



Capacity Management Program

Technical Memorandum No. 4 Interim Conveyance



Introduction

Water Environment Services (WES) is currently conducting pre-design activities that address the Board of County Commissioners recommendations for interim and long-term treatment and conveyance strategies for Clackamas County Service District No. 1 (CCSD No. 1). These activities are being carried out under WES' Capacity Management Program and its Implementation Team. The current focus is directed at developing pre-design packages for the interim treatment and conveyance options that include a facilities expansion at the Tri-City wastewater treatment plant and associated diversion pipelines, along with preliminary layouts for a potential new plant for the District.

This memorandum outlines the Capacity Management Program's decision-making approach as to a recommendation for the interim conveyance option(s). The basic function of this conveyance is to expand the existing diversion of wastewater flow from CCSD No.1 to the Tri-City Service District (Tri-City) treatment plant in Oregon City. The existing diversion carries about 0.5 mgd at an equivalent waste strength defined by 5,500-6,000 Equivalent Dwelling Units (EDUs). The interim flow strategy would expand that diversion to 20,000 EDUs (approximately 5 mgd) from CCSD No. 1 to Tri-City, achieving both an off-loading of flows and loads to Kellogg (capping its capacity at 28,000 EDUs) and expansion of interim treatment capacity required to serve the growth in CCSD No. 1. The interim diversion is expected to be in service by the end of 2008.

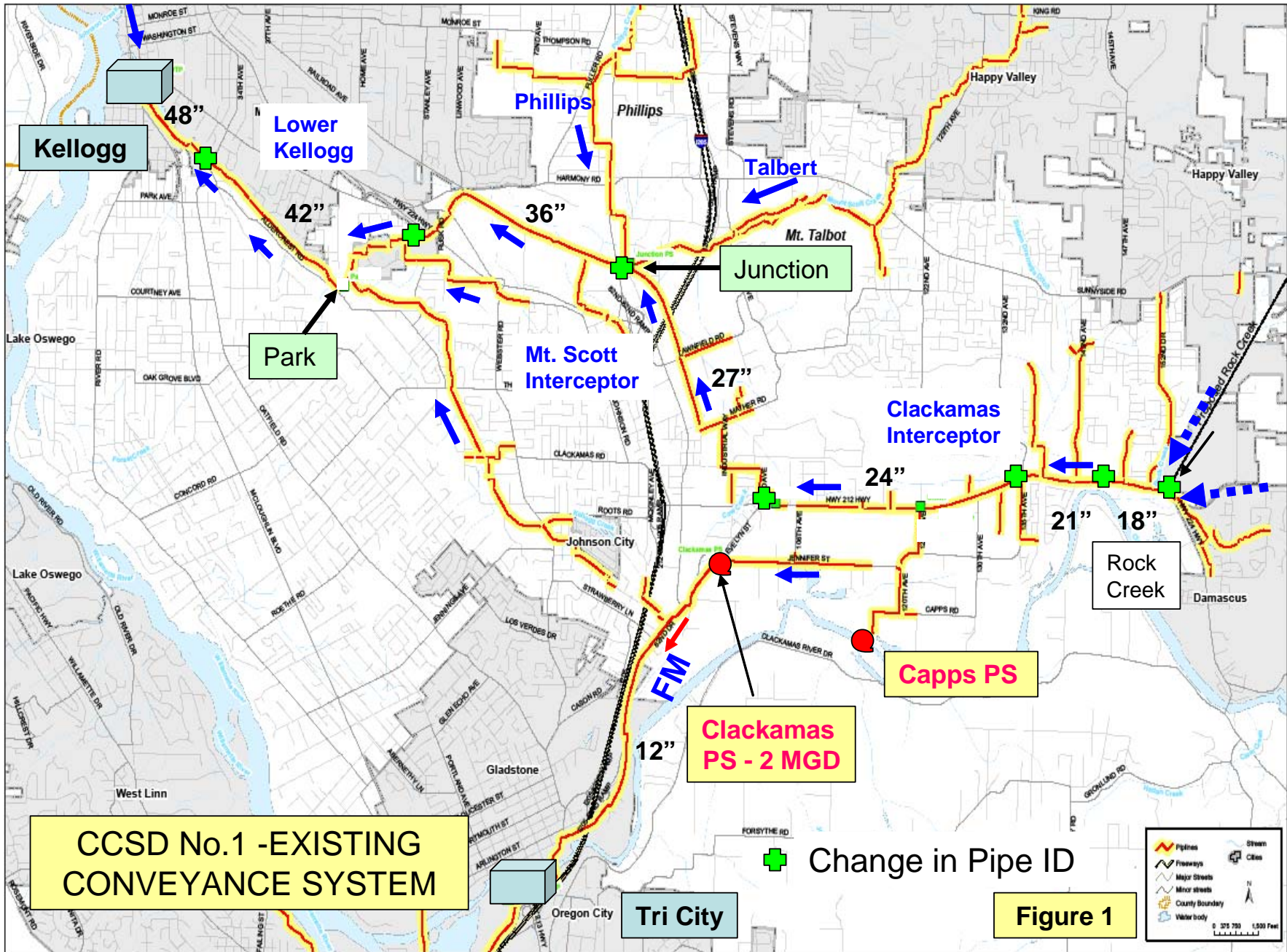
In order to do this, two basic conveyance options have been identified by the Capacity Management Program's Implementation Team. The first option, or so-called Junction Pump Station alignment, would add a pair of diversion pipelines extending from a point near the interchange of Highway 212/224 and I-205, through the existing Clackamas pump station, to the Tri-City plant; while the second or so-called Trolley-Trail alignment, would add a pair of diversion pipelines extending from the Kellogg treatment plant to the Tri-City plant. In either case, the two options also include a required upgrade of the existing conveyance backbone at its eastern end to accommodate added flows from planned service expansion in the Rock Creek area.

