Natural Resources Conservation Service
Denver Federal Center
Building 56, Room 2604
P.O. Box 25426
Denver, CO 80225

Al Albin
Geologist
(720) 544-2818
alton.albin@co.usda.gov

Erosion and Sedimentation Control Recommendations
Unnamed 3, Larimer County, Colorado

February 7, 2013

Prepared by: Al Albin, Dave Droullard, and Dave Wolff.

Purpose: The purpose of this report is to summarize the findings of our (NRCS) site evaluation of the Unnamed 3 watershed for the purpose of evaluating potential methods of controlling erosion and reducing and/or controlling the deposition of sediment on Highway 14 and into the Poudre River.

Background: Wildfire burned 259 homes and approximately 87,000 acres of forest land west of Fort Collins, Colorado in June 2012. Larimer County asked NRCS for assistance in evaluating the risk to property and structures as well as evaluating potential detrimental effects to infrastructure and the Poudre River due to flooding. This report includes the results of our investigation with recommendations for mitigation of potential losses.

NRCS Evaluation Team: Al Albin, Dave Droullard, and Dave Wolff.

Unnamed 3 Watershed: The Unnamed 3 watershed is small, 0.28 mi^2, 180 acres. The watershed is very steep. The mouth of the watershed opens onto Highway 14 which occupies the narrow space between the mountain side and the Poudre River. One 36-inch corrugated metal pipe (cmp) and a 24-inch cmp culvert are in place under the highway to conduct flows from Unnamed 3 to the Poudre. The 36-inch cmp is aligned with the mouth of Unnamed 3. It has been plugged with sediment at least since the flood in July, 2012. The second culvert is located about 275 feet east of the mouth of Unnamed 3. This culvert is open. The combined capacities of these culverts is about 75 cubic feet per second (cfs), even if both were open they do not have the capacity to pass the predicted 200 cfs flow from Unnamed 3 resulting from the 25 year-1 hour storm of 1.8 inches.

Assets and Resources at Risk: Highway 14 is subject to being overtopped by flood flows from Unnamed 3. This and the resultant deposition of sediment on the highway represent a potential hazard to motorists as well as a maintenance problem for CDOT. In addition, flood flows crossing the highway erode the highway embankment as is demonstrated by the erosion that occurred during the July, 2012 flood event. Flows crossing the highway deposit sediment in the Poudre River a few hundred feet upstream of a large diversion structure utilized by irrigation and municipal water providers. The sediment contributes to the accumulated sediment already impounded by the structure and has a potentially detrimental effect on water quality in the river. The input of sediment and debris is likely to affect the operation of the diversion and the quality of water delivered through that system.

The driveway that follows the Unnamed 3 drainage is susceptible to significant damage during high flow events. Material eroded from the driveway constitutes the majority of sediment deposited at the mouth of the drainage during flood events. It appears that flood flows in

Unnamed 3 are not likely to transport large woody debris to the highway or the Poudre although fine debris and charred particles could be.

Assessment of the Conditions: An assessment of the conditions in the watershed was conducted. Surveys were conducted along the highway at Unnamed 3, where the driveway crosses the main branch of the drainage, and at other culvert locations.

The driveway in the Unnamed 3 drainage serves as the only access for a single residence. The driveway crosses the main branch of the drainage 3 times and is very steep, with a slope gradient between 15 and 20 percent over a majority of its length. Each of these crossings has a 24-inch cmp culvert. The lower 2 culverts plugged or partially plugged during the July, 2012 flood event. The driveway also intercepts several minor tributaries as well as flow from the steep slopes above the driveway.

The accumulation of sediment upstream of the culverts along the driveway, along the side of the highway, and in the river gave very clear indications of the nature and magnitude of the problem. The very steep driveway had been reconstructed following the flood event earlier in the summer. Little attention was given to the development of roadside ditches or clearing of culverts during the reconstruction. The reconstructed driveway is sloped toward the mountainside in many places presumably as a safety measure for winter driving. As a result, water on the road will be directed toward the up slope side of the driveway. The culverts placed to conduct water from roadside ditches into the main drainage are inadequate for post fire conditions and they are susceptible to being plugged by sediment during a high flow event. There are few water bars on the driveway.

