GEODESIGN INC

PRELIMINARY REPORT OF DUE DILIGENCE GEOTECHNICAL ENGINEERING SERVICES

Proposed School Campus
Warrenton, Oregon

For
Warrenton-Hammond School District
July 25, 2018

GeoDesign Project: WarrHammSD-1-01

GEODESIGN INC

July 25, 2018

Warrenton-Hammond School District
820 SW Cedar Avenue
Warrenton, OR 97146

Attention: Mark Jeffery

Preliminary Report of Due Diligence
Geotechnical Engineering Services
Proposed School Campus
Warrenton, Oregon
GeoDesign Project: WarrHammSD-1-01

GeoDesign, Inc. is pleased to submit this due diligence report of geotechnical engineering services for the planned Warrenton-Hammond School District (WHSD) Campus Tax Lots 100, 103, and 2301 located east of Dolphin Road in Warrenton, Oregon. We understand that WHSD is interested in building a new K-12 school campus that is outside of the tsunami hazard zone in three phases. Our services for this project were conducted in accordance with our scope and updated fee dated May 31, 2018.

We appreciate the opportunity to be of service to you. Please call if you have questions regarding this report.

Sincerely,

GeoDesign, Inc.

Shawn M. Dimke, P.E., G.E.
Principal Engineer

CMC:SMD:kt
Attachments
One copy submitted (via email only)
Document ID: WarrHammSD-1-01-072518-geor.docx

TABLE OF CONTENTS		PAGE NO.

ACRONYMS AND ABBREVIATIONS

ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials
BGS	below ground surface
CPT	cone penetrometer test
CSZ	Cascadia Subduction Zone
DOGAMI	Oregon Department of Geology and Mineral Industries
FEMA	Federal Emergency Management Agency
g	gravitational acceleration (32.2 feet/second^2)
GPS	global positioning system
H:V	horizontal to vertical
IBC	International Building Code
LiDAR	light detection and ranging
OSHA	Occupational Safety and Health Administration
OSSC	Oregon Standard Specifications for Construction (2018)
pcf	pounds per cubic foot
psf	pounds per square foot
psi	pounds per square inch
SOSSC	State of Oregon Structural Specialty Code
WHSD	Warrenton-Hammond School District

1.0 INTRODUCTION

GeoDesign, Inc. is pleased to submit this due diligence report of geotechnical engineering services for the planned Warrenton-Hammond School District (WHSD) Campus Tax Lots 100, 103, and 2301 located east of Dolphin Road in Warrenton, Oregon. We understand that WHSD is interested in building a new K-12 school campus that is outside of the tsunami hazard zone. The new campus would be constructed in three phases, with the first phase consisting of a new building for Grades 6 through 8. The area of interest primarily includes Tax Lots 103, 2301, and the west one-third of 100. Figure 1 shows the site location relative to existing topographic and physical features. Preliminary development plans were not available for our review at the time of this report. Our services constitute a "due diligence" preliminary evaluation of the proposed site, with the primary purpose of our services to identify "fatal flaws" associated with development of the site for WHSD.

Acronyms and abbreviations used herein are defined above, immediately following the Table of Contents.

2.0 SCOPE OF SERVICES

The purpose of our geotechnical engineering services was to characterize site subsurface conditions and provide a due diligence preliminary geotechnical engineering evaluation of the site for use in a feasibility study for the proposed campus. Our scope of services included the following:

- Coordinated and managed the field evaluation, including utility checks, site access, and scheduling subcontractors and GeoDesign field staff.
- Reviewed prior geotechnical and geological reports and information available for the site.
- Conducted a field reconnaissance of the site.
- Completed the following subsurface explorations at the site:
  - Excavated 10 test pits to depths between 11.0 and 11.5 feet BGS.
  - Completed three CPT probes to depths between 41.0 and 61.4 feet BGS (practical refusal).
- Collected disturbed and undisturbed soil samples for laboratory testing at select depths from the test pit explorations.
- Classified the materials encountered in and maintained a detailed log of the test pit explorations.
- Completed the following laboratory tests on select soil samples collected from the test pit explorations:
  - Seventeen moisture content determinations in general accordance with ASTM D2216
  - One Atterberg limits test in general accordance with ASTM D4318
- Provided preliminary recommendations for site preparation, grading, and earthwork.
- Provided preliminary recommendations for the preferred foundation type. We anticipate that structures can be supported on shallow spread footings and foundation recommendations will include allowable capacity, settlement estimates, and lateral resistance parameters.
- Provided preliminary recommendations for preparation of floor slab subgrades.

- Provided preliminary recommendations for the management of identified groundwater conditions that may affect the performance of structures.
- Evaluated seismic hazards, including liquefaction, lateral spreading, tsunami inundation, and ground rupture.
- Provided preliminary recommendations for 2015 IBC seismic coefficients.
- Provided this preliminary report summarizing our explorations, laboratory testing, and preliminary recommendations.

3.0 SITE CONDITIONS

3.1 GEOLOGIC CONDITIONS

The site is located in the Clatsop Plains, which resides on the western flank of the Coast Range physiographic province. The Clatsop Plains is composed of a series of alluvial and marine terraces flanked by ocean beaches to the west, Youngs Bay and the Columbia River to the north, and the Coast Range uplands to the east. The terraces represent river and ocean wave-cut platforms formed on marine bedrock during past high sea level stands. The wave-cut platforms are covered by terrace sediments consisting of beach, fluvial, and estuary deposits and are generally mantled by old sand dune deposits. The marine terraces have been tectonically uplifted and faulted to their present position and deeply weathered and incised by coastal streams.

The near-surface geologic unit is mapped as Quaternary Age (up to 2 million years before present) terrace deposits. The deposits consist of unconsolidated clayey silt, clay, sand, and gravel (Niem and Niem, 1985; and Schlicker et al., 1972). The terrace deposits are locally overlain by eolian dune sand. Based on CPT logs completed for the project, it appears the unconsolidated sediments extend approximately 20 to 40 feet BGS at the site.

The terrace deposits overlie a lower member of the Smuggler Cove Formation, which is described as a late Eocene Age (approximately 37 million to 38 million years before present) silty claystone (Niem and Niem, 1985). The Smuggler Cove Formation is considered to extend approximately several hundred feet BGS in the site vicinity.

3.2 GEOLOGIC HAZARDS

We completed a review of available geologic publications, hazard mapping, and LiDAR topography along with a site reconnaissance to identify hazards relevant to the site. In our opinion, the major geologic and coastal hazards include earthquakes and tsunami inundation. A discussion of geologic and coastal hazards are summarized in the following sections.

3.2.1 Coastal Flooding

Geologic hazard mapping by Schlicker et al. (1972) indicates that the lower elevations on the site, primarily in the drainages, are flood hazard areas. We reviewed available flood hazard maps (Flood Insurance Rate Maps) for the site vicinity (FEMA, 2018). The proposed site is located in Zone X, which is described as an area of minimal flood hazard.

3.2.2 Earthquakes and Tsunami Inundation

Earthquake sources in the site vicinity include CSZ plate interface earthquakes, CSZ intraplate earthquakes (also referred to as Benioff Zone or intraslab earthquakes), and local crustal earthquakes. In our opinion, CSZ plate interface earthquakes are the most significant contributor to the earthquake hazard at the site. Geologic evidence indicates that CSZ plate interface earthquakes occur approximately every 200 to 800 years with average recurrence intervals of approximately 600 years. The most recent of these plate interface earthquakes, having a magnitude of approximately 9, occurred approximately 300 years ago.

Tsunamis in the Pacific Ocean can be generated from near-source locations (such as fault rupture on the CSZ) or from far-source locations (such as large subduction zone earthquakes in the Pacific Ocean [Alaska or Japan]). The proposed building site is elevated, and based on tsunami mapping (DOGAMI, 2013), tsunami events are not expected to inundate the building site. Lower non-building portions of the site as shown on Figure 2 may be inundated from a CSZ-generated tsunami.

3.2.3 Fault Rupture

Faults are not mapped beneath the site, and the nearest mapped fault is approximately 7 miles away. Consequently, it is our opinion that the probability of surface fault rupture beneath the site is low.

3.2.4 Liquefaction and Lateral Spreading

Liquefaction is caused by a rapid increase in pore water pressure that reduces the effective stress between soil particles to near zero. Granular soil, which relies on interparticle friction for strength, is susceptible to liquefaction until the excess pore pressures can dissipate. In general, loose, saturated sand soil with low silt and clay content is the most susceptible to liquefaction. The soil underlying the site is primarily silt and clay, so liquefaction and lateral spreading associated with liquefaction are not expected to be a design consideration for the proposed project.

3.3 SURFACE CONDITIONS

The site is located on relatively flat-lying ground between elevations of 40 and 60 feet that contains several incised drainage ravines that trend to the south. Figure 2 shows the existing site features and topography along with locations of our subsurface explorations. A low ridge extends up to an elevation of approximately 90 feet east of the site that has gentle to moderate slopes. A majority of the site is covered by agricultural grass. The drainages located in the south portion of the site contain dense vegetation and tree cover. The northwest corner of the site contains a gravel access road from Dolphin Road that leads to a variety of imported stockpiled materials. The stockpiled materials generally consisted of silt; silty gravel; coarse, angular, crushed aggregate; and boulders. The ground surrounding the stockpiles appeared to have been graded in the past and contained evidence of imported fill material. Based on a review of historical aerial photographs, we noted a disturbance area, indicating active fill placement in the northwest corner of the site. The disturbance appears to have started between 2006 and 2009. The area of disturbance is shown as the approximate undocumented fill area on Figure 2.

3.4 SUBSURFACE CONDITIONS

3.4.1 General

We explored subsurface conditions by excavating 10 test pits (TP-1 through TP-10) to depths between 11.0 and 11.5 feet BGS and completing three CPT probes (CPT-1 through CPT-3) to refusal depths between 41.0 and 61.4 feet BGS. The approximate exploration locations are shown on Figure 2. The test pit logs and results of the laboratory testing completed at the site by GeoDesign are presented in Appendix A. The CPT logs are presented in Appendix B.

In general, subsurface conditions consist of silt and clay soil with thin silty sand interbeds overlying sedimentary bedrock, which presumably resulted in refusal of the CPT probes. Localized areas of fill were also encountered in the west portion of the site. We encountered topsoil and tilled soil zones ranging from 6 to 18 inches thick and surficial root zones ranging from 2 to 3 inches thick. The following sections provide a detailed description of the subsurface conditions encountered.

3.4.2 Undocumented Fill

Undocumented fill presumably from nearby commercial development was encountered from the ground surface to 3.0 to 6.0 feet BGS in test pits TP-7, TP-8, and TP-10. The fill consists of stiff to very stiff silt with varying amount of sand, gravel, cobbles, and wood. The fill overlies a 1.0- to 2.0-foot-thick layer of medium stiff to stiff, dark brown silt that was interpreted to represent a buried topsoil layer. The area of undocumented fill is shown on Figure 2.

3.4.3 Native Soil

The topsoil and fill are underlain by native soil consisting of layered silt and clay with thin layers of silty sand that extend to the bottom of our test pit explorations. The silt and clay soil encountered in the test pits is generally medium stiff to stiff with trace organics. Medium dense, fine, silty sand layers ranging in thickness from 2 to 18 inches were encountered in several of the test pits. Very stiff to hard silt and clay was generally encountered at depths of approximately 20.2, 14.0, and 32.5 feet BGS in CPT-1, CPT-2, and CPT-3, respectively. Soft, fine-grained soil was also observed from approximately 8.9 to 10.2 feet BGS in CPT-1.

The tested moisture content of the silt and clay ranged from 33 to 64 percent at the time of our explorations. The tested moisture content of the silty sand ranged from 24 to 37 percent at the time of our explorations. One Atterberg limits test indicated the clay soil exhibits high plasticity with a plasticity index of 43.

3.4.4 Groundwater

Slow groundwater seepage was observed in test pits TP-5, TP-6, and TP-10 at depths ranging between 8.0 and 9.0 feet BGS. Pore pressure data from the CPT probes indicate groundwater at depths of approximately 10.5 feet BGS. Based on our observations and research, we anticipate water can be encountered at shallow depths below the ground surface, particularly near lower drainage areas and during the wet season. The depth to groundwater may fluctuate in response to seasonal changes, prolonged rainfall, changes in surface topography, and other factors not observed in this study.

4.0 CONCLUSIONS AND PRELIMINARY RECOMMENDATIONS

Based on our explorations, laboratory testing, and a review of information for the site, it is our opinion that the site is acceptable for development and the anticipated foundation loads can be supported on shallow spread footings bearing on minimum 6-inch-thick granular pads. The following are expected to be the primary geotechnical considerations impacting the proposed development of the site.

- The lower elevations of the site are in the mapped tsunami inundation area as shown on Figure 2. Although not shown on Figure 2, much of the tsunami inundation area is also mapped as wetlands. We understand the proposed development would need to be located above the mapped tsunami inundation area.
- Undocumented fill and a buried topsoil zone was encountered in the west portion of the site in the area indicated on Figure 2. Foundations should not be supported on undocumented fill or buried topsoil. The undocumented fill and buried topsoil zone should be removed in structural areas and replaced with structural fill if it is not removed for required site grading. Alternately, it may be possible to leave some of the undocumented fill in place in pavement areas with limited risk by only improving the surface of the exposed subgrade.
- Clay was encountered at shallow depths at the site and one Atterberg limits test indicates the clay exhibits high plasticity. We recommend evaluating the shrink-swell potential of the on-site soil with further laboratory testing. Depending on the tested expansion potential, design measures such as deeper granular pads for footings and foundation drains extending to the base of the granular pads could be needed to limit the shrink-swell potential for the proposed buildings.
- The majority of the site has a tilled zone from prior agricultural use. The tilled zone is soft when wet and has poor engineering properties from repeated disturbance. In areas where proposed site cuts will not remove the tilled zone, we recommend the tilled zone be removed and replaced with structural fill, scarified and re-compacted as structural fill, or stabilized using cement and/or lime amendment within all building and pavement areas.
- The on-site soil can be used for structural fill. Given the fine-grained nature of the soil at the site, the use of the on-site soil for structural fill can be sensitive to small changes in moisture content and difficult, if not impossible, to adequately compact during wet weather or when the moisture content of the soil is more than a couple of percent above the optimum required for compaction. We anticipate that the moisture content of the soil currently will be above optimum and drying will be required for use as structural fill. Drying the soil will require an extended period of dry weather, typically experienced from early July to mid-October. Alternately, on-site soil can be amended for placement as structural fill without drying to the optimum moisture content for compaction.
- SOSSC requires a seismic hazard evaluation for special occupancy structures. Special occupancy structures include "buildings for every public, private or parochial school through secondary level or day care centers with a capacity greater than 250 individuals." Accordingly, a seismic hazard report will be required as part of the final geotechnical report for the site.

Our preliminary design and construction recommendations for the project are provided in the following sections.

5.0 PRELIMINARY DESIGN RECOMMENDATIONS

5.1 PERMANENT SLOPES

Permanent cut slopes in the lower half of the site should not exceed a gradient of 3H:1V, and cut and fill slopes for the remainder of the site should not exceed a gradient of 2H:1V unless specifically evaluated for stability. Slopes that will be maintained by mowing should not be constructed steeper than 3H:1V. Slopes should be planted with appropriate vegetation to provide protection against erosion as soon as possible after grading. Surface water runoff should be collected and directed away from slopes to prevent water from running down the face of the slope.

5.2 DRAINAGE

5.2.1 Surface Drainage

We recommend that all roof drains be connected to a tightline leading to storm drain facilities. Pavement surfaces and open space areas should be sloped such that surface water runoff is collected and routed to suitable discharge points. We also recommend that ground surfaces adjacent to buildings be sloped away from the buildings to facilitate drainage away from the buildings.

5.2.2 Foundation Drains

We recommend installing a perimeter foundation drain around new buildings. The foundation drains should be constructed at a minimum slope of approximately ½ percent and pumped or drained by gravity to a suitable discharge. The perforated drainpipe should not be tied to a stormwater drainage system without backflow provisions. The foundation drains should consist of 4-inch-diameter, perforated drainpipe embedded in a minimum 2-foot-wide zone of crushed drain rock that extends up to 6 inches BGS and is wrapped in a drainage geotextile. The invert elevation of the drainpipe should be installed at least 18 inches below the finish floor elevation. The drain rock and drainage geotextile should meet the requirements specified in the "Materials" section.

5.3 SEISMIC DESIGN CRITERIA

5.3.1 Seismic Design Parameters

Preliminary seismic code-based seismic design parameters for the 2015 IBC are provided below. However, for the proposed special occupancy structures at the site, a site-specific seismic hazard evaluation in accordance with the 2014 SOSSC and ASCE 7-10 will be required for final development.

Table 1. Seismic Design Parameters

Parameter	Short Period (T_s = 0.2 second)	1 Second Period (T_1 = 1.0 second)
Spectral Acceleration, S	S_s = 1.331 g	S_1 = 0.682 g
Site Class	D	
Site Coefficient, F	F_a = 1.000	F_v = 1.500
Spectral Acceleration Parameters, S_M	S_{MS} = 1.331 g	S_{M1} = 1.023 g
Design Spectral Acceleration Parameters, S_D	S_{DS} = 0.887 g	S_{D1} = 0.682 g

5.3.2 Liquefaction and Lateral Spreading

Liquefaction is caused by a rapid increase in pore water pressure that reduces the effective stress between soil particles to near zero. Granular soil, which relies on interparticle friction for strength, is susceptible to liquefaction until the excess pore pressures can dissipate. In general, loose, saturated sand soil with low silt and clay content is the most susceptible to liquefaction. Saturated silty soil with low plasticity is moderately susceptible to liquefaction or cyclic failure under relatively higher levels of ground shaking. We did not encounter any significant amount of soil considered to be susceptible to liquefaction or cyclic failure at the site. Since the site is not near an open face with saturated conditions and has low susceptibility to liquefaction, lateral spreading is expected to be negligible at this site.

5.4 PRELIMINARY SHALLOW FOUNDATION RECOMMENDATIONS

5.4.1 General

Based on the results of our explorations, the proposed buildings can likely be supported on shallow spread footings bearing on minimum 6-inch-thick granular pads over firm, undisturbed native soil. Deeper granular pads may be necessary if soft, loose, or deleterious material is required or further testing indicates a shrink-swell potential for the on-site soil.

5.4.2 Bearing Capacity and Dimensions

Shallow footings can be proportioned using a preliminary allowable bearing pressure of 2,500 psf. The value above is a net bearing pressure; the weight of the footing and overlying backfill can be ignored in calculating footing sizes. The recommended allowable bearing pressure applies to the total of dead plus long-term live loads and can be doubled for short-term loads resulting from wind or seismic forces.

Isolated column and continuous wall footings should have minimum widths of 24 and 18 inches, respectively. The base of exterior footings should be founded at least 18 inches below the lowest adjacent finished grade. Interior footings can be founded 12 inches below the bottom of the floor slab.

Total consolidation-induced settlement should be less than 1 inch, with differential settlement of up to ½ inch between lightly loaded and heavily loaded footings.

5.4.3 Resistance to Sliding

Lateral loads on footings can be resisted by passive earth pressure on the sides of the structures and by friction on the base of the footings. Our analysis indicates that the available passive earth pressure for footings confined by on-site soil and structural fill is 350 pcf, modeled as an equivalent fluid pressure. Typically, the movement required to develop the available passive resistance may be relatively large; therefore, we recommend using a reduced passive pressure of 250 pcf equivalent fluid pressure. Adjacent floor slabs, pavements, or the upper 12-inch depth of adjacent, unpaved areas should not be considered when calculating passive resistance. For footings in contact with imported granular material, a coefficient of friction equal to 0.40 may be used when calculating resistance to sliding.

5.4.4 Subgrade Evaluations

All footing subgrades should be evaluated by a member of our geotechnical staff. Observations should also evaluate whether all loose or soft material, organics, unsuitable fill, prior topsoil zones, or softened subgrades (if present) have been removed and native soil subgrades have not dried excessively. Localized deepening of footing excavations may be required to penetrate debris, fill, softened, dried, or deleterious material, if encountered.

6.0 CONSTRUCTION

6.1 SITE PREPARATION

6.1.1 Demolition

Demolition includes removing existing buildings, pavements, concrete curbs, abandoned utilities, and any subsurface elements. Demolished material should be transported off site for disposal. Excavations remaining from removing basements (if present), foundations, utilities, and other subsurface elements should be backfilled with structural fill where these are below planned site grades. The base of the excavations should be excavated to expose firm subgrade before filling. The sides of the excavations should be cut into firm material and sloped a minimum of 1½H:1V. Utility lines abandoned under new structural components should be completely removed and backfilled with structural fill. Soft or disturbed soil encountered during demolition should be removed and replaced with structural fill.

6.1.2 Stripping

The existing topsoil zone should be stripped and removed from all fill areas. Based on our explorations, the average depth of stripping will be approximately 2 to 3 inches, although greater stripping depths may be required to remove localized zones of loose or organic soil. Greater stripping depths should be anticipated in areas with thicker vegetation and along the base of draws. The actual stripping depth should be based on field observations at the time of construction. Stripped material should be transported off site for disposal or used in landscaped areas.

6.1.3 Subgrade Evaluation

Upon completion of stripping and subgrade stabilization and prior to the placement of fill or pavement improvements, the exposed subgrade should be evaluated by proof rolling. The subgrade should be proof rolled with a fully loaded dump truck or similar heavy, rubber tire construction equipment to identify soft, loose, or unsuitable areas. A member of our geotechnical staff should observe proof rolling to evaluate yielding of the ground surface. During wet weather, subgrade evaluation should be performed by probing with a foundation probe rather than proof rolling. Subgrades should be covered to avoid excessive drying. Areas that appear soft or loose or subgrades that have dried excessively should be improved in accordance with subsequent sections of this report.

6.1.4 Test Pit Locations

The test pit excavations were backfilled using relatively minimal compactive effort; therefore, soft areas can be expected at these locations. We recommend that this relatively uncompacted soil be removed from the test pits located within proposed foundation and paved areas to a depth of 3 feet BGS. The resulting excavation should be brought back to grade with structural fill. Deeper removal depth will be required where foundations are located over test pit locations.

6.2 SUBGRADE PROTECTION

The fine-grained soil present on this site is easily disturbed. If not carefully executed, site preparation, utility trench work, and roadway excavation can create extensive soft areas and significant repair costs can result. Earthwork planning, regardless of the time of year, should include considerations for minimizing subgrade disturbance.

If construction occurs during or extends into the wet season, or if the moisture content of the surficial soil is more than a couple percentage points above optimum, site stripping and cutting may need to be accomplished using track-mounted equipment. Likewise, the use of granular haul roads and staging areas will be necessary for support of construction traffic during the rainy season or when the moisture content of the surficial soil is more than a few percentage points above optimum. The amount of staging and haul road areas, as well as the required thickness of granular material, will vary with the contractor's sequencing of a project and type/frequency of construction equipment. Based on our experience, between 12 and 18 inches of imported granular material is generally required in staging areas and between 18 and 24 inches in haul roads areas. Stabilization material may be used as a substitute, provided the top 4 inches of material consists of imported granular material. The actual thickness will depend on the contractor's means and methods and, accordingly, should be the contractor's responsibility. In addition, a geotextile fabric should be placed as a barrier between the subgrade and imported granular material in areas of repeated construction traffic. The imported granular material, stabilization material, and geotextile fabric should meet the specifications in the "Materials" section.

As an alternative to thickened crushed rock sections, haul roads and utility work zones may be constructed using amended subgrades overlain by a crushed rock wearing surface. If the subgrade is amended, the thickness of granular material in staging areas and along haul roads can typically be reduced to between 6 and 9 inches. This recommendation is based on an assumed minimum unconfined compressive strength of 100 psi for subgrade amended to a depth of 12 to 16 inches. The actual thickness of the amended material and imported granular material will depend on the contractor's means and methods and, accordingly, should be the contractor's responsibility. Amendment is discussed in the "Materials" section.

6.3 EXCAVATION

6.3.1 Excavation and Shoring

Temporary excavation sidewalls should stand vertical to a depth of approximately 4 feet, provided groundwater seepage is not observed in the sidewalls. Open excavation techniques may be used to excavate trenches with depths between 4 and 8 feet, provided the walls of the excavation are cut at a slope of 1H:1V and groundwater seepage is not present. At this inclination, the slopes may slough and require some ongoing repair. Excavations should be flattened to 1½H:1V or 2H:1V if excessive sloughing or raveling occurs. In lieu of large and open cuts, approved temporary shoring may be used for excavation support. A wide variety of shoring and dewatering systems are available. Consequently, we recommend that the contractor be responsible for selecting the appropriate shoring and dewatering systems. If box shoring is used, it should be understood that box shoring is a safety feature used to protect workers and does not prevent caving. If the excavations are left open for extended periods of time, caving of the sidewalls may occur. The presence of caved material will limit the ability to properly backfill and compact the trenches. The contractor should be prepared to fill voids between the box shoring and the sidewalls of the trenches with sand or gravel before caving occurs.

If shoring is used, we recommend that the type and design of the shoring system be the responsibility of the contractor, who is in the best position to choose a system that fits the overall plan of operation. All excavations should be made in accordance with applicable OSHA and state regulations.

6.3.2 Trench Dewatering

Dewatering will be required if groundwater is encountered. A sump located within the trench excavation will likely be sufficient to remove the accumulated water, depending on the amount and persistence of water seepage and the length of time the trench is left open. Flow rates for dewatering are likely to vary depending on location, soil type, and the season during which the excavation occurs. The dewatering systems should be capable of adapting to variable flows.

If groundwater is present at the base of utility excavations, we recommend placing at least 12 inches of stabilization material at the base of the excavations. Trench stabilization material should meet the requirements provided in the "Materials" section.

We note that these recommendations are for guidance only. The dewatering of excavations is the sole responsibility of the contractor, as the contractor is in the best position to select these systems based on their means and methods.

6.3.3 Safety

All excavations should be made in accordance with applicable OSHA requirements and regulations of the state, county, and local jurisdiction. While this report describes certain approaches to excavation and dewatering, the contract documents should specify that the contractor is responsible for selecting excavation and dewatering methods, monitoring the excavations for safety, and providing shoring (as required) to protect personnel and adjacent structural elements.

6.4 MATERIALS

6.4.1 Structural Fill

6.4.1.1 General

Fill should be placed on subgrade that has been prepared in conformance with the "Site Preparation" section. A variety of material may be used as structural fill at the site. However, all material used as structural fill should be free of organic matter or other unsuitable material and should meet the specifications provided in OSSC 00330 (Earthwork), OSSC 00400 (Drainage and Sewers), and OSSC 02600 (Aggregates), depending on the application. A brief characterization of some of the acceptable materials and our recommendations for their use as structural fill is provided in this section.

In locations where fill is to be placed on slopes steeper than 5H:1V, level benches should be cut into the existing sloping surfaces to remove the surface loose material and should extend into the structural fill of the existing embankment. The benches should be a minimum of 10 feet wide or 1½ times the width of the compaction equipment, whichever is wider.

6.4.1.2 On-Site Soil

The material at the site should be suitable for use as general structural fill in some areas, provided it is properly moisture conditioned; free of debris, organic material, and particles over 6 inches in diameter; and meets the specifications provided in OSSC 00330.12 (Borrow Material).

Based on laboratory test results, the moisture content of the on-site soil at the time of our explorations was above the optimum for compaction. Moisture conditioning (drying) will be required to use on-site soil for structural fill. Accordingly, extended dry weather (typically experienced between early July and mid-October) will be required to adequately condition and place the soil as structural fill. It will be difficult, if not impossible, to adequately compact on-site soil during the rainy season or during prolonged periods of rainfall.

When used as structural fill, native soil should be placed in lifts with a maximum uncompacted thickness of 6 to 8 inches and compacted to not less than 92 percent of the maximum dry density for fine-grained soil and 95 percent of the maximum dry density for granular soil, as determined by ASTM D1557.

6.5.1.3 Imported Granular Material

Imported granular material used as structural fill should be pit- or quarry-run rock, crushed rock, or crushed gravel and sand and should meet the specifications provided in OSSC 00330.14 (Selected Granular Backfill) or OSSC 00330.15 (Selected Stone Backfill). The imported granular material should also be angular, fairly well graded between coarse and fine material, have less than 5 percent by dry weight passing the U.S. Standard No. 200 sieve, and have at least two fractured faces. Material with a higher fines content of up to 12 percent is permissible provided compaction can be achieved.

Imported granular material should be placed in lifts with a maximum uncompacted thickness of 12 inches and compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D1557. During the wet season or when wet subgrade conditions exists, the initial lift should be approximately 18 inches in uncompacted thickness and should be compacted by rolling with a smooth-drum roller without using vibratory action.

6.5.1.4 Stabilization Material

Stabilization material used in staging or haul road areas, or as trench stabilization material, should consist of 4- or 6-inch-minus pit- or quarry-run rock, crushed rock, or crushed gravel and sand and should meet the specifications provided in OSSC 00330.15 (Selected Stone Backfill). The material should have a maximum particle size of 6 inches, less than 5 percent by dry weight passing the U.S. Standard No. 4 sieve, and at least two mechanically fractured faces. The material should be free of organic matter and other deleterious material. Stabilization material should be placed in lifts between 12 and 24 inches thick and compacted to a firm condition.

6.5.1.5 Trench Backfill

Trench backfill placed beneath, adjacent to, and for at least 12 inches above utility lines (i.e., the pipe zone) should consist of well-graded granular material with a maximum particle size of 1½ inches and less than 10 percent by dry weight passing the U.S. Standard No. 200 sieve and should meet the specifications provided in OSSC 00405.13 (Pipe Zone Material). The pipe zone backfill should be compacted to at least 90 percent of the maximum dry density, as determined by ASTM D1557, or as required by the pipe manufacturer or local building department.

Within roadway alignments, the remainder of the trench backfill up to the subgrade elevation should consist of well-graded granular material with a maximum particle size of 2½ inches and less than 10 percent by dry weight passing the U.S. Standard No. 200 sieve and should meet the specifications provided in OSSC 00405.14 (Trench Backfill; Class B, C, or D). This material should be compacted to at least 90 percent of the maximum dry density, as determined by ASTM D1557, or as required by the pipe manufacturer or local building department. The upper 3 feet of the trench backfill should be compacted to at least 95 percent of the maximum dry density, as determined by ASTM D1557.

Outside of structural improvement areas (e.g., roadway alignments or building pads) trench backfill placed above the pipe zone may consist of general fill material that is free of organics and material over 6 inches in diameter and meets the specifications provided in OSSC 00405.14 (Trench Backfill; Class A, B, C, or D). This general trench backfill should be compacted to at least 90 percent of the maximum dry density, as determined by ASTM D1557, or as required by the pipe manufacturer or local building department.

6.5.1.6 Drain Rock

Drain rock should consist of angular, granular material with a maximum particle size of 2 inches and should meet the specifications provided in OSSC 00430.11 (Granular Drain Backfill Material). The material should be free of roots, organic matter, and other unsuitable material; have less than 2 percent by dry weight passing the U.S. Standard No. 200 sieve (washed analysis); and have at least two mechanically fractured faces. Drain rock should be compacted to a well-keyed, firm condition.

6.5.1.7 Aggregate Base Rock
Imported granular material used as base rock for building floor slabs and pavements should consist of ¾- or 1½-inch-minus material (depending on the application) and meet the requirements in OSSC 00641 (Aggregate Subbase, Base, and Shoulders). In addition, the aggregate should have less than 5 percent by dry weight passing the U.S. Standard No. 200 sieve. The aggregate base should be compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D1557.

6.5.2 Geotextile Fabric
6.5.2.1 Subgrade Geotextile
Subgrade geotextile should conform to OSSC Table 02320-1 and OSSC 00350 (Geosynthetic Installation). A minimum initial aggregate base lift of 6 inches is required over geotextiles.

6.5.2.2 Drainage Geotextile
Drainage geotextile should conform to Type 2 material of OSSC Table 02320-1 and OSSC 00350 (Geosynthetic Installation). A minimum initial aggregate base lift of 6 inches is required over geotextiles.

6.5.3 Soil Amendment
6.5.3.1 General
In conjunction with an experienced contractor, the on-site soil can be amended to obtain suitable support properties without shrink-swell potential. Successful use of soil amendment depends on the use of correct mixing techniques, soil moisture content, and amendment quantities. Soil amending should be conducted in accordance with the specifications provided in OSSC 00344 (Treated Subgrade). The amount of lime or cement used during treatment should be based on an assumed soil dry unit weight of 100 pcf.

6.5.3.2 Subgrade Stabilization
Specific recommendations based on exposed site conditions for soil amending can be provided if necessary. However, for preliminary design purposes, we recommend a target strength for amended soils of 100 psi. The amount of lime and/or cement necessary will vary with moisture content, soil type, and desired strength. It is difficult to predict field performance of soil to lime and cement amendment due to variability in soil response, and we recommend laboratory testing to confirm expectations. Typically, 3 to 6 percent dried quicklime by weight or 4 to 8 percent cement by weight is required to stabilize soil. For preliminary design purposes, we recommend assuming 7 percent cement by weight will be necessary to amend the on-site soil for placement as structural fill at the current moisture contents. The amount of lime and cement added to the soil may need to be adjusted based on field observations and performance. Moreover, depending on the time of year and moisture content levels during amendment, water may need to be applied during tilling to appropriately condition the soil moisture content.

A minimum curing of four days is required between treatment and construction traffic access. Construction traffic should not be allowed on unprotected amended subgrade. To protect the treated surfaces from abrasion or damage, the finished surface should be covered with 4 to 6 inches of imported granular material.

The crushed rock placed over treated subgrades typically becomes contaminated with soil during construction. Contaminated base rock should be removed and replaced with clean rock in pavement areas. The actual thickness of the amended material and imported granular material for haul roads and staging areas will depend on the anticipated traffic, as well as the contractor's means and methods and, accordingly, should be the contractor's responsibility.

6.5.3.3 Other Considerations

On-site soil that because of elevated moisture contents would not otherwise be suitable for structural fill may be amended and placed as fill over a subgrade prepared in conformance with the "Site Preparation" section. Typically, a minimum curing of four days is required between treatment and construction traffic access. Consecutive lifts of fill may be treated immediately after the previous lift has been amended and compacted (e.g., the four-day wait period does not apply). However, where the final lift of fill is a building or roadway subgrade, the four-day wait period is in effect.

Portland cement- and lime-amended soil is hard and has low permeability. This soil does not drain well and it is not suitable for planting. Future planted areas should not be amended, if practical, or accommodations should be made for drainage and planting. Moreover, amending soil within building areas must be done carefully to avoid trapping water under floor slabs. We should be contacted if this approach is considered. Amendment should not be used if runoff during construction cannot be directed away from adjacent wetlands.

7.0 OBSERVATION OF CONSTRUCTION

Satisfactory foundation and earthwork performance depends to a large degree on quality of construction. Sufficient observation of the contractor's activities is a key part of determining that the work is completed in accordance with the construction drawings and specifications. Subsurface conditions observed during construction should be compared with those encountered during the subsurface exploration. Recognition of changed conditions often requires experience; therefore, qualified personnel should visit the site with sufficient frequency to detect if subsurface conditions change significantly from those anticipated.

We recommend that GeoDesign be retained to observe earthwork activities, including stripping, proof rolling of the subgrade and repair of soft areas, footing subgrade preparation, performing laboratory compaction and field moisture-density tests, observing final proof rolling of the pavement subgrade and base rock, and asphalt concrete placement and compaction.

8.0 LIMITATIONS

We have prepared this preliminary report for use by Warrenton-Hammond School District and members of the design and construction team for the proposed project. The data and report can be used for bidding or estimating purposes, but our report, conclusions, and interpretations should not be construed as warranty of the subsurface conditions and are not applicable to other nearby building sites.

Exploration observations indicate soil conditions only at specific locations and only to the depths penetrated. They do not necessarily reflect soil strata or water level variations that may exist between exploration locations. If subsurface conditions differing from those described are noted during the course of excavation and construction, re-evaluation will be necessary.

The site development plans and design details were preliminary at the time this report was prepared. When the design has been finalized and if there are changes in the site grades or location, configuration, design loads, or type of construction for the buildings, the conclusions and recommendations presented may not be applicable. If design changes are made, we request that we be retained to review our conclusions and recommendations and to provide a written modification or verification.

The scope does not include services related to construction safety precautions, and our recommendations are not intended to direct the contractor's methods, techniques, sequences, or procedures, except as specifically described in our report for consideration in design.

Within the limitations of scope, schedule, and budget, our services have been executed in accordance with generally accepted practices in this area at the time the report was prepared. No warranty, express or implied, should be understood.

♦ ♦ ♦

We appreciate the opportunity to be of service to you. Please call if you have questions concerning this report or if we can provide additional services.

Sincerely,

GeoDesign, Inc.

