ALTERNATIVES DEVELOPMENT AND EVALUATION

This chapter describes the process used to develop and evaluate alternatives for meeting the combined sewer overflow control objective for the South Magnolia Basin. Alternatives that could achieve the objective were developed for several broad CSO control approaches: storage, end-of-pipe treatment, convey-and-treat, peak flow reduction, or a combination of these.

Each alternative was evaluated for technical and non-technical considerations; impacts on the community, environmental impact, and cost. The number of alternatives was reduced from a preliminary set of 14 to a shortlist of three and, finally, to a recommendation of one alternative for further environmental review.

5.1 EVALUATION METHODOLOGY

Alternative development and evaluation was conducted in two phases. Phase 1, which began in January 2007, focused on reviewing flow projections, assessing the viability of broad CSO control approaches, and developing initial criteria for evaluating CSO control approaches. The work included the following:

- Define evaluation criteria.
- Identify potentially viable control approaches.
- Develop initial conceptual alternatives.
- Evaluate initial conceptual alternatives.

Existing flow data was reviewed during Phase 1, which indicated that fieldwork was needed to better define the origin of peak flows. Flow monitoring was conducted in several sub-basins between December 2007 and June 2008. The flow monitoring helped define peak flow contributions from discrete sub-basin areas and confirmed flow modeling previously performed by the County. As a result of this effort, CSO control volumes were developed for several sub-basins, and overall control volumes for the basin were refined.

Phase 2 built upon the results of Phase 1 and flow monitoring work. Phase 2 included the following:

- Refine and re-evaluate preliminary CSO control alternatives.
- Screen preliminary alternatives.
- Refine short-listed alternatives to select a proposed project.

5.1.1 Phase 1

Phase 1 comprised development of initial criteria to screen control approaches and identify initial alternatives that respond to the criteria. During this phase, the project boundaries were established, as depicted in Figure 5.1. This phase included the steps described below.

5.1.1.1 Step 1: Define Evaluation Criteria

This step began at project inception in January 2007. Criteria that were used to determine viability of CSO control approaches were defined by the project team. Seven criteria categories were selected, as illustrated in Table 5.1. Technical Memorandum *CSO Control Approaches and Planning Boundaries* (Carollo Engineers, December 2007) describes the considerations for these categories in more detail.

5.1.1.2 Step 2: Identify Potentially Viable Control Approaches

The CSO control approaches evaluated in this project are described in detail in TM 202.1. These approaches represent broad concepts for achieving CSO control without the detail of alternatives developed for specific sites. The following control approaches were considered:

- **Control Approach 1, Peak Flow Storage.** Store peak flows that exceed conveyance capacity in the basin during each storm event, and use existing pumping and piping facilities to convey stored flow downstream once the rainfall event has subsided.
- **Control Approach 2, Convey-and-Treat Peak Flows.** Convey peak flows out of the basin by increasing pumping and force main capacity, or the capacity of the gravity sewer system. This approach may also require treatment upgrades at the point where the peak flows are discharged, as the capacity of existing treatment facilities may not be adequate for additional flows and loads.
- **Control Approach 3, End-of-Pipe Treatment for Peak Flows.** Treat and discharge peak flows at or near the current CSO locations. The typical treatment process used for end of pipe treatment includes high rate clarification (HRC) and ultraviolet (UV) disinfection.
- **Control Approach 4, Peak-Flow Reduction.** Reduce the magnitude of the flow in the collection system through infiltration and inflow (I/I) reduction in separated systems, or by disconnecting impervious areas in combined systems.
- **Control Approach 5, Combined Approach.** Reduce peak flows within the basin by implementing a combination of two or more of the previously mentioned CSO approaches.

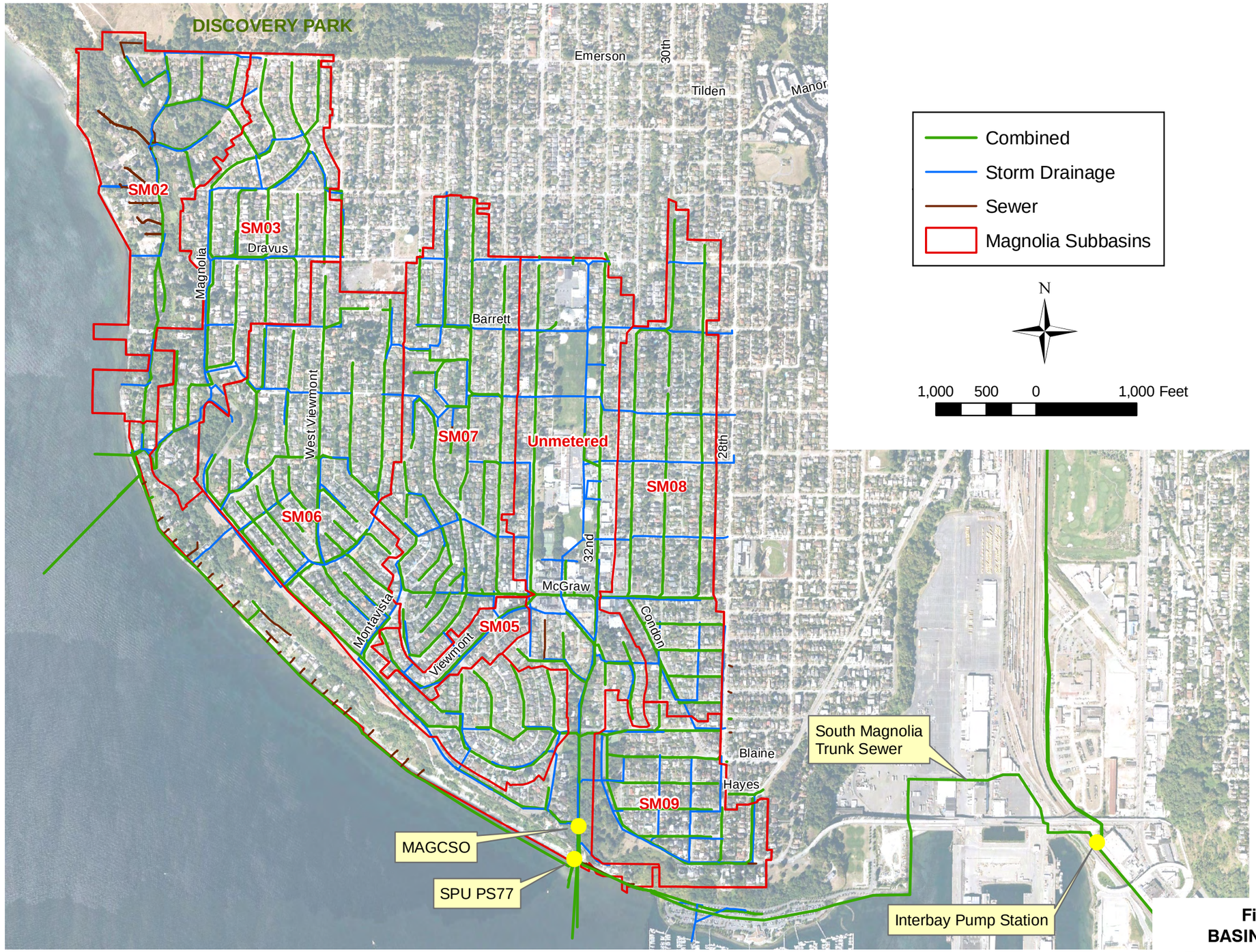

Figure 5.1
BASIN OVERVIEW

King County
Department of Natural Resources and Parks
Wastewater Treatment Division

FIGURE 5-1.ai

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Table 5.1 South Magnolia Initial Evaluation Criteria

Cost Effectiveness	Operations and Maintenance Feasibility	Technical Feasibility	Public Health and Environmental Benefits	Flexibility	Community	Compatibility with Other Programs and Initiatives
– Capital cost – Life cycle costs – Use of existing facilities – Grants/loan ranking	– Reliably meet CSO objectives – WTD automation – Ease of start-up/shut-down – Ease of maintenance – No adverse impacts on - County or City – Ease of regulatory reporting	– Compatible with existing system – Technically feasible – Can be permitted – Land is available – Minimize federal & state permit constraints	– Meet CSO requirements – Minimize public exposure – Minimal environmental footprint – Minimizes environmental risks – Minimize or avoid contact with endangered species – Coordinates with Puget Sound goals	– Future regulations – Climate change – Implementation	– Neighborhood equity – Cost allocation – Minimal shoreline impacts – Minimal property disruption – Minimal implementation impacts – Minimal operations impacts – Minimal disturbance of archeological areas	– Coordinate with Seattle parks, SPU, and transportation – Sediment management plan – County-wide planning policies – Stormwater management responsibilities – Conveyance system improvement policies – WTD productivity initiative – WTD CSO Program

5.1.1.1 Step 3: Develop Initial Conceptual Alternatives

Initial alternatives were developed in order to assess each control approach, as described in Technical Memorandum *CSO Control Approaches and Planning Boundaries*. Each initial alternative identified necessary infrastructure improvements associated with conceptual, acceptable locations. The locations were chosen based on their proximity to the combined sewer overflow location and the feasibility of using gravity sewerage to convey flow into and out of the proposed infrastructure. Storage alternatives identified during this phase were limited to a single centralized storage location, either in the basin or out of the basin; dispersed storage options were identified in Phase 2, after flow monitoring and modeling were completed.

5.1.1.2 Step 4: Evaluation of Initial Conceptual Alternatives

Following the development of initial alternatives, an assessment of the viability of each control approach was completed considering the constraints of the South Magnolia Basin (topography, land use, downstream capacity, and peak-flow sources). The conclusions of this assessment were as follows:

- **Peak-Flow Storage Approach.** The topography of the South Magnolia Basin is such that few locations exist for siting storage facilities. Each potential site identified faces construction challenges (geotechnical concerns). Use of some sites may require an upgraded Seattle Public Utilities (SPU) Pump Station #77 (located 200 feet south of the county's control structure) to convey peak flows to the storage facility. It was recommended that further consideration be given to locating a storage facility at either the CSO control point on 32nd Avenue W., or near the Elliott Bay Marina . It was recommended that geotechnical analysis of the two locations be conducted to further develop the viability of this CSO approach.
- **Convey and Treat Approach.** The convey and treat control approach was determined to be technically infeasible because of capacity limitations of the South Magnolia Trunk and the Interbay Pump Station (PS), impacts on CSO events along the North Interceptor, and the impacts on operations at the West Point Treatment Plant during a wet-weather event.
- **End-of-Pipe Treatment Approach.** End-of-pipe treatment was determined to be technically feasible. It was recommended that a geotechnical analysis of soil conditions be conducted to determine the feasibility of locating a facility near the CSO control structure.
- **Peak-Flow Reduction Approach.** Peak-flow reduction alone was evaluated, based on impervious area disconnection; results indicated that it might not be sufficient to reduce CSOs to one event per year in the South Magnolia Basin. Therefore, peak-flow reduction must be used in combination with storage to meet the CSO regulations. It was recommended that the costs and feasibility (e.g., technical, inter-jurisdictional) associated with implementing peak-flow reduction within the South

Magnolia Basin be more fully evaluated to determine the viability of this combined approach.

These were only initial assessments of the viability of the identified control approaches. Some further consideration was given in Phase 2 to the control approaches identified here as not viable (convey-and-treat and peak-flow reduction alone).

These conceptual alternatives were reviewed with agency stakeholders at Agency Workshop No. 1 on May 7, 2009. Stakeholders included King County, Ecology, and Seattle Public Utilities. Input from the workshop was used to help refine the alternatives and criteria for Phase 2.

5.1.2 Phase 2

Phase 2 included refinement and re-evaluation of CSO approaches and preliminary alternatives from Phase 1 following completion of flow monitoring. Community information meetings and briefings with citizens in the South Magnolia Basin in late 2007 and early 2009 elicited comments on community concerns and support or opposition to approaches and alternatives. Community members expressed several preferences and concerns:

- Avoid cutting steep, unstable slopes in areas of the neighborhood that have had historical slide occurrences.
- Avoid affecting surface groundwater flow by disconnecting stormwater from combined sewers in slide-prone areas.
- Encourage implementing rain gardens, cisterns, and similar approaches to retain and re-use rainwater.

5.1.2.1 Step 1: Refine and Re-Evaluate CSO Control Alternatives

The memoranda *Developing Criteria for Evaluating CSO Alternatives* (Carollo Engineers, August 2009) and *Selecting Candidate Sites for CSO Control Approaches* (Carollo Engineers, August 2009) describe the process used to refine and re-evaluate the preliminary alternatives. The process is summarized below.

5.1.2.1.1 Step 1A: Criteria Development

In order to develop criteria for evaluation of alternatives, the CSO Project Team appointed a “Category Lead” for each of seven categories of selection criteria. The Category Leads developed selection criteria and applied them in three steps:

1. Select up to five criteria for each final category shown in Table 5.2. In the operations and maintenance (O&M) category, for example, one criterion might be “Reliability,” another might be “Site Access,” etc. As part of this process, the seven categories developed in Phase 1 were refined. During refinement, some categories were combined and renamed as shown in Table 5.2. Two initial categories, “Flexibility” and “Compatibility with other Programs and Initiatives” were combined with other categories due to their interrelationship. The “Land Use/Acquisition/

Permitting" category was subdivided into two categories in recognition of differences between land acquisition and project permitting.

2. Develop questions to be answered for each criterion. These questions were used to "test" the impact of a particular alternative on the criteria being considered. For example, one question for the "Reliability" criterion was, "Does the alternative rely on complex automation for successful operation?" Another question may be, "Has the alternative proven to be a reliable CSO control method in other installations?"
3. Develop a description of how the criterion will be measured using the rating scale (i.e. Low, Moderate, and High impact). For the question, "Does the alternative rely on complex automation for successful operation?" a "High" score would be described by, "The alternative requires substantial automation of mechanical equipment for performance." A "Low" score would be described by, "The alternative is relatively simple and requires limited automation and equipment for performance." A copy of the final criteria and evaluation questions are included in the Alternatives Summary documentation in Appendix C.

Table 5.2 Evaluation Category Development

Initial Category (June 2007)	Final Category (September 2009)
Cost Effectiveness	Cost
Ease of Operations and Maintenance	Operations and Maintenance (O&M)
Technical Feasibility and Compatibility	Technical
Public Health and Environmental	Environmental
Community Considerations	Community Impact
Flexibility[1]	Land Use/Acquisition[2]
Compatibility with other Programs and Initiatives[1]	Land Use/Permitting[2]

Notes:
1. Criteria combined with other categories in final criteria category list.
2. Category added following initial criteria category development.

5.1.2.1.2 Step 1B: Alternatives Development

Site suitability criteria for the evaluation were developed and then used together with GIS data to identify potential preliminary sites.

Available land areas where new system components could be sited and constructed were identified based on the "technical feasibility" of the resulting alternative. "Technical feasibility" was defined as follows:

- Availability of Peak Flows. The resulting alternative must be sited in a location that allows sufficient peak flows to be captured and routed to the new facility.
- Constructability. The resulting alternative (and associated system components) must be constructible on the site. In order for an alternative to be constructible, the site where components would be built must be of sufficient size, with reasonable access for construction activities (staging, shoring, excavation, tank construction, etc.).
- Operational Performance. The resulting alternative (and system components) must be capable of meeting the intended performance within the existing hydraulic profile of the CSO outfall and CSS.

A hierarchy of technical considerations was used to judge "technical feasibility" and identify potential sites for the CSO control approaches. They are listed in order from most favorable to less favorable as follows:

1. Favor locations and facility configurations at the bottom of the basin near the existing CSO outfall.
   a. Provides ability to capture 100 percent of the flow in the basin and route it to the new facility.
   b. Reduces complexity of control system required to route flows to new facility; thereby reducing risks of future overflows.
   c. Minimizes conveyance system construction requirements.
2. Favor locations along existing combined sewer trunk lines through which 50 percent or more of the total basin peak flow is conveyed.
   a. Helps ensure sufficient volumes are captured to adequately reduce peak flows and volumes at the bottom of the basin at the existing CSO outfall.
3. Favor locations and facility configurations that allow a passive diversion of peak flows to the new facility (e.g. over a weir wall) rather than more complex control systems requiring telemetry or SCADA.
   a. Increases reliability by eliminating the need for power and control system.
   b. Reduces the potential need to oversize the facility to limit overflows.
4. Favor locations and facility configurations where the bottom of new structures will not exceed a depth of 30 feet below the ground surface elevation.
   a. Minimizes shoring and dewatering requirements.
   b. Requires less area for construction and staging.
   c. Shallower facilities are easier to access.
   d. Avoids excessive structural requirements for tanks and treatment facilities.
   e. Increases feasibility of cut-and-cover construction for storage pipes vs. riskier and more expensive tunneled construction.

5.1.2.2 Step 2: Preliminary Alternatives Screening

This step involved screening the alternatives to develop a shortlist of three for detailed evaluation. Step 2 was completed in a series of non-technical and technical meetings with the community and team members from August to December 2009. The screening process for reducing the preliminary alternatives to three is described in memoranda titled "*CSO*

*Control Alternative Review and Comment Procedure: (Carollo Engineers, September 200*9) and "*Alternative Narrowing Process*" (Triangle Associates, November 2009) and summarized in Table 5.3.

During the development of a shortlist of three alternatives, potential sites were further refined so the project team could focus on the characteristics of specific sites and how they would affect the implementation of each alternative.

5.1.2.3 Step 3: Refinement of Short-listed Alternatives and Selection of a Proposed Project

Between January 2010 and May 2010, the three short-listed alternatives were further developed. Detailed information is provided in , the "*Magnolia Alternatives Update Information Technical Memorandum*" (Carollo Engineers, June 2010), Appendix C of this chapter. Step 3 was completed in a series of non-technical (community relations, land use and permitting, environmental) and technical (technical implementation, operations and maintenance, cost) meetings to identify information needed to complete the alternative review and prepare evaluation matrices for each alternative.

Table 5.3 Screening Steps and Schedule for Shortlist of Alternatives

Workshop / Meeting Date	August 2009	September 2009	October 2009	November 2009	December 2009
Meeting Purpose	Basin Leads present preliminary alternatives for initial comment.	Non-technical focus meetings to identify information needed to complete alternative review matrices.	Technical focus meetings to add detail for O&M issues (layouts, configurations , etc.).	Team workshop to complete review matrices for each alternative.	Team workshops to select 3 alternatives.
Screening Results	Preliminary cut at alternatives by Consultant.	Revisions to preliminary alternative evaluations based on comments received from CSO Team (non-technical focus).	Revisions to preliminary alternative evaluations based on comments received from CSO Team (technical focus).	Revisions to preliminary alternative evaluations based on comments received from CSO Team	Select 3 alternatives for further evaluation.

5.2 NO ACTION ALTERNATIVE

RCW 90.48.480 and WAC 173-245-020 (22) require CSOs to be limited to an average of no more than one untreated discharge per year per outfall on a long-term average. In the

North Beach Basin, there were an average of 10 combined sewer overflows annually from 1991 to 2009, with an average annual total overflow of 2.2 million gallons.

The No Action Alternative entails no changes to the sewer system in the South Magnolia Basin. This alternative would result in CSOs in the South Magnolia Basin in excess of one per year on a long-term average based on historical data. The Basin would not comply with RCW 90.48.480 and WAC 173-245-020 (22) or the West Point Treatment Plant NPDES Permit.

The risk to Puget Sound water quality (e.g., bacteria, nutrients, and metals) would remain at present levels. Decreased water quality could adversely affect biological resources and potentially result in decreased availability of the beach and/or public exposure.

5.3 PRELIMINARY ALTERNATIVES

This section provides a detailed description of the alternatives developed under Step 1B of Phase 2 (as described in Section 5.1.2.1.2). Development of alternatives began with identification of preliminary sites suitable for CSO facilities. Based on this information and design criteria resulting from flow monitoring and modeling, preliminary alternatives were developed using the identified viable CSO control approaches.

5.3.1 Basis of Design

5.3.1.1 Basis of Planning

Table 5.4 summarizes the initial basis of design for control of the South Magnolia Basin. These data were developed by the County using flow monitoring and analysis of long term rainfall data. This information was used to size facilities for each CSO control approach during this phase. During development of refined preliminary alternatives in step 2 of Phase 2 (section 5.4 of this chapter) the basis of planning criteria were refined by updated county model results. Refer to Chapter 4 for details on the basis of planning development.

Table 5.4 South Magnolia Basin Initial Basis Of Planning Requirements

Required Storage Volume	1.8 MG
Required Conveyance Capacity w/No Storage	7.7MGD[1]
Required End of Pipe Treatment Capacity	7.7 MGD[2]
Storage Volume for 25% Impervious Disconnection	1.11 MG
Storage Volume for 50% Impervious Disconnection	0.49 MG
Storage Volume for 75% Impervious Disconnection	0.13 MG

Notes:
1. Required conveyance is the difference between "required peak conveyance capacity" and "existing conveyance capacity in basin."
2. Required treatment capacity is the difference between "required peak conveyance capacity" and "existing conveyance capacity in basin."

5.3.1.2 Basis of Design Criteria

The basis of design criteria are key criteria established as a basis for sizing equipment and laying out facilities. Consistency of design criteria is important for evaluating alternatives. Documenting the design criteria also provides key input for final design of the improvements.

Figures 5.2 through 5.4 illustrate typical details for potential facilities common to many of the alternatives developed, including storage (rectangular and pipeline), conveyance (pump station), and end of pipe treatment. Table 5.5 highlights key design criteria for preliminary screening.

