HYDROLOGY AND WATER QUALITY TECHNICAL REPORT

3^{RD} STREET AND FAIRFAX AVENUE LOS ANGELES, CALIFORNIA

TRACT 215, LOT 12, ARB 1 & 2

GEOCON
WEST, INC.
GEOTECHNICAL
ENVIRONMENTAL
MATERIALS

PREPARED FOR

HOLLAND ACQUISITION CO, LLC
LOS ANGELES, CALIFORNIA

PROJECT NO. A9713-06-01

JANUARY 31, 2019

GEOCON
WEST, INC.
GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS

Project No. A9713-06-01
January 31, 2019

Mr. Shaun Evans
Holland Acquisition Co., LLC
731 South Spring Street, Suite 202
Los Angeles, California 90014

Subject: HYDROLOGY AND WATER QUALITY TECHNICAL REPORT
3rd STREET AND FAIRFAX AVENUE
LOS ANGELES, CALIFORNIA

Dear Mr. Evans:

We have prepared this hydrology and water quality technical report for the property located at the southeast corner of 3rd Street and Fairfax Avenue in the City of Los Angeles, California.

If you have any questions regarding this report, or if we may be of further service, please contact the undersigned.

Very truly yours,

GEOCON WEST, INC.

REGISTERED GEOLOGIST ANDREW A. KOPANIA No. 4711 STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER JELISA THOMAS ADAMS GE3092 GEOTECHNICAL STATE OF CALIFORNIA

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1. INTRODUCTION

1.1. PROJECT DESCRIPTION

Holland Acquisition Co., LLC (Applicant) is proposing to develop a mixed-use project in the Mid City West neighborhood of the City of Los Angeles, on a lot bounded by Fairfax Avenue to the west, Third Street to the north, Ogden Drive to the east, and Hancock Park Elementary School to the south (Project Site). Figure 1 shows the Project Site location. The Project Site is located at 300-370 S Fairfax Avenue, 6300-6370 West Third Street, and 347 South Ogden Drive. The Project Site is currently improved with an approximately 214,736 square-foot retail center known as the Town and Country Shopping Center, located on an approximately 327,121 square-foot site. Existing conditions at the Project Site are shown on Figure 2.

The Proposed Project includes the partial demolition of an existing surface parking lot and commercial buildings, for up to 151,048 square feet of existing commercial floor area to be demolished (with 63,688 square feet of existing commercial floor area to remain); and the construction of a new mixed-use building containing 331 multi-family residential apartment dwelling units, for approximately 343,000 square feet of new residential floor area, and up to approximately 83,994 square feet of new commercial floor area, all located on the eastern portion of the Project Site. Existing buildings on the western portion of the Project Site are to remain and are not considered part of the Proposed Project.

Figure 3 shows the site layout of the Proposed Project. The Proposed Project will consist of a mid-rise, eight-story structure and two levels of subterranean parking, for a maximum height of approximately 100 feet. The residential component will consist of 70 studio units, 162 one-bedroom units, 66 two-bedroom units, and 33 three-bedroom units. The Project Site would provide a maximum of 1,156 automobile parking spaces, comprised of 982 new spaces within the mixed-use building as part of the Proposed Project, and 174 spaces within the existing surface parking lot to remain. Short- and long-term bicycle parking will be provided pursuant to the Los Angeles Municipal Code (LAMC). Vehicular access to the Project Site will be provided via four driveways, which include two new driveways (one residential and one commercial) with access to the parking areas for the new mixed-use building along South Ogden Drive, and two existing driveways along South Fairfax Avenue and West 3rd Street with access to the surface parking lot. For the purposes of the analyses presented in this report, it is assumed that the new mixed-use building will have a total hardscaped footprint of approximately 140,091 square feet.

1.2. SCOPE OF WORK

This report provides an assessment of surface water conditions under existing and proposed conditions, a description of existing soil and groundwater conditions at the Project Site, and an assessment of the effects of the Proposed Project on existing soil and groundwater conditions. The potential impacts of the Proposed Project on hydrology and water quality are also evaluated based on CEQA Appendix G thresholds of significance.

The evaluations presented in this report are based primarily on the following documents:

- County of Los Angeles, Department of Public Works, Hydrology Manual (January 2006) https://dpw.lacounty.gov/wrd/publication/engineering/2006_Hydrology_Manual/2006%20Hydrology%20Manual-Entire.pdf.
- City of Los Angeles, L.A. CEQA Thresholds Guide (2006) http://planning.lacity.org/Documents/MajorProjects/CEQAThresholdsGuide.pdf.
- City of Los Angeles, Planning and Land Development Handbook for Low Impact Development (LID), Part B, Planning Activities, 5th Edition (2016) https://www.lastormwater.org/wp-content/files_mf/lidmanualfinal.pdf.
- County of Los Angeles, Department of Public Works, Low Impact Development Standards Manual (February 2014) http://dpw.lacounty.gov/ldd/lib/fp/Hydrology/Low%20Impact%20Development%20Standards%20Manual.pdf.
- County of Los Angeles, Department of Public Works, Analysis of 85th Percentile 24-hour Rainfall Depth Analysis Within the County of Los Angeles (February 2004) http://ladpw.org/wrd/Publication/engineering/Final_Report-Probability_Analysis_of_85th_Percentile_24-hr_Rainfall1.pdf.
- County of Los Angeles, Department of Public Works, HydroCalc program http://dpw.lacounty.gov/wmd/dsp_LowImpactDevelopment.cfm.

Internet citations listed in this report were accessed multiple times during the weeks of August 6, 2018, August 13, 2018, and January 21, 2019.

2. EXISTING ENVIRONMENT

2.1. SURFACE WATER HYDROLOGY

2.1.1. REGIONAL

The Project Site is located within the greater Los Angeles area within the Ballona Creek Watershed. Ballona Creek is a 9 mile long flood protection channel that drains the Los Angeles basin, from the Santa Monica Mountains on the north, the Harbor Freeway (State Route 110) on the east, and the Baldwin Hills on the south. The Ballona Creek Watershed totals about 130 square miles. Major tributaries to Ballona Creek include Centinela Creek, Sepulveda Canyon Channel, Benedict Canyon Channel, and numerous storm drains. Figure 4 shows the upper part of the Ballona Creek watershed, isohyets for the 50-year 24-hour storm event, and soil types in the Project Site area.

The Project Site is located in a Federal Emergency Management Agency (FEMA) designated flood Zone X, meaning that it is in an area of minimal flood hazard and outside of any 100-year flood hazard areas. Ogden Avenue, Fairfax Boulevard, and 3rd Street adjacent to the Project Site, and the property to the north of the Project Site, are within an area identified by FEMA to be subject to a 0.2% chance of annual flooding, which is equivalent to a 500-year recurrence interval. The FEMA flood zones are shown on Figure 5. The boundary of the 500-year flood zone is also shown on Figure 2. The 500-year flood boundary appears to partially overlap the stand-alone bank building in the northwest corner of the Project Site.

2.1.2. ON SITE

The Project Site slopes toward the west, as indicated on Figure 2. The east side of the Project Site is at an elevation of approximately 186 ft while the west side of the Project Site is at an elevation of approximately 180 ft. Thus, the surface drops about 6 feet over a distance of approximately 660 ft, for a slope of 0.9 percent. The parking lot and the private driveway are graded to direct sheet flow runoff into concrete gutters, which route the runoff to storm drain drop inlets (DIs). The locations of the concrete gutters and the DIs are shown on Figure 2. The DIs are presumed to be connected to the City storm drain system. According to the Applicant, runoff from the roofs of the main commercial buildings is most likely piped directly to the City storm drains in the adjacent streets.

Surface water drainage collection, treatment and conveyance are regulated by the City of Los Angeles. Per the City's Special Order No. 007-1299, December 3, 1999, the City has adopted the Los Angeles County Department of Public Works (LACDPW) Hydrology Manual as its basis of design for storm drainage facilities. The LACDPW Hydrology Manual (2006) requires projects to have drainage facilities that meet the Urban Flood level of protection. The Urban Flood is runoff from a 25-year frequency design storm falling on a saturated watershed. The City also considers the 50-year frequency design storm event to analyze potential impacts on surface water hydrology as a result of development, as discussed further in Section 3 and Section 5.2. Thus, to provide a more conservative analysis, this report uses the larger storm event (the 50-year 24-hour storm) as the design storm event for evaluation of potential impacts.

The Low Impact Development documents for both the City of Los Angeles and the County of Los Angeles specify that a project of the type proposed for the Site mitigate stormwater runoff impacts. The design storm event for development of Best Management Practices (BMPs) for the Site is the greater of the 0.75-inch 24-hour rain event or the 85th percentile 24-hour rain event. The 85th percentile 24-hour rain event for the Site is 1.15 inches, as shown on the isohyetal map in the LACDPW Analysis of 85th Percentile 24-hour Rainfall Depth document cited above. Thus, the 85th percentile 24-hour rain event will be used as the design storm event for development of BMPs.

Since the Project Site is much less than 40 acres, the LACDPW HydroCalc software program was used to identify rainfall intensities, times of concentration, peak flow rates, and the total 24-hour runoff. Table 1 shows the results produced by HydroCalc for the 50-year 24-hour storm event. Appendix A includes the HydroCalc output files for the 50-year 24-hour storm event model evaluations. The percent impervious areas for existing and proposed conditions were taken from Appendix D of the LACDPW Hydrology Manual. The Project Site is currently a retail center (Code 1222) with a reported percent impervious of 96 percent. The west portion of the Project Site will remain as a retail center so there will be no material change in impervious cover as a result of the Proposed Project. The east portion of the Project Site will be redeveloped as mixed-use apartment building (Code 1124), with a reported percent impervious of 86 percent.

2.2. SURFACE WATER QUALITY

2.2.1. REGIONAL

The Project Site lies within the Ballona Creek Hydrologic Area of the Santa Monica Bay Hydrologic Unit as designated by the Regional Water Quality Control Board (RWQCB) (https://www.waterboards.ca.gov/losangeles/water_issues/programs/basin_plan/electronics_documents/FinalRevisedChapter1Text.pdf). The Ballona Creek watershed collects runoff from several partially urbanized canyons on the south slopes of the Santa Monica Mountains as well as from intensely urbanized areas of West Los Angeles, Culver City, Beverly Hills, Hollywood, Inglewood, Santa Monica, and parts of central Los Angeles. A large number of pollutants associated with urban development are found in stormwater in the Ballona Creek watershed, such as trash, sediment, metals, pesticides, and bacteria.

2.2.2. ON SITE

The Project Site currently has no means for treatment of stormwater runoff. As discussed above, the parking lot and the private driveway are graded to direct sheet flow runoff into concrete gutters, which route the runoff to DIs, which are presumed to be connected to the City storm drain system. The concrete gutters and DIs are shown on Figure 2. Runoff from the roofs of the main commercial buildings is believed to be piped directly to the City storm drains in the adjacent streets. Other than grates over the DIs that may prevent large debris and trash from entering the storm drains, there are not any apparent features currently on the Project Site intended to address stormwater quality.

2.3. GROUNDWATER HYDROLOGY

2.3.1. REGIONAL

The City of Los Angeles overlies the Los Angeles Coastal Plain Groundwater Basin. The Los Angeles Coastal Plain Basin is comprised of the Hollywood, Santa Monica, Central, and West Coast Subbasins. Groundwater flow in the Los Angeles Coastal Plain Groundwater Basin is generally south-southwesterly and may be restricted by natural geological features. Replenishment of groundwater basins occurs mainly by percolation of precipitation throughout the region via permeable surfaces, spreading grounds, and groundwater migration from adjacent basins, as well as injection wells designed to pump freshwater along specific seawater barriers to prevent the intrusion of salt water.

2.3.2. ON-SITE

Within the Los Angeles Coastal Plain Groundwater Basin, the Project Site overlies the Hollywood Subbasin. The Hollywood Subbasin is bounded on the north by the Santa Monica Mountains and the Hollywood fault, on the east by the Elysian Hills, the west by the Newport-Inglewood Uplift and the south by the La Brea high, an area of shallow bedrock. Groundwater in the Subbasin is replenished by percolation of precipitation and stream flow from the Santa Monica Mountains to the north. Urbanization has decreased the surface area open to direct percolation. Therefore, natural recharge is somewhat limited. The groundwater flow direction is generally toward the southwest.

Two geotechnical exploration programs and a Phase II Environmental Site Assessment (ESA) have been conducted at the Project Site. A preliminary geotechnical investigation was conducted by Krazen and Associates, Inc. in 2017. In early 2018, Geocon completed an additional geotechnical investigation. The Phase II ESA was completed in March 2018, by Northgate Environmental Management, Inc. The upper 5 to 6 feet of soils beneath the site consist of artificial fill material generated during prior grading and excavation of the Site. Quaternary alluvial material, consisting of interbedded layers of sand, silt, and clay, is present beneath the artificial fill. A shallow, perched aquifer was identified beneath part of the Project Site area, with the depth to groundwater varying seasonally between approximately 18 feet and 30 feet below ground surface. Figure 6 shows the area of perched groundwater identified in the east portion of the Project Site. The first major aquifer zone in the area is approximately 120 feet below ground surface and is referred to as the Exposition aquifer. Other regionally important groundwater aquifer zones are present below the Exposition aquifer.

2.4. GROUNDWATER QUALITY

2.4.1. REGIONAL

Due to the intense urbanization of the area overlying the Hollywood Subbasin, the groundwater has been impacted by a wide range of constituents. Constituents of concern listed for the subbasin include total dissolved solids (TDS), nitrate, volatile organic compounds (VOCs), petroleum hydrocarbons, and perchlorate. The area overlies numerous oil and gas fields and petroleum production has affected the soil and water in the region.

2.4.2. ON-SITE

According to the Phase II ESA, the Project Site was part of the Salt Lake Oil Field from the early 1900s through at least 1930. The Salt Lake Oil Field was a regional oil production area. One oil well was installed to an approximate depth of 2,909 feet below ground surface on the northeastern corner of the Project Site in 1906 and was abandoned in 1930. Three sumps used to collect oil field liquids are believed to have existed in the central portion of the Project Site during operation of the oil field. Figure 6 shows the location of historic sumps, tanks, and the abandoned oil well associated with the Salt Lake Oil Field.

Soil and perched groundwater testing were conducted as part of the Phase II ESA. The testing identified the presence of petroleum hydrocarbons consistent with diesel and motor oil in the soils above the groundwater level in the northeast and northwest parts of the parking lot on the Project Site. The petroleum hydrocarbon concentrations ranged from 160 milligrams per kilogram (mg/kg, equivalent to parts per million, or ppm) to 1,100 mg/kg in the soils. These concentrations exceed the RWQCB soil screening level for protection of groundwater of 100 mg/kg and the U.S. EPA residential screening level of 110 mg/kg for residential development. Figure 7 shows the areas of petroleum hydrocarbon impacts within the upper foot of soils on the east portion of the Project Site.

Petroleum hydrocarbons were also present in five of six perched groundwater samples, at concentrations ranging from 520 micrograms per liter (ug/L, equivalent to parts per billion, or ppb) to 2,000 ug/L. These concentrations exceed the RWQCB NPDES discharge limit of 100 ug/L and the U.S. EPA residential screening level for tap water of 5.5 ug/L. Figure 8 shows the locations of wells within the shallow perched groundwater zone that are impacted by petroleum hydrocarbons.

3. SIGNIFICANCE THRESHOLDS

Appendix G of the CEQA Guidelines contain thresholds of significance to analyze potential impacts on hydrology, water quality, and groundwater. This report includes and analyzes each applicable threshold. The CEQA Appendix G thresholds ask whether a Project would:

a) Violate any water quality standards or waste discharge requirements or otherwise substantially degrade surface or groundwater water quality;

b) Substantially decrease groundwater supplies or interfere substantially with groundwater recharge such that the project may impede sustainable groundwater management of the basin;

c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or through the addition of impervious surfaces, in a manner which would: (i) result in substantial erosion or siltation on- or off-site; (ii) substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site; (iii) create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff; (iv) impede or redirect flood flows?

d) In flood hazard, tsunami, or seiche zones, risk release of pollutants due to project inundation.

4. PROJECT CONDITIONS

4.1 DURING CONSTRUCTION

On the east portion of the Project Site, construction activities will include demolition of the existing buildings and parking lot, excavation to approximately 30 feet below grade to construct foundations and underground parking, and construction of the new mixed-use apartment building. On the west portion of the Project Site, the facades of the commercial buildings may be upgraded and parts of the parking lot may be re-paved and/or re-striped, but not as part of the Proposed Project. Prior to beginning any construction activity for the Proposed Project, including site clearing and demolition work, a construction Storm Water Pollution Prevention Plan (SWPPP), and implement applicable BMPs identified in the SWPPP. The SWPPP, any amendments, and monitoring reports are to be posted to the State Water Resources Control Board's Stormwater Multiple Application and Report Tracking System (SMARTS) website. BMPs will be designed and maintained as part of the implementation of the SWPPP in compliance with the Construction General Stormwater Permit.