Charles M. Clough, C.E.G.
Project Engineering Geologist

Shawn M. Dimke, P.E., G.E.
Principal Engineer

REGISTERED PROFESSIONAL ENGINEER
63114PE
OREGON
March 14, 2006
SHAWN DIMKE
EXPIRES: 12/31/19

REFERENCES

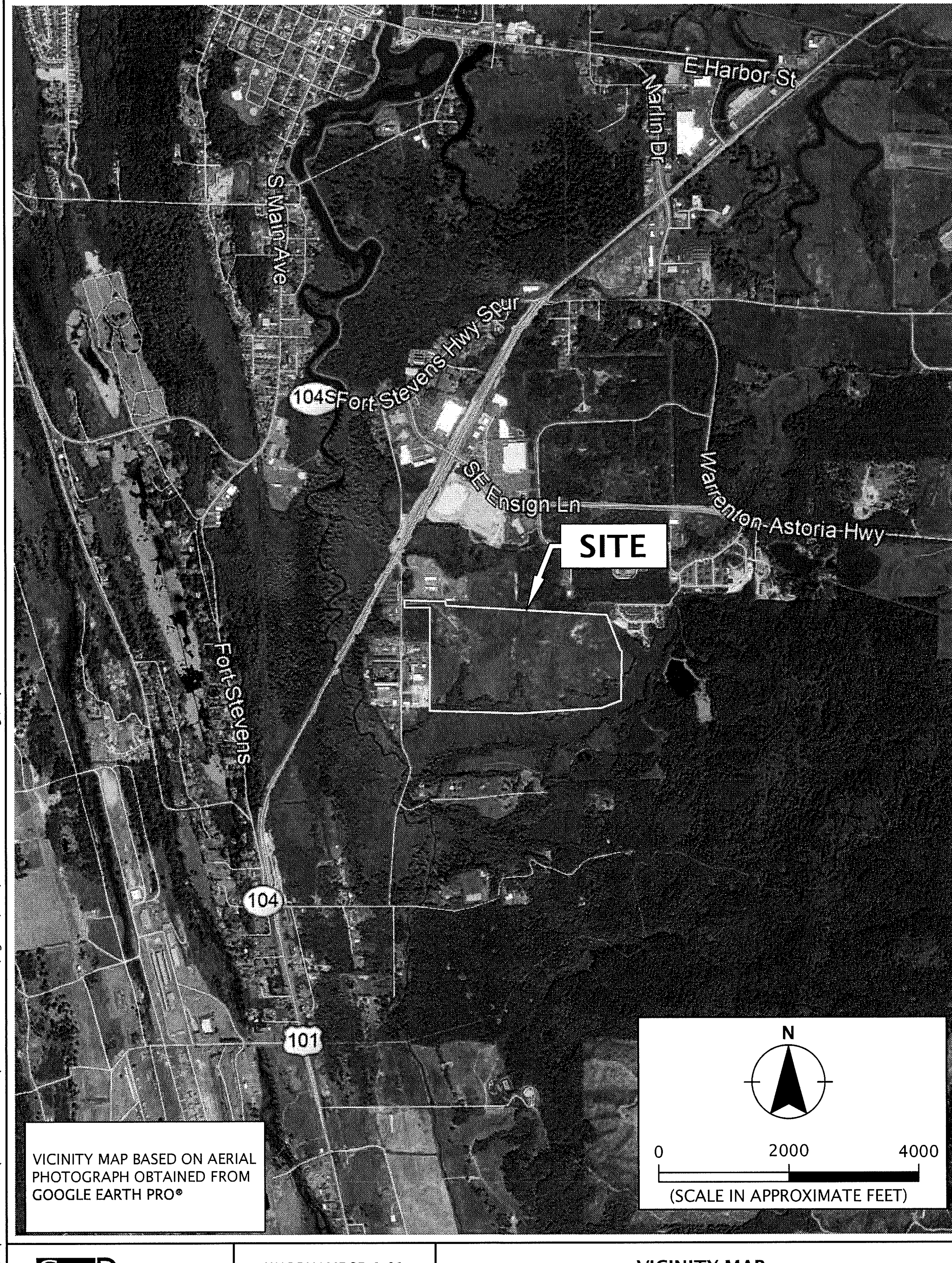
DOGAMI, 2013, Tsunami Inundation Maps for Warrenton South – Rilea, Clatsop County, Oregon, Department of Geology and Mineral Resources, TIM-Clat-03, 6/10/2013.

FEMA, 2018, *National Flood Hazard Layer FIRMette*, information available via the Internet: https://msc.fema.gov/portal/home, accessed July, 10, 2018.

Niem, A. R. and Niem, W. A., 1985, Oil and Gas Investigation of the Astoria Basin, Clatsop and Northernmost Tillamook Counties, Northwest Oregon: Oregon Department of Geology and Mineral Industries, Oil and Gas Investigation OGI-14, scale 1:100,000.

Schlicker, Herbert G., Deacon, Robert J., Beaulieu, John D., Olcott, Gordon W., 1972, Environmental Geology of the Coastal Region of Tillamook and Clatsop County, Oregon, Oregon Department of Geology and Mineral Industries Bulletin 74, scale 1:62,500

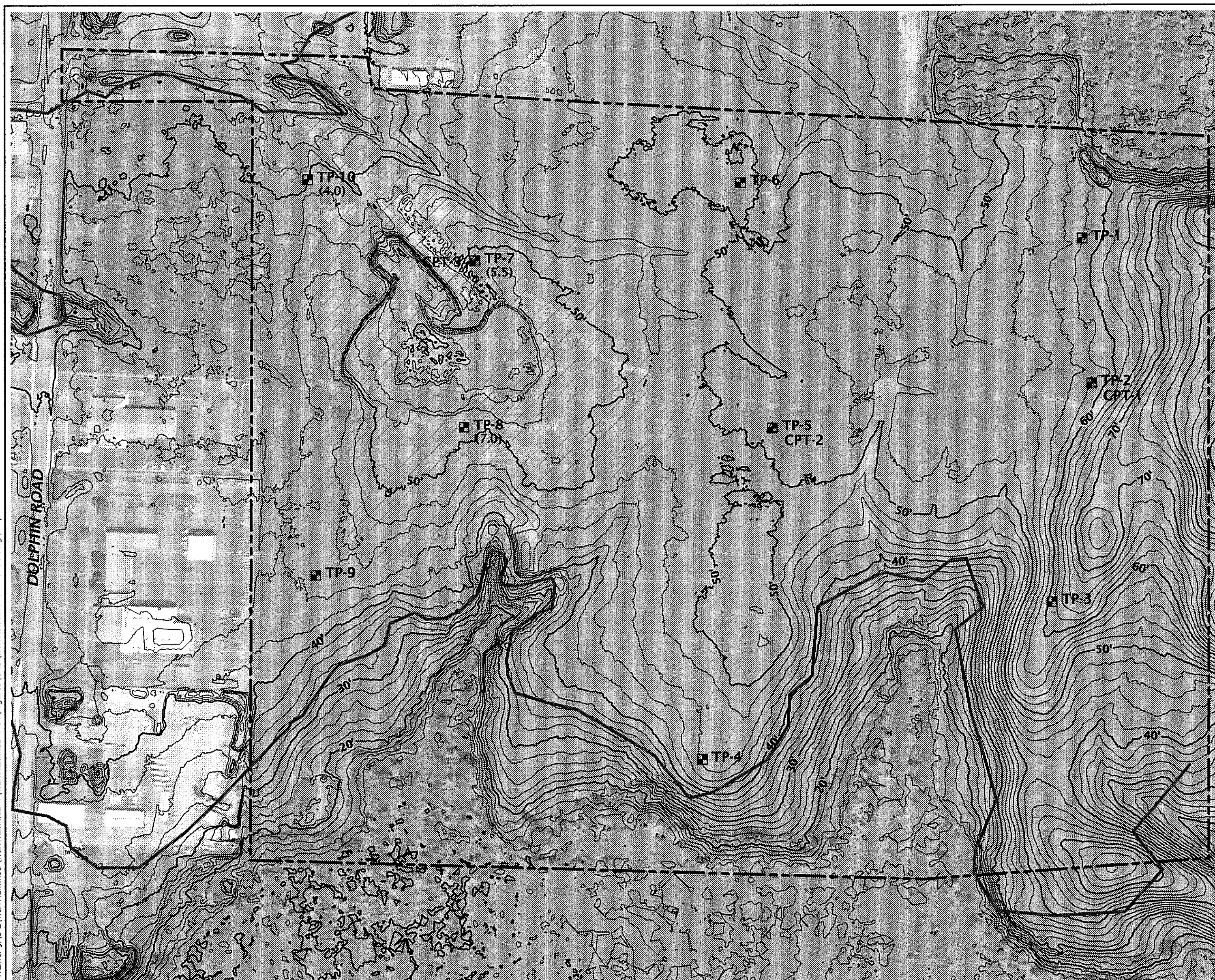
FIGURES



VICINITY MAP BASED ON AERIAL PHOTOGRAPH OBTAINED FROM GOOGLE EARTH PRO®

GEODESIGN INC 9450 SW Commerce Circle - Suite 300 Wilsonville OR 97070 503.968.8787 www.geodesigninc.com	WARRHAMDSD-1-01	VICINITY MAP	
	JULY 2018	PROPOSED SCHOOL CAMPUS WARRENTON, OR	FIGURE 1

Printed By: aday | Print Date: 7/20/2018 12:24:29 PM
File Name: J:\S-Z\WarrHammSD\WarrHammSD-1\WarrHammSD-1-01\Figures\CAD\WarrHammSD-1-01-VM01.dwg | Layout: FIGURE 1



LEGEND:

TP-1	TEST PIT
(5.5)	DEPTH IN FEET OF UNDOCUMENTED FILL AND BURIED TOPSOIL WHERE ENCOUNTERED
CPT-1	CONE PENETROMETER
	SITE BOUNDARY
	TSUNAMI INUNDATION LIMIT
	APPROXIMATE UNDOCUMENTED FILL AREA

SITE PLAN BASED ON AERIAL PHOTOGRAPH FROM GOOGLE EARTH PRO JULY 6, 2018

GEODESIGN INC
9450 SW Commerce Circle - Suite 300
Wilsonville OR 97070
503.968.8787 www.geodesigninc.com

WARRHAMDSD-1-01

JULY 2018

SITE PLAN

PROPOSED SCHOOL CAMPUS
WARRENTON, OR

FIGURE 2

Appendix D:

Wetland Report

- Wetland Delineation Concurrence Letter, DSL, 2019
- Wetland Delineation Report, Ecological Land Services, 2019
- Joint Permit Application (JPA), Ecological Land Services, 2019

Oregon
Kate Brown, Governor

Department of State Lands
775 Summer Street NE, Suite 100
Salem, OR 97301-1279
(503) 986-5200
FAX (503) 378-4844
www.oregon.gov/dsl

November 19, 2019

Warrenton-Hammond School District
Attn: Mike Moha
820 SW Cedar Avenue
Warrenton, OR 97146

Re: WD # 2019-0446 **Approved**
Wetland Delineation Report for the WHSD School Campus
Clatsop County; T8N R10W S34 TLs 103 and 105
APP # 62301
Warrenton Local Wetlands Inventory, Wetland F-1

Dear Mr. Moha:

The Department of State Lands has reviewed the wetland delineation report prepared by Ecological Land Services, Inc. for the site referenced above. Based upon the information presented in the report, a site visit on November 7, 2019, and additional information submitted upon request, we concur with the wetland and waterway boundaries as mapped in revised Sheet 6 of the report. Please replace all copies of the preliminary wetland maps with this final Department-approved map.

Within the study area, 13 wetlands (Wetland A-K, Z and DD, totaling approximately 8.02 acres) and 3 ditches (Ditch A-B and Stormwater Drainage Ditch) were identified. Wetlands A-K, Z and DD are subject to the permit requirements of the state Removal-Fill Law. Under current regulations, a state permit is required for cumulative fill or annual excavation of 50 cubic yards or more in wetlands or below the ordinary high-water line (OHWL) of the waterway (or the 2-year recurrence interval flood elevation if OHWL cannot be determined). The 3 ditches are exempt per OAR 141-085-0515(8); therefore, are not subject to current state Removal-Fill requirements.

This concurrence is for purposes of the state Removal-Fill Law only. Federal or local permit requirements may apply as well. The U.S. Army Corps of Engineers will determine jurisdiction under the Clean Water Act, which may require submittal of a complete Wetland Delineation Report.

Please be advised that state law establishes a preference for avoidance of wetland impacts. Because measures to avoid and minimize wetland impacts may include reconfiguring parcel layout and size or development design, we recommend that you work with Department staff on appropriate site design before completing the city or county land use approval process.

This concurrence is based on information provided to the agency. The jurisdictional determination is valid for five years from the date of this letter unless new information necessitates a revision. Circumstances under which the Department may change a determination are found in OAR 141-090-0045 (available on our web site or upon request). In addition, laws enacted by the legislature and/or rules adopted by the Department may result in a change in jurisdiction; individuals and applicants are subject to the regulations that are in effect at the time of the removal-fill activity or complete permit application. The applicant, landowner, or agent may submit a request for reconsideration of this determination in writing within six months of the date of this letter.

Thank you for having the site evaluated. If you have any questions, please contact the Jurisdiction Coordinator for Clatsop County, Daniel Evans, PWS, at (503) 986-5271.

Sincerely,

Peter Ryan Digitally signed by Peter Ryan
Date: 2019.11.19 14:19:02 -08'00'

Peter Ryan, PWS
Aquatic Resource Specialist

Enclosures

ec: Steffanie Taylor, Ecological Land Services
Warrenton Planning Department (Maps enclosed for updating LWI)
Brian Zabel, Corps of Engineers
Dan Cary, DSL
Oregon Coastal Management Program (Coastal Zone, coastpermits@state.or.us)

WETLAND DELINEATION / DETERMINATION REPORT COVER FORM

Fully completed and signed report cover forms and applicable fees are required before report review timelines are initiated by the Department of State Lands. Make checks payable to the Oregon Department of State Lands. To pay fees by credit card, go online at: https://apps.oregon.gov/DSL/EPS/program?key=4.

Attach this completed and signed form to the front of an unbound report or include a hard copy with a digital version (single PDF file of the report cover form and report, minimum 300 dpi resolution) and submit to: **Oregon Department of State Lands, 775 Summer Street NE, Suite 100, Salem, OR 97301-1279.** A single PDF of the completed cover from and report may be e-mailed to: **Wetland_Delineation@dsl.state.or.us.** For submittal of PDF files larger than 10 MB, e-mail DSL instructions on how to access the file from your ftp or other file sharing website.

Contact and Authorization Information

☒ Applicant ☐ Owner Name, Firm and Address:
Warrenton-Hammond School District, Contact: Mike Moha
820 SW Cedar Avenue
Warrenton, OR 97146

Business phone # (503) 861-2281
Mobile phone # (optional)
E-mail: moham@warrentonk12.org

☐ Authorized Legal Agent, Name and Address (if different):

Business phone #
Mobile phone # (optional)
E-mail:

I either own the property described below or I have legal authority to allow access to the property. I authorize the Department to access the property for the purpose of confirming the information in the report, after prior notification to the primary contact.

Typed/Printed Name: Mike Moha **Signature:** [signature]
Date: 11/14/2019 Special instructions regarding site access: ____

Project and Site Information

Project Name: WHSD School Campus

Latitude: 46.139666 Longitude: -123.914310
decimal degree - centroid of site or start & end points of linear project

Proposed Use:
New secondary school campus and future elementary and high school campuses

Tax Map # 81034
Tax Lot(s) 105 and 103
Tax Map #
Tax Lot(s)

Project Street Address (or other descriptive location):
West of SE Willow Drive and next to a portion of southern boundary of the North Coast Business Park in Warrenton.

Township 8N Range 10W Section 34 QQ NW
Use separate sheet for additional tax and location information

City: Warrenton County: Clatsop

Waterway: onsite wetlands River Mile: N/A

Wetland Delineation Information

Wetland Consultant Name, Firm and Address:
Ecological Land Services, Inc. - Steffanie Taylor
1157 3rd AVenue, Suite 220A
Longview, WA 98632

Phone # (360) 578-1371
Mobile phone # (if applicable)
E-mail: steff@eco-land.com

The information and conclusions on this form and in the attached report are true and correct to the best of my knowledge.
Consultant Signature: [signature] Date: 11/14/19

Primary Contact for report review and site access is ☒ Consultant ☐ Applicant/Owner ☐ Authorized Agent

Wetland/Waters Present? ☒ Yes ☐ No | Study Area size: 60 acres | Total Wetland Acreage: 8.0200

Check Applicable Boxes Below

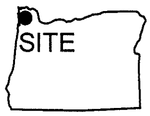
☐ R-F permit application submitted
☐ Mitigation bank site
☐ EFSC/ODOE Proj. Mgr: ____
☐ Wetland restoration/enhancement project (not mitigation)
☐ Previous delineation/application on parcel
If known, previous DSL # ____

☐ Fee payment submitted $ 454
☐ Resubmittal of rejected report ($100)
☐ Request for Reissuance. See eligibility criteria. (no fee)
DSL # ____ Expiration date ____
☐ LWI shows wetlands or waters on parcel
Wetland ID code ____

For Office Use Only

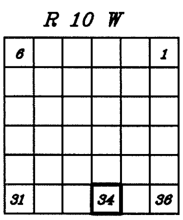
DSL Reviewer: ____ Fee Paid Date: ___/___/___ DSL WD # ____

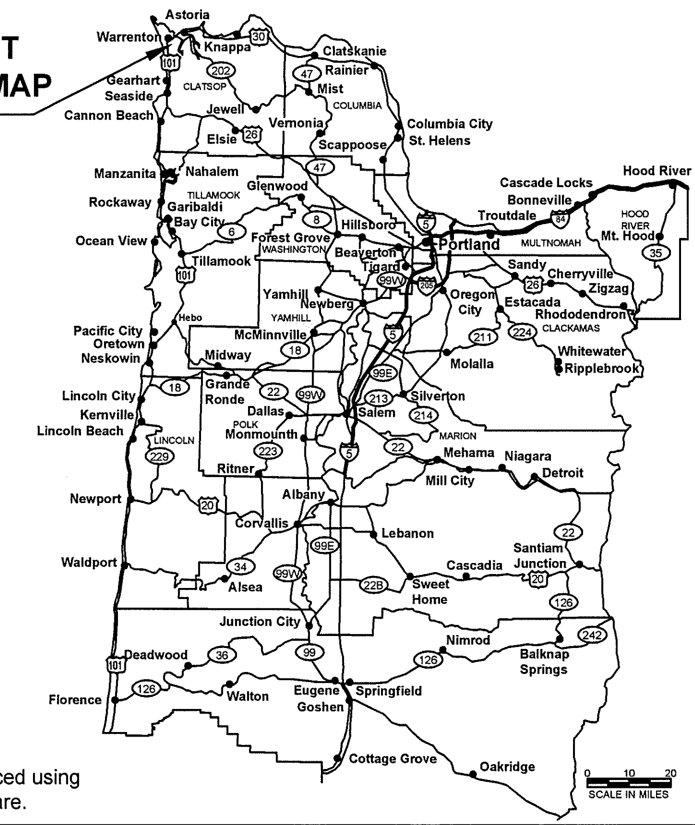
Date Delineation Received: ___/___/___ Scanned: ☐ Electronic: ☐ DSL App.# ____



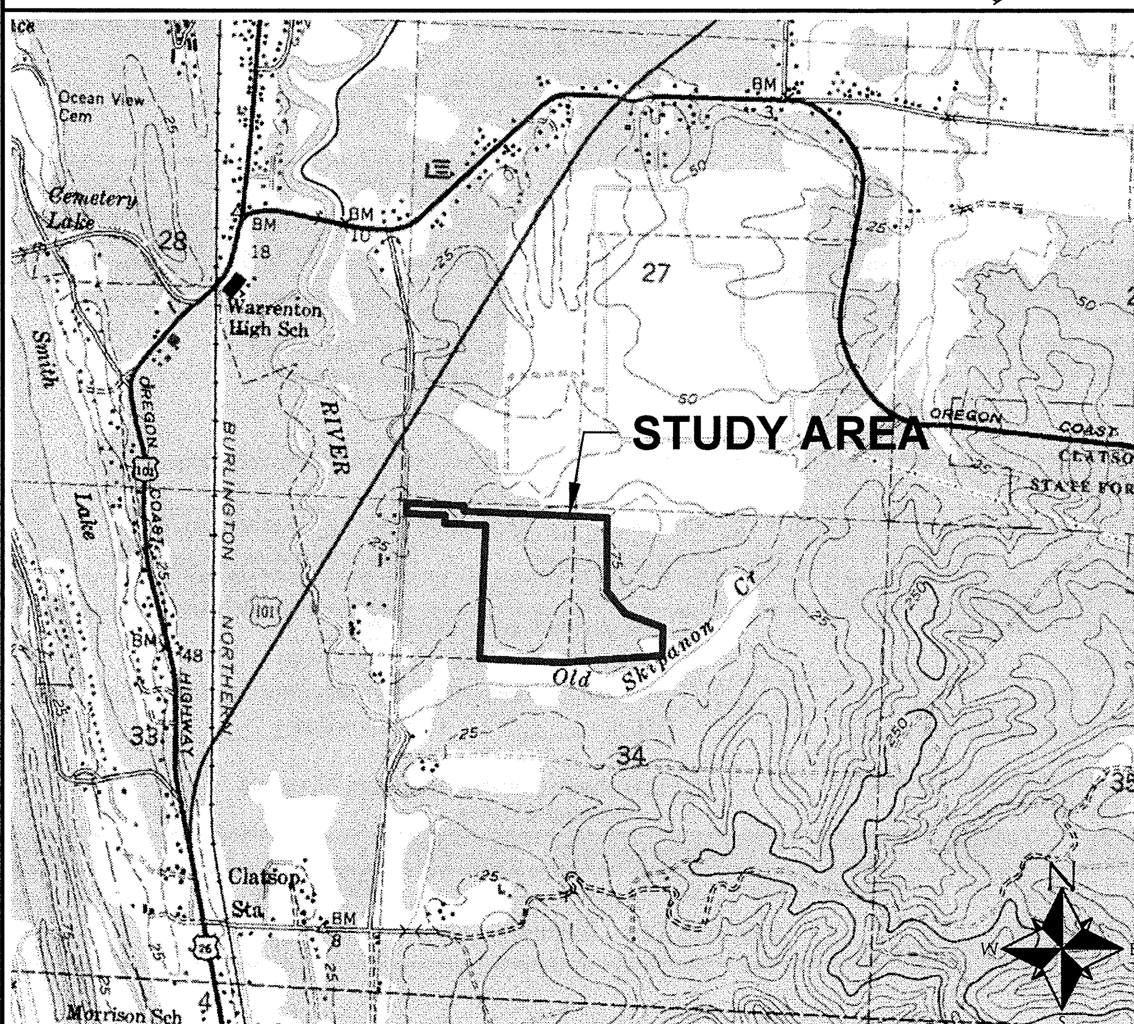
46.1388° Latitude
-123.9145° Longitude

LOCATION MAP





NOTE:
USGS topographic quadrangle map reproduced using MAPTECH Inc., Terrain Navigator Pro software.



VICINITY MAP

APPLICANT: Warrenton-Hammond School District
PROJECT NAME: WHSD New Campus
REFERENCE #: NWP-2019-386
SITE LOCATION ADDRESS:
East of Dolphin Road,
Warrenton, OR 97146

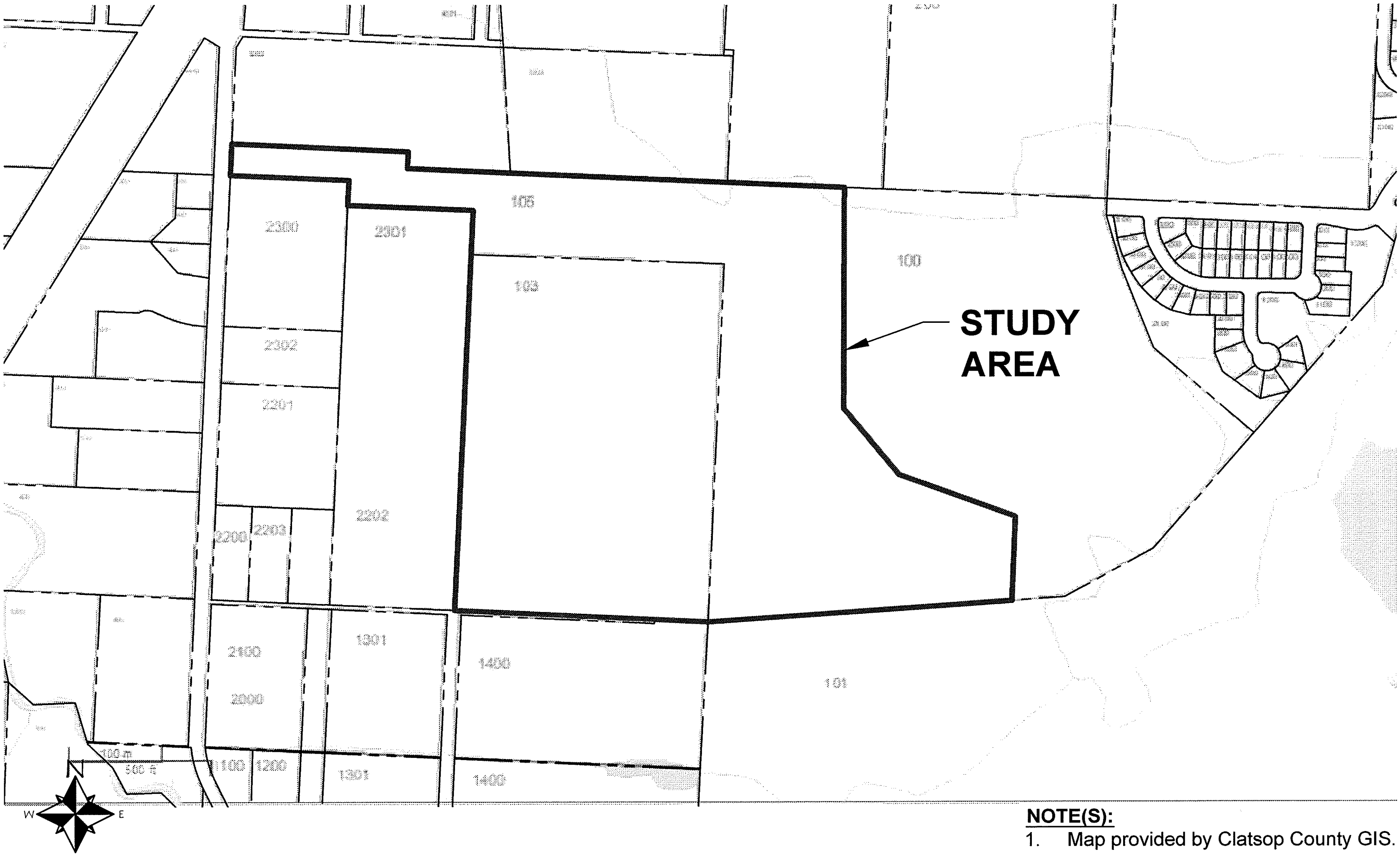
PROPOSED: Wetland Fill
IN Wetlands
NEAR: Warrenton
COUNTY: Clatsop **STATE:** OR
SHEET 1 **OF** 8
DATE: 11/13/19

PURPOSE: New School Campus

DATUM: NAD83
ADJACENT PROPERTY OWNERS:
See JPAF

SCALE IN FEET: 0, 2000, 4000

Ecological Land Services
1157 3rd Ave., Suite 220A
Longview, WA 98632
Phone: (360) 578-1371



NOTE(S):
1. Map provided by Clatsop County GIS.

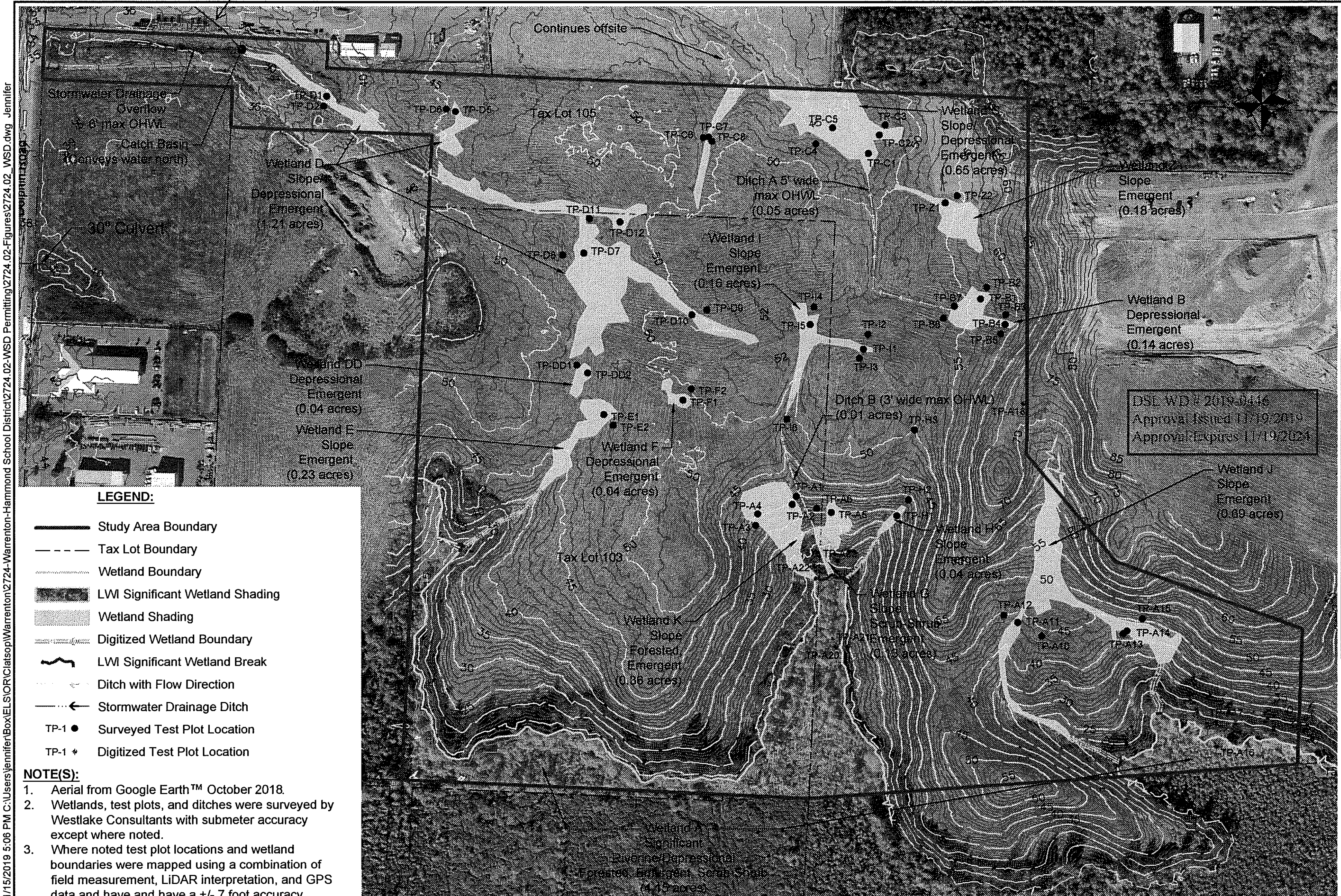
Ecological Land Services
1157 3rd Ave., Suite 220A
Longview, WA 98632
Phone: (360) 578-1371

PURPOSE: New School Campus

DATUM: NAD83
ADJACENT PROPERTY OWNERS: See JPAF

TAX LOT MAP
APPLICANT: Warrenton-Hammond School District
PROJECT NAME: WHSD New Campus
REFERENCE #: NWP-2019-386
SITE LOCATION ADDRESS: East of Dolphin Road, Warrenton, OR 97146

PROPOSED: Wetland Fill
IN Wetlands
NEAR: Warrenton
COUNTY: Clatsop **STATE:** OR
SHEET 2 **OF** 8
DATE: 11/13/19



LEGEND:

- Study Area Boundary
- Tax Lot Boundary
- Wetland Boundary
- LWI Significant Wetland Shading
- Wetland Shading
- Digitized Wetland Boundary
- LWI Significant Wetland Break
- Ditch with Flow Direction
- Stormwater Drainage Ditch
- TP-1 ● Surveyed Test Plot Location
- TP-1 ✦ Digitized Test Plot Location

NOTE(S):

1. Aerial from Google Earth™ October 2018.
2. Wetlands, test plots, and ditches were surveyed by Westlake Consultants with submeter accuracy except where noted.
3. Where noted test plot locations and wetland boundaries were mapped using a combination of field measurement, LiDAR interpretation, and GPS data and have and have a +/- 7 foot accuracy.

0 200 400
SCALE IN FEET

Ecological Land Services
1157 3rd Ave., Suite 220A
Longview, WA 98632
Phone: (360) 578-1371

PURPOSE: New School Campus

DATUM: NAD83
ADJACENT PROPERTY OWNERS: See JPAF

DELINEATION SITE MAP
APPLICANT: Warrenton-Hammond School District
PROJECT NAME: WHSD New Campus
REFERENCE #: NWP-2019-386
SITE LOCATION ADDRESS: East of Dolphin Road, Warrenton, OR 97146

PROPOSED: Wetland Fill
IN Wetlands
NEAR: Warrenton
COUNTY: Clatsop **STATE:** OR
SHEET 6 **OF** 8
DATE: 11/15/19

WETLAND DELINEATION / DETERMINATION REPORT COVER FORM

Fully completed and signed report cover forms and applicable fees are required before report review timelines are initiated by the Department of State Lands. Make checks payable to the Oregon Department of State Lands. To pay fees by credit card, go online at: https://apps.oregon.gov/DSL/EPS/program?key=4.

Attach this completed and signed form to the front of an unbound report or include a hard copy with a digital version (single PDF file of the report cover form and report, minimum 300 dpi resolution) and submit to: **Oregon Department of State Lands, 775 Summer Street NE, Suite 100, Salem, OR 97301-1279.** A single PDF of the completed cover from and report may be e-mailed to: **Wetland_Delineation@dsl.state.or.us**. For submittal of PDF files larger than 10 MB, e-mail DSL instructions on how to access the file from your ftp or other file sharing website.

Contact and Authorization Information

☒ Applicant ☐ Owner Name, Firm and Address:
Warrenton-Hammond School District, Contact: Mike Moha
820 SW Cedar Avenue
Warrenton, OR 97146

Business phone # (503) 861-2281
Mobile phone # (optional)
E-mail: moham@warrentonk12.org

☐ Authorized Legal Agent, Name and Address (if different):

Business phone #
Mobile phone # (optional)
E-mail:

I either own the property described below or I have legal authority to allow access to the property. I authorize the Department to access the property for the purpose of confirming the information in the report, after prior notification to the primary contact.

Typed/Printed Name: [signature] **Signature:** 8/6/19
Date: Special instructions regarding site access:

Project and Site Information

Project Name: WHSD School Campus	Latitude: 46.139666 Longitude: -123.914310 **decimal degree** - centroid of site or start & end points of linear project
Proposed Use: New secondary school campus and future elementary and high school campuses	Tax Map # 81034 Tax Lot(s) 100 and 103 Tax Map # Tax Lot(s)
Project Street Address (or other descriptive location): West of SE Willow Drive and next to a portion of southern boundary of the North Coast Business Park in Warrenton.	Township 8N Range 10W Section 34 QQ NW Use separate sheet for additional tax and location information
City: Warrenton County: Clatsop	Waterway: onsite wetlands River Mile: N/A

Wetland Delineation Information

Wetland Consultant Name, Firm and Address:
Ecological Land Services, Inc. - Steffanie Taylor
1157 3rd AVenue, Suite 220A
Longview, WA 98632

Phone # (360) 578-1371
Mobile phone # (if applicable)
E-mail: steff@eco-land.com

The information and conclusions on this form and in the attached report are true and correct to the best of my knowledge.
Consultant Signature: Date:

Primary Contact for report review and site access is ☒ Consultant ☐ Applicant/Owner ☐ Authorized Agent

Wetland/Waters Present? ☒ Yes ☐ No Study Area size: 60 acres Total Wetland Acreage: 8.0800

Check Applicable Boxes Below

- ☐ R-F permit application submitted
- ☐ Mitigation bank site
- ☐ EFSC/ODOE Proj. Mgr:
- ☐ Wetland restoration/enhancement project (not mitigation)
- ☐ Previous delineation/application on parcel
  If known, previous DSL # ____
- ☐ Fee payment submitted $ 454
- ☐ Resubmittal of rejected report ($100)
- ☐ Request for Reissuance. See eligibility criteria. (no fee)
  DSL # ____ Expiration date ____
- ☐ LWI shows wetlands or waters on parcel
  Wetland ID code ____

For Office Use Only

DSL Reviewer: ________ Fee Paid Date: ___/___/___ DSL WD # ________

Date Delineation Received: ___/___/___ Scanned: ☐ Electronic: ☐ DSL App.# ________

Ecological Land Services

WETLAND DELINEATION REPORT

July 31, 2019

WHSD New Campus
Warrenton, Oregon

Prepared for

Warrenton-Hammond School District
820 SW Cedar Avenue
Warrenton, Oregon 97146
(503) 861-2281

Prepared by

Ecological Land Services, Inc.

