Wildland Hydrology's submission to the Kootenai Tribe of Idaho illustrating a potential approach to Kootenai River Habitat Restoration.

Appendices I through VI

This conceptual design was submitted to the
Kootenai Tribe of Idaho by Wildland Hydrology
in May 2008 as part of the Kootenai River Habitat Restoration Project.

Appendix I

Kootenai River Valley & Stream Types

Figure I-1a. Kootenai River topographic depiction of valley and stream types.

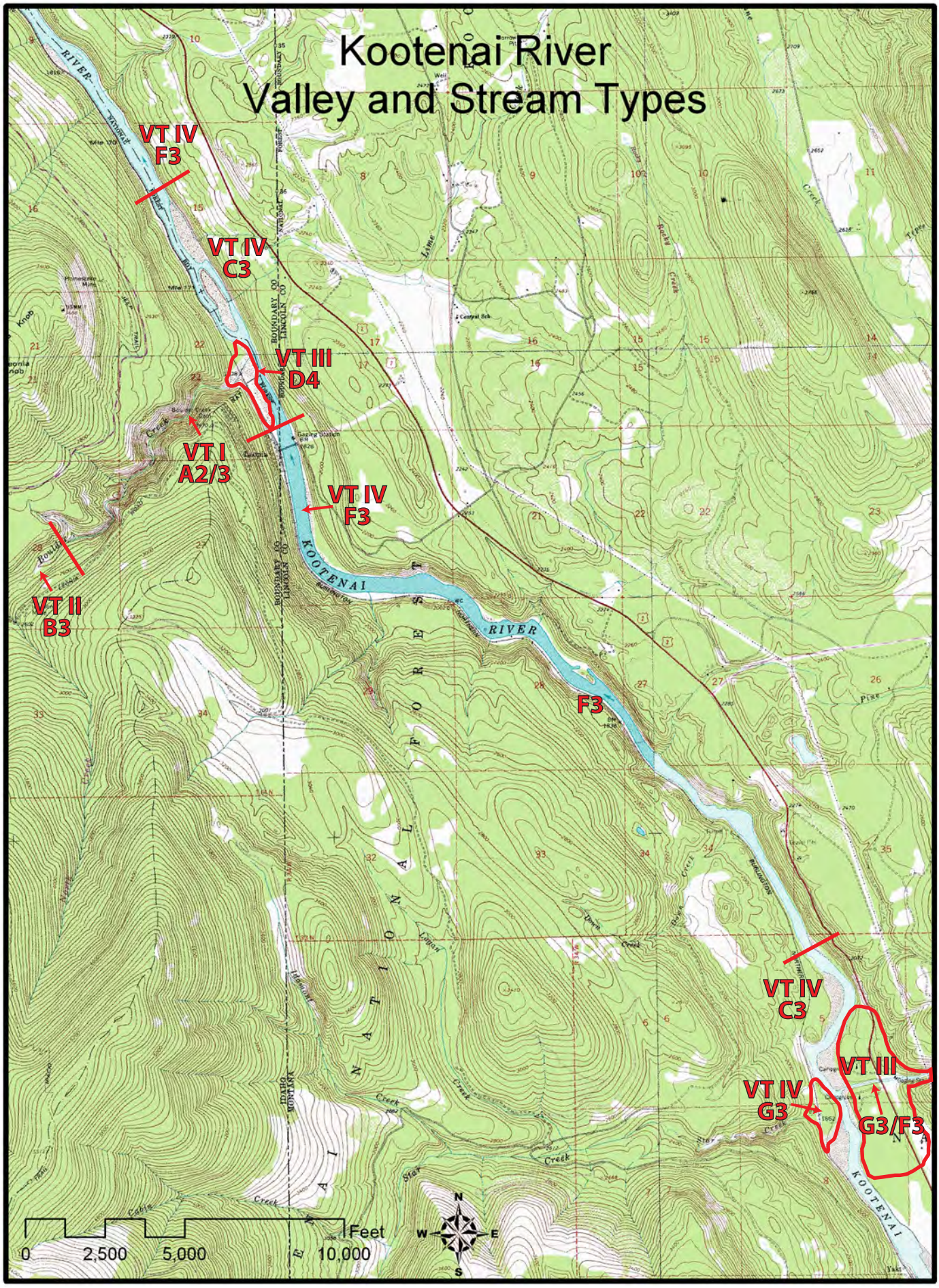


Figure I-1b. Kootenai River aerial depiction of valley and stream types.

Figure I-2a. Kootenai River topographic depiction of valley and stream types.

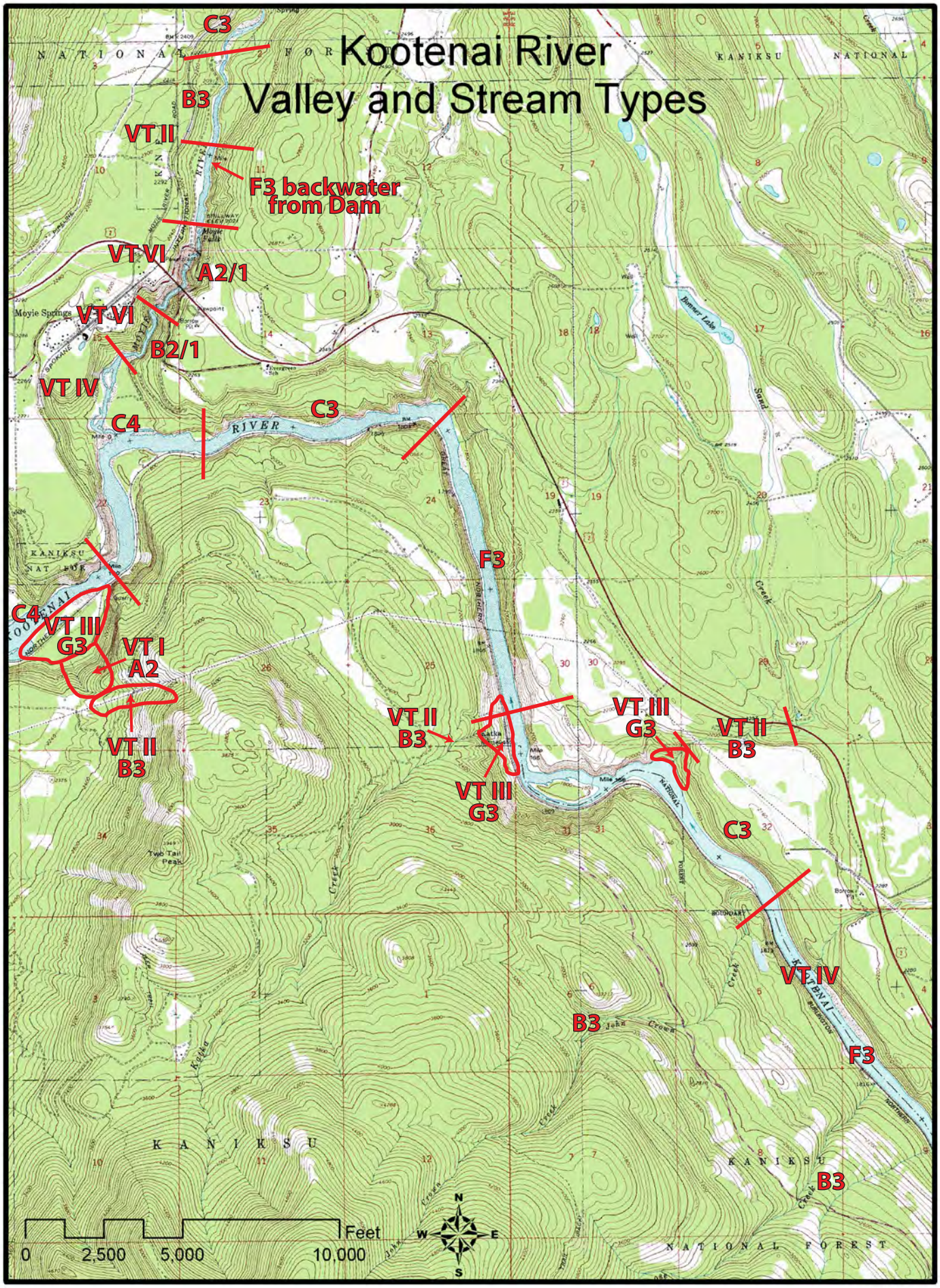


Figure I-2b. Kootenai River aerial depiction of valley and stream types.

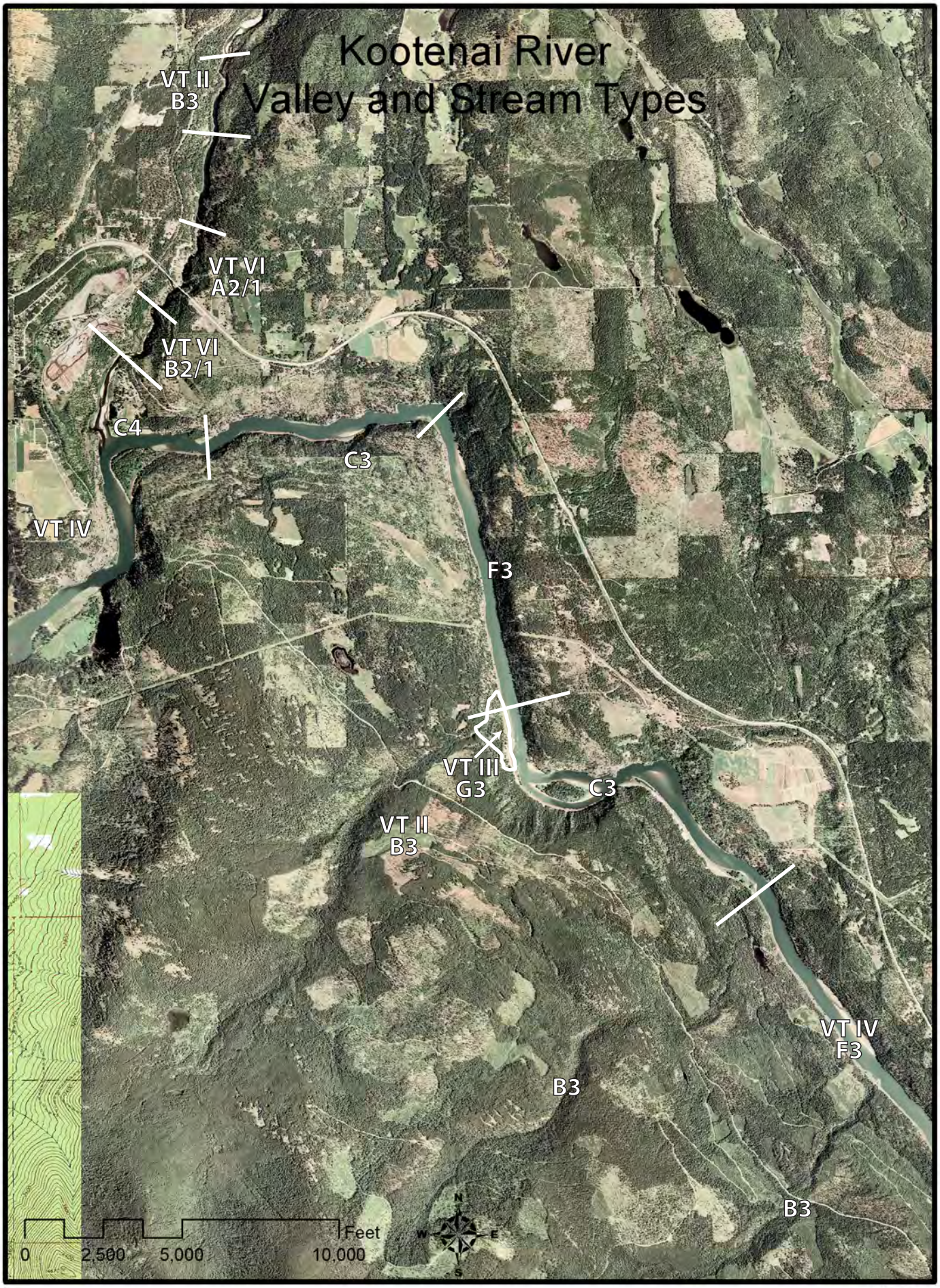


Figure I-3a. Kootenai River topographic depiction of valley and stream types.

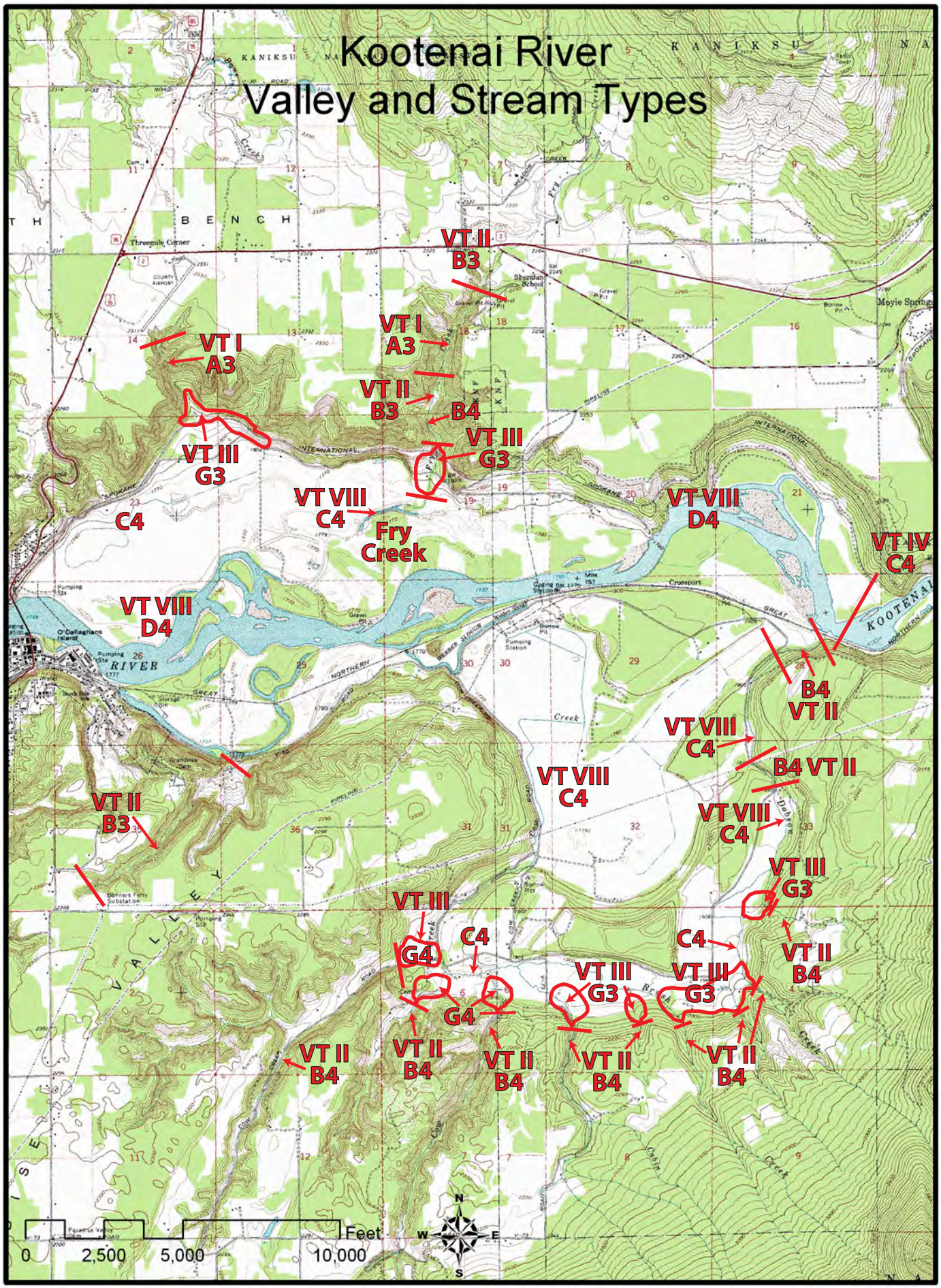


Figure I-3b. Kootenai River aerial depiction of valley and stream types.

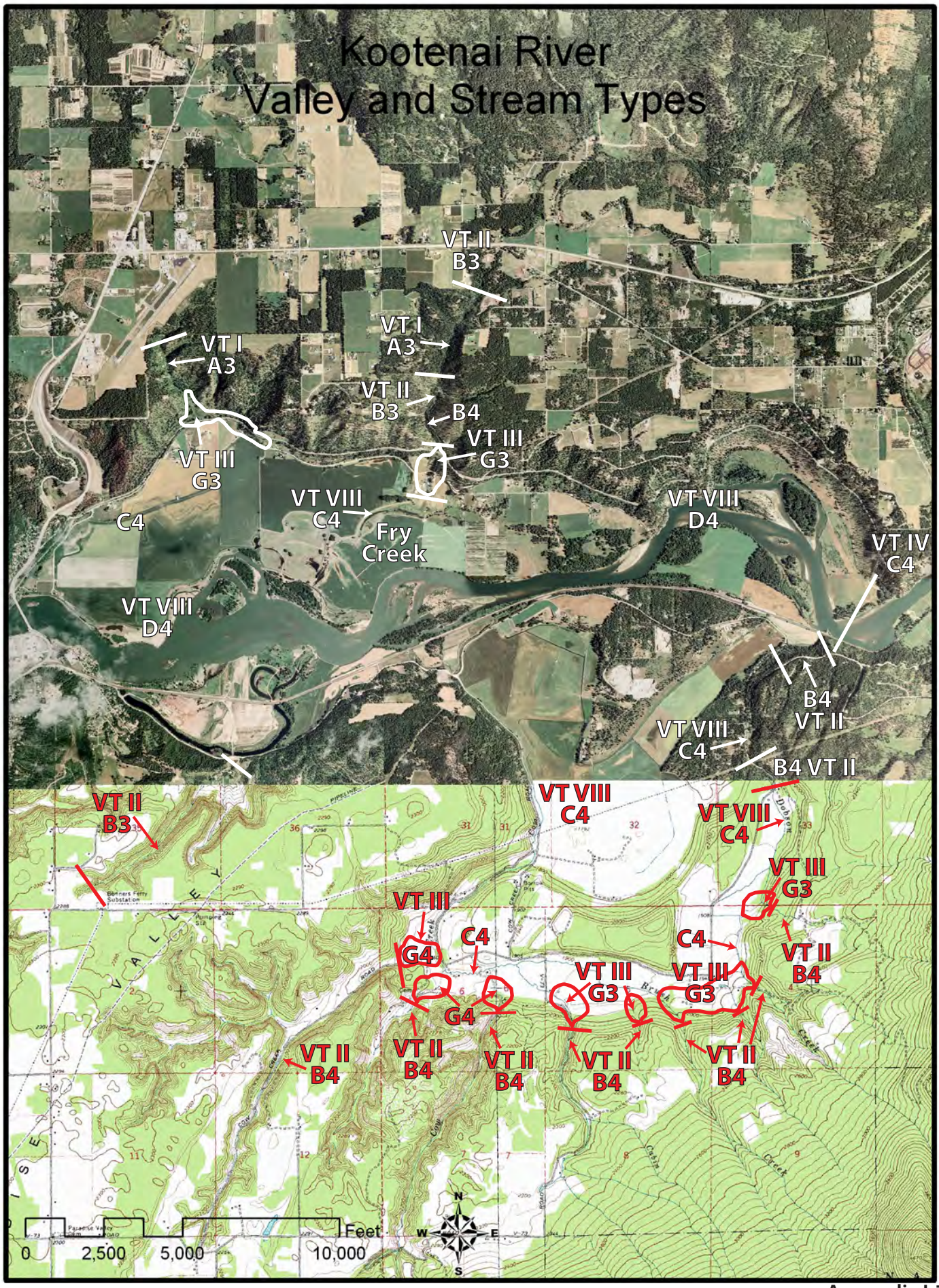


Figure I-4a. Kootenai River topographic depiction of valley and stream types.

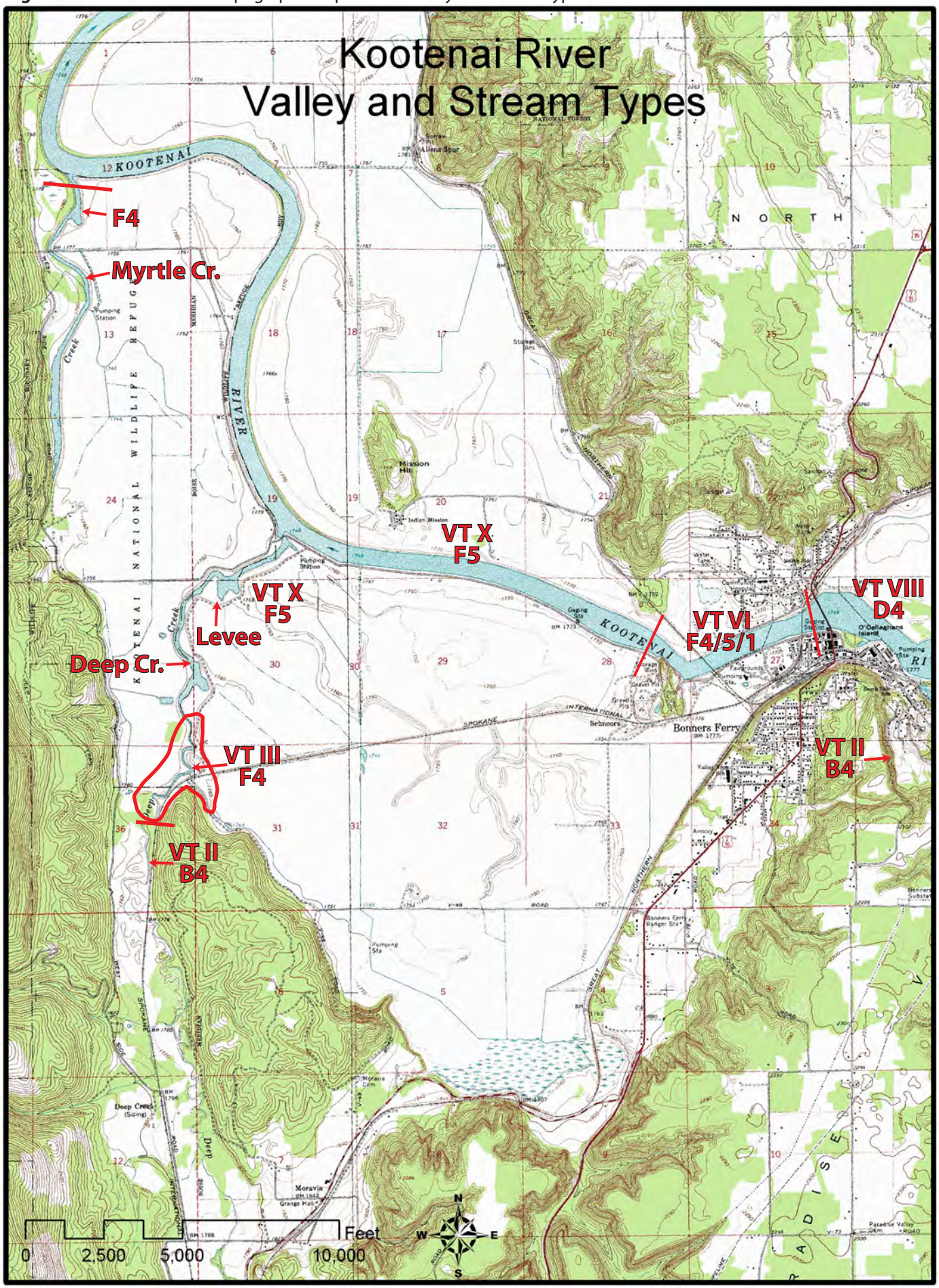


Figure I-4b. Kootenai River aerial depiction of valley and stream types.

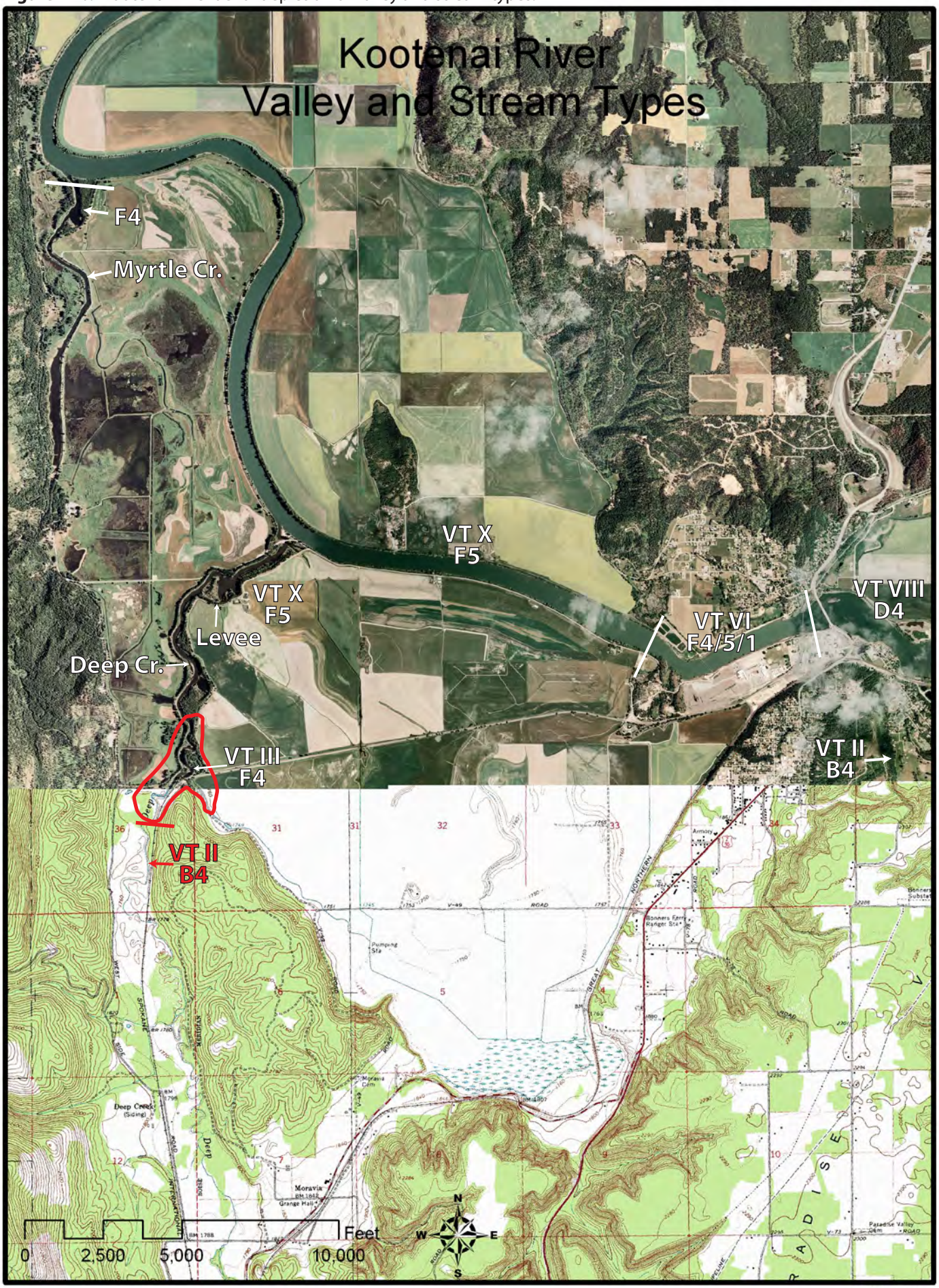


Figure I-5a. Kootenai River topographic depiction of valley and stream types.

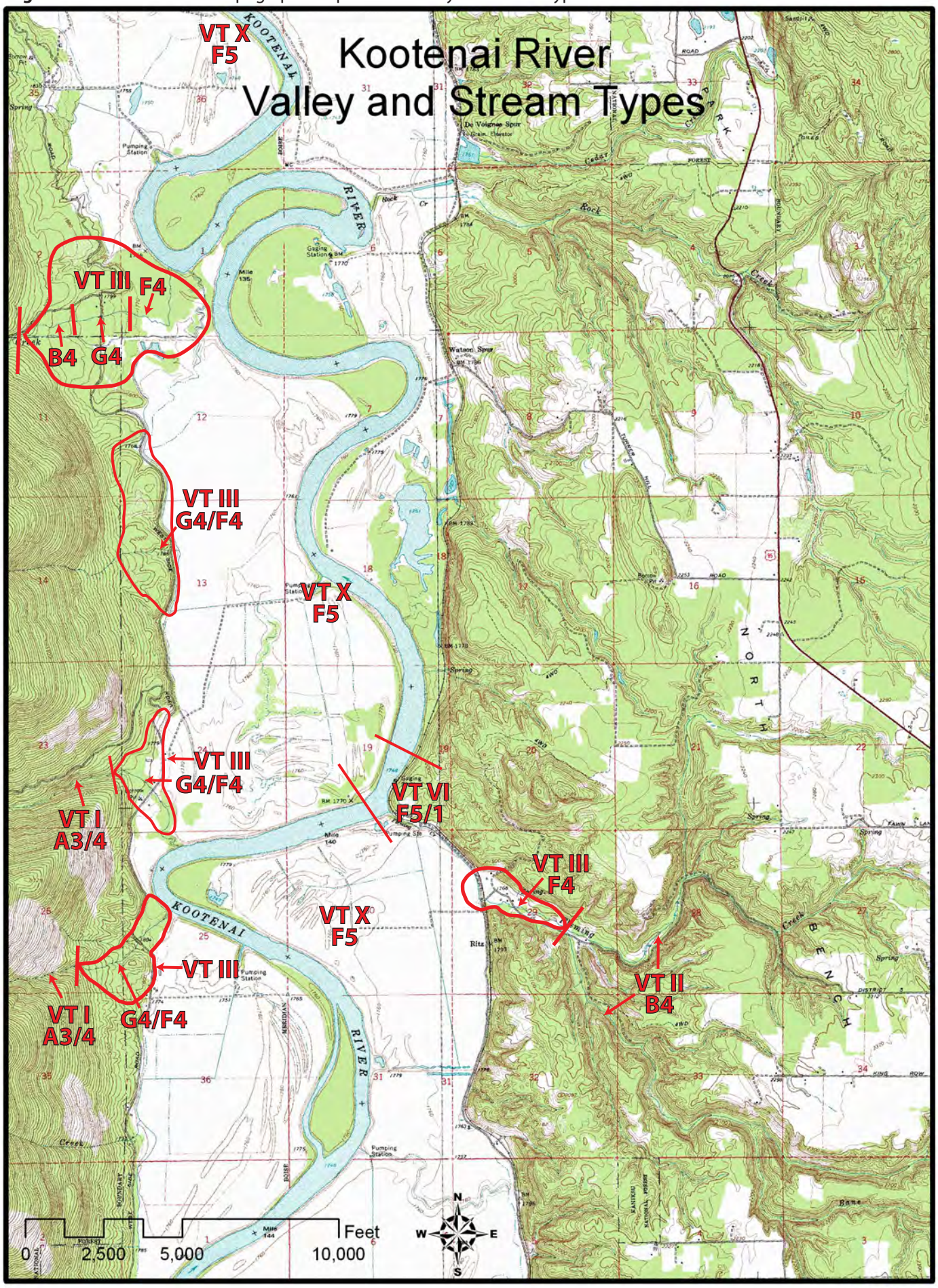


Figure I-5b. Kootenai River aerial depiction of valley and stream types.

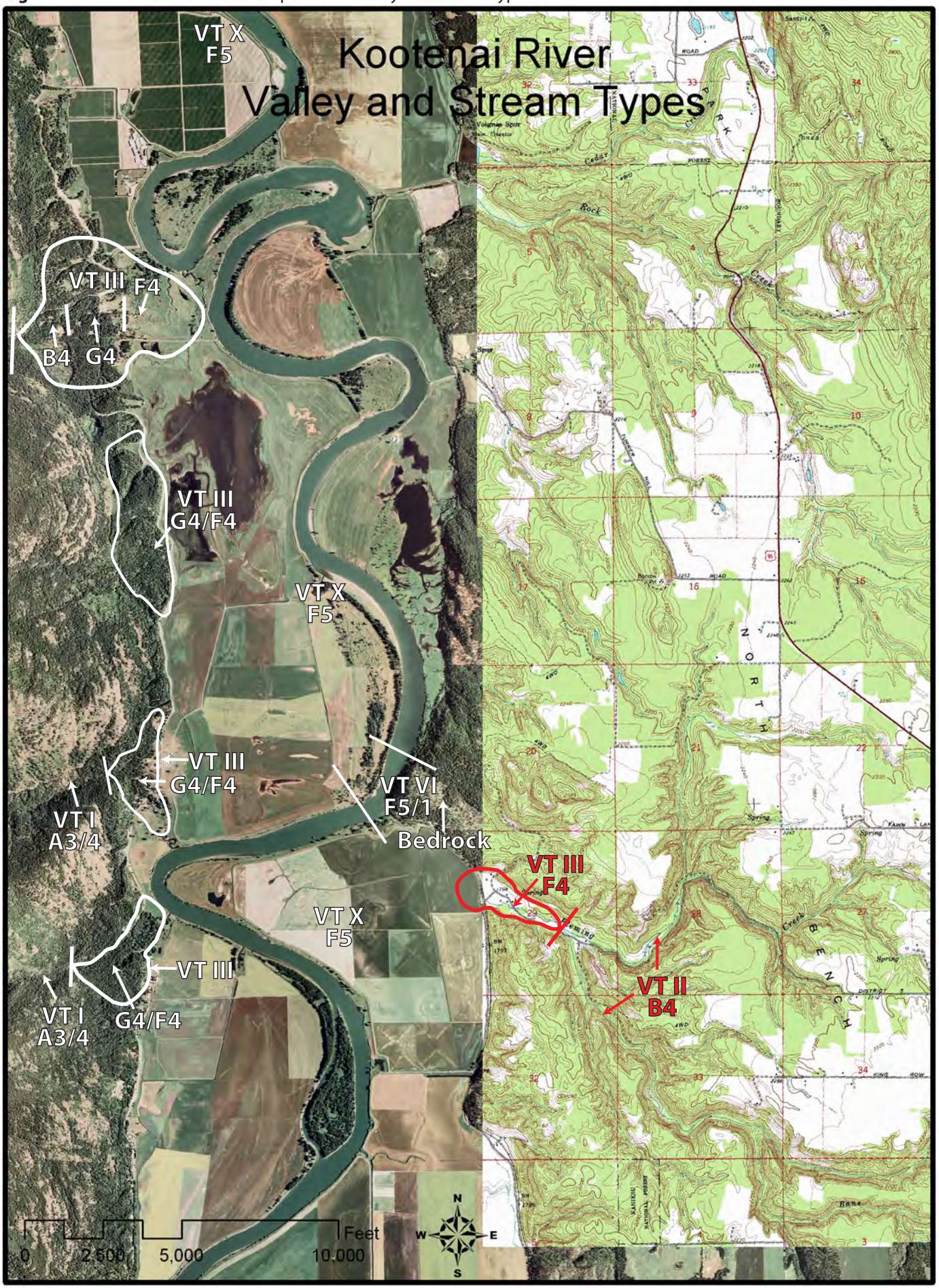


Figure I-6a. Kootenai River topographic depiction of valley and stream types.

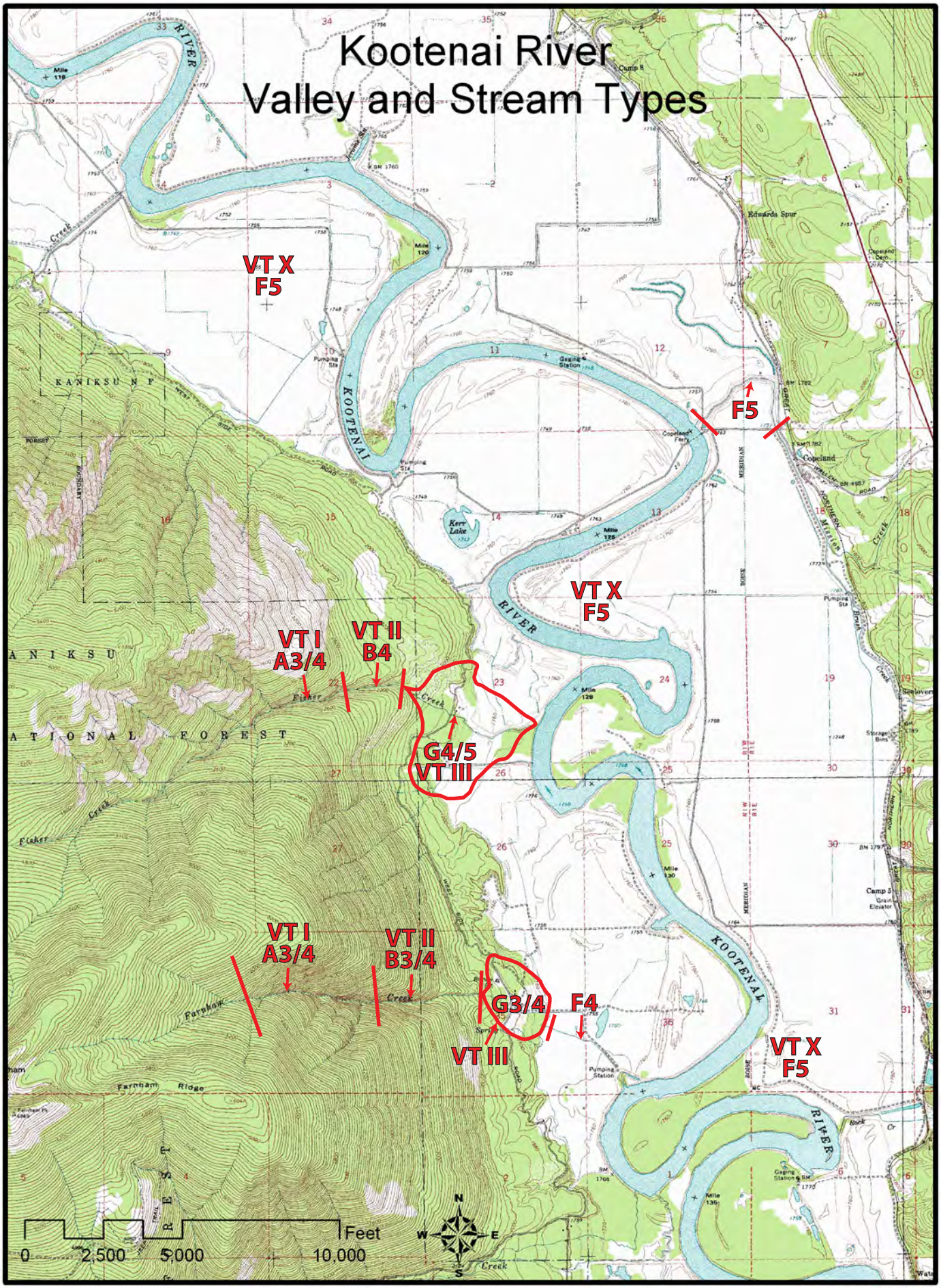


Figure I-6b. Kootenai River aerial depiction of valley and stream types.

Figure I-7a. Kootenai River topographic depiction of valley and stream types.

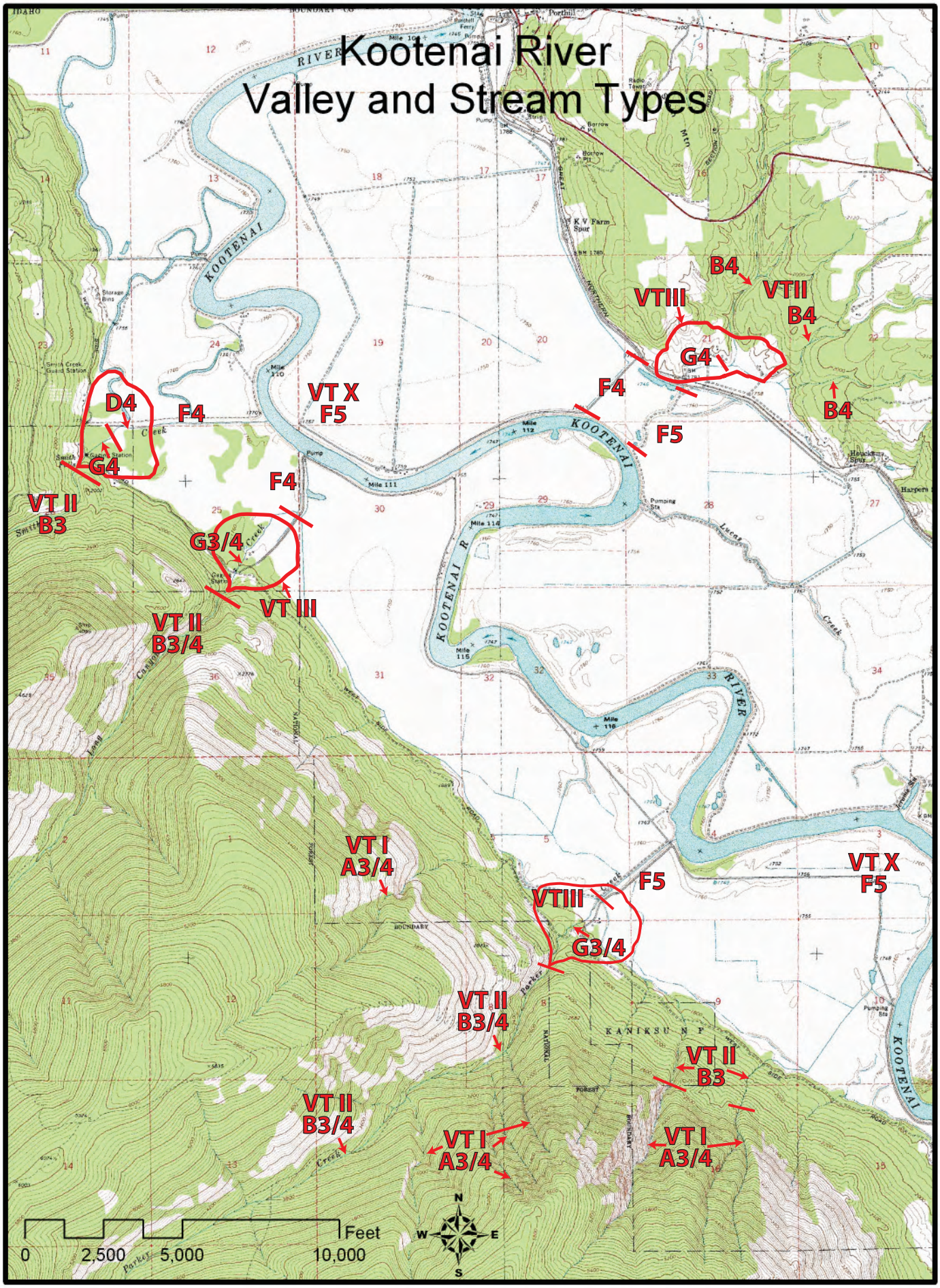
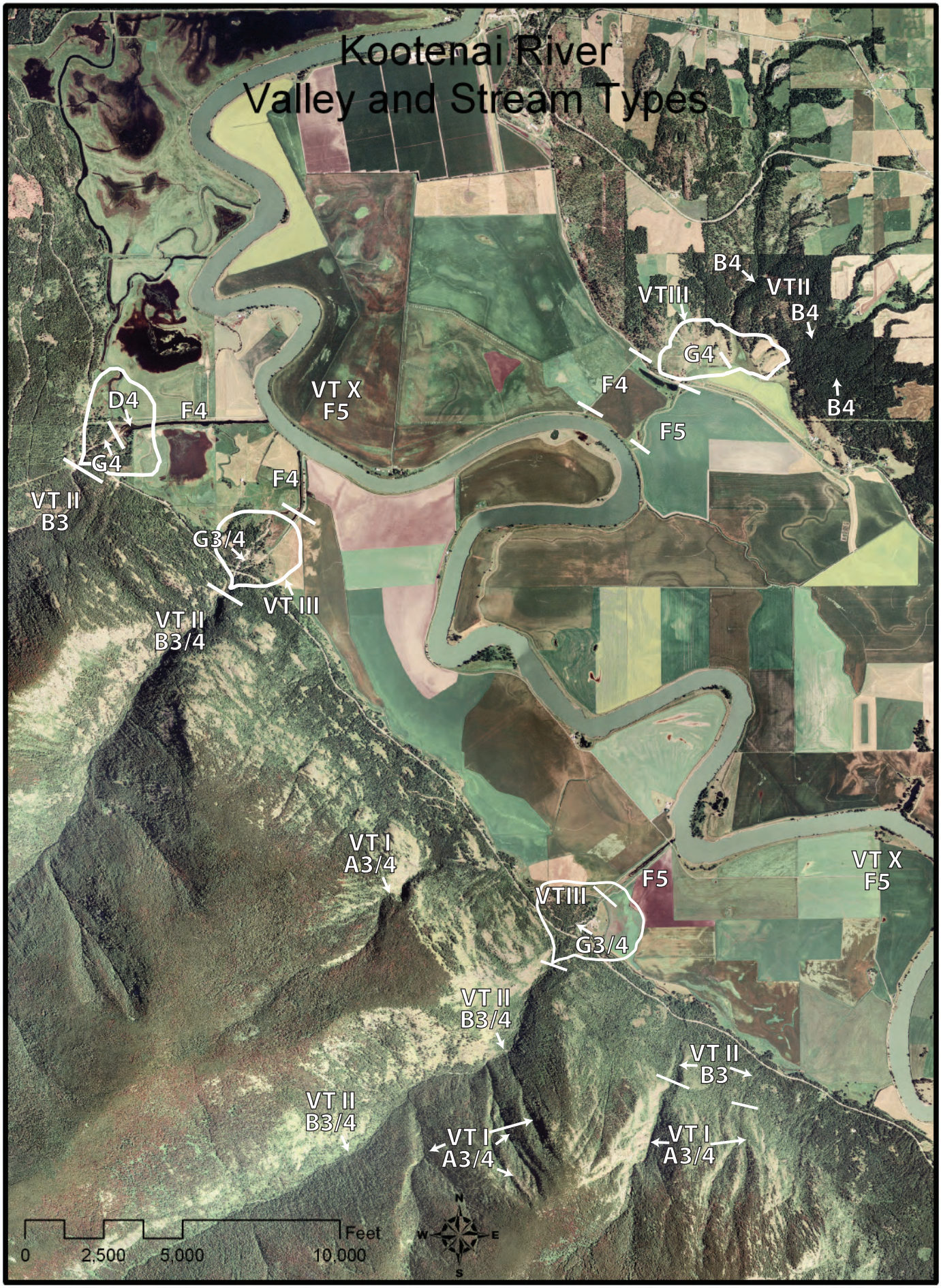


Figure I-7b. Kootenai River aerial depiction of valley and stream types.



Appendix II

Valley Types (Rosgen, 1996)

Valley Types

The stability and activity of a stream is dependent on location or valley type. **Table II-1** summarizes valley types and associated characteristics (Rosgen, 1996, 2006).

Table II-1. Valley types used in the geomorphic characterization (Rosgen, 1996, 2006).

Valley Types	Summary Description of Valley Types
I	Steep, confined, "V" notched canyons, rejuvenated side-slopes
II	Moderately steep, gentle-sloping side-slopes often in colluvial valleys
III	Alluvial fans and debris cones
IV	Gentle gradient canyons, gorges and confined alluvial and bedrock-controlled valleys
V	Moderately steep, "U" shaped glacial-trough valleys
VI	Moderately steep, fault, joint or bedrock (structural) controlled valleys
VII	Steep, fluvial dissected, high-drainage density alluvial slopes
VIII	Wide, gentle valley slope with well-developed floodplain adjacent to river and/or glacial terraces; alluvial valley fills
IX	Broad, moderate to gentle slopes, associated with glacial outwash and/or eolian sand dunes
X	Very broad and gentle valley slope, associated with glacio- and nonglacio-lacustrine deposits
XI	Deltas

The following Valley Type descritpions are extracted from Rosgen (1996, pp. 4-12 to 4-22). Note that Figure numbering has been changed from original publication.

Valley Morphology Related to Stream Types

Valley Type I

A Type I valley is V-shaped, confined, and is often structurally controlled and/or associated with faults. Elevational relief is high, valley floor slopes are greater than 2 percent, and landforms may be steep, glacial scoured lands, and/or highly dissected fluvial slopes. Valley materials vary from bedrock to residual soils occurring as colluvium, landslide debris, glacial tills, and other similar depositional materials. Stream types commonly observed in Valley Type I include types "A" and "G," which are typically step/pool channels with steeper channel slopes exhibiting cascade bed features. Stream channel erosional processes vary from very low and stable to highly erodible, producing debris torrents or avalanches. Often the "A" stream types in certain hydro-physiographic provinces are the starting or conveyance zones for snow avalanches. Examples of Valley Type I are shown in **Figure II-1a** and illustrated in **Figure II-1b**.

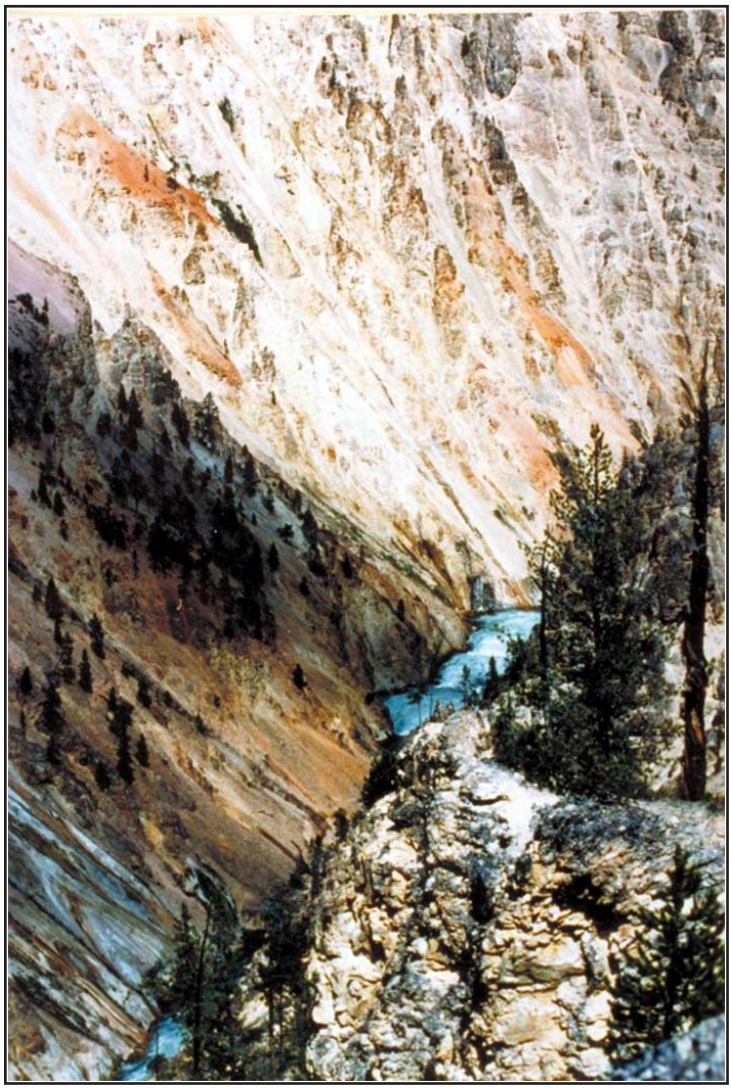


Figure II-1a. Valley Type I, "V" notched canyons, rejuvenated side slopes (A and G stream types) (Rosgen, 1996).