This memorandum documents the development of a series of decision criteria for selecting a preferred alignment, along with identifying sufficient detail to size and layout that alignment with any required pumping.

Basic Design Information

Existing System Description

The Kellogg plant presently treats sewage generated in the unincorporated areas of Clackamas County on both sides of Hwy 205 and from the cities of Milwaukie, Happy Valley, and Johnson City. The backbone of the existing conveyance system is a 45,000 feet long gravity sewer interceptor extending on the eastside from the Highway 212 crossing of Rock Creek (bridge) to the Kellogg plant located in Milwaukie on the west. The interceptor has three main sections known as the Clackamas Interceptor, Mount Scott Interceptor, and Lower Kellogg Interceptor. The interceptor and major contributing collectors are illustrated in **Figure 1**.



At its eastern end the interceptor starts as an 18-inch diameter pipe. Pipe sizes gradually increases in size to 48-inch diameter as it progresses west and arrives at the Kellogg plant. **Figure 2** illustrates the pipeline profile, change in pipe sizes, estimated sectional capacities and locations of major collector system contributions.

Design Assumptions

The following assumptions shall be used in identifying and developing interim diversion alternatives and sizing of its major components:

- 1) The proposed interim diversion system shall be designed and built in 2007 and 2008, put in service by the end of 2008, and remain in service until year 2014.
- 2) By the year 2014, a new treatment plant and a conveyance system will be built to convey and treat future sanitary flows. The location for the new treatment plant is being determined under a separate study being conducted at this time. A conclusion for that study is not anticipated until late 2007 or early 2008. As such, only general assumptions can be made as to its location and the conveyance facilities necessary to deliver flow to or to dispose treated water from the new plant, at this time. The desired outcome is that interim diversion facilities will have potential (preferred certainty) of becoming long term system elements.
- 3) CCSD No. 1 is committed to treat all present and future sanitary flows within its existing service area. These include the unincorporated areas within CCSD No. 1 and from the cities of Milwaukie, Happy Valley, and Johnson City.
- 4) No future sanitary flows from Damascus are explicitly considered in the sizing or alignment of the potential interim conveyance needs.
- 5) The proposed diversion system elements shall be sized to divert all flows in excess of the estimated Kellogg Plant capacity of 6.5 mgd during dry and 21 mgd during wet weather periods and transport them to the Tri-City plant.
- 6) Based on long-term flow projections developed for CCSD No. 1, the interim diversion expansion will increase the existing flow from about 0.5 mgd to 4.5 mgd on a dry weather basis and be capable of handling a peak flow of about 20.0 mgd during wet weather periods. Even though these flow values are approximate, they do represent the best available information and will be used for the preliminary sizing of the interim diversion system components, including pump stations, gravity conveyance, and force main lines.
- 7) Two separate pipelines will be used to convey diversion flows. A smaller pipeline will be used convey dry weather flows only, in combination with a second larger pipeline for conveying wet weather flows.

Hydraulic Characteristics of Existing Sanitary Trunk LK-MS-CL (from Kellogg WPCP to Rock Creek)

