# MASTER DEVELOPMENT DRAINAGE PLAN ADDENDUM

## For

# LEON YOUNG SERVICE CENTER - SOUTH

October, 2009
*Revised December 2009*

Project No. 09009

Prepared for:
Colorado Springs Utilities

Prepared by:
Obering, Wurth & Associates
Consulting Civil Engineers
Professional Land Surveyors

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## APPENDIX

## MAP POCKET

**Obering, Wurth & Associates**

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City of Colorado Springs
Engineering Unit
Subdivision Review
30 S. Nevada Ave., Suite 702
Colorado Springs, CO 80903

October, 2009
*Rev. December 2009*
Re: Master Development
Drainage Plan Addendum
for Leon Young Service
Center-South

Project No. 09009

Gentlemen:

Transmitted herewith is the Master Development Drainage Plan (MDDP) Addendum for Leon Young Service Center-South. The 21.3 acres site is in southern Colorado Springs. The site is located on the south side of Hancock Expressway opposite the Colorado Springs Utilities Leon Young Service Center. The site includes platted lots that are now located entirely within the City. Portions of the site that were previously within the County have been annexed into the City of Colorado Springs since the original preparation of this MDDP. The site has a combination of developed and undeveloped areas within it with the majority of the developed area being storage yards. This MDDP Addendum was completed in accordance with the current City of Colorado Springs Drainage Criteria manual in order to satisfy submittal requirements for a Development Plan. A Development Plan is being prepared to update the existing Concept Plan.

If there are any questions or comments regarding any portion of this drainage analysis, please contact the undersigned.

Very truly yours,
**Obering Wurth & Associates**

Steven G. Baggs, P. E.

Reviewed by:
Roland G. Obering, P.E. & P.L.S.

# Obering, Wurth & Associates

**Consulting Civil Engineers**
**Professional Land Surveyors**

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Master Development Drainage
Plan Addendum for Leon
Young Service Center - South

Project No. 09009

## ENGINEER'S STATEMENT

The attached drainage plan and report were prepared under my direction and supervision and are current 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 caused by any negligent acts, errors, or omissions on my part in preparing this report.

Roland G. Obering, P.E. & P.L.S. Colorado 13226

ROLAND G. OBERING
13226
12/11/09

## DEVELOPER'S STATEMENT

I, the developer, have read and will comply with all the requirements specified in this drainage report and plan.

Colorado Springs Utilities
Business Name

Valerie J Schmidt
By

FAC A/E Mgr
Title

456 W. Fontanero
Address

## 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

12/17/09
Date

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Master Development Drainage
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## FLOODPLAIN STATEMENT

To the best of my knowledge and belief, the Leon Young Service Center- South development plan area is not located within a designated floodplain as shown on FIRM panels 08041CO733F and 08041CO741F dated March 17, 1997. A copy of a portion of the appropriate FIRM panels is included in the Appendix of this study.

Roland G. Obering

Roland G. Obering, P.E. & P.L.S. Colorado No. 13226

## I. GENERAL

The proposed Leon Young Service Center-South Development Plan area is parcel of land consisting of approximately 21 acres located in south central Colorado Springs. The site is adjacent to the south right of way line of Hancock Expressway and is opposite the Leon Young Service Center which was platted as the Spring Creek Electric Service Center Filing No. 1. Railroad right of ways for the A.T. & S. F. Railroad and the D& R.G.W. Railroad are adjacent to the South. This development plan parcel is being developed in phases by Colorado Springs Utilities (CSU) and consists of two platted parcels known as Lot 1, Block 1 of Metro Subdivision and Leon Young Service Center-South, Filing No. 1. Drainage and Bridge Fees were determined and paid for at the time of platting so there are no further drainage/bridge fee obligations for this development plan parcel.

The platted area within Metro Subdivision is fully developed with existing buildings and paved parking and storage lots. Drainage impacts from this developed area will be analyzed in this Master Development Drainage Plan (MDDP). The Leon Young Service Center-South, Filing No. 1 area consists of developed and undeveloped land. The developed land consists of paved and unpaved storage yards with some building structures. The paved storage yard on the east end of the site was constructed in 2002 and included drainage improvements that were documented in a drainage report submitted to the County prior to construction. A storage yard office and wire strip facility was built when LYSC-South was platted. The site is impacted by numerous utilities and drainage infrastructure. The site is located within the Spring Creek Drainage Basin and a Miscellaneous Drainage Basin with the majority of the site being in the Spring Creek Drainage Basin.

The undeveloped portions of the site generally drain to the south toward the railroad embankment. Depression areas and swales collect and direct runoff to a major bridge/culvert crossing under the railroad. The undeveloped areas are covered with native vegetation including grasses and trees, unpaved access roads and training areas for lineman school. The soils in this area are Nelson-Jassel fine sandy loams that are classified as Hydrologic Soils Group B/D according to the Soil Survey of El Paso County by the Soil Conservation Service. The conservative Group "D" soil has been utilized in this drainage analysis. A copy of a portion of the Soil Survey Map is included in the Appendix. The original Concept Plan proposed that this site will be developed with various paved storage yards, covered storage area, storage and other buildings, and a paved driver training (CDL) course. This Development Plan will document completed phases of the site, identify future phasing and allow bulk grading of the site to continue as fill material and financing becomes available. Final development of the site will occur in phases as money is appropriated for various projects.

## II. DRAINAGE DESIGN CRITERIA

This MDDP Addendum has been prepared in accordance with the City of Colorado Springs Drainage Criteria Manual Volumes 1 and 2. The MDDP Addendum is to accompany a Development Plan submittal that is updating the approved Concept Plan for the Leon Young Service Center-South area. This report will provide an overall guide to drainage requirements and facilities for the continuing phased development of the site. Recommendations included in this MDDP will be refined by final design when necessary for individual phases. Drainage studies referenced in the preparation of this report include:

1.) Spring Creek DBPS, prepared by URS Consultants, October, 1993.

2.) Spring Creek Electric Service Center Final Drainage Report, prepared by GMS, Inc., filed July 2, 1997.

3.) PDR/FDR for Leon Young Service Center South Storage Yard, prepared by Obering Wurth & Associates, submitted December, 2001.

4.) PDR for Leon Young Service Center-South Storage Yard Office & FDR for Leon Young Service Center-South, Filing No. 1, prepared by Obering Wurth & Associates, filed December 26, 2007.

5.) Metro Subdivision Drainage Report & Plan, prepared by Leigh Whitehead & Associates, approved but not dated.

6.) Master Development Drainage Plan for Leon Young Service Center-South, prepared by Obering Wurth & Associates, filed November 3, 2004.

The drainage conditions at the site have been estimated using the Rational Method for runoff computations as required by the City of Colorado Springs Drainage Criteria Manual for sites with less than 100 acres. A summary of all hydrologic calculations has been included in the Appendix of this report. Two detention/water quality facilities were identified in the original MDDP and final design calculations for the one that has already been constructed and preliminary calculations for the other are included in this study. Storm sewer recommendations for the remaining phases have been provided on the MDDP Drainage Plan included in the Appendix but are subject to refinement by final drainage report or final design.

## III. DRAINAGE ISSUES

The proposed Leon Young Service Center-South site has three separate outfall locations that have distinct drainage issues. The site has been divided into various subbasins based on existing and proposed grading. These subbasins have been designated as W (West), M (Middle), E (East) and correspond to the three outfall locations. The subbasins will remain the same for this update however all of the E Subbasins and three of the four M Subbasins are now fully developed. Runoff estimates have been determined based on these subbasins and summarized in the Appendix.

The west end of the site is identified by the "W" subbasins and is located within a Miscellaneous Drainage Basin. This portion of the site has the most significant offsite drainage impacts. An existing major storm sewer crosses through this end of the site. According to the drainage report for Metro Subdivision, this system is the outfall for approximately 180 acres upstream of the site. Historically this existing system consists of a 48" CSP and 54" CSP that combined into a 60" CSP which crossed this site. The existing 60" CSP then daylighted in Subbasin W-4 at a concrete transition channel which then conveyed the runoff into a stone arch drainage tunnel under an abandoned railroad bed. The runoff then continues Southerly through a drainage crossing under the existing railroad track. Since the preparation of the original MDDP the 60"CSP has been replaced in part by a 60" RCP though the limits of the replacement are not known. The drainage pattern would be unchanged by the development of this site since all of the "W" subbasins currently drain to this outfall point. Subbasins W-3 and W-4 will consist mostly of paved lots for storage, parking and training purposes. Subbasin W-3 is currently a reclaimed asphalt pavement (RAP) parking area. Subbasin W-5 will be the location of a detention/water quality facility. A building addition is anticipated in a future phase for the existing building in Subbasins W-2A and W-2B. A building addition will not change any drainage conditions in those subbasins. Existing flows for Subbasins W-1, W-2A, W-2B and W-3 as well as proposed flows from Subbasins W-4 and W-5 are shown on the Drainage Plan. Proposed drainage facilities including a detention pond will allow the runoff to be conveyed efficiently through the improved site while maintaining the runoff quantity at its current level.

The middle portion of the site is also subject to some offsite drainage impacts. The "M" subbasins generate runoff that mostly flows to an existing natural channel located on the east side of the proposed detention/water quality facility in Subbasin M-4. This channel then conveys runoff to a 54" RCP culvert crossing under the existing railroad tracks. An existing 30" CMP storm sewer crosses Subbasin M-3 and also discharges into the previously mentioned natural channel. This storm sewer currently collects runoff from a portion of the Leon Young Service Center and from the Hancock Expressway. The inlet that historically collected the runoff from the Hancock Expressway road ditch in Subbasin M-3 was replaced with a curb inlet that connects to the 30" CMP. The Spring Creek Electric Service Center Final Drainage Report indicates that the 30" CMP carries runoff quantities of $Q_5$=18.5 cfs and $Q_{100}$=47.1 cfs and that will not change due to improvements in the "M" subbasins. Subbasin M-3 and a portion of Subbasin M-2 are already fully developed and generate runoff that will need to be treated for water quality and be detained to insure that the runoff quantity reaching the 54" RCP outfall is unchanged by this development. The majority of Subbasin M-2 is undeveloped but is scheduled for grading in an upcoming phase. Subbasin M-1, which consists of the south half of approximately 1730 ft. of Hancock Expressway, continues to drain into the 30" CMP.

The east end of the Leon Young Service Center-South is represented by Subbasins E-1 and E-2. An existing storm sewer system serves both of these subbasins. These subbasins are completely developed and the drainage requirements of the original MDDP have been fully addressed. The storm sewer was reconfigured when additional paving occurred in this portion of the site to insure that the runoff quantities leaving the east end of the site were in accordance with previous drainage reports. No further drainage considerations are required for the "E" subbasins due to their developed status. Maintaining this existing system will not require a water quality facility since it was installed prior to the adoption of the water quality requirements.

## IV. DRAINAGE SOLUTIONS

The proposed Leon Young Service Center-South site will continue to be developed with a combination of grading, storm sewer and detention/water quality facilities in order to maintain existing drainage patterns and insure that runoff quantities do not increase at the three outfall locations. This drainage approach limits drainage facility recommendations to onsite improvements only and should prevent any downstream impact at this site. The East Storm Sewer is complete and is shown as existing on the Drainage Plan. The Middle Storm Sewer is partially complete with some pond facilities and additional storm sewer in Subbasin M-2 still to be constructed. The West Storm Sewer is the main drainage component remaining at the LYSC-South site. Recommendations are subject to refinement as final design plans are prepared for the site.

The West Storm Sewer is the most extensive storm sewer recommended at the site. The majority of the facilities in this system improve or extend existing facilities. Subbasin W-1 includes Hancock Expressway from Fountain Boulevard to this site. Two 15' opening D-10-R curb inlets are recommended as shown on the Drainage Plan to keep most of the street runoff within the Miscellaneous Basin. Flowby at the lower inlet of $Q_5$=2.0 cfs and $Q_{100}$=6.8 cfs will result in a cross basin flow from the Miscellaneous Basin to the Spring Creek Basin. The upstream inlet (not yet constructed) will connect to an existing storm sewer. The downstream inlet and 18" RCP stub out was constructed with the Hancock Expressway curb and gutter improvements and will require an 18"/24" storm sewer that will extend to a junction box in Subbasin W-4. Subbasin W-2A requires no additional facilities while Subbasin W-2B will require the replacement of a concrete trough with a 15' opening D-10-R curb inlet and a 24" RCP storm sewer that extends to the previously mentioned junction box. These facilities will collect 5yr and 100yr flows from Subbasin W-2B. Some storm sewer could be associated with the future building addition in these two subbasins but that would be determined at the time of that phase. Subbasin W-3 has a grated inlet and 24" CMP pipe that currently extends to the location of the future junction box. The inlet will be replaced with a 15' opening curb inlet. The 24" CMP may be utilized as the outlet pipe for this inlet subject to alignment and grade verification in the field. If the 24" CMP can be utilized then the inlet in the Hancock Expressway with the 18" RCP stub could be connected to this curb inlet in Subbasin W-3. Subbasin W-4 is the location of the junction box that connects the storm sewer facilities from Subbasins W-1, W-2B and W-3 to the existing 60" RCP. A 60" RCP will extend south from the junction box as shown on the Drainage Plan. It will extend to the wall along the southerly edge of the site where it will discharge directly into the existing railroad crossing. An outfall transition/dissipator should be provided at this location. Actual runoff from Subbasin W-4 will not be directed to the junction box but will be directed overland through the paved Utility Support Staging Area to the West to the proposed detention/water quality facility (WQ-2) in Subbasin W-5. It should be noted that Subbasin W-4 straddles the basin line dividing the Miscellaneous Basin from the Spring Creek Basin with approximately 41% of the subbasin on the Spring Creek side. This results in a cross basin flow of $Q_5$=3.6 cfs and $Q_{100}$=7.2 cfs from Spring Creek to the Miscellaneous Basin. This should not be an issue since, based on the previously mentioned flowby in Hancock Expressway, the net cross basin flow is $Q_5$=1.6 cfs and $Q_{100}$=0.4 cfs into the Miscellaneous Basin which is fairly negligible in terms of overall basin flows. Also this minimal flow transfer should not affect any existing or proposed drainage facilities. The outfall facilities for the pond are subject to further analysis but will extend from the pond to the same outfall location as the 60" RCP. These facilities will be a combination of public and private facilities that will require drainage easements.

