Baseline Conditions Assessment

Schuster Slope Management Area
Tacoma, Washington

for
City of Tacoma

October 15, 2014

GeoEngineers
Earth Science + Technology

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Tacoma, Washington

File No. 0570-140-01

October 15, 2014

Prepared for:

City of Tacoma – Environmental Services
Center for Urban Waters
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Attention: Desiree Pooley

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INTRODUCTION

This report presents the results of the baseline conditions assessment conducted by GeoEngineers, Inc. (GeoEngineers) on behalf of the City of Tacoma (City). GeoEngineers was contracted by the City to review existing information, perform a field reconnaissance, and prepare this baseline conditions assessment report that describes the existing conditions in the study area. This includes the geology, slope characteristics, vegetation communities, presence of wetland areas, and other features such as trails and infrastructure. We understand the information presented in this report is to be used to prepare a Slope Management Plan by the City and Metro Parks Tacoma. Our efforts comprise a reconnaissance-level analysis and review of baseline conditions in the study area.

Project Location and Study Area

The study area is located in Tacoma, Washington, northwest of downtown (Figure 1). The study area is the slope located generally between Garfield Gulch and the Stadium Way off-ramp from Interstate 705 (Figures 2a and 2b).

Scope of Services

The services completed for this project were divided into the following tasks:

Task 1 – Existing Data Review

- Coordinated with City representatives to obtain relevant background information pertinent to the project. Technical data pertaining to the following topics was obtained: existing built environment/ infrastructure; geologic and geotechnical analysis (including slopes); wetlands and other aquatic areas; and baseline vegetation conditions.
- Reviewed the reports and background data that were obtained and synthesized the information regarding baseline conditions and included it in this report.

Task 2 – Field Reconnaissance

- Compiled Light Detection and Ranging (LiDAR) geo-data covering the study area and processed the data to develop a slope contour map. Reviewed the map to compare landslide and/or slope instability features visible on the map to landslide and/or slope instability areas identified in the 2001 report titled "Geologic and Engineering Services, Hillslope Area Between Schuster Parkway and Stadium Way, Tacoma, Washington" prepared by GeoEngineers (henceforth referred to as the 2001 report).
- Completed a limited geologic reconnaissance of the slope area over a two-day period, similar to what was performed for the 2001 report. The reconnaissance was limited to visual observations, comparing features mapped in the 2001 report to present conditions. The geologic reconnaissance that was performed did not include soil explorations, soil sample collection, or sample analysis.
- Provided preliminary wetland identification and mapping and identified approximate wetland locations and extents. The wetland inventory performed for this project does not include formal wetland delineation to the level of detail required for permitting but is intended to provide a general understanding of wetland conditions.

- Provided a general description and mapping of existing vegetation communities, including invasive species.
- Compiled the field data and compared the results with the features mapped in the 2001 report.
- Updated the existing geologic data by comparing present observations to features mapped by GeoEngineers in the 2001 report, and provided a summary of current conditions and an evaluation of the slope relative to soils, groundwater seeps, and readily observable stormwater structures. A qualitative assessment of slope stability, based on visual examination and information research, was also performed, similar to the assessment performed for the 2001 report.
- Identified other structures or features including the approximate routes of existing trails (based on the limited field reconnaissance or review of available maps).
- Synthesized the results into GIS-based graphics for illustrative purposes and to develop figures for inclusion in this report.

Task 3 – Communication, Coordination and Project Management

- Conducted telephone and email communication as needed with City personnel.
- Attended two meetings with City personnel.
- Conducted other project management activities as needed.

EXISTING DATA REVIEW

Existing Environment

The study area is a sloping piece of land that is generally located between: Stadium Way, Stadium High School, and private properties on the southwest; Schuster Parkway on the northeast; the Stadium Way exit ramp off Interstate 705 on the southeast; and Garfield Gulch on the northwest. Schuster Parkway is generally located at the bottom of the slope. Stadium Way is generally located at the top of the slope in the southern portion of the study area (i.e., approximately south of Stadium High School). Stadium High School and private residences are located at the top of the slope in the northern portion of the study area.

The overall inclination of the slope, as measured generally between the western boundary of the study area and Schuster Parkway, ranges between approximately 50 to 90 percent; however, there are localized slopes within the study area that are considerably steeper including multiple near vertical slopes in the northern portion of the study area with relief in excess of 20 vertical feet. Flatter "topographical benches," that are remnants of a historic road/railroad grade, are located approximately mid-slope in portions of the study area. Forested vegetation communities dominate, although many areas are instead dominated by invasive shrub vegetation, grass, landscaped areas, or bare ground. A number of springs/seeps occur on the slope, and flowing water has carved several gullies that trend eastward from their origins at the top or middle of the slope, some of which contain surface water channels.

A trail system known as the Bayside Trails was constructed on the slope in 1975. The trail system consisted of earthen-surfaced pedestrian trails and included a cross-slope pedestrian trail through the study area as well as several downslope connectors between Stadium Way and Schuster Parkway (City of Tacoma, 1979) (Figures 2a and 2b). Much of the cross-slope trail utilized the historic road/railroad grade. Portions of the Bayside Trails fell into disrepair, and the trail system was closed in 2000. Geo-spatial mapping of the trail system was provided to GeoEngineers by the City, but the date and method of mapping are unknown.

Previous Geologic, Geotechnical and Steep Slope Evaluations

GeoEngineers' 2001 report included the results of mapping fieldwork that documented geologic features at the study area, including landslides, springs/seeps, indicators of slope instability, and vegetation conditions. The report concluded that the project area met one or more of the City of Tacoma criteria for a Landslide Hazard Area, and that the landslide hazard risk for the project area in general was, in GeoEngineers' opinion, "significant." The report identified two qualitative risk areas within the study area, "moderate risk" and "high risk." There were no "low risk" areas identified in the study area as a part of the previous study.

Geologic materials observed during the 2001 report include the Kitsap Formation, which is observable at or near the bottom of the slope in the northern portion of the study area. This material generally comprises hard silt with some very dense sand material. Vashon advance outwash was observed above the Kitsap material. The contact between the Kitsap and Advance outwash units ranges from flat to undulatory in the study area.

Vashon glacial till has been mapped by others on relatively small-scale geologic maps. The till is mapped above the advance outwash on those maps; however, we did not observe exposures of till, as indicated in our 2001 report. Some landslide-deposited material was observed at the base of bluffs or at the base of slide scarps within the study area.

Although subsurface explorations were not performed as part of the 2001 report, man-placed fills were expected beneath all or part of Stadium Way adjacent to the southern portion of the study area and also east of Stadium High School.

