

**Susitna-Watana Hydroelectric Project  
(FERC No. 14241)**

**Geomorphology Study (6.5)**

**Part A - Figures**

**Initial Study Report**

Prepared for

Alaska Energy Authority



**SUSITNA-WATANA HYDRO**

*Clean, reliable energy for the next 100 years.*

Prepared By

Tetra Tech

Watershed GeoDynamics

June 2014

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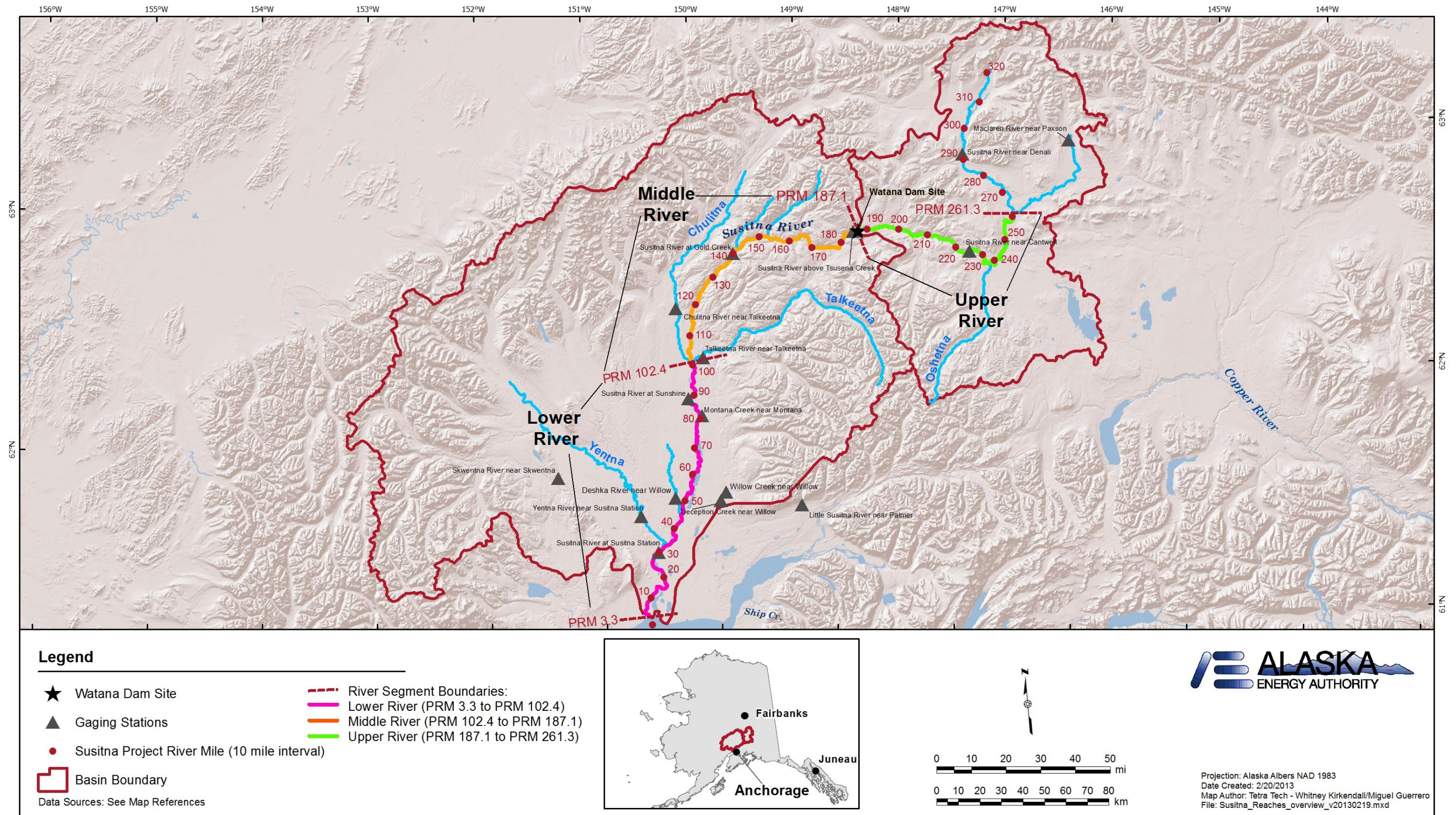


Figure 3-1. Susitna River geomorphology study area and large-scale river segments.



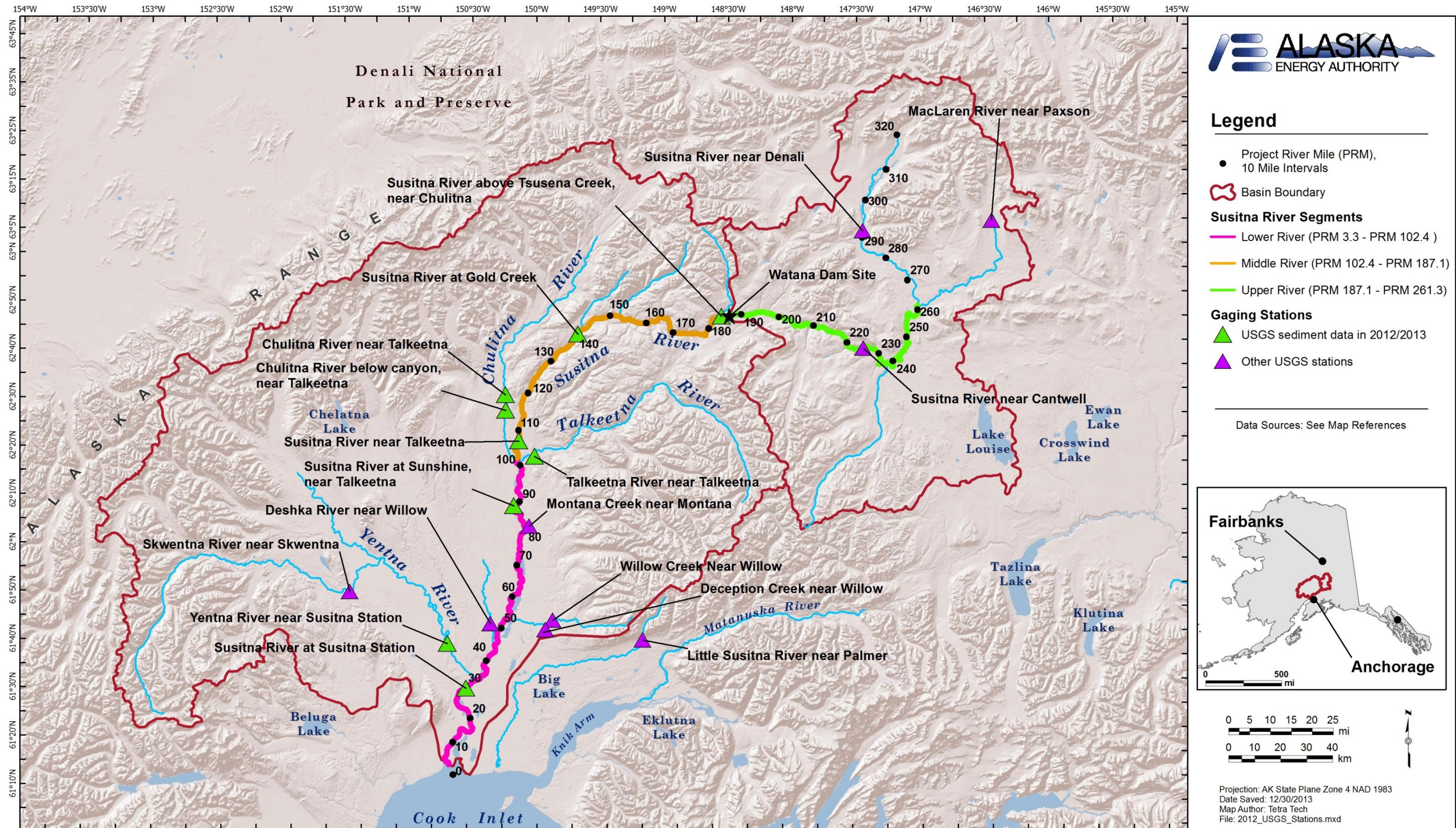


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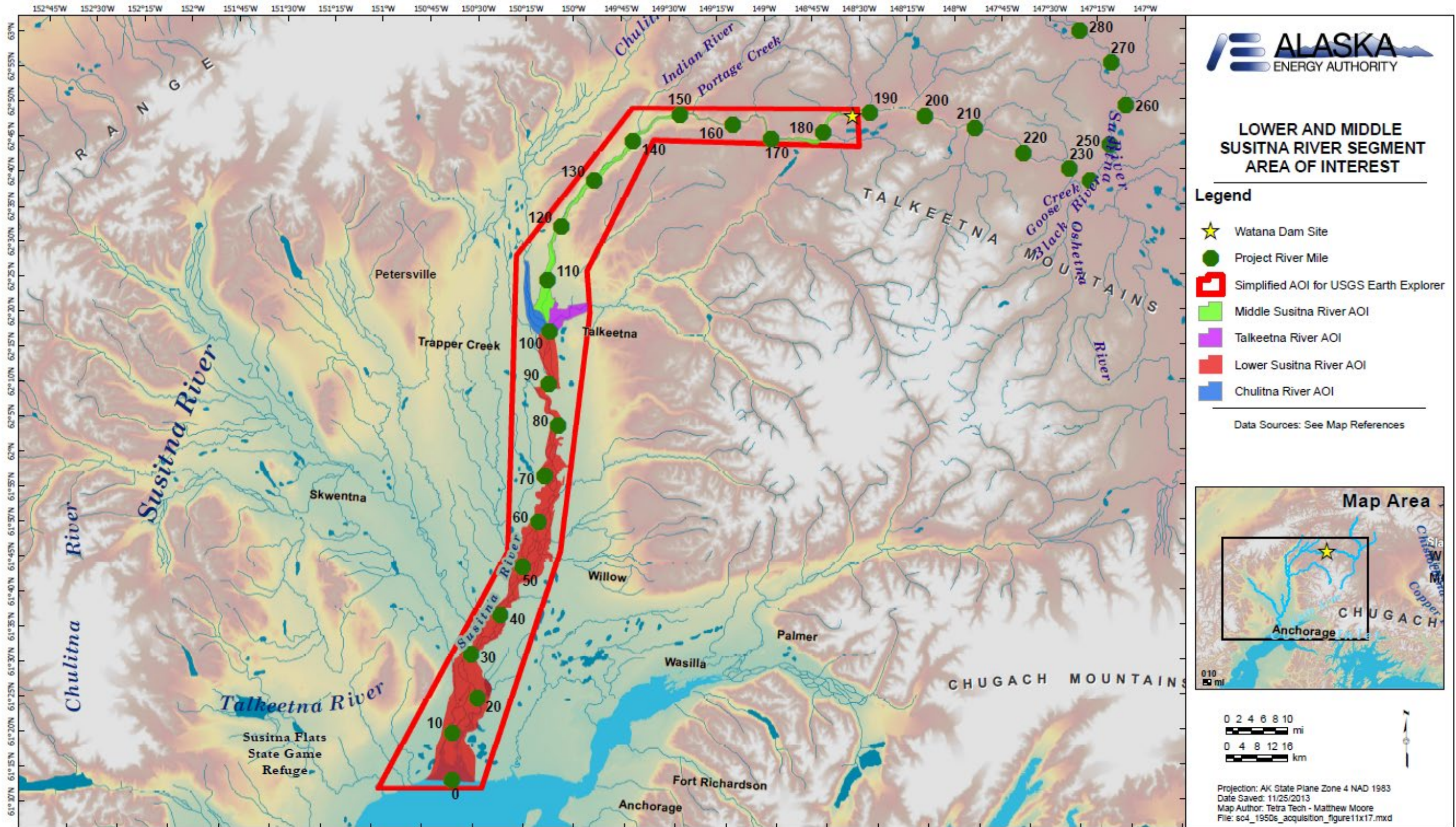
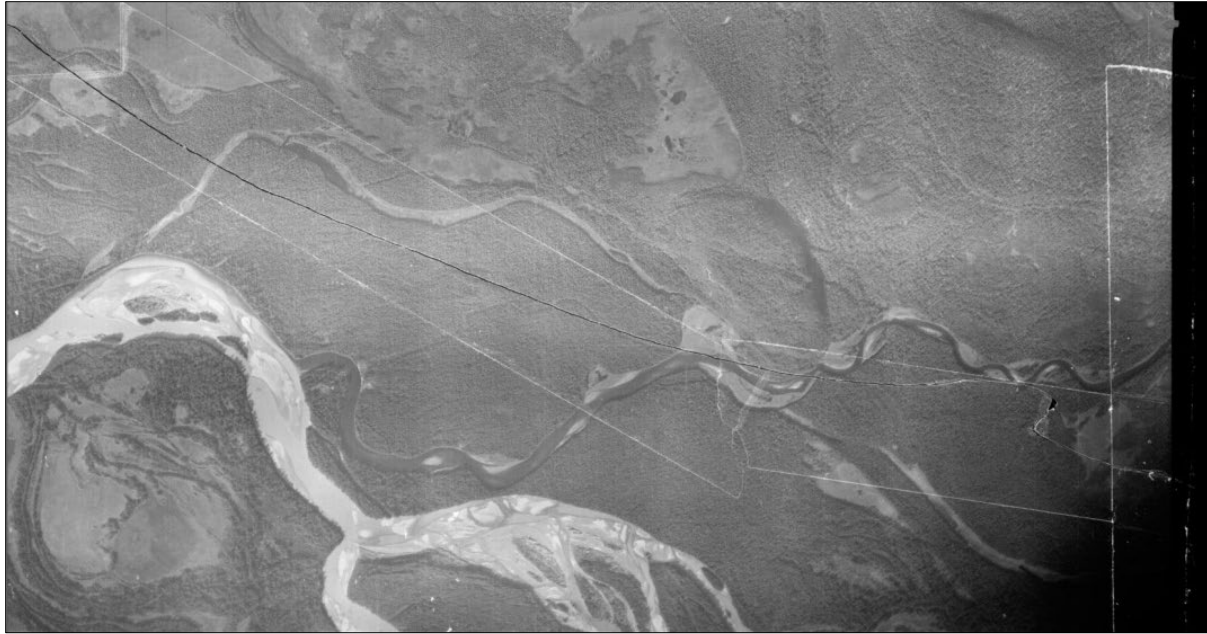


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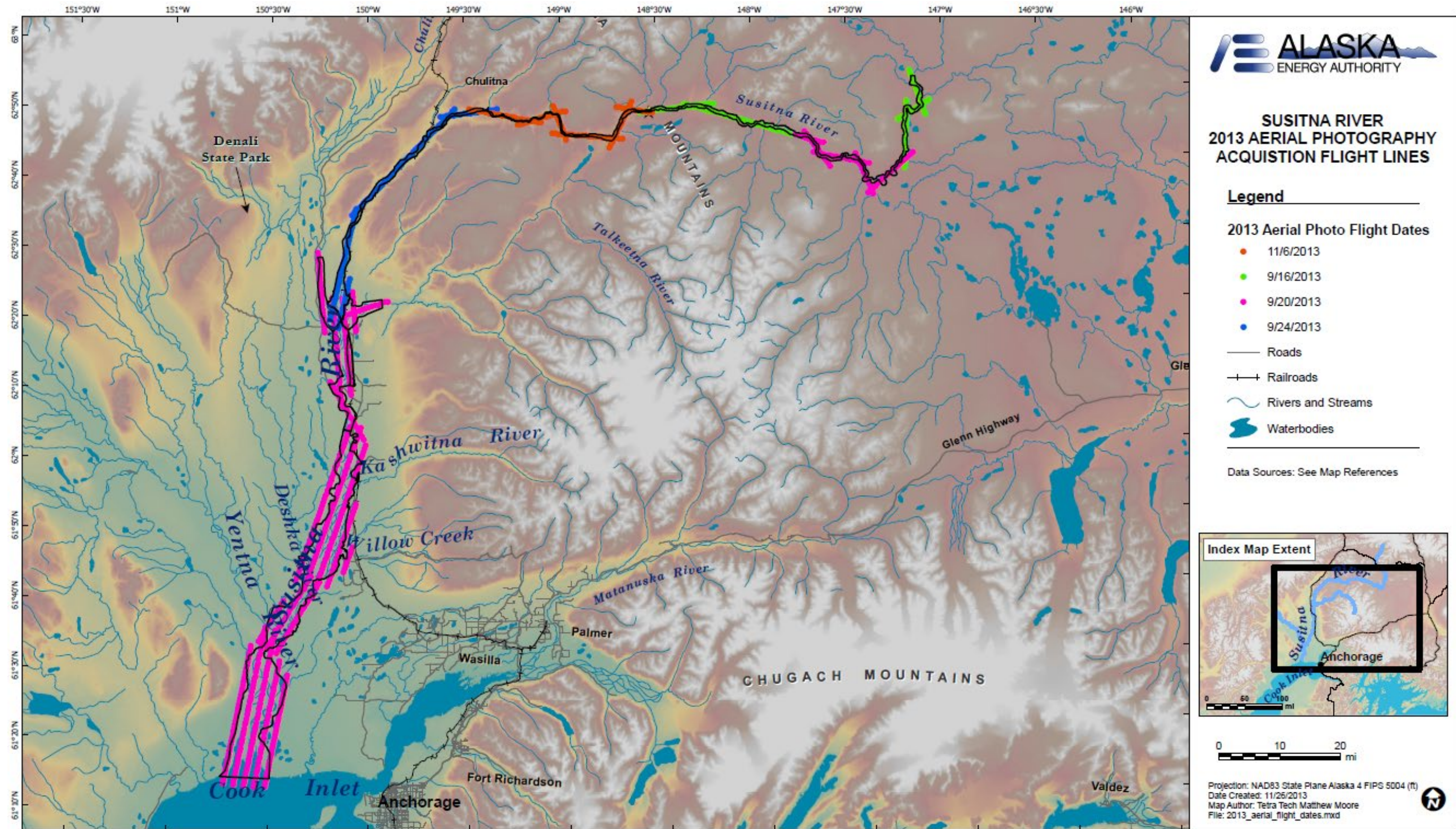


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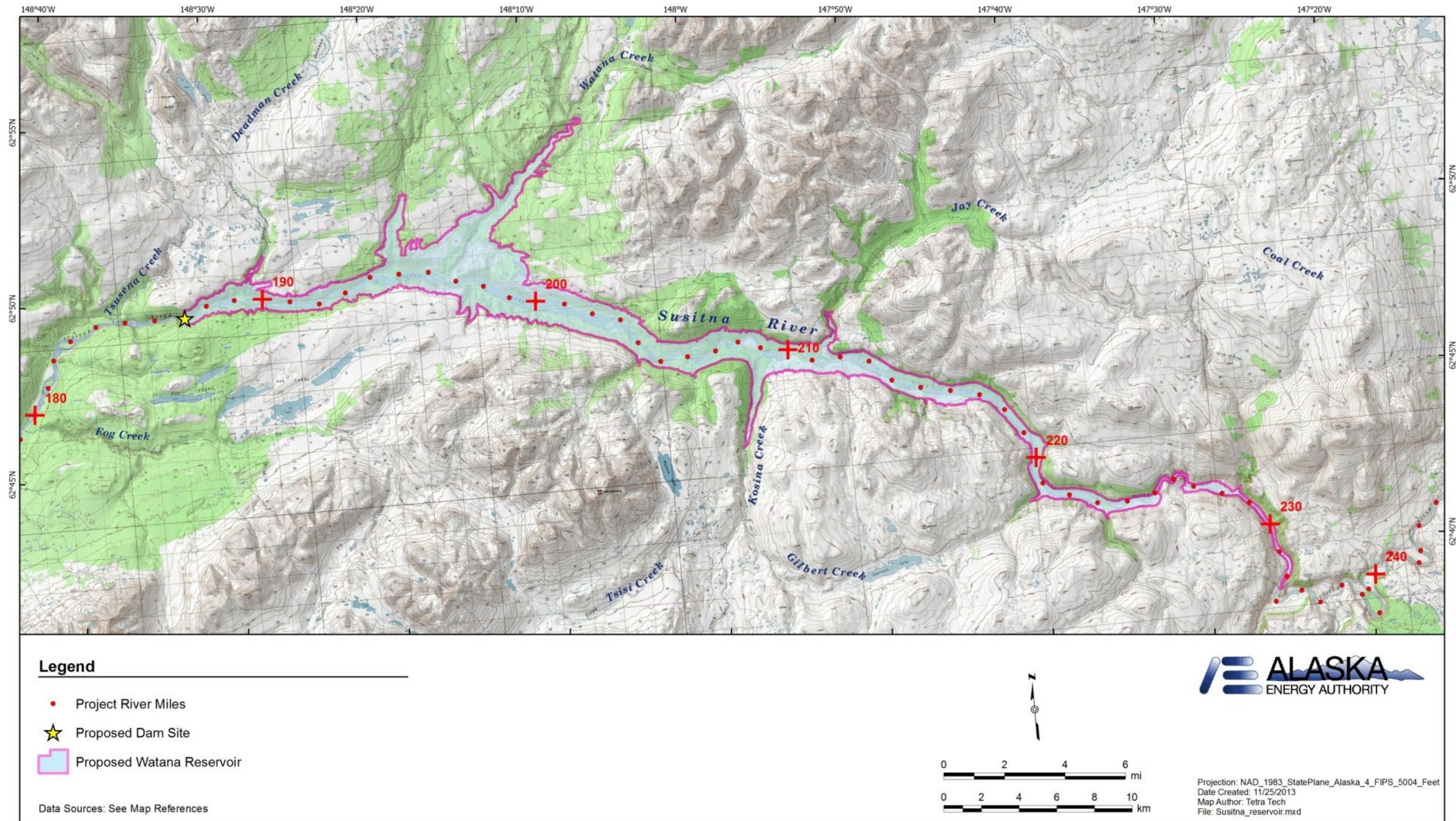


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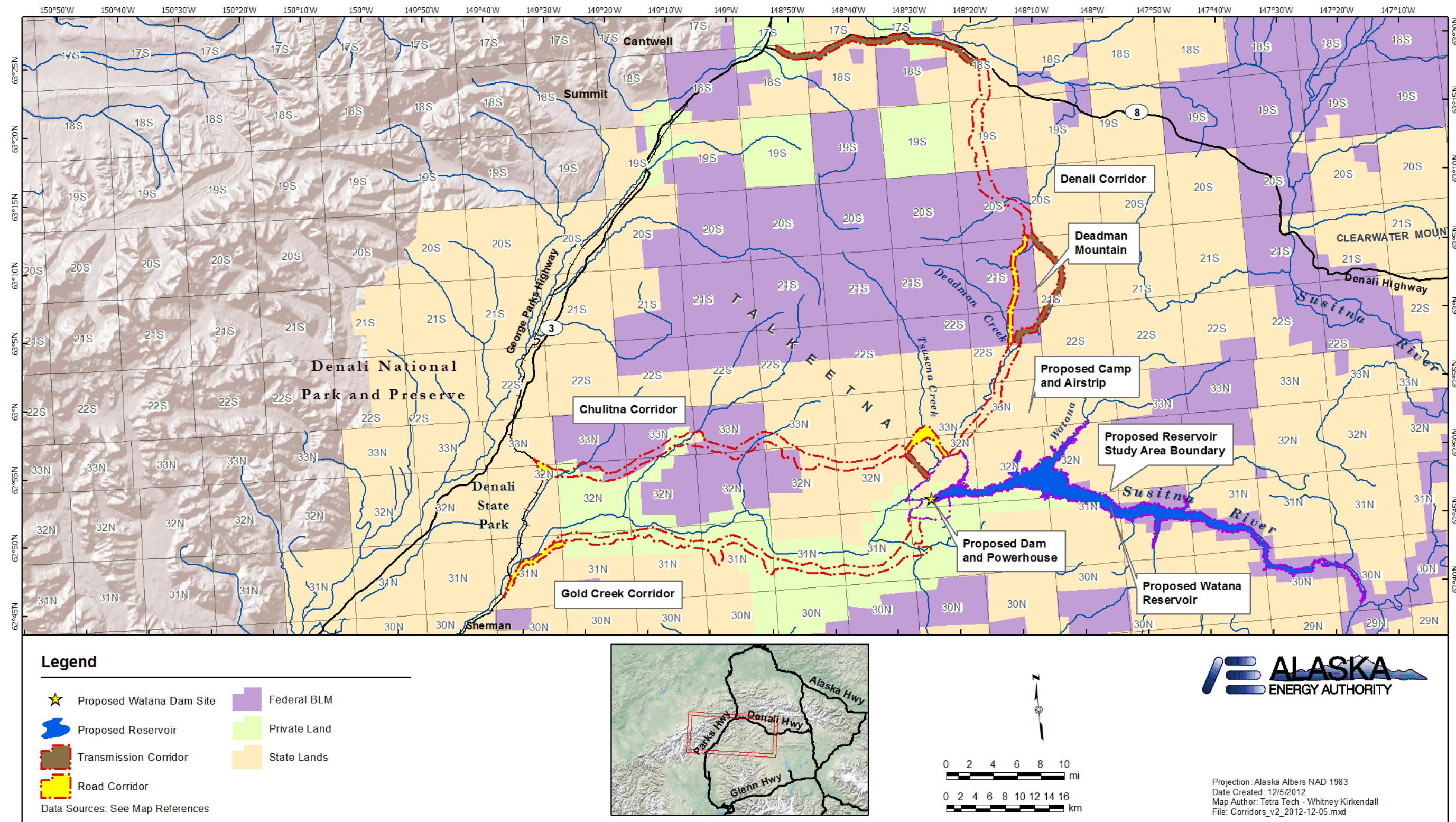


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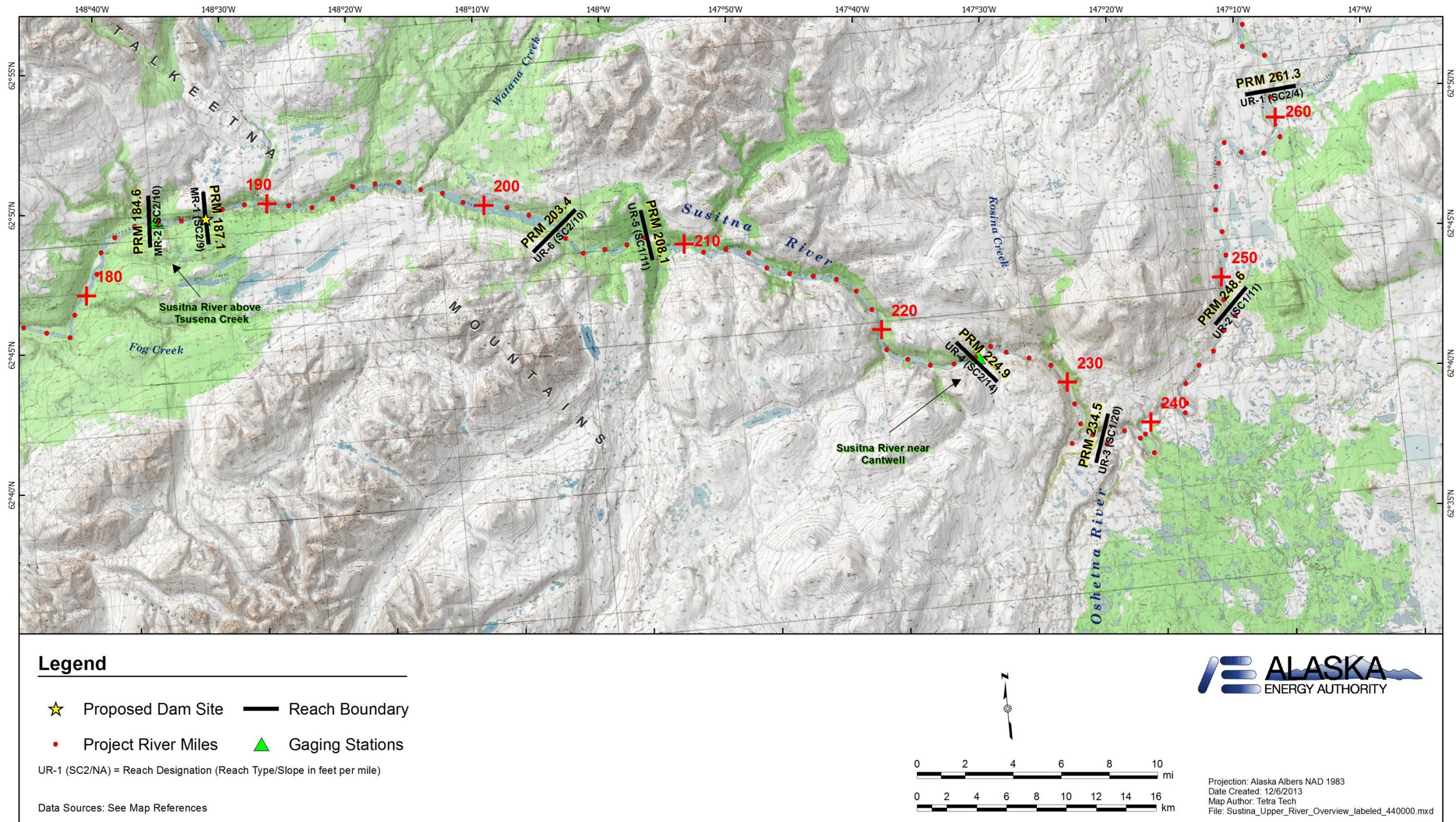


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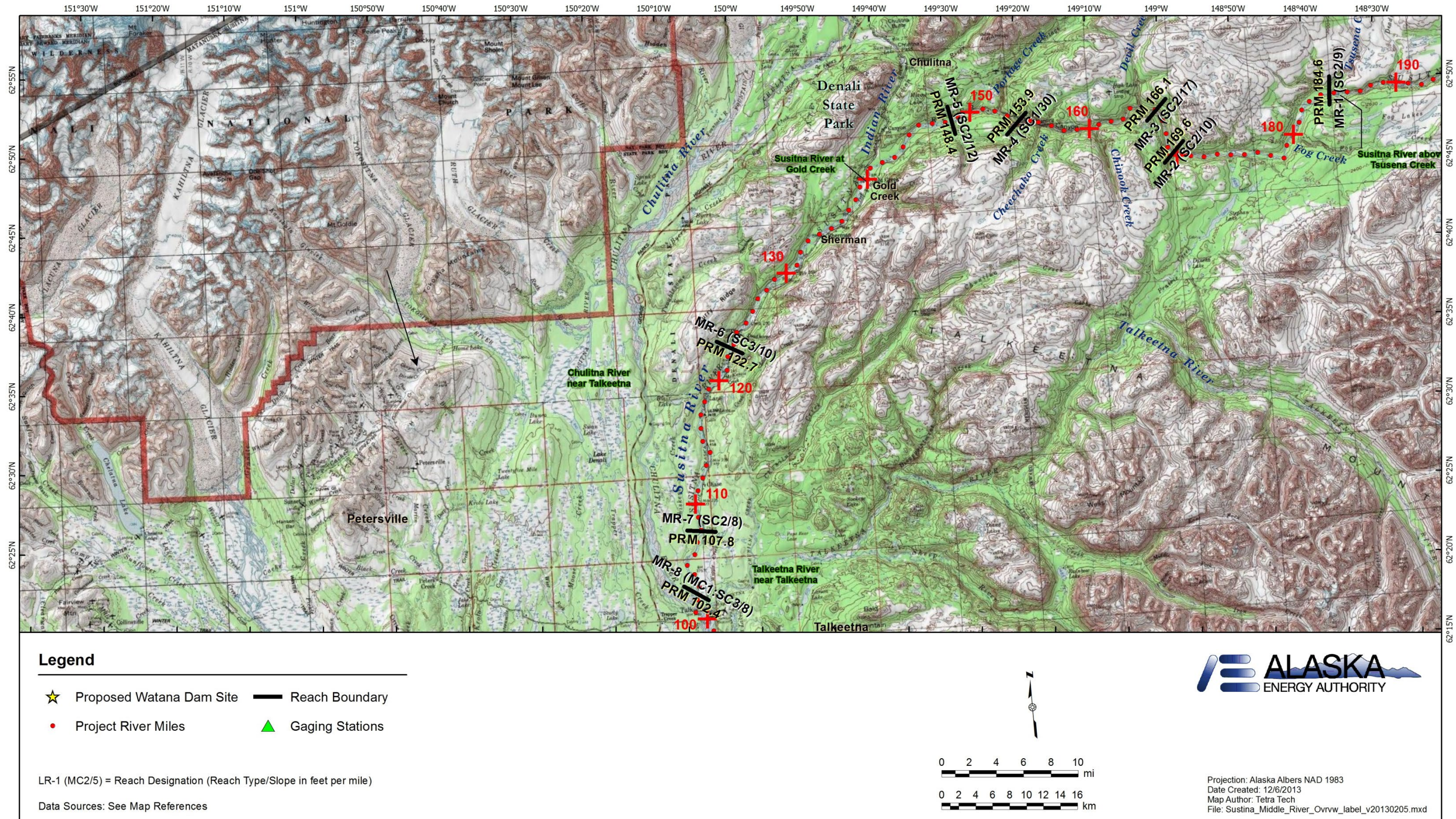


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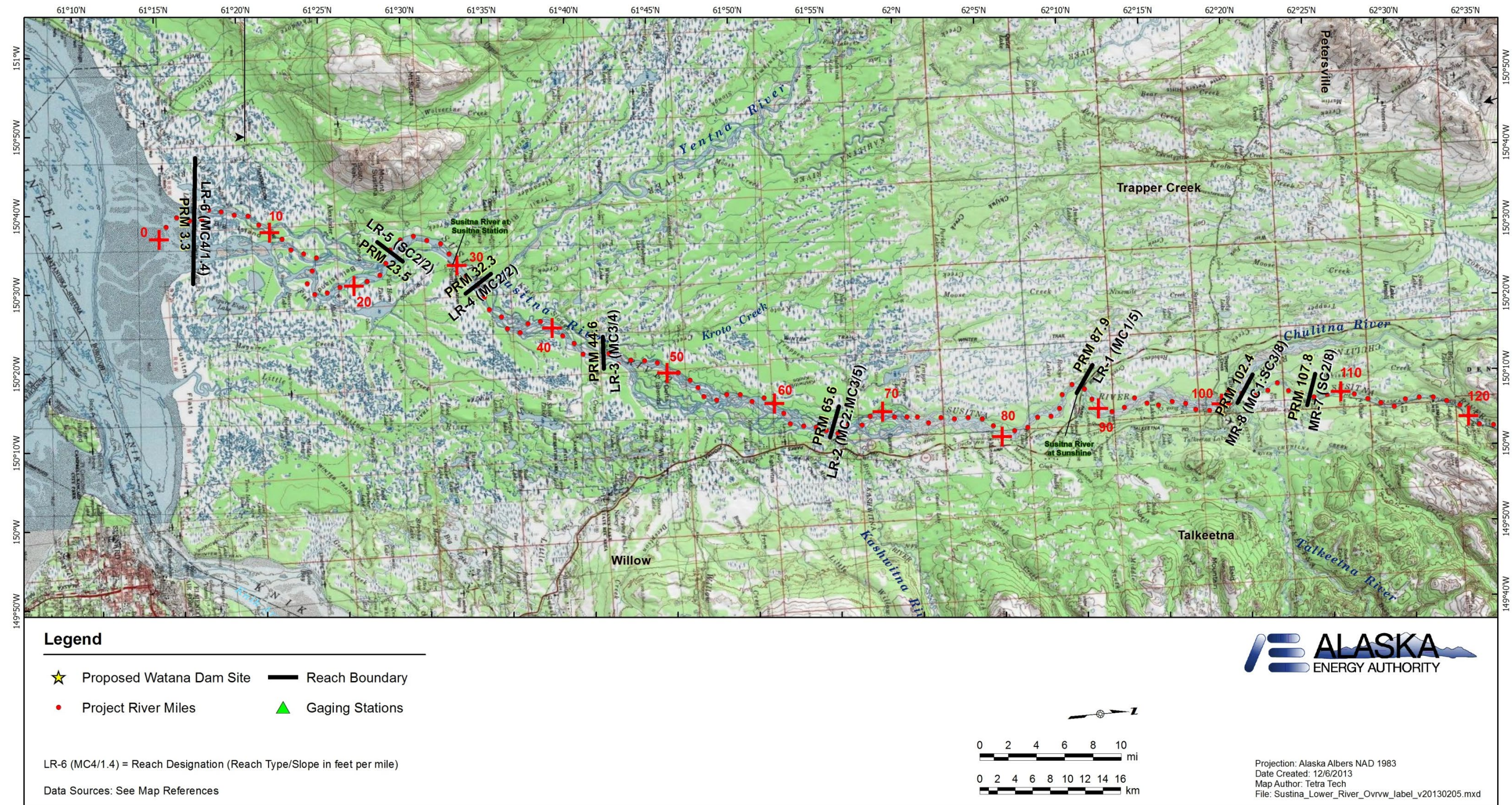


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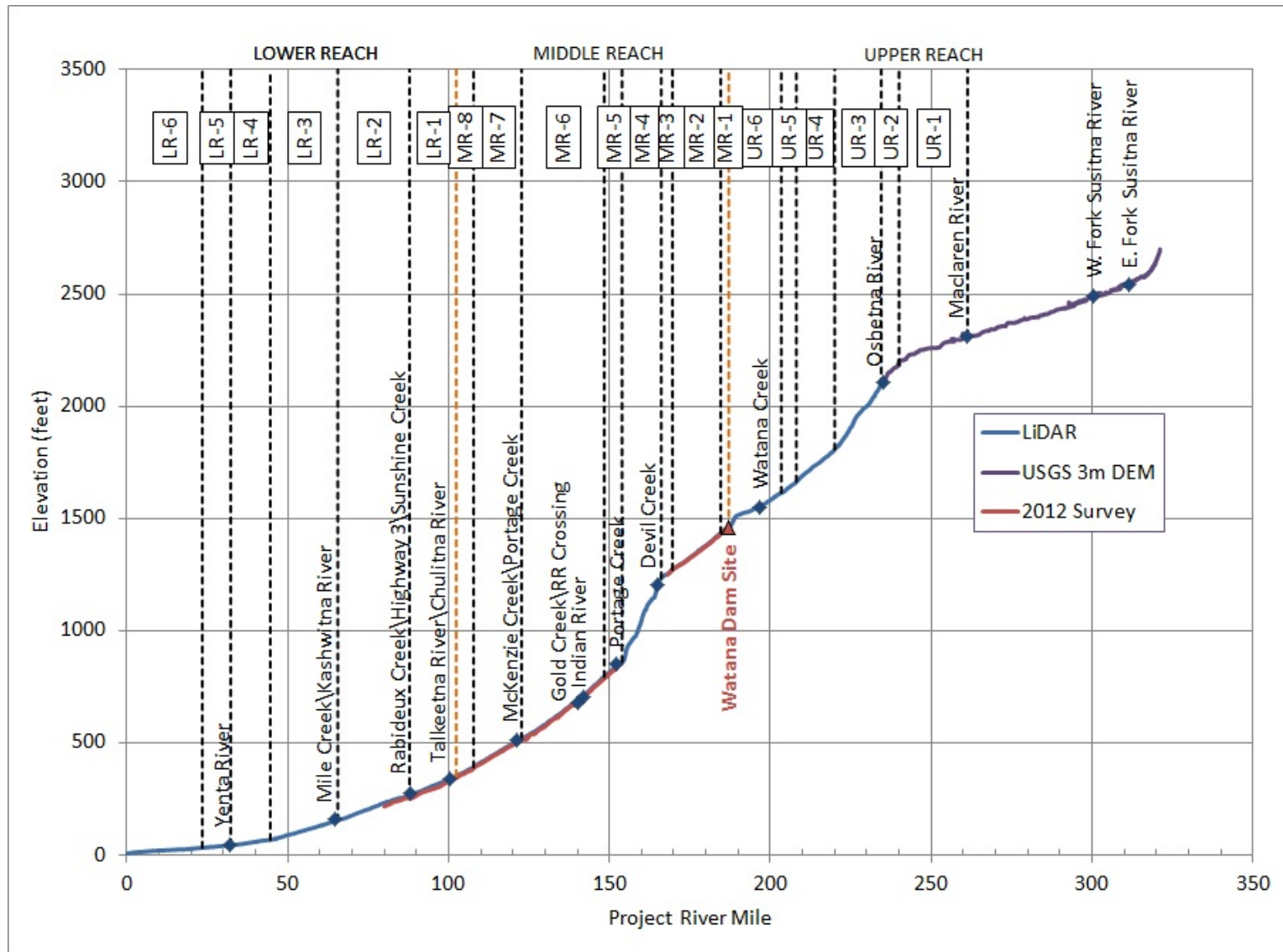


