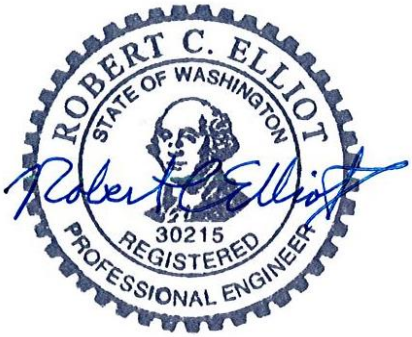
Memorandum

To: Tex Ladish, NW Educational Service District 189
Sarah Edens, Freeland and Associates

From: Bob Elliot and Nick Brouillard, WSE

Date: January 27, 2023

Re: Hydraulic Evaluation of Proposed Bus Barn in Sumas, WA



INTRODUCTION

This technical memorandum summarizes the hydraulic analyses performed by Watershed Science and Engineering (WSE) to evaluate potential flood impacts associated with a proposed bus barn to be located at Sumas Elementary School at 1024 Lawson St in the City of Sumas. The site plan for the project is shown in Figure 1. The project site is within the Nooksack River overflow path along the Johnson Creek corridor, identified as a Special Flood Hazard Zone (SFHA) as shown in the effective FEMA flood maps. The effective maps predict a base flood elevation (BFE) of approximately 43 feet NAVD at the site, as do draft maps released by FEMA in 2020. The most current FEMA draft workmaps, just released this month (January 2023) to the City of Sumas and other communities, show a BFE of 44 feet NAVD. A finished floor elevation (FFE) for the bus barn of 46.5 feet has been established (Figure 1), sufficiently high for the new increased BFE. Sumas Elementary School including the proposed fill site, while located in the SFHA floodplain, remains outside of any mapped floodway either on the effective FEMA maps or their new draft workmaps. It also lies outside the City's designated Special Flood Risk Zone[1]. However, to further ensure no adverse impacts to neighboring properties, the hydraulic analysis summarized herein was completed.

For the purpose of evaluating flood impacts of the project, newer models are available that improve upon the effective model from over 30 years ago, which was based on legacy software no longer available. Newer 1D unsteady modeling using FEQ software was completed in 2019, which resulted in the draft flood maps in 2020. More recent HEC-RAS 2D unsteady modeling of the Lower Nooksack River completed in 2022 by Northwest Hydraulic Consultants under contract to Whatcom County simulates 100-year base flooding but doesn't consider levee embankment failures. To determine worst-case 100-year flooding for the project site, WSE obtained this most recent 2D model and assumed an embankment failure scenario that would convey greater overflow from the Nooksack River, past Everson and into Sumas. This scenario assumes removal (failure) of a continuous embankment along the Nooksack River right bank (facing downstream), consisting of Massey Road west of SR 9, Emmerson Road, and Lagerway Dike continuing to Everson Road near Everson Bridge. These embankments function as a continuous flood control facility but are not certified by FEMA; therefore, it is prudent for their failures to be considered. The failure and non-failure cases were both evaluated for proposed and existing conditions to determine predicted rise in the BFE.

[1]https://www.cityofsumas.com/wp-content/uploads/2018/01/Map4_Sumas_FEMA_8_5x11_June2016_Revised.pdf