Wetlands and Aquatic Areas

The U.S. Fish & Wildlife Service (USFWS) National Wetland Inventory (NWI) dataset does not show any wetlands in the study area (USFWS, 2014). City of Tacoma GovME online mapping database, on the other hand, shows a number of small "known" or "high probability" wetland features on the slope (City of Tacoma, 2014). Map printouts from these sources are included as Appendix A.

The 2001 GeoEngineers report included mapping of previously identified and field-observed springs/seeps as well as vegetation classification that included a "marsh/wet" category. Previously identified springs/seeps were identified based on Dames & Moore studies from the early 1970s (Dames & Moore, 1971a, 1971b, 1972). In general, it appeared the locations of springs/seeps were similar in the early 1970s and 2001 (within the range of estimated locational accuracy of mapping efforts). Most of these springs/seeps originate mid-slope or lower, except in the northern-most portion of the study area, where several springs were noted near the top of the slope. Several wet areas were mapped within the same approximate elevation band as the springs/seeps as well as at the base of the slope along Schuster Parkway.

In 2012, the City performed general mapping of wetlands on the upper slope within the southern portion of the study area during planning and permitting for Stadium Way improvements. Because the proposed improvements were beyond the potential buffers for wetlands on the slope, wetlands were not fully mapped in detail at that time (Misty Blair, Planner - City of Tacoma, pers. comm.). We are not aware of any recent wetland mapping efforts in the northern portion of the study area.

In 2013, GeoEngineers conducted additional mapping along the base of the slope as part of a feasibility evaluation for the Schuster Parkway Promenade. The locations of wet areas mapped at that time appeared to be generally consistent with previous mapping efforts, and a number of drainage problems such as water flowing over the sidewalk and potentially undersized culverts were noted.

Vegetation

The 2001 GeoEngineers study included general vegetation classification. The purpose of the 2001 effort was to evaluate conditions with respect to the effects of vegetation on slope stability. Vegetation was classified into the following categories: *mature trees with sparse groundcover*; *mature trees with moderate groundcover*; *mixed small (or trimmed) trees with groundcover*; *marsh/wet*; *grasses and/or blackberry vines and/or yard waste*; and *no vegetation*. The majority of the current study area was identified in the 2001 report to consist of *mature trees with sparse groundcover*, *mature trees with moderate groundcover*, or *grasses and/or blackberry vines and/or yard waste*. *Mixed small (or trimmed) trees with groundcover* and *marsh/wet* classes were present but generally limited in distribution.

The 2001 report noted:

> It is significant that there are virtually no conifer trees in the mature forest, and we noted very few conifer stumps. We noted that the vast majority of trees are big leaf maple, red alder and black cottonwood. These species of trees are the most common in this region to voluntarily repopulate areas cleared of historical "native" trees. Clearing can occur deliberately, as with logging, or can be the result of landslides.

DATA GATHERING

Methods

Data gathering was accomplished through a combination of map/report review and field reconnaissance. Existing GIS data from the 2001 GeoEngineers report and other available datasets were compiled into a project-specific GIS database. We also acquired current aerial photography and 1-meter resolution LiDAR data from public sources, and processed the LiDAR data to develop a detailed topography dataset at 1-foot contour intervals. LiDAR at 5-foot contour intervals is shown on Figures 2a and 2b. Mapping data was used to assist two field personnel with the field reconnaissance during which existing data was verified and/or updated. The field reconnaissance was completed by a habitat biologist and a geologist on March 11 and June 19, 2014. Data were collected during the reconnaissance by recording GPS-based spatial data as well as field notes and sketches on paper maps.

Geologic Map Review

The geology in the project area is complex. The area has been mapped at various times and scales. We reviewed the Geologic map of the Tacoma North 7.5-minute quadrangle, Washington (Troost, in review), and the Geologic Map of the City of Tacoma (Smith, 1977). Due to the relatively large areas mapped by these documents, we consider these maps as guides; however, we provide additional interpretation based on field observations. Geologic units mapped in the study area, described from the bottom of the slope upwards, include:

- Undifferentiated pre-Vashon deposits (Qpog, Qpf, or Qns) – Dense, glacially overridden deposits including till, pebbly mud, and associated silt, sand, gravel and conglomerate. (In this report these units will be referred to as the Kitsap formation.)
- Esperance sand (Qe) – Thinly bedded unweathered light gray pebbly sand. (In this report the term Esperance sand will be replaced with Vashon Advance Outwash.)
- Ice contact deposits (Qvi) – Poorly sorted sand and gravel.
- Landslide deposits (Qls) - Two separate landslide deposits are mapped cutting through the Kitsap formation in the southern portion of the study area. Landslide deposits consist of a loose mixture of sand, gravel and silt.

Observations

General

General observations within the study area are shown on Figures 2a and 2b. We generally confirmed the location and alignment of the Bayside Trail system, which is in various states of disrepair as noted. We also observed a number of pipes (some intact; some broken), structures (for example, retaining walls and slope stabilization measures), and other miscellaneous features.

The GovME map (Appendix A) indicates stormwater is conveyed down the slope in stormwater pipes at three locations in the study area: One in the southern portion of the study area (north of the 6th Street alignment), one in the middle of the study area (adjacent to and north of Stadium High School), and one in the northern portion of the study area (8th Street alignment). GeoEngineers observed stormwater infrastructure at all three of the GovME-identified locations (Figures 2a and 2b). We observed an exposed 12-inch-diameter metal pipe in the southern portion of the study area (see the southern portion of Figure 2b). An approximately 20- to 30-foot-long portion of the pipe was observed exposed at grade. A slide scarp was observed north of and adjacent to the exposed section of pipe (Figure 3b), however it was difficult to tell if the slide scarp unearthed the pipe or if the pipe had been installed at grade. We observed stormwater drainage infrastructure (catch basins and manholes) in the middle of the study area (see the southern portion of Figure 2a). Water was observed flowing into a catch basin, and could be heard flowing in manholes. We observed an exposed 12-inch-diameter corrugated metal pipe in the northern portion of the study area (see the northern portion of Figure 2a). The pipe was exposed and a portion of the pipe was unsupported.

Two areas of minor soil erosion that, if left unchecked, may eventually affect recent Stadium Way improvements were observed at and south of the 4th Street bumpout. Minor soil erosion was noted at the base of the 4th Street bumpout. South of the bumpout (north of the 6th Avenue alignment), we noted a minor erosional feature beginning to be incised, likely by flowing surface water as a result of storm events.

Geology and Slopes

The lower portion of the study area is underlain by very hard/very dense silts, clays and sand. We interpret these deposits to be the Kitsap formation noted on geologic maps described above. These deposits are relatively impermeable, and are capable of maintaining relatively steep slopes. Exposures of the Kitsap formation are especially prevalent in the northern portion of the study area (i.e., north of Stadium High School), and can be observed from Schuster Parkway.

Medium dense silt, sand and gravel overly the very hard/very dense silts, clays and sand of the Kitsap Formation. We interpret the medium dense silt, sand and gravel as Vashon Advance Outwash.

