AMENDMENT NO. 4
PINE CREEK DRAINAGE BASIN
PLANNING STUDY AND
MASTER DEVELOPMENT DRAINAGE PLAN
FOR PINE CREEK SUBDIVISION
(Retrofit of Pine Creek Regional Detention Facility “C”
Part of Briargate Parkway Plaza Filing No. 1 (Track A))

In conjunction with:

Powers Boulevard Bridges Project
Briargate, Union, Pine Creek

February xx, 2012

Prepared for:

Colorado Department of Transportation
Region 2, Colorado Springs Residency

Prepared by:

TSIOUVARAS SIMMONS HOLDERNESS
CONSULTING ENGINEERS

5690 DTC Blvd, Ste 345W
Greenwood Village, Colorado 80111
303.771.6200
www.tshengineering.com
ENGINEERS STATEMENT:
The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the City for drainage reports and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability on my part in preparing this report.

George K. Cotton, Colorado
Colorado PE 19501
For and On Behalf of Tsiouvaras Simmons Holderness, Inc.

COLORADO DEPARTMENT OF TRANSPORTATION
REGION 2, COLORADO SPRINGS RESIDENCY

Resident Engineer

CITY OF COLORADO SPRINGS:
Filed in accordance with Section 7-7-906 of the Code of the City of Colorado Springs, 2001, as amended

For the City Engineer

Preliminary Drainage Report
Regional Detention Facility "C" Water Quality Retrofit
Powers Boulevard Bridges Project
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I. INTRODUCTION

CDOT is completing the segment of Powers Boulevard between Pine Creek and Briargate Parkway. The construction will complete the mainline bridges over Pine Creek, Union Boulevard and Briargate Parkway; and will pave the mainline. Within CDOT right-of-way limits, the stormwater runoff will be treated in accordance with CDOT and City of Colorado Springs MS4 permits. New permanent stormwater quality facilities (PSQF) will be constructed near Pine Creek and an existing PSQF will treat stormwater runoff for the segment of Powers Boulevard from Union Boulevard to Pine Creek.

Stormwater runoff from Powers Boulevard that is tributary to the Briargate Parkway drainage system currently has no PSQF. CDOT’s project requirements allowed for retrofit of Regional Detention Facility “C” (RDF-C) in accordance with an agreement with the City of Colorado Springs. The other option permitted by CDOT design requirements was for construction of a PSQF within Powers Boulevard right-of-way. Because of the difficulty of siting a large volume PSQF within the project, the design-build team of Edward Kramer & Sons (build) and Tsiouvaras Simmons Holderness (design) chose the RDF-C retrofit approach.

This report presents the basis of the retrofit design of the primary outlet for RDF-C. The purpose of the retrofit is to provide regional treatment for all stormwater runoff that is tributary to the facility, which includes runoff from Powers Boulevard to the Briargate Parkway storm drainage system.

II. GENERAL LOCATION AND DESCRIPTION

Regional Detention Facility “C” is located in the northwest quadrant of the intersection of Union Boulevard and Briargate Parkway (see Exhibit 1). The primary outlet for the detention pond is located in the southwest corner. Geodetic coordinates for the outlet are approximately 38°57'59"N and 104°45'37"W.

RDF-C was constructed as a component of the Master Development Drainage Plan for the Pine Creek Subdivision. RDF-C is within the South Fork branch of Pine Creek and is one of four regional detention facilities constructed within that tributary. All of the inflows to RDF-C are conveyed to the basin via closed conduits. The largest inflows to the pond are from the Pine Creek South storm drainage system. This system has two large
inlets to RDF-C: one from Briargate that enters at the southeast corner into the pond forebay, and one from Union along the east side of the pond. There are also two inlets to the pond for local drainage systems that drain areas that are the north of the pond.

While no natural drainageways enter RDF-C, there is a jurisdictional wetland within the pond. When the pond was constructed, a constructed wetland was located along the south side of the pond as mitigation for wetland loses due to development. The wetland is fed by discharges from the pond forebay. Since construction of the pond, additional wetlands have established beyond the limits of the original mitigation area. Other wetlands that now exist in the pond include the area around the pond outlet. These wetlands are below elevation 6870.0, which is the berm height for the constructed wetland. Several wetlands have also formed on the perimeter of the pond where pond excavation intercepted groundwater seeps. Seeps can be observed on the north and east sides of the ponds. Groundwater seeps are not found in the vicinity of the pond outlet. It has been assumed that the entire work area near the pond outlet that is below elevation 6870.0 is jurisdictional wetland. The project has applied for a nationwide permit for work within wetland areas for project (see Appendix for a copy of the permit application).

