Prepared for

City of Sunnyvale Environmental Services Department
P.O. BOX 3707
Sunnyvale, CA 94088-3707

SMaRT Station® Feasibility Study

Prepared by

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Geosyntec Project Number WW1940

11 December 2014

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1. INTRODUCTION

1.1 Purpose and Objectives

The SMaRT Station is a nine acre Materials Recovery Facility (MRF) facility that is operated by Bay Counties Waste Services for the cities of Sunnyvale, Mountain View, and Palo Alto that has been in operation since October 1, 1993. The SMaRT Station receives municipal solid waste (MSW) and recyclables from the cities of Sunnyvale, Mountain View, and Palo Alto; processes MSW to remove recyclable materials; prepares recyclables for secondary markets; and transfers the remaining waste to the Kirby Canyon Landfill in San Jose. The facility also serves as a public drop-off center for recyclables and certain universal waste items for local residents.

The SMaRT Station has been covered under the Industrial General Permit (IGP) since 2003. The SMaRT Station will obtain coverage under the revised IGP (Order No. 2014-0057-DWQ) that becomes effective on July 1, 2015.

The City of Sunnyvale (the City) as owner of the SMaRT Station has entered into a Stipulation and Settlement Agreement (Settlement Agreement) with San Francisco Baykeeper, effective October 10, 2013. Per the Settlement Agreement, the City must develop and implement Best Management Practices (BMPs) designed to comply with the narrative effluent and receiving water limitations of the revised IGP, including BMPs set forth in the Settlement Agreement. The Settlement Agreement includes Target Levels for stormwater discharges that are based on benchmark values from USEPA's Multi-Sector General Permit; these Target Levels will be replaced with the Numeric Action Levels (NALs) in the revised IGP (Table 1) once that permit becomes effective. Note that the revised IGP includes an NAL for pH, which was not included in the Settlement Agreement. Otherwise, the constituents are the same, but the Target Levels and revised IGP NALs for copper, lead, and zinc differ based on the hardness of the receiving water.

If the Target Levels were exceeded at the SMaRT Station during the 2013-14 storm season, the Settlement Agreement requires that the City develop a Feasibility Study and subsequent Timeframe/Implementation Plan for the SMaRT Station.[1] The Feasibility Study must include: (1) the proposed designation of permanent representative discharge monitoring locations for all future industrial stormwater monitoring ("Final Designated Discharge Points"), and (2) a preliminary analysis and estimate of all necessary financial, construction, timing, and permitting considerations required to fully implement each BMP alternative identified to address the constituent(s) that have exceeded the Target Levels/NALs in the facility's discharge monitoring, including but not limited to the following three structural BMPs:

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[1] If needed, a separate Feasibility Study and Timeframe/Implementation Plan will be prepared for the Concrete Recycling Facility.

- Roofing all or prioritized areas of the SMaRT Station to prevent exposure of materials to stormwater runoff;
- Segregation, pretreatment, and/or diversion of stormwater runoff to the City's Water Pollution Control Plant (WPCP); and
- Treatment of industrial stormwater prior to discharge to receiving waters or to the City's WPCP.[2]

Table 1: Settlement Agreement Target Levels and 2014 Industrial General Permit Numeric Action Levels

#	Constituent	MSGP Target Level	2014 IGP Annual Numeric Action Level
1	Total Suspended Solids	100 mg/L	100 mg/L / 400 mg/L[a]
2	Oil and Grease	15 mg/L	15 mg/L / 25 mg/L[a]
3	Total Iron	1.0 mg/L	1.0 mg/L
4	Chemical Oxygen Demand	120 mg/L	120 mg/L
5	Total Aluminum	0.75 mg/L	0.75 mg/L
6	Total Copper	15.6 µg/L[b]	33.2 µg/L[c]
7	Total Lead	95 µg/L[b]	262 µg/L[c]
8	Total Zinc	130 µg/L[b]	260 µg/L[c]
9	pH	N/A	<6.0 & >9.0 standard units[d]

a Annual Average NAL / Instantaneous Maximum NAL

b. These parameters are included in the 2008 Multi-Sector General Permit, but are hardness dependent. Hardness calculations are appropriate for discharges to freshwater. EPA benchmarks are set with an assumed hardness value of 100 mg/L. In any compliance determination, Sunnyvale shall establish that the assumed hardness value of 100 mg/L should not apply based on actual receiving water sample data.

c. The Numeric Action Level is the highest value used by the USEPA based on the hardness table in the 2008 MSGP (i.e., assumes a hardness greater than 250 mg/L in the receiving water).

d. Instantaneous Maximum NAL

This Feasibility Study evaluates the three structural BMPs[3] identified in the Settlement Agreement in terms of their ability to meet the Target Levels/NALs; implementability (e.g., disturbance to site activities, permitting, and operation and maintenance requirements); and capital and long-term costs. Based on an evaluation of these criteria, one BMP alternative is recommended for implementation.

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[2] Treatment of industrial stormwater prior to discharge to the City's WPCP is considered the same as pretreatment prior to diversion to the WPCP in this report.

[3] Flow segregation of runoff from non-industrial areas and building roof runoff is evaluated as a separate, fourth BMP.

1.2 Document Organization

This Feasibility Study is organized as follows. Section 2 provides a description of the SMaRT Station including site operations, drainage and receiving waters, soils, depth to groundwater, current structural and non-structural BMPs, and stormwater runoff quality. Section 3 provides an overview of each type of structural BMP evaluated including flow segregation of non-industrial areas and roof runoff, roofing structures in prioritized areas, diversion to the City's WPCP, and on-site stormwater treatment. Section 4 presents the alternatives analysis for two structural BMP alternatives for the SMaRT station that were developed based on the information presented in Section 3. Section 5 summarizes the recommended structural BMP alternative for the SMaRT Station. References are included in Section 6. Figures are provided at the end of the document.

2. FACILITY DESCRIPTION

2.1.1 Facility Operations

The SMaRT Station is located at 301 Carl Road, Sunnyvale, California (Figure 1), northeast of the junction of Borregas Avenue and Carl Road in north Sunnyvale. The site is bordered to the east and south by the East Hill and South Hill of the Sunnyvale Landfill, respectively; to the west by the City's WPCP; and to the north by several ditches, a former Cargill salt pond (Pond A4, currently owned by the Santa Clara Valley Water District (SCVWD)), Guadalupe Slough, and ultimately San Francisco Bay.

The SMaRT Station includes the main processing building and administrative office building, a public drop-off center, a covered used oil collection area, a maintenance shop, and a designated storage building for hazardous wastes removed during load check activities. Combined, the buildings and covered areas comprise approximately forty percent of the nine acre site, as shown on Figure 2.

The majority of the facility operations take place in the main processing building (see call-out #1 on Figure 2). The public drop-off center (where the public deposits recyclables and universal wastes in designated containers) and a staging area for recovered concrete and soil prior to load-out are located outside, south of the main processing building. Processed yard trimmings and processed wood are bulked outside (typically uncovered) in the northwest corner of the site prior to removal to an offsite composting facility.

Facility activities are distributed among the areas identified on Figure 2 as follows:

- Area 1 is the main processing building. MSW and recyclable materials are received and processed inside this area, and remaining MSW is loaded into trucks at the northeast end of the building (#10) for delivery to the Kirby Canyon Landfill. Bales of recyclable materials are stored inside Area 1 and loaded into trailers at the dock area at the northwest end of the building (#10).

- Area 2 includes the administrative office and non-industrial vehicle parking lot, and is not considered to be subject to the requirements of the IGP because no industrial activities take place in this area.
- Area 3 is the uncovered area on the north side of the building where processed yard trimmings and processed wood are bulked until these materials are loaded onto trucks for transport to markets or secondary processors.
- Area 4 is the enclosed maintenance shop. The 10,000 square foot maintenance shop is used for servicing and routinely maintaining forklifts, loaders, and recycling and transfer equipment. Oils and grease are stored inside the maintenance shop in appropriate containers equipped with secondary containment. The maintenance shop is also equipped with a floor drain that discharges to a dead end containment sump to prevent the release of spills.
- Area 5 is the public drop-off center used for drop-off of recyclables, including items such as paper, glass, universal waste electronic items, household batteries, sharps, and fluorescent light bulbs and tubes. Per the Settlement Agreement, the universal waste electronics bins must be covered before and during rain events.
- Area 6 is the covered oil storage area. The City bulks used motor oil collected from the public in an underground storage tank pending transport. The underground storage tank is double-walled and continually monitored for leaks and overfills. Cooking oil collected from the public is bulked in a 55-gallon drum for recycling. The entire storage area is surrounded by a 6-inch concrete curb for additional containment.
- Area 7 is the hazardous materials storage container. Hazardous materials discovered during load checks and processing are stored here until removed by a hazardous waste contractor. This container is manufactured for hazardous materials storage and is equipped with secondary containment and a fire suppression system.
- Areas 8 and 9 are uncovered areas where concrete and clean soil are temporarily stored until these materials are transported for recycling or secondary processors.
- Area 10 (northwest) is the loading area for baled materials and Area 10 (northeast) is the loading area for MSW as additionally described above under Area 1.
- Areas 11 are the storage areas for recyclable materials, such as plastic and glass, in roll-off bins. Materials are stored until the bins reach capacity and then are either baled or hauled to recycling markets.

- Area 12 is used for staging of scrap metal storage trailers. When filled, each trailer is hauled to a metal recycler and an empty trailer is staged in its place.
- Area 13 is used as overflow storage of baled recycled materials as needed.
- Area 14 is the driveway exiting the rear of the SMaRT Station.

2.1.2 Drainage and Receiving Waters

Surface water flow patterns, drain inlet locations, site drainage areas, and the site stormwater discharge points are shown on Figure 3. Roof drains discharge to the ground surface at locations indicated on Figure 3, and that drainage is captured by the various catch basins described below.

Stormwater from the southern portion of the SMaRT Station, the office parking lot, and the southwestern-most portion of the driveway exiting the rear of the SMaRT Station, collectively flow into catch basins that are connected in series and transmitted via a culvert into the north-south trending portion of the Carl Road drainage ditch (the last catch basin in this series is labeled SM-1).

Stormwater from the northern portions of the SMaRT Station drains into catch basins located along the curb at the northwestern, northeastern, and northern perimeters of the asphalt driveway area. The easternmost inlet drains via an underground conduit to the northeastern-most catch basin (SM-3), which then directly discharges through a corrugated metal pipe into the southern-most ditch that borders the north side of the SMaRT Station.

The northwestern drain inlet (SM-2) also discharges directly into this southern-most ditch. This southern-most ditch then flows through a culvert beneath the access road to Stormwater Pump Station No. 1 and into the Carl Road drainage ditch. Water from the Carl Road ditch is then pumped (by Stormwater Pump Station No. 1) into the southernmost of two east-west trending drainage ditches that are located west of the Baylands Pump Station. This ditch flows into Moffett Channel (the northern extension of the Sunnyvale West Flood Control Channel), then the Guadalupe Slough, and ultimately to San Francisco Bay. These ditches are located between the WPCP facility and the southern perimeter of the SCVWD Pond A4.

2.1.3 Soils

US Department of Agriculture Natural Resources Conservation Service (NRCS) soil maps indicate the soils in the area consist of urban land (disturbed and human transported material and fill), xerothents, and trash substratum (NRCS, 2014).

A geotechnical report by Wahler and Associates (1990) indicates that the SMaRT Station is located in alluvial flatlands and is underlain by older "San Francisco Bay Mud," made up of semi-consolidated organic-rich clay deposits. Pre-construction geotechnical investigations at the SMaRT Station revealed the following subsurface soil conditions (Wahler Associates, 1990):

- “Site consists of alluvial and bay deposits, overlain with 2½ to 10 feet of variable fill. The fill encountered in most of the borings and pits consisted predominantly of clayey gravel with some large to small concrete debris.”
- “Sludge material was mainly encountered in the north half of the site with the bottom of the sludge at about 7 feet from the surface. The sludge material varied in thickness from ½-foot to 4½-foot with increasing thickness to the west.”
- “The alluvial soils encountered are predominantly silty and sandy clays, interlayered with discontinuous silty sand and gravelly sand deposits. Generally the south portion of the site has 2½ to 8 feet of fill, increasing from west to east, overlying 63 to 69 feet of silty clay and sandy clay, and sand below a depth of 70 to 75 feet. The thick clay layer is interspersed with discontinuous sand layers 2½ to 4 feet thick. The north portion of the site has about 8 feet of fill overlying 22 to 24 feet of silty clay and sandy clay, 16 to 20 feet of silty sand, 30 to 32 feet of silty clay, and sandy clay and sand below a depth of 78 to 80 feet.” (Wahler Associates, 1990).

The Addendum Report (Wahler Associates, 1992) to the geotechnical investigation recommended removal of some of the existing fill and placement of additional engineered fill to raise the site elevation. Based on these recommendations and observations of the site, it is likely that engineered fill was placed before the SMaRT Station was constructed in 1993; however, the actual extent and characteristics of the site modifications are not known based on available reports.

2.1.4 Depth to Groundwater

Depth to groundwater information is based on groundwater monitoring conducted at the City of Sunnyvale landfill during two groundwater elevation monitoring events (September 2013 and March 2014) (Ulrick & Associates, 2014). The 2013-2014 wet season had below average rainfall, which might have influenced the observed groundwater levels.

