APPENDIX H

Alternatives Evaluation Information

Table H- 1. Table Defining Project Components for Each Alternative.

Alternative	Selected Project Components	Alternate Project Components
1 - Existing Conditions / No Action	-	
2 - Left Bank Floodplain Reconnection	1,4,5,6,17,19	Replace 1 with 2 and 4; add 7
3 - Left Bank and Right Bank Floodplain Reconnection and two new 300ft Crossings at SR 20	1,4,5,6,19 (Alternative 2) + 7,10,14,3,19, 20	Replace 14 with 15 and 16
4 - Right Bank Floodplain Reconnection, leave existing bridge and add 1 new 300ft-span Crossing at SR 20	3,10,14,19,20	Replace 14 with 15 and 16
5 - Left Bank and Right Bank Floodplain Reconnection	1,4,5,6,19 (Alternative 2) + 3,14,17, 19,22	Replace 14 with 15 and 16

Project Component Descriptions

1 Remove Entire LB Levee (and remove culverts 1 and 2)
2 Notch LB Levee (and remove culverts 1 and 2)
3 New access road to lower Goodell Group Camp (RB) moved to high ground west of existing location
4 Remove LB Debris/garbage
5 New access to upper Goodell Group Camp (LB) and Gravel Pit
6 Remove Upstream LB Rip Rap
7 Replace existing SR 20 bridge with New 300ft bridge on LB
10 Replace culvert 6 and 7 with new 300ft bridge
13 New 300 ft bridge further west than component #10
14 Remove entire RB levee
15 Notch RB Levee
16 Remove RB RipRap
17 Protect Cultural Resource Area
18 Excavate new channel north of Highway
19 Concrete removal on RB
20 Engineered wood structures to protect power line towers and encourage mainstem flow towards existing SR 20 bridge
21 Replace existing SR 20 bridge with New 300ft bridge on RB
22 Replace existing culverts 7 and 8 under SR 20 with 20 ft-span fish-passable bottomless culverts and add 1 additional 20 ft span fish-passable bottomless culvert between them to convey right bank floodplain flow and allow downstream fish passage to the Skagit RIver downstream of Goodell Creek. Includes some channel excavation upstream and downstream of new culverts to promote conveyance.

Table H-2. Definitions of Scoring Ratings and Metrics for Evaluation Criteria.

	Implementation Opportunity/Constraint			Habitat and Ecological Significance			
Score	**Construction Complexity** (Qualitative Metric considering the following construction elements: involves multiple crossings under SR20, requires multiple construction seasons/years to complete, requires construction during the rainy season, involves temporary construction impacts that negatively affect multiple land uses (more than one recreational use, gravel pit use/access, SCL access, WSDOT staging access), requires complex utilities coordination and/or relocation, requires the use of complicated or expensive construction equipment)	**Water Quality** (Qualitative metric considering potential exposure to the solid waste facility and contamination within the left bank levee)	**Phasing Potential** (Qualitative metric intended to capture the flexibility of the project to be constructed over time due to the availability of funding and access for construction, and the alternative's dependency on road crossings)	**Channel habitat** (Quantitative metric based on connected channel inundation areas (depth >0) associated with the low flow hydraulic model results)	**2-year floodplain inundation area** (Quantitative metric based on floodplain inundation areas associated with the 2-year hydraulic model results)	**Floodplain habitat** (Quantitative metric based on floodplain inundation areas associated with the 100-year hydraulic model results and subtracting the channel habitat)	**Adult Fish Passage/Connectivity** (Quantitative metric considering hydrologically connected areas during the 2-year flow with a minimum depth of 1 foot)
Unit Evaluated	**N/A - Qualitative**	**N/A - Qualitative**	**N/A - Qualitative**	**Area (acres)**	**Area (acres)**	**Area (acres)**	**Area (acres)**
Model Analysis Referenced	**N/A**	**N/A**	**N/A**	**low-flow time zero**	**2-year time zero**	**100-year time zero minus low-flow time zero**	**2-year time zero**
GIS Eval, project alternative map, or model screenshots	**project alternative figures**	**project alternative figures**	**project alternative figures**	**GIS**	**GIS**	**GIS**	**GIS**
1	Extremely Complex: several (4+) of the complex construction elements identified above	greatest potential for degraded water quality conditions	No Phasing Potential: Project must be constructed at one time.	Least channel habitat area	Least 2-year floodplain inundation area	Least floodplain habitat	Smallest adult fish passage/ connectivity area
2	Complex: 3-4 of the complex construction elements identified above	some potential for degraded water quality conditions	Very little phasing potential	Little channel habitat area	Little 2-year floodplain inundation area	Little floodplain habitat	Little adult fish passage/ connectivity area
3	Moderately Complex: 2-3 of the complex construction elements identified above	no change in water quality conditions	Moderate phasing potential	Moderate channel habitat area	Moderate 2-year floodplain inundation area	Moderate floodplain habitat	Moderate adult fish passage/ connectivity area
4	Fairly Complex: 1-2 of the complex construction elements identified above	some potential to improve water quality condtions	Good Phasing potential	Good channel habitat area	Good 2-year floodplain inundation area	Good floodplain habitat	Good adult fish passage/ connectivity area
5	Not Complex: none of the complex construction elements identified above	greatest potential to improve water quality conditions	Excellent phasing potential: Project is well-suited for being constructed during discrete phases and phased construction is straightforward	Greatest channel habitat area	Greatest 2-year floodplain inundation area	Greatest floodplain habitat	Largest adult fish passage/ connectivity area