III. DRAINAGE BASINS AND SUB-BASINS

RDF-C is a component of the drainage system for Pine Creek South Fork. The fully developed hydrology of this drainage basin is described in detail in the “Pine Creek Drainage Basin Planning Study” (JR Engineering, 1998). The watershed has 13 sub-basins of which 10 are tributary to RDF-C. The total drainage area to RDF-C is 1.04 square miles (664 acres) and has a weighted impervious area of 67.6%. The Powers Boulevard drainage basins that drain to Pine Creek South Fork have an area of 43.4 acres with an impervious percentage of 55%.

Sub-basin data is summarized in the appendix of this report (Hydrologic Input Calculations).
IV. DRAINAGE DESIGN CRITERIA

RDF-C is a non-jurisdictional detention dam that is currently privately owned by LP47, LLC and maintained and managed by the City of Colorado Springs. Design of the RDF-C water quality retrofit will conform to criteria of the City of Colorado Springs as stated in City of Colorado Springs “Drainage Criteria Manual” (DCM), Volumes 1, 2 and addenda. Specific sections of the DCM that are relevant to the detention facility retrofit design include Volume 1 Section 6.6 “Detention Storage Criteria” and Chapter 11 “Detention Storage”. Criteria for starting water surface elevations for extended detention basins are given in Volume 2 on page 4-22.

V. DRAINAGE FACILITY DESIGN

A. General Concept

The existing primary outlet for detention basin RDF-C will be modified to include a water quality outlet with a 40 hour drain time. The existing primary outlet consists of a 48-inch diameter reinforced concrete pipe that is supported by a standard headwall. To prevent debris from entering the pipe, the headwall has a sloping trash rack that is supported by the headwall and apron.

The new outlet design will raise the height of the headwall and wing-walls to a constant elevation. The elevation will be set to the stage in the RDF-C basin for the water quality capture volume (WQCV) plus 20% for accumulated sediment storage (i.e. design water quality volume).

The WQCV will be released though an orifice plate that is designed to drain that volume in 40 hours. The orifice plate will be placed on the front wall of the raised outlet headwall opposite the 48” outlet pipe. To prevent debris from clogging the orifice openings, a screen will be placed in front of the orifice plate. As a part of the screen design, a 2.5 foot deep micro-pool will be constructed to maintain a permanent pool of water in front of the screen, assuring that the lower portion of the screen will be free of floating debris. The micro-pool will be a square concrete sump that has side lengths equal to the existing headwall width of 8’-0”.

An additional fence-like screen will be placed along the perimeter of the micro-
pool for the purposed of collecting larger debris and limiting access to the micro-pool except by authorized maintenance personnel.

During regular rainfall conditions, stormwater will pool against the headwall up to the elevation of the design water quality volume and gradually release. A water quality volume of 12.46 ac-ft is calculated for the total watershed area of 658.4 acres (1.03 sq. mi.) and 57.2% imperviousness. The design height of the raised headwalls will be 6’-5”. From the base of the micro-pool, the structure will be 8’-11” high.

During storm rainfall conditions, stormwater will pool to the height of the headwall and begin spilling to the 48” outlet pipe. Initially, the headwall will act as a weir and will control the rate that water is released from the pond. However, once the flow increases, the release from the pond will be controlled by the outlet pipe.

Our analysis found that the outlet pipe runs in “inlet” control and that there is extra capacity in the Pine Creek South storm drain. We looked at the option of improving the headwall efficiency by adding a bevel around the outlet pipe (i.e. changing from an HDS Chart 1 outlet to an HDS Chart 3 outlet). This improvement would increase the outlet release from RDF-C by 12 to 14 percent and could partially make up for the initial period, when stormwater fills the WQCV and releases from the retrofit outlet are low. Analysis of this option however showed only minor overall improvement. Pond stage for the 100-year storm only decreased 0.1 foot and peak outflow by about 5.1 cfs (see Appendix, Hydrologic Model Output). This is well within the modeling error and so was not deemed to be a valid option.

To prevent debris from entering the outlet pipe, a sloping trash rack will be installed on top of the headwall. A prefabricated, tented rack was selected with raised sides and 60% open area that will be bolted to the outlet structure.

A new maintenance access road will be constructed from the existing access road near the forebay spillway along the toe slope (above the elevation of the wetland) to the micro-pool. The access road will be 10 feet wide on a level grade.
The access road will be surfaced with a 6 inch depth of aggregate base course (CDOT Class 6 material) to stabilize the road.

