CHAPTER 6

SECTION 6
FACILITIES PLANNING CRITERIA

Introduction

This chapter establishes planning criteria and introduces capital improvement alternatives to address the deficiencies summarized in the preceding chapters. The objective of all of the capital improvement alternatives is to enable reliable long-term water supply from the City's Rogue River source, meeting both demand and water quality requirements.

Planning Criteria

Planning criteria for developing capital improvement alternatives include the planning period, water demand projections, a pre-screening of treatment process alternatives, and considerations for redundancy and water supply reliability. Each of these criteria is discussed in the following sections.

Planning Period

Selection of an appropriate planning period for facility upgrades is critical to establishing hydraulic and process capacity requirements. In order to complete an equitable comparison of all possible capital improvement alternatives, the planning period must be the same for each alternative. Factors that affect selection of the planning period include:

- Life expectancy of new or existing civil, mechanical, and electrical equipment needed with the upgrade.
- Life expectancy of any new or existing structure being designed or integrated as part of the upgrade.
- Capacity limitations due to water rights, required space, or other restrictions that are likely to remain fixed for the planning period duration.
- Capacity limitations of existing infrastructure planned to remain.
- Other design considerations, such as desired level of treatment redundancy and nominal capacities of individual treatment trains.

It is anticipated that construction of a new WTP would begin in five to seven years, allowing time for potential property acquisition, design, environmental and regulatory permitting, public acceptance, financing, bidding, construction, and commissioning. Construction of improvements at the existing plant might begin sooner.

For facility replacement cost planning, a life expectancy of 20 to 30 years is often used for equipment with electrical, hydraulic, or mechanical support systems. Facilities such as pipe, concrete basins, and buildings are expected to last longer, with a minimum life expectancy of 75 years. If construction begins in 2020, these facilities would be expected to last until 2095. Therefore, the planning period for all alternatives is through 2095.

Water Demand Projections

To properly size the upgrades for all processes and transmission facilities, water demand projections must be established. The design flow for WTP capacity is normally MDD for water utilities that have adequate distribution system storage. Using MDD as the capacity criteria for upgrades within this Facility Plan Update is consistent with methodologies used in previous Grants Pass planning documents and adheres to State of Oregon and AWWA guidelines.

Table 6-1 summarizes future water demand projections developed as part of the April 2013 MSA technical memorandum titled Long-Term Water Demand Projections which is included as Appendix E. Development of these water demand projections considered existing service area, future service areas, and trending of historical population and water demand information. As recommended in the technical memorandum, these demands should be re-evaluated at regular intervals to account for changing conditions.

Chapter 4 establishes a current WTP capacity of approximately 20 mgd, which is estimated to meet MDD until year 2028. Therefore, the recommended immediate need for capital improvements is based less on capacity expansion and more on the condition and operational constraints of existing facilities.

The City recently made significant improvements to its raw water intake structure allowing for an ultimate intake capacity of 30 mgd. With seismic and structural upgrades, it is anticipated that the structure would be suitable for use through 2065 when system MDD reaches 30 mgd. The cost of upgrading the existing structure is lower than the cost of permitting and constructing a new intake. Constructing other facilities to an initial capacity of 30 mgd allows a consistent criteria for evaluating alternatives and maximizes use of the existing intake structure. Providing 30 mgd capacity is adequate to meet the City's projected MDD through year 2065. For the purposes of this study, the planning capacity for initial construction of all other WTP elements is chosen to match the capacity of the intake for the development of all improvement alternatives. The ultimate design capacity is chosen to be 45 mgd anticipating that new structures and buildings will have design life of 75 years.

Treatment Process Pre-Screening

This section presents a pre-screening of treatment processes considered for WTP improvement alternatives. Design criteria for appropriate treatment technologies used in the alternatives are discussed further in Chapters 7 and 8. Included as part of the pre-screening process is the nature of the Rogue River's source water quality, current and anticipated future water quality regulations, and the City's historical plant operation experience.

