PROPOSED ALTERNATIVE – SOUTH MAGNOLIA BASIN

This chapter provides engineering, cost and environmental information for the proposed alternative – Alternative 1F1 – Rectangular Tank Out of Basin Storage. Preliminary information for this alternative was provided in the previous chapter as part of the alternative development and evaluation documentation. The preliminary information along with additional design details and environmental information is provided in this chapter to provide a complete description of the proposed alternative.

6.1 ALTERNATIVE OVERVIEW

6.1.1 Overflow Frequency and Volume

Table 6.1 shows CSO frequency and volume at South Magnolia CSO outfall both prior to project implementation and anticipated after implementation.

Table 6.1 CSO Frequency and Volume from the South Magnolia Basin

CSO Frequency and Volume	Prior To Project Implementation	Anticipated After Project Implementation[2]
Annual Frequency	20 Overflows/year	1 Overflow/year
Annual Volume	19 MG	MG
30-year Simulation Total Volume	322MG[1]	139MG

Notes:

1. Based on MIKE Urban Model calibrated by Carollo Engineers, and a South Magnolia Trunk capacity of 4.3 MGD.
2. Based on MIKE Urban Model, South Magnolia Trunk capacity of 4.3 MGD, and 1.8 MG of storage at bottom of basin.

6.1.2 Existing Conveyance Operation

The Proposed Alternative will be integrated with the existing South Magnolia Trunk Sewer system. The existing conveyance system consists of three components, the King County Magnolia CSO Control Structure (MAGCSO), the county outfall, and the South Magnolia Trunk Sewer (SMTS.) The MAGCSO is located at approximately 6100 32nd Avenue W.

Combined sewage entering the existing MAGCSO structure at the origin of the SMTS flows from a 42-inch diameter City of Seattle sewer along 32nd Avenue W entering from the north, and a 10-inch diameter force main entering the structure from the City of Seattle SPU PS77 approximately 300-feet southwest of the structure. This flow pattern is not expected to change during the project life. However, the City of Seattle is planning an upgrade of its SPU PS77 to restore peak design capacity; increased flow is likely to slightly affect the draining schedule for

the South Magnolia CSO Facility tank, and possibly the number of uses of the tank annually[1]. A detailed operational schedule will be determined during design of the SMCF. During dry weather, flows exit the existing MAGCSO structure through a 30-inch diameter opening in the bottom of the structure that transitions to an 18-inch diameter ductile iron pressure sewer, the existing SMTS. The SMTS conveys up to 4.3 mgd from this structure approximately 3,700 linear feet along the Puget Sound shoreline to manhole W10-88 north of the Magnolia Bridge.

At manhole W10-88, the 18-inch sewer transitions to a 27-inch diameter concrete gravity sewer to convey flow from the basin, a local City of Seattle separated sewer, and a pressure sewer from the Port of Seattle industrial area 3,700 feet east to a manhole on the Elliott Bay Interceptor just outside the county's Interbay Pump Station. The Interbay Pump Station conveys flow from the Elliott Bay Interceptor and the SMTS north to conveyance tributary to the West Point Treatment Plant.

During wet weather and storm events, combined sewage entering the MAGCSO flows through the SMTS until flow in the pressure sewer causes the water level in the structure to rise to the level of a static weir in the structure. Flow exceeding the capacity of the SMTS tops the static weir into a 42-inch sewer that becomes a 36-inch diameter, 833-foot long outfall into Puget Sound (County outfall number 006), discharging at elevation minus 20 feet mean sea level (MSL).

6.1.3 Facility Sizing

The Proposed Alternative will augment the existing conveyance system. The basis of planning is detailed in Chapter 4 and summarized in Chapter 5, Table 5.5. The tank will provide a minimum of 1.8 million gallons of storage and the influent piping will convey a minimum of 15.7 mgd from the SMCF Diversion Structure to the tank.

Major project dimensions and sizes are provided in Table 6.1. Additional details of the proposed facilities can be found on the drawings in Figures 6.3 through 6.10 later in this chapter. The facility geometry and dimensions shown in this chapter are conceptual. The final location, geometry, and elevations will be determined during final design.

[1] SPU PS77 is a draw/fill pump station. Station upgrades will return peak flow rates to design capacity. Peak discharge rates may affect short term flows in the SMTS, causing intermittent water level increases at the MAGCSO. During tank draining cycles, the capacity limit of the downstream SMTS combined with peak discharge from PS77 may cause a short term reduction in tank draining flow rates. Typical peak discharges are expected to be 10-20 minutes duration based on historic wetwell data provided by SPU.

Table 6.2 South Magnolia Basin CSO Facility Design Criteria

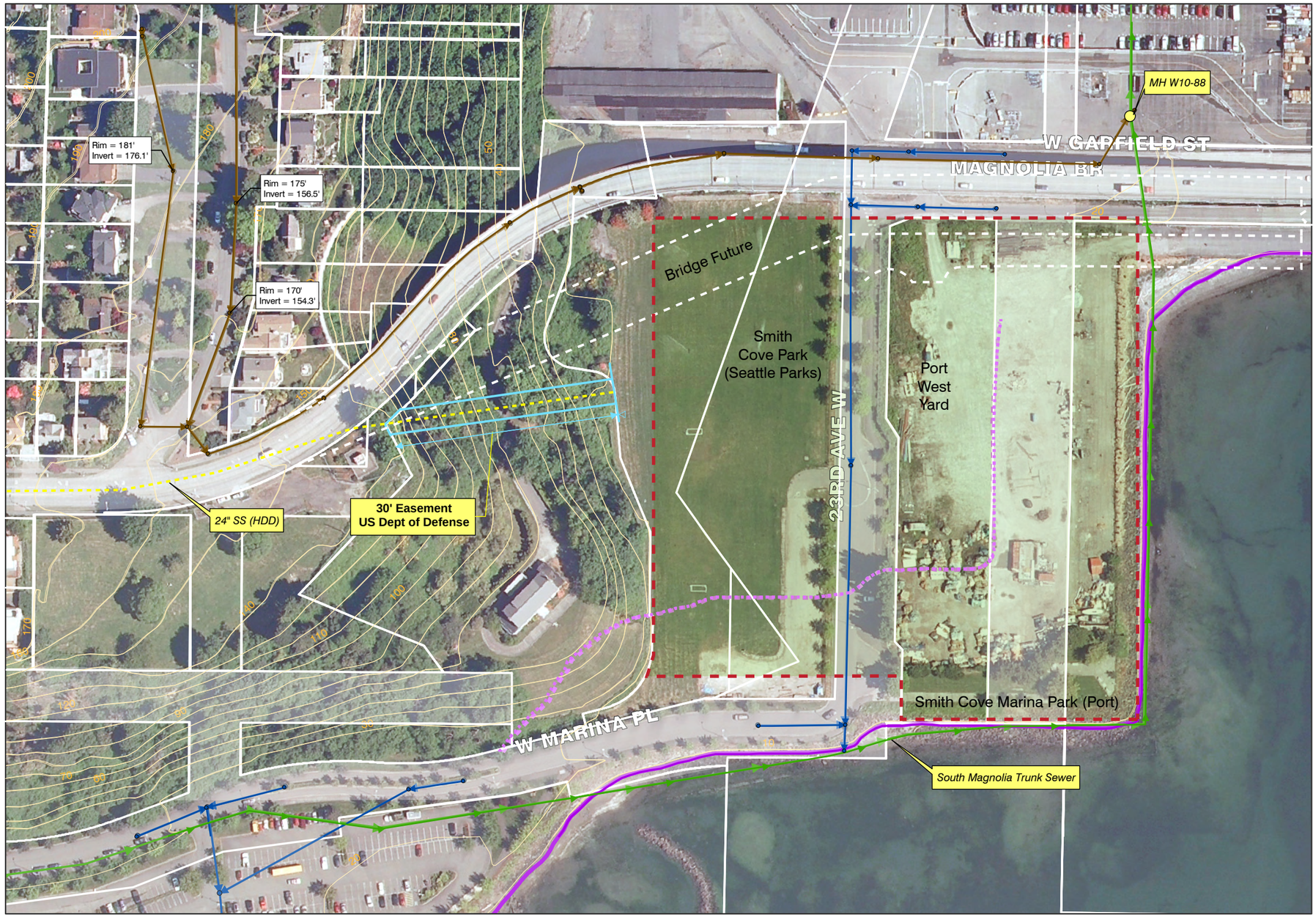
Facility Component	Design Criteria[1]
Tank	
Tank Volume	1.8 MG
Tank Length	190 feet
Tank Width	110 feet
Number of Channels	6
Floor Slope	1%±
Minimum Freeboard	2 feet
Number of Drain Pumps	2 duty + 1 standby
Drain Pump Type	Submersible
Drain Pump Capacity	680 gpm per pump
Diameter of Effluent Force Main	10-12 inches
Maximum Time to Drain Storage	24 hours (incl. time for tipping bucket filling)
Access	Maintenance hatches over all equipment Lift slabs over all equipment
Equipment Materials	Corrosion resistant (316 SS or FRP) Concrete
Ancillary Equipment Facility	
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; variable speed fan/blower
Occupied Space Ventilation	12 air changes per hour
Standby Generator	Total estimated load; diesel w/ 24 hour capacity
Backflow Preventer	4 inch
Air Gap Tank	TBD
Number of Utility Water Pumps	1 duty + 1 standby
Utility Water Pump Type	End-suction centrifugal
Utility Water Pump Capacity	80 -100 gpm
Facility Footprint	90 feet x 50 feet x 20-ft high

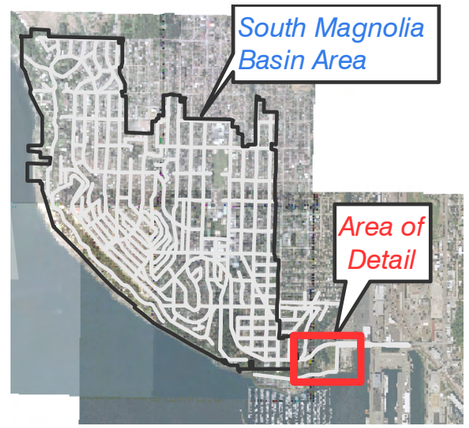
Notes:
1. Design criteria are approximate and may be revised during final design.

