



## Technical Memorandum Layng Creek Water System Improvements - Value Engineering

**Project Name:** Layng Creek Water System Value Engineering **Date:** March 29, 2006  
**Client:** City of Cottage Grove, Oregon **Project Number:** 7436A.00  
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**Reviewed By:** Bob Eimstad & Bill Simonds  
**Subject:** Technical Memorandum  
**Distribution:**

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### INTRODUCTION

The City of Cottage Grove hired Carollo Engineers (Carollo) to conduct an independent evaluation of alternatives for water system improvements to cost effectively provide water service to customers served from the existing Layng Creek Water Treatment Plant transmission pipeline east of the Dorena Mobile Home Park. The study area contains approximately 110 residential service connections east of the Dorena Mobile Home Park that are currently served from the Layng Creek supply. In addition, approximately 73 residential services are located west of the Dorena Mobile Home Park that can be served by either the Layng Creek or Row River supplies.

Existing facilities and potential alternative improvements are summarized in the following reports:

- Facility Plan - September 2002, LDC Design Group
- Feasibility Report for Transmission Line Customer Service - November 2003, Carollo Engineers
- Preliminary Design Report - December 2005, Brown & Caldwell

On February 25, 2006, Carollo staff met with City staff to inspect the existing water system and review the intended approach to the project.

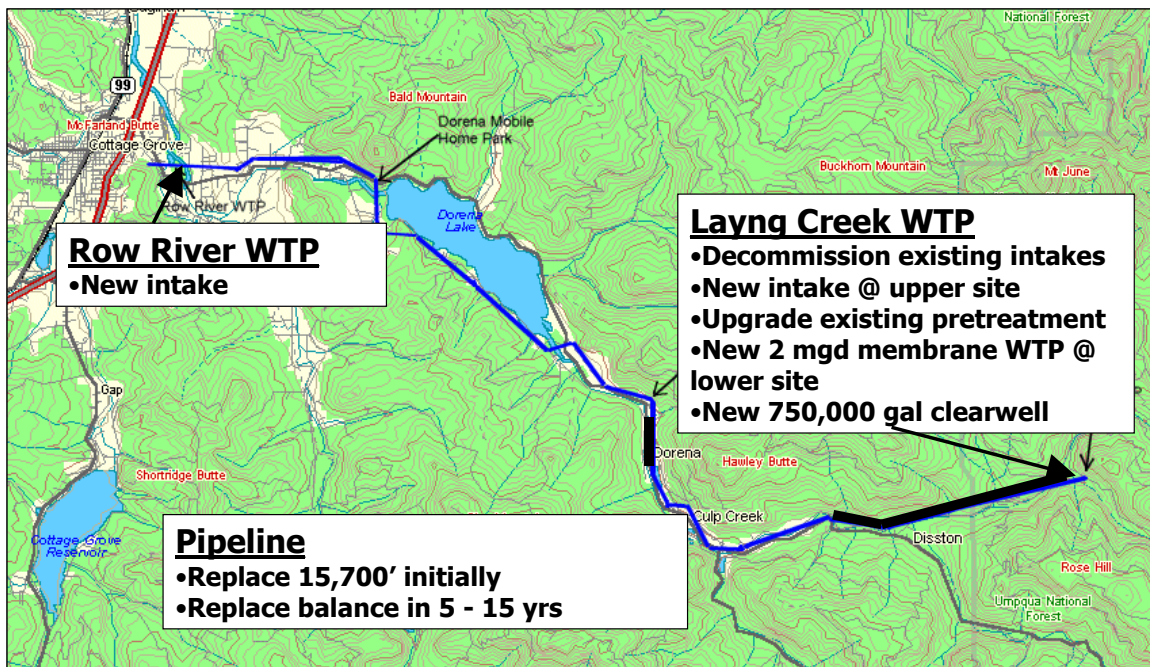
### ALTERNATIVES

With this background, a total of seven water supply alternatives were identified for further consideration:

- **Do Nothing.** This would consist of no significant changes to the existing water supply system. This option fails to meet requirements associated with the existing Bilateral Compliance Agreement (July 2005) between the City and the Oregon Department of Human Services and was dropped from further consideration and analysis.
- **Alternative 1 - Modified 2 mgd Membrane WTP at Layng Creek.** Initial capital

improvements associated with this alternative include a new 2 mgd submerged intake at the Layng Creek upper site, modifications to the existing pretreatment system at the upper site, a new 2 mgd membrane water treatment plant at the lower site, a new 750,000 gallon clearwell to serve pipeline customers, replacement of approximately 15,700 feet of 14" transmission pipeline between the Layng Creek WTP and Dorena Lake, decommissioning of the existing upstream intakes on Layng Creek and Prather Creek, and construction of a new infiltration gallery intake at the Row River Water Treatment Plant. This Alternative is shown in Figure 1.

**Figure 1 - Alternative 1**



Alternative 1 is essentially the same as the proposed improvements identified in the December 2005 Preliminary Design Report. However, it is proposed that the new intake be located at or near the existing upper site to take advantage of the existing flocculation / sedimentation units to provide pre-treatment based on source water quality, as recommended in the attached memorandum dated March 11, 2006. Continued use of the existing Layng Creek and Prather Creek intakes was considered as a potential cost savings measure to avoid the construction of a new intake; however, renewal and replacement of the existing pipelines from the existing intakes would cost at least as much as the proposed new intake. In addition, ongoing maintenance requirements and environmental impacts of the proposed new submerged intake would be substantially less than the existing surface intakes.

Future costs associated with Alternative 1 include replacement of the balance of the Layng Creek transmission line (approximately 87,000 ft) with a new 16" diameter pipeline over the next 5 to 15 years. The segments noted as first and second priority were identified in the 2002 Facility Plan as having reached the end of their useful life. While it would be appropriate to replace these highest priority segments as soon as possible, it is assumed these segments would be replaced within the next 5 years to