Table 6-1
Grants Pass Water Demand Projection Summary

Year	Service Area Population	AAGR[1] (percent)	Per Capita Demand (gpcd[2])	ADD[3] (mgd)	MDD[4] (mgd)
2015	38,632	2.1	170	6.6	15.5
2020	42,862	2.0	170	7.3	17.1
2025	47,323	1.9	170	8.0	18.9
2030	51,993	1.8	170	8.8	20.8
2035	56,844	1.7	170	9.7	22.7
2040	61,843	1.6	165	10.2	24.0
2045	66,951	1.5	160	10.7	25.2
2050	72,125	1.5	155	11.2	26.3
2055	77,700	1.5	150	11.7	27.4
2060	83,704	1.5	145	12.1	28.5
2065	90,173	1.5	140	12.6	29.7
2070	97,142	1.5	140	13.6	32.0
2075	104,650	1.5	140	14.7	34.4
2080	112,738	1.5	140	15.8	37.1
2085	121,451	1.5	140	17.0	40.0
2090	130,837	1.5	140	18.3	43.0
2095	140,948	1.5	140	19.7	46.4
2100	151,841	1.5	140	21.3	50.0
2105	163,576	1.5	140	22.9	53.8
2110	176,218	1.5	140	24.7	58.0

Notes

1. Average annual growth rate
2. Gallons per capita per day
3. Average day demand
4. Maximum day demand

Clarification

Water pumped from the river intake is called raw water and it is pumped from the river to sedimentation basins. Clarification is performed ahead of filtration and usually makes use of chemical coagulation. The clarification process removes a sufficient portion of sediment from the raw water to allow for an efficient filtration process. A conventional WTP uses separate chemical mixing, flocculation, and sedimentation facilities prior to filtration. The three sedimentation basins at the existing Grants Pass WTP currently fulfill this role. However, no flocculation process precedes the sedimentation basins after rapid in-line chemical mixing and none of the basins were designed for optimal hydraulic flow. In addition, chemical injection and mixing equipment is not optimal for the full range of plant flows. Cumulatively, this reduces the effectiveness of the clarification process and requires increased maintenance associated with basin cleaning and residuals removal. It also causes periodic increased solids loading on the filters which results in more frequent backwashing. The City's WTP has three sedimentation basins, each with a unique configuration and size.

Flow splitting between these existing basins is used because of their distinctly different hydraulic and treatment characteristics. Flow splitting is accomplished by visual observation of basin levels and manual valve throttling.

The performance and structural analysis of these basins found seismic deficiencies in all three basins, in addition to high maintenance needs associated with frequent manual basin cleaning. Given the visible cracking and structural degradation of basins 1 and 2, and the short-circuiting that occurs in basin 3, these basins are at the limits of their design life and are in need of replacement.

There are a number of potential clarification process alternatives including:

- Conventional mixing, flocculation, and sedimentation
- Solids contact and sludge blanket clarification
- Dissolved air flotation
- Ballasted flocculation
- No clarification

Table 6-2 shows advantages and disadvantages associated with these clarification processes, all of which would include chemical addition for coagulation. These factors are used to determine whether the technology is appropriate for further analysis. As shown in Table 6-2, both conventional clarification and ballasted flocculation are considered in capital improvement alternatives. These two technologies also present a range of planning-level cost considerations and space requirements associated with clarification.

Ozone

Ozone is a strong oxidant used for disinfection as well as taste and odor control. It can also be used in combination with granular activated carbon filter media to provide biologically active filtration that promotes multiple water quality benefits, including the removal of trace organic compounds. While water produced at the City's WTP has high overall water quality, occasional taste and odor events have occurred in recent years. The potential influence of climate change within the Rogue River watershed could result in more frequent algal blooms and increased taste and odor concerns. The addition of ozone to the treatment process will minimize the occurrence and severity of these events. The preferred location for ozone contact is between clarification and filtration, referred to as intermediate ozonation. Ozone technology is considered in all improvement alternatives as a potential future technology.