The principal problem at this site is the very substantial potential for high flows to produce large volumes of sediment at the mouth of the drainage. This is due in large part to the limited capacity of the existing driveway culverts on the main branch. In addition, the roadside ditches and smaller culverts draining the several minor tributaries intercepted by the driveway are not adequately developed, sized, and/or maintained to convey the estimated flows from a significant precipitation event under post fire conditions. Flows beyond the capacity of culverts or roadside ditches are forced onto the driveway. If the culvers become plugged, all the flow is forced onto the driveway. Water flowing down the steep driveway rapidly erodes the surface and roadbed material ultimately producing a large volume of sediment which is deposited at the bottom of the slope, on the highway and in the Poudre as happened in July, 2012. During that event, flow overtopped the driveway at the lowest crossing, at the driveway gate. The flow split at this crossing with the majority of the flow crossing the driveway and flowing onto the highway and into the Poudre. The other flow path followed the driveway to its intersection with the highway producing a second lobe of sediment.

Recommendations: Controlling and/or reducing the volume of sediment that might be deposited on the Highway 14 or in the Poudre River should be the principal objective.

Removing the accumulated sediment in two small natural basins created by the driveway crossings would provide for a small volume of sediment storage in the future and prevent the sediment currently in those basins from being remobilized and deposited on the highway or in the river. The lower basin is very small, extending about 50 feet upstream of the first crossing, at the driveway gate. The second basin is at the second crossing and is about 70 feet long and 25 feet wide and perhaps an average of 2 feet deep. These are relatively small, easily accomplished items of work especially if they are combined with other larger scale work items.

Reducing the amount of sediment deposited on the highway and in the Poudre can be accomplished with a sediment basin. Placing 32-inch high highway barriers from the boulders below the mouth of the drainage eastward for 200 feet along the shoulder of the highway would create a basin with potential sediment storage volume of more than 800 cubic yards.

The two culverts, a 24-inch and a 36-inch cmp, under Highway 14 in this area have a combined potential capacity of about 75 cfs. The culvert under the highway below the mouth of Unnamed 3 is plugged, currently covered by sediment. If a sediment basin were established in this location, this culvert directly below the mouth of the drainage would likely be plugged by sediment early in a flood event, assuming it had been reopened in the meantime. The other culvert under the highway is about 275 feet east of the mouth of Unnamed 3. The 2 year-1 hour rain event of 0.8 inches of rain is predicted to produce 28 cfs, slightly greater than the capacity of this single culvert. Under current conditions, water would cross the highway during any storm event larger than the 2 year storm. CDOT may wish to consider increasing the flow capacity culvert at this location. An additional 36-inch cmp culvert installed near the existing 24-inch cmp would increase capacity to about 125 cfs, close to the predicted runoff from the 10 year-1 hr storm, 1.5 inches, under post fire conditions.

Serious consideration should be given to reducing the volume of sediment produced by flood events in Unnamed 3. Reducing sediment production will require measures be taken to prevent or significantly reduce flood water flows from reaching and flowing down the driveway. Flows that get onto the driveway will rapidly erode the surface material which will contribute to filling and blocking culverts which will result in additional flow onto the driveway leading to additional sediment deposition below the mouth of the drainage. These measures referred to above must include increasing the flow capacity at driveway crossings as well as improving and maintaining roadside ditches so that flows are effectively conducted into the main drainage.

Installing a 36-inch culvert along with the existing 24-inch culvert in the main branch driveway crossings would improve the capacity to about 80 cfs. Installing a 48-inch culvert with the 24-inch culvert increases the capacity to about 110 cfs. This is still significantly less than the estimated 200 cfs flow produced by the 25 year-1 hour storm event. Alternatively, the existing culverts could be replaced by a cattle guard type structure consisting of an open concrete channel about 8 feet across and 3 feet deep with a removable grill over the top. The bottom of a structure could be constructed on a grade that would ensure that sediment would be carried through the structure. This type of structure would be easily inspected and easily cleared of debris by removing the grill. Two structures of this type would be needed, at the first and second crossings.

As a minimum, the existing culverts under the driveway on the main channel as well as the smaller culverts under the driveway and the roadside ditches must be cleared and maintained to remain functional during high flow events to at least limit the deposition of sediment at the bottom of the drainage.

