EXECUTIVE SUMMARY

1.1 BACKGROUND

The South Magnolia Basin, located in Seattle on Puget Sound, is illustrated in Figure 1.1. The basin covers approximately 744 acres, and its sewer system drains to a CSO control manhole (MAGCSO) located on 32nd Avenue W at its southern edge. The basin is bounded by Discovery Park on the north, 28th Avenue W on the east, and Puget Sound on the west and south edges.

Over the last twenty years, the county has measured an average of 19.2 overflows at the MAGCSO annually, with an average annual total of 20 million gallons per year. In 2009 there were 25 overflow events totaling 4.77 million gallons. 2009 was characterized by several small storms which caused small overflows, and a few large storms which resulted in the bulk of the overflow volume.

The South Magnolia basin sewer system was originally constructed as a combined sewer system, conveying both sanitary sewage and stormwater. The system has been modified over time; there is now existing a Municipal Storm Sewer System (MS4) that collects stormwater from most streets and alleyways in the basin. The existing combined sewer system (CSS) conveys sanitary sewage and rooftop drainage. The system is tributary to King County's South Magnolia Trunk Sewer via a network of sewers and Seattle Public Utilities (SPU) sewage pump station #77.

The existing South Magnolia Trunk Sewer (SMTS) conveys combined sewage (wastewater and stormwater) flow from the South Magnolia drainage basin to the Interbay Pump Station for further conveyance to the West Point Treatment Plant. The trunk sewer has inadequate capacity to convey all combined sewage flows from the drainage basin to downstream conveyance facilities. The capacity of the trunk sewer limits the peak flow rate that can be conveyed downstream to approximately 4.3 million gallons per day (mgd.) Flows in excess of 4.3 mgd overflow a weir in the County's control structure, referred to as "MAGCSO" to an existing 42-inch diameter overflow sewer and then to the 36-inch diameter CSO outfall (County #006) into Puget Sound. King County is proposing to construct a 1.8 million gallon (MG) storage tank outside the basin, on a site located southeast of the western terminus of the existing Magnolia Bridge.

This project was initiated to address the following regulations:

- **Revised Code of Washington (RCW) 90.48.480:** This law requires "the greatest reasonable reduction of combined sewer overflows."
- **Washington Administrative Code (WAC) 173-245-020 (22):** "The greatest reasonable reduction' means control of each CSO in such a way that an average of one untreated discharge may occur per year."

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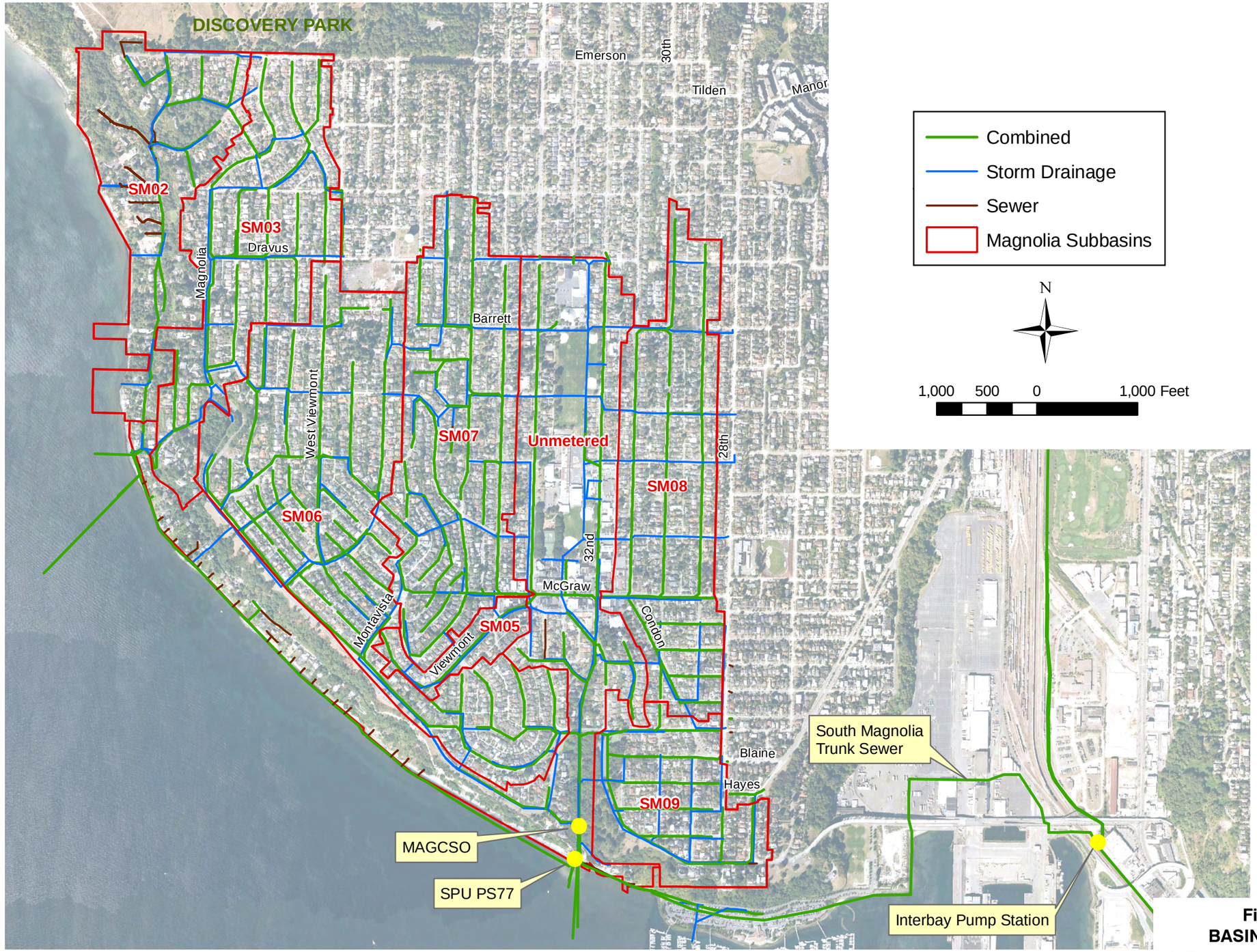

