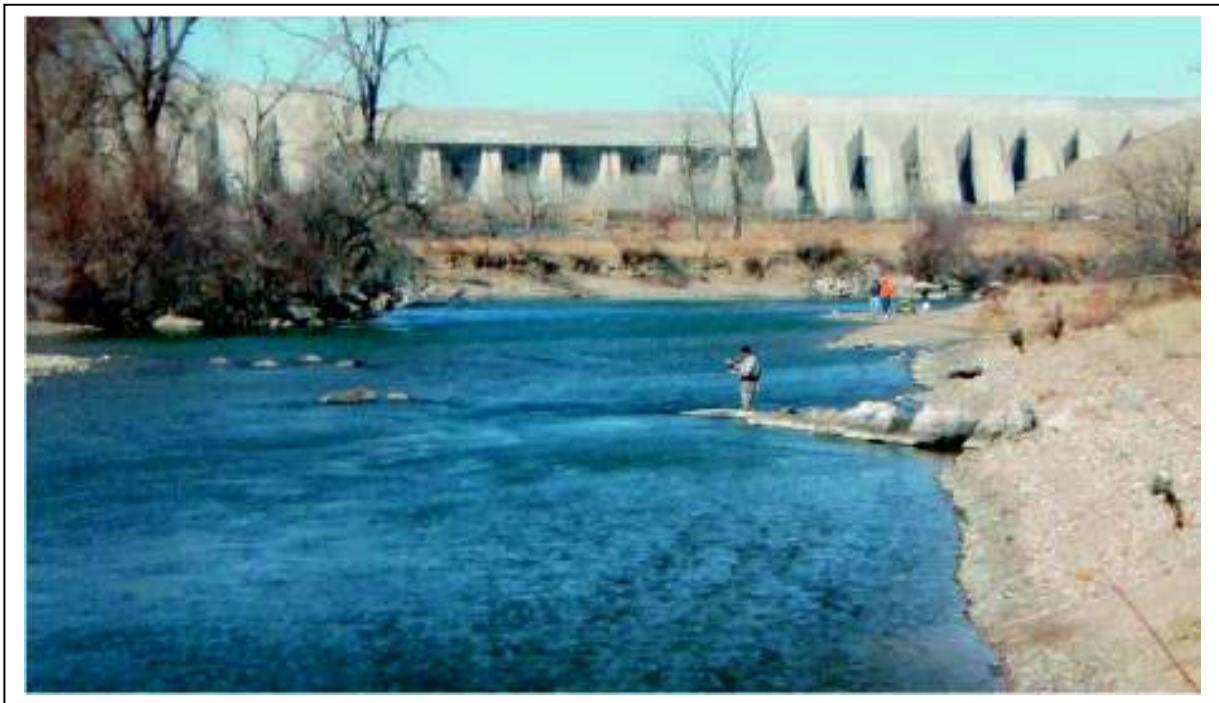


Arkansas River Legacy Habitat Improvement Project

**City of Pueblo
&
Colorado Department of Parks & Wildlife**

**Application for a Regional General Permit for Aquatic Habitat Enhancement
(RGP12)**



Submitted to:
United States Army Corps of Engineers
Southern Colorado Regulatory Office – Albuquerque District
200 S. Santa Fe Ave., Ste. 301
Pueblo, CO 81003

1(a) - Applicants:

City of Pueblo
211 East D Street
Pueblo, CO 81004
Jerry Pacheco – City Manager

Colorado Dept. of Parks & Wildlife
4255 Sinton Rd.
Colorado Springs, CO 80907
Dan Prenzlou – S.E. Region Manager

1(b) - Project Contacts:

Steven Meier – City Planner
(719) 553-2252
smeier@pueblo.us

Doug Krieger – S.E. Reg. Senior Fisheries Biologist
(719) 227-5202
Doug.Krieger@state.co.us

1(c) - Project Consultant / Agent:

Pete Gallagher
Fin-Up Habitat Consultants, Inc.
220 Illinois Avenue
Manitou Springs, CO 80829
(719) 332-2550
pete@fin-up.com



Project Area – Pueblo Reservoir to Wild Horse Creek

1(d) - Project Location & Ownership:

The project is located along approximately 7 miles of the Arkansas River from the Juniper Rd. bridge immediately downstream of the Pueblo Reservoir Dam downstream to the confluence with Wild Horse Creek. The upstream project boundary location is Lat. 38°16'18", Long. 104°43'03", in SE¼NE¼ sec. 36, T.20 S., R.66 W., in Pueblo County, Colorado. The hydrologic unit (HUC) is 11020002. The project area consists of mixed federal, state, and local municipal ownership, including the following entities.

City of Pueblo	Pueblo Conservancy District
Colorado Parks & Wildlife	USDI - Bureau of Reclamation

A map of the project area showing ownership is provided in Exhibit A

1(e) - Easements and Public Access

An easement has been granted by the Pueblo Conservancy District to the City of Pueblo for improvements & public access on PCD lands. Colorado Parks & Wildlife (Pueblo State Park) has granted an easement to the City of Pueblo for improvements & public access between Pueblo Reservoir & Pueblo Blvd. US Dept. of the Interior - Bureau of Reclamation lands are managed by the Colorado Parks & Wildlife (Pueblo State Park), and a special use permit (#03-LM-60-6461) has been granted to City of Pueblo for improvements & public access on USDI BOR lands as well.

2 – Project Drawings

Eleven plan view drawings (Plates 5-15) of the proposed project are provided in Exhibit B. These drawings outline the specific treatments and maintenance to be undertaken in the project. “Red” treatments indicate existing structures that will be maintained or modified. “Green” treatments indicate new structures that will be installed as part of the project. Additionally, plan & profile view schematic drawings are included of proposed new treatments, as well as photos of similar features previously constructed on other rivers. Photos of pre-project existing condition are provided in Exhibit C.

3- Project Purpose & Need

The Arkansas River Legacy Habitat Improvements - Phase II project consist of improving fish habitat structures along approximately 7 miles of the Arkansas River below the Pueblo Reservoir to the Dutch Clark Stadium. 60% of the scope of work will be modifications to existing structures that were installed in 2004 and 2005. The remaining 40% of the scope of work will be the installation of additional rock and log structures (approximately 3,000 additional boulders may be acquired). All aspects of the project are needed to promote insect life and help develop the aquatic habitat.

The original Legacy Habitat Project has resulted in the development of a high-quality trout fishery within the metropolitan area of Pueblo. The quality and accessibility of the fishery has led to its popularity for local anglers and those from across the Front Range, particularly during the period from November through March. Quality fishing regulations on a portion of this reach were enacted in 2011 for purposes of further increasing the size of trout. This fishery has been recognized by Fly Fisherman Magazine as one of the “Top 10” trout fisheries in the U.S. In an angler survey completed by the Colorado Division of Wildlife in 2008, the Arkansas River was listed as the #1 favorite fishing destinations by in-state angler respondents.

However, with this popularity, angler crowding has been increasing. While considering special regulations for this area, one of the overarching requests from anglers was to increase the amount of habitat structures in the river. This was suggested to improve both the trout populations, but also to provide more fishable water in this important stretch of the Arkansas River. This project will significantly increase available fish holding water (i.e., fishable water) within this reach, thereby providing more angling opportunity, less crowding, and greater angler satisfaction.

4- Project Description

Approximately 60% of the project will be maintaining existing rock structures that were previously installed in 2005 & 2006. Maintenance of existing rock structures will primarily consist of adjusting the elevations or moving rock vanes (“J”, “V” or “W” structures) and adjusting or moving boulder clusters. The other 40% of the project will consist of adding new “J” hook vanes, cross-vanes, additional boulder clusters; installation of habitat trees; and riparian bank-full benching.

While most of the materials necessary for the work are already present in the project reach, some additional materials may need to be acquired. In particular, we estimate that up to 3,000 additional boulders (4,500 yd³) may be needed to complete the entire 7.1 mile project reach. Boulders will be imported to the project reach from a quarry located in Canon City, Colorado. This quarry provided boulders for the initial Phase I project, and these new materials should match existing boulders already in place.

Habitat features will include some large cottonwood trees incorporated into the river banks, or as vanes to create scour and cover for resident trout. These features will be anchored into the river substrate using Foresight Products MR-1 and MR-4 dead-man anchors installed in the river bed using a pneumatic hammer.

Geo-textile fabric and erosion control fabric will be required for many of the bank stabilization efforts. Geo-textile fabric will be heavy-duty water permeable woven fabric at least six feet in width. EC matting will include straw / coconut bio-net.

Chaparral Construction of La Veta, CO will provide the heavy equipment and operators necessary to complete the project. The company is experienced in river work, having completed many high-profile projects in the Arkansas & South Platte watersheds over the last 15 years. Project management will be provided by Fin-Up Habitat Consultants, Inc. of Manitou Springs, CO. We anticipate that most of the work under this proposal will be completed utilizing a single 350 series excavator, equipped with a hydraulic thumb, a large front loader, and a 6 wheel articulated dump truck. Construction will begin at the upstream boundary of the project, and work downstream. Short sections will be worked on and completed before moving downstream to the next segment. It is not anticipated that more than 600 ft of channel will be disturbed at any given time.

The project will require two years to complete, with the work limited to the low-flow winter storage months from November through the middle of March. Our timeline for construction is between January and March 15, 2013, and between November 2013 and March 15, 2014. Approximately 3 miles of river habitat improvements will be completed in the first year, starting at the Pueblo Reservoir & extending downstream to the Pueblo Nature Center. The remaining 4 miles of river habitat improvements downstream to Wild Horse Creek will be completed the following year.

5- Existing Conditions

An assessment of the existing structures and habitat features in the project reach was conducted by Fin-Up Habitat Consultants, Inc. and Colorado Dept. of Parks & Wildlife personnel in March 2011. The assessment revealed that many of the structures installed in

2004 and 2005 were functioning at less than their potential. Issues identified during the assessment included problems with structure elevation, placement and alignment. Many structures had been constructed above the bank-full elevation of the channel, and were providing little or no scour or holding cover for resident sport fish. Several of the full-channel cross vanes and W weirs had partially failed as boulders rolled downstream, possibly due to inadequate footer boulder placement. The assessment identified structures that were at risk of failure or that required maintenance to prevent future problems. Additionally, the assessment identified features that had been planned in Phase I, but were not constructed, as well as locations where there was an opportunity for additional enhancement to improve habitat and holding cover.

6- Quantity of Waters / Wetlands Impacted by the Project

The length of river channel affected in the project reach is 37,488 feet. 1,500 linear feet of river bank will be stabilized utilizing bank-full benching consisting of boulder or cottonwood toe slope revetments lined with geo-textile fabric and back-filled with excess river bed spoils generated by the in-channel habitat feature construction. Bank full benching will be vegetated using sod & sedge mats and willow clumps harvested from designated areas adjacent to the river. Approximately 0.2 acres of riparian vegetation will be harvested from areas not located adjacent to the river for the riparian benches. Harvest areas will be leveled and replanted by volunteers following completion of the project. An additional 0.1 acres of stream bank riparian vegetation may be temporarily affected by access routes into the river, which will be kept to a minimum necessary to complete the work. All access routes will be closed and restored following completion of the work. No wetlands are expected to be effected by the work proposed under this project.