1157 3rd Avenue, Suite 220A • Longview, WA 98632
(360) 578-1371 • Project Number 2724.02

Signature Page

The information and data in this report were compiled and prepared under the supervision and direction of the undersigned.

Steffanie Taylor
Senior Biologist/Principal

Table of Contents

Introduction

Ecological Land Services, Inc. (ELS) completed a wetland delineation on Tax Lots 100 and 103 (Tax Map 81034) in Warrenton, Oregon (Figures 1 and 2). The study area totals approximately 60 acres and includes the entirety of Tax Lots 100 and 103, as well as two small areas adjacent to these tax lots respectively where portions of wetlands extend outside the tax lot boundaries. The study area is located in the northwest quarter of Section 34, Township 8 North, Range 10 West, of the Willamette Meridian. The northeastern corner of the study area borders the southern portion of the North Coast Business Park. Field work was conducted on June 5 and July 8, 9, and 28, 2019 to determine wetland presence and extent in the study area. The applicant, Warrenton-Hammond School District (WHSD), is planning to construct a new middle school campus at the site, as well as future elementary and high school campuses, including athletic fields. This report summarizes our findings in accordance with the City of Warrenton Development Code *Chapter 16.156 Wetland and Riparian Corridor Development Standards* (2019) and Oregon Administrative Rules 141-090-0005 through 141-090-0055.

A) Landscape Setting and Land Use

The project site is located on a small hill above a coastal plain with the Pacific Ocean to the west and the Youngs Bay estuary to the north-northeast. The greater Warrenton area has been historically diked and drained and was once a mosaic of tidally influenced wetlands and upland. The North Coast Business Park borders the site to the north, commercial and industrial properties border to the west separated by a vacant industrial zoned parcel, a residential subdivision (under construction) borders to the east, and a large forested, scrub-shrub, and emergent wetland system containing Old Skipanon Creek borders to the south. An unimproved extension of SE Willow Drive provides access to the northeastern portion of the study area, and Dolphin Road borders the northwestern corner of the study area. The project site is located within hydrologic unit code 1708000601.

The southern half and eastern edge of the study area consist of steep to rolling topography with wetlands at the bottom of ravines. The remaining study area is relatively flat and lies within the grading footprint of the North Coat Business Park, which was extensively graded historically as described in the *Site Alterations* section below.

The study area largely consists of pasture bordered by a forested fringe to the south and has been in hay production and used for livestock pasturing for many decades. There are currently no structures on the property except a stormwater catch basin in the northwestern corner that conveys site runoff to the north.

Vegetation

Vegetation found in the upland and wetland test plot locations are documented on the attached data sheets (Appendix B). The indicator status, which follows the scientific names of species within the test plots, indicates the likelihood of the species to be found in wetlands. A description of the indicator status categories is listed in Appendix D.

The uplands within pasture area of the site were dominated by orchardgrass (*Dactylis glomerata*, FACU), sweet vernalgrass (*Anthoxanthum odoratum*, FACU), tall fescue (*Schedonorus arundinaceous*, FAC), Agrostis species (*Agrostis sp*., assumed FAC), and velvetgrass (*Holcus lanatus*, FAC) with weedy species such as hairy cat's ear (*Hypochaeris radicata*, FACU) present as well. The hillslopes in the pasture areas are beginning to re-establish with evergreen huckleberry (*Vaccinium ovatum*, FACU) and salal (*Gaultheria shallon*, FACU), as well as Himalayan blackberry (*Rubus armeniacus*, FAC), evergreen blackberry (*R. laciniatus*, FACU), trailing blackberry (*R. ursinus*, FACU), and Scot's broom (*Cytisus scoparius*, FACU). Forested upland areas are dominated by Sitka spruce (*Picea sitchensis*, FAC), western hemlock (*Tsuga heterophylla*, FACU), red alder (*Alnus rubra*, FAC), salal, evergreen huckleberry, red elderberry (*Sambucus racemosa*, FACU), cascara (*Frangula purshiana*, FAC), salmonberry (*R. spectabilis*, FAC), Himalayan blackberry, trailing blackberry, and swordfern (*Polystichum munitum*, FACU).

Pasture wetlands were dominated by softrush (*Juncus effusus*, FACW), velvetgrass, birdsfoot trefoil (*Lotus corniculatus*, FAC), small-fruited bulrush (*Scirpus microcarpos*, OBL), Agrostis species, and reed canarygrass (*Phalaris arundinacea*, FACW). Forested and scrub-shrub wetland areas were dominated by Sitka spruce, red alder, Scouler willow (*Salix scoulariana*, FAC), salmonberry, slough sedge (*Carex obnupta*, OBL), reed canarygrass, and skunk cabbage (*Lysichiton americanum*, OBL).

Soils

The U.S.D.A. Natural Resource Conservation Service (NRCS), *Soil Survey of Clatsop County, Oregon* website (2019) designates the soils onsite as (6A) Braillier mucky peat, 0 to 1 percent slopes, (71B) Walluski medial silt loam 0 to 7 percent slopes, and (71D) Walluski medial silt loam 15 to 20 percent slopes (Figure 4). Braillier mucky peat soils consist of very poorly drained soils on floodplains with a depth to water table between 0 and 6 inches below ground surface. Walluski medial silt loam soils are described as moderately well drained soils on terraces with a depth to water table ranging from 24 to 36 inches below ground surface. Braillier mucky peat soils are located within Wetland A in the southern portion of the study area and are considered hydric soils (NRCS 2018). Soils within the test pits in Wetland A are consistent with the soil survey description. Soils within test plots (TP) A18, A17, and A20 through 23 appear to be native soils. The remaining test plots contained soils that were heavily disturbed from past grading activities and appear to be clay subsoil due to the high clay content and variety of matrix colors and redox features.

B) Site Alterations

The north-central portion of the study area lies within the footprint of the North Coast Business Park that was clear-cut and extensively graded during the early 1970s in preparation for an aluminum plant that was not constructed. Prior to the grading activities, the overall business park area contained rolling topography with deep ravines, similar to the southern portion of the study. Material from the higher elevations was pushed into the ravines and the business park area was made nearly level. These activities exposed poorly drained clay subsoil over the surface, severely altering hydrology and drainage. Soil disturbance is evident in the multiple soil colors present within the profile and high clay content.

Several ditches were dug at this time to aid in site drainage because of the nearly impermeable soils. Ditch A conveys runoff from the northeast corner of the study area north. The west flowing portion of Wetland D is an excavated ditch that conveys runoff northwest to a stormwater catch basin, which then pipes water to the northwest. A portion of Wetland I is also an excavated ditch which conveys runoff south to Wetland A. Wetlands B, C, D, and I appear to have been ditched as evidenced from multiple Google Earth historic aerial photos between 1994 and the present day. A Google Earth image from March 2004 (Figure 8) clearly shows this ditching. Evidence of historic logging and slash burning was present in multiple test pits. Small and large chunks of wood were found in the soil pits, as well as charcoal.

Cattle grazing and haying over the site has prevented scrub-shrub and forested vegetation from re-establishing in the higher elevation areas of the site. Since recent removal of the cattle, evergreen huckleberry, salal, blackberries, and Scot's broom are re-establishing.

C) Precipitation Data & Analysis

Precipitation data was gathered from the National Weather Service, Portland Office website and the Astoria Airport WETS Station and is summarized in the table below from data in Appendix D. This year (2019) has been particularly dry. In the three months prior to the initial field visit date in early June, only April was within the 30 percent exceedance range at 10 percent below normal. All other months (March, May, and June) were greater than 50 percent below normal rainfall.

Table 1. Precipitation Information

Date of Site Visit	Precipitation (inches)							
	Day of Site Visit[1]	2 Weeks Prior[1]	3 Months Prior			Deviation from Average	30% Below	30% Above
			Month	Average[1]	Actual			
6/5/19	Trace	0.33	3/2019	7.90	2.46	-69%	5.56	9.37
			4/2019	5.88	5.30	-10%	4.36	6.89
			5/2019	3.41	1.66	-51%	2.15	4.12
7/8/19 and 7/9/19	0.01 and Trace[2]	0.54 and 0.55	4/2019	5.88	5.30	-10%	4.36	6.89
			5/2019	3.41	1.66	-51%	2.15	4.12
			6/2019	2.33	1.08	-54%	1.57	2.79

[1]Based on Years 1990-2019
[2] 0.37 inches of rain was recorded on 7/9/19 but the majority occurred after field work was complete.

D) Methods

ELS staff evaluated, delineated, and gathered test plot information within the study area on June 5, and July 8, 9, and 28, 2019. Consecutively numbered orange or pink "WETLAND DELINEATION" flagging or pin flags were used to delineate the wetland boundaries. Test plot locations were marked with consecutively numbered plain orange or pink flagging or pin flags.

Vegetation, hydrology, and soils information were gathered from 67 test plots. During the July 28 site visit, four test plots were taken in areas that were lacking test plot coverage. Because the wetland boundaries were already delineated, additional precipitation data was not gathered for this field visit date. Soils in the majority of the pasture areas onsite were heavily disturbed so were not relied upon heavily in the wetland boundary determinations. In general, the wetland areas were within visible depressions (many excavated) and in nearly all instances the presence of softrush was a reliable wetland boundary indicator. The presence of oxidized rhizospheres were also present in wetland test plots.

Large ditches were flagged on both sides and the centerline of smaller ditches was flagged. The widest point of the ordinary high water line (OHWL) on the ditches was noted, and that width was used to calculate area. Ditch A was uniform in width with no scour along the channel bottom so the OHWL extended to the edge of wetland vegetation. Ditch B was approximately 25-feet wide. A scoured channel was obvious in the bottom of the ditch and was used to determine the OHWL. The ditches are shown on the site maps as a centerline because of scale. Intermittent drainage centerlines are also mapped based on the same methodology.

The Local Wetlands Inventory Map (LWI), National Wetlands Inventory (NWI) map (Sheets 3A and 3B), Clatsop County GIS maps, and recent and historic aerial photos were reviewed along with site exploration to determine location and connectivity of waters of the state.

E) Description of All Wetlands & Other Non-Wetland Waters

Thirteen wetlands were delineated within the study area (Table 2 and Figures 5, 6, and 7). The emergent pasture wetlands are mainly located in topographical depressions and are supported by a runoff, precipitation, and a perched water table. Because of past grading activities, clay subsoils have been exposed on the surface resulting in poorly drained conditions. The majority of the pasture wetlands have been historically ditched to facilitate drainage. Wetland A in the southern portion of the site lies outside of the grading disturbance.

Wetland A

Wetland A is a large, high-quality forested, scrub-shrub, and emergent riverine and depressional wetland system located in the southern portion of the study area that continues offsite to the south, east, and west. The wetland is designated as Significant on the Local Wetlands Inventory. Old Skipanon Creek is located within the wetland system and is a fish bearing stream. The riverine portion of the wetland is tidally influenced. A stream channel was observed in the offsite portion of the wetland adjacent to Dolphin Road. The stream flows beneath Dolphin Road through a 30-inch bottomless culvert and directly into Skipanon Creek (Figure 5). A stream channel was observed in the vicinity of the culvert, but it was not clear how far the channel extended east into the wetland, as it is not readily visible on aerial photography. The wetland boundary is well defined onsite along the base of the hillside and closely follows the 13- or 15-foot elevation contour. No defined channels were observed within the wetland fingers below Wetlands E, G, H, K, or J. The intermittent drainages exiting these wetlands dissipate at the base of the hillside. The wetland appears to be relatively undisturbed except for what appears to be fencing, or potentially ditching, visible on aerial photos extending through the wetland. Portions of the wetland along the southeastern corner of the study area contained bog-like conditions including bog plant species such as Labrador tea (*Ledum groenlandicum*) and peat-dominated soils. Numerous mature standing snags and down logs are present along the wetland edge.

Wetlands B and C

Wetlands B and C are emergent, slope/depressional wetlands located in the northeastern corner of the study area totaling 0.14 acres and 0.65 acres onsite respectively. Wetland B is connected to Wetland C by Ditch A. Water within Wetland C flows northerly, with offsite portions of Wetland C also being ditched. The wetlands likely have occasionally flooded and saturated-only hydroperiods.

Wetland D

Wetland D is an emergent, slope/depressional wetland totaling 1.34 acres in the study area (1.21 acres onsite). This wetland has been ditched in multiple locations and conveys water north to a catch basin. Wetland D likely contains a seasonally flooded hydroperiod. Water from the catch basin at the northwestern end of Wetland D is piped north to a wetland at the intersection Dolphin Road and Highway 101 (Figure 5). It is not known if the wetland at the intersection has an outlet.

Wetlands DD and F

Wetlands DD and F are emergent, depressional wetlands with no outlets located in the central-west portion of the study area. The wetlands total 0.04 acres each and likely have seasonally flooded hydroperiods.

Wetlands E and H

Wetlands E and H are emergent, slope wetlands that drain through vegetated, intermittent drainages at their downslope ends to Wetland A. Wetland E (0.19 acres) is located near the central-west portion of the study area and drains through a 2-foot wide intermittent drainage to the western most finger of Wetland A. Wetland H (0.02 acres) is located in the south-central portion of the study area and drains through a 1-foot wide intermittent drainage to the central finger of Wetland A. The wetlands likely have occasionally or seasonally flooded hydroperiods.

Wetland G

Wetland G is a 0.13-acre emergent, slope wetland located in the south-central portion of the study area that drains to Wetland A. Ditch A terminates along Wetland G's western boundary, dissipating into the wetland. The southern portion of the wetland flows into a forested area and contains scrub-shrub vegetation. Sources of hydrology for Wetland G stem from ditch runoff, precipitation, and groundwater discharge on the slope and are different than the sources of hydrology for Wetland A, therefore it was mapped as a separate wetland. Wetland G likely has occasionally flooded and saturated-only hydroperiods.

Wetland I

Wetland I is an emergent, slope wetland totaling 0.16 acres in the central portion of the study area. The majority of the wetland is located within a large excavated ditch. Flow concentrates into a distinct channel at the southern end of the wetland so was mapped as a ditch south of that point (Ditch B). The west-flowing arm of Wetland I also appears to have been historically ditched. The wetland likely contains a seasonally flooded hydroperiod.

Wetland J

Wetland J is an emergent, slope wetland totaling 0.71 acres in the southeastern corner of the study area (0.63 acres onsite). Drainage within the northern portion of the wetland flows south and splits into an eastern and western arm around a large hummock. The southern extents of both arms each concentrate into intermittently flowing drainages that continue into eastern most finger of Wetland A. Sources of hydrology for Wetland J stem from runoff, precipitation, and perched groundwater and are different than the sources of hydrology for Wetland A, therefore it was mapped as a separate wetland. Wetland J likely has occasionally flooded and saturated-only hydroperiods.

Wetland K

Wetland K is a 0.36-acre emergent and forested wetland located in the south-central portion of the study area, southwest of Ditch A. Forested vegetation is present at the southern end of the wetland. Sources of hydrology for Wetland K stem from precipitation and groundwater discharge on the slope and are different than the sources of hydrology for Wetland A, therefore it was mapped as a separate wetland. Wetland K likely has occasionally flooded and saturated-only hydroperiods.

Wetland Z

Wetland Z is an emergent, slope wetland located in the northeastern corner of the study area totaling 0.18 acres. Water within the wetland flows northwesterly and appears to infiltrate at the western end. The wetland likely has a saturated-only hydroperiod stemming from hillside runoff and precipitation. Wetland Z appears to be historically ditched and previously connected to Ditch A; however, a channel connection is no longer present.

Ditches and Intermittent Drainages

Two ditches were mapped onsite, Ditches A and B. Ditch A originates at the western edge of Wetland B in the northeast corner of the study area and conveys water northwesterly to Wetland C. The ditch continues northerly and offsite through the adjoining pasture to the north and into the North Coast Retail Mitigation Site. The ditch width is uniform and the OHWL was 5 feet wide. Ditch B originates within Wetland I in the central portion of the site and conveys water south, terminating in Wetland G. The ditch OHWL was approximately 1-foot wide where it exits Wetland I and widened to approximately 3-feet wide where flow concentrates on the steeper slope. This point is shown on Figure 5.

The centerline of four intermittent drainages were mapped exiting their respective wetlands. Flow concentrates at the downhill end of the wetlands and discharges intermittently during heavy rain events. All drainages were thickly vegetated. Drainage A exiting Wetland H was approximately 1-foot wide, Drainage B exiting the western arm of Wetland J was approximately 3-feet wide, Drainage C exiting the eastern arm of Wetland J was approximately 1-foot wide, and Drainage D exiting Wetland E was approximately 2-feet wide. These drainages do not likely contain deep enough or consistent flow to provide fish habitat.

Table 2. Wetland Summary

Name	Size (ac. Onsite)	Hydrogeomorphic Class	Cowardin Class	Local Designation
Wetlands				
A	4.15	Riverine/Depressional	FO/SS/EM	Significant
B	0.14	Depressional	EM	Non-significant
C	0.65	Slope	EM	
D	1.21 (0.13 ac offsite but in study area)	Depressional/Slope	EM	
DD	0.04	Depressional	EM	
E	0.19	Slope	EM	
F	0.04	Depressional	EM	
G	0.13	Slope	SS/EM	
H	0.02	Slope	EM	
I	0.16	Slope	EM	
J	0.63 (0.08 offsite but in study area)	Slope	EM	
K	0.36	Slope	FO/EM	
Z	0.18	Slope	EM	
Total	**7.90**			
Ditches and Intermittent Drainages				
Ditch A	0.05	N/A	N/A	N/A
Ditch B	0.01			
Intermittent Drainage A	0.01			
Intermittent Drainage B	0.01			
Intermittent Drainage C	0.01			
Intermittent Drainage D	0.01			
Total	**0.10**			

F) Deviation from NWI and LWI

The National Wetlands Inventory (NWI) maps multiple wetlands in the study area (Figure 3A, USFWS 2019). The approximately location of Wetland A is mapped as a Palustrine. forested, broad-leaved deciduous, seasonally flooded (PFO1C), Palustrine, scrub-shrub, broad-leaved deciduous/emergent, persistent seasonally flooded (PSS1/EM1C), and Palustrine, emergent, persistent, seasonally flooded (PEM1C) wetland. The approximate locations of Wetlands K, G, H, and J are mapped as PEM1C wetland, and the approximate location of Wetlands B and C are mapped as freshwater emergent wetland. The remaining wetlands delineated onsite are not depicted by the NWI map. ELS agrees with the approximate locations and types of the NWI mapped wetlands, but their actual boundaries are different.

The LWI map for the City of Warrenton depicts a Significant wetland in the approximate location as Wetland A (Figure 3B). ELS agrees with the general location of this wetland. The LWI does not depict any other wetlands in the study area, which is not accurate.

G) Mapping Method

Wetland boundaries and test plot locations were professionally surveyed by Westlake Consultants and have a +/- 1-foot accuracy. A sufficient number of flags were surveyed along the boundary of Wetland A within the forested area to determine that the wetland boundary closely followed the 13- or 15-foot contour. Where there were gaps in survey points, the points were connected using either the 13- or 15-foot contour.

H) Additional Information

Precipitation data information is located in Appendix D.

I) Results & Conclusions

The southern portion and eastern edge of the study area consists of steep to rolling topography with wetlands at the bottom of ravines. The remaining study area is relatively flat and lies within the grading footprint of the North Coast Business Park that was clear-cut and extensively graded during the early 1970s in preparation for an aluminum plant that was not constructed. Prior to the grading activities, this area contained rolling topography with deep ravines, similar to the southern portion of the site. Material from the higher elevations was pushed into the ravines and the area was made nearly level. These activities exposed poorly drained clay subsoil over the surface, severely altering hydrology and drainage. The majority of wetlands within the pasture area likely formed following grading activities. Ditching is evident in many of these wetlands in an effort to facilitate drainage when the property was in agricultural use. Evidence of historic logging and slash burning was present in many of the soil profiles in both uplands and wetlands.

ELS delineated 13 wetlands (see Table 2) within the study area (Figures 5, 6, and 7). Hydrology within the pasture wetlands stems from runoff, precipitation, and a perched groundwater table due to clay subsoil lying just under the ground surface. Wetland A is a large high-quality wetland system that lies at the base of the hillslope along southern study area boundary and is designated as a Significant wetland on the LWI map. The remaining wetlands onsite are not depicted by LWI mapping and are considered Nonsignificant. The downslope ends of slope Wetlands E, J, and H drain through intermittent drainages to Wetland A; these drainages are thickly vegetated and do not likely contain deep enough or consistent flow to provide fish habitat. Wetlands G and K drain through wetland swales to Wetland A that similarly do not provide fish habitat. Because the sources of hydrology for Wetlands G and K are different than the hydrology sources for Wetland A, they were mapped as separate wetlands. Wetlands G and K do not contain diverse wildlife habitat as the majority of the wetlands were historically grazed and/or mowed and only a very small portion of these wetlands is either forested or contains scrub-shrub vegetation. Neither wetland contains rare plant species or species listed by the state and federal government as sensitive, threatened, or endangered and neither wetland provides fish habitat; therefore, Wetland G and Wetland K should not be considered Significant wetlands.

J) Disclaimer

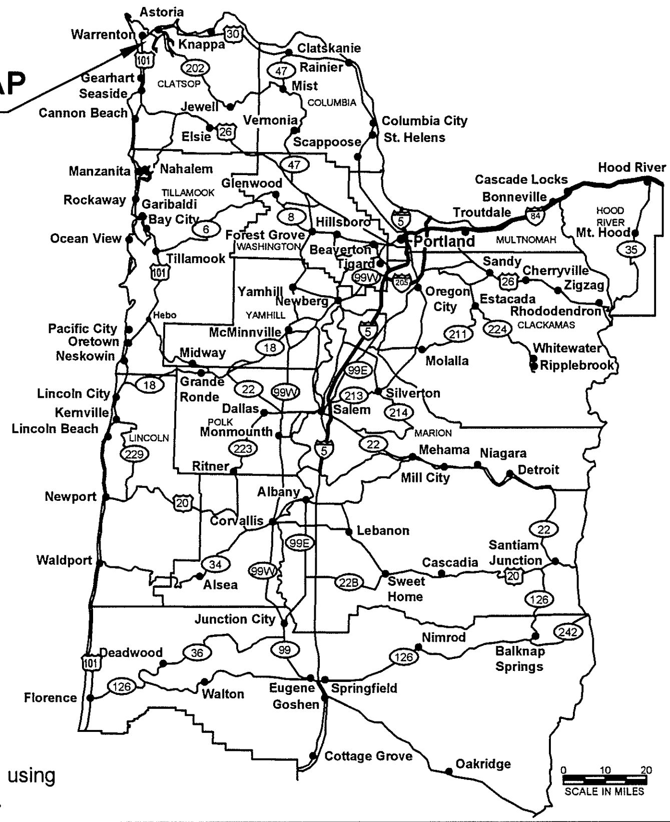
This report documents the investigation, best professional judgment, and conclusions of Ecological Land Services, Inc. It is correct and complete to the best of our knowledge. It should be considered a Preliminary Jurisdictional Determination of wetlands and other waters and used at your own risk until it has been reviewed and approved in writing by the Oregon Department of State Lands in accordance with OAR 141-090-0005 through 141-090-0055.

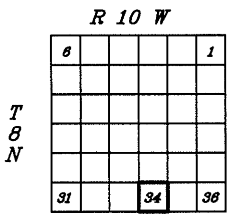
Appendix A: Maps

46.1388° Latitude
-123.9145° Longitude

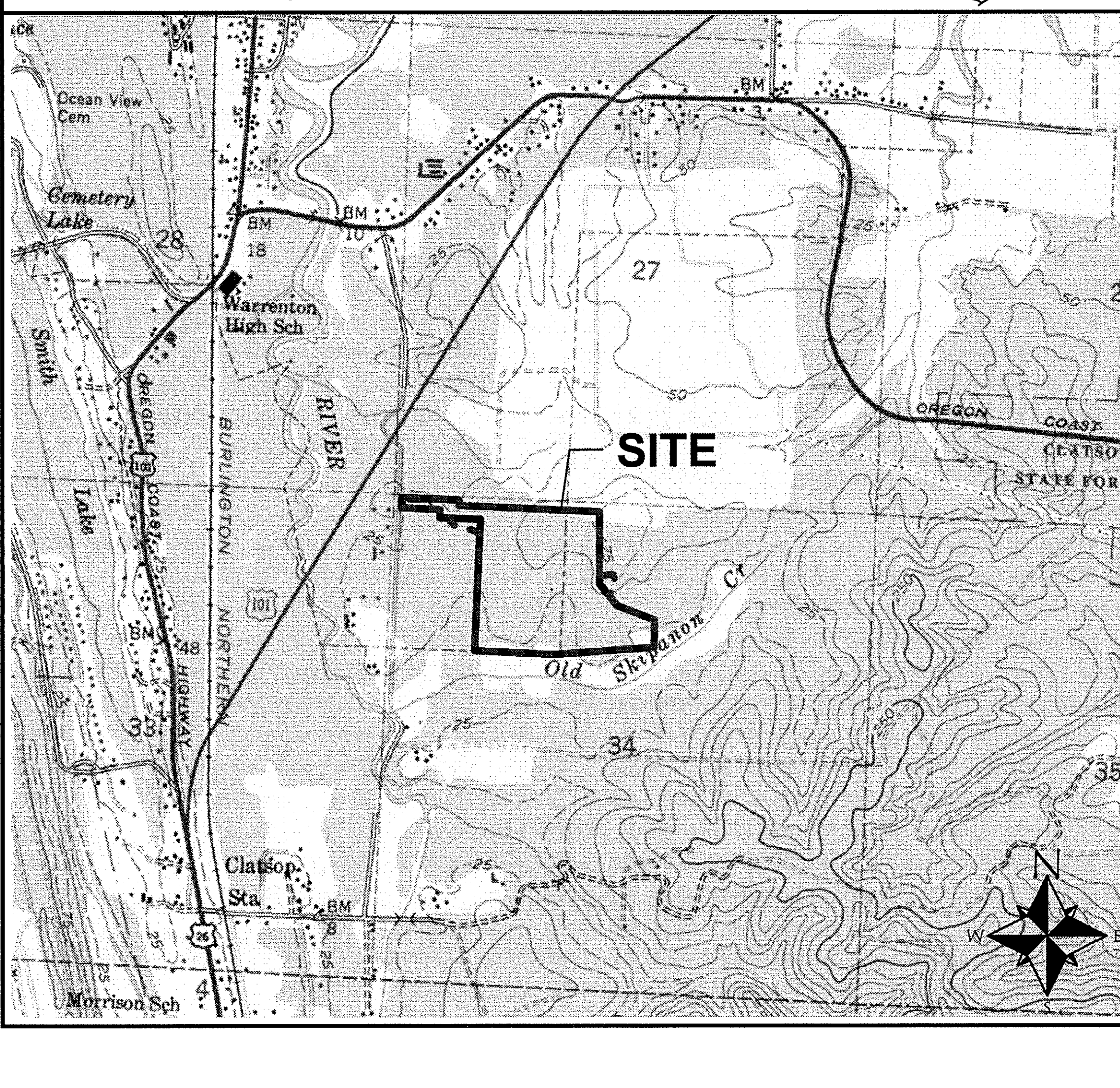
LOCATION MAP

PROJECT VICINITY MAP





NOTE:
USGS topographic quadrangle map reproduced using MAPTECH Inc., Terrain Navigator Pro software.



PROPOSED: Wetland Fill
IN Wetlands
NEAR: Warrenton
COUNTY: Clatsop STATE: OR
SHEET 1 OF 8
DATE: 7/31/19

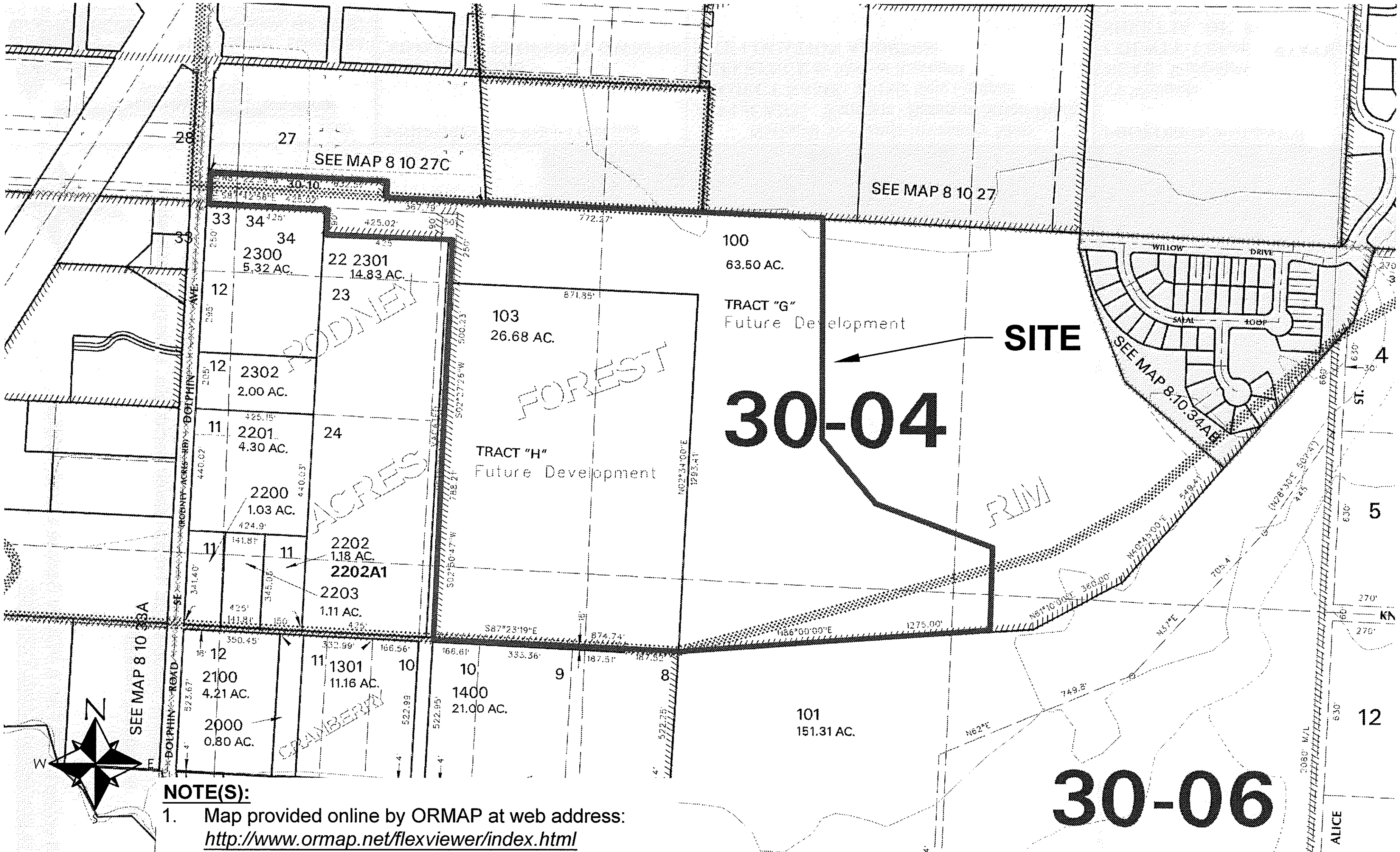
Vicinity Map
APPLICANT: Warrenton - Hammond School District
PROJECT NAME: WHSD New Campus
REFERENCE #: Not yet Assinged
SITE LOCATION ADDRESS:

PURPOSE: New School Campus

DATUM: NAD83
ADJACENT PROPERTY OWNERS:

0 2000 4000
SCALE IN FEET

Ecological Land Services
1157 3rd Ave., Suite 220A
Longview, WA 98632
Phone: (360) 578-1371



NOTE(S):

1. Map provided online by ORMAP at web address: *http://www.ormap.net/flexviewer/index.html*

0 500 1000
SCALE IN FEET

Ecological Land Services
1157 3rd Ave., Suite 220A
Longview, WA 98632
Phone: (360) 578-1371

PURPOSE: New School Campus

DATUM: NAD83
ADJACENT PROPERTY OWNERS:

Tax Lot Map
APPLICANT: Warrenton - Hammond School District
PROJECT NAME: WHSD New Campus
REFERENCE #: Not yet Assinged
SITE LOCATION ADDRESS:

PROPOSED: Wetland Fill

IN Wetlands
NEAR: Warrenton
COUNTY: Clatsop **STATE:** OR
SHEET 2 **OF** 8
DATE: 7/31/19

Mapped wetlands indicated onsite by US Fish & Wildlife Service.

LEGEND:

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland

PEM1C	Palustrine, emergent, persistent, seasonally flooded.
PFO1C	Palustrine, forested, broad-leaved deciduous, seasonally flooded.
PSS1/EM1C	Palustrine, scrub-shrub, broad-leaved deciduous, emergent, persistent, seasonally flooded.

