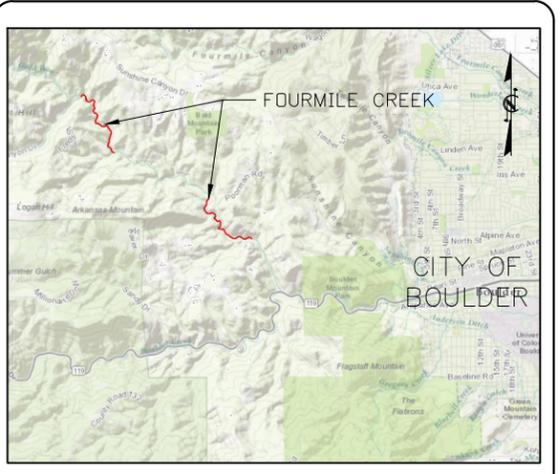


PROJECT: 138067 LOWER FOURMILE CREEK

DATE	STATE	BAKER PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
10/14/16	CO	138067	1	XX



VICINITY MAP

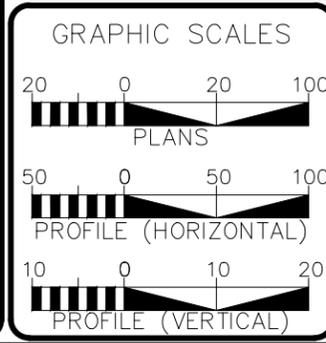
LOWER FOURMILE CREEK STREAM RESTORATION

LOCATION: FOURMILE CANYON DRIVE
TYPE OF WORK: DRAFT 30% STREAM RESTORATION PLANS

INDEX OF SHEETS	
1	TITLE SHEET
1-A	STREAM CONVENTIONAL SYMBOLS GENERAL NOTES VEGETATION SELECTION QUANTITIES
2-2B	DETAILS
3-9	PLAN SHEETS
P-1 - P-5	PROFILE SHEETS
X-1 - X-?	CROSS SECTION SHEETS
R-1 - R-2	REVEGETATION PLAN SHEETS



No.	DATE	DESCRIPTION	BY	APPROVED



PRELIMINARY DESIGN DATA

	North	South
DESIGN RECH LENGTH (ft)	= 5421	5783
BANKFULL XSEC AREA (sq ft)	= 34.8	40.3
BANKFULL WIDTH (ft)	= 26	27
BANKFULL DEPTH (ft)	= 1.34	1.49
W/D RATIO	= 19.4	18.1
DRAINAGE AREA (sq mi)	= 20	23.5

PREPARED FOR
BOULDER COUNTY
DEPARTMENT OF TRANSPORTATION

CONTACT: CLARISSA HAGEMAN

Michael Baker International
Michael Baker Engineering Inc.
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Littleton, CO 80120
Phone: 720.514.1100
Fax: 720.514.1120

TBD
LETTING DATE:

LUCAS BABBITT, PE, CFM
PROJECT ENGINEER

PROJECT ENGINEER

**PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION**

SIGNATURE: _____ P.E.

GENERAL NOTES

1. THE CONTRACTOR IS REQUIRED TO INSTALL INSTREAM STRUCTURES USING AN EXCAVATOR OR EQUIVALENT WITH A HYDRAULIC THUMB OF SUFFICIENT SIZE TO PLACE BOULDERS, LOGS, AND ROOTWADS.
2. WORK IS BEING PERFORMED AS AN ENVIRONMENTAL RESTORATION PLAN. THE CONTRACTOR SHOULD MAKE ALL REASONABLE EFFORTS TO REDUCE SEDIMENT LOSS AND MINIMIZE DISTURBANCE OF THE SITE WHILE PERFORMING THE CONSTRUCTION WORK.
3. CONTRACTOR SHALL CALL UTILITY NOTIFICATION CENTER OF COLORADO 2 - BUSINESS DAYS IN ADVANCE BEFORE DIGGING, GRADING, OR EXCAVATION FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.
4. PROPOSED CHANNEL ALIGNMENT IS INTENDED TO CAUSE MINIMAL DISTURBANCE TO THE EXISTING TREES AND VEGETATION. THE ON-SITE ENGINEER RESERVES THE RIGHT TO MAKE FIELD-FIT CHANGES TO THESE PLANS AND DETAILS TO FURTHER REDUCE DISTURBANCE.
5. NO FIELD FIT CHANGES SHALL BE MADE WITHOUT ENGINEER BEING PRESENT ON-SITE AND WITHOUT THEIR CONCURRENCE.
6. THIS IS A PRELIMINARY PLAN SET THAT WAS COMPLETED TO EVALUATE MAJOR DESIGN FEATURES PRIOR TO ADVANCING TO THE DESIGN-BUILD PHASE. CONSTRUCTION SHALL NOT BEGIN, OR CONTINUE, WITHOUT ENGINEER BEING PRESENT. AS SUCH, THE ENGINEER RESERVES THE RIGHT TO MAKE DESIGN MODIFICATIONS TO IMPROVE STREAM FUNCTION AND/OR CONSTRUCTABILITY. MODIFICATIONS COULD INCLUDE, BUT ARE NOT LIMITED TO, GRADING MODIFICATIONS, CHANGE IN MATERIAL TYPE, CHANGE IN MATERIAL SIZE, CHANGE IN MATERIAL PLACEMENT, ETC.
7. CONSTRUCTION SHALL BEGIN AT THE UPSTREAM END OF THE PROJECT AND CONTINUE TO THE DOWNSTREAM END IN ORDER TO AVOID DAMAGING PREVIOUSLY COMPLETED WORK.
8. THE CONTRACTOR SHALL CONFIRM THE RECEIPT OF ALL NECESSARY PERMITS AND APPROVALS BEFORE THE START OF CONSTRUCTION.
9. THE CONTRACTOR SHALL CONDUCT THEIR OPERATIONS IN SUCH A WAY THAT THE AREA OF DISTURBANCE IS MINIMIZED. ALL EXISTING TREES, SHRUBS AND VEGETATION SHALL BE PROTECTED UNLESS OTHERWISE NOTED ON THE DRAWINGS. NO TREES SHALL BE REMOVED WITHOUT APPROVAL FROM LANDOWNER, ENGINEER, BOULDER COUNTY, AND FOURMILE CREEK COALITION.
10. FOR ALL SITE GRADING, SMOOTH, PARABOLIC TRANSITIONS SHALL BE MADE BETWEEN CHANGES IN SLOPE.
11. THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR PROVIDING STABLE EXCAVATIONS AND TEMPORARY SLOPES AND FOR SATISFYING ALL APPLICABLE FEDERAL, STATE AND LOCAL REGULATIONS.
12. CONSTRUCTION OF THE PROPOSED WORK WILL TAKE PLACE WITHIN THE CHANNEL AND WATER CONTROL MEASURES WILL BE REQUIRED. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE ACCEPTANCE AND CONTROL OF DRAINAGE WATER FROM AREAS ADJACENT TO FOURMILE CREEK AND ITS TRIBUTARIES INCLUDING STORMWATER OUTFALLS. THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR ESTABLISHING MEANS AND METHODS OF GROUND AND SURFACE WATER CONTROL APPROPRIATE FOR CONSTRUCTION IN ACCORDANCE WITH THE REQUIREMENTS OF THE PROJECT DRAWINGS AND SPECIFICATIONS AND ALL APPLICABLE FEDERAL, STATE AND LOCAL REGULATIONS AND ALL PERMITS.
13. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROTECTING AND MAINTAINING IN CONTINUOUS OPERATION, ALL EXISTING STRUCTURES, NOT ALL POTENTIALLY IMPACTED STRUCTURES MAY BE SHOWN ON THE DRAWINGS AND IT IS THE CONTRACTOR'S RESPONSIBILITY TO IDENTIFY AND PROTECT ALL STRUCTURES INCLUDING BUT NOT LIMITED TO STREETS, CURB AND GUTTER, BRIDGE PIERS AND ABUTMENTS, CREEK BANK PROTECTION OF VARIOUS TYPES, CREEK DROP STRUCTURES, SIGNS, PEDESTRIAN WALKS, RETAINING WALLS AND FENCING. IN THE EVENT THAT A STRUCTURE OR UTILITY IS DAMAGED DURING CONSTRUCTION THE CONTRACTOR SHALL IMMEDIATELY NOTIFY BOULDER COUNTY IN WRITING AND MAKE REPAIRS IN ACCORDANCE WITH BOULDER COUNTY REQUIREMENTS.
14. ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE STANDARDS OF BOULDER COUNTY UNLESS SPECIFICALLY DETAILED OTHERWISE ON THESE PLANS AND ASSOCIATED SPECIFICATIONS.
15. THE CONTRACTOR SHALL MAINTAIN AT THE SITE AT ALL TIMES ONE SIGNED COPY OF THE PROJECT DRAWINGS AND SPECIFICATIONS, ONE COPY OF BOULDER COUNTY STANDARDS, AND ONE COPY OF ALL REQUIRED PERMITS.
16. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PREPARING AND SUBMITTING AS-BUILT DRAWINGS TO BOULDER COUNTY.
17. THE CONTRACTOR SHALL PREPARE AND MAINTAIN THE STORMWATER MANAGEMENT PLAN AND OBTAIN THE NATIONAL POLLUTION DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT THROUGH THE COLORADO DEPARTMENT OF PUBLIC HEALTH (CDPHE).
18. THE CONTRACTOR SHALL PROVIDE DAILY ON-SITE SURVEY CONTROL TO THE LEVEL OF DETAIL REQUIRED TO EVALUATE CONSTRUCTION VERSUS THESE DESIGN PLANS.

GROUND COORDINATE TABLE:

PT#	NORTHING	EASTING	ELEVATION	DESCRIPTION
301	260,918.86	37,998.29	6,498.1	#5 REBAR w/1-1/4" ORANGE PLASTIC CAP
302	257,914.18	40,324.93	6,370.5	#5 REBAR w/1-1/4" ORANGE PLASTIC CAP
303	256,805.77	43,418.89	6,233.4	2" BRASS CAP IN 4" CONCRETE POST "BOULDER 267"
304	254,795.59	45,583.99	6,018.9	#5 REBAR w/1-1/4" ORANGE PLASTIC CAP
305	249,657.54	50,020.78	5,760.7	#5 REBAR w/1-1/4" ORANGE PLASTIC CAP

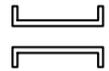
NOTES:

1. THE BASIS OF COORDINATES FOR THIS MAP IS THE NORTH AMERICAN DATUM OF 1983-2011 (NAD 83 (2011)) U.S. SURVEY FEET, BASED LOCALLY UPON THE DAVID EVANS AND ASSOCIATES, INC. CONTROL POINT DEA CP 302 FOR GROUND COORDINATE SCALE FACTOR DETERMINATION.
2. THE BASIS OF ELEVATIONS FOR THIS MAP IS THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88), BASED LOCALLY UPON THE CP 302. ELEVATIONS COMPUTED FROM A NGS OPUS SOLUTION REPORT USING A FOUR (4) HOUR OCCUPATION DATA SET AT DEA CP 302.
3. TO MODIFY GROUND CONTROL TO COLORADO STATE PLANE NORTH ZONE; ADD 1,000,000 FEET TO NORTH COORDINATE, ADD 3,000,000 FEET TO EAST COORDINATE AND MULTIPLY BY 1/CFS (COMBINED SCALE FACTOR = 1/1.000328515 = 0.999671593).
4. FIELDWORK FOR CONTROL WAS COMPLETED NOVEMBER 2013.
5. SET 18" LONG #5 REBAR w/1-1/4" OUTSIDE DIAMETER ORANGE PLASTIC CAP MARKED "DEA INC" AT ALL CONTROL POINTS UNLESS OTHERWISE NOTED, SEE GROUND COORDINATE TABLE ABOVE.

