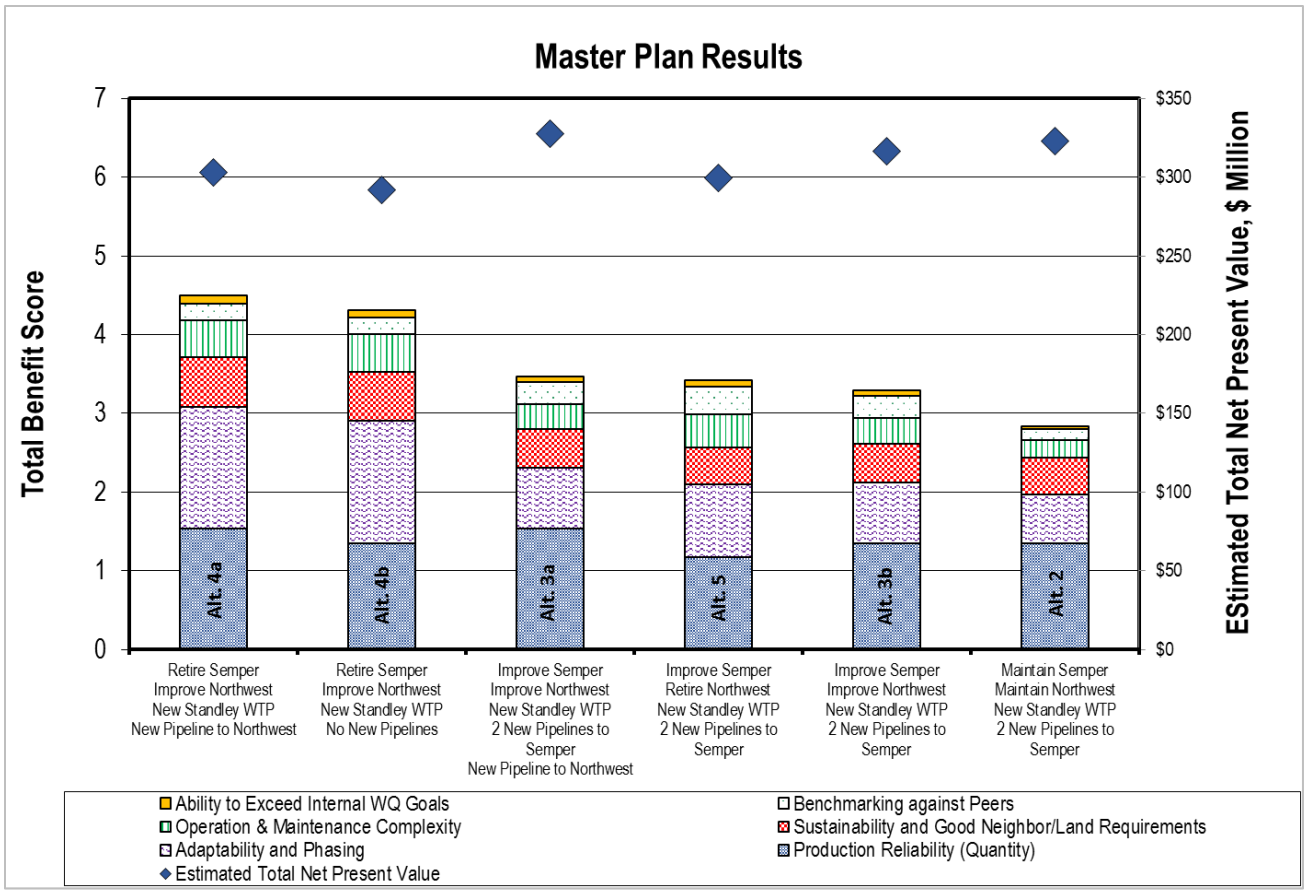

Figure 1. Benefit and Cost Summary for Each Water Treatment Location Alternative

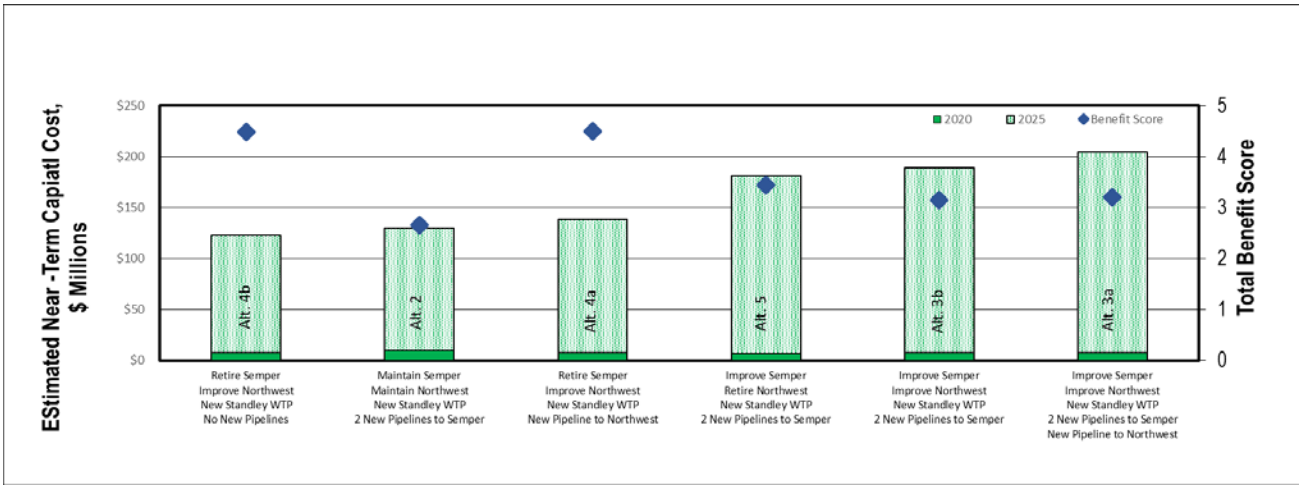

Figure 2. Utility Financial Planning Cash Flow

Westminster Master Plan Project Summary

PREPARED FOR:	City of Westminster
PREPARED BY:	CH2M
DATE:	August 5, 2016

Master Plan Summary

The 2015 Water Treatment Facilities Master Plan evaluated the full scope of City of Westminster (City) treatment processes, including the existing conditions of both Semper Water Treatment Facility (Semper) and Northwest Treatment Facility (NWTF), and the raw and source water quality of Standley Lake. This technical memorandum provides the City of Westminster direction on:

- The quantity of potable water required to meet future demands
- The future of the Semper Water Treatment Plant

The key recommendation of the Master Plan is to retire Semper and build a new facility at a new location (location not yet determined). As a placeholder, this new treatment plant is often referred to as the Standley Lake Water Treatment Plant throughout the technical memorandums. In reality, Standley Lake is just one of many locations in a siting study that will be independently conducted outside of this Master Plan. Construction of the new facility should be done using a phased implementation approach over the next 25 years. Initial construction is scheduled to begin in 2023 with the first phase online by 2025.

Key take-home messages from this Master Plan are as follows:

- The condition of the existing treatment facilities as they stand today is not the main driver of the recommendation of a new treatment facility at a new location.
- The existing water treatment facilities do not meet the City's potable water demand reliability goals now and the problem will worsen as increased growth occurs within the service area.
- The footprint is not adequate to expand existing facilities to meet potable water demand reliability goals now and in the future. A new water treatment plant is required for all viable alternatives.
- Cost is not a significant differentiator between water treatment location alternatives evaluated in this Master Plan.
- Retiring Semper in 2040 and phasing in a newly constructed facility at a new location provides the City with the greatest non-monetary benefit.

This Master Plan Project evaluated:

- Existing raw water quality
- Existing condition of Semper Water Treatment Facility
- Existing condition of Northwest Treatment Facility
- Existing and future potable demands
- Anticipated future raw water quality
- Anticipated future drinking water regulations
- Benefits of the existing Watershed Protection Program
- Benefits of different alternatives

- Near-term costs of different alternatives
- Net present worth of different alternatives through 2065

As described below and in the Technical Memoranda (TM) presented in Sections 2 through 11, the City will:

- **Construct additional treatment at a new location in 2025**
- **Retire Semper in about 2040**