Figure 1.1
BASIN OVERVIEW

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Wastewater Treatment Division

FIGURE 1-1.ai

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According to these regulatory requirements, CSOs must be controlled to an average of no more than one untreated discharge per year per outfall based on a long-term average. This Engineering Report outlines improvements to the King County sewer system serving the South Magnolia Basin that are necessary to control CSOs in compliance with the RCW and WAC.

1.2 BASIS OF PLANNING

During the planning process that is described in this report, four CSO control approaches were considered to be potentially effective at controlling overflows to the required level in the South Magnolia basin. These approaches were:

- Storage: storage of flow exceeding the SMTS capacity with later release to the existing conveyance system.
- Convey-and-Treat: conveyance of all flow via the Interbay Pump Station to West Point Treatment Plant for treatment.
- End-of-Pipe Treatment: High-rate clarification of peak flow exceeding SMTS capacity at or near the location of MAGCSO.
- Peak-Flow Reduction (Demand Management): disconnection of stormwater currently entering the CSS through rooftop and driveway drainage, combined with storage.

In addition, a combination of these approaches was considered wherever feasible.

Combined sewer flow in the South Magnolia basin was modeled based on historical flow monitoring, to determine peak wet-weather flows and volumes. The calibrated models were run for a 30-year long-term simulation for the period from January 1, 1978 to June 30, 2008. Based on the modeling data, the required storage volume and peak flow rate were compared for the following conditions:

- The long-term average from the entire rainfall record.
- The average of 20-year averages.
- The maximum 20-year rainfall period in the entire rainfall record.

Storage, treatment, or conveyance required by these three conditions were nearly the same (well within the accuracy of the analysis). Table 1.1 summarizes the resulting basis-of-planning requirements for the South Magnolia Basin.

Table 1.1 South Magnolia Basis-of-Planning Requirements

Control Approach	Required Volume or Capacity
Convey and Treat	**20 mgd[1]**
Required Peak Convey-and-Treat Capacity	**15.7** mgd
Existing Convey-and-Treat Capacity	4.3 mgd
Storage	**1.8 MG**
End-of-Pipe Treatment	**15.7 mgd[2]**
Peak Flow Reduction (Demand Management)	
Storage Volume for 25% Impervious Disconnection[3]	1.11 MG
Storage Volume for 50% Impervious Disconnection[3]	0.49 MG
Storage Volume for 75% Impervious Disconnection[3]	0.13 MG

Notes:
1. Required convey-and-treat capacity is the difference between "required peak convey-and-treat capacity" and "existing convey-and-treat capacity".
2. End-of-Pipe treatment capacity is the difference between "required peak convey-and-treat capacity" and "existing convey-and-treat capacity".
3. Represents the percentage of impervious surface currently connected to the combined sewer system that must be disconnected to reduce the required storage volume.