The Middle Storm Sewer System consists mostly of existing storm sewer with some additional proposed storm sewer still required to direct runoff to the partially complete detention/water quality facility. The existing 30" CSP that extends across Subbasin M-3 from an existing 16' opening D-10-R curb inlet on the north side of the Hancock Expressway to an existing natural drainage on the south side of the site was modified as recommended in the original MDDP. This occurred when the Hancock Expressway curb and gutter improvements and the Leon Young Service Center-South Storage Yard Office were constructed. This storm sewer collects all runoff from Subbasin M-1. The outfall for this existing system will be unchanged by future development. Runoff from Subbasins M-2 and M-3 is also directed into storm sewers. A combination of three 15' opening D-10-R curb inlets along the south side of Subbasin M-2 will collect runoff from Subbasin M-2. One of those inlets was constructed when the first portion of Subbasin M-2 was graded. Storm sewer pipe ranging from 18" to 30" RCP will convey the runoff to the detention/water quality facility. The portion of the pipe from the constructed inlet to the pond has also been installed. The remainder of the Subbasin M-2 storm sewer system will be completed as the next phase of grading and wall installation occurs. An existing storm sewer system including a 15' D-10-R curb inlet, a 15' grated inlet and a 10' grated inlet located on the southerly edge of Subbasin M-3 collects the runoff from Subbasin M-3. Pipes ranging from 18" to 24" RCP convey the runoff collected by these inlets to Subbasin M-4 where the detention/water quality facility (WQ-1) is located. The Detention/Water Quality Facilities section has additional information on the WQ-1 facility. The outfall facilities for the pond will be directed to the east to the existing natural channel. Riprap lining improvements recommended for the LYSC-South portion of the natural channel that extends south to an existing 54" RCP outfall pipe under the railroad track and runoff quantities in the channel will not be increased by development of the site.

The East Storm Sewer System is actually an existing system that was reconfigured after the original MDDP was written. The recommendations in the original MDDP were completed so no further drainage issues remain for this portion of the site. The existing system consists of two 5'

D-10-R curb inlets that collect runoff from Hancock Expressway (Subbasin E-1) and a 10' grated D-9 inlet that collects runoff from Subbasin E-2. This system is shown as an existing storm sewer on the Drainage Plan.

## V. DETENTION/WATER QUALITY FACILITIES

The Leon Young Service Center-South site has two detention /water quality facilities programmed into its storm water management scheme. Water Quality Facility No. 1 (WQ-1) is located in Subbasin M-4 and has been utilized as a temporary sediment pond for this project for several years. This facility is to be an Extended Detention Basin (EDB) that also provides detention for the middle portion of the site. The peak developed flows estimated to enter WQ-1 at Summary Point 1 are $Q_5$=31.3 cfs and $Q_{100}$=63.0 cfs from Subbasins M-2, M-3 and M-4. Historic runoff from those same subbasins is $Q_5$=8.4 cfs and $Q_{100}$=22.5 cfs and outflow from the pond will be limited to historic quantities or less. Final design and construction of WQ-1 outlet facilities has been completed and includes an EDB outlet structure with wingwalls. The outlet connects to the existing 18"HDPE pipe that currently drains the pond. The temporary riser outlet at the pond was removed. These facilities were to be installed in September/October 2009. Completion of the rest of the pond including forebays and final stabilization will not occur until the remainder of Subbasin M-2 is graded and drainage facilities are installed. A summary of the final pond data for WQ-1 is as follows:

| **Item** | **5yr Storm** | **100yr Storm** |
|---|---|---|
| Peak Inflow | 31.3 cfs | 63.0 cfs |
| Peak Outflow | 6.8 cfs | 22.3 cfs |
| Max. Pond Depth | 6.2 ft | 7.1 ft |
| Peak Storage | 0.67 ac-ft | 0.94 ac-ft |
| Freeboard to Spillway | 2.4 ft | 1.5 ft |

A summary of all WQ-1 detention and water quality calculations is included in the Appendix of this report.

The second detention/water quality facility (WQ-2) is proposed to be an Extended Detention Basin (EDB) located in Subbasin W-5 and would detain and treat the runoff from Subbasins W-4 and W-5. No other runoff would be directed to this pond since the remaining "W" subbasins are developed and any redevelopment of them will not change runoff conditions. Final design of this facility will not occur until Subbasins W-4 is developed. However preliminary pond information has been established as part of this MDDP. Peak developed runoff entering WQ-2 is estimated at Summary Point 2 to be $Q_5$=9.5 cfs and $Q_{100}$=19.1 cfs. Runoff leaving the pond will be limited to historic or less with historic flow for WQ-2 being estimated at $Q_5$=3.4 cfs and $Q_{100}$=9.1 cfs. The final design of WQ-2 will determine the final pond configuration, outlet facilities and the type of water quality treatment.

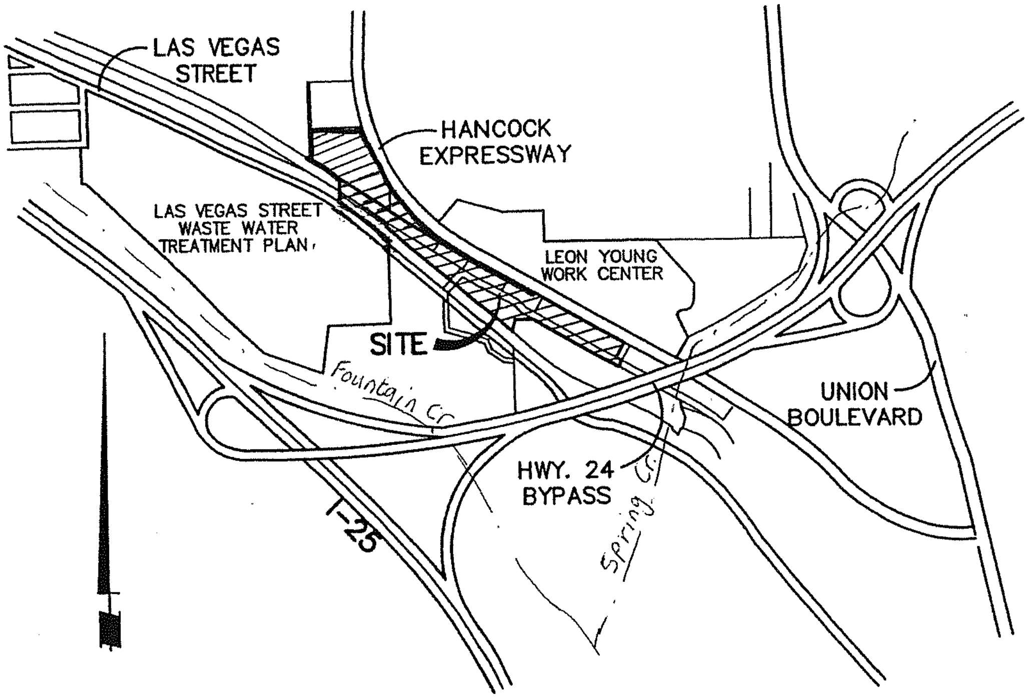
## VI. SUMMARY

This Master Development Drainage Plan has been prepared to accompany a Development Plan application for Leon Young Service Center-South. Drainage facilities and water quality facilities will be required at this site. Preliminary storm sewer facilities have been determined and are shown on the attached Drainage Plan. Detention/water quality facilities have been identified and located for this site. Phased development of this site will require final design of drainage facilities. Development of additional buildings on the site will require Development Plans including Final Drainage Reports or Addendums. All facilities shown on the Drainage Plan are subject to final design.

This Master Development Drainage Plan has been prepared in accordance with the current City of Colorado Springs Drainage Manual Volumes 1 and 2. Supporting information is included in the Appendix. It is believed that all pertinent information has been considered in the preparation of this MDDP. The recommendations contained herein are subject to the conditions set forth.

# Appendix

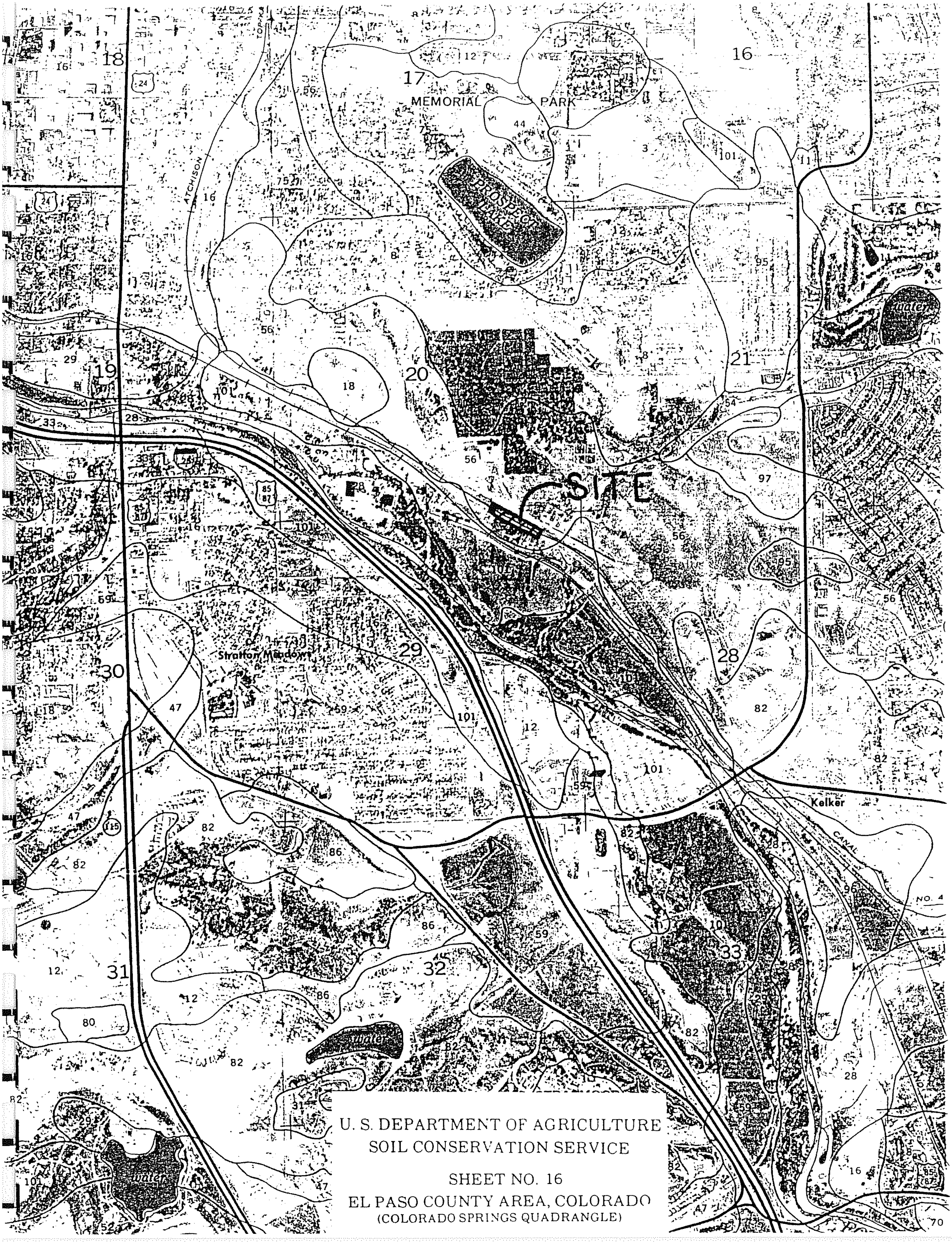
# Vicinity Map



# VICINITY MAP

N.T.S.

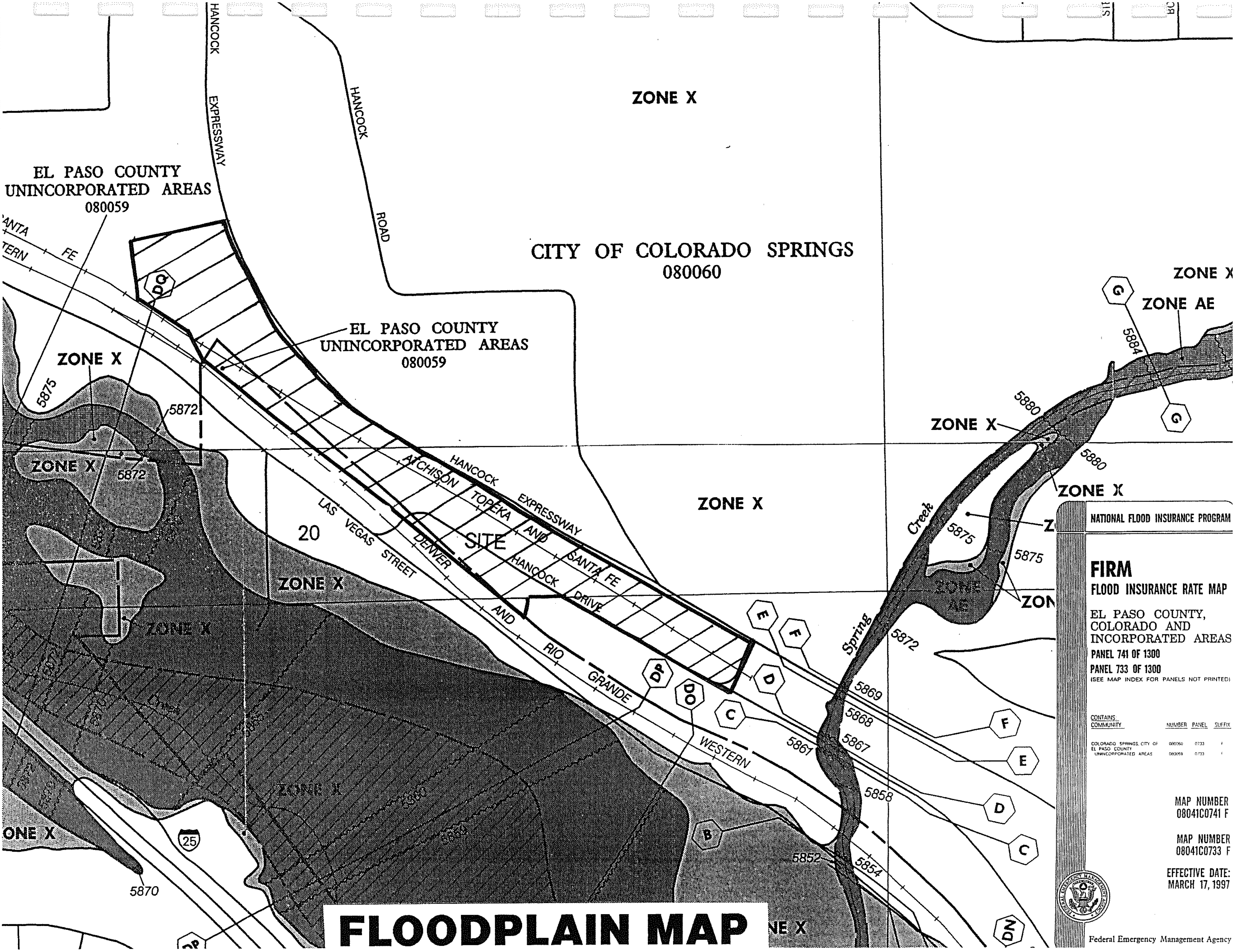
# Soils Map



U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 16
EL PASO COUNTY AREA, COLORADO
(COLORADO SPRINGS QUADRANGLE)