NOTICE:

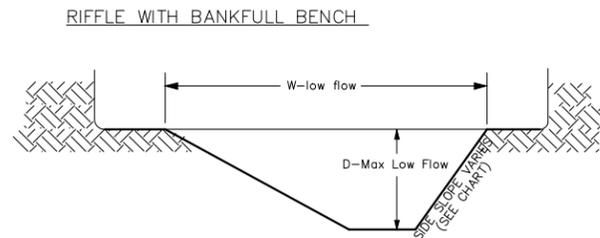
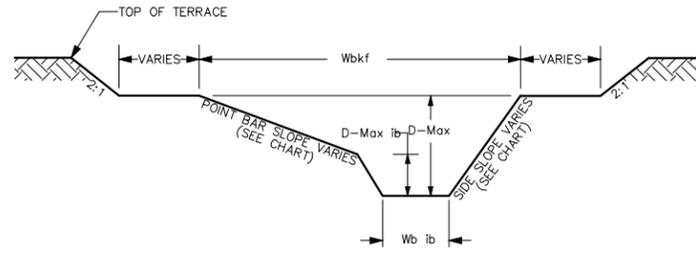
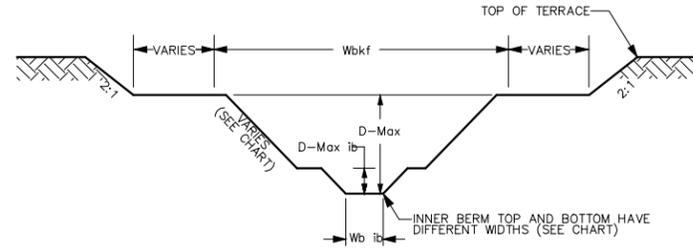
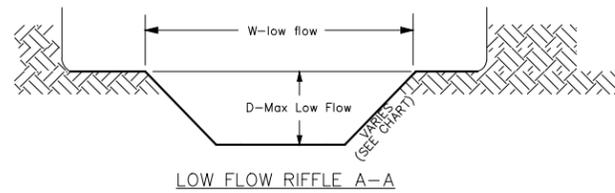
- ACCORDING TO COLORADO LAW YOU MUST COMMENCE ANY LEGAL ACTION BASED UPON ANY DEFECT IN THIS SURVEY WITHIN THREE YEARS AFTER YOU FIRST DISCOVERED SUCH DEFECT. IN NO EVENT MAY ANY ACTION BASED UPON ANY DEFECT IN THIS SURVEY BE COMMENCED MORE THAN TEN YEARS FROM THE DATE OF THE CERTIFICATION SHOWN HEREON.
19. THE PROJECT ENGINEER SHALL BE ON-SITE DURING CONSTRUCTION TO HELP INTERPRET DESIGN PLANS.
 20. THE PROPOSED PLANS WERE BASED ON NOVEMBER 2013 LIDAR INFORMATION AND NOT DETAILED SURVEY DATA. AS A RESULT, EXISTING TOPOGRAPHY INFORMATION SHOWN ON THIS PLAN
 21. FLOOD DEBRIS REMOVAL IS PART OF THIS PROJECT AND CONSISTS OF WOODY MATERIAL AND ALLUVIUM. THE LOCATION AND QUANTITY OF FLOOD DEBRIS REMOVAL HAS NOT BEEN DETERMINED. FLOOD DEBRIS REMOVAL WILL BE DETERMINED BY THE ENGINEER DURING CONSTRUCTION.
 22. SOME SECTIONS OF CREEK HAVE BEGUN, AND WILL CONTINUE TO HEAL AND WILL NOT REQUIRE RESOTRATION. THESE LOCATIONS HAVE BEEN IDENTIFIED ON THE PLANS. THESE LOCATIONS WILL BE IDENTIFIED BY ENGINEER DURING CONSTRUCTION.
 23. ROADWAY CENTERLINE AND EDGES SHOWN ON PROPOSED PLANS ARE APPROXIMATE.
 24. THE CONTRACTOR WILL WORK WITH THE ENGINEER TO IDENTIFY ALLUVIUM AND FLOODPLAIN DEBRIS TO BE REMOVED.
 25. THE CONTRACTOR WILL WORK WITH RESIDENTS TO IDENTIFY ACCESS POINTS.
 26. MINE TAILINGS EXIST THROUGHOUT THE PROJECT SITE. IN THE EVENT THAT MINE TAILINGS ARE ENCOUNTERED THE CONTRACTOR SHALL NOTIFY BOULDER COUNTY AND REFERENCE COLORADO DIVISION OF MINING RELCLAMATION AND SAFETY PROCEDURE FOR MANAGING HAZARDOUS MATERIALS.
 27. IT IS ANTICIPATED THAT BOULDERS WILL BE HARVESTED FROM THE PROJECT SITE OR FROM A NEARBY LOCATION AS DIRECTED BY THE ENGINEER. BOULDERS SHALL BE RELATIVELY FLAT ON EITHER SIDE IN THE SAME DIMENSION, PREFERABLY THE LONG DIMENSION.

STREAM CONVENTIONAL SYMBOLS

-  ROCK CROSS VANE
-  STREAM ALIGNMENT REQUIRED AS A RESULT OF ROADWAY IMPROVEMENTS
-  EXISTING STREAM ALIGNMENT
-  LOW FLOW CHANNEL WIDTH
-  BANKFULL CHANNEL WIDTH
-  EXISTING CROSSING
-  POOL
-  EXISTING MAJOR CONTOUR
-  EXISTING MINOR CONTOUR
-  CONVERGING BOULDER CLUSTER
-  BOULDER J-HOOK VANE
-  BOULDER BANK PROTECTION
-  EXISTING PROPERTY BOUNDARY
-  EXISTING STRUCTURE/HOMES
-  FLOODPLAIN RESTORATION/DEBRIS REMOVAL
-  POND
-  PROPOSED BANK STABILIZATION

BAKER PROJECT REFERENCE NO. 138067	SHEET NO. 1-A
<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> PRELIMINARY PLANS DO NOT USE FOR CONSTRUCTION </div>	
	

TYPICAL RIFFLE, POOL, AND BANKFULL BENCH CROSS SECTIONS
NTS



RIFFLE		POOL		Pool with Boulders
North	South	North	South	
26.0	27.0	27.0	28.0	28.0
1.3	1.5	1.5	1.6	1.6
2.2	2.4	2.9	3.1	3.0
19.4	18.1	17.8	17.1	17.5
3.0	3.0	1.0	1.0	2.0
2.8	2.8	2.2	2.1	2.3
34.8	40.3	40.9	45.9	44.9
3.4	3.1	-	-	-
12.0	12.5	10.5	11.2	12.0
6.5	7.0	6.0	6.5	6.0
0.7	0.7	1.2	1.3	1.1
1.0	1.0	1.4	1.5	1.4
16.6	17.1	8.7	8.6	11.2
8.7	9.1	12.7	14.6	12.9

NOTES:

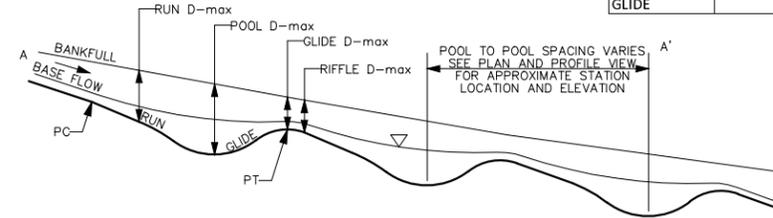
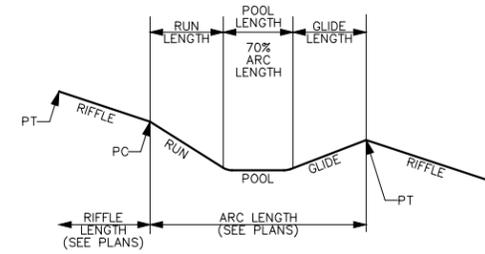
- DURING CONSTRUCTION CORNERS OF DESIGN CHANNEL WILL BE ROUNDED AND A THALWEG WILL BE SHAPED PER DIRECTION OF ENGINEER.
- POOL SHOWN ABOVE IS RIGHT BANK POOL ONLY.

RIFFLE WITH BANKFULL BENCH

LOW FLOW POOL

- WIDTH BANKFULL (Wbkf)
- AVERAGE DEPTH (D)
- MAXIMUM DEPTH (D-Max)
- WIDTH TO DEPTH RATIO (Wbkf/D)
- SIDE SLOPE
- INNER BERM SIDE SLOPE
- BANKFULL XSEC AREA
- INNER BERM BENCH WIDTH (Wbnch)
- INNER BERM WIDTH TOP (W ib)
- INNER BERM WIDTH BOTTOM (Wb ib)
- INNER BERM AVERAGE DEPTH (D ib)
- INNER BERM MAX DEPTH (D-max ib)
- INNER BERM W/D RATIO (W ib/D ib)
- INNER BERM AREA (A ib)

TYPICAL PROFILE
NTS



STREAM FACET	RANGE OF MAX DEPTHS (FT)			
	NORTH		SOUTH	
	MIN	MAX	MIN	MAX
RIFFLE	TBD	TBD	TBD	TBD
RUN	TBD	TBD	TBD	TBD
POOL	TBD	TBD	TBD	TBD
GLIDE	TBD	TBD	TBD	TBD

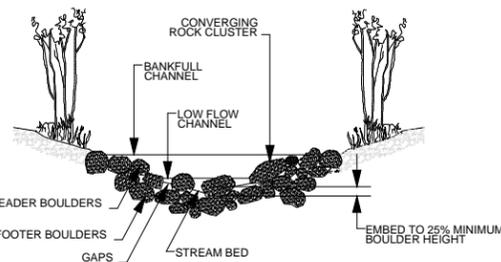
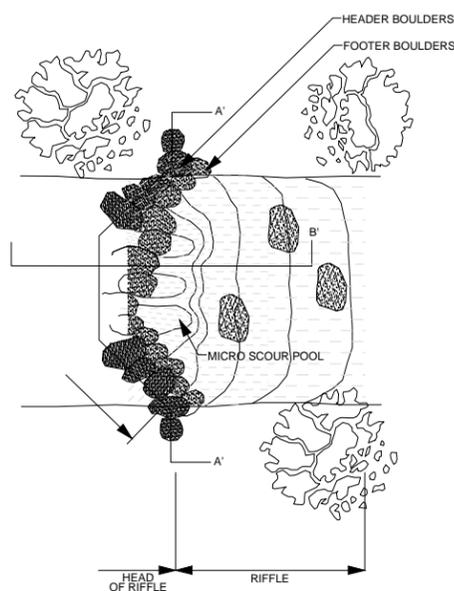
STREAM FACET	RANGE OF FACET SLOPE RATIOS	
	RATIO OF AVG. SLOPE TO FACET SLOPE	
	AVG. WATER SURFACE SLOPE VARIES BY REACH (SEE PLANS)	
	MIN	MAX
RIFFLE	SEE PLANS & PROFILE	
RUN	TBD	TBD
POOL	TBD	TBD
GLIDE	TBD	TBD

BAKER PROJECT REFERENCE NO. 138067 SHEET NO. 2

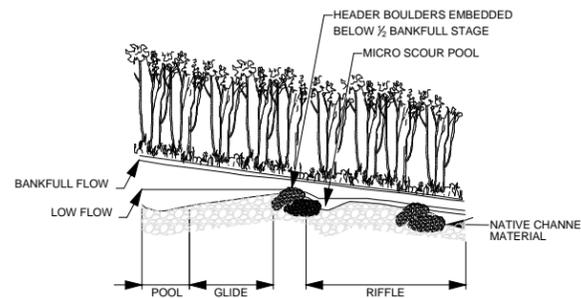
PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

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Littleton, COLORADO 80228
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Fax: 720.514.1120

CONVERGING BOULDER CLUSTER
NTS

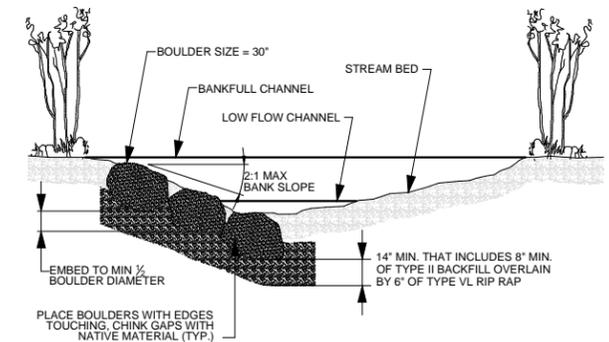
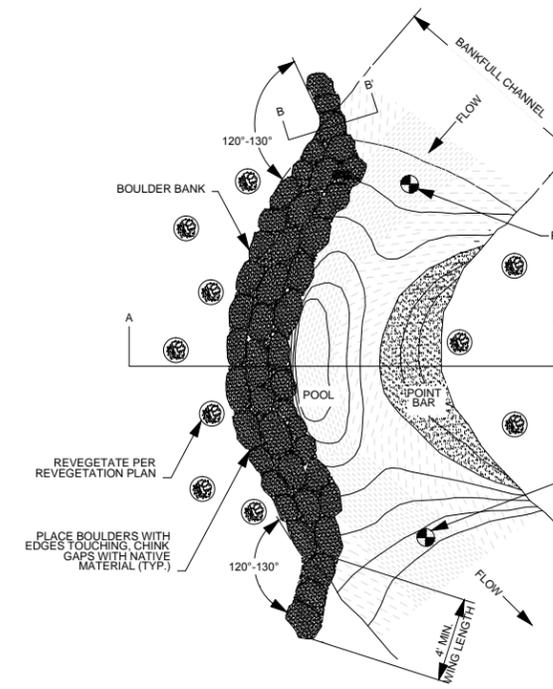


