FINAL REPORT

WSRA Grant
Fountain Creek Bank Restoration at the Frost Ranch

May 30, 2014

Submitted to:
Larry Small, Executive Director
Fountain Creek Watershed Flood Control and Greenway District

Fountain Creek Watershed
Flood Control & Greenway District

Matrix Design Group

Final Report for WSRA Grant

Fountain Creek Bank Restoration at the Frost Ranch

Prepared for:

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Prepared by:

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Colorado Springs, Colorado 80920

In conjunction with:

Final Report – May 2014
Matrix Project No.: 13.526.003.000

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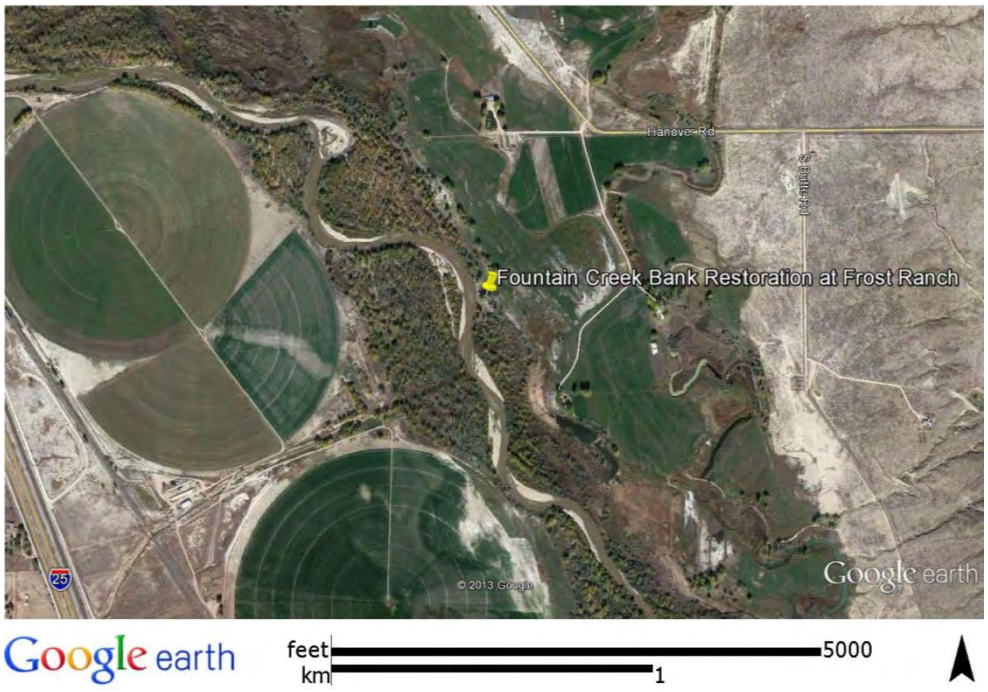
1.0 Introduction

The purpose of this report is to provide final documentation of work completed under the Water Supply Reserve Account (WSRA) Grant for the Fountain Creek Bank Restoration at the Frost Ranch (the Project). The Project was completed as a demonstration effort for the Fountain Creek Watershed Flood Control and Greenway District (the District) with funding from the District, the Arkansas Basin Roundtable, and the Colorado Water Conservation Board WSRA. The report outlines:

1. Alternatives considered
2. Design and permitting
3. Construction
4. Review of grant objectives and lessons learned

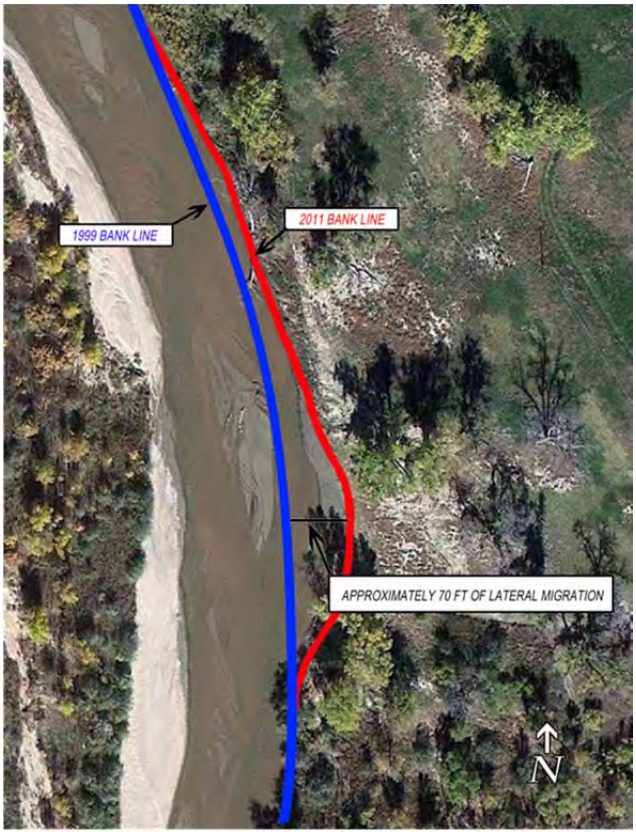
The Project site is located at 17825 Hanover Road, Fountain, CO, 80817 in southern El Paso County approximately 1.0 mile east of Interstate 25 and 0.3 miles south of Hanover Road on the Frost Ranch. An aerial map illustrating the Project location is provided below for reference.

Figure 1. Project Site



The Project lies along an eroding bendway where Fountain Creek migrated into a bank with little riparian vegetation, which led to accelerated soil erosion. Over the years, the bank erosion caused property loss and increased sediment supply. Eliminating erosion along the bank will protect viable agricultural land, reduce sediment supply downstream, and improve both terrestrial and aquatic habitat. Figure 2 shows the progression of bank erosion in recent years.

Figure 2. Bank Erosion



The lack of vegetation along about 400 feet of the left bank (looking downstream) allowed the soil to be readily removed during high flow events. Consequently, the landowner experienced flood damage and bank erosion that caused loss of property, damage to fences, loss of productivity, and loss of habitat and vegetation. Since 1999, the bank has migrated as much as 70 feet at one point.

As a result of the bank erosion, the creek became over widened from the stable Fountain Creek reference width of about 160 feet to more than 200 feet. Near the lower end of the Project, the bank "scalloped" out and created severe secondary currents (eddy) that would have aggravated future erosion. Using an estimate of erosion based on a bank erosion hazard index and near bank stress, it was predicted that routine (non-flood) erosion increased from about 0.1 tons/foot/year to nearly 1 tons/foot/year. Along the 400-foot Project reach that equates to an increase from 40 tons/year to 400 tons/year, or a ten-fold increase. The over widening and increased sediment supply caused downstream deposition which, if allowed to continue, would in-turn aggravate bank erosion.

With the exception of the Project bank, this reach of Fountain Creek is an exemplary healthy reach. The creek in this vicinity is relatively stable, well-vegetated and neither aggrading or degrading. It is bordered by dense riparian and wetland buffer and associated high-value habitat. The vegetation buffer provides roughness that slows velocities and root mass that holds the stream banks together during floods. Restoring the Project bank in this reach was intended to prevent further impacts to the otherwise healthy reach at much lower cost that repairing it after further damage. This healthy reach was recently used as a reference reach to collect stable geomorphic and survey data to guide another channel restoration project on a site upstream. As such, considerable data exists for the Project reach.

Photos 1 & 2. Pre-Project Conditions

The Project bank had a relatively low height compared to other severely eroding banks on Fountain Creek. That allowed the Project to proceed with available WSRA funds to demonstrate effective habitat-sensitive restoration techniques at a reasonable cost by comparison. The Project bank is readily accessible and will be an excellent location to demonstrate techniques that can be used to systematically address larger erosion and sedimentation issues along Fountain Creek. Addressing these issues will begin to reduce the sediment supply that is contributing to irrigation, flooding, and stream stability problems downstream on Fountain Creek and the Arkansas River.