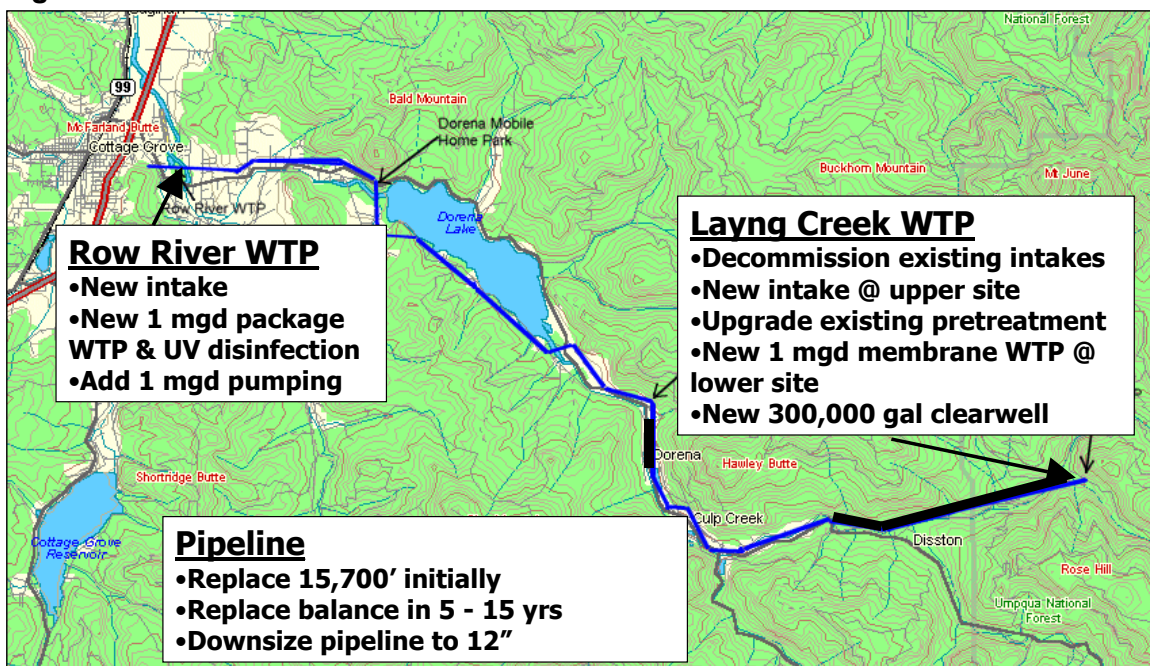
minimize the initial capital costs of the project. It is recommended the pipeline diameter be increased from 14" to 16" based on the design capacity of 2 mgd and typical design standards for transmission mains.

Operation and maintenance costs of this alternative assume a staffing level of four FTEs (three existing and one proposed for FY 06-07). This staffing requirement is consistent with the current operational requirements due to the need for operator staffing of the pretreatment process and operation and maintenance of the membrane filtration system.

- **Alternative 2 - Minimal 1 mgd Membrane WTP at Layng Creek.** This alternative is similar to Alternative 1; however, the following modifications and simplifications have been made to reduce the initial capital costs of the improvements:
  - The new submerged intake on Layng Creek would be located at or near the existing upper site, and would be sized for 1 mgd.
  - Existing pretreatment basins at the upper site would be modified to improve their effectiveness.
  - A new "skid-mounted" membrane filter package plant, located at the Layng Creek lower site, would be sized for a capacity of 1 mgd and the clearwell would be reduced in size to 300,000 gallons.
  - Replacement of sections of the transmission pipeline would use 12" diameter pipe due to the reduced supply capacity.
  - A 1 mgd conventional package plant (e.g., a Neptune Trident system) with a UV disinfection system would be added at the existing Row River Water Treatment Plant to replace the reduced capacity from the Layng Creek source.
  - High service pumping capacity at the Row River Water Treatment Plant would be increased by 1 mgd.

This alternative is shown in Figure 2.

**Figure 2 - Alternative 2**

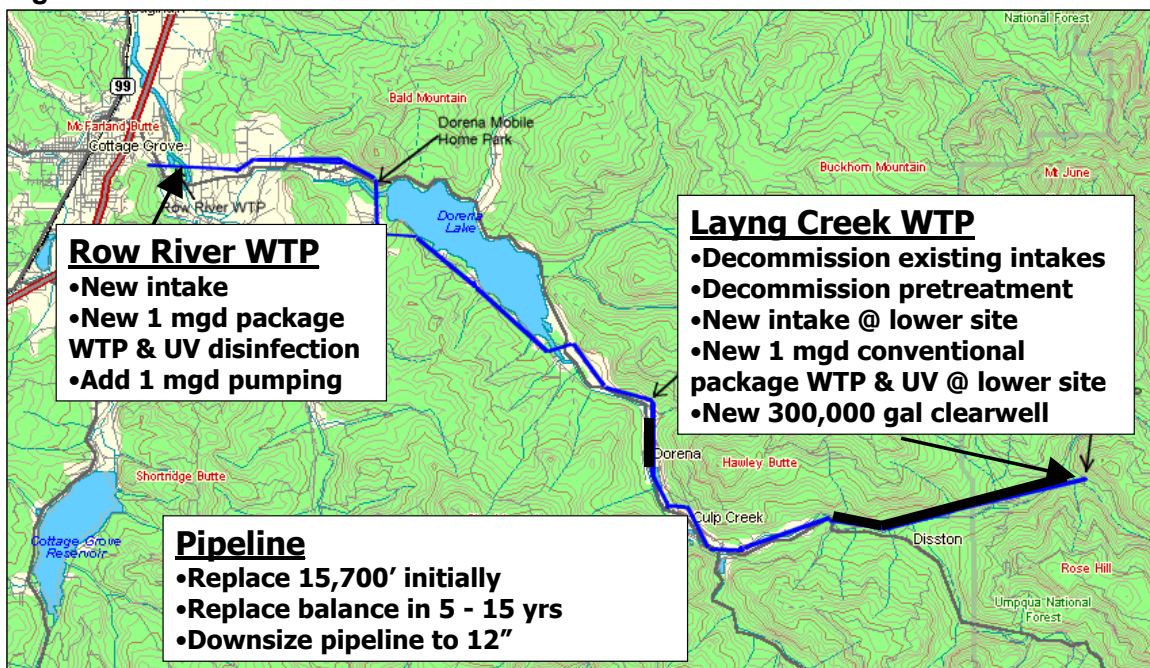


Future costs associated with Alternative 2 include replacement of the balance of the Layng Creek transmission line (approximately 87,000 ft) with a new 12" diameter pipeline over the next 15 years, with highest priority segments to be replaced within the next 5 years.

Operation and maintenance costs of this alternative are assumed consistent with the requirements of Alternative 2 due to the need for operator staffing of the pretreatment process and operation and maintenance of the membrane filtration system.

- **Alternative 3 - Minimal 1 mgd Conventional Package WTP at Layng Creek.** This alternative is similar to Alternative 2 except the new 1 mgd submerged intake would be located at the lower site and a new 1 mgd conventional treatment package plant (e.g., a Neptune Trident system) and UV disinfection would be located at the lower site. This alternative is shown in Figure 3.