Water bars constructed on the driveway will only be useful for diverting incidental flows that accumulate on the driveway or minor flows that exceed the capacity of ditches or culverts. However, water bars should be constructed below any location where water may come out on the driveway. Because of the driveway's steepness, the height required for a water bar to contain significant flows crossing the driveway makes water bars an impractical solution.

Realignment of the driveway between the second and third crossings, keeping the driveway on the east side of the drainage would eliminate much of the potential for flood waters to reach the

driveway. This would eliminate two crossings on the main branch of the drainage and result in a more direct path for drainage from other minor drainage points to the main drainage. Realignment would require significant excavation of the steep mountain side and would also result in further increasing the gradient on that section of the driveway. This option would also be much more costly than replacing the existing culverts.

In order to avoid splitting the flow at the first crossing and having two flood flows cross the highway, the crossing must be modified to ensure that the entirety of the flow is directed straight across the driveway and over the bank.

Summary: There are two fundamental aspects to controlling the sediment problem, containing the sediment and reducing the production of sediment. Sediment transported during high flow events can be retained, or largely retained, in at least two small, potential sediment basins along the driveway and the larger area along the highway at the mouth of the gulch. Sediment transported during high flow events can be reduced by improving the stream crossings and drainage ditches alongside the driveway. A combination of both approaches would produce the best results. Even with the sediment problem under control, the existing culverts under Highway 14 are not capable of conducting the quantity of runoff produced by this watershed during a large precipitation event under post fire conditions. If a larger culvert is not installed, water will flow over the highway during high flow events.

Beneficiaries: The beneficiaries of reducing and/or controlling the sediment load from this drainage are the resident of this property, motorists who travel the highway, the State Department of Transportation, and the various water districts and water users served by the diversion and intake structure immediately downstream of Unnamed 3. The resident benefits through reduced road maintenance costs following high flow events. Reduced occurrence and extent of flooding and sediment deposition on the highway reduces the risk to motorists and reduces maintenance costs for CDOT. The decreased influx of debris into the river which might otherwise negatively affect water supply and water quality benefits the water users.

Cost Estimates: A summary of recommended sediment control measures and cost estimates is attached. These figures are based on prevailing contract costs.

_____

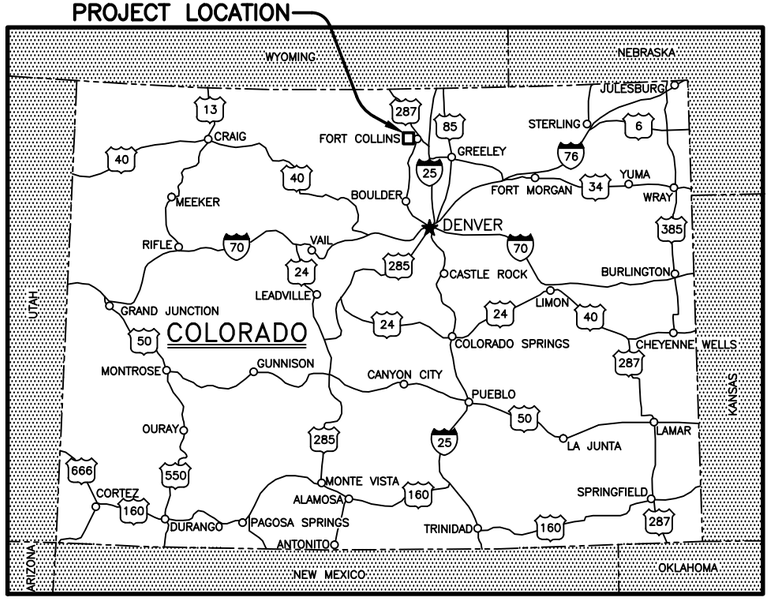
John Andrews
State Conservation Engineer

