# ATTACHMENT 5 - Floodplain Analysis and Delineation and King County Flood Hazard Certificate, David Evans and Associates, Inc.

# King County Flood Hazard Certification

Project Name: Lakeside Industries - Maple Valley Asphalt Plan

Parcel Number(s): 1923069026 DPER Permit Number: GRDE17-0069

**This form is current as of August 29, 2013.**

**Section A.1** *(to be completed by applicant or applicant's engineer)*

The goal of Section A.1 is to identify the type and location of the flood hazards on the project parcel and identify study requirements. If the proposed project does not meet the exemptions listed under Zero-Rise Analysis, Compensatory Storage Analysis, or Base Flood Depth and Base Flood Velocity Analysis, then you may need to do the specific analysis. If there are flooding issues on the project parcel, but they are not mapped, then you may need to do the specific analysis.

Find FEMA Map information at http://www.kingcounty.gov/environment/waterandland/flooding/maps.aspx or go directly to FEMA's site https://msc.fema.gov

The proposed development site lies at least partially within the King County regulatory floodplain based on review and determination from any of the following sources:

- ☐ FEMA Flood Insurance Rate Map (FIRM): Panel #_____ Panel date:_____
- ☑ Special Study as required by section 4.4.2 of the King County Surface Water Design Manual
- ☐ Other: (please note source)_____

Zero-Rise Analysis

**Based on section 21A.24.250 of the King County Code, and section 4.4.2 of the King County Surface Water Design Manual, the proposed development cannot create a measurable change to the water surface elevation or energy grade line for the 100-year flood event (base flood elevation). This is to be determined and certified by a registered professional engineer using standard methods and practices accepted by the King County Department of Natural Resources and Parks (DNRP) and will be referred to as a "zero-rise analysis".**

Based on a review of the potential impacts of this project, a "zero-rise analysis":

- ☑ Is required. Completion of Section B of this form by a professional engineer licensed in the State of Washington is a condition of the issuance of this permit.
- ☐ Is not required for the following reasons:
  - ☐ Elevating or improvement to an existing structure without increasing the foundation footprint of the structure.
  - ☐ Post and pier foundation system with no significant impedance to flow.
  - ☐ Coastal "A", "VE", "AE" zone.
  - ☐ Shallow flooding area (AO/AH zone) not adjacent to a riverine system. (Explain)
    _____
  - ☐ Ineffective flow area. (Explain)
    _____
  - ☐ Proposed project lies within a hydraulic shadow. (explain)
    _____
  - ☐ Other (explain)
    _____

Compensatory Storage Analysis:

**Based on section 21A.24.240 of the King County Code, the proposed development cannot reduce the effective base flood storage volume of the floodplain, and must provide compensatory storage if grading or other activity displaces any effective flood storage volume. This is to be determined and certified by a registered professional engineer using standard methods and practices accepted by the King County Department of Natural Resources and Parks (DNRP) and will be referred to as a "compensatory storage analysis".**

Based on a review of the potential impacts of this project, a "compensatory storage analysis":

- ☐ Is required. Completion of Section B of this form by a professional engineer licensed in the State of Washington is a condition of the issuance of this permit.
- ☑ Is not required for the following reasons:
  - ☐ Elevating or improvement to an existing structure without increasing the foundation footprint of the structure.
  - ☐ Post and pier foundation system with no significant reduction in flood storage.
  - ☐ Grading or fill placed within the foundation of an existing residential structure to bring the interior foundation grade to the same level as the lowest adjacent exterior grade.
  - ☑ Other (explain)

    Fill will not be placed within the floodplain

Base Flood Depth and Base Flood Velocity Analysis

**Based on section 21A.24.240 of the King County Code, development proposals and alterations are not allowed if the base flood depth exceeds three feet and the base flood velocity exceeds three feet per second. This is to be determined and certified by a registered professional engineer using standard methods and practices accepted by the King County Department of Natural Resources and Parks (DNRP) and will be referred to as a "base flood depth and base flood velocity analysis ".**

Based on a review of the potential impacts of this project, a "base flood depth and base flood velocity analysis":

- ☐ Is required. Completion of Section B of this form by a professional engineer licensed in the State of Washington is a condition of the issuance of this permit.
- ☑ Is not required for the following reasons:
  - ☐ The structure is an agricultural structure and will not be used for human habitation.
  - ☐ Elevating or improvement an existing structure without increasing the foundation footprint of the structure.
  - ☑ Other (explain)

    Development is not occuring within the floodplain.

Submitted by: _____ Date: _____

Applicant or Applicant's Engineer

**Section A.2** *(to be completed by the DPER Drainage Engineer when applicable)*

DPER Drainage Engineer Certification

- ☐ (For sites in unmapped flood hazard areas) The development proposal site is not within the unmapped flood hazard area based on inspection of the site, and therefore further flood hazard review is not required.
- ☐ The development proposal does not involve any site disturbance, clearing, or grading, and therefore only requires a permit or approval under K.C.C. chapter 16.04 or 17.04. Further flood hazard review is not required.

Reviewed by: _____ Date: _____

DPER Drainage Engineer

**Section B** ***(to be completed by the applicant's engineer)***

The goal of Section B is to identify and present which analytical methodologies were used to demonstrate compliance with the King County Code. This section shall be completed by an engineer licensed in the State of Washington when an analysis is required per Section A.

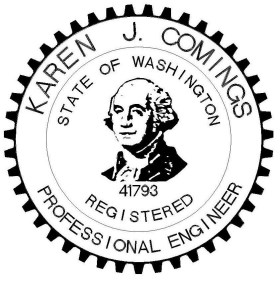
I have considered the hazards represented on Panel 53033C1004 F of the Flood Insurance Study for King County, dated May 16, 1995, and the supporting documentation for DPER Permit Number GRDE17-0069. I have also searched for and considered all other available information including: Preliminary Flood Insurance Rate Maps (P-FIRMs); Preliminary Flood Insurance Studies; Draft flood boundary work maps and associated technical reports; Critical areas reports prepared in accordance with FEMA standards set forth at 44 C.F.R. Part 65 and consistent with the King County Surface Water Design Manual provisions for floodplain analysis set forth at section 4.4.2; Letter of Map Amendments (LOMAs); Letter of Map Revisions (LOMRs); Channel migration zone maps and studies; Historical flood hazard information; and Site topography and ground elevations. All sources are clearly identified in the attached report. In addition, I have created new data where existing sources are not sufficient to assure compliance, and the attached report clearly documents my methods and assumptions.

I certify that the attached technical data supports the fact that this submitted design will meet requirements for protection of floodplain storage and floodplain conveyance, as well as base flood depth and base flood velocity requirements, as set forth in King County Code, Title 21A. Compliance is achieved as described below.

| **Code Requirement** | **Analytical Methodology** *(check one or more)* | **Engineering Certification Required?** |
|---|---|---|
| No impact to 100-year flood elevations, floodway elevations and floodway widths (no encroachments or obstruction of floodwaters). No reduction in floodplain conveyance both onsite and on adjacent properties, during 100-year flood event ("zero-rise" floodplain). | ❑ Hand calculations showing that flood conveyance **($K=1.49/n\ AR^{2/3}$)** will equal or exceed existing values at every location. | Yes |
| | ☑ HEC-RAS analysis showing that neither the water surface nor the energy grade will rise by even 0.01 feet at any location when proposed conditions are compared to existing conditions. See attached information | Yes |
| | ❑ Other. See attached information. | Yes |
| Compensatory floodplain storage provided (no net fill). | ❑ Volumetric calculations to show that compensatory storage provides equivalent volume at equivalent elevations to that being displaced, and is hydraulically connected to the source of flooding. For this purpose, equivalent elevations means having similar relationship to ordinary high water and to the best available ten-year, fifty-year and one-hundred-year water surface profiles; | Yes |
| | ❑ Other. See attached information. | Yes |
| Base flood depth does not exceed 3 feet or base flood velocity does not exceed 3 feet per second. | ❑ Base flood depth and base flood velocity mapping and data show less than 3 feet depth or less than a velocity of 3 feet per second at the project location. | Yes |
| | ❑ Other. See attached information. | Yes |

**Attached are all support data and calculations.**

*Professional Engineer's stamp, if methodology requires certification.*




Signature

August 30, 2018
Date

Karen Comings, Water Resources Engineer
Name and Title

David Evans and Associates, Inc.
Company

14432 SE Eastgate Way, Suite 400
Address

Bellevue, WA 98007
City, State, Zip

**Section C** ***(to be completed by the DNRP, RFMS engineer)***

Based on a review of the subject development proposal, the River and Floodplain Management Section of the Department of Natural Resources and Parks determines the following:

- ❑ No flood hazard analysis is required.

- ❑ A flood hazard analysis is required and the development proposal meets the zero rise, compensatory storage, and base flood depth and base flood velocity requirements of King County Code 21A.24.24.240, 21A.24.250, 21A.24.260 and the King County Surface Water Design Manual Section 4.4.2. This determination does not include a review of the other flood hazard areas standards in King County Code 21A.24.240, 21A.24.250, 21A.24.260, 21A.24.270, and 21A.24.272.

- ❑ A flood hazard analysis is required and the development proposal meets the zero rise, compensatory storage, and base flood depth and base flood velocity requirements of King County Code 21A.24.24.240, 21A.24.250, 21A.24.260 and the King County Surface Water Design Manual Section 4.4.2; however this approval is with additional comments or conditions (DNRP, RFMS shall provide comments in an e-mail or another written format to DPER).

- ❑ A flood hazard analysis is required and the development proposal *does not* meet the zero rise, compensatory storage, and base flood depth and base flood velocity requirements of King County Code 21A.24.24.240, 21A.24.250, 21A.24.260 and the King County Surface Water Design Manual Section 4.4.2.

  Reason(s) not approved:

  _____

  _____

  _____

  _____

  _____

Reviewed by: _____ Date: _____

DNRP, RFMS Engineer

DAVID EVANS
AND ASSOCIATES INC.

MEMORANDUM

**DATE:** September 7, 2018

**TO:** Rick Tomkins
DEA Project Manager

**FROM:** Karen Comings, P.E.
Water Resources Engineer

**SUBJECT:** Floodplain Analysis and Delineation

**PROJECT:** Lakeside Industries – Maple Valley Asphalt Plant

**CC:**

## 1. Introduction

Lakeside Industries, Inc. is planning to construct a new asphalt plant on a site east of the City of Renton in King County, Washington. The site is along Renton – Maple Valley Highway in Section 19 of Township 23 North, Range 6 East. Figure 1 shows the site location relative to the City of Renton and the Cedar River.

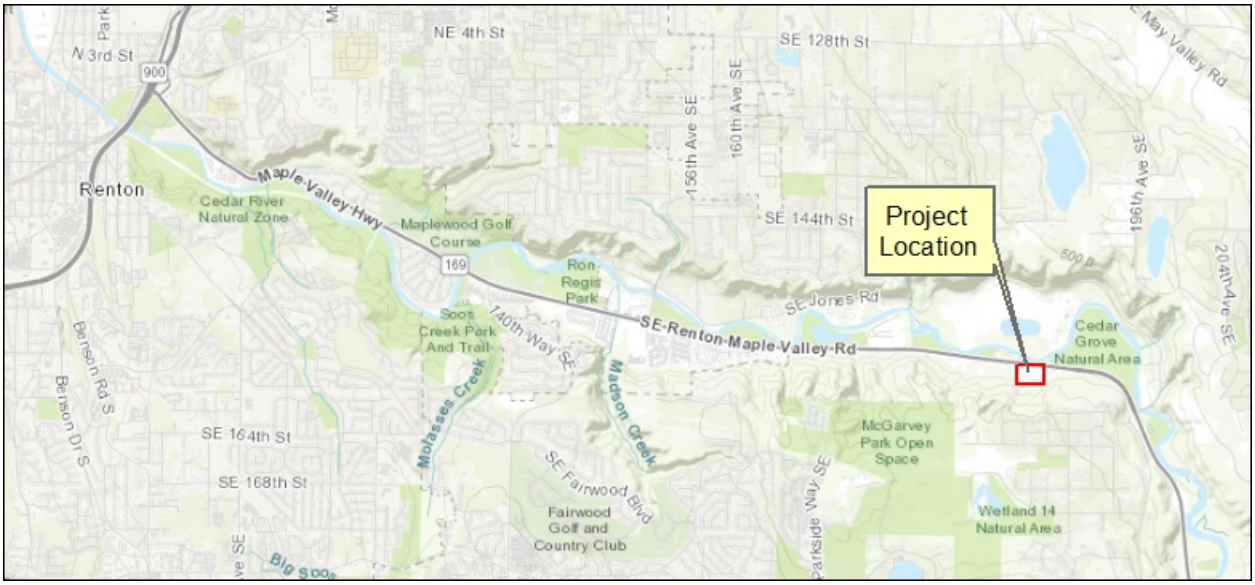



**FIGURE 1. PROJECT LOCATION**

The project property is at the bottom of a hillslope that extends across the southerly portion of the site. Runoff from this hillslope forms a narrow linear wetland (Wetland A) that flows from east to west along the south side of the proposed development area. This linear wetland drains through a 54" concrete culvert and emerges as a stream (Stream B). Near the southwest corner of the property a more well defined stream channel (Stream A) flows down the hillslope and merges with flow from Stream B. With combined flow from Stream A, Stream B continues north along the western boundary of the property. Under existing

conditions, runoff from the project area is collected at field inlets across the property and conveyed to Stream B via pipes to a discharge point along the west edge of the site. The proposed project will infiltrate on-site stormwater eliminating this direct discharge point. At the northwest corner of the property, the flow enters a wetland (Wetland C) and then discharges west into the Renton-Maple Valley Highway roadside ditch before crossing the highway in an off-site culvert further west and discharging to the Cedar River. These channels are illustrated on the map included as Attachment 1.

Stream C is a third channel associated with the property. Stream C is sourced from a groundwater seep in the hillside on the north side of the property. Stream C flows out from bottom of the hillslope and directly into the roadside ditch along the south side of Renton-Maple Valley Highway. The roadside ditch is considerably lower than the buildable area of the property. Because this channel is from a hillside seep, drains directly to a roadside ditch, and will not be affected by the project, a floodplain was not delineated for Stream C as part of this analysis.

Floodplains for the streams associated with this property are not mapped on Department of Homeland Security – Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRMs). The Cedar River floodplain is shown on the FIRMs but the Cedar River floodplain does not cross Renton – Maple Valley Highway. A firmette of this section on the FIRM is provided as Attachment 2.

