

# TECHNICAL MEMORANDUM



## WEST Consultants, Inc.

12509 Bel-Red Road  
Suite 100  
Bellevue, WA 98005-2525  
(425) 646-8806  
(425) 646-0570 Fax  
www.westconsultants.com

**Name:** Fazal Chaudry  
**Company:** B and M Group  
**Date:** November 10, 2022  
**From:** Andreas Kammereck, PE, and Marek Kossik  
**Subject:** Preliminary Hydrologic and Hydraulic Analysis for the Stillaguamish River Floodplain along SR530 near the Pilot Property

---

The following summarizes the current understanding of flood related assessments for the subject site, and is therefore preliminary pending further coordination with the project team and review by the City of Arlington for final forward-looking actions and/or permit submittal requirements.

## 1. Project Summary

A fill pad was constructed at a site along the north side of SR 530, east of I-5, and on the north side of the Pilot Property; the site is located within the City of Arlington city limits and corresponding jurisdiction, which run along the north side of where the fill was placed (Figure 1). Areas to the north of the pad fall within Snohomish County jurisdiction. Based on flood related municipal code for the City of Arlington (as the applicable jurisdiction), which are consistent with the Snohomish County flood code, an analysis and/or review of potential impacts to flooding in terms of storage and conveyance is required to support development activities. Refer to Figure 1 for the site location relative to the applicable FEMA Flood Insurance Rate Map (i.e. publicly available firmette generated from on-line FEMA web site). Refer to 2 showing an aerial image background with the approximate location of the fill highlighted. Refer to Figure 3 for a view of the fill pad shortly after placement.

## 2. FEMA Model Summary

The FEMA existing conditions HEC-RAS model for the site is 1-dimensional (1D) and uses a steady-state flow condition. We did not request the model from FEMA (due to long delays in acquiring the data, and confirmed the model based on previous work in the area.

## 3. City and County Municipal Code Review

Both the City of Arlington Municipal Code and the Snohomish County Municipal Code were preliminarily reviewed to determine each jurisdiction's requirements for the project to proceed. Reviewing both sets of code was necessary because the required compensatory storage will likely need to extend outside of the

---

City of Arlington jurisdiction and into the unincorporated Snohomish County jurisdiction, even though the project itself takes place within the City of Arlington limits.

### **3.1 City of Arlington Municipal Code**

The City of Arlington requires a flood hazard permit for any work on land within the defined special flood hazard areas. This project site lies in FEMA Zone AE defined as the areas of inundation under the 100-year flood flow and with a defined base flood elevation (BFE), and outside of the floodway. The BFE for the site is approximately 46.5 feet (see Appendix A for location of georeferenced BFE's from the FEMA FIS).

The following sub-sections outlined the minimum flood related considerations under the City of Arlington Municipal Flooding Code.

#### ***3.1.1 Compensatory Storage Requirements***

As outlined in the City's flood code, all "development proposals shall not reduce the effective base flood storage volume of the floodplain. Grading or other activity which would reduce the effective storage volume must be mitigated by creating compensatory storage either on-site or approved adjacent off-site location. The compensatory storage must be hydraulically connected to the source of floodwaters and excavated at an elevation at or below the elevation of the filled storage that is being compensated." (City of Arlington 2022). The fill placed on the site is assumed to be subject to the flood code requirements, and as such, compensatory storage will be required. Based on the limitations on available site area and close proximity to the Arlington City Limits, the compensatory storage will likely extend beyond the City limits and into the unincorporated Snohomish County jurisdiction to the north of the project site.

#### ***3.1.2 Conveyance Requirements***

Based on the the City's flood code, all "development proposals shall not reduce the hydraulic capability of the floodplain on-site to convey floodwaters through the property during the base flood event. No rise in base flood elevations is allowed on adjacent properties. Providing this compensatory conveyance capacity can be done in conjunction with the compensatory storage, either on-site or off-site." (City of Arlington 2022). The FEMA model for this reach of the Stilliquamish River uses a steady-state flow condition to determine the applicable flood hazard area. Review of the available FEMA model for the general area determined the project site is located in an ineffective flow area (Figures 4 and 5); ineffective flow areas are used in HEC-RAS 1D modeling to indicate areas within the study area where conveyance is insignificant and flow velocities are at or near zero. Only storage capacity is calculated and/or analyzed for ineffective flow areas and thereby the focus on conditioned technical assessments, and conveyance is not applicable and therefore not necessary in continued technical assessments of flood related hazards.

### **3.2 Snohomish County Municipal Code**

#### ***Land Disturbing Activity Permit***

In addition to the flood hazard permit required by the City of Arlington, the Snohomish County Municipal Code requires a land disturbing activity permit for most projects. The County Code defines a "Land disturbing activity" as, "any activity that will result in movement of earth or a change in the existing [soil](#) cover or the existing [soil](#) topography (both vegetative and non-vegetative), including the creation and/or replacement of [impervious surfaces](#). Land disturbing activities include, but are not limited to, [clearing](#), filling,

[excavation](#) and [grading](#).” (Snohomish County 2022). Based on the code language, the placement of the fill materials is categorized under City and County code as a land disturbing activity and therefore will most likely require a land disturbing activity permit.

The requirements for a land disturbing activity permit submittal indicate “the [land disturbing activity permit](#) application shall comply with the submittal checklist established by the [department](#) pursuant to SCC [30.70.030](#). The [permit](#) application shall contain the following plans and reports, when applicable”:

- (1) [Land disturbing activity site](#) plan pursuant to SCC [30.63B.190](#);
- (2) Engineered [construction plans](#) pursuant to SCC [30.63B.200](#);
- (3) [Geotechnical engineering](#) report pursuant to SCC [30.63B.220](#);
- (4) [Soils engineering](#) report pursuant to SCC [30.63B.230](#);
- (5) [Engineering geology](#) report pursuant to SCC [30.63B.240](#);
- (6) Liquefaction report pursuant to SCC [30.63B.250](#);
- (7) Zero-rise analysis pursuant to SCC [30.63B.120\(3\)](#);
- (8) Stormwater [site](#) plans and reports necessary for compliance with chapter [30.63A](#) SCC; and
- (9) Haul route agreements related to the [land disturbing activity](#).” (Snohomish County 2022)

This flood related report addressed item #7 for the sero-rise analysis, and the remaining sections are assumed to be addressed by other team subject matter experts.

### ***3.2.1 Habitat Assessment Report***

Snohomish County adopted FEMA (2020) Floodplain Habitat Assessment checklist (see Appendix B for details) for management of development and related potential hazards or impacts to the environment in floodplain areas. The Floodplain Habitat Assessment checklist evaluates project specific potential impacts on a case-by-case basis, and would apply for any work extending outside of the City’s jurisdiction and into County areas. A habitat assessment report is typically required, “...to help project proponents and government agencies identify and address potential impacts of a proposed development on protected areas that have potential to adversely affect habitat functions for species listed under the Endangered Species Act (ESA)”. Because there is often limited information on any given site’s natural features, a habitat assessment is almost always required to “identify (habitat) features and determine how the proposed project will affect them.” (FEMA 2010).

