

LIBERTY TREE ACADEMY
FINAL DRAINAGE REPORT

Prepared for:

Liberty Tree Academy
8579 Eastonville Road
Peyton, CO 80831

Prepared by:

Matrix Design Group, Inc.
1601 Blake Street, Suite 200
Denver, CO 80202

Project Number: 18.995.001

Submitted:

August 8, 2018

PPR-18-023



Engineer's 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/County 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.

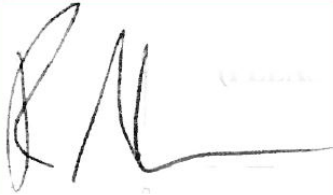


Andrew Beck, PE
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Developers Statement:

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



Ronnie Wilson, Vice President
Liberty Tree Academy Building Corporation
PO Box 64614
Colorado Springs, CO 80962

EL PASO COUNTY ONLY:

Filed in accordance with Section 51.1 of the El Paso Land Development Code, as amended

Director of Public Works

Date

Conditions:

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I. GENERAL LOCATION AND DESCRIPTION

A. Location

The proposed Liberty Tree Academy is within Township 12S, and Range 64W, Section 32, SW Quarter, of El Paso County, Colorado as shown in **Figure 1**. The approximate latitude and longitude are 38°57'35"N and 104°35'11". The lot is situated along the east side of Eastonville Road from Tex Tan Road to Snaffle Bit Road. The project area is located east, south, and north of residential parcels. Unplatted agricultural land exists to the east of the site. The project is situated in Woodmen Hills Filing No. 10 (Plat Number 10942). To the north is Woodmen Hills Filing No. 11 (Plat Number 11258). The current El Paso Assessor map is provided in **Appendix F**.

The project is located within the Bennett Ranch (CHWS1200) drainage basin. The project drains to the southeast to the Bennett Ranch drainageway.

B. Description of Property

The overall 12-acre lot consists of the 4.15 acre project area (school and detention), undeveloped land, and a 240-ft wide drainage easement. This Final Drainage Report only considers the 3.6-acre area disturbed by construction and 2.2-acre project site. The rest of the lot (except for the drainage easement) will be developed by future projects.

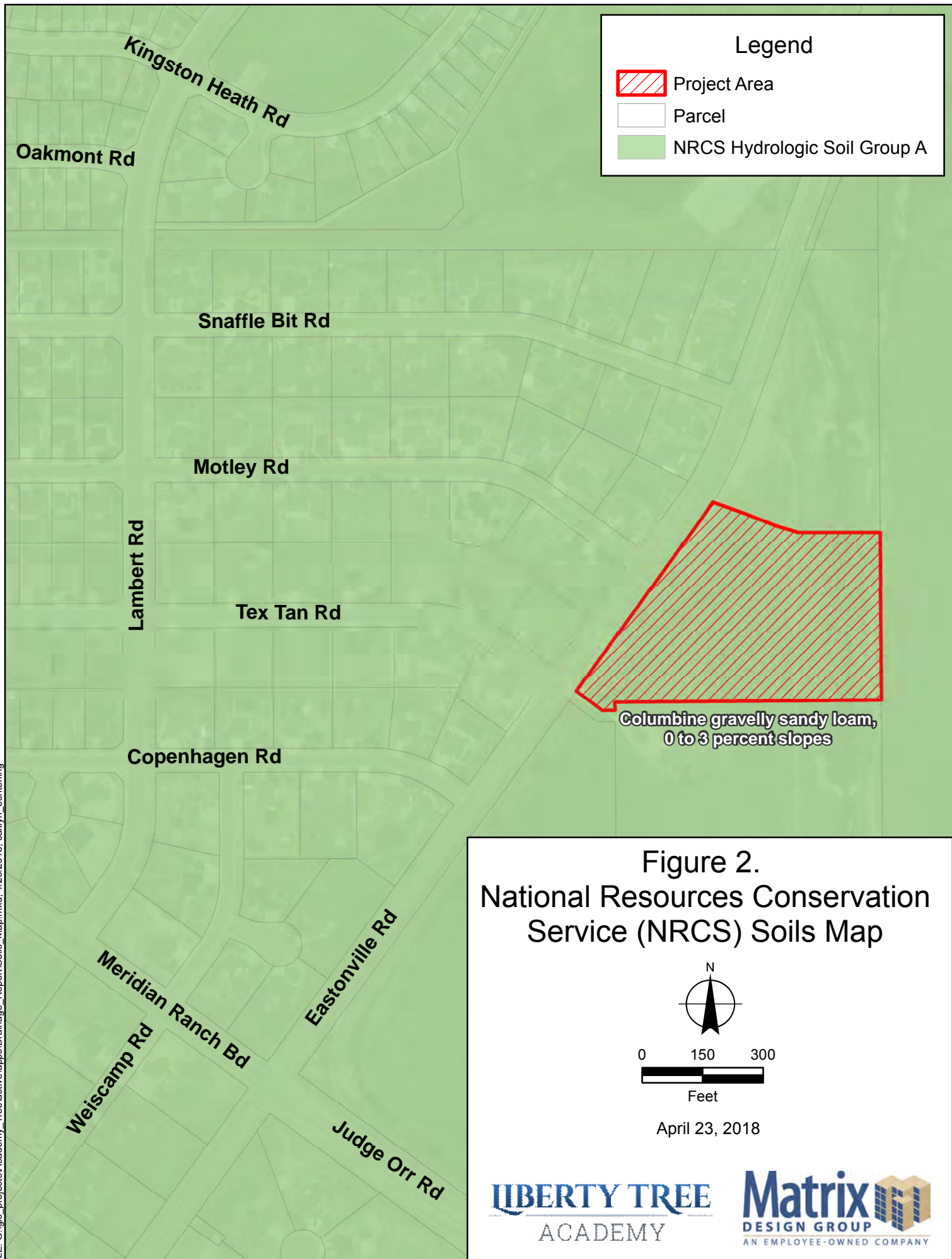
The ground cover currently consists of native grasses, including Blue Grama with a few dispersed alders and other plant species consistent with pasture land in the Colorado Semi-arid plains environment. Willows line the drainageway on the east side of the site. Photos of existing site vegetation are included in **Appendix A**.

Slopes across the property typically range from 1-5%, with some local slopes around small mounds up to 20%. The slope from the access road to the drainageway is approximately 8:1. According to National Resources Conservation Service (NRCS) soil datasets, the predominant soil type is Columbine gravelly sandy loam, 0 to 3 percent slopes. This soil type is generally consistent with a Type A hydrologic soil group (HSG). NRCS soil data was obtained from the Soil Survey Geographic (SSURGO) Database for Arapahoe County, Colorado. The spatial dataset was last updated September 23, 2016 (version 7) and the tabular dataset was last updated October 10, 2017 (version 14). The soils map and a breakdown of HSG group by basin is provided in **Figure 2**.

The site includes a 240-ft wide drainage easement along the eastern boundary associated with Bennett Ranch drainageway, which flows from north to south along the property boundary. The boundary of the drainage easement is marked by an existing access road, which overlays a parallel water line. Existing sewer, gas, fiber optic, underground electric, underground telephone, water, and storm utilities are located within the Eastonville Road right-of-way. General locations of existing utilities are presented in **Figure B-1**. No irrigation facilities exist onsite.



FILE: G:\gis_projects\Academy_Tree\active\apps\Drainage_Report\Soils_Map.mxd, 4/23/2018, caitlyn_echterling



II. DRAINAGE BASINS AND SUB-BASINS

A. Major Basin Descriptions

The project falls between Design Points (DP) D and C in the *Bennett Ranch Drainage Basin Planning Study (DBPS)* (El Paso County 2001). Between these design points, surface runoff flows to the southeast and the drainageway flows from north to south. The selected plan in the DBPS proposes a 50 acre-ft detention pond upstream of the project area at DP D and 9,500 linear-ft of new channel at 0.25% with thirteen 3-ft drop structures between Eastonville Road (DP D) and Drake Pond (between DP C and B). Based on the 2016 aerial, it appears that these proposed improvements are constructed. Selected pages from the DBPS are provided in **Appendix E**.

A Flood Insurance Study exists for El Paso County, Colorado and Incorporated Areas (FEMA 1999). The property is not located within a FEMA defined Floodplain, as identified on Flood Insurance Rate Map, Unincorporated El Paso County Community Panel Number 080059 0575 F, Effective March 17, 1997 (see **Appendix E**). The FIRM was revised in the vicinity of the project by Letter of Map Revision (LOMR) Case Number 12-08-0659P, on July 12, 2013. This LOMR extended the floodplain upstream, however, the project is located outside of this boundary.

B. Sub-basin Description

The overall proposed and historic drainage basins for the project area are coincident and both drain to Design Point 4. Existing topography routes surface flows southeast across the lot to the drainage easement access road. East of the access road, an approximately 8:1 embankment slopes to the east to the invert of the Bennett Ranch drainageway. The lot encompasses both banks of the drainageway within the 240-ft wide drainage easement.

The proposed project area is contained within Basin A with some grading to match the existing surface within Basins OS1 and OS2. Basin OS1 will be replanted consistent with existing ground cover until a future project by others develop this land. Under interim conditions, this off-site basin will drain to the proposed extended detention basin (Design Point 3). Basin OS2 will also be replanted consistent with existing ground cover and will be maintained as a drainage easement.

C. Conveyance of Offsite Runoff

Offsite runoff from basin OS-1 will sheet flow into a proposed Extended Detention Basin (EDB). The extended detention basin is designed to accommodate this extra undeveloped area; should this area develop in the future, the extended detention basin will have to be redesigned to accommodate the increased impervious area. Basin OS-2 will remain undeveloped and will continue to drain east to Bennett Ranch Drainageway.

A normal depth flow analysis was performed to ensure the existing off-site Bennett Ranch Drainageway could sufficiently pass 100-year peak offsite runoff without resulting in adverse site impacts. A detailed description of this analysis can be found in Section IV.C.3. 100-yr offsite runoff in the channel is lower than the emergency overflow weir elevation of the onsite extended detention basin.

III. DRAINAGE DESIGN CRITERIA

A. Development Criteria Reference

1. Design Criteria

This report is prepared in accordance with the following criterion:

- Chapter Six, Section 6.3.2 – Drainage and Section 6.3.5 - Grading and Erosion Control of the El Paso County Land Development Code.
- El Paso County Drainage Criteria Manual Volume 1 and Volume 1 Update (DCM-V1, DCM-V1-Update)
- El Paso County Drainage Criteria Manual Volume 2 (DCM-V2)
- Engineering Criteria Manual for El Paso County

In addition, Urban Drainage Flood Control District (UDFCD) criteria manuals and spreadsheet tools were used to guide design assumptions. El Paso County adopts the use of UDFCD UD-Rational and UD-Detention within the listed references above.

2. Previous Drainage Studies

There are several existing drainage reports and studies used in the development of this report. They are:

- El Paso County. 2001. Bennett Ranch Pilot Project Drainage Basin Planning Study. El Paso County. November 2001.
- Federal Emergency Management Agency (FEMA). 1999. Flood Insurance Study El Paso County, Colorado and Unincorporated Areas. Revised August 23, 1999.
- Federal Emergency Management Agency (FEMA). 1997. Flood Insurance Rate Map Number 08041C0575 F. El Paso County, Colorado and Unincorporated Areas. Effective August 17, 1997.
- Federal Emergency Management Agency (FEMA). 2013. Letter of Map Revision Case No. 12-08-0659P, Flood Insurance Rate Map Number 08041C0575 F. El Paso County, Colorado and Unincorporated Areas. Effective July 12, 2013.

The site is not within a FEMA regulatory floodplain (See **Appendix E**). The Bennet Ranch Pilot Project Drainage Basin Planning Study (Bennet Ranch DBPS) outlines the improvements to the adjacent drainage channel and upstream detention basin. Anticipated runoff in the adjacent channel during the 100-yr event may cause backwater events into the proposed extended detention basin, but will be below the crest elevation of the emergency overflow weir (see Section IV.C.4).

The site will utilize an extended detention basin and will therefore not cause significant increases in runoff rates due to development which would negatively impact downstream properties (see Section IV.C.2).

B. Hydrologic Criteria

Based on Figures 6-6 through 6-17 of the DCM-V1, the NOAA Atlas 2 rainfall depths presented in Table 6-2 of the DCM-V1 Update applies. The basin size is less than 2 square-miles; therefore, Depth Area Reduction Factors are not required. The one-hour rainfall depths used in this analysis are presented in **Table 3**.

Table 1 – One-Hour Rainfall Depths

| D ₂ (in) | D ₅ (in) | D ₁₀ (in) | D ₂₅ (in) | D ₅₀ (in) | D ₁₀₀ (in) |
|------------------------|------------------------|-------------------------|-------------------------|-------------------------|--------------------------|
| 1.19 | 1.50 | 1.75 | 2.00 | 2.25 | 2.52 |

The rational method was used to calculate the runoff, as outlined in Section 6.2 of the UDFCD Volume 1, with the exception of the impervious values, runoff coefficients, and intensities, which were taken from the DMC-V1-Update. For street and gutter capacity, the minor design storm was the 5-yr event. The major design storm is the 100-yr event.

Composite percent imperviousness, assuming Type A soils (see **Figure 2**), for each historic and proposed basin were determined using the land use categories in Table 6-6 of the DCM-V1-Update. These values are presented in **Table 4** and **Appendix C**. Percent imperviousness was calculated for Basin A as 74%, which is associated with the proposed school building, parking lots, drives, sidewalks, and playground. Basin OS2 consists of the drainage easement which will remain pasture/ lawn but is part of the grading extents of this project. The associated percent imperviousness is 0%. Basin OS1 consists of off-site land that drain to the proposed extended detention basin. This basin is included in the grading extents of this project but will be restored to natural conditions with an associated imperviousness of 0%. Should Basin OS-1 be developed in the future, the total runoff and detention volumes will need to be reevaluated.

Table 2 – Percent Imperviousness from Table 6-6 of DCM-V1-Update

| Land Use or Surface Characteristic | Percent Imperviousness |
|------------------------------------|------------------------|
| Pasture/ Meadow, Lawn | 0 |
| Playground | 13 |
| Paved, Drive and Walks, Detention | 100 |
| Roofs | 90 |

Water quality and stormwater detention will be provided by the onsite extended detention basin. Total detention volumes and discharges were determined using UDFCD's UD-Detention_v3.07 (See Section IV).

IV. DRAINAGE FACILITY DESIGN

A. General Concept

Generally, existing site flows are to the southeast. East of the access road, there is a surface break and the site slopes approximately 8:1 towards the offsite drainageway. This section of the property is not included in planned development in order to maintain existing drainage patterns and avoid changes to the drainage easement. A residential property is situated on the southern edge of the site. Under proposed conditions, the site will be sloped away from this property to prevent any adverse impacts.

All runoff from the developed area will be routed to the proposed extended detention basin (EDB) in northeast corner of the project area. The extended detention basin will maintain historic outflow to the existing Bennet Ranch Drainageway.

B. BMP Selection Process

Per section I.7.2 of El Paso ECM, a four-step process is used to select structural BMPs for the site. Discussion of these four steps and decision matrix is found below.

1. Employ Runoff Reduction Practices

Opportunities to minimize directly connected impervious areas were limited for this site; Most of the disturbed site is utilized for the building footprint or parking area. Vegetation is provided by landscape islands and around the building, although this was not considered as a formal water quality measure for our calculations. All runoff from the site is routed to an extended detention basin.

2. Stabilize Drainageways

All channelized runoff on the site is conveyed via curb and gutter to a curb cut at a riprap rundown to the extended detention basin, and energy is dissipated in a concrete forebay. A trickle channel conveys channelized runoff within the extended detention basin to its outlet. The extended detention basin outfalls to Bennet Ranch Drainageway, which was previously stabilized with drop structures, in accordance with the Bennet Ranch DBPS (See Section II.A and **Appendix E**).

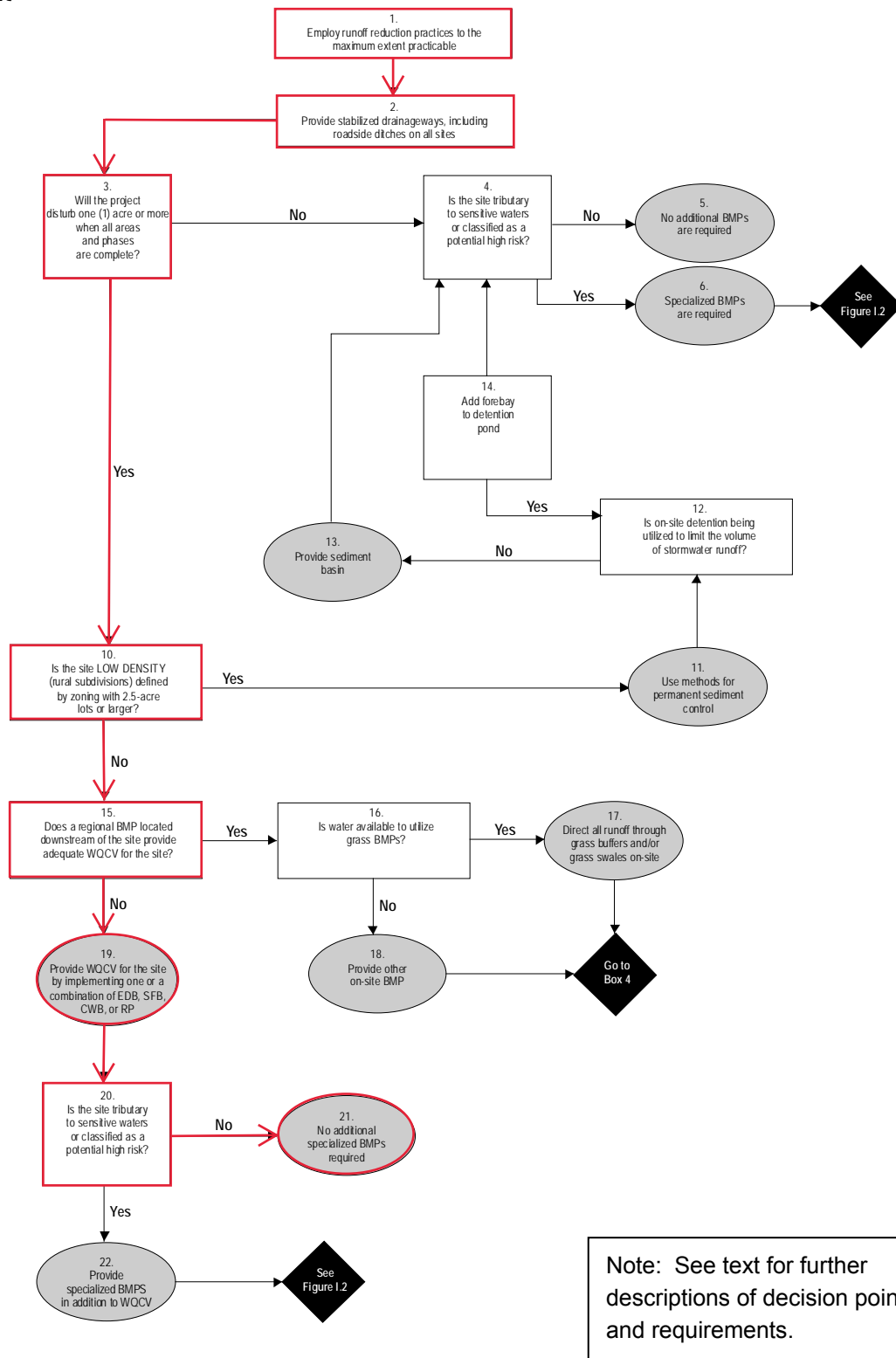
3. Provide WQCV

Water Quality Capture Volume (WQCV) is provided within the Excess Urban Runoff Volume (EURV) in the onsite extended detention basin. See **Appendix D** for extended detention basin design.

