# SE Lund Avenue
# Traffic Study Report

Prepared for

March 2022

Prepared by

**Parametrix**

# SE Lund Avenue Traffic Study Report

*Prepared for*

**Kitsap County Public Works**
614 Division Street, MS-26
Port Orchard, WA 98366

*Prepared by*

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# CITATION

Parametrix, 2022. SE Lund Avenue Traffic Study Report.
Prepared by Parametrix, Seattle, Washington. March 2022.

# CERTIFICATION

The technical material and data contained in this document were prepared under the supervision and direction of the undersigned, whose seal, as a professional engineer licensed to practice as such, is affixed below.

Prepared by Tresia Gonzalez

Checked by Mark Yand, PE

KEVIN L. HOUSE
STATE OF WASHINGTON
41824
REGISTERED
PROFESSIONAL ENGINEER
2/9/2024

Approved by Kevin House, PE

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**APPENDICES**

# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| BMX | bioretention soil mix |
| County | Kitsap County |
| Ecology | Washington State Department of Ecology |
| GULD | General Use Level Designation |
| HCM | Highway Capacity Manual |
| KCFMO | Kitsap County Fire Marshal's Office |
| KCSDM | Kitsap County Stormwater Design Manual |
| LOS | level of service |
| MUTCD | Manual on Uniform Traffic Control Devices |
| RAB | roundabout |
| ROW | right-of-way |
| sf | square feet |
| SKFR | South Kitsap Fire and Rescue |
| SR | State Route |
| SWMMWW | Stormwater Management Manual for Western Washington |
| TAPE | Technology Assessment Protocol – Ecology |
| v/c | volume-to-capacity |
| WSDOT | Washington State Department of Transportation |

# 1. INTRODUCTION

SE Lund Avenue is an important transportation corridor in South Kitsap County linking East Port Orchard with Parkwood and State Route (SR) 16. Between the intersections of Bethel Road SE and Jackson Avenue SE, Lund Avenue provides access to business, schools, South Kitsap Regional Park, and residential neighborhoods. This section of roadway lacks many of the amenities more typical of an urban arterial, such as sidewalks, landscaping, bike lanes, and stormwater collection facilities. In Kitsap County's Six Year Transportation Improvement Program, Lund Avenue between Hoover Avenue and Jackson Avenue is programmed for roadway and intersection improvements to improve safety and mobility for motorists, bicyclists, pedestrians, and transit. This report provides the results of a traffic study conducted for the SE Lund Avenue Traffic Study Project. The purpose of the traffic study was to develop a preferred approach and 30% design for improving multimodal safety and intersection level of service (LOS) on SE Lund Avenue between Bethel Road NE and Jackson Avenue SE.

Based on previous studies, SE Lund Avenue is identified as a "capacity project" (future 2036) in the Kitsap County Capital Facilities Plan. The current analysis expands upon a 2013 corridor study (Kitsap County 2013) and includes an alternatives analysis that considers improvements to major intersections within the corridor with observed LOS deficiencies (Harris Road SE, Hoover Avenue SE, and Chase Road SE). The alternatives analysis included the study of both roundabout and signalized control options at all three intersections.

# 2. METHODOLOGY

The study includes SE Lund Avenue from Bethel Road SE to east of Chase Road SE and includes the side street approaches of Cathie Avenue SE, Hoover Avenue SE, Harris Road SE, and Chase Road SE (see Exhibit 1 below).

The study utilized several traffic modeling tools to evaluate existing conditions in the corridor and to predict roadway and intersection performance with proposed improvements. The Synchro 10 tool was used to determine LOS and delay for stop-controlled and signalized intersections. Highway Capacity Manual (HCM) 2000 analysis was reported for signalized intersections. The SIDRA 8 tool was used to determine the roundabouts volume-to-capacity (v/c) ratios consistent with standard practice. The LOS for roundabouts was also reported to support local agency practice.

The analysis time periods were existing conditions (year 2020) and a plus-10-years horizon period (2030).

Existing and historic tube and turn movement counts were provided by Kitsap County (County) for use in the analysis (see Appendix A). Historic vehicle collision data was provided by the Washington State Department of Transportation (WSDOT) for the same study area for January 1, 2015, through December 31, 2019 (see Appendix B).

Traffic volumes were forecast based on the Bethel Corridor study (Port Orchard 2018) and result in about 38 percent growth in traffic on SE Lund Avenue within about 10 years. A nominal 5 percent growth rate was applied to the minor street approaches to SE Lund Avenue, including Cathie Avenue SE, Hoover Avenue SE, Harris Road SE, and Chase Road SE.

Alternatives were developed to address the needs in the corridor and screened using the criteria listed below. The alternatives were screened against the criteria and rated from not favorable to favorable. The project team used these criteria (high-priority and mid-priority) to select a preferred alternative. However, the criteria did not include a weighting process or value.

- High-Priority Screening Criteria:
  - Improve side street access onto SE Lund Avenue (at Hoover, Harris, Chase).
  - Improve access between SE Lund Avenue and private driveways.
  - Select traffic control methods warranted per the Manual on Uniform Traffic Control Devices (MUTCD).
  - Design should be compatible with Bethel Avenue and Cathie Road operations, including future roundabout (RAB) at Bethel and support potential to provide access management within City of Port Orchard right-of-way (ROW).
  - Minimize potential for traffic to cut through the neighborhood to avoid the Bethel and Jackson corridors.
  - Design should be compatible with urban residential neighborhood and adjacent corridors.
  - Improve identified safety issues.
  - Minimize pedestrian crossing lengths and improve crossings at intersections.
  - Design should be compatible with future midblock pedestrian crossing(s).
- Mid-Priority Screening Criteria:
  - Meet or exceed County operation standards along SE Lund Avenue and minimize additional delay.
  - Minimize maintenance cost.
  - Minimize cost to construct.
  - Minimize ROW impacts/takes.

# 3. EXISTING AND NO BUILD ALTERNATIVE CONDITIONS

The existing and horizon No Build (28 percent growth in traffic volumes, or approximately year 2030) traffic analysis determined that the existing unsignalized intersections at Hoover Avenue SE, Harris Road SE, and Chase Road SE would operate at LOS E/F for the minor street approaches. Under both conditions, SE Lund Avenue is free-flow with no stop control (see Exhibit 1). Both the existing and the 2030 No Build condition are based on existing channelization and stop control.

The South Kitsap Regional Park is a destination for bicycles and pedestrians. The current condition does not provide optimal conditions for nonmotorized travel along the corridor. In addition, driveways are located along SE Lund Avenue and vehicles stop the flow of traffic along SE Lund Avenue waiting for a gap in oncoming traffic. Left turns from driveways and businesses increase the number of conflicts and congestion in the corridor, reducing the corridor throughput. These conflicts, delays, and congestion will increase as traffic volumes on SE Lund Avenue continue to increase.

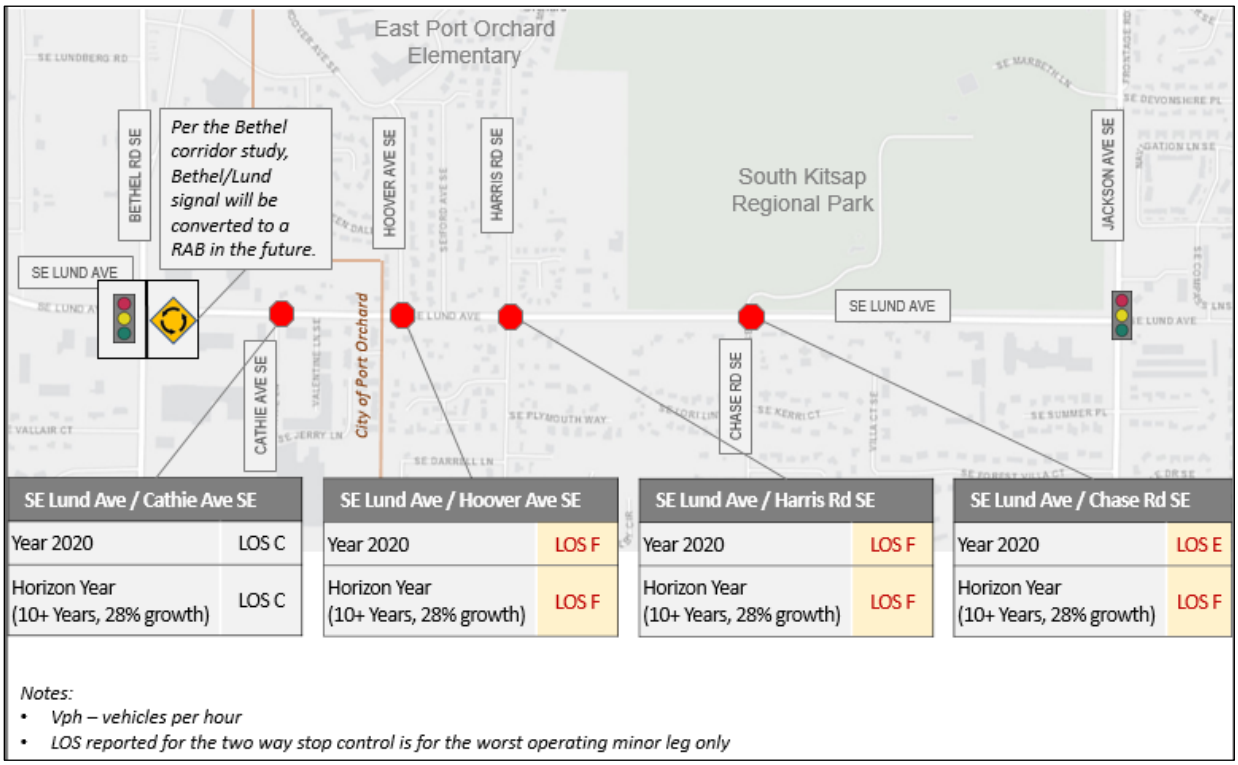



**Exhibit 1. Existing and Horizon Year Traffic Operations, PM Peak Hour**

# 4. DEVELOP AND SELECT PREFERRED ALTERNATIVE

Alternatives were developed to address identified traffic issues, improve safety, improve the pedestrian and bicycle experience, maintain emergency access, and fit the urban residential environment.

The following alternatives were evaluated for this study:

- Alternative 1 – No Build
- Alternative 2A – Signals
- Alternative 2B – Signals with Access Management
- Alternative 3A – Roundabouts
- Alternative 3B – Roundabouts with Access Management

The access management alternatives would eliminate left turns to or from side streets and driveways, and would reroute those movements to U-turns at signals or roundabouts.

## 4.1 Signal Alternatives (2A and 2B)

A strategy to reduce the side street delay and to improve local circulation was considered that provided signals at the intersections of SE Lund Avenue with Hoover Avenue SE, Harris Road SE, and Chase Road SE. However, signals are not warranted at Harris Road SE and Chase Road SE based on the MUTCD. Implementing a signal at Harris Road SE and Chase Road SE would provide benefit to the side street approaches, but that would not offset the increased delay incurred on the major street approach (SE Lund Avenue). See Exhibit 2.

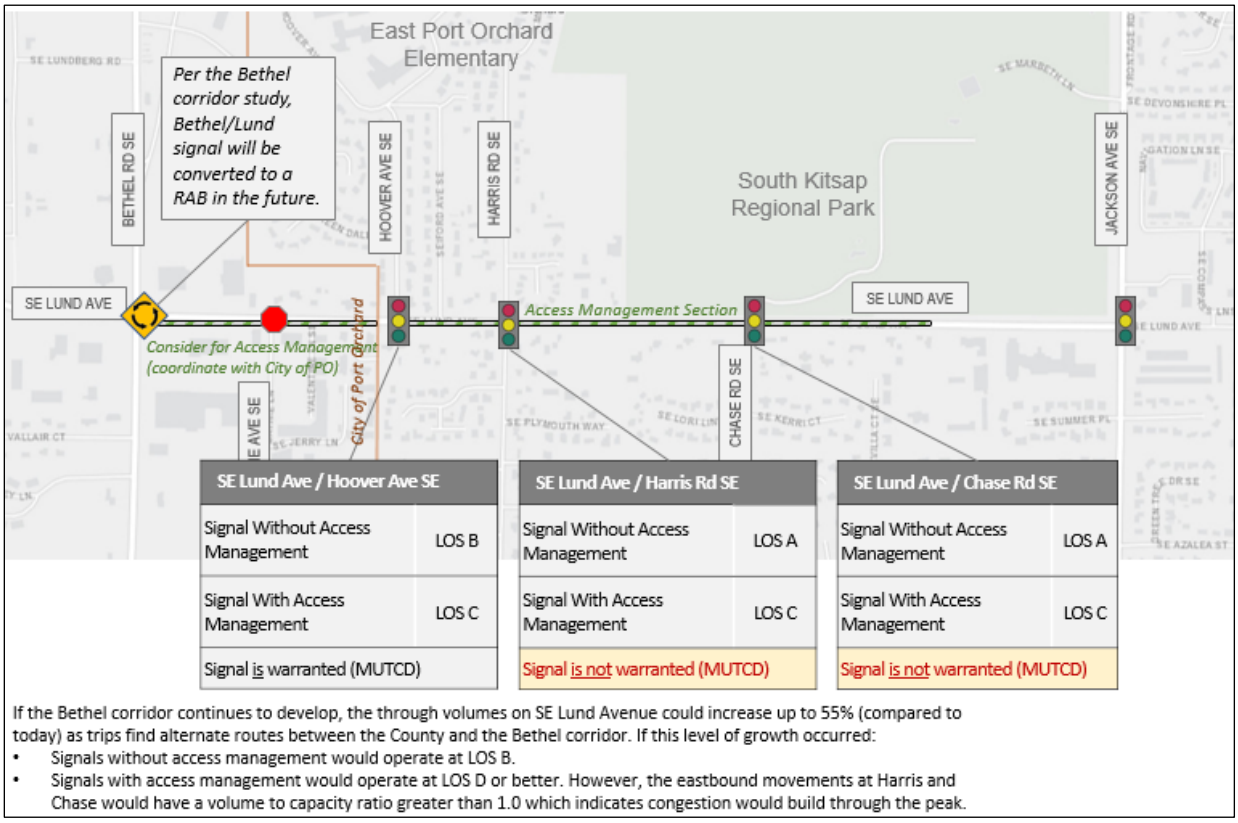



**Exhibit 2. Horizon Year Traffic Operations, PM Peak Hour, with Signal Improvements**

## 4.2 Roundabout Alternatives (3A and 3B)

An alternative solution was identified consisting of replacing the two-way stop-controlled intersections with RABs, thereby not degrading the SE Lund Avenue approach traffic, allowing circulation from the minor streets, and providing an opportunity to median-separate the corridor and provide future pedestrian enhancements. As shown in Exhibit 3, the roundabout solution would result in LOS A operations for the study intersections with v/c ratios under 0.92.

The roundabouts would allow for future access management, such as left-turn restrictions at driveways between the roundabouts with U-turns provided at the roundabouts. Roundabouts with access management would also allow the County to consider midblock pedestrian crossings in the future or consider having pedestrians cross at the roundabouts, which are typically safer than unmarked crossings or crossings at signals where traffic is approaching in multiple directions.

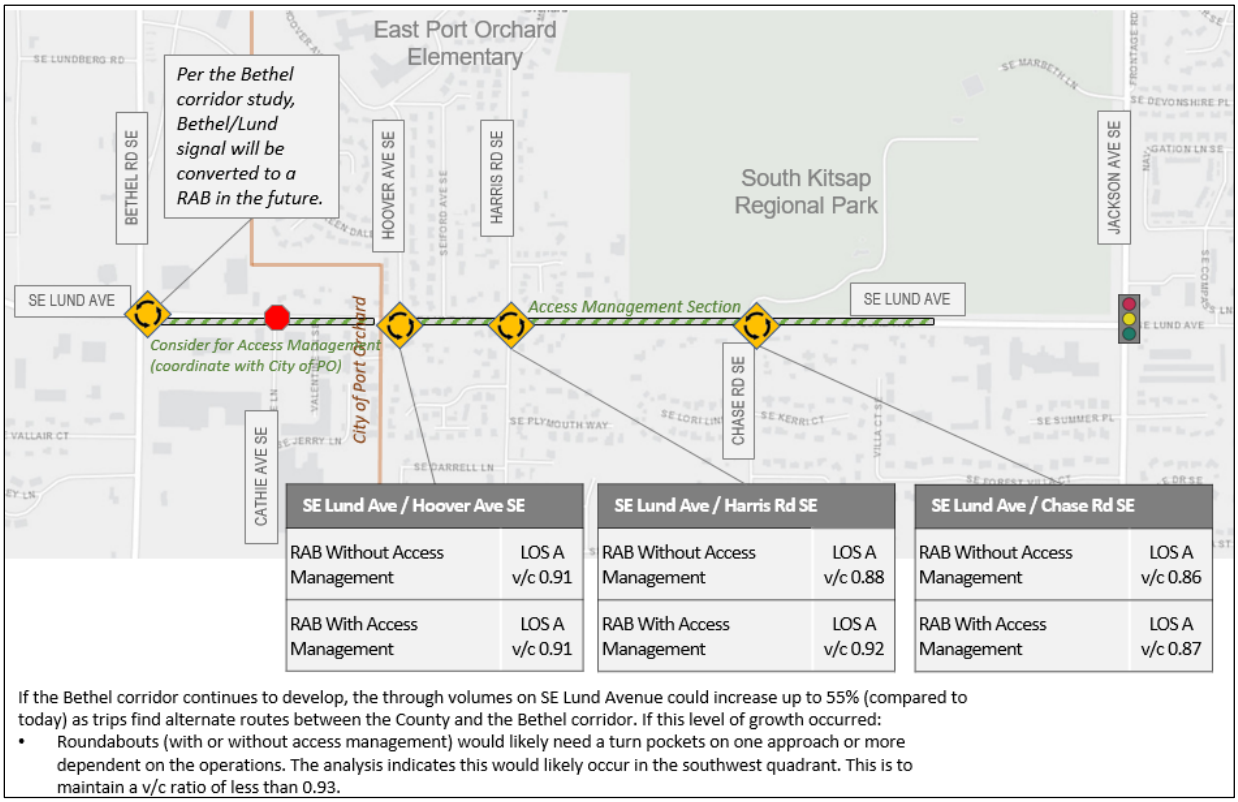



**Exhibit 3. Horizon Year Traffic Operations, PM Peak Hour, with Roundabout Improvements**

## 4.3 Preferred Alternative

The alternatives were compared with each other based on the screening criteria. The project team met in August 2020 to review the screening criteria and analyses and finalize a preferred alternative recommendation. The selected preferred alternative is Alternative 3B – Roundabouts with Access Management. The screening criteria and scoring is shown in Appendix C.

The project team selected Alternative 3B – Roundabouts with Access Management as the preferred alternative for the proposed corridor improvements. A significant factor in the selection was the ability to achieve LOS A in both the current and horizon years with roundabouts combined with the safety improvements provided by access control.

# 5. PREFERRED ALTERNATIVE DESIGN AND COST

Preliminary design, cost estimates, and approach to stormwater management were prepared for the Preferred Alternative (3B).

## 5.1 Preliminary (30%) Design

Construction phasing was identified for the Preferred Alternative as part of the design work. The concept was phased to prioritize the intersection roundabout improvements, as roundabouts allow traffic to U-turn and thus are necessary to allow access management sections to be constructed. The phasing plan is to construct the Harris Road SE roundabout first, followed by Hoover Avenue. When

Hoover Avenue is complete, it is then logical to connect the intersections with an access managed section. The last roundabout to be constructed is Chase Road SE, followed by access management improvements to Segments 2 and 3. A corridor plan showing proposed improvements and roadway segments is provided on Exhibit 4. Typical sections for roadway segments are provided in Exhibit 5 and Exhibit 6. The 30% complete plans for the Harris Road SE roundabout, Hoover Avenue SE roundabout, and roadway Segment 1 have been prepared and are provided separately from this traffic study report. Costs for the improvement phases are shown in Table 1. Detailed cost estimate spreadsheets are provided in Appendix D.

**Table 1. Estimated Project Costs by Phase**

| | | Cost ($M)[1] | | | |
|---|---|---|---|---|---|
| **Priority** | **Project** | **PE** | **Right-of-Way** | **Construction** | **Total** |
| 1 | **Phase 1 – Harris RD SE Roundabout** | $0.27 | $0.10 | $1.87 | $2.24 |
| 2 | **Phase 2 – Hoover Avenue Roundabout and Roadway Segment 1** | $0.35 | $0.09 | $2.51 | $2.95 |
| 3 | **Phase 3 – Chase Rd SE Roundabout** | $0.25 | $0.06 | $1.77 | $2.08 |
| 4 | **Phase 4 – Roadway Segment 2** | $0.29 | $0 | $2.06 | $2.35 |
| 5 | **Phase 5 – Roadway Segment 3** | $0.24 | $0 | $2.17 | $2.41 |
| | | | | **Total** | **$12.03** |

Notes:

1 Costs assume construction will occur in 2023.

## 5.2 Stormwater

A stormwater evaluation was performed to inform preliminary engineering design for Phases 1 and 2 and to guide conceptual design for the remainder of the corridor. The evaluation identified minimum stormwater management requirements for roadway improvements in accordance with the *Kitsap County Stormwater Design Manual* (KCSDM), effective October 4, 2021, and the Washington State Department of Ecology's (Ecology) *Stormwater Management Manual for Western Washington* (SWMMWW), effective July 2019. A draft preliminary Drainage Technical Memorandum (TM) (Parametrix 2021) is provided in Appendix E. Per the KCSDM, roadway improvements are considered redevelopment since the corridor has more than 35 percent existing impervious coverage. Project phases within the corridor that construct 2,000 square feet (sf) or more of new plus replaced hard surface or that result in the construction of more than 5,000 sf of new hard surface are subject to all minimum requirements. It is anticipated that all five corridor phases will be required to meet all minimum stormwater requirements based on preliminary design and concepts developed for the corridor. Stormwater facilities should be provided to treat, store, and slowly discharge stormwater for each project phase as required.

The preferred approach for stormwater treatment and flow control is to infiltrate stormwater into underlying soils where feasible. The draft preliminary Drainage TM describes infiltration feasibility within the corridor based on information from the project geotechnical report and Kitsap County's 2019 report *East Bremerton and East Port Orchard Stormwater Retrofit Plan*. According to information provided in these documents, infiltration is likely not feasible for the Hoover Avenue SE roundabout and Roadway Segment 1. The Harris Road SE roundabout, Roadway Segment 2, Chase Road SE roundabout, and Roadway Segment 3 are underlain by outwash soils where infiltration is considered feasible. The

concept for stormwater treatment and flow control in these areas is to install stormwater bioretention swales between roadway travel lanes and sidewalks. Stormwater treatment (where required) can be provided using an 18-inch-thick layer of bioretention soil mix (BMX) meeting the requirements of the SWMMWW at the base of the swales. This concept is illustrated in the typical roadway sections on Exhibit 4.

Where infiltration is not feasible, stormwater maybe treated using propriety curb inlet-type stormwater treatment vaults, such as Filterra® or Biopod® units, that have received Washington State Technology Assessment Protocol – Ecology (TAPE) General Use Level Designation (GULD) approval. Flow control may be provided using small-diameter detention vaults constructed using 36-inch-diameter corrugated metal pipe (or similar) located within the Kitsap County ROW. The advantage of locating the detention vaults in the ROW is that acquiring additional ROW for detention ponds from adjacent private property owners will not be required. The use of small-diameter pipes is required because vertical fall for stormwater conveyance to existing stormwater conveyance piping and ditches is limited.

## 5.3 Emergency Response

During the preliminary planning and design process, Parametrix and Kitsap County staff coordinated with South Kitsap Fire and Rescue (SKFR) and Kitsap County Fire Marshal's Office (KCFMO) staff regarding the proposed roadway design and emergency vehicle access throughout the corridor. The objective of the coordination was to communicate the goals of the corridor plan (increased LOS, safety, etc.) while receiving input to ensure that the design did not significantly inhibit emergency response operations or negatively impact response times. After review of the proposed design, SKFR and KCFMO staff expressed concern over the ability of emergency vehicles to pass vehicles that may pull over and stop within the roadway segments containing a raised center median separating the travel lanes. At these locations, the proposed design provides an unobstructed width of 18 feet curb to curb. The stated preference was that a clear and unobstructed width of 20 feet be provided per Kitsap County code. To address this concern, mountable medians are proposed that are spaced at approximately 200-foot intervals within the corridor (see Exhibit 4). The mountable medians, which are 170 feet long, 4 inches tall, and 1.5 feet wide, allow emergency vehicles to cross the median and encroach into the opposing travel lane when passing a parked vehicle. These roadway segments, designated as "fire lanes," also allow emergency vehicles to cross the mountable median and access vehicles and/or properties on the opposite side of the roadway. Refer to the typical roadway sections provided on Exhibit 5 and Exhibit 6 for depictions of both planted median and fire lane roadway segments.

# 6. REFERENCES

Kitsap County. 2013. SE Lund Avenue and Harris Road SE Traffic Study, Intersection Improvements – Signalization. Kitsap County Public Works. July.

Parametrix. 2021. Draft Preliminary Drainage Technical Memorandum. Prepared by Parametrix, Bremerton, WA.

Port Orchard. 2018. Bethel Road and Sedgwick Road Corridor Plan. City of Port Orchard, Washington. October.


Parametrix DATE: March 4, 2022 FILE: XPS1578156C-DE(FULLCORRIDOR)

N

0 240

SCALE IN FEET

LEGEND:

1.5' WIDE MOUNTABLE MEDIAN

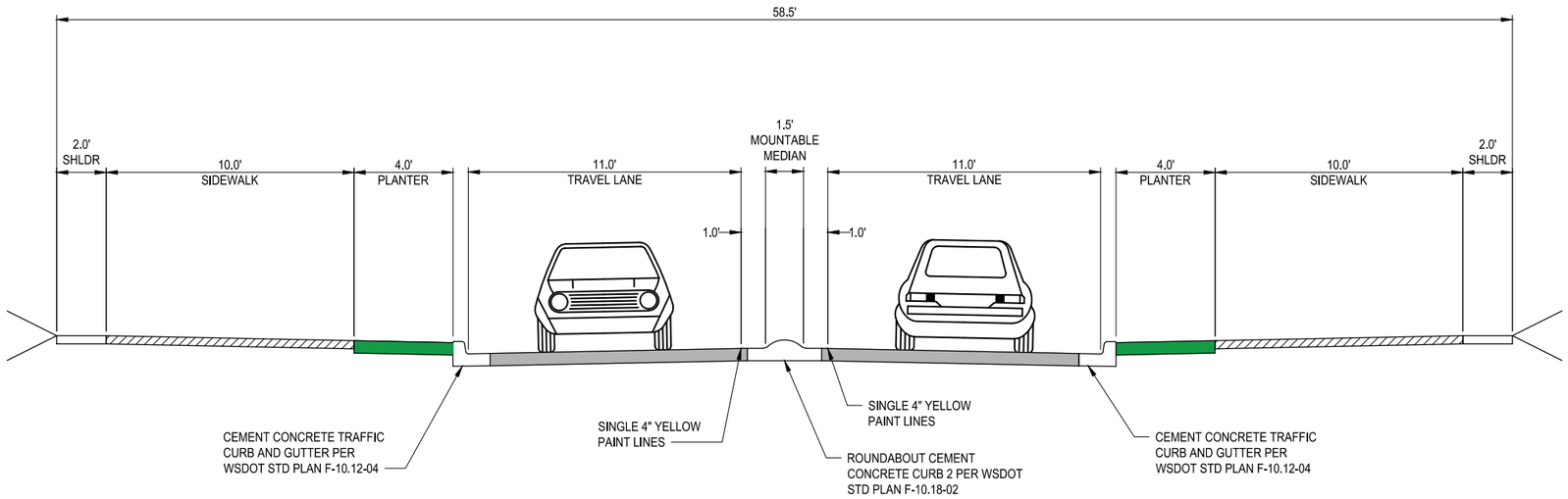
5.0' WIDE PLANTED MEDIAN

SINGLE LANE ROUNDABOUT

PROPOSED U-TURN FOR PASSENGER VEHICLE

**EXHIBIT 04**

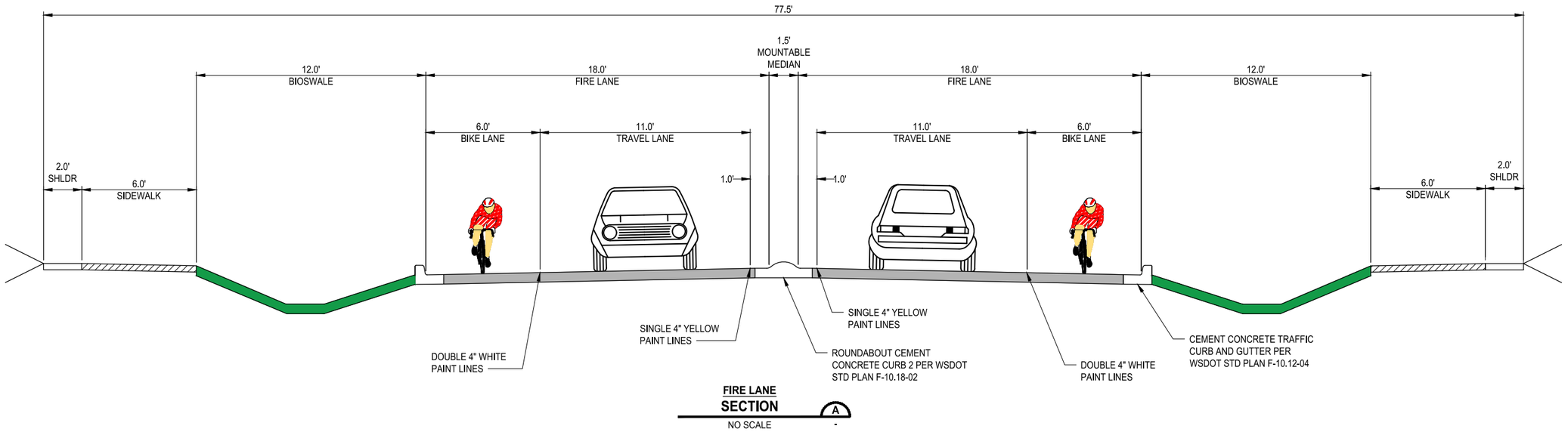
SE LUND AVENUE TRAFFIC STUDY
CONCEPTUAL CORRIDOR PLAN



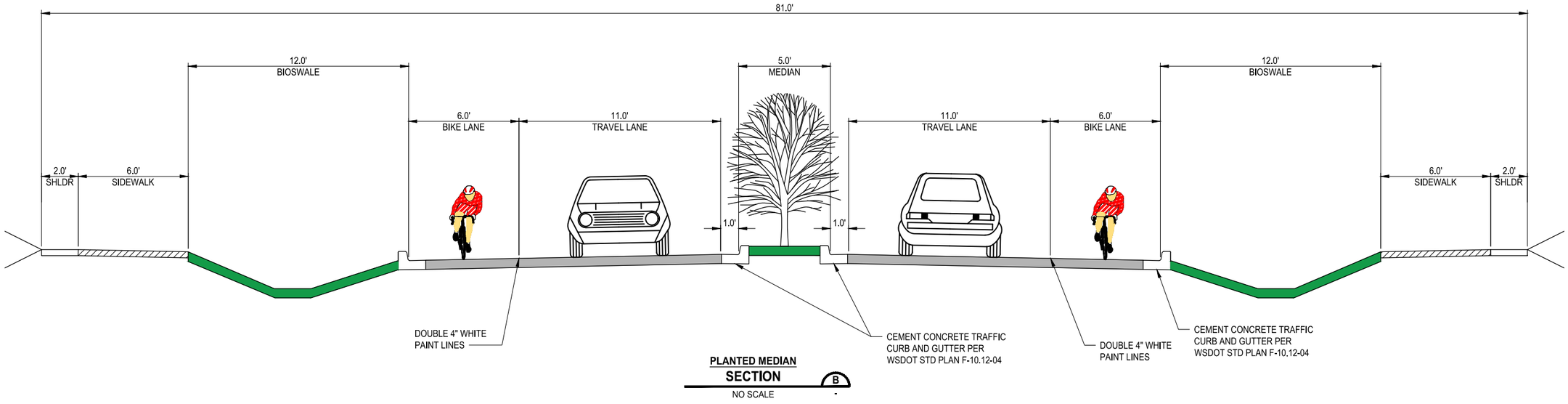

**SEGMENT 1**
**(BETWEEN HOOVER AND HARRIS)**
**SECTION** C
NO SCALE



**EXHIBIT 05**
**TYPICAL SECTION FOR SEGMENT 1**
SE LUND AVENUE TRAFFIC STUDY




**FIRE LANE**
**SECTION** A
NO SCALE -




**PLANTED MEDIAN**
**SECTION** B
NO SCALE -



**EXHIBIT 06**
**TYPICAL SECTIONS FOR ROADWAY SEGMENTS 2 AND 3**
SE LUND AVENUE TRAFFIC STUDY

# Appendix A

## Existing and Historic Tube and Turn Movement Counts

# Kitsap County Traffic Engineering

## Daily Vehicle Volume Report

Study Date: Wednesday, 02/05/2020 / Thursday, 02/06/2020
Unit ID: 8
Location: Lund Ave. E. of Cathie Ave. 284.0

| | Westbound Volume | Eastbound Volume | Total Volume |
|---|---|---|---|
| **11:00 - 11:59** | 463 | 446 | **909** |
| **12:00 - 12:59** | 479 | 503 | **982** |
| **13:00 - 13:59** | 489 | 513 | **1002** |
| **14:00 - 14:59** | 541 | 611 | **1152** |
| **15:00 - 15:59** | 545 | 739 | **1284** |
| **16:00 - 16:59** | 532 | 840 | **1372** |
| **17:00 - 17:59** | 505 | 800 | **1305** |
| **18:00 - 18:59** | 366 | 576 | **942** |
| **19:00 - 19:59** | 248 | 418 | **666** |
| **20:00 - 20:59** | 151 | 283 | **434** |
| **21:00 - 21:59** | 139 | 222 | **361** |
| **22:00 - 22:59** | 90 | 122 | **212** |
| **23:00 - 23:59** | 40 | 95 | **135** |
| **00:00 - 00:59** | 30 | 62 | **92** |
| **01:00 - 01:59** | 24 | 30 | **54** |
| **02:00 - 02:59** | 16 | 30 | **46** |
| **03:00 - 03:59** | 53 | 31 | **84** |
| **04:00 - 04:59** | 140 | 25 | **165** |
| **05:00 - 05:59** | 247 | 56 | **303** |
| **06:00 - 06:59** | 432 | 133 | **565** |
| **07:00 - 07:59** | 527 | 290 | **817** |
| **08:00 - 08:59** | 525 | 271 | **796** |
| **09:00 - 09:59** | 483 | 334 | **817** |
| **10:00 - 10:59** | 448 | 393 | **841** |
| **Totals** | **7513** | **7823** | **15336** |
| **AM Peak Time** | **07:51 - 08:50** | **11:00 - 11:59** | **11:00 - 11:59** |
| **AM Peak Volume** | **567** | **446** | **909** |
| **PM Peak Time** | **14:41 - 15:40** | **16:34 - 17:33** | **16:30 - 17:29** |
| **PM Peak Volume** | **580** | **876** | **1400** |

# Kitsap County Traffic Engineering

## Daily Total Classes Report

Study Date: Wednesday, 02/05/2020 / Thursday, 02/06/2020

Unit ID: 8

Location: Lund Ave. E. of Cathie Ave. 284.0

| | #1 | #2 | #3 | #4 | #5 | #6 | #7 | #8 | #9 | #10 | #11 | #12 | #13 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **11:00 - 11:59** | 6 | 704 | 126 | 1 | 67 | 4 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | **909** |
| **12:00 - 12:59** | 8 | 770 | 122 | 1 | 76 | 4 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | **982** |
| **13:00 - 13:59** | 5 | 790 | 134 | 3 | 60 | 6 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | **1002** |
| **14:00 - 14:59** | 12 | 883 | 154 | 8 | 89 | 5 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | **1152** |
| **15:00 - 15:59** | 16 | 990 | 179 | 6 | 83 | 6 | 1 | 1 | 0 | 0 | 0 | 0 | 2 | **1284** |
| **16:00 - 16:59** | 16 | 1077 | 171 | 13 | 89 | 4 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | **1372** |
| **17:00 - 17:59** | 18 | 1029 | 165 | 0 | 85 | 3 | 2 | 2 | 0 | 0 | 0 | 1 | 0 | **1305** |
| **18:00 - 18:59** | 2 | 760 | 116 | 1 | 62 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | **942** |
| **19:00 - 19:59** | 0 | 566 | 63 | 2 | 35 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **666** |
| **20:00 - 20:59** | 1 | 372 | 40 | 0 | 21 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **434** |
| **21:00 - 21:59** | 0 | 307 | 39 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **361** |
| **22:00 - 22:59** | 0 | 192 | 10 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **212** |
| **23:00 - 23:59** | 0 | 117 | 13 | 1 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **135** |
| **00:00 - 00:59** | 1 | 83 | 4 | 0 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **92** |
| **01:00 - 01:59** | 0 | 47 | 2 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **54** |
| **02:00 - 02:59** | 0 | 35 | 6 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **46** |
| **03:00 - 03:59** | 2 | 59 | 12 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **84** |
| **04:00 - 04:59** | 1 | 112 | 23 | 0 | 28 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | **165** |
| **05:00 - 05:59** | 1 | 217 | 43 | 0 | 40 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | **303** |
| **06:00 - 06:59** | 0 | 444 | 50 | 4 | 62 | 4 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | **565** |
| **07:00 - 07:59** | 1 | 647 | 98 | 3 | 63 | 2 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | **817** |
| **08:00 - 08:59** | 8 | 596 | 110 | 10 | 70 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **796** |
| **09:00 - 09:59** | 3 | 617 | 106 | 8 | 76 | 3 | 1 | 2 | 0 | 0 | 0 | 1 | 0 | **817** |
| **10:00 - 10:59** | 2 | 657 | 121 | 1 | 55 | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | **841** |
| **Totals** | **103** | **12071** | **1907** | **62** | **1114** | **47** | **8** | **11** | **7** | **0** | **0** | **3** | **3** | **15336** |
| **Percent of Total** | **0.7** | **78.7** | **12.4** | **0.4** | **7.3** | **0.3** | **0.1** | **0.1** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **100** |
| **Percent of AM** | **0.5** | **76.8** | **12.8** | **0.5** | **8.8** | **0.3** | **0.1** | **0.1** | **0.1** | **0.0** | **0.0** | **0.0** | **0.0** | **100** |
| **Percent of PM** | **0.8** | **79.8** | **12.2** | **0.4** | **6.4** | **0.3** | **0.0** | **0.1** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **100** |

**Truck Summary:**

Total Trucks: 1255 % Trucks: 8.2 AM % Trucks: 9.9 PM % Trucks: 7.2

---

Classification Scheme: FHWA (ID: 1)

#1 Motorcycles - 2 Axles
#2 Passenger Cars - 2 Axles
#3 Pickup Trucks, Vans - 2 Axles
#4 Buses
#5 Single Unit - 2 Axles, 6 Tires
#6 Single Unit Truck - 3 Axles
#7 Single Unit - 4 Axles
#8 Single Unit - 4 Axles or Less
#9 Double Unit - 5 Axles
#10 Double Unit - 6 Axles or More
#11 Multi-Unit - 5 Axles or Less
#12 Multi-Unit - 6 Axles
#13 Multi-Unit - 7 Axles or More

# Kitsap County Traffic Engineering

## Daily Total Speeds (MPH)

Study Date: Wednesday, 02/05/2020 / Thursday, 02/06/2020

Unit ID: 8

Location: Lund Ave. E. of Cathie Ave. 284.0

Posted Speed: 35

| | 5-14 | 15-19 | 20-24 | 25-29 | 30-34 | 35-39 | 40-44 | 45-49 | 50-54 | 55-59 | 60-64 | 65-69 | 70-74 | 75-79 | 80-99 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **11:00 - 11:59** | 5 | 30 | 73 | 137 | 367 | 249 | 46 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | **909** |
| **12:00 - 12:59** | 2 | 16 | 58 | 198 | 423 | 241 | 37 | 5 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | **982** |
| **13:00 - 13:59** | 2 | 36 | 81 | 187 | 431 | 225 | 31 | 2 | 3 | 0 | 0 | 1 | 1 | 2 | 0 | **1002** |
| **14:00 - 14:59** | 5 | 46 | 88 | 274 | 453 | 238 | 32 | 8 | 3 | 2 | 0 | 0 | 1 | 0 | 0 | **1150** |
| **15:00 - 15:59** | 4 | 51 | 157 | 354 | 456 | 225 | 28 | 2 | 4 | 0 | 0 | 1 | 0 | 0 | 1 | **1283** |
| **16:00 - 16:59** | 15 | 85 | 162 | 387 | 485 | 201 | 29 | 6 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | **1372** |
| **17:00 - 17:59** | 8 | 46 | 135 | 348 | 484 | 232 | 38 | 6 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | **1300** |
| **18:00 - 18:59** | 1 | 28 | 58 | 153 | 383 | 246 | 60 | 8 | 4 | 0 | 0 | 0 | 1 | 0 | 0 | **942** |
| **19:00 - 19:59** | 2 | 15 | 40 | 79 | 291 | 182 | 49 | 7 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | **666** |
| **20:00 - 20:59** | 0 | 8 | 17 | 61 | 176 | 137 | 25 | 5 | 1 | 3 | 0 | 0 | 1 | 0 | 0 | **434** |
| **21:00 - 21:59** | 3 | 7 | 8 | 46 | 129 | 126 | 36 | 3 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | **361** |
| **22:00 - 22:59** | 1 | 6 | 5 | 25 | 77 | 71 | 22 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **212** |
| **23:00 - 23:59** | 0 | 3 | 2 | 17 | 43 | 57 | 10 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | **135** |
| **00:00 - 00:59** | 1 | 3 | 7 | 15 | 27 | 23 | 11 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | **91** |
| **01:00 - 01:59** | 0 | 0 | 0 | 8 | 19 | 15 | 6 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **54** |
| **02:00 - 02:59** | 0 | 0 | 1 | 6 | 15 | 18 | 5 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | **46** |
| **03:00 - 03:59** | 0 | 2 | 8 | 10 | 21 | 27 | 11 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | **84** |
| **04:00 - 04:59** | 0 | 3 | 12 | 11 | 29 | 58 | 38 | 13 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | **165** |
| **05:00 - 05:59** | 0 | 4 | 20 | 18 | 54 | 127 | 62 | 16 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | **303** |
| **06:00 - 06:59** | 4 | 13 | 35 | 55 | 151 | 235 | 67 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | **565** |
| **07:00 - 07:59** | 0 | 26 | 47 | 89 | 301 | 275 | 72 | 4 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | **817** |
| **08:00 - 08:59** | 2 | 27 | 61 | 123 | 298 | 238 | 39 | 6 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | **796** |
| **09:00 - 09:59** | 2 | 23 | 60 | 124 | 326 | 224 | 48 | 3 | 4 | 1 | 0 | 1 | 0 | 0 | 0 | **816** |
| **10:00 - 10:59** | 2 | 30 | 62 | 155 | 356 | 203 | 25 | 5 | 2 | 0 | 0 | 1 | 0 | 0 | 0 | **841** |
| **Totals** | **59** | **508** | **1197** | **2880** | **5795** | **3873** | **827** | **123** | **35** | **9** | **2** | **7** | **5** | **4** | **2** | **15326** |
| **Percent of Total** | **0.4** | **3.3** | **7.8** | **18.8** | **37.8** | **25.3** | **5.4** | **0.8** | **0.2** | **0.1** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **100** |
| **Percent of AM** | **0.3** | **2.9** | **7.0** | **13.7** | **35.8** | **30.8** | **7.8** | **1.2** | **0.3** | **0.0** | **0.0** | **0.1** | **0.0** | **0.0** | **0.0** | **100** |
| **Percent of PM** | **0.4** | **3.5** | **8.2** | **21.6** | **38.9** | **22.2** | **4.0** | **0.6** | **0.2** | **0.1** | **0.0** | **0.0** | **0.1** | **0.0** | **0.0** | **100** |