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### GEOMORPHIC SUCCESSION MIDDLE SUSITNA RIVER SEGMENT

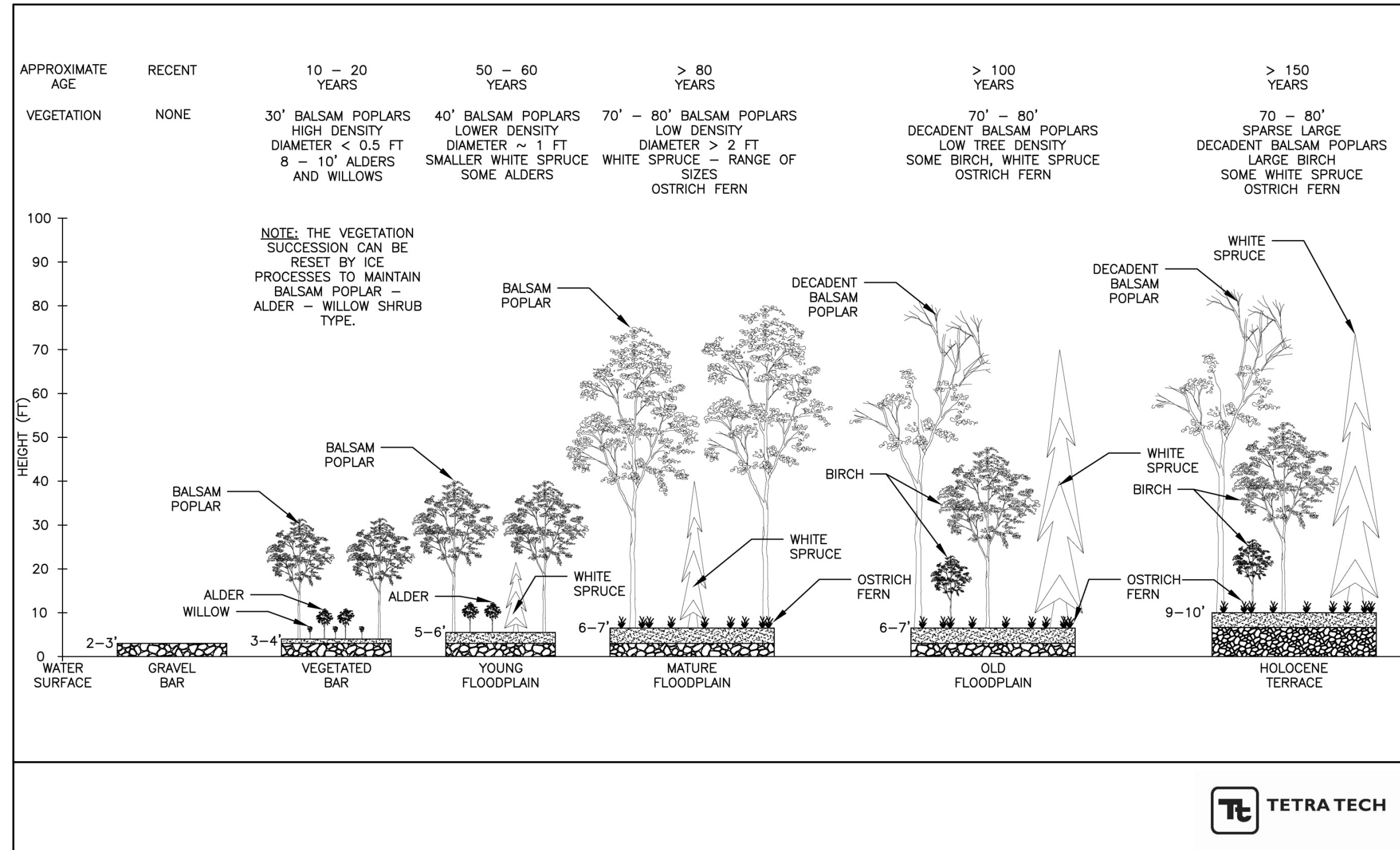


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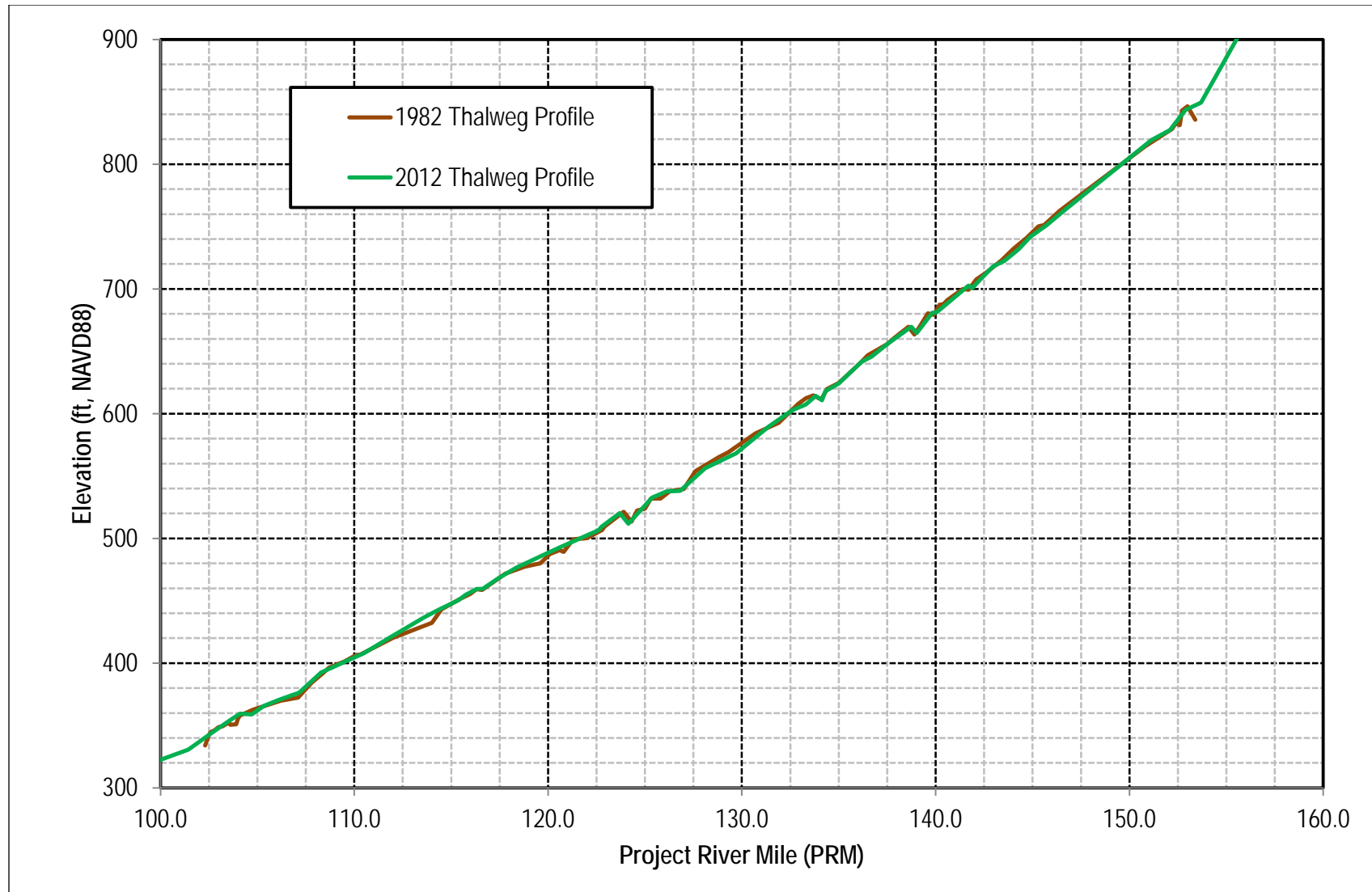


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SIDE CHANNEL AND SIDE SLOUGH DYNAMICS  
MIDDLE SUSITNA RIVER SEGMENT

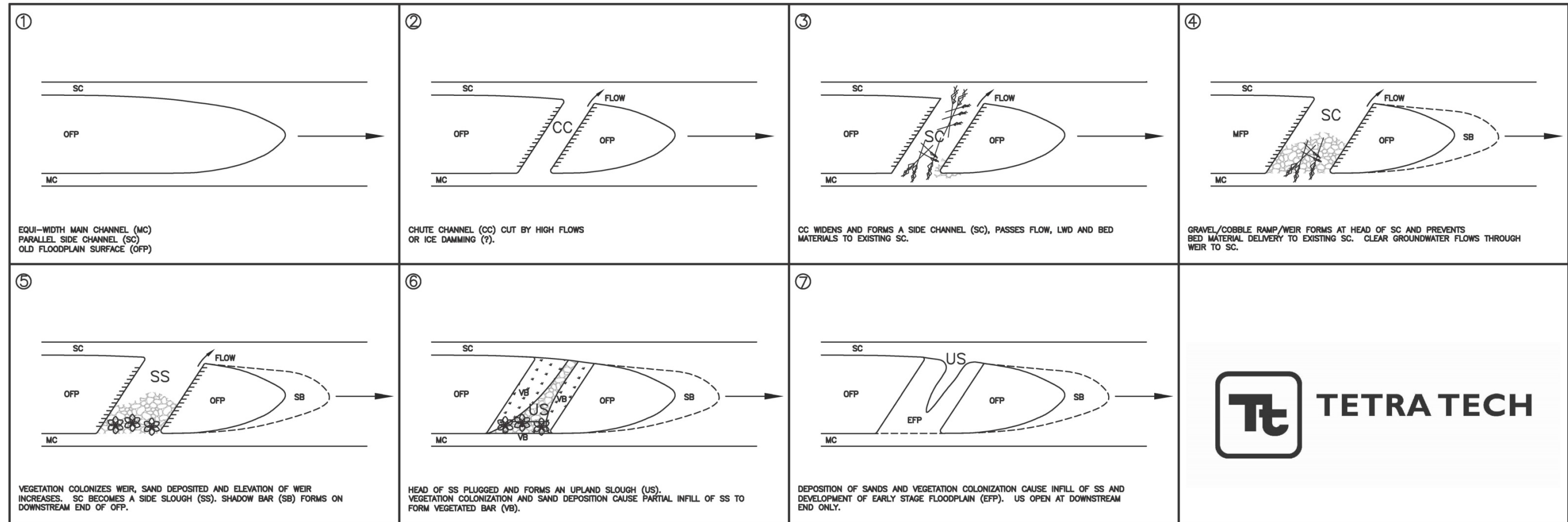


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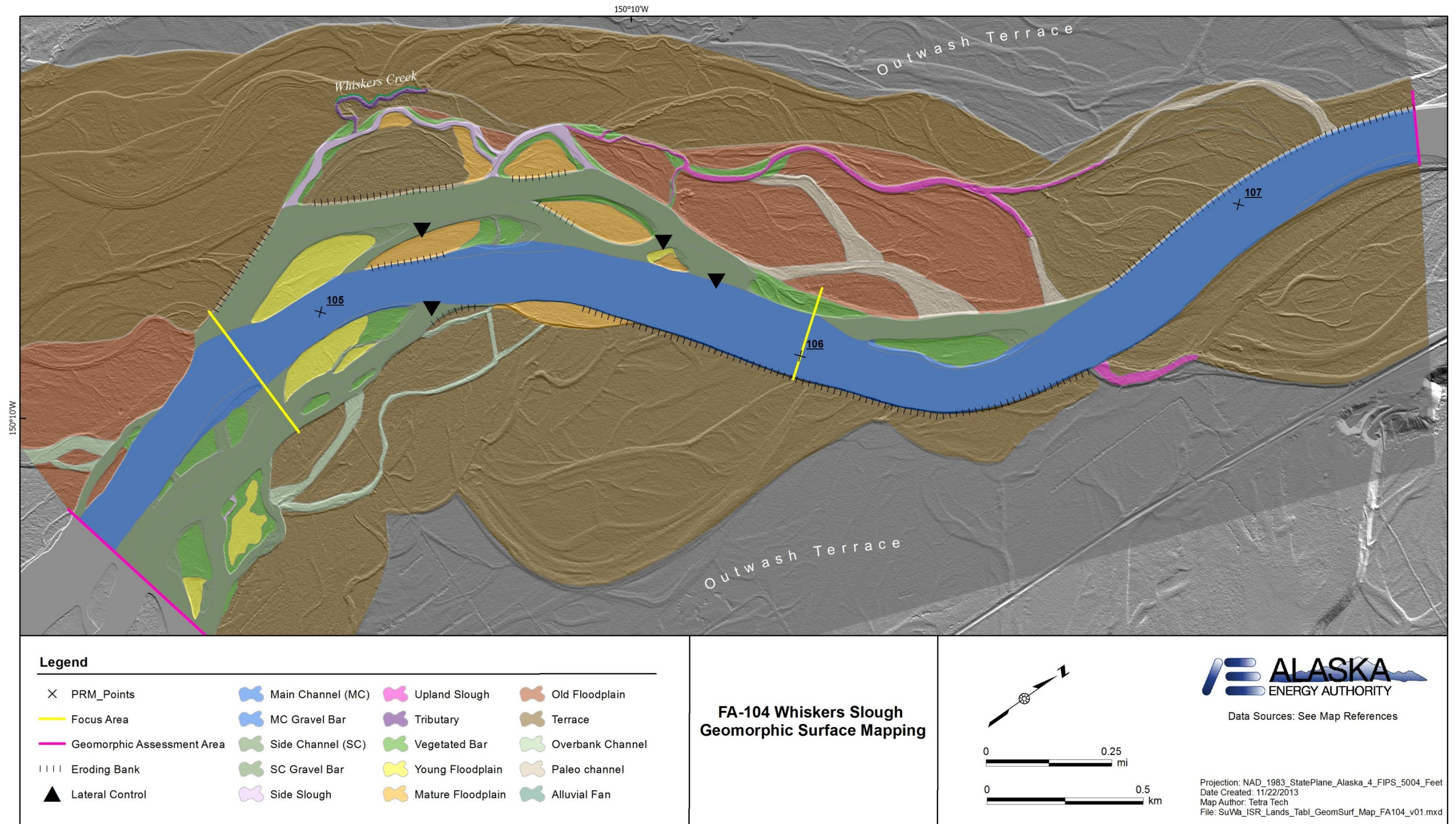


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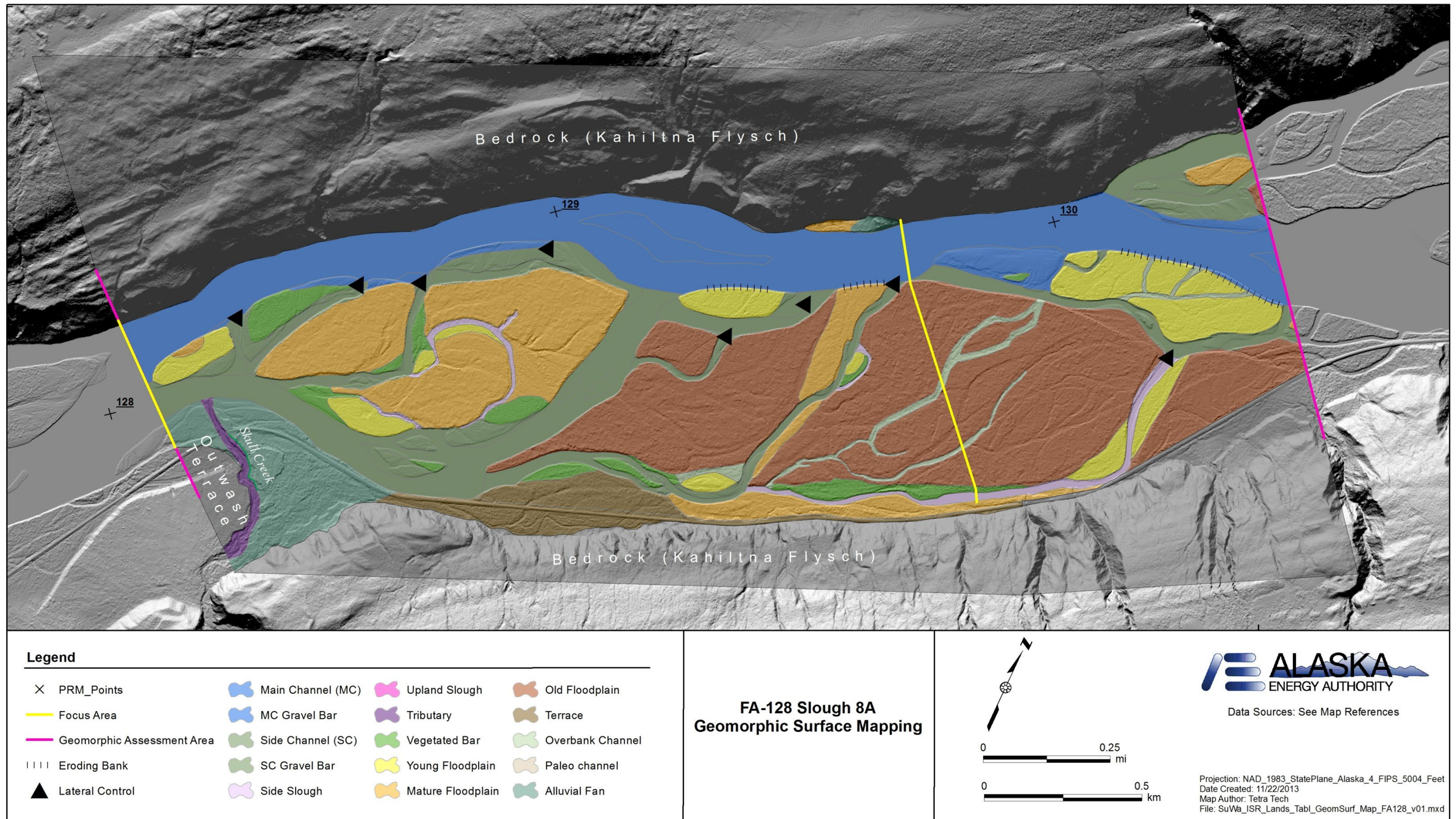


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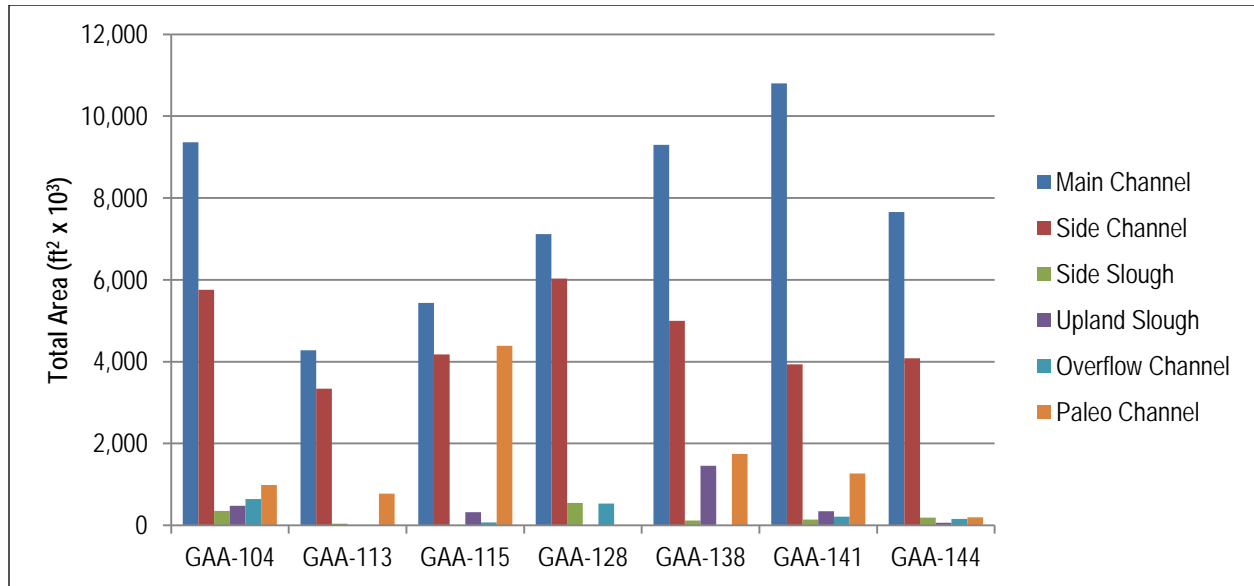


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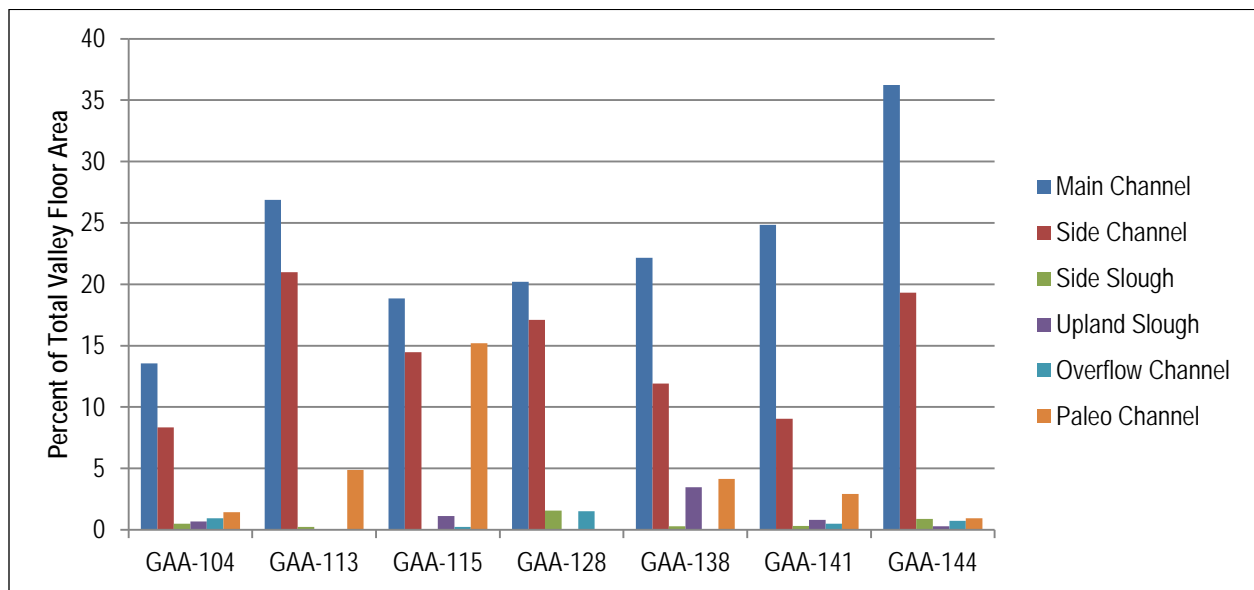


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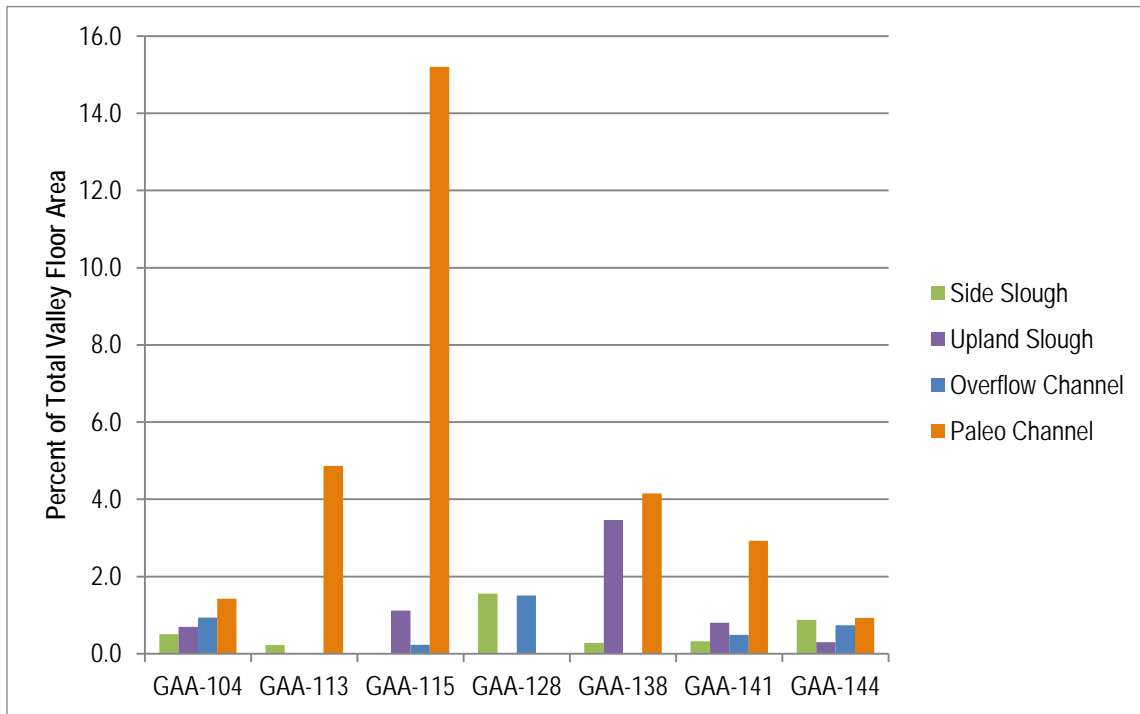
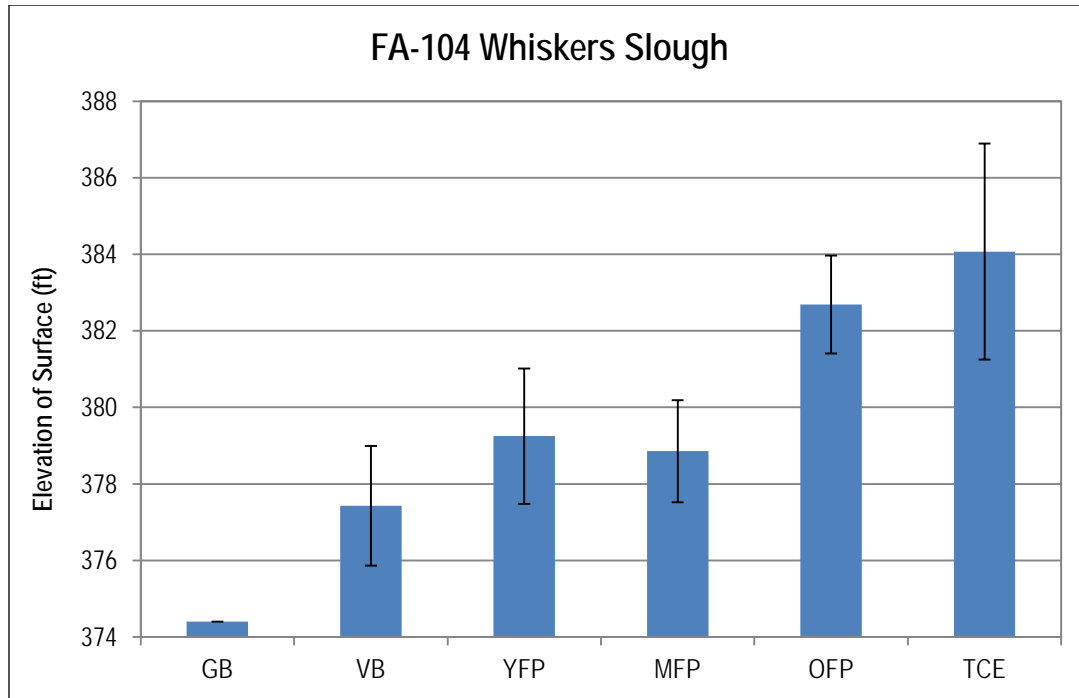
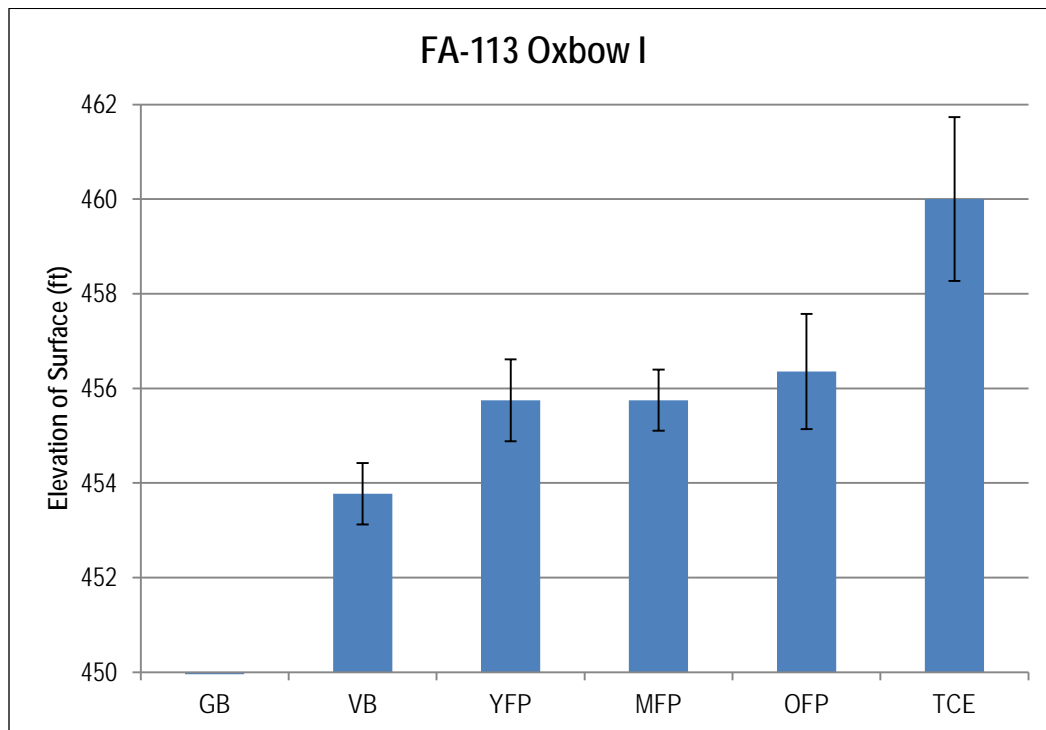


Figure 5.1-12: Percent of Total Valley Floor Area of geomorphic surfaces in 7 Focus Areas.



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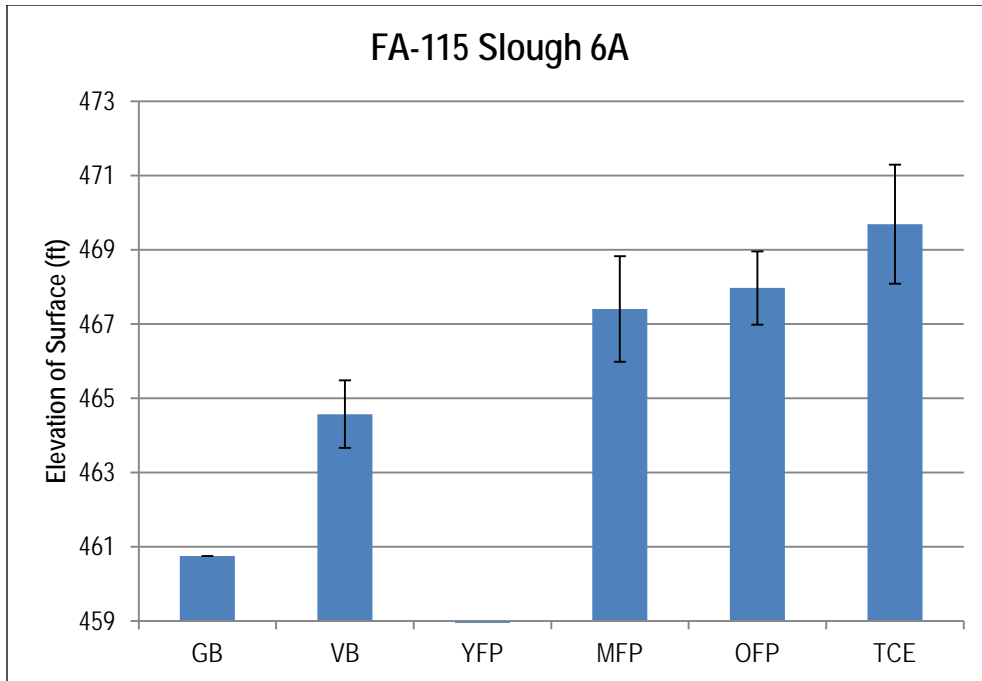


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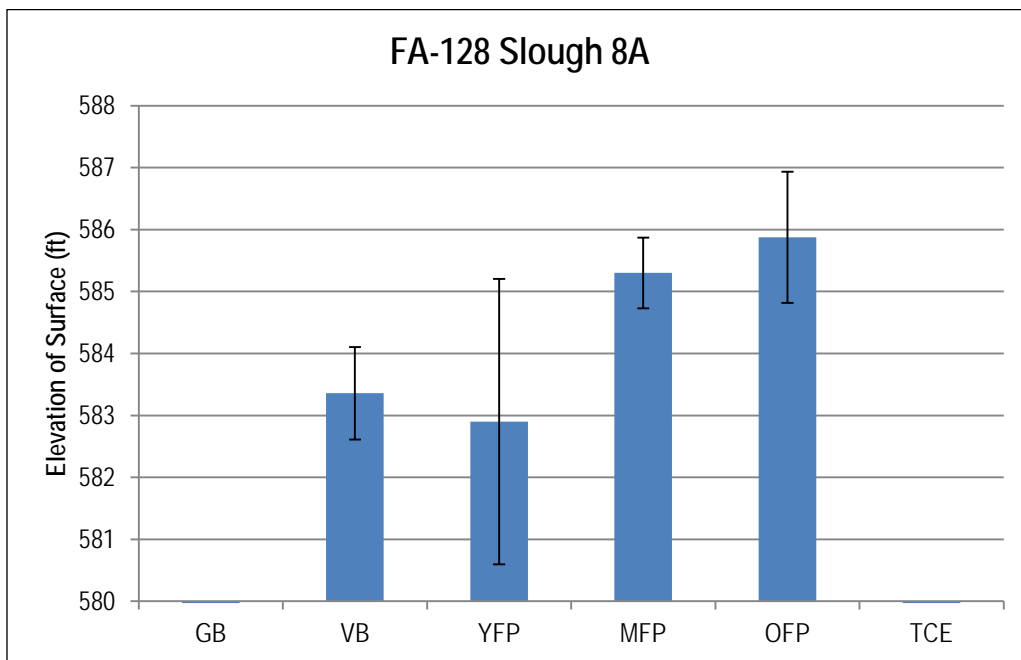


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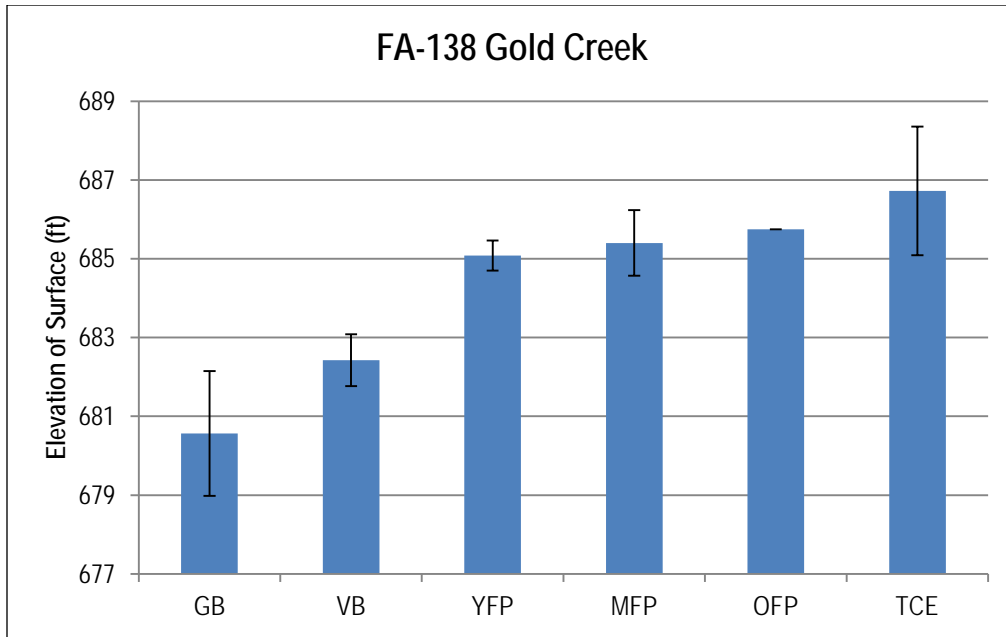


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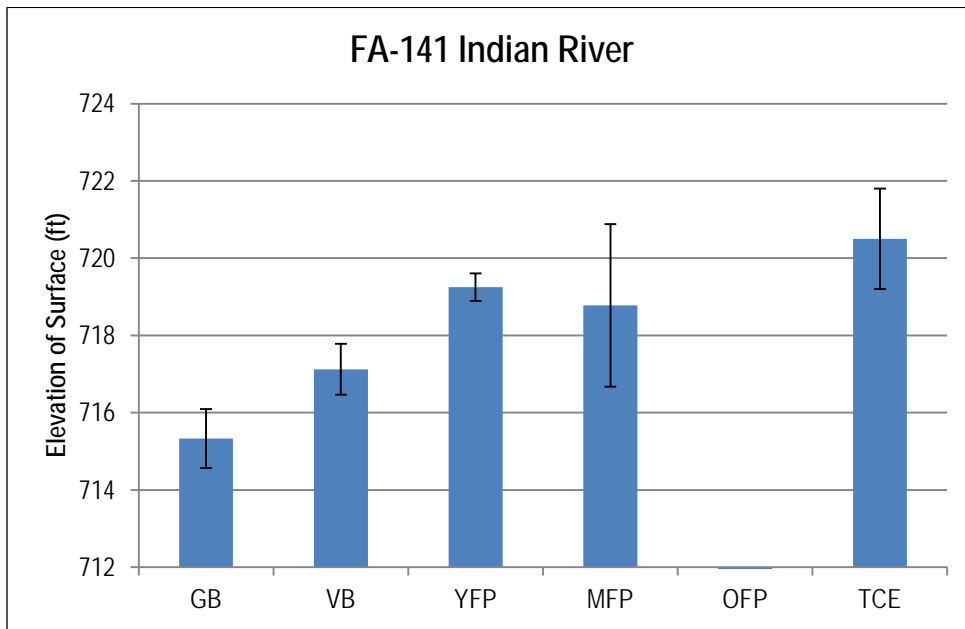


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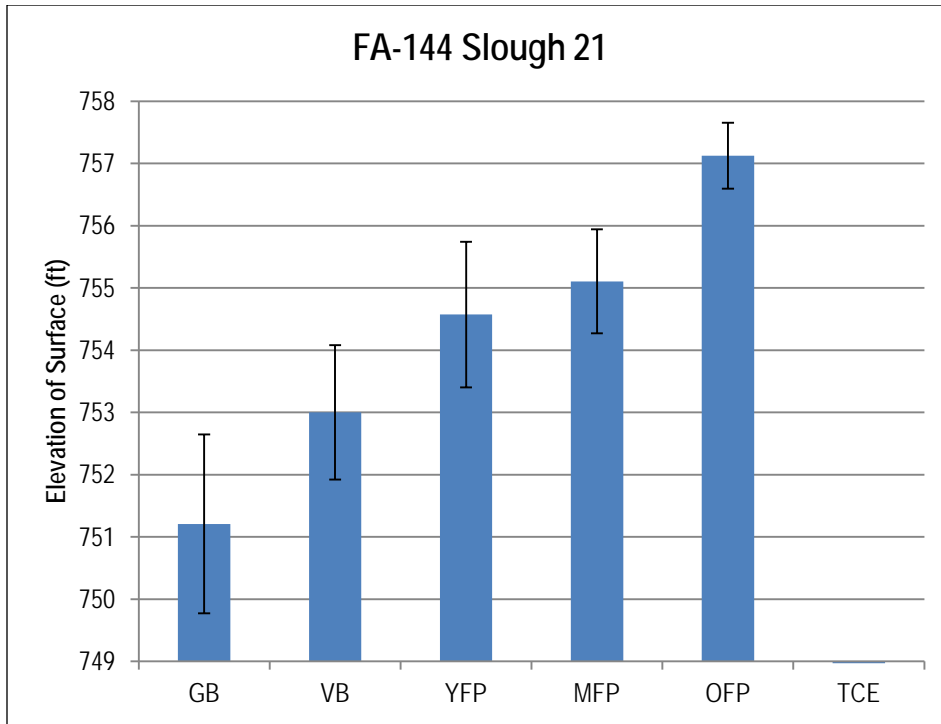