- **Maintain Northwest through 2065 (end of the study period)**

Based on cost-benefit and non-monetary analyses, the Master Plan recommends that Semper be retired by 2040 after a water treatment plant at a new location is brought online. To reduce the risk of disrupting service, a phased implementation approach over 25 years is recommended. Construction is scheduled to begin in 2023, with the first phase of treatment in service by 2025. This recommendation provides the City with the highest amount of flexibility to reach its potable demand reliability goals. This recommendation also reduces the complexity of construction sequencing and minimizes cost over the long term.

Details and reasoning behind these recommendations are described in this and the following TMs.

Project Objective

The City of Westminster owns two drinking water treatment facilities. Semper, a conventional dual-media filtration plant, is aging with much of the plant at or near the end of useful life. NWTF, a significantly newer plant in good condition, uses membrane technology.

The City has historically produced high-quality drinking water and has consistently met customer potable water demands. However, the City does not currently meet potable water demand reliability goals and the ability to continue providing high-quality drinking water, i.e., water that is compliant with changing regulations and at sufficient quantity, requires changes to existing treatment plants. The City currently invests $4 million annually in the aging Semper plant to maintain the ability to produce water, but this investment fails close the reliability gap. This Master Plan was developed to identify where and how to produce the required amount of drinking water through 2040 and beyond to meet the City's potable water demand reliability goal.

Challenges with Meeting City Goals

This Master Plan provides guidance on meeting future challenges in quantity and quality. Estimated buildout water max day demand (MDD) for potable water is 57 MGD. With regard to potable water demand, the City's reliability goal is to meet the potable water demand with the largest treatment train out of service. **The City does not currently meet reliability goals.** The City will not meet reliability goals at buildout without additional capacity.

The City has established water quality goals that meet or exceed current drinking water regulations. Semper may not meet the City's water quality goals under future conditions. Raw water quality may degrade from decomposition of dead trees resulting from beetle kill and forest fires. Raw water quality is also more challenging when using the Standley Lake bypass as compared to the lake and threatens finished water quality. When the plant operates under higher flows, consistent high finished water quality will be harder to maintain. This City will need to continue to monitor the source water, plant flows and finished water quality closely to anticipate treatment requirements and to plan for future treatment modifications.

