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Surface Water Hydrology Report

Stibnite Gold Project
Midas Gold Idaho, Inc.

May, 2018

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SECTION 1: INTRODUCTION

1.1 Purpose of Report

The purpose of the Surface Water Hydrology Report (Hydrology Report) is to summarize statistical analyses, assumptions, and support rationale for development of surface water hydrology within the Stibnite Gold Project (SGP) in central Idaho. The intent of the Hydrology Report is to support the SGP Plan of Restoration and Operations (Midas Gold, 2016).

1.2 Project Background

Figure 1-1 shows the location of the SGP site. The SGP is located in the Stibnite-Yellow Pine Mining District in central Idaho, near the Frank Church River of No Return Wilderness Area. Located in Valley County, the district is characterized by historic mining activities and unpatented (federal land) and patented (private land) mining claims with known deposits of gold, silver, tungsten, and antimony. The Stibnite-Yellow Pine Mining District (the District) is in the Boise National Forest but is administered by the Krassel Ranger District of the Payette National Forest.

Mining began in the District in the late 1800s and continued intermittently through 1997. Beginning in 2009, the Midas Gold group of companies, represented today by the operating company Midas Gold Idaho, Inc. (Midas Gold, a subsidiary of Midas Gold Corporation) began to acquire mining claims throughout the District from prior owners or by staking claims on its own behalf. With federal and state approval, Midas Gold initiated mineral exploration activities in 2009 to better define the mineral deposit potential for the area. Midas Gold also conducted extensive studies to understand the current environmental conditions at the site and designed the SGP to address and repair existing historical legacy issues. The current proposed SGP is described in the Plan of Restoration and Operations (Midas Gold, 2016).

1.2.1 Project Area Description

The SGP site is located along the East Fork of the South Fork of the Salmon River (EFSFSR) and its tributaries approximately 15 miles upstream of the town of Yellow Pine in central Idaho (Figure 1-1). The terrain within the SGP site consists of narrow valleys surrounded by steep mountains. Elevations along valley floors range from 6,000 to 6,600 feet above mean sea level (msl). The surrounding mountains reach elevations over 8,500 feet above msl. The main drainage basin at the SGP site is the EFSFSR.

Stream enhancement and restoration would accompany proposed future mining activities within the SGP site. These activities affect the surface and groundwater hydrology and planning level surface water hydrological information is needed to assist in the development of planning and mitigation of associated impacts. These affected reaches include the EFSFSR upstream of Sugar Creek and tributaries to the EFSFSR including Meadow Creek, Garnet Creek, Fiddle Creek, Midnight Creek, Hennessy Creek, and West End Creek (a tributary to Sugar Creek, which feeds the EFSFSR at the downstream limit of the project area) (Figure 1-2). Mining activities would also include removal of the existing Spent Ore Disposal Area (SODA), development of the proposed Tailings Storage Facility (TSF), emplacement of proposed Development Rock Storage Facilities (DRSFs), and excavation of three proposed open pits (Figure 1-2).

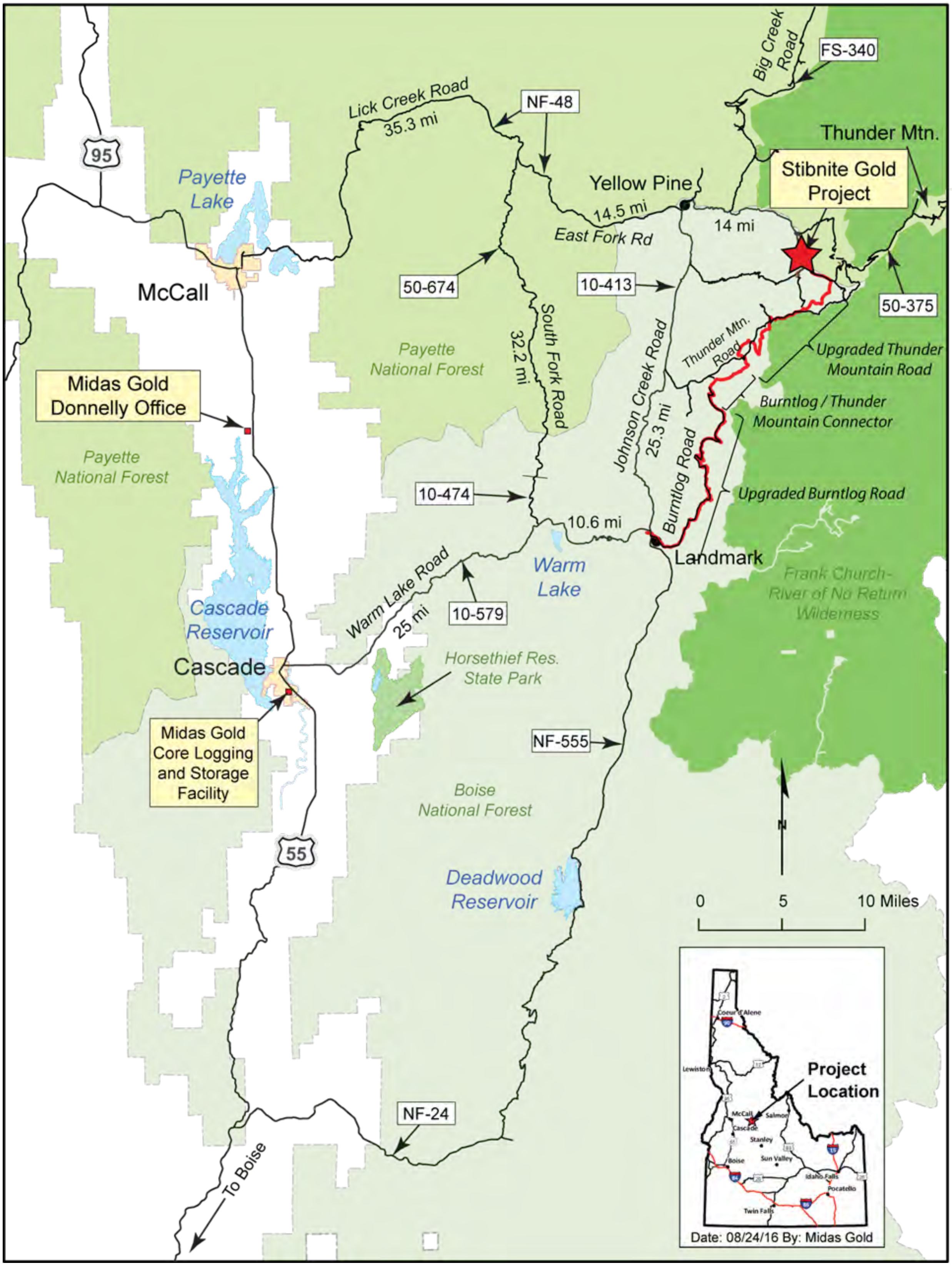

Figure 1-1. Vicinity Map.

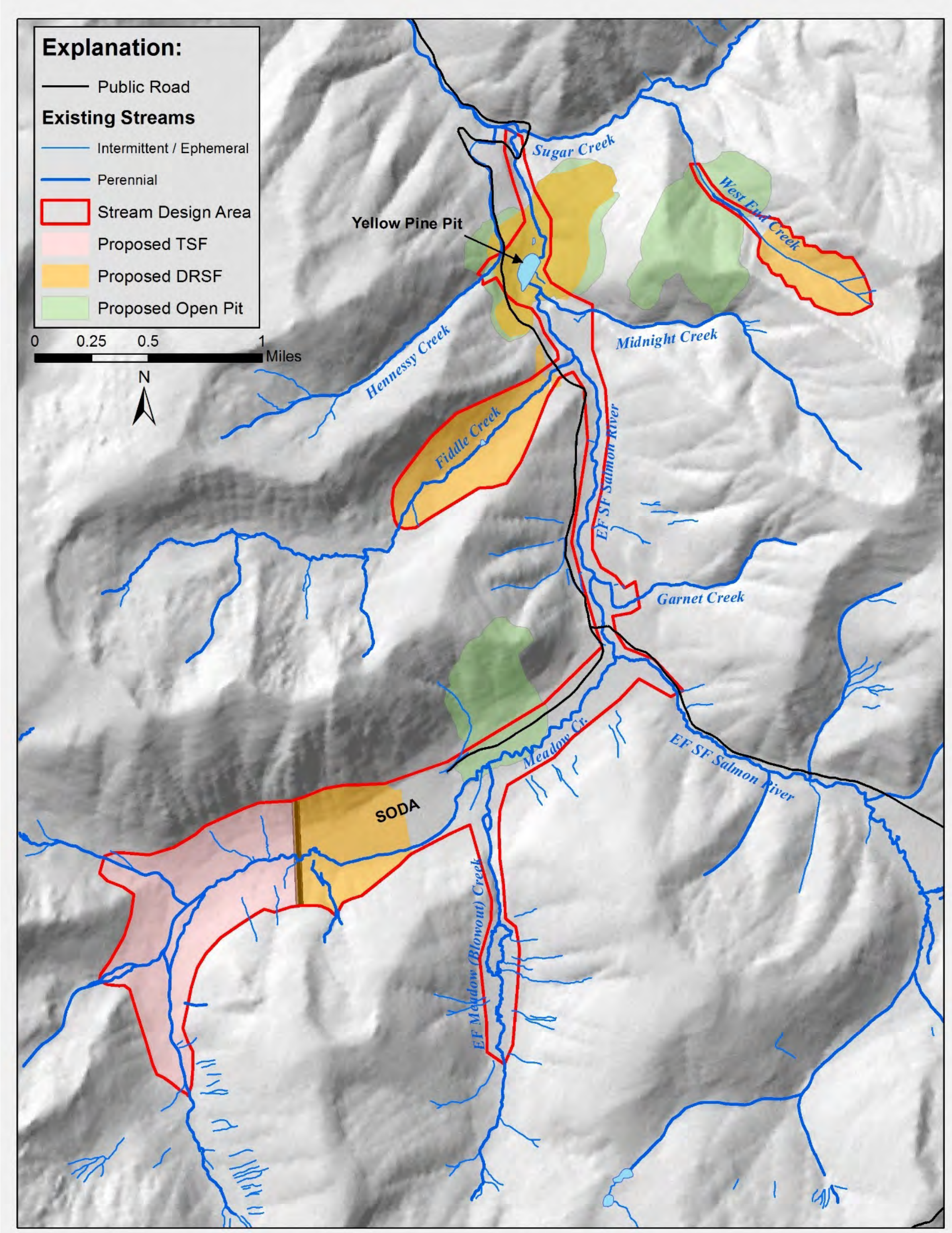

Figure 1-2. Stream Design Project Area Map.

The project area lies largely within the EFSFSR watershed upstream from its confluence with Sugar Creek, along with the West End Creek watershed; tributary of Sugar Creek (Figure 2-1). The EFSFSR basin (upstream of Sugar Creek) is approximately 25 square miles in size with elevations ranging from 9,220 feet down to 5,930 feet.. The basin averages 32.7 inches of mean annual precipitation, with the dominant form of precipitation occurring as snow in the winter months (USGS, 2017a). The watershed's stream network is largely dominated by snow and snowmelt processes resulting in peak runoff in May and June with base flows typically occurring in September through March.

For the proposed restoration, mitigation and operations planning important hydrologic conditions include peak flood flow frequencies to assess channel and floodplain stability and annual exceedance discharges (generated from daily streamflow data) to assess fish passage design criteria and associated aquatic habitat for all reaches and identified species and corresponding life stages. In addition to these metrics, monthly flows were assessed to evaluate seasonality, various low flows (7Q10, etc.) were estimated for use in National Pollutant Discharge Elimination System (NPDES) permitting, and peak flood flows at key facility locations were estimated for use in designing operational (life-of-mine) surface water diversions. These metrics were quantified at select locations using United States Geological Survey (USGS) stream gage data, and regression equations were developed to estimate hydrologic parameters anywhere within the watershed. This historic information was used in the development of proposed hydrologic scenarios and to assess potential climate change trends.

SECTION 2: USGS STREAM GAGING SITES

There are six stream gages, maintained by the USGS, near the project area that are collecting or have historically collected water stage and discharge data. This historic data was utilized to aid in the quantification of hydrological statistics and to estimate probabilistic discharges throughout the project area. The six gages all have varying historic data records. Additionally, there is a long-term gage on Johnson Creek located near its confluence with the EFSFSR that provides a consistent long-term record for data extrapolation and interpretation. A summary of gage numbers, locations, and periods of record are displayed in Table 2-1. These gage records contain both historic instantaneous peak flow data and average daily data.

Table 2-1. USGS Gaging Station Summary

Gage Number	Description	Latitude	Longitude	Period of Record	Years of Record
13310850	Meadow Creek Near Stibnite, ID	44.88953	115.36022	2012-2017	6
13310800	EFSF Salmon Above Meadow Creek Near Stibnite, ID	44.90225	115.32567	2012-2017	6
13311450	Sugar Creek Near Stibnite, ID	44.93636	115.33722	2012-2017	6
13311000	EFSF Salmon at Stibnite, ID	44.90572	115.32950	1929-1942, 1983-1997, 2011-2017	36
13311250	EFSF Salmon Above Sugar Creek Near Stibnite, ID	44.93478	115.33669	2012-2017	6
13311500	EFSF Salmon Near Stibnite, ID	44.93639	115.33944	1929-1941	13
13313000	Johnson Creek at Yellow Pine, ID	44.96167	115.50000	1928-2017	89

Note: Source is USGS website (USGS, 2017b). Gages with a period of record through 2017 are expected to continue to operate through 2018 and beyond; 2017 records were the most recent available and used in this analysis.

These gages are located throughout the project area as seen on Figure 2-1. As the project progresses additional data will be collected from the majority of these stream gaging sites (those that would not be relocated prior to or during mining operations), providing a longer period of record and allowing for any adjustments in assumptions and regression methodology prior to the development of final designs for any specific restoration site within the project boundary.

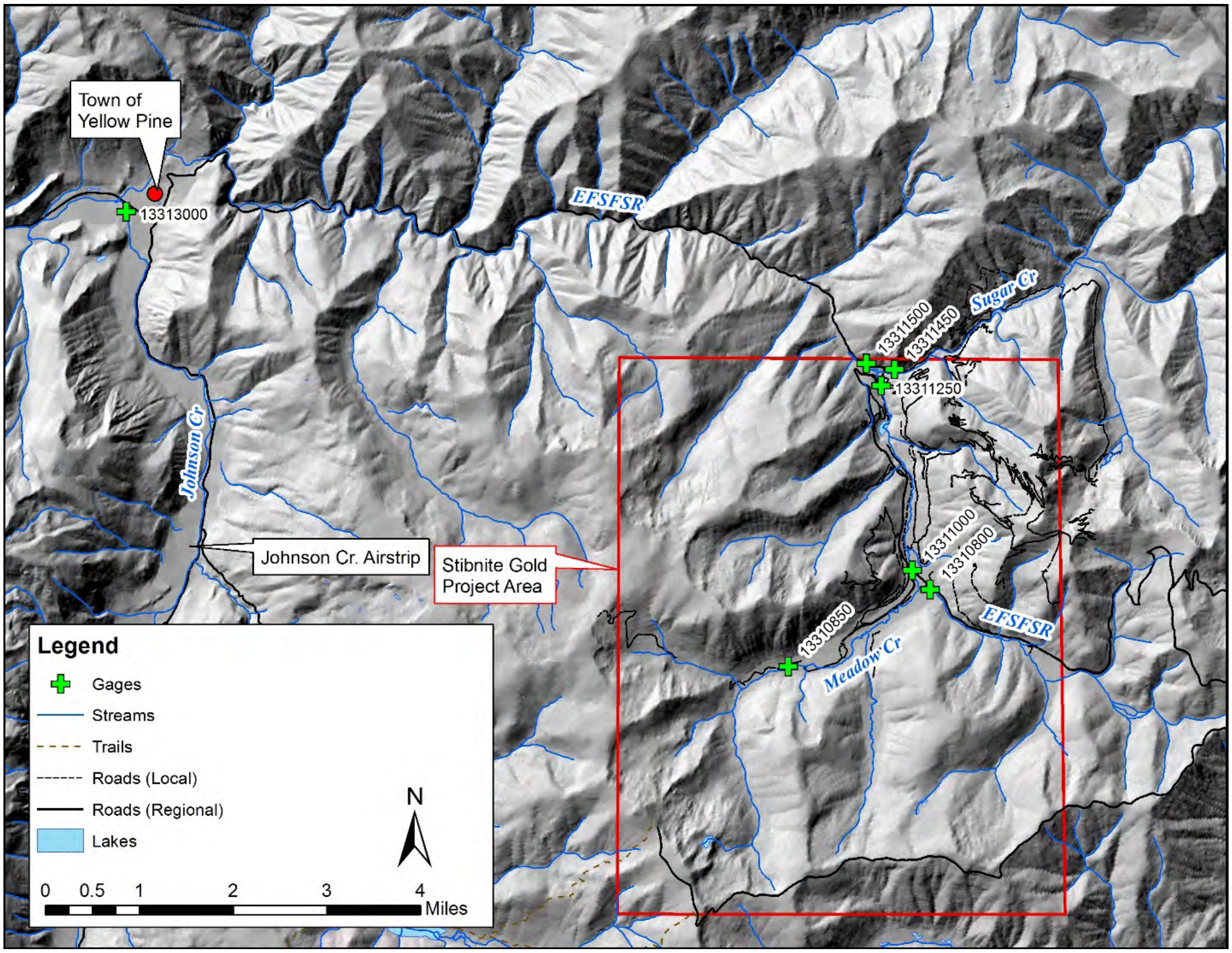

Figure 2-1. USGS Gaging Site Locations

Based on the most recent documentation for estimating flood frequency discharge values for the region, the most significant variables were basin area and average annual precipitation. Table 2-2 shows the basin area and mean annual precipitation for each basin based on computation from the USGS StreamStats program (USGS, 2017a).

Table 2-2. USGS Gaging Station Metrics

Gage Number	Description	Basin Area (mi^2)	Mean Annual Precipitation (in)
13310850	Meadow Creek Near Stibnite, ID	5.66	37.0
13310800	EFSF Salmon Above Meadow Creek Near Stibnite, ID	9.06	33.2
13311450	Sugar Creek Near Stibnite, ID	17.95	28.6
13311000	EFSF Salmon at Stibnite, ID	19.28	34.3
13311250	EFSF Salmon Above Sugar Creek Near Stibnite, ID	24.07	33.0
13311500	EFSF Salmon Below Sugar Creek Near Stibnite, ID	42.97	31.0
13313000	Johnson Creek at Yellow Pine, ID	217.87	34.5

SECTION 3: AVERAGE MONTHLY FLOWS

To assess seasonality of flows at each gage, average monthly discharge values were obtained for the period of record. For the majority of gages that period of record was 2012-2017. These short-term records were extended utilizing USGS Gage 13313000 (Johnson Creek) to create a complete monthly average discharge record extending from 1929-2017. To complete this record extension, it was assumed that the ratio of average discharges for a short record to discharges for a long record are equal between gage locations. This relationship is shown and defined in Equation 3-1. We developed estimates for the long term monthly average for the gages with only a short record ($Q(Gage_i)_{m\text{-}long}$). Solving for this unknown in Equation 3-1 gives us Equation 3-2 that was used to estimate long term (1929-2017) monthly average discharge at selected USGS gage sites with short records using USGS gage 13313000 to complete the record extension.

$$\frac{\overline{Q(13313000)}_{m-short}}{\overline{Q(13313000)}_{m-long}} = \frac{\overline{Q(Gage_i)}_{m-short}}{\overline{\boldsymbol{Q(Gage_i)}}_{\boldsymbol{m-long}}} \qquad \text{Equation 3-1}$$

$$\overline{\boldsymbol{Q(Gage_i)}}_{\boldsymbol{m-long}} = \frac{\overline{Q(Gage_i)}_{m-short}}{\overline{Q(13313000)}_{m-short}} \overline{Q(13313000)}_{m-long} \qquad \text{Equation 3-2}$$

Where:

$Q(13313000)_{m-long}$ is the long term average monthly flow for USGS Gage 13313000

$Q(13313000)_{m-short}$ is the average monthly flow for USGS Gage 13313000 for the period of record of $Gage_i$

$Q(Gage_i)_{m-long}$ is the estimated long term average monthly flow for $Gage_i$

$Q(Gage_i)_{m-long}$ is the average monthly flow for $Gage_i$ for the period of record of $Gage_i$

To assess the validity of this record extension approach we utilized USGS Gage 13313000 and USGS Gage 13311000 and the associated average monthly data from 2012-2017 to estimate the average monthly discharge from the period of record for USGS Gage 13311000 (1929-1942, 1983-1997, 2011-2017). The estimated results had an error ranging from -12 to 15% for each month, with an average error of -1%. Although this error range seems potentially high 75% of the estimated values are within 1 cfs of the actual period of record average. A summary of this test scenario can be seen in Table 3-1. A summary of average monthly discharge estimates for each gage for the 1929-2017 period of record can be seen in Table 3-2 and Figure 3-1. Chart of Average Monthly Discharge at USGS Gaging Stations (1929-2017).

Table 3-1. Average Monthly Discharge Methodology Validation

Month	Q(Gage$_i$) Gage 13311000	Q(Gage$_{13313000}$) Gage 13313000		Q(Gage$_i$) Gage 13311000			
	Historic	Historic		Estimated	Historic	Variation	Relative Error
	$Q_{m\text{-}short}$ 2012-2017	$Q_{m\text{-}short}$ 2012-2017	$Q_{m\text{-}long}$ 1929-1942, 1983-1997, 2011-2017	$Q_{m\text{-}long}$ 1929-1942, 1983-1997, 2011-2017	$Q_{m\text{-}long}$ 1929-1942, 1983-1997, 2011-2017		
	(cfs)						(%)
January	9	95	85	8	8	0	3%
February	10	125	87	7	8	-1	-10%
March	15	223	124	8	9	-1	-12%
April	40	660	406	25	24	1	5%
May	127	1,741	1,297	94	82	12	15%
June	103	1,119	1,157	107	101	6	6%
July	25	215	293	34	32	2	6%
August	14	106	108	14	14	0	-2%
September	12	93	80	10	11	-1	-5%
October	14	124	89	10	11	-1	-8%
November	13	127	99	10	10	0	-3%
December	11	118	92	8	9	0	-4%

Table 3-2. Average Monthly Discharge at USGS Gaging Stations (1929-2017)

Month	Gaged Discharge (cfs)	Estimated Discharge (cfs) based on record extension					
	13313000	13310850	13310800	13311450	13311000	13311250	13311500
January	89	2	3	6	8	10	19
February	88	2	3	6	8	8	19
March	105	2	2	7	8	9	21
April	335	7	7	17	19	27	44
May	1314	35	32	67	83	115	187
June	1358	51	46	88	118	148	257
July	360	14	18	35	40	49	87
August	119	4	7	12	16	18	35
September	89	3	5	8	12	13	26
October	98	3	4	7	12	12	24
November	104	3	4	7	11	12	24
December	95	3	3	6	9	10	22

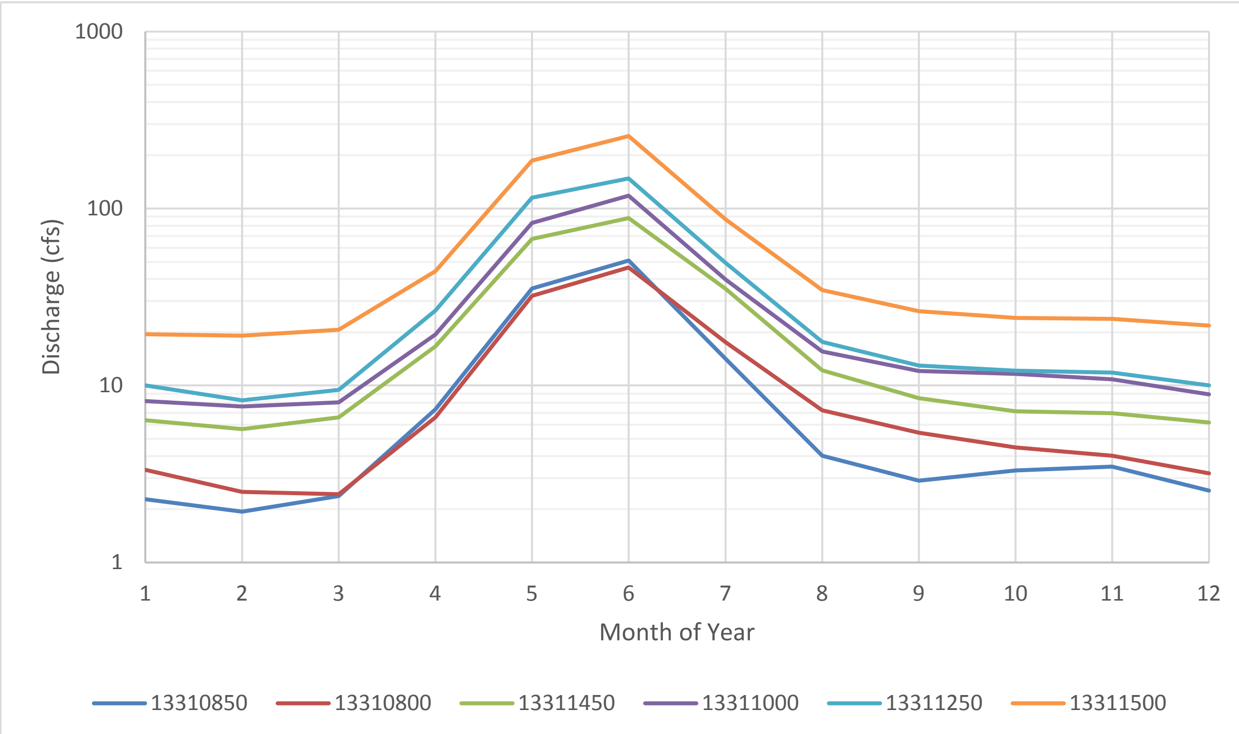

Figure 3-1. Chart of Estimated Average Monthly Discharge at USGS Gaging Stations (1929-2017)

SECTION 4: PEAK FLOWS

An instantaneous peak flow analysis was completed to identify various flood recurrence discharge estimates for stream design considerations. The project site is in a snowmelt dominated watershed. This is evident with the timing of peak flow runoff and the system receding to base flow in early fall as shown in the monthly average discharge figure above. The majority of peak flow events at the project site occur during spring and early summer: April (6%), May (56%) and June (39%) based on the period of record for USGS gage 13311000. This data includes a broken record from 1929 through 2017, but this gage's record holds the most historical observations at the project site. USGS gage 13313000 (Johnson Creek) is lower in elevation and while still peaking in April (8%), May (78%) and June (14%) this gage typically peaks earlier than the proposed project site (percentages are for the same period of record, 1929-1942, 1983-1997, 2011-2017).

To estimate annual (water year typically October 1 – September 30) instantaneous peak flows for the project area the historic annual peak instantaneous flows from the USGS stream gages were statistically analyzed using a Log-Pearson Type III distribution as defined within USGS Bulletin 17C (England, 2018). To ensure that all gages were being compared to the same hydrologic period all historic records were extended to match the full historic record of USGS Gage 13313000 on Johnson Creek. The six gages located near the project area were artificially extended utilizing the MOVE.3 (Maintenance of Variance-Extension) methodology as prescribed in Bulletin 17C (England, 2018). Instantaneous peak recurrence interval flows were estimated utilizing the USGS PeakFQ (USGS, 2014) program using the EMA (Exponential Moving Average) analysis option which adheres to Bulletin 17C (England, 2018). Per the Bulletin 17C guidelines a weighted skew coefficient was used. This analysis used a constant regional generalized skew based on regional Bayesian-Generalized Least Squares analysis. The constant regional generalized skew for Idaho is -0.07 with an associated mean square error of 0.18 (USGS, 2017c). Table 4-1 and Figure 4-1 show selected annual exceedance probabilities and their associated estimated discharge based upon a synthetic continuous record from 1929-2017 utilizing Bulletin 17C for all six USGS gaging locations near the project area. Raw data, MOVE.3 estimates and PeakFQ output files are available upon request.

Table 4-1. Peak Discharge Estimates at USGS Gaging Stations

Annual Exceedance Probability	Recurrence Interval (Years)	Lower, Upper Confidence Intervals and Average Estimate	Discharge (CFS) at USGS Gaging Sites						
			13310850	13310800	13311000	13311250	13311500	13311450	13313000
0.8	1.25	-95% CI	63	63	121	164	255	95	1,881
		Ave	71	70	140	188	297	112	2,113
		95% CI	78	77	158	210	338	128	2,320
0.667	1.5	-95% CI	76	75	154	205	327	124	2,268
		Ave	83	83	174	229	372	143	2,497
		95% CI	91	90	195	254	418	162	2,727
0.5	2	-95% CI	90	89	193	252	415	160	2,713
		Ave	98	97	215	279	465	181	2,962
		95% CI	107	105	240	307	520	204	3,230
0.429	2.33	-95% CI	97	96	211	273	454	177	2,911
		Ave	105	104	235	301	508	199	3,175
		95% CI	114	112	261	331	567	224	3,463
0.2	5	-95% CI	122	120	285	359	622	247	3,737
		Ave	132	130	316	395	693	278	4,079
		95% CI	144	141	353	437	777	314	4,491
0.1	10	-95% CI	140	138	341	423	749	301	4,356
		Ave	152	149	379	466	837	340	4,789
		95% CI	168	165	432	525	959	393	5,375
0.04	25	-95% CI	159	156	401	491	888	361	5,058
		Ave	175	171	454	550	1,010	415	5,652
		95% CI	200	195	539	643	1,207	502	6,592
0.02	50	-95% CI	170	167	438	532	973	398	5,521
		Ave	191	186	507	608	1,133	469	6,273
		95% CI	223	218	623	733	1,403	589	7,574
0.01	100	-95% CI	179	176	469	566	1,044	429	5,936
		Ave	205	200	557	662	1,249	520	6,877
		95% CI	247	241	710	826	1,606	680	8,617

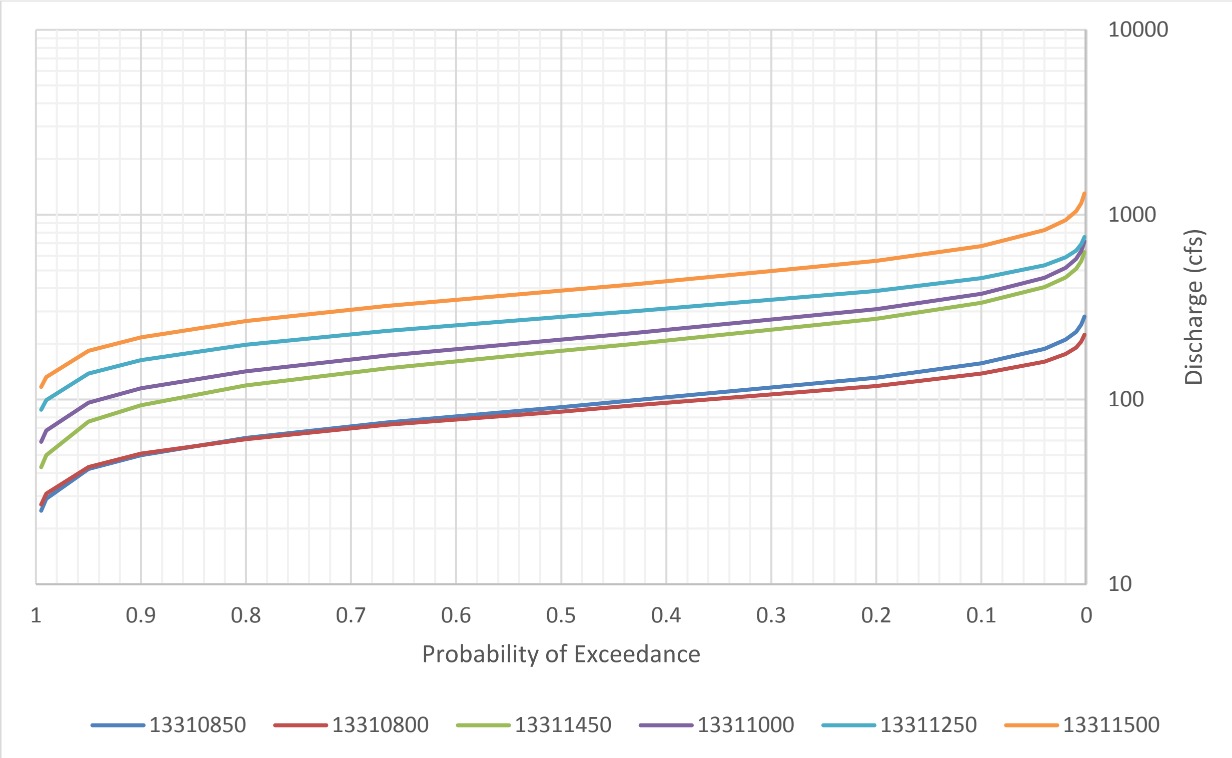

Figure 4-1. Peak Flood Flow Frequency Curves for USGS Gaging Stations

SECTION 5: LOW FLOWS

Extreme low flows were estimated for potential permitting requirements associated with setting effluent limits and allowable pollutant loads to meet water quality standards. These low flows include the 10-year, seven-day average low flow (7Q10) and the 10-year, one-day low flow (1Q10). The 7Q10 is the seven-day average low flow discharge that has a 0.1 probability (10-year recurrence interval) of occurring in any one year. The 1Q10 is the one day average low flow discharge that has a 0.1 probability of occurring in any one year. Average daily flows were analyzed to determine the historic one-day and seven-day low flow discharge for each climatic year (April 1 through March 31) for each gage (USGS, 2006). A climatic year was used as opposed to a typical water year (October 1 through September 30) because low flow periods typically occur during the fall and winter and the climatic year includes one complete season of low flows. Similar to the peak flow analysis, the MOVE.3 methodology was used to extend the historic records to a full 1929-2017 record. The extended records were best fit to a Log-Pearson Type III distribution to estimate low flow discharges and associated recurrence intervals. Low flow analysis was completed with the USGS PeakFQ program as the statistical analysis is the same as peak flows. It utilized the same EMA analysis as the peak flow analysis. The low outlier threshold setting within PeakFQ was set to zero to include all historic flows. The same constant regional generalized skew (-0.07) and associated mean square error (0.18) was used in this analysis as was used in the peak flow analysis.

Table 5-1 shows the estimated 7Q10 and 1Q10 discharge based upon a continuous synthetic record from 1929-2017 utilizing Bulletin 17C for all six USGS gaging locations near the project area. Raw data, MOVE.3 estimates and PeakFQ output files are available upon request.

Table 5-1. Annual Low Flow (1 day and 7 day duration) 10-year Discharge Estimates at USGS Gaging Stations

USGS Gage	0.1 Exceedance (10-year recurrence)	
	1 Day Duration (cfs)	7 Day Duration (cfs)
13310850	1.0	1.1
13310800	2.3	2.4
13311450	3.7	3.9
13311000	4.8	5.1
13311250	5.3	5.9
13311500	10.5	11.5

SECTION 6: DAILY EXCEEDANCE

Flow exceedance values are typically used to assess fish passage. Exceedance flows are analyzed for each fish species, life stage, and associated time of year they utilize the habitat being analyzed. Daily annual exceedance flows (i.e., flow duration curves) were calculated at each gage location from daily average flows analyzed using real and synthesized data representing the last 25 consecutive years. Exceedance flows represent a discharge that is met or exceeded for a certain percentage of the year. For example, the 5% annual daily exceedance flow is met or exceeded only 5% of the year (18 days). The last concurrent 25 years of data are used, as opposed to the entire period of record, based on National Marine Fisheries Service (NMFS) methods from their anadromous salmonid passage facility design guidelines (NMFS, 2011). Fish passage is assessed at low and high flows. Low fish passage is the lowest streamflow for which the fish of interest are expected to safely pass through the project. Low flow is the mean daily streamflow that is exceeded 95% of the time during periods when the fish of interest are normally present at the site. High flow fish passage is the highest streamflow for which the fish of interest are expected to safely pass through the site. High flow is the mean daily streamflow that is exceeded 5% of the time during periods when the fish of interest are normally present at the site (NMFS, 2011).

Daily average flows were analyzed based on the fish species, life stage, and timing of use as defined within fish periodicity charts for the area (BioAnalysts, Inc. 2018). Exceedance curves were developed for the species and time frames identified in Table 6-1. Fish periodicity dates reported here encompass the entire period during which any fish of each specified life stage could be present in the project area and are applied for habitat analysis of permanent (natural or restored) stream segments. Temporary facilities are analyzed under different criteria, documented under separate cover.

Table 6-1. Fish Species, Life Stage, and Period of Use

Fish Species and Life Stage	Period of Use	
	Start	End
Spring/summer Chinook Salmon (Adults)	May 1	September 30
Spring/summer Chinook Salmon (Juveniles)	Year Round	
Steelhead (Adults)	March 16	May 31
Steelhead (Juveniles)	Year Round	
Bull Trout (Adults)	June 16	September 15
Bull Trout (Juveniles)	Year Round	
Cutthroat (Adults)	March 16	July 15
Cutthroat (Juveniles)	Year Round	

To assess daily exceedance discharge at each gage, average daily discharge values were obtained for the period of record of each gage. For the majority of gages the period of record was 2012-

2017. The short-term records were extended utilizing USGS Gage 13313000 (Johnson Creek) to create a complete average daily discharge record extending over the past consecutive 25 years from 1993-2017. To complete this record extension, it was assumed that the ratio of the average discharges at a given gage for a short record to the discharges for a long record are equal between gage locations. This relationship was described above and is shown in Equation 1.

To assess the validity of this record extension approach, USGS Gage 13313000 and USGS Gage 13311000 were utilized, as was the associated average monthly data from 2012-2017 to estimate the daily average exceedance discharges from the past 20 years of record for USGS Gage 13311000 (1985-1997, 2011-2017). The error associated with this estimate method will vary depending upon species and life stage (seasonal variation in discharge), so the probable error associated this methodology was calculated for each species and life stage, as identified above. A summary of these error calculations can be seen in Table 6-2. For the use of estimating fish passage design flows, high flow design flows are on average are overestimated by less than 2% and have a maximum inaccuracy of 12 cfs. Estimated design low flows are all within 2 cfs of the historical record. Of all estimated exceedance flows, more than 60% are within 2 cfs of historical data. A summary of flow duration exceedance values for each gage for the augmented 25-year record (1993-2017) can be seen in Table 6-3.

Table 6-2. Summary of Predicted Error Associated with Historic Record Extension for All Species and Life Stages at USGS Gage 13311000 for historic record 1985-1997 and 2011-2017.

Species (Life Stage)	Calculation	Probability of Exceedance						
		0.05	0.1	0.25	0.5	0.75	0.9	0.95
Spring/summer Chinook Salmon (Adult)	Recorded Discharge (cfs)	167	119	63	22	12	9	7
	Estimated Discharge (cfs)	178	121	74	25	12	9	7
	Relative Error (%)	7%	2%	17%	14%	0%	0%	0%
Summer Steelhead (Adult)	Recorded Discharge (cfs)	161	117	62	28	11	8	7
	Estimated Discharge (cfs)	173	130	74	27	12	6	5
	Relative Error (%)	7%	11%	19%	-4%	9%	-25%	-29%
Bull Trout (Adult)	Recorded Discharge (cfs)	112	71	32	17	12	9	7
	Estimated Discharge (cfs)	107	64	33	18	12	9	7
	Relative Error (%)	-4%	-10%	3%	6%	0%	0%	0%
Cutthroat Trout (Adult)	Recorded Discharge (cfs)	195	145	83	38	17	9	8

Table 6-2. Summary of Predicted Error Associated with Historic Record Extension for All Species and Life Stages at USGS Gage 13311000 for historic record 1985-1997 and 2011-2017.

Species (Life Stage)	Calculation	Probability of Exceedance						
		0.05	0.1	0.25	0.5	0.75	0.9	0.95
	Estimated Discharge (cfs)	185	155	88	41	18	10	6
	Relative Error (%)	-5%	7%	6%	8%	6%	11%	-25%
All Species (Juveniles)	Recorded Discharge (cfs)	115	72	23	11	8	7	6
	Estimated Discharge (cfs)	116	81	22	11	8	6	6
	Relative Error (%)	1%	13%	-4%	0%	0%	-14%	0%

Table 6-3. Predicted Fish Passage Design Flows at USGS Gaging Sites for Synthetic Discharge Record Representing Years 1993-2017.

Fish Species (Life Stage)	Design Passage Flow	Discharge (cfs) at USGS gage location					
		13310850	13310800	13311450	13311000	13311250	13311500
Spring/summer Chinook Salmon (Adult)	High Flow (0.05 exceedance))	70	70	125	193	224	407
	Low Flow (0.95 exceedance)	2	4	7	9	11	22
Summer Steelhead (Adult)	High Flow	67	67	134	172	224	365
	Low Flow	2	2	5	9	8	18
Bull Trout (Adult)	High Flow	51	42	83	122	137	256
	Low Flow	2	4	7	9	10	22
Cutthroat Trout (Adult)	High Flow	73	72	130	203	225	441
	Low Flow	2	3	6	9	8	19
All Species (Juveniles)	High Flow	49	44	86	125	146	239
	Low Flow	1	3	5	7	7	14

SECTION 7: UNGAGED STREAM LOCATIONS

Hydrologic data is required at many more locations than only the existing USGS gage locations. These locations are associated with confluences, geomorphic reach breaks, mine facility locations, outfalls, points of interest for water quality and temperature modeling, etc. For estimating purposes these locations can fall into three categories:

- Scenario 1 - Unknown area of interest is located between 2 USGS gages
- Scenario 2 - Unknown area of interest is located either upstream or downstream of a USGS gage on the same stream channel and is within 0.5 – 1.5 times the drainage area.
- Scenario 3 - Unknown area of interest is located on a stream with no USGS gage or the area of interest is outside of 0.5 – 1.5 times the drainage area.

To estimate the hydrological event of interest at any location within the project area three basic relationships can be applied that represent the three categories above. For scenario 1 above a linear interpolation based on basin area can be applied to estimate the unknown discharge. This formula can be seen in Equation 7-1 (USGS, 2002). For scenario 2 above the hydrological flow of interest can be estimated by applying a basin ratio factor. This type of equation often applies an exponent to the basin area ratio as seen in Equation 7-2. This methodology is typically applied to locations that are within 0.5 to 1.5 times the basin area of the gaged location (USGS, 2002). For scenario 3 localized regression equations were developed based on physical characteristics of each basin. This type of regression equation (linear, parabolic, power curve) tends to vary based on the desired hydrologic flow (peak flow, low flow, or fish passage design flow) but relationships are generally based on basin area and/ or mean annual precipitation as seen in Equations 7-3 and 7-4.

$$Q_u = \frac{Q_{g1}(DA_{g2} - DA_u) + Q_{g2}(DA_u - DA_{g1})}{DA_{g2} - DA_{g1}}$$ Equation 7-1

Where:

Q_u	is discharge (cfs) for the selected frequency for the ungaged site between gaged sites 1 and 2,
Q_{g1}	is discharge (cfs) for the selected frequency for the upstream gaged site,
DA_{g2}	is the drainage area (mi^2) for the downstream gaged site,
DA_u	is drainage area (mi^2) for the ungaged site,
Q_{g2}	is discharge (cfs) for the selected frequency for the downstream gaged site, and
DA_{g1}	is drainage area (mi^2) for the upstream gaged site

$$Q_u = \left(\frac{DA_u}{DA_g}\right)^a Q_g$$ Equation 7-2

Where:

Q_u	is discharge (cfs) for the selected frequency for the ungaged site,
Q_g	is discharge (cfs) for the selected flood frequency for the gaged site,
DA_g	is the drainage area (mi^2) for the gaged site,
DA_u	is drainage area (mi^2) for the ungaged site, and
a	is exponent for drainage area and varies for analyzed discharge

$$Q_u = A\left({P_u}^b {DA_u}^c\right)^2 + B\left({P_u}^b {DA_u}^c\right)$$ Equation 7-3

Where:

Q_u	is discharge (cfs) for the selected frequency for the ungaged site,
A	is a constant based on regression trend line,
B	is a constant based on regression trend line, and
P_u	is the average annual precipitation (in)
DA_u	is drainage area (mi^2) for the ungaged site
b	is exponent for precipitation, and
c	is exponent for drainage area

$$Q_u = B\left({P_u}^b {DA_u}^c\right)^d$$ Equation 7-4

Where:

Q_u	is discharge (cfs) for the selected frequency for the ungaged site,
A	is a constant based on regression trend line,
B	is a constant based on regression trend line, and
P_u	is the average annual precipitation (in)
DA_u	is drainage area (mi^2) for the ungaged site
b	is exponent for precipitation, and
c	is exponent for drainage area
d	is exponent for power curve

The sections below will provide the exponents or constants associated with the referenced equations above.

Monthly Flows

For analysis of monthly flows throughout the project area equations 7-1 through 7-3 are valid. The exponent ‘a’ in Equation 7-2 is 1. Equation 7-3 utilizes only the drainage area as the variable in determining the average monthly discharge. The constants ‘A’ and ‘B’ for Equation 7-3 vary for each month’s hydrology and these constants are summarized in Table 7-1 along with each regression equation’s R^2 value. The exponent b is equal to 0 and the exponent c is equal to 1 for all monthly flows.

Table 7-1. Constant Coefficients For Monthly Discharge Estimates Regression Equation.

Month	α	A	B	b	c	R^2
January	1	0.0023	0.3884	0	1	0.994
February		0.0066	0.3516			0.997
March		0.0100	0.5914			0.997
April		0.0015	1.9826			0.983
May		-0.0074	6.1244			0.971
June		0.0013	4.8764			0.973
July		-0.0012	1.2553			0.995
August		0.0023	0.6138			0.995
September		0.0029	0.5080			0.990
October		0.0035	0.5609			0.983
November		0.0037	0.5170			0.982
December		0.0550	0.3903			0.992

Peak Flows

For analysis of instantaneous annual peak flows throughout the project area, Equations 7-1, 7-2 and7-4 are valid. Equation 7-3 is not valid for peak flows. The exponent ‘a’ in Equation 7-2 varies based on the recurrence interval as shown in Table 7-2. Constant ‘B’ for Equation 7-4 vary for each recurrence interval and these constants are summarized with each regression equation’s R^2 value along with the exponents ‘b’ and ‘c’ as shown in Table 7-2.

Table 7-2. Constants and Coefficients For Peak Flood Flow Discharge Estimates Regression Equations.