# Floodplain Map



# FLOODPLAIN MAP

# Hydrologic Calculations

# RATIONAL METHOD FOR RUNOFF COMPUTATIONS

| BASIN | AREA | GEOMETRY | | C | | Tc | INTENSITY,in/hr | | PEAK FLOW cfs | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (acres) | Length | Height | 5 yr | 100 yr | min. | 5 yr | 100yr | 5 yr | 100yr |
| W-1 | 3.56 | 1950 | 84 | 0.9 | 0.95 | 5 | 5.1 | 9.07 | 16.3 | 30.7 |
| W-2A | 2.37 | 480 | 43 | 0.7 | 0.79 | 5 | 5.1 | 9.07 | 8.5 | 17 |
| W-2B | 2.68 | 800 | 39 | 0.8 | 0.87 | 5 | 5.1 | 9.07 | 10.9 | 21.1 |
| W-3 | 0.64 | 180 | 10 | 0.9 | 0.95 | 5 | 5.1 | 9.07 | 2.9 | 5.5 |
| W-4 | 2.81 | 660 | 12 | 0.74 | 0.82 | 9 | 4.3 | 7.65 | 8.9 | 17.6 |
| W-5 | 0.39 | 70 | 23 | 0.3 | 0.45 | 5 | 5.1 | 9.07 | 0.6 | 1.6 |
| M-1 | 2.08 | 1425 | 20 | 0.9 | 0.95 | 5 | 5.1 | 9.07 | 9.5 | 17.9 |
| M-2 | 5.77 | 1120 | 20 | 0.81 | 0.88 | 8 | 4.5 | 8 | 21 | 40.6 |
| M-3 | 3.2 | 260 | 6 | 0.83 | 0.9 | 7 | 4.75 | 8.33 | 12.6 | 24 |
| M-4 | 0.6 | 50 | 11 | 0.3 | 0.45 | 5 | 5.1 | 9.07 | 0.9 | 2.4 |
| E-1 | 0.87 | 670 | 14 | 0.9 | 0.95 | 5 | 5.1 | 9.07 | 4 | 7.5 |
| E-2 | 2.68 | 690 | 17 | 0.83 | 0.89 | 6 | 4.9 | 8.65 | 10.9 | 20.6 |
| | | | | | | | | | | |

**OBERING, WURTH & ASSOCIATES**
CONSULTING CIVIL ENGINEERS
PROFESSIONAL LAND SURVEYORS

**LEON YOUNG WORK CENTER-SOUTH OF HANCOCK**
OWA PROJECT NO. 02034
August, 2004

D:stevefiles\drgdata\02\02034\subbasins.xls

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JOB 02034 Don Young Service Center - South
SHEET NO. 1 OF 4
CALCULATED BY SGB DATE Aug '04
CHECKED BY DATE
SCALE

Subbasin Calculations

1) <u>Subbasin W-1</u> Hancock Expressway $C_5 = 0.9$ $C_{100} = 0.95$

$L_{SC} = 1950'$ $h = 64'$ $S_{avg} =$ [illegible]

$V_{SC} = \frac{1.49}{0.016}(0.65)^{2/3}(0.043)^{1/2} = 14.5 \text{ ft/s}$

$T_c = \frac{1950}{14.5} \div 60 = 2.24 \text{ min}$ Use 5 min $i_5 = 5.1$ $i_{100} = 9.07$

2) <u>Subbasin W-2A</u> Portion of Metro Sub - Fully Developed

33% LS, 67% HS $C_5 = (.33)(0.3) + (.67)(0.9) = 0.70$
$C_{100} = (.33)(0.45) + (.67)(0.95) = 0.79$

$L_{OL} = 120'$ $L_{SC} = 360'$ $h = 43$ $S_{avg} = 9\%$

$T_{OL} = 1.87(1.1 - 0.7)(120)^{0.5}(9)^{-0.33} = 4 \text{ min}$

$V_{SC} = \frac{1.49}{0.016}(0.5)^{2/3}(.09)^{1/2} = 17.6 \text{ ft/s}$ $T_{ST} = \frac{360}{17.6} \div 60 = 0.34 \text{ min}$

$T_c = 4 + 0.34 = 4.34 \text{ min}$ Use 5 min

3) <u>Subbasin W-2B</u> Portion of Metro Sub - Fully Developed

17% LS 83% HS $C_5 = (.17)(.3) + (.83)(.9) = 0.80$
$C_{100} = (.17)(.45) + (.83)(.95) = 0.87$

Use $T_c = 5 \text{ min}$ (same as W-2A)

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JOB 02034 Leon Young Service Center - South
SHEET NO. 2 OF 4
CALCULATED BY SGB DATE Aug '04
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SCALE

## Subbasin Calculations (cont'd)

4) Subbasin W-3 Paved storage yard

$C_5 = 0.90 \quad C_{100} = 0.95$

$T_c = 5 \text{ min}$

5) Subbasin W-4 Future Storage Yard & CDL Course (Paved w/minimal LS)

$L_{OL} = 240' \quad L_{St} = 420' \quad h = 12' \quad S_{avg} = 1.8\%$

27% LS / 73% HS $\quad C_5 = (.27)(.3) + (.73)(0.9) = 0.74$

$C_{100} = (.27)(.45) + (.73)(.95) = 0.82$

$T_{OL} = .87(1.1 - 0.74)(240)^{0.5}(1.8)^{-0.33} = 8.59 \text{ min}$

$v_{St} = \frac{1.49}{0.016}(0.65)^{2/3}(0.018)^{1/2} = 9.4 \text{ ft/s} \quad T_{ST} = \frac{420}{9.4} \div 60 = 0.74 \text{ min}$

$T_c = 8.59 + 0.74 = 9.33 \text{ min}$ Use 9 min

6) Subbasin W-5 Prop detention/water quality pond

$C_5 = 0.30 \quad C_{100} = 0.45$

$T_c = 5 \text{ min}$

7) Subbasin M-1 Hancock Expressway $L = 1425 \quad h = 20' \quad S_{avg} = 1.4\%$

$v_{St} = \frac{1.49}{0.016}(0.65)^{2/3}(0.014)^{1/2} = 8.25 \text{ ft/s}$

$T_c = \frac{1425}{8.25} \div 60 = 2.88 \text{ min}$ Use 5 min

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SHEET NO. 3 OF 4
CALCULATED BY SGB DATE Aug '04
CHECKED BY DATE
SCALE

## Subbasin Calculations (cont'd)

8) <u>Subbasin M-2</u> Prop Storage Yard & Future Bldg

$L_{OL} = 240'$ $L_{ST} = 880'$ $H = 20'$ $S_{avg} = 1.8\%$

15% LS / 85% HS $C_5 = (.15)(.3) + (.85)(.9) = 0.81$
$C_{100} = (.15)(.45) + (.85)(.95) = 0.88$

$T_{OL} = 1.87(1.1 - 0.81)(240)^{0.5}(1.8)^{-0.33} = 6.92$ min

$v_{St} = \frac{1.49}{0.016}(0.65)^{2/3}(.018)^{1/2} = 9.4$ ft/s $T_{St} = \frac{880}{9.4} \div 60 = 1.56$ min

$T_c = 6.92 + 1.56 = 8.48$ min Use 8 min

9) <u>Subbasin M-3</u> Prop Storage Yard & Future Bldg

$L_{OL} = 260'$ $L_{St} = 530'$ $h = 6'$ $S_{avg} = 2.3\%$

11% LS / 89% HS $C_5 = (.11)(.3) + (.89)(.9) = 0.83$
$C_{100} = (.11)(.45) + (.89)(.95) = 0.90$

$T_{OL} = 1.87(1.1 - 0.83)(260)^{0.5}(2.3)^{-0.33} = 6.18$ min

$v_{Storm} = 11.4$ ft/s $T_{Storm} = \frac{530}{11.4} \div 60 = 0.78$ min

$T_c = 6.18 + 0.78 = 6.96$ Use 7 min

10) <u>Subbasin M-4</u> Prop Detention/Water Quality Pond

$C_5 = 0.30$ $C_{100} = 0.45$

$T_c = 5$ min

**Obering, Wurth & Associates**
Consulting Civil Engineers
Professional Land Surveyors

1015 Elkton Drive
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(719) 531-6200 FAX (719) 531-6266

JOB 02034 Leon Young Service Center - South
SHEET NO. 4 OF 4
CALCULATED BY SGB DATE Aug '04
CHECKED BY DATE
SCALE

Subbasin Calculations (cont'd)

11) Subbasin E-1 Hancock Expressway $L = 670'$ $H = 14'$ $S_{avg} = 2.1\%$

$$v_{st} = \frac{1.49}{0.016}(.65)^{2/3}(0.021)^{1/2} = 10.1\ ft/s$$

$$T_c = \frac{670}{10.1} \div 60 = 1.1\ min$$ Use 5 min

12) Subbasin E-2 Prop & Existing Storage Yard

$L_{OL} = 230'$ $L_{st} = 460'$ $H = 17'$ $S_{avg} = 2.5\%$

12% LS, 88% I

$$C_5 = (0.12)(.3) + (0.88)(.9) = 0.83$$
$$C_{100} = (0.12)(.45) + (0.88)(.95) = 0.89$$

$$T_{OL} = 1.87(1.1-0.83)(230)^{0.5}(2.5)^{-0.33} = 5.65\ min$$

$$v_{st} = \frac{1.49}{0.016}(0.65)^{2/3}(0.025)^{1/2} = 11.0\ ft/sec$$ $$T_{st} = \frac{460}{11.0} \div 60 = 0.7\ min$$

$$T_c = 5.65 + 0.7 = 6.35\ min$$ Use 6 min

# Inlet Calculator for Curb-Opening Inlets on Grade

| Inputs | | | | | Outputs | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Inlet Description | $S_x$ | $S_o$ | Q | $L_i$ | $(Q_i/Q)100$ | $Q/S_o^{1/2}$ | T | $F_w/S^{1/2}$ | $F_w$ | $F_wT$ | $L_1$ | $L_2$ | $L_3$ | $Q_2$ | $L_i<=L_2$ | $L_i>L_2$ | $Q_i$ | $Q_c$ |
| | (%) | (%) | (cfs) | (ft.) | (%) | (cfs) | (ft.) | | | (ft.) | (ft.) | (ft.) | (ft.) | (cfs) | | | (cfs) | (cfs) |
| H.E. @ metro sub | 2.00 | 2.13 | 16.30 | 15.00 | 55.34 | 111.69 | 17.82 | 13.54 | 1.98 | 35.20 | 27.11 | 16.28 | 58.08 | 9.79 | X | | 9.02 | 7.28 |
| 100yr @ above | 2.00 | 2.13 | 30.70 | 15.00 | 41.77 | 210.35 | 22.59 | 14.15 | 2.06 | 46.64 | 35.91 | 21.57 | 76.96 | 18.44 | X | | 12.82 | 17.88 |
| inlet@ basin bndry | 2.00 | 1.00 | 7.28 | 15.00 | 73.06 | 72.80 | 15.18 | 13.13 | 1.31 | 19.93 | 15.34 | 9.22 | 32.88 | 4.37 | | X | 5.32 | 1.96 |
| 100yr @ above | 2.00 | 1.00 | 17.88 | 15.00 | 62.25 | 178.80 | 21.26 | 13.99 | 1.40 | 29.73 | 22.90 | 13.75 | 49.06 | 10.74 | | X | 11.13 | 6.75 |
| m-2 west inlet(100yr | 2.00 | 1.24 | 18.20 | 15.00 | 60.59 | 163.44 | 20.55 | 13.90 | 1.55 | 31.81 | 24.50 | 14.71 | 52.49 | 10.93 | | X | 11.03 | 7.17 |
| m-2 mid inlet(100yr) | 2.00 | 1.53 | 17.90 | 15.00 | 58.18 | 144.71 | 19.63 | 13.79 | 1.71 | 33.48 | 25.78 | 15.48 | 55.24 | 10.75 | X | | 10.42 | 7.48 |
| m-3 west inlet(100yr | 1.25 | 0.50 | 7.30 | 10.00 | 60.18 | 103.24 | 23.21 | 13.14 | 0.93 | 21.57 | 14.42 | 7.89 | 35.59 | 3.99 | | X | 4.39 | 2.91 |
| m-3 mid inlet(100yr) | 1.25 | 0.50 | 11.10 | 15.00 | 65.72 | 156.98 | 27.15 | 13.52 | 0.96 | 25.97 | 17.37 | 9.49 | 42.85 | 6.07 | | X | 7.29 | 3.81 |
| m-3 west inlet(100yr | 1.78 | 2.00 | 12.30 | 15.00 | 59.98 | 86.97 | 17.45 | 13.22 | 1.87 | 32.63 | 24.26 | 14.24 | 53.84 | 7.22 | | X | 7.38 | 4.92 |
| | | | | | | | | | | | | | | | | | | |

***Based on Table 7-2 (pg.7-19) of Colorado Springs Drainage Criteria Manual***

*Assuming: W(ft.)= 2 n= 0.016*

| Variable | Definition | Units |
|---|---|---|
| $S_x$ | Cross slope of pavement | % |
| $S_o$ | Longitudinal slope of pavement | % |
| Q | Rate of discharge in street | cfs. |
| $Q_i$ | Rate of discharge intecepted by inlet | cfs. |
| T | Flow spread on pavement | ft. |
| $L_i$ | Length of inlet opening | ft. |
| $(Q_i/Q)100$ | Efficiency of Inlet (percentage of total flow intercepted) | % |
| Qc | Rate of discharge not intercepted by inlet (flowby) | cfs. |