It was found that even with improvements to the detention basin primary outlet that it will be necessary to increase the storage volume within the detention basin. The existing pond has a volume of 68.9 ac-ft at the spillway crest. Routing (using the HEC-HMS model) through the existing pond for the 100-year storm requires a volume of 72.8 ac-ft, which is equivalent to stage of 6882.1 (0.6 feet above the existing emergency spillway crest). [Note: The flood routing for Addendums No. 2 and No. 3 was accomplished using the older hydrologic analysis program, HEC-1 (USACE, 1990). In this computer program the routing time step is set manually. The hydrologic analysis for the current retrofit design used HEC-HMS, which has replaced HEC-1. In HEC-HMS, the computational time step is computed by the program to meet all tolerances. Addendum No. 2 used a 3.0 minute time step, while HEC-HMS finds this time step to be too long and computed a shorter time step of about 2.0 minutes. The shorter time step results in a more accurate routing computation and a larger volume of runoff stored in the pond. We estimate that continuity error in the original computation to be about 2.8% of the total inflow to the pond (209.3 ac-ft) based on the HEC-HMS analysis. This is a theoretical error and within the operational uncertainty of the detention pond.]

Routing of the 100-year storm with the primary outlet modified for water quality (with an initial stage corresponding to 0.5 WQCV) requires 81.3 ac-ft of flood storage. Raising the spillway approximately 1.5 feet provides 78.8 ac-ft of storage volume. The maximum 100-year stage is 6883.3 or 0.3 feet above the spillway elevation. In theory, this will result in a spill of 85 cfs over the spillway (similar to the estimated 84 cfs spill from the existing pond). The spill would be brief, lasting 36 minutes and releasing 3.3 ac-ft.

To accomplish the spillway raise, the existing concrete cutoff wall will be extended over a length of 190 feet by 1’-6”. The existing riprap protection will be removed and approximately 380 cubic yards of embankment added to the spillway. The riprap protection will then be replaced to match the new elevation
of the cutoff wall. The raised spillway will be 3 feet below the elevation of the basin embankment. If the primary outlet were totally plugged, our analysis shows that the 100-year storm flow could pass over the spillway with 2 feet of freeboard.

B. Specific Details

Design exhibits for the RDF-C water quality retrofit are provided in the Appendix of this report. The design is presented on four plan sheets, which are part of the plan set for the Powers Boulevard Bridges Project. Sheet 181 shows the planned grading for the pond access road. The design shows regrading of the existing access road to the forebay with the new access road extending west along the south perimeter of the pond to the outlet. The detail for extending the existing emergency spillway cutoff wall is also shown on this sheet.

Sheet 182 shows the plan and elevation of the modified outlet. A work pad is provided at the outlet on the east side. To accommodate the embankment slope of the work pad at the micro-pool, the east wall of the micro-pool is extended and sloped to match the embankment slope of the pad. Other components of the outlet shown on this sheet include: the location of the orifice plate and water quality screen, the over flow trash rack, and a perimeter fence around the micro-pool. The perimeter of the micro-pool is fenced with a standard 6’ high chain link fence. Access to the micro-pool is provided by a gate on the west side. A two foot concrete walkway around the perimeter of the micro-pool will provide a firm footing for removing debris from the perimeter fence.

Sheet 183 shows reinforcement and related structural details for the vault modifications and new micro-pool.

Sheet 184 shows fabrication details for the orifice plate and trash racks. The orifice place will be mounted on the exterior of the outlet vault and surrounded by bar-grate trash rack. In accordance with UDFCD recommendations for a trash rack of this size, Amico-Klempt grade model 19-W-4 with 4” cross bar spacing is specified. The grate is configured to provide a vertical orientation of the bars, which facilitates cleaning. Access to the orifice place is accomplished by
unbolting the bar grate from its vertical supports. A prefabricated overflow trash rack is specified. The Storm Rax structure is distributed by Contech and is manufactured with structural plastic (see product information in the Appendix).

C. **Grading and Erosion Control**

It is estimated that the retrofit construction will disturb 0.34 acres and require the placement of approximately 380 cubic yards of fill. Construction erosion control BMPs will be implemented at the site. A grading and erosion control permit will be obtained from the City of Colorado Springs for the retrofit.

D. **Other Government Agency Requirements**

The primary outlet for RDF-C is adjacent to a jurisdictional wetland. The area near the outlet will be disturbed in order to construct the retrofit. A Nationwide Permit No 43 Section 404 permit has been obtained for construction work in this wetland area from the U.S. Army Corps of Engineers (see Appendix: Letter from Van Truan to George Cotton, February 1, 2012).

