NEVADA CREEK PHASE 3 RESTORATION PROJECT
75% DESIGN

PROJECT PARTNERS

BIG BLACKFOOT CHAPTER OF
TROUT UNLIMITED
P.O. BOX 1
OVANDO, MONTANA 59854

US FISH AND WILDLIFE SERVICE
P.O. BOX 66
196 LOWER LAKE SIDE LANE
OVANDO, MONTANA 59854

MONTANA FISH, WILDLIFE & PARKS
3201 SPURGIN ROAD
MISSOULA, MONTANA 59804

STITT FAMILY

PROJECT DESCRIPTION

BIG BLACKFOOT CHAPTER OF TROUT UNLIMITED (BBCTU), IN COOPERATION WITH MONTANA FISH, WILDLIFE & PARKS (MFWP) AND THE U.S. FISH AND WILDLIFE SERVICE (USFWS), RETAINED RIVER DESIGN GROUP, INC. TO DEVELOP CHANNEL, AQUATIC HABITAT, AND FLOODPLAIN RESTORATION PLANS FOR A 8,900 REACH OF NEVADA CREEK, LOCATED APPROXIMATELY 55 MILES EAST OF MISSOULA, MONTANA. NEVADA CREEK IS A THIRD ORDER TRIBUTARY TO THE MIDDLE BLACKFOOT RIVER AND SUPPORTS POPULATIONS OF WESTSLOPE CUTTHROAT TROUT, RAINBOW TROUT, BROWN TROUT AND OTHER FISH SPECIES. NEVADA CREEK HAS BEEN IDENTIFIED AS AN IMPAIRED WATERBODY BY THE MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY. THE STREAM IS CONSIDERED NONSUPPORTING OF AQUATIC LIFE, COLD WATER FISHERY, AND CONTACT RECREATION DUE TO SEDIMENT AND HABITAT RELATED CAUSES (MDEQ 2008). PROBABLE CAUSES OF WATER QUALITY IMPAIRMENT INCLUDE LOW FLOW ALTERATION, TOTAL PHOSPHORUS, PHYSICAL SUBSTRATE, HABITAT ALTERATIONS, SEDIMENTATION/SILTATION, AND TOTAL NITROGEN. PROBABLE SOURCES OF IMPAIRMENT INCLUDE AGRICULTURE AND STREAMBANK MODIFICATION/DESTABILIZATION.

IN 2012, A 4,400 FOOT REACH OF NEVADA CREEK DOWNSTREAM OF NEVADA CREEK RESERVOIR (PHASE 1) WAS RESTORED TO ADDRESS PRIMARY CAUSES OF WATER QUALITY IMPAIRMENT INCLUDING STREAMBANK MODIFICATIONS AND PHYSICAL HABITAT ALTERATIONS. SIMILARLY IN 2017, A 3,350 FOOT REACH OF NEVADA CREEK (PHASE 2) WAS RESTORED TO ADDRESS THE SAME CONCERNS. THESE PROJECTS INVOLVED RESTORING STREAMBANK AND FLOODPLAIN CONDITIONS TO REDUCE STREAMBANK EROSION AND SEDIMENT LOADING TO NEVADA CREEK, AND ENHANCING CHANNEL MORPHOLOGY WITH RIFFLE AND POOL HABITAT FEATURES. BASED ON PHYSICAL EFFECTIVENESS MONITORING, PHASE 1 AND 2 HAVE BEEN SUCCESSFUL IN MEETING THE INTENDED PROJECT GOALS AND SEDIMENT REDUCTION TARGETS. THIS PROJECT IS A CONTINUATION OF PHASE 2, AND WILL CONSIST OF APPROXIMATELY 8,900 FEET OF CHANNEL. SIMILAR TO PHASE 1 AND 2, THIS PROJECT WILL SUBSTANTIALLY REDUCE STREAMBANK RELATED SOURCES OF SEDIMENT TO NEVADA CREEK AND RECONNECT AND RE-ESTABLISH FUNCTIONING FLOODPLAIN SURFACES, WHILE SETTING THE STAGE FOR RECOVERY OF THE RIPARIAN ZONE AND AQUATIC HABITAT CONDITIONS.

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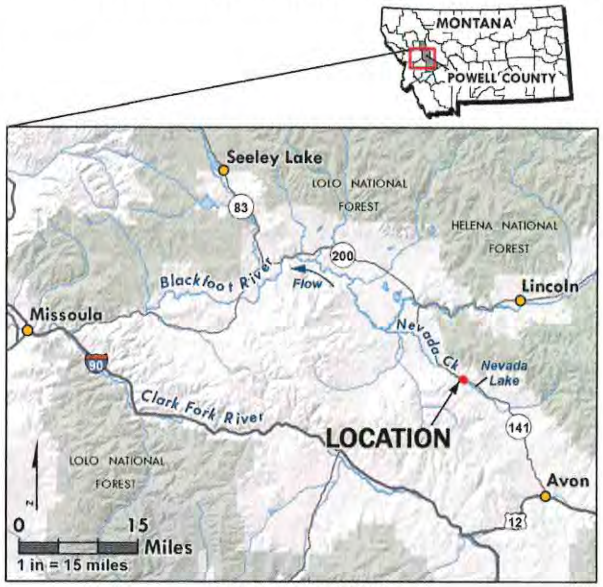
NEVADA CREEK PHASE 2 VICINITY MAP



LEGAL DESCRIPTION:
S10, T12N R10W, P.M., M
POWELL COUNTY, MONTANA

GENERAL NOTES

1. CONTOUR INTERVAL IS NOTED ON DRAWINGS.
2. SLOPES DESIGNATED AS 2:1, 1.5:1, ET CETERA, ARE THE RATIOS OF HORIZONTAL DISTANCE TO VERTICAL DISTANCE.
3. DIMENSIONS ARE NOTED IN FEET AND TENTHS OF A FOOT.
4. TOPOGRAPHY AND CROSS SECTION GROUND LINES ARE BASED ON SURVEY WORK PERFORMED FROM JULY TO AUGUST 2016. LIDAR DATA WAS COLLECTED BY TROUT UNLIMITED. ALL LIDAR DATA WAS COORDINATED BY RDG.
5. ALL EXISTING CONDITIONS ARE TO BE VERIFIED IN THE FIELD PRIOR TO CONSTRUCTION AND ANY ADJUSTMENTS TO THE DRAWINGS SHALL BE MADE AS DIRECTED BY THE ENGINEER.
6. EXISTING PRIVATE IMPROVEMENTS, WHICH LIE WITHIN THE CONSTRUCTION LIMITS, UNLESS OTHERWISE NOTED WILL BE REMOVED BY THE OWNER PRIOR TO CONSTRUCTION, OR ABANDONED IN PLACE.
7. PROTECT ALL TREES AND LAND AREAS NOT LOCATED WITHIN THE PROJECT CONSTRUCTION STAGING OR EARTHWORK LIMITS. EXERCISE CARE IN AREAS NOT SO MARKED TO AVOID UNNECESSARY DAMAGE TO NATURAL VEGETATION.
8. THE PROJECT SPONSOR IS RESPONSIBLE FOR COMPLYING WITH ALL PERMITS AND EASEMENTS INCLUDING ALL FEDERAL, STATE, COUNTY, AND LOCAL PERMIT CONDITIONS.
9. EXCAVATION, TRENCHING, SHORING, AND SHIELDING SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR PERFORMING THE WORK, THESE DRAWINGS ARE NOT INTENDED TO PROVIDE MEANS OR METHODS OF CONSTRUCTION.
10. EXCAVATION SHALL MEET THE REQUIREMENTS OF OSHA 29 CFR PART 1926, SUBPART P, EXCAVATIONS. ACTUAL SLOPES SHALL NOT EXCEED THE SLOPES AS INDICATED ON DRAWINGS.
11. ALL EXCAVATORS AND BULLDOZERS SHALL BE EQUIPPED WITH MACHINE GRADE GPS ((L1/L2/GLONASS)). CONSTRUCTION AREAS WILL BE STAKED OUT PRIOR TO CONSTRUCTION USING SURVEY GRADE GPS (L1/L2/GLONASS).
12. ENGINEER WILL PROVIDE SURVEY CONTROL AND GRADING SURFACES FOR EQUIPMENT WITH GPS MACHINE CONTROL CAPABILITY. CONTRACTOR SHALL PROVIDE SURVEY STAKING AND LAYOUT FOR CONSTRUCTION.
13. VERTICAL TOLERANCE FOR CONSTRUCTION COMPLIANCE WILL BE 0.3 FEET. HORIZONTAL TOLERANCE WILL BE 1.0 FEET.
14. CONTRACTOR SHALL CONFIRM QUANTITIES. REPORTED VOLUMES ARE NEATLINE AND DO NOT INCLUDE ADJUSTMENTS FOR COMPACTION OR OTHER FACTORS.

STANDARD OF PRACTICE

RIVER DESIGN GROUP, INC. WORKS EXCLUSIVELY IN THE RIVER ENVIRONMENT AND UTILIZES THE MOST CURRENT AND ACCEPTED PRACTICES AVAILABLE FOR PLANNING AND DESIGN OF RIVER, FLOODPLAIN, AND AQUATIC HABITAT RESTORATION PROJECTS. CURRENT STANDARDS FOR THE DESIGN OF RESTORATION PROJECTS VARY DEPENDING ON PROJECT GOALS. STABILITY CRITERIA INCLUDE DESIGNING STREAMBED AND STREAMBANK STRUCTURES FOR THE 10-YEAR RECURRENCE INTERVAL FLOOD. HEC-RAS, A ONE-DIMENSIONAL RIVER ANALYSIS MODEL WAS USED TO COMPLETE HYDRAULIC MODELING AND EVALUATE WATER SURFACE ELEVATIONS, CHANNEL AND OVERBANK SHEAR STRESSES, AND VELOCITIES FOR A RANGE OF FLOWS, INCLUDING BANKFULL DISCHARGE, THE 10-YEAR DESIGN STABILITY FLOW, AND HIGHER RETURN INTERVAL DISCHARGES INCLUDING THE 100-YEAR FLOW.

REUSE OF DRAWINGS

THESE DRAWINGS, THE IDEAS AND DESIGNS INCORPORATED HEREIN, AS AN INSTRUMENT OF PROFESSIONAL SERVICE, ARE THE PROPERTY OF RIVER DESIGN GROUP, INC. (RDG) AND ARE NOT TO BE USED , IN WHOLE OR IN PART, FOR ANY OTHER PROJECT WITHOUT THE WRITTEN AUTHORIZATION OF RDG. LIKEWISE, THESE DRAWINGS MAY NOT BE ALTERED OR MODIFIED WITHOUT AUTHORIZATION OF RDG. DRAWING DUPLICATION IS ALLOWED IF THE ORIGINAL CONTENT IS NOT MODIFIED.

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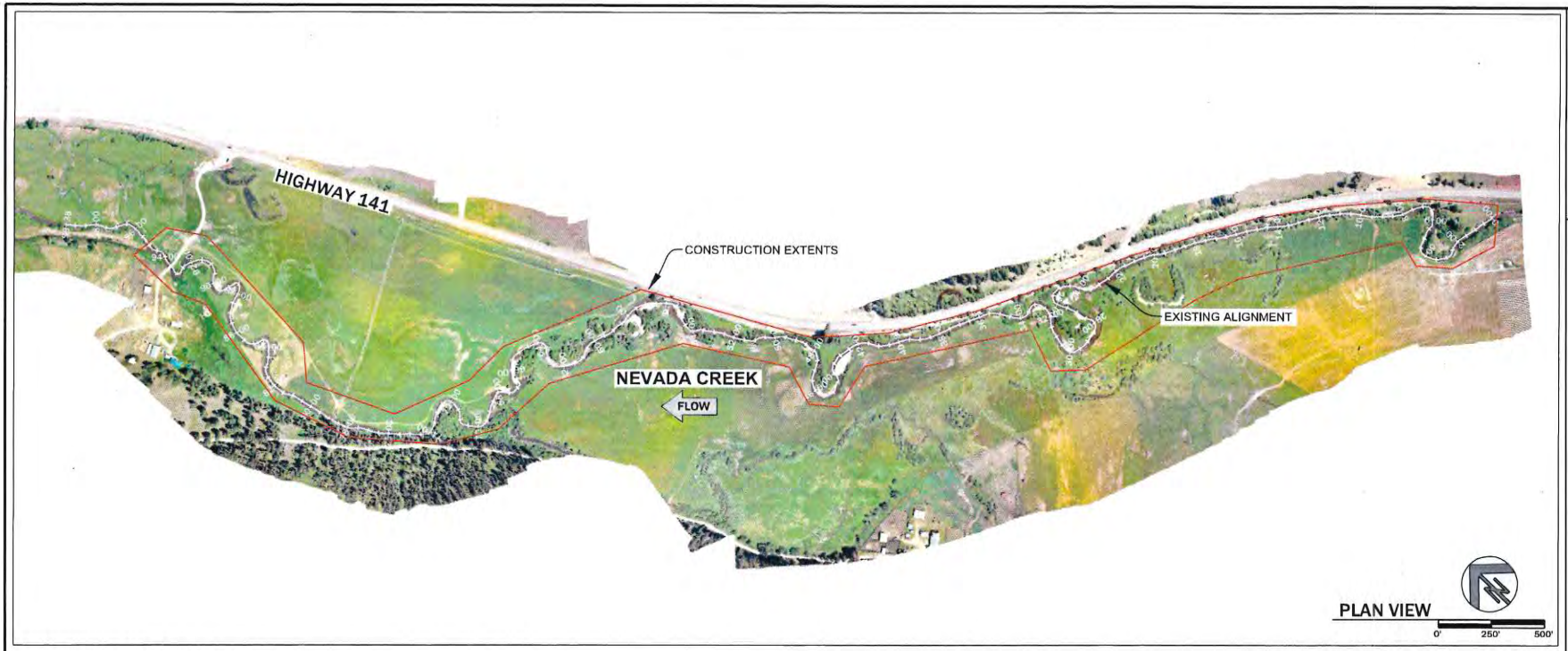
COVER PAGE
NEVADA CREEK PHASE 3
NEAR HELMVILLE, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
1	9-01-18	NW	75% DESIGN	JM

PROJECT NUMBER
RDG-18-001

SHEET NUMBER
1.0



EXISTING CONDITIONS

THE PHASE 3 PROJECT AREA IS LOCATED IN THE LOWER NEVADA CREEK WATERSHED, WHICH EXTENDS FROM NEVADA CREEK RESERVOIR TO THE CONFLUENCE WITH THE MAINSTEM BLACKFOOT RIVER. THE PROJECT AREA IS CONTAINED WITHIN A SEGMENT OF NEVADA CREEK THAT IS CONSIDERED NON-SUPPORTING OF AQUATIC LIFE, COLD WATER FISHERY, AND CONTACT RECREATION DUE TO SEDIMENT AND HABITAT RELATED IMPAIRMENT CAUSES. THE SEDIMENT/HABITAT RELATED 303(D) LISTINGS FOR LOWER NEVADA CREEK ARE FLOW ALTERATIONS, PHYSICAL SUBSTRATE HABITAT ALTERATIONS, AND SEDIMENTATION/SILTATION (MDEQ 2008). SOURCE OF IMPAIRMENT INCLUDE AGRICULTURE AND BANK MODIFICATION/DESTABILIZATION. AN ESTIMATED 215.6 TONS PER YEAR OF SEDIMENT ARE GENERATED IN THE PROJECT AREA FROM STREAMBANK RELATED SOURCES OF SEDIMENT. APPROXIMATELY 57% OF STREAMBANKS IN THE PROJECT AREA (10,398 FEET) DISPLAY MEDIUM TO VERY HIGH BANK ERODIBILITY HAZARD RATINGS. 792 LINEAR FEET OF STREAMBANK HAVE BEEN STABILIZED WITH ROCK RIP-RAP.

MFWP (PIERCE, ET AL, 2002B) HAS IDENTIFIED THE FOLLOWING FISHERIES-RELATED IMPAIRMENTS ON LOWER NEVADA CREEK: 1) IRRIGATION IMPACTS (ENTRAINMENT AND DEWATERING); 2) CHANNEL ALTERATIONS; 3) LACK OF INSTREAM COMPLEXITY; 4) DEGRADED RIPARIAN VEGETATION DUE TO EXCESSIVE LIVESTOCK ACCESS; AND 5) LOW WATER QUALITY. LOWER NEVADA CREEK HAS BEEN DESCRIBED AS HAVING HISTORICALLY LIKELY BEEN A BEAVER/WILLOW COMPLEX THAT HAS BEEN CONVERTED TO HAY/GRAZING MEADOWS THROUGH CONTROL OF BEAVER (PIERCE, ET AL, 2001). TO DATE, RESTORATION PROJECTS ON LOWER NEVADA CREEK HAVE INCLUDED GRAZING MANAGEMENT, INSTALLATION OF FISH LADDERS AND SCREENS ON IRRIGATION DIVERSIONS, AND IMPLEMENTATION OF THE PHASE 1 RESTORATION PROJECT IMMEDIATELY DOWNSTREAM OF NEVADA CREEK RESERVOIR IN 2012.

THE NEVADA CREEK PHASE 3 RESTORATION PROJECT ENCOMPASSES 8,800 OF CHANNEL. DUE TO CHANNEL WIDENING AND ENLARGEMENT, HISTORICAL FLOODPLAIN SURFACES ARE MOSTLY DISCONNECTED FROM THE CHANNEL. SEVERE STREAMBANK EROSION OCCURS OVER MOST OF THE MIDDLE AND LOWER REACHS DUE TO CHANNEL ENTRENCHMENT AND LAND USE PRACTICES THAT HAVE DISPLACED WOODY RIPARIAN VEGETATION RESULTING IN DECREASED STREAMBANK ROOTING DENSITY AND DEPTH. THE STREAM CLASSIFIES AS A HIGH WIDTH-TO-DEPTH RATIO F4 STREAM TYPE WITH GRADIENTS RANGING FROM 0.2 TO 0.5 PERCENT. BED MATERIALS ARE PREDOMINANTLY GRAVEL AND COBBLE WITH A HIGH PERCENTAGE OF SANDS AND SILTS.

THE UPPER REACH IS HIGHLY ENTRENCHED DUE TO CHANNEL STRAIGHTENING AND HIGHWAY ENCROACHMENT. BANK EROSION, LACK OF FLOODPLAIN CONNECTIVITY, STORMWATER RUNOFF FROM THE HIGHWAY, AND LACK OF WETLAND/RIPARIAN VEGETATION CHARACTERIZE THE REACH. THE STREAM CLASSIFIES AS BOTH B4 AND F4 STREAM TYPES DEPENDING ON THE DEGREE OF ENTRENCHMENT.

THE CONSTRAINTS AND LIMITING FACTORS IDENTIFIED DURING THE GEOMORPHIC INVESTIGATION INCLUDE:

- HIGH CHANNEL ENTRENCHMENT RATIOS AND DISCONNECTED FLOODPLAIN SURFACES, PARTICULARLY IN THE LOWER REACH.
- VERY HIGH CHANNEL WIDTH-TO-DEPTH RATIOS THROUGH MOST OF THE MIDDLE AND LOWER REACHES.
- MEDIUM TO VERY HIGH BANK ERODIBILITY CONDITIONS THROUGH MOST OF THE MIDDLE AND LOWER REACHES.
- LACK OF WOODY RIPARIAN SHRUBS THROUGH MOST OF THE UPPER AND LOWER REACHES.
- PAST BANK STABILIZATION PRACTICES, PRIMARILY RIP RAP, LIMIT VEGETATION ESTABLISHMENT AND CHANNEL MARGIN COMPLEXITY.
- SIMPLIFIED AQUATIC HABITAT CONDITIONS, INCLUDING LOW POOL FREQUENCY AND LONG, EXTENDED RIFFLES WITH A HIGH PERCENTAGE OF FINE SEDIMENT.