This FEMA habitat assessment also requires consideration of storage and conveyance flood related hazards.

## 4. Compensatory Storage Calculations

A preliminary assessment of compensatory storage requirements was completed, using a site survey completed by True North in October, 2022 (Appendix C). Comparison of the recent site survey with publicly available 2017 LiDAR data (i.e. based on review of Google imagery, the 2017 LiDAR was determined to represent the site grading elevations prior to recent placement of the fill) concluded the following regarding the fill volumes and corresponding compensatory storage requirements (refer to Appendix D):

1. The changes in elevation between stated topographic data is represented as a heat map, showing areas of cut and fill materials at the site, characterizing imported fill materials, and thereby quantifying the required compensatory storage requirements;
2. Based on the comparison of base 2017 LiDAR data and the October 2022 survey:
  - a. approximately 536 CYs were moved from existing piles at the site and used to build the pad, along with some cut along the east side of the pad and clearing/cleaning of the stormwater pond;
  - b. Then an additional 4,890 CYs of fill was imported and placed (ranges from approximately 0-2.5 ft thick) to build up and flatten the pad;
  - c. The fill is all below the BFE is approximately 46.5ft, therefore all this material is subject to mitigation under the flood code;
  - d. With the previous in mind, approximately 4,890 CYs of compensatory storage is needed by moving/removing the pad materials; and,
  - e. Based on review of available site topography (using 2017 LiDAR, as shown in Appendix A), it looks feasible to maintain hydraulic connection back toward the river by grading into existing swale that flow back to the river, but it would require grading outside the City limits and into the County jurisdiction.

A number of grading options were considered, and preliminary grading option was developed that provided sufficient compensation of volume (i.e. the approximately 4,890 CY's of fill material), and also maintained hydraulic connectivity back to the main river channel. The total volume to achieve both objectives totals approximately 10,472 CY's (Appendix E). Note, this option is not the final plan, but is intended for planning purposes and represents a feasible alternative that meets the mitigation requirements and falls within the property owner boundaries. As previously mentioned, the available area in and around the site and within the City is limited, therefore the preliminary grading option and any other compensatory mitigation option(s) is likely to extend outside of the City limits and into Snohomish County jurisdiction (see Appendix B for regulatory requirements). New and/or changed information will inform and/or may change the results and conclusions as discussed herein.

## 5. References

Arlington Municipal Code. Chapter 20.64. 28 July 2022

FEMA. Floodplain Habitat Assessment and Mitigation. FEMA Region 10. January 2010.

Snohomish County Code. Chapter 30.63B. July 2021

## Figures

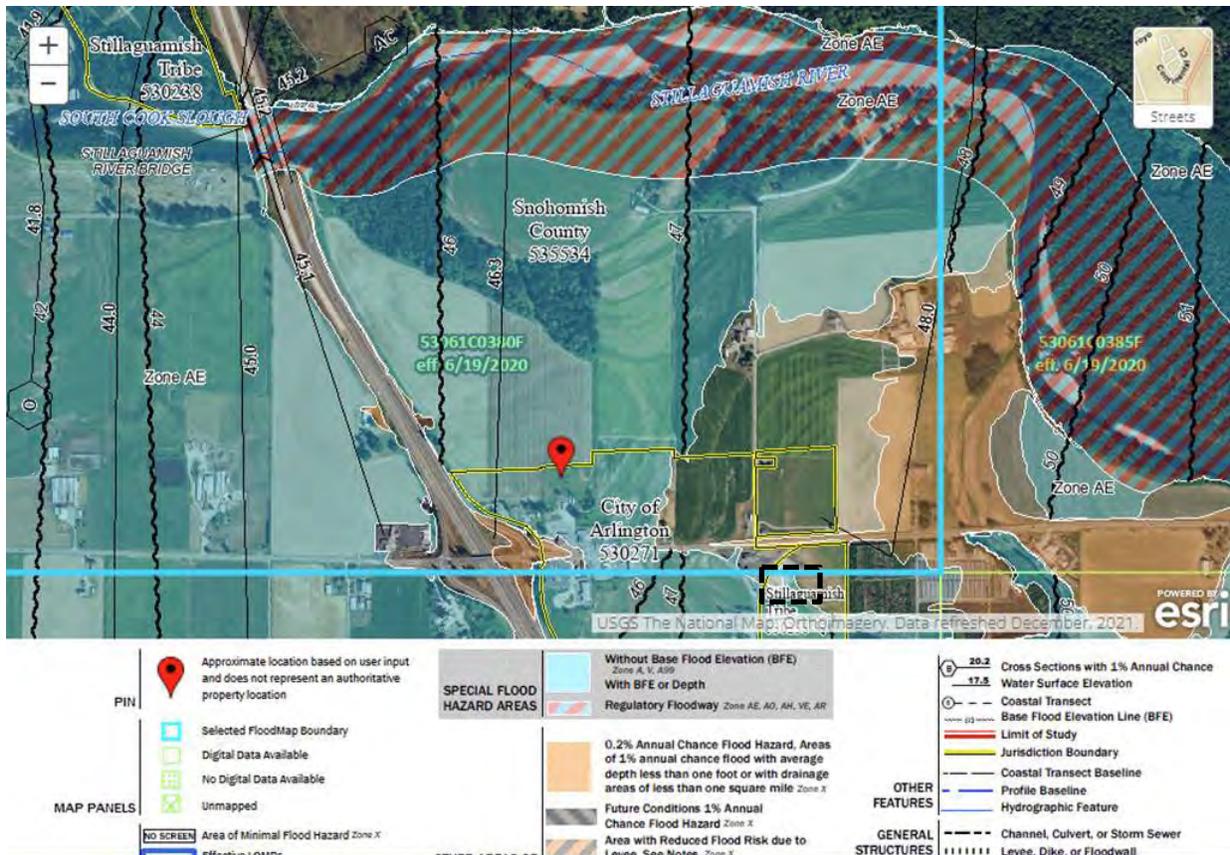


Figure 1: Snapshot of NFIP panel with city limits (approximate site highlighted by pin and dashed box).