Construction activities will involve the excavation and offsite disposal of soils, along with the dewatering of impacted shallow groundwater, if encountered. Existing soil testing data will be used to develop an excavation plan and a worker health and safety plan, and to conduct waste profiling to identify the appropriate disposition and disposal facility for the affected soils. These documents will be provided to the California Regional Water Quality Control Board – Los Angeles Region for review and approval prior to beginning excavation. Shallow groundwater, if encountered, will be pumped from the excavation and is proposed to be treated with a granular activated carbon treatment system consisting of a settling tank, two carbon vessels and potentially a particulate filter. The treated water would be discharged to either a local storm drain outfall under an NPDES permit or to a sanitary sewer tie-in, depending on discharge volume.

4.2 DURING OPERATION

The Proposed Project qualifies as a "Designated Project" under the LACDPW Low Impact Development (LID) standards because more than 5,000 square feet of impervious surface on a site that was previously developed will be replaced. The Project Site generally does not have stormwater quality control measures in the existing condition.

Runoff under existing (baseline) conditions and Proposed Project conditions as a result of a modeled 50-year 24-hour design storm event, calculated using the LACDPW HydroCalc program, are discussed in Section 2.1.2 and presented in Table 1. The City and County LID standards provide stormwater management requirements for "Designated Projects" and include items such as management of stormwater quality design volume (SWQDv) on-site using infiltration, evapotranspiration, stormwater runoff harvesting and re-use, or a combination of these methods.

On the east portion of the Project Site, the existing parking lot and commercial buildings will be replaced by a new mixed-use apartment building. Loading docks and waste management areas will be covered and not exposed to rainfall. Runoff from the roof, patios, and passageway areas will be harvested for re-use and any excess runoff will be routed through flow-through planter areas prior to discharge to the storm sewer system. Runoff from the west portion of the Project Site is anticipated to be managed in materially the same way it currently is, and any activities on that portion of the Project Site are not part of the Proposed Project. Also note that, since all of the DIs are currently located on the west portion of the Project Site, the amount of stormwater entering the DIs will be substantially reduced since there will be virtually no additional runoff from the east portion of the Project Site that is routed to the western portion in the existing conditions.

Due to the relatively shallow depth to groundwater, especially relative to the foundation for the underground parking garage, and the presence of petroleum hydrocarbons in the underlying soils, infiltration of stormwater is not technically feasible and would not be permitted by RWQCB. Therefore, other alternatives for stormwater management will need to be implemented at the site. As discussed above, site-specific source control measures are incorporated into the design of the new mixed-use building to be constructed on the east portion of the Project Site (i.e. covering all waste management and loading dock areas; harvesting rainwater; use of flow-through planters).

As defined in the LACDPW LID Standards, the SWQDv is the runoff from the larger of a 0.75-inch, 24-hour rain event or the 85th percentile rain event. Based on the isohyetal map in the LACDPW Analysis of the 85th Percentile 24-Hour Rainfall Depth document, the 85th percentile 24-hour rainfall event is 1.15 inches at the Project Site. Therefore, the SWQDv is based on the 85th percentile rain event and has been calculated using HydroCalc. Appendix B provides the HydroCalc output files for the 85th percentile model evaluations. As shown in the right-hand column of Table 1, for the Proposed Project on the east portion of the Project Site, the SWQDv is 10,440 cubic feet, or approximately 78,100 gallons.

Harvested rainwater will be used for landscape irrigation and maintenance needs. Rainwater harvesting will be accomplished using rooftop gutters and downspouts to route the water to cisterns or storage tanks within or beneath the building. This stormwater quality control measure is comparable to Measure RET-6: Rain Barrel/Cistern in Appendix E of the LACDPW LID Standards Manual, including the maintenance requirements, except that cisterns or large tanks will be used in lieu of rain barrels due to the size of the building.

Planters installed on the Project Site will be designed to filter excess runoff to improve stormwater quality. Runoff from the building roof and other areas that exceeds the SWQDv will be routed to flow-through planters to improve the quality of stormwater runoff that exceeds the retention requirements under the LID standards. In addition, available harvested rainwater will be used to irrigate the planters during the dry season to minimize the Proposed Project’s demand for potable water for landscape irrigation purposes. The planters would be comparable to Measures VEG-2: Stormwater Planter and VEG-3: Tree-Well Filter as described in Appendix E of the LACDPW LID Standards Manual. Appendix C contains the LACDPW LID descriptions for RET-6, VEG-2, and VEG-3.

5. PROJECT IMPACT ANALYSIS

5.1 CEQA APPENDIX G THRESHOLDS

a) Will the Project violate any water quality standards or waste discharge requirements or otherwise substantially degrade surface or groundwater water quality?

Construction activities for the Proposed Project include demolition of existing commercial buildings and paved parking areas, excavation to approximately 30 feet below grade for foundation and underground parking, building up the structure, and hardscape and landscape around the structure. Exposed and stockpiled soils may contain petroleum hydrocarbons and could be subject to erosion and conveyance into nearby storm drains. Dewatering of perched water, which also contains petroleum hydrocarbons, could result in the release of contaminants into the storm sewer or sanitary sewer system.

The construction area is greater than one acre, so the Proposed Project would be required to obtain coverage under the NPDES General Construction Activity Permit (order No. 2009-0009-SWQ). In accordance with the requirements of this permit, the Applicant would file an NOI and implement a SWPPP that specifies BMPs and erosion control measures to be used during construction. Construction activities are temporary and flow directions and runoff volumes during construction will be controlled. In addition, the Proposed Project would be required to comply with all applicable City grading permit regulations that require necessary measures, plans, and inspections to reduce sedimentation and erosion. Water produced during dewatering will be treated to remove contaminants and discharged under applicable permits to the storm or sanitary sewer system. Thus, through compliance with all NPDES General Construction Permit requirements, including preparation of a SWPPP, implementation of BMPs, compliance with applicable City grading regulations, and treatment of dewatering water prior to discharge, the Proposed Project would not violate any water quality standards or waste discharge requirements, or otherwise substantially degrade surface or groundwater quality during construction.

After completion of the Proposed Project construction, appropriate LID Stormwater Quality Control Measures will be implemented on the newly-constructed mixed-use building. These include Measures VEG-2 (flow-through planters) and VEG-3 (flow through tree rings) to filter runoff in excess of the SWQDv and harvested rainwater used for landscape irrigation. The total volume of runoff will also be reduced by harvesting the SWQDv (Measure RET-6 rainwater harvesting). Since there are currently no stormwater quality control measures present at the site, the Proposed Project will improve the quality and reduce the volume of stormwater runoff compared to existing conditions.

b) Will the Project substantially decrease groundwater supplies or interfere substantially with groundwater recharge such that the project may impede sustainable groundwater management of the basin?

The Proposed Project will not rely on groundwater for any water supply needs after it is constructed. During construction, dewatering may be required for excavation of the foundation and underground parking levels if the water levels in the shallow perched groundwater zone are within the depth of excavation. As shown on Figure 6, the extent of the perched groundwater zone is limited to the northern part of east portion of the Project Site. This perched groundwater zone is contaminated with petroleum hydrocarbons and is not suitable for potable groundwater supply. Furthermore, the perched groundwater zone is not part of the regional aquifers that provide usable groundwater supplies. The regional aquifers are at least 120 feet below ground surface in the area of the Project Site, which is much deeper than the maximum depth of excavation. The Project Site is currently covered with commercial buildings and a paved parking lot. The west portion of the Project Site will remain in materially the same condition, and any activities performed there are not considered part of the Proposed Project. On the east portion of the Project Site, the existing commercial buildings and parking lot will be replaced with a mixed-use apartment building. Due to the characteristics of the Proposed Project and the existing geologic and groundwater conditions, there will be no change in the amount of rainfall that might percolate through the Project Site to groundwater.

c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or through the addition of impervious surfaces, in a manner which would: (i) result in substantial erosion or siltation on- or off-site; (ii) substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site; (iii) create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff; (iv) impede or redirect flood flows?

The Proposed Project will not alter the overall drainage pattern of the Project Site and there are no streams or rivers on or near it. The Project Site is covered almost completely with impervious surfaces, under both existing and proposed conditions, such that there is little or no potential for erosion or siltation to occur. Due to the rainwater harvesting that will occur as part of the improvements on the east portion of the Project Site, there will be less runoff from the site after the Project is completed than under current conditions.

The Proposed Project will comply with City and County LID standards by harvesting rainwater (Measure RET-6) to reduce the amount of stormwater runoff compared to existing conditions, and by using flow-through planters and tree rings (Measures VEG-2 and VEG-3, respectively) to improve the quality of any remaining runoff from the east portion of the Project Site. Stormwater runoff volumes and management will not change on the west side of the Project Site, and it is not considered part of the Proposed Project for purposes of impact analysis.

As shown in Table 1, under existing conditions, runoff from the east portion of the Project Site for the 50-year 24-hour design storm event and for the SWQDv are 58,009 cubic feet and 11,500 cubic feet, respectively. After completion of the Proposed Project, runoff from the east portion of the Project Site for the 50-year 24-hour design storm event and for the SWQDv will be reduced to 53,215 cubic feet and 10,440 cubic feet, respectively. Thus, the Proposed Project will result in a reduction of the total volume of runoff and an improvement of the quality of the runoff.

As shown on Figure 5, the Project Site is not located in or near a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map. Therefore, the Project will not impede or redirect flood flows, or place housing within a 100-year flood hazard area.

The Project Site is within the potential inundation area of the Hollywood Reservoir according to the City of Los Angeles General Plan Safety Element, Exhibit G: Inundation and Tsunami Hazard Areas (https://planning.lacity.org/cwd/ gnlpln/saftyelt.pdf). Dam safety regulations are the primary means of reducing damage or injury due to inundation occurring from dam failure. The California Division of Safety of Dams (DSoD) regulates the siting, design, construction, and periodic review of all dams in the State. In addition, dams and reservoirs are monitored during storms and measures are instituted in the event of potential overflow. These measures include seismic retrofits and other related dam improvements completed under the requirements of the 1972 State Dam Safety Act. Further, in the event of a dam failure at the Hollywood Reservoir, existing urban development north of the Project Site, including the US 101 Freeway, would serve as a physical barrier between the reservoir and the Project Site. Therefore, the risk of flooding from inundation due to the failure of the dam at Hollywood Reservoir is considered low.

d) In flood hazard, tsunami, or seiche zones, risk release of pollutant due to project inundation?

A seiche is an oscillating wave that forms within an enclosed water body, such as a lake or a pond, due to prolonged winds or an earthquake. If the height of the oscillating wave exceeds the freeboard of the enclosed water body, then surrounding properties could be inundated. There are no enclosed water bodies in which a seiche could form near the Project Site.

A tsunami is a large wave that forms in an ocean or very large lake due to seismic shaking or an earthquake-generated submarine landslide. The Project Site is located 8.75 miles from the Pacific Ocean and is at an elevation of 180 feet or more above sea level. According to the City of Los Angeles General Plan Safety Element, Exhibit G: Inundation and Tsunami Hazard Areas (https://planning.lacity.org/cwd/gnlpln/saftyelt.pdf), the Project Site is not within a tsunami hazard area and thus is not prone to being inundated by a tsunami.

A mudflow forms when excessive rainfall occurs on steep slopes or slopes on which vegetation has been removed (for example, due to a brush fire). The Project Site is not located adjacent to and downslope of areas of steep slopes or bare soils, as indicated on Figures E-1 and E-2 of Appendix E of the City of Los Angeles LID Handbook, as cited above. All areas adjacent to the Project Site are urbanized and have been developed. Therefore, the Project Site is not subject to inundation by a mudflow.

6. OVERALL LEVEL OF SIGNIFICANCE

Based on the analysis contained in this report, no significant impacts have been identified for surface water and groundwater hydrology or for surface water and groundwater quality for the Proposed Project.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

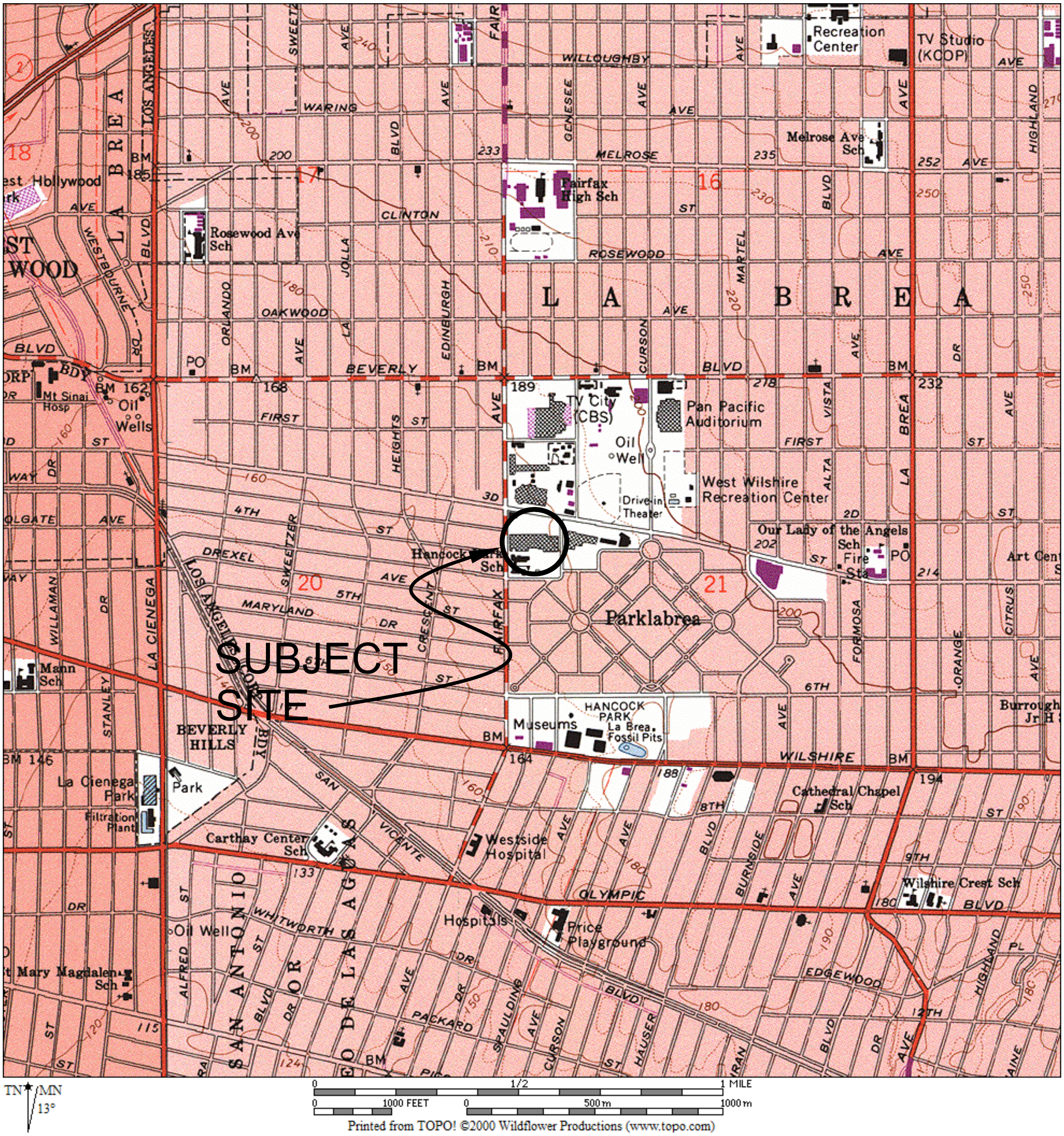
1. The recommendations of this report pertain only to the site investigated and are based upon the assumption that the soil and groundwater conditions do not deviate from those disclosed in the investigation. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that anticipated herein, Geocon West, Inc. should be notified so that supplemental recommendations can be given. The evaluation or identification of the potential presence of hazardous or corrosive materials was not part of the scope of services provided by Geocon West, Inc.

2. This report is issued with the understanding that it is the responsibility of the owner, or of his representative, to ensure that the information and recommendations contained herein are brought to the attention of the architect and engineer for the project and incorporated into the plans, and the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.

3. The findings of this report are valid as of the date of this report. However, changes in the conditions of a property can occur with the passage of time, whether they are due to natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of three years.