Semper is constrained physically. Construction of new facilities at Semper can occur only by taking one of the two trains out of service. The City cannot meet current maximum potable water demands with one train out of service. For example, if in an emergency one of the trains at Semper needs to be taken offline unexpectedly during the summer months, the City cannot meet current max day potable water demand. The Semper campus is too limited to build new facilities without taking existing processes out of service,

which would reduce capacity and compound the challenge of meeting the City's potable water demand reliability goals**. Additional capacity is required to be constructed at a different location**.

Current City of Westminster Water Portfolio

Basic information for each City water treatment facility is summarized in Table 1 and presented graphically in Figure 1.

Table 1. Westminster Water Treatment Facility Characteristics

	Semper	NWTF
Age	47 years old; a significant number of its assets at or beyond their predicted useful life	15 years old; NWTF is in better condition than Semper
Treatment Approach	Uses conventional dual-media (granular sand and anthracite) filter treatment technology	Uses membrane filtration treatment technology
Nameplate Treatment Capacity[1]	44 MGD	15 MGD
Firm Capacity[2] (largest train out of service)	22 MGD	15 MGD
Annual Maintenance Costs	Requires approximately $4M per year for near- and long-term for repairs to maintain services	Requires approximately $1M per year for basic upkeep

[1]Note: The City's storage tanks and pump stations are used to meet peak hour potable water demands. Treatment facilities are sized to meet max day potable water demands.

[2]Note: City direction is that NWTF can run for at least 4 weeks in the summer in direct filtration mode (e.g. bypassing floc/sed) at NWTF. As a result, the floc/capacity does not dictate the "firm" capacity of the NWTF. The plant is not intended to be run at its total capacity on a sustained basis because NWTF is limited by pretreatment and winter temperatures.

Originally, NWTF was designed as a peaking plant only. As shown in Figure 1, the facility has a single raw water pipeline, which conveys water from Standley Lake to the facility. Semper has two parallel raw water pipelines.