Note: Comparative Terms Refer to the Alternative 1 Results Which Are Existing Conditions at Time Zero and No-Action at a Point in Time 5 to 15 Years in the Future.

Table H-2. Definitions of Scoring Ratings and Metrics for Evaluation Criteria.

	Habitat and Ecological Significance (cont'd)						Infrastructure and Land Use Impacts
Score	**Juvenile Fish Passage/Connectivity** (Quantitative metric considering hydrologically connected areas with at least 0.1ft of depth and also with velocities less than 2ft/s for the 2-year flow)	**Reduced Stranding Potential** (Qualitative metric considering the areas that could become inundated under 2-year or greater flow inundation but become stranding areas as flows recede below that; compare to quantitative difference b/t 2-year floodplain inundation area and the adult fish passage/connectivity area)	**Physical Aquatic Habitat Quality and Diversity** (Qualitative metric considering the following habitat quality elements associated with the 2-year floodplain inundation area metric: range of high and low depth and high and low velocity areas, diversity of habitat types (pools, riffles), range of substrate sizes and sediment sorting, adjacent vegetative cover, LWD and LWD recruitment potential, hyporheic connectivity potential)	**Terrestrial and Riparian Habitat Quality** (Quantitative metric calculated as the intersection of mature forest land cover with areas within the alluvial fan project area that are not inundated by the 100-year floodplain)	**Ecological Resiliency** (Qualitative metric considering the overlay of the 2-year floodplain inundation area with mature forested land cover as a surrogate for the ecosystem's natural resiliency/ability to handle the hydrologic and geomorphic changes associated with the alternative)	**Sustainable Hydrogeomorphic Processes Restored** (Qualitative metric interpretting the results of previous quantitative habitat metrics for channel and floodplain habitat and fish passage and evaluating the long-term potential extent of main channel and floodplain engagement, and thus the connectivity of hydrologic and geomorphic processes)	**Flooding and Geomorphic Hazard/Risk to WSDOT Highway** (Qualitative metric considering the 100-year flood inundation area across the WSDOT highway, as a surrogate for the potential for avulsion and scour damage)
Unit Evaluated	**Area (acres)**	**N/A - Qualitative**	**N/A - Qualitative**	**Area (acres)**	**N/A - Qualitative**	**N/A - Qualitative**	**N/A - Qualitative**
Model Analysis Referenced	**2-year time zero**	**All (2-year time zero surrogate)**	**2-year time zero**	**100-year time zero**	**2-year time zero**	**All**	**100-year future aggradation, 100-year bulked future aggradation**
GIS Eval, project alternative map, or model screenshots	**GIS**	**Model Screenshots**	**Model Screenshots**	**GIS**	**GIS, Model Screenshots, Quantitative Habitat metric results**	**Model Screenshots, Quantitative Habitat metric results**	**Model Screenshots (velocity and Depth)**
1	Smallest juvenile fish passage/ connectivity area	Greatest stranding potential	Least number and extent of elements identified above	Least area	Least resiliency	No potential to restore hydrogeomorphic process	Greatest flood and aulsion risk to SR20
2	Little juvenile fish passage/ connectivity area	High stranding potential	Some number and extent of elements identified above	Some area	Some resiliency	Some potential to restore hydrogeomorphic process	Great flood and aulsion risk to SR20
3	Moderate juvenile fish passage/ connectivity area	Moderate stranding potential	Moderate number and extent of elements identified above	Comparable area	Moderate resiliency	Moderate potential to restore hydrogeomorphic process	Moderate flood and aulsion risk to SR20
4	Good juvenile fish passage/ connectivity area	Low stranding potential	Good number and extent of elements identified above	More area	Good resiliency	Good potential to restore hydrogeomorphic process	Some flood and aulsion risk to SR20
5	Largest juvenile fish passage/ connectivity area	Lowest stranding potential	Greatest number and extent of elements identified above	Most area	Best resiliency	Greatest potential to restore hydrogeomorphic process	Least flood and aulsion risk to SR20