**Figure 3 - Alternative 3**



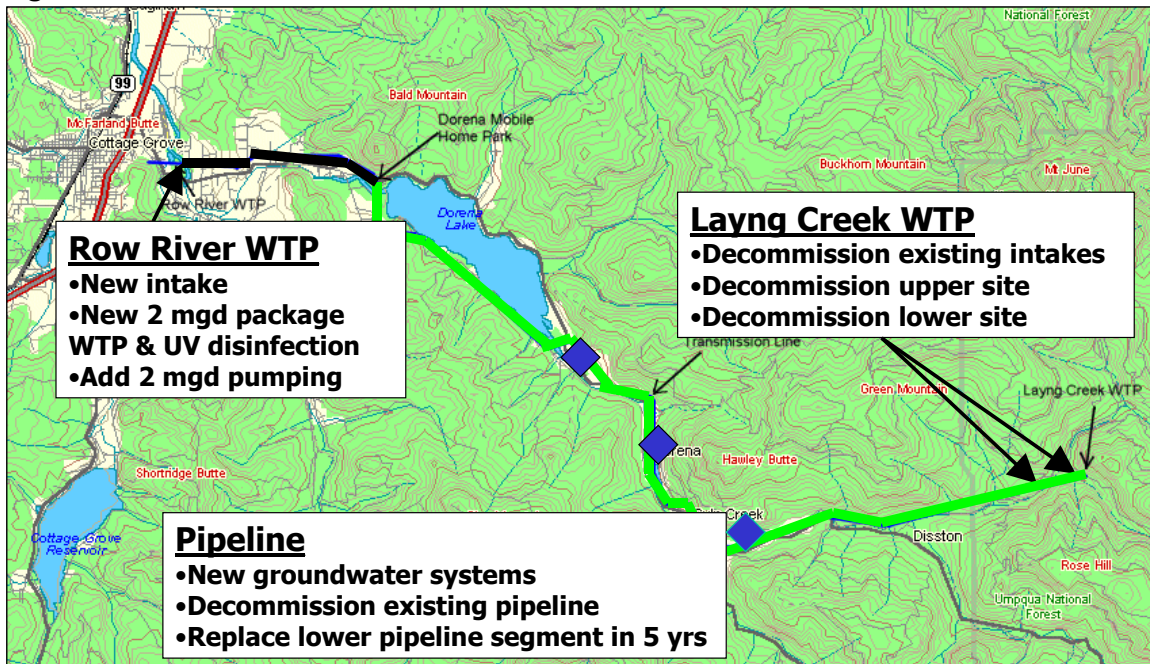
Future capital costs and O&M costs of Alternative 3 would be the same as outlined in Alternative 2.

- **Alternative 4 - Groundwater Supplies for Pipeline Customers.** This alternative consists of providing new individual and small community groundwater systems to serve the existing pipeline customers. Groundwater improvements would be as recommended in the November 2003 Feasibility Report for Transmission Line Customer Service to serve existing pipeline customers between the Layng Creek Water Treatment Plant and the Dorena Mobile Home Park. Pipeline customers between the Dorena Mobile Home Park and the Row River Water Treatment Plant would continue to be served from the

Row River Water Treatment Plant.

The existing Layng and Prather Creeks intakes and associated treatment facilities would be decommissioned. The existing 14" diameter pipeline from the Layng Creek Water Treatment Plant to the Dorena Mobile Home Park would be abandoned. In addition, a new 2 mgd conventional package water treatment plant (e.g., a Neptune Trident system) plus a UV disinfection system would be added at the existing Row River water treatment plant to replace the capacity currently provided by Layng Creek supply. This alternative is shown in Figure 4.

**Figure 4 - Alternative 4**



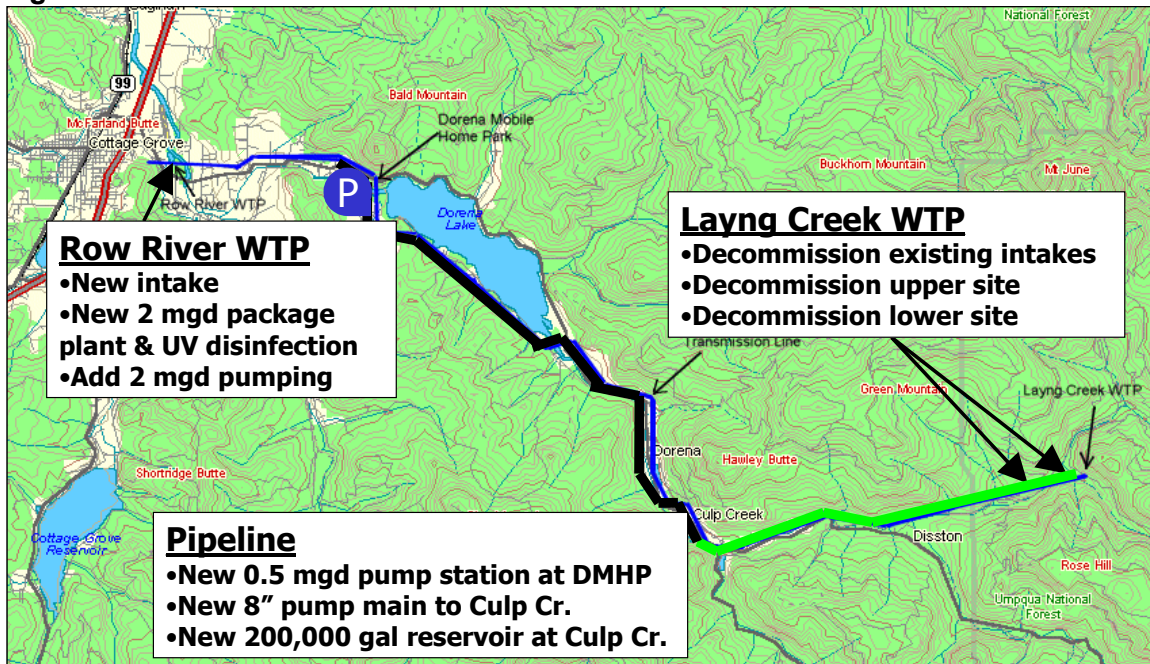
Future costs associated with Alternative 4 include replacement of approximately 17,000' of pipeline between the Row River WTP and the Dorena Mobile Home Park with a new 12" diameter pipeline within the next 5 years. This segment was identified in the 2002 Facility Plan as having reached the end of its useful life. While it would be appropriate to replace this pipeline segment as soon as possible, it is assumed this segment would be replaced within the next 5 years to minimize the initial capital costs of the project.