Filtration

The eight existing filters at the Grants Pass WTP all have identified seismic issues. Concrete deterioration and cracking of filters 1 through 5 have been observed, though not to the degree of the older exterior sedimentation basins. With an investment in retrofitting work that includes both seismic restraint and concrete basin rehabilitation, additional filter life can be

Table 6-2
Summary of Clarification Process Alternatives

Clarification Process	Advantages	Disadvantages	Screening for Further Consideration
Conventional sedimentation preceded by mixing and flocculation	• Proven treatment technique for Grants Pass • Multiple processes offers level of operational flexibility • Low equipment cost • Higher rate sedimentation can be offered through installation of inclined settlers	• Large footprint required • Higher cost associated with basin construction • Inadequate space at existing WTP site for 30 mgd	Considered at a new WTP site where space is less restrictive
Solids contact and sludge blanket clarification	• Smaller footprint than conventional sedimentation • Lower chemical use	• High operator attention required with changed water conditions • More mechanical components • Higher power costs associated with recirculation • Can take longer periods to achieve effective treatment at start up • Not commonly used	Not considered, other technologies offer higher clarification rates and reduced footprints
Dissolved air flotation	• Smaller footprint than conventional sedimentation • High clarification rate achievable • Lower chemical use	• High operator attention required • More mechanical components associated with skimming • Higher power costs associated with aeration • Not suited for turbid waters which contain silts and settleable solids	Not considered, other technologies offer higher clarification rates and reduced footprints
Ballasted flocculation	• Very high clarification rates achieved • Lowest footprint required • Lower overall capital cost than conventional • Increased recent popularity	• High operator attention required • More mechanical components associated with flocculation and sand addition • Higher power cost than conventional sedimentation and flocculation	Considered for existing WTP upgrades and new WTP construction
No clarification	• Smaller footprint and cost savings • Reduced operator time	• Direct filtration would require large clearwell/ additional disinfection time • Might create disinfection byproduct issues • Rogue River water quality not conducive to direct filtration	Not considered because direct filtration of Rogue River water would create an undue increase in maintenance associated with downstream facilities

achieved, though not the same design life of newly constructed filters. Retrofitting work may not eliminate the limitations on operational efficiencies that treatment processes currently experience as the analysis has found that hydraulics and filter media depth will limit filtration rates and a lack of air scouring can limit backwashing efficiencies.

Capital improvement alternatives include existing filter rehabilitation scenarios and new filter construction scenarios. The rehabilitation alternatives will be based on achieving a life expectancy sufficient to last through 2065 when system MDD reaches 30 mgd. This capacity has been determined as the maximum attainable capacity at the existing WTP site.

Filtration alternatives considered as part of this plan include:

- Mixed granular media
- Deep-bed granular media
- Low-pressure membranes
- Slow sand filtration
- Diatomaceous earth

Table 6-3 lists advantages and disadvantages associated with these filtration processes to identify whether the technology is appropriate for incorporation into capital improvement alternatives. Membrane filtration is a relatively new technology that comes at a premium but consistently produces high quality water. However, membranes do not usually perform well on water from turbid sources such as the Rogue River. As such, membrane technology is not considered to be a good candidate for Grants Pass because the Rogue River source water would require clarification before the membranes. The construction of clarification prior to membranes, which is not typical for membrane installations, makes the cost of this technology prohibitively high. For this reason, granular media filtration, including standard and deep-bed configurations, is the only technology incorporated into capital improvement alternatives.

Solids Dewatering and Residuals Handling

Until ten years ago, no dewatering was performed at the Grants Pass WTP. All solids accumulated through basin cleaning or backwashing cycles were eventually passed along to the old mill pond. Pond dredging and frequent hauling of solids residuals from the pond for disposal became increasingly expensive. Geomembrane bags have since been used effectively to reduce the amount of solids delivered to the pond, but this practice requires a lot of space and labor. The need for solids handling will only increase as demands increase, and this geomembrane method of dewatering could lead to obstacles in meeting NPDES discharge permit requirements for the outfall from the pond. Hauling fees for disposal in the near future might also be subject to increases associated with more stringent permitting.