Annual Exceedance Probability	Recurrence Interval (Years)	Variable					
		a	B	b	c	d	R^2
0.995	1.005	0.899[1]	0.0035	2.976	0.925	0.7404	0.970
0.99	1.01	0.899[1]	0.0027	2.980	0.925	0.7714	0.961
0.95	1.05	0.901[1]	0.0017	3.011	0.927	0.8287	0.940
0.9	1.11	0.904[1]	0.0012	3.055	0.930	0.8593	0.926
0.8	1.25	0.908	0.0018	2.840	0.934	0.8946	0.930
0.6667	1.5	0.913	0.0020	2.750	0.939	0.9249	0.927
0.5	2	0.918	0.0021	2.670	0.943	0.9561	0.924
0.4292	2.33	0.919	0.0023	2.630	0.944	0.9645	0.923
0.2	5	0.922	0.0025	2.530	0.945	1.0104	0.918
0.1	10	0.922	0.0027	2.470	0.944	1.0389	0.915
0.04	25	0.921	0.0027	2.420	0.941	1.0692	0.912
0.02	50	0.919	0.0028	2.390	0.939	1.0873	0.910
0.01	100	0.916	0.0027	2.370	0.936	1.1051	0.908
0.005	200	0.914	0.0027	2.350	0.934	1.1210	0.906
0.002	500	0.912	0.0025	2.340	0.931	1.1379	0.903

1. Values were linearly extrapolated from the exponents associated with the 1.25- and 1.5-year recurrence intervals.

Low Flows

Equations 7-1 through 7-3 are valid for analysis of 1-day and 7-day low flow events with a recurrence interval of 10 years throughout the project area. Table 7-3 below shows the constants and coefficients to estimate low flow parameters throughout the project site.

Table 7-3. Constants and Coefficients For Low Flow Estimates 1Q10 and 7Q10

Low Flow Event	Variable					
	a	A	B	b	c	R^2
1Q10	1	0.00074600	0.211587	0	1	0.991
7Q10		0.00000155	0.006533			0.955

Daily Exceedance Flows

For computing daily exceedance flows, Equations 7-1 through 7-3 have varying coefficients for each species and life stage (Equation 7-4 is not used in the estimation of daily exceedance flows associated with fish periodicity time frames). Regression equations also vary for different probability of exceedance. Table 7-4 through Table 7-8 document the variables for each life stage at various daily exceedance probabilities.

Table 7-4. Constants and Coefficients For Daily Exceedance Flows For Adult Spring/Summer Chinook Salmon (May Through September).

<table>
<tr><th rowspan="2">Exceedance Probability</th><th colspan="6">Variable</th></tr>
<tr><th>a</th><th>A</th><th>B</th><th>b</th><th>c</th><th>R^2</th></tr>
<tr><td>0.05</td><td rowspan="15">1</td><td>0.000044</td><td>0.247693</td><td rowspan="5">1</td><td rowspan="15">1</td><td>0.992</td></tr>
<tr><td>0.1</td><td>0.000018</td><td>0.187958</td><td>0.989</td></tr>
<tr><td>0.15</td><td>-0.000013</td><td>0.171800</td><td>0.985</td></tr>
<tr><td>0.2</td><td>-0.000007</td><td>0.147353</td><td>0.984</td></tr>
<tr><td>0.25</td><td>-0.000004</td><td>0.125078</td><td>0.981</td></tr>
<tr><td>0.30</td><td>0.008770</td><td>2.891185</td><td rowspan="10">0</td><td>0.975</td></tr>
<tr><td>0.4</td><td>-0.000317</td><td>2.065744</td><td>0.978</td></tr>
<tr><td>0.5</td><td>0.000091</td><td>1.353841</td><td>0.997</td></tr>
<tr><td>0.6</td><td>-0.000841</td><td>0.943811</td><td>0.999</td></tr>
<tr><td>0.7</td><td>0.001126</td><td>0.697532</td><td>0.996</td></tr>
<tr><td>0.75</td><td>0.001261</td><td>0.632881</td><td>0.995</td></tr>
<tr><td>0.8</td><td>0.002933</td><td>0.535832</td><td>0.993</td></tr>
<tr><td>0.85</td><td>0.002887</td><td>0.487132</td><td>0.992</td></tr>
<tr><td>0.9</td><td>0.002330</td><td>0.459591</td><td>0.992</td></tr>
<tr><td>0.95</td><td>0.003118</td><td>0.381871</td><td>0.994</td></tr>
</table>

Table 7-5. Constants and Coefficients For Daily Exceedance Flows For Adult Summer Steelhead (Mid-March Through May).

<table>
<tr><th rowspan="2">Exceedance Probability</th><th colspan="6">Variable</th></tr>
<tr><th>a</th><th>A</th><th>B</th><th>b</th><th>c</th><th>R^2</th></tr>
<tr><td>0.05</td><td rowspan="11">1</td><td>0.000011</td><td>0.260000</td><td rowspan="11">1</td><td rowspan="11">1</td><td>0.993</td></tr>
<tr><td>0.1</td><td>-0.000017</td><td>0.205942</td><td>0.982</td></tr>
<tr><td>0.15</td><td>-0.000008</td><td>0.156098</td><td>0.986</td></tr>
<tr><td>0.2</td><td>-0.000003</td><td>0.131107</td><td>0.984</td></tr>
<tr><td>0.25</td><td>0.000005</td><td>0.106798</td><td>0.983</td></tr>
<tr><td>0.30</td><td>0.000001</td><td>0.100121</td><td>0.963</td></tr>
<tr><td>0.4</td><td>0.000002</td><td>0.065682</td><td>0.948</td></tr>
<tr><td>0.5</td><td>0.000006</td><td>0.037893</td><td>0.984</td></tr>
<tr><td>0.6</td><td>0.000013</td><td>0.022333</td><td>0.993</td></tr>
<tr><td>0.7</td><td>0.000009</td><td>0.014019</td><td>0.992</td></tr>
<tr><td>0.75</td><td>0.000012</td><td>0.009621</td><td>0.993</td></tr>
</table>

Table 7-5. Constants and Coefficients For Daily Exceedance Flows For Adult Summer Steelhead (Mid-March Through May).

Exceedance Probability	Variable					
	a	A	B	b	c	R^2
0.8		0.000011	0.007866			0.990
0.85		0.000006	0.009194			0.984
0.9		0.000005	0.008018			0.974
0.95		0.000004	0.008387			0.962

Table 7-6. Constants and Coefficients For Daily Exceedance Flows For Adult Bull Trout (Mid-June Through Mid-September).

Exceedance Probability	Variable					
	a	A	B	b	c	R^2
0.05		0.000024	0.159538			0.986
0.1		0.000023	0.107314			0.989
0.15		0.000005	0.087626	1		0.993
0.2		-0.000001	0.072282			0.997
0.25		-0.000001	0.057194			0.998
0.30		0.001884	1.510501			0.998
0.4		-0.000436	1.158690			0.999
0.5	1	-0.001625	0.980567		1	0.999
0.6		0.000986	0.749126			0.996
0.7		0.001762	0.652572	0		0.996
0.75		0.002360	0.592930			0.992
0.8		0.003753	0.510465			0.990
0.85		0.004111	0.461066			0.992
0.9		0.002497	0.471297			0.988
0.95		0.002861	0.384315			0.993

Table 7-7. Constants and Coefficients For Daily Exceedance Flows For Adult Cutthroat Trout (Mid-March Through Mid-July).

Exceedance Probability	Variable					
	a	A	B	b	c	R^2
0.05		0.000065	0.242981			0.991
0.1		0.000010	0.228888			0.989
0.15		0.000001	0.178686			0.989
0.2		-0.000008	0.161939			0.986
0.25		-0.000008	0.145049			0.985
0.30		-0.000004	0.128391			0.976
0.4		0.000009	0.084460			0.984
0.5	1	0.000012	0.057758	1	1	0.989
0.6		0.000012	0.040587			0.991
0.7		0.000010	0.026365			0.995
0.75		0.000006	0.023593			0.988
0.8		0.000003	0.021142			0.978
0.85		0.000005	0.017268			0.983
0.9		0.000004	0.011790			0.990
0.95		0.000005	0.008185			0.983

Table 7-8. Constants and Coefficients For Daily Exceedance Flows For Juvenile Salmonids (Year-Round).

Exceedance Probability	Variable					
	a	A	B	b	c	R^2
0.05		-0.000001	0.180856			0.988
0.1		-0.000008	0.135958			0.984
0.15		0.000009	0.075654			0.990
0.2		0.000014	0.042347			0.992
0.25		0.000012	0.028007			0.995
0.30		0.000010	0.022677			0.994
0.4		0.000008	0.014811			0.995
0.5	1	0.000006	0.012880	1	1	0.998
0.6		0.000005	0.011939			0.998
0.7		0.000003	0.011560			0.998
0.75		0.000004	0.010408			0.999
0.8		0.000003	0.010177			0.999
0.85		0.000003	0.009879			0.999
0.9		0.000002	0.009227			0.997
0.95		0.000002	0.008033			0.996

SECTION 8: PROPOSED CONDITIONS

Based on reach breaks and proposed grading activities, new drainage areas (based on conditions at mine closure) are estimated and used to develop post mine surface water hydrology throughout the project site. Midas Gold is currently developing a proposed conditions hydrogeologic model to evaluate changes to surface and groundwater hydrology throughout and after the operational period of the mine. This model will be used to validate this initial assumption and later refine the hydrology for stream restoration design as the design process progresses from conceptual to final design. It is anticipated that the most potentially significant alteration to flow hydrology would be low flow characteristics through reclaimed mining areas. Channel-forming discharges are not likely to change.

SECTION 9: CLIMATE CHANGE

All of the streams designed for the project incorporate resiliency in the form of allowing natural process and therefore natural channel response to climate change and other exogenous drivers. It is assumed that if the climate changes, the restored streams would respond in a manner similar to other streams in the area naturally over time. Additionally, the stream design incorporates factors of safety to accommodate changes in hydrology associated with climate change. Estimates of potential increased flood discharge resulting in altered snowmelt and/or rain-on-snow conditions associated with climate change are relatively small (less than 10% increase – see below) compared with potential increased post-fire runoff (as much as 10x increase based on unpublished hydrologic modeling from similar projects). Factors of safety have been added to the designed channel and floodplain geometries to account for the increased conveyance required to address these potential changes. Additional measures have been taken on the TSF to account for potential long-term sediment accumulations associated with climate change, fire, and/or other natural disturbances (see Appendix D).

Increased discharge associated with altered snowmelt and/or rain-on-snow events was assessed by evaluating recent trends in the hydrologic record. Monthly flows were analyzed to see if there were any perceived alterations to the timing of flows. Peak flows and timing of peak flows were analyzed to make hypotheses as to whether there is a potential shift in flow regime (e.g. snowmelt to rain-on-snow) and or timing of peak flow. High and low flows were analyzed to see if extreme flow events were changing (higher highs and lower lows). This analysis was only completed on USGS Gage 13313000 since it has the longest historical record. It is assumed that trends seen at USGS Gage 13313000 are transferable to the project site and may be validated from the data available for USGS Gage 13311000.

In addition to discharge, climate change may affect stream temperatures. Research suggests that air temperatures in the Pacific Northwest are rising and stream temperatures are increasing throughout the year at average rates of 0.3^{o}F/decade during summer months (Isaak, 2012). Increased air and water temperatures lead to more evapotranspiration, more precipitation falling as rain, potentially earlier snowmelt and runoff, less groundwater storage and potential higher peak flows and lower base flows in the streams. Temperature increases can also limit or move available habitat for certain aquatic species. As temperatures increase in lower areas of a watershed it could affect the potential for migrating fish to pass through these warmer zones into more preferred upstream natal habitat for spawning (Rieman, 2010).

Flow Regime and Timing

Based on a review of average monthly discharge values for various time periods there does not appear to be a significant difference between earlier versus more recent monthly discharge values as shown in Figure 9-1. There are short term shifts, but no major long-term trends. A good example of a possible short-term trend is comparing the long-term average monthly discharge to the average monthly discharge for the last five years. This shows earlier than normal runoff through the spring peaking in May and receding back toward base flows through July.

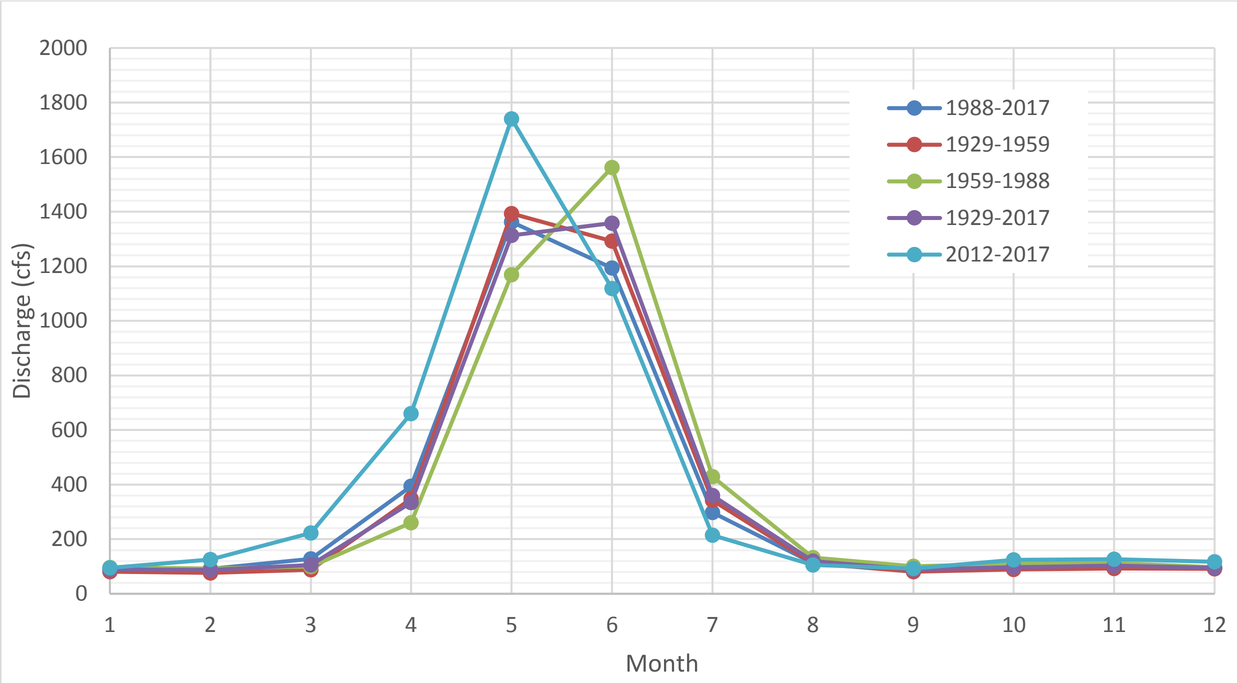

Figure 9-1. Monthly Average Discharge at USGS Gage 13313000 for Various Historic Time Periods (Month 1 is January)

Flow Variation

Reviewing statistical instantaneous peak flow data it appears that lower probability events, aka higher recurrence interval events, (e.g. 100-year) between earlier versus more recent instantaneous flows as shown in Table 9-1 may be increasing (+20%) (Figure 9-2) while more frequent, higher probability events may be slightly decreasing (-20%). While this could be associated with statistical variation on both end of the probabilistic curve, but generally agrees with climate change predictions of higher high discharge and lower low discharges.

Table 9-1. Instantaneous Peak Flow Events for Various Historic Time Frames and Deviation From 1988-2017 versus 1927-1987.

Annual Exceedance Probability	Recurrence Interval (Years)	USGS Gage 13313000 Discharge (cfs)				
		1929-2017	1929-1958	1958-1987	1988-2017	Deviation, 1988-2017 vs. 1958-1987
0.995	1.005	994	1,121	1,163	866	-26%
0.99	1.01	1,113	1,239	1,286	974	-24%
0.95	1.05	1,505	1,621	1,678	1,339	-20%
0.9	1.11	1,758	1,864	1,925	1,586	-18%
0.8	1.25	2,113	2,200	2,266	1,943	-14%
0.6667	1.5	2,497	2,560	2,627	2,346	-11%
0.5	2	2,962	2,992	3,056	2,856	-7%
0.4292	2.33	3,175	3,188	3,250	3,097	-5%
0.2	5	4,079	4,017	4,060	4,178	3%
0.1	10	4,789	4,663	4,682	5,087	9%
0.04	25	5,652	5,447	5,426	6,267	15%
0.02	50	6,273	6,009	5,953	7,165	20%
0.01	100	6,877	6,556	6,461	8,079	25%
0.005	200	7,469	7,092	6,954	9,013	30%
0.002	500	8,239	7,789	7,590	10,280	35%

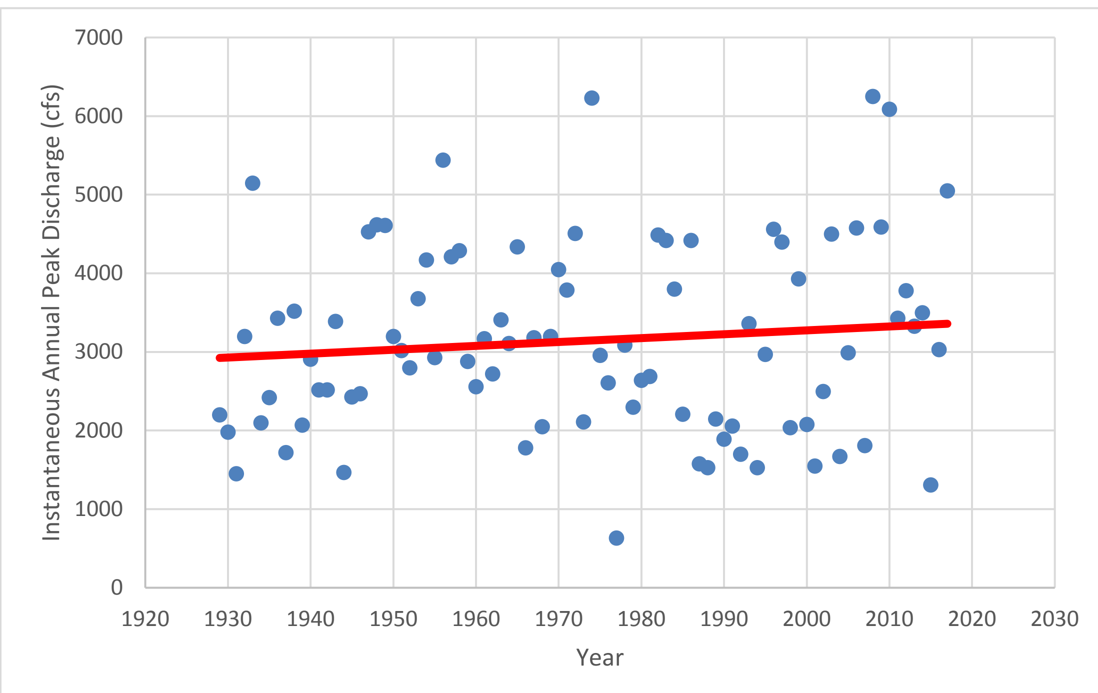

Figure 9-21. Long term trendline of annual instantaneous peak discharge for USGS gage 13313000 suggest a slight trend in increases in peak flow over the past 89 years.

A statistical comparison of low flows at various historic 30-year intervals shows little variation throughout the historic record as displayed in Table 9-2. The amount of variation is too small (Figure 9-3) to accurately come to a definitive conclusion if flows are currently being altered due to climate change.

Table 9-2. Statistical One Day Low Flow Event Estimates For Various Historic Time Frames and Deviation From 1988-2017 versus 1927-1987.

		USGS Gage 13313000				
Annual Exceedance Probability	**Recurrence Interval (Years)**	**1929-2017**	**1929-1958**	**1958-1987**	**1988-2017**	**Deviation, 1988-2017 vs. 1927-1987**
0.005	200	26	24	30	25	-7%
0.01	100	27	26	31	27	-5%
0.05	20	33	31	36	33	-1%
0.1	10	36	34	40	37	0%
0.2	5	41	39	44	42	1%
0.3333	3	46	43	49	47	2%
0.5	2	52	49	54	53	3%
0.5708	1.75	54	51	57	56	4%
0.8	1.25	65	62	67	66	2%
0.9	1.11	73	70	76	74	1%
0.96	1.04	84	80	87	83	-1%
0.98	1.02	91	87	95	89	-2%
0.99	1.01	98	94	103	95	-4%
0.995	1.01	105	101	111	101	-5%
0.998	1.00	114	110	122	108	-7%

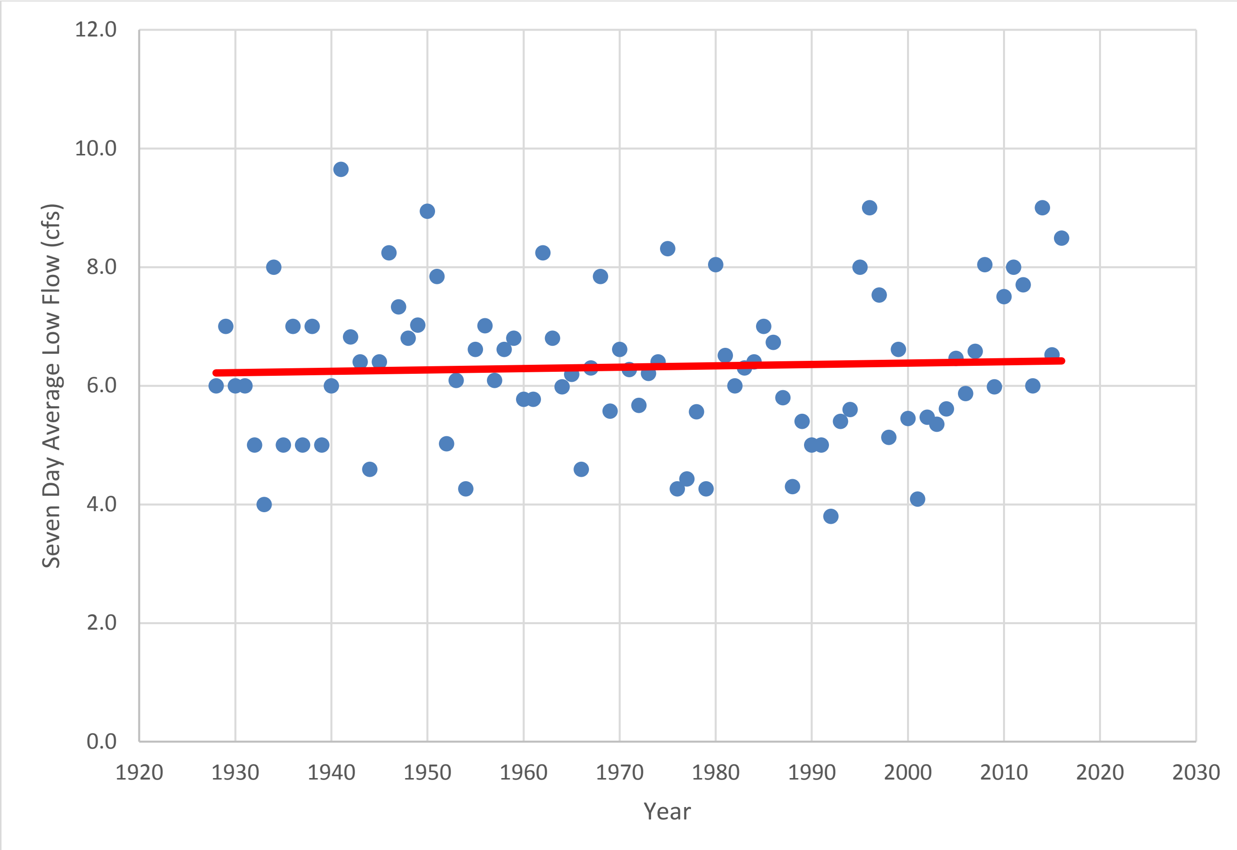

Figure 9-32. Long term trendline of seven-day average low flow discharge for USGS gage 13311000 (Historical data was extrapolated using MOVE.3. methodology from USGS gage 13313000) suggest little to no change in low flow associated with recent conditions possibly associated with climate change.

SECTION 10: REFERENCES

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SECTION 11: ACRONYMS

EFSFSR	East Fork South Fork Salmon River
Midas Gold	Midas Gold Idaho, Inc.
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
USGS	United States Geological Survey

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Appendix D
Reach-Scale Design Summary

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APPENDIX D - REACH-SCALE DESIGN SUMMARY

Project-scale design rationale is summarized within the body of this report (Draft Stream Design Report, Stibnite Gold Project, May 2018). The purpose of this appendix is to provide additional objectives (details, clarification, design rationale, and criteria) specific to each individual stream and/or stream reach to facilitate design review. The appendix includes project-scale biological and physical objectives summaries (below) followed by stream- and stream reach-specific biological and physical objectives.

D.1 Reach-Scale Biological Objectives

Biological objectives were established for different stream reaches identified in the plan of Restoration and Operations (Midas Gold 2016). Biological objectives identify the anticipated salmonid species and use (e.g., spawning, rearing) that is expected in the reach (Table D-1 and Figure D-1). Establishing a primary biological objective within a reach does not preclude multiple objectives. Indeed, salmonid spawning is often segregated temporally (i.e., time of spawning) while rearing can be spatially (i.e., pools vs. riffles) segregated within the same reach. Although the conceptual stream designs (Appendix E) were largely developed to accommodate physical site conditions and geomorphic suitability, the following biological objectives were used to refine the design within each reach to maximize habitat potential to the extent practicable.

Table D-1. Biological objectives by stream and reach.

Stream	Reach	Biological Objectives			
		I - Primary	II	III	IV
Meadow Creek	MC1 – MC2	Resident BT spawning and rearing	Resident WCT spawning and rearing		
	MC3	Water conveyance			
	MC4 – MC6	CH spawning and rearing	ST spawning and rearing	BT spawning and rearing	WCT Rearing
EF Meadow (Blowout) Creek	BC1	WCT Spawning and Rearing	Reduced sediment delivery		
	BC2	Water conveyance	Reduce sediment delivery		
	BC3	WCT Rearing	CH rearing	ST rearing	BT rearing
East Fork South Fork Salmon River (EFSFSR)	EF1 – EF4	ST spawning and rearing	CH spawning and rearing	BT spawning and rearing	WCT Rearing
Hennessy Creek	HC1	Water conveyance			
	HC2	ST rearing	CH rearing		
Midnight Creek	MNC1 – MNC2	ST rearing	CH rearing		
Fiddle Creek	FC1	Resident WCT spawning and rearing			
	FC2	Water conveyance			
West End Creek	WE1 - WE 3	Water conveyance			
Garnet Creek	GC1	ST rearing	CH rearing		

Note: Acronyms are used to identify Chinook salmon (CH), Steelhead (ST), Bull trout (BT) and Westslope cutthroat trout (WCT).

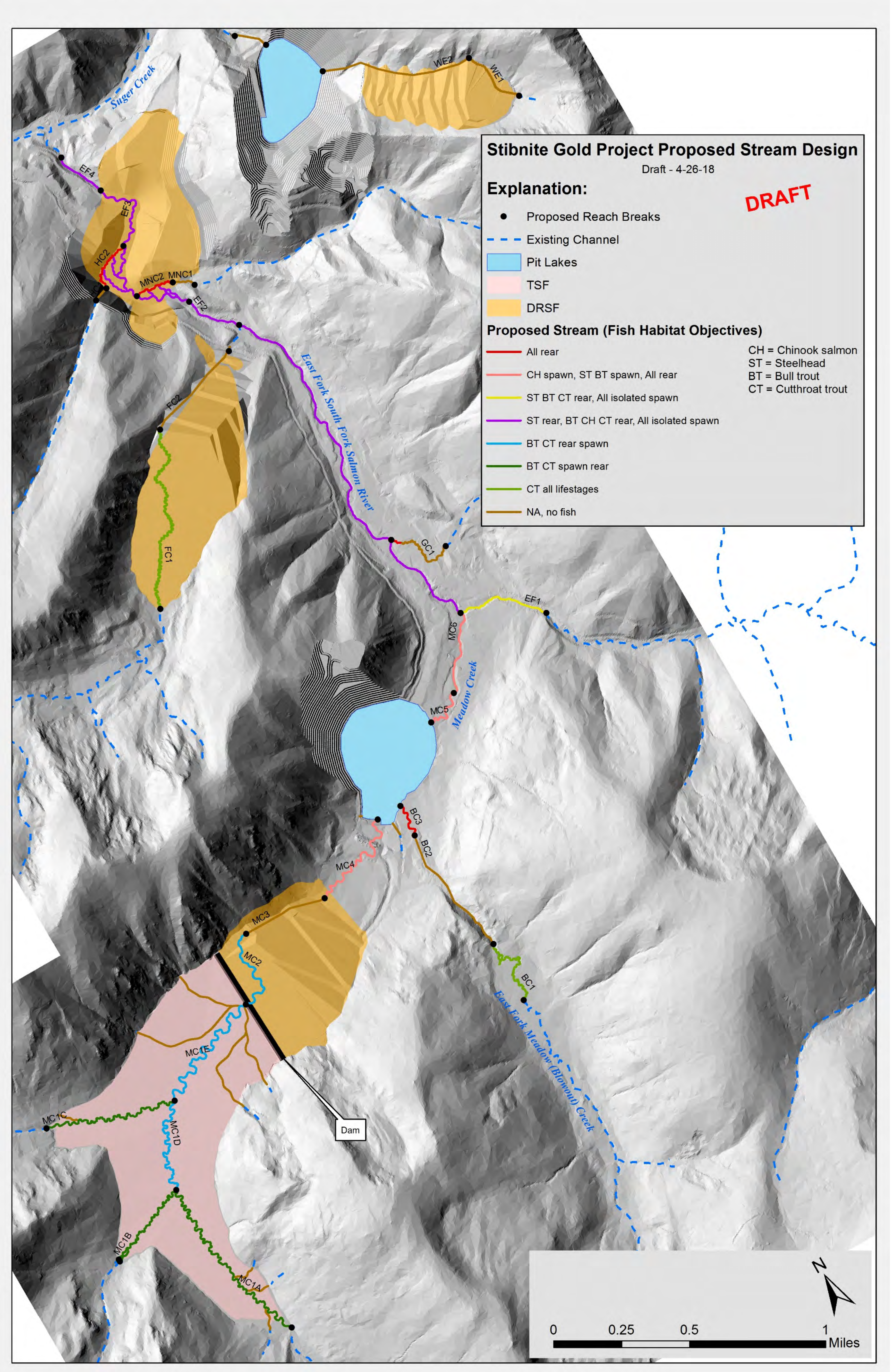

Figure D-1. Proposed Stream Design Reaches

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D.2 Reach-Scale Physical Objectives

Physical objectives were established for different stream reaches identified in the plan of operations and restoration (Midas Gold 2016), then refined in the body of this Stream Design Report. These physical objectives drive the basis of the design ensuring a stable, yet functionally dynamic and resilient stream channel and floodplain are developed and sustained over the short- and long-term. The goal of the channel design is to emulate natural conditions working with geomorphic processes occurring within each reach to establish and maintain appropriate aquatic habitat.

Project-scale physical objectives are outlined in the body of the Stream Design Report. Listed below are reach-scale physical objectives and considerations that informed each individual reach design in addition to the project-scale objectives. Design objectives were developed, in part, from reference site data as summarized in Table D-2.

Table D-2: Stream Reaches with Associated Reference Sites and Rationale

Reach ID	Reference Site(es)	Reference site selection rationale
MC1a	13, 17, 20	Low stream order, unconfined, moderate gradient, mixed fire history
MC1b	13, 17, 20	
MC1c	13, 17, 20	
MC1d	12,16	Moderate stream order, unconfined, low gradient, mixed fire history
MC1e	12,16	
MC2	12, 16	
MC3	4, 6, 19	Confined, very steep gradient
MC4	10, 11, 12, 14	Moderate to high stream order, unconfined, low gradient, mixed fire history, known Chinook salmon spawning habitat (11)
MC5	10, 11, 12	Moderate to high stream order, unconfined, low to moderate gradient, mixed fire history, known Chinook salmon spawning habitat (11)
MC6	10, 11, 12	
BC1	14, 16	Unconfined, low gradient
BC2	2, 4, 8, 19	Confined, very steep gradient, boulder-dominated
BC3	11, 15	Unconfined, moderate gradient, diverse physical habitat
EF1	1, 5, 15	Moderate stream order, range of confinement, moderate to steep gradient, mixed fire history
EF2	1, 5, 9, 15	Moderate stream order, range of confinement, moderate to steep gradient, mixed fire history, low sinuosity, plane-bed to step-pool bedform
EF3	1, 5, 9, 15	
EF4	1, 5, 9, 15	
FC1	13, 17, 20	Low stream order, unconfined, moderate gradient, mixed fire history
FC2	4, 6, 19	Confined, very steep gradient
MNC1	2, 4, 8, 19	Confined, very steep gradient, boulder-dominated
MNC2	13, 19	Low stream order, steep gradient, stable banks
HC1	4, 6, 19	Confined, very steep gradient
HC2	13, 19	Low stream order, steep gradient, stable banks
GC1	13, 19	Low stream order, moderate gradient, stable banks
WE1	13, 17,20	Low stream order, unconfined, moderate gradient, mixed fire history
WE2	4, 6, 19	Confined, very steep gradient
WE3	4, 6, 19	

Note: See Appendix B (Reference Sites) for more information regarding each reference site.

MEADOW CREEK

Biological Objectives

Meadow Creek has been heavily impacted by legacy mining-related activities including: deposition of tailings and spent heap leach ore, ore processing facilities and other infrastructure, stream relocation into straightened riprap channel and construction of an airstrip (Midas Gold 2016). The proposed plan for Meadow Creek includes restoring the channel on top of the Tailings Storage Facility (TSF) and routed downstream along the side of the Hangar Flats Development Rock Storage Facilities (DRSF). Below the DRSF, Meadow Creek would flow into Hangar Flats lake (along with Blowout Creek). The outfall from Hangar Flats lake would flow into the enhanced lower reach of Meadow Creek that flows into the East Fork South Fork Salmon River (EFSFSR).

Reaches MC1, MC2 & MC3

These reaches of Meadow Creek are currently occupied by bull trout and Westslope cutthroat trout (MWH 2017). These reaches would be upstream of a physical barrier (MC3) that would preclude migratory life histories (i.e., fluvial, adfluvial and anadromous). The biological objective in reaches MC1 and MC2 would be to provide spawning and rearing habitat for resident bull trout and Westslope cutthroat trout (Table D-1). Reach MC3 is a steep, boulder-lined channel with limited habitat, primarily intended to serve as a stable water conveyance to downstream reaches.

Reaches MC4, MC5 & MC6

Reaches MC4, MC5 and MC6 of Meadow Creek lie within a relatively unconfined alluvial valley. Reach MC4 of Meadow Creek would be upstream of the lake formed by Hangar Flats pit while reaches MC5 and MC6 would be downstream from the lake. Intrinsic potential for Chinook salmon varies based on the proposed conditions in these reaches and is dependent on gradient and channel confinement (Table D-3). Intrinsic potential is medium-to-high for Chinook salmon in reaches MC4 and MC5 as proposed, while reach MC6 has a low potential, largely because gradient exceeds 1.5%. For steelhead in the same reaches, intrinsic potential is high for all reaches regardless of gradient and confinement. Chinook salmon spawning and rearing was selected as the primary biological objective because these life stages are supported by the intrinsic potential of the proposed reaches, and because the channel gradients are less suitable for Chinook salmon in other reaches (see EFSFSR). As a result of the conditions within other streams/reaches, lower Meadow Creek represents the only location within the Stibnite Gold Project area where Chinook salmon spawning can be targeted as the principal biological objective. The potential habitat types (i.e., pool-riffle) associated with these reaches would provide favorable spawning and rearing conditions for nearly all salmonids. For this reason, additional secondary biological objectives were established beyond Chinook salmon spawning (Table D-1).

Table D-3. Basic intrinsic potential for Chinook Salmon and Steelhead

Species	Reach	Stream width/ Gradient Categories		Valley Width Ratio (ratio of valley width to bankfull stream width)		
		Bankfull Width (ft.)	Gradient (%)	Confined (≤4 x BFW)	Moderate (4 to 20 x BFW)	Wide (> 20 x BFW)
Chinook salmon	MC4	16	0.98	Low	Medium	High
	MC5	17	1.39	Low	Medium	High
	MC6	17	2.29	Low	Low	Medium
Steelhead	MC4	16	0.98	Low	High	High
	MC5	17	1.39	Low	High	High
	MC6	17	2.29	Low	High	High

Note: Intrinsic potential categories were based on proposed bankfull width (BFW), gradient (%), and the ratio of floodplain width (FPW) to bankfull width (FPW/BFW).

Physical Objectives

To understand the basis of the physical objectives for the Meadow Creek design, the structure of the proposed valley upon which the stream would flow must first be described. The upper reaches of Meadow Creek (MC1) are designed to flow within a lined[1] floodplain corridor on top of the TSF, and the middle reaches (MC2) would also flow within a lined floodplain corridor on top of the Hangar Flats DRSF, then cascade down the face of the DRSF (MC3) to feed the lower reaches (MC4, MC5, and MC6) which would flow into and out of the proposed Hangar Flats pit lake.

Reach MC1 would flow over the surface of the TSF, composed of deposited tailings ranging in thickness from 0 feet to approximately 400 feet, and retained by a large rockfill dam and associated development rock storage facility buttress (Midas Gold 2016). While the tailings would be fully contained with an impermeable liner (i.e. bottom liner) and covered with a layer of development rock fill and growth media, a linear corridor across the surface of the TSF would also be lined to contain the Meadow Creek channel and its entire floodplain (i.e. surface liner) and prevent direct interaction of Meadow Creek water with water that has been in contact with the tailings. Meadow Creek would flow through a small notch at the top of the dam passing onto the DRSF. Reach MC2, beginning immediately downstream of the dam crest, would flow over the surface of the DRSF, which would be composed primarily of coarse angular boulders and rock. The DRSF itself would not be contained within a bottom liner like the TSF, but to prevent excessive seepage losses from the channel and floodplain into the relatively permeable materials underneath, the MC2 stream corridor would be built over a surface liner similar to that of MC1. Regardless of the application (TSF or DRSF) and the type of impermeable surface liner used (see Midas Gold 2016 for more details regarding the surface liner), the liner itself must be bedded

[1] The need for liner underneath stream corridors atop the TSF and DRSFs was determined based on limited testing, design calculations, modeling, and assumptions about tailings consolidation rates, tailings and development rock permeability and geochemistry, and site hydrology. As new information becomes available, the need for impermeable liner will be reevaluated.

appropriately to minimize the risk of puncture, to prevent exposure, and to allow the stream to function naturally over the liner surface.

To prevent puncture, the surface liner must lie atop and be covered by approximately 6 to 12 inches of relatively fine-grained and rounded material (protection layer). The tailings material itself generally fits these criteria, eliminating the need for a protective layer beneath the surface liner on the TSF, unlike the DRSF which may require successive layers of protective material grading from the coarse rock of the DRSF itself to the relatively fine gravel and sand in contact with the liner. Most likely 12 inches of sand and/or rounded gravel would be used for the protective layer above the liner (Personal Communication with Tierra Group International, Ltd.).

To prevent future liner exposure due to scour and/or erosion, the liner and associated protective layer over its top must be armored with sufficiently coarse rock to resist scour given the gradient, discharge, and geometry of the proposed channel. Given the relatively low gradient, small discharge, and various possible channel geometries in MC1 and MC2, the rock armor layer would likely consist of large cobble-sized materials at a thickness of 1- to 1.5-times the maximum diameter of the cobble itself providing a roughly 9-inch to 12-inch armor layer.

To allow natural stream function, Meadow Creek reaches MC1 and MC2 have been designed with a stream bed and floodplain gradation and thickness suitable for the hydraulic and sediment transport conditions anticipated for each stream reach. The bed material must be placed at a minimum depth equal to the maximum pool depth, which is on the order of 1.5 feet, and the floodplain material must be placed at a minimum depth equal to the maximum bankfull channel depth, which is on the order of 1 to 2 feet. These minimum material thicknesses are required to accommodate the dynamic conditions of the natural channel without unnecessarily restraining or exacerbating its ability to scour pools, migrate laterally, and/or occasionally inundate the floodplain.

The Meadow Creek stream channel and the entirety of its floodplain must therefore be designed atop an impervious liner, covered by roughly 6 to 12 inches of protective sand and gravel, 9 to 12 additional inches of cobble armor, plus 3 to 3.5 feet of streambed and floodplain material, equaling roughly 5 feet of total thickness. This nuance is especially important in understanding the options considered for the Meadow Creek stream design atop the TSF (Reach MC1), as discussed below.

Reach MC1

When initially deposited in the TSF, the tailings material is largely saturated, fine-grained (P80 approximately 75 microns), unconsolidated, and roughly level (generally less than 0.5% gradient, sloping downwards from deposition points on the perimeter of the facility). The low shear strength and saturation of the material generally preclude access by heavy machinery. After consolidation and evaporation of excess water over several years, a veneer of relatively firm material is expected to form on the surface, enabling limited access by heavy machinery for placement of cover materials and limited excavation of tailings. It is anticipated that excavation into the tailings material would be limited to a 5 ft maximum allowable cut based on professional judgment (personal communication with Tierra Group International, Ltd). In addition, the consolidation results in differential settlement of the tailings material proportional to the thickness of the tailings. The greatest settlement is therefore expected to occur in the middle of the valley, particularly just upstream of the upstream toe of the dam, and little to no settlement is expected along the valley margins. The post-settlement surface would therefore be sloped toward the center of the valley from all sides, creating a depression likely roughly at the location of the operational supernatant pond. Absent late-operational tailings deposition, and/or subsequent backfill, that successfully fills the depression, at closure this depression atop the relatively impervious tailings would result in a pond filled by surface runoff and seepage from the tailings and would not naturally drain off the TSF surface. To maintain separation between Meadow Creek and water that may run off and accumulate in the depression/pond, Meadow Creek must either be routed around or over the pond. Three alternatives were considered to address these unique conditions, each possessing distinct risks and tradeoffs:

1) Divert Meadow Creek completely around the TSF.

   This option (similar to what would be employed during mine operations) would completely separate Meadow Creek from the TSF, but it has a high risk of failure over the long term. The post-consolidation low point of the TSF would be located in the middle of the valley, below the elevation of the edge of the TSF, and the diversion channel would (by necessity) be located above the valley bottom outside the limits of the TSF liner, resulting in a perched condition. Without ongoing maintenance, a debris flow or similar blockage of the channel would result in an avulsion toward the new valley bottom formed atop the tailings. Preventing an avulsion would require adequate space to accommodate any potential future debris flows and/or alluvial fans, which results in an exceedingly wide corridor that is not feasible to construct on the side of the steep valley slopes. For these reasons, this alternative was not advanced in the conceptual design.

2) Route Meadow Creek atop the TSF but around the location of supernatant pond

   This option routes the channel through the center (i.e. cross-sectional low point) of the TSF for as long as possible to reduce the risk of avulsion, then routes the channel nearer to the TSF margin approaching the dam, to avoid contact with the pond. As discussed above, the channel and floodplain cannot be cut into the tailings beyond approximately 5 vertical feet. The thickness of the liner, liner protection layer, erosion barrier, stream bed, floodplain material, floodwater depth, and adequate freeboard (factor of safety) exceeds 5 feet, requiring a levee to contain the channel and floodplain (i.e. the floodplain would be slightly perched above the surrounding tailings surface). The downstream reaches would be further perched above the tailings due to their location along the valley margin where differential settlement would be minimal. To eliminate the risk of avulsion, the channel and floodplain would need to be able to accommodate any future deposition and/or aggradation that may occur. This concept would address this risk by including accommodation space for an alluvial fan atop the protective liner and within the confining levees at the upstream extent of each channel. Additionally, an equilibrium slope has been calculated to determine the likely amount of aggradation below the alluvial fan. The designed levee height would be equally increased. As discussed below, this option is potentially feasible, but includes several significant risk factors. For these reasons, this alternative was not advanced in the conceptual design.

3) Allow Meadow Creek to flow down the middle of the TSF

   This option relies on the anticipated natural settlement of the TSF to focus the channel into the lowest part of the valley. This option presents the least potential for future avulsion off the lined floodplain corridor, but it requires placing additional fill in the depression formed by the differential settlement of the tailings near the dam to prevent the formation of a pond in this area. The amount of additional fill depends on the amount of differential settlement that occurs. The time required to accomplish the majority of consolidation-related settlement and the added expense of placing additional material over the consolidated tailings represent a tradeoff to reduce the risk of potential channel avulsion off the lined corridor. This alternative includes the least risk of avulsion and therefore the greatest likelihood of long-term success. **For these reasons, this alternative was selected and advanced in the conceptual designs (Appendix E).**

MC1 Alternatives Evaluation Additional Information

Alluvial Fans

As discussed in the body of the report, several existing alluvial fans have formed within the SGP area since the conclusion of the last ice age (approximately 10 to 12 thousand years ago). The upper reaches of MC1 (MC1a, MC1b, MC1c) would be transition zones between the relatively steep, narrow natural valley and the relatively flat, broad TSF. These transition zones are expected to develop alluvial fans over time. The floodplain and anticipated alluvial fan areas would be contained within rock-armored levees to ensure the channel does not migrate off the top of the protective liner (see Footnote 1 above) separating the stream from the underlying tailings. The levees and protective liner would flare at the upstream margin of each stream along the TSF to accommodate the predicted maximum future alluvial fan geometry such that the entire predicted fan area would be contained within the levees and therefore atop the liner. Maximum predicted alluvial fan geometries are expected not to exceed existing fan geometries as outlined in Table D-4.

Table D-4. Maximum Measured Alluvial Fan Geometry (Existing)

Width (ft)	Length (ft)	Height (ft)
820	708	26

Note: See body of Stream Design Report for alluvial fan discussion.

Equilibrium Slope

Risk associated with the proposed MC1 channel design is potentially compounded by the potential for future sediment aggradation. For all three alternatives discussed above, the proposed channel has a much lower gradient than existing conditions and is expected to accumulate sediment. Sediment deposition resulting in aggradation is expected to occur within the upper reaches of the TSF until the slope steepens sufficiently to transport the entire incoming sediment load (i.e., quasi-equilibrium). To accommodate potential future channel aggradation above and beyond potential alluvial fan development, an equilibrium slope has been calculated based on estimated quasi-equilibrium conditions using multiple lines of evidence. There is a large amount of variability and uncertainty regarding research and ultimately predictions of equilibrium slope. Estimates of equilibrium slope are therefore based on professional judgment given the limited amount of data and research available.

Literature Review

- Research in New Mexico, Wisconsin, California, and Israel (Woolhiser and Lenz 1965, Leopold and Bull 1979, and Leopold 1992) show the equilibrium slope associated with an increase in base elevation (sediment trap dam construction) ranges from 30-60% of the original unaltered slope. The average pre-Project slope in the TSF area is 4.6%, which would result in an equilibrium slope ranging from 1.4-2.7% upstream from the downstream grade control. Projecting these slopes upstream from the TSF dam face creates a surface up to 90-210 feet above the proposed TSF respectively. To fill the proposed floodplain to these heights would require 3.8-10.7 million cubic yards of fill respectively. This volume of sediment represents 1.8-5.3 feet of erosion respectively across the upper portion of the watershed (Reach MC1A). Based on a maximum existing sediment transport rate of 216 tons/year (scaled by drainage area) measured from United States Geological Survey (USGS) gaging stations in the South Fork Salmon Basin, it would take approximately 39,000-110,500 years respectively for the slope to obtain equilibrium.