4. Consider Need for Industrial and Commercial BMPs

The proposed use for this site, a school, does not warrant Covering of Storage/Handling Areas or Spill Containment and Control.

Figure I-1. BMP Requirements Flowchart for New Development and Redevelopment Sites - For Selecting Post-Construction BMPs in Compliance with El Paso County's Stormwater NPDES Permit



C. Specific Details

1. Proposed Runoff Patterns and Quantities

The proposed grading will preserve historic flow paths away from Eastonville Road towards the drainageway. Along the western boundary of the project area, the site will be graded towards the school to prevent site flows from running off onto the adjacent property, and a cross pan and high point in the driveway will keep offsite runoff in Eastonville Road from entering the project.

Basin A contains all developed area proposed within the site. Curb and gutter systems will capture and convey runoff from the fire lane and parking lot to the detention pond. A separate piped system will convey roof runoff to the detention pond. Basin OS-1 will remain vegetated and will drain via sheet flow to the proposed extended detention basin.

All regraded areas within OS2 will be revegetated. This basin will continue to sheet flow directly to Bennet Ranch Drainageway.

Historic and proposed runoff values are presented in **Tables 3** and **4**, respectively.

Table 3 – Pre-developed Hydrology

| Design Point | Drainage Area (ac) | Q ₅ (cfs) | Q ₁₀₀ (cfs) |
|------------------|--------------------|----------------------|------------------------|
| Eastonville Road | 0.46 | 1.81 | 3.23 |
| 4 (Basin HA) | 6.20 | 1.15 | 8.48 |

Notes:

1. See Appendix C for detailed hydrology calculations.

Table 4 – Post-developed Hydrology

| Design Point | Drainage Area (ac) | Q ₅ (cfs) | Q ₁₀₀ (cfs) |
|---------------|--------------------|----------------------|------------------------|
| 1 (Basin A) | 3.0 | 6.79 | 13.36 |
| 2 (Basin OS1) | 1.1 | 0.23 | 1.70 |
| 3 (A+OS1) | 4.1 | 6.38 | 13.98 |
| 4 (Basin OS2) | 2.1 | 0.34 | 2.48 |

Notes:

1. See Appendix C for detailed hydrology calculations.
2. See Appendix D for detailed hydraulics calculations.

2. Extended Detention Basin Design

The extended detention basin will be located at the northeast corner of the site and will intercept all developed runoff from the site and convey attenuated flows to the Bennett Ranch Drainageway. The proposed extended detention basin will preserve historic flow rates to Bennett Ranch Drainageway and provide full spectrum detention (WQCV, EURV and 100-yr detention). Detailed design calculations, outlet configuration, and design drawings for the following section can be found in **Appendix D**.

Volumes and Release Rates

The basin and outlet structure were sized using UD-Detention, version 3.07, in accordance with DCM-V1-Update criteria. The outlet structure utilizes an orifice plate to release the water quality capture volume (WQCV) over 40-hours and the extended urban runoff volume (EURV) in 72-hours. A 2.5' micropool in front of the orifice plate will provide settlement. A drop box and 18-inch pipe with a restrictor plate will attenuate runoff events exceeding the EURV. Outflows will be conveyed under to the existing stabilized channel in Bennett Ranch drainageway. Total detention volumes and release rate summary are provided in the table below:

Table 5 - EDB Volume and Flow Rates Summary

| Design Storm Return Period | EDB Summary | | | | | | | |
|---|-------------|---------|---------|---------|---------|---------|---------|----------|
| | WQCV | EURV | 2 Year | 5 Year | 10 Year | 25 Year | 50 Year | 100 Year |
| Predevelopment Peak Q (UDFCD) (cfs) | 0.0 | 0.0 | 0.002 | 0.015 | 0.034 | 0.074 | 0.56 | 1.38 |
| Predevelopment Peak Q (Rational) (cfs)= | N/A | N/A | 0.229 | 1.15 | 2.52 | 4.81 | 6.49 | 8.48 |
| Developed Peak Inflow Q (cfs) | 0.97 | 3.37 | 2.32 | 3.03 | 3.71 | 4.57 | 5.62 | 6.82 |
| Dev. Peak Outflow Q (UDFCD)(cfs)= | 0.031 | 0.102 | 0.082 | 0.10 | 0.29 | 1.12 | 1.21 | 1.24 |
| Calculated Runoff Volume (acre-ft) | 0.075 | 0.263 | 0.180 | 0.236 | 0.289 | 0.357 | 0.439 | 0.535 |
| Maximum Volume Stored (acre-ft) | 0.068 | 0.243 | 0.165 | 0.217 | 0.257 | 0.283 | 0.330 | 0.400 |
| Maximum Ponding Elevation (ft) | 6946.69 | 6948.12 | 6947.55 | 6947.94 | 6948.21 | 6948.38 | 6948.67 | 6949.08 |

In the 100-yr event, the proposed release rate from the detention basin will be 90% of the existing inflow rate. In the 2-yr through 50-yr events, the predevelopment runoff calculated using UD-Detention workbook was very low (<1 cfs), which is due to the small tributary area. As a result, the workbook calculated developed outflow exceeds the predeveloped inflow for these conditions. Restricting outflow for these conditions any further would cause retention in excess of 72 hours. A more appropriate method for calculating the 2-yr through 50-yr events is the rational method, the results of which are presented the table above. Proposed outflow from the extended detention basin at DP 3 is than the historic runoff at DP 3 as calculated with the rational method. **See Appendix C** for detailed calculations.

Emergency Overflow and Freeboard

The calculated 100-yr WSEL is 6949.08'. Placing the emergency overflow weir crest at this elevation would reduce the cover of the waterline parallel to the access road to less than 5'. In order to maintain 5' of cover over the waterline, it is proposed that the emergency overflow weir elevation be set at 6951.00'. In the condition that the outlet structure became completely clogged, the 100-yr event runoff volume, 0.439 ac-ft, would have a ponded depth of 6949.78'. Total freeboard between the 100-yr WSEL (clogged condition) and weir crest is 1.22'.

The 10-ft wide emergency spillway was sized to convey 100-year undetained flows (14.0 cfs) with 6 inches of flow depth and consists of soil riprap (Type VL riprap) in accordance with Figure 12-21 from UDFCD Volume 2. In the event the emergency overflow weir is activated, some ponding in the parking lot would occur, but would be less than 12".

Other Design Components

Runoff will enter the detention pond via the concrete pans within the parking lot and flow down a riprap rundown to the forebay. The 6" tall pond forebay is sized for 2% of the WQCV, as per DCM-V2. The target release rate (2% of undetained runoff into the EDB) is 0.28 cfs, which can be achieved with a 4.1-inch notch.

The trickle channel will be concrete and 4-inch deep as per DCM-V2. Per criteria, the capacity of the channel is sized to convey the maximum possible forebay outlet capacity, at a minimum. The flat bottom longitudinal slope will be graded at 0.5% per UDFCD Volume 3. The adjacent vegetated areas will slope towards the low flow channel at 3%, as per DCM-V2 and UDFCD Volume 3.

Maintenance access to the pond will be along the existing drainage easement access road via the proposed school fire lane and include ramps with less than 10% slopes to the forebay, pond bottom, and outlet structure. The pond will be maintained by Liberty Tree Academy as part of grounds maintenance via a Stormwater BMP Maintenance Agreement, which can be found in **Appendix F**.

3. Curb and Gutter/ Street Capacity

An 8-ft wide crosspan, in accordance with El Paso's Standard Details, will be constructed at the driveway intersection with Eastonville Road to convey offsite runoff within the road. Flowmaster V8i was used for the capacity calculations for the driveway/cross pan. Onsite curb/gutter capacity was calculated using UD-Inlet_v4.05. All street and curb calculations are provided in **Appendix D**.

4. Offsite Channel Capacity

In order to ensure the existing off-site drainageway can sufficiently pass 100-year peak runoff without resulting in adverse site impacts, a normal depth analysis was conducted using FlowMaster, version 8i. 100-year outflow from the upstream detention pond as described in the DBPS was considered in this analysis (see **Appendix E**). Two typical drainageway cross-sections were cut along the project extents. The longitudinal channel slope was estimated based on available contours and the DBPS Selected Alternative (0.25%).

The resulting typical cross-sections are presented in **Figure 4**. The cross-section points on the west bank are taken from survey. Cross section points from the east bank are calculated based on the typical channel cross section found in the *Bennet Ranch* DBPS (See **Appendix E**). It is assumed that some incision of the channel has occurred since the construction of the stabilized channel, and the toe (the invert of the original channel) is equal to the surveyed elevation 5' west of the surveyed flowline. The Manning's n for the channel sections is taken from Table 8-5 of UDFCD Volume 1, which is summarized in **Table 6**. The resulting water flow depths and freeboard are presented in **Table 7**.

Table 6 – Manning's n

| Location and Cover | Manning's n ¹ |
|--|--------------------------|
| <u>Main Channel (bankfull channel)</u> | |
| Sand or clay bed | 0.04 |
| <u>Vegetated Overbanks</u> | |
| Native Grasses | 0.05 |
| Willow Stands, woody shrubs | 0.16 |

Notes:

1. Manning's n for assessing water surface elevation and water depth

A detailed cross section and corresponding segments for each manning's n used can be found in **Appendix D**. Normal flow depths for the channel are as follows:

Table 7 – Offsite Channel Flow Depth Summary

| Scenario | 100-yr WSEL (feet) | Flow Depth (feet) | Freeboard (feet) |
|-----------------|-----------------------|----------------------|---------------------|
| Cross-section 1 | 6943.90 | 7.14 | 7.10 |
| Cross-section 2 | 6945.87 | 7.87 | 5.13 |

Notes:

1. 100-Year Master Planned Flow = 810 cfs, as per the DBPS for 100-year release rate from the upstream pond, see **Appendix E**.
2. Freeboard is measured from weir crest elevation. = 6951.0

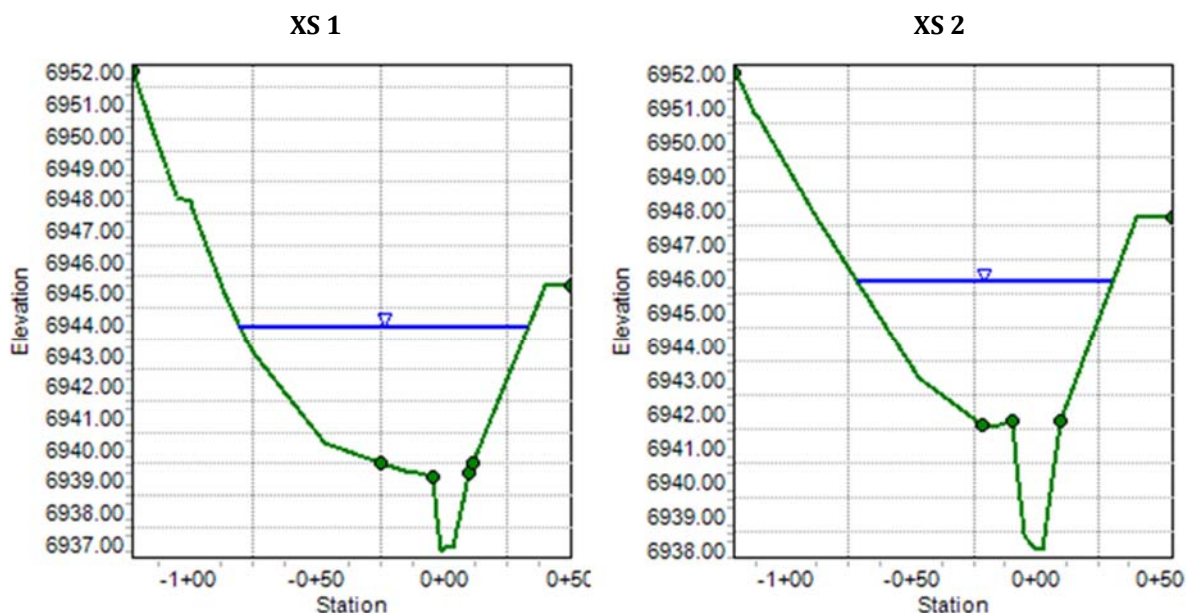


Figure 4 – Offsite Drainageway Capacity Evaluation

Cross sections, looking upstream
Q100=810 cfs (release rate of upstream basin)

There is a significant amount of freeboard between 100-yr channel WSEL and the onsite emergency overflow weir crest. The 100-yr WSEL at Section X2 (6945.87), however, is higher than the invert of the detention basin outlet pipe (6942.00). Because of difference in peak timing, it is not anticipated that this will negatively impact the ability for the EDB to drain in 72 hours or less.

The offsite channel can convey 60 cfs without any backwater effect on the pond (WSEL = invert of outlet pipe = 6942.00'). Backflow would not occur into the pond until offsite flow of 538 cfs (WSEL = Invert of pond = 6945). Calculations can be found in **Appendix D**.

V. DRAINAGE FEES

Drainage fees for the new development are calculated per Addendum "Revised Drainage Basin Fees Basin on Impervious Area for Unincorporated El Paso County Only" of the ECM. From Section 3.8a, cost per impervious acre is \$14,454. The area of the development is contained within Drainage Basin "A" (See **Appendix B** for proposed drainage exhibit). Estimated construction cost of the onsite detention basin is \$65,000. Fee for the impervious area is calculated as:

Impervious Area

3.0 acres at 74.2% x 3.0 acres = 2.26 impervious acres

Gross Fee

2.26 acres x \$14,454/acre of impervious area = \$32,666

Fee After Reduction

$\$32,666 - (\$65,000) / 2 = \$166$

Remove and replace with:

Drainage and Bridge fees were paid with the Woodmen Hills Filing # 10 final plat, therefore no fees are due.

This section
modified per
comment.

VI. REFERENCES

Bentley. 2009. FlowMaster Hydraulic Toolbox, Version 8i. November 4, 2009.

El Paso County. 2016. Engineering Criteria Manual, Revision 6. El Paso County. Adopted 12/23/2004. Revised 12/13/2016.

El Paso County. 1994. City of Colorado Springs Drainage Criteria Manual Volume 1 (DCM 1). Chapters 1 through 5. Prepared by City of Colorado Springs. Adopted by El Paso County. October 1994.

El Paso County. 2014. City of Colorado Springs Drainage Criteria Manual Volume 1 Update (DCM 1). Chapters 6 through 13. Prepared by City of Colorado Springs. Adopted by El Paso County. May 2014.

El Paso County. 2002. City of Colorado Springs Drainage Criteria Manual Volume 2 (DCM 2). Prepared by City of Colorado Springs. Adopted by El Paso County. November 2002.

El Paso County. 2000. El Paso County Land Development Code, Chapter V. El Paso County. Last Updated June 29, 2000.

El Paso County. 2001. Bennett Ranch Pilot Project Drainage Basin Planning Study. El Paso County. November 2001.

Federal Emergency Management Agency (FEMA). 1999. Flood Insurance Study El Paso County, Colorado and Unincorporated Areas. Revised August 23, 1999.

Federal Emergency Management Agency (FEMA). 1997. Flood Insurance Rate Map Number 08041C0575 F. El Paso County, Colorado and Unincorporated Areas. Effective August 17, 1997.

Federal Emergency Management Agency (FEMA). 2013. Letter of Map Revision Case No. 12-08-0659P, Flood Insurance Rate Map Number 08041C0575 F. El Paso County, Colorado and Unincorporated Areas. Effective July 12, 2013.

Urban Drainage and Flood Control District (UDFCD). 2018. Urban Storm Drainage Criteria Manual, Volumes 1 through 3. Urban Drainage and Flood Control District. Last updated April 2018.

Urban Drainage and Flood Control District (UDFCD). 2017a. UD-Detention, Version 3.07. Urban Drainage and Flood Control District. Last updated February 2017.

Urban Drainage and Flood Control District (UDFCD). 2017b. UD-Rational, Version 2.00. Urban Drainage and Flood Control District. Last updated May 2017.

APPENDIX A – SITE PHOTOS



Figure A1. Project area looking east.



Figure A2. Project area looking south east along utility access towards the drainage easement.



Figure A3. Project area looking north along Eastonville Road right-of-way.



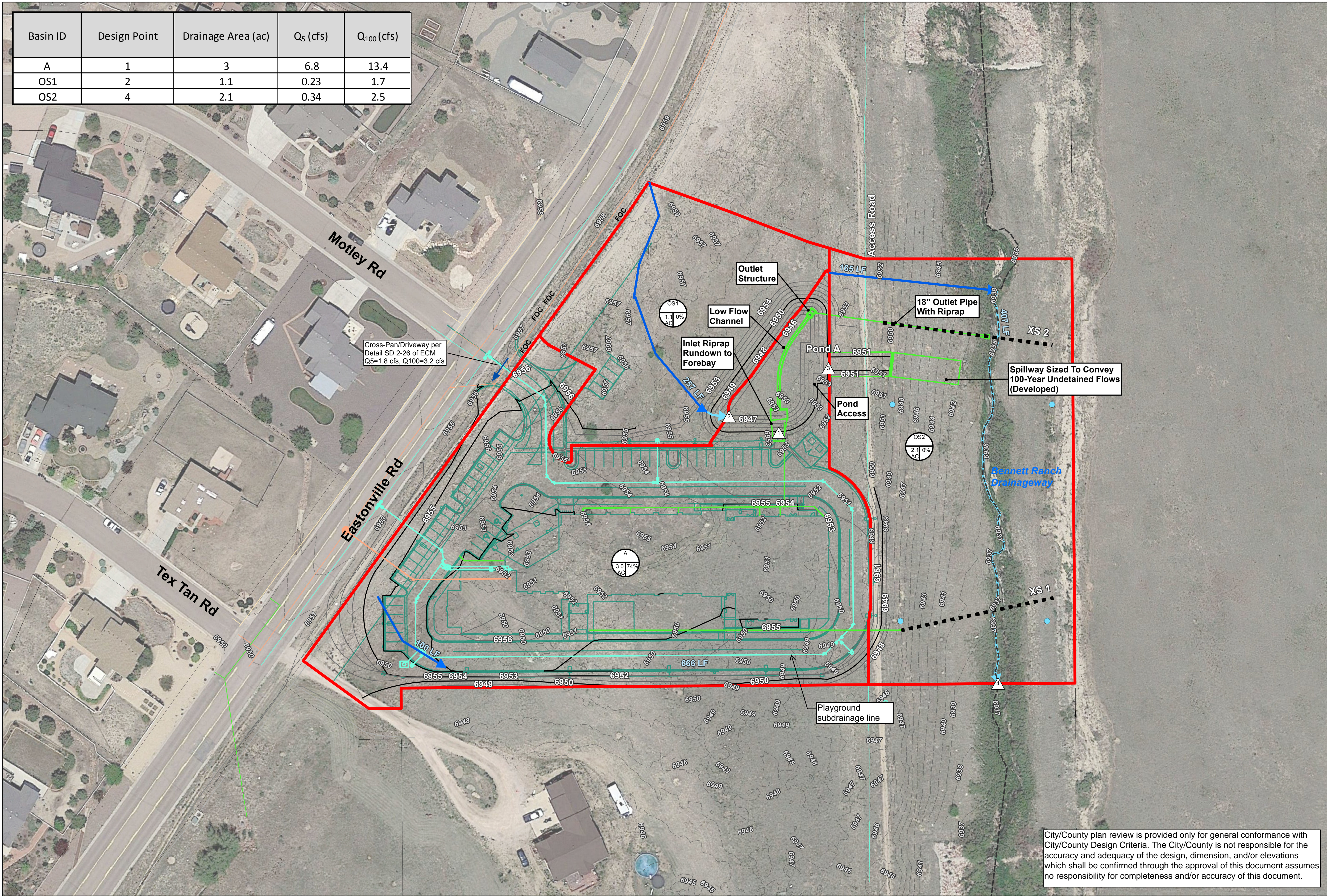
Figure A4. Project area looking south towards adjacent residential property.