Table 6-4 summarizes the advantages and disadvantages associated with common solids handling technologies. With reduced footprint either being required or desired, and with the

Table 6-3
Summary of Filtration Process Alternatives

Filtration Process	Advantages	Disadvantages	Screening for Further Consideration
Mixed granular media	• Proven treatment technique for Grants Pass • Lower equipment and capital costs compared to membrane filtration	• Lower filtration rates • Larger footprint required	Considered
Deep bed granular media	• Higher filtration rates available • Smaller footprint required	• Higher capital cost to construct deeper filters • Filter efficiency might decrease slightly compared to shallow media	Considered
Low-pressure membranes	• Consistent high quality water • Physical barrier against waterborne pathogens • Lower chemical use for coagulation • High level of redundancy	• High operator attention associated with control and testing/cleaning support systems • Very high capital cost • Higher operational costs • Cost prohibitive where savings in reduced clarification facilities cannot be achieved	Not considered, due to probable need for a clarification process and pre-screening to protect the membranes (cost prohibitive)
Slow sand filtration	• Simple, reliable technology • Low operator attention required • Low equipment cost	• Very low filtration rates • Requires longer ripening period at startup • Very large footprint required makes it prohibitive for both existing or a new property • Not appropriate for “live” rivers with turbidities > 10 NTU	Not considered due to regulatory constraints and raw water turbidities
Diatomaceous earth	• Lower equipment and chemical costs	• High operator attention associated with pre-coating process and frequent media changes • Not commonly used, very seldom for large capacity facilities • More expensive than granular media filters	Not considered because the media is not readily available

Table 6-4
Summary of Solids Handling Alternatives

Dewatering Process	Advantages	Disadvantages	Screening for Further Consideration
None	• Minimizes number of treatment facilities	• Recent operations indicate that the capacity limitation of the old mill pond renders this alternative as an undesirable high risk, cost-prohibitive alternative	Not considered because of risk and cost
Drying beds	• Simple technology • High percent solids can be achieved with adequate space and weather	• For solids production levels at 30 mgd, space prohibitive at either the existing or a new property	Not considered because space is too limited
Geomembranes	• Portable technology • High percent solids can be achieved with adequate space and weather	• Polymer needed • Space prohibitive at 30 mgd • Labor intensive • Extended process might result in future old mill pond discharge permit compliance issues	Not considered – this current practice is too labor-intensive and will take up too much space at future production levels
Mechanical	• More compact footprint • More automated process, less labor involved • High percent solids achievable without weather conditions • Reduction in hauled volumes	• High initial capital costs • Polymer and power needed • More mechanical equipment	Considered

possibility of increased disposal and permitting costs, mechanical dewatering is the appropriate technology to use with all capital improvements. The process typically uses dewatering equipment preceded by thickening.

As long as the City can continue to discharge liquid residuals from the old mill pond to Skunk Creek, then continued use of the pond to receive spent filter backwash water is considered feasible. Spent backwash water contains relatively low solids concentrations compared to residual streams produced by the clarification process.

Recycling of Residual Streams

The City does not currently recycle any liquid waste streams, and existing WTP site constraints might make it more challenging to use recycling alternatives at that site. No cost or space provisions are included in any of the capital improvement alternatives for liquid residual stream recycling. It may be beneficial to consider recycling larger residual streams at some future date, especially if a new WTP is constructed. Future increases in demand and potential NPDES discharge permit requirements might make continued use of the old mill pond too costly to continue. A brief evaluation of sending residual streams with a large volume to the wastewater collection system found that this is not a viable alternative.

The Filter Backwash Recycling Rule (FBRR) discussed in Chapter 3 regulates recycling of filter backwash, thickener supernatant, and water from dewatering. These streams must be re-introduced upstream of chemical addition for coagulation so that the water undergoes full treatment through the plant. Filter-to-waste is not regulated by the rule because it is typically of high quality and has been filtered, but it is often economical and practical to combine it with the other recycled streams to minimize capital improvement expenditures and operational complexities associated with recycling.

The FBRR does not require treatment of recycle streams as long as they are introduced into the plant ahead of all of the main treatment processes. However, some plants and states have found it beneficial to treat recycled water because it may contain higher levels of pathogens than raw water. The decision to treat recycled streams is usually made on a case-by-case basis between the utility and the regulatory agency.

If recycling were implemented, an equalization storage facility for the various streams would be required to control the recycle flow stream back to the front end of the treatment facility. Often, flow control is best managed by pumping. Equalization basins may be constructed with a common wall, or some other means of redundancy, to facilitate relatively infrequent manual cleaning of settled solids in the basins. Additional space might also be needed if future treatment of recycle streams is necessary.

Using an ultimate design capacity of 45 mgd, typical recovery rates and the potential recovery volumes that might be achieved by recycling the various waste streams under either alternative are shown in Table 6-5. The recovery rates are offered as general industry ranges.

