

# Memorandum

To: Chris vanStaalduinen, Habitat for Humanity of Whatcom

From: Bob Elliot, PE, WSE

Date: April 14, 2022

Re: Hydraulic Evaluation of Proposed Lincoln Street Development in Everson WA

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## INTRODUCTION

This technical memorandum summarizes hydraulic analyses undertaken by WATERSHED Science and Engineering (WSE) to evaluate hydraulic impacts associated with the Proposed Lincoln Street Development residential complex by Habitat for Humanity in the City of Everson, Washington. The project site, presently undeveloped save for a single storage building along its western margin, is located on the south side of the recently extended Lincoln Street between South Washington Street and Blair Drive. Everson Mobile Home Estates borders the project to the immediate south, and the Everson Market is located approximately one-half block north. The project site is partially located within the overflow floodplain of the Nooksack River, where large flood events bifurcate upstream of Everson, with overflows diverted from the river corridor and conveyed through Everson to the City of Sumas and into British Columbia, eventually reaching the Fraser River. Figure 1 identifies the site location on the effective (existing) FEMA flood hazard mapping, while Figure 2 identifies the site on updated draft FEMA mapping from 2020. On both maps, approximately two-thirds to three-quarters of the site is located within the 100-year floodplain (colored light blue), with the western to southwestern areas mapped outside the special flood hazard either as 500-year inundation (colored orange) or high and dry. A 100-year base flood elevation (BFE) of 88 feet NAVD 1988 datum passes through the site under both mapping scenarios. This is equivalent to a flood elevation of 84 feet in the older NGVD 1929 datum. The project is situated completely outside of the regulatory floodway (colored red). The latest site plan for the proposed development is illustrated in Figure 2.

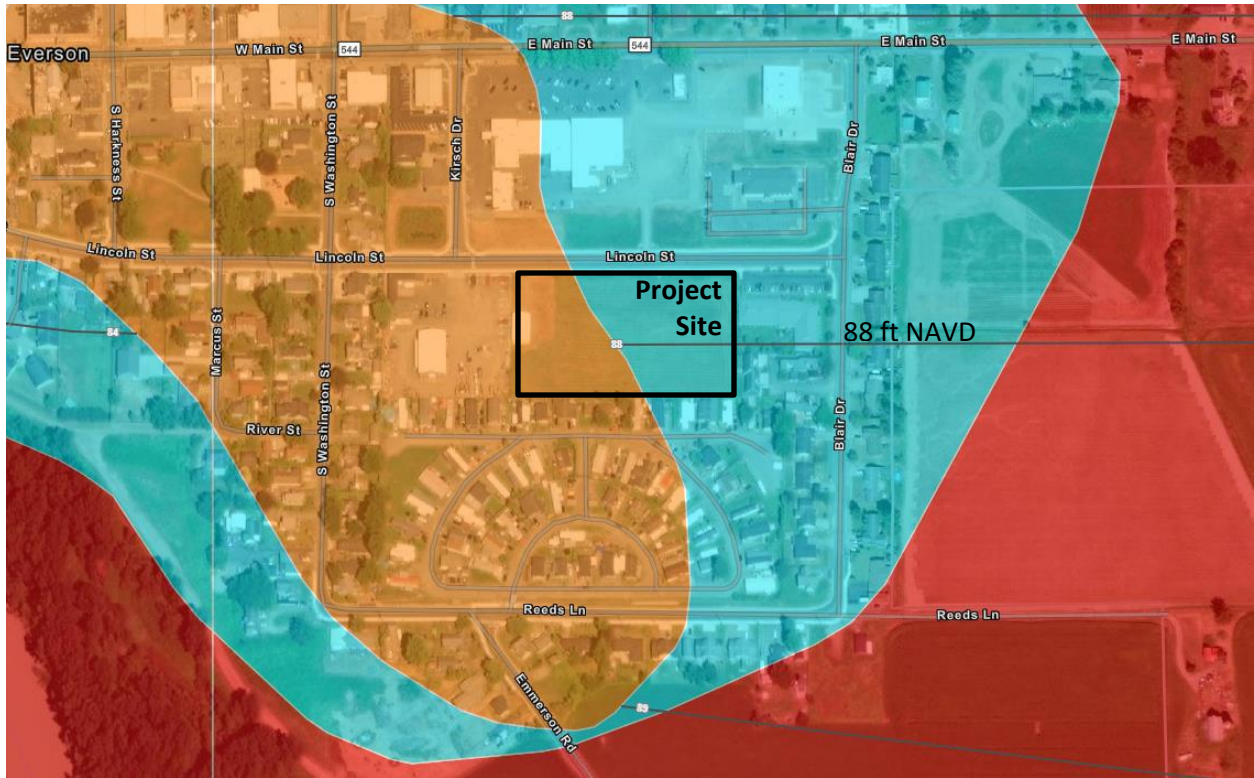


Figure 1 – Vicinity Map of Proposed Lincoln Street Development with Effective FEMA Mapping