2.0 Alternatives Considered

Three different bank restoration techniques were considered as alternatives on the Project. These alternatives included conventional soil riprap, brush layering, and a combination of toe wood and brush layering. Concept drawings were prepared for each alternative and advantages and disadvantages were evaluated. Table 1 outlines the advantages and disadvantages of each alternative. Concept drawings are attached in Appendix E.

Alternatives were presented to the District's Citizens Advisory Group (February 14) and Technical Advisory Committee (April 2), as well as to the landowner (February 19). The general consensus from the stakeholders was that they preferred the more natural approaches of brush layering or toe wood over soil riprap. They liked the idea of demonstrating a more natural solution that was habitat-sensitive, compatible with revegetation, and had a lower material cost, thereby making it more feasible for a landowner to implement in other locations.

During site visits with potential contractors, the availability of green trees in the vicinity of the Project was discussed. Green trees that are full of water and correspondingly heavy are best for constructing the toe wood alternative because they don't float during construction, are less susceptible to uplift during high flows, and they have greater longevity in the bank. Although, numerous dead or downed cottonwoods were available near the Project, few green or recently downed trees were available. After considering the number of trees required for the Project, the impact to the landowner, and the impact to avian nesting habitat, the Project team opted to abandon the idea of using toe wood.

Table 1. Alternatives Advantages and Disadvantages

Alternative	Advantages	Disadvantages
Soil Riprap	Well-defined design criteria; High contractor familiarity and easy to install; Demonstrated performance	High material costs; Susceptible to scour or undercutting; More difficult to revegetate; Less natural; Riprap hauling impacts
Brush Layering	Lower material costs; Easy to revegetate; Biodegradeable material; More natural	Less contractor familiarity and labor intensive; Less design and performance data; Susceptible to tearing from debris and abrasion from sediment
Toe wood /Brush Layering	Lowest material costs; Easy to revegetate; Biodegradable material; Trees for toe wood can be harvested locally; Best aquatic habitat value	Least contractor familiarity and difficult to install; Limited design and performance data; Susceptible to uplift; Limited availability of green (i.e. wet, heavy) trees in the vicinity

Based on the advantages and disadvantages of each alternative, input from stakeholders and the landowner, and site considerations, the brush layering concept was selected for the Project. If a future project site has different characteristics, other alternatives may be more applicable. For example, if high-value infrastructure required protection, the more proven riprap alternative might be preferred, particularly if material cost was less of an issue or if the availability of labor was limited. Where aquatic habitat is of paramount concern, the toe wood option would be the preferred solution, particularly if an experienced contractor was hired and green trees were readily available.

3.0 Design & Permitting

3.1 Engineering Analysis and Design

Matrix Design Group, Inc. (Matrix) completed a detailed topographic survey at the location of the Project on September 3, 2013. The survey encompassed the longitudinal and lateral extents of the eroded bank. Significant flooding and erosion occurred at the Project site from September 12 through 15, 2013. As a result we completed a re-survey of the Project site on February 26, 2014. In addition to the topographic survey, additional data was obtained from:

- Available geo-referenced aerial photography
- Hydrologic, hydraulic, geomorphic, and environmental reports completed as part of the Colorado Springs Utilities SDS Fountain Creek Realignment project upstream and applied as in-kind services for this WSRA grant.

- An initial site visit to evaluate existing conditions and observe the site post-flood.

Matrix completed engineering analyses needed to support the design of the bank restoration. These analyses primarily involved extracting pertinent information and data from the SDS Fountain Creek Realignment reports noted above 1 as well as, further evaluation of geomorphic and scour data collected specifically at the Project site. Engineering analyses included:

- Design flow selection: Bankfull flow of 3,600 cfs through a 10-year flow of 15,000 cfs.
- Hydraulic analysis: Design velocity of 8 ft/sec; Design shear stress of 1 lb/sf.
- Scour analysis: Observed scour depths of 3 ft; predicted scour depth of up to 5 ft.
- Geomorphic evaluation: Bankfull width of 160 ft; Width/depth ratio of 51; Slope of 0.35%.
- Vegetation assessment: Existing plant communities including woody vegetation (Sandbar willow and Plains cottonwood) and wetland plants (Nebraska sedge, Baltic rush, Pale bulrush).

The design concept for restoration was to utilize the construction of a bankfull bench against the eroding bank. The bench width will restore the creek to its reference width and improve sediment transport capacity. The bench will be stabilized using the selected brush layering alternative which incorporates willow and other riparian plantings to increase habitat and provide sustainable flood velocity mitigation and soil protection.

Matrix prepared preliminary design drawings for the selected brush layering alternative. We chose a woven 2-layer coir/jute blanket product, KoirWrap 1000®, for encapsulation of the soil lifts integral to the brush layering concept. This task included:

- Base mapping and survey control
- Site grading and cut/fill evaluation
- Brush layering details and specifications

The proposed restoration plan incorporated bioengineering soil wrap techniques, riparian seeding, and willow stakes into a brush layering system to stabilize the bank and allow for the establishment of woody vegetation. The alignment of the improvements was designed to be consistent with a stable meander geometry having a radius of curvature consistent with the inside of the bend and a bankfull width and width/depth ratio in accordance with extensive reference reach data collected at the site.

3.2 Permitting

Permitting for the project included Corps of Engineers 404 and Regional Building Department Floodplain Development permits. The Corps authorized the Project under Nationwide Permit No. 13 for Bank Stabilization. The Regional Building Department authorized the Project via a zero-rise certification letter. Copies of permits are attached in Appendix C. In addition, the property is located within a Colorado Open Lands (COL) conservation easement so proposed plans were provided to and reviewed by COL. A letter of support from COL is included in Appendix D.

4.0 Construction

4.1 Design/Build

Based on our evaluation and discussions with the Project team, it seemed prudent to pursue construction of the Project using a design/build delivery method in order to expedite the bidding process, ensure adequate construction oversight, and allow for adaptation to field conditions. As such, Matrix prepared a preliminary plan set sufficient to identify quantities and establish pricing. Further, we conserved budget in the design phase to allow for sufficient budget to provide field engineering and survey control during construction.

Matrix held on-site meetings with three prospective contractors to discuss the proposed work, verify quantities, and request pricing. Aztec General Contractors, LLC was selected by the District to construction the Project. All plant materials including willow stakes and bulrush were harvested on site and applied as in-kind contribution from the landowner for this WSRA grant. Final plans were prepared as post-construction, as-built drawings and are attached in Appendix A. The final budget accounting for the Project is included in Appendix B.

4.2 Construction Observation

Numerous site visits were conducted by Matrix and THK Associates, Inc. staff. Excavations were observed, as well as the installation of the soil-filled KoirWrap 1000®, willow stakes, seed and transplanted bulrush plants. The following photos provide an overview of construction and the finished project. All project photos are included on a CD attached in Appendix F.