The performance of the City's WTP will vary depending on actual conditions and plant operations.

Table 6-5
New Water Treatment Plant Waste Stream Recycling Summary

Waste Stream	Typical Volume (Percent of Production)	Regulated under FBRR	Potential Recovery at 45 mgd Production (mgd)
Spent Filter Backwash Water	2 to 5	Yes	0.90 to 2.25
Gravity Thickener Supernatant	0.07 to 1	Yes	0.03 to 0.45
Mechanical Dewatering Pressate	0.1 to 0.2	Yes	0.05 to 0.10
Filter-to-Waste	≈ 0.5	No	0.23
Total Potential Recovery from All Waste Streams			**1.21 to 3.03**
Total Potential Recovery from Filters Only (Backwash and Filter-to-Waste)			**1.13 to 2.48**

Chemical Systems

For the purposes of this plan, it is assumed that chemical systems associated with new facility construction will be proportionally similar in configuration and space requirements to existing chemical facilities. Cost estimates and space requirements will be included in improvement alternatives for multiple coagulant (alum, ACH, or PACl) injection systems, a filter aid, thickening agents, and chlorination. Although there are alternative systems associated with each of these chemical processes, such as on-site hypochlorite generation in lieu of 12.5 percent solution delivered, the cost differential between them is not considered consequential in the analysis of alternatives. Space requirements for the largest chemical systems are included in the analyses, as well as additional space for potential future ozonation and pH adjustment equipment systems.

Redundancy Considerations

Designing a WTP to provide redundancy such that the plant could still produce at MDD capacity with any one treatment train for each process off line or out of service comes at a significant capital investment. Additionally, redundant facilities would be underused under normal operating conditions. In practice, most planned facility shutdowns are operationally triggered and can be scheduled during non-peak production periods. Redundancy strategies used in the development of capital improvement alternatives include:

- Backup power supply through an on-site emergency generator sufficient for production of average day winter demands.

- Additional hydraulic capacity in basins and pipelines to provide operation at increased production rates for individual treatment trains over short periods of time.
- No redundancy in raw water pumping facilities to achieve a capacity of 30 mgd. There will be a minimum of six pumps required to meet this capacity, each rated at approximately 5 mgd. Space is available at the intake for no more than six pumps of this size.
- Full redundancy to meet MDD for other pumping facilities that represent critical plant operations including chemical injection, finished water service, and backwash pumping. Full redundancy of filters is also planned, as they represent a critical plant operation.
- No clarification and disinfection basin redundancy to meet MDD. Under this assumption, if only two treatment trains are planned for 30 mgd of clarification, more than 50 percent of MDD could be achieved from either train by running it at higher loading rates for short periods of time. Better raw water quality is anticipated to typically occur during periods of the year which coincide with peak demands. A clearwell which provides adequate CT is compartmentalized, so it is possible to remove portions of the clearwell from service for cleaning and inspection. This work can also be scheduled during a low demand period where CT is still adequately met.

Space Provisions

For new facilities design, several factors beyond the actual required square footage of the treatment process need to be considered in determining adequate treatment facility site footprint including:

- Space for support systems associated with the treatment process, such as air supply, electrical, chemical, HVAC equipment, and mechanical equipment.
- Adequate workspace for operational access to equipment and basins for purposes of inspection and maintenance.
- Code requirements, including building, electrical, mechanical, fire, and plumbing codes.
- Staffing areas such as offices, lunch areas, lockers, restrooms, meeting rooms, and administrative storage.
- Equipment storage and maintenance areas for tools and spare parts associated with treatment plant operations.
- Adequate vehicle access and parking, including consideration of ingress and egress and turning radiuses for large delivery trucks, as well as construction vehicles that will be needed to support future facility maintenance.
- Site designated land uses, setbacks, and consideration of identified critical areas.

Space provisions associated with these considerations are discussed further in the alternatives developed in Chapters 7 and 8, and general site plans are developed.