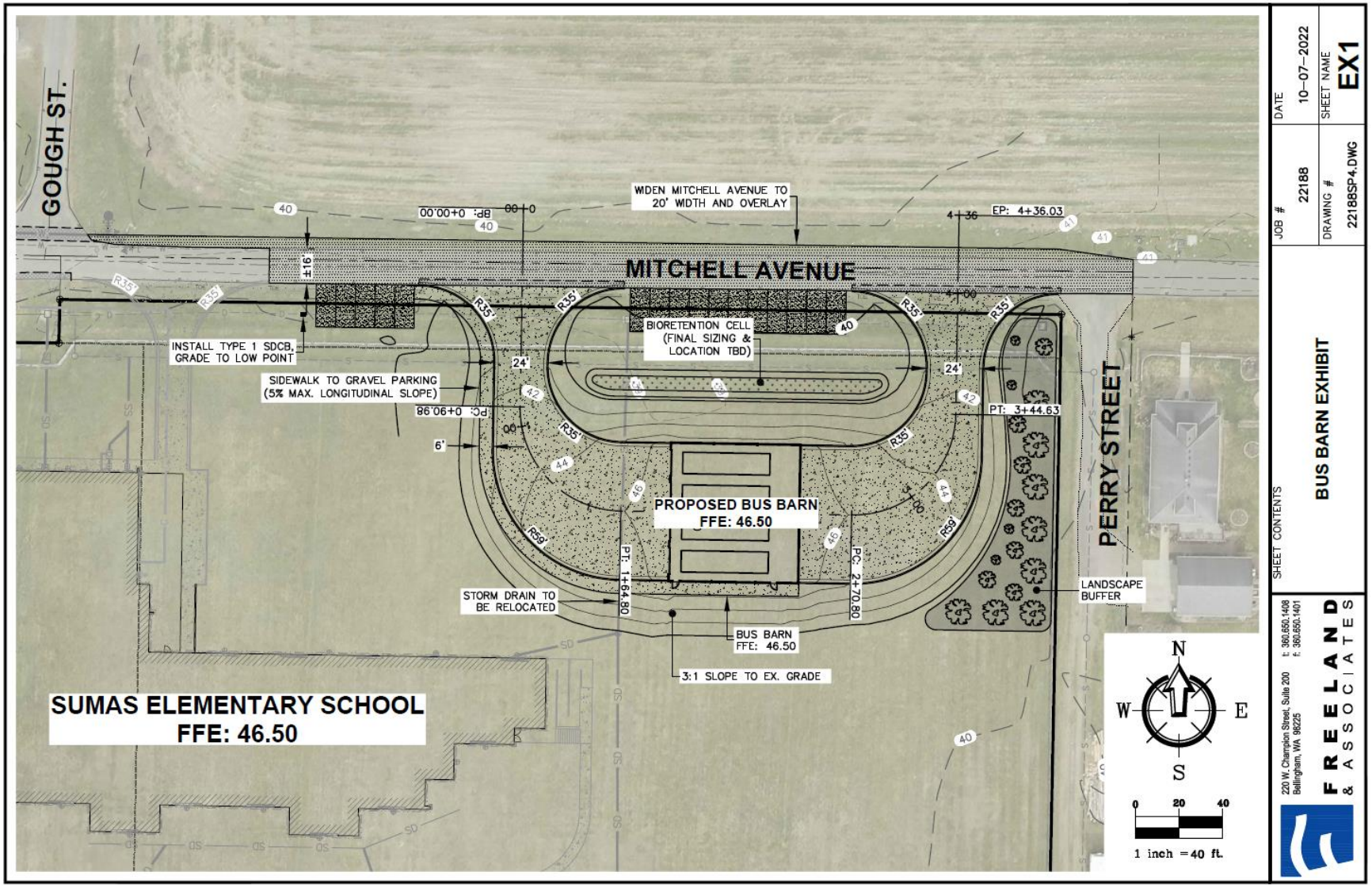


Figure 1 – Site Plan for Sumas Bus Barn

The January 2023 Nooksack River workmaps released by FEMA are based on the same HEC-RAS 2D 100-year model provided to WSE. FEMA further refined the modeling and examined various combinations of levee and roadway failures, along with a no failure scenario, combined to produce a composite flood map with BFEs assigned based on the worst-case at all locations. WSE obtained from FEMA polygon shapefile data defining the extent of roadway and levee failure described previously from SR 9 to Everson Bridge, which represents the worst-case scenario for flooding in Sumas.

ANALYSIS

Figure 2 illustrates the proposed 2D model terrain at the project site, based on 2015 LiDAR data. The proposed conditions terrain includes the proposed bus barn and ramp created using the terrain modifications feature in HEC-RAS Mapper. The model was run with the no levee failure as well the levee and roadway failure scenarios for both the existing and proposed conditions. Results of the proposed conditions were compared to the corresponding existing conditions results for each failure scenario. Figure 3 provides the flow depth results in shades of blue (darker blue represents greater depths) for the levee and roadway failure scenario to illustrate the predicted worst-case flood extents. The predicted flood extents are notably similar to the draft workmaps recently provided by FEMA to the City of Sumas, with a BFE within a few tenths of a foot of what can be interpolated from the new workmaps.