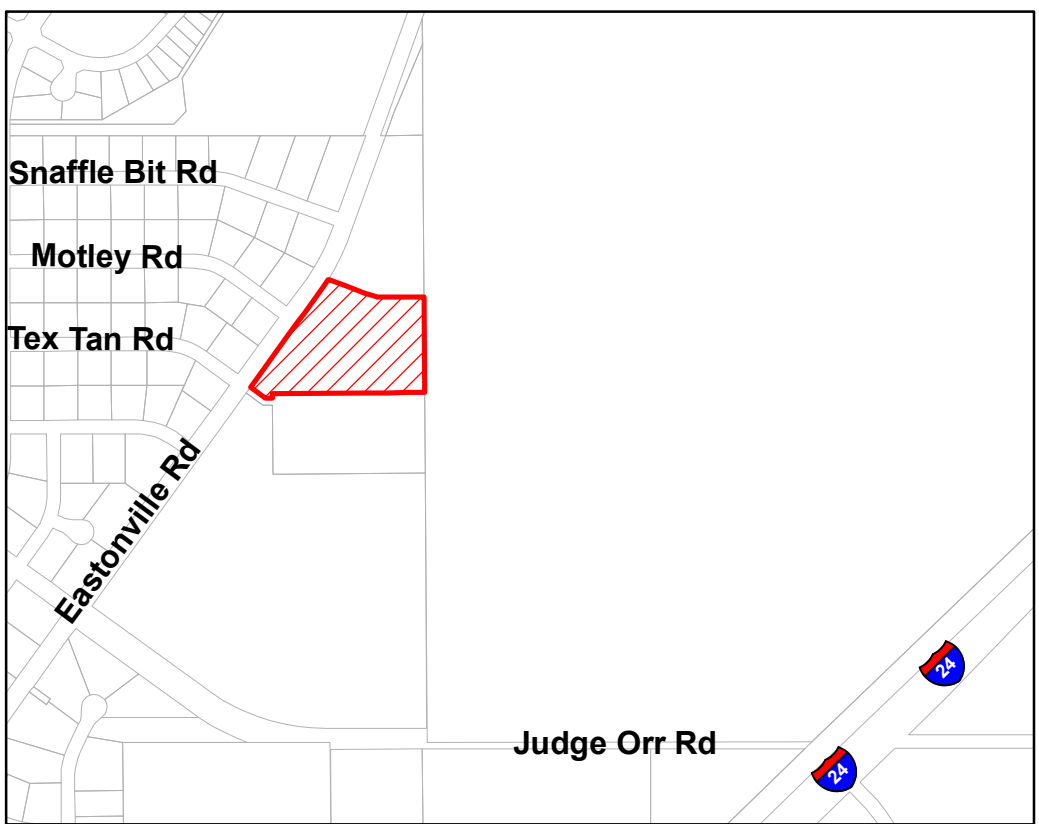
Figure A5. Bennett Ranch drainageway looking upstream (north) along eastern extent of the project area.

APPENDIX B – DRAINAGE PLANS

| Basin ID | Design Point | Drainage Area (ac) | Q ₅ (cfs) | Q ₁₀₀ (cfs) |
|----------|--------------|--------------------|----------------------|------------------------|
| A | 1 | 3 | 6.8 | 13.4 |
| OS1 | 2 | 1.1 | 0.23 | 1.7 |
| OS2 | 4 | 2.1 | 0.34 | 2.5 |



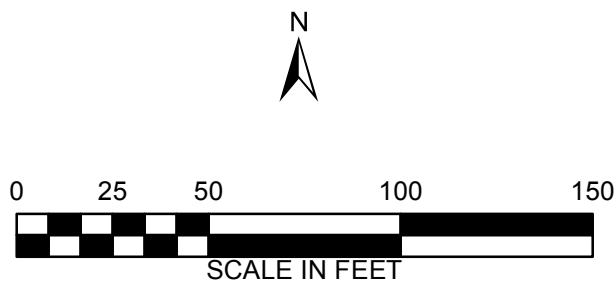
City/County plan review is provided only for general conformance with City/County Design Criteria. The City/County is not responsible for the accuracy and adequacy of the design, dimension, and/or elevations which shall be confirmed through the approval of this document assumes no responsibility for completeness and/or accuracy of this document.



VICINITY MAP

Legend

- Approximate 100-year Water Surface
- Channel Cross-section (XS)
- Proposed School and Parking
- Existing Contours (1ft)
- Existing Utilities
 - Fiber Optic Cable
 - Gas
 - Sewer
 - Storm
 - Underground Electric
 - Underground Telephone
 - Water
- Proposed contours
 - Major (5 ft)
 - Minor (1 ft)
- Proposed Flow Paths
 - Channelized
 - Overflow
- Parcel
- Proposed Utilities
 - Sewer
 - Storm
 - Water (Domestic & Fire)
- Proposed Drainage Basin



| | | | | |
|--|-----|------|--------------------------|----|
| REFERENCE DRAWINGS | | | | |
| | | | | |
| | | | | |
| | | | | |
| | No. | DATE | DESCRIPTION REVISIONS | BY |
| COMPUTER FILE MANAGEMENT | | | | |
| FILE NAME: G:\gis_projects\Liberty_Tree_Academy\active\apps\Drainage_Report\FigureA-1_Proposed_Drainage_Plan.mxd | | | | |
| CTB FILE: | | | | |
| PLOT DATE: 8/7/2018 | | | | |
| THIS DRAWING IS CURRENT AS OF THE PLOT DATE AND MAY BE SUBJECT TO CHANGE. | | | | |

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Matrix
DESIGN GROUP
AN EMPLOYEE-OWNED COMPANY

| |
|--|
| SEAL |
| |
| FOR AND ON BEHALF OF MATRIX DESIGN GROUP, INC. PROJECT No. |

| | | |
|------------------------------------|------------------|--------------|
| LIBERTY TREE ACADEMY | | |
| FINAL DRAINAGE PLAN | | |
| FIGURE A-1. PROPOSED DRAINAGE PLAN | | |
| DESIGNED BY: CE | SCALE | DATE ISSUED: |
| DRAWN BY: CE | HORIZ. 1" = 400' | SHEET OF |
| CHECKED BY: | VERT. | |

APPENDIX C – HYDROLOGIC ANALYSIS

Project Name: Liberty Tree Academy
Job Number: 18.995.001
Subject: Composite Runoff Coefficients
Date: 8/10/2018
Designed by: MAS

| Global Parameters | | | | | | | |
|----------------------------------|--------|----------------|----------------|-----------------|-----------------|-----------------|------------------|
| Land Use | % Imp. | C ₂ | C ₅ | C ₁₀ | C ₂₅ | C ₅₀ | C ₁₀₀ |
| Pasture/ Meadow, Lawn | 0 | 0.02 | 0.08 | 0.15 | 0.25 | 0.30 | 0.35 |
| Playground | 13 | 0.07 | 0.16 | 0.24 | 0.32 | 0.37 | 0.41 |
| Paved, Drive and Walk, Detention | 100 | 0.89 | 0.90 | 0.92 | 0.94 | 0.95 | 0.96 |
| Roofs | 90 | 0.71 | 0.73 | 0.75 | 0.78 | 0.80 | 0.81 |

*Type A Soils

| Subbasin | Total Area (acres) | Land Use Area per Sub-Basin | | | | | | | | Composite Imperviousness | Composite Runoff Coefficient | | | | | |
|---------------|--------------------|-----------------------------|--------|--------------|------|----------------------------------|--------|--------------|-------|--------------------------|------------------------------|--------|---------|---------|---------|----------|
| | | Pasture/ Meadow, Lawn | | Playground | | Paved, Drive and Walk, Detention | | Roofs | | | 2-year | 5-year | 10-year | 25-year | 50-year | 100-year |
| | | Area (acres) | % | Area (acres) | % | Area (acres) | % | Area (acres) | % | | | | | | | |
| EXISTING | | | | | | | | | | | | | | | | |
| Eatonville Rd | 0.46 | 0.00 | 0.0% | 0.00 | 0.0% | 0.46 | 100.0% | 0.00 | 0.0% | 100.0% | 0.89 | 0.90 | 0.92 | 0.94 | 0.95 | 0.96 |
| HA | 6.20 | 6.20 | 100.0% | 0.00 | 0.0% | 0.00 | 0.0% | 0.00 | 0.0% | 0.0% | 0.02 | 0.08 | 0.15 | 0.25 | 0.30 | 0.35 |
| PROPOSED | | | | | | | | | | | | | | | | |
| A | 3.00 | 0.61 | 20.2% | 0.12 | 4.0% | 1.64 | 54.8% | 0.63 | 20.9% | 74.2% | 0.64 | 0.67 | 0.70 | 0.74 | 0.76 | 0.78 |
| OS1 | 1.10 | 1.10 | 100.0% | 0.00 | 0.0% | 0.00 | 0.0% | 0.00 | 0.0% | 0.0% | 0.02 | 0.08 | 0.15 | 0.25 | 0.30 | 0.35 |
| OS2 | 2.10 | 2.10 | 100.0% | 0.00 | 0.0% | 0.00 | 0.0% | 0.00 | 0.0% | 0.0% | 0.02 | 0.08 | 0.15 | 0.25 | 0.30 | 0.35 |
| A+OS1 | 4.10 | 1.71 | 41.6% | 0.12 | 2.9% | 1.64 | 40.1% | 0.63 | 15.3% | 54.3% | 0.48 | 0.51 | 0.55 | 0.61 | 0.64 | 0.67 |

STORM DRAINAGE SYSTEM COMPUTATION FORM

Location: Liberty Tree Academy
 Date: August 10, 2018
 Designed by: MAS

Design Storm: 5 yr.
 P1, 5-yr: 1.5 in.

| Sub-Basin Data | | | | | Overland Time (ti) | | | Travel Time (tt) | | | | | tc Check | | | | | Runoff | |
|----------------|---------------|-------|------------------|------|--------------------|-------|--|------------------|-------|-----------------------|---|------|-------------------|--------------|---|------------|----------|---------------|---------------------------|
| Design Pt. | Basin ID | Area | Coefficient "C5" | CA | Length (300' max) | Slope | $t_i = (0.395(1.1 - C5) \cdot L_i^{0.5}) / S_0^{0.33}$ | Length | Slope | Cv, conveyance factor | Velocity = $C_v \cdot \text{Slope}^{0.5}$ | tt | $t_c = t_i + t_t$ | Total length | $t_c = (26 - 17i) + L_i / (60(14i + 9)S_i^{0.5})$ | Minimum tc | Final tc | Intensity "I" | Total Peak Discharge "Q5" |
| | | acres | | | ft | % | min. | ft | % | | fps | min | min | ft | min | min | min | in/hr | cfs |
| EXISTING | | | | | | | | | | | | | | | | | | | |
| | Eatonville Rd | 0.46 | 0.90 | 0.41 | 21 | 2.5% | 1.2 | 960 | 1.3% | 20 | 2.3 | 7.0 | 8.3 | 981 | 15.1 | 5.0 | 8.3 | 4.36 | 1.81 |
| 4 | HA | 6.20 | 0.08 | 0.50 | 300 | 2.0% | 25.7 | 385 | 2.4% | 7 | 1.1 | 5.9 | 31.6 | 685 | 30.6 | 5.0 | 30.6 | 2.33 | 1.15 |
| PROPOSED | | | | | | | | | | | | | | | | | | | |
| 1 | A | 3.00 | 0.67 | 2.01 | 100 | 0.5% | 10.0 | 665 | 1.1% | 20 | 2.1 | 5.2 | 15.2 | 765 | 18.8 | 5.0 | 15.2 | 3.39 | 6.79 |
| 2 | OS1 | 1.10 | 0.08 | 0.09 | 257 | 1.8% | 24.6 | 20 | 25.0% | 7 | 3.5 | 0.1 | 24.7 | 277 | 26.1 | 5.0 | 24.7 | 2.63 | 0.23 |
| 3 | A+OS1 | 4.10 | 0.51 | 2.09 | 100 | 0.5% | 13.6 | 665 | 1.1% | 20.0 | 2.1 | 5.2 | 18.8 | 765 | 23.1 | 5.0 | 18.8 | 3.04 | 6.38 |
| | | | | | | | | | | | | | | | | | | | |
| 4 | OS2 | 2.10 | 0.08 | 0.17 | 165 | 9.1% | 11.5 | 407 | 0.3% | 2.5 | 0.1 | 46.9 | 58.5 | 572 | 39.0 | 5.0 | 39.0 | 2.01 | 0.34 |

*Intensity values from Figure 6-5 of DCM-V1-Update

STORM DRAINAGE SYSTEM COMPUTATION FORM

Location: Liberty Tree Academy
Date: August 10, 2018
Designed by: MAS

Design Storm: 100 yr.
P1, 100-yr: 2.52 in.

| Sub-Basin Data | | | | | | Overland Time (ti) | | | Travel Time (tt) | | | | | tc Check | | | | | Runoff | |
|----------------|---------------|-------|------------------|--------------------|------|--------------------|-------|--|------------------|-------|-----------------------|---------------------------------------|------|----------|--------------|--|------------|----------|---------------|-----------------------------|
| Design Pt. | Basin ID | Area | Coefficient "C5" | Coefficient "C100" | CA | Length (300' max) | Slope | $t_i = (0.395(1.1 - C5) * L_i^{0.5}) / S_o^{0.33}$ | Length | Slope | Cv, conveyance factor | Velocity = $C_v * \text{Slope}^{0.5}$ | tt | tc=ti+tt | Total length | $t_c = (26 - 17i) + L_t / (60(14i + 9) S_t^{0.5})$ | Minimum tc | Final tc | Intensity "I" | Total Peak Discharge "Q100" |
| | | acres | | | | ft | % | min. | ft | % | | fps | min | min | ft | min | min | min | in/hr | cfs |
| EXISTING | | | | | | | | | | | | | | | | | | | | |
| | Eatonville Rd | 0.46 | 0.90 | 0.96 | 0.44 | 21 | 2.5% | 1.2 | 960 | 1.3% | 20 | 2.3 | 7.0 | 8.3 | 981 | 15.1 | 5.0 | 8.3 | 7.32 | 3.23 |
| 4 | HA | 6.20 | 0.08 | 0.35 | 2.17 | 300 | 2.0% | 25.7 | 385 | 2.4% | 7 | 1.1 | 5.9 | 31.6 | 685 | 30.6 | 5.0 | 30.6 | 3.91 | 8.48 |
| PROPOSED | | | | | | | | | | | | | | | | | | | | |
| 1 | A | 3.00 | 0.67 | 0.78 | 2.35 | 100 | 0.5% | 10.0 | 665 | 1.1% | 20 | 2.1 | 5.2 | 15.2 | 765 | 18.8 | 5.0 | 15.2 | 5.69 | 13.36 |
| 2 | OS1 | 1.10 | 0.08 | 0.35 | 0.39 | 257 | 1.8% | 24.6 | 20 | 25.0% | 7 | 3.5 | 0.1 | 24.7 | 277 | 26.1 | 5.0 | 24.7 | 4.42 | 1.70 |
| 3 | A+OS1 | 4.10 | 0.51 | 0.67 | 2.73 | 100 | 0.5% | 13.6 | 665 | 1.1% | 20.0 | 2.1 | 5.2 | 18.8 | 765 | 23.1 | 5.0 | 18.8 | 5.11 | 13.98 |
| | | | | | | | | | | | | | | | | | | | | |
| 4 | OS2 | 2.10 | 0.08 | 0.35 | 0.74 | 165 | 9.1% | 11.5 | 407 | 0.3% | 2.5 | 0.1 | 46.9 | 58.5 | 572 | 39.0 | 5.0 | 39.0 | 3.37 | 2.48 |

*Intensity values from Figure 6-5 of DCM-V1-Update

EXISTING RUNOFF ANALYSIS

Location: Liberty Tree Academy
Date: August 10, 2018
Designed by: MAS

| | |
|-------------|-------|
| Basin Name: | HA |
| Area (ac.) | 6.20 |
| Imperv. (%) | 0% |
| Tc (min.) | 30.60 |

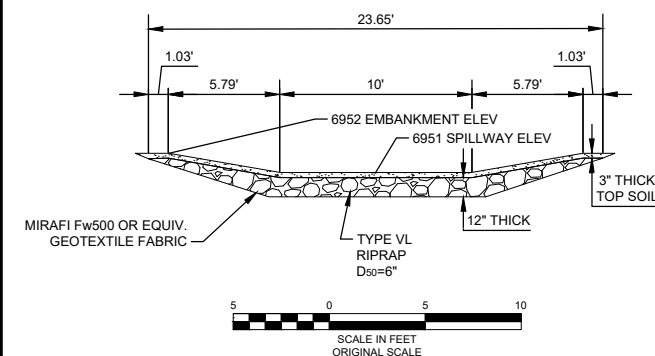
| Design Storm | P1 (in) | Runoff Coefficient | Intensity "I" | Total Peak Discharge "Q100" |
|--------------|---------|--------------------|---------------|-----------------------------|
| | | | in/hr | cfs |
| 2 | 1.19 | 0.02 | 1.85 | 0.23 |
| 5 | 1.5 | 0.08 | 2.33 | 1.15 |
| 10 | 1.75 | 0.15 | 2.71 | 2.52 |
| 25 | 2 | 0.25 | 3.10 | 4.81 |
| 50 | 2.25 | 0.30 | 3.49 | 6.49 |
| 100 | 2.52 | 0.35 | 3.91 | 8.48 |

*Intensity values from Figure 6-5 of DCM-V1-Update

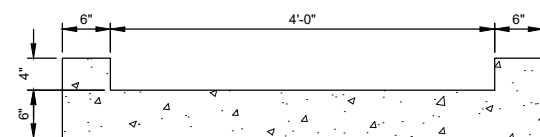
APPENDIX D – HYDRAULIC ANALYSIS

Extended Detention Basin Design

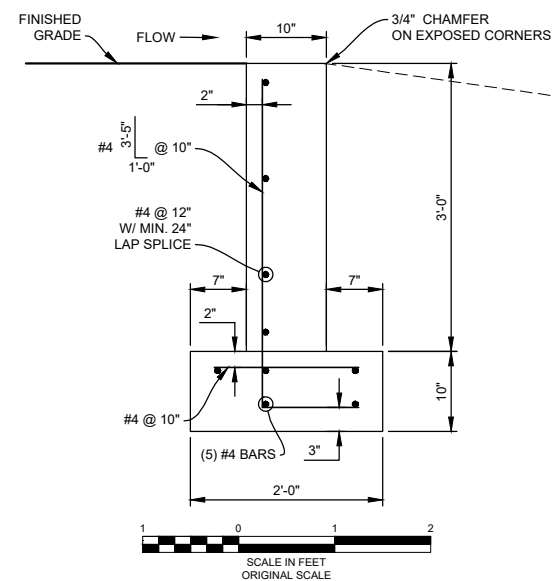
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SEE PLAN FOR LIMITS.