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# Inlet Calculator for Curb-Opening Inlets on Grade

| Inputs | | | | | Outputs | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Inlet Description | $S_x$ | $S_o$ | Q | $L_i$ | $(Q_i/Q)100$ | $Q/S_o^{1/2}$ | T | $F_w/S^{1/2}$ | $F_w$ | $F_wT$ | $L_1$ | $L_2$ | $L_3$ | $Q_2$ | $L_i<=L_2$ | $L_i>L_2$ | $Q_i$ | $Q_c$ |
| | (%) | (%) | (cfs) | (ft.) | (%) | (cfs) | (ft.) | | | (ft.) | (ft.) | (ft.) | (ft.) | (cfs) | | | (cfs) | (cfs) |
| m-3 west inlet(100yr | 1.25 | 0.50 | 3.80 | 10.00 | 67.59 | 53.74 | 18.17 | 12.56 | 0.89 | 16.14 | 10.79 | 5.90 | 26.63 | 2.08 | | X | 2.57 | 1.23 |
| m-3 mid inlet(100yr) | 1.25 | 0.50 | 5.50 | 15.00 | 74.43 | 77.78 | 20.87 | 12.89 | 0.91 | 19.02 | 12.72 | 6.95 | 31.39 | 3.01 | | X | 4.09 | 1.41 |
| m-3 east inlet(100yr | 1.78 | 2.00 | 5.90 | 15.00 | 68.40 | 41.72 | 13.25 | 12.54 | 1.77 | 23.50 | 17.47 | 10.25 | 38.77 | 3.46 | | X | 4.04 | 1.86 |
| e-1 west inlet(5yr) | 1.20 | 2.57 | 2.10 | 5.00 | 38.02 | 13.10 | 10.98 | 11.31 | 1.81 | 19.91 | 13.15 | 7.13 | 32.84 | 1.14 | X | | 0.80 | 1.30 |
| e-1 west inlet(100yr) | 1.20 | 2.57 | 4.10 | 5.00 | 28.15 | 25.58 | 14.11 | 11.89 | 1.91 | 26.89 | 17.76 | 9.63 | 44.37 | 2.22 | X | | 1.15 | 2.95 |
| e-1 east inlet(5yr) | 1.40 | 3.09 | 3.20 | 5.00 | 31.24 | 18.20 | 11.28 | 11.67 | 2.05 | 23.14 | 16.01 | 8.95 | 38.17 | 1.79 | X | | 1.00 | 2.20 |
| e-1 west inlet(5yr) | 1.40 | 3.09 | 6.40 | 5.00 | 22.88 | 36.41 | 14.62 | 12.29 | 2.16 | 31.58 | 21.85 | 12.22 | 52.11 | 3.58 | X | | 1.46 | 4.94 |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |

***Based on Table 7-2 (pg.7-19) of Colorado Springs Drainage Criteria Manual***

*Assuming: W(ft.)= 2 n= 0.016*

| Variable | Definition | Units |
|---|---|---|
| $S_x$ | Cross slope of pavement | % |
| $S_o$ | Longitudinal slope of pavement | % |
| Q | Rate of discharge in street | cfs. |
| $Q_i$ | Rate of discharge intecepted by inlet | cfs. |
| T | Flow spread on pavement | ft. |
| $L_i$ | Length of inlet opening | ft. |
| $(Q_i/Q)100$ | Efficiency of inlet (percentage of total flow intercepted) | % |
| Qc | Rate of discharge not intercepted by inlet (flowby) | cfs. |

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JOB 02034 Leon Young Service Center - South
SHEET NO. 1 OF 4
CALCULATED BY SGB DATE Aug '04
CHECKED BY DATE
SCALE

# Drainage Facility Solutions

## 1) Subbasin W-1

Runoff in Hancock Expressway currently flows to end of curb & gutter improvements and then across property to railroad crossing

Provide curb inlet @ Metro Sub entrance and at Miscellaneous/Spring Creek basin boundary

Provide 2-15' D-10-R Inlets in Hancock. Reduces runoff entering Spring Creek Basin due to proposed curb on Hancock. Cross basin flow $Q_5 = 2$ cfs $Q_{100} = 6.8$ cfs
Inlets to connect to existing 60" CSP system

## 2) Subbasin W-2A

All runoff drains to existing facilities in Metro Sub. No facilities required.

## 3) Subbasin W-2B

Existing concrete trough connects to existing concrete transition channel between 60" CSP and drainage tunnel.

Replace trough w/ D-10-R inlet & pipe

$Q_{DES} = Q_{100} = 21.1$ cfs   100yr pickup due to lack of overflow route

For 15' @ 9" Dep $Q_i = (3)(15)(0.75)^{1.5} \times 0.8 = 23.4$ cfs   Use 15' D-10-R Inlet

Use 24" RCP @ 1% min to connect to junction box

JOB 02034 Leon Young Service Center - South
SHEET NO. 2 OF 4
CALCULATED BY SGB DATE Aug '04
CHECKED BY DATE
SCALE

## Drainage Facility Solutions (cont'd)

4) Subbasin W-3

Existing grated inlet drains paved storage area currently. Replace w/ prop 10' D-10-R due to proposed grading & curb location.

5) Subbasin W-4

Runoff from this subbasin needs to be detained and treated for water quality. Runoff will be conveyed via c&g to SE corner. A concrete chase will then carry the runoff to a detention/water quality pond

Facilities from Subbasins W-1, W-2B, W-3 will combine at a proposed junction box at the end of the existing 60" CSP. A 60" RCP extends out of the junction box south to an existing drainage crossing under the railroad

6) Subbasin W-5

Proposed Detention/Water Quality Facility

7) Subbasin M-1

Hancock Expressway - Replace Grated Inlet with curb inlet

$Q_5 = 9.5$ cfs

$Q_{DES} = Q_{100} = 17.9$ cfs @ D = 9"/10' opn $Q_L = (3)(10)(.75)^{1.5} \times 0.8 = 15.6$ cfs

@ D = 10" $Q_L = (3)(10)(0.833)^{1.5} \times 0.8 = 18.3$ cfs ✓

Use 10' opng Radial Curb Inlet

JOB 02034 Leon Young Service Center - South
SHEET NO. 3 OF 4
CALCULATED BY SGB DATE Aug '04
CHECKED BY DATE
SCALE

## Drainage Facility Solutions (cont'd)

8) Subbasin M-2

Runoff drains to south curb line where proposed curb inlets will collect runoff and convey it to a detention/water quality facility

→ Use 2 -15' D-10-R on grade (see inlet calculator)
(Prorated 100yr Q for each inlet)

Sump inlet @ SE corner of subbasin

$Q_{des} = 19.2$ cfs For D=8' $L_L = 15$ $Q_i = (3)(15)(.67)^{1.5} \times 0.8 = 19.7$ cfs

Use 15' D-10-R in sump w/ 30" RCP @ 1% (Q=40.6 cfs)

9) Subbasin M-3

Use 3 on grade inlets to collect the majority of the subbasin runoff (see inlet calcs)

10) Subbasin M-4

Proposed Detention/Water Quality Facility

11) Subbasin E-1

Hancock Expressway - Replace existing grated inlets with curb inlets (see inlet calcs)

Use 2 - 5' D-10-R inlets & connect to existing storm sewer.

JOB 02034 Leon Young Service Center - South
SHEET NO. 4 OF 4
CALCULATED BY SGB DATE Aug '04
CHECKED BY DATE
SCALE

# Drainage Facility Solutions (cont'd)

12) Subbasin E-2

$$Q_{design} = Q_5 = \overset{(E-2)}{10.9} + \overset{(M-3)}{1.9} + 2.2 = 15.0 \text{ cfs}$$

Use D-9 inlet @ SE Corner

try 10' @ h = 8"

$$Q_i = c A \sqrt{2gh} \times \frac{2}{3} = (0.6)(9.5)\sqrt{(2)(32.2)(.67)} \times \frac{1}{2}$$

$Q_i$ = 18.7 cfs ok Note: 100 yr overflow to go to southeast.

Use 21" HDPE @ 0.65%

# DETENTION & WATER QUALITY CALCULATIONS

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**Colorado Springs, Colorado 80907**
**(719) 531-6200**
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JOB 09007 LYS - WQ Pond Outlet
SHEET NO. ______ OF ______
CALCULATED BY ______ DATE June '09
CHECKED BY ______ DATE ______
SCALE ______

## Water Quality Facility No 1

1) Will serve Subbasins M-2, M-3, M-4 (Sum Pt 1)

A = 9.57 ac

| Historic | Developed |
|---|---|
| $Q_5$ = 8.4 cfs | $Q_5$ = 31.3 cfs |
| $Q_{100}$ = 22.5 cfs | $Q_{100}$ = 63.0 cfs |

Flows from Approved FDR - Leon Young Service Center-South Filing No 1

Detention Requirement (limits outflow to historic or less)

Detained $Q_5$ = 22.9 cfs
Detained $Q_{100}$ = 40.5 cfs

2) Water Quality - EDB

Determine Impervious Area

| Subbasin | Pervious, ac | Impervious, ac |
|---|---|---|
| M-2 | 0.87 | 4.90 |
| M-3 | 0.35 | 2.85 |
| M-4 | 0.6 | 0.0 |
| Total | 1.82 | 7.75 |

% Impervious = $\frac{7.75}{9.57} \times 100$ = 81 % impervious

# Design Procedure Form: Extended Detention Basin (EDB) - Sedimentation Facility

Sheet 1 of 3

Designer: **SGB**
Company: **Obering Wurth & Associates**
Date: **June, 2009**
Project: **LYSC Water Quality Pond**
Location: **Leon Young Service Center**

1. Basin Storage Volume

| | |
|---|---|
| | $I_a$ = 81.00 % |
| A) Tributary Area's Imperviousness Ratio (i = $I_a$ / 100 ) | i = 0.81 |
| B) Contributing Watershed Area (Area) | Area = 9.57 acres |
| C) Water Quality Capture Volume (WQCV)<br>(WQCV =1.0 * (0.91 * $I^3$ - 1.19 * $I^2$ + 0.78 * I)) | WQCV = 0.33 watershed inches |
| D) Design Volume: Vol = (WQCV / 12) * Area * 1.2 | Vol = 0.320 acre-feet |

2. Outlet Works

| | |
|---|---|
| A) Outlet Type (Check One) | x Orifice Plate<br>___ Perforated Riser Pipe<br>___ Other: |
| B) Depth at Outlet Above Lowest Perforation (H) | H = 3.70 feet |
| C) Required Maximum Outlet Area per Row, ($A_o$) | $A_o$ = 0.30 square inches |
| D) Perforation Dimensions **(enter one only)**:<br>i) Circular Perforation Diameter **OR**<br>ii) 2" Height Rectangular Perforation Width | D = 0.6250 inches, **OR**<br>W = ___ inches |
| E) Number of Columns (nc, See Table 6a-1 For Maximum) | nc = 1 number |
| F) Actual Design Outlet Area per Row ($A_o$) | $A_o$ = 0.31 square inches |
| G) Number of Rows (nr) | nr = 11 number |
| H) Total Outlet Area ($A_{ot}$) | $A_{ot}$ = 3.41 square inches |

3. Trash Rack

| | |
|---|---|
| A) Needed Open Area: $A_t$ = 0.5 * (Figure 7 Value) * $A_{ot}$ | $A_t$ = 121 square inches |
| B) Type of Outlet Opening (Check One) | X ≤ 2" Diameter **Round**<br>___ 2" High **Rectangular**<br>___ Other: |
| C) For 2", or Smaller, **Round Opening** (Ref.: Figure 6a): | |
| i) Width of Trash Rack and Concrete Opening ($W_{conc}$) from Table 6a-1 | $W_{conc}$ = 3 inches |
| ii) Height of Trash Rack Screen ($H_{TR}$) | $H_{TR}$ = 68 inches |

# Design Procedure Form: Extended Detention Basin (EDB) - Sedimentation Facility

Sheet 2 of 3

Designer: **SGB**
Company: **Obering Wurth & Associates**
Date: **June, 2009**
Project: **LYSC Water Quality Pond**
Location: **Leon Young Service Center**

| | |
|---|---|
| iii) Type of Screen (Based on Depth H), Describe if "Other" | x S.S. #93 VEE Wire (US Filter)<br>Other: |
| iv) Screen Opening Slot Dimension, Describe if "Other" | X 0.139" (US Filter)<br>Other: |
| v) Spacing of Support Rod (O.C.)<br>Type and Size of Support Rod (Ref.: Table 6a-2) | 0.75 inches<br>**#156 VEE** |
| vi) Type and Size of Holding Frame (Ref.: Table 6a-2) | **3/8 in. x 1.0 in. flat bar** |
| D) For 2" High **Rectangular Opening** (Refer to Figure 6b): | |
| I) Width of Rectangular Opening (W) | W = inches |
| ii) Width of Perforated Plate Opening ($W_{conc}$ = W + 12") | $W_{conc}$ = inches |
| iii) Width of Trashrack Opening ($W_{opening}$) from Table 6b-1 | $W_{opening}$ = inches |
| iv) Height of Trash Rack Screen ($H_{TR}$) | $H_{TR}$ = inches |
| v) Type of Screen (based on depth H) (Describe if "Other") | Klemp$^{TM}$ KPP Series Aluminum<br>Other: |
| vi) Cross-bar Spacing (Based on Table 6b-1, Klemp$^{TM}$ KPP Grating). Describe if "Other" | inches<br>Other: |
| vii) Minimum Bearing Bar Size (Klemp$^{TM}$ Series, Table 6b-2)<br>(Based on depth of WQCV surcharge) | |
| 4. Detention Basin length to width ratio | 2.90 (L/W) |
| 5 Pre-sedimentation Forebay Basin - Enter design values | |
| A) Volume (5 to 10% of the Design Volume in 1D) | 0.032 acre-feet |
| B) Surface Area | 0.003 acres |
| C) Connector Pipe Diameter<br>(Size to drain this volume in 5-minutes under inlet control) | 8 inches |
| D) Paved/Hard Bottom and Sides | **yes** yes/no |

## Design Procedure Form: Extended Detention Basin (EDB) - Sedimentation Facility

Sheet 3 of 3

Designer: **SGB**
Company: **Obering Wurth & Associates**
Date: **June, 2009**
Project: **LYSC Water Quality Pond**
Location: **Leon Young Service Center**

| | |
|---|---|
| 6. Two-Stage Design | |
| A) Top Stage ($D_{WQ}$ = 2' Minimum) | $D_{WQ}$ = 2.00 feet<br>Storage= 0.249 acre-feet |
| B) Bottom Stage ($D_{BS}$ = $D_{WQ}$ + 1.5' Minimum, $D_{WQ}$ + 3.0' Maximum, Storage = 5% to 15% of Total WQCV) | $D_{BS}$ = 3.50 feet<br>Storage= 0.048 acre-feet<br>Surf. Area= 0.014 acres |
| C) Micro Pool (Minimum Depth = the Larger of 0.5 * Top Stage Depth or 2.5 Feet) | Depth= 2.50 feet<br>Storage= 0.023 acre-feet<br>Surf. Area= 0.009 acres |
| D) Total Volume: $Vol_{tot}$ = Storage from 5A + 6A + 6B Must be $\geq$ Design Volume in 1D | $Vol_{tot}$ = 0.329 acre-feet |
| 7. Basin Side Slopes (Z, horizontal distance per unit vertical) Minimum Z = 3, Flatter Preferred | Z = 3.00 (horizontal/vertical) |
| 8. Dam Embankment Side Slopes (Z, horizontal distance) per unit vertical) Minimum Z = 3, Flatter Preferred | Z = 3.00 (horizontal/vertical) |
| 9. Vegetation (Check the method or describe "Other") | x Native Grass<br>Irrigated Turf Grass<br>Other: |

Notes:

# Table of Contents

```
 **********************************************************************
 **********************************************************************
 *                                                                    *
 *                                                                    *
 *                    MODIFIED RATIONAL METHOD                        *
 *          ---- Grand Summary For All Storm Frequencies ----         *
 *                                                                    *
 *                                                                    *
 **********************************************************************
 **********************************************************************


     Q = CiA * Units Conversion;  Where Conversion = 43560 / (12 * 3600)


                  Area = 9.570 acres                   Tc = .1500 hrs
::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                                                              VOLUMES
Freq.  Adjusted  Duration     I        Qpeak   Allowable|  Inflow    Storage
years    'C'       hrs      in/hr       cfs       cfs   |  ac-ft      ac-ft
--------------------------------------------------------|---------------------
    100  .860     .3833    5.0000     41.49     22.50   |    1.315       .628
      5  .760     .4833    2.4800     18.19      8.40   |     .727       .401
```

```
Type.... Vol: Planimeter
Name.... WQ 1

File.... C:\Steve files\drgdata\09\LYSCWQ1.PPW

                        POND VOLUME CALCULATIONS

                    Planimeter scale:   20.00 ft/in

 Elevation   Planimeter   Area   A1+A2+sqr(A1*A2)  Volume     Volume Sum
   (ft)       (sq.in)    (acres)      (acres)      (ac-ft)      (ac-ft)
----------------------------------------------------------------------
  5883.40        .000     .0000        .0000         .000         .000
  5886.50       1.000     .0092        .0092         .009         .009
  5887.00      20.403     .1874        .2380         .040         .049
  5888.00      25.340     .2327        .6288         .210         .259
  5889.00      28.453     .2613        .7405         .247         .506
  5890.00      31.460     .2889        .8249         .275         .781
  5891.00      34.490     .3167        .9081         .303        1.083
  5892.00      37.843     .3475        .9960         .332        1.415
  5893.00      41.255     .3788       1.0892         .363        1.778

                        POND VOLUME EQUATIONS

  * Incremental volume computed by the Conic Method for Reservoir Volumes.

    Volume = (1/3) * (EL2-EL1) * (Area1 + Area2 + sq.rt.(Area1*Area2))

    where: EL1, EL2     = Lower and upper elevations of the increment
           Area1,Area2  = Areas computed for EL1, EL2, respectively
           Volume       = Incremental volume between EL1 and EL2
```

```
                 ***** COMPOSITE OUTFLOW SUMMARY ****

 WS Elev, Total Q                          Notes
 ---------------- -------- Converge -------------------------
  Elev.      Q      TW Elev  Error
   ft       cfs       ft     +/-ft   Contributing Structures
 --------  -------  --------  -----  --------------------------
5883.40       .00   Free Outfall      (no Q: oj,oi,oh,og,of,oe,od,oc,ob,oa,IB,ok,cu)
5883.90       .00   Free Outfall      (no Q: oj,oi,oh,og,of,oe,od,oc,ob,oa,IB,ok,cu)
5884.40       .00   Free Outfall      (no Q: oj,oi,oh,og,of,oe,od,oc,ob,oa,IB,ok,cu)
5884.90       .00   Free Outfall      (no Q: oj,oi,oh,og,of,oe,od,oc,ob,oa,IB,ok,cu)
5885.40       .00   Free Outfall      (no Q: oj,oi,oh,og,of,oe,od,oc,ob,oa,IB,ok,cu)
5885.90       .00   Free Outfall      (no Q: oj,oi,oh,og,of,oe,od,oc,ob,oa,IB,ok,cu)
5886.23       .01   Free Outfall    oa,cu  (no Q: oj,oi,oh,og,of,oe,od,oc,ob,IB,ok)
5886.40       .01   Free Outfall    ob,oa,cu  (no Q: oj,oi,oh,og,of,oe,od,oc,IB,ok)
5886.56       .01   Free Outfall    ob,oa,cu  (no Q: oj,oi,oh,og,of,oe,od,oc,IB,ok)
5886.90       .02   Free Outfall    oc,ob,oa,cu  (no Q: oj,oi,oh,og,of,oe,od,IB,ok)
5887.23       .04   Free Outfall    od,oc,ob,oa,cu  (no Q: oj,oi,oh,og,of,oe,IB,ok)
5887.40       .04   Free Outfall    oe,od,oc,ob,oa,cu  (no Q: oj,oi,oh,og,of,IB,ok)
5887.56       .05   Free Outfall    oe,od,oc,ob,oa,cu  (no Q: oj,oi,oh,og,of,IB,ok)
5887.90       .06   Free Outfall    of,oe,od,oc,ob,oa,cu  (no Q: oj,oi,oh,og,IB,ok)
5888.23       .08   Free Outfall    og,of,oe,od,oc,ob,oa,cu  (no Q: oj,oi,oh,IB,ok)
5888.40       .09   Free Outfall    oh,og,of,oe,od,oc,ob,oa,cu  (no Q: oj,oi,IB,ok)
5888.56       .10   Free Outfall    oh,og,of,oe,od,oc,ob,oa,cu  (no Q: oj,oi,IB,ok)
5888.90       .11   Free Outfall    oi,oh,og,of,oe,od,oc,ob,oa,cu  (no Q: oj,IB,ok)
5889.23       .13   Free Outfall    oj,oi,oh,og,of,oe,od,oc,ob,oa,cu  (no Q: IB,ok)
5889.40       .14   Free Outfall    oj,oi,oh,og,of,oe,od,oc,ob,oa,ok,cu  (no Q: IB)
5889.90     17.67   Free Outfall    oj,oi,oh,og,of,oe,od,oc,ob,oa,IB,ok,cu
5890.40     22.07   Free Outfall    IB,cu  (no Q: oj,oi,oh,og,of,oe,od,oc,ob,oa,ok)
5890.90     22.94   Free Outfall    IB,cu  (no Q: oj,oi,oh,og,of,oe,od,oc,ob,oa,ok)
5891.40     23.79   Free Outfall    IB,cu  (no Q: oj,oi,oh,og,of,oe,od,oc,ob,oa,ok)
5891.90     24.60   Free Outfall    IB,cu  (no Q: oj,oi,oh,og,of,oe,od,oc,ob,oa,ok)
5892.40     25.38   Free Outfall    IB,cu  (no Q: oj,oi,oh,og,of,oe,od,oc,ob,oa,ok)
5892.90     26.14   Free Outfall    IB,cu  (no Q: oj,oi,oh,og,of,oe,od,oc,ob,oa,ok)
5893.00     26.29   Free Outfall    IB,cu  (no Q: oj,oi,oh,og,of,oe,od,oc,ob,oa,ok)
```

```
Type.... Pond Routing Sumr                                    e 4.01
Name.... WQ 1          OUT   Tag: 5yr                     Ev    : 5 yr
File.... C:\Steve files\drgdata\09\LYSCWQ1.PPW
Storm... csnew 5yr    Tag: 5yr

                    LEVEL POOL ROUTING SUMMARY

 HYG Dir            = C:\Steve files\drgdata\09\
 Inflow  HYG file = work_pad.hyg - WQ 1          IN  5yr
 Outflow HYG file = work_pad.hyg - WQ 1          OUT 5yr

 Pond Node   Data = WQ 1
 Pond Volume Data = WQ 1
 Pond Outlet Data = Outlet 1

 No Infiltration

 INITIAL CONDITIONS
 ----------------------------------
 Starting WS Elev   =  5883.40 ft
 Starting Volume    =     .000 ac-ft
 Starting Outflow   =      .00 cfs
 Starting Infiltr.  =      .00 cfs
 Starting Total Qout=      .00 cfs
 Time Increment     =    .0500 hrs


 INFLOW/OUTFLOW HYDROGRAPH SUMMARY
 =======================================================
 Peak Inflow        =     18.19 cfs    at     .1500 hrs
 Peak Outflow       =      6.82 cfs    at     .6000 hrs   ← 5yr Qout
 -------------------------------------------------------
 Peak Elevation     =   5889.59 ft
 Peak Storage =            .665 ac-ft
 =======================================================


 MASS BALANCE (ac-ft)
 ---------------------------
+ Initial Vol   =        .000
+ HYG Vol IN    =        .727
- Infiltration  =        .000
- HYG Vol OUT   =        .676
- Retained Vol  =        .048
                   ----------
 Unrouted Vol =        -.002 ac-ft  (.311% of Inflow Volume)
```

```
Type.... Pond Routing Sumr                                  e 4.02
Name.... WQ 1         OUT   Tag: 100yr                   Even   100 yr
File.... C:\Steve files\drgdata\09\LYSCWQ1.PPW
Storm... csnew 100yr   Tag: 100yr

                   LEVEL POOL ROUTING SUMMARY

 HYG Dir           = C:\Steve files\drgdata\09\
 Inflow  HYG file = work_pad.hyg - WQ 1         IN  100yr
 Outflow HYG file = work_pad.hyg - WQ 1         OUT 100yr

 Pond Node    Data = WQ 1
 Pond Volume Data = WQ 1
 Pond Outlet Data = Outlet 1

 No Infiltration

 INITIAL CONDITIONS
 ----------------------------------
 Starting WS Elev   =  5883.40 ft
 Starting Volume    =     .000 ac-ft
 Starting Outflow   =      .00 cfs
 Starting Infiltr.  =      .00 cfs
 Starting Total Qout=      .00 cfs
 Time Increment     =    .0500 hrs


 INFLOW/OUTFLOW HYDROGRAPH SUMMARY
 ======================================================
 Peak Inflow        =     41.49 cfs    at     .1500 hrs
 Peak Outflow       =     22.32 cfs    at     .4500 hrs   100yr Qout
 ------------------------------------------------------
 Peak Elevation     =  5890.54 ft
 Peak Storage =           .940 ac-ft
 ======================================================


 MASS BALANCE (ac-ft)
 --------------------------
+ Initial Vol   =        .000
+ HYG Vol IN    =       1.315
- Infiltration =        .000
- HYG Vol OUT   =       1.264
- Retained Vol =        .048
                  ----------
 Unrouted Vol =       -.002 ac-ft  (.173% of Inflow Volume)
```

```
Type.... Mod. Rational Gr                                      Page 5.01
Name.... SUM PT 1           Tag: 5yr                         Event: 5 yr
File.... C:\Steve files\drgdata\09\LYSCWQ1.PPW
Storm... csnew 5yr   Tag: 5yr

                         MODIFIED RATIONAL METHOD
          ---- Graphical Summary for Maximum Required Storage ----
                                  Method T

     Q = CiA * Units Conversion;  Where Conversion = 43560 / (12 * 3600)

   **********************************************************************
   *  RETURN FREQUENCY: 5 yr      |  Allowable Outflow: 8.40 cfs        *
   *  'C' Adjustment: 1.000       |  Required Storage: .401 ac-ft       *
   *--------------------------------------------------------------------*
   *  Peak Inflow: 18.19 cfs                                            *
   * .HYG File:   5yr                                                   *
   **********************************************************************


Q |               Td = .4833 hrs                   |  Return Freq: 5 yr
  /------- Approx. Duration for Max. Storage ------/  C adj.factor:1.000
  |                                                |
  |                                                |
  |                Tc= .1500 hrs                   |
  |                I = 4.3000 in/hr                |  Area = 9.570 acres
  |              . Q = 31.54 cfs                   |  Weighted C = .760
  |              .|.                               |  Adjusted C = .760
  |             . | .                              |
  |            .  |  .            Required Storage |
  |           .       .       .-- .401 ac-ft       |  Td= .4833 hrs
  |          .    |    .      |                    |  I = 2.4800 in/hr
  |         .    x x x x x x x|x x x x x x x x x x x  Q = 18.19 cfs
  |        .                  |
  |       .    x                                      x
  |      .                o o o o o o o o o o o o o o o o   Q = 8.40 cfs
  |     .   x          o  |.                            |x  (Allow.Outflow)
  |    .           o      | .                           |
  |   .  x    o           |  .       NOT TO SCALE       |   x
  | .    o                |   .      ============       |
  | o                     |    .                        |      x
  `-----------------------|-----------------------------|-------------
                      .2600 hrs                     .5641 hrs       T
```

```
Type.... Mod. Rational Gr                                  e 5.02
Name.... SUM PT 1          Tag: 100yr                     Even    100 yr
File.... C:\Steve files\drgdata\09\LYSCWQ1.PPW
Storm... csnew 100yr   Tag: 100yr

                         MODIFIED RATIONAL METHOD
          ---- Graphical Summary for Maximum Required Storage ----
                                  Method T

     Q = CiA * Units Conversion;  Where Conversion = 43560 / (12 * 3600)

   **********************************************************************
   *  RETURN FREQUENCY: 100 yr    |  Allowable Outflow: 22.50 cfs       *
   *  'C' Adjustment: 1.132       |  Required Storage: .628 ac-ft       *
   *--------------------------------------------------------------------*
   *  Peak Inflow: 41.49 cfs                                            *
   *  .HYG File:   100yr                                                *
   **********************************************************************


Q |               Td = .3833 hrs                   |  Return Freq: 100 yr
  /------- Approx. Duration for Max. Storage ------/  C adj.factor:1.132
  |                                                |
  |                                                |
  |                Tc= .1500 hrs                   |
  |                I = 7.6500 in/hr                |  Area = 9.570 acres
  |              . Q = 63.49 cfs                   |  Weighted C = .760
  |             .|.                                |  Adjusted C = .860
  |            . | .                               |
  |           .  |  .          - Required Storage  |
  |          .       .        .-- .628 ac-ft       |  Td= .3833 hrs
  |         .    |    .       |                    |  I = 5.0000 in/hr
  |        .     x x x x x x x|x x x x x x x x x x x  Q = 41.49 cfs
  |       .                   |
  |      .     x                                      x
  |     .                 o o o o o o o o o o o o o o o o   Q = 22.50 cfs
  |    .   x          o   |.                            |x  (Allow.Outflow)
  |   .           o       | .                           |
  |  .  x     o           |  .       NOT TO SCALE       |   x
  | .   o                 |   .      ============       |
  | o                     |    .                        |      x
  `-----------------------|-----------------------------|------------
                      .2468 hrs                     .4520 hrs       T
```

JOB 09009 LYSC-South MDDP Update

SHEET NO. ______ OF ______

CALCULATED BY SGB DATE Sept '09

CHECKED BY ______ DATE ______

SCALE ______

## Drainage Calculations - WQ-2 (Summary Pt 2)

1) Determine developed flow in

Area = 3.2 acres (Sub W-4 & W-5)

