Appendix E

Rosgen Classification

Rosgen Stream Type Classifications

Using the morphometric parameters described above, stream reaches are classified into 7 major stream types (Aa+ through G) based on Rosgen's (1996) criteria. The relevant stream classifications for the Project Area are described below.

"Aa+" Stream Type

This stream type typically occurs in debris avalanche terrain, zones of deep deposition such as glacial tills and outwash terraces, or landforms that are structurally controlled or influenced by faults, joints, or other structural contact zones. "Aa+" channels are characterized by very high gradients (>10 percent), high entrenchment (low entrenchment ratio [<1.4]), low sinuosity (1.0–1.1), and a low width-to-depth ratio (<12). The bedforms associated with this stream type are typically cascade or step/pool morphology with vertical steps and deep scour pools. Aa+ channels are typically described as high energy/high sediment supply systems due to the steep channel slopes and narrow/deep channel cross-sections.

"A" Stream Type

This stream type typically occurs in areas of high relief, zones of deep deposition, or landforms that are structurally controlled. "A" channels are characterized by moderate to steep gradients (4-10 percent), high entrenchment (low entrenchment ratio [<1.4]), low sinuosity (1.0–1.2), and a low width-to-depth ratio (<12). The bedforms associated with this stream type are typically cascade or step/pool morphology with associated plunge or scour pools. "A" stream types typically exhibit a high energy/high sediment transport potential and a relatively low in-channel sediment storage capacity.

"B" Stream Type

This stream type primarily exists on moderately steep to gently sloped terrain in areas where structural contact zones, faults, joints, colluvial-alluvial deposits, and structurally controlled valley side-slopes limit the development of a wide floodplain. "B" channels are characterized by moderate to steep slopes (4-10 percent), moderate entrenchment (entrenchment ratio of 1.4–2.2), low sinuosity (>1.2), and a moderate width-to-depth ratio (>12). The bedforms associated with this stream type are typically rapids and scour pool morphology which may be influenced by debris constrictions and local confinement. Streambank erosion rates are typically low, and are generally considered to be vertically and laterally stable, particularly when the dominant bed particle size is bedrock, and boulder.

ROSGEN LEVEL 1 STREAM CLASSIFICATION DEFINITIONS

The following provides a brief overview of the Rosgen Level 1 stream classification system used to type the study stream. The Rosgen Level I classification is a broad-level delineation of stream types that are distinguished based on the following four morphometric parameters:

• **Entrenchment Ratio** – describes the degree of vertical containment of the channel in its valley. Entrenchment ratio is computed as the width of the flood prone area at an elevation twice the maximum bankfull depth divided by the top width of the bankfull channel. Low entrenchment values indicate that the channel is vertically constrained, whereas a high entrenchment ratio indicates that the channel can greatly enlarge its width during high flow events.

• **Width-Depth Ratio –** is an index of the channel cross-sectional shape, and is computed as the ratio of the bankfull width/mean bankfull depth. High values indicate the channel is relatively broad and shallow, whereas low values indicate that the channel is narrow and deep. Channel shape affects the distribution of energy within the channel. Channels with a high width-depth ratio tend to develop shear stress near the banks, while a low width-depth ratio indicates shear stress is more distributed across the bed.

• **Water Surface Slope** (i.e., gradient) – is the water surface gradient at bankfull discharge (usually approximated by the bed slope). Gradient is a significant factor representing the potential energy of the channel which strongly influences sediment transport capacity.

• **Sinuosity** – is a characterization of the channel planform, and is calculated as the stream length divided by the valley length. Higher sinuosity is associated wit a meandering channel planform, and lower sinuosity is associated with straighter channels. Sinuosity carries the least weight of the four parameters in the Rosgen classification system.