Hydrologic and Hydraulic analyses were conducted for Wetland A and Stream B to delineate the 100-year floodplain for this channel. Stream A is not directly adjacent to the proposed development area and so a floodplain was not delineated for this channel. Flow from Stream A was included in the hydraulic modeling for Stream B.

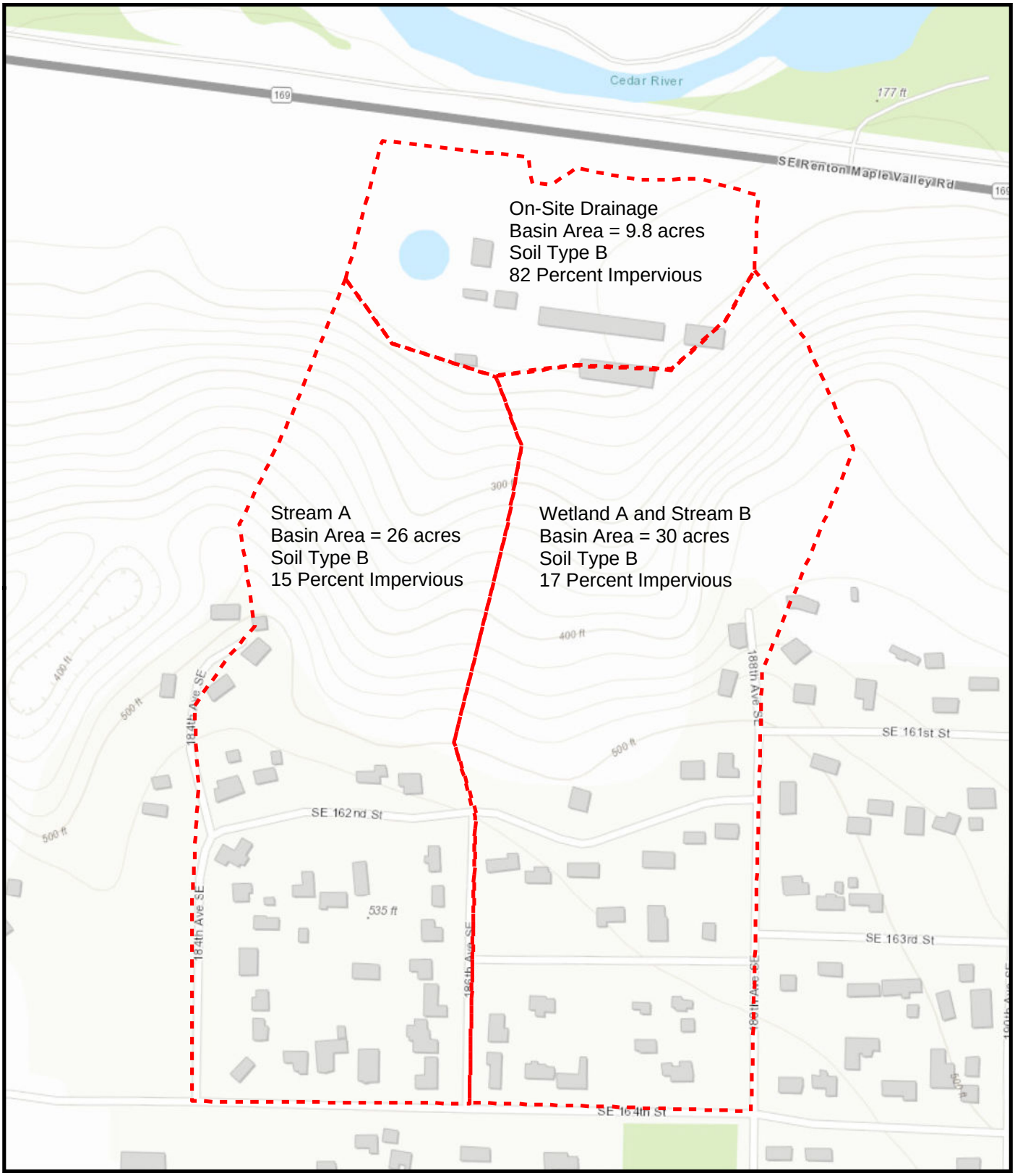
## 2. Hydrologic Analysis

Return period flows were determined using the hydrologic software MGSFlood. Three basins were delineated, one for Stream A flow, one for Stream B flow, and one for the on-site runoff. Figure 2 shows the drainage basin areas and relevant characteristics for the hydrologic modeling. Hydrologic Soil Groups were obtained from the Natural Resources Conservation Service Web Soil Survey. The Soil Resources Report is provided in Attachment 3. Table 1 shows the stream flow results that were used as input to the hydraulic model. Output reports from MGSFlood are included as Attachment 4.

**TABLE 1. FLOW VALUES USED FOR HYDRAULIC ANALYSIS**

| | **Cross Section**[1] | **2-Year (cfs)** | **10-Year (cfs)** | **50-Year (cfs)** | **100-Year (cfs)** | **200-Year (cfs)** |
|---|---|---|---|---|---|---|
| *Wetland A and Stream B* | 1155 | 1.77 | 2.87 | 4.31 | 6.45 | 6.87 |
| *Wetland A, Stream B and Stream A combined* | 443 | 3.14 | 5.02 | 7.84 | 11.87 | 12.56 |
| *Wetland A, Stream B , Stream A and On-Site* | 308 | 5.79 | 8.79 | 12.34 | 16.89 | 18.48 |

1. The HEC-RAS cross-section where flows were applied.




BasinArea

0 250 500 750 Feet

# Existing Conditions Drainage Basins

Lakeside Industries - Maple Valley

LKSD00000002

August 2018

Figure 2

DAVID EVANS AND ASSOCIATES INC.

DrainageBasins.mxd

Source: DEA, Inc. GIS

## 3. Hydraulic Analysis

A hydraulic model of Wetland A and Stream B was developed using the U.S. Army Corps of Engineers' Hydraulic Engineering Centers River Analysis System (HEC-RAS) software version 5.0.4. The existing conditions model geometry was determined from survey data taken of the site topography including the bordering channels. The geometry of Wetland A and the upstream section of Stream B along the south side of the project site consists of a steep left bank from the southern hillslope. The right bank is formed by a berm that was likely created during past grading of the site. Along the south side of the site, the right overbank area is generally lower than the channel bottom under existing conditions. Within the hydraulic model, a levee marker was placed along the top of the berm to prevent the model from using the right overbank as the low point of the channel. The hydraulic model shows that the 100-year floodplain is contained within the channel by the berm. However, because the overbank area is lower than the channel, it is possible that, during high flow conditions, water could seep through the berm and onto the site. If this were to happen, the water on-site would be collected by inlet drains across the site and discharged back to the channel at a point along the west edge of the site.

Under proposed conditions, the overbank area will be raised and graded so that the overbank within the stream buffer slopes toward the channel. This will restore the overbank morphology to natural conditions and eliminate the issue of leakage through the berm.

Wetland A drains through a culvert just upstream of the confluence with Stream A and emerges as Stream B. This culvert is included in the hydraulic model, though the project will not modify the culvert.

Downstream of the confluence with Stream A, along the west side of the site, Stream B becomes entrenched with a depth from thalweg to bank of about five feet.

## 4. No-Rise Analysis

The Proposed plan for the site will improve the right channel bank within the stream buffer by providing an overbank that slopes toward the channel within the stream buffer area. This will improve the channel and floodplain morphology. Buffer restoration activities will not occur within the active channel, and no buildings will be constructed within the floodplain. A comparison of the existing 100-year water surface elevations and energy grade lines to the proposed project shows that the proposed project will not cause a rise of the 100-year floodplain. This comparison is shown in Table 2. Output data tables from the HEC-RAS model are provided as Attachment 5.

**TABLE 2. COMPARISION OF EXISTING TO PROPOSED 100-YEAR WATER SURFACE ELEVATIONS**

| Cross Section No. | Existing WSEL (ft) | Proposed WSEL (ft) | Change in WSEL (ft) | Existing EGL (ft) | Proposed EGL (ft) | Change in EGL (ft) |
|---|---|---|---|---|---|---|
| 1155 | 172.36 | 172.36 | 0 | 172.39 | 172.39 | 0 |
| 1076 | 171.63 | 171.62 | -0.01 | 171.90 | 171.90 | 0 |
| 1002 | 171.73 | 171.72 | -0.01 | 171.73 | 171.73 | 0 |
| 917 | 171.59 | 171.59 | 0 | 171.65 | 171.65 | 0 |
| 834 | 171.42 | 171.42 | 0 | 171.43 | 171.43 | 0 |
| 756 | 171.35 | 171.35 | 0 | 171.36 | 171.36 | 0 |
| 678 | 170.84 | 170.83 | -0.01 | 171.16 | 171.16 | 0 |
| *Culvert* | | | | | | |
| 598 | 170.67 | 170.46 | -0.21 | 170.68 | 170.47 | -0.21 |
| 549 | 170.67 | 170.46 | -0.21 | 170.67 | 170.46 | -0.21 |
| 486 | 170.56 | 170.41 | -0.15 | 170.63 | 170.42 | -0.21 |
| 443 | 169.56 | 169.56 | 0 | 169.74 | 169.74 | 0 |
| 375 | 166.83 | 166.83 | 0 | 167.16 | 167.16 | 0 |
| 308 | 166.35 | 166.35 | 0 | 166.39 | 166.39 | 0 |
| 237 | 165.72 | 165.72 | 0 | 165.97 | 165.97 | 0 |
| 161 | 164.75 | 164.75 | 0 | 164.82 | 164.82 | 0 |
| 109 | 163.67 | 163.67 | 0 | 163.98 | 163.98 | 0 |
| 19 | 160.51 | 160.51 | 0 | 160.54 | 160.54 | 0 |

## 5. Floodplain Delineation

Once the water surface elevations were determined for the 100-year flow, the floodplain was mapped onto the site plan layout. This map is provided as Attachment 6. The 100-year floodplain is contained within the channel due to the very small flows that Wetland A and Stream B receive and due to the previously placed berm along the south side of the project site. There is some overbank flow at the southwest corner of the property within the channel buffer.

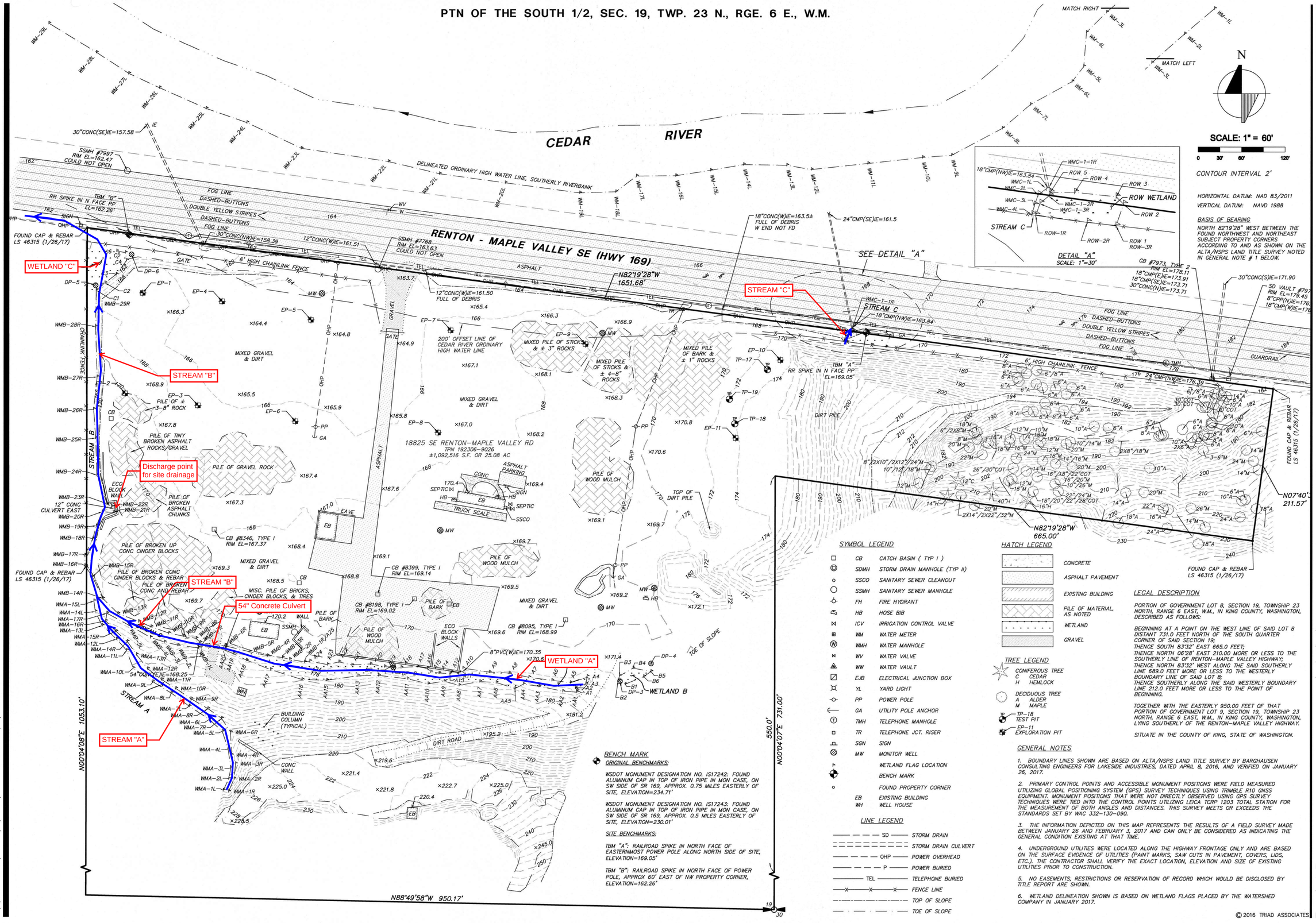
Attachments/Enclosures:

Attachment 1 – Flow Path Map
Attachment 2 – Firmette
Attachment 3 – Soil Report
Attachment 4 – MGSFlood Output Reports
Attachment 5 – HEC-RAS Output Data
Attachment 6 – 100-year Floodplain Map

File Path: Q:\L\LKSD00000002\0600INFO\WA\Flood Hazard Area\Memorandum\Lakeside_Maple Valley_Floodplain Memo_2018-0907.docx