Operation and maintenance costs of this alternative assume staffing requirements would be met with the existing three FTEs. It would not be necessary to add a fourth FTE due to the elimination of O&M requirements associated with the Layng Creek supply. It would not be possible to decrease staffing from current levels due to the increased operation of the Row River WTP. This alternative assumes the City would provide limited start-up assistance with the new groundwater system and turn over the facilities to the private property owners. It is assumed the City would not provide ongoing operations and maintenance support for the new groundwater supplies.

- **Alternative 5 - Pump Back from the Row River Water Treatment Plant.** This

alternative consists of abandoning the existing Layng Creek supply as described in Alternative 4, constructing a new 2 mgd conventional package plant (e.g., a Neptune Trident system) plus a UV disinfection system at the existing Row River water treatment plant, and pump back system to serve all existing pipeline customers from the expanded Row River WTP. The proposed pump back system would include construction of a new 0.5 mgd pump station in the vicinity of the Dorena Mobile Home Park, construction of a new 8" diameter pump main from the proposed pump station to Culp Creek (approximately 55,000 ft), and construction of a new 200,000 gallon reservoir in the vicinity of the Culp Creek community. This alternative is shown in Figure 5.

**Figure 5 - Alternative 5**

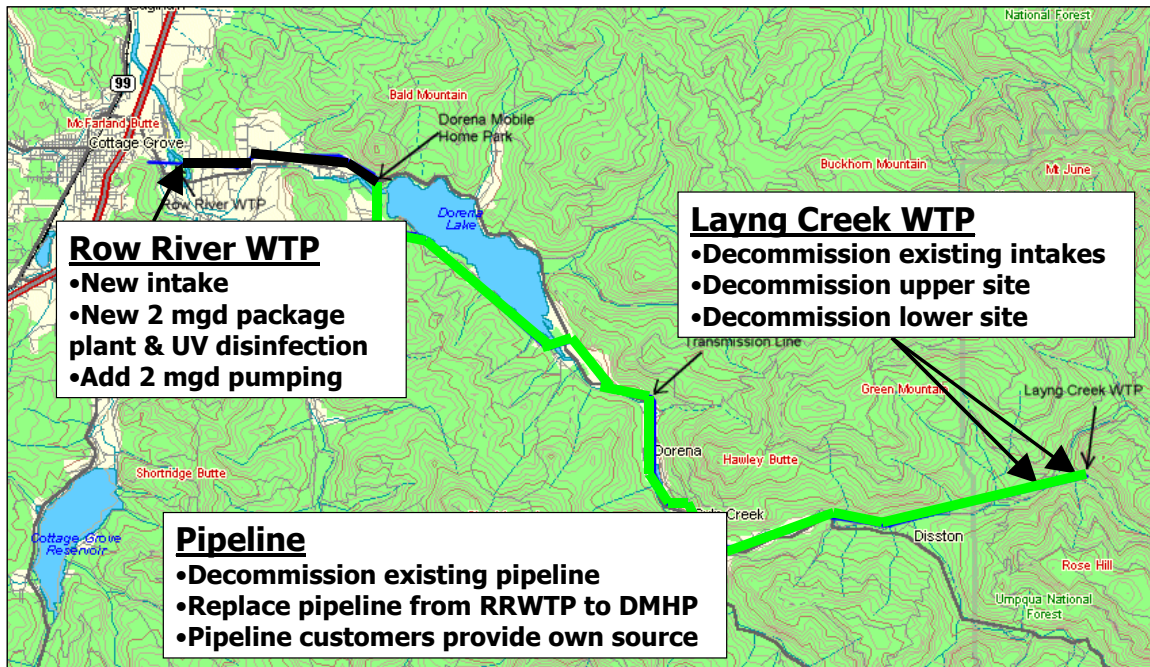


Future costs associated with Alternative 5 include replacement of approximately 17,000' of pipeline between the Row River WTP and the Dorena Mobile Home Park with a new 12" diameter pipeline within the next 5 years. While it would be appropriate to replace this pipeline segment as soon as possible, it is assumed this segment would be replaced within the next 5 years to minimize the initial capital costs of the project.

Operation and maintenance costs of this alternative would be similar to Alternative 4, and could be met with the existing three FTEs due to the elimination of O&M requirements associated with the Layng Creek supply.

- **Alternative 6 - Discontinue Service East of Dorena Mobile Home Park.** This alternative is similar to Alternative 5; however, the pump back system, including the pump station and new pipeline, would be eliminated. This alternative would still require replacement of approximately 17,000' of pipeline between the Row River WTP and the Dorena Mobile Home Park with a new 12" diameter pipeline. This alternative is shown in Figure 6.

Figure 6 - Alternative 6



This alternative assumes existing service to the 110 pipeline customers east of the Dorena Mobile Home Park would be discontinued. These customers would be required to obtain alternative water supplies on their own, presumably using local groundwater sources. Service to the 73 customers west of the mobile home park would continue to be served from the Row Water Treatment Plant.

Operation and maintenance costs of this alternative would be similar to Alternative 4, and could be met with the existing three FTEs due to the elimination of O&M requirements associated with the Layng Creek supply.

## FINANCIAL EVALUATION

The Financial Evaluation provides a tangible, quantified basis for comparing options based on anticipated costs for construction, debt service, operations, and maintenance. Financial criteria include:

- Capital cost of proposed improvements are based on estimated construction costs including construction costs (hard costs) and preliminary engineering, design, permitting, legal and project administration (soft costs).
- Costs are in March 2006 dollars.
- Costs are planning level estimates with relative accuracy of -30% to + 50% and are intended to be used for relative comparison between alternatives.

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- Project costs assume traditional project delivery (design-bid-build).
- Annual operation costs including labor, chemicals, energy, and disposal fees.
- Annual maintenance costs including labor, equipment, materials for routine maintenance and likely repairs.

Assumptions to be used in the financial evaluation include:

- The net discount rate or interest rate for financial calculations is 0%. This includes an assumed time value of money (e.g., return on investment) of 4% and an offsetting average annual inflation rate of 4% for labor, materials, chemicals, consumables, and energy (e.g., net discount rate = return on investment - inflation).
- Average labor rate is \$40.00 per hour. This is the current average rate for water operations staff, fully loaded with benefits and associated overhead.
- The 20-year present worth of cost of proposed improvements including capital costs and annual operations and maintenance costs.

Project costs for each alternative are summarized in Table 1.