Reference Reach Information

- Riordan Creek was analyzed as a reference in two areas immediately upstream of elevated grade controls – Hennessey Meadow (upstream of a terminal glacial moraine) and the area immediately upstream of Riordan Lake (formed by an ancient landslide). Channel slopes upstream of these ancient grade control features have equilibrated to 0.3% and 0.8% respectively. Projecting these slopes upstream from the TSF dam face creates a surface up to 4-48 feet above the proposed TSF respectively. To fill the proposed floodplain to these heights would require 0.1-2.9 million cubic yards of fill respectively. This volume of sediment represents 0.1-1.4 feet of erosion respectively across the upper watershed (Reach MC1A). Based on a maximum existing sediment transport rate of 216 tons/year measured from USGS gaging stations in the South Fork Salmon Basin, it would take approximately 1,500-30,500 years respectively for the slope to obtain equilibrium.
- This range of slopes is considered much more realistic as an equilibrium slope atop the TSF versus the researched estimates due to the high degree of similarity between the Riordan Creek reference sites and the Meadow Creek site.

Copeland’s Method

- The US Army Corps of Engineers HEC-RAS (V 5.0) hydraulic modeling software (USACE 2016) contains a stable channel design module that uses Copeland’s Method (Copeland 1994) for estimating equilibrium slope. Copeland’s Method requires user input of the estimated incoming sediment bedload gradation and concentration to calculate an equilibrium slope based on varied channel width and depth. Concentration of sediment was based on sediment transport rates associated with various USGS gaging stations in the South Fork Salmon Basin (USDA 2004). Bedload gradation was estimated using three different scenarios:
    - **Scenario 1** (worst-case) used a bedload gradation equal to the coarse bed armor measured from pebble counts collected on a low-gradient reference reach of Meadow Creek (Reference Site 21). These values included a D84 of 75mm, D50 of 21mm and D16 of 4mm. Sediment concentration was estimated as the maximum concentration (59 ppm) from previous studies completed within the South Fork Salmon drainage at bankfull discharge (USDA 2004).

- **Scenario 2** (best-case) used reference data from the USGS gage on Little Buckhorn Creek (a tributary of the South Fork Salmon River) which has a similar basin size, geologic history, gradient, and bed armor size (D50 of 28mm) as Meadow Creek. The measured bedload from this site included a D84 of 16mm, D50 of 2mm and an assumed D16 of 0.5mm. Sediment concentration was estimated as the average concentration (38 ppm) from previous studies done within the South Fork Salmon drainage at bankfull discharge (USDA 2004).
- **Scenario 3** (mid-range) used a sediment bedload gradation based on a combination of reference data for Little Buckhorn Creek and local reference reach data from Meadow Creek. The gradation maintained the larger mobile sediment size from Scenario 1 but used the D50 observed in Little Buckhorn Creek (Scenario 2) and a D16 estimate of 0.5mm. Sediment concentration was estimated as the average concentration (38 ppm) from previous studies completed within the South Fork Salmon drainage at bankfull discharge (USDA 2004).

- Bedload sediment values from Scenarios 1 and 3 were reduced longitudinally along the channel length to account for expected slope reductions associated with a concave longitudinal profile. Bedload sizes were unchanged for the three major incoming tributary channels on the TSF or the upper 3,000 feet of the tributary channel if it exceeded 3,000 feet in length. Downstream of these tributaries for approximately 3,000 feet along the main-stem of Meadow Creek the bedload gradation was reduced by 1/3 (e.g. D100=75 mm would be reduced to 50 mm). From this point the gradation was reduced again by 1/3 and carried through to the face of the dam.
- Applying the Copeland Method using the inputs from Scenario 1, 2, and 3 respectively resulted in equilibrium slopes of 0.7%, 0.25% and 0.3%, creating a surface elevated over the TSF by 60, 0 and 4 feet respectively at the upper end of the MC1 reach. To fill the proposed floodplain to this height would require 1.4, 0.05, and 0.1 million cubic yards of fill. This volume of sediment represents 0.7, 0.03, and 0.1 feet of erosion across the entire watershed. Based on an average existing sediment transport rate of 216 tons/year measured from USGS gaging stations in the South Fork Salmon Basin, it would take 15,000, 550, and 1,100 years for the slope to obtain equilibrium.

Without sediment supply data for the SGP area specifically, it is difficult to estimate long-term equilibrium slope conditions. The Copeland method is very sensitive to the assumed bed material gradation and the concentration of sediment input at the effective discharge. Additional analysis of existing and predicted sediment supply and size would be required to narrow the range of possible equilibrium slope values using the Copeland method.

- The average gradient for the Copeland method Scenario 1 (excluding the alluvial fan formation on top) is 0.007 ft/ft while Scenario 3 has an average gradient of approximately 0.0025 ft/ft. These both closely align with the range observed on the reference reach sites discussed above. Given the multiple lines of evidence, the proposed channel design for reaches atop the TSF uses a concave slope (reduces in slope longitudinally) falling within the range of values predicted by the Copeland Method (Scenario 3) and the Riordan Creek reference data. Designing the channel to match the anticipated equilibrium slope would greatly reduce the risk of excessive aggradation and potential avulsion over the long-term. The space reserved for alluvial fans at the upstream end of each Meadow

Creek tributary would further reduce the risk of avulsion as these areas are expected to accommodate nearly all of the incoming sediment volume estimated using the Copeland method Scenarios 1 and 2.

Channel and Floodplain Confinement Via Terraces

For all three alternatives discussed previously – (1) Routing the channel around the TSF, (2) Perching the channel near the margin of the TSF (within the impoundment but above the low point), and (3) Routing the channel down the center of the TSF – the stream channel within reach MC1 would need to be at least partially contained within terraces to accommodate the minimum of 5 feet of protective layer, armor, streambed material, and floodplain material (discussed above). Placing the required stream material atop the liner without confining terraces would result in a perched condition, increasing the risk of channel avulsion off the lined corridor. The terraces are also necessary to confine any potential channel movement to the lined area, and to route surface runoff and non-perennial streams across the unlined portion of the TSF through a series of wetlands prior to joining Meadow Creek where it passes through the designed notch in the TSF dam. The preferred alternative (3) in which the channel flows down the center of the TSF, requires the lowest terraces because the channel would already occupy the lowest portion of the valley. The terraces would be constructed by combination of cut and fill. As discussed previously, the maximum anticipated cut depth into the consolidated tailings is not to exceed 5 feet, which minimally accommodates only the thickness of the required fill material over the liner (i.e. bankfull elevation). To also contain flood water, while maintaining adequate freeboard plus a factor of safety, additional fill would be required to raise the terraces sufficiently above the surrounding TSF surface. The shape of the terraces would mimic broad, natural features, with heights less than approximately 4 feet above the surrounding floodplain and TSF surfaces. The base of the terraces would be armored with coarse rock to prevent channel migration beyond the designed floodplain corridor.

Reaches MC2 and MC3

From the notch in the TSF dam, Meadow Creek Reach MC2 would flow over the surface of the DRSF using the same channel design parameters as the lower portions of MC1. The only difference between MC1 and MC2 is that the DRSF can be built to accommodate confining terraces; therefore, the entire floodplain corridor would be inset within large terraces consisting of the finished surface of the DRSF with additional rock armor. The channel corridor would be routed from the center of the valley at the notch in the dam to the valley margin where it would drop down the face of the DRSF. MC3 takes the channel down the DRSF to the valley floor below, dropping steeply along the groin between the DRSF and the valley wall. A rock-lined channel and multiple energy dissipation pools would convey Meadow Creek Reach MC3 down to the valley floor.

Over the top and down the face of the DRSF (MC2 and MC3 respectively) the channel and floodplain would remain atop a surface liner to prevent seepage loss through the highly permeable DRSF. To maximize the length of available low-gradient habitat in upper and lower Meadow Creek, the slope of MC3 down the face of the DRSF has been maximized. In this way, the length required for the MC3 reach is minimized, bringing Meadow Creek down to the valley floor as early as possible, maximizing the length of the high-quality reaches downstream that would be accessible to anadromous fish.

Reaches MC4, MC5, and MC6

Once off the TSF and DRSF surfaces, the Meadow Creek channel is designed as a sinuous, single-thread stream flowing over native alluvium (MC4, MC5, and MC6). During the operation of Hangar Flats pit, Meadow Creek would be diverted around the active pit in a bioengineered stream corridor featuring a meandering channel and a broad floodplain with wetlands. The diversion channel would be lined (see Footnote 1 above) (similar to MC1 and MC2) to prevent excessive seepage loss to the dewatered Hangar Flats pit or the surrounding dewatering wells. Hangar Flats pit would fill with water after mining, at which time the diversion channel would be abandoned and MC4 would be constructed routing Meadow Creek into Hangar Flats lake, which would also capture Blowout Creek. The combined flow from these streams would naturally spillover from the lake into the designed Reach MC5, which feeds the existing (to be enhanced) Reach MC6. The sinuosity, meander wavelength, meander amplitude, bend radius of curvature, and width-to-depth ratio have all been optimized within MC4 and MC5 to enable geomorphic and habitat diversity. The channel is expected to be generally stable while allowing significant sediment sorting and periodic, long-term channel migration to recruit additional gravel-sized sediment and woody debris over time. MC4 and MC5 are restoration reaches where floodplain and channel conditions can be adjusted to maximize habitat for anadromous fish, while MC6 is an enhancement reach with less flexibility for adjustment. Within MC6, in-stream structure in the form of woody debris and boulder clusters would be placed along with riparian vegetation to increase the hydraulic and habitat diversity while increasing in-stream friction to collect and sort gravel-sized sediment.

Reach specific design criteria are summarized below.

Stream Design Workbook

Stibnite Gold Project

Meadow Creek

Meadow Creek Reach 1A (MC1A)

Reach Type: Meadow (Equiwidth Meandering)

Description

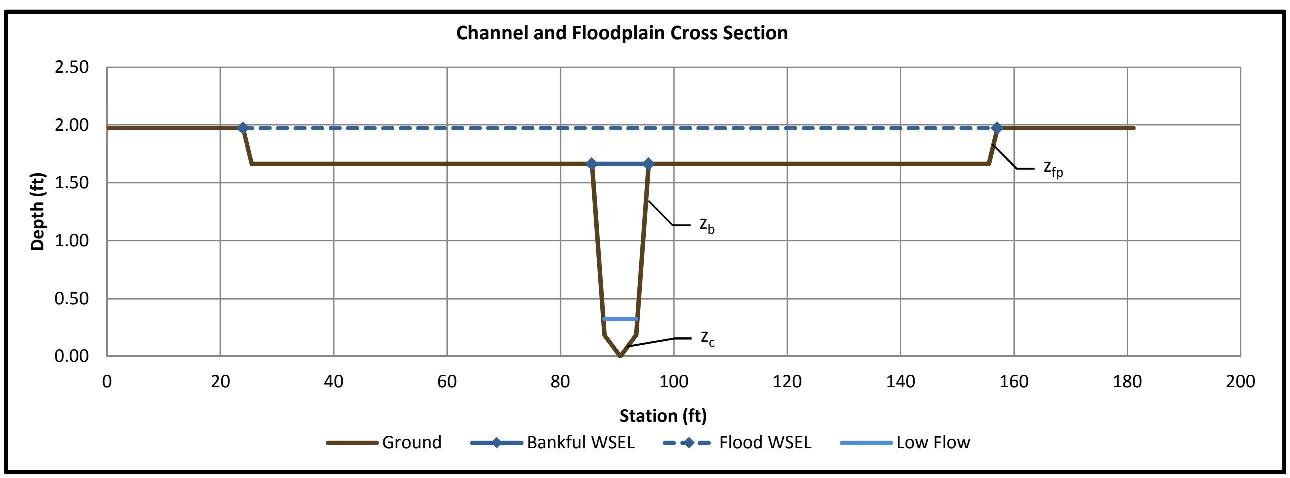
MC1A is located at the upstream most end of the proposed Tailings Storage Facilty (TSF). The channel and floodplain will be designed to be a sinuous, low-gradient, meadow stream with forested wetland riparian. The upstream most portion of the reach is located within a depositional alluvial fan zone and therefore the channel and floodplain would be expected to aggrade and steepen over time. The entire channel and floodplain would include an impermeable liner overlaid tailings. Reference Sites 13, 17, and 20 were used to inform channel and floodplain parameters. Habitat objectives would be primarily for resident fish.

Representative Reference Site Photo

Photo of Reference Site 20 - Fiddle Creek

	Design Guidelines / Input	
	Input	Explanation
Reach Characteristics	1.97	= DA = Drainage Area (mi^2)
	3589	= L_v = Valley Length (ft)
	5581	= L_c = Channel Length (ft)
	7084.4	= $ELEV_{US}$ = Upstream Elevation (ft)
	7054.8	= $ELEV_{DS}$ = Downstream Elevation (ft)
	1.56	= K = Sinuousity (ft/ft)
	0.0082	= S_v = Valley Slope (ft/ft)
	0.0053	= S_c = Channel Slope (ft/ft)
	130	= W_{FP} = Average Floodplain Width (ft)
Hydrology	0.6	= Q_{95} = 95% Annual Exceedance Flow (cfs)
	41	= Q_{BF} = Bankfull Discharge (cfs)
	83	= $Q_{100\text{-}YR}$ = 100-Year Discharge (cfs)
Channel Characteristics	9	= W_{BF} = Estimated Bankfull Width (ft)
	6	= W/D_{max} = Width/Max Depth Ratio (ft/ft)
	15	= z_c = Channel Bottom Side-Slopes (_H:1V)
	1.5	= z_b = Bank Side-Slopes (_H:1V)
	5	= z_{fp} = Floodplain Side-Slopes (_H:1V)
	0.086	= n_{low} = Manning's n Value (Baseflow)
	0.034	= n_b = Manning's n Value (Bankfull)
	0.1	= n_{fp} = Manning's n Value (Floodplain)

Calculated Design Estimates			
Q_{95}	Q_{BF}	$Q_{100\text{-}YR}$	Explanation
0.0053	0.0053	0.0082	= S = Slope (ft/ft)
0.6	41	83	= Required Discharge (cfs)
0.3	1.7	0.3	= D_{max} = Max Water Depth (ft)
6.0	10.0	133.1	= W_t = Top Width (ft)
5.55	5.55	130.00	= W_b = Bottom Width (ft)
1.31	12.00	52.61	= A = Cross-Sectional Area (ft)
6.06	10.89	134.06	= P = Wetted Perimeter (ft)
0.22	1.10	0.39	= R = Hydraulic Radius (ft)
0.46	3.42	3.98	= V_{ch} = Channel Velocity (ft/s)
NA	NA	0.61	= V_{FP} = Floodplain Velocity (ft/s)
0.07	0.36	0.46	= τ_{ch} = Channel Shear Stress (lbs/ft^2)
NA	NA	0.16	= τ_{fp} = Floodplain Shear Stress (lbs/ft^2)
0.6	41	83	= Q = Resulting Discharge (cfs)
0.17	0.55	0.44	= Froude Number
0.2	1.2	0.4	= D_{ave} = Average Depth (ft)
NA	8.3	NA	= W/D = Width to Depth Ratio (ft/ft)
4	22	27	= D_{50} = Uniform Mobile Sediment (mm)
5	27	35	= D_{84} = D_{84} Mobile Sediment (mm)



Stream Design Workbook

Stibnite Gold Project
Meadow Creek
Meadow Creek Trib. Reach 1B (MC1B)
Reach Type: Meadow (Equiwidth Meandering)

Description

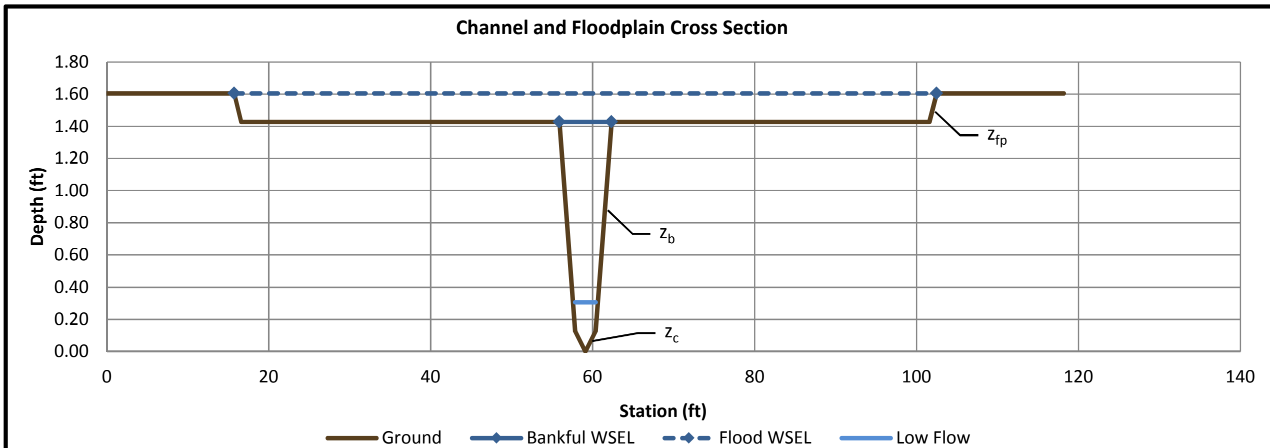
MC1B is a unnamed tributary to Meadow Creek located near the upstream most end of the proposed Tailings Storage Facilty (TSF). The channel and floodplain will be designed to be a sinuous, low-gradient, meadow stream with forested wetland riparian. The upstream most portion of the reach is located within a depositional alluvial fan zone and therefore the channel and floodplain would be expected to aggrade and steepen over time. The entire channel and floodplain would include an impermeable liner overlaid tailings. Reference Sites 13, 17, and 20 were used to guide channel and floodplain parameters (see representative photo). Habitat objectives would be primarily for resident fish.

Representative Reference Site Photo

Photo of Reference Site 13 - EFSFSR

	Design Guidelines / Input	
	Input	Explanation
Reach Characteristics	0.85	= DA = Drainage Area (mi^2)
	1701	= L_v = Valley Length (ft)
	2461	= L_c = Channel Length (ft)
	7077.5	= $ELEV_{US}$ = Upstream Elevation (ft)
	7055	= $ELEV_{DS}$ = Downstream Elevation (ft)
	1.45	= K = Sinuousity (ft/ft)
	0.0132	= S_v = Valley Slope (ft/ft)
	0.0091	= S_c = Channel Slope (ft/ft)
	85	= W_{FP} = Average Floodplain Width (ft)
Hydrology	0.3	= Q_{95} = 95% Annual Exceedance Flow (cfs)
	19	= Q_{BF} = Bankfull Discharge (cfs)
	33	= $Q_{100\text{-}YR}$ = 100-Year Discharge (cfs)
Channel Characteristics	6.3	= W_{BF} = Estimated Bankfull Width (ft)
	4.5	= W/D_{max} = Width/Max Depth Ratio (ft/ft)
	10	= z_c = Channel Bottom Side-Slopes (_H:1V)
	1.5	= z_b = Bank Side-Slopes (_H:1V)
	5	= z_{fp} = Floodplain Side-Slopes (_H:1V)
	0.111	= n_{low} = Manning's n Value (Baseflow)
	0.040	= n_b = Manning's n Value (Bankfull)
	0.1	= n_{fp} = Manning's n Value (Floodplain)

Calculated Design Estimates			
Q_{95}	Q_{BF}	$Q_{100\text{-}YR}$	Explanation
0.0091	0.0091	0.0132	= S = Slope (ft/ft)
0.3	19	33	= Required Discharge (cfs)
0.3	1.4	0.2	= D_{max} = Max Water Depth (ft)
3.1	6.4	86.8	= W_t = Top Width (ft)
2.52	2.52	85.00	= W_b = Bottom Width (ft)
0.66	5.98	21.23	= A = Cross-Sectional Area (ft)
3.18	7.22	87.61	= P = Wetted Perimeter (ft)
0.21	0.83	0.24	= R = Hydraulic Radius (ft)
0.45	3.18	3.57	= V_{ch} = Channel Velocity (ft/s)
NA	NA	0.54	= V_{FP} = Floodplain Velocity (ft/s)
0.12	0.47	0.56	= τ_{ch} = Channel Shear Stress (lbs/ft^2)
NA	NA	0.14	= τ_{fp} = Floodplain Shear Stress (lbs/ft^2)
0.3	19	33	= Q = Resulting Discharge (cfs)
0.17	0.58	0.55	= Froude Number
0.2	0.9	0.2	= D_{ave} = Average Depth (ft)
NA	6.9	NA	= W/D = Width to Depth Ratio (ft/ft)
7	28	33	= D_{50} = Uniform Mobile Sediment (mm)
8	36	43	= D_{84} = D_{84} Mobile Sediment (mm)



Stream Design Workbook

Stibnite Gold Project
Meadow Creek
Meadow Creek Tributary Reach 1C (MC1C-1)
Reach Type: Meadow (Equiwidth Meandering)

Description

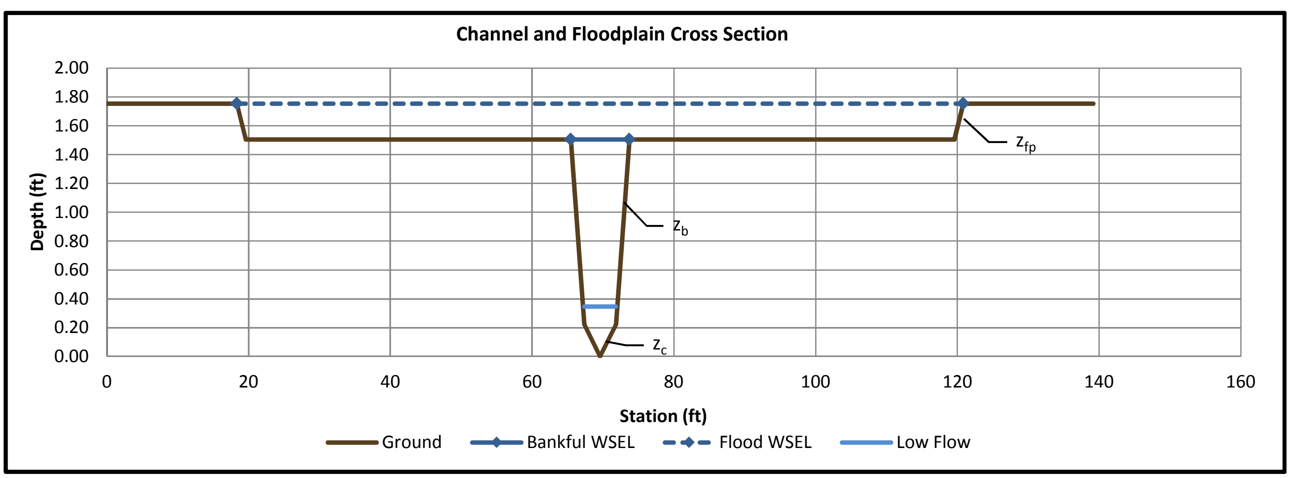
MC1C-1 is a unnamed tributary to Meadow Creek located near the upstream most end of the proposed Tailings Storage Facilty (TSF). The channel and floodplain will be designed to be a sinuous, low-gradient, meadow stream with forested wetland riparian. The upstream most portion of the reach is located within a depositional alluvial fan zone and therefore the channel and floodplain would be expected to aggrade and steepen over time. The entire channel and floodplain would include an impermeable liner overlaid tailings. Reference Sites 13, 17, and 20 were used to guide channel and floodplain parameters (see representative photo). Habitat objectives would be primarily for resident fish.

Representative Reference Site Photo

Photo of Reference Site 17 - Riordan Creek

	Design Guidelines / Input	
	Input	Explanation
Reach Characteristics	1.63	= DA = Drainage Area (mi^2)
Reach Characteristics	1383	= L_v = Valley Length (ft)
Reach Characteristics	1980	= L_c = Channel Length (ft)
Reach Characteristics	7072.4	= $ELEV_{US}$ = Upstream Elevation (ft)
Reach Characteristics	7055	= $ELEV_{DS}$ = Downstream Elevation (ft)
Reach Characteristics	1.43	= K = Sinuousity (ft/ft)
Reach Characteristics	0.0126	= S_v = Valley Slope (ft/ft)
Reach Characteristics	0.0088	= S_c = Channel Slope (ft/ft)
Reach Characteristics	100	= W_{FP} = Average Floodplain Width (ft)
Hydrology	0.5	= Q_{95} = 95% Annual Exceedance Flow (cfs)
Hydrology	30	= Q_{BF} = Bankfull Discharge (cfs)
Hydrology	58	= $Q_{100\text{-}YR}$ = 100-Year Discharge (cfs)
Channel Characteristics	8.5	= W_{BF} = Estimated Bankfull Width (ft)
Channel Characteristics	5.5	= W/D_{max} = Width/Max Depth Ratio (ft/ft)
Channel Characteristics	10	= z_c = Channel Bottom Side-Slopes (_H:1V)
Channel Characteristics	1.5	= z_b = Bank Side-Slopes (_H:1V)
Channel Characteristics	5	= z_{fp} = Floodplain Side-Slopes (_H:1V)
Channel Characteristics	0.108	= n_{low} = Manning's n Value (Baseflow)
Channel Characteristics	0.039	= n_b = Manning's n Value (Bankfull)
Channel Characteristics	0.1	= n_{fp} = Manning's n Value (Floodplain)

Calculated Design Estimates			
Q_{95}	Q_{BF}	$Q_{100\text{-}YR}$	Explanation
0.0088	0.0088	0.0126	= S = Slope (ft/ft)
0.5	30	58	= Required Discharge (cfs)
0.3	1.5	0.2	= D_{max} = Max Water Depth (ft)
4.8	8.3	102.5	= W_t = Top Width (ft)
4.43	4.43	100.00	= W_b = Bottom Width (ft)
1.07	8.65	33.85	= A = Cross-Sectional Area (ft)
4.90	9.08	103.34	= P = Wetted Perimeter (ft)
0.22	0.95	0.33	= R = Hydraulic Radius (ft)
0.47	3.47	4.00	= V_{ch} = Channel Velocity (ft/s)
NA	NA	0.66	= V_{FP} = Floodplain Velocity (ft/s)
0.12	0.52	0.65	= τ_{ch} = Channel Shear Stress (lbs/ft^2)
NA	NA	0.19	= τ_{fp} = Floodplain Shear Stress (lbs/ft^2)
0.5	30	58	= Q = Resulting Discharge (cfs)
0.17	0.60	0.53	= Froude Number
0.2	1.0	0.3	= D_{ave} = Average Depth (ft)
NA	7.9	NA	= W/D = Width to Depth Ratio (ft/ft)
7	31	38	= D_{50} = Uniform Mobile Sediment (mm)
9	40	50	= D_{84} = D_{84} Mobile Sediment (mm)



Stream Design Workbook

Stibnite Gold Project
Meadow Creek
Meadow Creek Tributary Reach 1C (MC1C-2)
Reach Type: Meadow (Equiwidth Meandering)

Description

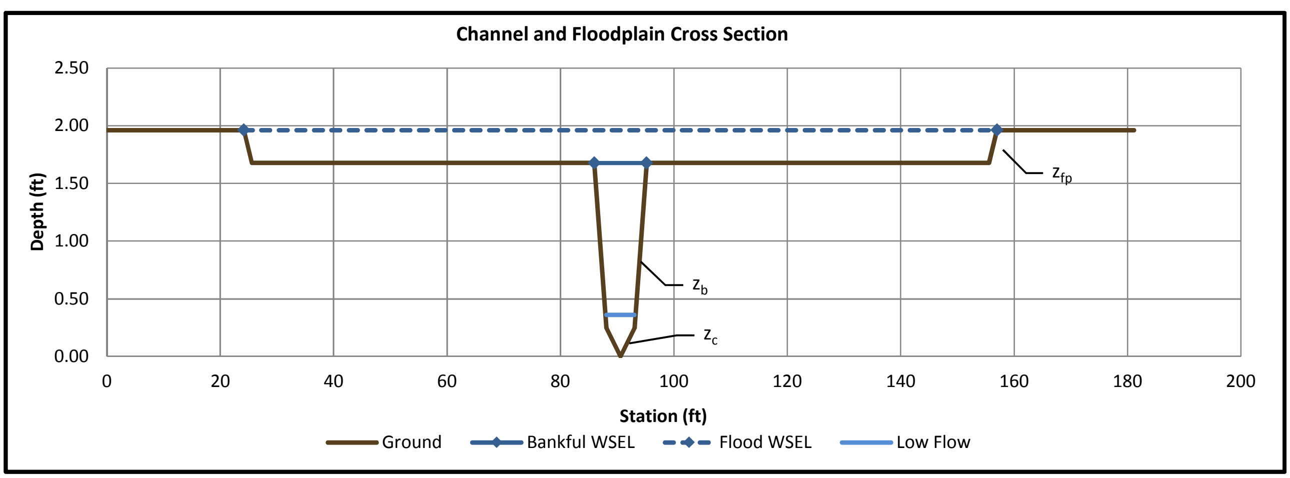
MC1C-2 is a unnamed tributary to Meadow Creek located near the upstream most end of the proposed Meadow Creek Tailings Storage Facilty (TSF). The channel and floodplain would be located within a depositional alluvial fan zone having a sinuous, low-gradient, meadow stream with forested wetland riparian. The entire channel and floodplain would include an impermeable liner overlaid tailings. Reference Sites 13, 17, and 20 were used to guide channel and floodplain parameters (see representative photo). Habitat objectives would be primarily for resident fish.

Representative Reference Site Photo

Photo of Reference Site 17 - Riordan Creek

	Design Guidelines / Input	
	Input	Explanation
Reach Characteristics	1.63	= DA = Drainage Area (mi^2)
	1190	= L_v = Valley Length (ft)
	1736	= L_c = Channel Length (ft)
	7055	= $ELEV_{US}$ = Upstream Elevation (ft)
	7049.75	= $ELEV_{DS}$ = Downstream Elevation (ft)
	1.46	= K = Sinuousity (ft/ft)
	0.0044	= S_v = Valley Slope (ft/ft)
	0.0030	= S_c = Channel Slope (ft/ft)
	130	= W_{FP} = Average Floodplain Width (ft)
Hydrology	0.5	= Q_{95} = 95% Annual Exceedance Flow (cfs)
	30	= Q_{BF} = Bankfull Discharge (cfs)
	58	= $Q_{100\text{-}YR}$ = 100-Year Discharge (cfs)
Channel Characteristics	8.5	= W_{BF} = Estimated Bankfull Width (ft)
	5.5	= W/D_{max} = Width/Max Depth Ratio (ft/ft)
	10	= z_c = Channel Bottom Side-Slopes (_H:1V)
	1.5	= z_b = Bank Side-Slopes (_H:1V)
	5	= z_{fp} = Floodplain Side-Slopes (_H:1V)
	0.071	= n_{low} = Manning's n Value (Baseflow)
	0.031	= n_b = Manning's n Value (Bankfull)
	0.1	= n_{fp} = Manning's n Value (Floodplain)

Calculated Design Estimates			
Q_{95}	Q_{BF}	$Q_{100\text{-}YR}$	Explanation
0.0030	0.0030	0.0044	= S = Slope (ft/ft)
0.5	30	58	= Required Discharge (cfs)
0.4	1.7	0.3	= D_{max} = Max Water Depth (ft)
5.3	9.2	132.8	= W_t = Top Width (ft)
4.93	4.93	130.00	= W_b = Bottom Width (ft)
1.19	10.74	48.18	= A = Cross-Sectional Area (ft)
5.37	10.12	133.80	= P = Wetted Perimeter (ft)
0.22	1.06	0.36	= R = Hydraulic Radius (ft)
0.42	2.79	3.23	= V_{ch} = Channel Velocity (ft/s)
NA	NA	0.42	= V_{FP} = Floodplain Velocity (ft/s)
0.04	0.20	0.25	= τ_{ch} = Channel Shear Stress (lbs/ft^2)
NA	NA	0.08	= τ_{fp} = Floodplain Shear Stress (lbs/ft^2)
0.5	30	58	= Q = Resulting Discharge (cfs)
0.16	0.46	0.35	= Froude Number
0.2	1.2	0.4	= D_{ave} = Average Depth (ft)
NA	7.9	NA	= W/D = Width to Depth Ratio (ft/ft)
2	12	15	= D_{50} = Uniform Mobile Sediment (mm)
3	15	18	= D_{84} = D_{84} Mobile Sediment (mm)



Stream Design Workbook

Stibnite Gold Project
Meadow Creek
Meadow Creek Reach 1D (MC1D)
Reach Type: Meadow (Equiwidth Meandering)

Description

MC1D is located on top of the proposed Tailings Storage Facilty (TSF). The channel and floodplain will be designed as a low gradient, sinuous, meadow stream. The riparian corridor would transition from forested wetland in the upper subreach to scrub/shrub and emergent marsh in the lower subreach. The entire channel and floodplain would include an impermeable liner overlaid tailings. Reference Sites 12 and 16 were used to inform channel and floodplain parameters. Habitat objectives would be primarily for resident fish.

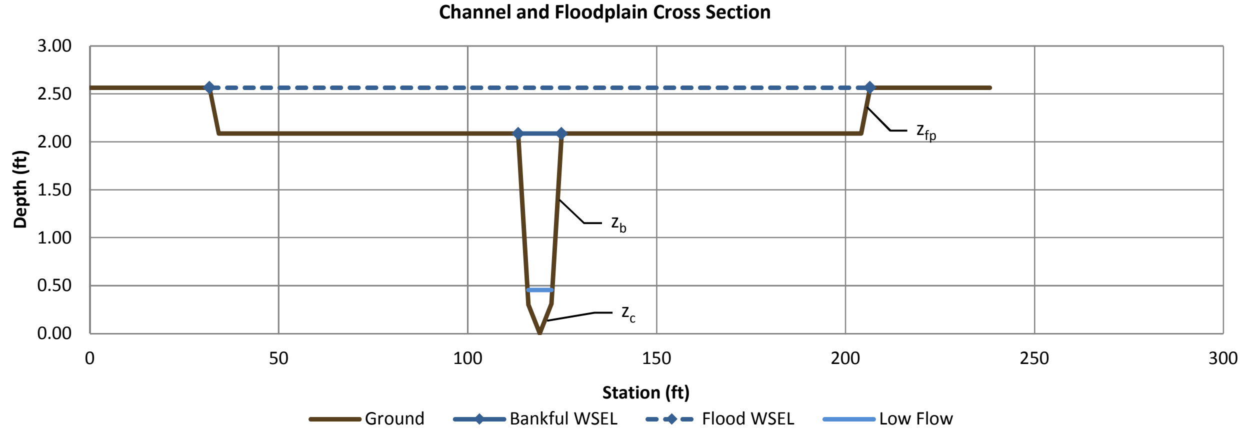
Representative Reference Site Photo

Photo of Reference Site 12 - EFSFSR

	Design Guidelines / Input	
	Input	Explanation
Reach Characteristics	2.84	= DA = Drainage Area (mi^2)
	1790	= L_v = Valley Length (ft)
	3002	= L_c = Channel Length (ft)
	7054.8	= $ELEV_{US}$ = Upstream Elevation (ft)
	7049.4	= $ELEV_{DS}$ = Downstream Elevation (ft)
	1.68	= K = Sinuousity (ft/ft)
	0.0030	= S_v = Valley Slope (ft/ft)
	0.0018	= S_c = Channel Slope (ft/ft)
	170	= W_{FP} = Average Floodplain Width (ft)
Hydrology	0.8	= Q_{95} = 95% Annual Exceedance Flow (cfs)
	44	= Q_{BF} = Bankfull Discharge (cfs)
	109	= $Q_{100\text{-}YR}$ = 100-Year Discharge (cfs)
Channel Characteristics	14	= W_{BF} = Estimated Bankfull Width (ft)
	5.5	= W/D_{max} = Width/Max Depth Ratio (ft/ft)
	10	= z_c = Channel Bottom Side-Slopes (_H:1V)
	1.5	= z_b = Bank Side-Slopes (_H:1V)
	5	= z_{fp} = Floodplain Side-Slopes (_H:1V)
	0.063	= n_{low} = Manning's n Value (Baseflow)
	0.029	= n_b = Manning's n Value (Bankfull)
	0.1	= n_{fp} = Manning's n Value (Floodplain)

Calculated Design Estimates			
Q_{95}	Q_{BF}	$Q_{100\text{-}YR}$	Explanation
0.0018	0.0018	0.0030	= S = Slope (ft/ft)
0.8	44	109	= Required Discharge (cfs)
0.5	2.1	0.5	= D_{max} = Max Water Depth (ft)
6.6	11.5	174.8	= W_t = Top Width (ft)
6.14	6.14	170.00	= W_b = Bottom Width (ft)
1.87	16.62	99.14	= A = Cross-Sectional Area (ft)
6.70	12.59	175.99	= P = Wetted Perimeter (ft)
0.28	1.32	0.56	= R = Hydraulic Radius (ft)
0.43	2.65	3.20	= V_{ch} = Channel Velocity (ft/s)
NA	NA	0.50	= V_{FP} = Floodplain Velocity (ft/s)
0.03	0.15	0.20	= τ_{ch} = Channel Shear Stress (lbs/ft^2)
NA	NA	0.09	= τ_{fp} = Floodplain Shear Stress (lbs/ft^2)
0.8	44	109	= Q = Resulting Discharge (cfs)
0.14	0.39	0.26	= Froude Number
0.3	1.4	0.6	= D_{ave} = Average Depth (ft)
NA	7.9	NA	= W/D = Width to Depth Ratio (ft/ft)
2	9	12	= D_{50} = Uniform Mobile Sediment (mm)
2	11	14	= D_{84} = D_{84} Mobile Sediment (mm)

Channel and Floodplain Cross Section



Stream Design Workbook

Stibnite Gold Project
Meadow Creek
Meadow Creek Reach 1E (MC1E)
Reach Type: Meadow (Equiwidth Meandering)

Description

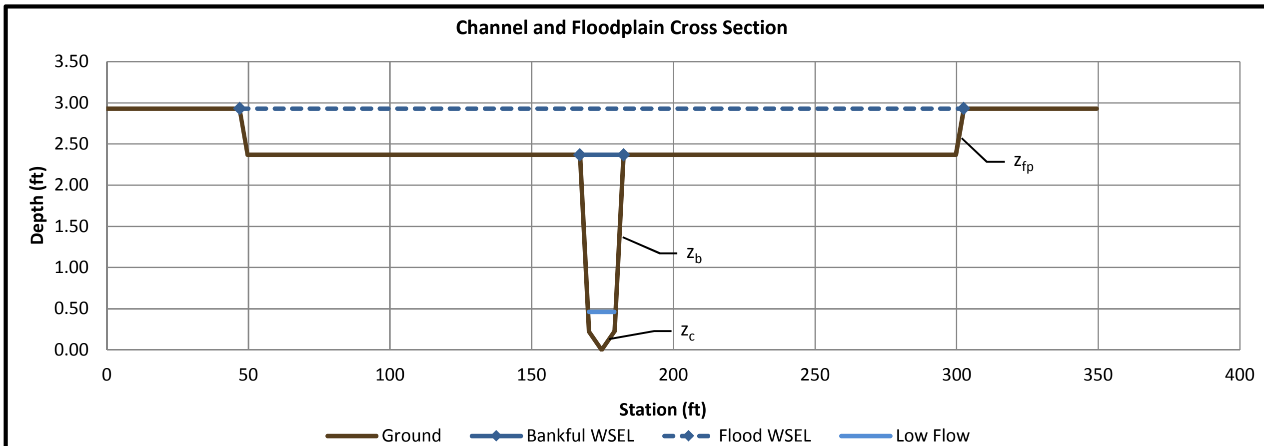
MC1E is located at the down valley end of the proposed Tailings Storage Facilty (TSF). The channel and floodplain will be designed as a low gradient, sinuous, meadow stream. The riparian corridor would transition from forested wetland in the upper subreach to scrub/shrub and emergent marsh in the lower subreach. The entire channel and floodplain would include an impermeable liner overlaid tailings. Reference Sites 12 and 16 were used to inform channel and floodplain parameters. Habitat objectives would be primarily for resident fish.

Representative Reference Site Photo

Photo of Reference Site 16 - Riordan Creek

	Design Guidelines / Input	
	Input	Explanation
Reach Characteristics	5.26	= DA = Drainage Area (mi^2)
	2314	= L_v = Valley Length (ft)
	4164	= L_c = Channel Length (ft)
	7049.4	= $ELEV_{US}$ = Upstream Elevation (ft)
	7044.8	= $ELEV_{DS}$ = Downstream Elevation (ft)
	1.80	= K = Sinuousity (ft/ft)
	0.0020	= S_v = Valley Slope (ft/ft)
	0.0011	= S_c = Channel Slope (ft/ft)
	250	= W_{FP} = Average Floodplain Width (ft)
Hydrology	1.3	= Q_{95} = 95% Annual Exceedance Flow (cfs)
	67	= Q_{BF} = Bankfull Discharge (cfs)
	166	= $Q_{100\text{-}YR}$ = 100-Year Discharge (cfs)
Channel Characteristics	14	= W_{BF} = Estimated Bankfull Width (ft)
	6.5	= W/D_{max} = Width/Max Depth Ratio (ft/ft)
	20	= z_c = Channel Bottom Side-Slopes (_H:1V)
	1.5	= z_b = Bank Side-Slopes (_H:1V)
	5	= z_{fp} = Floodplain Side-Slopes (_H:1V)
	0.059	= n_{low} = Manning's n Value (Baseflow)
	0.028	= n_b = Manning's n Value (Bankfull)
	0.1	= n_{fp} = Manning's n Value (Floodplain)

Calculated Design Estimates			
Q_{95}	Q_{BF}	$Q_{100\text{-}YR}$	Explanation
0.0011	0.0011	0.0020	= S = Slope (ft/ft)
1.3	67	166	= Required Discharge (cfs)
0.5	2.4	0.6	= D_{max} = Max Water Depth (ft)
9.7	15.4	255.6	= W_t = Top Width (ft)
8.97	8.97	250.00	= W_b = Bottom Width (ft)
3.24	27.14	169.07	= A = Cross-Sectional Area (ft)
9.84	16.71	257.04	= P = Wetted Perimeter (ft)
0.33	1.62	0.66	= R = Hydraulic Radius (ft)
0.40	2.47	2.97	= V_{ch} = Channel Velocity (ft/s)
NA	NA	0.45	= V_{FP} = Floodplain Velocity (ft/s)
0.02	0.11	0.15	= τ_{ch} = Channel Shear Stress (lbs/ft^2)
NA	NA	0.07	= τ_{fp} = Floodplain Shear Stress (lbs/ft^2)
1.3	67	166	= Q = Resulting Discharge (cfs)
0.12	0.33	0.21	= Froude Number
0.3	1.8	0.7	= D_{ave} = Average Depth (ft)
NA	8.7	NA	= W/D = Width to Depth Ratio (ft/ft)
1	7	9	= D_{50} = Uniform Mobile Sediment (mm)
2	8	11	= D_{84} = D_{84} Mobile Sediment (mm)



Stream Design Workbook

Stibnite Gold Project
Meadow Creek
Meadow Creek Reach 2 (MC2)
Reach Type: Meadow (Equiwidth Meandering)

Description

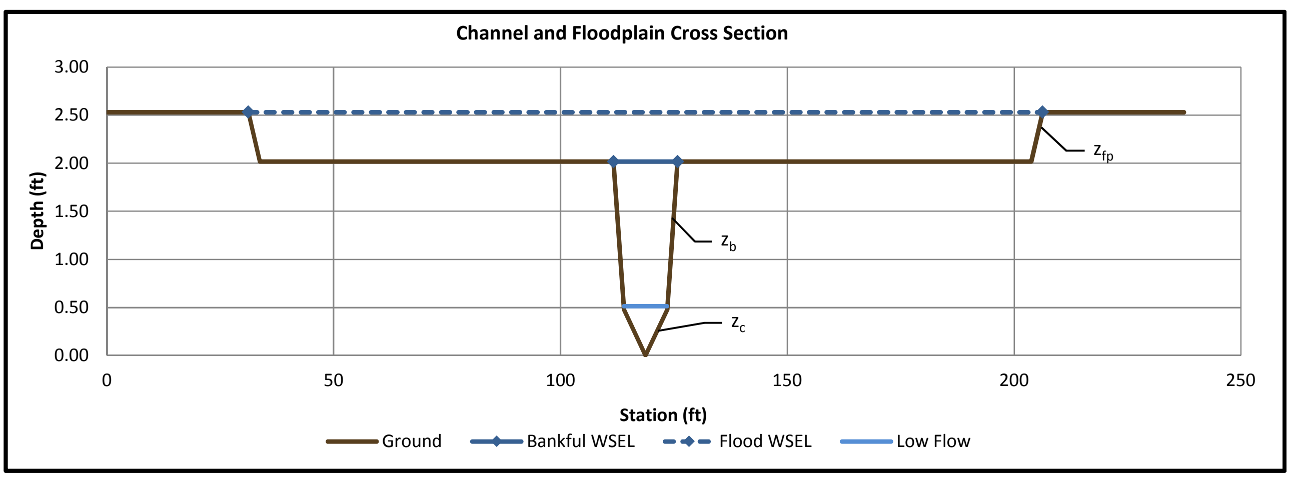
MC2 is located on top of the proposed Hangar Flats Development Rock Storage Facility (DRSF). The channel and floodplain would be characterized as a low gradient, sinuous, meadow stream. The riparian corridor would be primarily scrub/shrub and emergent marsh. The entire channel and floodplain would include an impermeable liner overlaid tailings. Reference Sites 12 and 16 were used to inform channel and floodplain parameters. Habitat objectives would be primarily for resident fish.

Representative Reference Site Photo

Photo of Reference Site 16 - Riordan Creek

	Design Guidelines / Input	
	Input	Explanation
Reach Characteristics	5.76	= DA = Drainage Area (mi^2)
	1656	= L_v = Valley Length (ft)
	2108	= L_c = Channel Length (ft)
	7044.8	= $ELEV_{US}$ = Upstream Elevation (ft)
	7031.5	= $ELEV_{DS}$ = Downstream Elevation (ft)
	1.27	= K = Sinuousity (ft/ft)
	0.0080	= S_v = Valley Slope (ft/ft)
	0.0063	= S_c = Channel Slope (ft/ft)
	170	= W_{FP} = Average Floodplain Width (ft)
Hydrology	1.4	= Q_{95} = 95% Annual Exceedance Flow (cfs)
	84	= Q_{BF} = Bankfull Discharge (cfs)
	208	= $Q_{100\text{-}YR}$ = 100-Year Discharge (cfs)
Channel Characteristics	15.3	= W_{BF} = Estimated Bankfull Width (ft)
	7	= W/D_{max} = Width/Max Depth Ratio (ft/ft)
	10	= z_c = Channel Bottom Side-Slopes (_H:1V)
	1.5	= z_b = Bank Side-Slopes (_H:1V)
	5	= z_{fp} = Floodplain Side-Slopes (_H:1V)
	0.092	= n_{low} = Manning's n Value (Baseflow)
	0.035	= n_b = Manning's n Value (Bankfull)
	0.1	= n_{fp} = Manning's n Value (Floodplain)

Calculated Design Estimates			
Q_{95}	Q_{BF}	$Q_{100\text{-}YR}$	Explanation
0.0063	0.0063	0.0080	= S = Slope (ft/ft)
1.4	84	208	= Required Discharge (cfs)
0.5	2.0	0.5	= D_{max} = Max Water Depth (ft)
9.6	14.1	175.1	= W_t = Top Width (ft)
9.50	9.50	170.00	= W_b = Bottom Width (ft)
2.61	20.48	109.04	= A = Cross-Sectional Area (ft)
9.68	15.11	176.22	= P = Wetted Perimeter (ft)
0.27	1.36	0.62	= R = Hydraulic Radius (ft)
0.54	4.10	5.02	= V_{ch} = Channel Velocity (ft/s)
NA	NA	0.85	= V_{FP} = Floodplain Velocity (ft/s)
0.11	0.53	0.72	= τ_{ch} = Channel Shear Stress (lbs/ft^2)
NA	NA	0.25	= τ_{fp} = Floodplain Shear Stress (lbs/ft^2)
1.4	84	208	= Q = Resulting Discharge (cfs)
0.18	0.60	0.43	= Froude Number
0.3	1.4	0.6	= D_{ave} = Average Depth (ft)
NA	9.7	NA	= W/D = Width to Depth Ratio (ft/ft)
6	32	43	= D_{50} = Uniform Mobile Sediment (mm)
8	41	56	= D_{84} = D_{84} Mobile Sediment (mm)



Stream Design Workbook

Stibnite Gold Project
Meadow Creek
Meadow Creek Reach 3 (MC3)
Reach Type: Chute

Description

MC3 flows down the face of the proposed Hangar Flats Development Rock Storage Facilty (DRSF). The channel would have little to no floodplain and consist of a steep, straight, boulder chute with stragetically placed energy dissipation pools. The entire channel and floodplain would include an impermeable liner overlaid development rock. Reference Sites 4, 6, and 19 were used to inform channel parameters. The reach is expected to have limited habitat value to resident fish and would not be designed to allow fish passage.