6.1.4 South Magnolia CSO Control Facility Description

The South Magnolia CSO Facility (SMCF) comprises a rectangular, below-grade, cast-in-place, six-channel CSO storage tank with an ancillary facility, will be located in the feasible project area shown in Figure 6.1. The tank provides 1.8 MG of combined sewage storage volume. Figure 6.2 South Magnolia CSO Facility Site Plan Layout – West illustrates related facilities that include a diversion structure located on 32nd Avenue W and a gravity sewer to convey flow to the tank. More detailed descriptions of the operation of major project elements are described in following paragraphs. This project includes the following elements:

- Modification of the existing below-grade MAGCSO will provide for flows from the control structure to be routed to the storage tank when peak flows into the structure exceed the capacity of the SMTS.
- A 2,700 LF, 15.7 mgd capacity gravity sewer installed using Horizontal Directional Drilling technique that will convey flow from the diversion structure to the storage tank. Gravity sewer elements include:
  - 24-inch diameter sewer, material to be selected during final design.
  - Manual isolation gate.
- A rectangular, below-grade, cast-in-place storage tank includes:
  - A 24-inch influent sewer and powered control gate.
  - A cast in place, below-grade storage tank, comprising six, 17-18-feet deep by 15-feet wide channels.
  - A tank flushing system including tipping buckets and non-potable water supply using City of Seattle water.
  - A pump station located in the tank, to discharge tank contents to the South Magnolia Trunk at manhole W10-88, within 24-hours following use of the tank.
  - A 10-inch to 12-inch diameter discharge force main, approximately 500-feet long from the tank to the discharge manhole.
  - Access hatches and lift slabs for routine and long-term operation and maintenance.
- An ancillary equipment facility for odor control, mechanical and electrical equipment including:
  - Control panels and MCCs.
  - Standby power generator with fuel storage tank.
  - Odor control system including mist eliminator, carbon scrubbers, and fans.
  - Ventilation system.
  - Utility water system including backflow preventer, air gap tank, pumps, and hydropneumatic tank.
- Site improvements including:
  - Improvements as required by SDOT and/or the Port of Seattle or City of Seattle Parks Department and the City of Seattle DPD, along 23rd Avenue W.
  - Tank site access paving and fencing as required.





N

0 50 100 200 300 Feet

Approximate Scale

Legend

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

Figure 6.1
SITE LAYOUT PLAN EAST

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Wastewater Treatment Division

FIGURE 6-1.ai

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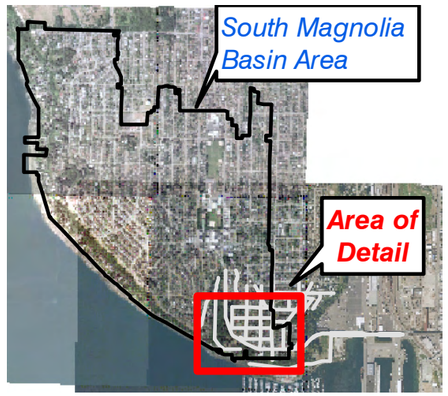

N

0 100 200 300 400'

Approximate Scale

Legend

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

Figure 6.2
SITE LAYOUT PLAN WEST

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Department of Natural Resources and Parks
Wastewater Treatment Division

FIGURE 6-2.ai

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6.1.4.1 SMCF Diversion Structure

A modified below-grade MAGCSO structure will include an opening for a 24-inch diameter gravity sewer to convey flow approximately 2,700 feet to the storage tank. Figure 6.3 illustrates the concept for the diversion structure at the MAGCSO control structure. It is anticipated that all structures associated with this diversion structure will be located in the right of way of 32nd Avenue W.

The inlet for the diversion box will be set at a level to allow gravity flow exceeding the capacity of the SMTS to enter a new gravity sewer. The pipeline will be designed to flow partially full when the design peak flow of approximately 15.7 mgd is being conveyed to the storage tank. Flow velocities in the gravity sewer are expected to be high enough to effectively draw air into the sewer, minimizing odors at this location.

The static weir in the MAGCSO structure that is the overflow control to the outfall will be raised to allow rising water levels in the structure to enter the SMTS and the gravity sewer to the SMCF. Total flow exceeding 20 mgd (4.3 mgd in the SMTS and 15.7 mgd in the gravity sewer) will pass over the weir into the existing outfall. Based on design decisions, a manual gate may be installed in this structure for redundant control of flows to the tank or for maintenance purposes.

6.1.4.2 Conveyance Pipeline

The SMCF Diversion structure will route flow to the gravity sewer and the SMCF. The conveyance pipeline will be a 24-inch diameter gravity sewer, 2,700 feet long, constructed using horizontal directional drill (HDD) techniques (2,200 feet) and cut and cover construction techniques (500 feet). Figure 6.2 illustrates the general location of the conveyance pipeline. In general the pipeline will vary from 6 feet to 150 feet below the ground surface, and be sloped to the east at about 1%±. The pipeline will be designed to flow partially full at design flow (15.7 mgd) to allow air to enter at the MAGCSO structure and move along the pipeline to the storage tank and odor control system.

The conveyance pipeline will likely be installed by drilling from east to west, originating near 23rd Avenue W and exiting near the diversion structure adjacent to 32nd Avenue W. Detailed design decisions will determine the sequence of drilling and carrier pipe insertion, and the material used for the carrier pipe. Near its origin on 23rd Avenue W the pipeline will be continued to the SMCF as a relatively shallow gravity sewer, using cut and cover construction techniques. The conveyance pipeline will terminate at the SMCF inlet box.

6.1.4.3 South Magnolia CSO Facility

The proposed SMCF will be a 1.8 million gallon, rectangular, below-grade, cast-in-place, six-channel storage tank with plan dimensions of approximately 110 feet by 190 feet to the outside of walls. The tank will have a working water depth of 15 feet and a freeboard of at least two feet. Figure 6.4 SMCF Plan shows a conceptual plan and Figure 6.5 SMCF Sections illustrates a conceptual section view of the tank. The ancillary facility on the site includes a single story, above-grade structure with a footprint of approximately 50 feet by 90 feet that houses carbon scrubber odor control unit with fans, electrical equipment, and a backup generator.

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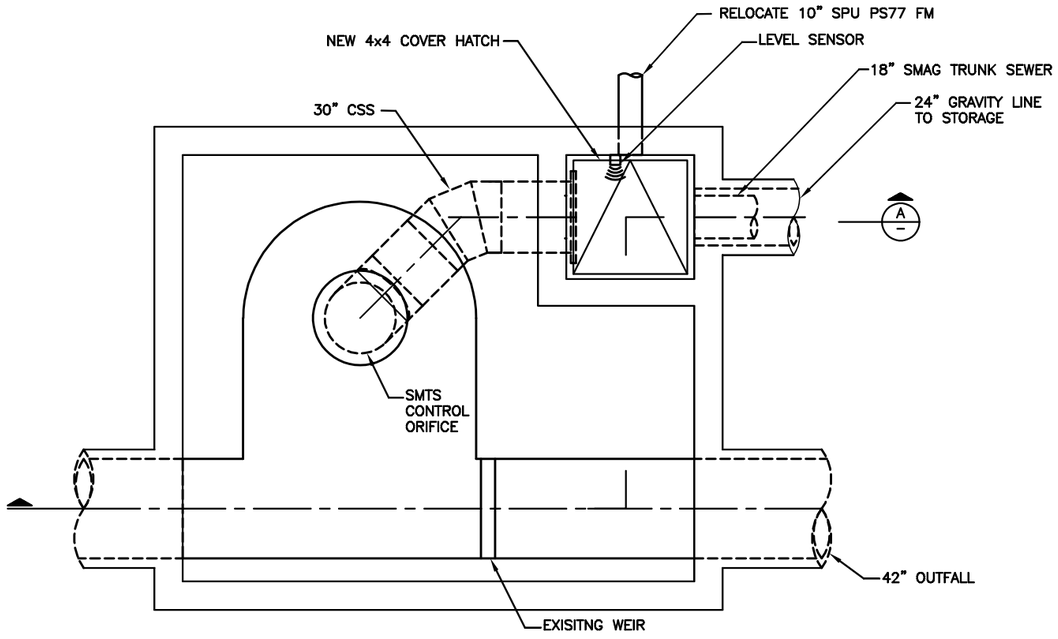

"MAGCSO" DIVERSION STRUCTURE PLAN
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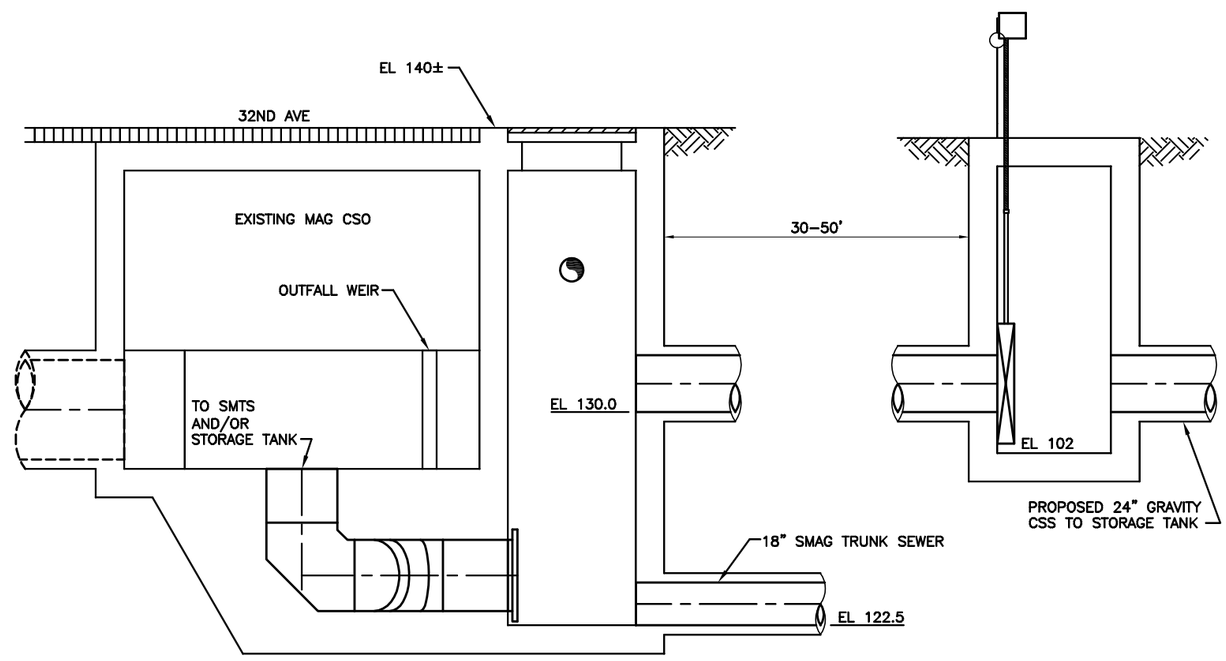

DIVERSION STRUCTURE SECTION A
SCALE: 1'–0"=3/8"

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FIGURE 6.3
DIVERSION STRUCTURE