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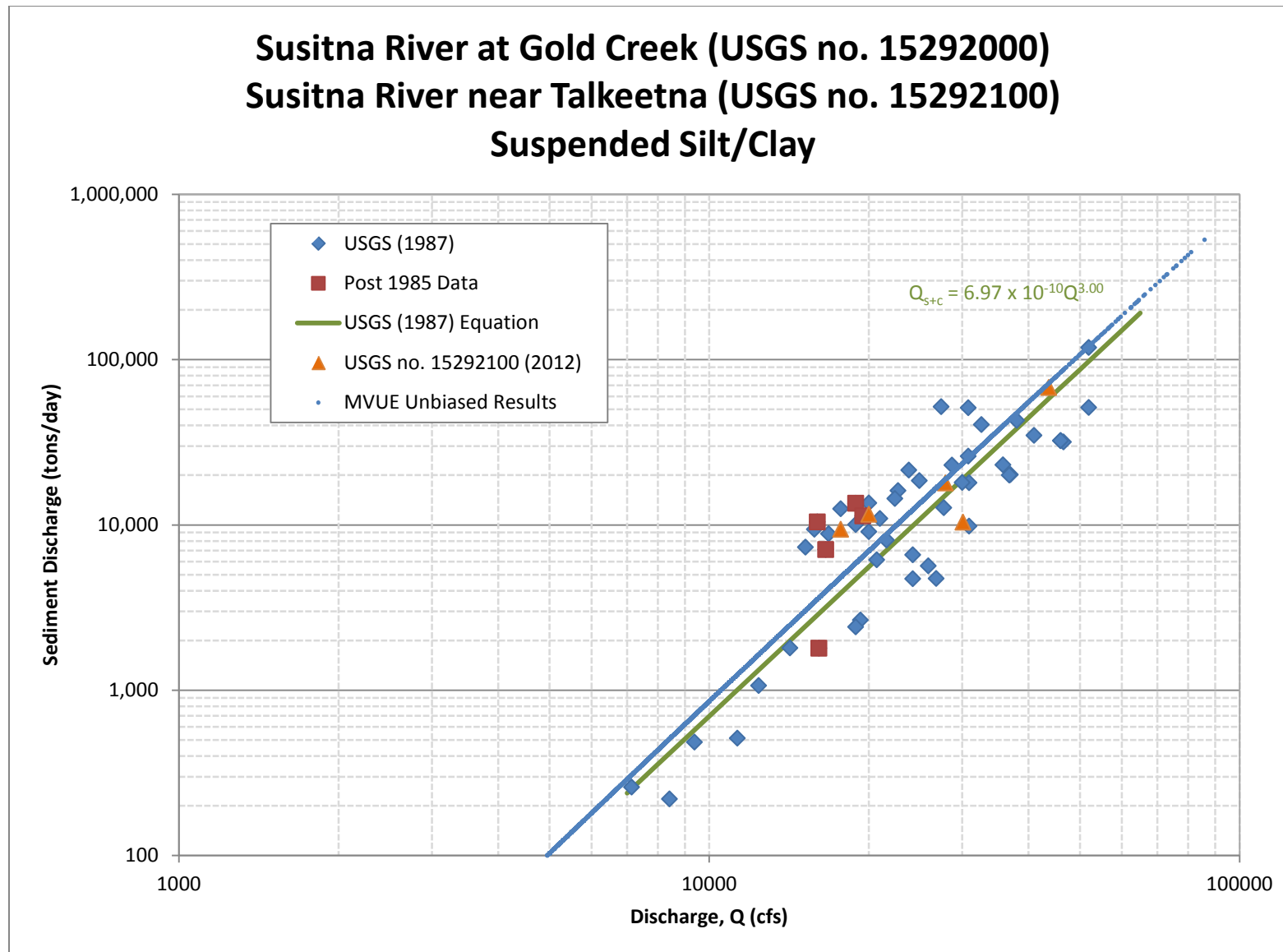


Figure 5.2-1 – Suspended silt/clay sediment-transport data and rating equations for Susitna River at Gold Creek and Susitna River near Talkeetna

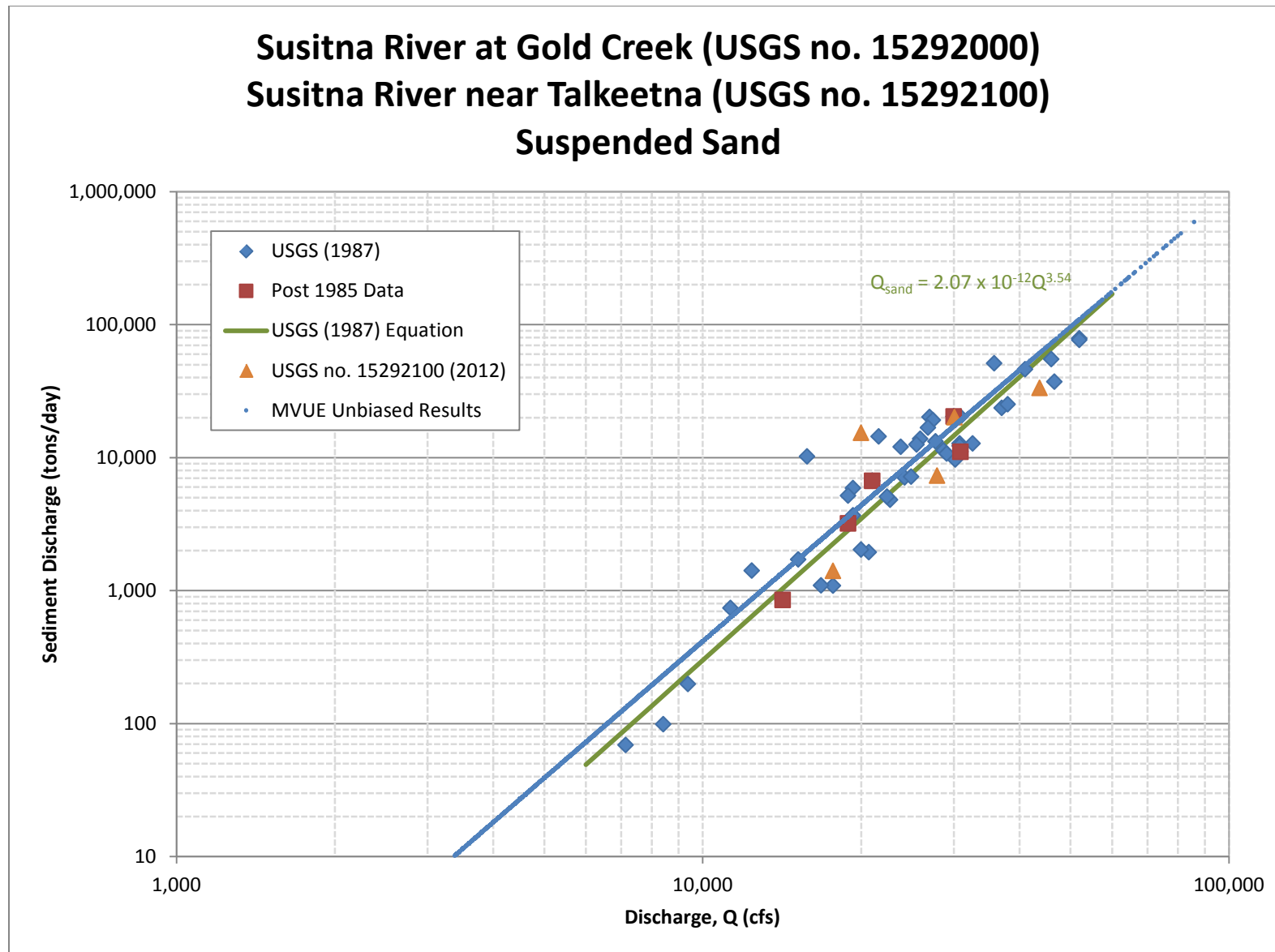


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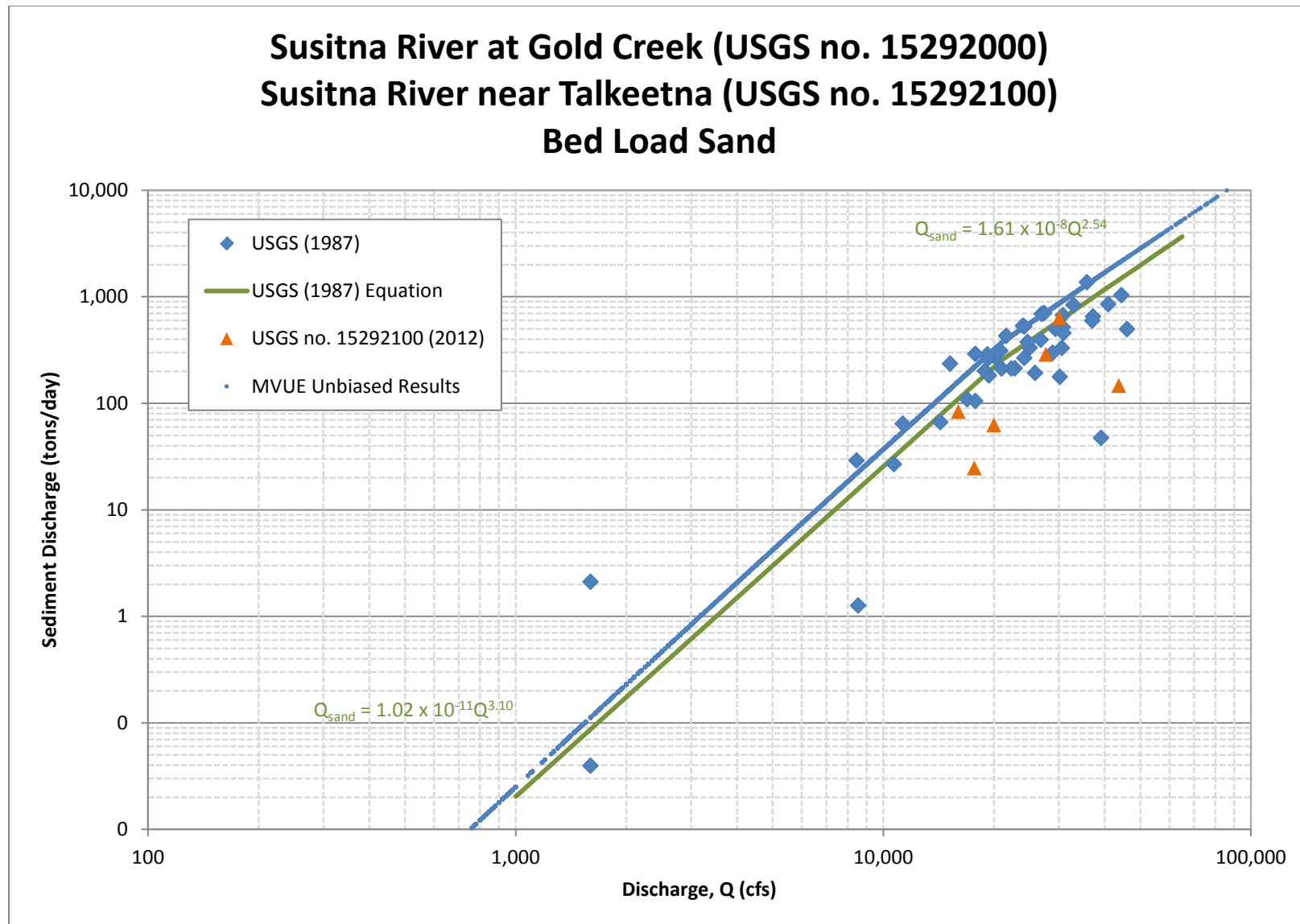


Figure 5.2-3 – Bed load sand sediment-transport data and rating equations for Susitna River at Gold Creek and Susitna River near Talkeetna



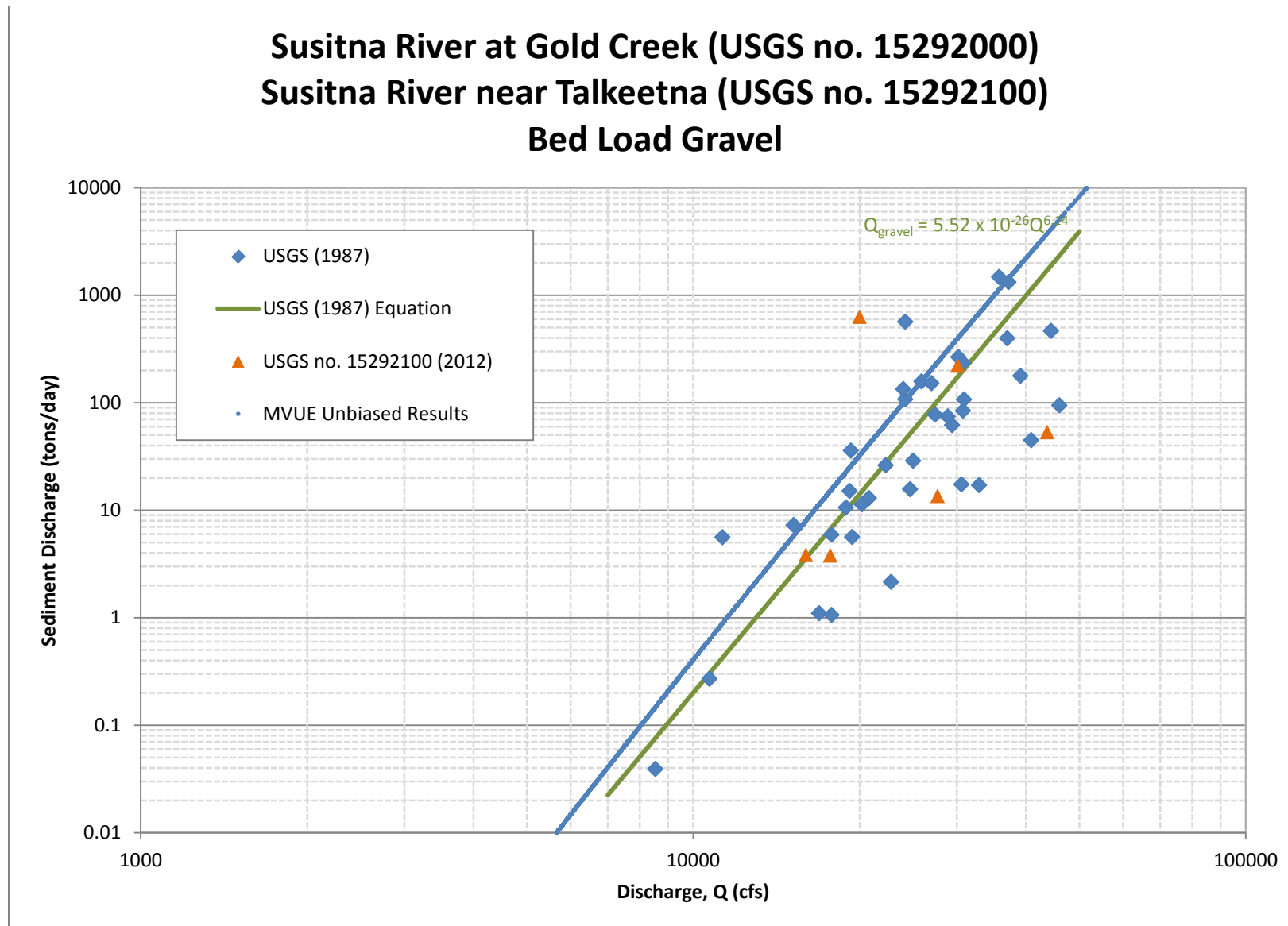


Figure 5.2-4 – Bed load gravel sediment-transport data and rating equations for Susitna River at Gold Creek and Susitna River near Talkeetna

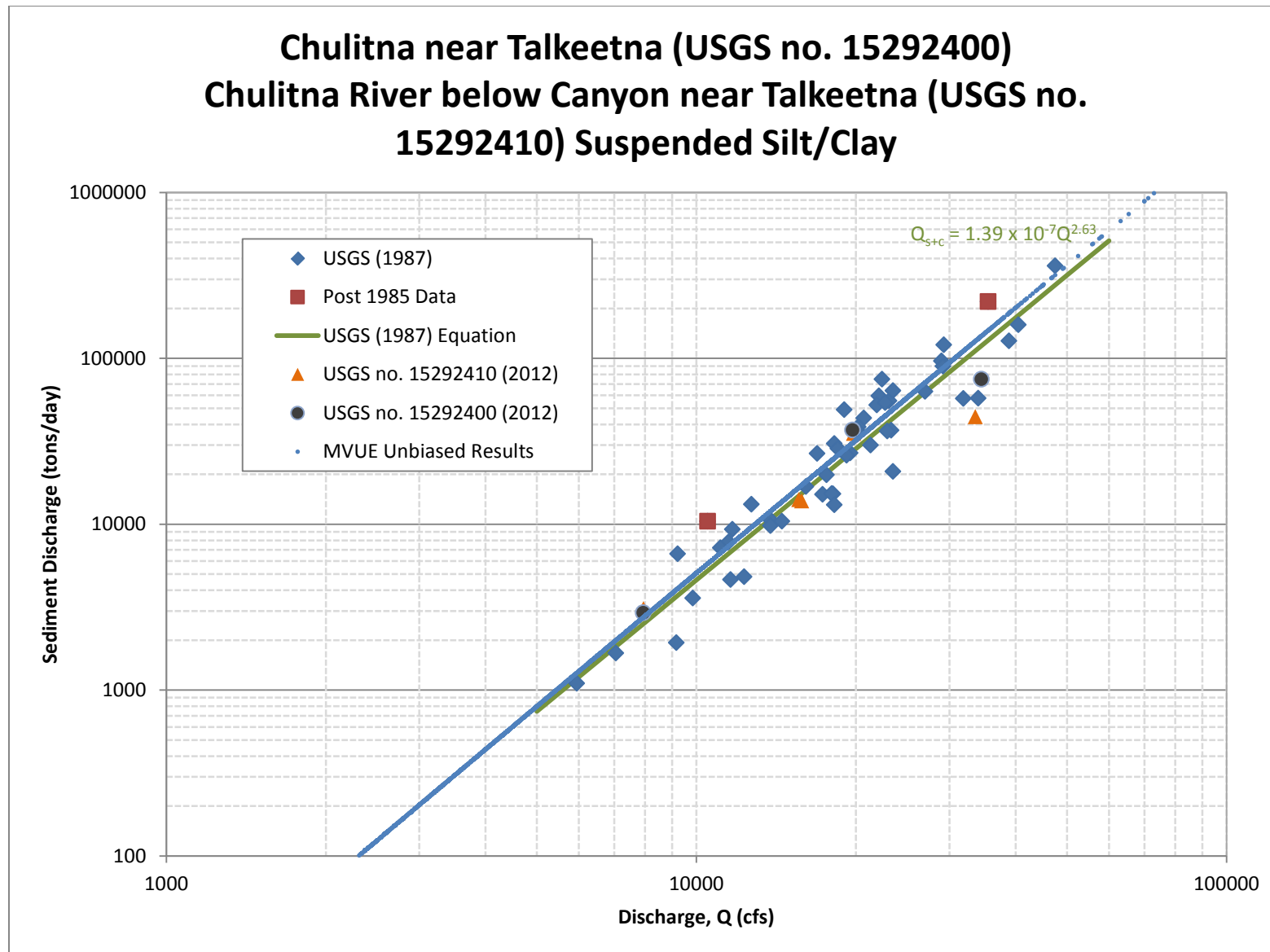


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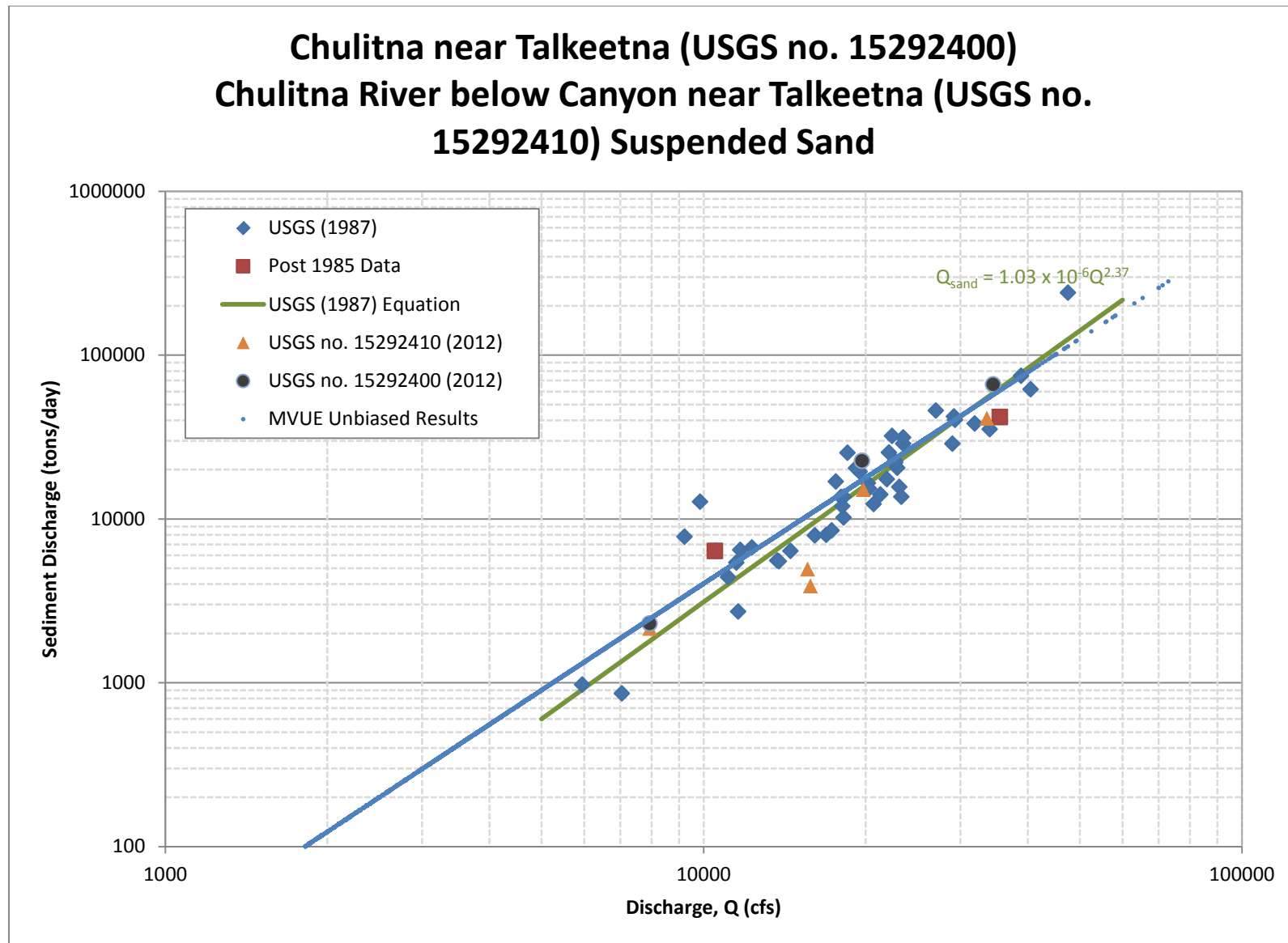


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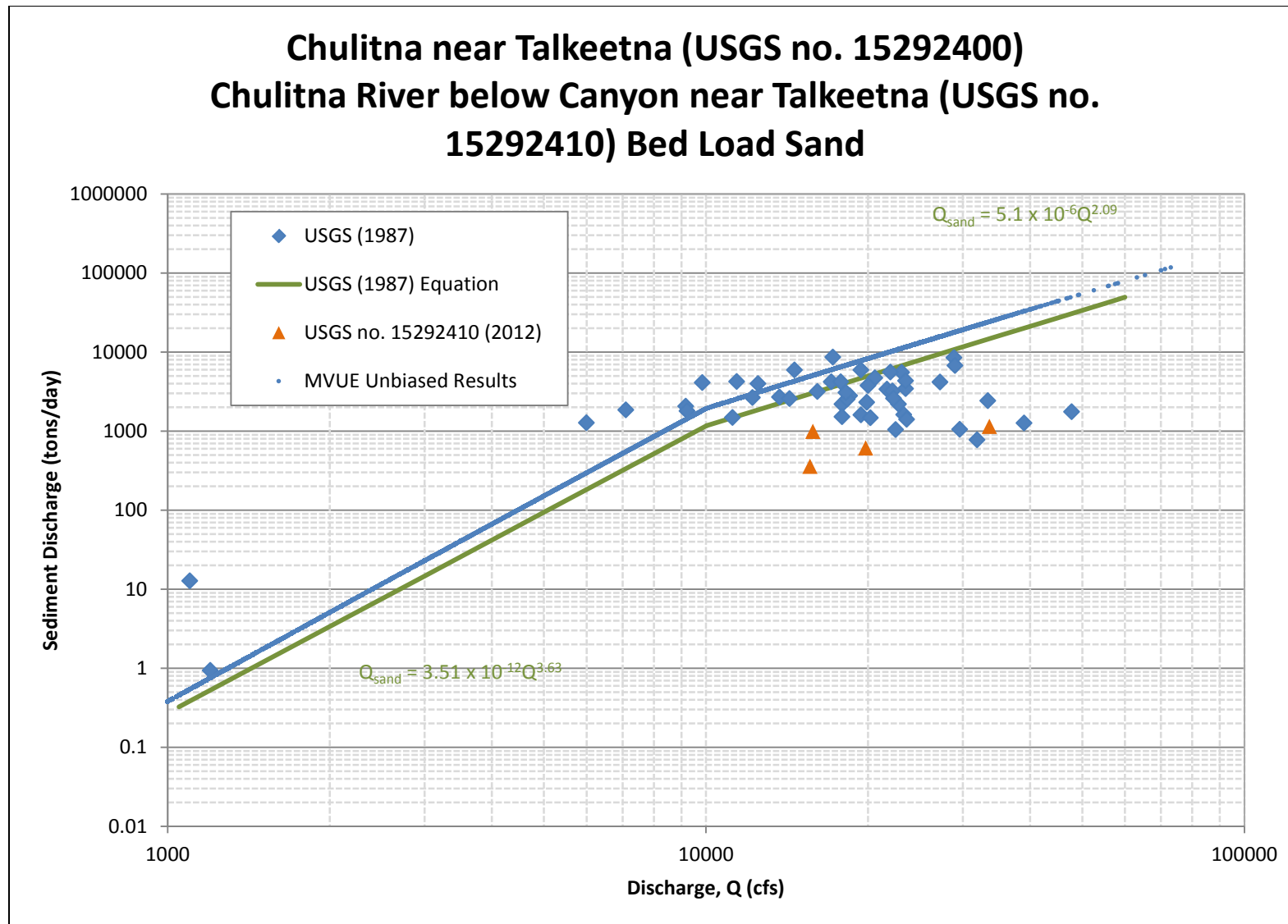


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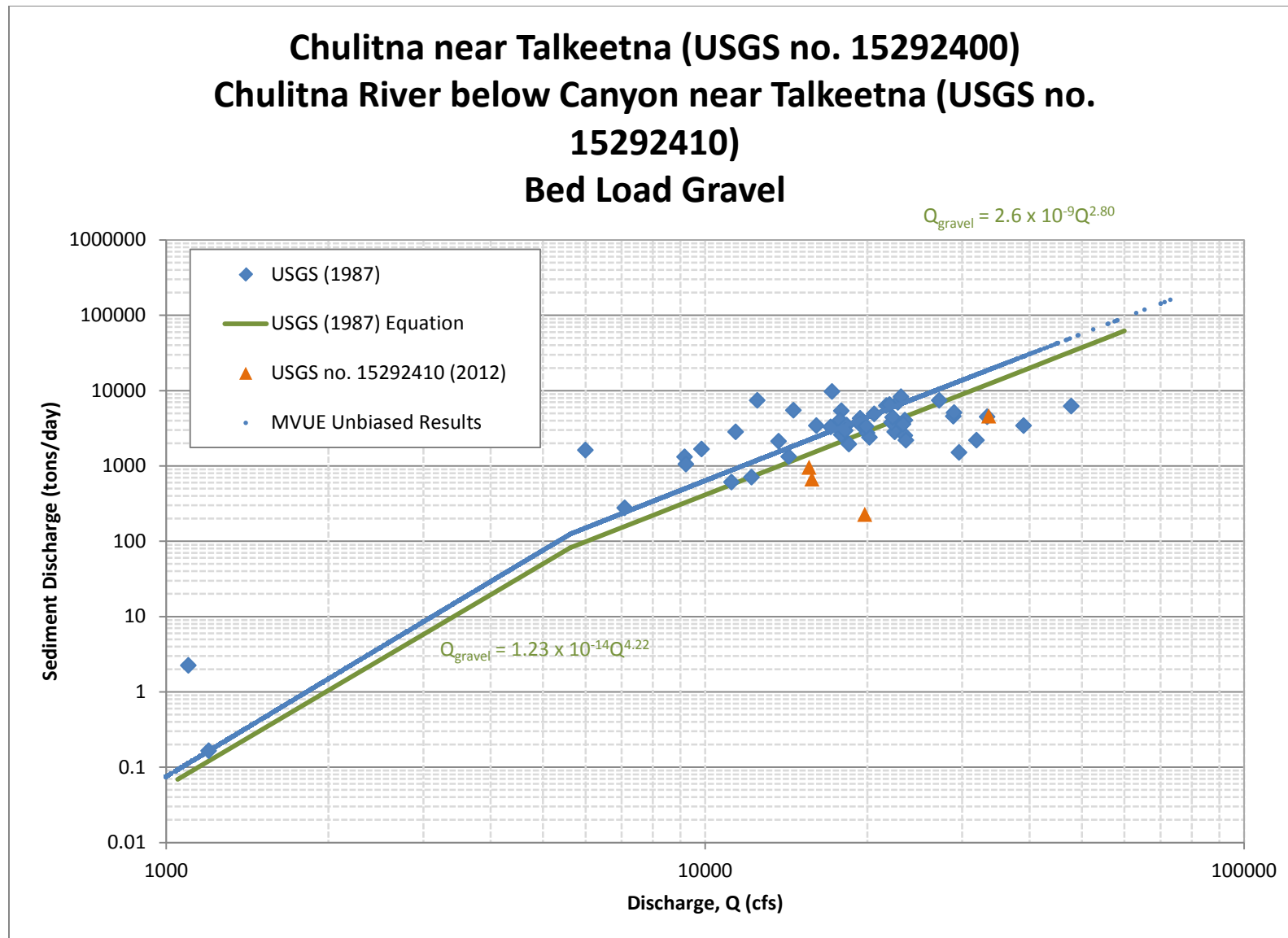


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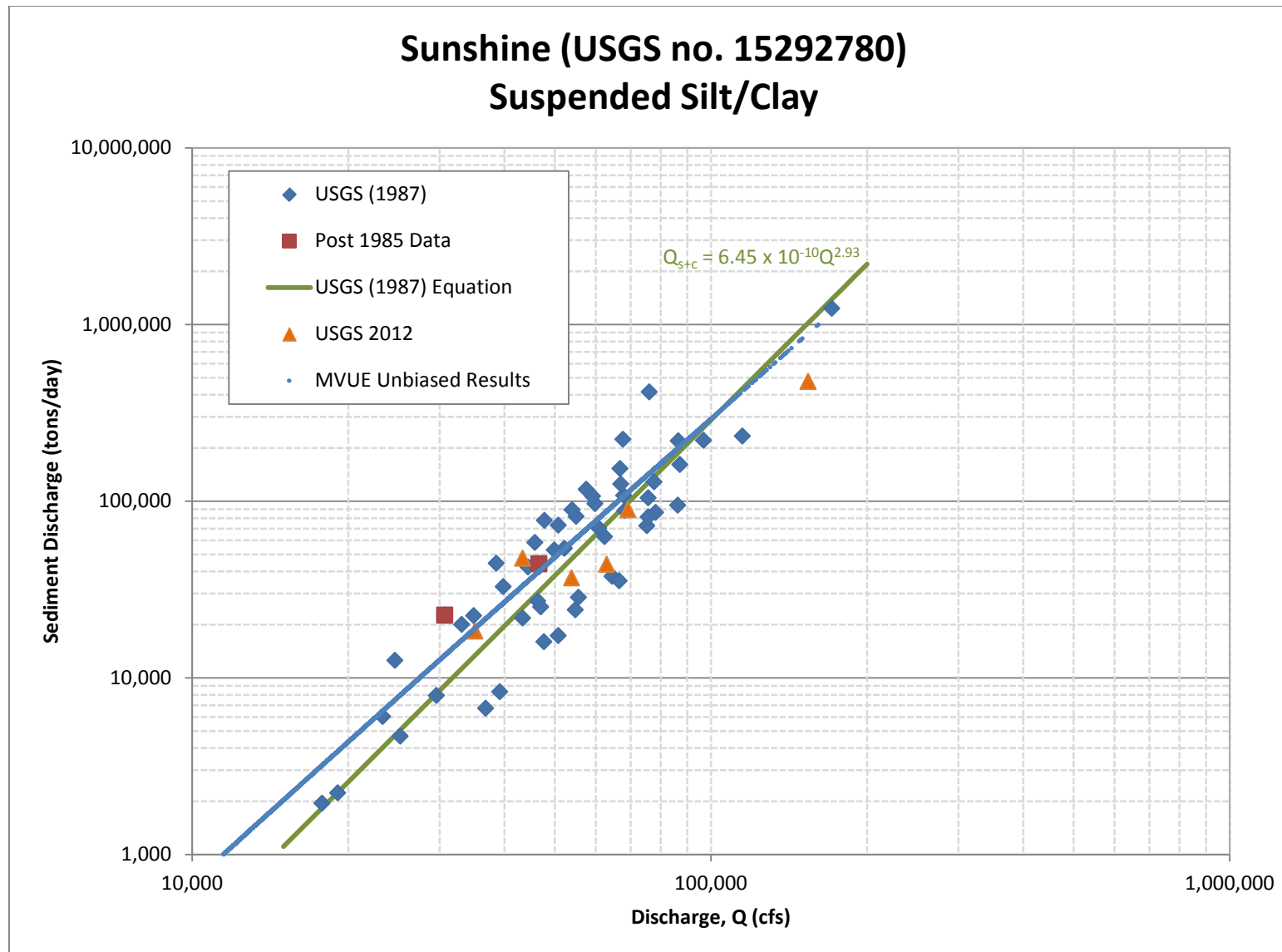


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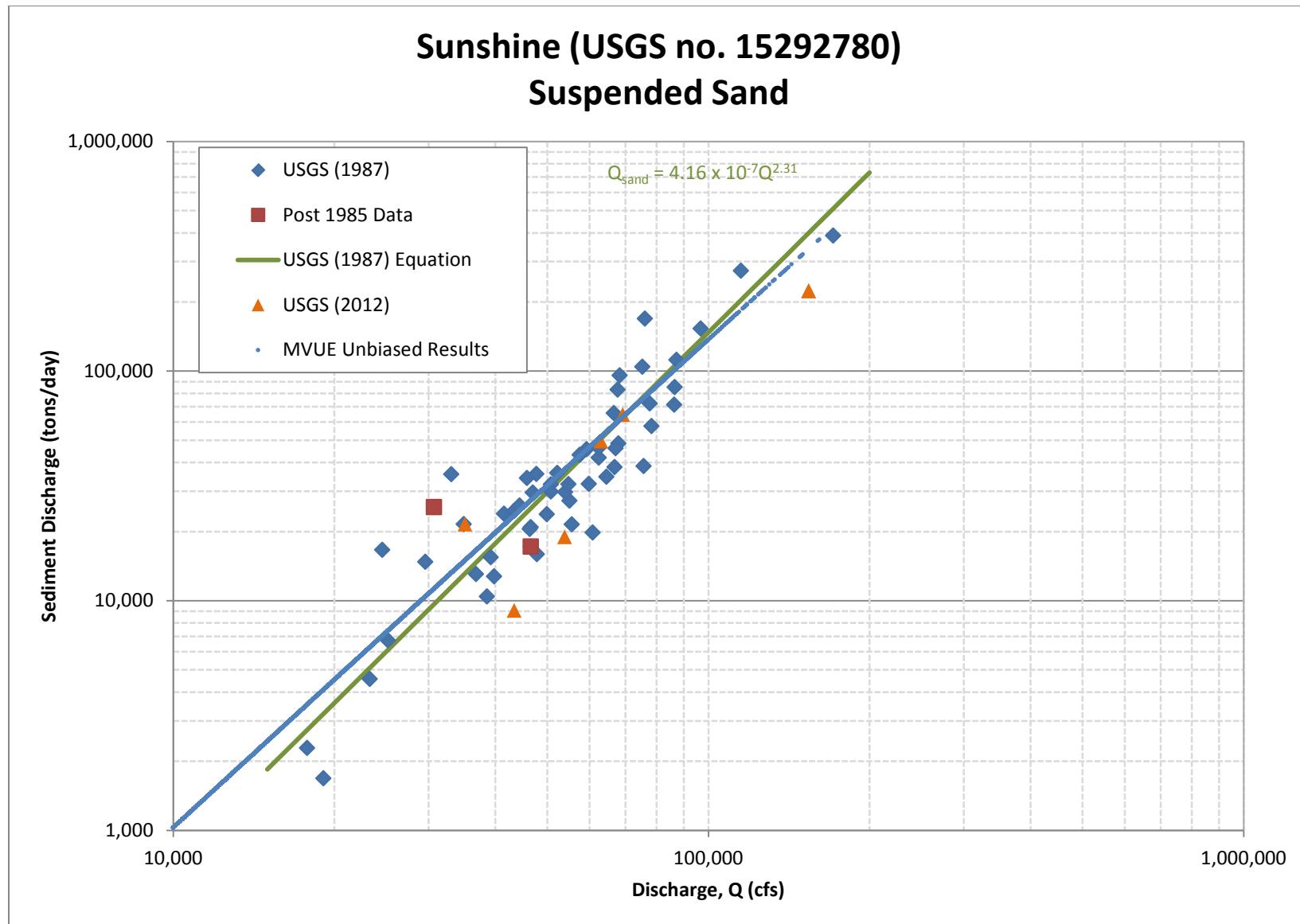


Figure 5.2-10 – Suspended sand sediment-transport data and rating equations for Susitna River at Sunshine

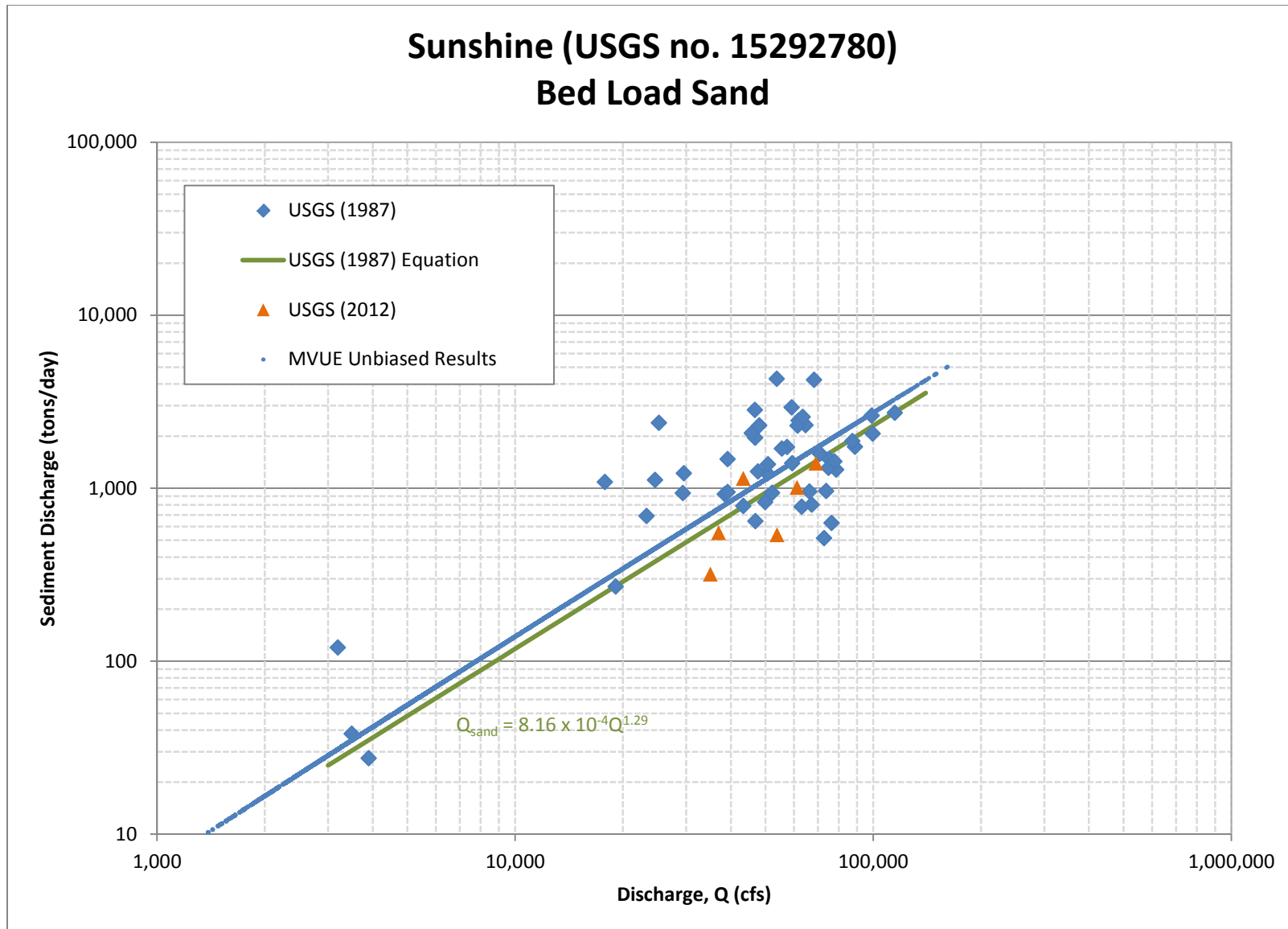


Figure 5.2-11 – Bed load sand sediment-transport data and rating equations for Susitna River at Sunshine