**Table 1  
 Cost Summary**

Improvements		Alternative					
		1	2	3	4	5	6
		Layng Creek Supply Options			Alternative Supply Options		
		2 mgd Membrane @ LCWTP (scope per Predesign Report)	1 mgd Membrane @ LCWTP and add 1 mgd Conventional @ RRWTP	1 mgd Conventional @ LCWTP and add 1 mgd Conventional @ RRWTP	Groundwater east of DMHP and add 2 mgd Conventional @ RRWTP	Pump Back east of DMHP and add 2 mgd Conventional @ RRWTP	No Service east of DMHP and add 2 mgd Conventional @ RRWTP
<b>INITIAL CAPITAL COSTS - PHASE 1</b>							
Intake (1)		570,000	400,000	400,000			
3-phase power extension (2)		300,000	300,000	200,000			
Upgrade existing pretreat @ upper site & 2 mgd membrane WTP @ lower site (3)		4,300,000					
Upgrade existing pretreat @ upper site & 1 mgd membrane WTP @ lower site (3)			2,800,000				
Upgrade existing pretreat @ upper site & 1 mgd package WTP+UV @ lower site (4)				1,500,000			
Transmission Line -15,700 ft, 16" dia (5)		2,620,000					
Transmission Line -15,700 ft, 12" dia (5)			2,150,000	2,150,000			
1 mgd package WTP + UV @ RRWTP, and 1 mgd high-service pump (6)			1,400,000	1,400,000			
2 mgd package WTP + UV @ RRWTP, and 2 mgd high-service pump (6)					1,600,000	1,600,000	1,600,000
New 0.5 mgd pump station located near DMHP (7)						350,000	
Transmission Line - Pump main from new pump sta to Culp Cr - 54,900 ft, 8" dia (8)						5,490,000	
Storage Reservoir - 200,000 gal near Culp Creek (9)						150,000	
Groundwater Options (10)					1,650,000		
Decommissioning (11)		300,000	300,000	410,000	410,000	410,000	410,000
RRWTP Intake Improvements (12)		560,000	560,000	560,000	560,000	560,000	560,000
SUBTOTAL		8,650,000	7,910,000	6,620,000	4,220,000	8,560,000	2,570,000
Contingency (13)	25%	2,163,000	1,978,000	1,655,000	1,055,000	2,140,000	643,000
SUBTOTAL		10,813,000	9,888,000	8,275,000	5,275,000	10,700,000	3,213,000
Engineering / Legal / Admin / Associated Costs (14)	17%	1,838,000	1,681,000	1,407,000	897,000	1,819,000	546,000
<b>TOTAL INITIAL CAPITAL</b>		<b>12,650,000</b>	<b>11,570,000</b>	<b>9,680,000</b>	<b>6,170,000</b>	<b>12,520,000</b>	<b>3,760,000</b>
<b>FUTURE CAPITAL COSTS - PHASES 2 &amp; 3</b>							
Transmission Line - First Priority - 17,100 ft, 16" dia (15)		2,850,000					
Transmission Line - First Priority - 17,100 ft, 12" dia (15)			2,340,000	2,340,000	2,340,000	2,340,000	2,340,000
Transmission Line - Second Priority - 24,500 ft, 16" dia (16)		4,100,000					
Transmission Line - Second Priority - 24,500 ft, 12" dia (16)			3,360,000	3,360,000			
Transmission Line - Third Priority - 43,500 ft, 16" dia (17)		7,250,000					
Transmission Line - Third Priority - 43,500 ft, 12" dia (17)			5,950,000	5,950,000			
SUBTOTAL		14,200,000	11,650,000	11,650,000	2,340,000	2,340,000	2,340,000
Contingency (12)	25%	3,550,000	2,913,000	2,913,000	585,000	585,000	585,000
SUBTOTAL		17,750,000	14,563,000	14,563,000	2,925,000	2,925,000	2,925,000
Engineering / Legal / Admin / Associated Costs (13)	17%	3,018,000	2,476,000	2,476,000	497,000	497,000	497,000
<b>TOTAL FUTURE CAPITAL</b>		<b>20,770,000</b>	<b>17,040,000</b>	<b>17,040,000</b>	<b>3,420,000</b>	<b>3,420,000</b>	<b>3,420,000</b>
<b>TOTAL CAPITAL COST - PHASES 1, 2 &amp; 3</b>							
<b>TOTAL 20-YR CAPITAL COST</b>		<b>33,420,000</b>	<b>28,610,000</b>	<b>26,720,000</b>	<b>9,590,000</b>	<b>15,940,000</b>	<b>7,180,000</b>
<b>OPERATION &amp; MAINTENANCE COST</b>							
Water Production Staffing (FTE)		4	4	4	3	3	3
Annual O&M (\$/YR) (18)		732,800	732,800	732,800	649,600	659,600	649,600
<b>20-YR PRESENT WORTH OF O&amp;M</b>		<b>14,656,000</b>	<b>14,656,000</b>	<b>14,656,000</b>	<b>12,992,000</b>	<b>13,192,000</b>	<b>12,992,000</b>
<b>TOTAL 20-YR PRESENT WORTH OF CAPITAL PLUS O&amp;M</b>							
<b>TOTAL 20-YR PRESENT WORTH</b>		<b>48,076,000</b>	<b>43,266,000</b>	<b>41,376,000</b>	<b>22,582,000</b>	<b>29,132,000</b>	<b>20,172,000</b>

Note - Table 1 abbreviations and footnotes on following page

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**Abbreviations & Footnotes for Table 1**