While glacial till has been mapped by others above the Vashon Advance Outwash, we did not observe till in the study area. In the southern portion of the study area only, we observed loose, comparatively coarse-grained sand, gravel and cobble deposits. We interpret these deposits to represent ice contact or landslide deposits.

For the purposes of this report, we have divided the study area into the following four zones based on the geologic deposits interpreted, and other slope characteristics (Figures 3a and 3b):

- Zone A (Figure 3b) is an area of relatively high landslide susceptibility. The area appears to be actively creeping. Slopes are 70 to 80 percent. Trees are limited to clumps of maples, many of which are butt-bowed (i.e., bent, likely as a result of slope creep). Ground cover vegetation is limited which could be an indication of soil creep. Surficial soils consist of a loose blanket of cobbles, gravel, and sand.
- Zone B (Figures 3a and 3b) is an area of moderate landslide susceptibility. Trees include a mix of mature maple, cedar, Douglas fir; some are straight and some are butt-bowed. Ground cover vegetation is relatively well established throughout much of the area. Surficial soils consist of medium dense silt, sand and gravel.
- Zone C is an area of moderate landslide susceptibility and is similar to Zone B, however we noted that there was not as much ground cover vegetation as in Zone B, indicating that this may be an area of lesser slope stability compared to Zone B.
- Zone D is an area of moderate landslide susceptibility, and consists of the vertical and near-vertical slopes composed of the Kitsap formation. Certain exposures have little or no vegetation. Where vegetation does exist, it consists of maple and alder trees as well as ground cover. Soils consist of hard silts and very dense sands.

Figures 3a and 3b also show the tops of slide scarps (black lines) and bluffs (hachured black lines). For the purposes of this report, bluffs and slide scarps are defined as follows: Bluffs are long, continuous sections of relatively steep slope that may or may not have vegetation. Slide scarps are erosional slopes less than approximately 150 feet long in map view having minimal or no vegetation, likely resulting from relatively recent landslide activity. The tops of bluffs and slide scarps shown on Figures 3a and 3b fall into one of three categories based on a comparison of 2001 and 2014 observations:

- Bluff and/or slide scarp features mapped in 2001 that were also observed in 2014 are shown in black.
- Slide scarp features mapped in 2001 that were not observed in 2014 are highlighted yellow. It is likely that re-vegetation has occurred in the time between observations. There were no bluffs mapped in 2001 that were not observed in 2014.

- Bluff and/or slide scarp features observed in 2014 that were not mapped in 2001 are highlighted blue. It is likely these represent landslide activity that is more recent than 2001.

Wetlands and Aquatic Areas

We mapped springs/seeps, surface water channels and wetlands throughout the study area (Figures 4a and 4b). This mapping effort was general in nature and did not include jurisdictional wetland boundary determinations (wetlands) or Ordinary High Water Mark identification (surface water channels); rather, the focus of this effort was to identify the general location and extent of these features for the purpose of developing a slope management plan.

The locations of springs/seeps were observed to be generally located where previously observed by GeoEngineers (2001), Dames & Moore (1971a, 1971b, 1972), and the City of Tacoma. However, the current study likely represents the most comprehensive mapping effort for aquatic critical areas within the study area.

Channels that we observed with flowing surface water would likely be considered by the City for regulatory purposes as Type Np or Ns streams, which are distinguished based on perennial or seasonal water flow. Our study did not attempt to identify seasonality of flow in these channels. As a conservative estimate, we have assumed a riparian buffer width of 100 feet would apply to mapped surface water channels, which corresponds to City of Tacoma regulations applicable to perennial non-fish-bearing streams (Type Np).

Wetlands identified within the study area would likely be considered Category III for regulatory purposes. We did not evaluate wetland functions or rate them according to the Washington Department of Ecology rating system to determine the categories as part of our study. However, a Category III rating would be consistent with our general observations, as well as those of the City planner during permitting for the Stadium Way project (Misty Blair, Planner – City of Tacoma, pers. comm.). City code requires a 75-foot buffer on Category III wetlands.

Vegetation

We mapped general vegetation communities throughout the study area (Figures 5a and 5b). The focus of the vegetation mapping was to classify vegetation conditions with regard to implications for slope stability and vegetation management that may be relevant for the slope management plan. In general, our classification scheme and the extent and distribution of vegetation communities is consistent with the mapping presented in the 2001 GeoEngineers report, but was updated in places based on the most recent field reconnaissance. Furthermore, we classified vegetation into the following community types which differ somewhat from the previous effort:

- Grass, lawn or landscaping;
- Mixed shrubs with few trees;
- Invasive shrub monoculture;
- Young tree stand with mixed understory;
- Mature canopy with sparse understory;
- Mature canopy with moderate to dense understory, and

- Mature canopy with invasive understory.

In contrast to the 2001 report, we did not classify wet areas as a vegetation type; instead, we included wet areas as part of the vegetation community types listed above. These wet areas occur as shrub and emergent communities within the understory of forested, shrub and grass communities as identified on Figures 5a and 5b.

Mature canopy areas were generally dominated by big leaf maple (*Acer macrophyllum*). Common understory species included Indian plum (*Oemleria cerasiformis*), salmonberry (*Rubus spectabilis*), sword fern (*Polystichum munitum*), Oregon grape (*Mahonia nervosa*), English holly (*Ilex aquifolium*), English ivy (*Hedera helix*), Himalayan blackberry (*Rubus armeniacus*), nightshade (*Solanum* sp.), and native/wild roses (*Rosa* spp.). Immature canopies (young tree stands) were typically dominated by red alder (*Alnus rubra*) with understories including Indian plum, sword fern, oceanspray (*Holodiscus discolor*), and thimbleberry (*Rubus parviflorus*). Invasive shrub monocultures were dominated by Himalayan blackberry to the exclusion of most other species.

SUMMARY

The goal of this report is to provide a baseline conditions assessment of the study area. We understand that the City and Metro Parks Tacoma will use these data to develop a slope management plan for the study area as defined in this report.

A number of slide scarps and bluffs exist within the study area (Figures 3a and 3b). Some portions of the study area also appear to consist of soils that are underlain by dense glacially consolidated soils. These soils can be stable at relatively steep angles with respect to deep-seated slope failures. However, shallow "skin" slides are common in sloping areas underlain by these materials. Deep seated rotational landslides are generally less common in these materials. The entire study area was mapped as a moderate to high landslide risk in our 2001 report. This condition does not appear to have changed in the intervening 13 years. Future landsliding at the study area should be expected.

A number of springs/seeps and surface water drainage channels have been identified in the study area (Figures 4a and 4b). These features have resulted in, and may continue to cause, erosion of the slope and existing abandoned trail infrastructure. Extensive wetland areas are also present primarily in the southern half of the project area. Estimated wetland and surface water buffers are shown for planning purposes.