**VI. DRAINAGE FACILITY MAINTENANCE**

CDOT and the City of Colorado Springs have agreed to jointly develop a maintenance plan for the outlet structure (see Appendix: Letter from Robin Kidder to Mark Andrew, February 11, 2011).
VII. REFERENCES

2. JR Engineering, 1998, “Amendment No. 2 to Pine Creek Drainage Basin
   Planning Study and Master Development Drainage Plan for Pine Creek
   Subdivision (portion contributing to Pine Creek)”, prepared for LP47, LLC
3. JR Engineering, 2002, “Amendment No. 3 to Pine Creek Drainage Basin
   Planning Study and Master Development Drainage Plan for Pine Creek
   Subdivision (portion contributing to Pine Creek)”, prepared for LP47, LLC
   Manual – Volume 3” Section T-5, Extended Detention Basin (EDB) and Section
   T-12, Outlet Structures
5. Urban Drainage and Flood Control District, 2011, “UD-BMP Workbook” version
   3.01
6. USACE, Hydrologic Engineering Center, 2000, “Hydrologic Modeling System,
7. USACE, Hydrologic Engineering Center, 1990, “HEC-1, Flood Hydrographic
   Package User’s Manual”
# APPENDIX

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Photo 1. Looking west from main inlet culvert to RDF-C showing existing constructed wetland along south side of pond (left edge of pond bottom). Pond forebay is in foreground below culvert apron. Outlet is in the distance in the southwest corner (top left area of photo).

Photo2. Existing pond outlet with steel trash rack. Outlet consists of a 48” RCP with headwall and wingwalls. Constructed wetland is in the background and new wetland has established near the pond outlet.
Photo 3. Looking east from RDF-C pond embankment showing existing constructed wetland along south side of pond (right half of pond bottom). Additional wetlands have established at other culvert inlets and groundwater seep points along the pond perimeter.

Photo 4. Looking south to pond outlet and spillway (highlighted in yellow) from RDF-C pond embankment.
LOCATION
COORDINATE
SPOT ELEV &

EXISTING GROUND

PROPOSED GROUND

EXISTING GROUND

VAR IE S

WALL AT ELEV. 6883
SET TOP OF CUTOFF
EXISTING CUTOFF WALL

#4 TYP
#4 @ 1'-6"
DOWEL

Elev=6870.00
E=3211581.75
N=1414101.16

Elev=6870.99
E=3211638.83
N=1414082.76

Elev=6871.99
E=3211697.62
N=1414070.93

Elev=6872.84
E=3211757.37
N=1414065.83

Elev=6873.60
E=3211817.33
N=1414067.28

Elev=6874.20
E=3211877.24
N=1414070.55

Elev=6874.97
E=3211937.14
N=1414073.87

Elev=6967.30
E=3211995.11
N=1414107.09

Elev=6877.61
E=3211819.14
N=1414044.97

Elev=6881.16
E=3211760.53
N=1414032.26

Elev=6882.62
E=3211700.93
N=1414025.37

Elev=6883.00
E=3211664.15
N=1414011.56

6" ABC CLASS 6

4%

ACCESS ROAD TYPICAL SECTION

EXTENSION TO EXISTING CUTOFF WALL

SAW CUT EXISTING CONCRETE TO ACHIEVE A MINIMUM
NEW CONCRETE THICKNESS OF 2" WALL AND DOWEL
WITH APPROVED EPOXY, PREPARE EXISTING CONCRETE
PER CONSTRUCTION SPECIFICATIONS PRIOR TO NEW CONCRETE
PLACEMENT. CONCRETE SHALL BE CLASS B.

CUTOFF WALL EXTENSION

POWERS BLVD - BRIARGATE TO PINE CREEK

1480 DualLake Loop, Suite A
Colorado Springs, CO  80906
Phone 719-634-2323  FAX 719-227-3298

POWERS C ACCESS ROAD PLAN

POWERS BLVD - BRIARGATE TO PINE CREEK

Region 2  MSA

Sheets Subset: DRNN

Sheet Number 181

Page 14
NOTES:
1. DRILL AND DOWEL WITH APPROVED EPOXY TO OBTAIN FULL TENSILE STRENGTH OF THE BAR.
2. PREPARE EXISTING CONCRETE PER CDOT SPECIFICATIONS PRIOR TO NEW CONCRETE PLACEMENT.
3. ALL REINFORCING TO BE GRADE 60.

STAGGER MATS BY 6"

Dowel Detail
Stagger Inside Face
and Outside Face
Dowels by 6"

EAST SIDE VIEW
(WEST SIDE SIMILAR)
Structural HDPE Products for Water Screening

StormRax™


Preliminary Drainage Report
Regional Detention Facility "C" Water Quality Retrofit

Powers Bridge Project
Key Advantages

Availability

CONTECH® Construction Products Inc. is pleased to introduce StormRax™ its line of structural plastic trash racks and debris cages for stormwater management basins and pond structures from Plastic Solutions Inc. In addition to the full line of standard sizes, we can also customize to fit your specific requirements.