Groundwater flow in the vicinity of the landfill is influenced by surface water ponds, channels, and ditches, and by underground sanitary sewer and storm drain conveyance. Groundwater elevation contour maps for 2013-2014 show a general flow pattern from east to west in the vicinity of the SMaRT Station. Groundwater elevations ranged from approximately -6.0 to -7.0 feet National Geodetic Vertical Datum (NGVD) during the September 2013 sampling event and -6.0 to -7.5 feet NGVD during the March 2014 sampling event. Based on groundwater elevations measured in the vicinity of the SMaRT Station, depth to water at the site likely ranges from 5 to 10 feet below ground surface.

Overall in the landfill area, groundwater elevations have risen by between 0.5 and 1 foot over the past twenty years. The increase in the water table elevation may be due to land subsidence, an increase in regional shallow groundwater levels, and/or sea level rise (Ulrick & Associates, 2014).

2.1.5 Existing BMPs

The Stormwater Pollution Prevention Plan (SWPPP) that covers the Concrete Recycling Plant, Recycle Yard, and SMaRT Station identifies the structural and non-structural BMPs in place at the SMaRT Station (Golder Associates, 2014). Primary non-structural and structural BMPs are summarized as follows; however, this list does not constitute the comprehensive list of BMPs described in the SWPPP:

- Good housekeeping in all outdoor areas associated with industrial activities and in the maintenance shop to minimize spills or leaks that could be tracked outdoors.
- Pre-rainy season annual inspections and clean out of storm drain inlets, catch basins, designated discharge points, and sediment control BMPs to remove any accumulated dust, sediment, or debris.
- Wet season weekly inspections, maintenance, and cleaning of storm drain inlets, catch basins and designated discharge points.
- Daily sweeping of accessible paved areas with a regenerative air sweeper and sweeping at least two times per day in the 24-hour period prior to a forecasted rain event.
- Designated personnel monitor weather forecasts and additional site control measures are implemented 24 hours prior to a forecasted rain event. These additional control measures include:
  - Additional uncovered accessible areas are swept by hand, vacuum, or cleaned using vacuum-assisted power washing.
  - Within twelve hours prior to a forecasted rain event, exposed materials including soil, concrete, electronic waste, and white goods are tarped or otherwise covered.
  - Linear sediment control BMPs (i.e. fiber rolls, rock filters, sand and gravel bag barriers, or gravel filter berms) are installed around the concrete storage area and if feasible, the concrete pile is tarped or otherwise covered when it is actively raining.
  - Two weighted wattles or sand and gravel bag barriers are installed around storm drain inlets to slow the flow of runoff and reduce the transport of sediment to existing storm drains.

2.1.6 Stormwater Runoff Quality

Table 2 summarizes stormwater runoff data collected at discharge locations SM-1, SM-2, and SM-3 for the past three wet seasons (2011/2012, 2012/2013, and 2013/2014) and data collected to date for the current wet season (2014/2015). Site-specific hardness data were used to calculate site-specific Target Levels/NALs for the hardness-dependent metals (copper, lead, and zinc). There have been no exceedances of Target Levels/NALs for total lead and pH. All of the other monitored constituents have exceeded Target Levels/NALs. Therefore, the constituents of concern for this Feasibility Study are:

- Total Suspended Solids (TSS)
- Chemical Oxygen Demand (COD)
- Metals (aluminum, copper, iron, and zinc)
- Oil and Grease

Table 3 compares total and dissolved metals data from the October 31, 2014 sampling event. Based on the limited monitoring data, copper is the most soluble metal in the site's stormwater runoff with approximately 35 percent to 58 percent of copper present in the dissolved form. Zinc is the next most soluble metal, with approximately 16 percent to 21 percent present in the dissolved form. Aluminum, iron, and lead are primarily associated with particulates. These data inform the stormwater treatment feasibility analysis.

Table 4 provides a summary of stormwater runoff data collected from certain roof downspouts (DS-A, DS-B, DS-C, and DS-D), which are shown on Figure 3. These data were collected in February 2014. Based on these limited data (one or two sampling events), only COD and TSS concentrations at the Downspout A location exceeded the Target Levels/NALs.

Table 2: Summary of IGP Stormwater Monitoring Data for SMaRT Station (Wet Season 2011/2012 through 2014/2015)

Wet Season	Avg Hardness[a] (mg/L)	Sampling Location	Sample Count	Average Value (mg/L)								
				Al	COD	Cu[b]	Fe	O&G	Pb[b]	TSS	Zn[b]	pH
Benchmark Value				--	--	--	*1.0*	*15*	--	*100*	--	--
2011-2012	--	SM-1	1	--	--	--	1.1	<5.3	--	592	--	7.1
		SM-2	1	--	--	--	11.2	<8.3	--	4,920	--	6.7
		SM-3	1	--	--	--	0.5	<5.3	--	1,820	--	6.2
Benchmark Value				--	--	--	*1.0*	*15*	--	--	--	--
2012-2013	--	SM-1	1	--	--	--	0.5	<5.6	--	720	--	7.2
		SM-2	0	--	--	--	--	--	--	--	--	
		SM-3	1	--	--	--	2.5	<5.6	--	436	--	7.4
Benchmark Value				*0.75*	*120*	*0.0332*	*1.0*	*15*	*0.262*	*100*	*0.26*	--
2013-2014	321	SM-1	4	2.28	570	0.047	5.8	10.1	0.017	159	0.38	7.4
		SM-2	4	3.50	555	0.041	6.3	8.1	0.021	298	0.25	7.7
		SM-3	4	3.58	654	0.080	8.5	17.0	0.029	333	0.38	7.3
Benchmark Value				*0.75*	*120*	*0.0332*	*1.0*	*15*	*0.262*	*100*	*0.26*	--
2014-2015	490	SM-1	2	3.09	1,950	0.058	6.1	26.8	0.021	365	0.35	7.0
		SM-2	2	5.40	960	0.088	10.8	16.6	0.036	350	0.41	6.6
		SM-3	2	6.95	2,850	0.340	16.5	28.9	0.081	775	1.33	6.7

NOTES:

a. Measured at Stormwater Pump Station No. 1.

b. Benchmark values were determined based on the SMaRT hardness concentration (the average concentration for each wet season was used), per the 2008 MSGP Appendix J (Calculating Hardness in Receiving Waters for Hardness Dependent Metals).

c. Colored cell indicates exceedance of benchmark (Target Level/NAL).

Table 3: Comparison of Total and Dissolved Metals Fraction for October 31, 2014 Sampling Event

Metals (mg/L)	SM-1	SM-2	SM-3
Aluminum, total	5.2	9.6	12.0
Aluminum, dissolved	0.035	0.100	0.140
% dissolved fraction	*0.7%*	*1.0%*	*1.2%*
Copper, total	0.076	0.083	0.390
Copper, dissolved	0.044	0.029	0.200
% dissolved fraction	*57.9%*	*34.9%*	*51.3%*
Iron, total	10	19	27
Iron, dissolved	0.64	0.27	2.30
% dissolved fraction	*6.4%*	*1.4%*	*8.5%*
Lead, total	0.038	0.057	0.140
Lead, dissolved	0.002	0.001	0.004
% dissolved fraction	*5.3%*	*1.9%*	*2.9%*
Zinc, total	0.42	0.50	2.00
Zinc, dissolved	0.089	0.080	0.350
% dissolved fraction	*21.2%*	*16.0%*	*17.5%*

Table 4: Summary of Roof Downspout Data

Sample Location	No. Samples	Al (mg/L)	COD (mg/L)	Cu (mg/L)	Fe (mg/L)	O&G (mg/L)	Pb (mg/L)	TSS (mg/L)	Zn (mg/L)
Benchmark Value		*0.75*	*120*	*0.0332*	*1.0*	*15*	*0.262*	*100*	*0.26*
Downspout A	1	0.66	270	0.0240	1	4.9	0.011	200	0.11
Downspout B	1	0.14	8.4	0.0018	0.16	4.8	0.002	8	0.03
Downspout C	1	0.077	8.7	0.0029	0.09	4.8	0.001	6	0.09
Downspout D[a]	2	0.175	38.5	0.0049	0.58	3.3	0.004	26.5	0.16

NOTES:

a. Results are the average of two sampling events.
b. Colored cell indicates exceedance of benchmark (Target Level/NAL).

3. BMP DESCRIPTIONS

3.1 Flow Segregation

Segregation of runoff from non-industrial areas and building roof runoff is a potential structural BMP that would allow for stormwater with concentrations below Target Levels/NALs to be separated from runoff containing higher concentrations of pollutants of concern from the facility's industrial areas, thus reducing the size of the diversion structures or treatment BMPs considered in this report.

3.1.1 Non-Industrial Areas

Areas of industrial activity subject to the IGP include all industrial storage areas and storage tanks, shipping and receiving areas, fueling areas, vehicle and equipment storage/maintenance areas, material handling and processing areas, waste treatment and disposal areas, dust or particulate generating areas, cleaning and material reuse areas, and other areas of industrial activity that may generate potential pollutant sources. The employee parking lot and administrative building roof are not subject to the IGP as the facility does not conduct industrial activities in these areas. Therefore, the runoff from these areas could be separated and diverted directly to the stormwater outfalls.

In order to separate these flows, the drainage areas upgradient of the parking lot (drainage areas C, D, E, and F on Figure 3) would be diverted through a new pipe around drainage areas A and B, as illustrated on Figures 11 and 12. Note that the north portion of the administrative office building flows to the north into drainage area H and ultimately to SM-2. The option to re-plumb this area to flow to the south will be investigated as part of the final design process.

3.1.2 Roof Runoff

The roof runoff monitoring data summarized in Table 4 above shows that the roof runoff in drainage areas C, D, E, F, and G shown on Figure 3 has relatively low pollutant levels; the data are generally an order of magnitude below the Target Levels/NALs. Therefore, the runoff from these roof areas could be separated from the remaining ground level area within each drainage area and diverted directly to the stormwater outfalls, similarly to the non-industrial areas. The roof runoff in drainage area H on Figure 3 shows elevated levels of contaminants, likely due to wood debris dust from the adjacent yard trimmings and wood waste processing area (Area #3 on Figure 2), thus this roof area has not been considered for segregation.

In order to segregate these roof areas, the roof drains would be connected to new below-ground storm drains that would flow to the outfalls at SM-1 and SM-3 (see Figures 11 and 12).

3.2 Roofing

Construction of structures providing overhead cover (i.e., roofing) would prevent stormwater from coming into contact with exposed materials and industrial activities that could be sources of pollutants. A primary feasibility consideration for roofing is related to site operations, as heavy equipment must be able to maneuver and sort materials around the site. Considerations must be made for both horizontal (e.g., truck turning and backing) and vertical (e.g., forklift reach and storage bin lift) movement of equipment. This section discusses the feasibility of roofing prioritized uncovered areas of the facility and summarizes key regulatory and permitting requirements for implementing this structural BMP.

The type of roofing structure evaluated is a pre-engineered steel building with no side walls (see Figure 4). Pre-engineered metal buildings are customizable structures designed to site specifications and to meet building codes by the product vendor. The product is designed and delivered by the vendor and assembled on-site by the buyer’s contractor. Steel buildings have a long lifespan and require minimal maintenance.

3.2.1 Summary of Areas Evaluated

Locations considered for roofing include areas where significant amounts of materials could be exposed to stormwater. These areas, shown on Figure 5, include:

- Processed yard trimmings and wood storage and loading area (Area R1);
- Overflow storage of baled recyclable materials (Area R2 and Area R5);
- Storage of recyclable materials in bins (Area R3 and Area R7);
- Compost stored outside for public pick-up (Area R4); and
- Storage of soil, concrete and brick materials (Area R6).

Roofing is not feasible in areas R1, R2, R3, R5, and R7 due to operational and safety constraints including:

- Material in these areas is handled with large heavy equipment including front end loaders, large forklifts, and debris box trucks.
- Installation of roofing would limit the ability of this equipment to maneuver properly.
- The potential for impacting the roof support structures would be high, resulting in a significant health and safety risk.

Activities in areas R4 and R6 include drop off of soil, concrete, and brick and pick up of compost by the public. In these areas, use of heavy equipment is limited. In area R4, structures with shorter roof heights (20 feet) could be constructed, while area R6 would require a 30-foot roof. Roofing in these areas would reduce contact of stormwater with stored materials.

3.2.2 Regulatory and Permitting Requirements

A roof-only structure would be treated like a new building by the City of Sunnyvale Building and Planning Divisions, requiring permitting and plan check, and would be subject to all current codes.

Current applicable codes in the City of Sunnyvale include:

- 2013 California Building Code,
- 2013 California Mechanical Code,
- 2013 California Electrical Code,
- 2013 California Green Building Code (CalGreen),
- 2013 California Fire Code (with local amendments),
- 2012 International Property Maintenance Code,
- 2008 State of California Title 24 Energy Regulations, and
- Sunnyvale Municipal Code (including local amendments to the above adopted codes and local green building requirements).

Local amendments that may apply to the type of structure being considered include:

- Roof coverings are required to be fire-retardant of at least Class B.
- Installation of automatic sprinkler systems is required for buildings and structures greater than 1,000 square feet.
- Leadership in Energy and Environmental Design (LEED) Silver Level with verification by a LEED Accredited Professional (AP) is required for new construction between 5,000 and 100,000 square feet (beginning January 1, 2015).
- LEED Gold Level with verification by a LEED AP is required for new construction greater than 100,000 square feet (beginning January 1, 2015).

Additionally, ADA compliance may be required depending on the location of the structure.