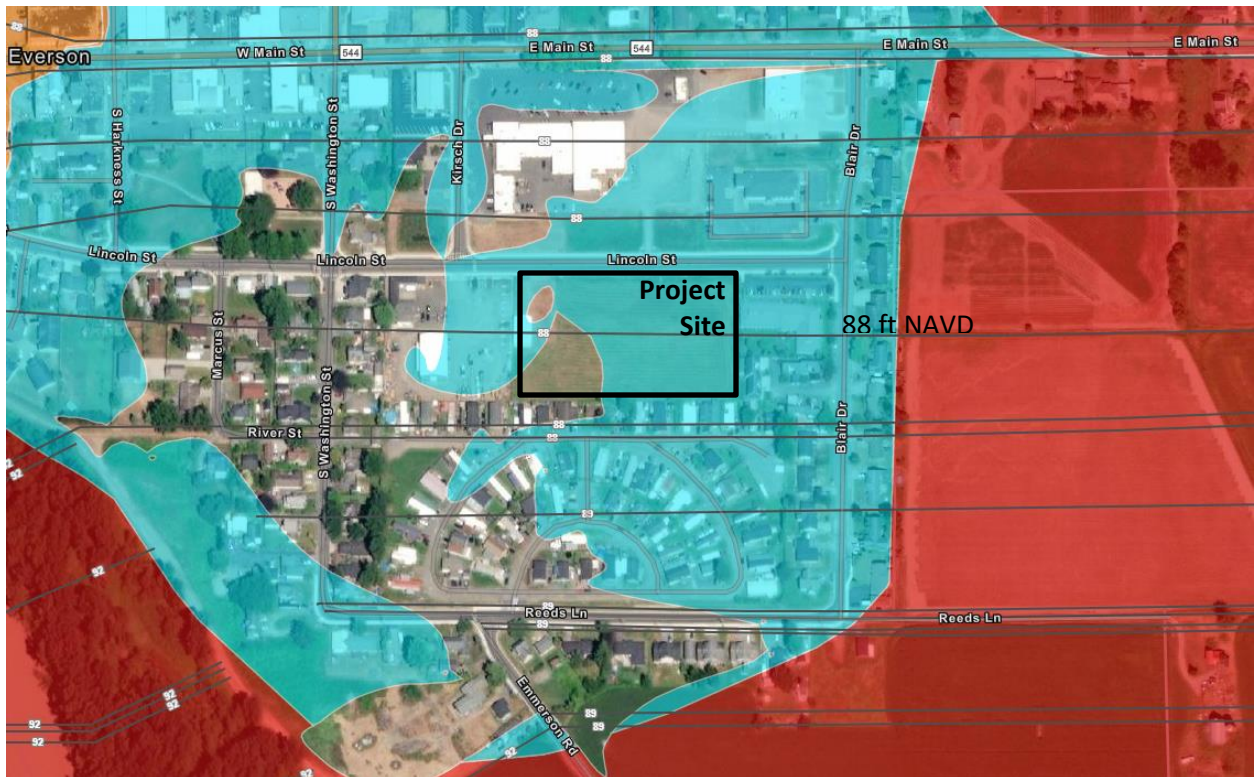


Figure 2 – Vicinity Map of Proposed Lincoln Street Development with Draft FEMA Mapping