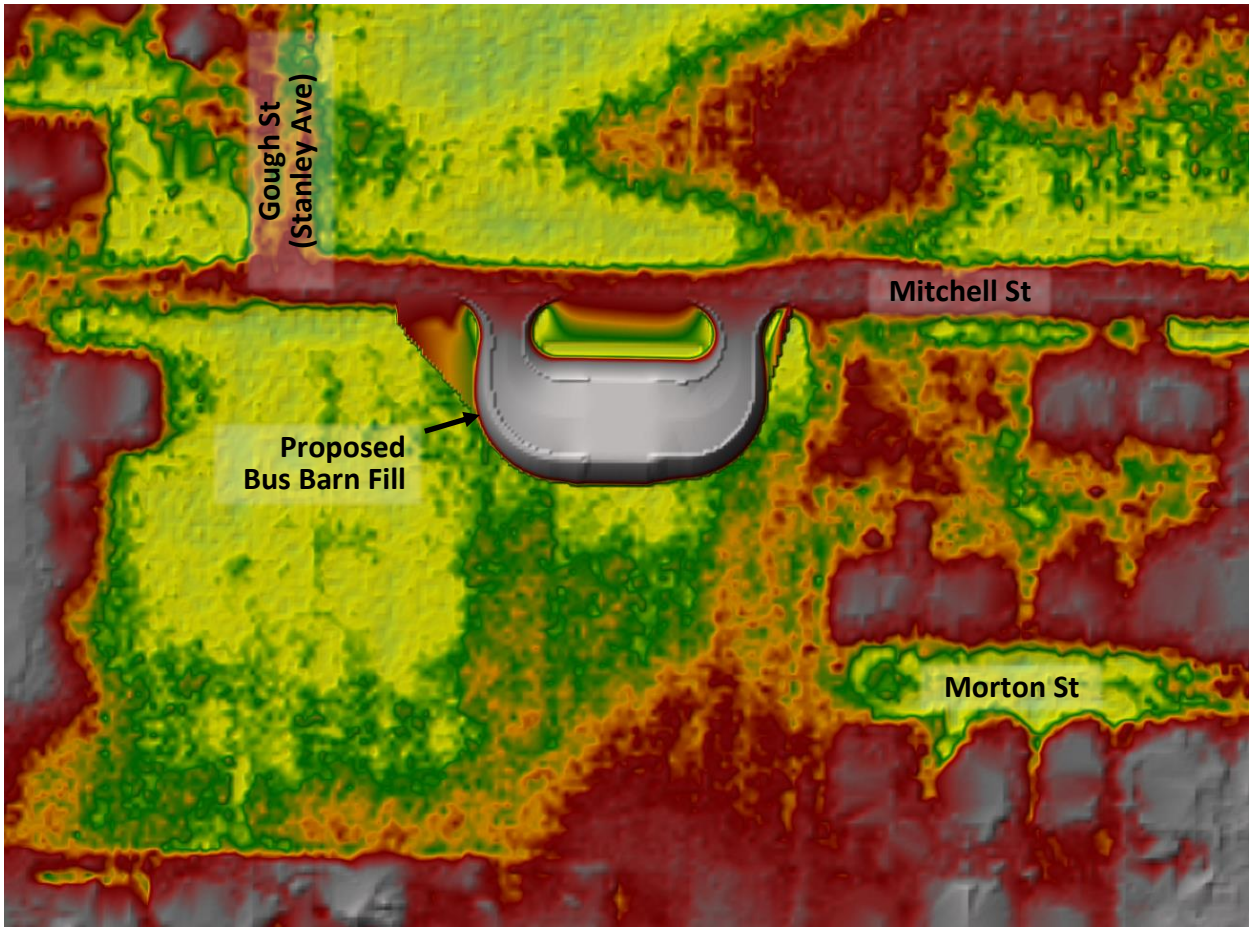


Figure 2 – Model Terrain with Proposed Bus Barn Fill for Ramp and Structure

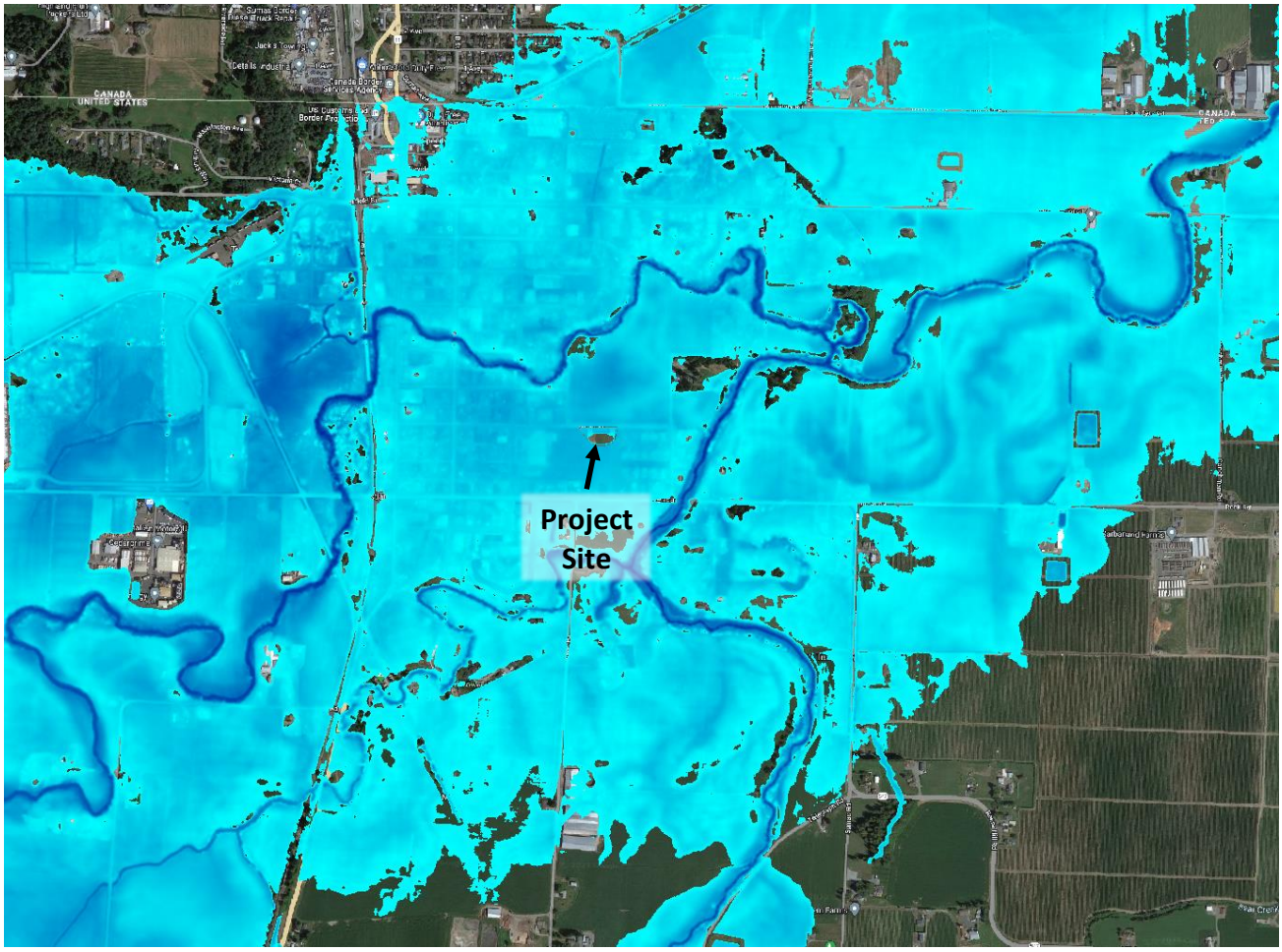


Figure 3 – Modeled 100-year Flood Depths with Everson Levee and Road Failures

RESULTS

Table 1 summarizes maximum water surface elevation and rise results from the no failure and failure scenarios for the existing and proposed conditions on the project site. Table 2 summarizes results outside of the Sumas Elementary School property. Under the worst-case levee failure scenario, the maximum increase in water surface elevation onsite is less than 0.1 feet. Offsite, on adjacent properties, the maximum rise is only about 0.05 feet. These results are based on the assumed Nooksack River levee and roadway failure scenario, which would be used to establish BFEs at the proposed bus barn and closely mimics the BFEs and flood extents shown on FEMA's new draft workmaps. For existing and proposed conditions, maximum simulated velocities are also small, less than 3 feet/sec, such that the proposed development would not likely deflect significant flow nor likely cause any erosion problems on adjacent properties.

Table 1 – 100-year Maximum Rise from 2D Model at Bus Ramp Fill

Failure Scenario	*Baseline (existing) Conditions Water Surface Elevation (feet NAVD88)*	*Proposed (project) Conditions Water Surface Elevation (feet NAVD88)*	*Change in Water Surface Elevation (feet)*
No levee or roadway failures	43.170	43.249	0.080
Levee and roadway failures	43.602	43.688	0.086

Table 2 – 100-year Maximum Rise from 2D Model Outside of Sumas Elementary