7- Monitoring Plan

Project goals and objectives are to enhance the amount and quality of fish habitat by restoring existing structures and providing new habitat structures in the 7 mile reach of the Arkansas River through Pueblo. The project is expected to result in a measurable increase in trout habitat and biomass. Angler fishing opportunity is expected to be improved by increasing quality trout holding habitat, dispersing angler use and enhancing experiences and satisfaction. Angler use is anticipated to increase by 25% in the project reach following completion of the project in 2014.

Post project monitoring of the goals and objectives will consist of repetition of photo-points established in March 2011, measurement of residual pool depth (RPD) in a sub-set of new pools and pocket-water habitats constructed during the project, creel census of fisherman use, and biometric monitoring, consisting of two-pass depletion electro-fishing.

Photo-point monitoring will be used to gauge the effectiveness of river bank stabilization efforts, and to verify that structures have not changed due to high-flows or other causes. RPD, which measures the difference between the maximum depth of a pool or pocket water and the riffle crest depth downstream of the feature, is a useful metric for assessing the effectiveness of scour in structures such as cross vanes and boulder clusters. A creel census will be utilized to monitor angler satisfaction and use, and electro-fishing will be conducted to assess whether or not trout biomass has been increased in the project reach.

The Colorado Division of Parks & Recreation conducted a creel census in the project area in 2008, and has permanent electro-fishing sampling stations already established in the project reach, providing the baseline conditions on which to measure success of the work.

As-Built plan drawings will be provided to the US Army Corps of Engineers within 90 days (June 15, 2014) following completion of all of the work. Post project monitoring data collection is expected to occur in 2016 & 2017, and a final report will be prepared and submitted by Dec. 31, 2017. The City of Pueblo and the Colorado Division of Parks & Wildlife will be responsible for post project monitoring requirements as outlined in this permit application.

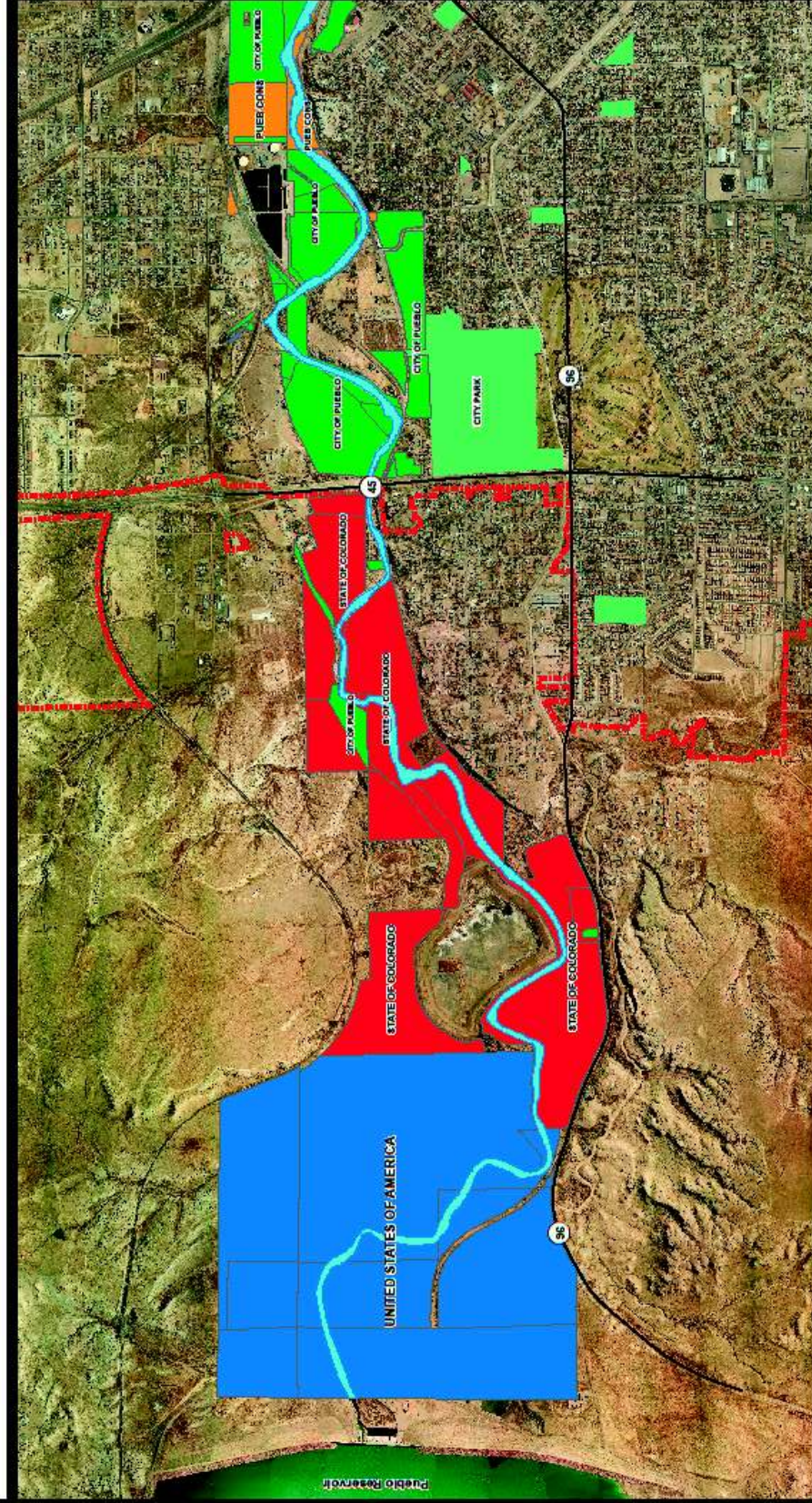


EXHIBIT A

PROJECT AREA MAP
(Including Ownership Parcels)



Arkansas River Legacy Habitat Improvements – Phase II City of Pueblo EXHIBIT A - “Project Map”



- Legend**
- Parcels Owners**
- City of Pueblo
 - Pueblo Conservancy
 - State of CO
 - USA
 - Highways
 - Arkansas River
 - City Parks
 - City Limits

PUEBLO
GIS DIVISION

This Map was created by Pueblo GIS and the data provided herein was derived from sources of varying accuracy with the City of Pueblo disclaiming all responsibility for accuracy or completeness of the information. It is to be used for informational purposes only.



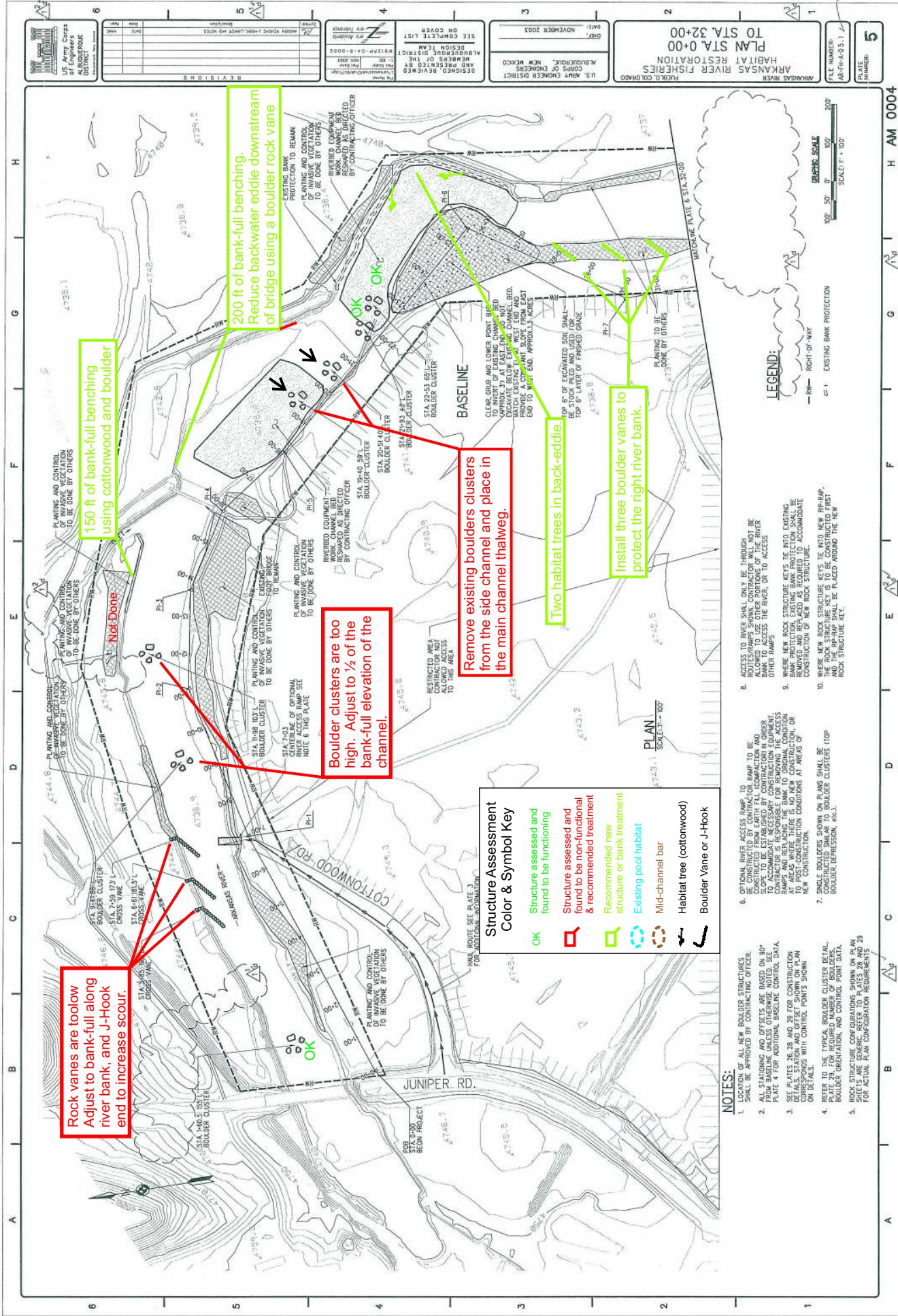
EXHIBIT B

PROJECT PLAN DRAWINGS

Project Structure Assessment & Plan
(Drawing Plates 5 – 15)

New Structure Plan & Profile Drawings

Pueblo Arkansas River Legacy Project



ARKANSAS RIVER FISHERIES HABITAT RESTORATION
 PLAN STA. 0+00 TO STA. 32+00
 U.S. ARMY ENGINEERS DISTRICT ALBUQUERQUE, NEW MEXICO
 DESIGNED, REVIEWED AND CHECKED BY: [Name]
 DESIGN TEAM: [Name]
 SEE COMPLETE LIST ON COVER
 DATE: NOVEMBER 2003
 FILE NUMBER: AR-FH-A-0.5.1
 PLATE NUMBER: 5
 SCALE: 1" = 100'
 SCALE: 1" = 500'

Structure Assessment Color & Symbol Key

OK	Structure assessed and found to be functioning
Red square	Structure assessed and found to be non-functional & recommended treatment
Green square	Recommended new structure or bank treatment
Blue circle	Existing pool habitat
Brown circle	Mid-channel bar
Black arrow	Habitat tree (cottonwood)
J-hook symbol	Boulder Vane or J-Hook

- NOTES:**
- LOCATION OF ALL NEW BOULDER STRUCTURES SHALL BE APPROVED BY CONTRACTING OFFICER.
 - ALL STATIONING AND OFFSETS ARE BASED ON 80' PLATE 4 FOR ADDITIONAL BASELINE CONTROL DATA.
 - SEE PLATES 26, 28 AND 29 FOR CONSTRUCTION DETAILS, STATION AND OFFSET SHOWN ON PLAN ON DETAILS WITH CONTROL POINTS SHOWN.
 - REFER TO THE TYPICAL BOULDER CLUSTER DETAIL, PLATE 29, FOR REQUIRED NUMBER OF BOULDER, BOULDER ORIENTATION, AND CONTROL POINT DATA.
 - ROCK STRUCTURE CONFIGURATIONS SHOWN ON PLAN PLATE 29 ARE GRAPHIC REFER TO PLATES 28 AND 29 FOR ACTUAL ROCK DIMENSION REQUIREMENTS.