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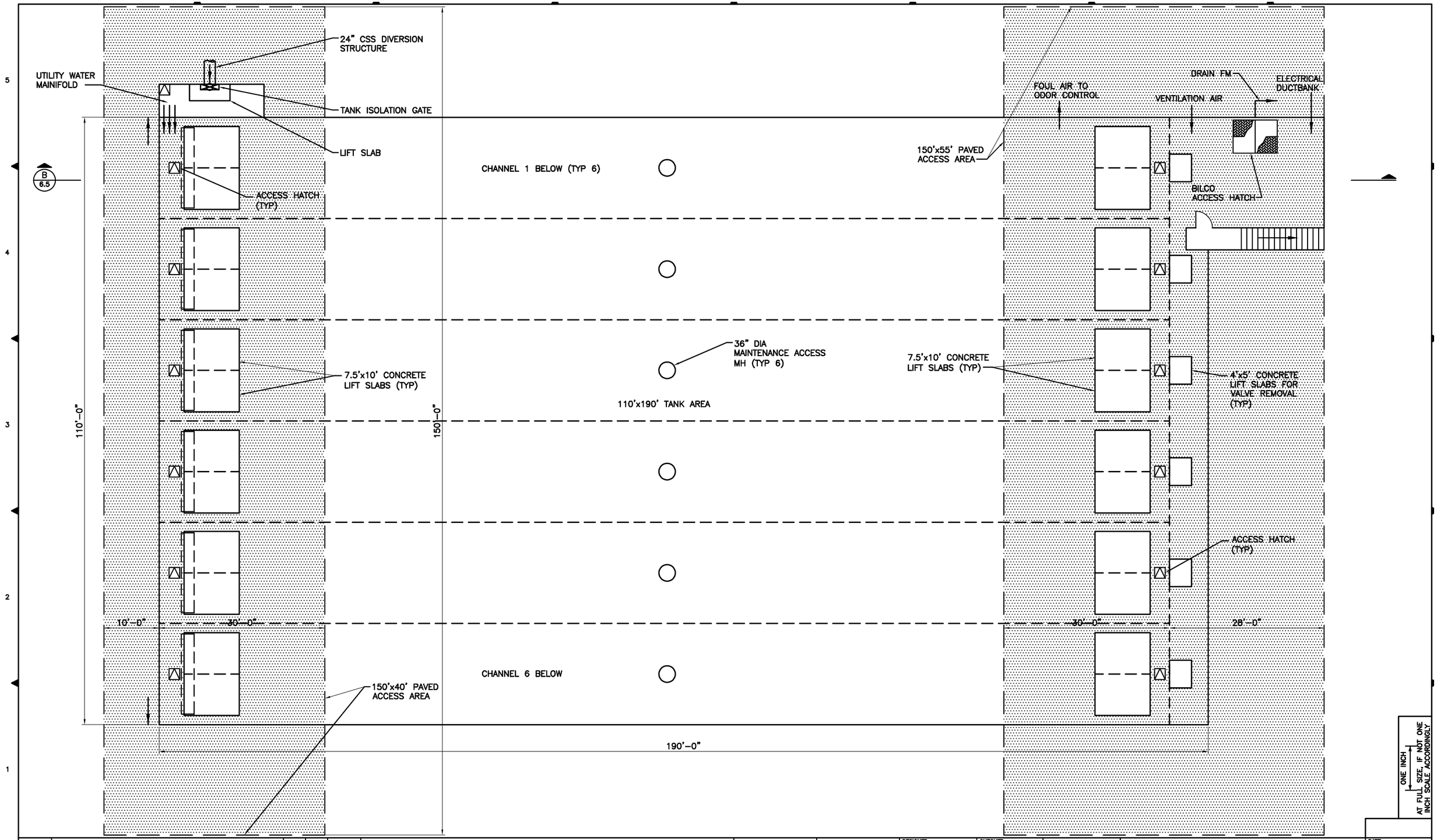

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FIGURE 6.4
PLAN

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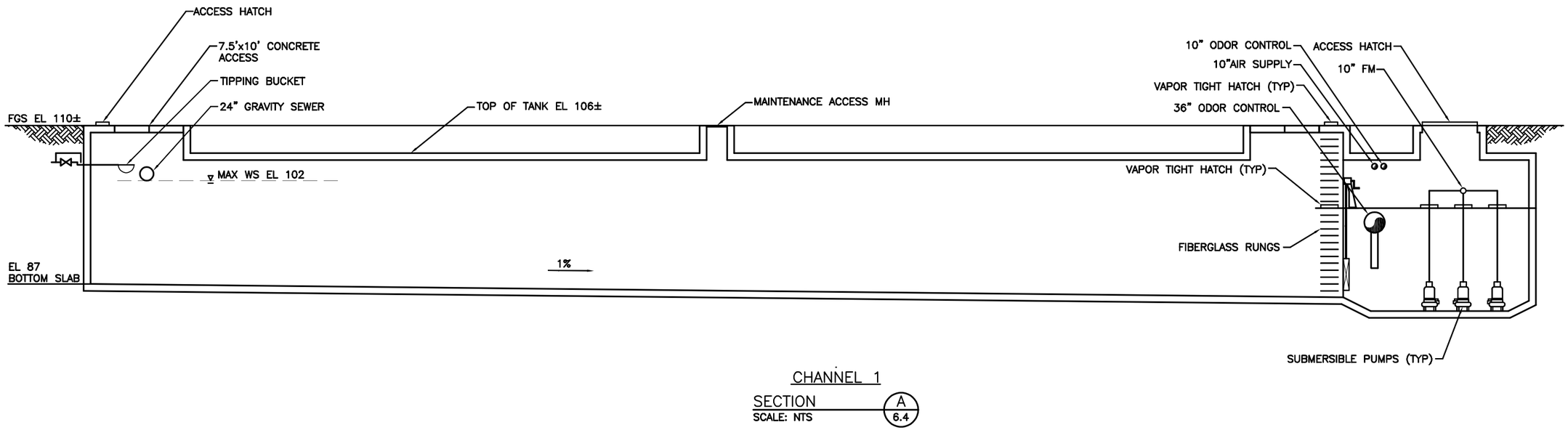

CHANNEL 1

SECTION A / 6.4

SCALE: NTS

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FIGURE 6.5
SECTION

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The storage tank will be constructed with access hatches over equipment at both ends of the tank. An underground gallery with ventilation and lighting, for access to control gates, level sensing devices and drain pumps will be provided at the discharge end of the tank. Lift slabs will be constructed over all major equipment to allow access for major equipment repairs or replacement.

The SMCF will control flow from the diversion structure at a powered inlet gate at where the gravity sewer enters the tank. Gate position will be controlled by level in the most downstream channel in the tank. Fixed weir openings between the tank channels in the tank will allow flow to enter each channel in sequence. The most upstream channel, Channel 1 will fill first; when it is full, flow will top the weir in the wall separating Channel 1 from Channel 2 and Channel 2 will fill. The channels will continue to fill in sequence until the tank has reached its maximum water level, as measured by a level sensing device in Channel 6. When the tank is full, the inlet isolation gate will close, terminating flow into the tank. Flow will backup in the conveyance pipeline, raising the water level in the MAGCSO structure until it overtops the static weir at the outfall entrance.

Water levels in the downstream SMTS and the Elliott Bay Interceptor (EBI) will be monitored. Following storm events, when water level in the EBI drops, drain pumps in the SMCF will initiate the draining and flushing cycle.

The tank channels will begin to drain in sequence by opening a drain gate at the end of tank Channel number 1. Each tank channel will empty into a common channel across the tank that ends at the sump for the drain pumps. As the drain gate opens, float switches in the drain pump station will activate one to two submersible pumps to convey flow through a 500-foot long force main to manhole W10-88 on the SMTS, northeast of the tank site.

As the water level drops in channel number 1, the inlet control gate at the SMCF will open to allow flow stored in the incoming gravity sewer to be emptied into the tank and drained.

As the water in Channel number 1 reaches it minimum level, a tipping bucket system will be filled using non potable water from the City of Seattle system, provided through a backflow preventer, air gap tank, and pumps. This water system will be located in the Odor Control/Electrical building. Manifold piping and automatic valves in the building will provide water to each tipping bucket in sequence as needed during cleaning.

The tipping bucket will empty by gravity when it fills; the flow will create a moving hydraulic jump to wash accumulated solids to the drain pump sump. When this cycle is complete, the Channel number 1 drain gate will be closed, and the cleaning cycle will proceed to Channel number 2, and so on, until the entire tank has been drained and flushed.

The flushing cycle is expected to last 24 hours when the tank has been completely filled during a storm event. At the conclusion of the cleaning cycle, the inlet control gate at the SMCF will open to prepare the system for the next use.

6.1.4.4 Ancillary Equipment Facility

An ancillary equipment facility, shown in Figure 6.6, will house the odor control system, mechanical equipment, and electrical equipment to support operation of the storage tank. The

exterior dimensions of the facility will be approximately 90 feet long by 50 feet wide. The above-grade building may be located above or adjacent to, the storage tank depending on siting decisions.

The odor control system will consist of one or more carbon adsorption scrubber vessels, mist eliminator, and fans. The ventilation rate will be two air changes per hour (ac/hr) or the equivalent of a maximum fill rate (15.7 mgd), whichever is greater. The odor control fan will be equipped with a variable speed fan to increase ventilation rates to 6 ac/hr to facilitate manned entry. The odor control system will be directly connected to the storage facility with buried corrosion-resistant ductwork or piping (PVC or fiberglass ductwork).

The building will also house HVAC equipment for the storage tank access galleries. The ventilation rate will be 12 air changes per hour.

To provide water for the flushing system and other facility needs, water drawn from a new service from the nearest City of Seattle water line will be routed through an above-grade backflow preventer and air break tank as required by current health codes. The air break tank will be a reservoir inside the ancillary facility. Utility water pumps will draw from the reservoir and pump the water into a hydropneumatic tank to pressurize the utility water system.

6.1.4.5 Dry Weather Flow Description

Operation of the SMCF was generally described in previous paragraphs. Figure 6.7 is a schematic of dry weather flow. Dry weather flow is defined as flow less than or equal to 4.3 mgd, which is the capacity of the SMTS.

6.1.4.6 Wet Weather Flow Description

Figure 6.8 is a schematic of wet weather flow. Wet weather flow is defined as flow greater than 4.3 mgd, and less that 20 mgd.