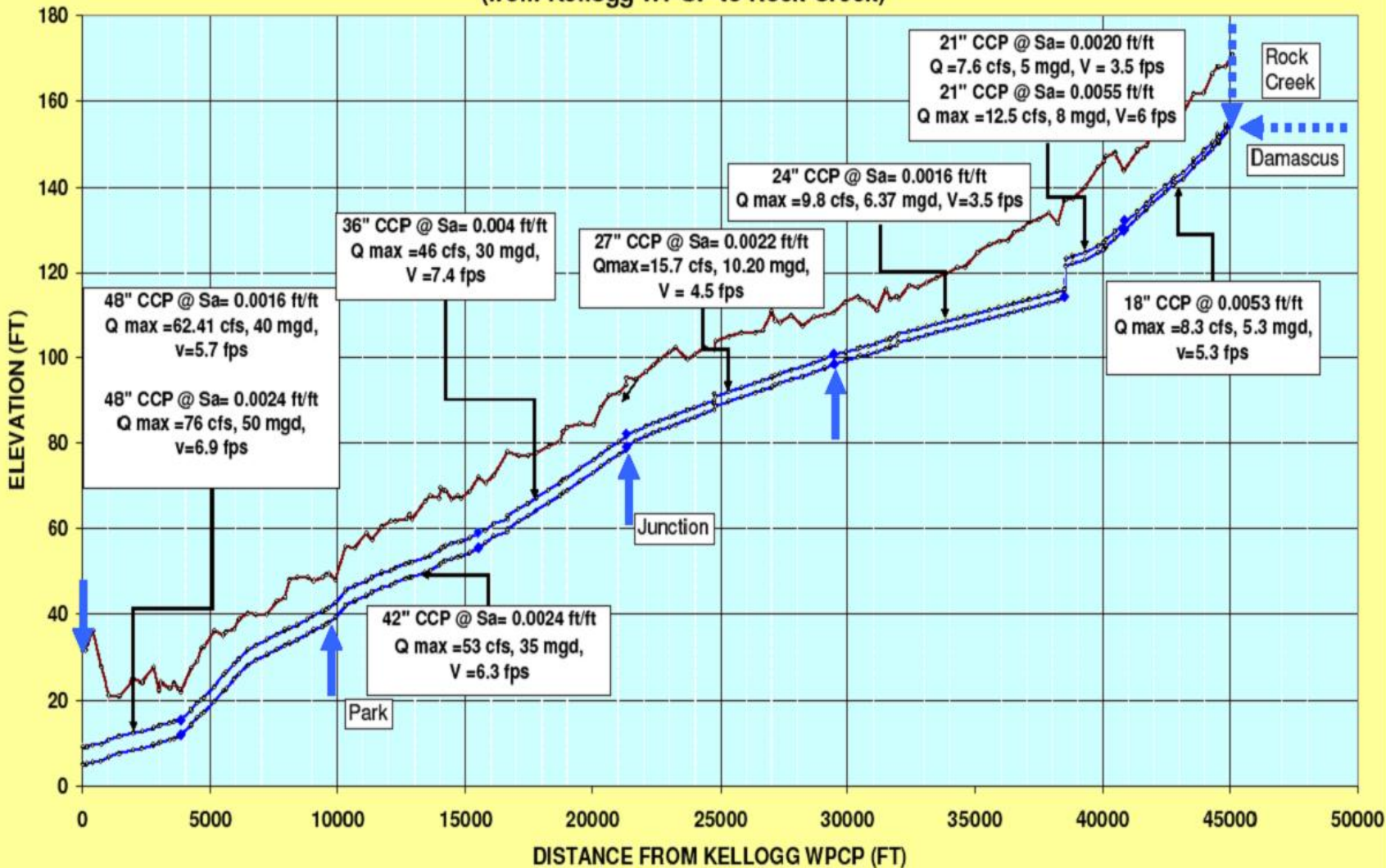


FIGURE 2

- 8) The minimum target flow velocity in force mains will be 2 feet per second (ft/s) to mitigate solids deposition during low flow periods. Where this is not possible (especially during early system life), a diurnal velocity of 3.5 ft/s for some portion of dry weather flow days will be considered to re-suspend and transport solids. It is possible that these criteria will not be attainable during early system life. As such, pipeline cleaning (pigging) facilities and measures to mitigate septic conditions within the pipeline(s) may be necessary. These types of issues will be part of the Oregon DEQ review process during pre-design phases.

Description of Alternatives

Through preliminary investigation of the existing conveyance system, the Capacity Management Team has identified two feasible alignment corridors for achieving the required interim diversion of flow from CCSD No. 1 to the Tri-City plant. The first option, herein referred to as the Trolley Trail alignment, identifies a pair of pipelines and pump station that would divert flow from the Kellogg plant site to Tri-City. The basic rationale for this alignment is one based on interconnecting the two plants, allowing potentially for bi-directional diversion of flow from one plant to the other. The second option, herein referred to as the Three Creeks alignment, also identifies a pair of pipelines and pump station that would be used to off-load the existing conveyance system as far to the east as practical, allowing for the appropriate diversion without compromising the capacity of the remaining conveyance backbone to the west. Both alternatives are described in greater detail below and are illustrated schematically in **Figure 3**.