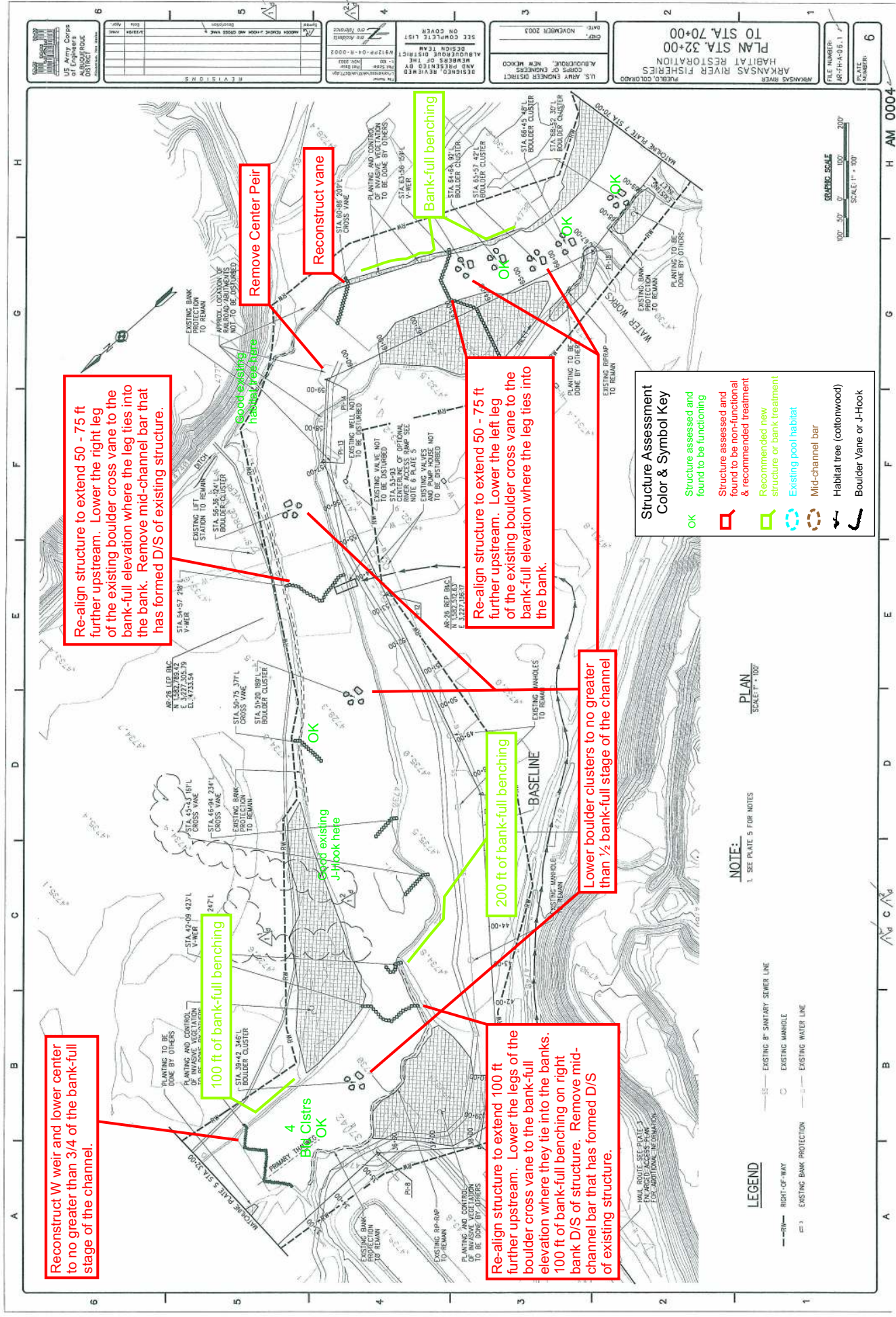
- OPTIONAL RIVER ACCESS RAMP TO RAMP TO BE CONSTRUCTED FROM EXISTING FULL CLOSURE AND SLOPE TO BE ESTABLISHED BY CONTRACTOR IN ORDER TO ACCESS THE RIVER OR TO ACCESS OTHER RAMPS.
- CONTRACTOR IS RESPONSIBLE FOR REMOVING THE ACCESS RAMPS AND REPAIRING THE BANK TO ORIGINAL CONDITION TO POST-CONSTRUCTION CONDITIONS AT AREAS OF NEW CONSTRUCTION.
- SINGLE BOULDERS SHOWN ON PLANS SHALL BE CONSTRUCTED SIMILAR TO BOULDER CLUSTERS TOP BOULDER DEPRESSION, ETC.
- WHERE NEW ROCK STRUCTURE KEYS ARE INTO EXISTING ROCK STRUCTURE KEYS, THE EXISTING ROCK STRUCTURE KEYS SHALL BE REMOVED AND RE-PLACED AS REQUIRED TO ACCOMMODATE CONSTRUCTION OF NEW ROCK STRUCTURE.
- WHERE NEW ROCK STRUCTURE KEYS ARE INTO NEW RIP-RAP, THE ROCK STRUCTURE KEYS TO BE CONSTRUCTED FIRST. ROCK STRUCTURE KEYS TO BE PLACED AROUND THE NEW ROCK STRUCTURE KEYS.

- LEGEND:**
- (RM) — RIGHT-OF-WAY
 - (E) — EXISTING BANK PROTECTION

ARKANSAS RIVER
 HABITAT RESTORATION
 PLAN STA. 0+00 TO STA. 32+00
 U.S. ARMY ENGINEERS DISTRICT ALBUQUERQUE, NEW MEXICO
 DESIGNED, REVIEWED AND CHECKED BY: [Name]
 DESIGN TEAM: [Name]
 SEE COMPLETE LIST ON COVER
 DATE: NOVEMBER 2003
 FILE NUMBER: AR-FH-A-0.5.1
 PLATE NUMBER: 5
 SCALE: 1" = 100'
 SCALE: 1" = 500'

Upper Segment of Reach 3

Pueblo Arkansas River Legacy Project



Reconstruct W weir and lower center to no greater than 3/4 of the bank-full stage of the channel.

100 ft of bank-full benching

Good existing J-hook here

Good existing habitat trees here

Remove Center Peir

Reconstruct vane

Bank-full benching

200 ft of bank-full benching

Lower boulder clusters to no greater than 1/2 bank-full stage of the channel

Re-align structure to extend 100 ft further upstream. Lower the legs of the boulder cross vane to the bank-full elevation where they tie into the banks. 100 ft of bank-full benching on right bank D/S of structure. Remove mid-channel bar that has formed D/S of existing structure.

Re-align structure to extend 50 - 75 ft further upstream. Lower the right leg of the existing boulder cross vane to the bank-full elevation where the leg ties into the bank. Remove mid-channel bar that has formed D/S of existing structure.

Re-align structure to extend 50 - 75 ft further upstream. Lower the left leg of the existing boulder cross vane to the bank-full elevation where the leg ties into the bank.

Structure Assessment Color & Symbol Key

OK	Structure assessed and found to be functioning
Red outline	Structure assessed and found to be non-functional & recommended treatment
Green outline	Recommended new structure or bank treatment
Blue outline	Existing pool habitat
Orange outline	Mid-channel bar
Black outline	Habitat tree (cottonwood)
Black outline	Boulder Vane or J-Hook

NOTE:
1. SEE PLATE 5 FOR NOTES

LEGEND

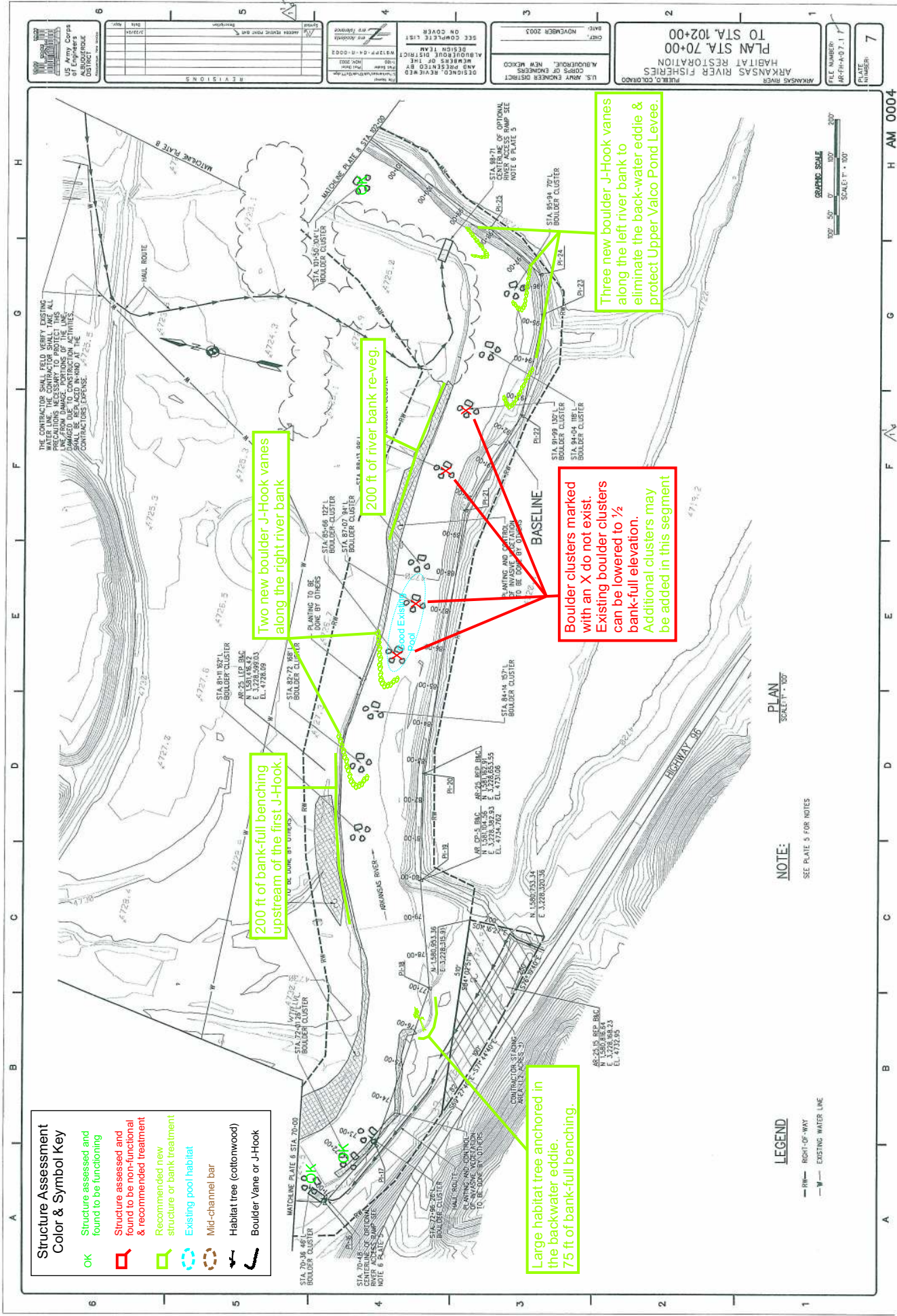
—S—	EXISTING B' SECONDARY SEWER LINE
—R—	RIGHT-OF-WAY
—M—	EXISTING MANHOLE
—W—	EXISTING WATER LINE
—P—	EXISTING BANK PROTECTION