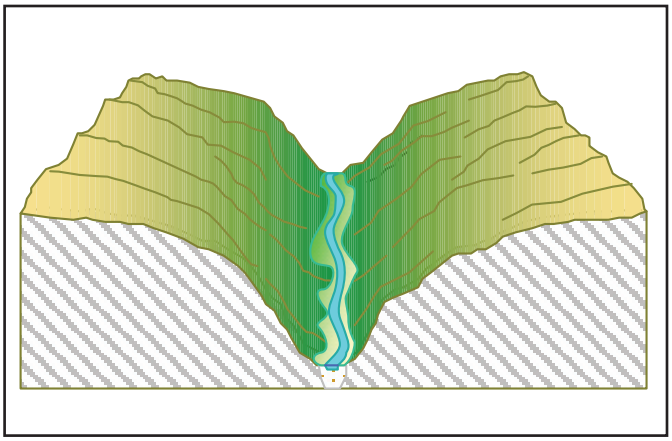


Figure II-1b. Valley Type I, "V" notched canyons, rejuvenated side slopes (Rosgen, 1996).

Valley Type II

Valley Type II exhibits moderate relief, relatively stable, moderate side slope gradients, and valley floor slopes that are often less than 4 percent with soils developed from parent material (residual soils), alluvium, and colluvium. Cryoplanated uplands dominated by colluvial slopes are typical of the land-types that generally comprise Valley Type II in the northern Rocky Mountains. The stream type most commonly found in Valley Type II are the "B" types, which are generally stable stream types, with a low sediment supply and bed features normally described as "rapids." Less common are "G" stream types that are observed generally under disequilibrium conditions. Examples of Valley Type II are shown in **Figure II-2a** and the illustration in **Figure II-2b**.

Figure II-2a. Valley Type II, moderately steep, gentle sloping side slopes often in colluvial valleys (B stream types) (Rosgen, 1996).

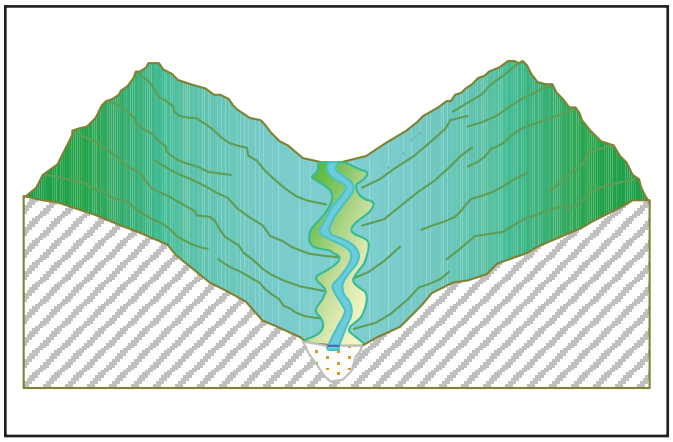


Figure II-2b. Valley Type II, moderately steep, gentle sloping side slopes often in colluvial valleys (Rosgen, 1996).

Valley Type III

Valley Type III is primarily depositional in nature with characteristic debris-colluvial or alluvial fan landforms, and valley-floor slopes that are moderately steep or greater than 2 percent. Stream types normally occurring in Valley type III are the "A," "B," "G," and "D" types. The "B" stream type, which is less common on alluvial or colluvial fans, occurs primarily on "non-building" stable fans and where riparian vegetation is well established along the drainage-way. The "G" stream type prevails where there is little established riparian vegetation in the presence of high bedload transport on actively "building" fans, similar to the multiple distributary channels of the "D" stream type. Examples of Valley Type III are shown in **Figure II-3a** and the illustration in **Figure II-3b**.

Figure II-3a. Valley Type III, alluvial fans and debris cones (A, G, D and B stream types (Rosgen, 1996).

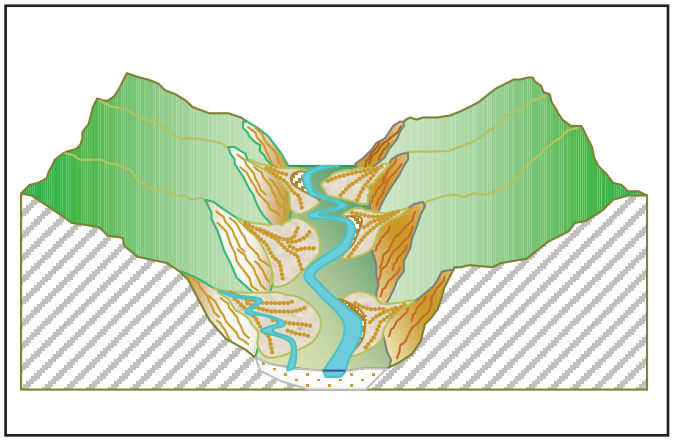


Figure II-3b. Valley Type III, alluvial fans and debris cones (Rosgen, 1996).

Valley Type IV

Valley Type IV consists of the classic meandering, entrenched or deeply incised, and confined landforms directly observed as canyons and gorges with gentle elevation relief and valley-floor gradients often less than 2 percent. Valley Type IV is generally structurally controlled and incised in highly weathered materials. These stream types are also often associated with tectonically "uplifted" valleys. The "F" stream type is most often found in Valley Type IV; however, where the width of the valley floor accommodates both the channel and a floodplain, C channels are often observed. Depending on streamside materials, the sediment supply is generally moderate to high. Examples of Valley Type IV are shown in **Figure II-4a** and the illustration in **Figure II-4b**.

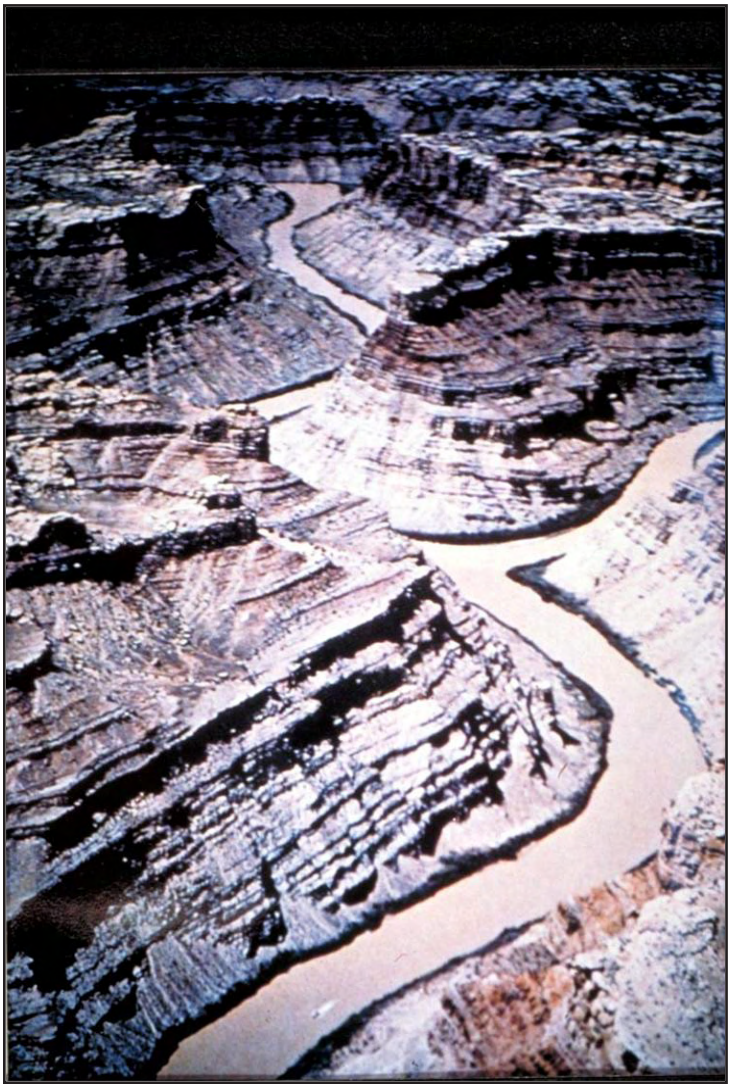


Figure II-4a. Valley Type IV, gentle gradient canyons, gorges and confined alluvial valleys (F or C stream types) (Rosgen, 1996).

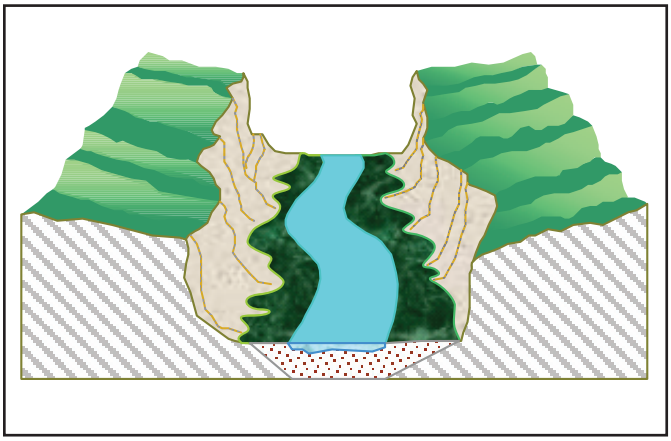


Figure II-4b. Valley Type IV, gentle gradient canyons, gorges and confined alluvial valleys (Rosgen, 1996).

Valley Type V

Valley Type V is the product of a glacial scouring process where the resultant trough is now a wide, "u-shaped" valley, with valley-floor slopes generally less than 4 percent. Soils are derived from materials deposited as moraines or more recent alluvium from the Holocene period to the present. Landforms locally include lateral and terminal moraines, alluvial terraces, and floodplains. Deep, coarse deposition of glacial till is common, as are glacio-fluvial deposits, with the finer size mixture of glacio-lacustrine deposition above structurally controlled reaches. The stream types most often seen in Valley Type V are "C," "D," and "G." Examples of Valley Type V are shown in **Figure II-5a** and the illustration in **Figure II-5b**.

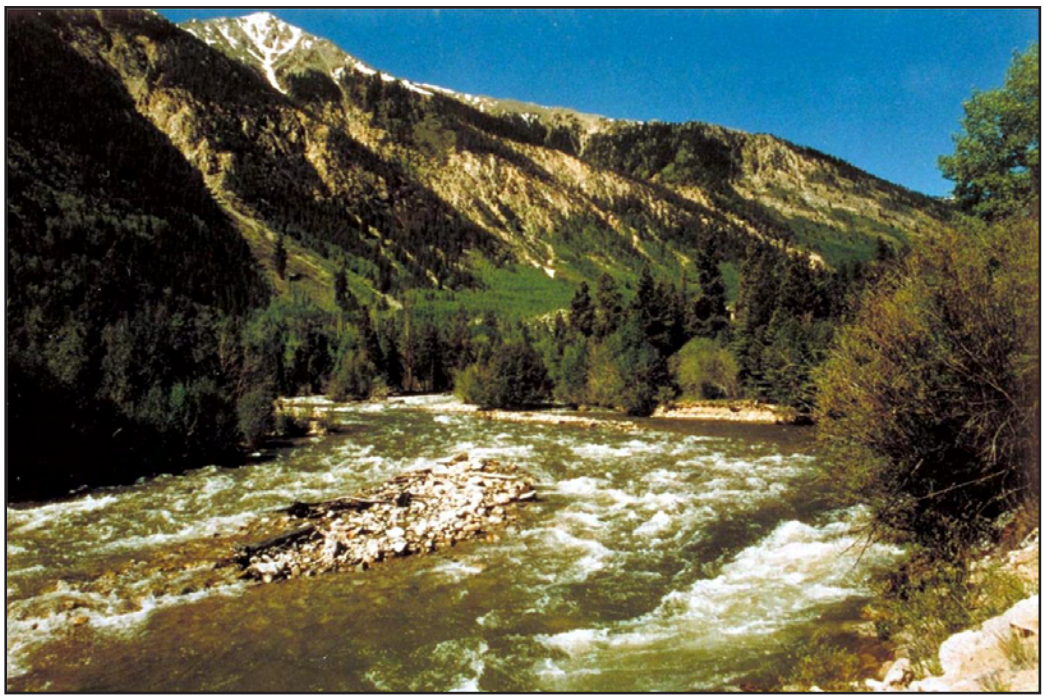


Figure II-5a. Valley Type V, moderately steep valley slopes, "U" shaped glacial trough valleys (D and C stream types) (Rosgen, 1996).

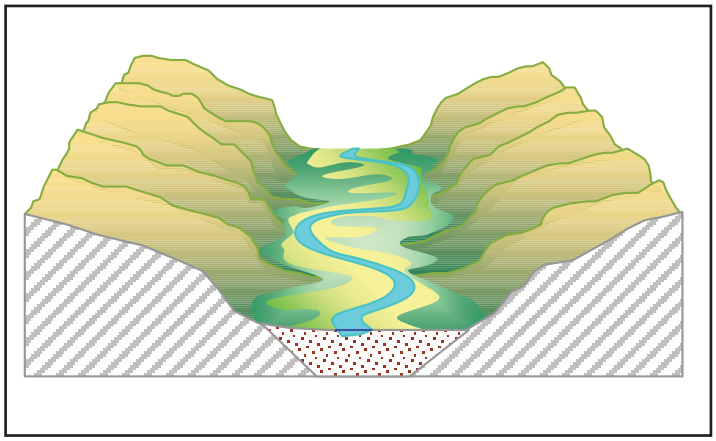


Figure II-5b. Valley Type V, moderately steep valley slopes, "U" shaped glacial trough valleys (Rosgen, 1996).

Valley Type VI

Valley Type VI, termed a fault-line valley, is structurally controlled and dominated by bedrock and/or colluvial slope building processes. The valley-floor gradients are moderate, often less than 4 percent, but can be steep. Some alluvium occurs amidst the extensive colluvial deposits and stream patterns are controlled by the confined, laterally controlled valley. Sediment supply is low. Stream types are predominantly "B" types with fewer occasions of "C" and "F" types in the wider and flatter valley reaches. Under steeper gradients, "A" and "G" stream types are observed. Examples of Valley Type VI are shown in **Figure II-6a** and the illustration in **Figure II-6b**.

Figure II-6a. Valley Type VI, moderately steep, fault controlled valleys (B, G and C stream types) (Rosgen, 1996).

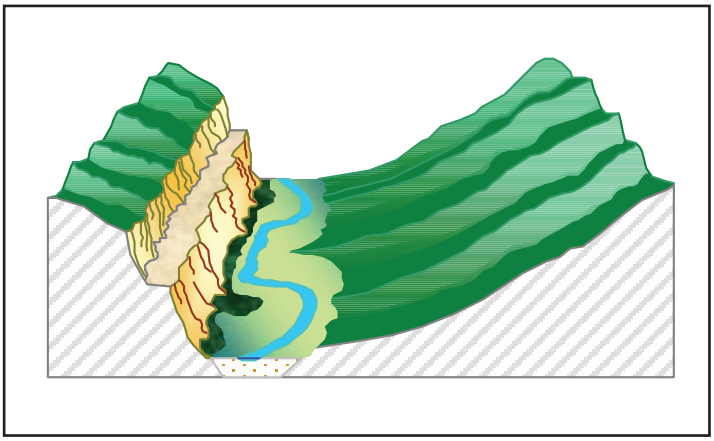


Figure II-6b. Valley Type VI, moderately steep, fault controlled valleys (Rosgen, 1996).

Valley Type VII

Valley Type VII consists of a steep to moderately steep landform, with highly dissected fluvial slopes, high drainage density, and a very high sediment supply. Streams are characteristically deeply incised in either colluvium and alluvium or in residual soils. The residual soils are often derived from sedimentary rocks such as marine shale. Depositional soils associated with these highly dissected slopes can often be eolian deposits of sand and/or marine sediments. This valley type can be observed over a variety of locations, from the provinces of the Palouse Prairie of Idaho, the Great Basin or high deserts of Nevada and Wyoming, the Sand Hills of Nebraska, to the Badlands of the Dakotas. The majority of stream types found in Valley Type VII are the "A" and "G" types, which are channels that have moderate to steep gradients, are entrenched (deeply incised), confined, and unstable due to the active lateral and vertical accretion processes. Examples of Valley Type VII are shown in **Figure II-7a** and the illustration in **Figure II-7b**.

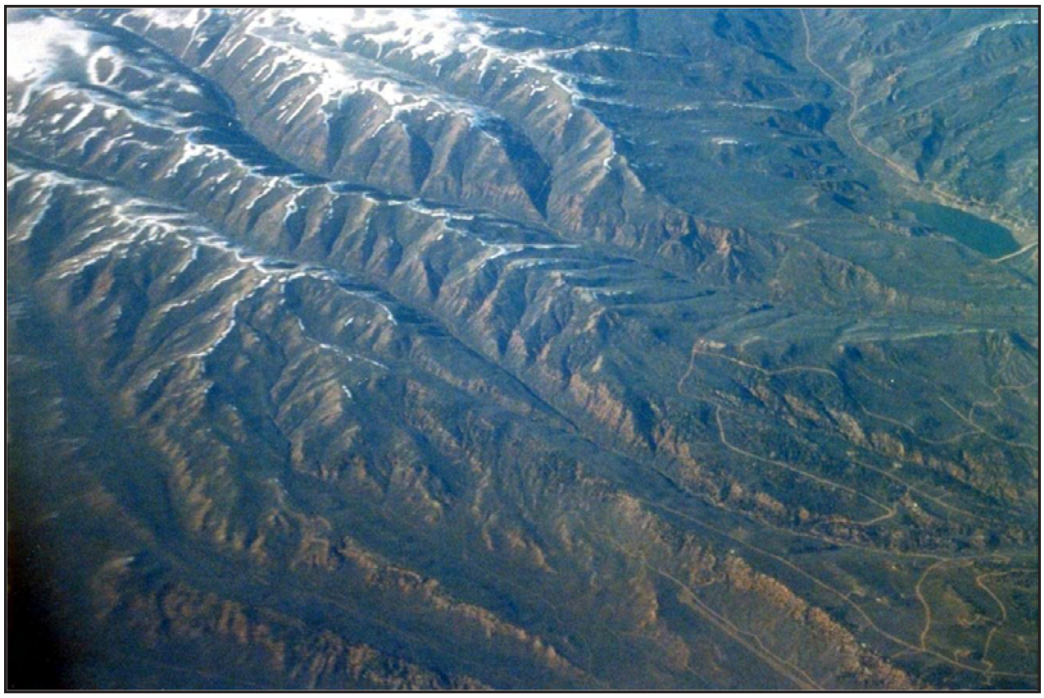


Figure II-7a. Valley Type VII, steep, highly dissected fluvial slopes (A and G stream types) (Rosgen, 1996).

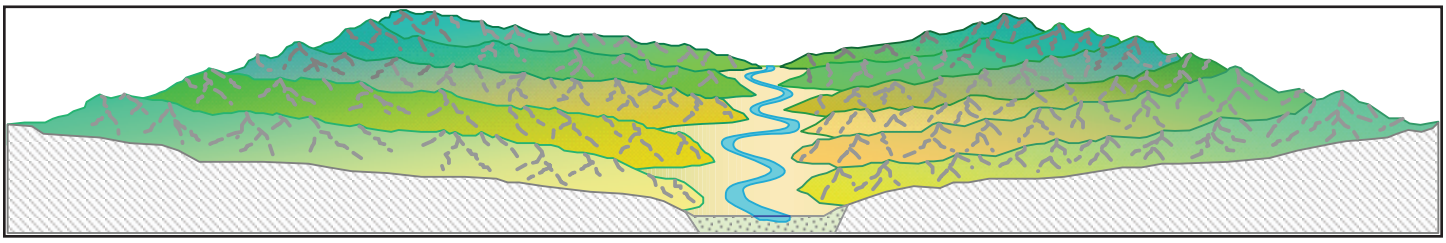


Figure II-7b. Valley Type VII, steep, highly dissected fluvial slopes (Rosgen, 1996).

Valley Type VIII

Valley type VIII is most readily identified by the presence of multiple river terraces positioned laterally along broad valleys with gentle, down-valley elevation relief. Alluvial terraces and floodplains are the predominant depositional landforms, which produce a high sediment supply. Glacial terraces can also occur in these valleys but stand much higher above the present river than the alluvial (Holocene) terraces. Soils are developed predominantly over alluvium originating from combined riverine and lacustrine depositional processes. Stream types "C" or "E," which have slightly entrenched, meandering channels that develop a riffle/pool bed-form, are normally seen in the Type VIII valley. However, "D," "F," and "G" stream types can also be found, depending on local stream and riparian conditions. Examples of Valley Type VIII are shown in **Figure II-8a** and the illustration in **Figure II-8b**.

Figure II-8a. Valley Type VIII, wide, gentle valley slope with a well developed floodplain adjacent to river terraces (Rosgen, 1996).

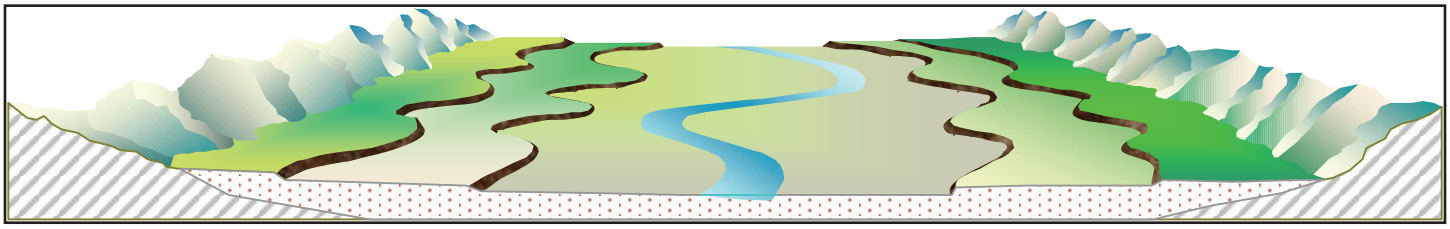


Figure II-8b. Valley Type VIII, wide, gentle valley slope with a well developed floodplain adjacent to river terraces (Rosgen, 1996).

Valley Type IX

Valley Type IX is observed as glacial outwash plains and/or dunes, where soils are derived from glacial, alluvial, and/or eolian deposits. Due to the depositional nature of the developed landforms, sediment supply is high, and the commonly occurring "C" and "D" stream types are associated with high rates of lateral migration. Examples of Valley Type IX are shown in **Figure II-9a** and the illustration in **Figure II-9b**.

Figure II-9a. Valley Type IX, broad, moderate to gentle slopes, associated with glacial outwash and/or eolian sand dunes (predominately D and some C stream types) (Rosgen, 1996).

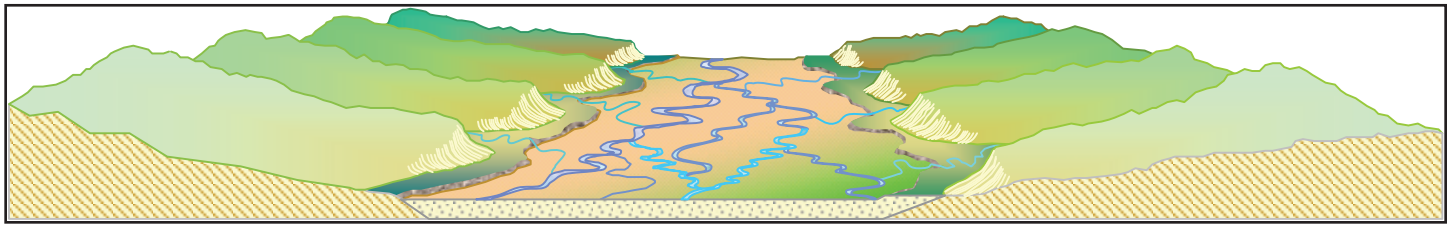


Figure II-9b. Valley Type IX, broad, moderate to gentle slopes, associated with glacial outwash and/or eolian sand dunes (Rosgen, 1996).

Valley Type X

Valley Type X is very wide with very gentle elevation relief and is mostly constructed with alluvial materials originating from both riverine and lacustrine deposition processes. Soils are primarily alluvium, and while less common, may also be derived from eolian deposition. Landforms commonly observed as Valley Type X are coastal plains, broad lacustrine and/or alluvial flats, which may exhibit peat bogs and expansive wetlands. Stream types "C," "E," and "DA" are the most commonly observed, although in many instances, where streams have been "channelized" or the local base level has been changed, "G" and "F" stream types are found. Examples of Valley Type X are shown in **Figure II-10a** and the illustration in **Figure II-10b**.

Figure II-10a. Valley Type X, very broad and gentle slopes, associated with extensive floodplains - Great Plains, semi-desert and desert provinces; coastal plains and tundra (Rosgen, 1996).

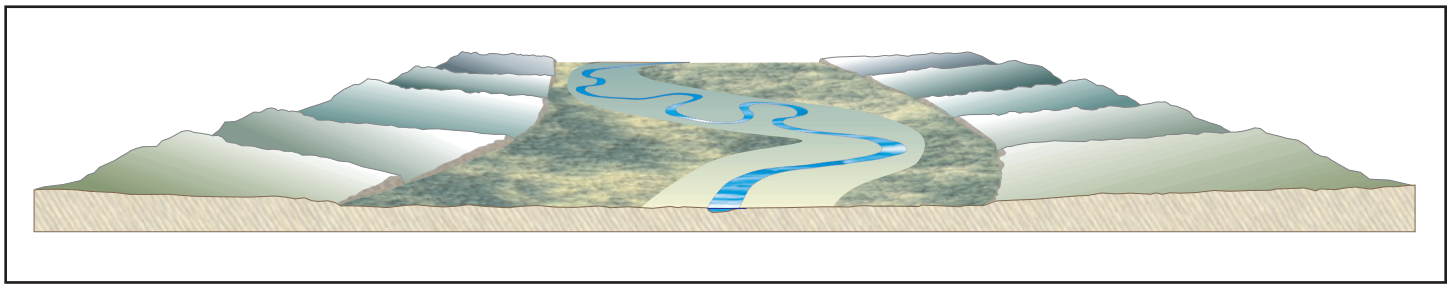


Figure II-10b. Valley Type X, very broad and gentle slopes, associated with extensive floodplains - Great Plains, semi-desert and desert provinces; coastal plains and tundra (Rosgen, 1996).

Valley Type XI

Valley type XI is a unique series of landforms consisting of large river deltas and tidal flats constructed of fine alluvial materials originating from riverine and estuarine depositional processes. The Type XI valleys or delta areas are often seen as freshwater and saltwater marshes, natural levees, and crevasse splays. There are four morphologically distinct delta areas, initially described by Fischer *et al*. (1969), which produce different stream types or patterns and include: the elongated, high-constructive delta (**Figure II-11**); the lobate, high constructive delta (**Figure II-12**); the wave-dominated, high destructive delta (**Figure II-13**); and the tide-dominated, high-constructive delta (**Figure II-14**). An additional delta landform is presented here, representative of extensive wetlands, peat, and cohesive sediments with multiple, stable channels typical of the "DA" (anastomosed) stream type (**Figure II-15**).

The corresponding stream types found in delta areas are primarily the distributary channels of stream type "DA," or the multiple channel systems of the "D" stream type, along with occasional "C" and "E" stream types. The "DA" stream type is more common to the delta landforms shown in **Figure II-15**, which are the tide-dominated, stable deltas with numerous wetland islands, and the base level of the channel system controlled by either lake or sea levels.

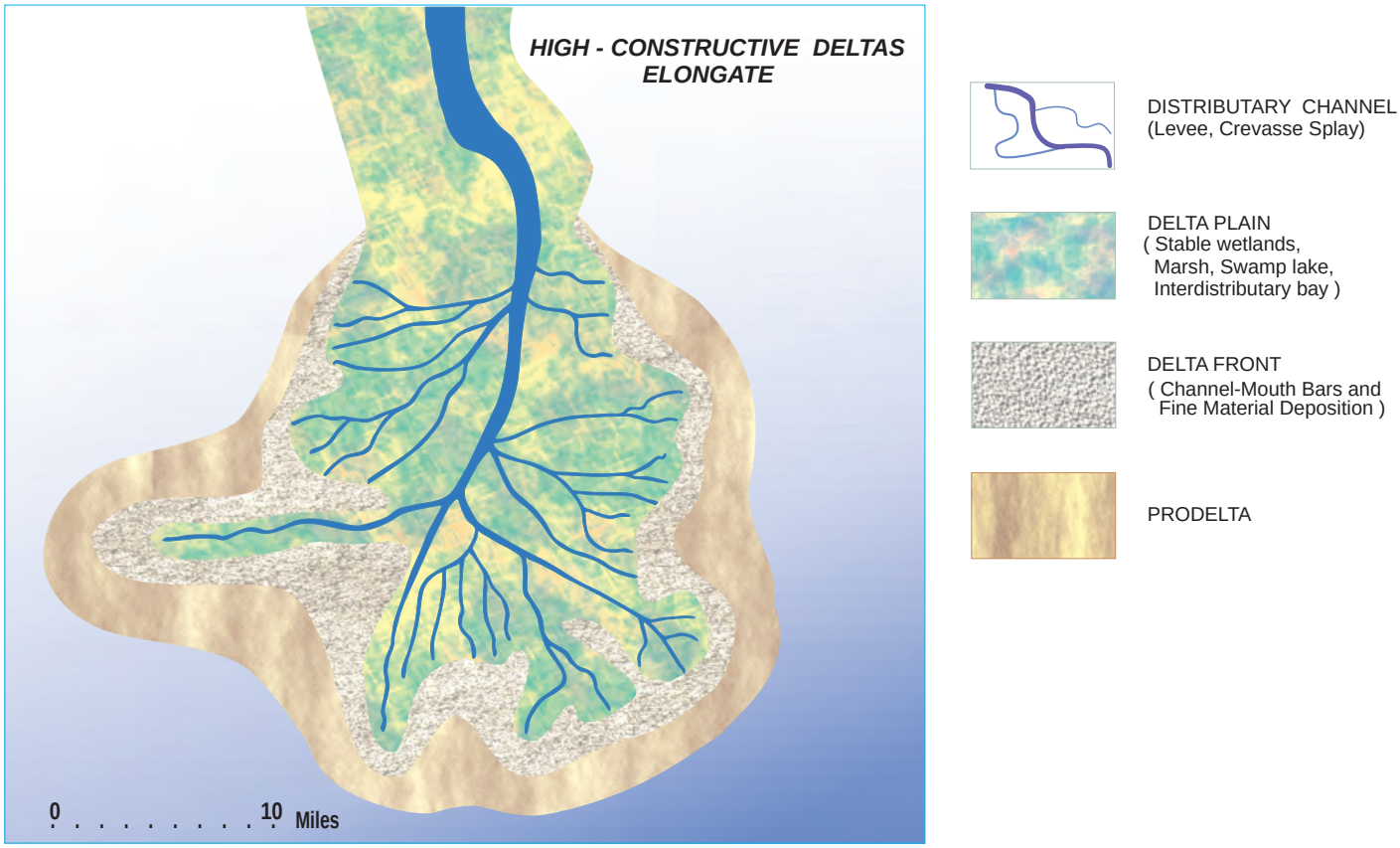


Figure II-11. Valley Type XI, Deltas - elongated, highly constructive delta with a distributary channel system (adapted from Fisher *et al*., 1969; Rosgen, 1996).

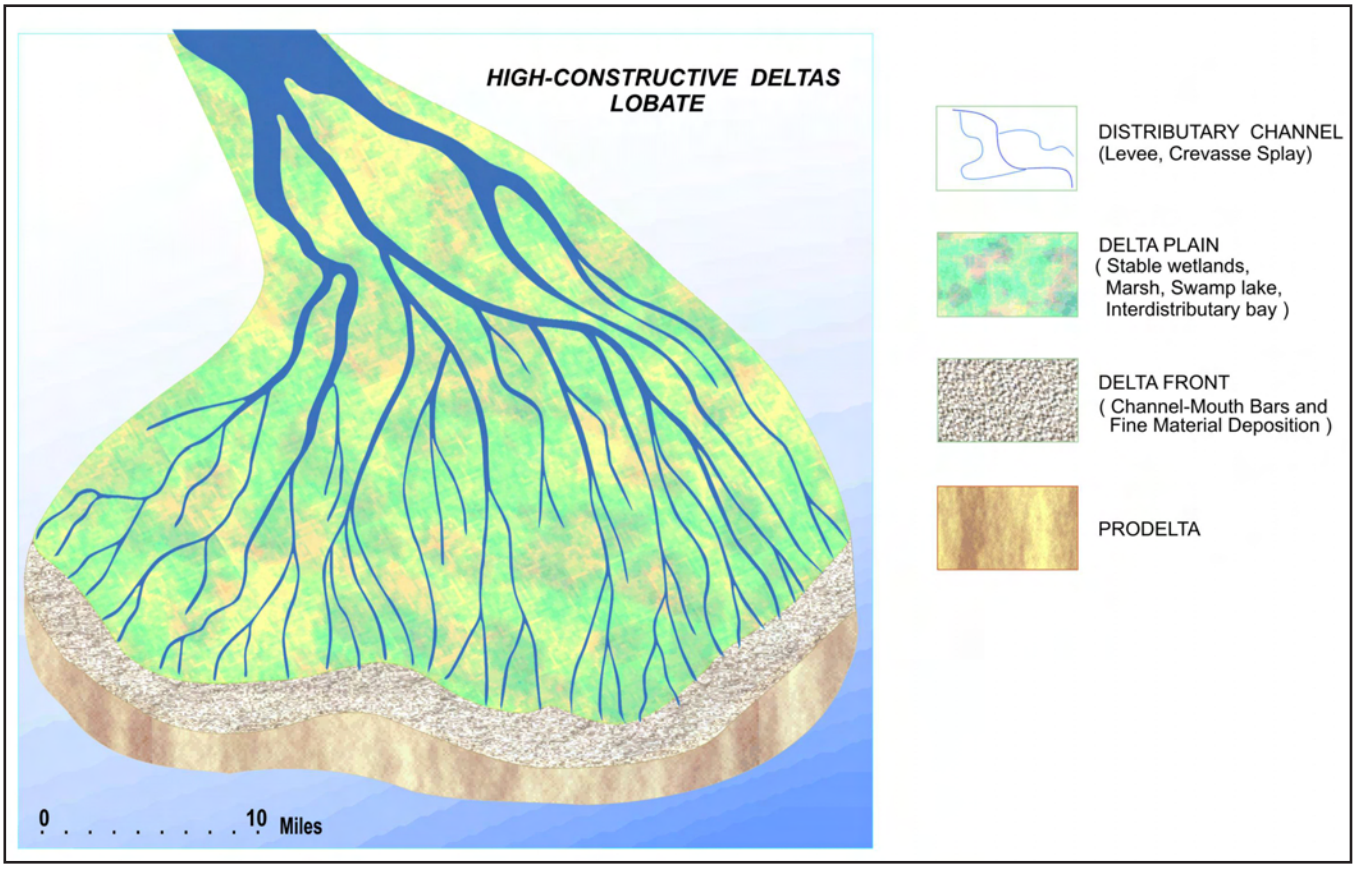


Figure II-12. Valley Type XI, Deltas - highly constructive deltas with a lobate configuration and distributary channel system (adapted from Fisher *et al*., 1969; Rosgen, 1996).

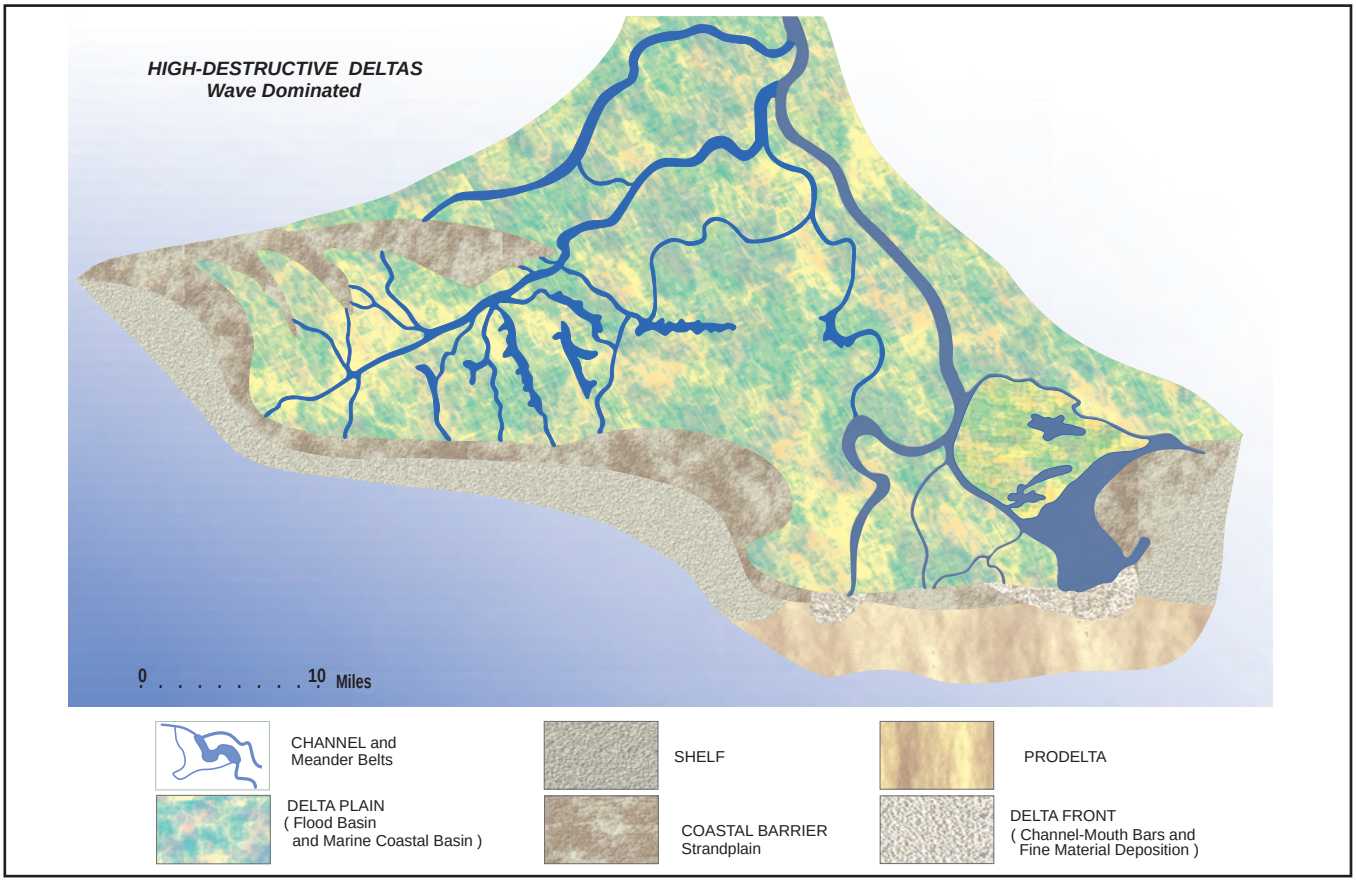


Figure II-13. Valley Type XI, Deltas - highly destructive, wave-dominated delta (adapted from Fisher *et al*., 1969; Rosgen, 1996).

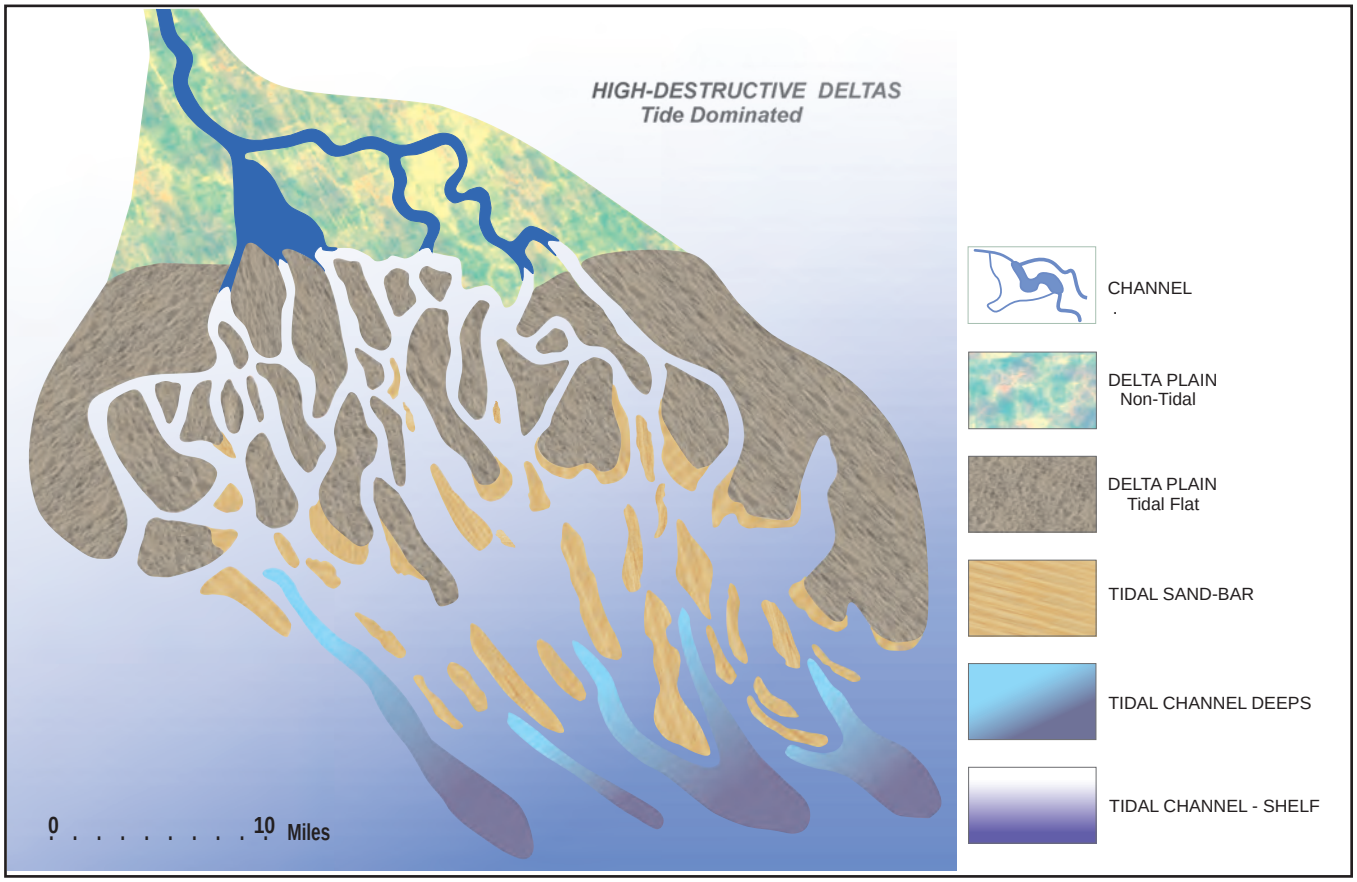


Figure II-14. Valley Type XI, Deltas - highly destructive, tide-dominated delta (adapted from Fisher *et al*., 1969; Rosgen, 1996).

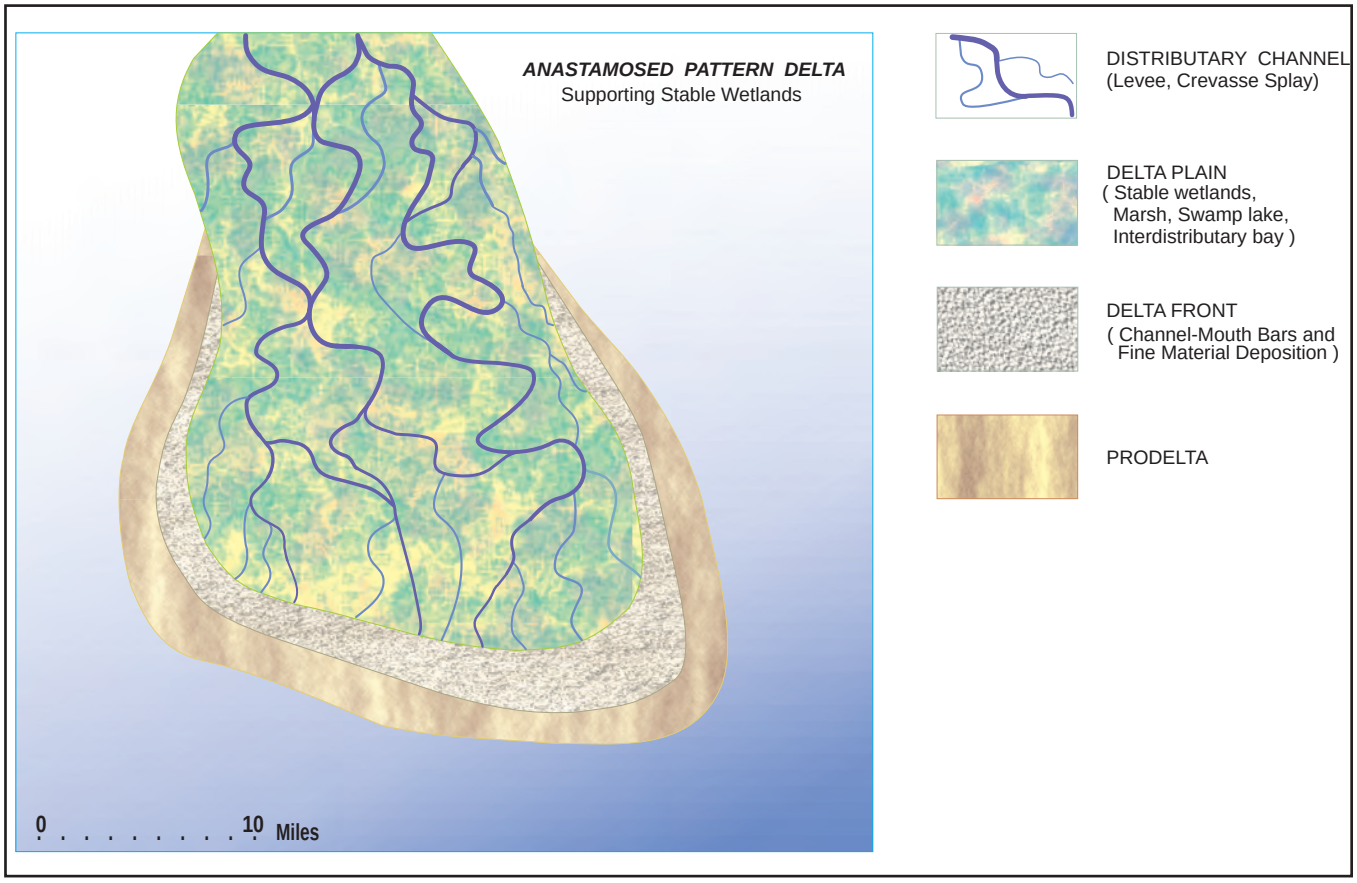


Figure II-15. Valley Type XI, Deltas - anastomosed river delta pattern with supporting stable wetlands and channels (adapted from Fisher *et al*., 1969; Rosgen, 1996).

Appendix III

Stream Classification (Rosgen, 1994, 1996)

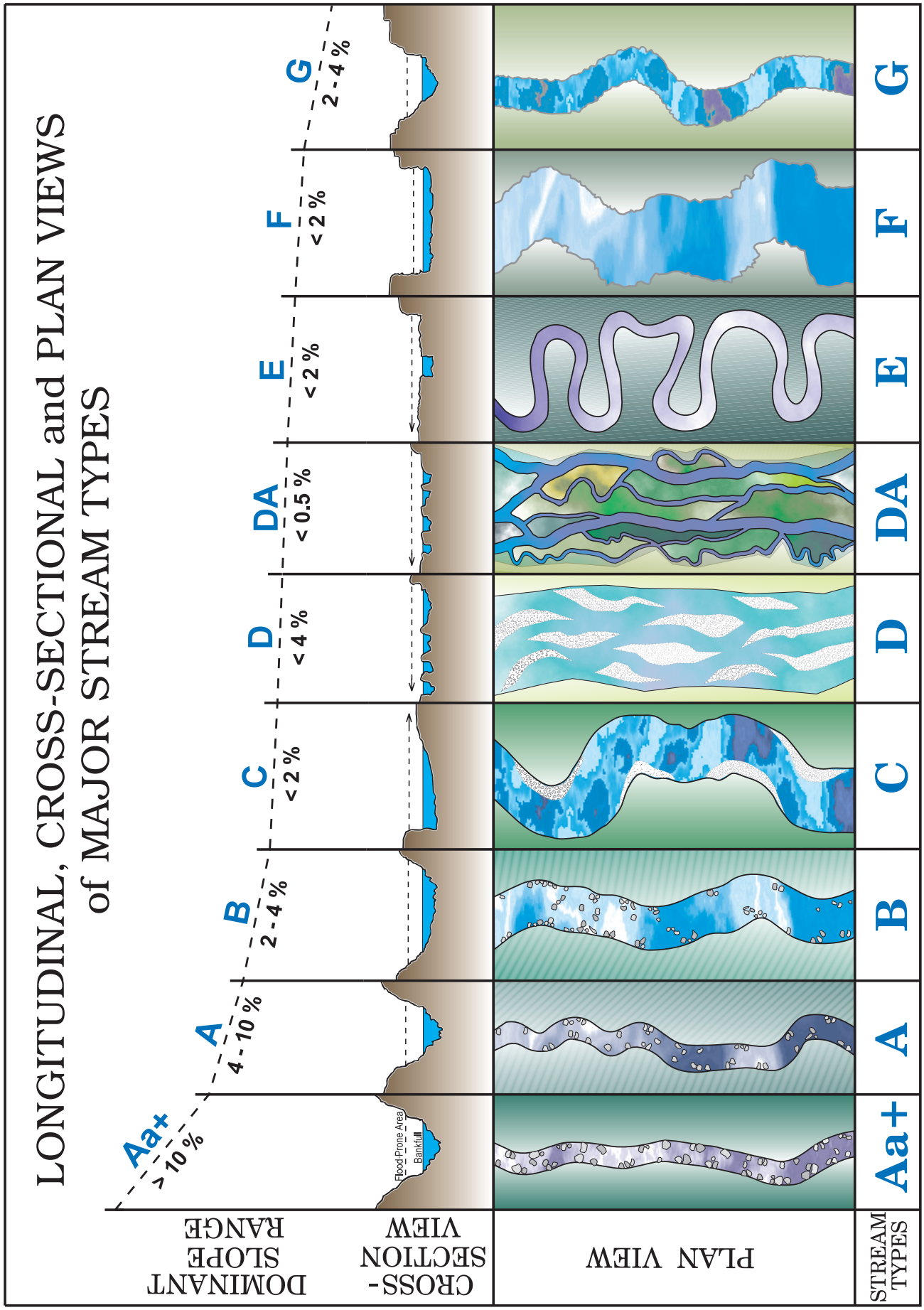
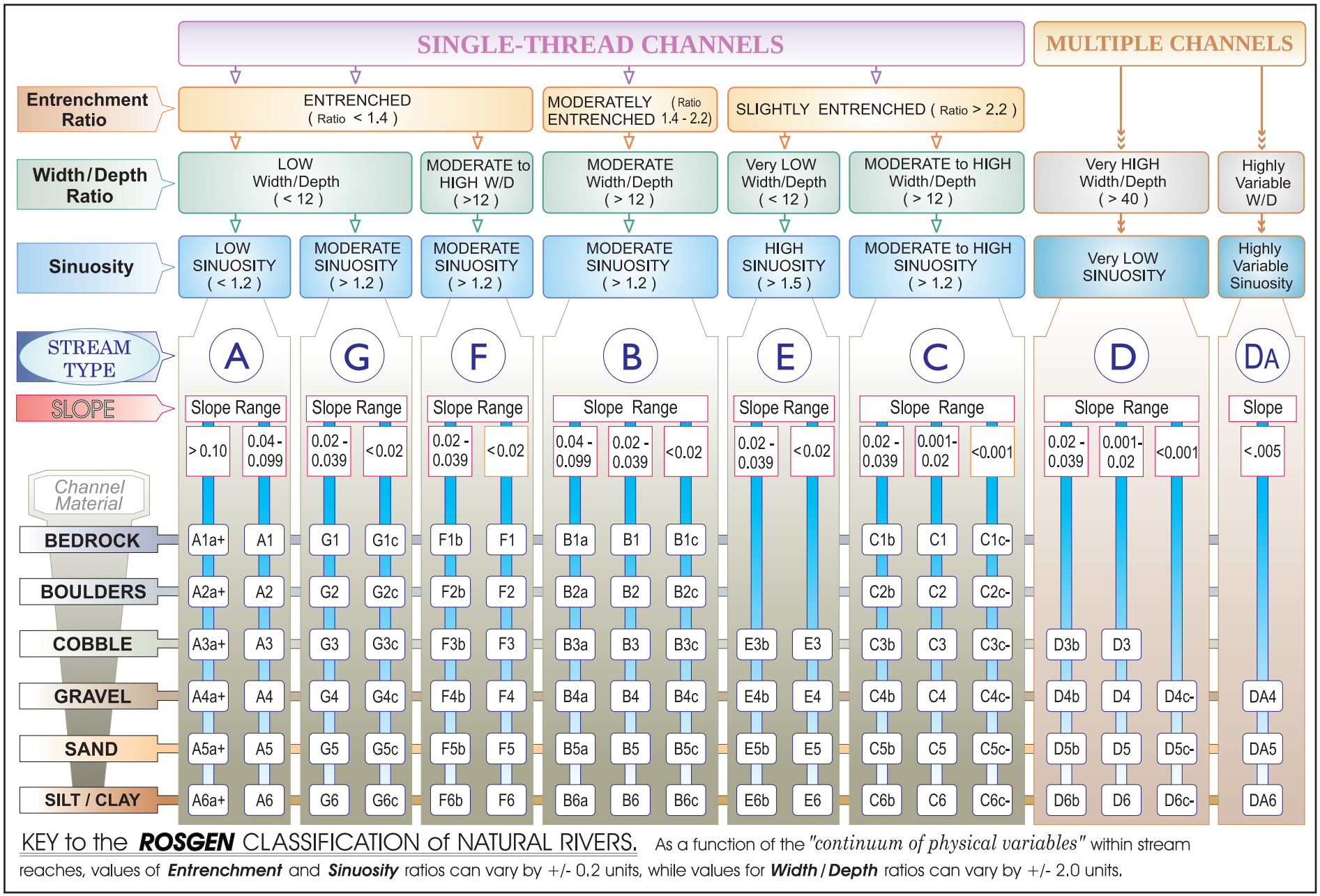


Figure III-1. Broad-level stream classification delineation showing longitudinal, cross-sectional and plan views of major stream types (Rosgen, 1994, 1996).