$C_5 = (0.12)(0.3) + (0.88)(0.74) = 0.69$

$C_{100} = (0.12)(0.45) + (0.88)(0.82) = 0.78$

$T_c = 9 min$ (Sub W-4) $i_5 = 4.3$ in/hr $i_{100} = 7.65$ in/hr

$Q_5 = (0.69)(4.3)(3.2) = \underline{\underline{9.5 \text{ cfs}}}$

$Q_{100} = (0.78)(7.65)(3.2) = \underline{\underline{19.1 \text{ cfs}}}$

2) Determine historic flow

Area = 3.2 acres $L = 310$ $h = 20\pm$ $S_{avg} = 6.45\%$

$C_5 = 0.3$ } same as Subbasin W-5
$C_{100} = 0.45$ }

$T_c = 1.87(1.1 - 0.30)(310)^{0.5}(6.45)^{-0.33} = 14.2$ Use 14 min

$\therefore i_5 = 3.55$ in/hr $i_{100} = 6.3$ in/hr

$Q_5 = (0.3)(3.55)(3.2) = 3.4$ cfs } Pond outflow
$Q_{100} = (0.45)(6.3)(3.2) = 9.1$ cfs } to be limited to these amounts

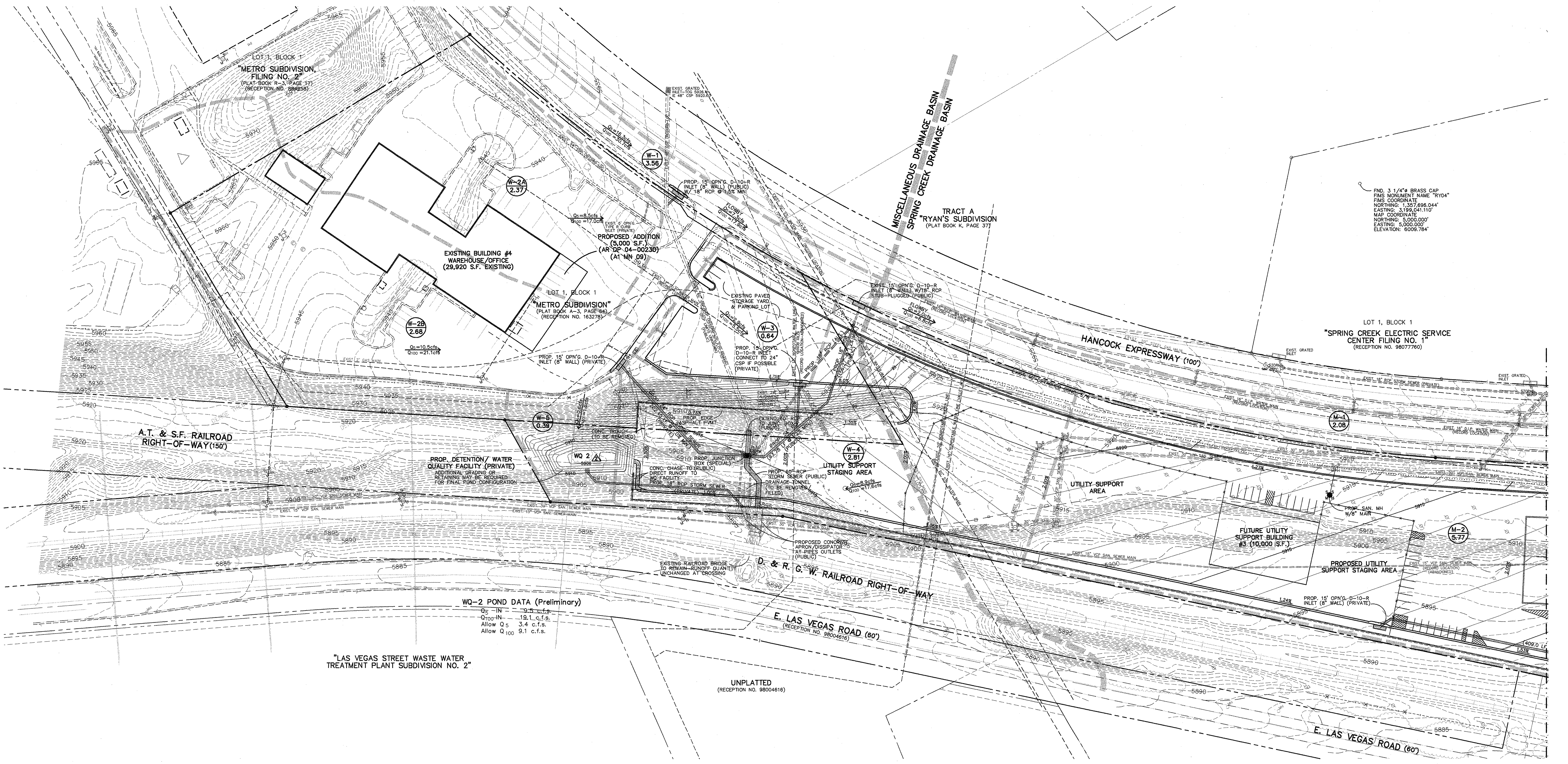
```
  ***********************************************************************
  ***********************************************************************
  *                                                                     *
  *                                                                     *
  *                       MODIFIED RATIONAL METHOD                      *
  *          ---- Grand Summary For All Storm Frequencies ----          *
  *                                                                     *
  *                                                                     *
  ***********************************************************************
  ***********************************************************************


      Q = CiA * Units Conversion;  Where Conversion = 43560 / (12 * 3600)

                  Area = 3.200 acres                    Tc = .1500 hrs
::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                                                               VOLUMES
Freq.  Adjusted  Duration    I        Qpeak   Allowable|  Inflow     Storage
years    'C'       hrs     in/hr       cfs        cfs  |   ac-ft       ac-ft
-------------------------------------------------------|--------------------
    100  .780     .2500    6.1500     15.48      9.10  |     .320       .138
      5  .690     .3833    2.8200      6.28      3.40  |     .199       .095
```

```
Type.... Vol: Planimeter
Name.... WQ 2

File.... C:\Steve files\drgdata\09\09009\LYSCWQ2.PPW

                        POND VOLUME CALCULATIONS

                    Planimeter scale:   50.00 ft/in

 Elevation    Planimeter    Area   A1+A2+sqr(A1*A2)  Volume     Volume Sum
   (ft)        (sq.in)    (acres)      (acres)      (ac-ft)      (ac-ft)
-----------------------------------------------------------------------
  5905.90        .000      .0000        .0000         .000         .000
  5906.00        .283      .0163        .0163         .001         .001
  5907.00        .530      .0304        .0689         .023         .024
  5908.00        .733      .0421        .1083         .036         .060
  5909.00       1.013      .0582        .1497         .050         .110
  5910.00       1.310      .0752        .1995         .066         .176


                        POND VOLUME EQUATIONS

  * Incremental volume computed by the Conic Method for Reservoir Volumes.

    Volume = (1/3) * (EL2-EL1) * (Area1 + Area2 + sq.rt.(Area1*Area2))

    where: EL1, EL2     = Lower and upper elevations of the increment
           Area1,Area2  = Areas computed for EL1, EL2, respectively
           Volume       = Incremental volume between EL1 and EL2
```

```
                         MODIFIED RATIONAL METHOD
          ---- Graphical Summary for Maximum Required Storage ----
                                  Method T

     Q = CiA * Units Conversion;  Where Conversion = 43560 / (12 * 3600)

   **********************************************************************
   *  RETURN FREQUENCY: 5 yr      |  Allowable Outflow: 3.40 cfs        *
   *  'C' Adjustment: 1.000       |  Required Storage: .095 ac-ft       *
   *--------------------------------------------------------------------*
   *  Peak Inflow: 6.28 cfs                                             *
   * .HYG File:   5yr                                                   *
   **********************************************************************


Q |               Td = .3833 hrs                   |  Return Freq: 5 yr
  /------- Approx. Duration for Max. Storage ------/  C adj.factor:1.000
  |                                                |
  |                                                |
  |                Tc= .1500 hrs                   |
  |                I = 4.3000 in/hr                |  Area = 3.200 acres
  |              . Q = 9.57 cfs                    |  Weighted C = .690
  |             .|.                                |  Adjusted C = .690
  |            . | .                               |
  |           .  |  .             Required Storage |
  |          .       .        .-- .095 ac-ft       |  Td= .3833 hrs
  |         .    |  .         |                    |  I = 2.8200 in/hr
  |        .     x x x x x x x|x x x x x x x x x x x  Q = 6.28 cfs
  |       .                   |
  |      .    x                                       x
  |     .                 o o o o o o o o o o o o o o o o   Q = 3.40 cfs
  |    .   x          o   |.                            |x  (Allow.Outflow)
  |   .           o       | .                           |
  |  .  x    o            |  .       NOT TO SCALE       |   x
  | .   o                 |   .      ============       |
  | o                     |    .                        |      x
  `-----------------------|-----------------------------|------------
                      .2467 hrs                     .4521 hrs       T
```

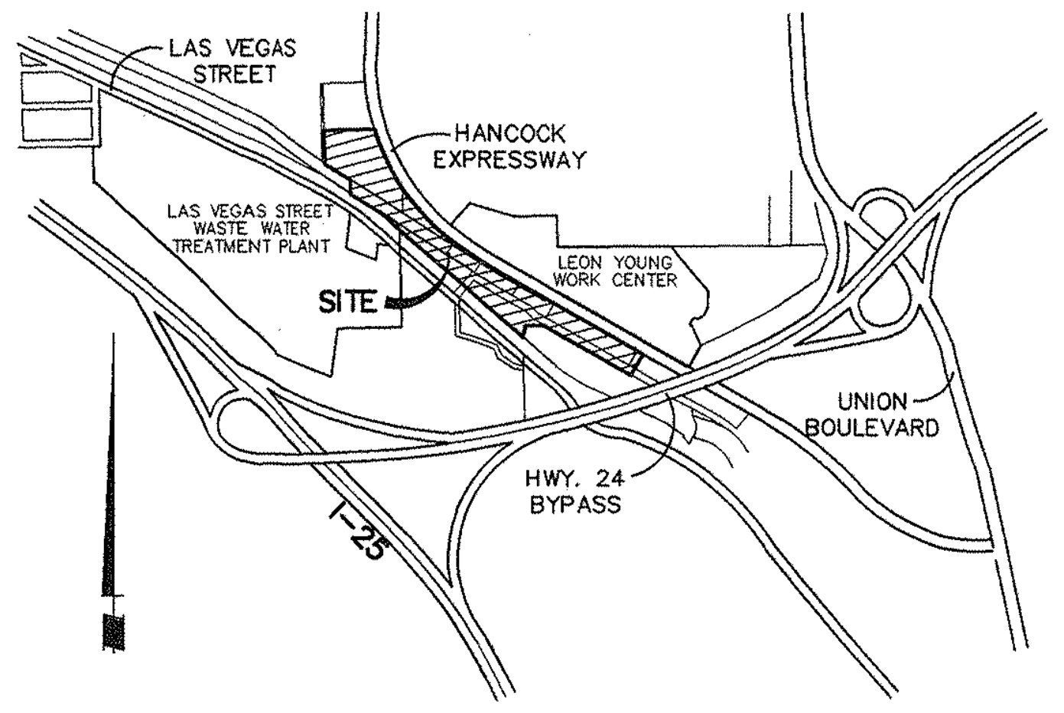
```
                         MODIFIED RATIONAL METHOD
          ---- Graphical Summary for Maximum Required Storage ----
                                  Method T

     Q = CiA * Units Conversion;  Where Conversion = 43560 / (12 * 3600)

   **********************************************************************
   *  RETURN FREQUENCY: 100 yr     |  Allowable Outflow: 9.10 cfs        *
   *  'C' Adjustment: 1.130        |  Required Storage: .138 ac-ft       *
   *--------------------------------------------------------------------*
   *  Peak Inflow: 15.48 cfs                                             *
   * .HYG File:   100yr                                                  *
   **********************************************************************


Q |               Td = .2500 hrs                   |  Return Freq: 100 yr
  /------- Approx. Duration for Max. Storage ------/  C adj.factor:1.130
  |                                                |
  |                                                |
  |                Tc= .1500 hrs                   |
  |                I = 7.6500 in/hr                |  Area = 3.200 acres
  |              . Q = 19.25 cfs                   |  Weighted C = .690
  |             .|.                                |  Adjusted C = .780
  |            . | .                               |
  |           .  |  .             Required Storage |
  |          .       .        .-- .138 ac-ft       |  Td= .2500 hrs
  |         .    |    .       |                    |  I = 6.1500 in/hr
  |        .     x x x x x x x|x x x x x x x x x x x  Q = 15.48 cfs
  |       .                   |
  |      .    x                                       x
  |     .                 o o o o o o o o o o o o o o o o   Q = 9.10 cfs
  |    .   x          o   |.                            |x  (Allow.Outflow)
  |   .           o       | .                           |
  |  .  x    o            |  .       NOT TO SCALE       |   x
  | .   o                 |   .      ============       |
  | o                     |    .                        |      x
  `-----------------------|-----------------------------|------------
                      .2291 hrs                     .3118 hrs       T
```

## Index of Starting Page Numbers for ID Names



0 25 50 100

SCALE IN FEET: 1" = 50'



VICINITY MAP
N.T.S.