Note: Comparative Terms Refer to the Alternative 1 Results Which Are Existing Conditions at Time Zero and No-Action at a Point in Time 5 to 15 Years in the Future.

Table H-2. Definitions of Scoring Ratings and Metrics for Evaluation Criteria.

	Infrastructure and Land Use Impacts (cont'd)				Cultural Concerns
Score	**Flooding and Geomorphic hazard/risk Campgrounds and recreational uses** (Qualitative metric considering the extent of 100-year flood inundation as a surrogate for the potential for avulsion and scour damage)	**Flooding and Geomorphic hazard/risk to SCL Infrastructure** (Qualitative metric considering the extent of 100-year flood inundation as a surrogate for the potential for avulsion and scour damage)	**Flooding and Geomorphic hazard/risk to Gravel pit access Road** (Qualitative metric considering the extent of 100-year flood inundation as a surrogate for the potential for avulsion and scour damage)	**Flooding and Geomorphic hazard/risk to WSDOT staging area and house** (Qualitative metric considering the extent of 100-year flood inundation as a surrogate for the potential for avulsion and scour damage)	**Flooding and Geomorphic hazard/risk to Cultural Resources** (Qualitative metric considering the extent of floodplain inundation across the range of flows evaluated and the associated potential for avulsion and scour damage)
Unit Evaluated	**N/A - Qualitative**	**N/A - Qualitative**	**N/A - Qualitative**	**N/A - Qualitative**	**Tribal Review**
Model Analysis Referenced	**100-year future aggradation, 100-year bulked future aggradation**	**100-year future aggradation, 100-year bulked future aggradation**	**100-year future aggradation, 100-year bulked future aggradation**	**100-year future aggradation, 100-year bulked future aggradation**	**Tribal Review**
GIS Eval, project alternative map, or model screenshots	**Model Screenshots (velocity and Depth)**	**Model Screenshots (velocity and Depth)**	**Model Screenshots (velocity and Depth)**	**Model Screenshots (velocity and Depth)**	**Tribal Review**
1	Greatest flood and aulsion risk to campgrounds and recreational uses	Greatest flood and aulsion risk to SCL infrastructure	Greatest flood and aulsion risk to the gravel pit access road	Greatest flood and aulsion risk to the WSDOT staging area and house	greatest increase in inundation areas and avulsion risk to areas that could impact cultural resources
2	Great flood and aulsion risk to campgrounds and recreational uses	Great flood and aulsion risk to SCL infrastructure	Great flood and aulsion risk to the gravel pit access road	Great flood and aulsion risk to the WSDOT staging area and house	Some increase in inundation areas and avulsion risk to areas that could impact cultural resources
3	Moderate flood and aulsion risk to campgrounds and recreational uses	Moderate flood and aulsion risk to SCL infrastructure	Moderate flood and aulsion risk to the gravel pit access road	Moderate flood and aulsion risk to the WSDOT staging area and house	No change in inundation areas and avulsion risk to areas that could impact cultural resources
4	Some flood and aulsion risk to campgrounds and recreational uses	Some flood and aulsion risk to areas adjacent to SCL infrastructure	Some flood and aulsion risk to areas adjacent to areas adjacent to the gravel pit access road	Some flood and aulsion risk to areas adjacent to WSDOT staging area and house	A good reduction in inundation areas and avulsion risk to areas that could impact cultural resources
5	Least flood and aulsion risk to campgrounds and recreational uses	Least flood and aulsion risk to SCL infrastructure	Least flood and aulsion risk to the gravel pit access road	Least flood and aulsion risk to the WSDOT staging area and house	Least Risk