A roof-only structure would require a "Miscellaneous Plan Permit" planning application to be submitted to the City. This type of permit requires staff level review. Submittal requirements include a project description, site plans, parking and circulation plans, roof plans, architectural elevations, building height, and all project data. Typical processing time is three to four weeks depending on the project and application, and revisions or resubmittals may be required. After the application is processed, the building permit application is filed. Structural, building, fire prevention, and planning must all sign off on the building permit.

3.2.3 Additional Information Required

Geotechnical evaluation of the foundation for adequacy would be required prior to design and installation of a pre-engineered building.

3.3 Diversion

The Settlement Agreement requires the Feasibility Study to provide a preliminary analysis of diverting stormwater runoff from the SMaRT Station to the City of Sunnyvale's WPCP and treatment of industrial stormwater prior to discharge to the City's WPCP. Key factors that must be examined to determine if such diversion is feasible include the physical infrastructure requirements for diversion and WPCP regulatory, policy, and capacity constraints. Those factors and additional information that would need to be collected for implementation are discussed below.

3.3.1 WPCP Regulatory Policy and Operational Constraints

Initial discussions with City of Sunnyvale Environmental Services Department WPCP staff indicate they are generally open to diverting SMaRT Station stormwater to the WPCP, subject to certain conditions. The stormwater diversion flow would be viewed as an industrial discharge even though it would consist of stormwater instead of industrial process wastewater. The diversion will, therefore, require permitting under the City's Pretreatment Program and compliance with Pretreatment Program requirements. The SMaRT Station is currently permitted by the Pretreatment Program as a Local Significant Industrial User (SIU) with a zero discharge. A change in status from zero discharge to allowing a discharge will require that the discharged water be characterized in the usual manner and that any discharge meet the City's local limits for industrial discharges. Consistent with current City policies to minimize inflow and infiltration to the sewer system and treatment plant, and to minimize potential impacts on the plant, the WPCP also seeks assurances that diversion flows will be minimized by excluding "unpolluted" stormwater runoff from the site, such as the segregation of flows previously discussed.

Pollutant concentrations are characterized to assess likely compliance with the City's local limits for wastewater discharges and also to assess the potential need for pretreatment prior to discharge. This is discussed further in the Pretreatment Program Requirements section below.

3.3.2 Flow Calculations

Section 3.1 above describes excluding runoff from the employee parking lot and relatively uncontaminated roof runoff in the outfall SM-1 and SM-3 drainage areas for diversion to the WPCP. This flow segregation would allow for only diverting the stormwater runoff from the industrial process areas (outside process and storage areas).

Estimates for the amount of runoff that would be diverted from these industrial process areas are based on the design storm standards for treatment control BMPs in the revised IGP (effective July 1, 2015). The new IGP design storm standards require capture and treatment of the volume of runoff produced from an 85th percentile, 24-hour storm event, as determined from local, historical rainfall records, or the maximum flow rate of runoff produced from a rainfall intensity of at least 0.2 inches per hour for each hour of a storm event (see Section 3.4.1 for further detail). The proposed diversion structures would provide for runoff flows that exceed the design condition to flow to the existing outfalls. However, since peak rainfall intensities are typically not achieved at the beginning of a rainfall event, the diversions to the WPCP would include “first flush” flows from the designated areas.

The 85th percentile, 24-hour storm event, for the SMaRT Station was determined using the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP) C3 Rainfall Map (SCVURPPP, 2012). The 85th percentile intensity for the site was determined to be 0.09 inches per hour (in/hr), which results in a design flow rate of 0.18 in/hr. This value is slightly lower than the generic alternative design storm intensity of 0.2 in/hr allowed in the IGP. Based on a storm intensity of 0.18 in/hr, the following design flow rates were calculated for each of the SMaRT Station outfall drainage areas.

Table 5: Projected Maximum Hourly Diversion Flow Rates

Drainage Area	Peak Hourly Flow for 0.18 in/hr Design Storm	
	gpm	**mgd (rate)**
SM-1 (excluding roof drains and employee parking area)	197	0.28
SM-2 (includes all paved areas and roof drains from NW roof area.)	102	0.15
SM-3 (excluding roof drains)	67	0.10
Entire Site (industrial process only)	366	0.53

The above table presents the flow rate to the WPCP only during those hours when the rainfall intensity is at or above 0.18 in/hr and does not represent the flow rate to the WPCP over the course of a day. Daily average flows during wet weather events would be significantly less, as described below.

Forty years of hourly rainfall data from the National Climatic Data Center precipitation database for San Jose were analyzed in order to assess the expected frequency of maximum flow events and the expected mean and maximum flows expressed in terms of daily totals. Figure 6 presents a histogram showing annualized frequencies of hourly stormwater runoff rates from an area corresponding to the proposed diversion area (i.e., with the flow segregation described in Section 3.1). Only hours during which rainfall occurred are included in the chart. Out of the 293 hours per year of rainfall on average, the projected runoff flow is less than or equal to 100 gpm (0.12 mgd rate) 77 percent of the time (225 hours per year). The maximum design flow of 366 gpm (0.53 mgd rate) occurs approximately seven hours per year.

The same data set was used to estimate the total daily flow for days when maximum hourly diversion rates would occur. The average daily flow for these days was 0.062 mgd. The maximum flow (based on the 40 years of rainfall data) was 0.28 mgd. Finally, the estimated average total annual flow to the WPCP, based on the historic data, would be 1.35 million gallons per year.

3.3.3 Grading and Infrastructure Requirements

Initial calculations indicated that the SMaRT Station's existing 8-inch sanitary sewer lacks the capacity to convey the maximum flows that would be generated by the diversion alternative. For this reason, the alternative has focused on construction of a separate pipeline to convey flows to the WPCP.

Site infrastructure requirements for diversion, illustrated in Figure 11, would include construction of a new diversion line around the north edge of the facility that would tie into a new diversion line that collects the drainage from the pavement areas on the south side of the facility and directs these flows to the WPCP along Carl Road. Several of the existing storm drain lines and inlets would be incorporated into the collection system along with new bypass structures for flows that exceed the design capacity of the treatment or diversion alternatives and junction boxes at key locations.

For conveying the diverted flow, both within the SMaRT Station site and to the WPCP, a gravity flow system is preferable on the basis of its simplicity and minimizing O&M requirements. A pressurized (force main) conveyance system would offer some advantages, but would be inherently more complex and would require a higher level of maintenance than a gravity system. For gravity flow, a 10-inch sewer main would be required to convey the maximum flow to the WPCP. Preliminary discussions with the designers of the new WPCP headworks and primary treatment facilities to be constructed in the area immediately west of the SMaRT Station suggest that it would be very difficult to locate a gravity sewer within the WPCP boundary, and thus (by default) the line would need to be located in Carl Road. A force main could more easily be routed around the new structures and other utilities, and thus could likely be accommodated within the boundary of the WPCP, immediately north of Carl Road. This trade-off will need to be evaluated as part of a more detailed engineering design effort. Another possible conveyance option would be to utilize an abandoned 39-inch sewer main that passes near the southwest corner of the SMaRT Station and terminates near the entrance to the WPCP. That line runs just north of the storm drainage ditch along Carl Road, within the WPCP boundary and beneath the proposed new facilities. The most likely scenario involving this line would be to utilize it as a pipe “chase”, so as to minimize the impact of construction in Carl Road. The current condition of the 39-inch line is unknown and its integrity could be compromised by construction of the new WPCP facilities in that area.

Near the entrance to the WPCP, the diversion line would tie into the existing system of manholes or would be brought into the new plant headworks/pumping structure. Because the new diversion line, as currently envisioned, would be completely independent of the existing sanitary sewer at the SMaRT Station, there is essentially no potential for the diversion flow to impact flows in the SMaRT Station’s sanitary sewer line.

Because the design of the WPCP’s new facilities is well underway, with completion of the 30% design scheduled for the end of January 2015, it will be critical to coordinate closely with the Public Works Department and their design consultants if potential synergies with that design effort are envisioned.

A system for tracking diversion flows will be needed to meet Pretreatment Permit requirements, which are discussed in greater detail in the following section. Flow measurement methods suitable for use in gravity flow systems require relatively high levels of maintenance and suffer from poor accuracy when the variations in flow are large, as would be the case for a stormwater diversion from the SMaRT Station. For this reason, a surrogate method for calculating flows based on rainfall data from a weather station installed at the site would be preferable for a gravity flow system. This approach would be somewhat analogous to the Pretreatment Program’s use of water billing records as a surrogate for effluent flow monitoring at industrial discharger facilities. For a force main system, conventional flow metering, or calculations based on pump run time, could be used.

3.3.4 Pretreatment Requirements

As stated previously, a change in Pretreatment Program SIU status from zero discharge to allow a discharge will require that the discharge be characterized in order to assess likely compliance with the City’s local limits for wastewater discharges and also to assess the potential need for pretreatment prior to discharge. The City’s local limits include maximum allowable concentrations for metals; pH; fats, oils, and grease (FOG); phenols; cresols; chlorinated hydrocarbons; and total toxic organics (see Table 6). Wastewater discharge compliance monitoring is typically conducted only for the constituents of concern for the specific industry served; for the SMaRT Station, these constituents would likely include pH, metals, and FOG. However, during the permit application process (or Baseline Monitoring Report), the City may require a larger set of parameters be sampled to demonstrate they are unlikely to be present in the discharge. Routinely, Pretreatment Program Inspectors require new facilities to sample four times for volatile organic compounds (EPA 624), cyanide, oil and grease, phenols, pH, and sulfide. This is consistent with 40 CFR 403.12(g)(4), Baseline Monitoring Report (BMR) requirements, which also allows the Pretreatment Program staff to lower the minimum BMR sampling requirements for facilities with available historical sampling data.

Table 6: City of Sunnyvale Local Limits for Wastewater [a]

Pollutant	Maximum Concentration (Grab Sample) mg/L	Maximum Concentration (Composite Sample) mg/L
Copper	0.7	0.5
Nickel	0.5	0.25

Pollutant	Maximum Concentration Allowable[a,b] mg/L
Antimony	1
Arsenic	0.3
Barium	1
Beryllium	0.5
Cadmium	0.1
Chlorinated hydrocarbons used for control of plants, insects, etc.	0.02
Chromium, total	1.7
Cobalt	1
Cresols	2
Cyanides	0.5
Lead	0.5
Mercury	0.01
Fats, oils and grease (total)	300
pH	6.0 to 10.5 standard units
Phenols[c]	1
Selenium	1
Silver	0.2

Pollutant	Maximum Concentration Allowable[a,b] mg/L
Total toxic organics[d]	1
Zinc	1.48

Notes:
a. Local Limits from Sunnyvale Municipal Code Section 12.12.120.
b. Applicable to samples collected as either grab or composite. All concentrations for metallic substances are for total metal.
c. Phenols defined by test procedures in 40 CFR 136.
d. Total toxic organics, as defined under 40 CFR Part 413.02(i), but excluding phenolic compounds.

There were six stormwater sampling events in 2014 (representing rainy seasons 2013/2014 and 2014/2015)[4] at the SMaRT Station sampling locations SM-1, SM-2 and SM-3[5] that have been summarized for this report (Table 7). These data reflect the facility's present runoff quality after the source control BMP requirements in the Settlement Agreement were implemented. There are sampling results for several parameters that have local limits: copper, lead, zinc, oil and grease, and pH. The concentrations of these constituents were all well below the City's local limits (see Table 7), except for zinc. However, these sample results include runoff from areas that would be excluded from the diversion alternative (i.e., employee parking lot in the SM-1 drainage area and roof drains in SM-1 and SM-3 drainage area). These "non-process" areas are being excluded from the diversion infrastructure because they are deemed to contribute only minimally (if at all) to the SMaRT Station industrial stormwater pollutant loadings. To account for the fact that roof runoff will be excluded in the final design, the maximum concentration values in Table 7 were adjusted by assuming that the roof runoff and employee parking area have contributed flow but no pollutants to the historic sample results. Thus, for the estimated maximum concentrations listed in Table 7, the same pollutant loadings are concentrated in a smaller volume of water, resulting in higher pollutant concentrations. This approach is conservative because even if the roof runoff has not contributed significant pollutant loadings, that runoff currently passes through the industrial process areas, potentially mobilizing more pollutants from those areas than would otherwise be the case. Using this conservative approach, the estimated maximum concentrations from the proposed diversion areas were all below the City's local limits, except for copper and zinc at SM-3.

[4] Four storm events were monitored in February 2014 and two events were monitored in October 2014.

[5] The sample results available from the previous 2 years (2012 and 2013) demonstrated compliance with the City's Local Limits.

Table 7: 2014 Routine Stormwater Sampling Results

Pollutant	Sample Results Maximum Concentration (mg/L)			Estimated Maximum Concentration from Proposed Diversion Area[a]				Local Limits (mg/L)
	SM-1	SM-2	SM-3	SM-1	SM-2	SM-3	Combined Flow[b]	
Aluminum	5.2	9.6	12	10	10	22	12.5	
COD	2,800	1,200	4,400	5,523	1,272	8,201	4,832	
Copper	0.097	0.092	0.39	0.19	0.10	0.73	0.26	0.7
Iron	10	19	27	20	20	50	26	
Oil and Grease	32.2	28.5	40.6	64	30	76	57	300
Lead	0.038	0.057	0.14	0.07	0.06	0.26	0.11	0.5
pH	7.74	8.44	7.9					6.0 – 10.5
Specific Conductivity	1,106	912	1,963	2,182	967	3,659	2,115	
TSS	700	570	1,440	1,381	604	2,684	1,404	
Zinc	0.48	0.5	2	0.95	0.5	3.7	1.3	1.48

Notes:

a. Estimated maximum concentration of proposed diversion area = sample concentration x total area/ diversion area.

