

# APPENDIX I



**King County**

Department of Natural Resources and Parks  
Wastewater Treatment Division

Black Diamond Wastewater Infrastructure Upgrade  
Phase 1 Storage Facility

## **Task 360: Alternatives Analysis Report**

May 2009



**TETRA TECH**

**DRAFT**

## EXECUTIVE SUMMARY

The King County Wastewater Treatment Division has proposed to construct a 0.75-million-gallon wastewater storage facility in the City of Black Diamond. This project will be designed to provide temporary peak capacity within the County's conveyance system from Black Diamond to the SE 277th Street Interceptor in Kent. The storage facility would provide flow equalization ahead of the Black Diamond Pump Station when the downstream Black Diamond Trunk sewer cannot accommodate projected peak flows associated with storm events. There is currently some excess capacity in the Black Diamond Trunk between the Black Diamond Pump Station and the SE 277<sup>th</sup> Street Interceptor. The earliest projected date when storage would be required to manage peak flows is in the year 2013 based on a preliminary estimate of development activity provided by the City of Black Diamond. The storage facility would be used to manage anticipated peak flows to be generated within the City between 2013 and 2020. After 2020, additional downstream conveyance capacity or a satellite treatment plant would be needed in addition to the storage facility to provide required wastewater system capacity. The proposed storage project is in accordance with the County's infrastructure development plans for this area.

This report presents an analysis of alternatives for the proposed storage facility. It provides guidance for future preliminary design on the proposed project. The analysis consisted of the following elements:

- Develop storage facility alternatives.
- Develop criteria to be used for evaluating the alternatives.
- Develop planning-level capital and operation and maintenance cost estimates for the alternatives.
- Identify a recommended alternative to be carried forward to preliminary design.

## PROJECT STATUS

Due to recent uncertainties regarding the rate of development in the Black Diamond area, the immediate need for a storage facility in the area is unclear. King County and the City of Black Diamond have agreed that this project will be delayed until it is warranted by an increased rate of development in the area. The project should be re-activated when the City makes a formal request to the County, providing a detailed schedule of permitted building and occupancy plans for additional residential units that would consume the current spare conveyance capacity in the County's wastewater system (the current spare capacity is about 850 equivalent residential units). This planning strategy keeps with King County's policy to respond to planned growth rather than provide facilities ahead of the growth.

For planning purposes, the County is estimating that the City will present a documented request for the project and the facility will be constructed and on-line by the end of 2013.

## PROJECT AREA AND EXISTING FACILITY DESCRIPTION

The Black Diamond Pump Station, its force main, and a portion of the Black Diamond Trunk are located within the city limits of Black Diamond. The pump station is on a fenced, 12,000-square-foot permanent easement on a privately owned parcel west of Railroad Avenue. An additional 15-foot-wide easement between the site and Railroad Avenue includes a gravel driveway used for site access. Development north and east of the site is primarily residential. Properties to the south and west are largely undeveloped: Jones Lake lies to the south, and the closest development to the west is a lagoon that was previously used by the City of Black Diamond for wastewater treatment. An unpaved road connects the Black Diamond



Pump Station site to the lagoon site. There are numerous wetlands in the general vicinity of the pump station, associated with nearby Rock Creek, Ginder Creek and Jones Lake.

The pump station discharges flow through a 10-inch diameter force main extending north across residential parcels to a gravity sewer along Morgan Street. This 16-inch Black Diamond Trunk gravity sewer conveys the flow to Covington, where it discharges to the Soos Creek Water and Sewer District's collection system. The District's system in turn discharges to King County's SE 277th Street Interceptor. The peak hydraulic capacity of the existing system is 1.7 million gallons per day (mgd).