ATTACHMENT 1

# PTN OF THE SOUTH 1/2, SEC. 19, TWP. 23 N., RGE. 6 E., W.M.




## BENCH MARK

*ORIGINAL BENCHMARKS:*

WSDOT MONUMENT DESIGNATION NO. IS17242: FOUND ALUMINUM CAP IN TOP OF IRON PIPE IN MON CASE, ON SW SIDE OF SR 169, APPROX. 0.75 MILES EASTERLY OF SITE, ELEVATION=234.71'

WSDOT MONUMENT DESIGNATION NO. IS17243: FOUND ALUMINUM CAP IN TOP OF IRON PIPE IN MON CASE, ON SW SIDE OF SR 169, APPROX. 0.5 MILES EASTERLY OF SITE, ELEVATION=230.01'

*SITE BENCHMARKS:*

TBM "A": RAILROAD SPIKE IN NORTH FACE OF EASTERNMOST POWER POLE ALONG NORTH SIDE OF SITE, ELEVATION=169.05'

TBM "B": RAILROAD SPIKE IN NORTH FACE OF POWER POLE, APPROX 60' EAST OF NW PROPERTY CORNER, ELEVATION=162.26'

## SYMBOL LEGEND

| | | |
|---|---|---|
| □ | CB | CATCH BASIN ( TYP I ) |
| ◎ | SDMH | STORM DRAIN MANHOLE (TYP II) |
| ○ | SSCO | SANITARY SEWER CLEANOUT |
| ◯ | SSMH | SANITARY SEWER MANHOLE |
| | FH | FIRE HYDRANT |
| | HB | HOSE BIB |
| | ICV | IRRIGATION CONTROL VALVE |
| | WM | WATER METER |
| Ⓦ | WMH | WATER MANHOLE |
| | WV | WATER VALVE |
| | WW | WATER VAULT |
| | EJB | ELECTRICAL JUNCTION BOX |
| | YL | YARD LIGHT |
| | PP | POWER POLE |
| | GA | UTILITY POLE ANCHOR |
| Ⓣ | TMH | TELEPHONE MANHOLE |
| | TR | TELEPHONE JCT. RISER |
| | SGN | SIGN |
| | MW | MONITOR WELL |
| | | WETLAND FLAG LOCATION |
| | | BENCH MARK |
| ○ | | FOUND PROPERTY CORNER |
| | EB | EXISTING BUILDING |
| | WH | WELL HOUSE |

## LINE LEGEND

- SD — STORM DRAIN
- STORM DRAIN CULVERT
- OHP — POWER OVERHEAD
- P — POWER BURIED
- TEL — TELEPHONE BURIED
- FENCE LINE
- TOP OF SLOPE
- TOE OF SLOPE

## HATCH LEGEND

- CONCRETE
- ASPHALT PAVEMENT
- EXISTING BUILDING
- PILE OF MATERIAL, AS NOTED
- WETLAND
- GRAVEL

## TREE LEGEND

- CONIFEROUS TREE — C CEDAR, H HEMLOCK
- DECIDUOUS TREE — A ALDER, M MAPLE

TP–18 TEST PIT

EP–11 EXPLORATION PIT

## LEGAL DESCRIPTION

PORTION OF GOVERNMENT LOT 8, SECTION 19, TOWNSHIP 23 NORTH, RANGE 6 EAST, W.M., IN KING COUNTY, WASHINGTON, DESCRIBED AS FOLLOWS:

BEGINNING AT A POINT ON THE WEST LINE OF SAID LOT 8 DISTANT 731.0 FEET NORTH OF THE SOUTH QUARTER CORNER OF SAID SECTION 19;
THENCE SOUTH 83°32' EAST 665.0 FEET;
THENCE NORTH 06°28' EAST 210.00 MORE OR LESS TO THE SOUTHERLY LINE OF RENTON–MAPLE VALLEY HIGHWAY;
THENCE NORTH 83°32' WEST ALONG THE SAID SOUTHERLY LINE 689.0 FEET MORE OR LESS TO THE WESTERLY BOUNDARY LINE OF SAID LOT 8;
THENCE SOUTHERLY ALONG THE SAID WESTERLY BOUNDARY LINE 212.0 FEET MORE OR LESS TO THE POINT OF BEGINNING.

TOGETHER WITH THE EASTERLY 950.00 FEET OF THAT PORTION OF GOVERNMENT LOT 8, SECTION 19, TOWNSHIP 23 NORTH, RANGE 6 EAST, W.M., IN KING COUNTY, WASHINGTON, LYING SOUTHERLY OF THE RENTON–MAPLE VALLEY HIGHWAY.

SITUATE IN THE COUNTY OF KING, STATE OF WASHINGTON.

## GENERAL NOTES

1. BOUNDARY LINES SHOWN ARE BASED ON ALTA/NSPS LAND TITLE SURVEY BY BARGHAUSEN CONSULTING ENGINEERS FOR LAKESIDE INDUSTRIES, DATED APRIL 8, 2016, AND VERIFIED ON JANUARY 26, 2017.

2. PRIMARY CONTROL POINTS AND ACCESSIBLE MONUMENT POSITIONS WERE FIELD MEASURED UTILIZING GLOBAL POSITIONING SYSTEM (GPS) SURVEY TECHNIQUES USING TRIMBLE R10 GNSS EQUIPMENT. MONUMENT POSITIONS THAT WERE NOT DIRECTLY OBSERVED USING GPS SURVEY TECHNIQUES WERE TIED INTO THE CONTROL POINTS UTILIZING LEICA TCRP 1203 TOTAL STATION FOR THE MEASUREMENT OF BOTH ANGLES AND DISTANCES. THIS SURVEY MEETS OR EXCEEDS THE STANDARDS SET BY WAC 332–130–090.

3. THE INFORMATION DEPICTED ON THIS MAP REPRESENTS THE RESULTS OF A FIELD SURVEY MADE BETWEEN JANUARY 26 AND FEBRUARY 3, 2017 AND CAN ONLY BE CONSIDERED AS INDICATING THE GENERAL CONDITION EXISTING AT THAT TIME.

4. UNDERGROUND UTILITIES WERE LOCATED ALONG THE HIGHWAY FRONTAGE ONLY AND ARE BASED ON THE SURFACE EVIDENCE OF UTILITIES (PAINT MARKS, SAW CUTS IN PAVEMENT, COVERS, LIDS, ETC.). THE CONTRACTOR SHALL VERIFY THE EXACT LOCATION, ELEVATION AND SIZE OF EXISTING UTILITIES PRIOR TO CONSTRUCTION.

5. NO EASEMENTS, RESTRICTIONS OR RESERVATION OF RECORD WHICH WOULD BE DISCLOSED BY TITLE REPORT ARE SHOWN.

6. WETLAND DELINEATION SHOWN IS BASED ON WETLAND FLAGS PLACED BY THE WATERSHED COMPANY IN JANUARY 2017.



triad
20300 Woodinville Snohomish Rd NE
Suite A • Woodinville, WA 98072
p: 425.415.2000 f: 425.486.5059
w: triadassociates.net

TOPOGRAPHIC SURVEY FOR
LAKESIDE INDUSTRIES, INC.
LAKESIDE MAPLE VALLEY
18825 RENTON-MAPLE VALLEY SE (HWY 169)
KING COUNTY, WASHINGTON

| NO. | DATE | REVISION | BY | CK |
|---|---|---|---|---|
| 1 | 02/27/17 | ADDITIONAL TOPO AFTER PILE REMOVAL | KBP | MHM |

BRIAN K. HANSEN, PE
PROJECT MANAGER
MARY H. McDOWELL, PLS
PROJECT SURVEYOR
PROJECT ENGINEER
PROJECT LANDSCAPE ARCHITECT
FIRST SUBMITTAL DATE: 2/10/2017
SCALE: HORIZ.: 1"=60' VERT.:

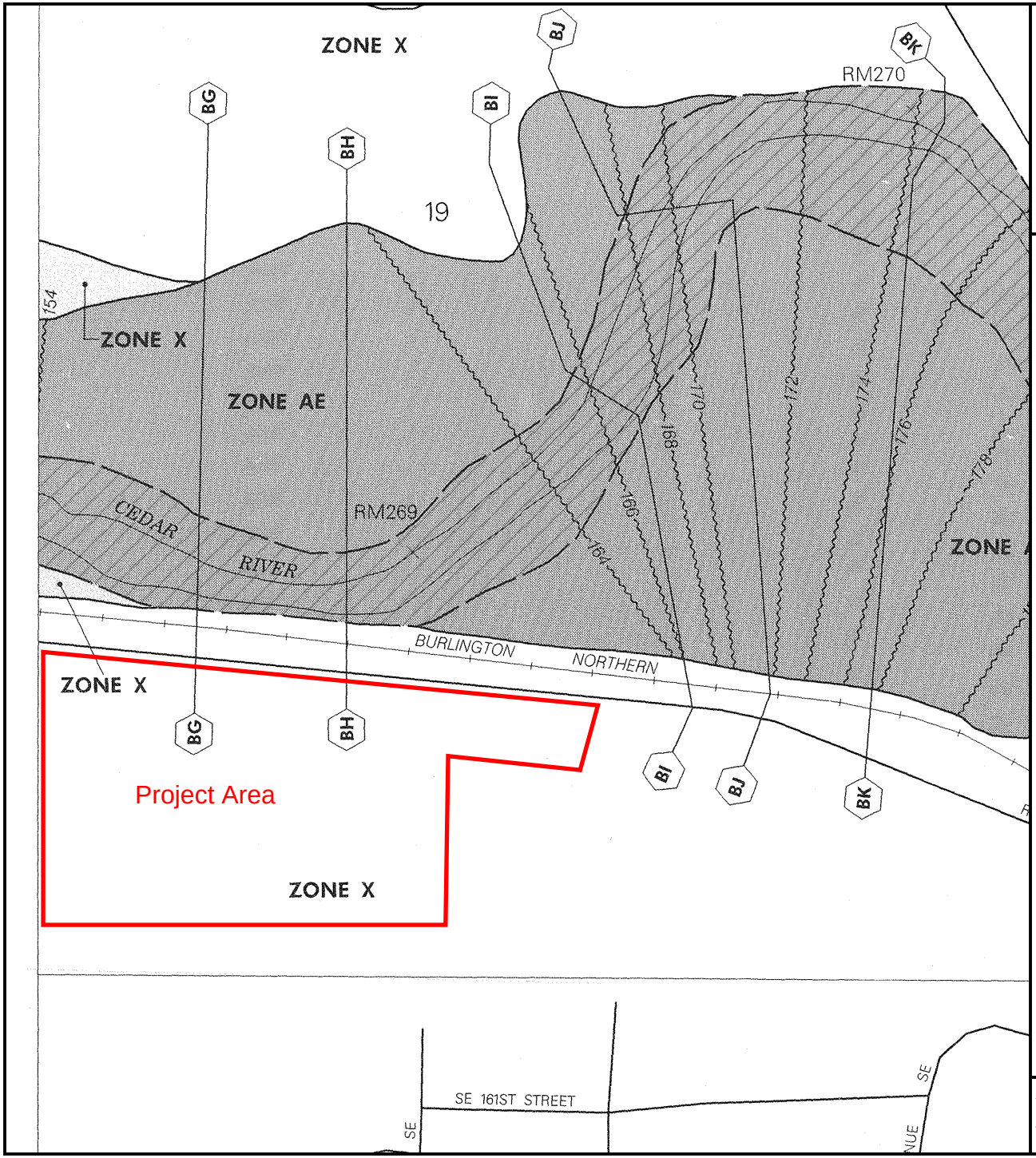
STAMP NOT VALID UNLESS SIGNED AND DATED

JOB NO. LKSD00000002

SHEET NO. 1 OF 1

SV–BS–1–LKSD0002.DWG, Topo 020717, SV–BS–X–LKSD0002.
kbpn, Feb 27, 2018 - 3:26pm
P:\LKSD00000002\0400CAD\SV\SHEETS\SV–BS–1–LKSD0002.DWG, Topo 020717

ATTACHMENT 2




APPROXIMATE SCALE IN FEET

500 0 500

NATIONAL FLOOD INSURANCE PROGRAM

# FIRM

## FLOOD INSURANCE RATE MAP

KING COUNTY, WASHINGTON AND INCORPORATED AREAS

**PANEL 1004 OF 1725**

(SEE MAP INDEX FOR PANELS NOT PRINTED)

| CONTAINS: COMMUNITY | NUMBER | PANEL | SUFFIX |
|---|---|---|---|
| KING COUNTY, UNINCORPORATED AREAS | 530071 | 1004 | F |

**MAP NUMBER 53033C1004 F**

**MAP REVISED: MAY 16, 1995**

Federal Emergency Management Agency

ATTACHMENT 3

United States Department of Agriculture

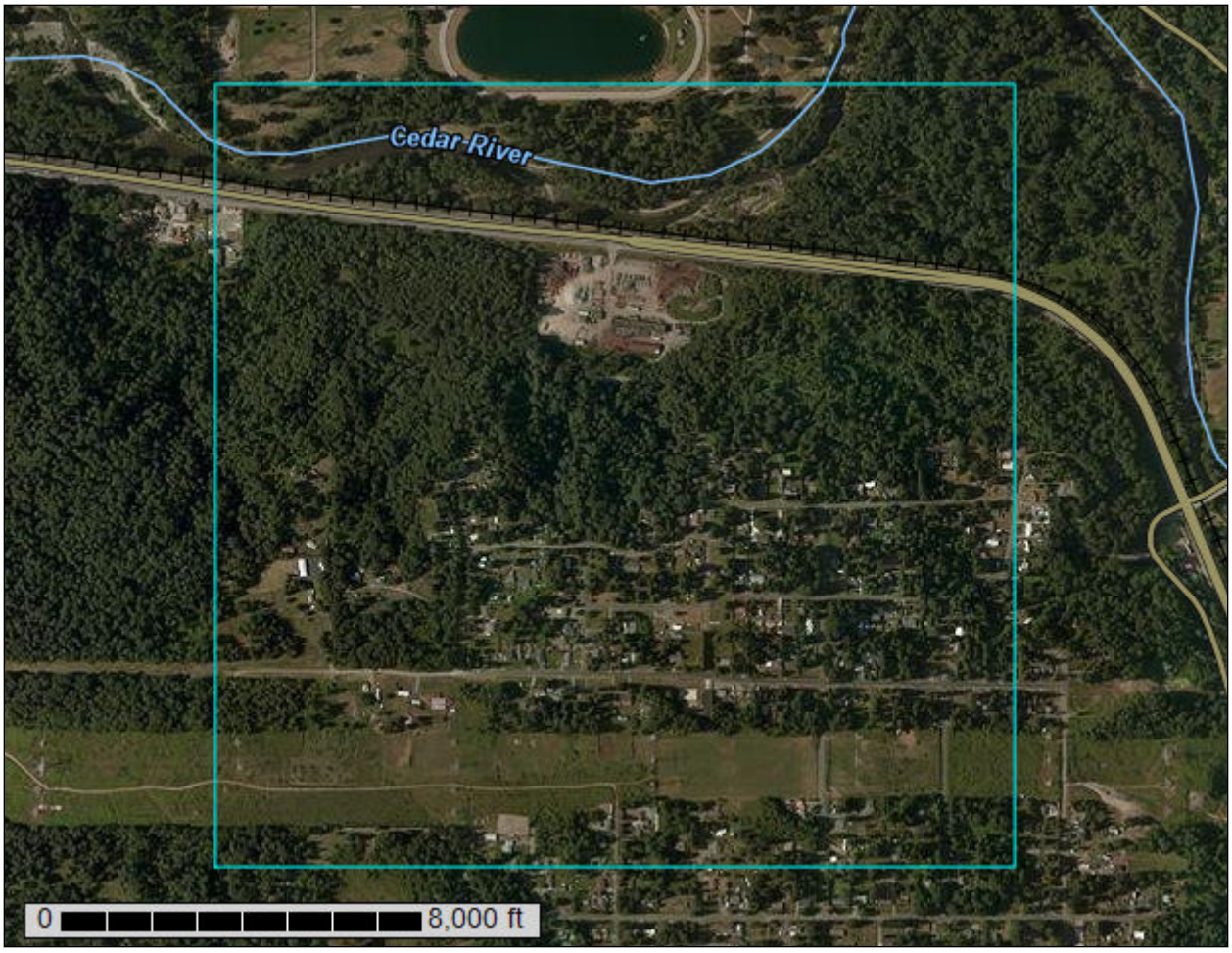
NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