ARIZONA ENGINEERING DISTRICT
 1515 W. WASHINGTON AVENUE, SUITE 100
 PHOENIX, ARIZONA 85007
 DESIGNED, REVIEWED & DRAWN BY: [Name]
 CHECKED BY: [Name]
 DATE: NOVEMBER 2003
 PROJECT: ARIZONA ENGINEERING DISTRICT
 ARIZONA ENGINEERING DISTRICT
 1515 W. WASHINGTON AVENUE, SUITE 100
 PHOENIX, ARIZONA 85007
 FILE NUMBER: AR-114-01.1
 PLATE NUMBER: 6

GRAPHIC SCALE
 1" = 100'
 SCALE: 1" = 100'

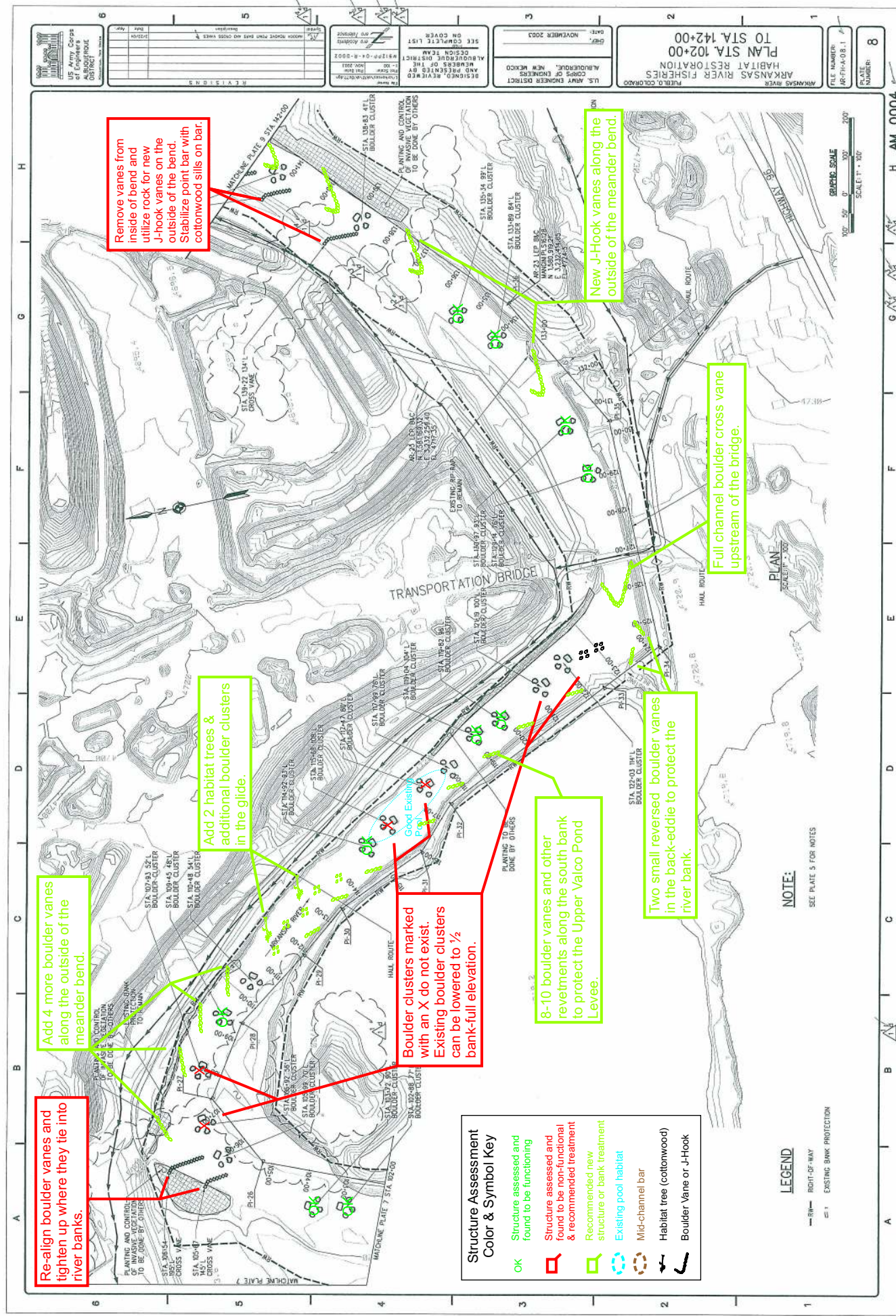
Upper Middle Segment of Reach 3

Pueblo Arkansas River Legacy Project



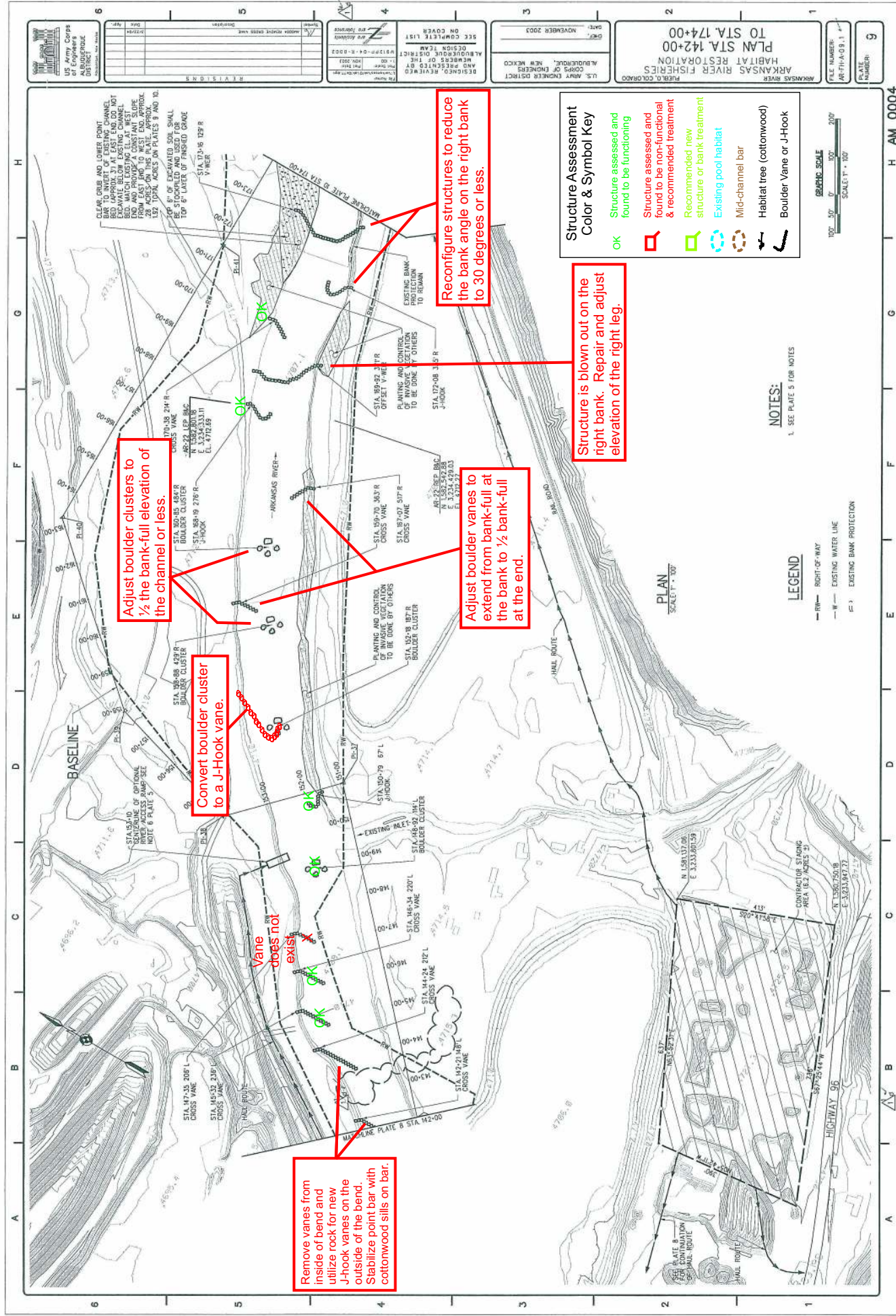
Lower Middle Segment of Reach 3

Pueblo Arkansas River Legacy Project



Lower Segment of Reach 3 / Upper Segment of Reach 2

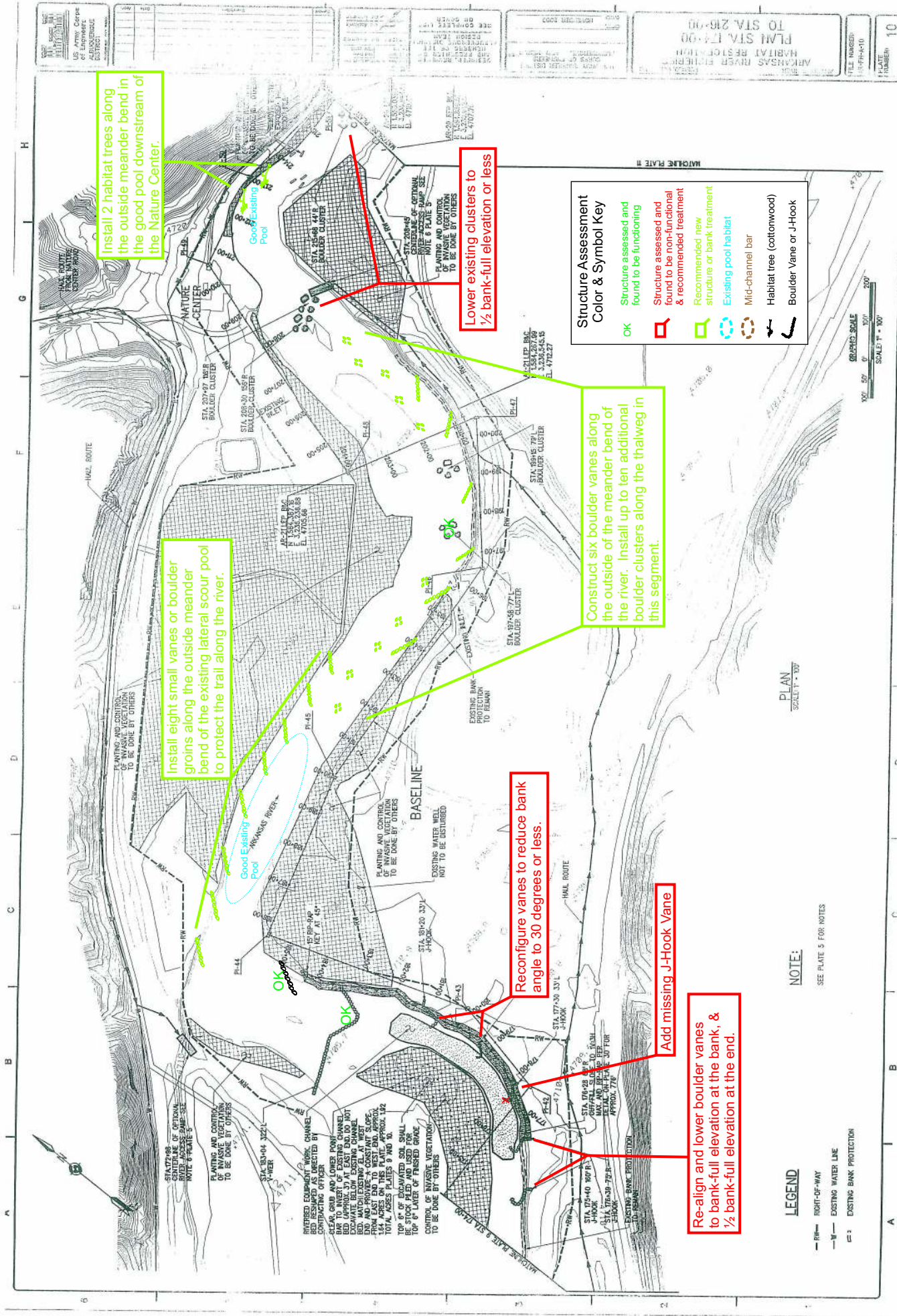
Pueblo Arkansas River Legacy Project



Upper Middle Segment of Reach 2

AM 0004

Pueblo Arkansas River Legacy Project



Install 2 habitat trees along the outside meander bend in the good pool downstream of the Nature Center.

Install eight small vanes or boulder groins along the outside meander bend of the existing lateral scour pool to protect the trail along the river.

Lower existing clusters to 1/2 bank-full elevation or less

Construct six boulder vanes along the outside of the meander bend of the river. Install up to ten additional boulder clusters along the thalweg in this segment.

Reconfigure vanes to reduce bank angle to 30 degrees or less.

Add missing J-Hook Vane

Re-align and lower boulder vanes to bank-full elevation at the bank, & 1/2 bank-full elevation at the end.

Structure Assessment Color & Symbol Key

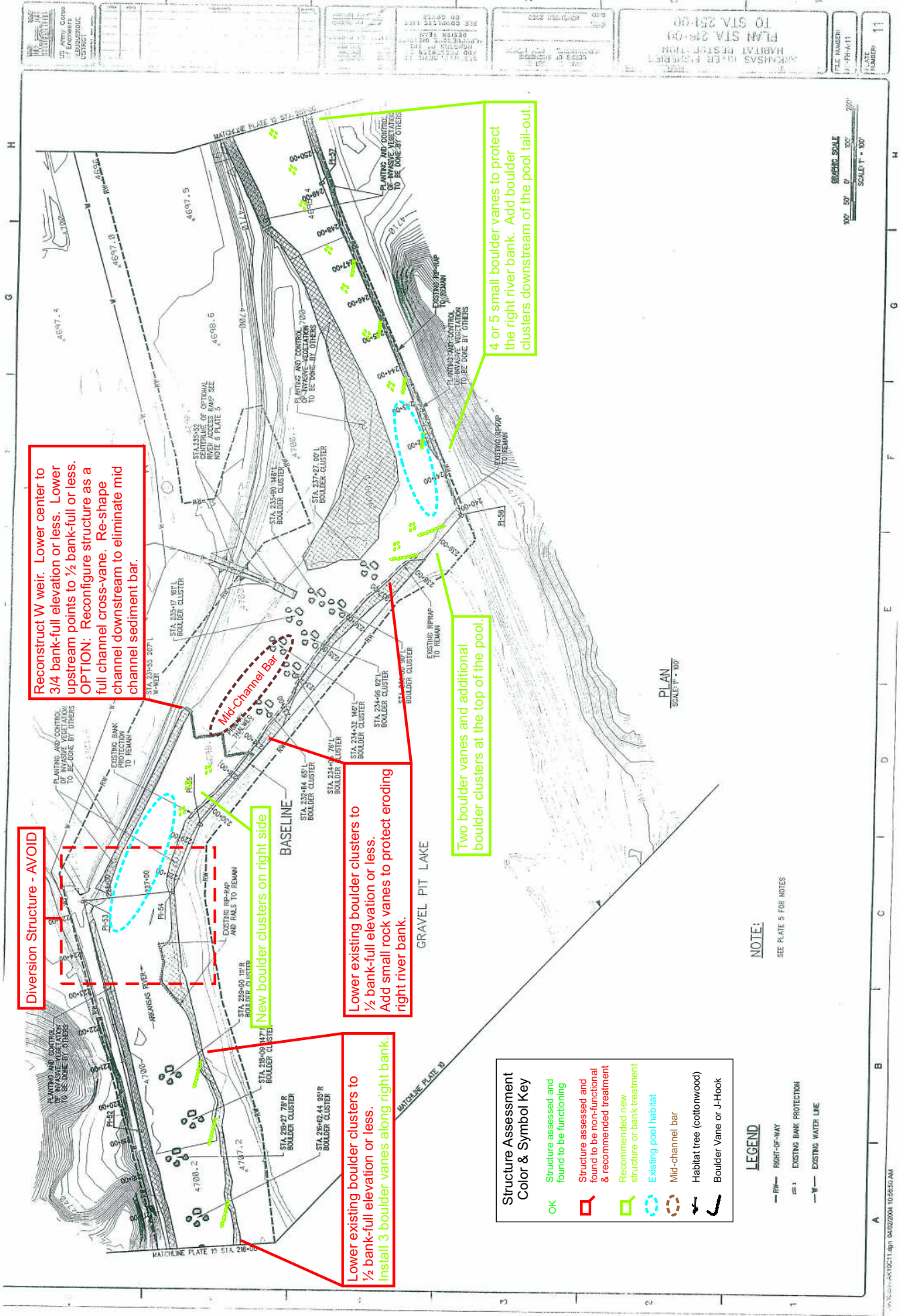
OK	Structure assessed and found to be functioning
Red outline	Structure assessed and found to be non-functional & recommended treatment