Vegetation mapping provides a baseline condition upon which future desired conditions can be planned. Much of the slope already contains a mature forested overstory, although areas of younger stands, shrub communities and grass/landscaped areas are also present. Invasive species are present throughout much of the study area. Areas dominated by invasive species represent opportunities for clearing of problematic vegetation and replacing it with native communities. These areas occur particularly at or near the top of the slope where Himalayan blackberry dominates. Many of the forested areas also contain extensive areas of English ivy, but eradiation of this invasive species would require a program spanning most of the slope and should be accompanied by a comprehensive invasive species management and landscaping program.

LIMITATIONS

We have prepared this baseline assessment report for use by the City of Tacoma. Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in the fields of engineering geology and biologic sciences in this area at the time this report was prepared. No warranty or other conditions, express or implied, should be understood.

Please refer to Appendix B titled “Report Limitations and Guidelines for Use” for additional information pertaining to use of this report.

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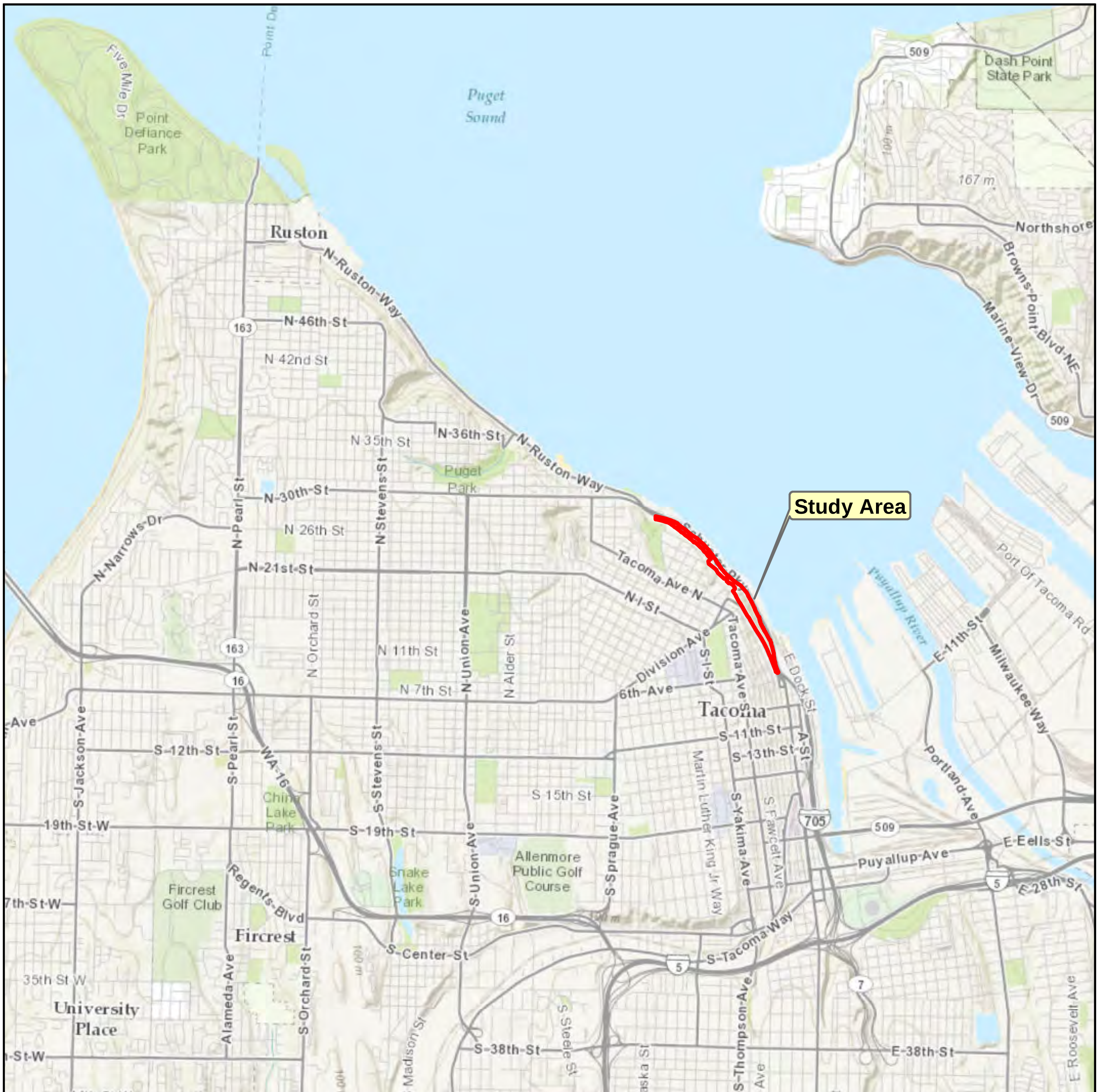

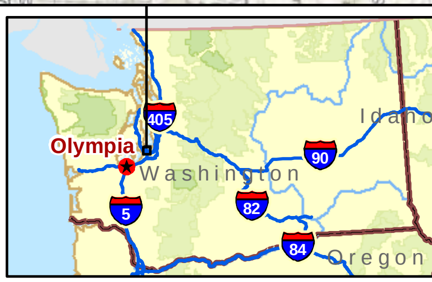

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Notes:
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2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: ESRI Data & Maps, Street Maps 2005

Transverse Mercator, State Plane South, North American Datum 1983
North arrow oriented to grid north