Unnamed 3 Summary of Recommended Flood Protection Measures			
Location	Recommendations		Estimated Cost *
Along Highway 14	Highway barriers, 10 feet long, 3 feet high	Trucking 20 barriers	8 hours @ $100/hr., $800
		Placing 20 barriers	$20 each, $400
		Total	$1,200
First driveway crossing, Sta. 0+90, see Site Plan	Install 48" cmp	40' cmp, excavation, backfilling	$6,600
Second driveway crossing, Sta. 7+45, see Site Plan	Install 48" cmp	70' cmp, excavation, backfilling	$11,600
Third driveway crossing, Sta. 8+70, see Site Plan	Install 48" cmp	40' cmp, excavation, backfilling	$6,600
Upstream of the third driveway cossing, near Sta. 8+70	Debris control structure	See attached design	$5,000
Various locations, see Site Plan	Excavate and remove accumulated sediment	Backhoe and dump truck, 1 day	$2,500
Driveway ditches and culverts	clear ditches along driveway, open culverts		$1,500
		Total estimated cost	$35,000
Highway 14	Install 36" cmp	Design and installation by CDOT	

* Costs are estimated based on prevailing contract costs.

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
UNNAMED THREE FLOOD PROTECTION RECOMMENDATIONS

PROJECT LOCATION



COLORADO STATE MAP
NOT TO SCALE

UNNAMED THREE PROJECT

16 MILES TO FORT COLLINS

PROJECT VICINITY MAP
NOT TO SCALE

INDEX OF DRAWINGS

TITLE	SHEET NO.
COVER SHEET	1
SITE PLAN	2
CROSS SECTIONS	3

GENERAL NOTES

CONSTRUCTION SPECIFICATIONS

NO.	TITLE

CONSTRUCTION QUANTITIES

COOPERATOR AGREEMENT

THIS PLAN HAS BEEN DISCUSSED WITH ME BY THE NRCS AND I AM IN AGREEMENT WITH THE CALCULATIONS AND DESIGN. I WILL PROVIDE NRCS WITH THE UTILITY NOTIFICATION CENTER OF COLORADO (UNCC) TICKET NUMBER MY CONTRACTOR HAS ACQUIRED PRIOR TO START OF CONSTRUCTION.

_____ DATE: _____

COOPERATOR

UTILITY NOTIFICATION

NOTICE TO THE COOPERATOR AND CONTRACTOR

NO REPRESENTATION IS MADE BY THE NATURAL RESOURCES CONSERVATION SERVICE AS TO THE EXISTENCE OR NONEXISTENCE OF UNDERGROUND UTILITIES. **CALL 2 BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.** CALL UTILITY NOTIFICATION CENTER OF COLORADO AT 1-800-922-1987 OR 811. IN THE METRO DENVER AREA CALL 303-232-0491 OR 811.

UNCC TICKET NUMBER: _____

CONSTRUCTION DATA & AS-BUILT DRAWINGS

LAYOUT BY:

_____ DATE: _____

CONTRACTOR NAME AND ADDRESS:

_____

_____

_____

CONSTRUCTION COMPLETED _ _ _ _ _ _ _ _ _ _ DATE: _____

PRACTICE (DOES) (DOES NOT) MEET STANDARDS AND SPECIFICATIONS.

_____ DATE: _____

_____

TITLE:

AS-BUILT DRAWINGS REVIEWED AND APPROVED BY:

_____ DATE: _____

TITLE:

DESIGNED D. WOLFF DATE 02/13
DRAWN D.D. DROULLARD DATE 02/13
CHECKED A. ALBIN DATE 02/13
APPROVED _____

COVER SHEET
UNNAMED THREE FLOOD PROTECTION RECOMENDATIONS
HIGH PARK BURN AREA
LARIMER COUNTY
COLORADO
JOB CLASS _____

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

FILE NO.

DRAWING NO.

SHEET 1 OF 3

ADD 48" CMP ALONG SIDE OF EXISTING 24" CMP OR REPLACE BOTH WITH ONE 60" CMP

POUDRE CANYON HWY. 14

CLEAN EXISTING SEDIMENT FROM THIS AREA AND PLACE (27) 10'Lx2'Wx32"H CONCRETE HIGHWAY BARRIERS.

0+00

1+00

SECTION 0+90

2+00

3+00

CLEAN EXISTING 24" CMP AND INSPECT FOR DAMAGE.

4+00

5+00

NEW 48" CMP PLACED ALONG SIDE OF EXISTING 24" CMP. REMOVE FILL IN FRONT OF EXISTING 36" CMP UNDER HWY. 14 AND FILL UPSTREAM FROM EXISTING 24" CMP.