Table III-1. General stream type descriptions and delineative criteria for broad-level classification (Rosgen, 1994, 1996).

Stream Type	General Description	Entrench-ment Ratio	W/D Ratio	Sinuosity	Slope	Landform / Soils / Features
Aa+	Very steep, deeply entrenched, debris transport, torrent streams.	<1.4	<12	1.0 to 1.1	>0.10	Very high relief. Erosional, bedrock or depositional features; debris flow potential. Deeply entrenched streams. Vertical steps with deep scour pools; waterfalls.
A	Steep, entrenched, cascading, step/pool streams. High energy/debris transport associated with depositional soils. Very stable if bedrock- or boulder-dominated channel.	<1.4	<12	1.0 to 1.2	0.04 to 0.10	High relief. Erosional or depositional and bedrock forms. Entrenched and confined streams with cascading reaches. Frequently spaced, deep pools in associated step/pool bed morphology.
B	Moderately entrenched, moderate gradient, riffle-dominated channel, with infrequently spaced pools. Very stable plan and profile. Stable banks.	1.4 to 2.2	>12	>1.2	0.02 to 0.039	Moderate relief, colluvial deposition and/or structural. Moderate entrenchment and width/depth ratio. Narrow, gently sloping valleys. Rapids predominate with scour pools.
C	Low gradient, meandering, point bar, riffle/pool, alluvial channels with broad, well-defined floodplains.	>2.2	>12	>1.2	<0.02	Broad valleys with terraces, in association with floodplains, alluvial soils. Slightly entrenched with well-defined meandering channels. Riffle/pool bed morphology.
D	Braided channel with longitudinal and transverse bars. Very wide channel with eroding banks.	n/a	>40	n/a	<0.04	Broad valleys with alluvium, steeper fans. Glacial debris and depositional features. Active lateral adjustment with abundance of sediment supply. Convergence. Divergence of bed features, aggradational processes, high bedload and bank erosion.
DA	Anastomosing (multiple channels) narrow and deep with extensive, well-vegetated floodplains and associated wetlands. Very gentle relief with highly variable sinuosities and width/depth ratios. Very stable streambanks.	>2.2	Highly Variable	Highly Variable	<0.005	Broad, low-gradient valleys with fine alluvium and/or lacustrine soils. Anastomosed (multiple channel) geologic control creating fine deposition with well-vegetated bars that are laterally stable with broad wetland floodplains. Very low bedload, high washload sediment.
E	Low gradient, meandering riffle/pool stream with low width/depth ratio and little deposition. Very efficient and stable. High meander width ratio.	>2.2	<12	>1.5	<0.02	Broad valley/meadows. Alluvial materials with floodplains. Highly sinuous with stable, well-vegetated banks. Riffle/pool morphology with very low width/depth ratios.
F	Entrenched meandering riffle/pool channel on low gradients with high width/depth ratio.	<1.4	>12	>1.2	<0.02	Entrenched in highly weathered material. Gentle gradients with a high width/depth ratio. Meandering, laterally unstable with high bank erosion rates. Riffle/pool morphology.
G	Entrenched "gully" step/pool and low width/depth ratio on moderate gradients.	<1.4	<12	>1.2	<0.039	Gullies, step/pool morphology with moderate slopes and low width/depth ratio. Narrow valleys or deeply incised in alluvial or colluvial materials; i.e., fans or deltas. Unstable with grade control problems and high bank erosion rates.



KEY to the ***ROSGEN*** CLASSIFICATION of NATURAL RIVERS. As a function of the *"continuum of physical variables"* within stream reaches, values of ***Entrenchment*** and ***Sinuosity*** ratios can vary by +/- 0.2 units, while values for ***Width / Depth*** ratios can vary by +/- 2.0 units.

Figure III-2. Stream classification key for natural rivers (Rosgen, 1994, 1996).

Table III-3. Management interpretations of various stream types (Rosgen, 1994, 1996).

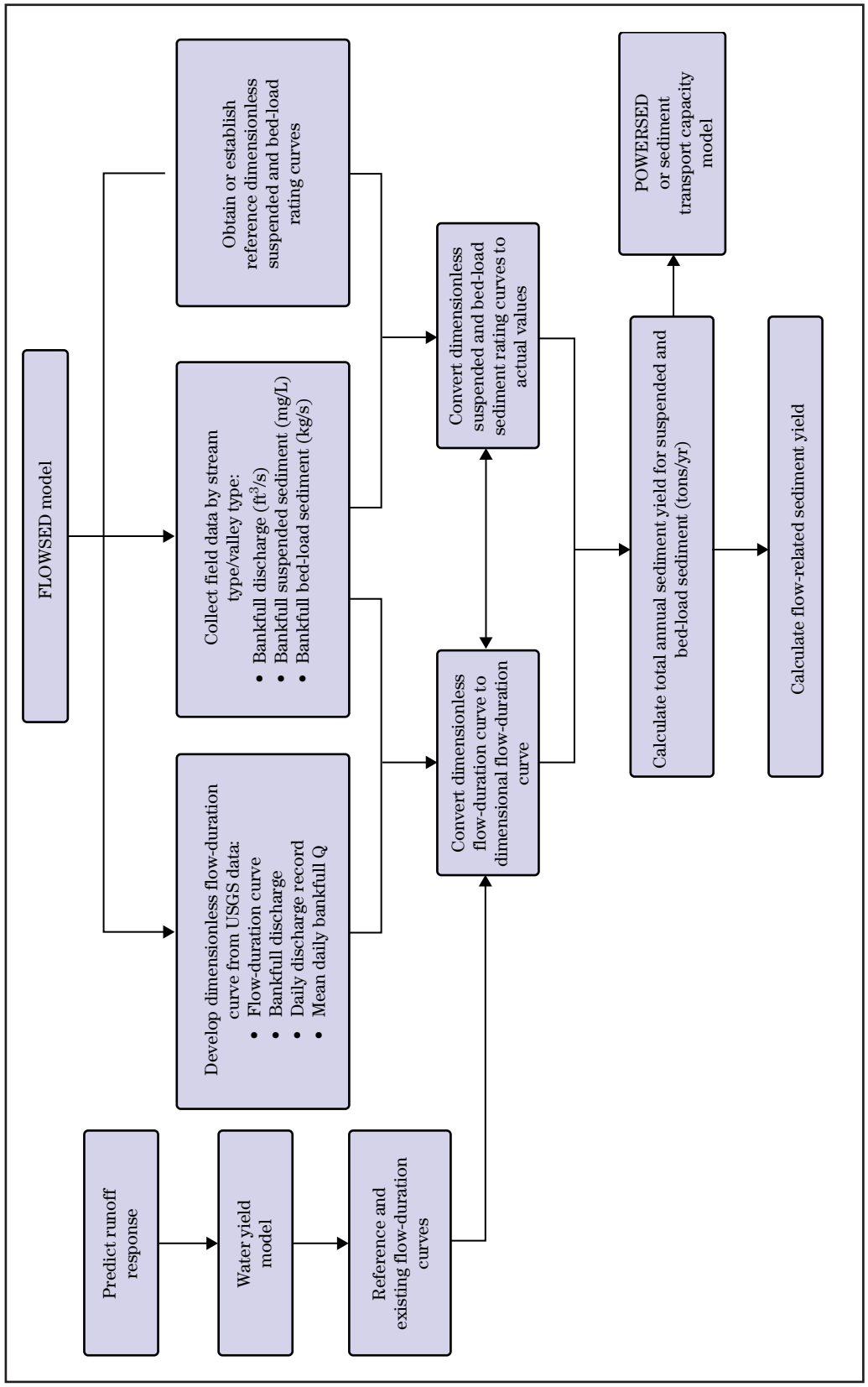
Stream Type	Sensitivity to Disturbance[a]	Recovery Potential[b]	Sediment Supply[c]	Streambank Erosion Potential	Vegetation Controlling Influence[d]
A1	very low	excellent	very low	very low	negligible
A2	very low	excellent	very low	very low	negligible
A3	very high	very poor	very high	very high	negligible
A4	extreme	very poor	very high	very high	negligible
A5	extreme	very poor	very high	very high	negligible
A6	high	poor	high	high	negligible
B1	very low	excellent	very low	very low	negligible
B2	very low	excellent	very low	very low	negligible
B3	low	excellent	low	low	moderate
B4	moderate	excellent	moderate	low	moderate
B5	moderate	excellent	moderate	moderate	moderate
B6	moderate	excellent	moderate	low	moderate
C1	low	very good	very low	low	moderate
C2	low	very good	low	low	moderate
C3	moderate	good	moderate	moderate	very high
C4	very high	good	high	very high	very high
C5	very high	fair	very high	very high	very high
C6	very high	good	high	high	very high
D3	very high	poor	very high	very high	moderate
D4	very high	poor	very high	very high	moderate
D5	very high	poor	very high	very high	moderate
D6	high	poor	high	high	moderate
DA4	moderate	good	very low	low	very high
DA5	moderate	good	low	low	very high
DA6	moderate	good	very low	very low	very high
E3	high	good	low	moderate	very high
E4	very high	good	moderate	high	very high
E5	very high	good	moderate	high	very high
E6	very high	good	low	moderate	very high
F1	low	fair	low	moderate	low
F2	low	fair	moderate	moderate	low
F3	moderate	poor	very high	very high	moderate
F4	extreme	poor	very high	very high	moderate
F5	very high	poor	very high	very high	moderate
F6	very high	fair	high	very high	moderate
G1	low	good	low	low	low
G2	moderate	fair	moderate	moderate	low
G3	very high	poor	very high	very high	high
G4	extreme	very poor	very high	very high	high
G5	extreme	very poor	very high	very high	high
G6	very high	poor	high	high	high

[a] Includes increases in streamflow magnitude and timing and/or sediment increases.
[b] Assumes natural recovery once cause of instabiilty is corrected.
[c] Includes supsended and bedload from channel derived sources and/or from stream adjacent slopes.
[d] Vegetation that influences width/depth ratio-stability.

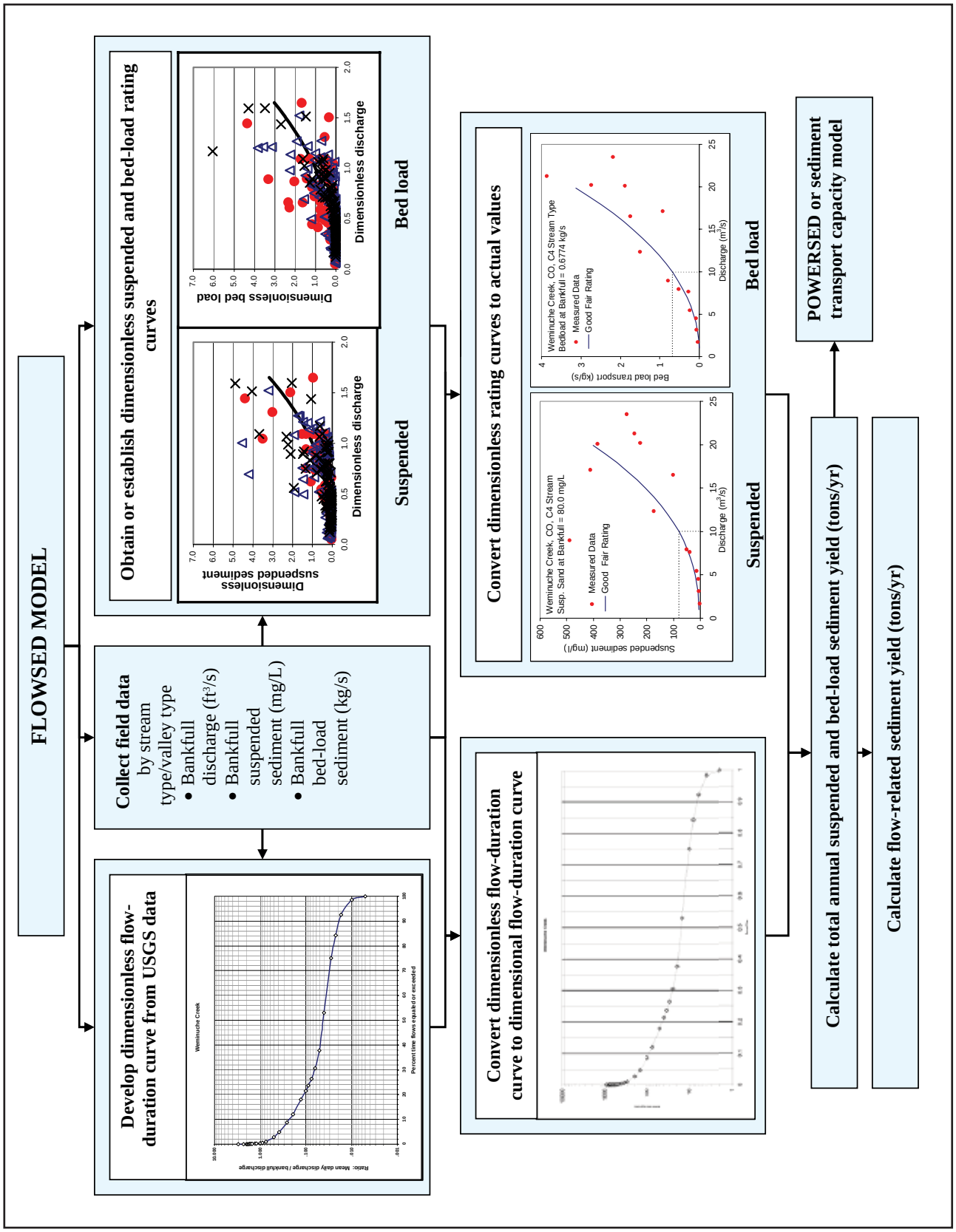
Appendix IV

FLOWSED/POWERSED: Sediment Transport Summary

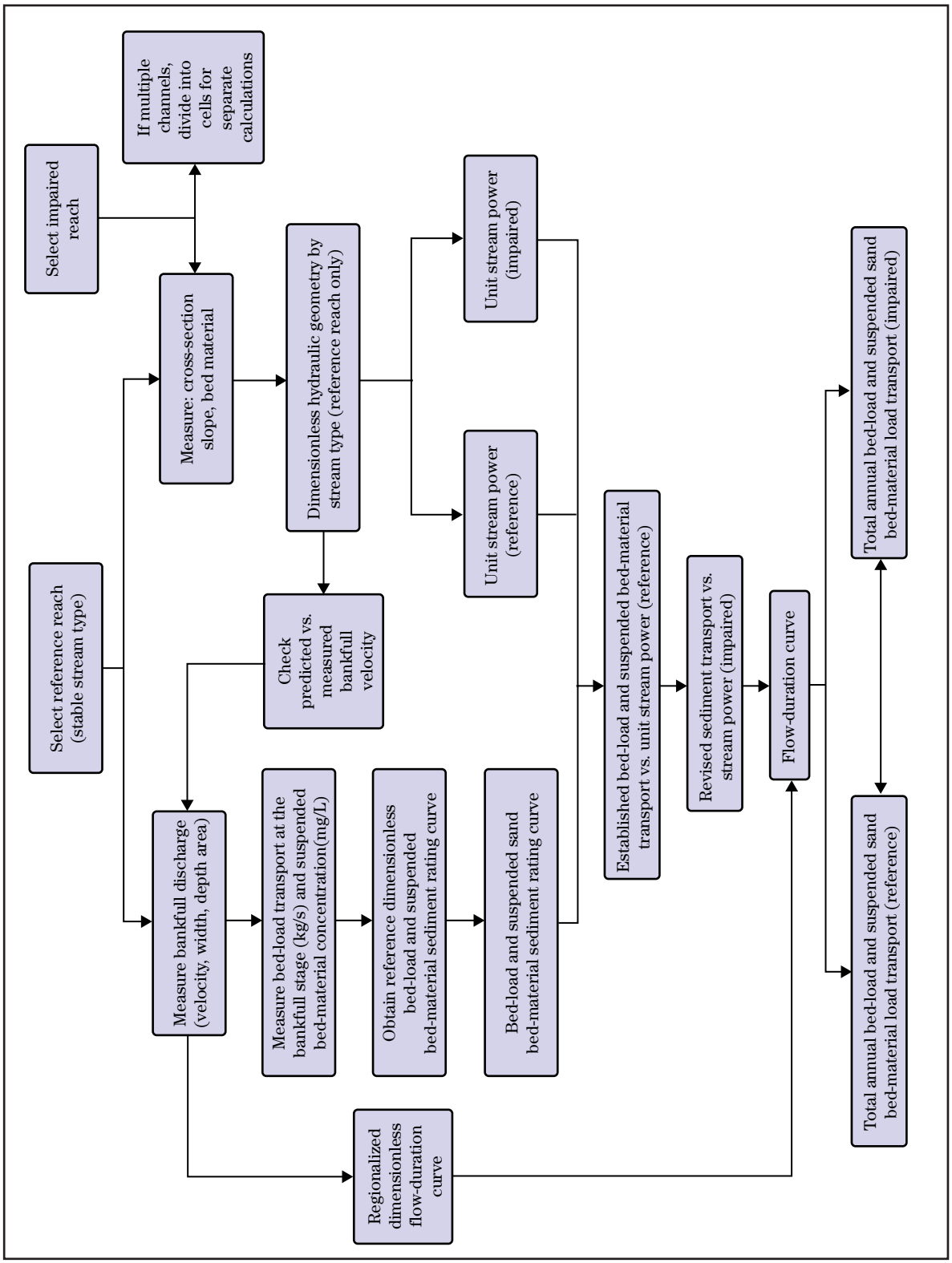
General Overview of the FLOWSED Model (Rosgen, 2007)



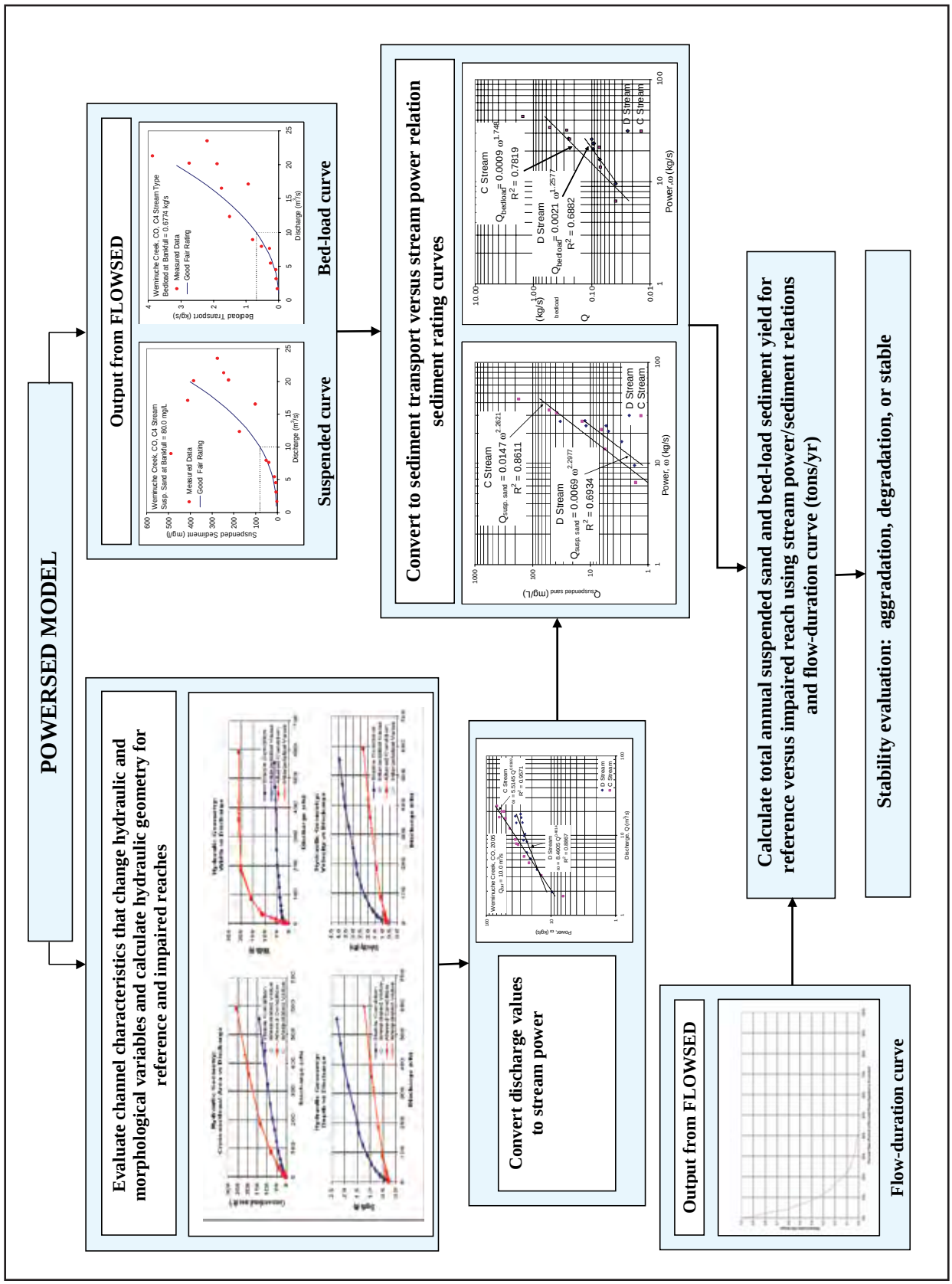
Graphical Depiction of the FLOWSED Model (Rosgen, 2007)



POWERSED Model to Predict Bedload and Suspended Sand Bed-material Load Transport (Rosgen, 2007)



Graphical Depiction of the POWERSED Model (Rosgen, 2007)



Summary of Annual Sediment Yields by Location for High and Low Sediment Supply and Lake Levels

	Existing Conditions; Low Lake Level; Low Bedload Transport Rate (8.6lb/s)	Existing Conditions; Low Lake Level; High Bedload Transport Rate (33lb/s)	Existing Conditions; Low Lake Level; Low Suspended Transport Rate (15mg/l)*	Existing Conditions; Low Lake Level; High Suspended Transport Rate (85mg/l)*	Existing Conditions; High Lake Level; Low Bedload Transport Rate (8.6lb/s)	Existing Conditions; High Lake Level; High Bedload Transport Rate (33lb/s)	Existing Conditions; High Lake Level; Low Suspended Transport Rate (15mg/l)*	Existing Conditions; High Lake Level; High Suspended Transport Rate (85mg/l)*	Design Conditions; Low Lake Level; Low Bedload Transport Rate (8.6lb/s)	Design Conditions; Low Lake Level; High Bedload Transport Rate (33lb/s)	Design Conditions; Low Lake Level; Low Suspended Transport Rate (15mg/l)*	Design Conditions; Low Lake Level; High Suspended Transport Rate (85mg/l)*	Design Conditions; High Lake Level; Low Bedload Transport Rate (8.6lb/s)	Design Conditions; High Lake Level; High Bedload Transport Rate (33lb/s)	Design Conditions; High Lake Level; Low Suspended Transport Rate (15mg/l)*	Design Conditions; High Lake Level; High Suspended Transport Rate (85mg/l)*	Existing Conditions; Bank Erosion Total Annual Erosion Yield = 152,500 Tons/YR
159.505	28,842	111,109	70,689	400,634	28,842	111,109	70,689	400,634	28,842	111,109	71,226	403,671	28,842	111,109	71,226	403,671	228
159.5																	
158.80									13,125	50,512	49,092	278,173	13,125	50,512	49,092	278,173	3,432
156.70	5,061	19,476	18,297	103,680	2,527	9,725	14,614	82,805	8,281	31,860	45,373	256,887	8,281	31,860	45,373	256,887	15,255
155.86									2,817	10,847	22,385	126,709	580	2,222	11,811	67,024	10,402
154.03	843	5,621	7,229	25,530	-	-	3,938	15,133	1,843	6,876	17,647	99,780	149	627	5,412	30,827	28,897
152.42									478	2,033	9,479	53,603	7	149	2,609	14,928	21,493
150.03	7	386	1,569	15,562	-		1,678	-	-	292	3,332	18,969	-	-	959	5,329	8,772
143.99									-	-	357	2,890	-	-	-	496	38,945
140.00																	25,064

* Suspended Sediment Values Exclude the Washload (Sediment Smaller than 0.062 mm)

Example FLOWSED/POWERSED Model Runs for the Existing Condition to Predict Bedload and Suspended Sand Bed-Material Load Transport

Stream: **Kootenai River, UPSTREAM REACH, STA: 7+53.43, (Riffle)** Location: Date:

Observers: Stream Type: Valley Type: Gage Station #: **12305000**

Flow-duration curve		Calculate	Hydraulic geometry				Measure	Calculate									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport **[(13)×(14)]**	Time adjusted suspended sand transport **[(13)×(15)]**	Time adjusted total transport **[(16)+(17)]**
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.0%	**3597.92**										**0%**						
90.0%	**5187.01**	**4392.47**	**1667.44**	**324.84**	**5.13**	**2.63**	**0.001**	**0.19**	**164.45**	**0.51**	**10%**	**36.50**	**5.20**	**73.30**	**0.52**	**7.33**	**7.85**
80.0%	**6386.31**	**5786.66**	**1992.05**	**335.00**	**5.95**	**2.90**	**0.001**	**0.22**	**216.65**	**0.65**	**10%**	**36.50**	**22.90**	**108.00**	**2.29**	**10.80**	**13.09**
70.0%	**7945.41**	**7165.86**	**2286.25**	**342.89**	**6.67**	**3.13**	**0.001**	**0.25**	**268.29**	**0.78**	**10%**	**36.50**	**46.70**	**153.40**	**4.67**	**15.34**	**20.01**
60.0%	**9684.41**	**8814.91**	**2614.05**	**351.14**	**7.44**	**3.37**	**0.001**	**0.28**	**330.03**	**0.94**	**10%**	**36.50**	**82.50**	**227.50**	**8.25**	**22.75**	**31.00**
50.0%	**11603.30**	**10643.86**	**2954.95**	**359.37**	**8.22**	**3.60**	**0.001**	**0.31**	**398.51**	**1.11**	**10%**	**36.50**	**133.10**	**343.40**	**13.31**	**34.34**	**47.65**
40.0%	**14001.92**	**12802.61**	**3333.85**	**368.13**	**9.06**	**3.84**	**0.001**	**0.34**	**479.33**	**1.30**	**10%**	**36.50**	**207.40**	**539.90**	**20.74**	**53.99**	**74.73**
30.0%	**16490.48**	**15246.20**	**3739.06**	**377.15**	**9.91**	**4.08**	**0.001**	**0.37**	**570.82**	**1.51**	**10%**	**36.50**	**311.90**	**862.80**	**31.19**	**86.28**	**117.47**
20.0%	**19998.46**	**18244.47**	**4197.98**	**384.41**	**10.92**	**4.35**	**0.001**	**0.41**	**683.07**	**1.78**	**10%**	**36.50**	**470.00**	**1446.80**	**47.00**	**144.68**	**191.68**
10.0%	**23596.38**	**21797.42**	**4709.69**	**391.98**	**12.02**	**4.63**	**0.001**	**0.45**	**816.10**	**2.08**	**10%**	**36.50**	**702.40**	**2483.00**	**70.24**	**248.30**	**318.54**
5.0%	**27284.25**	**25440.32**	**5562.34**	**471.01**	**11.81**	**4.57**	**0.001**	**0.44**	**952.49**	**2.02**	**5%**	**18.25**	**991.90**	**4036.80**	**49.60**	**201.84**	**251.44**
4.0%	**28273.68**	**27778.97**	**5997.77**	**497.94**	**12.05**	**4.63**	**0.001**	**0.45**	**1040.04**	**2.09**	**1%**	**3.65**	**1206.60**	**5352.2**	**12.07**	**53.52**	**65.59**
3.0%	**29383.04**	**28828.36**	**6180.25**	**507.42**	**12.18**	**4.66**	**0.001**	**0.45**	**1079.33**	**2.13**	**1%**	**3.65**	**1310.30**	**6033.90**	**13.10**	**60.34**	**73.44**
2.0%	**31092.05**	**30237.55**	**6425.32**	**520.23**	**12.35**	**4.71**	**0.00**	**0.46**	**1132.09**	**2.18**	**1%**	**3.65**	**1456.30**	**7046.50**	**14.56**	**70.47**	**85.03**
1.5%	**32081.48**	**31586.77**	**6664.22**	**533.46**	**12.49**	**4.74**	**0.001**	**0.46**	**1182.61**	**2.22**	**1%**	**1.83**	**1604.40**	**8125.90**	**8.02**	**40.63**	**48.65**
1.0%	**33970.39**	**33025.94**	**6957.67**	**555.33**	**12.53**	**4.75**	**0.00**	**0.46**	**1236.49**	**2.23**	**1%**	**1.83**	**1770.80**	**9403.90**	**8.85**	**47.02**	**55.87**
										Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):					**111109.7**	**400635.0**	**511744.6**

Example FLOWSED/POWERSED Model Runs for the Existing Condition to Predict Bedload and Suspended Sand Bed-Material Load Transport

Stream: **Kootenai River, BRAIDED REACH, STA: 225+53.28, (Riffle)** Location: Date:

Observers: Stream Type: Valley Type: Gage Station #: **12305000**

Flow-duration curve		Calculate	Hydraulic geometry				Measure	Calculate									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport **[(13)×(14)]**	Time adjusted suspended sand transport **[(13)×(15)]**	Time adjusted total transport **[(16)+(17)]**
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.0%	**1860.66**										**0%**						
90.0%	**2682.45**	**2271.55**	**1291.06**	**285.22**	**4.53**	**1.76**	**0.001**	**0.16**	**80.79**	**0.28**	**10%**	**36.50**	**0.00**	**30.50**	**0.00**	**3.05**	**3.05**
80.0%	**3302.67**	**2992.56**	**1557.02**	**301.16**	**5.17**	**1.92**	**0.001**	**0.18**	**106.44**	**0.35**	**10%**	**36.50**	**0.00**	**43.20**	**0.00**	**4.32**	**4.32**
70.0%	**4108.96**	**3705.82**	**1791.08**	**310.02**	**5.78**	**2.07**	**0.001**	**0.20**	**131.81**	**0.43**	**10%**	**36.50**	**0.00**	**57.60**	**0.00**	**5.76**	**5.76**
60.0%	**5008.27**	**4558.62**	**2054.07**	**319.93**	**6.42**	**2.22**	**0.001**	**0.23**	**162.14**	**0.51**	**10%**	**36.50**	**0.00**	**76.10**	**0.00**	**7.61**	**7.61**
50.0%	**6000.62**	**5504.45**	**2371.39**	**344.87**	**6.88**	**2.32**	**0.001**	**0.24**	**195.78**	**0.57**	**10%**	**36.50**	**13.00**	**96.50**	**1.30**	**9.65**	**10.95**
40.0%	**7241.06**	**6620.84**	**2657.83**	**346.68**	**7.67**	**2.49**	**0.001**	**0.27**	**235.49**	**0.68**	**10%**	**36.50**	**28.50**	**127.80**	**2.85**	**12.78**	**15.63**
30.0%	**8528.02**	**7884.54**	**2961.33**	**348.53**	**8.50**	**2.66**	**0.001**	**0.30**	**280.44**	**0.80**	**10%**	**36.50**	**51.00**	**173.10**	**5.10**	**17.31**	**22.41**
20.0%	**10342.16**	**9435.09**	**3309.02**	**350.00**	**9.45**	**2.85**	**0.001**	**0.33**	**335.59**	**0.96**	**10%**	**36.50**	**88.60**	**250.70**	**8.86**	**25.07**	**33.93**
10.0%	**12202.82**	**11272.49**	**3690.84**	**350.00**	**10.55**	**3.05**	**0.001**	**0.37**	**400.94**	**1.15**	**10%**	**36.50**	**148.60**	**387.10**	**14.86**	**38.71**	**53.57**
5.0%	**14110.00**	**13156.41**	**4058.95**	**350.00**	**11.60**	**3.24**	**0.001**	**0.40**	**467.95**	**1.34**	**5%**	**18.25**	**227.20**	**591.10**	**11.36**	**29.56**	**40.92**
4.0%	**14621.68**	**14365.84**	**4285.00**	**350.00**	**12.24**	**3.35**	**0.001**	**0.42**	**510.96**	**1.46**	**1%**	**3.65**	**286.80**	**763.7**	**2.87**	**7.64**	**10.51**
3.0%	**15195.38**	**14908.53**	**4384.16**	**350.00**	**12.53**	**3.40**	**0.001**	**0.43**	**530.27**	**1.52**	**1%**	**3.65**	**318.00**	**856.20**	**3.18**	**8.56**	**11.74**
2.0%	**16079.19**	**15637.29**	**4515.24**	**350.00**	**12.90**	**3.46**	**0.00**	**0.44**	**556.19**	**1.59**	**1%**	**3.65**	**358.60**	**990.10**	**3.59**	**9.90**	**13.49**
1.5%	**16590.87**	**16335.03**	**4638.65**	**350.00**	**13.25**	**3.52**	**0.001**	**0.45**	**581.00**	**1.66**	**1%**	**1.83**	**399.60**	**1130.40**	**2.00**	**5.65**	**7.65**
1.0%	**17567.72**	**17079.29**	**4768.22**	**350.00**	**13.62**	**3.58**	**0.00**	**0.47**	**607.48**	**1.74**	**1%**	**1.83**	**446.70**	**1296.70**	**2.23**	**6.48**	**8.71**

Notes:

Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):	**21243.0**	**70098.3**	**91341.3**
Upstream total annual sediment supply (tons/yr) (**Worksheet 5-12a**):	**111109.0**	**400634.0**	**511743.0**
Difference in sediment transport capacity (tons/yr) (+ or -):	**-89866.0**	**-330535.8**	**-420401.8**

Example FLOWSED/POWERSED Model Runs for the Existing Condition to Predict Bedload and Suspended Sand Bed-Material Load Transport

Stream: **Kootenai River, BRAIDED REACH, STA: 225+53.28, (Riffle)** Location: Date:

Observers: Stream Type: Valley Type: Gage Station #: **12305000**

Flow-duration curve		Calculate	Hydraulic geometry				Measure	Calculate									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport **[(13)×(14)]**	Time adjusted suspended sand transport **[(13)×(15)]**	Time adjusted total transport **[(16)+(17)]**
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.0%	**1095.96**										**0%**						
90.0%	**1580.01**	**1337.99**	**1229.88**	**560.11**	**2.20**	**1.09**	**0.001**	**0.08**	**47.59**	**0.08**	**10%**	**36.50**	**0.00**	**14.20**	**0.00**	**1.42**	**1.42**
80.0%	**1945.34**	**1762.68**	**1455.38**	**563.79**	**2.58**	**1.21**	**0.001**	**0.09**	**62.70**	**0.11**	**10%**	**36.50**	**0.00**	**19.50**	**0.00**	**1.95**	**1.95**
70.0%	**2420.25**	**2182.80**	**1659.09**	**567.25**	**2.92**	**1.32**	**0.001**	**0.10**	**77.64**	**0.14**	**10%**	**36.50**	**0.00**	**25.00**	**0.00**	**2.50**	**2.50**
60.0%	**2949.97**	**2685.11**	**1895.96**	**580.00**	**3.27**	**1.42**	**0.001**	**0.12**	**95.50**	**0.16**	**10%**	**36.50**	**0.00**	**31.50**	**0.00**	**3.15**	**3.15**
50.0%	**3534.48**	**3242.23**	**2124.22**	**580.00**	**3.66**	**1.53**	**0.001**	**0.13**	**115.32**	**0.20**	**10%**	**36.50**	**0.00**	**39.90**	**0.00**	**3.99**	**3.99**
40.0%	**4265.12**	**3899.80**	**2374.55**	**580.00**	**4.09**	**1.64**	**0.001**	**0.14**	**138.71**	**0.24**	**10%**	**36.50**	**0.00**	**50.20**	**0.00**	**5.02**	**5.02**
30.0%	**5023.16**	**4644.14**	**2638.62**	**580.00**	**4.55**	**1.76**	**0.001**	**0.16**	**165.18**	**0.28**	**10%**	**36.50**	**0.00**	**62.40**	**0.00**	**6.24**	**6.24**
20.0%	**6091.73**	**5557.45**	**2940.80**	**580.00**	**5.07**	**1.89**	**0.001**	**0.18**	**197.67**	**0.34**	**10%**	**36.50**	**0.00**	**79.40**	**0.00**	**7.94**	**7.94**
10.0%	**7187.69**	**6639.71**	**3274.74**	**580.00**	**5.65**	**2.03**	**0.001**	**0.20**	**236.16**	**0.41**	**10%**	**36.50**	**0.00**	**101.50**	**0.00**	**10.15**	**10.15**
5.0%	**8311.05**	**7749.37**	**3595.62**	**580.00**	**6.20**	**2.16**	**0.001**	**0.22**	**275.63**	**0.48**	**5%**	**18.25**	**0.00**	**126.00**	**0.00**	**6.30**	**6.30**
4.0%	**8612.44**	**8461.74**	**3792.22**	**580.00**	**6.54**	**2.23**	**0.001**	**0.23**	**300.97**	**0.52**	**1%**	**3.65**	**6.50**	**142.3**	**0.07**	**1.42**	**1.49**
3.0%	**8950.37**	**8781.41**	**3878.28**	**580.00**	**6.69**	**2.26**	**0.001**	**0.23**	**312.34**	**0.54**	**1%**	**3.65**	**9.10**	**150.30**	**0.09**	**1.50**	**1.59**
2.0%	**9470.95**	**9210.66**	**3992.00**	**580.00**	**6.88**	**2.31**	**0.00**	**0.24**	**327.60**	**0.56**	**1%**	**3.65**	**11.70**	**160.20**	**0.12**	**1.60**	**1.72**
1.5%	**9772.34**	**9621.65**	**4098.97**	**580.00**	**7.07**	**2.35**	**0.001**	**0.25**	**342.22**	**0.59**	**1%**	**1.83**	**15.10**	**171.50**	**0.08**	**0.86**	**0.94**
1.0%	**10347.72**	**10060.03**	**4211.14**	**580.00**	**7.26**	**2.39**	**0.00**	**0.25**	**357.82**	**0.62**	**1%**	**1.83**	**19.00**	**183.30**	**0.10**	**0.92**	**1.02**

Notes:

Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):	**167.9**	**20060.4**	**20228.3**
Upstream total annual sediment supply (tons/yr) (**Worksheet 5-12a**):	**111109.0**	**400634.0**	**511743.0**
Difference in sediment transport capacity (tons/yr) (+ or -):	**-110941.1**	**-380573.6**	**-491514.7**

Example FLOWSED/POWERSED Model Runs for the Existing Condition to Predict Bedload and Suspended Sand Bed-Material Load Transport

Stream: **Kootenai River, BRAIDED REACH, STA: 225+53.28, (Riffle)** Location: Date:

Observers: Stream Type: Valley Type: Gage Station #: **12305000**

Flow-duration curve		Calculate	Hydraulic geometry				Measure	Calculate									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport **[(13)×(14)]**	Time adjusted suspended sand transport **[(13)×(15)]**	Time adjusted total transport **[(16)+(17)]**
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.0%	**615.40**										**0%**						
90.0%	**887.20**	**751.30**	**569.47**	**194.22**	**2.93**	**1.32**	**0.001**	**0.10**	**26.72**	**0.14**	**10%**	**36.50**	**0.00**	**8.60**	**0.00**	**0.86**	**0.86**
80.0%	**1092.33**	**989.77**	**685.13**	**203.89**	**3.36**	**1.44**	**0.001**	**0.12**	**35.20**	**0.17**	**10%**	**36.50**	**0.00**	**11.80**	**0.00**	**1.18**	**1.18**
70.0%	**1359.01**	**1225.67**	**801.58**	**219.05**	**3.66**	**1.53**	**0.001**	**0.13**	**43.59**	**0.20**	**10%**	**36.50**	**0.00**	**15.10**	**0.00**	**1.51**	**1.51**
60.0%	**1656.45**	**1507.73**	**920.41**	**226.78**	**4.06**	**1.64**	**0.001**	**0.14**	**53.63**	**0.24**	**10%**	**36.50**	**0.00**	**19.40**	**0.00**	**1.94**	**1.94**
50.0%	**1984.66**	**1820.56**	**1045.22**	**234.82**	**4.45**	**1.74**	**0.001**	**0.16**	**64.75**	**0.28**	**10%**	**36.50**	**0.00**	**24.50**	**0.00**	**2.45**	**2.45**
40.0%	**2394.93**	**2189.80**	**1202.24**	**252.21**	**4.77**	**1.82**	**0.001**	**0.17**	**77.89**	**0.31**	**10%**	**36.50**	**0.00**	**30.40**	**0.00**	**3.04**	**3.04**
30.0%	**2820.58**	**2607.76**	**1344.09**	**255.90**	**5.25**	**1.94**	**0.001**	**0.19**	**92.75**	**0.36**	**10%**	**36.50**	**0.00**	**38.00**	**0.00**	**3.80**	**3.80**
20.0%	**3420.59**	**3120.59**	**1505.11**	**258.73**	**5.82**	**2.07**	**0.001**	**0.20**	**110.99**	**0.43**	**10%**	**36.50**	**0.00**	**48.50**	**0.00**	**4.85**	**4.85**
10.0%	**4035.99**	**3728.29**	**1683.27**	**261.31**	**6.44**	**2.21**	**0.001**	**0.23**	**132.61**	**0.51**	**10%**	**36.50**	**0.00**	**62.20**	**0.00**	**6.22**	**6.22**
5.0%	**4666.78**	**4351.39**	**1854.63**	**263.36**	**7.04**	**2.35**	**0.001**	**0.25**	**154.77**	**0.59**	**5%**	**18.25**	**15.10**	**77.50**	**0.76**	**3.88**	**4.64**
4.0%	**4836.01**	**4751.40**	**1958.58**	**264.04**	**7.42**	**2.43**	**0.001**	**0.26**	**169.00**	**0.64**	**1%**	**3.65**	**21.60**	**88**	**0.22**	**0.88**	**1.10**
3.0%	**5025.76**	**4930.89**	**2004.19**	**264.34**	**7.58**	**2.46**	**0.001**	**0.26**	**175.38**	**0.66**	**1%**	**3.65**	**24.60**	**93.10**	**0.25**	**0.93**	**1.18**
2.0%	**5318.08**	**5171.92**	**2064.51**	**264.74**	**7.80**	**2.51**	**0.00**	**0.27**	**183.95**	**0.69**	**1%**	**3.65**	**30.20**	**100.80**	**0.30**	**1.01**	**1.31**
1.5%	**5487.31**	**5402.70**	**2121.33**	**265.11**	**8.00**	**2.55**	**0.001**	**0.28**	**192.16**	**0.72**	**1%**	**1.83**	**35.90**	**108.80**	**0.18**	**0.54**	**0.72**
1.0%	**5810.40**	**5648.86**	**2181.00**	**265.50**	**8.21**	**2.59**	**0.00**	**0.29**	**200.92**	**0.76**	**1%**	**1.83**	**43.20**	**118.50**	**0.22**	**0.59**	**0.81**

Notes:

Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):	**704.5**	**12293.2**	**12997.7**
Upstream total annual sediment supply (tons/yr) (**Worksheet 5-12a**):	**111109.0**	**400634.0**	**511743.0**
Difference in sediment transport capacity (tons/yr) (+ or -):	**-110404.6**	**-388340.8**	**-498745.4**

Example FLOWSED/POWERSED Model Runs for the Existing Condition to Predict Bedload and Suspended Sand Bed-Material Load Transport

Stream: **Kootenai River, BRAIDED REACH, STA: 225+53.28, (Riffle)** Location: Date:

Observers: Stream Type: Valley Type: Gage Station #: **12305000**

Flow-duration curve		Calculate	Hydraulic geometry				Measure	Calculate									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport **[(13)×(14)]**	Time adjusted suspended sand transport **[(13)×(15)]**	Time adjusted total transport **[(16)+(17)]**
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.0%	**3456.56**										**0%**						
90.0%	**4983.20**	**4219.88**	**2545.27**	**615.43**	**4.14**	**1.66**	**0.001**	**0.15**	**150.09**	**0.24**	**10%**	**36.50**	**0.90**	**19.30**	**0.09**	**1.93**	**2.02**
80.0%	**6135.38**	**5559.29**	**3677.10**	**1022.38**	**3.60**	**1.51**	**0.001**	**0.13**	**197.73**	**0.19**	**10%**	**36.50**	**3.50**	**28.20**	**0.35**	**2.82**	**3.17**
70.0%	**7633.23**	**6884.31**	**4237.81**	**1057.79**	**4.01**	**1.62**	**0.001**	**0.14**	**244.86**	**0.23**	**10%**	**36.50**	**6.90**	**40.10**	**0.69**	**4.01**	**4.70**
60.0%	**9303.89**	**8468.56**	**4928.23**	**1130.67**	**4.36**	**1.72**	**0.001**	**0.15**	**301.21**	**0.27**	**10%**	**36.50**	**12.50**	**59.70**	**1.25**	**5.97**	**7.22**
50.0%	**11147.39**	**10225.64**	**5546.31**	**1144.79**	**4.84**	**1.84**	**0.001**	**0.17**	**363.71**	**0.32**	**10%**	**36.50**	**20.30**	**90.00**	**2.03**	**9.00**	**11.03**
40.0%	**13451.76**	**12299.58**	**6272.96**	**1180.48**	**5.31**	**1.96**	**0.001**	**0.19**	**437.47**	**0.37**	**10%**	**36.50**	**31.50**	**141.50**	**3.15**	**14.15**	**17.30**
30.0%	**15842.54**	**14647.15**	**6978.54**	**1185.56**	**5.89**	**2.10**	**0.001**	**0.21**	**520.97**	**0.44**	**10%**	**36.50**	**47.10**	**225.80**	**4.71**	**22.58**	**27.29**
20.0%	**19212.68**	**17527.61**	**7785.37**	**1190.28**	**6.54**	**2.25**	**0.001**	**0.23**	**623.42**	**0.52**	**10%**	**36.50**	**71.30**	**378.60**	**7.13**	**37.86**	**44.99**
10.0%	**22669.24**	**20940.96**	**8674.75**	**1194.17**	**7.26**	**2.41**	**0.001**	**0.26**	**744.83**	**0.62**	**10%**	**36.50**	**106.30**	**650.20**	**10.63**	**65.02**	**75.65**
5.0%	**26212.21**	**24440.73**	**9529.71**	**1197.63**	**7.96**	**2.56**	**0.001**	**0.28**	**869.31**	**0.73**	**5%**	**18.25**	**150.30**	**1057.20**	**7.52**	**52.86**	**60.38**
4.0%	**27162.76**	**26687.49**	**10051.50**	**1199.02**	**8.38**	**2.66**	**0.001**	**0.30**	**949.22**	**0.79**	**1%**	**3.65**	**182.70**	**1401.5**	**1.83**	**14.02**	**15.85**
3.0%	**28228.53**	**27695.64**	**10280.11**	**1199.62**	**8.57**	**2.69**	**0.001**	**0.30**	**985.08**	**0.82**	**1%**	**3.65**	**198.30**	**1580.10**	**1.98**	**15.80**	**17.78**
2.0%	**29870.39**	**29049.46**	**10582.00**	**1200.42**	**8.82**	**2.75**	**0.00**	**0.31**	**1033.23**	**0.86**	**1%**	**3.65**	**220.80**	**1845.50**	**2.21**	**18.45**	**20.66**
1.5%	**30820.95**	**30345.67**	**10866.13**	**1201.17**	**9.05**	**2.79**	**0.001**	**0.32**	**1079.33**	**0.90**	**1%**	**1.83**	**243.20**	**2127.80**	**1.22**	**10.64**	**11.86**
1.0%	**32635.64**	**31728.30**	**11163.88**	**1201.96**	**9.29**	**2.84**	**0.00**	**0.33**	**1128.51**	**0.94**	**1%**	**1.83**	**268.30**	**2462.90**	**1.34**	**12.31**	**13.65**
										Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):					**16837.5**	**104908.3**	**121745.8**

Example FLOWSED/POWERSED Model Runs for the Existing Condition to Predict Bedload and Suspended Sand Bed-Material Load Transport

Stream: **Kootenai River, STRAIGHT REACH, STA: 394+60.41, (Riffle)** Location: Date:

Observers: Stream Type: Valley Type: Gage Station #: **12305000**

Flow-duration curve		Calculate	Hydraulic geometry				Measure	Calculate									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport **[(13)×(14)]**	Time adjusted suspended sand transport **[(13)×(15)]**	Time adjusted total transport **[(16)+(17)]**
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.0%	**767.30**										**0%**						
90.0%	**1106.19**	**936.75**	**532.72**	**142.12**	**3.75**	**1.76**	**0.000**	**0.04**	**9.94**	**0.07**	**10%**	**36.50**	**0.00**	**5.90**	**0.00**	**0.59**	**0.59**
80.0%	**1361.95**	**1234.07**	**633.09**	**143.97**	**4.40**	**1.95**	**0.000**	**0.04**	**13.09**	**0.09**	**10%**	**36.50**	**0.00**	**7.50**	**0.00**	**0.75**	**0.75**
70.0%	**1694.45**	**1528.20**	**724.32**	**145.63**	**4.97**	**2.11**	**0.000**	**0.05**	**16.21**	**0.11**	**10%**	**36.50**	**0.00**	**9.00**	**0.00**	**0.90**	**0.90**
60.0%	**2065.31**	**1879.88**	**825.84**	**147.45**	**5.60**	**2.28**	**0.000**	**0.06**	**19.94**	**0.14**	**10%**	**36.50**	**0.00**	**10.50**	**0.00**	**1.05**	**1.05**
50.0%	**2474.53**	**2269.92**	**931.18**	**149.31**	**6.24**	**2.44**	**0.000**	**0.06**	**24.08**	**0.16**	**10%**	**36.50**	**0.00**	**12.20**	**0.00**	**1.22**	**1.22**
40.0%	**2986.06**	**2730.30**	**1047.95**	**151.30**	**6.93**	**2.61**	**0.000**	**0.07**	**28.96**	**0.19**	**10%**	**36.50**	**0.00**	**13.90**	**0.00**	**1.39**	**1.39**
30.0%	**3516.77**	**3251.42**	**1172.18**	**153.24**	**7.65**	**2.77**	**0.000**	**0.08**	**34.49**	**0.23**	**10%**	**36.50**	**0.00**	**15.20**	**0.00**	**1.52**	**1.52**
20.0%	**4264.89**	**3890.83**	**1315.70**	**155.32**	**8.47**	**2.96**	**0.000**	**0.08**	**41.27**	**0.27**	**10%**	**36.50**	**12.50**	**27.40**	**1.25**	**2.74**	**3.99**
10.0%	**5032.18**	**4648.54**	**1475.37**	**157.32**	**9.38**	**3.15**	**0.000**	**0.09**	**49.31**	**0.31**	**10%**	**36.50**	**18.60**	**39.30**	**1.86**	**3.93**	**5.79**
5.0%	**5818.66**	**5425.42**	**1630.34**	**159.17**	**10.24**	**3.33**	**0.000**	**0.10**	**57.55**	**0.36**	**5%**	**18.25**	**29.40**	**59.50**	**1.47**	**2.98**	**4.45**
4.0%	**6029.67**	**5924.17**	**1726.03**	**160.27**	**10.77**	**3.43**	**0.000**	**0.10**	**62.84**	**0.39**	**1%**	**3.65**	**35.90**	**74.7**	**0.36**	**0.75**	**1.11**
3.0%	**6266.25**	**6147.96**	**1768.14**	**160.75**	**11.00**	**3.48**	**0.000**	**0.11**	**65.22**	**0.41**	**1%**	**3.65**	**40.60**	**84.50**	**0.41**	**0.85**	**1.26**
2.0%	**6630.72**	**6448.49**	**1823.94**	**161.39**	**11.30**	**3.54**	**0.00**	**0.11**	**68.41**	**0.42**	**1%**	**3.65**	**42.80**	**92.30**	**0.43**	**0.92**	**1.35**
1.5%	**6841.73**	**6736.23**	**1876.62**	**161.99**	**11.58**	**3.59**	**0.000**	**0.11**	**71.46**	**0.44**	**1%**	**1.83**	**47.10**	**103.90**	**0.24**	**0.52**	**0.76**
1.0%	**7244.56**	**7043.15**	**1932.04**	**162.62**	**11.88**	**3.65**	**0.00**	**0.11**	**74.71**	**0.46**	**1%**	**1.83**	**53.10**	**119.40**	**0.27**	**0.60**	**0.87**

Notes:

Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):	**2295.9**	**7559.2**	**9855.0**
Upstream total annual sediment supply (tons/yr) (**Worksheet 5-12a**):	**16837.0**	**104908.0**	**121745.0**
Difference in sediment transport capacity (tons/yr) (+ or -):	**-14541.2**	**-97348.9**	**-111890.0**

Example FLOWSED/POWERSED Model Runs for the Existing Condition to Predict Bedload and Suspended Sand Bed-Material Load Transport

Stream: **Kootenai River, STRAIGHT REACH, STA: 394+60.41, (Riffle)** Location: Date:

Observers: Stream Type: Valley Type: Gage Station #: **12305000**

Flow-duration curve		Calculate	Hydraulic geometry				Measure	Calculate									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport **[(13)×(14)]**	Time adjusted suspended sand transport **[(13)×(15)]**	Time adjusted total transport **[(16)+(17)]**
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.0%	**1463.21**										**0%**						
90.0%	**2109.46**	**1786.34**	**1032.65**	**284.00**	**3.64**	**1.73**	**0.000**	**0.04**	**18.95**	**0.07**	**10%**	**36.50**	**0.00**	**11.30**	**0.00**	**1.13**	**1.13**
80.0%	**2597.20**	**2353.33**	**1220.56**	**284.00**	**4.30**	**1.93**	**0.000**	**0.04**	**24.96**	**0.09**	**10%**	**36.50**	**0.00**	**14.40**	**0.00**	**1.44**	**1.44**
70.0%	**3231.26**	**2914.23**	**1389.86**	**284.00**	**4.89**	**2.10**	**0.000**	**0.05**	**30.91**	**0.11**	**10%**	**36.50**	**0.00**	**17.20**	**0.00**	**1.72**	**1.72**
60.0%	**3938.48**	**3584.87**	**1576.62**	**284.00**	**5.55**	**2.27**	**0.000**	**0.06**	**38.03**	**0.13**	**10%**	**36.50**	**0.00**	**20.40**	**0.00**	**2.04**	**2.04**
50.0%	**4718.86**	**4328.67**	**1768.66**	**284.00**	**6.23**	**2.45**	**0.000**	**0.06**	**45.92**	**0.16**	**10%**	**36.50**	**0.00**	**23.30**	**0.00**	**2.33**	**2.33**
40.0%	**5694.34**	**5206.60**	**1979.84**	**284.00**	**6.97**	**2.63**	**0.000**	**0.07**	**55.23**	**0.19**	**10%**	**36.50**	**0.00**	**26.40**	**0.00**	**2.64**	**2.64**
30.0%	**6706.39**	**6200.37**	**2203.25**	**284.00**	**7.76**	**2.81**	**0.000**	**0.08**	**65.77**	**0.23**	**10%**	**36.50**	**0.00**	**29.00**	**0.00**	**2.90**	**2.90**
20.0%	**8133.02**	**7419.71**	**2459.73**	**284.00**	**8.66**	**3.02**	**0.000**	**0.09**	**78.71**	**0.28**	**10%**	**36.50**	**14.30**	**54.90**	**1.43**	**5.49**	**6.92**
10.0%	**9596.23**	**8864.63**	**2744.10**	**284.00**	**9.66**	**3.23**	**0.000**	**0.10**	**94.04**	**0.33**	**10%**	**36.50**	**22.50**	**82.80**	**2.25**	**8.28**	**10.53**
5.0%	**11096.03**	**10346.13**	**3018.35**	**284.00**	**10.63**	**3.43**	**0.000**	**0.10**	**109.75**	**0.39**	**5%**	**18.25**	**35.90**	**130.50**	**1.80**	**6.53**	**8.33**
4.0%	**11498.41**	**11297.22**	**3186.82**	**284.00**	**11.22**	**3.54**	**0.000**	**0.11**	**119.84**	**0.42**	**1%**	**3.65**	**42.80**	**161.7**	**0.43**	**1.62**	**2.05**
3.0%	**11949.57**	**11723.99**	**3260.72**	**284.00**	**11.48**	**3.60**	**0.000**	**0.11**	**124.37**	**0.44**	**1%**	**3.65**	**47.10**	**180.70**	**0.47**	**1.81**	**2.28**
2.0%	**12644.59**	**12297.08**	**3358.44**	**284.00**	**11.83**	**3.66**	**0.00**	**0.12**	**130.45**	**0.46**	**1%**	**3.65**	**53.10**	**208.50**	**0.53**	**2.09**	**2.62**
1.5%	**13046.98**	**12845.79**	**3450.47**	**284.00**	**12.15**	**3.72**	**0.000**	**0.12**	**136.27**	**0.48**	**1%**	**1.83**	**59.20**	**237.90**	**0.30**	**1.19**	**1.49**
1.0%	**13815.16**	**13431.07**	**3547.06**	**284.00**	**12.49**	**3.79**	**0.00**	**0.12**	**142.48**	**0.50**	**1%**	**1.83**	**65.20**	**269.40**	**0.33**	**1.35**	**1.68**

Notes:

Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):	**2752.1**	**15534.4**	**18286.5**
Upstream total annual sediment supply (tons/yr) (**Worksheet 5-12a**):	**16837.0**	**104908.0**	**121745.0**
Difference in sediment transport capacity (tons/yr) (+ or -):	**-14084.9**	**-89373.6**	**-103458.5**

Example FLOWSED/POWERSED Model Runs for the Existing Condition to Predict Bedload and Suspended Sand Bed-Material Load Transport

Stream: **Kootenai River, STRAIGHT REACH, STA: 394+60.41, (Riffle)** Location: Date:

Observers: Stream Type: Valley Type: Gage Station #: **12305000**

Flow-duration curve		Calculate	Hydraulic geometry				Measure	Calculate									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport **[(13)×(14)]**	Time adjusted suspended sand transport **[(13)×(15)]**	Time adjusted total transport **[(16)+(17)]**
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.0%	**1083.13**										**0%**						
90.0%	**1561.52**	**1322.33**	**687.99**	**162.60**	**4.23**	**1.92**	**0.000**	**0.04**	**14.03**	**0.09**	**10%**	**36.50**	**0.00**	**8.10**	**0.00**	**0.81**	**0.81**
80.0%	**1922.56**	**1742.04**	**820.40**	**166.17**	**4.94**	**2.12**	**0.000**	**0.05**	**18.48**	**0.11**	**10%**	**36.50**	**0.00**	**10.30**	**0.00**	**1.03**	**1.03**
70.0%	**2391.92**	**2157.24**	**942.13**	**169.73**	**5.55**	**2.29**	**0.000**	**0.06**	**22.88**	**0.13**	**10%**	**36.50**	**0.00**	**12.30**	**0.00**	**1.23**	**1.23**
60.0%	**2915.44**	**2653.68**	**1076.48**	**172.85**	**6.23**	**2.47**	**0.000**	**0.06**	**28.15**	**0.16**	**10%**	**36.50**	**0.00**	**14.30**	**0.00**	**1.43**	**1.43**
50.0%	**3493.11**	**3204.28**	**1213.46**	**174.92**	**6.94**	**2.64**	**0.000**	**0.07**	**33.99**	**0.19**	**10%**	**36.50**	**0.00**	**16.30**	**0.00**	**1.63**	**1.63**
40.0%	**4215.20**	**3854.16**	**1364.83**	**176.99**	**7.71**	**2.82**	**0.000**	**0.08**	**40.88**	**0.23**	**10%**	**36.50**	**0.00**	**18.00**	**0.00**	**1.80**	**1.80**
30.0%	**4964.36**	**4589.78**	**1525.90**	**179.04**	**8.52**	**3.01**	**0.000**	**0.09**	**48.69**	**0.27**	**10%**	**36.50**	**12.50**	**32.30**	**1.25**	**3.23**	**4.48**
20.0%	**6020.42**	**5492.39**	**1713.52**	**181.73**	**9.43**	**3.21**	**0.000**	**0.09**	**58.26**	**0.32**	**10%**	**36.50**	**20.30**	**48.30**	**2.03**	**4.83**	**6.86**
10.0%	**7103.55**	**6561.99**	**1923.62**	**184.69**	**10.42**	**3.41**	**0.000**	**0.10**	**69.61**	**0.38**	**10%**	**36.50**	**33.70**	**79.20**	**3.37**	**7.92**	**11.29**
5.0%	**8213.76**	**7658.66**	**2128.14**	**187.51**	**11.35**	**3.60**	**0.000**	**0.11**	**81.24**	**0.43**	**5%**	**18.25**	**44.90**	**113.70**	**2.25**	**5.69**	**7.94**
4.0%	**8511.63**	**8362.70**	**2254.38**	**189.16**	**11.92**	**3.71**	**0.000**	**0.12**	**88.71**	**0.47**	**1%**	**3.65**	**56.20**	**148.3**	**0.56**	**1.48**	**2.04**
3.0%	**8845.59**	**8678.61**	**2309.90**	**189.87**	**12.17**	**3.76**	**0.000**	**0.12**	**92.06**	**0.48**	**1%**	**3.65**	**59.20**	**160.70**	**0.59**	**1.61**	**2.20**
2.0%	**9360.08**	**9102.83**	**2383.50**	**190.80**	**12.49**	**3.82**	**0.00**	**0.12**	**96.56**	**0.51**	**1%**	**3.65**	**68.30**	**189.50**	**0.68**	**1.90**	**2.58**
1.5%	**9657.94**	**9509.01**	**2452.43**	**191.56**	**12.80**	**3.88**	**0.000**	**0.13**	**100.87**	**0.53**	**1%**	**1.83**	**74.70**	**214.40**	**0.37**	**1.07**	**1.44**
1.0%	**10226.59**	**9942.27**	**2524.79**	**192.31**	**13.13**	**3.94**	**0.00**	**0.13**	**105.47**	**0.55**	**1%**	**1.83**	**81.60**	**242.90**	**0.41**	**1.21**	**1.62**

Notes:

Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):	**4201.2**	**13457.6**	**17658.7**
Upstream total annual sediment supply (tons/yr) (**Worksheet 5-12a**):	**16837.0**	**104908.0**	**121745.0**
Difference in sediment transport capacity (tons/yr) (+ or -):	**-12635.9**	**-91450.5**	**-104086.3**

Example FLOWSED/POWERSED Model Runs for the Existing Condition to Predict Bedload and Suspended Sand Bed-Material Load Transport

Stream: **Kootenai River, STRAIGHT REACH, STA: 394+60.41, (Riffle)** Location: Date:

Observers: Stream Type: Valley Type: Gage Station #: **12305000**

Flow-duration curve		Calculate	Hydraulic geometry				Measure	Calculate									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport **[(13)×(14)]**	Time adjusted suspended sand transport **[(13)×(15)]**	Time adjusted total transport **[(16)+(17)]**
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.0%	**3471.54**										**0%**						
90.0%	**5004.80**	**4238.17**	**2306.70**	**592.91**	**3.89**	**1.84**	**0.000**	**0.04**	**44.96**	**0.08**	**10%**	**36.50**	**0.40**	**6.90**	**0.04**	**0.69**	**0.73**
80.0%	**6161.98**	**5583.39**	**2731.64**	**598.20**	**4.57**	**2.04**	**0.000**	**0.05**	**59.23**	**0.10**	**10%**	**36.50**	**1.30**	**10.10**	**0.13**	**1.01**	**1.14**
70.0%	**7666.32**	**6914.15**	**3114.55**	**602.36**	**5.17**	**2.22**	**0.000**	**0.05**	**73.35**	**0.12**	**10%**	**36.50**	**3.00**	**14.40**	**0.30**	**1.44**	**1.74**
60.0%	**9344.23**	**8505.28**	**3535.81**	**606.04**	**5.83**	**2.41**	**0.000**	**0.06**	**90.22**	**0.15**	**10%**	**36.50**	**5.20**	**21.40**	**0.52**	**2.14**	**2.66**
50.0%	**11195.72**	**10269.97**	**3969.39**	**609.68**	**6.51**	**2.59**	**0.000**	**0.07**	**108.94**	**0.18**	**10%**	**36.50**	**8.60**	**32.20**	**0.86**	**3.22**	**4.08**
40.0%	**13510.08**	**12352.90**	**4446.24**	**613.43**	**7.25**	**2.78**	**0.000**	**0.08**	**131.04**	**0.21**	**10%**	**36.50**	**13.00**	**50.70**	**1.30**	**5.07**	**6.37**
30.0%	**15911.23**	**14710.66**	**4951.24**	**617.40**	**8.02**	**2.97**	**0.000**	**0.08**	**156.05**	**0.25**	**10%**	**36.50**	**19.90**	**81.00**	**1.99**	**8.10**	**10.09**
20.0%	**19295.98**	**17603.61**	**5531.66**	**621.93**	**8.89**	**3.18**	**0.000**	**0.09**	**186.74**	**0.30**	**10%**	**36.50**	**29.80**	**135.90**	**2.98**	**13.59**	**16.57**
10.0%	**22767.52**	**21031.75**	**6174.98**	**626.61**	**9.85**	**3.41**	**0.000**	**0.10**	**223.10**	**0.36**	**10%**	**36.50**	**44.50**	**232.80**	**4.45**	**23.28**	**27.73**
5.0%	**26325.85**	**24546.69**	**6795.56**	**631.00**	**10.77**	**3.61**	**0.000**	**0.11**	**260.39**	**0.41**	**5%**	**18.25**	**62.60**	**379.10**	**3.13**	**18.96**	**22.09**
4.0%	**27280.52**	**26803.19**	**7176.56**	**633.57**	**11.33**	**3.73**	**0.000**	**0.12**	**284.33**	**0.45**	**1%**	**3.65**	**76.50**	**502.2**	**0.77**	**5.02**	**5.79**
3.0%	**28350.91**	**27815.72**	**7343.71**	**634.70**	**11.57**	**3.79**	**0.000**	**0.12**	**295.07**	**0.46**	**1%**	**3.65**	**82.90**	**566.30**	**0.83**	**5.66**	**6.49**
2.0%	**29999.90**	**29175.41**	**7564.77**	**636.18**	**11.89**	**3.86**	**0.00**	**0.12**	**309.49**	**0.49**	**1%**	**3.65**	**92.40**	**661.70**	**0.92**	**6.62**	**7.54**
1.5%	**30954.57**	**30477.24**	**7772.51**	**637.47**	**12.19**	**3.92**	**0.000**	**0.13**	**323.30**	**0.51**	**1%**	**1.83**	**101.50**	**762.80**	**0.51**	**3.81**	**4.32**
1.0%	**32777.13**	**31865.85**	**7990.37**	**638.77**	**12.51**	**3.99**	**0.00**	**0.13**	**338.03**	**0.53**	**1%**	**1.83**	**112.30**	**882.70**	**0.56**	**4.41**	**4.97**
										Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):					**7040.9**	**37602.3**	**44643.2**

Example FLOWSED/POWERSED Model Runs for the Existing Condition to Predict Bedload and Suspended Sand Bed-Material Load Transport

Stream: **Kootenai River, MEANDERING REACH, STA: 829+03.79, (Riffle)** Location: Date:

Observers: Stream Type: Valley Type: Gage Station #: **12305000**

Flow-duration curve		Calculate	Hydraulic geometry				Measure	Calculate									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport **[(13)×(14)]**	Time adjusted suspended sand transport **[(13)×(15)]**	Time adjusted total transport **[(16)+(17)]**
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.0%	**3560.15**										**0%**						
90.0%	**5132.55**	**4346.35**	**2979.64**	**410.74**	**7.25**	**1.46**	**0.000**	**0.02**	**10.85**	**0.03**	**10%**	**36.50**	**0.00**	**4.90**	**0.00**	**0.49**	**0.49**
80.0%	**6319.27**	**5725.91**	**3552.55**	**421.38**	**8.43**	**1.61**	**0.000**	**0.02**	**14.29**	**0.03**	**10%**	**36.50**	**0.00**	**6.50**	**0.00**	**0.65**	**0.65**
70.0%	**7862.00**	**7090.64**	**4073.63**	**430.30**	**9.47**	**1.74**	**0.000**	**0.02**	**17.70**	**0.04**	**10%**	**36.50**	**0.00**	**8.80**	**0.00**	**0.88**	**0.88**
60.0%	**9582.74**	**8722.37**	**4654.84**	**439.95**	**10.58**	**1.87**	**0.000**	**0.03**	**21.77**	**0.05**	**10%**	**36.50**	**0.00**	**11.50**	**0.00**	**1.15**	**1.15**
50.0%	**11481.48**	**10532.11**	**5264.46**	**450.81**	**11.68**	**2.00**	**0.000**	**0.03**	**26.29**	**0.06**	**10%**	**36.50**	**0.00**	**15.10**	**0.00**	**1.51**	**1.51**
40.0%	**13854.92**	**12668.20**	**5958.06**	**465.51**	**12.80**	**2.13**	**0.000**	**0.03**	**31.62**	**0.07**	**10%**	**36.50**	**0.00**	**19.20**	**0.00**	**1.92**	**1.92**
30.0%	**16317.35**	**15086.14**	**6732.16**	**486.12**	**13.85**	**2.24**	**0.000**	**0.03**	**37.66**	**0.08**	**10%**	**36.50**	**0.00**	**24.40**	**0.00**	**2.44**	**2.44**
20.0%	**19788.50**	**18052.93**	**7638.62**	**509.25**	**15.00**	**2.36**	**0.000**	**0.04**	**45.06**	**0.09**	**10%**	**36.50**	**0.90**	**31.20**	**0.09**	**3.12**	**3.21**
10.0%	**23348.65**	**21568.58**	**8643.16**	**530.92**	**16.28**	**2.50**	**0.000**	**0.04**	**53.84**	**0.10**	**10%**	**36.50**	**1.30**	**39.00**	**0.13**	**3.90**	**4.03**
5.0%	**26997.80**	**25173.23**	**9567.88**	**542.49**	**17.64**	**2.63**	**0.000**	**0.04**	**62.83**	**0.12**	**5%**	**18.25**	**3.00**	**52.30**	**0.15**	**2.62**	**2.77**
4.0%	**27976.85**	**27487.32**	**10137.98**	**549.23**	**18.46**	**2.71**	**0.000**	**0.05**	**68.61**	**0.12**	**1%**	**3.65**	**3.00**	**57.1**	**0.03**	**0.57**	**0.60**
3.0%	**29074.56**	**28525.71**	**10398.69**	**553.50**	**18.79**	**2.74**	**0.000**	**0.05**	**71.20**	**0.13**	**1%**	**3.65**	**3.90**	**63.20**	**0.04**	**0.63**	**0.67**
2.0%	**30765.63**	**29920.10**	**10738.54**	**558.27**	**19.24**	**2.79**	**0.00**	**0.05**	**74.68**	**0.13**	**1%**	**3.65**	**3.90**	**66.20**	**0.04**	**0.66**	**0.70**
1.5%	**31744.67**	**31255.15**	**11037.07**	**559.64**	**19.72**	**2.83**	**0.000**	**0.05**	**78.01**	**0.14**	**1%**	**1.83**	**4.30**	**74.30**	**0.02**	**0.37**	**0.39**
1.0%	**33613.75**	**32679.21**	**11350.63**	**561.08**	**20.23**	**2.88**	**0.00**	**0.05**	**81.57**	**0.15**	**1%**	**1.83**	**5.20**	**82.10**	**0.03**	**0.41**	**0.44**

Notes:

Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):	**193.5**	**7781.8**	**7975.3**
Upstream total annual sediment supply (tons/yr) (**Worksheet 5-12a**):	**7040.0**	**37602.0**	**44642.0**
Difference in sediment transport capacity (tons/yr) (+ or -):	**-6846.6**	**-29820.2**	**-36666.8**

Example FLOWSED/POWERSED Model Runs for the Existing Condition to Predict Bedload and Suspended Sand Bed-Material Load Transport

Stream: **Kootenai River, UPSTREAM REACH, STA: 7+53.43, (Riffle)** Location: Date:

Observers: Stream Type: Valley Type: Gage Station #: **12305000**

Flow-duration curve		Calculate	Hydraulic geometry				Measure	Calculate									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport **[(13)×(14)]**	Time adjusted suspended sand transport **[(13)×(15)]**	Time adjusted total transport **[(16)+(17)]**
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.0%	**3597.92**										**0%**						
90.0%	**5187.01**	**4392.47**	**1667.44**	**324.84**	**5.13**	**2.63**	**0.001**	**0.19**	**164.45**	**0.51**	**10%**	**36.50**	**1.30**	**12.90**	**0.13**	**1.29**	**1.42**
80.0%	**6386.31**	**5786.66**	**1992.05**	**335.00**	**5.95**	**2.90**	**0.001**	**0.22**	**216.65**	**0.65**	**10%**	**36.50**	**6.00**	**19.10**	**0.60**	**1.91**	**2.51**
70.0%	**7945.41**	**7165.86**	**2286.25**	**342.89**	**6.67**	**3.13**	**0.001**	**0.25**	**268.29**	**0.78**	**10%**	**36.50**	**12.10**	**27.10**	**1.21**	**2.71**	**3.92**
60.0%	**9684.41**	**8814.91**	**2614.05**	**351.14**	**7.44**	**3.37**	**0.001**	**0.28**	**330.03**	**0.94**	**10%**	**36.50**	**21.60**	**40.20**	**2.16**	**4.02**	**6.18**
50.0%	**11603.30**	**10643.86**	**2954.95**	**359.37**	**8.22**	**3.60**	**0.001**	**0.31**	**398.51**	**1.11**	**10%**	**36.50**	**34.60**	**60.60**	**3.46**	**6.06**	**9.52**
40.0%	**14001.92**	**12802.61**	**3333.85**	**368.13**	**9.06**	**3.84**	**0.001**	**0.34**	**479.33**	**1.30**	**10%**	**36.50**	**54.00**	**95.40**	**5.40**	**9.54**	**14.94**
30.0%	**16490.48**	**15246.20**	**3739.06**	**377.15**	**9.91**	**4.08**	**0.001**	**0.37**	**570.82**	**1.51**	**10%**	**36.50**	**80.80**	**152.30**	**8.08**	**15.23**	**23.31**
20.0%	**19998.46**	**18244.47**	**4197.98**	**384.41**	**10.92**	**4.35**	**0.001**	**0.41**	**683.07**	**1.78**	**10%**	**36.50**	**121.80**	**255.20**	**12.18**	**25.52**	**37.70**
10.0%	**23596.38**	**21797.42**	**4709.69**	**391.98**	**12.02**	**4.63**	**0.001**	**0.45**	**816.10**	**2.08**	**10%**	**36.50**	**182.30**	**437.90**	**18.23**	**43.79**	**62.02**
5.0%	**27284.25**	**25440.32**	**5562.34**	**471.01**	**11.81**	**4.57**	**0.001**	**0.44**	**952.49**	**2.02**	**5%**	**18.25**	**257.50**	**712.30**	**12.88**	**35.61**	**48.49**
4.0%	**28273.68**	**27778.97**	**5997.77**	**497.94**	**12.05**	**4.63**	**0.001**	**0.45**	**1040.04**	**2.09**	**1%**	**3.65**	**312.80**	**944.3**	**3.13**	**9.44**	**12.57**
3.0%	**29383.04**	**28828.36**	**6180.25**	**507.42**	**12.18**	**4.66**	**0.001**	**0.45**	**1079.33**	**2.13**	**1%**	**3.65**	**340.00**	**1064.80**	**3.40**	**10.65**	**14.05**
2.0%	**31092.05**	**30237.55**	**6425.32**	**520.23**	**12.35**	**4.71**	**0.00**	**0.46**	**1132.09**	**2.18**	**1%**	**3.65**	**377.60**	**1243.40**	**3.78**	**12.43**	**16.21**
1.5%	**32081.48**	**31586.77**	**6664.22**	**533.46**	**12.49**	**4.74**	**0.001**	**0.46**	**1182.61**	**2.22**	**1%**	**1.83**	**416.00**	**1433.60**	**2.08**	**7.17**	**9.25**
1.0%	**33970.39**	**33025.94**	**6957.67**	**555.33**	**12.53**	**4.75**	**0.00**	**0.46**	**1236.49**	**2.23**	**1%**	**1.83**	**459.20**	**1659.50**	**2.30**	**8.30**	**10.60**
										Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):					**28842.3**	**70689.6**	**99531.9**

Example FLOWSED/POWERSED Model Runs for the Existing Condition to Predict Bedload and Suspended Sand Bed-Material Load Transport

Stream: **Kootenai River, BRAIDED REACH, STA: 225+53.28, (Riffle)** Location: Date:

Observers: Stream Type: Valley Type: Gage Station #: **12305000**

Flow-duration curve		Calculate	Hydraulic geometry				Measure	Calculate									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport **[(13)×(14)]**	Time adjusted suspended sand transport **[(13)×(15)]**	Time adjusted total transport **[(16)+(17)]**
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.0%	**615.40**										**0%**						
90.0%	**887.20**	**751.30**	**569.47**	**194.22**	**2.93**	**1.32**	**0.001**	**0.10**	**26.72**	**0.14**	**10%**	**36.50**	**0.00**	**1.50**	**0.00**	**0.15**	**0.15**
80.0%	**1092.33**	**989.77**	**685.13**	**203.89**	**3.36**	**1.44**	**0.001**	**0.12**	**35.20**	**0.17**	**10%**	**36.50**	**0.00**	**2.10**	**0.00**	**0.21**	**0.21**
70.0%	**1359.01**	**1225.67**	**801.58**	**219.05**	**3.66**	**1.53**	**0.001**	**0.13**	**43.59**	**0.20**	**10%**	**36.50**	**0.00**	**2.60**	**0.00**	**0.26**	**0.26**
60.0%	**1656.45**	**1507.73**	**920.41**	**226.78**	**4.06**	**1.64**	**0.001**	**0.14**	**53.63**	**0.24**	**10%**	**36.50**	**0.00**	**3.40**	**0.00**	**0.34**	**0.34**
50.0%	**1984.66**	**1820.56**	**1045.22**	**234.82**	**4.45**	**1.74**	**0.001**	**0.16**	**64.75**	**0.28**	**10%**	**36.50**	**0.00**	**4.30**	**0.00**	**0.43**	**0.43**
40.0%	**2394.93**	**2189.80**	**1202.24**	**252.21**	**4.77**	**1.82**	**0.001**	**0.17**	**77.89**	**0.31**	**10%**	**36.50**	**0.00**	**5.30**	**0.00**	**0.53**	**0.53**
30.0%	**2820.58**	**2607.76**	**1344.09**	**255.90**	**5.25**	**1.94**	**0.001**	**0.19**	**92.75**	**0.36**	**10%**	**36.50**	**0.00**	**6.70**	**0.00**	**0.67**	**0.67**
20.0%	**3420.59**	**3120.59**	**1505.11**	**258.73**	**5.82**	**2.07**	**0.001**	**0.20**	**110.99**	**0.43**	**10%**	**36.50**	**0.00**	**8.60**	**0.00**	**0.86**	**0.86**
10.0%	**4035.99**	**3728.29**	**1683.27**	**261.31**	**6.44**	**2.21**	**0.001**	**0.23**	**132.61**	**0.51**	**10%**	**36.50**	**0.00**	**11.00**	**0.00**	**1.10**	**1.10**
5.0%	**4666.78**	**4351.39**	**1854.63**	**263.36**	**7.04**	**2.35**	**0.001**	**0.25**	**154.77**	**0.59**	**5%**	**18.25**	**3.90**	**13.60**	**0.20**	**0.68**	**0.88**
4.0%	**4836.01**	**4751.40**	**1958.58**	**264.04**	**7.42**	**2.43**	**0.001**	**0.26**	**169.00**	**0.64**	**1%**	**3.65**	**5.60**	**15.5**	**0.06**	**0.16**	**0.22**
3.0%	**5025.76**	**4930.89**	**2004.19**	**264.34**	**7.58**	**2.46**	**0.001**	**0.26**	**175.38**	**0.66**	**1%**	**3.65**	**6.50**	**16.40**	**0.07**	**0.16**	**0.23**
2.0%	**5318.08**	**5171.92**	**2064.51**	**264.74**	**7.80**	**2.51**	**0.00**	**0.27**	**183.95**	**0.69**	**1%**	**3.65**	**7.80**	**17.90**	**0.08**	**0.18**	**0.26**
1.5%	**5487.31**	**5402.70**	**2121.33**	**265.11**	**8.00**	**2.55**	**0.001**	**0.28**	**192.16**	**0.72**	**1%**	**1.83**	**9.50**	**19.30**	**0.05**	**0.10**	**0.15**
1.0%	**5810.40**	**5648.86**	**2181.00**	**265.50**	**8.21**	**2.59**	**0.00**	**0.29**	**200.92**	**0.76**	**1%**	**1.83**	**11.20**	**20.90**	**0.06**	**0.10**	**0.16**

Notes:

Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):	**189.8**	**2164.5**	**2354.3**
Upstream total annual sediment supply (tons/yr) (**Worksheet 5-12a**):	**28842.0**	**70689.0**	**99531.0**
Difference in sediment transport capacity (tons/yr) (+ or -):	**-28652.2**	**-68524.6**	**-97176.8**

Example FLOWSED/POWERSED Model Runs for the Existing Condition to Predict Bedload and Suspended Sand Bed-Material Load Transport

Stream: **Kootenai River, BRAIDED REACH, STA: 225+53.28, (Riffle)** Location: Date:

Observers: Stream Type: Valley Type: Gage Station #: **12305000**

Flow-duration curve		Calculate	Hydraulic geometry				Measure	Calculate									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport **[(13)×(14)]**	Time adjusted suspended sand transport **[(13)×(15)]**	Time adjusted total transport **[(16)+(17)]**
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.0%	**1095.96**										**0%**						
90.0%	**1580.01**	**1337.99**	**1229.88**	**560.11**	**2.20**	**1.09**	**0.001**	**0.08**	**47.59**	**0.08**	**10%**	**36.50**	**0.00**	**2.50**	**0.00**	**0.25**	**0.25**
80.0%	**1945.34**	**1762.68**	**1455.38**	**563.79**	**2.58**	**1.21**	**0.001**	**0.09**	**62.70**	**0.11**	**10%**	**36.50**	**0.00**	**3.40**	**0.00**	**0.34**	**0.34**
70.0%	**2420.25**	**2182.80**	**1659.09**	**567.25**	**2.92**	**1.32**	**0.001**	**0.10**	**77.64**	**0.14**	**10%**	**36.50**	**0.00**	**4.40**	**0.00**	**0.44**	**0.44**
60.0%	**2949.97**	**2685.11**	**1895.96**	**580.00**	**3.27**	**1.42**	**0.001**	**0.12**	**95.50**	**0.16**	**10%**	**36.50**	**0.00**	**5.60**	**0.00**	**0.56**	**0.56**
50.0%	**3534.48**	**3242.23**	**2124.22**	**580.00**	**3.66**	**1.53**	**0.001**	**0.13**	**115.32**	**0.20**	**10%**	**36.50**	**0.00**	**7.00**	**0.00**	**0.70**	**0.70**
40.0%	**4265.12**	**3899.80**	**2374.55**	**580.00**	**4.09**	**1.64**	**0.001**	**0.14**	**138.71**	**0.24**	**10%**	**36.50**	**0.00**	**8.80**	**0.00**	**0.88**	**0.88**
30.0%	**5023.16**	**4644.14**	**2638.62**	**580.00**	**4.55**	**1.76**	**0.001**	**0.16**	**165.18**	**0.28**	**10%**	**36.50**	**0.00**	**11.00**	**0.00**	**1.10**	**1.10**
20.0%	**6091.73**	**5557.45**	**2940.80**	**580.00**	**5.07**	**1.89**	**0.001**	**0.18**	**197.67**	**0.34**	**10%**	**36.50**	**0.00**	**14.00**	**0.00**	**1.40**	**1.40**
10.0%	**7187.69**	**6639.71**	**3274.74**	**580.00**	**5.65**	**2.03**	**0.001**	**0.20**	**236.16**	**0.41**	**10%**	**36.50**	**0.00**	**17.90**	**0.00**	**1.79**	**1.79**
5.0%	**8311.05**	**7749.37**	**3595.62**	**580.00**	**6.20**	**2.16**	**0.001**	**0.22**	**275.63**	**0.48**	**5%**	**18.25**	**0.00**	**22.20**	**0.00**	**1.11**	**1.11**
4.0%	**8612.44**	**8461.74**	**3792.22**	**580.00**	**6.54**	**2.23**	**0.001**	**0.23**	**300.97**	**0.52**	**1%**	**3.65**	**1.70**	**25.1**	**0.02**	**0.25**	**0.27**
3.0%	**8950.37**	**8781.41**	**3878.28**	**580.00**	**6.69**	**2.26**	**0.001**	**0.23**	**312.34**	**0.54**	**1%**	**3.65**	**2.20**	**26.60**	**0.02**	**0.27**	**0.29**
2.0%	**9470.95**	**9210.66**	**3992.00**	**580.00**	**6.88**	**2.31**	**0.00**	**0.24**	**327.60**	**0.56**	**1%**	**3.65**	**3.00**	**28.40**	**0.03**	**0.28**	**0.31**
1.5%	**9772.34**	**9621.65**	**4098.97**	**580.00**	**7.07**	**2.35**	**0.001**	**0.25**	**342.22**	**0.59**	**1%**	**1.83**	**3.90**	**30.10**	**0.02**	**0.15**	**0.17**
1.0%	**10347.72**	**10060.03**	**4211.14**	**580.00**	**7.26**	**2.39**	**0.00**	**0.25**	**357.82**	**0.62**	**1%**	**1.83**	**5.20**	**32.30**	**0.03**	**0.16**	**0.19**

Notes:

Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):	**43.8**	**3533.2**	**3577.0**
Upstream total annual sediment supply (tons/yr) (**Worksheet 5-12a**):	**28842.0**	**70689.0**	**99531.0**
Difference in sediment transport capacity (tons/yr) (+ or -):	**-28798.2**	**-67155.8**	**-95954.0**

Example FLOWSED/POWERSED Model Runs for the Existing Condition to Predict Bedload and Suspended Sand Bed-Material Load Transport

Stream: **Kootenai River, BRAIDED REACH, STA: 225+53.28, (Riffle)** Location: Date:

Observers: Stream Type: Valley Type: Gage Station #: **12305000**

Flow-duration curve		Calculate	Hydraulic geometry				Measure	Calculate									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport **[(13)×(14)]**	Time adjusted suspended sand transport **[(13)×(15)]**	Time adjusted total transport **[(16)+(17)]**
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.0%	**1860.66**										**0%**						
90.0%	**2682.45**	**2271.55**	**1291.06**	**285.22**	**4.53**	**1.76**	**0.001**	**0.16**	**80.79**	**0.28**	**10%**	**36.50**	**0.00**	**5.40**	**0.00**	**0.54**	**0.54**
80.0%	**3302.67**	**2992.56**	**1557.02**	**301.16**	**5.17**	**1.92**	**0.001**	**0.18**	**106.44**	**0.35**	**10%**	**36.50**	**0.00**	**7.60**	**0.00**	**0.76**	**0.76**
70.0%	**4108.96**	**3705.82**	**1791.08**	**310.02**	**5.78**	**2.07**	**0.001**	**0.20**	**131.81**	**0.43**	**10%**	**36.50**	**0.00**	**10.20**	**0.00**	**1.02**	**1.02**
60.0%	**5008.27**	**4558.62**	**2054.07**	**319.93**	**6.42**	**2.22**	**0.001**	**0.23**	**162.14**	**0.51**	**10%**	**36.50**	**0.00**	**13.40**	**0.00**	**1.34**	**1.34**
50.0%	**6000.62**	**5504.45**	**2371.39**	**344.87**	**6.88**	**2.32**	**0.001**	**0.24**	**195.78**	**0.57**	**10%**	**36.50**	**3.50**	**17.10**	**0.35**	**1.71**	**2.06**
40.0%	**7241.06**	**6620.84**	**2657.83**	**346.68**	**7.67**	**2.49**	**0.001**	**0.27**	**235.49**	**0.68**	**10%**	**36.50**	**7.30**	**22.50**	**0.73**	**2.25**	**2.98**
30.0%	**8528.02**	**7884.54**	**2961.33**	**348.53**	**8.50**	**2.66**	**0.001**	**0.30**	**280.44**	**0.80**	**10%**	**36.50**	**13.40**	**30.70**	**1.34**	**3.07**	**4.41**
20.0%	**10342.16**	**9435.09**	**3309.02**	**350.00**	**9.45**	**2.85**	**0.001**	**0.33**	**335.59**	**0.96**	**10%**	**36.50**	**23.30**	**44.30**	**2.33**	**4.43**	**6.76**
10.0%	**12202.82**	**11272.49**	**3690.84**	**350.00**	**10.55**	**3.05**	**0.001**	**0.37**	**400.94**	**1.15**	**10%**	**36.50**	**38.40**	**68.50**	**3.84**	**6.85**	**10.69**
5.0%	**14110.00**	**13156.41**	**4058.95**	**350.00**	**11.60**	**3.24**	**0.001**	**0.40**	**467.95**	**1.34**	**5%**	**18.25**	**59.20**	**104.40**	**2.96**	**5.22**	**8.18**
4.0%	**14621.68**	**14365.84**	**4285.00**	**350.00**	**12.24**	**3.35**	**0.001**	**0.42**	**510.96**	**1.46**	**1%**	**3.65**	**74.30**	**135**	**0.74**	**1.35**	**2.09**
3.0%	**15195.38**	**14908.53**	**4384.16**	**350.00**	**12.53**	**3.40**	**0.001**	**0.43**	**530.27**	**1.52**	**1%**	**3.65**	**82.50**	**150.90**	**0.83**	**1.51**	**2.34**
2.0%	**16079.19**	**15637.29**	**4515.24**	**350.00**	**12.90**	**3.46**	**0.00**	**0.44**	**556.19**	**1.59**	**1%**	**3.65**	**92.90**	**174.80**	**0.93**	**1.75**	**2.68**
1.5%	**16590.87**	**16335.03**	**4638.65**	**350.00**	**13.25**	**3.52**	**0.001**	**0.45**	**581.00**	**1.66**	**1%**	**1.83**	**103.70**	**199.40**	**0.52**	**1.00**	**1.52**
1.0%	**17567.72**	**17079.29**	**4768.22**	**350.00**	**13.62**	**3.58**	**0.00**	**0.47**	**607.48**	**1.74**	**1%**	**1.83**	**115.80**	**228.70**	**0.58**	**1.14**	**1.72**

Notes:

Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):	**5529.8**	**12388.1**	**17917.9**
Upstream total annual sediment supply (tons/yr) (**Worksheet 5-12a**):	**28842.0**	**70689.0**	**99531.0**
Difference in sediment transport capacity (tons/yr) (+ or -):	**-23312.3**	**-58300.9**	**-81613.2**

Example FLOWSED/POWERSED Model Runs for the Existing Condition to Predict Bedload and Suspended Sand Bed-Material Load Transport

Stream: **Kootenai River, BRAIDED REACH, STA: 102+58.34, (Riffle)** Location: Date:

Observers: Stream Type: Valley Type: Gage Station #: **12305000**

Flow-duration curve		Calculate	Hydraulic geometry				Measure	Calculate									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport **[(13)×(14)]**	Time adjusted suspended sand transport **[(13)×(15)]**	Time adjusted total transport **[(16)+(17)]**
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.0%	**2336.42**										**0%**						
90.0%	**3368.34**	**2852.38**	**1548.11**	**459.54**	**3.37**	**1.84**	**0.001**	**0.12**	**105.01**	**0.23**	**10%**	**36.50**	**0.00**	**5.40**	**0.00**	**0.54**	**0.54**
80.0%	**4147.15**	**3757.75**	**1848.11**	**473.16**	**3.91**	**2.03**	**0.001**	**0.14**	**138.35**	**0.29**	**10%**	**36.50**	**0.00**	**7.60**	**0.00**	**0.76**	**0.76**
70.0%	**5159.60**	**4653.38**	**2116.01**	**481.56**	**4.39**	**2.20**	**0.001**	**0.16**	**171.32**	**0.36**	**10%**	**36.50**	**0.00**	**10.30**	**0.00**	**1.03**	**1.03**
60.0%	**6288.87**	**5724.24**	**2406.61**	**486.76**	**4.94**	**2.38**	**0.001**	**0.18**	**210.74**	**0.43**	**10%**	**36.50**	**0.00**	**13.60**	**0.00**	**1.36**	**1.36**
50.0%	**7534.96**	**6911.92**	**2707.05**	**492.15**	**5.50**	**2.55**	**0.001**	**0.20**	**254.47**	**0.52**	**10%**	**36.50**	**2.20**	**18.10**	**0.22**	**1.81**	**2.03**
40.0%	**9092.58**	**8313.77**	**3051.40**	**503.19**	**6.06**	**2.72**	**0.001**	**0.22**	**306.08**	**0.61**	**10%**	**36.50**	**4.30**	**23.80**	**0.43**	**2.38**	**2.81**
30.0%	**10708.61**	**9900.60**	**3424.99**	**516.75**	**6.63**	**2.89**	**0.001**	**0.24**	**364.50**	**0.71**	**10%**	**36.50**	**7.30**	**32.30**	**0.73**	**3.23**	**3.96**
20.0%	**12986.62**	**11847.62**	**3853.84**	**530.09**	**7.27**	**3.07**	**0.001**	**0.27**	**436.18**	**0.82**	**10%**	**36.50**	**11.70**	**45.10**	**1.17**	**4.51**	**5.68**
10.0%	**15323.04**	**14154.83**	**4331.27**	**543.38**	**7.97**	**3.27**	**0.001**	**0.29**	**521.12**	**0.96**	**10%**	**36.50**	**106.30**	**251.90**	**10.63**	**25.19**	**35.82**
5.0%	**17717.87**	**16520.46**	**4845.47**	**570.30**	**8.50**	**3.41**	**0.001**	**0.31**	**608.22**	**1.07**	**5%**	**18.25**	**140.80**	**385.80**	**7.04**	**19.29**	**26.33**
4.0%	**18360.39**	**18039.13**	**5140.15**	**579.20**	**8.87**	**3.51**	**0.001**	**0.33**	**664.13**	**1.15**	**1%**	**3.65**	**175.00**	**522.6**	**1.75**	**5.23**	**6.98**
3.0%	**19080.79**	**18720.59**	**5267.37**	**582.33**	**9.05**	**3.55**	**0.001**	**0.33**	**689.22**	**1.18**	**1%**	**3.65**	**185.80**	**576.70**	**1.86**	**5.77**	**7.63**
2.0%	**20190.59**	**19635.69**	**5424.48**	**583.12**	**9.30**	**3.62**	**0.00**	**0.34**	**722.91**	**1.24**	**1%**	**3.65**	**215.10**	**701.40**	**2.15**	**7.01**	**9.16**
1.5%	**20833.10**	**20511.85**	**5571.50**	**583.62**	**9.55**	**3.68**	**0.001**	**0.35**	**755.16**	**1.29**	**1%**	**1.83**	**237.20**	**809.70**	**1.19**	**4.05**	**5.24**
1.0%	**22059.73**	**21446.42**	**5725.95**	**584.19**	**9.80**	**3.75**	**0.00**	**0.36**	**789.57**	**1.35**	**1%**	**1.83**	**403.90**	**950.80**	**2.02**	**4.75**	**6.77**

Notes:

Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):	**10654.4**	**31722.2**	**42376.5**
Upstream total annual sediment supply (tons/yr) (**Worksheet 5-12a**):	**15771.0**	**54290.0**	**70061.0**
Difference in sediment transport capacity (tons/yr) (+ or -):	**-5116.7**	**-22567.9**	**-27684.5**

Example FLOWSED/POWERSED Model Runs for the Existing Condition to Predict Bedload and Suspended Sand Bed-Material Load Transport

Stream: **Kootenai River, BRAIDED REACH, STA: 225+53.28, (Riffle)** Location: Date:

Observers: Stream Type: Valley Type: Gage Station #: **12305000**

Flow-duration curve		Calculate	Hydraulic geometry				Measure	Calculate									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport **[(13)×(14)]**	Time adjusted suspended sand transport **[(13)×(15)]**	Time adjusted total transport **[(16)+(17)]**
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.0%	**3456.56**										**0%**						
90.0%	**4983.20**	**4219.88**	**2545.27**	**615.43**	**4.14**	**1.66**	**0.001**	**0.15**	**150.09**	**0.24**	**10%**	**36.50**	**0.00**	**3.40**	**0.00**	**0.34**	**0.34**
80.0%	**6135.38**	**5559.29**	**3677.10**	**1022.38**	**3.60**	**1.51**	**0.001**	**0.13**	**197.73**	**0.19**	**10%**	**36.50**	**0.90**	**5.00**	**0.09**	**0.50**	**0.59**
70.0%	**7633.23**	**6884.31**	**4237.81**	**1057.79**	**4.01**	**1.62**	**0.001**	**0.14**	**244.86**	**0.23**	**10%**	**36.50**	**1.70**	**7.10**	**0.17**	**0.71**	**0.88**
60.0%	**9303.89**	**8468.56**	**4928.23**	**1130.67**	**4.36**	**1.72**	**0.001**	**0.15**	**301.21**	**0.27**	**10%**	**36.50**	**3.50**	**10.50**	**0.35**	**1.05**	**1.40**
50.0%	**11147.39**	**10225.64**	**5546.31**	**1144.79**	**4.84**	**1.84**	**0.001**	**0.17**	**363.71**	**0.32**	**10%**	**36.50**	**5.20**	**15.70**	**0.52**	**1.57**	**2.09**
40.0%	**13451.76**	**12299.58**	**6272.96**	**1180.48**	**5.31**	**1.96**	**0.001**	**0.19**	**437.47**	**0.37**	**10%**	**36.50**	**8.20**	**24.90**	**0.82**	**2.49**	**3.31**
30.0%	**15842.54**	**14647.15**	**6978.54**	**1185.56**	**5.89**	**2.10**	**0.001**	**0.21**	**520.97**	**0.44**	**10%**	**36.50**	**12.10**	**39.90**	**1.21**	**3.99**	**5.20**
20.0%	**19212.68**	**17527.61**	**7785.37**	**1190.28**	**6.54**	**2.25**	**0.001**	**0.23**	**623.42**	**0.52**	**10%**	**36.50**	**18.60**	**66.70**	**1.86**	**6.67**	**8.53**
10.0%	**22669.24**	**20940.96**	**8674.75**	**1194.17**	**7.26**	**2.41**	**0.001**	**0.26**	**744.83**	**0.62**	**10%**	**36.50**	**27.60**	**114.80**	**2.76**	**11.48**	**14.24**
5.0%	**26212.21**	**24440.73**	**9529.71**	**1197.63**	**7.96**	**2.56**	**0.001**	**0.28**	**869.31**	**0.73**	**5%**	**18.25**	**38.90**	**186.80**	**1.94**	**9.34**	**11.28**
4.0%	**27162.76**	**26687.49**	**10051.50**	**1199.02**	**8.38**	**2.66**	**0.001**	**0.30**	**949.22**	**0.79**	**1%**	**3.65**	**47.50**	**247.2**	**0.48**	**2.47**	**2.95**
3.0%	**28228.53**	**27695.64**	**10280.11**	**1199.62**	**8.57**	**2.69**	**0.001**	**0.30**	**985.08**	**0.82**	**1%**	**3.65**	**51.40**	**278.90**	**0.51**	**2.79**	**3.30**
2.0%	**29870.39**	**29049.46**	**10582.00**	**1200.42**	**8.82**	**2.75**	**0.00**	**0.31**	**1033.23**	**0.86**	**1%**	**3.65**	**57.50**	**325.50**	**0.57**	**3.26**	**3.83**
1.5%	**30820.95**	**30345.67**	**10866.13**	**1201.17**	**9.05**	**2.79**	**0.001**	**0.32**	**1079.33**	**0.90**	**1%**	**1.83**	**63.10**	**375.30**	**0.32**	**1.88**	**2.20**
1.0%	**32635.64**	**31728.30**	**11163.88**	**1201.96**	**9.29**	**2.84**	**0.00**	**0.33**	**1128.51**	**0.94**	**1%**	**1.83**	**69.60**	**434.30**	**0.35**	**2.17**	**2.52**
										Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):					**4361.8**	**18509.2**	**22870.9**

Example FLOWSED/POWERSED Model Runs for the Existing Condition to Predict Bedload and Suspended Sand Bed-Material Load Transport

Stream: **Kootenai River, STRAIGHT REACH, STA: 394+60.41, (Riffle)** Location: Date:

Observers: Stream Type: Valley Type: Gage Station #: **12305000**

Flow-duration curve		Calculate	Hydraulic geometry				Measure	Calculate									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport **[(13)×(14)]**	Time adjusted suspended sand transport **[(13)×(15)]**	Time adjusted total transport **[(16)+(17)]**
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.0%	**3471.54**										**0%**						
90.0%	**5004.80**	**4238.17**	**2306.70**	**592.91**	**3.89**	**1.84**	**0.000**	**0.04**	**44.96**	**0.08**	**10%**	**36.50**	**0.00**	**4.60**	**0.00**	**0.46**	**0.46**
80.0%	**6161.98**	**5583.39**	**2731.64**	**598.20**	**4.57**	**2.04**	**0.000**	**0.05**	**59.23**	**0.10**	**10%**	**36.50**	**0.00**	**5.70**	**0.00**	**0.57**	**0.57**
70.0%	**7666.32**	**6914.15**	**3114.55**	**602.36**	**5.17**	**2.22**	**0.000**	**0.05**	**73.35**	**0.12**	**10%**	**36.50**	**0.00**	**6.90**	**0.00**	**0.69**	**0.69**
60.0%	**9344.23**	**8505.28**	**3535.81**	**606.04**	**5.83**	**2.41**	**0.000**	**0.06**	**90.22**	**0.15**	**10%**	**36.50**	**0.00**	**8.00**	**0.00**	**0.80**	**0.80**
50.0%	**11195.72**	**10269.97**	**3969.39**	**609.68**	**6.51**	**2.59**	**0.000**	**0.07**	**108.94**	**0.18**	**10%**	**36.50**	**0.00**	**9.40**	**0.00**	**0.94**	**0.94**
40.0%	**13510.08**	**12352.90**	**4446.24**	**613.43**	**7.25**	**2.78**	**0.000**	**0.08**	**131.04**	**0.21**	**10%**	**36.50**	**0.00**	**10.70**	**0.00**	**1.07**	**1.07**
30.0%	**15911.23**	**14710.66**	**4951.24**	**617.40**	**8.02**	**2.97**	**0.000**	**0.08**	**156.05**	**0.25**	**10%**	**36.50**	**2.60**	**16.70**	**0.26**	**1.67**	**1.93**
20.0%	**19295.98**	**17603.61**	**5531.66**	**621.93**	**8.89**	**3.18**	**0.000**	**0.09**	**186.74**	**0.30**	**10%**	**36.50**	**4.30**	**25.20**	**0.43**	**2.52**	**2.95**
10.0%	**22767.52**	**21031.75**	**6174.98**	**626.61**	**9.85**	**3.41**	**0.000**	**0.10**	**223.10**	**0.36**	**10%**	**36.50**	**7.80**	**40.30**	**0.78**	**4.03**	**4.81**
5.0%	**26325.85**	**24546.69**	**6795.56**	**631.00**	**10.77**	**3.61**	**0.000**	**0.11**	**260.39**	**0.41**	**5%**	**18.25**	**10.40**	**59.60**	**0.52**	**2.98**	**3.50**
4.0%	**27280.52**	**26803.19**	**7176.56**	**633.57**	**11.33**	**3.73**	**0.000**	**0.12**	**284.33**	**0.45**	**1%**	**3.65**	**13.00**	**76.7**	**0.13**	**0.77**	**0.90**
3.0%	**28350.91**	**27815.72**	**7343.71**	**634.70**	**11.57**	**3.79**	**0.000**	**0.12**	**295.07**	**0.46**	**1%**	**3.65**	**13.80**	**83.40**	**0.14**	**0.83**	**0.97**
2.0%	**29999.90**	**29175.41**	**7564.77**	**636.18**	**11.89**	**3.86**	**0.00**	**0.12**	**309.49**	**0.49**	**1%**	**3.65**	**16.00**	**99.30**	**0.16**	**0.99**	**1.15**
1.5%	**30954.57**	**30477.24**	**7772.51**	**637.47**	**12.19**	**3.92**	**0.000**	**0.13**	**323.30**	**0.51**	**1%**	**1.83**	**17.70**	**111.90**	**0.09**	**0.56**	**0.65**
1.0%	**32777.13**	**31865.85**	**7990.37**	**638.77**	**12.51**	**3.99**	**0.00**	**0.13**	**338.03**	**0.53**	**1%**	**1.83**	**19.40**	**126.50**	**0.10**	**0.63**	**0.73**

Notes:

Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):	**952.7**	**7121.2**	**8073.8**
Upstream total annual sediment supply (tons/yr) (**Worksheet 5-12a**):	**4361.0**	**18509.0**	**22870.0**
Difference in sediment transport capacity (tons/yr) (+ or -):	**-3408.4**	**-11387.9**	**-14796.2**

Example FLOWSED/POWERSED Model Runs for the Existing Condition to Predict Bedload and Suspended Sand Bed-Material Load Transport

Stream: **Kootenai River, BRAIDED REACH, STA: 102+58.34b, (Riffle)** Location: Date:

Observers: Stream Type: Valley Type: Gage Station #: **12305000**

Flow-duration curve		Calculate	Hydraulic geometry				Measure	Calculate									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport **[(13)×(14)]**	Time adjusted suspended sand transport **[(13)×(15)]**	Time adjusted total transport **[(16)+(17)]**
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.0%	**126.32**										**0%**						
90.0%	**182.10**	**154.21**	**141.08**	**95.00**	**1.49**	**1.09**	**0.001**	**0.05**	**5.68**	**0.06**	**10%**	**36.50**	**0.00**	**0.20**	**0.00**	**0.02**	**0.02**
80.0%	**224.21**	**203.16**	**166.81**	**95.00**	**1.76**	**1.22**	**0.001**	**0.06**	**7.48**	**0.08**	**10%**	**36.50**	**0.00**	**0.30**	**0.00**	**0.03**	**0.03**
70.0%	**278.95**	**251.58**	**190.02**	**95.00**	**2.00**	**1.32**	**0.001**	**0.07**	**9.26**	**0.10**	**10%**	**36.50**	**0.00**	**0.40**	**0.00**	**0.04**	**0.04**
60.0%	**340.00**	**309.48**	**215.65**	**95.00**	**2.27**	**1.43**	**0.001**	**0.08**	**11.39**	**0.12**	**10%**	**36.50**	**0.00**	**0.50**	**0.00**	**0.05**	**0.05**
50.0%	**407.37**	**373.69**	**242.00**	**95.00**	**2.55**	**1.54**	**0.001**	**0.09**	**13.76**	**0.14**	**10%**	**36.50**	**0.00**	**0.60**	**0.00**	**0.06**	**0.06**
40.0%	**491.58**	**449.48**	**271.02**	**95.00**	**2.85**	**1.66**	**0.001**	**0.10**	**16.55**	**0.17**	**10%**	**36.50**	**0.00**	**0.80**	**0.00**	**0.08**	**0.08**
30.0%	**578.94**	**535.26**	**301.75**	**95.00**	**3.18**	**1.77**	**0.001**	**0.11**	**19.71**	**0.21**	**10%**	**36.50**	**0.00**	**1.00**	**0.00**	**0.10**	**0.10**
20.0%	**702.10**	**640.52**	**337.03**	**95.00**	**3.55**	**1.90**	**0.001**	**0.12**	**23.58**	**0.25**	**10%**	**36.50**	**0.00**	**1.20**	**0.00**	**0.12**	**0.12**
10.0%	**828.42**	**765.26**	**376.22**	**95.00**	**3.96**	**2.03**	**0.001**	**0.13**	**28.17**	**0.30**	**10%**	**36.50**	**0.00**	**1.60**	**0.00**	**0.16**	**0.16**
5.0%	**957.89**	**893.16**	**414.04**	**95.00**	**4.36**	**2.16**	**0.001**	**0.15**	**32.88**	**0.35**	**5%**	**18.25**	**0.00**	**2.00**	**0.00**	**0.10**	**0.10**
4.0%	**992.63**	**975.26**	**437.30**	**95.00**	**4.60**	**2.23**	**0.001**	**0.15**	**35.91**	**0.38**	**1%**	**3.65**	**0.00**	**2.2**	**0.00**	**0.02**	**0.02**
3.0%	**1031.57**	**1012.10**	**447.50**	**95.00**	**4.71**	**2.26**	**0.001**	**0.16**	**37.26**	**0.39**	**1%**	**3.65**	**0.00**	**2.30**	**0.00**	**0.02**	**0.02**
2.0%	**1091.57**	**1061.57**	**461.00**	**95.00**	**4.85**	**2.30**	**0.00**	**0.16**	**39.08**	**0.41**	**1%**	**3.65**	**0.00**	**2.50**	**0.00**	**0.03**	**0.03**
1.5%	**1126.31**	**1108.94**	**473.72**	**95.00**	**4.99**	**2.34**	**0.001**	**0.17**	**40.83**	**0.43**	**1%**	**1.83**	**0.00**	**2.60**	**0.00**	**0.01**	**0.01**
1.0%	**1192.62**	**1159.46**	**487.06**	**95.00**	**5.13**	**2.38**	**0.00**	**0.17**	**42.69**	**0.45**	**1%**	**1.83**	**0.00**	**2.80**	**0.00**	**0.01**	**0.01**

Notes:

Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):	**0.0**	**310.3**	**310.3**
Upstream total annual sediment supply (tons/yr) (**Worksheet 5-12a**):	**15771.0**	**54290.0**	**70061.0**
Difference in sediment transport capacity (tons/yr) (+ or -):	**-15771.0**	**-53979.8**	**-69750.8**

Example FLOWSED/POWERSED Model Runs for the Existing Condition to Predict Bedload and Suspended Sand Bed-Material Load Transport

Stream: **Kootenai River, BRAIDED REACH, STA: 102+58.34b, (Riffle)** Location: Date:

Observers: Stream Type: Valley Type: Gage Station #: **12305000**

Flow-duration curve		Calculate	Hydraulic geometry				Measure	Calculate									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport **[(13)×(14)]**	Time adjusted suspended sand transport **[(13)×(15)]**	Time adjusted total transport **[(16)+(17)]**
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.0%	**126.32**										**0%**						
90.0%	**182.10**	**154.21**	**141.08**	**95.00**	**1.49**	**1.09**	**0.001**	**0.05**	**5.68**	**0.06**	**10%**	**36.50**	**0.00**	**0.20**	**0.00**	**0.02**	**0.02**
80.0%	**224.21**	**203.16**	**166.81**	**95.00**	**1.76**	**1.22**	**0.001**	**0.06**	**7.48**	**0.08**	**10%**	**36.50**	**0.00**	**0.30**	**0.00**	**0.03**	**0.03**
70.0%	**278.95**	**251.58**	**190.02**	**95.00**	**2.00**	**1.32**	**0.001**	**0.07**	**9.26**	**0.10**	**10%**	**36.50**	**0.00**	**0.40**	**0.00**	**0.04**	**0.04**
60.0%	**340.00**	**309.48**	**215.65**	**95.00**	**2.27**	**1.43**	**0.001**	**0.08**	**11.39**	**0.12**	**10%**	**36.50**	**0.00**	**0.50**	**0.00**	**0.05**	**0.05**
50.0%	**407.37**	**373.69**	**242.00**	**95.00**	**2.55**	**1.54**	**0.001**	**0.09**	**13.76**	**0.14**	**10%**	**36.50**	**0.00**	**0.60**	**0.00**	**0.06**	**0.06**
40.0%	**491.58**	**449.48**	**271.02**	**95.00**	**2.85**	**1.66**	**0.001**	**0.10**	**16.55**	**0.17**	**10%**	**36.50**	**0.00**	**0.80**	**0.00**	**0.08**	**0.08**
30.0%	**578.94**	**535.26**	**301.75**	**95.00**	**3.18**	**1.77**	**0.001**	**0.11**	**19.71**	**0.21**	**10%**	**36.50**	**0.00**	**1.00**	**0.00**	**0.10**	**0.10**
20.0%	**702.10**	**640.52**	**337.03**	**95.00**	**3.55**	**1.90**	**0.001**	**0.12**	**23.58**	**0.25**	**10%**	**36.50**	**0.00**	**1.20**	**0.00**	**0.12**	**0.12**
10.0%	**828.42**	**765.26**	**376.22**	**95.00**	**3.96**	**2.03**	**0.001**	**0.13**	**28.17**	**0.30**	**10%**	**36.50**	**0.00**	**1.60**	**0.00**	**0.16**	**0.16**
5.0%	**957.89**	**893.16**	**414.04**	**95.00**	**4.36**	**2.16**	**0.001**	**0.15**	**32.88**	**0.35**	**5%**	**18.25**	**0.00**	**2.00**	**0.00**	**0.10**	**0.10**
4.0%	**992.63**	**975.26**	**437.30**	**95.00**	**4.60**	**2.23**	**0.001**	**0.15**	**35.91**	**0.38**	**1%**	**3.65**	**0.00**	**2.2**	**0.00**	**0.02**	**0.02**
3.0%	**1031.57**	**1012.10**	**447.50**	**95.00**	**4.71**	**2.26**	**0.001**	**0.16**	**37.26**	**0.39**	**1%**	**3.65**	**0.00**	**2.30**	**0.00**	**0.02**	**0.02**
2.0%	**1091.57**	**1061.57**	**461.00**	**95.00**	**4.85**	**2.30**	**0.00**	**0.16**	**39.08**	**0.41**	**1%**	**3.65**	**0.00**	**2.50**	**0.00**	**0.03**	**0.03**
1.5%	**1126.31**	**1108.94**	**473.72**	**95.00**	**4.99**	**2.34**	**0.001**	**0.17**	**40.83**	**0.43**	**1%**	**1.83**	**0.00**	**2.60**	**0.00**	**0.01**	**0.01**
1.0%	**1192.62**	**1159.46**	**487.06**	**95.00**	**5.13**	**2.38**	**0.00**	**0.17**	**42.69**	**0.45**	**1%**	**1.83**	**0.00**	**2.80**	**0.00**	**0.01**	**0.01**

Notes:

Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):	**0.0**	**310.3**	**310.3**
Upstream total annual sediment supply (tons/yr) (**Worksheet 5-12a**):	**15771.0**	**54290.0**	**70061.0**
Difference in sediment transport capacity (tons/yr) (+ or -):	**-15771.0**	**-53979.8**	**-69750.8**

Example FLOWSED/POWERSED Model Runs for the Existing Condition to Predict Bedload and Suspended Sand Bed-Material Load Transport

Stream: **Kootenai River, STRAIGHT REACH, STA: 394+60.41, (Riffle)** Location: Date:

Observers: Stream Type: Valley Type: Gage Station #: **12305000**

Flow-duration curve		Calculate	Hydraulic geometry				Measure	Calculate									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport **[(13)×(14)]**	Time adjusted suspended sand transport **[(13)×(15)]**	Time adjusted total transport **[(16)+(17)]**
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.0%	**3471.54**										**0%**						
90.0%	**5004.80**	**4238.17**	**2306.70**	**592.91**	**3.89**	**1.84**	**0.000**	**0.04**	**44.96**	**0.08**	**10%**	**36.50**	**0.00**	**1.40**	**0.00**	**0.14**	**0.14**
80.0%	**6161.98**	**5583.39**	**2731.64**	**598.20**	**4.57**	**2.04**	**0.000**	**0.05**	**59.23**	**0.10**	**10%**	**36.50**	**0.00**	**2.00**	**0.00**	**0.20**	**0.20**
70.0%	**7666.32**	**6914.15**	**3114.55**	**602.36**	**5.17**	**2.22**	**0.000**	**0.05**	**73.35**	**0.12**	**10%**	**36.50**	**0.40**	**2.80**	**0.04**	**0.28**	**0.32**
60.0%	**9344.23**	**8505.28**	**3535.81**	**606.04**	**5.83**	**2.41**	**0.000**	**0.06**	**90.22**	**0.15**	**10%**	**36.50**	**0.40**	**4.10**	**0.04**	**0.41**	**0.45**
50.0%	**11195.72**	**10269.97**	**3969.39**	**609.68**	**6.51**	**2.59**	**0.000**	**0.07**	**108.94**	**0.18**	**10%**	**36.50**	**0.90**	**6.40**	**0.09**	**0.64**	**0.73**
40.0%	**13510.08**	**12352.90**	**4446.24**	**613.43**	**7.25**	**2.78**	**0.000**	**0.08**	**131.04**	**0.21**	**10%**	**36.50**	**1.30**	**10.00**	**0.13**	**1.00**	**1.13**
30.0%	**15911.23**	**14710.66**	**4951.24**	**617.40**	**8.02**	**2.97**	**0.000**	**0.08**	**156.05**	**0.25**	**10%**	**36.50**	**2.20**	**15.90**	**0.22**	**1.59**	**1.81**
20.0%	**19295.98**	**17603.61**	**5531.66**	**621.93**	**8.89**	**3.18**	**0.000**	**0.09**	**186.74**	**0.30**	**10%**	**36.50**	**3.00**	**26.60**	**0.30**	**2.66**	**2.96**
10.0%	**22767.52**	**21031.75**	**6174.98**	**626.61**	**9.85**	**3.41**	**0.000**	**0.10**	**223.10**	**0.36**	**10%**	**36.50**	**4.80**	**45.40**	**0.48**	**4.54**	**5.02**
5.0%	**26325.85**	**24546.69**	**6795.56**	**631.00**	**10.77**	**3.61**	**0.000**	**0.11**	**260.39**	**0.41**	**5%**	**18.25**	**6.50**	**73.60**	**0.33**	**3.68**	**4.01**
4.0%	**27280.52**	**26803.19**	**7176.56**	**633.57**	**11.33**	**3.73**	**0.000**	**0.12**	**284.33**	**0.45**	**1%**	**3.65**	**8.20**	**97.7**	**0.08**	**0.98**	**1.06**
3.0%	**28350.91**	**27815.72**	**7343.71**	**634.70**	**11.57**	**3.79**	**0.000**	**0.12**	**295.07**	**0.46**	**1%**	**3.65**	**8.60**	**110.40**	**0.09**	**1.10**	**1.19**
2.0%	**29999.90**	**29175.41**	**7564.77**	**636.18**	**11.89**	**3.86**	**0.00**	**0.12**	**309.49**	**0.49**	**1%**	**3.65**	**9.50**	**128.40**	**0.10**	**1.28**	**1.38**
1.5%	**30954.57**	**30477.24**	**7772.51**	**637.47**	**12.19**	**3.92**	**0.000**	**0.13**	**323.30**	**0.51**	**1%**	**1.83**	**10.80**	**148.10**	**0.05**	**0.74**	**0.79**
1.0%	**32777.13**	**31865.85**	**7990.37**	**638.77**	**12.51**	**3.99**	**0.00**	**0.13**	**338.03**	**0.53**	**1%**	**1.83**	**11.70**	**172.10**	**0.06**	**0.86**	**0.92**
										Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):					**733.7**	**7336.5**	**8070.2**

Example FLOWSED/POWERSED Model Runs for the Existing Condition to Predict Bedload and Suspended Sand Bed-Material Load Transport

Stream: **Kootenai River, MEANDERING REACH, STA: 829+03.79, (Riffle)** Location: Date:

Observers: Stream Type: Valley Type: Gage Station #: **12305000**

Flow-duration curve		Calculate	Hydraulic geometry				Measure	Calculate									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport **[(13)×(14)]**	Time adjusted suspended sand transport **[(13)×(15)]**	Time adjusted total transport **[(16)+(17)]**
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.0%	**3560.15**										**0%**						
90.0%	**5132.55**	**4346.35**	**2979.64**	**410.74**	**7.25**	**1.46**	**0.000**	**0.02**	**10.85**	**0.03**	**10%**	**36.50**	**0.00**	**1.10**	**0.00**	**0.11**	**0.11**
80.0%	**6319.27**	**5725.91**	**3552.55**	**421.38**	**8.43**	**1.61**	**0.000**	**0.02**	**14.29**	**0.03**	**10%**	**36.50**	**0.00**	**1.40**	**0.00**	**0.14**	**0.14**
70.0%	**7862.00**	**7090.64**	**4073.63**	**430.30**	**9.47**	**1.74**	**0.000**	**0.02**	**17.70**	**0.04**	**10%**	**36.50**	**0.00**	**1.90**	**0.00**	**0.19**	**0.19**
60.0%	**9582.74**	**8722.37**	**4654.84**	**439.95**	**10.58**	**1.87**	**0.000**	**0.03**	**21.77**	**0.05**	**10%**	**36.50**	**0.00**	**2.40**	**0.00**	**0.24**	**0.24**
50.0%	**11481.48**	**10532.11**	**5264.46**	**450.81**	**11.68**	**2.00**	**0.000**	**0.03**	**26.29**	**0.06**	**10%**	**36.50**	**0.00**	**3.10**	**0.00**	**0.31**	**0.31**
40.0%	**13854.92**	**12668.20**	**5958.06**	**465.51**	**12.80**	**2.13**	**0.000**	**0.03**	**31.62**	**0.07**	**10%**	**36.50**	**0.00**	**4.10**	**0.00**	**0.41**	**0.41**
30.0%	**16317.35**	**15086.14**	**6732.16**	**486.12**	**13.85**	**2.24**	**0.000**	**0.03**	**37.66**	**0.08**	**10%**	**36.50**	**0.00**	**4.90**	**0.00**	**0.49**	**0.49**
20.0%	**19788.50**	**18052.93**	**7638.62**	**509.25**	**15.00**	**2.36**	**0.000**	**0.04**	**45.06**	**0.09**	**10%**	**36.50**	**0.00**	**6.30**	**0.00**	**0.63**	**0.63**
10.0%	**23348.65**	**21568.58**	**8643.16**	**530.92**	**16.28**	**2.50**	**0.000**	**0.04**	**53.84**	**0.10**	**10%**	**36.50**	**0.00**	**7.60**	**0.00**	**0.76**	**0.76**
5.0%	**26997.80**	**25173.23**	**9567.88**	**542.49**	**17.64**	**2.63**	**0.000**	**0.04**	**62.83**	**0.12**	**5%**	**18.25**	**0.40**	**10.20**	**0.02**	**0.51**	**0.53**
4.0%	**27976.85**	**27487.32**	**10137.98**	**549.23**	**18.46**	**2.71**	**0.000**	**0.05**	**68.61**	**0.12**	**1%**	**3.65**	**0.40**	**11.1**	**0.00**	**0.11**	**0.11**
3.0%	**29074.56**	**28525.71**	**10398.69**	**553.50**	**18.79**	**2.74**	**0.000**	**0.05**	**71.20**	**0.13**	**1%**	**3.65**	**0.40**	**12.30**	**0.00**	**0.12**	**0.12**
2.0%	**30765.63**	**29920.10**	**10738.54**	**558.27**	**19.24**	**2.79**	**0.00**	**0.05**	**74.68**	**0.13**	**1%**	**3.65**	**0.40**	**12.90**	**0.00**	**0.13**	**0.13**
1.5%	**31744.67**	**31255.15**	**11037.07**	**559.64**	**19.72**	**2.83**	**0.000**	**0.05**	**78.01**	**0.14**	**1%**	**1.83**	**0.40**	**14.30**	**0.00**	**0.07**	**0.07**
1.0%	**33613.75**	**32679.21**	**11350.63**	**561.08**	**20.23**	**2.88**	**0.00**	**0.05**	**81.57**	**0.15**	**1%**	**1.83**	**0.40**	**15.90**	**0.00**	**0.08**	**0.08**

Notes:

Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):	**7.3**	**1569.5**	**1576.8**
Upstream total annual sediment supply (tons/yr) (**Worksheet 5-12a**):	**733.0**	**7336.0**	**8069.0**
Difference in sediment transport capacity (tons/yr) (+ or -):	**-725.7**	**-5766.5**	**-6492.2**

Appendix V

FLOWSED/POWERSED Reference Paper

Rosgen, D.L. (2006a). FLOWSED/POWERSED: Prediction models for suspended and bedload transport. *In*: Proceedings of the Eighth Federal Interagency Sediment Conference, J.L. D'Ambrosio (Editor). Subcommittee on Sedimentation, Reno, Nevada.

FLOWSED/POWERSED – PREDICTION MODELS FOR SUSPENDED AND BEDLOAD TRANSPORT

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Abstract: FLOWSED and POWERSED are sediment transport models based on empirical and analytical methods used to predict both suspended load and bedload. The models predict changes in degradation and/or aggradation processes associated with impaired streams. The FLOWSED model involves the application of dimensionless sediment rating curves developed from reference streams that reflect sediment supply associated with a given stream type and stability rating. Measured bankfull discharge, as well as bankfull suspended and bedload sediment values are used as normalization parameters. Flow-duration curves from gage station data are also converted to a dimensionless form in order to develop localized flow-duration curves at ungaged sites. Measured bankfull values from the study stream are used to convert dimensionless to dimensional sediment rating and flow-duration curves. Annual sediment yields can then be determined using the predicted sediment rating and flow-duration curves.

Regionalized dimensionless sediment relations can be developed from measured data and tested against the dimensionless bedload and suspended sediment relations derived from the Colorado data presented in FLOWSED. Predicted sediment rating curves using this model are compared to observed values over a range of independent data sets representing small to large rivers in a variety of hydro-physiographic provinces.

The POWERSED model converts sediment rating curves from stream discharge to unit stream power. Changes in channel dimension, pattern, profile and velocity due to stability problems and/or proposed channel design options are evaluated in terms of sediment transport potential. Hydraulic geometry by stage is calculated to convert discharge to unit stream power. This conversion allows the user to predict sediment transport rates at different stages and channel response to changes in slope, depth and/or velocity for a given sediment supply. Sediment supply is determined from the dimensionless sediment rating curves stratified by stream type and stability using the FLOWSED model. Predicted annual suspended and bedload sediment yield values from both reference (stable) and impaired (unstable) reaches using POWERSED are compared to measured annual sediment yield. Applications of the models are presented for a) stability examinations; b) watershed and/or sediment supply assessments (WARSSS); c) fish habitat enhancement structures; d) flood level computations; e) bridge design; f) prediction of future reservoir capacity; and g) natural channel design for river restoration.

INTRODUCTION

Field practitioners must be able to accurately predict the sediment capacity of river channels in order to assess physical and biological function and stability. Recent stream restoration and fish enhancement projects have failed due to a lack of understanding of sediment transport and the importance of incorporating sediment transport into projects. For example, failure to include sediment transport estimates in calculating bridge hydraulics may result in the continued deposition of sediment in many of the bridge cells. Changes in the dimension, pattern, profile, materials and roughness of stream channels need to be assessed not only for sediment competency, but also for capacity. As channel boundary conditions and flow regimes change, it is imperative to ensure that the stream can transport the sediment made available from its catchment. Unfortunately, simple and accurate approaches to these problems are unavailable due to the inherent complexity and uncertainty of sediment transport prediction.

Using measured hydraulic and sediment data, Lopes et al. (2001) tested 7 bedload equations on 22 streams and concluded that the best overall sediment transport equations were developed by Schoklitsh (1962) and Bagnold (1980). Gomez and Church (1989) hypothesized that, when presented with limited hydraulic information, bedload is best predicted using equations incorporating the stream power concept. After testing 410 bedload events in gravel-bed rivers, however, Gomez and Church (1989) concluded that out of the 12 equations assessed, none performed consistently due to the limitation of the data and the complexity of the sediment phenomena. The authors concluded that sediment transport prediction involves 1) *"the need to collect localized bedload and suspended sediment rating curve data to establish sediment supply values; and, 2) the need to calibrate sediment transport models based on absolute values."* Without observed sediment values, predicted transport rates will continue to

differ significantly from actual transport rates. It is not uncommon for existing sediment transport models to overpredict or underpredict by two or three orders of magnitude, all on the same data sets (Parker, et al., 1982).

Purpose: Clearly, the need for a more accurate suspended and bedload transport model has not lessened. Since 1968, the author has measured suspended and bedload data on a wide range of flows for 160 rivers. The Rosgen data sets, combined with USDA Forest Service Rocky Mountain research data from sites in Colorado and Wyoming, were used to develop and test dimensionless relations of both suspended and bedload sediment rating curves by stream type/stability categories (Troendle, et al., 2001). The normalization parameter used to transform the sediment rating curves to dimensionless form was bankfull stage values of discharge, suspended and bedload sediment. With one exception, the relations found were power functions. The equations were tested and found to be statistically significantly ($p < 0.05$) different from one another, based on broad stream type groupings and associated "good/fair" versus "poor" stability ratings. Stream type alone was not significant, since stability ratings are needed to establish sediment supply (Rosgen, 2001). Where changes in stream type infer a stability shift, such as a change from an E5 to F5, there is an inferred relationship of not only a change in sediment supply with stream type change, but a shift in the sediment rating curve. The stream types are those described by Rosgen (1994), while the stability ratings are those by Pfankuch (1975), modified by Rosgen (2001). USGS sediment rating curves on Redwood Creek, California, were stratified into different sediment rating curves based on the Pfankuch stability ratings (USEPA,1980), explaining a range of 5 orders of magnitude in sediment supply for the same discharge. Bedload sediment rating curve data, published by Williams and Rosgen, (1989) were stratified by stream type to reduce the variability in the scatter of the data (Rosgen, 1996). The steeper slope of the sediment rating curves was related to a sediment supply condition and to channel processes described by stream type. Such relations eventually provide dimensionless sediment rating curves from measured values that represent the *supply* function in the sediment transport relations. Much like calibrating a model with measured values, bedload discharge, suspended and bedload sediment data are measured in order to convert the empirically derived dimensionless relation equation to a dimensional form for a given river reach. The FLOWSED model utilizes dimensionless sediment rating curves and dimensionless flow-duration curves. Dimensionless flow-duration curves were first presented by Emmett (1975).

One criticism of dimensionless ratio sediment rating curves offered by Kuhnle and Simon (2000) is that they will collapse into the same curve when the sediment rating curves of two rivers of different types are converted to a dimensionless form. This would be true if the stability/stream type/sediment supply relations were similar; however, tests of significance of "poor" versus "good/fair" stability were significantly different when made dimensionless (Troendle, et al., 2001). To demonstrate this point, USGS sediment rating curve data from Western Tennessee (Simon, 1986) from the Hatchie river (E5 stream type) and the South Fork of the Forked Deer river (F5 stream type), shown in Figure 1, indicate that for similar flows the South Fork of the Forked Deer river has 3 orders of magnitude higher sediment supply compared to the Hatchie river. When these relations were transformed to a dimensionless form, the curves did not collapse into one curve as asserted by Kuhnle and Simon (2000), but rather remained separate, as seen in Figure 1. If the curves had collapsed into the same relation, this would indicate a lack of statistically significant difference. In such a case, one dimensionless power function of discharge would then fit both streams.

The POWERSED model uses the output from FLOWSED, but simulates changes in stream power to predict transport relations due to stream channel dimension, pattern and profile changes. Thus, the combination of simple power functions from empirical and analytical relations of hydraulic geometry/stream power by stage are combined to provide a model that produces reasonable numbers. The empirical and analytical models and their validation over a wide range of geographic regions are presented below.

MODEL DESCRIPTION

FLOWSED: The framework for this model involves selecting streams of various types and stability ratings that have measured suspended and bedload sediment rating curves available. The streams selected should represent a "reference" condition for streams of various morphology and stability within a region. The sediment rating curves are then transformed to a dimensionless form over the entire range of flows using the bankfull stage values as the normalization parameter. Variations in the form of the relation describing the exponent and coefficient values depend on the nature of the streams in the region. Rivers of similar type and stability are grouped as in Troendle et al. (2001). Thus, the derived empirical relations can be extrapolated to similar rivers elsewhere. For the

development of dimensionless suspended sediment and bedload sediment rating curves, data from C4 stream types (gravel-bed, meandering, streams with floodplains, point bars, width/depth ratios >12, on slopes less than 0.02) (Rosgen, 1994) were selected to represent "good/fair" stability in the Pagosa Springs region of Southwestern Colorado. Two equations were established, one for suspended sediment and another for bedload sediment (Figure 2). Separate equations were developed for "poor" stability ratings for a region.

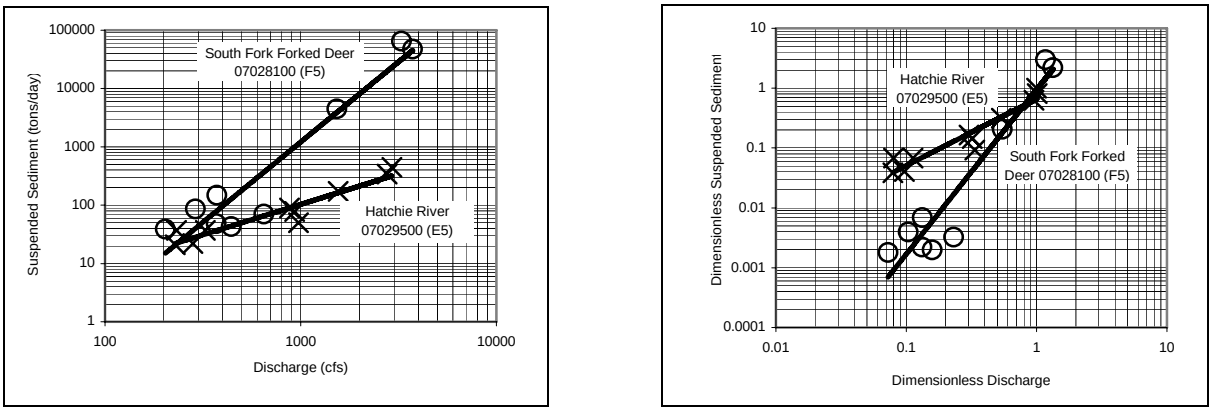

Figure 1 *Left graph*: Suspended sediment rating curves from West Tennessee for the South Fork forked Deer (F5 stream type) and Hatchie Rivers (E5 stream type). Data is from the USGS in English units as published by Simon, 1989. *Right graph:* Dimensionless ratio suspended sediment rating curves; separation of curves from one another.

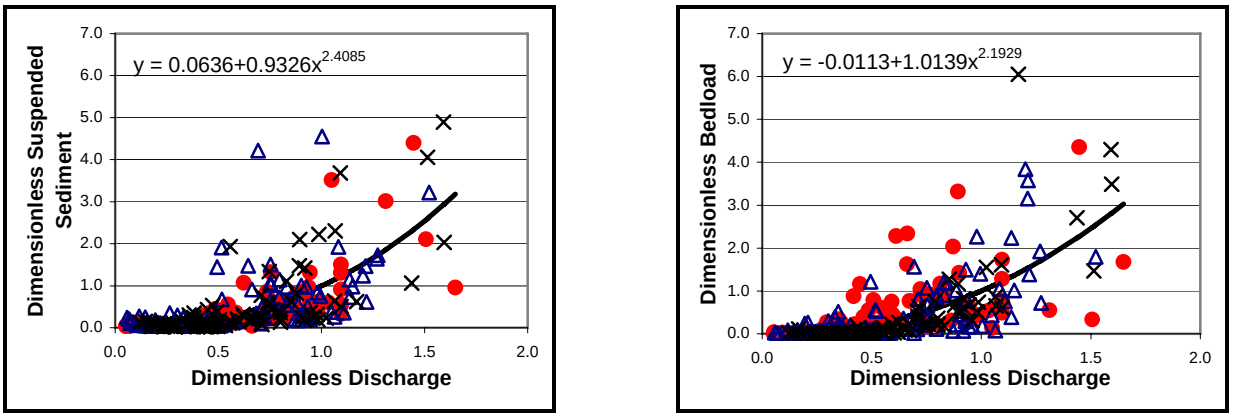

Figure 2 *Left graph*: Dimensionless ratio suspended sediment rating curves for "good/fair" stability categories. *Right graph*: Dimensionless bedload rating curves for "good/fair" stability categories. Both curves using data from Wolf Creek, the West Fork of the San Juan river and Fall Creek, Pagosa Springs, Colorado (1997 – 2001).

Flow-duration curves from USGS gage sites are also converted to dimensionless flow-duration curves using bankfull discharge as the normalization parameter. Since bankfull is a momentary maximum value, it must be converted to a "mean daily bankfull" value. USGS data is used to obtain the mean daily discharge on the day that the bankfull stage occurs. A ratio of mean daily discharge to the momentary maximum value is developed to establish the "mean daily bankfull" value. This value is used to normalize the flow-duration curve data. The use of dimensional flow-duration curves representing a hydro-physiographic province are used to obtain flow-duration curve data at ungaged sites once bankfull discharge is determined. Bankfull discharge is obtained from field investigations, measurement or extrapolation from regional curves for a hydro-physiographic region. The combination of sediment rating curves for both suspended and bedload sediment and flow-duration curves allows the calculation of total annual sediment yield. To convert the dimensionless sediment rating curve to dimensional values, measured suspended and bedload sediment must be obtained for the stream being studied. Regional bankfull sediment values such as those for suspended sediment (Simon, et al., 2004) could be used in the absence of locally measured values, but would require validation. Since direct measurements are necessary to calibrate

sediment models, then these same data can be used to convert a dimensionless relation in order to predict a sediment rating curve if the data collected is at or near the bankfull stage.

POWERSED: This model uses sediment supply data from the dimensionless suspended and bedload rating curves and dimensionless flow-duration cures in FLOWSED, but converts the full range of stream discharge into stream power. Stream power (ω) is defined as

$$(\omega) = \gamma QS \qquad (1)$$

where, γ is the specific weight of the fluid, Q is stream discharge, and S is the water surface slope. Stream power is calculated for each stage from hydraulic geometry relations. The hydraulic geometry relations are predicted using various resistance equations and roughness coefficients for a wide range of flows. Thus, changes in slope, hydraulic radius (depth), and velocity by stage are reflected in an altered stream power and a corresponding altered sediment transport rate. The sediment consequences and resulting channel stability of over-widened streams, multiple cell bridges, and/or structures that alter the slope, depth and/or velocity of flow can be determined. The suspended sediment data for POWERSED is further separated into the sand portion of the suspended sediment sample and the wash load since the sand portion is more controlled by energy than the wash load. Washload is defined as a portion of the suspended load at sediment sizes less than .062mm, the remaining concentration represents the suspended sand material load. Ratios of suspended sand concentrations versus total suspended sediment concentrations are used in the analysis.

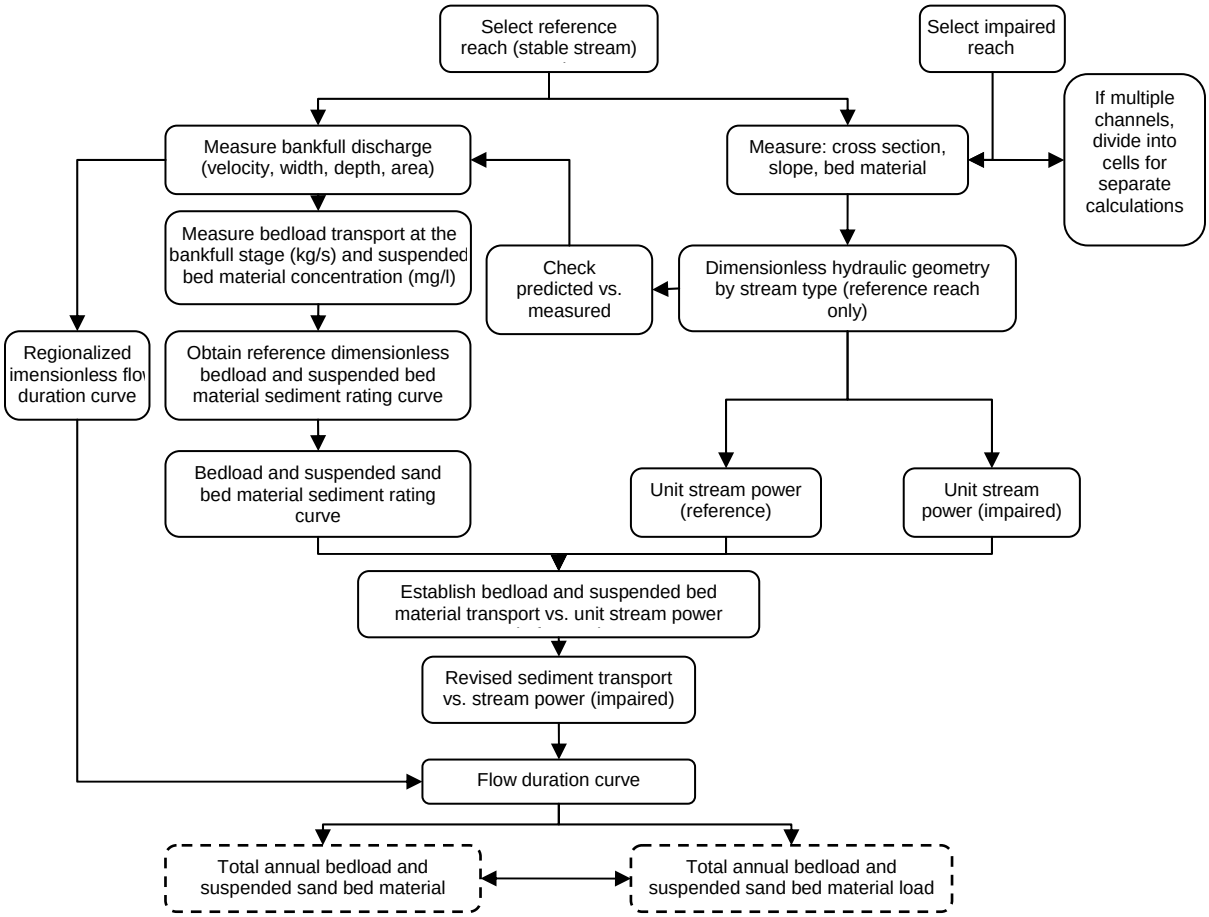

Figure 3 Flow chart for FLOWSED/POWERSED models when impaired and reference streams have the same discharge.

A flow chart depicting both models is shown in Figure 3. The user has an option to either route the same sediment supply through the impacted reach from the upstream reach or to measure sediment and flow at bankfull stage and re-enter the model to adjust sediment supply for the downstream reach. This option allows the user to insert locally

derived power function equations that best represent the altered stream. These models have been successfully used for river assessment, fish habitat structure evaluations and river restoration designs since 2001. The models are presently installed in a software program in RIVERMorph$_{TM}$ to assist users with rapid, multiple applications.

RESULTS AND DISCUSSION

Validation of both the FLOWSED and POWERSED models has been conducted using measured suspended and bedload data for a wide range of river sizes over diverse geographical areas. One measured data point representing discharge, suspended sediment and bedload sediment, all collected at the bankfull stage, was used to predict a sediment rating curve for each location. These rivers represented independent data sets, as none of the empirical dimensionless sediment rating curves tested were used to develop the relations. For validation, US Geological Survey data was obtained for measured bedload and suspended sediment in Alaska, Tennessee, Arkansas, Wyoming, Nevada, North Carolina and other states (Figure 4).

The reference dimensionless sediment rating curves for suspended and bedload sediment used for these predictions were the power function relations shown in Figure 2, from the Pagosa data. The comparison shows very good agreement between the predicted sediment rating curve and the measured values over a wide range of flows (Figure 4). The predicted sediment rating curves were derived from only one data point each representing the bankfull discharge, suspended sediment and bedload sediment values as depicted (dashed line) on each relation in Figure 4.

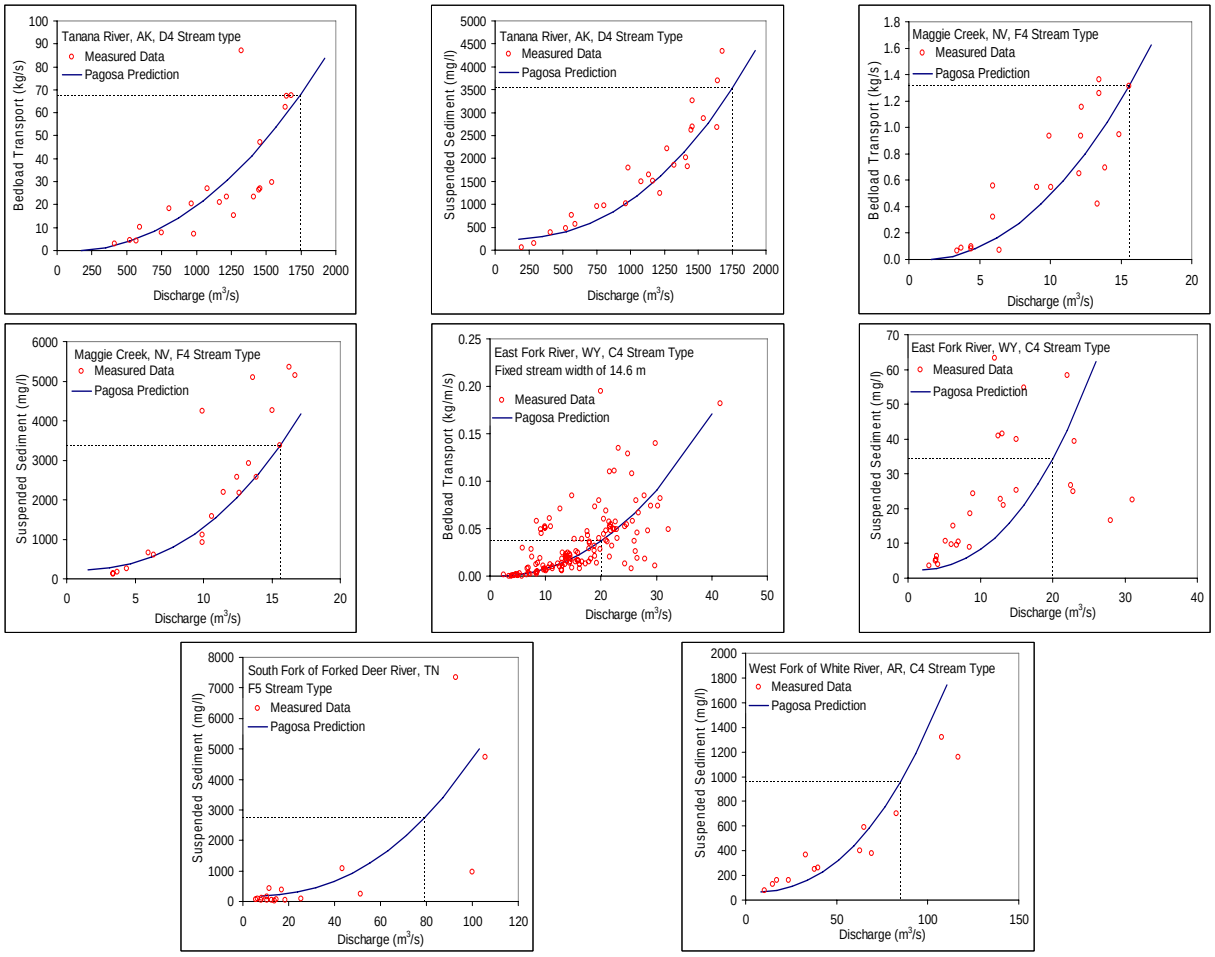

Figure 4 Predicted suspended and bedload sediment rating curves compared to observed data for a wide range of river sizes and geographical areas, using the FLOWSED model.

Field validation of the POWERSED model was recently conducted on Weminuche Creek in Southwestern Colorado. Annual suspended sediment and bedload sediment yield were measured at two locations on the same river for the same flows, but not the same stability. Bedload and suspended sediment, streamflow and hydraulic geometry data were collected concurrently on both reaches over a wide range of flows during snowmelt runoff. The upper reach was a C4 stream type with a width of 9.8 meters, width/depth ratio of 11, slope of 0.0047 and a D_{50} of 33 mm. The lower reach, 0.8 km downstream was a D4 (braided) stream type but of the same flow with a width of 72 meters, width/depth ratio of 412, slope of 0.0026 and a D_{50} of 22mm. The braided reach instability was caused by spraying willows and heavy grazing pressure, which caused excessive streambank erosion and channel aggradation. The braided channel sediment data included measuring 30 cells of individual verticals of suspended sediment and bedload data for a wide range of flows up to two times bankfull stage. Particle size analysis of each vertical was also collected and analyzed. The hydraulic geometry was also measured at each vertical including velocity, width, depth, and slope; used to calculate both discharge and stream power. This data was collected over the entire snowmelt runoff period in 2005 to calculate a transport rate for a range of flows on the braided channel by individual cell as well as for the total annual suspended, suspended sand and bedload transport. The same data was collected at the bridge site on the C4 stream type. Continuous streamflow data was also collected during the runoff season. A 152mm (6 inch) Helley Smith bedload sampler and a DH-48 depth-integrated suspended sediment sampler were used at both sites following standard field and lab analysis techniques. Due to an unusually heavy snowpack, stream flows reached twice the bankfull stage for Weminuche Creek in 2005.

Prediction of the measured suspended (sand) sediment and bedload rating curves for Weminuche Creek are shown in Figure 5. The prediction should be reasonable, as the reference dimensionless sediment rating curves were obtained from Southwestern Colorado, although not from Weminuche Creek. The next prediction represented annual sediment yield for both stream reaches. The same sediment supply function from the upstream C4 stream type was used for the downstream reach to determine how well the downstream reach could accommodate the sediment made available. In the case of the D4 stream type there was a major change in width, depth and velocity for the same discharge, thus a shift in stream power was predicted. The relation between stream discharge and stream power for the C4 and D4 stream type are depicted in Figure 6.

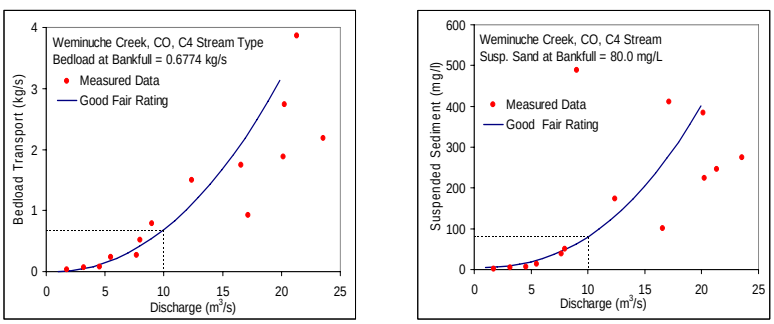

Figure 5 *Left graph*: Predicted suspended sand sediment rating curve compared to observed data. *Right graph*: Predicted bedload sediment rating curve compared to observed data using FLOWSED, C4 stream type, Weminuche Creek, Colorado, 2005.

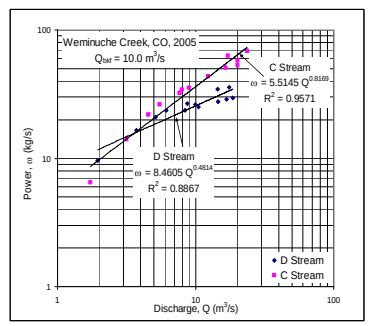

Figure 6 Relationship of stream discharge versus stream power for the C4 and D4 reaches of Weminuche Creek, Colorado, 2005.

The relationship between measured suspended sediment and bedload measurements versus stream power are shown in Figure 7 for each stream type. The D4 stream type stream power data reflects only reach averaged conditions rather than individual cells. The first POWERSED run using RIVERMorph$_{TM}$ on the braided reach did not separate the reach into cells across the section, but used reach averaged hydraulic geometry by stages to predict sediment transport. The resultant prediction was very low, (87 tons/year for bedload, 390 tons/year suspended sediment and a total of 477 tons/year, compared to an upstream supply on a C4 stream type of 2,557 tons/year of bedload, 1,852 suspended sediment tons/year, with a total of 4,452 tons/year). The next run, however on the braided reach was subsequently divided into three cells to develop hydraulic geometry and sediment transport separately.