LCWTP	Layng Creek Water Treatment Plant
RRWTP	Row River Water Treatment Plant
mgd	Million Gallons Per Day
DMHP	Dorena Mobile Home Park
(1)	Cost based on updated estimate from Preliminary Design Report; capacity adjusted to 1 mgd for alternatives 2 and 3.
(2)	Cost based on updated estimate from Preliminary Design Report; 3-phase service to upper site assumed for alternatives 1 and 2.
(3)	Cost of membrane WTP's based on updated estimate from Preliminary Design Report and vendor quote for membrane package plant. \$100,000 allowance for pretreatment.
(4)	Cost of conventional filtration package plant (e.g., Trident) based on costs for recent, similar projects. \$200,000 allowance for site work, disinfection upgrades.
(5)	Replacement of highest priority pipe segments from LCWTP to Dorena Lake per Preliminary Design Report. Costs based on updated estimate from Preliminary Design Report and adjusted for diameter as applicable for alternatives 2 and 3.
(6)	Cost of conventional filtration package plant (e.g., Trident) based on costs for recent, similar projects. \$100,000 allowance for high service pump upgrades.
(7)	Cost of new 0.5 mgd pump station based on recent, similar projects.
(8)	Cost of pump back pump main assumes construction on shoulder of road and minimum cover. Cost based on recent, similar projects.
(9)	Cost of low-cost storage reservoir based on Carollo cost curves.
(10)	Cost of groundwater options based on updated costs from Nov 2003 Feasibility Report.
(11)	Cost of decommissioning existing intakes and plant sites based on updated estimates from Preliminary Design Report.
(12)	Cost for new infiltration gallery intake at RRWTP based on updated estimates from Preliminary Engineering Report.
(13)	Contingency of 25% per Carollo planning level cost estimating standards and consistent with Preliminary Engineering Report.
(14)	Engineering, legal and admin allowance of 17% per Carollo planning level cost estimating standards. Includes allowance for permits, land acquisition, inspection, and testing services.
(15)	High priority pipeline segment from RRWTP to Dorena Mobile Home Park. Facility Plan notes this segment as having no remaining useful life. Cost based on recent, similar projects.
(16)	High priority pipeline segments between LCWTP and Dorena Mobil Home Park. Facility Plan notes these segments as having no remaining useful life. Cost assumes realignment to public rights-of-way and is based on recent, similar projects.
(17)	Moderate priority pipeline segments between LCWTP and Dorena Mobil Home Park. Facility Plan notes these segments as having 20 to 25 year remaining useful life. Cost assumes realignment to public rights-of-way and is based on recent, similar projects.
(18)	Annual operating costs include full-time staffing as noted and Water Production Materials & Services budget for FY 2005-2006.

## **NON-FINANCIAL EVALUATION**

The resulting improvements should be efficient, effective, and reliable in meeting the City's requirements. The resulting facilities and processes must meet or exceed all applicable federal and state water quality standards, must not adversely impact operation of the current water treatment process and must be flexible enough to accommodate unforeseen future events or changes in forecasted needs. The non-financial evaluation, while generally less quantifiable than the financial evaluation, provides equally important bases for comparison of the alternatives by considering such factors as reliability, regulatory considerations, flexibility to accommodate future needs, and potential environmental impacts. Criteria considered in the non-financial evaluation include:

- **Performance reliability** - Consistency of process performance, likelihood of breakdown or process upset, and vulnerability to power outages.
- **Operational and maintenance requirements** - Non-quantitative, non-financial factors such as operational skill-level requirements, and complexity of process and process-related equipment.
- **Supply reliability** - The availability of a second source to supplement the Row River supply, capable of meeting minimum needs of the City, would provide additional reliability.
- **Flexibility and ability to accommodate growth** - Ability of treatment process to accommodate changes in solids or hydraulic loading over time and/or ability to expand to meet future demands and plant expansions.
- **Regulatory compliance** - Ability to meet current regulations and potential impacts of anticipated future regulations.
- **Permitting requirements** - Ability to meet current zoning and permitting requirements such as land-use zoning and or disposal permit requirements.
- **Environmental impacts**. Potential environmental impacts associated with proposed process such as potential for odors, noise, and emissions.
- **Security** - Potential for changes in vulnerability of plant or related facilities that may be associated with proposed process modifications.

Alternatives were evaluated against these criteria based on professional judgment and experience of the Carollo project team. Results of the non-financial evaluation are summarized in Table 2.

**Table 2**  
**Non-Financial Evaluation Summary**

Improvements	Alternative					
	1	2	3	4	5	6
	Layng Creek Supply Options			Alternative Supply Options		
	2 mgd Membrane @ LCWTP (scope per Predesign Report)	1 mgd Membrane @ LCWTP and 1 mgd Conventional @ RRWTP	1 mgd Conventional @ LCWTP and 1 mgd Conventional @ RRWTP	Groundwater east of DMHP plus 2 mgd @ RRWTP	Pump Back east of DMHP plus 2 mgd @ RRWTP	No Service east of DMHP plus 2 mgd @ RRWTP
Operational and maintenance requirements	1	1	1	2	3	3
Supply reliability	3	2	2	1	1	1
Flexibility and ability to accommodate growth	3	3	3	3	3	3
Regulatory compliance	3	3	3	2	3	1
Permitting requirements	2	2	2	2	3	3
Environmental impacts	2	2	2	3	3	3
Security	2	2	2	3	3	3
<b>TOTAL SCORE</b>	<b>16</b>	<b>15</b>	<b>15</b>	<b>16</b>	<b>19</b>	<b>17</b>

**Legend**

- 0 = Does not satisfy criteria (not acceptable)
- 1 = Marginally satisfies criteria (low)
- 2 = Generally satisfies criteria (medium)
- 3 = Exceeds requirements of criteria (high)

**PROJECT DELIVERY METHODS**

Alternate project delivery approaches have been considered as a possible means to accelerate project completion of the proposed improvements. The following section summarizes the two most commonly used alternate approaches in the water and wastewater industry, Construction Manager/General Contractor (CM/GC) and the Design-Build (DB) approaches, and reviews the relative advantages and disadvantages of each approach and their impacts on project schedule and cost.

Project delivery methods commonly used for public works projects in Oregon include:

- **Traditional (Design-Bid-Build).** The Owner contracts with the designer to produce a final design, including plans and specifications. Following completion of design, the competitive bids are solicited and the project is awarded to the low bid construction contractor. The Owner contracts with this construction contractor to build the project.
- **Construction Manager/General Contractor (CMGC).** The Owner contracts with a designer in a similar manner as with the traditional approach. The difference is the Owner contracts with a general contractor early in the design process (usually at roughly 30 percent design). The Owner selects the general contractor based on price and qualifications. The contractor is able to influence the design in terms of value engineering and constructability reviews to enhance the value of the design. The contractor prepares a guaranteed maximum price (GMP) at roughly the 60-percent design completion. The GMP is a contractual commitment to construct the project for a

not-to-exceed price. Often the contractor can accelerate the delivery by ordering long-lead equipment and begin site preparation construction before the design is complete. This delivery approach is becoming more common in Oregon for infrastructure projects.

- **Design/Build (DB).** The Owner contracts with one entity, the Design/Builder, to provide both the design and construction of the project. The Owner has one contract with a single point of responsibility for project delivery. The Owner typically selects the Design/Builder based on price and qualifications. Because the design is not advanced at the time the Design/Builder is contracted, a GMP is developed after contract award much like with CM/GC.

Table 3, taken from the Oregon Public Contracting Coalition Guide to CM/GC Contracting, is a summary showing the comparisons among the three approaches. Notable differences involve schedule and the Owner's control of the design process. The CM/GC and DB approaches are faster because the construction can begin before the design is complete with construction and design activities being performed concurrently. With regard to design control, the traditional and CM/GC approaches require the Owner to have a separate design contract with the designer apart from the construction contract. The DB approach involves a single contract between the Owner and Design/Builder. Because the Owner does not have a separate design contract, the Owner's control of the design process is more limited using the DB approach.