- SM-1 total area = 4.76 acres; SM-1 diversion area = 2.41 acres
- SM-2 total area = 1.32 acres; SM-2 diversion area = 1.32 acres
- SM-3 total area = 1.54 acres; SM-3 diversion area = 0.82 acres

b. This represents the estimated maximum concentration from the combined flow of all three locations. The concentrations of all three proposed diversion areas were flow weighted and combined.

c. The stormwater grab sample results are compared to the Local Limit for copper grab samples. There is also a Local Limit for copper composite samples which is lower.

The maximum estimated copper concentration from the proposed SM-3 diversion area was slightly above the Local Limit value. The maximum estimated zinc concentration of the proposed SM-3 diversion area was above the Local Limit value. These values are the maximum concentrations from the sample events. The other copper values at SM-3 ranged from 0.095 – 0.29 mg/L and the other zinc values ranged from 0.36 – 0.66 mg/L. The other values in the data sets are much lower, and values at the other sampling locations are also much lower. When the diverted flows from all three locations are combined, before discharging to the WPCP, it is anticipated the samples from this combined flow would be lower than the conservative values presented in Table 7. For example, if the estimated maximum concentrations of all three proposed diversion areas (already conservative values as described above) were flow weighted and combined the single estimated maximum concentration of the site would be 0.26 mg/L for copper and 1.3 mg/L for zinc, both below the City's Local Limits.

In addition to the routine stormwater sampling discussed above, additional sampling was conducted at sampling location SM-3 on February 28, 2014. The stormwater samples were analyzed for EPA 624 (volatile organics), EPA 625 (semi-volatile organics), phenols (EPA 420.1), pesticides (EPA 608), PCBs (EPA 608), cyanide, and metals. Additional sampling was conducted for metals at all the sampling locations on October 31, 2014. The additional sample results, not already presented in Table 7 above, are in Table 8 below. All results were well below the City's Local Limits, even when adjusted using the conservative approach discussed above. Because data were not available for all constituents at all locations, the results presented in Table 8 were not combined to represent a single composite of the expected diversion flow as they were in Table 7 under "combined flow".

Table 8: 2014 Additional Sample Results

Parameter	10/31/14 Sample Results (mg/L)			2/28/14 Sample Results (mg/L)	Estimated Concentration of Proposed Diversion Areas (mg/L)				Local Limits (mg/L)
	SM-1	SM-2	SM-3	SM-3	SM-1	SM-2	SM-3 10/31	SM-3 2/28	
Antimony				0.0011				0.0021	1
Arsenic	0.0034	0.0073	0.012	0.0022	0.007	0.008	0.022	0.0041	0.3
Barium				0.046				0.088	1
Beryllium				<0.0014				<0.0026	0.5
Cadmium	0.00091	0.00098	0.0039	<0.00044	0.002	0.001	0.007	<0.0008	0.1
Chromium	0.025	0.037	0.066	0.0069	0.049	0.039	0.123	0.013	1.7
Cobalt				0.0015				0.0028	1
Cyanides	0.03	0.008	0.01	<0.01	0.059	0.008	0.019	<0.019	0.5
Mercury	<0.0002	<0.0002	<0.0002	J 0.000035	<0.0004	<0.0002	<0.0004	J 0.0001	0.01
Nickel	0.04	0.059	0.16	0.0086	0.079	0.063	0.298	0.016	0.5
Phenols				<0.05				<0.093	1
Selenium	0.00069	0.00042	0.002	J 0.00063	0.0014	0.0004	0.004	J 0.0012	1
Silver	0.00026	0.00032	0.00027	<0.0001	0.0005	0.0003	0.001	<0.0002	0.2
Total toxic organics[a]				0				0	1

Notes:
a. All EPA 624 results were ND with MDLs 0.1 – 0.2 µg/L. All EPA 625 results were ND with MDLs 0.68 – 2.6 µg/L. All EPA 608 results were ND except for aldrin (J 0.02 µg/L). There were no quantifiable values greater than 0.01 mg/L (10 µg/L).

The actual BMR monitoring would occur at the time of discharge (after construction). During that time an interim discharge permit is issued by the Pretreatment Program. The final discharge permit is contingent on the BMR sampling results and a demonstration the discharge can meet the Local Limits. The current sampling at the SMaRT Station is considered predictive and meant to inform possible future treatment requirements or potential compliance issues for the diversion alternative feasibility evaluation. At this time, the diversion of stormwater runoff is not anticipated to require additional pretreatment beyond the current BMPs in place at the site. Even though there were single copper and zinc results at one location above the local limits, the final combined diversion flow from industrial areas only is anticipated to be below the Local Limits.

The SMaRT Station diversion permitted by the WPCP Pretreatment Program would be subject to enforcement in accordance with the City's Enforcement Response Plan for any violation of a local limit or other Industrial User permit requirements.

Another consideration for discharge to the WPCP is the potential for slug pollutant loads and their impact on WPCP processes. Nothing in the available SMaRT Station monitoring data suggests a significant problem in that area. Considerable variability in diversion pollutant concentrations can be expected, and diversions that capture "first flush" runoff can be expected to exhibit higher concentrations. The WPCP's current secondary treatment process (oxidation ponds) is highly resistant to slug loads because of dilution provided by the normal plant influent flow and the very high volume of water contained in the ponds. However, the WPCP's future activated sludge system will be significantly more vulnerable to slug loads. Numeric thresholds values for inhibition of activated sludge and nitrification can be found in Appendix G of the EPA's Local Limits Development Guidance Manual. If representative of overall WPCP influent, some of the values listed in Table 7 (copper, zinc) would be of concern relative to inhibition of nitrification. However, current levels of copper and zinc in the WPCP influent are not elevated, and the normal plant influent flow will readily dilute these concentrations to levels well below inhibition thresholds. In general, the local limits provide protection against pollutant levels that would result in process inhibition.

A more likely scenario for slug loads in diverted stormwater would result from a spill or other release that reached the storm drainage system. By design, spills within the SMaRT Station building would be contained by the station's internal drainage system and would not reach storm drains. Spills originating outside the building do not have this inherent protection. Concerns about slug loads could be addressed through requirements in the Industrial User Permit by a Slug Load Evaluation, and if necessary based on the findings of that evaluation, a Slug Discharge Plan, prepared in accordance with 40 CFR 403.8(f)(2)(vi). The permit can also reference requirements of other agencies, such as the Hazardous Materials Business Plan. As an added precaution, the final diversion structure could be required to include a valve to prevent flow into the diversion line that leads to the WPCP. As for all industrial discharges, the WPCP reserves the right to prohibit discharges that could damage the treatment plant or cause an upset to its processes.

The available data indicated that concentrations of total suspended solids (TSS) and chemical oxygen demand (COD) would be higher than levels typically observed in wastewater influent. The City's wastewater fee schedules account for wastewater strength. Based on the industrial rate schedule, the estimated annual discharge fee would be $17,050/yr (1.35 mgal/yr at $6,314/mgal + $1,618/1,000 lb TOC discharged, assuming TOC = COD/3 = 590 mg/L). The commercial schedule for high strength wastewater would yield charges of approximately $11,200 per year. The estimated sewer connection fee would be approximately $108,000 if standard industrial connection rates were applied. However, because the new line will be constructed by the City and will not utilize capacity of the existing sewers, a lower fee might apply in this case.

3.3.5 Coordination and Monitoring Requirements

The proposed infrastructure for diverting to the WPCP includes a monitoring location for Pretreatment Program sampling that is representative of the discharge to the WPCP (see Figure 11). In addition to a monitoring location for sample collection, the SMaRT Station would be required to report flows to the Pretreatment Program. Flow monitoring is discussed in the above section describing infrastructure requirements.

If the diversion alternative is selected, the SMaRT Station would still be subject to the IGP requirements, including sampling stormwater runoff from industrial areas that discharge to the storm drain system. In addition to providing a suitable location for sampling of the combined diversion flow, the design of the new diversion infrastructure should include provisions for collecting representative samples of industrial process flows that are discharged through the existing stormwater outfalls, which may represent roof runoff and flows greater than the design event for diverted stormwater.

3.3.6 Additional Information Required

As mentioned above, the SMaRT Station should conduct additional predictive sampling to provide confidence that the diverted stormwater BMR monitoring results would meet the Pretreatment Program requirements. Currently not all of the stormwater sampling locations represent the discharge that will be diverted to the WPCP. Sampling location SM-1 includes the employee parking lot and roof drains. If it is possible to sample for the BMR constituents at a storm drain inlet upstream in the storm system, such a sample would still include the roof area but would remove the employee parking lot from the sample area, and would thus be more representative. Additionally, in the diversion alternative, all of the stormwater runoff from the industrial process area will be combined before discharge to the WPCP. To reduce the costs of sampling, it may be acceptable to composite the samples from the three sampling locations before analyzing for the BMR parameters. There should be discussions with the Pretreatment Program staff before conducting any further predictive BMR sampling to inform how to best characterize the stormwater runoff that would be diverted to the WPCP with the current site conditions and storm drain system. The costs for analyzing four sampling events for all of the required BMR parameters will depend on the number of sampling locations, and may range from $4,800 to $14,500.

3.4 Stormwater Treatment

Stormwater treatment BMPs include a wide variety of configurations and components designed to provide various treatment processes such as sedimentation, skimming, straining, filtration, sorption, and disinfection. The treatability of particular stormwater pollutants by a specific BMP is directly related to the unit processes utilized by the BMP, as well as the BMP sizing relative to inflows. For example, sediment (TSS) and particulate-bound pollutants (such as particulate-bound metals) may be removed by sedimentation or filtration, but dissolved constituents (such as dissolved metals and COD) may require adsorptive filtration or some type of biochemical process to be effectively removed. Based on the limited data collected at the site from the October 31, 2014 sampling event (see Table 3), copper and zinc are the metals with the highest fraction present in the dissolved form. Aluminum, iron, and lead are primarily associated with particulates.

Experience with industrial stormwater projects indicates that the dominant factors influencing control measure selection and design are site constraints including land availability and cost. Based on SMaRT Station drainage areas and site operations, there does not appear be sufficient above ground area available to construct treatment BMPs in the appropriate locations. Below-ground treatment facilities may be feasible to install; however, constructing and maintaining a below-ground system is more challenging than an above-ground system. Moreover, installing below-ground facilities at the site requires consideration of the shallow depth to groundwater.

3.4.1 IGP Requirements for Treatment Control BMPs

The design storm standards for treatment control BMPs included in the revised IGP require volume-based BMPs (e.g., bioretention areas) to be sized to treat the volume of runoff produced from an 85th percentile, 24-hour storm event or to capture 80 percent or more of the average annual runoff volume. The corresponding rainfall depth to achieve 80 percent capture is about 0.4 inches.[6] As a rule of thumb, bioretention areas sized to four percent of the tributary drainage area would meet this sizing requirement, which would require approximately 0.36 acres of treatment area. Based on available space and facility operations, use of volume-based BMPs is generally not considered feasible given the area requirements and site constraints.

Flow-based BMPs (such as most manufactured devices) should be sized to capture and treat runoff from the 85th percentile 24-hour event or the maximum flow rate of runoff produced from a rainfall intensity of at least 0.2 inches per hour for each hour of a storm event. The candidate

[6] Value was derived by selecting the curve for a site runoff coefficient of 0.75 for a BMP with a 48-hr drawdown time for surface ponding using the unit basin storage volume curve for San Jose in the CASQA New Development and Redevelopment Handbook.

treatment BMPs described below in Section 3.4.3 are flow-based BMPs. BMP treatment costs provided in Section 4 are based on sizing the treatment units to meet flow-based BMP requirements of 0.2 inches per hour.

3.4.2 Site Constraints

The SMaRT Station is an active industrial site, which presents some constraints for constructing above-grade treatment BMPs. Trucks delivering and picking up materials from the site utilize the driveway around the site perimeter, which is adjacent to the most downstream storm drain inlet for each of the stormwater outfalls. The exit from the site (Area J, Figure 3) is approximately 30 feet wide and is bounded to the east by the site's utility corridor, which precludes installation of above-grade treatment BMPs at the inlet to SM-1. The aboveground area is not as constrained further upstream from SM-1, at the storm drain inlet in Area C (Figure 3). Area H (Figure 3) contains the green waste outdoor storage and loading activities, as well as a depressed loading dock, which constrains the available above-grade surface area available for treatment BMPs at the inlet to SM-2. The non-roof portion of Area G (Figure 3) contains recycled materials storage trailers and overflow baled materials. Above-grade space can be made available at the inlet of SM-3 for treatment BMPs without adversely impacting industrial activities and the driveway.

Below-grade site constraints include alignment of the existing storm drain system, locations of other below ground utilities, and shallow depth to groundwater. Figure 3 shows the existing storm drain and sanitary sewer systems for the site, and shows the constraints of where underground treatment measures can feasibly tie into the existing system. The vegetated median between Areas A and J (Figure 3) is located above the site's main utility corridor; therefore, disturbance of that area should be limited. Depth to groundwater at the site is estimated to range from 5 to 10 feet below ground surface, which would not preclude the use of below-grade treatment BMPs, but would require additional measures to mitigate the potential effects of buoyancy and prevent interaction with the groundwater table. Specific measures to counteract buoyancy forces are further discussed in Section 4.

3.4.3 Candidate Treatment BMPs

Four flow-based manufactured treatment BMPs have been evaluated: StormFilter®, StormwaterRx Aquip®, Modular Wetland Linear, and downspout filters. Each BMP is discussed in more detail in the following sections.