Standard Deviation: 6.4 MPH

Mean Speed: 32.2 MPH

Median Speed: 32.6 MPH

Modal Speed: 32.5 MPH

Ten Mile Pace: 30 to 39 MPH

Percent in Ten Mile Pace: 63.1%

85th Percentile: 38.3 MPH

15th Percentile: 25.9 MPH

90th Percentile: 39.3 MPH

95th Percentile: 41.5 MPH

# Daily Vehicle Volume Report

Study Date: Tuesday, 02/11/2020 / Wednesday, 02/12/2020
Unit ID: 24
Location: Hoover Ave. N. of Lund Ave.

| | Southbound Volume | Northbound Volume | Total Volume |
|---|---|---|---|
| **11:00 - 11:59** | 65 | 57 | **122** |
| **12:00 - 12:59** | 77 | 79 | **156** |
| **13:00 - 13:59** | 55 | 93 | **148** |
| **14:00 - 14:59** | 107 | 88 | **195** |
| **15:00 - 15:59** | 82 | 96 | **178** |
| **16:00 - 16:59** | 96 | 127 | **223** |
| **17:00 - 17:59** | 82 | 99 | **181** |
| **18:00 - 18:59** | 53 | 58 | **111** |
| **19:00 - 19:59** | 36 | 43 | **79** |
| **20:00 - 20:59** | 26 | 33 | **59** |
| **21:00 - 21:59** | 12 | 26 | **38** |
| **22:00 - 22:59** | 11 | 13 | **24** |
| **23:00 - 23:59** | 1 | 8 | **9** |
| **00:00 - 00:59** | 1 | 3 | **4** |
| **01:00 - 01:59** | 0 | 2 | **2** |
| **02:00 - 02:59** | 4 | 0 | **4** |
| **03:00 - 03:59** | 6 | 3 | **9** |
| **04:00 - 04:59** | 7 | 6 | **13** |
| **05:00 - 05:59** | 13 | 25 | **38** |
| **06:00 - 06:59** | 38 | 53 | **91** |
| **07:00 - 07:59** | 42 | 108 | **150** |
| **08:00 - 08:59** | 54 | 87 | **141** |
| **09:00 - 09:59** | 83 | 141 | **224** |
| **10:00 - 10:59** | 77 | 68 | **145** |
| **Totals** | **1028** | **1316** | **2344** |
| **AM Peak Time** | **09:13 - 10:12** | **08:52 - 09:51** | **08:52 - 09:51** |
| **AM Peak Volume** | **84** | **143** | **224** |
| **PM Peak Time** | **14:07 - 15:06** | **16:05 - 17:04** | **16:06 - 17:05** |
| **PM Peak Volume** | **114** | **131** | **234** |

# Daily Southbound Classes Report

Study Date: Tuesday, 02/11/2020 / Wednesday, 02/12/2020
Unit ID: 24
Location: Hoover Ave. N. of Lund Ave.

| | #1 | #2 | #3 | #4 | #5 | #6 | #7 | #8 | #9 | #10 | #11 | #12 | #13 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **11:00 - 11:59** | 44 | 12 | 1 | 0 | 2 | 4 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | **65** |
| **12:00 - 12:59** | 51 | 18 | 2 | 0 | 3 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | **77** |
| **13:00 - 13:59** | 33 | 14 | 5 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **55** |
| **14:00 - 14:59** | 73 | 21 | 2 | 1 | 1 | 4 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | **107** |
| **15:00 - 15:59** | 55 | 24 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **82** |
| **16:00 - 16:59** | 70 | 21 | 1 | 0 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | **96** |
| **17:00 - 17:59** | 41 | 33 | 2 | 0 | 4 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | **82** |
| **18:00 - 18:59** | 36 | 14 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **53** |
| **19:00 - 19:59** | 12 | 23 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **36** |
| **20:00 - 20:59** | 9 | 13 | 3 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **26** |
| **21:00 - 21:59** | 3 | 8 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **12** |
| **22:00 - 22:59** | 3 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **11** |
| **23:00 - 23:59** | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** |
| **00:00 - 00:59** | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** |
| **01:00 - 01:59** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| **02:00 - 02:59** | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **4** |
| **03:00 - 03:59** | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **6** |
| **04:00 - 04:59** | 1 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **7** |
| **05:00 - 05:59** | 4 | 6 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **13** |
| **06:00 - 06:59** | 13 | 16 | 2 | 0 | 2 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | **38** |
| **07:00 - 07:59** | 22 | 9 | 3 | 1 | 1 | 4 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | **42** |
| **08:00 - 08:59** | 33 | 15 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | **54** |
| **09:00 - 09:59** | 63 | 15 | 2 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **83** |
| **10:00 - 10:59** | 55 | 14 | 4 | 0 | 1 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | **77** |
| **Totals** | **625** | **296** | **32** | **4** | **23** | **32** | **15** | **1** | **0** | **0** | **0** | **0** | **0** | **1028** |
| **Percent of Total** | **60.8** | **28.8** | **3.1** | **0.4** | **2.2** | **3.1** | **1.5** | **0.1** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **100** |
| **Percent of AM** | **61.3** | **25.1** | **4.1** | **0.8** | **2.6** | **4.4** | **1.5** | **0.3** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **100** |
| **Percent of PM** | **60.5** | **31.0** | **2.5** | **0.2** | **2.0** | **2.4** | **1.4** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **100** |

**Truck Summary:**

Total Trucks: 75 % Trucks: 7.3 AM % Trucks: 9.5 PM % Trucks: 6.0

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Classification Scheme: FHWA (ID: 1)

#1 Motorcycles - 2 Axles
#2 Passenger Cars - 2 Axles
#3 Pickup Trucks, Vans - 2 Axles
#4 Buses
#5 Single Unit - 2 Axles, 6 Tires
#6 Single Unit Truck - 3 Axles
#7 Single Unit - 4 Axles
#8 Single Unit - 4 Axles or Less
#9 Double Unit - 5 Axles
#10 Double Unit - 6 Axles or More
#11 Multi-Unit - 5 Axles or Less
#12 Multi-Unit - 6 Axles
#13 Multi-Unit - 7 Axles or More

# Daily Northbound Classes Report

Study Date: Tuesday, 02/11/2020 / Wednesday, 02/12/2020
Unit ID: 24
Location: Hoover Ave. N. of Lund Ave.

| | #1 | #2 | #3 | #4 | #5 | #6 | #7 | #8 | #9 | #10 | #11 | #12 | #13 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **11:00 - 11:59** | 0 | 48 | 6 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **57** |
| **12:00 - 12:59** | 0 | 60 | 12 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **79** |
| **13:00 - 13:59** | 0 | 72 | 10 | 1 | 9 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | **93** |
| **14:00 - 14:59** | 0 | 70 | 12 | 2 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **88** |
| **15:00 - 15:59** | 0 | 79 | 11 | 1 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **96** |
| **16:00 - 16:59** | 0 | 84 | 15 | 17 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **127** |
| **17:00 - 17:59** | 1 | 75 | 16 | 1 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **99** |
| **18:00 - 18:59** | 0 | 52 | 5 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **58** |
| **19:00 - 19:59** | 0 | 34 | 6 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **43** |
| **20:00 - 20:59** | 0 | 26 | 6 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **33** |
| **21:00 - 21:59** | 0 | 25 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **26** |
| **22:00 - 22:59** | 0 | 12 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **13** |
| **23:00 - 23:59** | 0 | 7 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **8** |
| **00:00 - 00:59** | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **3** |
| **01:00 - 01:59** | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **2** |
| **02:00 - 02:59** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| **03:00 - 03:59** | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **3** |
| **04:00 - 04:59** | 0 | 4 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **6** |
| **05:00 - 05:59** | 0 | 18 | 4 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **25** |
| **06:00 - 06:59** | 0 | 44 | 2 | 2 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **53** |
| **07:00 - 07:59** | 1 | 97 | 4 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **108** |
| **08:00 - 08:59** | 0 | 71 | 8 | 2 | 5 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **87** |
| **09:00 - 09:59** | 0 | 98 | 11 | 22 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **141** |
| **10:00 - 10:59** | 0 | 41 | 10 | 1 | 15 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **68** |
| **Totals** | **2** | **1024** | **144** | **52** | **91** | **2** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **1316** |
| **Percent of Total** | **0.2** | **77.8** | **10.9** | **4.0** | **6.9** | **0.2** | **0.1** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **100** |
| **Percent of AM** | **0.2** | **77.4** | **8.7** | **5.2** | **8.1** | **0.4** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **100** |
| **Percent of PM** | **0.1** | **78.1** | **12.6** | **3.0** | **6.0** | **0.0** | **0.1** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **100** |

**Truck Summary:**

Total Trucks: 146 % Trucks: 11.1 AM % Trucks: 13.7 PM % Trucks: 9.2

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Classification Scheme: FHWA (ID: 1)

#1 Motorcycles - 2 Axles
#2 Passenger Cars - 2 Axles
#3 Pickup Trucks, Vans - 2 Axles
#4 Buses
#5 Single Unit - 2 Axles, 6 Tires
#6 Single Unit Truck - 3 Axles
#7 Single Unit - 4 Axles
#8 Single Unit - 4 Axles or Less
#9 Double Unit - 5 Axles
#10 Double Unit - 6 Axles or More
#11 Multi-Unit - 5 Axles or Less
#12 Multi-Unit - 6 Axles
#13 Multi-Unit - 7 Axles or More

# Daily Total Classes Report

Study Date: Tuesday, 02/11/2020 / Wednesday, 02/12/2020
Unit ID: 24
Location: Hoover Ave. N. of Lund Ave.

| | #1 | #2 | #3 | #4 | #5 | #6 | #7 | #8 | #9 | #10 | #11 | #12 | #13 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **11:00 - 11:59** | 44 | 60 | 7 | 1 | 4 | 4 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | **122** |
| **12:00 - 12:59** | 51 | 78 | 14 | 0 | 10 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | **156** |
| **13:00 - 13:59** | 33 | 86 | 15 | 1 | 10 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | **148** |
| **14:00 - 14:59** | 73 | 91 | 14 | 3 | 5 | 4 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | **195** |
| **15:00 - 15:59** | 55 | 103 | 11 | 1 | 5 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **178** |
| **16:00 - 16:59** | 70 | 105 | 16 | 17 | 13 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | **223** |
| **17:00 - 17:59** | 42 | 108 | 18 | 1 | 10 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | **181** |
| **18:00 - 18:59** | 36 | 66 | 6 | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **111** |
| **19:00 - 19:59** | 12 | 57 | 6 | 1 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **79** |
| **20:00 - 20:59** | 9 | 39 | 9 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **59** |
| **21:00 - 21:59** | 3 | 33 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **38** |
| **22:00 - 22:59** | 3 | 20 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **24** |
| **23:00 - 23:59** | 0 | 8 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **9** |
| **00:00 - 00:59** | 0 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **4** |
| **01:00 - 01:59** | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **2** |
| **02:00 - 02:59** | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **4** |
| **03:00 - 03:59** | 3 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **9** |
| **04:00 - 04:59** | 1 | 10 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **13** |
| **05:00 - 05:59** | 4 | 24 | 5 | 1 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **38** |
| **06:00 - 06:59** | 13 | 60 | 4 | 2 | 7 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | **91** |
| **07:00 - 07:59** | 23 | 106 | 7 | 1 | 7 | 4 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | **150** |
| **08:00 - 08:59** | 33 | 86 | 10 | 3 | 6 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | **141** |
| **09:00 - 09:59** | 63 | 113 | 13 | 23 | 11 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **224** |
| **10:00 - 10:59** | 55 | 55 | 14 | 1 | 16 | 3 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | **145** |
| **Totals** | **627** | **1320** | **176** | **56** | **114** | **34** | **16** | **1** | **0** | **0** | **0** | **0** | **0** | **2344** |
| **Percent of Total** | **26.7** | **56.3** | **7.5** | **2.4** | **4.9** | **1.5** | **0.7** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **100** |
| **Percent of AM** | **25.5** | **55.8** | **6.8** | **3.4** | **5.8** | **2.0** | **0.6** | **0.1** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **100** |
| **Percent of PM** | **27.6** | **56.7** | **8.0** | **1.7** | **4.2** | **1.1** | **0.7** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **100** |

**Truck Summary:**

Total Trucks: 221 % Trucks: 9.4 AM % Trucks: 12.0 PM % Trucks: 7.7

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Classification Scheme: FHWA (ID: 1)

#1 Motorcycles - 2 Axles
#2 Passenger Cars - 2 Axles
#3 Pickup Trucks, Vans - 2 Axles
#4 Buses
#5 Single Unit - 2 Axles, 6 Tires
#6 Single Unit Truck - 3 Axles
#7 Single Unit - 4 Axles
#8 Single Unit - 4 Axles or Less
#9 Double Unit - 5 Axles
#10 Double Unit - 6 Axles or More
#11 Multi-Unit - 5 Axles or Less
#12 Multi-Unit - 6 Axles
#13 Multi-Unit - 7 Axles or More

# Daily Vehicle Volume Report

Study Date: Wednesday, 01/23/2013 / Thursday, 01/24/2013
Unit ID: 6
Location: Lund Ave. W. of Harris Rd. 236.1

| | East Bound Volume | West Bound Volume | Total Volume |
|---|---|---|---|
| 11:00 - 11:59 | 407 | 359 | 766 |
| 12:00 - 12:59 | 500 | 337 | 837 |
| 13:00 - 13:59 | 413 | 349 | 762 |
| 14:00 - 14:59 | 530 | 358 | 888 |
| 15:00 - 15:59 | 685 | 400 | 1085 |
| 16:00 - 16:59 | 694 | 369 | 1063 |
| 17:00 - 17:59 | 728 | 329 | 1057 |
| 18:00 - 18:59 | 559 | 303 | 862 |
| 19:00 - 19:59 | 406 | 194 | 600 |
| 20:00 - 20:59 | 364 | 152 | 516 |
| 21:00 - 21:59 | 233 | 98 | 331 |
| 22:00 - 22:59 | 132 | 70 | 202 |
| 23:00 - 23:59 | 81 | 44 | 125 |
| 00:00 - 00:59 | 60 | 21 | 81 |
| 01:00 - 01:59 | 41 | 14 | 55 |
| 02:00 - 02:59 | 19 | 15 | 34 |
| 03:00 - 03:59 | 22 | 22 | 44 |
| 04:00 - 04:59 | 24 | 71 | 95 |
| 05:00 - 05:59 | 50 | 210 | 260 |
| 06:00 - 06:59 | 98 | 324 | 422 |
| 07:00 - 07:59 | 259 | 446 | 705 |
| 08:00 - 08:59 | 245 | 487 | 732 |
| 09:00 - 09:59 | 338 | 387 | 725 |
| 10:00 - 10:59 | 332 | 370 | 702 |
| Totals | 7220 | 5729 | 12949 |
| AM Peak Time | 11:00 - 11:59 | 07:40 - 08:39 | 07:34 - 08:33 |
| AM Peak Volume | 407 | 534 | 812 |
| PM Peak Time | 16:47 - 17:46 | 14:49 - 15:48 | 16:36 - 17:35 |
| PM Peak Volume | 774 | 424 | 1117 |

# Daily Vehicle Volume Report

Study Date: Monday, 07/13/2009 / Tuesday, 07/14/2009
Unit ID: 16
Location: Lund Ave. W. of Harris Rd. 236.1

| | East Bound Volume | West Bound Volume | Total Volume |
|---|---|---|---|
| 11:00 - 11:59 | 475 | 500 | 975 |
| 12:00 - 12:59 | 564 | 543 | 1107 |
| 13:00 - 13:59 | 556 | 536 | 1092 |
| 14:00 - 14:59 | 586 | 549 | 1135 |
| 15:00 - 15:59 | 715 | 519 | 1234 |
| 16:00 - 16:59 | 831 | 528 | 1359 |
| 17:00 - 17:59 | 869 | 486 | 1355 |
| 18:00 - 18:59 | 673 | 461 | 1134 |
| 19:00 - 19:59 | 600 | 384 | 984 |
| 20:00 - 20:59 | 484 | 280 | 764 |
| 21:00 - 21:59 | 421 | 230 | 651 |
| 22:00 - 22:59 | 245 | 138 | 383 |
| 23:00 - 23:59 | 153 | 82 | 235 |
| 00:00 - 00:59 | 99 | 47 | 146 |
| 01:00 - 01:59 | 60 | 42 | 102 |
| 02:00 - 02:59 | 31 | 27 | 58 |
| 03:00 - 03:59 | 27 | 49 | 76 |
| 04:00 - 04:59 | 48 | 95 | 143 |
| 05:00 - 05:59 | 62 | 254 | 316 |
| 06:00 - 06:59 | 119 | 412 | 531 |
| 07:00 - 07:59 | 195 | 536 | 731 |
| 08:00 - 08:59 | 263 | 530 | 793 |
| 09:00 - 09:59 | 347 | 553 | 900 |
| 10:00 - 10:59 | 359 | 475 | 834 |
| Totals | 8782 | 8256 | 17038 |
| AM Peak Time | 11:00 - 11:59 | 07:08 - 08:07 | 11:00 - 11:59 |
| AM Peak Volume | 475 | 563 | 975 |
| PM Peak Time | 16:24 - 17:23 | 14:25 - 15:24 | 16:24 - 17:23 |
| PM Peak Volume | 887 | 561 | 1409 |

# Daily Vehicle Volume Report

Study Date: Tuesday, 10/02/2012 / Wednesday, 10/03/2012
Unit ID: 6
Location: Harris Rd. S. of Lund Ave.

| | North Bound Volume | South Bound Volume | Total Volume |
|---|---|---|---|
| 11:00 - 11:59 | 35 | 13 | 48 |
| 12:00 - 12:59 | 28 | 34 | 62 |
| 13:00 - 13:59 | 33 | 20 | 53 |
| 14:00 - 14:59 | 41 | 32 | 73 |
| 15:00 - 15:59 | 45 | 38 | 83 |
| 16:00 - 16:59 | 35 | 50 | 85 |
| 17:00 - 17:59 | 45 | 35 | 80 |
| 18:00 - 18:59 | 37 | 43 | 80 |
| 19:00 - 19:59 | 24 | 29 | 53 |
| 20:00 - 20:59 | 17 | 21 | 38 |
| 21:00 - 21:59 | 7 | 8 | 15 |
| 22:00 - 22:59 | 1 | 4 | 5 |
| 23:00 - 23:59 | 2 | 5 | 7 |
| 00:00 - 00:59 | 3 | 3 | 6 |
| 01:00 - 01:59 | 1 | 2 | 3 |
| 02:00 - 02:59 | 1 | 1 | 2 |
| 03:00 - 03:59 | 1 | 0 | 1 |
| 04:00 - 04:59 | 8 | 4 | 12 |
| 05:00 - 05:59 | 21 | 2 | 23 |
| 06:00 - 06:59 | 26 | 6 | 32 |
| 07:00 - 07:59 | 41 | 13 | 54 |
| 08:00 - 08:59 | 36 | 11 | 47 |
| 09:00 - 09:59 | 45 | 33 | 78 |
| 10:00 - 10:59 | 29 | 19 | 48 |
| Totals | 562 | 426 | 988 |
| AM Peak Time | 08:52 - 09:51 | 08:58 - 09:57 | 08:58 - 09:57 |
| AM Peak Volume | 50 | 34 | 82 |
| PM Peak Time | 14:33 - 15:32 | 15:32 - 16:31 | 15:38 - 16:37 |
| PM Peak Volume | 50 | 51 | 96 |

# Daily Vehicle Volume Report

Study Date: Tuesday, 10/02/2012 / Wednesday, 10/03/2012
Unit ID: 9
Location: Harris Rd. N. of Lund Ave.

| | North Bound Volume | South Bound Volume | Total Volume |
|---|---|---|---|
| 11:00 - 11:59 | 6 | 12 | 18 |
| 12:00 - 12:59 | 11 | 12 | 23 |
| 13:00 - 13:59 | 9 | 23 | 32 |
| 14:00 - 14:59 | 11 | 22 | 33 |
| 15:00 - 15:59 | 20 | 22 | 42 |
| 16:00 - 16:59 | 19 | 22 | 41 |
| 17:00 - 17:59 | 18 | 23 | 41 |
| 18:00 - 18:59 | 13 | 16 | 29 |
| 19:00 - 19:59 | 8 | 15 | 23 |
| 20:00 - 20:59 | 7 | 10 | 17 |
| 21:00 - 21:59 | 2 | 12 | 14 |
| 22:00 - 22:59 | 2 | 2 | 4 |
| 23:00 - 23:59 | 0 | 0 | 0 |
| 00:00 - 00:59 | 1 | 1 | 2 |
| 01:00 - 01:59 | 0 | 0 | 0 |
| 02:00 - 02:59 | 0 | 0 | 0 |
| 03:00 - 03:59 | 0 | 3 | 3 |
| 04:00 - 04:59 | 4 | 2 | 6 |
| 05:00 - 05:59 | 2 | 7 | 9 |
| 06:00 - 06:59 | 3 | 12 | 15 |
| 07:00 - 07:59 | 6 | 25 | 31 |
| 08:00 - 08:59 | 9 | 19 | 28 |
| 09:00 - 09:59 | 18 | 22 | 40 |
| 10:00 - 10:59 | 10 | 16 | 26 |
| Totals | 179 | 298 | 477 |
| AM Peak Time | 08:37 - 09:36 | 06:57 - 07:56 | 08:38 - 09:37 |
| AM Peak Volume | 21 | 28 | 48 |
| PM Peak Time | 14:58 - 15:57 | 14:42 - 15:41 | 14:42 - 15:41 |
| PM Peak Volume | 21 | 33 | 50 |

# Daily Vehicle Volume Report

Study Date: Monday, 01/28/2013 / Tuesday, 01/29/2013
Unit ID: Kitsap County-1/17079-14
Location: Lund Ave. E. of Harris Rd. 236.0

| | East Bound Volume | West Bound Volume | Total Volume |
|---|---|---|---|
| 11:00 - 11:59 | 420 | 410 | 830 |
| 12:00 - 12:59 | 410 | 413 | 823 |
| 13:00 - 13:59 | 443 | 400 | 843 |
| 14:00 - 14:59 | 509 | 430 | 939 |
| 15:00 - 15:59 | 583 | 485 | 1068 |
| 16:00 - 16:59 | 677 | 434 | 1111 |
| 17:00 - 17:59 | 724 | 382 | 1106 |
| 18:00 - 18:59 | 516 | 309 | 825 |
| 19:00 - 19:59 | 382 | 190 | 572 |
| 20:00 - 20:59 | 284 | 180 | 464 |
| 21:00 - 21:59 | 180 | 115 | 295 |
| 22:00 - 22:59 | 128 | 70 | 198 |
| 23:00 - 23:59 | 76 | 48 | 124 |
| 00:00 - 00:59 | 48 | 23 | 71 |
| 01:00 - 01:59 | 35 | 10 | 45 |
| 02:00 - 02:59 | 16 | 20 | 36 |
| 03:00 - 03:59 | 19 | 28 | 47 |
| 04:00 - 04:59 | 26 | 85 | 111 |
| 05:00 - 05:59 | 49 | 223 | 272 |
| 06:00 - 06:59 | 118 | 363 | 481 |
| 07:00 - 07:59 | 273 | 513 | 786 |
| 08:00 - 08:59 | 249 | 516 | 765 |
| 09:00 - 09:59 | 275 | 441 | 716 |
| 10:00 - 10:59 | 304 | 378 | 682 |
| Totals | 6744 | 6466 | 13210 |
| AM Peak Time | 11:00 - 11:59 | 07:34 - 08:33 | 07:32 - 08:31 |
| AM Peak Volume | 420 | 589 | 881 |
| PM Peak Time | 16:29 - 17:28 | 14:53 - 15:52 | 16:29 - 17:28 |
| PM Peak Volume | 729 | 510 | 1151 |

# Daily Vehicle Volume Report

Study Date: Tuesday, 08/07/2012 / Wednesday, 08/08/2012
Unit ID: 1100786-1/Kitsap County-11
Location: Lund Ave. E. of Harris Rd. 236.0

| | East Bound Volume | West Bound Volume | Total Volume |
|---|---|---|---|
| 10:00 - 10:59 | 302 | 442 | 744 |
| 11:00 - 11:59 | 333 | 487 | 820 |
| 12:00 - 12:59 | 396 | 490 | 886 |
| 13:00 - 13:59 | 409 | 444 | 853 |
| 14:00 - 14:59 | 377 | 434 | 811 |
| 15:00 - 15:59 | 487 | 460 | 947 |
| 16:00 - 16:59 | 584 | 474 | 1058 |
| 17:00 - 17:59 | 629 | 460 | 1089 |
| 18:00 - 18:59 | 452 | 404 | 856 |
| 19:00 - 19:59 | 341 | 308 | 649 |
| 20:00 - 20:59 | 297 | 257 | 554 |
| 21:00 - 21:59 | 225 | 181 | 406 |
| 22:00 - 22:59 | 116 | 137 | 253 |
| 23:00 - 23:59 | 93 | 63 | 156 |
| 00:00 - 00:59 | 51 | 34 | 85 |
| 01:00 - 01:59 | 27 | 32 | 59 |
| 02:00 - 02:59 | 22 | 18 | 40 |
| 03:00 - 03:59 | 14 | 27 | 41 |
| 04:00 - 04:59 | 22 | 70 | 92 |
| 05:00 - 05:59 | 49 | 184 | 233 |
| 06:00 - 06:59 | 58 | 328 | 386 |
| 07:00 - 07:59 | 137 | 398 | 535 |
| 08:00 - 08:59 | 186 | 422 | 608 |
| 09:00 - 09:59 | 238 | 418 | 656 |
| Totals | 5845 | 6972 | 12817 |
| AM Peak Time | 10:54 - 11:53 | 10:51 - 11:50 | 10:51 - 11:50 |
| AM Peak Volume | 335 | 489 | 820 |
| PM Peak Time | 16:57 - 17:56 | 12:23 - 13:22 | 16:41 - 17:40 |
| PM Peak Volume | 645 | 501 | 1111 |

# Kitsap County Traffic Engineering

## Daily Vehicle Volume Report

Study Date: Wednesday, 02/05/2020 / Thursday, 02/06/2020
Unit ID: 6
Location: Lund Ave. W. of Jackson Ave. 235.1

| | Eastbound Volume | Westbound Volume | Total Volume |
|---|---|---|---|
| **11:00 - 11:59** | 400 | 374 | **774** |
| **12:00 - 12:59** | 442 | 412 | **854** |
| **13:00 - 13:59** | 451 | 435 | **886** |
| **14:00 - 14:59** | 566 | 439 | **1005** |
| **15:00 - 15:59** | 629 | 501 | **1130** |
| **16:00 - 16:59** | 764 | 461 | **1225** |
| **17:00 - 17:59** | 717 | 446 | **1163** |
| **18:00 - 18:59** | 505 | 340 | **845** |
| **19:00 - 19:59** | 362 | 219 | **581** |
| **20:00 - 20:59** | 234 | 153 | **387** |
| **21:00 - 21:59** | 173 | 111 | **284** |
| **22:00 - 22:59** | 109 | 73 | **182** |
| **23:00 - 23:59** | 82 | 36 | **118** |
| **00:00 - 00:59** | 47 | 30 | **77** |
| **01:00 - 01:59** | 27 | 19 | **46** |
| **02:00 - 02:59** | 30 | 14 | **44** |
| **03:00 - 03:59** | 27 | 44 | **71** |
| **04:00 - 04:59** | 25 | 97 | **122** |
| **05:00 - 05:59** | 45 | 202 | **247** |
| **06:00 - 06:59** | 110 | 376 | **486** |
| **07:00 - 07:59** | 265 | 472 | **737** |
| **08:00 - 08:59** | 258 | 460 | **718** |
| **09:00 - 09:59** | 289 | 424 | **713** |
| **10:00 - 10:59** | 352 | 357 | **709** |
| **Totals** | **6909** | **6495** | **13404** |
| **AM Peak Time** | **11:00 - 11:59** | **07:36 - 08:35** | **07:25 - 08:24** |
| **AM Peak Volume** | **400** | **524** | **814** |
| **PM Peak Time** | **16:37 - 17:36** | **14:52 - 15:51** | **16:38 - 17:37** |
| **PM Peak Volume** | **789** | **534** | **1240** |

# Kitsap County Traffic Engineering

## Daily Total Classes Report

Study Date: Wednesday, 02/05/2020 / Thursday, 02/06/2020

Unit ID: 6

Location: Lund Ave. W. of Jackson Ave. 235.1

| | #1 | #2 | #3 | #4 | #5 | #6 | #7 | #8 | #9 | #10 | #11 | #12 | #13 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **11:00 - 11:59** | 1 | 582 | 104 | 0 | 82 | 3 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | **774** |
| **12:00 - 12:59** | 3 | 652 | 111 | 1 | 84 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | **854** |
| **13:00 - 13:59** | 3 | 663 | 124 | 4 | 85 | 3 | 0 | 3 | 1 | 0 | 0 | 0 | 0 | **886** |
| **14:00 - 14:59** | 5 | 731 | 145 | 15 | 105 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | **1005** |
| **15:00 - 15:59** | 3 | 857 | 155 | 4 | 110 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1130** |
| **16:00 - 16:59** | 9 | 914 | 172 | 6 | 122 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | **1225** |
| **17:00 - 17:59** | 3 | 893 | 156 | 1 | 109 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | **1163** |
| **18:00 - 18:59** | 1 | 652 | 121 | 0 | 71 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **845** |
| **19:00 - 19:59** | 1 | 459 | 73 | 3 | 45 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **581** |
| **20:00 - 20:59** | 1 | 304 | 55 | 0 | 27 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **387** |
| **21:00 - 21:59** | 0 | 234 | 36 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **284** |
| **22:00 - 22:59** | 0 | 159 | 12 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **182** |
| **23:00 - 23:59** | 0 | 98 | 13 | 1 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **118** |
| **00:00 - 00:59** | 0 | 62 | 9 | 0 | 5 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | **77** |
| **01:00 - 01:59** | 0 | 33 | 10 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **46** |
| **02:00 - 02:59** | 0 | 35 | 4 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **44** |
| **03:00 - 03:59** | 2 | 48 | 15 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **71** |
| **04:00 - 04:59** | 0 | 87 | 17 | 0 | 17 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | **122** |
| **05:00 - 05:59** | 1 | 183 | 29 | 1 | 31 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | **247** |
| **06:00 - 06:59** | 0 | 387 | 43 | 10 | 44 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | **486** |
| **07:00 - 07:59** | 4 | 578 | 82 | 6 | 65 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | **737** |
| **08:00 - 08:59** | 1 | 536 | 107 | 10 | 63 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **718** |
| **09:00 - 09:59** | 1 | 531 | 83 | 7 | 89 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **713** |
| **10:00 - 10:59** | 0 | 538 | 100 | 2 | 69 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **709** |
| **Totals** | **39** | **10216** | **1776** | **71** | **1268** | **15** | **1** | **11** | **7** | **0** | **0** | **0** | **0** | **13404** |
| **Percent of Total** | **0.3** | **76.2** | **13.2** | **0.5** | **9.5** | **0.1** | **0.0** | **0.1** | **0.1** | **0.0** | **0.0** | **0.0** | **0.0** | **100** |
| **Percent of AM** | **0.2** | **75.9** | **12.7** | **0.8** | **10.1** | **0.1** | **0.0** | **0.1** | **0.1** | **0.0** | **0.0** | **0.0** | **0.0** | **100** |
| **Percent of PM** | **0.3** | **76.4** | **13.5** | **0.4** | **9.1** | **0.1** | **0.0** | **0.1** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **100** |

**Truck Summary:**

Total Trucks: 1373 % Trucks: 10.2 AM % Trucks: 11.2 PM % Trucks: 9.7

---

Classification Scheme: FHWA (ID: 1)

#1 Motorcycles - 2 Axles
#2 Passenger Cars - 2 Axles
#3 Pickup Trucks, Vans - 2 Axles
#4 Buses
#5 Single Unit - 2 Axles, 6 Tires
#6 Single Unit Truck - 3 Axles
#7 Single Unit - 4 Axles
#8 Single Unit - 4 Axles or Less
#9 Double Unit - 5 Axles
#10 Double Unit - 6 Axles or More
#11 Multi-Unit - 5 Axles or Less
#12 Multi-Unit - 6 Axles
#13 Multi-Unit - 7 Axles or More

# Kitsap County Traffic Engineering

## Daily Total Speeds (MPH)

Study Date: Wednesday, 02/05/2020 / Thursday, 02/06/2020

Unit ID: 6

Location: Lund Ave. W. of Jackson Ave. 235.1

Posted Speed: 35

| | 5-14 | 15-19 | 20-24 | 25-29 | 30-34 | 35-39 | 40-44 | 45-49 | 50-54 | 55-59 | 60-64 | 65-69 | 70-74 | 75-79 | 80-99 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **11:00 - 11:59** | 0 | 0 | 2 | 15 | 165 | 411 | 155 | 24 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | **774** |
| **12:00 - 12:59** | 0 | 0 | 10 | 31 | 169 | 433 | 187 | 20 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | **854** |
| **13:00 - 13:59** | 0 | 3 | 8 | 34 | 245 | 449 | 129 | 15 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | **885** |
| **14:00 - 14:59** | 1 | 1 | 7 | 40 | 251 | 547 | 133 | 15 | 0 | 2 | 1 | 1 | 1 | 0 | 4 | **1004** |
| **15:00 - 15:59** | 0 | 3 | 5 | 46 | 362 | 531 | 161 | 17 | 2 | 0 | 1 | 0 | 0 | 1 | 1 | **1130** |
| **16:00 - 16:59** | 2 | 4 | 3 | 78 | 349 | 607 | 161 | 10 | 6 | 2 | 0 | 1 | 0 | 0 | 2 | **1225** |
| **17:00 - 17:59** | 0 | 0 | 1 | 52 | 325 | 553 | 212 | 14 | 4 | 1 | 0 | 0 | 0 | 1 | 0 | **1163** |
| **18:00 - 18:59** | 0 | 0 | 4 | 8 | 138 | 480 | 186 | 24 | 3 | 0 | 0 | 0 | 0 | 1 | 1 | **845** |
| **19:00 - 19:59** | 0 | 0 | 1 | 6 | 107 | 307 | 139 | 16 | 4 | 0 | 0 | 0 | 0 | 0 | 1 | **581** |
| **20:00 - 20:59** | 0 | 1 | 0 | 4 | 58 | 190 | 113 | 17 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | **387** |
| **21:00 - 21:59** | 0 | 0 | 0 | 1 | 41 | 117 | 101 | 18 | 4 | 1 | 0 | 0 | 0 | 0 | 1 | **284** |
| **22:00 - 22:59** | 0 | 0 | 1 | 3 | 23 | 103 | 42 | 8 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | **182** |
| **23:00 - 23:59** | 0 | 0 | 0 | 4 | 17 | 51 | 30 | 13 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | **118** |
| **00:00 - 00:59** | 0 | 0 | 0 | 1 | 9 | 35 | 22 | 7 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | **77** |
| **01:00 - 01:59** | 0 | 0 | 0 | 0 | 8 | 21 | 12 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | **46** |
| **02:00 - 02:59** | 0 | 0 | 1 | 0 | 4 | 21 | 14 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **44** |
| **03:00 - 03:59** | 0 | 0 | 0 | 7 | 11 | 30 | 12 | 8 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | **71** |
| **04:00 - 04:59** | 0 | 0 | 0 | 0 | 11 | 70 | 34 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **122** |
| **05:00 - 05:59** | 0 | 0 | 1 | 5 | 30 | 127 | 65 | 16 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | **247** |
| **06:00 - 06:59** | 0 | 0 | 0 | 7 | 84 | 256 | 122 | 13 | 3 | 0 | 1 | 0 | 0 | 0 | 0 | **486** |
| **07:00 - 07:59** | 0 | 1 | 1 | 5 | 184 | 393 | 130 | 16 | 4 | 0 | 0 | 1 | 1 | 1 | 0 | **737** |
| **08:00 - 08:59** | 0 | 0 | 1 | 11 | 195 | 348 | 146 | 14 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | **718** |
| **09:00 - 09:59** | 0 | 0 | 1 | 11 | 174 | 366 | 137 | 20 | 2 | 1 | 0 | 0 | 0 | 0 | 1 | **713** |
| **10:00 - 10:59** | 0 | 0 | 2 | 16 | 171 | 361 | 139 | 17 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | **709** |
| **Totals** | **3** | **13** | **49** | **385** | **3131** | **6807** | **2582** | **337** | **53** | **13** | **3** | **3** | **2** | **6** | **15** | **13402** |
| **Percent of Total** | **0.0** | **0.1** | **0.4** | **2.9** | **23.4** | **50.8** | **19.3** | **2.5** | **0.4** | **0.1** | **0.0** | **0.0** | **0.0** | **0.0** | **0.1** | **100** |
| **Percent of AM** | **0.0** | **0.0** | **0.2** | **1.6** | **22.0** | **51.4** | **20.8** | **3.2** | **0.4** | **0.1** | **0.0** | **0.0** | **0.0** | **0.1** | **0.1** | **100** |
| **Percent of PM** | **0.0** | **0.1** | **0.5** | **3.5** | **24.1** | **50.5** | **18.4** | **2.2** | **0.4** | **0.1** | **0.0** | **0.0** | **0.0** | **0.0** | **0.1** | **100** |

Standard Deviation: 5.0 MPH

Mean Speed: 37.4 MPH

Median Speed: 37.3 MPH

Modal Speed: 37.5 MPH

Ten Mile Pace: 30 to 39 MPH

Percent in Ten Mile Pace: 74.2%

85th Percentile: 41.9 MPH

15th Percentile: 32.5 MPH

90th Percentile: 43.2 MPH

95th Percentile: 44.5 MPH

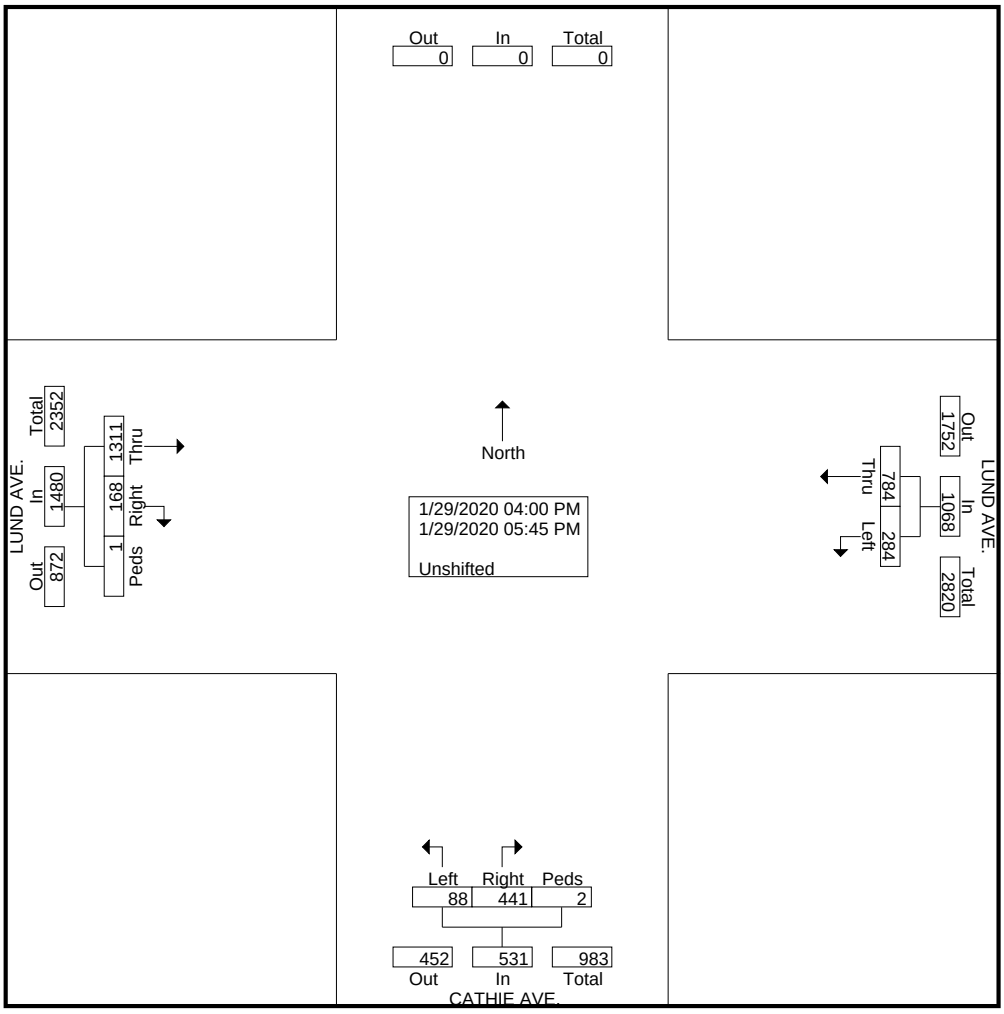
# Kitsap County Traffic Engineering

Lund Ave. & Cathie Ave.
Turn Count Movment
January
4:00 to 6:00

File Name : cathie-lund_01-30-20_tm_0
Site Code : 00000000
Start Date : 1/29/2020