## **STORAGE SIZING**

King County modeled projected wastewater flows from the Black Diamond area taking into account the most recent planned development for the area. Based on these flow projections, a storage facility on the order of 3.5 million gallons would be required to accommodate the 2050 20-year peak flow in the Black Diamond service area. In order to determine whether the size of the storage facility can be reduced, WTD staff took a closer look at two key design assumptions and found that a smaller storage volume of 0.75 million gallons would be sufficient to accommodate peak flow events on an interim basis until 2020:

- **Level of Service and Phasing**—The County typically sizes facilities to handle flows associated with a 20-year peak event. However, some projects may involve improvements that are phased such that the full 20-year level of service (5% likelihood of an overflow) is not attained until a future date. To limit the required storage volume for the facility, the County decided to apply a 5-year peak event level of service (20% likelihood of an overflow) for projected flows between 2013 and 2020 for the first phase of infrastructure improvements for Black Diamond. This resulted in a required storage volume of 0.75-MG. After 2020, additional regional conveyance improvements would come on line during a second phase of infrastructure improvements to achieve the County's 20-year peak event standard.
- **Infiltration and Inflow (I/I)**—For planning purposes, the County typically uses a standard I/I rate of 1,500 gallons per acre per day (gpad) for new construction to estimate flows for a sewered area. However, monitoring performed for the County's I/I Control Program in the early 2000s indicates that new sewers can have significantly lower I/I rates. Using a reduced I/I level for new construction of 750 gpad, the current study results in a reduced volume requirement for the Black Diamond storage facility. If new sewer construction in Black Diamond can be held to the reduced I/I level, then the 0.75-million-gallon storage facility would provide a 5-year level of service in 2020.

## **OPTIONS FOR INFRASTRUCTURE IMPROVEMENTS AFTER 2020**

King County developed a preliminary planning document that evaluated potential wastewater infrastructure improvements for the Black Diamond area (Tetra Tech, 2007):

- **Conveyance and Satellite Treatment**—This scenario assumes that a portion of the wastewater will continue to be conveyed downstream, possibly to a future Pump Station D in Covington, while another portion will be sent to a new satellite treatment facility. It is assumed that the existing capacity of the Black Diamond Trunk and of the Black Diamond Pump Station would remain unchanged and the storage facility would continue to be used to equalize flows ahead of the Black Diamond Pump Station and Trunk.
- **Satellite Treatment Only**—This scenario involves equalizing the peak flows using the storage facility and sending all equalized flows to a new satellite treatment facility. No flow would be directed to future Pump Station D.

- **Downstream Conveyance Only**—This scenario involves equalizing peak flows using the storage facility and increasing the capacity of the conveyance system between the Black Diamond Pump Station and future Pump Station D. This option represents King County's current plan as presented in the *King County Conveyance System Improvements Plan for the Soos Creek Area*.

The proposed storage facility will be designed so that it can effectively work in concert with any of the County's future plans for wastewater infrastructure development in the Black Diamond area.

## **STORAGE ALTERNATIVES**

Alternatives were developed through a collaborative process involving all stakeholders. Stakeholders included the City of Black Diamond citizens and staff, King County engineering staff, maintenance staff, and management. This process resulted in five alternatives which were deemed viable to evaluate. These alternatives are briefly described as follows:

### **Alternative A—Below-Grade Storage Tank at Black Diamond Pump Station, East Orientation**

A 750,000-gallon tank with four flushing chambers would be located along the path of the existing gravel driveway extending east to Railroad Avenue from the existing Black Diamond Pump Station site. To reduce or eliminate the overburdened soil weight on the structure, retaining walls would be built to the north, south, and east of the tank. Walls on the north side would extend nearly all the way across two privately owned lots for maintenance access, since the gravel driveway would no longer be available for access. Easements for site access would be required from the north. Wastewater flows beyond the capacity of the existing pump station would flow by gravity into the storage facility. Most of the stored volume would drain by gravity into the Black Diamond Pump Station after peak flows subside. A small pump station would be required to drain out residual storage volume. Odor control equipment would also be installed.

### **Alternative B—Below-Grade Storage Tank at Black Diamond Pump Station, North Orientation**

A below-grade, 750,000-gallon tank with five flushing chambers would extend north from the existing Black Diamond Pump Station site. Wastewater flows beyond the capacity of the existing pump station would flow by gravity into the storage facility. Stored volume would drain by gravity to the Black Diamond Pump Station after peak flows subside. A small pump station would be required to drain out residual storage volume. Retaining walls would be necessary along the north, east and south sides of the tank. Odor control equipment would also be installed. Two parcel purchases and easement for site access would be required from the north.