Table 1
Hydrology Parameters and HydroCalc Results
3rd and Fairfax Project
Los Angeles, California

Site Parameters					50-yr 24-hr rain event (L.A. CEQA Threshold)					85th Percentile 24-hr event (LID Manual)				
Site Area	Condition	Area (acres)	Slope	Percent Impervious	Rainfall Depth (in)	Peak Intensity (in/hr)	Time of Conc. (Cd, minutes)	Peak Flow Rate (cubic feet per second)	Peak Runoff (cubic feet)	Rainfall Depth (in)	Peak Intensity (in/hr)	Time of Conc. (Cd, minutes)	Peak Flow Rate (cubic feet per second)	Peak Runoff (cubic feet)
Entire Site	Existing	7.1	0.009	96	5.78	2.62	9	16.7	128,719	1.15	0.316	26	1.95	25,514
West Half	Existing & Proposed	3.9	0.0086	96	5.78	3.17	6	11.1	70,701	1.15	0.376	18	1.27	14,015
East Half	Existing	3.2	0.0097	96	5.78	3.45	5	9.9	58,009	1.15	0.397	16	1.1	11,500
East Half	Proposed	3.2	0.0097	86	5.78	3.45	5	9.9	53,215	1.15	0.386	17	0.97	10,440



REFERENCE:U.S.G.S. TOPOGRAPHIC MAPS, 7.5 MINUTE SERIES, HOLLYWOOD, CA QUADRANGLE

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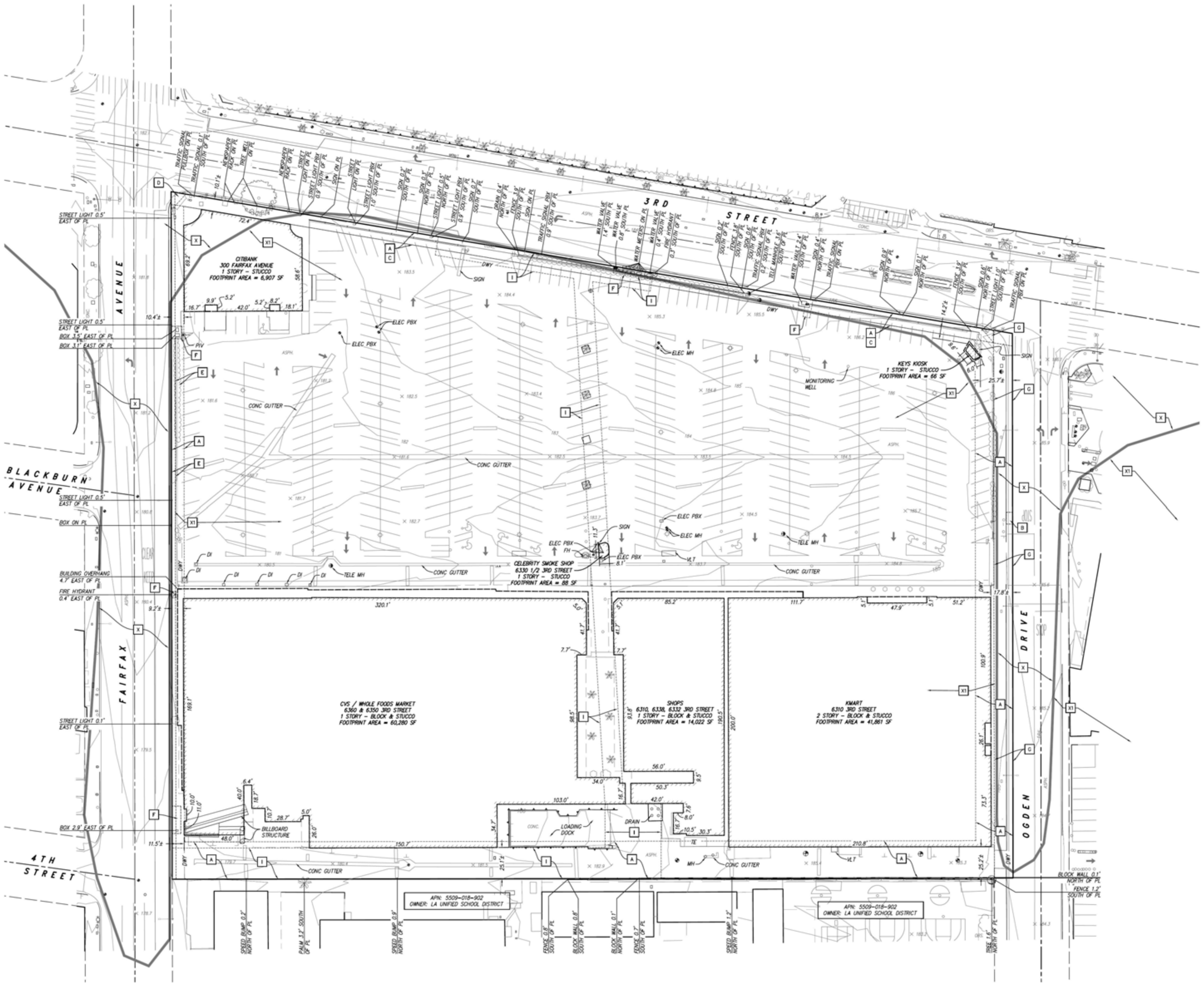
ENVIRONMENTAL GEOTECHNICAL MATERIALS
3303 N. SAN FERNANDO BLVD. - SUITE 100 - BURBANK, CA 91504
PHONE (818) 841-8388 - FAX (818) 841-1704

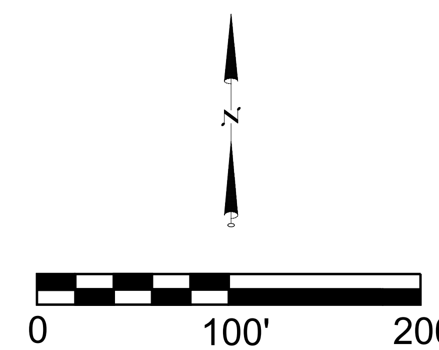
DRAFTED BY: JTA | CHECKED BY: NDB

PROJECT SITE LOCATION

3RD STREET AND FAIRFAX AVENUE
LOS ANGELES, CALIFORNIA

JAN 2019	PROJECT NO. A9713-06-01	FIG. 1





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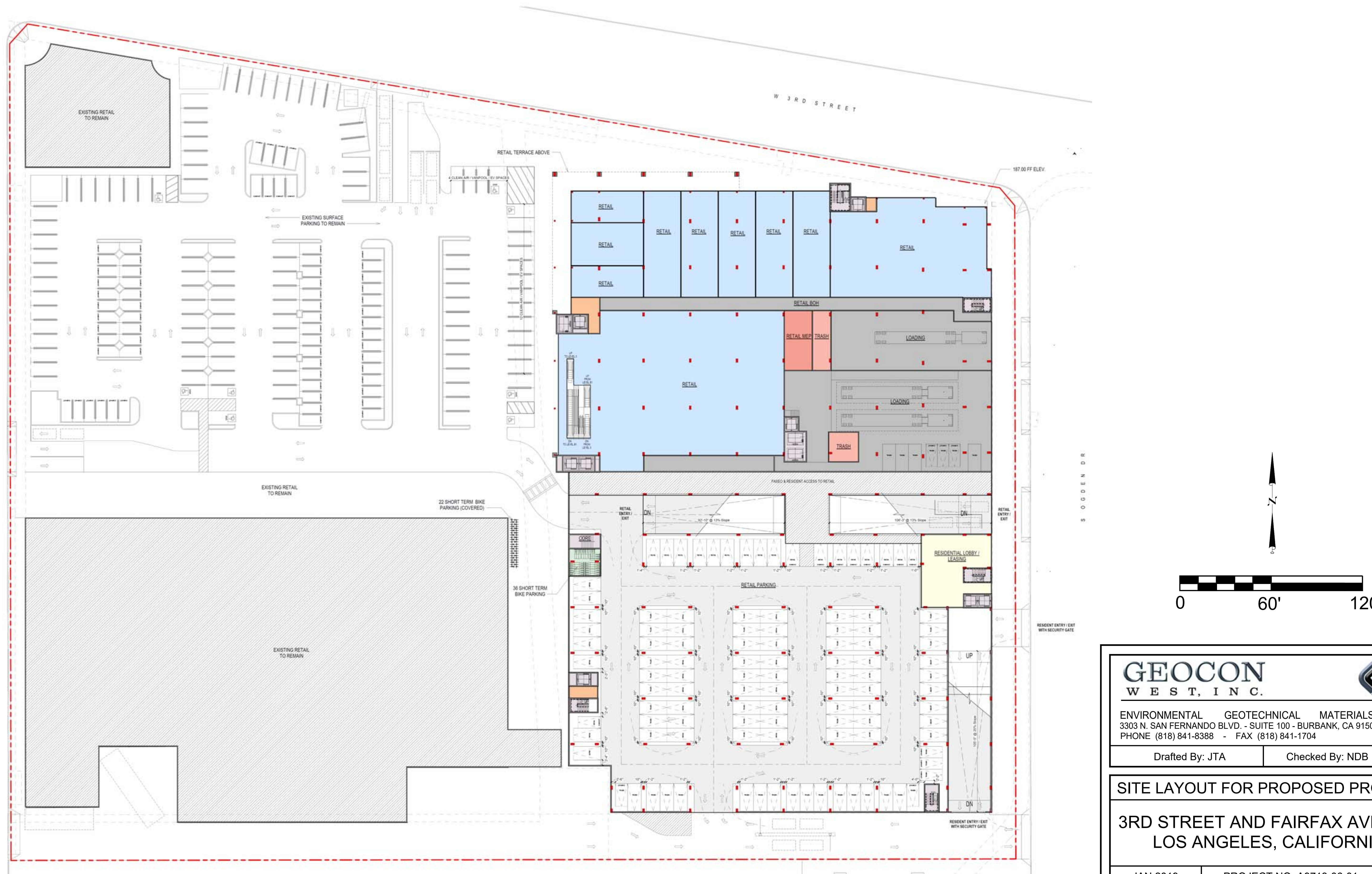
EXISTING CONDITIONS AT PROJECT SITE

3RD STREET AND FAIRFAX AVENUE
LOS ANGELES, CALIFORNIA

JAN 2019	PROJECT NO. A9713-06-01	FIG. 2



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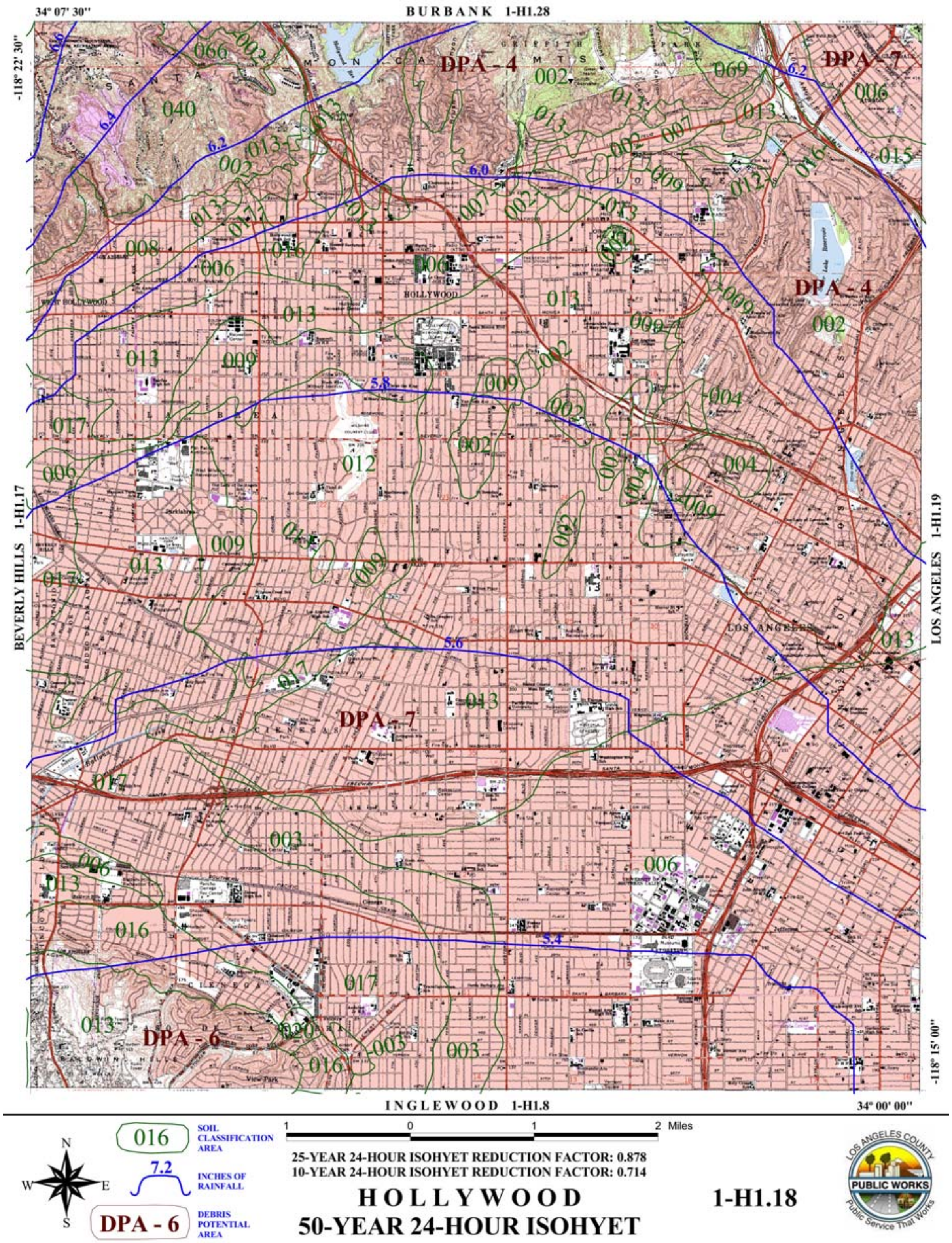
SITE LAYOUT FOR PROPOSED PROJECT

3RD STREET AND FAIRFAX AVENUE
LOS ANGELES, CALIFORNIA

JAN 2019	PROJECT NO. A9713-06-01	FIG. 3



HOLLYWOOD 50-YEAR 24-HOUR ISOHYET 1-H1.18

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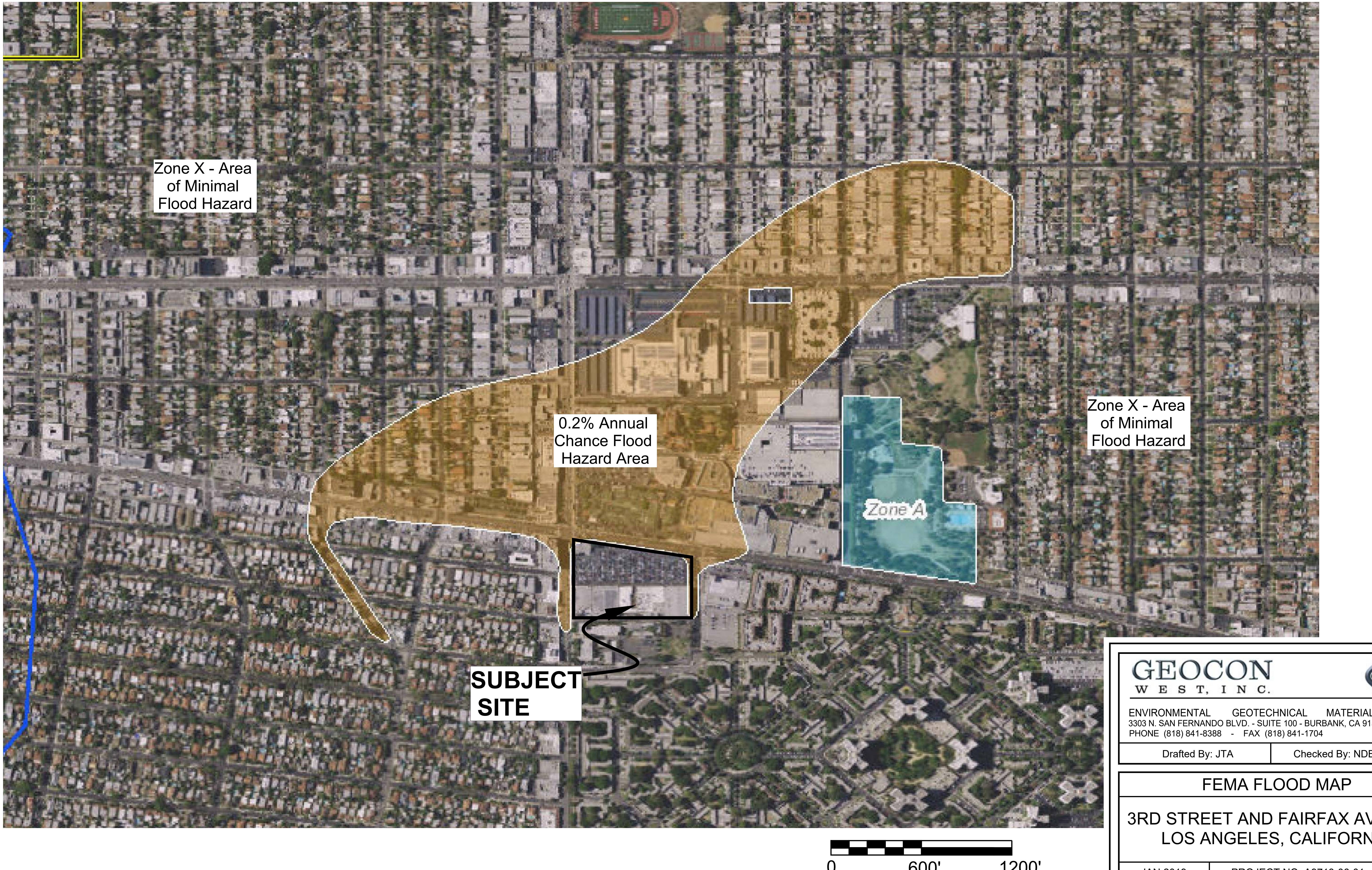
BALLONA CREEK WATERSHED