Green outline	Recommended new structure or bank treatment
Blue outline	Existing pool habitat
Orange outline	Mid-channel bar
Black outline	Habitat tree (cottonwood)
White outline	Boulder Vane or J-Hook

NOTE:
SEE PLATE 5 FOR NOTES

LEGEND
 - RW - RIGHT-OF-WAY
 - W - EXISTING WATER LINE
 - - - - EXISTING BANK PROTECTION

Lower Middle Segment of Reach 2

Pueblo Arkansas River Legacy Project



Reconstruct W weir. Lower center to 3/4 bank-full elevation or less. Lower upstream points to 1/2 bank-full or less. OPTION: Reconfigure structure as a full channel cross-vane. Re-shape channel downstream to eliminate mid channel sediment bar.

Diversion Structure - AVOID

Lower existing boulder clusters to 1/2 bank-full elevation or less. Add small rock vanes to protect eroding right river bank.

New boulder clusters on right side

Lower existing boulder clusters to 1/2 bank-full elevation or less. Install 3 boulder vanes along right bank.

Two boulder vanes and additional boulder clusters at the top of the pool.

4 or 5 small boulder vanes to protect the right river bank. Add boulder clusters downstream of the pool tail-out.

Structure Assessment Color & Symbol Key

OK	Structure assessed and found to be functioning
Red square	Structure assessed and found to be non-functional & recommended treatment
Green square	Recommended new structure or bank treatment
Blue circle	Existing pool habitat
Brown circle	Mid-channel bar
Black circle	Habitat tree (cottonwood)
Black line	Boulder Vane or J-Hook

LEGEND
 - RW - RIGHT-OF-WAY
 - B - EXISTING BANK PROTECTION
 - W - EXISTING WATER LINE

NOTE:
 SEE PLATE 5 FOR NOTES

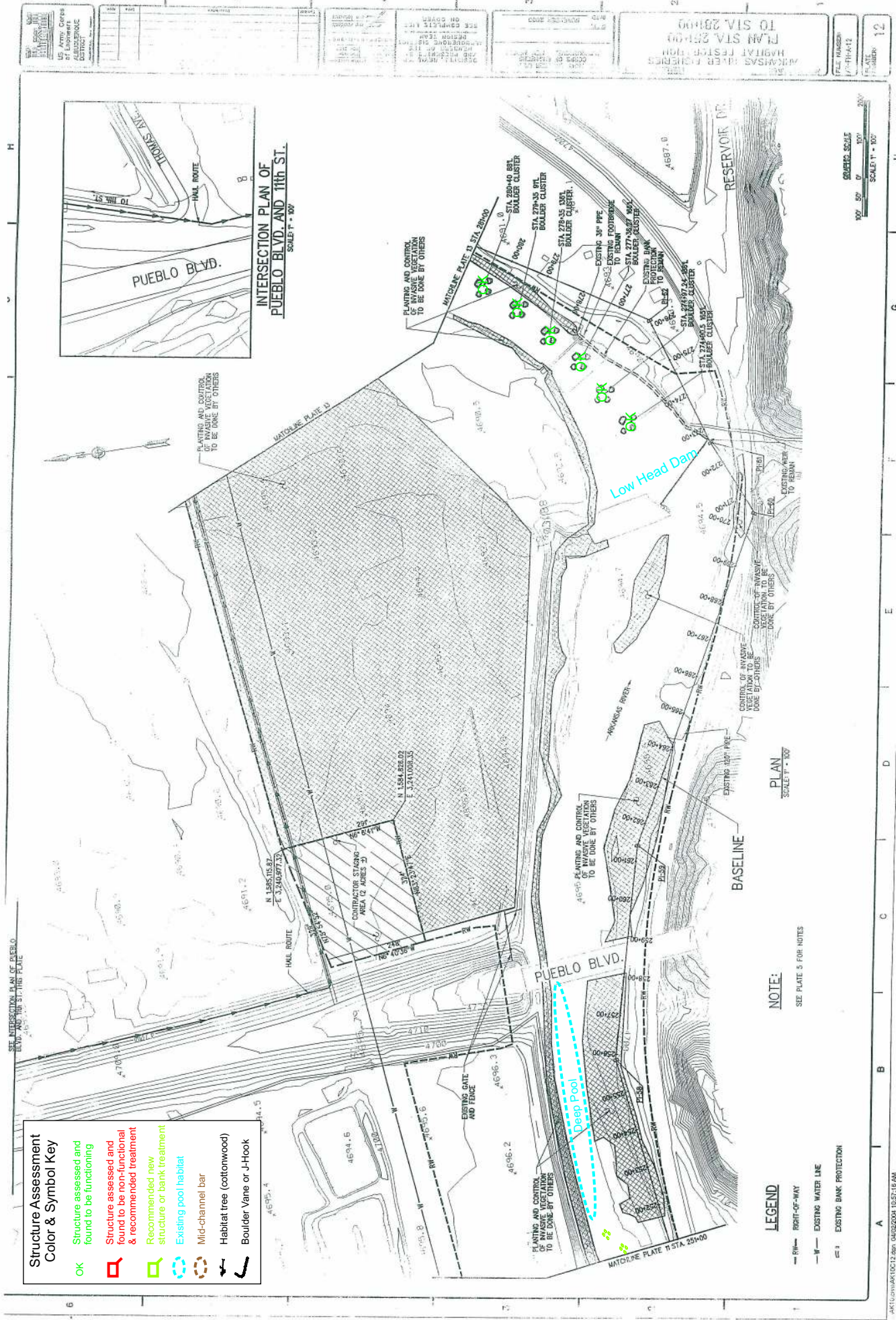
GRAPHIC SCALE
 1" = 100'
 SCALE T = 100'