CROSS SECTION A - A'

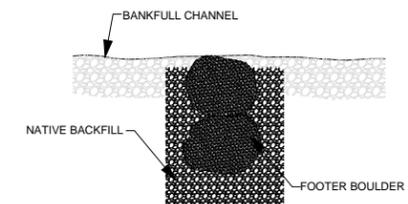


PROFILE B - B'

BOULDER BANK PROTECTION
NTS

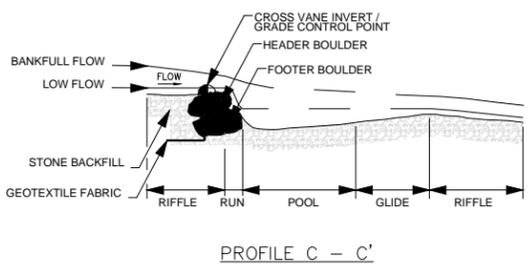
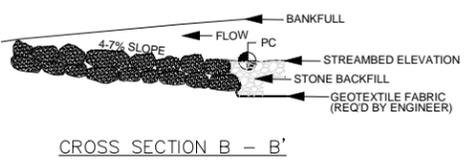
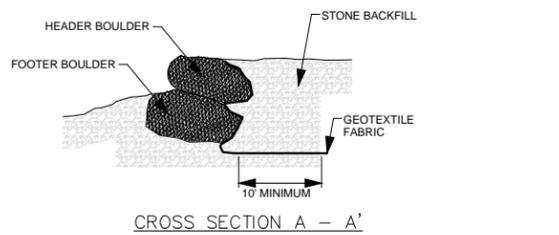
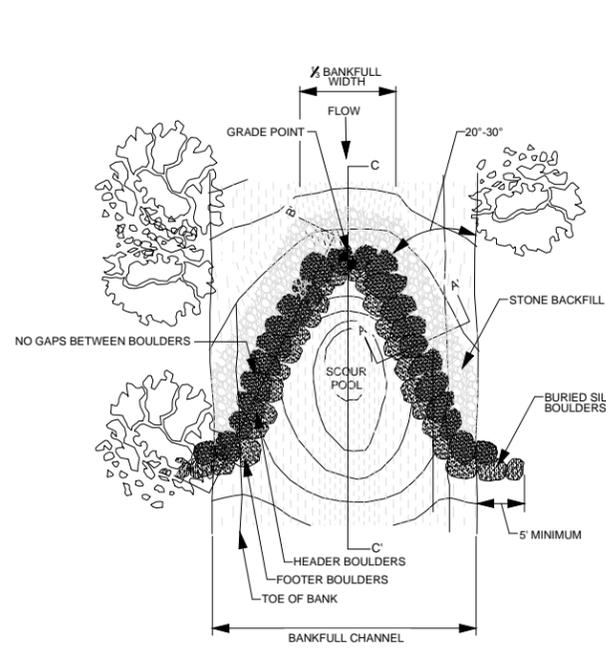


CROSS SECTION A - A'

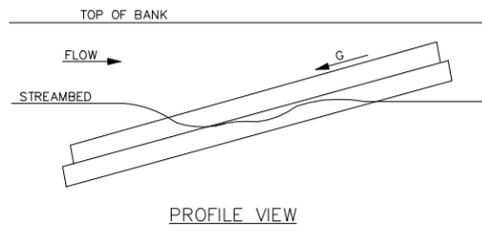
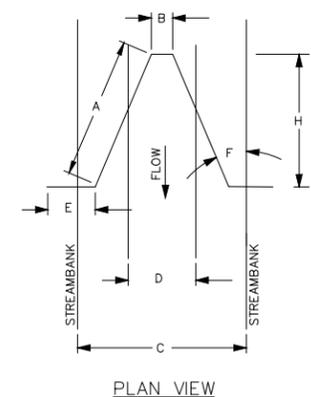


CROSS SECTION B - B'

ROCK CROSS VANE
NTS



CROSS VANE TYPICAL
NTS



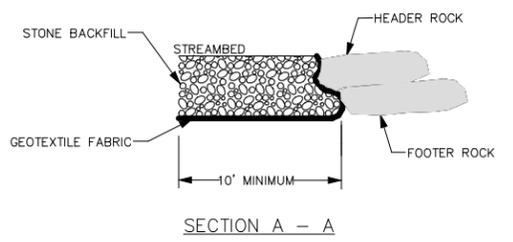
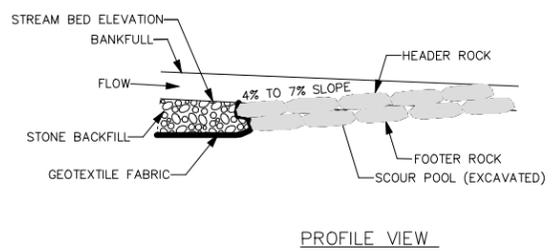
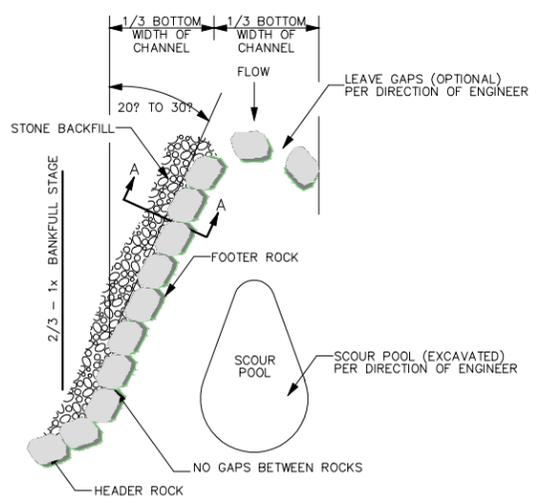
BAKER PROJECT REFERENCE NO. 138067 SHEET NO. 2-A

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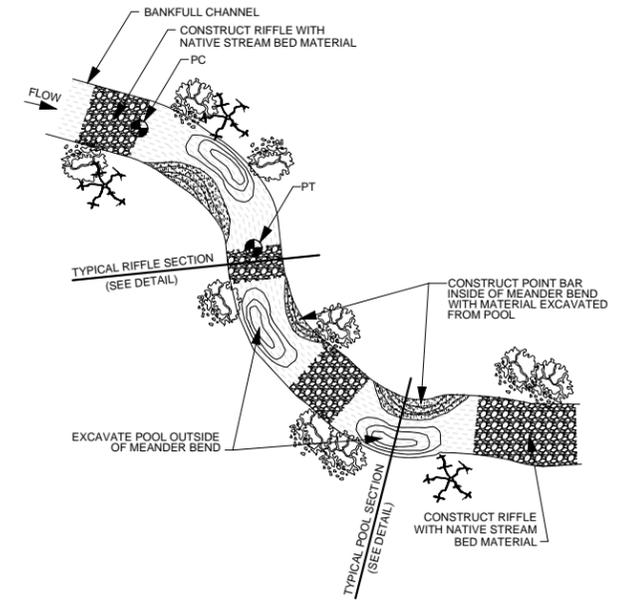
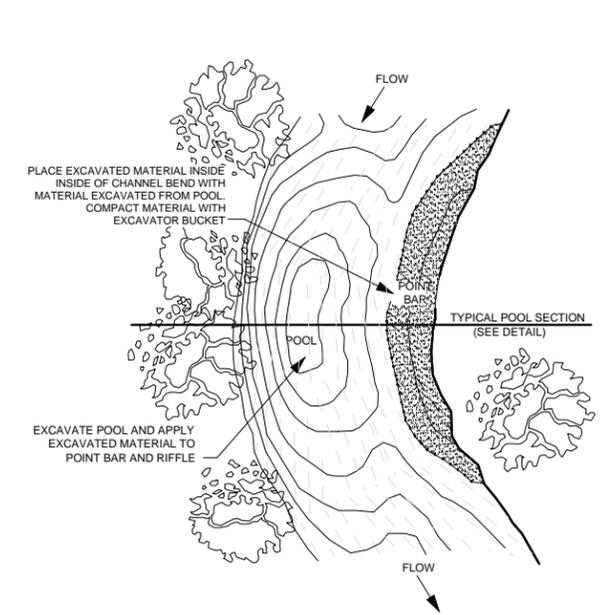
		NORTH	SOUTH
A	VANE ARM LENGTH	TBD	TBD
B	INVERT LENGTH	TBD	TBD
C	BANKFULL WIDTH	TBD	TBD
D	BOTTOM WIDTH	TBD	TBD
E	SILL LENGTH	TBD	TBD
F	VANE ARM ANGLE	TBD	TBD
G	VANE ARM SLOPE	TBD	TBD
H	STRUCTURE LENGTH	TBD	TBD

BOULDER J-HOOK VANE
NTS



- NOTES FOR ALL VANE STRUCTURES:**
1. INSTALL GEOTEXTILE FABRIC BEGINNING AT THE TOP OF THE HEADER ROCKS AND EXTEND DOWNWARD TO THE DEPTH OF THE BOTTOM FOOTER ROCK, AND THEN UPSTREAM TO A MINIMUM OF TEN FEET.
 2. DIG A TRENCH BELOW THE BED FOR FOOTER ROCKS AND PLACE FILL ON UPSTREAM SIDE OF VANE ARM, BETWEEN THE ARM AND STREAMBANK.
 3. START AT BANK AND PLACE FOOTER ROCKS FIRST AND THEN HEADER (TOP) ROCK.
 4. CONTINUE WITH STRUCTURE, FOLLOWING ANGLE AND SLOPE SPECIFICATIONS.
 5. AN EXTRA ROCK CAN BE PLACED IN SCOUR POOL FOR HABITAT IMPROVEMENT.
 6. USE HAND PLACED STONE TO FILL GAPS ON UPSTREAM SIDE OF HEADER AND FOOTER ROCKS.
 7. AFTER ALL STONE BACKFILL HAS BEEN PLACED, FILL IN THE UPSTREAM SIDE OF THE STRUCTURE WITH ON-SITE ALLUVIUM TO THE ELEVATION OF THE TOP OF THE HEADER ROCK.