Representative Reference Site Photo

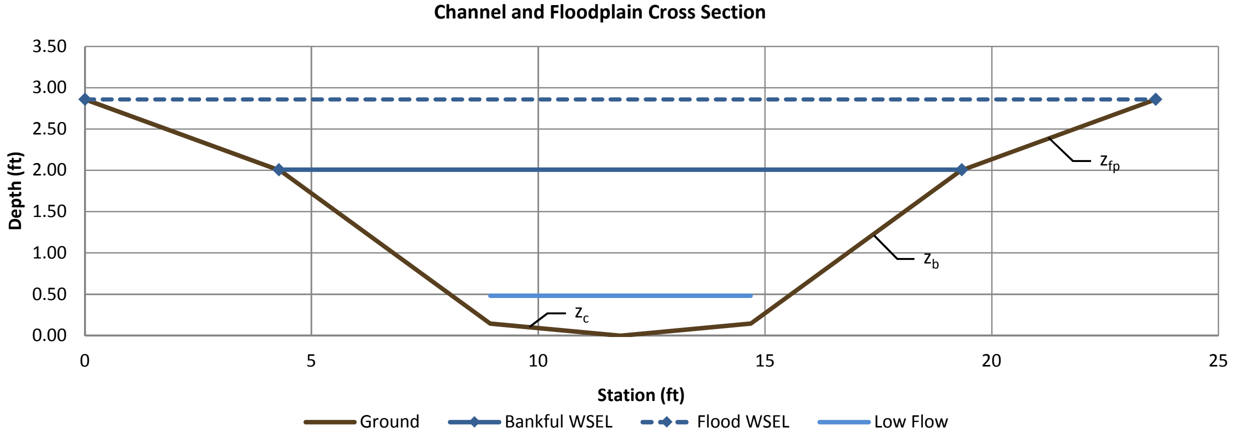
Photo of Reference Site 6 - Profile Creek

	Design Guidelines / Input	
	Input	Explanation
Reach Characteristics	5.76	= DA = Drainage Area (mi^2)
	1693	= L_v = Valley Length (ft)
	1693	= L_c = Channel Length (ft)
	6990	= $ELEV_{US}$ = Upstream Elevation (ft)
	6584	= $ELEV_{DS}$ = Downstream Elevation (ft)
	1.00	= K = Sinuousity (ft/ft)
	0.2398	= S_v = Valley Slope (ft/ft)
	0.2398	= S_c = Channel Slope (ft/ft)
	15.1	= W_{FP} = Average Floodplain Width (ft)
Hydrology	1.6	= Q_{95} = 95% Annual Exceedance Flow (cfs)
	84	= Q_{BF} = Bankfull Discharge (cfs)
	208	= $Q_{100\text{-}YR}$ = 100-Year Discharge (cfs)
Channel Characteristics	15.3	= W_{BF} = Estimated Bankfull Width (ft)
	7.5	= W/D_{max} = Width/Max Depth Ratio (ft/ft)
	20	= z_c = Channel Bottom Side-Slopes (_H:1V)
	2.5	= z_b = Bank Side-Slopes (_H:1V)
	5	= z_{fp} = Floodplain Side-Slopes (_H:1V)
	0.600	= n_{low} = Manning's n Value (Baseflow)
	0.200	= n_b = Manning's n Value (Bankfull)
	0.1	= n_{fp} = Manning's n Value (Floodplain)

Calculated Design Estimates			
Q_{95}	Q_{BF}	$Q_{100\text{-}YR}$	Explanation
0.2398	0.2398	0.2398	= S = Slope (ft/ft)
1.6	84	208	= Required Discharge (cfs)
0.5	2.0	0.9	= D_{max} = Max Water Depth (ft)
7.4	15.1	23.6	= W_t = Top Width (ft)
5.74	5.74	15.10	= W_b = Bottom Width (ft)
2.65	19.80	36.27	= A = Cross-Sectional Area (ft)
7.57	15.78	24.50	= P = Wetted Perimeter (ft)
0.35	1.25	1.48	= R = Hydraulic Radius (ft)
0.60	4.24	5.92	= V_{ch} = Channel Velocity (ft/s)
NA	NA	4.09	= V_{FP} = Floodplain Velocity (ft/s)
5.24	18.77	30.92	= τ_{ch} = Channel Shear Stress (lbs/ft^2)
NA	NA	6.28	= τ_{fp} = Floodplain Shear Stress (lbs/ft^2)
1.6	84	208	= Q = Resulting Discharge (cfs)
0.18	0.65	0.82	= Froude Number
0.4	1.3	1.5	= D_{ave} = Average Depth (ft)
NA	11.5	NA	= W/D = Width to Depth Ratio (ft/ft)
310	1111	1831	= D_{50} = Uniform Mobile Sediment (mm)
438	1655	2784	= D_{84} = D_{84} Mobile Sediment (mm)

9.3

Channel and Floodplain Cross Section



Stream Design Workbook

Stibnite Gold Project
Meadow Creek
Meadow Creek Reach 4 (MC4)
Reach Type: Meadow (Pool Riffle Meandering)

Description

MC4 is located between the the proposed Hangar Flats Development Rock Storage Facilty (DRSF) and the Hangar Flats Pit. The channel and floodplain would be characterized as sinuous, low-gradient, with broad forested wetland transitioning to scrub/shrub and emergent marsh near Hangar Flats Pit. The channel and floodplain would not be lined. Reference Sites 10, 11, 12, and 14 were used to inform channel and floodplain parameters. Habitat objectives would be primarily for anadromous fish.

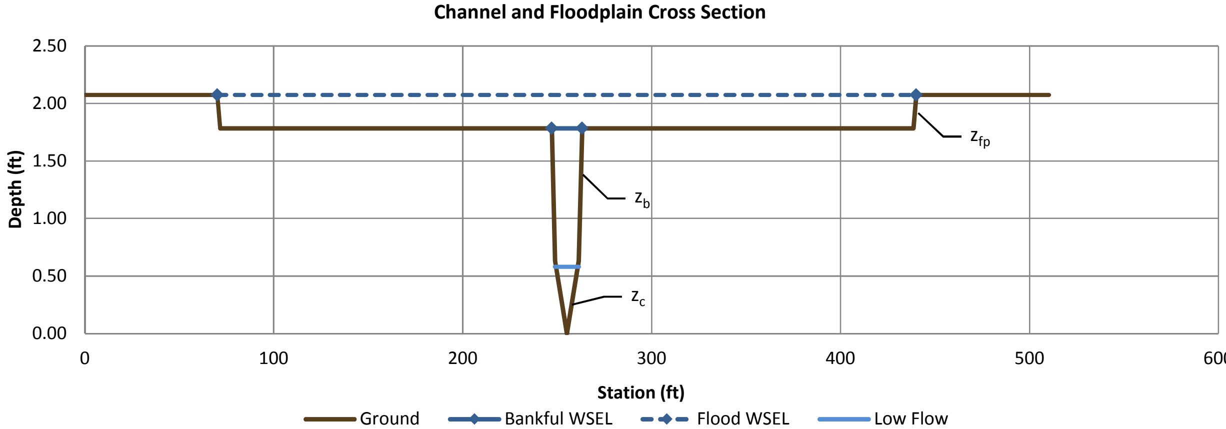
Representative Reference Site Photo

Photo of Reference Site 14 - Riordan Creek

	Design Guidelines / Input	
	Input	Explanation
Reach Characteristics	6.51	= DA = Drainage Area (mi^2)
	1925	= L_v = Valley Length (ft)
	2843	= L_c = Channel Length (ft)
	6580	= $ELEV_{US}$ = Upstream Elevation (ft)
	6535	= $ELEV_{DS}$ = Downstream Elevation (ft)
	1.48	= K = Sinuousity (ft/ft)
	0.0234	= S_v = Valley Slope (ft/ft)
	0.0158	= S_c = Channel Slope (ft/ft)
	367	= W_{FP} = Average Floodplain Width (ft)
Hydrology	1.7	= Q_{95} = 95% Annual Exceedance Flow (cfs)
	89	= Q_{BF} = Bankfull Discharge (cfs)
	227	= $Q_{100\text{-}YR}$ = 100-Year Discharge (cfs)
Channel Characteristics	16	= W_{BF} = Estimated Bankfull Width (ft)
	9	= W/D_{max} = Width/Max Depth Ratio (ft/ft)
	10	= z_c = Channel Bottom Side-Slopes (_H:1V)
	1.5	= z_b = Bank Side-Slopes (_H:1V)
	5	= z_{fp} = Floodplain Side-Slopes (_H:1V)
	0.154	= n_{low} = Manning's n Value (Baseflow)
	0.049	= n_b = Manning's n Value (Bankfull)
	0.1	= n_{fp} = Manning's n Value (Floodplain)

Calculated Design Estimates			
Q_{95}	Q_{BF}	$Q_{100\text{-}YR}$	Explanation
0.0158	0.0158	0.0234	= S = Slope (ft/ft)
1.7	89	227	= Required Discharge (cfs)
0.6	1.8	0.3	= D_{max} = Max Water Depth (ft)
12.4	16.1	369.9	= W_t = Top Width (ft)
12.60	12.60	367.00	= W_b = Bottom Width (ft)
3.35	20.51	127.45	= A = Cross-Sectional Area (ft)
12.48	16.82	370.72	= P = Wetted Perimeter (ft)
0.27	1.22	0.34	= R = Hydraulic Radius (ft)
0.51	4.34	4.97	= V_{ch} = Channel Velocity (ft/s)
NA	NA	1.00	= V_{FP} = Floodplain Velocity (ft/s)
0.27	1.20	1.48	= τ_{ch} = Channel Shear Stress (lbs/ft^2)
NA	NA	0.42	= τ_{fp} = Floodplain Shear Stress (lbs/ft^2)
1.7	89	227	= Q = Resulting Discharge (cfs)
0.17	0.68	0.53	= Froude Number
0.3	1.3	0.3	= D_{ave} = Average Depth (ft)
NA	12.6	NA	= W/D = Width to Depth Ratio (ft/ft)
16	71	88	= D_{50} = Uniform Mobile Sediment (mm)
20	95	117	= D_{84} = D_{84} Mobile Sediment (mm)

Channel and Floodplain Cross Section



Stream Design Workbook

Stibnite Gold Project
Meadow Creek
Meadow Creek Reach 5 (MC5)
Reach Type: Meadow (Pool Riffle Meandering)

Description

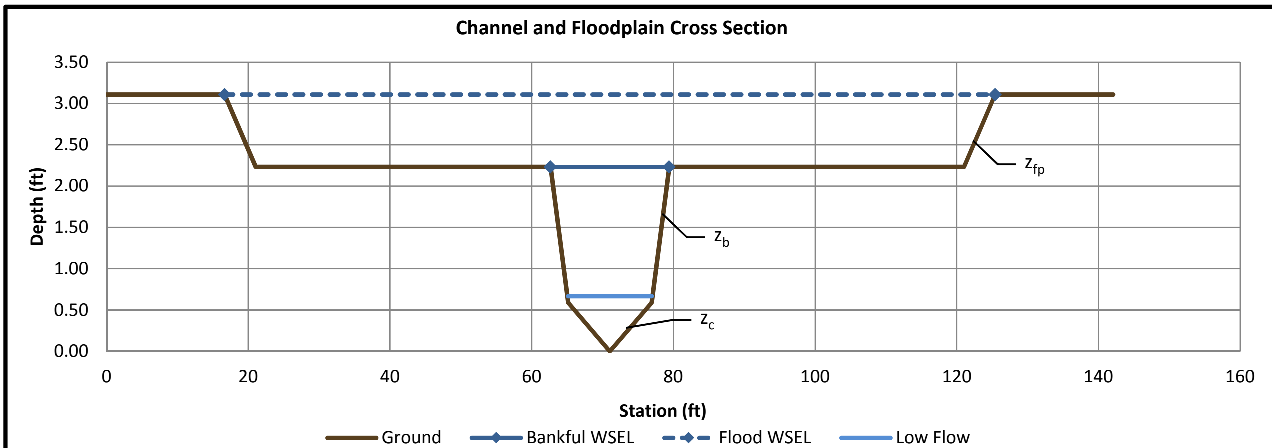
MC5 begins at the outlet to Hangar Flats Pit. The channel and floodplain would be characterized as sinuous, low-gradient, with broad forested wetland. The reach will be designed to provide spawing and rearing habitat to anadromous fish. The channel and floodplain would not be lined. Reference Sites 10, 11, and 12 were used to inform channel and floodplain parameters. Habitat objectives would be primarily for anadromous fish.

Representative Reference Site Photo

Photo of Reference Site 12 - EFSFSR

	Design Guidelines / Input	
	Input	Explanation
Reach Characteristics	9.34	= DA = Drainage Area (mi^2)
	345	= L_v = Valley Length (ft)
	450	= L_c = Channel Length (ft)
	6535	= $ELEV_{US}$ = Upstream Elevation (ft)
	6533	= $ELEV_{DS}$ = Downstream Elevation (ft)
	1.30	= K = Sinuousity (ft/ft)
	0.0058	= S_v = Valley Slope (ft/ft)
	0.0044	= S_c = Channel Slope (ft/ft)
	100	= W_{FP} = Average Floodplain Width (ft)
Hydrology	2.8	= Q_{95} = 95% Annual Exceedance Flow (cfs)
	108	= Q_{BF} = Bankfull Discharge (cfs)
	300	= $Q_{100\text{-}YR}$ = 100-Year Discharge (cfs)
Channel Characteristics	18	= W_{BF} = Estimated Bankfull Width (ft)
	7.5	= W/D_{max} = Width/Max Depth Ratio (ft/ft)
	10	= z_c = Channel Bottom Side-Slopes (_H:1V)
	1.5	= z_b = Bank Side-Slopes (_H:1V)
	5	= z_{fp} = Floodplain Side-Slopes (_H:1V)
	0.080	= n_{low} = Manning's n Value (Baseflow)
	0.033	= n_b = Manning's n Value (Bankfull)
	0.1	= n_{fp} = Manning's n Value (Floodplain)

Calculated Design Estimates			
Q_{95}	Q_{BF}	$Q_{100\text{-}YR}$	Explanation
0.0044	0.0044	0.0058	= S = Slope (ft/ft)
2.8	108	300	= Required Discharge (cfs)
0.7	2.2	0.9	= D_{max} = Max Water Depth (ft)
12.1	16.7	108.8	= W_t = Top Width (ft)
11.81	11.81	100.00	= W_b = Bottom Width (ft)
4.43	26.91	118.32	= A = Cross-Sectional Area (ft)
12.16	17.79	109.98	= P = Wetted Perimeter (ft)
0.36	1.51	1.08	= R = Hydraulic Radius (ft)
0.63	4.01	5.36	= V_{ch} = Channel Velocity (ft/s)
NA	NA	1.00	= V_{FP} = Floodplain Velocity (ft/s)
0.10	0.42	0.65	= τ_{ch} = Channel Shear Stress (lbs/ft^2)
NA	NA	0.30	= τ_{fp} = Floodplain Shear Stress (lbs/ft^2)
2.8	108	300	= Q = Resulting Discharge (cfs)
0.18	0.56	0.43	= Froude Number
0.4	1.6	1.1	= D_{ave} = Average Depth (ft)
NA	10.4	NA	= W/D = Width to Depth Ratio (ft/ft)
6	25	38	= D_{50} = Uniform Mobile Sediment (mm)
7	32	50	= D_{84} = D_{84} Mobile Sediment (mm)



Stream Design Workbook

Stibnite Gold Project
Meadow Creek
Meadow Creek Reach 6 (MC6)
Reach Type: Enhancement

Description

MC6 flows into the East Fork South Fork Salmon River (EFSFSR). It is characterized as having moderate gradient with forested and scrub/shrub wetland. Proposed work would consist of habitat enhancement by means of strategic placements of large woody material, regrading of the channel (limited to the addition of constructed riffles, alcoves, side channels, and deep pool fish habitat for improved rearing and refuge during summer and winter extremes), and floodplain regrading. Reference Sites 10, 11, and 12 were used to inform channel and floodplain parameters. Habitat objectives would be primarily for anadromous fish.

Representative Reference Site Photo

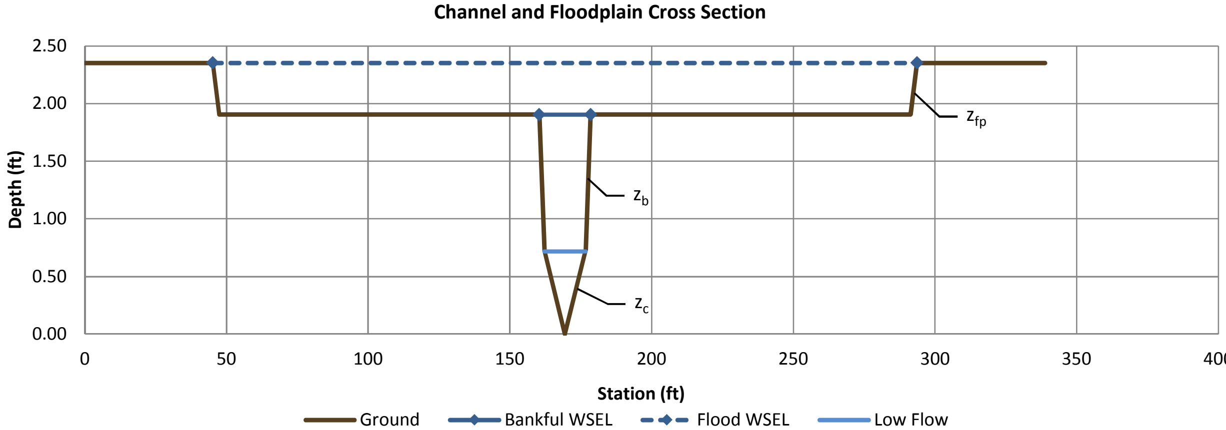
Photo of actual reach (2010)

	Design Guidelines / Input	
	Input	Explanation
Reach Characteristics	9.82	= DA = Drainage Area (mi[2])
	2057	= L_v = Valley Length (ft)
	2357	= L_c = Channel Length (ft)
	6533	= $ELEV_{US}$ = Upstream Elevation (ft)
	6486	= $ELEV_{DS}$ = Downstream Elevation (ft)
	1.15	= K = Sinuousity (ft/ft)
	0.0228	= S_v = Existing Valley Slope (ft/ft)
	0.0199	= S_c = Existing Channel Slope (ft/ft)
	244	= W_{FP} = Average Floodplain Width (ft)
Hydrology	3	= Q_{95} = 95% Annual Exceedance Flow (cfs)
	111	= Q_{BF} = Bankfull Discharge (cfs)
	313	= Q_{100-YR} = 100-Year Discharge (cfs)
Channel Characteristics	18	= W_{BF} = Estimated Bankfull Width (ft)
	9.5	= W/D_{max} = Width/Max Depth Ratio (ft/ft)
	10	= z_c = Channel Bottom Side-Slopes (_H:1V)
	1.5	= z_b = Bank Side-Slopes (_H:1V)
	5	= z_{fp} = Floodplain Side-Slopes (_H:1V)
	0.180	= n_{low} = Manning's n Value (Baseflow)
	0.055	= n_b = Manning's n Value (Bankfull)
	0.1	= n_{fp} = Manning's n Value (Floodplain)

Calculated Design Estimates			
Q_{95}	Q_{BF}	Q_{100-YR}	Explanation
0.0199	0.0199	0.0228	= S = Existing Slope (ft/ft)
3	111	313	= Required Discharge (cfs)
0.7	1.9	0.4	= D_{max} = Max Water Depth (ft)
14.5	18.1	248.5	= W_t = Top Width (ft)
14.57	14.57	244.00	= W_b = Bottom Width (ft)
5.15	24.53	135.02	= A = Cross-Sectional Area (ft)
14.60	18.89	249.36	= P = Wetted Perimeter (ft)
0.35	1.30	0.54	= R = Hydraulic Radius (ft)
0.58	4.53	5.48	= V_{ch} = Channel Velocity (ft/s)
NA	NA	1.31	= V_{FP} = Floodplain Velocity (ft/s)
0.44	1.62	2.15	= τ_{ch} = Channel Shear Stress (lbs/ft[2])
NA	NA	0.63	= τ_{fp} = Floodplain Shear Stress (lbs/ft[2])
3.0	111	313	= Q = Resulting Discharge (cfs)
0.17	0.69	0.55	= Froude Number
0.4	1.4	0.5	= D_{ave} = Average Depth (ft)
NA	13.4	NA	= W/D = Width to Depth Ratio (ft/ft)
26	96	127	= D_{50} = Uniform Mobile Sediment (mm)
33	129	173	= D_{84} = D_{84} Mobile Sediment (mm)

Note: Design estimates are targets for only certain enhancement elements - some design estimates may not be appropriate depending on the type of enhancement work.

Channel and Floodplain Cross Section



EAST FORK MEADOW (BLOWOUT) CREEK

Biological Objectives

Blowout Creek has been severely impacted as a result of legacy mining-related activities and failure of the water dam that had been constructed across its stream channel (Midas Gold 2016). This stream has been assumed to be the single largest source of sediment to the EFSFSR in the Project area. As outlined in the Plan of Restoration and Operations, Midas Gold proposes to rehabilitate Blowout Creek to control sediment delivery and restore incised and eroded stream reaches. The plan is to raise groundwater levels to restore wetland function and improve the incised stream channels in upper Blowout Creek and stabilize the confined, high gradient channel in the lower reach to reduce sediment delivery downstream. During mine operations, Blowout Creek would initially flow into the Meadow Creek diversion around Hangar Flats pit (reach MC4). At closure, it would then flow into the Hangar Flats pit lake.

Reaches BC1, BC2 & BC3

These reaches of Blowout Creek vary considerably from an upland meandering meadow stream (BC1) that cascades through a confined high gradient reach (BC2) that culminates with a stream flowing over an alluvial fan on the Meadow Creek floodplain (BC3). Current fish use is Westslope cutthroat trout in the upper (BC1) and lower (BC3) reaches with limited juvenile Chinook salmon rearing in the lower reach (MWH 2017). An average existing channel slope of 13.2% greatly limits the rearing potential for salmonids in BC3. The primary biological objective for BC1 is Westslope cutthroat trout spawning and rearing with additional biological objectives achieved for salmonid rearing in the lower reach (Reach B3) below the passage barrier (Reach B2). Additionally, the proposed project would improve channel stability, particularly in Reach BC2, thereby reducing sediment inputs throughout the three reaches and downstream.

Physical Objectives

Upper Blowout Creek (BC1) is a low-gradient channel occupying a historic meadow in a hanging valley above the glacial-formed Meadow Creek valley. The objective with BC1 is to install a grade control at the downstream end of the reach to elevate the water surface sufficiently to restore wetland hydrology for the surrounding meadow. It is anticipated that the channel would function similar to a beaver-dam impounded system, slowly filling with sediment over time. In-stream structures would be installed to add hydraulic and habitat diversity, and the riparian area would be planted with appropriate wetland vegetation.

The middle reach of Blowout Creek (BC2) has been previously identified as a large source of sand- and silt-sized sediment to lower Meadow Creek and the EFSFSR. A historical dam failure resulted in a destabilization of the steep slopes and a severe upstream migrating headcut where the hanging valley transitions to the Meadow Creek valley floor. A rock drain is proposed to initially stabilize the slopes and prevent further head cutting within this reach during mine operations. It is expected that over time, sediments may fill in voids of the rock drain, gradually reducing the flow capacity of the drain, forcing flow to the surface over the long-term resulting ultimately in a stable surface channel in this location. As with other rock-armored reaches, the channel is designed to be steep in order to maximize the length of high-value habitat in lower-gradient reaches upstream and downstream.

The lower portion of Blowout Creek (BC3), below the steep, rock-armored reach, would flow into the Meadow Creek diversion channel around Hangar Flats pit during mine operations. After mining has concluded in the pit, it would fill with water, at which time the Meadow Creek diversion would be abandoned and both Meadow Creek (MC4) and Blowout Creek (BC3) would be separately routed into the newly formed pit lake. The area occupied by the proposed BC3 channel and floodplain historically functioned as an alluvial fan due to the large sediment source from upstream. With the sediment source largely contained, the physical objectives for BC3 have been focused on conditions favorable for anadromous fish habitat including increased sinuosity and geomorphic diversity.

Reach-specific design criteria are provided below.

Stream Design Workbook

Stibnite Gold Project
Blowout Creek
Blowout Creek Reach 1 (BC1)
Reach Type: Meadow (Equiwidth Meandering)

Description

BC1 is the upstream most reach on Blowout Creek located in a meadow upstream of the existing steep channel cutting through existing lateral moraine. Work would consist of installing a grade control structure at the start of the boulder chute allowing the channel to fill naturally overtime thereby reconnecting Blowout Creek to the historic floodplain and recreating wetland function. The channel and floodplain would not be lined. Reference Sites 14 and 16 were used to inform channel and floodplain parameters. Habitat objectives would be primarily for resident fish.

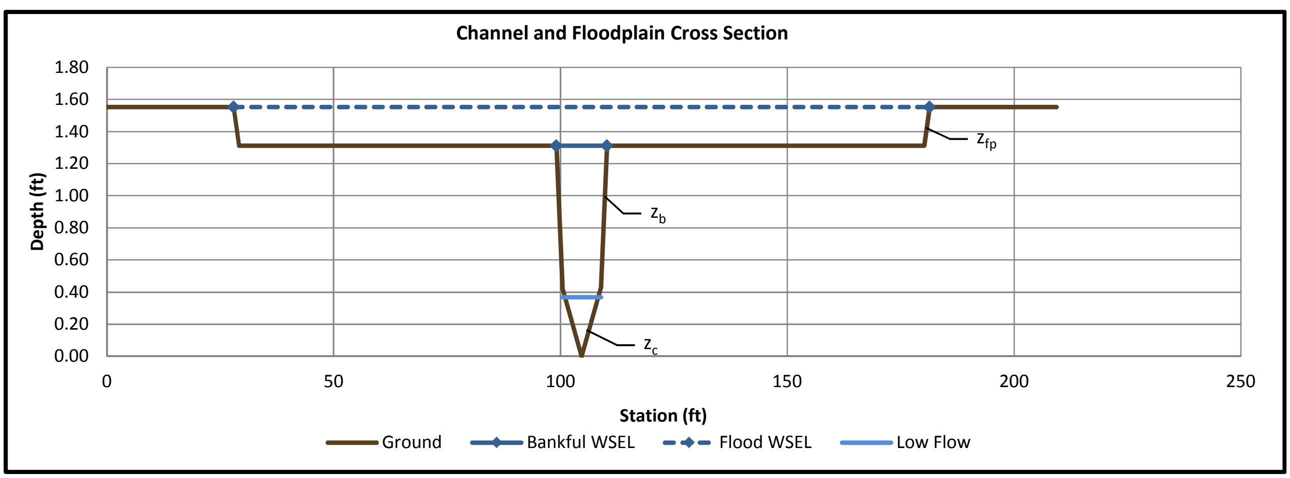
Representative Reference Site Photo

Photo of Reference Site 14 - Riordan Creek

	Design Guidelines / Input	
	Input	Explanation
Reach Characteristics	1.71	= DA = Drainage Area (mi^2)
Reach Characteristics	1615	= L_v = Valley Length (ft)
Reach Characteristics	1833	= L_c = Channel Length (ft)
Reach Characteristics	6982	= $ELEV_{US}$ = Upstream Elevation (ft)
Reach Characteristics	6970	= $ELEV_{DS}$ = Downstream Elevation (ft)
Reach Characteristics	1.13	= K = Sinuousity (ft/ft)
Reach Characteristics	0.0074	= S_v = Valley Slope (ft/ft)
Reach Characteristics	0.0065	= S_c = Channel Slope (ft/ft)
Reach Characteristics	151	= W_{FP} = Average Floodplain Width (ft)
Hydrology	0.5	= Q_{95} = 95% Annual Exceedance Flow (cfs)
Hydrology	33	= Q_{BF} = Bankfull Discharge (cfs)
Hydrology	65	= $Q_{100\text{-}YR}$ = 100-Year Discharge (cfs)
Channel Characteristics	8.8	= W_{BF} = Estimated Bankfull Width (ft)
Channel Characteristics	8.5	= W/D_{max} = Width/Max Depth Ratio (ft/ft)
Channel Characteristics	10	= z_c = Channel Bottom Side-Slopes (_H:1V)
Channel Characteristics	1.5	= z_b = Bank Side-Slopes (_H:1V)
Channel Characteristics	5	= z_{fp} = Floodplain Side-Slopes (_H:1V)
Channel Characteristics	0.094	= n_{low} = Manning's n Value (Baseflow)
Channel Characteristics	0.036	= n_b = Manning's n Value (Bankfull)
Channel Characteristics	0.1	= n_{fp} = Manning's n Value (Floodplain)

Calculated Design Estimates			
Q_{95}	Q_{BF}	$Q_{100\text{-}YR}$	Explanation
0.0065	0.0065	0.0074	= S = Slope (ft/ft)
0.5	33	65	= Required Discharge (cfs)
0.37	1.3	0.2	= D_{max} = Max Water Depth (ft)
8.3	11.1	153.4	= W_t = Top Width (ft)
8.49	8.49	151.00	= W_b = Bottom Width (ft)
1.3	10.51	47.17	= A = Cross-Sectional Area (ft)
8.33	11.73	154.04	= P = Wetted Perimeter (ft)
0.16	0.90	0.31	= R = Hydraulic Radius (ft)
0.38	3.14	3.65	= V_{ch} = Channel Velocity (ft/s)
NA	NA	0.49	= V_{FP} = Floodplain Velocity (ft/s)
0.07	0.37	0.46	= τ_{ch} = Channel Shear Stress (lbs/ft^2)
NA	NA	0.11	= τ_{fp} = Floodplain Shear Stress (lbs/ft^2)
0.5	33	65	= Q = Resulting Discharge (cfs)
0.17	0.57	0.44	= Froude Number
0.2	0.9	0.3	= D_{ave} = Average Depth (ft)
NA	11.8	NA	= W/D = Width to Depth Ratio (ft/ft)
4	22	27	= D_{50} = Uniform Mobile Sediment (mm)
5	27	35	= D_{84} = D_{84} Mobile Sediment (mm)

Note: Design estimates are targets for only certain enhancement elements - some design estimates may not be appropriate depending on the type of enhancement work.



Stream Design Workbook

Stibnite Gold Project
Blowout Creek
Blowout Creek Reach 2 (BC2)
Reach Type: Cascade

Description

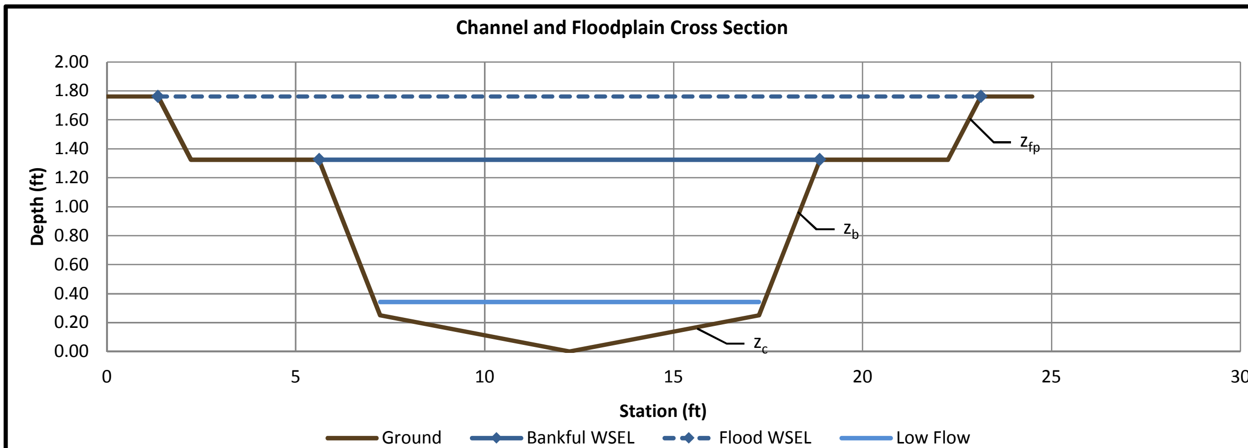
BC2 is located between the upper meadow and alluvial fan. The existing channel and banks consists of steep and loose, unconsolidated materials. The proposed channel will be designed to stabilize stream banks and upland slopes thereby reducing sediment load to downstream reachs. The channel and floodplain will be designed as a straight, high-gradient, cascading reach with pocket pools and possibly engineered energy dissipation pools. The channel may or may not be lined pending further evaluations. Reference Sites 2, 4, 8, and 19 were used to inform channel and floodplain parameters. Habitat objectives would be primarily for resident fish.

Representative Reference Site Photo

Photo of Reference Site 6 - Profile Creek

	Design Guidelines / Input	
	Input	Explanation
Reach Characteristics	2.2	= DA = Drainage Area (mi^2)
	2650	= L_v = Valley Length (ft)
	2670	= L_c = Channel Length (ft)
	6950	= $ELEV_{US}$ = Upstream Elevation (ft)
	6597	= $ELEV_{DS}$ = Downstream Elevation (ft)
	1.01	= K = Sinuousity (ft/ft)
	0.1332	= S_v = Valley Slope (ft/ft)
	0.1322	= S_c = Channel Slope (ft/ft)
	20.03	= W_{FP} = Average Floodplain Width (ft)
Hydrology	0.7	= Q_{95} = 95% Annual Exceedance Flow (cfs)
	37	= Q_{BF} = Bankfull Discharge (cfs)
	76	= Q_{100-YR} = 100-Year Discharge (cfs)
Channel Characteristics	9.8	= W_{BF} = Estimated Bankfull Width (ft)
	10	= W/D_{max} = Width/Max Depth Ratio (ft/ft)
	20	= z_c = Channel Bottom Side-Slopes (_H:1V)
	1.5	= z_b = Bank Side-Slopes (_H:1V)
	2	= z_{fp} = Floodplain Side-Slopes (_H:1V)
	0.600	= n_{low} = Manning's n Value (Baseflow)
	0.200	= n_b = Manning's n Value (Bankfull)
	0.1	= n_{fp} = Manning's n Value (Floodplain)

Calculated Design Estimates			
Q_{95}	Q_{BF}	Q_{100-YR}	Explanation
0.1322	0.1322	0.1332	= S = Slope (ft/ft)
0.7	37	76	= Required Discharge (cfs)
0.3	1.3	0.4	= D_{max} = Max Water Depth (ft)
10.3	13.2	21.8	= W_t = Top Width (ft)
10.03	10.03	20.03	= W_b = Bottom Width (ft)
2.19	13.76	22.89	= A = Cross-Sectional Area (ft)
10.37	13.91	22.65	= P = Wetted Perimeter (ft)
0.21	0.99	1.01	= R = Hydraulic Radius (ft)
0.32	2.69	3.40	= V_{ch} = Channel Velocity (ft/s)
NA	NA	2.87	= V_{FP} = Floodplain Velocity (ft/s)
1.74	8.16	11.59	= τ_{ch} = Channel Shear Stress (lbs/ft^2)
NA	NA	3.18	= τ_{fp} = Floodplain Shear Stress (lbs/ft^2)
0.7	37	76	= Q = Resulting Discharge (cfs)
0.12	0.47	0.57	= Froude Number
0.2	1.0	1.1	= D_{ave} = Average Depth (ft)
NA	12.8	NA	= W/D = Width to Depth Ratio (ft/ft)
103	483	686	= D_{50} = Uniform Mobile Sediment (mm)
139	695	1002	= D_{84} = D_{84} Mobile Sediment (mm)



Stream Design Workbook

Stibnite Gold Project
Blowout Creek
Blowout Creek Reach 3 (BC3)
Reach Type: Step Pool

Description

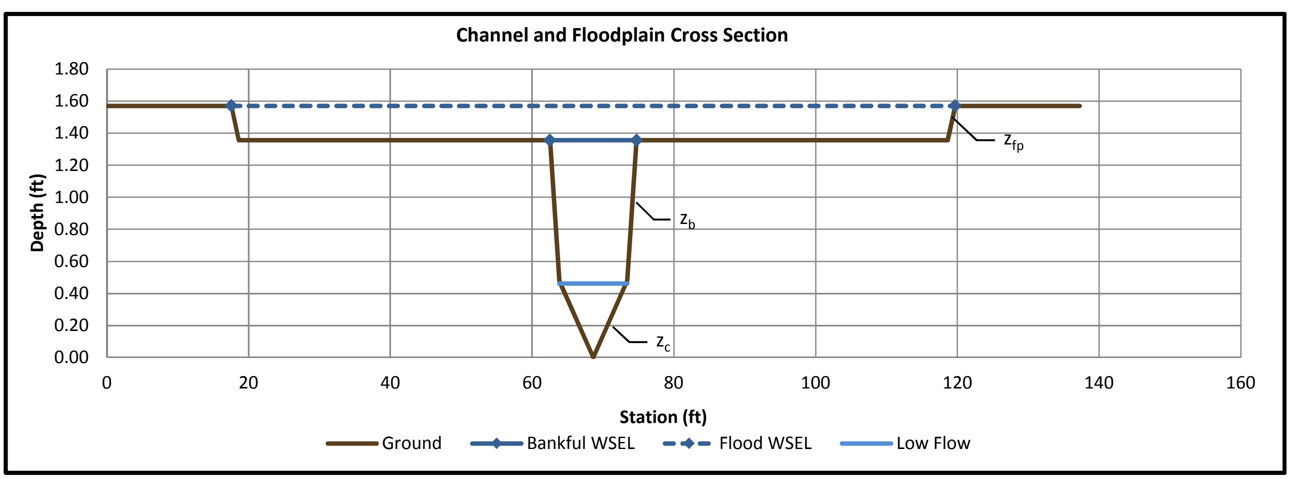
BC3 flows into Meadow Creek and is located on an alluvial fan. The proposed channel would be a relatively straight, incised, with adjacent scrub/shrub wetlands. The channel and floodplain is not expected to be lined. Reference Sites 11 and 15 were used to inform channel and floodplain parameters. Habitat objectives will be primarily for anadromous fish.

Representative Reference Site Photo

Photo of Reference Site 15 - Riordan Creek

	Design Guidelines / Input	
	Input	Explanation
Reach Characteristics	2.32	= DA = Drainage Area (mi^2)
	645	= L_v = Valley Length (ft)
	822	= L_c = Channel Length (ft)
	6575	= $ELEV_{US}$ = Upstream Elevation (ft)
	6535	= $ELEV_{DS}$ = Downstream Elevation (ft)
	1.27	= K = Sinuousity (ft/ft)
	0.0620	= S_v = Valley Slope (ft/ft)
	0.0487	= S_c = Channel Slope (ft/ft)
	100	= W_{FP} = Average Floodplain Width (ft)
Hydrology	0.7	= Q_{95} = 95% Annual Exceedance Flow (cfs)
	38	= Q_{BF} = Bankfull Discharge (cfs)
	78	= $Q_{100\text{-}YR}$ = 100-Year Discharge (cfs)
Channel Characteristics	9.8	= W_{BF} = Estimated Bankfull Width (ft)
	9	= W/D_{max} = Width/Max Depth Ratio (ft/ft)
	10	= z_c = Channel Bottom Side-Slopes (_H:1V)
	1.5	= z_b = Bank Side-Slopes (_H:1V)
	5	= z_{fp} = Floodplain Side-Slopes (_H:1V)
	0.365	= n_{low} = Manning's n Value (Baseflow)
	0.097	= n_b = Manning's n Value (Bankfull)
	0.1	= n_{fp} = Manning's n Value (Floodplain)

Calculated Design Estimates			
Q_{95}	Q_{BF}	$Q_{100\text{-}YR}$	Explanation
0.0487	0.0487	0.0620	= S = Slope (ft/ft)
0.7	38	78	= Required Discharge (cfs)
0.5	1.4	0.2	= D_{max} = Max Water Depth (ft)
9.5	12.2	102.1	= W_t = Top Width (ft)
9.58	9.58	100.00	= W_b = Bottom Width (ft)
2.12	11.86	33.49	= A = Cross-Sectional Area (ft)
9.56	12.79	102.76	= P = Wetted Perimeter (ft)
0.22	0.93	0.33	= R = Hydraulic Radius (ft)
0.33	3.21	3.66	= V_{ch} = Channel Velocity (ft/s)
NA	NA	1.32	= V_{FP} = Floodplain Velocity (ft/s)
0.67	2.81	3.44	= τ_{ch} = Channel Shear Stress (lbs/ft^2)
NA	NA	0.82	= τ_{fp} = Floodplain Shear Stress (lbs/ft^2)
0.7	38	78	= Q = Resulting Discharge (cfs)
0.12	0.57	0.72	= Froude Number
0.2	1.0	0.3	= D_{ave} = Average Depth (ft)
NA	12.6	NA	= W/D = Width to Depth Ratio (ft/ft)
40	167	203	= D_{50} = Uniform Mobile Sediment (mm)
52	229	282	= D_{84} = D_{84} Mobile Sediment (mm)



EAST FORK SOUTH FORK SALMON RIVER (EFSFSR)

Biological Objectives

The EFSFSR has been heavily impacted by legacy mining activities. These impacts include the existing Yellow Pine pit that cuts off fish passage, development rock dumps within and adjacent to the stream channel, tailings washed down from Meadow Creek valley, roads and infrastructure within and adjacent to the EFSFSR channel, dam construction across the EFSFSR main channel, and other legacy impacts (Midas Gold 2016). The plan during construction and operation is to temporarily relocate the EFSFSR from the Yellow Pine pit through a tunnel capable of protecting water quality and providing fish passage. At mine closure, the EFSFSR would be restored across the backfilled pit with no fish passage barriers.

Reaches EF1, EF2, EF3 & EF4

These reaches of the EFSFSR lie within a moderately confined valley with relatively steep slopes and a range of bankfull widths. Intrinsic potential for Chinook salmon in these proposed design reaches is consistently categorized as low, largely because gradients exceed 1.5% (Table D-5). However, steelhead intrinsic potential is either categorized as low or high depending on gradient and confinement. Low intrinsic potential is noted for proposed reaches EF1 and EF2c because gradient exceeded 4.0%. In reaches EF3a and EF4, the variation in channel confinement produces both low and high intrinsic potential. Overall, about 74% (2.3 mi) of the EFSFSR reaches are categorized with a high intrinsic potential for steelhead.

The primary biological objective assigned for the EFSFSR reaches is steelhead spawning and rearing. Dominant habitat types in these reaches would be higher gradient riffle and step-pool habitat. These types of habitats are more favorable to steelhead spawning and rearing than Chinook salmon. However, Chinook salmon and bull trout spawning and rearing objectives were also assigned for these reaches because there is an expectation that isolated areas would provide adequate habitat for spawning and rearing. The mainstem of the EFSFSR would also provide adult Westslope cutthroat trout rearing year-round and juvenile rearing for fish that emigrate from tributary spawning streams. Current fish use above the existing Yellow Pine pit includes bull trout and Westslope cutthroat trout. Juvenile Chinook salmon have also been observed in this area as the result of adult outplants.

Table D-5. EFSFSR basic intrinsic potential for Chinook Salmon and Steelhead

Species	Reach	Stream width/ Gradient Categories		Valley Width Ratio (ratio of valley width to bankfull stream width)		
		Bankfull Width (ft.)	Gradient (%)	Confined (≤4 x BFW)	Moderate (4 to 20 x BFW)	Wide (> 20 x BFW)
Chinook salmon	EF1	15	6.48	Negligible	Low	Low
	EF2a	25	3.07	Low	Low	Medium
	EF2b	25	2.85	Low	Low	Medium
	EF2c	25	6.61	Negligible	Low	Low
	EF3a	25	3.76	Low	Low	Medium
	EF3b	22	3.76	Low	Low	Medium
	EF3c	26	3.76	Low	Low	Medium
	EF3d	22	3.76	Low	Low	Medium
	EF3e	26	3.76	Low	Low	Medium
	EF4	26	2.62	Low	Low	Medium
Steelhead	EF1	15	6.48	None	Low	Low
	EF2a	25	3.07	Low	High	High
	EF2b	25	2.85	Low	High	High
	EF2c	25	6.61	None	Low	Low
	EF3a	25	3.76	Low	High	High
	EF3b	22	3.76	Low	High	High
	EF3c	26	3.76	Low	High	High
	EF3d	22	3.76	Low	High	High
	EF3e	26	3.76	Low	High	High
	EF4	26	2.62	Low	High	High

Note: Basic intrinsic potential categories (i.e., none - high) were assessed for Chinook salmon and steelhead in reaches of the EFSFSR. Intrinsic potential categories were based on proposed bankfull width (BFW), gradient (%), and the ratio of floodplain width (FPW) to bankfull width (FPW/BFW).

Physical Objectives

The stream design within the EFSFSR includes both restoration and enhancement. Physical objectives within enhancement reaches (EF1, EF2, and EF4) are focused around increasing hydraulic and geomorphic diversity while removing potential fish passage barriers. Woody debris and rock clusters would be used to enhance in-stream conditions, increase in-stream friction, sort sediment, and create localized velocity gradients. Grade control structures such as engineered riffles and/or channel-spanning rock or wood may be used to facilitate the development of relatively large pools intended to accommodate adult salmonids migrating upstream through this relatively steep reach (see design sheets in Appendix E for more details).

The middle portion of the EFSFSR project area (EF3) includes the existing Yellow Pine pit and proposed Yellow Pine DRSF (pit backfill). As part of the mining operation, the Yellow Pine pit would be backfilled with development rock from West End pit. The backfilled material would create the new valley bottom and valley walls in this reach. The shape of the new valley through this reach would be created to maximize its length in order to minimize its slope. Additionally, the width of the floodplain would vary to accommodate anticipated channel dynamics, side-channels, floodplain features, wetlands, and tributaries. The entire floodplain through EF3 would be lined (see Footnote 1 above) to prevent undue seepage loss into the otherwise highly porous Yellow Pine DRSF as described above for Meadow Creek reach MC2. A significant difference between the EF3 and MC2 design is the size and thickness of materials required to maintain a geomorphically stable channel and floodplain atop the liner. To accommodate the relatively steep gradient proposed for the EF3 reach, the protection layer and rock armoring of the surface liner along with the streambed and floodplain material would be composed of relatively coarse material. The space required for these protective layers would be provided by burying the liner at depth within the Yellow Pine DRSF. The liner would extend laterally to the floodplain margin. The margin of the floodplain would coincide with the valley margin, which would be composed of large boulders that would resist erosion and prevent long-term channel migration beyond the liner extents. As with all restoration reaches, strategic wood (and possibly boulder) placement would be utilized to increase hydraulic and geomorphic complexity within the reach.