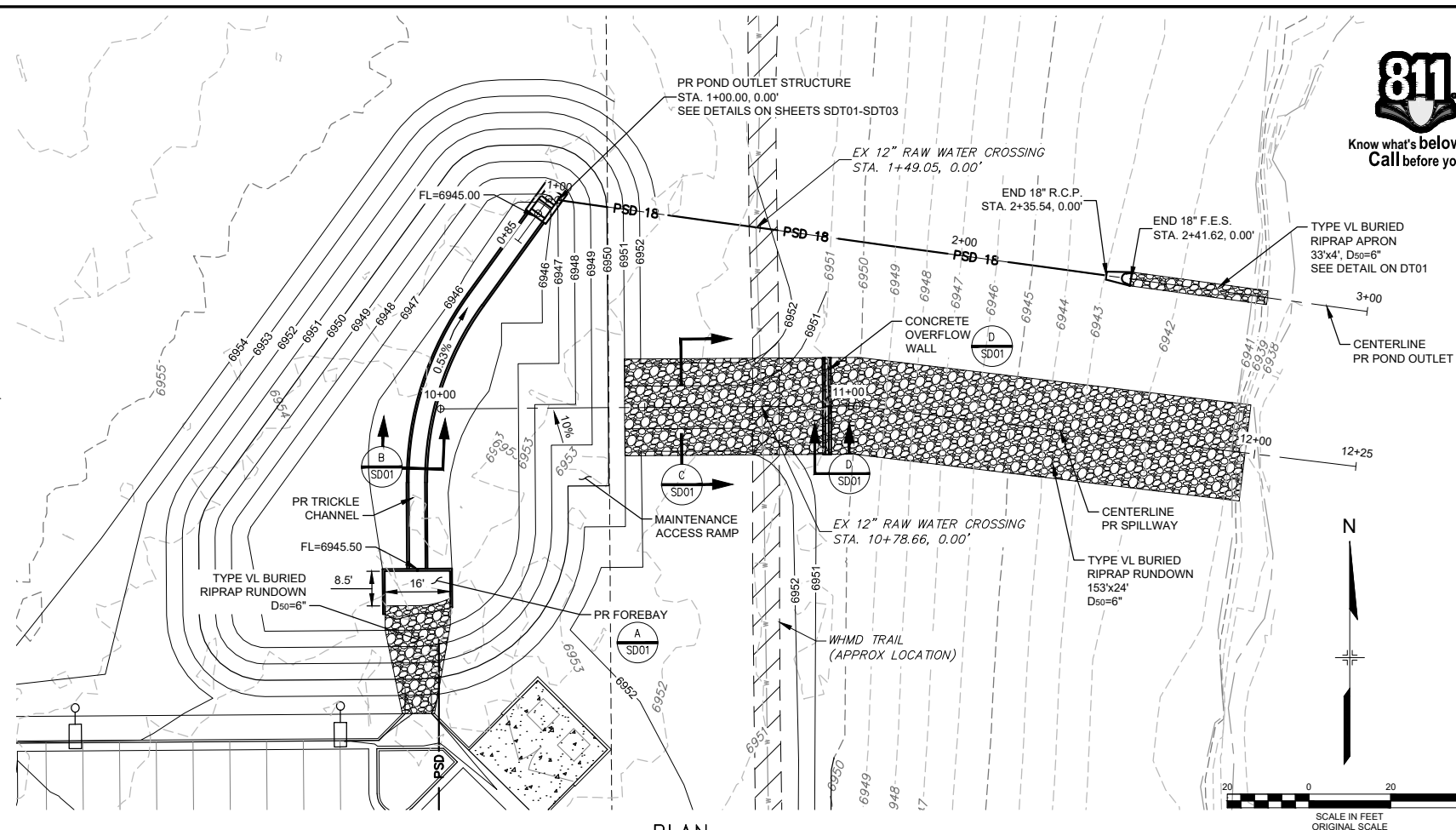
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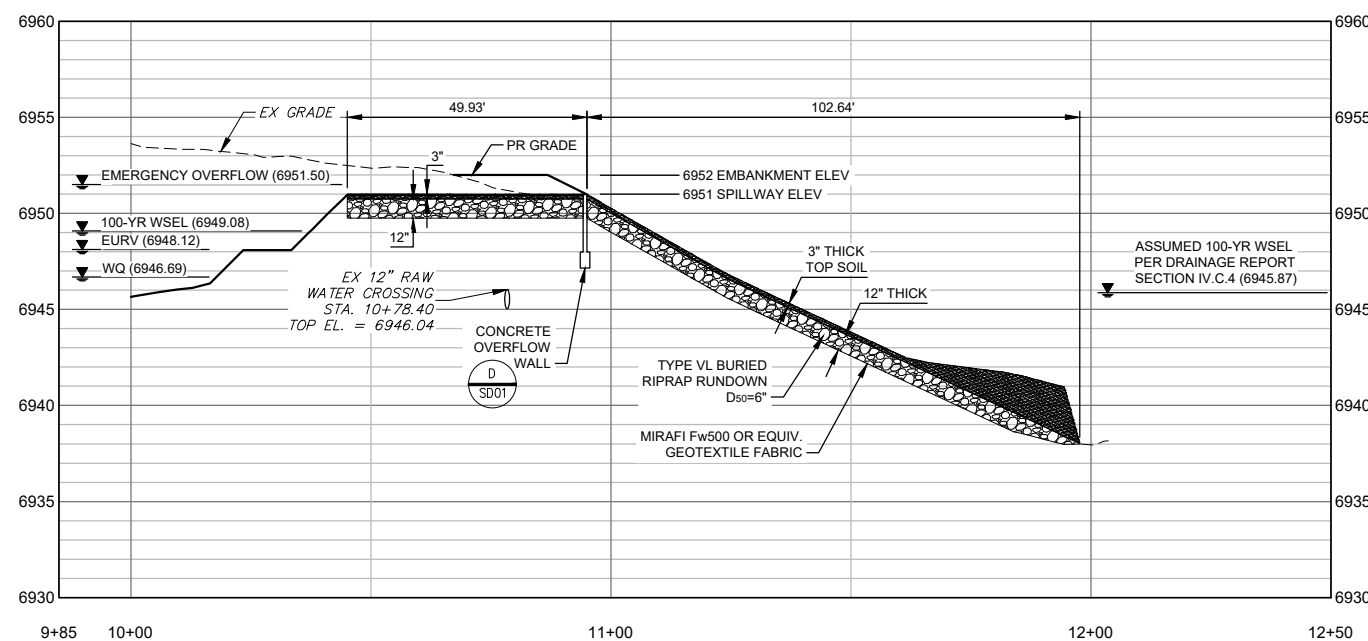
TRICKLE CHANNEL SECTION (B)



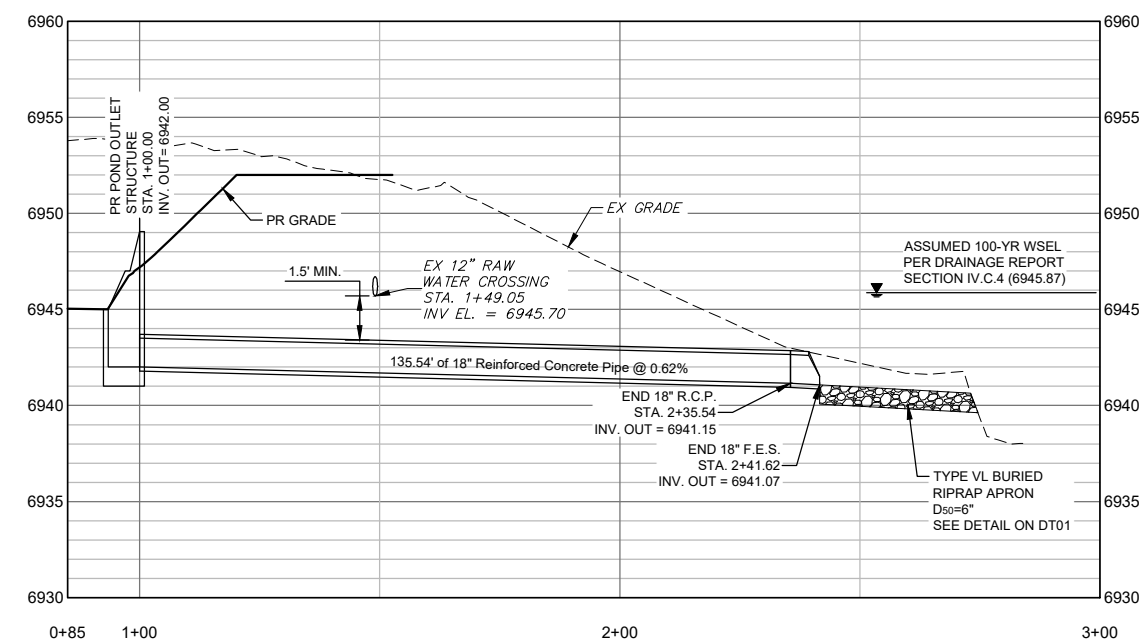
SCALE: 1" = 1'-0"



SCALE: 1"=20'



SCALE: 1"=20'(H), 1"=5'(V)



SCALE: 1"=20'(H), 1"=5'(V)

| | | | | | |
|---|------|-------------|--|--|----|
| REFERENCE DRAWINGS | | | | | |
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| | | | | | |
| X-995-MD-C22x34 X-995-PR-UTL X-995-EX-BASE X-995-EX-MAP X-995-PR-BASE | | | | | |
| No. | DATE | DESCRIPTION | | | BY |
| REVISIONS | | | | | |
| COMPUTER FILE MANAGEMENT | | | | | |
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| CTB FILE: | | | | | |
| PLOT DATE: 8/10/2018 11:14 AM | | | | | |
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SHEET KEY



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LIBERTY TREE
ACADEMY

PREPARED BY:

Matrix
DESIGN GROUP
AN EMPLOYEE-OWNED COMPANY

| |
|------|
| SEAL |
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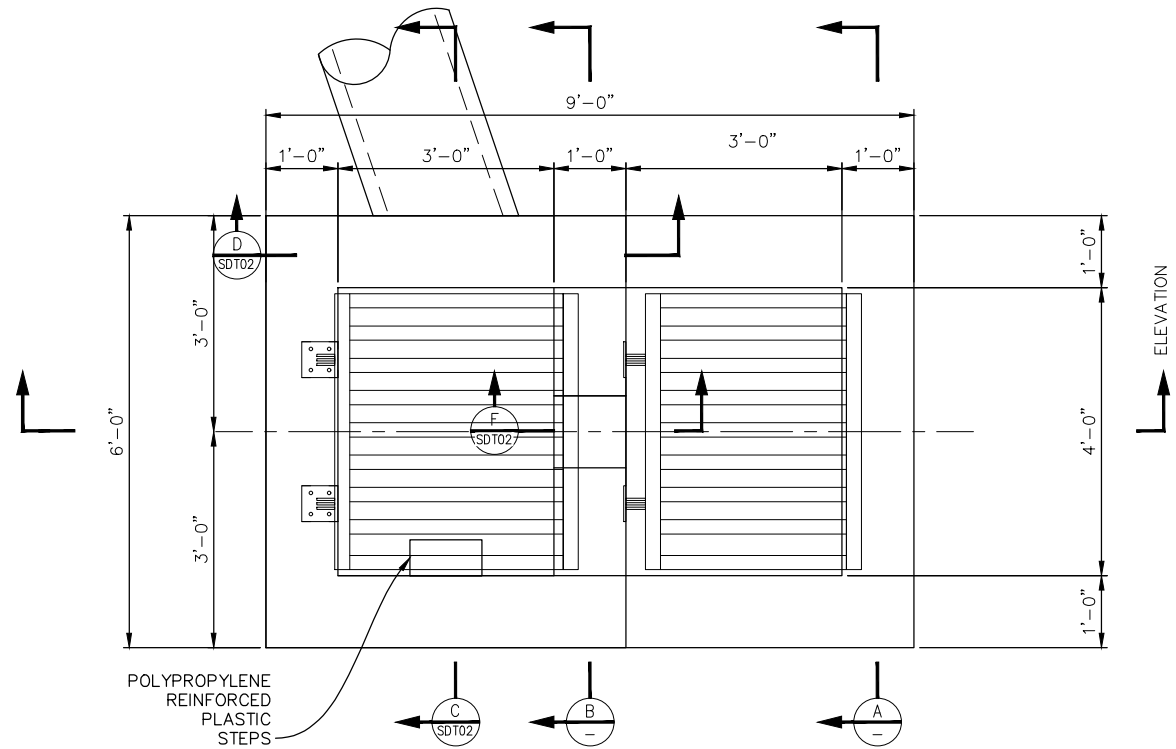
FOR AND ON BEHALF OF
MATRIX DESIGN GROUP, INC.
PROJECT No. 18.995.001

LIBERTY TREE ACADEMY

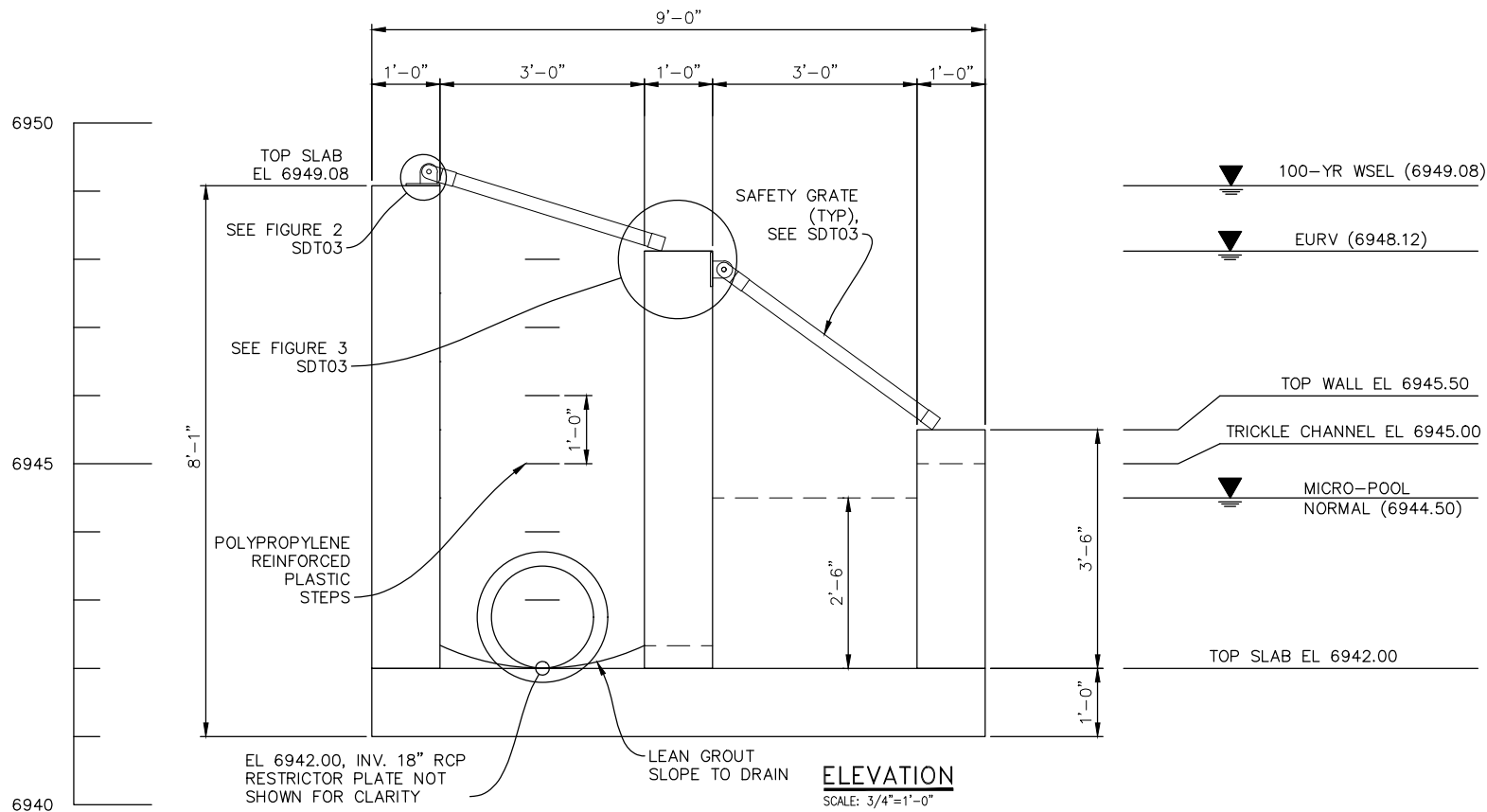
TOWN OF PEYTON, EL PASO COUNTY
CONSTRUCTION DOCUMENTS, PCD FILE NO. PPR-18-023

POND OUTLET & SPILLWAY PLAN & PROFILE

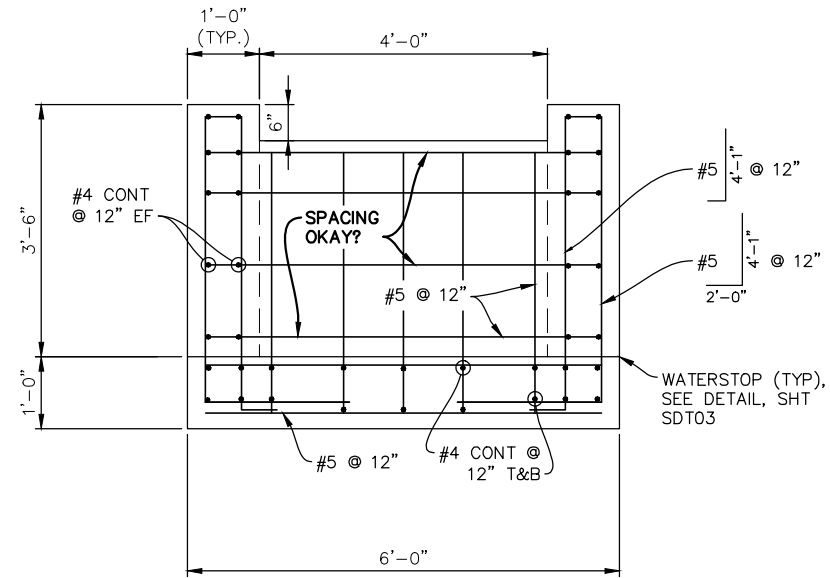
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|--------------|-----|------------------|--------------|-------------|--------------------------------|
| DESIGNED BY: | ACR | SCALE | DATE ISSUED: | AUGUST 2018 | DRAWING No. SD01 |
| DRAWN BY: | ACR | HORIZONTAL SHOWN | | | |
| CHECKED BY: | DRK | VERT. 1" = 5' | SHEET | 10 OF 29 | |