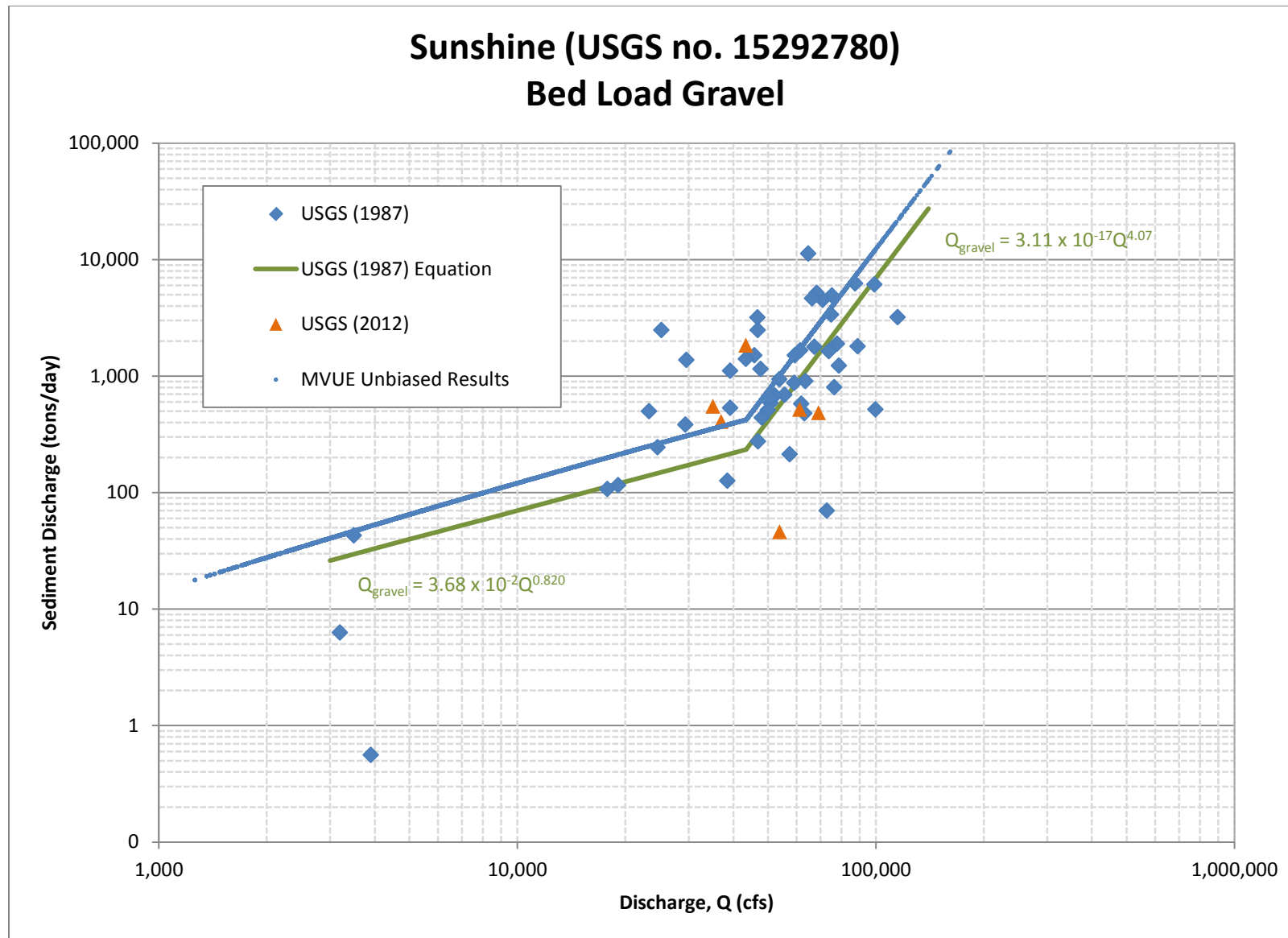


Figure 5.2-12 – Bed load gravel sediment-transport data and rating equations for Susitna River at Sunshine

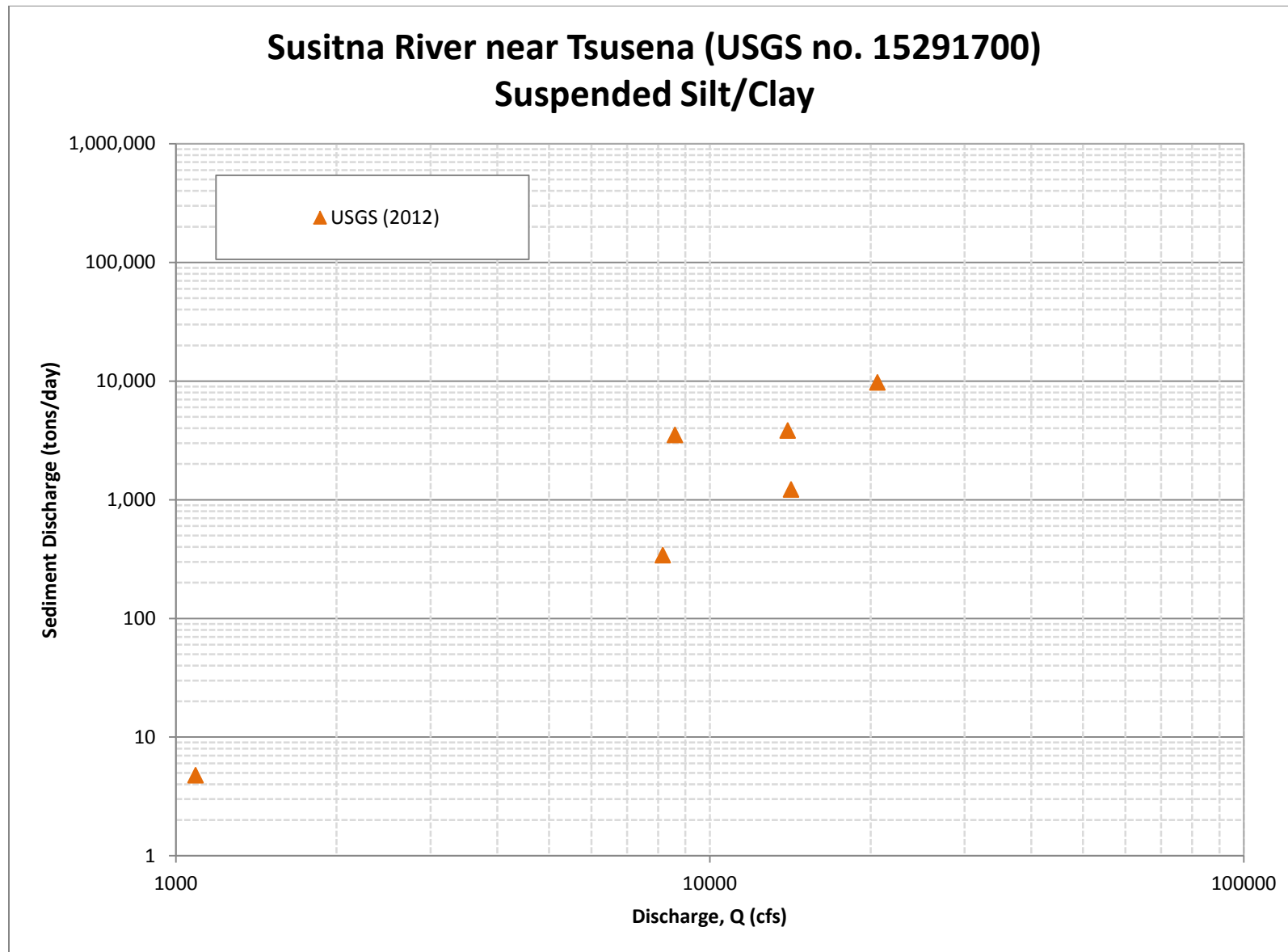


Figure 5.2-13 – Suspended silt/clay sediment-transport data for Susitna River near Tsusena

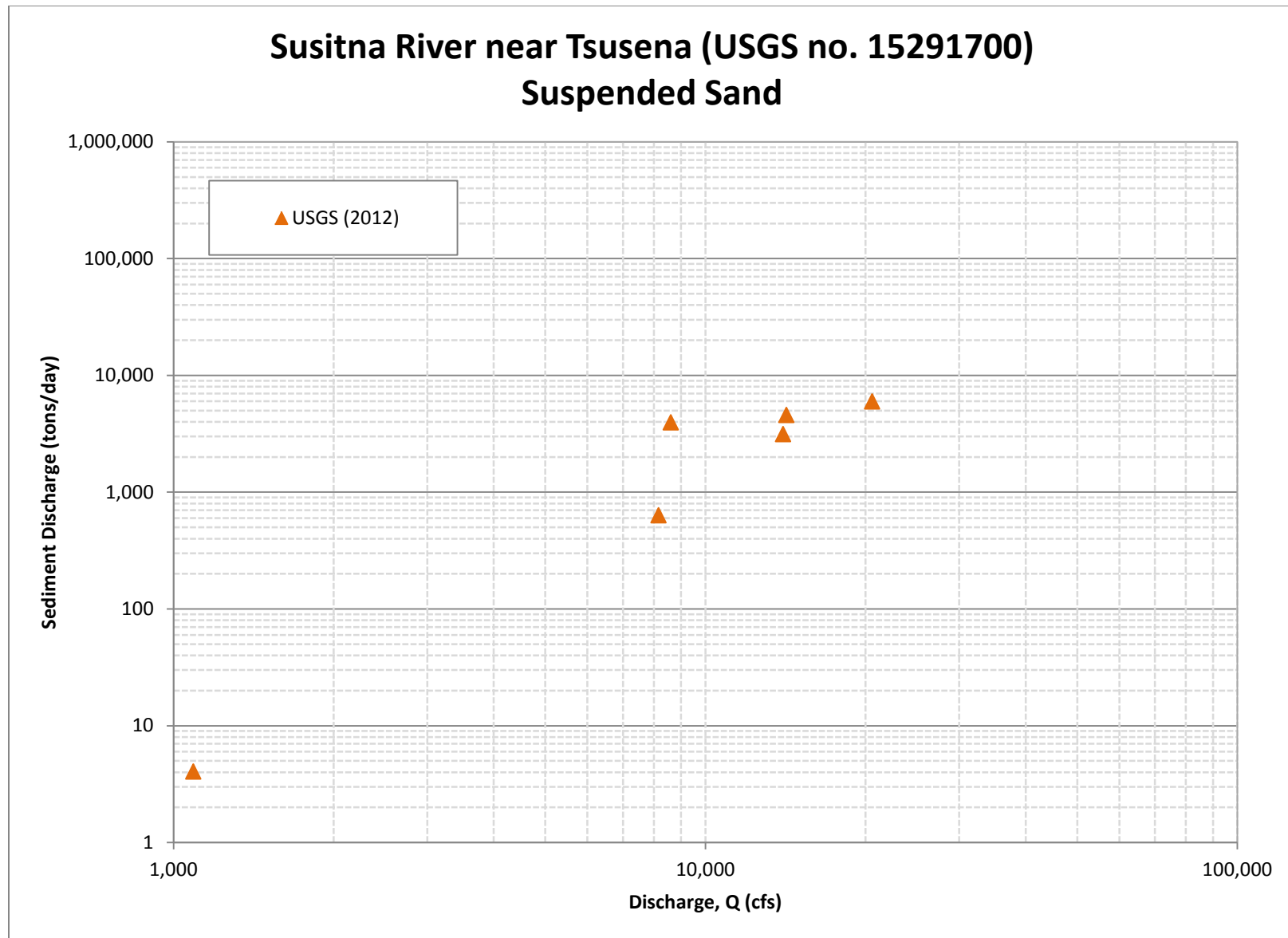


Figure 5.2-14 – Suspended sand sediment-transport data for Susitna River near Tsusena

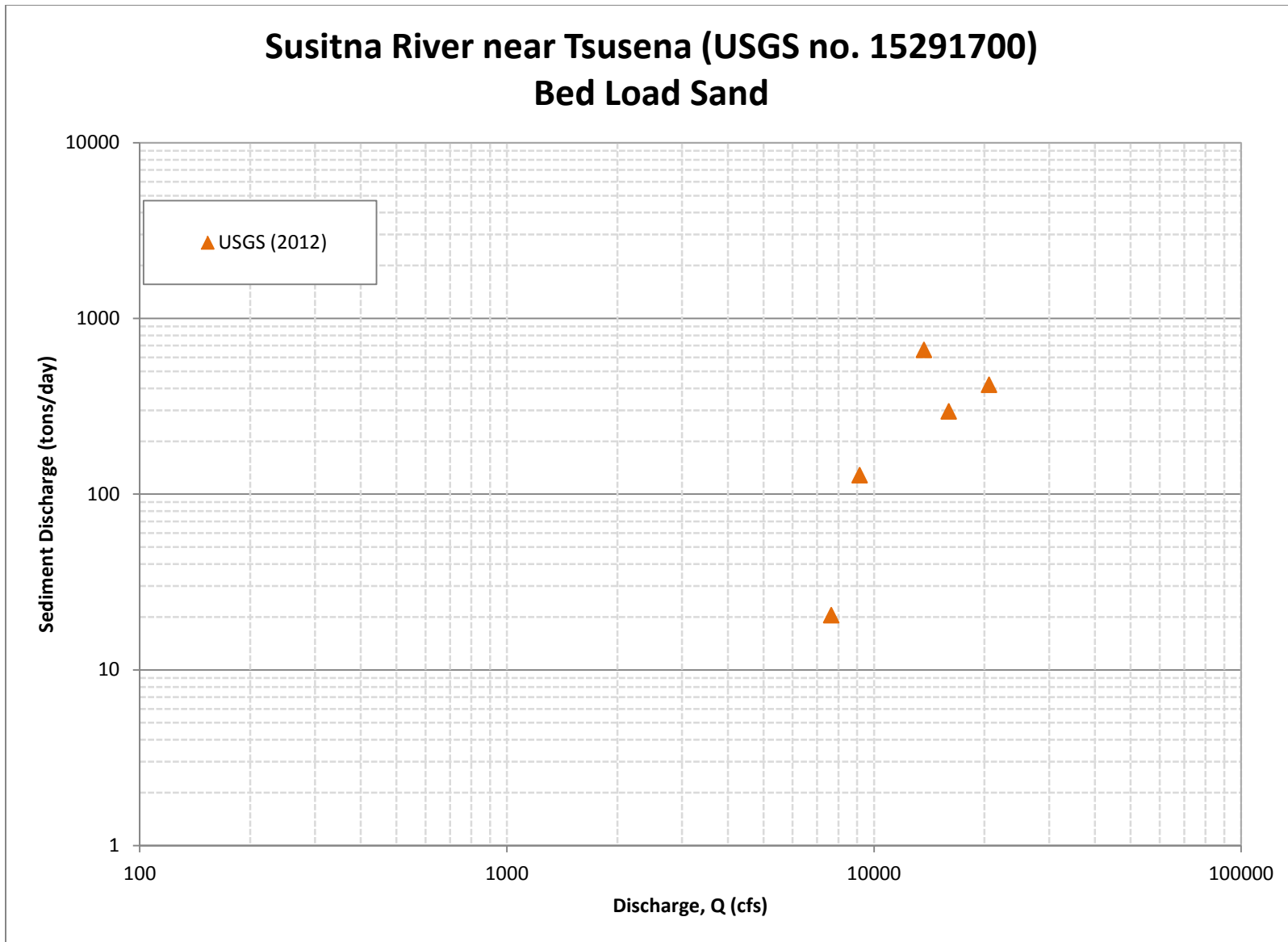


Figure 5.2-15 – Bed load sand sediment-transport data for Susitna River near Tsusena

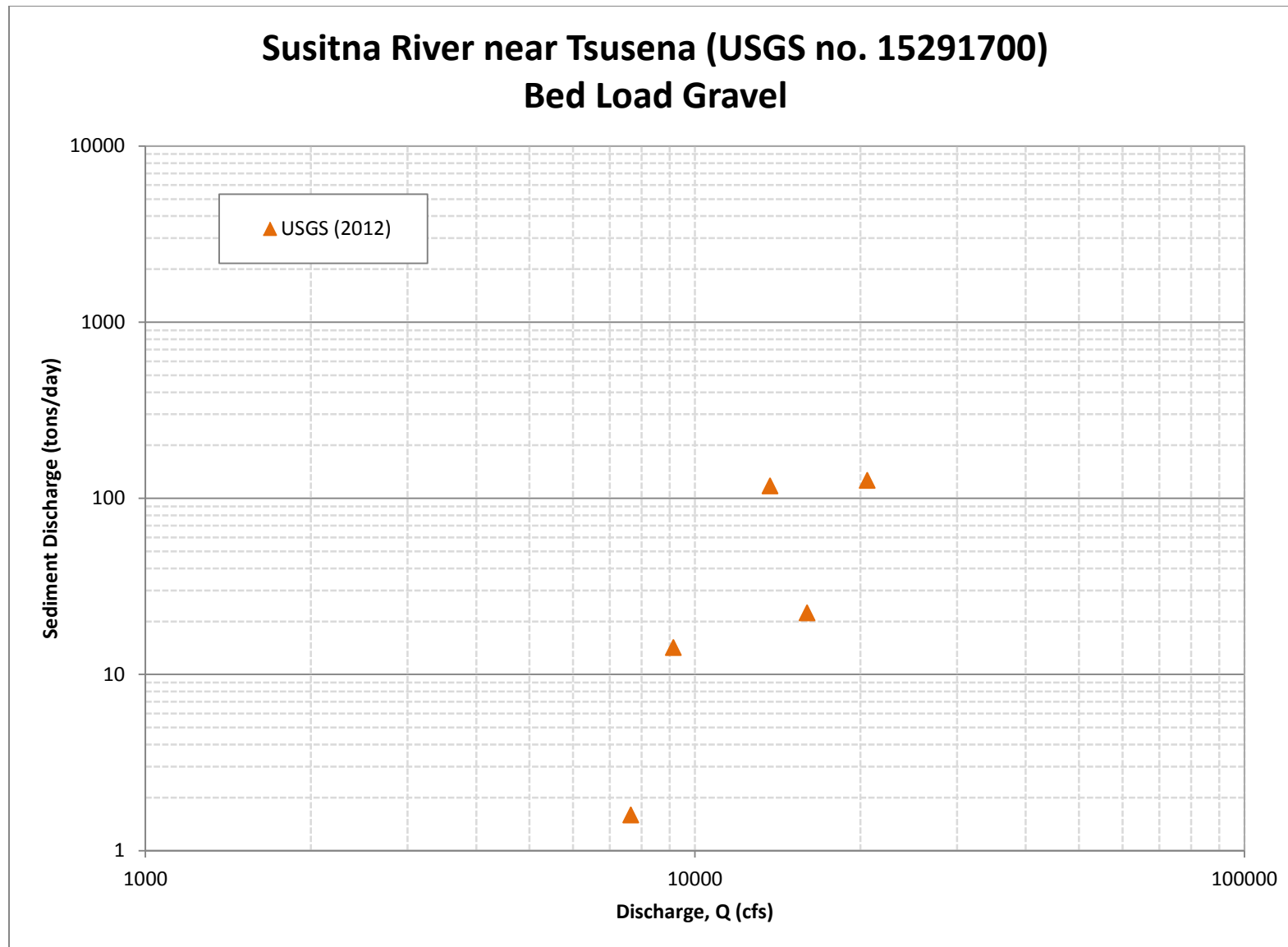


Figure 5.2-16 – Bed load gravel sediment-transport data for Susitna River near Tsusena

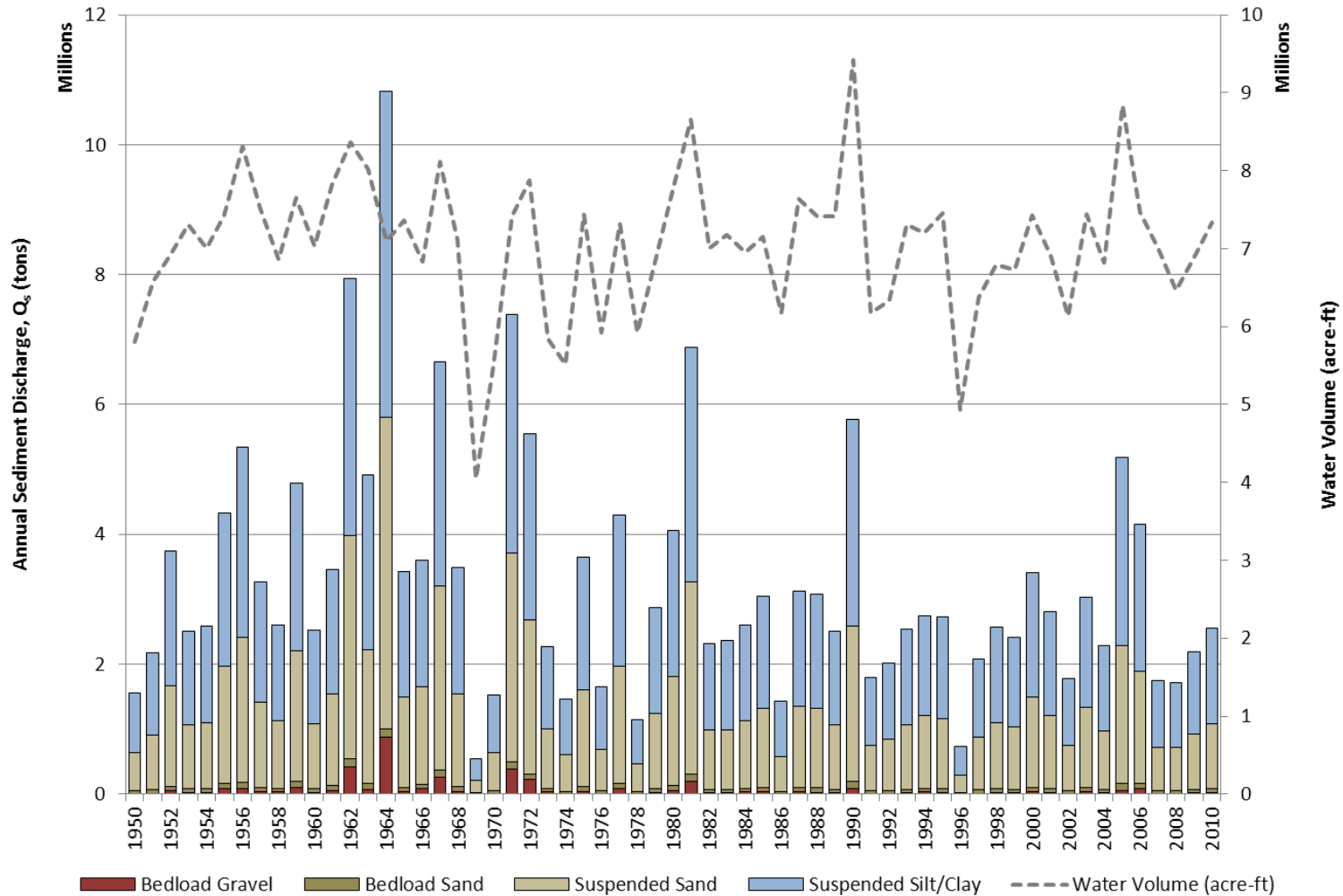


Figure 5.3-1. Estimated annual silt/clay, sand and gravel loads at the Gold Creek (Gage No. 15292000)/Susitna River near Talkeetna (Gage No. 15292100) gage over the 61-year period of flows under pre-Project conditions. Also shown is the annual flow volume for each of the years.

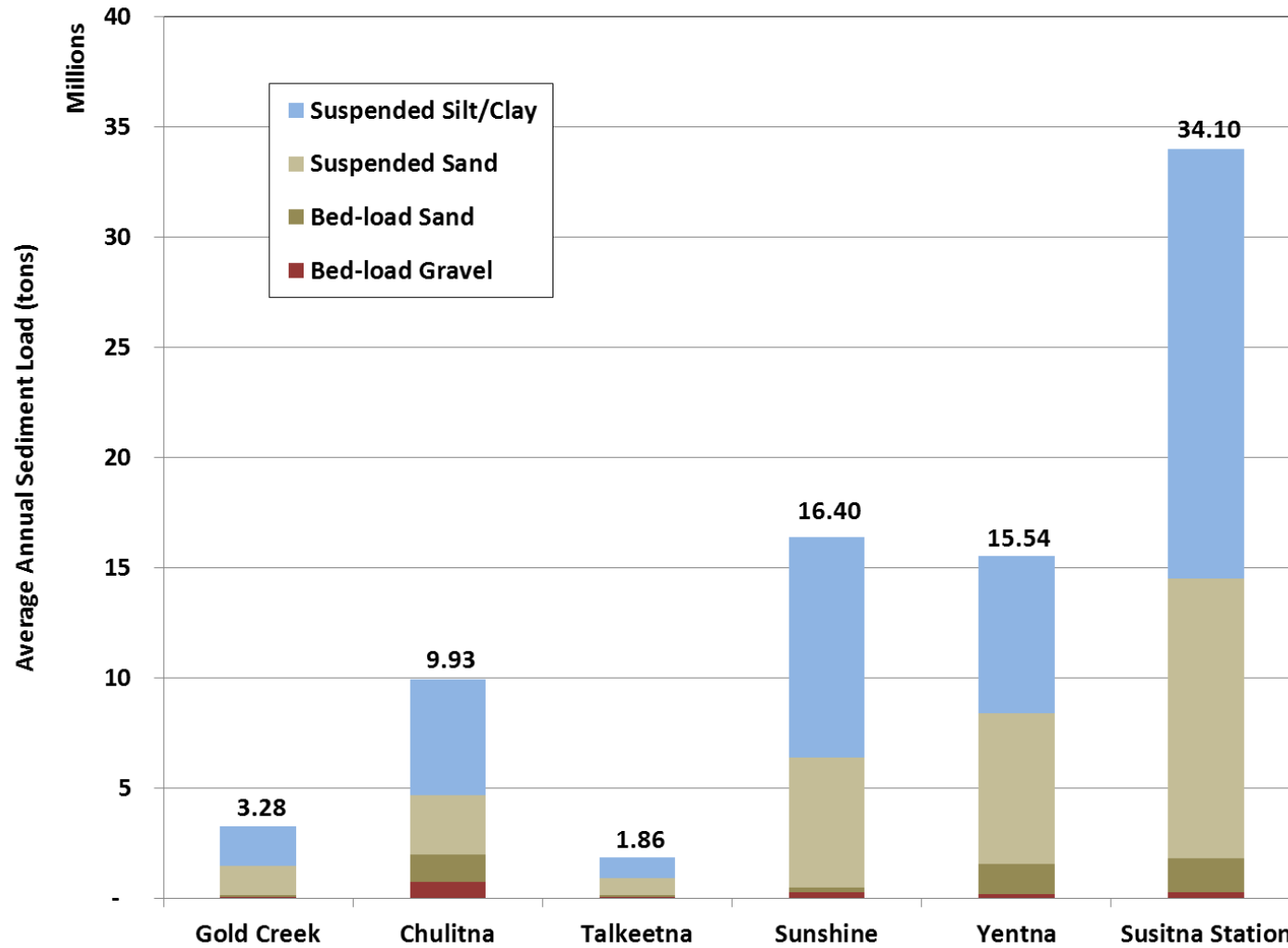


Figure 5.3-1. Estimated annual silt/clay, sand and gravel loads at the Gold Creek (Gage No. 15292000)/Susitna River near Talkeetna (Gage No. 15292100) gage over the 61-year period of flows under pre-Project conditions. Also shown is the annual flow volume for each of the years.

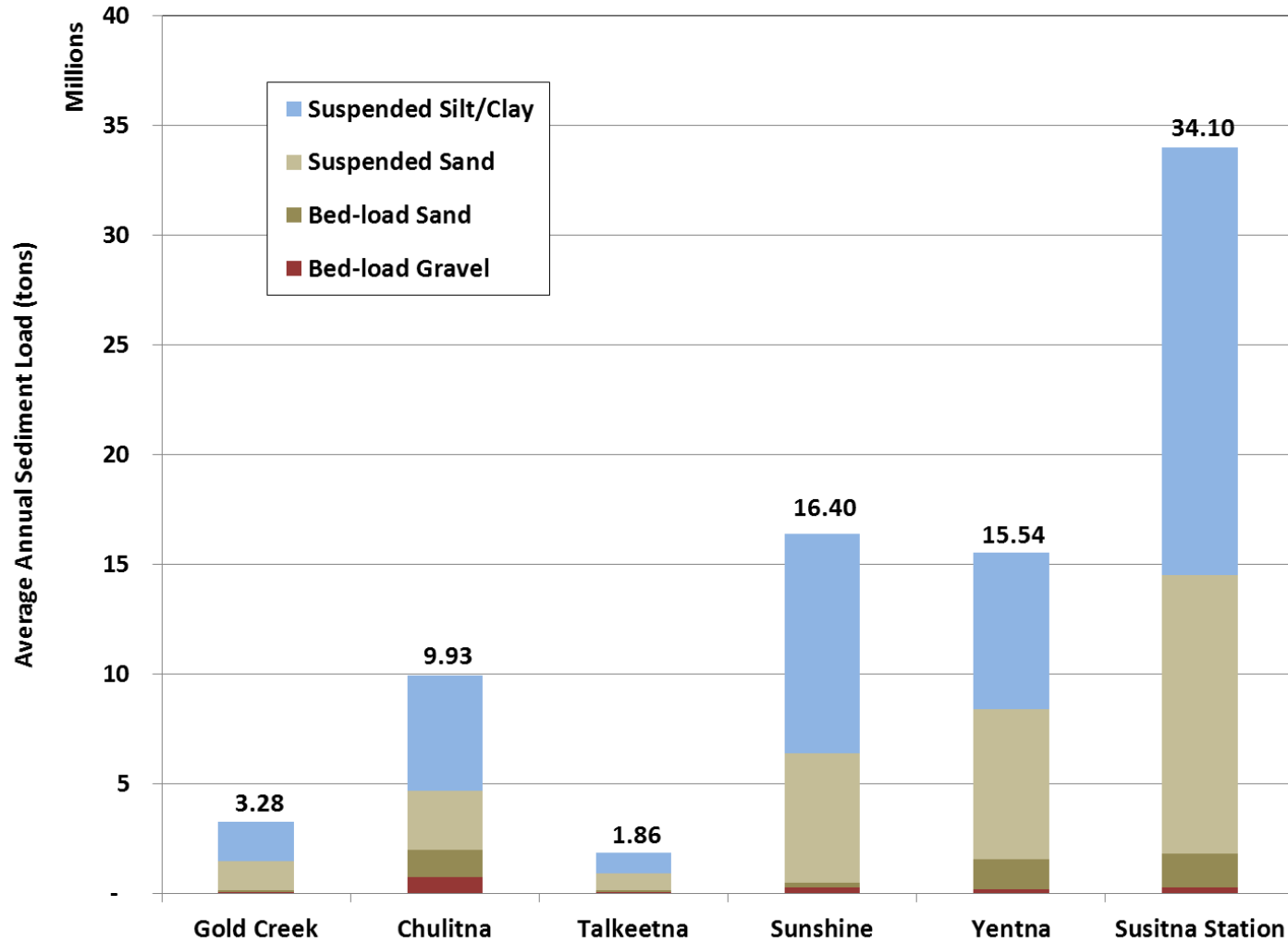


Figure 5.3-2. Average annual silt/clay, sand and gravel loads under pre-Project conditions for the three mainstem gages and three major tributary gages considered in the analysis.



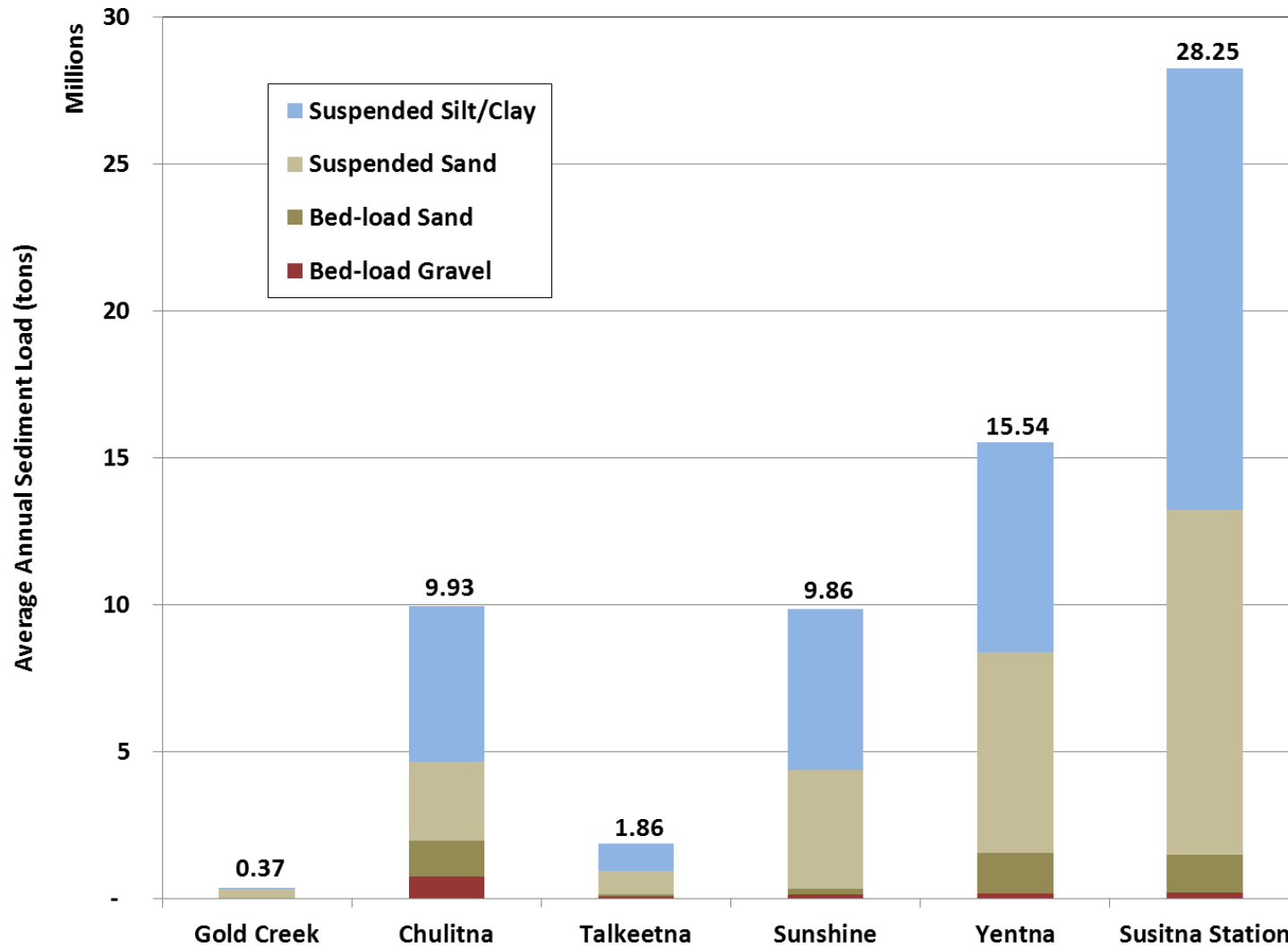


Figure 5.3.4. Average annual silt/clay, sand and gravel loads under Maximum Load Following OS-1 conditions for the three mainstem gages and three major tributary gages considered in the analysis. Note that the tributary loads are the same as pre-Project conditions.

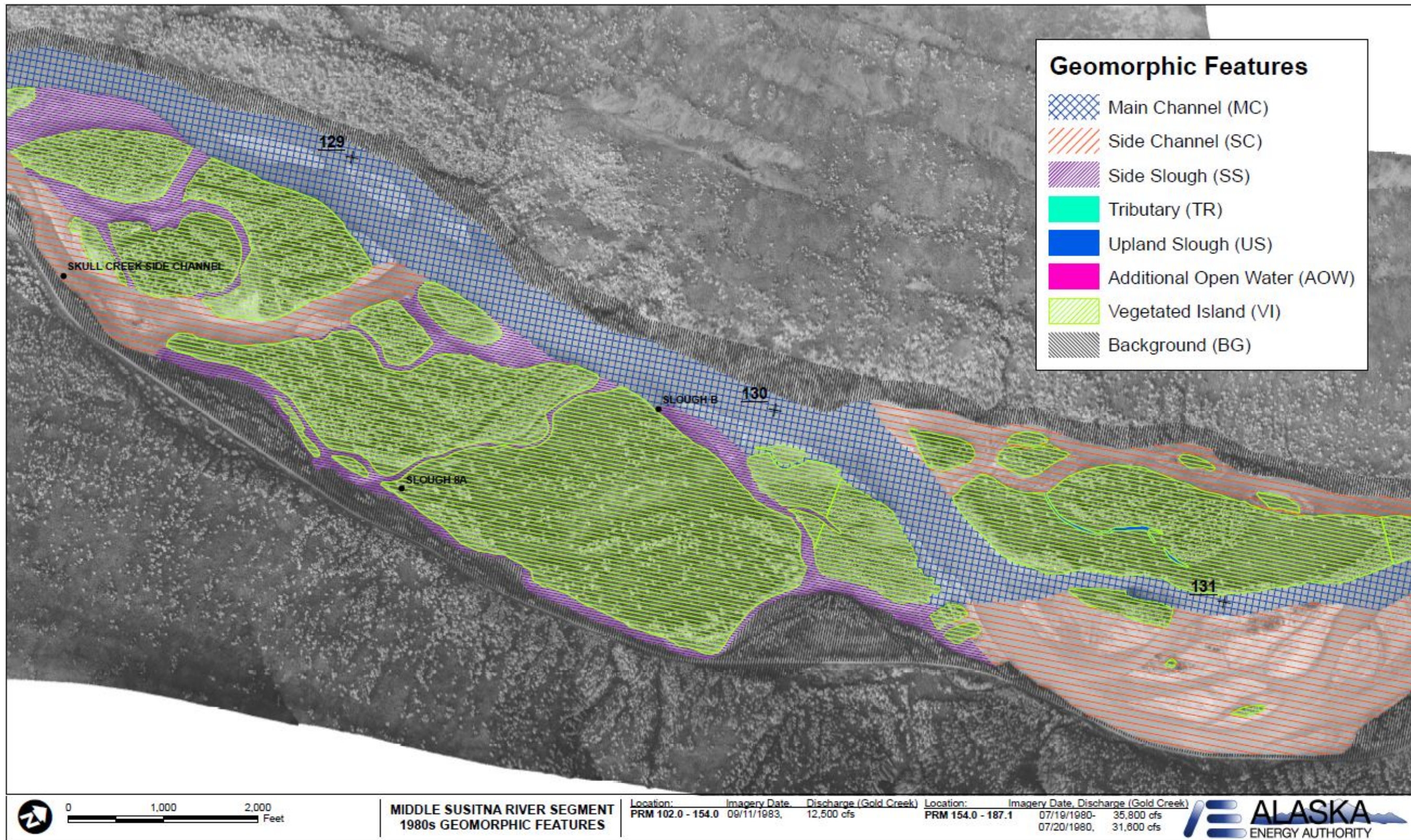


Figure 5.4-1: Example of 1980s Geomorphic Feature Mapping of the Middle River.

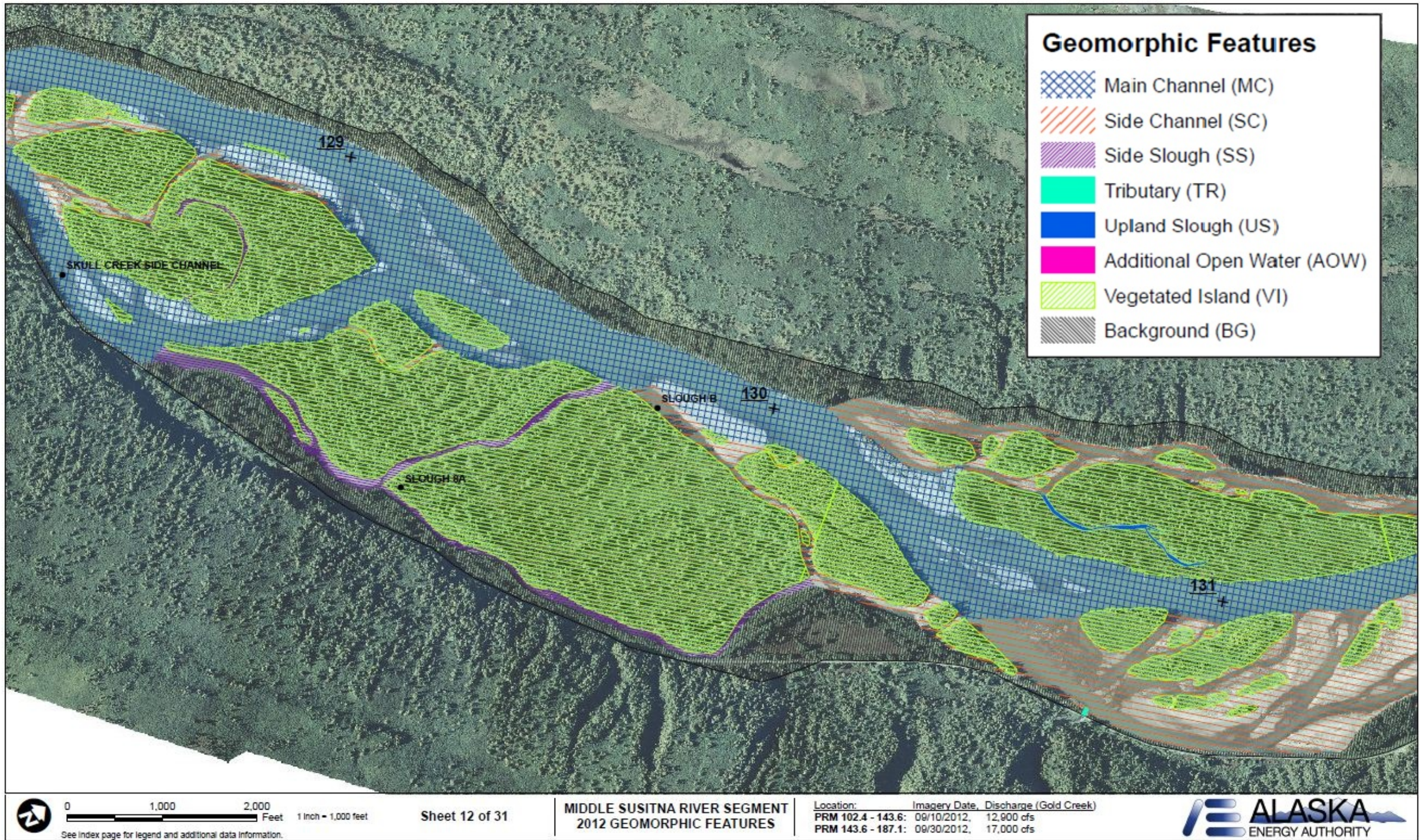


Figure 5.4-2: Example of 2012 Geomorphic Feature Mapping of the Middle River.