Groups Printed- Unshifted

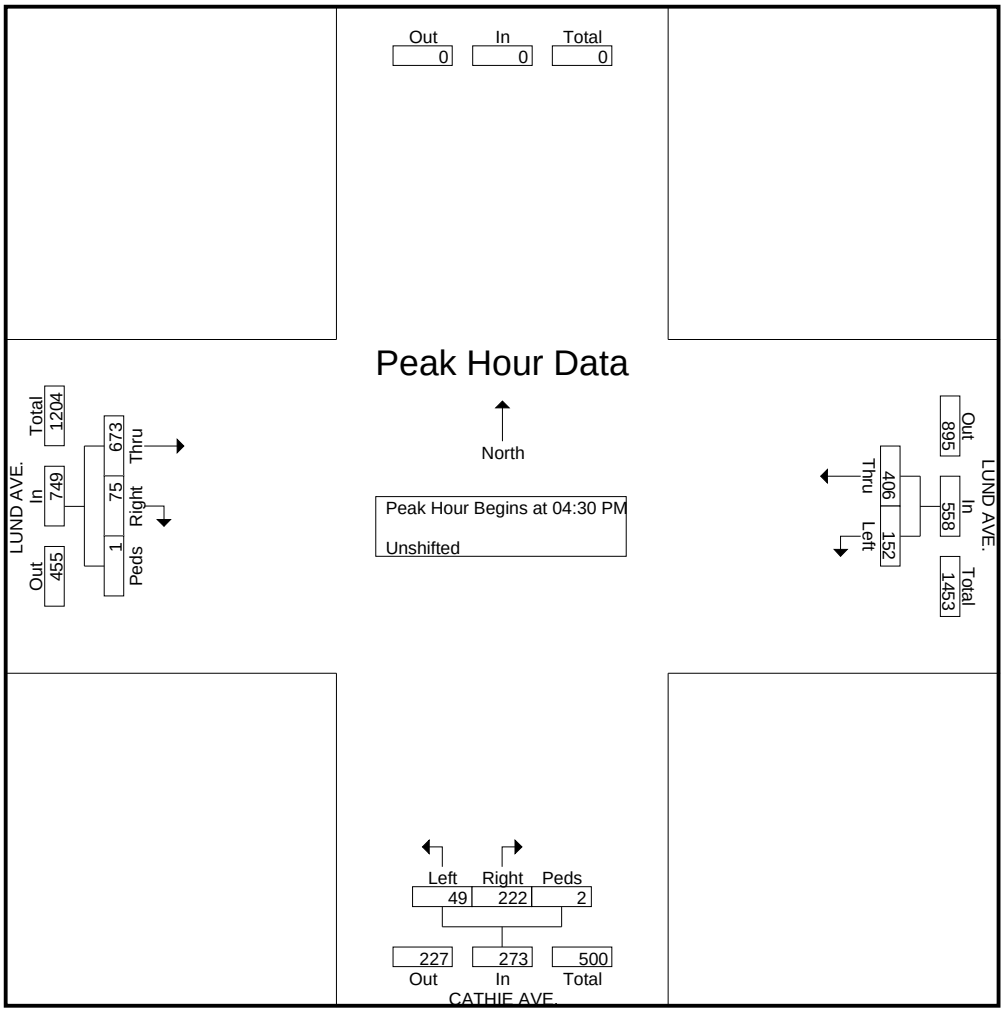
| | LUND AVE. From East | | | CATHIE AVE. From South | | | | LUND AVE. From West | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Thru | Left | App. Total | Right | Left | Peds | App. Total | Right | Thru | Peds | App. Total | Int. Total |
| 04:00 PM | 94 | 35 | 129 | 47 | 6 | 0 | 53 | 22 | 153 | 0 | 175 | 357 |
| 04:15 PM | 105 | 33 | 138 | 49 | 10 | 0 | 59 | 29 | 170 | 0 | 199 | 396 |
| 04:30 PM | 99 | 35 | 134 | 65 | 13 | 2 | 80 | 22 | 176 | 1 | 199 | 413 |
| 04:45 PM | 109 | 36 | 145 | 47 | 6 | 0 | 53 | 16 | 151 | 0 | 167 | 365 |
| Total | 407 | 139 | 546 | 208 | 35 | 2 | 245 | 89 | 650 | 1 | 740 | 1531 |
| | | | | | | | | | | | | |
| 05:00 PM | 97 | 40 | 137 | 59 | 17 | 0 | 76 | 16 | 166 | 0 | 182 | 395 |
| 05:15 PM | 101 | 41 | 142 | 51 | 13 | 0 | 64 | 21 | 180 | 0 | 201 | 407 |
| 05:30 PM | 84 | 25 | 109 | 67 | 8 | 0 | 75 | 25 | 176 | 0 | 201 | 385 |
| 05:45 PM | 95 | 39 | 134 | 56 | 15 | 0 | 71 | 17 | 139 | 0 | 156 | 361 |
| Total | 377 | 145 | 522 | 233 | 53 | 0 | 286 | 79 | 661 | 0 | 740 | 1548 |
| | | | | | | | | | | | | |
| Grand Total | 784 | 284 | 1068 | 441 | 88 | 2 | 531 | 168 | 1311 | 1 | 1480 | 3079 |
| Apprch % | 73.4 | 26.6 | | 83.1 | 16.6 | 0.4 | | 11.4 | 88.6 | 0.1 | | |
| Total % | 25.5 | 9.2 | 34.7 | 14.3 | 2.9 | 0.1 | 17.2 | 5.5 | 42.6 | 0 | 48.1 | |



# Kitsap County Traffic Engineering

File Name : cathie-lund_01-30-20_tm_0
Site Code : 00000000
Start Date : 1/29/2020
Page No : 2

| | LUND AVE. From East | | | CATHIE AVE. From South | | | | LUND AVE. From West | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Thru | Left | App. Total | Right | Left | Peds | App. Total | Right | Thru | Peds | App. Total | Int. Total |
| Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1 | | | | | | | | | | | | |
| Peak Hour for Entire Intersection Begins at 04:30 PM | | | | | | | | | | | | |
| 04:30 PM | 99 | 35 | 134 | **65** | 13 | **2** | **80** | **22** | 176 | **1** | 199 | **413** |
| 04:45 PM | **109** | 36 | **145** | 47 | 6 | 0 | 53 | 16 | 151 | 0 | 167 | 365 |
| 05:00 PM | 97 | 40 | 137 | 59 | **17** | 0 | 76 | 16 | 166 | 0 | 182 | 395 |
| 05:15 PM | 101 | **41** | 142 | 51 | 13 | 0 | 64 | 21 | **180** | 0 | **201** | 407 |
| Total Volume | 406 | 152 | 558 | 222 | 49 | 2 | 273 | 75 | 673 | 1 | 749 | 1580 |
| % App. Total | 72.8 | 27.2 | | 81.3 | 17.9 | 0.7 | | 10 | 89.9 | 0.1 | | |
| PHF | .931 | .927 | .962 | .854 | .721 | .250 | .853 | .852 | .935 | .250 | .932 | .956 |



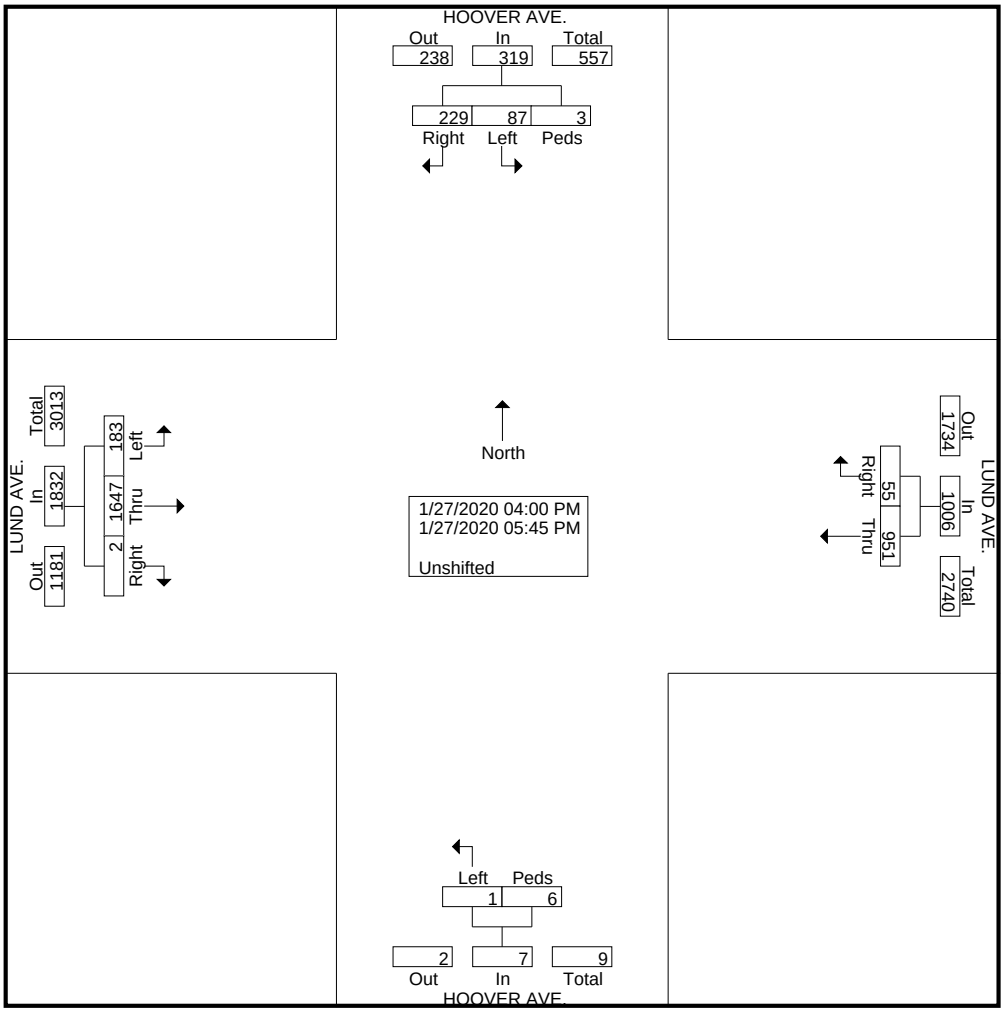
# Kitsap County Traffic Engineering

Lund Ave. & Hoover Ave.
Turn Count Movment
January
4:00 to 6:00

File Name : HOOVER-LUND_01-28-20_TM_0
Site Code : 00000000
Start Date : 1/27/2020
Page No : 1

Groups Printed- Unshifted

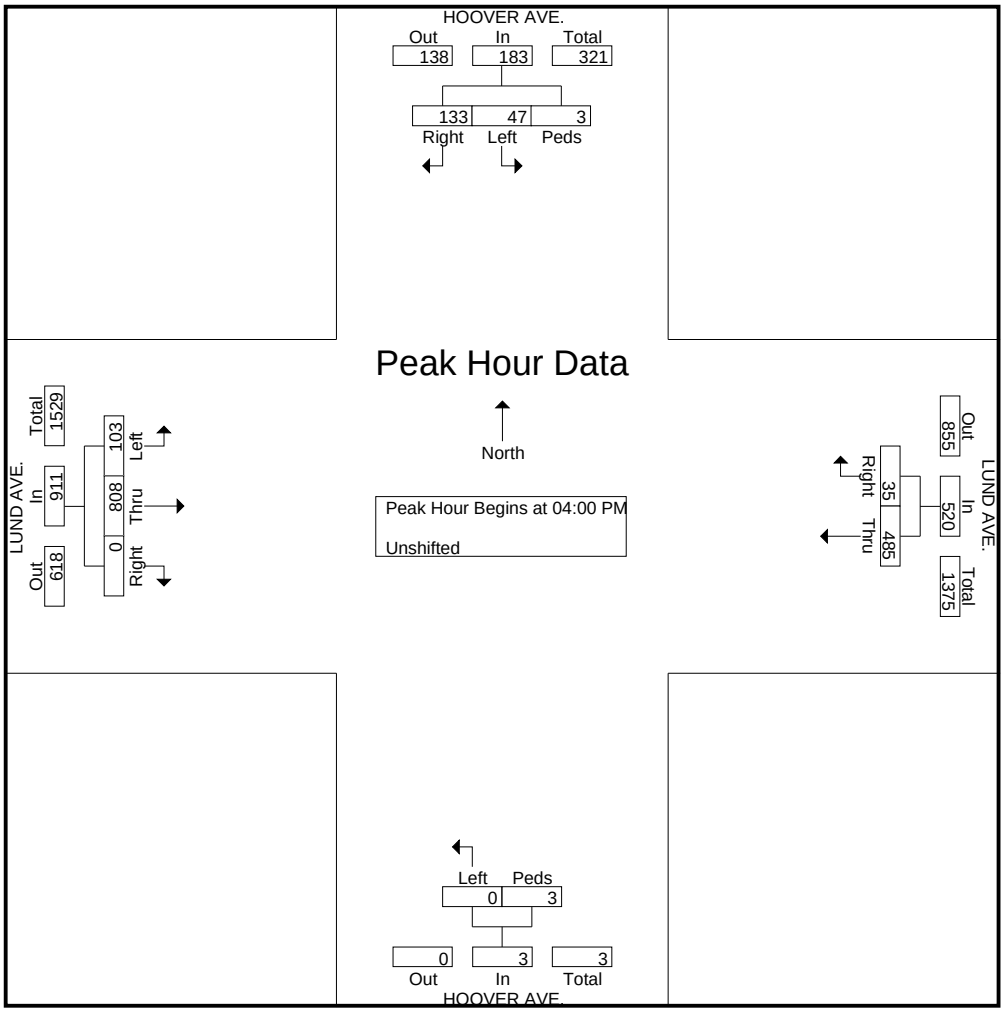
| | HOOVER AVE. From North | | | | LUND AVE. From East | | | HOOVER AVE. From South | | | LUND AVE. From West | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Right | Left | Peds | App. Total | Right | Thru | App. Total | Left | Peds | App. Total | Right | Thru | Left | App. Total | Int. Total |
| 04:00 PM | 28 | 6 | 0 | 34 | 3 | 139 | 142 | 0 | 0 | 0 | 0 | 198 | 29 | 227 | 403 |
| 04:15 PM | 28 | 7 | 0 | 35 | 13 | 127 | 140 | 0 | 0 | 0 | 0 | 206 | 25 | 231 | 406 |
| 04:30 PM | 32 | 13 | 0 | 45 | 12 | 106 | 118 | 0 | 2 | 2 | 0 | 206 | 30 | 236 | 401 |
| 04:45 PM | 45 | 21 | 3 | 69 | 7 | 113 | 120 | 0 | 1 | 1 | 0 | 198 | 19 | 217 | 407 |
| Total | 133 | 47 | 3 | 183 | 35 | 485 | 520 | 0 | 3 | 3 | 0 | 808 | 103 | 911 | 1617 |
| 05:00 PM | 24 | 10 | 0 | 34 | 7 | 109 | 116 | 0 | 0 | 0 | 1 | 196 | 30 | 227 | 377 |
| 05:15 PM | 30 | 9 | 0 | 39 | 5 | 118 | 123 | 0 | 0 | 0 | 0 | 212 | 20 | 232 | 394 |
| 05:30 PM | 25 | 11 | 0 | 36 | 7 | 111 | 118 | 0 | 3 | 3 | 0 | 245 | 19 | 264 | 421 |
| 05:45 PM | 17 | 10 | 0 | 27 | 1 | 128 | 129 | 1 | 0 | 1 | 1 | 186 | 11 | 198 | 355 |
| Total | 96 | 40 | 0 | 136 | 20 | 466 | 486 | 1 | 3 | 4 | 2 | 839 | 80 | 921 | 1547 |
| Grand Total | 229 | 87 | 3 | 319 | 55 | 951 | 1006 | 1 | 6 | 7 | 2 | 1647 | 183 | 1832 | 3164 |
| Apprch % | 71.8 | 27.3 | 0.9 | | 5.5 | 94.5 | | 14.3 | 85.7 | | 0.1 | 89.9 | 10 | | |
| Total % | 7.2 | 2.7 | 0.1 | 10.1 | 1.7 | 30.1 | 31.8 | 0 | 0.2 | 0.2 | 0.1 | 52.1 | 5.8 | 57.9 | |



# Kitsap County Traffic Engineering

File Name : HOOVER-LUND_01-28-20_TM_0
Site Code : 00000000
Start Date : 1/27/2020
Page No : 2

| | HOOVER AVE. From North | | | | LUND AVE. From East | | | HOOVER AVE. From South | | | LUND AVE. From West | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Right | Left | Peds | App. Total | Right | Thru | App. Total | Left | Peds | App. Total | Right | Thru | Left | App. Total | Int. Total |
| Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1 | | | | | | | | | | | | | | | |
| Peak Hour for Entire Intersection Begins at 04:00 PM | | | | | | | | | | | | | | | |
| 04:00 PM | 28 | 6 | 0 | 34 | 3 | **139** | **142** | 0 | 0 | 0 | 0 | 198 | 29 | 227 | 403 |
| 04:15 PM | 28 | 7 | 0 | 35 | **13** | 127 | 140 | 0 | 0 | 0 | 0 | **206** | 25 | 231 | 406 |
| 04:30 PM | 32 | 13 | 0 | 45 | 12 | 106 | 118 | 0 | **2** | **2** | 0 | 206 | **30** | **236** | 401 |
| 04:45 PM | **45** | **21** | **3** | **69** | 7 | 113 | 120 | 0 | 1 | 1 | 0 | 198 | 19 | 217 | **407** |
| Total Volume | 133 | 47 | 3 | 183 | 35 | 485 | 520 | 0 | 3 | 3 | 0 | 808 | 103 | 911 | 1617 |
| % App. Total | 72.7 | 25.7 | 1.6 | | 6.7 | 93.3 | | 0 | 100 | | 0 | 88.7 | 11.3 | | |
| PHF | .739 | .560 | .250 | .663 | .673 | .872 | .915 | .000 | .375 | .375 | .000 | .981 | .858 | .965 | .993 |



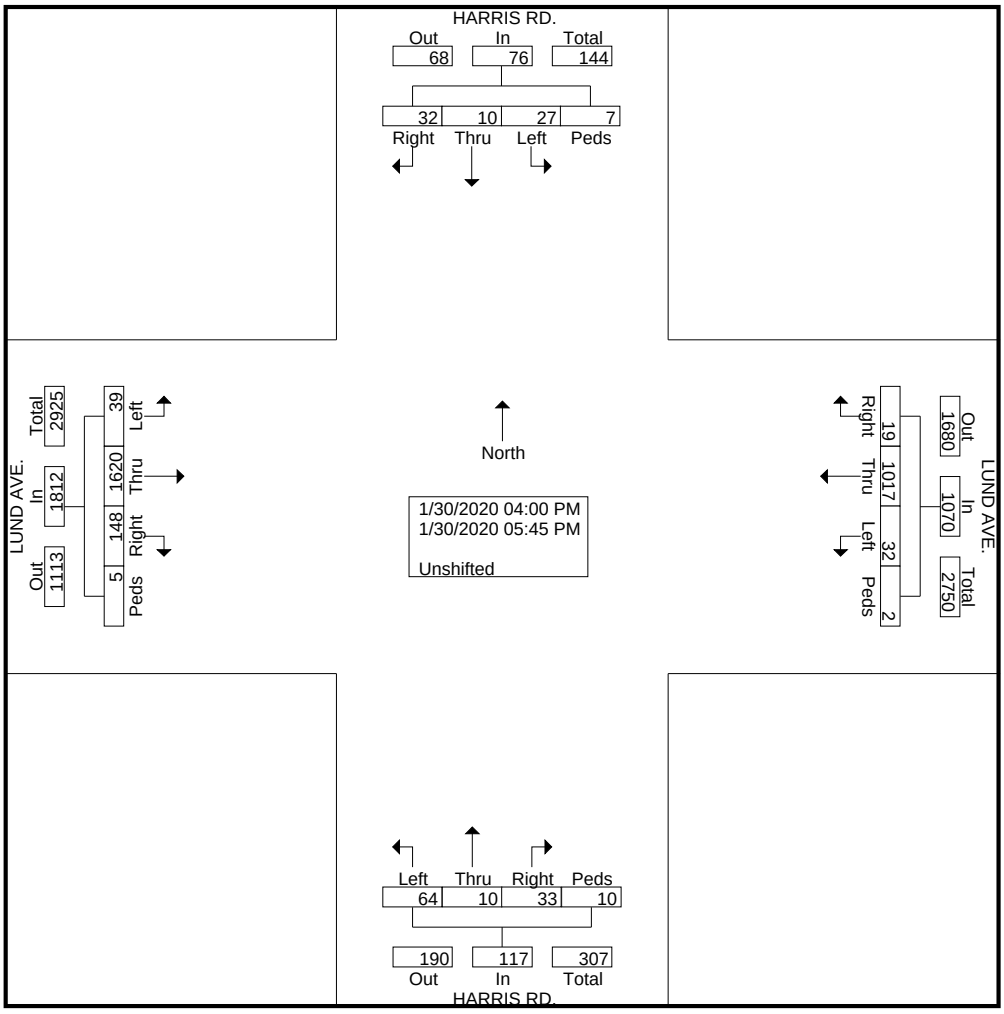
# Kitsap County Traffic Engineering

Lund Ave. & Harris Rd.
Turn Count Movment
January
4:00 to 6:00

File Name : HARRIS-LUND_02-03-20_TM_0
Site Code : 00000000
Start Date : 1/30/2020
Page No : 1

Groups Printed- Unshifted

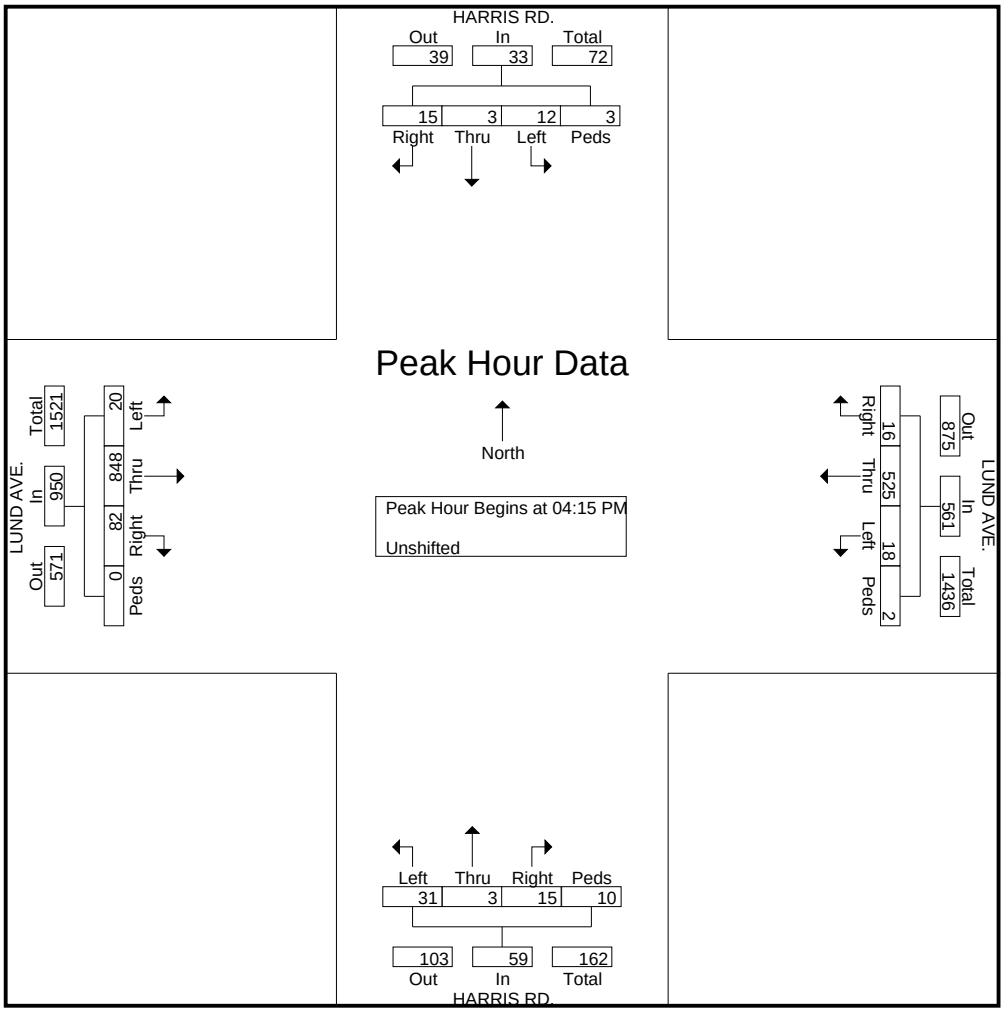
| | HARRIS RD. From North | | | | | LUND AVE. From East | | | | | HARRIS RD. From South | | | | | LUND AVE. From West | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Right | Thru | Left | Peds | App. Total | Right | Thru | Left | Peds | App. Total | Right | Thru | Left | Peds | App. Total | Right | Thru | Left | Peds | App. Total | Int. Total |
| 04:00 PM | 6 | 0 | 4 | 2 | 12 | 2 | 109 | 2 | 0 | 113 | 5 | 0 | 10 | 0 | 15 | 17 | 170 | 3 | 0 | 190 | 330 |
| 04:15 PM | 4 | 2 | 2 | 2 | 10 | 3 | 139 | 5 | 0 | 147 | 2 | 1 | 9 | 0 | 12 | 18 | 209 | 4 | 0 | 231 | 400 |
| 04:30 PM | 5 | 0 | 1 | 1 | 7 | 2 | 145 | 4 | 2 | 153 | 5 | 0 | 5 | 4 | 14 | 18 | 195 | 5 | 0 | 218 | 392 |
| 04:45 PM | 4 | 1 | 5 | 0 | 10 | 5 | 114 | 5 | 0 | 124 | 3 | 1 | 11 | 1 | 16 | 19 | 222 | 4 | 0 | 245 | 395 |
| Total | 19 | 3 | 12 | 5 | 39 | 12 | 507 | 16 | 2 | 537 | 15 | 2 | 35 | 5 | 57 | 72 | 796 | 16 | 0 | 884 | 1517 |
| 05:00 PM | 2 | 0 | 4 | 0 | 6 | 6 | 127 | 4 | 0 | 137 | 5 | 1 | 6 | 5 | 17 | 27 | 222 | 7 | 0 | 256 | 416 |
| 05:15 PM | 1 | 2 | 5 | 0 | 8 | 1 | 121 | 5 | 0 | 127 | 10 | 3 | 6 | 0 | 19 | 16 | 211 | 9 | 0 | 236 | 390 |
| 05:30 PM | 3 | 2 | 4 | 0 | 9 | 0 | 129 | 6 | 0 | 135 | 1 | 1 | 5 | 0 | 7 | 15 | 208 | 4 | 0 | 227 | 378 |
| 05:45 PM | 7 | 3 | 2 | 2 | 14 | 0 | 133 | 1 | 0 | 134 | 2 | 3 | 12 | 0 | 17 | 18 | 183 | 3 | 5 | 209 | 374 |
| Total | 13 | 7 | 15 | 2 | 37 | 7 | 510 | 16 | 0 | 533 | 18 | 8 | 29 | 5 | 60 | 76 | 824 | 23 | 5 | 928 | 1558 |
| Grand Total | 32 | 10 | 27 | 7 | 76 | 19 | 1017 | 32 | 2 | 1070 | 33 | 10 | 64 | 10 | 117 | 148 | 1620 | 39 | 5 | 1812 | 3075 |
| Apprch % | 42.1 | 13.2 | 35.5 | 9.2 | | 1.8 | 95 | 3 | 0.2 | | 28.2 | 8.5 | 54.7 | 8.5 | | 8.2 | 89.4 | 2.2 | 0.3 | | |
| Total % | 1 | 0.3 | 0.9 | 0.2 | 2.5 | 0.6 | 33.1 | 1 | 0.1 | 34.8 | 1.1 | 0.3 | 2.1 | 0.3 | 3.8 | 4.8 | 52.7 | 1.3 | 0.2 | 58.9 | |



# Kitsap County Traffic Engineering

File Name : HARRIS-LUND_02-03-20_TM_0
Site Code : 00000000
Start Date : 1/30/2020
Page No : 2

| | HARRIS RD. From North | | | | | LUND AVE. From East | | | | | HARRIS RD. From South | | | | | LUND AVE. From West | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Right | Thru | Left | Peds | App. Total | Right | Thru | Left | Peds | App. Total | Right | Thru | Left | Peds | App. Total | Right | Thru | Left | Peds | App. Total | Int. Total |
| Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1 | | | | | | | | | | | | | | | | | | | | | |
| Peak Hour for Entire Intersection Begins at 04:15 PM | | | | | | | | | | | | | | | | | | | | | |
| 04:15 PM | 4 | **2** | 2 | **2** | **10** | 3 | 139 | **5** | 0 | 147 | 2 | **1** | 9 | 0 | 12 | 18 | 209 | 4 | 0 | 231 | 400 |
| 04:30 PM | **5** | 0 | 1 | 1 | 7 | 2 | **145** | 4 | **2** | **153** | **5** | 0 | 5 | 4 | 14 | 18 | 195 | 5 | 0 | 218 | 392 |
| 04:45 PM | 4 | 1 | **5** | 0 | 10 | 5 | 114 | 5 | 0 | 124 | 3 | 1 | **11** | 1 | 16 | 19 | **222** | 4 | 0 | 245 | 395 |
| 05:00 PM | 2 | 0 | 4 | 0 | 6 | **6** | 127 | 4 | 0 | 137 | 5 | 1 | 6 | **5** | **17** | **27** | 222 | **7** | 0 | **256** | **416** |
| Total Volume | 15 | 3 | 12 | 3 | 33 | 16 | 525 | 18 | 2 | 561 | 15 | 3 | 31 | 10 | 59 | 82 | 848 | 20 | 0 | 950 | 1603 |
| % App. Total | 45.5 | 9.1 | 36.4 | 9.1 | | 2.9 | 93.6 | 3.2 | 0.4 | | 25.4 | 5.1 | 52.5 | 16.9 | | 8.6 | 89.3 | 2.1 | 0 | | |
| PHF | .750 | .375 | .600 | .375 | .825 | .667 | .905 | .900 | .250 | .917 | .750 | .750 | .705 | .500 | .868 | .759 | .955 | .714 | .000 | .928 | .963 |



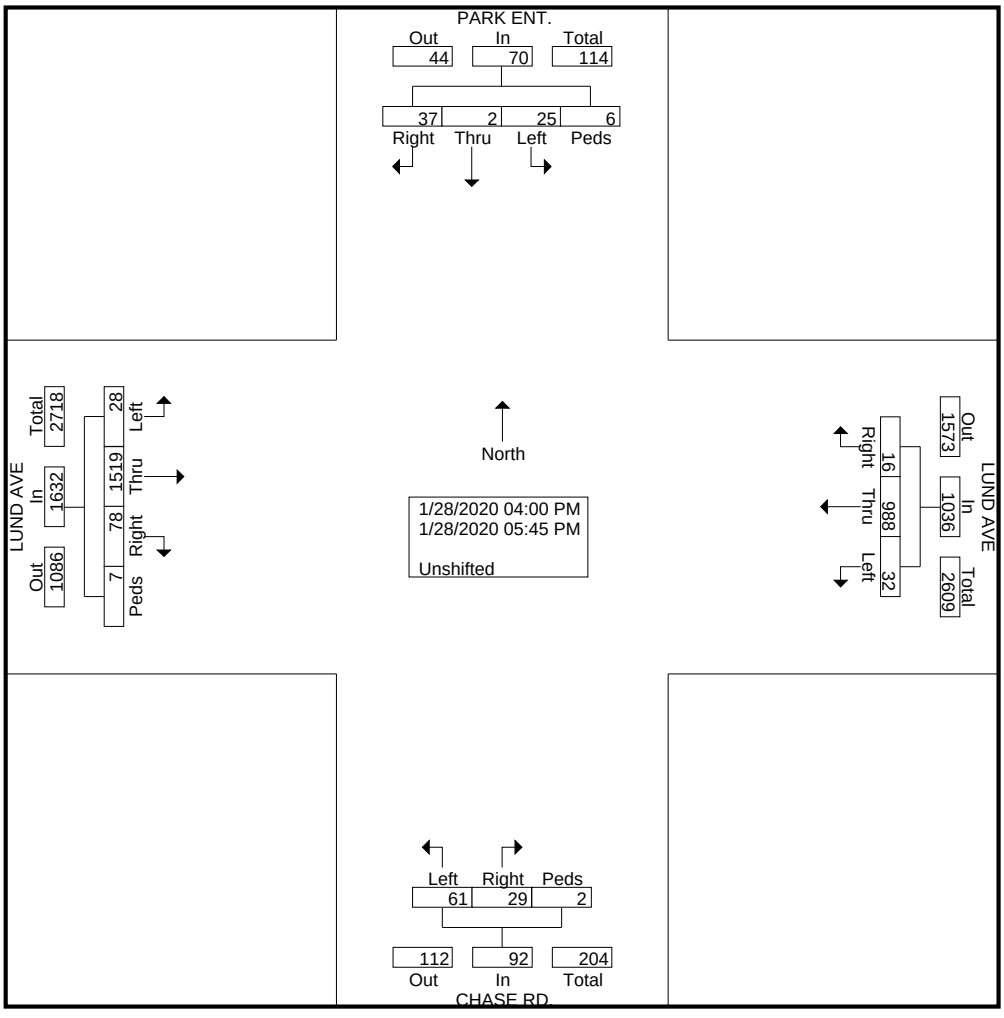
# Kitsap County Traffic Engineering

Lund Ave. & Chase Rd.
Turn Count Movment
January
4:00 to 6:00

File Name : CHASE-LUND_01-29-20_TM_0
Site Code : 00000000
Start Date : 1/28/2020
Page No : 1

Groups Printed- Unshifted

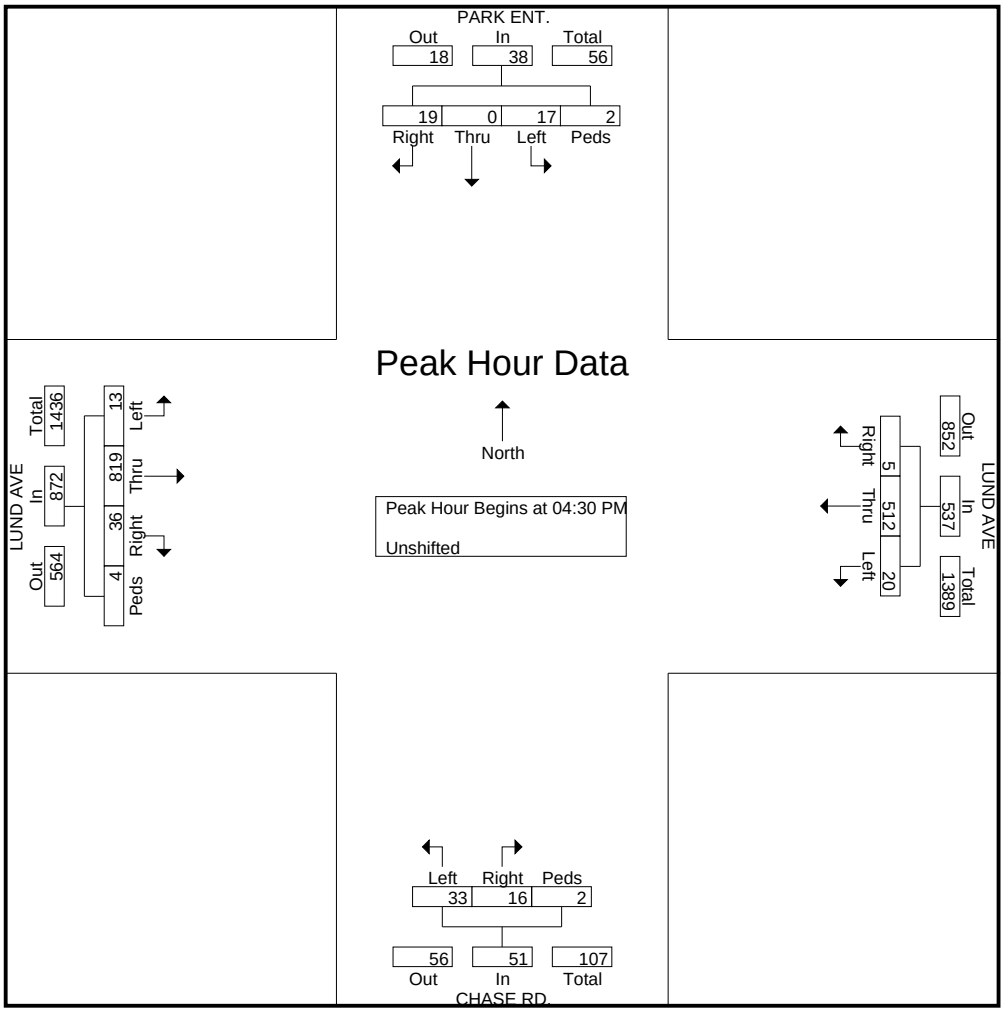
| | PARK ENT. From North | | | | | LUND AVE From East | | | | CHASE RD. From South | | | | LUND AVE From West | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Right | Thru | Left | Peds | App. Total | Right | Thru | Left | App. Total | Right | Left | Peds | App. Total | Right | Thru | Left | Peds | App. Total | Int. Total |
| 04:00 PM | 2 | 0 | 3 | 0 | 5 | 3 | 118 | 8 | 129 | 2 | 7 | 0 | 9 | 12 | 150 | 4 | 1 | 167 | 310 |
| 04:15 PM | 6 | 1 | 0 | 2 | 9 | 5 | 125 | 1 | 131 | 5 | 8 | 0 | 13 | 12 | 166 | 3 | 2 | 183 | 336 |
| 04:30 PM | 5 | 0 | 9 | 0 | 14 | 1 | 125 | 7 | 133 | 3 | 11 | 0 | 14 | 9 | 203 | 4 | 2 | 218 | 379 |
| 04:45 PM | 5 | 0 | 3 | 0 | 8 | 1 | 140 | 4 | 145 | 6 | 7 | 1 | 14 | 11 | 201 | 3 | 1 | 216 | 383 |
| Total | 18 | 1 | 15 | 2 | 36 | 10 | 508 | 20 | 538 | 16 | 33 | 1 | 50 | 44 | 720 | 14 | 6 | 784 | 1408 |
| 05:00 PM | 3 | 0 | 1 | 2 | 6 | 1 | 117 | 4 | 122 | 4 | 7 | 0 | 11 | 7 | 210 | 4 | 0 | 221 | 360 |
| 05:15 PM | 6 | 0 | 4 | 0 | 10 | 2 | 130 | 5 | 137 | 3 | 8 | 1 | 12 | 9 | 205 | 2 | 1 | 217 | 376 |
| 05:30 PM | 4 | 0 | 3 | 2 | 9 | 1 | 125 | 0 | 126 | 5 | 8 | 0 | 13 | 10 | 207 | 5 | 0 | 222 | 370 |
| 05:45 PM | 6 | 1 | 2 | 0 | 9 | 2 | 108 | 3 | 113 | 1 | 5 | 0 | 6 | 8 | 177 | 3 | 0 | 188 | 316 |
| Total | 19 | 1 | 10 | 4 | 34 | 6 | 480 | 12 | 498 | 13 | 28 | 1 | 42 | 34 | 799 | 14 | 1 | 848 | 1422 |
| Grand Total | 37 | 2 | 25 | 6 | 70 | 16 | 988 | 32 | 1036 | 29 | 61 | 2 | 92 | 78 | 1519 | 28 | 7 | 1632 | 2830 |
| Apprch % | 52.9 | 2.9 | 35.7 | 8.6 | | 1.5 | 95.4 | 3.1 | | 31.5 | 66.3 | 2.2 | | 4.8 | 93.1 | 1.7 | 0.4 | | |
| Total % | 1.3 | 0.1 | 0.9 | 0.2 | 2.5 | 0.6 | 34.9 | 1.1 | 36.6 | 1 | 2.2 | 0.1 | 3.3 | 2.8 | 53.7 | 1 | 0.2 | 57.7 | |



# Kitsap County Traffic Engineering

File Name : CHASE-LUND_01-29-20_TM_0
Site Code : 00000000
Start Date : 1/28/2020
Page No : 2

| | PARK ENT. From North | | | | | LUND AVE From East | | | | CHASE RD. From South | | | | LUND AVE From West | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Right | Thru | Left | Peds | App. Total | Right | Thru | Left | App. Total | Right | Left | Peds | App. Total | Right | Thru | Left | Peds | App. Total | Int. Total |
| Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1 | | | | | | | | | | | | | | | | | | | |
| Peak Hour for Entire Intersection Begins at 04:30 PM | | | | | | | | | | | | | | | | | | | |
| 04:30 PM | 5 | 0 | **9** | 0 | **14** | 1 | 125 | **7** | 133 | 3 | **11** | 0 | **14** | 9 | 203 | **4** | **2** | 218 | 379 |
| 04:45 PM | 5 | 0 | 3 | 0 | 8 | 1 | **140** | 4 | **145** | **6** | 7 | **1** | 14 | **11** | 201 | 3 | 1 | 216 | **383** |
| 05:00 PM | 3 | 0 | 1 | **2** | 6 | 1 | 117 | 4 | 122 | 4 | 7 | 0 | 11 | 7 | **210** | 4 | 0 | **221** | 360 |
| 05:15 PM | **6** | 0 | 4 | 0 | 10 | **2** | 130 | 5 | 137 | 3 | 8 | 1 | 12 | 9 | 205 | 2 | 1 | 217 | 376 |
| Total Volume | 19 | 0 | 17 | 2 | 38 | 5 | 512 | 20 | 537 | 16 | 33 | 2 | 51 | 36 | 819 | 13 | 4 | 872 | 1498 |
| % App. Total | 50 | 0 | 44.7 | 5.3 | | 0.9 | 95.3 | 3.7 | | 31.4 | 64.7 | 3.9 | | 4.1 | 93.9 | 1.5 | 0.5 | | |
| PHF | .792 | .000 | .472 | .250 | .679 | .625 | .914 | .714 | .926 | .667 | .750 | .500 | .911 | .818 | .975 | .813 | .500 | .986 | .978 |



# Appendix B

WSDOT Study Area Crashes
2015 through 2019


WSDOT, ESRI, © Mapbox, © OpenStreetMap

0 250 500 1,000 Feet

# Study Area Crashes 2015-2019

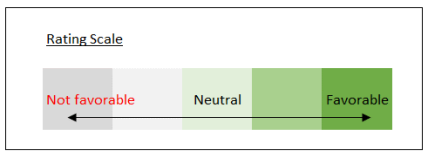
***SE Lund Avenue Traffic Study*** | Kitsap County

Date: 9/22/2020 Path: U:\PSO\Projects\Clients\1578-KitsapCo\233-1578-156 SELundAveTrafficStdy\99Svcs\GIS\MapDocs\Crash_Data.mxd