Photos 3 & 4. Coffer Dam Excavation 4/9/14

Photos 5 & 6. Bank Excavation & KoirWrap Installation 4/11/14

Photos 7 & 8. KoirWrap & Willow Installation 4/11/14

Photos 9 & 10. Bulrush Planting and Seeding 4/11/14

Photos 11 & 12. KoirWrap Installation with Batter Board 4/17/14

Photos 13 & 14. Vertical Willow Stake Installation 4/22/14

Photos 15 & 16. Brush Layering Nearing Completion/ Willows Still Dormant 4/25/14

Photos 17 & 18. Brush Layering Complete/ Coffer Dam Removed/ Bulrush Germination 5/2/14

Photos 19 & 20. Completed Project after Near Bankfull Flow Event 5/23/14

5.0 Review of Grant Objectives

This project met multiple objectives:

5.1 Objective A

By addressing erosion and sedimentation in Fountain Creek, the Project addressed multiple issues in the Arkansas River basin. The bank restoration effort reestablished the natural riparian vegetation and will improve both terrestrial and aquatic habitat, while reducing sedimentation. The vegetation will provide cover for wildlife and shade the creek bank for improved fisheries. Sedimentation in the Arkansas Basin is a major concern to water users. Sedimentation raises the grade in the Arkansas River and clogs irrigation diversions that significantly impact water users' ability to divert water. The restored creek bank in the Project area is estimated to yield 1,000% less sediment when compared to its pre-project impaired condition. Reduced sediment load in Fountain Creek will also result in improved water quality.

5.2 Objective B

The Project, while led by the Fountain Creek Watershed Flood Control and Greenway District, was supported by Colorado Open Lands, Central Colorado Conservation District, El Paso County and the private landowner. This Project is a low-cost, high return project that all supporters can promote as a key strategy and demonstration of techniques for reducing sedimentation in Fountain Creek. This is a key goal of the Fountain Creek Corridor Restoration Master Plan that was completed in October 2011 by the Fountain Creek Watershed Flood Control and Greenway District. This Project serves as a model of habitat-sensitive restoration techniques throughout the state of Colorado. It demonstrates the effectiveness of early identification of a problem and the implementation of cost-effective measures to stabilize river banks before the problem becomes much larger and much more expensive to correct.

5.3 Objective C

The improvements completed with this project address three of the four priorities identified in the Arkansas Basin Water Needs Assessment Report. The three priorities are:

- Maintain agricultural viability in the lower basins.
- Provide for adequate water quality to meet all needs.
- Ensure adequate water for future needs including municipal and industrial (M & I), agricultural, recreational and environmental purposes.

Also, the Project is located within the Fountain Creek Watershed, one of the three non-consumptive environmental and recreational water needs focus areas that were identified in the Arkansas Basin Water Needs Assessment Report.

5.4 Objectives D & E

WSRA funds were necessary for successful completion of the Project and future leveraging of local monies. WSRA funds, applied to the completion of design and permitting documents, leverage money and in-kind services provided by Colorado Springs Utilities, as a part of the Southern Delivery System Fountain Creek Realignment Study at Clear Spring Ranch and plant material provided by the landowner. Design of habitat-sensitive restoration techniques developed as a part of the Clear Spring Ranch project were applied to the Project.

The Fountain Creek Bank Restoration at Frost Ranch will serve as a demonstration of habitat-sensitive restoration techniques that will be proposed throughout the Fountain Creek Watershed. The Fountain Creek Watershed Flood Control and Greenway District will be initiating a series of sediment transport studies to identify priority sites along the main stem of Fountain Creek, similar to Frost Ranch, that can benefit from the demonstrated techniques to reduce erosion and sediment supply.

5.5 Objective F, I & J

The water activity helped meet environmental and recreational needs as identified in the Arkansas Basin Needs Assessment Report and in relationship to the amount of funds requested, provides a high level of benefit to the State of Colorado. The water activity is also complementary to, and assists in,

the implementation of other programs in the CWCB, including the Fish Passage at the Ray Nixon Power Plant diversion on Clear Spring Ranch upstream from the Frost Ranch.

5.6 Objective H

The water activity included bank and channel improvements that assist in the recovery of the Arkansas Darter, a threatened and endangered wildlife species and the Flathead Chub, a Colorado state species of concern.

6.0 Lessons Learned

Soil-filled blankets have a variety of methods of installation. The blankets were installed and backfilled with moist top soil in the front (creek side) of the lifts. By forming the leading edge with topsoil and a batter board, the overall appearance of the Project area was improved. It was critical to select a woven 2-layer coir/jute blanket in order to provide the strength of a woven product and the second layer of jute to hold soil particles in place. Single layer woven products have an open weave and prone to having soil wash out from underneath. Meanwhile, other mattress-style, non-woven products cannot provide the shear resistance and strength to withstand impact and abrasion.

Photo 21. Batter Board and Final Installation of KoirWrap Blanket 5/2/14

Extensive field observation and direction were required for the contractor and the instructions and methods of harvesting and storing willows. It was essential to keep these willows cool and dormant, with no leaf growth prior to planting.

Stockpiling and preserving existing on-site vegetation, in this case a large stand of bulrush, helped to increase the plant diversity of this project. Bulrushes were reinstalled along the leading edge of the soil-filled blankets.

Field direction of blanket staking ensued that the KoirWrap would remain in place. Additional stakes were installed at the overlapping blanket seams.

It will be important to monitor the Project going forward and provide on-going photo documentation. Determining the long-term effectiveness of the brush layering technique and the application of the KoirWrap 1000® product will be subject to:

- how well vegetation becomes established
- how well the blanket performs during floods with the corresponding abrasion from sediment and impact from debris
- how well the soil-filled lifts respond to scour at the toe of the bank

Photo 22. Harvested Willow Stakes and Willows Stakes Leafing Out

Photos 23 & 24. Salvaged Bulrush Plants

Appendix A – As-Builts

Know what's below. Call before you dig.

FOUNTAIN CREEK BANK RESTORATION AT FROST RANCH
AS-BUILT PLAN SET
MAY 2014

VICINITY MAP
N.T.S.

LOCATION MAP
N.T.S.

SHEET INDEX

VERTICAL DATUM:
FIMS CONTROL POINT "HR15" , BEING A 3.25" ALUMINUM FIMS CAP LOCATED ON CLEAR SPRINGS RANCH, WHICH HAS A PUBLISHED ELEVATION OF 5378.53'. (NGVD 29 DATUM)

STATEMENT:
ACCEPTANCE BY THE FOUNTAIN CREEK WATERSHED FLOOD CONTROL & GREENWAY DISTRICT OF DESIGN WORK BY DESIGN PROFESSIONALS CONSTITUTES BELIEF THAT THE WORK HAS BEEN DONE IN ACCORDANCE WITH THE DISTRICT STANDARDS. WORK PRODUCTS ARE THE RESPONSIBILITY OF THE DESIGN PROFESSIONAL AND ACCEPTANCE DOES NOT RELIEVE THE PROFESSIONAL OF SAID RESPONSIBILITY.

APPROVED

5-30-14
LARRY SMALL — DATE
EXECUTIVE DIRECTOR

PREPARED UNDER MY DIRECT SUPERVISION, FOR AND ON BEHALF OF MATRIX DESIGN GROUP, INC.

Graham W. Thompson 5/30/14
GRAHAM THOMPSON, PE — DATE
COLORADO P.E. NO. 37776

FOUNTAIN CREEK WATERSHED
FLOOD CONTROL & GREENWAY DISTRICT

P.O. BOX 26373
COLORADO SPRINGS, CO 80910-6373
TEL: (719) 447-5012

REFERENCE DRAWINGS

No.	DATE	DESCRIPTION	BY

REVISIONS

COMPUTER FILE MANAGEMENT
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FINAL
AS-BUILT

COLORADO LICENSED — GRAHAM W. THOMPSON — NO. 37776 — PROFESSIONAL ENGINEER — 5/30/14
FOR AND ON BEHALF OF MATRIX DESIGN GROUP, INC.