3RD STREET AND FAIRFAX AVENUE
LOS ANGELES, CALIFORNIA

JAN 2019	PROJECT NO. A9713-06-01	FIG. 4



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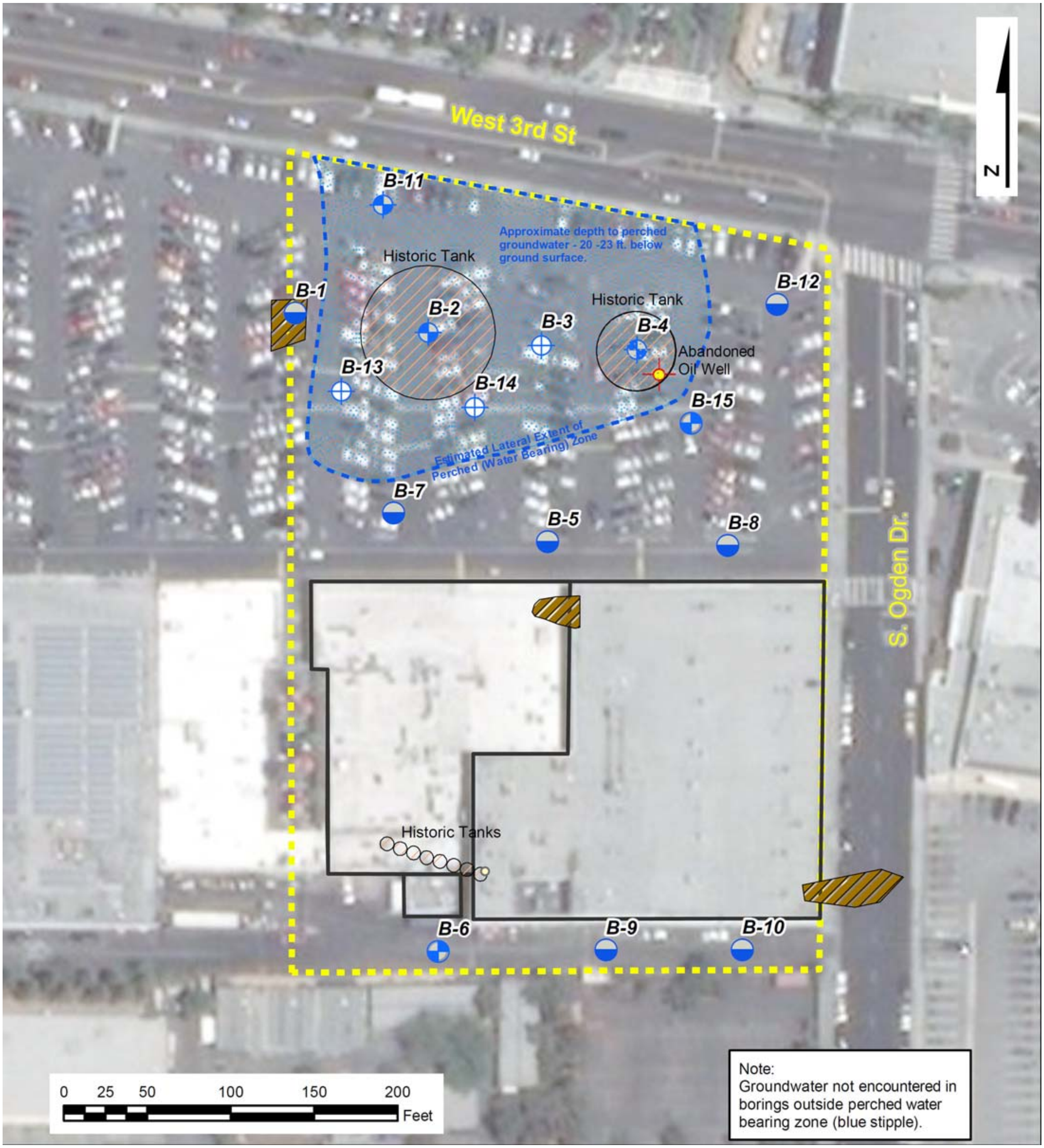
FEMA FLOOD MAP

3RD STREET AND FAIRFAX AVENUE
LOS ANGELES, CALIFORNIA

JAN 2019	PROJECT NO. A9713-06-01	FIG. 5



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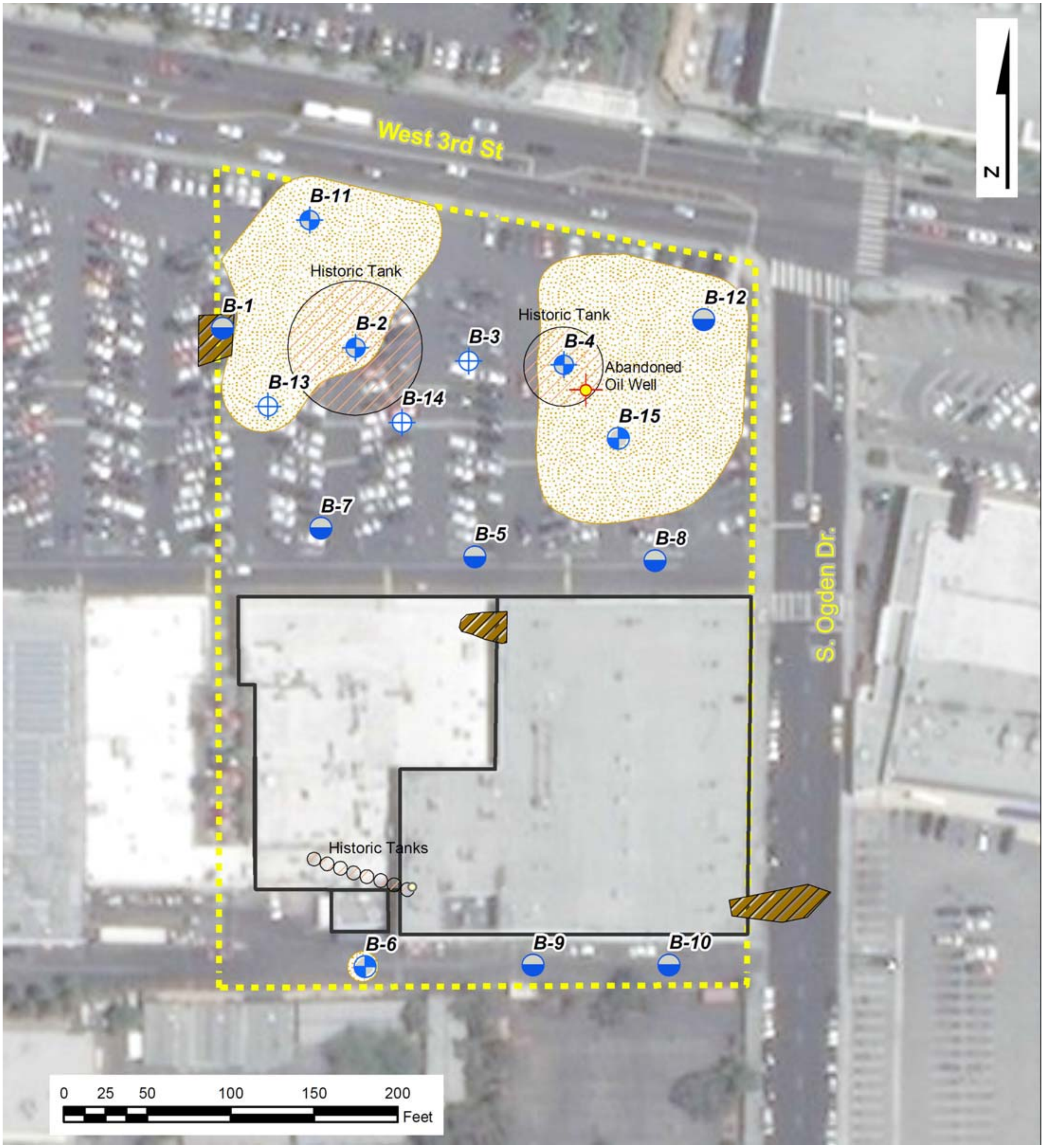
PERCHED WATER AND OIL FIELD FEATURES

3RD STREET AND FAIRFAX AVENUE
LOS ANGELES, CALIFORNIA

JAN 2019	PROJECT NO. A9713-06-01	FIG. 6



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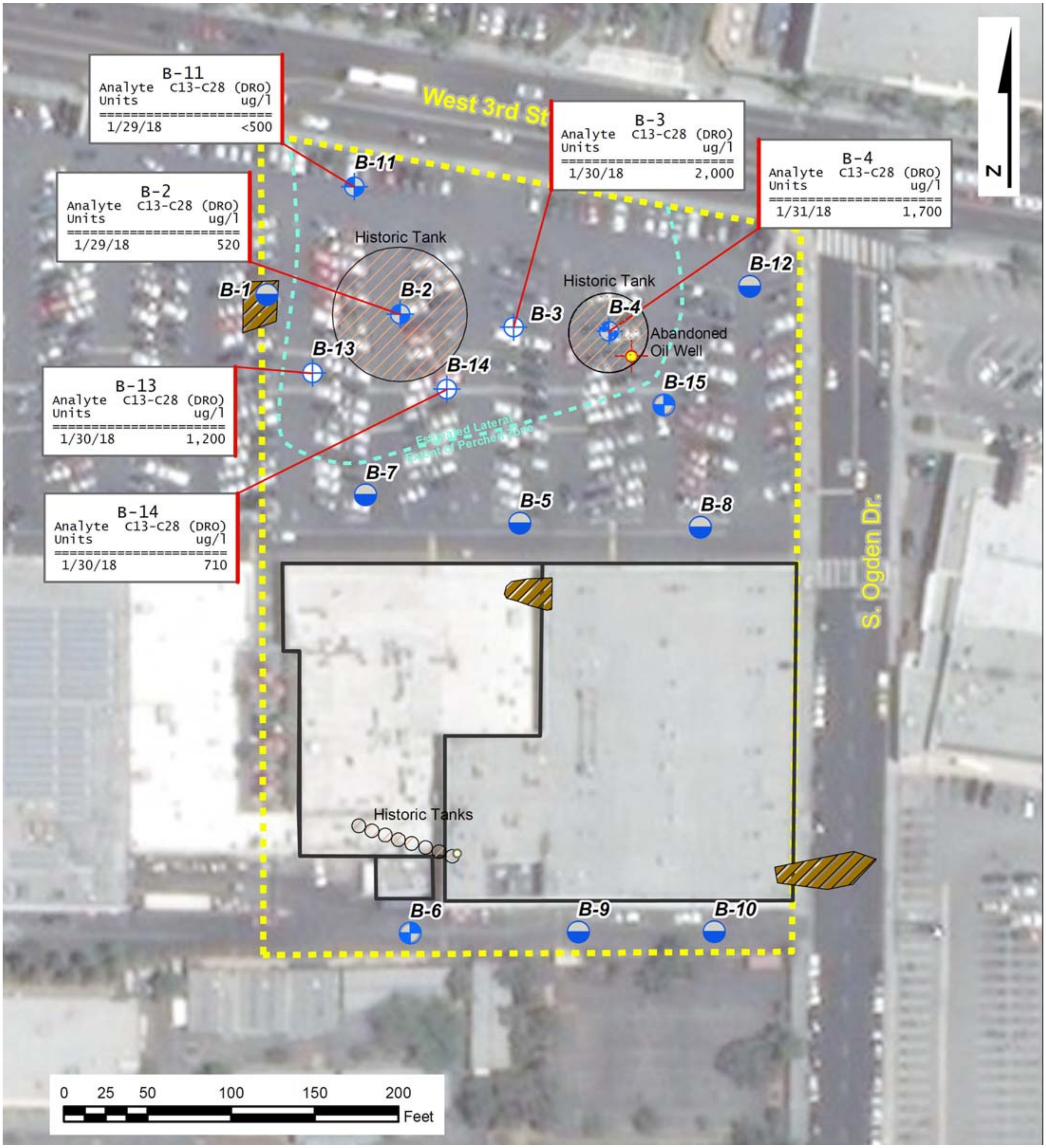
SOIL CONTAMINATION AREAS

3RD STREET AND FAIRFAX AVENUE
LOS ANGELES, CALIFORNIA

JAN 2019 | PROJECT NO. A9713-06-01 | FIG. 7



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PERCHED WATER IMPACTS

3RD STREET AND FAIRFAX AVENUE
LOS ANGELES, CALIFORNIA

DRAFTED BY: JTA	CHECKED BY: NDB	JAN 2019	PROJECT NO. A9713-06-01	FIG. 8

APPENDIX A

APPENDIX A

HYDROCALC MODEL OUTPUT
FOR 50-YEAR 24-HOUR DESIGN STORM EVENT

Peak Flow Hydrologic Analysis

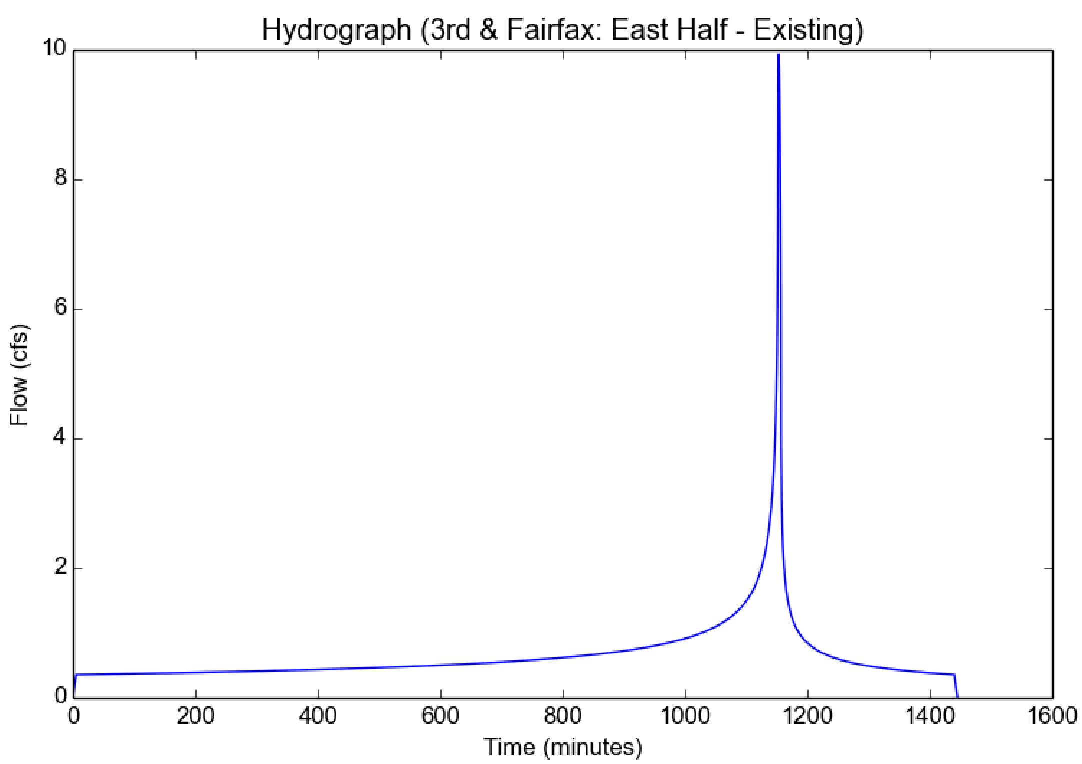
File location: C:/Users/Owner/Documents/Documents/Geocon/3rd & Fairfax/LA County DPW/3rd & Fairfax - East Half - Existing.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	3rd & Fairfax
Subarea ID	East Half - Existing
Area (ac)	3.2
Flow Path Length (ft)	310.0
Flow Path Slope (vft/hft)	0.0097
50-yr Rainfall Depth (in)	5.78
Percent Impervious	0.96
Soil Type	13
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	5.78
Peak Intensity (in/hr)	3.4485
Undeveloped Runoff Coefficient (Cu)	0.9
Developed Runoff Coefficient (Cd)	0.9
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	9.9317
Burned Peak Flow Rate (cfs)	9.9317
24-Hr Clear Runoff Volume (ac-ft)	1.3317
24-Hr Clear Runoff Volume (cu-ft)	58009.399