1.3 PRELIMINARY ALTERNATIVE DEVELOPMENT AND EVALUATION

Identification of preliminary alternatives included evaluation of sites suitable for facilities based on technical criteria including proximity to MAGCSO, downstream capacity, topography, and similar factors. Initial screening resulted in identification of several parcels and right-of-way locations meeting the project requirements.

Using these potential sites, preliminary alternatives were developed based upon control approaches and basis-of-planning requirements. Eleven preliminary alternatives were developed for the South Magnolia Basin as summarized in Table 1.2.

The alternatives were refined and evaluated between August 2009 and December 2009. The preliminary alternatives were evaluated based upon a range of factors:

- Technical feasibility
- Environmental impacts
- Community impacts
- Land use and permitting impacts
- Property acquisition
- Cost
- Operations and maintenance

Table 1.2 Summary of South Magnolia Basin Preliminary Alternatives

Approach	Alternative	Description
Centralized storage	1A	Rectangular storage at bottom of basin near MAGCSO.
	1B	Rectangular storage at bottom of basin near MAGCSO with increased conveyance to Interbay pump station (PS).
	1C/1B[1]	Rectangular storage in upper basin, pump station and storage at bottom of basin and increased conveyance.
	1D/1B[1]	Rectangular storage at bottom of basin, rectangular storage in upper basin, increased conveyance.
	1H	Tunnel storage under Magnolia bluff.
	1I/1J/1K[2]	Conveyance to rectangular storage out of basin.
Convey/Treat	2A	Pump Station, force main, gravity sewer to Interbay PS.
End-of-Pipe Treatment	3A	Treatment plant at bottom of basin.
Combined	5A	Rooftop disconnection of 600 homes and bottom of basin storage at bottom of basin.

Notes:

1. Potential alternatives were combined to describe dispersed storage alternatives where more than one storage tank location was used.
2. Alternatives 1I/1J/1K were variations of conveyance from MAGCSO to an out of basin storage tank location. The most feasible of these was selected and referred to as Alternative 1F1 later in the evaluation process.

The refined preliminary alternatives were reviewed in a team workshop on December 17, 2009, at which time they were screened using specific criteria and reduced to four alternatives for further evaluation. Alternatives that included upper basin storage were eliminated due to costs as well as affects on the community during construction.

- **Alternative 1A –** A below-grade, rectangular concrete storage tank, located adjacent to the existing county CSO control structure (MAGCSO) at the foot of 32nd Avenue W.
- **Alternative 1F1 (a refined version of 1I/1J/1K) –** A below-grade, rectangular concrete storage tank, located out of the basin adjacent to 23rd Avenue W and W Garfield Street. Wastewater flow into the tank would be diverted from the MAGCSO control structure through a gravity sewer installed using horizontal directional drilling techniques.
- **Alternative 2A –**12-foot diameter below-grade, in-line storage pipe located on Port of Seattle property north of the Magnolia Bridge between 23rd Avenue W and Elliott

Avenue W. Flow to the storage pipe would be diverted through a gravity sewer similar to Alternative 1F1.

- **Alternative 5A –**Peak-flow reduction by disconnection of approximately 600 rooftops or installation of approximately 1,200 rain gardens, and a storage tank near the MAGCSO control structure.

Subsequent to the workshop in December 2009, Alternative 5A was re-evaluated. Because of uncertainties regarding the level of voluntary participation required for this alternative to meet the CSO control objective (approximately 600 rooftop rain leader disconnections along with 1,200 rain gardens would be required on private property, and there is an existing stormwater system that serves most streets), this alternative was dropped from further consideration.

1.4 REFINEMENT OF SHORT-LISTED ALTERNATIVES

The project team convened several internal focus group meetings between January and May 2010. The team reviewed updated and new information about the alternatives developed by the technical engineering team, permitting, land use, environmental, and community program team members, and using community input from a public meeting in March 2010. The team refined criteria questions and evaluation ratings developed during preliminary alternatives analysis to reflect new and refined information developed as more information about the alternatives became available. At the May 2010 workshop the team selected Alternative 1F1, Out of Basin Storage as the alternative proposed for further environmental review.