Rosgen Classification Data by Stream

Old Cow Creek

Classification Data	Upstream from Diversion RM -0.13	Downstream from Diversion							
		RM 0.15	RM 0.54	RM 0.93	RM 1.68	RM 1.85	RM 1.97	RM 2.8	RM 2.8
Wbfl	50	40	40	40	30	30	40	35	40
Max Dbfl	4.5	4	4	5	3	4.5	3.5	2	4.5
Avg Dbfl	4	3	3	4	2.5	3.5	3	1.5	3.5
Wfp	60	58	60	65	55	45	65	40	55
W/D	12.50	13.33	13.33	10.00	12.00	8.57	13.33	23.33	11.43
Entrenchment	1.20	1.45	1.50	1.63	1.83	1.50	1.63	1.14	1.38
Slope (ft/ft)	0.098	0.0062	0.062	0.062	0.062	0.062	0.048	0.048	0.048
Dominant Particle Size	Boulder	Boulder	Boulder	Boulder/ Gravel	Boulder/ Rubble	Boulder/ Rubble	Boulder/ Rubble	Boulder	Boulder
Rosgen Stream Classification	**A2/A2a+**	**B2a**	**B2a**	**B2a/B4a**	**B2a**	**B2a**	**B2a**	**B2a**	**B2a**

Note: RM 1.13-1.19 channel is a A2a+ at location of landslide; RM 1.19-1.27 channel is a B2a; RM 1.5-1.65 channel is a B1; RM 2.57-2.67 channel is a B1; RM 2.67-downstream channel is B2a.

Bankfull Width (ft)= Wbfl
Maximum Depth at Bankfull (ft)= Max Dbfl
Average Depth at Bankfull (ft)= Avg Dbfl
Floodprone Width (ft)= Wfp
Width to Depth Ratio (Wbfl/Avg Dbfl)= W/D
Entrenchment Ratio (Avg Dbfl/Wbfl)= Entrenchment

South Cow Creek

Classification Data	Downstream from Diversion								
	RM 0.17	RM 0.49	RM 0.55	RM 0.70	RM 1.0	RM 1.70	RM 2.63	RM 2.9	RM 3.03
Wbfl	32	30	30	35	30	35	40	58	53
Max Dbfl	3	2	3	2.5	3	3	7	4	6
Avg Dbfl	2.5	1.5	2	2	2	2	3.5	3	3
Wfp	52	40	55	50	50	55	50	68	65
W/D	12.80	20.00	15.00	17.50	15.00	17.50	11.43	19.33	17.67
Entrenchment	1.63	1.33	1.83	1.43	1.67	1.57	1.25	1.17	1.23
Slope (ft/ft)	0.015	0.015	0.015	0.015	0.015	0.015	0.049	0.049	0.086
Dominant Particle Size	Cobble	Cobble	Cobble	Gravel/ Cobble	Sm. Boulder/ Cobble	Cobble	Boulder	Boulder	Boulder
Rosgen Stream Classification	**B3c**	**B3c**	**B3c**	**B3c/B4c**	**B2a**	**B3c**	**B2a**	**B2a**	**B2a**

Classification Data	Downstream from Diversion		
	RM 3.05	RM 3.60	RM 3.75
Wbfl	58	40	38
Max Dbfl	4.5	4	4.5
Avg Dbfl	3.5	2	3.75
Wfp	80	60	63
W/D	16.57	20.00	10.13
Entrenchment	1.38	1.50	1.66
Slope (ft/ft)	0.086	0.046	0.043
Dominant Particle Size	Boulder	Boulder/ Cobble	Boulder/ Cobble
Rosgen Stream Classification	**B2a**	**B2a/B3a**	**B2a/B3a**

Hooten Gulch

Classification Data	Upstream from Powerhouse		Downstream from Powerhouse	
	RM -0.14	RM -0.90	RM 0.07	RM 0.24
Wbfl	25	25	15	15
Max Dbfl	3	3	2	2.5
Avg Dbfl	2.5	2	1.5	2
Wfp	70	70	65	25
W/D	10.00	12.50	10.00	7.50
Entrenchment	2.80	2.80	4.33	1.67
Slope (ft/ft)	0.025	0.025	0.025	0.025
Dominant Particle Size	Cobble	Cobble	Gravel	Gravel
Rosgen Stream Classification	**B3**	**B3**	**B3/B4**	**B3/B4**