# Custom Soil Resource Report for King County Area, Washington

## Lakeside Industries - Maple Valley




August 13, 2018

# Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

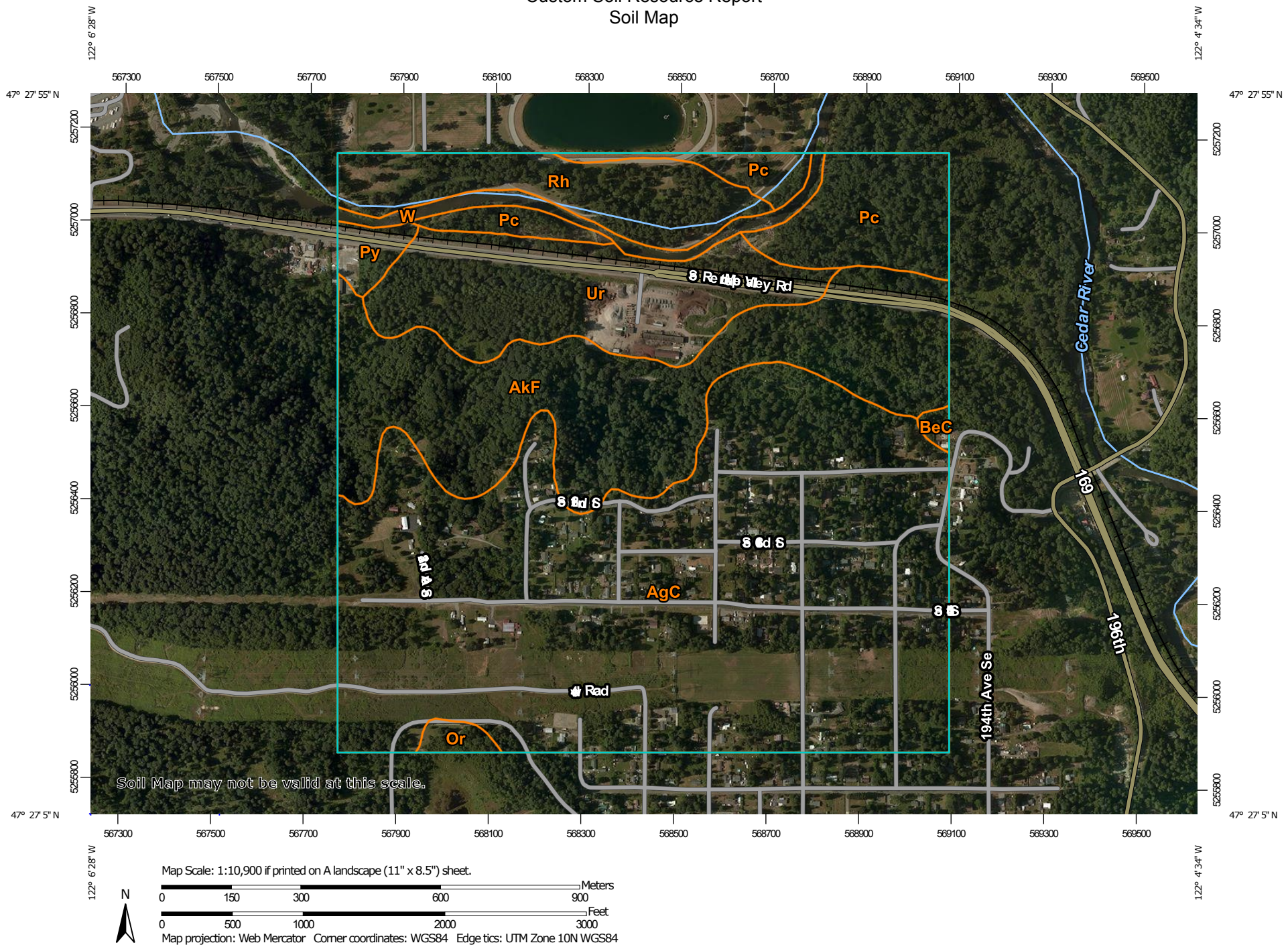
alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

# Contents

# Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

# Custom Soil Resource Report
## Soil Map




Map Scale: 1:10,900 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 150 300 600 900

Feet: 0 500 1000 2000 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

## MAP LEGEND

**Area of Interest (AOI)**
- Area of Interest (AOI)

**Soils**
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

**Special Point Features**
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

**Water Features**
- Streams and Canals

**Transportation**
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

**Background**
- Aerial Photography

## MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: King County Area, Washington
Survey Area Data: Version 13, Sep 7, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 8, 2014—Jul 15, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

# Map Unit Legend

| Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI |
|---|---|---|---|
| AgC | Alderwood gravelly sandy loam, 8 to 15 percent slopes | 216.2 | 51.1% |
| AkF | Alderwood and Kitsap soils, very steep | 84.2 | 19.9% |
| BeC | Beausite gravelly sandy loam, 6 to 15 percent slopes | 1.1 | 0.3% |
| Or | Orcas peat | 2.4 | 0.6% |
| Pc | Pilchuck loamy fine sand | 31.6 | 7.5% |
| Py | Puyallup fine sandy loam | 4.5 | 1.1% |
| Rh | Riverwash | 27.7 | 6.5% |
| Ur | Urban land | 47.7 | 11.3% |
| W | Water | 7.8 | 1.9% |
| **Totals for Area of Interest** | | **423.2** | **100.0%** |

# Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor

components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

# King County Area, Washington

## AgC—Alderwood gravelly sandy loam, 8 to 15 percent slopes

### Map Unit Setting

*National map unit symbol:* 2t626
*Elevation:* 50 to 800 feet
*Mean annual precipitation:* 20 to 60 inches
*Mean annual air temperature:* 46 to 52 degrees F
*Frost-free period:* 160 to 240 days
*Farmland classification:* Prime farmland if irrigated

### Map Unit Composition

*Alderwood and similar soils:* 85 percent
*Minor components:* 15 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Alderwood

#### Setting

*Landform:* Ridges, hills
*Landform position (two-dimensional):* Shoulder
*Landform position (three-dimensional):* Nose slope, talf
*Down-slope shape:* Linear, convex
*Across-slope shape:* Convex
*Parent material:* Glacial drift and/or glacial outwash over dense glaciomarine deposits

#### Typical profile

*A - 0 to 7 inches:* gravelly sandy loam
*Bw1 - 7 to 21 inches:* very gravelly sandy loam
*Bw2 - 21 to 30 inches:* very gravelly sandy loam
*Bg - 30 to 35 inches:* very gravelly sandy loam
*2Cd1 - 35 to 43 inches:* very gravelly sandy loam
*2Cd2 - 43 to 59 inches:* very gravelly sandy loam

#### Properties and qualities

*Slope:* 8 to 15 percent
*Depth to restrictive feature:* 20 to 39 inches to densic material
*Natural drainage class:* Moderately well drained
*Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.06 in/hr)
*Depth to water table:* About 18 to 37 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Available water storage in profile:* Very low (about 2.7 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 4s
*Hydrologic Soil Group:* B
*Forage suitability group:* Limited Depth Soils (G002XN302WA), Limited Depth Soils (G002XS301WA), Limited Depth Soils (G002XF303WA)
*Hydric soil rating:* No

**Minor Components**

**Everett**

*Percent of map unit:* 5 percent
*Landform:* Kames, eskers, moraines
*Landform position (two-dimensional):* Shoulder, footslope
*Landform position (three-dimensional):* Crest, base slope
*Down-slope shape:* Convex
*Across-slope shape:* Convex
*Hydric soil rating:* No

**Indianola**

*Percent of map unit:* 5 percent
*Landform:* Eskers, kames, terraces
*Landform position (three-dimensional):* Tread
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* No

**Shalcar**

*Percent of map unit:* 3 percent
*Landform:* Depressions
*Landform position (three-dimensional):* Dip
*Down-slope shape:* Concave
*Across-slope shape:* Concave
*Hydric soil rating:* Yes

**Norma**

*Percent of map unit:* 2 percent
*Landform:* Depressions, drainageways
*Landform position (three-dimensional):* Dip
*Down-slope shape:* Concave, linear
*Across-slope shape:* Concave
*Hydric soil rating:* Yes

## AkF—Alderwood and Kitsap soils, very steep

**Map Unit Setting**

*National map unit symbol:* 1hmsn
*Elevation:* 50 to 800 feet
*Mean annual precipitation:* 25 to 60 inches
*Mean annual air temperature:* 48 to 52 degrees F
*Frost-free period:* 160 to 220 days
*Farmland classification:* Not prime farmland

**Map Unit Composition**

*Alderwood and similar soils:* 50 percent
*Kitsap and similar soils:* 25 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Alderwood

#### Setting

*Landform:* Moraines, till plains
*Parent material:* Basal till with some volcanic ash

#### Typical profile

*H1 - 0 to 12 inches:* gravelly ashy sandy loam
*H2 - 12 to 27 inches:* very gravelly sandy loam
*H3 - 27 to 60 inches:* very gravelly sandy loam

#### Properties and qualities

*Slope:* 25 to 70 percent
*Depth to restrictive feature:* 24 to 40 inches to densic material
*Natural drainage class:* Moderately well drained
*Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.06 in/hr)
*Depth to water table:* About 18 to 37 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Available water storage in profile:* Very low (about 2.5 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 7e
*Hydrologic Soil Group:* B
*Hydric soil rating:* No

### Description of Kitsap

#### Setting

*Landform:* Terraces
*Parent material:* Lacustrine deposits with a minor amount of volcanic ash

#### Typical profile

*H1 - 0 to 5 inches:* ashy silt loam
*H2 - 5 to 24 inches:* ashy silt loam
*H3 - 24 to 60 inches:* stratified silt to silty clay loam

#### Properties and qualities

*Slope:* 25 to 70 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Moderately well drained
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.20 in/hr)
*Depth to water table:* About 18 to 36 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Available water storage in profile:* High (about 11.4 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 7e
*Hydrologic Soil Group:* C
*Hydric soil rating:* No

## BeC—Beausite gravelly sandy loam, 6 to 15 percent slopes

### Map Unit Setting

*National map unit symbol:* 1hmss
*Elevation:* 0 to 1,500 feet
*Mean annual precipitation:* 30 to 50 inches
*Mean annual air temperature:* 48 to 52 degrees F
*Frost-free period:* 160 to 220 days
*Farmland classification:* Not prime farmland

### Map Unit Composition

*Beausite and similar soils:* 95 percent
*Minor components:* 5 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Beausite

#### Setting

*Parent material:* Till over residuum from sandstone

#### Typical profile

*H1 - 0 to 6 inches:* gravelly ashy sandy loam
*H2 - 6 to 19 inches:* gravelly ashy sandy loam
*H3 - 19 to 38 inches:* very gravelly sandy loam
*H4 - 38 to 42 inches:* bedrock

#### Properties and qualities

*Slope:* 6 to 15 percent
*Depth to restrictive feature:* 24 to 40 inches to lithic bedrock
*Natural drainage class:* Well drained
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high (0.57 to 1.98 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Available water storage in profile:* Low (about 3.5 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 4s
*Hydrologic Soil Group:* C
*Forage suitability group:* Droughty Soils (G002XF403WA)
*Hydric soil rating:* No

### Minor Components

#### Norma

*Percent of map unit:* 3 percent
*Landform:* Depressions
*Hydric soil rating:* Yes

**Seattle**

*Percent of map unit:* 2 percent
*Landform:* Depressions
*Hydric soil rating:* Yes

## Or—Orcas peat

**Map Unit Setting**

*National map unit symbol:* 1hmtl
*Elevation:* 10 to 1,000 feet
*Mean annual precipitation:* 27 to 60 inches
*Mean annual air temperature:* 48 to 52 degrees F
*Frost-free period:* 160 to 180 days
*Farmland classification:* Prime farmland if drained

**Map Unit Composition**

*Orcas and similar soils:* 75 percent
*Minor components:* 25 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Orcas**

**Setting**

*Landform:* Depressions
*Parent material:* Mossy organic material

**Typical profile**

*H1 - 0 to 6 inches:* peat
*H2 - 6 to 60 inches:* peat

**Properties and qualities**

*Slope:* 0 to 1 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Very poorly drained
*Capacity of the most limiting layer to transmit water (Ksat):* Very high (19.98 to 99.90 in/hr)
*Depth to water table:* About 0 inches
*Frequency of flooding:* None
*Frequency of ponding:* Frequent
*Available water storage in profile:* Very high (about 26.9 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 6w
*Hydrologic Soil Group:* A/D
*Forage suitability group:* Wet Soils (G002XN102WA)
*Hydric soil rating:* Yes