Off-channel habitat in EF3 would be provided by several high-flow channels coalescing along the valley margin forming and maintaining backwater alcoves (wall-based channel). Additionally, cold-water tributaries (HC2 and MNC2) would be routed onto the floodplain in these locations to enhance baseflow volume and increase the overall diversity of these off-channel features.

Reach-specific design criteria are summarized below:

Stream Design Workbook

Stibnite Gold Project
East Fork South Fork Salmon River (EFSFSR)
EFSFSR Reach 1 (EF1)
Reach Type: Enhancement

Description

EF1 is located upstream of the confluence with Meadow Creek. Proposed work would consist of habitat enhancement by means of strategic placements of large woody material, regrading of the channel (limited to removing existing barriers to fish, construction of constructed riffles, and deep pool fish habitat for improved rearing and refuge during summer and winter extremes), and floodplain regrading. Reference Sites 1, 5, and 15 were used to inform channel and floodplain parameters. Habitat objectives would be primarily for anadromous fish.

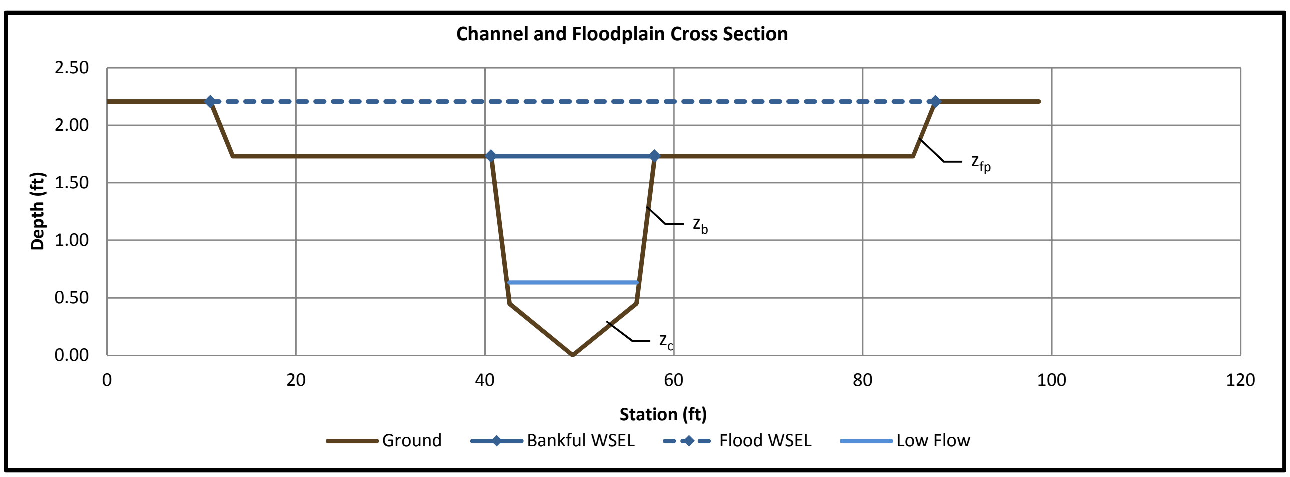
Representative Reference Site Photo

Photo of Reference Site 1 - Goat Creek

	Design Guidelines / Input	
	Input	Explanation
Reach Characteristics	8.87	= DA = Drainage Area (mi^2)
Reach Characteristics	1816	= L_v = Valley Length (ft)
Reach Characteristics	1897	= L_c = Channel Length (ft)
Reach Characteristics	6609	= $ELEV_{US}$ = Upstream Elevation (ft)
Reach Characteristics	6486	= $ELEV_{DS}$ = Downstream Elevation (ft)
Reach Characteristics	1.04	= K = Sinuousity (ft/ft)
Reach Characteristics	0.0677	= S_v = Existing Valley Slope (ft/ft)
Reach Characteristics	0.0648	= S_c = Existing Channel Slope (ft/ft)
Reach Characteristics	72	= W_{FP} = Average Floodplain Width (ft)
Hydrology	2.4	= Q_{95} = 95% Annual Exceedance Flow (cfs)
Hydrology	83	= Q_{BF} = Bankfull Discharge (cfs)
Hydrology	201	= $Q_{100\text{-}YR}$ = 100-Year Discharge (cfs)
Channel Characteristics	15	= W_{BF} = Estimated Bankfull Width (ft)
Channel Characteristics	10	= W/D_{max} = Width/Max Depth Ratio (ft/ft)
Channel Characteristics	15	= z_c = Channel Bottom Side-Slopes (_H:1V)
Channel Characteristics	1.5	= z_b = Bank Side-Slopes (_H:1V)
Channel Characteristics	5	= z_{fp} = Floodplain Side-Slopes (_H:1V)
Channel Characteristics	0.470	= n_{low} = Manning's n Value (Baseflow)
Channel Characteristics	0.121	= n_b = Manning's n Value (Bankfull)
Channel Characteristics	0.1	= n_{fp} = Manning's n Value (Floodplain)

Calculated Design Estimates			
Q_{95}	Q_{BF}	$Q_{100\text{-}YR}$	Explanation
0.0648	0.0648	0.0677	= S = Existing Slope (ft/ft)
2.4	83	201	= Required Discharge (cfs)
0.6	1.7	0.5	= D_{max} = Max Water Depth (ft)
14.0	17.3	76.8	= W_t = Top Width (ft)
13.47	13.47	72.00	= W_b = Bottom Width (ft)
5.55	22.77	58.11	= A = Cross-Sectional Area (ft)
14.16	18.13	77.65	= P = Wetted Perimeter (ft)
0.39	1.26	0.75	= R = Hydraulic Radius (ft)
0.43	3.64	4.48	= V_{ch} = Channel Velocity (ft/s)
NA	NA	2.29	= V_{FP} = Floodplain Velocity (ft/s)
1.59	5.08	6.92	= τ_{ch} = Channel Shear Stress (lbs/ft^2)
NA	NA	1.92	= τ_{fp} = Floodplain Shear Stress (lbs/ft^2)
2.4	83	201	= Q = Resulting Discharge (cfs)
0.12	0.56	0.70	= Froude Number
0.4	1.3	0.8	= D_{ave} = Average Depth (ft)
NA	13.2	NA	= W/D = Width to Depth Ratio (ft/ft)
94	301	410	= D_{50} = Uniform Mobile Sediment (mm)
126	424	585	= D_{84} = D_{84} Mobile Sediment (mm)

Note: Design estimates are targets for only certain enhancement elements - some design estimates may not be appropriate depending on the type of enhancement work.



Stream Design Workbook

Stibnite Gold Project
East Fork South Fork Salmon River (EFSFSR)
EFSFSR Reach 2A (EF2A)
Reach Type: Enhancement

Description

EF2A begins at the Meadow Creek confluence and ends at the Garnet Creek confluence. Proposed work would consist of habitat enhancement by means of strategic placements of large woody material, regrading of the channel (limited to the addition of constructed riffles, alcoves, side channels, and deep pool fish habitat for improved rearing and refuge during summer and winter extremes), and floodplain regrading. Reference Sites 1, 5, 9, and 15 were used to inform channel and floodplain parameters. Habitat objectives would be primarily for anadromous fish.

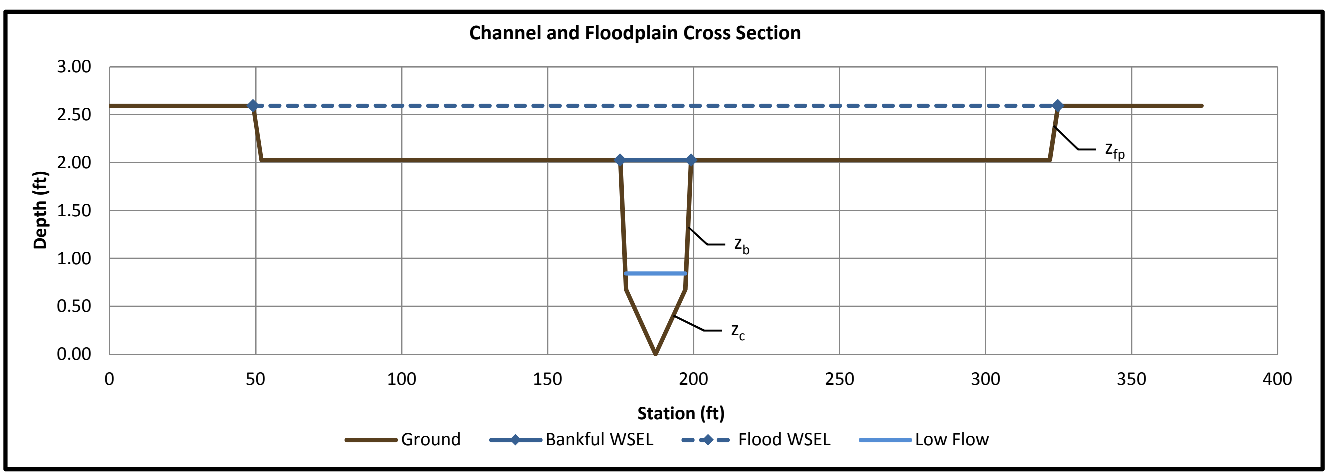
Representative Reference Site Photo

Photo of actual reach (2017)

	Design Guidelines / Input	
	Input	Explanation
Reach Characteristics	22.77	= DA = Drainage Area (mi^2)
	2020	= L_v = Valley Length (ft)
	2190	= L_c = Channel Length (ft)
	6489	= $ELEV_{US}$ = Upstream Elevation (ft)
	6422	= $ELEV_{DS}$ = Downstream Elevation (ft)
	1.08	= K = Sinuousity (ft/ft)
	0.0332	= S_v = Existing Valley Slope (ft/ft)
	0.0306	= S_c = Existing Channel Slope (ft/ft)
	270	= W_{FP} = Average Floodplain Width (ft)
Hydrolog	6.7	= Q_{95} = 95% Annual Exceedance Flow (cfs)
	175	= Q_{BF} = Bankfull Discharge (cfs)
	558	= $Q_{100\text{-}YR}$ = 100-Year Discharge (cfs)
Channel Characteristics	25	= W_{BF} = Estimated Bankfull Width (ft)
	12	= W/D_{max} = Width/Max Depth Ratio (ft/ft)
	15	= z_c = Channel Bottom Side-Slopes (_H:1V)
	1.5	= z_b = Bank Side-Slopes (_H:1V)
	5	= z_{fp} = Floodplain Side-Slopes (_H:1V)
	0.249	= n_{low} = Manning's n Value (Baseflow)
	0.071	= n_b = Manning's n Value (Bankfull)
	0.1	= n_{fp} = Manning's n Value (Floodplain)

Calculated Design Estimates			
Low_{normal}	$Bankfull_{normal}$	Floodplain	Explanation
0.0306	0.0306	0.0332	= S = Existing Slope (ft/ft)
6.7	175	558	= Required Discharge (cfs)
0.8	2.0	0.6	= D_{max} = Max Water Depth (ft)
20.8	24.3	275.7	= W_t = Top Width (ft)
20.25	20.25	270.00	= W_b = Bottom Width (ft)
10.27	36.92	191.94	= A = Cross-Sectional Area (ft)
20.90	25.17	276.66	= P = Wetted Perimeter (ft)
0.49	1.47	0.69	= R = Hydraulic Radius (ft)
0.65	4.74	5.86	= V_{ch} = Channel Velocity (ft/s)
NA	NA	1.85	= V_{FP} = Floodplain Velocity (ft/s)
0.94	2.80	3.85	= τ_{ch} = Channel Shear Stress (lbs/ft^2)
NA	NA	1.16	= τ_{fp} = Floodplain Shear Stress (lbs/ft^2)
6.7	175	558	= Q = Resulting Discharge (cfs)
0.16	0.68	0.61	= Froude Number
0.5	1.5	0.7	= D_{ave} = Average Depth (ft)
NA	16.0	NA	= W/D = Width to Depth Ratio (ft/ft)
56	166	228	= D_{50} = Uniform Mobile Sediment (mm)
73	228	317	= D_{84} = D_{84} Mobile Sediment (mm)

Note: Design estimates are targets for only certain enhancement elements - some design estimates may not be appropriate depending on the type of enhancement work.



Stream Design Workbook

Stibnite Gold Project

East Fork South Fork Salmon River (EFSFSR)

EFSFSR Reach 2B (EF2B)

Reach Type: Enhancement

Description

EF2B begins at the Garnet Creek confluence and ends at the Fiddle Creek confluence. Proposed work would consist of habitat enhancement by means of strategic placements of large woody material, regrading of the channel (limited to the addition of constructed riffles, alcoves, side channels, and deep pool fish habitat for improved rearing and refuge during summer and winter extremes), and floodplain regrading. Reference Sites 1, 5, 9, and 15 were used to inform channel and floodplain parameters. Habitat objectives would be primarily for anadromous fish.

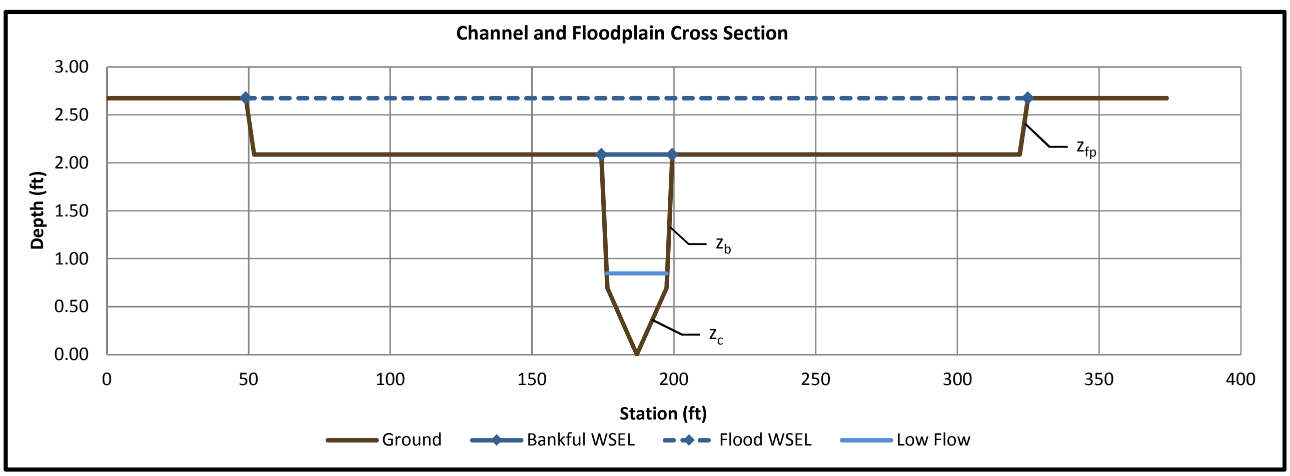
Representative Reference Site Photo

Photo of actual reach (2010)

	Design Guidelines / Input	
	Input	Explanation
Reach Characteristics	22.8	= DA = Drainage Area (mi^2)
	5420	= L_v = Valley Length (ft)
	5754	= L_c = Channel Length (ft)
	6422	= $ELEV_{US}$ = Upstream Elevation (ft)
	6257	= $ELEV_{DS}$ = Downstream Elevation (ft)
	1.06	= K = Sinuousity (ft/ft)
	0.0304	= S_v = Existing Valley Slope (ft/ft)
	0.0287	= S_c = Existing Channel Slope (ft/ft)
	270	= W_{FP} = Average Floodplain Width (ft)
Hydrology	6.9	= Q_{95} = 95% Annual Exceedance Flow (cfs)
	191	= Q_{BF} = Bankfull Discharge (cfs)
	590	= $Q_{100\text{-}YR}$ = 100-Year Discharge (cfs)
Channel Characteristics	25	= W_{BF} = Estimated Bankfull Width (ft)
	12	= W/D_{max} = Width/Max Depth Ratio (ft/ft)
	15	= z_c = Channel Bottom Side-Slopes (_H:1V)
	1.5	= z_b = Bank Side-Slopes (_H:1V)
	5	= z_{fp} = Floodplain Side-Slopes (_H:1V)
	0.236	= n_{low} = Manning's n Value (Baseflow)
	0.068	= n_b = Manning's n Value (Bankfull)
	0.1	= n_{fp} = Manning's n Value (Floodplain)

Calculated Design Estimates			
Low_{normal}	$Bankfull_{normal}$	Floodplain	Explanation
0.0287	0.0287	0.0304	= S = Existing Slope (ft/ft)
6.9	191	590	= Required Discharge (cfs)
0.8	2.1	0.6	= D_{max} = Max Water Depth (ft)
21.3	25.0	275.9	= W_t = Top Width (ft)
20.86	20.86	270.00	= W_b = Bottom Width (ft)
10.45	39.18	199.99	= A = Cross-Sectional Area (ft)
21.46	25.93	276.90	= P = Wetted Perimeter (ft)
0.49	1.51	0.72	= R = Hydraulic Radius (ft)
0.66	4.87	6.03	= V_{ch} = Channel Velocity (ft/s)
NA	NA	1.81	= V_{FP} = Floodplain Velocity (ft/s)
0.87	2.70	3.72	= τ_{ch} = Channel Shear Stress (lbs/ft^2)
NA	NA	1.11	= τ_{fp} = Floodplain Shear Stress (lbs/ft^2)
6.9	191	590	= Q = Resulting Discharge (cfs)
0.17	0.69	0.61	= Froude Number
0.5	1.6	0.7	= D_{ave} = Average Depth (ft)
NA	16.0	NA	= W/D = Width to Depth Ratio (ft/ft)
52	160	220	= D_{50} = Uniform Mobile Sediment (mm)
68	220	307	= D_{84} = D_{84} Mobile Sediment (mm)

Note: Design estimates are targets for only certain enhancement elements - some design estimates may not be appropriate depending on the type of enhancement work.



Stream Design Workbook

Stibnite Gold Project
East Fork South Fork Salmon River (EFSFSR)
EFSFSR Reach 2C (EF2C)
Reach Type: Enhancement

Description

EF2C is begins at the Fiddle Creek confluence. Proposed work would consist of habitat enhancement by means of strategic placements of large woody material, regrading of the channel (limited to the addition of constructed riffles, alcoves, side channels, and deep pool fish habitat for improved rearing and refuge during summer and winter extremes), and floodplain regrading. Reference Sites 1, 5, 9, and 15 were used to inform channel and floodplain parameters. Habitat objectives would be primarily for anadromous fish.

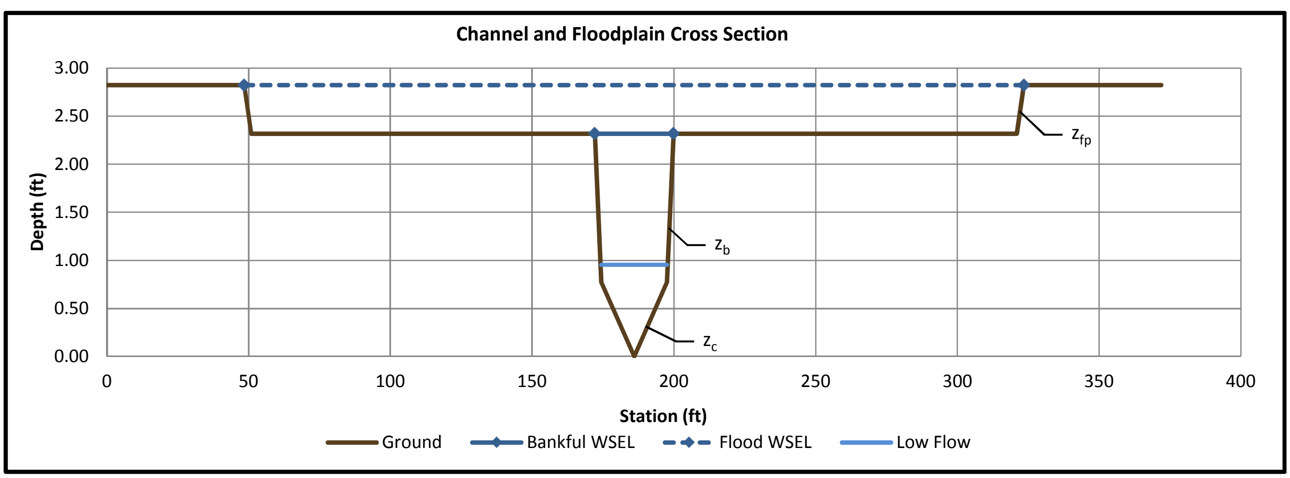
Representative Reference Site Photo

Photo of actual reach (2017)

	Design Guidelines / Input	
	Input	Explanation
Reach Characteristics	22.85	= DA = Drainage Area (mi^2)
Reach Characteristics	1094	= L_v = Valley Length (ft)
Reach Characteristics	1174	= L_c = Channel Length (ft)
Reach Characteristics	6257	= $ELEV_{US}$ = Upstream Elevation (ft)
Reach Characteristics	6181	= $ELEV_{DS}$ = Downstream Elevation (ft)
Reach Characteristics	1.07	= K = Sinuousity (ft/ft)
Reach Characteristics	0.0695	= S_v = Existing Valley Slope (ft/ft)
Reach Characteristics	0.0647	= S_c = Existing Channel Slope (ft/ft)
Reach Characteristics	270	= W_{FP} = Average Floodplain Width (ft)
Hydrology	7.2	= Q_{95} = 95% Annual Exceedance Flow (cfs)
Hydrology	214	= Q_{BF} = Bankfull Discharge (cfs)
Hydrology	634	= $Q_{100\text{-}YR}$ = 100-Year Discharge (cfs)
Channel Characteristics	25	= W_{BF} = Estimated Bankfull Width (ft)
Channel Characteristics	12	= W/D_{max} = Width/Max Depth Ratio (ft/ft)
Channel Characteristics	15	= z_c = Channel Bottom Side-Slopes (_H:1V)
Channel Characteristics	1.5	= z_b = Bank Side-Slopes (_H:1V)
Channel Characteristics	5	= z_{fp} = Floodplain Side-Slopes (_H:1V)
Channel Characteristics	0.469	= n_{low} = Manning's n Value (Baseflow)
Channel Characteristics	0.121	= n_b = Manning's n Value (Bankfull)
Channel Characteristics	0.1	= n_{fp} = Manning's n Value (Floodplain)

Calculated Design Estimates			
Low_{normal}	$Bankfull_{normal}$	Floodplain	Explanation
0.0647	0.0647	0.0695	= S = Existing Slope (ft/ft)
7.2	214	634	= Required Discharge (cfs)
1.0	2.3	0.5	= D_{max} = Max Water Depth (ft)
23.7	27.8	275.1	= W_t = Top Width (ft)
23.18	23.18	270.00	= W_b = Bottom Width (ft)
13.22	48.37	186.24	= A = Cross-Sectional Area (ft)
23.89	28.81	276.15	= P = Wetted Perimeter (ft)
0.55	1.68	0.67	= R = Hydraulic Radius (ft)
0.54	4.42	5.25	= V_{ch} = Channel Velocity (ft/s)
NA	NA	2.48	= V_{FP} = Floodplain Velocity (ft/s)
2.24	6.78	8.76	= τ_{ch} = Channel Shear Stress (lbs/ft^2)
NA	NA	2.17	= τ_{fp} = Floodplain Shear Stress (lbs/ft^2)
7.2	214	634	= Q = Resulting Discharge (cfs)
0.13	0.59	0.73	= Froude Number
0.6	1.7	0.7	= D_{ave} = Average Depth (ft)
NA	16.0	NA	= W/D = Width to Depth Ratio (ft/ft)
132	402	518	= D_{50} = Uniform Mobile Sediment (mm)
180	573	748	= D_{84} = D_{84} Mobile Sediment (mm)

Note: Design estimates are targets for only certain enhancement elements - some design estimates may not be appropriate depending on the type of enhancement work.



Stream Design Workbook

Stibnite Gold Project
East Fork South Fork Salmon River (EFSFSR)
EFSFSR Reach 3A (EF3A)
Reach Type: Step Pool

Description

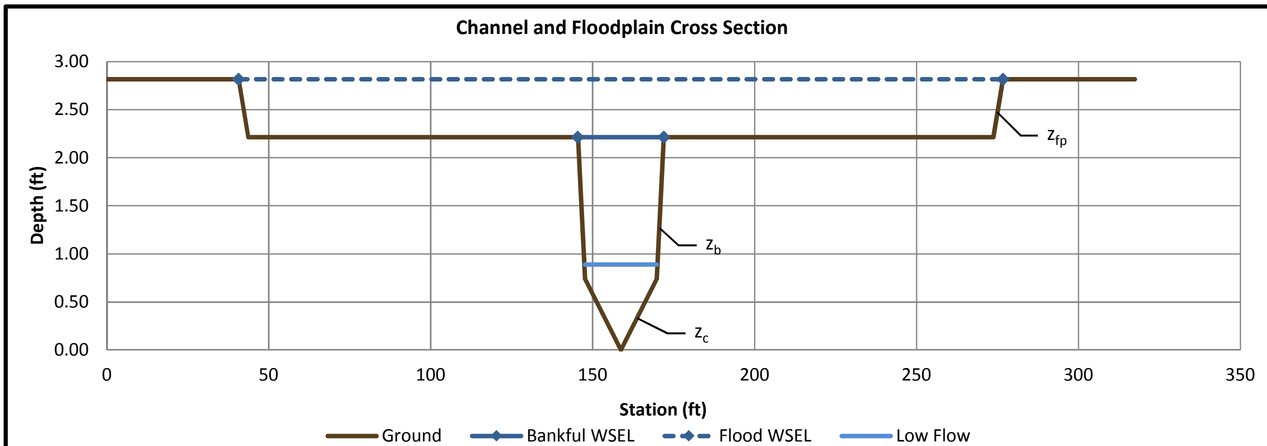
EF3A is located on the proposed backfilled Yellow Pine pit. Goals for channel design includes restoring fish passage and improving spawining and rearing habitat, and improved wetland function. The entire Reach 3 is comprised of three subreachs 3A, 3B, and 3C. Reach EF3A ends at the confluence with Midnight Creek. Reference Sites 1, 5, 9 and 15 were used to inform channel and floodplain parameters. Habitat objectives would be primarily for anadromous fish.

Representative Reference Site Photo

Photo of Reference Site 9 - Tamarack Creek

	Design Guidelines / Input	
	Input	Explanation
Reach Characteristics	22.89	= DA = Drainage Area (mi^2)
	1055	= L_v = Valley Length (ft)
	1243	= L_c = Channel Length (ft)
	6182.7	= $ELEV_{US}$ = Upstream Elevation (ft)
	6135.9	= $ELEV_{DS}$ = Downstream Elevation (ft)
	1.18	= K = Sinuousity (ft/ft)
	0.0444	= S_v = Valley Slope (ft/ft)
	0.0377	= S_c = Channel Slope (ft/ft)
	230	= W_{FP} = Average Floodplain Width (ft)
Hydrology	7.2	= Q_{95} = 95% Annual Exceedance Flow (cfs)
	215	= Q_{BF} = Bankfull Discharge (cfs)
	636	= Q_{100-YR} = 100-Year Discharge (cfs)
Channel Characteristics	25	= W_{BF} = Estimated Bankfull Width (ft)
	12	= W/D_{max} = Width/Max Depth Ratio (ft/ft)
	15	= z_c = Channel Bottom Side-Slopes (_H:1V)
	1.5	= z_b = Bank Side-Slopes (_H:1V)
	5	= z_{fp} = Floodplain Side-Slopes (_H:1V)
	0.294	= n_{low} = Manning's n Value (Baseflow)
	0.081	= n_b = Manning's n Value (Bankfull)
	0.1	= n_{fp} = Manning's n Value (Floodplain)

Calculated Design Estimates			
Low_{normal}	$Bankfull_{normal}$	Floodplain	Explanation
0.0377	0.0377	0.0444	= S = Slope (ft/ft)
7.2	215	636	= Required Discharge (cfs)
0.9	2.2	0.6	= D_{max} = Max Water Depth (ft)
22.6	26.6	236.0	= W_t = Top Width (ft)
22.14	22.14	230.00	= W_b = Bottom Width (ft)
11.53	44.14	184.57	= A = Cross-Sectional Area (ft)
22.74	27.52	237.09	= P = Wetted Perimeter (ft)
0.51	1.60	0.78	= R = Hydraulic Radius (ft)
0.62	4.87	5.99	= V_{ch} = Channel Velocity (ft/s)
NA	NA	2.22	= V_{FP} = Floodplain Velocity (ft/s)
1.19	3.77	5.14	= τ_{ch} = Channel Shear Stress (lbs/ft^2)
NA	NA	1.64	= τ_{fp} = Floodplain Shear Stress (lbs/ft^2)
7.2	215	636	= Q = Resulting Discharge (cfs)
0.15	0.67	0.69	= Froude Number
0.5	1.7	0.8	= D_{ave} = Average Depth (ft)
NA	16.0	NA	= W/D = Width to Depth Ratio (ft/ft)
71	223	304	= D_{50} = Uniform Mobile Sediment (mm)
94	311	429	= D_{84} = D_{84} Mobile Sediment (mm)



Stream Design Workbook

Stibnite Gold Project
East Fork South Fork Salmon River (EFSFSR)
EFSFSR Reach 3B (EF3B)
Reach Type: Step Pool

Description

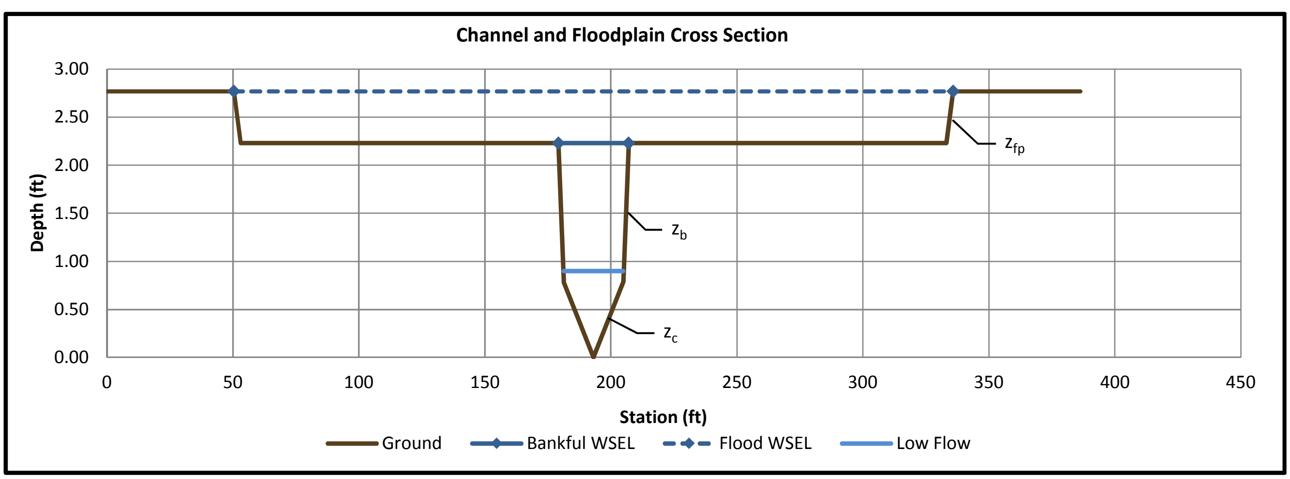
EF3B is located on the proposed backfilled Yellow Pine pit and is bounded by Midnight Creek and Hennessy Creek. Goals for channel design includes restoring fish passage and improving spawining and rearing habitat, and improved wetland function. Reference Sites 1, 5, 9 and 15 were used to inform channel and floodplain parameters. Habitat objectives would be primarily for anadromous fish.

Representative Reference Site Photo

Photo of Reference Site 11 - Sugar Creek

	Design Guidelines / Input	
	Input	Explanation
Reach Characteristics	22.89	= DA = Drainage Area (mi^2)
Reach Characteristics	1135	= L_v = Valley Length (ft)
Reach Characteristics	1464	= L_c = Channel Length (ft)
Reach Characteristics	6135.9	= $ELEV_{US}$ = Upstream Elevation (ft)
Reach Characteristics	6081	= $ELEV_{DS}$ = Downstream Elevation (ft)
Reach Characteristics	1.29	= K = Sinuousity (ft/ft)
Reach Characteristics	0.0484	= S_v = Valley Slope (ft/ft)
Reach Characteristics	0.0375	= S_c = Channel Slope (ft/ft)
Reach Characteristics	280	= W_{FP} = Average Floodplain Width (ft)
Hydrology	7.4	= Q_{95} = 95% Annual Exceedance Flow (cfs)
Hydrology	227	= Q_{BF} = Bankfull Discharge (cfs)
Hydrology	657	= $Q_{100\text{-}YR}$ = 100-Year Discharge (cfs)
Channel Characteristics	25	= W_{BF} = Estimated Bankfull Width (ft)
Channel Characteristics	12.5	= W/D_{max} = Width/Max Depth Ratio (ft/ft)
Channel Characteristics	15	= z_c = Channel Bottom Side-Slopes (_H:1V)
Channel Characteristics	1.5	= z_b = Bank Side-Slopes (_H:1V)
Channel Characteristics	5	= z_{fp} = Floodplain Side-Slopes (_H:1V)
Channel Characteristics	0.293	= n_{low} = Manning's n Value (Baseflow)
Channel Characteristics	0.081	= n_b = Manning's n Value (Bankfull)
Channel Characteristics	0.1	= n_{fp} = Manning's n Value (Floodplain)

Calculated Design Estimates			
Low_{normal}	$Bankfull_{normal}$	Floodplain	Explanation
0.0375	0.0375	0.0484	= S = Slope (ft/ft)
7.4	227	657	= Required Discharge (cfs)
0.9	2.2	0.5	= D_{max} = Max Water Depth (ft)
23.9	27.9	285.4	= W_t = Top Width (ft)
23.55	23.55	280.00	= W_b = Bottom Width (ft)
11.97	46.43	198.52	= A = Cross-Sectional Area (ft)
24.01	28.81	286.41	= P = Wetted Perimeter (ft)
0.50	1.61	0.69	= R = Hydraulic Radius (ft)
0.62	4.89	5.89	= V_{ch} = Channel Velocity (ft/s)
NA	NA	2.15	= V_{FP} = Floodplain Velocity (ft/s)
1.17	3.77	4.99	= τ_{ch} = Channel Shear Stress (lbs/ft^2)
NA	NA	1.61	= τ_{fp} = Floodplain Shear Stress (lbs/ft^2)
7.4	227	657	= Q = Resulting Discharge (cfs)
0.15	0.67	0.70	= Froude Number
0.5	1.7	0.7	= D_{ave} = Average Depth (ft)
NA	16.7	NA	= W/D = Width to Depth Ratio (ft/ft)
69	223	295	= D_{50} = Uniform Mobile Sediment (mm)
92	311	416	= D_{84} = D_{84} Mobile Sediment (mm)



Stream Design Workbook

Stibnite Gold Project
East Fork South Fork Salmon River (EFSFSR)
EFSFSR Reach 3C (EF3C)
Reach Type: Step Pool

Description

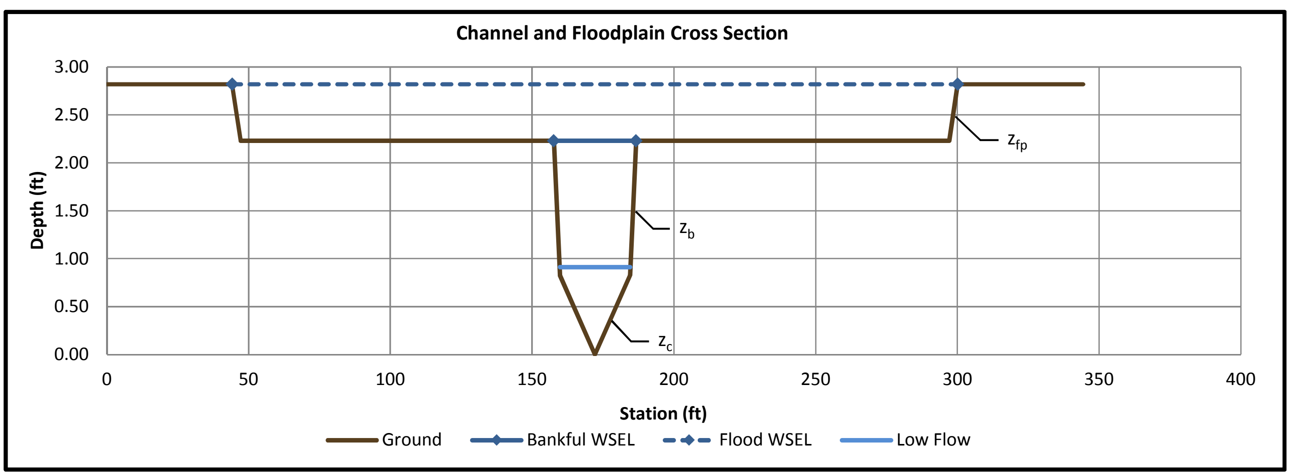
EF3C is located on the proposed backfilled Yellow Pine pit downstream of Hennessy Creek. Goals for channel design includes restoring fish passage and improving spawining and rearing habitat, and improved wetland function. Reference Sites 1, 5, 9 and 15 were used to inform channel and floodplain parameters. Habitat objectives would be primarily for anadromous fish.

Representative Reference Site Photo

Photo of Reference Site 9 - Tamarack Creek

	Design Guidelines / Input	
	Input	Explanation
Reach Characteristics	23.72	= DA = Drainage Area (mi^2)
Reach Characteristics	1560	= L_v = Valley Length (ft)
Reach Characteristics	1899	= L_c = Channel Length (ft)
Reach Characteristics	6081	= $ELEV_{US}$ = Upstream Elevation (ft)
Reach Characteristics	6009.6	= $ELEV_{DS}$ = Downstream Elevation (ft)
Reach Characteristics	1.22	= K = Sinuousity (ft/ft)
Reach Characteristics	0.0458	= S_v = Valley Slope (ft/ft)
Reach Characteristics	0.0376	= S_c = Channel Slope (ft/ft)
Reach Characteristics	250	= W_{FP} = Average Floodplain Width (ft)
Hydrology	7.6	= Q_{95} = 95% Annual Exceedance Flow (cfs)
Hydrology	234	= Q_{BF} = Bankfull Discharge (cfs)
Hydrology	682	= Q_{100-YR} = 100-Year Discharge (cfs)
Channel Characteristics	25	= W_{BF} = Estimated Bankfull Width (ft)
Channel Characteristics	13	= W/D_{max} = Width/Max Depth Ratio (ft/ft)
Channel Characteristics	15	= z_c = Channel Bottom Side-Slopes (_H:1V)
Channel Characteristics	1.5	= z_b = Bank Side-Slopes (_H:1V)
Channel Characteristics	5	= z_{fp} = Floodplain Side-Slopes (_H:1V)
Channel Characteristics	0.294	= n_{low} = Manning's n Value (Baseflow)
Channel Characteristics	0.081	= n_b = Manning's n Value (Bankfull)
Channel Characteristics	0.1	= n_{fp} = Manning's n Value (Floodplain)

Calculated Design Estimates			
Low_{normal}	$Bankfull_{normal}$	Floodplain	Explanation
0.0376	0.0376	0.0458	= S = Slope (ft/ft)
7.6	234	682	= Required Discharge (cfs)
0.9	2.2	0.6	= D_{max} = Max Water Depth (ft)
25.0	29.0	255.9	= W_t = Top Width (ft)
24.78	24.78	250.00	= W_b = Bottom Width (ft)
12.40	48.00	197.12	= A = Cross-Sectional Area (ft)
25.15	29.90	256.92	= P = Wetted Perimeter (ft)
0.49	1.61	0.77	= R = Hydraulic Radius (ft)
0.61	4.88	5.97	= V_{ch} = Channel Velocity (ft/s)
NA	NA	2.22	= V_{FP} = Floodplain Velocity (ft/s)
1.16	3.77	5.11	= τ_{ch} = Channel Shear Stress (lbs/ft^2)
NA	NA	1.66	= τ_{fp} = Floodplain Shear Stress (lbs/ft^2)
7.6	234	682	= Q = Resulting Discharge (cfs)
0.15	0.67	0.69	= Froude Number
0.5	1.7	0.8	= D_{ave} = Average Depth (ft)
NA	17.5	NA	= W/D = Width to Depth Ratio (ft/ft)
68	223	302	= D_{50} = Uniform Mobile Sediment (mm)
91	310	426	= D_{84} = D_{84} Mobile Sediment (mm)



Stream Design Workbook

Stibnite Gold Project
East Fork South Fork Salmon River (EFSFSR)
EFSFSR Reach 4 (EF4)
Reach Type: Enhancement

Description

EF4 is located downstream of the Yellow Pine pit. Proposed work would consist of habitat enhancement by means of strategic placements of large woody material, regrading of the channel (limited to the addition of constructed riffles, alcoves, side channels, and deep pool fish habitat for improved rearing and refuge during summer and winter extremes), and floodplain regrading. Reference Sites 1, 5, 9 and 15 were used to inform channel and floodplain parameters. Habitat objectives would be primarily for anadromous fish.

Representative Reference Site Photo

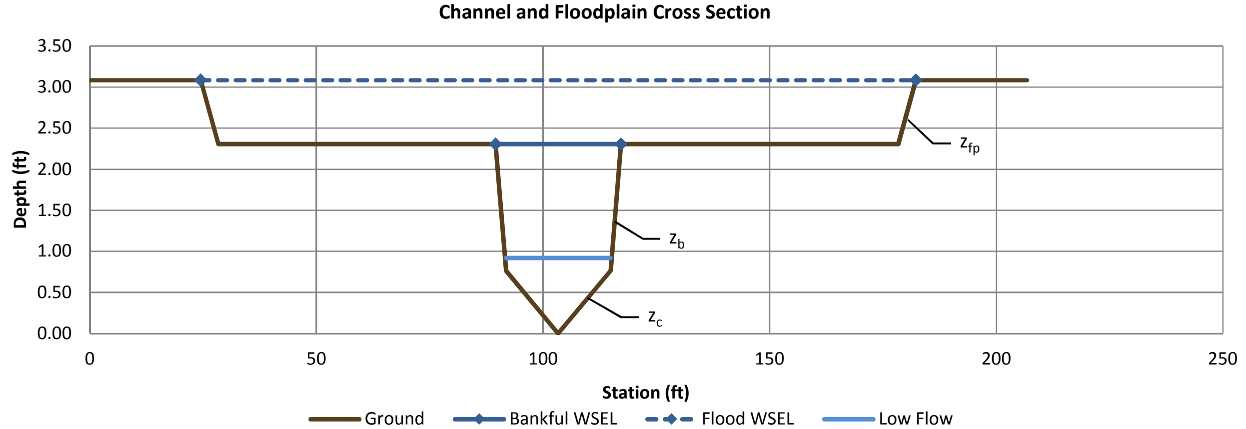
Photo of actual reach (2010)

	Design Guidelines / Input	
	Input	Explanation
Reach Characteristics	24.45	= DA = Drainage Area (mi^2)
	2030	= L_v = Valley Length (ft)
	2143	= L_c = Channel Length (ft)
	6010	= $ELEV_{US}$ = Upstream Elevation (ft)
	5923	= $ELEV_{DS}$ = Downstream Elevation (ft)
	1.06	= K = Sinuousity (ft/ft)
	0.0429	= S_v = Valley Slope (ft/ft)
	0.0406	= S_c = Channel Slope (ft/ft)
	150	= W_{FP} = Average Floodplain Width (ft)
Hydrology	7.7	= Q_{95} = 95% Annual Exceedance Flow (cfs)
	236	= Q_{BF} = Bankfull Discharge (cfs)
	690	= $Q_{100\text{-}YR}$ = 100-Year Discharge (cfs)
Channel Characteristics	27	= W_{BF} = Estimated Bankfull Width (ft)
	12	= W/D_{max} = Width/Max Depth Ratio (ft/ft)
	15	= z_c = Channel Bottom Side-Slopes (_H:1V)
	1.5	= z_b = Bank Side-Slopes (_H:1V)
	5	= z_{fp} = Floodplain Side-Slopes (_H:1V)
	0.313	= n_{low} = Manning's n Value (Baseflow)
	0.086	= n_b = Manning's n Value (Bankfull)
	0.1	= n_{fp} = Manning's n Value (Floodplain)

Calculated Design Estimates			
Low_{normal}	$Bankfull_{normal}$	Floodplain	Explanation
0.0406	0.0406	0.0429	= S = Existing Slope (ft/ft)
7.7	236	690	= Required Discharge (cfs)
0.9	2.3	0.8	= D_{max} = Max Water Depth (ft)
23.5	27.7	157.8	= W_t = Top Width (ft)
23.05	23.05	150.00	= W_b = Bottom Width (ft)
12.38	47.83	167.69	= A = Cross-Sectional Area (ft)
23.65	28.65	158.92	= P = Wetted Perimeter (ft)
0.52	1.67	1.06	= R = Hydraulic Radius (ft)
0.62	4.93	6.32	= V_{ch} = Channel Velocity (ft/s)
NA	NA	2.56	= V_{FP} = Floodplain Velocity (ft/s)
1.33	4.23	6.14	= τ_{ch} = Channel Shear Stress (lbs/ft^2)
NA	NA	2.02	= τ_{fp} = Floodplain Shear Stress (lbs/ft^2)
7.7	236	690	= Q = Resulting Discharge (cfs)
0.15	0.66	0.70	= Froude Number
0.5	1.7	1.1	= D_{ave} = Average Depth (ft)
NA	16.0	NA	= W/D = Width to Depth Ratio (ft/ft)
78	250	363	= D_{50} = Uniform Mobile Sediment (mm)
105	350	516	= D_{84} = D_{84} Mobile Sediment (mm)

Note: Design estimates are targets for only certain enhancement elements - some design estimates may not be appropriate depending on the type of enhancement work.

Channel and Floodplain Cross Section



HENNESSY CREEK

Biological Objectives

The lower portions of Hennessy Creek have been significantly impacted by legacy mine-related activities including stream diversion, road construction that buried the stream channel, and mining infrastructure (Midas Gold 2016). A portion of Hennessy Creek flows underground through development rock dumps and along road ditches, degrading water quality (MWH 2017). During construction and operation, the stream would be routed into the diversion tunnel carrying the EFSFSR. At closure, the impacted portion of Hennessy Creek would be restored and connected to the EFSFSR within the Yellow Pine pit DRSF (Midas Gold 2016).

Reaches HC1 and HC2

Hennessy Creek is a very small stream and its character varies considerably in the proposed project reaches, with HC1 cascading down a very steep slope into an energy dissipation basin where it would flow into off-channel habitat along the EFSFSR floodplain margin. There is no current fish use noted for Hennessy Creek in these reaches (MWH 2017). However, with stream restoration, lower Hennessy Creek (HC2) may provide limited rearing habitat for juvenile salmonids. The primary biological objective for Hennessy Creek therefore is to provide limited juvenile rearing habitat near the confluence of EFSFSR.