Vicinity Map

Schuster Slope Management Area
Tacoma, Washington

GeoEngineers

Figure 1

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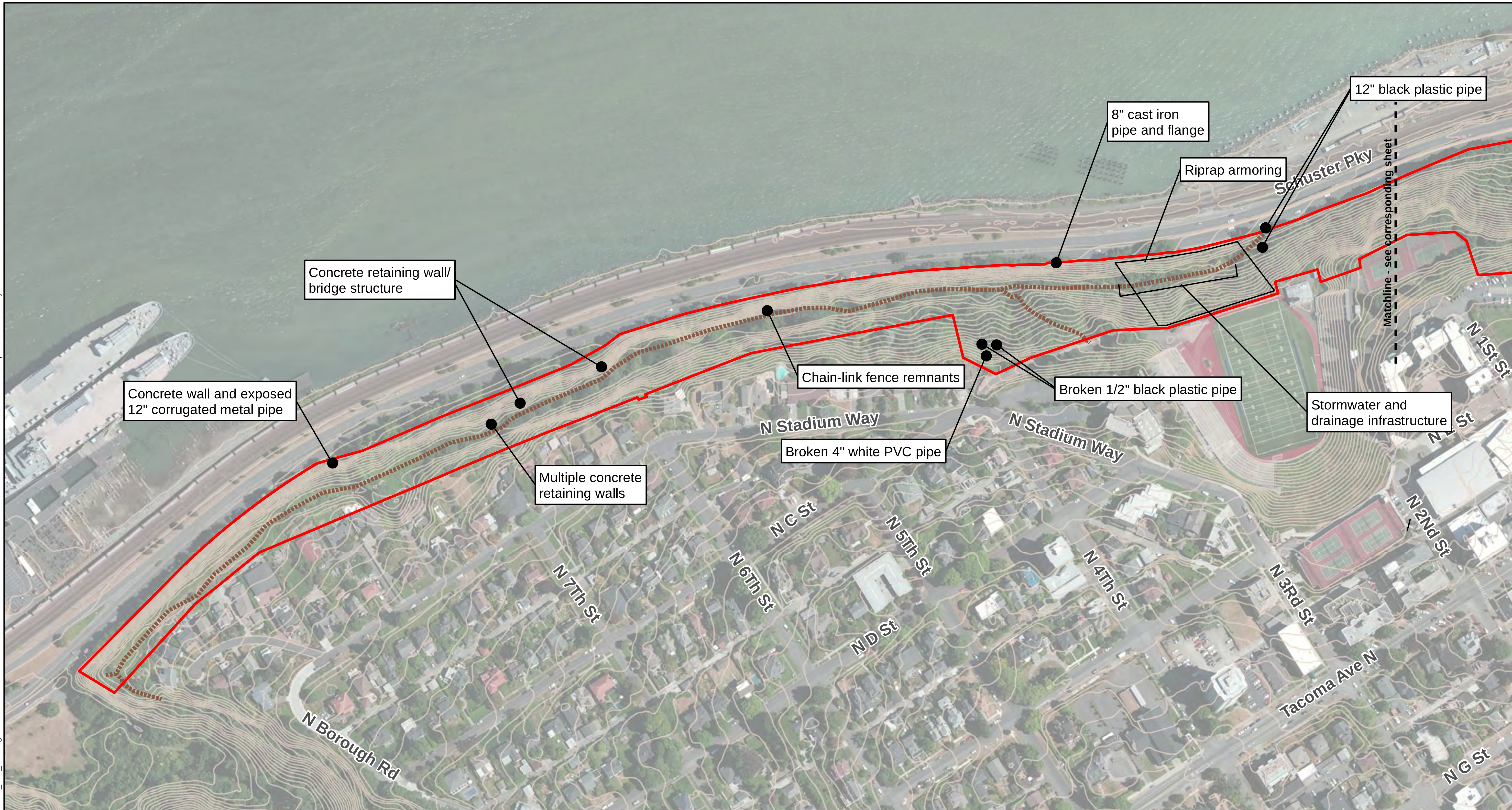

Map Revised: 10 July 2014 tkauhi

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Data sources: 5-ft contours created from LiDAR data obtained from Puget Sound LiDAR Consortium; aerial imagery and street names from ESRI.

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Study Area

5-ft contours

Existing trail alignment

N E S W

250 0 250

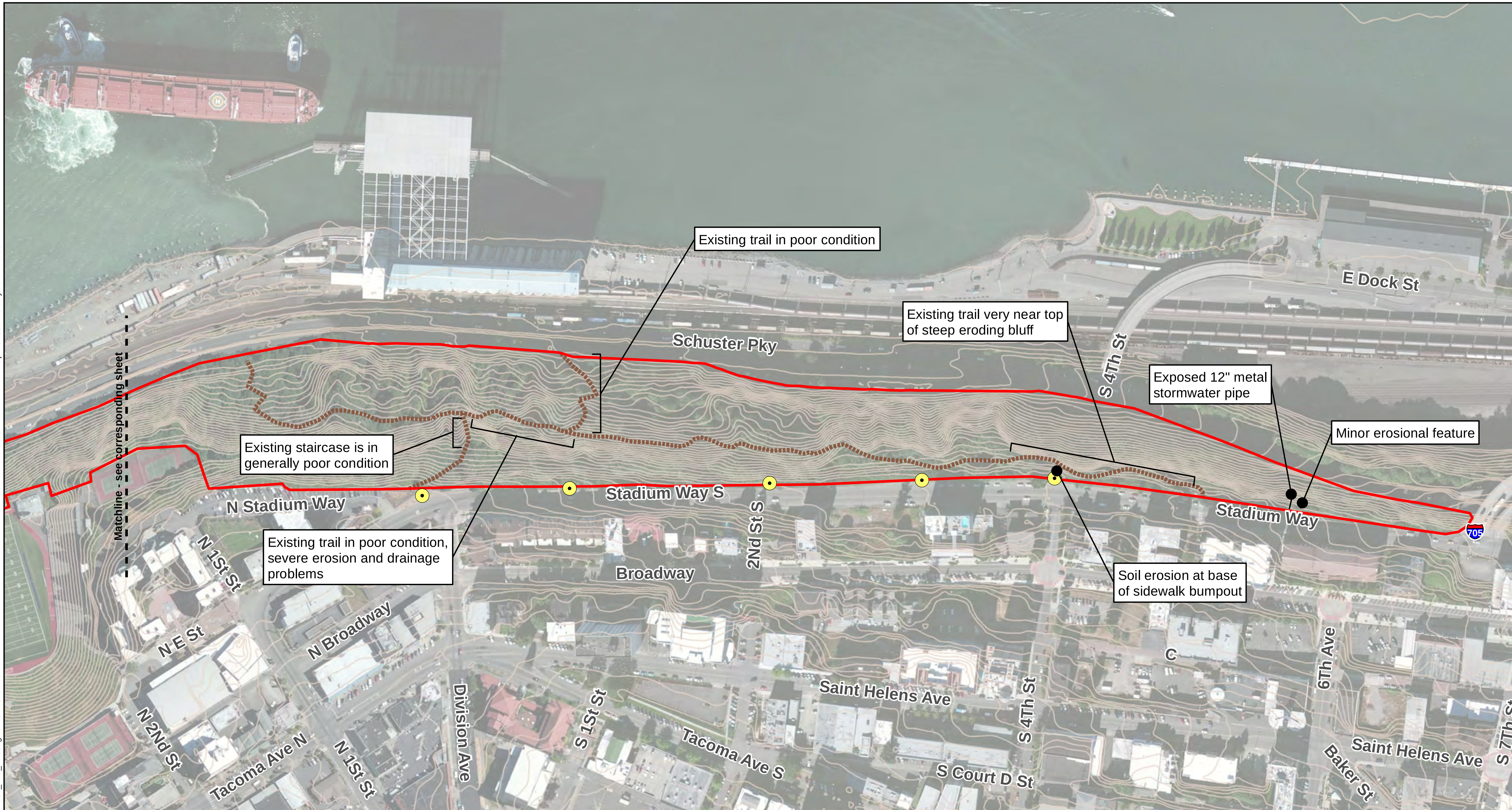
Feet

Topography and General Observations (North Half)

Schuster Slope Management Area
Tacoma, Washington

GeoEngineers

Figure 2a



Map Revised: 10 July 2014 tkauhi

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Data sources: 5-ft contours created from LiDAR data obtained from Puget Sound LiDAR Consortium; aerial imagery and street names from ESRI.