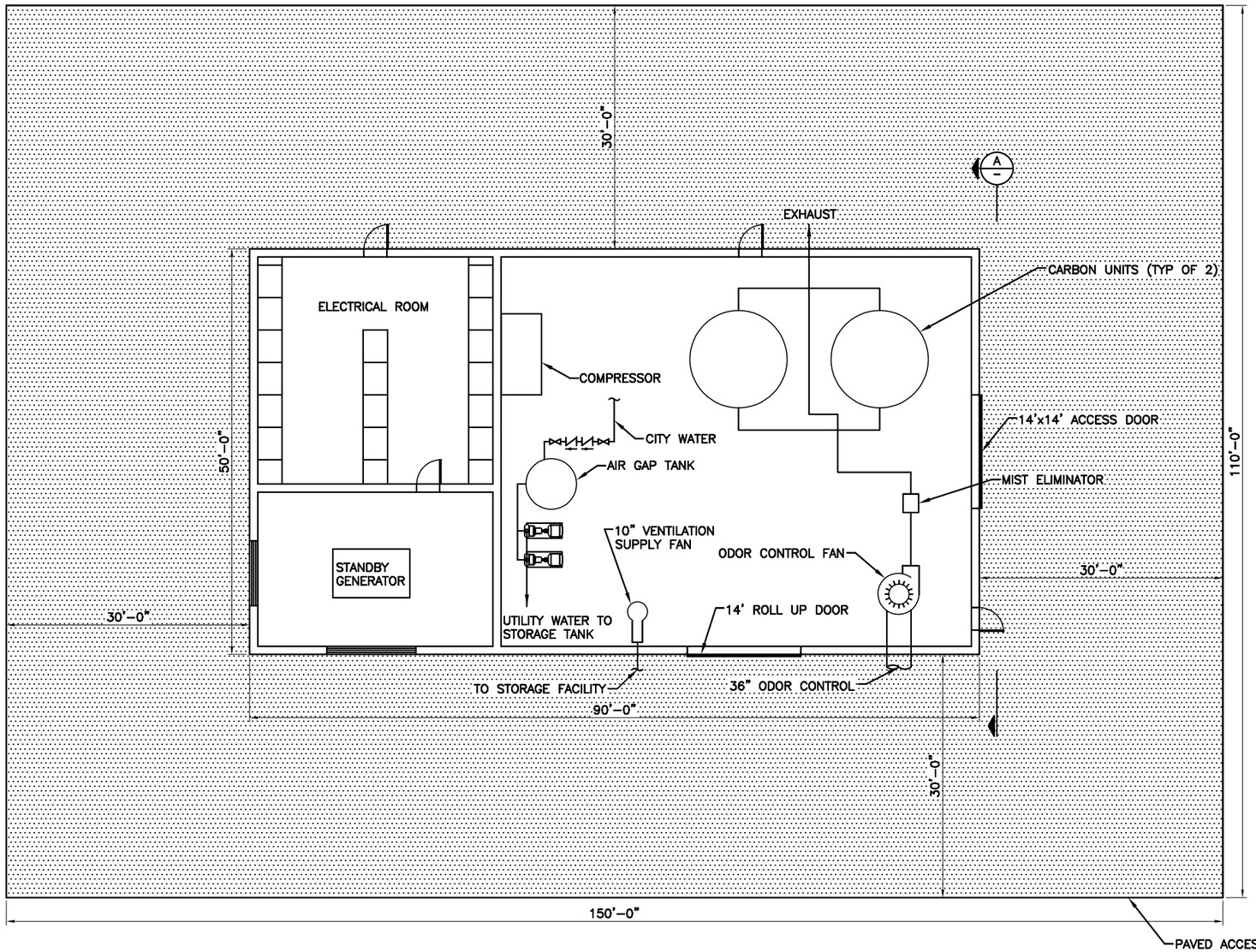
6.1.4.7 Process Flow Diagram

Instrumentation and controls strategies will be developed during final design of this project. The SCADA system will provide the operator with applicable control set points and will generate level alarms when the storage facilities approach and reach their fill levels and when flows over-top weirs. Figure 6.9 the process flow. Appropriate control actions will be implemented for the following situations:

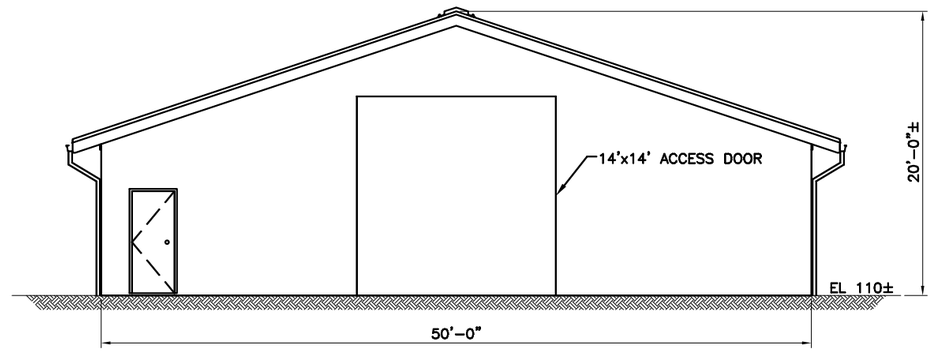
- Power failure and restore.
- Communications failure and restore.
- PLC self-diagnostics alarms and restore.
- Level measure calibration, out of range (high and low), and restore.
- Set point entry range checking.

6.1.4.8 Hydraulic Profile

The hydraulic profile of the SMCF is shown in Figure 6.10.



ANCILLARY EQUIPMENT FACILITY
SCALE: NTS



ELEVATION A
SCALE: NTS

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FIGURE 6.6
ANCILLARY EQUIPMENT FACILITY
PLAN AND ELEVATION

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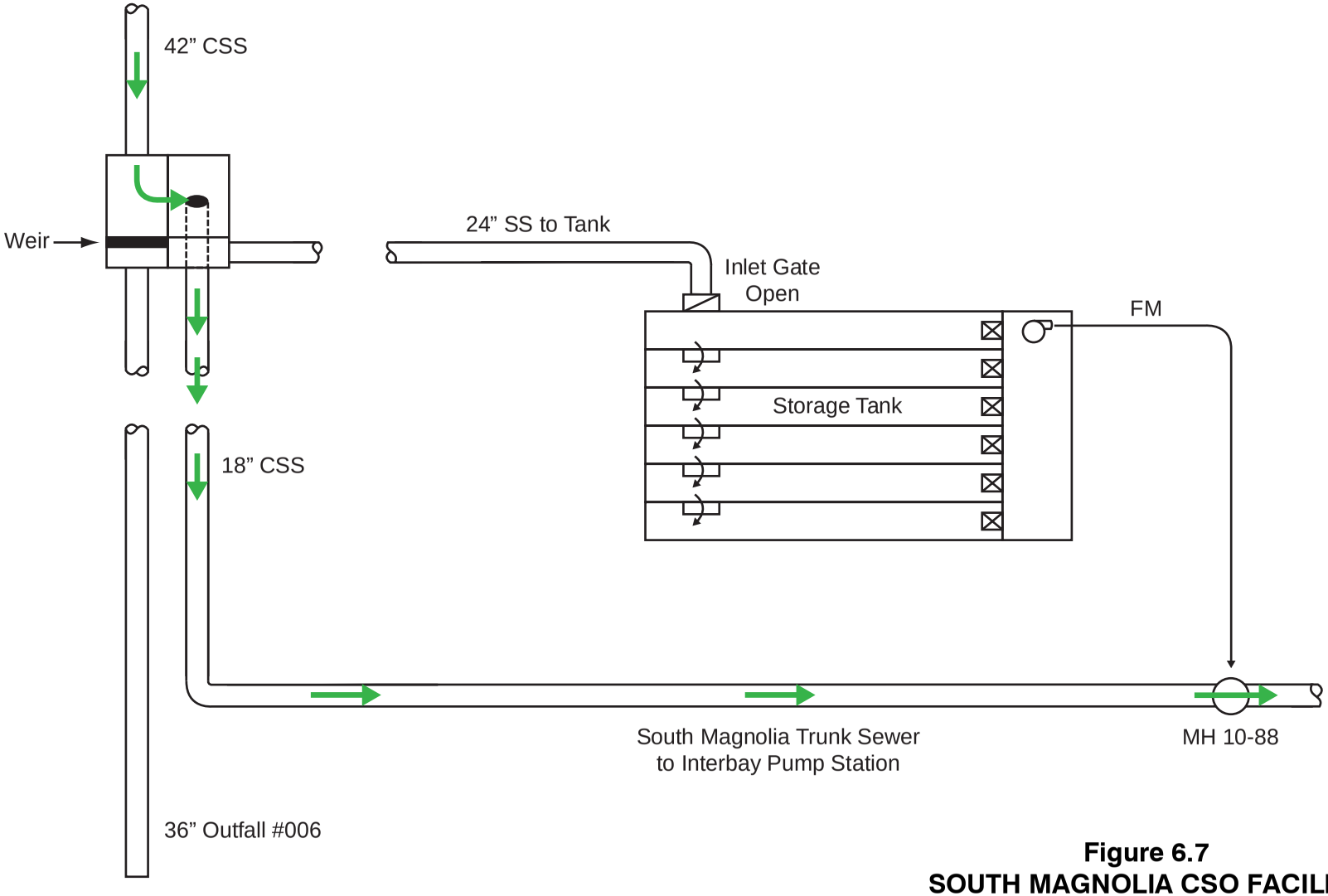