# Appendix C

## Alternatives Analysis

**Lund Ave SE Corridor Study**
**Alternatives Analysis**

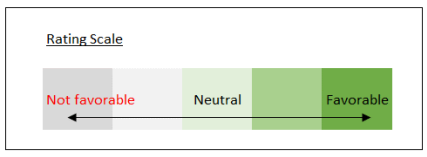



**Screening Analysis**

| | Criteria | Target | Alt 1 - No Build | Alt 2A - Signals | Alt 2B - Signals with Access Management |
|---|---|---|---|---|---|
| High Priority Criteria | 1 Improve side street access onto Lund (at Hoover, Harris, Chase) | LOS D or better (neutral); and reduction in delay per vehicles (favorable) | All three study intersections degrade to LOS F due to side street delay.<br>*Hoover* *Harris* *Chase*<br>*LOS F* *LOS F* *LOS F* | Only the intersetion of Lund/Hoover meets signal warrants.<br>All three study intersections operate at LOS A/B.<br>*Hoover* *Harris* *Chase*<br>*LOS B* *Not warranted and v/c > 1.0* *Not warranted and v/c > 1.0* | All three study intersections operate at LOS C. At Harris and Chase, signals are not warranted and with access Management, the eastbound movement has a v/c greater than 1.0.<br>*Hoover* *Harris* *Chase*<br>*LOS C* *Not warranted and v/c > 1.0* *Not warranted and v/c > 1.0* |
| | 2 Improve access between Lund and private driveways | Minimize delays, qualitative comparison | Driveway access points will experience delay as traffic volumes increase. Between Harris and Chase, where a two-way-left-turn lane (TWLTL) is not provided, delay could be significant. In addition, vehicles on Lund turning left onto driveways would stop the through trips on Lund. | Same as No Build. | Access management would result in trips travelling longer to get to/from driveways. However it would reduce delays for vehicles access Lund (right turn only) and eliminate the delay between Harris and Chase which occurs when a vehicle turns left from Lund to a driveway. |
| | 3 Traffic control is warranted per the MUTCD | Warranted | TWSC is warranted | Warrants are not met at Harris and Chase. Warrants met at Hoover. | Warrants are not met at Harris and Chase. Warrants met at Hoover. |
| | 4 Compatible with Bethel and Cathie operations including future RAB at Bethel and potential to provide access management within City of PO ROW | Compatible | Does not provide improvement nor conflicts. | Does not provide improvement nor conflicts. | The signals at Hoover or Harris both have adequate capacity to provide u-turns for vehicles turning to/from Lund between Bethel and Hoover, thus are compatable with any potential access management within the City ROW east of Bethel. |
| | 5 Do not increase potential for traffic to cut through the neighborhood to avoid the Bethel and Jackson corridors | Does not increase likelihood of cut through (qualitative comparison of alternatives) | Unlikely to promote cut through as significant delay is incurred turning onto Lund (TWSC at Harris and Chase) | Signals at Harris and Chase potentially promote cut through to/from the south to avoid the Bethel and Jackson corridors. | See note under Signals. |
| | 6 Compatible with urban residential neighborhood and adjacent corridors | Compatible | No change | Signals are not out of character with an urban corridor; however the lower volume side streets do not warrant signals and would not fit in the environment. | See note under Signals.<br>Access management in conjunction with pedestrian and bike enhancements and other speed management would fit into the residential corridor. Simply restricting access however could result in more occurrences of users travelling at a high speed. |
| | 7 Improve identified safety issues | Better than today | [To be determined when data is available. Will be used to refine or prioritize alternatives if safety issues are identified.] | [To be determined when data is available. Will be used to refine or prioritize alternatives if safety issues are identified.] | [To be determined when data is available. Will be used to refine or prioritize alternatives if safety issues are identified.] |
| | 8 Minimize pedestrian crossing lengths and improve crossings at intersections | Improved compared to today | No change compared to today. | No change compared to today. | Providing u-turns at the study intersections would widen the pedestrian crossings |
| | 9 Compatible with future mid-block pedestrian crossing | Compatible | Condition does not preclude a future mid-block pedestrian crossing. | Condition does not preclude a future mid-block pedestrian crossing. | See note under Signals.<br>Center median could be provide a refuge. |
| Mid-Priority | 10 Traffic operations along Lund operate above County standard and additional delay is minimized | LOS D or better (neutral); and no increase in delay per vehicles (favorable) | Lund is near free-flow | Adding signals where not warranted (Harris and Chase) tends to impede travel along the main corridor. | See note under Signals. |
| | 11 Minimize maintenance cost | Additional costs beyond a signalized corridor (not favorable). Signalized corridor (neutral). No added maintenance (favorable). | No change | Long term O&M costs are greater for signals than RABs. | See note under Signals.<br>Potentially some landscape with median. |
| | 12 Minimize cost to construct | Qualitative comparison between alternatives | No cost | Construction costs are typically less for signalized intersections than for roundabouts. | See note under Signals.<br>Raised medians increase costs slightly |
| | 13 Minimize ROW impacts/takes | Qualitative comparison between alternatives | No ROW impacts | No ROW impacts | Accommodating U turns requires additional ROW |

** Additional information to be included in the design scope/efforts:

**Lund Ave SE Corridor Study**
**Alternatives Analysis**

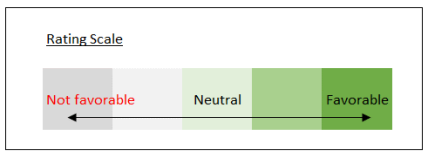



**Screening Analysis**

| | Criteria | Target | Alt 3A - Roundabouts | Alt 3B - Roundabouts with Access Management |
|---|---|---|---|---|
| High Priority Criteria | 1 Improve side street access onto Lund (at Hoover, Harris, Chase) | LOS D or better (neutral); and reduction in delay per vehicles (favorable) | LOS A or better (v/c up to 0.91) with 28% growth at Hoover, Harris, and Chase. A RAB at Chase also provides flexible capacity to manage surge events entering/exiting the park.<br>If additional growth occurs, monitor operations to determine if need slip lane lanes.<br>*Hoover* *Harris* *Chase*<br>*LOS A* *LOS A* *LOS A* | The RABs would operate with a LOS A with access Management (v/c up to 0.92). A RAB at Chase also provides flexible capacity to manage surge events entering/exiting the park.<br>If additional growth occurs, monitor operations to determine if need slip lane lanes.<br>*Hoover* *Harris* *Chase*<br>*LOS A* *LOS A* *LOS A* |
| | 2 Improve access between Lund and private driveways | Minimize delays, qualitative comparison | Same as No Build. | Access management would result in trips travelling longer to get to/from driveways. However it would reduce delays for vehicles access Lund (right turn only) and eliminate the delay between Harris and Chase which occurs when a vehicle turns left from Lund to a driveway. |
| | 3 Traffic control is warranted per the MUTCD | Warranted | No warrant requirements for a RAB | See note under Roundabouts. |
| | 4 Compatible with Bethel and Cathie operations including future RAB at Bethel and potential to provide access management within City of PO ROW | Compatible | RABs would be consistent wtih City improvements at Bethel. Also, the RABs at Hoover or Harris both have adequate capacity to provide u-turns for vehicles turning to/from Lund between Bethel and Hoover, thus are compatable with any potential access management within the City ROW east of Bethel. | See note under Roundabouts. |
| | 5 Do not increase potential for traffic to cut through the neighborhood to avoid the Bethel and Jackson corridors | Does not increase likelihood of cut through (qualitative comparison of alternatives) | RABs at Harris and Chase potentially promote cut through | See note under Roundabouts. |
| | 6 Compatible with urban residential neighborhood and adjacent corridors | Compatible | Consistent with Bethel/Lund improvements | See note under Roundabouts.<br>Access management in conjunction with roundabouts and other pedestrian and bicycle enhancements would fit into the residential corridor |
| | 7 Improve identified safety issues | Better than today | [To be determined when data is available. Will be used to refine or prioritize alternatives if safety issues are identified.] | [To be determined when data is available. Will be used to refine or prioritize alternatives if safety issues are identified.] |
| | 8 Minimize pedestrian crossing lengths and improve crossings at intersections | Improved compared to today | Roundabouts are favorable for pedestrians as traffic approaches from one direction only.<br>Pedestrian crossings could occur at Hoover, Harris, and/or Chase. | See note under Roundabout. |
| | 9 Compatible with future mid-block pedestrian crossing | Compatible | Condition does not preclude a future mid-block pedestrian crossing. | See note under Roundabout.<br>Center median could be provide a refuge. |
| Mid-Priority | 10 Traffic operations along Lund operate above County standard and additional delay is minimized | LOS D or better (neutral); and no increase in delay per vehicles (favorable) | Lund would incur small delays approaching the RABs. | See note under Roundabout. |
| | 11 Minimize maintenance cost | Additional costs beyond a signalized corridor (not favorable). Signalized corridor (neutral). No added maintenance (favorable). | Long term O&M costs are greater for signals than RABs. | See note under Signals.<br>Potentially some landscape with median. |
| | 12 Minimize cost to construct | Qualitative comparison between alternatives | Construction costs are typically lower for signalized intersections than for roundabouts. | See note under Roundabouts.<br>Raised medians increase costs slightly |
| | 13 Minimize ROW impacts/takes | Qualitative comparison between alternatives | The smallest compact RAB that will still provide capacity requires additional ROW. | See note under Roundabouts. |

** Additional information to be included in the design scope/effort

**Lund Ave SE Corridor Study**
**Alternatives Analysis**




| | | Screening Analysis | |
|---|---|---|---|
| | | Criteria | Target |
| High Priority Criteria | 1 | Improve side street access onto Lund (at Hoover, Harris, Chase) | LOS D or better (neutral); and reduction in delay per vehicles (favorable) |
| | 2 | Improve access between Lund and private driveways | Minimize delays, qualitative comparison |
| | 3 | Traffic control is warranted per the MUTCD | Warranted |
| | 4 | Compatible with Bethel and Cathie operations including future RAB at Bethel and potential to provide access management within City of PO ROW | Compatible |
| | 5 | Do not increase potential for traffic to cut through the neighborhood to avoid the Bethel and Jackson corridors | Does not increase likelihood of cut through (qualitative comparison of alternatives) |
| | 6 | Compatible with urban residential neighborhood and adjacent corridors | Compatible |
| | 7 | Improve identified safety issues | Better than today |
| | 8 | Minimize pedestrian crossing lengths and improve crossings at intersections | Improved compared to today |
| | 9 | Compatible with future mid-block pedestrian crossing | Compatible |
| Mid-Priority | 10 | Traffic operations along Lund operate above County standard and additional delay is minimized | LOS D or better (neutral); and no increase in delay per vehicles (favorable) |
| | 11 | Minimize maintenance cost | Additional costs beyond a signalized corridor (not favorable). Signalized corridor (neutral). No added maintenance (favorable). |
| | 12 | Minimize cost to construct | Qualitative comparison between alternatives |
| | 13 | Minimize ROW impacts/takes | Qualitative comparison between alternatives |

** Additional information to be included in the design scope/effort

# Appendix D

## Opinion (Estimate) of Probable Cost

# Harris Road SE Roundabout
# Opinion (Estimate) of Probable Cost

| | | | |
|---|---|---|---|
| **Project Name** | SE Lund Ave Traffic Study | | |
| **Project #** | 233-1578-156 | | |
| **Location** | Port Orchard | | |
| **Owner** | Kitsap County | | |
| Date of Estimate | 07/21/21 | Checked: Eddie Soto, P.E. | |
| By: | D. Dinkuhn, P.E. | Date: 07/19/21 | |

| ITEM NO. | SPEC SECTION | DESCRIPTION | UNIT | TOTAL QTY | UNIT PRICE | TOTAL COST |
|---|---|---|---|---|---|---|
| 1 | 1-04 | Minor Change | FA | 1 | $30,000.00 | $30,000.00 |
| 2 | 1-05 | Roadway Surveying | LS | 1 | $25,000.00 | $25,000.00 |
| 3 | 1-07 | SPCC Plan | LS | 1 | $1,000.00 | $1,000.00 |
| 4 | 1-07 | Pothole Existing Utilities | Each | 10 | $400.00 | $4,000.00 |
| 5 | 1-09 | Mobilization | LS | 1 | $126,944.98 | $126,944.98 |
| 6 | 1-10 | Project Temporary Traffic Control | LS | 1 | $200,000.00 | $200,000.00 |
| 7 | 2-01 | Clearing and Grubbing | ACRE | 0.20 | $40,000.00 | $8,000.00 |
| 8 | 2-02 | Removal of Structures and Obstructions | LS | 1 | $10,000.00 | $10,000.00 |
| 9 | 2-02 | Removing Asphalt Concrete Pavement | SY | 4000 | $8.00 | $32,000.00 |
| 10 | 2-02 | Removing Drainage Structure | EA | 5 | $710.00 | $3,550.00 |
| 11 | 2-03 | Roadway Excavation Incl. Haul | CY | 1,372 | $40.00 | $54,880.00 |
| 12 | 4-04 | Crushed Surfacing Top Course | TON | 1,111 | $45.00 | $49,982.38 |
| 13 | 4-04 | Crushed Surfacing Base Course | TON | 1,071 | $41.00 | $43,930.68 |
| 14 | 5-04 | HMA CL 1/2 In. PG 58H-22 | TON | 890 | $150.00 | $133,506.25 |
| 15 | 5-05 | Cement Conc. Pad for Bus Stop | SY | 22 | $90.00 | $2,000.00 |
| 16 | 5-05 | Cement Conc. Truck Apron | SY | 147 | $150.00 | $22,033.33 |
| 17 | 5-05 | Cement Conc. Splitter Island | SY | 141 | $150.00 | $21,200.00 |
| 18 | 5-05 | Cement Conc. Median | SY | 0 | $150.00 | $0.00 |
| 19 | 7-04 | Schedule A Storm Sewer Pipe 12 In. Diam. | LF | 600 | $83.00 | $49,800.00 |
| 20 | 7-04 | Connection to Existing Storm Pipe | EACH | 1 | $1,200.00 | $1,200.00 |
| 21 | 7-05 | Catch Basin Type 1 | EACH | 8 | $1,800.00 | $14,400.00 |
| 22 | 7-05 | Catch Basin Type 2 with Standipe | EACH | 0 | $4,000.00 | $0.00 |
| 23 | 8-01 | Erosion Control and Water Pollution Prevention | LS | 1 | $16,000.00 | $16,000.00 |
| 24 | 8-02 | Seeding, Fertilizing, and Mulching | ACRE | 0.20 | $20,000.00 | $4,000.00 |
| 25 | 8-02 | Bioretention Cell | SF | 3,905 | $26.92 | $105,152.84 |
| 26 | 8-02 | Median Landscaping | SF | 1,925 | $11.81 | $22,741.16 |
| 27 | 8-02 | Roundabout Center Median Landscaping | SF | 1,257 | $11.81 | $14,851.22 |
| 28 | 8-02 | Sidewalk Planter Landscaping | SF | 0 | $11.81 | $0.00 |
| 29 | 8-03 | Irrigation System | LS | 1 | $20,800.00 | $20,800.00 |

| ITEM NO. | SPEC SECTION | DESCRIPTION | UNIT | TOTAL QTY | UNIT PRICE | TOTAL COST |
|---|---|---|---|---|---|---|
| 30 | 8-04 | Cement Conc. Traffic Curb and Gutter | LF | 2,052 | $35.00 | $71,820.00 |
| 31 | 8-04 | Roundabout Truck Apron Cem. Conc. Curb and Gutter | LF | 188 | $38.00 | $7,144.00 |
| 32 | 8-04 | Roundabout Cem. Conc. Curb and Gutter | LF | 425 | $38.00 | $16,150.00 |
| 33 | 8-04 | Roundabout Center Island Cem. Conc. Curb and Gutter | LF | 129 | $47.00 | $6,063.00 |
| 34 | 8-06 | Cement Conc. Driveway Entrance Type 1 | SY | 55 | $75.00 | $4,125.00 |
| 35 | 8-12 | Wood Fence Under 6 Ft. Tall | LF | 60 | $60.00 | $3,600.00 |
| 36 | 8-14 | Cement Conc. Sidewalk | SY | 1,222 | $60.00 | $73,320.00 |
| 37 | 8-14 | Cement Conc. Curb Ramp Type Perpendicular | EACH | 4 | $3,000.00 | $12,000.00 |
| 38 | 8-14 | Cement Conc. Curb Ramp Type Single Direction | EACH | 4 | $3,000.00 | $12,000.00 |
| 39 | 8-14 | Cement Conc. Curb Ramp Type Parallel | EACH | 0 | $3,000.00 | $0.00 |
| 40 | 8-14 | Detectable Warning Surface | SF | 240 | $55.00 | $13,200.00 |
| 41 | 8-20 | Illumination System, Complete | LS | 1 | $125,000.00 | $125,000.00 |
| 42 | 8-21 | Permanent Signing | LS | 1 | $15,000.00 | $15,000.00 |
| 43 | 8-22 | Pavement Markings | LS | 1 | $10,000.00 | $10,000.00 |
| 44 | 8-30 | Bus Shelter | EACH | 1 | $10,000.00 | $10,000.00 |

Notes: All costs in $2023.
Escalation = 5%/year

| | | | | |
|---|---|---|---|---|
| CONSTRUCTION SUBTOTAL | | | | $1,396,394.83 |
| CONSTRUCTION CONTINGENCY (25%) | | | | $349,098.71 |
| **CONSTRUCTION TOTAL** | | | | **$1,745,493.54** |
| Right of Way | SF | 3,773 | $12.00 | $45,276.00 |
| ROW Services (3%) | | | | $52,365 |
| CULTURAL RESOURCES LUMP SUM | | | | $5,000 |
| DESIGN ENGINEERING (15%) | | | | $261,824 |
| CONSTRUCTION ENGINEERING (7%) | | | | $122,185 |
| **GRAND TOTAL** | | | | **$2,232,143** |

# Hoover Ave Roundabout
## Opinion (Estimate) of Probable Cost

**Project Name** SE Lund Ave Traffic Study

**Project #** 233-1578-156

**Location** Port Orchard

**Owner** Kitsap County

**Date of Estimate** 03/07/22 **By:** D. Dinkuhn, P.E. **Checked By:** Eddie Soto, P.E.
**Date:** **Date:** 07/21/21

| ITEM NO. | SPEC SECTION | DESCRIPTION | UNIT | TOTAL QTY | UNIT PRICE | TOTAL COST ($2023) | Comments |
|---|---|---|---|---|---|---|---|
| 1 | 1-04 | Minor Change | FA | 1 | $30,000.00 | $30,000.00 | |
| 2 | 1-05 | Roadway Surveying | LS | 1 | $25,000.00 | $25,000.00 | 2-man crew $2.5K/day, 10 days total |
| 3 | 1-07 | SPCC Plan | LS | 1 | $1,000.00 | $1,000.00 | Engineer's Estimate |
| 4 | 1-07 | Pothole Existing Utilities | Each | 10 | $400.00 | $4,000.00 | Engineer's Estimate |
| 5 | 1-09 | Mobilization | LS | 1 | $122,244.10 | $122,244.10 | 10%. |
| 6 | 1-10 | Project Temporary Traffic Control | LS | 1 | $200,000.00 | $200,000.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 7 | 2-01 | Clearing and Grubbing | ACRE | 0.20 | $40,000.00 | $8,000.00 | Engineer's Estimate |
| 8 | 2-02 | Removal of Structures and Obstructions | LS | 1 | $10,000.00 | $10,000.00 | Engineer's Estimate |
| 9 | 2-02 | Removing Asphalt Concrete Pavement | SY | 3750 | $8.00 | $30,000.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 10 | 2-02 | Removing Drainage Structure | EA | 0 | $710.00 | $0.00 | JBLM Bid Tab (March 2021) Escalated 10% |
| 11 | 2-03 | Roadway Excavation Incl. Haul | CY | 1,222 | $40.00 | $48,880.00 | Assumes 1' Cut Pavement Areas, Salmonberry Escalated 16% |
| 12 | 4-04 | Crushed Surfacing Top Course | TON | 973 | $45.00 | $43,787.68 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 13 | 4-04 | Crushed Surfacing Base Course | TON | 890 | $41.00 | $36,491.79 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 14 | 5-04 | HMA CL 1/2 In. PG 58H-22 | TON | 739 | $150.00 | $110,899.31 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 15 | 5-05 | Cement Conc. Pad for Bus Stop | SY | 0 | $130.00 | $0.00 | Engineer's Estimate |
| 16 | 5-05 | Cement Conc. Truck Apron | SY | 147 | $150.00 | $22,033.33 | Engineer's Estimate |
| 17 | 5-05 | Cement Conc. Splitter Island | SY | 91 | $150.00 | $13,650.00 | Engineer's Estimate |
| 18 | 5-05 | Cement Conc. Median | SY | 6 | $150.00 | $833.33 | Engineer's Estimate |
| 19 | 7-04 | Schedule A Storm Sewer Pipe 12 In. Diam. | LF | 600 | $83.00 | $49,800.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 20 | 7-04 | Connection to Existing Storm Pipe | EACH | 0 | $1,200.00 | $0.00 | Engineer's Estimate |
| 21 | 7-05 | Catch Basin Type 1 | EACH | 8 | $1,800.00 | $14,400.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 22 | 7-05 | Catch Basin Type 2 with Standipe | EACH | 1 | $4,000.00 | $4,000.00 | Engineer's Estimate |
| 23 | 7-05 | BioPod Curb Inlet Treatment Vault | EACH | 1 | $18,500.00 | $18,500.00 | Vendor Information |
| 24 | 8-01 | Erosion Control and Water Pollution Prevention | LS | 1 | $16,000.00 | $16,000.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 25 | 8-02 | Seeding, Fertilizing, and Mulching | ACRE | 0.20 | $20,000.00 | $4,000.00 | Engineer's Estimate |
| 26 | 8-02 | Bioretention/detention Pond | SF | 4,225 | $19.77 | $83,508.69 | Does not include any sidewalk planter. Engineer's Estimate |
| 27 | 8-02 | Median Landscaping | SF | 2,280 | $12.22 | $27,865.78 | Engineer's Estimate |
| 28 | 8-02 | Roundabout Center Median Landscaping | SF | 1,257 | $12.22 | $15,362.84 | Engineer's Estimate |
| 29 | 8-02 | Sidewalk Planter Landscaping | SF | 3,463 | $12.22 | $42,324.21 | Engineer's Estimate |
| 30 | 8-03 | Irrigation System | LS | 1 | $20,800.00 | $20,800.00 | JBLM Bid Tab (March 2021) Escalated 10% |
| 31 | 8-04 | Cement Conc. Traffic Curb and Gutter | LF | 1,219 | $35.00 | $42,665.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 32 | 8-04 | Roundabout Truck Apron Cem. Conc. Curb and Gutter | LF | 188 | $38.00 | $7,144.00 | WSDOT Curb 1 JBLM Bid Tab (March 2021) Escalated 16% |
| 33 | 8-04 | Roundabout Cement Concrete Curb and Gutter | LF | 310 | $38.00 | $11,780.00 | WSDOT Curb 2 JBLM Bid Tab (March 2021) Escalated 16% |
| 34 | 8-04 | Roundabout Center Island Cem. Conc. Curb and Gutter | LF | 125 | $47.00 | $5,875.00 | WSDOT Curb 3 JBLM Bid Tab (March 2021) Escalated 16% |
| 35 | 8-06 | Cement Conc. Driveway Entrance Type 1 | SY | 100 | $75.00 | $7,500.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 36 | 8-12 | Wood Fence Under 6 Ft. Tall | LF | 60 | $60.00 | $3,600.00 | Engineer's Estimate |

| ITEM NO. | SPEC SECTION | DESCRIPTION | UNIT | TOTAL QTY | UNIT PRICE | TOTAL COST ($2023) | Comments |
|---|---|---|---|---|---|---|---|
| 37 | 8-14 | Cement Conc. Sidewalk | SY | 1,259 | $60.00 | $75,540.00 | JBLM Bid Tab (March 2021) Escalated 10% |
| 38 | 8-14 | Cement Conc. Curb Ramp Type Perpendicular | EACH | 4 | $3,000.00 | $12,000.00 | Engineer's Estimate |
| 39 | 8-14 | Cement Conc. Curb Ramp Type Single Direction | EACH | 4 | $3,000.00 | $12,000.00 | Engineer's Estimate |
| 40 | 8-14 | Cement Conc. Curb Ramp Type Parallel | EACH | 0 | $3,000.00 | $0.00 | Engineer's Estimate |
| 41 | 8-14 | Detectable Warning Surface | SF | 240 | $55.00 | $13,200.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 42 | 8-20 | Illumination System, Complete | LS | 1 | $125,000.00 | $125,000.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 43 | 8-21 | Permanent Signing | LS | 1 | $15,000.00 | $15,000.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 44 | 8-22 | Pavement Markings | LS | 1 | $10,000.00 | $10,000.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 45 | 8-30 | Bus Shelter | EACH | 0 | $10,000.00 | $0.00 | Engineer's Estimate |
| | | | | | | $1,344,685.05 | CONSTRUCTION SUBTOTAL |
| | | | | | | $336,171.26 | CONSTRUCTION CONTINGENCY (25%) |
| | | | | | | **$1,680,856.31** | **CONSTRUCTION TOTAL** |
| | | Right of Way | SF | 3,359 | $12.00 | $40,308.00 | Kitsap Lake Elementary (January 2020) Escalated 16% |
| | | | | | | $50,426 | ROW Services (3%) |
| | | | | | | $5,000 | CULTURAL RESOURCES LUMP SUM |
| | | | | | | $252,128 | DESIGN ENGINEERING (15%) |
| | | | | | | $117,660 | CONSTRUCTION ENGINEERING (7%) |
| | | | | | | **$2,146,378** | **GRAND TOTAL** |

# Segment 1
# Opinion (Estimate) of Probable Cost

**Project Name** SE Lund Ave Traffic Study

**Project #** 233-1578-156

**Location** Port Orchard

**Owner** Kitsap County

**Date of Estimate** 07/21/21 **By:** D. Dinkuhn, P.E. **Checked By:** Eddie Soto, P.E.
**Date:** **Date:**

| ITEM NO. | SPEC SECTION | DESCRIPTION | UNIT | TOTAL QTY | UNIT PRICE | TOTAL COST | Comments |
|---|---|---|---|---|---|---|---|
| 1 | 1-04 | Minor Change | FA | 1 | $15,000.00 | $15,000.00 | |
| 2 | 1-05 | Roadway Surveying | LS | 1 | $12,500.00 | $12,500.00 | 2-man crew $2.5K/day, 5 days total |
| 3 | 1-07 | SPCC Plan | LS | 1 | $1,000.00 | $1,000.00 | Engineer's Estimate |
| 4 | 1-07 | Pothole Existing Utilities | Each | 6 | $400.00 | $2,400.00 | Engineer's Estimate |
| 5 | 1-09 | Mobilization | LS | 1 | $48,326.16 | $48,326.16 | 10%. |
| 6 | 1-10 | Project Temporary Traffic Control | LS | 1 | $50,000.00 | $50,000.00 | 1/4 Roundabout, Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 7 | 2-01 | Clearing and Grubbing | ACRE | 0.10 | $40,000.00 | $4,000.00 | Engineer's Estimate |
| 8 | 2-02 | Removal of Structures and Obstructions | LS | 1 | $5,000.00 | $5,000.00 | Engineer's Estimate |
| 9 | 2-02 | Removing Asphalt Concrete Pavement | SY | 1500 | $8.00 | $12,000.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 10 | 2-02 | Removing Drainage Structure | EA | 0 | $710.00 | $0.00 | JBLM Bid Tab (March 2021) Escalated 10% |
| 11 | 2-03 | Roadway Excavation Incl. Haul | CY | 328 | $40.00 | $13,120.00 | Assumes 1' Cut Ave Pavement Areas, Salmonberry Escalated 16% |
| 12 | 4-04 | Crushed Surfacing Top Course | TON | 373 | $45.00 | $16,786.35 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 13 | 4-04 | Crushed Surfacing Base Course | TON | 394 | $41.00 | $16,155.70 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 14 | 5-04 | HMA CL 1/2 In. PG 58H-22 | TON | 327 | $150.00 | $49,097.50 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 15 | 5-05 | Cement Conc. Pad for Bus Stop | SY | 0 | $90.00 | $0.00 | Engineer's Estimate |
| 16 | 5-05 | Cement Conc. Truck Apron | SY | 0 | $150.00 | $0.00 | Engineer's Estimate |
| 17 | 5-05 | Cement Conc. Splitter Island | SY | 0 | $150.00 | $0.00 | Engineer's Estimate |
| 18 | 5-05 | Cement Conc. Median | SY | 26 | $150.00 | $3,916.67 | Engineer's Estimate |
| 19 | 7-04 | Schedule A Storm Sewer Pipe 12 In. Diam. | LF | 200 | $83.00 | $16,600.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 20 | 7-04 | Connection to Existing Storm Pipe | EACH | 4 | $1,200.00 | $4,800.00 | |
| 21 | 7-05 | Catch Basin Type 1 | EACH | 4 | $1,800.00 | $7,200.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 22 | 7-05 | Catch Basin Type 2 with Standipe | EACH | 0 | $4,000.00 | $0.00 | Engineer's Estimate |
| 23 | 7-05 | Biopod Curb Inlet Unit 4 ft x 4 ft | EACH | 0 | $18,000.00 | $0.00 | Vendor Information |
| 24 | 8-01 | Erosion Control and Water Pollution Prevention | LS | 1 | $4,000.00 | $4,000.00 | 1/4 Roundabout, Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 25 | 8-02 | Seeding, Fertilizing, and Mulching | ACRE | 0.20 | $20,000.00 | $4,000.00 | Engineer's Estimate |
| 26 | 8-02 | Bioretention Cell | SF | 1,740 | $27.36 | $47,594.74 | Includes sidewalk planter area. Engineer's Estimate |
| 27 | 8-02 | Median Landscaping | SF | 605 | $13.35 | $8,073.60 | Engineer's Estimate |
| 28 | 8-02 | Roundabout Center Median Landscaping | SF | 0 | $13.35 | $0.00 | Engineer's Estimate |
| 29 | 8-02 | Sidewalk Planter Landscaping | SF | 0 | $13.35 | $0.00 | Engineer's Estimate |
| 30 | 8-03 | Irrigation System | LS | 1 | $5,200.00 | $5,200.00 | 1/4 Roundabout JBLM Bid Tab (March 2021) Escalated 10% |
| 31 | 8-04 | Cement Conc. Traffic Curb and Gutter | LF | 629 | $35.00 | $22,015.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 32 | 8-04 | Roundabout Truck Apron Cem. Conc. Curb and Gutter | LF | 0 | $38.00 | $0.00 | WSDOT Curb 1 JBLM Bid Tab (March 2021) Escalated 10% |
| 33 | 8-04 | Median Concrete Curb and Gutter | LF | 229 | $38.00 | $8,702.00 | WSDOT Curb 2 JBLM Bid Tab (March 2021) Escalated 10% |
| 34 | 8-04 | Roundabout Center Island Cem. Conc. Curb and Gutter | LF | 0 | $47.00 | $0.00 | WSDOT Curb 3 JBLM Bid Tab (March 2021) Escalated 10% |
| 35 | 8-06 | Cement Conc. Driveway Entrance Type 1 | SY | 46 | $75.00 | $3,450.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 36 | 8-12 | Wood Fence Under 6 Ft. Tall | LF | 0 | $60.00 | $0.00 | Engineer's Estimate |

| ITEM NO. | SPEC SECTION | DESCRIPTION | UNIT | TOTAL QTY | UNIT PRICE | TOTAL COST | Comments |
|---|---|---|---|---|---|---|---|
| 37 | 8-14 | Cement Conc. Sidewalk | SY | 963 | $50.00 | $48,150.00 | JBLM Bid Tab (March 2021) Escalated 10% |
| 38 | 8-14 | Cement Conc. Curb Ramp Type Perpendicular | EACH | 0 | $3,000.00 | $0.00 | Engineer's Estimate |
| 39 | 8-14 | Cement Conc. Curb Ramp Type Single Direction | EACH | 0 | $3,000.00 | $0.00 | Engineer's Estimate |
| 40 | 8-14 | Cement Conc. Curb Ramp Type Parallel | EACH | 0 | $3,000.00 | $0.00 | Engineer's Estimate |
| 41 | 8-14 | Detectable Warning Surface | SF | 0 | $55.00 | $0.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 42 | 8-20 | Illumination System, Complete | LS | 1 | $96,000.00 | $96,000.00 | 6 Light Standards 100 ft O.C. each side, $16,000 Each |
| 43 | 8-21 | Permanent Signing | LS | 1 | $4,000.00 | $4,000.00 | 1/4 Roundabout, Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 44 | 8-22 | Pavement Markings | LS | 1 | $2,500.00 | $2,500.00 | 1/4 Roundabout, Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 45 | 8-30 | Bus Shelter | EACH | 0 | $10,000.00 | $0.00 | Engineer's Estimate |

Notes: All costs in $2023.
Escalation = 5%/year

| | | | | | |
|---|---|---|---|---|---|
| | | | | $531,587.71 | CONSTRUCTION SUBTOTAL |
| | | | | $132,896.93 | CONSTRUCTION CONTINGENCY (25%) |
| | | | | **$664,484.63** | **CONSTRUCTION TOTAL** |
| Right of Way | SF | 0 | $12.00 | $0.00 | Kitsap Lake Elementary (January 2020) Escalated 16% |
| | | | | $0 | ROW Services (3%) |
| | | | | $5,000 | CULTURAL RESOURCES (LUMP SUM) |
| | | | | $99,673 | DESIGN ENGINEERING (15%) |
| | | | | $46,514 | CONSTRUCTION ENGINEERING (7%) |
| | | | | **$810,671** | **GRAND TOTAL** |

# Chase Road SE Roundabout
# Opinion (Estimate) of Probable Cost

**Project Name** SE Lund Ave Traffic Study

**Project #** 233-1578-156

**Location** Port Orchard

**Owner** Kitsap County

**Date of Estimate** 07/21/21 **By:** D. Dinkuhn, P.E. **Checked By:** Eddie Soto, P.E.
**Date:** **Date:** 07/19/21

| ITEM NO. | SPEC SECTION | DESCRIPTION | UNIT | TOTAL QTY | UNIT PRICE | TOTAL COST | Comments |
|---|---|---|---|---|---|---|---|
| 1 | 1-04 | Minor Change | FA | 1 | $30,000.00 | $30,000.00 | |
| 2 | 1-05 | Roadway Surveying | LS | 1 | $25,000.00 | $25,000.00 | 2-man crew $2.5K/day, 10 days total |
| 3 | 1-07 | SPCC Plan | LS | 1 | $1,000.00 | $1,000.00 | Engineer's Estimate |
| 4 | 1-07 | Pothole Existing Utilities | Each | 10 | $400.00 | $4,000.00 | Engineer's Estimate |
| 5 | 1-09 | Mobilization | LS | 1 | $120,057.17 | $120,057.17 | 10%. |
| 6 | 1-10 | Project Temporary Traffic Control | LS | 1 | $200,000.00 | $200,000.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 7 | 2-01 | Clearing and Grubbing | ACRE | 0.20 | $40,000.00 | $8,000.00 | Engineer's Estimate |
| 8 | 2-02 | Removal of Structures and Obstructions | LS | 1 | $10,000.00 | $10,000.00 | Engineer's Estimate |
| 9 | 2-02 | Removing Asphalt Concrete Pavement | SY | 4000 | $8.00 | $32,000.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 10 | 2-02 | Removing Drainage Structure | EA | 0 | $710.00 | $0.00 | JBLM Bid Tab (March 2021) Escalated 10% |
| 11 | 2-03 | Roadway Excavation Incl. Haul | CY | 1,277 | $40.00 | $51,080.00 | Assumes 1' Cut Ave Pavement Areas, Salmonberry Escalated 16% |
| 12 | 4-04 | Crushed Surfacing Top Course | TON | 1,052 | $45.00 | $47,343.72 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 13 | 4-04 | Crushed Surfacing Base Course | TON | 1,068 | $41.00 | $43,773.28 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 14 | 5-04 | HMA CL 1/2 In. PG 58H-22 | TON | 887 | $150.00 | $133,027.92 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 15 | 5-05 | Cement Conc. Pad for Bus Stop | SY | 22 | $90.00 | $2,000.00 | Engineer's Estimate |
| 16 | 5-05 | Cement Conc. Truck Apron | SY | 147 | $150.00 | $22,033.33 | Engineer's Estimate |
| 17 | 5-05 | Cement Conc. Splitter Island | SY | 128 | $150.00 | $19,166.67 | Engineer's Estimate |
| 18 | 5-05 | Cement Conc. Median | SY | 0 | $150.00 | $0.00 | Engineer's Estimate |
| 19 | 7-04 | Schedule A Storm Sewer Pipe 12 In. Diam. | LF | 600 | $83.00 | $49,800.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 20 | 7-04 | Connection to Existing Storm Pipe | EACH | 0 | $1,200.00 | $0.00 | Engineer's Estimate |
| 21 | 7-05 | Catch Basin Type 1 | EACH | 8 | $1,650.00 | $13,200.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 22 | 7-05 | Catch Basin Type 2 with Standipe | EACH | 0 | $4,000.00 | $0.00 | Engineer's Estimate |
| 23 | 8-01 | Erosion Control and Water Pollution Prevention | LS | 1 | $20,000.00 | $20,000.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 24 | 8-02 | Seeding, Fertilizing, and Mulching | ACRE | 0.20 | $20,000.00 | $4,000.00 | Engineer's Estimate |
| 25 | 8-02 | Bioretention Cell | SF | 3,407 | $26.65 | $90,777.03 | Includes all sidewalk planter. Engineer's Estimate |
| 26 | 8-02 | Median Landscaping | SF | 1,710 | $12.36 | $21,131.33 | Engineer's Estimate |
| 27 | 8-02 | Roundabout Center Median Landscaping | SF | 1,257 | $12.36 | $15,533.38 | Engineer's Estimate |
| 28 | 8-02 | Sidewalk Planter Landscaping | SF | 0 | $12.36 | $0.00 | Engineer's Estimate |
| 29 | 8-03 | Irrigation System | LS | 1 | $20,800.00 | $20,800.00 | JBLM Bid Tab (March 2021) Escalated 10% |
| 30 | 8-04 | Cement Conc. Traffic Curb and Gutter | LF | 1,772 | $35.00 | $62,020.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 31 | 8-04 | Roundabout Truck Apron Cem. Conc. Curb and Gutter | LF | 188 | $38.00 | $7,144.00 | WSDOT Curb 1 JBLM Bid Tab (March 2021) Escalated 10% |
| 32 | 8-04 | Roundabout Cement Concrete Curb and Gutter | LF | 431 | $38.00 | $16,378.00 | WSDOT Curb 2 JBLM Bid Tab (March 2021) Escalated 10% |
| 33 | 8-04 | Roundabout Center Island Cem. Conc. Curb and Gutter | LF | 129 | $47.00 | $6,063.00 | WSDOT Curb 3 JBLM Bid Tab (March 2021) Escalated 10% |
| 34 | 8-06 | Cement Conc. Driveway Entrance Type 1 | SY | 0 | $75.00 | $0.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 35 | 8-12 | Wood Fence Under 6 Ft. Tall | LF | 0 | $60.00 | $0.00 | Engineer's Estimate |
| 36 | 8-14 | Cement Conc. Sidewalk | SY | 962 | $50.00 | $48,100.00 | JBLM Bid Tab (March 2021) Escalated 10% |

| ITEM NO. | SPEC SECTION | DESCRIPTION | UNIT | TOTAL QTY | UNIT PRICE | TOTAL COST | Comments |
|---|---|---|---|---|---|---|---|
| 37 | 8-14 | Cement Conc. Curb Ramp Type Perpendicular | EACH | 4 | $3,000.00 | $12,000.00 | Engineer's Estimate |
| 38 | 8-14 | Cement Conc. Curb Ramp Type Single Direction | EACH | 4 | $3,000.00 | $12,000.00 | Engineer's Estimate |
| 39 | 8-14 | Cement Conc. Curb Ramp Type Parallel | EACH | 0 | $3,000.00 | $0.00 | Engineer's Estimate |
| 40 | 8-14 | Detectable Warning Surface | SF | 240 | $55.00 | $13,200.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 41 | 8-20 | Illumination System, Complete | LS | 1 | $125,000.00 | $125,000.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 42 | 8-21 | Permanent Signing | LS | 1 | $15,000.00 | $15,000.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 43 | 8-22 | Pavement Markings | LS | 1 | $10,000.00 | $10,000.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 44 | 8-30 | Bus Shelter | EACH | 1 | $10,000.00 | $10,000.00 | Engineer's Estimate |

Notes: All costs in $2023.
Escalation = 5%/year

| | | | | | |
|---|---|---|---|---|---|
| $1,320,628.83 | CONSTRUCTION SUBTOTAL | | | | |
| $330,157.21 | CONSTRUCTION CONTINGENCY (25%) | | | | |
| **$1,650,786.04** | **CONSTRUCTION TOTAL** | | | | |
| $13,200.00 | Kitsap Lake Elementary (January 2020) Escalated 16% | Right of Way | SF | 1,100 | $12.00 |
| $49,524 | ROW Services (3%) | | | | |
| $5,000 | CULTURAL RESOURCES (LUMP SUM) | | | | |
| $247,618 | DESIGN ENGINEERING (15%) | | | | |
| $115,555 | CONSTRUCTION ENGINEERING (7%) | | | | |
| **$2,076,683** | **GRAND TOTAL** | | | | |