Peak Flow Hydrologic Analysis

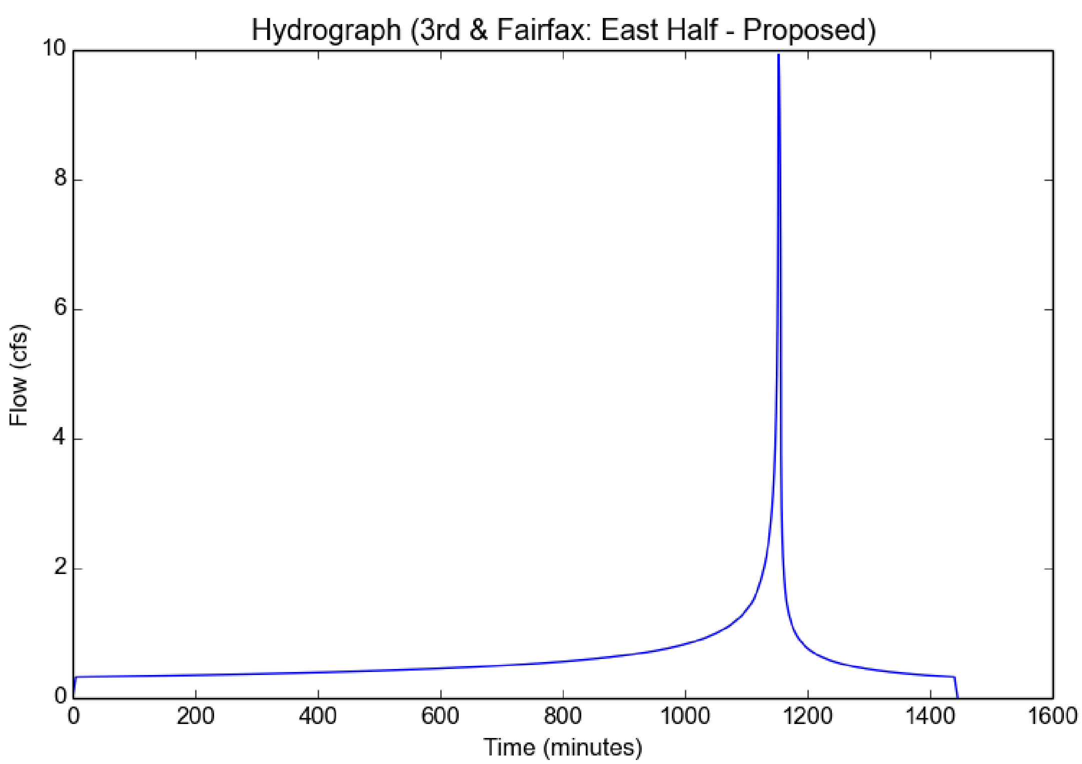
File location: C:/Users/Owner/Documents/Documents/Geocon/3rd & Fairfax/LA County DPW/3rd & Fairfax - East Half - Proposed.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	3rd & Fairfax
Subarea ID	East Half - Proposed
Area (ac)	3.2
Flow Path Length (ft)	310.0
Flow Path Slope (vft/hft)	0.0097
50-yr Rainfall Depth (in)	5.78
Percent Impervious	0.86
Soil Type	13
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	5.78
Peak Intensity (in/hr)	3.4485
Undeveloped Runoff Coefficient (Cu)	0.9
Developed Runoff Coefficient (Cd)	0.9
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	9.9317
Burned Peak Flow Rate (cfs)	9.9317
24-Hr Clear Runoff Volume (ac-ft)	1.2217
24-Hr Clear Runoff Volume (cu-ft)	53215.2495



Peak Flow Hydrologic Analysis

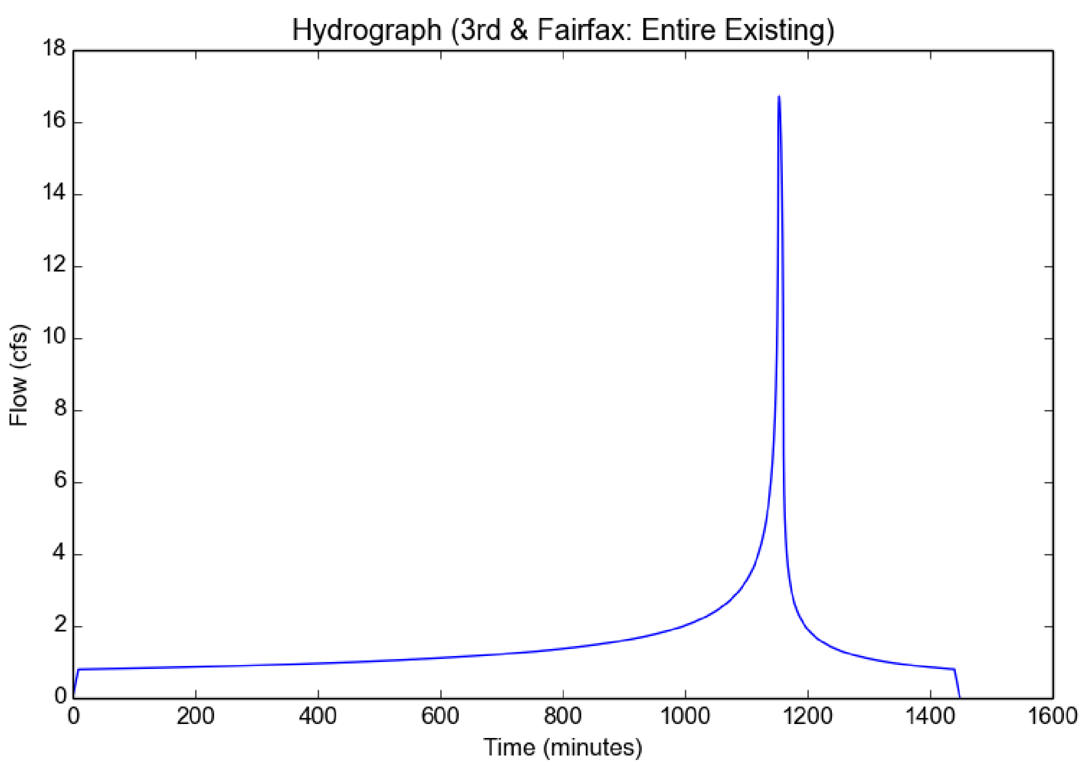
File location: C:/Users/Owner/Documents/Documents/Geocon/3rd & Fairfax/LA County DPW/3rd & Fairfax - Entire Existing.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	3rd & Fairfax
Subarea ID	Entire Existing
Area (ac)	7.1
Flow Path Length (ft)	660.0
Flow Path Slope (vft/hft)	0.009
50-yr Rainfall Depth (in)	5.78
Percent Impervious	0.96
Soil Type	13
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	5.78
Peak Intensity (in/hr)	2.6161
Undeveloped Runoff Coefficient (Cu)	0.8992
Developed Runoff Coefficient (Cd)	0.9
Time of Concentration (min)	9.0
Clear Peak Flow Rate (cfs)	16.7163
Burned Peak Flow Rate (cfs)	16.7163
24-Hr Clear Runoff Volume (ac-ft)	2.955
24-Hr Clear Runoff Volume (cu-ft)	128719.0593



Peak Flow Hydrologic Analysis

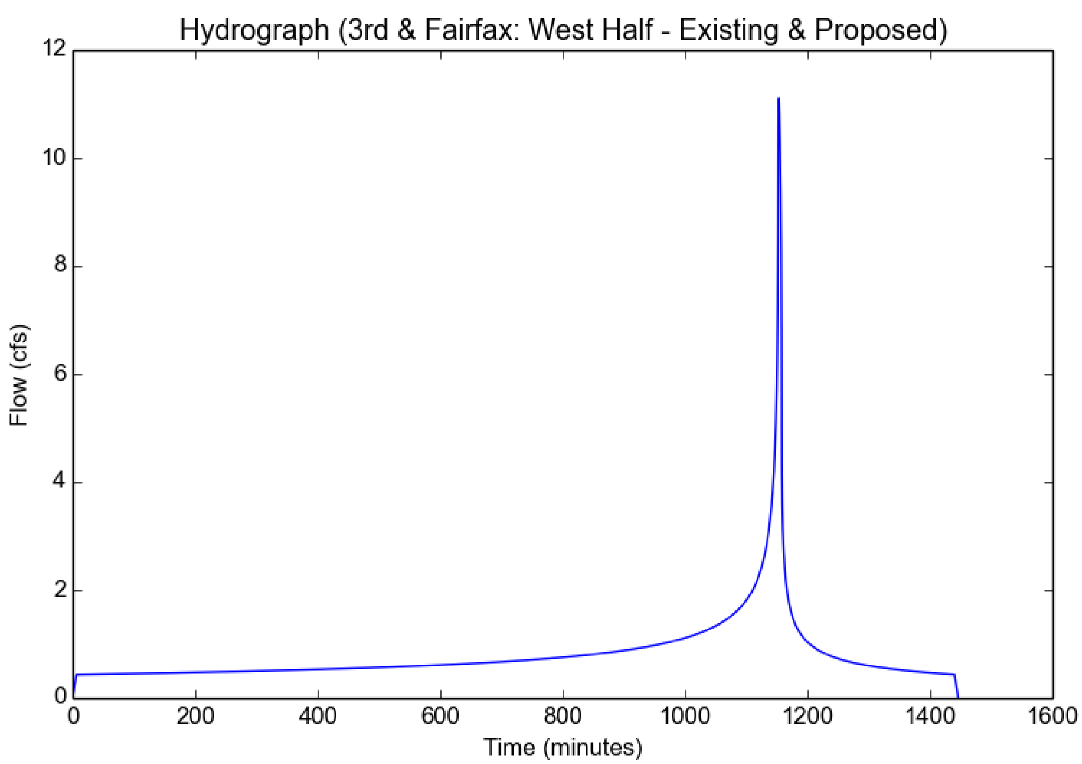
File location: C:/Users/Owner/Documents/Documents/Geocon/3rd & Fairfax/LA County DPW/3rd & Fairfax - West Half - Existing & Proposed.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	3rd & Fairfax
Subarea ID	West Half - Existing & Proposed
Area (ac)	3.9
Flow Path Length (ft)	350.0
Flow Path Slope (vft/hft)	0.0086
50-yr Rainfall Depth (in)	5.78
Percent Impervious	0.96
Soil Type	13
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	5.78
Peak Intensity (in/hr)	3.1653
Undeveloped Runoff Coefficient (Cu)	0.9
Developed Runoff Coefficient (Cd)	0.9
Time of Concentration (min)	6.0
Clear Peak Flow Rate (cfs)	11.1102
Burned Peak Flow Rate (cfs)	11.1102
24-Hr Clear Runoff Volume (ac-ft)	1.6231
24-Hr Clear Runoff Volume (cu-ft)	70700.8692



APPENDIX B

APPENDIX B

HYDROCALC MODEL OUTPUT
FOR 85TH PERCENTILE 24-HOUR RAIN EVENT

Peak Flow Hydrologic Analysis

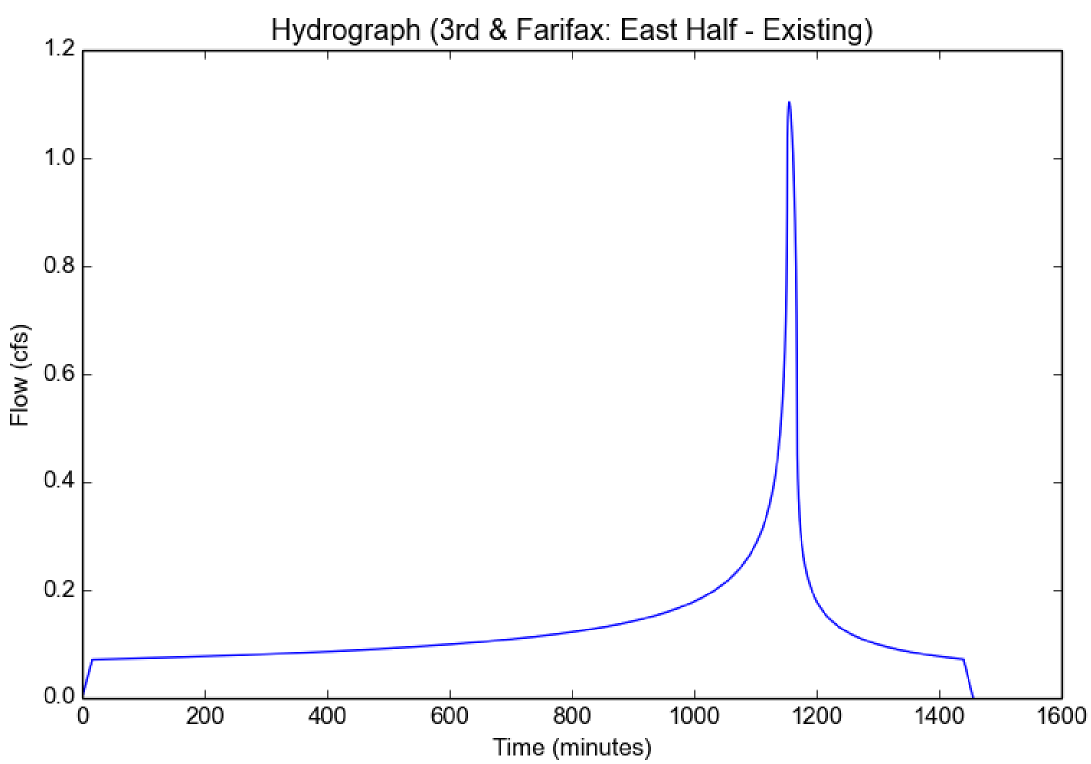
File location: C:/Users/Owner/Documents/Documents/Geocon/3rd & Fairfax/LA County DPW/3rd & Farifax - East Half - Existing - 85.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	3rd & Farifax
Subarea ID	East Half - Existing
Area (ac)	3.2
Flow Path Length (ft)	310.0
Flow Path Slope (vft/hft)	0.0097
85th Percentile Rainfall Depth (in)	1.15
Percent Impervious	0.96
Soil Type	13
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	1.15
Peak Intensity (in/hr)	0.3972
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.868
Time of Concentration (min)	16.0
Clear Peak Flow Rate (cfs)	1.1032
Burned Peak Flow Rate (cfs)	1.1032
24-Hr Clear Runoff Volume (ac-ft)	0.264
24-Hr Clear Runoff Volume (cu-ft)	11499.3012



Peak Flow Hydrologic Analysis

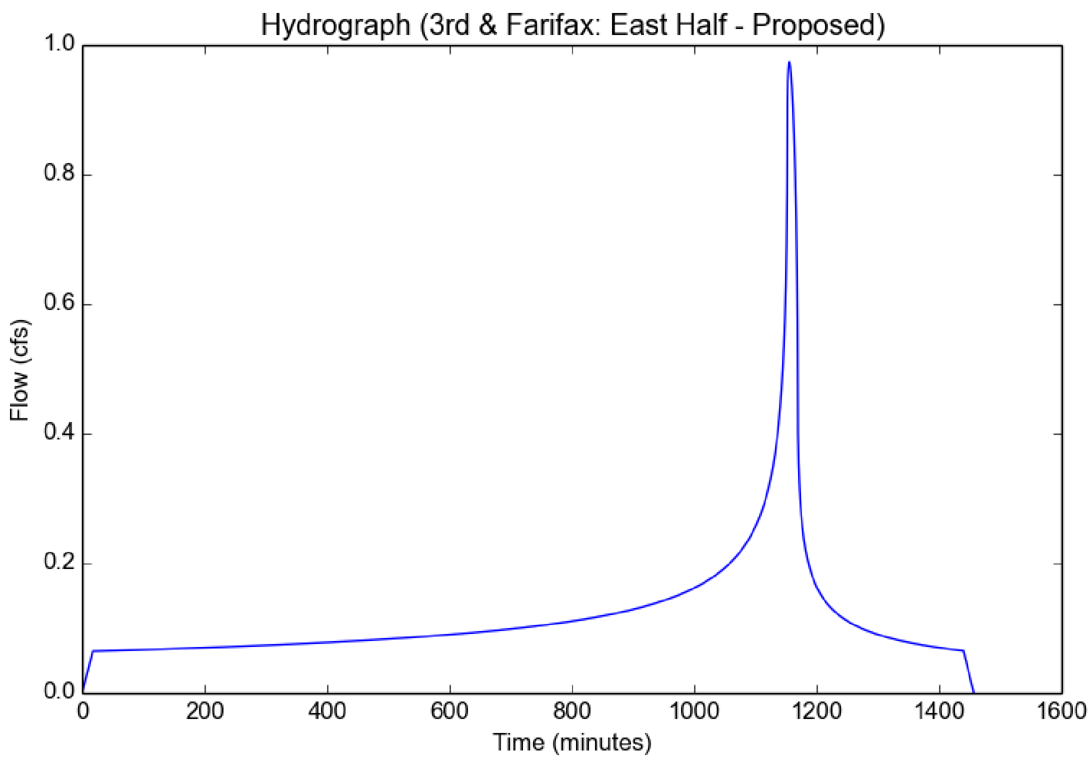
File location: C:/Users/Owner/Documents/Documents/Geocon/3rd & Fairfax/LA County DPW/3rd & Farifax - East Half - Proposed - 85.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	3rd & Farifax
Subarea ID	East Half - Proposed
Area (ac)	3.2
Flow Path Length (ft)	310.0
Flow Path Slope (vft/hft)	0.0097
85th Percentile Rainfall Depth (in)	1.15
Percent Impervious	0.86
Soil Type	13
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	1.15
Peak Intensity (in/hr)	0.386
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.788
Time of Concentration (min)	17.0
Clear Peak Flow Rate (cfs)	0.9734
Burned Peak Flow Rate (cfs)	0.9734
24-Hr Clear Runoff Volume (ac-ft)	0.2397
24-Hr Clear Runoff Volume (cu-ft)	10439.4622