**Minor Components**

**Seattle**
*Percent of map unit:* 10 percent
*Landform:* Depressions
*Hydric soil rating:* Yes

**Tukwila**
*Percent of map unit:* 10 percent
*Landform:* Depressions
*Hydric soil rating:* Yes

**Bellingham**
*Percent of map unit:* 5 percent
*Landform:* Depressions
*Hydric soil rating:* Yes

## Pc—Pilchuck loamy fine sand

**Map Unit Setting**
*National map unit symbol:* 1hmtr
*Elevation:* 0 to 820 feet
*Mean annual precipitation:* 35 to 60 inches
*Mean annual air temperature:* 48 to 52 degrees F
*Frost-free period:* 160 to 210 days
*Farmland classification:* Prime farmland if irrigated

**Map Unit Composition**
*Pilchuck and similar soils:* 90 percent
*Minor components:* 10 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Pilchuck**

**Setting**
*Landform:* Flood plains, terraces
*Parent material:* Gravelly and sandy alluvium

**Typical profile**
*H1 - 0 to 20 inches:* loamy fine sand
*H2 - 20 to 38 inches:* loamy fine sand
*H3 - 38 to 60 inches:* gravelly sand

**Properties and qualities**
*Slope:* 0 to 2 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Excessively drained
*Capacity of the most limiting layer to transmit water (Ksat):* High to very high (5.95 to 19.98 in/hr)
*Depth to water table:* About 24 to 48 inches
*Frequency of flooding:* Occasional

*Frequency of ponding:* None
*Available water storage in profile:* Low (about 3.3 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 4s
*Hydrologic Soil Group:* A
*Forage suitability group:* Droughty Soils (G002XN402WA)
*Hydric soil rating:* No

**Minor Components**

**Oridia**

*Percent of map unit:* 5 percent
*Landform:* Depressions
*Hydric soil rating:* Yes

**Briscot**

*Percent of map unit:* 5 percent
*Landform:* Flood plains
*Hydric soil rating:* Yes

## Py—Puyallup fine sandy loam

**Map Unit Setting**

*National map unit symbol:* 1hmtv
*Elevation:* 0 to 820 feet
*Mean annual precipitation:* 35 to 60 inches
*Mean annual air temperature:* 50 degrees F
*Frost-free period:* 170 to 200 days
*Farmland classification:* All areas are prime farmland

**Map Unit Composition**

*Puyallup and similar soils:* 75 percent
*Minor components:* 25 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Puyallup**

**Setting**

*Landform:* Terraces, flood plains
*Parent material:* Alluvium

**Typical profile**

*H1 - 0 to 8 inches:* ashy fine sandy loam
*H2 - 8 to 34 inches:* very fine sandy loam
*H3 - 34 to 60 inches:* sand

**Properties and qualities**

*Slope:* 0 to 2 percent
*Depth to restrictive feature:* 20 to 40 inches to strongly contrasting textural stratification

*Natural drainage class:* Well drained
*Capacity of the most limiting layer to transmit water (Ksat):* High (1.98 to 5.95 in/hr)
*Depth to water table:* About 48 to 60 inches
*Frequency of flooding:* Occasional
*Frequency of ponding:* None
*Available water storage in profile:* Low (about 4.7 inches)

**Interpretive groups**

*Land capability classification (irrigated):* 3w
*Land capability classification (nonirrigated):* 3w
*Hydrologic Soil Group:* A
*Forage suitability group:* Droughty Soils (G002XN402WA)
*Hydric soil rating:* No

**Minor Components**

**Briscot**

*Percent of map unit:* 8 percent
*Landform:* Depressions
*Hydric soil rating:* Yes

**Newberg**

*Percent of map unit:* 6 percent
*Landform:* Depressions
*Hydric soil rating:* Yes

**Woodinville**

*Percent of map unit:* 5 percent
*Landform:* Depressions
*Hydric soil rating:* Yes

**Nooksack**

*Percent of map unit:* 3 percent
*Hydric soil rating:* No

**Oridia**

*Percent of map unit:* 3 percent
*Landform:* Depressions
*Hydric soil rating:* Yes

## Rh—Riverwash

**Map Unit Composition**

*Riverwash:* 100 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Riverwash**

**Setting**

*Landform:* Drainageways
*Parent material:* Alluvium

**Typical profile**

*H1 - 0 to 60 inches:* Error

**Properties and qualities**

*Slope:* 0 to 3 percent
*Depth to water table:* About 0 to 24 inches
*Frequency of flooding:* Frequent

**Interpretive groups**

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 8
*Hydric soil rating:* Yes

## Ur—Urban land

**Map Unit Composition**

*Urban land:* 100 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Urban Land**

**Interpretive groups**

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 8
*Hydric soil rating:* No

## W—Water

**Map Unit Composition**

*Water:* 100 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

# References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

ATTACHMENT 4

# Subbasin B

(Basin for Wetland A and Stream B)

---

# MGS FLOOD
# PROJECT REPORT

**Program Version: MGSFlood 4.46**
**Program License Number: 200410013**
**Project Simulation Performed on: 08/28/2018 7:35 AM**
**Report Generation Date: 08/28/2018 7:35 AM**

---

Input File Name: LakesideInd.fld
Project Name: Lakeside Industries
Analysis Title: Flood Hazard Certification
Comments:

## PRECIPITATION INPUT

Computational Time Step (Minutes): 60

Extended Precipitation Time Series Selected
Climatic Region Number: 5

Full Period of Record Available used for Routing
Precipitation Station : 95004805 Puget West 48 in_5min 10/01/1939-10/01/2097
Evaporation Station : 951048 Puget West 48 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) | 65.900 | 65.900 |
| Area of Links that Include Precip/Evap (acres) | 0.000 | 0.000 |
| Total (acres) | 65.900 | 65.900 |

**----------SCENARIO: PREDEVELOPED**
Number of Subbasins: 3

---------- Subbasin : Subbasin A ----------
-------Area (Acres) --------

| | |
|---|---|
| Outwash Forest | 13.000 |
| Outwash Grass | 9.000 |
| Impervious | 4.000 |

---

Subbasin Total 26.000

---------- Subbasin : Subbasin B ----------
-------Area (Acres) --------
Outwash Forest 15.100
Outwash Grass 10.000
Impervious 5.000
---
Subbasin Total 30.100

---------- Subbasin : On-Site Area ----------
-------Area (Acres) --------
Till Grass 1.800
Impervious 8.000
---
Subbasin Total 9.800

**----------SCENARIO: POSTDEVELOPED**
Number of Subbasins: 3

---------- Subbasin : Subbasin A ----------
-------Area (Acres) --------
Outwash Forest 13.000
Outwash Grass 9.000
Impervious 4.000
---
Subbasin Total 26.000

---------- Subbasin : Subbasin B ----------
-------Area (Acres) --------
Outwash Forest 15.100
Outwash Grass 10.000
Impervious 5.000
---
Subbasin Total 30.100

---------- Subbasin : On-Site Area ----------
-------Area (Acres) --------
Till Grass 1.800
Impervious 8.000
---
Subbasin Total 9.800

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

----------SCENARIO: PREDEVELOPED
Number of Links: 1

**----------**
**Link Name: New Channel Lnk1**
Link Type:  Open Channel
Downstream Link: None

----------Left Overbank
Upper Sideslope (z)  : 0.500
Upper Width (ft)  : 3.000
Middle Sideslope (z)  : 10.000
Middle Width (ft)  : 10.000
Mannings n  : 0.040

----------Main Channel
Lower Sideslope Left (z)  : 0.500
Lower Width Left (ft)  : 3.000
Lower Sideslope Right (z)  : 0.500
Lower Width Right (ft)  : 3.000
Mannings n  : 0.024
Base Width (ft)  : 10.0
Elevation (ft)  : 100.00
Channel Slope (ft/ft)  : 0.020
Channel Length (ft)  : 1000.0

----------Right Overbank
Upper Sideslope (z)  : 0.500
Upper Width (ft)  : 3.000
Middle Sideslope (z)  : 10.000
Middle Width (ft)  : 10.000
Mannings n  : 0.040

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr)  : 0.0
Depth to Water Table (ft)  : 100.0
Bio-Fouling Potential  : Low
Maintenance  : Average or Better

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

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

**----------**
**Link Name: New Channel Lnk1**
Link Type:  Open Channel
Downstream Link: None

----------Left Overbank
Upper Sideslope (z)  : 0.500
Upper Width (ft)  : 3.000
Middle Sideslope (z)  : 10.000
Middle Width (ft)  : 10.000
Mannings n  : 0.040

----------Main Channel

Lower Sideslope Left (z) : 0.500
Lower Width Left (ft) : 3.000
Lower Sideslope Right (z) : 0.500
Lower Width Right (ft) : 3.000
Mannings n : 0.024
Base Width (ft) : 10.0
Elevation (ft) : 100.00
Channel Slope (ft/ft) : 0.020
Channel Length (ft) : 1000.0

----------Right Overbank
Upper Sideslope (z) : 0.500
Upper Width (ft) : 3.000
Middle Sideslope (z) : 10.000
Middle Width (ft) : 10.000
Mannings n : 0.040

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.0
Depth to Water Table (ft) : 100.0
Bio-Fouling Potential : Low
Maintenance : Average or Better

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

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 3
Number of Links: 1

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 3
Number of Links: 1

**********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: Subbasin A | 8713.084 |
| Subbasin: Subbasin B | 9922.893 |
| Subbasin: On-Site Area | 240.883 |
| Link: New Channel Lnk1 | Not Computed |
| Total: | 18876.860 |

Total Post Developed Recharge During Simulation

| Model Element | Recharge Amount (ac-ft) |
|---|---|
| Subbasin: Subbasin A | 8713.084 |
| Subbasin: Subbasin B | 9922.893 |
| Subbasin: On-Site Area | 240.883 |
| Link: New Channel Lnk1 | Not Computed |

Total: 18876.860

**Total Predevelopment Recharge Equals Post Developed**
**Average Recharge Per Year, (Number of Years= 158)**
**Predeveloped: 119.474 ac-ft/year, Post Developed: 119.474 ac-ft/year**

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

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

Number of Links: 1

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

Number of Links: 1

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

Scenario Predeveloped Compliance Subbasin: Subbasin B

Scenario Postdeveloped Compliance Subbasin: Subbasin B

***** 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 | 1.774 | 2-Year | 1.774 |
| 5-Year | 2.378 | 5-Year | 2.378 |
| 10-Year | 2.870 | 10-Year | 2.870 |
| 25-Year | 3.740 | 25-Year | 3.740 |
| 50-Year | 4.312 | 50-Year | 4.312 |
| 100-Year | 6.450 | 100-Year | 6.450 |
| 200-Year | 6.871 | 200-Year | 6.871 |

** 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%): | 0.0% | PASS |
| Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%): | 0.1% | FAIL |
| Maximum Excursion from Q2 to Q50 (Must be less than 10%): | 0.0% | PASS |
| Percent Excursion from Q2 to Q50 (Must be less than 50%): | 2.7% | PASS |

# Subbasins A and B

(Basin for Combined Wetland A, Stream B and Stream A)

---

# MGS FLOOD
# PROJECT REPORT

**Program Version: MGSFlood 4.46**
**Program License Number: 200410013**
**Project Simulation Performed on: 08/28/2018 7:43 AM**
**Report Generation Date: 08/28/2018 7:43 AM**

---

Input File Name: LakesideInd.fld
Project Name: Lakeside Industries
Analysis Title: Flood Hazard Certification
Comments:

## PRECIPITATION INPUT

Computational Time Step (Minutes): 60

Extended Precipitation Time Series Selected
Climatic Region Number: 5

Full Period of Record Available used for Routing
Precipitation Station : 95004805 Puget West 48 in_5min 10/01/1939-10/01/2097
Evaporation Station : 951048 Puget West 48 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) | 65.900 | 65.900 |
| Area of Links that Include Precip/Evap (acres) | 0.000 | 0.000 |
| Total (acres) | 65.900 | 65.900 |

**----------SCENARIO: PREDEVELOPED**
Number of Subbasins: 3

---------- Subbasin : Subbasin A ----------

| | -------Area (Acres) -------- |
|---|---|
| Outwash Forest | 13.000 |
| Outwash Grass | 9.000 |
| Impervious | 4.000 |

---

Subbasin Total 26.000

---------- Subbasin : Subbasin B ----------
-------Area (Acres) --------
Outwash Forest 15.100
Outwash Grass 10.000
Impervious 5.000
---
Subbasin Total 30.100

---------- Subbasin : On-Site Area ----------
-------Area (Acres) --------
Till Grass 1.800
Impervious 8.000
---
Subbasin Total 9.800

**----------SCENARIO: POSTDEVELOPED**
Number of Subbasins: 3

---------- Subbasin : Subbasin A ----------
-------Area (Acres) --------
Outwash Forest 13.000
Outwash Grass 9.000
Impervious 4.000
---
Subbasin Total 26.000

---------- Subbasin : Subbasin B ----------
-------Area (Acres) --------
Outwash Forest 15.100
Outwash Grass 10.000
Impervious 5.000
---
Subbasin Total 30.100

---------- Subbasin : On-Site Area ----------
-------Area (Acres) --------
Till Grass 1.800
Impervious 8.000
---
Subbasin Total 9.800

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

----------SCENARIO: PREDEVELOPED
Number of Links: 1

**----------**
**Link Name: New Channel Lnk1**
Link Type:  Open Channel
Downstream Link: None

----------Left Overbank
Upper Sideslope (z)  : 0.500
Upper Width (ft)  : 3.000
Middle Sideslope (z)  : 10.000
Middle Width (ft)  : 10.000
Mannings n  : 0.040

----------Main Channel
Lower Sideslope Left (z)  : 0.500
Lower Width Left (ft)  : 3.000
Lower Sideslope Right (z)  : 0.500
Lower Width Right (ft)  : 3.000
Mannings n  : 0.024
Base Width (ft)  : 10.0
Elevation (ft)  : 100.00
Channel Slope (ft/ft)  : 0.020
Channel Length (ft)  : 1000.0

----------Right Overbank
Upper Sideslope (z)  : 0.500
Upper Width (ft)  : 3.000
Middle Sideslope (z)  : 10.000
Middle Width (ft)  : 10.000
Mannings n  : 0.040

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr)  : 0.0
Depth to Water Table (ft)  : 100.0
Bio-Fouling Potential  : Low
Maintenance  : Average or Better

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

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

**----------**
**Link Name: New Channel Lnk1**
Link Type:  Open Channel
Downstream Link: None

----------Left Overbank
Upper Sideslope (z)  : 0.500
Upper Width (ft)  : 3.000
Middle Sideslope (z)  : 10.000
Middle Width (ft)  : 10.000
Mannings n  : 0.040