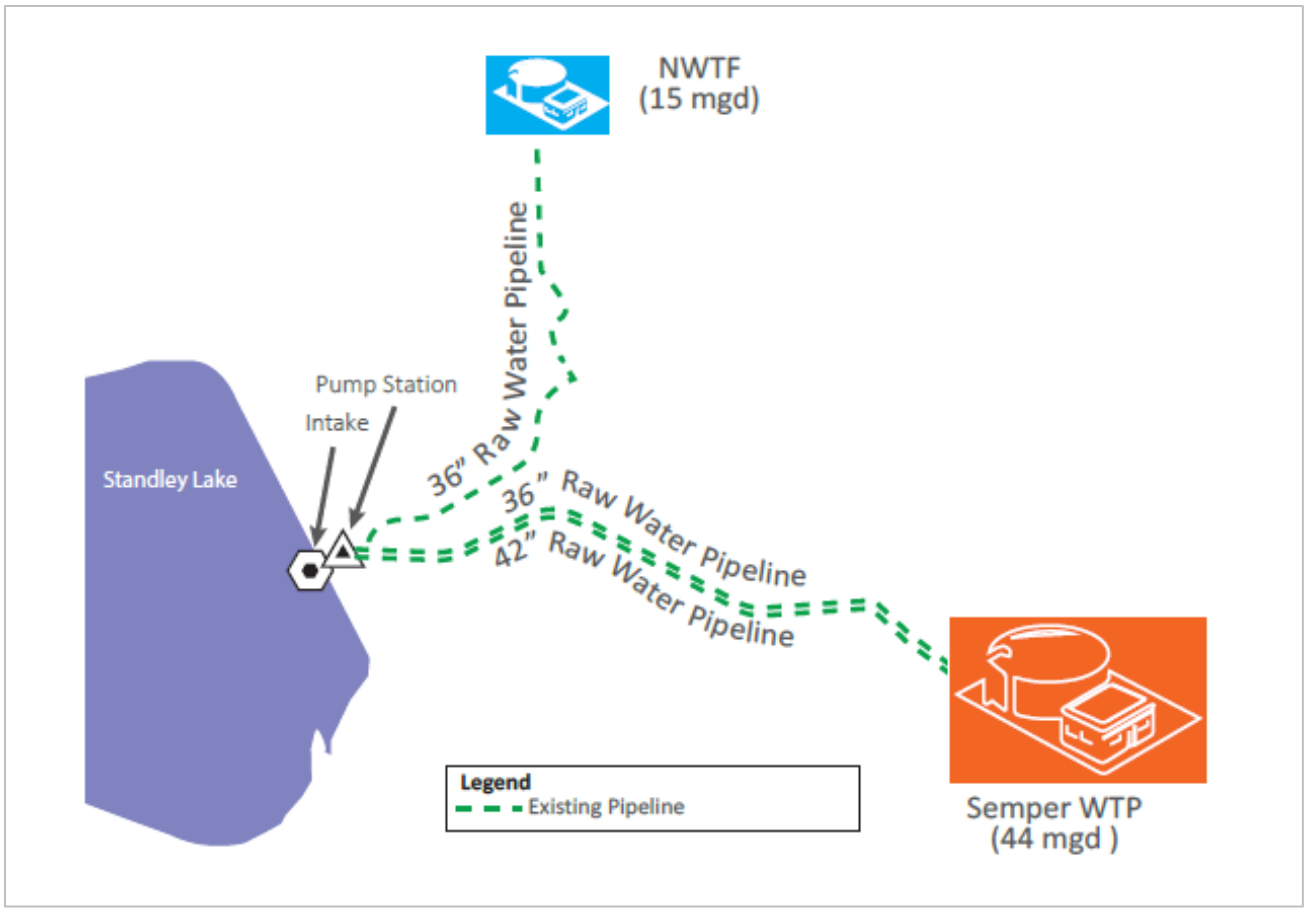

Figure 1. City of Westminster Current Water Treatment Infrastructure

Potable water demand in the City is expected to grow consistently. Table 2 displays existing potable water demand (both average and maximum daily demand) and estimated future demand.

Table 2. Westminster Water Treatment Facility Characteristics

Scenario	Average Daily Demand (ADD) (MGD)	Max Daily Demand (MDD) (MGD)
Existing (2015)	20.0	42.2
2025	22.3	48.0
2030	23.5	50.5
2035	25.1	53.9
2040 (Buildout)	26.6	57.2

Challenges with Current Treatment Process

Challenges to the existing City water treatment facilities are becoming more apparent. These challenges affect the facilities singularly and collectively.

Potable Water Demand

As shown above, potable water demand estimates are projected to increase as the City reaches buildout. The current structure of the City's water treatment plants do not meet established potable water demand reliability goals. Current MDD is about 42 MGD and has held steady despite population increase. Current

firm capacity is 37 MGD (22 MGD at Semper with one train out of service and 15 MGD at NWTF), an approximate 14 percent shortfall. This firm capacity shortfall will increase to 35 percent by 2040 if capacity is not increased.

Quantity is one part of potable water demand. Source water quality is the other. The citizens of Westminster are accustomed to high-quality potable water, and a recent citizen survey reported water quality as a primary concern. The City maintains a minimum goal of attaining compliance with Safe Drinking Water Act (SDWA) requirements. The City also has established a goal to meet or exceed the Partnership for Safe Water goals.

Source water quality can be erratic, resulting in rising treatment challenges. The Semper plant may not be able to treat the projected quality of source water under potential conditions, such as a wildfire upstream of Standley Lake, at max demands closer to its rated capacity of 44 MGD. Semper also may not meet water quality goals using water directly from Farmer's Highline Canal during an emergency or under challenging watershed conditions such as those following forest fires.

Future Regulations

At current flows, the City's treatment plants produce high quality water that meets or exceeds existing regulations. Changing source water quality and potential future regulations may cause challenges.

Within source water, forest fires and decay of dead trees resulting from beetle kill may increase compounds in the source water that will lead to algae growth and degrade source water quality. The City can treat current levels of these compounds with current processes; however, the City should continue to monitor the source water closely to identify upcoming treatment requirements and plan for future process improvements.

A number of compounds are being considered for future regulation. The City should continue to monitor water quality throughout the watershed and stay current on the regulatory climate as it pertains to new compounds.

Inability to Increase Capacity at Current Plants

In the future, the City will need to add treatment processes to meet upcoming water quantity, water quality, and future regulation requirements. Neither Semper nor NWTF have the space at their current sites to add treatment processes. To add treatment processes at Semper, current processes would have to be torn down. The construction phase would exacerbate reliability and capacity issues, such that existing potable water demands could not be met.

Impact of the Watershed Protection Program

The City of Westminster participates in the Clear Creek and Standley Lake Watershed Agreement regarding water quality protection of the upper Clear Creek watershed and Standley Lake. The goal of the Watershed Protection Program is to protect both of these resources as a water supply for more than a quarter million people and to maintain Clear Creek as an aquatic and recreational resource. Concepts addressed in the program requirements include:

- Water-Quality Monitoring
- Water-Quality Policy, Planning, and Management
- Water Quality Best Management Practices (including supporting efforts by permitted wastewater treatment works to reduce nutrient loads to Clear Creek)
- Funding Water-Quality Related Actions

Participation in the Watershed Protection Program offers a number of benefits, including non-monetary (e.g., increased citizen education and stakeholder involvement) and financial benefits to the City. As a result of the water quality benefits (i.e., reduced nutrient load) from the Watershed Protection Program, the City

does not need to regularly treat water for taste and odor at Semper. To quantify the benefit of this avoided treatment, an order-of-magnitude conceptual cost estimate was completed based on what it would take to implement taste and odor control at each plant today. If a fully operational Powered Activated Carbon (PAC) facility for taste and odor control were implemented for seasonal use at Semper, this could cost $1.9 million in construction cost, as much as $300,000 per year in operation and maintenance costs, and about $74,000 per year in PAC solids disposal costs (2015 dollars).