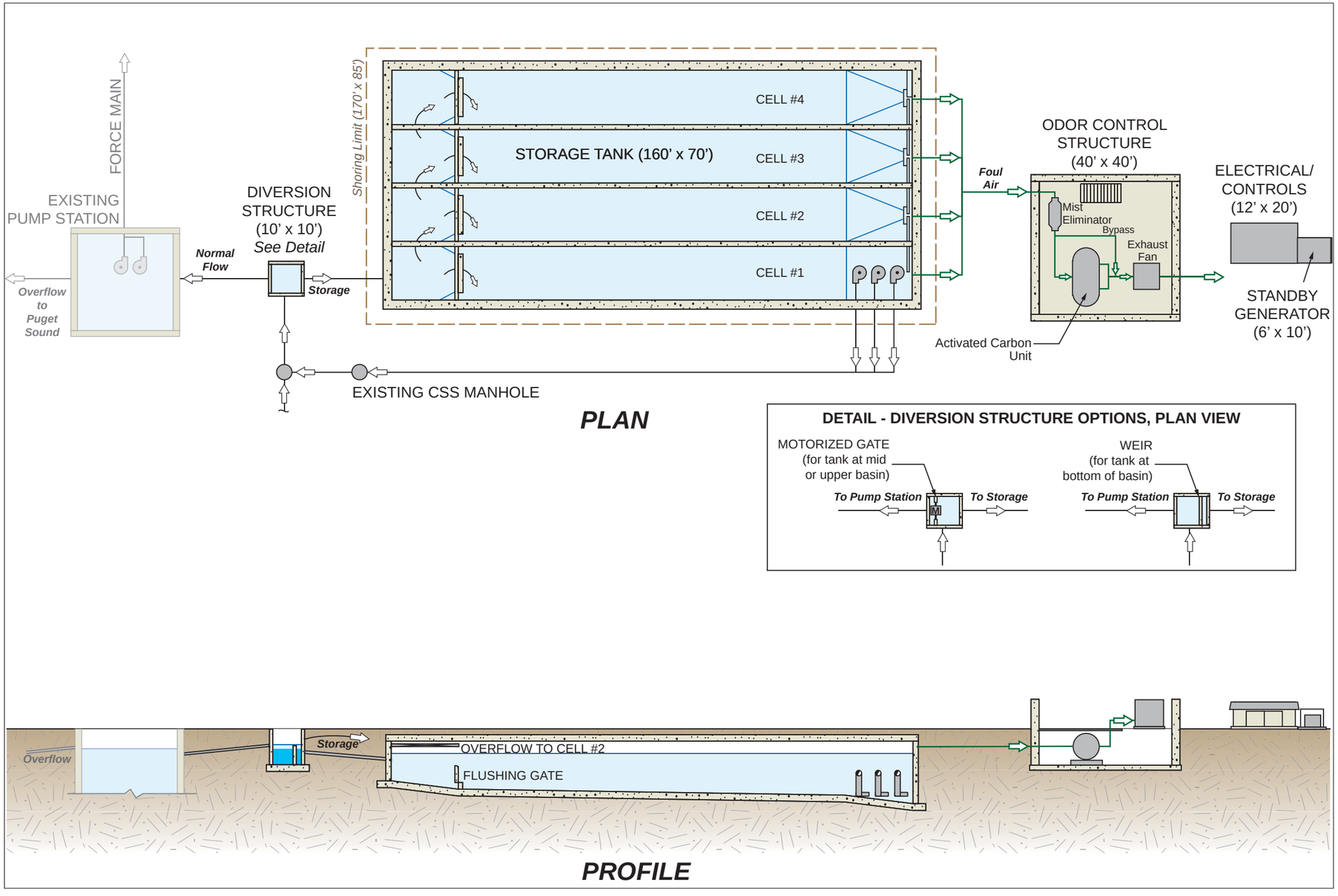

Figure 5.2
RECTANGULAR STORAGE BASIS OF DESIGN TYPICAL DETAIL

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Figure 5-2.ai

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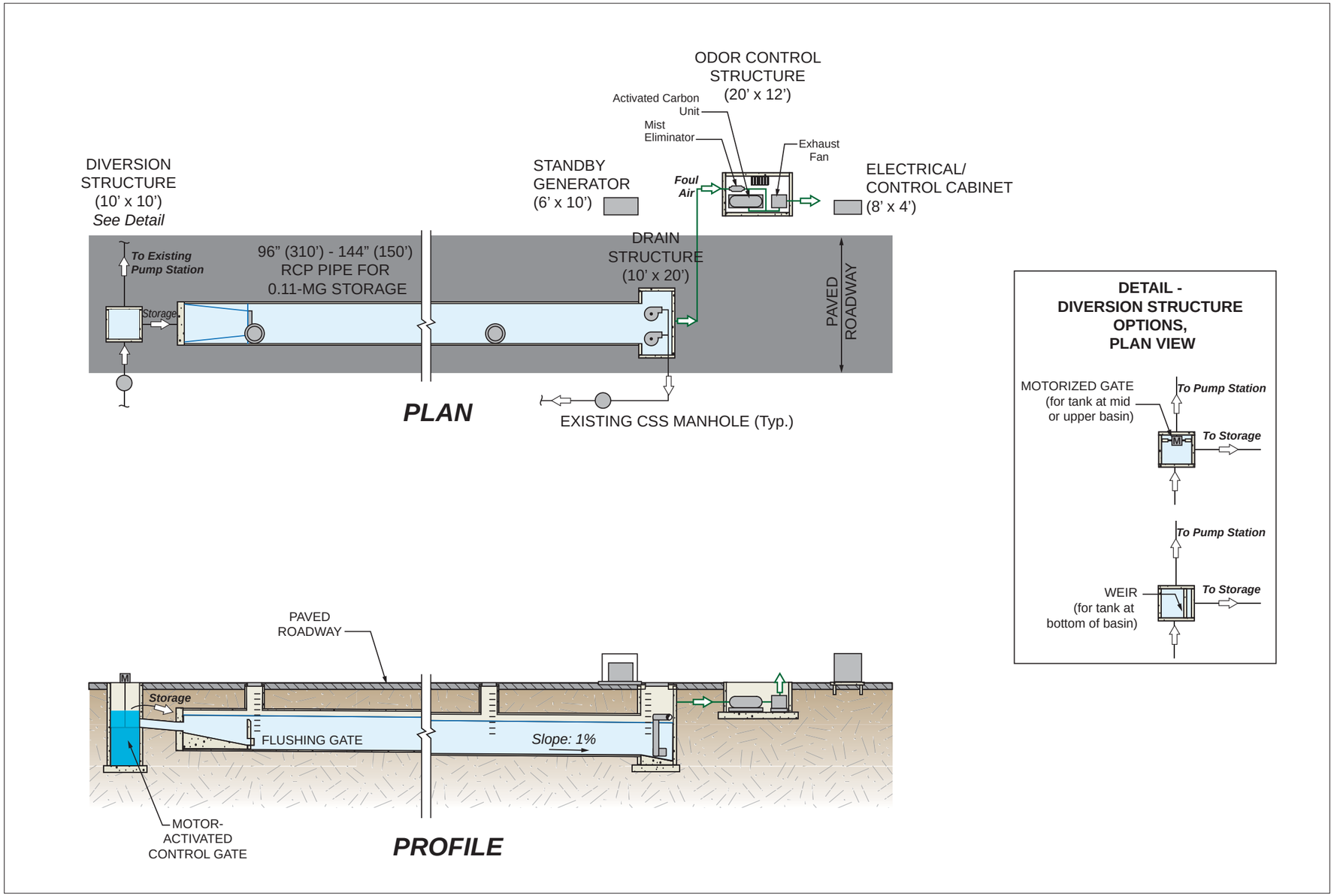

Figure 5.3
PIPE STORAGE BASIS OF DESIGN TYPICAL DETAIL

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Figure 5-2.ai

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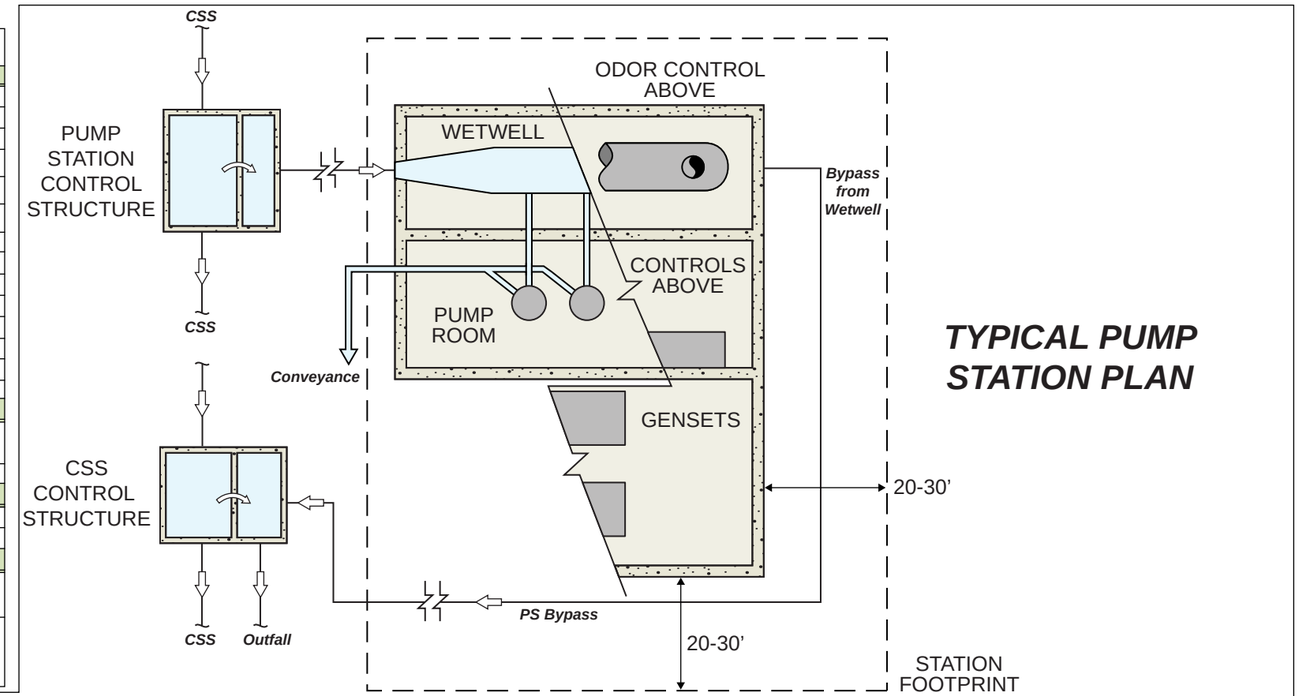
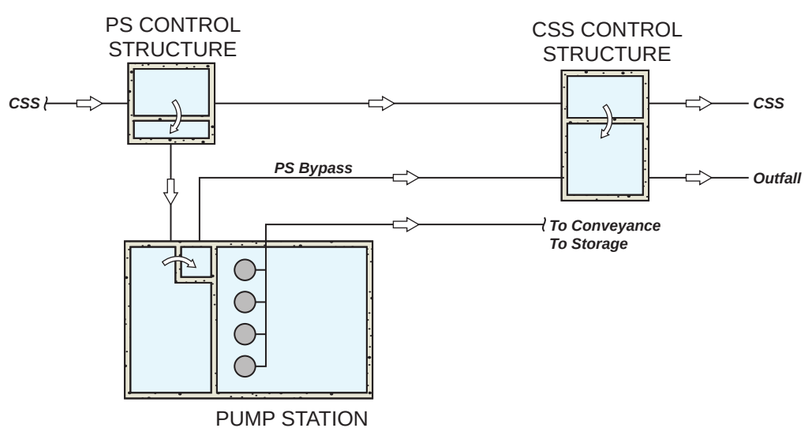
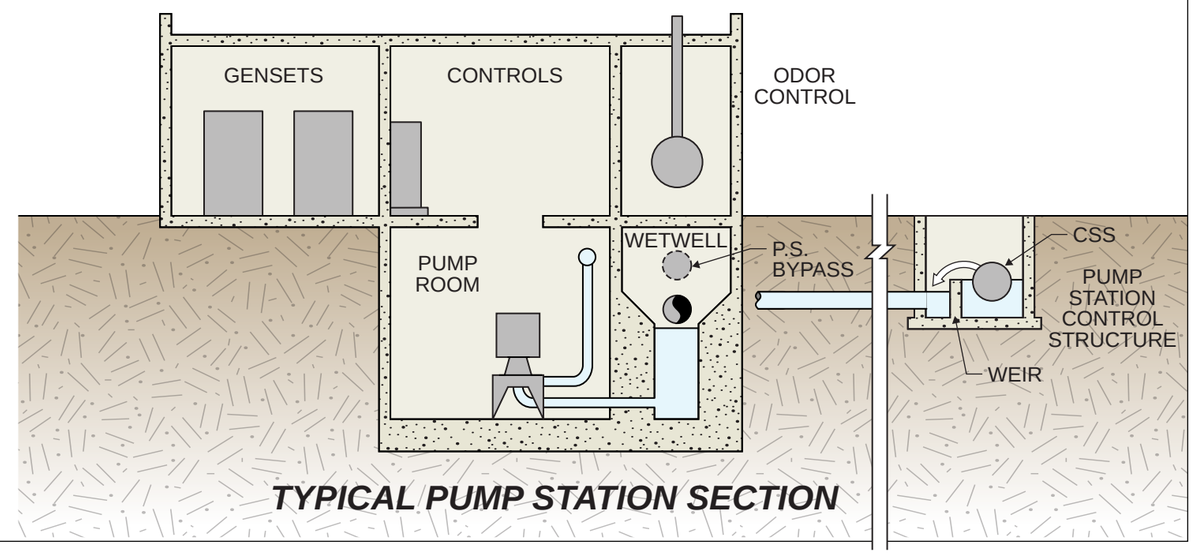
7 to 30 Mgd Pump Station Criteria and Assumptions				
General				
Firm Capacity mgd		7	20	30
Hydraullic Conditions		70 - 200 ft head	70 - 200 ft head	Over 200 ft Head
		single stage	single stage	series, two stage
Number pumps installed		4	4	8
Motor Size, Hp		50 - 125 at 7mgd	125 - 325 at 20mgd	200 - 700 at 30mgd
Standby power, kW		1@200 - 400	2@250 - 650	2@600-1250
		Station Footprint, with setbacks		
Wetwell		Circular, rectangular	Rectangular	Rectangular
Pump types, installation	Submersible wet pit	90 x 90	110 x 105	NA
	Centrifugal dry pit	110 x 90	110 x 90	115 x 100
	VTSH dry pit	90 x 90	NA	NA
Average depth, ft		25	25	25
Outer Walls, ft		2	2	2
Shoring		5ft beyond walls		
Mechanical				
Ventilation	12 air changes per hour in occupied space when operational.			
Odor Control	Carbon scrubber and fan, 2AC/hr for wetwell. Operates when pump station on line.			
Ancillary Eqpmt.	Typical service air, water, gates, valves for ww pump station			
Electrical				
Pump drives	Close coupled motors, VFD			
Emergency Power	Permanent generator(s), diesel, sound attenuated. 36-hour fuel capacity in buried tank			
Flow Control Strategy				
Diversion Structure	Divert peak flows using a weir and/or gate structure on the sewer upstream of the CSO control structure.			
Control Strategy	Peak flows are diverted over a weir when water elevation exceeds capacity of sewer or existing dry wet weather pump station. Flows exceeding pump station capacity overflow to outfall.			



TYPICAL PUMP STATION PLAN

GENERAL ARRANGEMENT PLAN





TYPICAL PUMP STATION SECTION

Figure 5.4
PUMP STATION BASIS OF DESIGN TYPICAL DETAIL

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Wastewater Treatment Division

Figure 5-4.ai

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Table 5.5 South Magnolia Basin Basis of Design Criteria

Control Facility	Design Criteria
Peak Flow Storage (Rectangular or Pipeline)	
Number of Cells	Rectangular - 2 to 4; Pipeline - 1
Floor Slope	1%
Minimum Freeboard	2 feet
Number of Drain Pumps	3 duty
Type of Pumps	Submersible
Maximum Time to Drain Storage	24 hours
Odor Control	Peak air displacement rate (peak flow to storage) or 2 air changes per hour (whichever is greater)
Air Treatment	Activated carbon; 1 pass; 50 fpm; constant speed fan/blower
Occupied Space Ventilation	12 air changes per hour
Standby Generator	Total estimated load; diesel w/ 24 hour capacity
Access	Every 200 feet (maximum); outside right-of-way
Equipment Materials	Corrosion resistant (316 SS or FRP)
Conveyance (Convey-and-Treat)	
Number of Pumps	3 duty + 1 standby (per stage[1])
Type of Pumps	Centrifugal, dry-pit
Firm Capacity	Required conveyance capacity[2]
Wet well	Self-cleaning
Odor Control	2 air changes per hour (wetwell)
Air Treatment	Activated carbon; 1 pass; 50 fpm; constant speed fan/blower
Occupied Space Ventilation	12 air changes per hour
Standby Generator	Total estimated load; diesel w/ 36 hour capacity
Force Main	2 @ Firm Capacity; 8 feet per second (maximum)
Equipment Materials	Corrosion resistant (316 SS or FRP)
End-of-Pipe Treatment	
Influent Screening	
Type	Perforated plate
Number of Screens	2
Screen Spacing	6 mm
High Rate Clarification	
Number of Trains	2
TSS Removal	85% or 10 mg/L (maximum)
BOD Removal	50% or 10 mg/L (maximum)

Table 5.5 South Magnolia Basin Basis of Design Criteria

Control Facility	Design Criteria
Chemical Feed Systems	Coagulant and Polymer
Ultraviolet Disinfection	
Number of Channels	1
Transmittance @254 nm	70%
Minimum Dose	40 mJ/sqcm
Odor Control	2 air changes per hour (process basins)
Air Treatment	Activated carbon; 1 pass; 50 fpm; constant speed fan/blower
Occupied Space Ventilation	12 air changes per hour
Standby Generator	Total estimated load; diesel w/ 36 hour capacity
Equipment Materials	Corrosion resistant (316 SS or FRP)

Notes:
1. Total head above 200 feet requires 2-stage pumping for solids handling pumps.
2. See Table 5.4.

5.3.2 Identification of Preliminary Sites

Potential sites for facilities were evaluated using the criteria provided in Table 5.6 and GIS data from King County and the City of Seattle. The first screening identified 70 parcels meeting the criteria. A windshield survey and review of the site characteristics narrowed these to three candidate sites. Additional sites were identified by the windshield survey and included in the candidate site list. Figure 5.5 illustrates parcels in the South Magnolia Basin that could be suitable for siting CSO alternatives.

The viable control approaches were matched with the preliminary sites based on the results of flow monitoring and modeling and basin reconnaissance. Potential areas were defined roughly by the ability to route flow to the CSO facility location, topography, and distance from the existing CSO control facility. An important project assumption is that existing CSO outfalls would not be modified due to environmental and permitting impacts on the required CSO implementation schedule. Therefore, it is important that no new control points were created by the alternatives.

Table 5.6 Site Suitability Analysis

CSO Control Approach	Configuration	Minimum Requirements for Potential Sites
1. Peak Flow Storage		
Bottom of Basin	Rectangular.	• Flat (< 5%)area near existing CSO. • Outside public right-of-way. • Greater than 1 acre. • Less than Elevation 60.
Bottom of Basin / "Up-Basin"	Rectangular, conveyance to Carkeek Pump Station.	• Flat (< 5%) area for pump station and storage. • Outside public right-of-way. • Pump station sized for peak flow. • Approximately 1 acre for storage; greater than 1/4 acre for pump station. • Pump station less than Elevation 50.
	Rectangular, conveyance to 8th Ave. Interceptor.	• Flat (< 5%) area for pump station and storage. • Outside public right-of-way. • Sized for peak flow pump station. • Approximately 1 acre for storage; greater than 1/4 acre for pump station. • Storage greater than Elevation 350. • Pump station less than Elevation 50.
	Deep Tunnel.	• Flat (< 5%) area for tunnel access portals. • Outside public right-of-way. • Approximately 2,600 feet at 14-feet diameter • Greater than 1/4 acre for downstream access; less than Elevation 50. • Greater than 1/2 acre for upstream access.

Table 5.6 Site Suitability Analysis

CSO Control Approach	Configuration	Minimum Requirements for Potential Sites
2. Convey-and-Treat		
Bottom of Basin	Peak flow pump station, pipeline to Carkeek CSO TP through Beach Alignment.	• Flat (< 5%) area for pump station. • Outside public right-of-way. • Sized for peak flow pump station. • Greater than 1/4 Acre for pump station. • Pump Station less than Elevation 50. • Carkeek CSO TP modifications.
	Peak flow pump station, pipeline to Carkeek CSO TP through Neighborhood Alignment.	• Flat (< 5%) area for pump station. • Outside public right-of-way. • Sized for peak flow pump station. • Greater than 1/4 Acre for pump station. • Pump station less than Elevation 50. • Carkeek CSO TP modifications.
3. End-of-Pipe Treatment		
Bottom of Basin	New high-rate clarification and UV disinfection treatment facility.	• Flat (< 5%) area for treatment facility. • Outside public right-of-way. • Greater than 1 acre. • Less than Elevation 50.
Bottom of Basin / ”Up-Basin”	Peak flow pump station, pipeline to new high rate clarification and UV disinfection treatment facility.	• Flat (< 5%) area for pump station and treatment facility. • Both sites outside public right-of-way. • Greater than 1/4 Acre for pump station. • Pump station less than Elevation 50. • Greater than 1 acre for treatment facility.

Table 5.6 Site Suitability Analysis

CSO Control Approach	Configuration	Minimum Requirements for Potential Sites
4. Peak Flow Reduction		
Rooftop Separation	Disconnection of impervious areas (roof drains and catch basins) with stormwater re-routed to new or existing MS4.	• Available impervious area for disconnection. • Inside or outside public right-of-way.
Green Stormwater Infrastructure (GSI)	Implementation of GSI techniques to limit stormwater response to rainfall.	• See GSI findings for constraints.
MS4 Construction	Disconnection of impervious areas in the right-of-way (catch basins) with stormwater re-routed to new or existing MS4.	• Combined system inside public right-of-way. • See GSI findings for constraints.
5. Combined Approach		
I/I Control	Rehabilitation of sewers and laterals and disconnection of impervious areas (roof drains and catch basins). May require MS4 construction to prevent localized flooding.	• I/I assessment of sewers. • Available impervious area for disconnection. • Inside and outside public right-of-way.

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Figure 5.5
PRELIMINARY SITES

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Wastewater Treatment Division

Figure 5-5.ai

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5.3.3 Preliminary Alternatives Overview

Development of preliminary alternatives is described in detail in TM 507.5 – "Planning Confirmation" (Carollo Engineers, March 2010) and TM 505.1 – "Siting Report" (Carollo Engineers, June 2010). The following alternatives were developed for the South Magnolia Basin:

- Control Approach 1 – Peak Flow Storage:
  - Alternative 1A – Centralized single tank, Bottom of Basin Storage.
  - Alternative 1B – Increased S. Magnolia Trunk conveyance, and bottom of basin Storage.
  - Alternative 1C – Pump station and centralized single tank, upper basin.
  - Alternative 1D – Distributed storage, two tanks, bottom of basin and upper basin.
  - Alternative 1E – Distributed storage, three tanks, bottom of basin and upper basin.
  - Alternative 1F – Distributed storage, three tanks, bottom of basin and upper basin.
  - Alternative 1G – Distributed storage, bottom of basin tank, and two pipe storage tanks in upper basin.
  - Alternative 1H – Tunnel storage bottom of basin.
  - Alternatives 1I, 1J, 1K – Three options for conveyance to out-of-basin single tank storage.
- Control Approach 2 - Convey and Treat:
  - Alternative 2A – Pump station and conveyance force main to Interbay PS.
- Control Approach 3 – End-of-Pipe Treatment:
  - Alternative 3A – End-of-Pipe Treatment at the Bottom of the Basin.
- Control Approach 5 - Combined Approach:
  - Alternative 5A - Peak Flow Reduction and Storage.