### **Alternative C—Storage Tunnel Between the Black Diamond Pump Station and Lagoon Site**

An 11-foot-diameter storage pipe, providing approximately 850,000 gallons of storage volume, would be installed immediately downstream of the pump station. The storage tunnel would be routed approximately 1,200 feet southwest to the lagoon site. The tunnel insertion shaft would be excavated at the pump station site immediately southeast of the station. The tunnel would run beneath at least four parcels of property. A construction and pipeline utility easement would be required. Wastewater flows beyond the capacity of the existing pump station would flow by gravity into the tunnel. A flushing station and odor control facility would be located at the existing lagoon site or the existing Black Diamond Pump Station site. A



small pump station at the flushing station would be required to pump out the lower reach of the tunnel back to the Black Diamond Pump Station wet well after peak events have passed.

### **Alternative D—Pipeline Storage, Open-Cut**

One 12-foot diameter in-line storage pipe, providing approximately 760,000 gallons of storage volume, would be installed immediately upstream of the pump station connecting to the existing pipeline approximately 900 feet to the north of the pump station. The pipe would generally reside in a new 25- to 30-foot wide easement that would generally parallel the existing incoming sewer pipe and force main, which reside in a 10-foot wide easement across six lots. Odor control equipment would be located south of the Black Diamond Pump Station. A flushing station and upstream diversion structure would be located at the upstream end of the tunnel. A small pump station would be required for pumping out the lower reach of the storage pipe after peak events.

### **Alternative E—Storage at the Abandoned Lagoon Site**

A 750,000-gallon tank would be built at the former wastewater lagoon 1,300 feet southwest of the pump station site. A peak flow pump station would be constructed adjacent to the existing Black Diamond Pump Station in order to pump the entire peak flow volume up to the storage facility in the abandoned treatment lagoon site. A 12-inch force main/gravity sewer would connect the storage tank and the peak flow pump station. The peak pump station would be outfitted with odor control and emergency generator equipment.

## **RESULTS OF SCREENING AND EVALUATION PROCESS**

### **Preliminary Screening**

The alternatives were evaluated through a collaborative process involving all stakeholders to assess whether any should be removed from consideration due to potential fatal flaws. Stakeholders included City of Black Diamond citizens and staff, and King County engineering staff, maintenance staff and management. Two alternatives were removed from further consideration during the preliminary screening process: Alternative B, because it requires the removal of a single-family residence; and Alternative C, because it involves tunneling, with associated risks due to highly variable geology and a history of coal mining in the project area.

### **Cost Estimates and Final Evaluation**

A 5-percent level of design cost estimate was developed for each of the remaining alternatives (A, D, and E), and they were evaluated using criteria developed with stakeholder input. Table ES-1 summarizes key findings of the evaluation.

### **Recommended Alternative**

Based on the alternative evaluation, *Alternative D—Pipeline Storage Open-Cut Option* is recommended. This alternative provides the preferred operational characteristics for a storage facility: it does not require pumping to fill the storage facility; it does not require a large retaining wall; and it has a lower estimated life cycle cost than the other alternatives considered.

## **ANTICIPATED PROJECT SCHEDULE AND FUTURE STEPS**

Because this project is driven by the uncertain future development in the City of Black Diamond, the project will be suspended until the City relays its schedule for receiving and processing development

permits. Upon learning the City's timeline for permitting and development, the project team will complete design and enter construction. Design and construction will take four years.

To ensure that the project team receives appropriate information and feedback about the facility design from the public, the County has prepared an anticipated schedule of public involvement activities. Table ES-2 summarizes the activities and timeline for design, construction and public involvement.