Often, the abrasive nature of PAC is too damaging to membrane filtration systems to be considered at treatment plants like NWTF. However, PAC is permitted in the Pall Microza membrane filtration system though operational modifications (excess recirculation) may be required depending on the carry-over in the settled water. The cost of a PAC facility at NWTF would be around $1.2 million dollars to construct, $118,000 per year in operations and maintenance, and an estimated $17,000 per year for PAC solids disposal. Participation in the Watershed Protection Program saves the City in terms of both capital and ongoing operational cost each year.

Alternatives Considered for New Water Treatment Portfolio

Four water treatment portfolio alternatives were developed and evaluated as part of this Master Plan. Alternative 1, refurbish existing facilities only, was immediately eliminated because this Alternative would not meet the City's potable water demand reliability goals. Due to the size and configuration of the existing drinking water treatment facilities and the fact that no additional footprint remains for expansion at either location, a new water treatment plant is required for all viable master plan alternatives. The remaining Alternatives are as follows:

- Alternative 2 – Maintain Semper, Maintain NWTF, New WTP
- Alternative 3 – Improve Semper, Improve NWTF, New WTP
- Alternative 4 – Retire Semper, Improve NWTF, New WTP
- Alternative 5 – Retire NWTF, Improve Semper, New WTP

A redundant pipeline to NWTF would increase reliability, so Alternatives 3 and 4 were each split into two sub-alternatives to accommodate inclusion of the redundant pipeline as an option. Alternatives 3a and 4a include the redundant pipeline, while Alternatives 3b and 4b do not.

Figure 2 presents the criteria used to evaluate the various alternatives as well as the Net Present Value (NPV) of each alternative. Alternatives 4A and 4B were the highest scoring alternatives; 4A had a slightly higher score due to the increased reliability associated with the parallel raw water pipeline. Alternative 4B had the lowest NPV Cost. Generally, the cost estimates for Alternatives 2, 3, and 4 were relatively close and practically indistinguishable given the high-level conceptual nature of the cost estimates. Therefore, NPV was not a differentiator in the outcome of this assessment.