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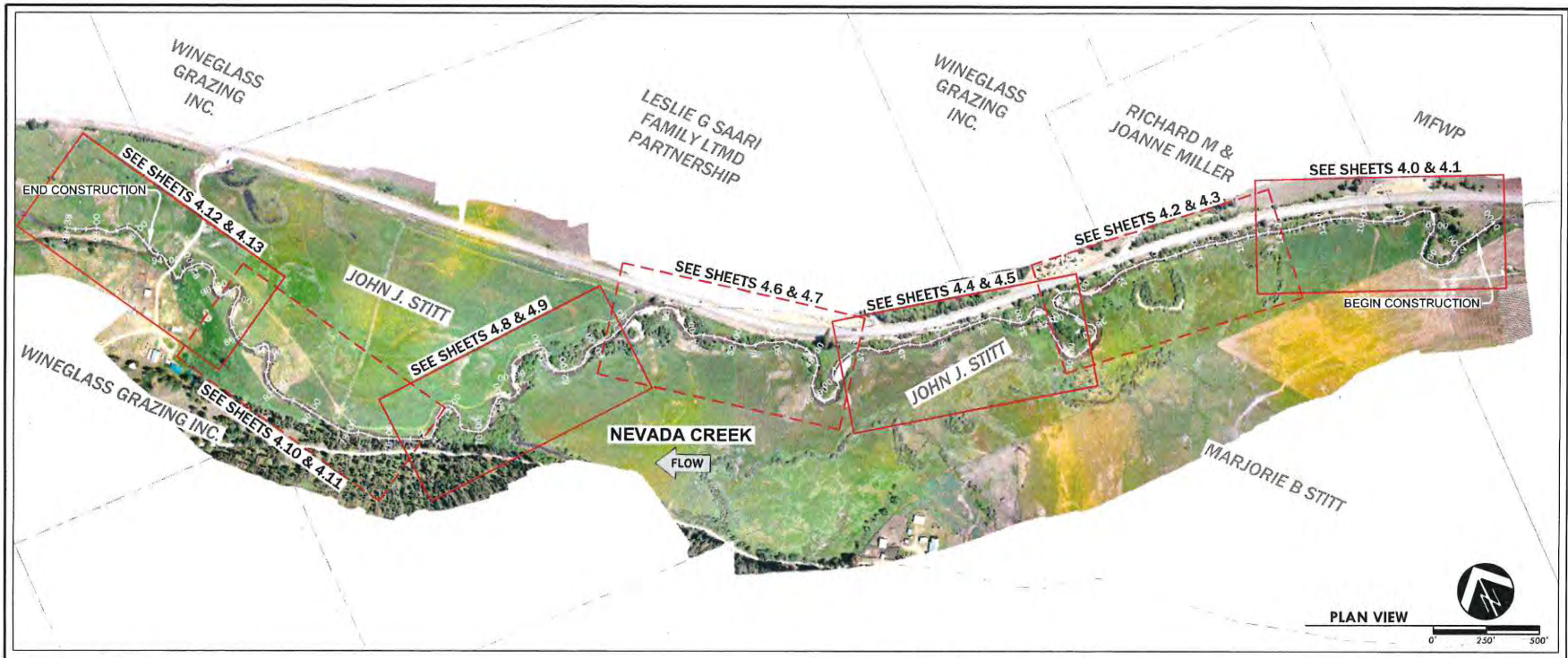
EXISTING CONDITIONS
NEVADA CREEK PHASE 3
NEAR HELMVILLE, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
1	9-01-18	NW	75% DESIGN	JM

PROJECT NUMBER
RDG-18-001

SHEET NUMBER
2.0



RESTORATION ALTERNATIVES

RESTORATION ALTERNATIVES FOR THE NEVADA CREEK PHASE 3 RESTORATION PROJECT WERE DEVELOPED BY RIVER DESIGN GROUP IN CONSULTATION WITH BBCTU, MFWP, AND USFWS. ALTERNATIVES CONSIDERED BUT NOT SELECTED RANGED FROM NO ACTION (ALTERNATIVE 1) TO EXPANDING THE FLOODPLAIN AND CONVERTING THE EXISTING CHANNEL TO A C4 STREAM TYPE (ALTERNATIVE 2). DUE TO LANDOWNER CONCERNS, A PREFERRED ALTERNATIVE (ALTERNATIVE 3) WAS DEVELOPED THAT BALANCES NATURAL RESOURCE OBJECTIVES AND FUTURE LAND USE NEEDS (RANCHING AND AGRICULTURE). THE PREFERRED ALTERATIVE WILL RESTORE THE CHANNEL AND FLOODPLAIN WITHIN THE EXISTING MEANDER BELT WIDTH ALONG A MAJORITY OF THE PROJECT LENGTH. EXISTING TERRACES THAT CURRENTLY SUPPORT UPLAND VEGETATION WILL BE LOWERED TO BANKFULL ELEVATION TO ENCOURAGE DEVELOPMENT OF HERBACEOUS AND SCRUB-SHRUB WETLAND COMMUNITIES ON NEWLY CREATED FLOODPLAIN SURFACES. THE PREFERRED ALTERNATIVE INCORPORATES A GRAZING STRATEGY THAT MANAGES GRAZING WITHIN THE FLOODPLAIN CORRIDOR. EXCLOSURE FENCING, WATER GAPS, AND OFF-CHANNEL WATERING SOURCES WILL BE INSTALLED AS COMPONENTS TO THE PLAN.

RESTORATION OBJECTIVES

THE FOLLOWING OBJECTIVES WERE DEVELOPED BY BBCTU IN CONJUNCTION WITH USFWS AND MFWP:

- IMPROVE INSTREAM AQUATIC HABITAT CONDITIONS FOR SALMONIDS BY LOWERING CHANNEL WIDTH-TO-DEPTH RATIOS, INCREASING POOL FREQUENCY, OVERHEAD COVER, CHANNEL MARGIN COMPLEXITY, AND THE DISTRIBUTION OF RIFFLE, RUN, POOL AND GLIDE CHANNEL HABITAT UNITS.
- DECREASE SURFACE WATER TEMPERATURE BY REDUCING CHANNEL WIDTH-TO-DEPTH RATIOS, INCREASING VEGETATION COVER AND SHADE, AND ENHANCING HYPORHEIC FLOW EXCHANGE BETWEEN THE FLOODPLAIN, WETLANDS, AND CHANNEL.
- REDUCE SEDIMENT SUPPLY BY RESTORING STREAMBANKS WITH VEGETATION AND WOOD.
- IMPLEMENT FLOODPLAIN RESTORATION TREATMENTS THAT SET THE STAGE FOR NATURAL RECRUITMENT OF RIPARIAN VEGETATION.
- IMPLEMENT A GRAZING MANAGEMENT PLAN TO PROTECT SENSITIVE FLOODPLAIN AND RIPARIAN AREAS.
- UTITLIZE NATURAL CHANNEL DESIGN TECHNIQUES AND AVOID THE USE OF HARDENED, NON-DEFORMABLE STRUCTURES SUCH AS ROCK AND LOG VANES, WEIRS, AND OTHER CHANNEL SPANNING STRUCTURES.

RESTORATION TREATMENTS

THE RESTORATION PLAN FOCUSES ON RESTORING ERODING STREAMBANKS, RE-ESTABLISHING PROPER CHANNEL CROSS-SECTION, PLAN FORM AND LONGITUDINAL PROFILE DIMENSIONS, AND IDENTIFYING OPPORTUNITIES TO INCREASE FLOODPLAIN CONNECTIVITY. SPECIFICALLY, THE FOLLOWING GUIDELINES WERE USED IN DEVELOPING THE DESIGN:

- MINIMIZE STREAMBED TREATMENTS AND TO UTILIZE ON-SITE NATIVE MATERIAL FOR CHANNEL SHAPING AND RECONSTRUCTION, TO THE GREATEST EXTENT PRACTICAL.
- INCORPORATE VEGETATED WOOD AND BRUSH FASCINE MATRIX STRUCTURES AND LIMIT THE USE OF ROCK AND VEGETATED SOIL LIFTS. LARGE WOOD WILL BE USED ONLY WHERE NECESSARY FOR BANK STABILIZATION AND POOL HABITAT DEVELOPMENT/ENHANCEMENT.
- SHAPE THE CHANNEL TO FORM THE APPROPRIATE CHANNEL DIMENSIONS WITHIN THE OVER-WIDENED STREAM CORRIDOR, INCLUDING RIFFLE, RUN, POOL AND GLIDE CHANNEL HABITAT FEATURES;
- INCREASE SINUOSITY WHILE MAINTAINING OPEN WATER HABITAT THROUGH THE USE OF FINGER BARS (VEGETATED FLOODPLAIN SURFACES), ALCOVES, AND BACKWATER BAYS.
- EXPAND THE FLOODPLAIN IN ENTRENCHED SECTIONS BY REDUCING BANK HEIGHTS AND CREATING A NARROW FLOODPLAIN CORRIDOR THAT WILL SUPPORT EMERGENT AND SCRUB-SHRUB WETLANDS. CONVERT THE "F" STREAM TYPE SECTIONS TO "B" STREAM TYPES WHERE FEASIBLE.
- INCREASE AQUATIC HABITAT COMPLEXITY IN AREAS WHERE COST LIMITS MORE ACTIVE RESTORATION OPPORTUNITIES.
- MITIGATE WATER QUALITY AND HABITAT IMPACTS WHERE THE STREAM INTERACTS WITH THE HIGHWAY EMBANKMENT.

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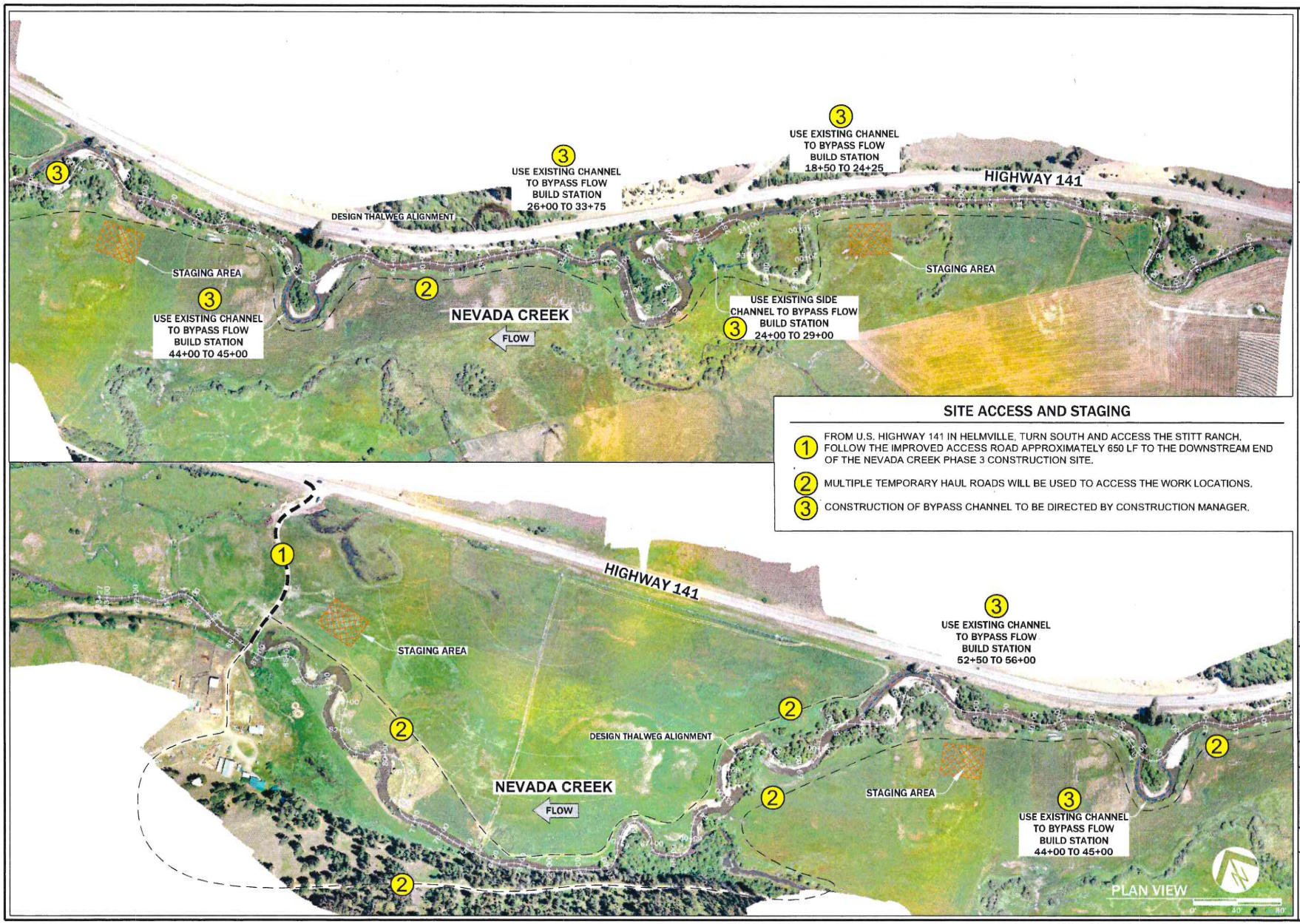
SITE PLAN AND INDEX

NEVADA CREEK PHASE 3
NEAR HELMVILLE, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
1	9-01-18	KW	75% DESIGN	JM

PROJECT NUMBER
RDG-18-001

SHEET NUMBER
3.0



SITE ACCESS AND STAGING

1. FROM U.S. HIGHWAY 141 IN HELMVILLE, TURN SOUTH AND ACCESS THE STITT RANCH. FOLLOW THE IMPROVED ACCESS ROAD APPROXIMATELY 650 LF TO THE DOWNSTREAM END OF THE NEVADA CREEK PHASE 3 CONSTRUCTION SITE.
2. MULTIPLE TEMPORARY HAUL ROADS WILL BE USED TO ACCESS THE WORK LOCATIONS.
3. CONSTRUCTION OF BYPASS CHANNEL TO BE DIRECTED BY CONSTRUCTION MANAGER.

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ACCESS, STAGING AND DEWATERING PLAN

NEVADA CREEK PHASE 3
NEAR HELMVILLE, MONTANA

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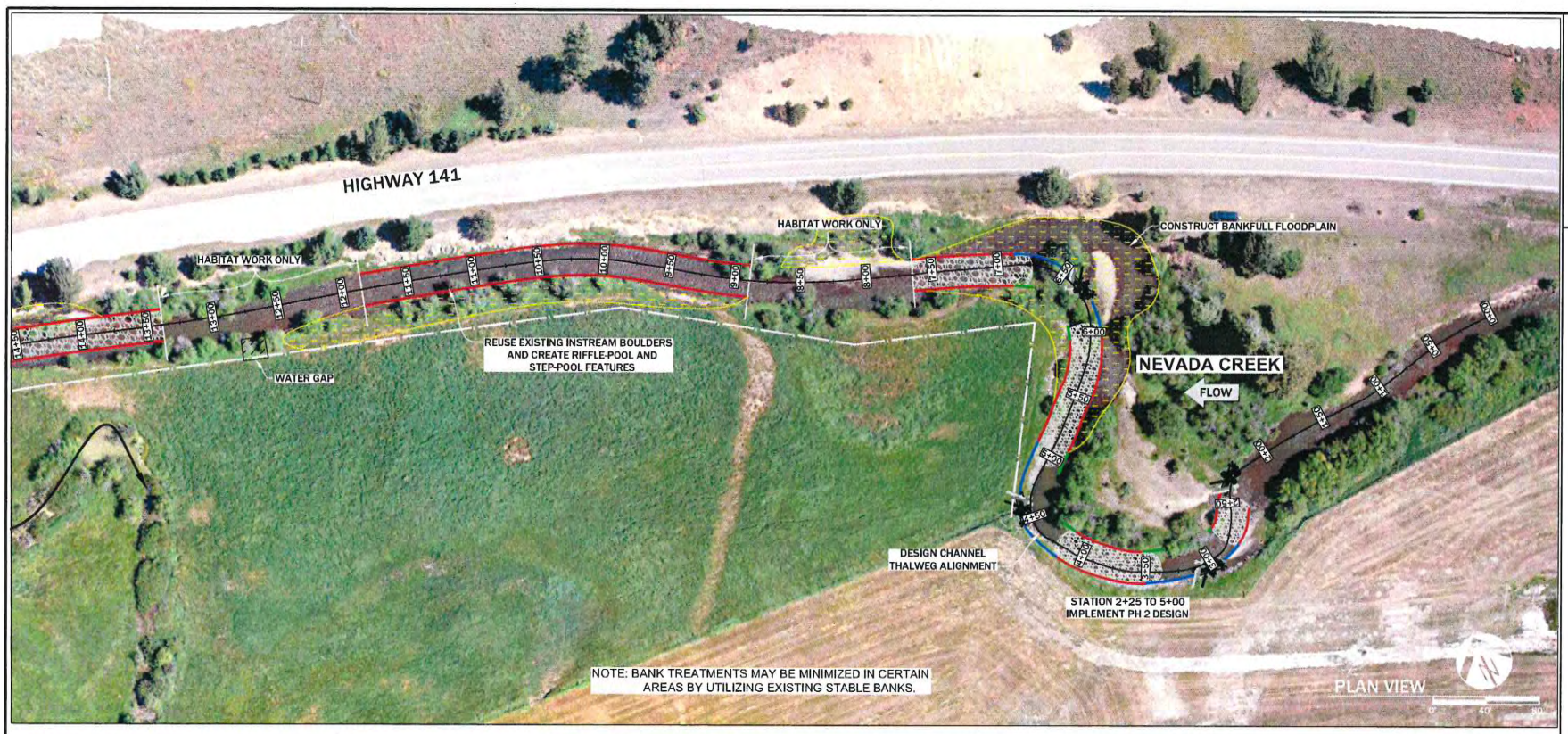
PROJECT NUMBER
RDG-18-001

SHEET NUMBER
3.1



CHANNEL TOP OF BANK ELEVATIONS

STATION	ELEVATION (FT)
0+00	4517.19
1+00	4516.68
2+00	4516.16
3+00	4515.70
4+00	4515.20
5+00	4514.71
6+00	4514.28
7+00	4513.76
8+00	4513.43
9+00	4513.08
10+00	4512.75
11+00	4512.44
12+00	4512.12
13+00	4511.78
14+00	4511.45

LEGEND

STRUCTURES	DETAIL SHEET #
LARGE WOOD STRUCTURE (LWS)	6.1
SOD AND BRUSH BANK TYPE 1 (SBB 1)	6.2
SOD AND BRUSH BANK TYPE 2 (SBB 2)	6.2
SOD AND BRUSH BANK TYPE 3 (SBB 3)	6.2
CONSTRUCTED STREAMBED (CS)	6.3
BANKFULL FLOODPLAIN/ FLOODPLAIN ROUGHNESS	6.4
ALCOVE	
ELECTRIC FENCE LINE	
BARB WIRE FENCE LINE	

STRUCTURE SCHEDULE

STATION START	STATION END	BANK	STRUCTURE	STATION START	STATION END	BANK	STRUCTURE
0+00	2+21	C	CS	4+67	5+08	L	SBB 3
0+00	2+11	L	SBB 2	4+90	6+08	C	CS
2+20	2+40	R	LWS	4+90	5+08	R	SBB 1
2+40	2+84	C	CS	5+08	5+95	R	SBB 2
2+40	2+77	R	SBB 2	5+08	5+95	L	SBB 2
2+50	2+92	L	SBB 3	5+95	6+08	L	SBB 1
2+77	2+84	R	SBB 1	5+95	6+25	R	SBB 3
2+92	3+12	L	LWS	6+25	6+45	R	LWS
3+12	3+51	L	SBB 3	6+45	6+88	R	SBB 3
3+32	4+29	C	CS	6+68	18+63	C	CS
3+32	3+51	R	SBB 1	6+68	6+88	L	SBB 1
3+51	4+15	R	SBB 2	6+88	7+65	R	SBB 2
3+51	4+15	L	SBB 2	6+88	7+65	L	SBB 2
4+15	4+29	R	SBB 1	8+90	11+85	R	SBB 2
4+15	4+47	L	SBB 3	8+90	11+85	L	SBB 2
4+47	4+67	L	LWS	13+35	18+50	R	SBB 2
				13+35	18+50	L	SBB 2

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PLAN VIEW AND DATA SHEET

NEVADA CREEK PHASE 3
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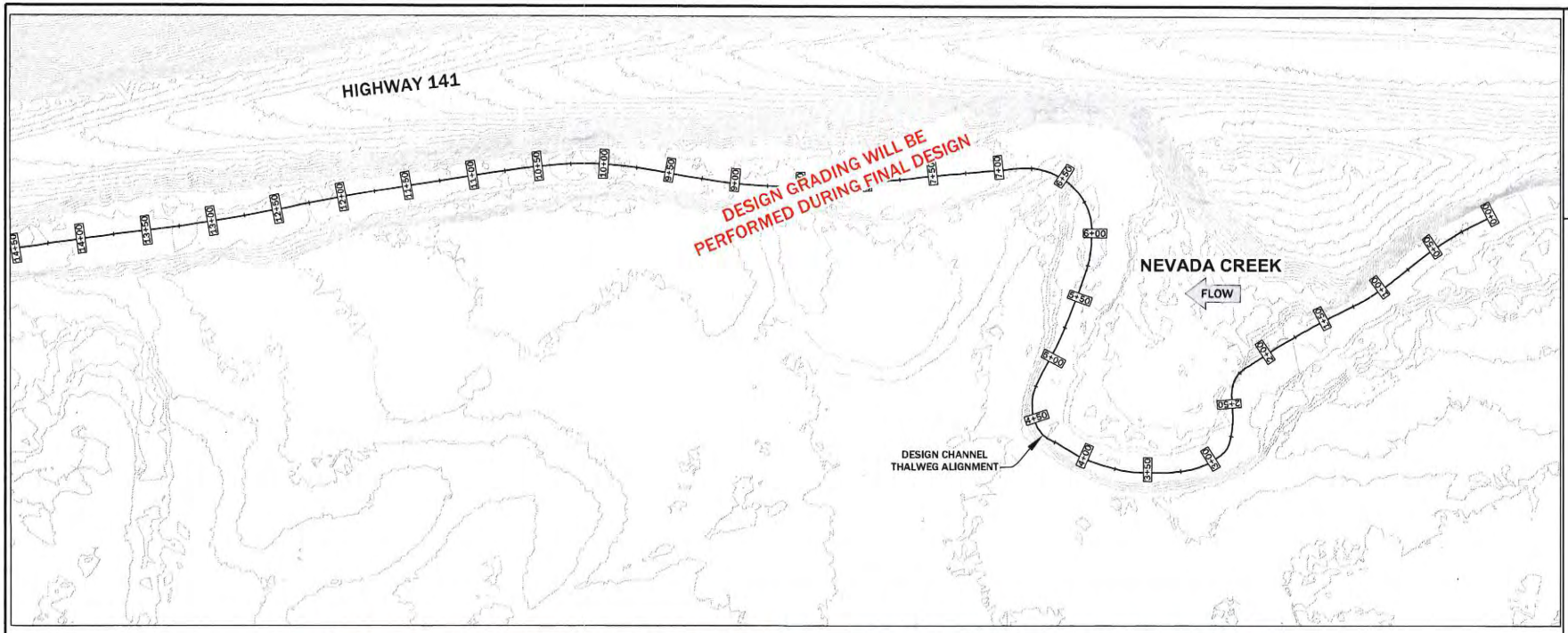
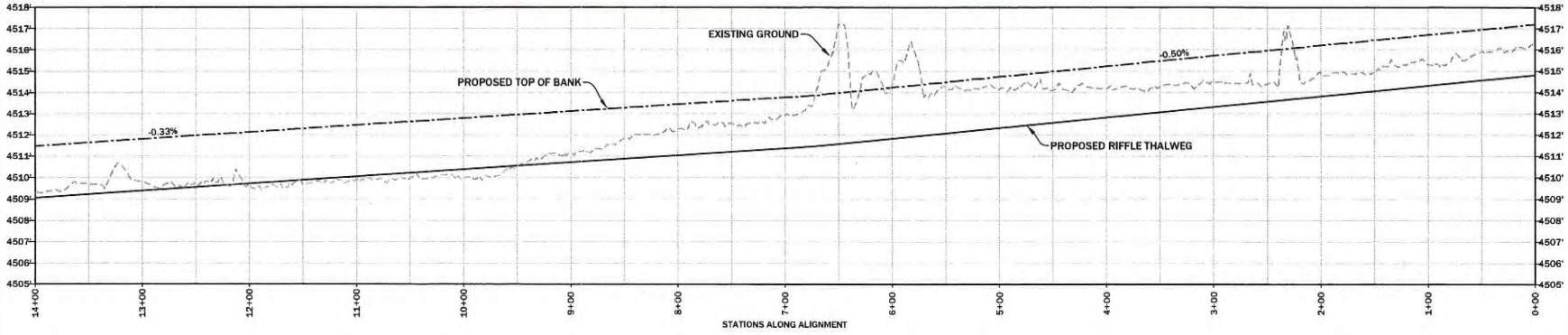