ADD 2' HIGH DRAINAGE DIP ACROSS ROAD AT STATION 7+00

6+00

7+00

SECTION 7+32

ADD 48" CMP ALONG SIDE OF EXISTING 24" CMP OR RFPLACE BOTH WITH ONE 60" CMP (SEE SECTION 7+32)

8+00

9+00

10+00

SECTION 10+00

11+00

12+00

13+00

14+00

SECTION 13+50

REMOVE FILL IN FRONT OF EXISTING 24" CMP AND CLEAN OUT CULVERT. (SEE SECTION 13+50)

15+00

16+00

16+88

CLEAN FILL AND DEBRIS FROM EXISTING 15" CMP AND INSPECT FOR DAMAGE. REPLACE WITH 24" CMP IF CULVERT IS NOT REPAIRABLE.

SECTION 8+70

ADD 48" CMP ALONG SIDE OF EXISTING 24" CMP OR RFPLACE BOTH WITH ONE 60" CMP WITH TRASH RACK. (SEE SECTION 8+70)

MAIN CHANNEL FLOW

SITE PLAN

50 0 50 100

SCALE IN FEET

DESIGNED D. WOLFF — DATE 02/13

DRAWN D.D. DROULLARD — DATE 02/13

CHECKED A. ALBIN — DATE 02/13

APPROVED ____

COLORADO

SITE PLAN

UNNAMED NUMBER THREE

HIGH PARK BURN AREA

LARIMER COUNTY

NRCS

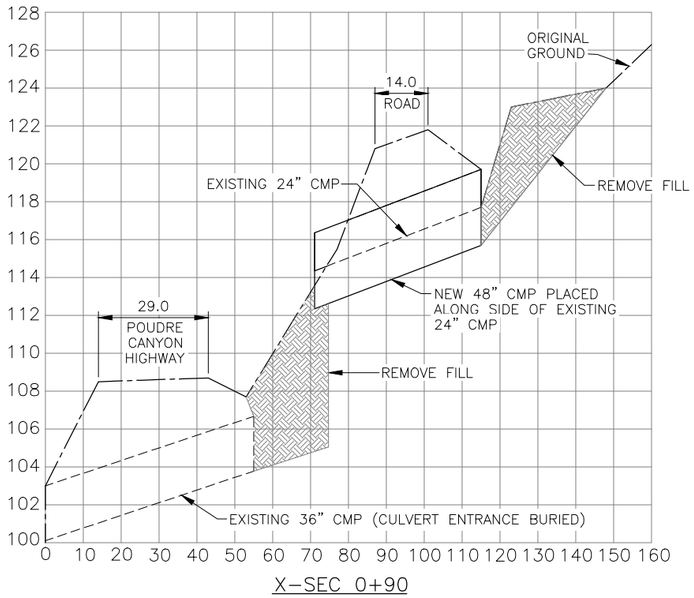
Natural Resources Conservation Service

United States Department of Agriculture

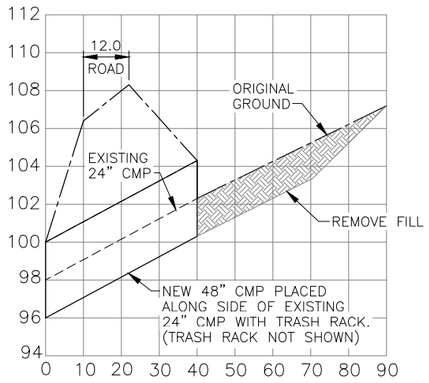
FILE NO.

DRAWING NO.