Peak Flow Hydrologic Analysis

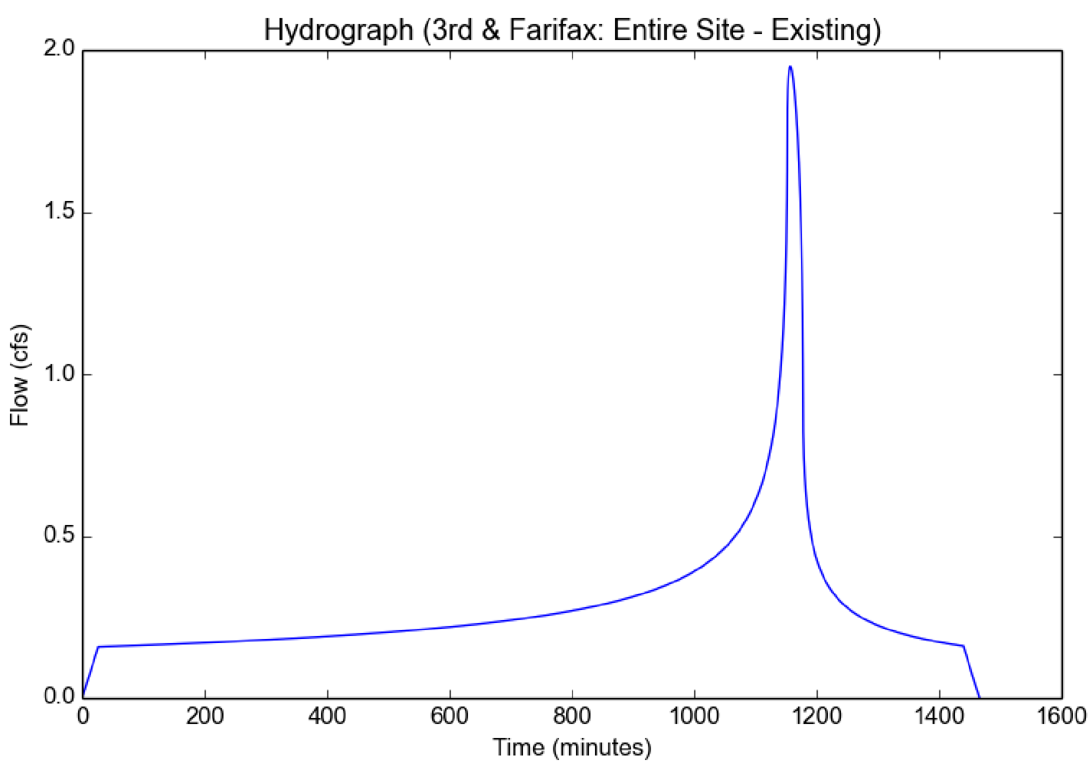
File location: C:/Users/Owner/Documents/Documents/Geocon/3rd & Fairfax/LA County DPW/3rd & Farifax - Entire Site - Existing - 85th.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	3rd & Farifax
Subarea ID	Entire Site - Existing
Area (ac)	7.1
Flow Path Length (ft)	660.0
Flow Path Slope (vft/hft)	0.009
85th Percentile Rainfall Depth (in)	1.15
Percent Impervious	0.96
Soil Type	13
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	1.15
Peak Intensity (in/hr)	0.3161
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.868
Time of Concentration (min)	26.0
Clear Peak Flow Rate (cfs)	1.9483
Burned Peak Flow Rate (cfs)	1.9483
24-Hr Clear Runoff Volume (ac-ft)	0.5857
24-Hr Clear Runoff Volume (cu-ft)	25514.2115



Peak Flow Hydrologic Analysis

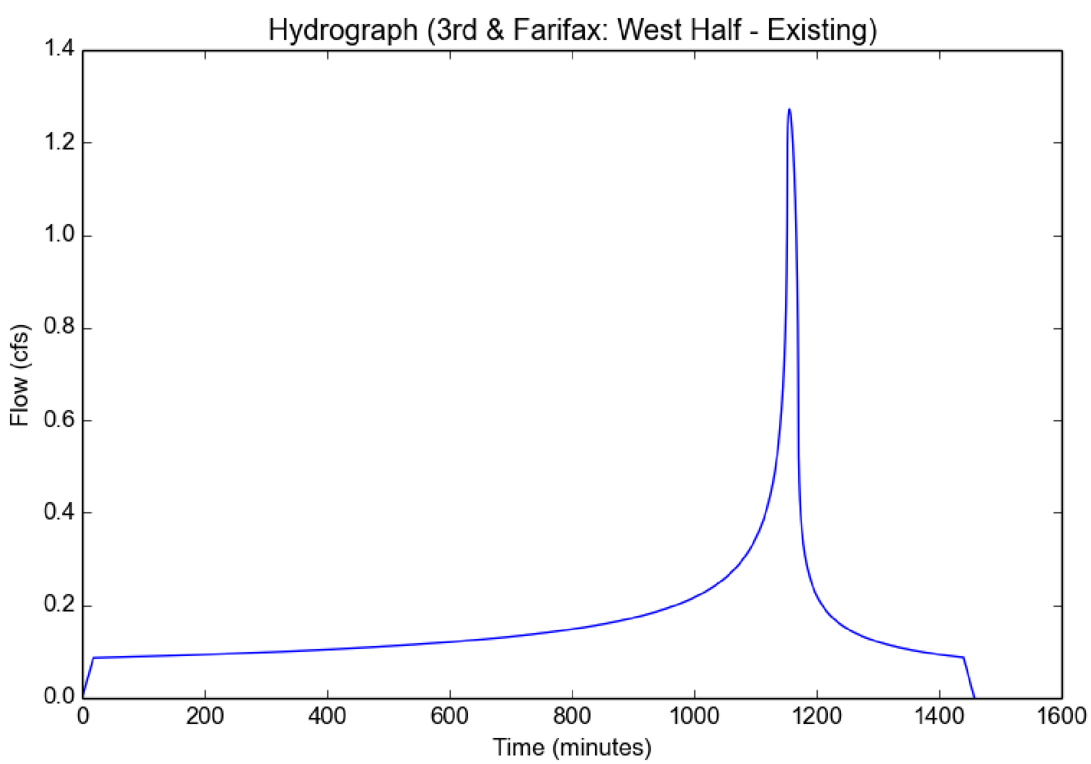
File location: C:/Users/Owner/Documents/Documents/Geocon/3rd & Fairfax/LA County DPW/3rd & Farifax - West Half - Existing - 85.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	3rd & Farifax
Subarea ID	West Half - Existing
Area (ac)	3.9
Flow Path Length (ft)	350.0
Flow Path Slope (vft/hft)	0.0086
85th Percentile Rainfall Depth (in)	1.15
Percent Impervious	0.96
Soil Type	13
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	1.15
Peak Intensity (in/hr)	0.3758
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.868
Time of Concentration (min)	18.0
Clear Peak Flow Rate (cfs)	1.2721
Burned Peak Flow Rate (cfs)	1.2721
24-Hr Clear Runoff Volume (ac-ft)	0.3217
24-Hr Clear Runoff Volume (cu-ft)	14014.7855



APPENDIX C

APPENDIX C

LACDPW LID STORMWATER QUALITY CONTROL MEASURES TO BE USED AT THE PROPOSED PROJECT

RET-6: Rain Barrel/Cistern

Description

Rain barrels and cisterns are containers that collect and store precipitation from rooftop drainage systems that would otherwise be lost to stormwater runoff and diverted to the storm drain system or receiving water. Collection of this precipitation reduces the volume of stormwater runoff and reduces the mobilization of potential pollutants.

Rain barrels are placed above ground beneath a shortened downspout next to a home or building and typically range in size from 50 to 180 gallons. Cisterns are larger storage tanks that may be located above or below ground. Both cisterns and rain barrels rely on gravity flow, not pumping devices. Rain barrels are equipped with a removable cover to allow access for maintenance, a screened inlet opening to trap debris and exclude vectors, an outlet spigot typically fitted for garden hose attachment, and an overflow outlet with discharge pipe or hose. Stored precipitation is typically used for landscape irrigation, but may also be used for washing. Water stored in rain barrels and cisterns should not be discharged to the storm drain system.

A schematic of a typical rain barrel is presented in Figure E-6.

LID Ordinance Requirements

Rain barrels and cisterns may be used to comply with the on-site retention requirements of the LID Ordinance for at least its tributary rooftop drainage area. The remaining project site SWQDv may need to be routed to other stormwater quality control measures for on-site retention. Rain barrels and cisterns will prevent pollutants in the SWQDv in its tributary rooftop drainage area from being discharged off-site.

Advantages

- Has a low installation cost
- Has a small footprint
- Reduces stormwater runoff volume and pollutant discharge
- Conserves water usage
- Is easy to maintain

Source: LID Center

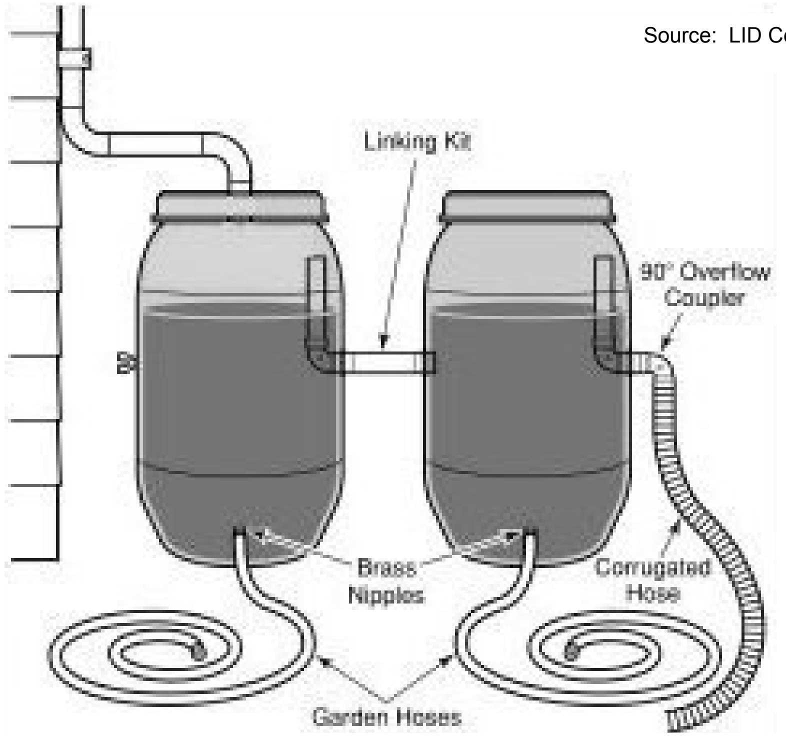


Figure E-6. Rain Barrel Schematic

Disadvantages

- May have limited storage volume
- Collects water that is not suitable for human or pet consumption or contact with fruits/vegetables
- May not be compatible with site aesthetics
- May result in standing water, which may allow vector breeding if not properly covered and maintained
- Requires individual owners/tenants to perform maintenance and empty rain barrels between storms

General Constraints and Implementation Considerations

- Rain barrels and cisterns should be located to allow for easy access and maintenance.
- Rain barrels should be elevated above the ground surface with a sturdy platform to provide spigot clearance.
- Screens or deflectors on rain gutters should be installed to minimize discharge of debris to rain barrels.
- Overflow from cisterns must be directed away from building foundations and to vegetated areas.

Maintenance Requirements

Maintenance and regular inspections are important for proper function of rain barrels and cisterns. Maintenance requirements for rain barrels are minimal and consist only of regular inspection of the unit as a whole and any of its constituent parts and accessories. The following are general maintenance requirements:

- Inspect all components (i.e., roof connection, gutter, downspout, rain barrel/cistern, mosquito screen, overflow pipe) at least twice per year, and repair or replace as needed.
- Clean insect and debris screens as needed.
- Eliminate standing water to prevent vector breeding.

A summary of potential problems that may need to be addressed by maintenance activities is presented in Table E-11.

The County requires execution of a maintenance agreement to be recorded by the property owner for the on-going maintenance of any privately-maintained stormwater quality control measures. The property owner is responsible for compliance with the maintenance agreement. A sample maintenance agreement is presented in Appendix H.

Table E-11: Rain Barrel/Cistern Troubleshooting Summary

Problem	Conditions When Maintenance Is Needed	Maintenance Required
Vector Breeding	Standing water longer than 96 hours after storm event	Empty rain barrel/cistern. Inspect insect screen to determine if it needs to be replaced.
Obstructions	Flow into rain barrel/cistern impeded	Remove obstructions.
Leaks	Leaks observed at roof connection, gutter, downspout, overflow pipe	Replace or repair components as needed. Replace entire rain barrel/cistern if necessary.

VEG-2: Stormwater Planter

Description

A stormwater planter is a stormwater quality control measure that is completely contained within an impermeable structure with an underdrain. Stormwater planters function as a soil- and plant-based filtration device that remove pollutants though a variety of physical, biological, and chemical treatment processes. A stormwater planter consists of a ponding area, mulch layer, planting soils, plantings, and an underdrain within the planter box. As stormwater runoff passes through the planting soil, pollutants are filtered, adsorbed, and biodegraded by the soil and plants. Stormwater planters are typically planted with native, drought-tolerant vegetation that does not require fertilization and can withstand wet soils for at least 96 hours.

Stormwater planters may be placed adjacent to or near buildings, other structures, or sidewalks. Stormwater planters can be used directly adjacent to buildings beneath downspouts as long as the planters are properly lined on the building side and the overflow outlet discharges away from the building to ensure water does not percolate into footings or foundations. They can also be placed further away from buildings by conveying roof runoff in shallow engineered open conveyances, shallow pipes, or other innovative drainage structures.

A schematic of a typical stormwater planter is presented in Figure E-9.

LID Ordinance Requirements

Stormwater planters can be used as a stormwater quality control measure to treat stormwater runoff for the following alternative compliance measures:

- Off-site infiltration;
- Groundwater replenishment projects; and
- Off-site retrofit of existing development.

The project applicant must ensure that all pollutants of concern are addressed when using a stormwater planter (see Section 7.4). The following table identifies the pollutants of concern that are treated to the water quality benchmark (see Table 7-2 of the LID Standards Manual) by a stormwater planter:

Pollutant of Concern	Treated by Stormwater Planters?
Suspended solids	No
Total phosphorus	No
Total nitrogen	Yes
Total Kjeldahl nitrogen	Yes
Cadmium, total	No
Chromium, total	Yes
Copper, total	No
Lead, total	Yes
Zinc, total	No

Source: Treatment Best Management Practices Performance, Los Angeles Regional Water Quality Control Board, December 9, 2013.

Advantages

- Has a low cost when integrated into site landscaping
- Can be useful for disconnecting downspouts
- Requires little space
- Is suitable for parking lots and sites with limited open area available for stormwater runoff treatment
- Reduces peak flows during small storm events
- Enhances site aesthetics
- May conserve water
- Requires little maintenance

Disadvantages

- May not be appropriate for industrial sites or locations with contaminated soils or where spills may occur because of the potential threat to groundwater contamination
- Is not suitable for areas with steep slopes
- Requires irrigation, which may conflict with water conservation ordinances or landscape requirements, to maintain vegetation
- May result in potentially increased cost due to waterproofing exterior building walls, if needed

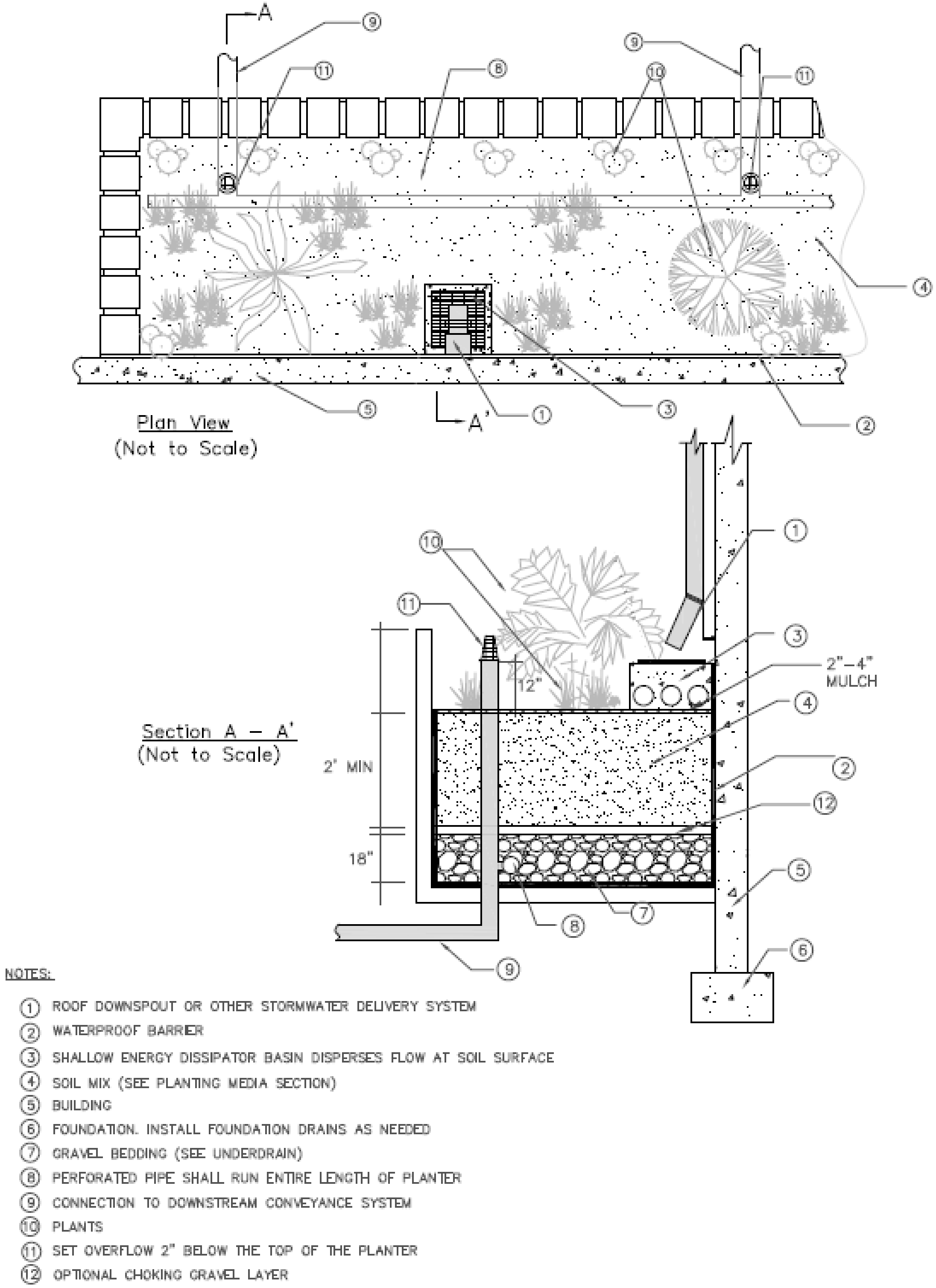


Figure E-9. Stormwater Planter Schematic

General Constraints and Implementation Considerations

- Stormwater planters are suitable for smaller tributary areas such as urban infill projects.
- Stormwater planters can be integrated into other landscaping areas.
- For stormwater planters next to buildings, waterproofing of exterior building walls must be provided as directed by an architect or structural engineer.
- The site topography must be relatively flat.
- During construction activities should avoid compaction of native soils below planting media layer or gravel zone.
- Stormwater runoff must be diverted around the stormwater planter during the period of vegetation establishment. If diversion is not feasible, the graded and seeded areas must be protected with suitable sediment controls (i.e., silt fences).
- All damaged areas should be repaired, seeded, or re-planted immediately.
- The general landscape irrigation system should incorporate the stormwater planter, as applicable.