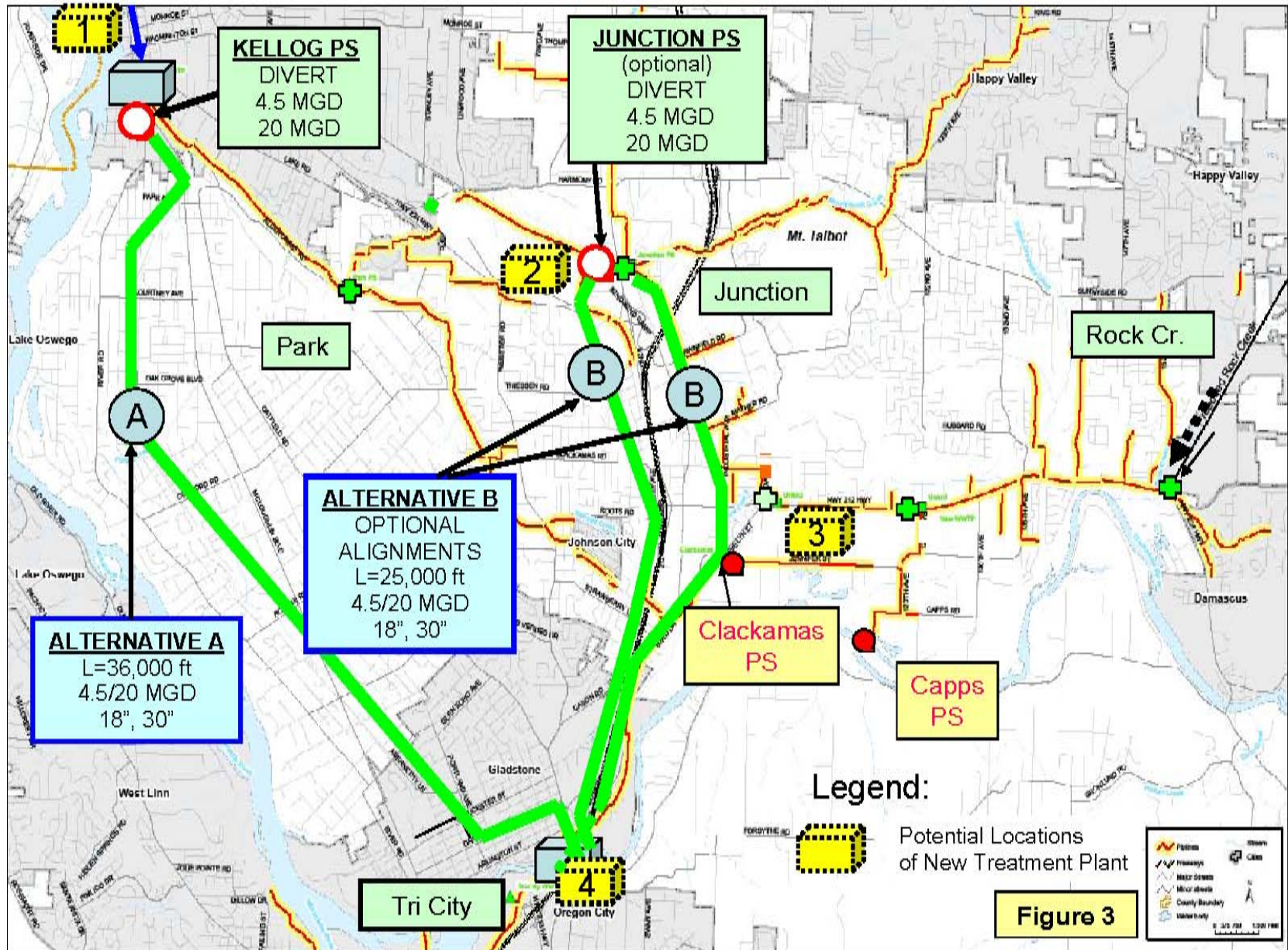
Trolley Trail Alignment

This alternative provides for a diversion pump station to be built at the existing Kellogg plant site, allowing for sufficient flow to the Tri-City plant. The pump station would deliver wastewater flow along a pair of pipelines, each approximately 36,000 feet in length. The general alignment follows the old trolley line and River Road corridor, with a crossing of the Clackamas River on the pedestrian bridge adjacent to the Tri-City plant. It would terminate in the Headworks facility just upstream of the existing bar screens.

The proposed pipelines would be comprised of a 18 and 30-inch diameter pair, with the smaller pipeline being dedicated to conveying dry weather flows and the second, larger pipeline, designed to pick-up wet weather flows. This alignment would traverse mostly along an existing trail and not require a lot of surface restoration, nor may it require the acquisition of any permanent easements from private property owners. It will, however, require significant pumping in excess of typical friction losses with a maximum lift of about 165 feet and a total pumping head in excess of 200 feet.