Matrix DESIGN GROUP
2435 Research Parkway, Suite 300
Colorado Springs, CO 80920
Phone 719-575-0100
Fax 719-575-0208

FOUNTAIN CREEK WATERSHED DISTRICT

FOUNTAIN CREEK BANK RESTORATION AT FROST RANCH

TITLE SHEET

DESIGNED BY:	GWT	SCALE		DATE ISSUED: MAY 2014	TS01
DRAWN BY:	JJM	HORIZ:	N/A		
CHECKED BY:	GWT	VERT:	N/A	SHEET NO. 1 OF 3 13.526.003	

811
Know what's below.
Call before you dig.

RIPARIAN SEED MIX SPECIFICATIONS

A. Riparian Seed Mix: All seed mixes shall consist of certified seed varieties that are free of noxious weeds and have been tested for purity and germination within six (6) months of the planting date. Certification labels which indicate the species, purity, germination, weed content, origin, and test date shall be submitted for all seed materials. Riparian areas shall be seeded with the following mix:

Scientific Name	Common Name-Variety	% of Mix	PLS lbs/ Acre
Andropogon gerardii 'Champ'	Big Bluestem-Champ	5.2	1.6
Andropogon hallii 'Garden'	Sand Bluestem-Garden	9.2	2.8
Elymus canadensis	Canada Wildrye-VNS	9.8	3.0
Elymus lanceolatus spp. lanceolatus 'Critana'	Thickspike Wheatgrass-Critana	5.6	1.7
Elymus trachycaulus 'San Luis'	Slender Wheatgrass-San Luis	7.2	2.2
Glyceria striata	Fowl Mannagrass-VNS	6.5	2.0
Panicum virgatum 'Blackwell'	Switchgrass-Blackwell	4.9	1.5
Pascopyrum smithii 'Arriba'	Western Wheatgrass-Arriba	4.9	1.5
Sorghastrum nutans 'Cheyenne' or 'Holt'	Yellow Indiangrass- Cheyenne or Holt	6.5	2.0
Spartina pectinata	Prairie Cordgrass-VNS	6.5	2.0
Sporobolus airoides 'Salado'	Alkali Sacaton-Salado	0.7	0.2
Sporobolus cryptandrus	Sand Dropseed-VNS	0.2	0.06
Avena sativa 'Monida'	Oats-Monida	32.7	10

B. Seeding Dates: Seeding shall occur during the fall (September-November) or spring (March-May) to maximize planting success. If the project schedule does not coincide with the preferred seeding periods, or there are unsuitable site conditions (i.e., frozen ground), then soil stabilization and/or storm water Best Management Practices shall be implemented to stabilize the area until the next appropriate seeding date.

C. Seeding Methods: Drill seeding or broadcast seeding shall be used for revegetation. As outlined below, the size and slope of the disturbed area shall determine which seeding method(s) is appropriate and acceptable. Where feasible, drill seeding is the required method. If broadcast seeding is employed, either by hand, spreader, hydro-seeder, or other means, the seeding rate (PLS lbs/Acre) shall be doubled.

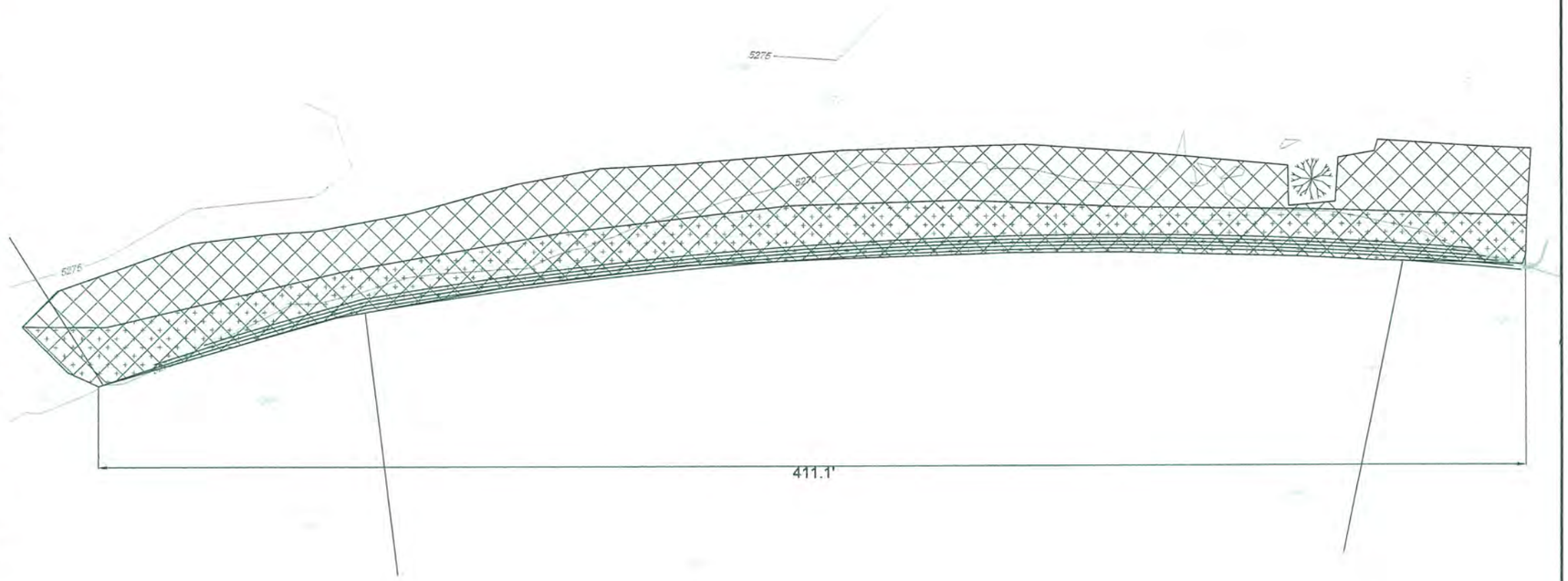
1. Slopes equal to or less than 3:1 - Seed shall be planted using a rangeland drill with a small seed/legume box and an agitator box for fluffy or bulky seed. Seed rows shall be spaced seven (7) to ten (10) inches apart, and planted one-half (0.5) to three-quarters (0.75) of an inch deep. The drill shall have double-disk furrow openers with depth bands (or other depth control configurations as approved) and packer wheels. Seeding shall be accomplished using bi-directional drilling and with the second direction following the slope contour. The drill equipment shall be calibrated each day or whenever there is a change in the seed mix to ensure proper seed distribution and rate.

2. Slopes greater than 3:1 - Seed shall be broadcast by hand, mechanical spreader, or hydro-seeding equipment. Broadcast seeded areas shall be raked or harrowed to incorporate the seed into the soil at a depth not exceeding three-quarters (0.75) of an inch. Broadcast seeding shall be avoided when wind speed exceeds 15 miles per hour.

LEGEND

AS-BUILT LIMITS OF KOIRWRAP 1000 SEEDED WITH RIPARIAN MIX

AS-BUILT LIMITS OF LIVE WILLOW STAKING SPACED @ 2' O.C.



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REFERENCE DRAWINGS

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		REVISIONS	

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FINAL AS-BUILT

COLORADO LICENSED GRAHAM W. TAYLOR 37776 PROFESSIONAL ENGINEER 5/30/14
FOR AND ON BEHALF OF MATRIX DESIGN GROUP, INC.

Matrix DESIGN GROUP
2435 Research Parkway, Suite 300
Colorado Springs, CO 80920
Phone 719-575-0100
Fax 719-575-0208

FOUNTAIN CREEK WATERSHED DISTRICT

FOUNTAIN CREEK BANK RESTORATION AT FROST RANCH

GRADING & EROSION CONTROL PLAN

DESIGNED BY:	GWT	SCALE		DATE ISSUED: MAY 2014	GN01
DRAWN BY:	JJM	HORIZ:	1"=20'		
CHECKED BY:	GWT	VERT:	NA	SHEET NO. 2 OF 3 13.526.003	

Know what's below. Call before you dig.