EXISTING GROUND SURFACE COMPARED TO NC PH 3 DESIGN SURFACE



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GRADING PLAN AND PROFILE

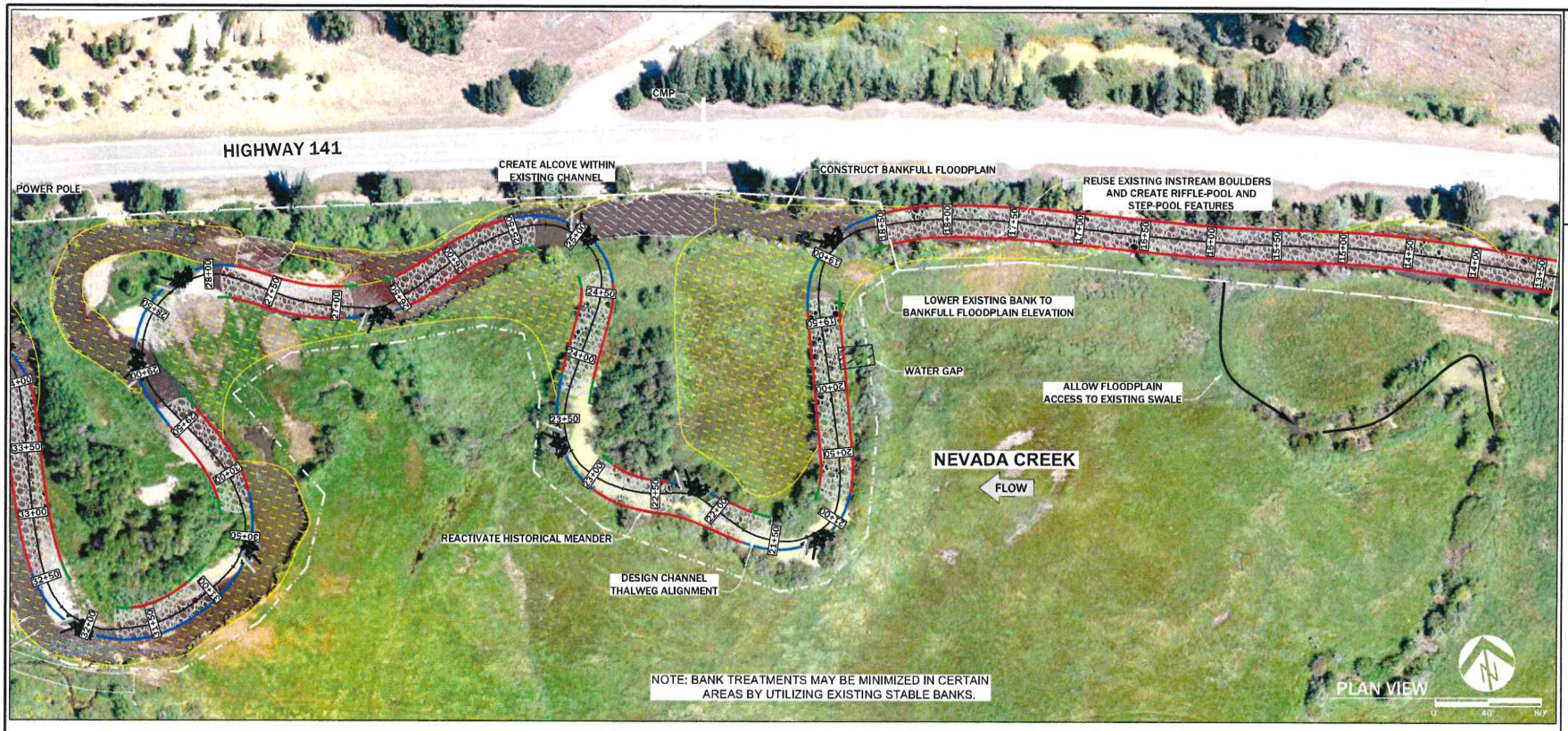
NEVADA CREEK PHASE 3

NEAR HELMVILLE, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
1	9-21-18	NW	75% DESIGN	JM

PROJECT NUMBER
RDG-18-001

SHEET NUMBER
4.1



CHANNEL TOP OF BANK ELEVATIONS

STATION	ELEVATION (FT)
15+00	4511.13
16+00	4510.80
17+00	4510.45
18+00	4510.14
19+00	4509.76
20+00	4509.48
21+00	4509.13
22+00	4508.81
23+00	4508.45
24+00	4508.11
25+00	4507.81
26+00	4507.50
27+00	4507.15
28+00	4506.72
29+00	4506.17
30+00	4505.87
31+00	4505.47
32+00	4505.08

LEGEND

STRUCTURES	DETAIL SHEET #
LARGE WOOD STRUCTURE (LWS)	6.1
SOD AND BRUSH BANK TYPE 1 (SBB 1)	6.2
SOD AND BRUSH BANK TYPE 2 (SBB 2)	6.2
SOD AND BRUSH BANK TYPE 3 (SBB 3)	6.2
CONSTRUCTED STREAMBED (CS)	6.3
BANKFULL FLOODPLAIN/ FLOODPLAIN ROUGHNESS	6.4
ALCOVE	
ELECTRIC FENCE LINE	
BARB WIRE FENCE LINE	

STRUCTURE SCHEDULE

STATION START	STATION END	BANK	STRUCTURE	STATION START	STATION END	BANK	STRUCTURE	STATION START	STATION END	BANK	STRUCTURE
13+35	18+50	R	SBB 2	22+32	23+06	C	CS	26+78	26+93	L	SBB 3
13+35	18+50	L	SBB 2	22+93	23+06	R	SBB 1	26+81	27+95	C	CS
18+50	18+63	L	SBB 1	22+93	23+23	L	SBB 3	26+81	26+93	R	SBB 1
18+50	18+80	R	SBB 3	23+23	23+43	L	LWS	26+93	27+81	R	SBB 2
18+80	19+00	R	LWS	23+43	23+84	L	SBB 3	26+93	27+81	L	SBB 2
19+00	19+41	R	SBB 3	23+65	24+70	C	CS	27+81	27+95	L	SBB 1
19+22	20+92	C	CS	23+65	23+84	R	SBB 1	27+81	28+11	R	SBB 3
19+22	19+41	L	SBB 1	23+84	24+56	R	SBB 2	28+11	28+31	R	LWS
19+41	20+79	R	SBB 2	23+84	24+56	L	SBB 2	28+31	28+83	R	SBB 3
19+41	20+79	L	SBB 2	24+56	24+70	L	SBB 1	28+83	29+03	R	LWS
20+79	20+92	R	SBB 1	24+56	24+88	R	SBB 3	29+03	29+44	R	SBB 3
20+79	21+10	L	SBB 3	24+88	25+08	R	LWS	29+25	30+30	C	CS
21+10	21+30	L	LWS	25+08	25+50	R	SBB 3	29+25	29+44	L	SBB 1
21+30	21+73	L	SBB 3	25+31	26+58	C	CS	29+44	30+17	R	SBB 2
21+54	22+12	C	CS	25+31	25+50	L	SBB 1	29+44	30+17	L	SBB 2
21+54	21+73	R	SBB 1	25+50	26+47	R	SBB 2	30+17	30+30	R	SBB 1
21+73	22+11	R	SBB 2	25+50	26+47	L	SBB 2	30+17	30+47	L	SBB 3
21+73	22+93	L	SBB 2	26+47	26+58	R	SBB 1	30+47	30+67	L	LWS
22+11	22+31	R	LWS	26+47	26+58	L	SBB 3	30+67	31+96	L	SBB 3
22+31	22+93	R	SBB 2	26+58	26+78	L	LWS	30+89	31+79	C	CS
								31+96	32+16	L	LWS

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PLAN VIEW AND DATA SHEET

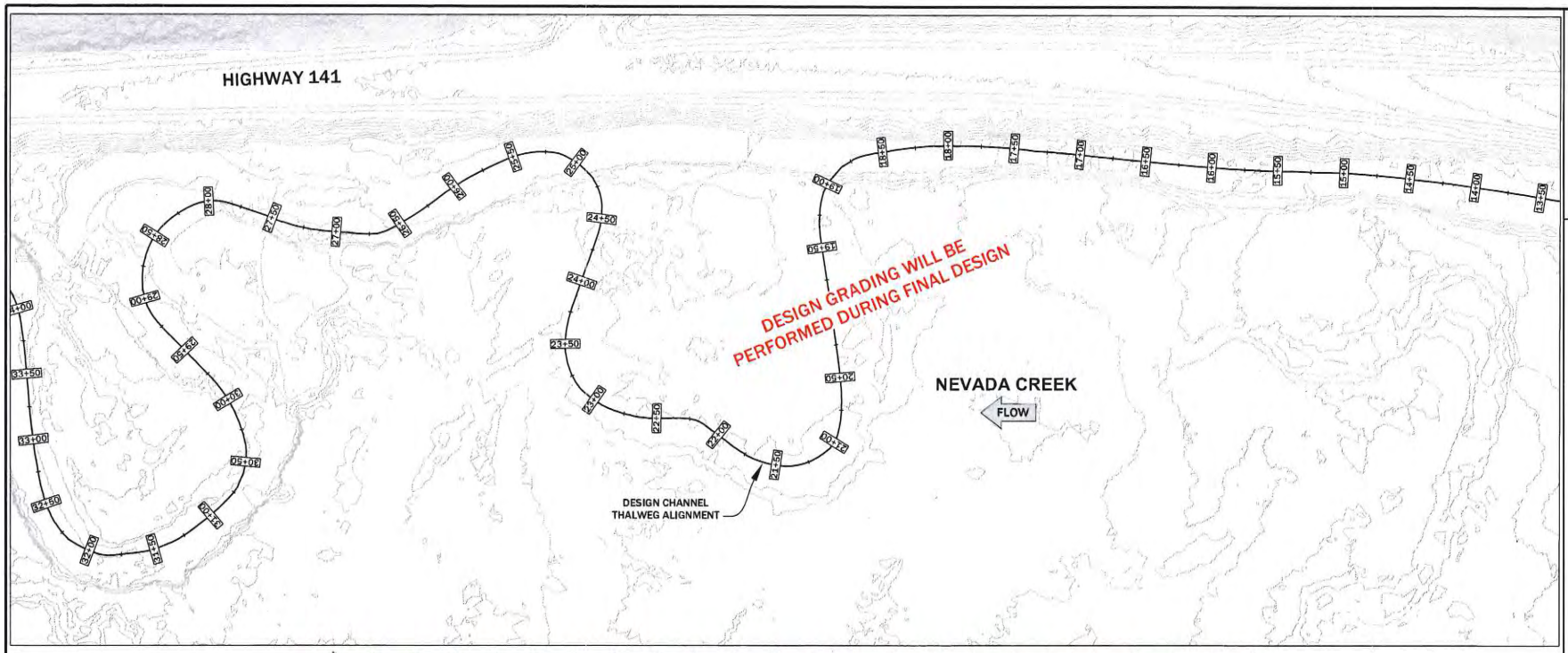
NEVADA CREEK PHASE 3

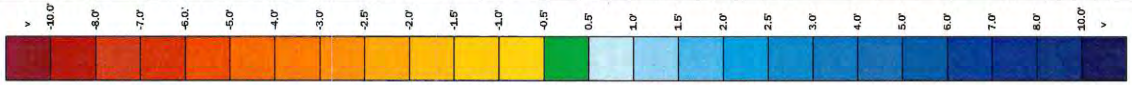
NEAR HELMVILLE, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
1	9-01-18	NW	75% DESIGN	JM

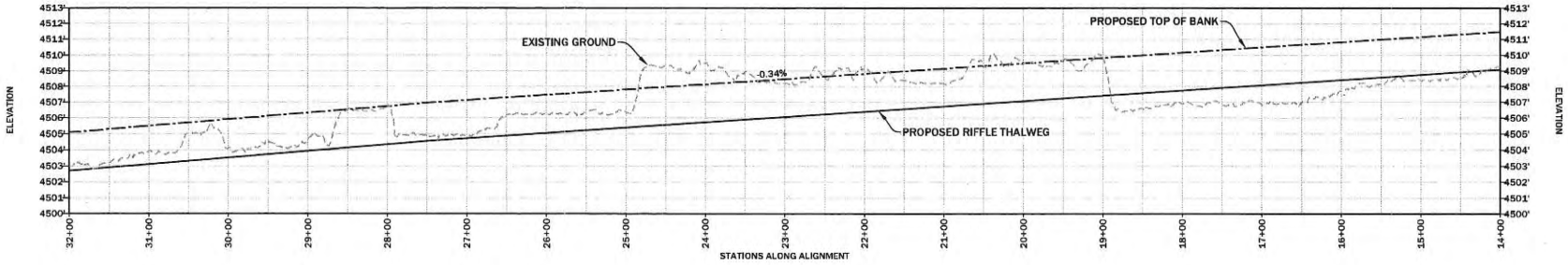
PROJECT NUMBER
RDG-18-001

SHEET NUMBER
4.2





EXISTING GROUND SURFACE COMPARED TO NC PH 3 DESIGN SURFACE



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GRADING PLAN AND PROFILE

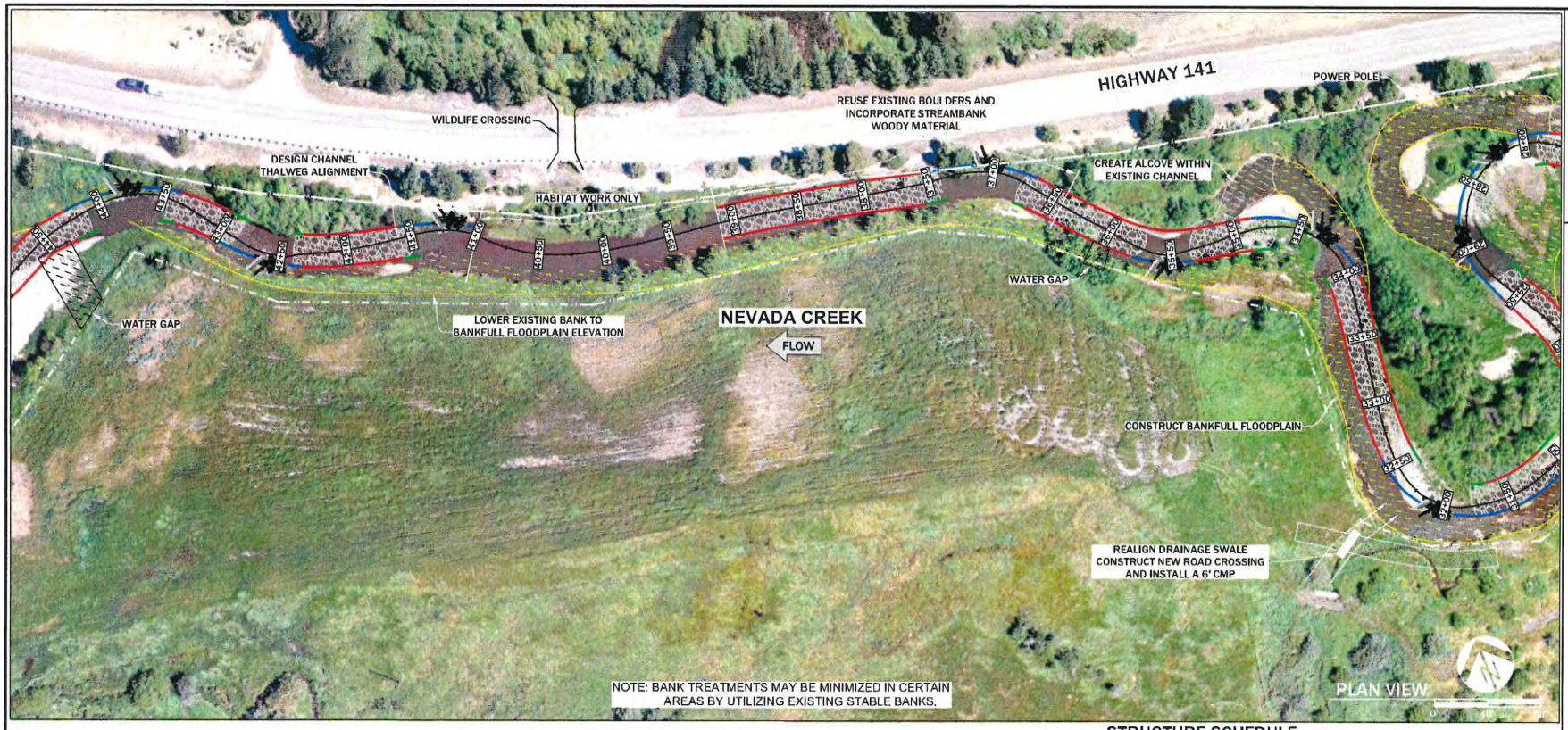
NEVADA CREEK PHASE 3

NEAR HELMVILLE, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
1	9-01-18	HW	75% DESIGN	JM

PROJECT NUMBER
RDG-18-001

SHEET NUMBER
4.3



CHANNEL TOP OF BANK ELEVATIONS

STATION	ELEVATION (FT)
33+00	4504.69
34+00	4504.37
35+00	4503.91
36+00	4503.52
37+00	4503.11
38+00	4502.72
39+00	4502.31
40+00	4501.88
41+00	4501.47
42+00	4501.07
43+00	4500.65
44+00	4500.26

LEGEND

STRUCTURES	DETAIL SHEET #
LARGE WOOD STRUCTURE (LWS)	6.1
SOD AND BRUSH BANK TYPE 1 (SBB 1)	6.2
SOD AND BRUSH BANK TYPE 2 (SBB 2)	6.2
SOD AND BRUSH BANK TYPE 3 (SBB 3)	6.2
CONSTRUCTED STREAMBED (CS)	6.3
BANKFULL FLOODPLAIN/ FLOODPLAIN ROUGHNESS	6.4
ALCOVE	
ELECTRIC FENCE LINE	
BARB WIRE FENCE LINE	

STRUCTURE SCHEDULE

STATION START	STATION END	BANK	STRUCTURE	STATION START	STATION END	BANK	STRUCTURE
32+16	32+57	L	SBB 3	37+37	37+55	L	SBB 1
32+38	34+08	C	CS	37+55	40+91	R	SBB 2
32+38	32+57	R	SBB 1	37+55	40+91	L	SBB 2
32+57	33+95	R	SBB 2	40+91	41+11	L	SBB 1
32+57	33+95	L	SBB 2	40+91	41+09	R	SBB 3
33+95	34+08	L	SBB 1	41+09	41+29	R	LWS
33+95	34+24	R	SBB 3	41+29	41+58	R	SBB 3
34+24	34+44	R	LWS	41+43	42+42	C	CS
34+44	34+86	R	SBB 3	41+43	41+58	L	SBB 1
34+67	35+44	C	CS	41+58	42+34	R	SBB 2
34+67	34+86	L	SBB 1	41+58	42+34	L	SBB 2
34+86	36+66	R	SBB 2	42+34	42+42	R	SBB 1
34+86	35+33	L	SBB 2	42+34	42+48	L	SBB 3
35+33	35+44	L	SBB 3	42+48	42+68	L	LWS
35+44	35+64	L	LWS	42+58	42+97	R	SBB 1
35+64	35+80	L	SBB 3	42+68	42+97	L	SBB 3
35+67	36+79	C	CS	42+82	43+50	C	CS
35+80	36+66	L	SBB 2	42+97	43+37	R	SBB 2
36+66	36+79	L	SBB 1	42+97	43+37	L	SBB 2
36+66	36+95	R	SBB 3	43+37	43+50	L	SBB 1
36+95	37+15	R	LWS	43+37	43+66	R	SBB 3
37+15	37+55	R	SBB 3	43+66	43+86	R	LWS
37+37	41+01	C	CS	43+86	43+89	R	SBB 3