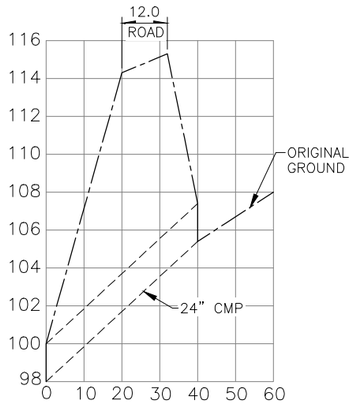
SHEET 2 OF 3



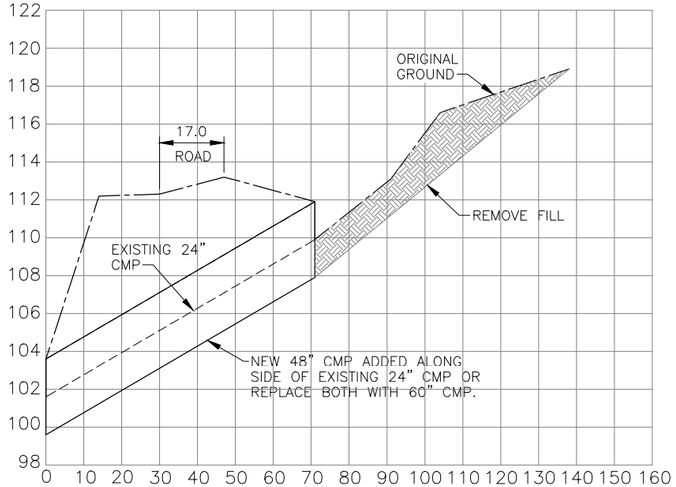
X–SEC 0+90



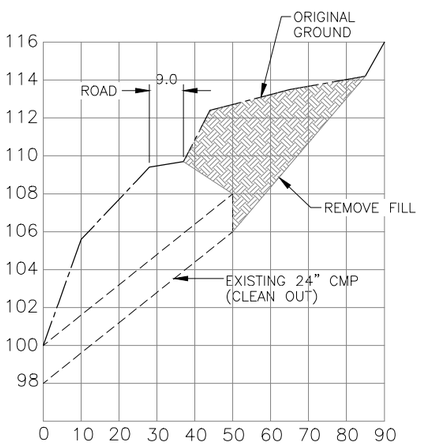
X–SEC 8+70



X–SEC 10+00
(THIS CULVERT IS IN GOOD SHAPE)