# Segment 2
# Opinion (Estimate) of Probable Cost

**Project Name** SE Lund Ave Improvements TIB Grant

**Project #** 233-1578-156

**Location** Port Orchard

**Owner** Kitsap County

**Date of Estimate** 07/21/21 **By:** D. Dinkuhn, P.E. **Checked By:** Eddie Soto, P.E.
**Date:** **Date:** 07/19/21

| ITEM NO. | SPEC SECTION | DESCRIPTION | UNIT | TOTAL QTY | UNIT PRICE | TOTAL COST | Comments |
|---|---|---|---|---|---|---|---|
| 1 | 1-04 | Minor Change | FA | 1 | $30,000.00 | $30,000.00 | |
| 2 | 1-05 | Roadway Surveying | LS | 1 | $12,500.00 | $12,500.00 | 2-man crew $2.5K/day, 5 days total |
| 3 | 1-07 | SPCC Plan | LS | 1 | $1,000.00 | $1,000.00 | Engineer's Estimate |
| 4 | 1-07 | Pothole Existing Utilities | Each | 6 | $400.00 | $2,400.00 | Engineer's Estimate |
| 5 | 1-09 | Mobilization | LS | 1 | $140,286.41 | $140,286.41 | 10%. |
| 6 | 1-10 | Project Temporary Traffic Control | LS | 1 | $100,000.00 | $100,000.00 | 1/2 Roundabout, Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 7 | 2-01 | Clearing and Grubbing | ACRE | 0.20 | $40,000.00 | $8,000.00 | Engineer's Estimate |
| 8 | 2-02 | Removal of Structures and Obstructions | LS | 1 | $10,000.00 | $10,000.00 | Engineer's Estimate |
| 9 | 2-02 | Removing Asphalt Concrete Pavement | SY | 4500 | $8.00 | $36,000.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 10 | 2-02 | Removing Drainage Structure | EA | 0 | $710.00 | $0.00 | JBLM Bid Tab (March 2021) Escalated 16% |
| 11 | 2-03 | Roadway Excavation Incl. Haul | CY | 1,564 | $40.00 | $62,560.00 | Assumes 1' Cut Ave Pavement Areas, Salmonberry Escalated 16% |
| 12 | 4-04 | Crushed Surfacing Top Course | TON | 1,289 | $45.00 | $58,017.91 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 13 | 4-04 | Crushed Surfacing Base Course | TON | 1,311 | $41.00 | $53,741.77 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 14 | 5-04 | HMA CL 1/2 In. PG 58H-22 | TON | 1,089 | $150.00 | $163,322.36 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 15 | 5-05 | Cement Conc. Pad for Bus Stop | SY | 0 | $90.00 | $0.00 | Engineer's Estimate |
| 16 | 5-05 | Cement Conc. Truck Apron | SY | 0 | $150.00 | $0.00 | Engineer's Estimate |
| 17 | 5-05 | Cement Conc. Splitter Island | SY | 0 | $150.00 | $0.00 | Engineer's Estimate |
| 18 | 5-05 | Cement Conc. Median | SY | 52 | $150.00 | $7,816.67 | Engineer's Estimate |
| 19 | 7-04 | Schedule A Storm Sewer Pipe 12 In. Diam. | LF | 1,000 | $83.00 | $83,000.00 | Full Conveyance S. Side, Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 20 | 7-04 | Connection to Existing Storm Pipe | EACH | 2 | $1,200.00 | $2,400.00 | Engineer's Estimate |
| 21 | 7-05 | Catch Basin Type 1 | EACH | 8 | $1,800.00 | $14,400.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 22 | 7-05 | Catch Basin Type 2 with Standipe | EACH | 0 | $4,000.00 | $0.00 | Engineer's Estimate |
| 23 | 7-05 | Biopod Curb Inlet Unit 4 ft x 4 ft | EACH | 0 | $18,000.00 | $0.00 | Vendor Information |
| 24 | 8-01 | Erosion Control and Water Pollution Prevention | LS | 1 | $16,000.00 | $16,000.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 25 | 8-02 | Seeding, Fertilizing, and Mulching | ACRE | 0.20 | $20,000.00 | $4,000.00 | Engineer's Estimate |
| 26 | 8-02 | Bioretention Cell | SF | 3,899 | $26.76 | $104,335.47 | Includes 45% sidewalk planter area. Engineer's Estimate |
| 27 | 8-02 | Sidewalk and Median Planter Landscaping | SF | 9,272 | $11.81 | $109,546.96 | Engineer's Estimate |
| 28 | 8-02 | Roundabout Center Median Landscaping | SF | 0 | $11.81 | $0.00 | Engineer's Estimate |
| 29 | 8-03 | Irrigation System | LS | 1 | $20,800.00 | $20,800.00 | JBLM Bid Tab (March 2021) Escalated 10% |
| 30 | 8-04 | Cement Conc. Traffic Curb and Gutter | LF | 2,812 | $35.00 | $98,420.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 31 | 8-04 | Roundabout Truck Apron Cem. Conc. Curb and Gutter | LF | 0 | $38.00 | $0.00 | WSDOT Curb 1 JBLM Bid Tab (March 2021) Escalated 10% |
| 32 | 8-04 | Median Concrete Curb and Gutter | LF | 456 | $38.00 | $17,328.00 | WSDOT Curb 2 JBLM Bid Tab (March 2021) Escalated 10% |
| 33 | 8-04 | Roundabout Center Island Cem. Conc. Curb and Gutter | LF | 0 | $47.00 | $0.00 | WSDOT Curb 3 JBLM Bid Tab (March 2021) Escalated 10% |
| 34 | 8-06 | Cement Conc. Driveway Entrance Type 1 | SY | 133 | $75.00 | $9,975.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 35 | 8-12 | Wood Fence Under 6 Ft. Tall | LF | 0 | $60.00 | $0.00 | Engineer's Estimate |
| 36 | 8-14 | Cement Conc. Sidewalk | SY | 1,455 | $60.00 | $87,300.00 | JBLM Bid Tab (March 2021) Escalated 10% |
| 37 | 8-14 | Cement Conc. Curb Ramp Type Perpendicular | EACH | 0 | $3,000.00 | $0.00 | Engineer's Estimate |

| ITEM NO. | SPEC SECTION | DESCRIPTION | UNIT | TOTAL QTY | UNIT PRICE | TOTAL COST | Comments |
|---|---|---|---|---|---|---|---|
| 38 | 8-14 | Cement Conc. Curb Ramp Type Single Direction | EACH | 2 | $3,000.00 | $6,000.00 | Engineer's Estimate |
| 39 | 8-14 | Cement Conc. Curb Ramp Type Parallel | EACH | 0 | $3,000.00 | $0.00 | Engineer's Estimate |
| 40 | 8-14 | Detectable Warning Surface | SF | 0 | $55.00 | $0.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 41 | 8-20 | Illumination System, Complete | LS | 1 | $256,000.00 | $256,000.00 | 16 Light Standards, 100 ft O.C. Each Side, $16,000 Each |
| 42 | 8-21 | Permanent Signing | LS | 1 | $16,000.00 | $16,000.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 43 | 8-22 | Pavement Markings | LS | 1 | $12,000.00 | $12,000.00 | Engineer's Estimate |
| 44 | 8-30 | Bus Shelter | EACH | 0 | $10,000.00 | $0.00 | Engineer's Estimate |

Notes: All costs in $2023.
Escalation = 5%/year

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | $1,543,150.56 | CONSTRUCTION SUBTOTAL |
| | | | | | $385,787.64 | CONSTRUCTION CONTINGENCY (25%) |
| | | | | | **$1,928,938.20** | **CONSTRUCTION TOTAL** |
| | | Right of Way | SF | 0 | $12.00 | $0.00 Kitsap Lake Elementary (January 2020) Escalated 16% |
| | | | | | | $0 ROW Services (3%) |
| | | | | | | $5,000 CULTURAL RESOURCES (LUMP SUM) |
| | | | | | | $289,341 DESIGN ENGINEERING (15%) |
| | | | | | | $135,026 CONSTRUCTION ENGINEERING (7%) |
| | | | | | | **$2,353,305 GRAND TOTAL** |

# Segment 3
# Opinion (Estimate) of Probable Cost

**Project Name** SE Lund Ave Improvements TIB Grant

**Project #** 233-1578-156

**Location** Port Orchard

**Owner** Kitsap County

**Date of Estimate** 07/21/21 **By:** D. Dinkuhn, P.E. **Checked By:** Eddie Soto, P.E.
**Date:** 07/19/21

| ITEM NO. | SPEC SECTION | DESCRIPTION | UNIT | TOTAL QTY | UNIT PRICE | TOTAL COST | Comments |
|---|---|---|---|---|---|---|---|
| 1 | 1-04 | Minor Change | FA | 1 | $30,000.00 | $30,000.00 | |
| 2 | 1-05 | Roadway Surveying | LS | 1 | $25,000.00 | $25,000.00 | 2-man crew $2.5K/day, 10 days total |
| 3 | 1-07 | SPCC Plan | LS | 1 | $1,000.00 | $1,000.00 | Engineer's Estimate |
| 4 | 1-07 | Pothole Existing Utilities | Each | 10 | $400.00 | $4,000.00 | Engineer's Estimate |
| 5 | 1-09 | Mobilization | LS | 1 | $147,677.99 | $147,677.99 | 10%. |
| 6 | 1-10 | Project Temporary Traffic Control | LS | 1 | $150,000.00 | $150,000.00 | 3/4 Roundabout, Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 7 | 2-01 | Clearing and Grubbing | ACRE | 0.30 | $40,000.00 | $12,000.00 | Engineer's Estimate |
| 8 | 2-02 | Removal of Structures and Obstructions | LS | 1 | $10,000.00 | $10,000.00 | Engineer's Estimate |
| 9 | 2-02 | Removing Asphalt Concrete Pavement | SY | 4320 | $8.00 | $34,560.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 10 | 2-02 | Removing Drainage Structure | EA | 2 | $710.00 | $1,420.00 | JBLM Bid Tab (March 2021) Escalated 16% |
| 11 | 2-03 | Roadway Excavation Incl. Haul | CY | 1,652 | $40.00 | $66,080.00 | Assumes 1' Cut Ave Pavement Areas, Salmonberry Escalated 16% |
| 12 | 4-04 | Crushed Surfacing Top Course | TON | 1,363 | $45.00 | $61,335.12 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 13 | 4-04 | Crushed Surfacing Base Course | TON | 1,390 | $41.00 | $56,975.90 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 14 | 5-04 | HMA CL 1/2 In. PG 58H-22 | TON | 1,154 | $150.00 | $173,150.97 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 15 | 5-05 | Cement Conc. Pad for Bus Stop | SY | 0 | $90.00 | $0.00 | Engineer's Estimate |
| 16 | 5-05 | Cement Conc. Truck Apron | SY | 0 | $150.00 | $0.00 | Engineer's Estimate |
| 17 | 5-05 | Cement Conc. Splitter Island | SY | 0 | $150.00 | $0.00 | Engineer's Estimate |
| 18 | 5-05 | Cement Conc. Median | SY | 52 | $150.00 | $7,816.67 | Engineer's Estimate |
| 19 | 7-04 | Schedule A Storm Sewer Pipe 12 In. Diam. | LF | 1,000 | $83.00 | $83,000.00 | Full Conveyance S. Side,Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 20 | 7-04 | Connection to Existing Storm Pipe | EACH | 2 | $1,200.00 | $2,400.00 | Engineer's Estimate |
| 21 | 7-05 | Catch Basin Type 1 | EACH | 8 | $1,800.00 | $14,400.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 22 | 7-05 | Catch Basin Type 2 with Standipe | EACH | 0 | $4,000.00 | $0.00 | Engineer's Estimate |
| 23 | 7-05 | Biopod Curb Inlet Unit 4 ft x 4 ft | EACH | 0 | $18,000.00 | $0.00 | Vendor Information |
| 24 | 8-01 | Erosion Control and Water Pollution Prevention | LS | 1 | $16,000.00 | $16,000.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 25 | 8-02 | Seeding, Fertilizing, and Mulching | ACRE | 0.30 | $20,000.00 | $6,000.00 | Engineer's Estimate |
| 26 | 8-02 | Bioretention Cell | SF | 3,899 | $26.76 | $104,335.47 | Includes 43% sidewalk planter area. Engineer's Estimate |
| 27 | 8-02 | Sidewalk and Median Planter Landscaping | SF | 9,840 | $11.81 | $116,257.78 | Engineer's Estimate |
| 28 | 8-02 | Roundabout Center Median Landscaping | SF | 0 | $11.81 | $0.00 | Engineer's Estimate |
| 29 | 8-03 | Irrigation System | LS | 1 | $20,800.00 | $20,800.00 | JBLM Bid Tab (March 2021) Escalated 10% |
| 30 | 8-04 | Cement Conc. Traffic Curb and Gutter | LF | 2,647 | $35.00 | $92,645.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 31 | 8-04 | Roundabout Truck Apron Cem. Conc. Curb and Gutter | LF | 0 | $38.00 | $0.00 | WSDOT Curb 1 JBLM Bid Tab (March 2021) Escalated 10% |
| 32 | 8-04 | Median Concrete Curb and Gutter | LF | 456 | $38.00 | $17,328.00 | WSDOT Curb 2 JBLM Bid Tab (March 2021) Escalated 10% |
| 33 | 8-04 | Roundabout Center Island Cem. Conc. Curb and Gutter | LF | 0 | $47.00 | $0.00 | WSDOT Curb 3 JBLM Bid Tab (March 2021) Escalated 10% |
| 34 | 8-06 | Cement Conc. Driveway Entrance Type 1 | SY | 133 | $75.00 | $9,975.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 35 | 8-12 | Wood Fence Under 6 Ft. Tall | LF | 0 | $60.00 | $0.00 | Engineer's Estimate |
| 36 | 8-14 | Cement Conc. Sidewalk | SY | 1,526 | $50.00 | $76,300.00 | JBLM Bid Tab (March 2021) Escalated 10% |
| 37 | 8-14 | Cement Conc. Curb Ramp Type Perpendicular | EACH | 0 | $3,000.00 | $0.00 | Engineer's Estimate |

| ITEM NO. | SPEC SECTION | DESCRIPTION | UNIT | TOTAL QTY | UNIT PRICE | TOTAL COST | Comments |
|---|---|---|---|---|---|---|---|
| 38 | 8-14 | Cement Conc. Curb Ramp Type Single Direction | EACH | 0 | $3,000.00 | $0.00 | Engineer's Estimate |
| 39 | 8-14 | Cement Conc. Curb Ramp Type Parallel | EACH | 0 | $3,000.00 | $0.00 | Engineer's Estimate |
| 40 | 8-14 | Detectable Warning Surface | SF | 0 | $55.00 | $0.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 41 | 8-20 | Illumination System, Complete | LS | 1 | $256,000.00 | $256,000.00 | 16 Light Standards 100 ft O.C. Each Side, $16,000 Each |
| 42 | 8-21 | Permanent Signing | LS | 1 | $16,000.00 | $16,000.00 | Salmonberry and Jackson Bid Tab (May 2020) Escalated 16% |
| 43 | 8-22 | Pavement Markings | LS | 1 | $12,000.00 | $12,000.00 | Engineer's Estimate |
| 44 | 8-30 | Bus Shelter | EACH | 0 | $10,000.00 | $0.00 | Engineer's Estimate |

Notes: All costs in $2023.
Escalation = 5%/year

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | $1,624,457.90 | CONSTRUCTION SUBTOTAL |
| | | | | | $406,114.48 | CONSTRUCTION CONTINGENCY (25%) |
| | | | | | **$2,030,572.38** | **CONSTRUCTION TOTAL** |
| | | Right of Way | SF | 0 | $12.00 | $0.00 Kitsap Lake Elementary (January 2020) Escalated 16% |
| | | | | | | $0 ROW Services (3%) |
| | | | | | | $243,669 DESIGN ENGINEERING (12%) |
| | | | | | | $142,140 CONSTRUCTION ENGINEERING (7%) |
| | | | | | **$2,416,381** | **GRAND TOTAL** |

# Appendix E

## Draft Preliminary Drainage Technical Memorandum

**Parametrix**
ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

60 WASHINGTON AVENUE, SUITE 390 | BREMERTON, WA 98337 | P 360.377.0014

# DRAFT TECHNICAL MEMORANDUM

| | |
|---|---|
| DATE: | January 25, 2021 |
| TO: | David Forte, Kitsap County Public Works |
| FROM: | Joanna Johnson<br>David Dinkuhn, PE |
| SUBJECT: | SE Lund Avenue Traffic Study<br>Preliminary Drainage Technical Memorandum |
| CC: | |
| PROJECT NUMBER: | 233-1578-156 |
| PROJECT NAME: | SE Lund Avenue Traffic Study |

## PROJECT OVERVIEW

This draft drainage technical memorandum describes preliminary stormwater requirements and a recommended design approach for the SE Lund Avenue Traffic Study project (project) in Port Orchard, Washington (see Figure 1 for a project vicinity map). Project drainage requirements have been determined in accordance with the *Kitsap County Stormwater Design Manual, effective December 31, 2016* (KCSDM).

### Site Location and Size

The project's first phase of improvements will construct two roundabouts along SE Lund Avenue at Hoover Avenue SE and Harris Road SE in Port Orchard/Kitsap County. The project site is within Section: 36; Township: 24N; Range: 01E and Section: 1; Township: 23N; Range: 01E. The project site can be generally described as improving approximately 1,000 feet of right-of-way along SE Lund Avenue.

From Bethel Road SE to Jackson Avenue SE, SE Lund Avenue serves as a minor arterial with residential driveways along the corridor and access to side streets. There are a cluster of shopping centers at the Bethel Road intersection near the west end of the project. To the northeast of the project is South Kitsap Regional Park (park) and Karcher Creek, a type F stream (fish bearing). SE Lund Avenue forms the southern boundary of the park.

Construction limits for the project will be within existing Kitsap County (County) right-of-way (ROW) and some ROW purchased for the project, affecting approximately 2.66 acres.

### Project Description

The purpose of the two roundabouts is to relieve traffic congestion and improve safety in the Lund Avenue Corridor. According to traffic studies performed for the project, the intersections to receive roundabouts are currently performing at level of service (LOS) F. Improving the intersections with roundabouts will increase LOS to category A at both intersections in the opening year and horizon year (10+ years). Features of the roundabout improvements include curb and gutter, sidewalks, bikes lanes, a center median for access control, stormwater flow control and treatment. See Attachment A for a conceptual layout for the roundabouts.

## EXISTING SITE CONDITIONS

Existing roadway runoff along SE Lund Avenue can be delineated into two threshold discharge areas (TDAs). See Figure 2 and Table 1 below.

The east half of the project is within a Category II Critical Aquifer Recharge area, mapped by Kitsap County Geographic Information System Division (Kitsap County GIS). Additionally, the project improvements touch parcels outside of the ROW categorized as Critical Drainage Areas per Kitsap County Code (KCC) 12.28. See Figure 3 for a critical areas map.

There are a variety of soils delineated near the project site. The National Resource Conservation Service (NRCS) classifies soils underlying the project site as following:

- Ragnar fine sandy loam, 0 to 6 percent slopes. Hydrologic soil group A. Well drained soil. (TDA 2.)
- Urban land-alderwood complex, 0 to 8 percent slopes. Hydrologic soil group D. Moderately well-drained soil. (TDA 1 and TDA 2.)

A geotechnical subsurface investigation was completed as part of this project. Soil borings were installed at both intersections to evaluate the soils for infiltration feasibility and to provide recommendations for light pole foundation design. A draft geotechnical report is included as Attachment B. Soil units encountered in the borings consisted of fill, ice contact deposits, and advance outwash. The feasibility for infiltration in the soil units is described as relatively poor, with estimated (uncorrected) infiltration rates of 0.5 to 1 inch per hour. Surface facilities such as bio-infiltration cells or infiltration ponds may be feasible given the relatively low rates of infiltration that are likely present. If required for final design, infiltration rates will be determined using Pilot Infiltration Tests (PITs) per the requirements of the KCSDM.

The SE Lund Avenue corridor was investigated for Low Impact Development (LID) feasibility as part of the County's *East Bremerton and East Port Orchard Stormwater Retrofit Plan* (2019). The stormwater retrofit plan involved a desktop, GIS-based infiltration assessment to identify opportunities for shallow and deep infiltration. Soils within the project site are mapped as glacial till and advance outwash. The boundary between the two soil units occurs at approximately the Harris Road intersection with NE Lund Avenue west of the intersection underlain by glacial till and NE Lund Avenue east of the intersection underlain by advance outwash. See Figure 4 for a surficial geology map reproduced from the retrofit study. In addition, infiltration feasibility along Lund Avenue between Harris Road SE and Jackson Avenue SE was assessed using targeted borings and borehole infiltration tests (BIT). In the assessment, a BIT performed at the northwest corner of the intersection of Harris Road SE and Lund Avenue concluded that infiltration is feasible with a reported preliminary design infiltration rate of 3.1 inches per hour for bioretention facilities (see Appendix E of the stormwater retrofit plan). Soil samples taken from this borehole were classified as advance outwash. Refer to Figure 5 for a bioretention retrofit plan reproduced from the stormwater retrofit report.

### TDA 1

Water in TDA 1 generally flows along SE Lund Avenue from east to west in roadside ditches on the north and south side of the roadway. Culverts allow water to flow through a network of ditches and pass under Hoover Avenue SE, Seiford Avenue SE, and residential driveways. West of the SE Lund Avenue and Hoover Avenue SE intersection and east of the SE Lund Avenue and Valentine Lane SE intersection, the ditch on the south side of SE Lund Avenue connects into the City of Port Orchard manmade closed conveyance system. The ditch on the north side of SE Lund Avenue also connects into the City of Port Orchard closed conveyance system

approximately halfway between Cathie Avenue SE and Valentine Lane SE. Water from Hoover Avenue SE and Seiford Avenue SE flows to the north, away from the project site.

### TDA 2

Water in TDA 2 generally flows along SE Lund Avenue in either roadside ditches or manmade closed conveyance owned by the County and converges at Harris Road SE. Water along Harris Road SE flows from south to north in roadside ditches on the east and west side of the roadway. Culverts allow water to flow through a network of ditches and pass under residential driveways. Along Harris Road SE, culverts pass under SE Lund Avenue on the east and west side of the street. The water then enters a County closed conveyance system and travels north along Harris Road SE to a dry detention pond eventually discharging into Karcher Creek.

The existing site is a combination of impervious surface area (roadway) and landscaping area. For existing land cover conditions, see Table 1 below.

**Table 1. TDAs and Existing Site Land Cover Conditions**

| Threshold Discharge Area | Area Description | Impervious Surface Area | Pervious Surface Area | Total Area |
|---|---|---|---|---|
| TDA 1 | SE Lund Avenue and Hoover Avenue SE intersection to a highpoint in roadway profile, which is located approximately halfway between Seiford Avenue SE and Harris Road SE | 46,450 sf (1.07 ac) | 17,150 sf (0.39 ac) | 63,600 sf (1.46 ac) |
| TDA 2 | Halfway between Seiford Avenue SE and Harris Road SE to the intersection of SE Lund Avenue and Harris Road SE | 34,240 sf (0.79 ac) | 18,420 sf (0.41 ac) | 52,660 sf (1.20 ac) |

Notes: TDA = Threshold Discharge Area; sf = square feet; ac = acres

## DEVELOPED SITE CONDITIONS

Site development will result in the construction of new and replaced hard surfaces. Surface areas for new and replaced hard surfaces under conceptual developed conditions are presented in Figure 6 and Figure 7 and Table 2.

**Table 2. TDA Developed Site Land Cover Conditions**

| Threshold Discharge Area | New Hard Surface Area | Replaced Hard Surface Area | Total Hard Surface Area | Pervious Surface Area | Total Area |
|---|---|---|---|---|---|
| TDA 1 | 7,440 sf (0.17 ac) | 42,100 sf (1.14 ac) | 49,540 sf (1.14 ac) | 14,050 sf (0.32 ac) | 63,600 sf (1.46 ac) |
| TDA 2 | 10,270 sf (0.24 ac) | 31,100 sf (0.71 ac) | 41,370 sf (0.95 ac) | 11,290 sf (0.26 ac) | 52,660 sf (1.20 ac) |

Notes: TDA = Threshold Discharge Area; sf = square feet; ac = acres

Stormwater will be collected and conveyed through a system of catch basins and storm sewer pipe. Flow control and treatment structures will be selected and installed to meet the minimum requirements of the KCSDM as outlined below.

## MINIMUM REQUIREMENTS

The project is considered redevelopment given that the site has more than 35 percent existing impervious coverage. See Figure 8 for a flow chart used in determining which minimum requirements apply for redevelopment under the KCSDM. The project results in 2,000 square feet (sf) or more of new plus replaced hard surface area. Additionally, the project is within the Port Orchard Urban Growth Area (UGA) and results in more than 5,000 sf of new hard surface. Per the KCSDM, minimum requirements (MR) 1 through 9 apply to new hard surfaces and converted vegetation areas. MRs 1 through 5 apply to the replaced hard surfaces and the land disturbed by the project. A summary of the approach to each MR is below.

### Minimum Requirements 1 and 2: Preparation of Stormwater Site Plan and SWPPP

According to MRs 1 and 2, a Stormwater Site Plan and a Construction Stormwater Pollution Prevention Plan (SWPPP) are to be completed. A final Stormwater Site Plan and SWPPP will be completed for final design.

### Minimum Requirement 3: Source Control of Pollution

A general overview of source control best management practices (BMPs) suggested for the project will be provided in the final Stormwater Site Plan. The project design will also detail temporary erosion and sediment control plans to be included in the final design plans.

### Minimum Requirement 4: Preservation of Natural Drainage Systems and Outfalls

No new outfalls or drainage paths will be created. All existing drainage patterns will be maintained.

### Minimum Requirement 5: On-Site Stormwater Management

This project is categorized as a large project for which all nine minimum requirements apply, per KCC 12.08, and is considered redevelopment within an UGA. According to Table 4.2 of the KCSDM, on-site stormwater management requirement for this project is LID Performance Standard and BMP T5.13 – Post-construction Soil Quality and Depth, or List #2. See Figure 9 for a flow chart determining LID minimum requirement #5.

On-site stormwater management is evaluated using List #2 for each surface:

- Lawn and Landscape Areas: BMP T5.13 – Post Construction Soil Quality and Depth will be used in disturbed areas of the site.
- Roofs: Not Applicable
- Other Hard Surfaces: For this project, BMP T5.15 – Permeable Pavement and Bioretention BMPs are possible and will be evaluated during the final design process for feasibility. A minimum of one PIT will be conducted at each bioretention BMP location for determination of design infiltration rates. BMP T5.30 – Full Dispersion and BMP T5.12 – Sheet Flow Dispersion are considered infeasible due to the lack of space available for the required minimum vegetated flow path of each BMP.

### Minimum Requirement 6: Runoff Treatment

The total project area for new pollution generating hard surface (PGHS) is 5,599 sf, which exceeds the treatment threshold of 5,000 sf. Therefore, runoff treatment BMPs are required for all new PGHS. See Figure 10 and Table 3 below for PGHS surface area quantities.

**Table 3. Pollution Generating Hard Surface (PGHS) Areas**

| Threshold Discharge Area | New PGHS | Replaced PGHS | Total PGHS |
|---|---|---|---|
| TDA 1 | 1,716 sf (0.04 ac) | 35,108 sf (0.8 ac) | 36,824 sf (0.85 ac) |
| TDA 2 | 3,883 sf (0.09 ac) | 25,510 sf (0.59 ac) | 29,393 sf (0.67 ac) |

Notes: TDA = Threshold Discharge Area; sf = square feet; ac = acres

Developed site catch basins will be installed at low points along the flow line of the proposed curb and gutter. Stormwater conveyance will maintain the same drainage patterns within each TDA. To meet runoff treatment requirements for both TDAs, two possible approaches will be evaluated during final design. The first is to achieve treatment requirements for new PGHS using bioretention BMPs located in the vegetated buffer zones between the travel lanes and the sidewalk. If this proves to be infeasible, stormwater will be treated using proprietary treatment vaults such as Modular Wetland, Biopod, or Filterra units before leaving the project site.

### Minimum Requirement 7: Flow Control

The total project area for new hard surfaces is 17,710 sf (Table 1), which exceeds the flow control threshold of 10,000 sf. Therefore, flow control BMPs are required for all new hard surfaces. Similar to MRs 5 and 6, the first approach for flow control will be to achieve the requirement using bioretention basins located with vegetated buffer areas. If this approach is infeasible, flow control will be achieved using subsurface detention vaults.

Infiltration feasibility was evaluated by modeling a preliminary infiltration basin using MGSFLOOD software. Model output is provided in Attachment C. The model assumes a 35-foot square (3-foot deep) bioretention basin with 3 horizontal to 1 vertical side slopes. A constant infiltration rate of 0.5 inches per hour was assumed. The assumed outlet structure contains a 24-inch-diameter riser with the top of the riser located 2 feet above the pond bottom. Since the selected basin will likely be in the clear zone, the ponding depth was set at the maximum depth allowed (2 feet). A worst-case scenario was assumed using TDA 2 with 10,270 sf of new hard surface area. As shown in the output report, this basin configuration meets the flow control and LID performance standards for TDA 2.

### Minimum Requirement 8: Wetlands Protection

This site is not affected by wetlands.

### Minimum Requirement 9: Operations and Maintenance

Maintenance standards for the BMPs used during project construction will be addressed during the final drainage report. All proposed drainage facilities and on-site stormwater management BMPs will be located within the ROW or easements owned by the County and will be maintained according to the County's respective maintenance schedules.

## SUMMARY AND RECOMMENDATIONS

The proposed development will construct a total 17,710 sf of new hard surface area 5,599 sf of new PGHS. The KCSDM requires that stormwater runoff from these new hard surfaces meet MRs No. 5 (On-Site Stormwater Management), No. 6 (Runoff Treatment), and No. 7 (Flow Control). Existing data from the County's 2019 stormwater retrofit plan, the project geotechnical report, and the preliminary modeling results described above strongly suggest bioretention or infiltration is feasible at the site. If site soils can infiltrate stormwater at a sufficient rate as determined by future infiltration testing, it is likely that all three minimum requirements can be met using this approach. Parametrix recommends that the roundabout designs move forward to a 30 percent

complete level with the assumption that the vegetated buffer area between the travel lanes and the sidewalks will be used for bioretention. A conservative design infiltration rate of 0.5 inches per hour should be assumed based on preliminary data. Actual design infiltrations rates will be determined during final design using PITs.

## ATTACHMENTS

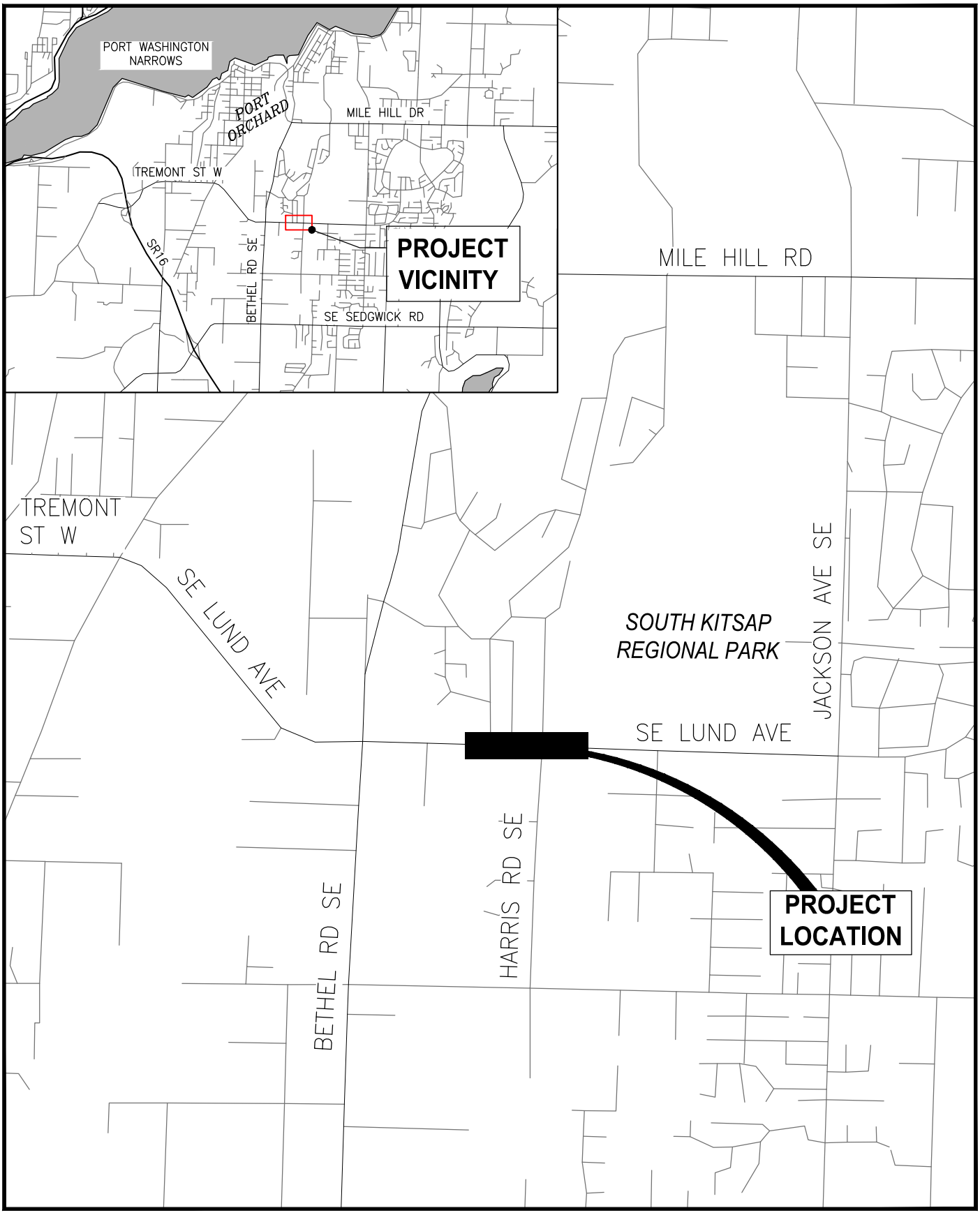
Figures 1 through 10

Attachment A – Conceptual Roundabout Layout Plan

Attachment B – Draft Geotechnical Report

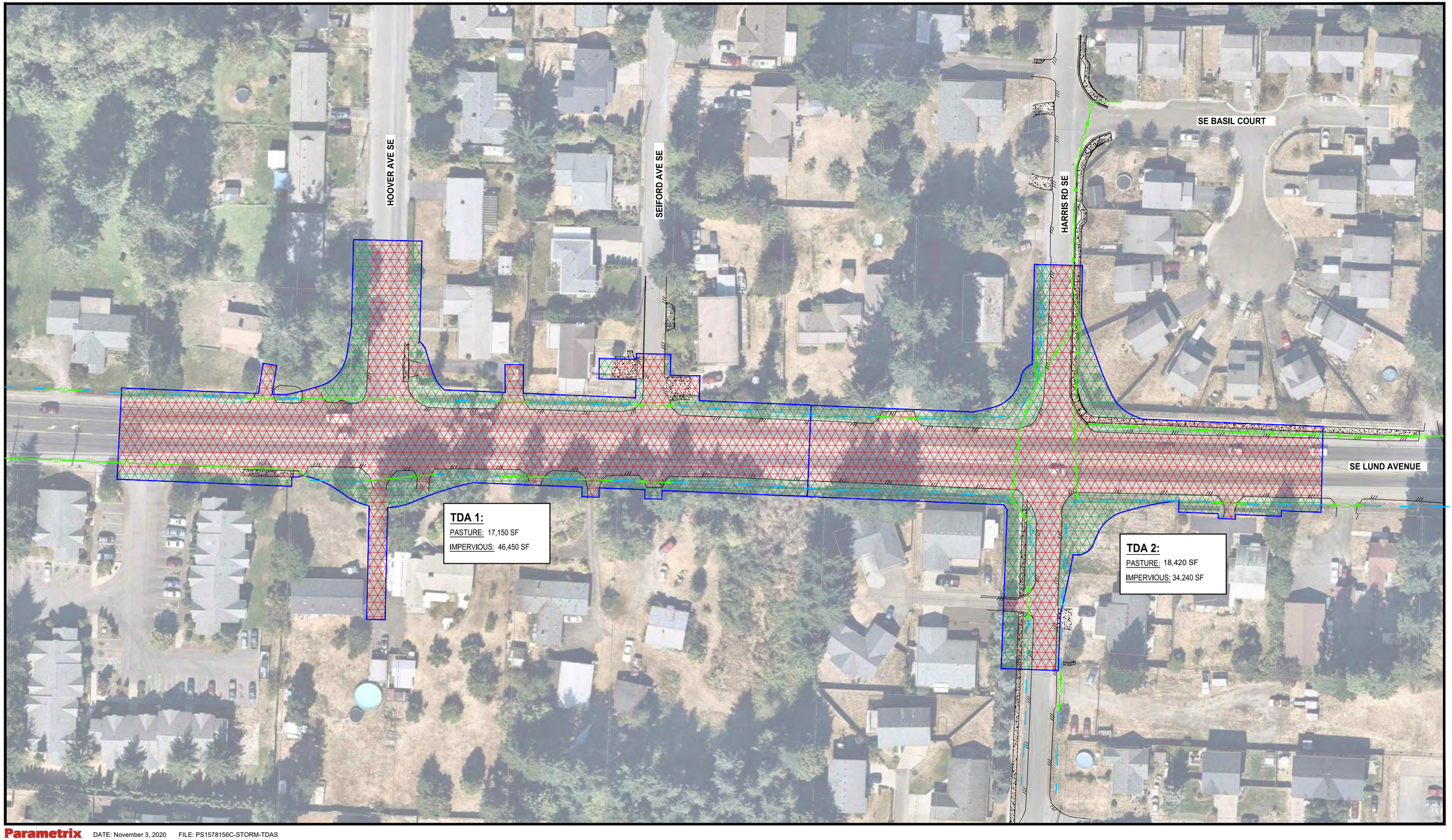
Attachment C – MGSFLOOD Model

Figures




Parametrix DATE: October 29, 2020 FILE: PS1578156C-VIC-MAP

**VICINITY AND LOCATION MAP**
**FIGURE 1**
City of Port Orchard
SE Lund Avenue Traffic Study




Parametrix DATE: November 3, 2020 FILE: PS1578156C-STORM-TDAS

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0 40

SCALE IN FEET

**LEGEND:**

- PASTURE
- IMPERVIOUS
- TDA BOUNDARY
- DITCH & FLOW DIRECTION
- SD SD EXISTING STORMWATER NETWORK & STORMWATER FLOW DIRECTION

**FIGURE 2**

**TDAS AND EXISTING LAND USE**

SE LUND AVE TRAFFIC STUDY

Map Scale: 1 : 10,000

Printed: Friday. Nov 6, 2020

**Streams**

Watercourse - DNR and Wildfish Conservancey

- (S) Designated Shoreline of the State
- (F) Fish Habitat
- (N) Non-fish Habitat
- (U) Unknown, unmodeled hydrographic feature
- No Channel as depicted by DNR

**Critical Areas**

Waterbodies

- Includes DNR NWI and Surveyed Wetlands

Wetlands

- DNR NWI Surveyed Wetlands

FEMA Flood Hazard Areas

- 100 Year Floodplain
- Storm Induced Velocity Wave Hazard

Hydric Soils

- Potential Wetlands

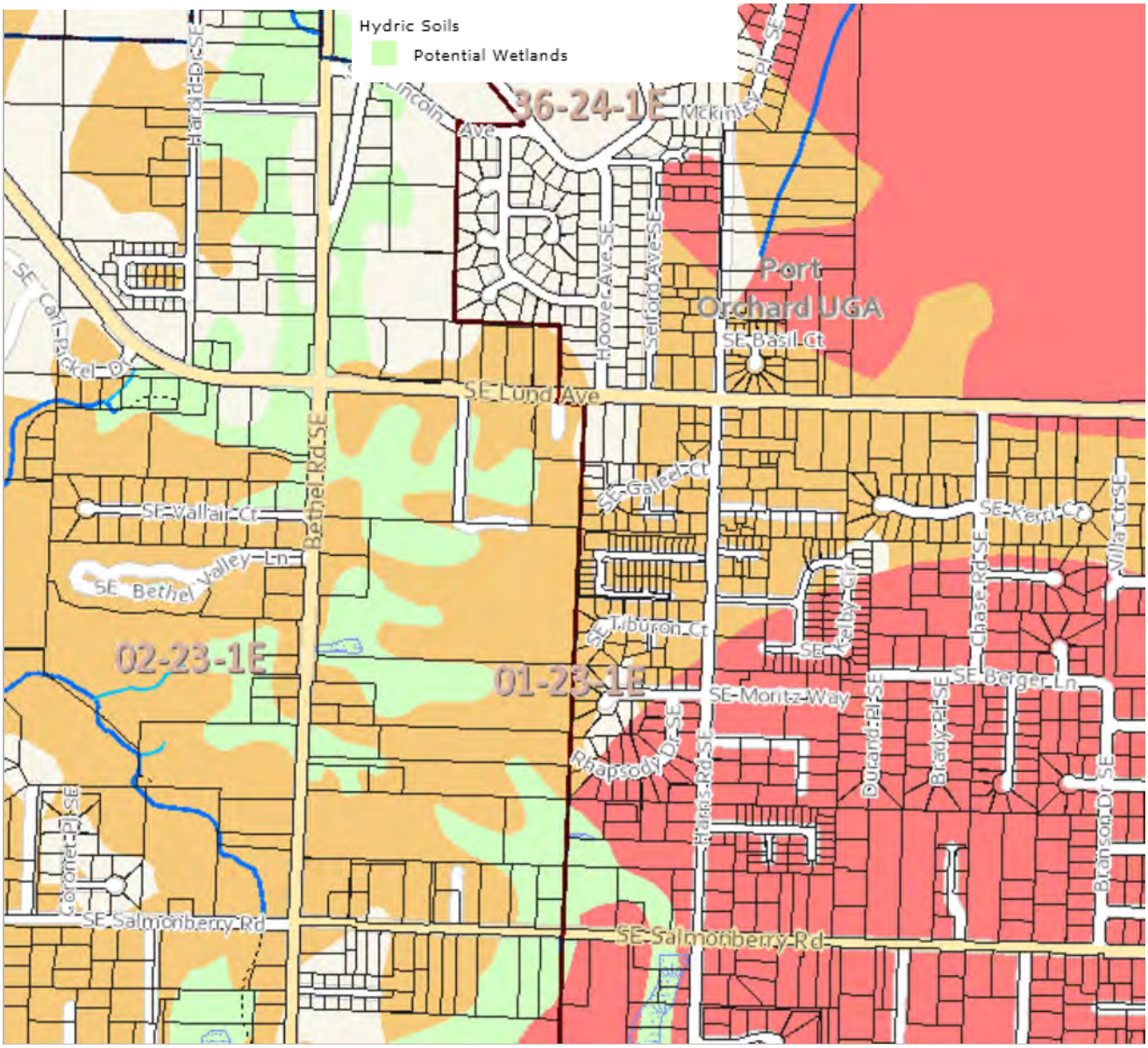
**Critical Aquifers**

Category I Critical Aquifer Recharge Areas

Category II Critical Aquifer Recharge Areas

**Critical Drainage Areas**

Critical Drainage Areas



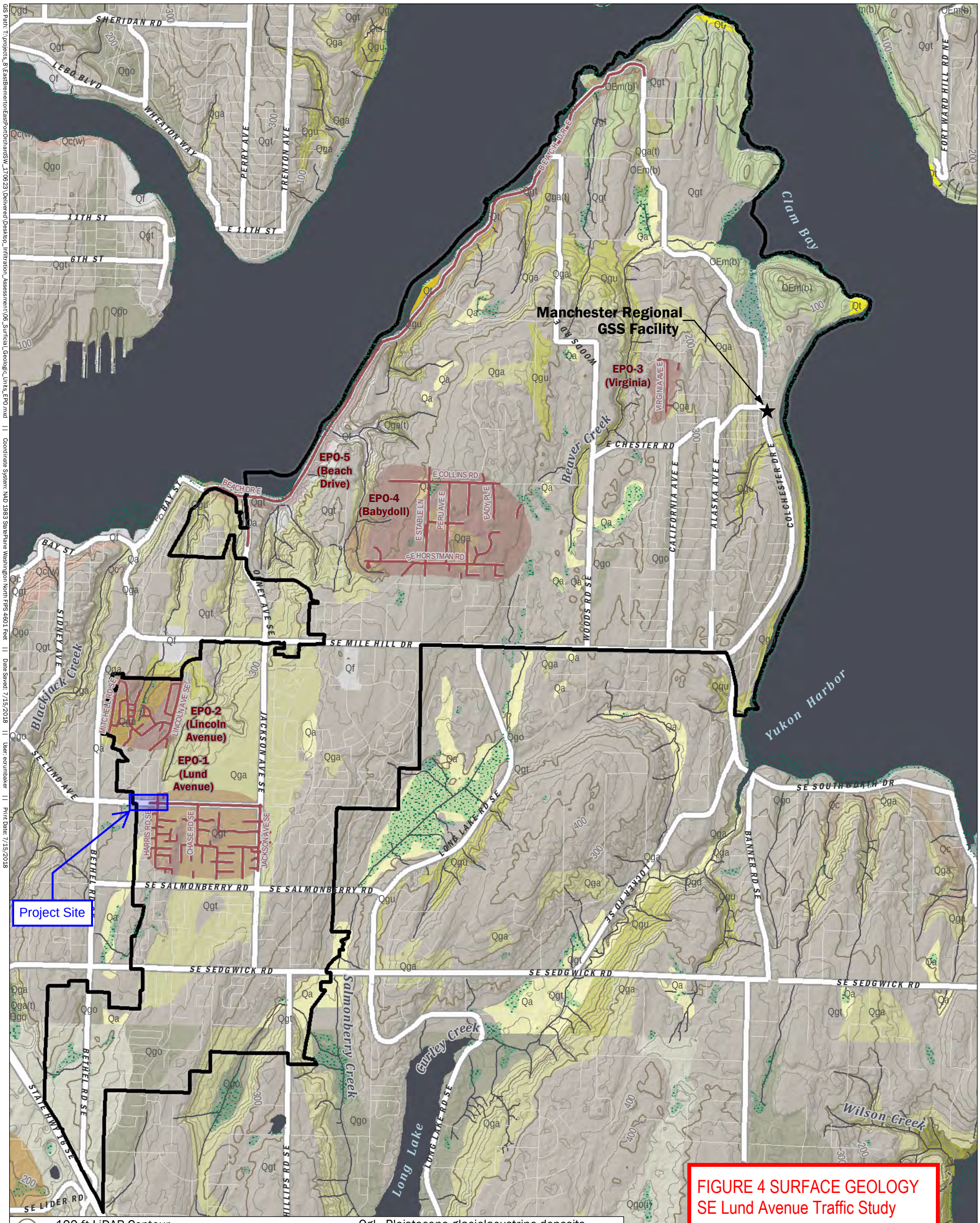

** This map is not a substitute for field survey **

0 500 1000ft

Comments

N W E S

FIGURE 3 CRITICAL AREAS
SE Lund Avenue Traffic Study




100-ft LiDAR Contour
25-ft LiDAR Contour
Initial problem areas
Study Extent

**Surficial Geology (WADNR 1:100,000)**

Qt - Quaternary terraced deposits
Qls - Quaternary mass-wasting deposits, mostly landslides
Qgu - Pleistocene glacial drift, undivided
Qgt - Pleistocene continental glacial till, Fraser-age mostly Vashon Stade
Qgpc - Pleistocene continental glacial drift, pre-Fraser, and nonglacial deposits
Qgo(i) - Pleistocene continental glacial outwash, Fraser-age ice-contact recessional outwash
Qgo - Pleistoceen continental glacial outwash, Fraser-age mostly Vashon Stade.
Qgl - Pleistocene glaciolacustrine deposits, Fraser-age
Qgd - Pleistocene continental glacial drift, Fraser-age mostly Vashon Stade
Qga(t) - Pleistocene advance continental glacial outwash, Fraser-age transitional beds of Menard (1985)
Qga - Pleistocene advance continental glacial outwash, Fraser-age mostly Vashon Stade
Qf - Holocene artificial fill and modified land
Qc(w) - Pleistocene continental sedimentary deposits or rocks Whidbey Formation
Qc - Quaternary continental sedimentary deposits or rocks
Qa - Quaternary alluvium
OEm(b) - Oligocene-Eocene marine sedimentary rocks
Wetland