KOIRWRAP 1000 INSTALLATION GUIDELINES

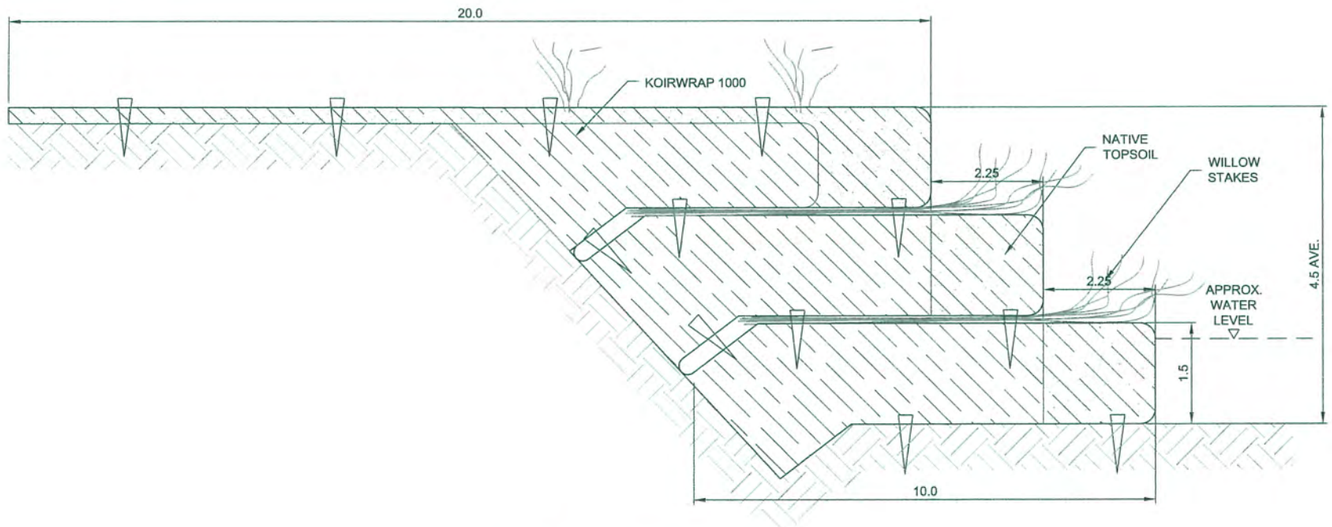
CLEAN AND GRADE THE BASE OF THE SLOPE OR STREAM BANK TO CREATE A LEVEL AND COMPACT SOIL SURFACE. PLACE A STABILIZER BOARD (3/4" PLYWOOD CUT TO THE LIFT HEIGHT) VERTICALLY ON THE OUTSIDE FACE OF THE BASE LIFT. SECURE THE STABILIZER BOARD USING 2" x 2" WOOD STAKES OR #4 REBAR PINS OR OTHER METHOD.

UNROLL KOIRWRAP PERPENDICULAR TO THE STREAM BANK OR FACE OF THE SLOPE AS THE CASE MAY BE. ENSURE THAT THE SECONDARY LAYER (JUTE FABRIC) IS ON TOP. DRAPE KOIRWRAP OVER THE STABILIZER BOARD SO THAT IT FORMS A 90° ANGLE WHERE THE INNER FACE OF THE STABILIZER BOARDMEETS THE SOIL SURFACE. KEEP A MINIMUM EMBEDMENT LENGTH OF 10'. ANCHOR KOIRWRAP USING 12" ECOSTAKES AT 3' SPACING ALONG THE STABILIZER BOARD AND ALONG THE EDGE OF KOIRWRAP. BACKFILL WITH A WELL GRADED MIXTURE OF ALLUVIAL MATERIAL AND SOIL.

COMPACT SOIL LIGHTLY. SPREAD RIPARIAN SEED MIX ON THE PORTION OF THE LIFT THAT WILL BE EXPOSED TO SUNLIGHT. STRETCH KOIRWRAP OVER THE COMPACTED SOIL AND EXTEND TOWARDS THE BANK. ANCHOR KOIRWRAP USING STAKES AT 3' SPACING. THIS BASE LIFT FORMS THE FOUNDATION FOR THE UPPER LIFTS AND PROVIDES ADEQUATE STABILITY TO THE SLOPE. PLACE LIVE SELF-ROOTING CUTTINGS.

REPEAT THE SAME PROCEDURE FOR THE UPPER LIFTS. NATIVE SOIL WITHOUT ROCK SHALL BE USED AS BACKFILL FOR UPPER LIFTS. OFFSET EACH LIFT 27" FROM THE PREVIOUS LIFT AS SPECIFIED.

ON THE TOP LIFT, SPREAD TOPSOIL AND RIPARIAN SEED MIX PRIOR TO PLACEMENT OF KOIWRAP.



BRUSH LAYERING DETAIL
N.T.S.

AS-BUILT SITE PHOTO
N.T.S.

NOTES

1. STRIP AND STOCKPILE NATIVE TOPSOIL TO THE EXTENT PRACTICAL AND PLACE IN ENDS OF LIFTS AND TOP OF UPPER LIFT IN LIEU OF ALLUVIAL MATERIAL.
2. WILLOW STAKES SHALL BE SPACED AT 6' O.C. WITHIN LAYER AND 2' O.C.ON SURFACE. WILLOW STAKES SHALL BE HARVESTED PRIOR TO LEAF CUT.
3. KOIRWRAP ANCHORS TO BE 12" WOODEN "ECOSTAKES" WITH HEAD FACING UPSTREAM AND STAKE ANGLED UPSTREAM ON 18" O.C. IN THE MIDDLE OF BLANKET AND 6" O.C. ALONG SEAMS.
4. KOIRWRAP SHALL OVERLAP AT SEAMS BY 12" WITH TOP LAYER IN THE DOWNSTREAM DIRECTION.

REFERENCE DRAWINGS

No.	DATE	DESCRIPTION	BY

REVISIONS

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FINAL
AS-BUILT

COLORADO LICENSED
GRAHAM W. THOMPSON
37776
PROFESSIONAL ENGINEER
5/30/14

FOR AND ON BEHALF OF
MATRIX DESIGN GROUP, INC.

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2435 Research Parkway, Suite 300
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Phone 719-575-0100
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FOUNTAIN CREEK WATERSHED DISTRICT

FOUNTAIN CREEK BANK RESTORATION AT FROST RANCH

BRUSH LAYERING DETAIL

DESIGNED BY:	GWT	SCALE		DATE ISSUED:	MAY 2014
DRAWN BY:	JJM	HORIZ.	NTS		
CHECKED BY:	GWT	VERT:	NA	SHEET NO. 3 OF 3	13.526.003