NOTE(S):

1. Map provided online by US Fish & Wildlife Service at web address: *http://www.fws.gov/wetlands/data/index.html*

N W E S

PROPOSED: Wetland Fill
IN Wetlands
NEAR: Warrenton
COUNTY: Clatsop **STATE:** OR
SHEET 3A **OF** 8
DATE: 7/31/19

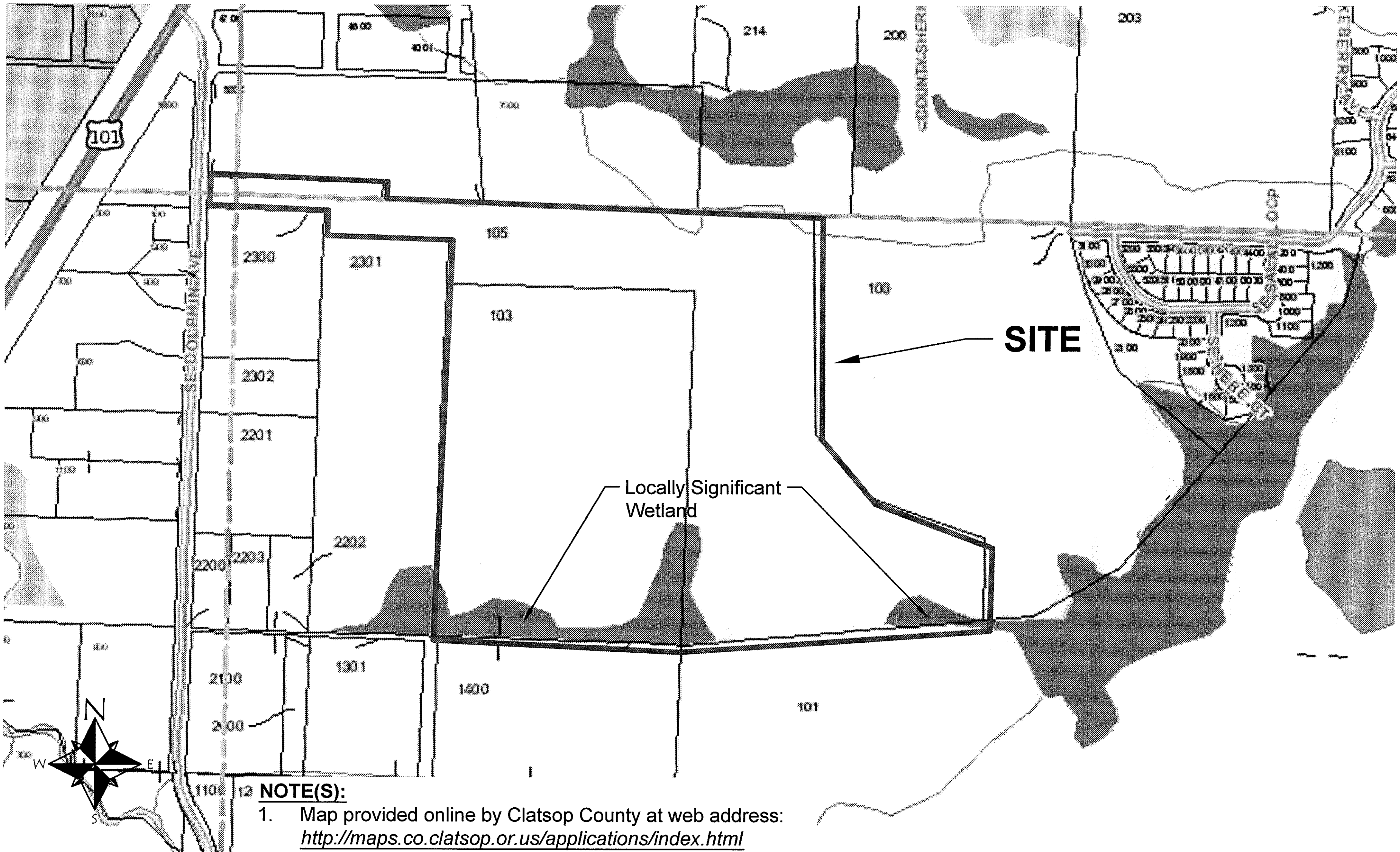
National Wetlands Inventory Map
APPLICANT: Warrenton - Hammond School District
PROJECT NAME: WHSD New Campus
REFERENCE #: Not yet Assinged
SITE LOCATION ADDRESS:

PURPOSE: New School Campus
DATUM: NAD83
ADJACENT PROPERTY OWNERS:

0 600 1200
SCALE IN FEET

Ecological Land Services
1157 3rd Ave., Suite 220A
Longview, WA 98632
Phone: (360) 578-1371

7/31/2019 4:23 PM c:\Users\CPayne\Box\ELS\OR\Clatsop\warrenton\2724-warrenton-hammond school district\2724.02-wsd permitting\2724.02-figures\2724.02_WSD.dwg Cpayne



NOTE(S):

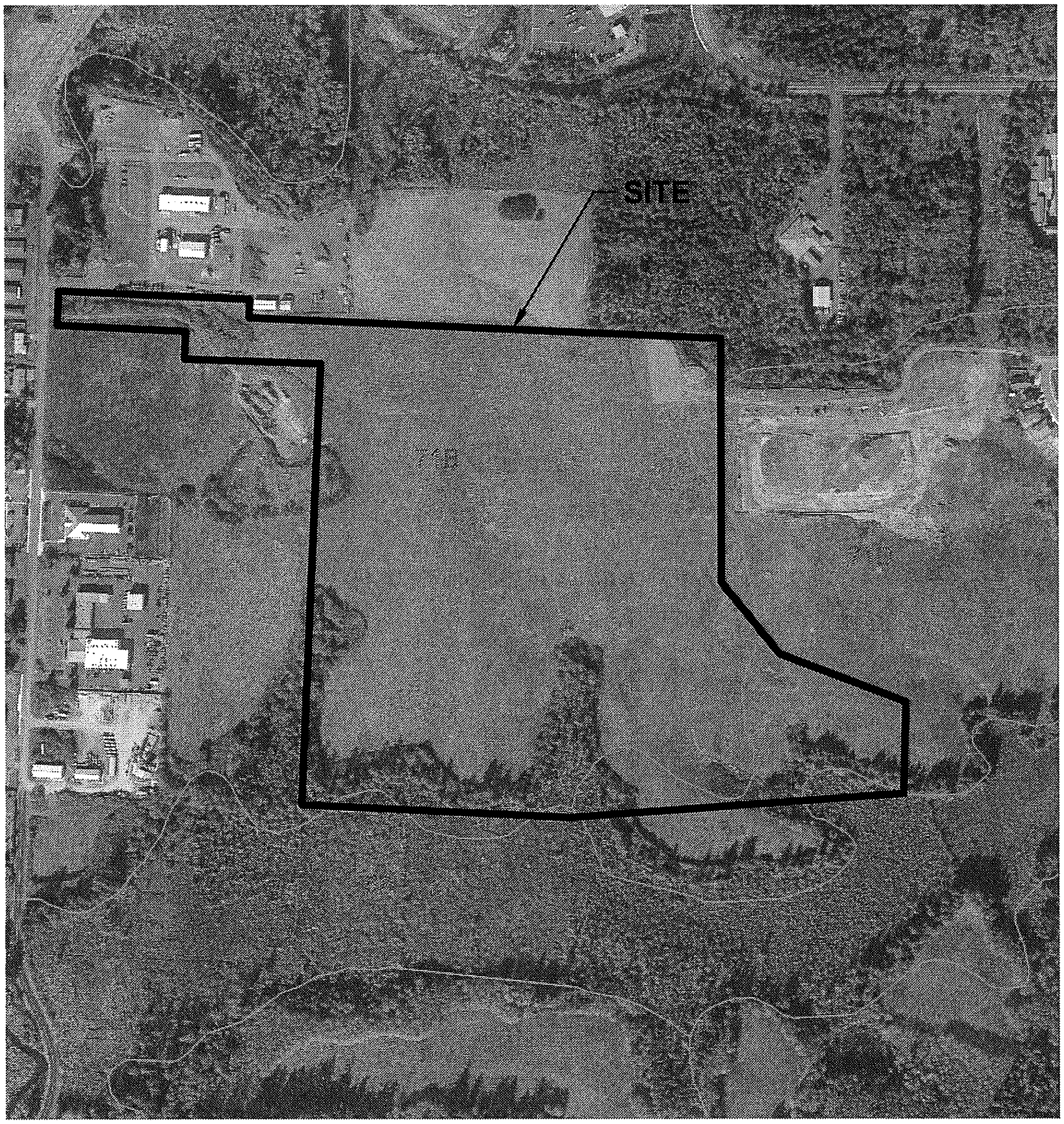
1. Map provided online by Clatsop County at web address: *http://maps.co.clatsop.or.us/applications/index.html*

0 500 1000
SCALE IN FEET

Ecological Land Services
1157 3rd Ave., Suite 220A
Longview, WA 98632
Phone: (360) 578-1371

PURPOSE: New School Campus **DATUM:** NAD83 **ADJACENT PROPERTY OWNERS:**	Local Wetland Inventory Map **APPLICANT:** Warrenton - Hammond School District **PROJECT NAME:** WHSD New Campus **REFERENCE #:** Not yet Assinged **SITE LOCATION ADDRESS:**	**PROPOSED:** Wetland Fill **IN** Wetlands **NEAR:** Warrenton **COUNTY:** Clatsop **STATE:** OR **SHEET** 3B **OF** 8 **DATE:** 7/31/19

7/31/2019 4:23 PM c:\Users\CPayne\Box\ELS\OR\Clatsop\warrenton\2724-warrenton-hammond school district\2724.02-wsd permitting\2724.02-figures\2724.02 WSD.dwg Cpayne



LEGEND:

6A Brallier mucky peat, 0 to 1 percent slopes. **Hydric.**
71B Walluski medial silt loam, 0 to 7 percent slopes. Not hydric.
71D Walluski medial silt loam, 15 to 20 percent slopes. Not hydric.

NOTE(S):

1. Map provided online by NRCS at web address: *http://websoilsurvey.nrcs.usda.gov/app/*

N W E S

0 600 1200
SCALE IN FEET

Ecological Land Services
1157 3rd Ave., Suite 220A
Longview, WA 98632
Phone: (360) 578-1371

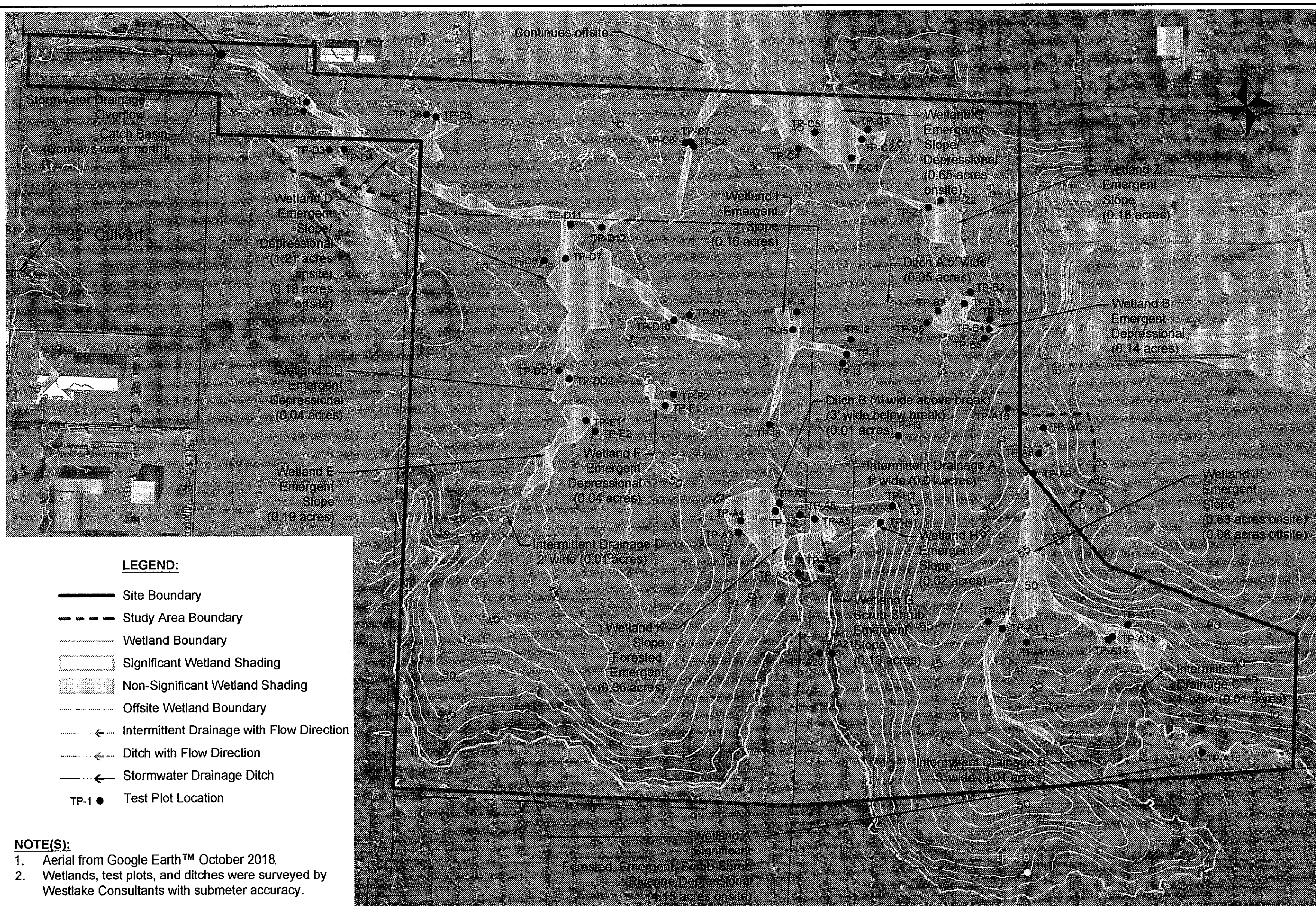
PURPOSE: New School Campus
DATUM: NAD83
ADJACENT PROPERTY OWNERS:

NRCS Soil Survey Map
APPLICANT: Warrenton - Hammond School District
PROJECT NAME: WHSD New Campus
REFERENCE #: Not yet Assinged
SITE LOCATION ADDRESS:

PROPOSED: Wetland Fill
IN Wetlands
NEAR: Warrenton
COUNTY: Clatsop **STATE:** OR
SHEET 4 **OF** 8
DATE: 7/31/19

7/31/2019 4:23 PM c:\Users\CPayne\Box\ELS\OR\Clatsop\warrenton\2724-warrenton-hammond school district\2724.02-wsd permitting\2724.02-figures\2724.02_WSD.dwg Cpayne

Ecological Land Services 1157 3rd Ave., Suite 220A Longview, WA 98632 Phone: (360) 578-1371	**PURPOSE:** New School Campus **DATUM:** NAD83 **ADJACENT PROPERTY OWNERS:**	Overview Delineation Site Map **APPLICANT:** Warrenton - Hammond School District **PROJECT NAME:** WHSD New Campus **REFERENCE #:** Not yet Assinged **SITE LOCATION ADDRESS:**	**PROPOSED:** Wetland Fill **IN** Wetlands **NEAR:** Warrenton **COUNTY:** Clatsop **STATE:** OR **SHEET** 5 **OF** 8 **DATE:** 7/31/19



LEGEND:

- Site Boundary
- Study Area Boundary
- Wetland Boundary
- Significant Wetland Shading
- Non-Significant Wetland Shading
- Offsite Wetland Boundary
- Intermittent Drainage with Flow Direction
- Ditch with Flow Direction
- Stormwater Drainage Ditch
- TP-1 ● Test Plot Location

NOTE(S):

1. Aerial from Google Earth™ October 2018.
2. Wetlands, test plots, and ditches were surveyed by Westlake Consultants with submeter accuracy.

SCALE IN FEET: 0 200 400

Ecological Land Services
1157 3rd Ave., Suite 220A
Longview, WA 98632
Phone: (360) 578-1371

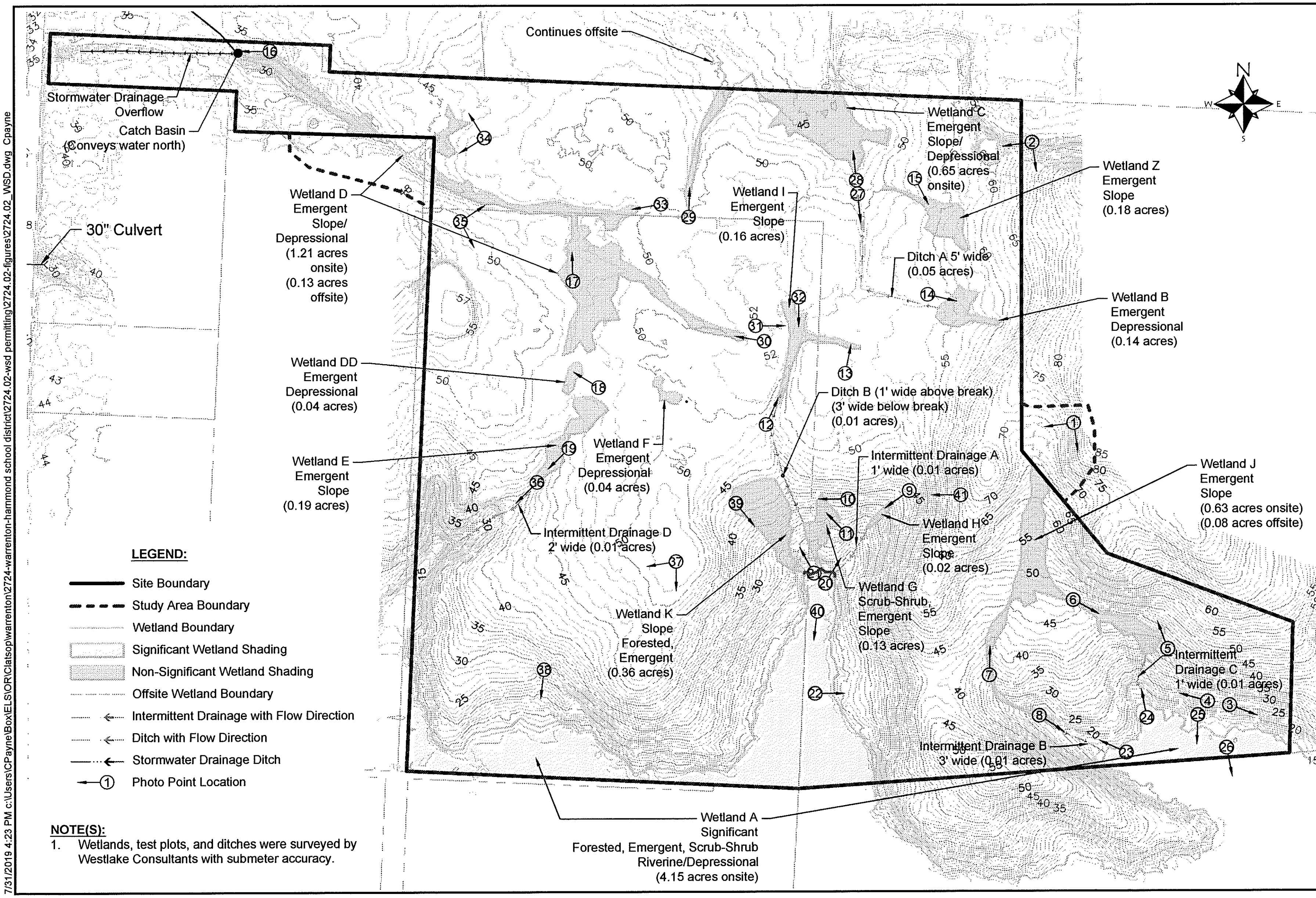
PURPOSE: New School Campus

DATUM: NAD83
ADJACENT PROPERTY OWNERS:

Delineation Site Map
APPLICANT: Warrenton - Hammond School District
PROJECT NAME: WHSD New Campus
REFERENCE #: Not yet Assinged
SITE LOCATION ADDRESS:

PROPOSED: Wetland Fill
IN Wetlands
NEAR: Warrenton
COUNTY: Clatsop **STATE:** OR
SHEET 6 **OF** 8
DATE: 7/31/19

7/31/2019 4:23 PM c:\Users\CPayne\Box\ELS\OR\Clatsop\warrenton\2724-warrenton-hammond school district\2724.02-wsd permitting\2724.02-figures\2724.02_WSD.dwg Cpayne



Ecological Land Services
1157 3rd Ave., Suite 220A
Longview, WA 98632
Phone: (360) 578-1371

PURPOSE: New School Campus

DATUM: NAD83
ADJACENT PROPERTY OWNERS:

Delineation Site Map - Photo Locations
APPLICANT: Warrenton - Hammond School District
PROJECT NAME: WHSD New Campus
REFERENCE #: Not yet Assinged
SITE LOCATION ADDRESS:

PROPOSED: Wetland Fill
IN Wetlands
NEAR: Warrenton
COUNTY: Clatsop STATE: OR
SHEET 7 OF 8
DATE: 7/31/19

7/31/2019 4:23 PM c:\Users\CPayne\Box\ELS\OR\Clatsop\warrenton\2724-warrenton-hammond school district\2724.02-wsd permitting\2724.02-figures\2724.02_WSD.dwg Cpayne

Ecological Land Services 1157 3rd Ave., Suite 220A Longview, WA 98632 Phone: (360) 578-1371	**PURPOSE:** New School Campus **DATUM:** NAD83 **ADJACENT PROPERTY OWNERS:**	2004 Google Earth Image **APPLICANT:** Warrenton - Hammond School District **PROJECT NAME:** WHSD New Campus **REFERENCE #:** Not yet Assinged **SITE LOCATION ADDRESS:**	**PROPOSED:** Wetland Fill **IN** Wetlands **NEAR:** Warrenton **COUNTY:** Clatsop **STATE:** OR **SHEET** 8 **OF** 8 **DATE:** 7/31/19

Appendix E:

Transportation Impact Study (TIS) and Parking Analysis

Lancaster Mobley (2020)

Warrenton-Hammond School District
Master Plan

Transportation and Parking Impact Analysis

Warrenton, Oregon

Date:
January 10, 2020

Prepared for:
Tom Rogozinski
Warrenton-Hammond School District

Prepared by:
Daniel Stumpf, PE
Melissa Webb, PE
Terrington Smith, EI
William Farley, PE

REGISTERED PROFESSIONAL ENGINEER
88808PE
OREGON
MAR. 12, 2019
DANIEL STUMPF
RENEWS: 6/30/2020

LANCASTER
ENGINEERING

321 SW 4th Ave., Suite 400 | Portland, OR 97204 | 503.248.0313 | lancasterengineering.com

1e

Table of Contents

1e

Table of Figures

Table of Tables

1e

Executive Summary

1. This study analyzes the transportation and parking impacts related to the proposed Warrenton-Hammond School District Master Plan. The analyses of transportation safety, intersection operation, and parking impacts are detailed on pages 16, 24, and 38, respectively.
2. The proposed Warrenton-Hammond School District Master Plan project will include the construction and relocation of the school district's K-12 schools in Warrenton, Oregon, outside of the tsunami inundation zone. The proposed relocation project will occur in four phases over a span of approximately 10 to 20 years, where the phased development will begin with the Middle School, then the High School, and finally the Elementary School.
3. The trip generation calculations show that after full buildout and occupancy, the proposed project is projected to generate an additional 454 morning peak hour trips, 262 mid-day peak hour trips, 122 evening peak hour trips, and 1,554 weekday site trips.
4. No significant trends or crash patterns were identified at any of the study intersections that were indicative of safety concerns. In addition, none of the study intersections exhibit crash rates near or above the 1.00 CMEV threshold nor do any of the ODOT study intersections exhibit a crash rate exceeding ODOT's 90th percentile rate.
5. There are six study intersections that are either currently or projected to operate in excess of acceptable jurisdictional performance standards throughout the study period. These intersections and potential mitigation are included in the following table:

2e

No.	Intersection Name	Phase Mitigation is Required	City TSP Project #	Potential Mitigation
2	Main Avenue at OR-104S	Phase 2 (Year 2021 without High School)	N/A	Install a traffic signal with dedicated WB left-turn and right-turn lanes OR reconstruct the intersection as a roundabout.
4	Harbor Street at Marlin Avenue	Phase 3 (Year 2026 with Elementary School)	R16	Install a traffic signal OR reconstruct the intersection as a roundabout.
5	US-101 at Marlin Avenue	Phase 3 (Year 2026 with Elementary School)	R6 and R19	Modify signal timing & optimize traffic operations AND install dedicated NB & SB right-turn lanes.
7	US-101 at Ensign Lane	Phase 3 (Year 2026 with Elementary School)	N/A	Install an additional SB left-turn lane; reconstruct the EB approach with dedicated left-turn, through, and right-turn lanes; widen eastern intersection leg to accommodate two receiving lanes.
9	Ensign Lane at 19th Street	Phase 3 (Year 2026 with Elementary School)	N/A	Convert the intersection to all-way stop-control.
12	Bugle Road at Ensign Lane (Future Intersection)	Phase 3 (Year 2026 with Elementary School)	N/A	Install all-way stop-controls when Bugle Road is constructed.

All other study intersections are currently operating acceptably per City of Warrenton, Clatsop County, and ODOT standards and are projected to continue operating acceptably through the 2036 buildout year of the entire project. No operational mitigation is necessary or recommended at these intersections.

6. With full buildout of the proposed school project, the proposed development should provide enough parking spaces to accommodate between 303 to 408 vehicles, based on the ITE *Parking Generation Manual*. Per the City of Warrenton's Municipal Code, the finished campus will require 427 parking; however, this standard as well as the higher range of vehicles per the ITE manual may not take into consideration efficiencies associated with a shared campus that result with staff/volunteers who work at more than one school or parents who have children attending different schools at the same time. As a result, it is expected that parking generation will be substantially lower than what is required per City code. If necessary, overflow on-street parking along the south side of Warrior Way is available to accommodate large influxes of parking demand during the morning and afternoon school bell times.

Project Description

Introduction

The proposed Warrenton-Hammond School District Master Plan project will include the construction and relocation of the school district's K-12 schools in Warrenton, Oregon. The intent of the project is to relocate the existing schools outside the tsunami inundation zone as well as expand the current capacity of the schools to accommodate projected growth in the City. The proposed relocation project will occur in four phases over a span of approximately 10 to 20 years, where the phased development will begin with the Middle School, then the High School, and finally the Elementary School with some minor additions to the Middle and High Schools during and after construction of the Elementary School. A detailed breakdown of each project phase is described as follows:

- Phase 1: Construct an 11-classroom Middle School by 2021 and Warrior Way to City of Warrenton standards.
- Phase 2: Construct a 21-classroom High School by 2026.
- Phase 3: Construct a 34-classroom Elementary School with a 5-classroom addition to the Middle School by 2031.
- Phase 4: Construct a 5-classroom addition to the High School by 2036.

This report addresses the impacts of the proposed relocation project on the nearby street system. Based on correspondence with the City of Warrenton, Clatsop County, and the Oregon Department of Transportation (ODOT), the report conducts safety and capacity/level of service analyses at the following intersections:

1. Main Avenue at 9th Street;
2. Main Avenue at Fort Stevens Highway Spur (OR-104S);
3. Ensign Lane at OR-104S;
4. Harbor Street at Marlin Avenue;
5. Oregon Coast Highway (US-101) at Marlin Avenue;
6. US-101 at OR-104S;
7. US-101 at Ensign Lane;
8. US-101 at Dolphin Avenue;
9. Ensign Lane at 19th Street;
10. Ensign Lane at Warrenton-Astoria Highway (US-101B);
11. Bugle Road at Ensign Lane (future intersection); and
12. Bugle Road at 19th Street (future intersection).

The purpose of this study is to determine whether the transportation system within the vicinity of the site is capable of safely and efficiently supporting the existing and proposed uses and to determine any mitigation that may be necessary to do so. Detailed information on traffic counts, trip generation calculations, safety analyses, and level of service calculations is included in the appendix to this report.

1e

Location Description

The project site is located south of Ensign Lane and east of US-101 in Warrenton, Oregon. The subject site is located within a developing area of the City, with a residential subdivision to the east (currently under construction), industrial/commercial uses to the west and northwest, and undeveloped land to the north and south.

The site consists of two tax lots (lots 100 and 103), which encompass an approximate total of 64 acres. The site is currently vacant, but upon development will include three school buildings (Elementary, Middle, and High Schools) as well as sports fields. Construction of the proposed project will be divided into four phases: Phase 1 will include the partial construction of the Middle School, Phase 2 will include the partial construction of the High School, Phase 3 will include the construction of the Elementary School with an addition to the Middle School, and Phase 4 will include an addition to the High School. The main points of access to the site will be provided via Bugle Avenue to the east and Dolphin Avenue to the west. However, the school district intends to limit access to Dolphin Avenue by routing school bus traffic to Ensign Lane via Bugle Avenue and the future roadway alignment, Bugle Road.

Vicinity Streets

The proposed development is expected to impact eight roadways near the site. Table 1 provides a description of each of the vicinity roadways.

Table 1: Vicinity Roadway Descriptions

Roadway	Jurisdiction	Functional Classification	Cross-Section	Speed	On-street Parking	Bicycle Lanes	Curbs	Sidewalks
US-101	ODOT	Principal Arterial/ Statewide Hwy	2 to 6 Lanes	45/55 mph Posted	Not Permitted	Both Sides	Partial Both Sides	Partial Both Sides
Harbor Street	ODOT	Major Collector/ District Hwy	2 to 4 Lanes	45 mph Posted	Not Permitted	Both Sides	Partial South Side	None
9th Street	City of Warrenton	Minor Collector	2 Lanes	35 mph Posted	Partially Permitted	None	Partial Both Sides	Partial North Side
OR-104S	ODOT	Major Collector/ District Hwy	2 Lanes	45 mph Posted	Not Permitted	Both Sides	Partial South Side	Partial South Side
Ensign Lane	Clatsop County	Minor Arterial	3 to 5 Lanes	25/35 mph Posted	Not Permitted	Both Sides	Both Sides	Partial Both Sides
US-101B (Marlin Avenue)	ODOT	Maj. Collector/ Min. Arterial/ District Hwy	2 to 3 Lanes	35/45/55 mph Posted	Not Permitted	Partial Both Sides	Partial Both Sides	Partial Both Sides
Main Avenue	ODOT	Major Collector/ District Hwy	2 to 3 Lanes	35 mph Posted	Partially Permitted	Both Sides	Partial Both Sides	Partial Both Sides
19th Street	Clatsop County	Major Collector	2 Lanes	35 mph Posted	Not Permitted	None	Partial Both Sides	Partial Both Sides

Note: Jurisdiction & Functional Classification based on City of Warrenton Transportation System Plan (Volume 1 Figure 9) and ODOT Oregon Highway Plan/Oregon Transportation Map.

Study Intersections

A majority of site trips generated by the proposed development are expected to impact ten existing and two future planned intersections of significance. A summarized description of these intersections is provided in Table 2 and Table 3.

1e

Table 2: Existing Study Intersection Descriptions

Number	Name	Geometry	Traffic Control	Phasing/Stopped Approaches
1	Main Avenue at 9th Street	Four-Legged	Stop-Controlled	EB/WB Stop-Controlled Approaches
2	Main Avenue at OR-104S	Three-Legged	Stop-Controlled	WB Stop-Controlled Approach
3	Ensign Lane at OR-104S	Three-Legged	Stop-Controlled	NB Stop-Controlled Approach
4	Harbor Street at Marlin Avenue	Three-Legged	Stop-Controlled	NB Stop-Controlled Approach, EB Right-turn Slip Lane
5	US-101 at Marlin Avenue	Four-Legged	Signalized	Permitted NB/SB Left-turns, Protected NEB/SWB Left-turns
6	US-101 at OR-104S	Four-Legged	Stop-Controlled	EB Stop-Controlled, Partially Restricted SB/EB/WB Turning Movements
7	US-101 at Ensign Lane	Four-Legged	Signalized	Protected NB/SB Left-turns, Permitted/Overlap NB/WB Right-turns, Protected EB/WB Left-turns
8	US-101 at Dolphin Avenue	Three-Legged	Stop-Controlled	WB Stop-Controlled Approach
9	Ensign Lane at 19th Street	Four-Legged	Stop-Controlled	NB/SB Stop-Controlled Approaches
10	Ensign Lane at US-101B	Three-Legged	Stop-Controlled	SB Stop-Controlled Approach

le

Table 3: Future Study Intersection Descriptions

Number	Name	Geometry	Traffic Control	Phasing/Stopped Approaches
11	Bugle Road at Ensign Lane (Future Intersection)	Temporarily Three-Legged	Stop-Controlled	NB Stop-Controlled Approach
12	Bugle Road at 19th Street (Future Intersection)	Four-Legged	Stop-Controlled	EB/WB Stop-Controlled Approaches

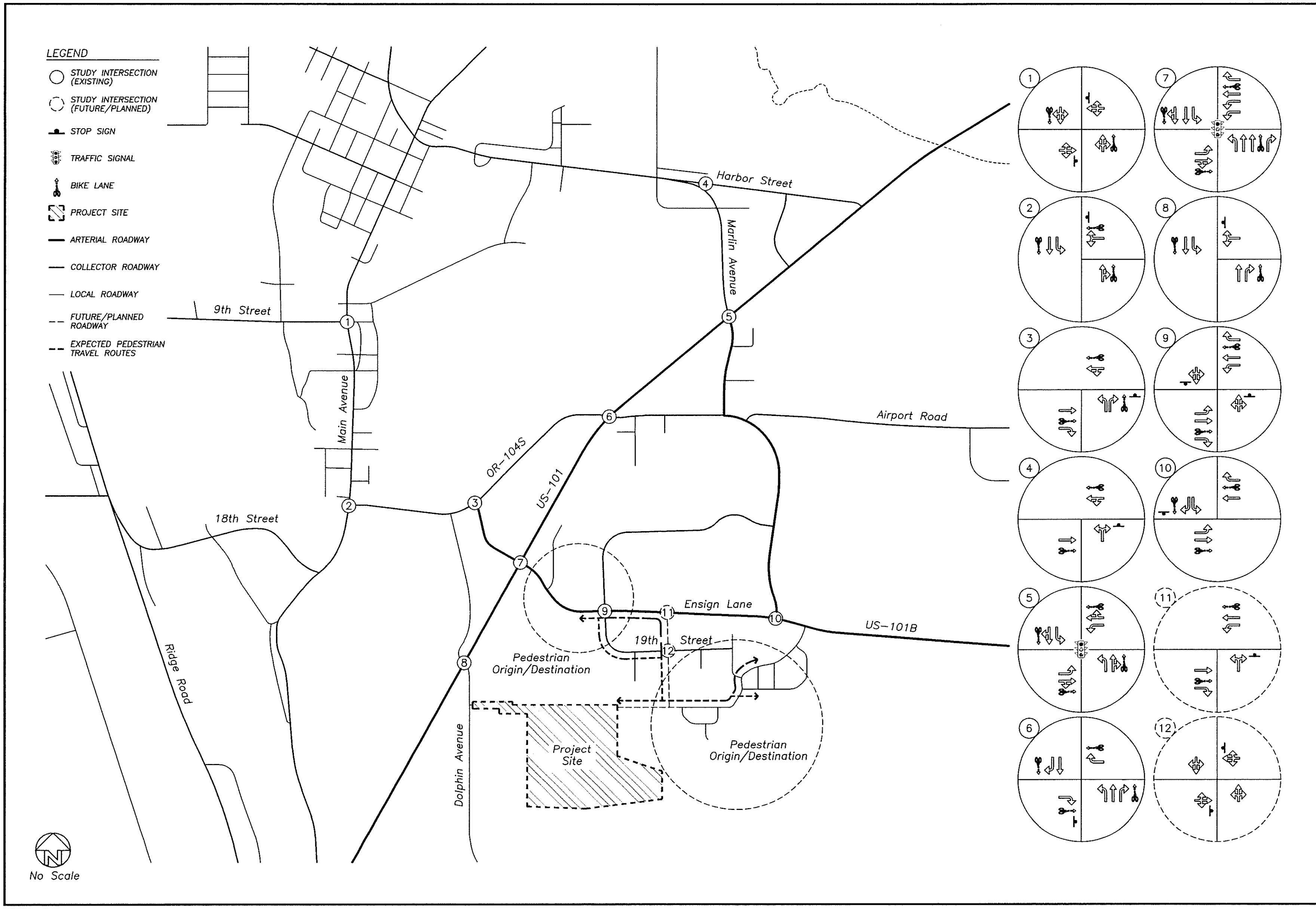
A vicinity map displaying the project site, vicinity streets, and the study intersections with their associated lane configurations is shown in Figure 1 on page 8.

Public Transit

The project site is located near two transit lines which have four stops within a one-mile walking/biking distance of the site, located at the intersections of US-101 at Ensign Lane, Discovery Lane at Ensign Lane, Chokeberry Avenue at 19th Street, and Huckleberry Avenue at Willow Drive.

Bus line *Route 101 – Astoria-Warrenton-Gearhart-Seaside* provides service between the aforementioned cities, with notable stops near Astoria Transit Center, Astoria High School, and Clatsop Community College. Weekday service is scheduled from approximately 6:00 AM to 9:50 PM, and has headways of approximately one to two hours.

The *Pacific Connector* provides limited service between the Cities of Astoria and Cannon Beach, with stops near Warrenton, Gearhart, Seaside, and Cannon Beach. Weekend service is scheduled from approximately 8:30 AM to 8:30 PM and has headways of approximately two to three hours.



VICINITY MAP
Intersection Configurations
Traffic Control Devices and Lane Configurations

FIGURE 1
Page 8

1e

Site Trips

Trip Generation

The proposed Warrenton-Hammond School District Master Plan project will include the construction and relocation of the school district's K-12 schools. Specifically, the schools proposed for construction include an Elementary School with 34 classrooms, Middle School with an initial 11 classrooms plus a subsequent 5-classroom addition, and High School with an initial 21 classrooms plus a subsequent 5-classroom addition. Additionally, trips currently generated by the existing School District's Grade and High Schools will be relocated to each of the proposed schools upon completion of each phase of development. Specifically, Phase 1 will include construction of the Middle School, Phase 2 will include construction of the High School, Phase 3 will include the construction of the Elementary School plus an addition to the Middle School, and Phase 4 will include the construction of an addition to the High School.

To estimate the number of trips that will be generated by each of the proposed schools, trip rates from the *Trip Generation Manual* [1] were used. Data from the following land use codes were utilized for each school to project trip generation based on the number of students:

- Land use code 520, *Elementary School*;
- Land use code 522, *Middle School/Junior High School*; and
- Land use code 530, *High School*.

Since the proposed project will include relocating the existing Grade and High School's student body to the project site, trips associated with these existing schools were deducted from the total trip generation of the Warrenton-Hammond School District to reflect the net change in trip impacts to the transportation system.

To determine the current number of students at the existing Grade and High Schools, student enrollment numbers for the 2018-2019 academic school year were provided by the Warrenton-Hammond School District. To determine the projected enrollment capacity for each of the proposed schools, it is assumed each classroom could have a reasonable maximum capacity of 24 students.

The trip generation calculations show that after full buildout the proposed project is projected to generate an additional 454 morning peak hour trips, 262 mid-day peak hour trips, 122 evening peak hour trips, and 1,554 weekday site trips. The trip generation estimates are summarized in Table 4. Detailed trip generation calculations are included in the technical appendix to this report.

---

[1] Institute of Transportation Engineers (ITE), *Trip Generation Manual*, 10th Edition, 2017.

le

Table 4: Trip Generation Summary

	ITE Code	Size	AM Peak Hour			MD Peak Hour			PM Peak Hour			ADT
			In	Out	Total	In	Out	Total	In	Out	Total	
Phase 1: Middle School												
Existing Grade School	522	246 students	77	66	143	40	46	86	21	21	42	524
Proposed MS	522	264 students	83	70	153	42	50	92	22	23	45	562
Net New Trips			6	4	10	2	4	6	1	2	3	38
Phase 2: High School												
Existing HS	530	263 students	92	45	137	28	58	86	18	19	37	534
Proposed HS	530	504 students	176	86	262	53	113	166	34	37	71	1,024
Net New Trips			84	41	125	25	55	80	16	18	34	490
Phase 3: Elementary School plus Middle School Addition												
Existing Grade School	520	538 students	194	166	360	82	101	183	44	47	91	1,016
Proposed ES	520	816 students	295	252	547	125	152	277	67	72	139	1,542
Proposed MS Addition	522	120 students	38	32	70	19	23	42	10	10	20	256
Net New Trips			139	118	257	62	74	136	33	35	68	782
Phase 4: High School Addition												
Proposed HS Addition	530	120 students	42	20	62	13	27	40	8	9	17	244
Net New Trips			42	20	62	13	27	40	8	9	17	244
Existing School District Trips		**1,047 students**	**363**	**277**	**640**	**150**	**205**	**355**	**83**	**87**	**170**	**2,074**
Proposed School District Trips		**1,824 students**	**634**	**460**	**1,094**	**252**	**365**	**617**	**141**	**151**	**292**	**3,628**
Net New School District Trips		**777 students**	**271**	**183**	**454**	**102**	**160**	**262**	**58**	**64**	**122**	**1,554**

Note: Elementary School, Middle School, and High School denoted as ES, MS, and HS, respectively.