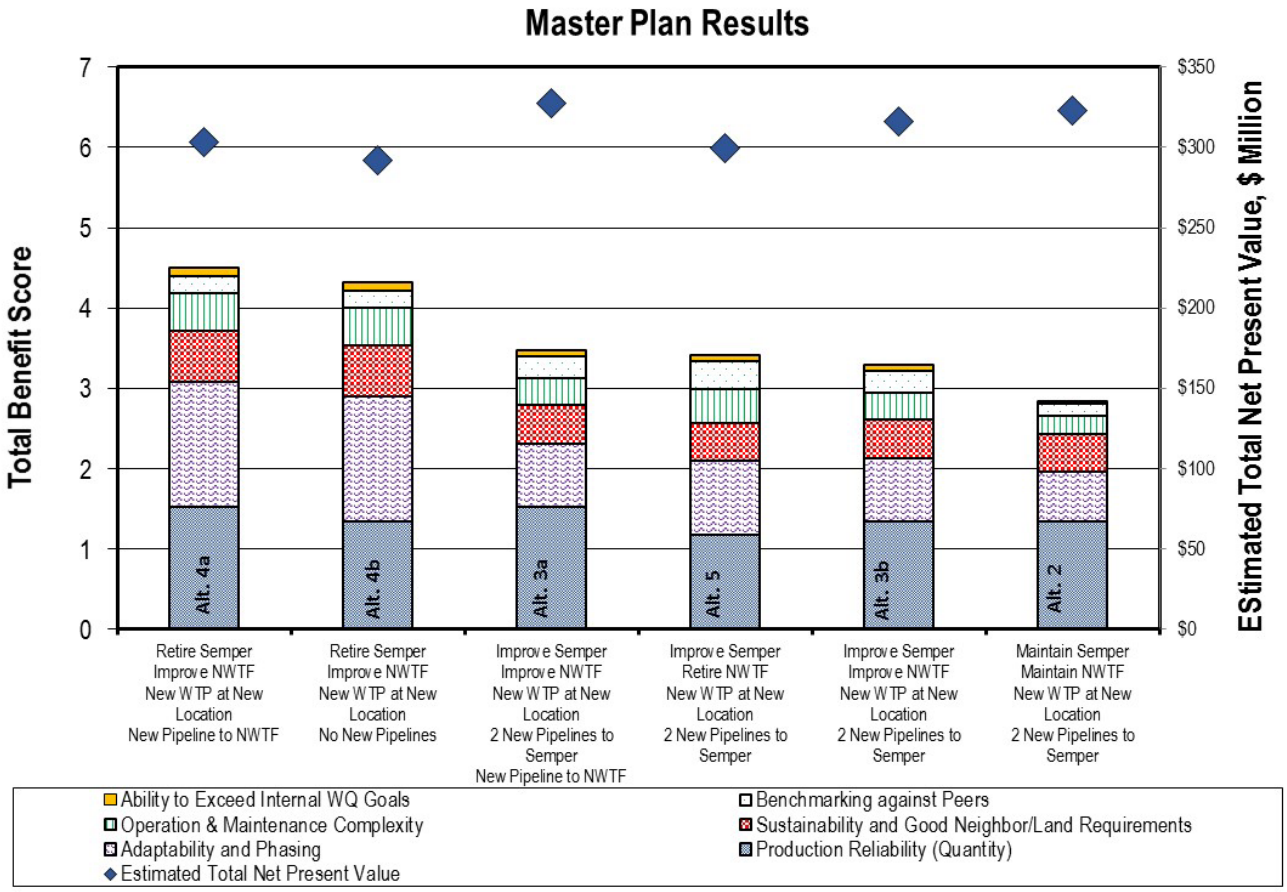

Figure 2. Comparison of Alternatives

Selected Alternative

Alternative 4B: Retire Semper, Improve NWTF, Phase in Large New WTP was selected as the preferred alternative. This alternative has the lowest lifecycle cost and provides significant benefit to the City by retaining the use of the existing WTPs while the new plant is designed and constructed, enhancing the City's cash flow in both the near and long term (see Figure 3). For the incremental increase in non-monetary benefit in terms of reliability, the City may opt to construct a parallel raw water pipeline for NWTF, but that decision can be deferred until a later date. Semper will continue to provide the City with high-quality water until the new WTP is phased in at buildout capacity, at which time the plant will be retired. This allows the City to utilize the full value of Semper before retiring the plant. At retirement, the Semper site will be repurposed in alignment with the new Downtown Westminster vision. Figure 4 represents the buildout of this alternative and assumes Standley Lake as the potential site for the new plant as a placeholder.