The preliminary alternatives are described below and summarized in Table 5.7. Conceptual layouts for improvement facilities were developed and drawn at representative sites within the alternative locations.

Table 5.7 Magnolia Basin Preliminary Alternatives

Approach	Alternative	Description	Site (Figure 5.2)
Peak Flow Centralized storage	1A	One tank, 1.8 MG	A
	1B	Increase conveyance 1.2 mgd, with one tank, 0.8 MG	A
	1C	7.7 MG PS with one tank, 1.8 MG	A,E
Distributed Storage	1D	Two tanks, 1.08, 0.72 MG	A,E
	1E	Three tanks, 0.93, 0.72, 0.15 MG	A,B,F
	1F	Three tanks, 0.98, 0.67, 0.15 MG	A,D,F
	1G	Maximize pipe storage, 0.48MG tank, 0.45, 0.72, 0.15 MG pipes	A,G,H,J
Out of Basin Storage	1H	12-ft Tunnel storage, 2.5 MG	A,C
	1I	7.7 mgd Gravity sewer, one tank, 1.8 MG	A, I, C
	1J	7.7 mgd PS, FM, one tank, 1.8MG	A,I,C
	1K	12 mgd PS, FM, one tank, 1.8 MG	A,C
Convey/Treat	2A	7.7 mgd PS, FM, gravity sewer	A,I
End-of-Pipe Treatment	3A	7.7 mgd HRC treatment plant	A
Combined	5A	Rooftop disconnection and tank storage	Multiples sites

5.3.4 Alternatives Using Control Approach 1 – Peak-Flow Storage

This control approach requires one or more storage tanks, tunnels, or pipes large enough to achieve the control objective. Alternatives with one tank, tunnel, or pipe are termed “centralized storage”, while alternatives with more than one location for storage are termed “distributed storage.”

Storage could be located anywhere in the basin or out of the basin. It could be at the CSO control location where the flows already are conveyed, or it could include a pump station and conveyance to collect and convey wastewater from the collection system to the storage site. The preliminary alternatives are described in following paragraphs.

Alternative 1A - Centralized Storage at Site A - Figure 5.6. This alternative comprises a 1.8-MG storage tank at Site A, adjacent to the Magnolia CSO control structure. Figure 5.3 illustrates the alternative. It includes the following elements:

- Storage tank. A below-grade storage tank with approximate dimensions of 85 x 300 x 15 feet deep.
- Infrastructure. A new diversion structure in the City of Seattle trunk sewer upstream of the tank site to divert flow into the tank. The Magnolia CSO diversion structure modified to return flow to the South Magnolia Trunk sewer.
- A pump station to empty the tank contents over a 24-hour period after a storm.
- Odor control comprising carbon scrubbers.
- Standby power with fuel storage.
- The site includes surface access, fencing, and parking off street.

Alternative 1B - Increased Conveyance and Storage at Site A - Figure 5.7. This alternative comprises an increase in the capacity of the South Magnolia Trunk Sewer by raising the overflow weir in the South Magnolia CSO control structure. A 0.8-MG storage tank is located on Site A, adjacent to the Magnolia CSO diversion structure. Figure 5.4 illustrates the alternative. It includes the following elements:

- The control structure modified to raise weir approximately 3 feet to increase pressure in trunk sewer and capacity to 5.5 mgd.
- Storage tank. A below-grade storage tank with dimensions of approximately 70 x 180 x 15 feet deep.
- Infrastructure. A new diversion structure in the City of Seattle trunk sewer upstream of the tank site to divert flow into the tank. The Magnolia CSO diversion structure modified to return flow to the South Magnolia Trunk sewer.
- A pump station to empty the tank contents over a 24-hour period after a storm.
- Odor control comprising carbon scrubbers.
- Standby power with fuel storage.
- The site includes surface access, fencing, and parking off street.

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Figure 5.6
PRELIMINARY ALTERNATIVE 1A

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Figure 5.7
PRELIMINARY ALTERNATIVE 1B

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Alternative 1C - Pump Station at Site A and Centralized Storage at Site E - Figure 5.8. This alternative comprises a pump station at Site A, a 2,500-LF force main, and a 1.8-MG storage tank at Site E. A 7.7-mgd sewage pump station is located on Site A, adjacent to the Magnolia CSO diversion structure. Site E comprises a storage tank and ancillary facilities located in the SE corner of the West Magnolia Play Field site beneath existing baseball fields. Figure 5.5 illustrates the alternative. It includes the following elements:

- Infrastructure. A new diversion structure in the City of Seattle trunk sewer upstream of the tank site to divert flow into the pump station.
- A 7.7-mgd high-head pump station on Site A.
- A 21-inch diameter, 2,500-LF force main along 32nd Avenue W to Site E.
- The tank at Site E is 170 x 140 x 15 feet deep and includes a pump station to empty its contents over a 24-hour period after a storm.
- Odor control comprising carbon scrubbers.
- Standby power with fuel storage.
- The site includes a 10,000-SF fenced area for access and odor control.

Alternative 1D - Distributed Storage at Sites A and E - Figure 5.9. This alternative comprises two tanks, a 1.08-MG storage tank on Site A, adjacent to the Magnolia CSO control structure, and a 0.72-MG tank at Site E. Figure 5.6 illustrates the alternative. It includes the following elements:

- A below-grade storage tank at Site A with dimensions of 85 x 185 x 15 feet deep.
- Infrastructure. A new diversion structure in the City of Seattle trunk sewer upstream of the tank site to divert flow into the tank at Site A. The Magnolia CSO diversion structure modified to return flow to the South Magnolia Trunk sewer.
- A below-grade storage tank at Site E with dimensions of 85 x 130 x 15 feet deep. The tank could be located under existing tennis courts at the southwest corner of the site.
- Infrastructure modifications along W McGraw Street. Two to three diversion structures to divert flow from Sub-basins SM05, SM07, and SM08 into sewerage to convey flow to Site E.
- New sewerage along 32nd Avenue W and 34th Avenue W to convey flow to Site E from the diversion structures.
- Two pump stations to empty the tank contents over a 24-hour period after a storm.
- Both tanks include odor control comprising carbon scrubbers.
- Both tanks include standby power and fuel storage.
- Both tanks include surface access, fencing, and parking off-street.

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Figure 5.8
PRELIMINARY ALTERNATIVE 1C AND 1C/B

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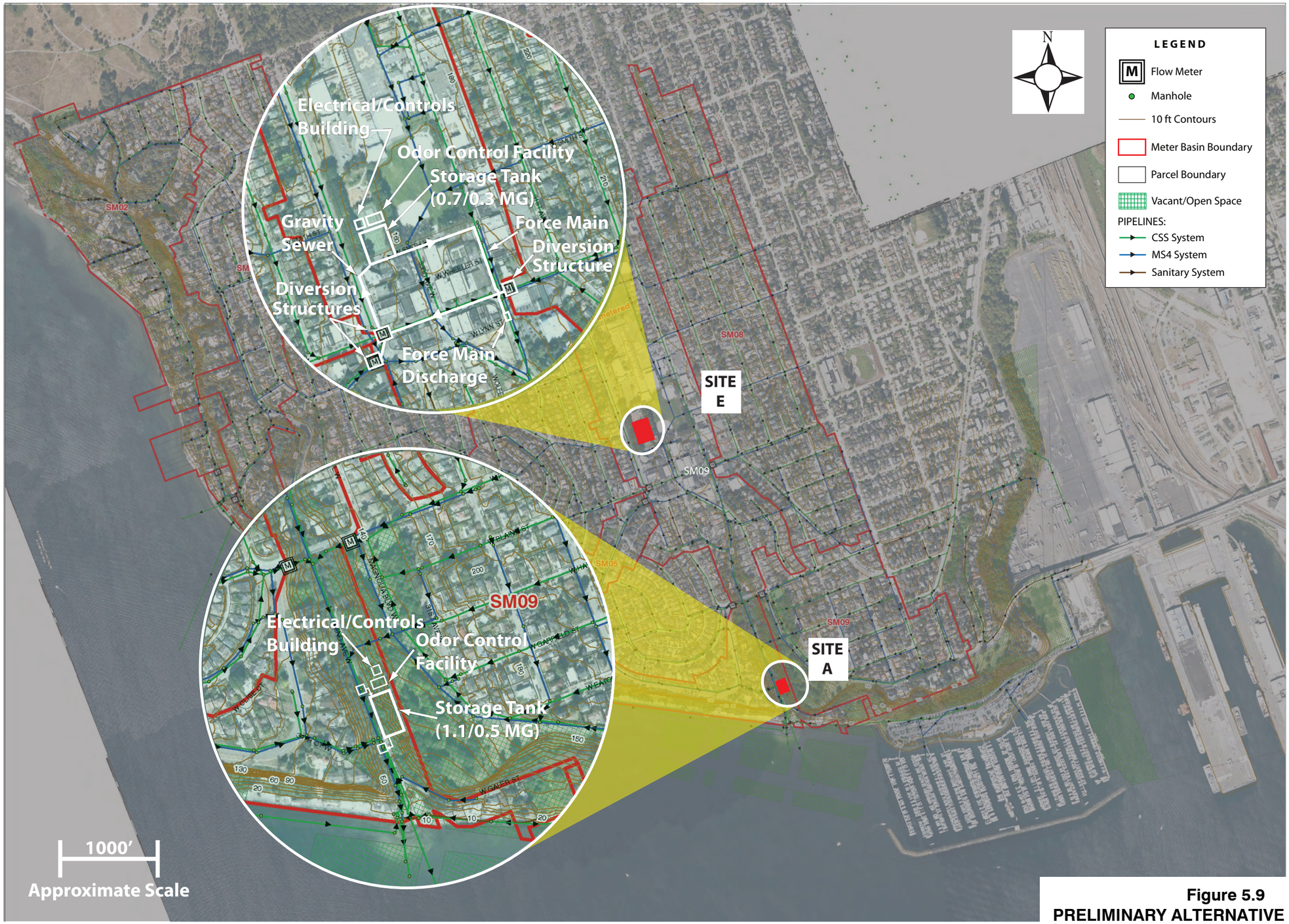

Figure 5.9
PRELIMINARY ALTERNATIVE 1D AND 1D/B

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Alternative 1E - Distributed Storage at Sites A, B, and F - Figure 5.10. This alternative comprises three tanks, a 0.93-MG storage tank on Site A, adjacent to the Magnolia CSO control structure, a 0.72-MG storage tank at Site B, and a 0.15-MG tank at Site F. Figure 5.7 illustrates the alternative. It includes the following elements:

- A buried storage tank at Site A with dimensions of 85 x 160 x 15 feet deep.
- Infrastructure. A new diversion structure in the City of Seattle trunk sewer upstream of the tank site to divert flow into the tank at Site A. The Magnolia CSO diversion structure modified to return flow to the South Magnolia Trunk sewer.
- A buried storage tank at Site B with dimensions of 70 x 165 x 15 feet deep. This tank is located under a parking lot.
- A below-grade storage tank is constructed at Site F with dimensions of 70 x 70 x 10 feet deep. This tank is located under a tennis court.
- Infrastructure modifications along W McGraw Street. Two to three diversion structures to divert flow from Sub-basins SM05, SM07, and SM08 into sewerage to convey flow to Site B.
- New sewerage along 32nd Avenue W and W McGraw Street to convey flow to Site B from the diversion structures.
- Construction of a diversion structure on W Howe Street to divert flow to Site F.
- All tanks include a pump station to empty the tank contents over a 24-hour period after a storm. Tanks at Sites B and F return flow to the downstream sewer.
- All tanks include odor control comprising carbon scrubbers.
- All tanks include standby power.
- Site B and F tanks include surface access.
- Site A tank includes surface access, fencing, and off-street parking.

Alternative 1F - Distributed Storage at Sites A, D, and F - Figure 5.11. This alternative comprises three tanks, a 0.98-MG storage tank on Site A, adjacent to the Magnolia CSO control structure, a 0.67-MG storage tank at Site D, and a 0.15-MG tank at Site F. Figure 5.8 illustrates the alternative. It includes the following elements:

- A below-grade storage tank is constructed at Site A with dimensions of 85 x 165 x 15 feet deep.
- Infrastructure. A new diversion structure in the City of Seattle trunk sewer upstream of the tank site to divert flow into the tank at Site A. The Magnolia CSO diversion structure modified to return flow to the South Magnolia Trunk sewer.
- A below-grade storage tank is constructed at Site D with dimensions of 100 x 100 x 15 feet deep. This tank is located on a former residential lot. Demolition of one house is required.
- A below-grade storage tank is constructed at Site F with dimensions of 70 x 70 x 10 feet deep. This tank is located under a tennis court.

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Figure 5.10
PRELIMINARY ALTERNATIVE 1E

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Figure 5.11
PRELIMINARY ALTERNATIVE 1F

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- Infrastructure modifications along W McGraw Street. Two to three diversion structures to divert flow from Sub-basins SM05, SM07, and SM08 into sewerage to convey flow to Site D.
- New sewerage along 32nd Avenue W and W McGraw Street to convey flow to Site D from the diversion structures.
- Construction of a diversion structure on W Howe Street to divert flow to Site F.
- All tanks include a pump station to empty the tank contents over a 24-hour period after a storm. Tanks at Sites B and F return flow to the downstream sewer.
- All tanks include odor control comprising carbon scrubbers.
- All tanks include standby power.
- Site F tank includes surface access.
- Site A and D tanks include surface access, fencing, and off-street parking.

Alternative 1G - Distributed Storage at Sites A, G, H, and J - Figure 5.12. This alternative comprises one tank, a 0.48-MG storage tank on Site A adjacent to the Magnolia CSO control structure, and three 12-foot-diameter buried parallel pipe storage tanks at Sites G, H, and J. Figure 5.9 illustrates the alternative. It includes the following elements:

- A below-grade storage tank is constructed at Site A with dimensions of 70 x 135 x 12.5 feet deep.
- Infrastructure. A new diversion structure in the City of Seattle trunk sewer upstream of the tank site to divert flow into the tank at Site A. The Magnolia CSO diversion structure modified to return flow to the South Magnolia Trunk sewer.
- Pipe storage, 600 LF, 0.45 MG, at Site G, located in the right of way of Magnolia Boulevard, north of Montista Place.
- Pipe storage, 950 LF, 0.72 MG, at Site H. located in the right of way in 32nd Avenue W, north of W McGraw Street.
- Pipe storage, 200 LF, 0.15 MG, at Site J, located in the right of way of Clise Place W, north of W Howe Street.
- Diversion structures at sited G and J to divert sewage into the storage pipes.
- Infrastructure modifications along W. McGraw Street. Two to three diversion structures to divert flow from Sub-basins SM05, SM07, and SM08 into sewerage to convey flow to Site H.
- New sewerage along 32nd Avenue W and W McGraw Street to convey flow to Site H from the diversion structures.
- All tanks are assumed to be gravity flow in and out.
- All tanks include below-grade odor control comprising carbon scrubbers.
- No standby power is assumed.
- All tanks are accessed from the roadway.

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Figure 5.12
PRELIMINARY ALTERNATIVE 1G

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Alternative 1H - Tunnel Storage at Sites A, C, and I - Figure 5.13. This alternative comprises a 3,000-LF tunnel for storage. This alternative provides 2.5 MG of storage due to the length and diameter required to traverse the alignment. Diversion structures and tunnel portals are located at Sites A and C. Figure 5.10 illustrates the alternative. It includes the following elements:

- The Magnolia CSO diversion structure modified to divert flow to the tunnel.
- A tunnel portal outside the right of way on Site A.
- A 3,000-LF 12-foot diameter bored tunnel along Site I, generally under City of Seattle property and W Galer Street right of way from Site A to the western edge of Site C.
- A tunnel portal and connecting infrastructure at Site C to connect to the existing South Magnolia Trunk sewer on W Marina Place. As illustrated in the figure, modifications to the existing sewerage are required to make this connection, including modifications to the existing lift station serving the marina.

Alternative 1I - Gravity Sewer and Storage at Sites A, C, and I - Figure 5.14. This alternative comprises a new gravity sewer between Site A and Site C to convey peak flow, and a 1.8-MG storage tank at Site C. The gravity sewer could be directionally drilled. Figure 5.11 illustrates the alternative. It includes the following elements:

- The Magnolia CSO diversion structure modified to divert flow to the new sewer.
- A new, 3,100-LF, 21-inch, 7.7-mgd gravity sewer using horizontal directional drilling (HDD) techniques along Site I, generally under City of Seattle property and W Galer Street to Site C.
- A 1.8-MG storage tank having dimensions of 120 x 200 x 15 feet deep. Soils at the site may require pile foundations.
- Diversion structure and pumping facilities to discharge the tank into the existing South Magnolia Trunk sewer on W. Marina Place. As illustrated in the figure, modifications to the existing sewerage are required to make this connection, including modifications to the existing lift station serving the marina.

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Figure 5.13
PRELIMINARY ALTERNATIVE 1H

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Figure 5.14
PRELIMINARY ALTERNATIVE 1I

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Alternative 1J - Pump Station, Force Main, and Storage Tank at Sites A, C, and I - Figure 5.15. This alternative comprises a new 7.7-mgd pump station at Site A, 3,100 LF of 18- to 21-inch force main, and a 1.8-MG tank at Site C. Figure 5.12 illustrates the alternative. It includes the following elements:

- The Magnolia CSO diversion structure modified to divert flow to the new pump station.
- A new 7.7 mgd pump station out of the right of way on Site A.
- A new, 3,100-LF, 21-inch, 7.7-mgd force main using a combination of HDD and cut-and-cover construction along Site I, generally under City of Seattle property and W Galer Street to Site C. HDD would be used at the east and west ends of the alignment where the force main traverses steep slopes.
- A 1.8 MG storage tank having dimensions of 120 x 200 x 15 feet deep. Soils at the site may require pile foundations.
- Diversion structure and pumping facilities to discharge the tank into the existing South Magnolia Trunk sewer on W Marina Place. As illustrated in the figure, modifications to the existing sewerage are required to make this connection, including modifications to the existing lift station serving the marina.

Alternative 1K - Pump Station, Converted Sewer, and Storage Tank at Sites A, C, and I - Figure 5.16. This alternative comprises a new 12-mgd pump station at Site A, conversion of the existing 4.3-mgd gravity South Magnolia Trunk Sewer to a 12-mgd force main, and a storage tank at Site C. Figure 5.13 illustrates the alternative. It includes the following elements:

- The Magnolia CSO diversion structure modified to divert flow to the new pump station.
- A new 12-mgd pump station out of the right of way on Site A.
- The existing 18-inch ductile iron pipe pressure sewer between Site A and Site C is converted to a force main.
- A 1.8-MG storage tank having dimensions of 120 x 200 x 15 feet deep. Soils at the site may require pile foundations.
- Diversion structure and pumping facilities to discharge the tank into the existing South Magnolia Trunk sewer on W. Marina Place.

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Figure 5.15
PRELIMINARY ALTERNATIVE 1J

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Figure 5.16
PRELIMINARY ALTERNATIVE 1K

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5.3.5 Alternative Using Control Approach 2 - Convey and Treat

This control approach comprises conveyance capacity increases to convey peak flows out of the basin to downstream facilities. One alternative is presented, although various alignments and construction methods could be used. A significant constraint of this approach is the apparent limitations on capacity of the Interbay PS and downstream facilities to accept an increase in peak flow of 7.7 mgd or more.

Alternative 2A - Pump Station, Force Main from Site A to Site C and a Gravity Sewer to the Interbay PS - Figure 5.17. This alternative comprises a new 7.7-mgd pump station at Site A, and a new force main and gravity sewer from Site A to the Interbay PS. The existing South Magnolia Trunk sewer would continue to convey up to 4.3 mgd. Figure 5.16 illustrates the alternative. It includes the following elements:

- The Magnolia CSO diversion structure modified to divert flow to the new pump station.
- A new 7.7 mgd pump station out of the right of way on Site A.
- A new, 3,100-LF, 21-inch, 12-mgd force main using a combination of HDD and cut-and-cover construction along Site I, generally under City of Seattle property and W. Galer Street to Site C. HDD would be used at the east and west ends of the alignment where the force main traverses steep slopes.
- A new, 3,500-LF 30-inch gravity sewer with a capacity of 8.4 mgd from the force main terminus on Site C to the Interbay PS. The sewer would be a sealed ductile iron pipe, may require pile support in some areas, and would require new easements from the City of Seattle and Port of Seattle.
- Diversion structure and pumping facilities to discharge the tank into the existing South Magnolia Trunk sewer on W. Marina Place.

5.3.6 Alternative Using Control Approach 3 - End of Pipe Treatment

This control approach includes end-of-pipe treatment of peak flows between 4.3 and 12 mgd that are tributary to the CSO control location. One alternative is presented, located at Site A, which makes use of the existing outfall to convey treated flow. Other sites, such as Site C may be used, but would require additional facilities and new outfalls.

Alternative 3A - End of Pipe Treatment at Site A - Figure 5.18. This alternative comprises a 7.7-mgd high rate clarification (HRC) wet-weather treatment plant at Site A. Figure 5.15 illustrates the alternative. It includes the following elements.

- A new diversion structure in the City of Seattle trunk sewer upstream of the Site A to divert flow into the treatment plant influent pump station.
- A new 7.7-mgd influent pump station out of the right of way on Site A to convey flow into the treatment plant.
- A 7.7-mgd HRC plant with approximate dimensions of 90 x 105 feet.
- The Magnolia CSO diversion structure modified to return flow to the South Magnolia Trunk sewer.