Trip Distribution

The directional distribution of site trips to/from the project site was estimated based on the locations of likely trips destinations (such as residential neighborhoods), locations of major transportation facilities, and existing travel patterns at the study intersections.

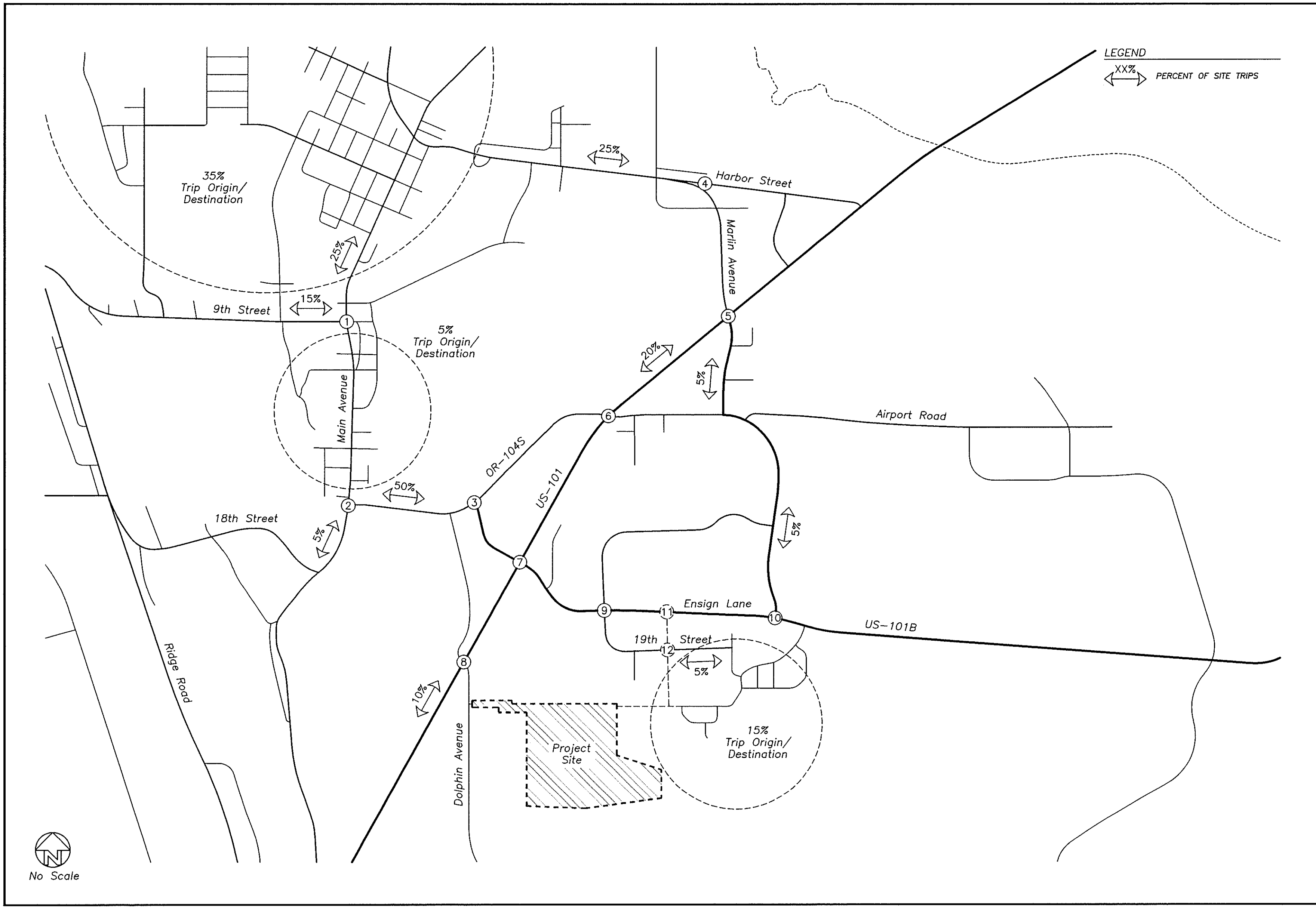
2e

The following trip distribution was estimated and used for analysis:

- Approximately 25 percent of site trips will travel to/from the west along Harbor Street;
- Approximately 25 percent of site trips will travel to/from the north along Main Avenue;
- Approximately 15 percent of site trips will travel to/from the west along 9th Street;
- Approximately 10 percent of site trips will travel to/from the south along US-101;
- Approximately 5 percent of site trips will travel to/from the south along Main Avenue;
- Approximately 5 percent of site trips will travel to/from the east along 19th Street; and
- Approximately 15 percent of site trips will travel to/from locales within the immediate site vicinity.

A vicinity map depicting the estimated site trip distribution is shown in Figure 2 on page 12 while the trip distribution within individual study intersections for the existing schools as well as project site are shown in Figure 3. The trip assignment for the trips generated by the project site during the morning, mid-day, and evening peak hours are shown for Phase 1, Phase 2, Phase 3, and Phase 4 in Figure 4, Figure 5, Figure 6, and Figure 7, respectively. Figure 3 through Figure 7 are included in the appendix to this report.

Since the proposed project will include relocating the existing Grade and High School's student body to the project site, trips associated with these existing schools were deducted from the transportation system and rerouted to the project site for each applicable development Phase.



SITE TRIP DISTRIBUTION MAP
Proposed Development Plan – Project Site Trips
AM, MD, & PM Peak Hours

FIGURE 2
Page 12

1e

Traffic Volumes

Existing Conditions

Traffic counts were conducted at the study intersections on the following dates to capture traffic conditions during the morning peak hour, mid-day peak hour, and evening peak hour:

- Wednesday, October 31^{st}, 2018, from 7:00 AM to 9:00 AM;
- Tuesday, November 13^{th}, 2018, from 2:00 PM to 4:00 PM; and
- Tuesday, October 30^{th}, 2018, from 4:00 PM to 6:00 PM.

Data was used from each intersection's respective morning, afternoon, and evening peak hours. It should be noted that the intersection of Harbor Street at Marlin Avenue has a slip lane on the eastbound approach. This allows eastbound right-turning vehicles the ability to travel southbound along Marlin Avenue without impeding the turning movements of either stopped vehicles along the northbound approach of Marlin Avenue or westbound left-turning vehicles. Since the eastbound right-turning volumes will not significantly impact operation at the intersection, volumes associated with this movement were removed from further analysis.

Per the requirements established in ODOT's *Analysis Procedures Manual* (APM) as well as direction from ODOT staff, seasonal adjustment factors were calculated and applied to each highway's through movement traffic volumes to reflect the highest hour volumes along ODOT facilities while the Warrenton-Hammond schools are in session. The adjustment factors were calculated based on an average of the Commuter and Coastal Destination Route seasonal trends, utilizing ODOT's *Seasonal Trend Table*. The following factors were applied to US-101B/Marlin Avenue, Main Avenue (OR-104), and OR-104S for each set of collected count data:

- 1.1490 for the October 31^{st} counts (morning peak hour);
- 1.2003 for the November 13^{th} counts (mid-day peak hour); and
- 1.1457 for the October 30^{th} counts (evening peak hour).

Per the City of Warrenton's *Transportation System Plan* (TSP) *Update*, alternative mobility standards and methodologies for US-101 were recommended and will be presented to the Oregon Transportation Commission (OTC). One of these alternative mobility standards includes analyzing the segment of US-101 within Warrenton city limits based on the annual average weekday volumes rather than the 30^{th} highest hour volumes. Since it is expected these alternative standards will be adopted by the OTC prior to submittal of the proposed Master Plan application, the traffic volumes for intersections along US-101 were adjusted to reflect the annual average weekday volumes.

Figure 8, which is included in the appendix to this study, shows the existing morning, mid-day, and evening peak hour traffic volumes at the study intersections.

1e

2021 Background Conditions

To provide an analysis of the potential impacts of the proposed relocation project on the nearby transportation facilities, an estimate of future traffic volumes is required.

In order to calculate the future traffic volumes for non-ODOT facilities, a compounded growth rate of 1.81 percent per year was applied to the measured existing traffic volumes over a three-year period to approximate year 2021 background conditions. The assumed 1.81 percent per year growth rate is based on the expected population growth reported in the City of Warrenton's TSP Update between years 2015 to 2035.

To estimate the future traffic volumes for ODOT facilities, linear growth rates were calculated for the traffic volumes along US-101, US-101B/Marlin Avenue, Main Avenue (OR-104), and OR-104S, using ODOT's *2037 Future Volumes Table.* The following growth rates were determined for the aforementioned roadways:

- 1.04 percent per year along US-101;
- 1.30 percent per year along US-101B/Marlin Avenue (also assumed for the ODOT facilities of Harbor Street and Fort Stevens Highway Spur east of US-101);
- 1.02 percent per year along Main Avenue; and
- 2.18 percent per year along OR-104S.

For intersections where the major-street is an ODOT facility and the minor-street is a local jurisdiction facility, these aforementioned growth rates were applied to the measured existing through volumes traveling along each of the ODOT facilities while a compounded growth rate of 1.81 percent per year was applied to the non-ODOT turning movement traffic volumes. For instances where the major-street and minor-street approaches of a study intersection are ODOT facilities with differing growth rates, an iterative calculation for balancing volume growth between the intersection approaches was conducted with the resulting growth rate applied to the intersection.

In addition to the traffic volume growth described above, the nearby Roosevelt Subdivision to the east of the site is currently approved for construction and is expected to impact nearby study intersections. The in-process development is currently not fully contributing trips to the transportation system, but may potentially be by the buildout year of the site. Additional trips corresponding to the in-process development were added to the existing year traffic volumes in addition to the three years of traffic growth at each of the applicable study intersections. To maintain a conservative analysis of operation at the study intersections, full buildout of the Roosevelt Subdivision is assumed to be completed by year 2021.

Figure 9, which is included in the appendix to this study, shows the projected year 2021 background traffic volumes at the study intersections during the morning, mid-day, and evening peak hours.

Future Year Buildout Conditions

The proposed relocation project will occur in four phases: Phase 1 will include the construction of a Middle School by year 2021, Phase 2 will construct a High School by year 2026, Phase 3 will construct an Elementary School and an addition to the Middle School by year 2031, and Phase 4 will construct an addition to the High School by year 2036. Since the construction of each school will occur over a span of approximately 17 years, analysis scenarios were examined for each expected year of construction and occupancy, with and without each subsequent phase of development.

Peak hour trips calculated to be generated by each phase of development, as described earlier within the *Site Trips* section, were added to the projected future year traffic volumes. Projected volume growth between each future year analysis scenario was based growth methodologies and assumptions presented in the *2021 Background Conditions* section of this report.

The following figures, which are included in the appendix to this report, show the projected future year buildout traffic volumes at the study intersections during the morning, mid-day, and evening peak hours:

- Figure 10 – Year 2021 Buildout Conditions (Phase 1);
- Figure 11 – Year 2026 Background Conditions (Phase 1);
- Figure 12 – Year 2026 Buildout Conditions (Phases 1 & 2);
- Figure 13 – Year 2031 Background Conditions (Phases 1 & 2);
- Figure 14 – Year 2031 Buildout Conditions (Phases 1, 2, & 3);
- Figure 15 – Year 2036 Background Conditions (Phases 1, 2, & 3); and
- Figure 16 – Year 2036 Buildout Conditions (Phases 1, 2, 3, & 4).

1e

Safety Analysis

Crash Data Analysis

Using data obtained from ODOT's Crash Analysis and Reporting Unit, a review of the most recent available five years of crash history (January 2013 to December 2017) at the study intersections was performed. The crash data was evaluated based on the number of crashes, the type of collisions, the severity of the collisions, and the resulting crash rate for the intersection. Crash rates provide the ability to compare safety risks at different intersections by accounting for both the number of crashes that have occurred during the study period and the number of vehicles that typically travel through the intersection. Crash rates were calculated using the common assumption that traffic counted during the evening peak period represents approximately 10 percent of the annual average daily traffic (AADT) at the intersection. Crash rates in excess of 1.00 crashes per million entering vehicles (CMEV) may be indicative of design deficiencies and therefore require a need for further investigation and possible mitigation.

With regard to crash severity, ODOT classifies crashes in the following categories:

- Property Damage Only (*PDO*);
- Possible Injury – Complaint of Pain (*Injury C*);
- Non-Incapacitating Injury (*Injury B*);
- Incapacitating Injury – Bleeding, Broken Bones (*Injury A*); and
- Fatality or Fatal Injury.

The study intersections along Main Avenue, US-101, US-101B, and OR-104S are ODOT facilities which adhere to the crash analysis methodologies within ODOT's APM. According to *Exhibit 4-1: Intersection Crash Rates per MEV by Land Type and Traffic Control* of the APM, intersections which experience crash rates in excess of their respective 90th percentile crash rates should be "flagged for further analysis". For intersections in rural and urban settings (i.e. intersections within City limits), the following 90th percentile rates are applicable to the study intersections:

- Unsignalized, three-legged intersection (rural): 0.475 CMEV;
- Unsignalized, three-legged intersection (urban): 0.293 CMEV;
- Unsignalized, four-legged intersection (urban): 0.408 CMEV; and
- Signalized, four-legged intersection (urban): 0.860 CMEV.

Table 5 provides a summary of crash types while Table 6 summarizes crash severities and rates for each of the study intersections. Crash data is included in the technical appendix to this report.

1e

Table 5: Crash Type Summary

	Intersection	Crash Type						Total Crashes
		Rear End	Turn	Angle	Side Swipe	Ped/ Bike	Other	
1	Main Avenue at 9th Street	0	0	0	0	0	0	0
2	Main Avenue at OR-104S	2	1	0	0	0	0	3
3	Ensign Lane at OR-104S	0	1	0	0	0	1	2
4	Harbor Street at Marlin Avenue	0	0	0	0	0	0	0
5	US-101 at Marlin Avenue	9	3	2	0	0	1	15
6	US-101 at OR-104S	0	0	0	1	0	0	1
7	US-101 at Ensign Lane	9	17	0	0	1	1	28
8	US-101 at Dolphin Avenue	0	0	0	0	0	0	0
9	Ensign Lane at 19th Street	1	1	1	0	0	1	4
10	Ensign Lane at US-101B	0	0	0	0	0	0	0

1e

Table 6: Crash Severity and Rate Summary

	Intersection	Crash Severity						Total Crashes	AADT	Crash Rate
		PDO	C	B	A	Fatal	Unknown			
1	Main Avenue at 9th Street	0	0	0	0	0	0	0	7,280	0.00
2	Main Avenue at OR-104S	2	1	0	0	0	0	3	8,020	0.20
3	Ensign Lane at OR-104S	1	1	0	0	0	0	2	6,050	0.18
4	Harbor Street at Marlin Avenue	0	0	0	0	0	0	0	9,750	0.00
5	US-101 at Marlin Avenue	7	7	0	1	0	0	15	18,180	0.45
6	US-101 at OR-104S	1	0	0	0	0	0	1	14,970	0.04
7	US-101 at Ensign Lane	14	11	3	0	0	0	28	24,100	0.64
8	US-101 at Dolphin Avenue	0	0	0	0	0	0	0	12,920	0.00
9	Ensign Lane at 19th Street	2	1	1	0	0	0	4	6,560	0.33
10	Ensign Lane at US-101B	0	0	0	0	0	0	0	6,610	0.00

BOLDED text indicates a crash rate in excess of either 1.0 CMEV or the 90th Percentile CMEV per ODOT's APM.

Based on a review of the crash data, there were two crashes which involved either a pedestrian/bicyclist or was classified as *Injury A*. An in-depth analysis of these intersections and crashes are detailed in the following sections.

US-101 at Marlin Avenue

The intersection of US-101 at Marlin Avenue had one reported crash that was classified as *Injury A*. The crash occurred when the driver of a southwest-bound passenger car (Vehicle 1) was following too close to another passenger car in front (Vehicle 2) and rear-ended Vehicle 2 once it had stopped at the intersection. Vehicle 2 then collided with another stopped passenger car at the intersection (Vehicle 3). None of the occupants of Vehicles 1 or 2 were injured while two passengers in Vehicle 3 were injured: one passenger sustained injuries consistent with *Injury C* classification while the other sustained injuries consistent with *Injury A* classification.

1e

US-101 at Ensign Lane

The intersection of US-101 at Ensign Lane had one reported crash that involved a bicyclist. According to the crash data, the collision occurred when a northwest-bound bicyclist, who was utilizing an intersection crosswalk, failed to yield right of way to a right-turning, northwest-bound passenger car. The bicyclist sustained injuries consistent with *Injury B* classification.

Analysis Conclusions

Based on a review of the most recent five years of available crash data, no significant trends or crash patterns were identified at any of the study intersections that were indicative of safety concerns. In addition, none of the study intersections exhibit crash rates near or above the 1.00 CMEV threshold nor do any of the ODOT study intersections exhibit a crash rate exceeding ODOT's 90th percentile rate. Accordingly, no safety mitigation is recommended per the crash data analysis.

Warrant Analysis

Left-turn lane and preliminary traffic signal warrants were examined for the study intersections where such treatments would be applicable. In addition, preliminary multi-way stop warrants were evaluated at the intersections of Ensign Lane at 19th Street and Bugle Road at 19th Street.

Left-turn Lane Warrants

A left-turn refuge lane is primarily a safety consideration for the major-street, removing left-turning vehicles from the through traffic stream. The left-turn lane warrants used for the non-ODOT intersections were developed from the *National Cooperative Highway Research Project's* (NCHRP) *Report 457* while the warrants used for ODOT intersections implement the design curves developed by the Texas Transportation Institute, as adopted by ODOT in its APM. Turn lane warrants were evaluated based on the number of advancing and opposing vehicles as well as the number of turning vehicles, the travel speed, and the number of through lanes.

Left-turn lane warrants are projected to be met for the following intersections:

1. Main Avenue at 9th Street: The northbound approach under existing conditions as well as the southbound approach under year 2036 background conditions, regardless of whether the proposed school project is constructed.
3. Ensign Lane at OR-104S: The westbound approach under existing conditions.
4. Harbor Street at Marlin Avenue: The westbound approach under existing conditions.
12. Bugle Road at 19th Street: The northbound approach under year 2031 buildout conditions (Phases 1, 2, & 3).

1e

Although left-turn lane warrants are met at the intersection of Main Avenue at 9th Street, the intersection is projected to operate acceptably per ODOT standards (as described in the *Intersection Capacity Analysis* section) and is currently operating safely based on the *Crash Data Analysis*. Given the installation of a left-turn lane would also be inconsistent with the character of the roadway (i.e. the surrounding residential area and the fact left-turn lanes are currently not provided along the roadway until the intersection of OR-104S to the south), a left-turn lane is not recommended or deemed necessary at this intersection.

Preliminary Traffic Signal Warrants

Preliminary traffic signal warrants were examined for the unsignalized study intersections to determine whether the installation of a new traffic signal will be warranted at the intersections by full buildout of the proposed schools. Based on the analysis, the preliminary traffic signal warrants are projected to be met for the intersection of Harbor Street at Marlin Avenue under existing conditions. Due to insufficient main and side-street traffic volumes, traffic signal warrants are not projected to be met at any of the other unsignalized study intersections under any of the analysis scenarios.

Preliminary Multi-Way Stop Warrants

Preliminary multi-way stop warrants were evaluated for the intersections of Ensign Lane at 19th Street and Bugle Road at 19th Street. To determine whether the installation of all-way stop-control is warranted or nearing warrants at these intersections, the *Manual of Uniform Traffic Control Devices for Streets and Highways*[2] (MUTCD) was referenced. According to *Section 2B.07 Multi-Way Stop Applications* of the MUTCD, installation of a multi-way stop control may be implemented at an intersection given the following criteria are considered:

A. Where traffic control signals are justified, the multi-way stop is an interim measure that can be installed quickly to control traffic while arrangements are being made for the installation of the traffic control signal.

B. Five or more reported crashes in a 12-month period that are susceptible to correction by a multi-way stop installation. Such crashes include right-turn and left-turn collisions as well as right-angle collisions.

C. Minimum volumes:

  1. The vehicular volume entering the intersection from the major street approaches (total of both approaches) averages at least 300 vehicles per hour for any 8 hours of an average day; and

  2. The combined vehicular, pedestrian, and bicycle volume entering the intersection from the minor street approaches (total of both approaches) averages at least 200 units per hour for the same 8 hours, with an average delay to minor-street vehicular traffic of at least 30 seconds per vehicle during the highest hour; but

---

[2] Federal Highway Administration (FTA), American Traffic Safety Services Association (ATSSA), Institute of Transportation Engineers (ITE), American Association of State Highway and Transportation Officials (AASHTO), *Manual on Uniform Traffic Control Devices for Streets and Highways* (MUTCD), 2009 Edition, 2010.

1e

3. *If the 85th-percentile approach speed of the major-street traffic exceeds 40 mph, the minimum vehicular volume warrants are 70 percent of the values provided in Items 1 and 2.*

D. *Where no single criterion is satisfied, but where Criteria B, C.1, and C.2 are all satisfied to 80 percent of the minimum values, Criterion C.3 is excluded from this condition.*

Taking into consideration Criterion C alone as well as the posted intersecting roadway speeds of 25 mph to 35 mph, the major-street approach volumes must average at least 300 vehicles over eight hours during a typical day while the minor-street approaches must average at least 200 vehicles during the same hours to meet the minimum volume requirements for implementing multi-way stop controls. In addition, the minor-street average approach delays must be at least 30 seconds during the highest hour (see the *Intersection Capacity Analysis* section on page 24).

Based on the analysis, the preliminary multi-way stop warrants are projected to be met at the intersections under the following conditions:

9. Ensign Lane at 19th Street: Under year 2036 buildout conditions (Phases 1, 2, 3, & 4), preliminary warrants are not projected to be met based on the projected ADT entering the intersection. However, by year 2031 buildout conditions (Phases 1, 2, & 3), the preliminary warrants are projected to be met for all three peak hours.

12. Bugle Road at 19th Street: Under year 2036 buildout conditions (Phases 1, 2, 3, & 4), preliminary warrants are not projected to be met based on the projected ADT entering the intersection. However, by year 2031 buildout conditions (Phases 1, 2, & 3), the preliminary warrants are projected to be met for the morning and mid-day peak hours.

Since criterion C is partially met per the preliminary warrant analysis, the conversion of intersections to all-way stop-control may potentially be warranted at both intersections.

Multi-Modal Access and Safety

Motor Vehicles

As described in the *Crash Data Analysis* section, the calculated crash rates at the study intersections were well below the 1.00 CMEV threshold of safety as well as below ODOT's 90th percentile crash rate for applicable intersections. In addition, only one serious injury collision (i.e. reported as *Injury A*) involving motor vehicle traffic was reported at the study intersections over the five-year analysis period. Since the reported crashes within the study area resulted in a low number of serious injuries, a low number of bicycle/pedestrian related crashes, and the calculated crash rates at the study intersection were relatively low, there do not appear to be any trends indicative of significant safety hazards at the nearby transportation facilities.

With regard to site access, based on correspondence with ODOT staff, access to Ensign Lane is strongly preferred over Dolphin Avenue given the intersection of US-101 at Ensign Lane had been built out to accommodate larger volumes of traffic. According to the school district, a majority of school generated traffic

1e

is expected to access the site via Ensign Lane by way of the future roadway alignment of Bugle Road. The use of Dolphin Avenue will be limited since the school district does not intend to funnel bus traffic along this route. While access will be provided via Dolphin Avenue, the intent of this access is to increase connectivity to the site in the event of emergencies, such as an incoming tsunami where the proposed schools will serve as a gathering place.

Based on a review of motor vehicle access and safety, no mitigation pertaining to this specific mode of travel is necessary or recommended.

Pedestrians

As described in the *Crash Data Analysis* section, there were no pedestrian-related collisions reported at the study intersections over the five-year analysis period.

With buildout of the proposed schools, pedestrian facilities will be constructed along the south side of the proposed east/west roadway connection (located along the north side of the site) between Dolphin Avenue and the in-process Roosevelt Subdivision to the east of the site. With construction of both the east/west roadway and the in-process Roosevelt Subdivision, sidewalks will generally be complete between the school and the nearby residential uses to the east, the exception being the limited sidewalks along Willow Drive between Salal Loop and Honeysuckle Loop. Although sidewalks will be limited along this short segment of Willow Drive, low vehicular volumes and low travel speeds (i.e. a posted speed of 20 mph), will allow pedestrians the ability to safely and comfortably walk along the shoulders of Willow Drive when necessary.

The construction of sidewalks along Dolphin Avenue is not recommended for the following reasons:

- Constructing sidewalks north to US-101 would encourage pedestrian travel (i.e. students) toward the highway, creating unnecessary safety issues.
- There are a limited number of low-density residential uses to the south of the site which could benefit from the installation of a sidewalk.

Pedestrian access to and from retail uses north of the site may be provided via planned local roadway/pedestrian connections, such as Bugle Road.

According to City of Warrenton staff, no direct vehicle access will be provided along the segment of Willow Drive just east of the planned Bugle Road alignment; however, pedestrian and bicycle access will be maintained.

Bicycles

As described in the *Crash Data Analysis* section, there was one bicycle-related collision that occurred within the study area, specifically at the intersection of US-101 at Ensign Lane. Upon closer inspection of the crash data, the crash does not appear to have occurred due to a design issue of the intersection.

1e

Within the nearby site vicinity, bicycle lanes and paved shoulders wide enough to accommodate bicyclists are available along both sides of US-101 and Ensign Lane. For nearby local streets, such as Dolphin Avenue, 19th Street, Willow Drive, etc, low vehicular traffic volumes and low roadway speeds allow bicyclists the ability to safely and comfortably share the roadway with motor vehicle traffic when necessary. Future planned roadways near the site, such as Bugle Road and the planned east/west connection along the north side of the site, are also expected to serve low volumes of traffic traveling at low speeds.

Transit Users

Regarding transit users of the school, excluding parent pickup/drop-off of students or high school aged students driving to and from school, a majority of students are expected to utilize school buses for transportation to and from the site. Alternatively, nearby public transit is also available to both students, parents, and employees. The nearby transit stops may be accessed via walking/biking, with stops located at the intersections of US-101 at Ensign Lane, Discovery Lane at Ensign Lane, Chokeberry Avenue at 19th Street, and Huckleberry Avenue at Willow Drive.

Given the accessibility of nearby transit stops and services, no mitigation pertaining to this specific mode of travel is necessary or recommended.

1e

Operational Analysis

Intersection Capacity Analysis

A capacity and delay analysis were conducted for each of the study intersections per the signalized and unsignalized intersection analysis methodologies in the *Highway Capacity Manual* [3] (HCM). Intersections are generally evaluated based on the average control delay experienced by vehicles and are assigned a grade according to their operation. The level of service (LOS) of an intersection can range from LOS A, which indicates very little or no delay experienced by vehicles, to LOS F, which indicates a high degree of congestion and delay. The volume-to-capacity (v/c) ratio is a measure that compares the traffic volumes (demand) against the available capacity of an intersection.

According to the City of Warrenton's TSP, signalized and unsignalized intersections under City jurisdiction are required to operate at LOS D during the peak hour of analysis.

Per Clatsop County's TSP as well as direction by Clatsop County staff, the following minimum operation standards apply at intersections under County jurisdiction:

- Signalized, roundabout, and all-way stop-controlled intersections shall operate at LOS E or better with a v/c ratio no greater than 0.85.
- Two-way stop-controlled and yield-controlled intersections shall operate at LOS E or better with a v/c ratio no greater than 0.90.

In addition, all study intersections that are composed of and operate under the jurisdiction of ODOT must meet standards established in the *Oregon Highway Plan*. Based on each highway's respective classification, location, and posted speed, the following operation standards apply:

- Study intersections along US-101 are required to operate with a v/c ratio of 0.80 or less (see paragraph below);
- US-101B at SE Ensign Lane, located outside of City limits, is required to operate with a v/c ratio of 0.75 or less; and
- All other study intersections are required to operate with a v/c ratio of 0.90 or less.

Per the City of Warrenton's TSP, alternative mobility standards which include utilizing a v/c ratio of 0.85 for intersections along US-101, within Warrenton city limits, were recommended to the OTC. It is expected these alternative standards will be adopted by the OTC prior to submittal of the proposed Master Plan application whereby an 0.85 v/c ratio standard of operation was applied to the study intersections along US-101.

---

[3] Transportation Research Board, *Highway Capacity Manual*, 2000.

le

The v/c, delay, and LOS results of the capacity analysis are shown in Tables 7 through 10 for the morning, mid-day, and evening peak hours. Specifically, analysis scenarios included in each table are summarized below:

- Table 7 details intersection capacity impacts associated with the development of Phase 1, where existing traffic conditions as well as future year 2021 conditions with and without Phase 1 were analysed.
- Table 8 details intersection capacity impacts associated with the development of Phase 2, where future year 2026 conditions with and without Phase 2 were analysed.
- Table 9 details intersection capacity impacts associated with the development of Phase 3, where future year 2031 conditions with and without Phase 3 were analysed.
- Table 10 details intersection capacity impacts associated with the development of Phase 4, where future year 2036 conditions with and without Phase 4 were analysed. Additionally, an added year 2036 "No Build" scenario without the proposed project was analysed.

As described in the fourth bullet point, an added analysis scenario was included within Table 10 showing year 2036 background conditions without construction of the new schools. The intent of the additional analysis scenario is to show future traffic conditions and potential transportation deficiencies without impacts associated with the schools. The year 2036 background traffic volumes without the proposed schools are shown in Figure 17 in the appendix to this report.

The following sections detail intersection operation on a per Phase basis with narrative describing potential mitigation, if necessary, following each applicable Table. For determining potential mitigation, the City's TSP, the County's TSP, and ODOT's Statewide Transportation Improvement Plan (STIP) were reviewed to determine any planned projects at these intersections. The reported results for the signalized study intersections are based on the analysis methodologies provided in the HCM 2000 per the methodologies in ODOT's APM. Detailed calculations as well as tables showing the relationship between delay and LOS are included in the appendix to this report.

Proposed Middle School (Phase 1)

Table 7 details intersection capacity impacts associated with the development of Phase 1, where capacity results for existing traffic conditions as well as future year 2021 conditions, with and without Phase 1, are shown.

1e

Table 7: Capacity Impacts of Middle School (Phase 1)

	AM Peak Hour			MD Peak Hour			PM Peak Hour		
	LOS	Delay	v/c	LOS	Delay	v/c	LOS	Delay	v/c
1 Main Avenue at 9th Street									
Existing Conditions	C	20	0.41	C	20	0.38	C	18	0.29
2021 Background Conditions	C	21	0.45	C	21	0.42	C	19	0.32
2021 Buildout Conditions (Phase 1)	C	20	0.34	C	19	0.34	C	19	0.30
2 Main Avenue at OR-104S									
Existing Conditions	C	17	0.44	D	26	0.72	C	19	0.61
2021 Background Conditions	C	19	0.50	D	33	0.79	C	22	0.67
2021 Buildout Conditions (Phase 1)	C	22	0.58	E	38	0.84	C	23	0.69
3 Ensign Lane at OR-104S									
Existing Conditions	B	11	0.17	B	13	0.33	B	14	0.37
2021 Background Conditions	B	11	0.19	B	13	0.36	B	14	0.40
2021 Buildout Conditions (Phase 1)	B	12	0.23	B	14	0.39	B	15	0.41
4 Harbor Street at Marlin Avenue									
Existing Conditions	C	18	0.22	D	26	0.49	D	25	0.52
2021 Background Conditions	C	18	0.25	D	29	0.54	D	29	0.57
2021 Buildout Conditions (Phase 1)	C	20	0.31	D	32	0.59	D	30	0.59
5 US-101 at Marlin Avenue									
Existing Conditions	C	23	0.48	C	29	0.67	C	31	0.66
2021 Background Conditions	C	24	0.51	C	30	0.69	C	32	0.70
2021 Buildout Conditions (Phase 1)	C	26	0.53	C	31	0.71	C	33	0.70
6 US-101 at OR-104S									
Existing Conditions	B	11	0.01	B	14	0.05	B	14	0.03
2021 Background Conditions	B	12	0.01	B	15	0.06	B	14	0.03
2021 Buildout Conditions (Phase 1)	B	12	0.01	B	15	0.06	B	14	0.03

BOLDED text indicates intersection operation above jurisdictional standards.

Table 7: Capacity Impacts of Middle School (Phase 1)

	AM Peak Hour			MD Peak Hour			PM Peak Hour		
	LOS	Delay	v/c	LOS	Delay	v/c	LOS	Delay	v/c
7 US-101 at Ensign Lane									
Existing Conditions	C	33	0.41	D	41	0.65	D	40	0.63
2021 Background Conditions	C	34	0.44	D	42	0.68	D	41	0.67
2021 Buildout Conditions (Phase 1)	C	35	0.48	D	43	0.69	D	41	0.67
8 US-101 at Dolphin Avenue									
Existing Conditions	C	17	0.11	C	18	0.10	B	15	0.13
2021 Background Conditions	C	18	0.11	C	19	0.11	C	15	0.14
2021 Buildout Conditions (Phase 1)	C	20	0.17	C	20	0.13	C	16	0.15
9 Ensign Lane at 19th Street									
Existing Conditions	B	12	0.12	B	14	0.16	B	15	0.16
2021 Background Conditions	B	14	0.17	C	15	0.18	C	17	0.21
2021 Buildout Conditions (Phase 1)	B	15	0.23	C	16	0.23	C	17	0.23
10 Ensign Lane at US-101B									
Existing Conditions	B	12	0.10	B	14	0.18	B	14	0.22
2021 Background Conditions	B	12	0.10	B	15	0.19	B	15	0.24
2021 Buildout Conditions (Phase 1)	B	12	0.10	B	15	0.19	C	15	0.24
11 Bugle Road at Ensign Lane									
2021 Background Conditions	B	11	0.06	B	11	<0.01	B	13	0.04
2021 Buildout Conditions (Phase 1)	B	11	0.10	B	12	0.04	B	13	0.06
12 Bugle Road at 19th Street									
2021 Background Conditions	B	10	0.12	A	10	0.09	A	10	0.09
2021 Buildout Conditions (Phase 1)	B	11	0.17	A	10	0.10	B	10	0.10

BOLDED text indicates intersection operation above jurisdictional standards.

Based on the analysis results shown in Table 7, all study intersections are currently and projected to operate acceptably per jurisdictional standards through year 2021 with completion of Phase 1.

1e

Proposed High School (Phase 2)

Table 8 details intersection capacity impacts associated with the development of Phase 2, where capacity results for future year 2026 conditions, with and without Phase 2, are shown.

Table 8: Capacity Impacts of High School (Phase 2)

	AM Peak Hour			MD Peak Hour			PM Peak Hour		
	LOS	Delay	v/c	LOS	Delay	v/c	LOS	Delay	v/c
1 Main Avenue at 9th Street									
2026 Background Conditions (Phase 1)	C	23	0.40	C	22	0.40	C	21	0.35
2026 Buildout Conditions (Phases 1 & 2)	C	23	0.44	C	22	0.42	C	21	0.36
2 Main Avenue at OR-104S									
2026 Background Conditions (Phase 1)	D	28	0.69	F	65	**0.98**	D	31	0.79
2026 Buildout Conditions (Phases 1 & 2)	E	37	0.79	F	85	**>1.00**	D	33	0.82
3 Ensign Lane at OR-104S									
2026 Background Conditions (Phase 1)	B	12	0.26	B	15	0.44	C	16	0.47
2026 Buildout Conditions (Phases 1 & 2)	B	13	0.31	C	17	0.53	C	17	0.50
4 Harbor Street at Marlin Avenue									
2026 Background Conditions (Phase 1)	C	22	0.35	E	40	0.67	E	37	0.67
2026 Buildout Conditions (Phases 1 & 2)	C	24	0.43	F	53	0.79	E	39	0.70
5 US-101 at Marlin Avenue									
2026 Background Conditions (Phase 1)	C	26	0.55	C	33	0.75	C	35	0.74
2026 Buildout Conditions (Phases 1 & 2)	C	29	0.59	C	35	0.77	D	36	0.75
6 US-101 at OR-104S									
2026 Background Conditions (Phase 1)	B	12	0.01	C	15	0.07	C	15	0.04
2026 Buildout Conditions (Phases 1 & 2)	B	12	0.01	C	15	0.07	C	15	0.04
7 US-101 at Ensign Lane									
2026 Background Conditions (Phase 1)	D	36	0.51	D	45	0.75	D	43	0.73
2026 Buildout Conditions (Phases 1 & 2)	D	39	0.60	D	46	0.77	D	44	0.75

BOLDED text indicates intersection operation above jurisdictional standards.