DT01

Appendix B – Final Budget

WSRA GRANT FTN CREEK BANK RESTORATION AT FROST RANCH -
BUDGET & INVOICES

TASK	DESCRIPTION	INVOICE DATE	CWCB FUNDS	DISTRICT FUNDS	CWCB INVOICE AMT	DISTRICT INVOICE AMT
	DESIGN					
1	Survey & Sata Collection		$2,664.00	$1,166.00		
		10/22/2013				$253.00
		2/6/2014				$802.50
		3/11/2014			$1,895.50	
		5/30/2014			$835.00	$110.50
2	Engineering Analysis		$3,548.00	$1,552.00		
		3/11/2014			$1,537.50	
		4/30/2014			$1,050.00	
		5/30/2014			$960.50	$764.50
3	Preliminary (60%) Design		$5,273.00	$2,307.00		
		3/11/2014			$1,986.00	
		4/30/2014			$1,879.00	
		5/30/2014			$1,408.00	$1,110.29
4	Final (100%) Design		$5,134.00	$2,246.00		
		5/30/2014			$5,332.50	$1,843.80
5	Permit Support		$1,336.00	$584.00		
		4/30/2014			$855.00	
		5/30/2014			$216.00	$584.00
6	Construction Bidding		$1,085.00	$475.00		
		3/11/2014			$450.00	
		4/30/2014			$635.00	$902.50
7	Construction Mgmt, Proj Mgmt, Direct Expenses		$10,960.00	$4,795.00		
		3/11/2014			$1,080.00	
		4/17/2014			$900.00	
		4/30/2014			$2,674.50	
		5/30/2014			$6,305.50	$6,753.91
	SUBTOTAL - DESIGN		**$30,000.00**	**$13,125.00**	**$30,000.00**	**$13,125.00**
	CONSTRUCTION					
8	Mobilization		$6,998.00	$3,002.00		
		4/17/2014			$6,998.00	$3,002.00
9	Construction Staking/Survey		$3,149.00	$1,351.00		
		4/17/2014			$3,149.00	$1,351.00
10	Excavation/Bank Reconstruction		$52,606.00	$22,569.00		
		4/17/2014			$49,805.00	
		4/30/2014			$2,801.00	$22,569.00
11	Final grading		$7,698.00	$3,302.00		
		4/30/2014			$7,698.00	$3,302.00
12	Revegetation/Planting		$4,549.00	$1,951.00		
		4/30/2014			$4,549.00	$1,951.00
	SUBTOTAL - CONSTRUCTION		**$75,000.00**	**$32,175.00**	**$75,000.00**	**$32,175.00**
	TOTAL PROJECT		**$105,000.00**	**$45,300.00**	**$105,000.00**	**$45,300.00**

Appendix C – Permits

DEPARTMENT OF THE ARMY
ALBUQUERQUE DISTRICT, CORPS OF ENGINEERS
200 SOUTH SANTA FE AVENUE, SUITE 301
PUEBLO, COLORADO 81003-4270

REPLY TO
ATTENTION OF

March 21, 2014

Regulatory Division

SUBJECT: Nationwide Permit Verification – Action No. SPA-2014-00121-SCO, Fountain Creek Bank Restoration at Frost Ranch, El Paso County, Colorado

Mr. Larry Small
Executive Director
Fountain Creek Watershed Flood Control and Greenway District
P.O. Box 26373
Colorado Springs, CO 80910

Dear Mr. Small:

I am writing this letter in response to your March 18, 2014 request for a determination of permit requirements for the proposed Fountain Creek Bank Restoration at Frost Ranch, located at approximately latitude 38.5736187393352, longitude -104.638587754633, in El Paso County, Colorado. The work, as described in your letter, will consist of bioengineered soil wrapping, riparian seeding, and willow stakes in brush layering to stabilize, re-vegetate, and restore the bank. Approximately 480 linear feet (0.11 acres) of Fountain Creek bank and channel will be temporarily impacted as a result of restoration activities. We have assigned Action No. SPA-2014-00121-SCO to this project. Please reference this number in all future correspondence concerning the project.

Based on the information provided, we have determined that the project is authorized by Nationwide Permit No. 13 for Bank Stabilization. A summary of this permit and the Colorado Regional Conditions are available on our website at www.spa.usace.army.mil/reg/nwp. Please refer to our website at www.spa.usace.army.mil/reg/wqc for specific information regarding compliance with state water quality certification requirements. The permittee must ensure that the work complies with the terms and conditions of the permit, including Colorado Regional Conditions and conditions of water quality certification.

Our review of this project also addressed its effects on threatened and endangered species and historic properties in accordance with general conditions 18 and 20. Based on the information provided, we have determined that this project will not affect any federally listed threatened or endangered species or any historic properties listed, or eligible for listing, in the National Register of Historic Places. However, please note that the permittee is responsible for meeting the requirements of general condition 18 on endangered species and general condition 20 on historic properties.

This verification is only valid for the project as described in your letter. Appropriate erosion and sediment controls should be implemented to ensure that construction materials and/or activities do not enter any wetlands or other waterbodies beyond the scope of the authorization.

If there are any changes in the project purpose, location, or design, you should contact our office for a reevaluation of Department of the Army permit requirements.

This letter does not constitute approval of the project design features, nor does it imply that the construction is adequate for its intended purpose. This permit does not authorize any injury to property or invasion of rights or any infringement of federal, state or local laws or regulations. The permittee and/or any contractors acting on behalf of the permittee must possess the authority and any other approvals required by law, including property rights, in order to undertake the proposed work.

This permit verification is valid until March 18, 2017 (33 CFR 330.6), unless the nationwide permit is modified, suspended, revoked or reissued prior to that date. Continued confirmation that an activity complies with the terms and conditions, and any changes to the nationwide permit, is the responsibility of the permittee. Activities that have commenced, or are under contract to commence, in reliance on a nationwide permit will remain authorized provided the activity is completed within 12 months of the date of the nationwide permits expiration, modification, or revocation.

Within 30 days of project completion, the permittee must fill out the enclosed Certification of Compliance form and return it to our office. The landowner must allow Corps representatives to inspect the authorized activity at any time deemed necessary to ensure that it is being, or has been, accomplished in accordance with the terms and conditions of the nationwide permit.

I am forwarding a copy of this letter to Graham Thompson, Matrix Design Group, graham_thompson@matrixdesigngroup.com. If you have any questions, please contact me at 719-543-8102 or by e-mail at Christopher.M.Grosso@usace.army.mil. At your convenience, please complete a Customer Service Survey on-line available at http://corpsmapu.usace.army.mil/cm_apex/f?p=regulatory_survey.

Sincerely,

Christopher Grosso
Regulatory Project Manager

Enclosure(s)

Pikes Peak Regional Building Department

Permit # 14026

FLOOD PLAIN DEVELOPMENT PERMIT

Date 08-Apr-2014

Owner Information

Name: FROST LIVESTOCK CO. **Phone: (719) 491-1789**

Address: 18350 HANOVER RD.
COLORADO SPRINGS, CO 80817
Attention: LARRY SMALL

Project Location

Address: 17825 HANOVER RD

COLORADO SPRINGS, CO 80928

Location/Directions:

Contractor/Engineer: Aztec General Contractors Phone: (719) 531-5000

Project Description

Single Family Residential:	[ ]	Addition/Remodel (<50%):	[ ]
Multi-Family Residential:	[ ]	Rehabilitation	[X]
Manuf. (Mobile Home:	[ ]	Subst. (>50 Appraisal) Imprv:	[ ]
Non-Residential	[ ]	Fill	[ ]
New Construction	[ ]	Bridge/Culvert	[ ]
Watercourse Modification:	[ ]	Levee:	[ ]

Project Cost: $0.00
Structure Market Value: $0.00
Creek: Fountain Creek
Description of work: Restore stream bank to original pre-flood condition. Utilize natural and sustainable stabilization techniques.

Flood Hazard Data

Location: Floodway
Base (1%) Flood Elevation: 5280
Lowest Floor Elevation:
Floodproofing Level:
Souree Document:

Permit Action

Permit Granted (Y/N): Yes Variance Granted (Y/N): No
Action Comments:

Compliance Section

Elevation Certificate: N Date:

LOMA: N Date: CLOMR: N Date: LOMR: N Date:

Site Inspection:
Preliminary Required: N Date:
Final Required: Y Date:

For Inspection Requests call: Michael 327-2938

Complianee Comments:

Regional Floodplain Division:

Date 08-Apr-2014

NOTE: This permit expires twelve (12) months from the date it is issued.