Figure 6.7
SOUTH MAGNOLIA CSO FACILITY
DRY WEATHER FLOW SCHEMATIC

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FIGURE 6-7.ai

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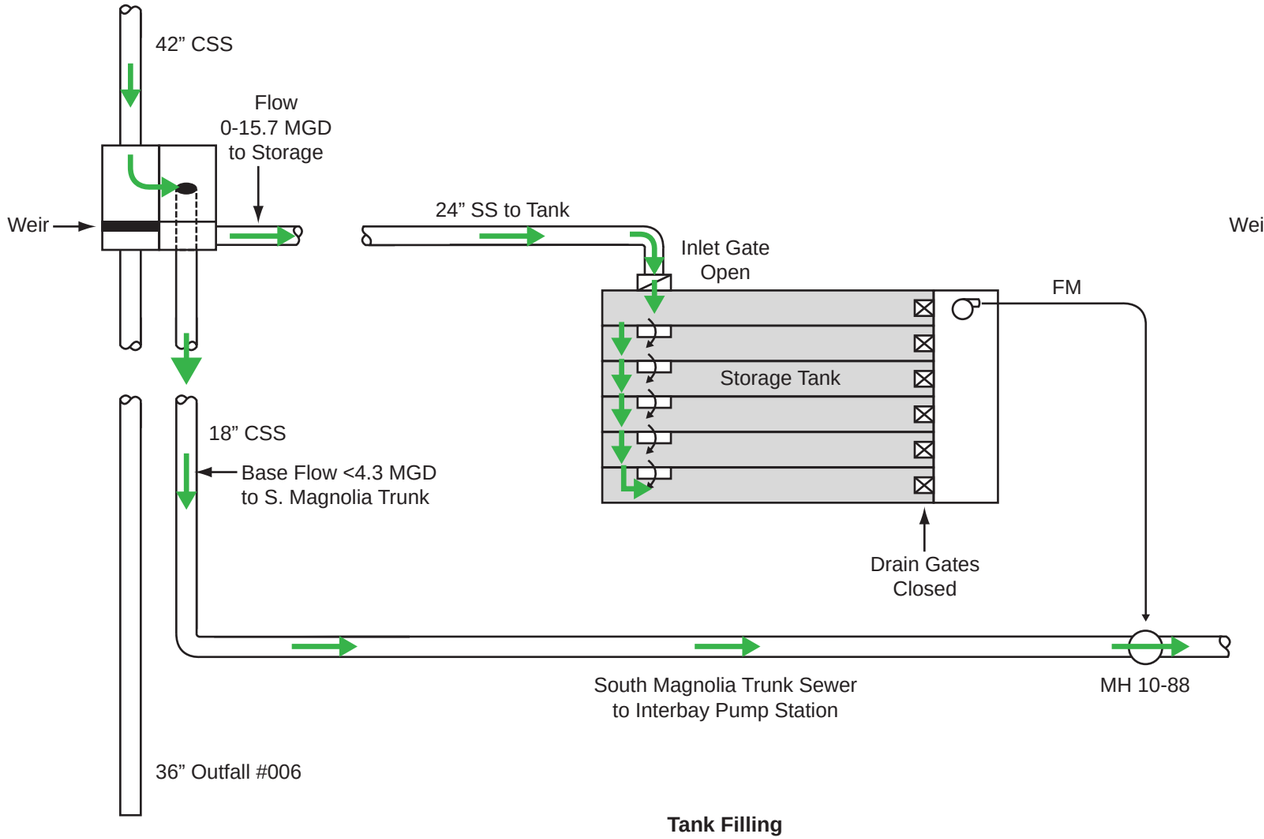
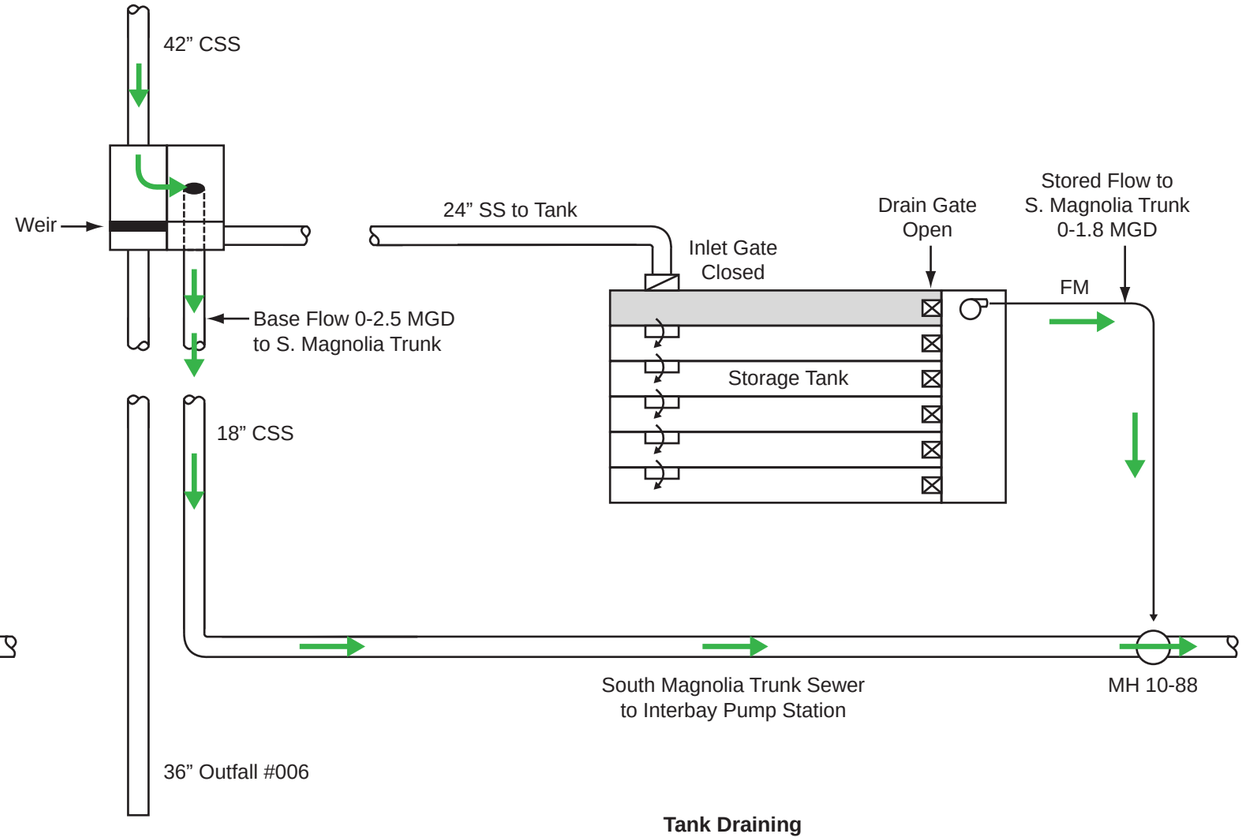


Tank Filling



Tank Draining

Figure 6.8
SOUTH MAGNOLIA CSO FACILITY
WET WEATHER FLOW SCHEMATIC

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Department of Natural Resources and Parks
Wastewater Treatment Division

FIGURE 6-8.ai

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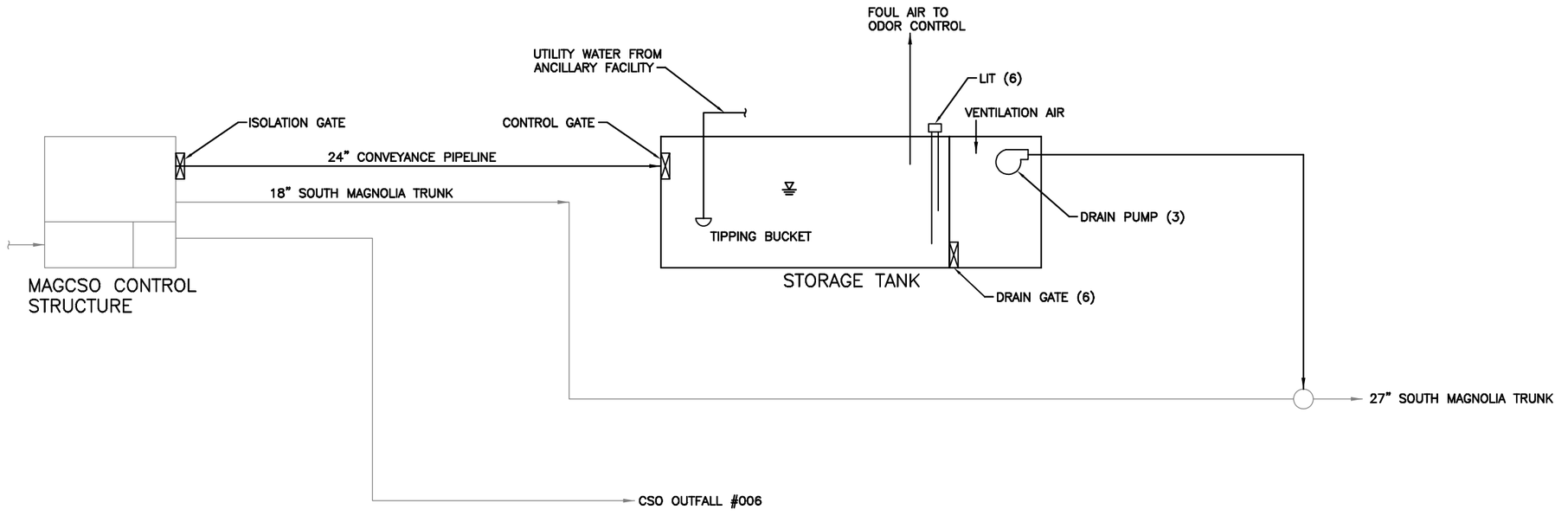

PROCESS FLOW DIAGRAM
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FIGURE 6.9
PROCESS FLOW DIAGRAM

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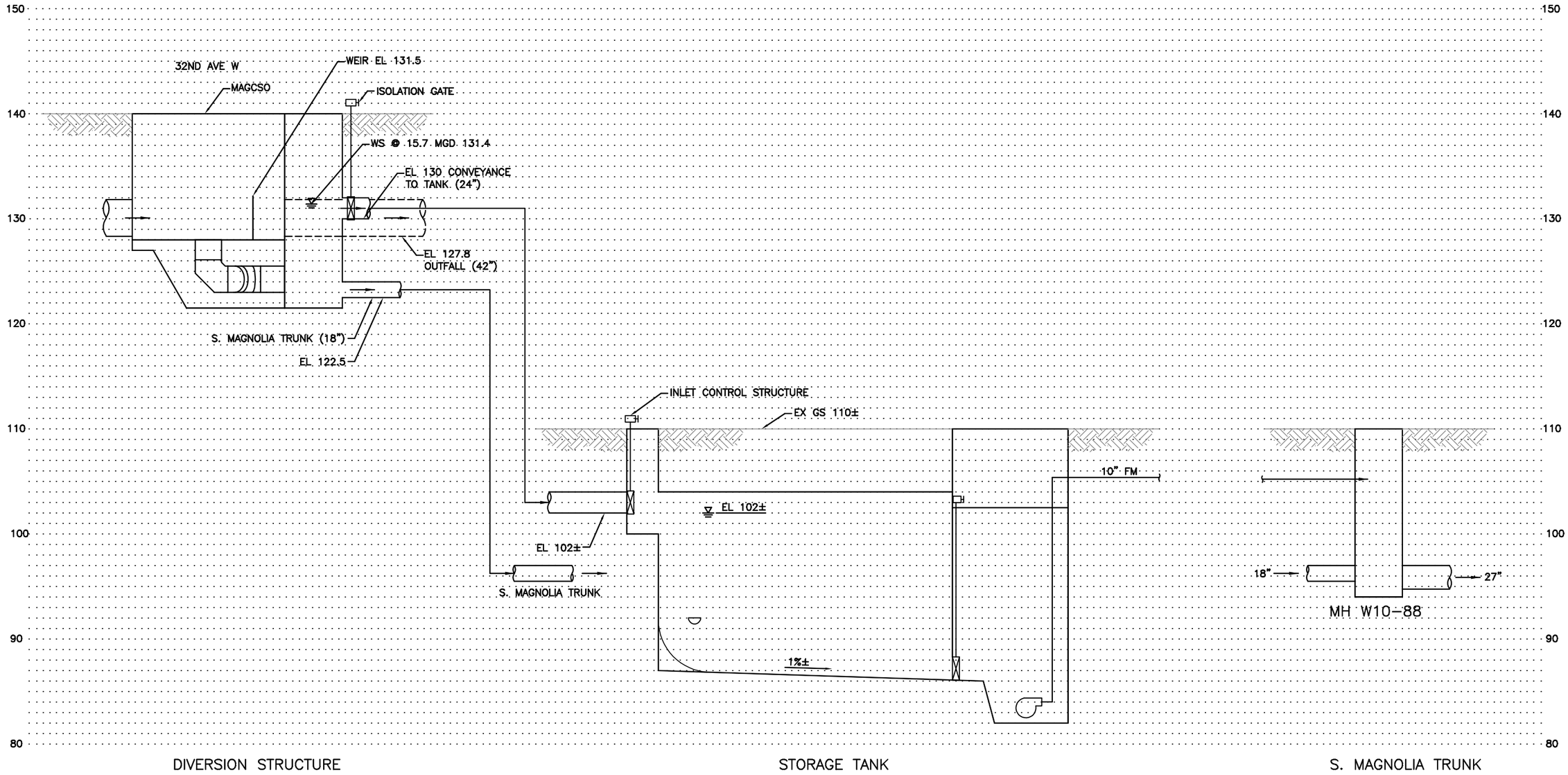