Table 8: Capacity Impacts of High School (Phase 2)

	AM Peak Hour			MD Peak Hour			PM Peak Hour		
	LOS	Delay	v/c	LOS	Delay	v/c	LOS	Delay	v/c
8 US-101 at Dolphin Avenue									
2026 Background Conditions (Phase 1)	C	21	0.20	C	22	0.16	C	17	0.17
2026 Buildout Conditions (Phases 1 & 2)	C	24	0.27	D	26	0.25	C	18	0.20
9 Ensign Lane at 19th Street									
2026 Background Conditions (Phase 1)	C	16	0.27	C	18	0.27	C	19	0.28
2026 Buildout Conditions (Phases 1 & 2)	C	20	0.39	C	22	0.41	C	21	0.32
10 Ensign Lane at US-101B									
2026 Background Conditions (Phase 1)	B	12	0.12	C	16	0.22	C	16	0.27
2026 Buildout Conditions (Phases 1 & 2)	B	12	0.12	C	16	0.22	C	16	0.27
11 Bugle Road at Ensign Lane									
2026 Background Conditions (Phase 1)	B	12	0.11	B	13	0.04	B	13	0.06
2026 Buildout Conditions (Phases 1 & 2)	B	12	0.17	B	14	0.13	B	14	0.09
12 Bugle Road at 19th Street									
2026 Background Conditions (Phase 1)	B	11	0.18	B	10	0.11	B	10	0.11
2026 Buildout Conditions (Phases 1 & 2)	B	14	0.31	B	11	0.15	B	11	0.11

BOLDED text indicates intersection operation above jurisdictional standards.

Based on the analysis results shown in Table 8, the intersection of Main Avenue at OR-104S is projected to operate with v/c ratios in excess of 0.90 (ODOT standards) under future year 2026 conditions, regardless of whether Phase 2 is completed. However, the intersection is also projected to operate in excess of ODOT standards by year 2036 regardless of whether the proposed schools are constructed. The City of Warrenton's TSP does not include any capacity-related improvements for this intersection; however, two potential mitigative measures which will improve intersection operation to acceptable levels include the following:

- Install a traffic signal at the intersection, as described within the *Warrant Analysis* section of this report. In addition, the westbound approach will need to be reconstructed with separate left-turn and right-turn lanes; or

1e

- Reconstruct the intersection as a roundabout, without any need to re-design the number of approach lanes or lane configurations.

Either mitigation will allow the intersection to operate within acceptable levels of capacity through year 2036 (refer to the *Mitigation Analysis* section of this report). The school district is willing to pay a proportionate share fee as part of its Phase 2 to mitigate future capacity issues at the intersection given the issue is expected to occur regardless of whether or not the proposed schools are constructed.

Proposed Elementary School plus Addition to Middle School (Phase 3)

Table 9 details intersection capacity impacts associated with the development of Phase 3, where capacity results for future year 2031 conditions, with and without Phase 3, are shown.

Table 9: Capacity Impacts of Elementary School plus Minor Middle School Addition (Phase 3)

	AM Peak Hour			MD Peak Hour			PM Peak Hour		
	LOS	Delay	v/c	LOS	Delay	v/c	LOS	Delay	v/c
1 Main Avenue at 9th Street									
2031 Background Conditions (Phases 1 & 2)	C	25	0.53	D	28	0.52	C	25	0.43
2031 Buildout Conditions (Phases 1, 2 & 3)	D	28	0.30	C	23	0.34	C	23	0.37
2 Main Avenue at OR-104S									
2031 Background Conditions (Phases 1 & 2)	F	61	**0.93**	F	>120	**>1.00**	F	51	**0.94**
2031 Buildout Conditions (Phases 1, 2 & 3)	F	>120	**>1.00**	F	>120	**>1.00**	F	75	**>1.00**
3 Ensign Lane at OR-104S									
2031 Background Conditions (Phases 1 & 2)	B	13	0.35	C	19	0.59	C	19	0.57
2031 Buildout Conditions (Phases 1, 2 & 3)	C	18	0.58	C	25	0.73	C	22	0.65
4 Harbor Street at Marlin Avenue									
2031 Background Conditions (Phases 1 & 2)	D	28	0.48	F	74	0.90	F	52	0.80
2031 Buildout Conditions (Phases 1, 2 & 3)	F	50	0.79	F	111	**>1.00**	F	65	0.88
5 US-101 at Marlin Avenue									
2031 Background Conditions (Phases 1 & 2)	C	30	0.62	D	37	0.82	D	38	0.79
2031 Buildout Conditions (Phases 1, 2 & 3)	D	37	0.71	D	41	**0.87**	D	40	0.82

BOLDED text indicates intersection operation above jurisdictional standards.

le

Table 9: Capacity Impacts of Elementary School plus Minor Middle School Addition (Phase 3)

	AM Peak Hour			MD Peak Hour			PM Peak Hour		
	LOS	Delay	v/c	LOS	Delay	v/c	LOS	Delay	v/c
6 US-101 at OR-104S									
2031 Background Conditions (Phases 1 & 2)	B	13	0.02	C	16	0.08	C	16	0.04
2031 Buildout Conditions (Phases 1, 2 & 3)	B	14	0.02	C	17	0.08	C	16	0.04
7 US-101 at Ensign Lane									
2031 Background Conditions (Phases 1 & 2)	D	40	0.64	D	48	0.83	D	46	0.81
2031 Buildout Conditions (Phases 1, 2 & 3)	D	46	0.81	D	53	**0.90**	D	48	0.84
8 US-101 at Dolphin Avenue									
2031 Background Conditions (Phases 1 & 2)	D	27	0.31	D	29	0.29	C	19	0.24
2031 Buildout Conditions (Phases 1, 2 & 3)	E	49	0.62	E	37	0.45	C	22	0.30
9 Ensign Lane at 19th Street									
2031 Background Conditions (Phases 1 & 2)	C	23	0.43	D	27	0.47	C	24	0.38
2031 Buildout Conditions (Phases 1, 2 & 3)	**F**	102	**>1.00**	**F**	53	0.77	D	31	0.51
10 Ensign Lane at US-101B									
2031 Background Conditions (Phases 1 & 2)	B	13	0.13	C	18	0.25	C	18	0.32
2031 Buildout Conditions (Phases 1, 2 & 3)	B	13	0.13	C	18	0.26	C	18	0.32
11 Bugle Road at Ensign Lane									
2031 Background Conditions (Phases 1 & 2)	B	13	0.18	B	14	0.14	B	14	0.10
2031 Buildout Conditions (Phases 1, 2 & 3)	C	17	0.41	C	17	0.29	C	15	0.17
12 Bugle Road at 19th Street									
2031 Background Conditions (Phases 1 & 2)	B	15	0.32	B	12	0.16	B	11	0.12
2031 Buildout Conditions (Phases 1, 2 & 3)	**F**	85	0.78	C	16	0.26	B	12	0.16

BOLDED text indicates intersection operation above jurisdictional standards.

Based on the analysis results shown in Table 9, the following five additional study intersections are projected to operate in excess of acceptable jurisdictional performance standards:

4. Harbor Street at Marlin Avenue: Operates with a v/c ratio in excess of 0.90 (ODOT standards) by year 2031 with buildout of Phase 3.
5. US-101 at Marlin Avenue: Operates with v/c ratios in excess of 0.85 (alternative ODOT standards) by year 2031 with buildout of Phase 3.

7. US-101 at Ensign Lane: Operates with v/c ratios in excess of 0.85 (alternative ODOT standards) by year 2031 with buildout of Phase 3.
9. Ensign Lane at 19th Street: Operates at LOS E or worse with v/c ratios in excess of 0.90 (Clatsop County standards) by year 2031 with buildout of Phase 3.
12. Bugle Road at 19th Street: Operate at LOS D or worse (City of Warrenton standards) by year 2031 with buildout of Phase 3.

The following sections detail potential mitigation at these five intersections that will improve intersection operations to acceptable levels through year 2036 (refer to the *Mitigation Analysis* section of this report).

Harbor Street at Marlin Avenue

The intersection of Harbor Street at Marlin Avenue is projected to operate with a v/c ratio in excess of 0.90 under year 2031 conditions with buildout of Phase 3. Per the City of Warrenton's TSP *Table 4: Possibly Funded Projects*, intersection capacity improvements are planned at the intersection and may include the installation of a traffic signal, the construction of additional turn lanes, and/or the reconstruction of the intersection as a roundabout (Project R16). Based on the project description, the following two potential mitigative measures would improve intersection operate to acceptable levels:

- Install a traffic signal at the intersection, as described within the *Warrant Analysis* section of this report; or

- Reconstruct the intersection as a roundabout. It is assumed that the eastbound right-turn slip lane may be removed if a roundabout were constructed, whereby vehicles associated with this turning movement were included when analyzing the intersection as a roundabout.

US-101 at Marlin Avenue

The intersection of US-101 at Marlin Avenue is projected to operate with a v/c ratio in excess of 0.85 under year 2031 conditions with buildout of Phase 3. Per the City of Warrenton's TSP *Table 4: Possibly Funded Projects* and *Table 5: Aspirational Project List*, intersection capacity improvements are planned at the intersection (Projects R6 and R19, respectively). Project R6 will include modifying signal timing and optimizing traffic operations (e.g. installing Flashing-Yellow-Arrow phasing, etc) while Project R19 will include installing intersection capacity improvements, such as right-turn lanes along Marlin Avenue. Implementation of both projects will improve intersection operation to acceptable levels for all analysis scenarios

US-101 at Ensign Lane

The intersection of US-101 at Ensign Lane is projected to operate with a v/c ratio in excess of 0.85 under year 2031 conditions with buildout of Phase 3; however, regardless of whether the proposed development is constructed, the intersection is projected to operate above acceptable levels of capacity by year 2036. The City of Warrenton's TSP does not include any capacity-related improvements for this intersection. In order to improve intersection operation to acceptable levels, one possible mitigative measure could include constructing an additional southbound left-turn lane; reconstructing the eastbound approach to include

1e

dedicated left-turn, through, and right-turn lanes; and widening the eastern intersection leg to accommodate two receiving lanes.

The school district is willing to pay a proportionate share fee as part of its Phase 3 projects to mitigate future capacity issues at the intersection given the issue is expected to occur regardless of whether or not the proposed schools are constructed.

Ensign Lane at 19th Street

The intersection of Ensign Lane at 19th Street is projected to operate at LOS F with a v/c ratio in excess of 0.90 under year 2031 conditions with buildout of Phase 3. The City of Warrenton's TSP does not include any capacity-related improvements for this intersection; however, based on how the intersection is currently built, it is assumed that installation of a traffic signal had been considered at the intersection when initially designed. As described in the *Warrant Analysis* section of this report, traffic signal warrants are not expected to be met under any of the analysis scenarios; however, all-way stop-control warrants are projected to be met at the intersection. Until such a time signal warrants are met it is recommended that the intersection be converted to all-way stop-control. Provided implementation of this potential mitigative measure occurs, the intersection is projected to operate acceptably for all analysis scenarios.

Bugle Road at 19th Street

The intersection of Bugle Road at 19th Street is projected to operate in excess of the City of Warrenton's LOS E standard under year 2031 conditions with buildout of Phase 3. While the intersection currently does not exist, for the purposes of this analysis it was assumed the intersection would operate under two-way stop-control for the eastbound and westbound approaches of 19th Street. However, with buildout of the proposed school relocation project and per the analyses described in the *Warrant Analysis* section of this report, all-way stop-control warrants are projected to be met at the intersection for the morning and mid-day peak hours. Provided implementation of this potential mitigative measure occurs, the intersection is projected to operate acceptably for all analysis scenarios.

Proposed Addition to High School (Phase 4)

Table 10 details intersection capacity impacts associated with the development of Phase 4, where capacity results for future year 2036 conditions, with and without Phase 4, as well as 2036 analysis scenarios without the school project are shown.

1e

Table 10: Capacity Impacts of Minor High School Addition (Phase 4)

	AM Peak Hour			MD Peak Hour			PM Peak Hour		
	LOS	Delay	v/c	LOS	Delay	v/c	LOS	Delay	v/c
1 Main Avenue at 9th Street									
2036 Background Conditions (Phases 1, 2 & 3)	D	32	0.35	D	26	0.43	D	27	0.45
2036 Buildout Conditions (Phases 1, 2, 3, & 4)	D	34	0.37	D	26	0.45	D	28	0.46
2036 Background Conditions (No Build)	E	48	0.78	E	43	0.70	D	31	0.53
2 Main Avenue at OR-104S									
2036 Background Conditions (Phases 1, 2 & 3)	F	>120	**>1.00**	F	>120	**>1.00**	F	>120	**>1.00**
2036 Buildout Conditions (Phases 1, 2, 3, & 4)	F	>120	**>1.00**	F	>120	**>1.00**	F	>120	**>1.00**
2036 Background Conditions (No Build)	E	43	0.82	F	>120	**>1.00**	F	71	**>1.00**
3 Ensign Lane at OR-104S									
2036 Background Conditions (Phases 1, 2 & 3)	C	20	0.62	D	32	0.81	D	28	0.74
2036 Buildout Conditions (Phases 1, 2, 3, & 4)	C	21	0.65	D	35	0.84	D	29	0.75
2036 Background Conditions (No Build)	B	13	0.27	C	18	0.53	C	21	0.61
4 Harbor Street at Marlin Avenue									
2036 Background Conditions (Phases 1, 2 & 3)	F	65	0.86	F	>120	**>1.00**	F	93	**0.99**
2036 Buildout Conditions (Phases 1, 2, 3, & 4)	F	69	**0.89**	F	>120	**>1.00**	F	96	**>1.00**
2036 Background Conditions (No Build)	C	24	0.36	F	61	0.81	F	62	0.85
5 US-101 at Marlin Avenue									
2036 Background Conditions (Phases 1, 2 & 3)	D	38	0.74	D	45	**0.91**	D	44	**0.86**
2036 Buildout Conditions (Phases 1, 2, 3, & 4)	D	39	0.75	D	46	**0.91**	D	44	**0.86**
2036 Background Conditions (No Build)	C	26	0.60	D	36	0.81	D	40	0.83
6 US-101 at OR-104S									
2036 Background Conditions (Phases 1, 2 & 3)	B	14	0.02	C	17	0.10	C	17	0.05
2036 Buildout Conditions (Phases 1, 2, 3, & 4)	B	14	0.02	C	17	0.10	C	17	0.05
2036 Background Conditions (No Build)	B	12	0.02	C	17	0.09	C	16	0.05

BOLDED text indicates intersection operation above jurisdictional standards.

Table 10: Capacity Impacts of Minor High School Addition (Phase 4)

	AM Peak Hour			MD Peak Hour			PM Peak Hour		
	LOS	Delay	v/c	LOS	Delay	v/c	LOS	Delay	v/c
7 US-101 at Ensign Lane									
2036 Background Conditions (Phases 1, 2 & 3)	D	48	0.85	E	59	**0.96**	D	52	**0.90**
2036 Buildout Conditions (Phases 1, 2, 3, & 4)	D	49	0.87	E	60	**0.97**	D	52	**0.91**
2036 Background Conditions (No Build)	D	37	0.55	D	50	**0.87**	D	48	0.85
8 US-101 at Dolphin Avenue									
2036 Background Conditions (Phases 1, 2 & 3)	F	61	0.69	E	43	0.51	C	24	0.34
2036 Buildout Conditions (Phases 1, 2, 3, & 4)	F	67	0.73	E	46	0.53	C	24	0.34
2036 Background Conditions (No Build)	C	23	0.19	C	24	0.18	C	18	0.21
9 Ensign Lane at 19th Street									
2036 Background Conditions (Phases 1, 2 & 3)	**F**	>120	**>1.00**	**F**	80	**0.90**	E	40	0.61
2036 Buildout Conditions (Phases 1, 2, 3, & 4)	**F**	>120	**>1.00**	**F**	96	**0.96**	E	42	0.62
2036 Background Conditions (No Build)	C	17	0.26	C	21	0.31	C	25	0.36
10 Ensign Lane at US-101B									
2036 Background Conditions (Phases 1, 2 & 3)	B	14	0.15	C	20	0.30	C	20	0.36
2036 Buildout Conditions (Phases 1, 2, 3, & 4)	B	14	0.15	C	20	0.30	C	20	0.36
2036 Background Conditions (No Build)	B	14	0.14	C	19	0.29	C	20	0.36
11 Bugle Road at Ensign Lane									
2036 Background Conditions (Phases 1, 2 & 3)	C	18	0.44	C	18	0.31	C	16	0.19
2036 Buildout Conditions (Phases 1, 2, 3, & 4)	C	18	0.46	C	18	0.34	C	17	0.20
2036 Background Conditions (No Build)	B	12	0.07	B	12	<0.01	B	15	0.05
12 Bugle Road at 19th Street									
2036 Background Conditions (Phases 1, 2 & 3)	**F**	98	0.84	C	16	0.28	B	12	0.17
2036 Buildout Conditions (Phases 1, 2, 3, & 4)	**F**	>120	>1.00	C	17	0.29	B	12	0.17
2036 Background Conditions (No Build)	B	10	0.16	A	10	0.12	B	10	0.12

BOLDED text indicates intersection operation above jurisdictional standards.

Based on the analysis results shown in Table 10, all study intersections, excluding those previously determined as requiring mitigation under Phase 2 and Phase 3, are projected to operate acceptably per jurisdictional standards through year 2036 with completion of Phase 4.

1e

Mitigation Analysis

As described previously, there are six study intersections that are projected to exceed acceptable levels of operation per their respective jurisdictional standards, even with the adoption of the City of Warrenton's alternative mobility standards along US-101. However, with implementation of suggested mitigation described in the preceding sections, all study intersections are expected to operate acceptably through year 2036 with full completion of the school relocation project.

Table 11 shows the v/c, delay, and LOS results for these intersections under future year 2036 conditions with and without suggested mitigation in place.

Table 11: Mitigated Intersection Capacity Analysis Summary

	AM Peak Hour			MD Peak Hour			PM Peak Hour		
	LOS	Delay	v/c	LOS	Delay	v/c	LOS	Delay	v/c
2 Main Avenue at OR-104S									
2036 Buildout Conditions (Phases 1, 2, 3, & 4)	F	>120	**>1.00**	F	>120	**>1.00**	F	>120	**>1.00**
2036 Mitigated Conditions (w/ Signal)	D	36	0.88	C	24	0.76	B	19	0.68
2036 Mitigated Conditions (w/ Roundabout)	B	12	0.69	B	10	0.69	A	8	0.56
4 Harbor Street at Marlin Avenue									
2036 Buildout Conditions (Phases 1, 2, 3, & 4)	F	69	**0.89**	F	>120	**>1.00**	F	96	**>1.00**
2036 Mitigated Conditions (w/ Signal)	B	11	0.67	B	12	0.68	B	10	0.63
2036 Mitigated Conditions (w/ Roundabout)	B	13	0.77	B	10	0.60	A	9	0.52
5 US-101 at Marlin Avenue									
2036 Buildout Conditions (Phases 1, 2, 3, & 4)	D	39	0.75	D	46	**0.91**	D	44	**0.86**
2036 Mitigated Conditions	C	23	0.56	C	30	0.79	C	29	0.74
7 US-101 at Ensign Lane									
2036 Buildout Conditions (Phases 1, 2, 3, & 4)	D	49	0.87	E	60	**0.97**	D	52	**0.91**
2036 Mitigated Conditions	D	41	0.70	D	46	0.81	D	43	0.74
9 Ensign Lane at 19th Street									
2036 Buildout Conditions (Phases 1, 2, 3, & 4)	**F**	>120	**>1.00**	**F**	96	**0.96**	E	42	0.62
2036 Mitigated Conditions	D	31	-	D	26	-	C	19	-
12 Bugle Road at 19th Street									
2036 Buildout Conditions (Phases 1, 2, 3, & 4)	**F**	>120	>1.00	C	17	0.29	B	12	0.17
2036 Mitigated Conditions	C	22	-	A	10	-	A	8	-

BOLDED text indicates intersection operation above jurisdictional standards.

1e

Parking Analysis

Parking Requirements – City of Warrenton Municipal Code

Per Table 16.128.030.A in the City of Warrenton's Municipal Code, elementary and junior high schools are required to provide 1.5 spaces per classroom or 1 space per 4 seats (8 feet of bench) in the auditorium or assembly room, whichever is greater. High schools under the code are required to provide 1.5 spaces per classroom plus whatever is greater between 1 space per 10 students the school is designed to accommodate or 1 space per 4 seats (8 feet of bench) in the auditorium.

Based on the City of Warrenton's requirements and the projected student capacity of the school campus and estimated seating in the auditoriums, the finished school campus will require 427 parking spaces.

Per Section 16.244.040.E.1, the City of Warrenton's Planning Commission may adjust minimum parking requirements for institutional development based on a parking impact study provided by the applicant. Accordingly, further analysis of parking demand was conducted using data provided by the Institute of Transportation Engineers.

Parking Requirements – ITE Parking Rates

To better estimate the parking demand that will be generated by the proposed co-located school facilities, the average and 85th percentile peak parking demand rates from *Parking Generation Manual* [4] were referenced. These parking rates were derived by measuring the peak parking demand that occurs at any point of the day for multiple school sites of each grade level. The 85th percentile rate accounts for the observed variation in sites by ensuring that 85 percent of comparable schools experience no greater peak parking demand than the reported rate. Accordingly, the 85th percentile parking rate is conservative and represents demands that are unlikely to occur at typical suburban schools.

Since there is concern regarding parking demand during special events at the campus, it was assumed that using the 85th percentile rate would be sufficient to ensure the parking demand of the school campus will be accommodated by available parking on or near the site. However, it should be noted that using the 85th percentile parking rate to determine the required parking for all three schools would likely be highly conservative since the ITE data is based on studies of individual schools and does not account for efficiencies that may result from the shared parking facilities

For middle schools/junior high schools, the ITE manual reported the 85th percentile parking demand to be 0.12 vehicles per student and the average parking demand to be 0.09 vehicles per student. For high schools, the manual reported the 85th percentile parking demand to be 0.32 vehicles per student and the average parking demand to be 0.26 vehicles per student. For elementary schools, the 85th percentile parking demand

[4] Institute of Transportation Engineers (ITE), *Parking Generation Manual, 5th Edition*, 2019.

was reported to be 0.20 vehicles per student and the average parking demand was reported to be 0.13 vehicles per student.

Based on the parking demand rates reported in the ITE *Parking Generation Manual* and the projected student capacity, the middle school (Phase 1) will have a peak parking demand between 24 and 32 parking spaces. With the construction of the High School in Phase 2, the campus is projected to have an additional peak parking demand of 131 to 161 parking spaces. After the completion of Phase 3, the new Elementary School and addition to the Middle School will increase the parking demand by between 117 and 177 parking spaces. The parking demand for the consolidated campus after the completion of Phase 4 is projected to be between 303 and 408 total parking spaces.

It should be noted that the parking demand of elementary schools is more so related to parent pick-up/drop-off of students during the school's morning and afternoon bell times rather than consistent parking throughout the day. Accordingly, actual campus parking demand throughout the remainder of a school day is expected to be significantly less than that described above. If necessary, overflow on-street parking along the south side of Warrior Way is available to accommodate large influxes of parking demand during the morning and afternoon school bell times.

As stated previously, the higher end of the parking demand range (408 parking spaces) is expected to be highly conservative and would reflect conditions when all three schools are operating at capacity and simultaneously experience the 85^{th} percentile parking demand. This is an unlikely scenario representing a reasonable "worst case" parking demand for the co-located school facilities. In reality, with the three schools on the same campus and sharing parking facilities, the parking demand is expected to be substantially lower as a result of efficiencies arising due to staff or volunteers who work at more than one school, or parents who have children attending different schools at the same time.

Table 12 on the following page summarizes the parking demands based on the City of Warrenton's parking requirements as well as the ITE average and 85^{th} percentile parking rates.

1e

Table 12: Parking Analysis Summary

	Classrooms	Student Capacity	Gym Seating (ft)	City Code Total	ITE Parking Generation	
					Average	85th Percentile
Phase 1						
Middle School	11	264	750	94	24	32
Phase 2						
High School	21	504	1,800	257	131	161
Phase 3						
Elementary School	34	816	544	68	106	163
Middle School Addition	5	120	0	0	11	14
Phase 4						
High School Addition	5	120	0	8	31	38
Campus Total				**427**	**303**	**408**

1e

Conclusions

No significant trends or crash patterns were identified at any of the study intersections that were indicative of safety concerns. In addition, none of the study intersections exhibit crash rates near or above the 1.00 CMEV threshold nor do any of the ODOT study intersections exhibit a crash rate exceeding ODOT's 90th percentile rate.

There are six study intersections that are either currently or projected to operate in excess of acceptable jurisdictional performance standards. These intersections and potential mitigation are included in the following table:

No.	Intersection Name	Phase Mitigation is Required	City TSP Project #	Potential Mitigation
2	Main Avenue at OR-104S	Phase 2 (Year 2021 without High School)	N/A	Install a traffic signal with dedicated WB left-turn and right-turn lanes OR reconstruct the intersection as a roundabout.
4	Harbor Street at Marlin Avenue	Phase 3 (Year 2026 with Elementary School)	R16	Install a traffic signal OR reconstruct the intersection as a roundabout.
5	US-101 at Marlin Avenue	Phase 3 (Year 2026 with Elementary School)	R6 and R19	Modify signal timing & optimize traffic operations AND install dedicated NB & SB right-turn lanes.
7	US-101 at Ensign Lane	Phase 3 (Year 2026 with Elementary School)	N/A	Install an additional SB left-turn lane; reconstruct the EB approach with dedicated left-turn, through, and right-turn lanes; widen eastern intersection leg to accommodate two receiving lanes.
9	Ensign Lane at 19th Street	Phase 3 (Year 2026 with Elementary School)	N/A	Convert the intersection to all-way stop-control.
12	Bugle Road at Ensign Lane (Future Intersection)	Phase 3 (Year 2026 with Elementary School)	N/A	Install all-way stop-controls when Bugle Road is constructed.

1e

All other study intersections are currently operating acceptably per City of Warrenton, Clatsop County, and ODOT standards and are projected to continue operating acceptably through the 2036 buildout year of the entire project. No operational mitigation is necessary or recommended at these intersections.

With full buildout of the proposed school project, the proposed development should provide enough parking spaces to accommodate between 303 to 408 vehicles, based on the ITE *Parking Generation Manual.* Per the City of Warrenton's Municipal Code, the finished campus will require 427 parking; however, this standard as well as the higher range of vehicles per the ITE manual may not take into consideration efficiencies associated with a shared campus that result with staff/volunteers who work at more than one school or parents who have children attending different schools at the same time. As a result, it is expected that parking generation will be substantially lower than what is required per City code. If necessary, overflow on-street parking along the south side of Warrior Way is available to accommodate large influxes of parking demand during the morning and afternoon school bell times. Refer to the *Parking Analysis* section on page 36.

All study intersections are projected to operate acceptably under future year 2021 conditions with buildout and occupancy of the proposed Middle School. Therefore, no mitigation is necessary or recommended as part of Phase 1 of the proposed project.

Appendix F:

Architectual Design Standards

Warrenton-Hammond School District
Scott Rose, AIA (2020)

WARRENTON-HAMMOND SCHOOL DISTRICT
MASTER CAMPUS

ARCHITECTURAL AND SITE DESIGN STANDARDS

A. Orientation of Buildings (as much as practical).
   1. Locate allowing for code required setbacks on all sides.
   2. Locate with future additions in mind if student enrollment growth dictates.
   3. Orient entrances inward (toward the center of site) for strong and safe visibility between entrances of all campus buildings.
   4. Locate parking and primary pedestrian ways between buildings to centralize noise, activity, and sightlines.
   5. While not desired as a long-term solution, identify potential temporary portable structure locations when enrollment outpaces capital funding availability. Locate off future addition locations and assume double-wide unit to minimize overall footprint.
   6. Locate middle school and high school buildings in close proximity to leverage the sharing of common use areas.

B. Natural Features (as much as practical).
   1. Retain natural elements at site perimeter to provide consistent drainage to off-site areas and to create natural sound and visual barriers to adjacent properties. These may include trees and natural vegetation as well as natural site grading.
   2. Water features shall be limited to existing wetlands around site perimeter and minimize natural drainage features to the interior of the site that would adversely impact pedestrian and vehicular circulation.
   3. Natural elements on the site interior (if any) shall allow for safe and secure sightlines and not encourage wildlife to migrate into the building entries or plaza areas. Ideally, manicured landscape shall be provided at the site interior where better control can be established.
   4. Opportunities for guided interaction between students and pre-existing natural elements can be explored and implemented when budgets allow. Phasing in these opportunities over the long term is acceptable.
   5. Re-creating natural elements with open storm treatment is encouraged. Be mindful of long-term maintenance costs.

C. Building Requirements (as much as practical).
   1. Primary Entries: Clearly defined through the sue of vertical and/or horizontal building elements and articulation of the façade. Canopies or similar overhangs shall be present at this location to create visual cuing.
   2. Secondary Entries: These shall be under-stated compared to the primary entry but shall also have overhangs or similar architectural devices to guard against inclement weather.
   3. Roof Designs:
      a. Low slope roofs shall be employed over programmatically large interior volumes (i.e. gymnasiums).

b. Daylight to interior spaces is allowed through use of clerestory elements, thus impacting roof slope and visual articulation from the ground level.
c. Strategic overhangs to encourage outdoor learning opportunities are allowed.
d. The visual aesthetic of the roofing material, shape, and volume shall be considered and evaluated with the hole of the façade design, so it appears coordinated.
e. More than one roof form is encouraged, but simplicity of drainage shall be a primary driver.

4. Materials:
   a. Maintenance, durability, and a regional vernacular shall all be considered in material selection:
   b. Pre-finished metal is preferred as the primary siding choice but should be varied in profile and/or color.
   c. Durable materials shall be selected at lower, accessible building exteriors.
   d. The use of masonry is allowed but shall be minimized as it is not a typical regional material.
   e. The use of wood shall be limited (if used at all) to areas fully protected from weather such as the underside of canopies and overhangs but set back far enough to not be adversely impacted by wind-driven weather.
   f. Cementitious or composite materials are allowed but shall not be greater than the percentage of the exterior that is metal.
   g. Field painting of materials is allowed on a limited basis and preferred out of weather areas.
5. Architectural Features: Elements that are integral to the structure (i.e. recesses, projections, etc.) or employed as part of an architectural vernacular (i.e. arcade, balcony, etc.) are encouraged in so much as they provide visual appeal and recognition as a place of education.
6. Building Colors: In general, selection for a neutral or earthen palette are preferred. Colored accent features are allowed for the purposes of breaking up a large mass or drawing attention to a feature (i.e. primary entrance, activity area, etc.).
7. Mechanical Equipment, Outdoor Storage and Service Areas: These shall be located away from the primary entrance drive and shall be screened. Materiality for screenings and enclosures shall be compatible with the primary building materials.

D. <u>Community Amenities (as much as practical)</u>.

1. Buildings shall incorporate elements typical for an educational environment which by their nature may also be used by the community after hours (i.e. gymnasium, meeting spaces, etc.). Designs shall employ safety and security measures to control, yet encourage, usage of interior elements and spaces.
2. Sites shall incorporate elements to keep areas safe and secure during normal school hours yet allow for controlled usage after hours. Areas may include parking, playgrounds, fields, and similar recreational spaces. Control elements may include fencing and gates, locking elements, lighting, and signage.

E. <u>Outdoor Lighting (as much as practical)</u>.

1. In general, site lighting shall be shielded and directed down into the site and shall not significantly shine or glare onto adjacent property or streets. Light poles, light fixtures and flag poles shall not exceed 35 feet in height (except field lighting that shall not exceed 50 feet).
2. Sports Field Lighting

    a) Illumination Criteria:
        i) Minimum average target illuminance level for each lighted area for each sports venue and for the indicated class of play according to IESNA RP-6.
    b) CV and maximum-to-minimum uniformity ratios for each lighted area equal to or less than those listed in IESNA RP-6 for the indicated class of play.
    c) UG levels within each lighted area equal to or less than those listed in IESNA RP-6 for the indicated speed of sport.
    d) Design Criteria:
        i) Minimum Average Target Illumination: Per IESNA RP-6-15 Sports and Recreation Area Lighting.
        ii) CV: 0.21 or less.
        iii) Maximum-to-Minimum Uniformity Ratio: 2.0:1.
        iv) UG Level: 1.5 or less.
        v) E. Illumination Calculations: Computer-analyzed point method complying with IESNA RP-6 to optimize selection, location, and aiming of luminaires.
    e) Grid Pattern Dimensions: For playing areas of each sport and areas of concern for spill-light control, correlate and reference calculated parameters to the grid areas. Each grid point represents the center of the grid area defined by the length and width of the grid spacing.
    f) Spill-Light Control: Spill light must follow the City of Warrenton Oregon and 2018 International Dark-Sky Association (IDA) requirements.
        i) Calculate the horizontal and vertical illuminance due to spill light for points spaced 30 feet (m) apart in areas indicated on Drawings as "spill-light critical," to ensure that design meets the criteria in 2018 International Dark-Sky Association IDA-Criteria for Community Friendly Outdoor Lighting.
    g) Automatic Controls:
        i) Provide Automatic control system via smartphone apps, or direct remote communication to the company facility responsible for handling the lighting controls, to enforce shut-off at locally established curfew time.
        ii) On-site manual and/or remote-control system shall also be provided to allow for the lights to be turned on or off at will (before curfew) to assure that only active sports fields are lighted.
        iii) Provide readily accessible controls to implement uniform and variable adaptive illumination levels for different task lighting needs on field, e.g. IES class of play, competition athletics, band practice, striping, mowing, sports practice, etc.
        iv) Adaptive dimming shall be possible across the range of 25% to 100% of full illumination.

F. <u>Parking Areas (as much as practical)</u>.

1. Parking shall be located with safe pedestrian ways to the main building entries or event fields comprised of walks, hatched zones, and/or crosswalks and shall be designed to accommodate a balance of standard-sized and "truck" sized vehicles, minimizing compact areas except as is required by code. Configure parking to minimize pedestrians crossing traffic.
2. Bus parking shall be separated from visitor and parent parking and drop-off / pick-up traffic to minimize congestion and leverage safe pedestrian traffic patterns.

G. Pathways/Walkways from Parking Area to Building Entrance(s) (as much as practical).

1. Internal pedestrian walkways shall be developed for persons who need access to the building(s) or event fields from the parking areas.
2. These walkways shall have a minimum width of six feet with no car overhang or other obstruction.
3. The walkways must also be designed for disabled access according to the local municipal code.

H. Landscaping. Landscaping shall meet the requirements in the City Code Chapter 16.124 (Landscaping, Street Trees, Fences and Walls).

END OF STANDARDS

Appendix G:

Stormwater Report

KPFF (2020)

Stormwater Management Report for Design Review

Warrenton-Hammond School Campus

Owner: Warrenton-Hammond School District
Prepared for: DLR
Prepared by: Molly Bluhm
Project Engineer: Nalini Chandran, PE

January 2020 | KPFF Project #1900183

kpff

KPFF'S COMMITMENT TO SUSTAINABILITY

As a member of the US Green Building Council, a sustaining member of Oregon Natural Step, and a member of the Sustainable Products Purchasers Coalition, KPFF is committed to the practice of sustainable design and the use of sustainable materials in our work.

When hardcopy reports are provided by KPFF, they are prepared using recycled and recyclable materials, reflecting KPFF's commitment to using sustainable practices and methods in all of our products.

Table of Contents

Tables

Appendices

Appendix A

Vicinity Map

Appendix B

Geotechnical Report

Appendix C

Site Plans and Basin Maps

Appendix D

Water Quality Calculations and Basin Hydrographs

Appendix E

Operations & Maintenance Information

Project Overview

Purpose of this report

This report describes the stormwater management design strategies for the proposed development. This report was developed using the City of Warrenton 2013 Engineering Specifications and Design Criteria, applicable ODOT standards, the Standard Local Operating Procedures for Endangered Species (SLOPES) V, and requirements outlined therein. The purpose of the proposed stormwater management facilities is to protect the overall health of the watershed.

Project Description

The new school campus consists of approximately 59.1 acres in Warrenton, Oregon. The project site is bounded by Dolphin Road to the west, future Warrior Way to the north and the Roosevelt Subdivision to the east. See Appendix A for the project vicinity map. Proposed development includes a new high school, middle school and elementary school campus. Site work includes the construction of a new public road, surface parking, a softball and baseball complex, a synthetic turf football field and additional fields and landscape areas. The project will be split into multiple phases and this report addresses the full master plan build out of the site. The first phase will consist of the middle school and construction of Warrior Way from Dolphin Avenue to the terminus of Bugle Road to the east.

Existing Conditions

Topography of the existing site is generally rolling grassland with downward slopes between 0% and 7% with a ridge running east to west. A majority of the site drains to the south of the property, while the remainder of the site drains north. Both existing basins drain into a wetland tributary of the Skipanon River estuary. The site is currently undeveloped. See Appendix C for an existing basin map.

A geotechnical report for the middle school location was conducted by GeoDesign, Inc., dated October 28, 2019 (see Appendix B). The geotechnical investigations from two test pits and 10 borings found that the subsurface conditions consist of predominately clay soil overlying sedimentary bedrock and concluded that on-site infiltration will not be feasible.