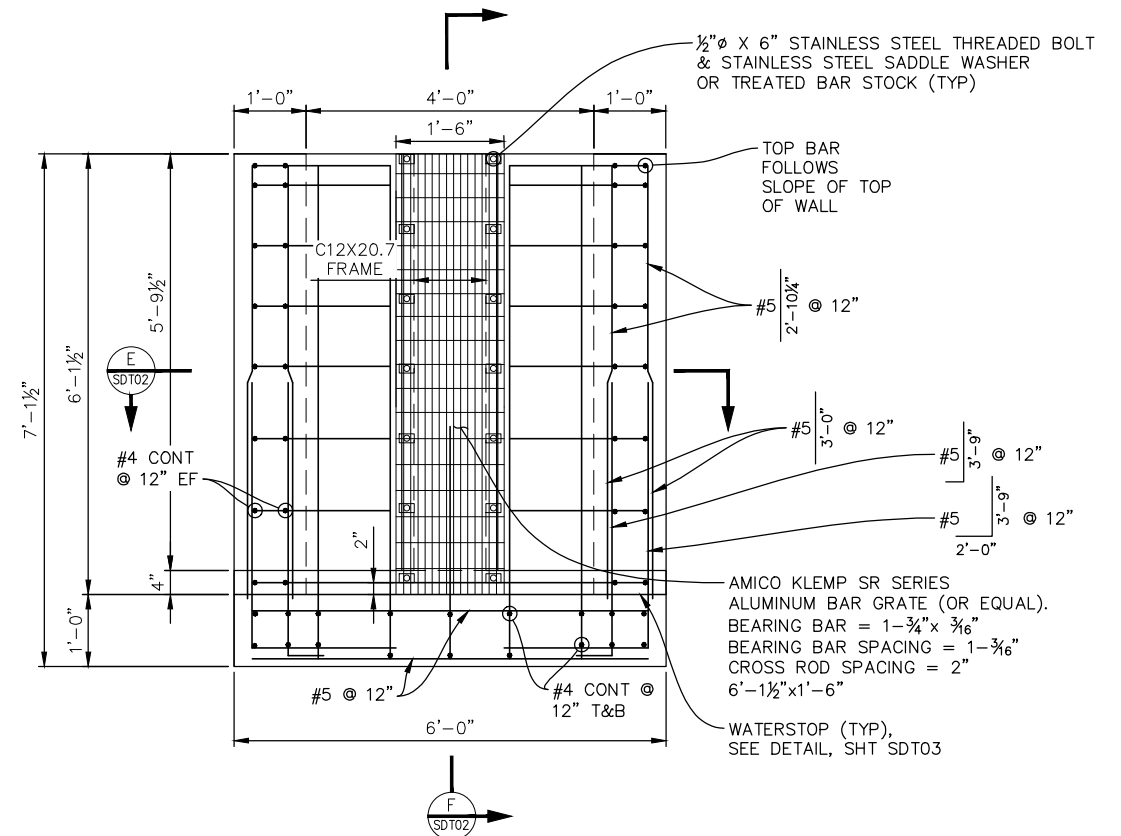
PLAN
SCALE: 3/4"=1'-0"



ELEVATION
SCALE: 3/4"=1'-0"



SECTION A
SCALE: 3/4"=1'-0"



SECTION B
SCALE: 3/4"=1'-0"

| REFERENCE DRAWINGS | | | |
|--|------|-------------|----|
| X-995-MDG22X34 | | | |
| No. | DATE | DESCRIPTION | BY |
| REVISIONS | | | |
| COMPUTER FILE MANAGEMENT | | | |
| FILE NAME: R:\18.995.001 (Liberty Tree Academy)\Dwg\Construction Plans\Structures\SDT01-03.dwg | | | |
| CTB FILE: --- | | | |
| PLOT DATE: 8/10/2018 8:34 AM | | | |
| THIS DRAWING IS CURRENT AS OF PLOT DATE AND MAY BE SUBJECT TO CHANGE. | | | |

| SHEET KEY | |
|-----------|--|
| N | |

PREPARED FOR:
LIBERTY TREE ACADEMY

PREPARED BY:
Matrix DESIGN GROUP
AN EMPLOYEE-OWNED COMPANY

SEAL
PROFESSIONAL ENGINEER
24520
8/10/18

FOR AND ON BEHALF OF
MATRIX DESIGN GROUP, INC.
PROJECT No. 18.995.001

LIBERTY TREE ACADEMY
TOWN OF PEYTON, EL PASO COUNTY
CONSTRUCTION DOCUMENTS, PCD FILE NO. PPR-18-023

POND OUTLET STRUCTURE DETAILS

| | | | |
|------------------|--------------------------|--------------------------|-------------------|
| DESIGNED BY: ACR | SCALE: HORIZ. 3/8"=1'-0" | DATE ISSUED: AUGUST 2018 | DRAWING No. SDT01 |
| CHECKED BY: DRK | VERT. 3/8"=1'-0" | SHEET 20 OF 29 | |

[illegible]

SECTION D

SCALE: 3/4"=1'-0"

8'-1"

7'-1"

1'-0"

2" CLR (TYP.)

18" Ø RCP

#5 @ 45° E.F. (TYP.)

ADD #5 E.F.

WATERSTOP (TYP.), SEE DETAIL, SHT SDT03

Diagram illustrating the elevation view of a circular structure, likely a manhole or access point, showing dimensions and components:

- Overall Dimensions:**
 - Horizontal dimension: 2'-2"
 - Vertical dimension: 1'-8"
- Internal Structure:**
 - Central circular opening: 18" ϕ RCP (Reinforced Concrete Pipe)
 - Inner circular structure: 18" ϕ RCP
- External Structure:**
 - Outer structure floor: Indicated by a horizontal line at the bottom.
 - Outer structure wall thickness: 1 1/8"
- Access Point Details:**
 - Top access point: 1" X 26" X 20" STAINLESS STEEL PLATE
 - Top access point diameter: 2" ϕ EL
 - Top access point offset: 1 1/2" (TYP.)

Technical drawing showing a cross-section of a vertical wall structure. The drawing includes the following components and dimensions:

- C12X20.7 CHANNEL FRAME**: Indicated at the top of the wall section.
- ORIFICE PLATE SEE SDT03**: Indicated on the left side of the wall.
- AMICO KLEMP SR SERIES ALUMINUM BAR GRATE (OR EQUAL)**: Indicated on the right side of the wall.
- MICRO POOL NORMAL W.S.**: Indicated on the right side of the wall, showing the water level.
- Dimensions**:
 - Vertical dimension on the right: $3'-7\frac{1}{2}"$ (total height), $6'-1\frac{1}{2}"$ (height to water level), $2'-6"$ (height below water level).
 - Horizontal dimension on the left: $4"$ (width of the orifice plate).
 - Horizontal dimension on the right: $12"$ (width of the grate).
- WATERSTOP (TYP), SEE DETAIL, SHT SDT03**: Indicated at the bottom of the wall section.

SECTION

SCALE: $\frac{3}{4}"=1'-0"$

F
SDT01

STEEL PERFORATED FLOW CONTROL (ORIFICE) PLATE, SEE SHEET SDT03 FOR BOLT TYPE AND LOCATIONS

AMICO KLEMP SR SERIES ALUMINUM BAR GRATE, SEE SECTION B, SHT SDT01, FOR BOLT TYPE AND LOCATIONS

C12x20.7 AMERICAN STANDARD STRUCTURAL STEEL CHANNEL FORMED INTO CONCRETE ON BOTH SIDES AND ABOVE

BOLT BAR GRATE USING STAINLESS STEEL SADDLE WASHERS OR TREATED STEEL BAR STOCK

SECTION E
SDT01

SCALE: 1/2"=1'-0"

| | | | | |
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| REFERENCE DRAWINGS | | | | |
| X-995-MDG22x34 | | | | |
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| | No. | DATE | DESCRIPTION | BY |
| REVISIONS | | | | |
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| PLOT DATE: 8/10/2018 8:35 AM | | | | |
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LIBERTY TREE
ACADEMY

PREPARED BY:

Matrix 
DESIGN GROUP

AN EMPLOYEE-OWNED COMPANY

SEAL



| | | | |
|--|-----|-------|--------------------------|
| <i>LIBERTY TREE ACADEMY</i> | | | |
| <i>TOWN OF PEYTON, EL PASO COUNTY CONSTRUCTION DOCUMENTS, PCD FILE NO. PPR-18-023</i> | | | |
| <i>POND OUTLET STRUCTURE DETAILS</i> | | | |
| DESIGNED BY: | ACR | SCALE | DATE ISSUED: AUGUST 2018 |
| DRAWN BY: | ACR | HORIZ | DRAWING No. |
| CHECKED BY: | PBK | VERT | SHEET 21 OF 29 |
| | | | <i>SDT02</i> |

Diagram illustrating the elevation view of a pipe rack structure. The structure is supported by two HINGE points, spaced 2'-0" apart, with 11" of clearance on each side. The total width is 3'-10". The height is 3'-5" overall, with a 3'-0" section for the pipes. The pipes are 2" EXTRA STRONG PIPE (A242), 9 PIPES EQUALLY SPACED. The bottom section is labeled TS 2½"x2½"x¼". The spacing between the pipes is 3" CLEAR SPACING (TYP).

Technical drawing of a window assembly. The drawing shows a cross-section of a window with a frame and multiple vertical panes. Key dimensions and materials are labeled:

- Top Hinges:** Two hinges are shown at the top, each labeled "HINGE". The distance between the centerlines of the hinges is "2'-0\"". The distance from the centerline of each hinge to the edge of the frame is "11\"".
- Frame Height:** The total height of the frame is "3'-8\"". The height of the glass panes is "3'-6\"".
- Frame Material:** The frame is labeled "2\" EXTRA STRONG PIPE (A242), 9 PIPES EQUALLY SPACED".
- Corner Detail:** A detail view of a corner joint is shown, labeled "1/4\"".
- Bottom Track:** The bottom track is labeled "TS 2 1/2\" x 2 1/2\" x 1/4\"".
- Clearance:** The distance from the bottom of the frame to the bottom track is "3\" CLEAR".
- Bottom Spacing:** The distance between the bottom of the frame and the bottom track is "SPACING (TYP)".
- Bottom Dimension:** The total width of the assembly is "3'-10\"".

1 1/4" (Left side dimension)
 1 1/8" (Top left corner dimension)
 1'-8" (Top center dimension)
 1 1/8" (Top right corner dimension)
 TOP = 6948.12 (Top right elevation)
 1~1 1/16" Ø OPENING (Callout to top opening)
 6946.91 (Elevation of top opening center)
 1'-2 7/16" (Vertical dimension between top opening and first lower opening)
 6945.71 (Elevation of first lower opening center)
 2~1 1/16" Ø OPENINGS (Callout to two lower openings)
 1'-2 7/16" (Vertical dimension between first and second lower opening)
 6944.50 (Elevation of second lower opening center)
 2'-6" (Vertical dimension between second lower opening and bottom flange)
 3/8" Ø x 4 1/2" STAINLESS STEEL THREADED BOLTS & 1/2" Ø BOLT HOLE (TYP) (Callout to bolt holes)
 PL 1/4" x 20" x 6'-1 1/2" (Callout to plate)
 2 1/4" (Bottom left corner dimension)
 1 1/8" (Bottom left corner dimension)
 10" (Bottom center dimension)
 TOP = 6942.00 (Bottom right elevation)

24"

10" (TYP)

24"

10" (TYP)

STD HOOK (TYP. INSIDE FACE)

HORIZONTAL REINFORCEMENT

10" (TYP)

R REINFORCING DETAIL

PLAN VIEW

$\frac{3}{8}" = 1' - 0"$

DETAIL B.2
(UPPER SAFETY GRATE
3"=1'-0")

DETAIL C
HINGE BRACKET
3"=1'-0"

DETAIL D
RACK-HINGE BRACKET
3"=1'-0"

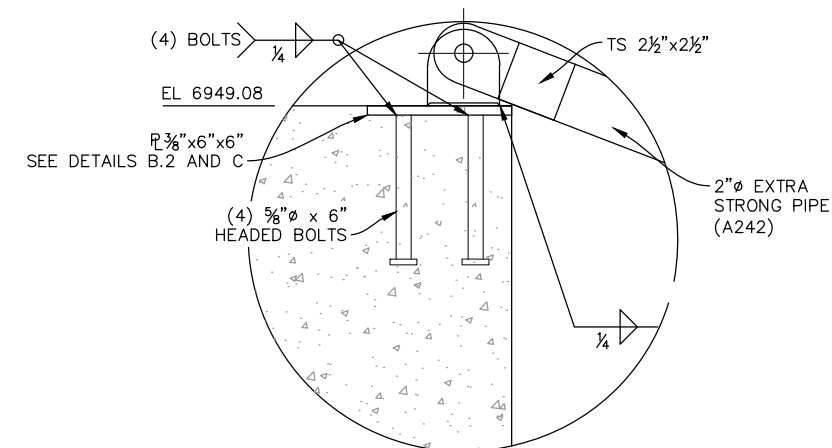


FIGURE 2
SAFETY GRATE HINGE
3"=1'-0"

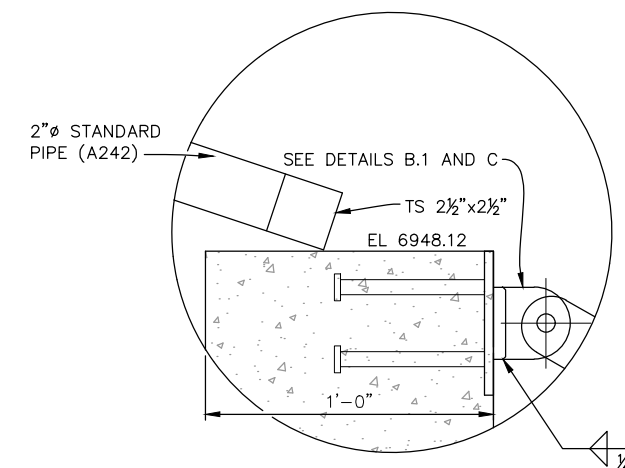
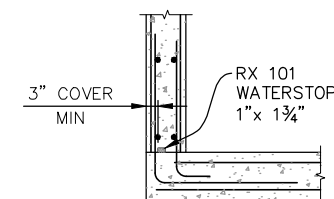


FIGURE 3
SAFETY GRATE HINGE
3"=1'-0"



WATERSTOP SHALL BE VOLCLAY WATERSTOP
RX 101 OR EARTHSHIELD JP 648 OR
APPROVED EQUAL.

PLACE WATERSTOP FOR ENTIRETY OF EACH
HORIZONTAL & VERTICAL CONSTRUCTION
JOINT.

FOLLOW MANUFACTURER'S INSTALLATION INSTRUCTIONS.

WATERSTOP DETAIL

| | | | | |
|--|-----|------|-------------|----|
| REFERENCE DRAWINGS | | | | |
| X-995-MDG22x34 | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | No. | DATE | DESCRIPTION | BY |
| REVISIONS | | | | |
| COMPUTER FILE MANAGEMENT | | | | |
| FILE NAME: R:\18.995.001 (Liberty Tree Academy)\Dwg\Construction Plans\Structures\SDT01-03.dwg | | | | |
| CTB FILE: _____ | | | | |
| PLOT DATE: 8/10/2018 10:16 AM | | | | |
| THIS DRAWING IS CURRENT AS OF PLOT DATE AND MAY BE SUBJECT TO CHANGE. | | | | |

SHEET KEY



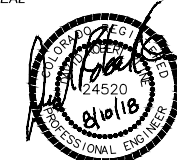
| |
|---------------|
| PREPARED FOR: |
|---------------|

LIBERTY TREE
ACADEMY

PREPARED BY:

Matrix
DESIGN GROUP
AN EMPLOYEE-OWNED COMPANY

| | |
|--|------|
| | SEAL |
|--|------|



FOR AND ON BEHALF OF
MATRIX DESIGN GROUP, INC.
PROJECT No. 18.995.001

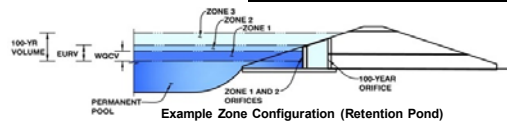
| | | | |
|------------------|-----------------|--------------------------|-----------------------------|
| DESIGNED BY: ACR | SCALE | DATE ISSUED: AUGUST 2018 | DRAWING No. STD03 |
| DRAWN BY: ACR | HORIZ. AS SHOWN | SHEET 22 OF 29 | |
| CHECKED BY: DRK | VERT. AS SHOWN | | |

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Liberty Tree

Basin ID: Extended Detention Basin



Required Volume Calculation

| | | |
|---|------------|-----------|
| Selected BMP Type = | EDB | |
| Watershed Area = | 4.10 | acres |
| Watershed Length = | 765 | ft |
| Watershed Slope = | 0.010 | ft/ft |
| Watershed Imperviousness = | 54.28% | percent |
| Percentage Hydrologic Soil Group A = | 100.0% | percent |
| Percentage Hydrologic Soil Group B = | 0.0% | percent |
| Percentage Hydrologic Soil Groups C/D = | 0.0% | percent |
| Desired WQCV Drain Time = | 40.0 | hours |
| Location for 1-hr Rainfall Depth = | User Input | |
| Water Quality Capture Volume (WQCV) = | 0.075 | acre-feet |
| Excess Urban Runoff Volume (EURV) = | 0.263 | acre-feet |
| 2-yr Runoff Volume (P1 = 1.19 in.) = | 0.180 | acre-feet |
| 5-yr Runoff Volume (P1 = 1.5 in.) = | 0.236 | acre-feet |
| 10-yr Runoff Volume (P1 = 1.75 in.) = | 0.289 | acre-feet |
| 25-yr Runoff Volume (P1 = 2 in.) = | 0.357 | acre-feet |
| 50-yr Runoff Volume (P1 = 2.25 in.) = | 0.439 | acre-feet |
| 100-yr Runoff Volume (P1 = 2.52 in.) = | 0.535 | acre-feet |
| 500-yr Runoff Volume (P1 = 0 in.) = | 0.000 | acre-feet |
| Approximate 2-yr Detention Volume = | 0.169 | acre-feet |
| Approximate 5-yr Detention Volume = | 0.223 | acre-feet |
| Approximate 10-yr Detention Volume = | 0.271 | acre-feet |
| Approximate 25-yr Detention Volume = | 0.329 | acre-feet |
| Approximate 50-yr Detention Volume = | 0.366 | acre-feet |
| Approximate 100-yr Detention Volume = | 0.409 | acre-feet |