HYDRAULIC PROFILE
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V = NTS

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FIGURE 6.10
HYDRAULIC PROFILE

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6.1.5 Site Improvements

6.1.5.1 Access to Proposed Facilities

The site for the SMCF is depicted in Figure 6.1. The SMCF will be located on this site as determined by design decisions. Factors in location of the tank include potential location and impacts of the future Magnolia Bridge replacement project, and other sites uses as determined by the property owner. There are currently two property owners of land, City of Seattle Parks Department and Port of Seattle, that may be used for the SMCF. Ownership of the site may reside with the current owner, with the county having subsurface and surface use rights.

It is anticipated that access to the SMCF for operations and maintenance will be from 23rd Avenue W. or from an extension of W Garfield Street, or both. It is also anticipated that some area over the top of the tank will be used for other purposes as determined by the property owner.

The characteristics of access to the SMCF include:

- Street access to the entire SMCF site around the tank and ancillary facility. Street access may be shared with the property owner.
- Dedicated paved access around the equipment hatches and lift slabs.
- Dedicated paved access around the ancillary facility.
- It is not anticipated that the site will be fenced.

6.1.5.2 Right-of-Way Improvements

The right-of-way along a portion of 23rd Avenue W and/or W Garfield Street may be required to meet current SDOT pavement and street restoration requirements, and/or the requirements of the Port of Seattle:

- Ordinance 122615 (Sidewalks Improvement Initiative) requires that development projects provide full street improvements.
- Pavement removal and restoration in the right-of-way will conform to Seattle Department of Transportation Director's Rule 2004-02.
- Any new landscaping will be in accordance with City of Seattle standards.
- Stormwater requirements will conform to Seattle Department of Planning and Development Director's Rule 17-2009 (SMC Chapters 22.800 – 22.808).
- Temporary relocation of the Elliott Bay Bike Path along 23rd Avenue W.

6.1.5.3 Stormwater Requirements

Due to likely improvements both within the right-of-way and on a parcel, this alternative will be classified as a "Joint Project" requiring that both parcel-based and roadway stormwater requirements be met (SMC 22.805.070). The area of impact for the proposed project will include greater than 7,000 square feet of new or replaced impervious surface. Therefore, for site

stormwater control, according to the November 2009 Directors' Rules for the Seattle Stormwater Code (SMC Chapters 22.800-22.808), runoff from the site will require water quality treatment. The design water quality treatment volume will be equal to 91 percent of the total volume of the simulation period using an approved continuous model (SMC 22.805.090.B1.a).

The site is tributary to a storm sewer system that drains to Puget Sound, which is classified as a designated receiving water and will not require the project to implement flow control.

This location is not been designated as "capacity-constrained," which requires peak flow control (SMC 22.805.080.B4). However, as a "large" project (replacing 5,000 square feet or more of impervious surface), an analysis of the downstream system within 1/4-mile of the site will be required to ensure sufficient capacity of the drainage system (SMC 22.805.020.I). Should the downstream system be determined to have insufficient capacity (based on the peak flow's four percent annual probability or 25-year recurrence interval), peak flow control or improvements to the drainage system may be necessary.

This alternative will implement Green Stormwater Infrastructure (GSI) BMPs to the maximum extent feasible (SMC 22.805.020.F), including, but not limited to, the use of permeable surfacing and bioretention planters for water quality treatment. Using the City's current standards for design of GSI concepts, the size of the treatment facility required will be based on the percentage of existing impervious surface and will vary based on the technologies used.

6.1.5.4 Landscaping

There is no landscaping on the project site on 32nd Avenue W. A variety of shrubs and existing grass along 23rd Avenue W and in Smith Cove Park will likely be removed during construction. There are large deciduous trees along 32nd Avenue W. The 23rd Avenue W site potentially has significant large trees. The area and extent of impact within Smith Cove Park will depend upon the final tank location.

Areas disturbed by construction will be replanted with drought tolerant or native planting, or both, as developed during final design. Landscaping will be in accordance with City of Seattle standards and the county will work with the community to develop the landscaping plan.

6.2 ENVIRONMENTAL IMPACTS

The project will reduce the CSO volume and frequency to Puget Sound which is anticipated to enhance water quality and wildlife habitat. Elements evaluated during initial analyses included ecosystems, groundwater and surface water, earth resources, land use, recreational resources, utilities, transportation, odor and air quality, noise, vibration, cultural resources, endangered/ threatened species and habitats. The County is preparing a SEPA Environmental Checklist in accordance with WAC 197-11 and plans to issue a threshold determination in April 2011. A copy of the Environmental Checklist and threshold determination will be provided in Appendix D when available.

6.2.1 Ecosystems

The primary project area consists of a parcel adjacent to 23rd Avenue W south of W Garfield Street in the City of Seattle. The site contains two parcels, one owned by the City of Seattle Parks Department and the other by the Port of Seattle. Each site is approximately 6 acres. The steep slope area west of Smith Cove Park also contains a mature forested community dominated by big-leaf maple and western red cedar and likely provides habitat for migratory and resident wildlife.

The ravine above 32nd Avenue W and west of South Magnolia Park contains a mature deciduous forest community dominated by big-leaf maple and provides habitat for migratory and resident wildlife.

6.2.1.1 Wetlands

The 23rd Avenue W site is bordered by Puget Sound on the east side. No wetlands are mapped for this location; however, during a site investigation, wet soils and hydrophytic vegetation were observed at the base of the 32nd Avenue W ravine within a ditch on the east side of the road.

6.2.1.2 Streams and Ditches

There are no streams on or adjacent to the site. A historical stream, Wolf Creek, now exists in a piped section near the 32nd Avenue W project area.

6.2.1.3 Fish Resources

Existing mapping does not indicate fish usage for the piped portion of Wolf Creek through the 32nd Avenue W project area (WDFW 2010; WDFW 2008). The site is adjacent to Puget Sound. Construction staging of pipe in the water (floating) could occur depending on future design decisions; this may have a temporary effect on fish, as yet undetermined. The project will limit combined sewer overflows to Puget Sound which is anticipated to enhance water quality and wildlife habitat. Therefore, no negative impact to fish resources is expected.

6.2.2 Groundwater and Surface Water

Shannon & Wilson, Inc. performed a preliminary geologic/geotechnical evaluation of South Magnolia alternatives for this project (Shannon & Wilson, Inc., December 2009). As described in Chapter 3, the evaluation included an assessment of the geologic conditions in the project area and information on the geotechnical limitations.

The depth to groundwater is unknown, but it is probably close to the ground surface due to its proximity to Puget Sound.

Since the storage tank will be approximately 30 feet below ground surface, groundwater is assumed to be encountered during excavation for the tank. Dewatering water will most likely be discharged through the existing sewer or storm drain systems.

There is some possibility of contaminated groundwater at the site based on the proximity to a state-listed hazardous materials site approximately 1,000 feet east of the site. Currently available information does not indicate contamination on the proposed project site. The City of

Seattle Critical Areas map, Figure 3.7 identifies a potentially leaking underground storage tank on the west side of 23rd Avenue W on part of the proposed site. Its location is not confirmed.

Puget Sound lies to the south and east of the project area. Based on design decisions, there may be some impacts to Puget Sound due to a need to stage carrier pipe for the horizontally directionally drilled conveyance sewer to be installed as part of the project. The project will have a long-term beneficial impact on water resources since it will satisfy Ecology's CSO requirements by complying with the one untreated event per year on average requirement.

6.2.3 Earth Resources

6.2.3.1 Soils

Due to soils in the tank site area, the tank may require pile support. Shoring and groundwater control are likely to be required to support construction. All soils excavated for the storage tank will be hauled off-site to approved locations. There is a potential for soil contamination at the site due to a state-listed hazardous materials site approximately 1,000 feet east of the site. Geotechnical exploration for the project site will include sampling for contamination in the soils and groundwater. Soils on the project site are likely to be fill 10-20 feet thick below the improved surfaces. Dewatering water from excavation activities will likely be discharged to the SMTS, capacity allowing.

Soils at the diversion structure site on 32nd Ave. W. are likely to be glacial outwash near the surface, with interception of the Lawton clay layer close to the point of HDD entry/exit. The diversion structure will be a small utility structure; typical dewatering and shoring for a 12-15 foot deep structure are expected. Shoring and near surface water control will likely be needed for the HDD entry/exit point. Groundwater from the HDD construction will be collected at the east end of the alignment near 23rd Ave. W. and likely be discharged to the County's SMTS.

6.2.3.2 Geologic Hazards

A review of the Critical Areas Maps (Figures 3.6 and 3.7 in Chapter 3) shows a potential for liquefaction at the site due to the nature of fill materials underlying the site. The extreme western edge of the site is adjacent to steep slopes with landslide potential according to City of Seattle sensitive area maps. The Magnolia Bluff area has a well documented history of landslide activity. Construction activities using HDD techniques will likely be routed in pre glacial clay deposits below the later glacial and post glacial materials of the bluffs. See Appendix A of this document for more information.

6.2.3.3 Soil and Groundwater Contamination

There are no known contaminated areas located on the project site. However there is a state-listed (under the Model Toxics Control Act) hazardous materials site approximately 1,000 feet east of the site.

6.2.4 Land Use

The zoning at the location of the facilities near the bottom of 32nd Avenue W is single family (SF 7200). Structures in the street right of way will require a street use permit from the Seattle Department of Transportation (SDOT), while structures out of the right of way will require Master Use Permits from the City of Seattle Department of Planning and Development (DPD). If on Seattle Parks property, approvals from City of Seattle Parks Department (Parks) will also be needed.