Note: Comparative Terms Refer to the Alternative 1 Results Which Are Existing Conditions at Time Zero and No-Action at a Point in Time 5 to 15 Years in the Future.

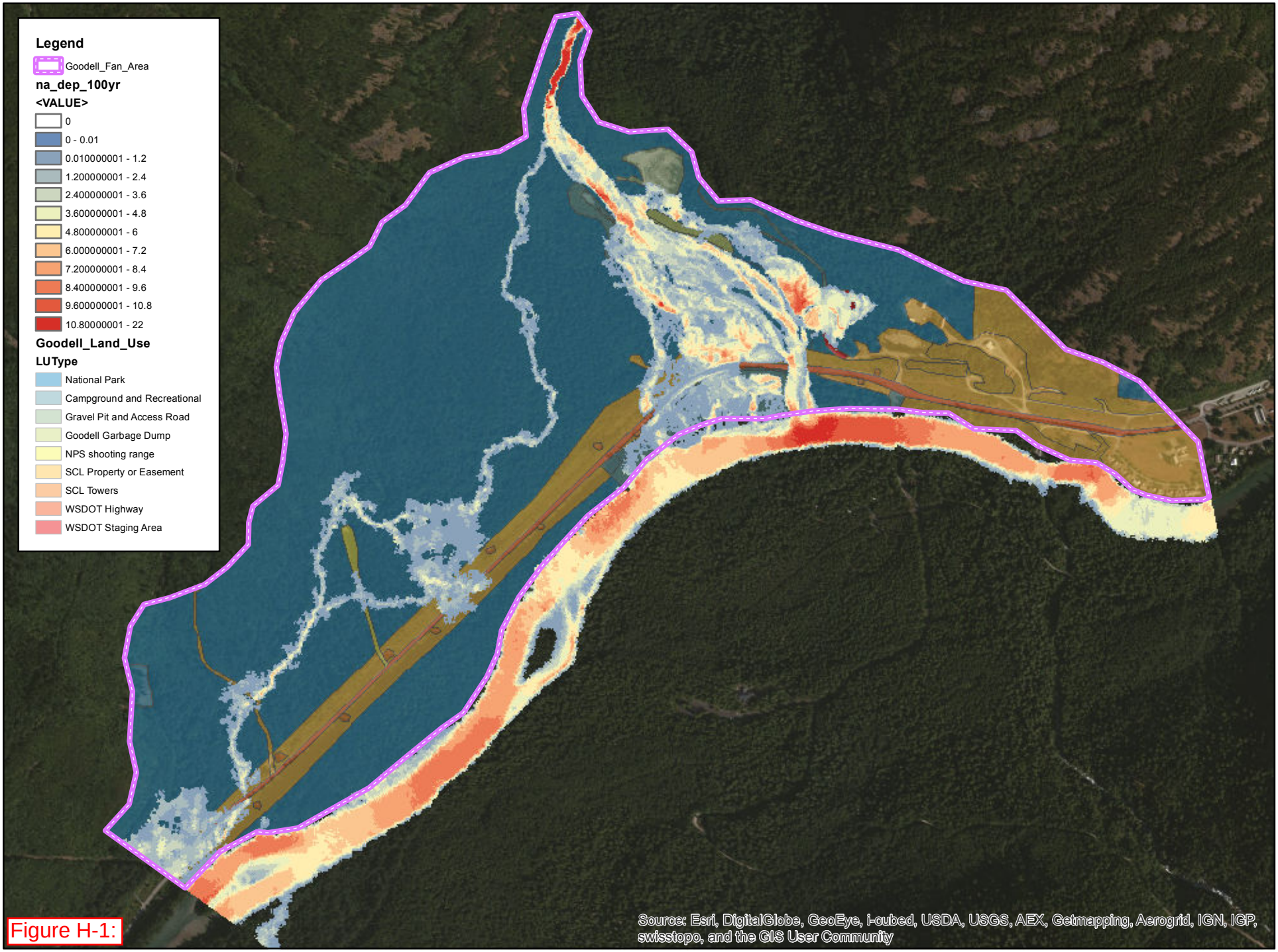

Figure H-1:

Alternative 1 - No Action 100-year Aggradation Land Use Impacts.