FILE NUMBER:
 P-RH-11
 SHEET NUMBER:
 11

Lower Middle Segment of Reach 2

Pueblo Arkansas River Legacy Project

Lower Segment of Reach 2 / Upper Segment of Reach 1



Structure Assessment Color & Symbol Key

OK	Structure assessed and found to be functioning
Red square	Structure assessed and found to be non-functional & recommended treatment
Green square	Recommended new structure or bank treatment
Blue circle	Existing pool habitat
Orange circle	Mid-channel bar
Black circle	Habitat tree (cottonwood)
Black square	Boulder Vane or J-Hook

LEGEND

— RW —	RIGHT-OF-WAY
— W —	EXISTING WATER LINE
— E —	EXISTING BANK PROTECTION

NOTE: SEE PLATE 5 FOR NOTES

SEE INTERSECTION PLAN OF PUEBLO BLVD. AND 11TH ST. (SEE PLATE 1)

INTERSECTION PLAN OF PUEBLO BLVD. AND 11TH ST. SCALE 1" = 100'

PLAN SCALE 1" = 100'

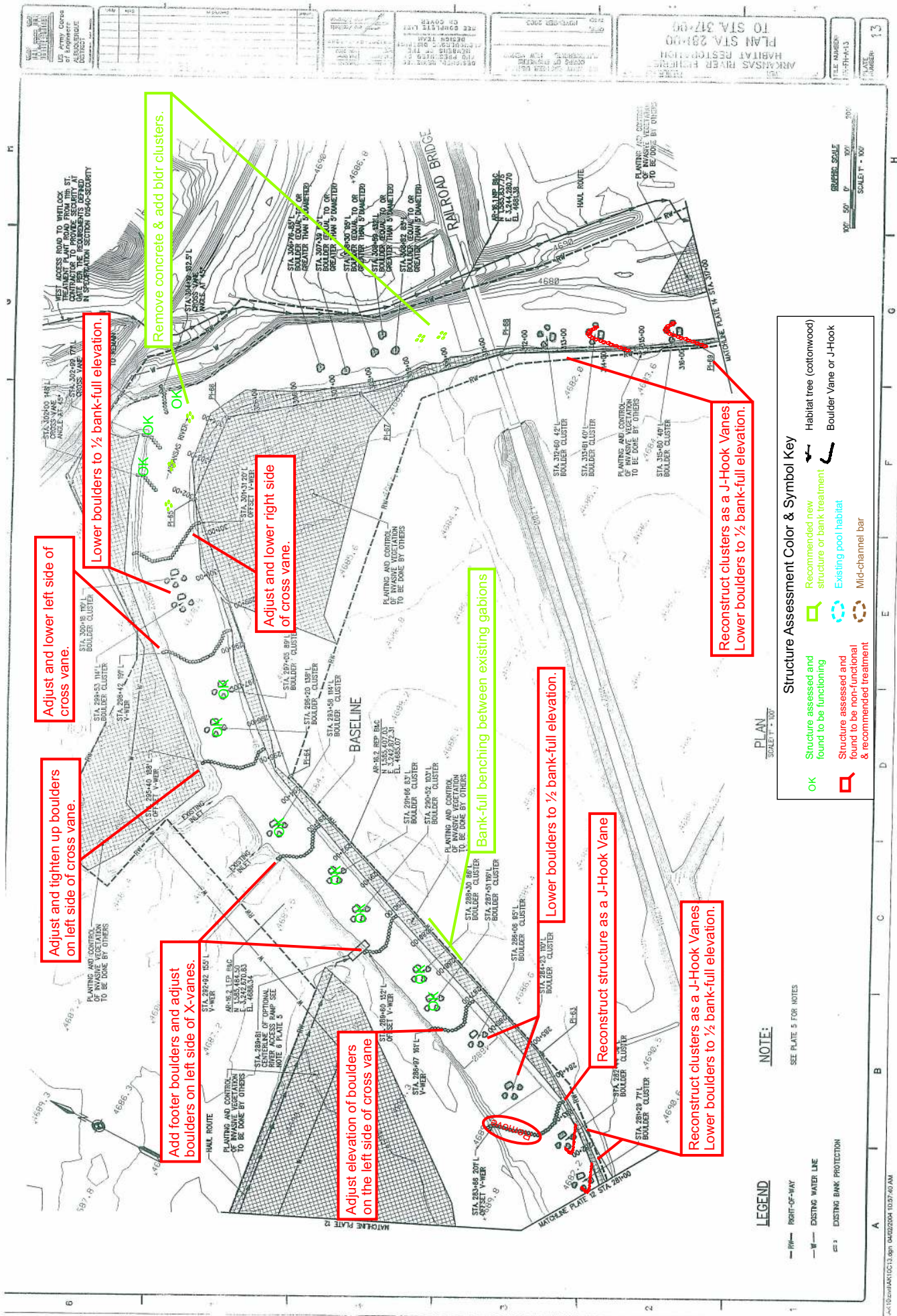
GRAPHIC SCALE
100' 50' 0' 100' 200'

FILE NUMBER: P/11-11A-12
PLATE NUMBER: 12

ARKANSAS RIVER PROJECT
PLAN STA 250+00
TO STA 280+00

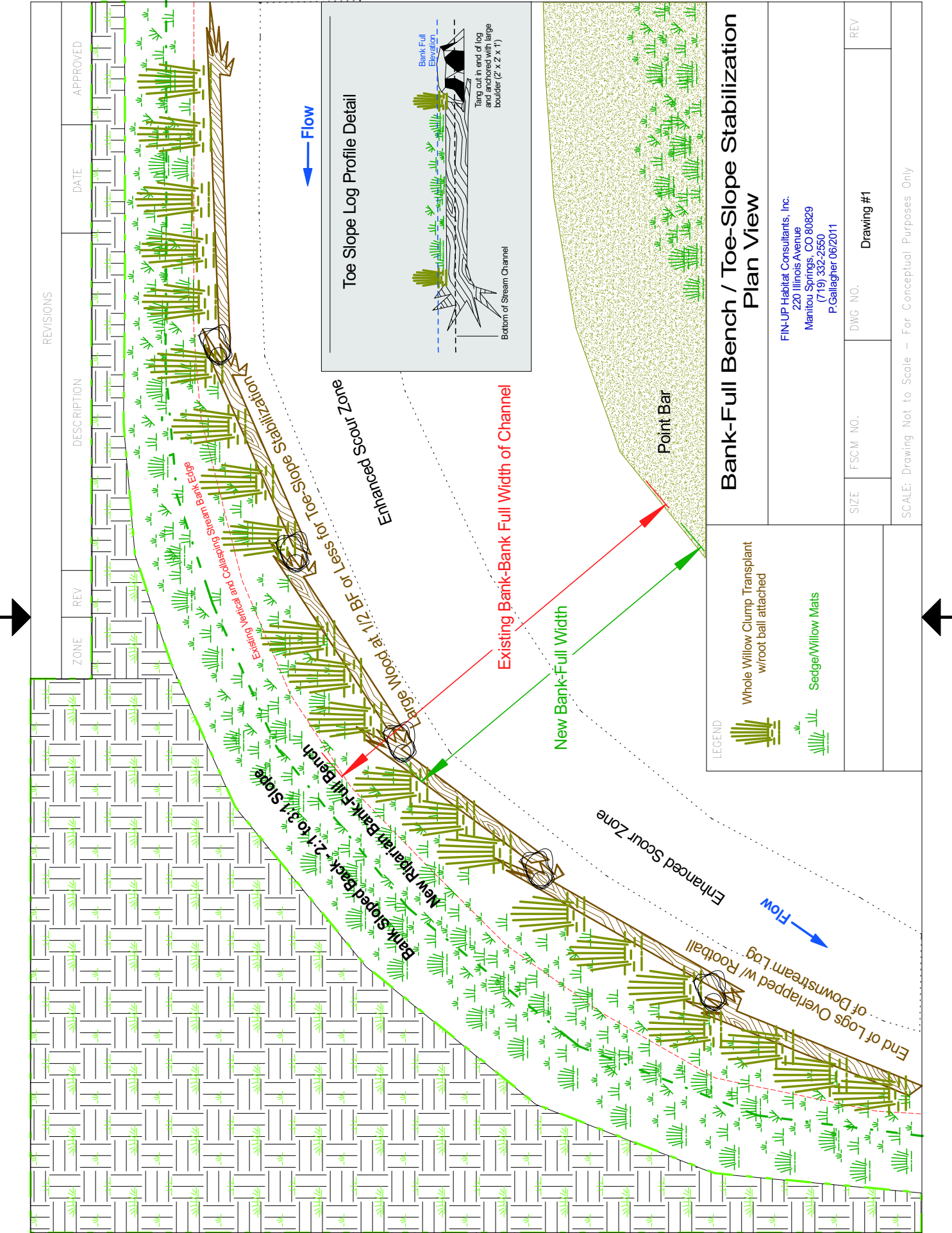
US Army Corps of Engineers
ALBUQUERQUE DISTRICT
PROJECT NO. 11-11A-12
DATE: 11/11/11

Pueblo Arkansas River Legacy Project

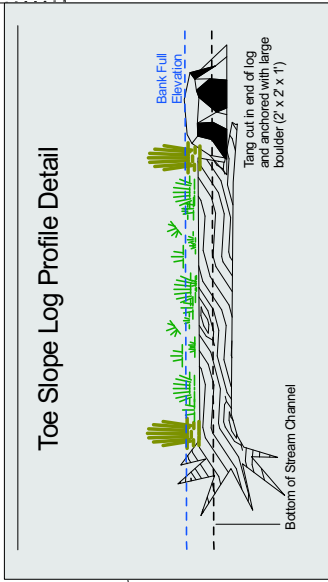


Upper Middle Segment of Reach 1

Arkansas River Federal Project
 HABITAT RESTORATION
 PLAN STA 287+00
 TO STA 317+00
 DATE 11/11/13
 SHEET NUMBER 13



REVISIONS		DATE	APPROVED
ZONE	REV	DESCRIPTION	



Bank-Full Bench / Toe-Slope Stabilization Plan View

FIN-UP Habitat Consultants, Inc.
 220 Illinois Avenue
 Manitou Springs, CO 80829
 (719) 332-2550
 P. Gallagher 06/2011