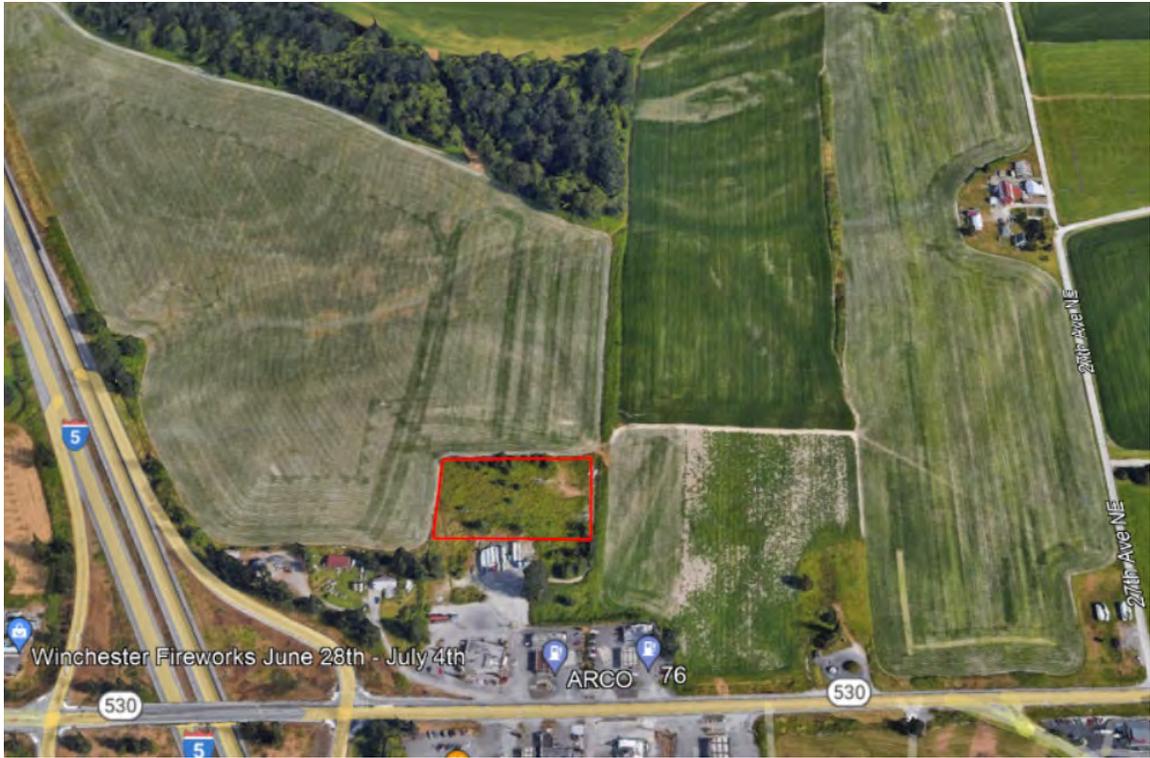


Figure 2: Location of project site prior to fill pad construction.



Figure 3: Image of fill pad on project site.

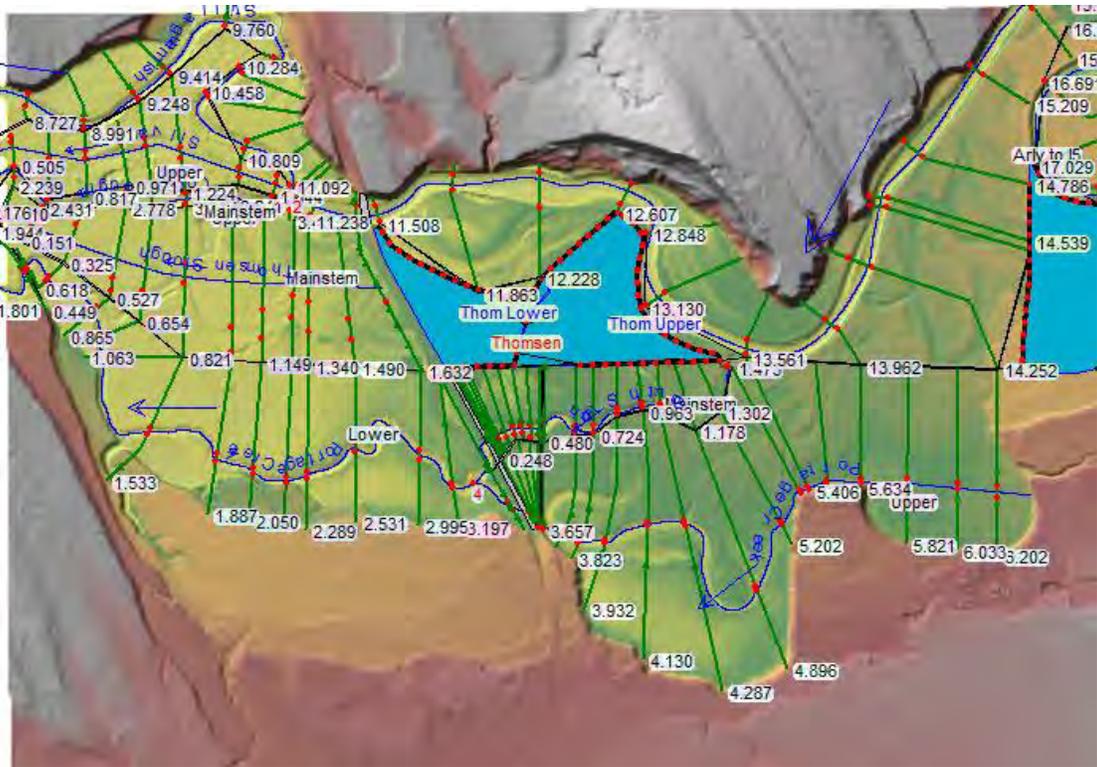


Figure 4: Model storage area where project site lies.

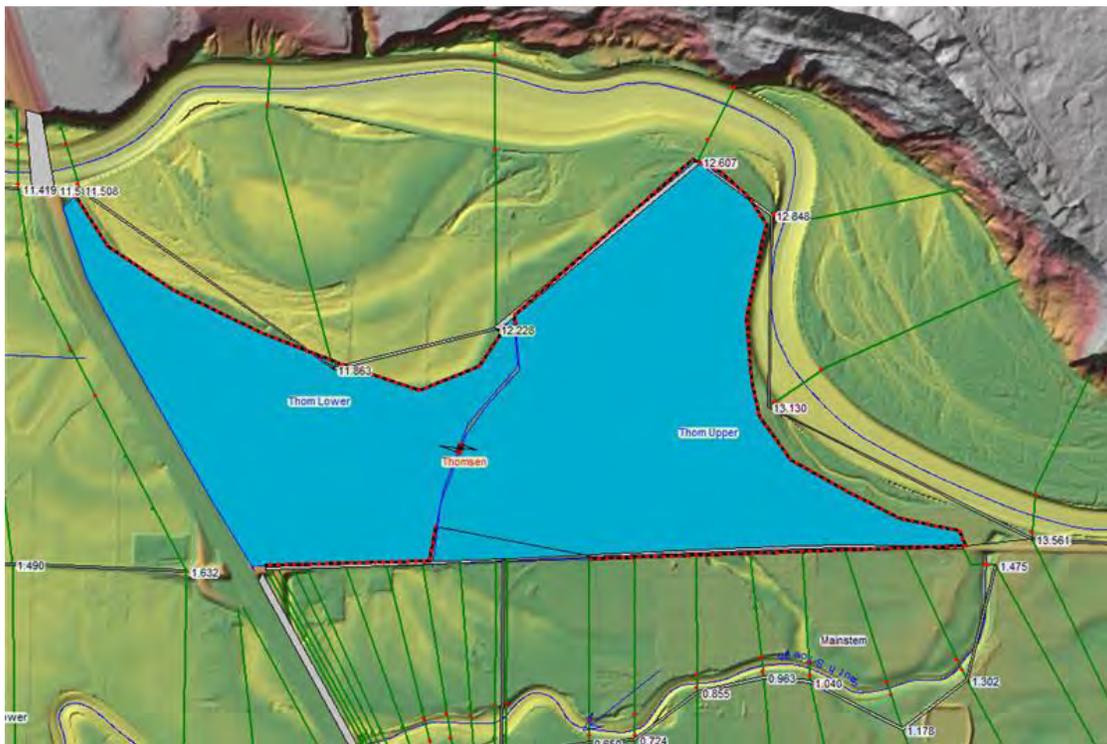


Figure 5: Zoomed view of model storage area.