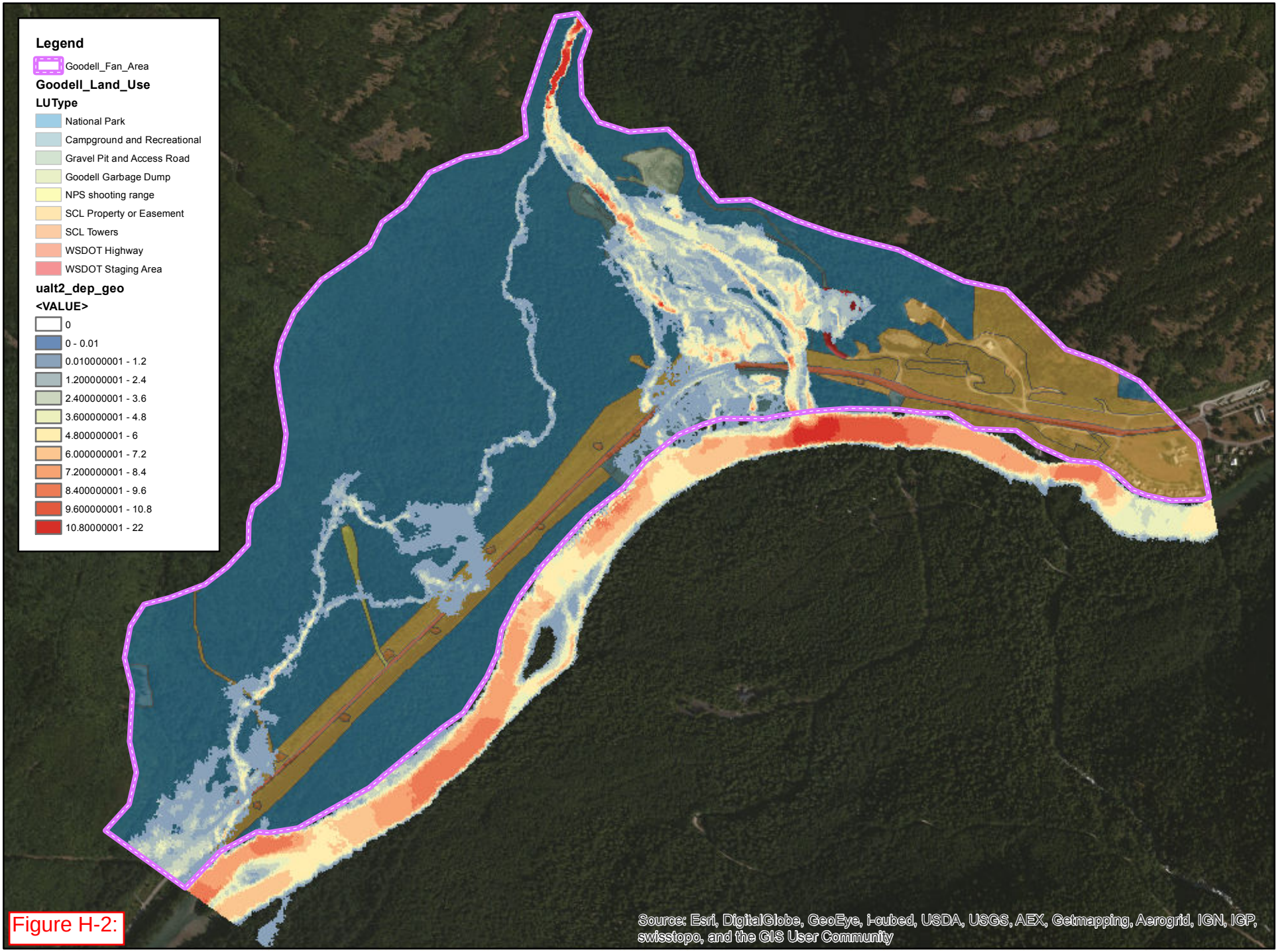

Figure H-2:

Alternative 2 - Left Bank Floodplain 100-year Aggradation Land Use Impacts.