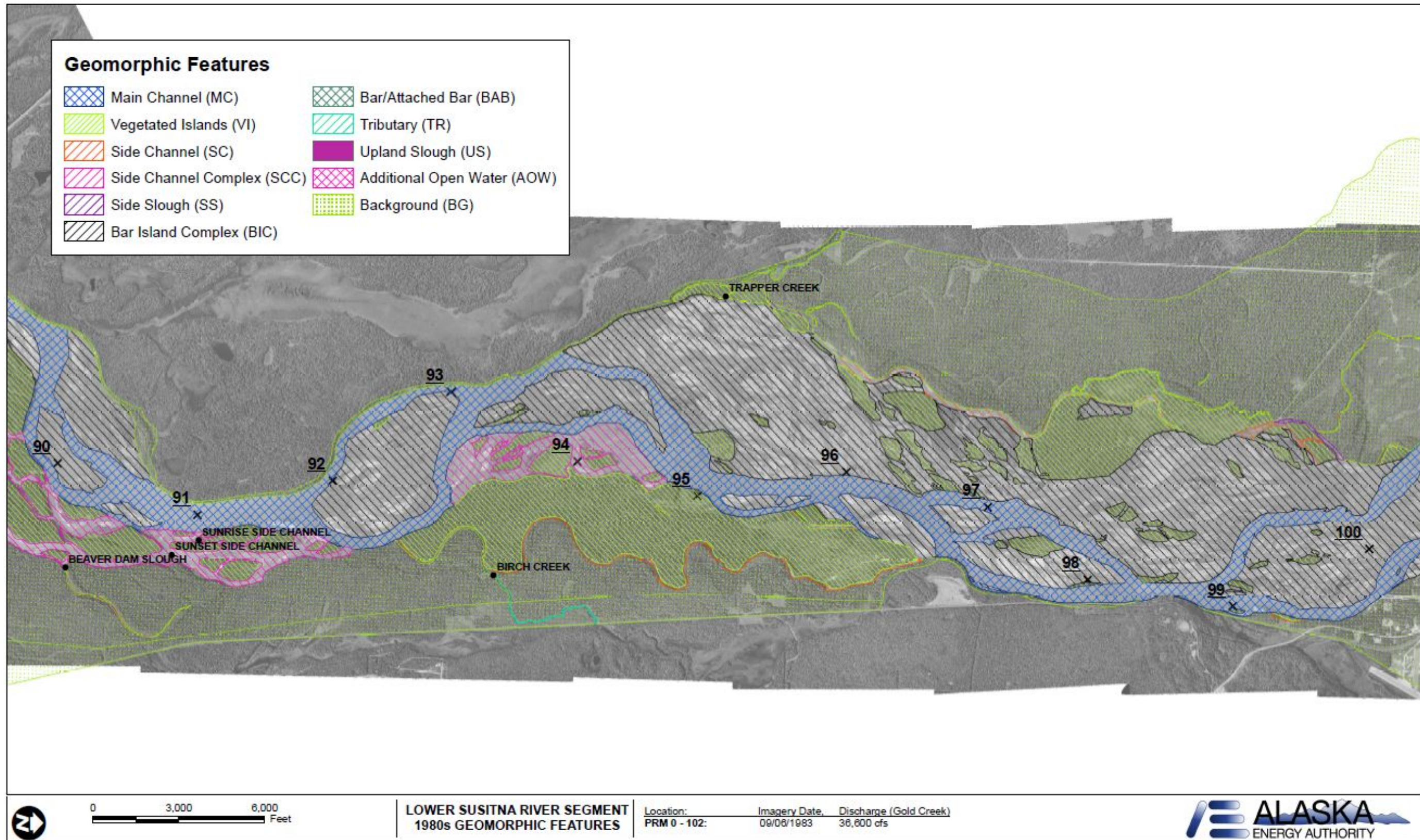


Figure 5.4-3: Example of 1980s Geomorphic Feature Mapping of the Lower River.

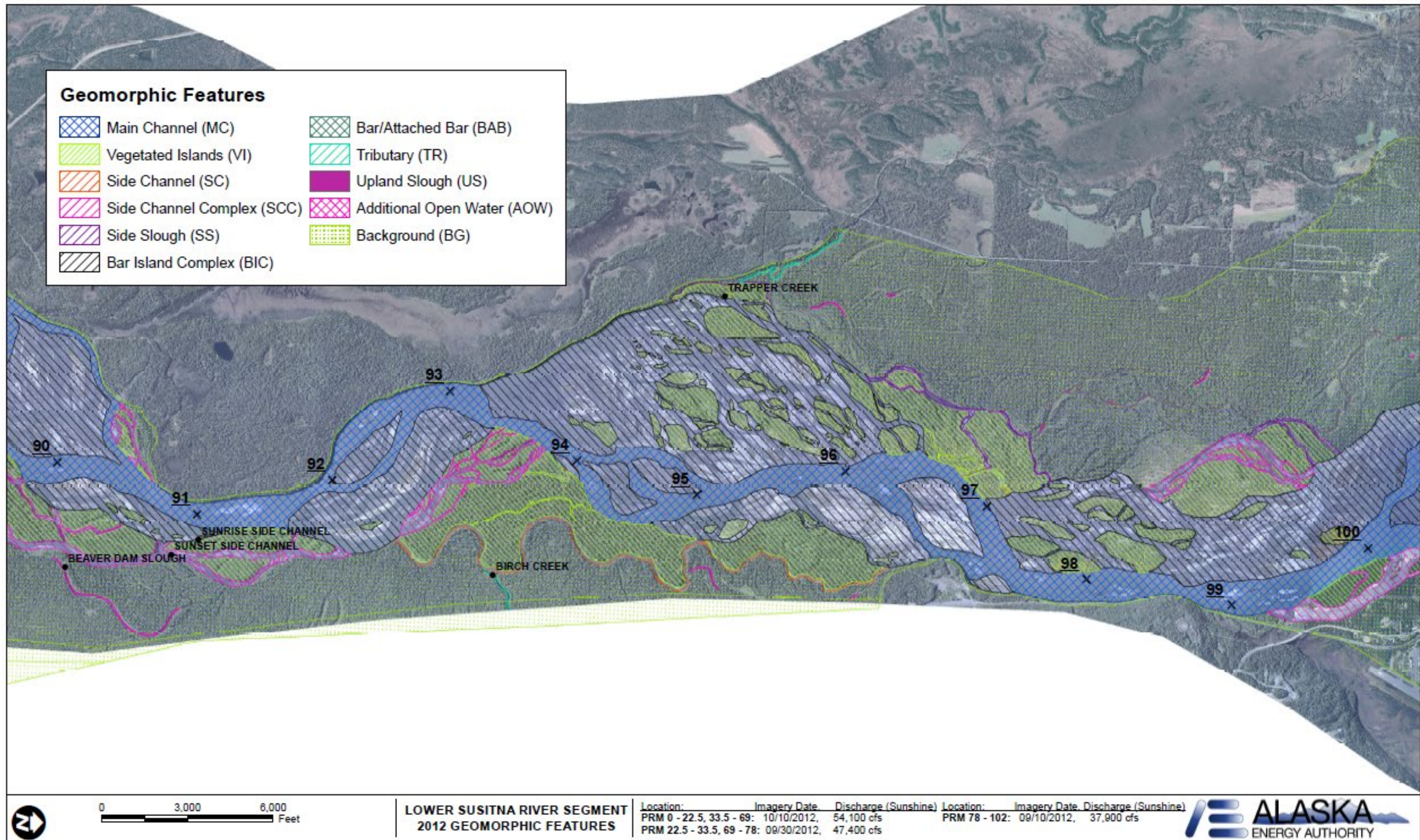


Figure 5.4-4: Example of 2012 Geomorphic Feature Mapping of the Lower River.

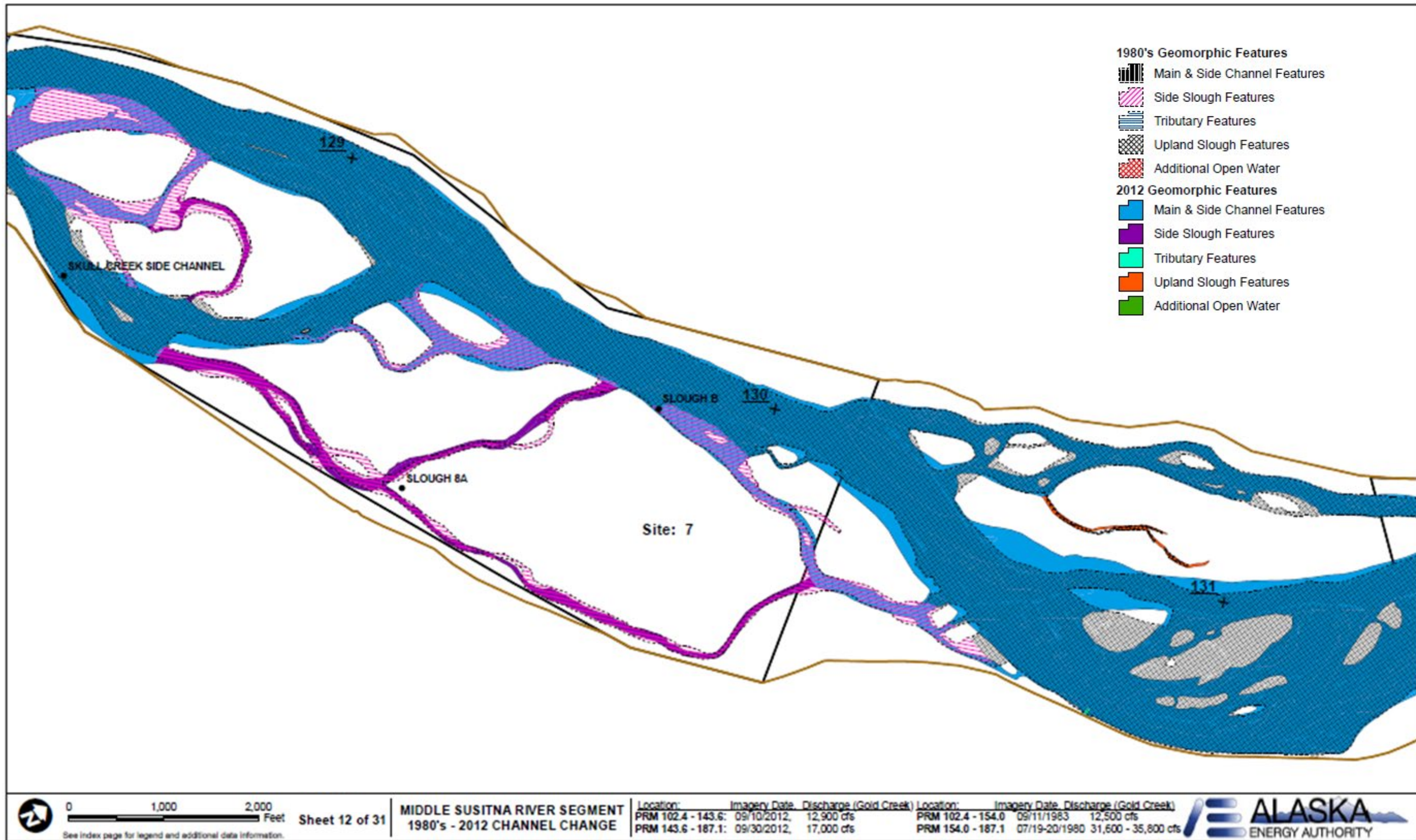


Figure 5.4-5: Example of 1980s Geomorphic Feature Overlay Mapping of the Middle River.

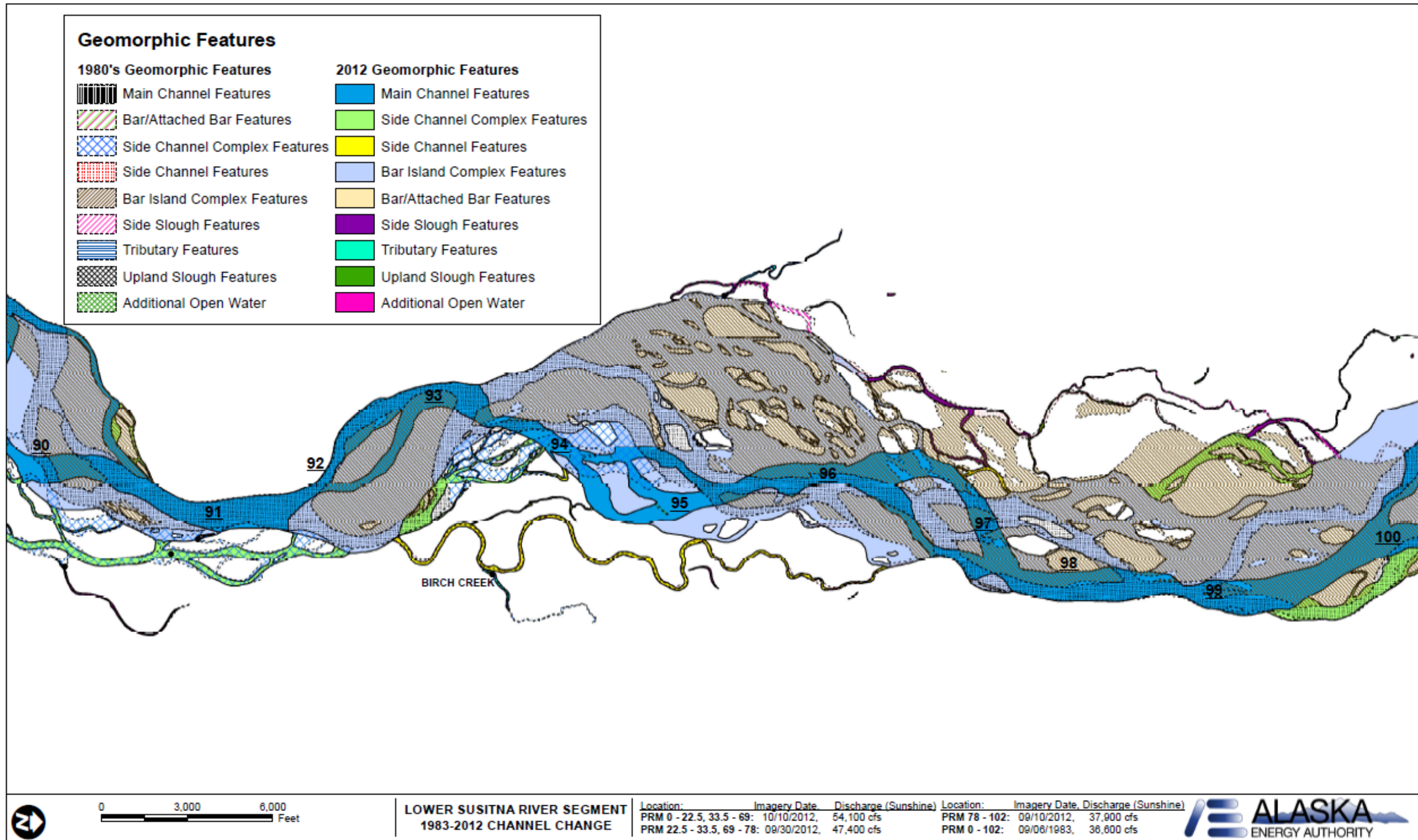


Figure 5.4-6: Example of 1980s Geomorphic Feature Overlay Mapping of the Lower River.

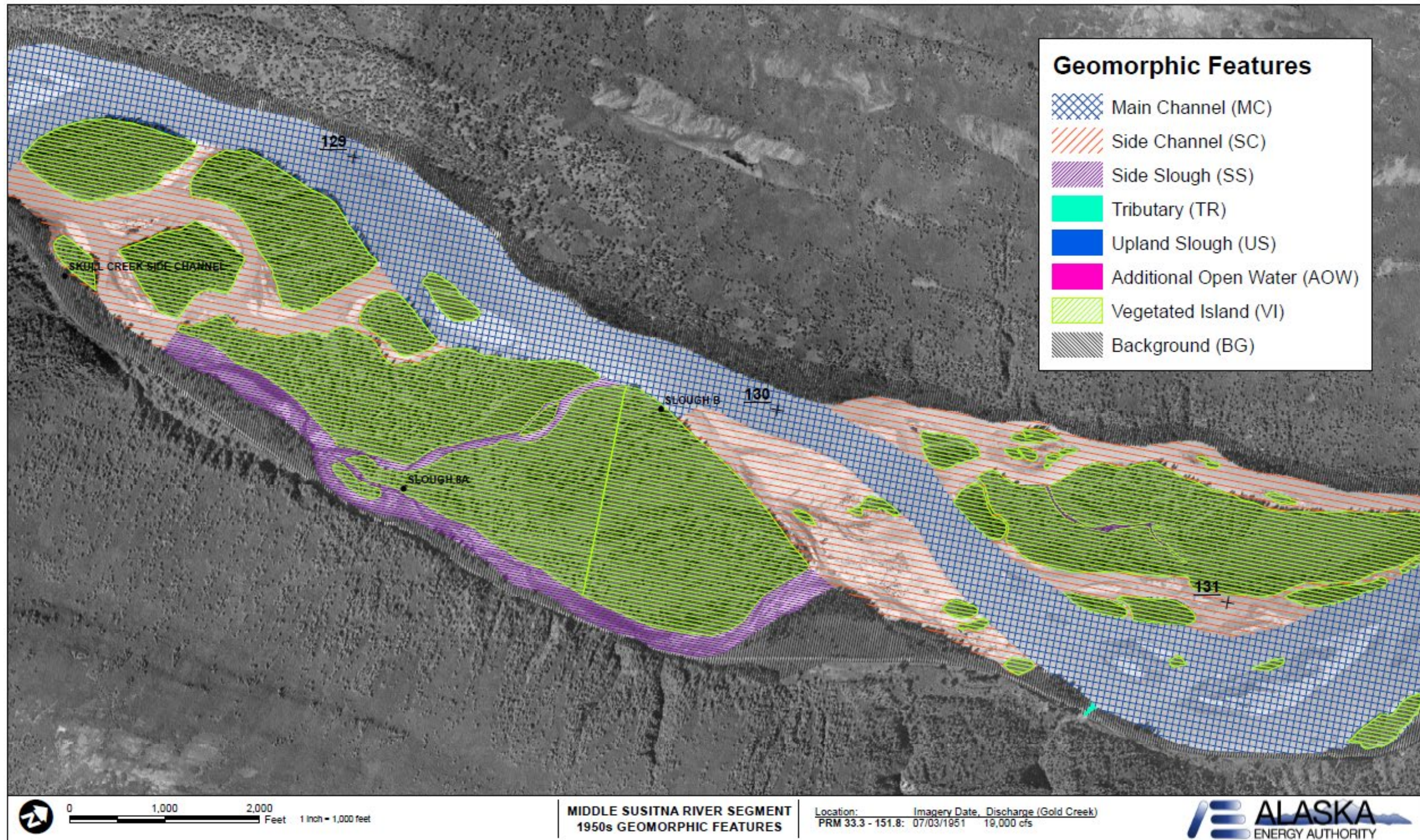


Figure 5.4-7: Example of 1950s Geomorphic Feature Mapping of the Middle River.



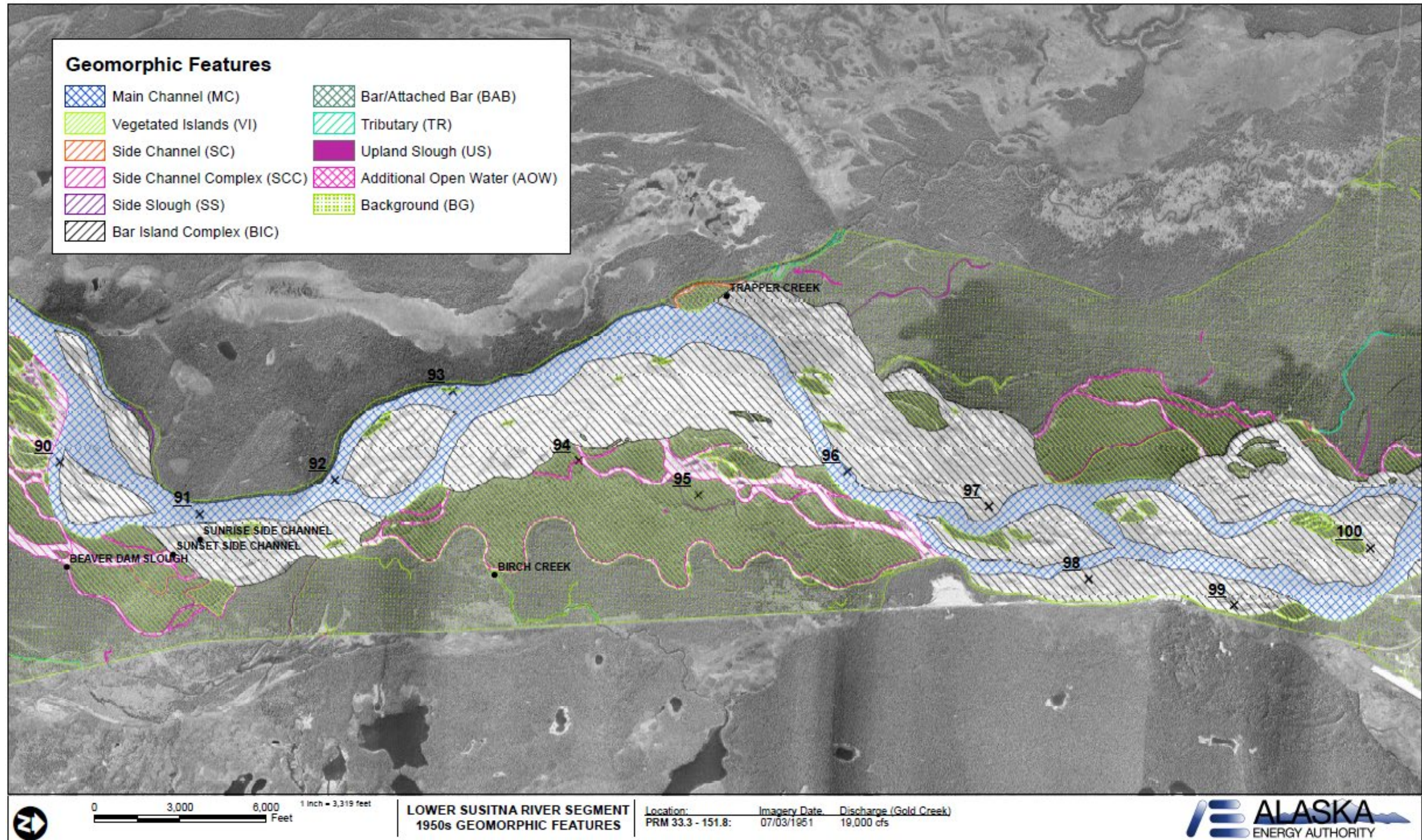


Figure 5.4-8: Example of 1950s Geomorphic Feature Mapping of the Lower River.

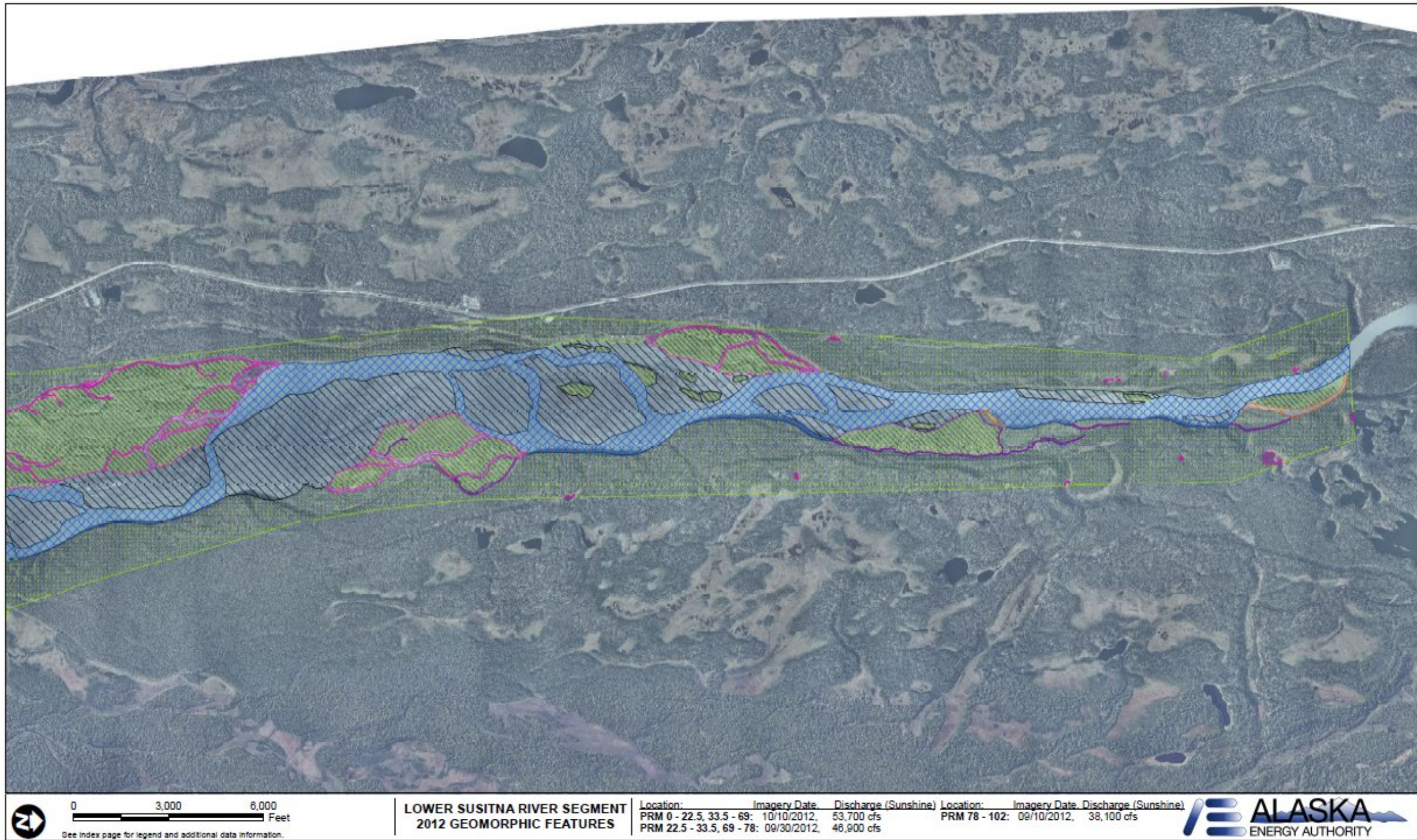


Figure 5.4-9: Extended 2012 Geomorphic Feature Mapping of the Chulitna River.

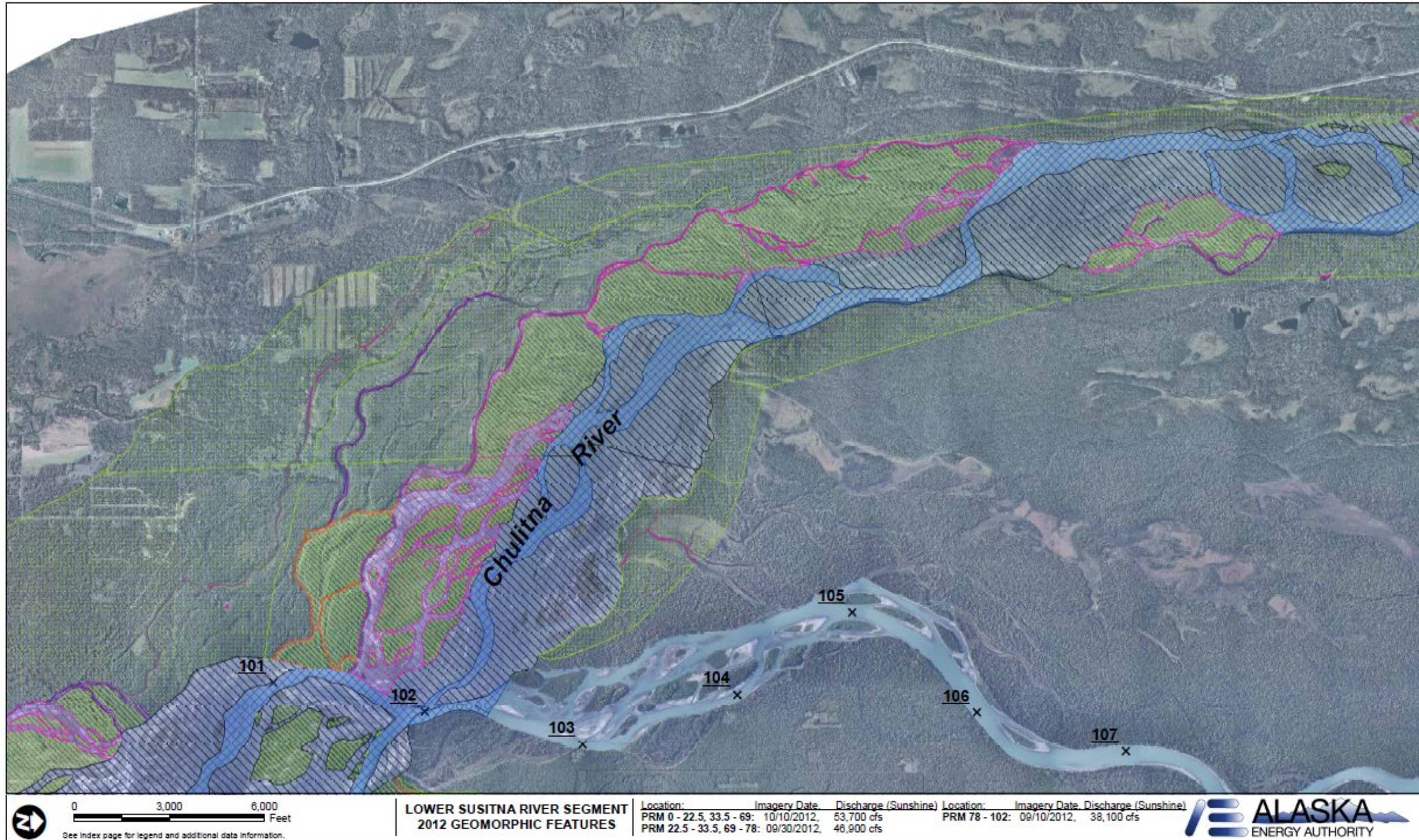


Figure 5.4-10: Extended 2012 Geomorphic Feature Mapping of the Chulitna River.

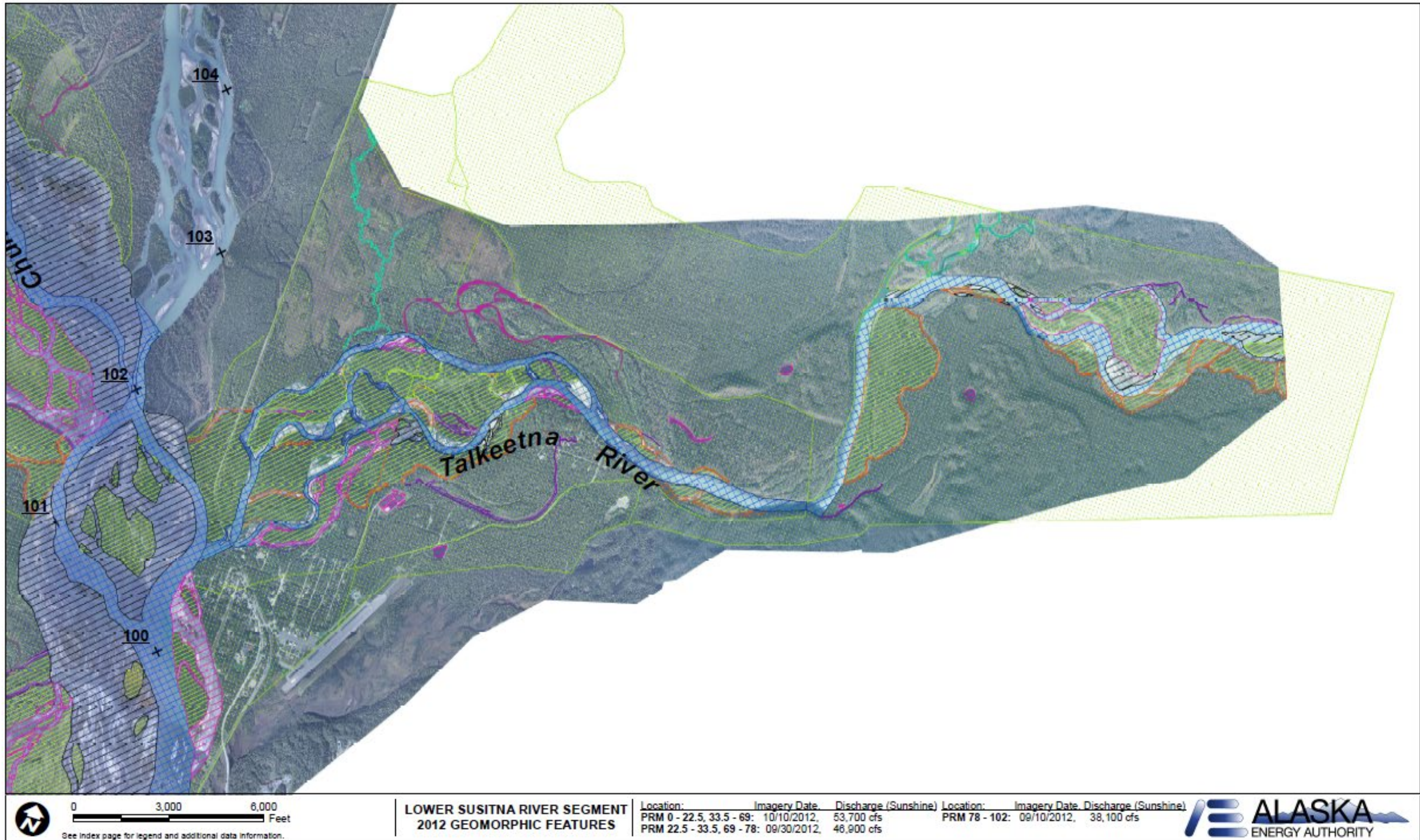


Figure 5.4-11: Extended 2012 Geomorphic Feature Mapping of the Talkeetna River.

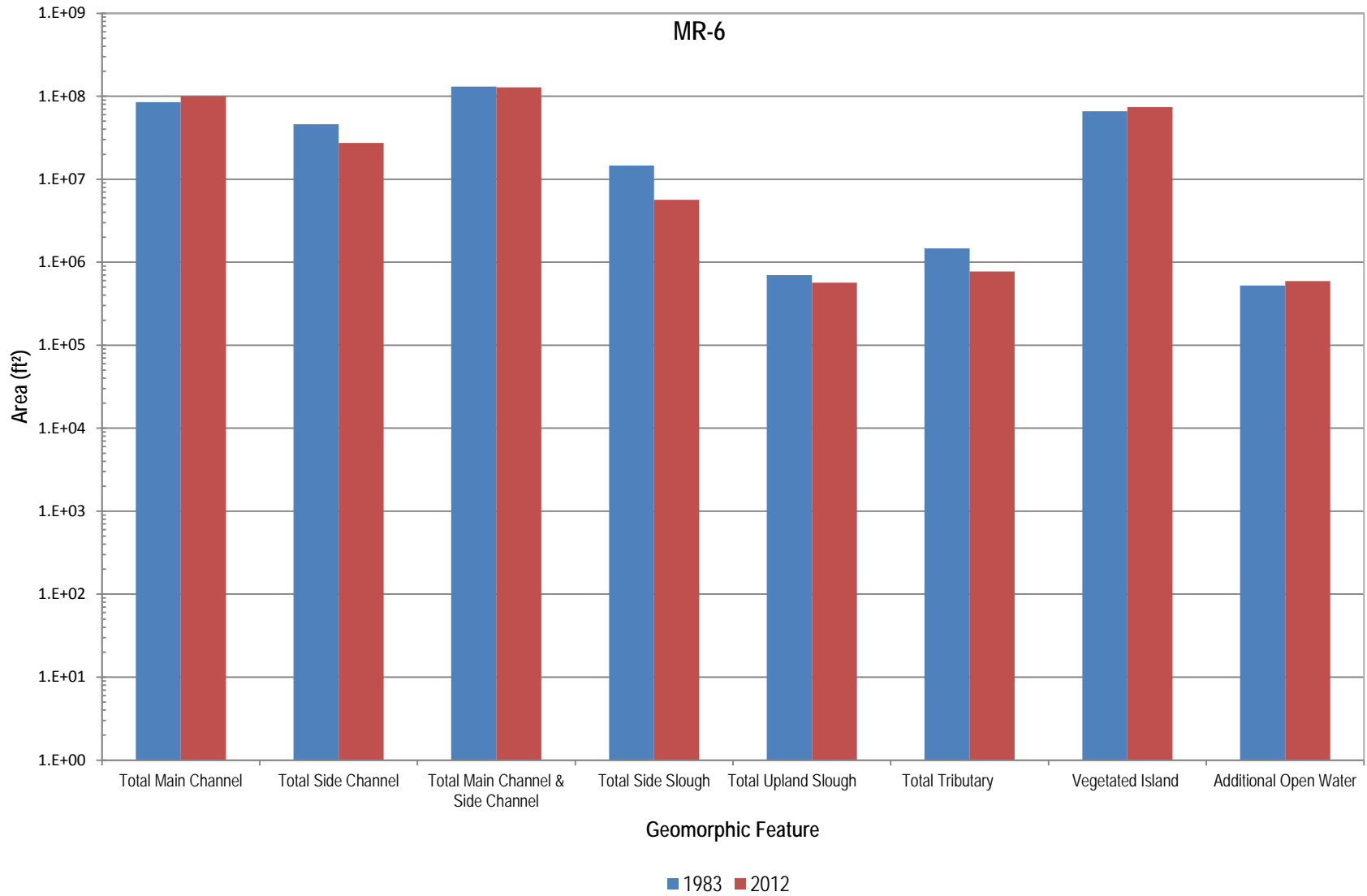


Figure 5.4-12: Middle River Geomorphic Reach 6 comparison of 1980s and 2012 mapped geomorphic feature areas (sq. ft.) on a logarithmic axis.