**Appendix A**  
**Site Plan and BFE**



FIRM: WEST CONSULTANTS, INC.  
 ADDRESS: 12509 BEL-RED ROAD  
 STE 100  
 BELLEVUE, WA 98005-2535  
 PHONE: 425-646-8806  
 DATE: NOVEMBER 2022



**Appendix B**  
**FEMA Region 10 Habitat Assessment Checklist**



### INTRODUCTION

The National Flood Insurance Program (NFIP) is a voluntary federal program through which property owners in participating communities can purchase federal flood insurance as a protection against flood losses. In exchange, communities must enact local floodplain management regulations to reduce flood risk and flood-related damages within the mapped Special Flood Hazard Area (SFHA). The National Marine Fisheries Service's Biological Opinion (BiOp) (September 22, 2008) on the implementation of the National Flood Insurance Program in Puget Sound requires local communities that do not have BiOp-compliant floodplain management ordinances to require and review a Habitat Assessment (HA) before approving a floodplain permit, with some exceptions as noted below.

This worksheet is a tool for land use planners and biologists to 1) determine if an HA is needed and 2) identify items that must, at a minimum, be addressed in HAs. If a project does not fit into the categories in Section 1.1 or 1.2, then an HA would be required.

The permit application reviewer can use this worksheet to work through whether the application meets the requirements. By checking the box, the reviewer can track that the activity has been completed satisfactorily. If an HA is not required, check the box by the criteria that apply and retain this worksheet with the permit file. If an HA is required, complete the worksheet and retain a copy with the permit file.

The [Regional Guidance for Floodplain Habitat Assessment and Mitigation](#) (August 2013) provides more detail on how to prepare an HA and assess impacts of land management actions on Endangered Species Act (ESA)-listed salmonid species, orcas, and their designated critical habitats within floodplains.

For each permit decision, a community is required to retain the documentation relied upon in making the determination of effects on ESA-listed salmonids and orcas in perpetuity. Such documentation may include this completed checklist, the HA, or any other documents, reports, or studies that support the determination of effect on ESA-listed species.

### 1. EXCEPTIONS

#### 1.1 Neither a Floodplain Permit nor Habitat Assessment is needed

Communities may allow the following activities in the floodplain without requiring a floodplain development permit, provided all applicable federal, state, and local requirements are met. A Floodplain Permit is not required because these activities do not meet the NFIP definition of "development". Note: local community regulations may be more restrictive than the minimum standards (44 CFR 59).

- Routine maintenance of existing landscaping that does not involve grading, excavation, or filling.
- Removal of noxious weeds, hazard trees, and replacement of non-native vegetation with native vegetation.
- Normal maintenance of above ground utilities and facilities, such as replacing power lines and utility poles.
- Normal road maintenance, such as filling potholes, repaving, installing signs and traffic signals, but not including any expansion.
- Normal maintenance of a levee or other flood control facility as prescribed in the operations and maintenance plan for the facility. Normal maintenance does not include repair from flood damage, any expansion of the prism, face or toe expansion, or the addition of material for protection or armor.
- Plowing and other normal farm practices (other than new structures or filling) on legally existing agricultural areas. Clearing additional land for agriculture will likely require a floodplain development permit and a Habitat Assessment.

**"Development"** is "any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations or storage of equipment or materials." *Source: FEMA*

## 1.2 A Floodplain Permit is required but a Habitat Assessment is not Required

Communities may allow the following activities in the floodplain without an HA, provided a floodplain development permit is obtained, and all applicable federal, state, and local requirements are met. Please include documentation that supports the determination that an application is exempt from the HA requirement in the permit file when any of the following are applied to a project. Documentation must be kept in perpetuity.

- Normal maintenance, repairs, or remodeling of structures, such as re-roofing and replacing siding, provided such work is not a substantial improvement or a repair of substantial damage. To comply, such work must be less than 50% of the value of the structure(s).
- Expansion or reconstruction of an existing structure that is no greater than 10% beyond its existing footprint. If the structure is in the floodway, there shall be no change in the structure's dimensions perpendicular to flow. All other federal and state requirements and restrictions relating to floodway development still apply.
- Activities with the sole purpose of creating, restoring or enhancing natural functions associated with floodplains, streams, lakes, estuaries, marine areas, habitat, and riparian areas that meet federal and state standards, provided the activities do not include structures, grading, fill, or impervious surfaces.
- Development of open space and recreational facilities, such as parks, trails, and hunting grounds, that do not include structures, fill, impervious surfaces or removal of more than 5% of the native vegetation on that portion of the property in the floodplain.
- Repair to onsite septic systems, provided ground disturbance is the minimal necessary and best management practices (BMP's) to prevent stormwater runoff and soil erosion are used.
- Projects that have already received concurrence under another permit or other consultation with the Services, either through Section 7, Section 4d, or Section 10 of the Endangered Species Act (ESA) that addresses the entirety of the project in the floodplain (such as an Army Corps 404 permit or non-conversion Forest Practice activities including any interrelated and interdependent activities.).
- Repair of an existing, functional bulkhead in the same location and footprint with the same materials when the Ordinary High Water Mark (OHWM) is still outside of the face of the bulkhead (i.e. if the work qualifies for a Corps exemption from Section 404 coverage).

A "**Regulatory Floodway**" is the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height.  
Source: [FEMA](#)

Table 1: Bulkhead Considerations

| Armoring Scope   | Habitat Assessment Needed?  | Floodplain Development Permit Required |
|--|---|--|
| Bulkhead repair in same location and footprint with same materials. Bulkhead must be functioning and OHWM cannot be behind the structure to qualify as a repair. | No HA required  | Yes                                    |
| Bulkhead replacement: different material, different place, or different angle  | Yes – An abbreviated HA may be appropriate and address the <a href="#">Marine Shorelines Design Guidelines</a> (MSDG)/ <a href="#">Integrated Streambank Protection Guidelines</a> (ISPG) methodology | Yes                                    |
| New bulkhead   | Yes, address MSDG or ISPG methodology   | Yes                                    |

# PUGET SOUND BIOLOGICAL OPINION FLOODPLAIN HABITAT ASSESSMENT MINIMUM STANDARDS WORKSHEET (V 1.5)

Brief Description of Proposal: \_\_\_\_\_

Permit # \_\_\_\_\_

This checklist is intended to assist permit reviewers in determining whether an HA meets the minimum standards for the habitat assessment analysis.