Physical Objectives

Proposed upper Hennessy Creek (HC1) physical objectives include conveying flows down the steep face of the Yellow Pine pit to the lower reach where habitat potential is much greater. The channel would flow over primarily bedrock with a steep slope in order to maximize the length of channel available for improved habitat potential within the lower reach. The lower reach (HC2) would flow over the relatively low-gradient EFSFSR floodplain and is designed to maximize hydraulic and geomorphic complexity. Sinuosity is maximized to the extent geomorphically appropriate in order to reduce gradient providing more opportunity for anadromous fish habitat. The channel over the EFSFSR floodplain is placed along the valley margin with tributary high-flow channels from the EFSFSR converging to concentrate flow during floods sufficiently to scour, maintain, and dynamically modify the off-channel features over time.

Reach-specific design criteria are summarized below:

Stream Design Workbook

Stibnite Gold Project
Hennessy Creek
Hennessy Creek -1 (HC1)
Reach Type: Chute

Description

HC1 is the upper of two reaches on Hennessy Creek located at the proposed Yellow Pine pit. The channel would be a straight, high-gradient, chute notched in the highwall of the Yellow Pine pit. The downstream extent of the channel ends at the EFSFSR floodplain. The channel would not provide any fish habitiat due to the high channel gradient.

Representative Reference Site Photo

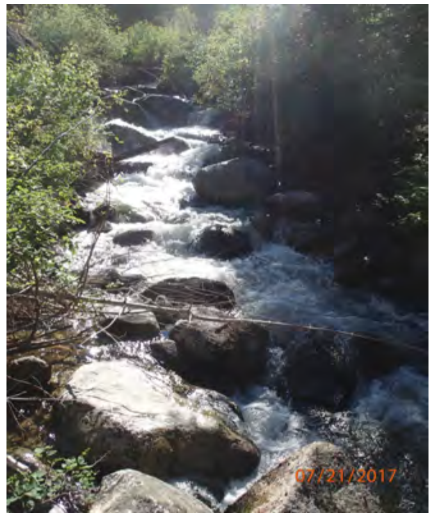
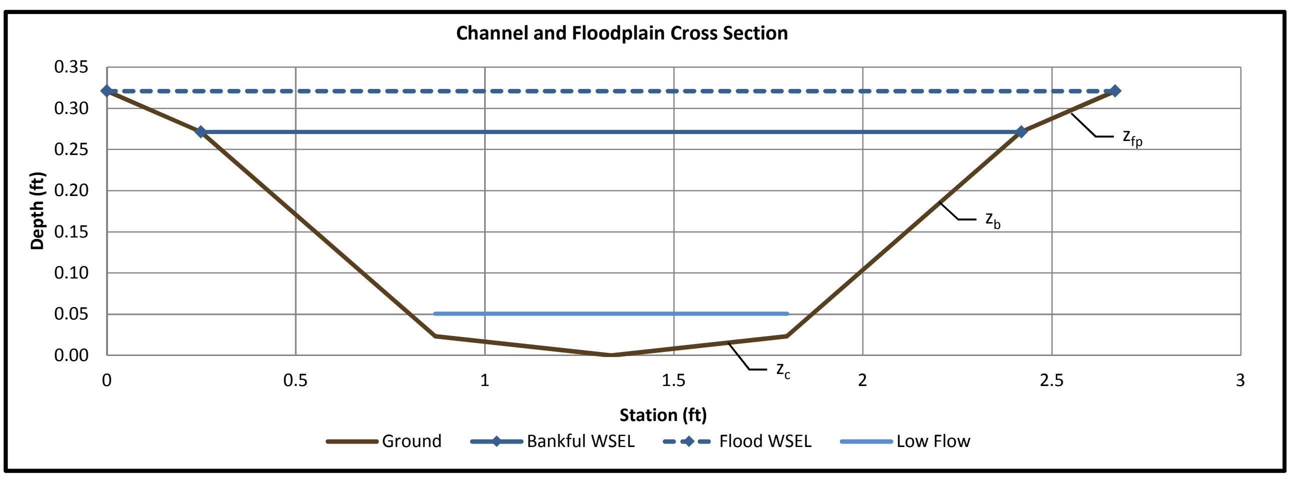


Photo of Reference Site 4 - Fourmile Creek

	Design Guidelines / Input	
	Input	Explanation
Reach Characteristics	0.71	= DA = Drainage Area (mi^2)
Reach Characteristics	287	= L_v = Valley Length (ft)
Reach Characteristics	287	= L_c = Channel Length (ft)
Reach Characteristics	6375	= $ELEV_{US}$ = Upstream Elevation (ft)
Reach Characteristics	6100	= $ELEV_{DS}$ = Downstream Elevation (ft)
Reach Characteristics	1.00	= K = Sinuousity (ft/ft)
Reach Characteristics	0.9582	= S_v = Valley Slope (ft/ft)
Reach Characteristics	0.9582	= S_c = Channel Slope (ft/ft)
Reach Characteristics	2.2	= W_{FP} = Average Floodplain Width (ft)
Hydrology	0.2	= Q_{95} = 95% Annual Exceedance Flow (cfs)
Hydrology	6	= Q_{BF} = Bankfull Discharge (cfs)
Hydrology	9	= $Q_{100\text{-}YR}$ = 100-Year Discharge (cfs)
Channel Characteristics	3.8	= W_{BF} = Estimated Bankfull Width (ft)
Channel Characteristics	8	= W/D_{max} = Width/Max Depth Ratio (ft/ft)
Channel Characteristics	20	= z_c = Channel Bottom Side-Slopes (_H:1V)
Channel Characteristics	2.5	= z_b = Bank Side-Slopes (_H:1V)
Channel Characteristics	5	= z_{fp} = Floodplain Side-Slopes (_H:1V)
Channel Characteristics	0.030	= n_{low} = Manning's n Value (Baseflow)
Channel Characteristics	0.030	= n_b = Manning's n Value (Bankfull)
Channel Characteristics	0.05	= n_{fp} = Manning's n Value (Floodplain)

Calculated Design Estimates			
Low_{normal}	$Bankfull_{normal}$	Floodplain	Explanation
0.9582	0.9582	0.9582	= S = Slope (ft/ft)
0.2	6	9	= Required Discharge (cfs)
0.1	0.3	0.0	= D_{max} = Max Water Depth (ft)
1.1	2.2	2.7	= W_t = Top Width (ft)
0.93	0.93	2.17	= W_b = Bottom Width (ft)
0.04	0.40	0.52	= A = Cross-Sectional Area (ft)
1.08	2.27	2.77	= P = Wetted Perimeter (ft)
0.04	0.17	0.19	= R = Hydraulic Radius (ft)
5.24	15.17	17.82	= V_{ch} = Channel Velocity (ft/s)
NA	NA	2.45	= V_{FP} = Floodplain Velocity (ft/s)
2.12	10.43	13.27	= τ_{ch} = Channel Shear Stress (lbs/ft^2)
NA	NA	1.46	= τ_{fp} = Floodplain Shear Stress (lbs/ft^2)
0.2	6	9	= Q = Resulting Discharge (cfs)
4.88	6.26	6.99	= Froude Number
0.0	0.2	0.2	= D_{ave} = Average Depth (ft)
NA	11.9	NA	= W/D = Width to Depth Ratio (ft/ft)
125	617	786	= D_{50} = Uniform Mobile Sediment (mm)
170	897	1154	= D_{84} = D_{84} Mobile Sediment (mm)



Stream Design Workbook

Stibnite Gold Project
Hennessy Creek
Hennessy Creek -2 (HC2)
Reach Type: Step Pool

Description

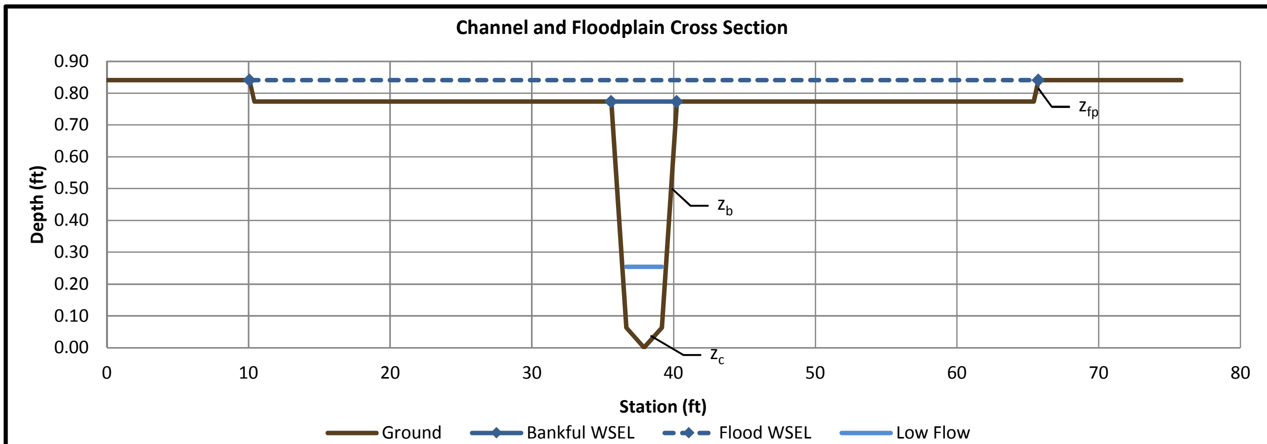
HC2 is the lower of two reaches on Hennessy Creek located at the proposed backfilled Yellow Pine pit. The channel and floodplain would be characterized as a moderate-gradient, step pool reach. During high flow events, flushing flows originating from the EFSFSR would be introducted to Hennessy Creek thereby providing improved rearing habitat. The channel and floodplain would be lined. The downstream extent of the channel ends at the EFSFSR confluence. Reference Sites 13 and 19 were used to inform channel and floodplain parameters. Habitat objectives would be primarily for anadromous fish.

Representative Reference Site Photo

Photo of Reference Site 13 - EFSFSR

	Design Guidelines / Input	
	Input	Explanation
Reach Characteristics	0.71	= DA = Drainage Area (mi^2)
	1000	= L_v = Valley Length (ft)
	1193	= L_c = Channel Length (ft)
	6100	= $ELEV_{US}$ = Upstream Elevation (ft)
	6055.5	= $ELEV_{DS}$ = Downstream Elevation (ft)
	1.19	= K = Sinuousity (ft/ft)
	0.0445	= S_v = Valley Slope (ft/ft)
	0.0373	= S_c = Channel Slope (ft/ft)
	55	= W_{FP} = Average Floodplain Width (ft)
Hydrology	0.2	= Q_{95} = 95% Annual Exceedance Flow (cfs)
	6	= Q_{BF} = Bankfull Discharge (cfs)
	9	= $Q_{100\text{-}YR}$ = 100-Year Discharge (cfs)
Channel Characteristics	3.8	= W_{BF} = Estimated Bankfull Width (ft)
	6	= W/D_{max} = Width/Max Depth Ratio (ft/ft)
	20	= z_c = Channel Bottom Side-Slopes (_H:1V)
	1.5	= z_b = Bank Side-Slopes (_H:1V)
	5	= z_{fp} = Floodplain Side-Slopes (_H:1V)
	0.292	= n_{low} = Manning's n Value (Baseflow)
	0.081	= n_b = Manning's n Value (Bankfull)
	0.1	= n_{fp} = Manning's n Value (Floodplain)

Calculated Design Estimates			
Low_{normal}	$Bankfull_{normal}$	Floodplain	Explanation
0.0373	0.0373	0.0445	= S = Slope (ft/ft)
0.2	6	9	= Required Discharge (cfs)
0.3	0.8	0.1	= D_{max} = Max Water Depth (ft)
3.1	4.6	55.7	= W_t = Top Width (ft)
2.51	2.51	55.00	= W_b = Bottom Width (ft)
0.61	2.62	6.34	= A = Cross-Sectional Area (ft)
3.20	5.07	56.12	= P = Wetted Perimeter (ft)
0.19	0.52	0.11	= R = Hydraulic Radius (ft)
0.33	2.29	2.47	= V_{ch} = Channel Velocity (ft/s)
NA	NA	0.52	= V_{FP} = Floodplain Velocity (ft/s)
0.45	1.20	1.34	= τ_{ch} = Channel Shear Stress (lbs/ft^2)
NA	NA	0.19	= τ_{fp} = Floodplain Shear Stress (lbs/ft^2)
0.2	6	9	= Q = Resulting Discharge (cfs)
0.13	0.54	0.74	= Froude Number
0.2	0.6	0.1	= D_{ave} = Average Depth (ft)
NA	8.2	NA	= W/D = Width to Depth Ratio (ft/ft)
26	71	80	= D_{50} = Uniform Mobile Sediment (mm)
34	94	106	= D_{84} = D_{84} Mobile Sediment (mm)



MIDNIGHT CREEK

Biological Objectives

Portions of Midnight Creek have been impacted by legacy mining activities, including open pit mining, development rock dumps, and road construction (Midas Gold 2016). During construction and operation, the stream would be diverted into the EFSFSR and the diversion tunnel carrying the EFSFSR around the Yellow Pine Pit. At closure, the impacted portion of Midnight Creek would be restored and reconnected to the EFSFSR (Midas Gold 2016) atop the newly constructed EFSFSR floodplain.

Reaches MNC1 and MNC2

Midnight Creek is a very small stream and only a short segment would need to be restored. There is no current fish use noted for Midnight Creek in these reaches (MWH 2017). However, with stream restoration, lower Midnight Creek (MN2) would flow into off-channel habitat along the EFSFSR and may provide limited rearing habitat for juvenile salmonids. The primary biological objective for Midnight Creek is to provide limited juvenile rearing habitat near the confluence of EFSFSR.

Physical Objectives

Upper Midnight Creek (MNC1) physical objectives include conveying flows over a stable channel to the EFSFSR floodplain where the habitat potential is much greater. The lower reach (MNC2) would flow over the relatively low-gradient EFSFSR floodplain and is designed to maximize hydraulic and geomorphic complexity. Sinuosity is maximized to the extent geomorphically appropriate in order to reduce gradient providing more opportunity for anadromous fish habitat. The channel over the EFSFSR floodplain is placed along the valley margin with tributary high-flow channels from the EFSFSR converging to concentrate flow during floods sufficiently to scour, maintain, and dynamically modify the off-channel feature over time.

Reach-specific design criteria are summarized below:

Stream Design Workbook

Stibnite Gold Project
Midnight Creek
Midnight Creek -1 (MNC1)
Reach Type: Cascade

Description

MNC1 is the upper of two reaches on Midnight Creek located at the upstream end of the proposed backfilled Yellow Pine pit. The channel and floodplain is characterized as a straight, high-gradient, cascading reach with pocket pools that may be enhaced by engineered energy dissipation pools. The channel and floodplain would not be lined. The downstream extent of the channel ends at the EFSFSR floodplain. Reference Sites 2, 4 , 8, and 19 were used to inform channel and floodplain parameters. Habitat objectives would be primarily for resident fish.

Representative Reference Site Photo

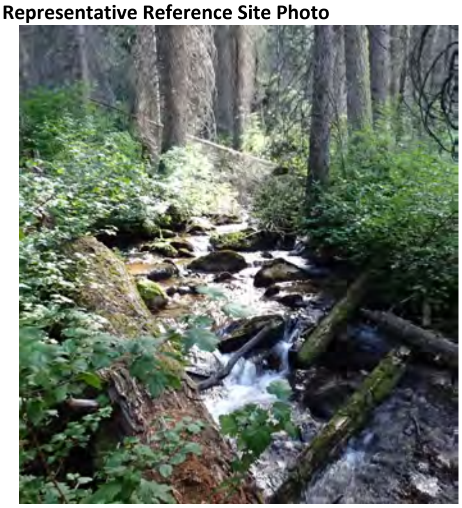
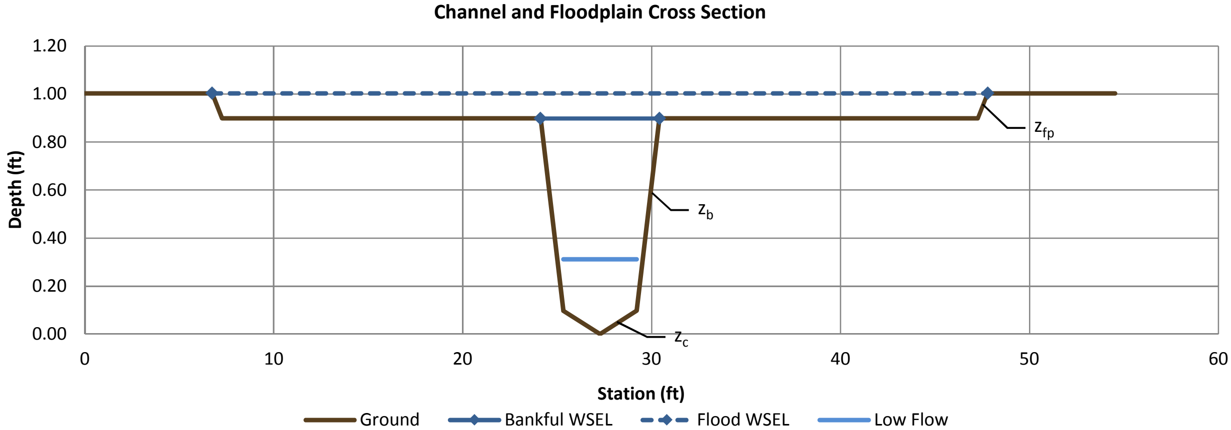


Photo of Reference Site 19 - Fiddle Creek

	Design Guidelines / Input	
	Input	Explanation
Reach Characteristics	0.83	= DA = Drainage Area (mi^2)
	440	= L_v = Valley Length (ft)
	468	= L_c = Channel Length (ft)
	6220	= $ELEV_{US}$ = Upstream Elevation (ft)
	6180	= $ELEV_{DS}$ = Downstream Elevation (ft)
	1.06	= K = Sinuousity (ft/ft)
	0.0909	= S_v = Valley Slope (ft/ft)
	0.0855	= S_c = Channel Slope (ft/ft)
	40	= W_{FP} = Average Floodplain Width (ft)
Hydrology	0.3	= Q_{95} = 95% Annual Exceedance Flow (cfs)
	9	= Q_{BF} = Bankfull Discharge (cfs)
	15	= $Q_{100\text{-}YR}$ = 100-Year Discharge (cfs)
Channel Characteristics	4.9	= W_{BF} = Estimated Bankfull Width (ft)
	7	= W/D_{max} = Width/Max Depth Ratio (ft/ft)
	20	= z_c = Channel Bottom Side-Slopes (_H:1V)
	1.5	= z_b = Bank Side-Slopes (_H:1V)
	5	= z_{fp} = Floodplain Side-Slopes (_H:1V)
	0.603	= n_{low} = Manning's n Value (Baseflow)
	0.151	= n_b = Manning's n Value (Bankfull)
	0.1	= n_{fp} = Manning's n Value (Floodplain)

Calculated Design Estimates			
Low_{normal}	$Bankfull_{normal}$	Floodplain	Explanation
0.0855	0.0855	0.0909	= S = Slope (ft/ft)
0.3	9	15	= Required Discharge (cfs)
0.3	0.9	0.1	= D_{max} = Max Water Depth (ft)
4.5	6.3	41.1	= W_t = Top Width (ft)
3.88	3.88	40.00	= W_b = Bottom Width (ft)
1.09	4.26	8.52	= A = Cross-Sectional Area (ft)
4.66	6.78	41.56	= P = Wetted Perimeter (ft)
0.23	0.63	0.21	= R = Hydraulic Radius (ft)
0.27	2.11	2.32	= V_{ch} = Channel Velocity (ft/s)
NA	NA	0.99	= V_{FP} = Floodplain Velocity (ft/s)
1.25	3.36	3.87	= τ_{ch} = Channel Shear Stress (lbs/ft^2)
NA	NA	0.59	= τ_{fp} = Floodplain Shear Stress (lbs/ft^2)
0.3	9	15	= Q = Resulting Discharge (cfs)
0.10	0.45	0.68	= Froude Number
0.2	0.7	0.2	= D_{ave} = Average Depth (ft)
NA	9.3	NA	= W/D = Width to Depth Ratio (ft/ft)
74	199	229	= D_{50} = Uniform Mobile Sediment (mm)
98	275	320	= D_{84} = D_{84} Mobile Sediment (mm)

Channel and Floodplain Cross Section



Stream Design Workbook

Stibnite Gold Project

Midnight Creek

Midnight Creek -2 (MNC2)

Reach Type: Step Pool

Description

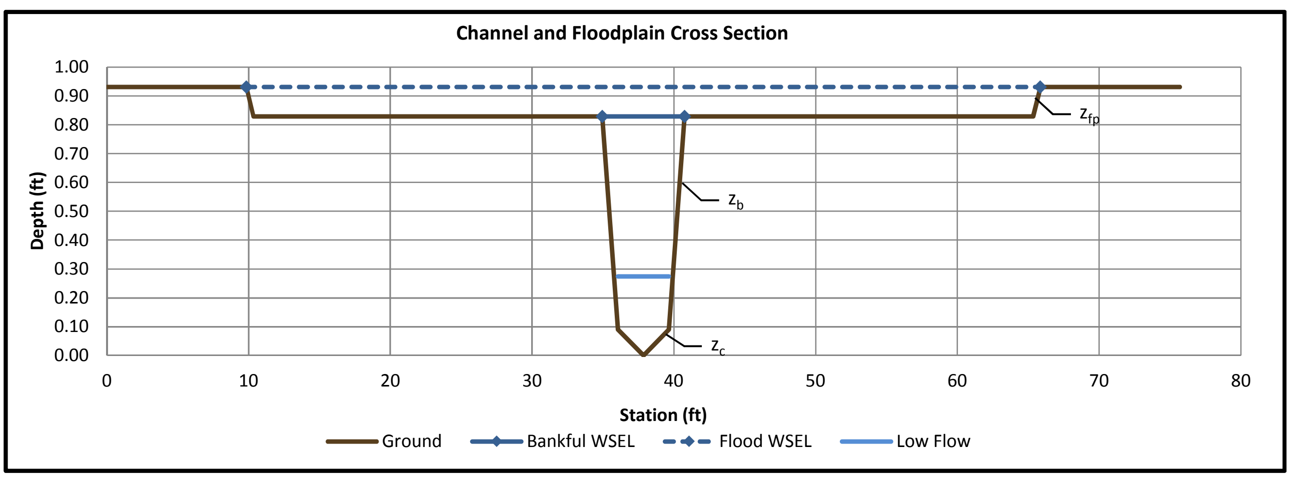
MNC2 is the lower of two reaches on Midnight Creek located at the upstream end of the proposed backfilled Yellow Pine pit. The channel and floodplain would be characterized as a moderate-gradient, step pool reach. During high flow events, flushing flows originating from the EFSFSR would be introducted to Midnight Creek thereby providing improved rearing habitat. The channel and and floodplain would be lined. The downstream extent of the channel ends at the EFSFSR confluence. Reference Sites 13 and 19 were used to inform channel and floodplain parameters. Habitat objectives would be primarily for anadromous fish.

Representative Reference Site Photo

Photo of Reference Site 13 - EFSFSR

	Design Guidelines / Input	
	Input	Explanation
Reach Characteristics	0.83	= DA = Drainage Area (mi^2)
	760	= L_v = Valley Length (ft)
	893	= L_c = Channel Length (ft)
	6169.2	= $ELEV_{US}$ = Upstream Elevation (ft)
	6135.9	= $ELEV_{DS}$ = Downstream Elevation (ft)
	1.18	= K = Sinuousity (ft/ft)
	0.0438	= S_v = Valley Slope (ft/ft)
	0.0373	= S_c = Channel Slope (ft/ft)
	55	= W_{FP} = Average Floodplain Width (ft)
Hydrology	0.3	= Q_{95} = 95% Annual Exceedance Flow (cfs)
	9	= Q_{BF} = Bankfull Discharge (cfs)
	15	= $Q_{100\text{-}YR}$ = 100-Year Discharge (cfs)
Channel Characteristics	4.9	= W_{BF} = Estimated Bankfull Width (ft)
	7	= W/D_{max} = Width/Max Depth Ratio (ft/ft)
	20	= z_c = Channel Bottom Side-Slopes (_H:1V)
	1.5	= z_b = Bank Side-Slopes (_H:1V)
	5	= z_{fp} = Floodplain Side-Slopes (_H:1V)
	0.292	= n_{low} = Manning's n Value (Baseflow)
	0.081	= n_b = Manning's n Value (Bankfull)
	0.1	= n_{fp} = Manning's n Value (Floodplain)

Calculated Design Estimates			
Low_{normal}	$Bankfull_{normal}$	Floodplain	Explanation
0.0373	0.0373	0.0438	= S = Slope (ft/ft)
0.3	9	15	= Required Discharge (cfs)
0.3	0.8	0.1	= D_{max} = Max Water Depth (ft)
4.1	5.8	56.0	= W_t = Top Width (ft)
3.59	3.59	55.00	= W_b = Bottom Width (ft)
0.87	3.63	9.29	= A = Cross-Sectional Area (ft)
4.26	6.26	56.49	= P = Wetted Perimeter (ft)
0.21	0.58	0.16	= R = Hydraulic Radius (ft)
0.34	2.48	2.74	= V_{ch} = Channel Velocity (ft/s)
NA	NA	0.68	= V_{FP} = Floodplain Velocity (ft/s)
0.48	1.35	1.57	= τ_{ch} = Channel Shear Stress (lbs/ft^2)
NA	NA	0.28	= τ_{fp} = Floodplain Shear Stress (lbs/ft^2)
0.3	9	15	= Q = Resulting Discharge (cfs)
0.13	0.55	0.70	= Froude Number
0.2	0.6	0.2	= D_{ave} = Average Depth (ft)
NA	9.3	NA	= W/D = Width to Depth Ratio (ft/ft)
28	80	93	= D_{50} = Uniform Mobile Sediment (mm)
36	107	125	= D_{84} = D_{84} Mobile Sediment (mm)



FIDDLE CREEK

Biological Objectives

Fiddle Creek fish passage is currently cut off from the EFSFSR as a result of legacy mining operations, road construction and culvert installation (Midas Gold 2016). Fiddle Creek was also the site of a former water storage reservoir that has left portions of the drainage in an unnatural condition. As part of mine construction, the plan is to divert Fiddle Creek around the perimeter of the Fiddle DRSF in a channel to protect water quality and prevent surface water from running onto the DRSF. After closure of the Fiddle DRSF, the plan is to restore the stream of stream atop the DRSF before it is routed down the face of the DRSF. From there, Fiddle Creek would reenter the existing channel.

Reaches FC1 and FC2

The restored stream channel (FC1) would flow upstream of a physical barrier (FC2) that would preclude fish passage. Westslope cutthroat trout were the only salmonids observed in Fiddle Creek (MWH 2017) or detected in eDNA surveys. The primary biological objective established for reach FC1 in Fiddle Creek is Westslope cutthroat trout spawning and rearing. The main purpose for FC2 would be for water conveyance.

Physical Objectives

Upper Fiddle Creek (FC1) would flow atop the Fiddle DRSF in a highly sinuous, low-gradient, single-thread channel. The channel and associated floodplain areas would be lined (see Footnote 1 above) to prevent seepage loss into the highly porous Fiddle DRSF. As described for the Hangar Flats DRSF (Reach MC2), the surface liner would be buried at sufficient depth within the DRSF to confine the Fiddle Creek channel and floodplain within armored terraces. As described for upper Meadow Creek (Reach MC1), the floodplain (and associated liner area) in the Upper FC1 is designed to accommodate anticipated alluvial fan development where the relatively steep and narrow valley transitions to a relatively flat and broad valley. The channel form has been developed to maximize length and generally mirror reference conditions from hanging valleys located farther upstream (Reference Site #20). In-stream woody debris and boulder features would be added strategically to increase localized hydraulic and geomorphic complexity.

As with other steep, low habitat value reaches, lower Fiddle Creek (FC2) is designed to minimize its length, therefore maximizing the length of higher habitat value reaches upstream (FC1). The channel and floodplain remain atop an impermeable liner with boulder armor and occasional energy dissipation pools in-place to increase friction and reduce in-stream energy while conveying flows to downstream reaches.

Reach-specific design criteria are summarized below:

Stream Design Workbook

Stibnite Gold Project
Fiddle Creek
Fiddle Creek -1 (FC1)
Reach Type: Meadow (Equiwidth Meandering)

Description

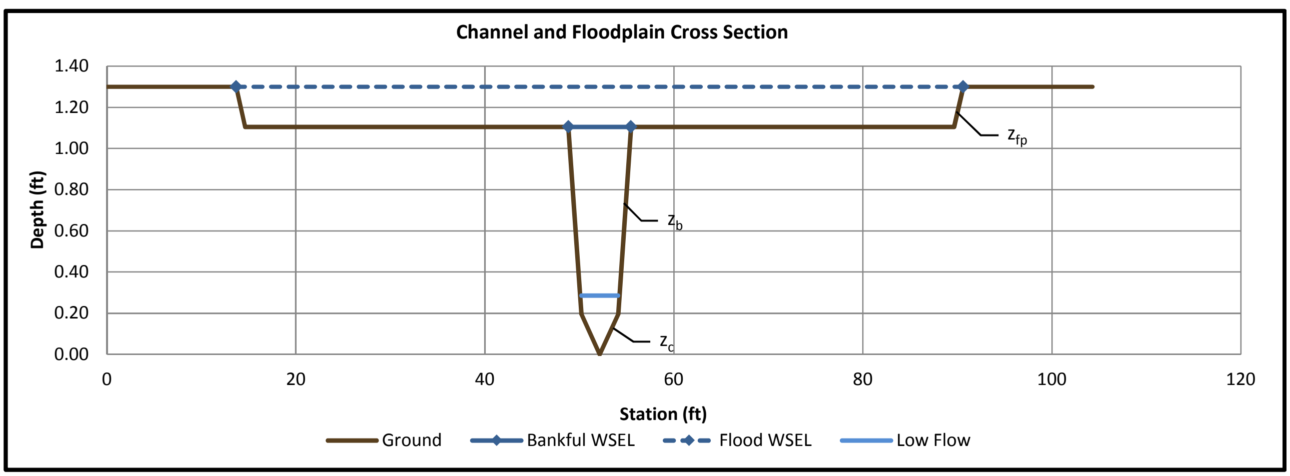
FC1 is the upstream most reach on Fiddle Creek located on top of the Fiddle Development Rock Storage Facility (DRSF). The channel beginning at the upstream most extents would be positioned in a depositional alluvial fan zone transitioning to a sinuous, low-gradient, meadow stream with forested wetland riparian. The channel and floodplain would be characterized as sinuous, low-gradient, with scrub/shrub and emergent marsh. The channel and floodplain would be lined. Reference Sites 13, 17 and 20 were used to inform channel and floodplain parameters. Habitat objectives would be primarily for resident fish.

Representative Reference Site Photo

Photo of Reference Site 13 - EFSFSR

	Design Guidelines / Input	
	Input	Explanation
Reach Characteristics	1.43	= DA = Drainage Area (mi^2)
Reach Characteristics	3822	= L_v = Valley Length (ft)
Reach Characteristics	5860	= L_c = Channel Length (ft)
Reach Characteristics	7078.22	= $ELEV_{US}$ = Upstream Elevation (ft)
Reach Characteristics	7040	= $ELEV_{DS}$ = Downstream Elevation (ft)
Reach Characteristics	1.53	= K = Sinuousity (ft/ft)
Reach Characteristics	0.0100	= S_v = Valley Slope (ft/ft)
Reach Characteristics	0.0065	= S_c = Channel Slope (ft/ft)
Reach Characteristics	75	= W_{FP} = Average Floodplain Width (ft)
Hydrology	0.3	= Q_{95} = 95% Annual Exceedance Flow (cfs)
Hydrology	14	= Q_{BF} = Bankfull Discharge (cfs)
Hydrology	27	= $Q_{100\text{-}YR}$ = 100-Year Discharge (cfs)
Channel Characteristics	6.3	= W_{BF} = Estimated Bankfull Width (ft)
Channel Characteristics	6	= W/D_{max} = Width/Max Depth Ratio (ft/ft)
Channel Characteristics	10	= z_c = Channel Bottom Side-Slopes (_H:1V)
Channel Characteristics	1.5	= z_b = Bank Side-Slopes (_H:1V)
Channel Characteristics	5	= z_{fp} = Floodplain Side-Slopes (_H:1V)
Channel Characteristics	0.094	= n_{low} = Manning's n Value (Baseflow)
Channel Characteristics	0.036	= n_b = Manning's n Value (Bankfull)
Channel Characteristics	0.1	= n_{fp} = Manning's n Value (Floodplain)

Calculated Design Estimates			
Low_{normal}	$Bankfull_{normal}$	Floodplain	Explanation
0.0065	0.0065	0.0100	= S = Slope (ft/ft)
0.3	14	27	= Required Discharge (cfs)
0.3	1.1	0.2	= D_{max} = Max Water Depth (ft)
4.2	6.6	76.9	= W_t = Top Width (ft)
3.90	3.90	75.00	= W_b = Bottom Width (ft)
0.75	5.17	19.98	= A = Cross-Sectional Area (ft)
4.25	7.20	77.56	= P = Wetted Perimeter (ft)
0.18	0.72	0.26	= R = Hydraulic Radius (ft)
0.40	2.71	3.14	= V_{ch} = Channel Velocity (ft/s)
NA	NA	0.50	= V_{FP} = Floodplain Velocity (ft/s)
0.07	0.29	0.37	= τ_{ch} = Channel Shear Stress (lbs/ft^2)
NA	NA	0.12	= τ_{fp} = Floodplain Shear Stress (lbs/ft^2)
0.3	14	27	= Q = Resulting Discharge (cfs)
0.17	0.54	0.47	= Froude Number
0.2	0.8	0.3	= D_{ave} = Average Depth (ft)
NA	8.5	NA	= W/D = Width to Depth Ratio (ft/ft)
4	17	22	= D_{50} = Uniform Mobile Sediment (mm)
5	22	27	= D_{84} = D_{84} Mobile Sediment (mm)



Stream Design Workbook

Stibnite Gold Project
Fiddle Creek
Fiddle Creek -2 (FC2)
Reach Type: Chute

Description

FC2 flows down the face of the proposed Fiddle Development Rock Storage Facilty (DRSF). The channel would have little to no floodplain and consist of a steep, straight, boulder chute with stragetically placed energy dissipation pools. The channel would be contained within a lined portion of the DRSF. Reference Sites 4, 6, and 19 were used to inform channel parameters. The reach is expected to have limited habitat value to resident fish and would not be designed to allow fish passage.

Representative Reference Site Photo

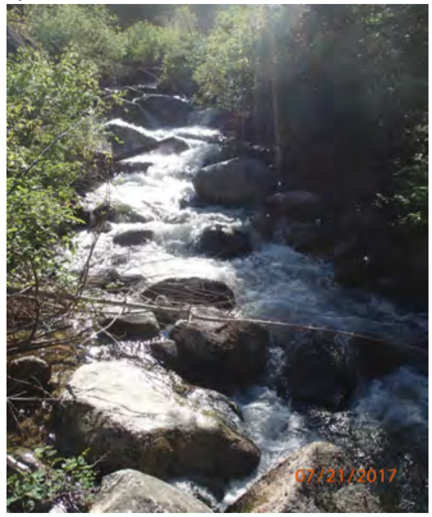
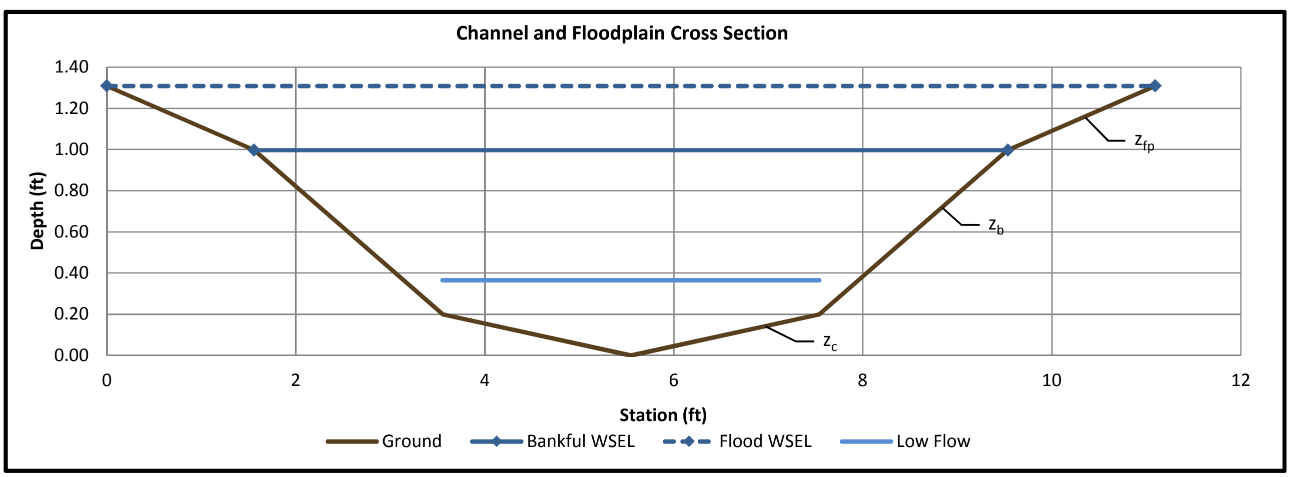


Photo of Reference Site 4 - Fourmile Creek

	Design Guidelines / Input	
	Input	Explanation
Reach Characteristics	1.81	= DA = Drainage Area (mi^2)
	2106	= L_v = Valley Length (ft)
	2216	= L_c = Channel Length (ft)
	7040	= $ELEV_{US}$ = Upstream Elevation (ft)
	6320	= $ELEV_{DS}$ = Downstream Elevation (ft)
	1.05	= K = Sinuousity (ft/ft)
	0.3419	= S_v = Valley Slope (ft/ft)
	0.3249	= S_c = Channel Slope (ft/ft)
	8.0	= W_{FP} = Average Floodplain Width (ft)
Hydrology	0.6	= Q_{95} = 95% Annual Exceedance Flow (cfs)
	16	= Q_{BF} = Bankfull Discharge (cfs)
	32	= $Q_{100\text{-}YR}$ = 100-Year Discharge (cfs)
Channel Characteristics	6.3	= W_{BF} = Estimated Bankfull Width (ft)
	8	= W/D_{max} = Width/Max Depth Ratio (ft/ft)
	10	= z_c = Channel Bottom Side-Slopes (_H:1V)
	2.5	= z_b = Bank Side-Slopes (_H:1V)
	5	= z_{fp} = Floodplain Side-Slopes (_H:1V)
	0.600	= n_{low} = Manning's n Value (Baseflow)
	0.200	= n_b = Manning's n Value (Bankfull)
	0.1	= n_{fp} = Manning's n Value (Floodplain)

Calculated Design Estimates			
Low_{normal}	$Bankfull_{normal}$	Floodplain	Explanation
0.3249	0.3249	0.3419	= S = Slope (ft/ft)
0.6	16	32	= Required Discharge (cfs)
0.4	1.0	0.3	= D_{max} = Max Water Depth (ft)
4.8	8.0	11.1	= W_t = Top Width (ft)
3.99	3.99	7.98	= W_b = Bottom Width (ft)
1.13	5.17	8.14	= A = Cross-Sectional Area (ft)
4.90	8.30	11.48	= P = Wetted Perimeter (ft)
0.23	0.62	0.71	= R = Hydraulic Radius (ft)
0.53	3.10	4.02	= V_{ch} = Channel Velocity (ft/s)
NA	NA	2.49	= V_{FP} = Floodplain Velocity (ft/s)
4.67	12.62	18.69	= τ_{ch} = Channel Shear Stress (lbs/ft^2)
NA	NA	3.26	= τ_{fp} = Floodplain Shear Stress (lbs/ft^2)
0.6	16	32	= Q = Resulting Discharge (cfs)
0.19	0.68	0.81	= Froude Number
0.2	0.6	0.7	= D_{ave} = Average Depth (ft)
NA	12.3	NA	= W/D = Width to Depth Ratio (ft/ft)
277	747	1107	= D_{50} = Uniform Mobile Sediment (mm)
389	1095	1648	= D_{84} = D_{84} Mobile Sediment (mm)



WEST END CREEK

Biological Objectives

West End Creek has been heavily impacted by legacy mining and mining-related activities, including development rock dumped over the stream channel, diversion of the stream into French drains and (now failed) culvert under the legacy rock dumps, and mining portions of the stream channel (Midas Gold 2016). Midas Gold proposes to temporarily redirect West End Creek around the West End pit, existing development rock dumps, and West End DRSF during operations and restore the stream atop the West End DRSF at closure.

Reaches WE1, WE2 & WE3

West End Creek is a small, primarily non-perennial tributary to Sugar Creek. Fish have been observed only in the lowermost, perennial segments of West End Creek, below the proposed mining impacts. No fish have been observed within the area of proposed mining impacts as a result of channel size, steep gradient, and intermittent flow; therefore, no proposed biological objectives for salmonids have been assigned to the proposed restoration reaches.

Physical Objectives

The portion of West End Creek within the project area is primarily an intermittent, non-fish bearing stream. The primary physical objectives therefore include supporting wetland development where appropriate and passing flow downstream in a stable and efficient manner while minimizing the potential for increasing fine sediment, temperature, or contaminant transport downstream.

The proposed upper West End Creek (WE1) would consist of a highly sinuous lined channel and floodplain atop the West End DRSF similar to the proposed Fiddle Creek channel atop the Fiddle DRSF (Reach FC1) and proposed Meadow Creek channel atop the Hangar Flats DRSF (Reach MC2). The liner (see Footnote 1 above) would be required to prevent excessive seepage loss through the highly permeable DRSF. The surface liner would be buried at sufficient depth within the DRSF to confine the West End Creek channel and floodplain within armored terraces. The channel is very small and primarily would function as a headwater meadow similar to those formed in glacial cirques. The upper extent of the proposed WE1 channel would lie very near the upper drainage divide, and likely would not develop a significant alluvial fan (or require associated accommodation space within the lined corridor) due to the lack of upstream basin area.

Where the proposed channel flows off the top and down the face of the DRSF (WE2), the physical design objective transitions to stability in order to prevent unnecessary erosion of the DRSF. The channel and narrow floodplain in this reach would be lined with coarse boulders to provide stability and energy dissipation. WE2 would spill into the lake that would ultimately develop in West End pit, thereby capturing any potential sediment generated from the upper reaches. The outflow of the pit lake would form the lower Reach (WE3). As with WE2, WE3 will be designed to transport flow from to the lower reaches of West End Creek. Channel stability is the primary physical objective that would be met with large boulder channel armor.

Reach-specific design criteria are summarized below:

Stream Design Workbook

Stibnite Gold Project
West End Creek
West End Creek Reach 1 (WE1)
Reach Type: Meadow (Equiwidth Meandering)

Description

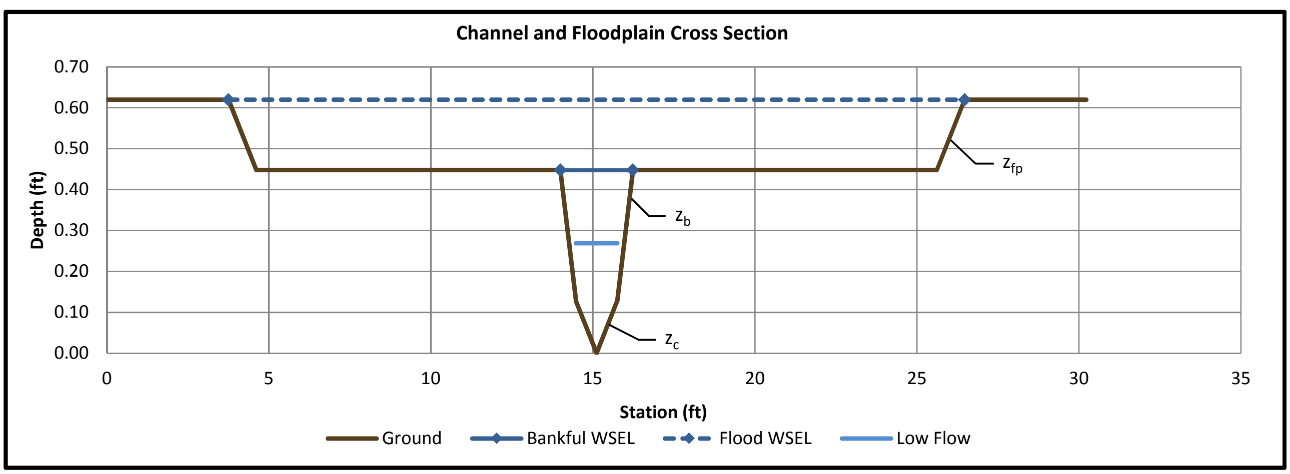
WE1 is the upstream most reach on West End Creek located on top of the West End Development Rock Storage Facility (DRSF). The channel would be a sinuous, low-gradient, meadow stream with wetland riparian. The channel and floodplain would be characterized as sinuos, low-gradient, with scrub/shrub and emergent marsh. The channel and floodplain would be lined. Reference Sites 13, 17 and 20 were used to inform channel and floodplain parameters. The channel is not expected to sustain a viable fish population.

Representative Reference Site Photo

Photo of Reference Site 20 - Fiddle Creek

	Design Guidelines / Input	
	Input	Explanation
Reach Characteristics	0.05	= DA = Drainage Area (mi^2)
	1307	= L_v = Valley Length (ft)
	1456	= L_c = Channel Length (ft)
	8080	= $ELEV_{US}$ = Upstream Elevation (ft)
	8075.7	= $ELEV_{DS}$ = Downstream Elevation (ft)
	1.11	= K = Sinuousity (ft/ft)
	0.0033	= S_v = Valley Slope (ft/ft)
	0.0030	= S_c = Channel Slope (ft/ft)
	21	= W_{FP} = Average Floodplain Width (ft)
Hydrology	0.1	= Q_{95} = 95% Annual Exceedance Flow (cfs)
	0.7	= Q_{BF} = Bankfull Discharge (cfs)
	2.4	= $Q_{100\text{-}YR}$ = 100-Year Discharge (cfs)
Channel Characteristics	1.8	= W_{BF} = Estimated Bankfull Width (ft)
	5	= W/D_{max} = Width/Max Depth Ratio (ft/ft)
	5	= z_c = Channel Bottom Side-Slopes (_H:1V)
	1.5	= z_b = Bank Side-Slopes (_H:1V)
	5	= z_{fp} = Floodplain Side-Slopes (_H:1V)
	0.071	= n_{low} = Manning's n Value (Baseflow)
	0.030	= n_b = Manning's n Value (Bankfull)
	0.1	= n_{fp} = Manning's n Value (Floodplain)

Calculated Design Estimates			
Low_{normal}	$Bankfull_{normal}$	Floodplain	Explanation
0.0030	0.0030	0.0033	= S = Slope (ft/ft)
0.1	0.7	2.4	= Required Discharge (cfs)
0.3	0.4	0.2	= D_{max} = Max Water Depth (ft)
1.7	2.2	22.7	= W_t = Top Width (ft)
1.28	1.28	21.00	= W_b = Bottom Width (ft)
0.29	0.64	4.41	= A = Cross-Sectional Area (ft)
1.81	2.46	22.98	= P = Wetted Perimeter (ft)
0.16	0.26	0.19	= R = Hydraulic Radius (ft)
0.34	1.09	1.49	= V_{ch} = Channel Velocity (ft/s)
NA	NA	0.26	= V_{FP} = Floodplain Velocity (ft/s)
0.03	0.05	0.08	= τ_{ch} = Channel Shear Stress (lbs/ft^2)
NA	NA	0.03	= τ_{fp} = Floodplain Shear Stress (lbs/ft^2)
0.1	1	2	= Q = Resulting Discharge (cfs)
0.14	0.36	0.22	= Froude Number
0.2	0.3	0.2	= D_{ave} = Average Depth (ft)
NA	7.8	NA	= W/D = Width to Depth Ratio (ft/ft)
2	3	5	= D_{50} = Uniform Mobile Sediment (mm)
2	3	5	= D_{84} = D_{84} Mobile Sediment (mm)



Stream Design Workbook

Stibnite Gold Project
West End Creek
West End Creek Reach 2 (WE2)
Reach Type: Chute

Description

WE2 flows down the face of the proposed West End Development Rock Storage Facilty (DRSF) and ends at the West End pit lake. The channel would have little to no floodplain and consist of a steep, straight, boulder chute with stragetically placed energy dissipation pools. The channel would be contained within a lined portion of the DRSF. Reference Sites 4, 6, and 19 were used to inform channel parameters. The reach would be expected to have limited habitat value to resident fish and would not be designed to allow fish passage.