Three Creeks Alignment

This alternative provides for a diversion in the vicinity of the confluence of the Three Creeks near the interchange between Hwy. 212/224 and I-205. The general alignment includes potential routes on both the east and west sides of I-205, crossing of the Clackamas River on the pedestrian bridge adjacent to the Tri-City plant, and discharge to the plant facilities as described in the option above. The exact location of the diversion, herein referred to as the Junction Pump Station, would be placed as far to the east as possible to lessen the requirements for upgrading the existing (overstressed) conveyance backbone and as far to the west as to allow for sufficient flow interception to feed the treatment expansion at the



Tri-City plant. The Junction site is the furthest upstream section on the Clackamas Interceptor with a high probability that flows entering the interceptor downstream of this point will not exceed the proposed reduced capacity of the Kellogg plant.

The proposed pipelines would be comprised of a 18 and 30-inch diameter pair, with the smaller pipeline being dedicated to conveying dry weather flows and the second, larger pipeline, designed to pick-up wet weather flows. This alignment would traverse mostly along municipal right of way and may require a lot of surface restoration (e.g. pavement, sidewalks, etc.), as well as existing utility conflicts. The alignment will also not require any significant pumping beyond that required to overcome standard friction loss (fairly flat grade) but may require acquisition of permanent easement from private property owners along a small portion of the alignment.

The two alternatives and the various route options are illustrated in **Figure 3**. It is important to note that for each alternative, it is assumed that all proposed force mains and gravity lines between diversion points and the Tri-City plant can be installed within the existing road and railroad right-of-ways or within the permanent easements of the existing CCSD No. 1 conveyance lines.

A summary of the technical characteristics for each alternative is described in the **Table 1**.

Table 1. Interim Diversion Alternatives Technical Characteristics			
System Elements	Characteristics	Trolley Trail Alignment	Three Creeks Alignment
Pump Station	Location	Kellogg Plant	Junction to HWY 224 Crossing
	Design Flows	20 mgd wet (5 dry)	20 mgd wet (5 dry)
	Static Head (ft)	165	45 to 85
	Pumping Head (ft)	210	95 to 110
	PS Power kW/Hp	750 kW / 1000 Hp	350kW / 480 Hp to 400 kW / 550 Hp
Pipelines	Sizes (inch)	18 (dry flows) 30 (combine dry and wet flows)	18 (dry flows) 30 (combine dry and wet flows)
	Length (ft) each	36,000	25,000
	Length Total (ft)	72,000	50,000

Evaluation Criteria

In order to evaluate the various alternatives, a series of criteria were established to assess the feasibility of each alternative in terms of operation, maintenance, constructability, economics and integration with other facilities. In working with the Implementation Team, the following list of evaluation criteria was established:

1. Length and Diameter: The length and pipe size are an important element of potential capital cost and operational parameters.
2. Pumping Requirements: Pumping requirements define the energy required to operate the pipeline and are a direct reflection of potential variable and maintenance costs.
3. Flexibility: Flexibility refers to the potential for a given alternative to serve multiple purposes or be used in one more than one mode of operation.
4. Stranded Investment Risk: Stranded investment risk refers to the potential for the pipeline not to be used to its fullest extent at some point in the future because of a change in operation or need - or in the worse case to be obsolete (or non-functional) prior to its normal useful life.
5. Useful with Other Infrastructure: This item refers to an alternative's ability to serve a useful purpose to other existing or planned infrastructure.
6. Constructability and Timing: Constructability and timing refer to the ease with which a given alternative may be built and the timeliness of projected construction, along with potential impact to adjacent businesses and landowners.
7. Benefits to Other Assets: This item defines the usefulness of a given alternative to other assets or capacity not necessarily those owned and operated by WES.
8. Construction Costs: Construction costs are defined by the estimated capital costs for a given alternative.
9. Operational Costs: Operational costs are largely defined by the estimated pumping costs for a given alternative.

Evaluation of Alternatives

The two main alternatives were evaluated against each of the criteria listed above. A summary of those findings is shown in **Table 2**. A detailed review of the assessment for each alternative is outlined in the respective subsection below.