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PLAN VIEW AND DATA SHEET

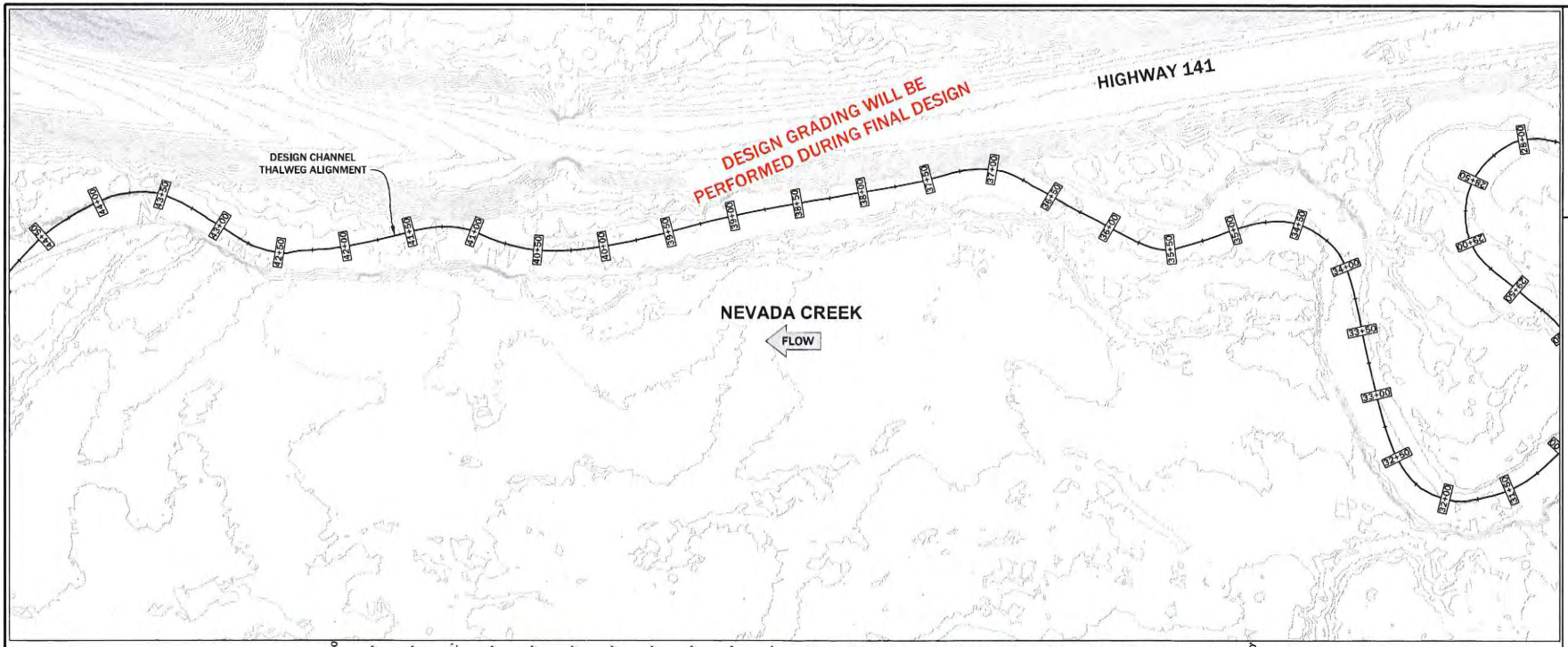
NEVADA CREEK PHASE 3

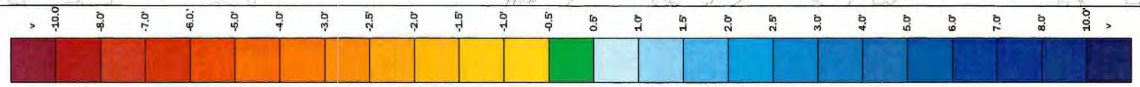
NEAR HELMVILLE, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
1	9-01-18	NW	75% DESIGN	JM

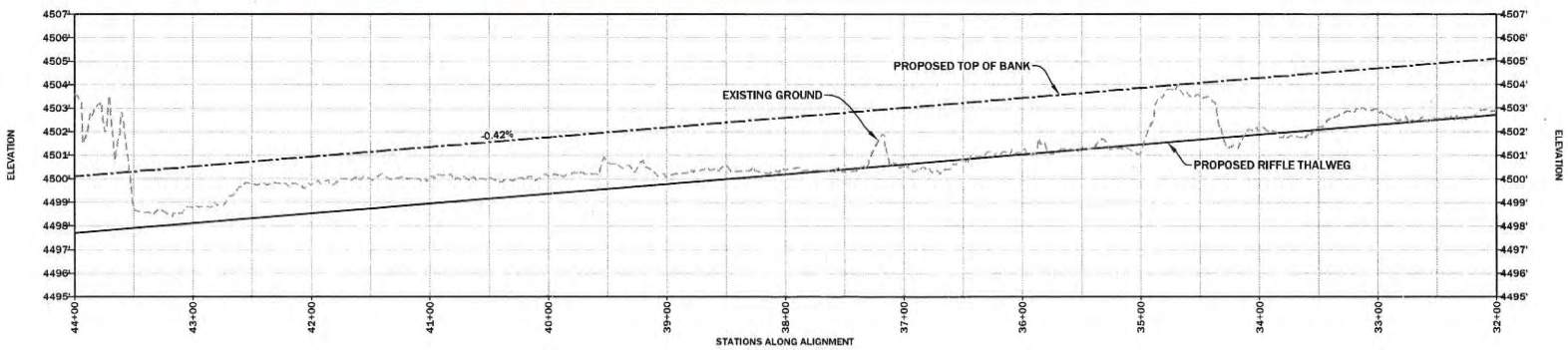
PROJECT NUMBER
RDG-18-001

SHEET NUMBER
4.4





EXISTING GROUND SURFACE COMPARED TO NC PH 3 DESIGN SURFACE



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GRADING PLAN AND PROFILE

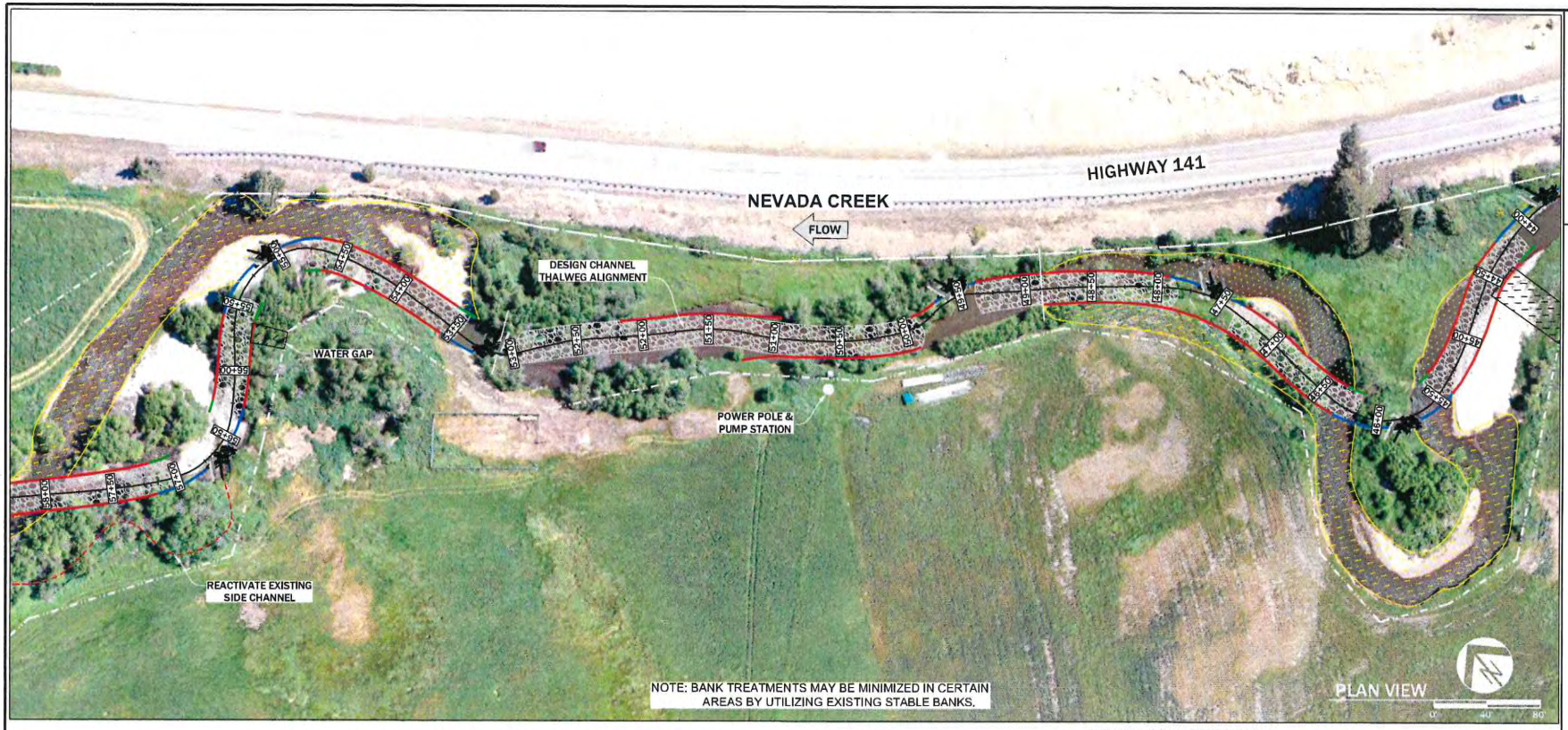
NEVADA CREEK PHASE 3

NEAR HELMVILLE, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
1	9.01.18	KVW	75% DESIGN	JM

PROJECT NUMBER
RDG-18-001

SHEET NUMBER
4.5



CHANNEL TOP OF BANK ELEVATIONS

STATION	ELEVATION (FT)
45+00	4499.81
46+00	4499.27
47+00	4498.76
48+00	4498.36
49+00	4497.95
50+00	4497.55
51+00	4497.14
52+00	4496.73
53+00	4496.33
54+00	4495.78
55+00	4495.13
56+00	4494.49
57+00	4493.84

LEGEND

STRUCTURES	DETAIL SHEET #
LARGE WOOD STRUCTURE (LWS)	6.1
SOD AND BRUSH BANK TYPE 1 (SBB 1)	6.2
SOD AND BRUSH BANK TYPE 2 (SBB 2)	6.2
SOD AND BRUSH BANK TYPE 3 (SBB 3)	6.2
CONSTRUCTED STREAMBED (CS)	6.3
BANKFULL FLOODPLAIN/ FLOODPLAIN ROUGHNESS	6.4
ALCOVE	
ELECTRIC FENCE LINE	
BARB WIRE FENCE LINE	

STRUCTURE SCHEDULE

STATION START	STATION END	BANK	STRUCTURE	STATION START	STATION END	BANK	STRUCTURE
43+89	45+40	R	SBB 2	49+83	53+00	C	CS
44+08	45+53	C	CS	50+95	52+16	R	SBB 2
44+08	44+26	L	SBB 1	51+48	51+68	L	LWS
44+26	45+40	L	SBB 2	51+68	53+56	L	SBB 3
45+40	45+53	R	SBB 1	53+41	54+81	C	CS
45+40	45+70	L	SBB 3	53+41	53+56	R	SBB 1
45+70	45+90	L	LWS	53+56	54+67	R	SBB 2
45+90	46+33	L	SBB 3	53+56	54+67	L	SBB 2
46+14	47+45	C	CS	54+67	54+81	L	SBB 1
46+14	46+33	R	SBB 1	54+67	54+97	R	SBB 3
46+33	47+32	R	SBB 2	54+97	55+17	R	LWS
46+33	47+30	L	SBB 2	55+17	55+59	R	SBB 3
47+32	47+47	R	SBB 3	55+40	56+40	C	CS
47+47	47+67	R	LWS	55+40	55+59	L	SBB 1
47+67	47+93	R	SBB 3	55+59	56+26	R	SBB 2
47+75	49+44	C	CS	55+59	56+26	L	SBB 2
47+93	49+36	R	SBB 2	56+26	56+40	R	SBB 1
48+35	49+70	L	SBB 2	56+26	56+56	L	SBB 3
49+36	49+50	R	SBB 3	56+56	56+76	L	LWS
49+50	49+70	R	LWS	56+76	57+17	L	SBB 3
49+70	49+92	R	SBB 3	56+98	58+72	C	CS
				56+98	57+17	R	SBB 1

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PLAN VIEW AND DATA SHEET

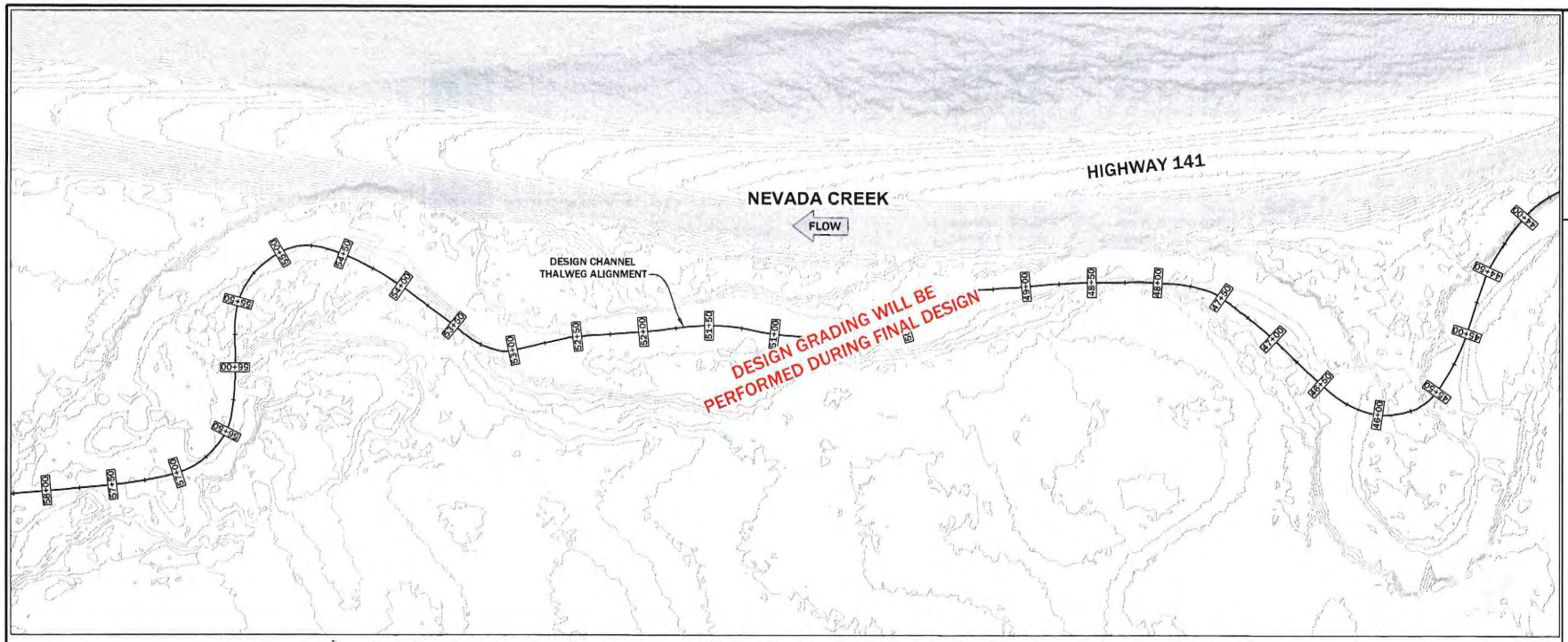
NEVADA CREEK PHASE 3

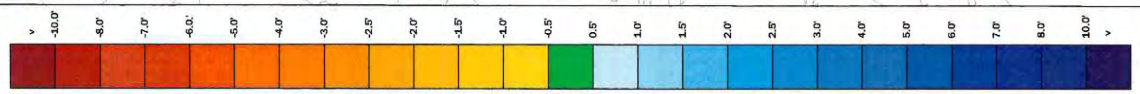
NEAR HELMVILLE, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
1	9-01-18	NW	75% DESIGN	JM

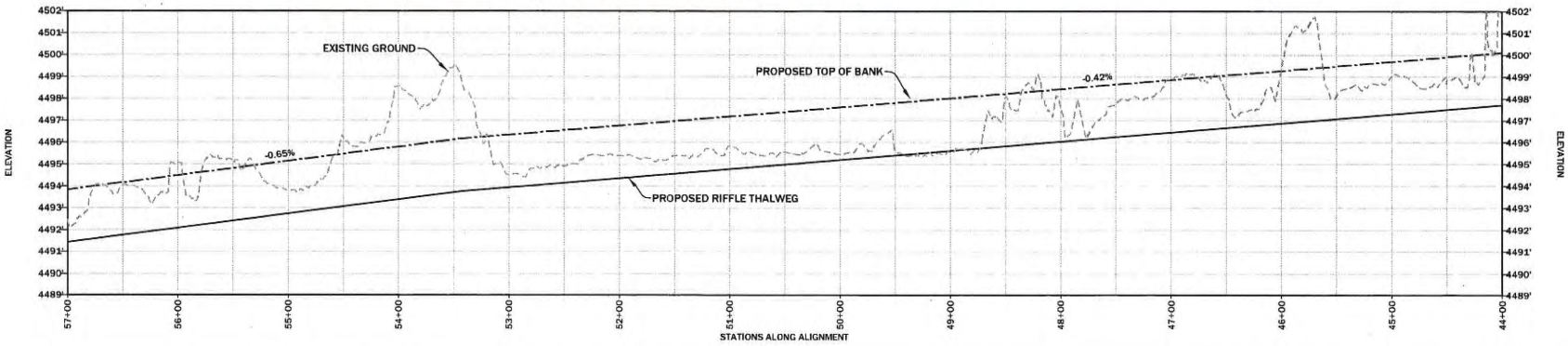
PROJECT NUMBER
RDG-18-001

SHEET NUMBER
4.6





EXISTING GROUND SURFACE COMPARED TO NC PH 3 DESIGN SURFACE



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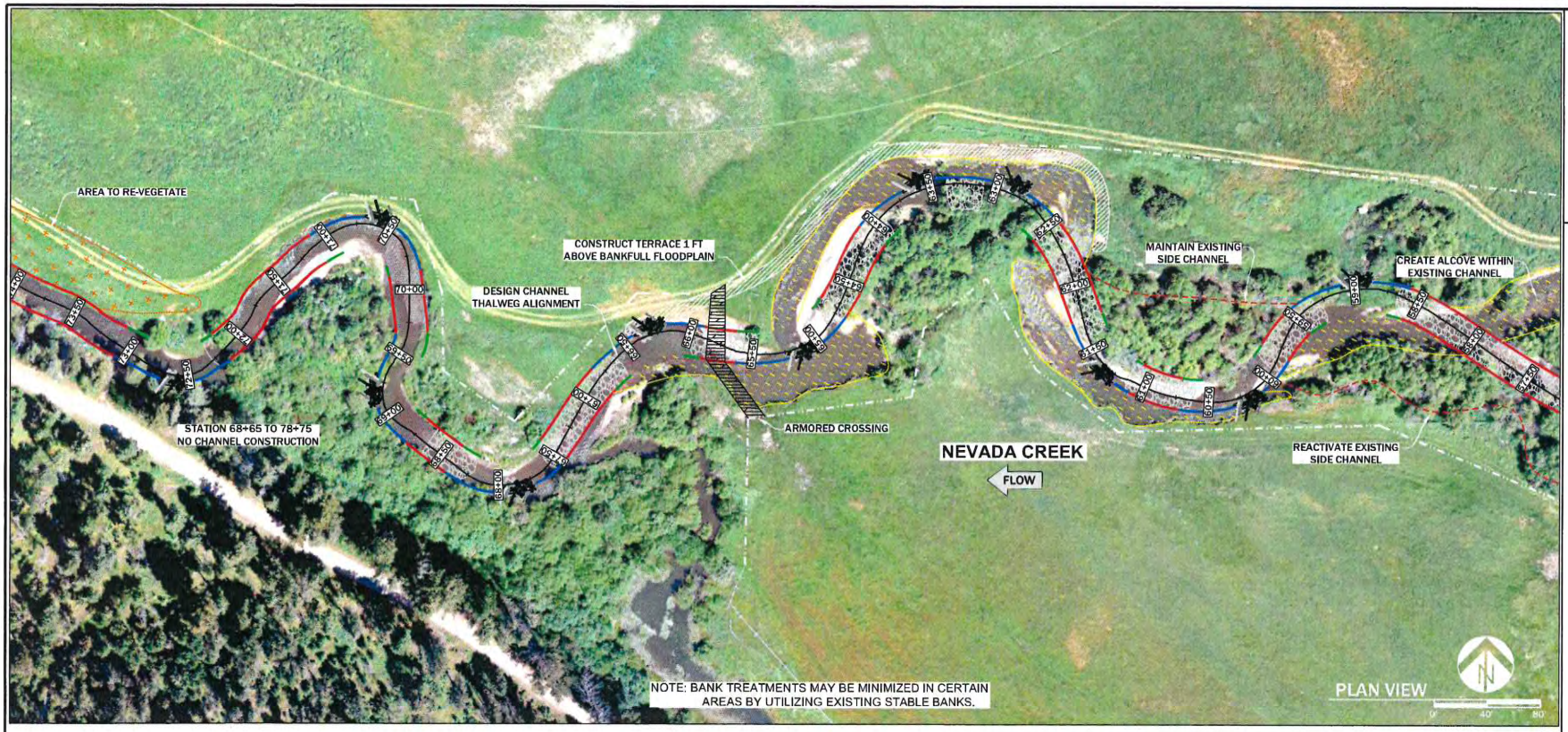
GRADING PLAN AND PROFILE

NEVADA CREEK PHASE 3
NEAR HELMVILLE, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
1	9-01-18	NW	75% DESIGN	JM

PROJECT NUMBER
RDG-18-001

SHEET NUMBER
4.7



CHANNEL TOP OF BANK ELEVATIONS

STATION	ELEVATION (FT)
58+00	4493.17
59+00	4492.50
60+00	4491.87
61+00	4491.26
62+00	4490.94
63+00	4490.61
64+00	4490.29
65+00	4489.92
66+00	4489.50
67+00	4489.17
68+00	4488.85
69+00	4488.53
70+00	4488.21
71+00	4487.89
72+00	4487.55
73+00	4487.23

LEGEND

STRUCTURES	DETAIL SHEET #
LARGE WOOD STRUCTURE (LWS)	6.1
SOD AND BRUSH BANK TYPE 1 (SBB 1)	6.2
SOD AND BRUSH BANK TYPE 2 (SBB 2)	6.2
SOD AND BRUSH BANK TYPE 3 (SBB 3)	6.2
CONSTRUCTED STREAMBED (CS)	6.3
BANKFULL FLOODPLAIN/ FLOODPLAIN ROUGHNESS	6.4
ALCOVE	
REVEGETATION ZONE	
ELECTRIC FENCE LINE	
BARB WIRE FENCE LINE	