The excellent results for both stream reaches of predicted versus measured values are shown in Table 1. The predicted total sediment yield for the C4 stream type was a 3.1% underestimate. The predicted annual sediment yield for the D4 stream type was 6.0% below the measured values. Predicted bedload was very close to that

produced for the C4 and the D4 stream type, as shown in Table 1. These results are very encouraging, as they suggest the field practitioner's ability to rapidly and accurately predict both sand-sized suspended and bedload transport rates and annual yields. The sand portion of the suspended sediment induced deposition on the stream bed when changing from a C4 stream type (1,895 tons/year measured versus 2,153 tons/year predicted), to a braided D4 stream type (878 tons/year measured versus 949 tons/year predicted) represents a reduction in sand size suspended

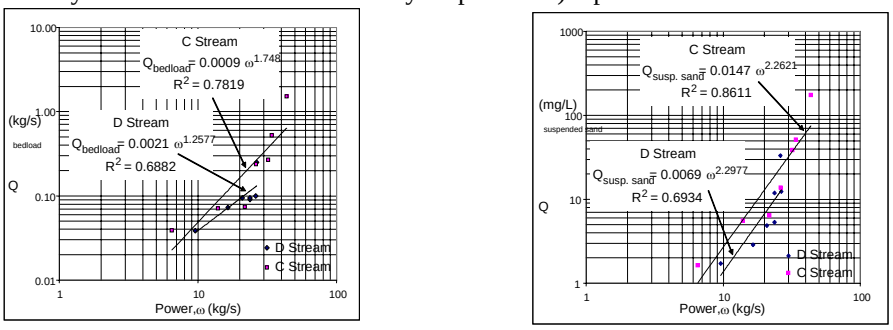

Figure 7 *Left graph*: Relationship of measured bedload sediment to stream power for C4 and D4 stream type. *Right graph*: Relationship of measured suspended sand sediment versus stream power – both relationships from Weminuche Creek, Colorado (2005).

sediment transport of 916 tons/year measured versus 1,275 tons/year predicted. The reduction in bedload transport when changing from a C4 stream type (2,557 tons/year measured versus 2,160 tons/year predicted), to a braided D4 stream type (636 tons/year measured versus 612 tons/year predicted) is 1,921 tons/year for the measured value and 1,548 tons per year for the predicted value. This excess deposition is the result of a reduction in stream power due to the consequence of an increased width to depth ratio (11 for the C4 stream type compared to 412 for the D4 stream type). The change in stream power for the braided D4 stream type was largely due to the reduction of mean depth and velocity. The hydraulic geometry by stage prediction of the POWERSED model closely approximates the measured values. In other words, the combined FLOWSED/POWERSED models not only predict the annual suspended sand and bedload yield, but they also accurately predict the channel consequence of aggradation rate (Table1).

A similar prediction was accomplished on the North Prong of the South Fork of the Mitchell River (12.6 km^2) near Jonesville, North Carolina from work initiated in 2004. The upstream stable reference reach cross-section was used to predict the suspended and bedload sediment using the Pagosa data (Figure 2). A very close agreement between the predicted and measured suspended and bedload data was observed. The downstream, impacted reach had a width/depth ratio of 24-29 compared to a width/depth ratio of 12 for the upstream reference. The POWERSED model indicated that approximately 40% of the total annual sediment yield would be deposited, including sand-sized particles. Twelve permanently monumented cross-sections were resurveyed one year later, all of which showed aggradation ranging from 0.06m to 0.18m and a shift to a higher percentage of sand. Interestingly, the competence of the river was maintained, as a 95-mm particle was predicted to be entrained and 100-mm particles were entrained in the bed, scouring down to 0.12m. The bed subsequently aggraded over the scour chains, depositing excess fine gravel and sand on the recession limb of the hydrograph over the previously installed scour chains. This study and model validation indicated that a stream may have adequate sediment *competence*, but lack the sediment *capacity* to maintain stability. The model was successful in that it predicted an aggradation process that matched field observations.

CONCLUSIONS

The close agreement between predicted versus observed data of both suspended and bedload sediment rating curves is very encouraging. Study results indicate that 1) a reference dimensionless sediment rating curve is appropriate to represent sediment supply in the region being studied; 2) a dimensionless flow-duration curve represents the hydro-physiographic province of the study site; and 3) near bankfull values are obtained in the field to transform the dimensionless relations to dimensional values. Researchers/practitioners could establish a range of dimensionless sediment rating curves for a given region and bankfull suspended and bedload sediment data by drainage area. Continued field measurements and comparisons of model prediction-to-observed values are recommended over a

wide range of regions. The initial development and testing of FLOWSED/POWERSED shows promise in predicting river behavior for stability assessment, fish habitat enhancements, bridge design, reservoir studies and river restoration applications.

Table 1 Comparison of predicted suspended (sand), bedload and total sediment loads to measured values for the C4 and D4 stream types on Weminuche Creek, Colorado, 2005.

STREAM LOCATION	PREDICTED VALUES (TONS/YEAR)	MEASURED VALUES (TONS/YEAR)	DIFFERENCE (%)
C4 Stream Type			
Bedload	2,160	2,557	
Suspended load (sand only)	2,153	1,895	
C4 Stream Type Total Sediment Load	**4,313**	**4,452**	**3.1% under**

STREAM LOCATION	PREDICTED VALUES (TONS/YEAR)	MEASURED VALUES (TONS/YEAR)	DIFFERENCE (%)
D4 Stream Type Cell 6.1			
Bedload	547	530	
Suspended load (sand only)	788	806	
Total	1,335	1,336	
D4 Stream Type Cell 6.2			
Bedload	65	104	
Suspended load (sand only)	83	141	
Total	148	245	
D4 Stream Type Cell 6.3			
Bedload	0	2	
Suspended load (sand only)	7	2	
Total	7	4	
D4 Stream Type Total			
Bedload	612	636	
Suspended load (sand only)	878	949	
D4 Stream Type Total Sediment Load	**1,490**	**1,585**	**6.0% under**

Acknowledgements: Special thanks to Dr. John Stamm for conducting and coordinating the field, lab and data analysis for the Weminuche Creek sediment study. Thanks to Brandon Rosgen, Keith Candelaria, Tiffany Thompson, Emily Davis, Christina Alvord, Josh Oberleas and Seth Kurt-Mason for field and lab work on Weminuche Creek, to Dr. William Emmett for supplying bankfull sediment data, and to George Athanasakes and Brian Belcher with FMSM Engineers, Inc., Louisville, KY (RIVERMorph$_{TM}$) for the FLOWSED and POWERSED programming and data analyses.

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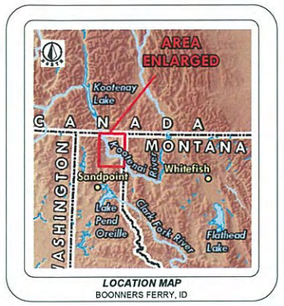
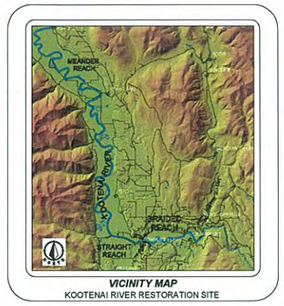
Appendix VI

Design Plan Sheets

KOOTENAI RIVER STREAM RESTORATION



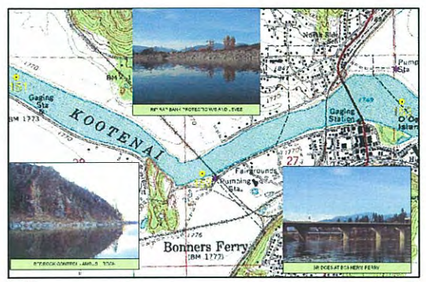
LOCATION MAP
BOONERS FERRY, ID

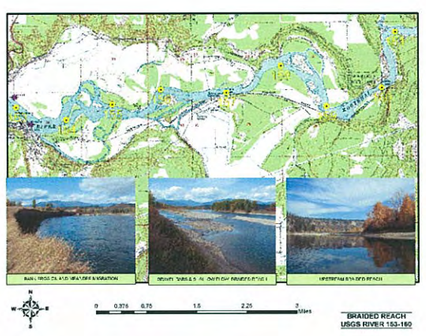


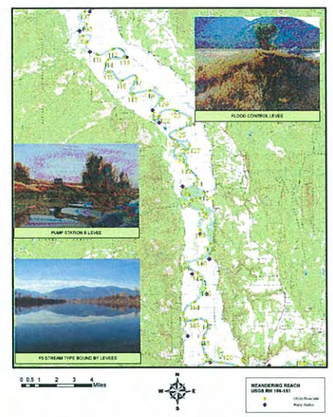
VICINITY MAP
KOOTENAI RIVER RESTORATION SITE

CONCEPTUAL DESIGN
PLAN AND PROFILE SHEETS
DRAFT

KOOTENAI TRIBE
WILDLAND HYDROLOGY







NORTH
NOTE: NTS

SHEET INDEX:

1. COVER SHEET

PLAN VEIW DESIGN SHEET

2. PLAN SHEET LAYOUT VIEW
3. PL-1 PLAN SHEET 1
4. PL-2 PLAN SHEET 2
5. PL-3 PLAN SHEET 3
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PLAN AND PROFILE SHEETS

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16. PR-2 PROFILE SHEET 2
17. PR-3 PROFILE SHEET 3
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36. PR-22 PROFILE SHEET 22

NO	REVISIONS	DRN	CHK	DATE
1	CONCEPTUAL DESIGN – RESTORATION PLAN SET DRAFT #1	DAB	DLR	05/16/08

DRAFT

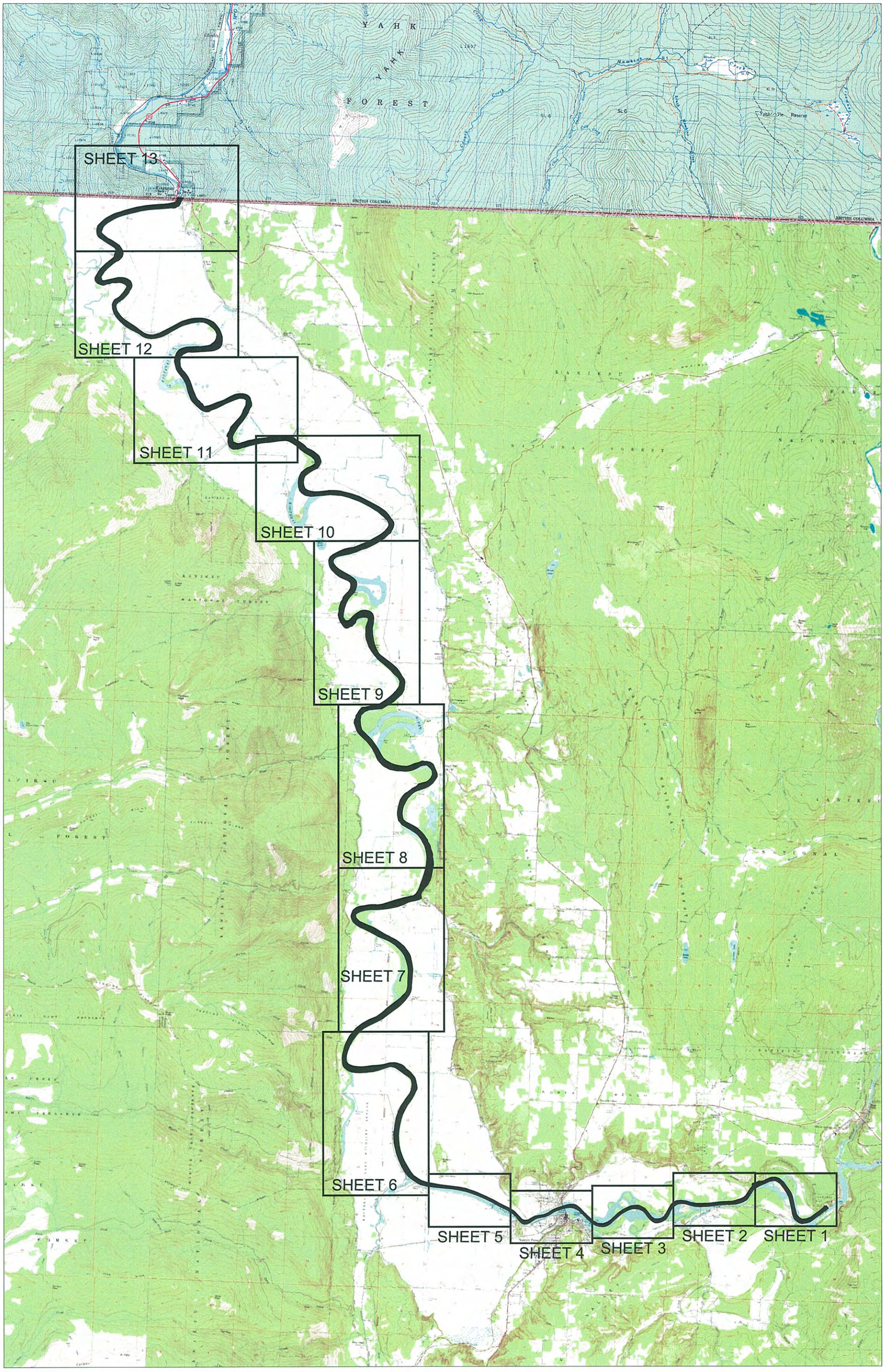
COVER SHEET
CONCEPTUAL DESIGN
PLAN AND PROFILE SHEETS

PREPARED FOR: KOOTENIA TRIBE OF IDAHO
242 HATCHERY ROAD
BONNERS FERRY, ID 83805
(208) 289-3620

KOOTENAI RIVER
Stream Restoration/Stabilization
Boundary County, ID

PREPARED BY: WILDLAND HYDROLOGY
11210 N COUNTY RD 19
FORT COLLINS, CO 80524
(970) 568-0002

DATE:	05/16/08
PROJECT NO.	
FILE NAME:	Kootenai River.DWG
SHEET NAME:	1
SHEET NO.	1



SHEET NO. 2	SHEET NAME: 2	FILE NAME: Kootenai River.DWG	PROJECT NO.	DATE: 05/16/08	KOOTENAI RIVER Stream Restoration/Stabilization Boundary County, ID WILDLAND HYDROLOGY KOOTENIA TRIB	DESIGN PLAN VIEW SHEETS COVER SHEET - CONCEPTUAL PLAN VIEW SCALE 1"=300' 0 5000 1000 NORTH	

NO	REVISIONS	DRN	CHK	DATE:
1	CONCEPTUAL DESIGN – RESTORATION PLAN SET DRAFT #1	DAB	DLR	05/16/08

DRAFT

NO	REVISIONS	DRN	CHK	DATE
1	CONCEPTUAL DESIGN – RESTORATION PLAN SET DRAFT #1	DAB	DLR	05/16/08

DRAFT

DESIGN PLAN VIEW SHEETS
SHEET PL-1 OF PL-13

NORTH

SCALE 1"=300'
0 300 600

KOOTENAI RIVER
Stream Restoration/Stabilization
Boundary County, ID

WILDLAND HYDROLOGY
KOOTENAI TRIBE

DATE:	05/16/08
PROJECT NO.	
FILE NAME:	Kootenai River.DWG
SHEET NAME:	PL-1
SHEET NO.	3

SHEET 3 MATCH LINE - STATION 215+51

SHEET 1 MATCH LINE - STATION 115+73

KOOTENAI RIVER Stream Restoration/Stabilization Boundary County, ID	DESIGN PLAN VIEW SHEETS SHEET PL-2 OF PL-13		1	CONCEPTUAL DESIGN – RESTORATION PLAN SET DRAFT #1	DAB DLR 05/16/08
WILDLAND HYDROLOGY KOOTENAI TRIBE	SCALE 1"=300' 0 300 600	DRAFT	NO	REVISIONS	DRN CHK DATE:

DATE: 05/16/08
PROJECT NO.
FILE NAME: Kootenai River.DWG
SHEET NAME: PL-2
SHEET NO. 4

NO.	REVISIONS	DRN.	CHK.	DATE:
1	CONCEPTUAL DESIGN – RESTORATION PLAN SET DRAFT #1	DAB	DLR	05/16/08

DRAFT

DESIGN PLAN VIEW SHEETS
SHEET PL-3 OF PL-13

NORTH

SCALE 1"=300'
0 300 600

KOOTENAI RIVER
Stream Restoration/Stabilization
Boundary County, ID

WILDLAND HYDROLOGY
KOOTENAI TRIBE

DATE:	05/16/08
PROJECT NO.	
FILE NAME:	Kootenai River.DWG
SHEET NAME:	PL-3
SHEET NO.	5

SHEET 5 MATCH LINE - STATION 435+81

SHEET 3 MATCH LINE - STATION 329+21

NO	REVISIONS	DRN	CHK	DATE
1	CONCEPTUAL DESIGN – RESTORATION PLAN SET DRAFT #1	DAB	DLR	05/16/08

DRAFT

DESIGN PLAN VIEW SHEETS
SHEET PL-4 OF PL-13

SCALE 1"=300'
0 300 600

NORTH

KOOTENAI RIVER
Stream Restoration/Stabilization
Boundary County, ID

WILDLAND HYDROLOGY
KOOTENAI TRIBE

DATE:	05/16/08
PROJECT NO.	
FILE NAME:	Kootenai River.DWG
SHEET NAME:	PL-4
SHEET NO.	6

SHEET 6 MATCH LINE - STATION 531+31

SHEET 4 MATCH LINE - STATION 435+81

DATE: 05/16/08	KOOTENAI RIVER Stream Restoration/Stabilization Boundary County, ID	DESIGN PLAN VIEW SHEETS SHEET PL-5 OF PL-13	1	CONCEPTUAL DESIGN – RESTORATION PLAN SET DRAFT #1	DAB DLR 05/16/08
PROJECT NO.		SCALE 1"=300' 0 300 600		DRAFT	
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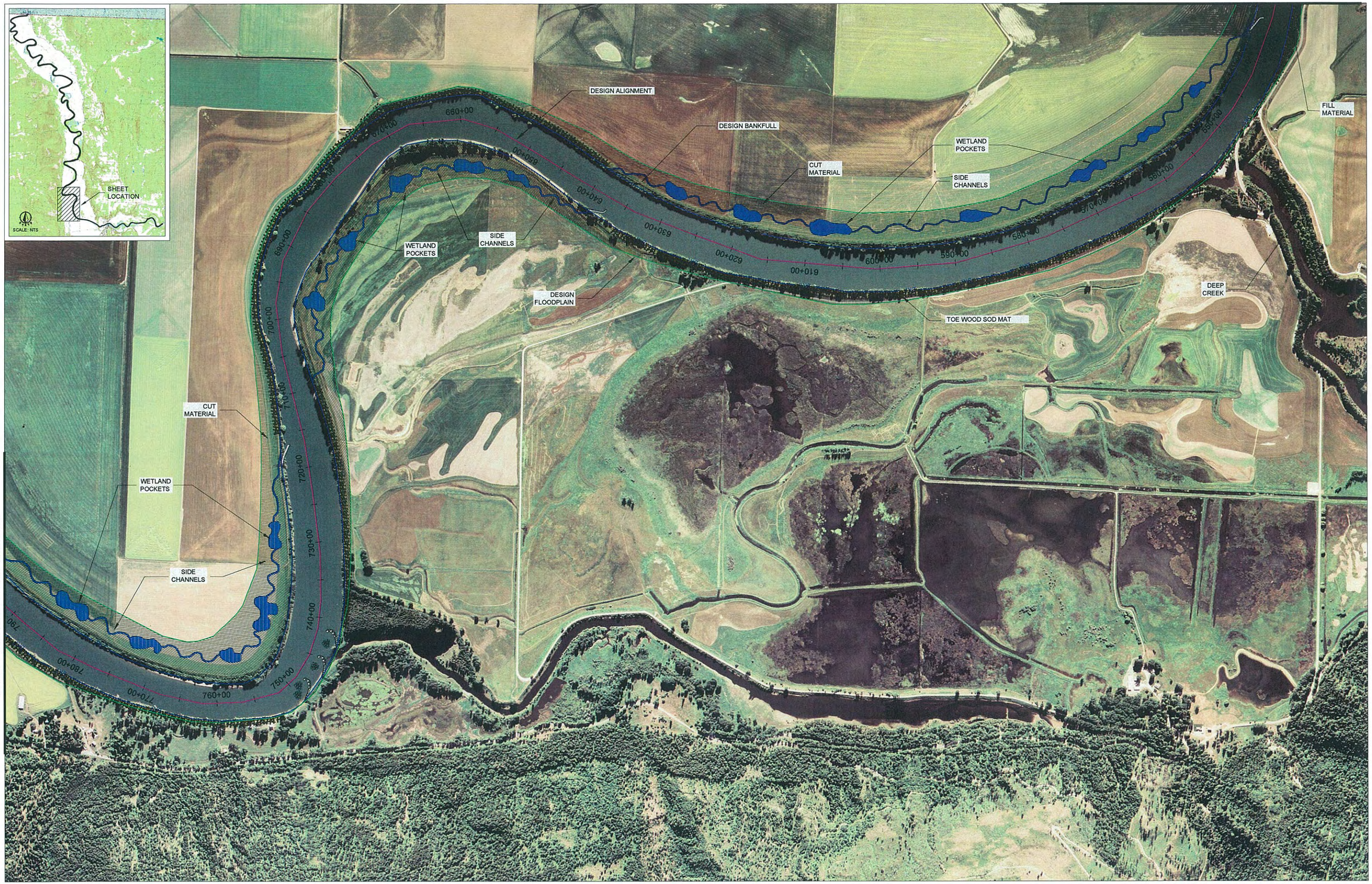
SHEET NO. 7					

SHEET 5 MATCH LINE - STATION 531+31



SHEET 7 MATCH LINE - STATION 792+07

NO	REVISIONS	DRN	CHK	DATE:
1	CONCEPTUAL DESIGN – RESTORATION PLAN SET DRAFT #1	DAB	DLR	05/16/08

DRAFT

DESIGN PLAN VIEW SHEETS
SHEET PL-6 OF PL-13

SCALE 1"=600'
0 600 1200

NORTH

KOOTENAI RIVER
Stream Restoration/Stabilization
Boundary County, ID

WILDLAND HYDROLOGY
KOOTENAI TRIBE

DATE:	05/16/08
PROJECT NO.	
FILE NAME:	Kootenai River.DWG
SHEET NAME:	PL-6
SHEET NO.	8

SHEET 8 MATCH LINE - STATION 1092+45

SHEET 6 MATCH LINE - STATION 792+07

DATE: 05/16/08	KOOTENAI RIVER Stream Restoration/Stabilization Boundary County, ID	DESIGN PLAN VIEW SHEETS SHEET PL-7 OF PL-13		1 CONCEPTUAL DESIGN – RESTORATION PLAN SET DRAFT #1	DAB DLR 05/16/08
PROJECT NO.	WILDLAND HYDROLOGY KOOTENAI TRIBE	SCALE 1"=600' 0 600 1200	NORTH	DRAFT	
FILE NAME: Kootenai River.DWG					
SHEET NAME: PL-7					
SHEET NO. 9				NO REVISIONS	DRN CHK DATE:

SHEET 9 MATCH LINE - STATION 1387+67

SHEET 7 MATCH LINE - STATION 1092+45

SHEET NO. 10	SHEET NAME: PL-8	FILE NAME: Kootenai River.DWG	PROJECT NO.	DATE: 05/16/08	
KOOTENAI RIVER Stream Restoration/Stabilization Boundary County, ID			WILDLAND HYDROLOGY KOOTENAI TRIBE		
DESIGN PLAN VIEW SHEETS SHEET PL-8 OF PL-13			SCALE 1"=600' 0 600 1200	NORTH	

NO	REVISIONS	DRN	CHK	DATE:
1	CONCEPTUAL DESIGN – RESTORATION PLAN SET DRAFT #1	DAB	DLR	05/16/08

DRAFT

SHEET 10 MATCH LINE - STATION 1682+73

SHEET 8 MATCH LINE - STATION 1387+67

SHEET NO. 11	DATE: 05/16/08	KOOTENAI RIVER Stream Restoration/Stabilization Boundary County, ID	DESIGN PLAN VIEW SHEETS SHEET PL-9 OF PL-13	1 CONCEPTUAL DESIGN – RESTORATION PLAN SET DRAFT #1	DAB DLR 05/16/08
SHEET NAME: PL-9	PROJECT NO.	WILDLAND HYDROLOGY KOOTENAI TRIBE	SCALE 1"=600' 0 600 1200	DRAFT	
FILE NAME: Kootenai River.DWG			NORTH	NO REVISIONS	DRN CHK DATE:

SHEET NO. 12	PROJECT NO.	DATE: 05/16/08	KOOTENAI RIVER Stream Restoration/Stabilization Boundary County, ID	DESIGN PLAN VIEW SHEETS SHEET PL-10 OF PL-13	
	FILE NAME: Kootenai River.DWG		WILDLAND HYDROLOGY KOOTENAI TRIBE	SCALE 1"=600' 0 600 1200	NORTH
	SHEET NAME: PL-10				

NO	REVISIONS	DRN	CHK	DATE:
1	CONCEPTUAL DESIGN – RESTORATION PLAN SET DRAFT #1	DAB	DLR	05/16/08

DRAFT

SHEET 12 MATCH LINE - STATION 2142+84

SHEET 10 MATCH LINE - STATION 1893+03

NO	REVISIONS	DRN	CHK	DATE:
1	CONCEPTUAL DESIGN – RESTORATION PLAN SET DRAFT #1	DAB	DLR	05/16/08

DRAFT

DESIGN PLAN VIEW SHEETS
SHEET PL-11 OF PL-13

SCALE 1"=600'
0 600 1200

NORTH

KOOTENAI RIVER
Stream Restoration/Stabilization
Boundary County, ID

WILDLAND HYDROLOGY
KOOTENAI TRIBE

DATE:	05/16/08
PROJECT NO.	
FILE NAME:	Kootenai River.DWG
SHEET NAME:	PL-11
SHEET NO.	13

SHEET 13 MATCH LINE - STATION 2451+61

SHEET 11 MATCH LINE - STATION 2142+84

NO	REVISIONS	DRN	CHK	DATE:
1	CONCEPTUAL DESIGN – RESTORATION PLAN SET DRAFT #1	DAB	DLR	05/16/08

DRAFT

DESIGN PLAN VIEW SHEETS
SHEET PL-12 OF PL-13

SCALE 1"=600'
0 600 1200
NORTH

KOOTENAI RIVER
Stream Restoration/Stabilization
Boundary County, ID

WILDLAND HYDROLOGY
KOOTENAI TRIBE

DATE:	05/16/08
PROJECT NO.	
FILE NAME:	Kootenai River.DWG
SHEET NAME:	PL-12
SHEET NO.	14

NO	REVISIONS	DRN	CHK	DATE:
1	CONCEPTUAL DESIGN – RESTORATION PLAN SET DRAFT #1	DAB	DLR	05/16/08

DRAFT

DESIGN PLAN VIEW SHEETS
SHEET PL-13 OF PL-13

SCALE 1" = 600'
0 600 1200

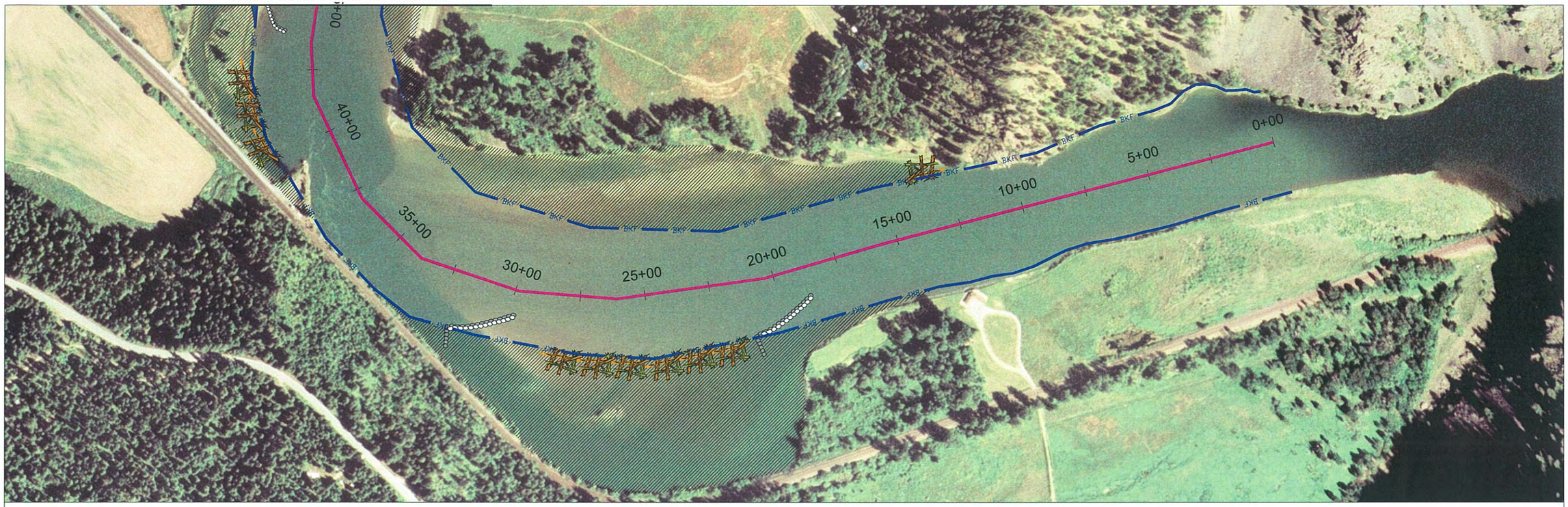
NORTH

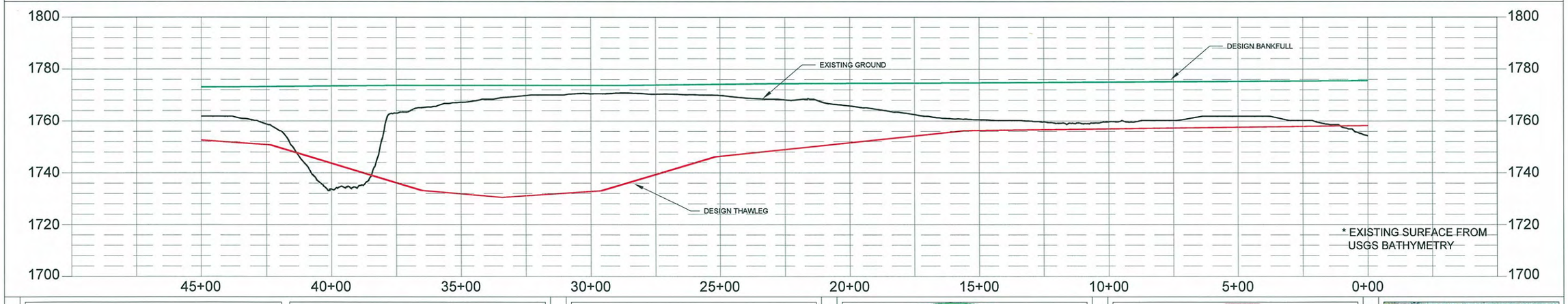
KOOTENAI RIVER
Stream Restoration/Stabilization
Boundary County, ID

WILDLAND HYDROLOGY
KOOTENAI TRIBE

DATE:	05/16/08
PROJECT NO.	
FILE NAME:	Kootenai River.DWG
SHEET NAME:	PL-13
SHEET NO.	15

SHEET PR-2 MATCH LINE - STATION 45+00





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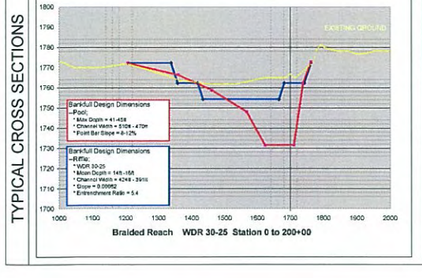
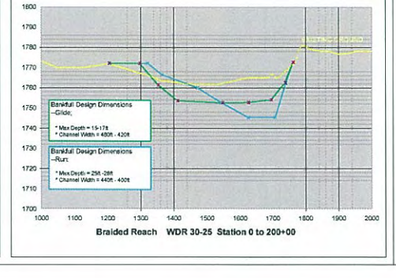
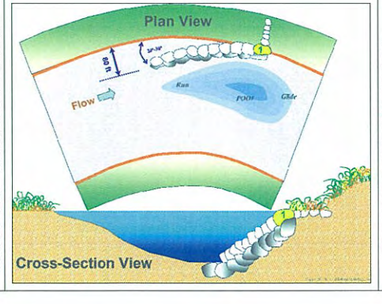
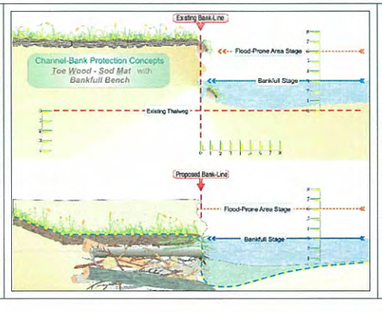




ROCK VANE STRUCTURE DETAIL



TOE WOOD SOD MAT DETAIL



SHEET LOCATION MAP

NO	REVISIONS	DRN	CHK	DATE:
1	CONCEPTUAL DESIGN – RESTORATION PLAN SET DRAFT #1	DAB	DLR	05/16/08

DRAFT

DESIGN PLAN VIEW SHEETS
SHEET PR-1 OF PR-22

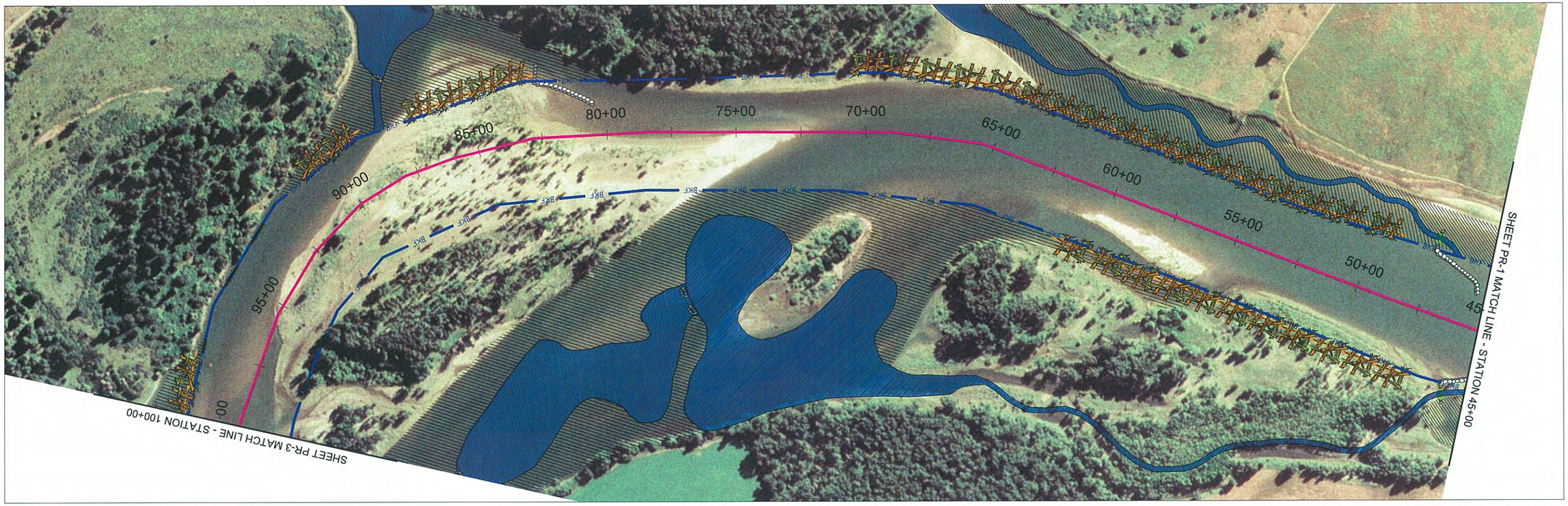
SCALE 1"=200'
0 200 400

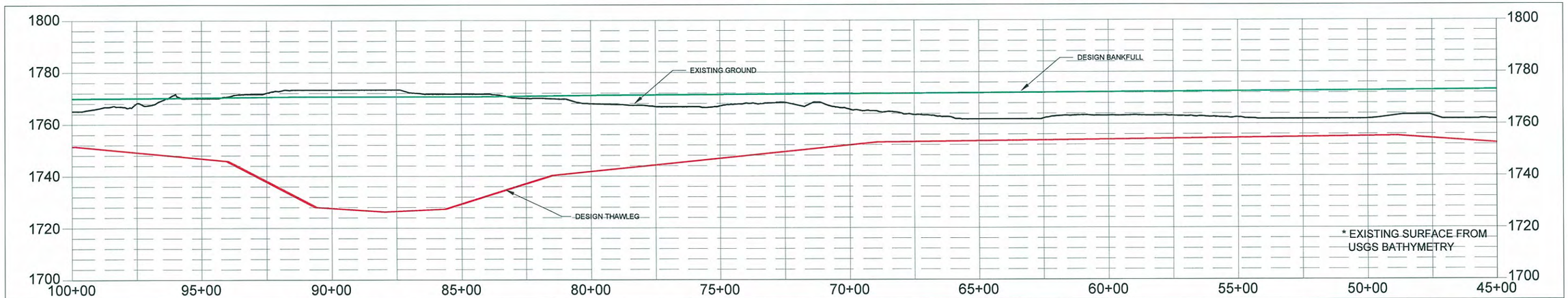
NORTH

KOOTENAI RIVER
Stream Restoration/Stabilization
Boundary County, ID

WILDLAND HYDROLOGY
KOOTENAI TRIBE

DATE:	05/16/08
PROJECT NO.	
FILE NAME:	Kootenai River.DWG
SHEET NAME:	PR-1
SHEET NO.	16





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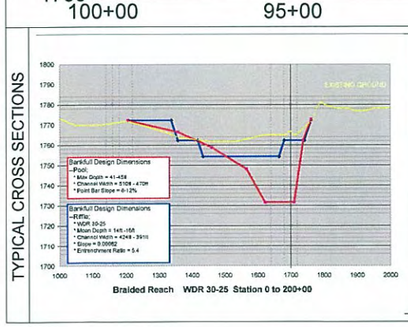
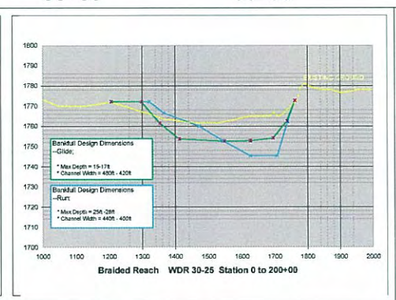
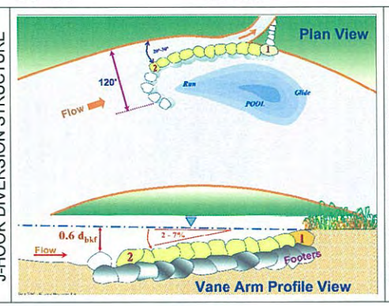
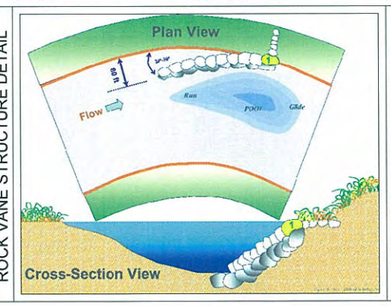




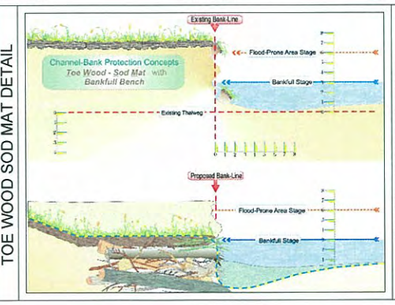
J-HOOK DIVERSION STRUCTURE



ROCK VANE STRUCTURE DETAIL



TOE WOOD SOD MAT DETAIL



SHEET LOCATION MAP

NO	REVISIONS	DRN	CHK	DATE:
1	CONCEPTUAL DESIGN – RESTORATION PLAN SET DRAFT #1	DAB	DLR	05/16/08

DRAFT

DESIGN PLAN VIEW SHEETS
SHEET PR-2 OR PR-22

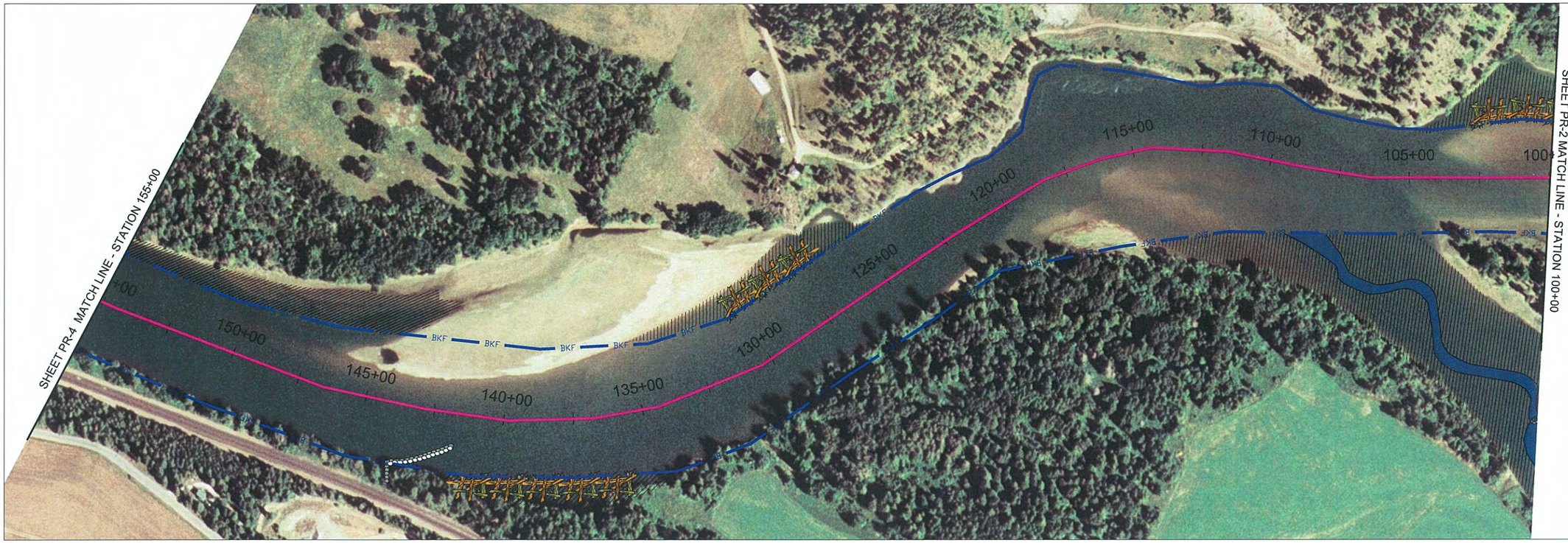
SCALE 1"=200'
0 200 400

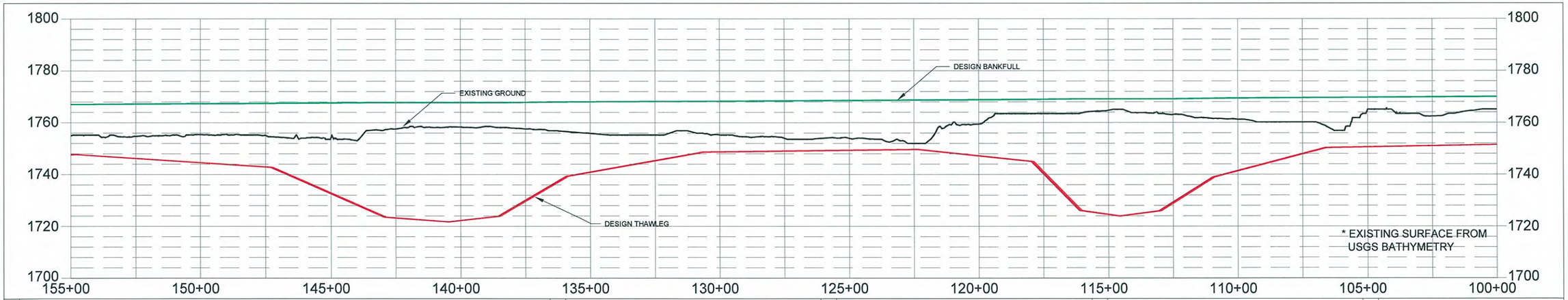
NORTH

KOOTENAI RIVER
Stream Restoration/Stabilization
Boundary County, ID

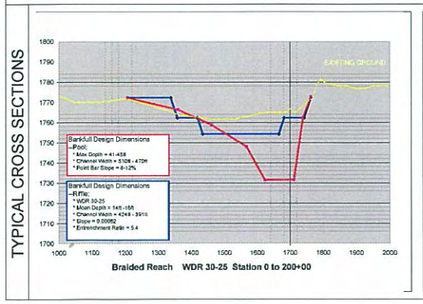
WILDLAND HYDROLOGY
KOOTENAI TRIBE

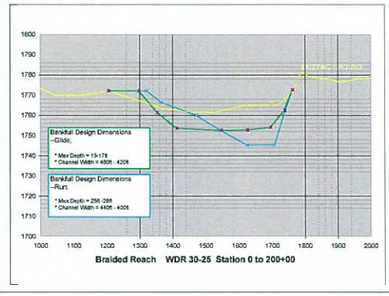
DATE:	05/16/08
PROJECT NO.	
FILE NAME:	Kootenai River.DWG
SHEET NAME:	PR-2
SHEET NO.	16



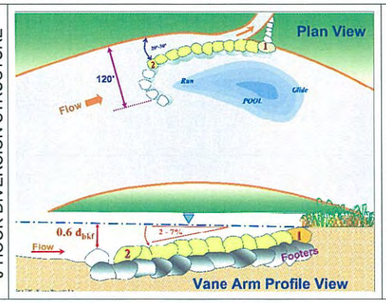


TYPICAL CROSS SECTIONS

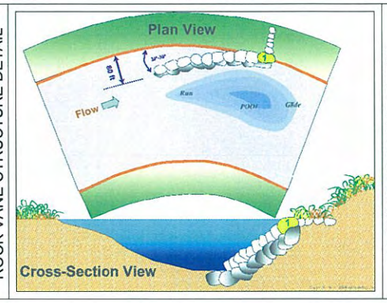




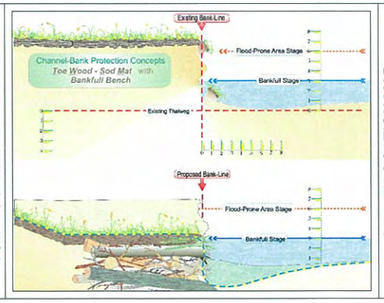
J-HOOK DIVERSION STRUCTURE



ROCK VANE STRUCTURE DETAIL



TOE WOOD SOD MAT DETAIL



SHEET LOCATION MAP

NO	REVISIONS	DRN	CHK	DATE
1	CONCEPTUAL DESIGN – RESTORATION PLAN SET DRAFT #1	DAB	DLR	05/16/08

DRAFT

DESIGN PLAN VIEW SHEETS
SHEET PR-3 OF PR-22

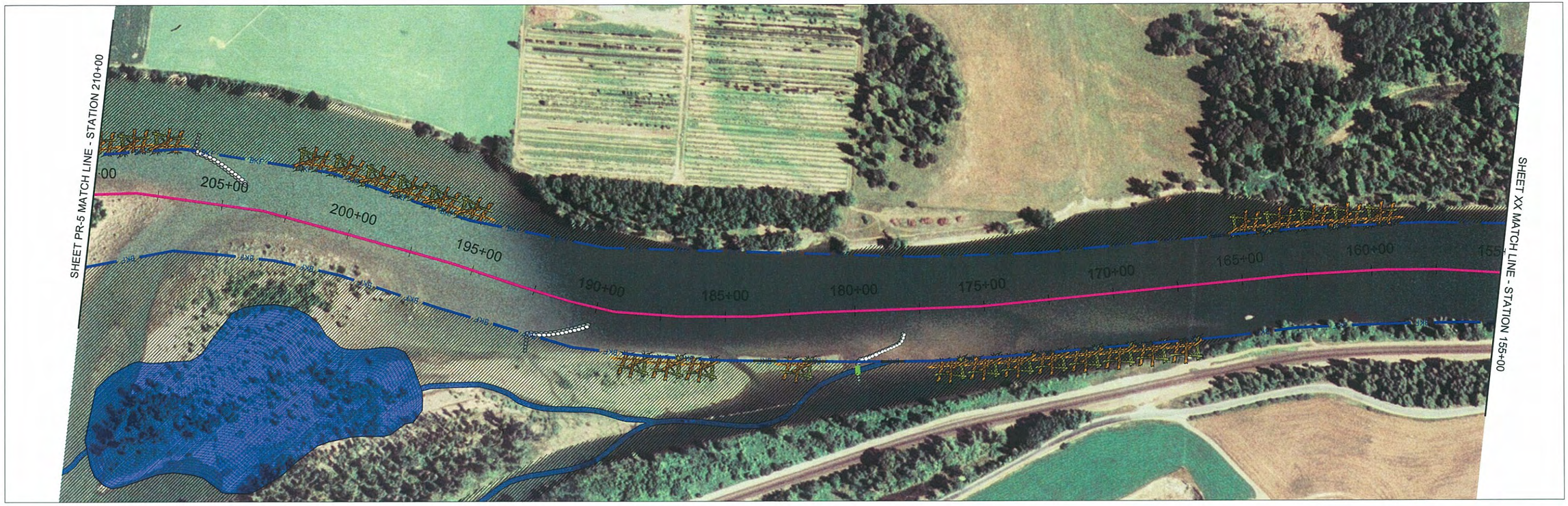
NORTH

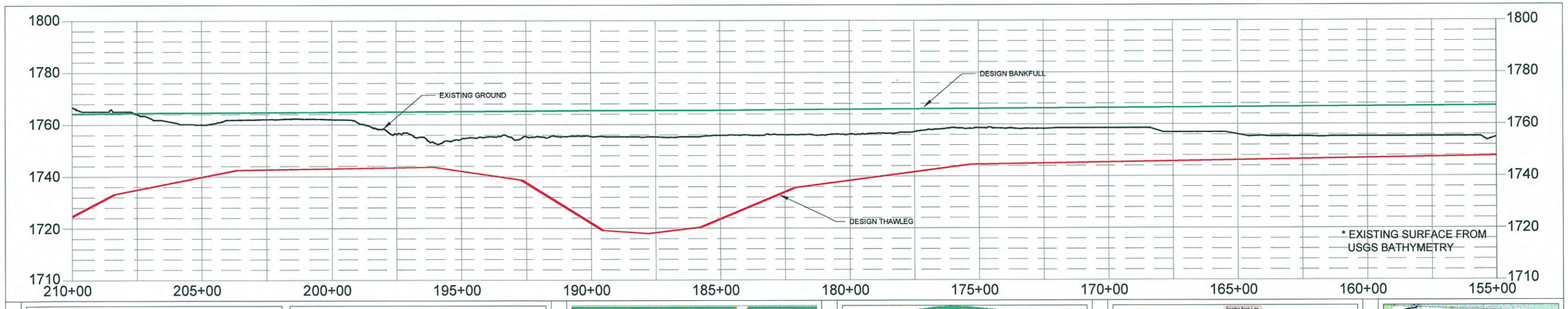
SCALE 1"=200'
0 200 400

KOOTENAI RIVER
Stream Restoration/Stabilization
Boundary County, ID

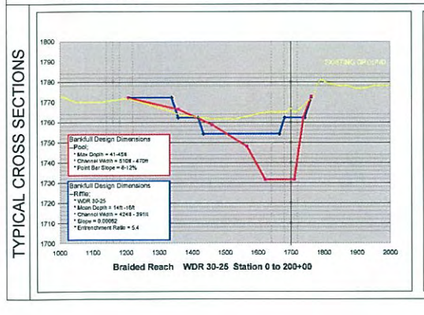
WILDLAND HYDROLOGY
KOOTENAI TRIBE

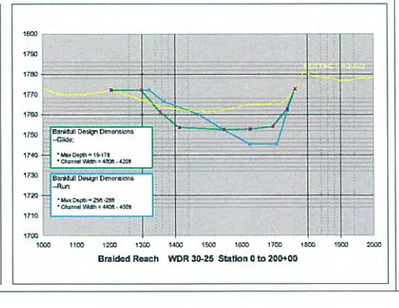
DATE:	05/16/08
PROJECT NO.	
FILE NAME:	Kootenai River.DWG
SHEET NAME:	PR-3
SHEET NO.	17