StormFilter®

StormFilter® is a passive, flow-through, modular stormwater filtration system manufactured by Contech (Figure 7). The system consists of rechargeable media cartridges designed to trap particulates and sorb dissolved metals, hydrocarbons, and nutrients. Various configurations and filter media are available based on the site conditions and pollutants of concern. The system is typically housed in one or more precast concrete vaults or manholes. Stormwater is directed through an energy dissipater after entering the system, percolates horizontally through the media housed in the filter cartridges, and is collected in an outlet sump.

StormFilter® cartridges are available in three different heights. The tallest (27 inch) filter can treat up to 22.5 gallons per minute (gpm) but requires 3.05 feet of driving head. The 18-inch filter requires 2.3 feet of driving head and can treat 15 gpm. A low drop cartridge is also available that only requires 1.8 feet of driving head but has a maximum treatment capacity of 10 gpm. Each drainage area should be able to support the unit that requires 3.05 feet of driving head. Given the cartridge heights and hydraulic drop requirements, it is unlikely that the StormFilter® installation would encroach on the groundwater table (located at 5-10 feet bgs). However, the treatment system can be designed to account for buoyancy effects associated with shallow groundwater, if encountered, as discussed further in Section 4.2.2. Depending on the filter height selected, the number of cartridges required for each drainage area ranges from three (SM-3) to eight (SM-1) for the 27 inch filter, four to twelve cartridges for the 18 inch filter and six to eighteen cartridges for the low drop filter. Pumping would not be required to convey the treated effluent to the storm drain system, although the discharge pipe may need to be altered.

Various media types are available and may be used in combination if needed. Media types include perlite, zeolite, granulated activated carbon (GAC), PhosphoSorb (perlite and activated alumina), ZPG (zeolite, perlite, GAC blend) and CSF Leaf Media (leaf compost product). Perlite is a naturally occurring material made from volcanic ash that is effective at removing TSS and oil and grease. GAC is effective at removing organic pollutants, metals, and oil and grease. Zeolite is a naturally occurring mineral that is effective at removing dissolved metals and especially ionic forms of copper. Compost has been shown to effectively remove dissolved metals, TSS, and oil and grease. Activated alumina enhances the sorption of anions such as nitrate and phosphate, which are not pollutants of concern at the site.

Maintenance requirements and frequency vary depending on pollutant loading characteristics. In general, inspections should be conducted at least once per year. It is recommended to also perform inspections after major storm events as maintenance activities may be required due to excessive sediment loading from an extreme storm or site erosion. Maintenance activities include removal of sediment and replacement of cartridges. Average maintenance lifecycles are in the range of 1 to 3 years.

StormwaterRx Aquip®

The Aquip® stormwater filtration system is a passive, flow-through system manufactured by StormwaterRx that is designed to reduce suspended solids, metals, BOD, COD, and nutrients

(Figure 8). The system contains a pretreatment chamber with buffer media, followed by a chamber containing inert and adsorptive filtration media that may be customized for specific pollutants of concern. The system also allows for adjustable head control to optimize loading on the filter bed and contact between the stormwater influent and media. An outlet sample port is incorporated in the system to provide access to the treated effluent for stormwater compliance sampling.

The Aquip® stormwater system may be installed as an above-grade, below-grade, or as a portable (downspout) system. Below-grade applications are designed as pre-cast concrete vault systems and can be constructed with a solid lid for traffic-rated applications. The below-grade system requires a minimum driving head of four feet below ground surface. Both the above-grade and below-grade systems are available with the capacity to receive the design flows from each treatment area of the site.

The Aquip® portable system contains an advanced media configuration, which is a very fine gradation sorptive media designed to treat stormwater with lower TSS concentrations. The portable system can treat up to 0.25 acres and a maximum flow rate of 15 gpm. A flow splitter would convey flows above design flow for treatment away from the treatment system and into the storm drain.

The main operations and maintenance activities associated with the Aquip® system include routine surface (top) media maintenance, replacement of the inert media, and replacement of the adsorptive media. Surface media maintenance is intended to remove visible accumulation of sediment and discolored inert media from the pretreatment and filtration chambers. The typical surface media maintenance frequency is monthly during periods when precipitation occurs. Inert media replacement is recommended when water in the operational filtration chamber routinely reaches two feet. Inert media replacement extends the underlying sorptive media life and typically is required every 12 months. Sorptive media replacement frequencies are typically every 24 months. However, change outs may be more frequent depending on site specific pollutant loading.

Modular Wetland System Linear

The Modular Wetland System (MWS) Linear is a passive, horizontal flow-through below-grade filtration system manufactured by Modular Wetlands (Figure 9). The MWS Linear incorporates an advanced pre-treatment chamber that features separation and pre-filter cartridges. The system can be designed to incorporate surface vegetation; however, due to the above ground space constraints at the site, the MWS Linear would not include this component.

The pretreatment modules can be designed to accept flows directly from a storm drain system. There is a low flow diversion trough that can be installed into existing inlets to intercept the first flush and bypass higher flows. The MWS Linear models come in four foot or eight foot wide configurations, with variable lengths depending on the desired media surface contact area and design flow rate (up to 0.46 cubic feet per second capacity).

The MWS Linear can also be utilized in a downspout application to accept runoff from roofs. The system can be configured as a raised planter or placed in ground to match existing grade and adjacent buildings.

The main operation and maintenance activities associated with the MWS Linear system include removal of trash from the screening device, removal of sediment from the separation chamber, replacement of the filter media, and replacement of the drain down filter media. The “drain down” is an optional feature that completely drains the pretreatment chamber. Water that drains from the pretreatment chamber between storm events is treated by the drain down filter.

Typical maintenance frequencies for sediment removal and media replacement are every 12 to 24 months, but may be longer based on site specific pollutant loading.

Roof Downspout Filters

The StormFilter device is also available in a configuration that can be integrated into existing downspouts to treat roof runoff. Figure 10 shows an example of a roof downspout filter treatment system. The StormFilter system has a typical footprint of 2.5 feet by 5 feet and holds two StormFilter cartridges in single- or dual-stage configurations. A second treatment stage can be added if needed to increase removal efficiency.

The existing downspout directs runoff into the cartridge chamber where it percolates through the media and is then directed to the outlet pipe. Up to 14,000 square feet of rooftop area can be treated with one single-stage two-cartridge system. The system has an internal overflow weir to allow for bypass of high flows. A sample collection port is also provided in the system. System maintenance is performed by removing and replacing filter cartridges as breakthrough occurs.

StormwaterRx Aquip® and MSW Linear products are also available in a configuration that can be integrated into existing downspouts to treat rooftop runoff.

3.4.4 Additional Information Required

It is presumed based on the unit processes utilized that the StormFilter®, StormwaterRx Aquip®, and (MWS) Linear would provide relatively equivalent levels of treatment for site runoff. Additional data on metals speciation (i.e., total and dissolved fraction), BOD, and size distribution of particulates should be collected to facilitate optimizing the treatment media and ascertain if any differences in effluent quality among the three systems are anticipated based on the site-specific runoff characteristics.

4. ALTERNATIVES ANALYSIS

Based on the evaluation of the different structural BMPs presented in Section 3, two structural BMP alternatives for the SMaRT station have emerged. The first alternative primarily relies on diversion of stormwater runoff from industrial areas to the WPCP. Stormwater runoff from the parking area and the southern and northeastern portion of the roofs would be segregated and discharged at existing outfall locations SM-1 and SM-3. Stormwater runoff from the northwestern portion of the roof would be diverted to the WPCP. Stormwater flows in excess of the design storm would bypass the diversion to the WPCP and be discharged at the SM-1, SM-2, and SM-3 locations. The conceptual layout for this diversion alternative is presented in Figure 11.

The second alternative includes treatment of stormwater runoff from industrial areas and roofing target prioritized areas to prevent stormwater from coming into contact with industrial activities. Like the diversion alternative, stormwater runoff from the parking area and the southern and eastern portion of the roofs under this treatment alternative would be segregated and discharged at existing outfall locations. Stormwater runoff from the northwestern portion of the roof would receive downspout filtration as described in Section 3.4.3. The remaining industrial runoff would be treated using the StormwaterRx treatment units as described in Section 3.4.3 (or equivalent treatment). The conceptual layout for this treatment alternative is presented in Figure 12.

In this section, both the diversion and treatment alternatives will be further evaluated to support selection of the most feasible alternative. A description of the evaluation criteria and detailed evaluations of each alternative based on these criteria are presented in the following subsections.

4.1 <u>Evaluation Criteria</u>

The two structural BMP alternatives are evaluated based on their effectiveness, implementability, and cost. Each of these criteria is explained further below.

4.1.1 Effectiveness

Effectiveness is generally evaluated based on how well the alternative is expected to achieve the Target Levels/NALs presented in Table 1. Specifically, the effectiveness evaluation is based on the following:

- The ability of the BMPs to meet the Target Level/NAL for each of the pollutants associated with the SMaRT Station;

- The level of assuredness to which the BMPs will work under varying storm conditions and changes in pollutant loading; and
- The degree to which the BMPs will be effective in the future considering change in Target Levels/NALs.

4.1.2 Implementability

The implementability criterion evaluates how well the alternative can be applied and installed at the SMaRT Station. Implementability is evaluated based on the technical feasibility of implementation and the availability of each BMP associated with the alternative. This criterion also considers the technical and institutional ability to monitor, maintain, and replace the BMP, and the administrative feasibility of implementing the BMP. The implementability evaluation is based on the following:

- The technical ability to apply the BMP at the site, including access, space and/or physical limitations, and ability to route runoff through the BMP;
- The disruption to site activities that would be necessary to construct, operate, and maintain the BMP;
- The administrative aspects of implementation, including the ability to obtain necessary permits and acceptance by other stakeholders;
- The availability of support services and equipment required to operate and maintain the BMP; and
- The degree to which the BMP has been demonstrated at other sites.

4.1.3 Cost

This criterion considers the costs associated with implementing each alternative based on the conceptual designs (Figure 11 and Figure 12). The cost estimates include a breakdown of capital costs and annual operation and maintenance costs. Labor and material costs are estimated from published unit costs, estimated costs from vendors, and experience with similar projects; contractor and vendor bids were not obtained. Actual project costs may vary depending on the final design of construction elements, changed site conditions, additional evaluations, regulatory and community requirements, and availability of labor and materials at the time of implementation. Operational cost estimates are based on a maximum duration of 30 years and do not include routine inspection, cleaning, or repairs that would be common amongst all alternatives.

4.2 Evaluation of Alternatives

4.2.1 Alternative 1-WPCP Diversion

The WPCP Diversion alternative would divert stormwater flows from outside areas around the SMaRT Station and from roof drains in the northwest corner of the site, as illustrated in Figure 11. Runoff from the remaining roofed areas and from the employee parking area would continue to flow to the existing outfalls. Flows that exceeded the design intensity of 0.18 inches/hr would also flow to existing outfalls. Peak hourly flow rates would be approximately 366 gallon/minute (0.53 million gallons/day rate). Based on an analysis of historic data, the daily average flows to the WPCP during diversion events would be 62,000 gallons/day (0.062 mgd) for days when there is flow. Diversion structures on each of the three outfall lines would divert flows to a separate drainage system, shown in red in Figure 11. The diverted flows would be routed to the WPCP influent. The conceptual design calls for use of a gravity line to collect flows and transport them to the WPCP. A possible option would use gravity lines for the on-site portion of the system, and a force main to convey the flow to the WPCP. In all other regards, the two diversion options are identical.

Alternative 1 Effectiveness

Effluent quality for the diverted flow would improve substantially by treatment through the WPCP. For metals, reductions on the order of 90% are typical. Reductions for COD, TSS and oil and grease would be even greater.

Effluent quality for the non-diverted flow can be expected to improve relative to the current discharge, since the non-diverted portion will consist mainly of roof and parking area runoff. The quality of flows that that are discharged because they exceed design flows for the diversion would also improve because the diverted flows would have removed “first flush” pollutants.

Alternative 1 Implementability

The project appears to be constructible, in that there are no apparent fundamental obstacles to construction of the proposed system. Some disruption of normal SMaRT Station operations would occur during construction of the new drainage and diversion facilities, and construction of a new conveyance line on Carl Road (if required) would disrupt normal traffic flow patterns. The latter is not insignificant given its heavy use by trucks entering and exiting the SMaRT Station and the Concrete Recycling Facility to the east.

Permitting of the diversion would follow normal WPCP Pretreatment Program practice for industrial dischargers and would include additional characterization sampling for a Baseline Monitoring Report, evaluation of slug discharges (and possible Slug Discharge Control Plan), and other routine requirements. Evaluation of the current monitoring results indicates that all local limits can be met on a combined flow basis without the need for additional on-site pretreatment. If this were not the case, then the diversion alternative would be much less attractive from a cost standpoint. The remaining BMR sampling should be well thought out to provide more confidence that the diversion discharge would meet local limits with representative sampling locations. Ongoing monitoring requirements would be determined after review of the Baseline Monitoring Report by the WPCP. The number of pollutants included in the ongoing monitoring program would likely be significantly fewer that what is required for the Baseline Monitoring Report.

Timing considerations for this alternative are critical insofar as coordination with the WPCP primary facilities design is concerned. This applies to the potential of routing the diversion line within the WPCP boundary rather than on Carl Road. As discussed previously, such routing appears much more feasible for a pressured line (force main) than for a gravity line. Realistically, the approval of the conceptual design, preparation of detailed design plans and specifications, bidding, and construction is likely to require at least 24 months.