STRUCTURE SCHEDULE

STATION START	STATION END	BANK	STRUCTURE	STATION START	STATION END	BANK	STRUCTURE	STATION START	STATION END	BANK	STRUCTURE	STATION START	STATION END	BANK	STRUCTURE
57+17	58+59	R	SBB 2	61+24	61+44	L	LWS	65+22	65+63	L	SBB 3	68+40	68+76	R	SBB 2
57+17	58+59	L	SBB 2	61+44	61+74	R	SBB 3	65+44	66+02	C	CS	68+76	68+89	R	SBB 1
58+59	58+72	L	SBB 1	61+44	61+74	L	SBB 3	65+44	65+63	R	SBB 1	69+08	69+28	L	LWS
58+59	58+88	R	SBB 3	61+58	62+63	C	CS	65+63	65+89	R	SBB 2	69+28	69+67	L	SBB 3
58+88	59+08	R	LWS	61+74	62+50	R	SBB 2	65+63	65+89	L	SBB 2	69+50	70+28	C	CS
59+08	59+49	R	SBB 3	61+74	62+50	L	SBB 2	65+89	66+02	L	SBB 1	69+50	69+67	R	SBB 1
59+30	59+94	C	CS	62+50	62+63	L	SBB 1	65+89	66+19	R	SBB 3	69+67	70+14	R	SBB 2
59+30	59+49	L	SBB 1	62+50	62+79	R	SBB 3	66+19	66+39	R	LWS	69+67	70+14	L	SBB 2
59+49	59+81	R	SBB 2	62+79	62+99	R	LWS	66+39	66+80	R	SBB 3	70+14	70+28	L	SBB 1
59+49	59+81	L	SBB 2	62+99	63+48	R	SBB 3	66+62	67+60	C	CS	70+14	70+47	R	SBB 3
59+81	59+94	R	SBB 1	63+48	63+68	R	LWS	66+62	66+80	L	SBB 1	70+47	70+67	R	LWS
59+81	60+11	L	SBB 3	63+68	64+09	R	SBB 3	66+80	67+46	R	SBB 2	70+67	71+10	R	SBB 3
60+11	60+31	L	LWS	63+90	64+85	C	CS	66+80	67+46	L	SBB 2	70+91	72+30	C	CS
60+31	61+24	L	SBB 3	63+90	64+09	L	SBB 1	67+46	67+60	R	SBB 1	70+91	71+10	L	SBB 1
60+53	61+18	C	CS	64+09	64+72	R	SBB 2	67+46	67+77	L	SBB 3	71+10	72+17	R	SBB 2
60+53	60+72	R	SBB 1	64+09	64+72	L	SBB 2	67+77	67+97	L	LWS	71+10	72+17	L	SBB 2
60+72	61+09	R	SBB 2	64+72	64+85	R	SBB 1	67+97	69+08	L	SBB 3	72+17	72+30	R	SBB 1
61+09	61+24	R	SBB 3	64+72	65+02	L	SBB 3	68+20	68+89	C	CS	72+17	72+48	L	SBB 3
61+24	61+44	R	LWS	65+02	65+22	L	LWS	68+20	68+40	R	SBB 1	72+48	72+68	L	LWS
												72+68	73+08	L	SBB 3

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PLAN VIEW AND DATA SHEET

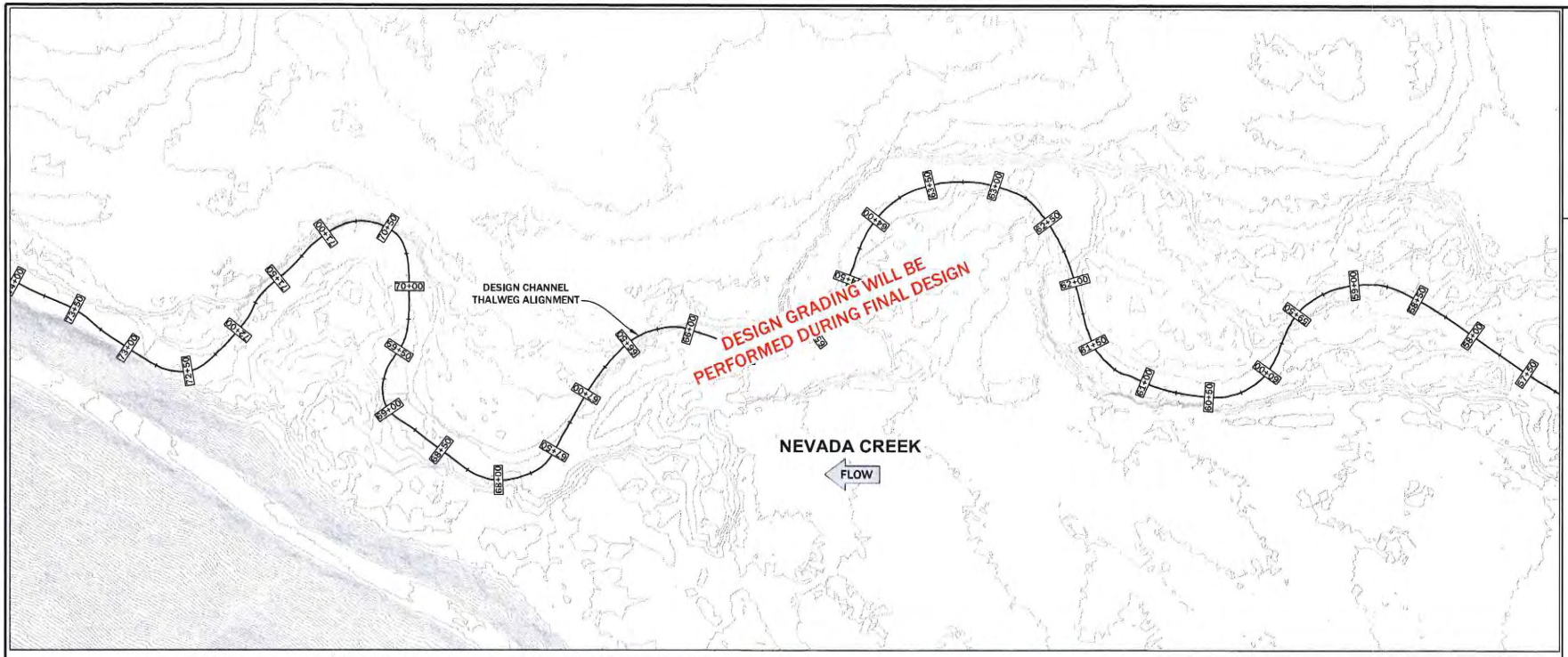
NEVADA CREEK PHASE 3

NEAR HELMVILLE, MONTANA

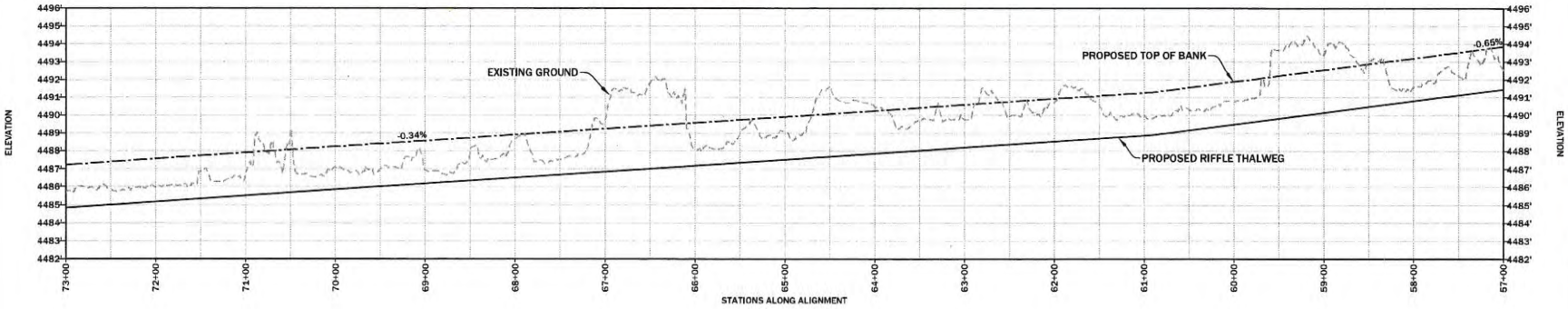
NO.	DATE	BY	DESCRIPTION	CHK
1	9-01-18	NW	75% DESIGN	JM

PROJECT NUMBER
RDG-18-001

SHEET NUMBER
4.8



EXISTING GROUND SURFACE COMPARED TO NC PH 3 DESIGN SURFACE



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GRADING PLAN AND PROFILE

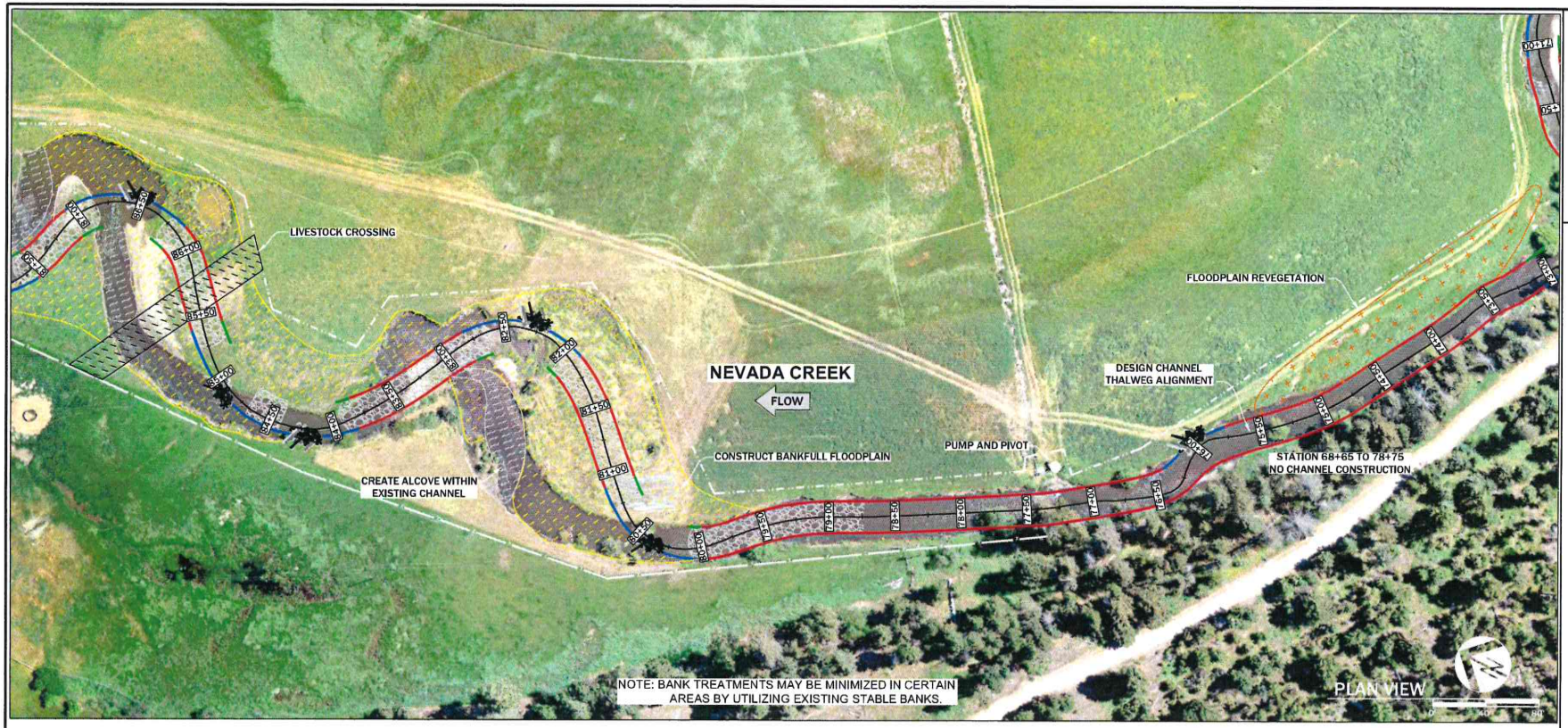
NEVADA CREEK PHASE 3

NEAR HELMVILLE, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK.
1	9-07-18	KVV	75% DESIGN	JM

PROJECT NUMBER
RDG-18-001

SHEET NUMBER
4.9



CHANNEL TOP OF BANK ELEVATIONS

STATION	ELEVATION (FT)
74+00	4486.89
75+00	4486.54
76+00	4486.21
77+00	4485.89
78+00	4485.55
79+00	4485.14
80+00	4484.70
81+00	4484.32
82+00	4483.91
83+00	4483.53
84+00	4483.12
85+00	4482.74

LEGEND

STRUCTURES	DETAIL SHEET #
LARGE WOOD STRUCTURE (LWS)	6.1
SOD AND BRUSH BANK TYPE 1 (SBB 1)	6.2
SOD AND BRUSH BANK TYPE 2 (SBB 2)	6.2
SOD AND BRUSH BANK TYPE 3 (SBB 3)	6.2
CONSTRUCTED STREAMBED (CS)	6.3
BANKFULL FLOODPLAIN/ FLOODPLAIN ROUGHNESS	6.4
ALCOVE	
REVEGETATION ZONE	
ELECTRIC FENCE LINE	
BARB WIRE FENCE LINE	

STRUCTURE SCHEDULE

STATION START	STATION END	BANK	STRUCTURE	STATION START	STATION END	BANK	STRUCTURE
72+90	75+83	C	CS	80+91	81+88	L	SBB 2
72+90	73+08	R	SBB 1	81+88	82+01	L	SBB 1
73+08	75+75	R	SBB 2	81+88	82+18	R	SBB 3
73+08	77+25	L	SBB 2	82+18	82+38	R	LWS
75+75	75+90	R	SBB 3	82+38	82+80	R	SBB 3
75+90	76+10	R	LWS	82+61	83+95	C	CS
76+10	76+36	R	SBB 3	82+61	82+80	L	SBB 1
76+36	80+00	R	SBB 2	82+80	83+82	R	SBB 2
76+53	80+13	C	CS	82+80	83+82	L	SBB 2
77+25	80+29	L	SBB 3	83+82	83+95	R	SBB 1
80+00	80+13	R	SBB 1	83+82	84+11	L	SBB 3
80+29	80+49	L	LWS	84+11	84+31	L	LWS
80+49	80+91	L	SBB 3	84+31	84+81	L	SBB 3
80+72	82+01	C	CS	84+81	85+01	L	LWS
80+72	80+91	R	SBB 1	84+81	86+14	L	SBB 2
80+91	81+88	R	SBB 2	85+01	85+40	L	SBB 3

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PLAN VIEW AND DATA SHEET

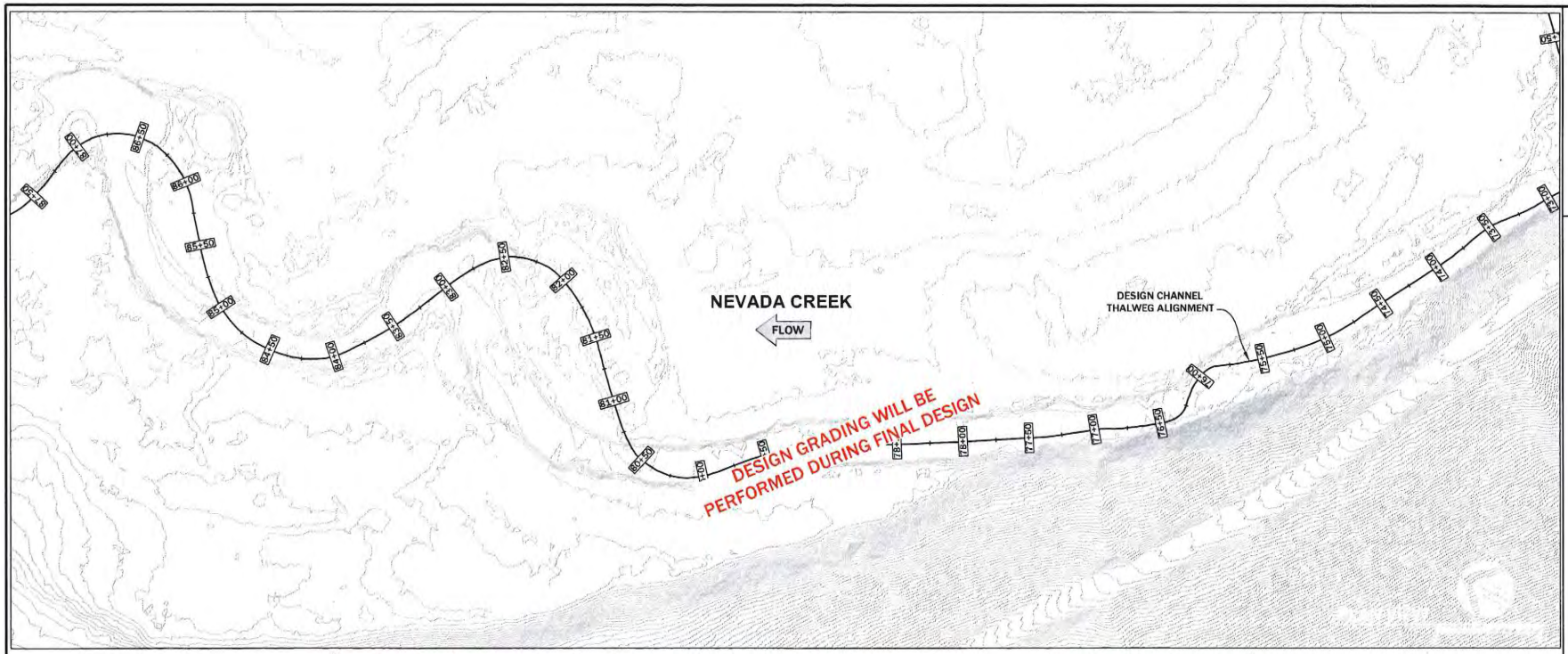
NEVADA CREEK PHASE 3

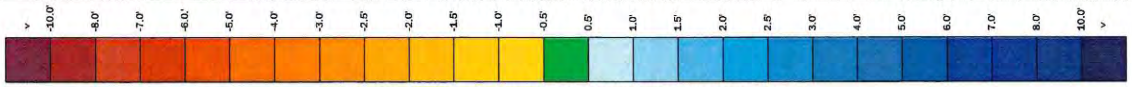
NEAR HELMVILLE, MONTANA

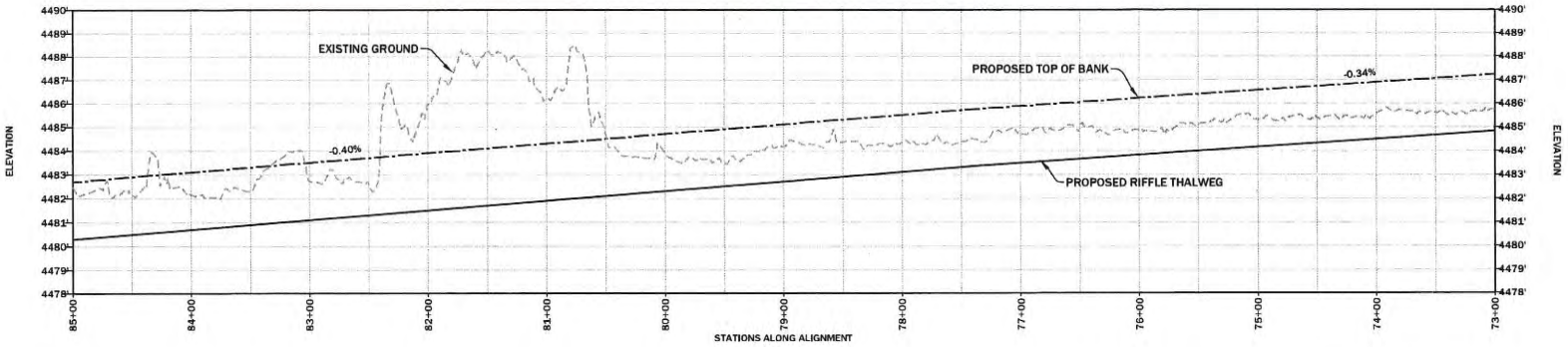
NO.	DATE	BY	DESCRIPTION	CHK
1	9-01-18	NW	75% DESIGN	JM

PROJECT NUMBER
RDG-18-001

SHEET NUMBER
4.10







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GRADING PLAN AND PROFILE

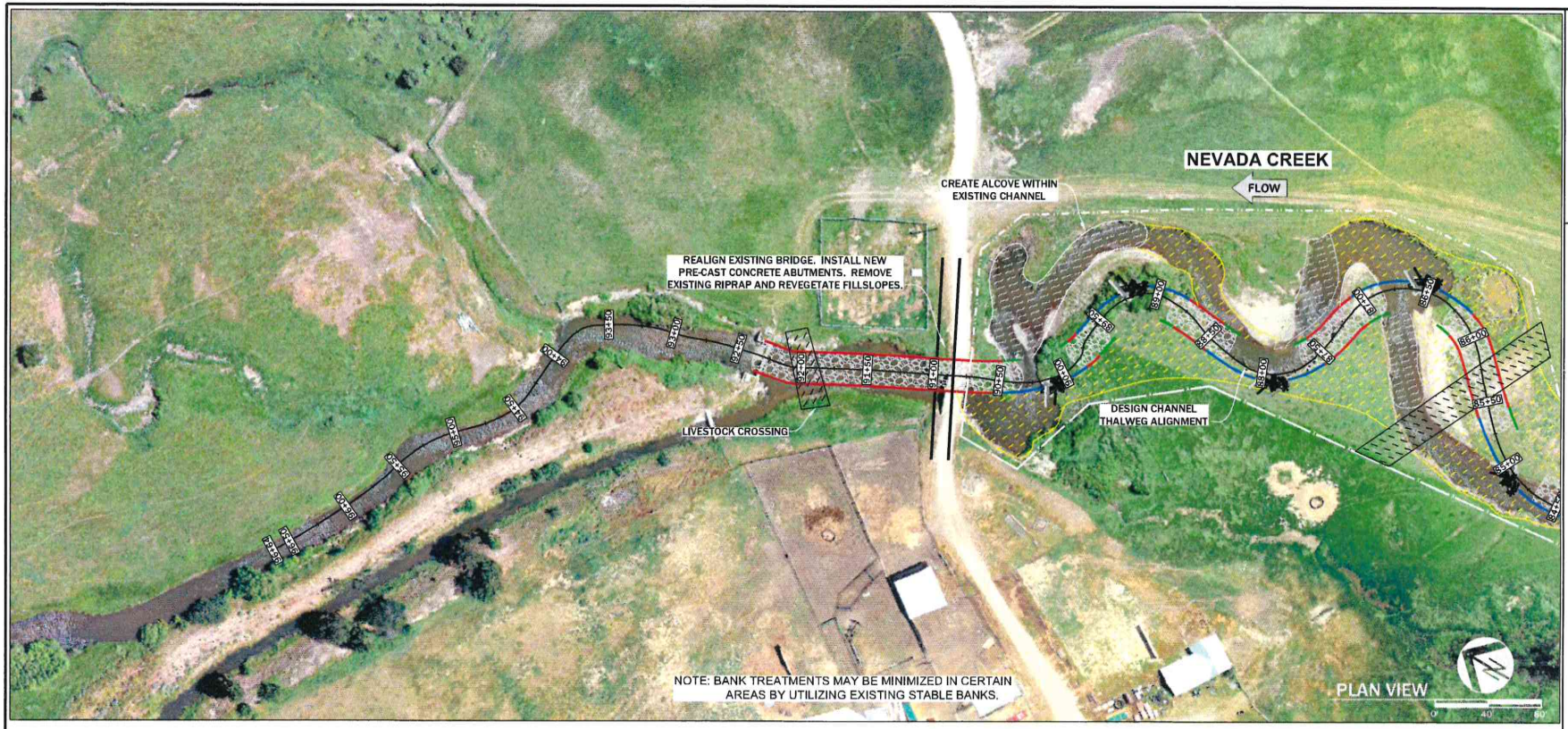
NEVADA CREEK PHASE 3

NEAR HELMVILLE, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
1	9-01-18	NW	75% DESIGN	JM