Optional User Override
1-hr Precipitation

| | |
|------|--------|
| 1.19 | inches |
| 1.50 | inches |
| 1.75 | inches |
| 2.00 | inches |
| 2.25 | inches |
| 2.52 | inches |
| | inches |

Stage-Storage Calculation

| | | |
|--|-------|-----------|
| Zone 1 Volume (WQCV) = | 0.075 | acre-feet |
| Zone 2 Volume (EURV - Zone 1) = | 0.188 | acre-feet |
| Zone 3 Volume (100-year - Zones 1 & 2) = | 0.146 | acre-feet |
| Total Detention Basin Volume = | 0.409 | acre-feet |

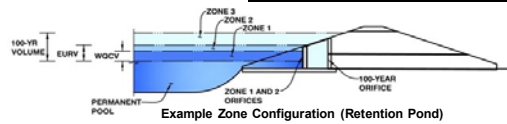
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DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Liberty Tree

Basin ID: Extended Detention Basin



Required Volume Calculation

| | | |
|---|------------|-----------|
| Selected BMP Type = | EDB | |
| Watershed Area = | 4.10 | acres |
| Watershed Length = | 765 | ft |
| Watershed Slope = | 0.010 | ft/ft |
| Watershed Imperviousness = | 54.28% | percent |
| Percentage Hydrologic Soil Group A = | 100.0% | percent |
| Percentage Hydrologic Soil Group B = | 0.0% | percent |
| Percentage Hydrologic Soil Groups C/D = | 0.0% | percent |
| Desired WQCV Drain Time = | 40.0 | hours |
| Location for 1-hr Rainfall Depths = | User Input | |
| Water Quality Capture Volume (WQCV) = | 0.075 | acre-feet |
| Excess Urban Runoff Volume (EURV) = | 0.263 | acre-feet |
| 2-yr Runoff Volume (P1 = 1.19 in.) = | 0.180 | acre-feet |
| 5-yr Runoff Volume (P1 = 1.5 in.) = | 0.236 | acre-feet |
| 10-yr Runoff Volume (P1 = 1.75 in.) = | 0.289 | acre-feet |
| 25-yr Runoff Volume (P1 = 2.1) = | 0.357 | acre-feet |
| 50-yr Runoff Volume (P1 = 2.25 in.) = | 0.439 | acre-feet |
| 100-yr Runoff Volume (P1 = 2.52 in.) = | 0.535 | acre-feet |
| 500-yr Runoff Volume (P1 = 3.41 in.) = | 0.821 | acre-feet |
| Approximate 2-yr Detention Volume = | 0.169 | acre-feet |
| Approximate 5-yr Detention Volume = | 0.223 | acre-feet |
| Approximate 10-yr Detention Volume = | 0.271 | acre-feet |
| Approximate 25-yr Detention Volume = | 0.329 | acre-feet |
| Approximate 50-yr Detention Volume = | 0.366 | acre-feet |
| Approximate 100-yr Detention Volume = | 0.409 | acre-feet |

Optional User Override
1-hr Precipitation

| | |
|------|--------|
| 1.19 | inches |
| 1.50 | inches |
| 1.75 | inches |
| 2.00 | inches |
| 2.25 | inches |
| 2.52 | inches |
| 3.41 | inches |

Stage-Storage Calculation

| | | |
|--|-------|-----------|
| Zone 1 Volume (WQCV) = | 0.075 | acre-feet |
| Zone 2 Volume (EURV - Zone 1) = | 0.188 | acre-feet |
| Zone 3 Volume (100-year - Zones 1 & 2) = | 0.146 | acre-feet |
| Total Detention Basin Volume = | 0.409 | acre-feet |

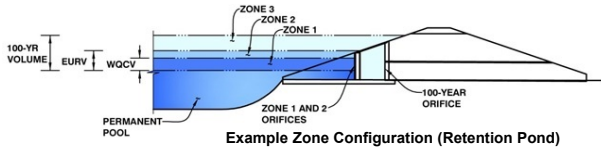
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Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: **Liberty Tree**

Basin ID: **Extended Detention Basin**



Example Zone Configuration (Retention Pond)

| | Stage (ft) | Zone Volume (ac-ft) | Outlet Type |
|-------------------|------------|---------------------|----------------------|
| Zone 1 (WQCV) | 2.27 | 0.075 | Orifice Plate |
| Zone 2 (EURV) | 3.75 | 0.188 | Orifice Plate |
| Zone 3 (100-year) | 4.63 | 0.146 | Weir&Pipe (Restrict) |
| | | 0.409 | Total |

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth = ft (distance below the filtration media surface)
Underdrain Orifice Diameter = inches

Calculated Parameters for Underdrain

Underdrain Orifice Area = ft²
Underdrain Orifice Centroid = feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Invert of Lowest Orifice = ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate = ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing = inches
Orifice Plate: Orifice Area per Row = inches

Calculated Parameters for Plate

WQ Orifice Area per Row = ft²
Elliptical Half-Width = feet
Elliptical Slot Centroid = feet
Elliptical Slot Area = ft²

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

| | Row 1 (required) | Row 2 (optional) | Row 3 (optional) | Row 4 (optional) | Row 5 (optional) | Row 6 (optional) | Row 7 (optional) | Row 8 (optional) |
|--------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| Stage of Orifice Centroid (ft) | 0.00 | 1.21 | 2.41 | | | | | |
| Orifice Area (sq. inches) | 0.37 | 0.37 | 1.62 | | | | | |

| | Row 9 (optional) | Row 10 (optional) | Row 11 (optional) | Row 12 (optional) | Row 13 (optional) | Row 14 (optional) | Row 15 (optional) | Row 16 (optional) |
|--------------------------------|------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Stage of Orifice Centroid (ft) | | | | | | | | |
| Orifice Area (sq. inches) | | | | | | | | |

User Input: Vertical Orifice (Circular or Rectangular)

Invert of Vertical Orifice = ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice = ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter = inches

Calculated Parameters for Vertical Orifice

Vertical Orifice Area = ft²
Vertical Orifice Centroid = feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

Overflow Weir Front Edge Height, H_o = ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length = feet
Overflow Weir Slope = H:V (enter zero for flat grate)
Horiz. Length of Weir Sides = feet
Overflow Grate Open Area % = %, grate open area/total area
Debris Clogging % = %

Calculated Parameters for Overflow Weir

Height of Grate Upper Edge, H_u = feet
Over Flow Weir Slope Length = feet
Grate Open Area / 100-yr Orifice Area = should be ≥ 4
Overflow Grate Open Area w/o Debris = ft²
Overflow Grate Open Area w/ Debris = ft²

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

Depth to Invert of Outlet Pipe = ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter = inches
Restrictor Plate Height Above Pipe Invert = inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

Outlet Orifice Area = ft²
Outlet Orifice Centroid = feet
Half-Central Angle of Restrictor Plate on Pipe = radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage = ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length = feet
Spillway End Slopes = H:V
Freeboard above Max Water Surface = feet

Calculated Parameters for Spillway

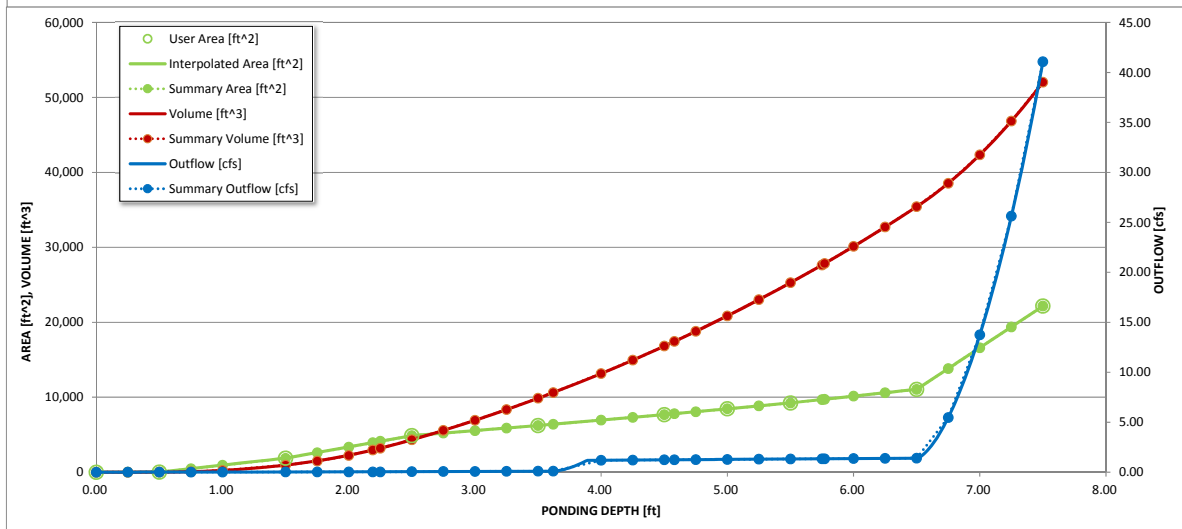
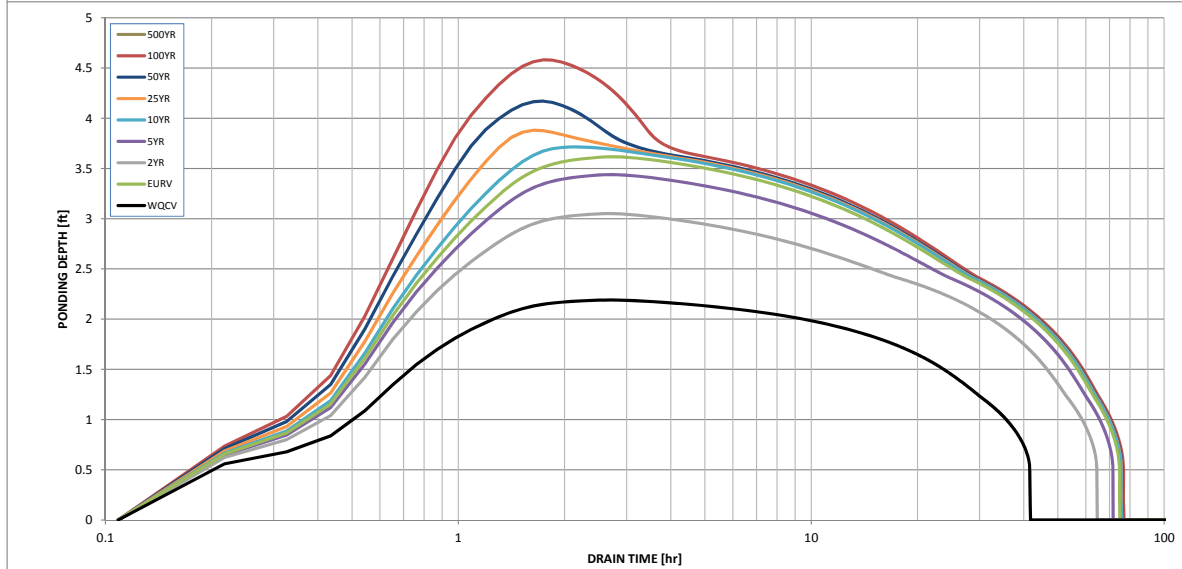
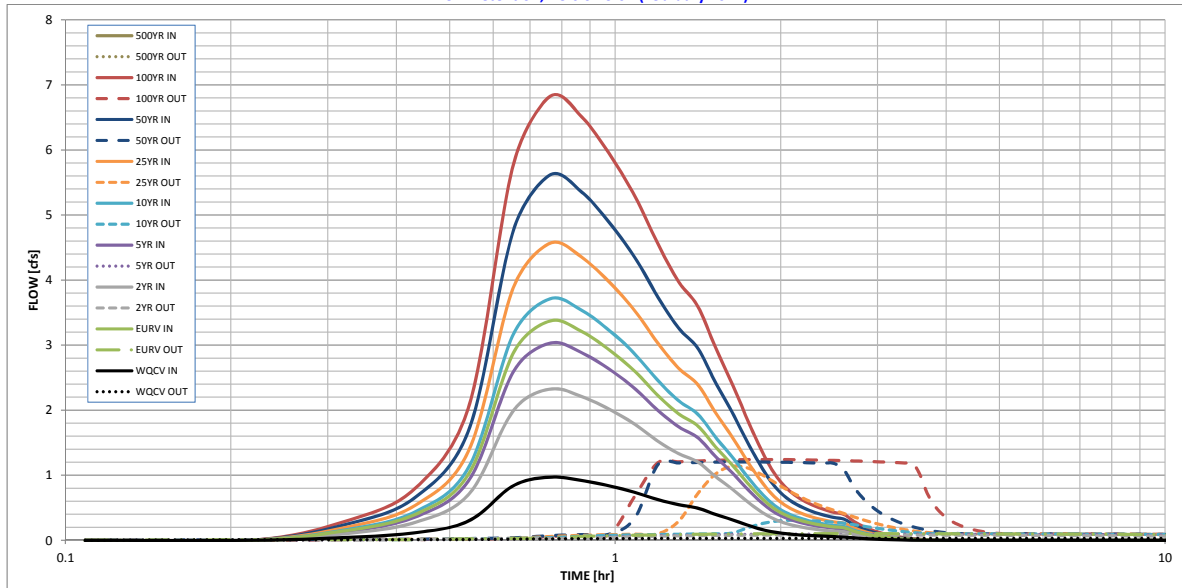
Spillway Design Flow Depth = feet
Stage at Top of Freeboard = feet
Basin Area at Top of Freeboard = acres

Routed Hydrograph Results

| | WQCV | EURV | 2 Year | 5 Year | 10 Year | 25 Year | 50 Year | 100 Year | 500 Year |
|---|-------|-------|--------|--------|------------------|----------------|----------------|----------------|----------|
| Design Storm Return Period | 0.53 | 1.07 | 1.19 | 1.50 | 1.75 | 2.00 | 2.25 | 2.52 | 0.00 |
| One-Hour Rainfall Depth (in) | 0.075 | 0.263 | 0.180 | 0.236 | 0.289 | 0.357 | 0.439 | 0.535 | 0.000 |
| Calculated Runoff Volume (acre-ft) | | | | | | | | | |
| OPTIONAL Override Runoff Volume (acre-ft) | | | | | | | | | |
| Inflow Hydrograph Volume (acre-ft) | 0.074 | 0.262 | 0.180 | 0.235 | 0.289 | 0.356 | 0.439 | 0.535 | #N/A |
| Predevelopment Unit Peak Flow, q (cfs/acre) | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.14 | 0.34 | 0.00 |
| Predevelopment Peak Q (cfs) | 0.0 | 0.0 | 0.002 | 0.015 | 0.034 | 0.074 | 0.564 | 1.4 | 0.0 |
| Peak Inflow Q (cfs) | 1.0 | 3.4 | 2.324 | 3.031 | 3.713 | 4.567 | 5.615 | 6.8 | #N/A |
| Peak Outflow Q (cfs) | 0.0 | 0.1 | 0.082 | 0.097 | 0.294 | 1.116 | 1.206 | 1.2 | #N/A |
| Ratio Peak Outflow to Predevelopment Q | N/A | N/A | N/A | 6.6 | 8.7 | 15.1 | 2.1 | 0.9 | #N/A |
| Structure Controlling Flow | Plate | Plate | Plate | Plate | Overflow Grate 1 | Outlet Plate 1 | Outlet Plate 1 | Outlet Plate 1 | #N/A |
| Max Velocity through Grate 1 (fps) | N/A | N/A | N/A | N/A | 0.0 | 0.1 | 0.1 | 0.1 | #N/A |
| Max Velocity through Grate 2 (fps) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | #N/A |
| Time to Drain 97% of Inflow Volume (hours) | 39 | 67 | 59 | 64 | 67 | 65 | 64 | 62 | #N/A |
| Time to Drain 99% of Inflow Volume (hours) | 41 | 72 | 63 | 69 | 73 | 72 | 72 | 71 | #N/A |
| Maximum Ponding Depth (ft) | 2.19 | 3.62 | 3.05 | 3.44 | 3.72 | 3.89 | 4.17 | 4.58 | #N/A |
| Area at Maximum Ponding Depth (acres) | 0.09 | 0.15 | 0.13 | 0.14 | 0.15 | 0.16 | 0.17 | 0.18 | #N/A |
| Maximum Volume Stored (acre-ft) | 0.068 | 0.243 | 0.165 | 0.217 | 0.257 | 0.283 | 0.330 | 0.400 | #N/A |

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)



Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

| Stage - Storage Description | Stage [ft] | Area [ft^2] | Area [acres] | Volume [ft^3] | Volume [ac-ft] | Total Outflow [cfs] |
|-----------------------------|---------------|----------------|-----------------|------------------|-------------------|---------------------------|
| Micropool = 6944.5 | 0.00 | 0 | 0.000 | 0 | 0.000 | 0.00 |
| 6944.75 | 0.25 | 6 | 0.000 | 1 | 0.000 | 0.01 |
| 6945 | 0.50 | 12 | 0.000 | 3 | 0.000 | 0.01 |
| 6945.25 | 0.75 | 459 | 0.011 | 60 | 0.001 | 0.01 |
| 6945.5 | 1.00 | 926 | 0.021 | 233 | 0.005 | 0.01 |
| 6946 | 1.50 | 1,858 | 0.043 | 928 | 0.021 | 0.02 |
| 6946.25 | 1.75 | 2,595 | 0.060 | 1,484 | 0.034 | 0.03 |
| 6946.5 | 2.00 | 3,345 | 0.077 | 2,226 | 0.051 | 0.03 |
| WQCV = 6946.69 | 2.19 | 3,944 | 0.091 | 2,955 | 0.068 | 0.03 |
| 6946.75 | 2.25 | 4,124 | 0.095 | 3,197 | 0.073 | 0.03 |
| 6947 | 2.50 | 4,873 | 0.112 | 4,322 | 0.099 | 0.05 |
| 6947.25 | 2.75 | 5,211 | 0.120 | 5,582 | 0.128 | 0.07 |
| 6947.5 | 3.00 | 5,549 | 0.127 | 6,927 | 0.159 | 0.08 |
| 6947.75 | 3.25 | 5,887 | 0.135 | 8,357 | 0.192 | 0.09 |
| 6948 | 3.50 | 6,225 | 0.143 | 9,871 | 0.227 | 0.10 |
| EURV = 6948.12 | 3.62 | 6,400 | 0.147 | 10,628 | 0.244 | 0.10 |
| 6948.5 | 4.00 | 6,952 | 0.160 | 13,165 | 0.302 | 1.19 |
| 6948.75 | 4.25 | 7,315 | 0.168 | 14,949 | 0.343 | 1.21 |
| 6949 | 4.50 | 7,678 | 0.176 | 16,823 | 0.386 | 1.24 |
| 100-YR WSEL = 6949.08 | 4.58 | 7,803 | 0.179 | 17,442 | 0.400 | 1.24 |
| 6949.25 | 4.75 | 8,067 | 0.185 | 18,791 | 0.431 | 1.26 |
| 6949.5 | 5.00 | 8,455 | 0.194 | 20,856 | 0.479 | 1.28 |
| 6949.75 | 5.25 | 8,844 | 0.203 | 23,019 | 0.528 | 1.30 |
| 100-YR (clogged) = 6949.78 | 5.28 | 8,890 | 0.204 | 23,285 | 0.535 | 1.30 |
| 6950 | 5.50 | 9,232 | 0.212 | 25,278 | 0.580 | 1.32 |
| 6950.25 | 5.75 | 9,689 | 0.222 | 27,643 | 0.635 | 1.34 |
| 6950.5 | 6.00 | 10,145 | 0.233 | 30,122 | 0.692 | 1.36 |
| 6950.75 | 6.25 | 10,601 | 0.243 | 32,716 | 0.751 | 1.38 |
| Spillway Crest = 6951 | 6.50 | 11,057 | 0.254 | 35,423 | 0.813 | 1.40 |
| 6951.25 | 6.75 | 13,833 | 0.318 | 38,534 | 0.885 | 5.47 |
| 6951.5 | 7.00 | 16,608 | 0.381 | 42,339 | 0.972 | 13.75 |
| 6951.75 | 7.25 | 19,384 | 0.445 | 46,838 | 1.075 | 25.62 |
| Berm Crest = 6952 | 7.50 | 22,159 | 0.509 | 52,031 | 1.194 | 41.08 |