----------Main Channel

Lower Sideslope Left (z) : 0.500
Lower Width Left (ft) : 3.000
Lower Sideslope Right (z) : 0.500
Lower Width Right (ft) : 3.000
Mannings n : 0.024
Base Width (ft) : 10.0
Elevation (ft) : 100.00
Channel Slope (ft/ft) : 0.020
Channel Length (ft) : 1000.0

----------Right Overbank
Upper Sideslope (z) : 0.500
Upper Width (ft) : 3.000
Middle Sideslope (z) : 10.000
Middle Width (ft) : 10.000
Mannings n : 0.040

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.0
Depth to Water Table (ft) : 100.0
Bio-Fouling Potential : Low
Maintenance : Average or Better

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

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 3
Number of Links: 1

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 3
Number of Links: 1

**********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: Subbasin A | 8713.084 |
| Subbasin: Subbasin B | 9922.893 |
| Subbasin: On-Site Area | 240.883 |
| Link: New Channel Lnk1 | 0.000 |
| Total: | 18876.860 |

Total Post Developed Recharge During Simulation

| Model Element | Recharge Amount (ac-ft) |
|---|---|
| Subbasin: Subbasin A | 8713.084 |
| Subbasin: Subbasin B | 9922.893 |
| Subbasin: On-Site Area | 240.883 |
| Link: New Channel Lnk1 | 0.000 |

Total: 18876.860

**Total Predevelopment Recharge Equals Post Developed**
**Average Recharge Per Year, (Number of Years= 158)**
**Predeveloped: 119.474 ac-ft/year, Post Developed: 119.474 ac-ft/year**

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

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

Number of Links: 1

********** Link: New Channel Lnk1 **********

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 5055.52
Inflow Volume Including PPT-Evap (ac-ft): 5055.52
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 5060.93
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

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

Number of Links: 1

********** Link: New Channel Lnk1 **********

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 5055.52
Inflow Volume Including PPT-Evap (ac-ft): 5055.52
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 5060.93
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

| Predevelopment Runoff | | Postdevelopment Runoff | |
|---|---|---|---|
| Tr (Years) | Discharge (cfs) | Tr (Years) | Discharge (cfs) |
| 2-Year | 3.138 | 2-Year | 3.138 |
| 5-Year | 4.237 | 5-Year | 4.237 |
| 10-Year | 5.023 | 10-Year | 5.023 |
| 25-Year | 6.638 | 25-Year | 6.638 |
| 50-Year | 7.841 | 50-Year | 7.841 |
| 100-Year | 11.868 | 100-Year | 11.868 |
| 200-Year | 12.556 | 200-Year | 12.556 |

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

# Subbasins A and B, and On-Site Area

(Basin for Combined Wetland A, Stream B, Stream A and On-Site Area)

---

# MGS FLOOD
# PROJECT REPORT

**Program Version: MGSFlood 4.46**
**Program License Number: 200410013**
**Project Simulation Performed on: 08/28/2018 7:31 AM**
**Report Generation Date: 08/28/2018 7:31 AM**

---

Input File Name: LakesideInd.fld
Project Name: Lakeside Industries
Analysis Title: Flood Hazard Certification
Comments:

## PRECIPITATION INPUT

Computational Time Step (Minutes): 60

Extended Precipitation Time Series Selected
Climatic Region Number: 5

Full Period of Record Available used for Routing
Precipitation Station : 95004805 Puget West 48 in_5min 10/01/1939-10/01/2097
Evaporation Station : 951048 Puget West 48 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) | 65.900 | 65.900 |
| Area of Links that Include Precip/Evap (acres) | 0.000 | 0.000 |
| Total (acres) | 65.900 | 65.900 |

**----------SCENARIO: PREDEVELOPED**
Number of Subbasins: 3

---------- Subbasin : Subbasin A ----------

| | -------Area (Acres) -------- |
|---|---|
| Outwash Forest | 13.000 |
| Outwash Grass | 9.000 |
| Impervious | 4.000 |

---

Subbasin Total 26.000

---------- Subbasin : Subbasin B ----------
-------Area (Acres) --------
Outwash Forest 15.100
Outwash Grass 10.000
Impervious 5.000
---
Subbasin Total 30.100

---------- Subbasin : On-Site Area ----------
-------Area (Acres) --------
Till Grass 1.800
Impervious 8.000
---
Subbasin Total 9.800

**----------SCENARIO: POSTDEVELOPED**
Number of Subbasins: 3

---------- Subbasin : Subbasin A ----------
-------Area (Acres) --------
Outwash Forest 13.000
Outwash Grass 9.000
Impervious 4.000
---
Subbasin Total 26.000

---------- Subbasin : Subbasin B ----------
-------Area (Acres) --------
Outwash Forest 15.100
Outwash Grass 10.000
Impervious 5.000
---
Subbasin Total 30.100

---------- Subbasin : On-Site Area ----------
-------Area (Acres) --------
Till Grass 1.800
Impervious 8.000
---
Subbasin Total 9.800

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

----------SCENARIO: PREDEVELOPED
Number of Links: 1

**----------**
**Link Name: New Channel Lnk1**
Link Type:  Open Channel
Downstream Link: None

----------Left Overbank
Upper Sideslope (z)  : 0.500
Upper Width (ft)  : 3.000
Middle Sideslope (z)  : 10.000
Middle Width (ft)  : 10.000
Mannings n  : 0.040

----------Main Channel
Lower Sideslope Left (z)  : 0.500
Lower Width Left (ft)  : 3.000
Lower Sideslope Right (z)  : 0.500
Lower Width Right (ft)  : 3.000
Mannings n  : 0.024
Base Width (ft)  : 10.0
Elevation (ft)  : 100.00
Channel Slope (ft/ft)  : 0.020
Channel Length (ft)  : 1000.0

----------Right Overbank
Upper Sideslope (z)  : 0.500
Upper Width (ft)  : 3.000
Middle Sideslope (z)  : 10.000
Middle Width (ft)  : 10.000
Mannings n  : 0.040

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr)  : 0.0
Depth to Water Table (ft)  : 100.0
Bio-Fouling Potential  : Low
Maintenance  : Average or Better

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

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

**----------**
**Link Name: New Channel Lnk1**
Link Type:  Open Channel
Downstream Link: None

----------Left Overbank
Upper Sideslope (z)  : 0.500
Upper Width (ft)  : 3.000
Middle Sideslope (z)  : 10.000
Middle Width (ft)  : 10.000
Mannings n  : 0.040

----------Main Channel

Lower Sideslope Left (z) : 0.500
Lower Width Left (ft) : 3.000
Lower Sideslope Right (z) : 0.500
Lower Width Right (ft) : 3.000
Mannings n : 0.024
Base Width (ft) : 10.0
Elevation (ft) : 100.00
Channel Slope (ft/ft) : 0.020
Channel Length (ft) : 1000.0

----------Right Overbank
Upper Sideslope (z) : 0.500
Upper Width (ft) : 3.000
Middle Sideslope (z) : 10.000
Middle Width (ft) : 10.000
Mannings n : 0.040

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.0
Depth to Water Table (ft) : 100.0
Bio-Fouling Potential : Low
Maintenance : Average or Better

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

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 3
Number of Links: 1

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 3
Number of Links: 1

**********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: Subbasin A | 8713.084 |
| Subbasin: Subbasin B | 9922.893 |
| Subbasin: On-Site Area | 240.883 |
| Link: New Channel Lnk1 | 0.000 |
| Total: | 18876.860 |

Total Post Developed Recharge During Simulation

| Model Element | Recharge Amount (ac-ft) |
|---|---|
| Subbasin: Subbasin A | 8713.084 |
| Subbasin: Subbasin B | 9922.893 |
| Subbasin: On-Site Area | 240.883 |
| Link: New Channel Lnk1 | 0.000 |

Total: 18876.860

**Total Predevelopment Recharge Equals Post Developed**
**Average Recharge Per Year, (Number of Years= 158)**
**Predeveloped: 119.474 ac-ft/year, Post Developed: 119.474 ac-ft/year**

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

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

Number of Links: 1

********** Link: New Channel Lnk1 **********

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 10009.50
Inflow Volume Including PPT-Evap (ac-ft): 10009.50
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 10028.61
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

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

Number of Links: 1

********** Link: New Channel Lnk1 **********

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 10009.50
Inflow Volume Including PPT-Evap (ac-ft): 10009.50
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 10028.61
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

| Predevelopment Runoff | | Postdevelopment Runoff | |
|---|---|---|---|
| Tr (Years) | Discharge (cfs) | Tr (Years) | Discharge (cfs) |
| 2-Year | 5.787 | 2-Year | 5.787 |
| 5-Year | 7.538 | 5-Year | 7.538 |
| 10-Year | 8.787 | 10-Year | 8.787 |
| 25-Year | 10.810 | 25-Year | 10.810 |
| 50-Year | 12.337 | 50-Year | 12.337 |
| 100-Year | 16.888 | 100-Year | 16.888 |
| 200-Year | 18.477 | 200-Year | 18.477 |