Failure Scenario	*Baseline (existing) Conditions Water Surface Elevation (feet NAVD88)*	*Proposed (project) Conditions Water Surface Elevation (feet NAVD88)*	*Change in Water Surface Elevation (feet)*
No levee or roadway failures	43.194	43.249	0.055
Levee and roadway failures	43.633	43.686	0.053

CONCLUSION

Unsteady two-dimensional (2D) modeling has been completed for the purposes of evaluating potential increases in flood levels as a result of a proposed bus barn facility on Sumas Elementary School property at 1024 Lawson St in Sumas, WA. The bus barn will be located on Mitchell Ave at the NE corner of the school property (see Figure 1), within the effective mapped floodplain of the Nooksack River which was established more than 30 years ago. Applying newer 2D modeling, WSE determined that a worst-case levee failure (based on scenarios provided by FEMA) resulted in predicted BFEs and flood extents similar to the new draft workmaps recently released by FEMA. Simulating the proposed conditions by adding terrain representing the proposed bus barn fill resulted in a predicted BFE increase of less than 0.1 foot.

The project site lies outside of any mapped floodway from the effective regulatory maps, the proposed 2020 draft mapping, or the latest draft workmaps released this month (January 2023). Neither is the site within the City's identified Special Flood Risk Zone. Per Sumas flood code, additional floodplain analyses were technically not required, but requested just to ensure no adverse impacts to properties adjacent to Sumas Elementary School. Hydraulic modeling and results summarized in this document should satisfy any possible concern of significant offsite flood impacts.