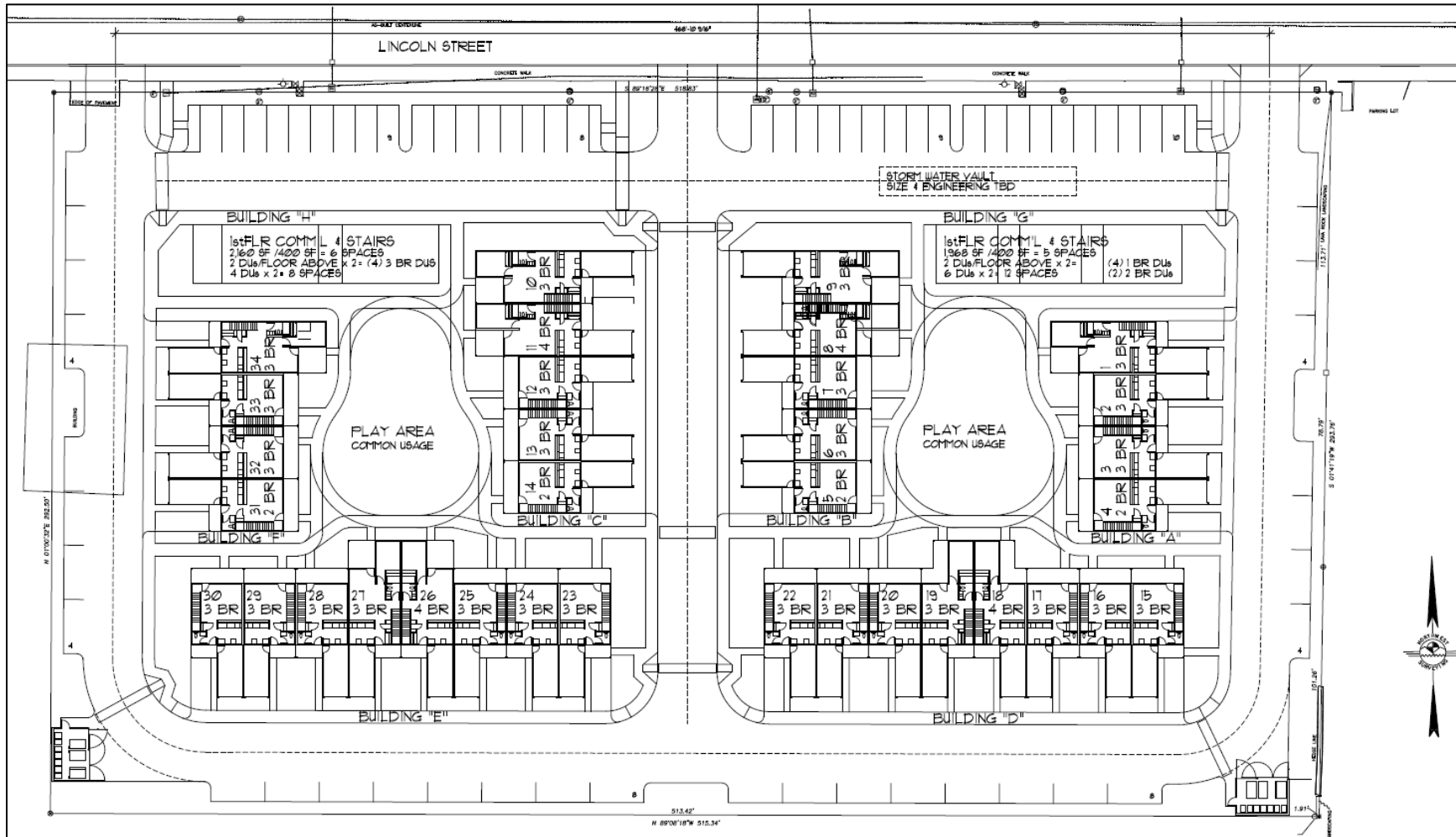


Figure 3 – Proposed Site Plan of Habitat for Humanity Proposed Lincoln Street Development

## ANALYSIS

Whatcom County's unsteady 1D branched-flow hydraulic model of the Lower Nooksack River, which includes the Everson overflow, was used for this evaluation. The model, based upon the FEQ (Full Equations) software developed by the late Delbert Franz of Linsley Kraeger Associates, was recently updated to support the FEMA flood insurance remapping study illustrated in Figure 2. It has been calibrated to multiple flood events dating back to November 1990 across a range of recurrence intervals. As an unsteady model, it takes into account the impacts due to loss of storage as well as loss of conveyance. In addition to its contributions to the latest FEMA modeling, it represents the best tool currently available and approved by the County for evaluating projects on the Lower Nooksack River. The model existing conditions are generally based upon 2006 LiDAR topography. More recent LiDAR and available site topography has shown little change to floodplain topography, with a minimum ground elevation of about 87 feet NAVD within the flooded areas. Given a BFE of 88 feet NAVD, present 100-year flooding is only about 1 foot deep or less within the undeveloped site.