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Figure 5.17
PRELIMINARY ALTERNATIVE 2A

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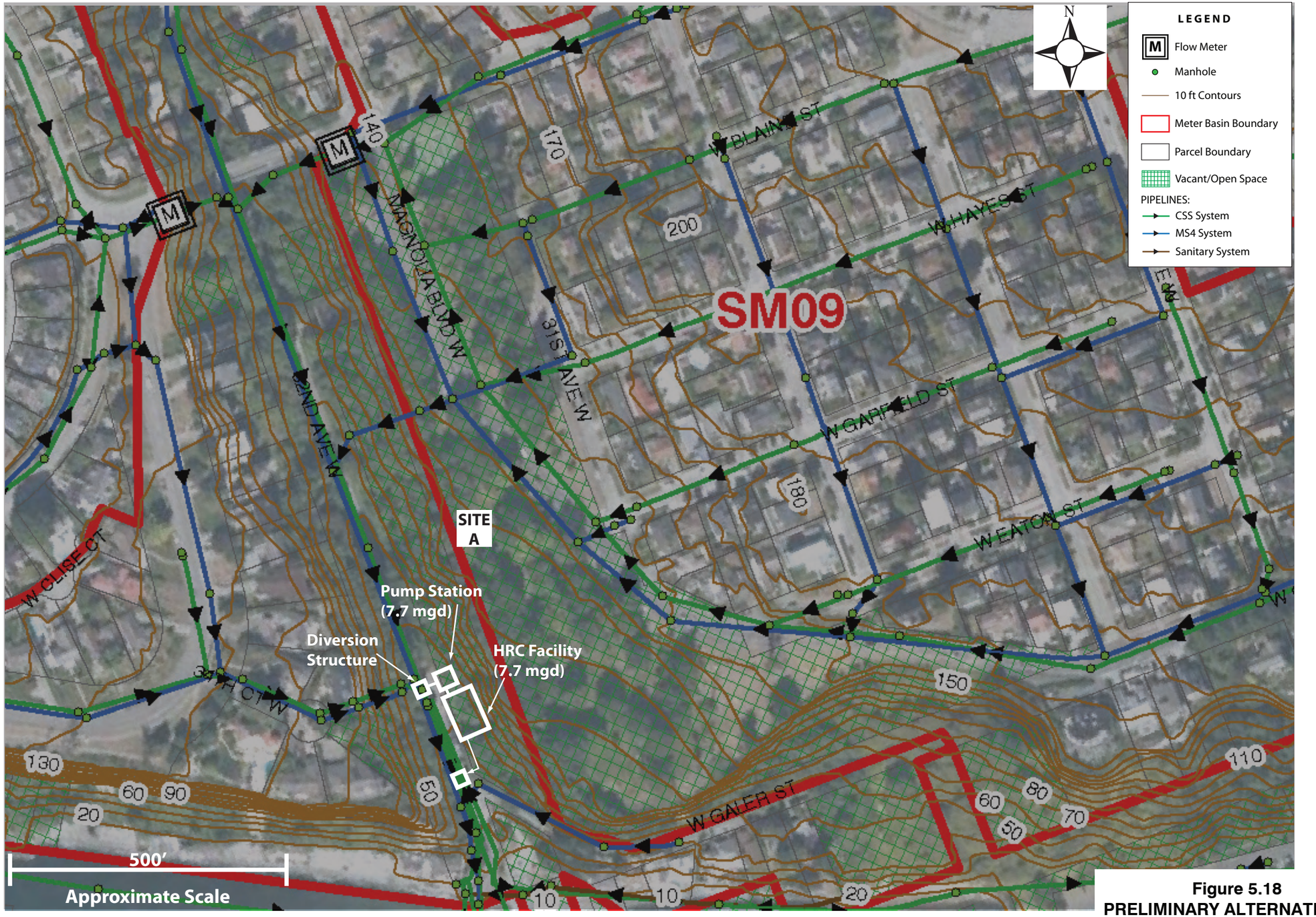

Figure 5.18
PRELIMINARY ALTERNATIVE 3A

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5.3.7 Alternative Using Control Approach 5 - Combined Storage or Conveyance and Stormwater Reduction

This approach reduces stormwater from rooftops that are currently connected to the CSS, in combination with storage. It is assumed that disconnected rooftops would be routed to rain gardens in order to not increase stormwater flows to the existing storm system, thereby requiring treatment of storm flows. The approach is variable depending on how many houses are separated. One alternative is presented that assumes 50% disconnection of rooftops. According to City of Seattle guidelines, one rain garden will provide storage for 700 square feet of rooftop. Based on the average building size as determined from GIS data, an average house will require two rain gardens. The number of rooftops connected and the number needing to be disconnected for various levels of storage reduction is shown in Table 5.8. It is noted that 100% disconnection reduces peak flow storage requirements by 93% so that some storage is needed regardless of disconnections.

Table 5.8 Alternative 5A Rooftop Disconnection. Connected Rooftops by Sub Basin

Sub Basin #	# Rooftops Connected per model	25% Reduction #disconnected	75% Reduction #disconnected
02	15	4	11
03	57	15	44
05	23	6	18
06	638	160	480
07	207	52	156
08	184	46	138
09	79	20	60
Total	1204	303	907

Alternative 5A - Rooftop Disconnection- (not illustrated.) This alternative comprises 50 percent rooftop disconnection in Sub-basins 06, 07, 08, and 09. Additional reductions are taken in Sub-basin 06, to account for Sub-basins 02, 03, and 05. This reduces the total storage requirement to 1.11 MG. This alternative comprises one tank at Site A. It includes the following elements:

- A below-grade 1.11-MG storage tank at Site A, with dimensions of 85 x 115 feet.
- Infrastructure. A new diversion structure in the City of Seattle trunk sewer upstream of the tank site to divert flow into the tank at Site A. The Magnolia CSO diversion structure modified to return flow to the South Magnolia Trunk sewer.
- The tank is assumed to be gravity flow in and out.

- The tank includes below-grade odor control comprising carbon scrubbers.
- Standby power is provided for odor control.

5.4 SCREENING OF PRELIMINARY ALTERNATIVES

This section provides a detailed description of the alternatives screening performed under Step 2 of Phase 2 (as described in Section 5.1.3.2). The screening process is described in detail in memoranda titled "CSO Control Alternative Review and Comment Procedure: (Carollo Engineers, September 2009) and "Alternative Narrowing Process" (Triangle Associates, November 2009).

5.4.1 Refined Preliminary Alternatives

The project team used the selection criteria to perform a screening of the preliminary alternatives. Further information was available to the team through ongoing evaluation of community input, CSO modeling by the county, and review of land use and permitting criteria. The screening took advantage of refinements in the selection criteria evaluation questions based on the expanded information. As a result of team deliberations, some alternatives were dropped from further consideration and some were modified or combined. The result is summarized in Table 5.9.

The refined preliminary alternatives were further developed and evaluated between August and December 2009. Team workshops held each month focused on technical and nontechnical aspects of the alternatives. Engineering schematics of each of the CSO control approaches were developed in order to refine costs as a result of county operations and maintenance input. The schematics were used to develop a basis of costs for the alternatives. A planning level cost estimate for each of the alternatives was developed and included in the evaluation. The refined alternatives are illustrated in Figures 5.19 through 5.29.

Table 5.9 South Magnolia Basin, Summary of Refined Preliminary Alternatives

ALT#	Alternative	Reasons for Selection	Constraints
1A	• Centralized storage at Site A.	• One tank, central location next to CSO. • Simple, familiar infrastructure.	• Acquisition of property needed for construction and operations. • Constructability on site due to steep slopes, soils, groundwater may be limiting. • Access for construction and operations is limited. • Community impacts during construction may be significant for 11 homes.
1B	• Centralized storage Site A, 0.8MG. • Increased conveyance capacity of 5.5 mgd.	• Simple modification to existing CSO control structure and slight increase in peak flows at Interbay PS reduce storage capacity requirements by up to 56%.	• Modeling and hydraulic analysis needed to confirm capacity increase at CSO and Interbay PS. • Same constructability and access constraints as 1A.
1C/1B	• Centralized storage at Site E, 0.8 MG. • Combination of 1C and 1B • Reduced size 4 mgd PS and force main from Site A to E. • Increased conveyance capacity, 5.5 mgd.	• Moves central storage out of constrained area at existing CSO to flat ground. • Collects 36% of peak flows in upper basin, offloading downstream facilities and required pump station capacity. • Same conveyance benefit as 1B.	• Site E is in a developed and heavily used recreation site owned by the City of Seattle. A ground lease would be required for the tank and acquisition would be required for odor control and access. • Sewer construction in the Magnolia commercial area would disrupt businesses. • Access for construction at Site A would impact up to 11 residences.

Table 5.9 South Magnolia Basin, Summary of Refined Preliminary Alternatives

ALT#	Alternative	Reasons for Selection	Constraints
1D/1B	• Decentralized storage at Site A, 0.8 MG and Site E, 0.32 MG. • Combination of 1D and 1B. • Increased conveyance capacity of 1B, 5.5 mgd.	• Reduces storage capacity at Site E. • Collects 36% of peak flows in upper basin. • Same conveyance benefits as 1B.	• Same constraints as 1A and 1C/1B combined.
1H	• Tunnel storage, 1./8MG, Site I.	• No facilities on surface in the basin. • Easements appear to be on public property. • 20% additional storage volume built in. • Small use of Site C for odor control and access. • Site C underutilized.	• Acquisition of property needed for construction and operation at Site C. • Soil conditions unknown.
1I/1J/1K (Became Alts 1F1 through 1F3)	• Conveyance out of basin and Storage at Site C, 1.8 MG. • Evaluate all three options for conveyance. • Select most attractive option.	• Simple, familiar infrastructure. • Moves central storage out of constrained area at to flat ground at Site C. • Three options available for conveyance to central site.	• Acquisition of property needed for construction and operation at Site C. • Soils may require pile support of tank. • Conversion of existing sewer requires larger pump station; feasibility needs to be confirmed by further study. • Pump station required at Site A. Acquisition of property needed. • Access during construction at Site A

Table 5.9 South Magnolia Basin, Summary of Refined Preliminary Alternatives

ALT#	Alternative	Reasons for Selection	Constraints
			would affect up to 11 residences.
2A	• Convey and Treat 7.7 mgd peak flow with PS, FM, and SS combination.	• Eliminates storage requirement.	• Site A development reduced.May not be capacity at Interbay PS and downstream facilities for additional 7.7 mgd peak flow. • Requires easements from Port of Seattle for new gravity sewer. • Utilities along gravity sewer alignment may be problematic.
3A	• End of Pipe Treatment at Site A.	• Eliminates storage requirement. • Modular, can be expanded. • Small footprint.	• Zoning may not allow use of Site A for treatment plant.
5A	• Combination separation (25% disconnection) in Sub-basins 6, 8, and 9, and storage at Site A, 1.11 MG.	• Examine potential for peak flow. reduction in sub basins with highest response to rainfall. • Reduces storage requirement at Site A.	• 25% disconnection requires participation by 600 homeowners; implementation may be problematic. • Same constraints at Site A as for Alternative 1A.

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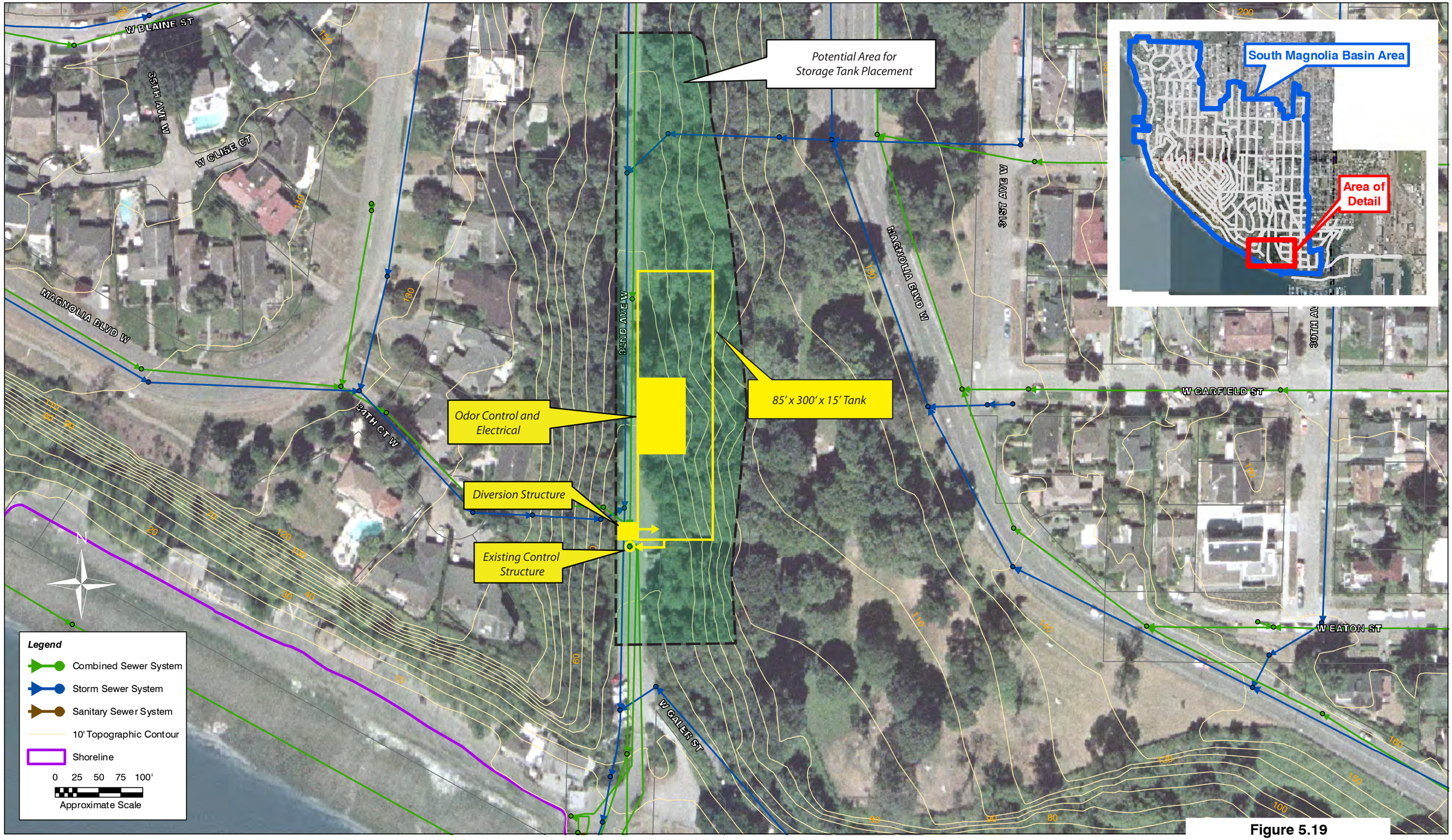

Figure 5.19
ALTERNATIVE 1A

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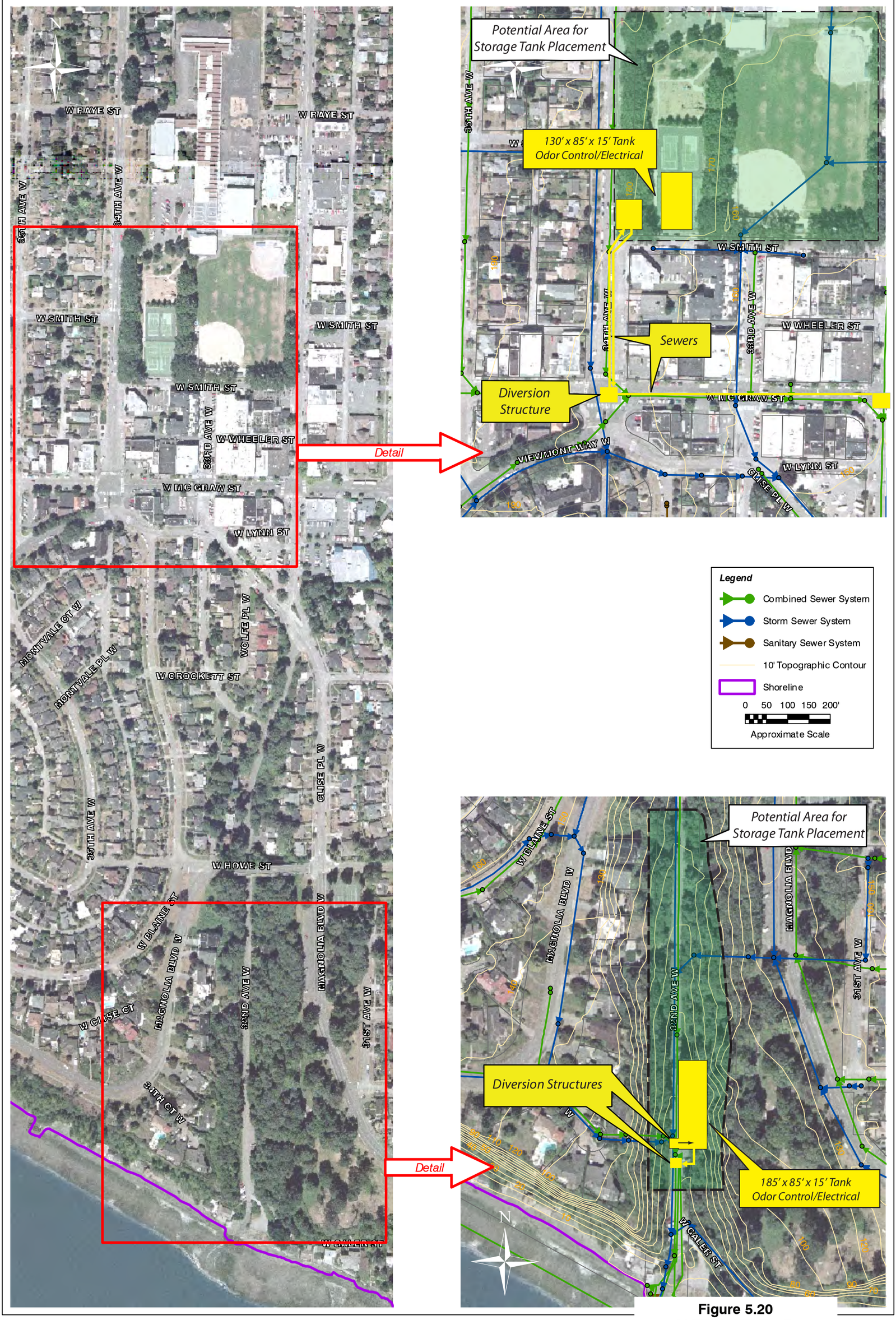

Figure 5.20
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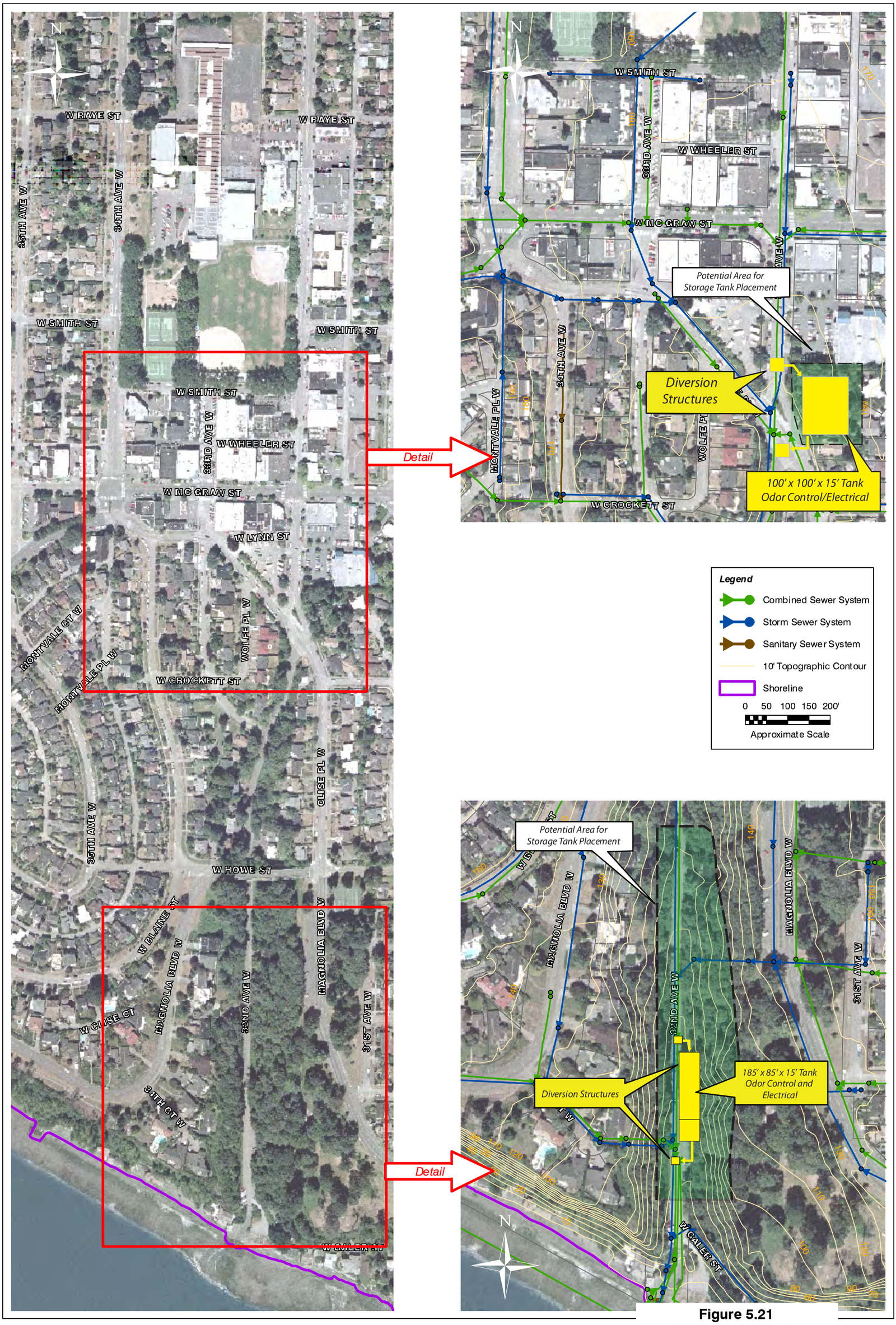