FIGURE 4 SURFACE GEOLOGY
SE Lund Avenue Traffic Study

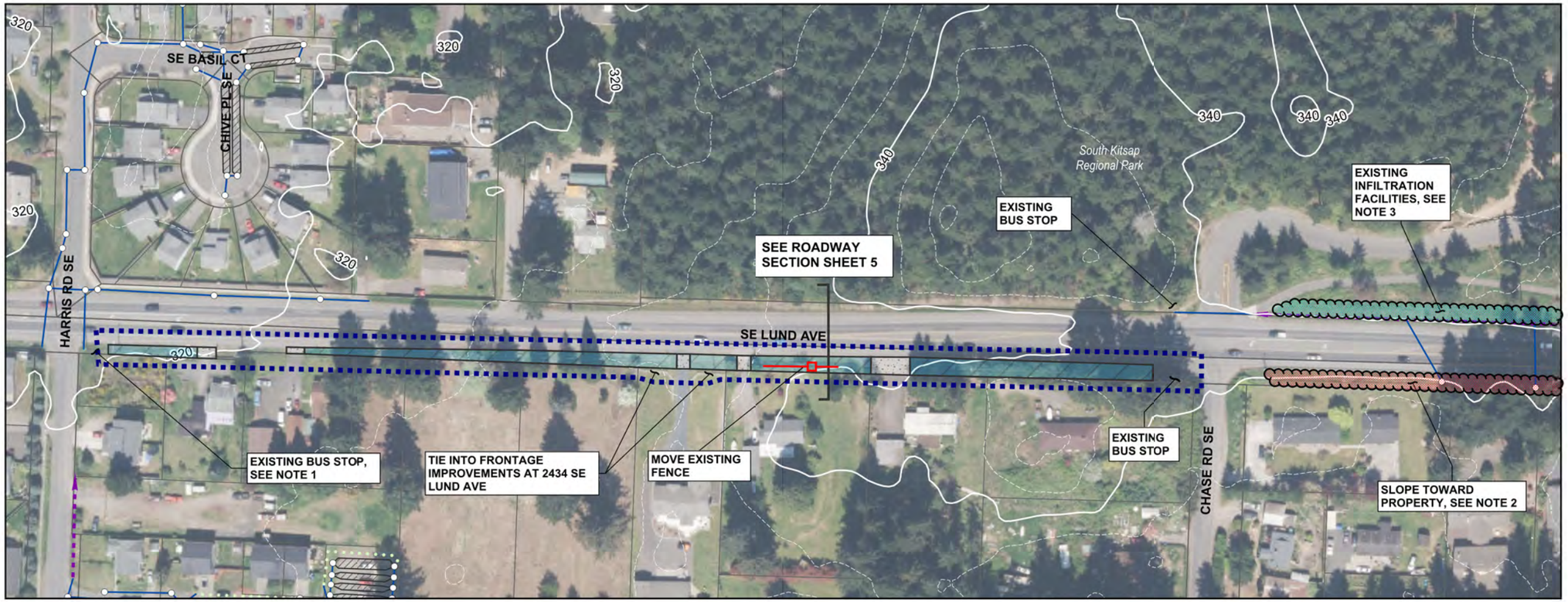
# Surficial Geologic Units
# East Port Orchard

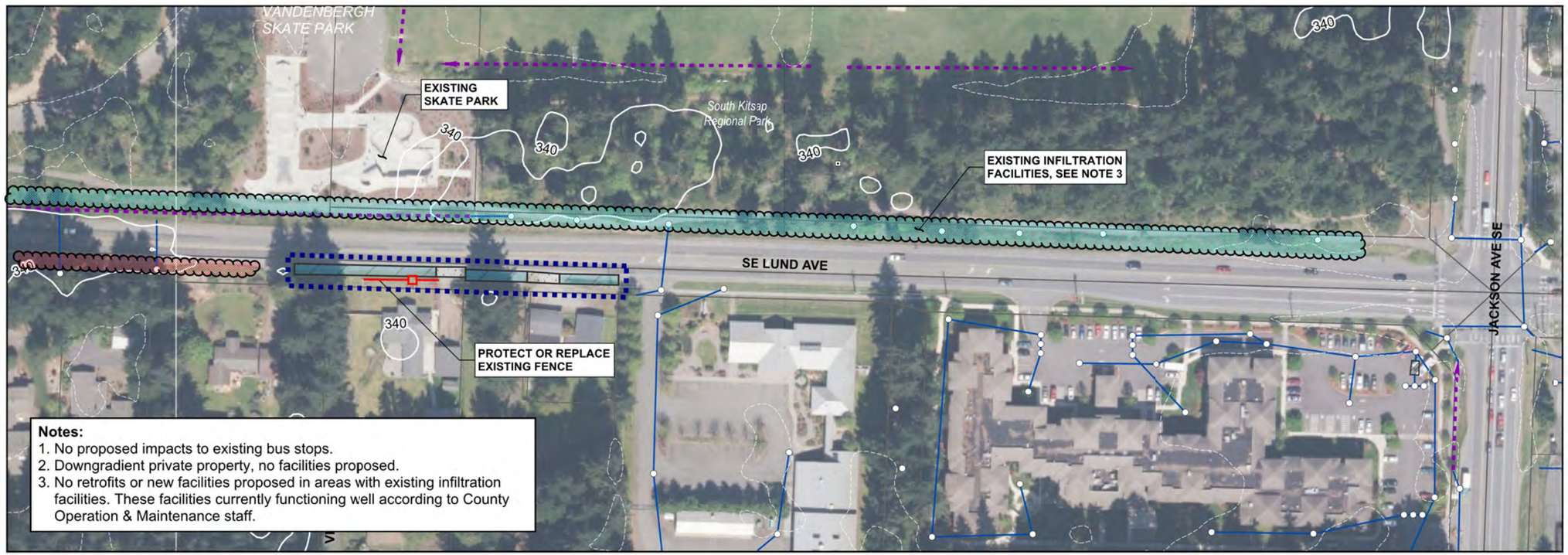
Desktop Infiltration Assessment
East Bremerton and East Port Orchard Stormwater Retrofit Study
Kitsap County, Washington

| RKI planning engineering / Aspect CONSULTING | JUL-2018 | BY: EAC / RKI | FIGURE NO. 4 |
|---|---|---|---|
| | PROJECT NO. 170623 | REVISED BY: --- | |

GIS Path: T:\projects_8\EastBremertonEastPortOrchardSW_170623\Delivered\Desktop_Infiltration_Assessment\06_Surficial_Geologic_Units_EPO.mxd || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 7/15/2018 || User: ecrumbaker || Print Date: 7/15/2018

04/18/2019




**Notes:**
1. No proposed impacts to existing bus stops.
2. Downgradient private property, no facilities proposed.
3. No retrofits or new facilities proposed in areas with existing infiltration facilities. These facilities currently functioning well according to County Operation & Maintenance staff.

## Sheet 1 - SE Lund Ave
East Port Orchard

Kitsap County Public Works
East Bremerton/East Port Orchard Stormwater Retrofit Plan

### LEGEND

- Proposed Retrofit Site (Approximate Extent)

EXISTING
- Conveyance Structure
- Conveyance Pipe
- Conveyance Ditch
- Fence
- Slope Toward Property
- Infiltration Facility

PROPOSED
- Bioretention With Curb Cut Inflow and Outflow
- Replaced Driveway

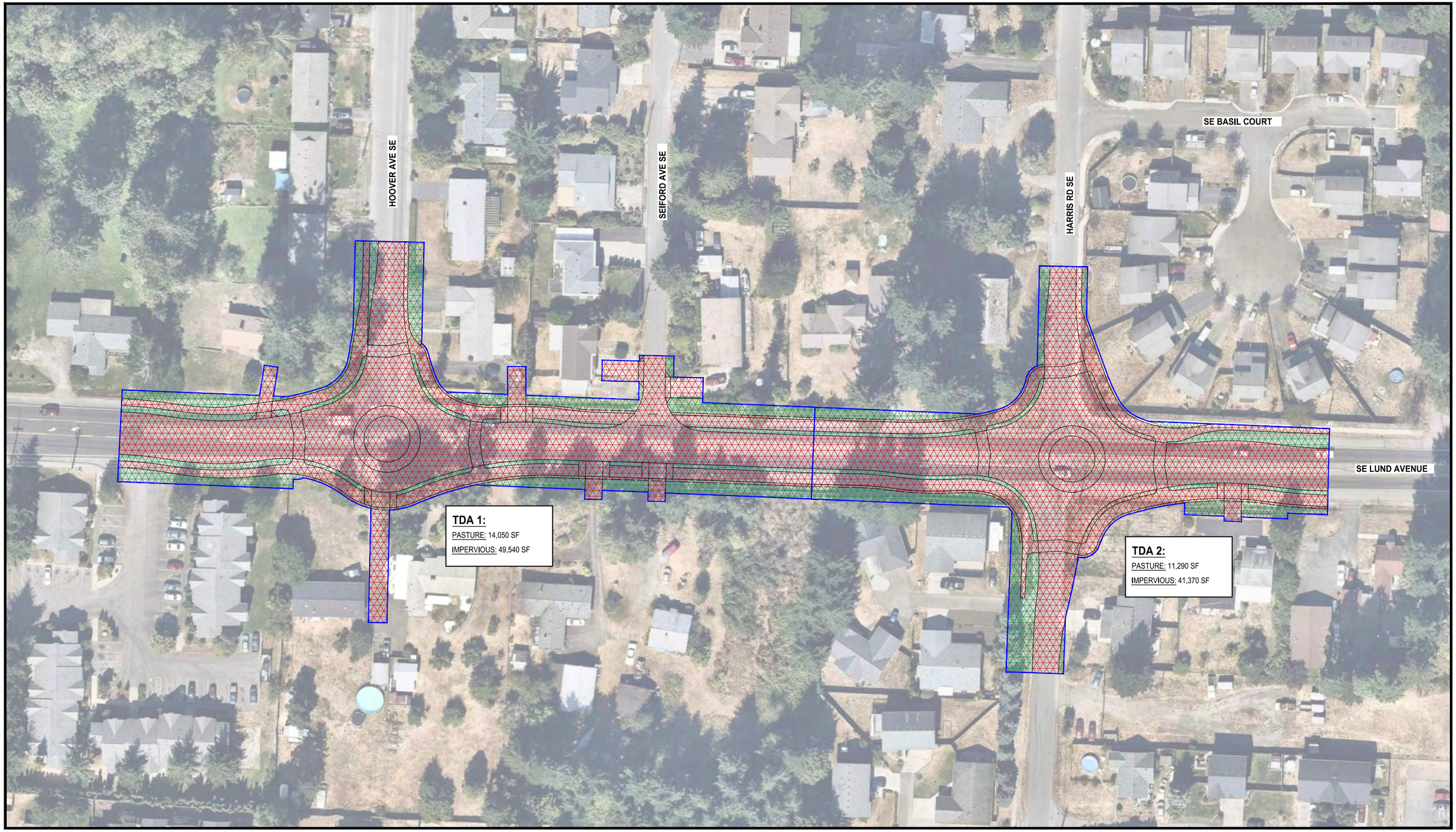
FIGURE 5
SE Lund Avenue Traffic Study


RKI planning engineering
OSBORN CONSULTING INCORPORATED
russell lambert LANDSCAPE ARCHITECTURE

Data Sources: ESRI, Kitsap County GIS
Accessed: 04/12/18

N

0 65 130 260 Feet




Parametrix DATE: November 3, 2020 FILE: PS1578156C-STORM-TDAS

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SCALE IN FEET

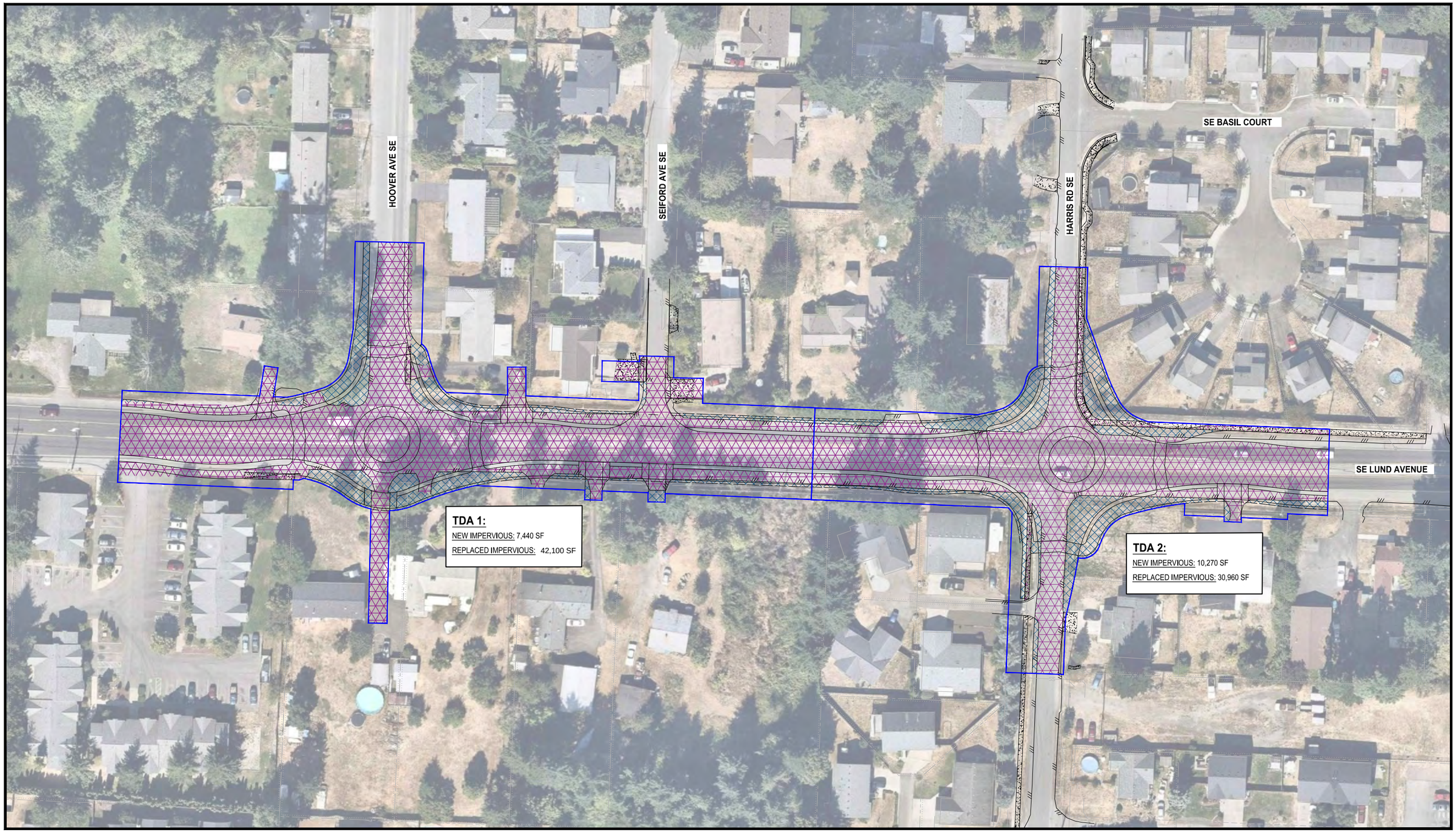
**LEGEND:**

- PASTURE
- IMPERVIOUS
- TDA BOUNDARY
- DITCH & FLOW DIRECTION
- SD SD EXISTING STORMWATER NETWORK & STORMWATER FLOW DIRECTION

**FIGURE 6**

**DEVELOPED CONDITIONS**

SE LUND AVE TRAFFIC STUDY




Parametrix DATE: November 3, 2020 FILE: PS1578156C-STORM-TDAS

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SCALE IN FEET

**LEGEND:**

NEW IMPERVIOUS

REPLACED IMPERVIOUS

TDA BOUNDARY

**FIGURE 7**

**NEW VS REPLACED IMPERVIOUS SURFACE AREA**

SE LUND AVE TRAFFIC STUDY

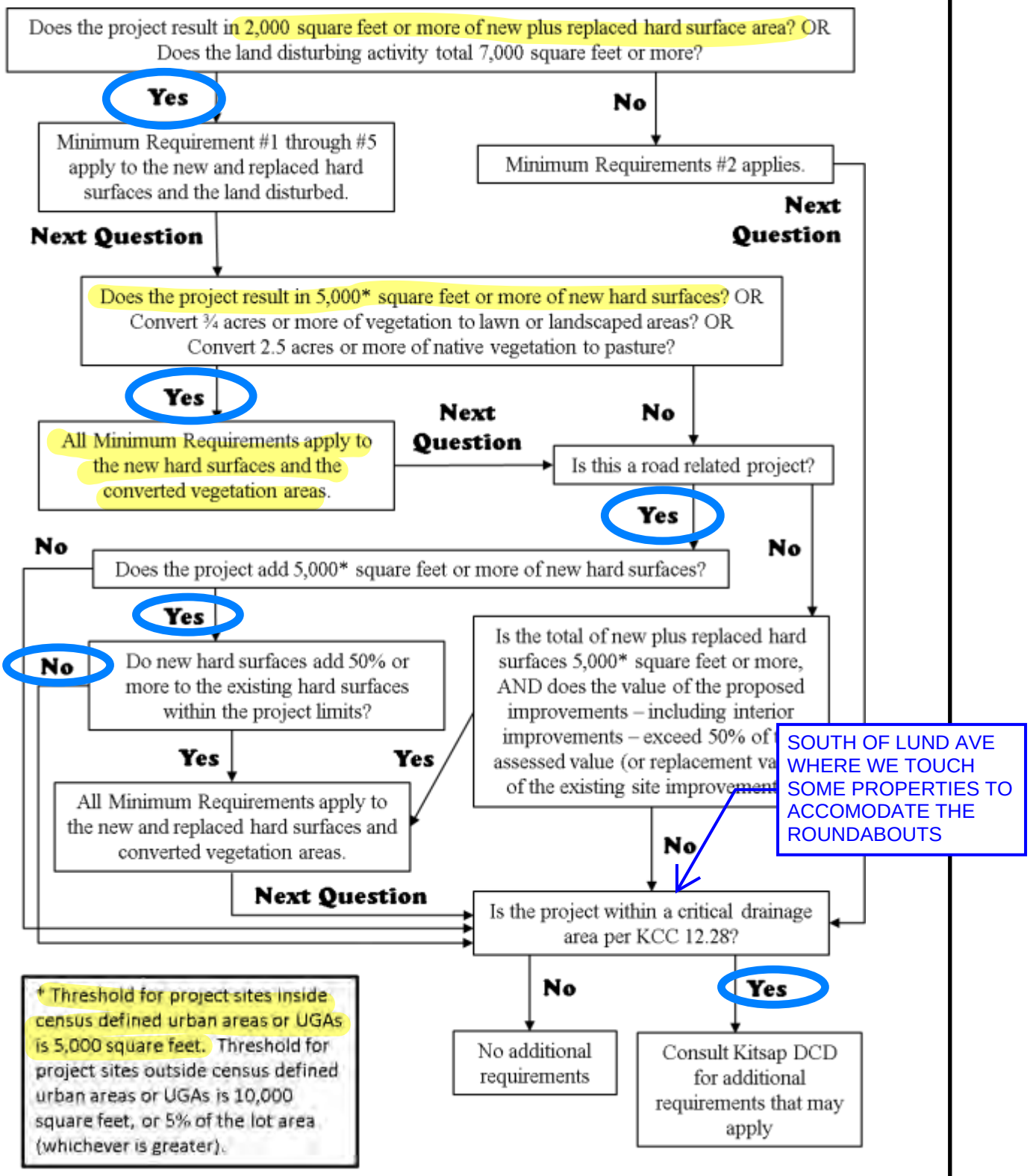



**Figure 4.2 – Flow Chart for Determining Minimum Requirements for Redevelopment Projects**
Source: Adapted from Figure 2.4.2 of Volume I of the Ecology Manual.

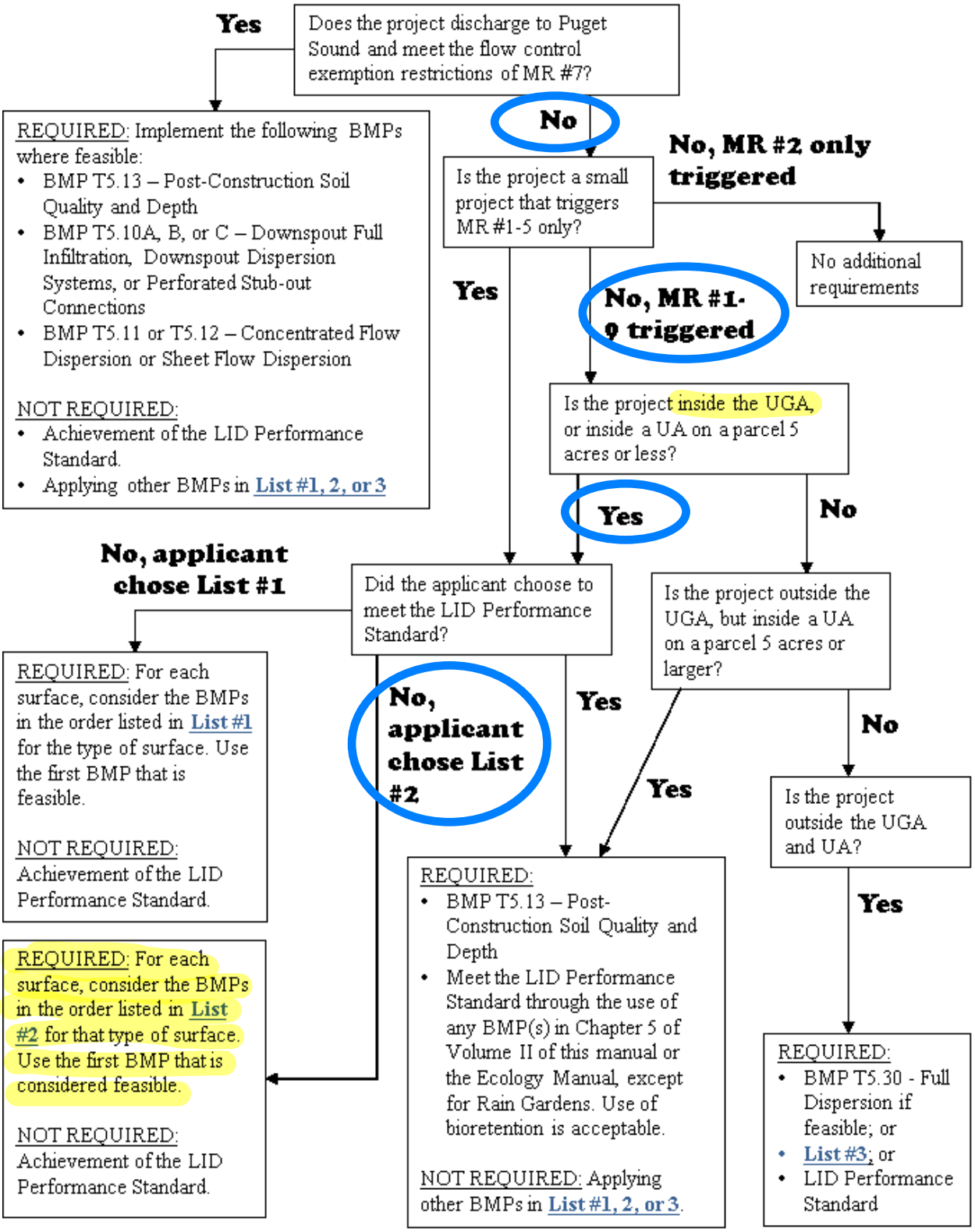
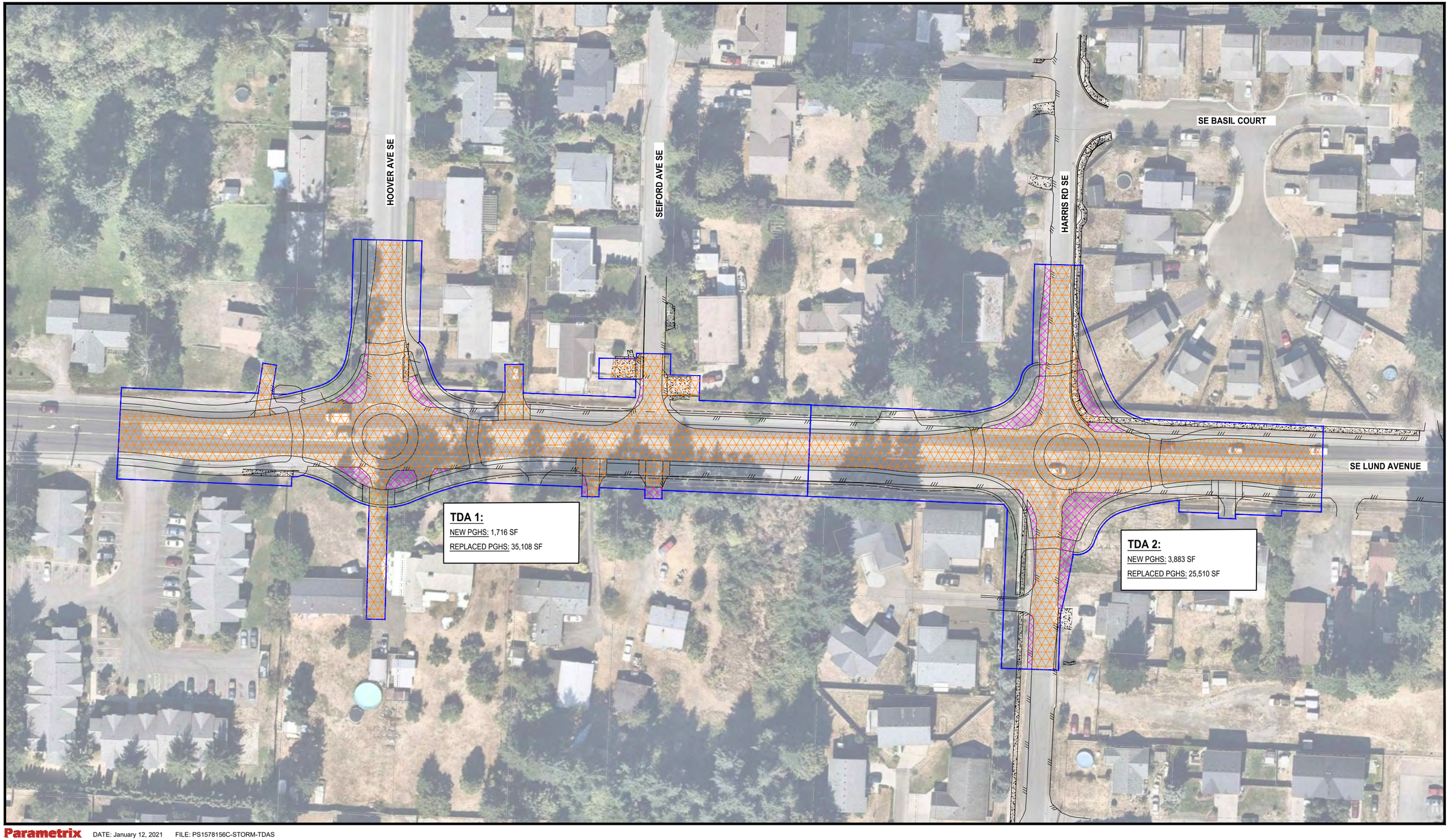



**Figure 4.3 – Flow Chart for Determining LID MR #5 Requirements**
Source: From Figure 2.5.1 in Volume I, Ecology Manual.

FIGURE 9
SE Lund Avenue Traffic Study




Parametrix DATE: January 12, 2021 FILE: PS1578156C-STORM-TDAS

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SCALE IN FEET

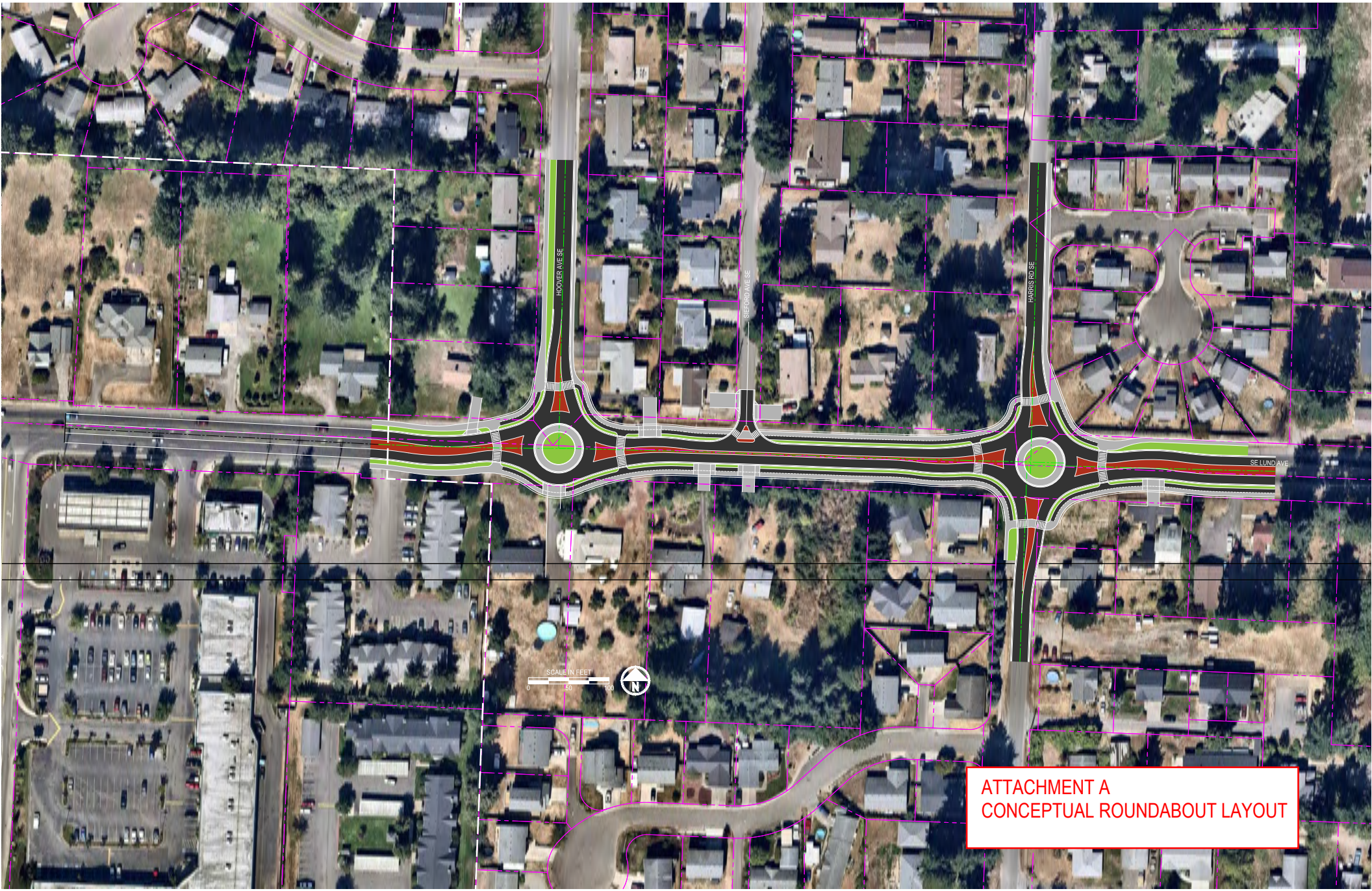
**LEGEND:**

- NEW POLLUTION GENERATING HARD SURFACE AREA (PGHS)
- REPLACED POLLUTION GENERATING HARD SURFACE AREA (PGHS)
- TDA BOUNDARY

**FIGURE 10**
**POLLUTION GENERATING HARD SURFACE AREA**
SE LUND AVE TRAFFIC STUDY

# Attachment A

## Conceptual Roundabout Layout Plan




ATTACHMENT A
CONCEPTUAL ROUNDABOUT LAYOUT

# Attachment B

## Draft Geotechnical Report

SUBMITTED TO:
Parametrix, Inc.
60 Washington Avenue,
Suite 390
Bremerton, WA 98337

BY:
Shannon & Wilson
400 N. 34th Street, Suite 100
Seattle, WA 98103

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DRAFT

GEOTECHNICAL REPORT

# Lund Avenue Intersections Improvements

PORT ORCHARD, WASHINGTON

SHANNON & WILSON

January 20, 2021

Shannon & Wilson No: 103704-001

Submitted To: Parametrix, Inc.
60 Washington Avenue, Suite 390
Bremerton, WA 98337

Subject: DRAFT GEOTECHNICAL REPORT, LUND AVENUE INTERSECTIONS IMPROVEMENTS, PORT ORCHARD, WASHINGTON

Shannon & Wilson prepared this report and participated in this project as a subconsultant to Parametrix, Inc. Our scope of services was specified in a Subconsultant Agreement for Parametrix project number 233-1578-156 (Kitsap County KC 583-19) signed by Darby Watson dated January 1, 2020, and a subcontract amendment dated October 28, 2020. This report presents the results of our subsurface explorations and geotechnical engineering recommendations; and was prepared by the undersigned.

We appreciate the opportunity to be of service to you on this project. If you have questions concerning this report, or we may be of further service, please contact us.

Sincerely,

SHANNON & WILSON

Nikolas Polzin
Geotechnical Staff


Martin W. Page, PE, LEG
Vice President
Geotechnical Engineer

NLP:MWP/nlp

CONTENTS



## Exhibits

CONTENTS

## Figures



## Appendices

# 1 INTRODUCTION

This report presents the results of our subsurface explorations, engineering analysis, and recommendations for design and construction for the Lund Avenue Intersections Improvements project (project) near Port Orchard, Washington. Our services were conducted in general accordance with the scope of geotechnical services described in our proposal dated October 18, 2019, and in our Subconsultant Agreement dated January 1, 2020.

The objective of our services was to provide Parametrix with geotechnical design and construction recommendations for the proposed intersection improvements at the intersections of SE Lund Avenue and Harris Rd SE, and SE Lund Avenue and Hoover Avenue SE. The project design services are being provided to Kitsap County Department of Public Works. We completed the following tasks for this project:

- Coordinate geotechnical drilling and traffic control subcontractors
- Mark boring locations and submit public utility locate requests
- Complete drilling six geotechnical soil borings
- Perform geotechnical engineering analysis
- Perform laboratory testing of soil sample index properties
- Prepare this report

Our conclusions and recommendations are based on:

- Our understanding of the Project through information provided to us by Parametrix.
- Subsurface conditions observed in six geotechnical soil borings performed for this Project.
- Publicly available published geologic maps of the project area.

# 2 SITE AND PROJECT DESCRIPTION

The project site is located withing Kitsap County right-of-way along SE Lund Avenue near Port Orchard, Washington. The project site is shown in relation to nearby geographic features in Figure 1, Vicinity Map. Lund Avenue is an arterial roadway that is intersected by the side streets Harris Rd SE and Hoover Avenue SE. At these intersections, through traffic on Lund Avenue takes priority, and vehicles are allowed to turn onto Lund Avenue from the side streets after stopping at the stop signs. We understand that the project

endeavors to ease congestion on the side streets by modifying the arterial to side street intersection configuration. Based on plans provided to us by Parametrix, a roundabout will be constructed at each intersection. Roundabout construction will include new pavement, curb and gutter, signs, and lighting.

We understand that the project will be designed using the Kitsap County Road Standards (Kitsap County Public Works, 2020), the Washington State Department of Transportation (WSDOT) Geotechnical Design Manual (GDM) (WSDOT, 2019), the WSDOT Standard Specifications for Road, Bridge, and Municipal Construction (WSDOT, 2020), and the current set of WSDOT Standard Plans for Road, Bridge, and Municipal Construction.

# 3 SUBSURFACE CONDITIONS

Published geologic maps showing the project site indicate that the site is underlain by soil deposited during the Vashon Stade of the Fraser Glacial period (Yount and others, 1993). High resolution (1:24,000 scale) maps were not available at the time this report was written. Large-scale maps indicate that the site is underlain either by Glacial Till, or Advance Outwash. The site is located at the margin of these two units as mapped at 1:48,000 scale (Sceva, 1957). Generally, both of these soil units provide competent subgrade soil conditions. Due to the presence of roadways and other development in the area, it is likely that near-surface soils consist of human-made fills.

## 3.1 Subsurface Soil Conditions

We drilled six soil borings (three at each intersection) to evaluate the subsurface soil conditions at the project site. Logs of our borings and a discussion of the geotechnical drilling and sampling procedures we used are provided in Appendix A of this report. The results of laboratory testing are presented in Appendix B. All borings were made to approximately 20 feet below ground surface (bgs). We identified the following soil units in our borings:

**Fill (Hf):**

- Human-made fill and modified surficial soils
- Typically less than 3 feet thick, assumed to be present below existing pavements
- Indistinct contact with underlying native soil indicates re-use of on-site native soil

**Ice Contact Deposit (Qvi):**

- Medium Dense or Stiff to Very Stiff, Sandy Silt and Sandy, Lean Clay
- Observed in the upper 5 to 7 feet in B-02 and B-06

**Advance Outwash (Qva):**

- Medium Dense to Dense, Silty Sand
- Oxidized to red-brown near ground surface, decreasing oxidation with depth
- Scattered lenses of Poorly Graded Sand
- Frequent lenses of till-like diamict Silty Sand with Gravel

## 3.2 Groundwater Conditions

Groundwater is evidenced by the moisture content of retrieved soil samples, as well as the presence of water on the surfaces of sampling equipment. Indications of groundwater were generally observed at depths between 10 and 20 feet bgs. Indications of groundwater in our soil borings were inconsistent between nearby borings. In our opinion, these observations indicate groundwater is locally perched above impermeable soil layers, and water observed in the borings does not represent a regional groundwater table depth.

# 4 GEOTECHNICAL ENGINEERING RECOMMENDATIONS

## 4.1 Pole Foundation Design

We understand that the project will include new signal poles and light poles utilizing WSDOT standard plan designs. WSDOT GDM Chapter 17.2 provides a procedure for determining the lateral bearing capacity of soil for use in pole foundation design.

### 4.1.1 Vertical Bearing Capacity

Generally, vertical bearing capacity does not govern the design of small pole foundations. GDM Chapter 17.2 does not specify how the vertical bearing capacity of such a foundation should be determined. For the purposes of this report, we assume that pole foundations will bear between 5 and 10 feet bgs and will behave as if they are shallow spread footings. Based on these assumptions, an allowable bearing capacity of 8,000 pounds per square foot may be used for pole foundation design.