**TABLE ES-1.  
ALTERNATIVES MATRIX FOR BLACK DIAMOND STORAGE FACILITY**

Rank	Description	Estimated Construction Cost Range <sup>a</sup>	Estimated Annual Operating Cost Range <sup>b</sup>	Other Key Factors	High-High Risks
1	Alternative D: 11-foot diameter cut & cover pipe parallel to existing force main	\$7.5M— \$9.5M	\$180,000— \$190,000		<ol style="list-style-type: none"> <li>1. Easements—need for condemnation of at least 1 of 9 properties could delay construction (this alternative only)</li> <li>2. Varying flow modeling could change design size and construction schedule (all alternatives)</li> <li>3. Economic shifts or ability to fund project could affect schedule or scope (all alternatives)</li> </ol>
2	Alternative A: Rectangular tank in hillside at Black Diamond Pump Station	\$13M— \$15M	\$182,000— \$192,000	Visual impacts, safety due to high retaining walls	
3	Alternative E: Rectangular tank at lagoon	\$12.5M— \$14.5M	\$199,000— 209,000	Lower reliability, higher electric cost due to pumping all peak flows	
<ol style="list-style-type: none"> <li>a. Construction costs in 2008 dollars</li> <li>b. Annual estimated operation and maintenance costs (labor, electricity, activated carbon) for 2013. See Appendix D for operating cost estimates and King County Life Cycle Cost (LCC) spreadsheets.</li> </ol>					