The FEQ model was used to evaluate potential hydraulic and flood impacts due to the project, by conservatively blocking out on model cross sections the entire footprint of the site assuming complete fill raised to an elevation above the 100-year flood. Figure 4 identifies the cross sections modified accordingly, with black lines representing the portion of each cross section raised (blocked out). RDXSZD\_RB is the only cross section in the model that passes through the proposed developed. Figure 5 illustrates the ground terrain of this cross section with and without fill. However, the adjacent cross sections off the property both to the north and south, cross sections RDXSZC\_RB and RDXSZE\_RB respectively, were also conservatively assumed filled (Figure 4). This ensures the entire length of the site would be blocked out in the model, and also allows comparison to the existing baseline model without the need to add or duplicate cross sections at the fill limits.

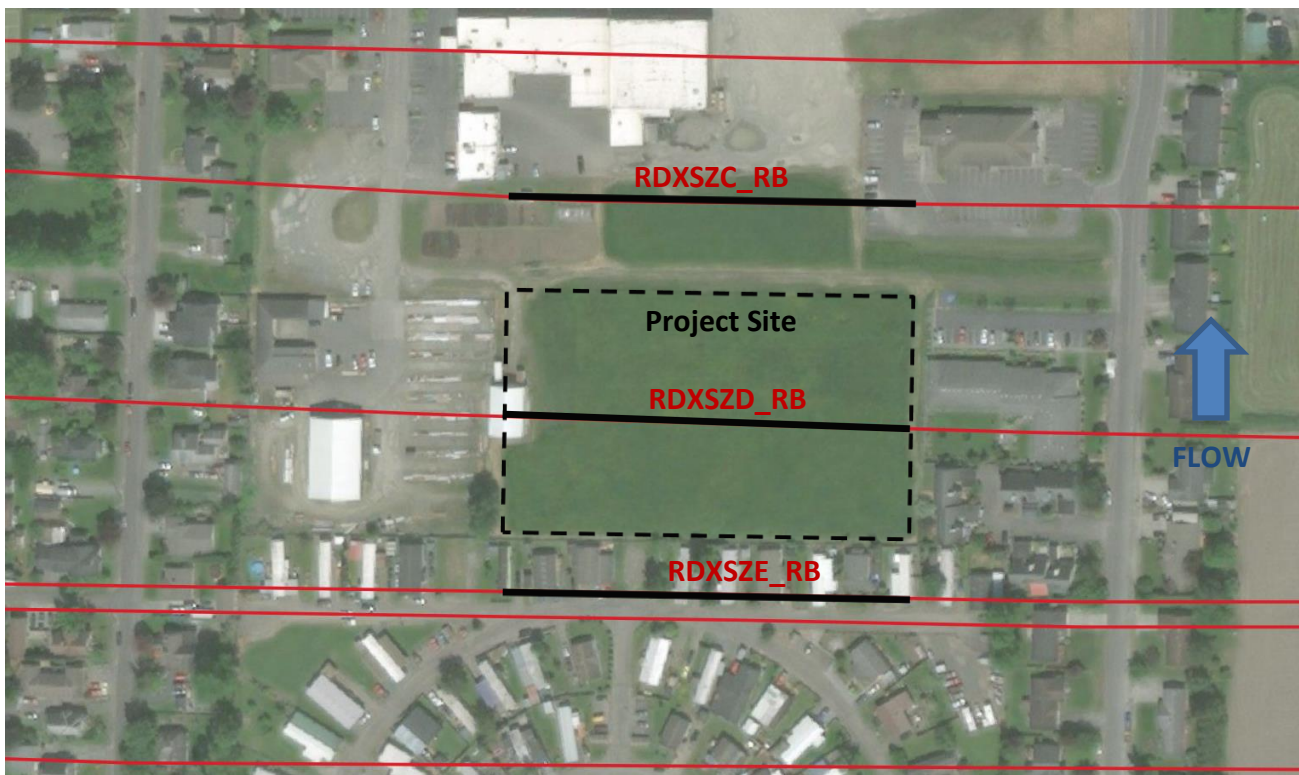
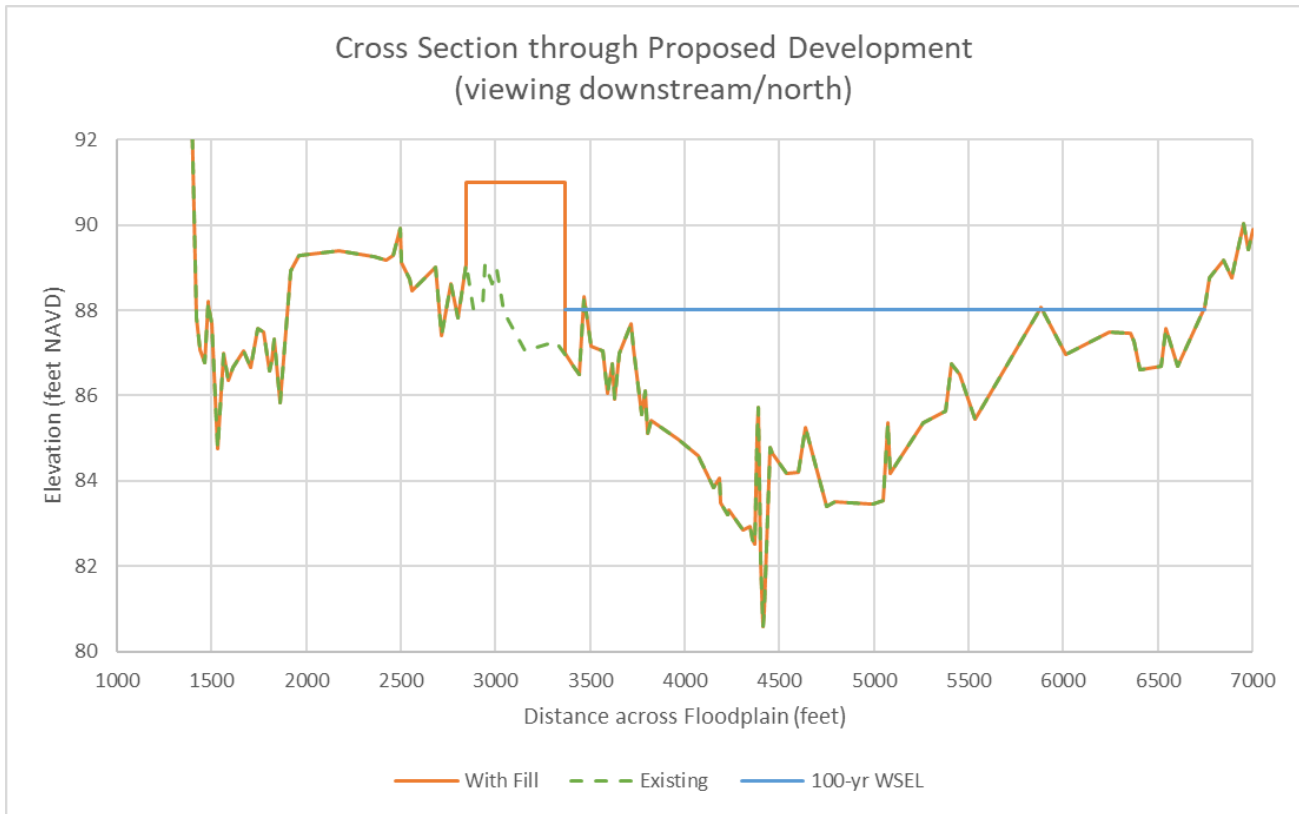