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Study Area
5-ft contours
Existing trail alignment
Stadium Way sidewalk bumpouts

N E S W

250 0 250
Feet

Topography and General Observations (South Half)

Schuster Slope Management Area
Tacoma, Washington

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Figure 2b

Existing trail alignment

Top of Bluff

Observed in 2001 and 2014

Observed in 2014

Top of Scarp

Observed in 2001 and 2014

Observed in 2001 but not 2014

Observed in 2014 but not 2001

Geologic Hazard Zones (see report text)

Zone B: Area of moderate landslide susceptibility: vegetated, medium dense soil

Zone C: Area of moderate landslide susceptibility: less vegetated than Zone B, medium dense soil

Zone D: Area of moderate landslide susceptibility: very steep slopes, mix of vegetated and non-vegetated, hard/ very dense soil.

N E S W

250 0 250

Feet

Data sources: aerial imagery and street names from ESRI.

Notes:
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Slope Conditions (North Half)

Schuster Slope Management Area
Tacoma, Washington

GeoEngineers

Figure 3a

Map Revised: 10 July 2014 tkauhi

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Existing trail alignment

Top of Bluff

Observed in 2001 and 2014

Observed in 2014

Top of Scarp

Observed in 2001 and 2014

Observed in 2001 but not 2014

Observed in 2014 but not 2001

Geologic Hazard Zones (see report text)

Zone A: Area of high landslide susceptibility: active soil creep, limited vegetation, loose soil.

Zone B: Area of moderate landslide susceptibility: vegetated, medium dense soil

Zone C: Area of moderate landslide susceptibility: less vegetated than Zone B, medium dense soil

250 0 250
Feet

Data sources: aerial imagery and street names from ESRI.

Notes:
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Slope Conditions (South Half)

Schuster Slope Management Area
Tacoma, Washington

GeoEngineers

Figure 3b

Map Revised: 10 July 2014 tkauhi

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Map Revised: 10 July 2014 tkauhi

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Existing trail alignment

Culvert Inlet or Catch Basin

Aquatic Critical Areas

Springs/seeps

Flowing water observed on June 19, 2014

Wetlands

Aquatic critical area buffers (wetlands = 75 ft.; streams = 100 ft.)

Data sources: aerial imagery and street names from ESRI.

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

250 0 250

Feet

Aquatic Areas and Buffers (North Half)

Schuster Slope Management Area
Tacoma, Washington

GeoEngineers

Figure 4a

Map Revised: 10 July 2014 tkauhi

Existing trail alignment

Culvert Inlet or Catch Basin

Aquatic Critical Areas

Springs/seeps

Flowing water observed on March 11, 2014

Wetlands

Aquatic critical area buffers (wetlands = 75 ft.; streams = 100 ft.)

250 0 250

Feet

Data sources: aerial imagery and street names from ESRI.

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Aquatic Areas and Buffers (South Half)

Schuster Slope Management Area
Tacoma, Washington

GeoEngineers

Figure 4b

Path: \\tac\projects\0\0570140\GIS\MXD\057014001_F4b_AquaticAreas.mxd

Data sources: aerial imagery and street names from ESRI.

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

- Existing trail alignment
- Grass, lawn or landscaping
- Mixed shrubs with few trees
- Invasive shrub monoculture
- Young tree stand with mixed understory
- Mature canopy with sparse understory
- Mature canopy with moderate-dense understory
- Mature canopy with invasive understory

250 0 250
Feet

Vegetation Classification (North Half)

Schuster Slope Management Area
Tacoma, Washington

GEOENGINEERS

Figure 5a

Map Revised: 10 July 2014 tkauhi

Path: \\tac\projects\0\0570140\GIS\MXD\057014001_F5a_Vegetation.mxd

Map Revised: 10 July 2014 tkauhi

Path: \\tac\projects\0\0570140\GIS\MXD\057014001_F5b_Vegetation.mxd

Data sources: aerial imagery and street names from ESRI.

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

- Existing trail alignment
- Grass, lawn or landscaping
- Mixed shrubs with few trees
- Invasive shrub monoculture
- Young tree stand with mixed understory
- Mature canopy with sparse understory
- Mature canopy with moderate-dense understory
- Mature canopy with invasive understory

N E S W

250 0 250
Feet

Vegetation Classification (South Half)

Schuster Slope Management Area
Tacoma, Washington

GeoEngineers

Figure 5b

Appendix A
Public Database Maps – Aquatic Critical Areas

City of Tacoma - Schuster Slope (North Half)

Property

Parcel

Critical Areas

Streams (City)

Wetlands
- Filled
- High Probability
- Known
- Non-Jurisdictional

Sewer - Sanitary

Sanitary Sewer

Sewer - Storm

Storm Sewer

Storm Sewer (Private)