Representative Reference Site Photo

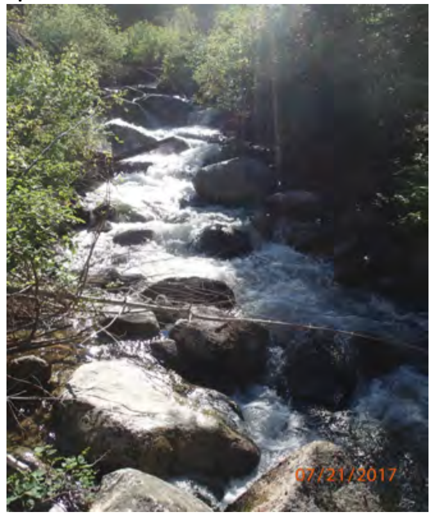
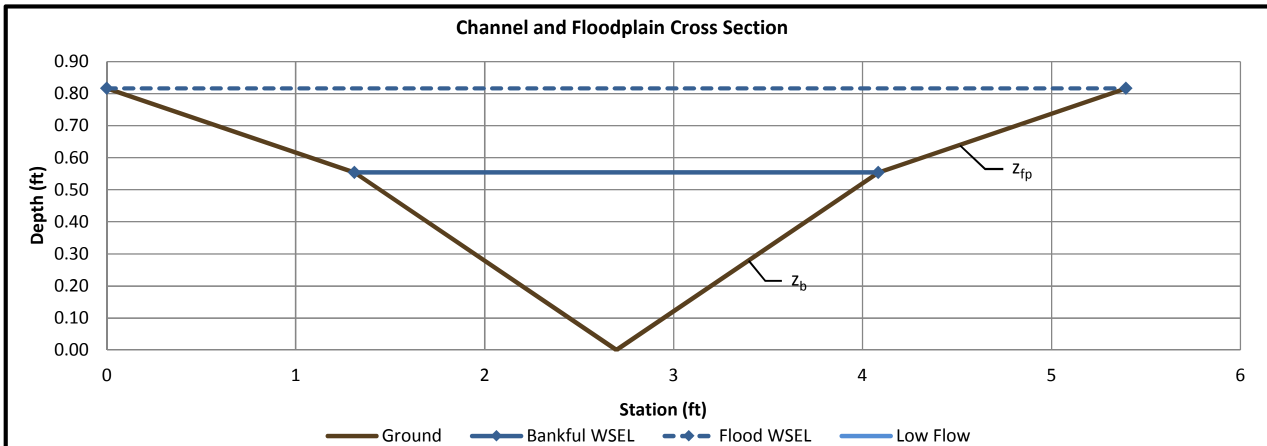


Photo of Reference Site 4 - Fourmile Creek

	Design Guidelines / Input	
	Input	Explanation
Reach Characteristics	0.14	= DA = Drainage Area (mi^2)
	3025	= L_v = Valley Length (ft)
	2923	= L_c = Channel Length (ft)
	8075.7	= $ELEV_{US}$ = Upstream Elevation (ft)
	6500	= $ELEV_{DS}$ = Downstream Elevation (ft)
	0.97	= K = Sinuousity (ft/ft)
	0.5209	= S_v = Valley Slope (ft/ft)
	0.5391	= S_c = Channel Slope (ft/ft)
	2.8	= W_{FP} = Average Floodplain Width (ft)
Hydrology	0.1	= Q_{95} = 95% Annual Exceedance Flow (cfs)
	1.7	= Q_{BF} = Bankfull Discharge (cfs)
	6.1	= $Q_{100\text{-}YR}$ = 100-Year Discharge (cfs)
Channel Characteristics	2.6	= W_{BF} = Estimated Bankfull Width (ft)
	5	= W/D_{max} = Width/Max Depth Ratio (ft/ft)
		= z_c = Channel Bottom Side-Slopes (_H:1V)
	2.5	= z_b = Bank Side-Slopes (_H:1V)
	5	= z_{fp} = Floodplain Side-Slopes (_H:1V)
	0.600	= n_{low} = Manning's n Value (Baseflow)
	0.200	= n_b = Manning's n Value (Bankfull)
	0.1	= n_{fp} = Manning's n Value (Floodplain)

Calculated Design Estimates			
Low_{normal}	$Bankfull_{normal}$	Floodplain	Explanation
0.5391	0.5391	0.5209	= S = Slope (ft/ft)
0.1	1.7	6.1	= Required Discharge (cfs)
0.3	0.6	0.3	= D_{max} = Max Water Depth (ft)
1.4	2.8	5.4	= W_t = Top Width (ft)
0.00	0.00	2.77	= W_b = Bottom Width (ft)
0.21	0.77	1.84	= A = Cross-Sectional Area (ft)
1.56	2.99	5.66	= P = Wetted Perimeter (ft)
0.13	0.26	0.32	= R = Hydraulic Radius (ft)
0.48	2.21	3.45	= V_{ch} = Channel Velocity (ft/s)
NA	NA	2.74	= V_{FP} = Floodplain Velocity (ft/s)
4.51	8.66	16.85	= τ_{ch} = Channel Shear Stress (lbs/ft^2)
NA	NA	4.18	= τ_{fp} = Floodplain Shear Stress (lbs/ft^2)
0.1	1.7	6	= Q = Resulting Discharge (cfs)
0.22	0.74	1.00	= Froude Number
0.1	0.3	0.3	= D_{ave} = Average Depth (ft)
NA	10.0	NA	= W/D = Width to Depth Ratio (ft/ft)
267	513	998	= D_{50} = Uniform Mobile Sediment (mm)
375	739	1479	= D_{84} = D_{84} Mobile Sediment (mm)



Stream Design Workbook

Stibnite Gold Project
West End Creek
West End Creek Reach 3 (WE3)
Reach Type: Chute

Description

WE3 flows out of the proposed West End pit lake. The channel would have little to no floodplain and consist of a steep, straight, boulder chute with stragetically placed energy dissipation pools. The channel would not be lined. Reference Sites 4, 6, and 19 were used to inform channel parameters. The reach would be expected to have limited habitat value to resident fish and would not be designed to allow fish passage.

Representative Reference Site Photo

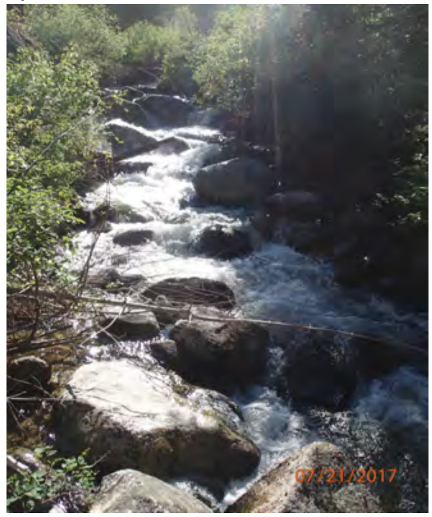
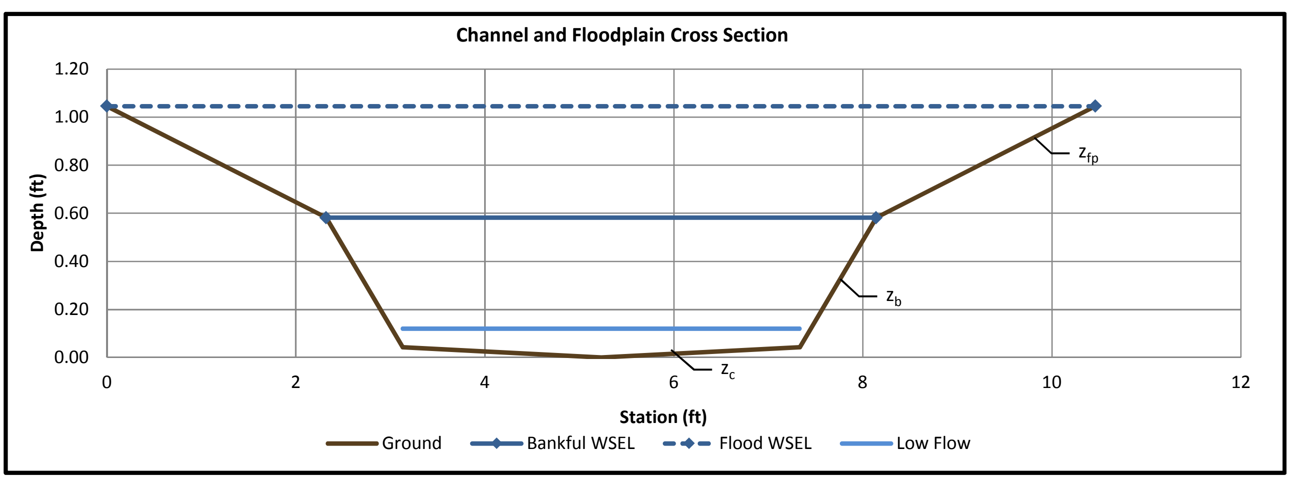


Photo of Reference Site 4 - Fourmile Creek

	Design Guidelines / Input	
	Input	Explanation
Reach Characteristics	0.52	= DA = Drainage Area (mi^2)
	678	= L_v = Valley Length (ft)
	678	= L_c = Channel Length (ft)
	6500	= $ELEV_{US}$ = Upstream Elevation (ft)
	6359.6	= $ELEV_{DS}$ = Downstream Elevation (ft)
	1.00	= K = Sinuousity (ft/ft)
	0.2071	= S_v = Valley Slope (ft/ft)
	0.2071	= S_c = Channel Slope (ft/ft)
	27	= W_{FP} = Average Floodplain Width (ft)
Hydrology	0.1	= Q_{95} = 95% Annual Exceedance Flow (cfs)
	5.6	= Q_{BF} = Bankfull Discharge (cfs)
	20	= $Q_{100\text{-}YR}$ = 100-Year Discharge (cfs)
Channel Characteristics	4.1	= W_{BF} = Estimated Bankfull Width (ft)
	10	= W/D_{max} = Width/Max Depth Ratio (ft/ft)
	50	= z_c = Channel Bottom Side-Slopes (_H:1V)
	1.5	= z_b = Bank Side-Slopes (_H:1V)
	5	= z_{fp} = Floodplain Side-Slopes (_H:1V)
	0.600	= n_{low} = Manning's n Value (Baseflow)
	0.200	= n_b = Manning's n Value (Bankfull)
	0.1	= n_{fp} = Manning's n Value (Floodplain)

Calculated Design Estimates			
Low_{normal}	$Bankfull_{normal}$	Floodplain	Explanation
0.2071	0.2071	0.2071	= S = Slope (ft/ft)
0.1	5.6	20	= Required Discharge (cfs)
0.1	0.6	0.5	= D_{max} = Max Water Depth (ft)
4.4	5.8	10.5	= W_t = Top Width (ft)
4.20	4.20	5.82	= W_b = Bottom Width (ft)
0.43	2.79	6.57	= A = Cross-Sectional Area (ft)
4.48	6.15	10.88	= P = Wetted Perimeter (ft)
0.09	0.45	0.60	= R = Hydraulic Radius (ft)
0.23	2.00	3.15	= V_{ch} = Channel Velocity (ft/s)
NA	NA	2.53	= V_{FP} = Floodplain Velocity (ft/s)
1.23	5.87	11.55	= τ_{ch} = Channel Shear Stress (lbs/ft^2)
NA	NA	2.94	= τ_{fp} = Floodplain Shear Stress (lbs/ft^2)
0.1	6	20	= Q = Resulting Discharge (cfs)
0.13	0.51	0.68	= Froude Number
0.1	0.5	0.6	= D_{ave} = Average Depth (ft)
NA	12.1	NA	= W/D = Width to Depth Ratio (ft/ft)
73	348	684	= D_{50} = Uniform Mobile Sediment (mm)
96	493	998	= D_{84} = D_{84} Mobile Sediment (mm)



GARNET CREEK

Biological Objectives

Garnet Creek has been impacted by mining infrastructure across and adjacent to the stream channel and is currently routed through several man-made ditches which are not ideal for aquatic species (Midas Gold 2016). Midas Gold proposes to route Garnet Creek around and through the processing facilities area during construction and operations to protect water quality and prevent clean runoff from entering the process area. At closure, the stream would be restored to its existing location with enhanced habitat in the lowest segment of the channel where fish access is most likely.

Reach GC1

Garnet Creek is a small tributary stream to the EFSFSR and has a bankfull discharge of about 4 cfs and a moderate gradient within Reach GC1. The relatively small size of the stream and gradient suggest limited rearing potential. There is no current fish use noted for Garnet Creek (MWH 2017). The primary biological objective for Garnet Creek is to provide limited juvenile rearing habitat near the confluence with the EFSFSR.

Physical Objectives

Garnet Creek is a very small, moderate-gradient stream that has been severely modified over the past 100 years to accommodate mining-related activities. Only the lower roughly 200 feet of Garnet Creek would be restored to include reestablishing a more appropriate channel form (sinuosity, wavelength, with-to-depth ratio, etc.) and the addition of in-stream structure to create isolated areas of hydraulic and geomorphic complexity. The floodplain would be revegetated and augmented with appropriate riparian species. The proposed road and culvert crossings would be removed and the channel recontoured to match existing conditions.

Reach-specific design criteria are summarized below:

Stream Design Workbook

Stibnite Gold Project
Garnet Creek
Garnet Creek Reach 1 (GC1)
Reach Type: Step Pool

Description

GC1 flows into the EFSFSR at the downstream end of Reach EF2A. The channel and floodplain will be designed as a meadow reach. The channel and and floodplain would not be lined. Reference Sites 13 and 20 were used to inform channel and floodplain parameters. Habitat objectives would be primarily for resident and anadromous fish.

Representative Reference Site Photo

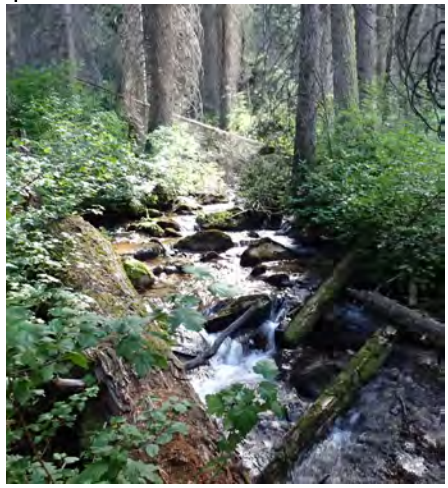
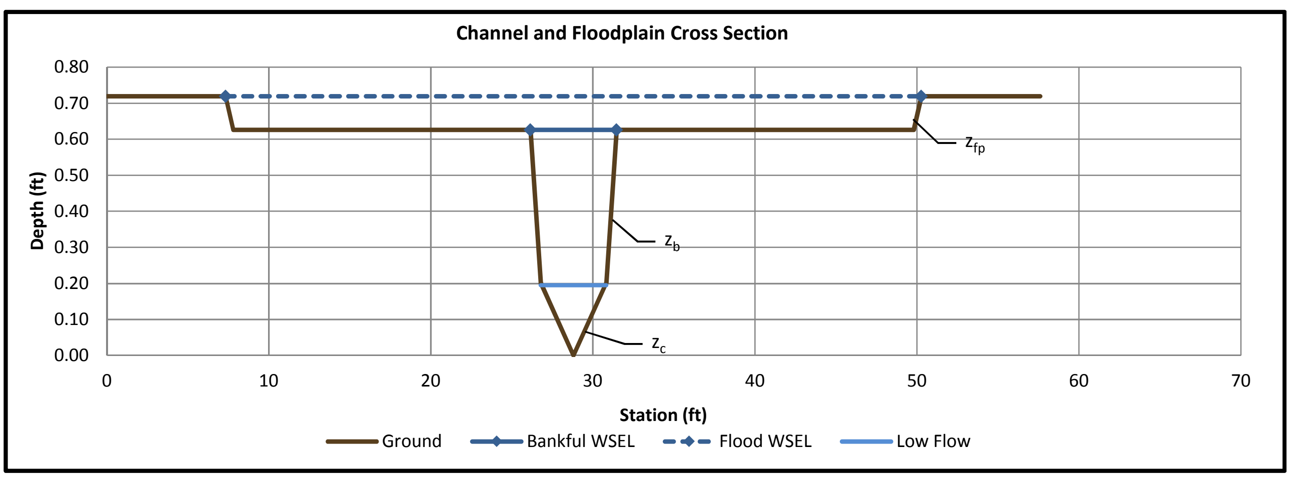


Photo of Reference Site 13 - EFSFSR

	Design Guidelines / Input	
	Input	Explanation
Reach Characteristics	0.44	= DA = Drainage Area (mi^2)
	249	= L_v = Valley Length (ft)
	285	= L_c = Channel Length (ft)
	6424	= $ELEV_{US}$ = Upstream Elevation (ft)
	6421	= $ELEV_{DS}$ = Downstream Elevation (ft)
	1.14	= K = Sinuousity (ft/ft)
	0.0120	= S_v = Valley Slope (ft/ft)
	0.0105	= S_c = Channel Slope (ft/ft)
	42	= W_{FP} = Average Floodplain Width (ft)
Hydrology	0.1	= Q_{95} = 95% Annual Exceedance Flow (cfs)
	5	= Q_{BF} = Bankfull Discharge (cfs)
	8	= $Q_{100\text{-}YR}$ = 100-Year Discharge (cfs)
Channel Characteristics	5.3	= W_{BF} = Estimated Bankfull Width (ft)
	8.5	= W/D_{max} = Width/Max Depth Ratio (ft/ft)
	10	= z_c = Channel Bottom Side-Slopes (_H:1V)
	1.5	= z_b = Bank Side-Slopes (_H:1V)
	5	= z_{fp} = Floodplain Side-Slopes (_H:1V)
	0.119	= n_{low} = Manning's n Value (Baseflow)
	0.042	= n_b = Manning's n Value (Bankfull)
	0.1	= n_{fp} = Manning's n Value (Floodplain)

Calculated Design Estimates			
Low_{normal}	$Bankfull_{normal}$	Floodplain	Explanation
0.0105	0.0105	0.0120	= S = Slope (ft/ft)
0.1	5	8	= Required Discharge (cfs)
0.2	0.6	0.1	= D_{max} = Max Water Depth (ft)
4.0	5.3	42.9	= W_t = Top Width (ft)
4.05	4.05	42.00	= W_b = Bottom Width (ft)
0.38	2.39	6.36	= A = Cross-Sectional Area (ft)
4.04	5.60	43.23	= P = Wetted Perimeter (ft)
0.09	0.43	0.15	= R = Hydraulic Radius (ft)
0.26	2.09	2.37	= V_{ch} = Channel Velocity (ft/s)
NA	NA	0.33	= V_{FP} = Floodplain Velocity (ft/s)
0.06	0.28	0.34	= τ_{ch} = Channel Shear Stress (lbs/ft^2)
NA	NA	0.07	= τ_{fp} = Floodplain Shear Stress (lbs/ft^2)
0.1	5	8	= Q = Resulting Discharge (cfs)
0.15	0.55	0.58	= Froude Number
0.1	0.4	0.1	= D_{ave} = Average Depth (ft)
NA	11.8	NA	= W/D = Width to Depth Ratio (ft/ft)
4	17	20	= D_{50} = Uniform Mobile Sediment (mm)
4	21	25	= D_{84} = D_{84} Mobile Sediment (mm)



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Appendix E
Design Sheets

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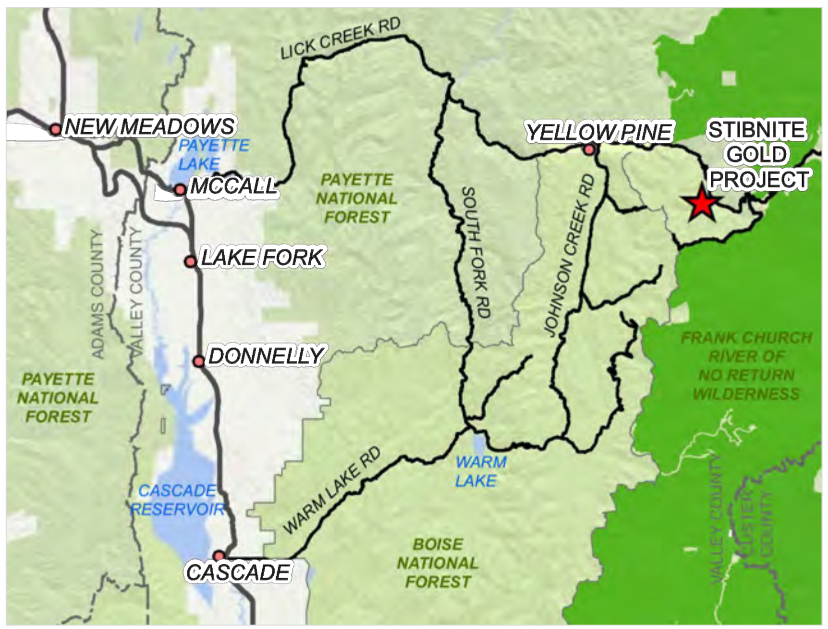
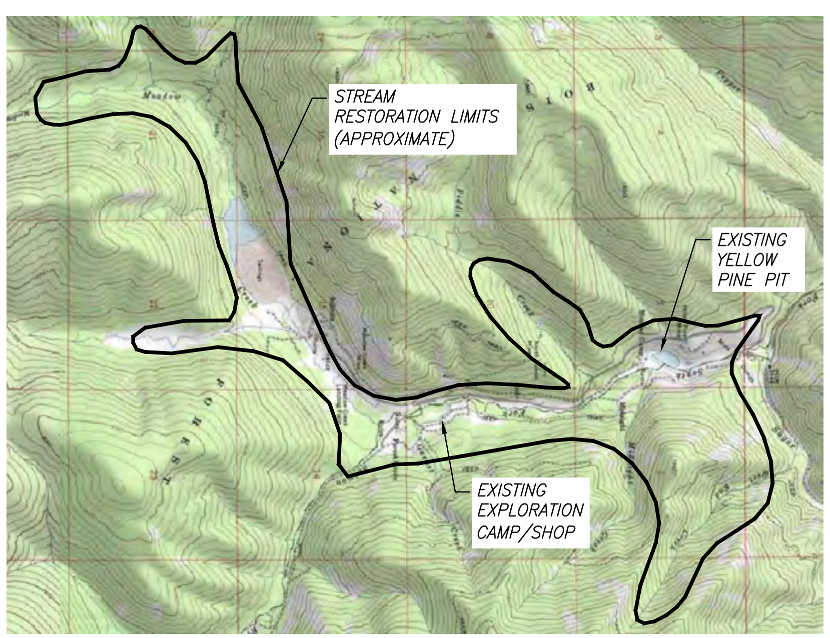
STIBNITE GOLD PROJECT
STREAM AND WETLAND RESTORATION CONCEPT DESIGN DRAWINGS
VALLEY COUNTY, IDAHO



VICINITY MAP
1" = 14 MILES

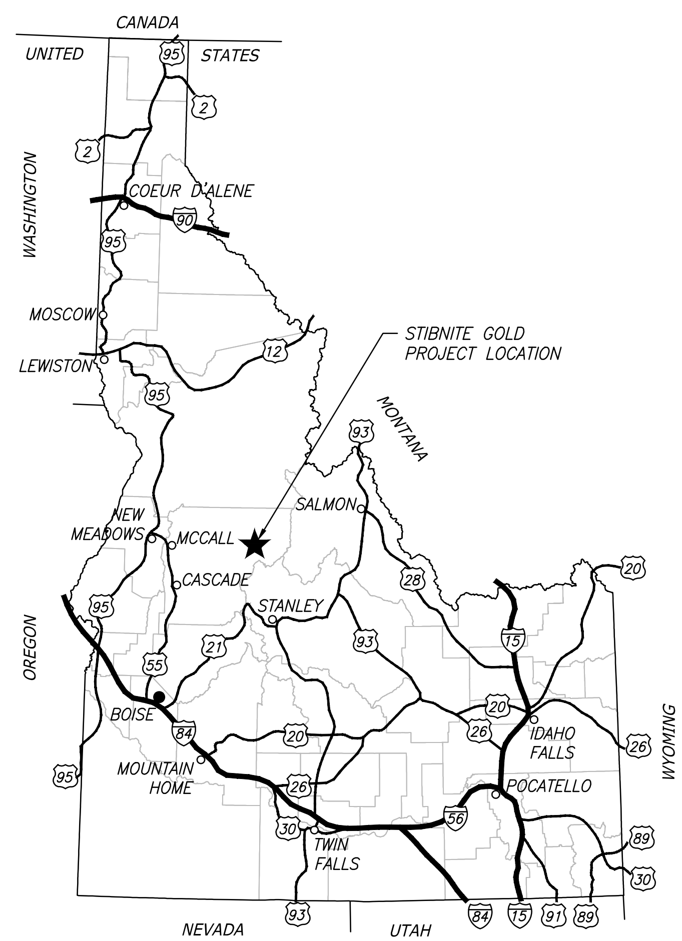


PROJECT MAP
1" = 3,000'

PREPARED FOR:
MIDAS GOLD IDAHO, INC.
405 S. 8TH ST.
SUITE 201
BOISE, ID 83702

PREPARED BY:
RIO APPLIED SCIENCE & ENGINEERING
2449 S. VISTA AVE.
SUITE B
BOISE, ID 83705

TETRA TECH
3380 AMERICANA TERRACE
SUITE 201
BOISE, ID 83706



LOCATION MAP

SHEET INDEX

SHEET COUNT	DRAWING NUMBER	SHEET TITLE
1	G-1	COVER SHEET
2	G-2	GENERAL NOTES
3	G-3	GENERAL WETLAND NOTES
4	G-4	PROPOSED STREAM REACHES
5	G-5	PROPOSED FLOODPLAIN WETLAND AREAS
6	G-6	GENERAL LEGEND AND ABBREVIATIONS
7	MC1A-1	MC1A OVERVIEW SHEET - 1
8	MC1A-2	MC1A OVERVIEW SHEET - 2
9	MC1A-3	MC1A TYPICAL PLAN AND PROFILE
10	MC1A-4	MC1A QUANTITIES
11	MC1A-5	MC1A WETLAND SHEET - 1
12	MC1A-6	MC1A WETLAND SHEET - 2
13	MC1A-7	MC1A WETLAND PLANTING SHEET - 1
14	MC1A-8	MC1A WETLAND PLANTING SHEET - 2
15	MC1B-1	MC1B OVERVIEW SHEET
16	MC1B-2	MC1B TYPICAL PLAN AND PROFILE
17	MC1B-3	MC1B QUANTITIES
18	MC1B-4	MC1B WETLAND SHEET
19	MC1B-5	MC1B WETLAND PLANTING SHEET
20	MC1C-1	MC1C OVERVIEW SHEET
21	MC1C-2	MC1C TYPICAL PLAN AND PROFILE
22	MC1C-3	MC1C QUANTITIES
23	MC1C-4	MC1C WETLAND SHEET
24	MC1C-5	MC1C WETLAND PLANTING SHEET
25	MC1D-1	MC1D OVERVIEW SHEET
26	MC1D-2	MC1D TYPICAL PLAN AND PROFILE
27	MC1D-3	MC1D QUANTITIES
28	MC1D-4	MC1D WETLAND SHEET
29	MC1D-5	MC1D WETLAND PLANTING SHEET
30	MC1E-1	MC1E OVERVIEW SHEET - 1
31	MC1E-2	MC1E OVERVIEW SHEET - 2
32	MC1E-3	MC1E TYPICAL PLAN AND PROFILE
33	MC1E-4	MC1E QUANTITIES
34	MC1E-5	MC1E WETLAND SHEET
35	MC1E-6	MC1E WETLAND PLANTING SHEET
36	MC2-1	MC2 OVERVIEW SHEET
37	MC2-2	MC2 TYPICAL PLAN AND PROFILE
38	MC2-3	MC2 QUANTITIES
39	MC2-4	MC2 WETLAND SHEET
40	MC2-5	MC2 WETLAND PLANTING SHEET
41	MC3-1	MC3 OVERVIEW SHEET
42	MC3-2	MC3 QUANTITIES
43	MC4-1	MC4 OVERVIEW SHEET
44	MC4-2	MC4 TYPICAL PLAN AND PROFILE
45	MC4-3	MC4 QUANTITIES
46	MC4-4	MC4 WETLAND PLANTING SHEET
47	MC4-5	MC4 WETLAND PLANTING SHEET
48	MC5-1	MC5 OVERVIEW SHEET
49	MC5-2	MC5 TYPICAL PLAN AND PROFILE
50	MC5-3	MC5 QUANTITIES
51	MC5-4	MC5 WETLAND PLANTING SHEET
52	MC6-1	MC6 OVERVIEW SHEET
53	MC6-2	MC6 QUANTITIES
54	BC1-1	BC1 OVERVIEW SHEET
55	BC1-2	BC1 QUANTITIES
56	BC1-3	BC1 WETLAND SHEET
57	BC2-1	BC2 OVERVIEW SHEET
58	BC2-2	BC2 TYPICAL PLAN AND PROFILE
59	BC2-3	BC2 QUANTITIES
60	BC3-1	BC3 OVERVIEW SHEET
61	BC3-2	BC3 TYPICAL PLAN AND PROFILE
62	BC3-3	BC3 QUANTITIES
63	EF1-1	EF1 OVERVIEW SHEET
64	EF1-2	EF1 QUANTITIES
65	EF2-1	EF2 OVERVIEW SHEET - 1
66	EF2-2	EF2 OVERVIEW SHEET - 2
67	EF2-3	EF2 OVERVIEW SHEET - 3
68	EF2-4	EF2 QUANTITIES
69	EF3-1	EF3 OVERVIEW SHEET
70	EF3-2	EF3 TYPICAL PLAN AND PROFILE
71	EF3-3	EF3 QUANTITIES
72	EF3-4	EF3 WETLAND SHEET
73	EF3-5	EF3 WETLAND PLANTING SHEET
74	EF4-1	EF4 OVERVIEW SHEET
75	EF4-2	EF4 QUANTITIES
76	FC1-1	FC1 OVERVIEW SHEET - 1
77	FC1-2	FC1 OVERVIEW SHEET - 2
78	FC1-3	FC1 TYPICAL PLAN AND PROFILE
79	FC1-4	FC1 QUANTITIES
80	FC1-5	FC1 WETLAND SHEET - 1
81	FC1-6	FC1 WETLAND SHEET - 2
82	FC1-7	FC1 WETLAND PLANTING SHEET - 1
83	FC1-8	FC1 WETLAND PLANTING SHEET - 2
84	FC2-1	FC2 OVERVIEW SHEET
85	FC2-2	FC2 QUANTITIES
86	MNC1-1	MNC1 OVERVIEW SHEET
87	MNC1-2	MNC1 TYPICAL PLAN AND PROFILE
88	MNC1-3	MNC1 QUANTITIES
89	MNC2-1	MNC2 OVERVIEW SHEET
90	MNC2-2	MNC2 TYPICAL PLAN AND PROFILE
91	MNC2-3	MNC2 QUANTITIES
92	HC1&2-1	HC1&2 OVERVIEW SHEET
93	HC1&2-2	HC1&2 TYPICAL PLAN AND PROFILE
94	HC1&2-3	HC1&2 QUANTITIES
95	GC1-1	GC1 OVERVIEW SHEET
96	GC1-2	GC1 TYPICAL PLAN AND PROFILE
97	GC1-3	GC1 QUANTITIES
98	WE1-1	WE1 OVERVIEW SHEET
99	WE1-2	WE1 QUANTITIES
100	WE1-3	WE1 WETLAND SHEET
101	WE1-4	WE1 WETLAND PLANTING SHEET
102	WE2-1	WE2 OVERVIEW SHEET - 1
103	WE2-2	WE2 OVERVIEW SHEET - 2
104	WE2-3	WE2 QUANTITIES
105	WE3-1	WE3 OVERVIEW SHEET
106	WE3-2	WE3 QUANTITIES
107	MC4D-1	MC4D OVERVIEW SHEET
108	MC4D-2	MC4D TYPICAL PLAN AND PROFILE
109	MC4D-3	MC4D QUANTITIES
110	MC5D-1	MC5D OVERVIEW SHEET
111	MC5D-2	MC5D TYPICAL PLAN AND PROFILE
112	MC5D-3	MC5D QUANTITIES
113	BC3D-1	BC3D OVERVIEW SHEET
114	BC3D-2	BC3D TYPICAL PLAN AND PROFILE
115	BC3D-3	BC3D QUANTITIES
116	D-1	TYPICAL DETAILS - 1
117	D-2	TYPICAL DETAILS - 2
118	D-3	TYPICAL DETAILS - 3
119	D-4	TYPICAL DETAILS - 4
120	D-5	TYPICAL DETAILS - 5
121	D-6	TYPICAL DETAILS - 6
122	D-7	TYPICAL DETAILS - 7
123	D-8	TYPICAL DETAILS - 8
124	D-9	TYPICAL DETAILS - 9
125	D-10	TYPICAL DETAILS - 10
126	D-11	TYPICAL DETAILS - 11
127	D-12	TYPICAL DETAILS - 12
128	D-13	TYPICAL DETAILS - 13
129	D-14	TYPICAL DETAILS - 14
130	D-15	TYPICAL DETAILS - 15
131	D-16	TYPICAL DETAILS - 16
132	D-17	TYPICAL DETAILS - 17
133	D-18	TYPICAL DETAILS - 18
134	D-19	TYPICAL DETAILS - 19
135	D-20	TYPICAL DETAILS - 20
136	D-21	WETLAND DETAIL SHEET - 1
137	D-22	WETLAND DETAIL SHEET - 2
138	D-23	WETLAND DETAIL SHEET - 3
139	D-24	WETLAND DETAIL SHEET - 4

Applied Science & Engineering
2449 S. Vista Ave. Suite B
Boise, Idaho 83705

TETRA TECH

Stibnite Gold Project
Stream and Wetland Restoration Concept Design
Cover Sheet
Valley County, Idaho

Draft

Date: Feb. 2019
Designed: JF, JY, MP
Drawn: JF, JY, MP
Checked: RR
Approved: --

Drawing Name
Cover Sheet

Drawing No.
G-1

STIBNITE GOLD PROJECT STREAM RESTORATION GOALS, OBJECTIVES AND APPROACH:

1. PROJECT GOAL IS TO RESTORE STREAMS AND ASSOCIATED RIPARIAN CORRIDORS WITHIN THE STIBNITE MINE TO BETTER THAN EXISTING CONDITIONS POST MINING OPERATIONS.
2. STREAM DESIGN OBJECTIVES INCLUDE:
   - REMOVAL OF YELLOW PINE PIT BARRIER TO RESTORE FISH PASSAGE AND MAKE APPROXIMATELY 29,500 LINEAL FEET OF THE EAST FORK SOUTH FORK SALMON RIVER (EFSFSR) AND MEADOW CREEK ACCESSIBLE TO ANADROMOUS FISH FOR THE FIRST TIME SINCE 1938.
   - RESTORE AND ENHANCE ROUGHLY 14.5 MILES OF PERENNIAL AND NON-PERENNIAL STREAM AND RIPARIAN HABITAT.
3. THE OVERALL STREAM ENHANCEMENT AND RESTORATION APPROACH IS TO RESTORE PERMANENT FISH PASSAGE ABOVE THE EXISTING YELLOW PINE PIT BARRIER BY FILLING THE PIT AND BUILDING A NEW STREAM CHANNEL OVER THE TOP OF THE FILL, RESTORE HIGH-QUALITY STREAM CHANNELS OVER THE TOP OF AREAS THAT WILL BE IMPACTED BY FUTURE MINING OPERATIONS, AND ENHANCE CERTAIN STREAMS THAT WILL BE OTHERWISE UNAFFECTED BY MINING.
   - ENHANCE = IMPROVE PHYSICAL CHANNEL PROCESSES AND HABITAT WITHIN THE EXISTING STREAM CHANNEL.
   - RESTORE = CREATE A NEW STREAM CHANNEL WHERE THE NATURAL CHANNEL HAS BEEN FILLED OR OTHERWISE ALTERED BY MINING-RELATED ACTIVITIES.

CONCEPTUAL DESIGN PHILOSOPHY:

1. THIS CONCEPTUAL DESIGN SHOWS PROPOSED CONDITIONS AT POST MINING OPERATIONS.
2. THE PROJECT AREA HAS BEEN DIVIDED INTO MULTIPLE REACHES FOR EACH STREAM CHANNEL.
3. STREAMS HAVE BEEN DIVIDED INTO REACHES BY VARIATION IN CHANNEL SLOPE, CHANGES IN DRAINAGE AREA (TRIBUTARY CONNECTION), AND CHANGES FROM RESTORATION TO ENHANCEMENT.
4. EACH STREAM REACH DESIGN INCLUDES ONE OR MORE PLAN VIEW SHEETS DEPICTING THE CHANNEL PATTERN AND ASSOCIATED FLOODPLAIN WIDTH. THESE PLAN VIEW SHEETS SHOW THE PROPOSED OR EXISTING CHANNEL ALIGNMENT AND PROVIDE METRICS INCLUDING PROPOSED VALLEY LENGTH, PROPOSED CHANNEL LENGTH, PROPOSED CHANNEL SINUOUSITY, PROPOSED VALLEY SLOPE AND PROPOSED CHANNEL SLOPE ON A PER REACH BASIS.
5. FOLLOWING EACH REACH'S PLAN VIEW DESIGN SHEETS IS A TYPICAL DIMENSIONS SHEET THAT REPRESENTS APPROXIMATELY ONE FULL MEANDER WAVE LENGTH. THESE SHEETS PROVIDE A TYPICAL RANGE IN DIMENSIONS FOR CHANNEL SHAPE IN SECTION, PLANFORM AND VERTICAL PROFILE. CONCEPTUAL SECTIONS INCLUDE A TYPICAL SECTION AT A RIFFLE AND A TYPICAL SECTION AT A POOL. THE TYPICAL PROFILE SHOWS TYPICAL RIFFLE-POOL SEQUENCING OR STEP POOL SEQUENCING DEPENDING ON CHANNEL SLOPE.
6. IT IS INTENDED THAT THE ASSOCIATED RANGES IN CHANNEL DIMENSIONS BE UTILIZED AND THESE SECTIONS AND PROFILES WILL BE REPEATED FOR THE PROPOSED CHANNEL ALIGNMENT SHOWN IN THE PLAN SHEETS WITH SMOOTH TRANSITIONS BETWEEN RIFFLE AND POOL SECTIONS. TYPICAL SECTIONS FOR RUNS AND GLIDES WILL BE ADDED TO THE DRAWINGS FOR ADDITIONAL DETAIL IN A FUTURE DESIGN PHASE.
7. THE CHANNEL SHAPE WILL VARY WITHIN THE ALLOWABLE RANGE TO ALLOW FOR NATURAL VARIATION WITHIN THE CHANNEL AND FLOODPLAIN INCREASING THE HYDRAULIC DIVERSITY AND ASSOCIATED AQUATIC HABITAT WITHIN EACH RESTORED CHANNEL.
8. FOLLOWING THE TYPICAL PLAN AND PROFILE SHEET IS A QUANTITIES SHEET FOR EACH REACH. THIS QUANTITIES SHEET INCLUDES ASSOCIATED BANK TREATMENTS, LOG HABITAT STRUCTURES, CONSTRUCTED RIFFLES, PLANTING ZONES AND ASSOCIATED AREAS. THESE QUANTITIES WILL ALLOW FOR FUTURE ACCURATE IMPLEMENTATION, ESTIMATING, AND QUANTIFICATION OF CERTAIN METRICS ASSOCIATED WITH WATERSHED CONDITION INDICATOR (WCI) SCORING.
9. AT THE END OF THE CONCEPTUAL PLAN SET IS A NUMBER OF TYPICAL DETAILS RANGING FROM TYPICAL BANK TREATMENTS, RIFFLE CONSTRUCTION, VARIOUS WOOD HABITAT STRUCTURES, PLANTING PLAN AND SCHEDULE, ETC. EACH OF THESE DETAILS INCLUDES NOTES ON APPLICATION FREQUENCY, AND PROVIDES REPRESENTATIVE PHOTOS FOR CONCEPTUAL REFERENCE.

GENERAL NOTES:

1. THESE DESIGNS AND DRAWINGS HAVE BEEN PREPARED FOR THE EXCLUSIVE USE OF MIDAS GOLD IDAHO, INC. AND THEIR REPRESENTATIVE AUTHORIZED AGENTS. NO OTHER PARTY MAY RELY ON THE PRODUCT OF OUR SERVICES UNLESS RIO APPLIED SCIENCE AND ENGINEERING AND TETRA TECH AGREE IN WRITING IN ADVANCE OF SUCH USE.
2. THESE PLANS ARE INTENDED FOR CONCEPTUAL USE ONLY AND ARE NOT INTENDED FOR CONSTRUCTION.
3. THE ENHANCEMENT DESIGNS DEPICTED HEREIN ARE APPROXIMATE AND ARE INTENDED TO EXPRESS THE OVERALL DESIGN INTENT OF THE PROJECT.
4. DRAWING HORIZONTAL COORDINATES ARE REFERENCED TO IDAHO STATE PLANE WEST, US FEET, USING THE NORTH AMERICAN DATUM OF 1983.
5. VERTICAL ELEVATION IS REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988.
6. THESE DESIGN DRAWINGS WERE ORIGINALLY PRODUCED IN COLOR.
7. THESE PLANS DO NOT SHOW LOCATIONS OF INDIVIDUAL WOOD STRUCTURES. HOWEVER, APPROPRIATE REACHES (IDENTIFIED IN THE BASIS OF DESIGN REPORT) WILL INCLUDE WOOD STRUCTURES TO MEET DESIGN OBJECTIVES AND MINIMUM WOOD LOADING RATES.
8. FOR THE SGP STREAM DESIGN NON-PERENNIAL REFER TO A STREAM WITH DISTINCT BED AND BANKS THAT EXHIBITS SURFACE FLOW DURING ONLY A PORTION OF THE YEAR (I.E. NOT PERENNIAL).

CONCEPT DESIGN RESTORED AND ENHANCED CHANNEL LENGTH SUMMARY

MINE FEATURE	STREAM NAME	STREAM REACH(S)	REACH DRAWING(S)	PERENNIAL CHANNEL LENGTH (FT)**	NON-PERENNIAL CHANNEL LENGTH (FT)**	TRANSITIONAL PERENNIAL CHANNEL LENGTH** (FT)	TRANSITIONAL NON-PERENNIAL CHANNEL LENGTH** (FT)
TAILINGS STORAGE FACILITY (TSF)	MEADOW CREEK AND TRIBUTARIES	MC1A, MC1B, MC1C, MC1D, & MC1E	MC1A-1 TO MC1A-2, MC1B-1, MC1C-1, MC1D-1, & MC1E-1 TO MC1E-2	19,291	9,012	2,124	1,262
HANGAR FLATS DEVELOPMENT ROCK STORAGE FACILITY (DRSF)	MEADOW CREEK	MC2 & MC3	MC2-1 & MC3-1	3,801	0	0	0
HANGAR FLATS PIT	MEADOW CREEK	MC4 & MC5	MC4-1 & MC5-1	3,293	180	0	0
	MEADOW CREEK[E]	MC6	MC6-1	2,357	0	0	0
	BLOWOUT CREEK	BC3	BC3-1	822	0	0	0
BLOWOUT CREEK RESTORATION	BLOWOUT CREEK	BC1 & BC2	BC1-1 & BC2-1	4,682	0	0	0
PROCESSING FACILITY	EAST FORK SOUTH FORK SALMON RIVER[E] (EFSFSR)	EF1	EF1-1	1,897	0	0	0
	GARNET CREEK	GC1	GC1-1	285	0	0	0
FIDDLE DRSF	FIDDLE CREEK	FC1 & FC2	FC1-1 TO FC1-2 & FC2-1	8,076	0	176	0
YELLOW PINE PIT / YELLOW PINE DRSF	EFSFSR	EF3	EF3-1	4,606	2,011	0	0
	EFSFSR[E]	EF2 & EF4	EF2-1 TO EF2-3 & EF4-1	11,261	0	0	0
	HENNESSY CREEK	HC1 & HC2	HC1&2-1	1,480	0	246	0
	MIDNIGHT CREEK	MNC1 & MNC2	MNC1-1 & MNC2-1	1,361	0	2,098	427
WEST END PIT / WEST END DRSF	WEST END CREEK*	WE1, WE2, & WE3	WE1-1 TO WE1-2, WE2-1 TO WE2-2, & WE3-1	0	5,057	0	0
			TOTAL STREAM RESTORATION LENGTH	47,697	16,260	4,644	1,689
			TOTAL STREAM ENHANCEMENT LENGTH	15,515	0	0	0
			TOTAL STREAM MITIGATION LENGTH (RESTORATION AND ENHANCEMENT)	63,212	16,260	4,644	1,689

E = ENHANCEMENT OF EXISTING STREAM CHANNEL (REMOVE FISH PASSAGE BARRIERS, ENHANCE HABITAT, IMPROVE RIPARIAN CONDITIONS WITHOUT CHANGES TO CHANNEL'S GENERAL LINE AND GRADE). ALL OTHER STREAMS ARE PLANNED FOR RESTORATION.

* WEST END CREEK IS ASSUMED TO REMAIN NON-PERENNIAL UPSTREAM AND DOWNSTREAM OF THE PIT LAKE, BUT MAY BE NON-PERENNIAL BELOW WEST END DRSF WETLANDS AND/OR WEST END PIT LAKE SPILLWAY AT CLOSURE. STREAM RESTORATION QUANTITY MAY BE REVISED AS PIT LAKE HYDROLOGY IS BETTER UNDERSTOOD.