Design Specifications

The following sections describe the design specifications for stormwater planters.

Geotechnical

Due to the potential to contaminate groundwater, cause slope instability, impact surrounding structures, and potential for insufficient infiltration capacity, an extensive geotechnical site investigation must be conducted during the site planning process to verify site suitability for a stormwater planter. All geotechnical investigations must be performed according to the most recent GMED Policy GS 200.1. Soil infiltration rates and the groundwater table depth must be evaluated to ensure that conditions are satisfactory for proper operation of a stormwater planter. The project applicant must demonstrate through infiltration testing, soil logs, and the written opinion of a licensed civil engineer that sufficiently permeable soils exist on-site to allow the construction of a properly functioning stormwater planter.

Geometry

- The minimum soil depth should be 12 to 18 inches. The minimum soil depth is required to provide a beneficial root zone for the chosen vegetation and adequate storage capacity for stormwater runoff. A deeper planting soil depth will provide a smaller surface area footprint.
- The minimum stormwater planter width is 30 inches.
- Any stormwater planter shape configuration is possible as long as the other design specifications are met.

- The distance between the downspouts and the overflow outlet should be maximized in order to increase the opportunity for stormwater runoff retention and filtration.

Sizing

Stormwater planters are sized using a simple sizing method where the SWQDv must be completely filtered within 96 hours. If the incoming stormwater runoff flow rate is lower than the long term filtration rate, above ground storage does not need to be provided. If the incoming stormwater runoff flow rate is higher than the long term filtration rate, above ground storage shall be provided (see steps below).

Step 1: Calculate the design volume

Stormwater planters areas should be sized to capture and treat the SWQDv (see Section 6 for SWQDv calculation procedures) that is not reliability retained on the project site, as calculated by the equation below:

$$V_{SP} = \mathrm{SWQDv} - \mathrm{V_r}$$

Where:

V_{SP} = Biofiltration volume [ft^3];
SWQDv = Stormwater quality design volume [ft^3]; and
V_R = Volume of stormwater runoff reliably retained on-site [ft^3].

Step 2: Calculate the design infiltration rate

Determine the corrected in-situ infiltration rate (f_{design}) of the native soil using the procedures described in the most recent GMED Policy GS 200.1.

Step 3: Calculate the surface area

Select a surface ponding depth (d) that satisfies the geometric criteria and meets the site constraints. Selecting a deeper ponding depth (up to 1.5 ft) generally yields a smaller footprint, however, it will require greater consideration for public safety, energy dissipation, and plant selection.

Calculate the time for the selected ponding depth to filter through the planting media using the following equation:

$$t_p = \frac{d}{\left(\frac{f_{design}}{12}\right)}$$

Where:

t_p = Required detention time for surface ponding (max 96 hr) [hr];
d = Ponding depth (max 1.5 ft) [ft]; and
f_{design} = Design infiltration rate [in/hr].

If t_p exceeds 96 hours, reduce surface ponding depth (d). In nearly all cases, t_p should not approach 96 hours unless f_{design} is low.

Calculate the required infiltrating surface (filter bottom area) using the following equation:

$$A = \frac{V_B}{d}$$

Where:

A = Bottom surface area of biofiltration area [ft^2];
V_B = Biofiltration design volume [ft^3]; and
d = Ponding depth (max 1.5 ft) [ft].

Flow Entrance and Energy Dissipation

The following types of flow entrance can be used for stormwater planters:

- Piped entrances, such as roof downspouts, should include rock, splash blocks, or other erosion controls at the entrance to dissipate energy and disperse flows.
- Woody plants (trees, shrubs, etc.) can restrict or concentrate flows and can be damaged by erosion around the root ball and must not be placed directly in the entrance flow path.

Drainage

Stormwater planters must be designed to drain below the planting soil depth in less than 96 hours. Soils must be allowed to dry out periodically in order to restore hydraulic capacity to receive stormwater runoff from subsequent storm events, maintain infiltration rates, maintain adequate soil oxygen levels for healthy soil biota and vegetation, and provide proper soil conditions for biodegradation and retention of pollutants.

Underdrain

Stormwater planters require an underdrain to collect and discharge stormwater runoff that has been filtered through the soil media, but not infiltrated, to another stormwater quality control measure, storm drain system, or receiving water. The underdrain shall have a mainline diameter of eight inches using slotted PVC SDR 26 or PVC C9000. Slotted PVC allows for pressure water cleaning and root cutting, if necessary. The slotted pipe should have two to four rows of slots cut perpendicular to the axis of the pipe or at right angles to the pitch of corrugations. Slots should be 0.04 to 0.1 inches wide with a length of 1 to 1.25 inches. Slots should be longitudinally-spaced such that the pipe has a minimum of one square inch opening per lineal foot and should face down.

The underdrain should be placed in a gravel envelope (Class 2 Permeable Material per Caltrans Spec. 68-1.025) that measures three feet wide and six inches deep. The underdrain is elevated from the bottom of the stormwater planter by six inches within the gravel envelope to create a fluctuating anaerobic/aerobic zone below the underdrain to facilitate denitrification within the anaerobic/anoxic zone and reduce nutrient concentrations. The top and sides of the underdrain pipe should be covered with gravel to a minimum depth of 12 inches. The underdrain and gravel envelope should be covered with a geomembrane liner to prevent clogging. The following aggregate should be used for the gravel envelope:

Particle Size (ASTM D422)	% Passing by Weight
¾ inch	100%
¼ inch	30-60%
#8	20-50%
#50	3-12%
#200	0-1%

Underdrains should be sloped at a minimum of 0.5 percent, and must drain freely to an acceptable discharge point.

Rigid non-perforated observation pipes with a diameter equal to the underdrain diameter should be connected to the underdrain to provide a clean-out port as well as an observation well to monitor drainage rates. The wells/clean-outs should be connected to the perforated underdrain with the appropriate manufactured connections. The wells/clean-outs should extend six inches above the top elevation of the stormwater planter mulch, and should be capped with a lockable screw cap. The ends of underdrain pipes not terminating in an observation well/clean-out should also be capped.

Hydraulic Restriction Layer

A geomembrane liner may be placed between the planting media and the drain rock. If a geomembrane liner is used, it should meet a minimum permittivity rate of 75 gal/min/ft^2 and should not impede the infiltration rate of the soil media. The geomembrane liner must meet the minimum requirements presented in Table E-16.

Table E-16 Geomembrane Liner Specifications for Stormwater Planters

Parameter	Test Method	Specification
Trapezoidal Tear	ASTM D4533	40 lbs (minimum)
Permeability	ASTM D4491	0.2 cm/sec (minimum)
AOS (sieve size)	ASTM D4751	#60 – #70 (minimum)
Ultraviolet Resistance	ASTM D4355	>70%

Preferably, aggregate should be used in place of a geomembrane layer to reduce the potential for clogging. This aggregate layer should consist of two to four inches of washed sand underlain with two inches of choking stone (typically #8 or #89 washed).

Vegetation

Prior to installation, a licensed landscape architect must certify that all plants, unless otherwise specifically permitted, conform to the standards of the current edition of American Standard for Nursery Stock as approved by the American Standards Institute, Inc. All plant grades shall be those established in the current edition of American Standards for Nursery Stock.

- Shade trees must have a single main trunk. Trunks must be free of branches below the following heights:

CALIPER (in)	Height (ft)
1½-2½	5
3	6

- Plants must be tolerant of summer drought, ponding fluctuations, and saturated soil conditions for up to 96 hours.
- It is recommended that a minimum of three types of tree, shrubs, and/or herbaceous groundcover species be incorporated to protect against facility failure due to disease and insect infestations of a single species.
- Native plant species and/or hardy cultivars that are not invasive and do not require chemical inputs must be used to the maximum extent practicable.

The stormwater planter should be vegetated to resemble a terrestrial forest community ecosystem, which is dominated by understory trees, a shrub layer, and herbaceous ground cover. Stormwater planters should be planted to cover at least 50 percent of the planter surface. Select vegetation that:

- Is suited to well-drained soil;
- Will be dense and strong enough to stay upright, even in flowing water;
- Has minimum need for fertilizers;

- Is not prone to pests and is consistent with Integrated Pest Management practices; and
- Is consistent with local water conservation ordinance requirements.

Irrigation System

Provide an irrigation system to maintain viability of vegetation, if applicable. The irrigation system must be designed to local code or ordinance specifications.

Planter Walls

Planter walls must be made of stone, concrete, brick, clay, plastic, wood, or other stable, permanent material. The use of pressure-treated wood or galvanized metal at or around a stormwater planter is prohibited.

Overflow Device

An overflow device is required at the 18-inch ponding depth. The following, or equivalent, should be provided:

- A vertical PVC pipe (SDR 26) to act as an overflow riser.
- The overflow riser(s) should be eight inches or greater in diameter, so it can be cleaned without damage to the pipe.
- The inlet to the riser should be a maximum of 18 inches above the planting soil, and be capped with a spider cap to exclude floating mulch and debris. Spider caps should be screwed in or glued (e.g., not removable). The overflow device should convey stormwater runoff in excess of the SWQDv to an approved discharge location (another stormwater quality control measure, storm drain system, or receiving water).

Maintenance Requirements

Maintenance and regular inspections are important for proper function of stormwater planters. Stormwater planters require annual plant, soil, and mulch layer maintenance to ensure optimal infiltration, storage, and pollutant removal capabilities. In general, stormwater planter maintenance requirements are typical landscape care procedures and include:

- Irrigate plants as needed during prolonged dry periods. In general, plants should be selected to be drought-tolerant and not require irrigation after establishment (two to three years).
- Inspect flow entrances, ponding area, and surface overflow areas periodically, and replace soil, plant material, and/or mulch layer in areas if erosion has occurred. Properly-designed facilities with appropriate flow velocities should not cause erosion except potentially during in extreme events. If erosion occurs, the flow velocities and gradients within the stormwater planter and flow dissipation

and erosion protection strategies in the flow entrance should be reassessed. If sediment is deposited in the stormwater planter, identify the source of the sediment within the tributary area, stabilize the source, and remove excess surface deposits.

- Prune and remove dead plant material as needed. Replace all dead plants, and if specific plants have a high mortality rate, assess the cause and, if necessary, replace with more appropriate species.
- Remove weeds as needed until plants are established. Weed removal should become less frequent if the appropriate plant species are used and planting density is attained.
- Select the proper soil mix and plants for optimal fertility, plant establishment, and growth to preclude the use of nutrient and pesticide supplements. By design, stormwater planters are located in areas where phosphorous and nitrogen levels are often elevated such that these should not be limiting nutrients. Addition of nutrients and pesticides may contribute pollutant loads to receiving waters.
- Analyze soil for fertility and pollutant levels if necessary. Stormwater planter soil media are designed to maintain long-term fertility and pollutant processing capability.
- Excavate and clean the stormwater planter if it does not drain within 96 hours after a storm event. Replace stormwater planter soil media as needed to improve the infiltration rate.
- Eliminate standing water to prevent vector breeding.
- Inspect, and clean if necessary, the underdrain.
- Inspect overflow devices for obstructions or debris, which should be removed immediately. Repair or replace damaged pipes upon discovery.
- Repair structural deficiencies to the stormwater planter including rot, cracks, and failure.
- Implement Integrated Pest Management practices if pests are present in the stormwater planter.
- Provide training and/or written guidance to all property owners and tenants. Provide a copy of the Maintenance Plan to all property owners and tenants.

A summary of potential problems that may need to be addressed by maintenance activities is presented in Table E-17.

The County requires execution of a maintenance agreement to be recorded by the property owner for the on-going maintenance of any privately-maintained stormwater quality control measures. The property owner is responsible for compliance with the maintenance agreement. A sample maintenance agreement is presented in Appendix H.

Table E-17. Stormwater Planter Troubleshooting Summary

Problem	Conditions When Maintenance Is Needed	Maintenance Required
Vegetation	Overgrown vegetation	Mow and prune vegetation as appropriate.
	Presence of invasive, poisonous, nuisance, or noxious vegetation or weeds	Remove this vegetation and plant native species as needed.
Trash and Debris	Trash, plant litter, and dead leaves present	Remove and properly dispose of trash and debris.
Irrigation (if applicable)	Not functioning correctly	Check irrigation system for clogs or broken lines and repair as needed.
Inlet/Overflow	Inlet/overflow areas clogged with sediment and/or debris	Remove material. Ensure the downspout is clear of debris.
	Overflow pipe blocked or broken	Repair as needed.
Erosion/Sediment Accumulation	Splash pads or spreader incorrectly placed Presence of erosion or sediment accumulation	Check inlet structure to ensure proper function. Repair, or replace if necessary, the inlet device. Repair eroded areas with gravel as needed. Re-grade the stormwater planter as needed.
Contaminants and Pollution	Any evidence of oil, gasoline, contaminants, or other pollutants	Remove any evidence of visual contamination from floatables such as oil and grease.
Standing water	Standing water observed more than 96 hours after storm event	Inspect, and clean as needed, the underdrain to ensure proper function. Clear clogs as needed. Remove and replace planter media (sand, gravel, topsoil, mulch) and vegetation.

VEG-3: Tree-Well Filter

Description

Source: Low Impact Development Center (top) and University of New Hampshire Stormwater Center (bottom)

A tree-well filter is similar to a biofiltration area and stormwater planters and consists of one or multiple chambered pre-cast concrete boxes with a small tree or shrub planted in a bed filled with soil media. Tree-well filters are typically installed along the edge of a parking lot or roadway, where a street tree might normally be planted, and is designed to receive, retain, and infiltrate stormwater runoff from adjoining paved areas. During storm events, stormwater runoff enters the chamber and gradually infiltrates and filters through the soil media into the underlying soil, or collected by an underdrain system.

Treatment occurs through a variety of natural mechanisms as the stormwater runoff filters through the root zone of the vegetation and during detention of the stormwater runoff in the pore space of the soil media. A portion of stormwater runoff held in the root zone of the soil media is returned to the atmosphere through transpiration by the vegetation. Stormwater runoff that reaches the bottom of the tree-well filter and does not infiltrate into underlying soils is collected and discharged through an underdrain.

A schematic of a typical tree-well filter is presented in Figure E-10.

LID Ordinance Requirements

Tree-well filters can be used as a stormwater quality control measure to treat stormwater runoff for the following alternative compliance measures:

- Off-site infiltration;
- Groundwater replenishment projects; and
- Off-site retrofit of existing development.

The project applicant must ensure that all pollutants of concern are addressed when using a tree-well filter (see Section 7.4). The following table identifies the pollutants of concern that are treated to the water quality benchmark (see Table 7-2 of the LID Standards Manual) by tree-well filter:

Pollutant of Concern	Treated by Tree-Well Filter?
Suspended solids	No
Total phosphorus	No
Total nitrogen	Yes
Total Kjeldahl nitrogen	Yes
Cadmium, total	No
Chromium, total	Yes
Copper, total	No
Lead, total	Yes
Zinc, total	No

Source: Treatment Best Management Practices Performance, Los Angeles Regional Water Quality Control Board, December 9, 2013.