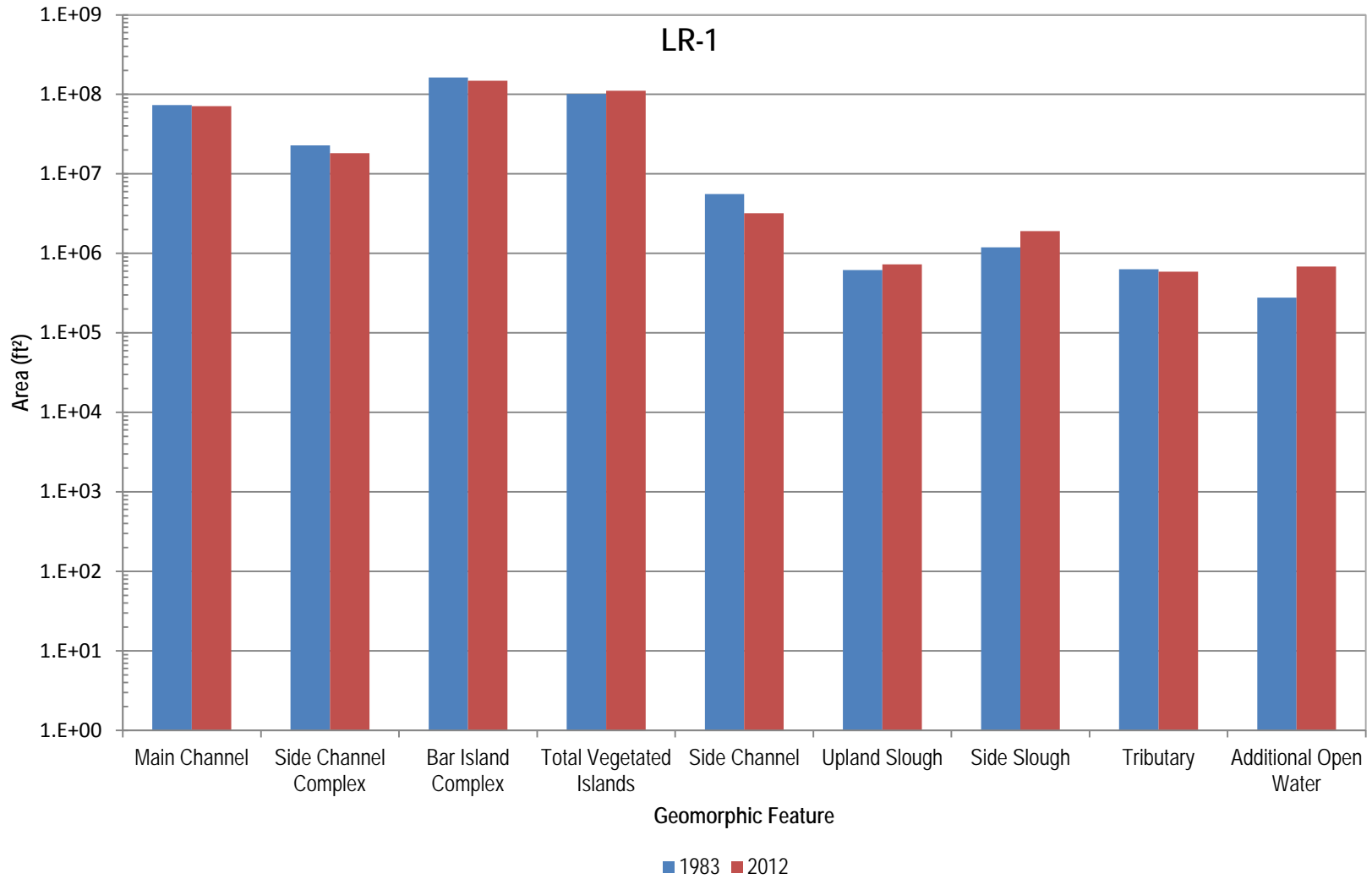
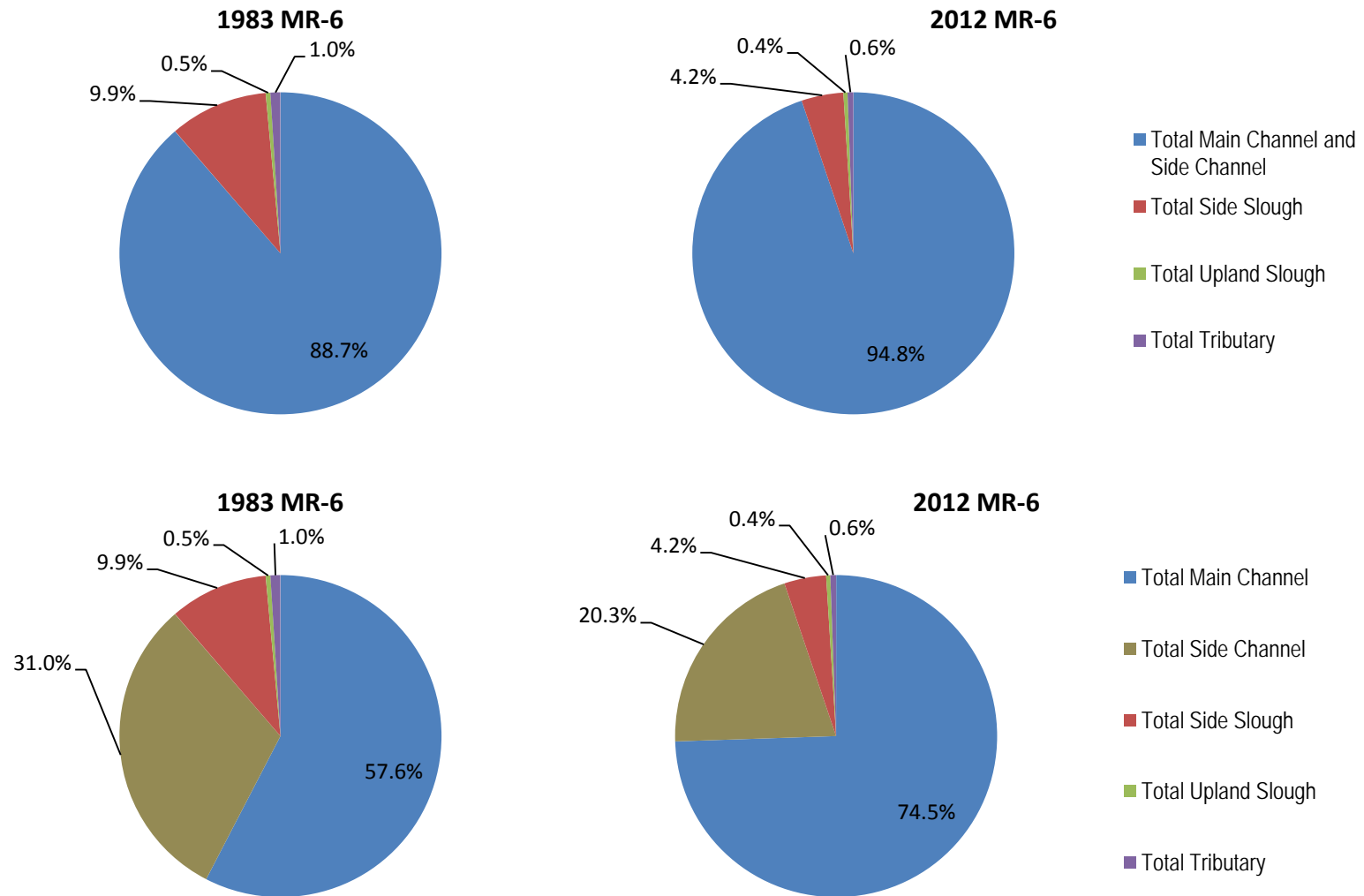
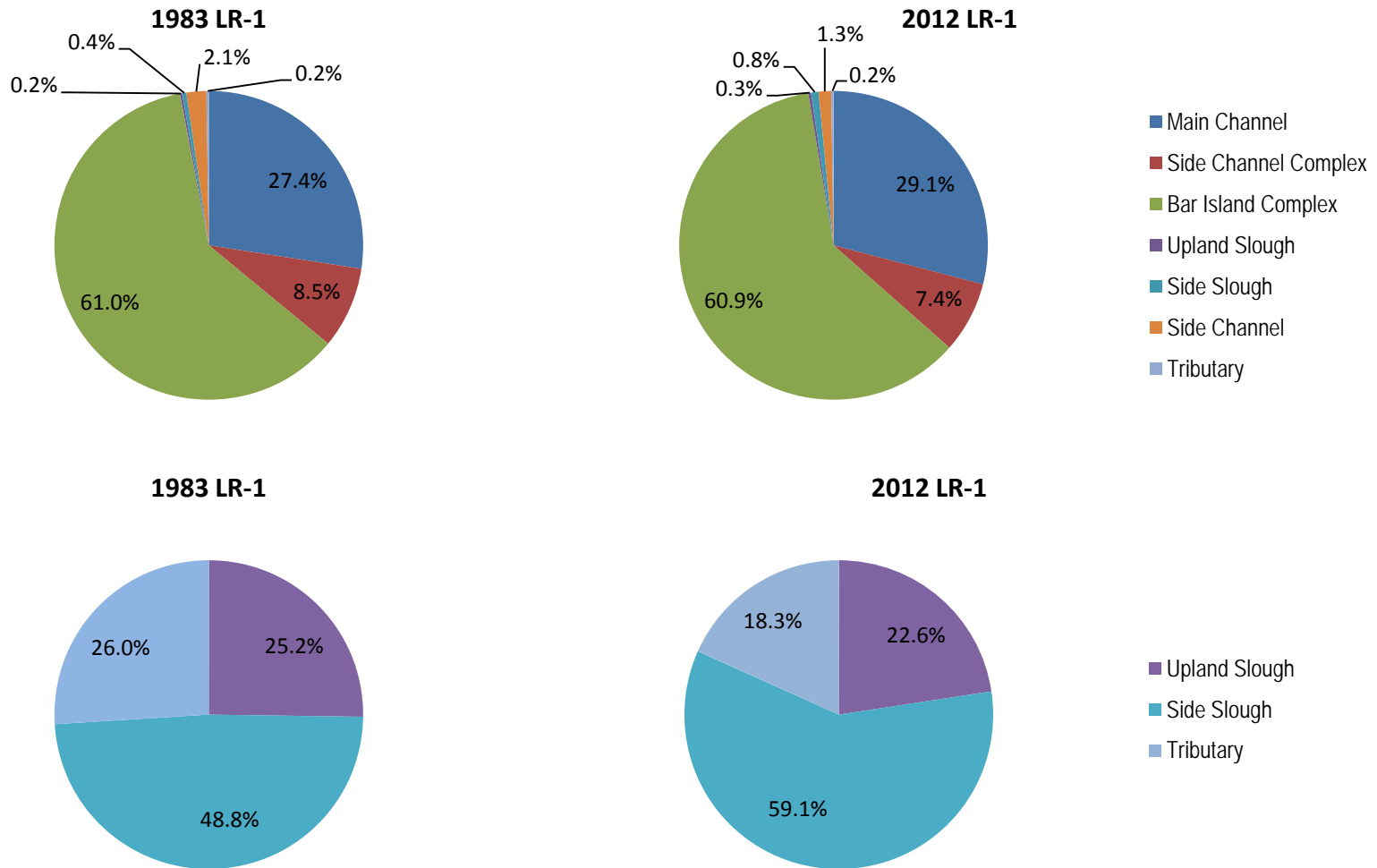


Figure 5.4-13: Lower River Geomorphic Reach 1 comparison of 1980s and 2012 mapped geomorphic feature areas (sq. ft.) on a logarithmic axis.



**Figure 5.4-14: Relative proportion of geomorphic features in MR-6 of the Middle Susitna River Segment for 1983 and 2012 (top charts main channels and side channels combined / bottom charts main channels and side channels tracked separately).**



**Figure 5.4-15: Relative proportion of geomorphic features in LR-1 of the Lower Susitna River Segment for 1983 and 2012 (top charts are geomorphic features with wetted and exposed regions / bottom charts are geomorphic features with primary aquatic habitat).**



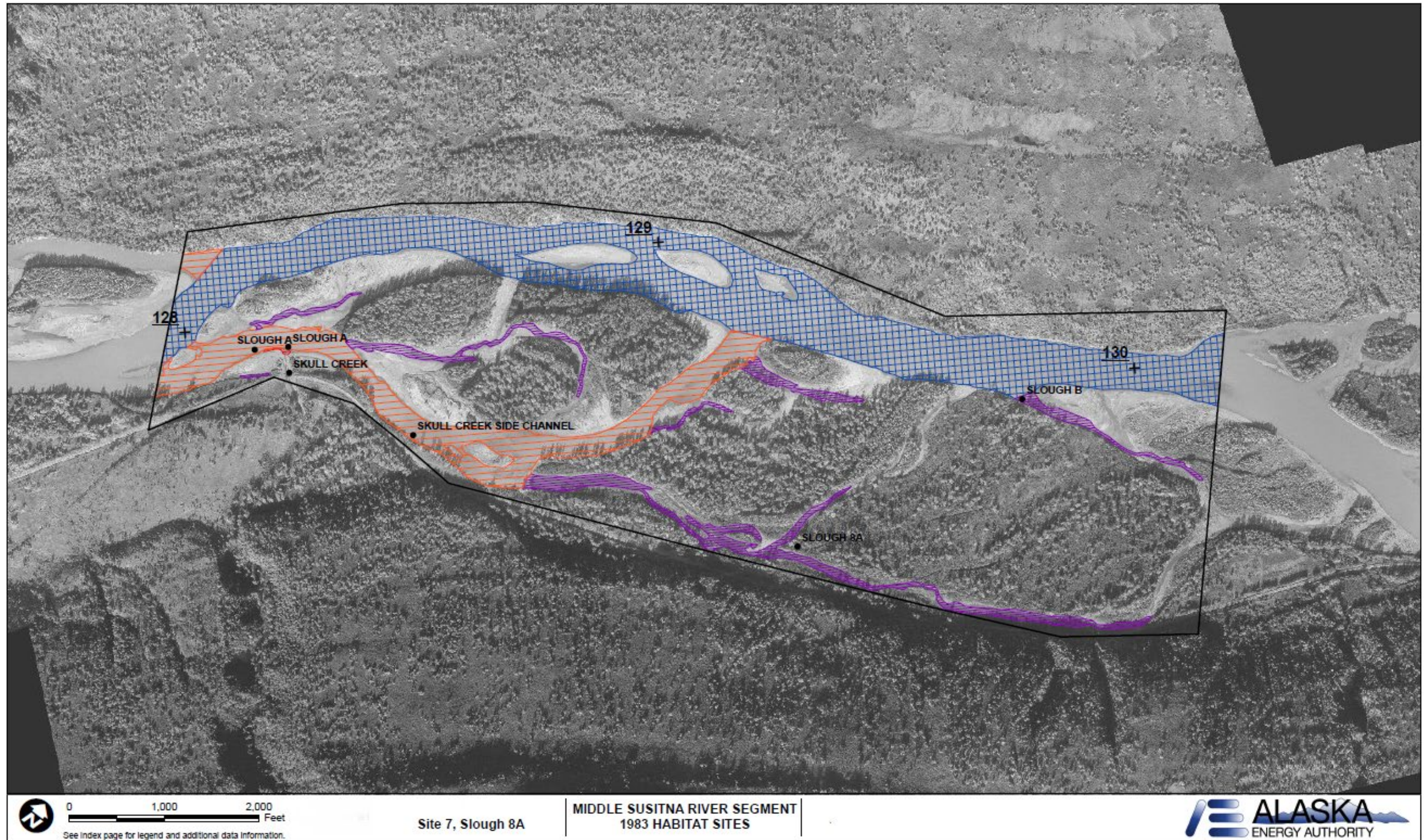


Figure 5.5-1. 1980s aquatic macrohabitat types at the Slough 8A habitat site

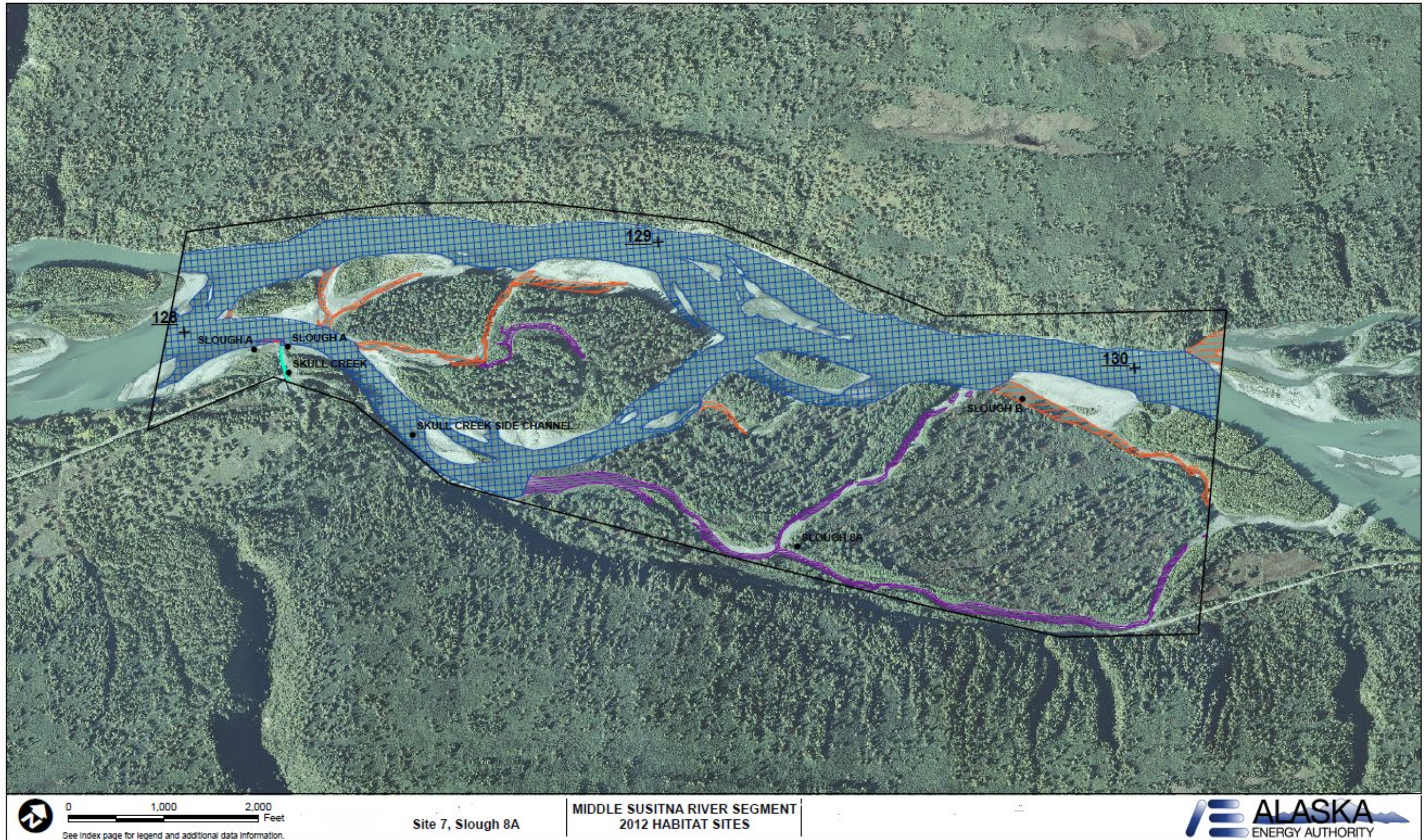


Figure 5.5-2. 2012 aquatic macrohabitat types at the Slough 8A habitat site

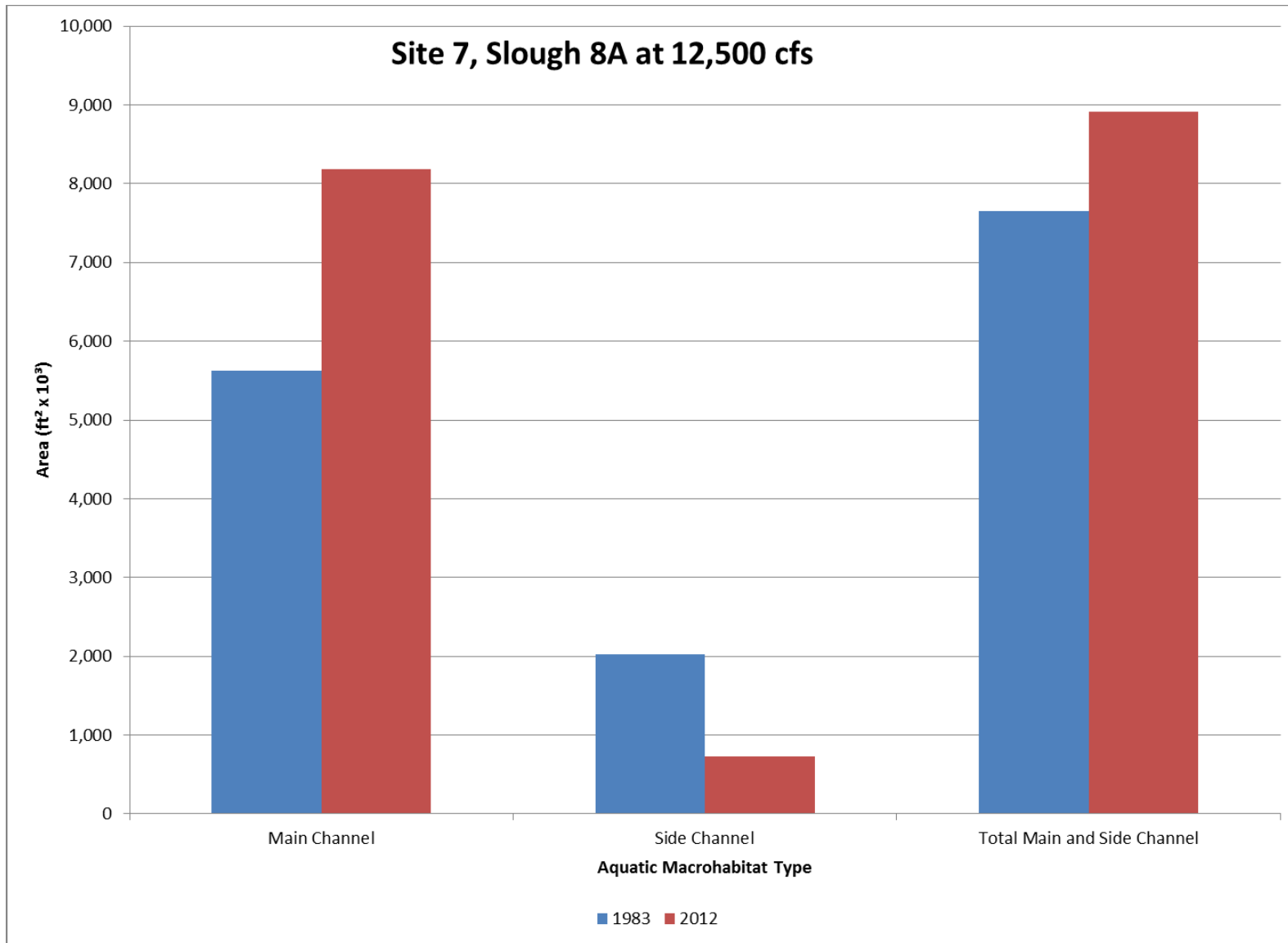


Figure 5.5-3. Comparison of mapped areas of main and side channel aquatic macrohabitat types from 1983 to 2012 at Slough 8A.

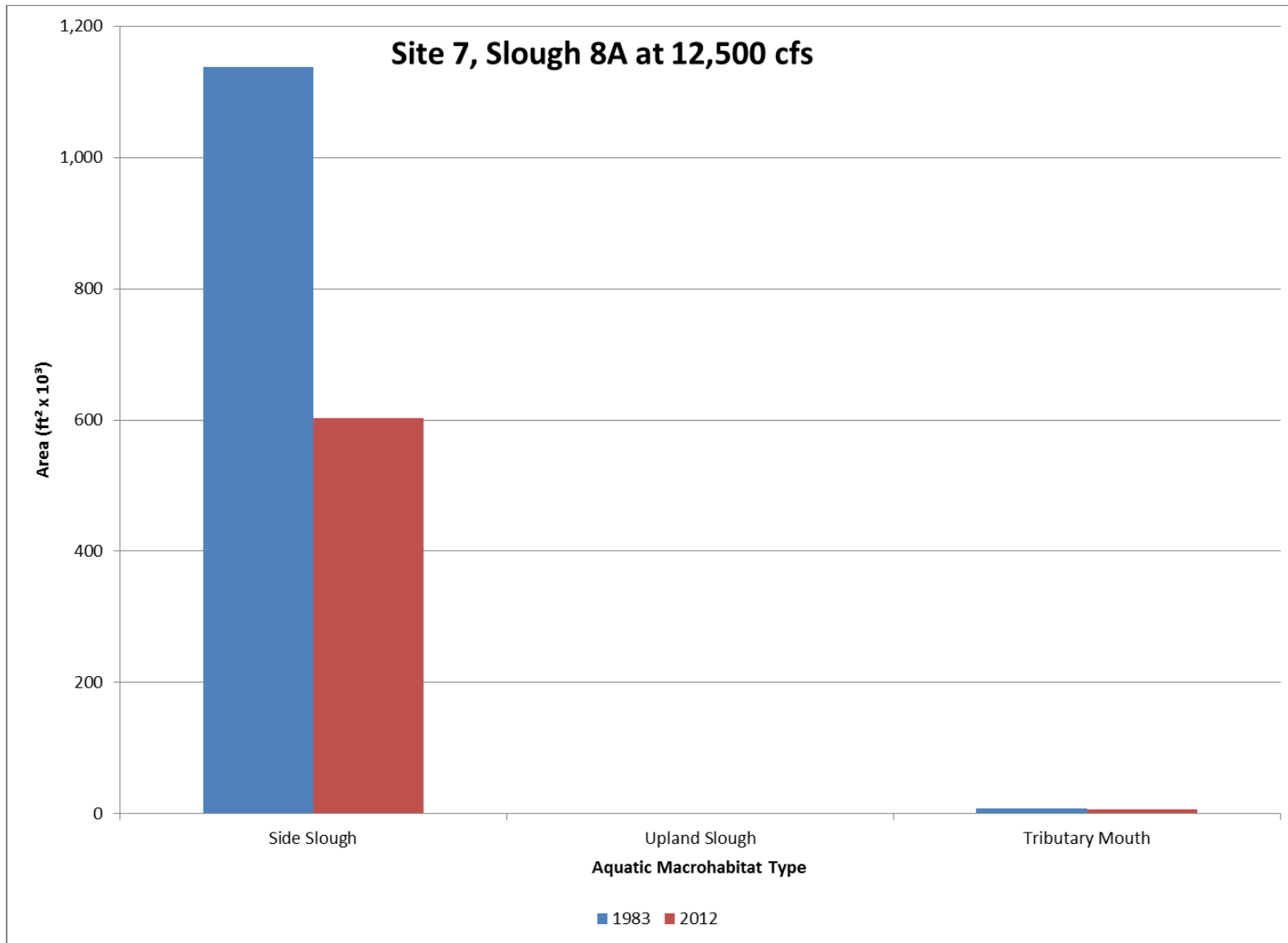


Figure 5.5-4. Comparison of mapped areas for side slough, upland slough and tributary mouth aquatic macrohabitat types from 1983 to 2012 at Slough 8A.

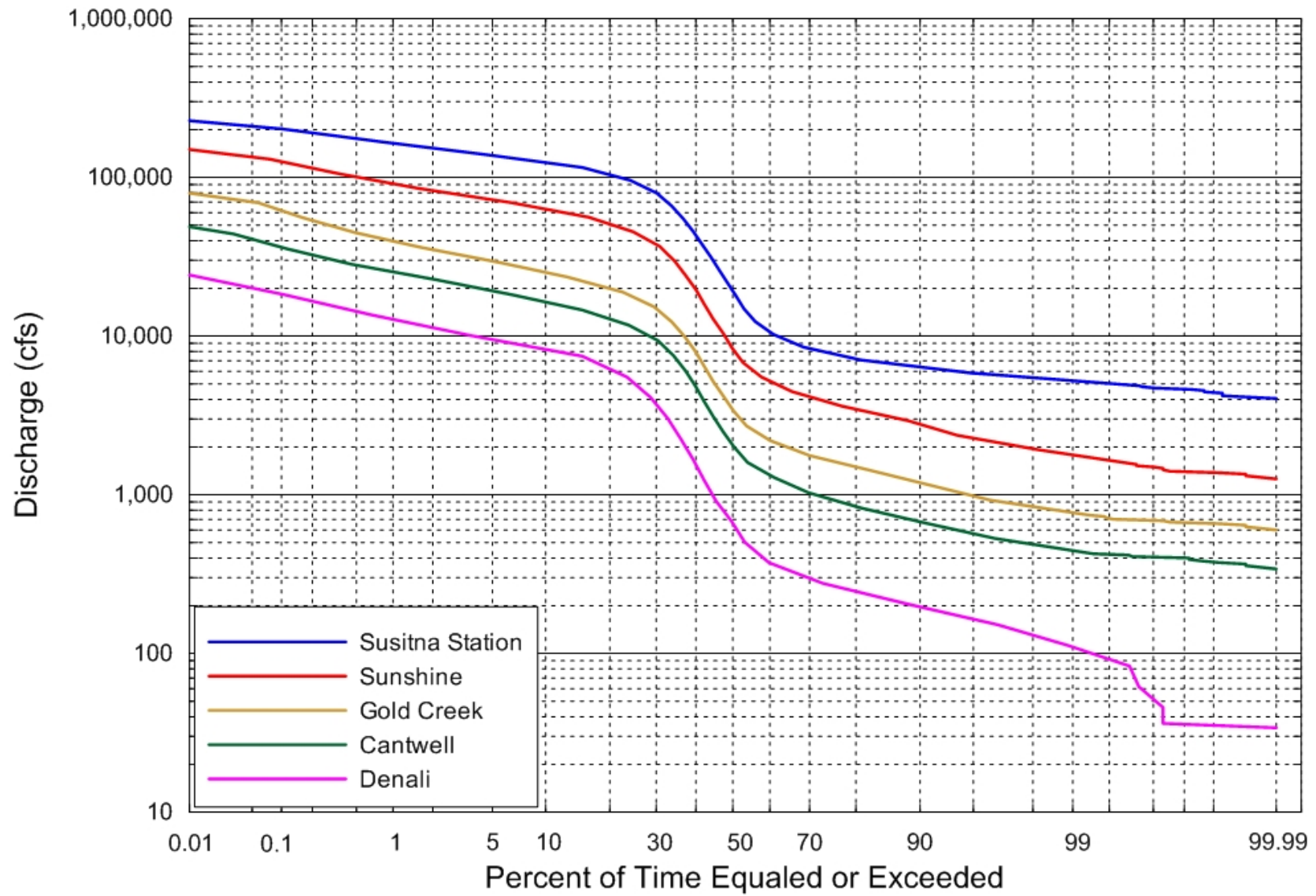


Figure 5.6.1. Annual flow-duration curves for mainstem gages for pre-Project conditions based on the USGS extended record (Tetra Tech 2013d)

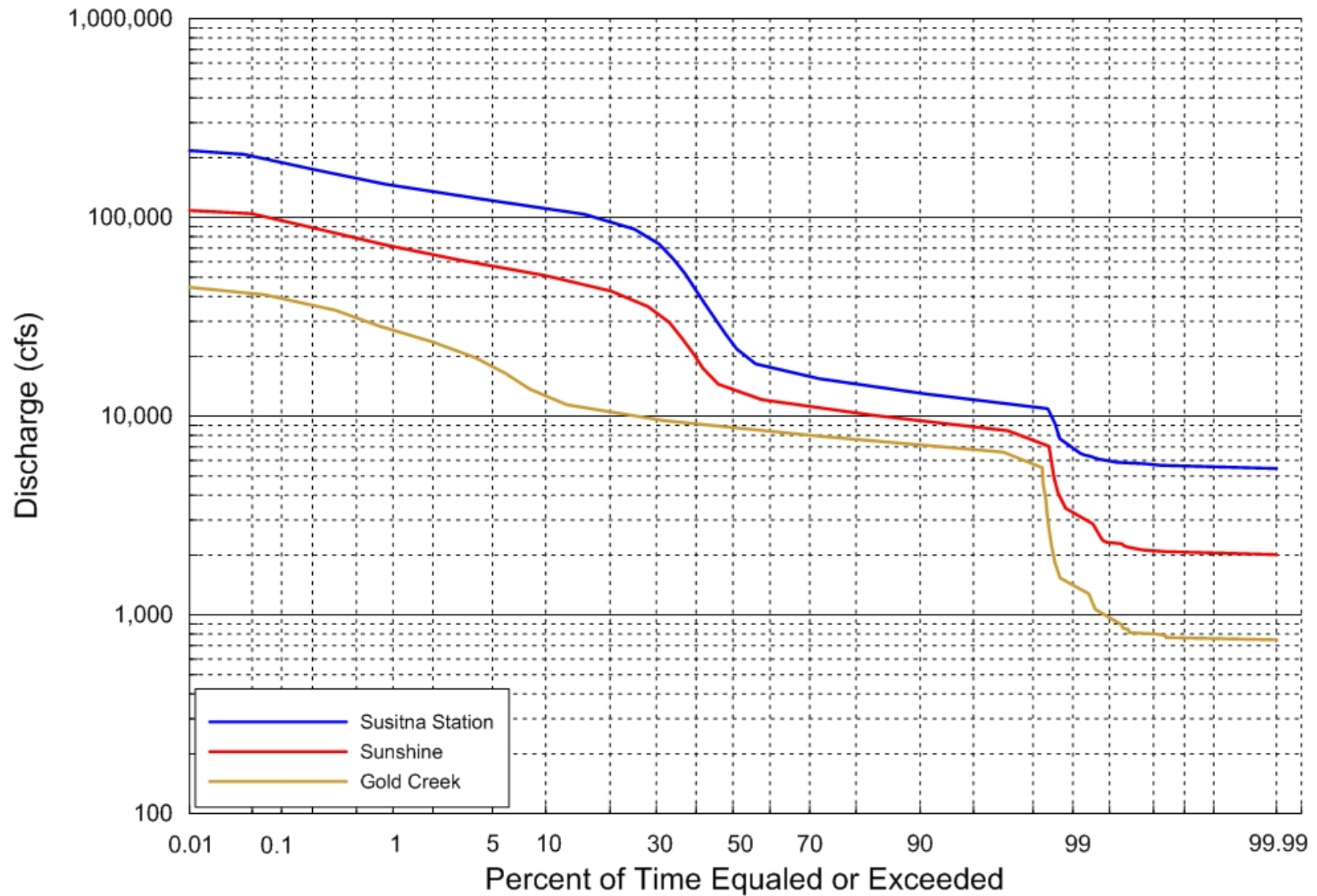


Figure 5.6-2. Annual flow-duration curves for three mainstem gages for Maximum Load Following OS-1 Conditions based on HEC-ResSim model. (Tetra Tech 2013d)

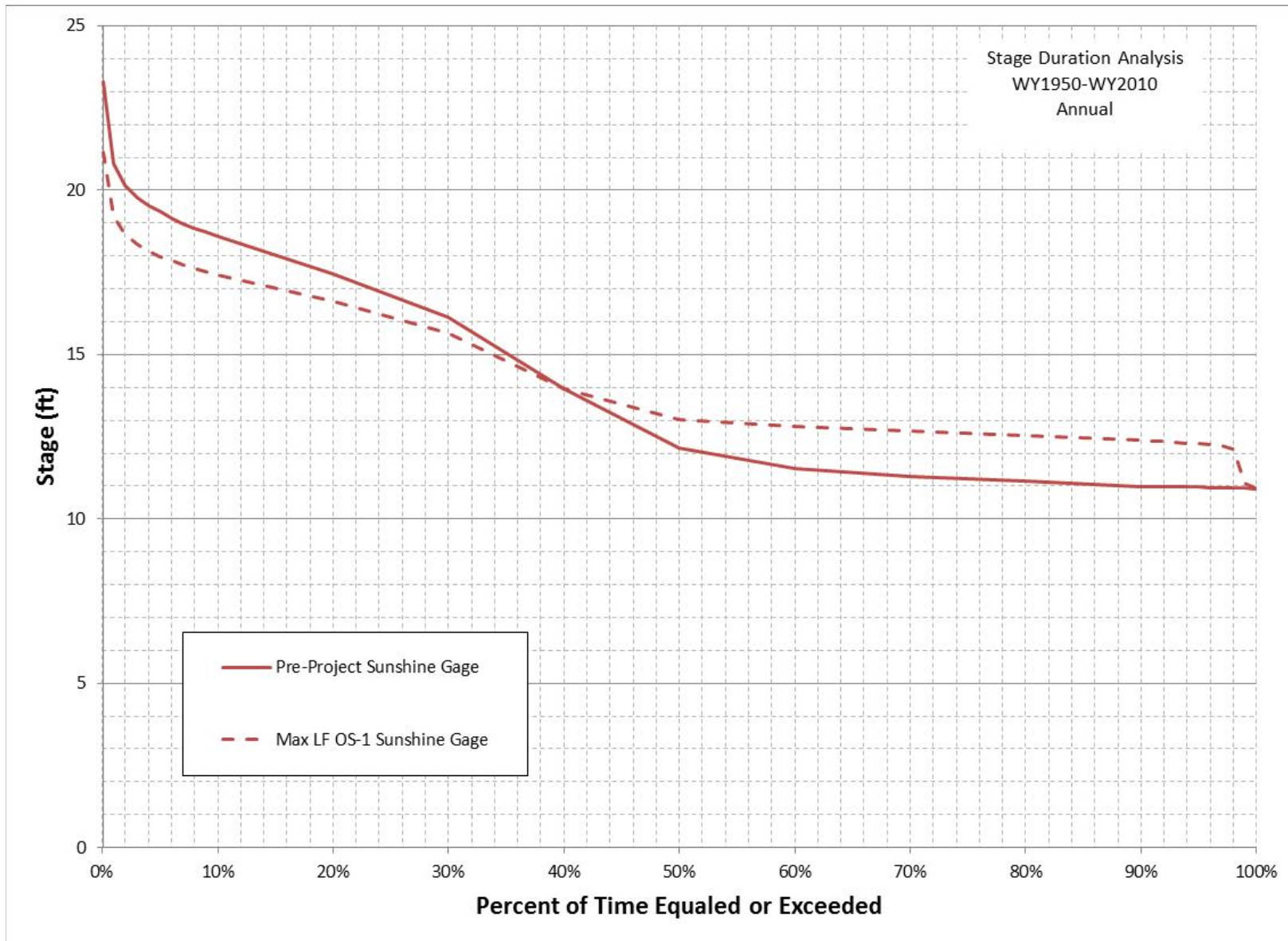


Figure 5.7-1. Annual Stage-Exceedance Relationships for pre-Project and Max LF OS-1 Conditions, Sunshine Gage (Tetra Tech, Inc. 2013d).

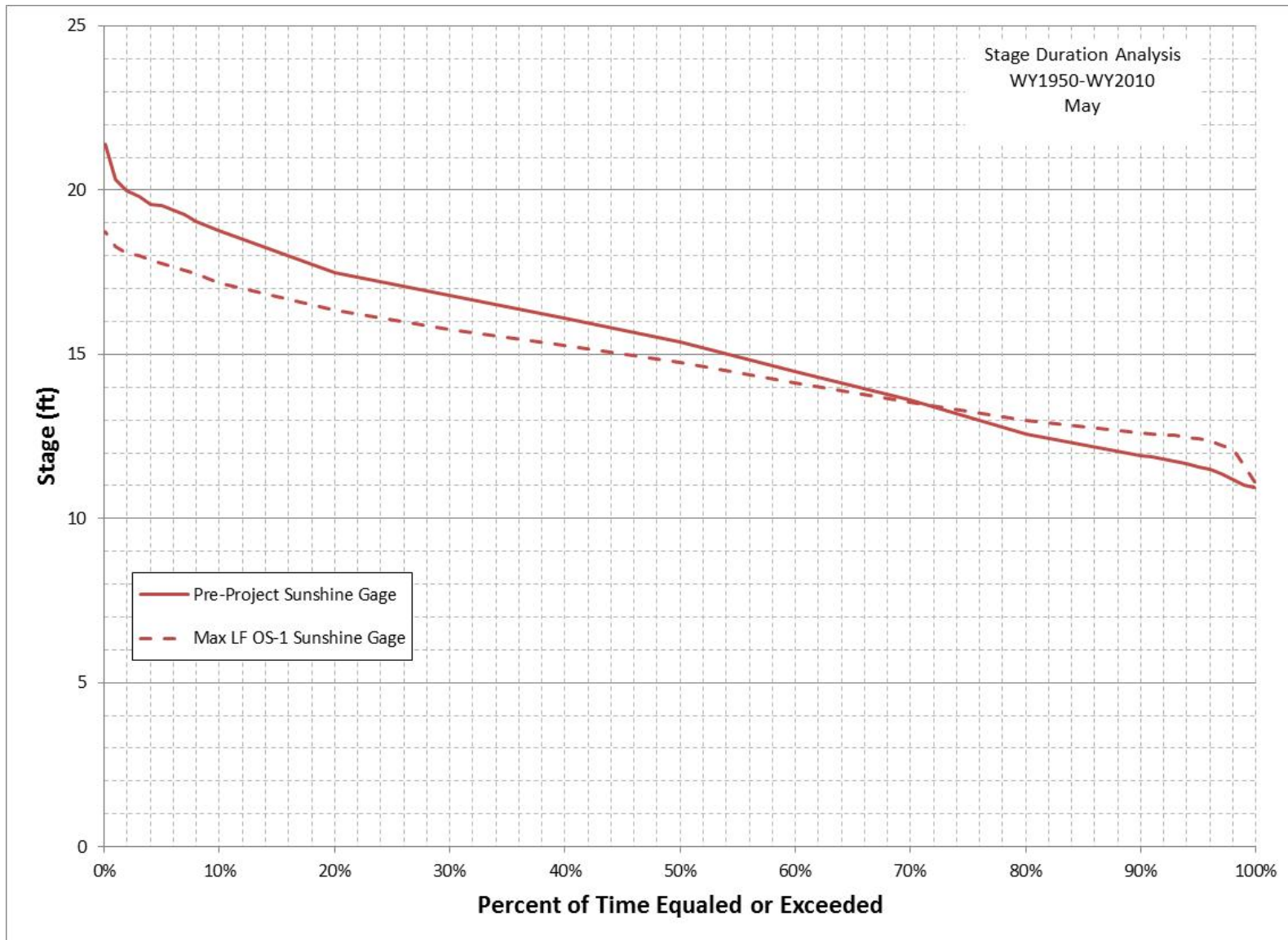


Figure 5.7-2. Monthly Stage-Exceedance Relationships for May for pre-Project and Max LF OS-1 Conditions, Sunshine Gage (Tetra Tech, Inc. 2013d).