## LEGEND

| | |
|---|---|
| W-5 0.39 | SUBBASIN DESIGNATION AREA (ACRES) |
| Q5=0.6cfs Q100=1.6cfs | FLOW DIRECTION/QUANTITY |
| 2 | SUMMARY PT. |
| ▨ | SUBBASIN BOUNDARY |
| ▨ | DRAINAGE BASIN BOUNDARY |
| 6470 | EXISTING INDEX CONTOURS (5' INTERVAL) |
| | EXISTING INTERMEDIATE CONTOURS (1' INTERVAL) |
| 70 | PROPOSED INDEX CONTOURS (5' INTERVAL) |
| | PROPOSED INTERMEDIATE CONTOURS (1' INTERVAL) |
| | EXISTING STORM SEWER FACILITIES |
| | PROPOSED STORM SEWER FACILITIES |
| | PROPOSED RETAINING WALLS |

| NO. | DATE | REVISION | BY |
|---|---|---|---|
| 1 | 12/11/09 | REVISE PER COMMENTS-RESUBMIT | TLW |

SHEET TITLE:
**MDDP DRAINAGE PLAN UPDATE**

PROJECT:
**LEON YOUNG SERVICE CENTER SOUTH, FILIING NO. 1**

PREPARED BY:
Obering, Wurth & Associates
Consulting Civil Engineers
Professional Land Surveyors
1042 Elkton Drive
Colorado Springs, Colorado
Phone (719) 531-6200 - Fax (719) 531-6266
E-mail Address: owacivil1@mindspring.com

FIELD BOOK NO. N/A
SCALE: 1" = 50'
DATE: SEPT. 28, 2009
DESIGNED BY: TLW
CHECKED BY: TLW/RGO
DRAWN BY: TLW
PROJECT NO. 09009
SHEET NO. **DR1**
OF 2 SHEETS

PROJECT NAME: LEON YOUNG SERVICE CENTER SOUTH FILING NO. 1 - DEVELOPMENT PLAN
DRAWN BY: OBERING, WURTH & ASSOCIATES (TLW)
ACAD DWG. NAME: D:\09009\909BSFDRX.DWG
PROJECT NO: 09009 UPDATED VERSION: 12-11-2009

## WQ-1 POND DATA

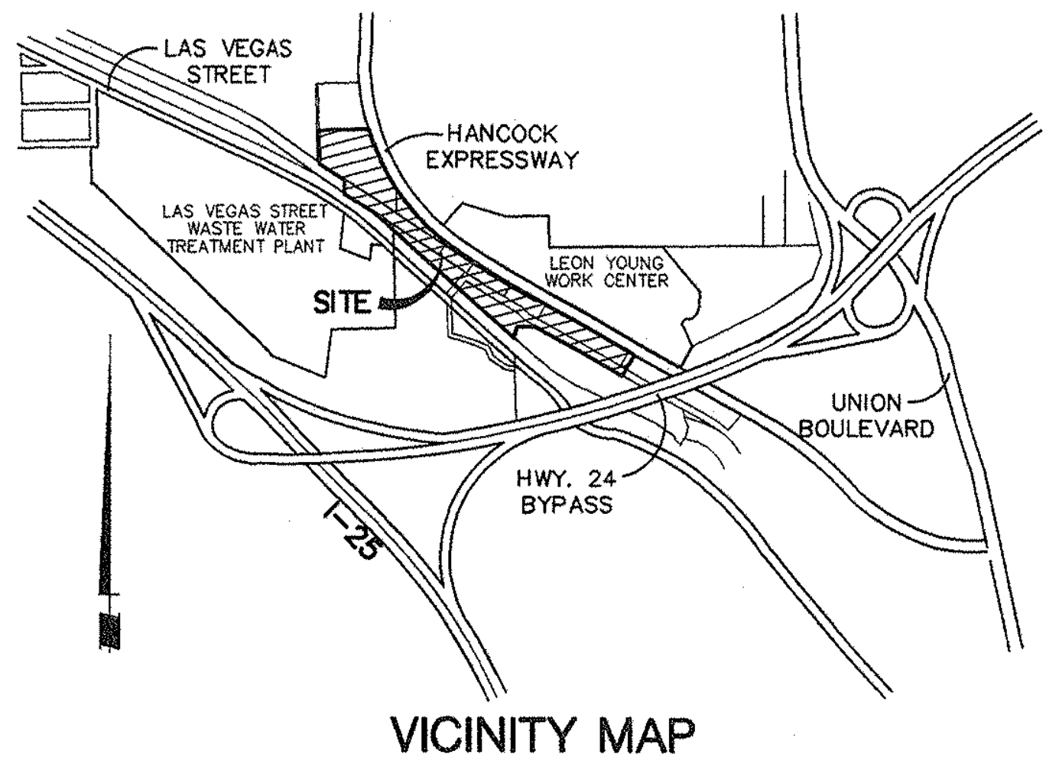
| ITEM | 5yr. Storm | 100Yr. Storm |
|---|---|---|
| Peak Inflow | 31.1 cfs | 63.0 cfs |
| Peak Outflow | 6.8 cfs | 22.3 cfs |
| Max. Pond Depth | 6.2 ft. | 7.1 ft. |
| Peak Storage | 0.67 ac-ft. | 0.94 ac-ft |
| Freeboard to Spillway | 2.4 ft. | 1.5 ft. |

0 25 50 100

SCALE IN FEET: 1" = 50'

## LEGEND

| | |
|---|---|
| W-5 0.39 | SUBBASIN DESIGNATION AREA (ACRES) |
| ← $Q_5$=0.6cfs $Q_{100}$=1.6cfs | FLOW DIRECTION/QUANTITY |
| △2 | SUMMARY PT. |
| ▨ ▨ ▨ | SUBBASIN BOUNDARY |
| ▨ ▨ ▨ | DRAINAGE BASIN BOUNDARY |
| 6470 | EXISTING INDEX CONTOURS (5' INTERVAL) |
| — | EXISTING INTERMEDIATE CONTOURS (1' INTERVAL) |
| 70 | PROPOSED INDEX CONTOURS (5' INTERVAL) |
| — | PROPOSED INTERMEDIATE CONTOURS (1' INTERVAL) |
| ═□ | EXISTING STORM SEWER FACILITIES |
| ═■ | PROPOSED STORM SEWER FACILITIES |
| ═ | PROPOSED RETAINING WALLS |



VICINITY MAP
N.T.S.

PROJECT NAME: LEON YOUNG SERVICE CENTER SOUTH FILING NO. 1 – DEVELOPMENT PLAN
DRAWN BY: OBERING, WURTH & ASSOCIATES (TLW)
ACAD DWG. NAME: D:\09009\909BSFDRX.DWG
PROJECT NO: 09009 UPDATED VERSION: 12-11-2009

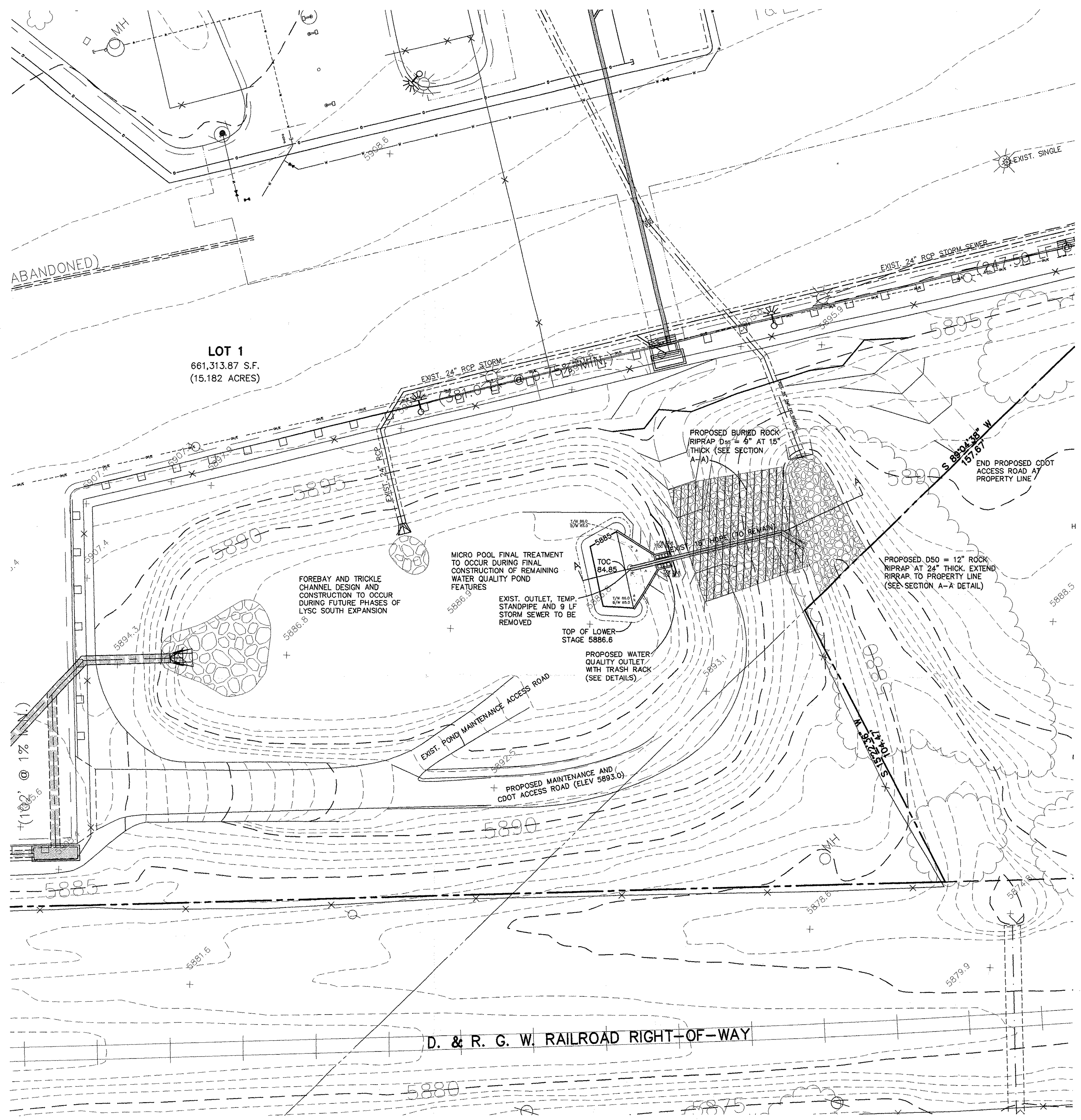
| NO. | DATE | REVISION | BY |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| 1 | 12/11/09 | REVISE PER COMMENTS–RESUBMIT | TLW |

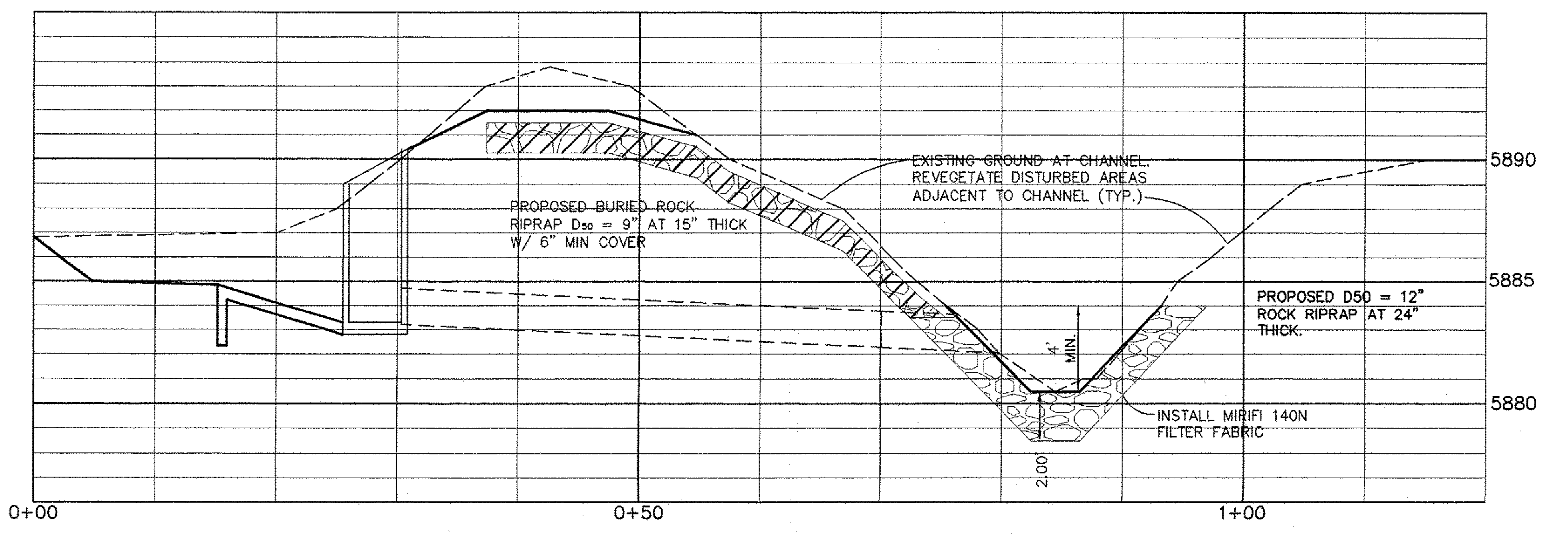
SHEET TITLE:
# MDDP DRAINAGE PLAN UPDATE

PROJECT:
## LEON YOUNG SERVICE CENTER SOUTH, FILIING NO. 1

PREPARED BY:
**Obering, Wurth & Associates**
Consulting Civil Engineers
Professional Land Surveyors
1042 Elkton Drive
Colorado Springs, Colorado
Phone (719) 531–6200 – Fax (719) 531–6266
E–mail Address: owacivil1@mindspring.com

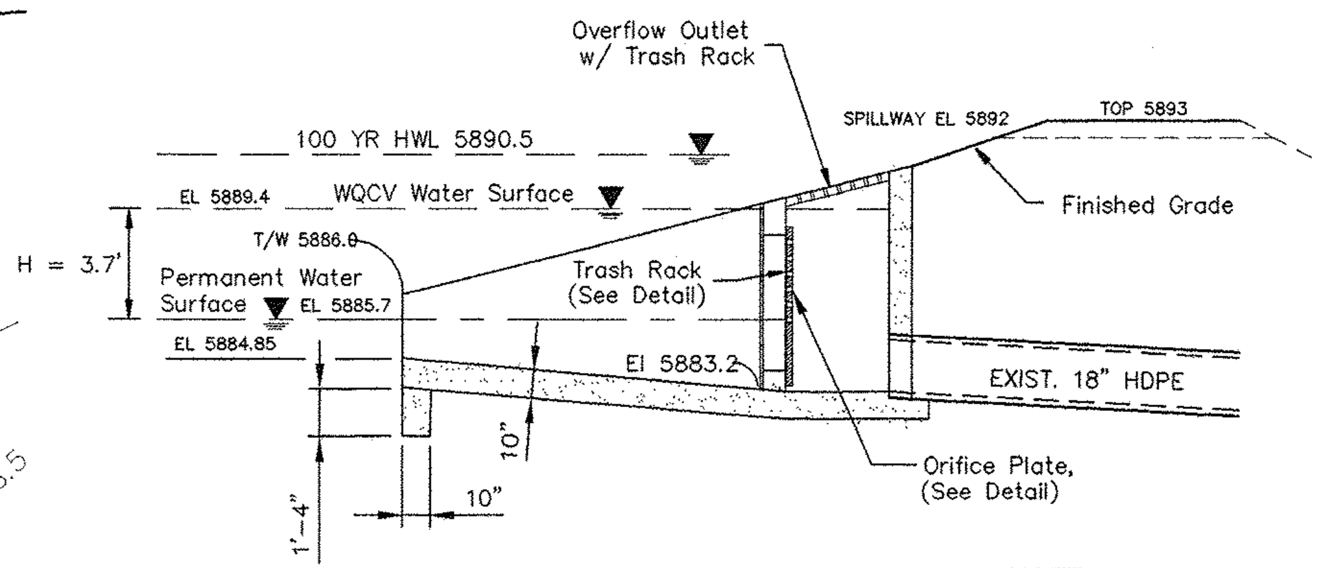
FIELD BOOK NO. N/A
SCALE: 1" = 50'
DATE: SEPT. 28, 2009
DESIGNED BY: TLW
CHECKED BY: TLW/RGO
DRAWN BY: TLW
PROJECT NO. 09009
SHEET NO. DR2
OF 2 SHEETS