Proposed Conditions

Onsite Proposed Conditions

The impervious area of the proposed development is comprised of buildings, roads, parking lots, sidewalks, covered play areas, and synthetic turf surfaces. Runoff from these surfaces will be collected by catch basins and roof drains and conveyed via the underground piped storm system to water quality facilities. Interim open conveyance channels will be installed in Phase I till the underground pipes are installed in future phases along the southern portion of the bus parking lot. The development will increase the impervious area to approximately 40% of the entire site. A map showing the proposed storm network, tributary impervious basins, and stormwater facility locations can be found in Appendix C.

The proposed topography of the site is gently sloped, generally from the northeast corner of the site to the south and from the northwest corner of the site to the south. There is approximately 15 feet of drop across the site. In addition, the phased design and steep slopes by the existing wetlands prevent the possibility of one large stormwater facility to treat the site's impervious areas. This results in the necessity to have several smaller stormwater facilities throughout the site. In order to mimic the natural drainage patterns, all proposed on-site stormwater facilities will discharge to the south, except for Warrior Way, the elementary school parking lot, and a portion of the middle school building discharging to the north. This portion of the existing site already discharges north and the peak flowrate pre and post developed for the 10 year storm for this area is included in Table 1.

Table 1: 10-year Storm Flow Discharge to North Wetland

Description	Flow rate (cfs)
Existing Conditions	5.77
Post-Development	3.78

To abide by the requirements outlined in SLOPES V, the 2016 City of Portland Stormwater Management Manual was used for the design of vegetated water quality facilities. There are four types of facilities used for water quality on the site:

- Grassy Swale (page 2-94 in 2016 City of Portland BES Stormwater Management Manual)
- Stormwater Treatment Basin (page 2-85 in 2016 City of Portland BES Stormwater Management Manual)
- Green Street Style Planters (page 2-79 in 2016 City of Portland BES Stormwater Management Manual)
- Bioswales (page 2-64 in 2016 City of Portland BES Stormwater Management Manual).

See Appendix C, Exhibit 2 for water quality facility typical cross sections. The sections are provided for reference only and more detailed sections will be provided with the construction documents for each facility.

All stormwater facilities have been sized to treat the water quality storm event and convey the 100-year design storm. The following table summarizes the dimensions of the site best management practices (BMPs). More detailed calculations can be found in Appendix D.

Table 2 Campus BMP Dimensions

BMP #	Tributary Impervious Area (sf)	WQ Flow (cfs)	Length (ft)	Width (ft)	Slope (%)	Residence Time (minute)
Rain Garden-02	399,470	3.13	240	50	n/a	n/a
Rain Garden-03	458,860	3.613	250	56	n/a	n/a
Rain Garden-04	40,560	0.315	100	12	n/a	n/a
Bioswale-01	13,050	0.099	80	6	n/a	n/a
Bioswale-02	8,670	0.068	162.5	2	n/a	n/a
Grassy Swale-01	94,890	0.752	100	12	0.5	9
FTP-02	9,130	0.072	53	9.5	n/a	n/a
FTP-03	13,170	0.103	53	9.5	n/a	n/a

- BMP "Rain Garden-2" will treat impervious runoff collected from catch basins in the middle school parking lots and parking lots to the west and south of the elementary school. A majority of the middle school roof drains will tie into the storm system draining to Rain Garden-2. This BMP will also treat impervious runoff from the softball and baseball facility as well as a portion of the campus roadway loop. Runoff will be infiltrated by a soil capable of infiltrating at least 2-inches per hour. It will then enter a perforated pipe encased in drainage rock and exit the facility. The portion of Rain Garden-2 constructed in Phase I will be to accommodate the Phase I improvements only. The rain garden will be extended in future phases to accommodate the full build-out of the site.

- BMP "Rain Garden-3" will treat impervious runoff collected from the high school roof drains and catch basins in the high school parking lots, as well as the synthetic turf football stadium and a portion of the campus roadway loop. Runoff will be infiltrated by a soil capable of infiltrating at least 2-inches per hour. It will then enter a perforated pipe encased in drainage rock and exit the facility.

- BMP "Rain Garden-4" will treat impervious runoff collected from the parking lot north of the elementary school and the elementary school plaza. Runoff will be infiltrated by a soil capable of infiltrating at least 2-inches per hour. It will then enter a perforated pipe encased in drainage rock and exit the facility.

- BMP "Bioswale-1" will treat impervious runoff collected from catch basins in the middle school bus driveway and parking south of the covered play. Runoff will be infiltrated by a soil capable of infiltrating at least 2-inches per hour. It will then enter a perforated pipe encased in drainage rock and exit the facility.

- BMP "Bioswale-2" will treat impervious runoff collected from a series of roof drains along the northern portion of the middle school roof. Runoff will be infiltrated by a soil capable of infiltrating at least 2-inches per hour. It will then enter a perforated pipe encased in drainage rock and exit the facility.

- BMP "Grassy Swale-1" will treat impervious runoff collected from elementary school roof drains and two catch basins. All runoff will be conveyed directly to the beginning of the BMP via piped storm system. This BMP flows approximately north to south.

- BMP "FTP-02" will treat impervious runoff from roadway surfaces along the western school access road. Runoff will be infiltrated by a soil capable of infiltrating at least 2-inches per hour. It will then enter a perforated pipe encased in drainage rock and exit the facility.

- BMP "FTP-03" will treat impervious runoff from roadway surfaces along the western school access road. Runoff will be infiltrated by a soil capable of infiltrating at least 2-inches per hour. It will then enter a perforated pipe encased in drainage rock and exit the facility.

Riprap is to be placed at the flow entry and exit points of all facilities. For detailed flow routes, chronology, distances of conveyance network and distances to receiving waters see Appendix C.

Offsite Proposed Conditions

A new road will be constructed as part of Phase 1 of the school campus buildout. Warrior Way will run to the north of the school campus and will connect to Dolphin Avenue and the future Roosevelt Subdivision. Impervious surface runoff will drain to one of two public stormwater facilities. The stormwater facilities will also abide by the requirements outlined in SLOPES V and the 2016 City of Portland Stormwater Management Manual. The two types of facilities used for water quality for the public road include:

- Stormwater Treatment Basin (page 2-85 in 2016 City of Portland BES Stormwater Management Manual)
- Green Street Style Planters (page 2-79 in 2016 City of Portland BES Stormwater Management Manual)

The public stormwater facilities have been sized to treat the water quality storm event and convey the 100-year design storm. The following table summarizes the dimensions of the offsite best management practices (BMPs). More detailed calculations can be found in Appendix D.

Table 3: Warrior Way BMP Dimensions

BMP #	Tributary Impervious Area (sf)	WQ Flow (cfs)	Length (ft)	Width (ft)
FTP-01	5220	0.041	36	5.5
Rain Garden-01	73,570	0.556	170	29.5

- BMP "FTP-01" will treat impervious runoff from a small western section of Warrior Way. Runoff will be infiltrated by a soil capable of infiltrating at least 2-inches per hour. It will then enter a perforated pipe encased in drainage rock and exit the facility.

- BMP "Rain Garden-01" will treat impervious runoff from the remainder of Warrior Way. Runoff will be infiltrated by a soil capable of infiltrating at least 2-inches per hour. It will then enter a perforated pipe encased in drainage rock and exit the facility.

Riprap is to be placed at the flow entry and exit points of all facilities. For detailed flow routes, chronology, distances of conveyance network and distances to receiving waters (see Appendix B).

Detention

The site discharges stormwater into the wetland tributary of the Skipanon River estuary, which drains into the Columbia River and the Pacific Ocean. Treated stormwater generated by this project is proposed to discharge offsite without detention. Downstream conditions are considered to have adequate capacity to accept undetained flows from the project site, given the presence of wetlands in downstream receiving streams and discharge into tidally controlled waters. Detention facilities for onsite post-development flows would also have a much smaller residence time than the wetlands immediately downstream.

Water Quality

The water quality design storm per ODOT requirements is a 1.55-inch 24-hour type 1A storm. Per ODOT, a factor must be applied to the calculation of each water quality design storm based on a climate zone breakdown. The City of Warrenton falls in Climate Zone 1, which applies a factor of 50% to the 2-year, 24-hour storm. The ODOT design for the area in which this site resides is a 3.1-inch 24-hour type 1A storm. Applying the climate zone factor yields a 1.55-inch 24-hour type 1A water quality storm.

A five minute time of concentration was used for the water quality design storm, generating peak flows used to size water quality facilities. Because the grassy swale BMP facilities are sized on flow alone, the volume of stormwater runoff to be managed and treated is not considered for the water quality design storm. The stormwater treatment basin BMPs, rain garden BMPs and the bioswale BMP treats water quality design storm volumes seen in Table 3 below. Detailed peak flow calculation of tributary impervious areas for each BMP can be found in Appendix C.

Table 4: BMP Water Quality Design Storm Volumes

BMP #	Water Quality Design Storm Volume (ft^3)
Rain Garden-1	900
Rain Garden-2	11,760
Rain Garden-3	13,440
Rain Garden-4	1,128
Bioswale-1	242
Bioswale-2	163
FTP-1	98
FTP-2	120
FTP-3	250

Conveyance

The onsite conveyance system piping and stormwater facilities have been sized to convey the peak runoff from the 100-year design storm. Conveyance calculations will be provided with the building permit submission.

Operations and Maintenance

Site O&M Responsible Party

The facility is to be maintained by the Warrenton-Hammond School District. The preparer has worked closely with the owner to design a system that can be easily maintained by maintenance staff.

Contact Information for Legally Responsible Party for Inspecting and Maintaining Stormwater Facilities:
Warrenton-Hammond School District
Attn: Mike Moha, Business Manager
moham@warrentonk12.org
503-681-2281

I. Inspection Guidelines and Visual Indicators of Diminished Performance

- The water quality systems shall be operated and maintained in accordance with the City of Portland standards (see Appendix E). The vegetated facilities shall be inspected quarterly for the first two years from the date of installation, two times per year thereafter and within 48 hours of a major storm event (more than 1 inch of rain over a 24-hour period).
- Sediment accumulation over 4-inches shall be removed and if the vegetated facilities do not drain within 48 hours, the facilities should be tilled and replanted.
- An inspection log and checklist is provided in Appendix E.

II. Maintenance Activities

- Specific procedures for each facility type, as well as a contingency and repair plan can be found in Appendix E.
- There are no non-standard, likely deficiencies expected for the BMPs of this site.

Engineering Conclusions

Given the lack of infiltrating soils and wetlands on site, pollutant removal is achieved to the maximum extent feasible by using vegetated BMPs which mimic natural drainage patterns.

The rain gardens, flow-through planters, bioswale and grassy swale provide water quality solutions with site constraints in mind. They all meet the water quality and quantity control requirements of SLOPES V and the 2016 City of Portland Stormwater Management Manual. By meeting these requirements, the health of the Skipanon River is protected.

Appendix A

Vicinity Map

kpff

This page deliberately left blank to facilitate double-sided printing.

Appendix B

Geotechnical Report

REPORT OF GEOTECHNICAL ENGINEERING SERVICES

Proposed Middle School
Warrenton, Oregon

For
Warrenton-Hammond School District
October 28, 2019

GeoDesign Project: WarrHammSD-1-03

GEODESIGN INC
AN NV5 COMPANY

October 28, 2019

Warrenton-Hammond School District
c/o R&C Management Group, LLC
23210 NE Cove Orchard Road
Yamhill, OR 97148

Attention: Scott Rose

Report of Geotechnical Engineering Services
Proposed Middle School
Warrenton, Oregon
GeoDesign Project: WarrHammSD-1-03

GeoDesign, Inc. is pleased to submit this report of geotechnical engineering services for the planned Warrenton-Hammond School District (WHSD) middle school located in Warrenton, Oregon. Our services for this project were conducted in accordance with the Agreement for Consulting Services between WHSD and GeoDesign dated September 9, 2019.

We appreciate the opportunity to be of service to you. Please call if you have questions regarding this report.

Sincerely,

GeoDesign, Inc.

Shawn M. Dimke, P.E., G.E.
Principal Engineer

cc: Kalina Kunert, DLR Group (via email only)
Nalini Chandran, KPFF Consulting Engineers (via email only)
Trevor Wyckoff, Skanska (via email only)

SPM:NNP:SMD:kt
Attachments
One copy submitted (via email only)
Document ID: WarrHammSD-1-03-102819-geor.docx

Table 1. Minimum Pavement Thicknesses

Traffic Levels		Pavement Thicknesses without CTB[1] (inches)		Pavement Thicknesses with CTB[1,2] (inches)	
Pavement Area	ESALs	AC	Aggregate Base	AC	Aggregate Base
Light (cars only)	5,000	2.5	8.0	2.5	4.0
Heavy (buses/trucks and cars)	127,000	4.0	12.0	4.0	6.0

1. All thicknesses are intended to be the minimum acceptable values.
2. CTB layer is assumed to be a minimum of 12 inches thick and have a minimum seven-day compressive strength of 80 psi.

These pavement sections are meant for dry weather construction; increased aggregate base sections will be needed if constructed outside the dry weather period (typically early July to mid-September) as discussed in the "Subgrade Protection" section. Depending on the moisture content of the on-site soil at the time of construction, thicker aggregate base sections may be needed during the dry season as well.

The AC and aggregate base should meet the requirements outlined in the "Structural Fill" section. Construction traffic should be limited to non-building, unpaved portions of the site or haul roads. Construction traffic should not be allowed on new pavement. If construction traffic is to be allowed on newly constructed road sections, an allowance for this additional traffic will need to be made in the design pavement section.

4.6 INFILTRATION SYSTEMS

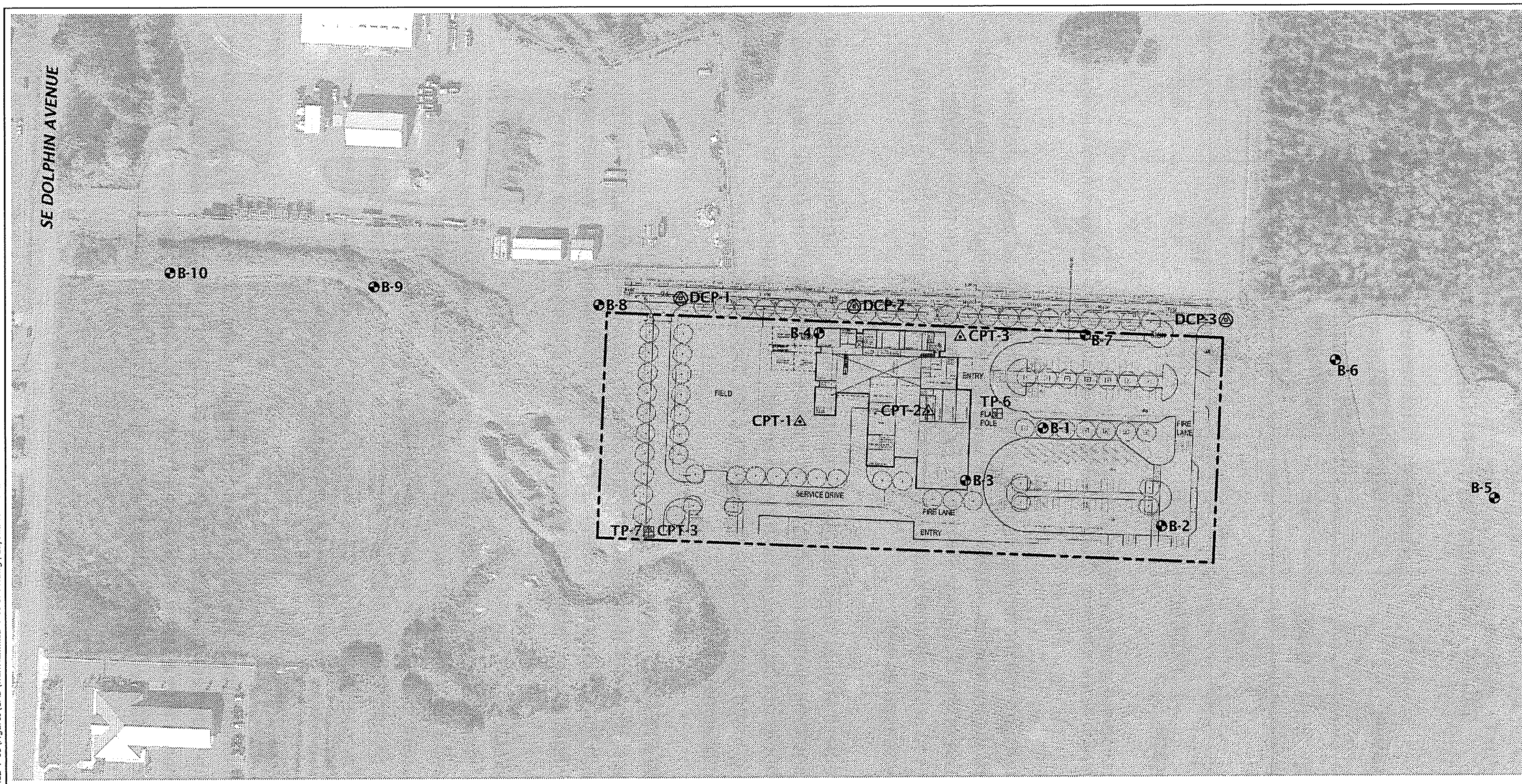
We understand on-site stormwater disposal by means of infiltration will be evaluated for this project. As discussed in the "Infiltration Testing" section, field infiltration rates were extremely low. Based on the negligible rates, infiltration systems are not recommended for the site.

4.7 PERMANENT SLOPES

Permanent cut and fill slopes should not exceed 2H:1V. Slopes within stormwater detention areas should not exceed 3H:1V. Access roads and pavement should be located at least 5 feet from the top of permanent slopes. The setback should be increased to 10 feet for buildings. New slopes should be planted with appropriate vegetation to provide protection against erosion as soon as possible after grading. Surface water runoff should be collected and directed away from slopes to prevent water from running down the face of the slope.

4.8 DRAINAGE

Where possible, the finished ground surface around the building should be sloped away from the structure at a minimum 2 percent gradient for a distance of at least 5 feet. Downspouts or roof scuppers should discharge into a storm drain system that carries the collected water to an appropriate stormwater system. Trapped planter areas should not be created adjacent to the



LEGEND:

— — —	SITE BOUNDARY
B-1	BORING
DCP-1	DYNAMIC CONE PENETROMETER
CPT-1	CONE PENETRATION TEST
TP-6	TEST PIT (2018 GEODESIGN STUDY)
CPT-3	CONE PENETRATION TEST (2018 GEODESIGN STUDY)

N

0 150 300

(SCALE IN FEET)

SITE PLAN BASED ON IMAGE OF SCHEMATIC SITE PLAN DATED AUGUST 15, 2019 PREPARED BY DLR GROUP AND AERIAL PHOTOGRAPH OBTAINED FROM GOOGLE EARTH PRO SEPTEMBER 20, 2019

GEODESIGN INC
AN NV5 COMPANY

WARRHAMMSD-1-03

OCTOBER 2019

SITE PLAN

PROPOSED MIDDLE SCHOOL
WARRENTON, OR

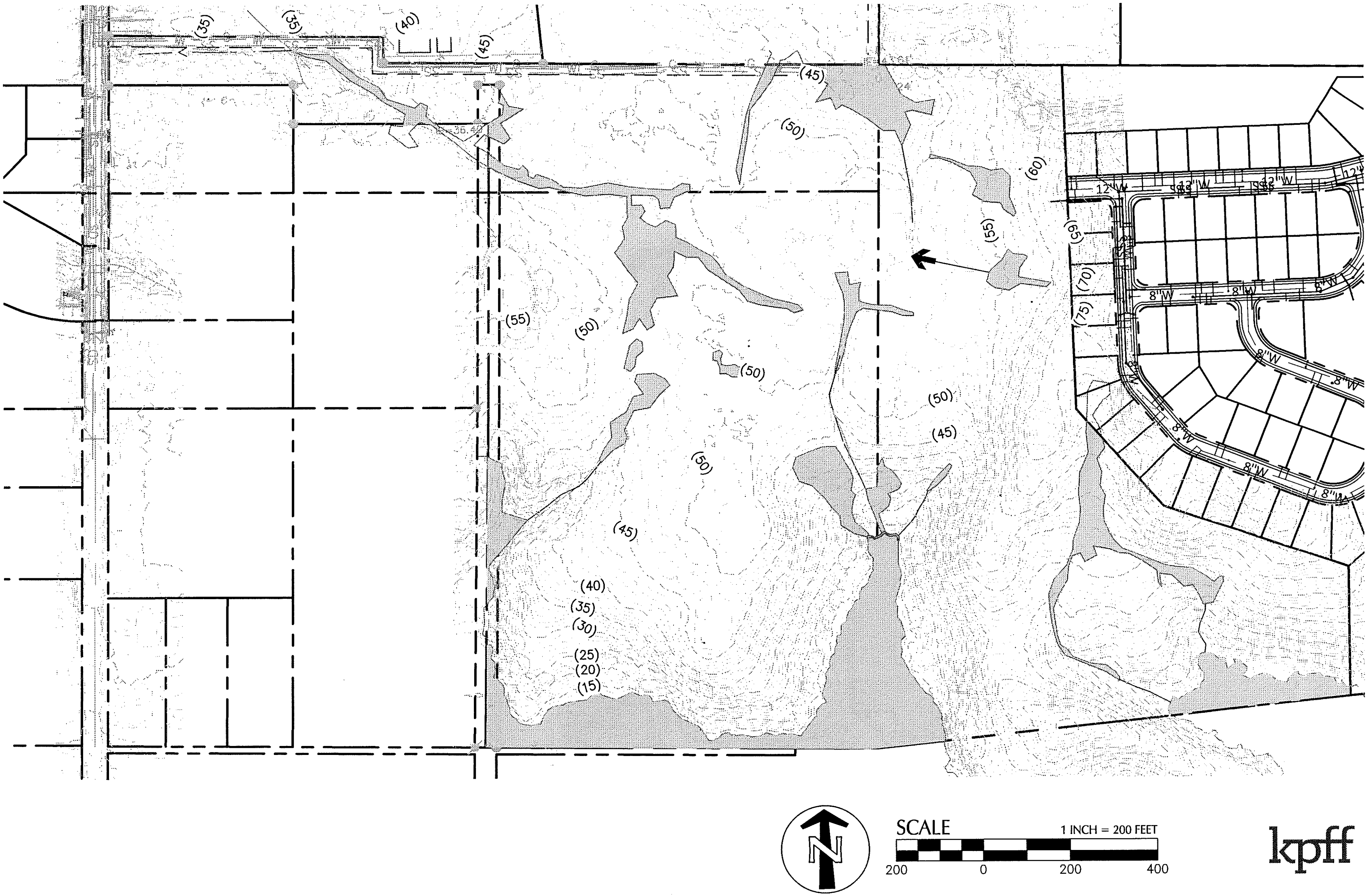
FIGURE 2

Printed By: mmiller | Print Date: 10/28/2019 10:32:49 AM
File Name: J:\S-Z\WarrHammSD\WarrHammSD-1\WarrHammSD-1-03\Figures\CAD\WarrHammSD-1-03-SP01.dwg | Layout: FIGURE 2

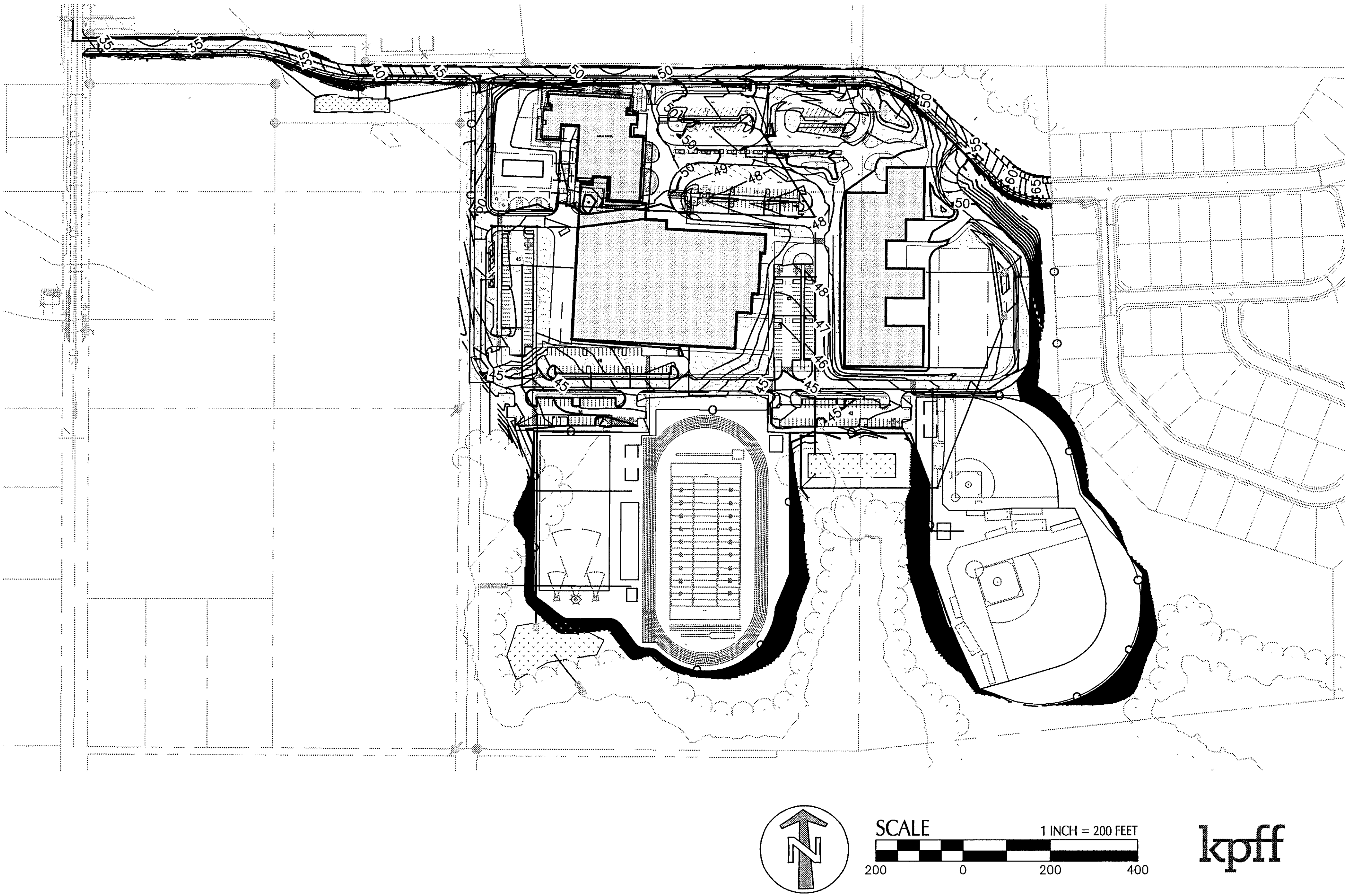
This page deliberately left blank to facilitate double-sided printing.

Appendix C

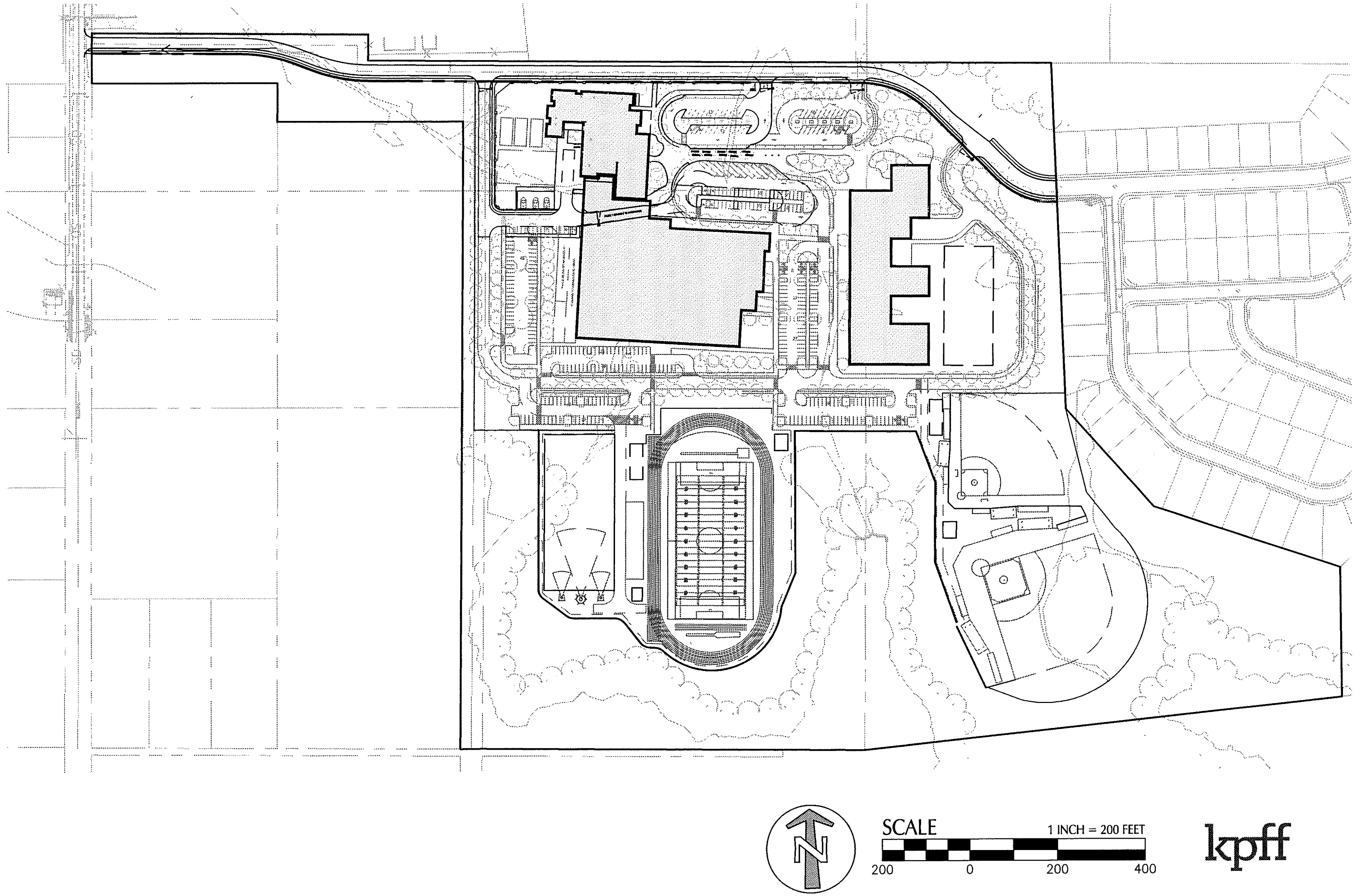
Site Plans and Basin Maps

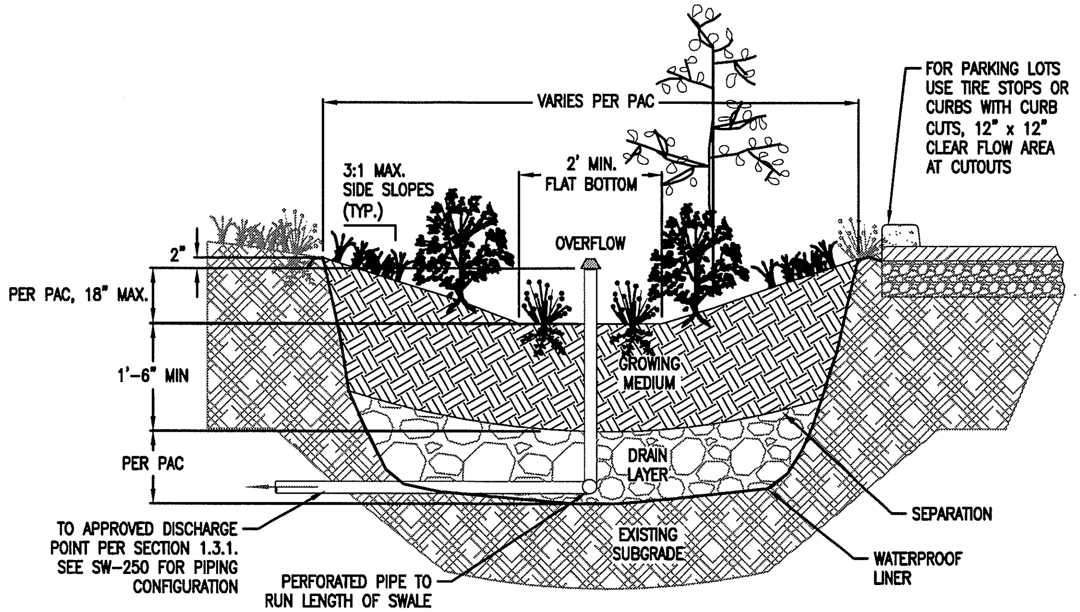


(35)
(35)
(40)
(45)
(45)
(50)
(60)
(55)
(65)
(70)
(75)
12"W
8"W
(55)
(50)
(50)
(50)
(45)
(50)
(45)
(40)
(35)
(30)
(25)
(20)
(15)
N
SCALE
1 INCH = 200 FEET
200
0
200
400
kpff



kpff


N
SCALE
1 INCH = 200 FEET
200
0
200
400
kpff



1. Detail intended as an example. Detail must match PAC assumptions and/or design report.

2. Dimensions:
   Width of basin: 5' minimum
   Depth of basin (from top of growing medium to overflow elevation): per PAC
   Flat bottom width: 2' minimum.
   Side slopes of swale: Per PAC, 3:1 maximum.

3. Setbacks: None required.

4. Overflow:
   Basins must connect to approved discharge point according to SWMM Section 1.3.
   Inlet elevation must allow for 2" of freeboard, minimum.
   Protect from debris and sediment with strainer or grate.

5. Piping must be ABS Sch.40, cast iron, or PVS Sch.40. 3" pipe required for facilities draining up to 1500 s.f., otherwise 4" min. pipe. Piping must have 1% grade and follow the Uniform Plumbing Code.

6. Drain Layer:
   Determined by designer. Options include, but are not limited to drain mat, 3/4" washed round rock, or other approved system.

7. Separation between drain and growing medium:
   Use appropriate filter fabric or a gravel lens (3/4 – 1/4 inch washed, crushed rock 2 to 3 inches deep), or as per approved design.

8. Growing Medium:
   18" minimum depth. Use sand/loam/compost 3-way mix, or approved mix that will support healthy plants.
   24" minimum depth is required if the lined facility is also meeting BDS landscape requirements.

9. Vegetation: Follow landscape plans otherwise refer to plant list in SWMM Section 2.4.1. Minimum container size is #1 container. # of plantings per 100sf of facility area:
   Zone A (wet): 80 herbaceous plants OR 72 herbaceous plants and 4 small shrubs.
   Zone B (moderate to dry): 7 large or small shrubs AND 70 groundcover plants.
   The delineation between Zone A and B shall be either at the outlet elevation or the check dam elevation, whichever is lowest.
   If project area is over 200sf consider adding a tree.

10. Waterproof Liner: 30 mil EPDM, HDPE or approved equivalent.

11. Splash Block: Install 4-6" washed river rock or splash pad for erosion control at inlets and downspout.

12. Inspections: Call BDS IVR Inspection Line, (503) 823-7000, request 487. 3 inspections required.

– DRAWING NOT TO SCALE –

STORMWATER MANAGEMENT TYPICAL DETAILS

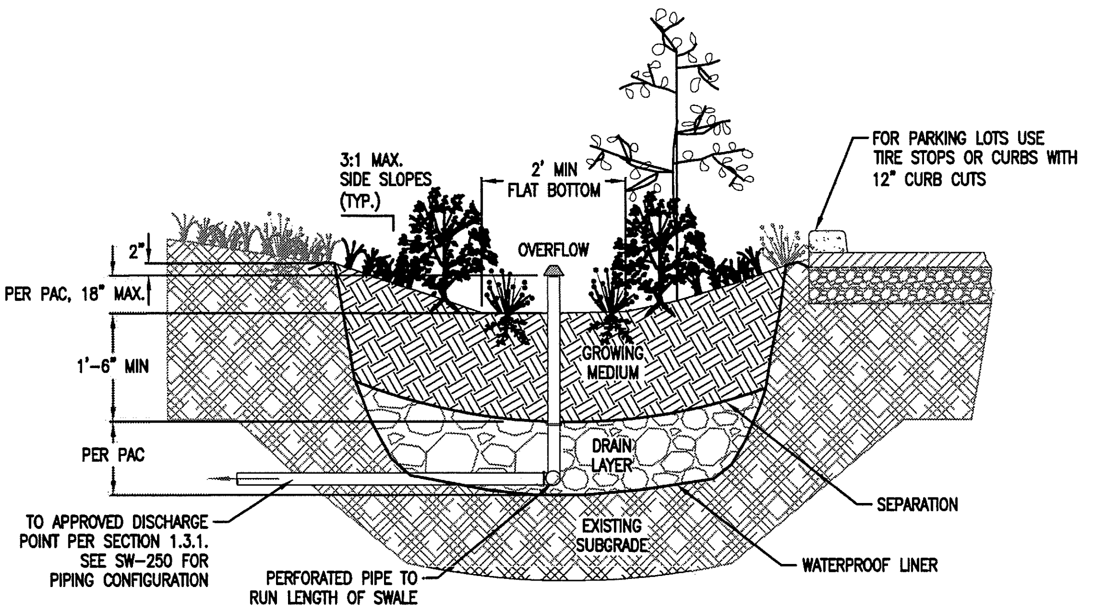
– Presumptive and Performance Design Approach –

Basin – lined

Bureau of Environmental Services

NUMBER
SW-240
7-1-16

kpff



NOTES:

1. Detail intended as an example. Detail must match PAC assumptions and/or design report.

2. Dimensions:
   Width of swale: 6'-6" minimum
   Depth of swale (from top of growing medium to overflow elevation): per PAC
   Longitudinal slope of swale: 6.0% or less.
   Flat bottom width: 2' minimum.
   Side slopes of swale: per PAC, 3:1 maximum.