PIKES PEAK REGIONAL BUILDING DEPARTMENT

2880 International Circle
Colorado Springs, Colorado 80910
Website: http://www.pprbd.org

4/8/2014 8:14:40 AM
(MICHAEL)
Receipt #: 1188002

Invoice

Customer: FROST LIVESTOCK CO.

Transaction Summary

Account	Description	Reference	Amount
3306600	FLOODPLAIN PERMIT FEES	14026	$500.00

Total Due: $500.00

Payment Summary

Account	Description	Reference	Amount
5020000	COLLECTION, CHECK	9950	$500.00

Total Tendered: $500.00

Comment: FP# 14026--17825 HANOVER RD

Appendix D – COL Letter

COLORADO OPEN LANDS OUR LAND. OUR WATER. OUR FUTURE.

Mr. Jay Frost
Frost Livestock Co.
18350 Hanover Road
Pueblo, CO 81008

January 29, 2013

Dear Jay,

On January 3rd, 2013, Colorado Open Lands was notified of your intent to work with the Fountain Creek Watershed Flood Control and Greenway District ("District") to implement bank stabilization on approximately 400 linear feet of the east bank of Fountain Creek.

I have reviewed the basic project concept and it appears that the activities contemplated under this project are consistent with the purpose and terms of the conservation easement held by Colorado Open Lands and recorded at reception #207074279 in the records of El Paso County. Please accept this letter as approval of the proposed project under Section 5. I. of the conservation easement.

As a member of the Districts' Citizens Advisory Group, I am pleased to see the District partnering with private landowners to mitigate impacts of flooding along Fountain Creek, and I'm even more pleased to see the Frost Livestock Co. participating in the Districts' programs to improve bank stability and riparian habitat along Fountain Creek. I'm hopeful that demonstration projects like this will increase the engagement between the District and landowners along Fountain Creek.

Good luck with the application to the Arkansas Basin Roundtable and please let me know if the plans change substantially from what I've reviewed.

All my best,

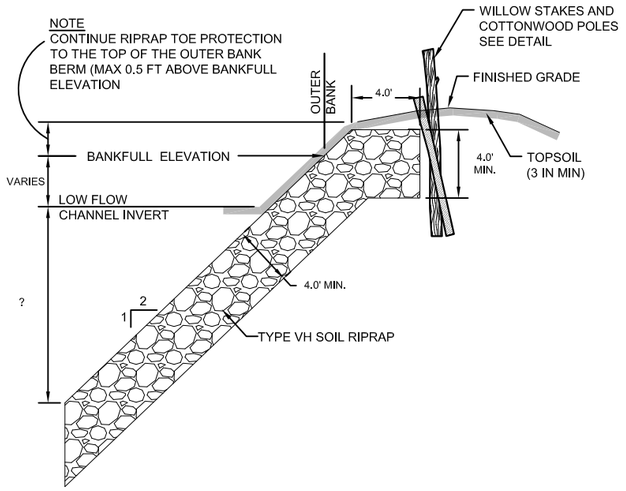
Dieter Erdmann
Director of Conservation Operations

274 UNION BOULEVARD, SUITE 320 LAKEWOOD, CO 80228 WWW.COLORADOOPENLANDS.ORG T.303.988.2373 F.303.988.2383

PHOTO COMPLIMENTS OF JOHN FIELDER

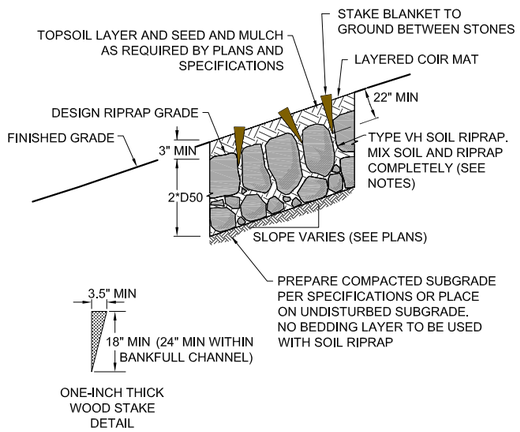
Appendix E – Concept Drawings

Know what's **below.**
Call before you dig.



TYPICAL SECTION - RIPRAP TOE PROTECTION

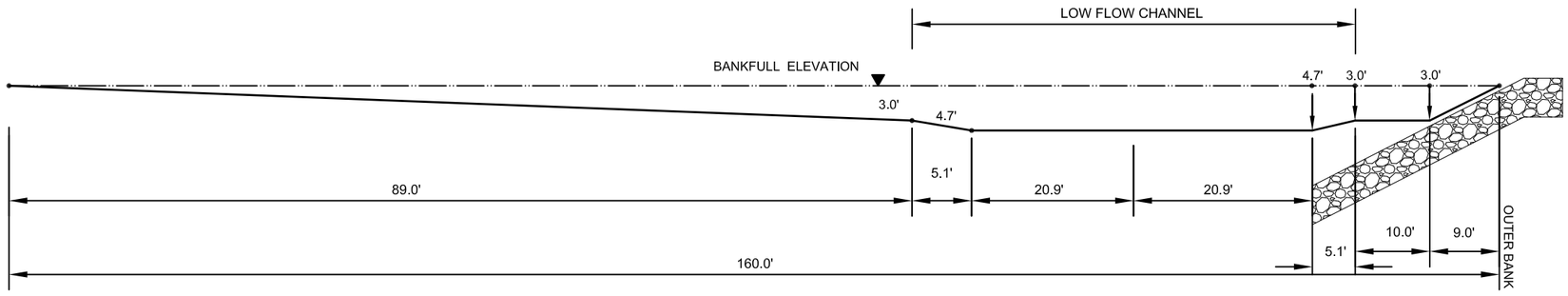
N.T.S.



NOTES:
1. SOIL RIPRAP DETAILS ARE APPLICABLE TO SLOPED AREAS. REFER TO THE SITE PLAN ACTUAL LOCATION AND LIMITS.
2. MIX UNIFORMLY 65% RIPRAP BY VOLUME WITH 35% OF APPROVED SOIL BY VOLUME PRIOR TO PLACEMENT.
3. PLACE STONE-SOIL MIX TO RESULT IN SECURELY INTERLOCKED ROCK AT THE DESIGN THICKNESS AND GRADE. COMPACT AND LEVEL TO ELIMINATE ALL VOIDS AND ROCKS PROJECTING ABOVE DESIGN RIPRAP TOP GRADE.
4. COVER ALL RIPRAP AREAS WITH LAYERED COIR MAT AS SPECIFIED
5. SOIL RIPRAP SHALL BE MIXED ON SITE.
6. CLASS A TOPSOIL SHALL BE USED.

BURIED SOIL RIPRAP WITH LAYERED COIR MAT

N.T.S.



BANKFULL (BENDWAY) CROSS-SECTION

N.T.S.

REFERENCE DRAWINGS				
	No.	DATE	DESCRIPTION	BY
	REVISIONS			
	COMPUTER FILE MANAGEMENT			

CONCEPT
NOT FOR
CONSTRUCTION

FOR AND ON BEHALF OF
MATRIX DESIGN GROUP, INC.