## General BiOp Minimum Standards:

Each of the following must be documented in the permit file or an explanation provided as to why it does not apply to the project.

- New structures located in the least impactful location, as practicable. The permit file should include documentation of the measures taken to avoid placing structures in the floodplain and to minimize the impacts of the proposed project on floodplain functions (see [Floodplain Habitat Assessment and Mitigation](#), Section 5.2).
- Any removed large woody debris is replaced per [WDFW Aquatic Habitat guidelines](#).
- Bank armoring/stabilization follows and documents methodology consistent with WDFW [Marine Shorelines Design Guidelines](#) or the [Integrated Streambank Protection Guidelines](#). A needs and alternatives analysis is essential for these projects.
- The project is either inherently designed to avoid adverse impacts on floodplain functions (if in the Protected Area) or compensatory mitigation is provided so there are no adverse impacts on floodplain functions that support ESA listed species. See below for more information.
- As part of the flood permit, applicant has been notified that their property contains land within the Riparian Buffer Zone (RBZ) and/or floodplain.
- Prior to permit issuance, the applicant has recorded a notice on the title of the property stating that the property is within the RBZ and/or the 100-year floodplain.

The **Protected Area** is defined as greater of the Floodway, Riparian Buffer Zone (RBZ), or Channel Migration Zone (CMZ). If no CMZ is identified in a riverine system, the Protected Area extends to the outer limits of the floodplain. **Please note the Protected Area does not extend outside of the SFHA.**

## Minimum Habitat Assessment Standards:

In addition to customary elements of a project application such as a project description, site plans, and methods of work, the HA must show that the proposal will result in no adverse effects on floodplain functions and/or includes appropriate compensatory mitigation. The HA document and analysis must include the elements listed below. This checklist is provided to assist the HA reviewer in determining whether an HA is sufficient.

- Project and action area description, maps, and site plans have been provided
- Methods of work are described
- Projects in the Protected Area are designed to inherently avoid detrimental impacts without mitigation.
- The HA specifically considers both direct and indirect impacts. Indirect impacts are a result of an action and can occur later in time or in a different place and are reasonably foreseeable.
- The HA evaluates the impacts of interrelated and interdependent activities.

The **action area** to be analyzed should typically be well beyond the subject parcel(s) and must consider all areas that could be impacted by the proposal, especially including indirect effects and effects of interrelated and interdependent actions, in the vicinity of and downstream from the proposal (and only within the SFHA).

An **interrelated activity** is part of the the proposed action and depends on the proposed action for its justification. An interdependent activity has no independent utility apart from the proposed action (USFWS, NMFS 1998)

- The HA specifically considers cumulative impacts of reasonably foreseeable projects beyond the subject proposal/lot for all of the elements of the analysis listed below, and especially loss of storage.
- The HA contains sufficient analysis for each specific item below to demonstrate a claim of no adverse effect on the existing (legal) condition of the floodplain functions (baseline condition). If an element does not apply to a particular project, the HA should briefly explain why.
- 1. Water quantity and quality will not be affected by demonstrating that pre-development water pattern will be substantially the same as the post-development water pattern. The following items should be included in the analysis:
  - The HA demonstrates how low impact development techniques have been used
  - New impervious surfaces are noted and included in the analysis
  - Water temperature impacts from development have been evaluated
  - Potential changes in groundwater and hyporheic functions, pollutants, and sediment runoff have been evaluated
  - Stormwater leaves the site with the same frequency, timing, and duration as before the development
- 2. Flood velocities and volumes are not increased, even when considering cumulative impacts.
- 3. Flood storage capacity is not affected or compensatory storage has been proposed that:
  - Provides sufficient capacity to hold displaced flood storage volume
  - Restores ground elevations that are comparable to the existing conditions
  - Maintains floodplain connectivity and fish access (fish will not be stranded or trapped as the floodplain fills and drains)
  - Provides floodplain refugia and habitat for listed fish comparable to the existing condition
  - Is hydrologically connected to the flooding source
  - Is located within the same hydraulic reach as the proposed development to minimize effects on fish populations.
- 4. Riparian vegetation evaluation has been included
- 5. Measures to preserve habitat forming processes (such as large woody debris recruitment) are included
- 6. Refuge from higher velocity floodwaters is provided
- 7. Spawning substrate is provided or protected
- 8. Ensure there are no adverse effects resulting from:
  - Habitat isolation
  - Bank armoring
  - Channel straightening
  - Construction effects (transport of sediment from the work area, noise, etc.)
  - Direct effects

**Cumulative impacts** are the incremental effect of an action, together with impacts of present and reasonably foreseeable future actions by state, tribal, local, or private entities. Cumulative effects can result from individually minor but collectively significant actions taking place over time.

The **hyporheic zone** is a region beneath and alongside a stream bed, where there is mixing of shallow groundwater and surface water.

**Compensatory storage** is generally necessary for displaced flood storage volume and loss of accessible floodplain refugia for listed fish when a project includes fill or structural displacement.

A **refugium** (plural: refugia) is a location which supports an isolated or relict population of a once more widespread species.

**Substrate:** a substance or layer that underlies something, or on which some process occurs, in particular.

- the surface or material on or from which an organism lives, grows, or obtains its nourishment.
- the substance on which an enzyme acts.

**Habitat Isolation** means the separation of habitat components (such as main channel and off channel habitats) such that a species can no longer access all of the habitat elements even though they may still be present on the landscape.

## Effect Determinations:

Following the evaluation of potential effects, the HA should make a determination of the effect of the proposed development on listed salmonid species and orcas. The effects determination should be one of the following options. Please check which effects determination has been made in the HA under review.

- No Effect (NE):** The project will have no effect whatsoever on listed species and designated floodplain functions. An insignificant or discountable affect is not the same as no effect. If work affects any items evaluated in the HA section above, even insignificantly, an NE determination is typically not appropriate.
- May Affect, Not Likely to Adversely Affect (NLAA):** The appropriate conclusion when effects on the species or floodplain functions that support those species are expected to be beneficial, discountable, or insignificant - even when considering direct, indirect, and cumulative impacts. Beneficial effects are positive impacts without any adverse effects on fish or habitat. Insignificant effects refer to the size of the impact and discountable effects are those extremely unlikely to occur due to timing. Based on best judgement, a person cannot meaningfully measure, detect, or evaluate insignificant effects or expect discountable effects to occur. The term "negligible" means the same as "insignificant" (immeasurable).
- Likely to Adversely Affect (LAA):** The effect of the project is likely to result in a short or long-term adverse effect on listed species or floodplain functions.