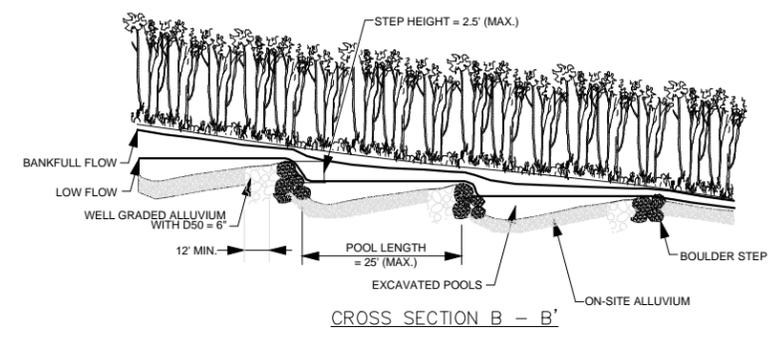
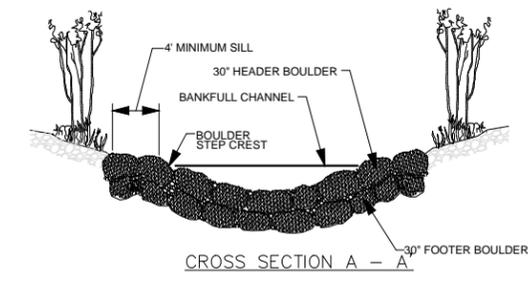
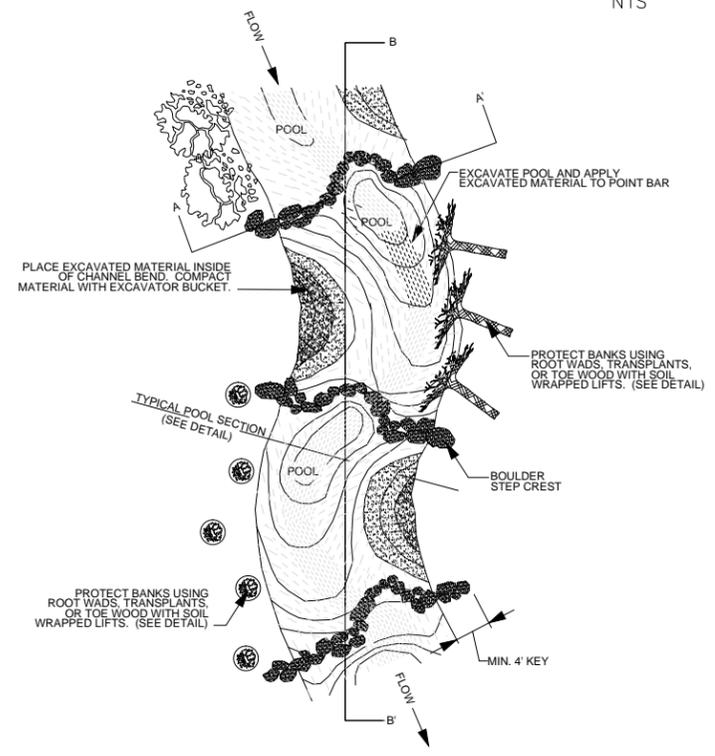
CONSTRUCTED POOL AND POINT BAR
NTS



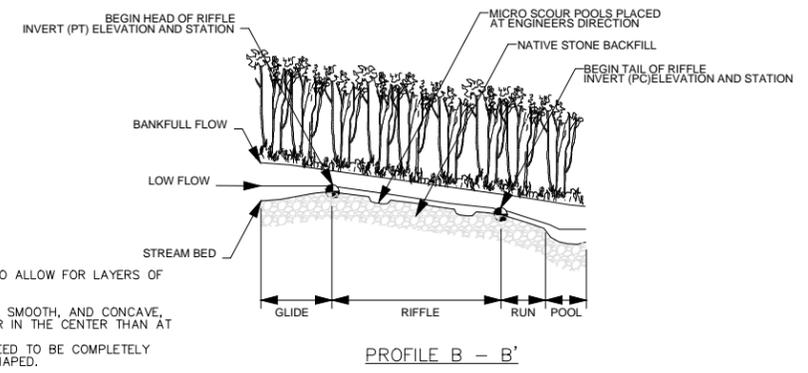
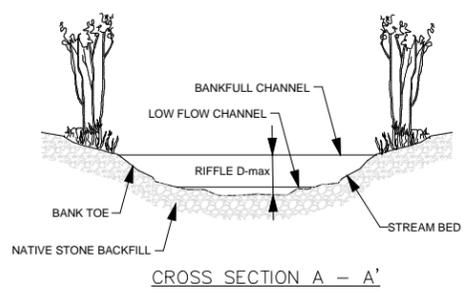
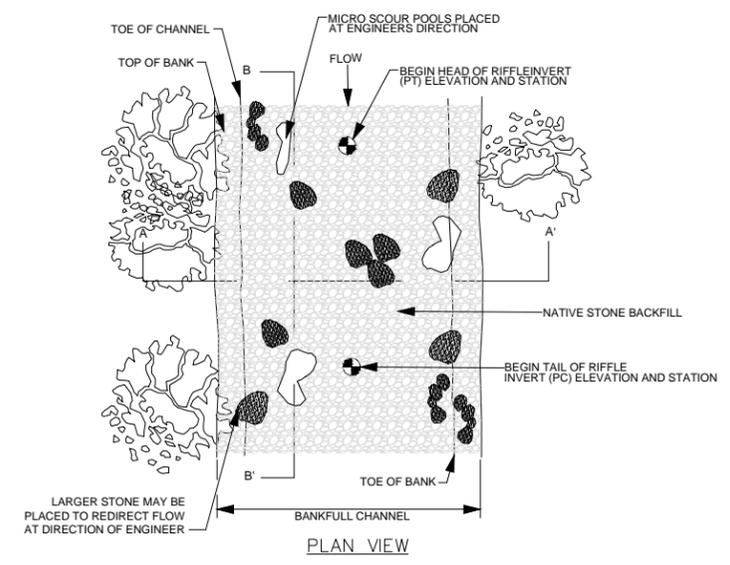
PRELIMINARY PLANS
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INTERNATIONAL

ROCK STEP POOL
NTS



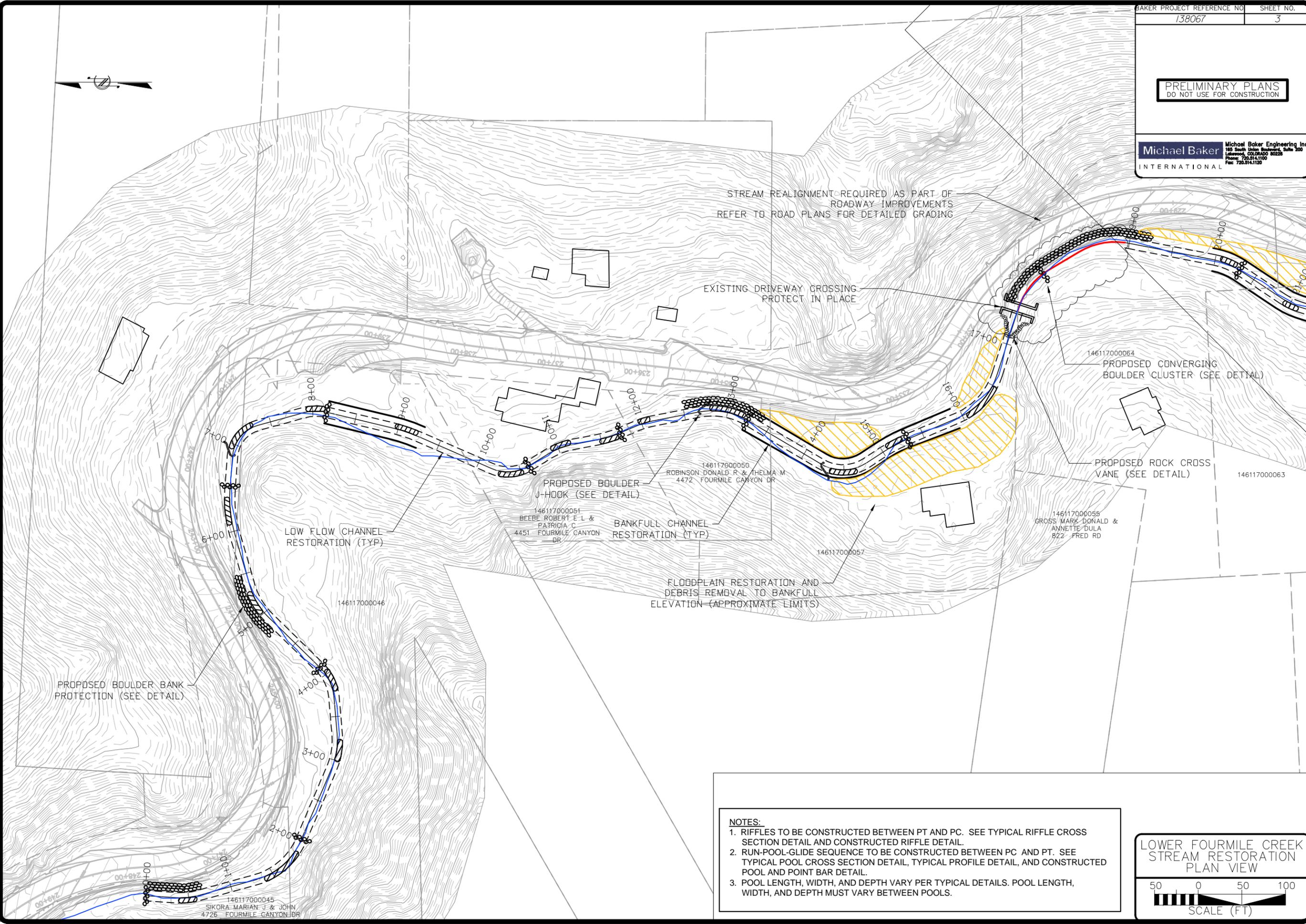
CONSTRUCTED RIFFLE / CASCADE
NTS



- NOTES:
1. UNDERCUT CHANNEL BED ELEVATION AS NEEDED TO ALLOW FOR LAYERS OF STONE TO ACHIEVE FINAL GRADE.
 2. INSTALL STONE BACKFILL, COMPACTED TO GRADE.
 3. FINAL CHANNEL BED SHAPE SHOULD BE ROUNDED, SMOOTH, AND CONCAVE, WITH THE ELEVATION OF THE BED 0.2 FT DEEPER IN THE CENTER THAN AT THE EDGES.
 4. NOT ALL RIFFLE LOCATIONS SHOWN ON PLANS NEED TO BE COMPLETELY RECONSTRUCTED, SOME JUST NEED TO BE RESHAPED.

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

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Fax: 720.514.1129



STREAM REALIGNMENT REQUIRED AS PART OF ROADWAY IMPROVEMENTS REFER TO ROAD PLANS FOR DETAILED GRADING

EXISTING DRIVEWAY CROSSING PROTECT IN PLACE

146117000064
PROPOSED CONVERGING BOULDER CLUSTER (SEE DETAIL)

PROPOSED ROCK CROSS VANE (SEE DETAIL)

PROPOSED BOULDER J-HOOK (SEE DETAIL)

BANKFULL CHANNEL RESTORATION (TYP)

LOW FLOW CHANNEL RESTORATION (TYP)

FLOODPLAIN RESTORATION AND DEBRIS REMOVAL TO BANKFULL ELEVATION (APPROXIMATE LIMITS)

PROPOSED BOULDER BANK PROTECTION (SEE DETAIL)

NOTES:

1. RIFFLES TO BE CONSTRUCTED BETWEEN PT AND PC. SEE TYPICAL RIFFLE CROSS SECTION DETAIL AND CONSTRUCTED RIFFLE DETAIL.
2. RUN-POOL-GLIDE SEQUENCE TO BE CONSTRUCTED BETWEEN PC AND PT. SEE TYPICAL POOL CROSS SECTION DETAIL, TYPICAL PROFILE DETAIL, AND CONSTRUCTED POOL AND POINT BAR DETAIL.
3. POOL LENGTH, WIDTH, AND DEPTH VARY PER TYPICAL DETAILS. POOL LENGTH, WIDTH, AND DEPTH MUST VARY BETWEEN POOLS.