StormRax trash racks are available in numerous sizes and shapes to accommodate nearly every type of application.

Strength & Durability

Structural plastic has a cellular core surrounded by integral skins forming a totally integrated structure. Structural molded parts made from HDPE and fiberglass have a high strength-to-weight ratio and have 3 to 4 times greater rigidity than solid parts of the same material of equal weight.

Racks are designed to withstand the conditions of pond structures - rough handling, high/low temperatures and long term weather exposure. Structural plastic has replaced wood, concrete, solid plastics and metals in a variety of applications.

Quality Alternative

Structural plastic racks are a great alternative to painted and galvanized steel racks for use in stormwater management ponds and general water screening. They also provide a structurally sound product with a long lasting quality appearance.

With structural plastic, you can take advantage of the many benefits such as:

- Lighter Weight
- Elimination of Corrosion
- Design Flexibility
- Greater Part Stiffness and Stability
- Chemical Resistance
- Installation Savings
Applications and Options

Round Series

Peak Series

Flat Series

StormRax pyramid racks are available with an anti-vortex device and racks can be mounted on concrete structures, plastic and metal pipe.

New Modular Design - Improved ‘Round Series’

Our newest trash rack evolution is constructed of Structural Foam Molded High Density Polyethylene, a strong and lightweight replacement for steel that has proven to be a durable and economical alternative.
CONTECH Construction Products Inc. provides site solutions for the civil engineering industry. CONTECH’s portfolio includes bridges, drainage, retaining walls, sanitary sewer, stormwater, erosion control and soil stabilization products.

For more information about the products in this brochure, or to reach a sales representative in your region, call CONTECH’s Corporate Office at 513-645-7000 or call toll free at 800-338-1122.

Visit our web site: www.contech-cpi.com

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### Design Procedure Form: Extended Detention Basin (EDB)

**Designer:** George Cotton  
**Company:** TSH Engineering  
**Date:** February 6, 2012  
**Project:** Powers Blvd (SH 21) Bridges  
**Location:** RDF "C" Pine Creek South Fork

## 1. Basin Storage Volume

- **A)** Effective Imperviousness of Tributary Area, \( I_a \)
  - \( I_a = 57.2 \% \)
- **B)** Tributary Area's Imperviousness Ratio (\( i = I_a / 100 \) )
  - \( i = 0.572 \)
- **C)** Contributing Watershed Area
  - \( \text{Area} = 658.400 \text{ ac} \)
- **D)** For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm
  - \( d_6 = 0.43 \text{ in} \)
- **E)** Design Concept
  - (Select EURV when also designing for flood control)
- **F)** Design Volume (1.2 WQCV) Based on 40-hour Drain Time
  - \( V_{\text{DESIGN}} = \frac{(1.0 \times (0.91 \times i - 1.19 \times i^2 + 0.78 \times i)}{12 \times \text{Area} \times 1.2} \)
  - \( V_{\text{DESIGN}} = 14.953 \text{ ac-ft} \)
- **G)** For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume
  - \( V_{\text{WQCV OTHER}} = (d_6 \times (V_{\text{DESIGN}} / 0.43)) \)
  - \( V_{\text{DESIGN OTHER}} = 14.953 \text{ ac-ft} \)
- **H)** User Input of Water Quality Capture Volume (WQCV) Design Volume
  - (Only if a different WQCV Design Volume is desired)
- **I)** Predominant Watershed NRCS Soil Group
- **J)** Excess Urban Runoff Volume (EURV) Design Volume
  - For HSG A: \( EURV_A = (0.1878i - 0.0104) \times \text{Area} \)
  - For HSG B: \( EURV_B = (0.1178i - 0.0042) \times \text{Area} \)
  - For HSG C/D: \( EURV_{C/D} = (0.1043i - 0.0031) \times \text{Area} \)

## 2. Basin Shape: Length to Width Ratio

- (A basin length to width ratio of at least 2:1 will improve TSS reduction.)
  - \( L : W = 2.0 : 1 \)

## 3. Basin Side Slopes

- **A)** Basin Maximum Side Slopes
  - (Horizontal distance per unit vertical, 4:1 or flatter preferred)
  - \( Z = 4.00 \text{ ft} /\text{ft} \)