Figure 4 – FEQ Model Cross Sections with Assumed Fill Blockage



**Figure 5 – Cross Section RDXSZD\_RB Representation of Proposed Fill (viewing downstream)**

Roughness coefficients, representing resistance to flow due to various land cover types (e.g. bed material, vegetation, development) were already determined through calibration efforts, as mentioned above. These were not modified from those already specified in the FEQ model, which assumed an n-value of 0.050 for the existing floodplain at the development site. Other portions of the cross-sections assign an n-value of 0.035, most notably further east along the primary overflow corridor where deeper flow exists. These roughness coefficients are reasonable and within the expected range for the observed conditions along this floodplain.

Simulations were completed for the 100-year proposed conditions FEQ model, with results compared to the existing baseline FEQ model for the 100-year event. Total discharge in the model along the Everson overflow at the project site is 12,790 cfs, with a corresponding 100-year Nooksack River discharge at the Everson highway bridge (downstream of the flow split) of 54,480 cfs.

**RESULTS**

Per City of Everson flood code, impacts in terms of predicted rise must remain below 0.1 feet. Maximum impact due to the assumed complete fill at the Lincoln Street Development is predicted to be only 0.002 feet, well below the allowable rise and even qualifying as “no-rise” per FEMA guidelines (rounding to 0.00 feet). Predicted maximum water surface elevation varies from 88.0 feet to 87.8 feet NAVD from the south to the north side of the development (upstream to downstream), consistent with both the effective and draft FEMA mapped BFE of 88 feet (Figures 1 and 2). Maximum increase to the mean velocity (averaged across the entire cross section) is only 0.003 feet/second, which is negligible. The project is located outside the regulatory floodway and will have no impact to adjacent properties at the 100-year flood, according to the FEQ modeling.