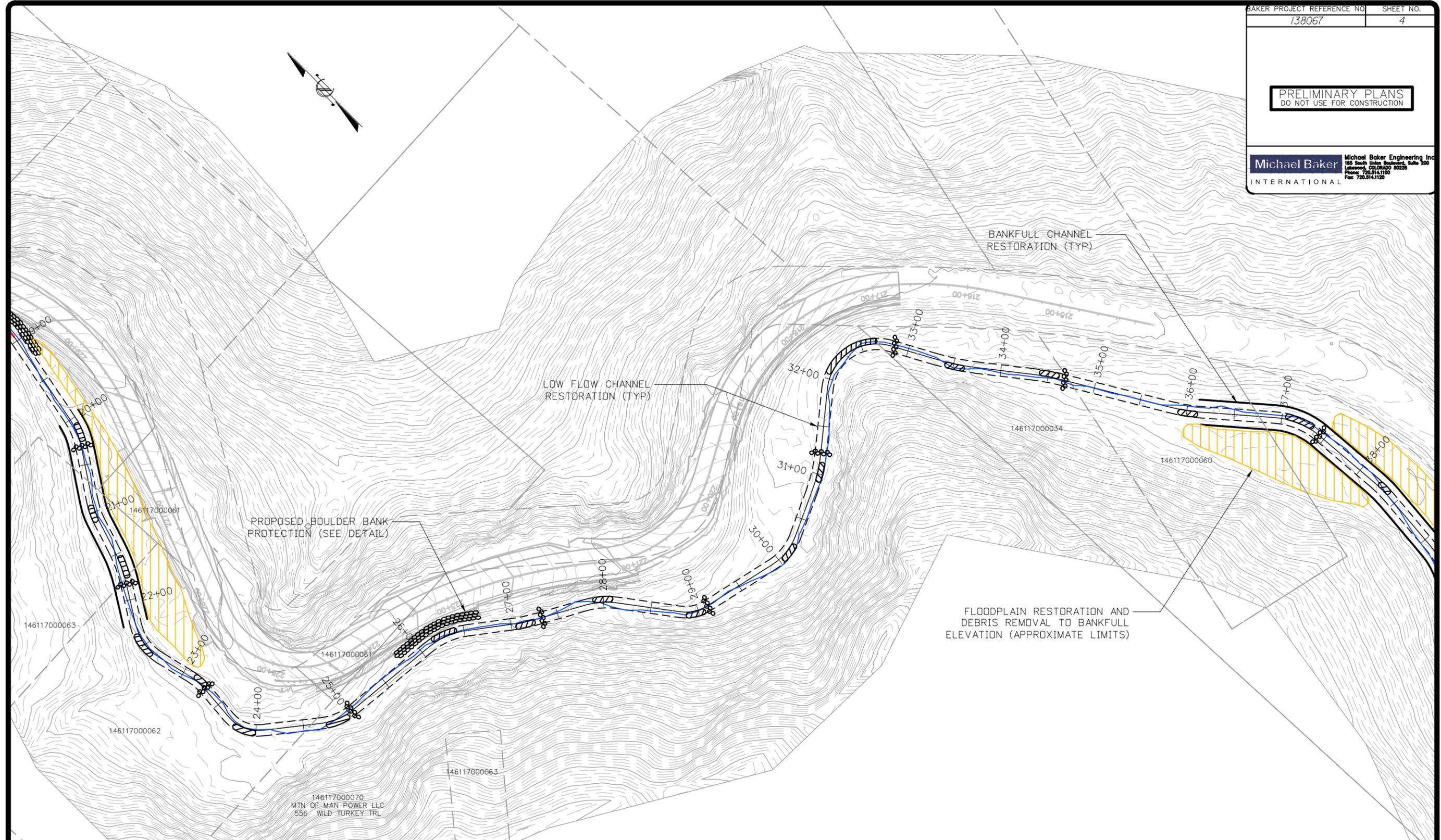
LOWER FOURMILE CREEK
STREAM RESTORATION
PLAN VIEW



146117000045
SIKORA MARIAN J & JOHN
4726 FOURMILE CANYON DR

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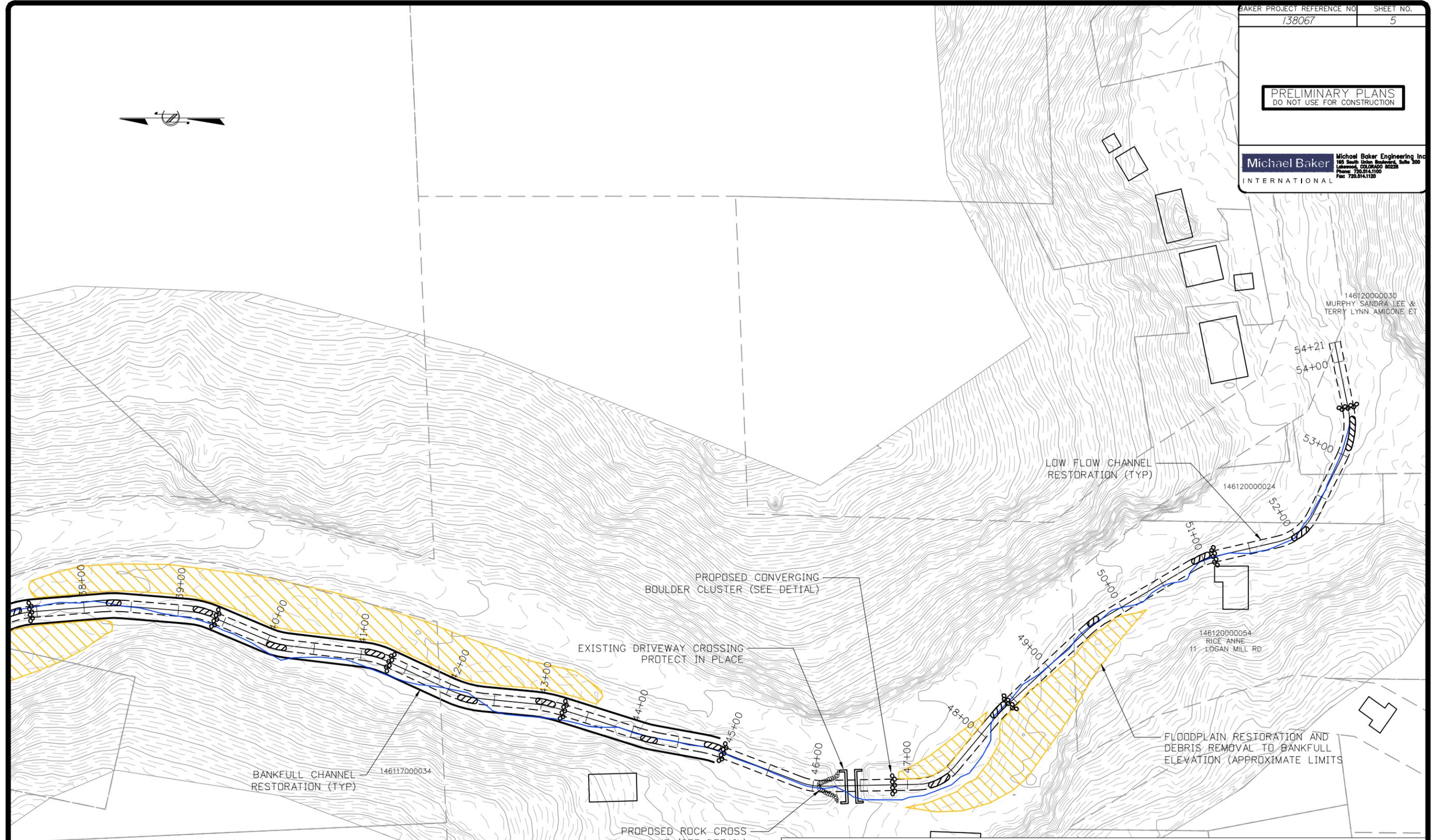
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LOWER FOURMILE CREEK
STREAM RESTORATION
PLAN VIEW

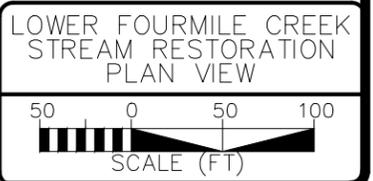
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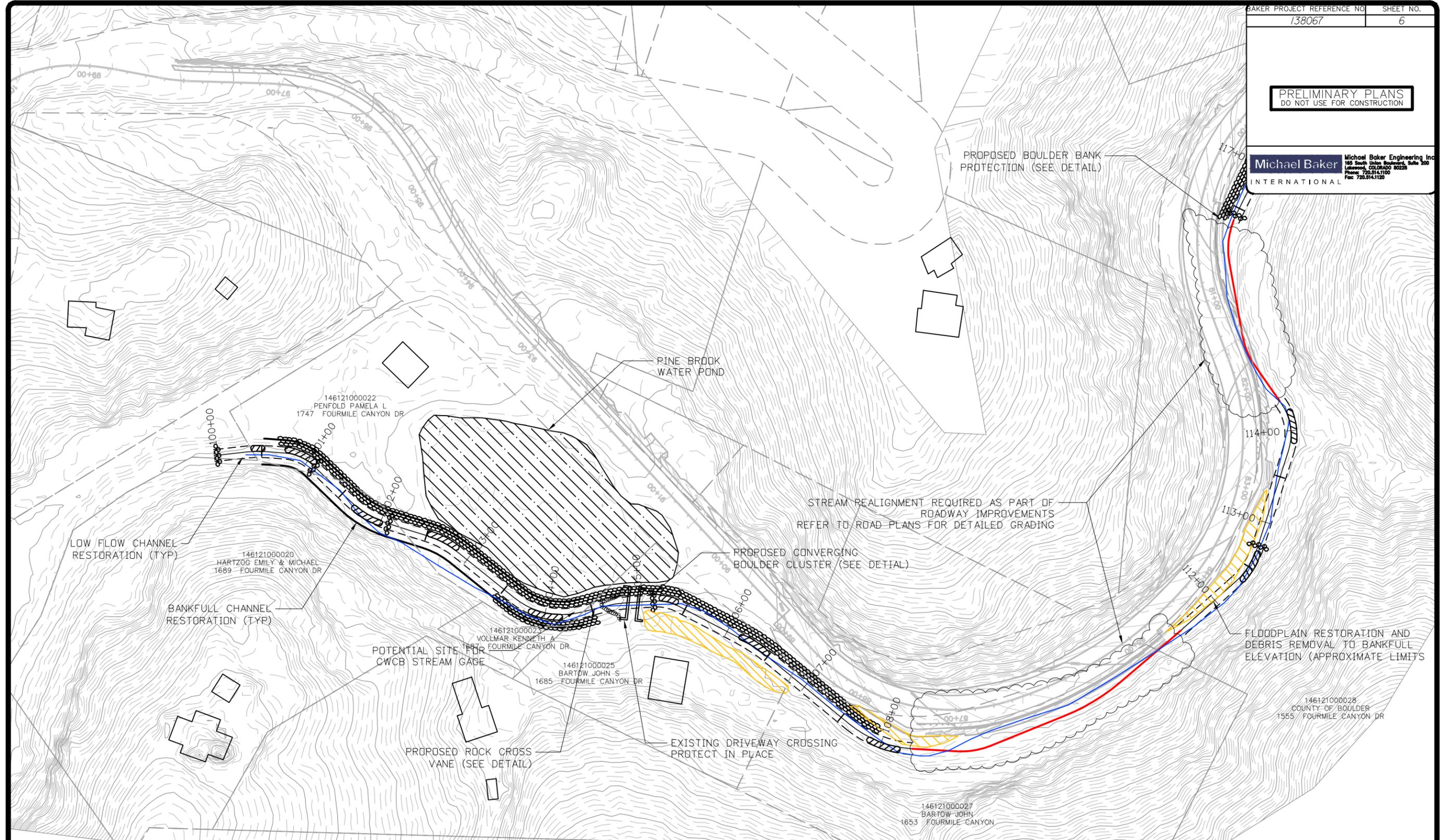


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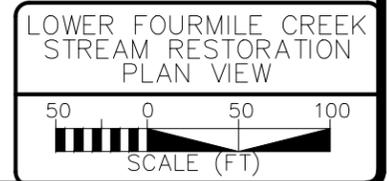