Capital Improvement Alternatives Overview

Five capital improvement alternatives were developed to represent a full range of potential space, cost, and risk scenarios that address the identified WTP deficiencies and promote reliable, long-term supply of the Rogue River source of supply. The capital improvement alternatives include two existing plant upgrade scenarios and three new plant construction scenarios. The alternatives are as follows:

- Alternative 1: Existing Water Treatment Plant Upgrade, Maximize Reuse of Existing Facilities
- Alternative 2: Existing Water Treatment Plant Upgrade, Phased Replacement of Facilities
- Alternative 3: Construct a New Water Treatment Plant with Consolidated Footprint
- Alternative 4: Construct a New Water Treatment Plant with Large Footprint
- Alternative 5: Construct a New Water Treatment Plant with Consolidated Footprint on Property that the City Already Owns

Chapter 7 discusses the development of Alternatives 1 and 2 which propose improvements at the existing WTP. Chapter 8 discusses the development of Alternatives 3, 4, and 5 which propose construction of a new WTP at a new site.

Other Alternatives

Two other alternatives were initially considered. These alternatives are discussed in this section.

Baseline Alternative

The baseline alternative proposes to make the required structural and seismic upgrades to all of the existing plant structures. A new clearwell and high service pump station would be constructed to enable continued water supply to the distribution system while the existing clearwells and high service pump station are renovated. The cost of these improvements is approximately $12.5 million.

This alternative defers capital investments necessary to expand the plant's capacity and extends the useful life of the existing facilities. The initial capital investment is smaller than that of other alternatives, but the lifecycle cost of this alternative is higher for the following reasons:

- Some of the structures that would initially be renovated would be demolished during later improvements needed to increase plant capacity. A significant portion of the investment to renovate those structures would be wasted.

- The existing plant would still operate inefficiently so annual operations and maintenance costs would continue to be higher than other alternatives.

In addition, this alternative does not address long-term capacity needs or structural longevity needs beyond year 2065, when a capacity of more than 30 mgd is needed. Due to existing property size and constraints, a new WTP with a capacity of 45 mgd would need to be built at a new location. The approximate cost of this new WTP is $75.4 million (2013 dollars). Because of the inherent economic and operational challenges associated with this alternative, it was not evaluated any further.

Peaking Facility Alternative

Another alternative which was initially considered proposes to continue use of the existing plant as a "peaking facility" during peak demand periods. The City would construct a new plant with a capacity of 10 to 15 mgd capable of providing off-peak system demands with provisions to expand capacity up to 45 mgd in the future. The intent of this alternative is to minimize investments in the existing plant and to use the new plant throughout the year as a baseline production facility.

This alternative may have lower initial costs than other alternatives, but it presents major risks and challenges. In addition, the City would need to operate two separate facilities for four to five months every year, requiring additional staff and higher operations and maintenance costs. The existing plant would be "mothballed" every fall and re-started every spring which also presents additional costs and challenges.

Based on preliminary discussions with City staff, it was decided that this option was not due any further analysis. The main reason for this decision was to avoid the need to hire additional plant staff and to avoid the additional annual costs which would be incurred. The higher life cycle cost from the additional labor costs was deemed to be high enough to exclude this option from further consideration.

Summary

A summary of the WTP improvement planning criteria established in this chapter is shown in Table 6-6. The planning criteria summarized in this chapter serve as a basis for development of the capital improvement alternatives discussed in Chapters 7 and 8.

Table 6-6
WTP Improvement Alternatives Planning Criteria Summary

Item	General Criteria Adopted for Improvement Alternatives
Capacity of Structures	30 mgd initial, 45 mgd ultimate
Capacity of Equipment	30 mgd or less initially, deferment as appropriate to save life expectancy, 45 mgd ultimate
Design Life Expectancy of New Equipment	20 to 30 years minimum
Design Life Expectancy of New Structures	75 years minimum
Design Life Expectancy of Refurbished Structures	45 years
Clarification Processes Considered	Conventional clarification, ballasted flocculation
Filtration Processes Considered	Granular media, standard or deep-bed, high-rate
Solids Handling Processes Considered	Mechanical thickening and dewatering
Chemical Systems	Largest alternative space requirement for each, provisional space for ozone and pH adjustment
Full Redundancy	Hydraulic capacity, finished water service and backwash supply pumping, chemical injection pumping, filtration
Partial Redundancy	Emergency power supply, raw water pumping, clarification, disinfection