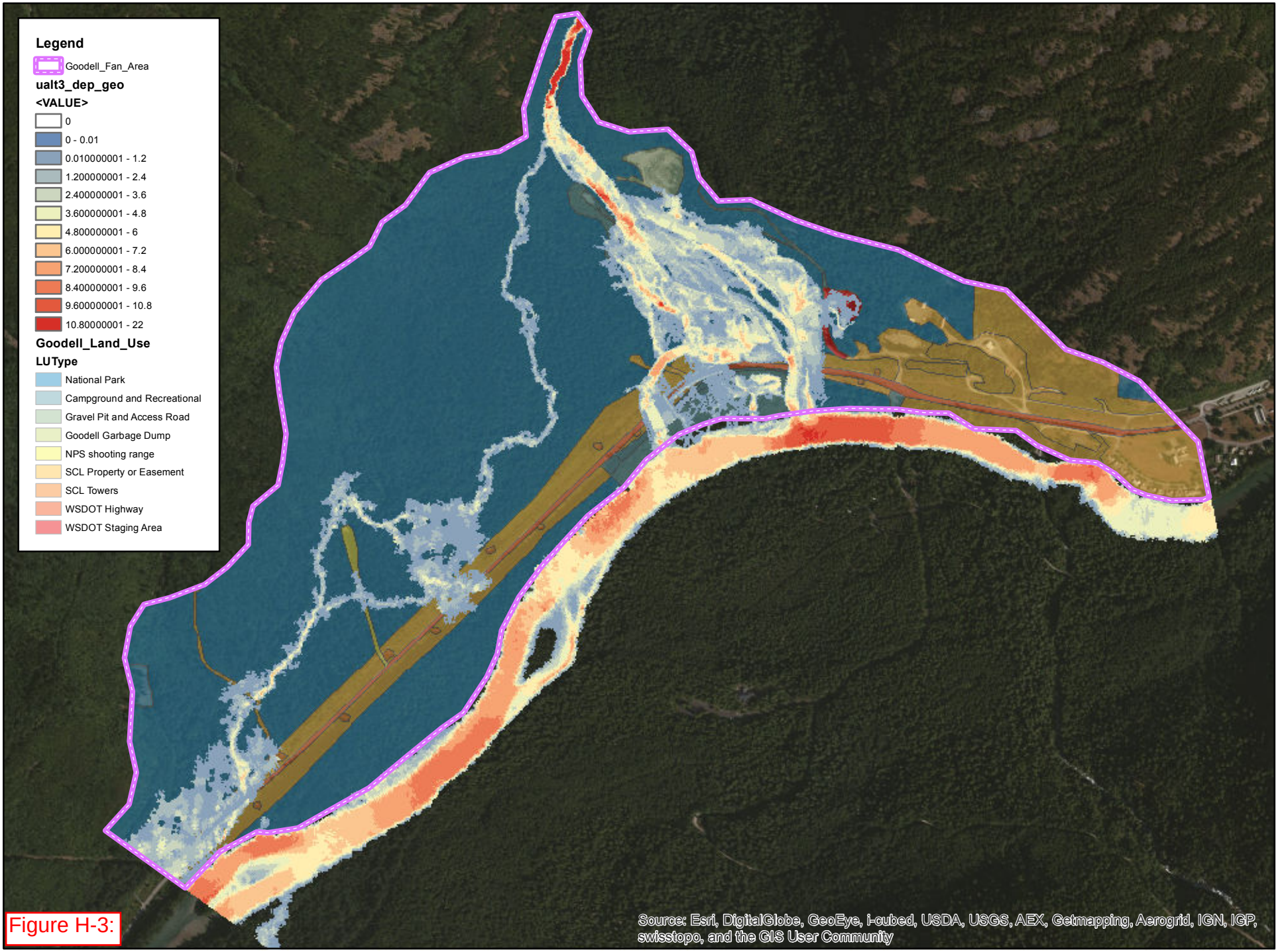

Figure H-3:

Alternative 3 - Left and Right Bank Floodplain with new bridges - 100-year Agg Land Use Impacts.