Figure 5.21
ALTERNATIVE 1C

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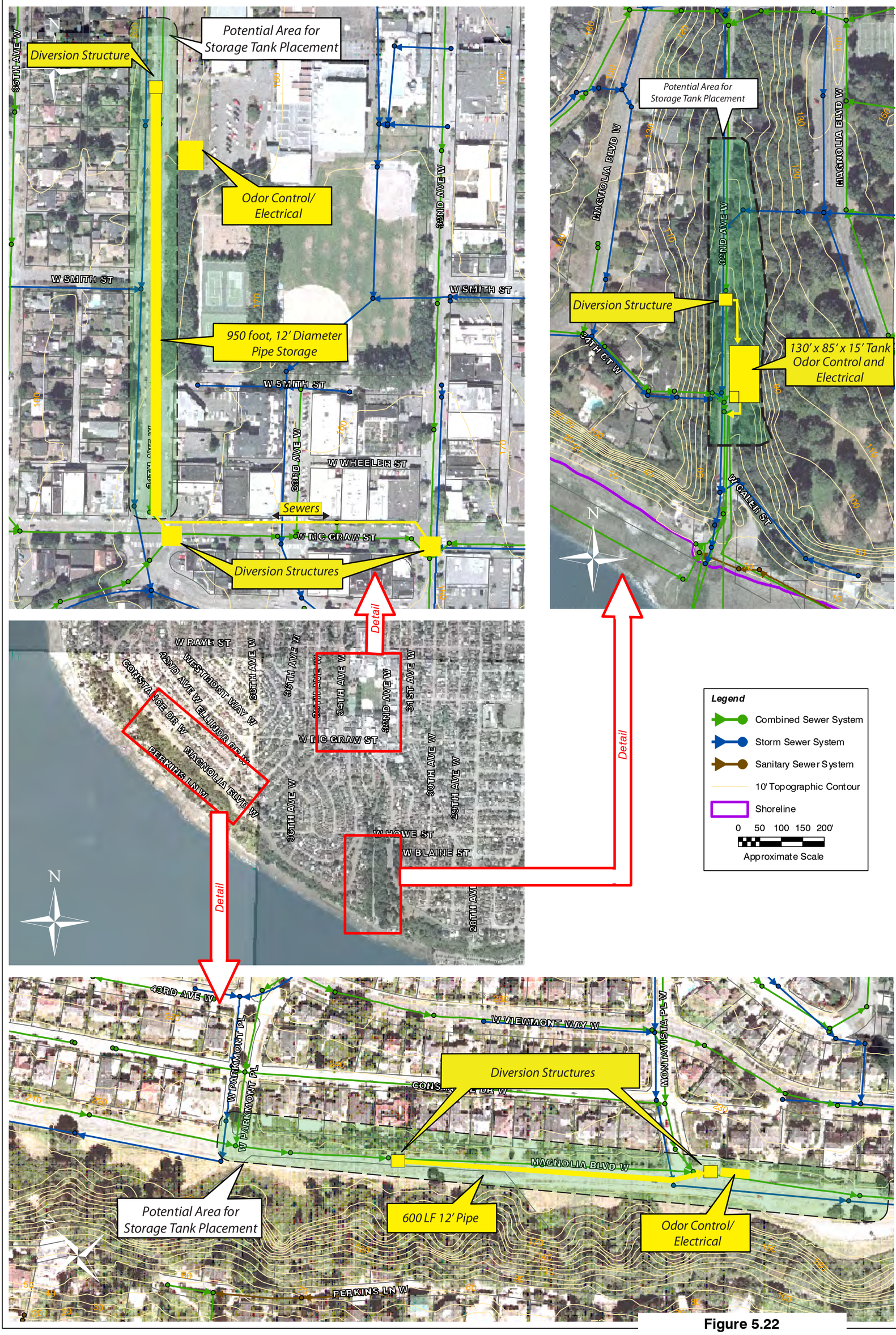

Figure 5.22
ALTERNATIVE 1D

King County
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Wastewater Treatment Division

Figure 5-22.ai

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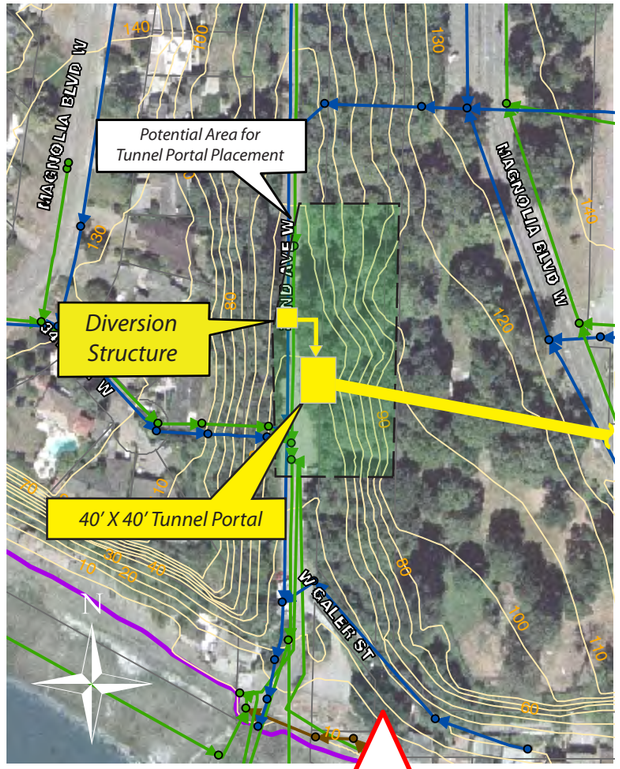

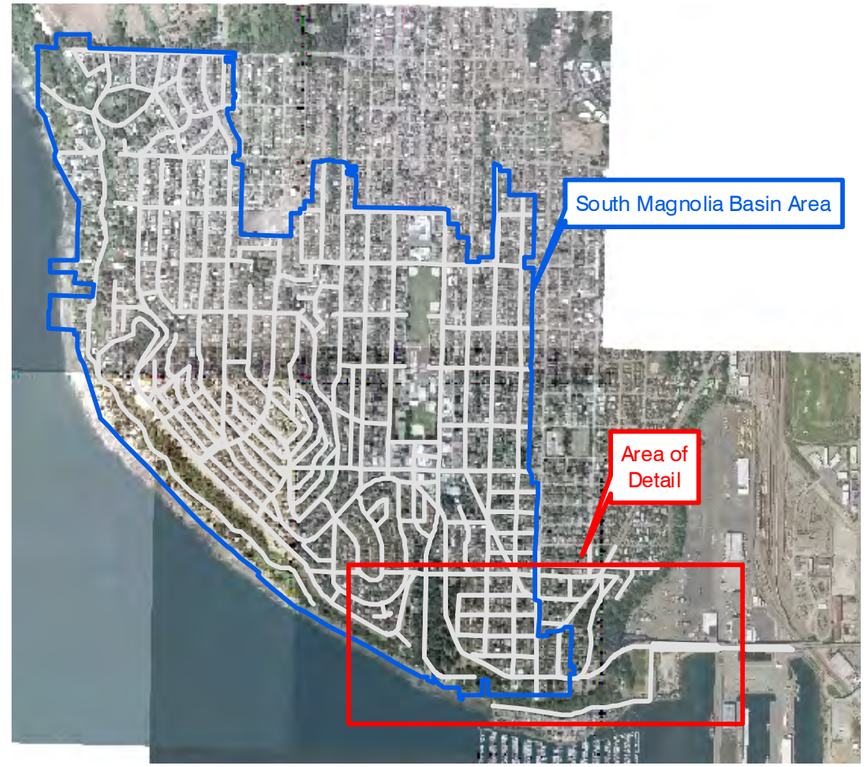

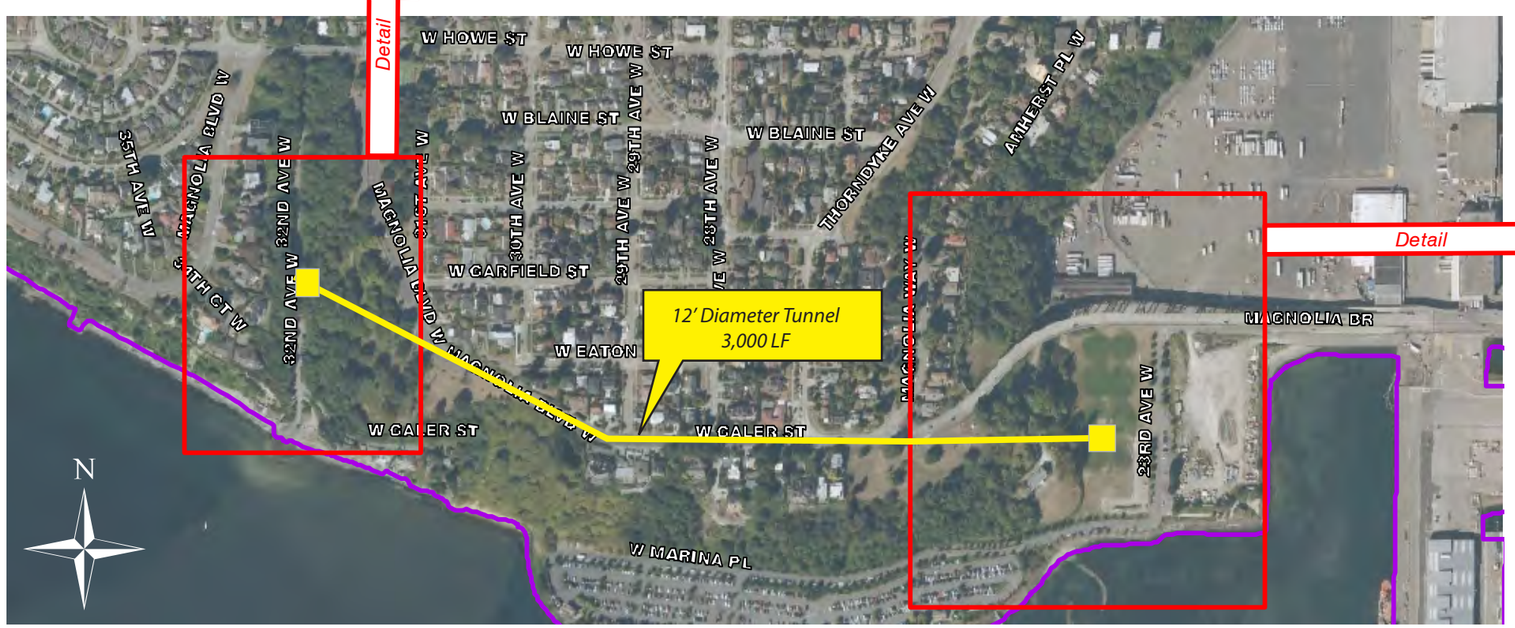

Legend

- Combined Sewer System
- Storm Sewer System
- Sanitary Sewer System
- 10' Topographic Contour
- Shoreline

0 50 100 150 200'

Approximate Scale

Figure 5.23
ALTERNATIVE 1E

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Department of Natural Resources and Parks
Wastewater Treatment Division

Figure 5-23.ai

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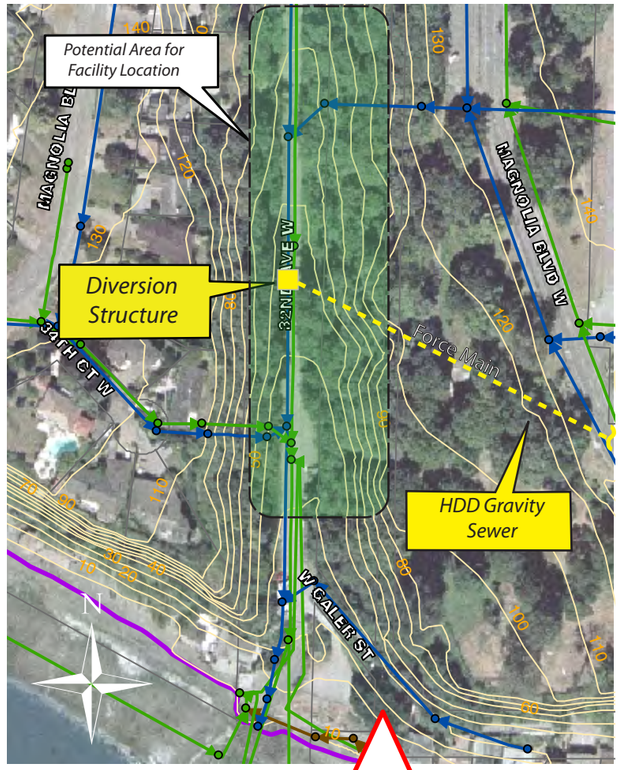

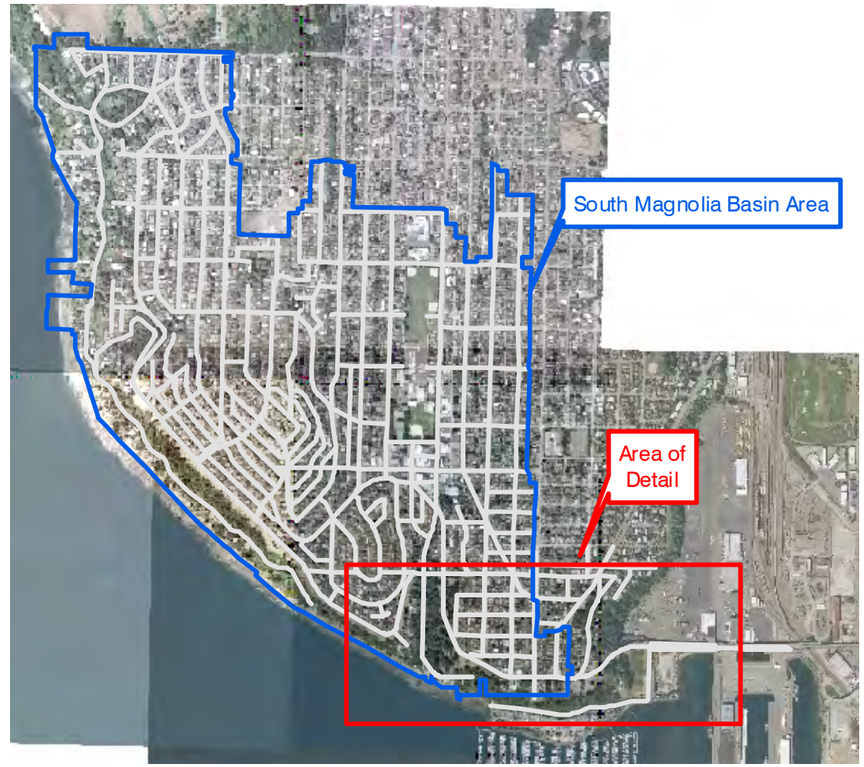

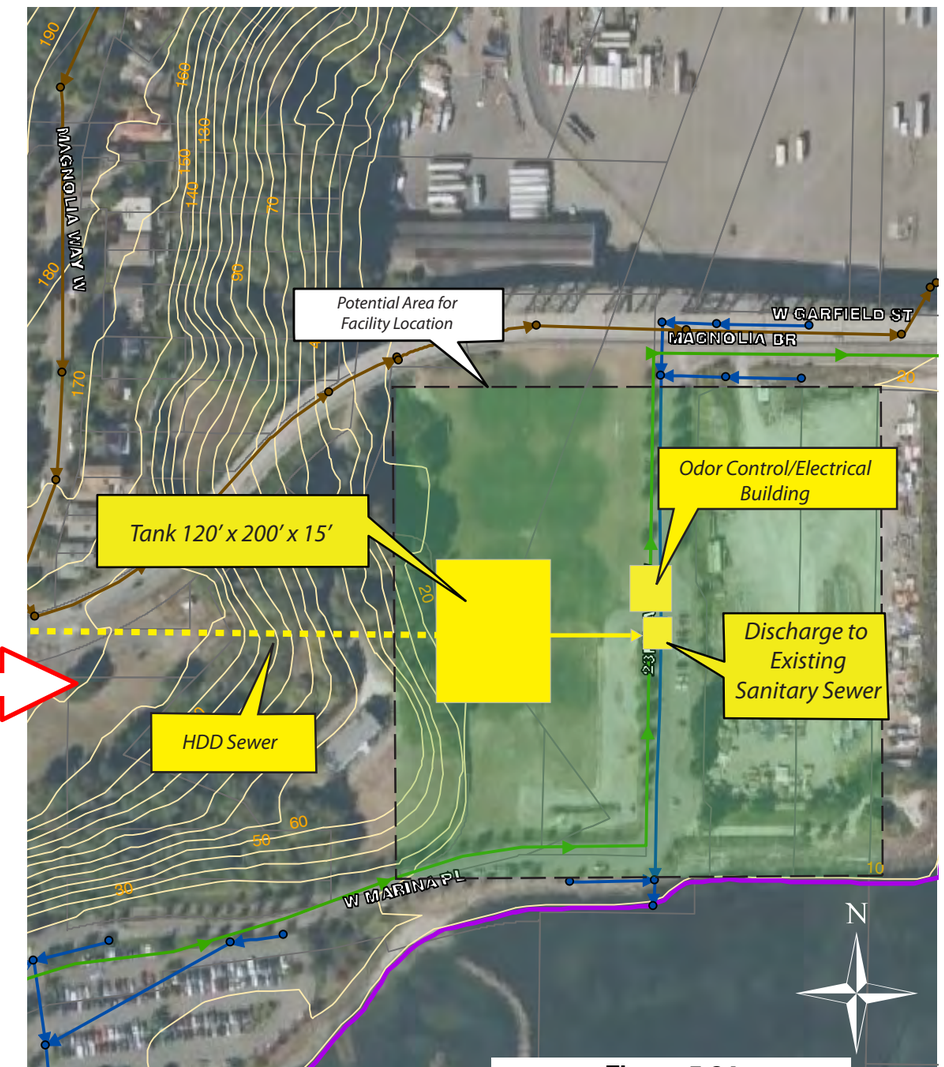

Legend

- Combined Sewer System
- Storm Sewer System
- Sanitary Sewer System
- 10' Topographic Contour
- Shoreline

0 50 100 150 200'

Approximate Scale

Figure 5.24
ALTERNATIVE 1F1

King County
Department of Natural Resources and Parks
Wastewater Treatment Division

Figure 524.ai

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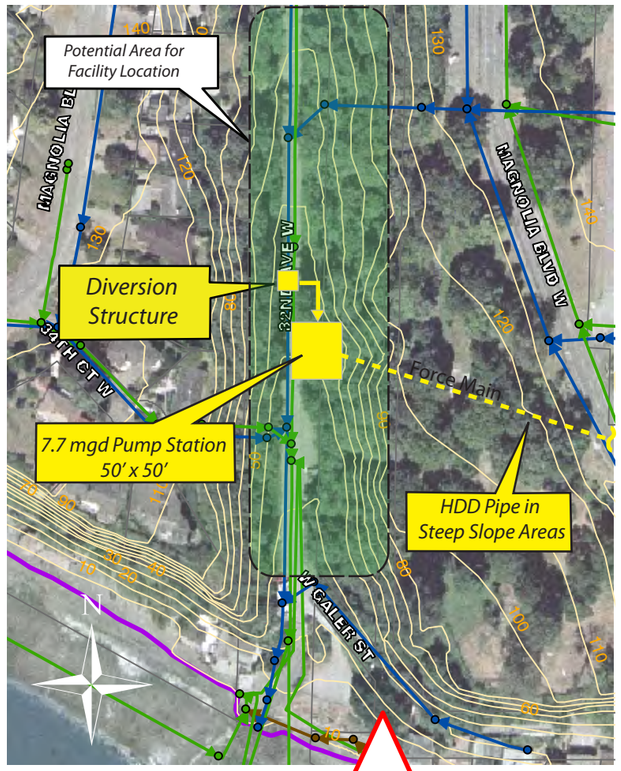