Advantages

- Enhances site aesthetics
- Integrates well with street landscapes
- Takes up very little space and may be ideal for highly-developed sites
- May be used in variety of site conditions
- Reduces stormwater runoff volume and pollutant discharge

Disadvantages

- May not be appropriate for industrial sites or locations with contaminated soils or where spills may occur because of the potential threat to groundwater contamination
- May require individual owners/tenants to perform maintenance
- Requires irrigation, which may conflict with water conservation ordinances for landscape requirements, to maintain vegetation

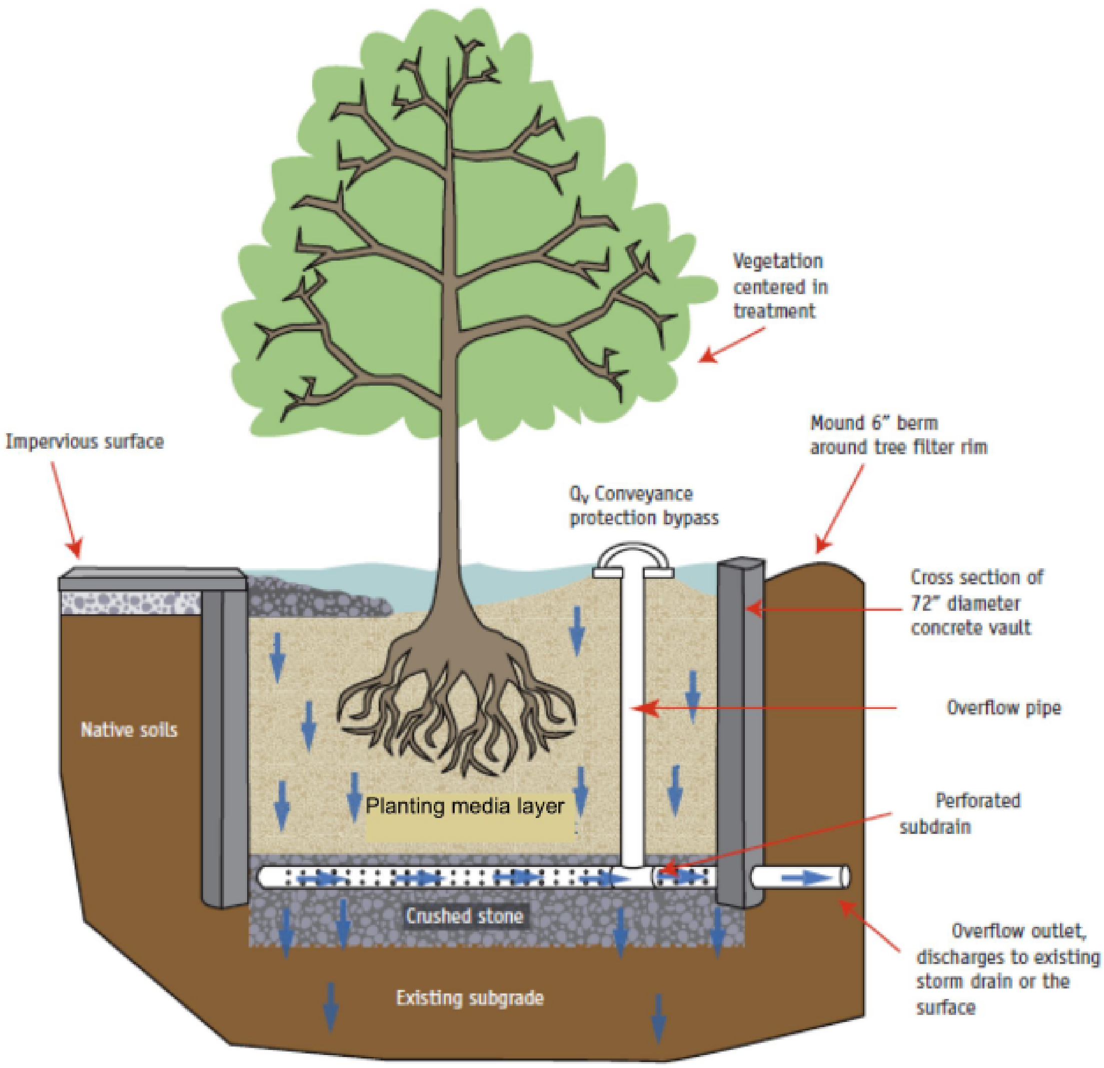


Figure E-10. Tree-Well Filter Schematic

General Constraints and Implementation Considerations

- Tree-well filters are ideally suited for small areas such as parking lot islands, perimeter building planters, street medians, roadside swale features, and site entrance or buffer features.
- Tree-well filters can be integrated into other landscape areas. Tree-well filters can have a non-rectangular footprint to fit site landscape design.
- Tree-well filters should be placed where site topography is relatively flat to allow stormwater runoff to drain to it.
- Stormwater runoff must be diverted around the tree-well filter during the period of vegetation establishment. If diversion is not feasible, the graded and seeded areas should be protected with suitable erosion controls (i.e., silt fences).
- Areas to be used for tree-well filters should be clearly marked before site work begins to avoid soil disturbance and compaction during construction. No vehicular traffic, except that specifically used to construct the tree-well filter, should be allowed within ten feet of the tree-well filter areas.
- Repair, seed, or re-plant damaged areas immediately.
- The general landscape irrigation system should incorporate the tree-well filter, as applicable.

Design Specifications

The following sections describe the design specifications for tree-well filters.

Geotechnical

Due to the potential to contaminate groundwater, cause slope instability, and impact surrounding structures, and potential for insufficient infiltration capacity, an extensive geotechnical site investigation must be conducted during the site planning process to verify site suitability for a tree-well filter. All geotechnical investigations must be performed according to the most recent GMED Policy GS 200.1. Soil infiltration rates and the groundwater table depth must be evaluated to ensure that conditions are satisfactory for proper operation of a tree-well filter. The project applicant must demonstrate through infiltration testing, soil logs, and the written opinion of a licensed civil engineer that sufficiently permeable soils exist on-site to allow the construction of a properly functioning tree-well filter.

Tree-well filters are appropriate for soils with a minimum corrected in-situ infiltration rate of 0.3 in/hr. The geotechnical report must determine if the proposed project site is suitable for a tree-well filter and must recommend a design infiltration rate (see “Design Infiltration Rate” under the “Sizing” section). The geotechnical investigation should be such that a good understanding is gained as to how the stormwater runoff will move through the soil (horizontally or vertically) and if there are any geological conditions that could inhibit the movement of water.

Sizing

Tree-well filters are sized using a simple sizing method where the SWQDv must be completely filtered within 96 hours. If the incoming stormwater runoff flow rate is lower than the long term filtration rate, above ground storage does not need to be provided. If the incoming stormwater runoff flow rate is higher than the long term filtration rate, above ground storage shall be provided (see steps below).

<u>Step 1: Calculate the design volume</u>

Tree-well filter areas should be sized to capture and treat the SWQDv (see Section 6 for SWQDv calculation procedures) that is not reliability retained on the project site, as calculated by the equation below:

$$V_{SP} = \mathrm{SWQDv} - \mathrm{V_r}$$

Where:

V_{SP} = Biofiltration volume [ft^3];
SWQDv = Stormwater quality design volume [ft^3]; and
V_R = Volume of stormwater runoff reliably retained on-site [ft^3].

<u>Step 2: Calculate the design infiltration rate</u>

Determine the corrected in-situ infiltration rate (f_{design}) of the native soil using the procedures described in the most recent GMED Policy GS 200.1.

<u>Step 3: Calculate the surface area</u>

Select a surface ponding depth (d) that satisfies the geometric criteria and meets the site constraints. Selecting a deeper ponding depth (up to 1.5 ft) generally yields a smaller footprint, however, it will require greater consideration for public safety, energy dissipation, and plant selection.

Calculate the time for the selected ponding depth to filter through the planting media using the following equation:

$$t_p = \frac{d}{\left(\frac{f_{design}}{12}\right)}$$

Where:

t_p = Required detention time for surface ponding (max 96 hr) [hr];
d = Ponding depth (max 1.5 ft) [ft]; and
f_{design} = Design infiltration rate [in/hr].

If t_p exceeds 96 hours, reduce surface ponding depth (d). In nearly all cases, t_p should not approach 96 hours unless f_{design} is low.

Calculate the required infiltrating surface (filter bottom area) using the following equation:

$$A = \frac{V_B}{d}$$

Where:

A = Bottom surface area of biofiltration area [ft^2];
V_B = Biofiltration design volume [ft^3]; and
d = Ponding depth (max 1.5 ft) [ft].

Tree-well filters must be sized to capture and treat the SDWQv at a 18-inch maximum ponding depth acre.

The required surface area for the tree-well filter is determined from the SWQDv and ponding depth as follows:

$$A_s = \frac{SWQDv}{D_{pz}}$$

Where:

A_s = Surface area of tree-well filter [ft^2];
SWQDv = Stormwater quality design volume [ft^3]; and
D_{pz} = Average ponding depth (max 1.5 ft) [ft].

Flow Entrance and Energy Dissipation

The following types of flow entrance can be used for tree-well filters:

- Level spreaders (i.e., slotted curbs) can be used to facilitate sheet flow.
- Dispersed flow across pavement or gravel and past wheel stops for parking areas.
- Piped entrances, such as roof downspouts, should include rock, splash blocks, or other erosion controls at the entrance to dissipate energy and disperse flows.
- Curb cuts for roadside or parking lot areas, if approved by LACDPW: curb cuts should include rock or other erosion controls in the channel entrance to dissipate energy. Flow entrance should drop two to three inches from curb line and provide an area for settling and periodic removal of sediment and coarse material before flow dissipates to the remainder of the tree-well filter.

Drainage

Tree-well filters must be designed to drain below the planting soil depth in less than 96 hours. Soils must be allowed to dry out periodically in order to restore hydraulic capacity to receive stormwater runoff from subsequent storm events, maintain infiltration rates, maintain adequate soil oxygen levels for healthy soil biota and vegetation, and provide proper soil conditions for biodegradation and retention of pollutants.

Underdrain

Tree-well filters require an underdrain to collect and discharge stormwater runoff that has been filtered through the soil media, but not infiltrated, to another stormwater quality control measure, storm drain system, or receiving water. The underdrain shall have a mainline diameter of eight inches using slotted PVC SDR 26 or PVC C9000. Slotted PVC allows for pressure water cleaning and root cutting, if necessary. The slotted pipe should have two to four rows of slots cut perpendicular to the axis of the pipe or at right angles to the pitch of corrugations. Slots should be 0.04 to 0.1 inches wide with a length of 1 to 1.25 inches. Slots should be longitudinally-spaced such that the pipe has a minimum of one square inch opening per lineal foot and should face down.

The underdrain should be placed in a gravel envelope (Class 2 Permeable Material per Caltrans Spec. 68-1.025) that measures three feet wide and six inches deep. The underdrain is elevated from the bottom of the tree-well filter by six inches within the gravel envelope to create a fluctuating anaerobic/aerobic zone below the underdrain to facilitate denitrification within the anaerobic/anoxic zone and reduce nutrient concentrations. The top and sides of the underdrain pipe should be covered with gravel to a minimum depth of 12 inches. The underdrain and gravel envelope should be covered with a geomembrane liner to prevent clogging. The following aggregate should be used for the gravel envelope:

Particle Size (ASTM D422)	% Passing by Weight
¾ inch	100%
¼ inch	30-60%
#8	20-50%
#50	3-12%
#200	0-1%

Underdrains should be sloped at a minimum of 0.5 percent, and must drain freely to an acceptable discharge point.

Rigid non-perforated observation pipes with a diameter equal to the underdrain diameter should be connected to the underdrain to provide a clean-out port as well as an observation well to monitor drainage rates. The wells/clean-outs should be connected to the perforated underdrain with the appropriate manufactured connections. The wells/clean-outs should extend six inches above the top elevation of the tree-well filter mulch, and should be capped with a lockable screw cap. The ends of underdrain pipes not terminating in an observation well/clean-out should also be capped.

Hydraulic Restriction Layer

A geomembrane liner may be placed between the planting media and the drain rock. If a geomembrane liner is used, it should meet a minimum permittivity rate of 75 gal/min/ft^2, should not impede the infiltration rate of the soil medium. The geomembrane liner must meet the minimum requirements presented in Table E-18.

Table E-18. Geomembrane Liner Specifications for Tree-Well Filters

Parameter	Test Method	Specification
Trapezoidal Tear	ASTM D4533	40 lbs (minimum)
Permeability	ASTM D4491	0.2 cm/sec (minimum)
AOS (sieve size)	ASTM D4751	#60 – #70 (minimum)
Ultraviolet Resistance	ASTM D4355	>70%

Preferably, aggregate should be used in place of a geomembrane layer to reduce the potential for clogging. This aggregate layer should consist of two to four inches of washed sand underlain with two inches of choking stone (typically #8 or #89 washed).

Vegetation

Select a tree that:

- Is suited to well-drained soil;
- Will be dense and strong enough to stay upright, even in flowing water;
- Has minimum need for fertilizers;
- Is not prone to pests and is consistent with Integrated Pest Management practices;
- Will withstand being inundated for periods of time; and
- Is consistent with local water conservation ordinance requirements.

Irrigation System

Provide an irrigation system to maintain viability of vegetation, if applicable. The irrigation system must be designed to local code or ordinance specifications.

Overflow Device

An overflow device is required at the 18-inch ponding depth. The following, or equivalent, should be provided:

- A vertical PVC pipe (SDR 26) to act as an overflow riser.

- The overflow riser(s) should be eight inches or greater in diameter, so it can be cleaned without damage to the pipe.
- The inlet to the riser should be a maximum of 18 inches above the planting soil, and be capped with a spider cap to exclude floating mulch and debris. Spider caps should be screwed in or glued (e.g., not removable). The overflow device should convey stormwater runoff in excess of the SWQDv to an approved discharge location (another stormwater quality control measure, storm drain system, or receiving water).

Maintenance Requirements

Maintenance and regular inspections are important for proper function of tree-well filters. Tree-well filters require annual plant, soil, and mulch layer maintenance to ensure optimal infiltration, storage, and pollutant removal capabilities. In general, tree-well filter maintenance requirements are typical landscape care procedures and include:

- Irrigate tree as needed. In general, trees should be selected to be drought-tolerant.
- Inspect flow entrances, ponding area, and surface overflow areas periodically, and replace soil, plant material, and/or mulch layer in areas if erosion has occurred. Properly designed facilities with appropriate flow velocities should not cause erosion except potentially during in extreme events. If erosion occurs, the flow velocities and gradients within the tree-well filter and flow dissipation and erosion protection strategies in the flow entrance should be reassessed. If sediment is deposited in the tree-well filter, identify the source of the sediment within the tributary area, stabilize the source, and remove excess surface deposits.
- Prune the tree as needed.
- Remove weeds in the tree-well filter.
- Select the proper soil mix and plants for optimal fertility, tree establishment, and growth to preclude the use of nutrient and pesticide supplements. By design, tree-well filters are located in areas where phosphorous and nitrogen levels are often elevated such that these should not be limiting nutrients. Addition of nutrients and pesticides may contribute pollutant loads to receiving waters.
- Analyze soil for fertility and pollutant levels if necessary. Soil mixes for tree-well filters are designed to maintain long-term fertility and pollutant processing capability.
- Excavate and clean the tree-well filter if it does not drain within 96 hours after a storm event. Replace tree-well filter soil media as needed to improve the infiltration rate.
- Eliminate standing water to prevent vector breeding.
- Inspect, and clean if necessary, the underdrain.

- Inspect overflow devices for obstructions or debris, which should be removed immediately. Repair or replace damaged pipes upon discovery.
- Repair structural deficiencies to the tree-well filter including rot, cracks, and failure.
- Implement Integrated Pest Management practices if pests are present in the tree-well filter.

A summary of potential problems that may need to be addressed by maintenance activities is presented in Table E-19.

The County requires execution of a maintenance agreement to be recorded by the property owner for the on-going maintenance of any privately-maintained stormwater quality control measures. The property owner is responsible for compliance with the maintenance agreement. A sample maintenance agreement is presented in Appendix H.

Table E-19. Tree-Well Filter Troubleshooting Summary

Problem	Conditions When Maintenance Is Needed	Maintenance Required
Vegetation	Overgrown vegetation	Mow and prune vegetation as appropriate.
	Presence of invasive, poisonous, nuisance, or noxious vegetation or weeds	Remove this vegetation and plant native species as needed.
Trash and Debris	Trash, plant litter, and dead leaves present	Remove and properly dispose of trash and debris.
Irrigation (if applicable)	Not functioning correctly	Check irrigation system for clogs or broken lines and repair as needed.
Inlet/Overflow	Inlet/overflow areas clogged with sediment and/or debris	Remove material. Ensure the downspout is clear of debris.
	Overflow pipe blocked or broken	Repair as needed.
Erosion/Sediment Accumulation	Inlet structure incorrectly placed Presence of erosion or sediment accumulation	Check inlet structure to ensure proper function. Repair, or replace if necessary, the inlet device. Repair eroded areas with gravel as needed. Re-grade the tree-well filter as needed.
Contaminants and Pollution	Any evidence of oil, gasoline, contaminants, or other pollutants	Remove any evidence of visual contamination from floatables such as oil and grease.
Standing water	Standing water observed more than 96 hours after storm event	Inspect, and clean as needed, the underdrain to ensure proper function. Clear clogs as needed. Remove and replace tree-well filter media (sand, gravel, topsoil, mulch) and vegetation.