In June 2010, the project team conducted two project implementation risk assessment workshops for the short-listed alternatives. The purpose of these workshops was to identify potential high-impact risks, such as Shoreline Permit appeals, that would have a high-probability (greater than 60 percent) of impacting the project schedule and/or cost to County rate payers. Alternatives 1A and 2A had potential high-risk and high-probability risks associated with land use and contaminated soil that would likely result in cost and schedule impacts. Alternative 1F1 had one potential high impact risk and much lower risk to rate payers. The results of the risk analysis confirmed the team's earlier selection of Alternative 1F1. Table 1.3 provides a summary of the project team analysis of the three short-listed alternatives.

Table 1.3 Alternatives Analysis Summary

	Alternative 1A: Bottom of Basin Storage	**Alternative 1F1: Out of Basin Storage**	**Alternative 2A: Out of Basin Pipe Storage.**
Alternative Evaluation	Had the most negative impacts to the community, the environment, land use and permitting.	Has the lowest impact to the community, operations and maintenance, and the environment.	In terms of negative impacts there was one high impact rating for contaminated soils.
Technical Considerations	Slope stability above the site; shoring and groundwater. Restricted physical space due to steep slopes.	Horizontal Directional Drill (HDD)installation, shoring required for the storage tank due to poor soil conditions and high potential for soil liquefaction	HDD drilling, In-line storage location along the alignment of the existing Magnolia Trunk sewer and contaminated soil/water
Sensitivity Analysis	There is no need to increase the size of the tank for a higher average rainfall.	There is no need to increase the size of the tank for a higher average rainfall.	There is no need to increase the size of the pipe for a higher average rainfall.
Costs			
Capital	$28,300,000	$30,900,000	$26,500,000
Land Acquisition	$35,000	$45,000	$65,000
Street Use Permits	$1,760,000	$2,150,000	$1,430,000
Total	**$30,100,000**	**$33,100,000**	**$28,000,000**
Life Cycle Costs (average project annual cost)	$1,930,000	$2,140,000	$1,800,000
Public Input	Strong opposition to this alternative.	Support for this alternative.	Support for this alternative.
Real Estate	Seattle Parks voiced concerns about cutting into the hillside in Magnolia Park.	Discussions with the Port of Seattle indicated that the Port is willing to consider using Smith Cove Marina Park or the Port West Yard sites for storage.	Port of Seattle has concerns about impact to cruise ship passenger parking at the terminal
Land Use Permits In addition to the typical construction permits	Seattle Parks permit, Environmental Critical Areas review Seattle Council Conditional use permit – high probability of appeal	Shoreline permit, Environmental Critical Areas review, Council Conditional use permit Least complicated to permit of the three alternatives.	Shoreline permit, Environmental Critical Areas review, Council Conditional use permit
Environmental Considerations	Steep slopes greater than >40% with the potential for landslides.	Leaking storage tank in Smith Cove Park.	Known contaminated soils on the Port property.
High – High Risks	a) Both Seattle Parks and the community oppose use of this site for the CSO project and could challenge the required zoning change from Single Family use to Industrial Use to build the facility. b) Significant construction on a steep slope and clearing of 2.5 acres of vegetation, which is opposed by citizens and which will trigger critical area review by the city.	a) Specialty contractors required for the horizontal directional drilling are limited and could drive up the cost.	a) Specialty contractors required for the horizontal directional drilling are limited and could drive up the cost. b) Sites the project on land that is federally registered as hazardous material area, requiring additional environmental review and increasing risk of added cost and liability. c) Potentially could impede the Port's plans for future development.

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1.5 PROPOSED ALTERNATIVE

Alternative 1F1 includes a rectangular, below-grade, cast-in-place, six-channel storage tank with an ancillary facility, located somewhere on the site illustrated in Figure 1.2. The tank provides 1.8 MG of combined sewage storage volume. The final location of the tank will be determined by the County and the property owners during 2011.

Figure 1.3 illustrates related facilities that include a diversion structure located on 32nd Avenue W and a gravity sewer to convey flow to the tank.