## 4. Inlet

- **A)** Describe means of providing energy dissipation at concentrated inflow locations:
  - One main inlet with SAF energy dissipator
  - Two other storm drain inlets with riprap aprons
5. Forebay

A) Minimum Forebay Volume
   \[ V_{\text{MIN}} = 0.374 \text{ ac-ft} \]
   \((V_{\text{MIN}} = 3\% \text{ of the WQCV})\)

B) Actual Forebay Volume
   \[ V_f = 0.510 \text{ ac-ft} \]

C) Forebay Depth
   \[ D_f = 1.6 \text{ in} \]
   \((D_f = 30 \text{ inch maximum})\)

D) Forebay Discharge
   - Undetained 100-year Peak Discharge
     \[ Q_{100} = 1840.00 \text{ cfs} \]
   - Forebay Discharge Design Flow
     \[ Q_f = 36.80 \text{ cfs} \]
     \((Q_f = 0.02 \times Q_{100})\)

E) Forebay Discharge Design

F) Discharge Pipe Size (minimum 8-inches)
   \[ \text{Calculated } D_p = \text{in} \]

G) Rectangular Notch Width
   \[ \text{Calculated } W_N = 2724.1 \text{ in} \]

6. Trickle Channel

A) Type of Trickle Channel
   - Soil Riprap Lined Channels are Not Recommended.
   - Minimum Depth of 1.5 Feet

F) Slope of Trickle Channel
   \[ S = 0.0063 \text{ ft / ft} \]

7. Micropool and Outlet Structure

A) Depth of Micropool (2.5-feet minimum)

B) Surface Area of Micropool (10 ft² minimum)

C) Outlet Type

D) Depth of Design Volume (EURV or 1.2 WQCV) Based on the Design Concept Chosen Under 1.E.
   \[ H = 6.25 \text{ feet} \]

E) Volume to Drain Over Prescribed Time

F) Drain Time
   \( \text{(Min } T_D \text{ for } \text{WQCV}= 40 \text{ hours; Max } T_D \text{ for } \text{EURV}= 72 \text{ hours)} \)

G) Recommended Maximum Outlet Area per Row, \( A_o \)
   \[ A_o = 9.55 \text{ square inches} \]

H) Orifice Dimensions:
   - Circular Orifice Diameter or Rectangular Orifice

I) Number of Columns

J) Actual Design Outlet Area per Row, \( A_o \)
   \[ A_o = 9.55 \text{ square inches} \]
   \[ n_o = 1 \text{ number} \]

K) Number of Rows (nr)

L) Total Outlet Area, \( A_{ot} \)
   \[ A_{ot} = 179.3 \text{ square inches} \]

M) Depth of WQCV, \( H_{\text{WQCV}} \)
   \[ H_{\text{WQCV}} = \text{feet} \]

N) Ensure Minimum 40 Hour Drain Time for WQCV
   \[ T_{\text{WQCV}} = \text{hours} \]
### 8. Initial Surcharge Volume

- **A) Depth of Initial Surcharge Volume**
  - Minimum recommended depth is 4 inches
  - **D_s** = 12.0 in
- **B) Minimum Initial Surcharge Volume**
  - Minimum volume of 0.3% of the WQCV
  - **V_s** = 1,628.4 cu ft
- **C) Initial Surcharge Provided Above Micropool**
  - **V_c** = 64.0 cu ft

### 9. Trash Rack

- **A) Type of Water Quality Orifice Used**
- **B) Water Quality Screen Open Area: A_t = 38.5*(e^(0.066*D))/A_{ot}**
  - **A_t** = 5,707 square inches
- **C) For 2”, or Smaller, Circular Opening (See Fact Sheet T-12):**
  - **i) Width of Water Quality Screen and Concrete Opening (W_{screen})**
  - **ii) Height of Water Quality Screen (H_{ts})**
  - **iii) Type of Screen, Describe if “Other”**
- **D) For 2” High Rectangular Opening:**
  - **i) Width of Rectangular Opening (W_{rect})**
  - **ii) Width of Water Quality Screen Opening (W_{opening})**
  - **iii) Height of Water Quality Screen (H_{ts})**
  - **iv) Type of Screen, Describe if “Other”**
  - **v) Cross-bar Spacing**
  - **2 1/4 inch x 3/16 inch**
  - **vi) Minimum Bearing Bar Size**
### 10. Overflow Embankment

A) Describe embankment protection for 100-year and greater overtopping:

- 175 foot broad crested weir with riprap revetment

B) Slope of Overflow Embankment

\( Z_e = \frac{10.00 \text{ ft}}{\text{ft}} \)

10.00 ft/ft (Horizontal distance per unit vertical, 4:1 or flatter preferred)

### 11. Vegetation

- Choose One:
  - Irrigated
  - Not Irrigated

### 12. Access

A) Describe Sediment Removal Procedures

- 10' wide access road to micropool
- Access road to forebay currently exists.