Conveyance east from the bottom of 32nd Avenue W will variously traverse (below grade) street rights of way and/or Seattle Parks property, and approvals as described above will be necessary. The storage tank would be located on Port of Seattle property zoned industrial (IG, General Industrial).

6.2.5 Recreational Resources

There are two recreational areas potentially impacted by the project. Adjacent to the 32nd Ave. W. site of the CSO diversion structure, there is an undeveloped park area. Construction impacts to the area within the right of way and adjacent to 32nd Avenue W are likely to be limited to small areas of tree removal at the base of the slope for construction equipment related to installation of the HDD gravity sewer. Following construction, access is not likely to be affected.

The west half of the potential project tank site adjacent to 23rd Avenue W will be impacted during construction, and potentially for the long term, depending on location of the storage tank. During construction, horizontal directional drilling equipment will be located on the north half of the parcel west of 23rd Avenue W, and a cut and cover sewer will be constructed across this area to 23rd Avenue W. If the storage tank is located on this parcel, the sewer will not be constructed, however access hatches, removable slabs, the ancillary equipment facility, and other surface features will reduce recreational uses of the site. Construction may affect access to Elliott Bay Marina and Thorndyke Park during some work activities.

Long term access to the recreational field west of 23rd Avenue W may be reduced if the tank is located on that parcel, due to the need for surface access to the tank for operations and maintenance purposes. While the tank will be underground, several surface hatches will affect use of the area as a park. The ancillary facility, an above-grade 4,500 square foot building will also occupy approximately 16,500 square feet when access is included. This facility could be constructed over the tank or adjacent to it.

6.2.6 Utilities

Existing utilities along 23rd Avenue W may be affected as part of facility construction and improvements to the property. Existing sewer, drainage, power, gas, and telecommunications services will be maintained through temporary and/or permanent relocation of utilities as required by the final design.

6.2.7 Transportation

There will be limited impacts to traffic and access during construction as a result of construction. Potential delays and detours during construction could have temporary, indirect impacts.

One lane of 32nd Avenue W will likely be closed near the site during construction. Informal parking in the right-of-way will be displaced.

Temporary lane closures will occur on 23rd Avenue W within the construction area to construct the conveyance pipeline. The length of traffic interruption will vary depending on the selected construction sequence for the HDD pipeline installation and the road crossing of 23rd Avenue W.

In addition to road closures and detours during construction, there will be increased construction traffic to and from the project site. The peak number of daily construction trips will occur during excavation and backfilling of the storage tank and asphalt paving and are estimated at approximately 30 trips per day. During other phases of construction, the number of daily construction trips is likely to be less than 30 trips per day. If construction is scheduled appropriately in consideration of other uses in the Port of Seattle area adjacent to the site, it is likely that the general construction traffic will have little impact on the level of service in the area.

The contractor will be required to submit a traffic control plan detailing the haul route for construction traffic. Additional traffic control measures, such as warning signs and flaggers, may be a requirement of the haul route approval.

Measures to reduce or control transportation impacts by the completed project will not be required.

6.2.8 Odor and Air Quality

Air quality impacts from earth-moving activities during construction are typical for large construction projects. Best Management Practices (BMP) will be implemented for dust control including street sweeping, watering exposed soil surfaces, and covering soil stockpiles to help minimize the amount of fugitive dust and particulate pollution to the surrounding areas. Other similar BMPs might be employed by the contractor to minimize dust. Construction activities often concentrate heavy equipment powered by gas or diesel engines in a particular location. Air pollution from engines could increase during certain activities, such as queuing trucks for loading and offloading of materials, or during heavy excavation. Provisions to limit idling of mechanical equipment typically are included in King County projects and will be employed during construction to minimize the amount of air pollution generated from gas- and diesel-engine-driven machinery, as well as to limit greenhouse gas effects.

Long-term impacts (continuous emissions) from odors associated with operation of the facilities would be minimized and mitigated through several design features. Odor generation in the new Diversion Structure would be minimized by limiting turbulence and keeping the hatches to the structure closed. Odors generated at the storage tank would be minimized through the automated flushing system installed to clean settled solids from the tank after each storage event. Periodic manual wash down of the accessible portions of the tank walls could be used to minimize odorous gas formation in the tank further; however, the current design prioritizes the automated flushing system. Any odors generated within the tank from stored wastewater or solids not removed from the wash down system would be mitigated through operation of the planned odor control facility.

Instrumentation to measure inlet and outlet gas concentrations at the odor control facility will help determine the functional performance and life remaining on the carbon filter media to more accurately schedule carbon replacement. This active monitoring will ensure that foul odors are controlled to the extent possible by the installed system.

6.2.9 Noise

Noise impacts during construction will be mitigated by contract documents requiring compliance with noise regulations, local jurisdictional codes, and the county's noise policy. Variances may be obtained if the schedule requires working additional hours beyond current ordinance allowances.

Equipment operation after the facility is in operation will produce little if any noticeable noise. Pumps in the storage tank are submersible and will not produce noticeable noise levels. All functional noise controls, such as insulation under access hatches, will be implemented so that noise levels at the property line will not exceed those levels required for the site's current zoning.

Odor control equipment, pump motor starters and standby generator will be housed in a facility on the storage tank site. Additional noise mitigation measures such as louver baffles, acoustical shrouds, and exhaust stack silencers will be included as necessary to provide minimum noise conditions at the site's property line. Additional measures such as cabinet acoustical insulation or noise-suppressing insulation inside the structure may be required if noise levels at the site become unacceptable to the adjacent residents.

6.2.10 Vibration

Vibration during construction of the facilities will be monitored at nearby residences. Standards of care will be applied and specified in the contract documents.

During normal operation of the storage tank and completed facility equipment, vibrations will be localized to the degree that only those persons standing near the equipment enclosure or on hatches directly adjacent to equipment will notice vibrations. Pumps currently sized for this facility are not large enough to create vibration issues, particularly given the mass of the new storage facility. Odor control equipment and standby generator will be fitted with anti-vibration components in the equipment anchoring systems specified for the project.

6.2.11 Cultural Resources

A review of known, potential cultural, archaeological, and historic resources within the South Magnolia Basin has been conducted. There are no known archaeological sites or historic structures on or near the proposed project site. Based on site characteristics and location, the project area near 23rd Avenue W has a high probability of containing archaeological or cultural resources, while the location of the small diversion structure and gravity pipeline near 32nd Avenue W has a low probability.Near the 23rd Avenue W site, the area at the base of the east facing Magnolia bluff has a high probability of cultural resources. The Admiral's House (Figure 6.1) is a historic structure, although construction will not likely affect this house.

6.2.12 Endangered/Threatened Species or Habitats

There are no threatened or endangered species known to be on or immediately adjacent to the project site. Project construction at the Diversion Structure will be approximately 200 to 300 feet north of Puget Sound. Project construction for the tank could be within 200 feet of the shoreline of Puget Sound. Long-term effects of the project will be beneficial to listed species in Puget Sound as water quality will be improved with a reduction in the combined sewer outfall overflow events.

6.2.13 Prime or Unique Farmland

There is no farmland within the project area, so there are no impacts to prime or unique farmland.

6.3 DESIGN LIFE

The design life of the storage facility is based on a 50-year life cycle and the primary equipment design life is based on a 20-year life cycle. Routine maintenance of the facility and replacement of equipment will occur as needed to obtain the design life.

6.4 RESIDUALS MANAGEMENT

The proposed pipeline storage tank will be designed with a tipping bucket flushing system, so that any solids will be flushed out of the tank following a CSO event and not likely accumulate in the storage tank. Residual solids will be flushed through the tank drain pumps and back into the South Magnolia Trunk Sewer. However, should the tank need additional cleaning, it will be designed to allow for multiple flush cycles, and access for manual cleaning.

6.5 ABILITY TO EXPAND

It is not anticipated the South Magnolia Basin will experience any significant demographic or land use changes in the future. The area is considered built out and population levels are anticipated to remain relatively constant. The need for this project is not due to anticipated population growth or increase in sewered areas (connecting on-site systems to sewer system); therefore, it is not anticipated that future demographics, land use, or population growth will increase the storage volume required to meet current Ecology requirements.

In the event the facility is undersized, the county has the option to add on to the tank on the site, or support additional CSO reduction measures including a focus on the City of Seattle's Residential RainWise Program and the City of Seattle Drainage Code.

The City's Residential RainWise Program aims at reducing the amount of stormwater runoff (inflow) from private properties into the sewer collection system. By removing residential stormwater connections from the combined system, the volume and flow rate of wet weather peak flows are reduced. This reduction increases the capacity of the existing facilities within the basin.

6.6 O&M STAFFING NEEDS

The recommended alternative will need regular maintenance to ensure the design life of the facility is met and proper operation occurs. Table 6.3 shows the types of O&M activities that could occur, the frequency of each activity, and staffing requirements to perform those activities.

Key issues for O&M include:

- Design for safety of personnel.
- Monitor the system remotely during a wet weather event.
- Design the system for ease of operations and maintenance including post-wet weather event cleaning.
- Design so that maintenance staff will not need to routinely enter the storage tank.
- Provide provisions for safe entry to storage tank and maintenance, if needed.
- Visually integrate the ancillary facility with the surrounding neighborhood.