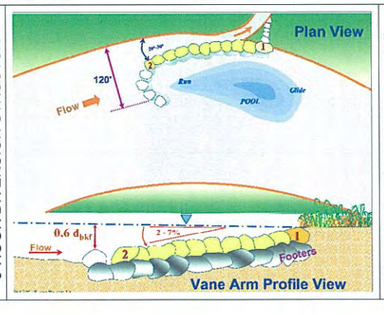


TYPICAL CROSS SECTIONS

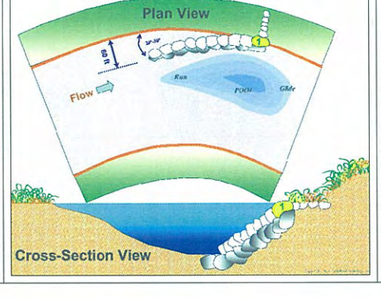




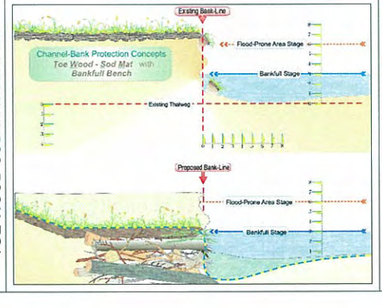
J-HOOK DIVERSION STRUCTURE



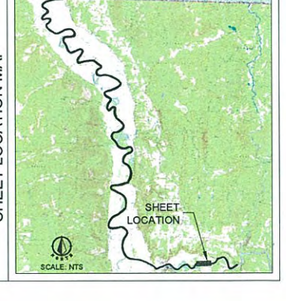
ROCK VANE STRUCTURE DETAIL



TOE WOOD SOD MAT DETAIL



SHEET LOCATION MAP



NO.	REVISIONS	DRN.	CHK.	DATE:
1	CONCEPTUAL DESIGN – RESTORATION PLAN SET DRAFT #1	DAB	DLR	05/16/08

DRAFT

DESIGN PLAN VIEW SHEETS
SHEET PR-4 OF PR-22

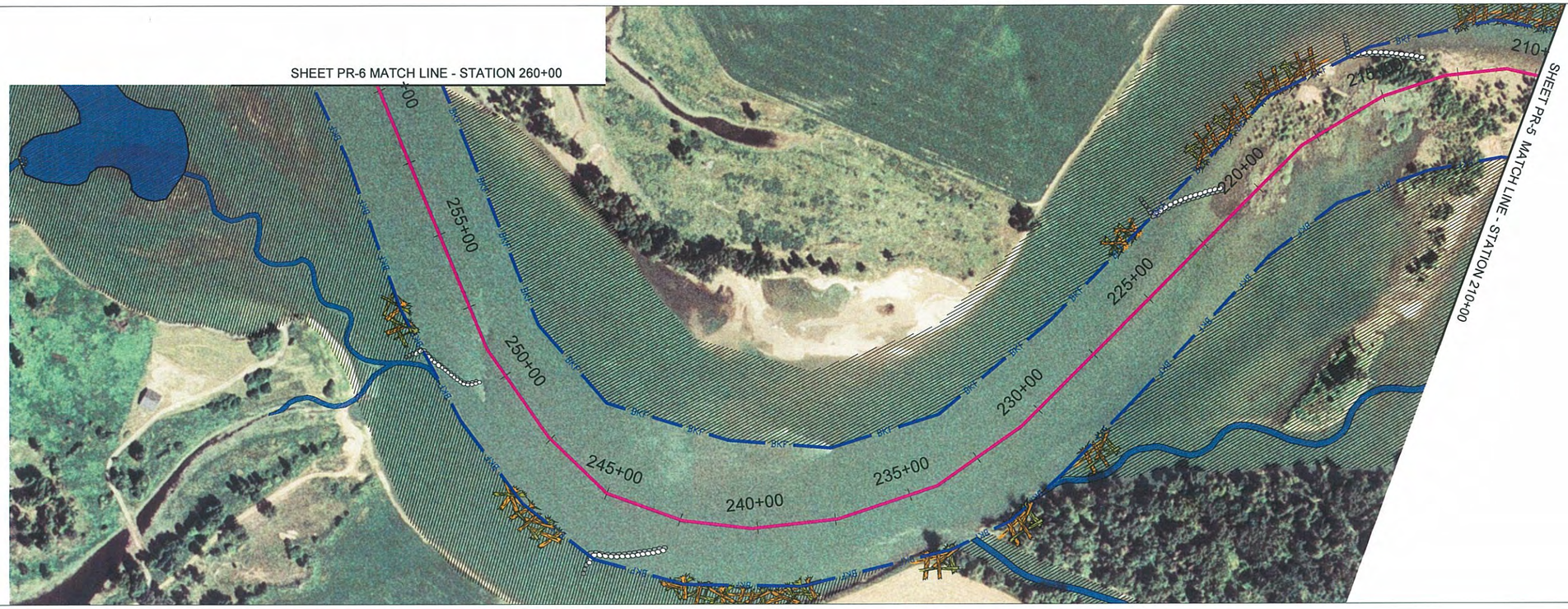
SCALE 1"=200'
0 200 400

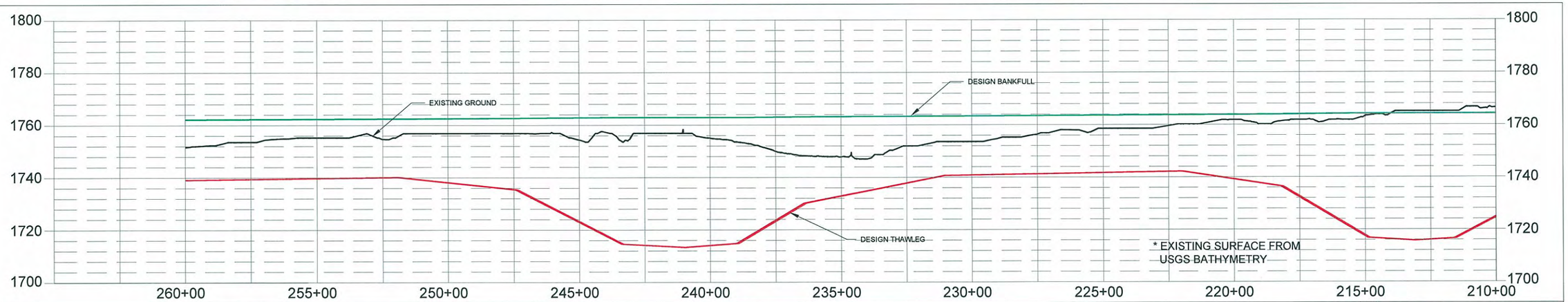
NORTH

KOOTENAI RIVER
Stream Restoration/Stabilization
Boundary County, ID

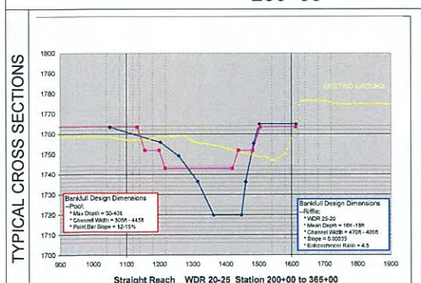
WILDLAND HYDROLOGY
KOOTENAI TRIBE

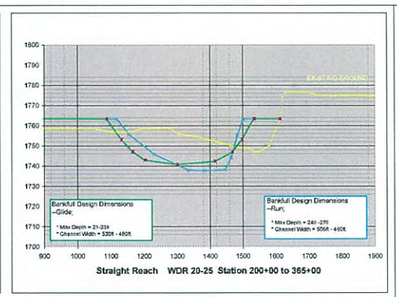
DATE:	05/16/08
PROJECT NO.	
FILE NAME:	Kootenai River.DWG
SHEET NAME:	PR-4
SHEET NO.	18



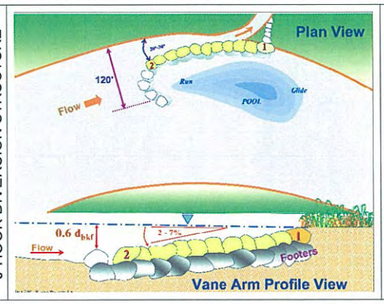


TYPICAL CROSS SECTIONS

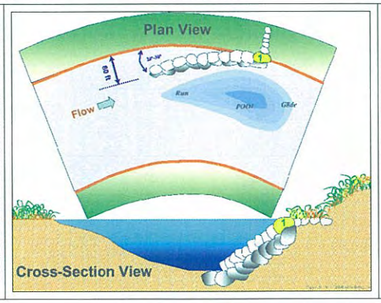




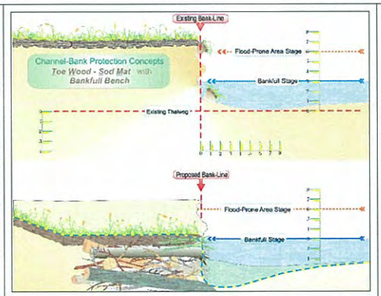
J-HOOK DIVERSION STRUCTURE



ROCK VANE STRUCTURE DETAIL



TOE WOOD SOD MAT DETAIL



SHEET LOCATION MAP

NO	REVISIONS	DRN	CHK	DATE:
1	CONCEPTUAL DESIGN – RESTORATION PLAN SET DRAFT #1	DAB	DLR	05/16/08

DRAFT

DESIGN PLAN VIEW SHEETS
SHEET PR-5 OF PR-22

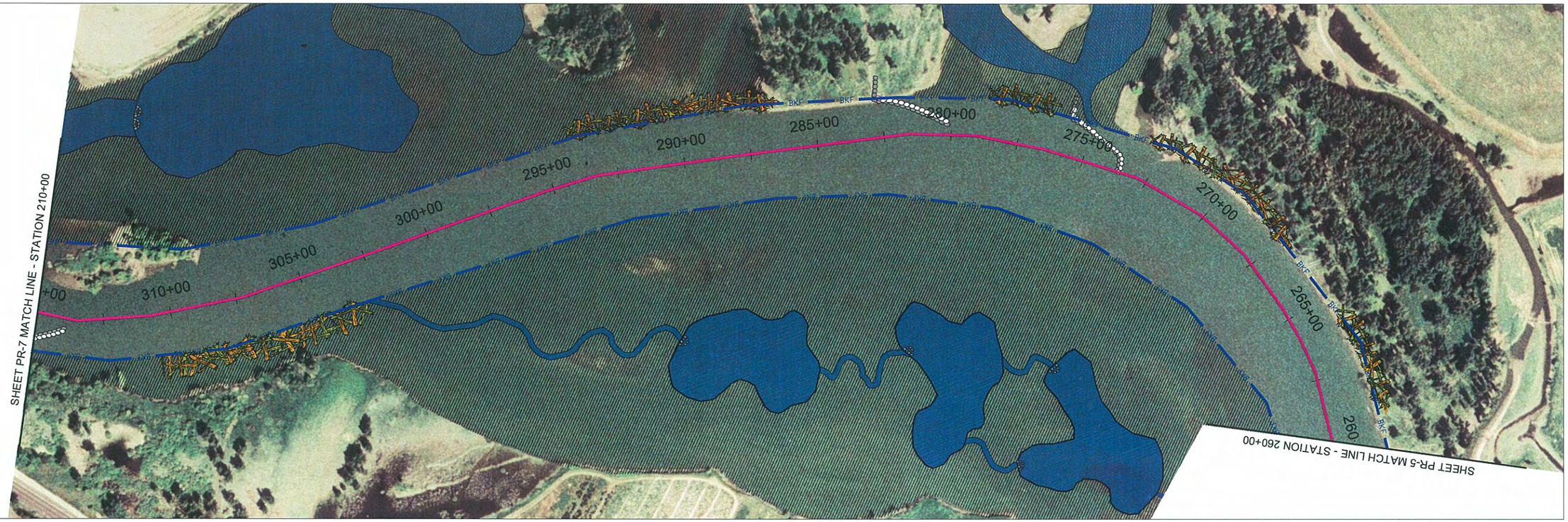
SCALE 1"=200'
0 200 400

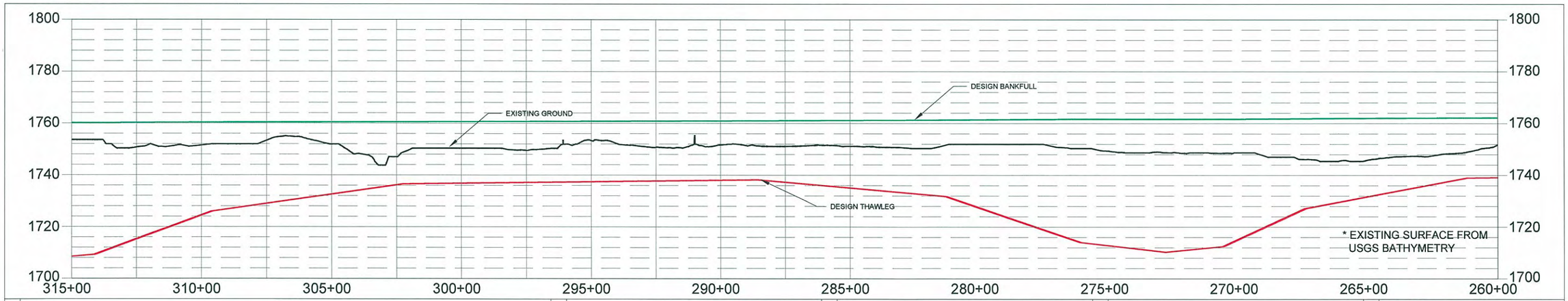
NORTH

KOOTENAI RIVER
Stream Restoration/Stabilization
Boundary County, ID

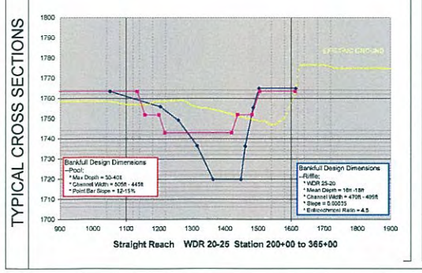
WILDLAND HYDROLOGY
KOOTENAI TRIBE

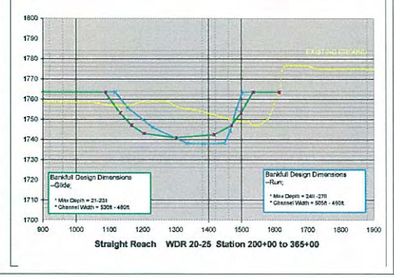
DATE:	05/16/08
PROJECT NO.	
FILE NAME:	Kootenai River.DWG
SHEET NAME:	PR-5
SHEET NO.	19



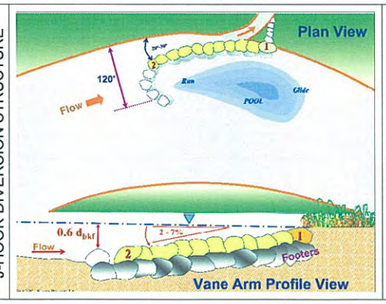


TYPICAL CROSS SECTIONS

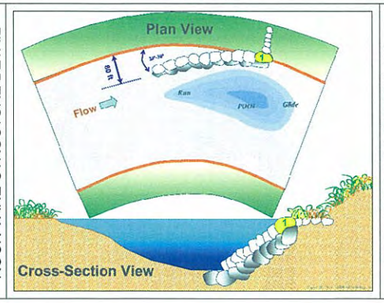




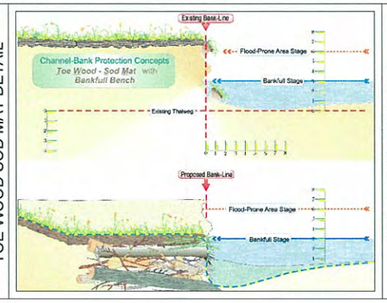
J-HOOK DIVERSION STRUCTURE



ROCK VANE STRUCTURE DETAIL



TOE WOOD SOD MAT DETAIL



SHEET LOCATION MAP

NO	REVISIONS	DRN	CHK	DATE:
1	CONCEPTUAL DESIGN – RESTORATION PLAN SET DRAFT #1	DAB	DLR	05/16/08

DRAFT

DESIGN PLAN VIEW SHEETS
SHEET PR-6 OF PR-22

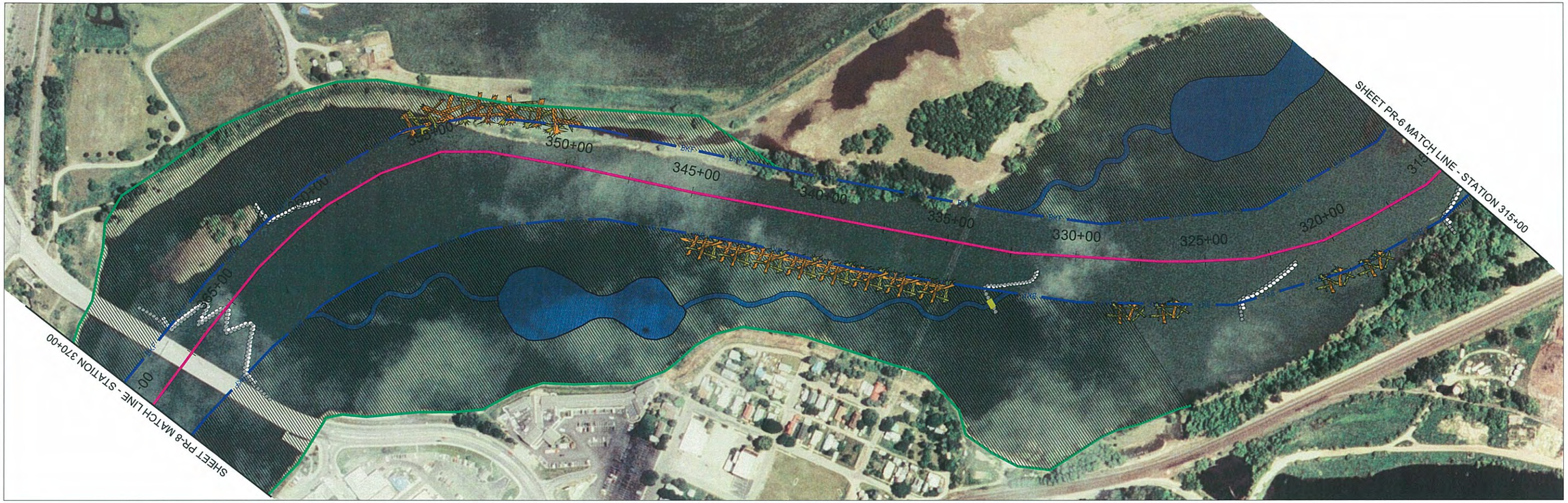
SCALE 1" = 200'
0 200 400

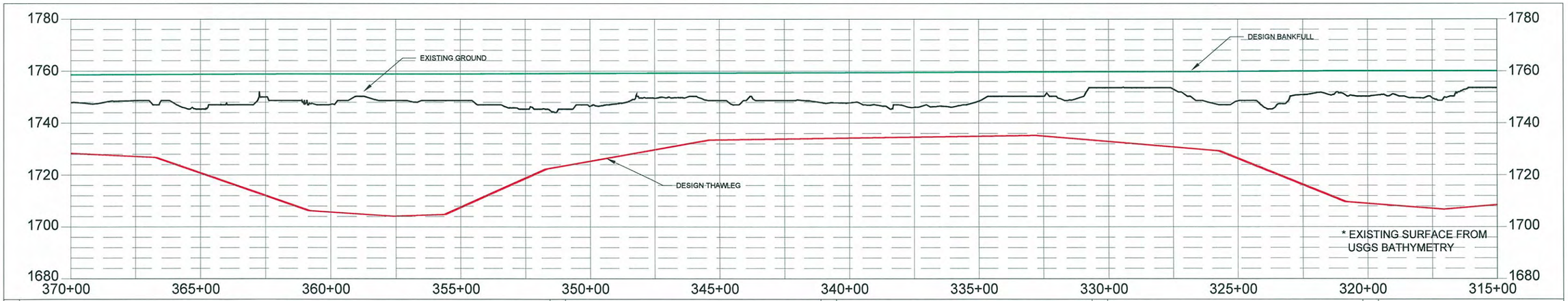
NORTH

KOOTENAI RIVER
Stream Restoration/Stabilization
Boundary County, ID

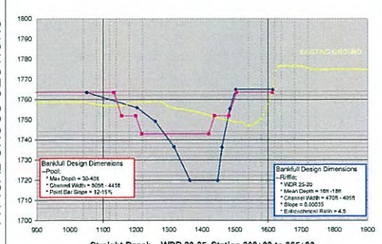
WILDLAND HYDROLOGY
KOOTENAI TRIBE

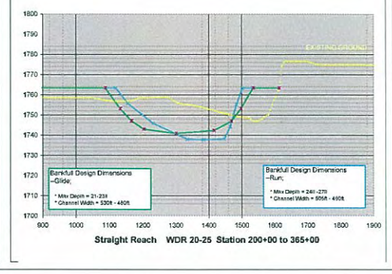
DATE:	05/16/08
PROJECT NO.	
FILE NAME:	Kootenai River.DWG
SHEET NAME:	PR-6
SHEET NO.	20



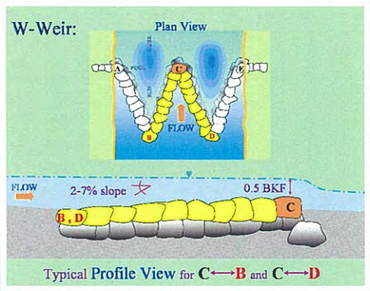


TYPICAL CROSS SECTIONS

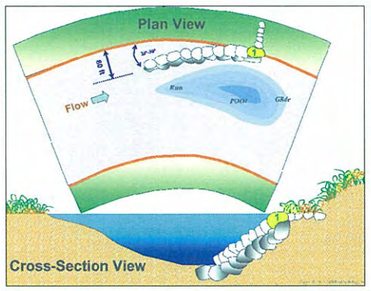




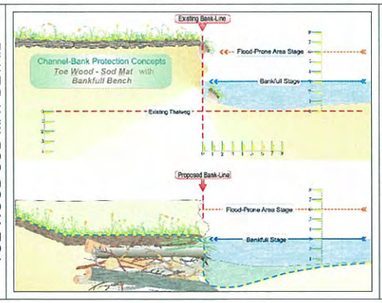
J-HOOK DIVERSION STRUCTURE



ROCK VANE STRUCTURE DETAIL



TOE WOOD SOD MAT DETAIL



SHEET LOCATION MAP

NO	REVISIONS	DRN	CHK	DATE
1	CONCEPTUAL DESIGN – RESTORATION PLAN SET DRAFT #1	DAB	DLR	05/16/08

DRAFT

DESIGN PLAN VIEW SHEETS
SHEET PR-7 OF PR-22

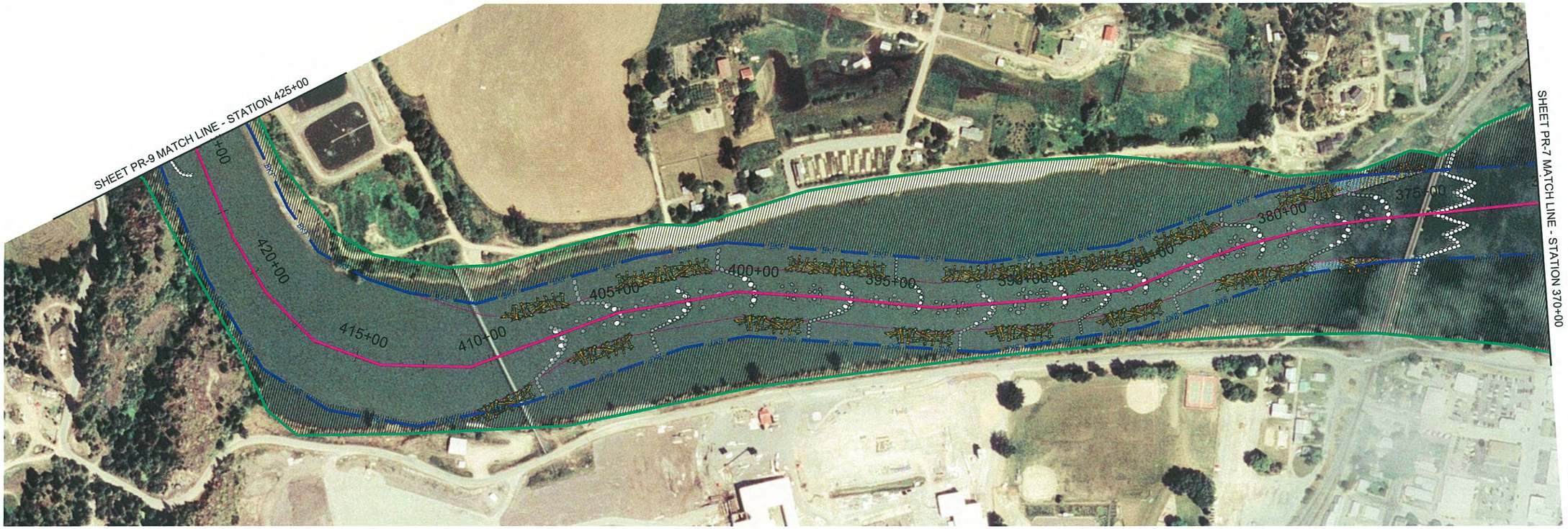
SCALE 1"=200'
0 200 400

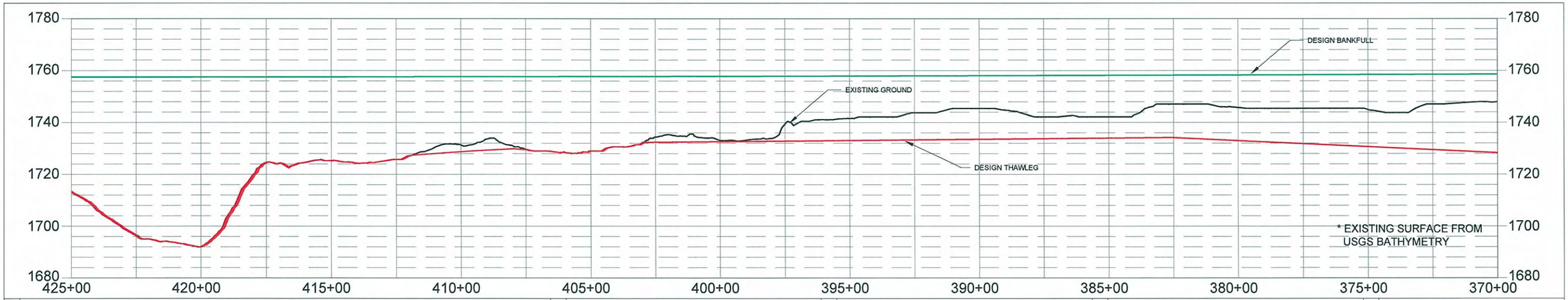
NORTH

KOOTENAI RIVER
Stream Restoration/Stabilization
Boundary County, ID

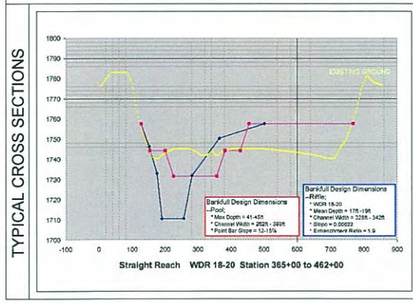
WILDLAND HYDROLOGY
KOOTENAI TRIBE

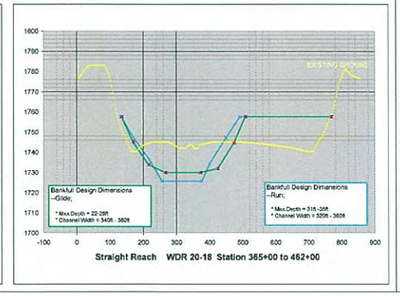
DATE:	05/16/08
PROJECT NO.	
FILE NAME:	Kootenai River.DWG
SHEET NAME:	PR-7
SHEET NO.	21



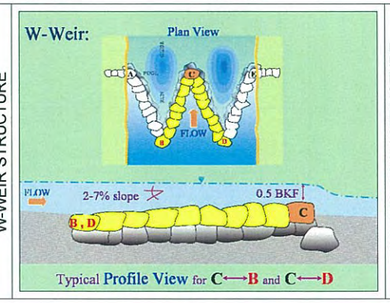


TYPICAL CROSS SECTIONS

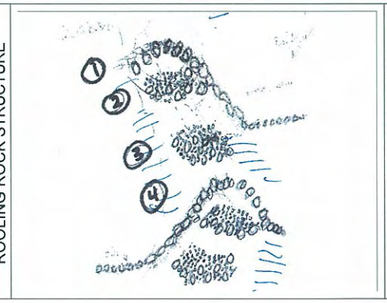




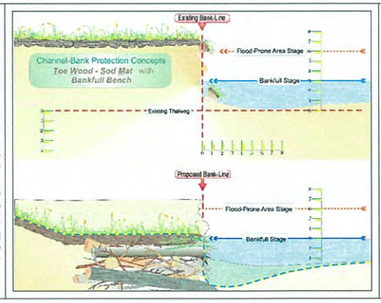
W-WEIR STRUCTURE



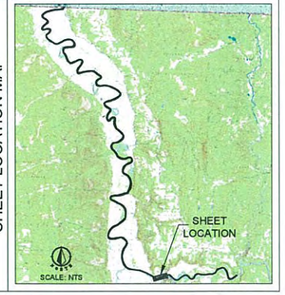
ROOLING ROCK STRUCTURE



TOE WOOD SOD MAT DETAIL



SHEET LOCATION MAP



NO	REVISIONS	DRN	CHK	DATE
1	CONCEPTUAL DESIGN – RESTORATION PLAN SET DRAFT #1	DAB	DLR	05/16/08

DRAFT

DESIGN PLAN VIEW SHEETS
SHEET PR-8 OF PR-22

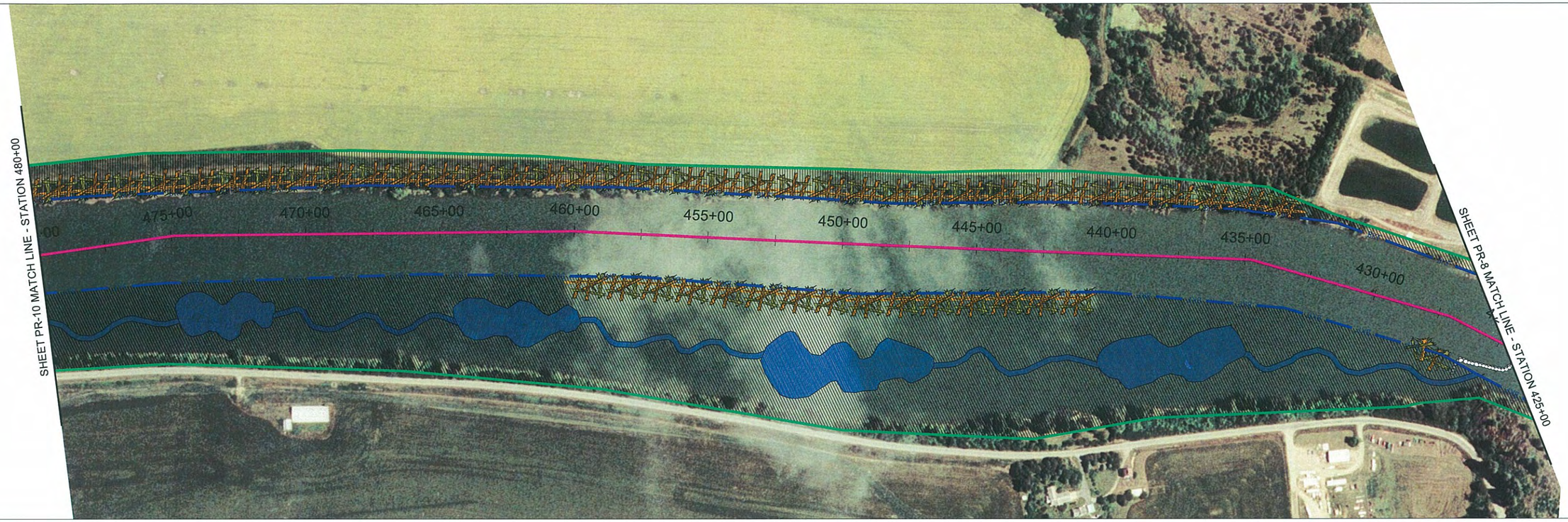
SCALE 1"=200'
0 200 400

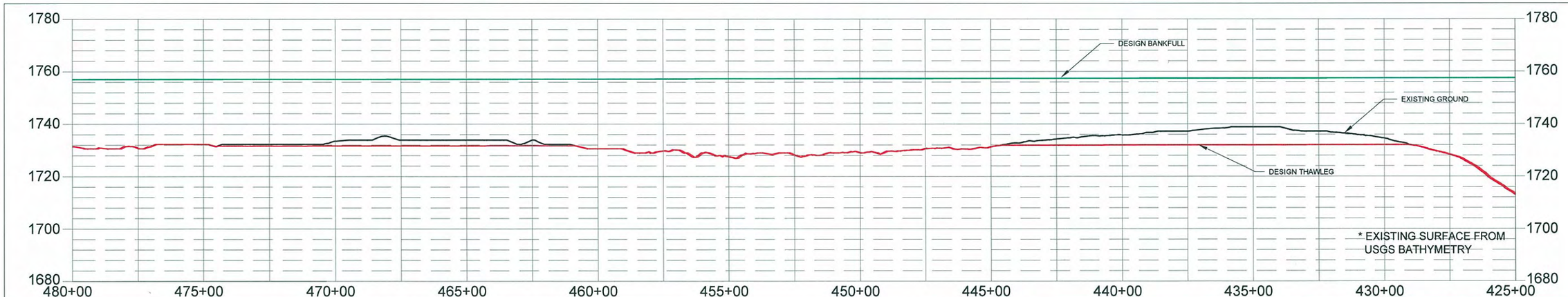
NORTH

KOOTENAI RIVER
Stream Restoration/Stabilization
Boundary County, ID

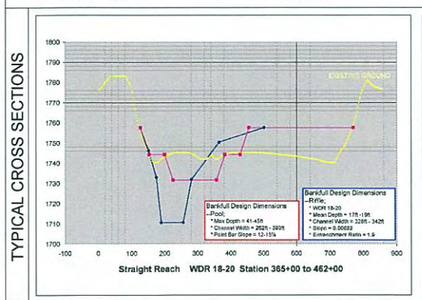
WILDLAND HYDROLOGY
KOOTENAI TRIBE

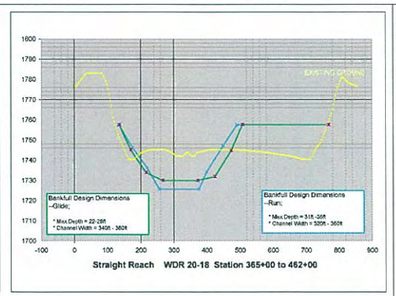
DATE:	05/16/08
PROJECT NO.	
FILE NAME:	Kootenai River.DWG
SHEET NAME:	PR-8
SHEET NO.	22



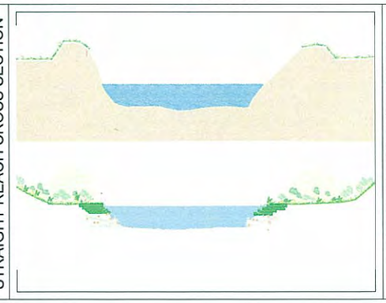


TYPICAL CROSS SECTIONS

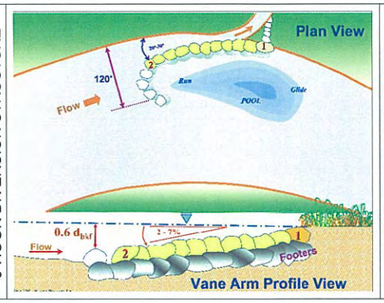




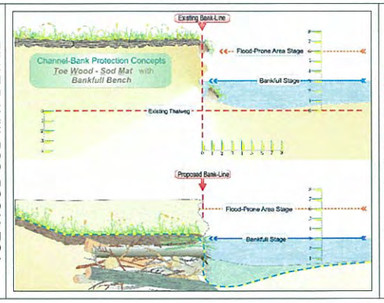
STRAIGHT REACH CROSS SECTION



J-HOOK DIVERSION STRUCTURE



TOE WOOD SOD MAT DETAIL



SHEET LOCATION MAP

NO	REVISIONS	DRN	CHK	DATE
1	CONCEPTUAL DESIGN – RESTORATION PLAN SET DRAFT #1	DAB	DLR	05/16/08

DRAFT

DESIGN PLAN VIEW SHEETS
SHEET PR-9 OF PR-22

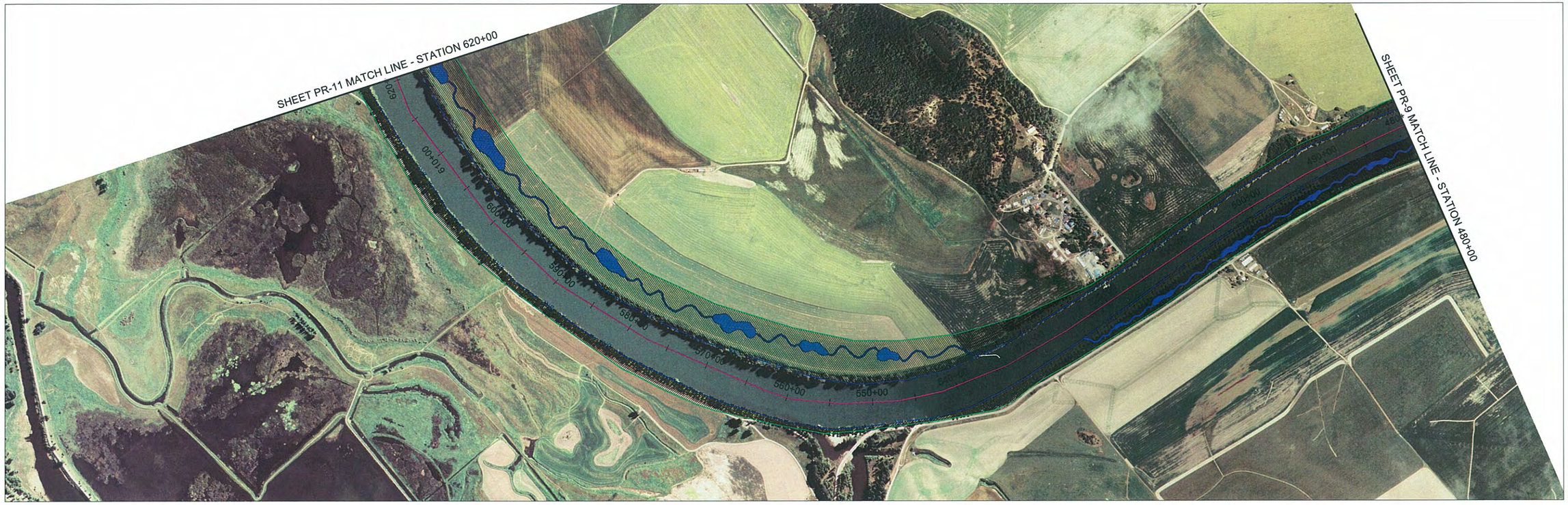
NORTH

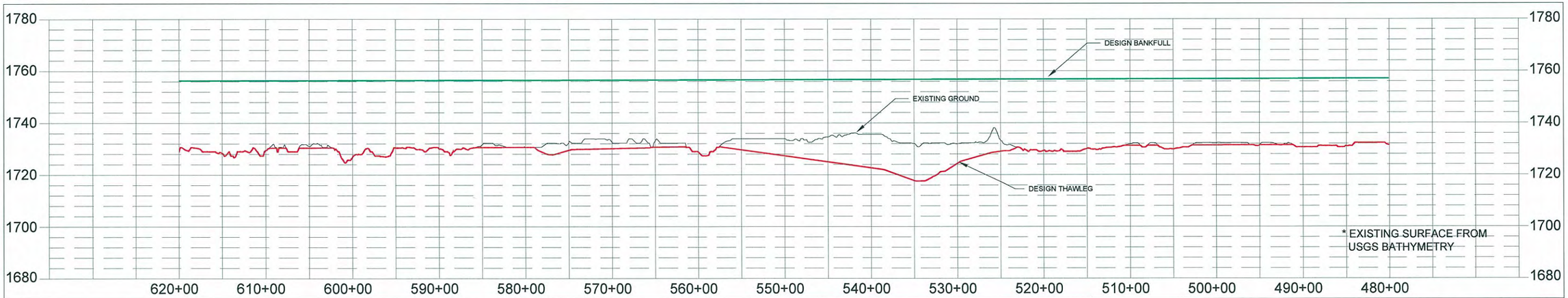
SCALE 1" = 200'
0 200 400

KOOTENAI RIVER
Stream Restoration/Stabilization
Boundary County, ID

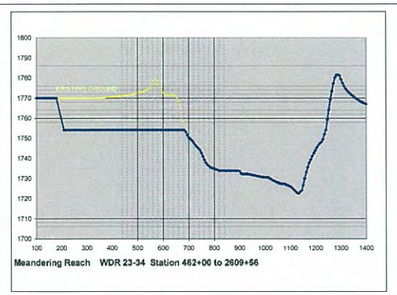
WILDLAND HYDROLOGY
KOOTENAI TRIBE

DATE:	05/16/08
PROJECT NO.	
FILE NAME:	Kootenai River.DWG
SHEET NAME:	PR-9
SHEET NO.	22

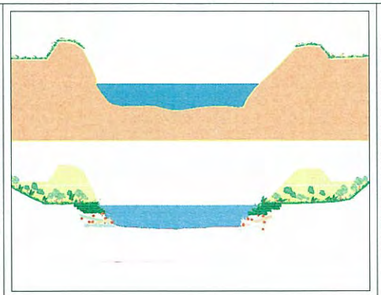




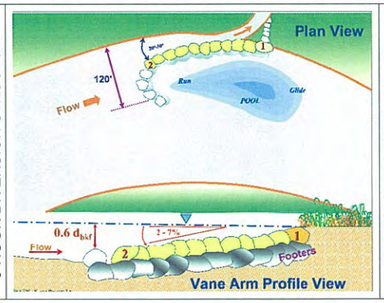
TYPICAL CROSS SECTIONS



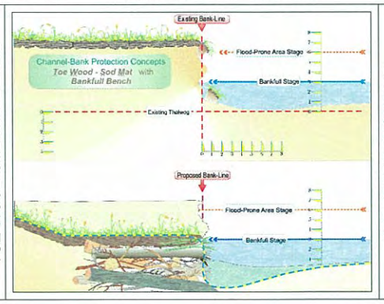
EXISTING VS. DESIGN



J-HOOK DIVERSION STRUCTURE



TOE WOOD SOD MAT DETAIL



SHEET LOCATION MAP

NO	REVISIONS	DRN	CHK	DATE
1	CONCEPTUAL DESIGN – RESTORATION PLAN SET, DRAFT #1	DAB	DLR	05/16/08

DRAFT

DESIGN PLAN VIEW SHEETS
SHEET PR-10 OF PR-22

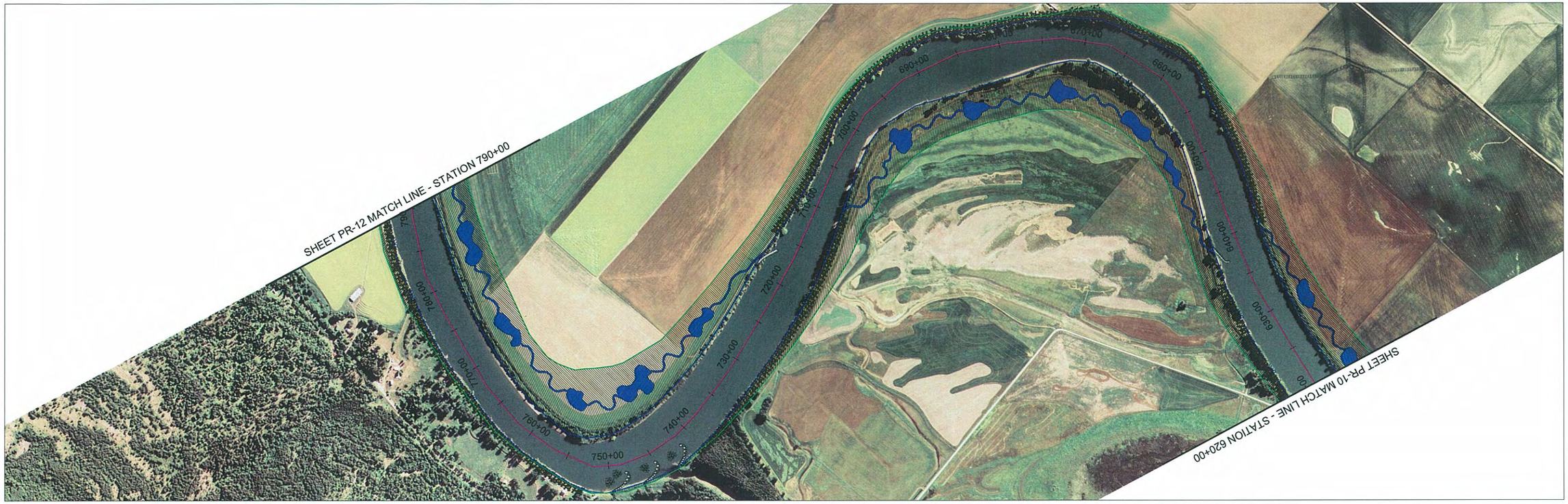
SCALE 1"=600'
0 600 1200

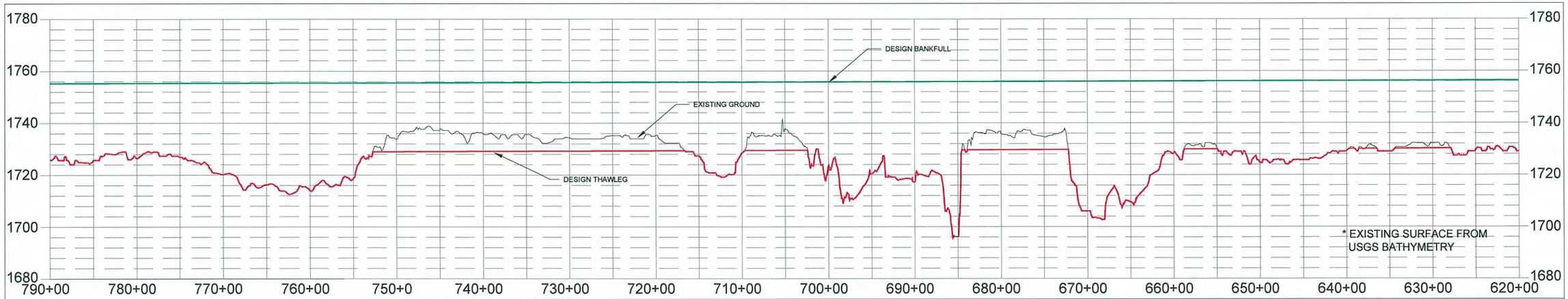
NORTH

KOOTENAI RIVER
Stream Restoration/Stabilization
Boundary County, ID

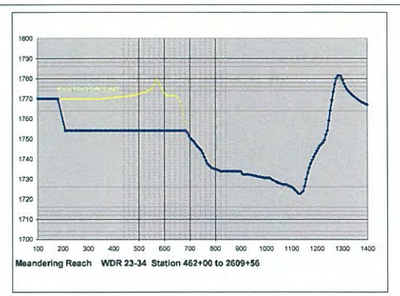
WILDLAND HYDROLOGY
KOOTENAI TRIBE

DATE:	05/16/08
PROJECT NO.	
FILE NAME:	Kootenai River.DWG
SHEET NAME:	PR-10
SHEET NO.	24

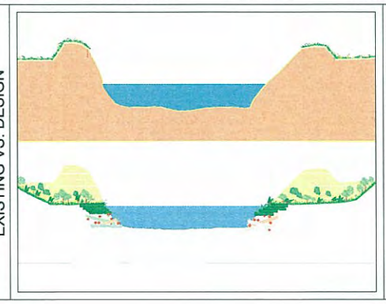




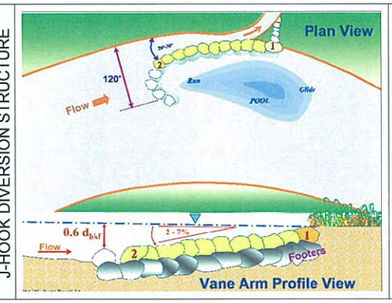
TYPICAL CROSS SECTIONS



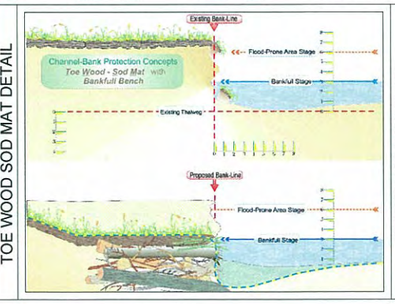
EXISTING VS. DESIGN



J-HOOK DIVERSION STRUCTURE



TOE WOOD SOD MAT DETAIL



SHEET LOCATION MAP

NO	REVISIONS	DRN	CHK	DATE:
1	CONCEPTUAL DESIGN – RESTORATION PLAN SET DRAFT #1	DAB	DLR	05/16/08

DRAFT

DESIGN PLAN VIEW SHEETS
SHEET PR-11 OF PR-22

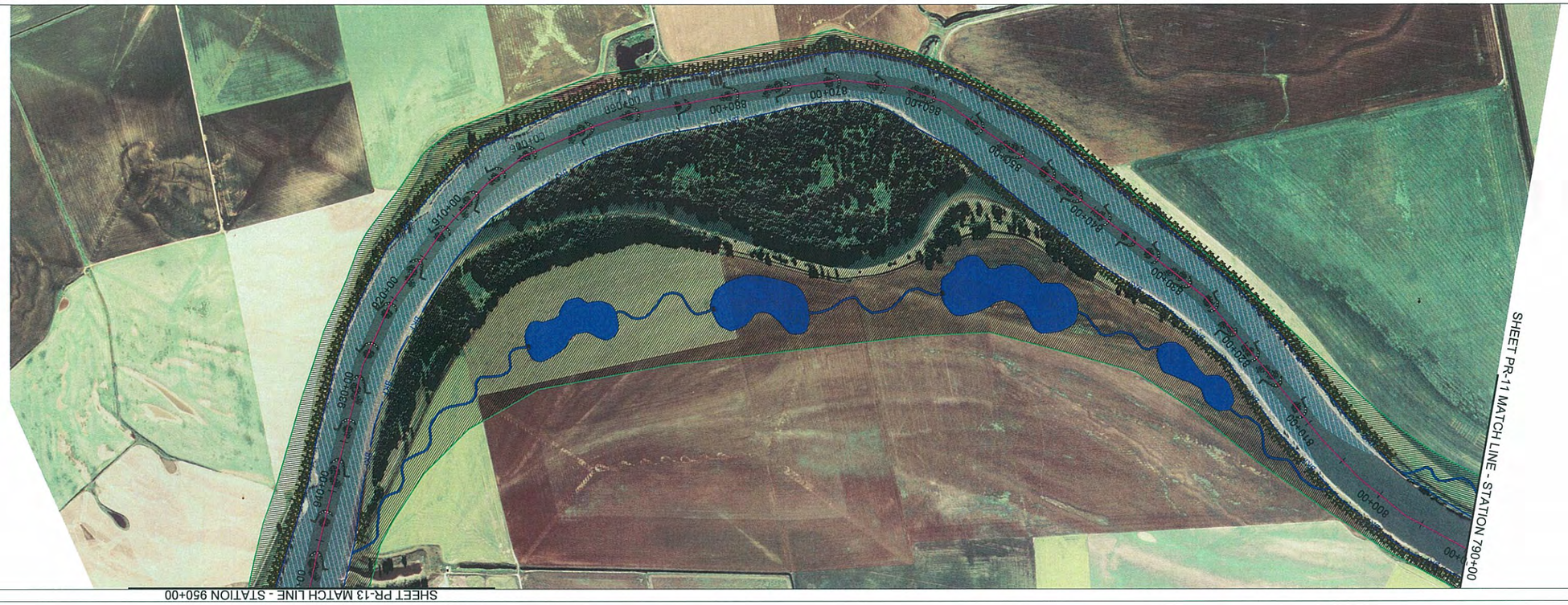
SCALE 1"=600'
0 600 1200

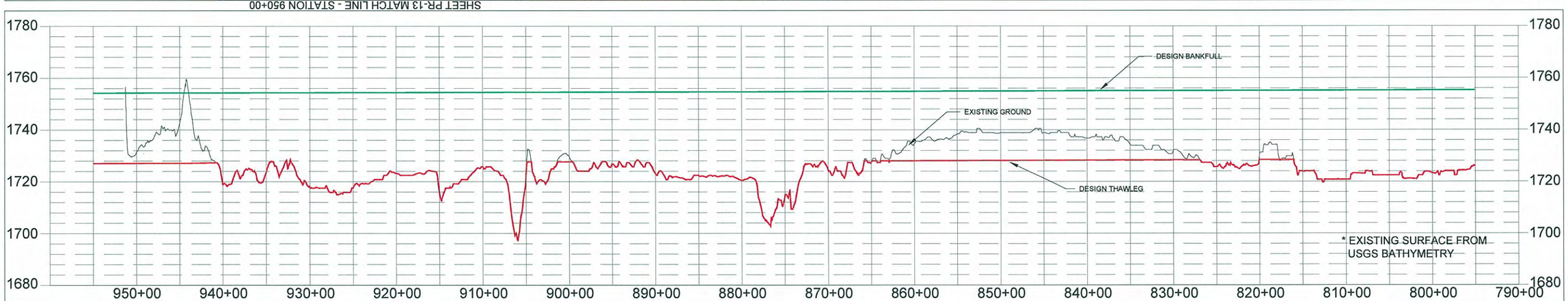
NORTH

KOOTENAI RIVER
Stream Restoration/Stabilization
Boundary County, ID

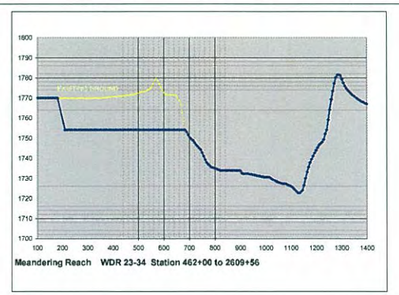
WILDLAND HYDROLOGY
KOOTENAI TRIBE

DATE:	05/16/08
PROJECT NO.	
FILE NAME:	Kootenai River.DWG
SHEET NAME:	PR-11
SHEET NO.	25