Alternate delivery can be a significant challenge for an Owner who is not familiar with the different approaches. For example, Oregon statutes (ORS Chapter 279) require an exemption to the otherwise required process of competitive sealed bids if the Owner selects the contractor based on qualifications. The exemption process involves the filing of project findings and a public hearing as outlined in ORS 270.015(2), (3), and (6).

Table 4 summarizes the advantages and disadvantages of each approach including the schedule and design control features.

**Table 3**  
**Comparison of Contracting Methods**

<b>Criteria</b>	<b>CM/GC (Alternative)</b>	<b>Design-Bid-Build (Traditional)</b>	<b>Design-Build (Alternative)</b>
<b>Project Characteristics</b>			
Complexity	Probably high; may have multiple bid packages.	Moderate to low.	Usually either high or low, but not in-between.
Schedule	Aggressive; fast-tracking possible.	Reasonable; not a key factor.	Aggressive; fast-tracking possible.
Budget	High priority; likely fixed; usually GMP.	Normal importance.	Likely fixed.
Design quality		Owner controls quality.	Owner has limited control.
Construction quality	Complexity implies higher quality.	Not a driving factor.	Not a driving factor.
<b>Contractual Structure</b>			
Compensation	Standard fees to design team; GMP to CM/GC.	Lump sum - all participants.	Lump sum to consolidated team.
Contract arrangement	AIA contract form or variant for design; bid or negotiate for construction.	Agency - Design professional. Agency - Contractor.	Single-point contract with Design-Builder.
<b>Delivery Team Structure</b>			
Disciplines required	Standard design team plus CM/GC.	Typical project design and construction teams.	Contracting and design consolidated.
Experience needed	High degree of experience required for all participants (Owner, Designer, Contractor).	Moderate.	Experience in DB needed.
Communications	Design professional as agent; CM is contractor; "open book bidding."	Traditional design professional as agent.	Consolidated. Single point of responsibility.

**Table 3**  
**Comparison of Contracting Methods**

<b>Criteria</b>	<b>CM/GC (Alternative)</b>	<b>Design-Bid-Build (Traditional)</b>	<b>Design-Build (Alternative)</b>
<b>Legal/Risk Management</b>			
Liability	CM/GC "at risk," but design team further exposed.	Standard.	Single point of response with DB firm.
Dispute resolution	Standard, but in partnering atmosphere.	Standard dispute resolution, mediation, litigation.	Standard ADR, mediation, litigation.
Conflict of interest	Potential to CM/GC - dual roles during pre-construction and construction.	None.	Potential professional conflict for design team.
<b>Project Control</b>			
Schedule control	By CM/GC.	By Contractor.	Agency looks to DB team for guidance. Distribution of responsibilities within DB team is internal issue.
Cost control	By CM/GC with design team consultation.	Contractor/Design professional.	Design-Builder.
Quality control	By CM/GC with design team consultation.	Design professional/ Contractor.	Design-Builder.
Owner staff	Must be able to meet Owner's obligations in pre-construction services and contract administration.	Standard.	Depends upon degree of Owner control over the design and construction.

**Table 3  
 Project Delivery Systems at a Glance**

		<b>Control</b>	<b>Quality</b>	<b>Budget/Schedule</b>	<b>Risk Assessment</b>
<b>Traditional Project</b>	<b>Advantages</b>	<ul style="list-style-type: none"> <li>• Allows maximum Owner control over project variables.</li> <li>• Allows the Owner to promote greater distribution of work to local consultants, contractors, and vendors through increased number of contracts.</li> <li>• Design and construction management professionals function as the Owner's agents, promoting the Owner's interests and goals.</li> </ul>	<ul style="list-style-type: none"> <li>• The Owner can define and detail their needs and requirements to absolute specification.</li> <li>• The Owner-managed delivery system process allows time for the Owner, consultant engineers, board, community governmental agencies, and funding agencies to coordinate throughout the design process to ensure the Owner is buying a product acceptable to all parties.</li> </ul>	<ul style="list-style-type: none"> <li>• There is potential for increased savings to the Owner through increased contractor competition and through well-conceived and consistent bid documents. This will result in tight bid spreads.</li> <li>• The Owner has greater control over interface milestones and other critical interfaces.</li> <li>• Project delivery system allows the greatest funding flexibility – design and construction contracts can be let according to Owner cash flow.</li> </ul>	<ul style="list-style-type: none"> <li>• As a result of retaining overall project management responsibilities and control, the Owner also retains the majority of the risk (unless risk-sharing is built into contracts with other parties such as the CM).</li> <li>• While contractors are required to perform to the level of contractual obligations, risk for overall project quality, start-up, site safety, unforeseen conditions, craft control, payment schedules, scope changes, and programming are the Owner's responsibility.</li> </ul>
	<b>Disadvantages</b>	<ul style="list-style-type: none"> <li>• Owner has a greater management role and needs a larger staff to maintain proper project control.</li> <li>• Multiple interfaces between the Owner, design consultant, construction manager, and contractor(s) can result in the Owner acting as a referee.</li> </ul>	<ul style="list-style-type: none"> <li>• Potential for design change exists up to the contract letting.</li> <li>• To the extent not covered by Errors and Omissions coverages, Owner is responsible for approving design and living with a poor design.</li> </ul>	<ul style="list-style-type: none"> <li>• Owner is ultimately responsible for project schedule.</li> <li>• Management of the interfaces are usually the greatest area for delays and changes.</li> </ul>	