3. Setbacks:
   None required.

4. Overflow:
   Swales must connect to approved discharge point according to SWMM Section 1.3.1.
   Inlet elevation must allow for 2" of freeboard, minimum.
   Protect from debris and sediment with strainer or grate.

5. Piping must be ABS Sch.40, cast iron, or PVS Sch.40. 3" pipe required for facilities draining up to 1500 s.f., otherwise 4" min. pipe. Piping must have 1% grade and follow the Uniform Plumbing Code.

6. Drain Layer:
   Determined by designer. Options include, but are not limited to drain mat, 3/4" washed round rock, or other approved system.
   Separation between drain and growing medium:
   Use appropriate filter fabric or a gravel lens (3/4 – 1/4 inch washed, rock 2 to 3 inches deep), or as per approved design.

7. Growing Medium:
   18" minimum depth. Use sand/loam/compost 3-way mix, or approved mix that will support healthy plants.
   24" minimum depth is required if the lined facility is also meeting BDS landscape requirements.

8. Vegetation: Follow landscape plans otherwise refer to plant list in SWMM, Section 2.4.1. Minimum container size is #1 container. # of plantings per 100sf of facility area:
   Zone A (wet): 80 herbaceous plants OR 72 herbaceous plants and 4 small shrubs.
   Zone B (moderate to dry): 7 large or small shrubs AND 70 groundcover plants.
   The delineation between Zone A and B must be either at the outlet elevation or the check dam elevation, whichever is lowest.
   If project area is over 200 sf consider adding a tree.

9. Check Dams: Must be placed per PAC and be equal to the width of the swale.

10. Waterproof Liner: 30 mil EPDM, HDPE or approved equivalent.

11. Splash Block: Install 4-6" washed river rock or splash pad for erosion control at inlets and downspout.

12. Inspections: Call BDS IVR Inspection Line, (503) 823-7000, request 487. 3 inspections required.

- DRAWING NOT TO SCALE -

STORMWATER MANAGEMENT TYPICAL DETAILS

– Presumptive and Performance Design Approach –

Swale – lined

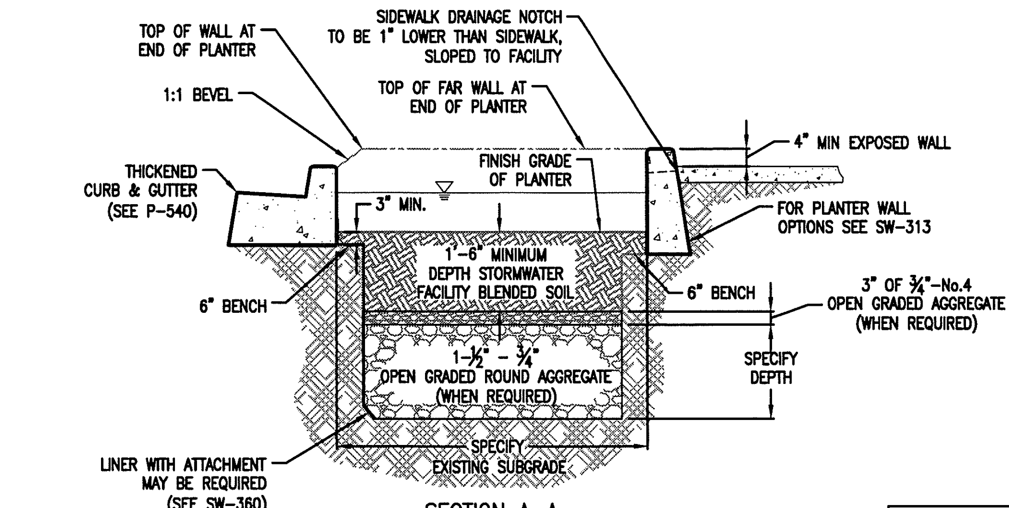
Bureau of Environmental Services

NUMBER

SW-220

7-1-16

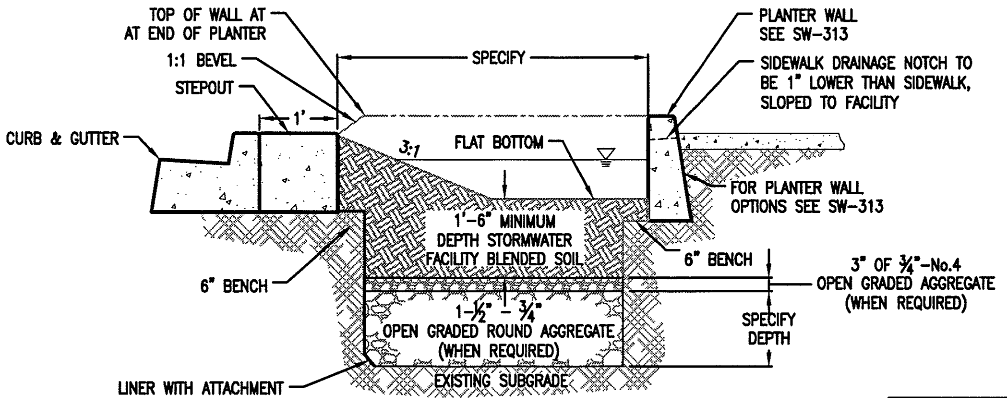
kpff



SECTION A–A

PLANTER WITHOUT PARKING

FOR PLAN VIEW
SEE SW-310



SECTION B–B

PLANTER WITH PARKING (1' Step–out)

FOR PLAN VIEW
SEE SW-311B

DESIGNER INFORMATION

1. Show liner and perf–pipe in the Section view if they are required.
2. Maximize 9" of surface storage.
3. Minimun facility width is 30" from back of curb to face of planter wall.
4. Top of curb and top of sidewalk at approximately same elevation, unless stormwater facility retrofit.

CONSTRUCTION NOTE

In facilities that are unlined, fracture and loosen soil to a depth of 12" below grade before installing blended soil or aggregate. Do not till.

– DRAWING NOT TO SCALE –

STORMWATER MANAGEMENT MANUAL TYPICAL DETAILS

– Green Streets –

Section Views

Planters

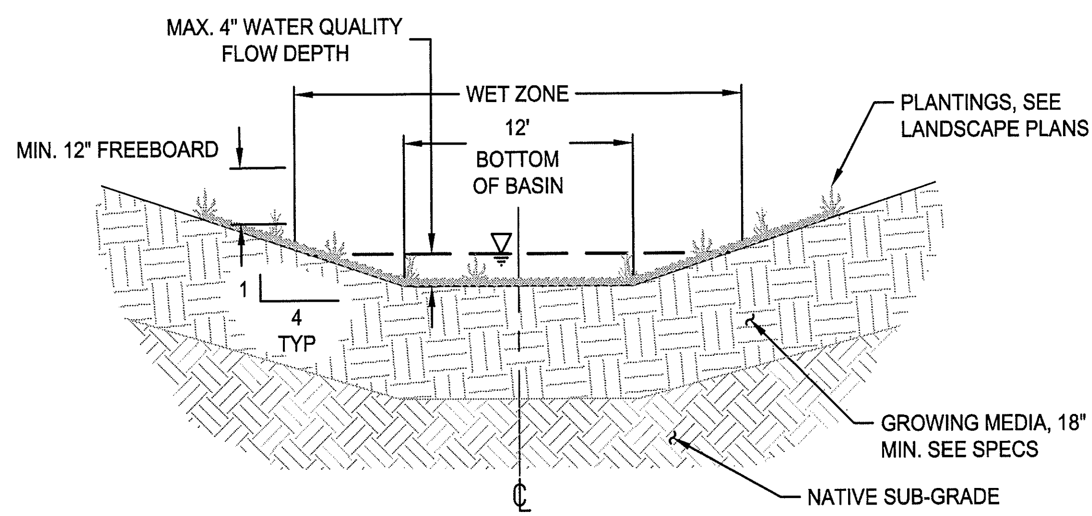
Bureau of Environmental Services

NUMBER

SW–312A

7–1–2016

kpff



2 GRASSY SWALE CROSS SECTION

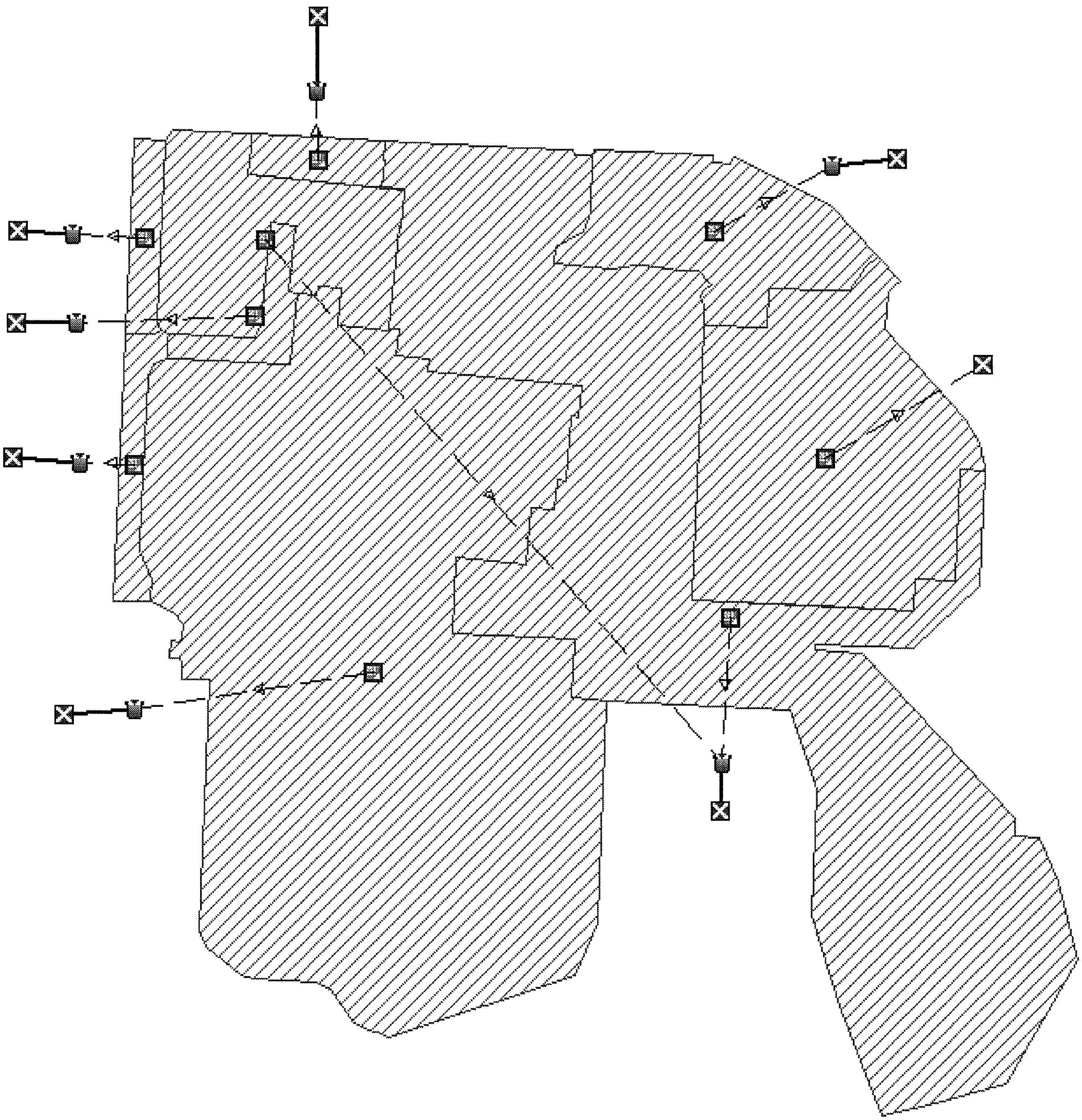
SCALE: NTS

kpff

This page deliberately left blank to facilitate double-sided printing.

Appendix D

Water Quality Calculations and Basin Hydrographs



kpff

kpff

kpff

kpff

kpff

kpff

kpff

kpff

kpff

Stormwater Facility Maximum Exfiltration Rates

Appendix D

WARRENTON-HAMMOND SCHOOLS
KPFF Job No 1900183
Designer: MB
Check Engineer: NC

Facility	Facility Bottom Area (sf)	Growing Medium Infiltration Rate (in/hr)	Maximum Exfiltration Rate - Conversion (cfs) (Area)*(2inch/hour)(1 foot/12 inches)(1 hour/3600 seconds)
RG-01	5000	2	0.2315
RG-02	12000	2	0.5556
RG-03	14000	2	0.6481
RG-04	1200	2	0.0556
BS-01	475	2	0.0220
BS-02	325	2	0.0150
FTP-01	200	2	0.0093
FTP-02	500	2	0.0231
FTP-03	500	2	0.0231

kpff

Water Quality Grassy Swale Sizing
Appendix C

WARRENTON-HAMMOND SCHOOLS
KPFF Job No 1900183
Designer: MB
Check Engineer: NC

Design Storms
Per ODOT Water Quality Storm Event (1.55 inch, 24-hr type 1A storm)

Grassy Swale-1

WQ Flow	**0.75**	**cfs**		
Bottom Width	12.00	ft		
Manning's *n*	0.25			
Impervious Area	94890	sf		
Pervious Area	0	sf		
Area Total	94890	sf		
NRCS Impervious CN	0.98			
Slope	0.005	ft/ft		
Side Slope (Z:1)	4.00			
Minimum Hydraulic Residence Time	9.00	min	540.00	sec
Calculated WQ Depth (max .33 feet)	0.32	ft		
Area WQ	4.23	sf		
WQ Velocity (max 3ft/sec)	0.18	ft/sec		
Calculated Required Length (min 100 feet)	95.98	ft		
Designed Length	100.00	ft		
Designed Width	12.00	ft		

This page deliberately left blank to facilitate double-sided printing.

Appendix E

Operations & Maintenance Information

3.1.2 Performance Approach Maintenance Requirements

When the Performance Approach is used to design stormwater management facilities on private property, the required O&M submittal to BES is:

- A completed O&M Form that has been recorded with the appropriate county, including a site plan attached to the form.
- A site-specific O&M Plan. The plan defines the O&M procedures, schedule, and persons responsible for implementing and documenting O&M activities. It must fully address the requirements of the site and the proposed stormwater infrastructure, including all stormwater management facilities and conveyance features.

The site-specific O&M Plan is a component of the Stormwater Management Report and must be prepared for review by BES using the outline in Figure 3-1. The plan must include a description of each type of facility servicing the site, the impervious area draining to the facilities, all stormwater conveyance pipes, and the facilities' discharge locations. The plan must also detail the visual indicators and activities necessary to maintain each facility type.

Figure 3-1. O&M Plan Outline

I. Description
• Summary of the onsite stormwater system. • Table identifying each stormwater facility and conveyance feature, including stormwater source, square footage managed, and discharge location. • Location of stormwater facilities and conveyance features in relation to permanent structures or landmarks.
II. Inspection and Visual Indicators of Diminished Performance
• When and how often the stormwater facilities or conveyance features will be inspected. • Definition of what storm sizes require additional inspections. • Description of visual indicators that would trigger maintenance activities.
III. Maintenance Activities
• Specific procedures for each facility type. • Likely deficiencies and corrective actions. • Course of action for unexpected deficiencies. • Site BMPs for effective stormwater management.
IV. Financial Responsibility
• Designation and contact information of entity responsible for site operation and maintenance.
V. Inspection and Maintenance Logs
• Instructions for maintaining required logs.

I. Description

The summary must adequately describe the overall stormwater management objectives and the responsibilities of the property owner. It must include the Stormwater Hierarchy, specifically whether the managed stormwater is infiltrated onsite or discharged offsite. It must also describe the stormwater system in the area impacted by the development, including details about the function of each stormwater management facility and all natural and constructed conveyance features such as drainageways, culverts, and outfalls.

A table must be included listing each stormwater facility with the facility type, size, location, stormwater source (rooftop, parking lot, or road runoff), source area (square footage), discharge location, and access point.

The site plan must identify the location of each stormwater facility and conveyance feature. Locations must be clarified by measurements from permanent structures or GPS coordinates.

II. Inspection and Visual Indicators of Diminished Performance

All components of the O&M Plan should be inspected at least:

- Quarterly for the first two years.
- Twice a year thereafter.
- Within 48 hours of major rainfall events (defined as more than one inch of rain over a 24-hour period).

For at least the first two years, the design drawings and the O&M Plan should be present during inspections so it is clear how the site should function. The O&M Plan will help the inspector recognize signs of diminished performance. Visual indicators of maintenance needs should be noted for each facility.

III. Maintenance Activities

Each type of stormwater facility and conveyance feature must have its own section that describes the duties required to maintain that facility or feature and keep it in working order. It is expected that variations in facility configurations as well as variations in sources (rooftop, parking lot, or roadway runoff) will result in different procedures. Maintenance indicators and their corrective actions must also be described.

Maintenance activities must also include best management practices specific to site activities and functions to improve system performance. Examples include lot sweeping or catch basin cleaning.

The following sections present different types of maintenance activities that may be necessary in the site-specific O&M Plan. If usual maintenance practices do not resolve issues, professional services may be required.

Site Best Management Practices

Onsite maintenance practices can reduce maintenance needs for stormwater facilities. Good housekeeping procedures such as trash or source control practices can reduce spills and prevent pollutants from entering facilities.

Remove trash, debris and sediment from parking lots and catch basins. Identify sources of visible pollutants or spills and clean up sources to protect the stormwater system. Sweep or vacuum parking lots or other ground-level surfaces. Report all spills that threaten or enter the public sanitary or storm system (503-823-7180).

Sediment and Oil Removal and Disposal

Stormwater facilities are designed to remove pollutants by capturing sediment, dirt, leaves and litter. Removing sediment and oil helps maintain facility infiltration rates, provide good water quality treatment, and prevent clogging and flooding.

In vegetated facilities, sediment should be removed when it reaches a depth of four inches, when the quantity reaches 30 percent of total capacity (as designed or measured) or when accumulated sediment is impeding facility function. Examples include when sediment is damaging vegetation, preventing the facility from draining, blocking inlets or causing bypass.

Remove sediment by hand unless professionals are needed because of confined space entry requirements or the need for a vactor truck. Dispose of sediment per solid waste disposal requirements. Removing sediment during dry periods is easier because the material weighs substantially less.

Vegetation Management

Healthy plants play important roles: the root systems absorb stormwater, help maintain infiltration rates, prevent erosion, and capture pollutants. Vegetated facilities must be checked for maintenance needs quarterly for the first two years and then twice a year after that.

If a vegetated stormwater facility has bare soil, or if vegetation is stressed, unhealthy, or dead, replant per the approved planting plan and/or address cause of stress. Remove nuisance and invasive plants.

Healthy vegetation must cover at least 90% of stormwater facility surface area. Grass must be mowed to keep it four to nine inches tall. Prune or trim vegetation or roots to ensure free conveyance of stormwater or improve sight lines. Remove leaves or other debris. Use weed-free mulch to inhibit weeds. Irrigate as needed.

The use of fertilizers and pesticides (including herbicides) is strongly discouraged in stormwater management facilities because of the potential for negative impacts to downstream systems. Integrated Pest Management strategies are encouraged to reduce or eliminate the need for pesticides. If pesticides are required, use the services of a licensed applicator and products approved for aquatic use.

Erosion, Bank Failure, and Channel Formation

Erosion in the flow path, inside or outside a facility, can clog inlets and outlets and reduce both conveyance efficiency and infiltration rates. Forms of erosion include channels, undercutting, scouring, and slumping. Any area with erosion more than two inches deep must be addressed. Install long-term erosion control practices and fill the eroded areas.

Structural Repairs

Structural components control the conveyance of stormwater. Examples include inlets, outlets, trash racks, concrete curbs, retaining walls, manholes and check dams. Repair or replace items when damaged, loose, broken, cracked, or askew. Monitor minor damage such as dents, rust, or minor cracks in concrete for indications of when repair or replacement is required.

Ponding water

Most stormwater facilities are designed to drain in a certain amount of time. The O&M Plan should specify the anticipated ponding depth, infiltration rate, and drawdown time. When the facility does not drain as anticipated, inspect the facility to determine the cause. Clear clogged inlets or outlets, remove sediment that may be preventing infiltration, or add vegetation.

Pests

Stormwater facilities are designed to drain quickly enough to avoid providing breeding areas for pests. If mosquitos are found, the stormwater facility may be ponding water longer than the approved design but also search for nearby sources of standing water. If rodents are found, remove plant debris, fruit or nuts that are providing shelter and food and contact the appropriate county vector control office for trapping and removal.

Safety

Stormwater facilities must be maintained to protect workers, visitors, and the general public. Vegetation should be pruned for adequate visual clearance. Avoid maintenance in wet weather to reduce potential injuries from slipping and always use appropriate safety gear. Only personnel approved for confined space entry should enter underground stormwater facilities.

Manufactured Stormwater Treatment Technology Maintenance

Operations and maintenance (O&M) of manufactured stormwater treatment technologies (MSTT) are specific to the device and are critical to their performance removing pollutants from runoff. Design and installation of individual devices is done in partnership with the manufacturer, who provides a letter confirming that the device has been sited, sized, and designed appropriately. The project designer is responsible for confirming that any conditions of use from the City of Portland are met.

Each MSTT has a recommended operations and maintenance guide or plan provided by the manufacturer that includes minimum inspection frequencies, maintenance triggers, and typical media replacement frequencies. The specific MSTT operations and maintenance plan must be attached to the Operations and Maintenance Plan.

Changes to pollutant loading or site conditions, spills, localized erosion, or large storm events may require more frequent maintenance visits in order to maintain performance. Minimum maintenance practices or frequencies may require modification in order to maintain MSTT functionality.

Even if the manufacturer includes a maintenance plan or warranty with the device at the time of purchase, ultimate responsibility for operations and maintenance is with the property owner. It is the property owner's responsibility to document completion of maintenance per any maintenance agreement or while under warranty.

IV. Financial Responsibility

The party responsible for current and ongoing O&M activities must be identified. The name of the responsible party must be updated as needed whenever the facility is inspected under BES's Maintenance Inspection Program (MIP).

A facility maintenance fund is recommended for both operating procedures (regular maintenance) and capital procedures (major overhauls or replacement). Costs depend on the characteristics of the facility, the site, and the drainage area. The general recommendation is that annual maintenance costs should be 5 to 10 percent of the facility's total capital cost. Routine scheduled maintenance can help keep costs down by addressing problems before they require major attention.

V. Inspection and Maintenance Logs

Portland City Code requires property owners to keep an Inspection and Maintenance Log. In general, the log must note all inspection dates, the facility components that were inspected, and any maintenance or repairs performed. The property owner is responsible for ensuring that the maintenance is completed and records are kept, even if someone other than the property owner is performing the maintenance, such as a facility manger or maintenance company. City may accept other documentation including work orders, invoices, or receipts in lieu of an inspection and maintenance log. The intent is to demonstrate compliance with O&M requirements.

If there is a maintenance contract with the manufacturer of a manufactured stormwater treatment technology, the manufacturer's maintenance logs must generally include the same type of information and level of detail as required for stormwater management facilities.

Owners who are not sure their maintenance documentation is sufficient can call BES at 503-823-7761 for proposed O&Ms (those still under development review) or 503-823-5600 for existing O&Ms (already constructed facilities) to get review and approval of their forms.

Operations and Maintenance Log

Date	Work Performed By	Type of Work Performed				Notes	Initials
		Sediment and Trash Removal	Plant Replacement type, location	Structural Repairs – type, location	Other		

3.1.3 Stormwater Conveyance Features

Stormwater conveyance features include drainageways, culverts, and outfalls that are used to transport drainage, stormwater and surface waters. Conveyance features serve important hydrologic, hydraulic, and water quality functions for Portland's waterways and stormwater systems.

Drainageways and any related encroachments must be maintained to preserve key watershed processes. In addition to ecological benefits, they provide beneficial functions such as flood attenuation and water quality treatment. Culverts and outfalls must be maintained to minimize negative effects on watershed processes and ecological functions while adequately conveying flows downstream.

The private property owner is responsible for preserving and maintaining conveyance features as protected or constructed to approved plans. Any future development proposals must protect stormwater conveyance features to ensure continuation of flow conveyance and other benefits. Stormwater Conveyance features require an O&M submittal to BES that includes:

- A Standard O&M Plan for conveyance features; and
- A completed O&M Form that has been recorded with the appropriate county. A Site Plan (either sketched or attached) must be included.

O&M submittal requirements are listed in Section 3.1.4. Specific requirements for conveyance features are outlined below.

Drainageways, Drainage Reserves, and related Encroachments

An Operations and Maintenance (O&M) plan is required for drainageways on properties undergoing development proposal review, regardless of whether the drainageway is being impacted by the development proposal. O&M plans are required when drainage reserves are being applied to a drainageway during development proposal review or for a permitted improvement or encroachment to a drainage reserve. Operations and Maintenance Plans must be recorded with an O&M Form in the county of the subject property.

Culverts and Outfalls

An O&M Plan is required for culverts and outfalls on properties undergoing development proposal review, regardless of whether or not the culvert or outfall is directly associated with a stormwater management facility.

3.1.1.8. Planters

	MAINTENANCE INDICATOR	CORRECTIVE ACTION
Structural components must be operated and maintained in accordance with the design specifications.		
	MAINTENANCE INDICATOR	**CORRECTIVE ACTION**
	Clogged inlets or outlets	Remove sediment and debris from catch basins, trench drains, curb inlets, and pipes; maintain at least 50% conveyance at all times.
	Broken inlets or outlets	Repair/replace broken downspouts, curb cuts, standpipes, and screens.
	Damaged liners and walls	Extend and secure liner to planter walls above the high water mark. The facility must be water tight to protect abutting foundations from moisture damage.
	Cracked or exposed drain pipes	Repair or seal cracks. Replace when repair is insufficient. Cover with 6 inches of growing medium to prevent freeze/thaw and UV damage
Vegetation must cover at least 90% of the facility at maturity.		
	MAINTENANCE INDICATOR	**CORRECTIVE ACTION**
	Dead or stressed vegetation	Replant per original planting plan, or substitute from the plant list in Section 2.4.1. Irrigate and mulch as needed; prune tall, dry grasses and remove clippings.
	Tall grass and vegetation	Maintain grass height at 6"-9". Trim to allow sight lines and foot traffic, also to ensure inlets and outlets freely convey stormwater into and/or out of facility.
	Weeds	Manually remove weeds.
Growing medium must sustain healthy plant cover and infiltrate within 48 hours.		
	MAINTENANCE INDICATOR	**CORRECTIVE ACTION**
	Gullies, erosion, exposed soils, sediment accumulations	Fill in and lightly compact areas of erosion with City-approved soil mix (see Section 2.3.6) and replant according to planting plan or substitute from the plant list in Section 2.4.1. Sediment more than 4 inches deep must be removed.
	Scouring at the inlet(s)	Ensure splash blocks or inlet gravel/rock are adequate.
	Ponding	Rake, till, or amend soil surface with City-approved soil mix to restore infiltration rate. Remove and replace sediment at entrances.

Annual Maintenance Schedule

Summer	Make structural repairs; clean gutters and downspouts; remove any build-up of weeds or organic debris.
Fall	Replant exposed soil and replace dead plants. Remove sediment and plant debris.
Winter	Clear gutters and downspouts.
Spring	Remove sediment and plant debris. Replant exposed soil and replace dead plants.
All seasons	Weed as necessary.

Maintenance Records: All facility operators are required to keep an inspection and maintenance log. Record date, description, and contractor (if applicable) for all repairs, landscape maintenance, and facility cleanout activities. Keep work orders and invoices on file and make available upon request of the City inspector.

Fertilizers/Pesticides/Herbicides: Their use is strongly discouraged because of the potential for damage to downstream systems. If pesticides or herbicides are required, use the services of a licensed applicator and products approved for aquatic use.

Access: Maintain ingress/egress per design standards.

Infiltration/Flow Control: All facilities must drain within 48 hours. Record time/date, weather, and conditions when ponding occurs.

Pollution Prevention: All sites must implement Best Management Practices to prevent contamination of stormwater. Call 503-823-7180 to report spills. Never wash spills into a stormwater facility. If contamination occurs, document the circumstances and the corrective action taken; include the time/date, weather, and site conditions.

Vectors (Mosquitoes and Rats): Stormwater facilities must not harbor mosquito larvae or rodents that pose a threat to public health or that undermine facility structures. Record the time/date, weather, and site conditions when vector activity observed. Record when vector abatement started and ended.

Operations and Maintenance Log

Date	Work Performed By	Type of Work Performed					Notes	Initials
		Clean inlets and Outlets	Sediment and Trash Removal	Plant Replacement type, location	Structural Repairs – type, location	Other		

STANDARD O&M PLAN FOR THE SIMPLIFIED APPROACH

3.1.1.5. Rain Gardens

Structural components must be operated and maintained in accordance with the design specifications.		
	MAINTENANCE INDICATOR	**CORRECTIVE ACTION**
	Clogged gutters, drains, downspouts, or inlets	Remove sediment, debris, and blockages from downspouts, gutters, pipes, and inlets to maintain at least 50% conveyance at all times. Clean at least twice a year depending on the presence of overhanging trees. Clear any build-up of soil, bark dust, and/or vegetative growth from around downspout extension and/or splash blocks. Verify there is sufficient slope so that water flows away from the foundation.
	Damaged or missing pipes, gutters, and downspouts	Repair or replace broken gutters and downspouts as needed. Identify possible leaks and verity that roof flashing directs water into gutters. Look for low spots or sagging areas along the gutter line and repair as needed with new hangers.
Vegetation must cover at least 90% of the facility at maturity.		
	MAINTENANCE INDICATOR	**CORRECTIVE ACTION**
	Dead or stressed vegetation	Remove dead material; replant per original planting plan, or substitute from the plant list in Section 2.4.1.
	Dry grass or other plants	Irrigate and mulch as needed. Maintain grass height at 6"-9".
	Weeds	Manually remove weeds
Growing medium must sustain healthy plant cover and infiltrate within 48 hours.		
	MAINTENANCE INDICATOR	**CORRECTIVE ACTION**
	Gullies, erosion, exposed soils, sediment accumulation	Fill in and lightly compact areas of erosion with City-approved soil mix (see Section 2.3.6) and replant according to planting plan or substitute from the plant list in Section 2.4.1. Any erosion deeper than 2 inches must be addressed. Sediment more than 4 inches deep must be removed.
	Scouring at the inlet(s)	Ensure splash blocks or inlet gravel/rock are adequate
	Ponding	Till, amend, or rake soil as needed to ensure ponding water drains within 48 hours.

Annual Maintenance Schedule

Summer	**Make structural repairs; clean gutters and downspouts; remove any build-up of weeds or organic debris.**
Fall	Replant exposed soil and replace dead plants. Remove sediment and plant debris.
Winter	Clear gutters and downspouts.
Spring	Remove sediment and plant debris. Replant exposed soil and replace dead plants.
All seasons	Weed as necessary.

Maintenance Records: All facility operators are required to keep an inspection and maintenance log. Record date, description, and contractor (if applicable) for all repairs, landscape maintenance, and facility cleanout activities. Keep work orders and invoices on file and make available upon request of the City inspector.

Fertilizers/Pesticides/Herbicides: Their use is strongly discouraged because of the potential for damage to downstream systems. If pesticides or herbicides are required, use the services of a licensed applicator and products approved for aquatic use.

Access: Maintain ingress/egress per design standards.

Infiltration/Flow Control: All facilities must drain within 48 hours. Record time/date, weather, and conditions when ponding occurs.

Pollution Prevention: All sites must implement Best Management Practices to prevent contamination of stormwater. Call 503-823-7180 to report spills. Never wash spills into a stormwater facility. If contamination occurs, document the circumstances and the corrective action taken; include the time/date, weather, and site conditions.

Vectors (Mosquitoes and Rats): Stormwater facilities must not harbor mosquito larvae or rodents that pose a threat to public health or that undermine the facility structure. Record the time/date, weather, and site conditions when vector activity observed. Record when vector abatement started and ended.

Operations and Maintenance Log

Date	Work Performed By	Type of Work Performed					Notes	Initials
		Clean inlets and Outlets	Sediment and Trash Removal	Plant Replacement type, location	Structural Repairs – type, location	Other		

3.1.1.6. Swales

Structural components must be operated and maintained in accordance with the design specifications.		
	MAINTENANCE INDICATOR	**CORRECTIVE ACTION**
	Clogged inlets or outlets	Remove sediment and debris from catch basins, trench drains, curb inlets, and pipes; maintain at least 50% conveyance at all times.
	Broken inlets or outlets	Repair or replace broken downspouts, curb cuts, standpipes, and screens as needed.
	Cracked or exposed drain pipes	Repair or seal cracks. Replace when repair is insufficient. Cover with 6 inches of growing medium to prevent freeze/thaw and UV damage.
	Check dams missing or with gaps	Maintain or replace check dams as per design specifications.
	Perforated liner	Repair or replace as necessary.
Vegetation must cover at least 90% of the facility at maturity.		
	MAINTENANCE INDICATOR	**CORRECTIVE ACTION**
	Dead or stressed vegetation	Replant per planting plan or substitute from the plant list in Section 2.4.1.
	Dry grass or other plants	Irrigate and mulch. Maintain grass height at 6”-9”.
	Tall grass and vegetation	Prune to allow sight lines and foot traffic. Prune to ensure inlets and outlets freely convey stormwater into and/or out of facility.
	Weeds	Manually remove weeds.
Growing medium must sustain healthy plant cover and infiltrate within 48 hours.		
	MAINTENANCE INDICATOR	**CORRECTIVE ACTION**
	Erosion and sediment accumulation	Fill in and lightly compact areas of erosion with City-approved soil mix (see Section 2.3.6); replant according to planting plan or substitute from the plant list in Section 2.4.1. Erosion deeper than 2 inches must be addressed. Sediment more than 4 inches deep must be removed.
	Scouring at the inlet(s)	Ensure splash blocks or inlet gravel/rock are adequate.
	Slope slippage	Stabilize 3:1 slopes/banks with plantings from the original planting plan or from the plant list in Section 2.4.1.
	Ponding	Rake, till, or amend soil surface with City-approved soil mix to restore infiltration rate.

Annual Maintenance Schedule

Summer	Make structural repairs; clean gutters and downspouts; remove any build-up of weeds or organic debris.
Fall	Replant exposed soil and replace dead plants. Remove sediment and plant debris.
Winter	Clear gutters and downspouts.
Spring	Remove sediment and plant debris. Replant exposed soil and replace dead plants.
All seasons	Weed as necessary.

Maintenance Records: All facility operators are required to keep an inspection and maintenance log. Record date, description, and contractor (if applicable) for all repairs, landscape maintenance, and facility cleanout activities. Keep work orders and invoices on file and make available upon request of the City inspector.

Fertilizers/Pesticides/Herbicides. Their use is strongly discouraged because of the potential for damage to downstream systems. If pesticides or herbicides are required, use the services of a licensed applicator and products approved for aquatic use.

Access: Maintain ingress/egress per design standards.

Infiltration/Flow Control: All facilities must drain within 48 hours. Record time/date, weather, and site conditions when ponding occurs.

Pollution Prevention: All sites must implement Best Management Practices to prevent contamination of stormwater. Call 503-823-7180 to report spills. Never wash spills into a stormwater facility. If contamination occurs, document the circumstances and the corrective action taken; include the time/date, weather, and site conditions.

Vectors (Mosquitoes and Rats): Stormwater facilities must not harbor mosquito larvae or rodents that pose a threat to public health or that undermine the facility structure. Record the time/date, weather, and site conditions when vector activity observed. Record when vector abatement started and ended.

Operations and Maintenance Log

Date	Work Performed By	Type of Work Performed					Notes	Initials
		Clean inlets and Outlets	Sediment and Trash Removal	Plant Replacement type, location	Structural Repairs – type, location	Other		

This page deliberately left blank to facilitate double-sided printing.