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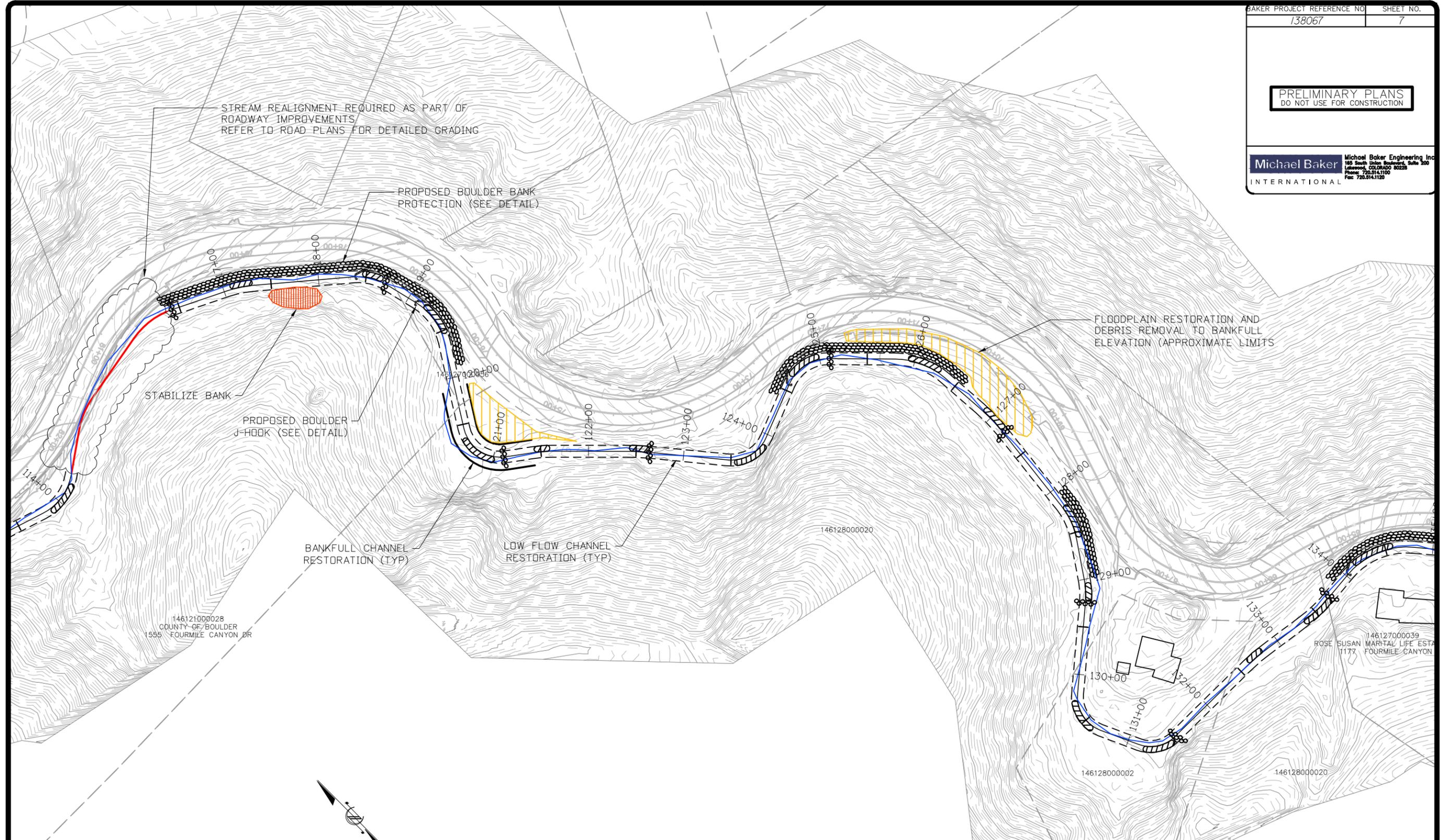


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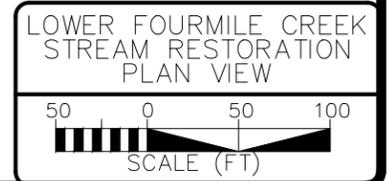


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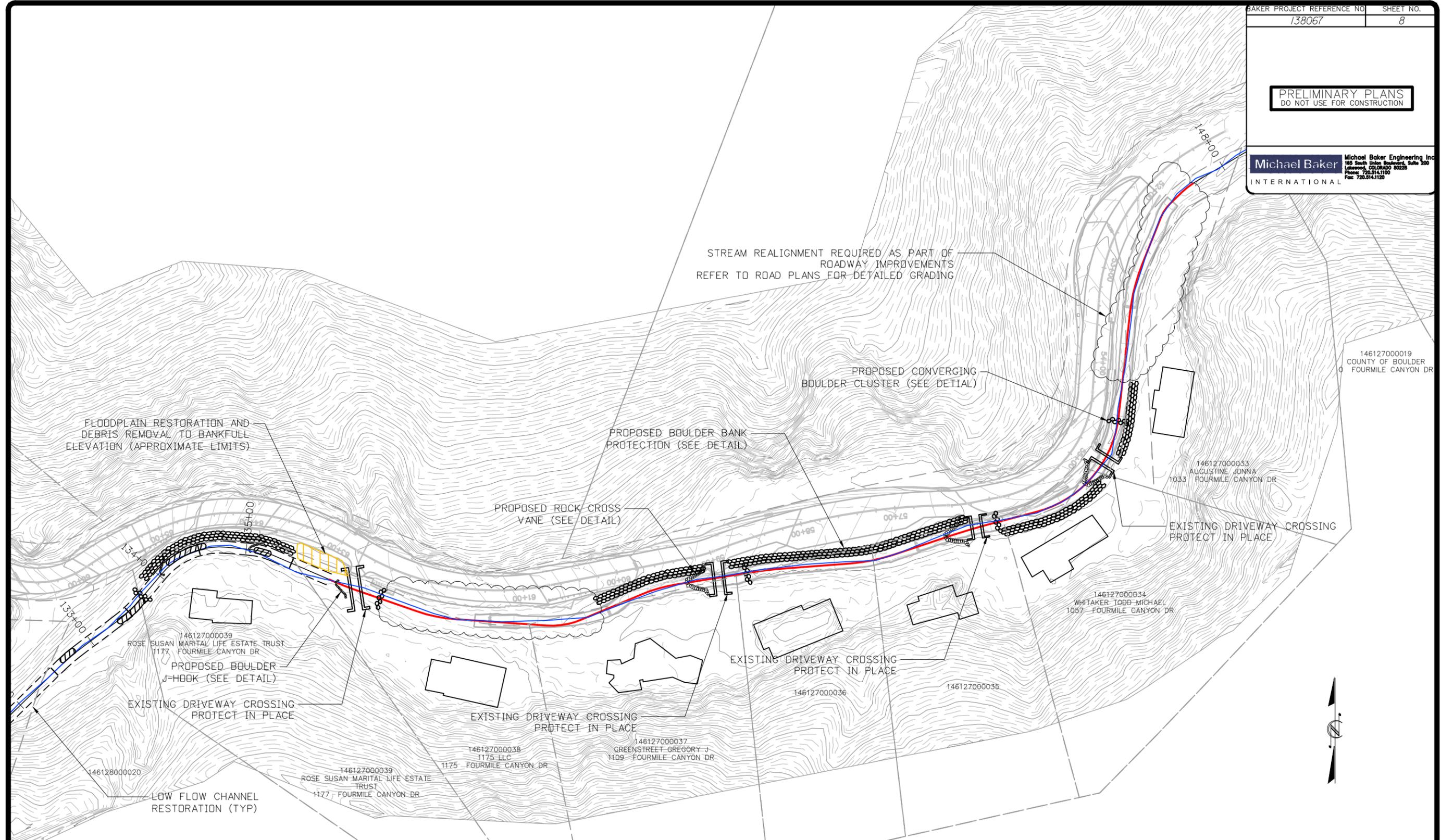


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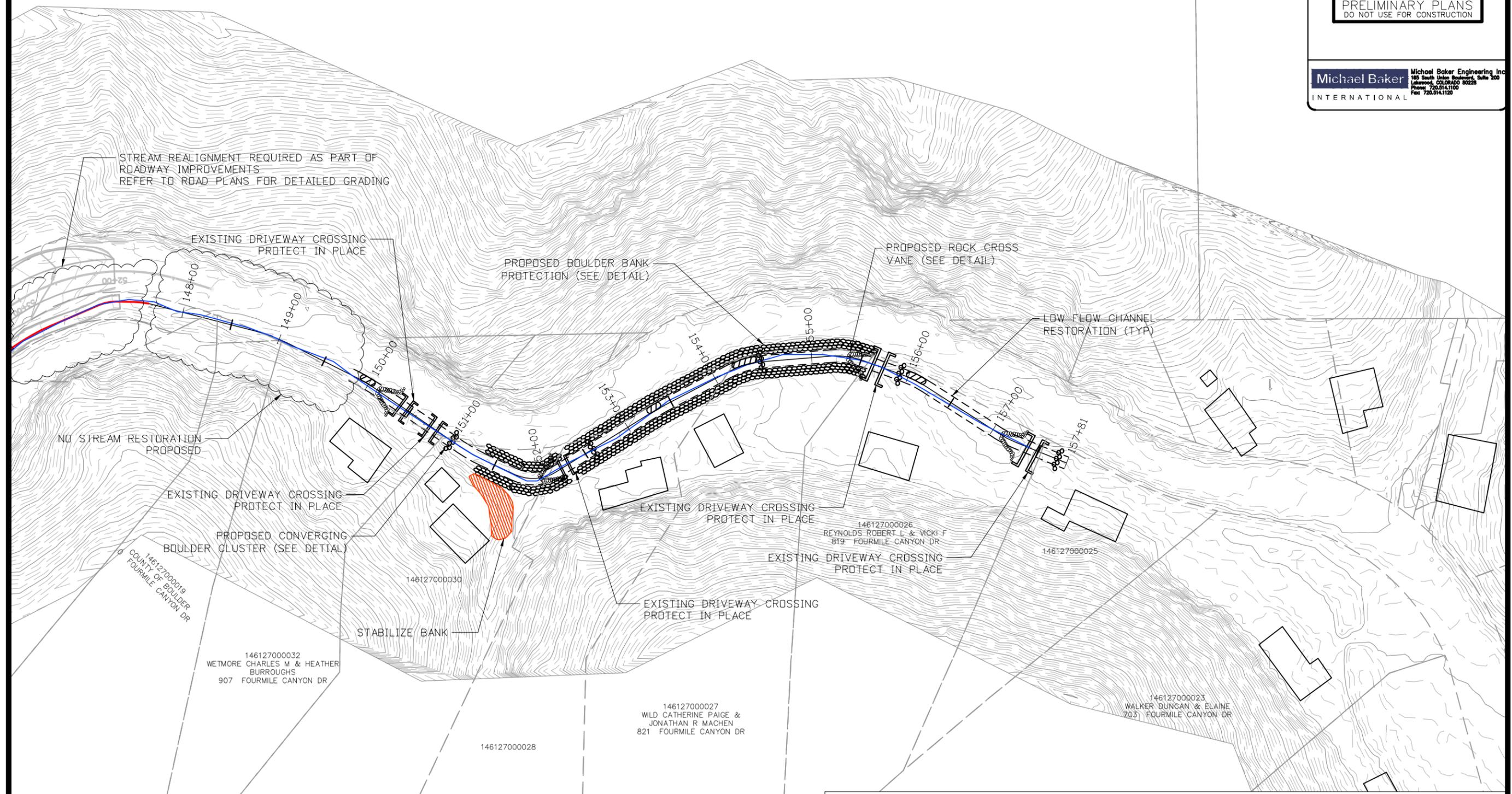
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LOWER FOURMILE CREEK
STREAM RESTORATION
PLAN VIEW

SCALE (FT)