PROJECT NUMBER
RDG-18-001

SHEET NUMBER
4.11



CHANNEL TOP OF BANK ELEVATIONS

STATION	ELEVATION (FT)
86+00	4482.33
87+00	4481.95
88+00	4481.56
89+00	4481.17
90+00	4480.79
91+00	4480.34
92+00	4479.90

LEGEND

STRUCTURES	DETAIL SHEET #
LARGE WOOD STRUCTURE (LWS)	6.1
SOD AND BRUSH BANK TYPE 1 (SBB 1)	6.2
SOD AND BRUSH BANK TYPE 2 (SBB 2)	6.2
SOD AND BRUSH BANK TYPE 3 (SBB 3)	6.2
CONSTRUCTED STREAMBED (CS)	6.3
BANKFULL FLOODPLAIN/ FLOODPLAIN ROUGHNESS	6.4
ALCOVE	
ELECTRIC FENCE LINE	
BARB WIRE FENCE LINE	

STRUCTURE SCHEDULE

STATION START	STATION END	BANK	STRUCTURE	STATION START	STATION END	BANK	STRUCTURE
85+22	86+27	C	CS	88+45	88+77	R	SBB 2
85+22	85+40	R	SBB 1	88+45	88+77	L	SBB 2
85+40	86+14	R	SBB 2	88+77	88+91	L	SBB 1
86+14	86+27	L	SBB 1	88+77	89+08	R	SBB 3
86+14	86+43	R	SBB 3	89+08	89+28	R	LWS
86+43	86+63	R	LWS	89+28	89+70	R	SBB 3
86+63	87+06	R	SBB 3	89+51	89+91	C	CS
86+86	87+67	C	CS	89+51	89+70	L	SBB 1
86+86	87+06	L	SBB 1	89+70	89+83	R	SBB 2
87+06	87+54	R	SBB 2	89+70	89+83	L	SBB 2
87+06	87+54	L	SBB 2	89+83	89+91	R	SBB 1
87+54	87+67	R	SBB 1	89+83	89+97	L	SBB 3
87+54	87+84	L	SBB 3	89+97	90+17	L	LWS
87+84	88+04	L	LWS	90+17	90+47	L	SBB 3
88+04	88+45	L	SBB 3	90+31	92+37	C	CS
88+26	88+91	C	CS	90+31	90+47	R	SBB 1
88+26	88+45	R	SBB 1	90+47	92+37	R	SBB 2
				90+47	92+37	L	SBB 2

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PLAN VIEW AND DATA SHEET

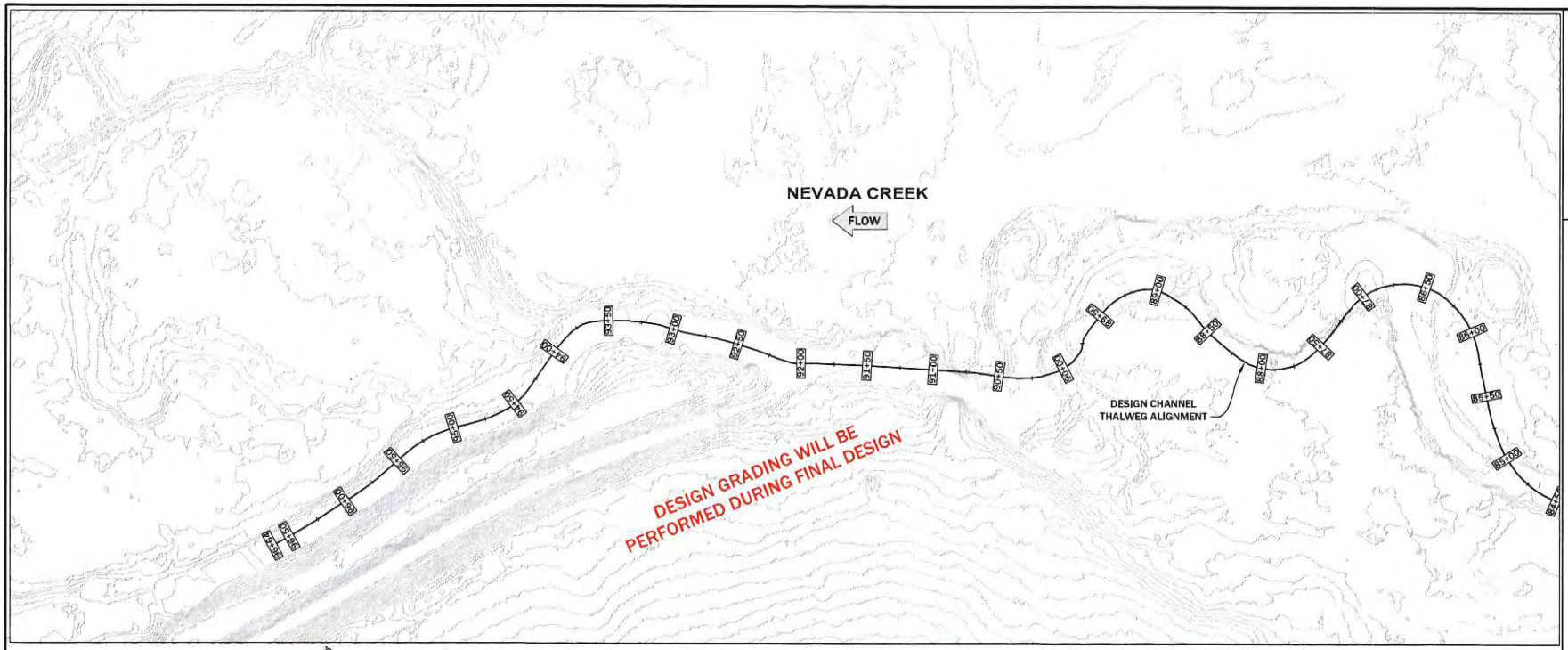
NEVADA CREEK PHASE 3

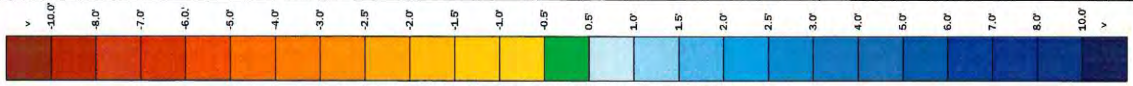
NEAR HELMVILLE, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
1	9-01-18	NW	75% DESIGN	JM

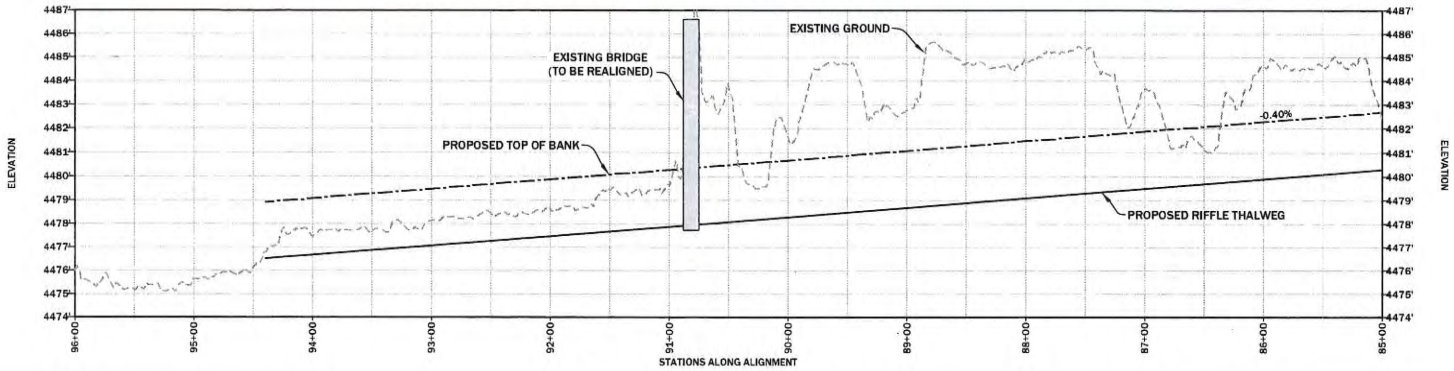
PROJECT NUMBER
RDG-18-001

SHEET NUMBER
4.12





EXISTING GROUND SURFACE COMPARED TO NC PH 3 DESIGN SURFACE



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GRADING PLAN AND PROFILE

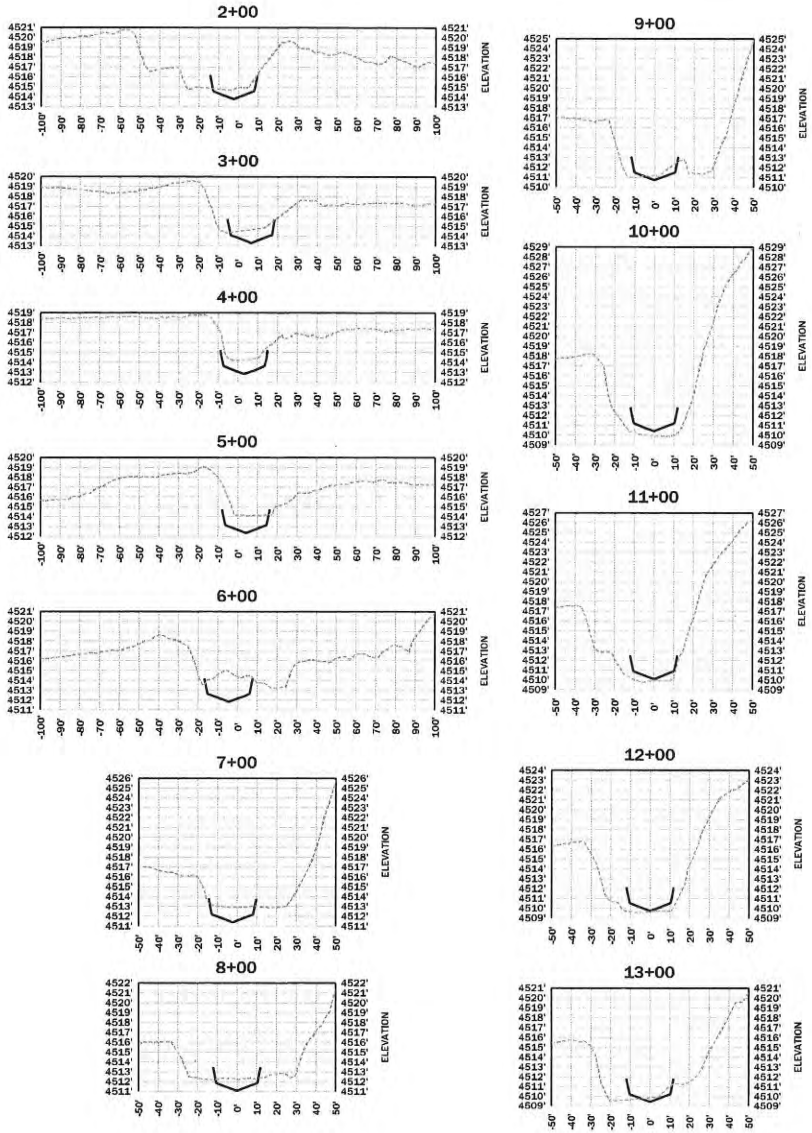
NEVADA CREEK PHASE 3

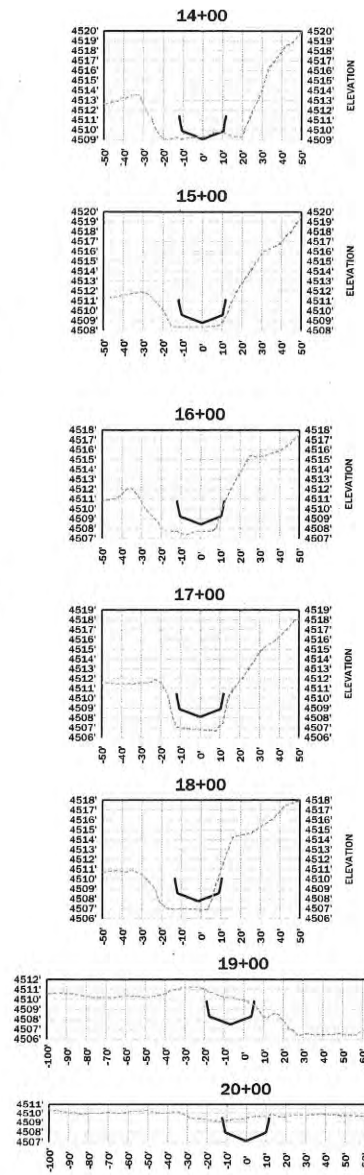
NEAR HELMVILLE, MONTANA

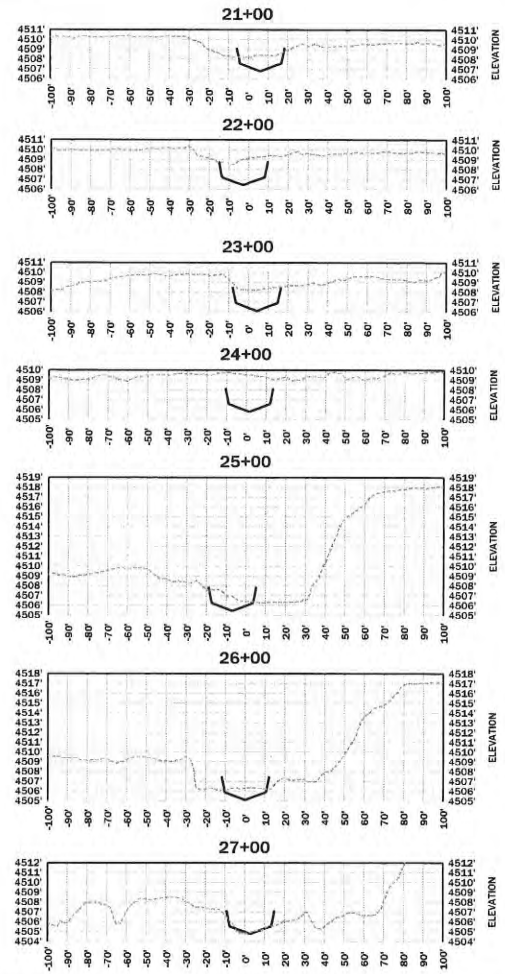
NO.	DATE	BY	DESCRIPTION	CHK
1	9-07-18	MW	75% DESIGN	JM

PROJECT NUMBER
RDG-18-001

SHEET NUMBER
4.13







LEGEND

EXISTING GROUND

DESIGN SURFACE

CUT

FILL

NOTE: DESIGN SURFACE REPRESENTS A RIFFLE CROSS SECTION. COMPLETE GRADING WILL BE PERFORMED DURING FINAL DESIGN.

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CROSS SECTIONS

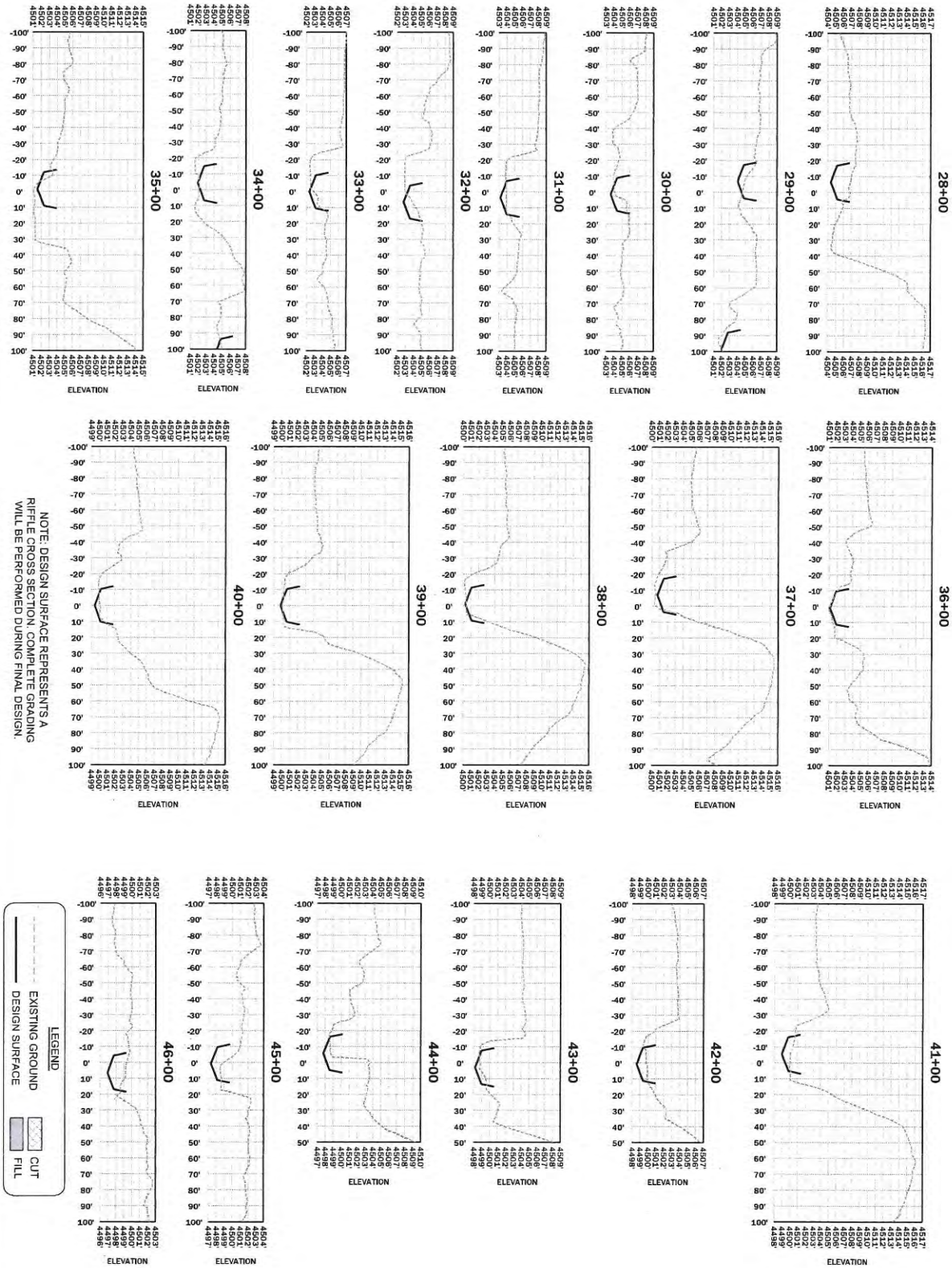
NEVADA CREEK PHASE 3

NEAR HELMVILLE, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
1	9-01-18	NW	75% DESIGN	JM

PROJECT NUMBER
RDG-18-001

SHEET NUMBER
5.0



NOTE: DESIGN SURFACE REPRESENTS A RIFFLE CROSS SECTION. COMPLETE GRADING WILL BE PERFORMED DURING FINAL DESIGN.