Table 6.3 Operation and Maintenance Activities

Component	Activity	Frequency	Staff Needed	Special Equipment Needed
Control Structures				
Access Hatches	Inspect hatches for wear and tear from surface by opening access hatches and visually assess conditions; replace worn or damaged components	Annually	2	Repair components from manufacturer/ supplier
Gates	Grease riser stems, adjust seats, etc., depending on type of gate	Annually or Per Manufacturer Recommendations	2	None
Gates	Replace gates	As needed	6	Confined Space Entry Equipment
Operators/Actuators	Grease riser stems, packing, seats, etc., depending on type of operator/actuator	Annually or Per Manufacturer Recommendations	2	None
Level Gauges	Inspect and take readings	Monthly	1	None
Level Gauges	Calibrate	Annually	1	None
Level Gauges	Repair/Replace gauges	As needed	2	None
Tank Storage				
Access Hatches	Inspect hatches for wear and tear from surface by opening access hatches and visually assess conditions; replace worn or damaged components	Annually	2	Repair components from manufacturer/ supplier
Tipping Bucket	Inspect for wear and tear from surface by opening access hatches to view and visually assess conditions	Monthly	2	None
Flushing Filling System	Inspect for damage to filling system; replace worn or damaged components	Monthly	2	Repair components from manufacturer/ supplier
Storage Pipeline	Supplemental manual cleaning.	Every 3 to 5 years	10	Boom truck, Vactor™ truck, confined space entry equipment
Storage Pipeline	Flushing after CSO event.	~10 times per year	2	None
Storage Tank	Surface inspection – open hatches and inspect visible areas with surface-supplied lighting to monitor for debris accumulation	After each event for first year. Thereafter, annually at a minimum.	2	Surface direction lighting

Table 6.3 Operation and Maintenance Activities

Component	Activity	Frequency	Staff Needed	Special Equipment Needed
Storage Tank	Manned structural inspection – perform manned entry into tank area to inspect concrete structure	10-year cycle/post-seismic event	5	Confined Space Entry Equipment, Fire Department Standby
Storage Tank	Survey of existing structure for settlement	10-year cycle/post-seismic event	4	Survey Crew and Equipment
Pumps	Routine maintenance – bearings, sensors; can be done at surface	Semi-Annually	3	None
Pumps	Pump Start/Stop cycling; operate pumps manually to ensure start/stop	Monthly	2	None
Pumps	Clearing rags, blockages; can be done at surface	As needed	3	None
Pumps	Slide rail– inspect for wear and tear	Every 10 years/when manned structural inspection is performed	5	Confined Space Entry Equipment, Fire Department Standby
Valves	Grease riser stems, packing, seats, etc., depending on type of valves	Annually or Per Manufacturer Recommendations	3	None
Valves	Replace valves	As needed	3	None
Gates	Grease riser stems, adjust seats, etc., depending on type of gate	Annually or Per Manufacturer Recommendations	3/5	None/Confined Space Entry Equipment
Gates	Replace gates	As needed	6	Confined Space Entry Equipment
Operators/Actuators	Grease riser stems, packing, seats, etc., depending on type of operator/actuator	Semi-annually or Per Manufacturer Recommendations	3	None
Flowmeter	Inspect and take readings	Weekly	1	None
Flowmeter	Calibrate	Annually	1	None
Flowmeter	Repair/Replace gauges	As needed	2	None
Level Gauges	Inspect and take readings	Weekly	1	None
Level Gauges	Calibrate	Annually	1	None
Level Gauges	Repair/Replace gauges	As needed	2	None
Electrical Room				
Panels	Routine inspection and maintenance	Semi-annually or per manufacturer	1	None

Table 6.3 Operation and Maintenance Activities

Component	Activity	Frequency	Staff Needed	Special Equipment Needed
VFDs	Routine inspection and maintenance	Semi-annually or per manufacturer	1	None
PLC	Routine inspection and maintenance	Semi-annually or per manufacturer	1	None
MCC	Routine inspection and maintenance	Semi-annually or per manufacturer	1	None
Motor Starters	Routine inspection and maintenance	Semi-annually or per manufacturer	1	None
Standby Generator	Routine inspection and maintenance	Semi-annually or per manufacturer	2	None
Standby Generator	Routine testing	Monthly	2	None
Mechanical Room				
Air Gap Tank	Visually inspect for leaks, corrosion and fouled contacts on instruments/floats	Monthly	1	None
AG Tank Filling System	Visually inspect for leaks, manually operate valves or system by hand-adjusting floats/level controllers	Annually	1	None
HVAC	Belts and Bearings – Inspect and replace as needed	Semi-annually or per manufacturer	1	None
Carbon Filter Media	Sample carbon for saturation; collect analytical sample for analysis by vendor/laboratory	Semi-annually	1	None
Carbon Filter Media	Inspect filter bed for crusting/fouling – use rake/hand tools to break up fouled surface (horizontal bed only)	Semi-annually oras indicated by pressure gauges across filter bed	1	None
Carbon Filter Media	Replace carbon media	On 5-year intervals/as indicated by carbon testing results	3	Vactor™ truck, boom truck or lifting equipment if facility not equipped
Fan – Odor Control Fan	Belts and Bearings - Inspect and replace as needed	Semi-annually or per manufacturer	1	None
Fan – HVAC	Belts and Bearings - Inspect and replace as needed	Semi-annually or per manufacturer	1	None
Grease/Mist Eliminator	Remove fouled media filters and replace with clean filters; clean fouled filters off-site and store	Semi-annually or as indicated by pressure gauges across filter bed	2	Flatbed truck to haul filters, lifting equipment if facility is not equipped
Pressure Gauges	Inspect all gauges and record readings	Monthly based on visits to facility	1	None

Table 6.3 Operation and Maintenance Activities

Component	Activity	Frequency	Staff Needed	Special Equipment Needed
Pressure Gauges	Repair/Replace gauges	As needed	1	None
Fiberglass Ductwork	Visually inspect all ductwork for cracking or leaks	Annually and after seismic events	1	None
Dampers	Visually inspect all dampers and actuators for damage or wear and tear	Annually	1	None
Silencer	Visually inspect silencer for damage or wear and tear	Annually	1	None

6.7 DESIGN GUIDELINES

This section summarizes the guiding principles being used for the design of the proposed alternative.

6.7.1 Site Design

The finished design of the site must provide for adequate traffic movement and safety while providing adequate access, working space, and parking for maintenance of the facilities. Minimizing impact to existing land uses is an important design parameter in the final design of the alternative.

6.7.2 Traffic

It is important to minimize road closuvres and impacts to traffic during construction of the alternative.

Once the facility is completed, King County O&M staff will periodically be required to visit the site. Disruption to traffic should be minimized without compromising King County's ability to effectively operate and maintain the facility.

6.7.3 Structural/Geotechnical

Shoring for earthwork shall be of a type appropriate for the available space on the site and other site conditions. Shoring for earthwork must adequately support the sides of the excavation and protect adjacent areas and structures.

Anticipated groundwater levels will require dewatering during construction of the tank, piping and Diversion Structure. The structural design of the storage tank also will need to counteract buoyancy due to groundwater while avoiding or minimizing the need for piles or other foundation supports.

6.7.4 Stormwater Management

Stormwater design will follow the City of Seattle Stormwater Code for water quality treatment for runoff. The design water quality treatment volume will be equal to 91 percent of the total volume of the simulation period using an approved continuous model (SMC 22.805.090.B1.a). The stormwater design also will incorporate GSI concepts to the extent feasible including, but not limited to, the use of permeable surfacing and bioretention swales.

6.7.5 Architecture/Landscaping

The ancillary equipment facility will be architecturally designed to be visually integrated with the surrounding neighborhood. Architectural consideration will be given to retaining walls, exhaust stacks, intake and exhaust plenum vaults, and other exposed above-grade features to ensure compatibility with the existing site's aesthetic characteristics. Landscape design will be compatible with the surrounding neighborhood and park, will utilize native or drought-tolerant plants, and will minimize irrigation and maintenance requirements.

6.7.6 O&M and Facility Inspections

An important objective in the design of the project is for simple, reliable and safe operation and maintenance. This includes avoiding the need to routinely enter the storage tank to perform O&M activities by including a post-event flushing system and other design features.

The storage tank will be maintainable from access portals or the ground surface whenever possible, including the post-event solids removal activities. Access portals will be located so that O&M crews can access the equipment and pipeline storage tank, if needed.

Provisions for personnel and equipment to enter the tank will be provided. For example, removable concrete panels will be incorporated into the design to allow large equipment to be placed inside or removed. Smaller access hatches will also be provided to allow access for routine operation and maintenance. Furthermore, the overall facility will be remotely monitored during operation to verify the mechanical systems are working properly.

Pumps will be used to drain the storage facility rather than to drain storage by gravity. When downstream capacity is available, the storage facility will drain at the maximum flow rate possible without overloading the downstream conveyance system. The pumps will be rail-guided submersible pumps to minimize the need for entry for maintenance.

The odor control system can assist in ventilation for maintenance activities as well as odor control. The ventilation rate will be two ac/hr to control odors, with provisions for six ac/hr with a bypass around the carbon scrubber prior to entry into the storage facility. Auxiliary portable ventilation equipment could be employed for infrequent entrance into the tank.

6.7.7 Reliability

The location of the site allows for filling of storage by gravity. The existing outfall also provides a relief point in the event flow rates or volumes exceed the capacity of the tank and influent piping.

The odor control equipment, drain pumps, and other items requiring power are not considered critical to storing flows to prevent CSOs since the storage tank will fill by gravity. Loss of power would prevent the storage facility from being drained by the pumps after an event; however, this would not prevent the sewer collection system from continuing to operate. Furthermore, it is anticipated that the CSO facility will only be used a few times a year and that the likelihood of back-to-back uses of the facility is very low. However, the design does currently include on-site standby power for reliability of some facility equipment such as inlet control gates and telemetry systems.

6.7.8 Effects of Sea Level Rise

In March of 2006, the King County Executive issued an executive order on Global Warming Preparedness directing all agencies to prepare for the affects of climate change including adaptation, mitigation and sequestration. The Wastewater Treatment Division is evaluating the effects of rising sea levels associated with climate change. Sea level rise (SLR) scenarios were developed by combining prediction of future SLR and storm surge from statistical analysis. The three main sources for the scenarios came from the University of

Washington's Climate Impacts Group, Department of Ecology Report *Sea Level Rise in the Coastal Waters of Washington State* (2008) and *Response of Extreme Storm Tide Levels to Long-Term Sea Level Change* (C.E. Zervas, 2005).

To give a broad array of possibilities 1, 2, 10, and 100 year storm events were considered for each of the SLR scenarios. Table 6.4 shows the values used for possible future sea-level conditions with storm events.

Table 6.4 Puget Sound Sea-Level Rise Scenarios with Storm Surge

Sea-Level Rise Scenarios (Metro datum in ft.)	**Storm Surge**				
	No Storm	1 yr (1.48')	2 yr (2.27')	10 yr (2.79')	100 yr (3.19')
Current Conditions (Mean High High-Water)	105.36	106.84	107.63	108.15	108.55
Medium SLR 2050 (6")	105.86	107.34	108.13	108.65	109.05
Medium SLR 2100 (13")	106.44	107.92	108.71	109.23	109.63
Very High SLR 2050 (22")	107.19	108.67	109.46	109.98	110.38
Very High SLR 2100 (50")	109.53	111.01	111.8	112.32	112.72

No facilities associated with the CSO project are vulnerable to sea level rise scenarios. The lowest point vulnerable to SLR is the bottom of the storage pipeline at (Elevation 109.0 Metro) which will be designed for high groundwater conditions.

The outfall flow rate could be diminished under future SLR scenarios. This is being evaluated for the entire combined sewer system and adaptation plans will be evaluated under a separate project.

6.8 FEASABILITY OF IMPLEMENTATION

Based on an evaluation of landuse/permitting, environmental impacts, engineering, operations and maintenance, and community impacts, implementation of Alternative 1F1 – Rectangular Out of Basin Storage - appears to be feasible with no identification of fatal flaws.