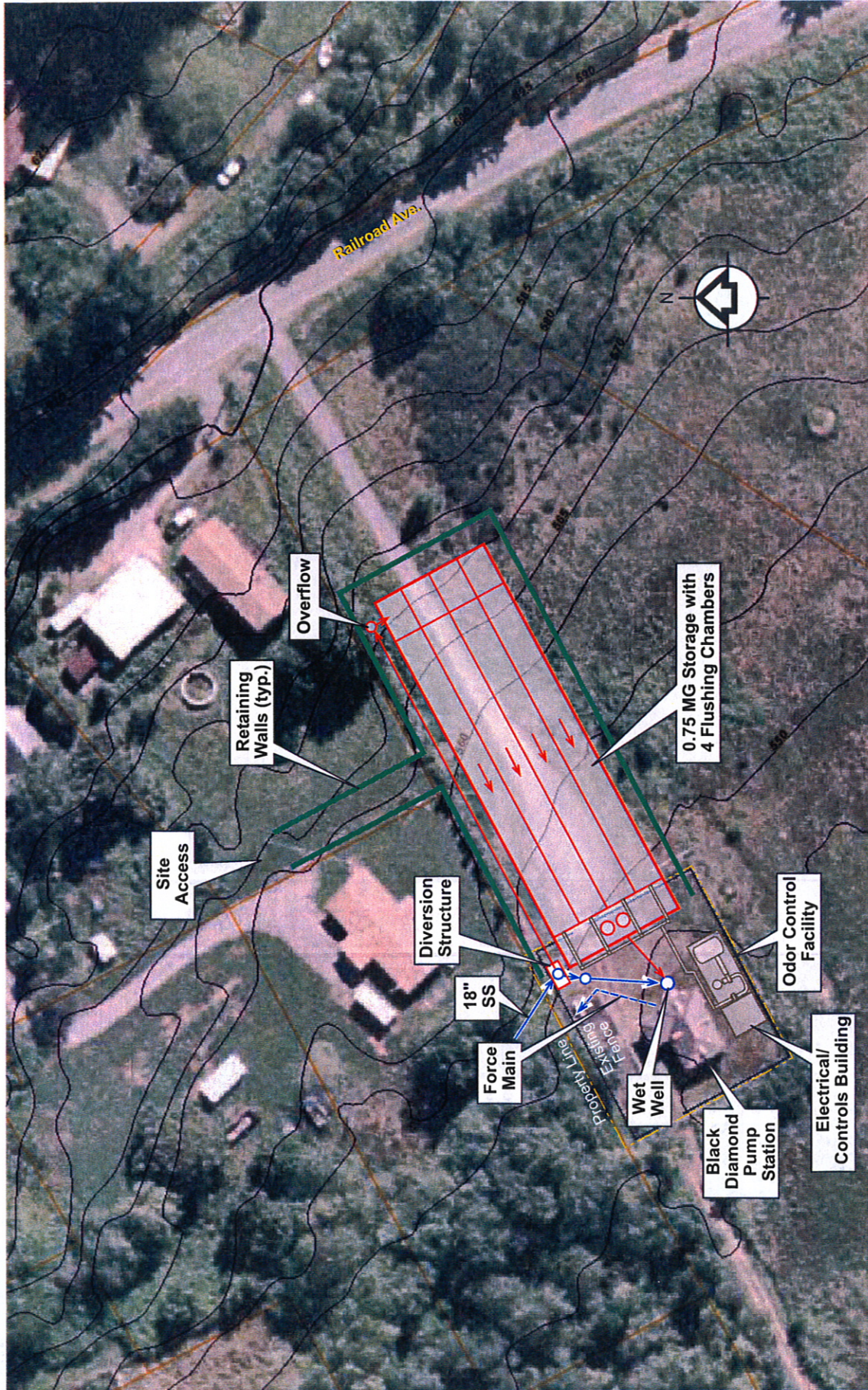
**TABLE ES-2.  
ANTICIPATED PROJECT SCHEDULE AND PUBLIC INVOLVEMENT PLAN**

Dates/Duration	Phase/Objective	Public Involvement	
		Activities	Materials to be Produced
<b>ALTERNATIVE EVALUATION</b> — <i>During predesign, a facility concept and functions are selected. This includes the rough sizes and functional arrangement of equipment, which drives the dimensions and configurations of buildings. Support elements such as civil site work, architecture, landscaping, plumbing, HVAC and electrical are less defined at this stage.</i>			
January – April 2009	Phase 1 community outreach (second round) <ul style="list-style-type: none"><li>No further action per City's directions.</li></ul> Alternatives Analysis Report	<ul style="list-style-type: none"><li>Follow-up letter from King County to City confirming City's direction to conduct no further public outreach action regarding the storage facility at this time.</li><li>Review Black Diamond's Wastewater Plan when draft is available.</li></ul>	<ul style="list-style-type: none"><li>No other materials produced to complete this phase.</li></ul>
Pending release of Black Diamond's development schedule	Predesign Report	<ul style="list-style-type: none"><li>Update affected stakeholders</li></ul>	City-wide mailing
<b>PRELIMINARY DESIGN</b> — <i>The team approximates the rough sizes and functional arrangement of equipment, which will drive the dimensions and configurations of the facility. Soil and groundwater investigations, utility locations, and other field work add context to the design, which helps determine foundation requirements and construction methods later.</i>			
1 year duration (pending release of Black Diamond development schedule and completion of predesign report)	Field work Facility design refined	<ul style="list-style-type: none"><li>Update City staff and affected stakeholders as necessary</li></ul>	<ul style="list-style-type: none"><li>Email / phone updates</li><li>Update web page</li><li>Community meeting</li></ul>
	Environmental Review	<ul style="list-style-type: none"><li>Informal permitting/ regulator briefing</li><li>Public notification mailing</li><li>Update City staff and affected stakeholders</li></ul>	<ul style="list-style-type: none"><li>Flier</li><li>Update web page</li></ul>
	Storage Facility Design and Landscaping	<ul style="list-style-type: none"><li>Update City staff and affected stakeholders</li><li>Community meeting</li></ul>	<ul style="list-style-type: none"><li>Email/phone updates</li><li>Citywide mailing</li><li>Web site update</li></ul>
<b>FINAL DESIGN</b> — <i>The project team incorporates any new information into the design and begins finalizing the facility design. Final details are worked out and any remaining issues identified during the design review process are addressed. The drawings and specifications are essentially complete. Final permits and final easements are obtained and final comments are incorporated. The project bid is solicited and awarded.</i>			
1 year duration (pending release of Black Diamond development schedule, completion of predesign report and initial design activities)	Complete design Bid solicitation, evaluation and award	<ul style="list-style-type: none"><li>Update City staff and affected stakeholders</li></ul>	<ul style="list-style-type: none"><li>Email/phone updates</li><li>Citywide mailing</li><li>Web site update</li></ul>