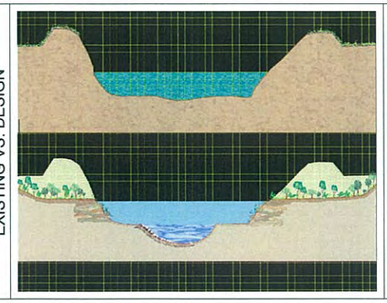




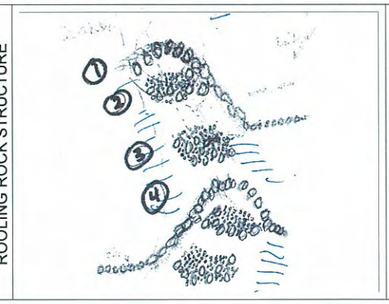
TYPICAL CROSS SECTIONS



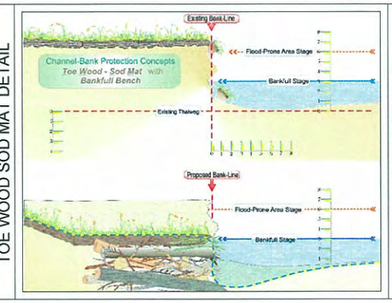
EXISTING VS. DESIGN



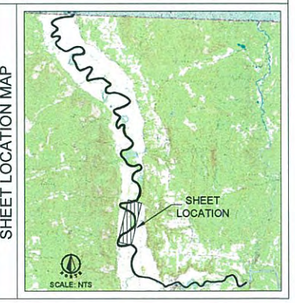
ROOLING ROCK STRUCTURE



TOE WOOD SOD MAT DETAIL



SHEET LOCATION MAP



NO	REVISIONS	DRN	CHK	DATE:
1	CONCEPTUAL DESIGN – RESTORATION PLAN SET DRAFT #1	DAB	DLR	05/16/08

DRAFT

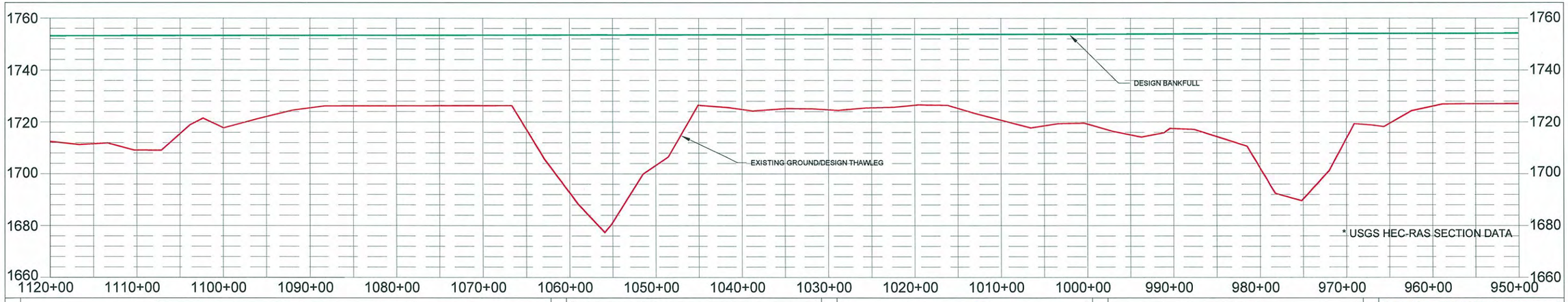
DESIGN PLAN VIEW SHEETS
SHEET PR-12 OF PR-22

SCALE 1"=600'
0 600 1200

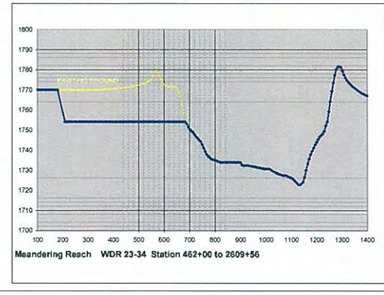
KOOTENAI RIVER
Stream Restoration/Stabilization
Boundary County, ID

WILDLAND HYDROLOGY
KOOTENAI TRIBE

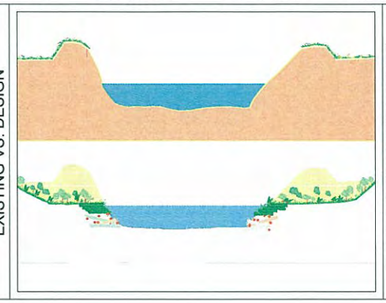
DATE:	05/16/08
PROJECT NO.	
FILE NAME:	Kootenai River.DWG
SHEET NAME:	PR-12
SHEET NO.	26



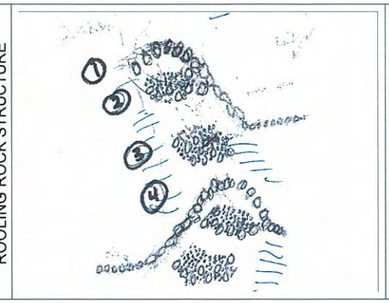
TYPICAL CROSS SECTIONS



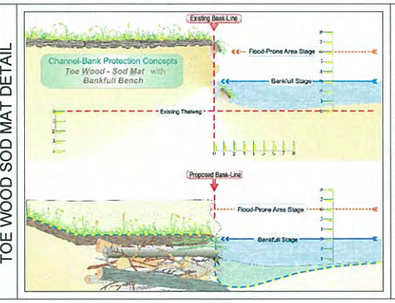
EXISTING VS. DESIGN



ROOLING ROCK STRUCTURE



TOE WOOD SOD MAT DETAIL



SHEET LOCATION MAP

NO	REVISIONS	DRN	CHK	DATE:
1	CONCEPTUAL DESIGN – RESTORATION PLAN SET DRAFT #1	DAB	DLR	05/16/08

DRAFT

DESIGN PLAN VIEW SHEETS
SHEET PR-13 OF PR-22

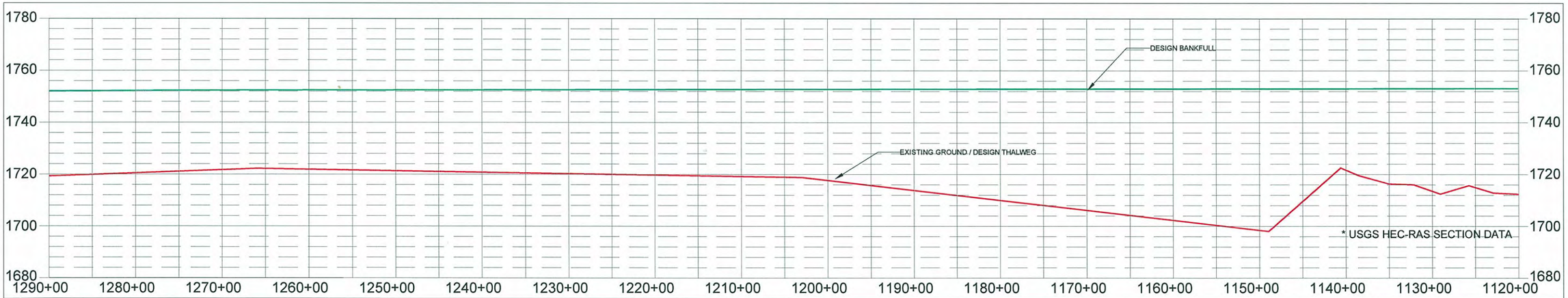
SCALE 1"=600'
0 600 1200

NORTH

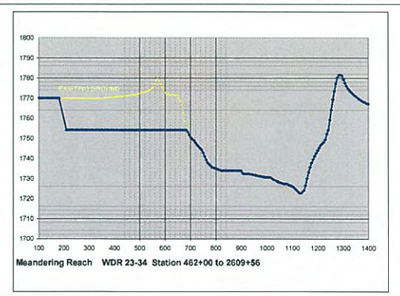
KOOTENAI RIVER
Stream Restoration/Stabilization
Boundary County, ID

WILDLAND HYDROLOGY
KOOTENAI TRIBE

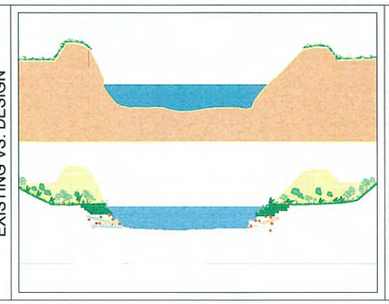
DATE:	05/16/08
PROJECT NO.	
FILE NAME:	Kootenai River.DWG
SHEET NAME:	PR-13
SHEET NO.	27



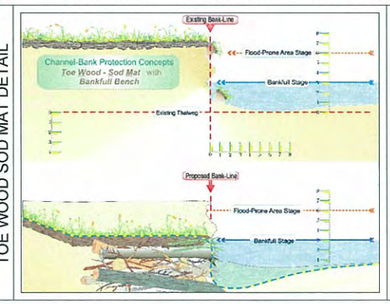
TYPICAL CROSS SECTIONS



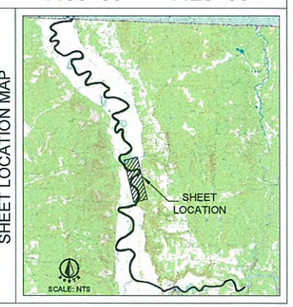
EXISTING VS. DESIGN



TOE WOOD SOD MAT DETAIL



SHEET LOCATION MAP



NO	REVISIONS	DRN	CHK	DATE:
1	CONCEPTUAL DESIGN – RESTORATION PLAN SET DRAFT #1	DAB	DLR	05/16/08

DRAFT

DESIGN PLAN VIEW SHEETS
SHEET PR-14 OF PR-22

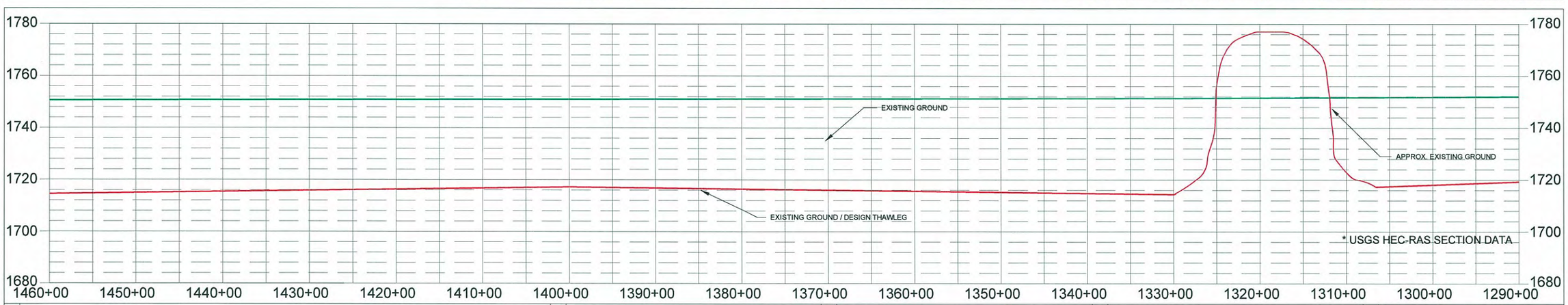
SCALE 1"=600'
0 600 1200

NORTH

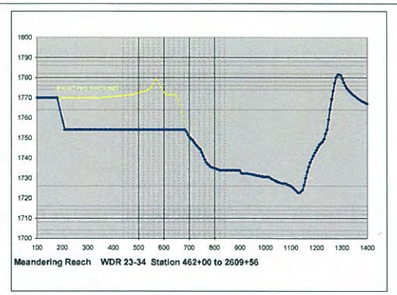
KOOTENAI RIVER
Stream Restoration/Stabilization
Boundary County, ID

WILDLAND HYDROLOGY
KOOTENAI TRIBE

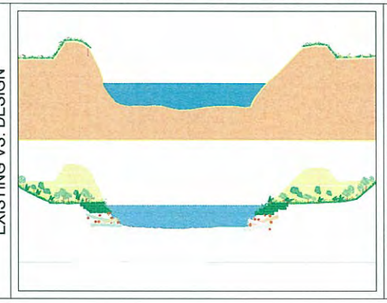
DATE:	05/16/08
PROJECT NO.	
FILE NAME:	Kootenai River.DWG
SHEET NAME:	PR-14
SHEET NO.	28



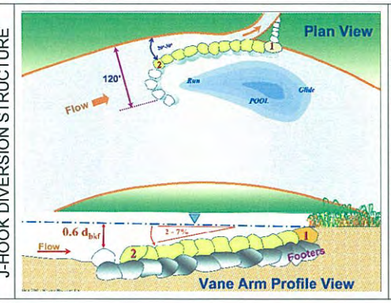
TYPICAL CROSS SECTIONS



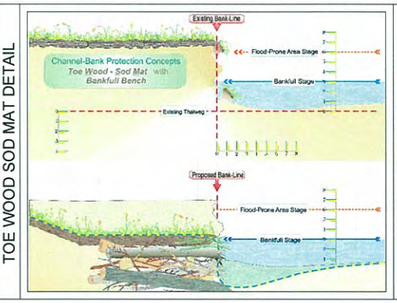
EXISTING VS. DESIGN



J-HOOK DIVERSION STRUCTURE



TOE WOOD SOD MAT DETAIL



SHEET LOCATION MAP

NO.	REVISIONS	DRN	CHK	DATE
1	CONCEPTUAL DESIGN – RESTORATION PLAN SET DRAFT #1	DAB	DLR	05/16/08

DRAFT

DESIGN PLAN VIEW SHEETS
SHEET PR-15 OF PR-22

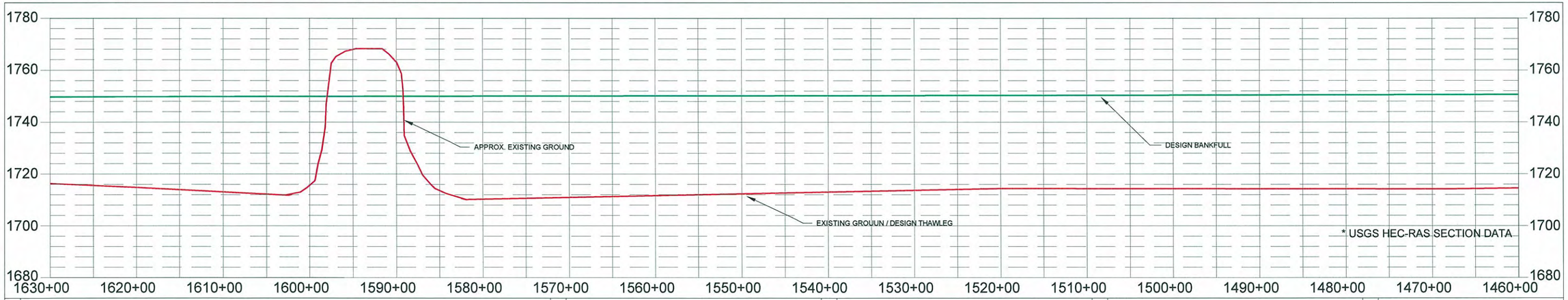
SCALE 1" = 600'
0 600 1200

NORTH

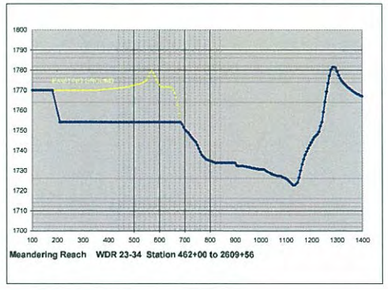
KOOTENAI RIVER
Stream Restoration/Stabilization
Boundary County, ID

WILDLAND HYDROLOGY
KOOTENAI TRIBE

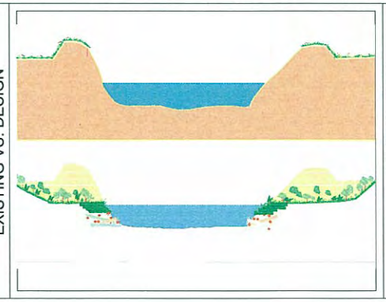
DATE:	05/16/08
PROJECT NO.	
FILE NAME:	Kootenai River.DWG
SHEET NAME:	PR-15
SHEET NO.	29



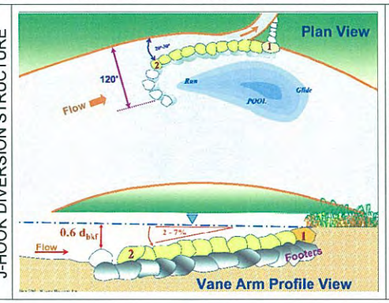
TYPICAL CROSS SECTIONS



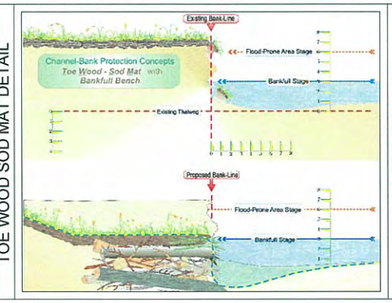
EXISTING VS. DESIGN



J-HOOK DIVERSION STRUCTURE



TOE WOOD SOD MAT DETAIL



SHEET LOCATION MAP

NO	REVISIONS	DRN	CHK	DATE:
1	CONCEPTUAL DESIGN – RESTORATION PLAN SET DRAFT #1	DAB	DLR	05/16/08

DRAFT

DESIGN PLAN VIEW SHEETS
SHEET PR-16 OF PR-22

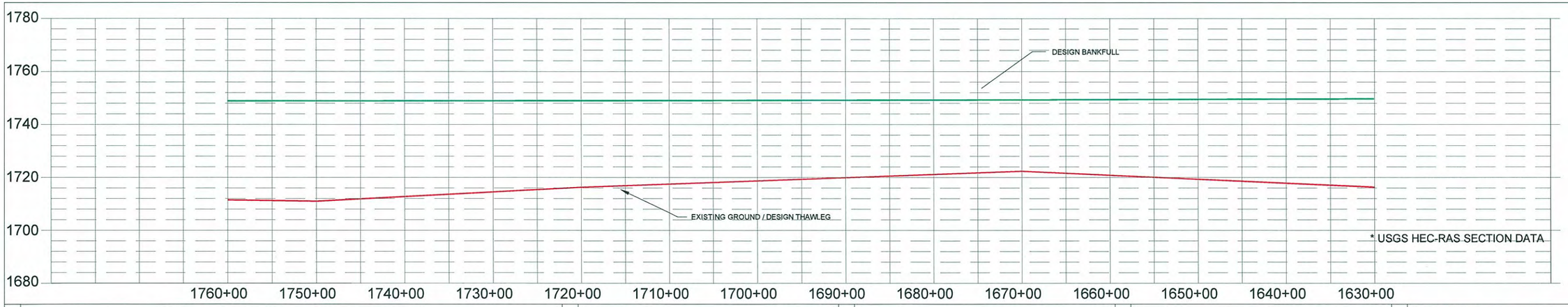
SCALE 1"=600'
0 600 1200

NORTH

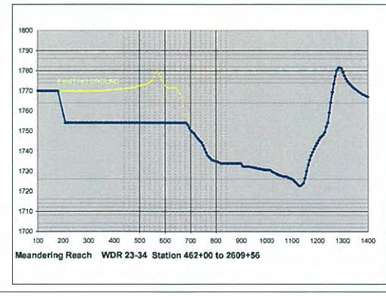
KOOTENAI RIVER
Stream Restoration/Stabilization
Boundary County, ID

WILDLAND HYDROLOGY
KOOTENAI TRIBE

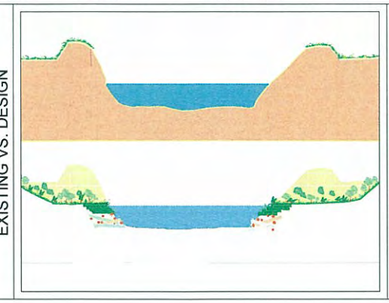
DATE:	05/16/08
PROJECT NO.	
FILE NAME:	Kootenai River.DWG
SHEET NAME:	PR-16
SHEET NO.	30



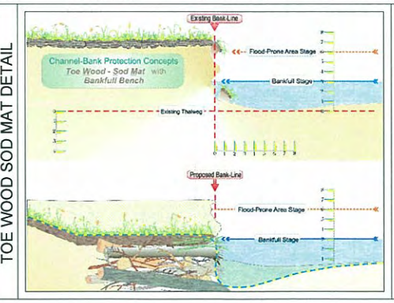
TYPICAL CROSS SECTIONS



EXISTING VS. DESIGN



TOE WOOD SOD MAT DETAIL



SHEET LOCATION MAP

NO	REVISIONS	DRN	CHK	DATE:
1	CONCEPTUAL DESIGN – RESTORATION PLAN SET DRAFT #1	DAB	DLR	05/16/08

DRAFT

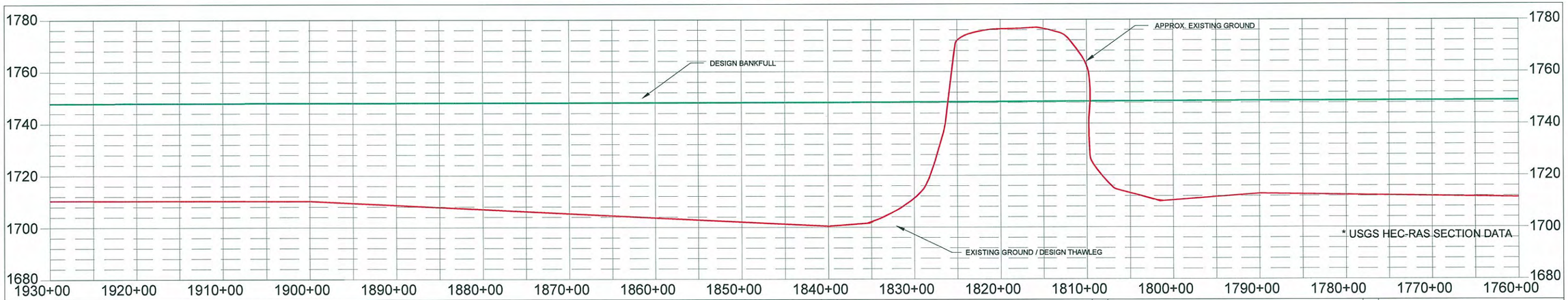
DESIGN PLAN VIEW SHEETS
SHEET PR-17 OF PR-22

SCALE 1"=600'
0 600 1200

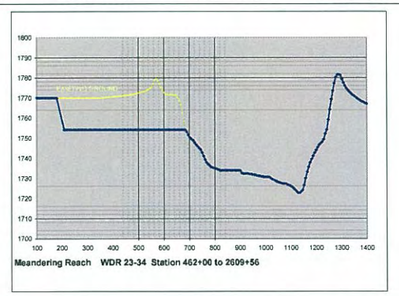
KOOTENAI RIVER
Stream Restoration/Stabilization
Boundary County, ID

WILDLAND HYDROLOGY
KOOTENAI TRIBE

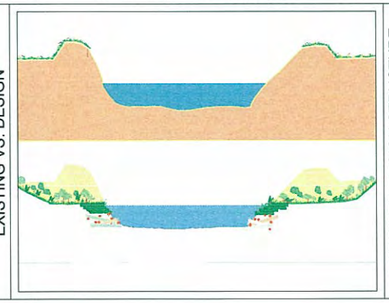
DATE:	05/16/08
PROJECT NO.	
FILE NAME:	Kootenai River.DWG
SHEET NAME:	PR-17
SHEET NO.	31



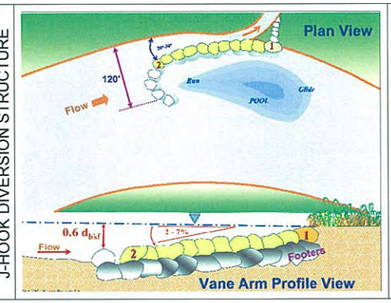
TYPICAL CROSS SECTIONS



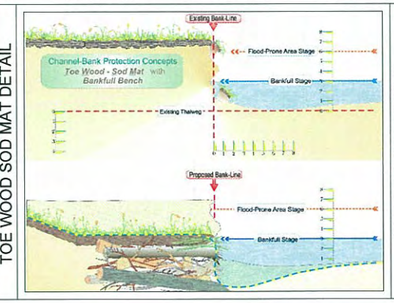
EXISTING VS. DESIGN



J-HOOK DIVERSION STRUCTURE



TOE WOOD SOD MAT DETAIL



SHEET LOCATION MAP

NO	REVISIONS	DRN	CHK	DATE:
1	CONCEPTUAL DESIGN – RESTORATION PLAN SET DRAFT #1	DAB	DLR	05/16/08

DRAFT

DESIGN PLAN VIEW SHEETS
SHEET PR-18 OF PR-22

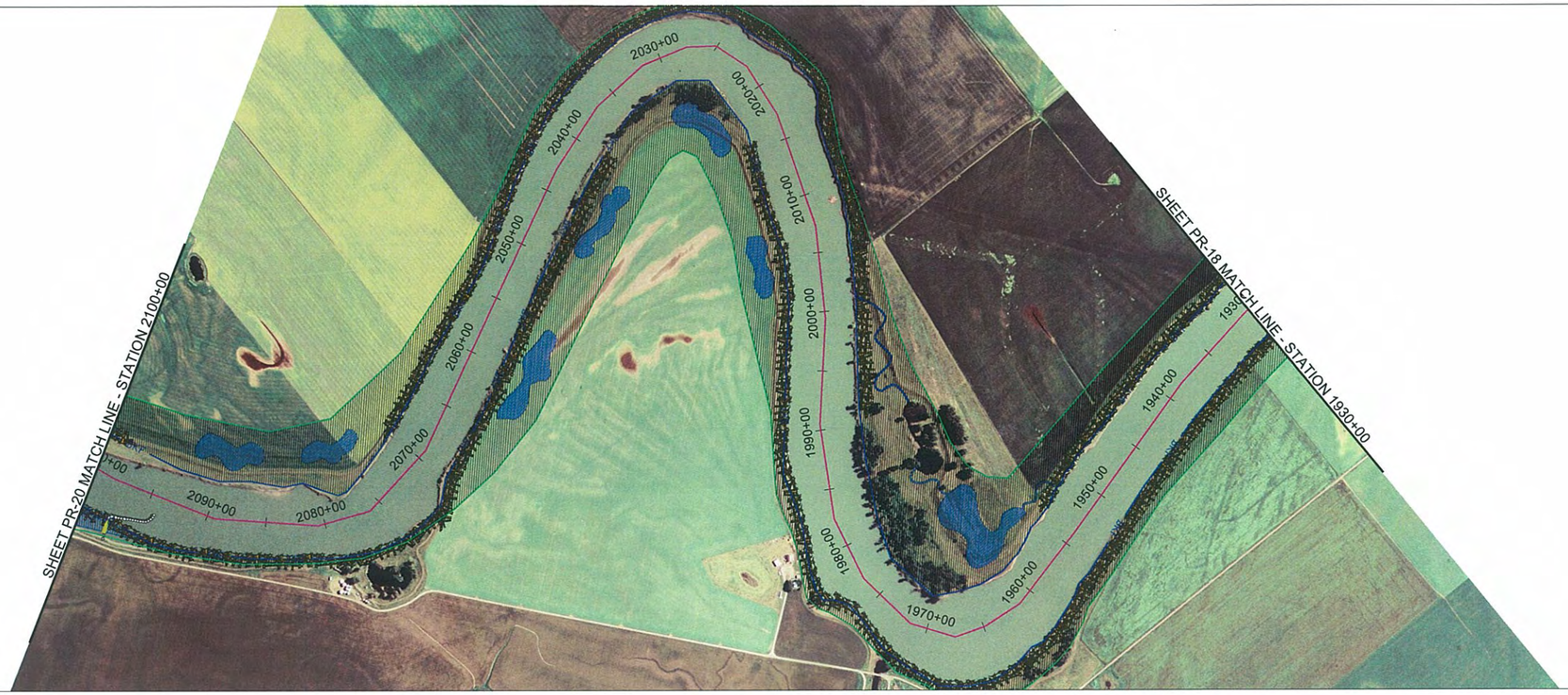
SCALE 1"=600'
0 600 1200

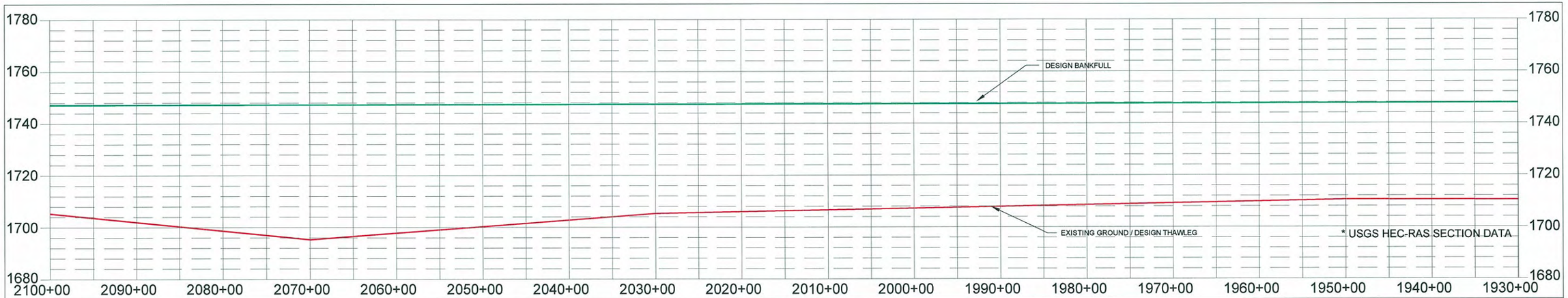
NORTH

KOOTENAI RIVER
Stream Restoration/Stabilization
Boundary County, ID

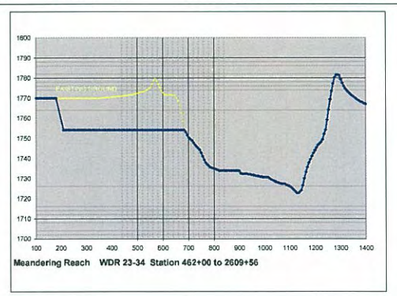
WILDLAND HYDROLOGY
KOOTENAI TRIBE

DATE:	05/16/08
PROJECT NO.	
FILE NAME:	Kootenai River.DWG
SHEET NAME:	PR-18
SHEET NO.	32

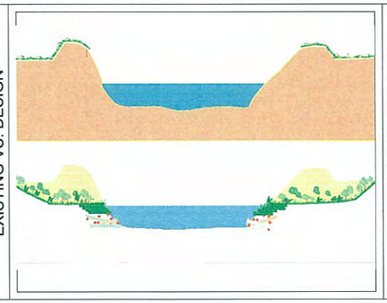




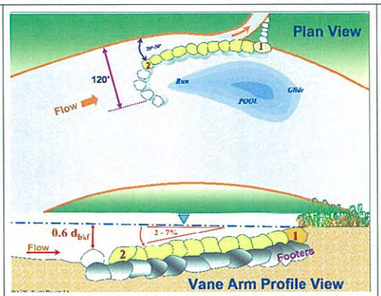
TYPICAL CROSS SECTIONS



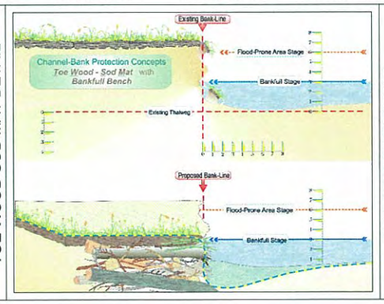
EXISTING VS. DESIGN



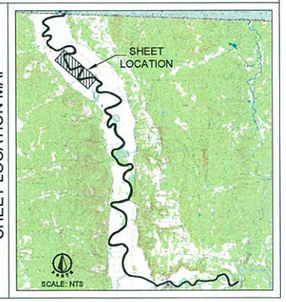
J-HOOK DIVERSION STRUCTURE



TOE WOOD SOD MAT DETAIL



SHEET LOCATION MAP



NO	REVISIONS	DRN	CHK	DATE:
1	CONCEPTUAL DESIGN – RESTORATION PLAN SET DRAFT #1	DAB	DLR	05/16/08

DRAFT

DESIGN PLAN VIEW SHEETS
SHEET PR-19 OF PR-22

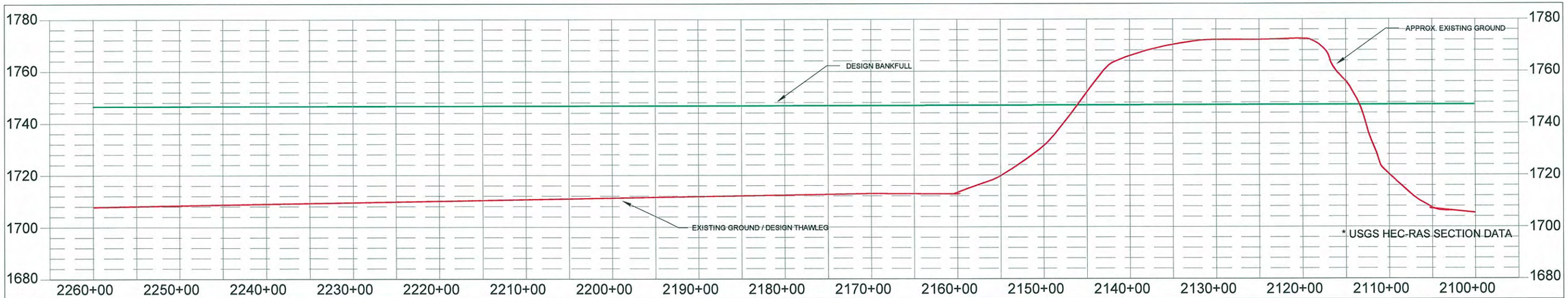
SCALE 1"=600'
0 600 1200

NORTH

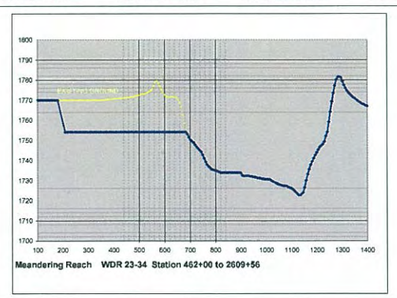
KOOTENAI RIVER
Stream Restoration/Stabilization
Boundary County, ID

WILDLAND HYDROLOGY
KOOTENAI TRIBE

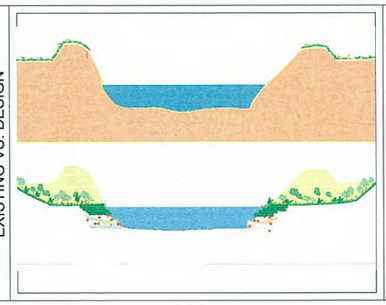
DATE:	05/16/08
PROJECT NO.	
FILE NAME:	Kootenai River.DWG
SHEET NAME:	PR-19
SHEET NO.	33



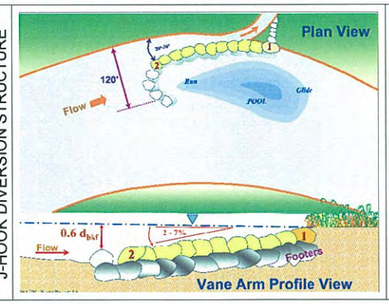
TYPICAL CROSS SECTIONS



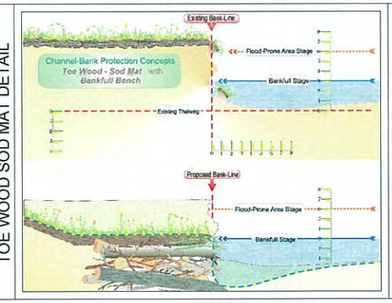
EXISTING VS. DESIGN



J-HOOK DIVERSION STRUCTURE



TOE WOOD SOD MAT DETAIL



SHEET LOCATION MAP

NO	REVISIONS	DRN	CHK	DATE:
1	CONCEPTUAL DESIGN – RESTORATION PLAN SET DRAFT #1	DAB	DLR	05/16/08

DRAFT

DESIGN PLAN VIEW SHEETS
SHEET PR-20 OF PR-22

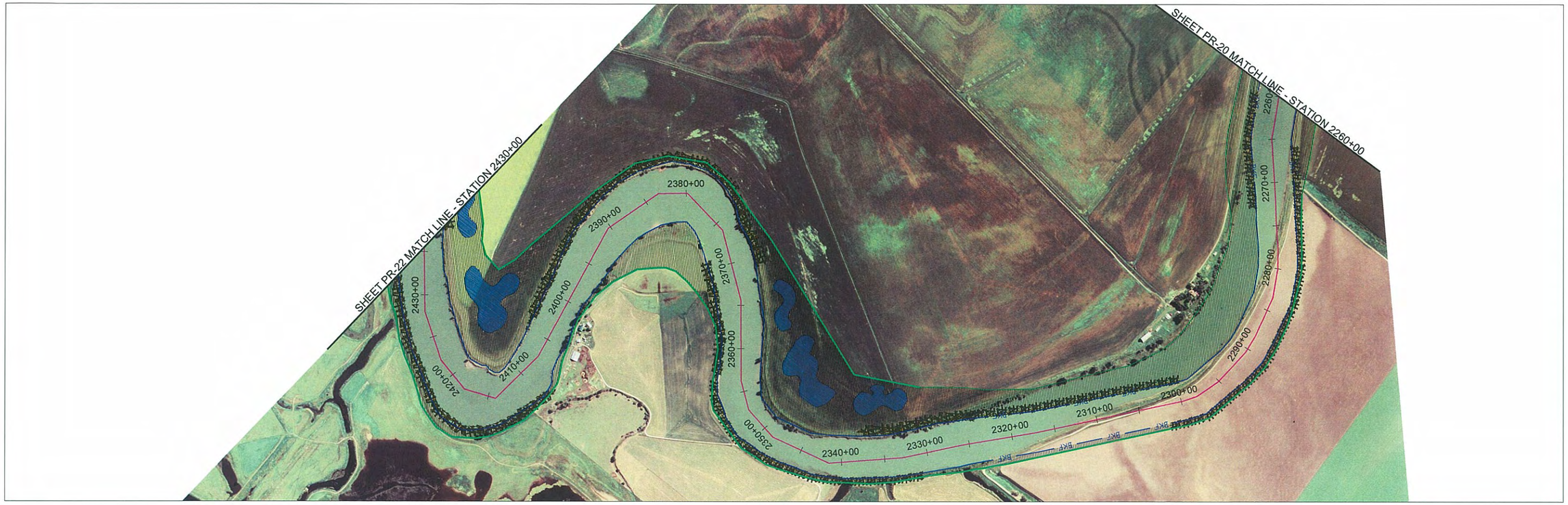
SCALE 1"=600'
0 600 1200

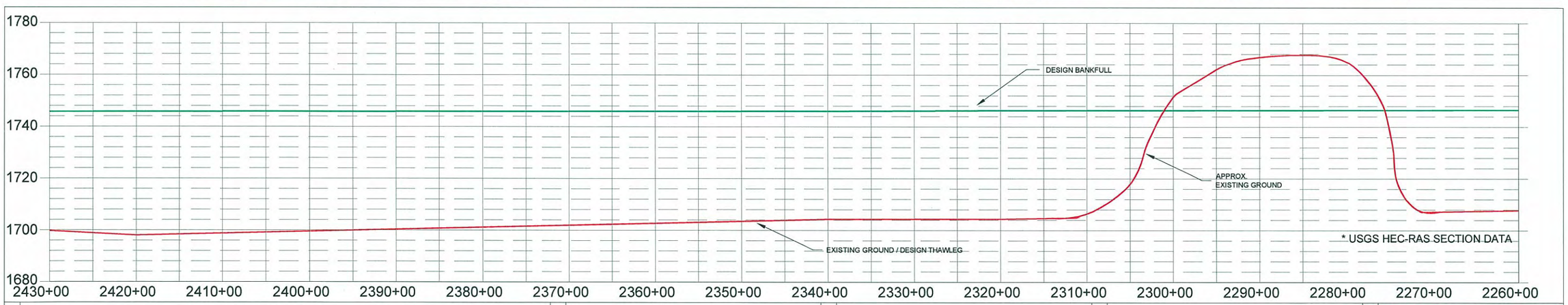
NORTH

KOOTENAI RIVER
Stream Restoration/Stabilization
Boundary County, ID

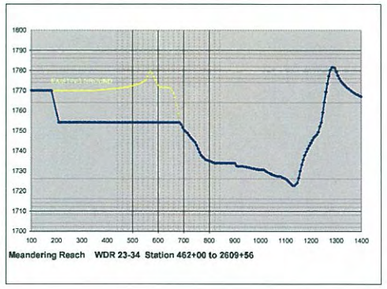
WILDLAND HYDROLOGY
KOOTENAI TRIBE

DATE:	05/16/08
PROJECT NO.	
FILE NAME:	Kootenai River.DWG
SHEET NAME:	PR-20
SHEET NO.	34

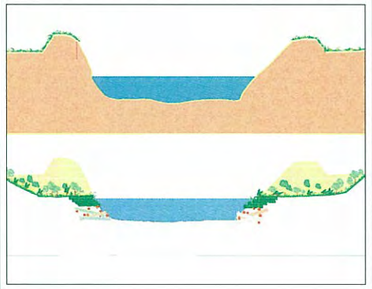




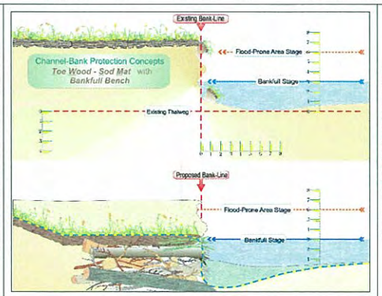
TYPICAL CROSS SECTIONS



EXISTING VS. DESIGN



TOE WOOD SOD MAT DETAIL



SHEET LOCATION MAP

NO	REVISIONS	DRN	CHK	DATE:
1	CONCEPTUAL DESIGN – RESTORATION PLAN SET DRAFT #1	DAB	DLR	05/16/08

DRAFT

DESIGN PLAN VIEW SHEETS
SHEET PR-21 OF PR-22

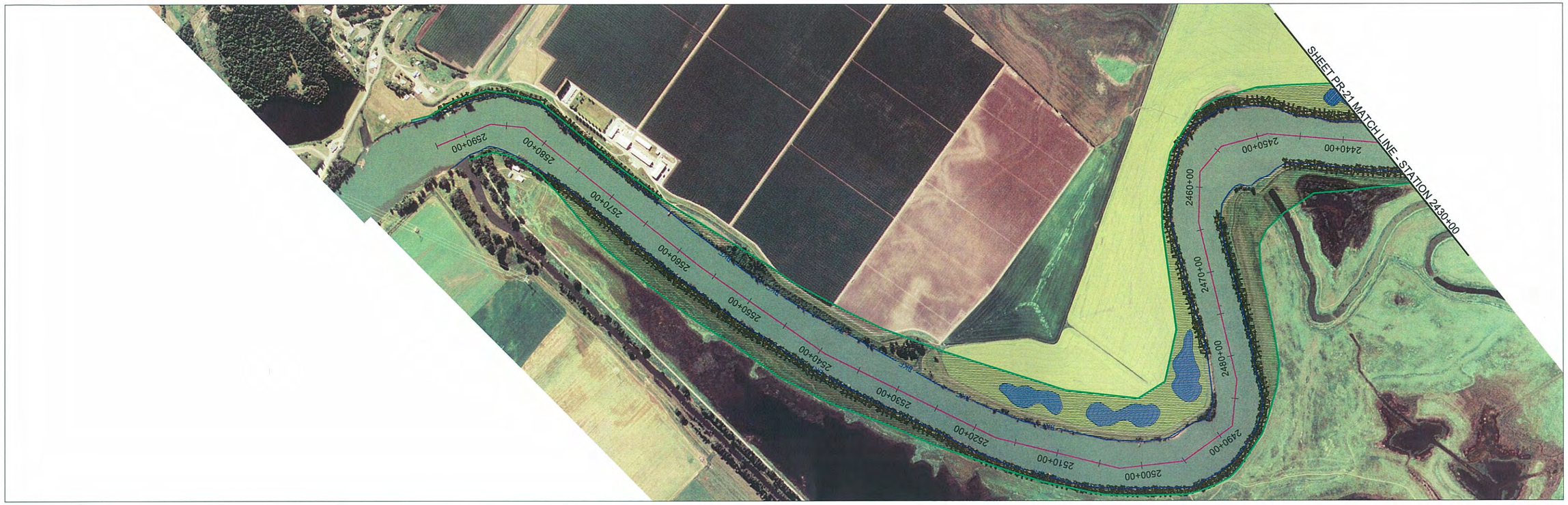
SCALE 1"=600'
0 600 1200

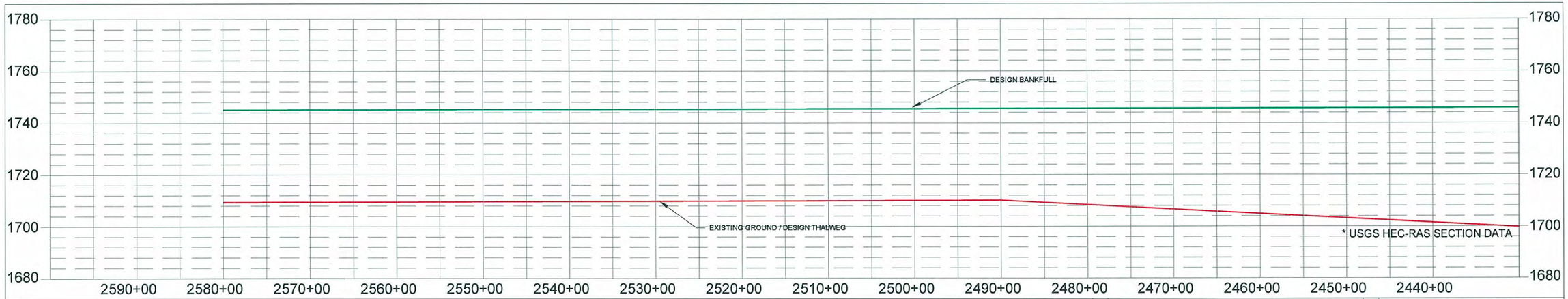
NORTH

KOOTENAI RIVER
Stream Restoration/Stabilization
Boundary County, ID

WILDLAND HYDROLOGY
KOOTENAI TRIBE

DATE:	05/16/08
PROJECT NO.	
FILE NAME:	Kootenai River.DWG
SHEET NAME:	PR-21
SHEET NO.	35





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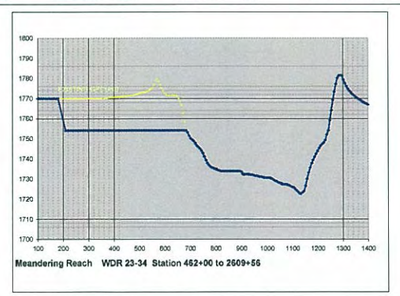
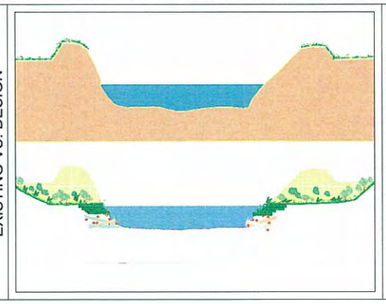
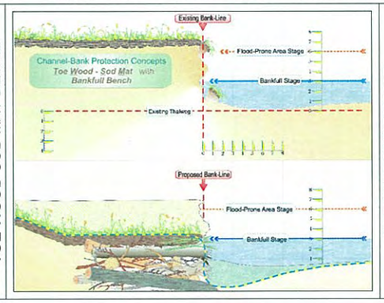


EXISTING VS. DESIGN



TOE WOOD SOD MAT DETAIL



SHEET LOCATION MAP

NO	REVISIONS	DRN	CHK	DATE:
1	CONCEPTUAL DESIGN – RESTORATION PLAN SET DRAFT #1	DAB	DLR	05/16/08

DRAFT

DESIGN PLAN VIEW SHEETS
SHEET PR-22 OF PR-22

SCALE 1"=600'
0 600 1200

KOOTENAI RIVER
Stream Restoration/Stabilization
Boundary County, ID

WILDLAND HYDROLOGY
KOOTENAI TRIBE

DATE:	05/16/08
PROJECT NO.	
FILE NAME:	Kootenai River.DWG
SHEET NAME:	PR-22
SHEET NO.	36