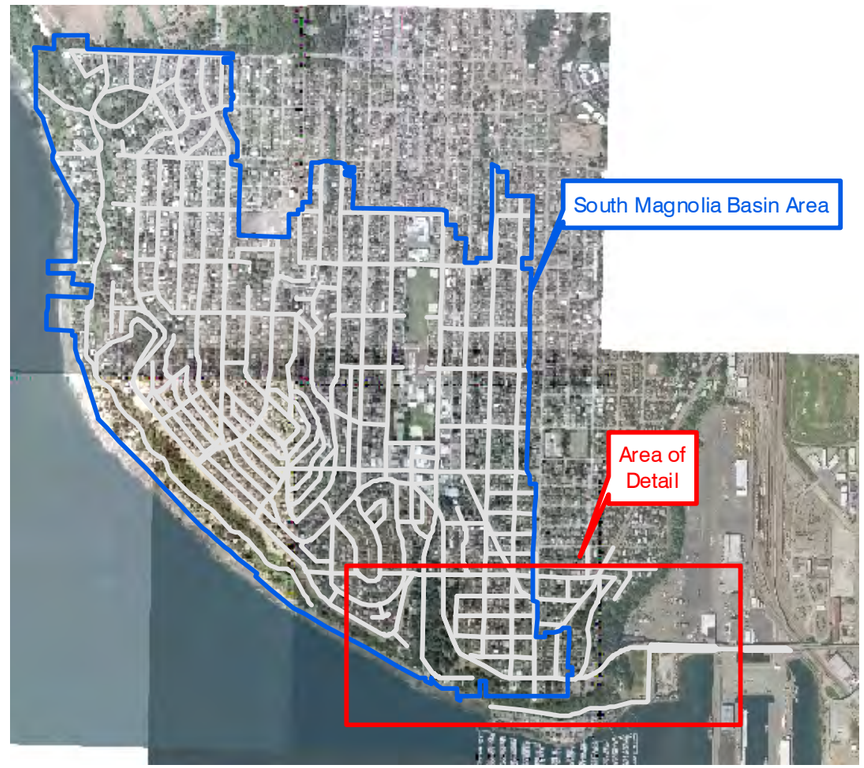

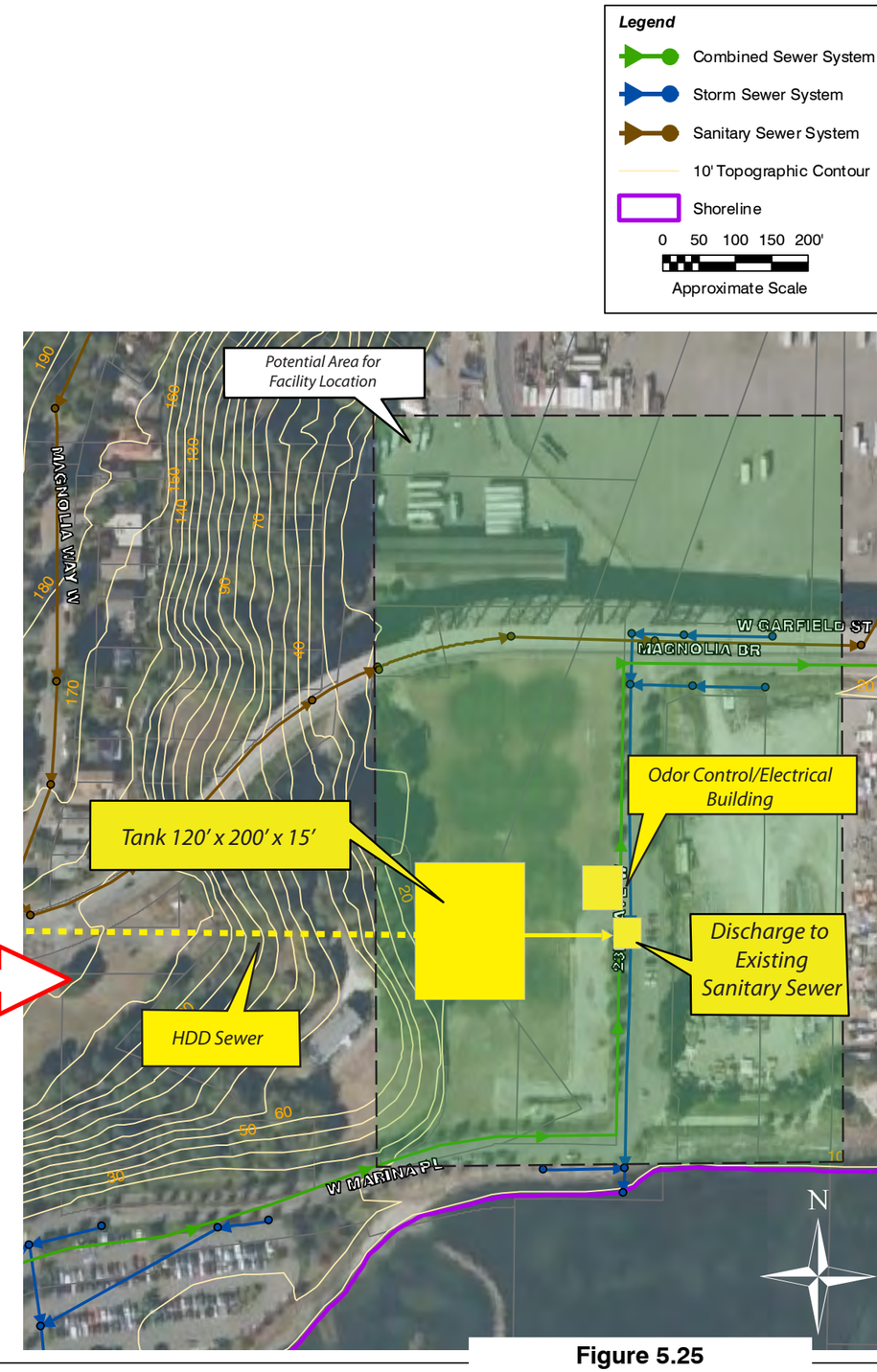

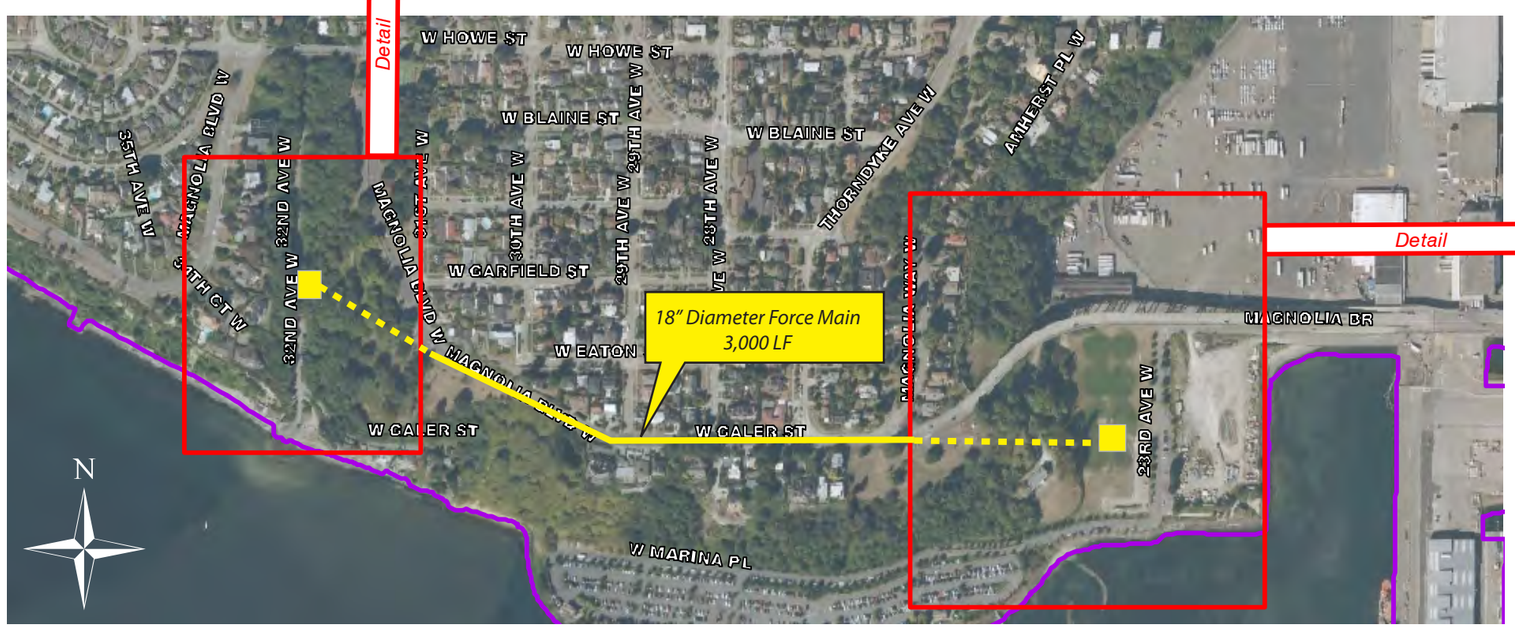

Figure 5.25
ALTERNATIVE 1F2

King County
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Figure 525.ai

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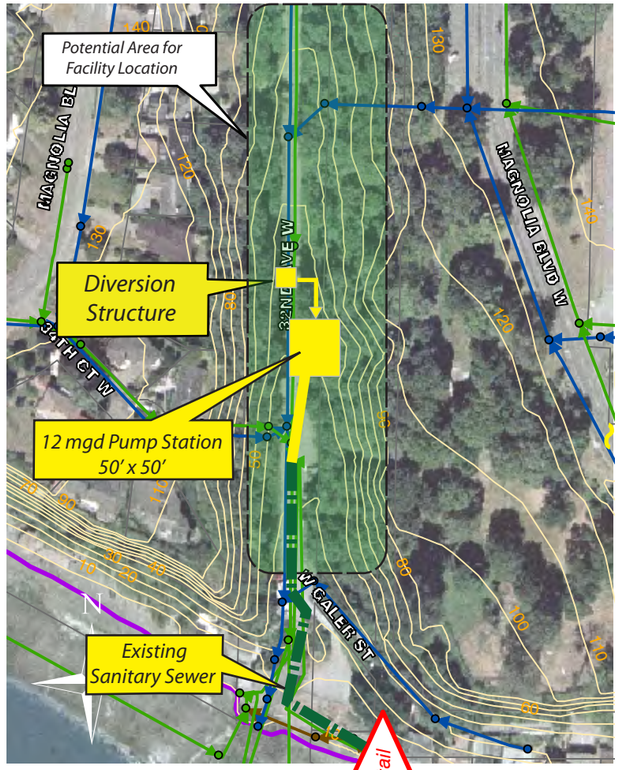

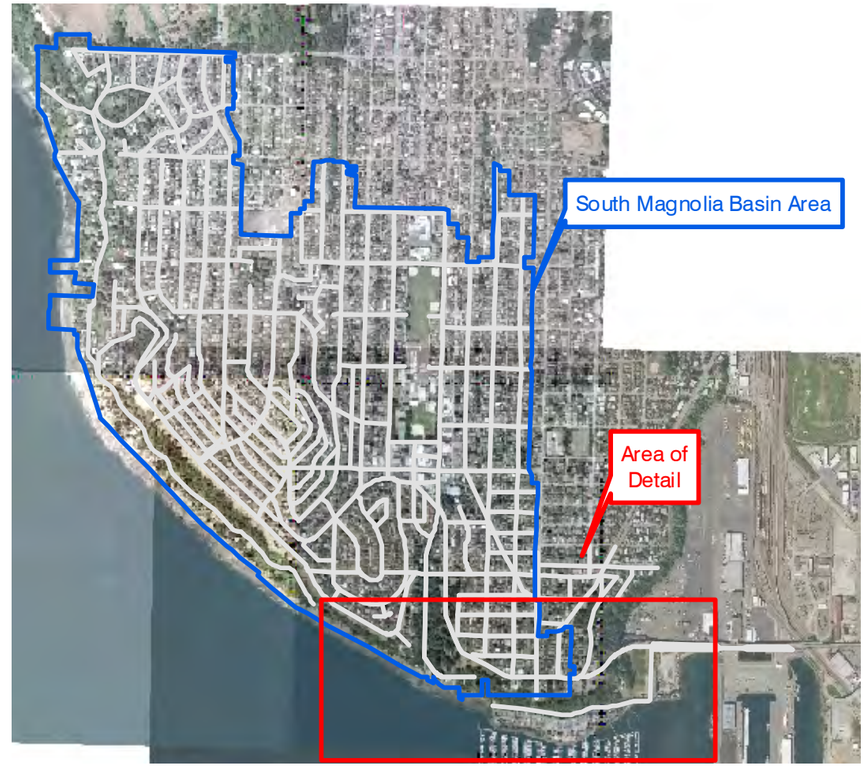

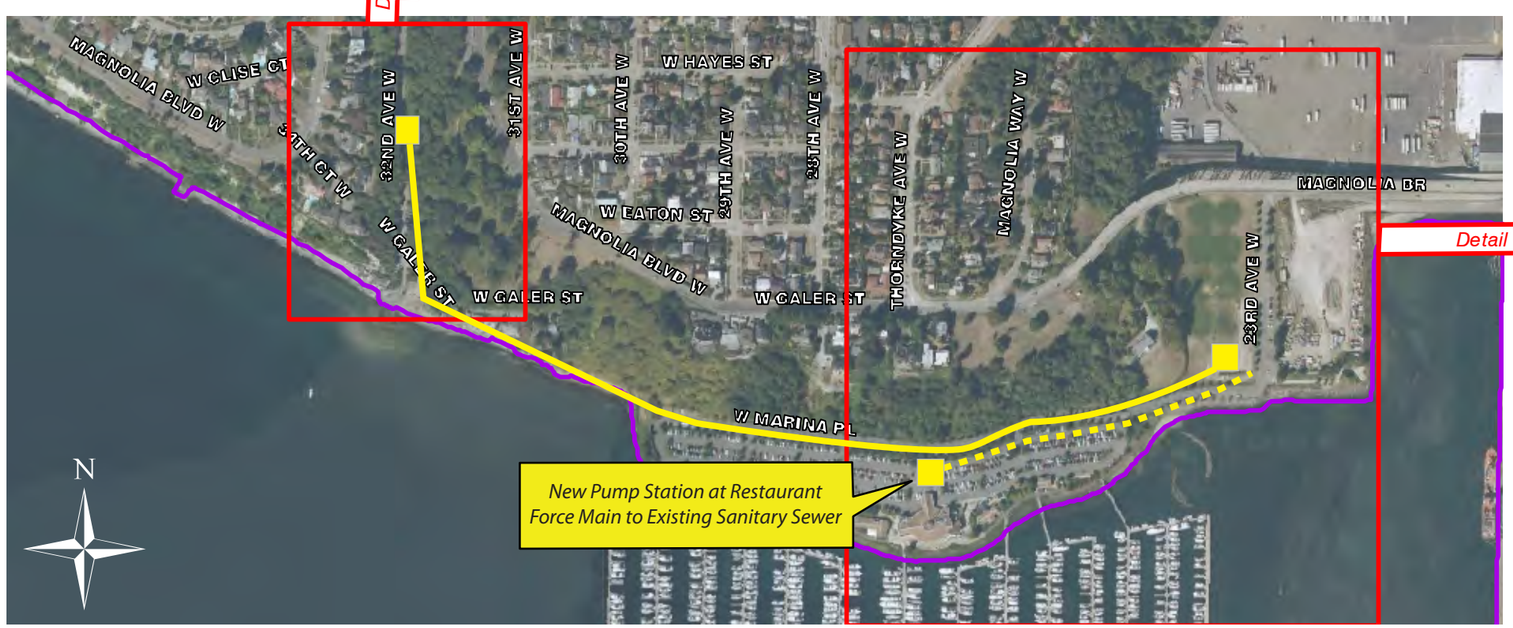

Legend

- Combined Sewer System
- Storm Sewer System
- Sanitary Sewer System
- 10' Topographic Contour
- Shoreline

0 50 100 150 200'
Approximate Scale

Figure 5.26
ALTERNATIVE 1F3

King County
Department of Natural Resources and Parks
Wastewater Treatment Division

Figure 526.ai

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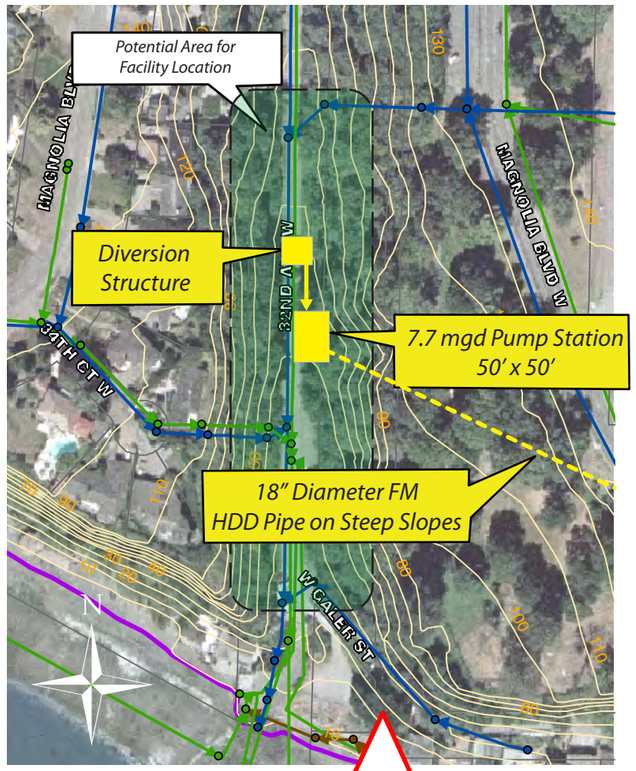

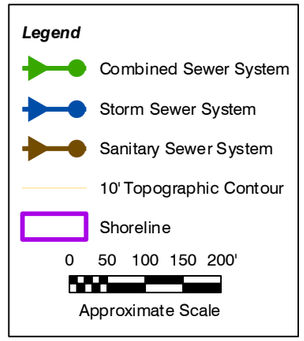

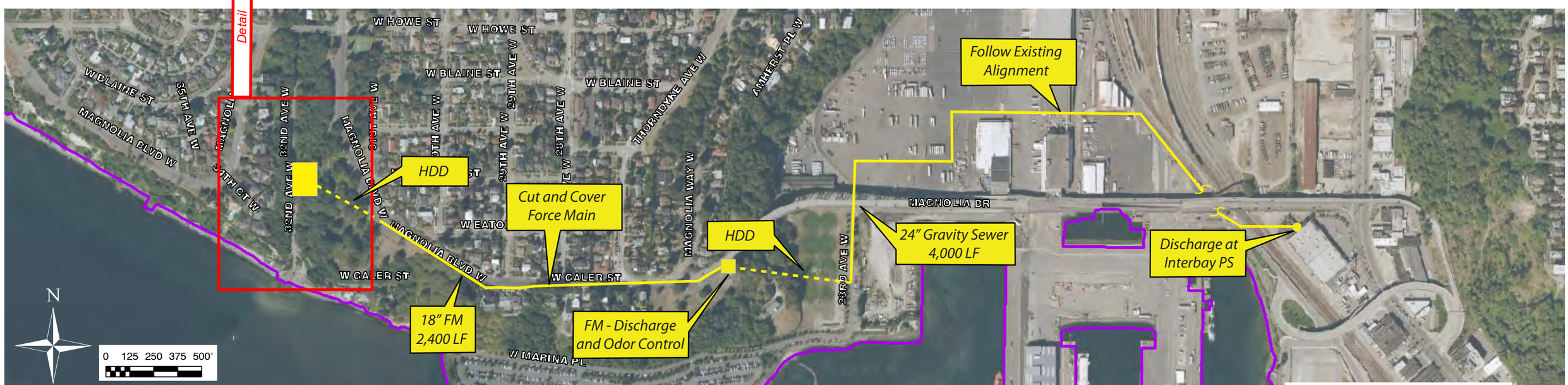

Figure 5.27
ALTERNATIVE 2A

King County
Department of Natural Resources and Parks
Wastewater Treatment Division

Figure 527.ai

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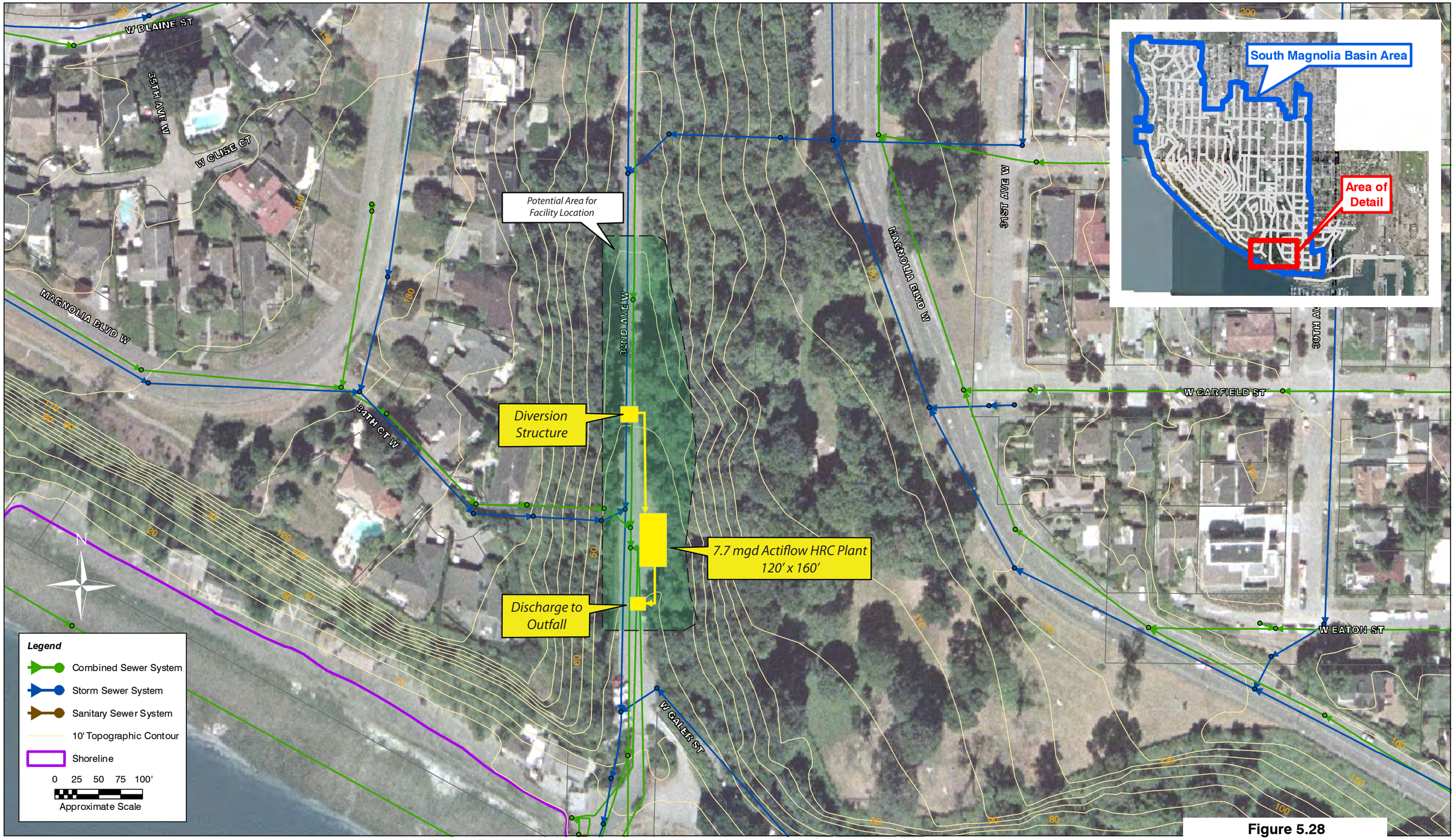

Figure 5.28
ALTERNATIVE 3A

King County
Department of Natural Resources and Parks
Wastewater Treatment Division

Figure 528.ai

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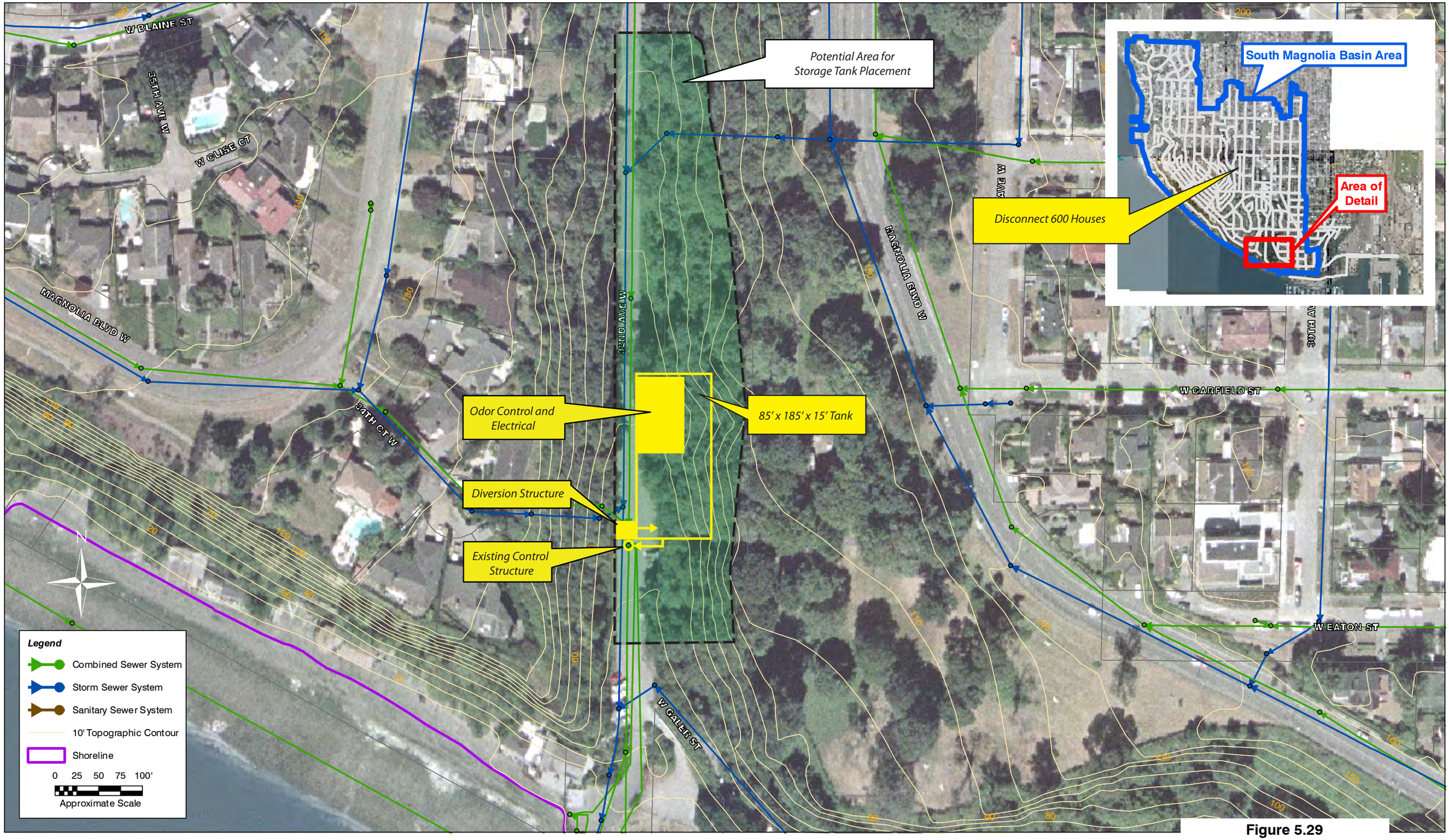

Figure 5.29
ALTERNATIVE 5A

King County
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Wastewater Treatment Division

Figure 529.ai

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5.4.2 Short-List Development

Technical aspects of some alternatives changed as a result of the ongoing development between August and December 2009. The peak flow entering the CSO control facilities was revised from 12 mgd to 20 mgd to reflect new modeling information. The result of this revision was that peak conveyance and/or treatment requirement was increased to 15.7 mgd. Required storage volume was not affected. Cost estimates for the alternatives were revised as needed. Further, it was determined that downstream capacity at the Interbay PS would limit increases in peak flows from the basin to 1 mgd or less. Table 5.10 shows the refined basis of planning criteria.