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 3

Designer: **MAS**
 Company: **Matrix**
 Date: **August 9, 2018**
 Project: **Liberty Tree Academy**
 Location: **Rundown Forebay**

| | |
|---|--|
| <p>1. Basin Storage Volume</p> <p>A) Effective Imperviousness of Tributary Area, I_a</p> <p>B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)</p> <p>C) Contributing Watershed Area</p> <p>D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm</p> <p>E) Design Concept (Select EURV when also designing for flood control)</p> <p>F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * \text{Area})$)</p> <p>G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV \text{ OTHER}} = (d_6 * (V_{DESIGN} / 0.43))$)</p> <p>H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)</p> <p>I) NRCS Hydrologic Soil Groups of Tributary Watershed i) Percentage of Watershed consisting of Type A Soils ii) Percentage of Watershed consisting of Type B Soils iii) Percentage of Watershed consisting of Type C/D Soils</p> <p>J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$</p> <p>K) User Input of Excess Urban Runoff Volume (EURV) Design Volume (Only if a different EURV Design Volume is desired)</p> | <p>$I_a =$ <input type="text" value="54.0"/> %</p> <p>$i =$ <input type="text" value="0.540"/></p> <p>Area = <input type="text" value="4.100"/> ac</p> <p>$d_6 =$ <input type="text" value=""/></p> <p>Choose One</p> <p><input type="radio"/> Water Quality Capture Volume (WQCV)</p> <p><input checked="" type="radio"/> Excess Urban Runoff Volume (EURV)</p> <p>$V_{DESIGN} =$ <input type="text" value="0.074"/> ac-ft</p> <p>$V_{DESIGN \text{ OTHER}} =$ <input type="text" value=""/></p> <p>$V_{DESIGN \text{ USER}} =$ <input type="text" value=""/></p> <p>HSG A = <input type="text" value="100"/> %</p> <p>HSG B = <input type="text" value="0"/> %</p> <p>HSG C/D = <input type="text" value="0"/> %</p> <p>$EURV_{DESIGN} =$ <input type="text" value="0.261"/> ac-ft</p> <p>$EURV_{DESIGN \text{ USER}} =$ <input type="text" value=""/></p> |
| <p>2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.)</p> | <p>$L : W =$ <input type="text" value="2.0"/> : 1</p> |
| <p>3. Basin Side Slopes</p> <p>A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred)</p> | <p>$Z =$ <input type="text" value="4.00"/> ft / ft</p> |
| <p>4. Inlet</p> <p>A) Describe means of providing energy dissipation at concentrated inflow locations:</p> | <p><input type="text"/></p> <p><input type="text"/></p> <p><input type="text"/></p> |
| <p>5. Forebay</p> <p>A) Minimum Forebay Volume ($V_{MIN} =$ <input type="text" value="2"/> % of the WQCV)</p> <p>B) Actual Forebay Volume</p> <p>C) Forebay Depth ($D_F =$ <input type="text" value="18"/> inch maximum)</p> <p>D) Forebay Discharge</p> <p>i) Undetained 100-year Peak Discharge</p> <p>ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)</p> <p>E) Forebay Discharge Design</p> <p>F) Discharge Pipe Size (minimum 8-inches)</p> <p>G) Rectangular Notch Width</p> | <p>$V_{MIN} =$ <input type="text" value="0.001"/> ac-ft</p> <p>$V_F =$ <input type="text" value="0.002"/> ac-ft</p> <p>$D_F =$ <input type="text" value="6.0"/> in</p> <p>$Q_{100} =$ <input type="text" value="14.10"/> cfs</p> <p>$Q_F =$ <input type="text" value="0.28"/> cfs</p> <p>Choose One</p> <p><input type="radio"/> Berm With Pipe</p> <p><input checked="" type="radio"/> Wall with Rect. Notch</p> <p><input type="radio"/> Wall with V-Notch Weir</p> <p>Flow too small for berm w/ pipe</p> <p>Calculated $D_P =$ <input type="text" value=""/> in</p> <p>Calculated $W_N =$ <input type="text" value="4.1"/> in</p> |

Cross Section for Trickle Channel

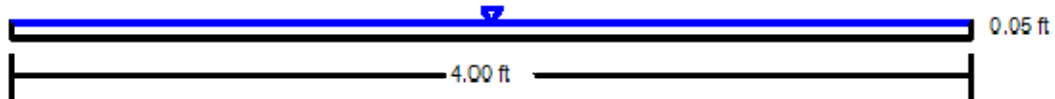
Project Description

| | |
|-----------------|-----------------|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

Input Data

| | | |
|-----------------------|---------|--------------------|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 0.00500 | ft/ft |
| Normal Depth | 0.05 | ft |
| Bottom Width | 4.00 | ft |
| Discharge | 0.25 | ft ³ /s |

Cross Section Image



V: 1
H: 1



Spillway Capacity Calculation

Spillway Section

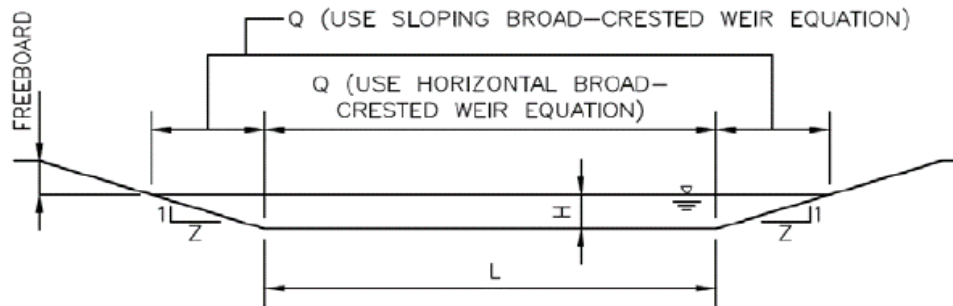


Fig. 12-20 of UDFCD V1

Horizontal Broad Crested Weir: $Q = C_{BCW} L H^{1.5}$ Eq. 12-20 of UDFCD V1

Sloping Broad-Crested Weir: $Q = \left(\frac{2}{5}\right) C_{BCW} Z H^{2.5}$ Eq. 12-21 of UDFCD V1

100-yr Undetained Runoff

$Q = 13.98$ cfs

Side slope (horizontal: vertical)

$Z = 4$

Broad Crested Weir Coefficient

$C_{BCW} = 3.0$

Head above Weir Crest

$H = 0.5$ ft

Total Required Length

$$L = \frac{Q - 2\left(\frac{2}{5}\right) C_{BCW} Z H^{2.5}}{C H^{1.5}}$$

Bottom Length of Weir

$L = 10$ ft

Unit Discharge

$q = 1.40$ cfs/ft

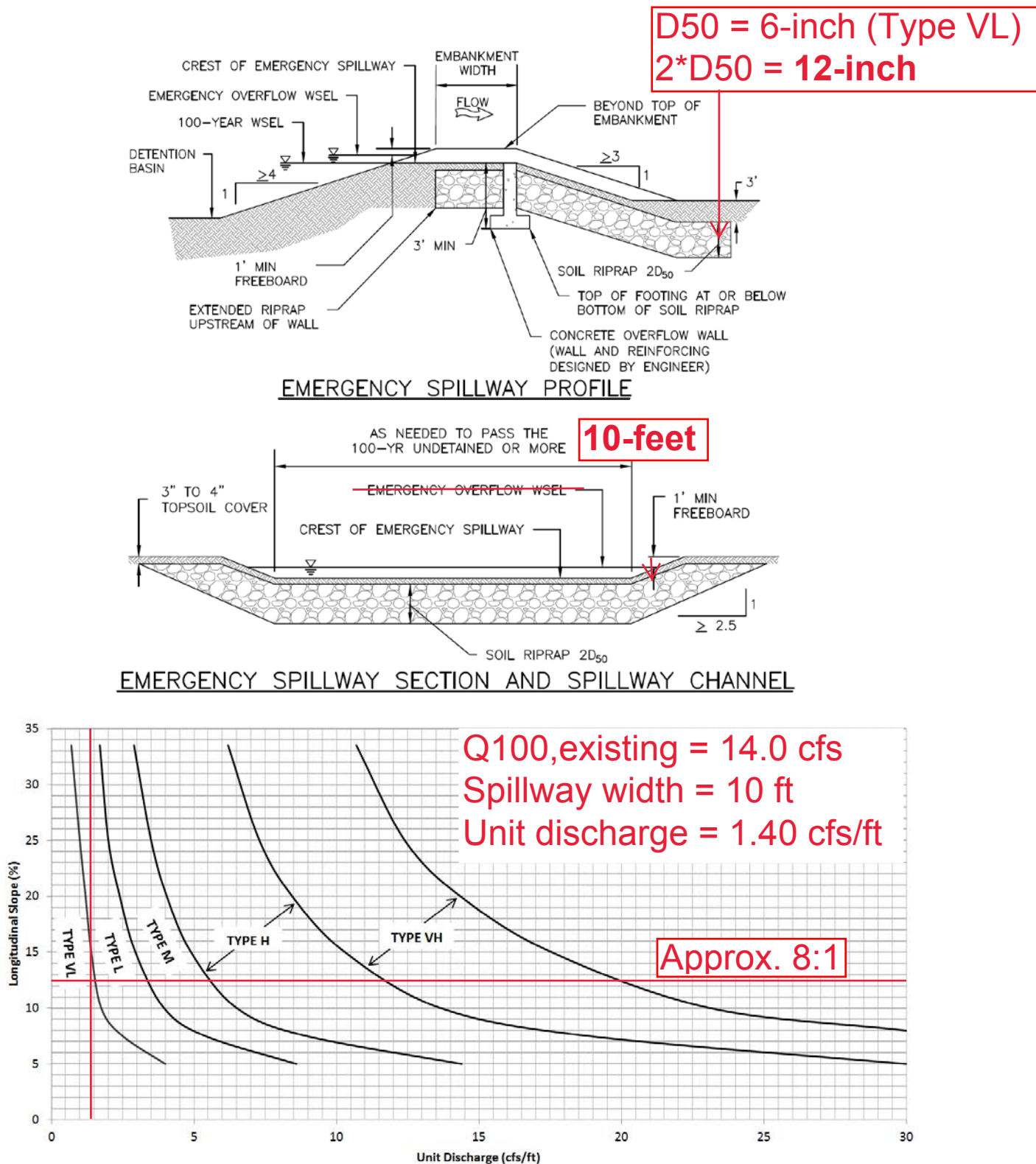
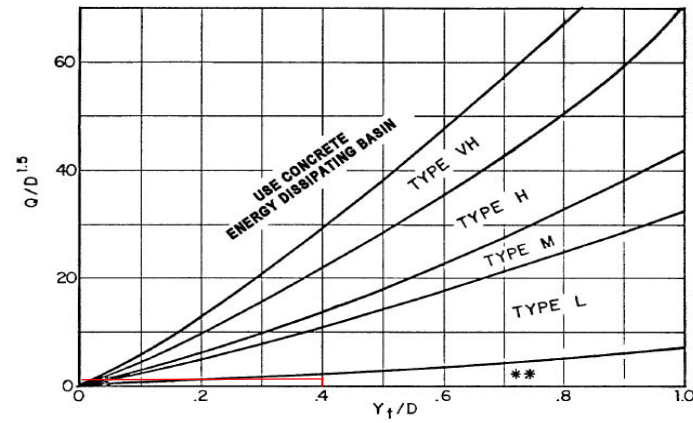


Figure 12-21. Embankment protection details and rock sizing chart (adapted from Arapahoe County)

18" RCP Outfall Protection

| Q (cfs) | Dc (ft) | Yt/Dt | Yt | $Q/D^{1.5}$ | Selected Riprap |
|---------|---------|-------|-----|-------------|-----------------|
| 1.24 | 1.5 | 0.4 | 0.6 | 0.674971 | Type-VL |



Use D_0 instead of D whenever flow is supercritical in the barrel.
 ** Use Type L for a distance of 3D downstream.

Figure 9-38. Riprap erosion protection at circular conduit outlet (valid for $Q/D^{1.5} \leq 6.0$)

Curb and Gutter / Street Capacity

Existing Gutter Capacity Determination

1. Calculate upstream runoff along the gutter line.

The gutter line on the southeast side of Eastonville extends from the proposed driveway to the north side of the Bennet Ranch drainageway crossing.



Google Streetview at the upstream end of the gutter line (north side of Bennet Ranch drainageway crossing).



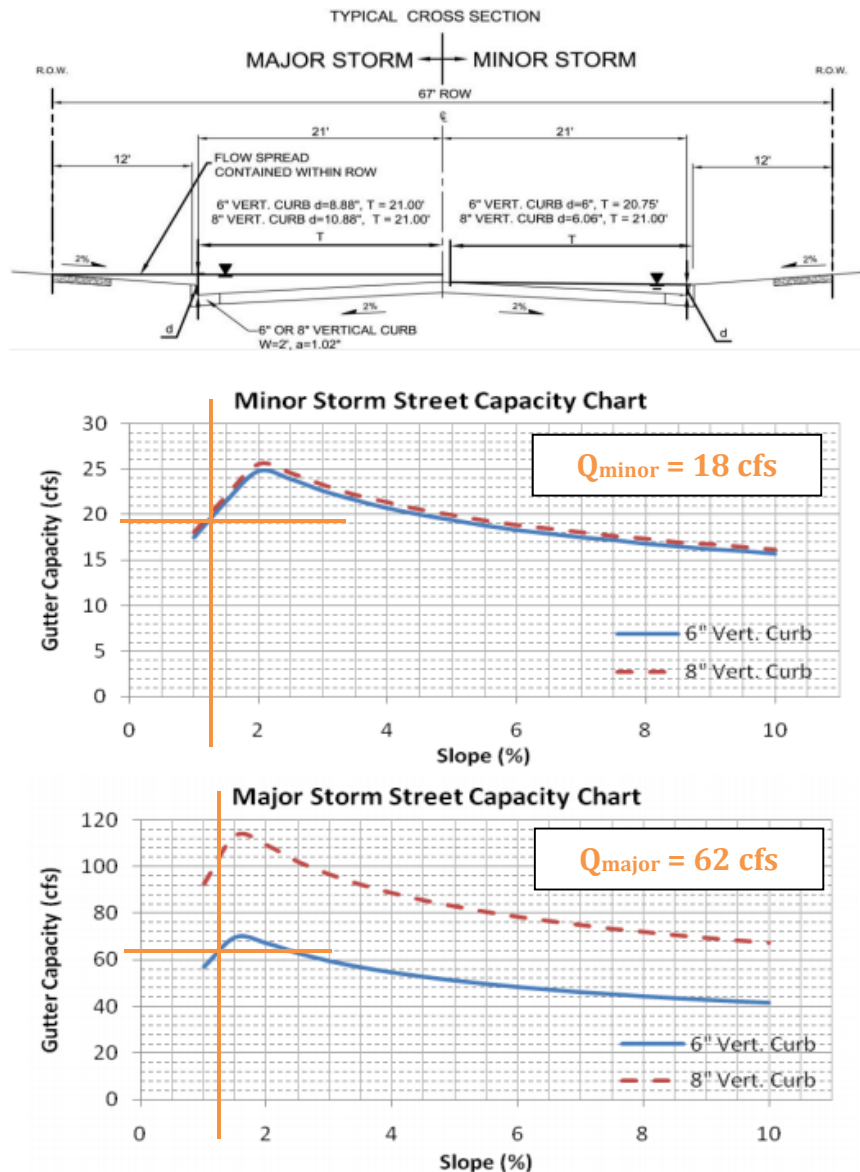
Google Streetview at the upstream end of the gutter line (south side of Bennet Ranch drainageway crossing). Transition from block to 6 inch curb.

The roadway is crowned in the center with two 20 ft wide lanes plus 2 ft wide gutters on each side as per survey, aerial, and CDOT data. To determine the drainage area to the project driveway, the length was measured along the flow line from the driveway to the upstream end of the gutter line. This length (960 ft) was then multiplied by the lane width (20 ft) to get a drainage area of 0.46 acres. The entire drainage area is paved (100% imperviousness). Runoff was calculated using the Rational Method (see **Appendix C, Existing Conditions**).

- Calculate maximum allowable flow in gutter based on El Paso criteria for minor arterials.

Gutter capacity was determined using the street capacity charts in Chapter 7 of DCM-V1-Update. The street is a minor arterial, however, the typical cross-section in Figure 7-5 for Collectors with Parking applies to this roadway (6" vertical curve, $d = 6"$, $T_{\max} = 22'$ (20' travel lane with 2' wide gutter)).

Figure 7-5. Street Capacity Charts Collector (with Parking)



These charts shall only be used for the standard street sections as shown. The capacity shown is based on $\frac{1}{2}$ the street section as calculated by the UD-Inlet spreadsheets. Minor storm capacities are based on no crown overtopping, curb height or maximum allowable spread widths. Major storm capacities are based on flow being contained within the public right-of-way, including conveyance capacity behind the curb. The UDFCD Safety Reduction Factor was applied. An 'n_{STREET}' of 0.016 and 'n_{BACK}' of 0.020 was used. Calculations were done using UD-Inlet 3.00.xls, March, 2011.

| Parameter | Value | Note |
|--------------------------------|------------|--|
| Flow spread, T (ft) | 21 | Length from crown to gutterline (based on CDOT lane width) plus 1 ft gutter width. |
| Longitudinal slope, S (ft/ft) | 0.013 | Measured from the 5958 to 5951 contour. |
| Manning's n, n | 0.016 | From Figure 7-5 of DCM-V1-Update. |
| Minor gutter capacity, Q (cfs) | 18 | Using Figure 7-5 of DCM-V1-Update. |
| 5-year Q (cfs) | 1.8 | From Existing Conditions, UD-Rational. |
| Major gutter capacity, Q (cfs) | 62 | Using Figure 7-5 of DCM-V1-Update. |
| 100-year Q (cfs) | 3.2 | From Existing Conditions, UD-Rational. |

As summarized in the table above, runoff in the minor and major event will be contained within the R.O.W. of Eastonville Road without entering the site.