SIZE	FSCM NO.	DWG. NO.	REV
		Drawing #1	

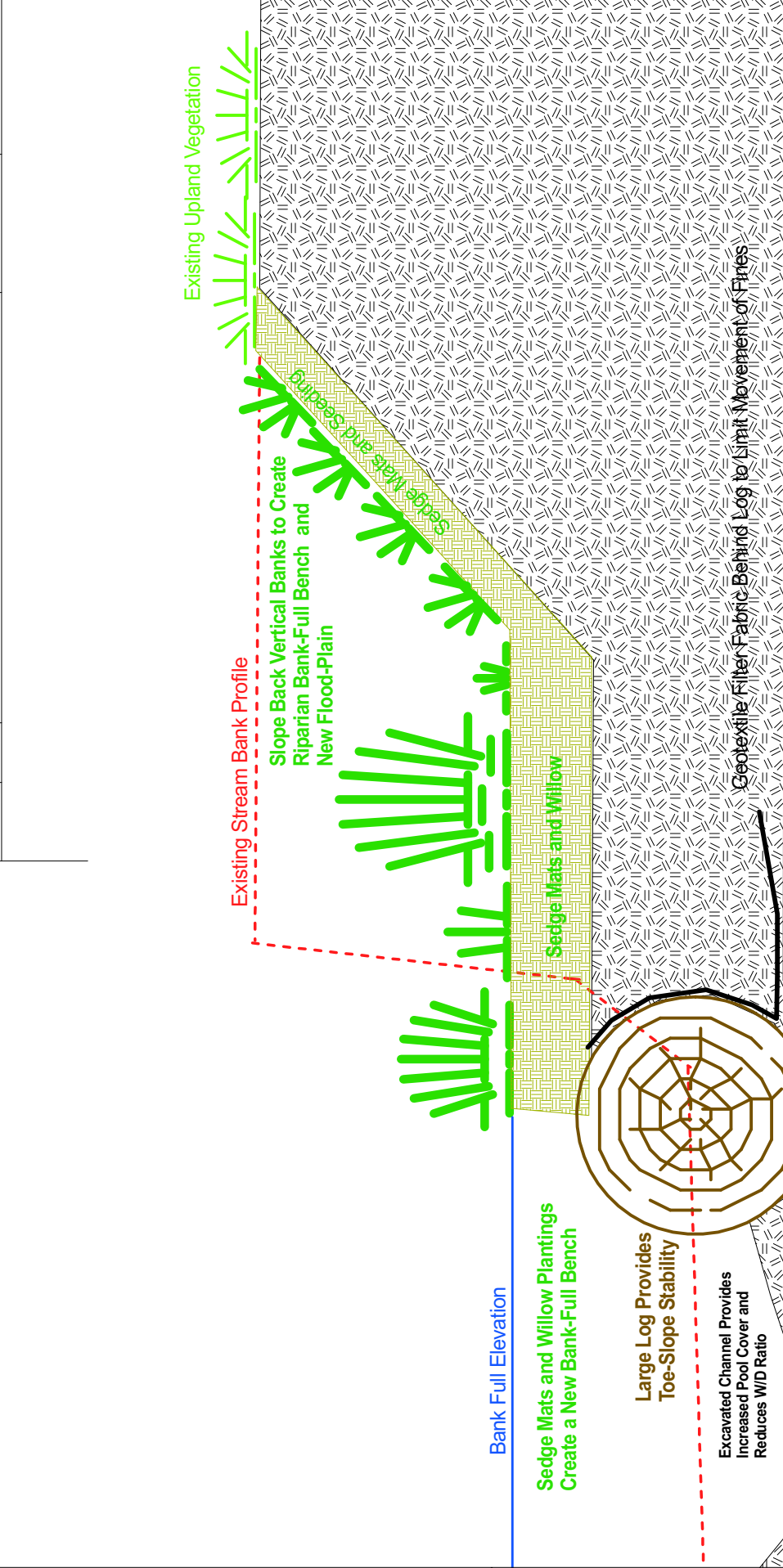
SCALE: Drawing Not to Scale - For Conceptual Purposes Only

LEGEND

- Whole Willow Clump Transplant w/root ball attached
- Sedge/Willow Mats



REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED



Bank-Full Bench / Toe-Slope Stabilization Vertical Profile View	
FIN-UP Habitat Consultants, Inc. 220 Illinois Avenue Manitou Springs, CO 80829 (719) 332-2550 P.Gallagher_06/2011	
SIZE	DWG. NO.
FSCM NO.	Drawing #2
REV	REV

SCALE: Drawing Not to Scale -- For Conceptual Purposes Only



REVISIONS

ZONE

REV

DESCRIPTION

DATE

APPROVED

Existing Upland Vegetation

Existing Stream Bank Profile

Slope Back Vertical Banks to Create Riparian Bank-Full Bench and New Flood-Plain

Geotextile Filter Fabric Behind Log to Limit Movement of Pines

Sedge Mats and Willow Plantings Create a New Bank-Full Bench

Bank Full Elevation

Boulder Provides Toe-Slope Stability

Channel Scour Provides Increased Pool Cover and Reduces WD Ratio

Sedge Mats and Willow

Bank-Full Bench / Toe-Slope Stabilization Vertical Profile View

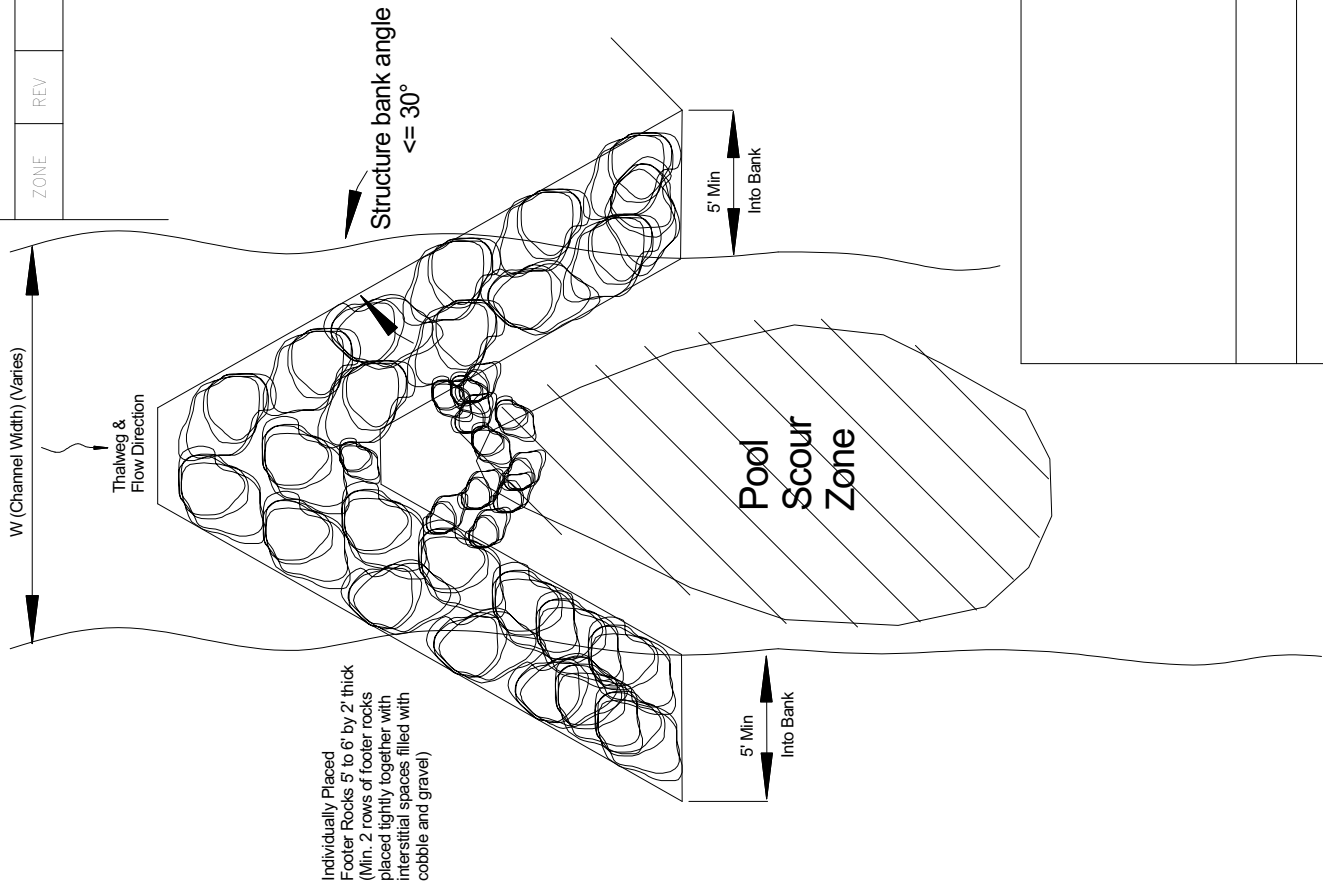
FIN-UP Habitat Consultants, Inc.
220 Illinois Avenue
Manitou Springs, CO 80829
(719) 332-2550
P.Gallagher_06/2011

SIZE FSCM NO. DWG NO. Drawing #3 REV

SCALE: Drawing Not to Scale - For Conceptual Purposes Only



REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED



Cross-Vane Plan View

FIN-UP Habitat Consultants, Inc.
 220 Illinois Avenue
 Manitou Springs, CO 80829
 (719) 332-2550
 P.Gallagher 06/2011

SIZE	FSCM NO.	DWG. NO.	Drawing #4	REV

SCALE: Drawing Not to Scale - For Conceptual Purposes Only

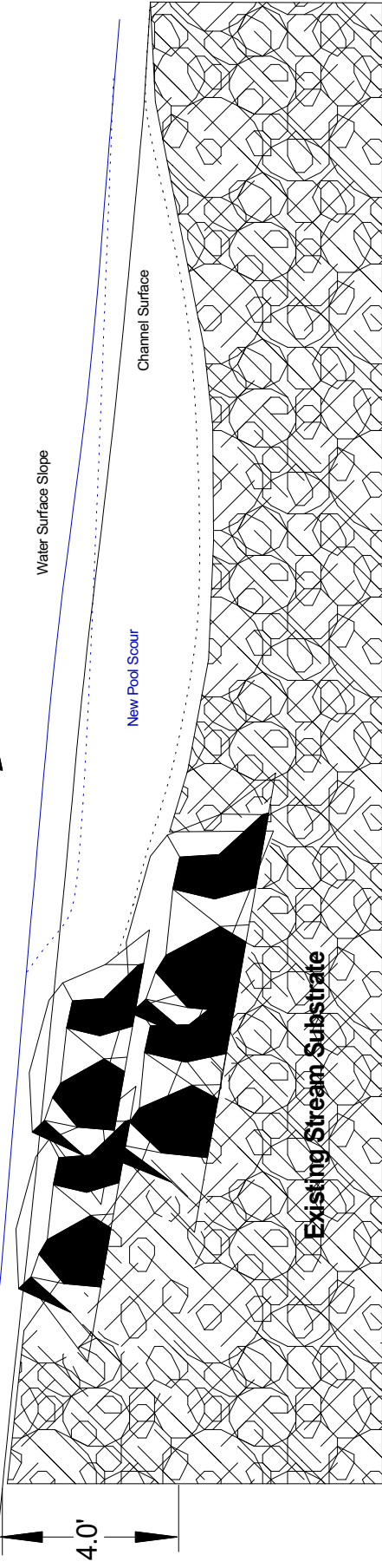


REVISIONS			
ZONE	REV	DESCRIPTION	DATE
			APPROVED

..... New Water Surface Slope

..... New Channel Profile

Individually placed boulders
(3' to 4' by 3' thick)
Back-fill upstream of structure with stream substrate
to the level of the existing channel grade



4.0'

6' to 12'



Cross-Vane Vertical Profile (Center of Structure)