- Choose One:
  - Irrigated
  - Not Irrigated

Notes:
Comparison of Addendum No. 2 and No. 3 Hydrology

The planning for the Pine Creek Drainage has progressed through three phases. The original planning study was completed by Obering, Worth and Associates in 1988. This plan was updated in 1998 by JR Engineering and again in 2002. The design of Pine Creek Regional Detention Facility “C” was completed in 1998 and constructed in the same year. In 2003, the pond was retrofit to include a constructed wetland.

Addendum No. 2 identified ten (10) sub-basins that were tributary to Pond “C” with a total drainage area of 664.4 acres (1.038 sq. mi.). The weighted SCS curve number for the basin was 87.2 and the impervious fraction of the basin was 67.2%.

Addendum No. 3 refined the watershed and has 20 sub-basins that are tributary to Pond “C” with a total drainage area of 658.4 acres (1.029 sq. mi.). The weighted SCS curve number for the basin decreases slightly to 84.6 and the impervious fraction of the basin to 57.2%.

Despite the additional detail in hydrologic modeling, the inflow to Pond “C” is similar for the two Addendums. The Addendum No. 2 inflow peak was 1840 cfs, which is nearly identical to the Addendum No. 3 inflow peak of 1825 cfs. Peak outflows are essentially the same with Addendum No. 2 releasing at a peak rate of 227 cfs and Addendum No. 3 at 228 cfs. Peak stage and maximum storage volume are 77.4 feet and 69 ac-ft, respectively for Addendum No. 2, and 77.6 feet and 72 ac-ft, respectively for Addendum No. 3.

Given the similarity in hydrology of both models, it was decided that it was acceptable and slightly conservative to base the pond routing on the simpler Addendum No. 2 model. The design water quality volume, however was based on updated impervious data for the watershed provided in Addendum No. 3.
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<th>Sub-Basin Label</th>
<th>Total Area (acres)</th>
<th>Total Area (s.m.)</th>
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<th>Weighted Percent Impervious</th>
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Notes: (1) CNs were adjusted by JRE to match rational method calculations
Sub-Basin Parameters / Fully Developed Conditions
from JR Engineering, 2002, "Amendment No. 3"

Map 1. Fully Developed Conditions

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At RDF-C

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Preliminary Drainage Report
Regional Detention Facility "C" Water Quality Retrofit

Powers Bridge Project
## Type IIA Storm Pattern (15 m interval)

Pine Creek Drainage Basin Colorado Springs, CO

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Notes:
1. 4' RCP (Chart 1 / square edge with headwall) \( S = 0.050 \) '/
2. 4' RCP (Chart 3 / beveled-ring edge with headwall) \( S = 0.050 \) '/
3. Sharp crested weir, \( L = 15 \) ft (effective length)
4. 15 rows 6.33"x2.0" orifices
5. Assumes that Csprings datum is NGVD29 and project is NAVD88 (Project = CSprgs + 3.824')
6. Raised spillway crest 1.5'
# Outlet Rating Curves - Retrofit Configuration #2 (Beveled Headwall Outlet Pipe)

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(6) Raised spillway crest 1.5'
Pine Creek HEC-HMS Schematic
Comparison of reservoir operations in Pine Creek South Fork

Description: Update survey of RDF-C reservoir area

Alternative 1: New water quality outlet w/ 1.45' raised spillway crest

Existing headwall conditions at pipe outlet

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*51 min / 84 cfs / 3.4 af

*36 min / 85 cfs / 3.3 af
DEPARTMENT OF THE ARMY
ALBUQUERQUE DISTRICT, CORPS OF ENGINEERS
Southern Colorado Regulatory Office
200 S. Santa Fe Avenue, Suite 301
Pueblo, Colorado 81003

February 1, 2012

ATTN: George Cotton
Tsiouvaras Simmons Holderness, Inc.
5690 DTC Blvd., Ste 345W
Greenwood Village, Colorado 80111

Mr. Cotton:

We received your e-mail dated January 31, 2012 concerning Retrofit of Regional Detention Facility "C", El Paso County, Colorado. We have assigned Action No. SPA-2012-00051 to this activity. To avoid delay, please include this number in all future correspondence concerning this project.

We have reviewed this project in accordance with Section 404 of the Clean Water. Under Section 404, the Corps regulates the discharge of dredged and fill material into waters of the United States (U.S.), including wetlands. Based on your description of the proposed work, and other information available to us, we have determined that the proposed project will involve activities subject to Section 404. Therefore, a Department of the Army permit is required.