NO.	DATE	BY	DESCRIPTION	CHK
1	9-01-18	NW	75% DESIGN	JM

PROJECT NUMBER
RDG-18-001

SHEET NUMBER
5.1

CROSS SECTIONS

NEVADA CREEK PHASE 3

NEAR HELMVILLE, MONTANA

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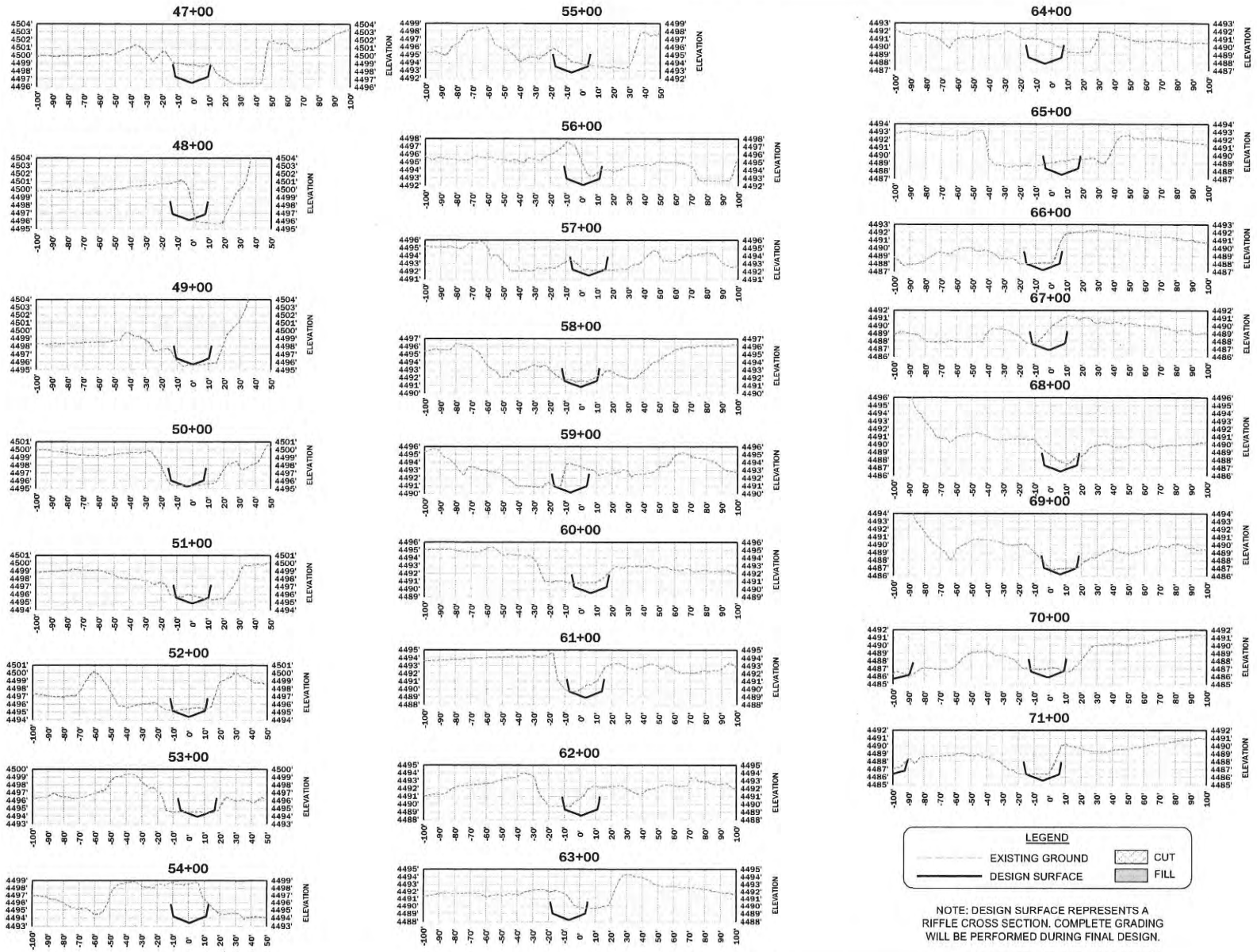

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CROSS SECTIONS

NEVADA CREEK PHASE 3

NEAR HELMVILLE, MONTANA

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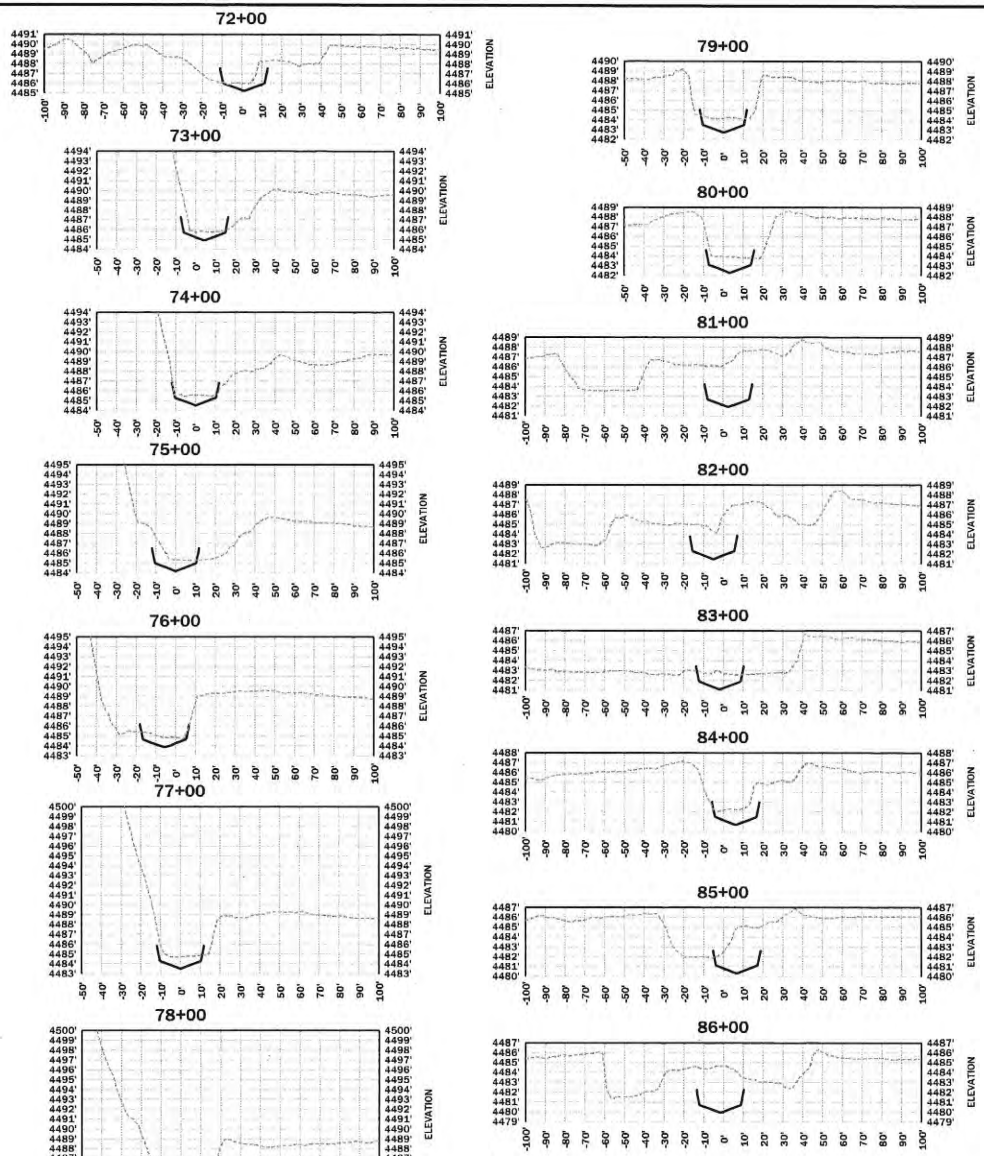
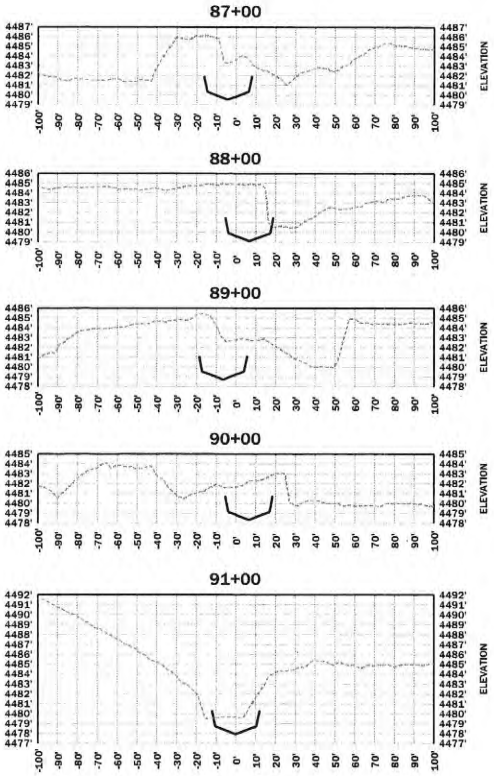
1	9-01-18	NW	75% DESIGN	JM

PROJECT NUMBER
RDG-18-001

SHEET NUMBER
5.2





LEGEND

EXISTING GROUND

DESIGN SURFACE

CUT

FILL

NOTE: DESIGN SURFACE REPRESENTS A RIFFLE CROSS SECTION. COMPLETE GRADING WILL BE PERFORMED DURING FINAL DESIGN.

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CROSS SECTIONS

NEVADA CREEK PHASE 3

NEAR HELMVILLE, MONTANA

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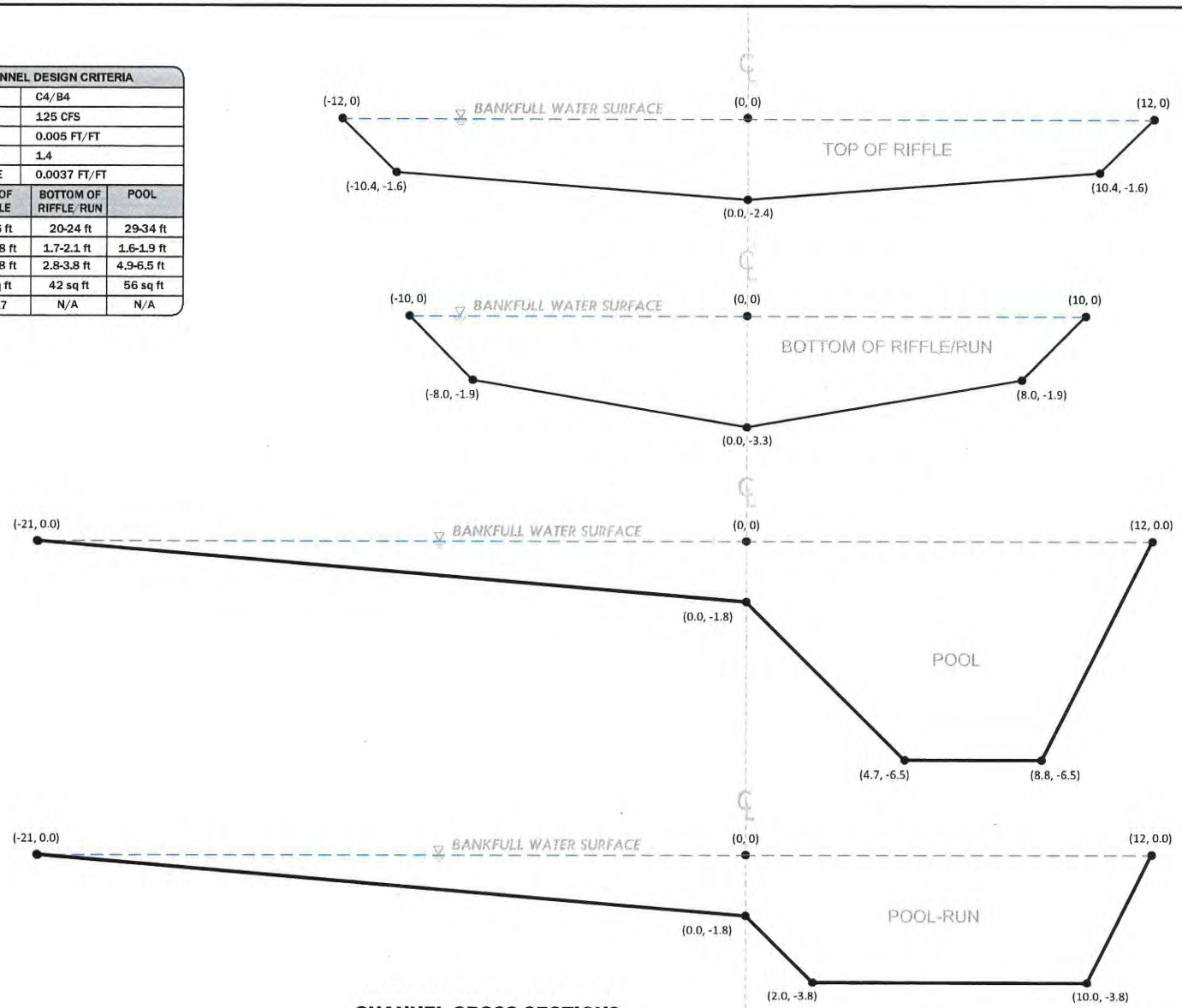
RDG-18-001

SHEET NUMBER
5.3

BANKFULL CHANNEL DESIGN CRITERIA			
STREAM TYPE	C4/B4		
DISCHARGE	125 CFS		
VALLEY SLOPE	0.005 FT/FT		
SINUOSITY	1.4		
CHANNEL SLOPE	0.0037 FT/FT		
PARAMETER / FEATURE	TOP OF RIFFLE	BOTTOM OF RIFFLE/RUN	POOL
WIDTH	23-26 ft	20-24 ft	29-34 ft
MEAN DEPTH	1.5-1.8 ft	1.7-2.1 ft	1.6-1.9 ft
MAX. DEPTH	2.1-2.8 ft	2.8-3.8 ft	4.9-6.5 ft
XS AREA	40 sq ft	42 sq ft	56 sq ft
WIDTH:DEPTH	13-17	N/A	N/A



CHANNEL CROSS SECTIONS
TYPICAL

0' 1.5' 3'

NOTE: COORDINATES ARE REFERENCED FROM TOP OF BANK CENTERLINE

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CHANNEL CROSS SECTION DIMENSIONS

NEVADA CREEK PHASE 3
NEAR HELMVILLE, MONTANA

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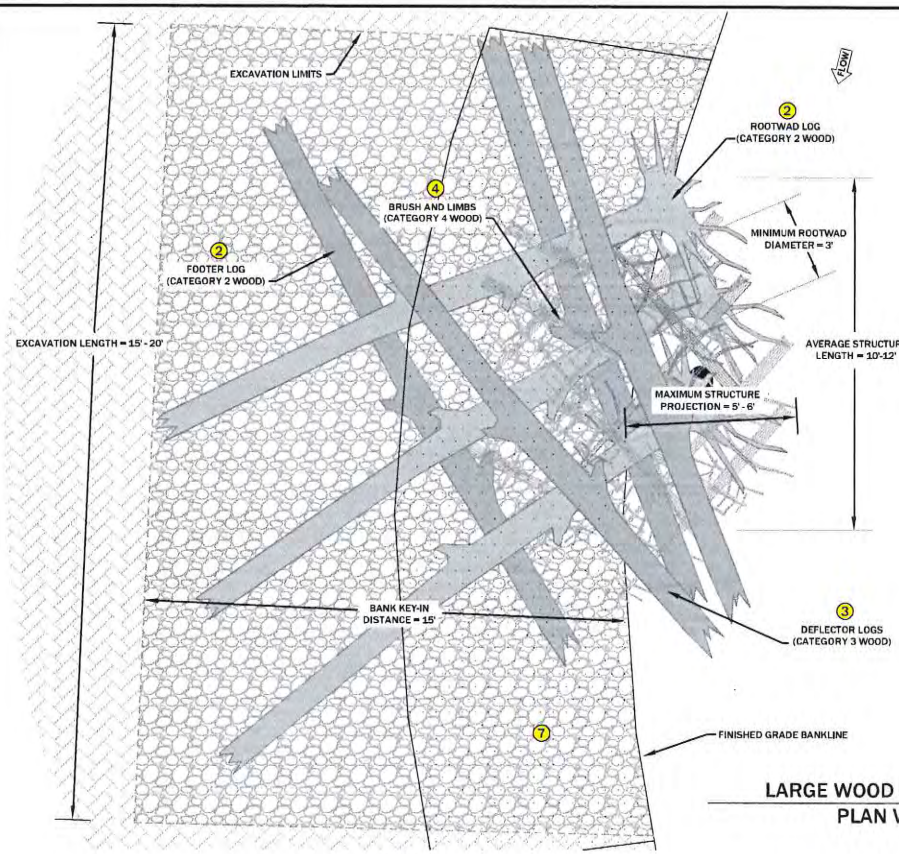
PROJECT NUMBER
RDG-18-001

SHEET NUMBER
6.0



LARGE WOOD STRUCTURE
PLAN VIEW
NTS

GENERAL NOTES

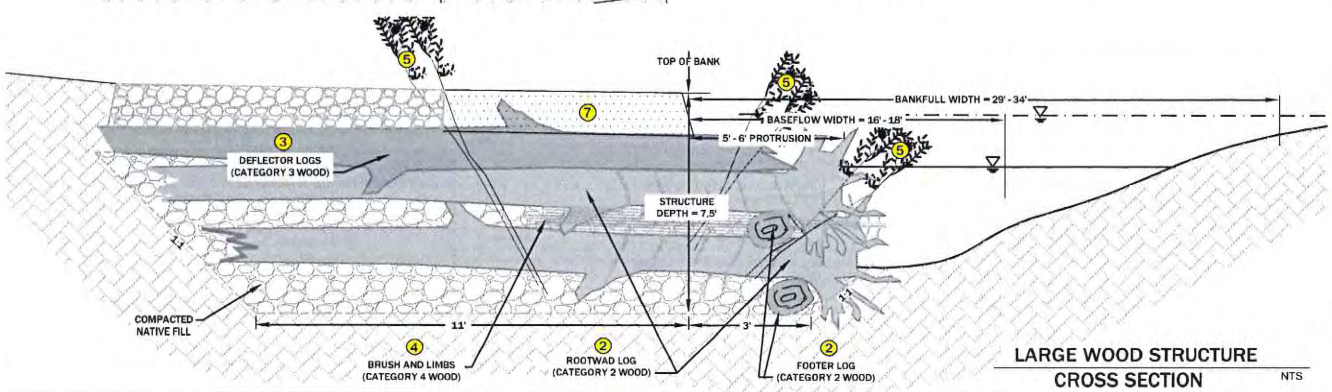
1. ANY CHANGES TO THE CONSTRUCTION SEQUENCE MUST BE APPROVED THE ENGINEER.
2. FIELD ENGINEER SHALL MARK THE GENERAL CONSTRUCTION LOCATION FOR EACH LARGE WOOD STRUCTURE PRIOR TO CONSTRUCTION.

NOTES ON LARGE WOOD STRUCTURE INSTALLATION

1. EXCAVATE TO THE EXCAVATION LIMITS. EXCAVATED MATERIAL SHALL BE STOCKPILED ON THE FLOODPLAIN OUTSIDE OF THE IMMEDIATE WORK AREA.
2. INSTALL TWO FOOTER LOGS (CATEGORY 2 WOOD) AT THE BASE OF THE EXCAVATED TRENCH AT THE ORIENTATIONS NOTED IN PLAN VIEW. FOOTER LOGS SHALL PROJECT NO GREATER THAN 2 FT. BEYOND THE FINISH GRADE BANK LINE. EXPOSED ENDS OF FOOTER LOGS SHALL BE BROKEN/ROUGHENED SO AS TO APPEAR NATURAL. SAWED ENDS OF FOOTER LOGS SHALL NOT BE EXPOSED.
3. INSTALL TWO TO THREE ROOTWAD LOGS (CATEGORY 2 WOOD) INTERSECTING BOTH FOOTER LOGS AT THE ORIENTATION NOTED IN PLAN VIEW. THE UPSTREAM ROOTWAD SHALL NOT PROJECT INTO THE CHANNEL AND SHALL BE FLUSH WITH THE FINISHED BANK LINE. THE DOWNSTREAM ROOTWAD SHALL PROJECT NO GREATER THAN 5-8 FT. BEYOND THE FINISHED BANK LINE.
4. BACKFILL TRENCH WITH STOCKPILED MATERIAL UP TO THE TOP OF THE FOOTER LOGS. BACKFILL SHALL BE BUCKET COMPACTED.
5. INSTALL A SECOND TIER MADE UP OF BRUSH AND LIMBS (CATEGORY 3 AND CATEROGRY 4 WOOD). BRUSH AND LIMBS SHALL PROJECT NO GREATER THAN 3 FT. BEYOND THE FINISHED BANK LINE.
6. BACKFILL TRENCH WITH STOCKPILED MATERIAL UP TO THE TOP OF THE LAYERED BRUSH AND SMALL WOOD. BACKFILL SHALL BE BUCKET COMPACTED.
7. INSTALL DEFLECTOR LOGS (CATEGORY 3 WOOD) AT APPROXIMATE 45° ANGLE TO ROOTWAD STEMS. DEFLECTOR LOGS SHALL PROJECT NO GREATER THAN 3 FT. BEYOND THE FINISHED BANK LINE. EXPOSED ENDS OF FOOTER LOGS SHALL BE BROKEN/ROUGHENED SO AS TO APPEAR NATURAL. SAWED ENDS OF FOOTER LOGS SHALL NOT BE EXPOSED.
8. PLACE AND BUCKET COMPACT STOCKPILED MATERIAL TO THE FINISHED BANK LINE. NO AREAS BEHIND THE FINISHED BANKLINE ARE TO BE LEFT BELOW FINISHED GRADE.