Sanitary Sewer Assets

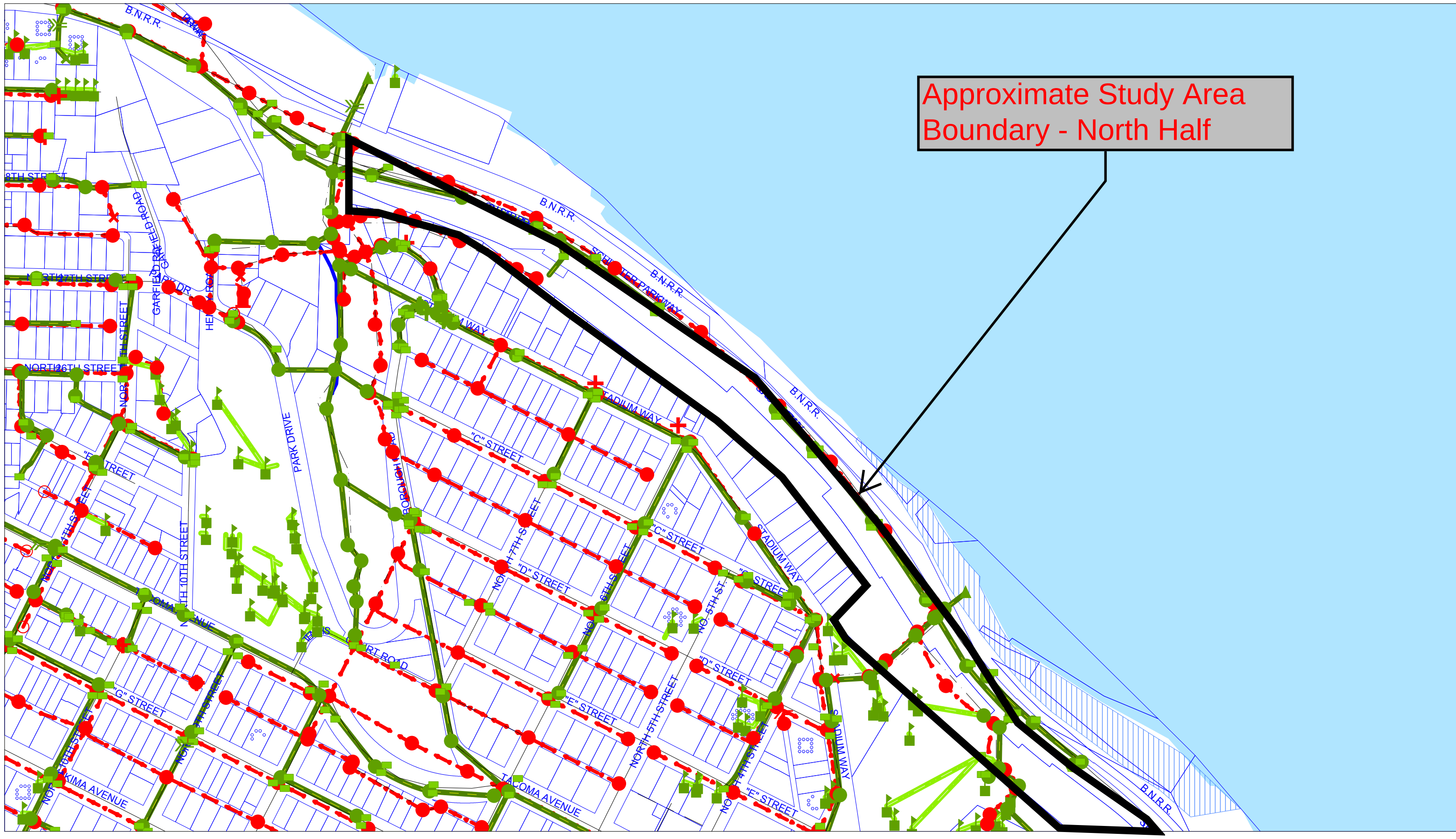
Sanitary Abandon

A-Style

Catch Basin

Lamphole

Manhole



SCALE 1 : 8,042

500 0 500 1,000 1,500

FEET

Tuesday, October 14, 2014 9:23 AM

City of Tacoma - Schuster Slope (South Half)

Property

Parcel

Critical Areas

Streams (City)

Wetlands
- Filled
- High Probability
- Known
- Non-Jurisdictional

Sewer - Sanitary

Sanitary Sewer

Sewer - Storm

Storm Sewer

Storm Sewer (Private)