Trolley Trail Alignment

This alternative is predicated on continuing to move the entire wastewater flow volume within CCSD No. 1 to the Kellogg treatment plant site prior to diversion to the Tri-City facility. The diversion would be sized to meet the planned future loading of Kellogg at 28,000 EDUs. This alternative is particularly desirable if the Kellogg plant is decommissioned in the near-term and/or a new plant is constructed near the Willamette River. The diversion planned by this alternative allows for an important direct hydraulic link between Kellogg (or the new plant) and Tri-City, as well as potentially convenient pipeline for consolidating biosolids treatment from Kellogg (or a new plant constructed

near the Willamette River) to the Tri-City plant. It also lends itself to a potential future interconnection with the Oak Lodge plant.

If constructed, the alignment is relatively open and free of obstruction or impact to local landowners. However, the alignment is nearly 50% longer than the other alternative (Three Creeks) and requires significant pumping (lift) during operations. Moreover, the pipeline does nothing to reduce or eliminate the capacity problems associated with the remaining existing conveyance backbone. Because of that fact, this alternative may require additional investment to upgrade the existing conveyance backbone throughout its extent east to west to meet future flow capacity needs. In addition, this pipeline alternative is more attractive in the interim horizon if Kellogg were to be decommissioned in that same time frame. However, the uncertainty of a new plant (and its location) only further adds to the unknowns regarding the long-term fate of Kellogg and the potential stranded investment risk associated with this alternative.

Three Creeks Alignment

This alignment is designed to intercept wastewater flow at an intermediate location along the existing conveyance backbone, thus eliminating the over-capacity element that may arise with added flows from Happy Valley (particularly the Rock Creek area). The pipeline and associated pump station would be tied into the existing Clackamas Pump Station and expand the existing diversions to the Tri-City plant. Several of the alignment options for this alternative are relatively flat from start to end and require little pumping to overcome lift. With its location, the pipeline may offer an important link between the central portion of growth within Happy Valley and the Tri-City plant.

Because of the capacity problems associated with the eastern end of the existing Clackamas interceptor, this diversion may be required under almost any interim configuration; thus, it offers little if any risk in terms of potential future stranded investment. Even if a new plant was built to accommodate all existing and future flows from CCSD No. 1, this set of pipelines and pump station may be useful in delivering reuse water from the Tri-City plant back to points within the District. To a lesser extent, this alternative may also be used to aid in the consolidation of biosolids treatment at Tri-City or as an influent pump station or outfall line to a new plant, particularly if that new plant is built in the vicinity of I-205 (or points east thereof).

The relative lower capital cost of pipeline and equipment, along with lower long-term operating costs, are an attractive feature for this alternative. However, this alignment more significantly impacts local neighborhoods and existing infrastructure potentially requiring extensive street restoration as part of construction and/or permanent easements from local landowners. Hence, careful pricing between the alternatives must be done in order to make a fair cost comparison between the alternatives.

Conclusions

The two alternatives offer several unique features. However, in almost any future treatment and conveyance scenario for the District, the construction of the Three Creeks diversion will be required in order to eliminate overloading of the eastern end of the existing conveyance backbone serving CCSD No. 1 and the Kellogg plant. Moreover, the current lack of knowledge regarding the actual long-term fate of Kellogg or the construction of the new plant brings great uncertainty to the decision regarding the Trolley Trail alignment, thus giving rise to significant stranded investment risk in the near-term for this alternative. Hence, the preferred interim alternative for conveyance is to proceed with the construction of the Three Creeks diversion.

The Three Creeks alternative will likely always be needed and the decision to construct it is a lasting positive addition to the District's facilities inventory. It will also be desirable to any number of other municipal entities, such as the cities of Happy Valley or Damascus, as part of future planned wastewater diversions by those agencies. Accordingly, the Implementation Team clearly recommends the District move forward with the construction of the Three Creeks alternative to serve its interim conveyance needs.