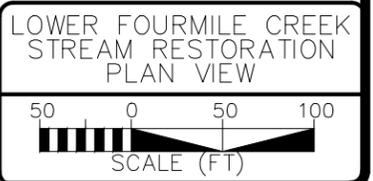
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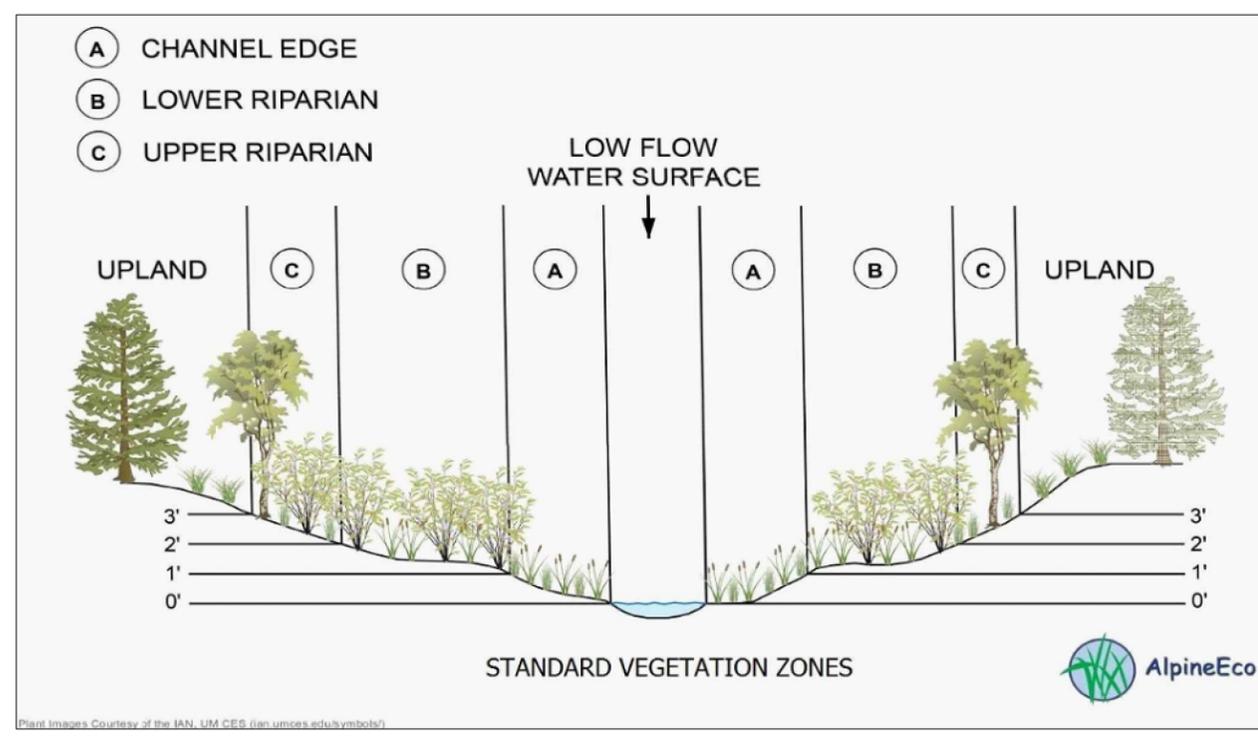
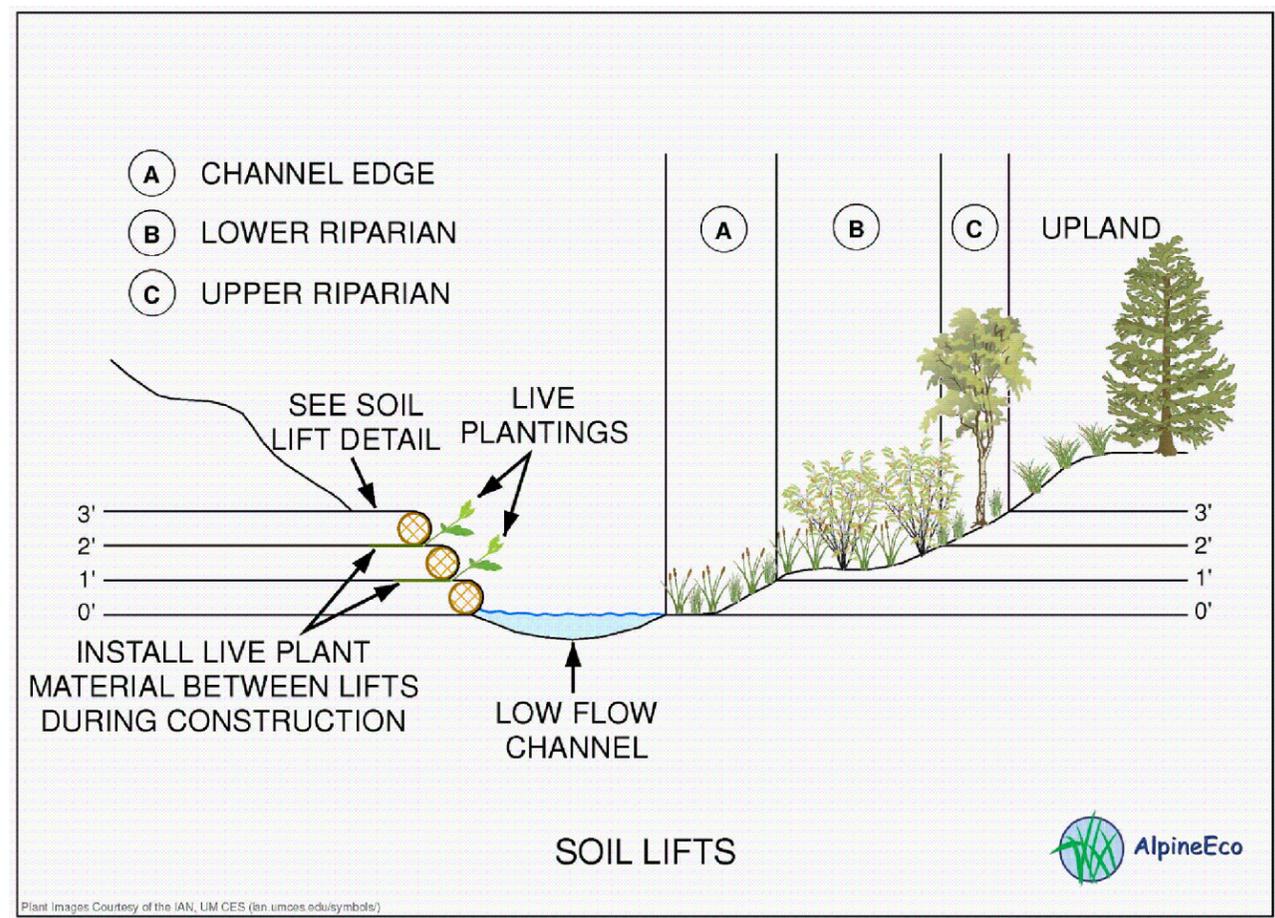
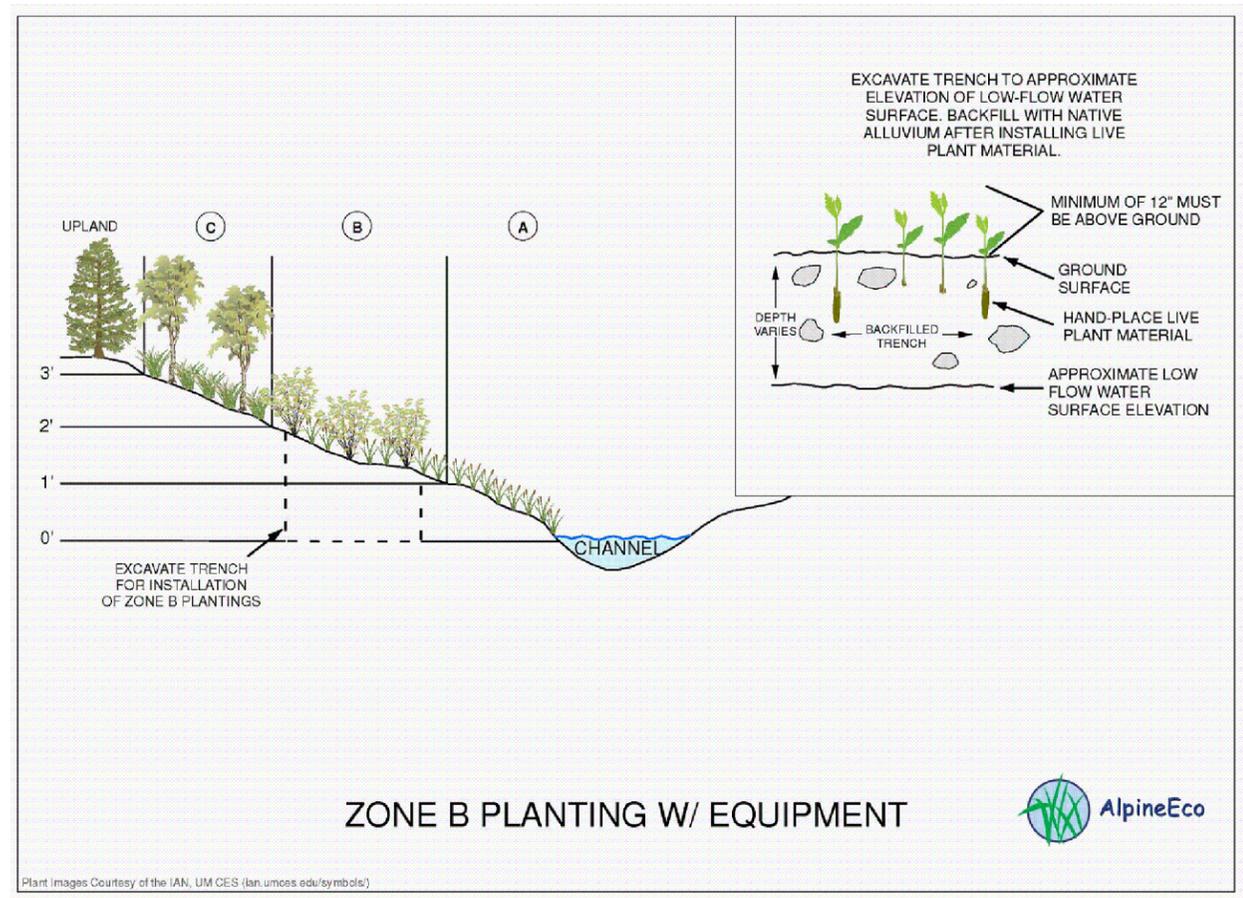


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Table 1: Plants Needed for Standard Restoration¹

Common Name	Scientific Name	Plant Size (cubic inch)	Plants per Acre
Zone A: Channel Edge²			
Bluejoint	<i>Calamagrostis canadensis</i>	10	750
Nebraska sedge	<i>Carex nebrascensis</i>	10	1,500
Woolly sedge	<i>Carex pellita</i>	10	1,000
Creeping spikerush	<i>Eleocharis palustris</i>	10	1,000
Baltic rush	<i>Juncus balticus</i>	10	1,000
Red-tinge bulrush	<i>Scirpus microcarpus</i>	10	750
	Total		6,000
Zone B: Lower Riparian²			
Thinleaf alder	<i>Alnus incana</i>	40	1,000
Water birch	<i>Betula occidentalis</i>	40	750
Redosier dogwood	<i>Cornus alba</i>	40	750
Mixed cottonwood/willow alder	<i>Populus/Salix/Alnus spp.</i>	Transplant	As available
Narrowleaf cottonwood	<i>Populus angustifolia</i>	40	1,250
Narrowleaf cottonwood	<i>Populus angustifolia</i>	5' cutting	2,000
Mixed willow	<i>Salix spp.</i>	5' cutting	2,000
Narrowleaf willow	<i>Salix exigua</i>	40	1,250
Dewsystem willow	<i>Salix irrorata</i>	40	1,000
	Total		10,000
Zone C: Upper Riparian³			
Narrowleaf cottonwood	<i>Populus angustifolia</i>	40	350
Chokecherry	<i>Prunus virginiana</i>	40	250
Common snowberry	<i>Symphoricarpos alba</i>	40	250
White-stem gooseberry	<i>Ribes inerme</i>	40	200
Woods' rose	<i>Rosa woodsii</i>	40	350
	Total		1,400

¹Zone A is 0-1', Zone B is 1-2', and Zone C is 2-3' above the water surface of the low-flow channel; exact planting locations will be based on final grading and directed by a qualified ecologist; plant nomenclature from Corps 2016
²Quantity of containerized stock based on approximately 3-foot centers. When ever possible, Zone B plants will be installed in a trench (excavated using earthmoving equipment) parallel to the channel located at approximately the edge of the bankfull channel; the bottom of the trench will be approximately the elevation of the low-flow water surface; mixed willow will be harvested from Boulder County (or adjacent counties) within 1,000 vertical feet (see notes); all plants randomly mixed; plant nomenclature from Corps 2016
³Based on approximately 6-foot centers

Table 2: Plants Needed for Rootwads/Channel Blocks¹

Common Name	Scientific Name	Plant Size (cubic inch)	Plants per Rootwad
Zone A: Channel Edge			
Nebraska sedge	<i>Carex nebrascensis</i>	10	75
Creeping spikerush	<i>Eleocharis palustris</i>	10	75
Red-tinge bulrush	<i>Scirpus microcarpus</i>	10	75
	Total		225
Zone B: Lower Riparian			
Thinleaf alder	<i>Alnus incana</i>	40	5
Water birch	<i>Betula occidentalis</i>	40	5
Narrowleaf cottonwood	<i>Populus angustifolia</i>	40	5
Narrowleaf cottonwood	<i>Populus angustifolia</i>	5' cutting	50
Mixed willow	<i>Salix spp.</i>	5' cutting	50
Mixed riparian shrub	--	transplant	as available
Narrowleaf willow	<i>Salix exigua</i>	40	5
Dewsystem willow	<i>Salix irrorata</i>	40	5
	Total		125

¹Zone A is 0-1' and Zone B is 1-2' above the water surface of the low-flow channel; exact planting locations will be based on final grading and directed by a qualified ecologist; mixed willow will be harvested from Boulder County (or adjacent counties) within 1,000 vertical feet (see notes); plant nomenclature from Corps 2016

Table 3: Plants Needed for Soil Lifts¹

Common Name	Scientific Name	Plant Size (cubic inch)	Plants per Linear Foot
Zone A: Channel Edge²			
Nebraska sedge	<i>Carex nebrascensis</i>	10	3
Woolly sedge	<i>Carex pellita</i>	10	3
	Total		6
Zone B: Lower Riparian³			
Mixed willow	<i>Salix spp.</i>	5' cutting	6
	Total		6

¹Plant nomenclature from Corps 2016
²Zone A plants only placed between lifts that are within 1 foot (vertical) of the low-flow water surface elevation; species not mixed, a minimum of 16 linear feet of each species
³Zone B plants only placed between lifts that are 1 to 2 feet (vertical) above the low-flow water surface elevation; mixed willow will be harvested from Boulder County (or adjacent counties) within 1,000 vertical feet (see notes).