## Proposal is Within the Protected Area

If the proposal is within the Protected Area, the following four conditions must be met through the HA analysis. The Protected Area is defined below.

- All "General BiOp Minimum Standards" have been met.
- All minimum "Habitat Assessment Standards" have been addressed.
- No mitigation is proposed. The project design inherently avoids adverse effects. Project design elements that consider and improve floodplain functions that support ESA-listed species may be incorporated.
- The proposal will result in an NE or NLAA effects determination for ESA-listed species..

Table 2: Minimum Area of Habitat Assessment in Protected Areas

| Water/Stream Type            | RBZ         |
|------------------------------|-------------|
| CMZ                          | CMZ+50 feet |
| S (Shorelines of the State)  | 250 feet    |
| F >5' and Marine Shorelines  | 200 feet    |
| F <5' and Lakes <sup>1</sup> | 150 feet    |
| N w/unstable slopes          | 225 feet    |
| N                            | 150 feet    |

The **riparian buffer zone (RBZ)** is the land adjacent to streams and other bodies of water where vegetation is strongly influenced by the presence of water. They are often thin lines-of-green containing native grasses, flowers, shrubs and trees that line the banks of streams and other bodies of water.

The **channel migration zone (CMZ)** is the area along a river within which the channel(s) can be reasonably predicted to migrate over time as a result of natural and normally occurring hydrological and related processes.

<sup>1</sup> Lakes are defined as over 20 acres.



**Appendix C**  
**True North Site Survey**

SURVEYED: TC/RS  
 DRAWN: CM  
 CHECKED: RJM

| REV | REVISION | DATE | BY | APP'D |
|-----|----------|------|----|-------|
|     |          |      |    |       |
|     |          |      |    |       |
|     |          |      |    |       |
|     |          |      |    |       |
|     |          |      |    |       |
|     |          |      |    |       |
|     |          |      |    |       |
|     |          |      |    |       |
|     |          |      |    |       |
|     |          |      |    |       |