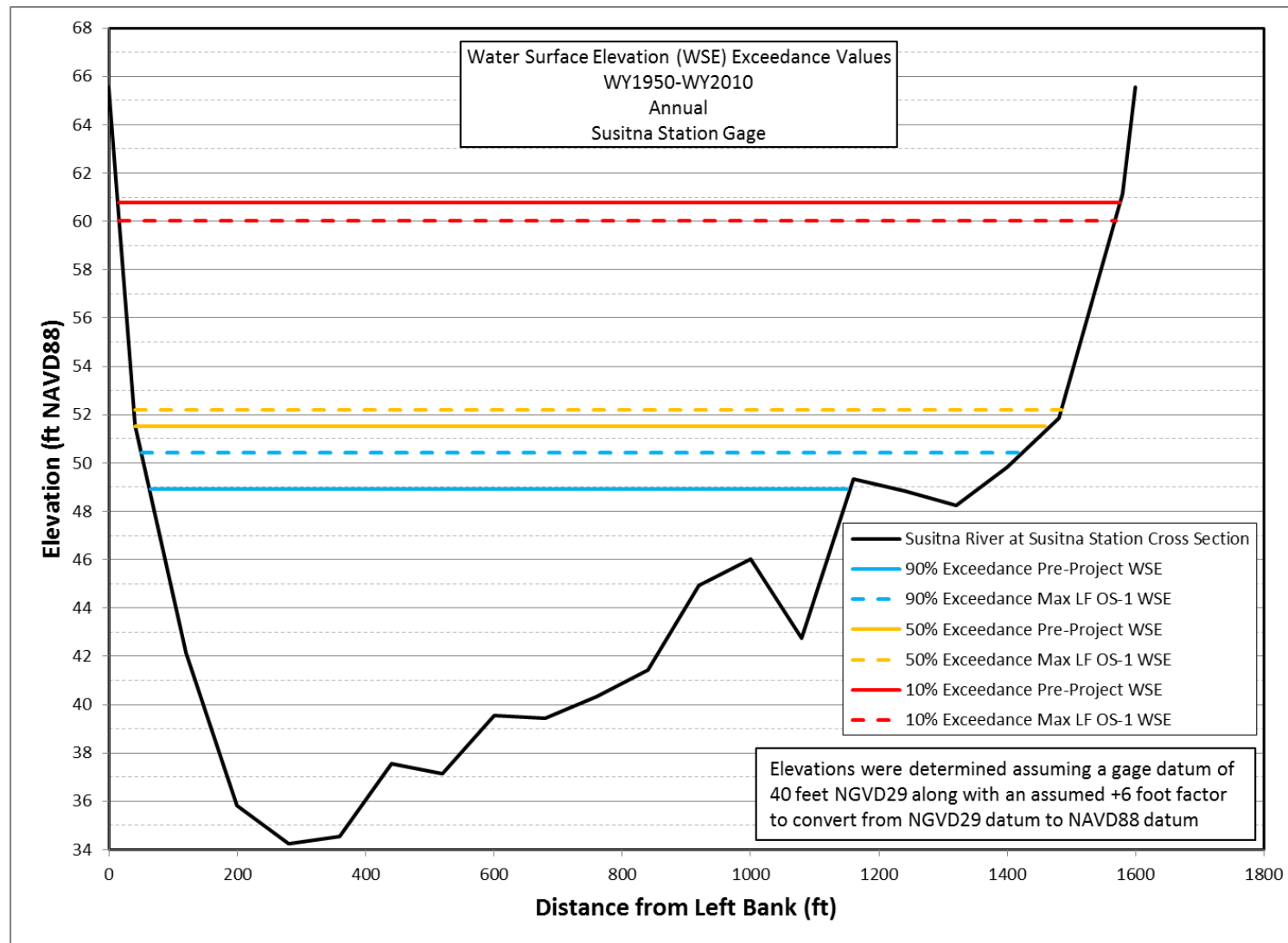


Figure 5.7-3. Select Annual Water-Surface Elevation Exceedance Values for pre-Project and Max LF OS-1 Conditions, Susitna Station Gage(Tetra Tech, Inc. 2013d).

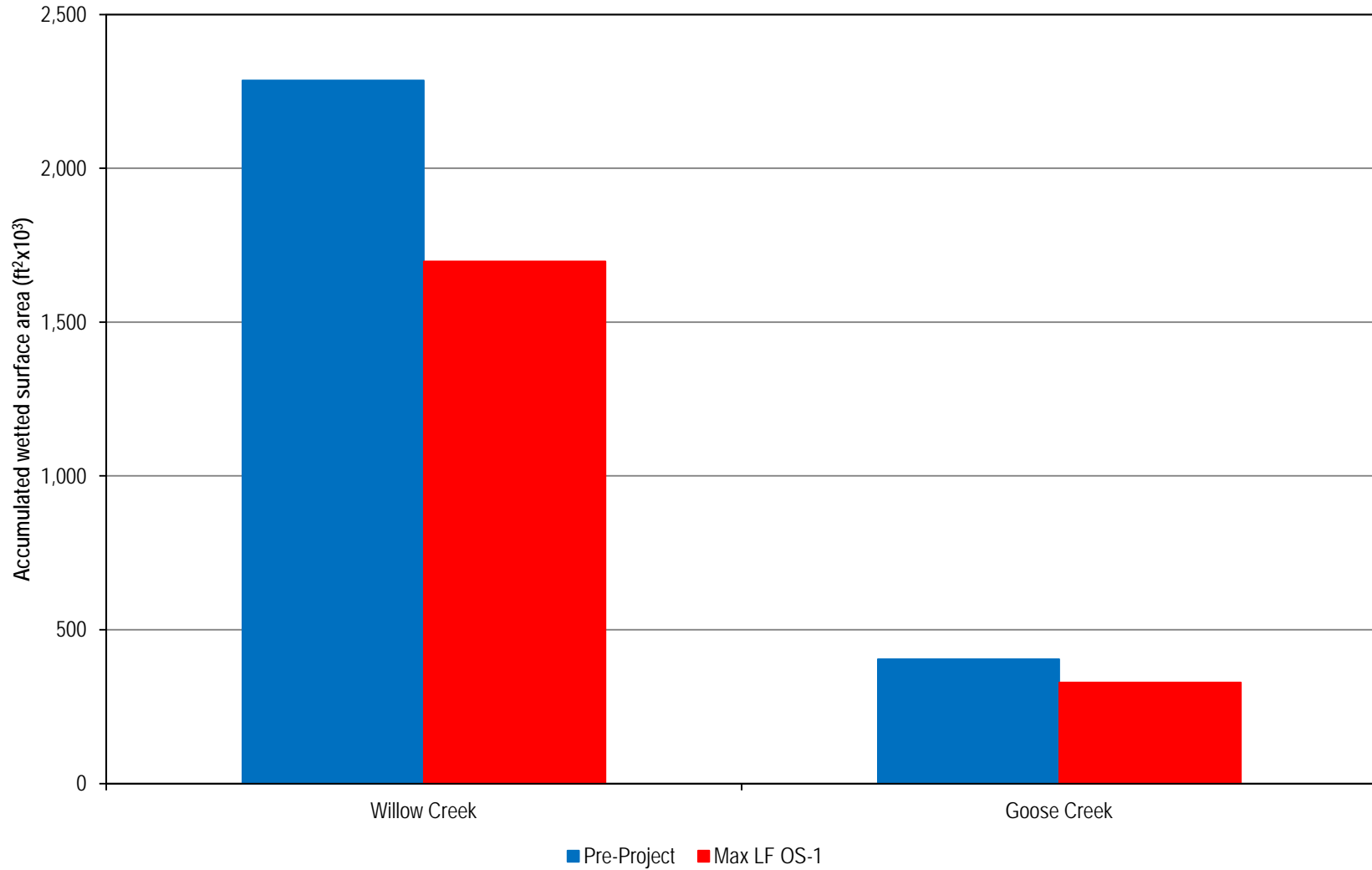


Figure 5.7-4. Accumulated wetted surface area (ft<sup>2</sup>x10<sup>3</sup>) computed over June-September for the median monthly discharge at Sunshine gage presented for the tributary mouth habitat (Tetra Tech, Inc 2013e)

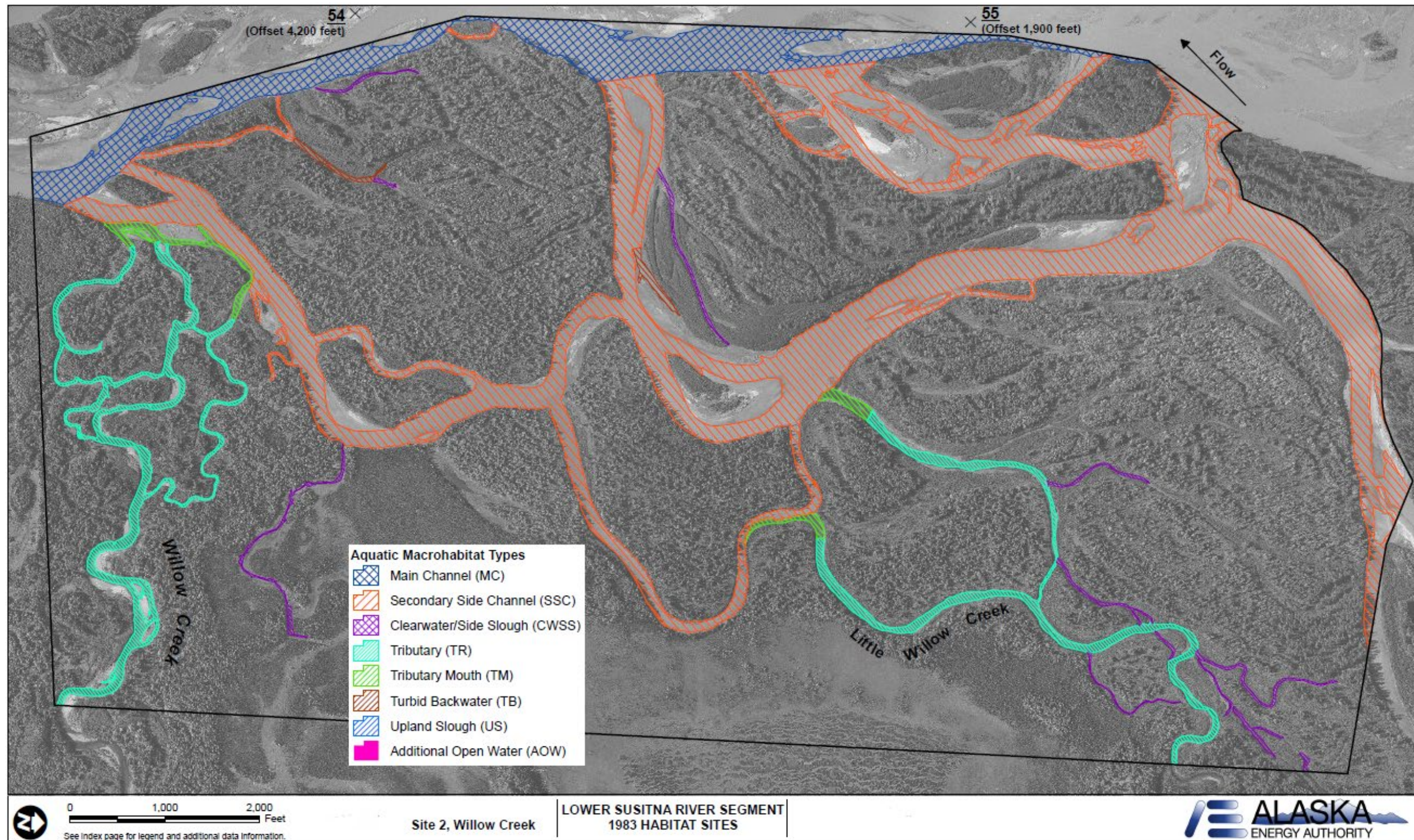


Figure 5.7-5. 1980s Aquatic macrohabitat types in the Willow Creek habitat site (Tetra Tech, Inc. 2013f).

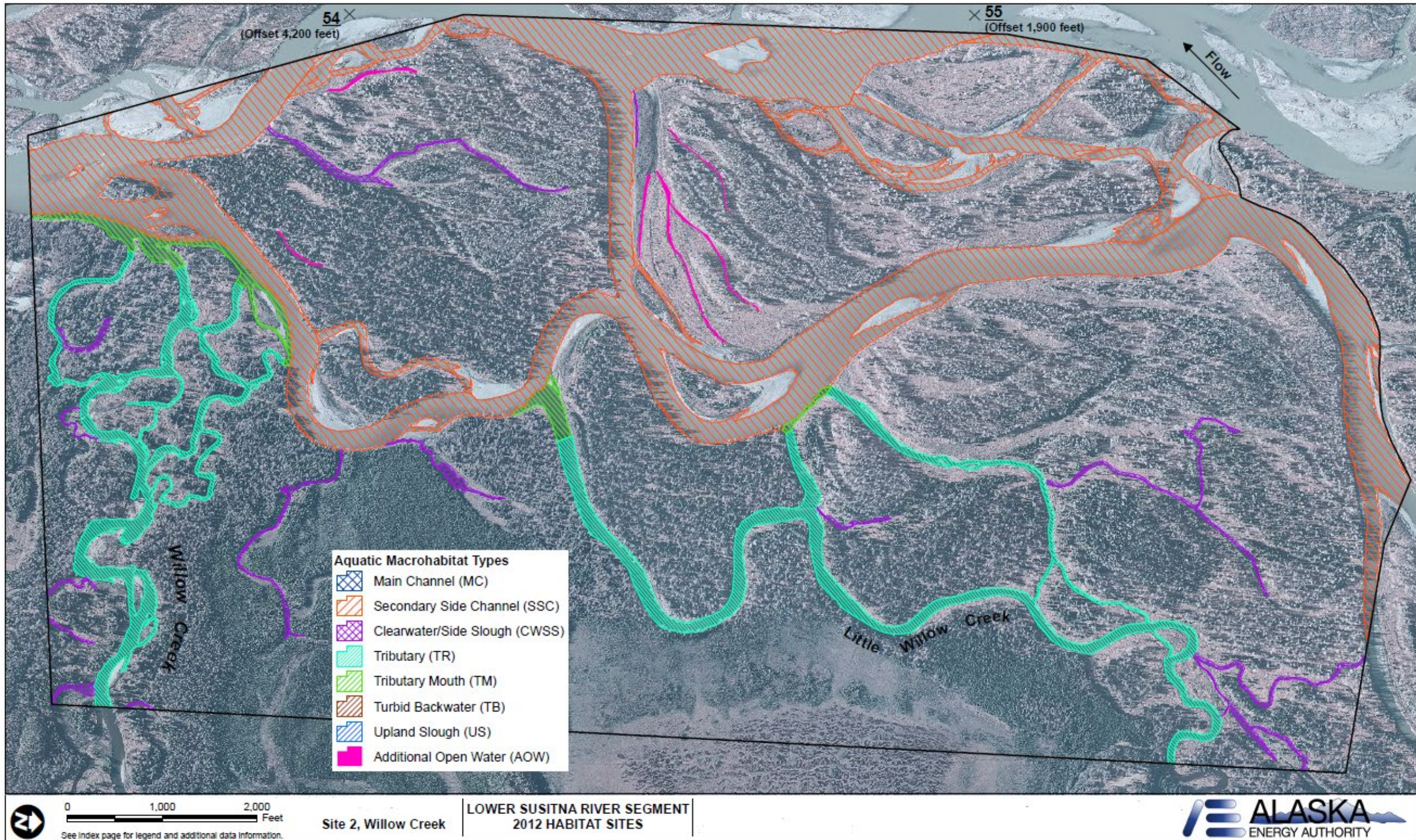


Figure 5.7-6. 2012 Aquatic macrohabitat types in the Willow Creek habitat site (Tetra Tech, Inc. 2013f).

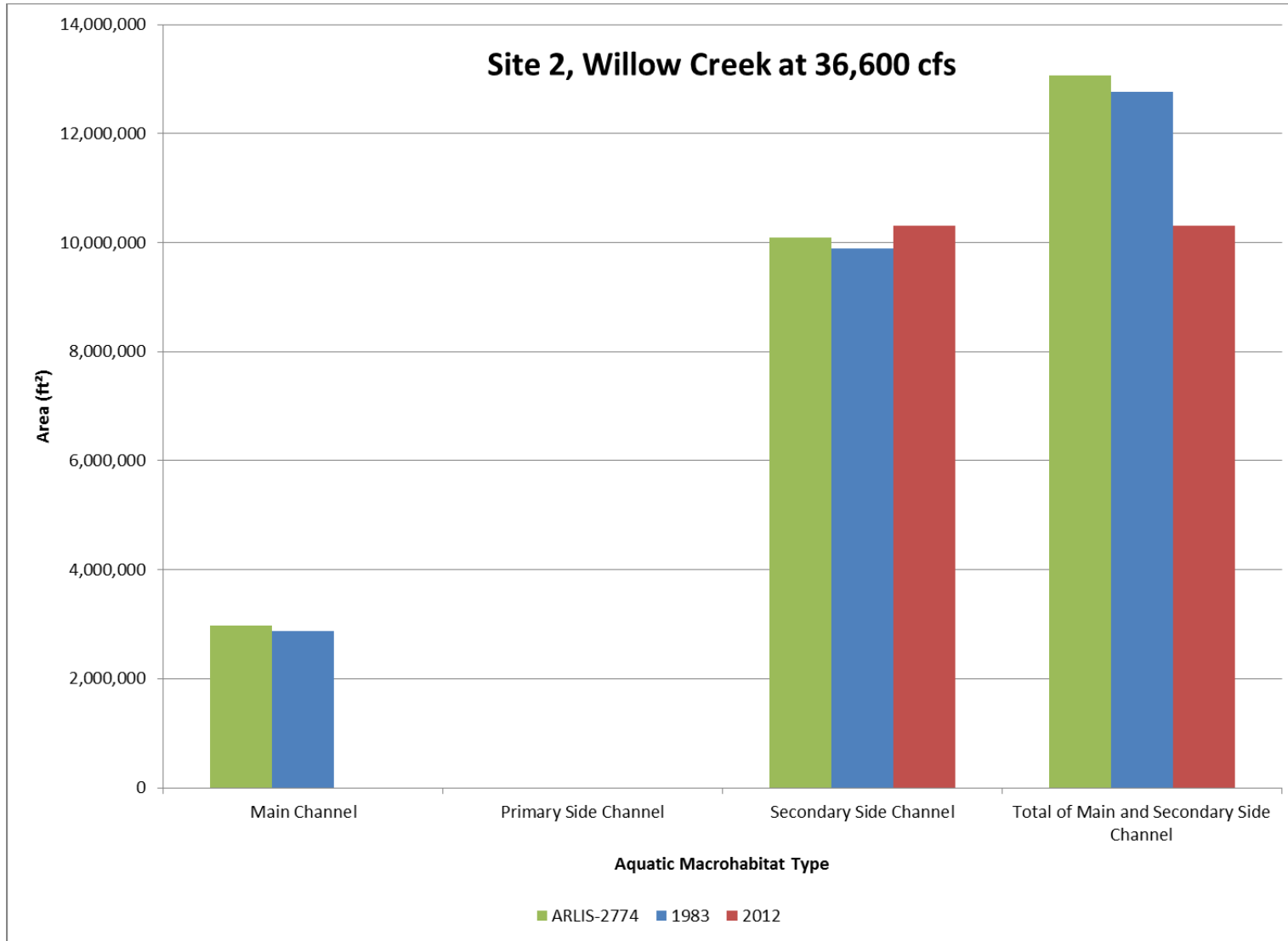


Figure 5.7-7. Comparison of aquatic macrohabitat types from 1983 to 2012 at Willow Creek, main channel and side channel habitats (Tetra Tech, Inc. 2013f).

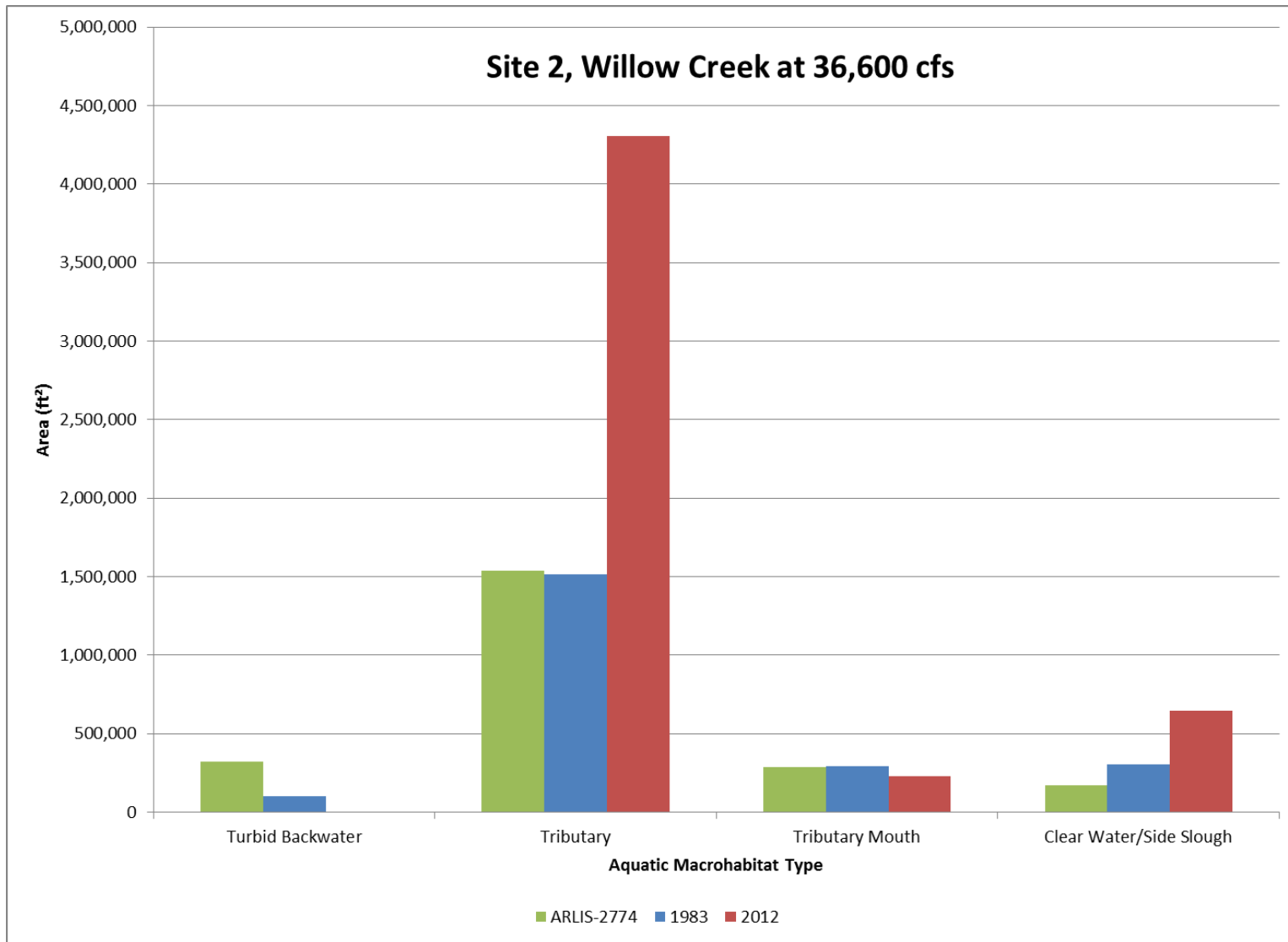


Figure 5.7-8. Comparison of aquatic macrohabitat types from 1983 to 2012 at Willow Creek, tributary and side slough habitats (Tetra Tech, Inc. 2013f).



**Figure 5.8-2: Typical bank profile with armored toe and mid-bank, FA-104. Flow in the river was approximately 24,000 cfs.**

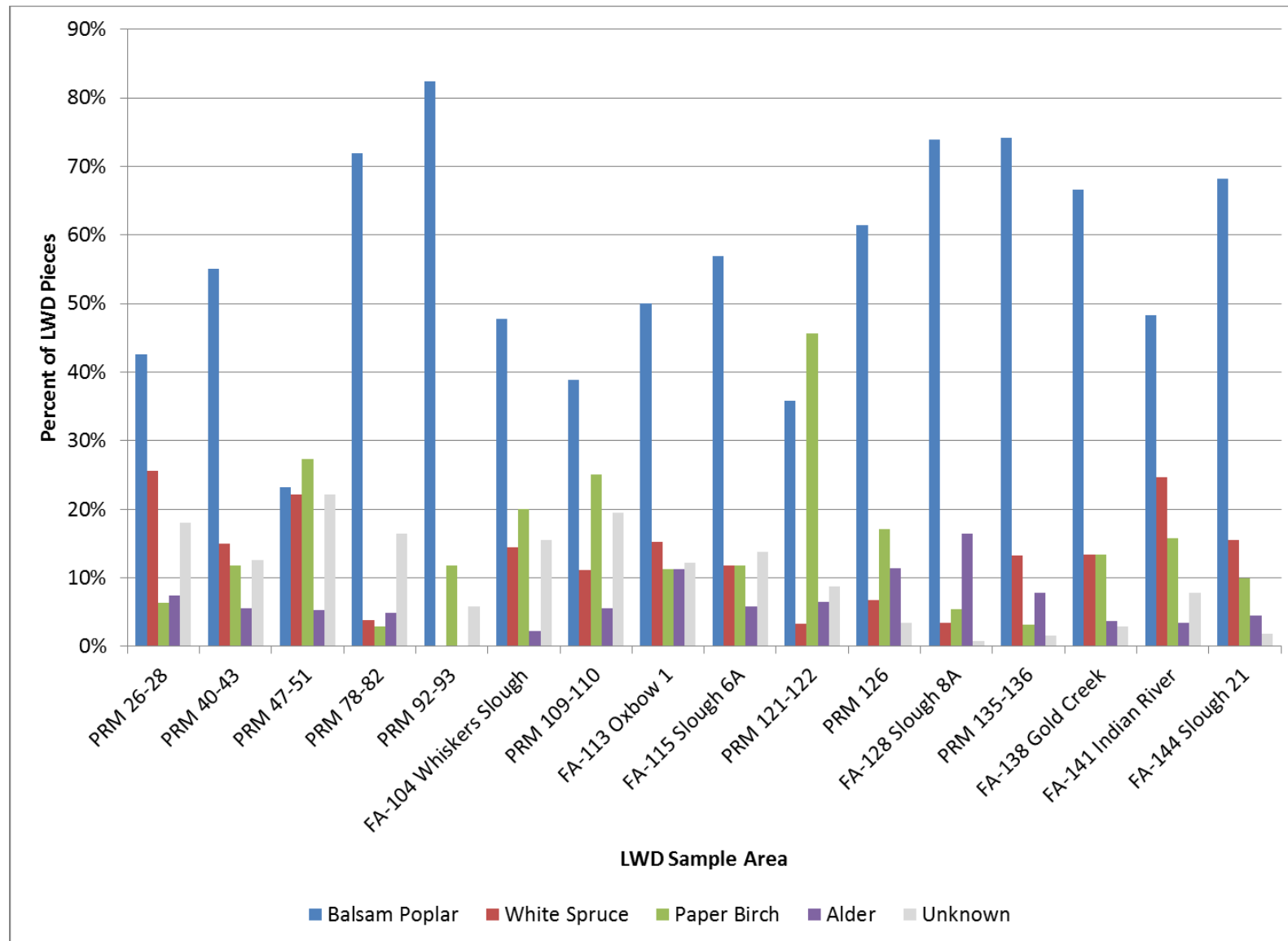


Figure 5.9-1. Large Woody Debris (LWD) by Species, 2013 Field Inventory.



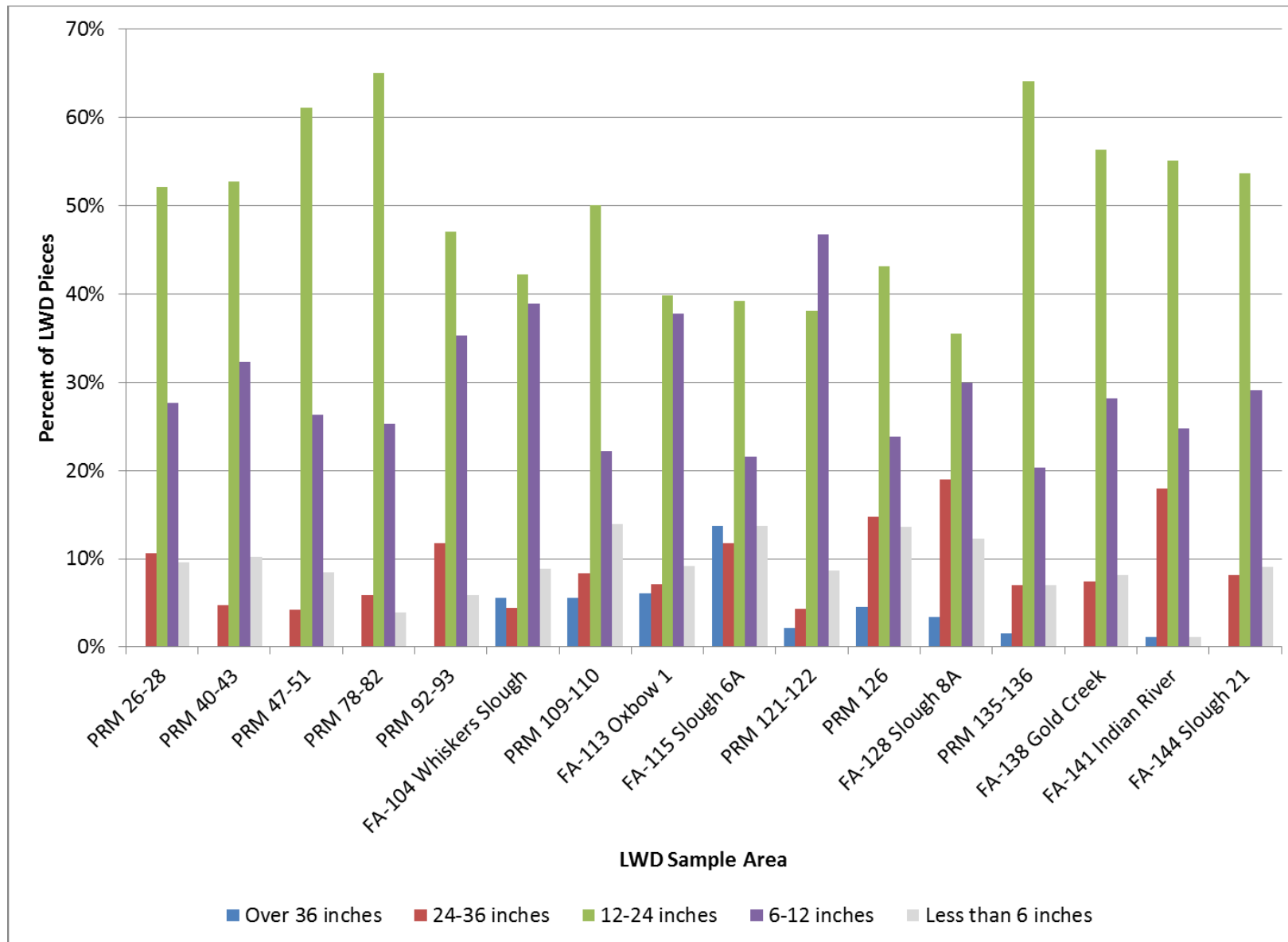


Figure 5.9-2. Large Woody Debris (LWD) by Diameter, 2013 Field Inventory

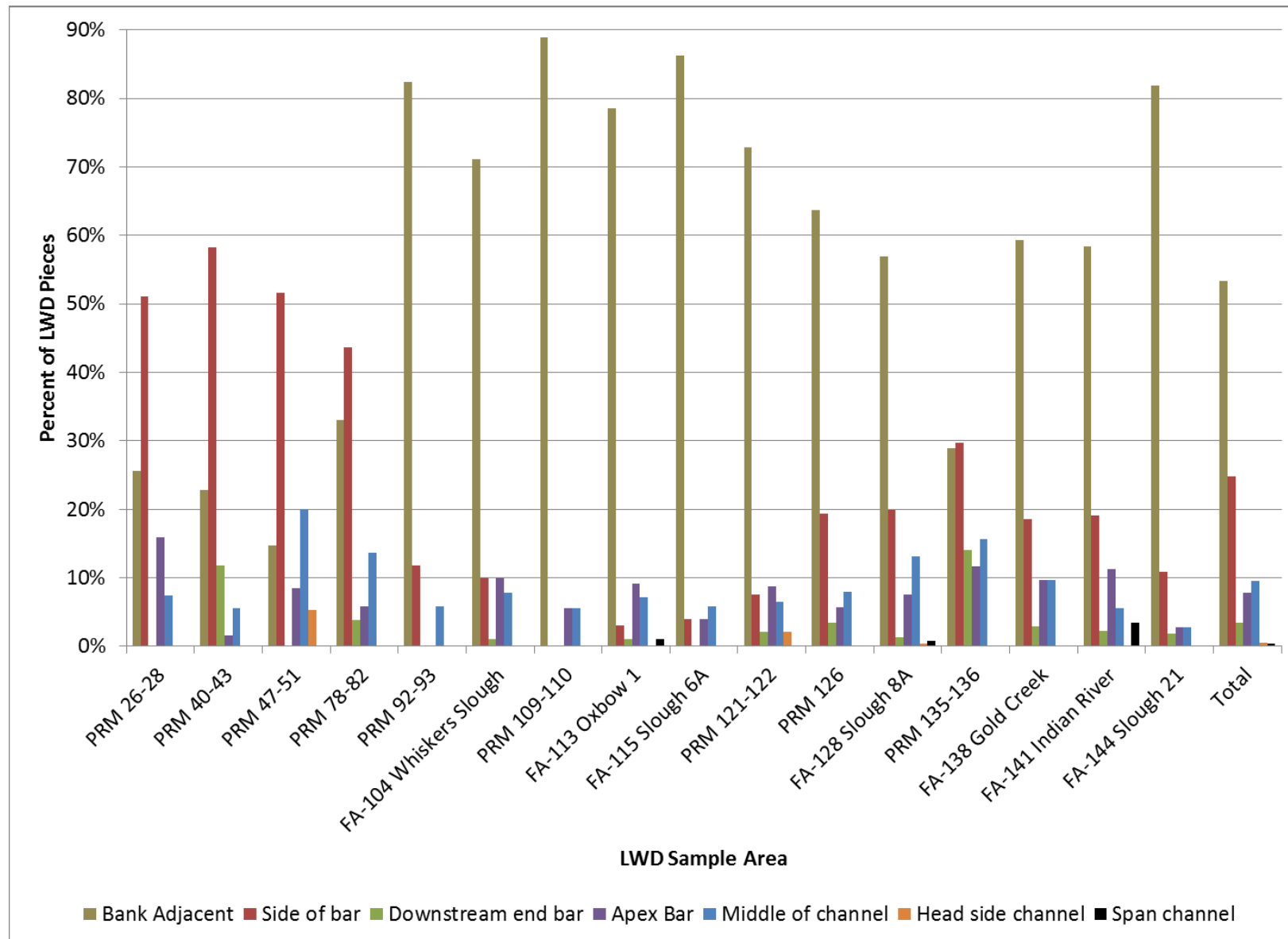


Figure 5.9-3. Large Woody Debris (LWD) by Channel Position, 2013 Field Inventory.

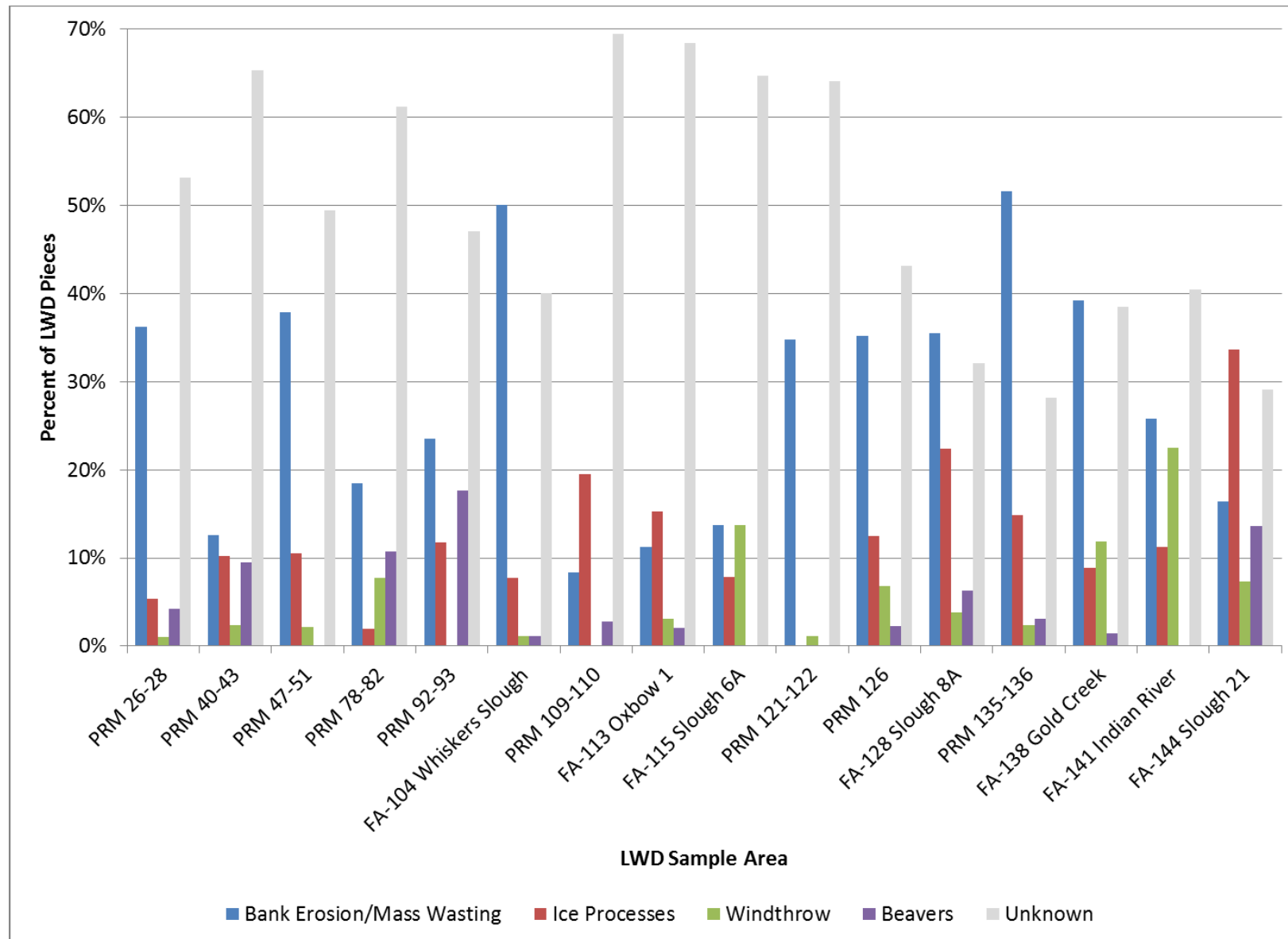


Figure 5.9-4. Large Woody Debris (LWD) by Input Process, 2013 Field Inventory.

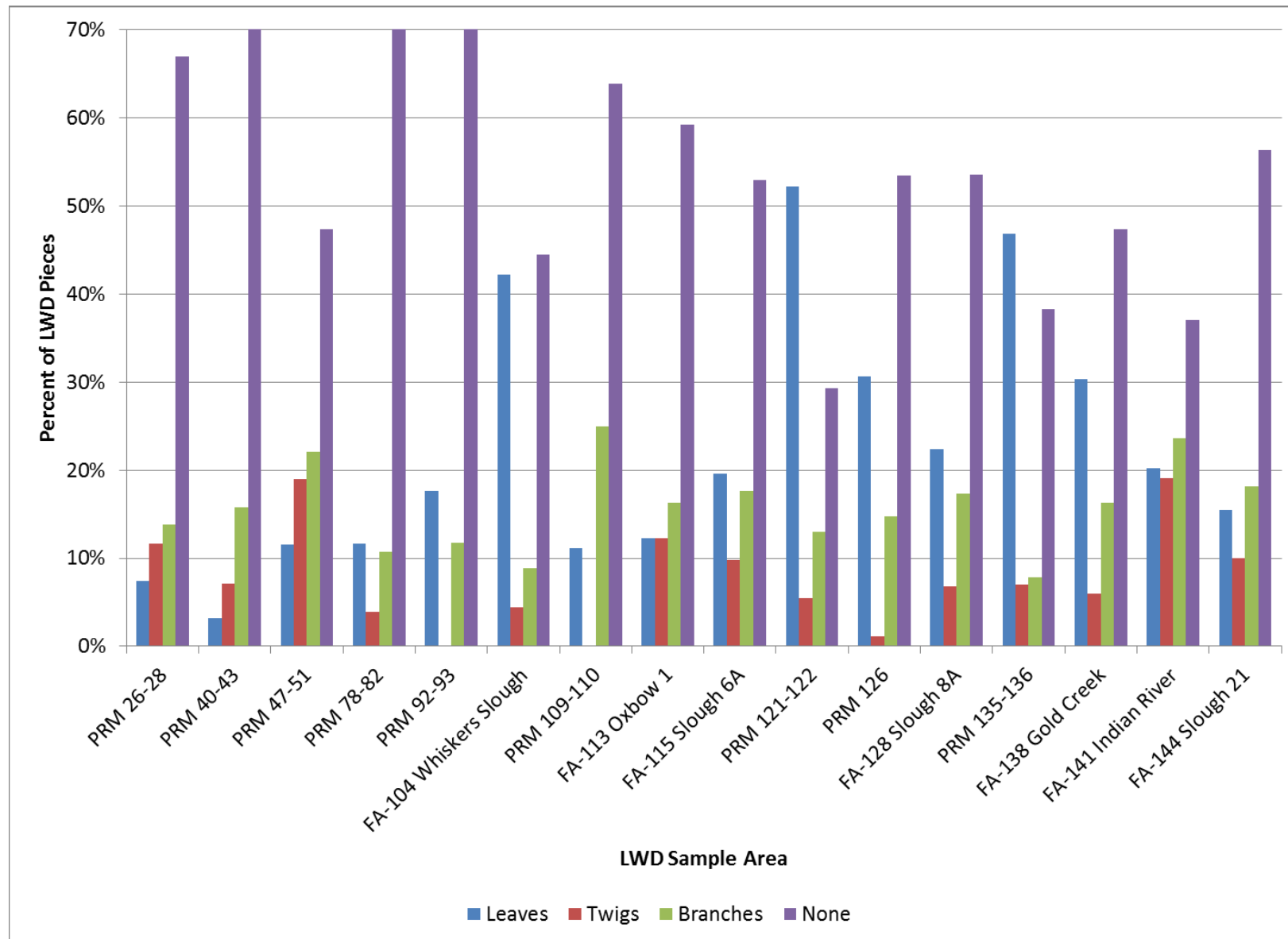


Figure 5.9-5. Large Woody Debris (LWD) by Freshness of Wood, 2013 Field Inventory.