We have determined that this project is authorized by Nationwide Permit No. 43 for Stormwater Management Facilities. A summary of this permit and the regional conditions for Colorado is available on our website at www.spa.usace.army.mil/reg/. You are only authorized to conduct the work described in your submittal.

Our review of this project also addressed its effects on threatened and endangered species and historic properties in accordance with general conditions 17 and 18. Based on the information provided, we have determined that this project will not affect any species listed as threatened or endangered by the U.S. Fish and Wildlife Service within the permit area. We have also determined that this project will not affect historic properties listed, or eligible for listing, in
the National Register of Historic Places. However, please note that you are responsible for meeting the requirements of general condition 17 on endangered species and general condition 18 on historic properties.

This verification is valid until March 18, 2012, unless the Nationwide Permit is modified, suspended, revoked or reissued prior to that date. The Corps will issue a public notice when the Nationwide permits are reissued. If you commence or are under contract to commence the authorized activity before the date that the relevant Nationwide permit(s) is modified, reissued or revoked you will have twelve (12) months from the date of the modification, reissuance, or revocation of the Nationwide permits to complete the activity under the present terms and conditions of the Nationwide permits. Continued confirmation that an activity complies with the terms and conditions, and any changes to the Nationwide permit, is the responsibility of the permittee.

You must allow representatives from this office 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.

You must sign and submit to us the enclosed certification that the work, including any required mitigation, was completed in compliance with the Nationwide permit. You should submit your certification within 30 days of the completion of work.

This permit is not an 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. You must possess the authority, including property rights, to undertake the proposed work.

If you have any questions concerning our regulatory program, please contact Joshua Carpenter at 719-543-6914 or by e-mail at joshua.g.carpenter@usace.army.mil. At your convenience, please complete a Customer Service Survey on-line available at http://per2.nwp.usace.army.mil/survey.html.

Sincerely,

Van Truan
Chief, Southern Colorado
Regulatory Office
Certification of Compliance
with Department of the Army Nationwide Permit

Action Number: SPA-2012-00051

Name of Permittee: Colorado Department of Transportation

Nationwide Permit: No. 43 for Stormwater Management Facilities

Upon completion of the activity authorized by this permit and any mitigation required by the permit, sign this certification and return it to the following address:

Van Truan
U.S. Army Corps of Engineers, Albuquerque District
Southern Colorado Regulatory Office
200 S. Santa Fe Avenue, Suite 301
Pueblo, Colorado 81003

Please note that your permitted activity is subject to a compliance inspection by an U.S. Army Corps of Engineers representative. If you fail to comply with this permit, you are subject to permit suspension, modification, or revocation.

Please enclose photographs showing the completed project (if available).

I hereby certify that the work authorized by the above referenced permit has been completed in accordance with the terms and conditions of the said permit, and required mitigation was completed in accordance with the permit conditions.

Date Work Started ______________________

Date Work Completed ______________________

Date ___________________ Signature of Permittee
February 11, 2011

Mark S. Andrew  
CDOT Resident Engineer  
1480 Quail Lake Loop Suite A  
Colorado Springs, CO 80906

Re:  Briargate and Union Detention Pond  
Colorado Springs, CO

Dear Mark,

This is a follow up letter to the meeting on February 9, 2011, with City Engineering, City Streets Division and CDOT regarding CDOT's request to modify the outlet structure at the large detention pond at Union and Briargate. The City concurs with this request, which will allow CDOT to modify the outlet structure with the following commitments from CDOT:

- During the design process, the City will be involved in the decision making to ensure the design meets current City specifications, as well as accepted industry practices for BMP design. The design will be reviewed and accepted by both the City and CDOT prior to construction.

- The outlet structure will require maintenance at recommended intervals. CDOT will commit to maintaining the outlet structure for every other maintenance cycle. The maintenance cycle will be determined based on the features of the final design of the outlet structure. CDOT will use best design practices to minimize maintenance for both the City and CDOT.

- CDOT will provide better access to the outlet structure to ensure that maintenance equipment can access the site.
• CDOT will also honor all requirements to other regulatory parties such as US Fish and Wildlife Service, which may limit access to seasonal periods.

• CDOT to follow up with an Intergovernmental Agreement that will specify further details including maintenance commitments from CDOT once the final design is completed.

Sincerely,

Robin Kidder
City Engineer

C: Tim Mitros, City of Colorado Springs
Bard Lower, City Streets Division
Dave Poling, CDOT R2 Program Engineer
Yun Han, CDOT Project Engineer