O&M requirements will vary depending on the specific components of the final design. O&M requirements for the diversions structures themselves should be minimal if all existing storm drain inlet filters are retained, as recommended.

Alternative 1 Costs

Preliminary cost estimates for constructing this alternative are presented in Table 9. Costs include a system to collect and reroute drainage from roofs to the various outfalls. Other costs include a possible connection fee for the new diversion line, WPCP wastewater discharge/treatment fees (estimated to be approximately $17,000 per year), costs associated with ongoing monitoring for the IGP, and O&M costs. The connection fee is estimated to be approximately $108,000 if standard industrial connection rates are applied. However, because the new line will be constructed by the City and will not utilize capacity of the existing sewers, a lower fee might apply in this case. As indicated, a gravity conveyance system will likely have lower O&M cost than the option that utilizes a force main (and associated pumping and controls equipment) to convey the diverted flow to the WPCP.

4.2.2 Alternative 2-Stormwater Treatment

As shown in Figure 12, Alternative 2 includes treatment of stormwater runoff from industrial areas and the northwestern roof area, roofing selected prioritized areas with exposed materials, and segregating runoff from the parking lot and the southern and eastern roof areas. As discussed in Section 3.4, StormFilter®, StormwaterRx Aquip®, and MWS Linear are expected to provide relatively equivalent levels of treatment of stormwater runoff constituents reported at the SMaRT

Station. Therefore, for evaluation and cost estimating purposes, we have assumed that three StormwaterRx Aquip® below grade units would be used to treat runoff from industrial areas up to the design storm standards.

For each discharge location, the media would be contained in an 8 ft. wide, 32 ft. long, and 4 – 4.5 ft. deep vault. The vaults would contain a proprietary multimedia mix to treat multiple pollutants of concern. These units would be installed adjacent to the current discharge locations SM-1, SM-2, and SM-3. The existing curb drain inlets located adjacent to these discharge locations would be replaced with new field drain inlets to convey surface flows through the treatment devices. New bypass vaults would also be installed to route flow greater than the design storm directly to the discharge location. Based on historic rain data collected near the SMaRT Station, the design capacity of the treatment units, and average TSS concentrations, it is expected that media change outs in each StormwaterRx Aquip® unit would need to be completed three times per year.

Based on the elevated TSS and COD concentrations reported in downspout samples collected from the northwestern portion of the roof, downspout treatment for this roof area would be included in Alternative 2. Flow from each downspout in this area would be combined and diverted to a downspout treatment device. For evaluation and cost estimating purposes, it has been assumed that a StormwaterRx Aquip® portable unit would be installed to treat roof flows in this area up to the design storm. The footprint for the unit is 3 feet by 9 feet, and the unit would contain a proprietary multimedia mix.

TABLE 9
DIVERSION TO WATER POLLUTION CONTROL PLANT ALTERNATIVE - COST ESTIMATE
SMaRT STATION STORMWATER TREATMENT SYSTEM
CITY OF SUNNYVALE

CAPITAL COSTS

		Quantity	Unit	Unit Cost	Line Totals	Notes/Assumptions
1.0	**Project Planning**	**Quantity**	**Unit**	**Unit Cost**	**Line Totals**	**Notes/Assumptions**
1.1	Project Management	1	ls	$ 12,000	$ 12,000	Includes meetings with City and coordination with the WPCP during design process. Assume 4 month design period
1.2	Engineering Design (PS&E)	1	ls	$ 60,000	$ 60,000	Includes design plans, specifications and engineering estimate for all stormwater infrastructure.
1.3	Construction SWPPP	1	ls	$ 10,000	$ 10,000	Required for construction activities
1.4	Permitting	5%	%	$ 484,400	$ 24,200	Includes plan check fees for storm water management plan, grading permit, encroachment permit, permit fees assumed to be 5% of total project cost.
1.5	BMR Monitoring	4	each	$ 1,200	$ 4,800	laboratory analysis costs for Pretreatment Permit
1.6	Contractor Selection	1	ls	$ 7,400	$ 7,400	Includes preparation of bid documents, bid sheets, contractor site walk, and bid evaluation.
	Contingency	10%	%	$ 118,400	$ 11,800	
				Subtotal	**$ 130,200**	
2.0	**Construction Management and Coordination**	**Quantity**	**Unit**	**Unit Cost**	**Line Totals**	**Notes/Assumptions**
2.1	Project Management	1	ls	$ 18,000	$ 18,000	Includes scheduling and meetings with SMaRT and WPCP managers. Assume 3 months construction, 40 hours per month.
2.2	Contractor Mobilization	1	ls	$ 10,000	$ 10,000	Assume contractor mobilization is local. Includes mob and demob.
2.3	Site Security and Safety	1	ls	$ 8,800	$ 8,800	Includes temporary fencing, trench plates, and delineators, flag person, for two months
2.4	Construction BMPs	1	ls	$ 5,000	$ 5,000	Includes waddles, drain inlet covers, silt fence during construction activities
2.5	Utility Clearance	1	ls	$ 2,500	$ 2,500	Includes USA and private utility locator for all work areas
2.6	Utility Potholing	10	each	$ 1,500	$ 15,000	Includes potholing at existing utility crossings to determine as-built conditions. Assumes 10 locations, and temporary backfill.
2.7	Engineering Support and CQA	1	ls	$ 19,200	$ 19,200	Includes time for change conditions review, submittals, materials review, meetings, compaction testing, Assume 16 hours per week for 2 months
2.8	Record Drawings	1	ls	$ 10,000	$ 10,000	Prepare a complete set of drawings in CAD based on final as-built conditions
2.9	Construction Completion Report	1	ls	$ 5,000	$ 5,000	Includes summary of work completed
2.10	Preparation of O&M Manual / Site Management Plan (SMP)	1	ls	$ 8,000	$ 8,000	Includes maintenance requirements for all new stormwater infrastructure.
	Contingency	10%	%	$ 101,500	$ 10,200	
				Subtotal	**$ 111,700**	
3.0	**Construction Activities**	**Quantity**	**Unit**	**Unit Cost**	**Line Totals**	**Notes/Assumptions**
3.1	Remove Existing DI's	4	each	$ 1,500	$ 6,000	Assumes existing DI will need to be removed to accommodate new bypass structures and SD piping
3.2	Asphalt Removal and Grading for New DI and Bypass	2400	sf	$ 3	$ 7,200	Asphalt will need to be removed and area regarded near bypass structures and new DIs. RS Means
3.3	Install Bypass Structures	4	each	$ 16,000	$ 64,000	Includes excavation, bypass installation, SD connections, connection existing outfalls, backfill and compaction and disposal of overburden.
3.4	Install New Drain Inlets	4	each	$ 4,500	$ 18,000	Includes installation of DIs, connection SDs, backfill and compaction, and disposal of overburden.
3.5	Install Manholes	10	each	$ 4,000	$ 40,000	Includes excavation, installation of DIs, SD connections, backfill and compaction, and disposal of overburden.
3.6	Remove Asphalt, Trench, Backfill, & Compact for New SDs	2825	lf	$ 16	$ 45,200	Includes asphalt removal, trenching, backfill, compaction, and disposal of overburden. Assumes 3' wide trench.
3.7	8" Storm Drain Installation	1850	lf	$ 25	$ 46,250	Includes cut and removal of asphalt, trenching , backfill, compaction, and disposal of overburden.
3.8	10" Storm Drain Installation	975	lf	$ 30	$ 29,250	Includes installation of pipe bedding and SD.
3.9	Asphalt Resurfacing	8700	sf	$ 5	$ 43,500	Assume 4" AC over 8" AB with seal coat
3.10	Roof Drainage Piping	800	lf	$ 16	$ 12,800	Assume 4" to 6" corrugated plastic pipe, hung under roof overhang
3.11	Rain Gauge Installation and Programming	1	ls	$ 1,500	$ 1,500	Tipping bucket style with USB downloadable data port, installed on roof of office building. Used for estimate discharge to WPCP.
3.12	Sewer Conncetion fees	1	ls	$ 108,000	$ 108,000	Based on City's 2014/15 sewer connection fee for high strength commercial or industrial (similar fees). Actual fee may be less because new sewer will not utilize existing collection system capacity.
	Contingency	20%	%	$ 313,700	$ 62,700	
				Subtotal	**$ 484,400**	
TOTAL CAPITAL COSTS					**$ 726,300**	

TABLE 9
DIVERSION TO WATER POLLUTION CONTROL PLANT ALTERNATIVE - COST ESTIMATE
SMaRT STATION STORMWATER TREATMENT SYSTEM
CITY OF SUNNYVALE

ANNUAL COSTS

4.0	**OPERATIONS & MAINTENANCE (O&M)[3]**	**Quantity**	**Unit**	**Unit Cost**	**Amount Per Year**	**Notes/Assumptions**
4.1	WPCP Flow Estimation	30	yr	$ 600	$ 18,000	Includes time for data review, flow calculation and monthly reporting to the WPCP. Assume 2 hours per month during raining season.
4.2	WPCP Discharge Fees	30	yr	$ 17,100	$ 513,000	Unit cost based on SIU rate of $4677/mgal + $1618/1000 lb TOC discharged. Assumes 1.35 mgal/yr with estimated TOC of 590 mg/L
4.3	Pretreatment Monitoring	30	yr	$ 1,440	$ 43,200	estimated laboratory analysis costs for Pretreatment monitoring
	Contingency	10%	%	$ 531,000	$ 53,100	
				Subtotal	**$ 627,300**	
TOTAL ANNUAL COSTS					**$ 627,300**	
SMaRT STATION STORMWATER DIVERSION SYSTEM TOTAL COSTS					**$ 1,353,600**	

Notes:
1. Contingencies are based on uncertainty of the scope of work.
2. Costs have been rounded to the nearest $100.
3. Annual O&M cost do not include routine inspection, minor structural repairs, vault and manhole cleaning, sampling, and SWPPP updates. These are assumed equal amongst all alternatives.

Abbreviations:

cy:	cubic yards
lf:	lineal feet
ls:	lump sum
sf:	square feet
yr:	year

As discussed in Section 3.2, pre-engineered steel buildings without sidewalls would be installed over the exposed materials in the public buy-back area under Alternative 2. These buildings will prevent stormwater from coming in contact with soil, compost, brick, and concrete stored in these areas. For cost estimating purposes we have assumed that a 110 by 30 foot building would be used to cover the compost pile area and a 130 by 50 foot steel building would be used to cover the soil, brick and concrete storage areas. The minimum overhang height for the smaller building would be 20 feet and for the larger building would be 30 feet, so that small equipment and trucks could maneuver in these areas. Prior to construction, a geotechnical evaluation would be completed to determine the appropriate foundations for the steel buildings. These steel buildings would be designed to meet site specifications and local building codes. Once installed, very little maintenance would be required for these buildings.

As a component of both alternatives, stormwater runoff from the southern and eastern roofs and the parking lot would be segregated from other industrial activities. Segregation of roof runoff would be accomplished by connecting the roof drains together with corrugated plastic piping and directing runoff through new underground storm drains to the existing discharge locations. Similarly, existing parking lot drains would be isolated from the industrial runoff and directly discharge near SM-1 through separate storm drains.

Alternative 2 Effectiveness

In general, each of the BMPs included under Alternative 2 is expected to be effective at achieving Target Levels/NALs. All of the BMPs selected for Alternative 2 have been shown to be effective at reducing pollutant loading at numerous other sites with similar conditions. The use of steel buildings to cover stored materials in the buy-back area would eliminate stormwater contact with stockpiled materials, which would significantly improve water quality. Further, segregation of roof runoff in the southern and eastern areas will reduce the amount of stormwater that comes in contact with pollutant sources.

Although the StormwaterRx Aquip® and the StormFilter® units are expected to reduce pollutant concentrations to below Target Levels/NALs based on vendor testing data, additional stormwater quality data would need to be collected from the SMaRT Station to confirm their effectiveness. Specifically, stormwater runoff would need to be tested for BOD and dissolved metals. These data are needed to better understand the ratio of BOD to COD and dissolved to total metals in the runoff. In general, all of the treatment units evaluated are less effective at removing BOD and dissolved metals then they are at removing COD and total metals. This is because the units rely heavily upon filtration and chemical adsorption to remove pollutants. If additional stormwater quality testing reported high BOD and dissolved metals, additional bench or pilot scale testing would be required to determine if the treatment units could achieve Target Levels/NALs and to select the most effective treatment device.

Each of the evaluated treatment BMPs have been tested at numerous sites and are capable of handling design storm flows. However, their effectiveness is highly dependent upon how well treatment equipment is maintained. If the treatment units are not routinely raked to remove particulate matter and the media is not periodically replaced, their effectiveness will be reduced or the units may not be able to handle the design flow rate. If properly maintained, the treatment BMPs are expected to last a significant time into the future without requiring replacement.

Alternative 2 Implementability

Overall, Alternative 2 would be relatively challenging to implement due to available space, facility operations, and shallow groundwater constraints. The BMPs included under Alternative 2 are readily available for purchase and are commonly installed by local contractors. However, access at the SMaRT Station is relatively limited and facility operations would be severely impacted during construction activities.

For these reasons, the StormwaterRx Aquip® units would need to be installed below grade, requiring large areas to be excavated, regraded, and resurfaced. Additionally, each of the units would need to be anchored to prevent buoyant forces from causing them to float. This would likely be accomplished by installing an anti-floatation slab or increasing the wall thickness of the treatment unit, making installation more challenging overall.