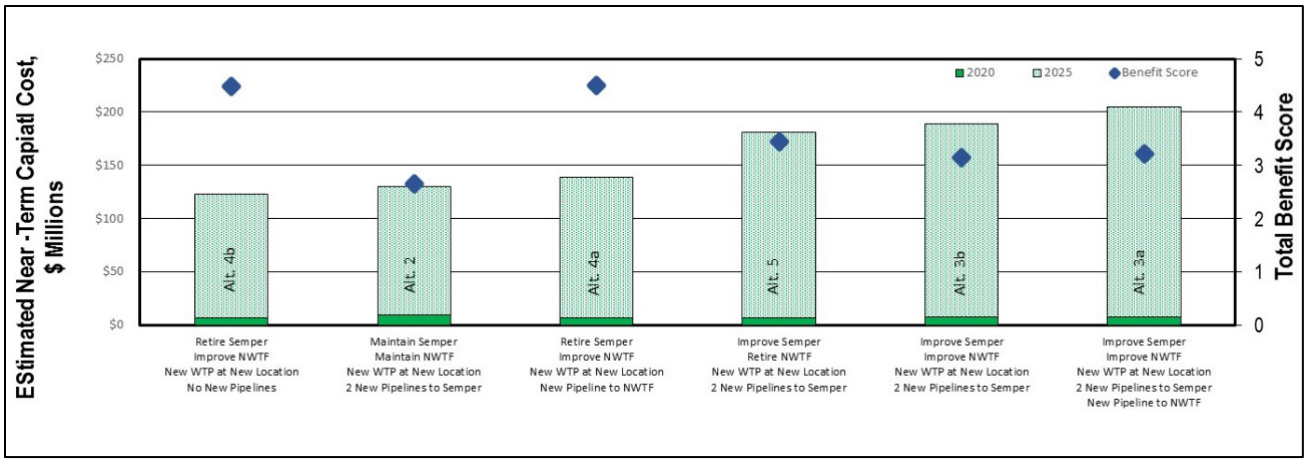

Figure 3. Alternative Cash Flow

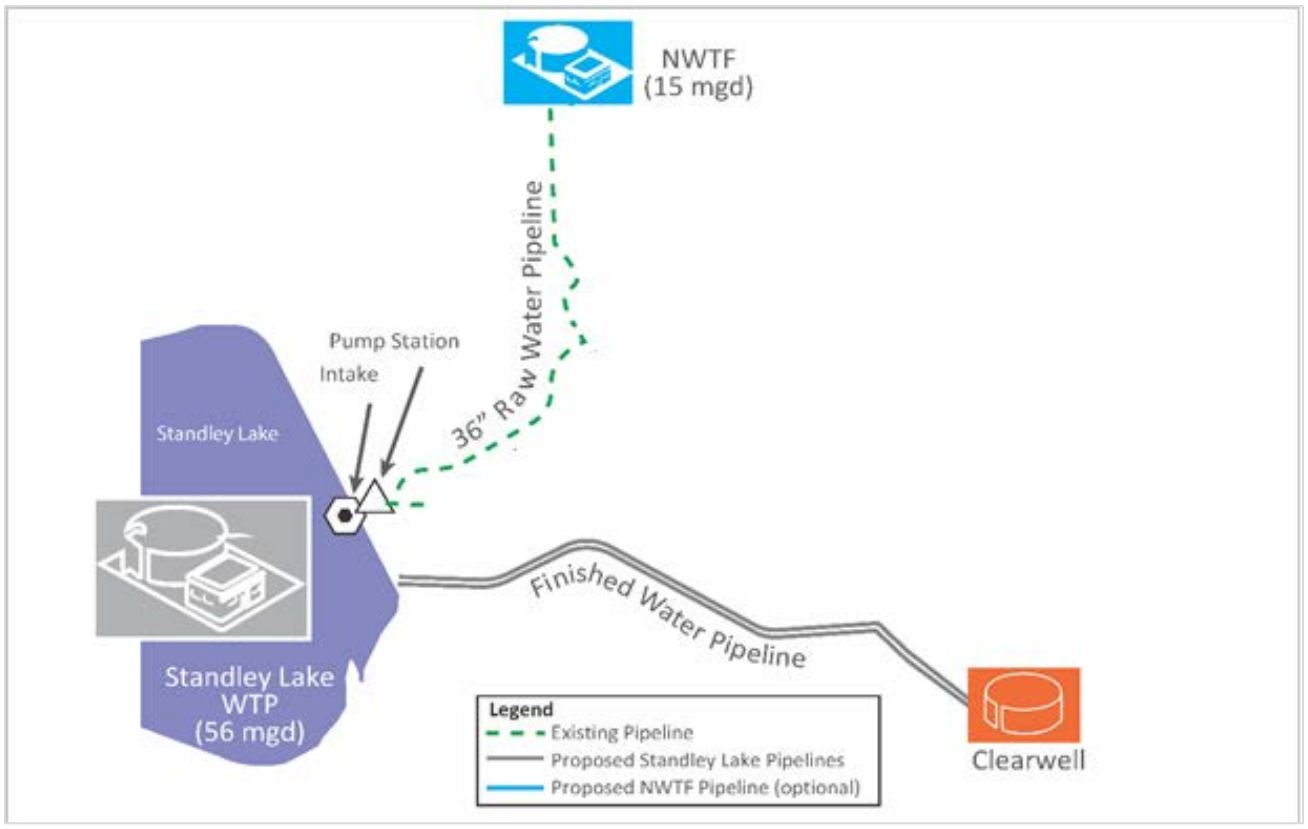

Figure 4. Selected Alternative at Buildout

Initial Siting Study

Subsequent to this Master Plan, a preliminary siting study will be conducted to select a preferred location for the new plant. Figure 5 identifies potential sites that may be included in the siting study. These locations will be refined and further vetted as part of the siting study that is anticipated to occur in 2018 in accordance with the Master Plan schedule.