** PERENNIAL CHANNEL LENGTH REPORTED ON THIS SHEET AND THE OVERVIEW SHEETS INCLUDES THE LENGTH OF THE MAIN STEM AND PERENNIAL SIDE CHANNELS INCLUDED IN THE PROPOSED DESIGN. THE PROPOSED CHANNEL LENGTH REPORTED ON THE OVERVIEW SHEETS INCLUDES THE LENGTH OF ONLY THE MAIN STEM PERENNIAL CHANNEL TO SUPPORT SINUOSITY AND GRADIENT CALCULATIONS.

*** EXISTING STREAM LENGTH DOES NOT INCLUDE STREAM LENGTH THROUGH THE EXISTING YELLOW PINE PIT LAKE.

**** PROPOSED STREAM LENGTH DOES NOT INCLUDE STREAM LENGTH THROUGH THE PROPOSED HANGAR FLATS PIT LAKE OR WEST END PIT LAKE.

STIBNITE GOLD PROJECT IMPACTS VERSUS PROPOSED TREATMENTS CHANNEL LENGTH SUMMARY

DRAINAGE	STIBNITE GOLD PROJECT STREAM IMPACTS				PROPOSED STREAM TREATMENTS			
	PERENNIAL CHANNEL LENGTH** (FT)	NON-PERENNIAL CHANNEL LENGTH** (FT)	TRANSITIONAL PERENNIAL CHANNEL LENGTH** (FT)	TRANSITIONAL NON-PERENNIAL CHANNEL LENGTH** (FT)	PERENNIAL CHANNEL LENGTH** (FT)	NON-PERENNIAL CHANNEL LENGTH** (FT)	TRANSITIONAL PERENNIAL CHANNEL LENGTH** (FT)	TRANSITIONAL NON-PERENNIAL CHANNEL LENGTH** (FT)
BLOWOUT CREEK (EAST FORK MEADOW CREEK)****	6,509	0	0	0	5,504	0	0	0
EAST FORK SOUTH FORK SALMON RIVER***	16,255	6,113	0	0	17,764	2,011	0	0
FIDDLE CREEK	6,630	589	175	0	8,076	0	176	0
GARNET CREEK	239	0	0	0	285	0	0	0
HENNESSY CREEK	4,012	475	246	0	1,480	0	246	0
MEADOW CREEK****	30,193	10,739	2,124	1,195	28,741	9,192	2,124	1,262
MIDNIGHT CREEK	598	0	2,124	427	1,361	0	2,098	427
WEST END CREEK	0	6,884	0	0	0	5,057	0	0
TOTAL	64,436	24,800	4,669	1,622	63,212	16,260	4,644	1,689

NOTE:

1. A COMPREHENSIVE SUMMARY OF MINING RELATED IMPACTS TO STREAM CHANNELS IS INCLUDED IN APPENDIX F - DRAFT CONCEPTUAL WETLAND AND STREAM MITIGATION PLAN OF THE PLAN OF RESTORATION AND OPERATIONS DATED SEPTEMBER 2016 (MIDAS GOLD, 2016).

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Stibnite Gold Project
Stream and Wetland Restoration Concept Design
General Notes, Design Philosophy, Impacts Summary
Valley County, Idaho

Draft

Date: Feb. 2019
Designed: JF, JY, MP
Drawn: JF, JY, MP
Checked: RR
Approved: --

Drawing Name: General Notes

Drawing No. G-2

Wetland Restoration Goals and Objectives

1. Project Goal is to design high quality replacement wetlands to be constructed over mine facilities and on adjacent lands to repair legacy impacts and replace the functions and values of wetlands removed during mine, mill, road and powerline construction.

2. Design goal is to design a complex mosaic of general wetland types which are generally classified as Riparian Fringe And Floodplain Wetlands, Valley Margin Wetlands, and Groundwater Discharge Wetlands. Restoration of wetlands presently located in Upper Blowout Creek and previously impacted by dam failure and headcutting is also a design goal.

3. Within each general wetland type described above, design a complex mosaic of wetland vegetation consisting of four general planting zones including the following:
1. *Palustrine Emergent (PEM)*
2. *Palustrine Shrub-Scrub (PSS)*
3. *Palustrine Forested (PFO)*
4. *Palustrine Aquatic Bed (PAB)*

Conceptual Design Philosophy

1. Design wetlands within lined reaches whose overall dimensions (floodplain width), configuration and location have been selected for restored stream reaches.

2. Design floodplain surface so as to be low enough so that the groundwater surface is within 12 inches of the finished floodplain elevation for all but 14 days out of the growing season in at least 5 out of 10 years. This philosophy exceeds Corps of Engineers' criteria for wetlands as defined in ERDC/EL 10-3. This results in an 'inset' floodplain surface that is in some instances lower the bankfull elevation of the stream within the floodplain.

3. Design wetlands generally within the stream reaches which are lined with an impermeable liner. This allows predictability of the elevation of the water table within the lined reach and provides certainty that the criteria noted above in 2 will be met.

4. The designs included herein are conceptual in nature and are not intended for use during construction.

5. The design sheets presented herein generally consist of a wetlands overview sheet showing the locations, types and extents of a wetlands associated with a particular stream reach followed by a wetlands planting sheet that shows the desired planting zones and vegetation within each wetland.

SUMMARY TABLE OF WETLAND DESIGN ACREAGES

Drainage	Mine Feature	Stream Reach ID	Proposed Year of Construction	Location	Valley Margin Wetlands			Riparian Fringe and Floodplain Wetlands				Groundwater Discharge						
					PEM	PSS	PFO	PAB	PEM	PSS	PFO	PEM	PSS	PAB	PEM	PSS		
		MC1a	17	Southernmost branch of creek on TSF	0.58	0.51	1.61	1.04	25.05	3.82	3.03	-	-	-	-	-	35.64	276.37
		MC1b	17	Middle branch of creek on TSF	0.08	0.10	0.09	0.17	4.89	1.64	1.25	-	-	-	-	-	8.22	65.76
		MC1c	17	Northern branch of creek on TSF	0.79	0.69	0.35	0.27	9.75	1.58	0.96	-	-	-	-	-	14.39	110.10
		MC1d	17	Trunk stream between middle branch and northern branch on TSF	-	-	-	0.30	5.30	0.48	-	-	-	-	-	-	6.08	46.71
		MC1e	17	Trunk stream below confluence of northern branch on TSF	-	-	-	0.55	10.72	0.88	-	-	-	-	-	-	12.15	93.41
	Hangar Flats Development Rock Storage Facility (DRSF) (top)	MC2	17	Area on Development Rock Storage Facility (DRSF) Upstream of Chute	-	-	-	0.27	3.40	-	-	-	-	-	-	-	3.67	27.69
	Hangar Flats DRSF (face)	MC3		Chute on face of DRSF	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Hangar Flats DRSF (toe)	MC4	15	Between Chute and Hangar Flats pit	-	-	-	-	4.30	-	-	19.61	-	-	-	-	23.91	204.91
	Hangar Flats pit	MC5	15	Enhancement of existing channel below pit	-	-	-	-	2.90	-	-	-	-	-	-	-	2.9	22.48
	Below Hangar Flats pit	MC6		Enhancement of existing channel below pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Blowout Creek (Meadow)	BC1	1	Meadow channel upstream of boulder chute	-	-	-	-	-	-	-	-	-	-	8.30	-	8.30	18.38
	Blowout Creek (Boulder Chute)	BC2		Steep channel between meadow and alluvial fan	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Hangar Flats pit	BC3		Channel into Hangar Flats pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EFSFSR	Processing Facility	EF1		Section upstream of confluence with Meadow Cr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Yellow Pine pit	EF2		Section upstream of Yellow Pine pit restoration reach	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Yellow Pine pit	EF3	11	Final stream segment replacing the temporary tunnel	-	-	-	0.79	20.59	1.97	-	-	-	-	-	-	23.35	180.52
	Yellow Pine pit	EF4		Section downstream of Yellow Pine Pit restoration reach	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Fiddle DRSF (top)	FC1	8	Restoration upstream of boulder chute	0.18	-	-	0.38	10.10	2.81	1.74	-	-	-	-	-	15.21	121.09
	Fiddle DRSF (face)	FC2		Chute on face of DRSF	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Yellow Pine pit	MNC1		Steep reach above EFSFSR floodplain	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Yellow Pine pit	MNC2	12	Channel on top of EFSFSR floodplain	-	-	-	-	1.66	-	-	-	-	-	-	-	1.66	12.87
	Yellow Pine pit	HC1		Cascade over edge of Yellow Pine Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Yellow Pine pit	HC2	11	Channel on top of EFSFSR floodplain	-	-	-	-	1.38	-	-	-	-	-	-	-	1.38	10.70
Garnet Creek	Processing Facility	GC1		Upstream of confluence with EFSFSR; May be too steep for habitat	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	West End DRSF (top)	WE1	7	Restoration on top of the West End DRSF	-	-	-	-	4.22	-	-	-	-	-	-	-	4.22	32.71
	West End DRSF (face)	WE2		Chute on face of DRSF	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	West End Pit (lower)	WE3		Downstream of West End Pit within mining disturbance area	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		TOTAL			**1.63**	**1.30**	**2.05**	**3.77**	**104.26**	**13.18**	**6.98**	**19.61**	**0.00**	**0.00**	**8.30**	**0.00**	**161.08**	**1,228.80**

TETRA TECH

MIDAS GOLD

Stibnite Gold Project
Stream And Wetland Restoration Concept Design
General Wetland Notes
Valley County, Idaho

Draft

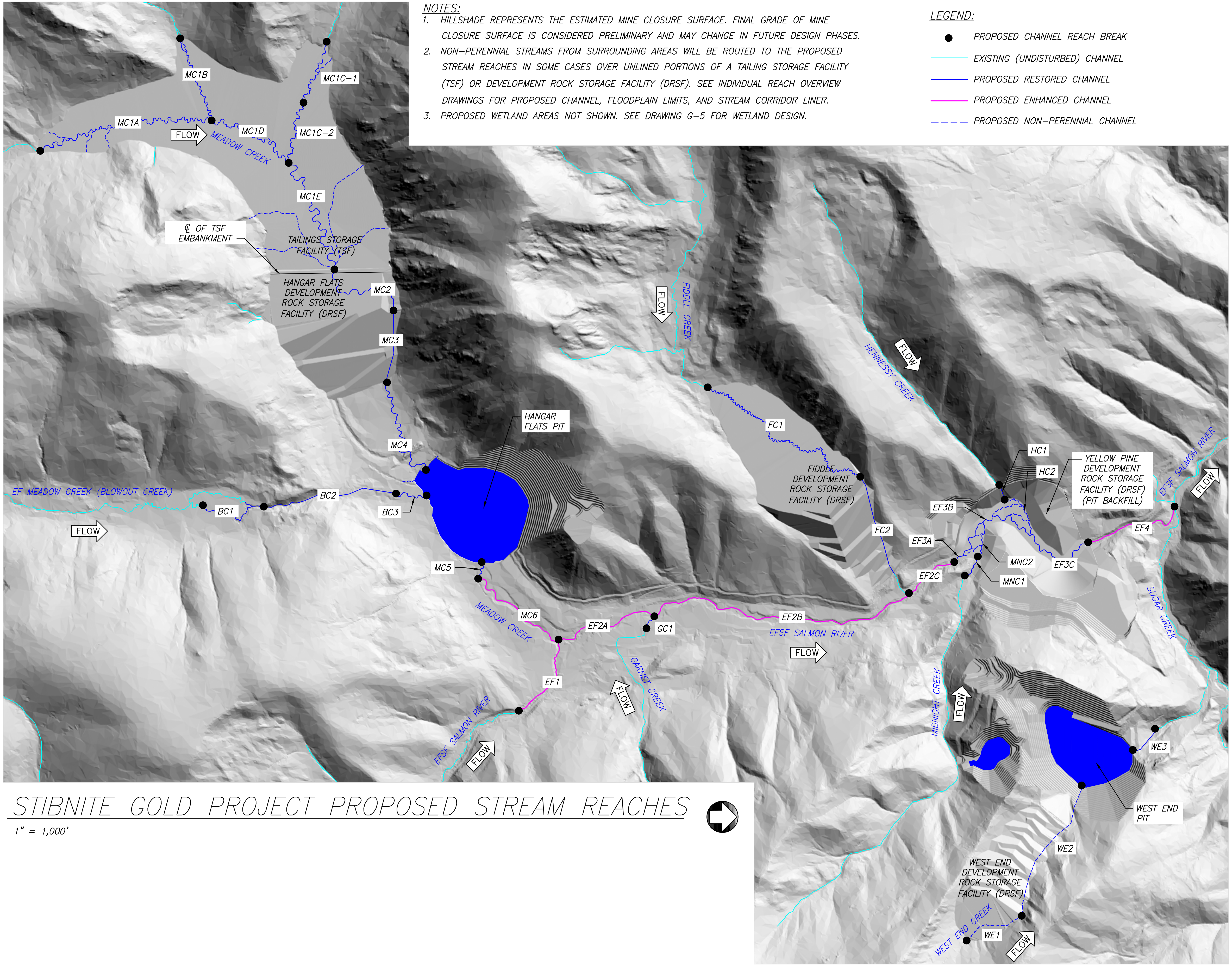
Date: Feb. 2019
Designed: LC
Drawn: JHD
Checked: LC
Approved: ---

Drawing Name
General Wetland Notes

Drawing No.
G3

NOTES:
1. HILLSHADE REPRESENTS THE ESTIMATED MINE CLOSURE SURFACE. FINAL GRADE OF MINE CLOSURE SURFACE IS CONSIDERED PRELIMINARY AND MAY CHANGE IN FUTURE DESIGN PHASES.
2. NON-PERENNIAL STREAMS FROM SURROUNDING AREAS WILL BE ROUTED TO THE PROPOSED STREAM REACHES IN SOME CASES OVER UNLINED PORTIONS OF A TAILING STORAGE FACILITY (TSF) OR DEVELOPMENT ROCK STORAGE FACILITY (DRSF). SEE INDIVIDUAL REACH OVERVIEW DRAWINGS FOR PROPOSED CHANNEL, FLOODPLAIN LIMITS, AND STREAM CORRIDOR LINER.
3. PROPOSED WETLAND AREAS NOT SHOWN. SEE DRAWING G-5 FOR WETLAND DESIGN.

LEGEND:
- ● PROPOSED CHANNEL REACH BREAK
- EXISTING (UNDISTURBED) CHANNEL
- PROPOSED RESTORED CHANNEL
- PROPOSED ENHANCED CHANNEL
- PROPOSED NON-PERENNIAL CHANNEL



STIBNITE GOLD PROJECT PROPOSED STREAM REACHES

1" = 1,000'

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MIDAS GOLD

Stibnite Gold Project
Stream and Wetland Restoration Concept Design
Proposed Stream Reaches
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Draft

Date: Feb. 2019
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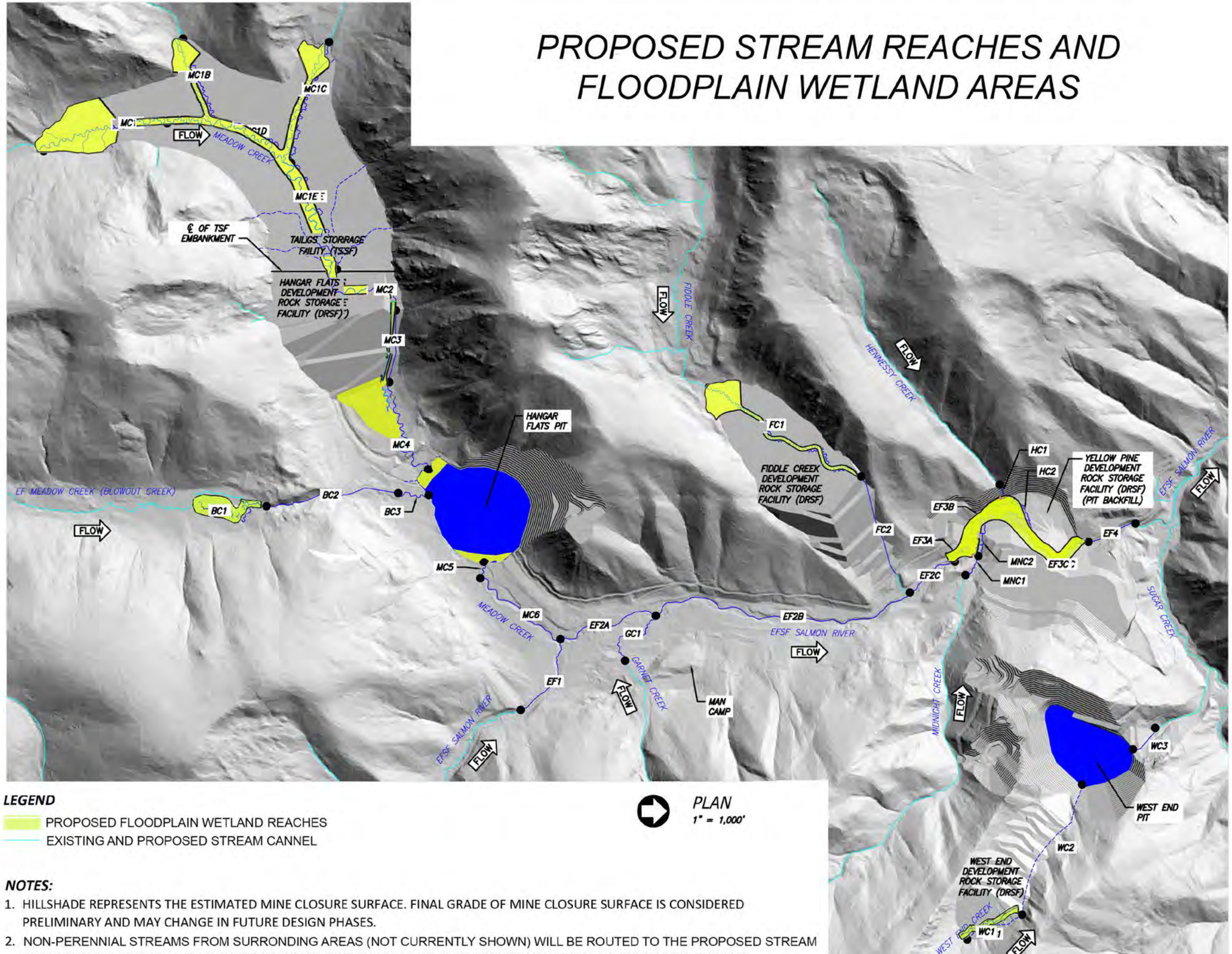
Drawn: JF, JY, MP
Checked: RR
Approved: --

Drawing Name: Proposed Stream Reaches

Drawing No. G-4

PROPOSED STREAM REACHES AND FLOODPLAIN WETLAND AREAS



LEGEND

PROPOSED FLOODPLAIN WETLAND REACHES

EXISTING AND PROPOSED STREAM CANNEL

PLAN

1" = 1,000'

NOTES:

1. HILLSHADE REPRESENTS THE ESTIMATED MINE CLOSURE SURFACE. FINAL GRADE OF MINE CLOSURE SURFACE IS CONSIDERED PRELIMINARY AND MAY CHANGE IN FUTURE DESIGN PHASES.
2. NON-PERENNIAL STREAMS FROM SURROUNDING AREAS (NOT CURRENTLY SHOWN) WILL BE ROUTED TO THE PROPOSED STREAM REACHES IN SOME CASES OVER UNLINED PORTIONS OF THE TSF AND DRSF. SEE INDIVIDUAL REACH OVERVIEW DRAWINGS FO PROPOSED CHANNEL FLOODPLAIN LIMITS AND LINER LIMITS.

TETRA TECH

MIDAS GOLD

Stibnite Gold Project
Stream And Wetland Restoration Concept Design
Proposed Floodplain Wetland Areas
Valley County, Idaho

Draft

Date: Feb. 2019
Designed: LC, JHD
Drawn: JHD
Checked: LC
Approved: — —

Drawing Name
Proposed Floodplain Wetland Areas

Drawing No.
G5

LEGEND:

- CHANNEL ALIGNMENT
- EXISTING CHANNEL
- EXISTING NON–PERENNIAL CHANNEL
- EXISTING MAJOR CONTOUR (25)
- EXISTING MINOR CONTOUR (5)
- EXISTING PEM WETLAND
- EXISTING PFO WETLAND
- EXISTING PSS WETLAND
- EXISTING RELIC DAM DEMOLITION
- EXISTING ROAD
- EXISTING SEEP
- FLOW DIRECTION (FLOW)
- MINE OPERATIONAL DISTURBANCE LIMITS
- PROPOSED ENHANCEMENT REACH ALTERNATING BANK JOG JAMS
- PROPOSED ENHANCEMENT REACH EXISTING FEATURE
- PROPOSED ENHANCEMENT REACH CHANNEL GRADING
- PROPOSED ENHANCEMENT REACH WHOLE TREE
- PROPOSED DRSF/TSF SURFACE
- PROPOSED ENHANCED CHANNEL
- PROPOSED ENHANCED/RESTORED WETLAND
- PROPOSED ENERGY DISSIPATION BASIN
- PROPOSED FLOODPLAIN LIMITS (FP)
- PROPOSED GRADING LIMIT (GL)
- PROPOSED GROUNDWATER DISCHARGE WETLAND
- PROPOSED HIGH FLOW NON–PERENNIAL CHANNEL
- PROPOSED LAKE WATER SURFACE
- PROPOSED NON–PERENNIAL CHANNEL
- PROPOSED PAB WETLAND
- PROPOSED PEM WETLAND
- PROPOSED PFO WETLAND
- PROPOSED PSS WETLAND
- PROPOSED REACH BREAK
- PROPOSED RESTORED CHANNEL
- PROPOSED RESTORED CHANNEL (SEE REFERENCED SHEET)
- PROPOSED RIPARIAN FLOODPLAIN WETLAND
- PROPOSED ROCK GRADE CONTROL STRUCTURE
- PROPOSED STREAM CORRIDOR LINER LIMITS
- PROPOSED SURFACE WATER DIVERSION
- PROPOSED TUNNEL AND PORTAL
- PROPOSED VALLEY MARGIN WETLAND

DETAIL AND SECTION REFERENCING:

24 / D–13 — DETAIL REFERENCE NUMBER; SHEET ON WHICH DETAIL APPEARS

MATCHLINE SHEET 1 STA X+00.00 — SPECIFIES STATIONING AND SHEET NUMBER FOR CONTINUING ALIGNMENT ON NEXT OR PERVIOUS SHEET

A' — A — SPECIFIES LOCATION OF THE SECTION, ORIENTATION AND VIEW DIRECTION

20 VIEWTITLE SCALE: — DETAIL REFERENCE NUMBER

VIEWTITLE — ON DRAWINGS WHERE ONLY A TITLE IS REQUIRED

ABBREVIATIONS:

AC	ACRE
APPROX	APPROXIMATE
BMP	BEST MANAGEMENT PRACTICE
CF	CUBIC FOOT OR FEET
CFS	CUBIC FEET PER SECOND
℄	CENTERLINE
CP	CONTROL POINT
CY	CUBIC YARD
DIAM	DIAMETER
DRSF	DEVELOPMENT ROCK STORAGE FACILITY
EA	EACH
EL, El	ELEVATION
EXST	EXISTING
FG	FINISHED GRADE OR GROUND
FT	FOOT OR FEET
LF	LINEAR FOOT OR FEET
LiDAR	LIGHT DETECTION AND RANGING
LS	LUMP SUM
MIN	MINUMUM
MAX	MAXIMUM
N	NORTH
NO.	NUMBER
NTS	NOT TO SCALE
OG	ORIGINAL GRADE OR GROUND
PAB	PALUSTRINE AQUATIC BED
PEM	PALUSTRINE EMERGENT
PFO	PALUSTRINE FORESTED
PLS	PURE LIVE SEED
PROP	PROPOSED
PSS	PALUSTRINE SHRUB–SCRUB
SF	SQUARE FEET
STA	STATION
SWPPP	STORM WATER POLLUTION PREVENTION PLAN
SY	SQUARE YARD OR YARDS
TSF	TAILINGS STORAGE FACILITY
TYP	TYPICAL
WL	WETLAND
"	INCH
'	FOOT OR FEET
°	DEGREE

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MIDAS GOLD

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Stream and Wetland Restoration Concept Design
General Legend and Abbreviations
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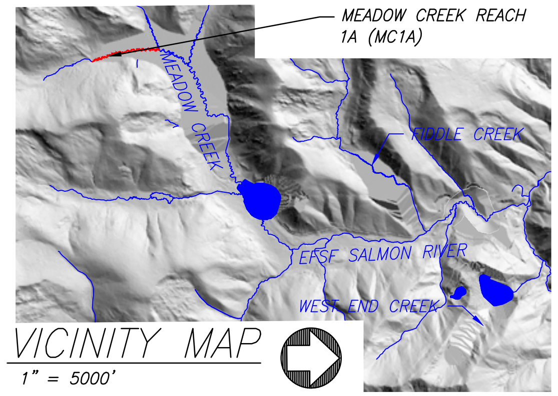
Approved: ––

Drawing Name
General Legend and Abbreviations

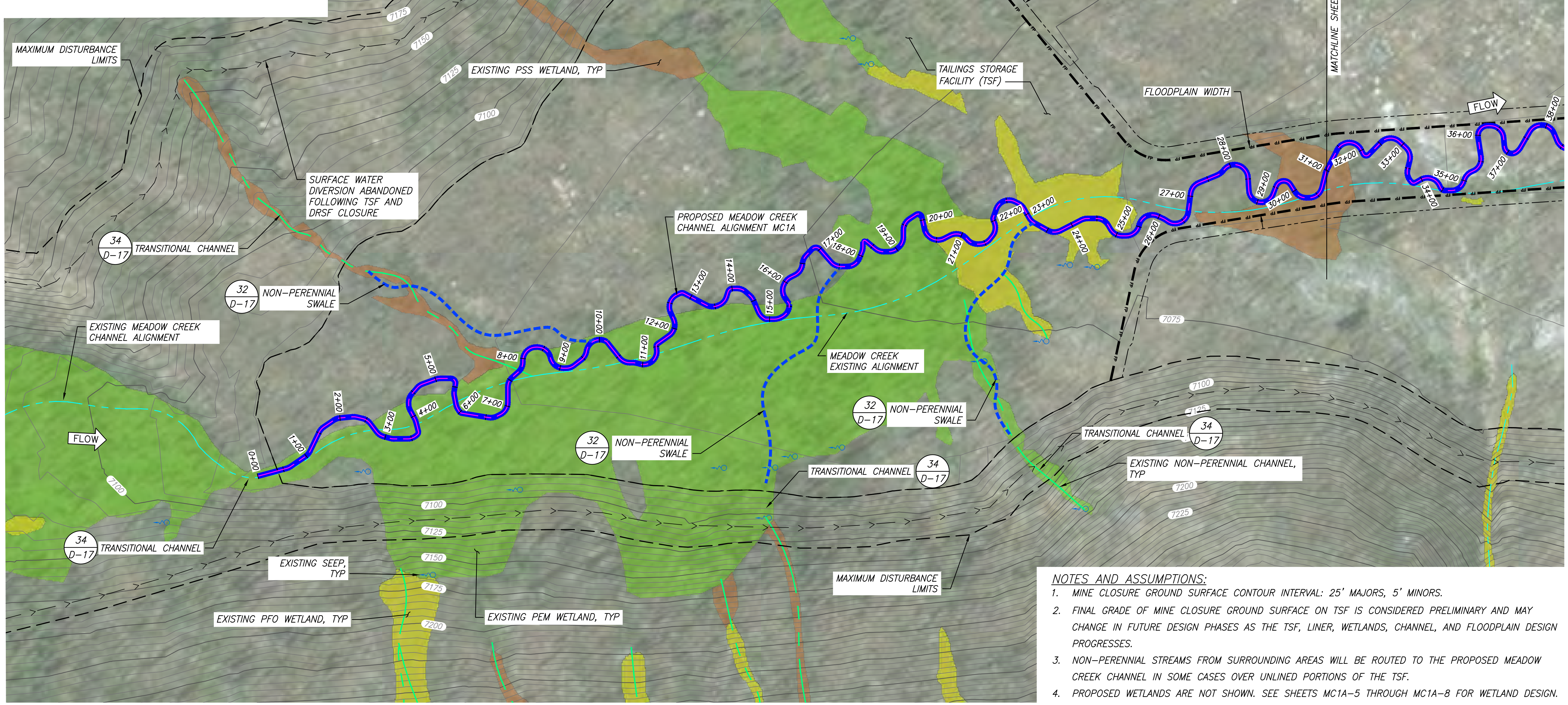
Drawing No.
G–6



VICINITY MAP
1" = 5000'

MC1A PROPOSED CHANNEL CHARACTERISTICS					
REACH ID	VALLEY LENGTH (FT)	CHANNEL LENGTH (FT)	SINUOSITY	VALLEY SLOPE (%)	REACH SLOPE (%)
MC1A	3,589	5,581	1.6	0.82	0.53

MC1A PROPOSED STREAM TREATMENTS		
REACH ID	PERENNIAL CHANNEL LENGTH (FT)	NON-PERENNIAL CHANNEL LENGTH (FT)
MC1A	5,581	1,423



NOTES AND ASSUMPTIONS:

1. MINE CLOSURE GROUND SURFACE CONTOUR INTERVAL: 25' MAJORS, 5' MINORS.
2. FINAL GRADE OF MINE CLOSURE GROUND SURFACE ON TSF IS CONSIDERED PRELIMINARY AND MAY CHANGE IN FUTURE DESIGN PHASES AS THE TSF, LINER, WETLANDS, CHANNEL, AND FLOODPLAIN DESIGN PROGRESSES.
3. NON-PERENNIAL STREAMS FROM SURROUNDING AREAS WILL BE ROUTED TO THE PROPOSED MEADOW CREEK CHANNEL IN SOME CASES OVER UNLINED PORTIONS OF THE TSF.
4. PROPOSED WETLANDS ARE NOT SHOWN. SEE SHEETS MC1A-5 THROUGH MC1A-8 FOR WETLAND DESIGN.

MEADOW CREEK REACH 1A – RESTORATION REACH SITE OVERVIEW PLAN

0 200 400 Feet

Rio Applied Science & Engineering
2449 S. Vista Ave. Suite B
Boise, Idaho 83705

MIDAS GOLD

Stibnite Gold Project
Stream and Wetland Restoration Concept Design
Meadow Creek - TSF - Reach MC1A
Valley County, Idaho

Draft

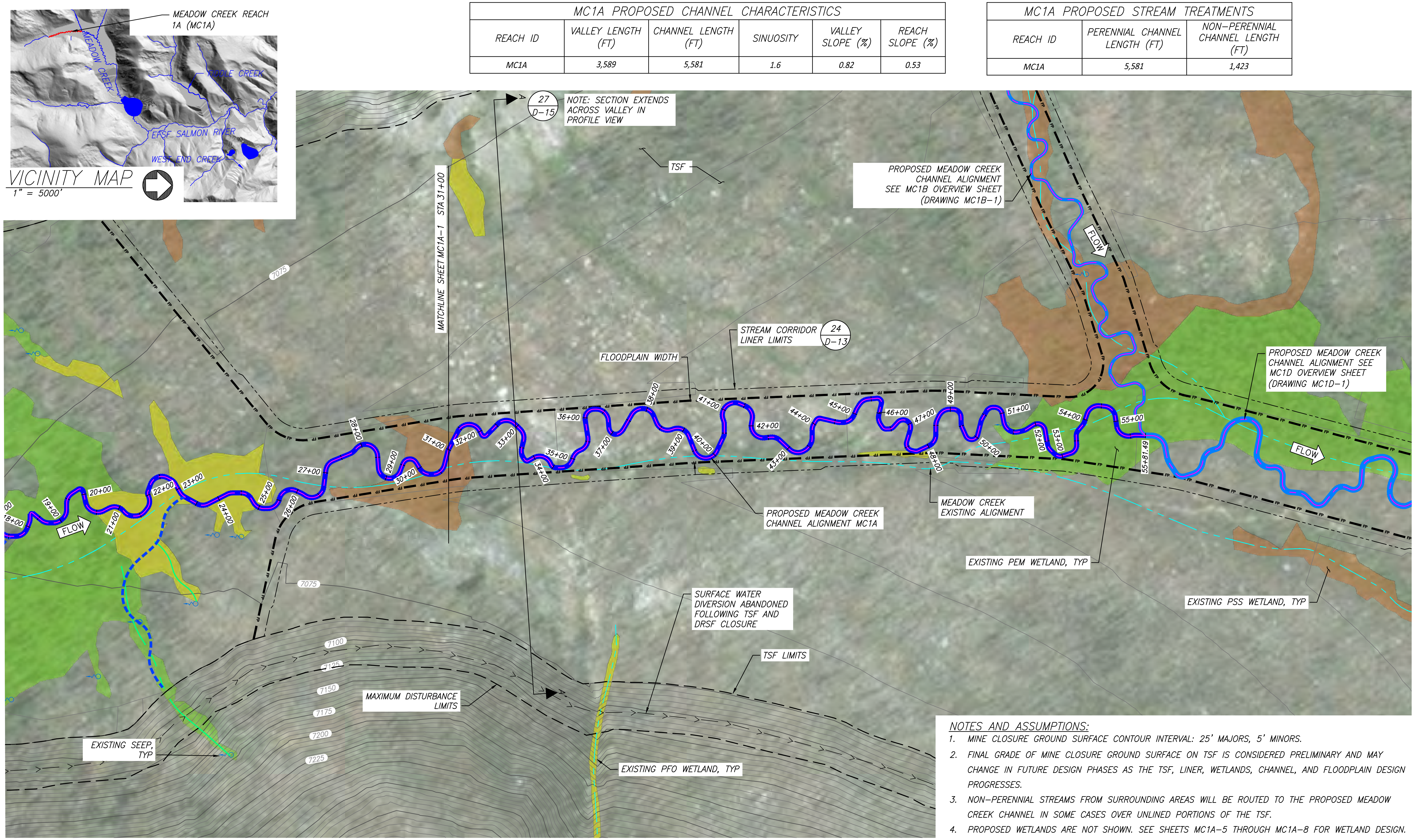
Date: Feb. 2019
Designed: JF, JY, MP
Drawn: JF, JY, MP
Checked: RR
Approved: --

Drawing Name
MC1A Overview Sheet – 1

Drawing No.
MC1A–1

MC1A PROPOSED CHANNEL CHARACTERISTICS					
REACH ID	VALLEY LENGTH (FT)	CHANNEL LENGTH (FT)	SINUOSITY	VALLEY SLOPE (%)	REACH SLOPE (%)
MC1A	3,589	5,581	1.6	0.82	0.53

MC1A PROPOSED STREAM TREATMENTS		
REACH ID	PERENNIAL CHANNEL LENGTH (FT)	NON–PERENNIAL CHANNEL LENGTH (FT)
MC1A	5,581	1,423



NOTES AND ASSUMPTIONS:

1. MINE CLOSURE GROUND SURFACE CONTOUR INTERVAL: 25' MAJORS, 5' MINORS.
2. FINAL GRADE OF MINE CLOSURE GROUND SURFACE ON TSF IS CONSIDERED PRELIMINARY AND MAY CHANGE IN FUTURE DESIGN PHASES AS THE TSF, LINER, WETLANDS, CHANNEL, AND FLOODPLAIN DESIGN PROGRESSES.
3. NON–PERENNIAL STREAMS FROM SURROUNDING AREAS WILL BE ROUTED TO THE PROPOSED MEADOW CREEK CHANNEL IN SOME CASES OVER UNLINED PORTIONS OF THE TSF.
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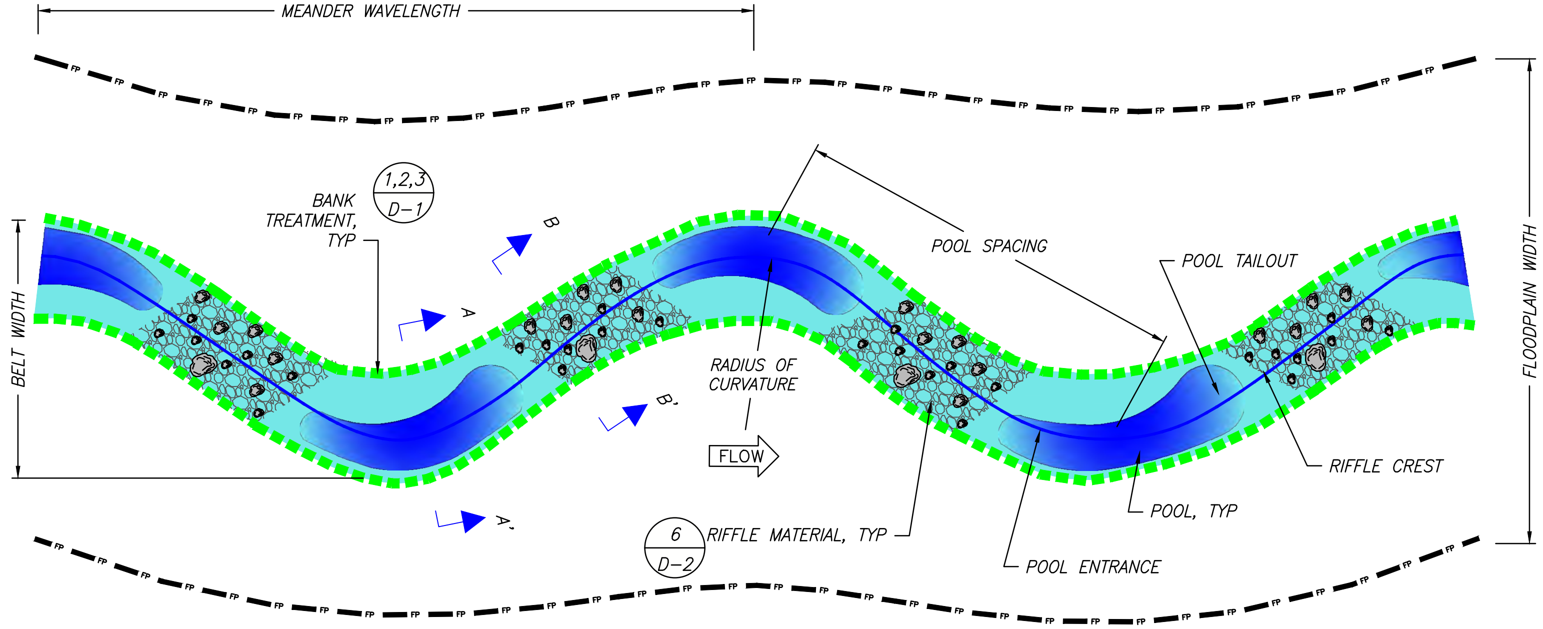
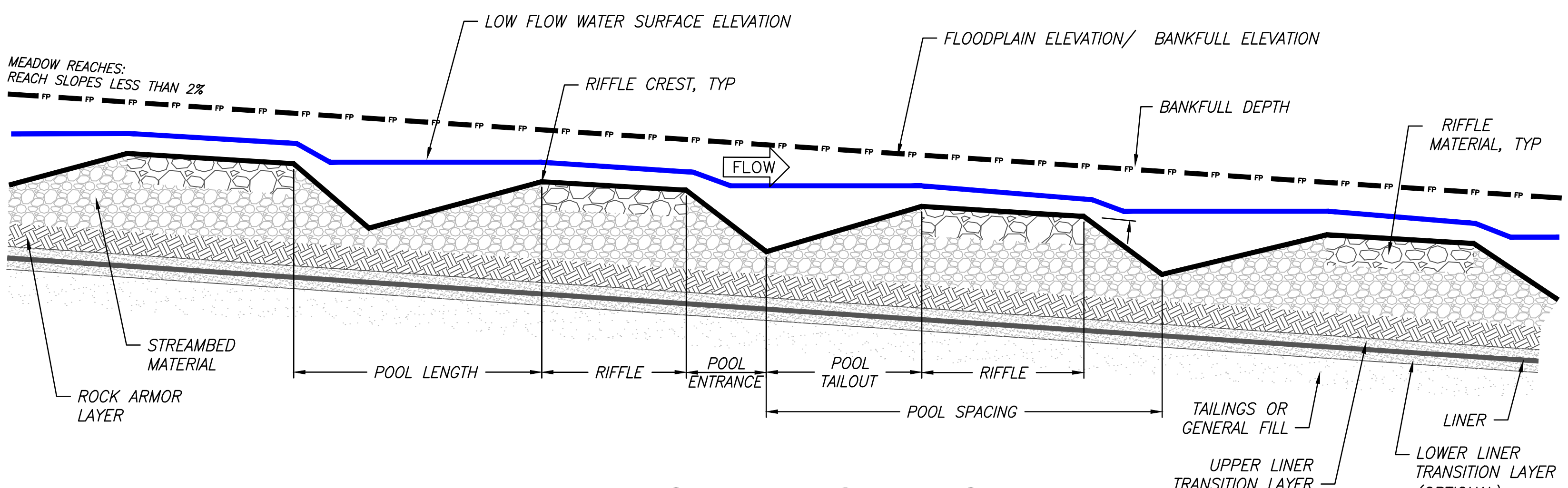
Drawing Name
MC1A Overview Sheet – 2

Drawing No.
MC1A–2



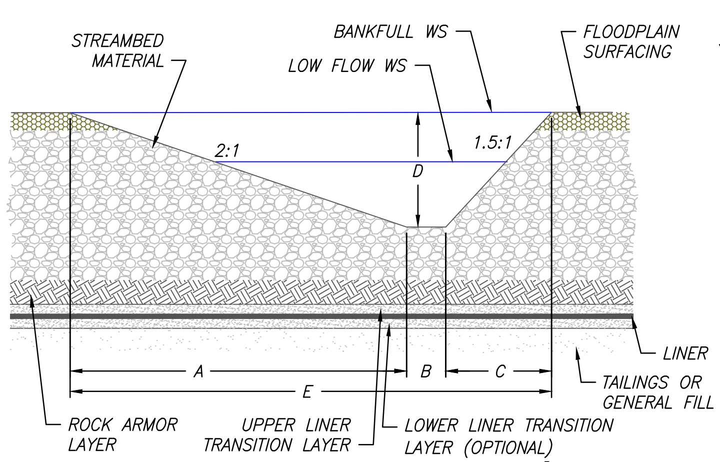
MEADOW REACH PLAN VIEW

NTS



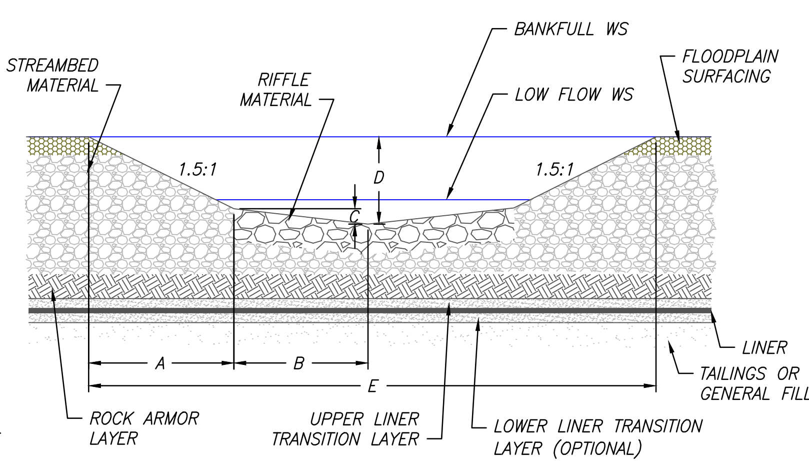
MEADOW REACH PROFILE

NTS



POOL SECTION A-A'

NTS



RIFFLE SECTION B-B'

NTS

NOTES

1. CHANNEL AND FLOODPLAIN SHALL BE CONSTRUCTED TO THE DIMENSIONS IDENTIFIED IN THE CHANNEL DEFINITION TABLES AND AT THE LOCATIONS SHOWN IN INDIVIDUAL REACH OVERVIEW PLAN SHEETS.
2. CHANNEL SIZING FOR TYPICAL POOL AND RIFFLE CROSS SECTIONS IS BASED ON CHANNEL FORMING (BANKFULL) DESIGN FLOW. DETAILED TYPICAL SECTIONS FOR OTHER STREAM HABITATS WILL BE DEVELOPED IN A FUTURE DESIGN PHASE.
3. BANK TREATMENT TYPES ARE NOT DEPICTED IN THE TYPICAL POOL AND RIFFLE SECTIONS. SEE SHEETS D-1 AND D-2 FOR BANK TREATMENT DETAILS.
4. SEE SHEETS D-3 THROUGH D-10 FOR HABITAT STRUCTURE DETAILS.
5. HABITAT STRUCTURE SPACING AND ASSOCIATED QUANTITIES ARE SUMMARIZED IN INDIVIDUAL REACH QUANTITY SHEETS.
6. SEE SHEETS D-1 AND D-20 FOR PLANTING AND SEEDING DETAILS AND PLANTING SCHEDULES.
7. SEE SHEETS D-13 THROUGH D-14 FOR TYPICAL FLOODPLAIN CROSS SECTIONS.

MC1A – MEADOW REACH PROPOSED CHANNEL DEFINITION TABLES

PLAN TABLE

REACH ID	BANKFULL FLOW (CFS)	BANKFULL WIDTH (FT)	WIDTH/ DEPTH RATIO	AVERAGE DEPTH AT BANKFULL (FT)	MEANDER WAVELENGTH (FT)	MEANDER BELT WIDTH (FT)	RADIUS OF CURVATURE (FT)	AVG POOL SPACING (FT)	FLOODPLAIN WIDTH (FT)
MC1A	41	10	8	1.2	95 - 125	50 - 105	15 - 60	40 - 125	130

PROFILE TABLE

REACH ID	RIFFLE LENGTH (FT)	POOL LENGTH (FT)	POOL ENTRANCE SLOPE (%)	POOL TAILOUT SLOPE (%)
MC1A	15 - 115	10 - 25	38 - 45	19 - 45

MATERIALS TABLE

REACH ID	STREAMBED MATERIAL TYPE	STREAMBED MATERIAL AVG THICKNESS (FT)	RIFFLE MATERIAL TYPE	RIFFLE MATERIAL AVG THICKNESS (FT)	FLOODPLAIN MATERIAL TYPE	FLOODPLAIN MATERIAL AVG THICKNESS (FT)	FLOODPLAIN SURFACING TYPE	FLOODPLAIN SURFACING AVG THICKNESS (FT)
MC1A								

NOTES

1. MATERIALS TABLE TO BE DEVELOPED IN FUTURE DESIGN.
2. STREAMBED MATERIAL TYPES: S1 (D50 = XX"), S2 (D50 = XX"), S3 (D50 = XX").
3. RIFFLE MATERIAL TYPES: S1, S2, S3, R1 (D50 = XX"), R2 (D50 = XX").
4. FLOODPLAIN SURFACING MATERIAL TYPES: GROWTH MEDIA, ALGAE, HYDROMULCH, OR NONE.

SECTIONS TABLE

SECTION	A (FT)	B (FT)	C (FT)	D (FT)	E (FT)
POOL SECTION A - A'	6.0	0.5	4.5	3.0	11.0
RIFFLE SECTION B - B'	2.3	3.0	0.2	1.7	10.0

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Approved: ––

Drawing Name
MC1A Typical Plan and Profile

Drawing No.
MC1A–3