Once installed, the treatment units would need frequent maintenance, including several media change outs per year. These change outs would require use of a vactor truck to remove filter media, waste profiling and disposal, and replacement of the filter media. Based on the estimated loading of the treatment units, it is expected that media change outs would be required approximately three times per year for each unit. Additional maintenance would be required prior to storm events to rake and remove sediment from the top of the media.

Construction of the steel buildings in the buy-back area would require procurement of building permits and completion of a geotechnical investigation to design appropriate foundations. Procurement of these permits and completion of the geotechnical investigation are relatively easy to implement, but construction of the buildings would cause significant disruption to facility operations. Once the buildings were constructed they would be relatively easy to maintain.

Diversion of roof runoff would also be relatively easy to implement. It is expected that this could be completed without significant disruption to site activities because the drains are accessible from the roof. Each of the roof drains would be diverted using corrugated plastic pipe secured to the side of the building. Once at the surface, diverted runoff from the roof would be conveyed to the discharge locations through new below grade storm drain piping. Installation of these 12- to 18-inch diameter storm drains would require trenching through the parking area and along the northeast and southwest portions of the SMaRT Station, resulting in significant disruption to facility operations.

Downspout treatment devices are readily available and would be relatively easy to install. Careful consideration of their location would be required to protect from vehicular impact damage. Features like crash bollards would be required to prevent damage to the units. Maintenance of the downspout treatment units would be similar to the below ground StormwaterRx Aquip® units.

Alternative 2 Costs

The planning level cost estimate for Alternative 2 is provided in Table 10. The total capital cost for Alternative 2 is $1,247,300 and the total O&M cost is $4,125,000 over 30 years. The primary drivers for the capital cost are the treatment devices and the new steel buildings. Together, these two items account for approximately half of the total capital cost. The O&M cost does not include routine inspection, minor structural repairs, vault and manhole cleaning, sampling, and SWPPP updates because they are assumed to be equal amongst Alternatives 1 and 2. The Alternative 2 O&M costs are based on vendor information and assume three complete media change outs per year per unit and limited maintenance activity prior to storm events.

TABLE 10
ON-SITE STORMWATER TREATMENT ALTERNATIVE - COST ESTIMATE
SMaRT STATION STORMWATER TREATMENT SYSTEM
CITY OF SUNNYVALE

CAPITAL COSTS

1.0	**Project Planning**	**Quantity**	**Unit**	**Unit Cost**	**Line Totals**	**Notes/Assumptions**
1.1	Project Management	1	ls	$ 12,000	$ 12,000	Includes meetings with City and coordination with the WPCP during design process. Assume 4 month design period
1.2	Engineering Design (PS&E)	1	ls	$ 75,000	$ 75,000	Includes design plans, specifications and engineering estimate for all stormwater infrastructure, treatment devices and new roofs.
1.3	Construction SWPPP	1	ls	$ 10,000	$ 10,000	Required for construction activities
1.4	Permitting	5%	%	$ 957,800	$ 47,900	Includes plan check fees for storm water management plan, grading permit, encroachment permit, permit fees assumed to be 5% of total project cost.
1.5	Contractor Selection	1	ls	$ 7,400	$ 7,400	Includes preparation of bid documents, bid sheets, contractor site walk, and bid evaluation.
	Contingency	10%	%	$ 152,300	$ 15,200	
				Subtotal	**$ 167,500**	
2.0	**Construction Management and Coordination**	**Quantity**	**Unit**	**Unit Cost**	**Line Totals**	**Notes/Assumptions**
2.1	Project Management	1	ls	$ 18,000	$ 18,000	Includes scheduling and meetings with SMaRT managers and contractors. Assume 3 months construction, 40 hours per month.
2.2	Contractor Mobilization	1	ls	$ 10,000	$ 10,000	Assume contractor mobilization is local. Includes mob and demob.
2.3	Site Security and Safety	1	ls	$ 8,800	$ 8,800	Includes temporary fencing, trench plates, and delineators, flag person, for two months
2.4	Construction BMPs	1	ls	$ 5,000	$ 5,000	Includes waddles, drain inlet covers, silt fence during construction activities
2.5	Utility Clearance	1	ls	$ 2,500	$ 2,500	Includes USA and private utility locator for all work areas
2.6	Utility Potholing	7	each	$ 1,500	$ 10,500	Includes potholing at existing utility crossings to determine as-built conditions. Assumes 7 locations, and temporary backfill.
2.7	Engineering Support and CQA	1	ls	$ 19,200	$ 19,200	Includes time for change conditions review, submittals, materials review, meetings, compaction testing, Assume 16 hours per week for 2 months
2.8	Record Drawings	1	ls	$ 12,000	$ 12,000	Prepare a complete set of drawings in CAD based on final as-built conditions
2.9	Construction Completion Report	1	ls	$ 5,000	$ 5,000	Includes summary of work completed
2.10	Preparation of O&M Manual / Site Management Plan (SMP)	1	ls	$ 8,000	$ 8,000	Includes maintenance requirements for all new stormwater infrastructure.
	Contingency	10%	%	$ 99,000	$ 9,900	
				Subtotal	**$ 108,900**	
3.0	**Construction Activities**	**Quantity**	**Unit**	**Unit Cost**	**Line Totals**	**Notes/Assumptions**
3.1	Remove Existing DI's	4	each	$ 1,500	$ 6,000	Assumes existing DI will need to be removed to accommodate new bypass structures and SD piping
3.2	Asphalt Removal and Grading for New DI and Bypass and BG Treatment Devices	4000	sf	$ 3	$ 12,000	Asphalt will need to be removed and area regraded near the treatment structure, bypass structures, and new DIs.
3.3	Install Bypass Structures	3	each	$ 16,000	$ 48,000	Includes excavation, bypass installation, SD connections, connection existing outfalls, backfill and compaction and disposal of overburden.
3.4	Install New Drain Inlets	4	each	$ 4,500	$ 18,000	Includes installation of DIs, connection SDs, backfill and compaction, and disposal of overburden.
3.5	Install Manholes	11	each	$ 4,000	$ 44,000	Includes excavation, installation of DIs, SD connections, backfill and compaction, and disposal of overburden.
3.6	Subsurface Treatment Devices	3	each	$ 113,000	$ 339,000	Assume 3 Stormwater RX Aquip model 210SBI treatment units (180 gpm each). Includes provisions for anchorage to protect from buoyancy,
3.7	Remove Asphalt, Trench, Backfill, & Compact for New SDs	900	lf	$ 16	$ 14,400	Includes asphalt removal, trenching, backfill, compaction, and disposal of overburden. Assumes 3' wide trench.
3.8	12" Storm Drain Installation	600	lf	$ 30	$ 18,000	Includes installation of pipe bedding and SD.
3.9	15" Storm Drain Installation	100	lf	$ 35	$ 3,500	Includes installation of pipe bedding and SD.
3.10	18" Storm Drain Installation	200	lf	$ 42	$ 8,400	Includes installation of pipe bedding and SD.
3.11	Asphalt Resurfacing	6700	sf	$ 5	$ 33,500	Assume 4" AC over 8" AB with seal coat
3.12	Roof Drainage Piping	800	lf	$ 16	$ 12,800	Assume 4" to 6" corrugated plastic pipe, hung under roof overhang
3.13	Downspout Treatment	1	each	$ 25,000	$ 25,000	Assume
3.14	Install New Roofing	9800	sf	$ 22	$ 215,600	Assume roofing over public compost pile and concrete/brick storage area on the southern portion of the SMaRT station. Assume steel frame, 20'
	Contingency	20%	%	$ 798,200	$ 159,600	
				Subtotal	**$ 957,800**	
TOTAL CAPITAL COSTS					**$ 1,234,200**	

TABLE 10
ON-SITE STORMWATER TREATMENT ALTERNATIVE - COST ESTIMATE
SMaRT STATION STORMWATER TREATMENT SYSTEM
CITY OF SUNNYVALE

ANNUAL COSTS

4.0	**OPERATIONS & MAINTENANCE (O&M)[3]**	**Quantity**	**Unit**	**Unit Cost**	**Amount Per Year**	**Notes/Assumptions**
4.1	Subsurface Treatment Device O&M	30	yr	$ 125,000	$ 3,750,000	Assume use of 3 Stormwater RX Aquip 210B1 treating and 180 gpm and 1 StormFilter. O&M cost provided by Stormwater RX based on 25
	Contingency	10%	%	$ 3,750,000	$ 375,000	
				Subtotal	**$ 4,125,000**	
TOTAL ANNUAL COSTS					**$ 4,125,000**	
SMaRT STATION STORMWATER TREATMENT SYSTEM TOTAL COSTS					**$ 5,359,200**	

Notes:
1. Contingencies are based on uncertainty of the scope of work.
2. Costs have been rounded to the nearest $100.
3. Annual O&M cost do not include routine inspection, minor structural repairs, vault and manhole cleaning, sampling, and SWPPP updates. These are assumed equal amongst all alternatives.

Abbreviations:
cy: cubic yards
lf: lineal feet
ls: lump sum
sf: square feet
yr: year

5. RECOMMENDED PROJECT ALTERNATIVE

5.1 Recommended Alternative

From the two alternatives presented in Section 4, Alternative 1, the Diversion Alternative is the recommended alternative based on the evaluation criteria for effectiveness and cost. Treatment of industrial stormwater runoff at the WPCP is considered to be more effective than on-site stormwater treatment. Based on the costs presented in Table 9 and Table 10, the Diversion Alternative cost would be significantly less than the Stormwater Treatment Alternative.

5.2 Final Discharge Monitoring Locations

Figure 11 shows the proposed Final Discharge Monitoring Locations for the Diversion Alternative. One location (adjacent to the diversion line to the WPCP) would be used to monitor compliance with the City's WPCP pretreatment requirements. The other three monitoring locations would be used to monitor runoff from the roof area not diverted to the WPCP, and bypass of stormwater runoff not conveyed to the WPCP for treatment, which represents runoff flows above the design storm intensity of 0.18 inches per hour. Monitoring would be conducted at these three locations in accordance with the IGP monitoring requirements.

6. REFERENCES

Golder Associates, Inc., 2014. Stormwater Pollution Prevention Plan City of Sunnyvale Concrete Recycling Plant, Recycle Yard, and Sunnyvale Materials Recovery and Transfer Station (SMaRT Station). Prepared for City of Sunnyvale Environmental Services Department. January.

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US Department of Agriculture Natural Resources Conservation Service (NRCS), 2014. Custom Soil Resource Report for Santa Clara Area, California, Western Part. Accessed November 4, 2014 http://websoilsurvey.sc.egov.usda.gov/

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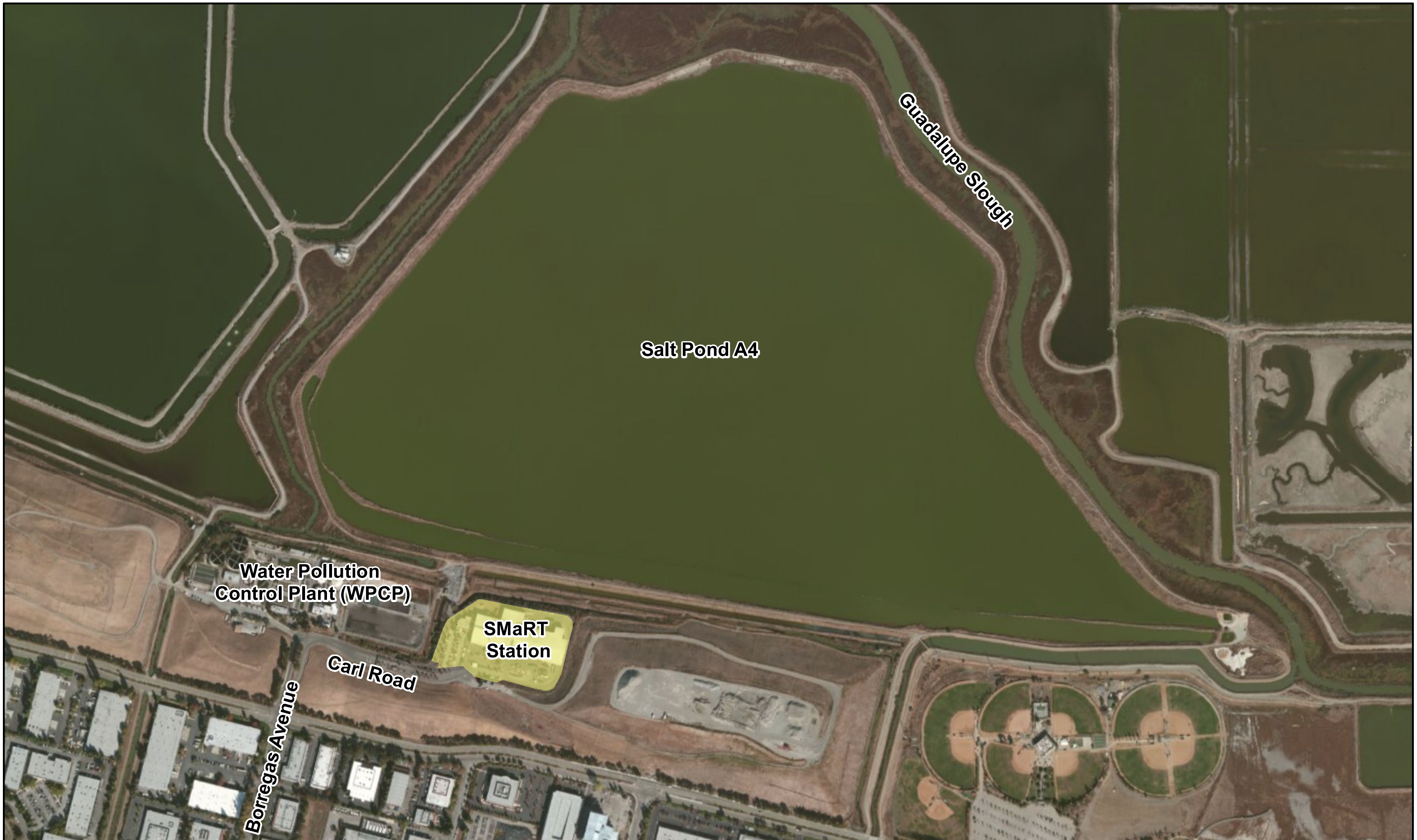
Wahler Associates, 1992. Addendum Report, Sunnyvale Materials and Recovery Station. August 20.