Sanitary Sewer Assets

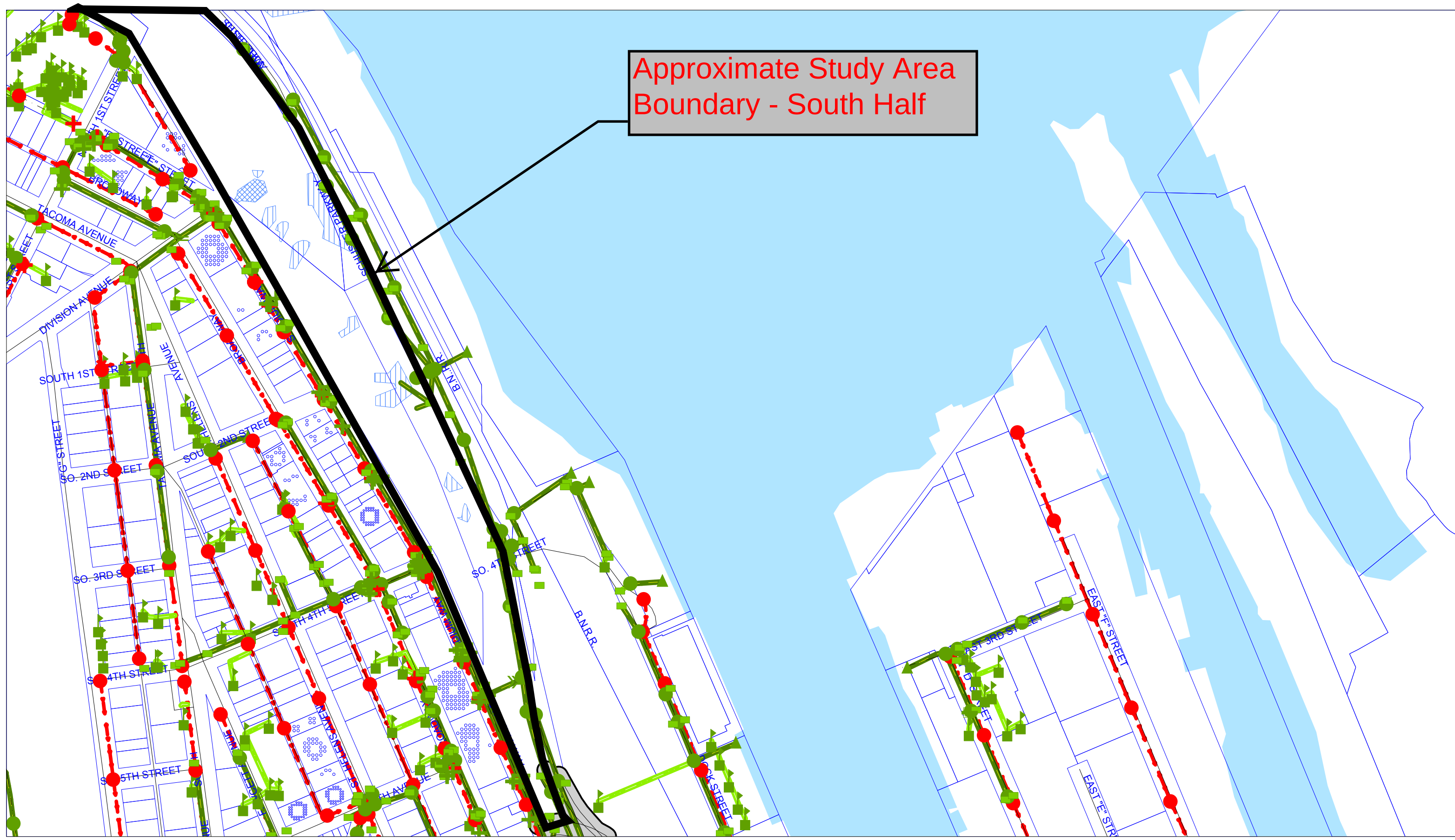
Sanitary Abandon

A-Style

Catch Basin

Lamphole

Manhole



SCALE 1 : 8,042

500 0 500 1,000 1,500

FEET

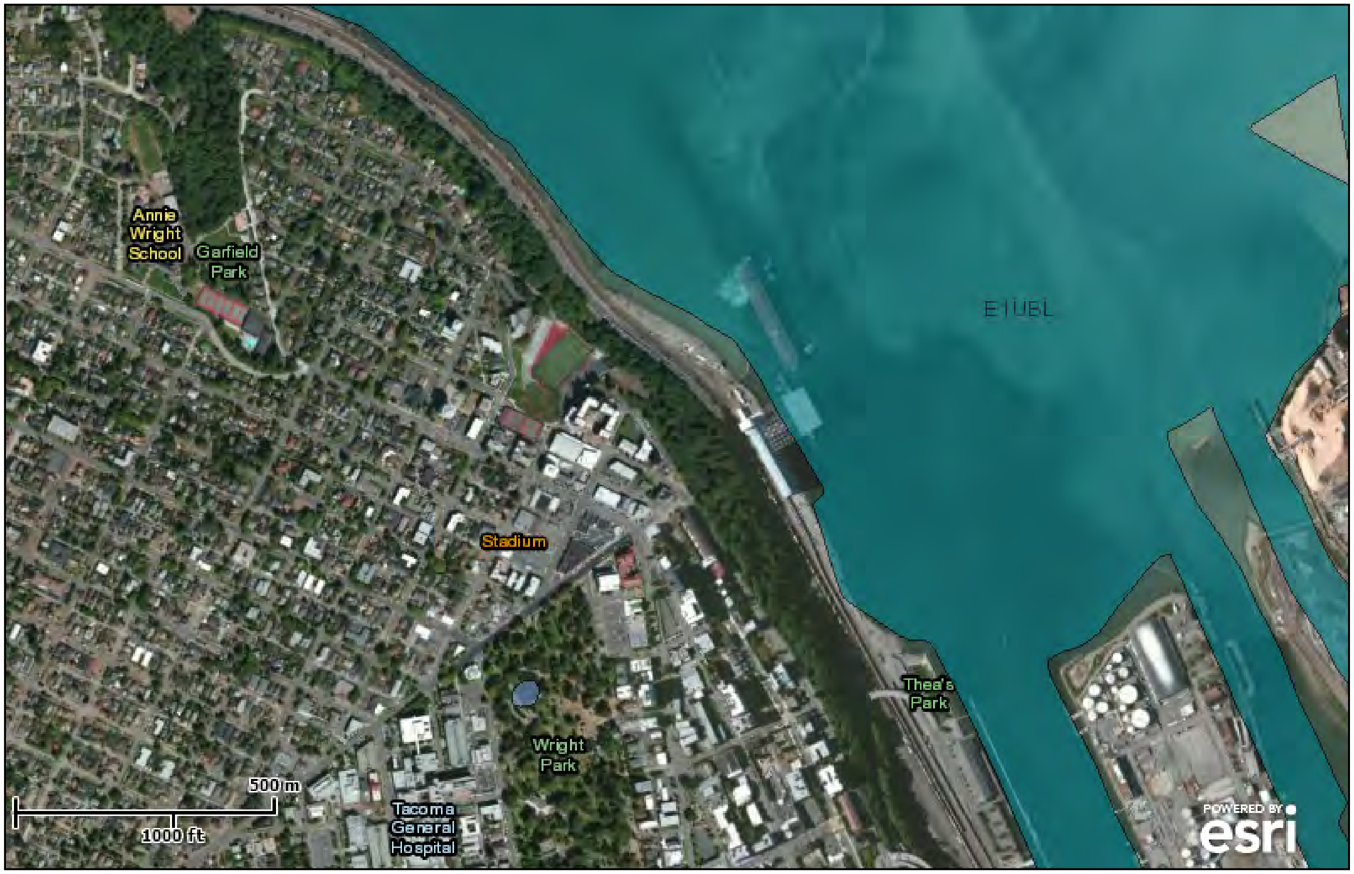
Tuesday, October 14, 2014 9:37 AM

U.S. Fish and Wildlife Service

National Wetlands Inventory

Schuster Slope Management Area

Jun 30, 2014



Wetlands

- Freshwater Emergent
- Freshwater Forested/Shrub
- Estuarine and Marine Deepwater
- Estuarine and Marine
- Freshwater Pond
- Lake
- Riverine
- Other

Riparian

- Herbaceous
- Forested/Shrub

Riparian Status

- Digital Data

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

User Remarks:

APPENDIX B
Report Limitations and Guidelines for Use

APPENDIX B
REPORT LIMITATIONS AND GUIDELINES FOR USE

This appendix provides information to help you manage your risks with respect to the use of this report.

Geologic and Biologic Services are performed for specific purposes, persons and projects

This report has been prepared for use by the City of Tacoma. This report is not intended for use by others, and the information contained herein is not applicable to other sites.

GeoEngineers structures our services to meet the specific needs of our clients. No one except the City of Tacoma and their agents should rely on this report without first conferring with GeoEngineers. This report should not be applied for any purpose or project except the one originally contemplated.

Geologic and/or Biologic Reports are Based on a Unique Set of Project-Specific Factors

This baseline conditions assessment report has been prepared the area of sloping ground in the City of Tacoma as described in this document. GeoEngineers considered a number of unique, project-specific factors when establishing the scope of services for this project and report. Unless GeoEngineers specifically indicates otherwise, do not rely on this report if it was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site, or
- completed before important project changes were made.

If important changes are made after the date of this report, GeoEngineers should be given the opportunity to review our interpretations and recommendations and provide written modifications or confirmation, as appropriate.

Subsurface, Surface Geologic and Biologic Conditions Can Change

This report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by manmade events such as construction on or adjacent to the site, or by natural events such as floods, earthquakes, slope instability or groundwater fluctuations. Always contact GeoEngineers before applying a report to determine if it remains applicable.

Most Geologic and Biologic Findings are Professional Opinions

Our interpretations of surface and subsurface conditions are based on field observations from widely spaced locations at the site. GeoEngineers reviewed the observational and map data and then applied our professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ, sometimes significantly, from those indicated in this report. Our report, conclusions and interpretations should not be construed as a warranty of the subsurface conditions.

Read These Provisions Closely

Some clients, design professionals and contractors may not recognize that the geoscience practices (geology and biology) are far less exact than other engineering and natural science disciplines. This lack of understanding can create unrealistic expectations that could lead to disappointments, claims and disputes. GeoEngineers includes these explanatory “limitations” provisions in our reports to help reduce such risks. Please confer with GeoEngineers if you are unclear how these “Report Limitations and Guidelines for Use” apply to your project or site.