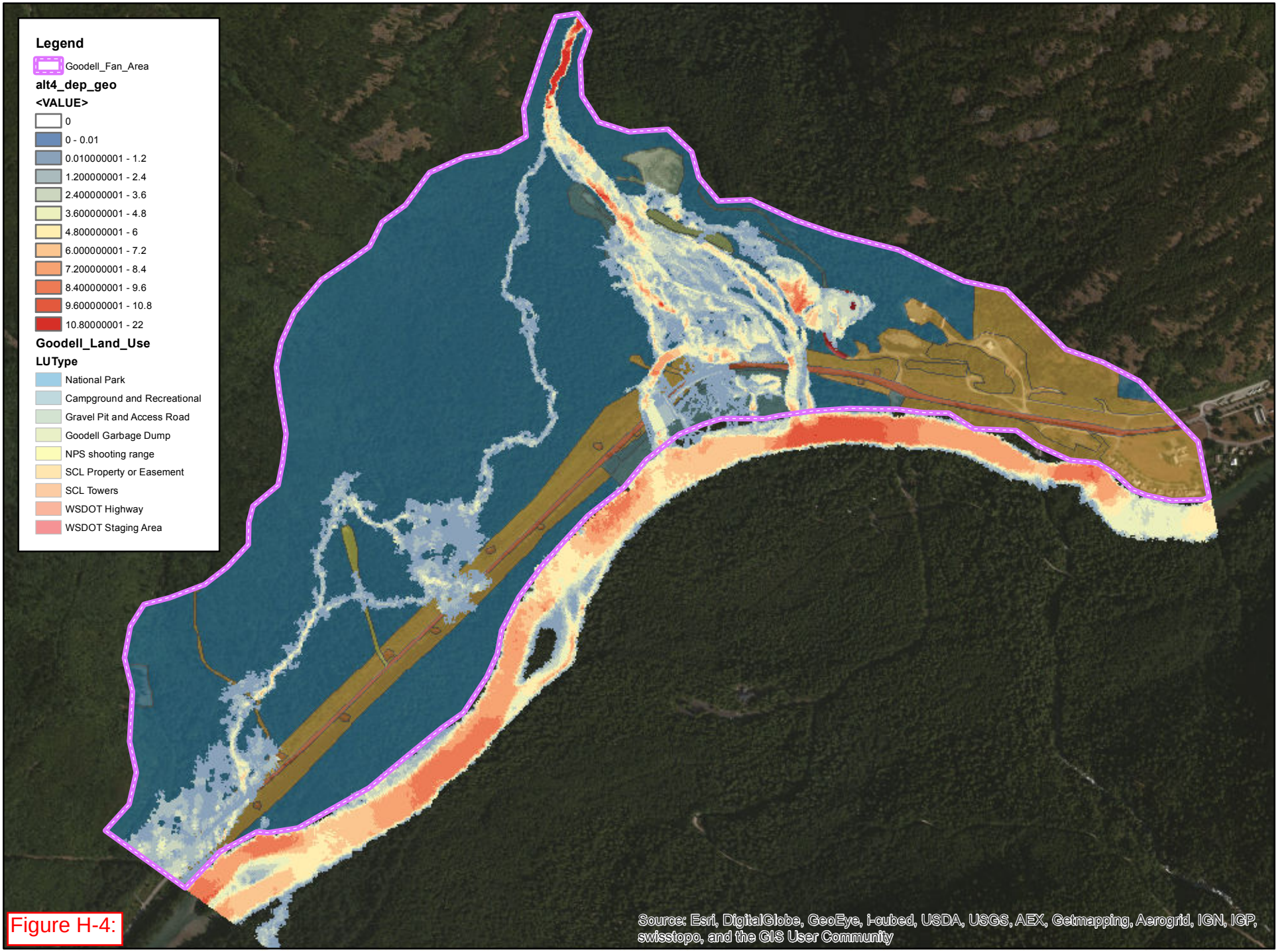

Figure H-4:

Alternative 4 - Right Bank Floodplain with 1 new bridge - 100-year Agg Land Use Impacts.