The project includes the following elements:

- Modification of the MAGCSO control structure to provide connection of a pipeline to convey flow to the storage tank when peak flows into the structure exceed the capacity of the SMTS.
- A 2,700 LF, 15.7 mgd capacity gravity sewer that will convey flow from the modified MAGCSO structure to the storage tank. Gravity sewer elements include:
  - 24-inch diameter carrier pipe, material to be selected during final design.
  - An isolation gate for maintenance and reliability uses.
- A rectangular, below-grade, cast-in-place storage tank includes:
  - A 24-inch diameter influent sewer.
  - A cast in place, buried storage tank, comprising six, 17-18-feet deep by 15-feet wide channels.
  - A tank flushing system including tipping buckets and non-potable water supply using City of Seattle water.
  - A pump station located in the tank, to discharge tank contents to the SMTS at manhole W10-88, within 24-hours following use of the tank.
  - A 10-inch to 12-inch diameter discharge force main, approximately 500-feet long from the tank to the discharge manhole.
  - Access hatches and lift slabs for routine and long-term operation and maintenance.
- An ancillary equipment facility for odor control, mechanical, and electrical equipment including:
  - Control panels and motor control centers (MCC).
  - Standby power generator including fuel storage tank.
  - Odor control system including mist eliminator, carbon scrubbers, and fans.
  - Ventilation system.
  - Utility water system including backflow preventer, air gap tank, pumps, and hydropneumatic tank.

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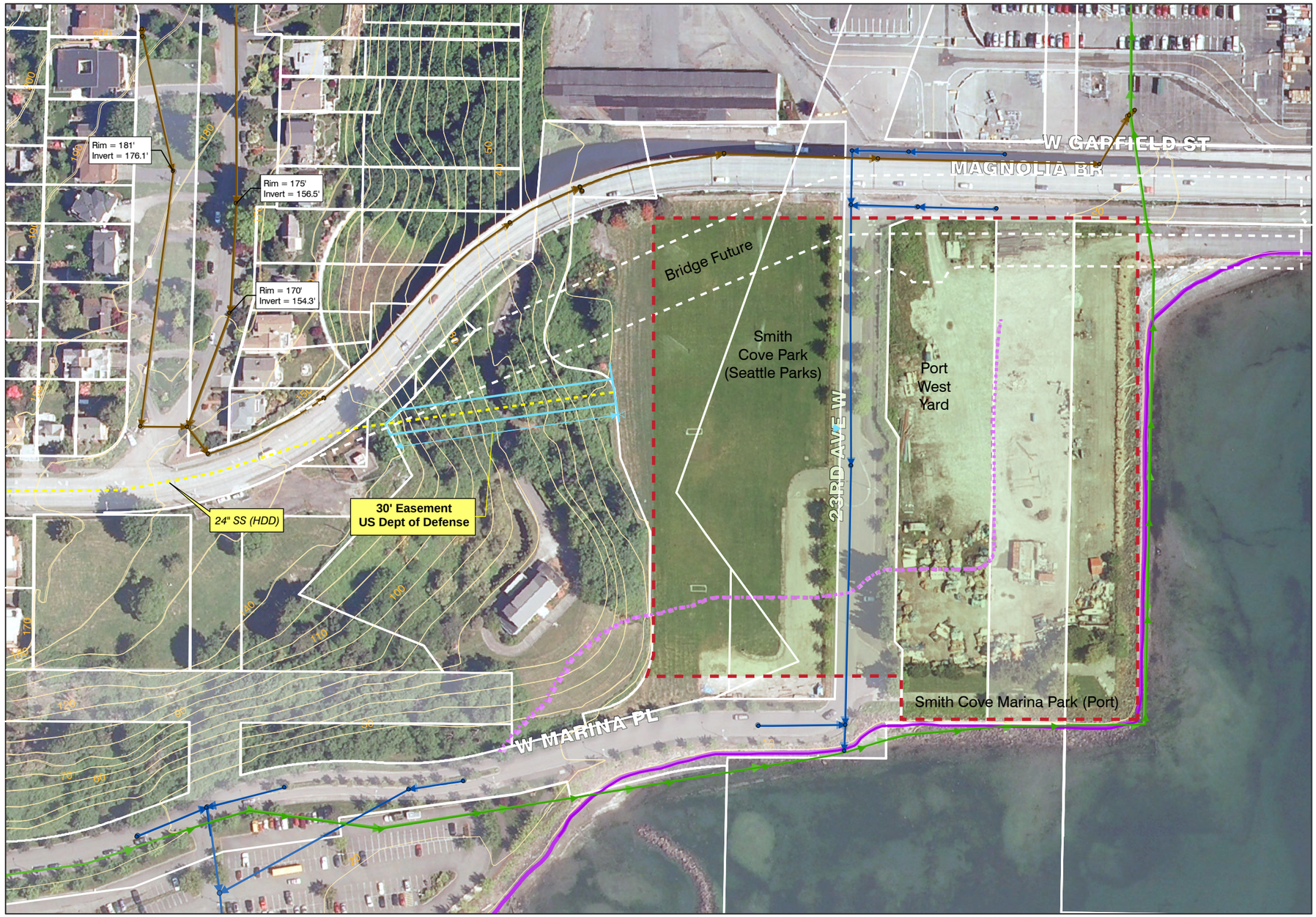