**TABLE ES-2 (continued).  
ANTICIPATED PROJECT SCHEDULE AND PUBLIC INVOLVEMENT PLAN**

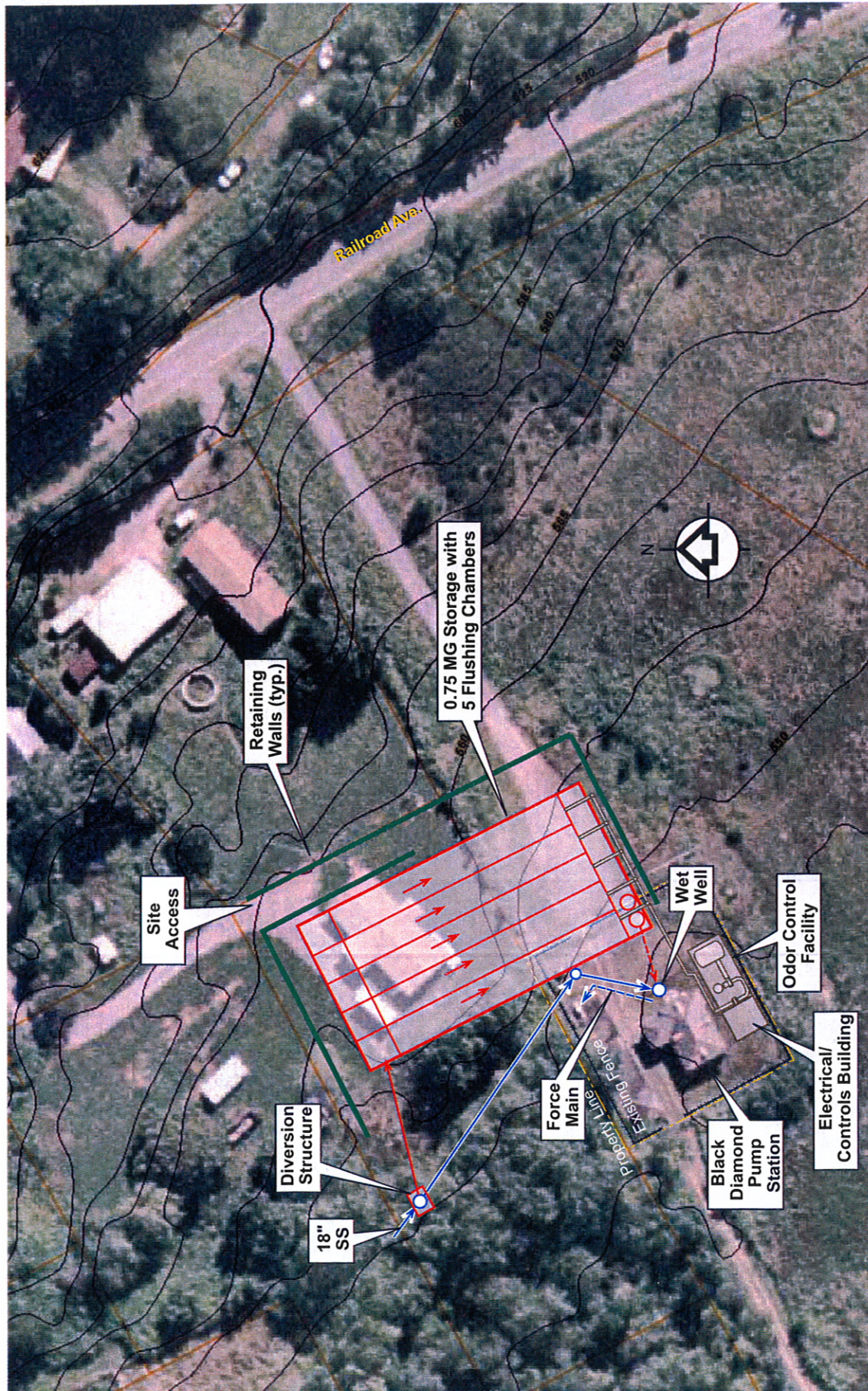
Dates	Phase/Objective	Public Involvement	
		Activities	Materials to be Produced
CONSTRUCTION			
2 year duration (pending release of Black Diamond development schedule and completion of all design activities)	Share construction schedule, impacts with community. Discuss ways to minimize	<ul style="list-style-type: none"><li>• Pre-construction community meeting</li><li>• Pre-construction meeting with City</li><li>• 24-hour construction hotline</li><li>• Signs</li><li>• Fliers as necessary</li></ul>	<ul style="list-style-type: none"><li>• Establish project hotline</li><li>• Update web page</li><li>• Fliers</li><li>• Email updates</li></ul>