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

ATTACHMENT 5

# Existing Conditions

HEC-RAS Plan: Existing River: Stream B Reach: Stream B

Wetland A

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Stream B | 1155 | 2 Year | 1.77 | 171.04 | 171.78 | 171.31 | 171.79 | 0.001599 | 0.78 | 2.30 | 3.96 | 0.17 |
| Stream B | 1155 | 10 Year | 2.87 | 171.04 | 171.95 | 171.39 | 171.97 | 0.001801 | 0.97 | 3.02 | 4.33 | 0.19 |
| Stream B | 1155 | 50 Year | 4.31 | 171.04 | 172.14 | 171.49 | 172.16 | 0.001973 | 1.17 | 3.85 | 4.64 | 0.21 |
| Stream B | 1155 | 100 Year | 6.45 | 171.04 | 172.36 | 171.62 | 172.39 | 0.002204 | 1.42 | 4.89 | 4.97 | 0.23 |
| Stream B | 1155 | 200 Year | 6.87 | 171.04 | 172.39 | 171.64 | 172.43 | 0.002244 | 1.46 | 5.08 | 5.03 | 0.23 |
| | | | | | | | | | | | | |
| Stream B | 1076 | 2 Year | 1.77 | 171.00 | 171.28 | 171.28 | 171.40 | 0.063611 | 2.83 | 0.63 | 2.52 | 0.99 |
| Stream B | 1076 | 10 Year | 2.87 | 171.00 | 171.37 | 171.37 | 171.54 | 0.056515 | 3.31 | 0.88 | 2.72 | 0.99 |
| Stream B | 1076 | 50 Year | 4.31 | 171.00 | 171.49 | 171.49 | 171.70 | 0.049995 | 3.74 | 1.19 | 2.94 | 0.97 |
| Stream B | 1076 | 100 Year | 6.45 | 171.00 | 171.63 | 171.62 | 171.90 | 0.043301 | 4.19 | 1.65 | 3.25 | 0.95 |
| Stream B | 1076 | 200 Year | 6.87 | 171.00 | 171.66 | 171.65 | 171.93 | 0.042052 | 4.25 | 1.74 | 3.30 | 0.94 |
| | | | | | | | | | | | | |
| Stream B | 1002 | 2 Year | 1.77 | 170.34 | 171.27 | 170.51 | 171.27 | 0.000123 | 0.27 | 6.68 | 9.67 | 0.05 |
| Stream B | 1002 | 10 Year | 2.87 | 170.34 | 171.38 | 170.57 | 171.38 | 0.000205 | 0.38 | 7.75 | 10.10 | 0.07 |
| Stream B | 1002 | 50 Year | 4.31 | 170.34 | 171.52 | 170.63 | 171.52 | 0.000276 | 0.49 | 9.22 | 10.66 | 0.09 |
| Stream B | 1002 | 100 Year | 6.45 | 170.34 | 171.73 | 170.72 | 171.73 | 0.000325 | 0.60 | 11.49 | 11.47 | 0.10 |
| Stream B | 1002 | 200 Year | 6.87 | 170.34 | 171.76 | 170.73 | 171.77 | 0.000332 | 0.62 | 11.92 | 11.61 | 0.10 |
| | | | | | | | | | | | | |
| Stream B | 917 | 2 Year | 1.77 | 171.00 | 171.16 | 171.16 | 171.23 | 0.067128 | 2.14 | 0.83 | 5.52 | 0.98 |
| Stream B | 917 | 10 Year | 2.87 | 171.00 | 171.21 | 171.21 | 171.31 | 0.067646 | 2.57 | 1.11 | 5.66 | 1.02 |
| Stream B | 917 | 50 Year | 4.31 | 171.00 | 171.38 | 171.28 | 171.44 | 0.018819 | 2.06 | 2.11 | 5.98 | 0.60 |
| Stream B | 917 | 100 Year | 6.45 | 171.00 | 171.59 | 171.35 | 171.65 | 0.009135 | 1.94 | 3.42 | 6.38 | 0.45 |
| Stream B | 917 | 200 Year | 6.87 | 171.00 | 171.63 | 171.37 | 171.69 | 0.008374 | 1.94 | 3.66 | 6.45 | 0.44 |
| | | | | | | | | | | | | |
| Stream B | 834 | 2 Year | 1.77 | 170.00 | 170.78 | 170.22 | 170.79 | 0.000890 | 0.61 | 2.92 | 4.49 | 0.13 |
| Stream B | 834 | 10 Year | 2.87 | 170.00 | 170.98 | 170.29 | 170.99 | 0.001057 | 0.74 | 3.86 | 4.87 | 0.15 |
| Stream B | 834 | 50 Year | 4.31 | 170.00 | 171.18 | 170.39 | 171.20 | 0.001078 | 0.87 | 5.27 | 7.30 | 0.15 |
| Stream B | 834 | 100 Year | 6.45 | 170.00 | 171.42 | 170.50 | 171.43 | 0.001127 | 1.03 | 7.01 | 7.78 | 0.16 |
| Stream B | 834 | 200 Year | 6.87 | 170.00 | 171.46 | 170.52 | 171.47 | 0.001135 | 1.05 | 7.33 | 7.86 | 0.16 |
| | | | | | | | | | | | | |
| Stream B | 756 | 2 Year | 1.77 | 170.00 | 170.72 | 170.18 | 170.73 | 0.000607 | 0.51 | 3.46 | 5.48 | 0.11 |
| Stream B | 756 | 10 Year | 2.87 | 170.00 | 170.92 | 170.24 | 170.92 | 0.000664 | 0.64 | 4.56 | 5.90 | 0.12 |
| Stream B | 756 | 50 Year | 4.31 | 170.00 | 171.12 | 170.32 | 171.13 | 0.000721 | 0.77 | 6.09 | 12.89 | 0.13 |
| Stream B | 756 | 100 Year | 6.45 | 170.00 | 171.35 | 170.41 | 171.36 | 0.000701 | 0.87 | 9.24 | 13.85 | 0.14 |
| Stream B | 756 | 200 Year | 6.87 | 170.00 | 171.39 | 170.42 | 171.40 | 0.000693 | 0.88 | 9.82 | 13.94 | 0.14 |
| | | | | | | | | | | | | |
| Stream B | 678 | 2 Year | 1.77 | 170.00 | 170.40 | 170.40 | 170.55 | 0.067169 | 3.20 | 0.56 | 1.81 | 1.01 |
| Stream B | 678 | 10 Year | 2.87 | 170.00 | 170.52 | 170.52 | 170.73 | 0.058084 | 3.70 | 0.79 | 2.05 | 0.99 |
| Stream B | 678 | 50 Year | 4.31 | 170.00 | 170.66 | 170.66 | 170.92 | 0.049493 | 4.13 | 1.11 | 2.33 | 0.96 |
| Stream B | 678 | 100 Year | 6.45 | 170.00 | 170.84 | 170.84 | 171.16 | 0.043756 | 4.63 | 1.55 | 2.68 | 0.94 |
| Stream B | 678 | 200 Year | 6.87 | 170.00 | 170.86 | 170.86 | 171.20 | 0.043913 | 4.75 | 1.62 | 2.73 | 0.95 |
| | | | | | | | | | | | | |
| Stream B | 638 | | Culvert | | | | | | | | | |
| | | | | | | | | | | | | |
| Stream B | 598 | 2 Year | 1.77 | 167.00 | 170.29 | 167.71 | 170.29 | 0.000008 | 0.11 | 17.03 | 11.58 | 0.01 |
| Stream B | 598 | 10 Year | 2.87 | 167.00 | 170.40 | 167.86 | 170.40 | 0.000017 | 0.16 | 18.27 | 11.82 | 0.02 |
| Stream B | 598 | 50 Year | 4.31 | 167.00 | 170.52 | 168.05 | 170.52 | 0.000031 | 0.23 | 19.75 | 12.11 | 0.03 |
| Stream B | 598 | 100 Year | 6.45 | 167.00 | 170.67 | 168.19 | 170.68 | 0.000054 | 0.32 | 21.64 | 12.47 | 0.04 |
| Stream B | 598 | 200 Year | 6.87 | 167.00 | 170.71 | 168.21 | 170.72 | 0.000057 | 0.33 | 22.14 | 12.57 | 0.04 |
| | | | | | | | | | | | | |
| Stream B | 549 | 2 Year | 1.77 | 168.00 | 170.29 | 168.67 | 170.29 | 0.000039 | 0.19 | 10.07 | 11.35 | 0.03 |
| Stream B | 549 | 10 Year | 2.87 | 168.00 | 170.39 | 168.82 | 170.40 | 0.000076 | 0.28 | 11.27 | 11.56 | 0.04 |
| Stream B | 549 | 50 Year | 4.31 | 168.00 | 170.52 | 169.05 | 170.52 | 0.000125 | 0.39 | 12.70 | 11.81 | 0.06 |
| Stream B | 549 | 100 Year | 6.45 | 168.00 | 170.67 | 169.15 | 170.67 | 0.000196 | 0.51 | 14.51 | 12.12 | 0.07 |
| Stream B | 549 | 200 Year | 6.87 | 168.00 | 170.71 | 169.16 | 170.71 | 0.000204 | 0.53 | 14.98 | 12.20 | 0.07 |
| | | | | | | | | | | | | |
| Stream B | 486 | 2 Year | 1.77 | 170.00 | 170.25 | 170.16 | 170.28 | 0.014414 | 1.35 | 1.32 | 5.81 | 0.49 |
| Stream B | 486 | 10 Year | 2.87 | 170.00 | 170.34 | 170.22 | 170.37 | 0.013335 | 1.59 | 1.83 | 6.09 | 0.50 |
| Stream B | 486 | 50 Year | 4.31 | 170.00 | 170.44 | 170.28 | 170.49 | 0.011756 | 1.80 | 2.47 | 6.43 | 0.49 |
| Stream B | 486 | 100 Year | 6.45 | 170.00 | 170.56 | 170.37 | 170.63 | 0.010938 | 2.06 | 3.30 | 6.85 | 0.49 |
| Stream B | 486 | 200 Year | 6.87 | 170.00 | 170.60 | 170.38 | 170.67 | 0.009713 | 2.04 | 3.57 | 6.98 | 0.47 |
| | | | | | | | | | | | | |
| Stream B | 443 | 2 Year | 3.14 | 169.00 | 169.27 | 169.22 | 169.33 | 0.028658 | 1.98 | 1.59 | 6.41 | 0.70 |
| Stream B | 443 | 10 Year | 5.02 | 169.00 | 169.35 | 169.29 | 169.44 | 0.030103 | 2.42 | 2.09 | 6.58 | 0.75 |
| Stream B | 443 | 50 Year | 7.84 | 169.00 | 169.44 | 169.38 | 169.57 | 0.032239 | 2.95 | 2.69 | 6.78 | 0.80 |
| Stream B | 443 | 100 Year | 11.87 | 169.00 | 169.56 | 169.50 | 169.74 | 0.031295 | 3.45 | 3.53 | 7.04 | 0.83 |
| Stream B | 443 | 200 Year | 12.56 | 169.00 | 169.55 | 169.51 | 169.76 | 0.036775 | 3.70 | 3.48 | 7.02 | 0.89 |
| | | | | | | | | | | | | |
| Stream B | 375 | 2 Year | 3.14 | 166.00 | 166.43 | 166.43 | 166.57 | 0.059772 | 3.07 | 1.02 | 3.53 | 1.00 |
| Stream B | 375 | 10 Year | 5.02 | 166.00 | 166.54 | 166.54 | 166.73 | 0.053586 | 3.55 | 1.43 | 3.92 | 1.00 |
| Stream B | 375 | 50 Year | 7.84 | 166.00 | 166.68 | 166.68 | 166.93 | 0.046156 | 4.04 | 2.02 | 4.46 | 0.98 |
| Stream B | 375 | 100 Year | 11.87 | 166.00 | 166.83 | 166.83 | 167.16 | 0.045066 | 4.71 | 2.72 | 5.03 | 1.00 |
| Stream B | 375 | 200 Year | 12.56 | 166.00 | 166.89 | 166.89 | 167.20 | 0.037682 | 4.55 | 3.04 | 5.64 | 0.93 |
| | | | | | | | | | | | | |
| Stream B | 308 | 2 Year | 5.79 | 165.00 | 165.80 | | 165.82 | 0.001661 | 0.93 | 6.22 | 8.59 | 0.19 |
| Stream B | 308 | 10 Year | 8.79 | 165.00 | 165.99 | | 166.01 | 0.001899 | 1.12 | 7.84 | 8.95 | 0.21 |

HEC-RAS Plan: Existing River: Stream B Reach: Stream B (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Stream B | 308 | 50 Year | 12.34 | 165.00 | 166.16 | | 166.19 | 0.002053 | 1.31 | 9.46 | 9.76 | 0.23 |
| Stream B | 308 | 100 Year | 16.89 | 165.00 | 166.35 | | 166.39 | 0.002184 | 1.51 | 11.41 | 10.53 | 0.24 |
| Stream B | 308 | 200 Year | 18.48 | 165.00 | 166.41 | | 166.45 | 0.002240 | 1.58 | 12.02 | 10.71 | 0.24 |
| | | | | | | | | | | | | |
| Stream B | 237 | 2 Year | 5.79 | 165.00 | 165.41 | | 165.51 | 0.027924 | 2.52 | 2.29 | 6.01 | 0.72 |
| Stream B | 237 | 10 Year | 8.79 | 165.00 | 165.52 | | 165.66 | 0.029275 | 3.01 | 2.92 | 6.21 | 0.77 |
| Stream B | 237 | 50 Year | 12.34 | 165.00 | 165.62 | | 165.81 | 0.030679 | 3.50 | 3.55 | 6.40 | 0.81 |
| Stream B | 237 | 100 Year | 16.89 | 165.00 | 165.72 | 165.66 | 165.97 | 0.032748 | 4.04 | 4.24 | 6.60 | 0.86 |
| Stream B | 237 | 200 Year | 18.48 | 165.00 | 165.75 | 165.70 | 166.03 | 0.033606 | 4.22 | 4.45 | 6.67 | 0.88 |
| | | | | | | | | | | | | |
| Stream B | 161 | 2 Year | 5.79 | 164.00 | 164.40 | | 164.43 | 0.008419 | 1.42 | 4.09 | 10.67 | 0.40 |
| Stream B | 161 | 10 Year | 8.79 | 164.00 | 164.51 | | 164.55 | 0.008280 | 1.67 | 5.29 | 10.84 | 0.42 |
| Stream B | 161 | 50 Year | 12.34 | 164.00 | 164.62 | | 164.68 | 0.008292 | 1.91 | 6.51 | 11.01 | 0.43 |
| Stream B | 161 | 100 Year | 16.89 | 164.00 | 164.75 | | 164.82 | 0.008043 | 2.14 | 7.98 | 11.21 | 0.44 |
| Stream B | 161 | 200 Year | 18.48 | 164.00 | 164.80 | | 164.87 | 0.007952 | 2.21 | 8.47 | 11.27 | 0.44 |
| | | | | | | | | | | | | |
| Stream B | 109 | 2 Year | 5.79 | 163.00 | 163.34 | 163.34 | 163.49 | 0.056815 | 3.20 | 1.81 | 5.79 | 1.00 |
| Stream B | 109 | 10 Year | 8.79 | 163.00 | 163.44 | 163.44 | 163.65 | 0.050985 | 3.66 | 2.42 | 5.97 | 1.00 |
| Stream B | 109 | 50 Year | 12.34 | 163.00 | 163.55 | 163.55 | 163.80 | 0.046786 | 4.08 | 3.07 | 6.17 | 0.99 |
| Stream B | 109 | 100 Year | 16.89 | 163.00 | 163.67 | 163.67 | 163.98 | 0.043642 | 4.52 | 3.82 | 6.39 | 0.99 |
| Stream B | 109 | 200 Year | 18.48 | 163.00 | 163.71 | 163.71 | 164.04 | 0.042801 | 4.66 | 4.08 | 6.46 | 0.99 |
| | | | | | | | | | | | | |
| Stream B | 19 | 2 Year | 5.79 | 160.00 | 160.27 | 160.12 | 160.28 | 0.005002 | 0.87 | 6.67 | 25.14 | 0.30 |
| Stream B | 19 | 10 Year | 8.79 | 160.00 | 160.35 | 160.16 | 160.36 | 0.005002 | 1.02 | 8.58 | 25.29 | 0.31 |
| Stream B | 19 | 50 Year | 12.34 | 160.00 | 160.42 | 160.20 | 160.45 | 0.005003 | 1.17 | 10.54 | 25.45 | 0.32 |
| Stream B | 19 | 100 Year | 16.89 | 160.00 | 160.51 | 160.24 | 160.54 | 0.005002 | 1.33 | 12.75 | 25.62 | 0.33 |
| Stream B | 19 | 200 Year | 18.48 | 160.00 | 160.54 | 160.26 | 160.57 | 0.005002 | 1.38 | 13.47 | 25.68 | 0.33 |