**Table 2 - Comparative Analysis Interim Diversion Options
Water Environment Services
Capacity Management Program**

Criteria	Option A – Trolley Trail Diversion	Option B – Three Creeks Diversion
General Description	Diversion extends from Kellogg WWTP to Tri-City WWTP. Includes new P/S at Kellogg and pipeline along Trolley Trail alignment.	Diversion extends from the Junction P/S site to Tri-City WWTP. Includes a new P/S and pipeline along an alignment just east (or west) of I-205.
Length and Diameter(s)	36,000 lf; twin barrel 18 and 30-inch	25,000 lf; twin barrel 18 and 30-inch.
Pumping Requirements (with head loss)	210 ft; 1000 Hp	95-110 ft; 400-550 Hp; depending on alignment
Flexibility	<p>May provide important link between Kellogg and TC plants; potential for bi-directional flow operations.</p> <p>May provide important link between TC and New Plant if New Plant is built near Willamette River.</p> <p>Will be useful in diverting Kellogg flows if plant is decommissioned and flow sent to TC.</p>	<p>Provides important flow relief to downstream conveyance backbone.</p> <p>May provide important link to serve reuse water from TC to central part of District.</p> <p>May be used by New Plant as influent P/S or outfall if New Plant is built east of (or near) I-205.</p> <p>Maybe not be useful to New Plant if located near Willamette River or in diverting Kellogg flows if decommissioned (both will require back pumping and additional conveyance).</p>
Stranded Investment Risk	<p>Construction may require substantial upgrading of a large portion of the existing conveyance backbone to Kellogg.</p> <p>Will not eliminate overload on existing conveyance backbone to Kellogg.</p> <p>Useful largely if Kellogg is decommissioned or New Plant is built near Willamette River.</p>	<p>Required under nearly every option to eliminate overload to existing conveyance system.</p> <p>May be used as supplement conveyance element under a wide variety of options.</p>

Table 2 - Comparative Analysis Interim Diversion Options (cont'd)
Water Environment Services
Capacity Management Program

Criteria	Option A – Trolley Trail Diversion	Option B – Three Creeks Diversion
Coordinate with Other Infrastructure	<p>May be used to convey liquid digested biosolid waste from Kellogg to TC.</p> <p>May provide biosolid consolidation conveyance option at TC for New Plant if located near Willamette River.</p>	<p>May be used to convey liquid digested biosolid waste from Kellogg to TC but requires additional pumping from Kellogg to Junction P/S.</p> <p>May provide biosolid consolidation conveyance option at TC for New Plant if located east of (or near) I-205.</p>
Constructability/Timing	<p>Preferred alignment may require relatively less street and improvement restoration.</p> <p>No significant difference in timing or permitting issues.</p> <p>High impact to residential areas.</p>	<p>Preferred alignment may require relatively more street and improvement restoration.</p> <p>No significant difference in timing or permitting issues.</p> <p>High impact to business and commercial areas.</p>
Benefits to Other Assets/Capacity	<p>May provide important future link to Tri-City for Milwaukie and Oak Lodge.</p>	<p>May provide important connection for future additional diversions to Tri-City from Happy Valley.</p>
Estimated Construction Costs	<p>Relatively high, especially considering the additional requirements for upgrading the existing conveyance backbone.</p>	<p>Potentially less given the shorter length. However, may require more extensive restoration costs to repair curb, street and existing infrastructure.</p>
Annual Pumping Costs	<p>Relatively high given the lift requirements for pumping.</p>	<p>Relatively low (depending on selected route) given the low requirement for lift.</p>
Additional Costs	<p>This option may require a substantial investment to upgrade the entire conveyance backbone leading to Kellogg to accommodate the entirety of future flows.</p>	<p>This option will require additional investments to upgrade the eastern portion of the existing conveyance system to accommodate added flows from Rock Creek.</p>