**Table 3**  
**Project Delivery Systems at a Glance**

		<b>Control</b>	<b>Quality</b>	<b>Budget/Schedule</b>	<b>Risk Assessment</b>
<b>Construction Manager / General Contractor</b>	<b>Advantages</b>	<ul style="list-style-type: none"> <li>Allows flexibility during construction, as Owner retains right to modify plans and approve subcontracting packages.</li> <li>Allows for a high degree of control over specialized construction work, even if the Owner has insufficient in-house resources or expertise to manage the contracts.</li> </ul>	<ul style="list-style-type: none"> <li>Advice from the general contractor during the design stage leads to early "buildability" input.</li> </ul>	<ul style="list-style-type: none"> <li>Overlap of design and construction can lead to early start and early project completion.</li> <li>Involvement of contractor at the planning stage allows packaging contracts to be compatible with contractors' strategies.</li> <li>Increased reliability of cost and time estimates since individual packages can be let at the last minute to enable flexibility, and more accurate and complete pricing.</li> </ul>	<ul style="list-style-type: none"> <li>Risk is distributed more evenly between Owner and GC – funding, conceptual planning, and site selection liabilities are the Owner's (and/or the Owner's design consultant) responsibility while the GC takes charge of construction, quality control, site safety, cost risk and craft control as soon as construction begins.</li> </ul>
	<b>Disadvantages</b>	<ul style="list-style-type: none"> <li>Multiple contracts can create scheduling difficulties for GC as well as interface related changes from various subcontractors that affect separately held contracts by the Owner.</li> </ul>	<ul style="list-style-type: none"> <li>On a "fast track" program, design may suffer if designer is overly pressured.</li> </ul>	<ul style="list-style-type: none"> <li>Uncertainty about cost of the complete project at the start of construction if proceeding on a "fast track."</li> <li>Without contract incentive or GMP limits, GC has no reason to keep costs down (especially if they are working on a percentage fee basis).</li> <li>If GC falls behind, subcontractors may not be paid – progress can grind to a halt.</li> </ul>	

**Table 3  
 Project Delivery Systems at a Glance**

		<b>Control</b>	<b>Quality</b>	<b>Budget/Schedule</b>	<b>Risk Assessment</b>
<b>Design-Build</b>	<b>Advantages</b>	<ul style="list-style-type: none"> <li>• Owner requires a smaller staff to oversee the construction effort.</li> <li>• Owner does not have to act as a referee between the designer and contractor.</li> <li>• Owner has a single point of contact to resolve issues.</li> </ul>	<ul style="list-style-type: none"> <li>• Contractor is responsible for delivering a product that meets the Owner-approved quality manual.</li> <li>• Any deviation from quality requirements can directly be attributable to the contractor, making it their responsibility to correct any deficiencies.</li> </ul>	<ul style="list-style-type: none"> <li>• Contractor's increased control may result in lower overall costs.</li> <li>• Potential for early completion on a "fast-track" schedule is heightened because construction and manufacturing can begin before the plans and specifications are completed.</li> <li>• Single source for design and construction may permit increased communication and faster reaction to project developments.</li> </ul>	<ul style="list-style-type: none"> <li>• Responsibility and risk are delegated to a single source for design and construction.</li> <li>• Majority of project completion risk and budget conformance is allocated to the contractor.</li> <li>• Owner must rely on contractor to construct a functional facility without benefit of the level of oversight normally available through other delivery methods.</li> </ul>
	<b>Disadvantages</b>	<ul style="list-style-type: none"> <li>• Drawings, plans, and specifications may remain the property of the contractor unless otherwise established in the contract.</li> <li>• Owner may find it difficult to induce contractor to produce construction drawings for review unless they are compensated for their costs.</li> </ul>	<ul style="list-style-type: none"> <li>• Potential for objectivity among DB participants to become obscured (ex: design professionals hired by contractor have no obligation to inform Owner about defects and deficiencies in contractor's work).</li> <li>• Contractor is solely responsible for furnishing design work limiting Owner's input on detailed design – may result in project not being constructed exactly as Owner expected.</li> </ul>	<ul style="list-style-type: none"> <li>• Differences in interpretation of the preliminary engineering (30% design) products may result in claims and schedule delays.</li> <li>• Owner must coordinate interfaces between the DB contractors.</li> <li>• Can be uncertainty over final project cost if proceeding on a "fast track."</li> <li>• Owner may pay a premium if there are major changes on the project.</li> </ul>	

As noted in the previous tables, alternative project delivery methods may result in reduced project schedules. Based on Carollo's experience with similar projects, use of alternative project delivery methods may reduce the overall schedule by up to 25% for projects similar to the alternatives considered in this analysis. However, Carollo has found that little, if any, cost savings is realized due to the higher level of risk that DB contractors and CMGC teams must accept, and therefore include in their prices, for alternative delivery projects. This is especially true on pipeline projects where there can be significant uncertainties regarding underground conditions and potential delays associated with permitting processes.

## **CONCLUSIONS AND RECOMMENDATIONS**

The three alternatives that include upgrading the existing Layng Creek Water Treatment Plant (Alternatives 1, 2 and 3) all have initial capital costs that exceed the City's available Phase 1 capital budget of \$7.2 million. In addition, these alternatives have the highest total project costs due the need to replace the exiting transmission main over the next 15 years. This is especially significant since major portions of the existing transmission main (approximately 41,600 ft) should be replaced as soon as possible based on information from the Facility Plan report indicating that these sections have no remaining useful life. Given their high initial capital costs, high long-term capital costs, and high operations and maintenance costs, these three alternatives are not recommended.

Alternative 4 (Groundwater east of Dorena Mobile Home Park and add 2 mgd at Row River WTP) can initially be constructed within the City's available Phase 1 capital budget. However, to achieve this goal, it is necessary to defer replacement of the high priority pipeline segment between the Row River Water Treatment Plant and the Dorena Mobile Home Park. Based on information in the Facility Plan, this pipe segment should be replaced as soon as possible.

Alternative 5 (Pump Back east of Dorena Mobile Home Park and add 2 mgd at Row River WTP) offers the most cost-effective alternative for supplying City water to customers east of the mobile home park based on both total project capital cost and 20-year present worth. However, this alternative is not affordable based on the City's available Phase 1 capital budget.

Alternative 6 (Discontinue Service east of Dorena Mobile Home Park and add 2 mgd at Row River WTP) is affordable and could include construction of the high priority pipeline segment between the Row River Water Treatment Plant and the Dorena Mobile Home Park as part of Phase 1 of the project. However, this alternative discontinues service to existing pipeline customers east of the mobile home park.

Given the City's available Phase 1 capital budget and assuming there is a desire to continue to provide a water source for the existing pipeline customers east of the mobile home park, it is recommended the City proceed with predesign and design of Alternative 4 (Groundwater east of Dorena Mobile Home Park and add 2 mgd at Row River WTP). It is further recommended that at least a portion of the existing pipe segment between the Row River Water Treatment Plant and the Dorena Mobile Home Park be replaced as part of the Phase 1 improvements project. This appears feasible based on the Phase 1 capital budget and should be pursued following completion of the predesign and updated cost estimates for the proposed improvements.

It is also recommended the City consider the use of CM/GC as an alternative project delivery method to potentially reduce the overall schedule requirements to complete these improvements. This is based to the potential time savings generally associated with alternative project delivery methods. In addition, by shifting some risks to the City, the CM/GC method has the potential to provide greater opportunities for cost control as compared to the DB method.