# Proposed Conditions

HEC-RAS Plan: Flood Haz River: Stream B Reach: Stream B

Wetland A

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Stream B | 1155 | 2 Year | 1.77 | 171.04 | 171.78 | 171.31 | 171.79 | 0.001571 | 0.77 | 2.31 | 3.96 | 0.17 |
| Stream B | 1155 | 10 Year | 2.87 | 171.04 | 171.95 | 171.39 | 171.97 | 0.001800 | 0.97 | 3.02 | 4.33 | 0.19 |
| Stream B | 1155 | 50 Year | 4.31 | 171.04 | 172.14 | 171.49 | 172.16 | 0.001972 | 1.17 | 3.85 | 4.64 | 0.21 |
| Stream B | 1155 | 100 Year | 6.45 | 171.04 | 172.36 | 171.62 | 172.39 | 0.002190 | 1.41 | 4.90 | 4.97 | 0.23 |
| Stream B | 1155 | 200 Year | 6.87 | 171.04 | 172.40 | 171.64 | 172.43 | 0.002223 | 1.45 | 5.10 | 5.03 | 0.23 |
| | | | | | | | | | | | | |
| Stream B | 1076 | 2 Year | 1.77 | 171.00 | 171.28 | 171.28 | 171.40 | 0.064487 | 2.84 | 0.62 | 2.52 | 1.00 |
| Stream B | 1076 | 10 Year | 2.87 | 171.00 | 171.37 | 171.37 | 171.54 | 0.056540 | 3.31 | 0.88 | 2.72 | 0.99 |
| Stream B | 1076 | 50 Year | 4.31 | 171.00 | 171.48 | 171.48 | 171.70 | 0.051256 | 3.77 | 1.18 | 2.94 | 0.98 |
| Stream B | 1076 | 100 Year | 6.45 | 171.00 | 171.62 | 171.62 | 171.90 | 0.045859 | 4.26 | 1.62 | 3.22 | 0.97 |
| Stream B | 1076 | 200 Year | 6.87 | 171.00 | 171.65 | 171.65 | 171.93 | 0.045300 | 4.35 | 1.70 | 3.27 | 0.97 |
| | | | | | | | | | | | | |
| Stream B | 1002 | 2 Year | 1.77 | 170.34 | 171.27 | 170.51 | 171.27 | 0.000121 | 0.27 | 6.88 | 11.05 | 0.05 |
| Stream B | 1002 | 10 Year | 2.87 | 170.34 | 171.38 | 170.57 | 171.38 | 0.000199 | 0.38 | 8.12 | 12.01 | 0.07 |
| Stream B | 1002 | 50 Year | 4.31 | 170.34 | 171.52 | 170.64 | 171.52 | 0.000265 | 0.48 | 9.89 | 13.27 | 0.08 |
| Stream B | 1002 | 100 Year | 6.45 | 170.34 | 171.72 | 170.72 | 171.73 | 0.000303 | 0.58 | 12.77 | 15.09 | 0.09 |
| Stream B | 1002 | 200 Year | 6.87 | 170.34 | 171.76 | 170.73 | 171.76 | 0.000308 | 0.59 | 13.33 | 15.42 | 0.09 |
| | | | | | | | | | | | | |
| Stream B | 917 | 2 Year | 1.77 | 171.00 | 171.15 | 171.15 | 171.23 | 0.076073 | 2.23 | 0.80 | 5.51 | 1.03 |
| Stream B | 917 | 10 Year | 2.87 | 171.00 | 171.21 | 171.21 | 171.31 | 0.065763 | 2.55 | 1.12 | 5.67 | 1.01 |
| Stream B | 917 | 50 Year | 4.31 | 171.00 | 171.38 | 171.27 | 171.44 | 0.018775 | 2.06 | 2.12 | 5.98 | 0.60 |
| Stream B | 917 | 100 Year | 6.45 | 171.00 | 171.59 | 171.35 | 171.65 | 0.009096 | 1.94 | 3.43 | 6.38 | 0.45 |
| Stream B | 917 | 200 Year | 6.87 | 171.00 | 171.63 | 171.37 | 171.69 | 0.008377 | 1.94 | 3.66 | 6.45 | 0.44 |
| | | | | | | | | | | | | |
| Stream B | 834 | 2 Year | 1.77 | 170.00 | 170.78 | 170.22 | 170.79 | 0.000894 | 0.61 | 2.92 | 4.49 | 0.13 |
| Stream B | 834 | 10 Year | 2.87 | 170.00 | 170.98 | 170.30 | 170.99 | 0.001066 | 0.75 | 3.85 | 4.87 | 0.15 |
| Stream B | 834 | 50 Year | 4.31 | 170.00 | 171.19 | 170.38 | 171.20 | 0.001070 | 0.87 | 5.28 | 7.30 | 0.15 |
| Stream B | 834 | 100 Year | 6.45 | 170.00 | 171.42 | 170.49 | 171.43 | 0.001122 | 1.02 | 7.02 | 7.78 | 0.16 |
| Stream B | 834 | 200 Year | 6.87 | 170.00 | 171.46 | 170.51 | 171.47 | 0.001132 | 1.05 | 7.33 | 7.87 | 0.16 |
| | | | | | | | | | | | | |
| Stream B | 756 | 2 Year | 1.77 | 170.00 | 170.72 | 170.18 | 170.73 | 0.000609 | 0.51 | 3.46 | 5.48 | 0.11 |
| Stream B | 756 | 10 Year | 2.87 | 170.00 | 170.91 | 170.24 | 170.92 | 0.000670 | 0.64 | 4.54 | 5.89 | 0.12 |
| Stream B | 756 | 50 Year | 4.31 | 170.00 | 171.12 | 170.32 | 171.13 | 0.000712 | 0.76 | 6.13 | 13.10 | 0.13 |
| Stream B | 756 | 100 Year | 6.45 | 170.00 | 171.35 | 170.41 | 171.36 | 0.000696 | 0.86 | 9.27 | 13.86 | 0.13 |
| Stream B | 756 | 200 Year | 6.87 | 170.00 | 171.39 | 170.43 | 171.40 | 0.000691 | 0.88 | 9.83 | 13.94 | 0.13 |
| | | | | | | | | | | | | |
| Stream B | 678 | 2 Year | 1.77 | 170.00 | 170.40 | 170.40 | 170.55 | 0.065537 | 3.17 | 0.56 | 1.81 | 1.00 |
| Stream B | 678 | 10 Year | 2.87 | 170.00 | 170.52 | 170.52 | 170.73 | 0.057988 | 3.70 | 0.79 | 2.05 | 0.99 |
| Stream B | 678 | 50 Year | 4.31 | 170.00 | 170.66 | 170.66 | 170.92 | 0.050981 | 4.17 | 1.09 | 2.32 | 0.97 |
| Stream B | 678 | 100 Year | 6.45 | 170.00 | 170.83 | 170.83 | 171.16 | 0.045156 | 4.68 | 1.53 | 2.66 | 0.95 |
| Stream B | 678 | 200 Year | 6.87 | 170.00 | 170.86 | 170.86 | 171.20 | 0.044158 | 4.76 | 1.61 | 2.73 | 0.95 |
| | | | | | | | | | | | | |
| Stream B | 638 | | Culvert | | | | | | | | | |
| | | | | | | | | | | | | |
| Stream B | 598 | 2 Year | 1.77 | 167.00 | 170.22 | 167.70 | 170.22 | 0.000009 | 0.11 | 18.35 | 27.88 | 0.01 |
| Stream B | 598 | 10 Year | 2.87 | 167.00 | 170.29 | 167.85 | 170.29 | 0.000020 | 0.17 | 20.45 | 32.25 | 0.02 |
| Stream B | 598 | 50 Year | 4.31 | 167.00 | 170.37 | 168.05 | 170.37 | 0.000036 | 0.23 | 23.26 | 37.30 | 0.03 |
| Stream B | 598 | 100 Year | 6.45 | 167.00 | 170.46 | 168.18 | 170.47 | 0.000064 | 0.32 | 27.11 | 43.27 | 0.04 |
| Stream B | 598 | 200 Year | 6.87 | 167.00 | 170.49 | 168.20 | 170.49 | 0.000069 | 0.34 | 28.07 | 44.64 | 0.04 |
| | | | | | | | | | | | | |
| Stream B | 549 | 2 Year | 1.77 | 168.00 | 170.22 | 168.67 | 170.22 | 0.000045 | 0.20 | 11.08 | 28.07 | 0.03 |
| Stream B | 549 | 10 Year | 2.87 | 168.00 | 170.28 | 168.81 | 170.29 | 0.000090 | 0.29 | 13.18 | 33.54 | 0.05 |
| Stream B | 549 | 50 Year | 4.31 | 168.00 | 170.36 | 169.06 | 170.37 | 0.000150 | 0.39 | 16.08 | 39.85 | 0.06 |
| Stream B | 549 | 100 Year | 6.45 | 168.00 | 170.46 | 169.15 | 170.46 | 0.000234 | 0.51 | 20.12 | 47.26 | 0.07 |
| Stream B | 549 | 200 Year | 6.87 | 168.00 | 170.48 | 169.17 | 170.48 | 0.000243 | 0.53 | 21.15 | 48.98 | 0.08 |
| | | | | | | | | | | | | |
| Stream B | 486 | 2 Year | 1.77 | 170.00 | 170.19 | 170.13 | 170.21 | 0.012743 | 1.06 | 2.42 | 20.20 | 0.44 |
| Stream B | 486 | 10 Year | 2.87 | 170.00 | 170.25 | 170.16 | 170.27 | 0.010532 | 1.16 | 3.75 | 24.84 | 0.42 |
| Stream B | 486 | 50 Year | 4.31 | 170.00 | 170.32 | 170.20 | 170.34 | 0.008068 | 1.21 | 5.68 | 30.35 | 0.38 |
| Stream B | 486 | 100 Year | 6.45 | 170.00 | 170.41 | 170.25 | 170.42 | 0.006489 | 1.27 | 8.45 | 36.82 | 0.36 |
| Stream B | 486 | 200 Year | 6.87 | 170.00 | 170.43 | 170.25 | 170.44 | 0.005788 | 1.24 | 9.28 | 38.55 | 0.34 |
| | | | | | | | | | | | | |
| Stream B | 443 | 2 Year | 3.14 | 169.00 | 169.27 | 169.22 | 169.33 | 0.028798 | 1.98 | 1.59 | 6.41 | 0.70 |
| Stream B | 443 | 10 Year | 5.02 | 169.00 | 169.35 | 169.29 | 169.44 | 0.030122 | 2.42 | 2.09 | 6.58 | 0.75 |
| Stream B | 443 | 50 Year | 7.84 | 169.00 | 169.44 | 169.38 | 169.57 | 0.032322 | 2.95 | 2.69 | 6.78 | 0.81 |
| Stream B | 443 | 100 Year | 11.87 | 169.00 | 169.56 | 169.50 | 169.74 | 0.031391 | 3.45 | 3.53 | 7.04 | 0.83 |
| Stream B | 443 | 200 Year | 12.56 | 169.00 | 169.55 | 169.52 | 169.76 | 0.036750 | 3.70 | 3.48 | 7.02 | 0.89 |
| | | | | | | | | | | | | |
| Stream B | 375 | 2 Year | 3.14 | 166.00 | 166.43 | 166.43 | 166.57 | 0.059772 | 3.07 | 1.02 | 3.53 | 1.00 |
| Stream B | 375 | 10 Year | 5.02 | 166.00 | 166.54 | 166.54 | 166.73 | 0.053586 | 3.55 | 1.43 | 3.92 | 1.00 |
| Stream B | 375 | 50 Year | 7.84 | 166.00 | 166.68 | 166.68 | 166.93 | 0.046156 | 4.04 | 2.02 | 4.46 | 0.98 |
| Stream B | 375 | 100 Year | 11.87 | 166.00 | 166.83 | 166.83 | 167.16 | 0.045066 | 4.71 | 2.72 | 5.03 | 1.00 |
| Stream B | 375 | 200 Year | 12.56 | 166.00 | 166.89 | 166.89 | 167.20 | 0.037682 | 4.55 | 3.04 | 5.64 | 0.93 |
| | | | | | | | | | | | | |
| Stream B | 308 | 2 Year | 5.79 | 165.00 | 165.80 | 165.28 | 165.82 | 0.001661 | 0.93 | 6.22 | 8.59 | 0.19 |
| Stream B | 308 | 10 Year | 8.79 | 165.00 | 165.99 | 165.36 | 166.01 | 0.001899 | 1.12 | 7.84 | 8.95 | 0.21 |

HEC-RAS Plan: Flood Haz River: Stream B Reach: Stream B (Continued)

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Stream B | 308 | 50 Year | 12.34 | 165.00 | 166.16 | 165.45 | 166.19 | 0.002053 | 1.31 | 9.46 | 9.76 | 0.23 |
| Stream B | 308 | 100 Year | 16.89 | 165.00 | 166.35 | 165.55 | 166.39 | 0.002184 | 1.51 | 11.41 | 10.53 | 0.24 |
| Stream B | 308 | 200 Year | 18.48 | 165.00 | 166.41 | 165.59 | 166.45 | 0.002240 | 1.58 | 12.02 | 10.71 | 0.24 |
| | | | | | | | | | | | | |
| Stream B | 237 | 2 Year | 5.79 | 165.00 | 165.41 | 165.33 | 165.51 | 0.027924 | 2.52 | 2.29 | 6.01 | 0.72 |
| Stream B | 237 | 10 Year | 8.79 | 165.00 | 165.52 | 165.44 | 165.66 | 0.029275 | 3.01 | 2.92 | 6.21 | 0.77 |
| Stream B | 237 | 50 Year | 12.34 | 165.00 | 165.62 | 165.54 | 165.81 | 0.030679 | 3.50 | 3.55 | 6.40 | 0.81 |
| Stream B | 237 | 100 Year | 16.89 | 165.00 | 165.72 | 165.66 | 165.97 | 0.032748 | 4.04 | 4.24 | 6.60 | 0.86 |
| Stream B | 237 | 200 Year | 18.48 | 165.00 | 165.75 | 165.70 | 166.03 | 0.033606 | 4.22 | 4.45 | 6.67 | 0.88 |
| | | | | | | | | | | | | |
| Stream B | 161 | 2 Year | 5.79 | 164.00 | 164.40 | 164.22 | 164.43 | 0.008419 | 1.42 | 4.09 | 10.67 | 0.40 |
| Stream B | 161 | 10 Year | 8.79 | 164.00 | 164.51 | 164.29 | 164.55 | 0.008280 | 1.67 | 5.29 | 10.84 | 0.42 |
| Stream B | 161 | 50 Year | 12.34 | 164.00 | 164.62 | 164.36 | 164.68 | 0.008292 | 1.91 | 6.51 | 11.01 | 0.43 |
| Stream B | 161 | 100 Year | 16.89 | 164.00 | 164.75 | 164.44 | 164.82 | 0.008043 | 2.14 | 7.98 | 11.21 | 0.44 |
| Stream B | 161 | 200 Year | 18.48 | 164.00 | 164.80 | 164.47 | 164.87 | 0.007952 | 2.21 | 8.47 | 11.27 | 0.44 |
| | | | | | | | | | | | | |
| Stream B | 109 | 2 Year | 5.79 | 163.00 | 163.34 | 163.34 | 163.49 | 0.056815 | 3.20 | 1.81 | 5.79 | 1.00 |
| Stream B | 109 | 10 Year | 8.79 | 163.00 | 163.44 | 163.44 | 163.65 | 0.050985 | 3.66 | 2.42 | 5.97 | 1.00 |
| Stream B | 109 | 50 Year | 12.34 | 163.00 | 163.55 | 163.55 | 163.80 | 0.046786 | 4.08 | 3.07 | 6.17 | 0.99 |
| Stream B | 109 | 100 Year | 16.89 | 163.00 | 163.67 | 163.67 | 163.98 | 0.043642 | 4.52 | 3.82 | 6.39 | 0.99 |
| Stream B | 109 | 200 Year | 18.48 | 163.00 | 163.71 | 163.71 | 164.04 | 0.042801 | 4.66 | 4.08 | 6.46 | 0.99 |
| | | | | | | | | | | | | |
| Stream B | 19 | 2 Year | 5.79 | 160.00 | 160.27 | 160.12 | 160.28 | 0.005002 | 0.87 | 6.67 | 25.14 | 0.30 |
| Stream B | 19 | 10 Year | 8.79 | 160.00 | 160.35 | 160.16 | 160.36 | 0.005002 | 1.02 | 8.58 | 25.29 | 0.31 |
| Stream B | 19 | 50 Year | 12.34 | 160.00 | 160.42 | 160.20 | 160.45 | 0.005003 | 1.17 | 10.54 | 25.45 | 0.32 |
| Stream B | 19 | 100 Year | 16.89 | 160.00 | 160.51 | 160.24 | 160.54 | 0.005002 | 1.33 | 12.75 | 25.62 | 0.33 |
| Stream B | 19 | 200 Year | 18.48 | 160.00 | 160.54 | 160.26 | 160.57 | 0.005002 | 1.38 | 13.47 | 25.68 | 0.33 |

ATTACHMENT 6

Roadside Ditch
Wetland C
SR 169
19
109
161
237
308
375
443
486
549
598
678
756
834
917
1002
1076
1155
Stream B
54" Concrete Culvert
Wetland A
Stream A