### 4.1.2 Lateral Bearing Capacity

Lateral bearing capacity for pole foundations is determined using a correlation provided in GDM Chapter 17.2.1. The correlation directly relates uncorrected Standard Penetration Test blow count to lateral bearing capacity. WSDOT standard plans for pole foundations specify the minimum lateral bearing capacity required for a particular foundation type (signal

standard, light pole, etc.). If the specified lateral bearing capacity is not met, a special foundation design is required.

For our analysis, we assume that the pole foundations will be constructed in the upper 10 feet of the soil profile. Exhibit 4-1 presents the results of our analyses for each boring.

Exhibit 4-1: Lateral Bearing Capacity for Pole Foundations

| Boring | Cross Street | Average Blow Count[1] | Lateral Bearing Capacity (psf) |
|---|---|---|---|
| B-01 | Hoover | 17 | 2900 |
| B-02 | Hoover | 32 | 4500 |
| B-03 | Hoover | 42 | 4500 |
| B-04 | Harris | 28 | 4500 |
| B-05 | Harris | 13 | 2100 |
| B-06 | Harris | 13 | 2100 |

NOTES:
1 Uncorrected blow counts averaged over the upper 10 feet of each boring.
psf = pounds per square foot

GDM Chapter 17.2.1 also provides for an increased shaft length for poles founded in or near sloping ground. We do not anticipate that such a correction will be needed for the pole foundations use in the project. However, this correction should be considered during pole foundation design.

## 4.2 Seismic Design Considerations

### 4.2.1 Seismic Response Spectrum

WSDOT GDM outlines a procedures for developing a design response spectrum based on design spectral acceleration values. The seismological input parameters for peak ground acceleration, $S_S$, and $S_1$ corresponding to a Site Class B/C were determined in accordance with the WSDOT GDM for the safety evaluation earthquake seismic hazard level (1,000-year return period). The seismological parameters were then multiplied by site soil response factors as provided in the WSDOT GDM based on the seismic Site Class of the project site.

Based on the soil profiles at the project site, the site can be classified as a Site Class D. The response spectra parameters for Site Class D are listed in Exhibit 4-2.

Exhibit 4-2: Response Spectrum Parameters for Site AASHTO Class D

| Parameter | WSDOT (2019), SEE |
|---|---|
| Peak Ground Acceleration, PGA (g) | 0.49 |
| Short-Period Spectral Acceleration, $S_s$ (g) | 1.112 |
| Spectral Acceleration at 1-second Period, $S_1$ (g) | 0.33 |
| Design Spectral Response Acceleration Coefficient, $S_{DS}$ (g) | 1.17 |
| Design Spectral Response Acceleration Coefficient, $S_{D1}$ (g) | 0.65 |
| Site Modified As (g) | 0.54 |

NOTES:
AASHTO = American Association of State Highway and Transportation Officials; g = acceleration due to gravity; MCE = maximum considered earthquake; SEE = safety evaluation earthquake

### 4.2.2 Seismically Induced Geologic Hazards

Seismically induced geologic hazards that may affect a given site include landsliding, fault-related ground rupture, and liquefaction and its associated effects (such as loss of shear strength, bearing capacity failure, settlement, and lateral spreading).

#### 4.2.2.1 Seismically Induced Landsliding

Since the site is relatively flat, we estimate that the risk of seismically induced landsliding is low and not a design issue.

#### 4.2.2.2 Ground Surface Fault Rupture

The nearest known potentially active fault to the site is the east-west-trending Seattle Fault Zone located about 2.5 miles from the project site. Therefore, we estimate that the risk of fault-related ground rupture is low and not a design issue.

#### 4.2.2.3 Liquefaction

Soil liquefaction is a phenomenon in which porewater pressure in saturated granular soils increases during ground shaking to a level near the initial effective stress, resulting in a reduction of shear strength of the soil (a quicksand-like condition). Shallow foundations may experience a reduction in bearing capacity and liquefaction-induced settlement. Due to the generally dense soil conditions and lack of saturated soils, the risk of liquefaction at the project site is low and not a design issue.

## 4.3 Preliminary infiltration Rate Estimate

Soil infiltration rates are highly dependent on the grain-size distribution and degree of compaction of the receiving soils. We performed soil grain-size distribution tests on

near-surface samples S-1 from borings B-1, B-02, B-04, and B-06. We have identified the near-surface soils in these borings as silty sand, silt, silty sand with gravel, and sandy silt. These near-surface soils are also in a medium dense or stiff condition, indicating that they have been overconsolidated by glacial ice. Because of these factors, we estimate that the infiltration rates of these soils will be relatively low, e.g., in the range of 0.5 to 1.0 inch per hour (uncorrected/unfactored rates). We also note that perched groundwater was observed in several of the borings, indicating that relatively impervious soils underlie the project corridor at various locations. Therefore, it is unlikely that infiltration facilities such as buried chambers would be feasible along this project corridor. Surface facilities such as bio-infiltration swales may be feasible given the relatively low rates of infiltration that are likely present. We recommend that small-scale Pilot Infiltration Tests be performed at any proposed infiltration facility location during the design process.

# 5 CONSTRUCTION CONSIDERATIONS

## 5.1 Structural Fill Selection, Placement, and Compaction

All fill placed beneath areas to be paved or against belowgrade poles foundations or other structures should be structural fill. If used to raise subgrade elevation for structural elements (i.e., pavements), fill should be placed on native soil subgrade that has been prepared as described in Section 5.4.2.

Structural fill should meet the WSDOT Specification 9-03.14(1) for Gravel Borrow (WSDOT 2018). During wet weather or wet conditions, the fill should not contain more than 5% fines (i.e., material passing the No. 200 sieve) by weight, based on the minus ¾-inch soil fraction. Structural fill should not contain organic or other deleterious material. The structural fill should be placed in horizontal lifts and compacted to a dense and unyielding condition to at least 95% of the maximum dry density determined by ASTM D1557 (ASTM, 2015). The thickness of loose lifts should not exceed 4 inches for hand-operated compactors or 8 inches for heavy-equipment compactors. A geotechnical engineer or technician should be on site to confirm the material is compacted in accordance with our recommendations.

Based on the results of our geotechnical laboratory testing program, the surficial soil at the Project site generally has fines percentages between 17 and 97% by mass. Due to the high fines percentage, the existing surficial soil is sensitive to moisture content, and only suitable for use as structural fill during the dry weather months. If existing soils are to be used as fill, their moisture content should be carefully controlled to be within 2% of their optimum moisture content as determined by ASTM D1557. If the soil moisture content cannot be maintained within this range, or the soil cannot be compacted to the required specification,

imported gravel borrow should be used. Existing soils unable to be used as structural fill may be used to fill in landscape areas where soil settlement is acceptable.

## 5.2 Excavation and Temporary/Permanent Cut Slopes

Excavations could be accomplished with conventional excavating equipment, such as a dozer, front-end loader, or excavator. Based on the results of our subsurface exploration program, cobbles and boulders may be present in the diamict silty sand lenses. The Contractor should be prepared to remove such materials as needed.

For planning purposes, we recommend that temporary, unsupported, open-cut slopes be no steeper than 1.5 Horizontal to 1 Vertical (1.5V:1H). Flatter cut slopes could be required where loose soil or seepage zones are encountered. We recommend that all exposed cut slopes be protected with a waterproof covering during periods of wet weather to mitigate sloughing and erosion. Permanent cuts should be sloped no steeper than 2H:1V. Appropriate vegetation should be installed on permanent slopes to promote long-term stability. We do not anticipate deep excavations will be required for the project and are not aware of any need for temporary shoring. If required during construction, we can assist the design team with selecting viable temporary shoring options.

## 5.3 Groundwater Control

Although we do not expect the Contractor to encounter groundwater during excavation, increased precipitation during the wet, winter months may disturb and impede activity on site. Therefore, we recommend that the Contractor be prepared to install a system of temporary trenches and sump pumps within excavations. If water is encountered at or above the depth of the footing subgrade or seeps onto the subgrade during excavation, the Contractor should take measures to pump water from the surface of subgrade and then stabilize the exposed subgrade prior to placement of concrete.

## 5.4 Wet Weather Earthwork

In this region, wet weather generally begins in October and continues through May, although rainy periods could occur at any time of the year. Earthwork performed during wet weather months could cost more and take longer to complete. While most stormwater is expected to infiltrate into the soil, surface water runoff due to heavy rain may need to be controlled using drainage ditches and sumps. Standing water on the ground surface, along with construction activity, could result in disturbance and an unstable surface that could require overexcavation and replacement with clean crushed rock.

The following recommendations are applicable for footings, general excavation, floor slabs, or pavements:

- If there is to be traffic over the exposed subgrade, the subgrade should be protected from disturbance. A lean concrete pad, about 2 to 3 inches thick (e.g., a rat slab or mud mat), could be placed immediately following excavation on the undisturbed subgrade soil. This could be done, as needed, to protect the exposed soil and act as a working surface. Overexcavation could be needed to accommodate the lean concrete pad.
- The ground surface in the construction area should be sloped and sealed with a smooth-drum roller to promote runoff of precipitation. This will also help promote surface water flow and prevent the ponding of water.
- Work areas should be covered with plastic and/or sloping, ditching, and dewatering methods should be employed as discussed in Section 5.3.
- Earthwork should be accomplished in small sections to minimize exposure to wet conditions. That is, each section should be small enough so that the removal of unsuitable soil and placement and compaction of structural fill can be accomplished on the same day. The size of construction equipment may have to be limited to prevent soil disturbance. Native soil or fill soil that becomes wet and unstable and/or too wet to suitably compact should be removed and replaced with structural fill as described in Section 5.1.
- Excavation and backfill should not occur during periods of heavy, continuous rainfall.

The recommendations above apply for all weather conditions but are most important for wet weather earthwork. They should be incorporated into the contract specifications for excavations, foundations, and pavement construction.

### 5.4.1 Materials

Hot-mis asphalt (HMA) and portland cement concrete (PCC) pavements should be constructed in accordance with Kitsap County Road Standards, and WSDOT Standard Specifications (WSDOT, 2018). HMA and PCC should conform to Sections 5-04 and 5-05 in the WSDOT Standard Specifications, respectively.

Aggregate for PCC and HMA should meet the requirements of Sections 9-03.1 and 9 03.8, respectively. HMA should consist of HMA Class ½-inch aggregate in accordance with Section 9-03.8(2). Base course should meet the requirements of WSDOT Standard Specifications Section 9-03.9(3) for CSBC. The base course should be compacted to at least 95% of the Modified Proctor maximum dry density (ASTM D1557).

### 5.4.2 Evaluation

Proof-rolling to identify loose, soft, or yielding subgrade or crushed surfacing base course (CSBC) should be performed at all areas to receive pavement. Any loose, soft, or yielding areas identified by proof-rolling should be compacted in place or removed and replaced with compacted structural fill/CSBC. Proof-rolling of subgrade and CSBC should be accomplished with a fully loaded dump truck or equivalent. A geotechnical engineer or technician should be on site to observe this process and recommend subgrade or CSBC improvements if necessary.

# 6 LIMITATIONS

This report was prepared for the exclusive use of Parametrix and their design team. It should be made available to prospective contractors for information on factual data only, and not as a warranty of subsurface conditions such as those interpreted from the exploration logs and presented in the discussions of geologic conditions included in this report.

Within the limitations of the scope, schedule, and budget, the analyses, conclusions, and recommendations presented in this report were prepared in accordance with generally accepted professional geotechnical and hydrogeological principles and practice in this area at the time this report was prepared. We make no other warranty, either expressed or implied.

The analyses, conclusions, and recommendations contained in this report are based on site conditions as they presently exist, and further assume that the soil borings are representative of the subsurface conditions throughout the Project area; that is, the subsurface conditions everywhere are not significantly different from those disclosed by the explorations. Our conclusions and recommendations are based on our understanding of the Project as described in this report and the site conditions as interpreted from the soil borings.

If, during final design and construction, subsurface conditions different from those encountered in the field explorations are observed or appear to be present, we should be advised at once so that we could review these conditions and reconsider our recommendations where necessary. If there is substantial lapse of time between the submission of this report and the start of work at the site, or if conditions have changed because of natural forces or construction operations at or adjacent to the site, we recommend that this report be reviewed to determine the applicability of the conclusions and recommendations concerning the changed conditions or the time lapse.

Unanticipated soil conditions are commonly encountered and cannot fully be determined merely by taking soil samples at a limited number of explorations. Such unexpected conditions frequently require that additional expenditures be made to attain properly constructed projects. Therefore, some contingency fund is recommended to accommodate such potential extra costs.

The scope of our services did not include any environmental assessment or evaluation regarding the presence or absence of hazardous or toxic materials in the soil, surface water, groundwater, or air on or below the site, or any evaluation for disposal of contaminated soils.

Shannon & Wilson has prepared "Important Information About Your Geotechnical/ Environmental Report," to assist you and others in understanding the use and limitations of our reports.

# 7 REFERENCES

ASTM International (ASTM), 2012, Standard test methods for laboratory compaction characteristics of soil using modified effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)), D1557-12e1: West Conshohocken, Pa., ASTM International, Annual book of standards, v. 04.08, soil and rock (I): D420 - D5876, 14 p., available: www.astm.org.

Kitsap County Public Works, 2020, Road Standards, Port Orchard, Wash, available: https://www.kitsapgov.com/pw/plan-your-project/roads-standards.

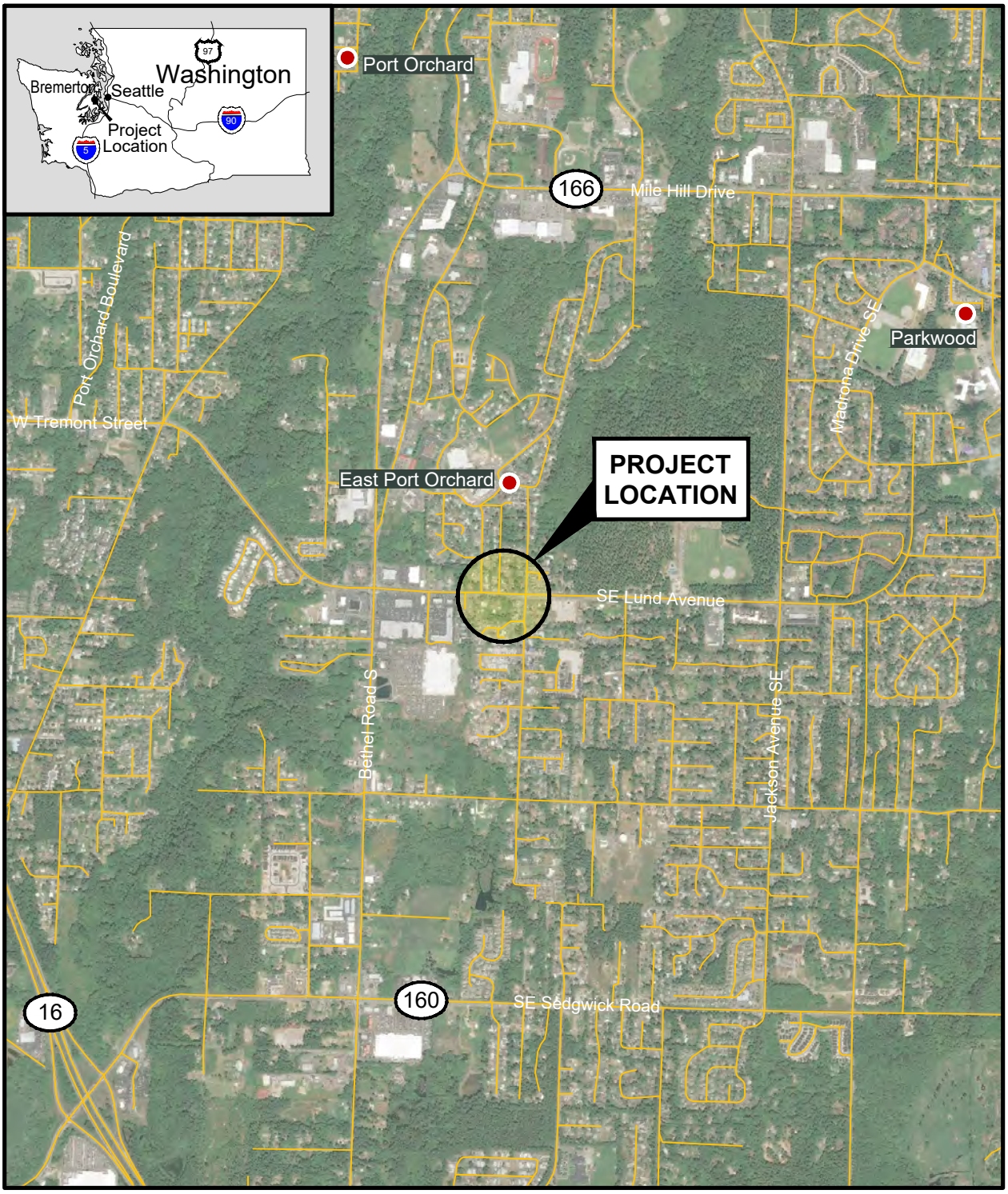
Sceva, J.E., 1957, Geology and ground-water resources of Kitsap County, Washington: U.S. Geological Survey, Water-Supply Paper 1413, scale 1:48,000.

Washington Department of Transportation (WSDOT), 2018, Standard plans for road and bridge construction: Olympia, Wash., WSDOT, Manual M 21-01, May, available: https://www.wsdot.wa.gov/Design/Standards/default.htm.

Washington State Department of Transportation (WSDOT), 2019, Geotechnical design manual: Olympia, Wash., WSDOT, Manual M 46-03, 1 v., July, available: https://www.wsdot.wa.gov/Publications/Manuals/M46-03.htm.

Washington Department of Transportation (WSDOT), 2020, Standard specifications for road, bridge, and municipal construction: Olympia, Wash., WSDOT, Manual M 41-10, November, 1 v., available: https://www.wsdot.wa.gov/Publications/Manuals/M41-10.htm.

Yount, J. C.; Minard, J. P.; and Dembroff, G. R., 1993, Geologic map of surficial deposits in the Seattle 30' by 60' quadrangle, Washington: U. S. Geological Survey Open-File Report 93-233, 2 sheets, scale 1:100, 000.




0 2,000 4,000

Approximate Scale in Feet

Lund Avenue Intersections Improvements
Port Orchard, Washington

**VICINITY MAP**

December 2020 103704-001

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**FIG. 1**

Filename: C:\Users\jrs\CAD Group Dropbox\JDrive_SEA\103704\001\103704-001 Vicinity Map.dwg Date: 12-07-2020 Login: JRS

Filename: C:\Users\jrs\CAD Group Dropbox\JDrive_SEA\103704\001\103704-001 Explorations.dwg Layout: Figure 2 Date: 12-07-2020 Login: JRS


LEGEND

B-01 Boring Designation and Approximate Location

0 120 240

Scale in Feet

Lund Avenue Intersections Improvements
Port Orchard, Washington

**SITE AND EXPLORATION PLAN**

December 2020 103704-001

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FIG. 2

FIG. 2

APPENDIX A: SUBSURFACE EXPLORATION

Appendix A

# Subsurface Exploration

APPENDIX A: GEOTECHNICAL EXPLORATIONS

Appendix A

# Geotechnical Explorations

## Field Exploration Details and Exploration Logs

## CONTENTS



## Figures

APPENDIX A: GEOTECHNICAL EXPLORATIONS

## A.1 GENERAL

The subsurface exploration program consisted of drilling six soil borings. Three borings were drilled at the Intersection of Lund Ave SE and SE Harris Rd. Three Borings were drilled at the intersections of Lund Ave SE and SE Hoover Ave. The purpose of the program was to develop an understanding of the subsurface geologic soil conditions.

## A.2 GEOTECHNICAL BORINGS

Geotechnical borings were drilled to 20 feet below ground surface at various locations throughout the Project site. The boring locations are shown in the Site and Exploration Plan, Figure 2, in the main report.

Geologic Drill Partners, Inc. drilled the borings on November 17, 2020 under subcontract to Shannon & Wilson. Geologic used a trailer-mounted drill rig and advanced the borings using hollow-stem auger drilling techniques. The borings were backfilled with bentonite chips per Washington State Department of Ecology Requirements. Soil Boring logs a presented in figures A-6 through A-9.

## A.3 SAMPLING AND CLASSIFICATION

A representative from Shannon & Wilson was present during the explorations to observe drilling and excavation, retrieve representative soil samples for subsequent laboratory testing, and prepare descriptive field logs of the explorations. We based soil sample classification on the ASTM Designation D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) (ASTM, 2017a), and ASTM Designation D2488, Standard Practice for Description and Identification of Soils (Visual/Manual Procedure) (ASTM, 2017b). We used the Unified Soil Classification System, as described in Figure A-1 of this appendix, to classify the material encountered.

We obtained disturbed soil samples in conjunction with the Standard Penetration Test (SPT). We performed SPTs in general accordance with ASTM Designation D1586, Standard Test Method for Standard Penetration Test and Split-Barrel Sampling of Soils (ASTM, 2018). We collected SPTs in the borings at 2.5-foot intervals. The SPT consists of driving a 2-inch-outside-diameter split-spoon sampler a total distance of 18 inches below the bottom of the drill hole with a 140-pound hammer falling 30 inches. The number of blows required to advance the split spoon from 6 to 18 inches of penetration is termed the Standard Penetration Resistance (N-value). This value is an empirical parameter that provides a

means for evaluating the relative density, or compactness, of granular soils and the consistency, or stiffness, of cohesive soils. Figure A-1 presents the terminology used to describe the relative density or consistency of the soil.

## A.4 REFERENCES

ASTM International, 2017a, Standard practice for classification of soils for engineering purposes (unified soil classification system), D2487-17: West Conshohocken, Pa., ASTM International, Annual book of standards, v. 04.08, soil and rock (I): D420 - D5876, 10 p., available: www.astm.org.

ASTM International, 2017b, Standard practice for description and identification of soils (visual/manual procedure), D2488-17e1: West Conshohocken, Pa., ASTM International, Annual book of standards, v. 04.08, soil and rock (I): D420 - D5876, 13 p., available: www.astm.org.

ASTM International, 2018, Standard test method for standard penetration test (SPT) and split-barrel sampling of soils , D1586-18: West Conshohocken, Pa., ASTM International, Annual book of standards, v. 04.08, soil and rock (I): D420 - D5876, 26 p., available: www.astm.org.

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# SOIL DESCRIPTION AND LOG KEY

**Lund and Harris Intersection Improvements Project**
**Port Orchard, Washington**



*Shannon & Wilson uses a soil identification system modified from the Unified Soil Classification System (USCS). Elements of the USCS and other definitions are provided on this and the following page. Soil descriptions are based on visual-manual procedures (ASTM D2488) and laboratory testing procedures (ASTM D2487), if performed.*

## Structure[1]

| | |
|---|---|
| Interbedded | Alternating layers of varying material or color with layers at least 1/4-inch-thick; singular: bed. |
| Laminated | Alternating layers of varying material or color with layers less than 1/4-inch-thick; singular: lamination. |
| Fissured | Breaks along definite planes or fractures with little resistance. |
| Slickensided | Fracture planes appear polished or glossy; sometimes striated. |
| Blocky | Cohesive soil that can be broken down into small angular lumps that resist further breakdown. |
| Lensed | Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay. |
| Homogeneous | Same color and appearance throughout. |

## Angularity and Shape[1]

| | |
|---|---|
| Angular | Sharp edges and unpolished planar surfaces. |
| Subangular | Similar to angular, but with rounded edges. |
| Subrounded | Nearly planar sides with well-rounded edges. |
| Rounded | Smoothly curved sides with no edges. |
| Flat | Width/thickness ratio > 3. |
| Elongated | Length/width ratio > 3. |

## Standard Penetration Test (SPT)[3]

| | |
|---|---|
| Hammer | 140 pounds with a 30-inch free fall. Rope on 6- to 10-inch-diameter cathead 2-1/4 rope turns, > 100 rpm. If automatic hammers are used, blow counts shown on boring logs should be adjusted to account for efficiency of hammer. |
| Sampler | 10 to 30 inches long<br>Shoe I.D. = 1.375 inches<br>Barrel I.D. = 1.5 inches<br>Barrel O.D. = 2 inches |
| N-Value | Sum blow counts for second and third 6-inch increments.<br>Refusal: 50 blows for 6 inches or less or 10 blows for 0 inch. |

## Moisture Content

| | |
|---|---|
| Dry | Absence of moisture, dusty, dry to the touch. |
| Moist | Damp but no visible water. |
| Wet | Visible free water, from below water table. |

## Gradation

| | |
|---|---|
| Poorly Graded | Narrow range of grain sizes present or, within the range of grain sizes present, one or more sizes are missing (Gap Graded). Meets criteria in ASTM D2487, if tested. |
| Well-Graded | Full range and even distribution of grain sizes present. Meets criteria in ASTM D2487, if tested. |

## Cementation[1]

| | |
|---|---|
| Weak | Crumbles/breaks with handling or slight finger pressure. |
| Moderate | Crumbles or breaks with considerable finger pressure. |
| Strong | Will not crumble or break with finger pressure. |

## Plasticity[2]

| | | |
|---|---|---|
| Nonplastic | Cannot roll a 1/8-in. thread at any water content. | PI < 4 |
| Low | A thread can barely be rolled and a lump cannot be formed when drier than the plastic limit. | 4 < PI < 10 |
| Medium | A thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. A lump crumbles when drier than the plastic limit. | 10 < PI < 20 |
| Hard | It takes considerable time rolling and kneading to reach the plastic limit. A thread can be rerolled several times after reaching the plastic limit. A lump can be formed without crumbling when drier than the plastic limit. | PI > 21 |

## Additional Terms

| | |
|---|---|
| Mottled | Irregular patches of different colors. |
| Bioturbated | Soil disturbance or mixing by plants or animals. |
| Diamict | Nonsorted sediment; sand and gravel in silt and/or clay matrix. |
| Cuttings | Material brought to surface by drilling. |
| Slough | Material that caved from sides of borehole. |
| Sheared | Disturbed texture, mix of strengths. |

**Notes:**

[1]Reprinted, with permission, from ASTM D2488 - 09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org.

[2]Adapted, with permission, from ASTM D2488 - 09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org.

[3]Penetration resistances (N-values) shown on boring logs are as recorded in the field and have not been corrected for hammer efficiency, overburden, or other factors.

SHANNON & WILSON

# SOIL DESCRIPTION AND LOG KEY

**Lund and Harris Intersection Improvements Project**
**Port Orchard, Washington**



## Unified Soil Classification System (USCS)
Modified From USACE Tech Memo 3-357, ASTM D2487, and ASTM D2488

| Major Divisions | | | Symbol | Typical Identifications |
|---|---|---|---|---|
| Coarse-Grained Soils (more than 50% retained on No. 200 sieve) | Gravels (more than 50% of coarse fraction retained on No. 4 sieve) | Gravel (less than 5% fines) | GW | Well-graded Gravel; Well-graded Gravel with Sand |
| | | | GP | Poorly Graded Gravel; Poorly Graded Gravel with Sand |
| | | Silty or Clayey Gravel (more than 12% fines) | GM | Silty Gravel; Silty Gravel with Sand |
| | | | GC | Clayey Gravel; Clayey Gravel with Sand |
| | Sands (50% or more of coarse fraction passes the No. 4 sieve) | Sand (less than 5% fines) | SW | Well-graded Sand; Well-graded Sand with Gravel |
| | | | SP | Poorly Graded Sand; Poorly Graded Sand with Gravel |
| | | Silty or Clayey Sand (more than 12% fines) | SM | Silty Sand; Silty Sand with Gravel |
| | | | SC | Clayey Sand; Clayey Sand with Gravel |
| Fine-Grained Soils (50% or more passes the No. 200 sieve) | Silts and Clays (liquid limit less than 50) | Inorganic | ML | Silt; Silt with Sand or Gravel; Sandy or Gravelly Silt |
| | | | CL | Lean Clay; Lean Clay with Sand or Gravel; Sandy or Gravelly Lean Clay |
| | | Organic | OL | Organic Silt or Clay; Organic Silt or Clay with Sand or Gravel; Sandy or Gravelly Organic Silt or Clay |
| | Silts and Clays (liquid limit 50 or more) | Inorganic | MH | Elastic Silt; Elastic Silt with Sand or Gravel; Sandy or Gravelly Elastic Silt |
| | | | CH | Fat Clay; Fat Clay with Sand or Gravel; Sandy or Gravelly Fat Clay |
| | | Organic | OH | Organic Silt or Clay; Organic Silt or Clay with Sand or Gravel; Sandy or Gravelly Organic Silt or Clay |
| Highly Organic Soils | Primarily organic matter, dark in color, and organic odor | | PT | Peat or other highly organic soils (see ASTM D4427) |

## Acronyms and Abbreviations

| | | | | | |
|---|---|---|---|---|---|
| ATD | At Time of Drilling | MgO | Magnesium Oxide | psi | Pounds per Square Inch |
| Diam. | Diameter | mm | Millimeter | PVC | Polyvinyl Chloride |
| Elev. | Elevation | MnO | Manganese Oxide | rpm | Rotations per Minute |
| ft | Feet | NA | Not Applicable or Not Available | SPT | Standard Penetration Test |
| FeO | Iron Oxide | NP | Nonplastic | USCS | Unified Soil Classification System |
| gal | Gallons | O.D. | Outside Diameter | $q_u$ | Unconfined Compressive Strength |
| Horiz. | Horizontal | OW | Observation Well | VWP | Vibrating Wire Piezometer |
| HSA | Hollow-Stem Auger | pcf | Pounds per Cubic Foot | Vert. | Vertical |
| I.D. | Inside Diameter | PID | Photoionization Detector | WOH | Weight of Hammer |
| in | Inches | PMT | Pressuremeter Test | WOR | Weight of Rods |
| lbs | Pounds | ppm | Parts per Million | Wt | Weight |

## Relative Density
Cohesionless Soils

| N, SPT, Blows/ft | Relative Density |
|---|---|
| < 4 | Very loose |
| 4 - 10 | Loose |
| 10 - 30 | Medium dense |
| 30 - 50 | Dense |
| > 50 | Very dense |

## Relative Consistency
Cohesive Soils

| N, SPT, Blows/ft | Relative Consistency |
|---|---|
| < 2 | Very soft |
| 2 - 4 | Soft |
| 4 - 8 | Medium stiff |
| 8 - 15 | Stiff |
| 15 - 30 | Very stiff |
| > 30 | Hard |

## Percentages[1, 2]

| | |
|---|---|
| Trace | < 5% |
| Few | 5 to 10% |
| Little | 15 to 25% |
| Some | 30 to 45% |
| Mostly | 50 to 100% |

## Well and Backfill Symbols

- Bentonite Cement Grout
- Bentonite Grout
- Bentonite Chips
- Silica Sand
- Perforated or Screened Casing
- Surface Cement Seal
- Asphalt or Cap
- Slough
- Inclinometer or Non-perforated Casing
- Instrumentation Riser or Electrical Lead
- Vibrating Wire Piezometer with Designation

**Notes:**

Dual symbols *(symbols separated by a hyphen, i.e., SP-SM, Sand with Silt)* are used for soils with between 5% and 12% fines or when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart. Graphics shown on the logs for these soil types are a combination of the two graphic symbols (e.g., SP and SM).

Borderline symbols *(symbols separated by a slash, i.e., CL/ML, Lean Clay to Silt; SP-SM/SM, Sand with Silt to Silty Sand)* indicate that the soil properties are close to the defining boundary between two groups.

No. 4 size = 4.75 mm = 0.187 in.; No. 200 size = 0.075 mm = 0.003 in.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Total Depth: | *21.5 ft.* | Northing: | | Drilling Method: | *Hollow Stem Auger* | Hole Diam.: | *6 in.* |
| Top Elevation: | *~* | Easting: | | Drilling Company: | *Geologic Drill Partners* | Rod Diam.: | |
| Vert. Datum: | | Station: | | Drill Rig Equipment: | *Deep XL Trailer Drill* | Hammer Type: | *Cathead* |
| Horiz. Datum: | | Offset: | | Other Comments: | | | |

**SOIL DESCRIPTION**

*Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.*

Depth, ft. | Symbol | Samples | Ground Water | Depth, ft.

**PENETRATION RESISTANCE** (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*

0.2 — Asphalt (2.5 inches).

Medium dense, red-brown to light brown, *Silty Sand (SM)*; moist; fine sand.

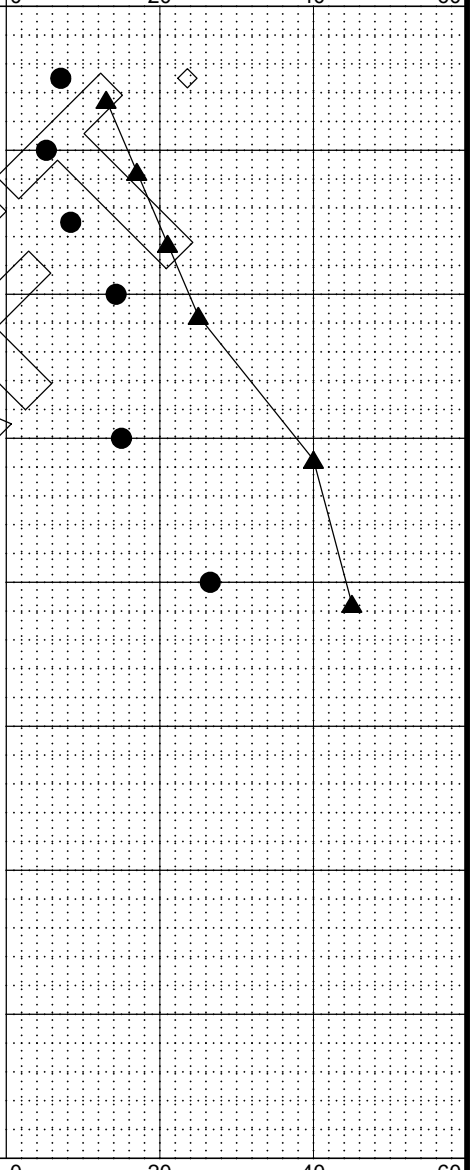
7.0 — Medium dense, light gray *Sand with Silt (SP-SM)*; moist; fine sand.

9.0 — Medium dewnse to dense, gray, *Silty Sand with Gravel (SM)*; moist to wet; diamict silty sand lenses; fine to medium sand.

21.5 — BOTTOM OF BORING
COMPLETED 11/17/2020

During Drilling ▽






LEGEND

* Sample Not Recovered

I 2.0" O.D. Split Spoon Sample

▽ Ground Water Level ATD

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Lund and Harris Intersection Improvements Project
Port Orchard, Washington

# LOG OF BORING B-01

January 2021 | 103704-001

**SHANNON & WILSON, INC.**
Geotechnical and Environmental Consultants

**FIG.**

*REV 2 - Log in Progress*

MASTER LOG E 103704.GPJ SHAN_WIL.GDT 01/06/21 Log: NLP/KXH Rev: NLP Typ: LKN

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Total Depth: | *21.5 ft.* | Northing: | | Drilling Method: | *Hollow Stem Auger* | Hole Diam.: | *6 in.* |
| Top Elevation: | *~* | Easting: | | Drilling Company: | *Geologic Drill Partners* | Rod Diam.: | |
| Vert. Datum: | | Station: | | Drill Rig Equipment: | *Deep XL Trailer Drill* | Hammer Type: | *Cathead* |
| Horiz. Datum: | | Offset: | | Other Comments: | | | |

**SOIL DESCRIPTION**

*Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.*

Asphalt (approximately 4.5 inches). — 0.4

Medium dense, gray-brown, mottled, *Silt (ML)*; moist. — 4.5

Medium dense to dense, light gray-brown to gray, *Silty Sand (SM)*; moist to wet; scattered iron oxide staining; lenses of clean, fine to medium sand; lenses of diamict silty sand with gravel.

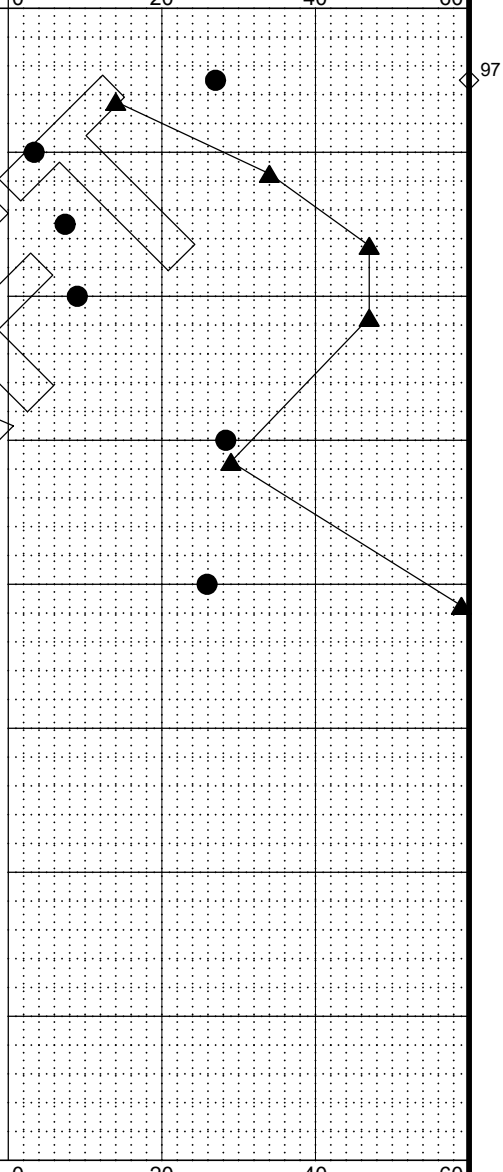
BOTTOM OF BORING — 21.5
COMPLETED 11/17/2020

Depth, ft. | Symbol | Samples | Ground Water Depth, ft.

Ground Water: None Observed During Drilling

**PENETRATION RESISTANCE** (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*






LEGEND

* Sample Not Recovered

⌶ 2.0" O.D. Split Spoon Sample

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Lund and Harris Intersection Improvements Project
Port Orchard, Washington

# LOG OF BORING B-02

January 2021 — 103704-001

**SHANNON & WILSON, INC.**
Geotechnical and Environmental Consultants

**FIG.**

*REV 2 - Log in Progress*

MASTER LOG E 103704.GPJ SHAN_WIL.GDT 01/06/21 — Log: NLP/KXR Rev: NLP Typ: LKN

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Total Depth: | *21.5 ft.* | Northing: | | Drilling Method: | *Hollow Stem Auger* | Hole Diam.: | *6 in.* |
| Top Elevation: | *~* | Easting: | | Drilling Company: | *Geologic Drill Partners* | Rod Diam.: | |
| Vert. Datum: | | Station: | | Drill Rig Equipment: | *Deep XL Trailer Drill* | Hammer Type: | *Cathead* |
| Horiz. Datum: | | Offset: | | Other Comments: | | | |

**SOIL DESCRIPTION**

*Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.*

Depth, ft. | Symbol | Samples | Ground Water | Depth, ft.

**PENETRATION RESISTANCE** (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*

0 | 20 | 40 | 60

Asphalt pavement. — 0.5

Medium dense to very dense, light gray-brown to gray, *Silty Sand (SM)*; moist to wet; lenses of diamict silty sand with gravel; oxidized orange in upper 10 feet.

1 2 3 4 5 6 7 8

During Drilling ▽

5 10 15 20 25 30 35

63

92/10"

63

BOTTOM OF BORING — 21.5
COMPLETED 11/17/2020



0 | 20 | 40 | 60

◇ % Fines (<0.075mm)
● % Water Content

LEGEND

* Sample Not Recovered
⌶ 2.0" O.D. Split Spoon Sample
▽ Ground Water Level ATD

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Lund and Harris Intersection Improvements Project
Port Orchard, Washington

# LOG OF BORING B-03

January 2021 | 103704-001

**SHANNON & WILSON, INC.**
Geotechnical and Environmental Consultants

**FIG.**

*REV 2 - Log in Progress*

MASTER LOG E 103704.GPJ SHAN_WIL.GDT 01/06/21 Log: NLP/KXM Rev: NLP Typ: LKN

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Total Depth: | *21.5 ft.* | Northing: | | Drilling Method: | *Hollow Stem Auger* | Hole Diam.: | *6 in.* |
| Top Elevation: | *~* | Easting: | | Drilling Company: | *Geologic Drill Partners* | Rod Diam.: | |
| Vert. Datum: | | Station: | | Drill Rig Equipment: | *Deep XL Trailer Drill* | Hammer Type: | *Cathead* |
| Horiz. Datum: | | Offset: | | Other Comments: | | | |

**SOIL DESCRIPTION**

*Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.*

Depth, ft. | Symbol | Samples | Ground Water | Depth, ft.