**True NORTH**  
 LAND SURVEYING, INC.  
 1930 6th Avenue S  
 Suite 401  
 Seattle, WA 98134  
 206.332.0800

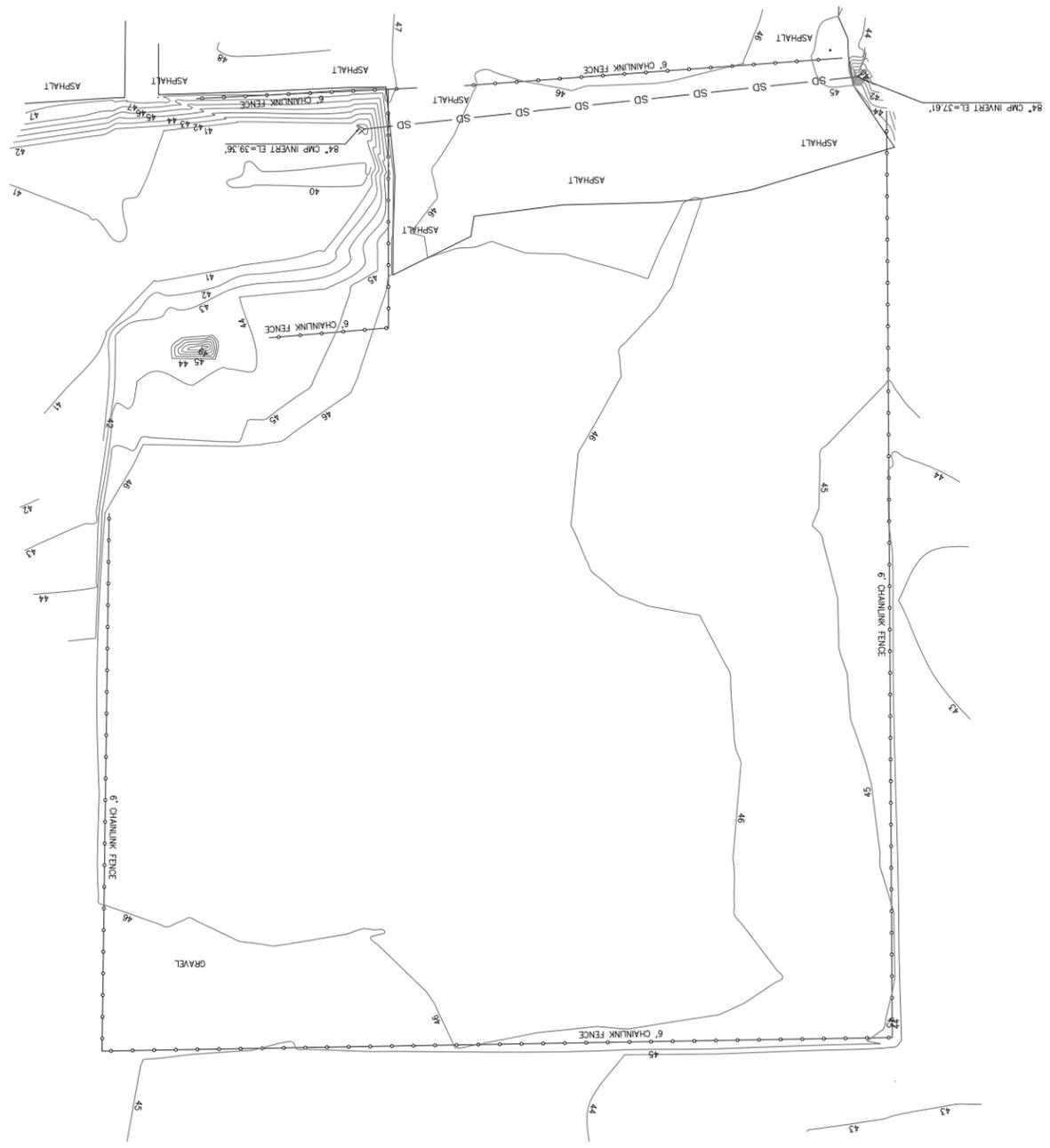


Date: 11-1-22  
 Scale: 1" = 40'  
 Book: J22-193.dwg

**2208 SR 530- Arlington**  
 TOPOGRAPHIC SURVEY  
 For West Consultants

Job Number: J22-193.00  
 Sheet: 1 of 1

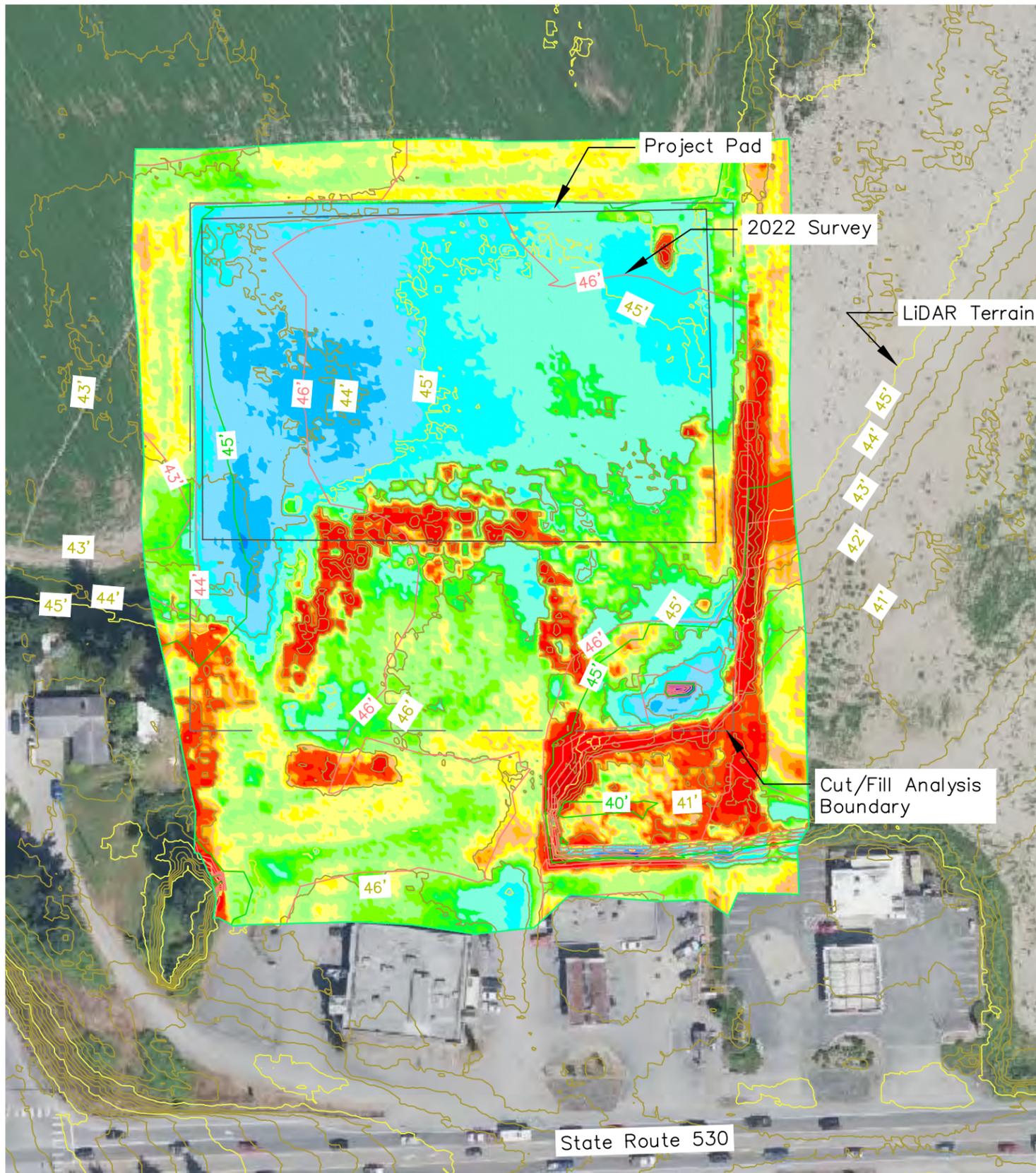
LEGEND  
 ○ FENCE LINE AS NOTED  
 — UNDERGROUND STORM LINE  
 < CULVERT AS NOTED



1. HORIZONTAL DATUM: WASHINGTON STATE PLANE COORDINATE SYSTEM NORTH ZONE NAD 83/2011  
 MON ID: 958  
 DESIGNATION: GP31530-42  
 OWNER: WSDOT  
 TO REACH THE STATION FROM THE JUNCTION OF SR 005 AND SR 530 OVER-CROSSING, GO EAST 1.10 MILES ALONG SR 530 TO MARK ON LEFT. IT IS LOCATED 1.9 METERS @ 160 DEGREES FROM A WITNESS POST, 4.0 METERS @ 220 DEGREES FROM THE 1.8 METERS DIA. O.C.P. AND 7.2 METERS @ 220 DEGREES FROM THE APPROXIMATE CENTERLINE OF SR 530. THE MARK IS A WSDOT BRASS DISK SET INTO A ROUND CONCRETE MONUMENT AND IS SET 9 CM BELOW THE GROUND SURFACE.  
 SCALE: 0.99994301  
 COMB FACTOR: 0.99994397  
 CONV ANGLE: -1° 00' 05.6"  
 ELEVATION: 54.278'  
 NORTHING: 436473.238  
 EASTING: 1312292.926  
 MON ID: 1518  
 DESIGNATION: GP31005-55  
 OWNER: WSDOT  
 THE STATION IS LOCATED AT THE JUNCTION OF SR 005 AND SR 530, NEAR THE END OF THE WINGWALL ON THE NORTHEAST CORNER OF THE UNDER-CROSSING STRUCTURE. THE MARK IS A WSDOT BRASS DISK SET LEVEL WITH THE TOP OF THE CONCRETE WINGWALL.  
 SCALE: 0.99994300  
 COMB FACTOR: 0.99994330  
 CONV ANGLE: -1° 01' 09.3"  
 ELEVATION: 68.336'  
 NORTHING: 436293.885'  
 EASTING: 1306499.293'  
 2. VERTICAL DATUM: NAVD 88  
 WSDOT MONUMENT ID: 1518  
 DESIGNATION: GP31005-55  
 ELEVATION= 68.336 USFT  
 3. DATE OF SURVEY: OCTOBER 18TH, 2022  
 4. EQUIPMENT USED: LEICA TS 16.  
 5. UTILITIES SHOWN HEREON WERE FROM PHYSICAL STRUCTURES.  
 6. 1' CONTOUR INTERVAL

PORTION OF THE SW 1/4 OF THE NW 1/4 OF SECTION 8, T 31 N, R 5 E, W.M.

**Appendix D**  
**Compensatory Storage Calculation**



Cut and Fill Table

| Number | Minimum Elevation | Maximum Elevation | Area     | Color         |
|--------|-------------------|-------------------|----------|---------------|
| 1      | -7.50             | -5.00             | 117.54   | Dark Red      |
| 2      | -5.00             | -3.00             | 2059.32  | Red           |
| 3      | -3.00             | -1.00             | 14334.67 | Bright Red    |
| 4      | -1.00             | -0.50             | 15335.10 | Orange-Red    |
| 5      | -0.50             | -0.40             | 4799.42  | Orange        |
| 6      | -0.40             | -0.30             | 5903.67  | Yellow-Orange |
| 7      | -0.30             | -0.20             | 8871.68  | Light Orange  |
| 8      | -0.20             | -0.10             | 17058.81 | Yellow        |
| 9      | -0.10             | 0.00              | 28262.91 | Light Yellow  |
| 10     | 0.00              | 0.10              | 26403.22 | Light Green   |
| 11     | 0.10              | 0.20              | 21494.50 | Light Green   |
| 12     | 0.20              | 0.30              | 17216.20 | Light Green   |
| 13     | 0.30              | 0.40              | 12777.92 | Light Green   |
| 14     | 0.40              | 0.50              | 10412.29 | Light Green   |
| 15     | 0.50              | 1.00              | 41588.55 | Light Green   |
| 16     | 1.00              | 1.50              | 28828.99 | Light Blue    |
| 17     | 1.50              | 2.00              | 30192.18 | Light Blue    |
| 18     | 2.00              | 2.50              | 9912.61  | Light Blue    |
| 19     | 2.50              | 3.00              | 166.00   | Light Blue    |
| 20     | 3.00              | 5.00              | 135.31   | Light Blue    |
| 21     | 5.00              | 7.02              | 59.02    | Light Blue    |