Background Photo Source: King County IMAP Web Site





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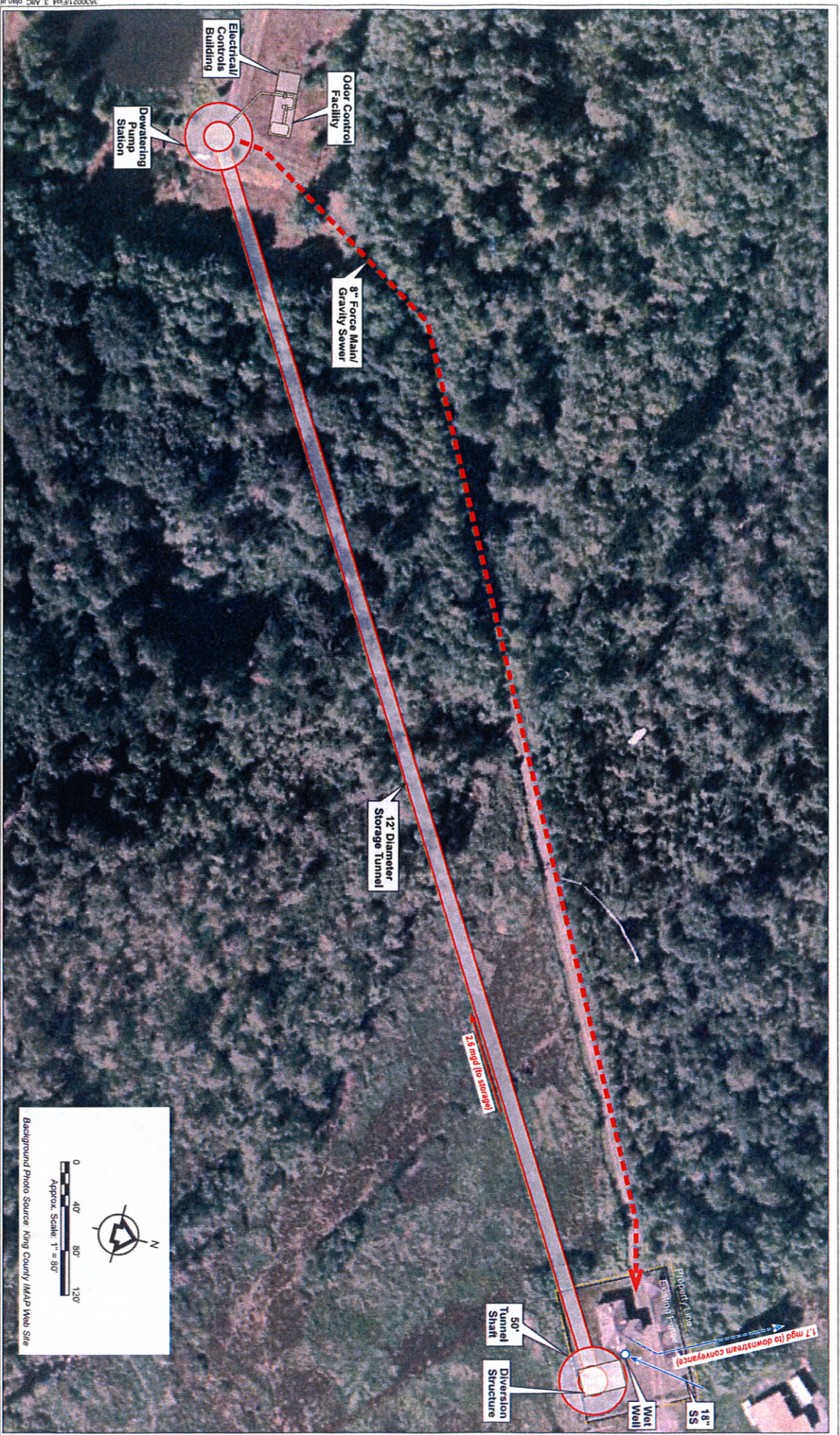
**Figure 4-2.**  
ALTERNATIVE B; BELOW-GRADE STORAGE TANK  
AT BLACK DIAMOND PUMP STATION,  
NORTH ORIENTATION

Black Diamond Wastewater Infrastructure Upgrade  
Phase 1 Storage Facility  
ALTERNATIVES ANALYSIS REPORT