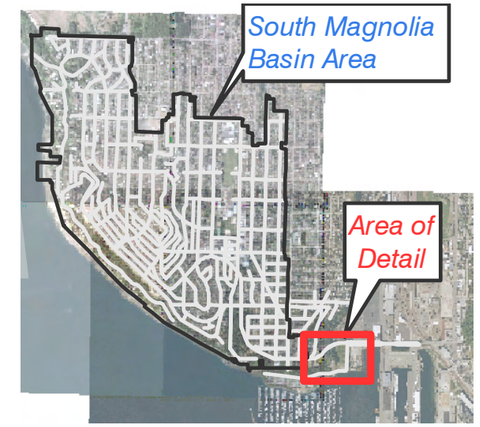

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0 50 100 200 300 Feet

Approximate Scale

Legend

- Combined Sewer System
- Storm Sewer System
- Sanitary Sewer System
- 10' Topographic Contour
- Shoreline
- 200' Shoreline Setback
- Feasible Area for Tank Location
- Permanent Easement
- Horizontal Directional Drilled Gravity Sewer

Figure 1.2
SITE LAYOUT PLAN EAST

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FIGURE 1-2.ai

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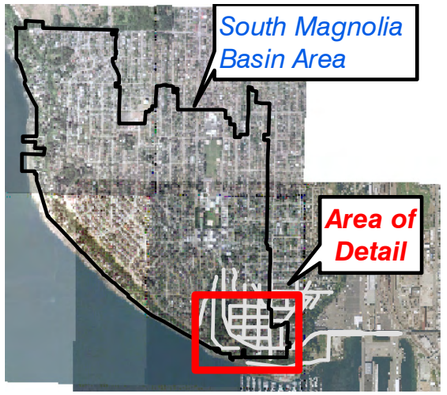

N

0 100 200 300 400'

Approximate Scale

Legend

- Combined Sewer System
- Storm Sewer System
- Sanitary Sewer System
- 10' Topographic Contour
- Shoreline
- Permanent Easement
- Horizontal Directional Drilled Gravity Sewer

Figure 1.3
SITE LAYOUT PLAN WEST

King County
Department of Natural Resources and Parks
Wastewater Treatment Division

FIGURE 1-3.ai

DRAFT – December 2010

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- Site improvements including:
  - Improvements as required by Seattle Department of Transportation (SDOT) and/or the Port of Seattle or City of Seattle Parks Department and the City of Seattle DPD, along 23rd Avenue W.
  - Tank site, tank, and AEF surface improvement, including access paving, fencing and landscape modification, and restoration.

Table 1.4 Summarizes estimated project costs for the Proposed Alternative.

Table 1.4 Project Cost Summary

Item	Amount
Construction	$21,100,000
Property Costs (Temporary construction easements and construction staging)	$ 2,200,000
Additional Costs (tax, allied costs, permit fees, and project contingency)	$15,400,000
Total	**$38,700,000**

Table 1.5 summarizes estimated O&M costs for the first year of operation. Subsequent years are escalated at 3 percent per annum for the life-cycle cost calculations.

Table 1.5 South Magnolia CSO Facility - Annual O&M Cost Summary

Item	$/yr, 2015
Operations and Maintenance (Tank, Diversion Structure, Odor Control, Sewer) and prorated labor for 5-yr major maintenance cycle.	$ 102,000[1]
Electrical (ventilation, power)	$ 1,000
Chemicals (activated carbon replacement once per two years)	$ 11,000
Materials, annual cost for 5-year major maintenance cycle and equipment replacement	$55,000
Generator	$5,000
Total	**$174,000**

Note:
1. It is assumed in the life cycle cost estimates that O&M costs will escalate yearly after the first year of operation.

The preliminary project schedule is summarized in Table 1.6. The dates are approximate and the schedule will be updated as the project progresses.

Table 1.6 Preliminary Project Schedule

Activity	Anticipated Dates
Engineering Report	June 2010 – December 31, 2010
SEPA Threshold Determination	April 2011
Engineering Report Approval	June 1, 2011
Permitting	June 1, 2011 – January 1, 2013
Final Design	June 1, 2011 – December 31, 2012
Construction	July 1, 2013 – October 1, 2015
Startup	October 1, 2015 – June 1, 2016