Table 4: Riparian Seed Mix¹

Type	Common Name	Scientific Name	Variety ²	Seeds per Pound ³	Seeds per Square Foot	Pounds of Pure Live Seed/Acre	
Graminoids	Sideoats grama	<i>Bouteloua curtipendula</i>	Butte or Pierre	191,000	5.3	1.2	
	Blue grama ⁴	<i>Bouteloua gracilis</i> ⁴	Birds Eye, Alma, or Lovington	825,000	11.4	0.6	
	Standar wheatgrass	<i>Elymus trachycalyx</i>	White River or San Luis	159,000	4.4	1.2	
	Idaho fescue ⁴	<i>Festuca idahoensis</i> ⁴	Wardwester	450,000	8.3	0.8	
	Fowl mangrass	<i>Glyceria striata</i>	-	180,000	8.3	2.0	
	Needle and thread	<i>Hesperostipa comata</i>	-	115,000	5.3	2.0	
	Prairie junegrass ⁵	<i>Koeleria macrantha</i> ⁵	-	2.3 million	5.3	0.1	
	Baltic rush ⁵	<i>Juncus balticus</i> ⁵	-	10.9 million	25.0	0.1	
	Torrey's rush ⁵	<i>Juncus torreyi</i> ⁵	-	12.3 million	28.2	0.1	
	Green needlegrass	<i>Nassella viridula</i>	Cucharas or Lodam	181,000	4.2	1.0	
	Western wheatgrass	<i>Pascopyrum smithii</i>	Amiba	110,000	10.1	4.0	
	Fowl bluegrass ⁵	<i>Poa palustris</i> ⁵	-	3.2 million	7.3	0.1	
	Sandberg bluegrass ⁵	<i>Poa secunda</i> ⁵	Slim Mesa or High Plains	1 million	6.9	0.3	
	Bluebunch wheatgrass	<i>Pseudoroegneria spicata</i>	P7	140,000	6.4	2.0	
	Little bluestem	<i>Schizachyrium scoparium</i>	Pastara, Cimarron, or Camper	260,000	6.0	1.0	
	Forbs	Common yarrow ⁶	<i>Achillea millefolium</i> ⁶	-	2.7 million	6.2	0.1
		Rocky Mountain bee plant	<i>Cleome serrulata</i>	-	66,000	3.0	2.0
		Golden tickseed ⁶	<i>Coreopsis tinctoria</i> ⁶	-	1.4 million	3.2	0.1
Blanketflower		<i>Gallardia aristata</i>	Merweather	132,000	1.5	0.5	
Showy goldeneye ⁶		<i>Helianthus multiflorus</i> ⁶	-	1 million	2.3	0.1	
Rocky Mountain penstemon		<i>Penstemon strictus</i>	Bandera	490,000	2.2	0.2	
American vetch		<i>Vicia americana</i>	-	33,000	0.8	1.0	
Bulk	Rice hulls	-	-	-	4.5		
	Total			161.6	25.0		

¹Nomenclature follows PLANTS Database (NRCS 2016); seeding rate based on hand-broadcasting; any substitutions must be native to Colorado and from the US or Canada seed source.
²Source: NRCS 2016, Granite Seed 2016, Western Native Seed 2016, NSN 2016
³Bag separately if drill-seeding

- Standard Revegetation (see Tables 1 and 4)
 - Standard treatment areas include the entire natural floodplain, unless otherwise noted. The standard revegetation plan includes three planting zones (A, B, and C), and seeding in all zones.
 - Planting Zone A (Channel Edge) encompasses those areas between 0 and 1 foot (vertical) above the low flow channel water surface elevation and generally in areas protected from scour/direct flow. Zone B (Lower Riparian) includes those areas between 1 and 2 feet above the low flow channel, and Zone C (Upper Riparian) includes those areas between 2 and 3 feet above. See typical cross-section.
 - All portions of the project corridor (including areas where no earthwork occurs) will be hand-seeded with the Riparian Seed Mix (Table 4) at approximately 25.0 pounds of pure live seed per acre, including rice hulls for bulk.
 - All portions of Zones B and C where earthwork occurs will be hand-mulched with excelsior (spun aspen wood) at a rate of approximately 1,800 pounds per acre (approximately 30 bales at 60 pounds each).
- Rootwads/Channel Blocks (see Table 2)
 - The treatment for Root Wads/Channel Blocks conforms with the typical detail and includes the installation of live plant material (transplants, containerized stock, and cuttings). These materials will be installed during and after the construction of the rootwads/channel blocks and placed primarily in the area downstream of the rootwad (where a back eddy may form), but will also be installed in other areas of suitable hydrology (according to the elevation above the low-flow channel water surface—see Treatment 1 typical cross-section for planting zones).
 - Willow cuttings (3-foot long) will be placed during installation of the rootwads in areas where a portion of the cutting is the elevation is between 1 and 2 feet above the low-flow water surface.
 - Containerized herbaceous plants (10 ci) will be placed after the rootwads are installed in areas protected from direct flow/scour (mainly on the downstream side of the rootwad) where the elevation is 1 foot or less above the low-flow water surface.
- Soil Lifts (see Table 3)
 - This treatment involves the installation of live plant material during the construction of the soil lifts. Containerized herbaceous plants (10 ci) will be placed in between lifts (during construction of the lifts) where the elevation is 1 foot or less above the water surface of the low-flow channel. Willow cuttings (5-foot long) will be installed between the lifts (during construction) where the elevation is between 1 and 2 feet above the low-flow water surface.
 - The lifts will be constructed with native soil mixed with compost (300 cubic yards/acre) and then hand-seeded with the Riparian Mix at approximately 25.0 pounds of pure live seed per acre (including rice hulls for bulk) before wrapping with fabric. Seed should be placed on the soil surface, just beneath the fabric.

Literature Cited

Granite Seed and Erosion Control (Granite Seed). 2016. Website: <http://www.graniteseed.com/>
 Native Seed Network (NSN). 2016. Website: <http://www.nativeseednetwork.org>
 Natural Resources Conservation Service (NRCS). 2016. The PLANTS Database (<http://plants.usda.gov>). National Plant Data Team, Greensboro, NC 27401-4901 USA.
 US Army Corps of Engineers (Corps). 2016. *National Wetland Plant List*, version 3.2. Website: <http://wetland.plants.usace.army.mil/>. Accessed in September.
 Western Native Seed. 2016. Website: <http://www.westernnativeseed.com/>

General Notes:

- If existing riparian shrubs or small trees (<4" diameter at breast height) are present but too high above the low-flow channel to be wetted through capillary action (because of channel degradation associated with the flood), then the banks will be laid back and the existing vegetation will be moved (transplanted) to the appropriate elevation above the water surface of the low-flow channel; 0 to 1 foot above for herbaceous wetland vegetation and 1 to 3 feet for wetland/riparian woody vegetation.
- All natural floodplain areas (including those not disturbed by restoration activities) will be hand-seeded with the Riparian Seed Mix (Table 4) at approximately 25.0 pounds of pure live seed per acre, including rice hulls for bulk. Seeding will only be performed between September 1 and when the ground freezes, and when the ground thaws and June 1, unless approved by a qualified ecologist.
- After seeding, all portions of Zone B and C disturbed by restoration activities will be hand-mulched using excelsior (spun aspen wood) mulch applied at approximately 1,800 pounds per acre (approximately 30 bales at 60 pounds each). Although floodplain areas not disturbed by restoration activities will be seeded, only those disturbed will be mulched.
- The exact locations of live plant material will be based on the final grading, as determined by a qualified ecologist.
- All areas disturbed by restoration activities, including the soil lifts, will be amended with 300 cubic yards per acre of compost. The compost will be mixed with native soil/alluvium to a depth of 12 inches. The compost will have the following characteristics:
 - pH: 5.5-8.0
 - Moisture content: 35-55 percent
 - Particle size: pass through 1-inch screen or smaller
 - Stability: stable to highly stable, providing nutrients for plant growth
 - Maturity/growth screening: demonstrate ability to enhance plant growth
 - Soluble salt concentration: 2.5 dS (mmhos/cm) or less preferred
 - Organic matter content: 30-70 percent
 - Suggested compost source: A-1 Organic, Eaton, Colorado 970-454-3492 or an approved equal.
- All willow and cottonwood cuttings will be collected on-site or from elsewhere in Boulder County (or immediately adjacent counties) within 1,000 vertical feet of near the site, as directed by a qualified ecologist. Acceptable willow species for "mixed willow" include (nomenclature from Corps 2016): *Salix exigua*, *S. interior*, *S. irrorata*, *S. bebbiana*, *S. maritima*, *S. drummondiana*, *S. ligulifolia*, *S. lasiocarpa*, and *S. lutea*. No one species can account for more than 70 percent of the mix.
- All willow and cottonwood cuttings will be harvested when dormant (before leaves emerge or after they are dropped) from live plants 0.5 to 1.0 inch in diameter. The stem will be stripped of all branches before cutting and then trimmed to the desired length. The lower (rooting) end of the stem will be cut at a 45 degree angle and the upper end will be cut at 90 degree angle. The cuttings will be placed into water within two minutes of cutting and soaked—completely submerged—for at least 72 hours, but not more than 14 days, prior to planting. The cuttings will be kept wet until placed into the ground and will not be allowed out of water for more than 10 minutes during planting. All cuttings will be trimmed after installation to ensure that no more than one-third of their length is left above ground.
- Whenever possible, Zone B live plant material (containerized stock and cuttings) will be installed by using equipment to excavate a trench parallel to the channel, with the bottom of the trench corresponding to the approximate elevation of the low-flow channel water surface. The plant material will be placed into the trench, backfilled, and lightly tamped. Willow and cottonwood cuttings may be completely buried (horizontally or vertically), but containerized stock and transplants will be placed upright and so that at least 1/3 of the above-ground plant mass is above the new ground surface.
- All containerized plants will be inspected by a qualified ecologist prior to planting. Any dead, dying, stressed, or badly "rootbound" plants will be rejected.
- A qualified ecologist will direct and supervise all plantings
- In an attempt to avoid the continued spreading of noxious weeds, all discrete populations of Colorado List A or B noxious weeds found in or within 100 feet of the restoration area will be sprayed with the appropriate herbicide(s) prior to construction in coordination with the Boulder County weed coordinator.
- All finish grades will be left rough and natural with no smooth surfaces, straight edges, or right angles
- All work areas (other than the immediate channel banks) will be loosened to a depth of 12 inches before planting and seeding
- No equipment will be allowed in the restoration area after seeding or planting
- Any trees to be removed for the project will be removed during the non-nesting season for migratory birds (between September 1 and March 31). If this is not possible, active nest surveys for migratory birds may be required.
- All finish grades will be left rough and natural with no smooth surfaces, straight edges, or right angles
- All work areas (other than the immediate channel banks) will be loosened to a depth of 12 inches before planting and seeding
- No equipment will be allowed in the restoration area after seeding or planting
- Any trees to be removed for the project will be removed during the non-nesting season for migratory birds (between September 1 and March 31). If this is not possible, active nest surveys for migratory birds may be required.
- All best management practices (BMPs) used shall be selected, installed, implemented, and maintained according to appropriate engineering, hydrologic and pollution control practices.
- The use of chemicals such as soil stabilizers, dust palliatives, herbicides, growth inhibitors, fertilizers, deicing salts, etc., shall be in accordance with the manufacturer's recommended application rates, frequency, and instructions. These chemicals shall not be used, stored, or stockpiled within 50 horizontal feet of the creek or other aquatic habitats.
- Construction equipment, fuels, lubricants, and other petroleum distillates shall not be stored or stockpiled within 50 horizontal feet of the creek or other aquatic habitats. Equipment fueling and servicing shall occur only within approved designated areas.

LOWER FOURMILE CREEK
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