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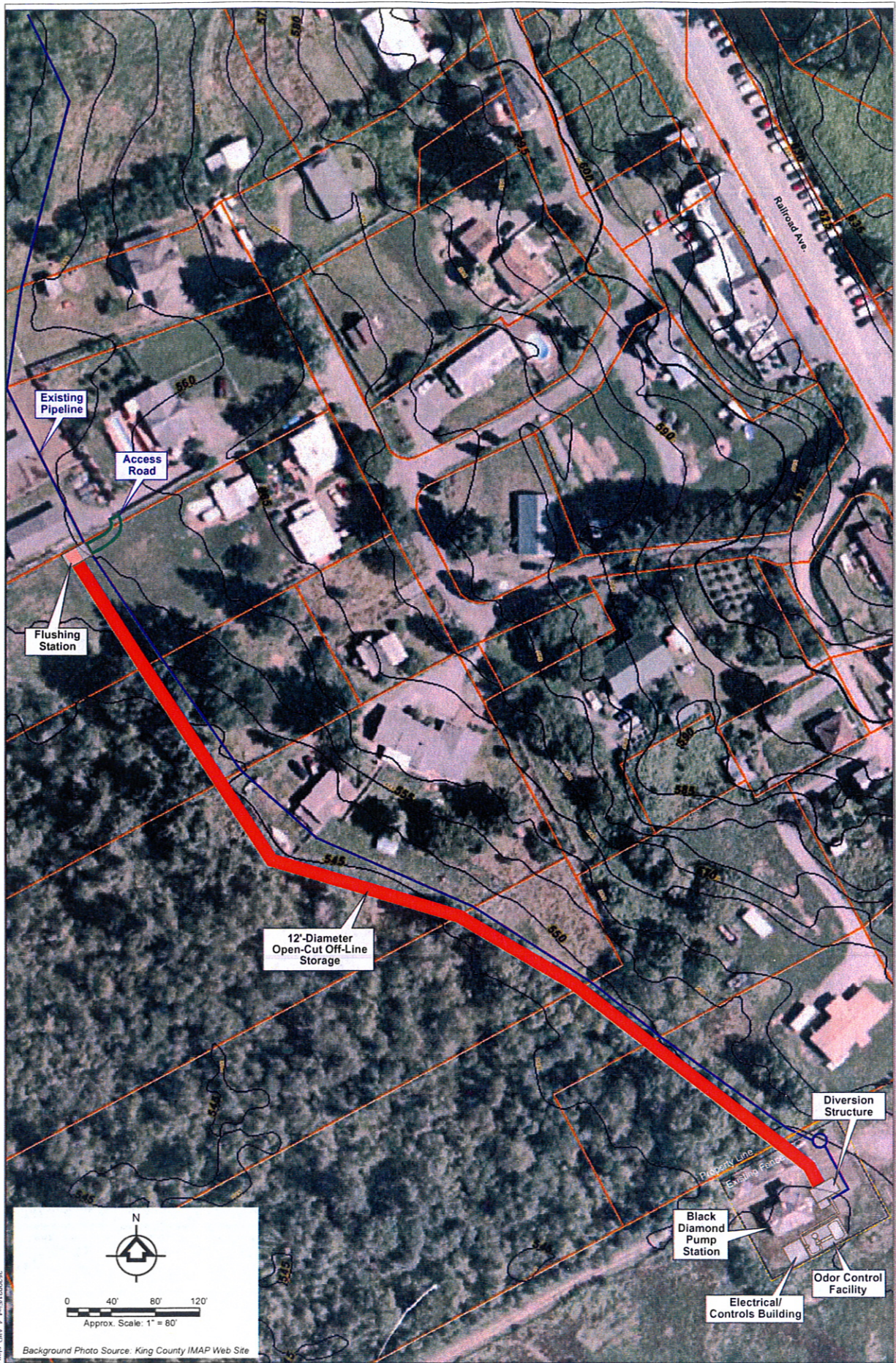
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**Black Diamond Wastewater Infrastructure Upgrade**  
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**ALTERNATIVES ANALYSIS REPORT**

**Figure 4-3.**  
 ALTERNATIVE C:  
 STORAGE TUNNEL BETWEEN BLACK DIAMOND  
 PUMP STATION AND LAGOON SITE









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**Figure 4-5.**  
**ALTERNATIVE E:**  
**STORAGE AT THE ABANDONED LAKE SITE**