MATERIAL SCHEDULE (PER STRUCTURE)

	ITEM	QUANTITY
2	CATEGORY 2 WOOD	5
3	CATEGORY 3 WOOD	4
4	CATEGORY 4 WOOD	7
5	WILLOW CUTTINGS	30
7	SEDGE SOD MAT	20 LF



LARGE WOOD STRUCTURE
CROSS SECTION
NTS

EXAMPLE LARGE WOOD STRUCTURE COMBINED WITH VEGETATED WOOD MATRIX TYPE 2 BANK TREATMENT

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LARGE WOOD STRUCTURE DETAIL

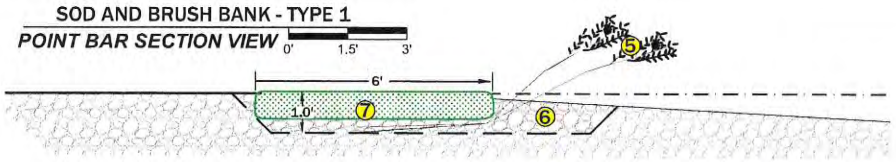
NEVADA CREEK PHASE 3
NEAR HELMVILLE, MONTANA

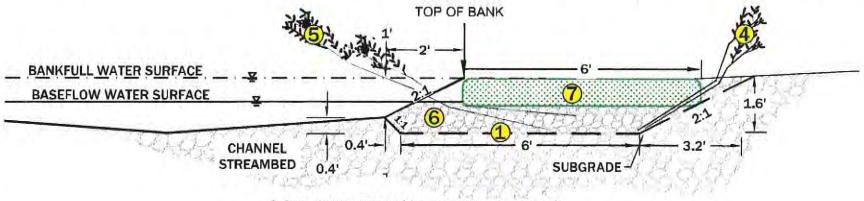
NO.	DATE	BY	DESCRIPTION	CHK
1	9-01-18	NW	75% DESIGN	JM

PROJECT NUMBER
RDG-18-001

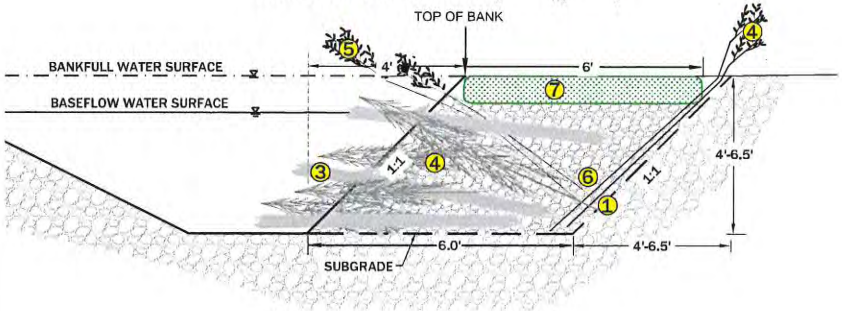
SHEET NUMBER
6.1

SOD AND BRUSH BANK - TYPE 1
POINT BAR SECTION VIEW

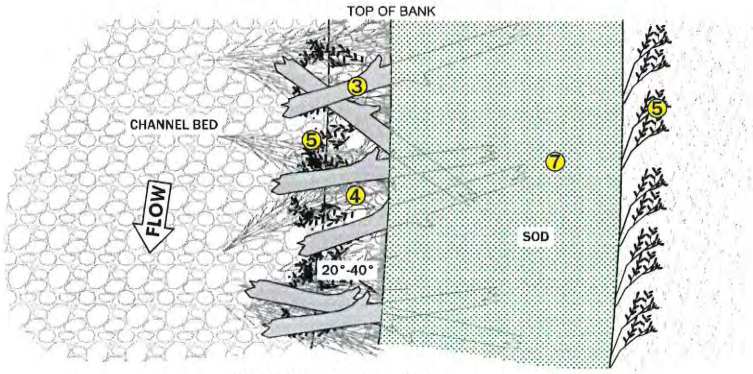




SOD AND BRUSH BANK - TYPE 2
RIFFLE SECTION VIEW



SOD AND BRUSH BANK - TYPE 3
POOL SECTION VIEW



SOD AND BRUSH BANK
PLAN VIEW

GENERAL NOTES

1. ANY CHANGES TO THE CONSTRUCTION SEQUENCE MUST BE APPROVED THE ENGINEER.
2. FIELD ENGINEER SHALL MARK THE GENERAL CONSTRUCTION LOCATION FOR EACH SOD AND BRUSH BANK STRUCTURE PRIOR TO CONSTRUCTION.

NOTES ON SOD AND BRUSH BANK INSTALLATION

1. EXCAVATE STREAMBANK TO SUBGRADE ELEVATIONS.
2. PLACE SMALL LOGS IN THE STREAMBANK AT SKEWED ANGLE TO THE STREAMBANK (AS APPLICABLE). LOGS SHALL BE PLACED BELOW THE TOP OF BANK ELEVATION. LOGS MAY OVERLAP.
3. PLACE BRUSH WITHIN THE MATRIX OF SMALL LOGS (AS APPLICABLE). BRUSH SHALL PLACED BELOW TOP OF BANK LINE.
4. PLACE CUTTINGS INTO THE LOG/BRUSH MATRIX WITH THE STEMS IN CONTACT WITH THE BASEFLOW WATER TABLE AND THE LEAVES AT OR ABOVE THE BANKFULL WATER SURFACE ELEVATION.
5. BACKFILL STREAMBANK WITH STREAMBANK FILL PER THE GRADATION SHOWN ON THE DRAWINGS.
6. WASH FINES AND WATER FROM ONSITE INTO THE STREAMBANK FILL TO SEAL THE VOIDS IN THE BACKFILL.
7. PLACE A 8-12 INCH SOD MAT BEGINNING AT BANKLINE AND EXTENDING BACK 6 FEET IN TO FLOODPLAIN TO MATCH FINISHED GROUND ELEVATIONS. REFER TO VEGETATION SALVAGE PLAN FOR SOD SOURCES.

STREAMBANK FILL GRADATION

SIZE (INCHES)	PERCENT PASSING	REPRESENTATIVE SIZE CLASS
6	95	D100
5	90-95	D95
4	85-90	D84
2.5	65 - 85	D65
2.0	50 - 65	D50
1.5	30 - 50	D35
0.6	10 - 30	D15
FINES	0	

MATERIAL SCHEDULE (PER LINEAR FOOT)

	ITEM	TYPE 1 QUANTITY	TYPE 2 QUANTITY	TYPE 3 QUANTITY	DIA. (IN)	LENGTH (FT)
1	CY OF SUBGRADE EXCAVATION	0.1	0.34	1		
6	CY OF STREAMBANK FILL	0.05	0.1	0.3		
3	CATEGORY 3 WOOD	-	-	1	3-6	8-10
4	CATEGORY 4 WOOD	-	-	1	1-3	8-10
7	SEDGE SOD MAT	6 SF	6 SF	6 SF	8-12 (THICK)	
5	WILLOW CUTTINGS	5	5	5	0.75-1.5	6-8

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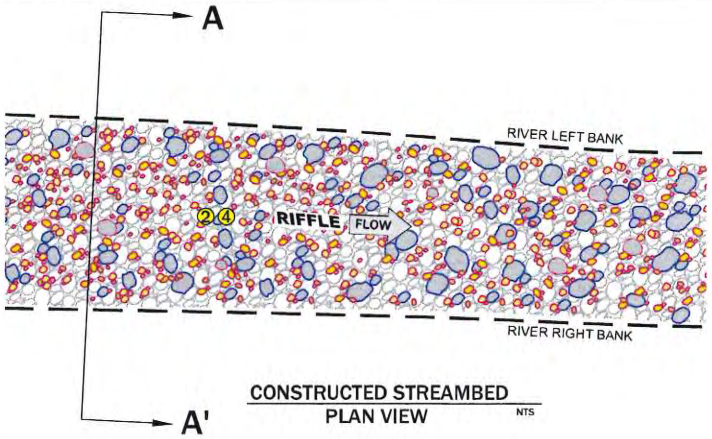
SOD AND BRUSH BANK DETAIL
NEVADA CREEK PHASE 3
NEAR HELMVILLE, MONTANA

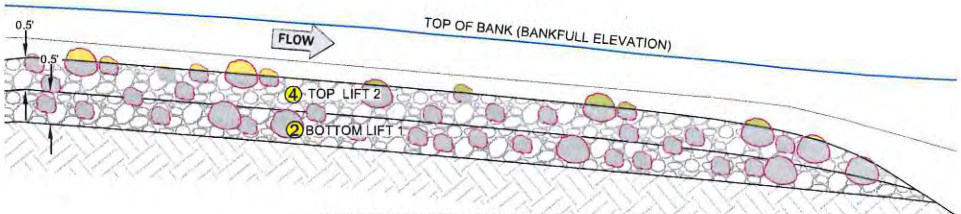
NO.	DATE	BY	DESCRIPTION	CHK
1	9-01-18	NW	75% DESIGN	JM

PROJECT NUMBER
RDG-18-001

SHEET NUMBER
6.2



CONSTRUCTED STREAMBED
PLAN VIEW
NTS



CONSTRUCTED STREAMBED
PROFILE VIEW
NTS

GENERAL NOTES

1. ANY CHANGES TO THE CONSTRUCTION SEQUENCE MUST BE APPROVED THE ENGINEER.
2. CONTRACTOR SHALL MARK THE UPSTREAM AND DOWNSTREAM EXTENTS OF THE LOCATIONS OF THE CONSTRUCTED STREAMBED STRUCTURES.

NOTES ON CONSTRUCTED STREAMBED INSTALLATION

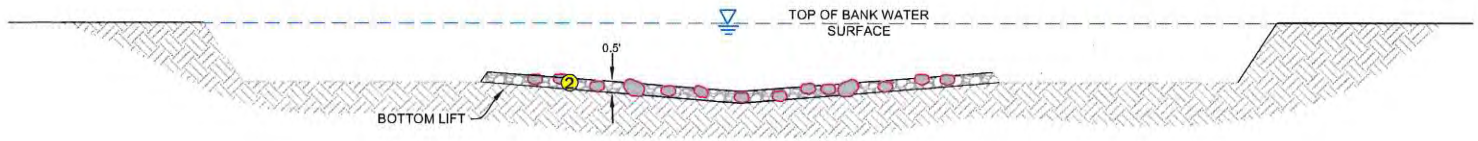
1. EXCAVATE STREAMBED TO SUBGRADE ELEVATIONS. THE ENGINEER WILL CONFIRM WHETHER SUBGRADE EXCAVATION AND RIFFLE CONSTRUCTION ARE NECESSARY BASED ON OBSERVED SUBSTRATE CONDITIONS.
2. PLACE THE BOTTOM LIFT OF RIFFLE MATERIAL. RIFFLE MATERIAL SHALL CONSIST OF THE DESIGNATED STREAMBED MATERIAL GRADATION.
3. COMPACT THE BOTTOM LIFT OF RIFFLE MATERIAL USING WEIGHT OF EQUIPMENT OR BUCKET COMPACTION. WASH WATER AND FINES INTO THE LIFT TO FILL VOIDS.
4. PLACE THE TOP LIFT OF RIFFLE MATERIAL LOOSELY ON TOP OF THE FIRST LIFT AND GRADE TO FINISHED ELEVATIONS. DO NOT COMPACT OR TRACK EQUIPMENT OVER THE TOP LIFT OF RIFFLE MATERIAL.
5. WASH WATER AND FINES INTO THE TOP LIFT TO FILL VOIDS.

STREAMBED FILL GRADATION

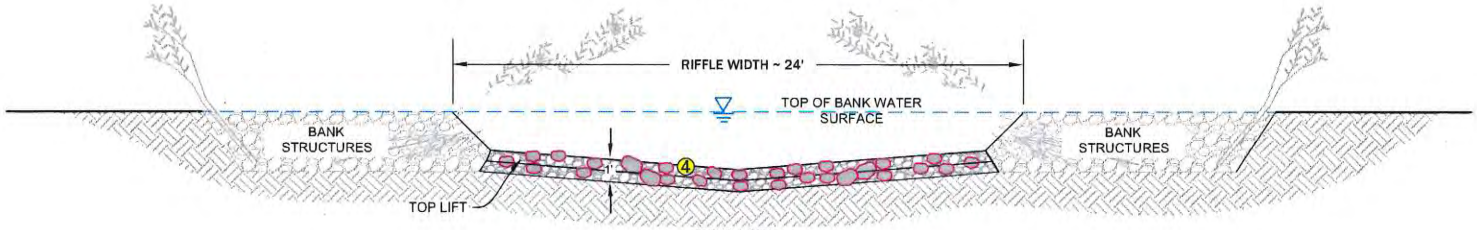
SIZE (INCHES)	PERCENT PASSING	REPRESENTATIVE SIZE CLASS
6	95	D100
5	90-95	D95
4	85-90	D84
2.5	65 - 85	D65
2.0	50 - 65	D50
1.5	30 - 50	D35
0.6	10 - 30	D15
FINES	0-10	

MATERIAL SCHEDULE (PER LINEAR FOOT)

	ITEM	DIAMETER (IN)	QUANTITY
2 4	STREAMBED MATERIAL	SEE GRADATION	1.0 CY



BOTTOM LIFT
A - A'
0' 2.5' 5'



TOP LIFT
A - A'
0' 2.5' 5'

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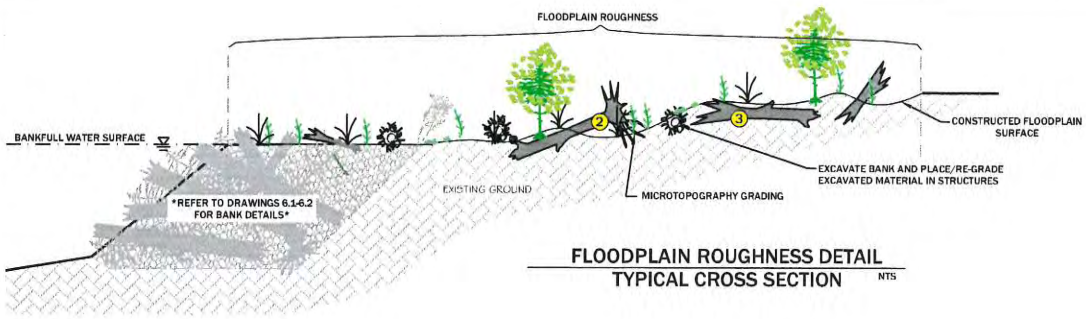
CONSTRUCTED STREAMBED DETAIL

NEVADA CREEK PHASE 3
NEAR HELMVILLE, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
1	9-01-18	NW	75% DESIGN	JM

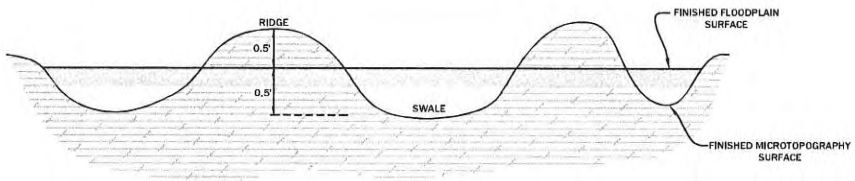
PROJECT NUMBER
RDG-18-001

SHEET NUMBER
6.3



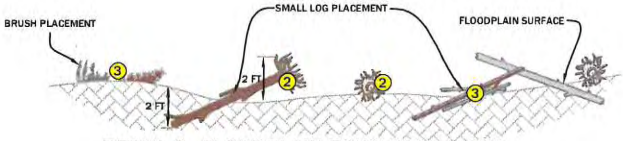
FLOODPLAIN ROUGHNESS DETAIL
TYPICAL CROSS SECTION

NTS



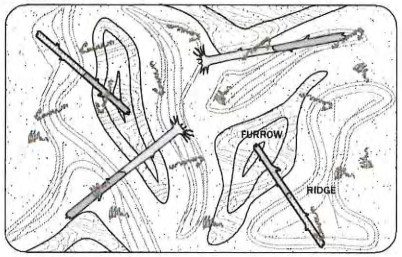
DETAIL 1 - MICROTOPOGRAPHY GRADING
SECTION VIEW

NTS



DETAIL 2 - FLOODPLAIN ROUGHNESS WOOD
SECTION VIEW

NTS



DETAIL 3 - MICROTOPOGRAPHY AND FLOODPLAIN WOOD PLACEMENT
PLAN VIEW

NTS

GENERAL NOTES

1. ANY CHANGES TO THE CONSTRUCTION SEQUENCE MUST BE APPROVED BY THE ENGINEER.

NOTES ON FLOODPLAIN ROUGHNESS INSTALLATION

1. CONTRACTOR SHALL DEVELOP MICROTOPOGRAPHY AND PLACE WOODY MATERIAL IN THE CONSTRUCTED FLOODPLAIN.
2. TRANSPORT COARSE WOOD AND BRUSH FROM DESIGNATED BORROW SOURCES OR STOCKPILE AREAS AND PLACE IT WITHIN THE MICROTOPOGRAPHY TREATMENT AREA AS SHOWN ON DRAWINGS.
3. PLACE WOOD CATEGORY 2 WOOD AT A RATE OF 50 PIECES PER ACRE, CATEGORY 3 WOOD AT A RATE OF 150 PIECES PER ACRE AND SPACED AT A TYPICAL DISTANCE OF 20 FEET FROM OTHER COARSE WOOD.
4. BURY COARSE WOOD WITHIN THE FLOODPLAIN SURFACE, WITH ONE HALF OF THE LENGTH BURIED TO A DEPTH OF 3-FT. AND ONE HALF EXPOSED AS SHOWN ON DRAWING.
5. CONSTRUCT LOW AND HIGH FEATURES (RIDGES AND FURROWS) AS SHOWN ON DRAWINGS. MAXIMUM HEIGHT OF RIDGES AND DEPTH OF FURROWS SHALL BE NO GREATER THAN 0.5-FT. RELATIVE TO FINISHED FLOODPLAIN SURFACE.

MATERIAL SCHEDULE (PER ACRE)

	ITEM	QUANTITY
2	CATEGORY 2 WOOD	50
3	CATEGORY 3 WOOD	150

EXAMPLE OF CONSTRUCTED FLOODPLAIN SWALE

EXAMPLE OF CONSTRUCTED FLOODPLAIN ROUGHNESS ELEMENT

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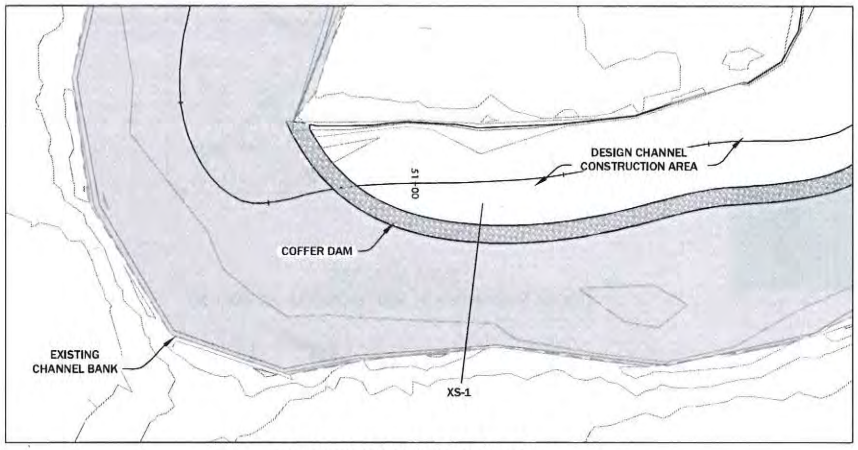
FLOODPLAIN ROUGHNESS DETAIL

NEVADA CREEK PHASE 3
NEAR HELMVILLE, MONTANA

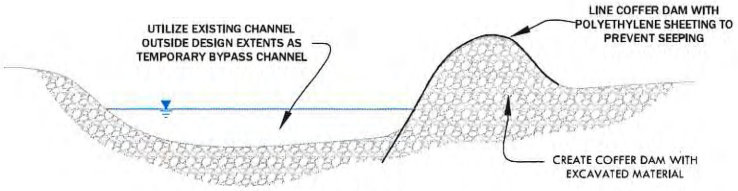
NO.	DATE	BY	DESCRIPTION	CHK
1	9-01-18	NW	75% DESIGN	JM

PROJECT NUMBER
RDG-18-001

SHEET NUMBER
6.4



TEMPORARY COFFER DAM DETAIL
PLAN VIEW
0' 10' 20'



TEMPORARY COFFER DAM DETAIL
XS-1
NTS NTS NTS

BULK BAG NOTES

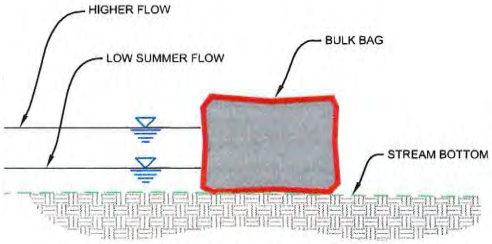
BULK BAGS ARE ALSO CALLED FLEXIBLE INTERMEDIATE BULK CONTAINERS (FIBC) THAT CAN BE CUSTOM MADE FROM VARIOUS FABRIC. THE FOLLOWING REQUIREMENTS ARE NECESSARY FOR THE RIVER ENVIRONMENT:

LARGE BULK BAGS SHALL BE CONSTRUCTED OF 8 oz WOVEN FABRIC, 1200 HOUR UV RESISTANT WITH SEWN LIFTING LOOPS. WHEN FILLED WITH NATIVE RIVER SAND AND GRAVEL, THE BAGS ARE APPROXIMATELY 6' WIDE x 6' LONG x 4' HIGH.

SMALL BULK BAGS SHALL BE CONSTRUCTED OF 8 oz WOVEN FABRIC, 1200 HOUR UV RESISTANT WITH SEWN LIFTING LOOPS. WHEN FILLED WITH NATIVE RIVER SAND AND GRAVEL, THE BAGS ARE APPROXIMATELY 3' WIDE x 3' LONG x 2.5' HIGH.

BULK BAGS SHALL BE CAREFULLY PLACED TO ENSURE NO TEARING OR CUTTING OF THE BAGS OCCURS.

BULK BAGS SHALL BE PLACED USING A HYDRAULIC CRANE OR TRACKHOE USING LIFTING BARS AND STEEL CABLES TO EQUALIZE LOAD ON LIFTING LOOPS.



TYPICAL BULK BAG PLACEMENT
0' 2.5' 5'

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BMP DETAILs
NEVADA CREEK PHASE 3
NEAR HELMVILLE, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
1	9-01-18	NW	75% DESIGN	JM

PROJECT NUMBER
RDG-16-041

SHEET NUMBER
7.0

Category	Item	Quantity	Units	Diameter	Length	Rootwad
Wood	Category 2 Wood	235	ea	6 in - 10 in	10 ft - 12 ft	Yes
	Category 3 Wood	3,329	ea	3 in - 6 in	10 ft	No
	Category 4 Wood	3,945	ea	< 3 in	10 ft	No
	Riparian Cuttings	43,512	ea	0.25 in	6 ft - 8 ft	No

Category	Item	Quantity	Units	Gradation
Rock	Streambed Fill	8,702	cy	6" minus (see gradation)

Category	Item	Quantity	Units
Earthwork	Cut	TBD	cy
	Fill	TBD	cy

Category	Item	Quantity	Units	Diameter	Length
Floodplain Mic	Category 3 Wood	238	ea	3 in - 6 in	10 ft
	Category 4 Wood	713	ea	< 3 in	10 ft

Category	Item	Quantity	Units	Quantity	Units
Misc.	Sod	85,144	sf	1.95	ac
	Fencing - Barb Wire	5,152	lf		
	Fencing - Electric	8,031	lf		
	Fence post (wood or T-post)	659	ea		

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MATERIALS LIST

NEVADA CREEK PHASE 3
NEAR HELMVILLE, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
1	9-01-18	NW	75% DESIGN	JM

PROJECT NUMBER
RDG-18-001

SHEET NUMBER
8.0