FIGURES



Legend

SMaRT Station Drainage Area

N

0 840 Feet

SMaRT Station Location

1111 Broadway
Oakland, California

Geosyntec consultants

Figure 1

WW1940

October 2014

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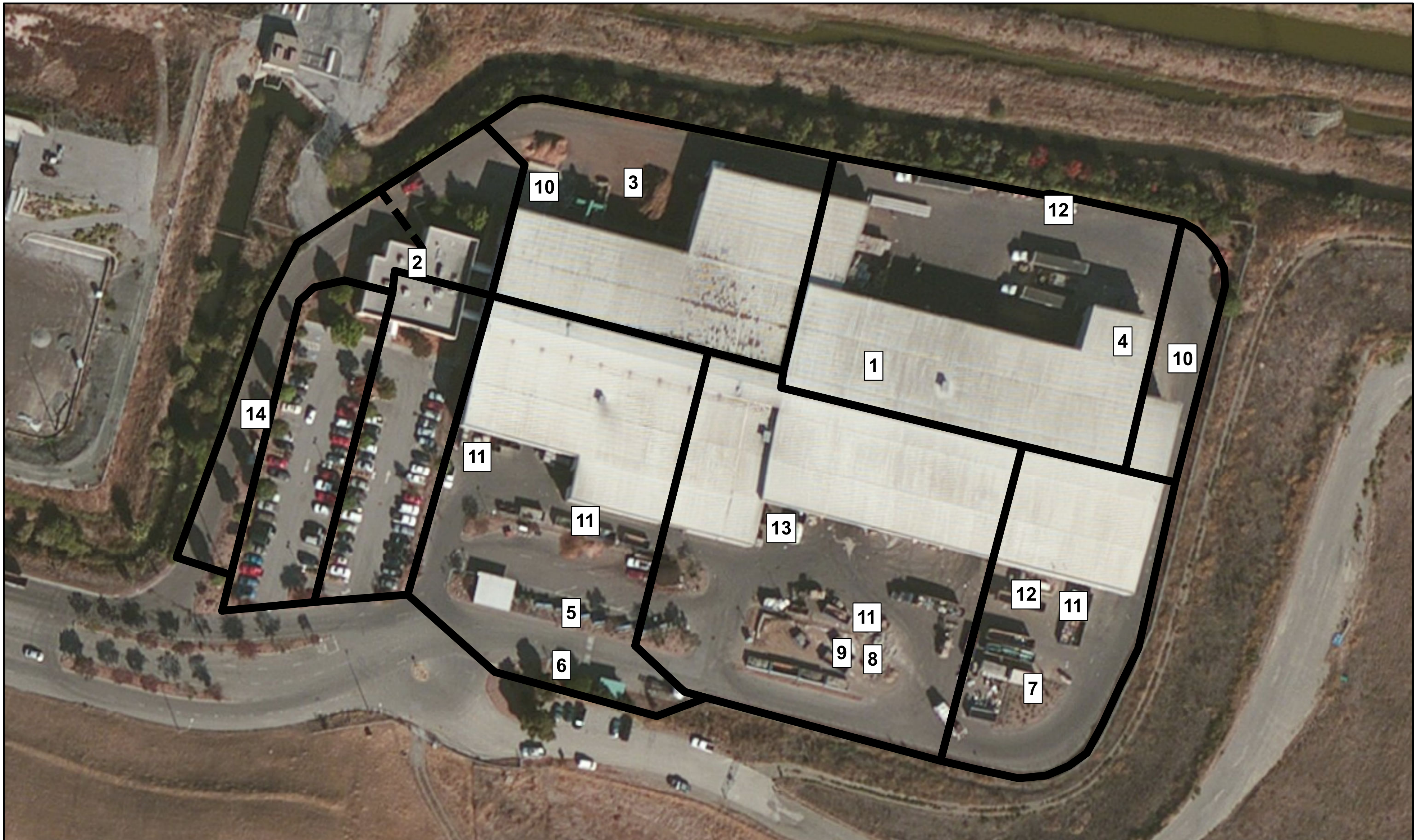

Legend

Sub-Drainage Areas

Drainage Area (to be verified)

1- MRF Operations
2- Offices
3- Greenwaste Outside Storage and Loading
4- Shop
5- Public Drop-Off Area
6- Used Oil with Secondary Containment Curb
7- Steel Hazmat Storage Building
8- Concrete Storage
9- Soil Storage
10- Loading Dock
11- Recycled Materials Storage Bins
12- Recycled Materials Storage Trailers
13- Overflow Baled Recyclable Storage
14- Exit Road

0 100 Feet

N

SMaRT Station Site Map

1111 Broadway
Oakland, California

Geosyntec consultants

Figure 2

WW1940 | October 2014

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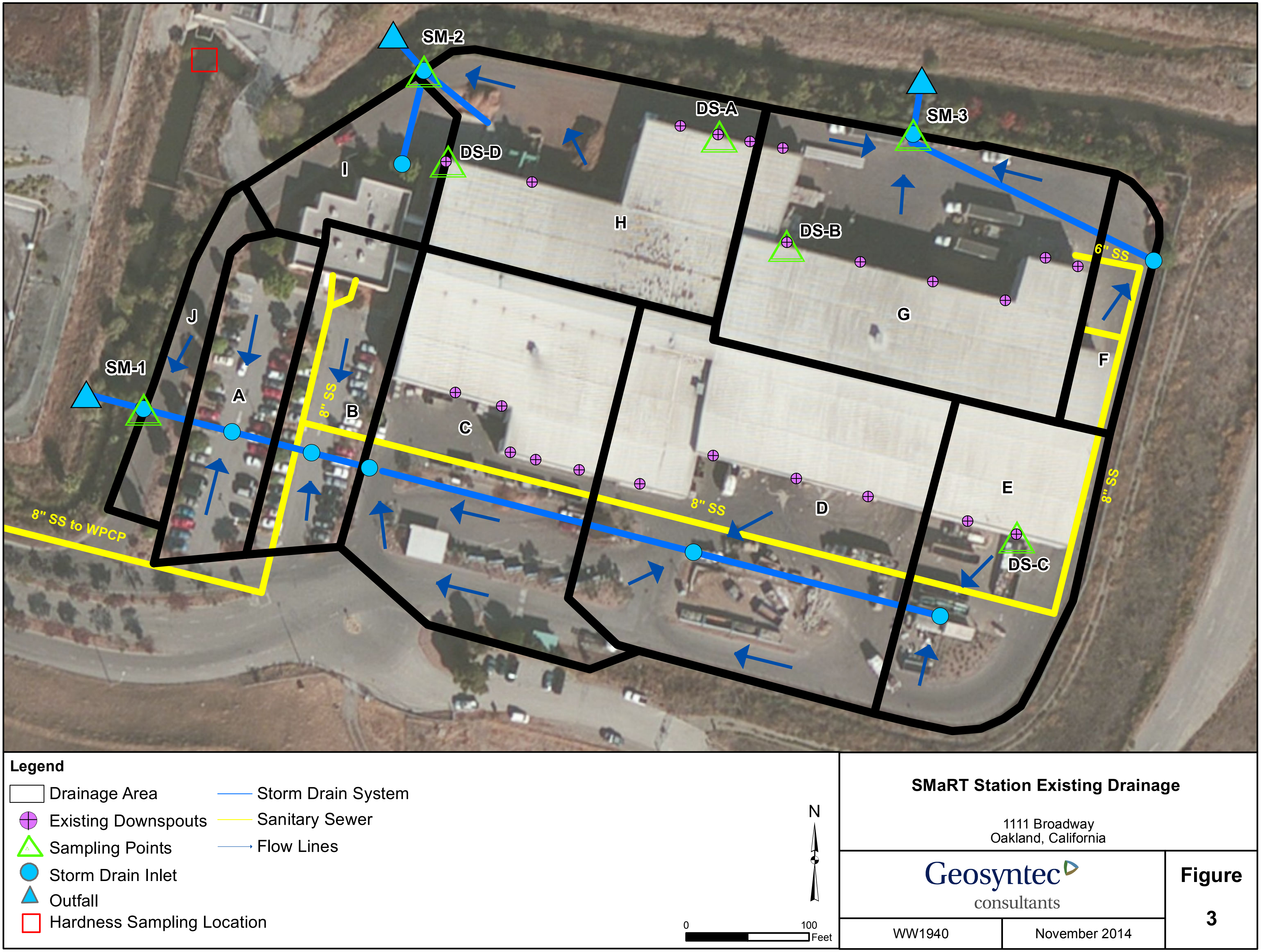

SMaRT Station Existing Drainage

1111 Broadway
Oakland, California

Geosyntec consultants

WW1940 | November 2014

Figure 3

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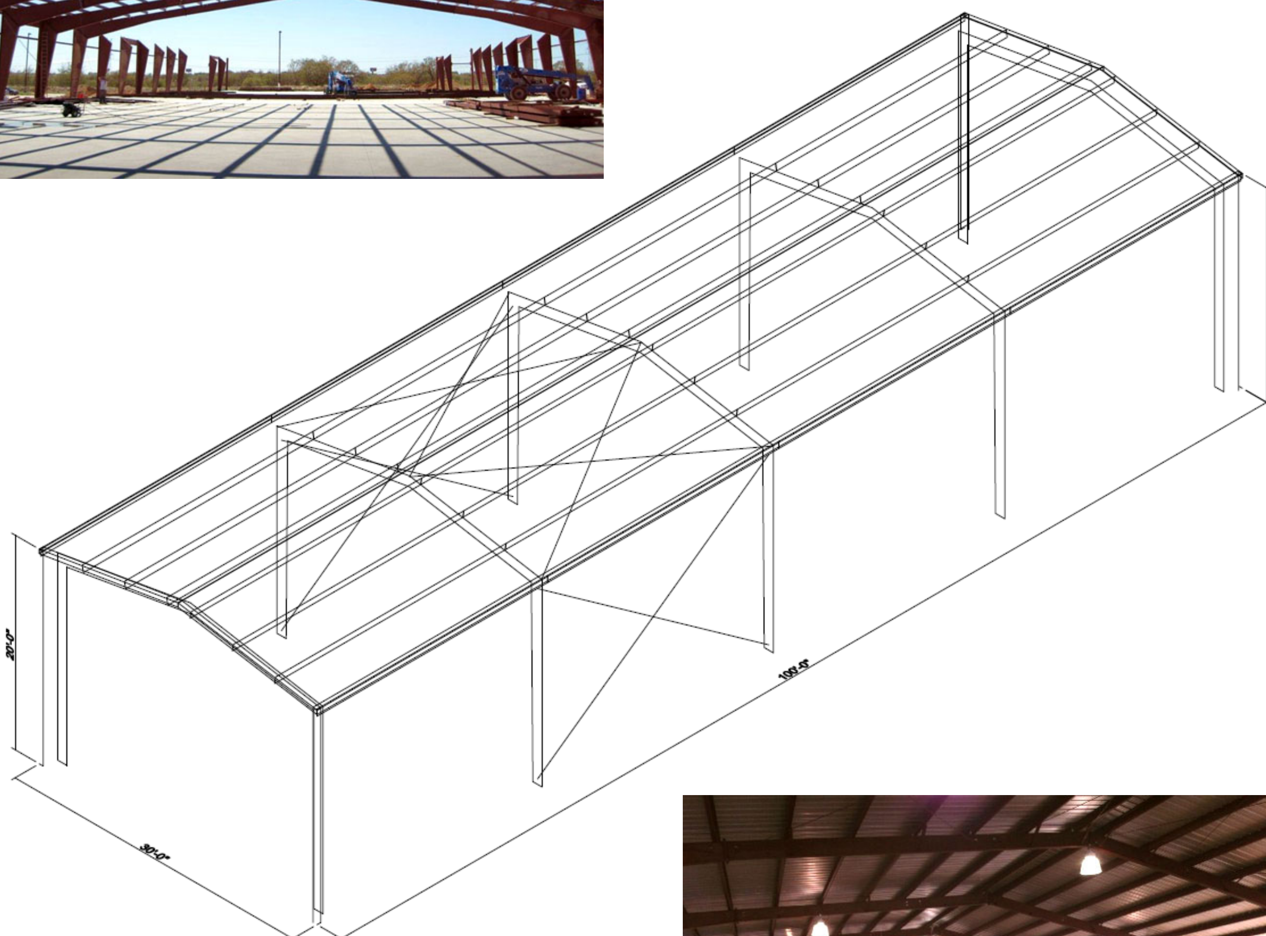

RHINO Steel Building Example Schematic

SMaRT Station

Geosyntec consultants

Oakland	November 2014	Figure 4

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