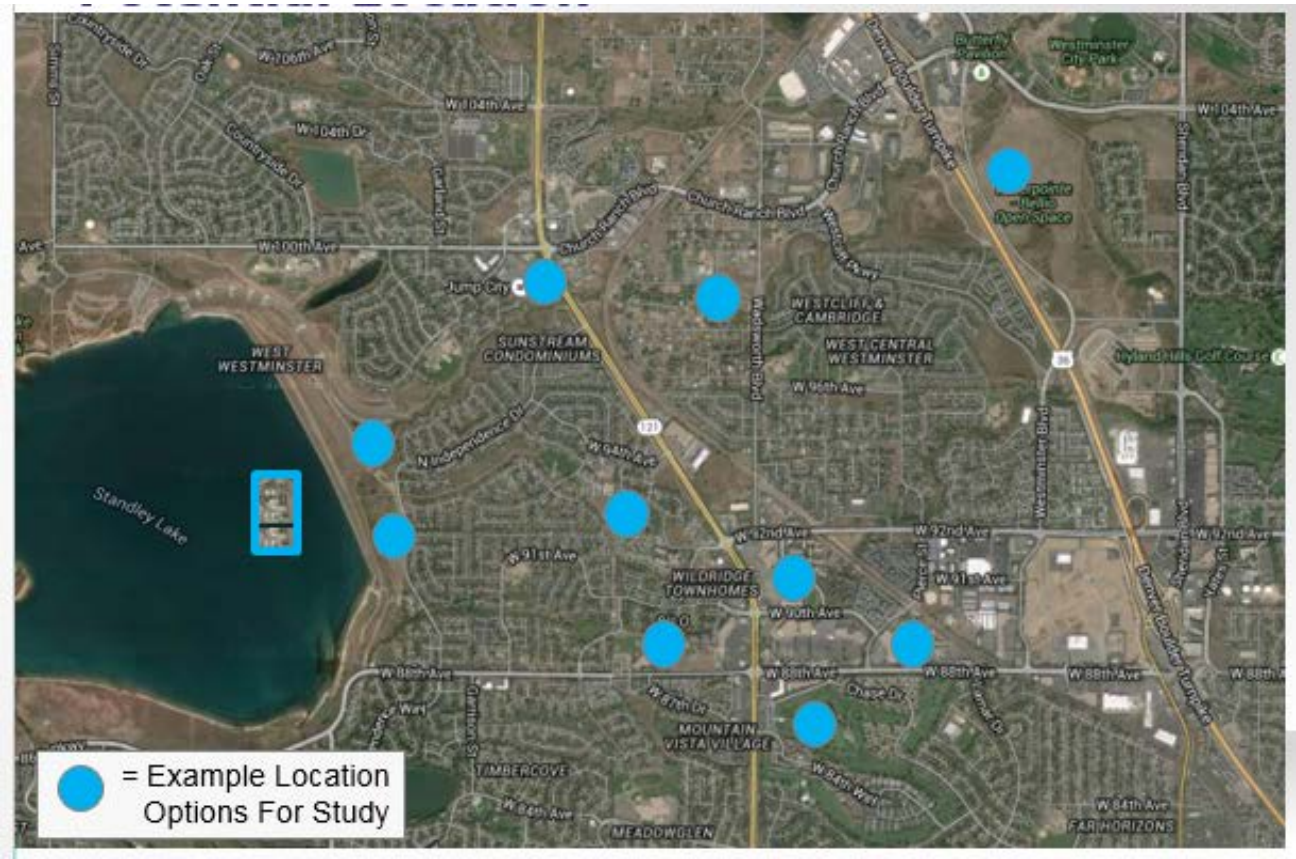

Figure 5. Initial Locations for Siting Study

Schedule

- The new treatment facility will be constructed in two phases over 25 years. Construction will begin in 2023, with the first 14 MGD placed in service in 2025. The second phase (buildout) of the new WTP will begin in 2038 with completion scheduled for 2040 bringing the total treatment capacity for the City to 71 MGD.
- The timeline presented in Figure 5 illustrates the key steps for implementation of the preferred alternative.

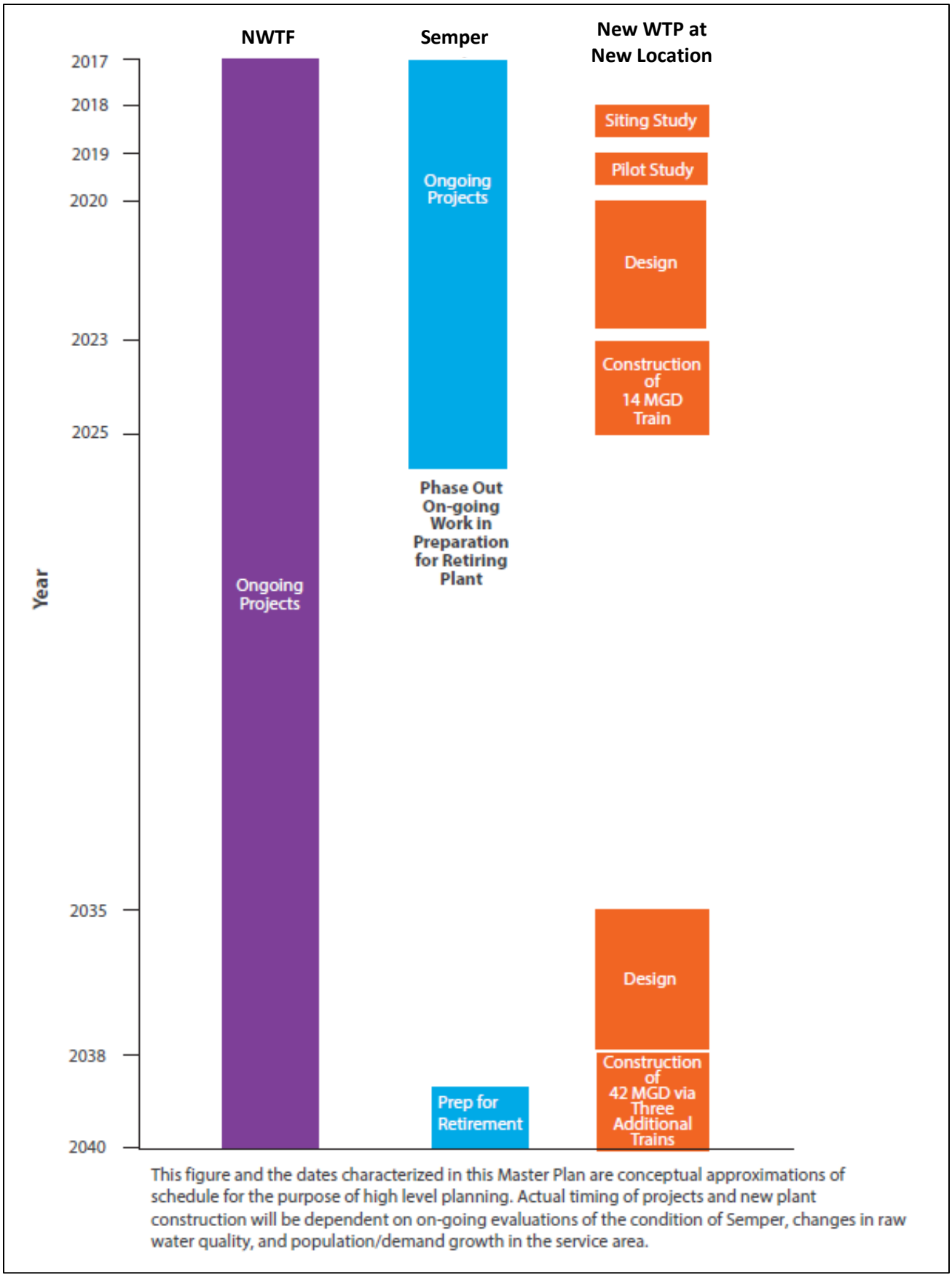

Figure 6. Preferred Alternative Timeline