Cut & Fill Analysis Results

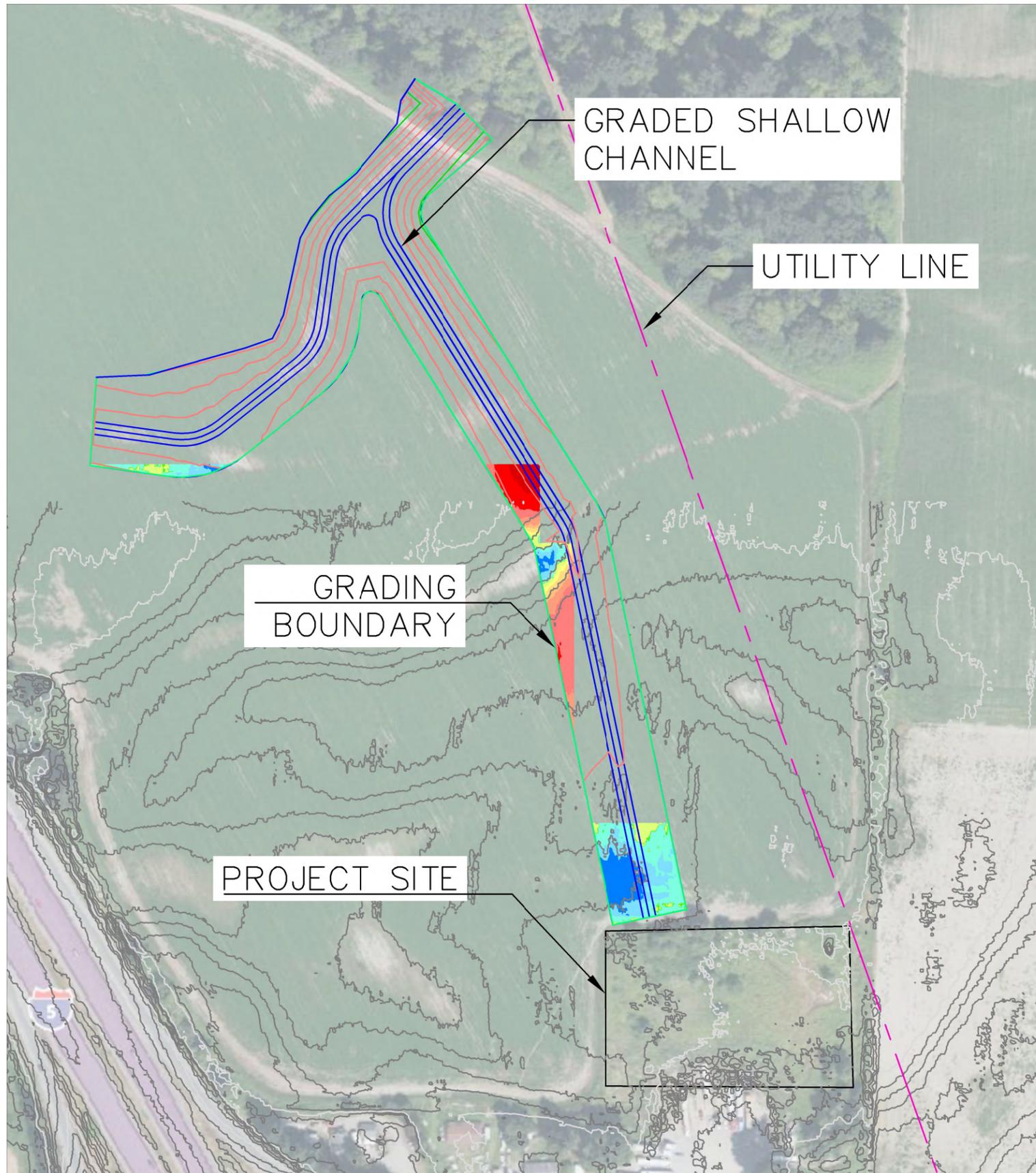
| Boundary          | Area (sq. ft.) | Cut (CY) | Fill (CY) | Net (CY)     |
|-------------------|----------------|----------|-----------|--------------|
| Project Pad       | 99,606         | 181      | 4,176     | 3,995 (fill) |
| Cut/Fill Analysis | 171,467        | 536      | 5,426     | 4,890 (fill) |

FIRM: WEST CONSULTANTS, INC.  
 ADDRESS: 12509 BEL-RED ROAD  
 STE 100  
 BELLEVUE, WA 98005-2535  
 PHONE: 425-646-8806  
 DATE: NOVEMBER 2022



## **Appendix E**

Option for Compensatory Storage Grading Pla



| Number | Min. Difference (ft) | Max Difference (ft) | Area     | Color       |
|--------|----------------------|---------------------|----------|-------------|
| 1      | -5.01                | -3.00               | 18288.40 | Red         |
| 2      | -3.00                | -2.00               | 36344.18 | Red         |
| 3      | -2.00                | -1.50               | 29665.17 | Red         |
| 4      | -1.50                | -1.00               | 35278.50 | Red         |
| 5      | -1.00                | -0.75               | 17647.81 | Orange      |
| 6      | -0.75                | -0.50               | 23084.78 | Yellow      |
| 7      | -0.50                | -0.25               | 27025.87 | Yellow      |
| 8      | -0.25                | -0.01               | 27747.80 | Light Green |
| 9      | -0.01                | 0.01                | 2511.83  | Green       |
| 10     | 0.01                 | 0.25                | 23258.61 | Cyan        |
| 11     | 0.25                 | 0.50                | 9473.55  | Light Blue  |
| 12     | 0.50                 | 1.50                | 5602.05  | Blue        |

| Boundary | Area (sq. ft.) | Cut (CY) | Fill (CY) | Net (CY)     |
|----------|----------------|----------|-----------|--------------|
| GRADING  | 255,961        | 10,844   | 372       | 10,472 (cut) |

FIRM: WEST CONSULTANTS, INC.  
 ADDRESS: 12509 BEL-RED ROAD  
 STE 100  
 BELLEVUE, WA 98005-2535  
 PHONE: 425-646-8806  
 DATE: FEBRUARY 2023



PAGE LEFT INTENTIONALLY BLANK