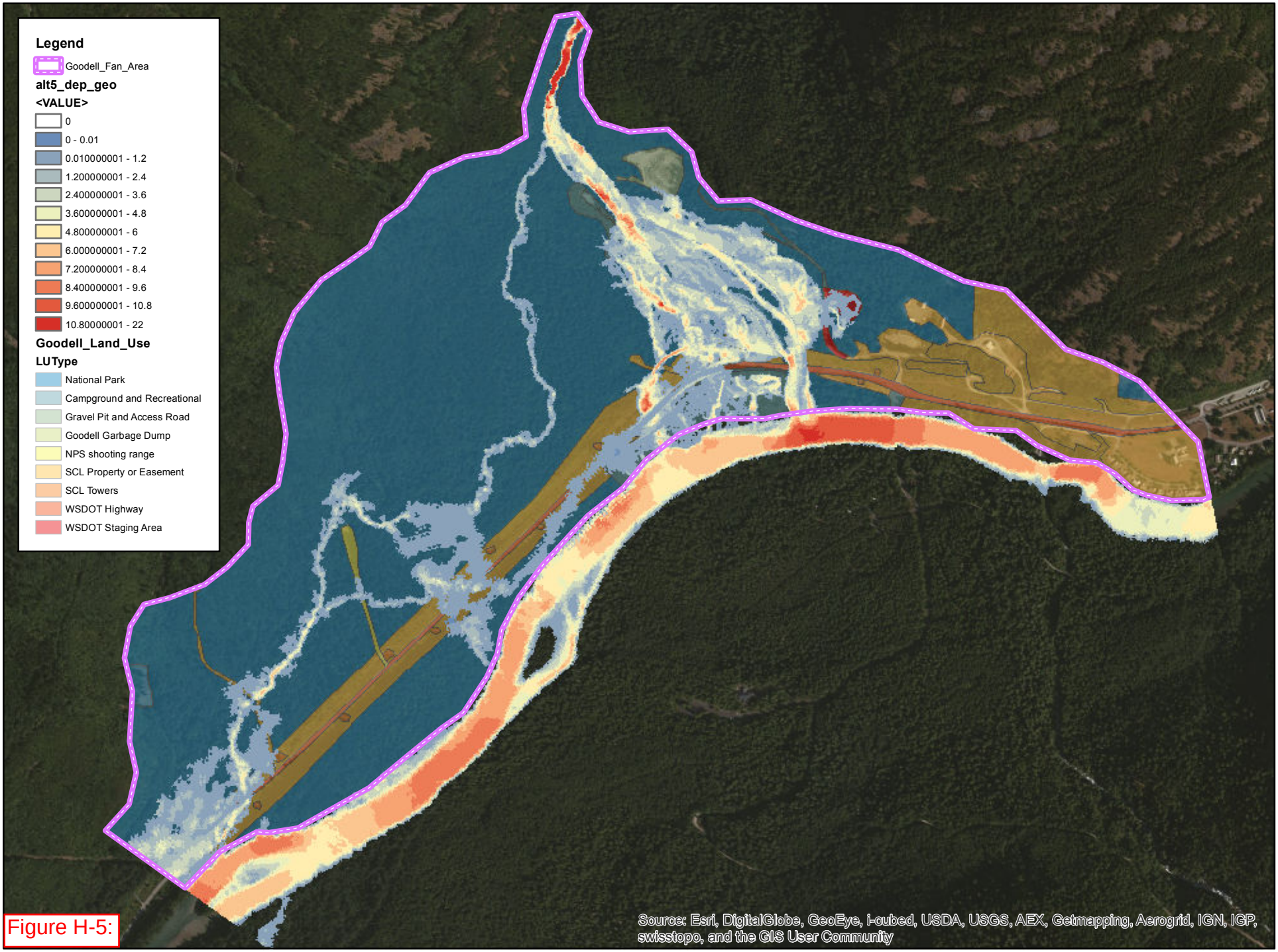

Figure H-5:

Alternative 5 - Left and Right Bank Floodplain - 100-year Agg Land Use Impacts.