**PENETRATION RESISTANCE** (blows/foot)

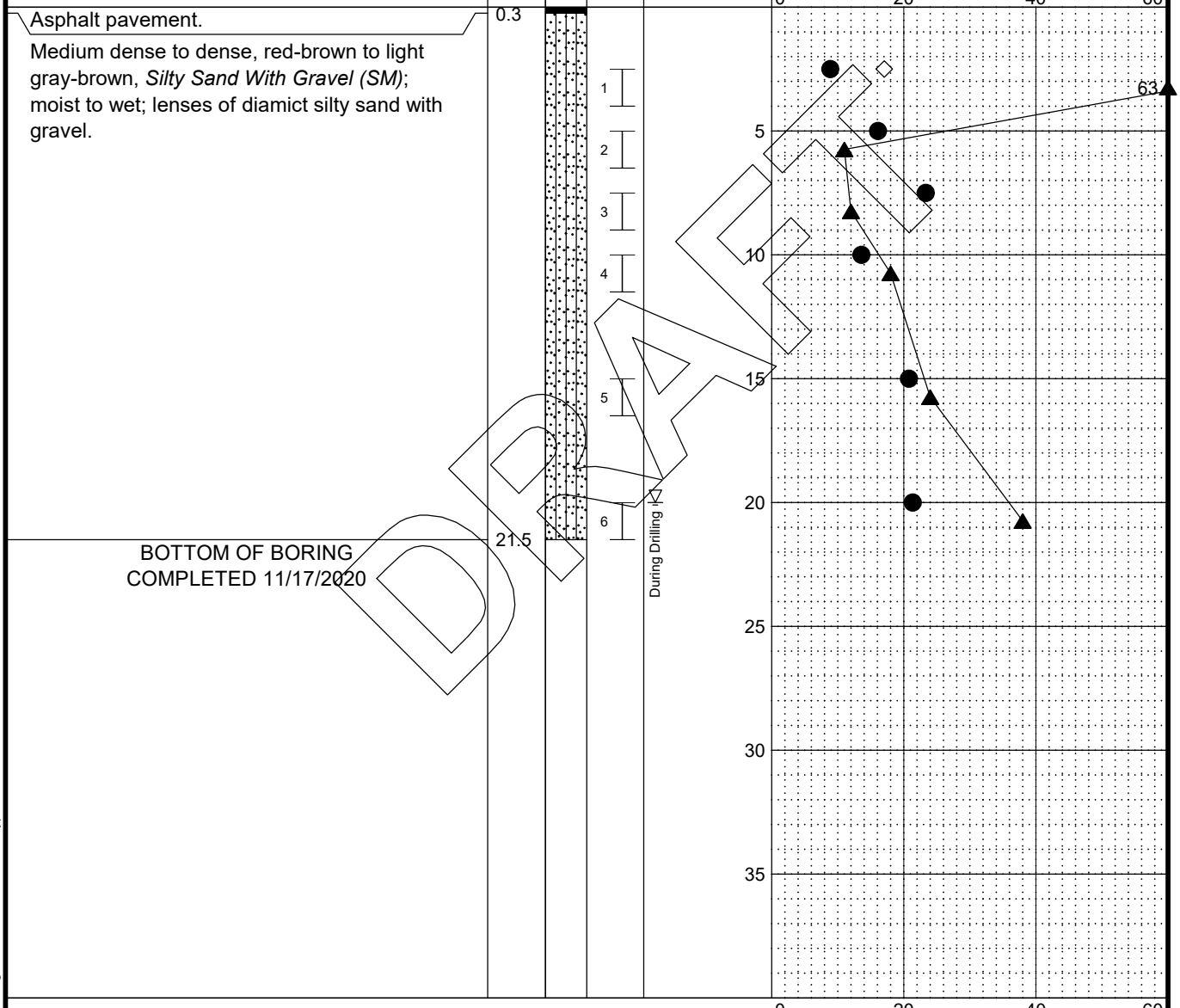
▲ Hammer Wt. & Drop: *140 lbs / 30 inches*

0.3 Asphalt pavement.

Medium dense to dense, red-brown to light gray-brown, *Silty Sand With Gravel (SM)*; moist to wet; lenses of diamict silty sand with gravel.

21.5 BOTTOM OF BORING COMPLETED 11/17/2020

During Drilling ▽






LEGEND

* Sample Not Recovered

⌶ 2.0" O.D. Split Spoon Sample

▽ Ground Water Level ATD

◇ % Fines (<0.075mm)

● % Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Lund and Harris Intersection Improvements Project
Port Orchard, Washington

# LOG OF BORING B-04

January 2021 103704-001

**SHANNON & WILSON, INC.**
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**FIG.**

*REV 2 - Log in Progress*

MASTER LOG E 103704.GPJ SHAN_WIL.GDT 01/06/21 Log: NLP/KXM Rev: NLP Typ: LKN

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Total Depth: | *21.5 ft.* | Northing: | | Drilling Method: | *Hollow Stem Auger* | Hole Diam.: | *6 in.* |
| Top Elevation: | *~* | Easting: | | Drilling Company: | *Geologic Drill Partners* | Rod Diam.: | |
| Vert. Datum: | | Station: | | Drill Rig Equipment: | *Deep XL Trailer Drill* | Hammer Type: | *Cathead* |
| Horiz. Datum: | | Offset: | | Other Comments: | | | |

**SOIL DESCRIPTION**

*Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.*

Depth, ft. | Symbol | Samples | Ground Water | Depth, ft.

**PENETRATION RESISTANCE** (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*

0 | 20 | 40 | 60

0.3 Asphalt pavement.

Loose to medium dense, red-breown to light brown, *Silty Sand (SM)*; moist to wet; lenses of diamict silty sand with gravel.

Sample 1 — Sample 2 — Sample 3 — Sample 4 — Sample 5 — Sample 6 — Sample 7 — Sample 8

During Drilling ▽

21.5 BOTTOM OF BORING COMPLETED 11/17/2020

5 | 10 | 15 | 20 | 25 | 30 | 35

0 | 20 | 40 | 60

◇ % Fines (<0.075mm)

● % Water Content



LEGEND

* Sample Not Recovered

⌶ 2.0" O.D. Split Spoon Sample

▽ Ground Water Level ATD

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Lund and Harris Intersection Improvements Project
Port Orchard, Washington

# LOG OF BORING B-05

January 2021 | 103704-001

**SHANNON & WILSON, INC.**
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**FIG.**

*REV 2 - Log in Progress*

MASTER LOG E 103704.GPJ SHAN_WIL.GDT 01/06/21 Log: NLP/KXM Rev: NLP Typ: LKN

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Total Depth: | *21.5 ft.* | Northing: | | Drilling Method: | *Hollow Stem Auger* | Hole Diam.: | *6 in.* |
| Top Elevation: | *~* | Easting: | | Drilling Company: | *Geologic Drill Partners* | Rod Diam.: | |
| Vert. Datum: | | Station: | | Drill Rig Equipment: | *Deep XL Trailer Drill* | Hammer Type: | *Cathead* |
| Horiz. Datum: | | Offset: | | Other Comments: | | | |

**SOIL DESCRIPTION**

*Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.*

Asphalt pavement. — 0.5

Stiff to very stiff, gray-brown, *Sandy Silt (ML)* and *Sandy, Lean Clay (CL)*; moist to wet.

Medium dense, light brown, *Silty Sand (SM)*; moist. — 7.0

Meidum dense to very dense, gray, *Silty Sand with Gravel (SM)*; moist; diamict. — 15.0

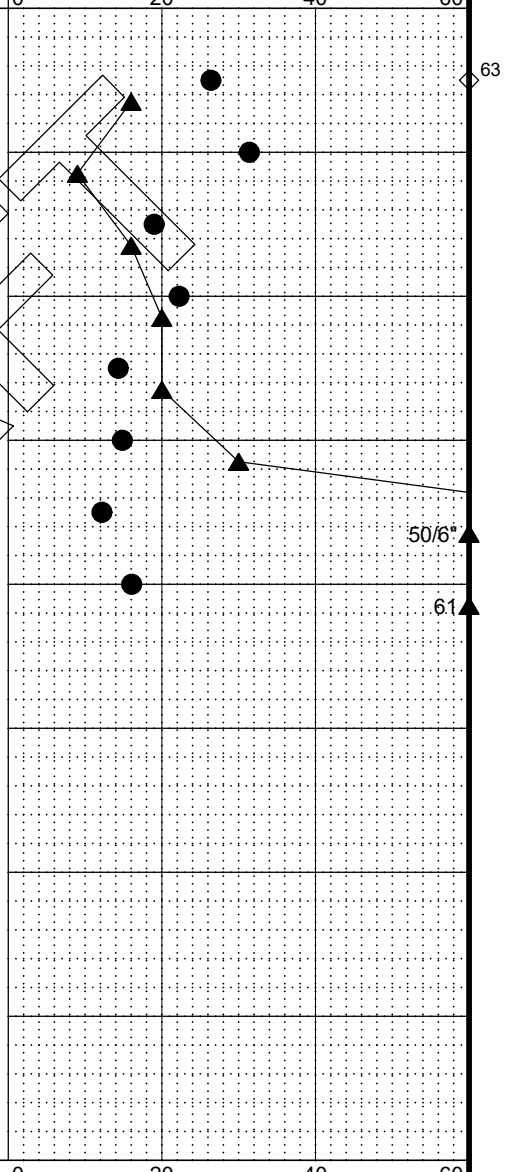
BOTTOM OF BORING — 21.5
COMPLETED 11/17/2020

Depth, ft. | Symbol | Samples | Ground Water | Depth, ft.

Ground Water: None Observed During Drilling

**PENETRATION RESISTANCE** (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*




◇ % Fines (<0.075mm)
● % Water Content

LEGEND

* Sample Not Recovered

2.0" O.D. Split Spoon Sample

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Lund and Harris Intersection Improvements Project
Port Orchard, Washington

# LOG OF BORING B-06

January 2021 — 103704-001

**SHANNON & WILSON, INC.**
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**FIG.**

*REV 2 - Log in Progress*



MASTER LOG E 103704.GPJ SHAN_WIL.GDT 01/06/21 Log: NLP/KXR Rev: NLP Typ: LKN

APPENDIX B: GEOTECHNICAL LABORATORY TESTING

Appendix B

# Geotechnical Laboratory Testing

APPENDIX B: GEOTECHNICAL LABORATORY TESTING

Appendix B

# Geotechnical Laboratory Testing

## CONTENTS



## Figures

APPENDIX B: GEOTECHNICAL LABORATORY TESTING

## B.1 GENERAL

We performed geotechnical laboratory testing on selected soil samples retrieved from our borings and test pits in order to classify the soil and provide data for engineering studies. Our laboratory testing program included visual classification, water content determinations, and grain-size distribution analyses.

## B.2 VISUAL CLASSIFICATION

We visually classified soil samples retrieved from the borings using a system based on ASTM Designation D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) (ASTM, 2017a), and ASTM Designation D2488, Standard Practice for Description and Identification of Soils (Visual/Manual Procedure) (ASTM, 2017b). We assigned a Unified Soil Classification System (USCS) group name and symbol based on our visual classification of particles finer than 76.2 millimeters (3 inches). We revised visual classifications, shown in our Appendix A boring logs, using results of the index tests discussed below.

## B.3 WATER CONTENT DETERMINATION

We tested the water content of selected samples in accordance with ASTM D2216-10, Standard Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass (ASTM, 2010). Comparison of the water content of a soil with its index properties can be useful in characterizing soil unit weight, consistency, compressibility, and strength. We present water content test results graphically on the Appendix A boring logs.

## B.4 GRAIN-SIZE DISTRIBUTION ANALYSIS

Grain-size distribution analyses separate soil particles through mechanical or sedimentation processes. Grain-size distributions are used to classify the granular component of soils and can correlate with soil properties, including frost susceptibility, permeability, shear strength, liquefaction potential, capillary action, and sensitivity to moisture. We plot grain-size distribution analysis results in this appendix as Figures B-1 through B-4. Grain-size distribution plots provide tabular information about each specimen, including USCS group symbol and group name, water content, constituent (i.e., cobble, gravel, sand, and fines) percentages, coefficients of uniformity and curvature, personnel initials, ASTM standard designation, and testing remarks. Fines contents are also plotted as data points on the Appendix A boring logs.

We performed mechanical sieve analyses on selected soil specimens to determine the grain-size distribution of coarse-grained soil particles in accordance with ASTM C136M-14, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates (ASTM, 2014).

## B.5 REFERENCES

ASTM International, 2010, Standard test methods for laboratory determination of water (moisture) content of soil and rock by mass, D2216-10: West Conshohocken, Pa., ASTM International, Annual book of standards, v. 04.08, soil and rock (I): D420 - D5876, 7 p., available: www.astm.org.

ASTM International, 2014, Standard test method for sieve analysis of fine and coarse aggregates, C136-14: West Conshohocken, Pa., ASTM International, Annual book of standards, v. 04.02, concrete and aggregates, 5 p., available: www.astm.org.

ASTM International, 2017a, Standard practice for classification of soils for engineering purposes (unified soil classification system), D2487-17: West Conshohocken, Pa., ASTM International, Annual book of standards, v. 04.08, soil and rock (I): D420 - D5876, 10 p., available: www.astm.org.

ASTM International, 2017b, Standard practice for description and identification of soils (visual/manual procedure), D2488-17e1: West Conshohocken, Pa., ASTM International, Annual book of standards, v. 04.08, soil and rock (I): D420 - D5876, 13 p., available: www.astm.org.

Table B-1 - Summary of Laboratory Testing

| Boring | Top Depth (feet) | Sample No. | Sample Type | Blow Count | USCS | ESU | Geologic Unit | Water Content | Wet Unit Weight | % Gravel | % Sand | % Fines | % <2mic | % Cobbles Removed | Specific Gravity | Liquid Limit | Plastic Limit | NP | Organic Content | Soil Description |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B-01 | 2.5 | 1 | SPT | 13 | SM | | | 7.1 | | | 76 | 23.6 | | | | | | | | Silty Sand |
| B-01 | 5 | 2 | SPT | 17 | | | | 5.2 | | | | | | | | | | | | |
| B-01 | 7.5 | 3 | SPT | 21 | | | | 8.4 | | | | | | | | | | | | |
| B-01 | 10 | 4 | SPT | 25 | | | | 14.3 | | | | | | | | | | | | |
| B-01 | 15 | 5 | SPT | 40 | | | | 15 | | | | | | | | | | | | |
| B-01 | 20 | 6 | SPT | 45 | | | | 26.6 | | | | | | | | | | | | |
| B-02 | 2.5 | 1 | SPT | 14 | ML | | | 27 | | | 3 | 96.7 | | | | | | | | Silt |
| B-02 | 5 | 2 | SPT | 34 | | | | 3.4 | | | | | | | | | | | | |
| B-02 | 7.5 | 3 | SPT | 47 | | | | 7.4 | | | | | | | | | | | | |
| B-02 | 10 | 4 | SPT | 47 | | | | 9 | | | | | | | | | | | | |
| B-02 | 15 | 5 | SPT | 29 | | | | 28.3 | | | | | | | | | | | | |
| B-02 | 20 | 6 | SPT | 59 | | | | 25.9 | | | | | | | | | | | | |
| B-03 | 2.5 | 1 | SPT | 22 | | | | 9.6 | | | | | | | | | | | | |
| B-03 | 5 | 2 | SPT | 37 | | | | 12.1 | | | | | | | | | | | | |
| B-03 | 7.5 | 3 | SPT | 63 | | | | 8.6 | | | | | | | | | | | | |
| B-03 | 10 | 4 | SPT | 92/10" | | | | 5.4 | | | | | | | | | | | | |
| B-03 | 12.5 | 5 | SPT | 63 | | | | 6.6 | | | | | | | | | | | | |
| B-03 | 15 | 6 | SPT | 40 | | | | 18.5 | | | | | | | | | | | | |
| B-03 | 17.5 | 7 | SPT | 49 | | | | 23 | | | | | | | | | | | | |
| B-03 | 20 | 8 | SPT | 39 | | | | 24.4 | | | | | | | | | | | | |
| B-04 | 2.5 | 1 | SPT | 63 | SM | | | 8.9 | | 27 | 56 | 17 | | | | | | | | Silty Sand with Gravel |
| B-04 | 5 | 2 | SPT | 11 | | | | 16.1 | | | | | | | | | | | | |
| B-04 | 7.5 | 3 | SPT | 12 | | | | 23.3 | | | | | | | | | | | | |
| B-04 | 10 | 4 | SPT | 18 | | | | 13.6 | | | | | | | | | | | | |
| B-04 | 15 | 5 | SPT | 24 | | | | 20.8 | | | | | | | | | | | | |
| B-04 | 20 | 6 | SPT | 38 | | | | 21.4 | | | | | | | | | | | | |
| B-05 | 2.5 | 1 | SPT | 7 | | | | 10.6 | | | | | | | | | | | | |
| B-05 | 5 | 2 | SPT | 8 | | | | 7.4 | | | | | | | | | | | | |
| B-05 | 7.5 | 3 | SPT | 24 | | | | 7.4 | | | | | | | | | | | | |
| B-05 | 10 | 4 | SPT | 22 | | | | 10.8 | | | | | | | | | | | | |
| B-05 | 12.5 | 5 | SPT | 14 | | | | 27.9 | | | | | | | | | | | | |
| B-05 | 15 | 6 | SPT | 23 | | | | 24.1 | | | | | | | | | | | | |
| B-05 | 17.5 | 7 | SPT | 22 | | | | 14.3 | | | | | | | | | | | | |
| B-05 | 20 | 8 | SPT | 26 | | | | 14.5 | | | | | | | | | | | | |
| B-06 | 2.5 | 1 | SPT | 16 | ML | | | 26.4 | | | 37 | 62.5 | | | | | | | | Sandy Silt |
| B-06 | 5 | 2 | SPT | 9 | | | | 31.4 | | | | | | | | | | | | |
| B-06 | 7.5 | 3 | SPT | 16 | | | | 19 | | | | | | | | | | | | |
| B-06 | 10 | 4 | SPT | 20 | | | | 22.2 | | | | | | | | | | | | |

Table B-1 - Summary of Laboratory Testing

| Boring | Top Depth (feet) | Sample No. | Sample Type | Blow Count | USCS | ESU | Geologic Unit | Water Content | Wet Unit Weight | % Gravel | % Sand | % Fines | % <2mic | % Cobbles Removed | Specific Gravity | Liquid Limit | Plastic Limit | NP | Organic Content | Soil Description |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B-06 | 12.5 | 5 | SPT | 20 | | | | 14.3 | | | | | | | | | | | | |
| B-06 | 15 | 6 | SPT | 30 | | | | 14.9 | | | | | | | | | | | | |
| B-06 | 17.5 | 7 | SPT | 50/6" | | | | 12.2 | | | | | | | | | | | | |
| B-06 | 20 | 8 | SPT | 61 | | | | 16.1 | | | | | | | | | | | | |

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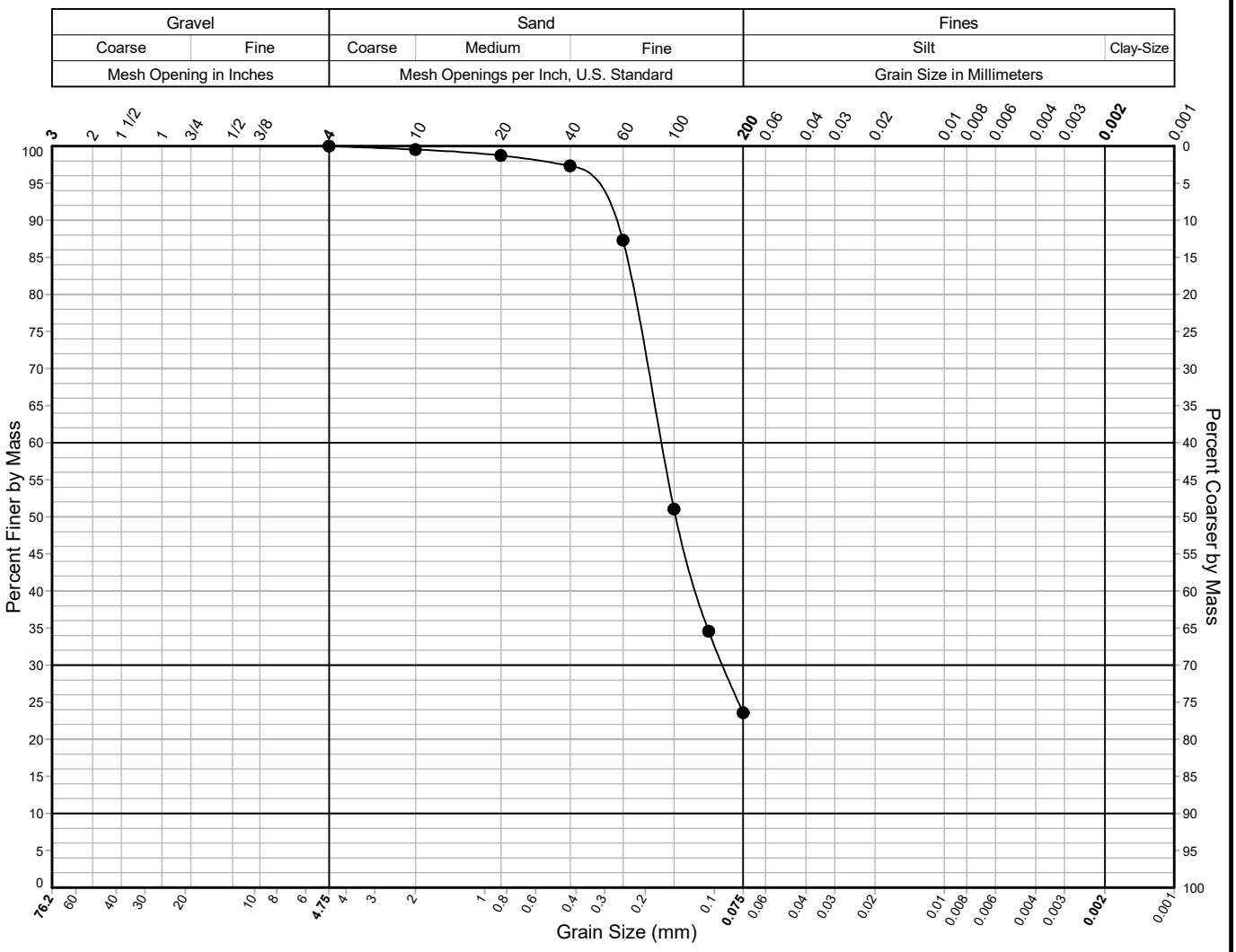
# GRAIN SIZE DISTRIBUTION PLOT

**Lund and Harris Intersection Improvements Project**
**Port Orchard, Washington**

## BORING B-01




| Sample Identification | Depth (ft) | USCS Group Symbol | USCS Group Name | Gravel % | Sand % | Fines % | < 20µm % | < 2µm % | WC % | Tested By | Review By | ASTM Std. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ● B-01, S-1* | 2.5 | SM | Silty Sand | | 76 | 24 | | | 7.1 | NS | AKV | D6913 |

* *Test specimen did not meet minimum mass recommendations.*

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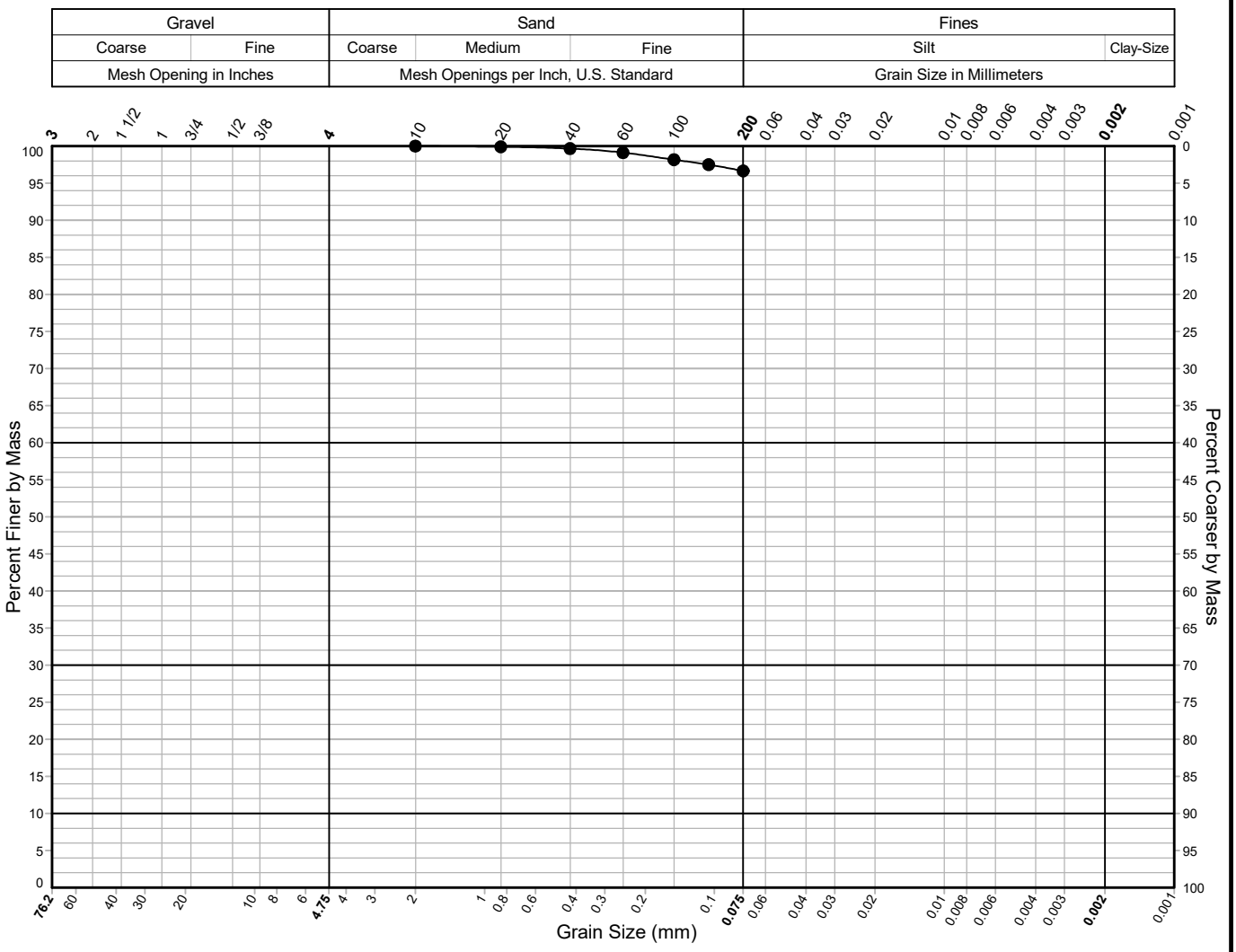
# GRAIN SIZE DISTRIBUTION PLOT

**Lund and Harris Intersection Improvements Project**
**Port Orchard, Washington**

## BORING B-02




| Sample Identification | Depth (ft) | USCS Group Symbol | USCS Group Name | Gravel % | Sand % | Fines % | < 20µm % | < 2µm % | WC % | Tested By | Review By | ASTM Std. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ● B-02, S-1* | 2.5 | ML | Silt | | 3 | 97 | | | 27.0 | NS | AKV | D6913 |

* *Test specimen did not meet minimum mass recommendations.*

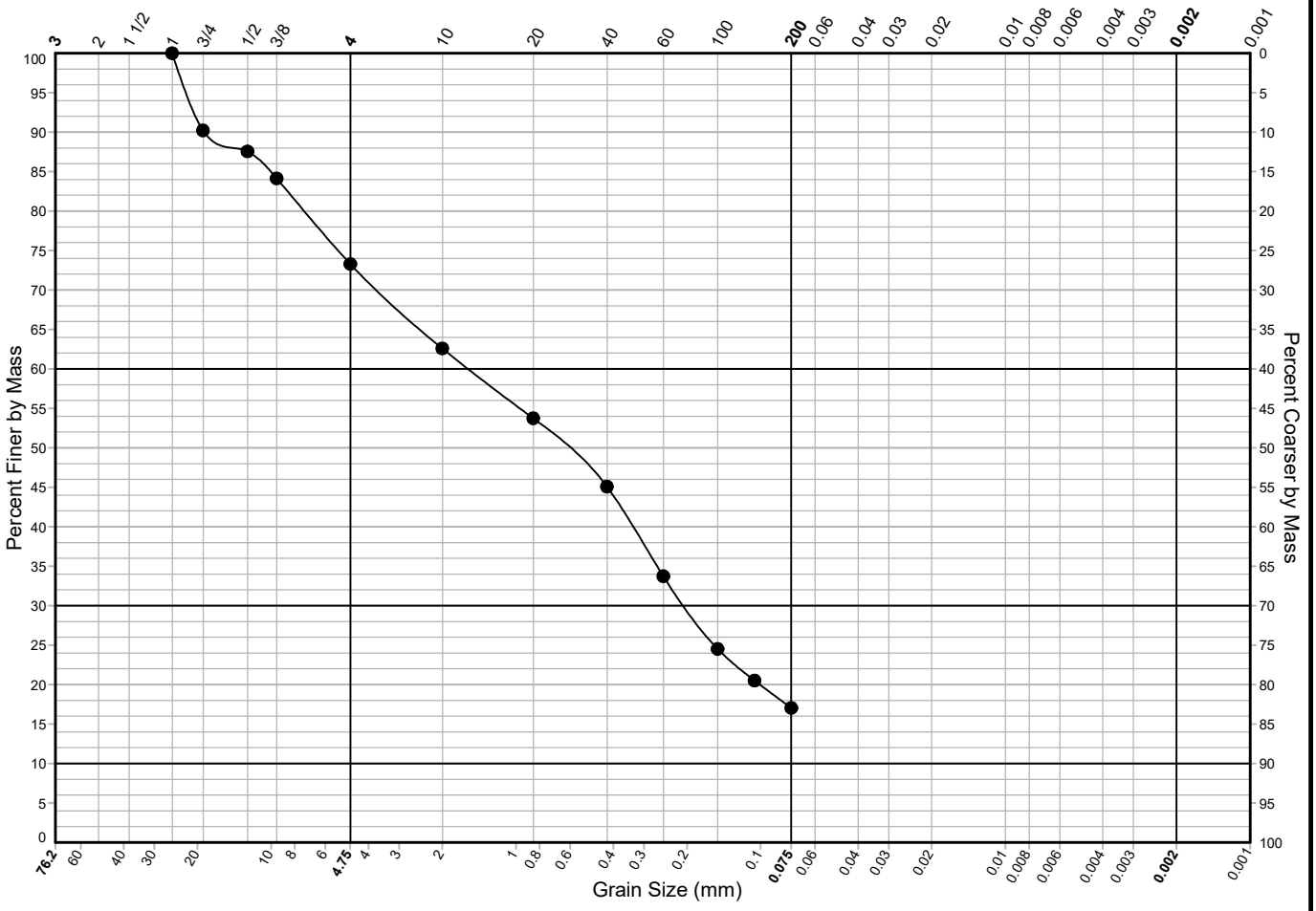
SHANNON & WILSON, INC.

# GRAIN SIZE DISTRIBUTION PLOT

**Lund and Harris Intersection Improvements Project**
**Port Orchard, Washington**

## BORING B-04

| Gravel | | Sand | | | Fines | |
|---|---|---|---|---|---|---|
| Coarse | Fine | Coarse | Medium | Fine | Silt | Clay-Size |
| Mesh Opening in Inches | | Mesh Openings per Inch, U.S. Standard | | | Grain Size in Millimeters | |




| Sample Identification | Depth (ft) | USCS Group Symbol | USCS Group Name | Gravel % | Sand % | Fines % | < 20µm % | < 2µm % | WC % | Tested By | Review By | ASTM Std. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ● B-04, S-1* | 2.5 | SM | Silty Sand with Gravel | 27 | 56 | 17 | | | 8.9 | NS | AKV | D6913 |

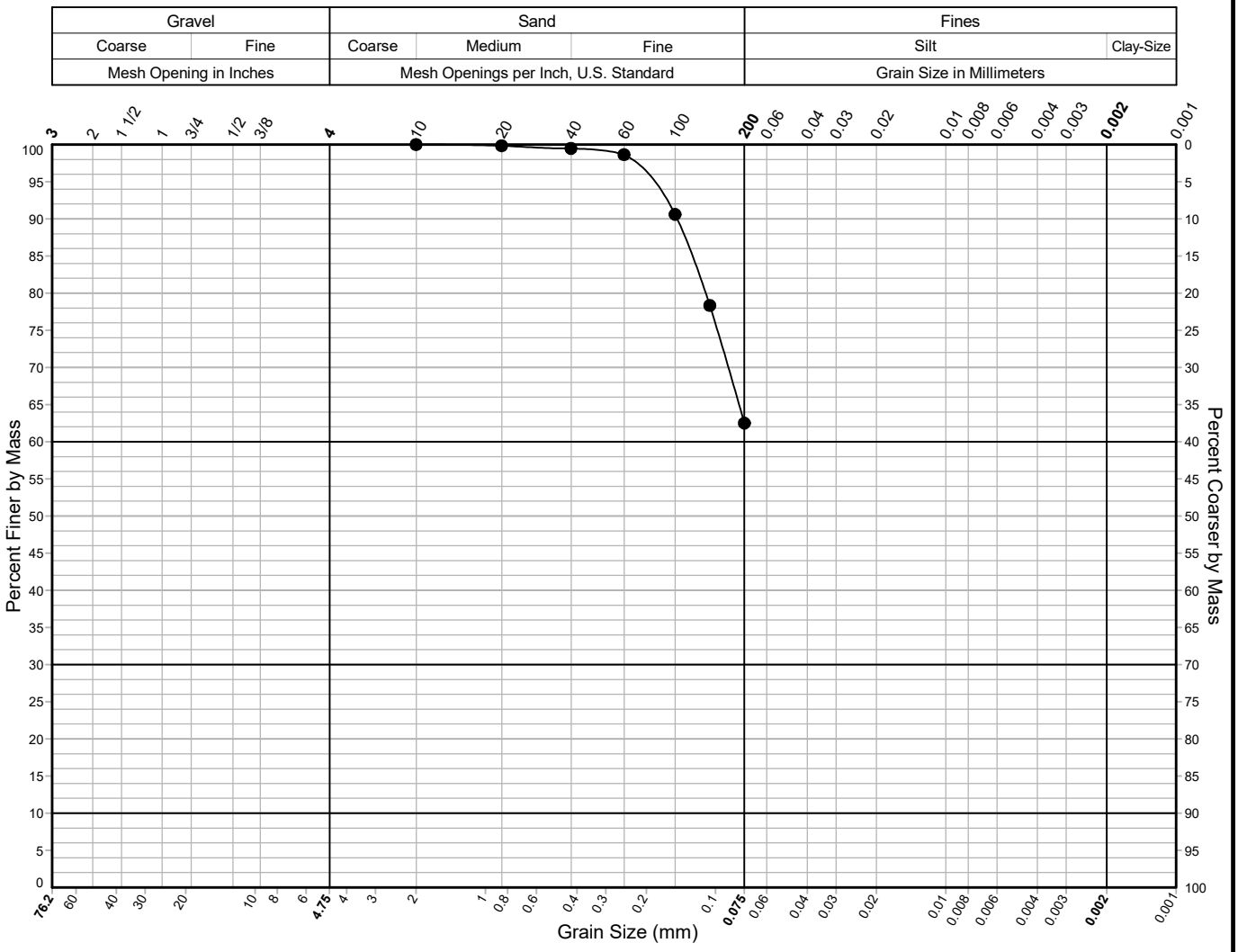
* *Test specimen did not meet minimum mass recommendations.*

SHANNON & WILSON, INC.

# GRAIN SIZE DISTRIBUTION PLOT

**Lund and Harris Intersection Improvements Project**
**Port Orchard, Washington**

## BORING B-06




| Sample Identification | Depth (ft) | USCS Group Symbol | USCS Group Name | Gravel % | Sand % | Fines % | < 20µm % | < 2µm % | WC % | Tested By | Review By | ASTM Std. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ● B-06, S-1* | 2.5 | ML | Sandy Silt | | 37 | 63 | | | 26.4 | NS | AKV | D6913 |

* *Test specimen did not meet minimum mass recommendations.*

IMPORTANT INFORMATION

# Important Information

## About Your Geotechnical Report

IMPORTANT INFORMATION

## CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

## THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors that were considered in the development of the report have changed.

## SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events and should be consulted to determine if additional tests are necessary.

## MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your consultant can work together to help reduce their impacts. Retaining

IMPORTANT INFORMATION

your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

## A REPORT'S CONCLUSIONS ARE PRELIMINARY.

The conclusions contained in your consultant's report are preliminary, because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

## THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

## BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

## READ RESPONSIBILITY CLAUSES CLOSELY.

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims

being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports, and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

**The preceding paragraphs are based on information provided by the ASFE/Association of Engineering Firms Practicing in the Geosciences, Silver Spring, Maryland**

# Attachment C

## MGSFLOOD Model

# MGS FLOOD
# PROJECT REPORT

**Program Version: MGSFlood 4.50**
**Program License Number: 200510005**
**Project Simulation Performed on: 01/21/2021 4:21 PM**
**Report Generation Date: 01/21/2021 4:22 PM**

Input File Name: Lund TDA2 Report 012121.fld
Project Name:
Analysis Title:
Comments:

## PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 6

Full Period of Record Available used for Routing
Precipitation Station : 95005205 Puget West 52 in_5min 10/01/1939-10/01/2097
Evaporation Station : 951052 Puget West 52 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

## ********** WATERSHED DEFINITION **********

**Predevelopment/Post Development Tributary Area Summary**

| | Predeveloped | Post Developed |
|---|---|---|
| Total Subbasin Area (acres) | 0.240 | 0.240 |
| Area of Links that Include Precip/Evap (acres) | 0.000 | 0.000 |
| Total (acres) | 0.240 | 0.240 |

**----------SCENARIO: PREDEVELOPED**
Number of Subbasins: 1

---------- Subbasin : TDA2 ----------

| | -------Area (Acres) -------- |
|---|---|
| Till Forest | 0.240 |
| Subbasin Total | 0.240 |

**----------SCENARIO: POSTDEVELOPED**
Number of Subbasins: 1

---------- Subbasin : TDA2 ----------

| | -------Area (Acres) -------- |
|---|---|
| Impervious | 0.240 |
| Subbasin Total | 0.240 |

## ********** LINK DATA **********

----------SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 1

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**Link Name: New Structure Lnk1**
Link Type: Structure
Downstream Link: None

Prismatic Pond Option Used

| | | |
|---|---|---|
| Pond Floor Elevation (ft) | : 100.00 | |
| Riser Crest Elevation (ft) | : 102.00 | |
| Max Pond Elevation (ft) | : 103.00 | |
| Storage Depth (ft) | : 2.00 | |
| Pond Bottom Length (ft) | : 35.0 | |
| Pond Bottom Width (ft) | : 35.0 | |
| Pond Side Slopes (ft/ft) | : L1= 3.00 | L2= 3.00 W1= 3.00 W2= 3.00 |
| Bottom Area (sq-ft) | : 1225. | |
| Area at Riser Crest El (sq-ft) | : 2,209. | |
| (acres) | : 0.051 | |
| Volume at Riser Crest (cu-ft) | : 3,386. | |
| (ac-ft) | : 0.078 | |
| Area at Max Elevation (sq-ft) | : 2809. | |
| (acres) | : 0.064 | |
| Vol at Max Elevation (cu-ft) | : 5,889. | |
| (ac-ft) | : 0.135 | |

Constant Infiltration Option Used
Infiltration Rate (in/hr): 0.50

Riser Geometry

| | |
|---|---|
| Riser Structure Type | : Circular |
| Riser Diameter (in) | : 24.00 |
| Common Length (ft) | : 0.000 |
| Riser Crest Elevation | : 102.00 ft |

Hydraulic Structure Geometry

Number of Devices: 1

---Device Number 1 ---

| | |
|---|---|
| Device Type | : Circular Orifice |
| Control Elevation (ft) | : 100.00 |
| Diameter (in) | : 0.65 |
| Orientation | : Horizontal |
| Elbow | : Yes |

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------**SCENARIO: PREDEVELOPED**
Number of Subbasins: 1
Number of Links: 0

----------**SCENARIO: POSTDEVELOPED**
Number of Subbasins: 1
Number of Links: 1

********** **Subbasin: TDA2** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

| Tr (yrs) | Flood Peak (cfs) |
|---|---|
| ========== | ========== |

| | |
|---|---|
| 2-Year | 0.110 |
| 5-Year | 0.139 |
| 10-Year | 0.166 |
| 25-Year | 0.197 |
| 50-Year | 0.220 |
| 100-Year | 0.274 |
| 200-Year | 0.281 |
| 500-Year | 0.289 |

********** Link: New Structure Lnk1 ********** Link Inflow Frequency Stats

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

| Tr (yrs) | Flood Peak (cfs) |
|---|---|
| 2-Year | 0.110 |
| 5-Year | 0.139 |
| 10-Year | 0.166 |
| 25-Year | 0.197 |
| 50-Year | 0.220 |
| 100-Year | 0.274 |
| 200-Year | 0.281 |
| 500-Year | 0.289 |

********** Link: New Structure Lnk1 ********** Link WSEL Stats

WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

| Tr (yrs) | WSEL Peak (ft) |
|---|---|
| 1.05-Year | 100.304 |
| 1.11-Year | 100.345 |
| 1.25-Year | 100.428 |
| 2.00-Year | 100.578 |
| 3.33-Year | 100.733 |
| 5-Year | 100.844 |
| 10-Year | 101.021 |
| 25-Year | 101.356 |
| 50-Year | 101.404 |
| 100-Year | 101.488 |

**********Groundwater Recharge Summary **********

Recharge is computed as input to Perlnd Groundwater Plus Infiltration in Structures

Total Predeveloped Recharge During Simulation

| Model Element | Recharge Amount (ac-ft) |
|---|---|
| Subbasin: TDA2 | 51.913 |
| Total: | 51.913 |

Total Post Developed Recharge During Simulation

| Model Element | Recharge Amount (ac-ft) |
|---|---|
| Subbasin: TDA2 | 0.000 |
| Link: New Structure Lnk1 | 125.763 |
| Total: | 125.763 |

**Total Predevelopment Recharge is Less than Post Developed**
**Average Recharge Per Year, (Number of Years= 158)**
**Predeveloped: 0.329 ac-ft/year, Post Developed: 0.796 ac-ft/year**

**********Water Quality Facility Data **********

----------**SCENARIO: PREDEVELOPED**

Number of Links: 0

----------**SCENARIO: POSTDEVELOPED**

Number of Links: 1

********** Link: New Structure Lnk1 **********

Basic Wet Pond Volume (91% Exceedance): 1609. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 2414. cu-ft

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 146.78
Inflow Volume Including PPT-Evap (ac-ft): 146.78
Total Runoff Infiltrated (ac-ft): 125.76, 85.68%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 21.42
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 85.68%

**********Compliance Point Results **********

Scenario Predeveloped Compliance Subbasin: TDA2

Scenario Postdeveloped Compliance Link: New Structure Lnk1

*** Point of Compliance Flow Frequency Data ***
Recurrence Interval Computed Using Gringorten Plotting Position

| Predevelopment Runoff | | Postdevelopment Runoff | |
|---|---|---|---|
| Tr (Years) | Discharge (cfs) | Tr (Years) | Discharge (cfs) |
| 2-Year | 1.056E-02 | 2-Year | 8.138E-03 |
| 5-Year | 1.657E-02 | 5-Year | 9.840E-03 |
| 10-Year | 2.191E-02 | 10-Year | 1.082E-02 |
| 25-Year | 2.818E-02 | 25-Year | 1.247E-02 |
| 50-Year | 3.540E-02 | 50-Year | 1.269E-02 |
| 100-Year | 3.948E-02 | 100-Year | 1.306E-02 |
| 200-Year | 5.354E-02 | 200-Year | 1.373E-02 |
| 500-Year | 7.246E-02 | 500-Year | 1.462E-02 |

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

**** Flow Duration Performance ****

| | | |
|---|---|---|
| Excursion at Predeveloped 50%Q2 (Must be Less Than or Equal to 0%): | -44.6% | PASS |
| Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%): | -44.6% | PASS |
| Maximum Excursion from Q2 to Q50 (Must be less than 10%): | -86.8% | PASS |
| Percent Excursion from Q2 to Q50 (Must be less than 50%): | 0.0% | PASS |

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MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS
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**** LID Duration Performance ****

| | | |
|---|---|---|
| Excursion at Predeveloped 8%Q2 (Must be Less Than 0%): | -64.2% | PASS |
| Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%): | -41.8% | PASS |

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MEETS ALL LID DURATION DESIGN CRITERIA: PASS
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