FIN-UP Habitat Consultants, Inc.
220 Illinois Avenue
Manitou Springs, CO 80829
(719) 332-2550
P.Gallagher 06/2011

SIZE	FSCM NO.	DWG. NO.	REV
		Drawing #5	

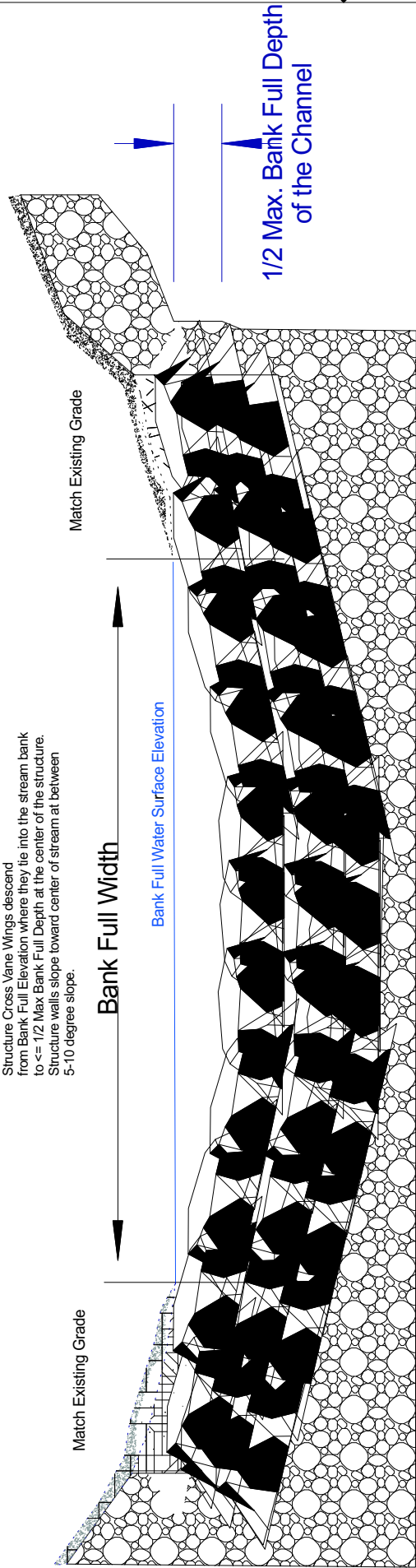
SCALE: Drawing Not to Scale - For Conceptual Purposes Only





REVISIONS			
ZONE	REV	DESCRIPTION	DATE
			APPROVED

Structure Cross Vane Wings descend from Bank Full Elevation where they tie into the stream bank to \leq 1/2 Max Bank Full Depth at the center of the structure. Structure walls slope toward center of stream at between 5-10 degree slope.



Cross-Vane Vertical Profile Cross Section Elevations)

FIN-UP Habitat Consultants, Inc.
220 Illinois Avenue
Manitou Springs, CO 80829
(719) 332-2560
P.Gallagher 06/2011

SIZE	FSCM NO.	DWG. NO.	Drawing #6	REV
------	----------	----------	------------	-----

SCALE: Drawing Not to Scale - For Conceptual Purposes Only





REVISIONS

ZONE

REV

DESCRIPTION

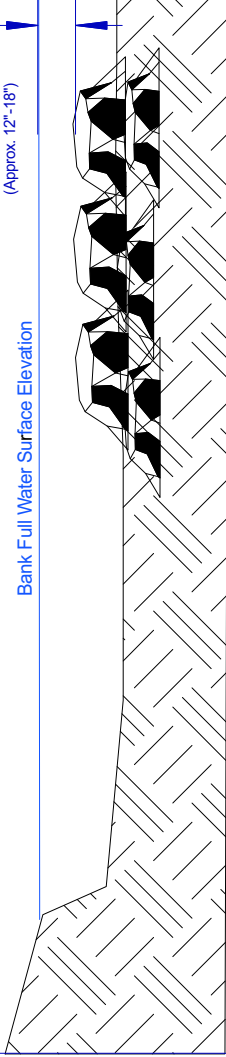
DATE

APPROVED

Profile View

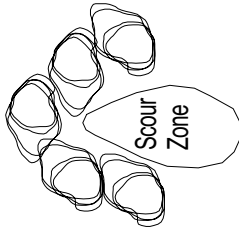
1/2 Max. Bank Full Depth
of the Channel
(Approx. 12"-18")

Bank Full Water Surface Elevation



4" to 6" Spacing between boulders to provides variation in velocity and habitat complexity. Footer rocks should be placed tightly together, with interstitial spaces back-filled with stream substrate

Thalweg & Flow Direction

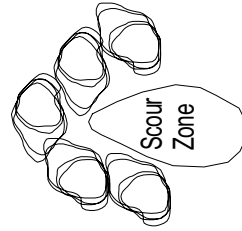


4" - 6" Gaps may be set between boulders to enhance flow complexity and improve holding and feeding habitats for trout. (Optional - Depending on vertical channel stability)

Individually Placed Footer Rocks 3" to 4" by 3" thick (Min. 1 row of footer rocks placed tightly together with interstitial spaces filled with cobble and gravel)



Bank Full Channel Width (Varies)



Plan View

Boulder Cluster Habitat Structure Plan and Profile View

FIN-UP Habitat Consultants, Inc.
220 Illinois Avenue
Manitou Springs, CO 80829
(719) 332-2550
P. Gallagher 06/2011

SIZE

FSCM NO.

DWG. NO.

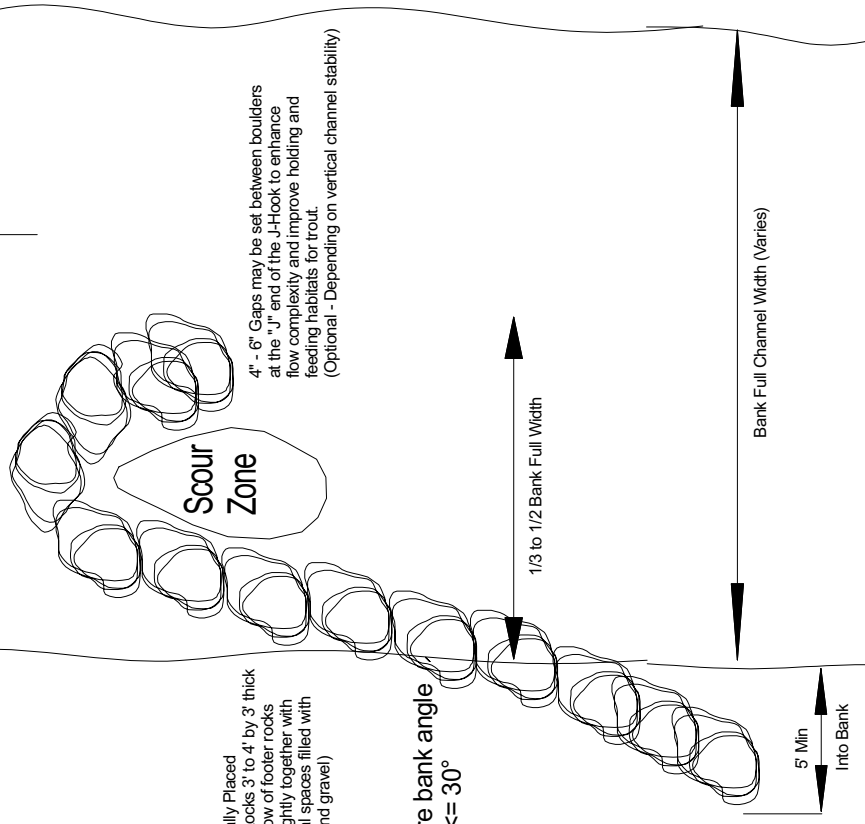
Drawing #7

REV

SCALE: Drawing Not to Scale - For Conceptual Purposes Only

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED

Thalweg & Flow Direction



Individually Placed Footer Rocks 3' to 4' by 3' thick (Min. 1 row of footer rocks placed tightly together with interstitial spaces filled with cobble and gravel)

4" - 6" Gaps may be set between boulders at the "J" end of the J-Hook to enhance flow complexity and improve holding and feeding habitats for trout. (Optional - Depending on vertical channel stability)

Structure bank angle $\le 30^\circ$

1/3 to 1/2 Bank Full Width

Bank Full Channel Width (Varies)

5' Min Into Bank

Rock J-Hook Vane - Plan View

FIN-UP Habitat Consultants, Inc.
220 Illinois Avenue
Manitou Springs, CO 80829
(719) 332-2860
P.Gallagher 06/2011

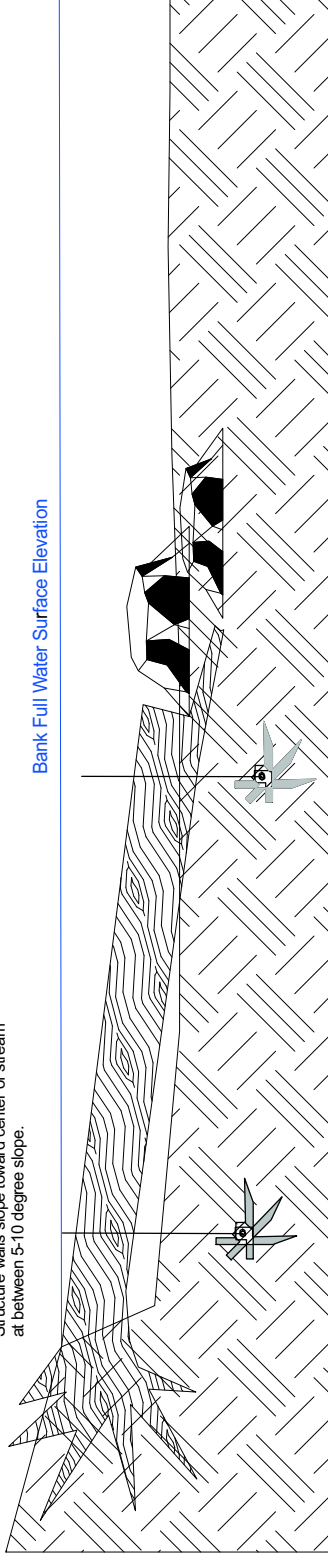
SIZE	FSCM NO.	DWG. NO.	Drawing #8	REV

SCALE: Drawing Not to Scale - For Conceptual Purposes Only



REVISIONS			
ZONE	REV	DESCRIPTION	DATE
			APPROVED

Match Existing Grade
 Top elevation of large tree descends from Bank Full Elevation where it ties into the stream bank to \leq 1/2 Max Bank Full Depth. Structure walls slope toward center of stream at between 5-10 degree slope.



1/2 Max. Bank Full Depth of the Channel

Manta-Ray Deadman Anchors
 Driven 3' to 4' into stream substrate and set with excavator. Stainless Steel Cable wrapped around tree bole and secured with cable clamps (Optional)

Habitat Tree Anchoring Detail Vertical Profile

FIN-UP Habitat Consultants, Inc.
 220 Illinois Avenue
 Manitou Springs, CO 80829
 (719) 332-2550
 P.Gallagher 06/2011

SIZE	FSCM NO.	DWG NO.	Drawing #9	REV
------	----------	---------	------------	-----

SCALE: Drawing Not to Scale - For Conceptual Purposes Only



EXHIBIT C
PRE-PROJECT EXISTING CONDITION
&
PHOTO-POINTS