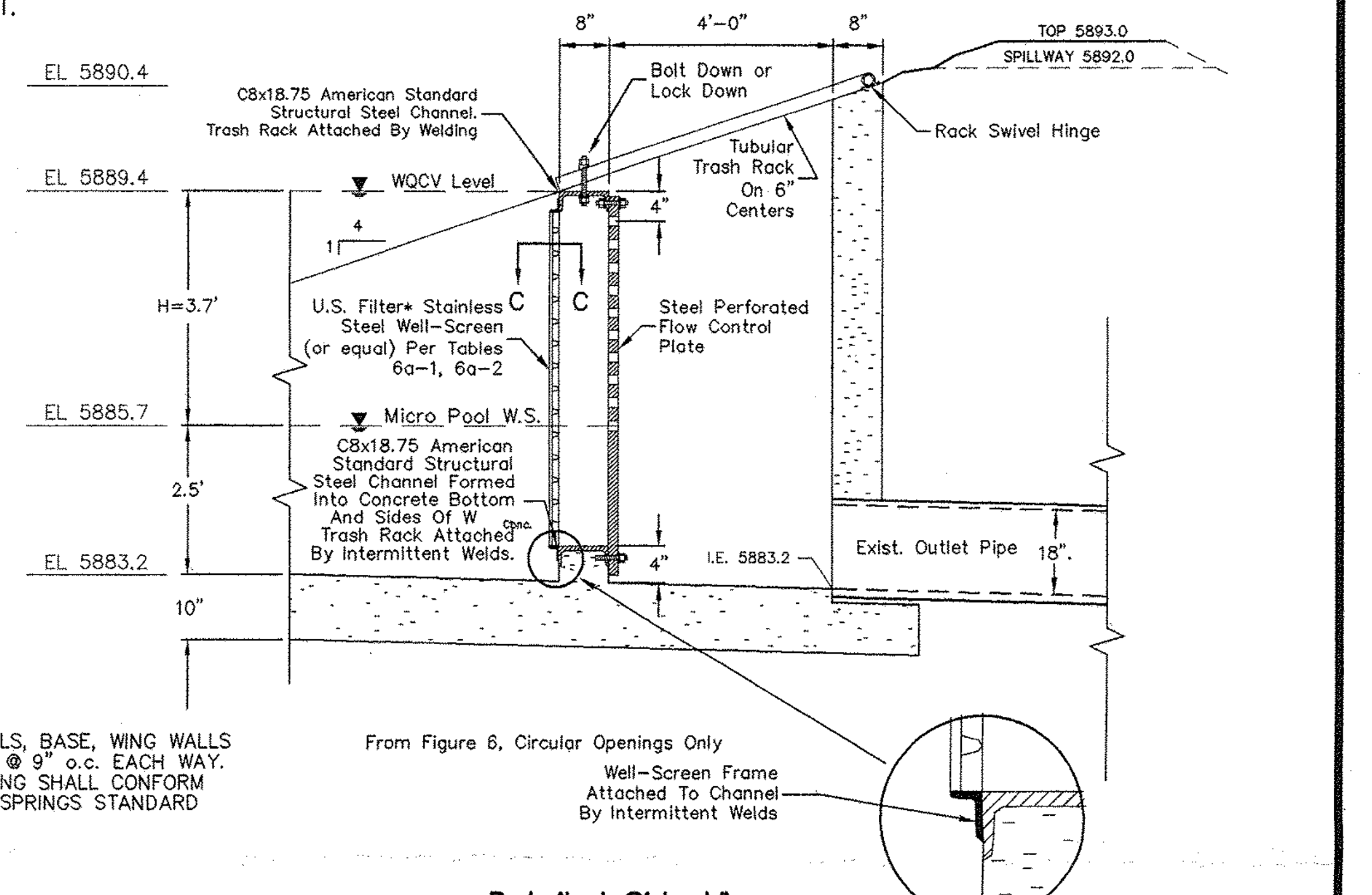
## SECTION A–A
## RIPRAP OUTFALL CHANNEL CONNECTION

SCALE 1" = 10' HORIZ.
SCALE 1" = 5' VERT.



Side View

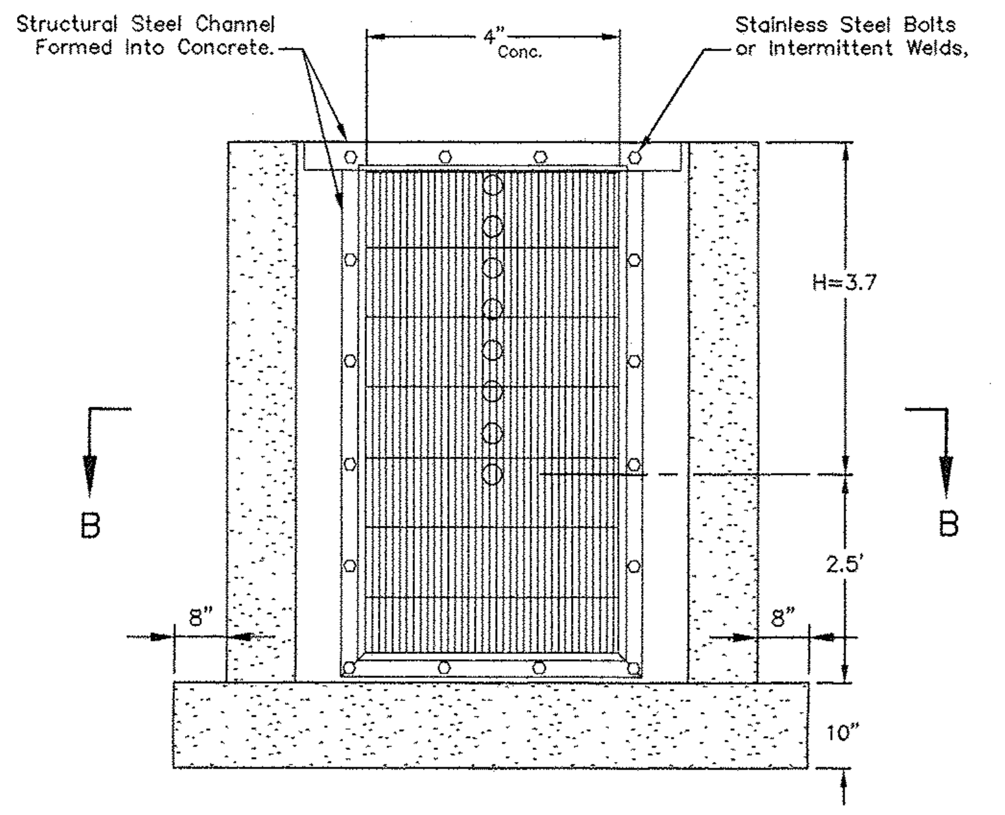
NOTE:
OUTLET REINFORCING FOR WALLS, BASE, WING WALLS AND APRON TO BE #4 REBAR @ 9" o.c. EACH WAY. ALL CONCRETE AND REINFORCING SHALL CONFORM WITH THE CITY OF COLORADO SPRINGS STANDARD SPECIFICATIONS.



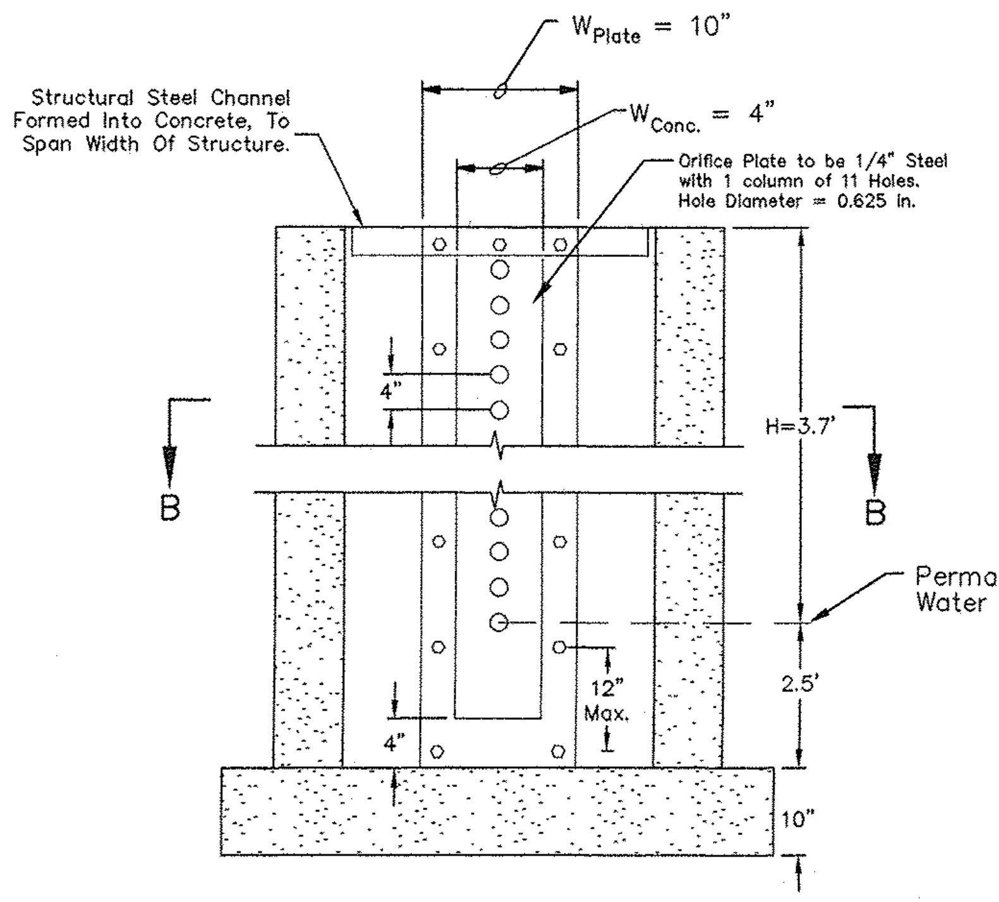
Detailed Side View

## WATER QUALITY OUTLET

NOT TO SCALE



Elevation
NOT TO SCALE



## ORIFICE PERFORATION DETAIL

NOT TO SCALE

WQCV Trash Racks:

1. Well–screen trash racks shall be stainless steel and shall be attached by intermittent welds along the edge of the mounting frame.
2. Bar grate trash racks shall be aluminum and shall be bolted using stainless steel hardware.
3. Trash Rack widths are for specified trash rack material. Finer well–screen or mesh size than specified is acceptable, however, trash rack dimensions need to be adjusted for materials having a different open area/gross area ratio (R value)
4. Structural design of trash rack shall be based on full hydrostatic head with zero head downstream of the rack.

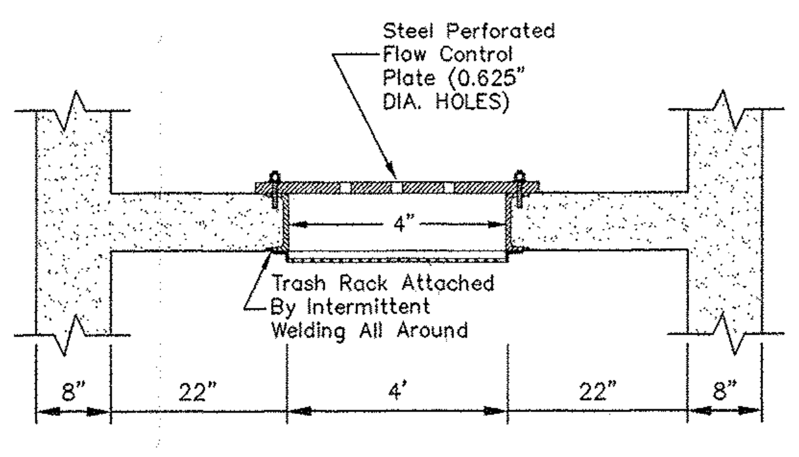
Overflow Trash Racks:

1. All trash racks shall be mounted using stainless steel hardware and provided with hinged and lockable or boltable access panels.
2. Trash racks shall be stainless steel, aluminum, or steel. Steel trash racks shall be hot dip galvanized and may be hot powder painted after galvanizing.
3. Trash Racks shall be designed such that the diagonal dimension of each opening is smaller than the diameter of the outlet pipe.
4. Structural design of trash rack shall be based on full hydrostatic head with zero head downstream of the rack.

## OUTLET TRASH RACK DETAIL

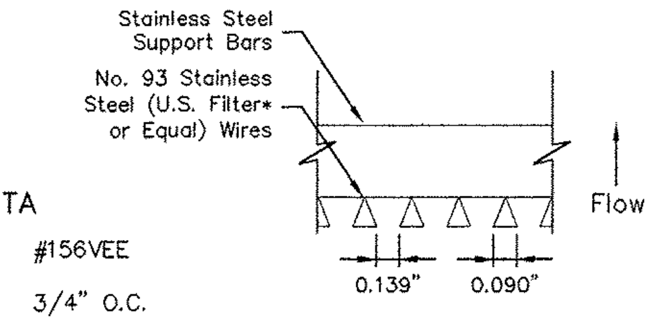
NOT TO SCALE

Steve & Roland: These Outlet
Details Are Acceptable
To City Engineering.
thank You
SB Kubo 8/5/09



Section B–B – Top View

| TRASH RACK DATA | |
|---|---|
| SUPPORT ROD | #156VEE |
| SUPPORT ROD SPACING | 3/4" O.C. |
| TOTAL SCREEN THICKNESS | 0.31' |
| CARBON STEEL FRAME TYPE | |



Section C–C

1. All outlet plate openings are circular.

*U.S. Filter, St. Paul, Minnesota, USA

R Value = (net open area)/(gross rack area)
= 0.60

## TRASH RACK

NOT TO SCALE

ISSUE FOR
CONSTRUCTION
8/6/09

| NO. | DATE | REVISION | BY |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

SHEET TITLE:
OUTLET & OUTLET DETAILS
WATER QUALITY DETENTION POND

PROJECT:
(LYSC SOUTH)
LEON YOUNG SERVICE CENTER
COLORADO SPRINGS, COLORADO

PREPARED BY:
Obering, Wurth & Associates
Consulting Civil Engineers
Professional Land Surveyors
1042 Elkton Drive
Colorado Springs, Colorado
Phone (719) 531-6200
EMAIL: owacivil1@mindspring.com

FIELD BOOK NO. N/A
SCALE: 1" = 20'
DATE: 06/02/09
DESIGNED BY:
CHECKED BY: SGB
DRAWN BY: VPT
PROJECT NO. 09007
SHEET NO. 1
OF 1 SHEETS

18785-1

D:\09\09007 LYSC POND\907pond.dwg Thu Jul 30 11:05:57 2009 VPT
PROJECT NAME: LYSC POND MODIFICATIONS