Table 5.10 South Magnolia Final 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.

The refined preliminary alternatives were evaluated using the criteria and reviewed in a team workshop on December 17, 2009, at which they were reduced to four alternatives for further evaluation:

- Alternative 1A – A below-grade, rectangular concrete storage tank, located adjacent to the existing county CSO control structure on 32nd Avenue W, and comprising 1.8 MG of combined sewage storage volume. Gravity flow in, and pumped flow out of tank. Above-grade odor control and electrical facilities are included. Modification of the existing CSO control structure to add a diversion control structure with gates and hydraulic operators.
- Alternative 1F1 – During development of alternatives, there were three versions of this alternative, Figures 5.24 through 5.26. These were combined for evaluation, with the simplest and most cost effective option selected for development. Alternative 1F1 was

selected for further development for the evaluation process. The resulting alternative is a below-grade, rectangular concrete storage tank, located out of the basin adjacent to 23rd Avenue W. and W. Garfield Street, and comprising 1.8 MG of combined sewage storage volume. Gravity flow into the tank via a 24-inch diameter, 2,700-LF sewer installed by HDD and 500 LF of cut-and-cover pressure sewer. Above-grade odor control and electrical facilities are included. Modification of the existing CSO control structure to add a diversion control structure with gates and hydraulic operators.

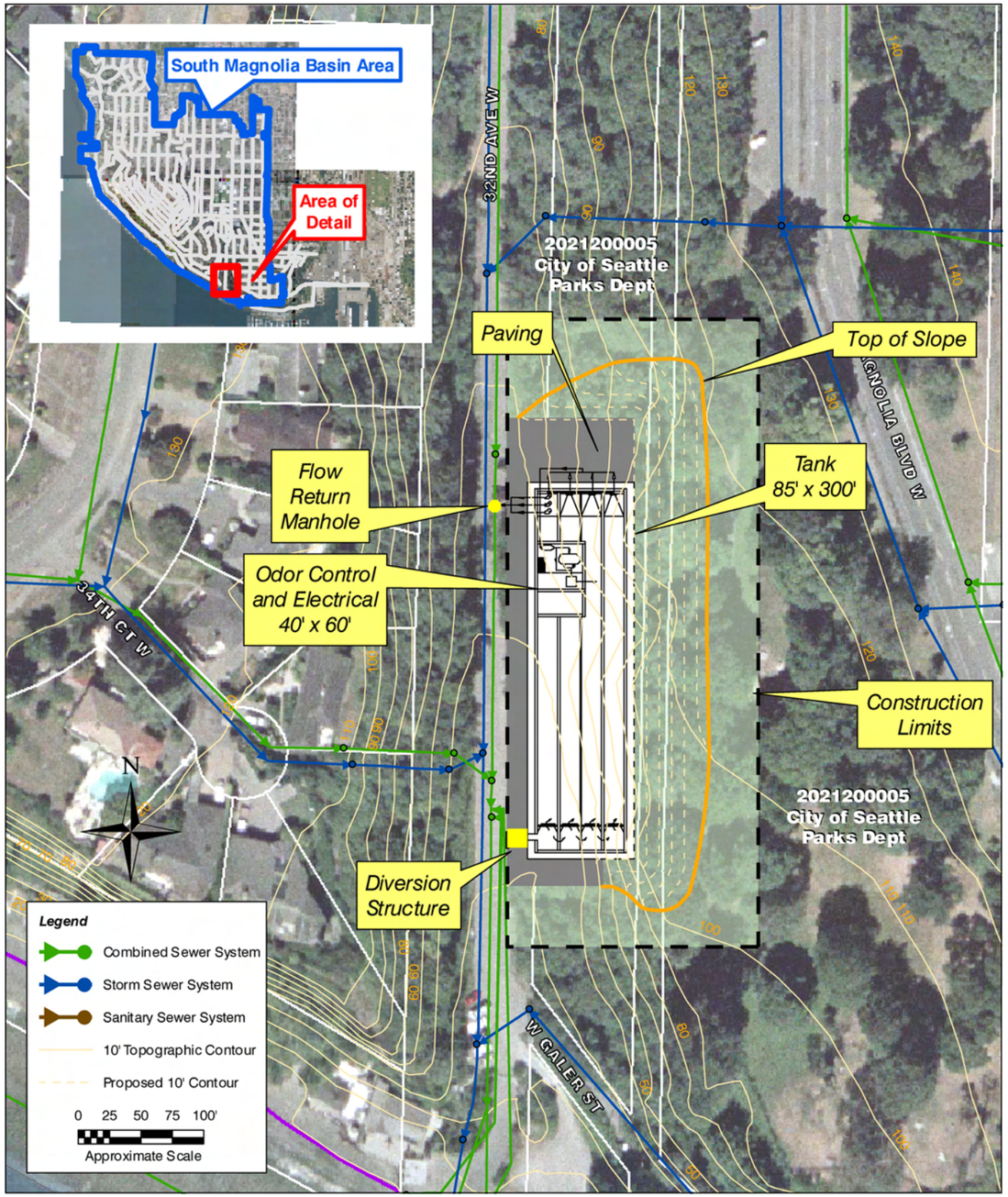
- Alternative 2A – 2,100 LF of 12-foot diameter buried in-line storage pipe or similar sized precast concrete box section, located on Port of Seattle property adjacent to the existing South Magnolia Trunk sewer, north of the Magnolia Bridge between 23rd Avenue W and Elliott Avenue W. Gravity flow into the storage pipe via a 27-inch diameter, 2,700-LF sewer installed by HDD and approximately 800 LF of 27-inch pressure sewer installed by cut-and-cover methods. Above-grade odor control and electrical facilities are included. Modification of the existing CSO control structure to add a diversion control structure with gates and hydraulic operators.
- Alternative 5A – Peak-flow reduction by disconnection of approximately 600 rooftops or installation of approximately 1,200 rain gardens. Storage at Site A, 1.1 MG.

The process and results are described in meeting notes for this workshop (407.2 Planning Confirmation Workshop, December 17, 2009) are included as Appendix C.

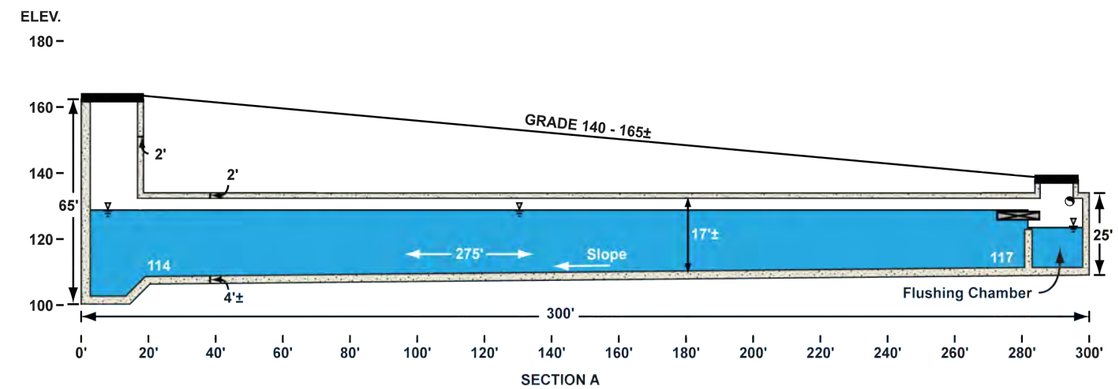
Subsequent to the workshop, Alternative 5A was re-evaluated. Because of uncertainties regarding the level of voluntary participation that would be required for this alternative to meet the CSO control objective (disconnection of rooftops and installation of rain gardens would be required, and there is an existing stormwater system that serves most streets), this alternative was dropped from further consideration, leaving three alternatives to be further considered.

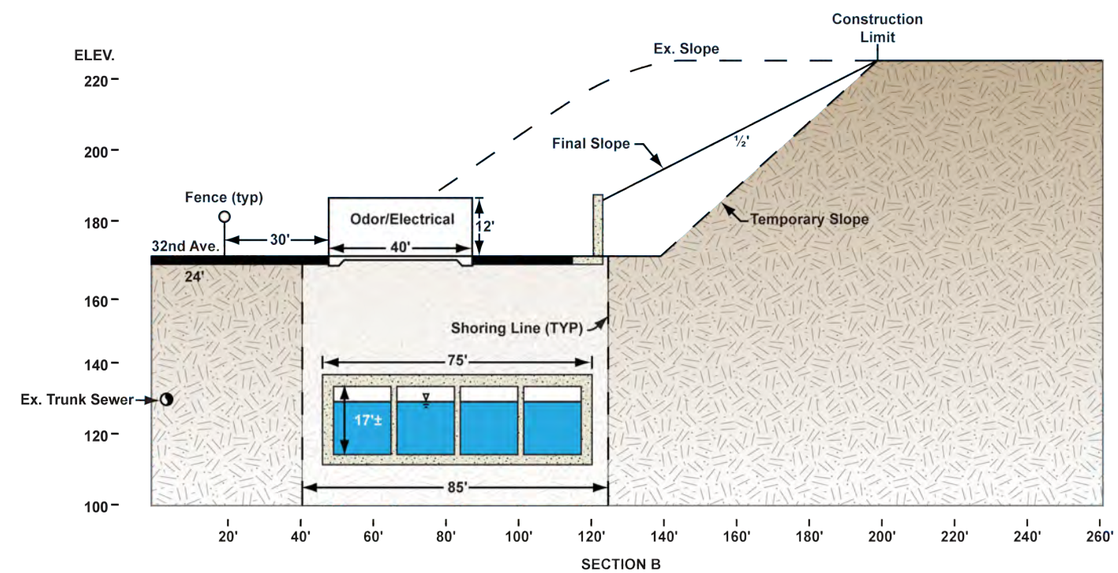
5.4.3 Refinement of Short-Listed Alternatives

Between January 2010 and May 2010, three alternatives were further developed. These three alternatives were subjected to close scrutiny by the project team Category Leaders, Basin Leads, and team at large. This evaluation culminated in selection of one alternative; the process and outcome is described at the end of this chapter. The three alternatives are described in the following sections and are illustrated in Figures 5.30 through 5.32.



South Magnolia Alternative 1A - Storage Bottom of Basin





Project Elements:

- 1.8 MG buried tank
- Gravity in, pumped out - telemetry controlled
- Diversion structure in 32nd Avenue - telemetry controlled

Benefits:

- Single facility
- Lowest level of complexity to operate and maintain
- Similar to other county facilities, operators familiar
- Not in Shoreline zone

Challenges:

- Street use permit required
- Narrow street restricts working area and access to nearby homes
- Steep slopes may require special permitting and construction techniques.
- Requires land acquisition or easements from Seattle Parks

Planning Level Cost Estimate:

- Capital – $28.3 million
- Land – $1.76 million
- Street Use Permits – $32,000

Figure 5.30
SHORTLISTED ALTERNATIVE 1A

King County
Department of Natural Resources and Parks
Wastewater Treatment Division

Figure 5-30.indd

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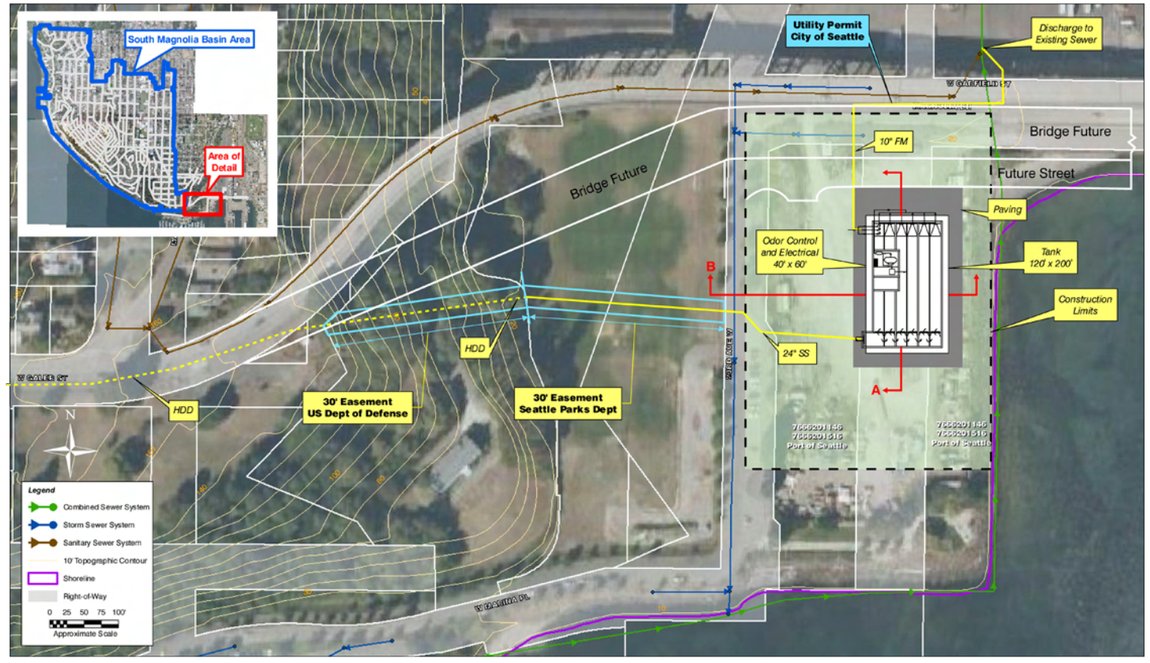
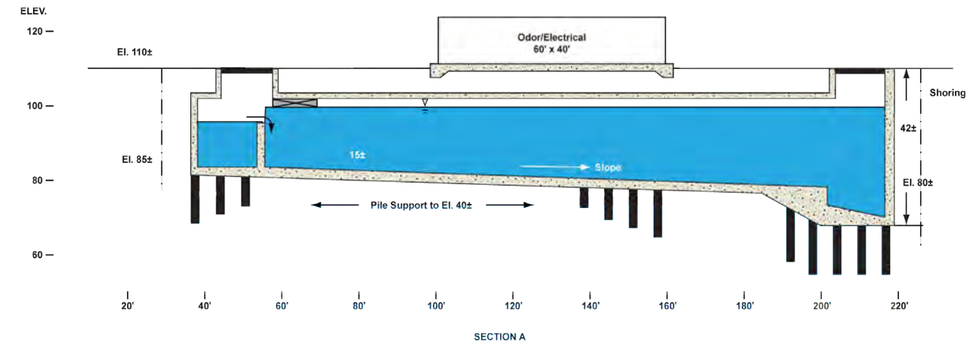
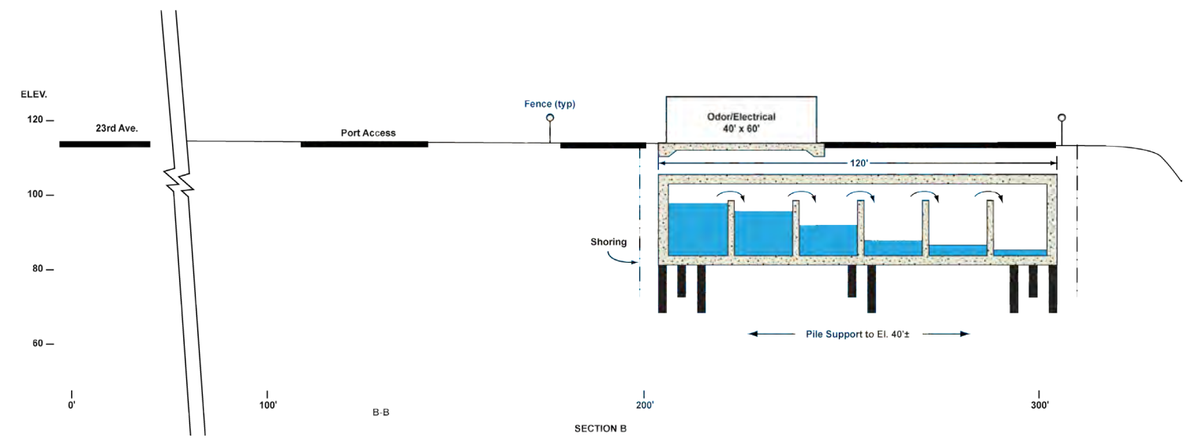


South Magnolia Alternative 1F1 - Storage Out of Basin





Project Elements:

- Horizontal directional drill (HDD)/trenchless technology installation of gravity sewer from 32nd Ave. to tank
- 1.8 million gallon buried tank
- Gravity in, pumped out - telemetry controlled
- Diversion structure in 32nd Ave. - telemetry controlled

Benefits:

- Single facility
- Low level of complexity to operate and maintain
- Similar to other county facilities, operators familiar

Challenges:

- Street use permit required
- Trenchless technique slightly risky - geotechnical conditions good
- Tank site has poor soils - may require pile support
- Requires land acquisition or easements from Seattle Parks
- High probability for cultural resources at base of east bluff
- Possibility of contaminated soils northeast of site

Planning Level Budget:

- Capital – $30.9 million
- Land – $2.1 million
- Street Use Permits – $40,000

Figure 5.31
SHORTLISTED ALTERNATIVE 1F1

King County
Department of Natural Resources and Parks
Wastewater Treatment Division