X–SEC 7+32



X–SEC 13+50

CROSS SECTIONS

20 0 20 40

SCALE IN FEET

DESIGNED D. WOLFF DATE 02/13

DRAWN D.D. DROULLARD 02/13

CHECKED A. ALBIN 02/13

APPROVED

CROSS SECTIONS

UNNAMED NUMBER THREE

HIGH PARK BURN AREA

COLORADO

LARIMER COUNTY

NRCS

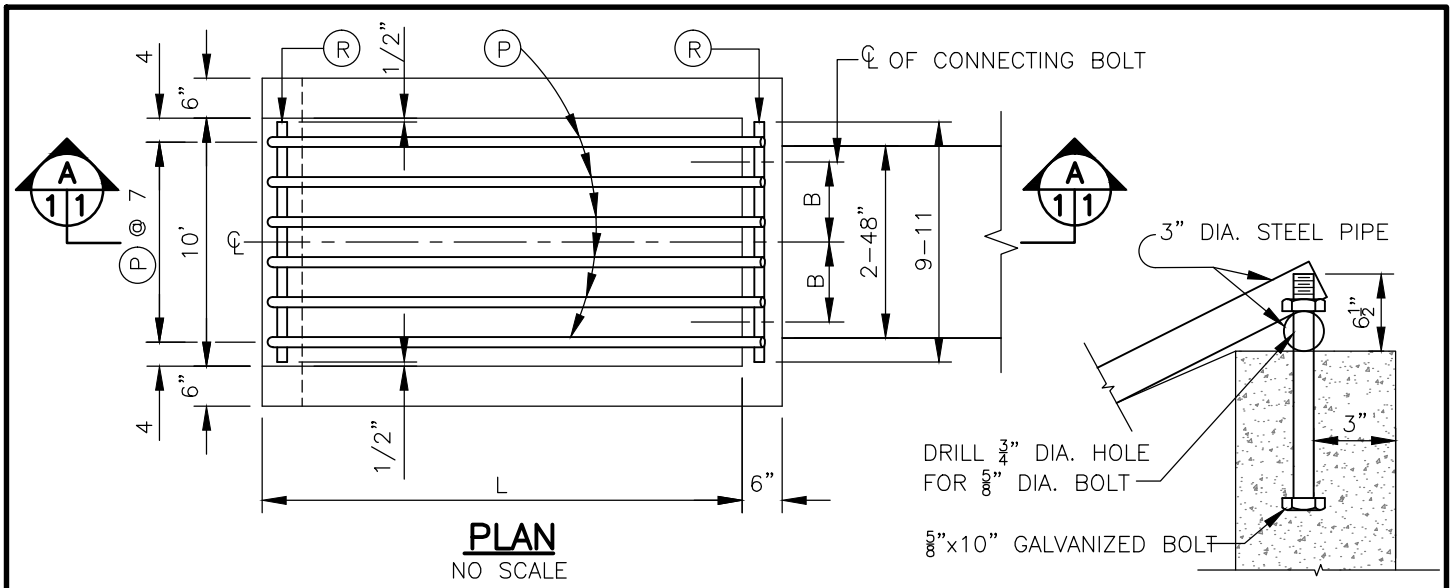
Natural Resources Conservation Service

United States Department of Agriculture

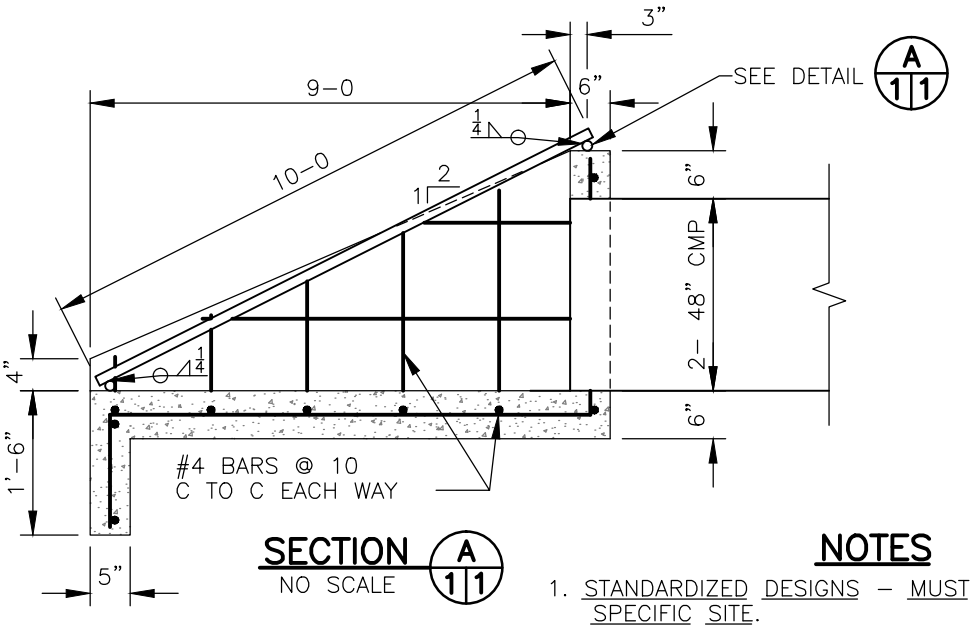
FILE NO.

DRAWING NO.

SHEET 3 OF 3



PLAN
NO SCALE



SECTION
NO SCALE

DETAIL
NO SCALE

NOTES

1. STANDARDIZED DESIGNS – MUST BE ADAPTED TO THE SPECIFIC SITE.
2. THE STRUCTURE SHALL CONFORM TO ENGINEERING STANDARD AND SPECIFICATIONS 37B, POND.

TABLE OF DIMENSIONS AND QUANTITIES FOR INLET

D PIPE DIA. (IN)	B (IN)	L (FT-IN)	W (FT-IN)	CONCRETE (CU. YDS.)	REINFORCING STEEL (APPROX. LBS.)	CONNECTING BOLTS NEEDED (EACH)
48	10	9-0	10-0	3.30	246	2

TRASH RACK DIMENSIONS

D PIPE DIA. (IN)	A (IN)	C (FT-IN)	G (FT-IN)	NO. OF MARK Ⓟ REQ'D.	NO. OF MARK Ⓡ REQ'D.	TOTAL LENGTH OF PIPE REQ'D.
48	40	10-0	9-11	17	2	89-10

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

INLET AND TRASH RACK DETAIL

(REVISED LAST ON 10-09)

		Date
Designed	RDM	7-69
Drawn	DDD	8-08
Checked	DW	3-13
Approved	J.E. ANDREWS S.C.E.	10-09

File Name

Drawing Name
CO-SSP-26

Sheet 1 of 1