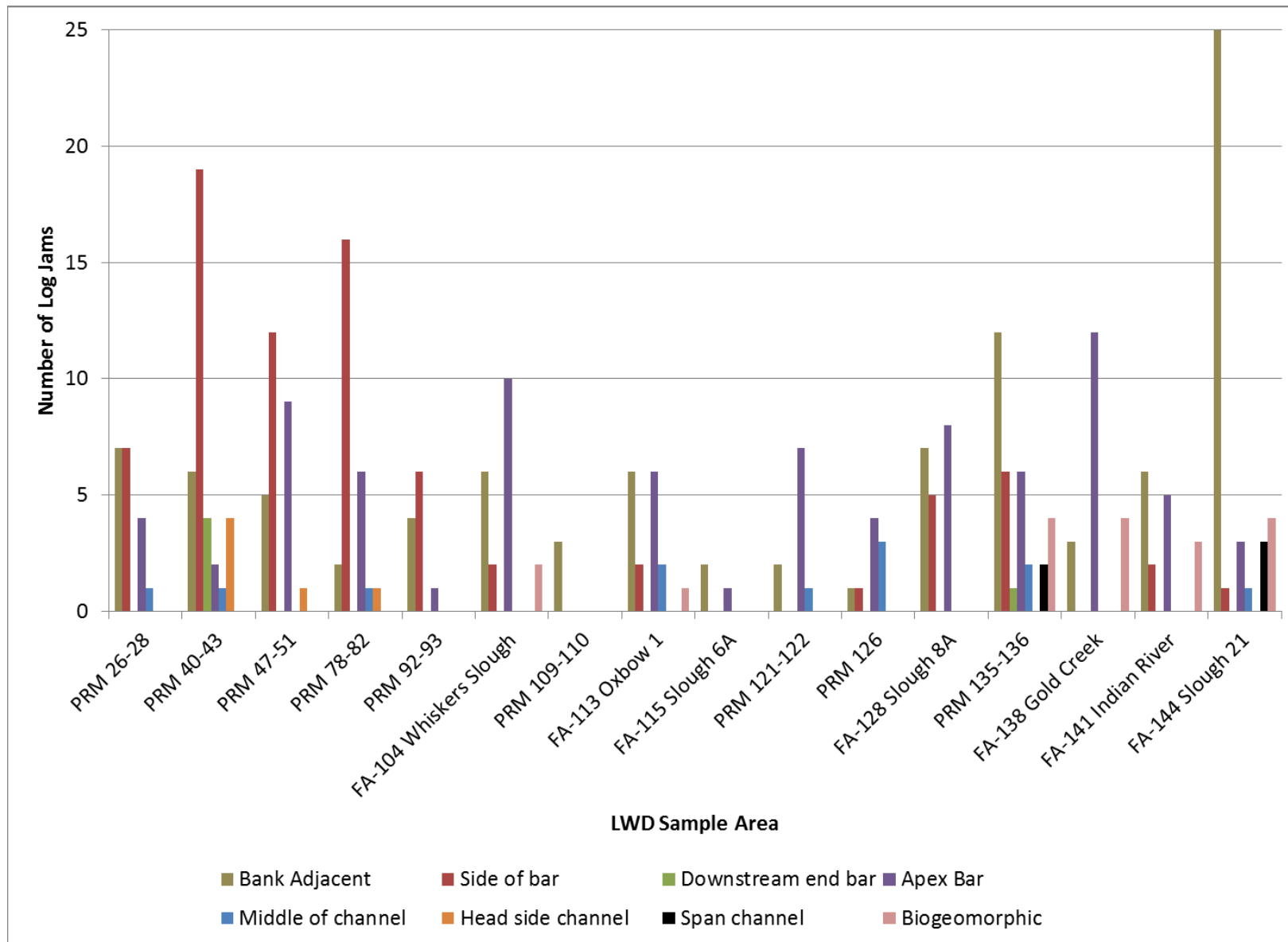


Figure 5.9-6. Log Jams by Channel Position, 2013 Field Inventory.

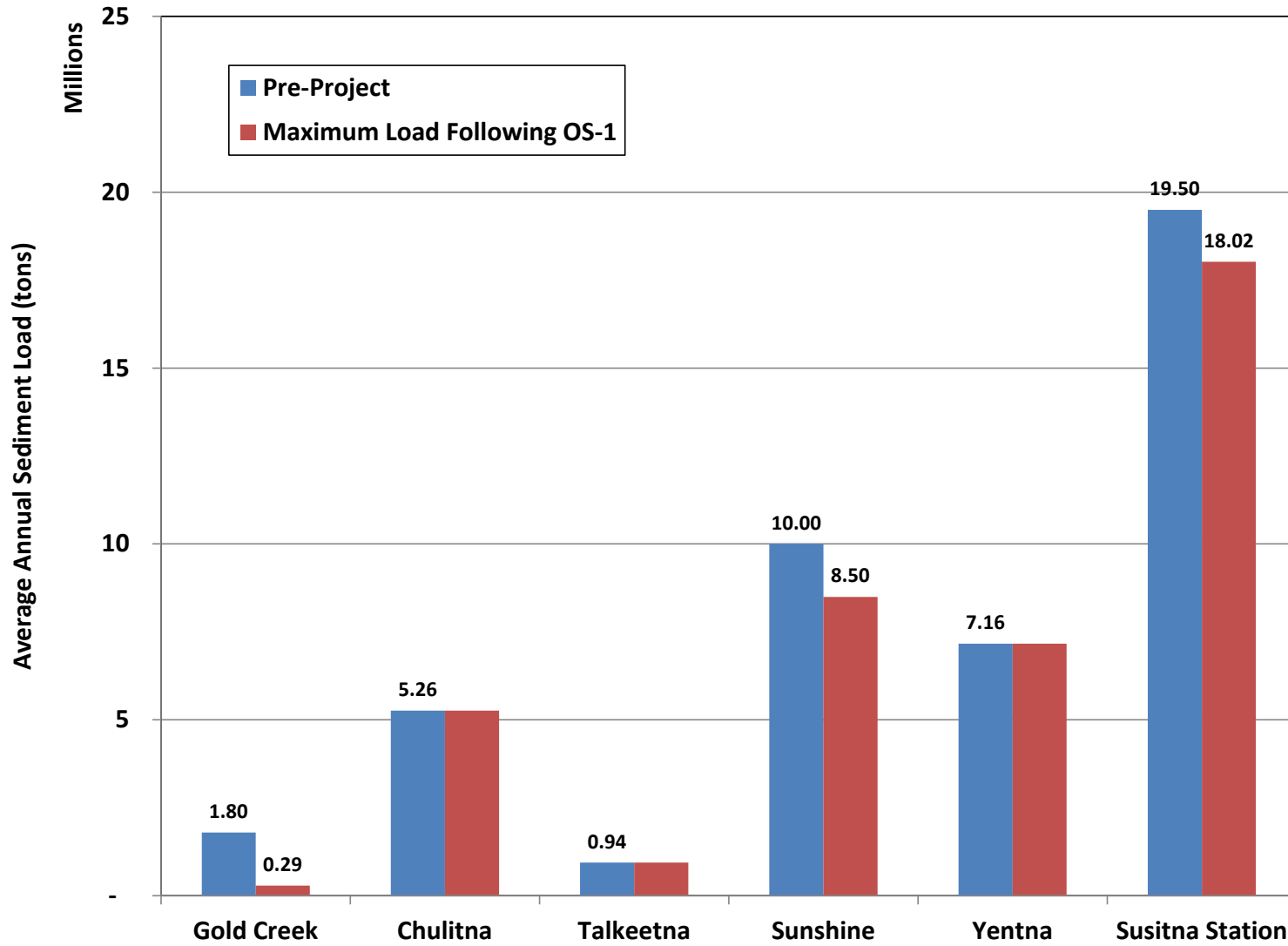


Figure 6.3-1. Average annual silt/clay loads at the three mainstem gages and the three primary tributary gages under pre-Project and Maximum Load Following OS-1 conditions.

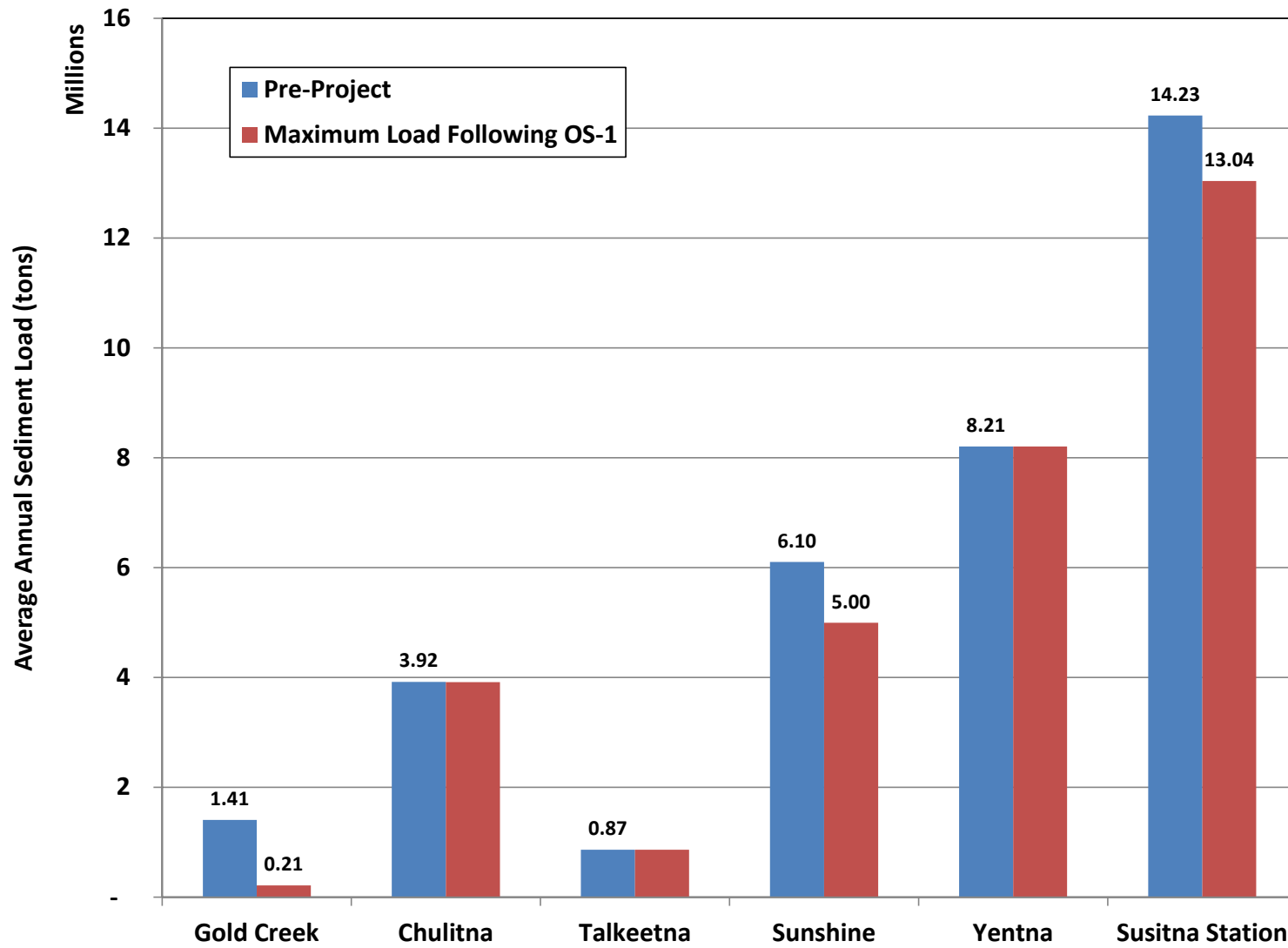


Figure 6.3-2. Average annual sand loads at the three mainstem gages and the three primary tributary gages under pre-Project and Maximum Load Following OS-1 conditions.

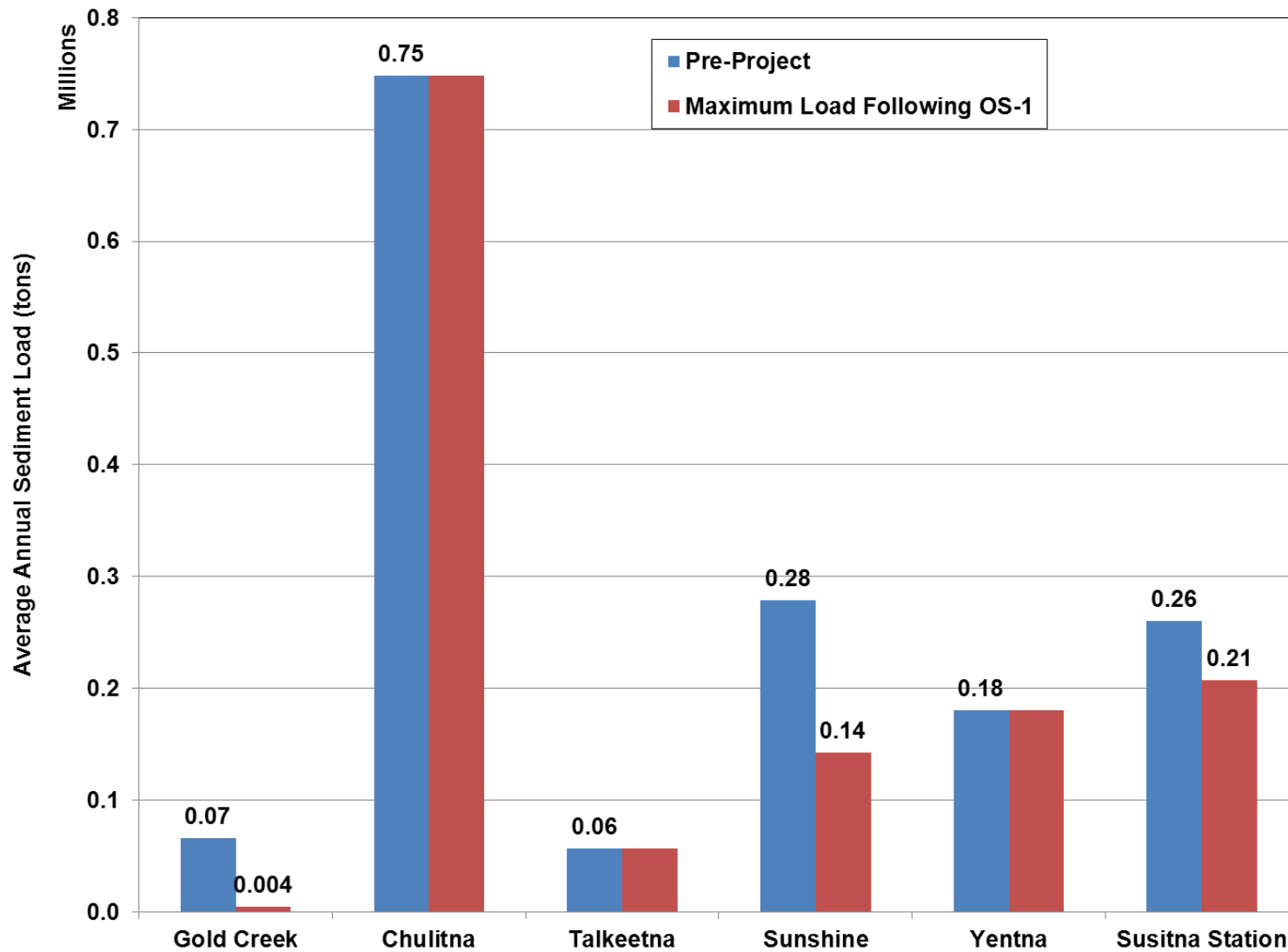


Figure 6.3-3. Average annual gravel loads at the three mainstem gages and the three primary tributary gages under pre-Project and Maximum Load Following OS-1 conditions.



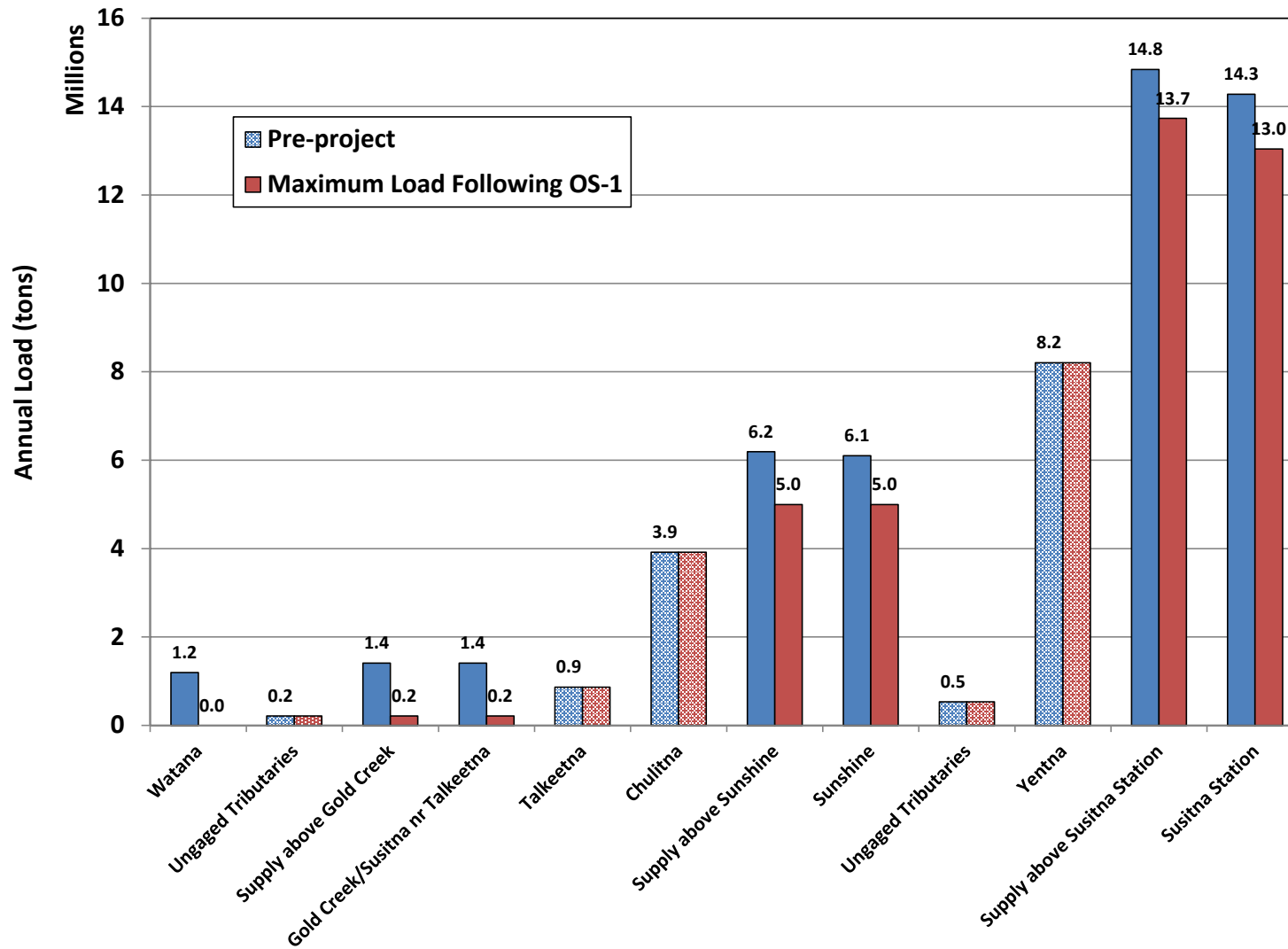


Figure 6.3-4. Average annual sand loads at the mainstem and tributary gages, along with the estimated annual sand load from ungaged tributaries, under pre-Project and Maximum Load Following OS-1 conditions. Also shown is the accumulated sediment supply to key points along the reach based on the gaged and ungaged sand loads.

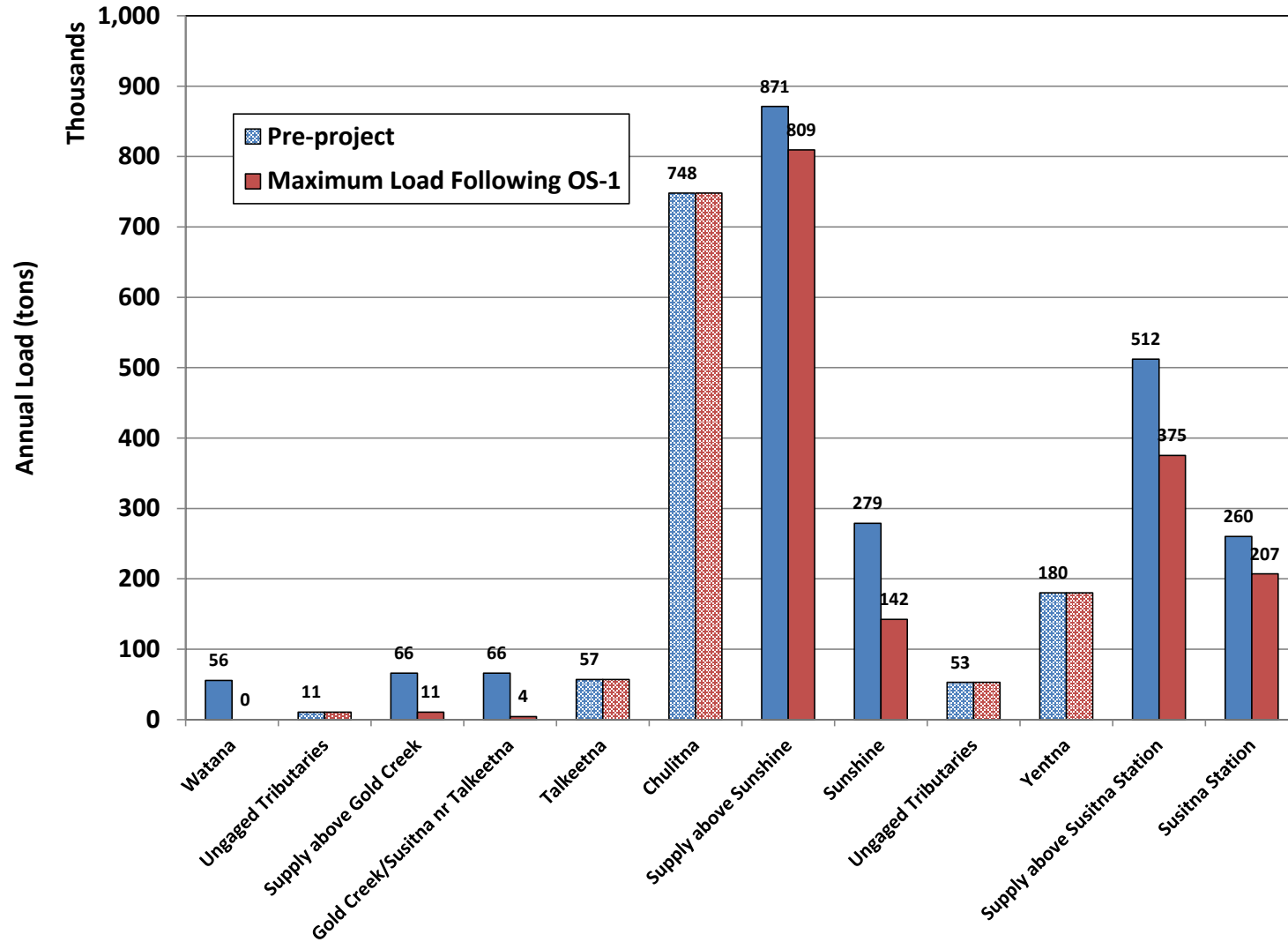


Figure 6.3-5. Average annual gravel loads at the mainstem and tributary gages, along with the estimated annual gravel load from ungaged tributaries, under pre-Project and Maximum Load Following OS-1 conditions. Also shown is the accumulated sediment supply to key points along the reach based on the gaged and ungaged gravel loads.

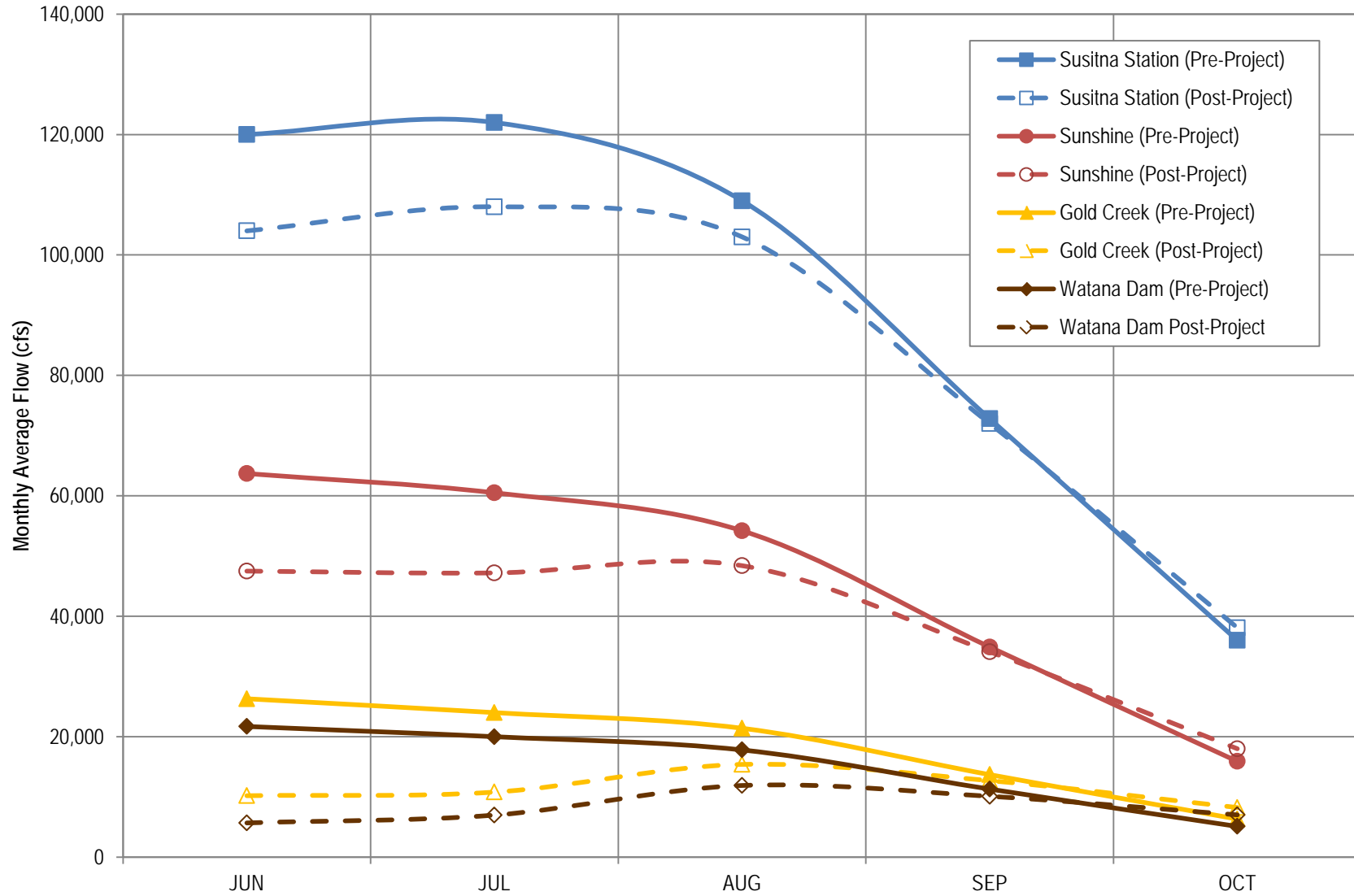


Figure 6.6.1. Average monthly flows (cfs) during the open-water period in the Susitna River watershed for pre-Project and Maximum Load Following OS-1 conditions. (Tetra Tech 2013d).

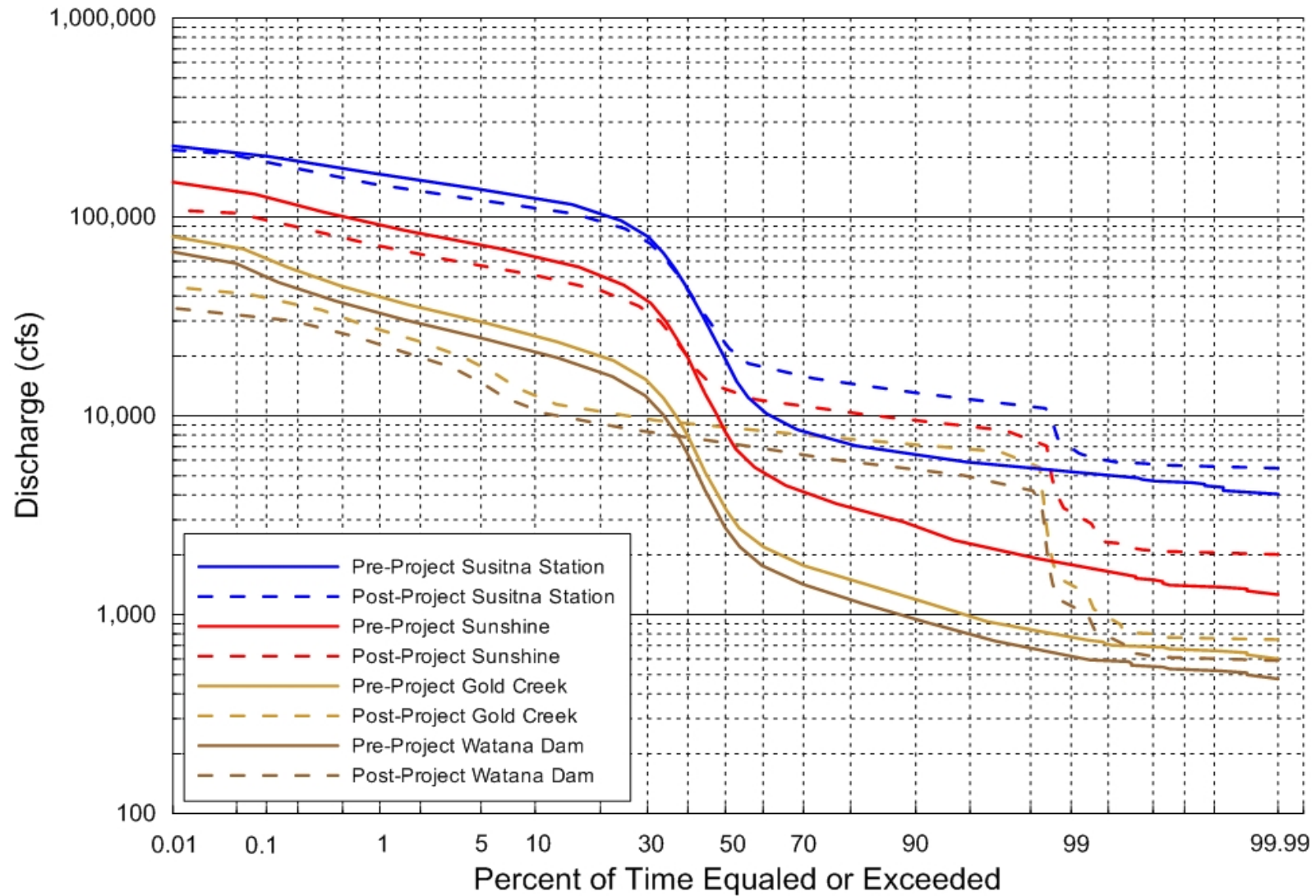


Figure 6.6.2. Annual flow-duration curve comparison for Pre-Project and Maximum Load Following OS-1 conditions.

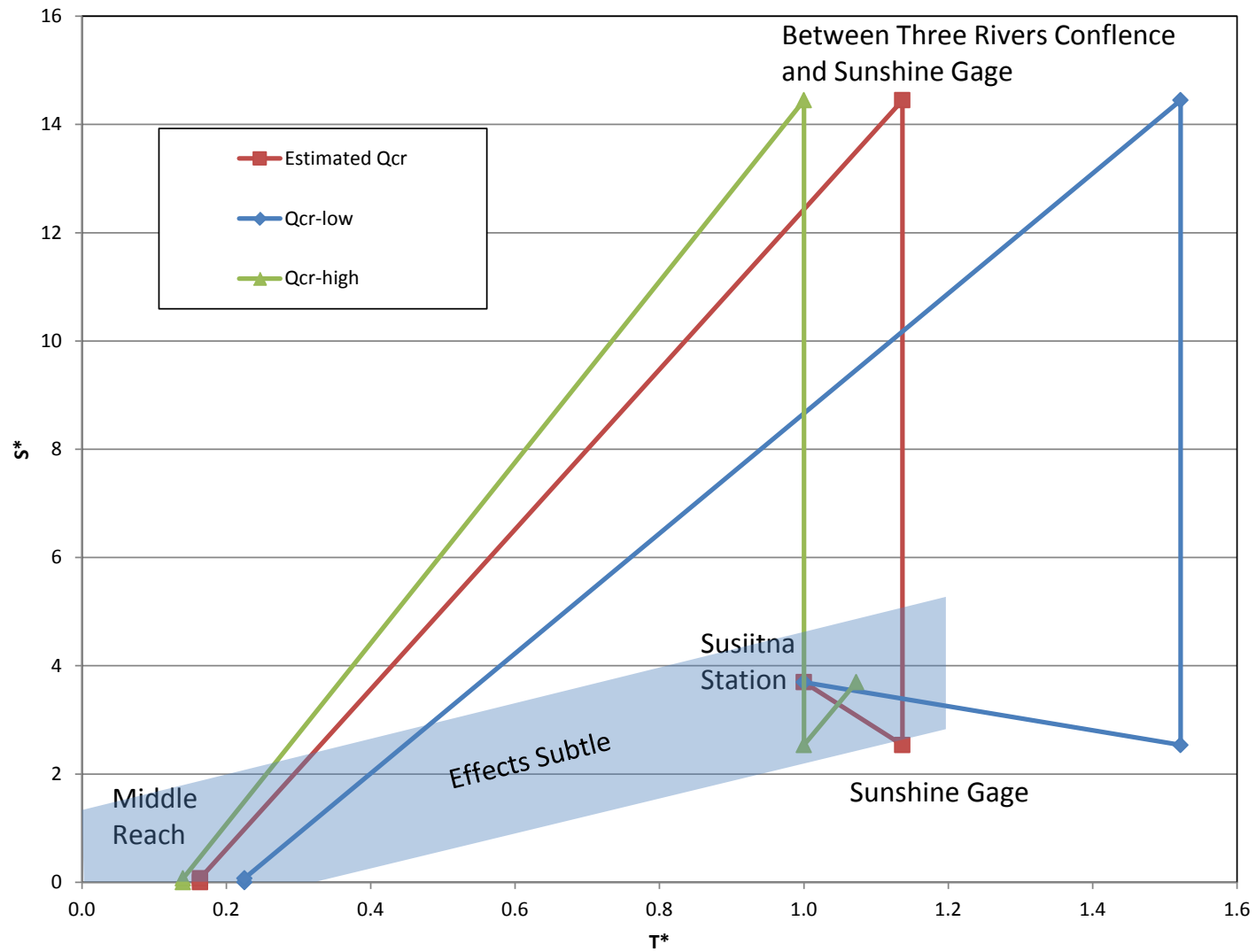


Figure 6.6.3.  $S^*$  and  $T^*$  on the Middle and Lower Susitna River Reaches.

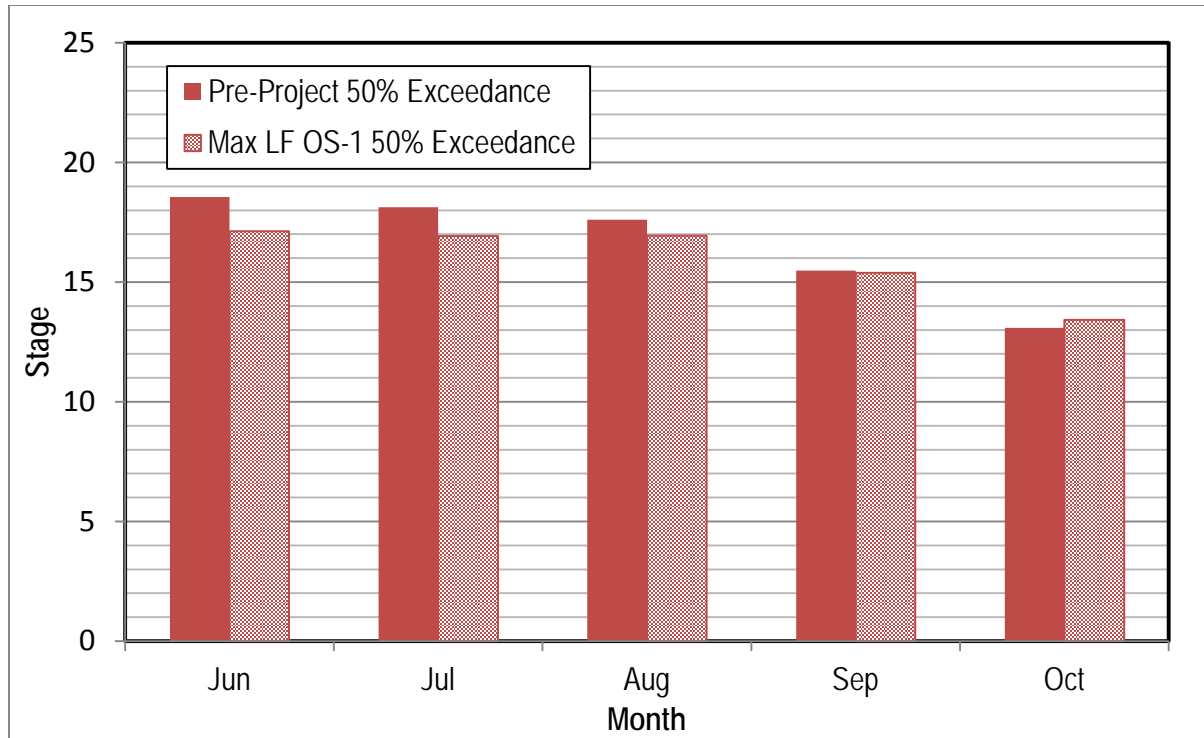


Figure 6.7-1. Monthly 50 percent pre-Project and Max LF OS-1 Stage-Exceedance Values at Sunshine Gage during the open-water period (Tetra Tech, Inc. 2013d).

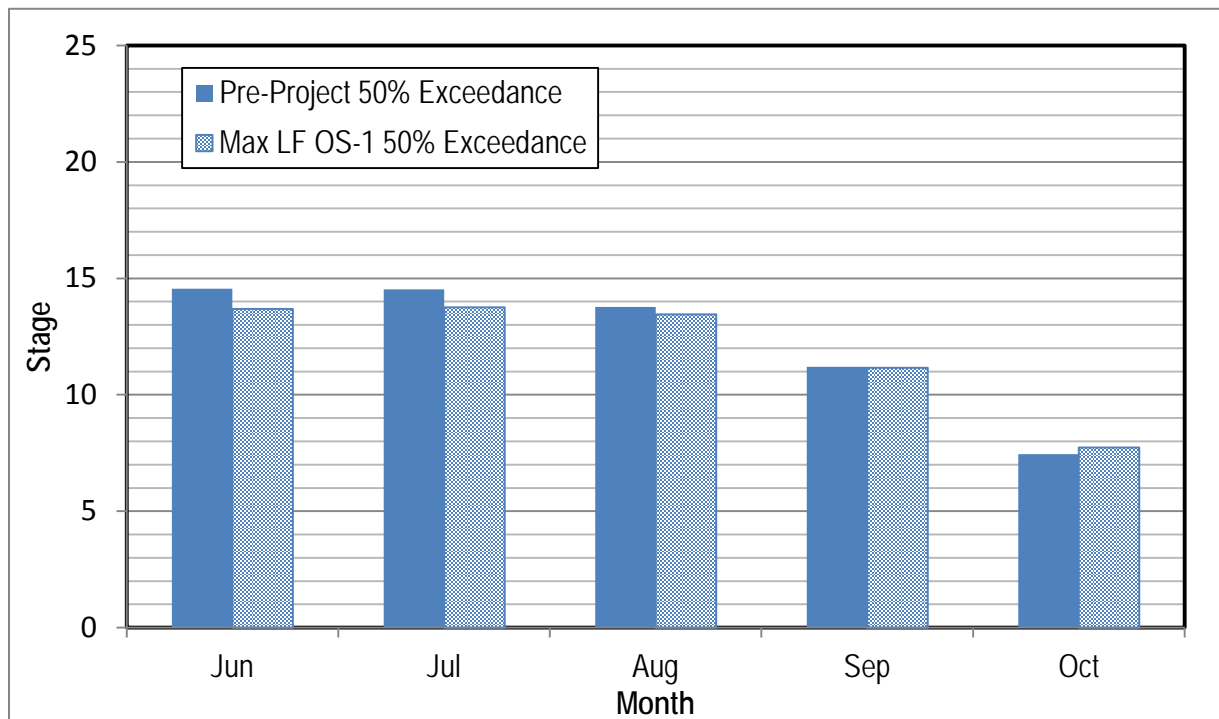


Figure 6.7-2. Monthly 50 percent pre-Project and Max LF OS-1 Stage-Exceedance Values at Susitna Station Gage during the open-water period (Tetra Tech, Inc. 2013d).