Matrix DESIGN GROUP
2435 Research Parkway, Suite 300
Colorado Springs, CO 80920
Phone 719-575-0100
Fax 719-575-0208

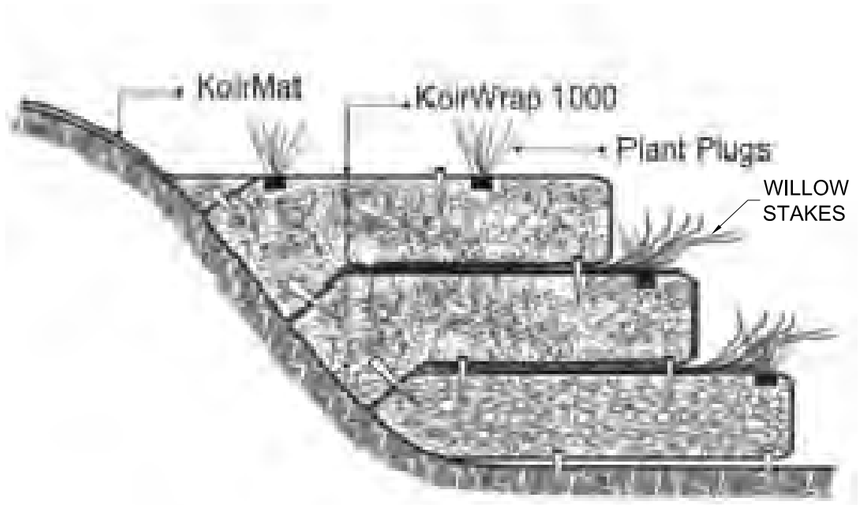
FOUNTAIN CREEK WATERSHED DISTRICT

FOUNTAIN CREEK BANK RESTORATION AT FROST RANCH

SOIL RIPRAP DETAIL

DESIGNED BY:		SCALE	DATE ISSUED: FEBRUARY 2014
DRAWN BY:	JJM	HORIZ:	
CHECKED BY:		VERT:	SHEET NO. OF 13,526,003

Know what's below.
Call before you dig.



BRUSH LAYERING DETAIL
N.T.S.

REFERENCE DRAWINGS

No.	DATE	DESCRIPTION	BY

REVISIONS

COMPUTER FILE MANAGEMENT

CONCEPT
NOT FOR
CONSTRUCTION

FOR AND ON BEHALF OF
MATRIX DESIGN GROUP, INC.

Matrix DESIGN GROUP
2435 Research Parkway, Suite 300
Colorado Springs, CO 80920
Phone 719-575-0100
Fax 719-575-0208

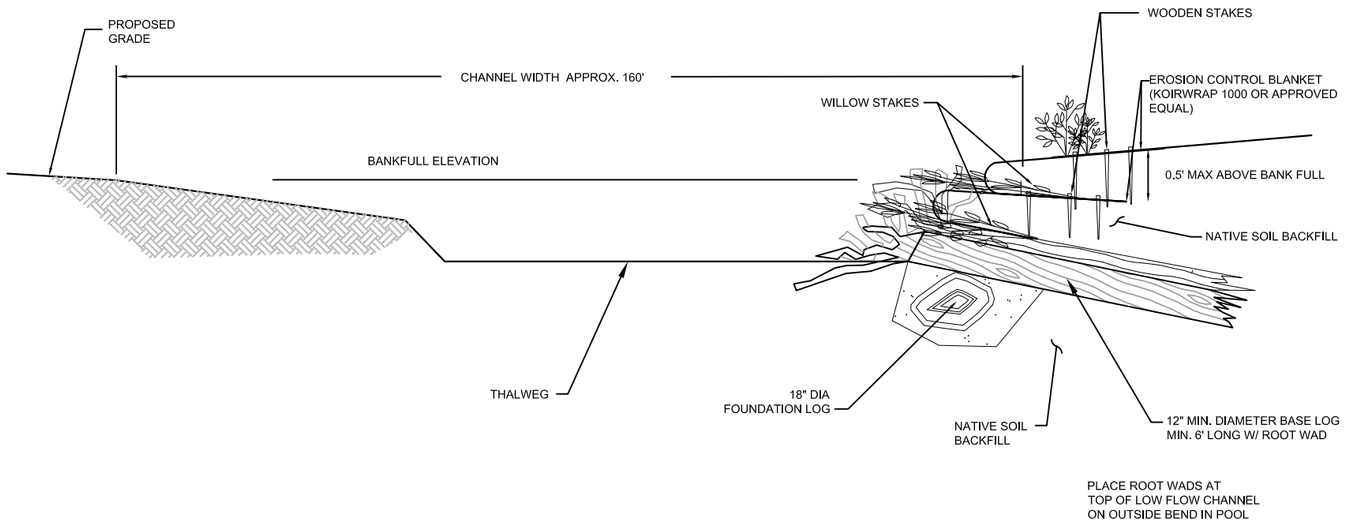
FOUNTAIN CREEK WATERSHED DISTRICT

FOUNTAIN CREEK BANK RESTORATION AT FROST RANCH

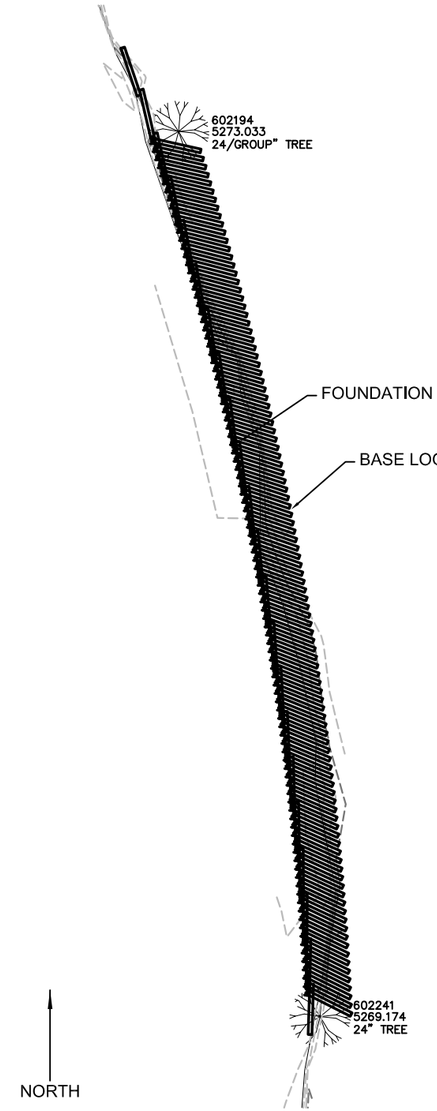
BRUSH LAYERING DETAIL

DESIGNED BY:
DRAWN BY: JJM
CHECKED BY:
SCALE
HORIZ:
VERT:
DATE ISSUED: FEBRUARY 2014
SHEET NO. OF 13,526,003

Know what's **below.**
Call before you dig.



TOE WOOD DETAIL
N.T.S.



TOE WOOD LAYOUT
N.T.S.

REFERENCE DRAWINGS

No.	DATE	DESCRIPTION	BY

REVISIONS

COMPUTER FILE MANAGEMENT

CONCEPT
NOT FOR
CONSTRUCTION

FOR AND ON BEHALF OF
MATRIX DESIGN GROUP, INC.

Matrix DESIGN GROUP
2435 Research Parkway, Suite 300
Colorado Springs, CO 80920
Phone 719-575-0100
Fax 719-575-0208

FOUNTAIN CREEK WATERSHED DISTRICT

FOUNTAIN CREEK BANK RESTORATION AT FROST RANCH

TOE WOOD DETAIL

DESIGNED BY:		SCALE	DATE ISSUED: FEBRUARY 2014
DRAWN BY:	JJM	HORIZ:	
CHECKED BY:		VERT:	SHEET NO. OF 13,526,003

Appendix F – Project CD

Matrix Design Group
2435 Research Parkway
Suite 300
Colorado Springs, CO 80920
719.575.0100

Atlanta, GA

Anniston, AL

Colorado Springs, CO

Denver, CO

Niceville, FL

Parsons, KS

Phoenix, AZ

Pueblo, CO

Sacramento, CA

Washington, DC