Figure 5-31.indd

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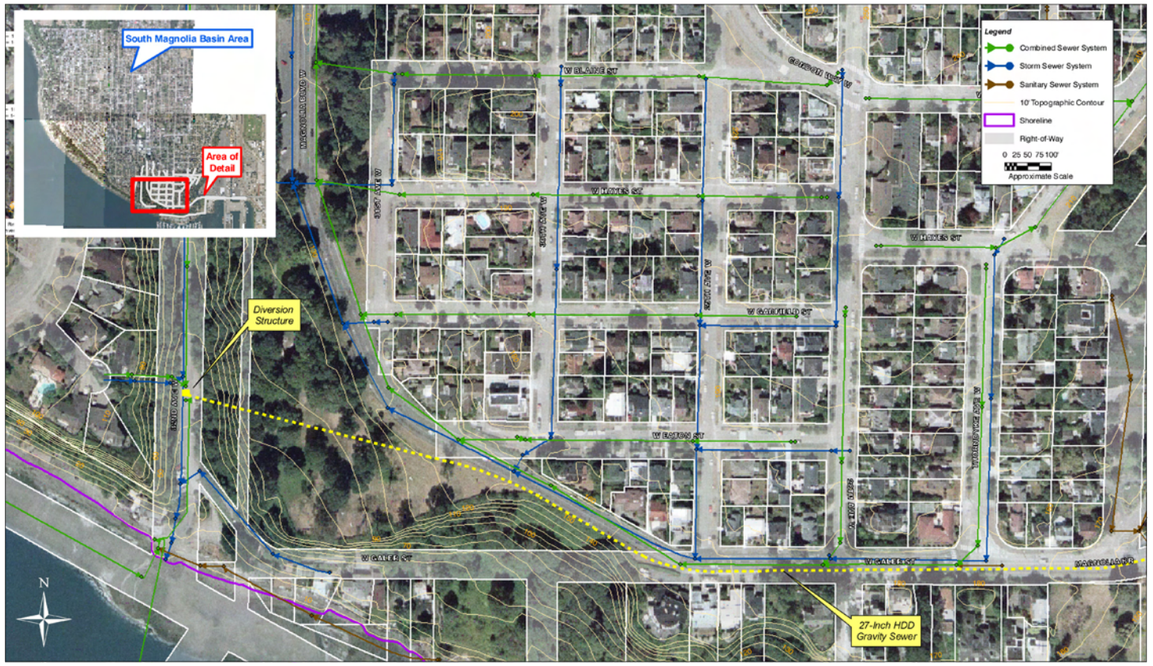
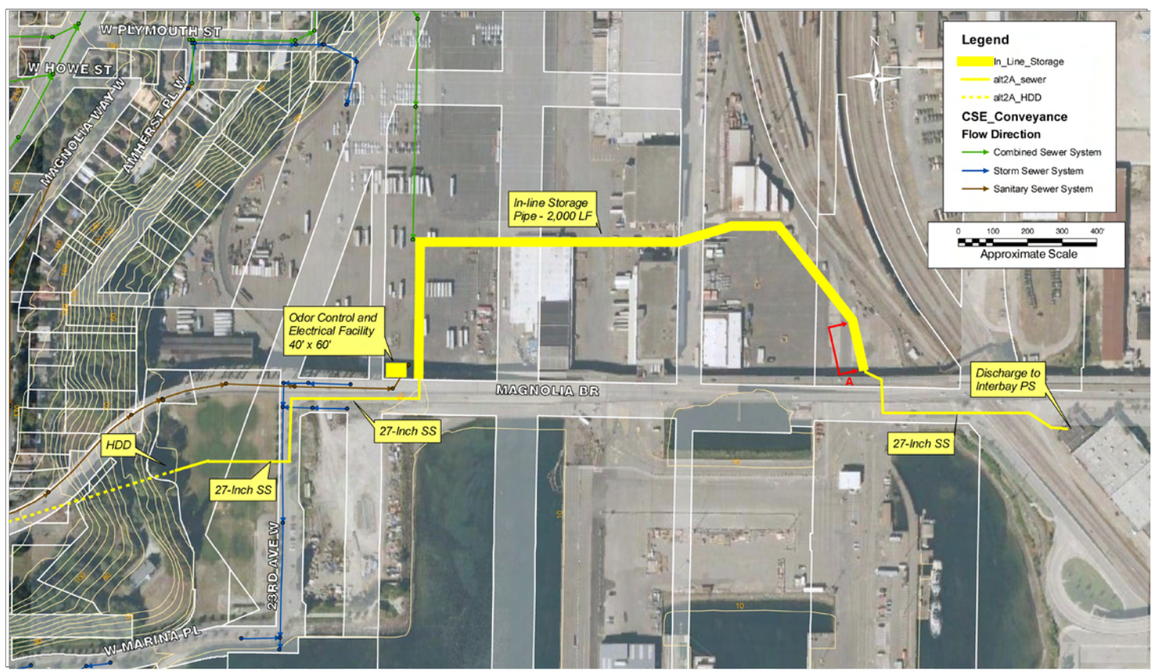
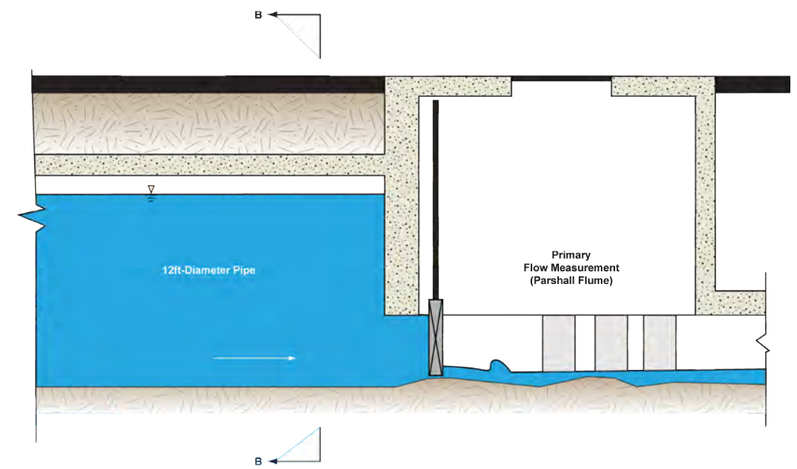
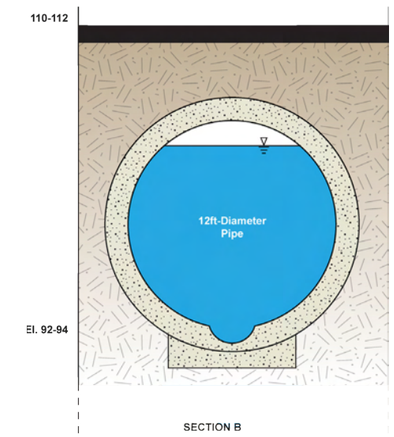




South Magnolia Alternative 2A - Pipe Storage



SECTION A



SECTION B

Project Elements:

- Horizontal directional drill (HDD)/trenchless technology installation of 27" gravity sewer to 23rd Ave.
- 12' diameter storage pipe
- 27" gravity sewer to Interbay Pump Station

Benefits:

- Transfers all flows out of basin
- Similar to other county facilities, operators familiar

Challenges:

- Possible contaminated soils
- Street use permit required
- Work in port industrial area will affect businesses
- Requires land acquisition or easements from Seattle Parks and Port of Seattle
- Some probability of cultural resources
- Contaminated soils identified in east 500 feet of alignment

Planning Level Cost Estimate:

- Capital – $26.5 million
- Land – $1.4 million
- Street Use Permits – $40,000

Figure 5.32
SHORTLISTED ALTERNATIVE 2A

King County
Department of Natural Resources and Parks
Wastewater Treatment Division

Figure 5-32.indd

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Appendix C of this chapter includes a detailed description of the three alternatives considered, *Technical Memorandum "South Magnolia Alternatives Update Information,"* Carollo Engineers, , May 2010. Appendix C includes detailed operational descriptions and control narratives. Summaries of the alternatives are given below. Table 5.11 summarizes pertinent data for the three alternatives.

Table 5.11 Short-Listed Alternatives Data

	Alternative 1A (Fig 5-29)	**Alternative 1F1 (Fig 5-30)**	**Alternative 2A (Fig 5-31)**
Type of vessel, Dims., ft.	Below Grade, Rectangular Tank, 285 x 75 x 15	Below Grade, Rectangular Tank, 185 x 105 x 15	Buried, In-Line Storage Pipe/Box, 12 ft Dia. or 12 x 10 Box, 2,100 LF
# Internal Channels	4	6	1
Sewer, Diameter inch/ length, ft/ construction	NA	24/ 2,700 LF/ HDD 24/ 500 LF/ Cut-and-Cover	27/ 2,700 LF/ HDD 27/ 1,600 LF/ Cut-and-Cover
Excavation Limits to Shoring, L x W x H (depth), ft	300 x 85 x 34 (ave)	200 x 120 x 30	16 x 2,100 x 18
Diversion Control Structure Dims L x W x H (depth), ft	15 x 15 x 15	15 x 15 x 15	15 x 15 x 15
Odor Control/Electrical Footprint, L x W x H (height),ft	40 x 60 x 13-15	40 x 60 x 13-15	40 x 60 x 13-15
Land acquisition, SF	27,000 (Tank)	27,000 (Tank)	5,000 (Odor Control Structure)
Construction Limits, Staging, SF	100,000 (required for slope modification.)	158,000 (Potentially available.)	126,000 (60-ft TCE along storage pipeline.)
Planning Level Construction Cost, $	28,300,000	$30,800,000	$26,500,000
Preliminary Land Acquisition Cost, $	$1,760,000	$2,150,000	$1,430,000

5.4.3.1 Alternative 1A – Below-Grade Rectangular Storage Tank, 32nd Avenue W

See Figure 5.30. This alternative includes a 1.8-MG rectangular, below-grade, cast-in-place concrete storage tank, diversion structure, tank cleaning mechanism, and submersible pumps for tank draining. It is located at approximately 6120 32nd Avenue W along the east

edge of the right of way. The tank would have dimensions of 285 feet x 75 feet x 15 feet (water depth). The tank would be constructed by cut-and-cover methods. A large excavation into the hillside would be required to accommodate the tank. Cuts up to 60 feet high would necessary and require special shoring. Vegetation would be removed from the hillside. Several restoration options are available, ranging from a permanent, concrete tie-back wall to restoring the hillside.

Operationally, the alternative would comprise a simple overflow structure added to the CSO control structure that would divert flow through pipeline to the tank at a pre-set level, illustrated in Figure 5.28 at the end of this chapter. A control gate would be remotely controlled to close when the tank is nearly full, and flow exceeding the capacity of the S. Magnolia Trunk Sewer would be diverted to the CSO outfall. The tank would retain the required volume, depending on the total peak storm volume, until rainfall has ceased for a pre-set time. At that time, automatic cleaning cycles would empty each of the four tank channels in turn, and the contents would be pumped back into the S. Magnolia Trunk Sewer over a 24-hour period using submersible pumps in the tank.

The tank would be equipped with carbon scrubber odor control, electrical equipment, and a backup generator, housed in a separate above-grade structure. The tank would be accessed from the top at the ends for maintenance. Cleaning equipment would likely consist of either flushing gates or tipping buckets, to be determined during detailed design.

Category Leads evaluated this alternative using the evaluation criteria shown in Appendix C of this chapter. The sections below describe evaluation considerations for this alternative.

5.4.3.1.1 Land Use and Permitting Considerations

The site for Alternative 1A is located in a residentially zoned area, and on open space owned by the City of Seattle Parks Department. The site is part of Magnolia Park. Use will require a conditional use permit and determination of consistency with Parks uses. Property acquisition and a construction easement will be required from Parks.

5.4.3.1.2 Environmental Effects

The 32nd Ave. W. site is in a narrow, steeply sided, wooded ravine. Construction of the storage tank would require substantial cuts into the hillside east of the roadway, extending 50-60 feet up the hill and up to 100-ft to the east. Removal of trees and regrading would likely result in the need for specialized stabilization techniques. Cuts east of the tank site would likely affect trails and the existing public restroom facility in the Seattle Parks property at the top of the slope, requiring fencing and other measures for site stability.

The adjacent street is narrow and is the only access to the waterfront boat ramp, a City-owned water access site. The street is the only access to approximately 12 residences. Because of the constrained site, water access by the contractor via the existing boat ramp at the foot of 32nd Avenue W may be needed during construction.

5.4.3.1.3 Technical Considerations

Alternative 1A is the simplest to operate of the three alternatives because the tank is located immediately adjacent to the CSO control structure. There is ease of control and access for coordinated operations and maintenance.

Site location and size will limit the ability to expand the tank for greater peak flows than currently predicted.

Alternative 1A has one substantial construction consideration: slope changes above the site. While early geotechnical studies indicate the feasibility of slope stabilization methods - including compacted embankment, reinforced soil, retaining walls, mechanically stabilized earth or combinations thereof - design geotechnical studies as well as slope restoration requirements that may be identified during final design will determine the post-construction slope topography and finish.

5.4.3.1.4 Operations and Maintenance Considerations

The tank concept is familiar to the county for operations. The concept is simple to operate and maintain. There is more limited access to the site because of the street and topography.

5.4.3.1.5 Costs

This alternative is the second least costly of the short-listed alternatives; at this level of estimating its cost is essentially equal to that of Alternative 2A. However, construction contingencies at this planning level may increase cost due to geotechnical and slope excavation conditions. Capital and Life Cycle Cost estimates are included in Appendix C of this chapter.

5.4.3.1.6 Community Impacts

Construction at this site has two substantial impacts on the community:

- Short-term impacts from approximately 7,500 truck trips for removal of excavated materials and import of construction materials. The haul route is through the Magnolia commercial area and residential areas.
- Short-term impacts from reduction of parking and restriction of access to the 12 residences along the shoreline.
- The community expressed concerns about steep unstable slopes in Magnolia in general.

5.4.3.2 Alternative 1F1 – Below Grade Rectangular Storage Tank, 23rd Avenue W and W Garfield Street

See Figure 5.31 at the end of this chapter. This alternative comprises a diversion structure, 3,200 feet of 24-inch diameter gravity sewer, a 1.8-MG rectangular, below-grade, cast-in-place concrete storage tank, tank cleaning mechanism, and submersible pumps for tank draining. The diversion structure is located at approximately 6120 32nd Avenue W. along the east edge of the right of way. The gravity sewer would be installed using horizontal directional drilling and cut-and-cover techniques and would connect the diversion structure to

the storage tank. The tank would be located adjacent to 23rd Avenue W. on one of two 6-acre parcels. Siting of the tank on these parcels would be determined during final design in 2011.

The tank would have dimensions of 105 feet by 185 feet by 15 feet (water depth). The tank would be constructed by cut-and-cover methods. A shored excavation in level ground would be required. It is anticipated that the tank would be covered by 2 to 4 feet of earth and gravel or asphalt pavement. A 50-foot by 90-foot above- or below-grade structure would house carbon scrubber odor control, electrical equipment, and a backup generator.

The tank would be accessed from the top at the ends for maintenance. Cleaning equipment would likely consist of either flushing gates or tipping buckets, to be determined during detailed design.

Operationally, the alternative would comprise a simple overflow structure added to the CSO control structure that would divert flow through the gravity sewer to the tank at a pre-set level. A control gate would be remotely controlled to close when the tank is nearly full, and flow exceeding the capacity of the S. Magnolia Trunk Sewer would be diverted to the CSO outfall. The tank would retain the required volume, depending on the total peak storm volume, until rainfall has ceased for a pre-set time. At that time, automatic cleaning cycles would empty each of the six tank channels in turn, and the contents would be pumped back into the S. Magnolia Trunk Sewer over a 24-hour period using submersible pumps in the tank. A small force main would convey tank contents to the existing S. Magnolia Trunk Sewer within 500 feet of the tank near the Magnolia Bridge.

Category Leads evaluated this alternative using the evaluation criteria shown in Appendix C of this chapter. The sections below describe evaluation considerations for this alternative.

5.4.3.2.1 Land Use and Permitting Considerations

This site is in a General Industrial zoned area of the Port of Seattle and Seattle Parks. The site for the control structure and directional drilling is in residential zoned land and open space. Site uses at both locations may require a conditional use permit. Depending on final location, the tank site may be in the Shoreline zone, requiring a Shoreline permit. An HPA may be needed in order to stage pipe near or in water for the directional drilling operation. Property acquisition and easements from Parks and the Port of Seattle will be necessary.

5.4.3.2.2 Environmental Effects

The site for the diversion structure, along 32nd Avenue W. is constrained but impacts here will be minimal. At the tank site there may be impacts from near-shoreline construction or soil/groundwater contamination, as yet unconfirmed. The area at the base of Magnolia Bluff, adjacent to Parks property, has a high probability for cultural resources. There is potential for historical resources in Smith Cove Park.

5.4.3.2.3 Technical Considerations

This alternative is relatively straightforward to construct and operate. The site is on flat ground with easy access through the Port of Seattle. Operation would be somewhat more

complex than Alternative 1A due to the distance between the CSO control structure and the tank location. Controls to prevent tank overtopping during filling will require somewhat more complex control.

This site offers the greatest flexibility for expansion if flows are greater than currently predicted.

Some technical considerations may complicate final construction:

- Preliminary data review indicates geotechnical conditions for the gravity sewer are likely favorable for HDD, but layout space for pipe installation may be a challenge due to the constrained areas at either end of the pipeline alignment.
- Due to poor soil conditions and a high potential for soil liquefaction, the storage tank will likely be pile supported.
- There is some chance of soil and groundwater contamination in the area of the tank site.

5.4.3.2.4 Operations and Maintenance Considerations

Access for maintenance for this alternative is the best of the short-listed alternatives. The site is easily accessed through Port property and there is adequate space around the tank for maintenance. The tank is a familiar concept for the county. Communications with the diversion structure are critical to operational success, and extra consideration for communications reliability is necessary.

5.4.3.2.5 Costs

Because of soil and groundwater conditions, and the historical uses of the site, this alternative has the highest cost of the short-listed alternatives. Construction related cost contingencies include soil conditions and post-construction site restoration. Capital and Life Cycle Cost estimates are included in Appendix C of this chapter.

5.4.3.2.6 Community Impacts

Depending on final siting of the facility, there may be impacts on the community's use of the recreational areas of the overall site. There will be some short-term disruptions of traffic and pedestrian access to the Elliott Bay Marina and Smith Cove Park.

5.4.3.3 Alternative 2A – In-Line Storage in Port of Seattle Property

See Figure 5.30 at the end of this chapter. This alternative comprises a diversion structure, 4,300 feet of 27-inch diameter gravity sewer, a 1.8-MG concrete storage pipe comprising 12-foot diameter concrete pipe or similar construction, and submersible pumps for tank draining. The diversion structure is located at approximately 6120 32nd Avenue W. along the east edge of the right of way. The gravity sewer would be installed using HDD and cut-and-cover techniques and would connect the diversion structure to the storage pipe. The storage pipe would be located north of the Magnolia Bridge along an expanded, existing sewer easement in the Port of Seattle industrial area. Siting of the storage pipe would be determined during final design.

The storage pipe would have dimensions of 2,100 linear feet with a 12-foot water depth. The storage pipe would be constructed by cut-and-cover methods. A shored excavation in level ground would be required along the length of the storage pipe. It is anticipated that the tank would be covered by 4 to 6 feet of earth and asphalt pavement. A 50-foot by 90-foot above- or below-grade structure would house carbon scrubber odor control, electrical equipment, and a backup generator. The structure would be located near the inlet end of the storage pipe, with a location to be determined during final design.

The storage pipe would be accessed from the top at the ends for maintenance. The pipe would be sloped slightly to the east to facilitate draining to a sump housing submersible pumps for draining.

Operationally, the alternative would comprise a simple overflow structure added to the CSO control structure that would divert flow through the gravity sewer to the storage pipe at a pre-set level, illustrated in Figure 5.32 at the end of this chapter. A control gate would be remotely controlled to close when the storage pipe is nearly full, and flow exceeding the capacity of the S. Magnolia Trunk Sewer would be diverted to the CSO outfall. The storage pipe would retain the required volume, depending on the total peak storm volume, until rainfall has ceased for a pre-set time. At that time, the contents would be pumped to the Interbay PS through a 500-foot force main, over a 24-hour period.

Category Leads evaluated this alternative using the evaluation criteria shown in Appendix A-2 of this chapter. The sections below describe evaluation considerations for this alternative.

5.4.3.3.1 Land Use and Permitting Considerations

Portions of this alternative are in the Shoreline zone and will require a Shorelines permit. Other uses in the industrially zoned area are consistent with zoning; however, the overall project may require a conditional use permit. An HPA may be required to support the HDD construction process. Property acquisition and easements from Parks and the Port of Seattle will be necessary.

5.4.3.3.2 Environmental Effects

Portions of the site on Port of Seattle property are listed by the State of Washington and USEPA as a hazardous materials site.

5.4.3.3.3 Technical Considerations

This alternative will have the most complex operations and maintenance of the three alternatives due to distance from the CSO control structure, the method of draining and cleaning, and access to the storage pipe. This alternative offers some limited ability for expansion.

Alternative 2A has three technical considerations:

- Geotechnical conditions for the gravity sewer are consistent for HDD, but layout space for pipe installation may be a challenge due to the constrained areas at either end of the pipeline alignment.

- The pipeline alignment for in-line storage is depicted as parallel to the existing S. Magnolia Trunk Sewer as an extension of the existing alignment. A detailed site survey will be needed to confirm the viability of this assumed route.
- There is confirmed soil and groundwater contamination in the area of the tank site; the east end of the site is regulated by RCRA.

5.4.3.3.4 Operations and Maintenance Considerations

Access to the facilities is the most complex of the short-listed alternatives. The linear arrangement through an industrial area will make access for operations and maintenance more difficult. Odor control for the long pipe will be relatively more difficult and expensive to construct and operate. Direct discharge to the Interbay PS from the tank will increase the complexity of operational control. This pipe storage concept would be the second of this type operated by the county.

5.4.3.3.5 Costs

While costs appear to be the least of the short-listed alternatives, construction contingencies associated with the RCRA-regulated area of contaminated soil and water and working in an active industrial area may add more cost to the project. Capital and Life Cycle Cost estimates are included in Appendix C of this chapter.

5.4.3.3.6 Community Impacts

Community impacts will be limited to the minor construction along 32nd Avenue W. for the diversion structure. There will be short-term traffic disruptions during directional drilling. There will be some disruption of access and operations in the Port area.

5.5 SELECTION OF A PROPOSED ALTERNATIVE

This section describes the selection of a proposed alternative under Step 3 of Phase 2 (as described in Section 5.1.3.3). Detailed information is provided in Appendix C of the “South Magnolia Alternatives Update Information Project Memorandum” (Carollo Engineers, June 2010).

5.5.1 Refinement of Evaluation Criteria

The evaluation template used by the project team to evaluate these alternatives is attached in Appendix C of this chapter. It describes the team’s comments on the various factors affecting selection of alternatives.

5.5.2 Evaluation Process

5.5.2.1 Screening Analysis

The project team convened several focus group meetings between March 2010 and August 2010. The team reviewed updated and new information about the alternatives developed by the team and elicited from community input. The team refined the criteria questions and evaluation ratings as a result of the updated and new information.

The team compiled evaluation results from the focus group meetings and convened a workshop in August 2010 to make a recommendation for a proposed alternative to carry forward for further environmental review. Meeting notes from the workshop are in Appendix C of this chapter. Table 5.11 contains a summary of the project team's analysis of the three shortlisted alternatives.

5.5.2.2 Project Implementation Risk Analysis

In June 2010 the project team conducted two project risk assessment workshops for the short-listed alternatives. The resulting risk assessment matrices are in Appendix C. Alternative 1A and 2A had a number of potential high impact and high probability risks as shown in Table 5.12. This resulted in higher cost and schedule risk for these alternatives that would affect ability to meet the compliance schedule and would affect final project costs. Alternative 1F1 had only one potential high impact risk.

5.5.3 Proposed Alternative for Further Environmental Review

Alternative 1F1 (Rectangular Storage Tank Out of Basin) is the alternative recommended for further environmental review (Proposed Alternative). The selection was based on the following considerations.

- Alternative 1A has environmental and community impacts associated with slope modification and park use both during and after construction.
- Alternative 2A has substantial risks associated with known soil contamination, impacts to Port of Seattle operations, and O&M access difficulties.

Chapter 6 describes development of the alternative for review and approval. The environmental review process under SEPA is underway as of the date of this Engineering Report.

Table 5.12 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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