3. Calculate maximum allowable flow in cross pan/driveway section.

The driveway section geometry was determined from El Paso County Detail SD 2-26 for Typical Cross Pan Layout Detail. Depth from the flowline of the cross pan to the crown of the road is 6.8 inches; the corresponding maximum allowable flow is 51.0 cfs, as shown in the following FlowMasterV8i calculation sheets. The minor and major events will be sufficiently to conveyed in the proposed cross pan along Eatonville Road without entering the site.

Cross Pan and Driveway Section

Project Description

| | |
|-----------------|-----------------|
| Friction Method | Manning Formula |
| Solve For | Discharge |

Input Data

| | | |
|---------------------|---------|-------|
| Channel Slope | 0.01300 | ft/ft |
| Normal Depth | 0.57 | ft |
| Section Definitions | | |

| Station (ft) | Elevation (ft) |
|--------------|----------------|
| -0+22 | 0.57 |
| -0+02 | 0.17 |
| 0+00 | 0.00 |
| 0+06 | 0.17 |
| 0+36 | 0.76 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---------------|----------------|-----------------------|
| (-0+22, 0.57) | (-0+02, 0.17) | 0.016 |
| (-0+02, 0.17) | (0+06, 0.17) | 0.013 |
| (0+06, 0.17) | (0+36, 0.76) | 0.016 |

Options

| | |
|-----------------------------------|---------------------|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

Results

| | | |
|------------------|-----------------|--------------------|
| Discharge | 50.95 | ft ³ /s |
| Elevation Range | 0.00 to 0.76 ft | |
| Flow Area | 11.87 | ft ² |
| Wetted Perimeter | 48.02 | ft |
| Hydraulic Radius | 0.25 | ft |
| Top Width | 48.00 | ft |

Cross Pan and Driveway Section

Results

| | | |
|-----------------|---------------|-------|
| Normal Depth | 0.57 | ft |
| Critical Depth | 0.65 | ft |
| Critical Slope | 0.00522 | ft/ft |
| Velocity | 4.29 | ft/s |
| Velocity Head | 0.29 | ft |
| Specific Energy | 0.85 | ft |
| Froude Number | 1.52 | |
| Flow Type | Supercritical | |

GVF Input Data

| | | |
|------------------|------|----|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

GVF Output Data

| | | |
|---------------------|----------|-------|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.57 | ft |
| Critical Depth | 0.65 | ft |
| Channel Slope | 0.01300 | ft/ft |
| Critical Slope | 0.00522 | ft/ft |

Cross Pan and Driveway Section

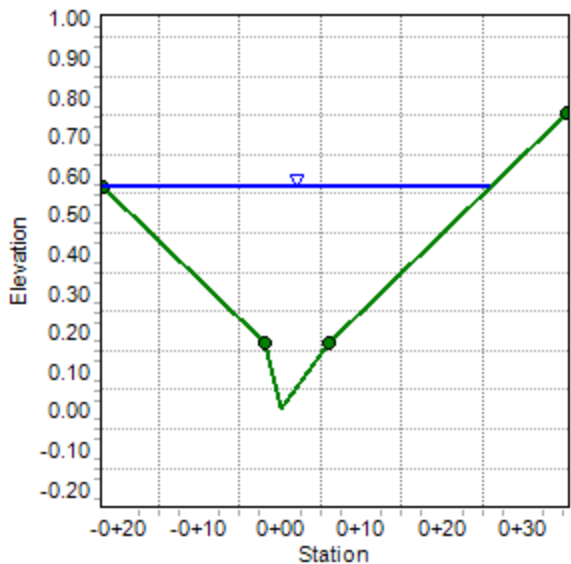
Project Description

| | |
|-----------------|-----------------|
| Friction Method | Manning Formula |
| Solve For | Discharge |

Input Data

| | | |
|---------------|---------|--------------------|
| Channel Slope | 0.01300 | ft/ft |
| Normal Depth | 0.57 | ft |
| Discharge | 50.95 | ft ³ /s |

Cross Section Image



ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

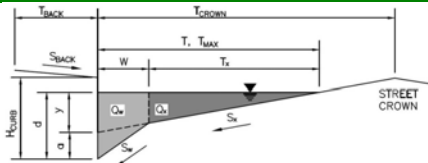
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Liberty Tree Academy

Inlet ID:

Parking Lot - 1' Gutter Vertical Catch Curb

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb

 $T_{BACK} = 20.0$ ft

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

 $S_{BACK} = 0.020$ ft/ft

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

 $n_{BACK} = 0.016$

Height of Curb at Gutter Flow Line

 $H_{CURB} = 6.00$ inches

Distance from Curb Face to Street Crown

 $T_{CROWN} = 30.0$ ft

Gutter Width

 $W = 1.00$ ft

Street Transverse Slope

 $S_X = 0.020$ ft/ft

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

 $S_W = 0.083$ ft/ft

Street Longitudinal Slope - Enter 0 for sump condition

 $S_O = 0.008$ ft/ft

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

 $n_{STREET} = 0.016$

Max. Allowable Spread for Minor & Major Storm

| | Minor Storm | Major Storm | |
|-------------|-------------|-------------|----|
| $T_{MAX} =$ | 30.0 | 30.0 | ft |

Max. Allowable Depth at Gutter Flowline for Minor & Major Storm

| | Minor Storm | Major Storm | |
|-------------|-------------|-------------|--------|
| $d_{MAX} =$ | 6.0 | 12.0 | inches |

Allow Flow Depth at Street Crown (leave blank for no)

☐ ☒ check = yes
MINOR STORM Allowable Capacity is based on Depth Criterion

| | Minor Storm | Major Storm | |
|---------------|-------------|-------------|-----|
| $Q_{allow} =$ | 16.9 | 143.0 | cfs |

MAJOR STORM Allowable Capacity is based on Depth Criterion

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

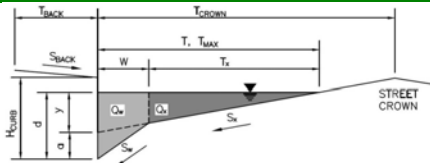
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Liberty Tree Academy

Inlet ID:

Parking Lot - 2' Gutter Vertical Catch Curb

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb

 $T_{BACK} = 20.0$ ft

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

 $S_{BACK} = 0.020$ ft/ft

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

 $n_{BACK} = 0.016$

Height of Curb at Gutter Flow Line

 $H_{CURB} = 6.00$ inches

Distance from Curb Face to Street Crown

 $T_{CROWN} = 30.0$ ft

Gutter Width

 $W = 2.00$ ft

Street Transverse Slope

 $S_X = 0.020$ ft/ft

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

 $S_W = 0.083$ ft/ft

Street Longitudinal Slope - Enter 0 for sump condition

 $S_O = 0.008$ ft/ft

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

 $n_{STREET} = 0.016$

Max. Allowable Spread for Minor & Major Storm

| | Minor Storm | Major Storm | |
|-------------|-------------|-------------|--------|
| $T_{MAX} =$ | 30.0 | 30.0 | ft |
| $d_{MAX} =$ | 6.0 | 12.0 | inches |

Max. Allowable Depth at Gutter Flowline for Minor & Major Storm

Allow Flow Depth at Street Crown (leave blank for no)

☐ ☒ check = yes
MINOR STORM Allowable Capacity is based on Depth Criterion**MAJOR STORM Allowable Capacity is based on Depth Criterion**

| | Minor Storm | Major Storm | |
|---------------|-------------|-------------|-----|
| $Q_{allow} =$ | 11.9 | 126.2 | cfs |

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Bennet Ranch Drainageway Capacity

Worksheet for X1

Project Description

Manning Formula

Normal Depth

Input Data

0.00250 ft/ft

810.00 ft³/s

Section Definitions

| Station (ft) | Elevation (ft) |
|--------------|----------------|
| -1+22 | 6952.00 |
| -1+16 | 6950.54 |
| -1+13 | 6950.00 |
| -1+10 | 6949.29 |
| -1+09 | 6949.00 |
| -1+09 | 6948.91 |
| -1+06 | 6948.39 |
| -1+05 | 6948.06 |
| -1+05 | 6948.00 |
| -1+00 | 6947.87 |
| -1+00 | 6947.87 |
| -0+99 | 6947.65 |
| -0+86 | 6944.96 |
| -0+78 | 6943.42 |
| -0+74 | 6942.94 |
| -0+47 | 6940.17 |
| -0+25 | 6939.53 |
| -0+16 | 6939.30 |
| -0+10 | 6939.19 |
| -0+04 | 6939.09 |
| -0+03 | 6937.77 |
| -0+02 | 6937.26 |
| -0+02 | 6936.77 |
| -0+01 | 6936.76 |
| 0+00 | 6936.87 |
| 0+03 | 6936.85 |
| 0+04 | 6936.83 |

Worksheet for X1

Input Data

| Station (ft) | Elevation (ft) |
|--------------|----------------|
| 0+04 | 6936.87 |
| 0+10 | 6939.19 |
| 0+12 | 6939.53 |
| 0+40 | 6945.19 |
| 0+50 | 6945.19 |

| Start Station | Ending Station | Roughness Coefficient |
|------------------|------------------|-----------------------|
| (-1+22, 6952.00) | (-0+25, 6939.53) | 0.050 |
| (-0+25, 6939.53) | (-0+04, 6939.09) | 0.160 |
| (-0+04, 6939.09) | (0+10, 6939.19) | 0.040 |
| (0+10, 6939.19) | (0+12, 6939.53) | 0.160 |
| (0+12, 6939.53) | (0+50, 6945.19) | 0.050 |

Options

| | |
|-----------------------------------|---------------------|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

Results

| | | |
|------------------|-----------------------|-----------------|
| Normal Depth | 7.14 | ft |
| Elevation Range | 6936.76 to 6952.00 ft | |
| Flow Area | 396.96 | ft ² |
| Wetted Perimeter | 115.86 | ft |
| Hydraulic Radius | 3.43 | ft |
| Top Width | 113.90 | ft |
| Normal Depth | 7.14 | ft |
| Critical Depth | 4.13 | ft |
| Critical Slope | 0.08816 | ft/ft |

Worksheet for X1

Results

| | | |
|-----------------|-------------|------|
| Velocity | 2.04 | ft/s |
| Velocity Head | 0.06 | ft |
| Specific Energy | 7.20 | ft |
| Froude Number | 0.19 | |
| Flow Type | Subcritical | |

GVF Input Data

| | | |
|------------------|------|----|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

GVF Output Data

| | | |
|---------------------|----------|-------|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 7.14 | ft |
| Critical Depth | 4.13 | ft |
| Channel Slope | 0.00250 | ft/ft |
| Critical Slope | 0.08816 | ft/ft |

Cross Section for X1

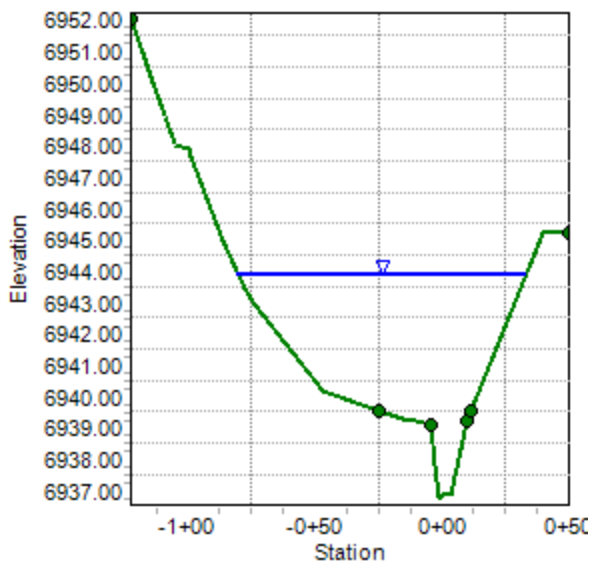
Project Description

| | |
|-----------------|-----------------|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

Input Data

| | | |
|---------------|---------|--------------------|
| Channel Slope | 0.00250 | ft/ft |
| Normal Depth | 7.14 | ft |
| Discharge | 810.00 | ft ³ /s |

Cross Section Image



Worksheet for X2

Project Description

| | |
|-----------------|-----------------|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

Input Data

| | | |
|---------------------|---------|-------|
| Channel Slope | 0.00250 | ft/ft |
| Discharge | 810.00 | ft³/s |
| Section Definitions | | |

| Station (ft) | Elevation (ft) |
|--------------|----------------|
| -1+21 | 6952.00 |
| -1+18 | 6951.62 |
| -1+13 | 6950.84 |
| -1+11 | 6950.71 |
| -0+89 | 6947.86 |
| -0+87 | 6947.61 |
| -0+85 | 6947.40 |
| -0+47 | 6943.05 |
| -0+46 | 6943.02 |
| -0+22 | 6941.67 |
| -0+17 | 6941.62 |
| -0+10 | 6941.78 |
| -0+08 | 6940.48 |
| -0+05 | 6938.40 |
| -0+03 | 6938.21 |
| 0+00 | 6938.00 |
| 0+02 | 6938.02 |
| 0+03 | 6938.02 |
| 0+10 | 6941.78 |
| 0+40 | 6947.78 |
| 0+55 | 6947.78 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---------------|----------------|-----------------------|
|---------------|----------------|-----------------------|

Worksheet for X2

Input Data

| Start Station | Ending Station | Roughness Coefficient |
|------------------|------------------|-----------------------|
| (-1+21, 6952.00) | (-0+22, 6941.67) | 0.050 |
| (-0+22, 6941.67) | (-0+10, 6941.78) | 0.160 |
| (-0+10, 6941.78) | (0+10, 6941.78) | 0.040 |
| (0+10, 6941.78) | (0+55, 6947.78) | 0.050 |

Options

| | |
|-----------------------------------|---------------------|
| Current Roughness weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

Results

| | | |
|------------------|-----------------------|-----------------|
| Normal Depth | 7.87 | ft |
| Elevation Range | 6938.00 to 6952.00 ft | |
| Flow Area | 346.08 | ft ² |
| Wetted Perimeter | 104.77 | ft |
| Hydraulic Radius | 3.30 | ft |
| Top Width | 102.19 | ft |
| Normal Depth | 7.87 | ft |
| Critical Depth | 4.97 | ft |
| Critical Slope | 0.06270 | ft/ft |
| Velocity | 2.34 | ft/s |
| Velocity Head | 0.09 | ft |
| Specific Energy | 7.96 | ft |
| Froude Number | 0.22 | |
| Flow Type | Subcritical | |

GVF Input Data

| | | |
|------------------|------|----|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

GVF Output Data

| | | |
|----------------|------|----|
| Upstream Depth | 0.00 | ft |
|----------------|------|----|

Worksheet for X2

GVF Output Data

| | | |
|---------------------|----------|-------|
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 7.87 | ft |
| Critical Depth | 4.97 | ft |
| Channel Slope | 0.00250 | ft/ft |
| Critical Slope | 0.06270 | ft/ft |

Cross Section for X2

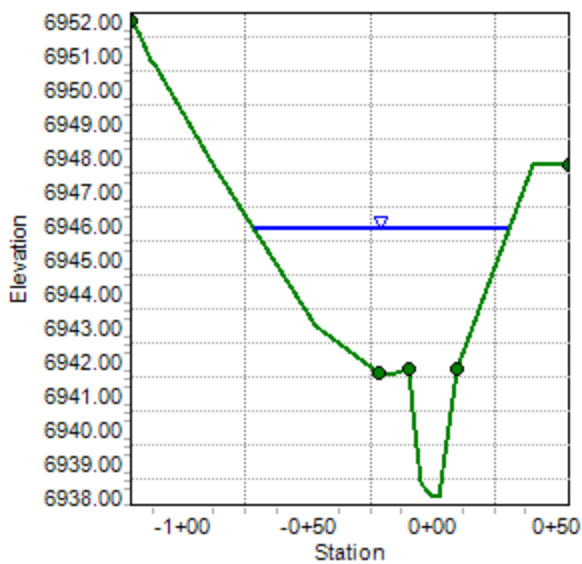
Project Description

| | |
|-----------------|-----------------|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

Input Data

| | | |
|---------------|---------|--------------------|
| Channel Slope | 0.00250 | ft/ft |
| Normal Depth | 7.87 | ft |
| Discharge | 810.00 | ft ³ /s |

Cross Section Image



Cross Section for X2, WSEL = 6942

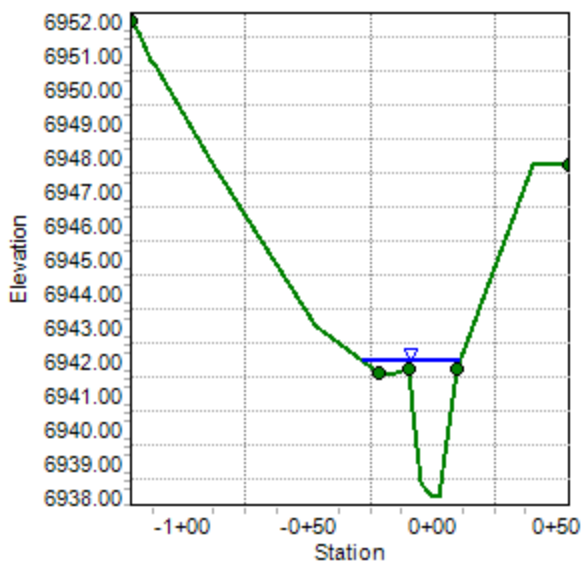
Project Description

| | |
|-----------------|-----------------|
| Friction Method | Manning Formula |
| Solve For | Discharge |

Input Data

| | | |
|---------------|---------|--------------------|
| Channel Slope | 0.00250 | ft/ft |
| Normal Depth | 4.00 | ft |
| Discharge | 59.97 | ft ³ /s |

Cross Section Image



Cross Section for X2, WSEL = 6945

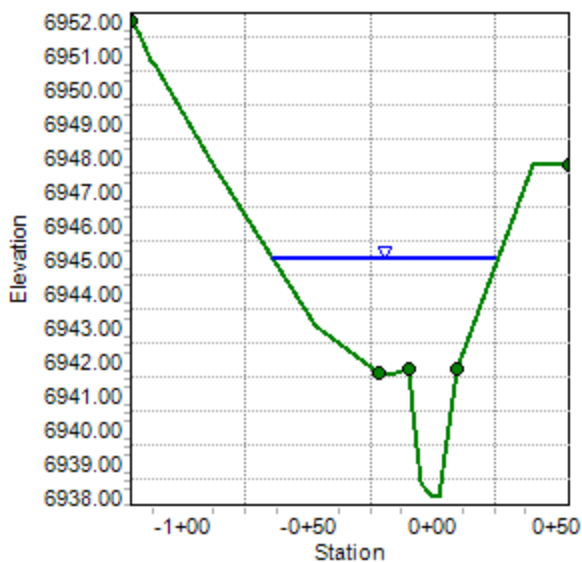
Project Description

| | |
|-----------------|-----------------|
| Friction Method | Manning Formula |
| Solve For | Discharge |

Input Data

| | | |
|---------------|---------|--------------------|
| Channel Slope | 0.00250 | ft/ft |
| Normal Depth | 7.00 | ft |
| Discharge | 537.83 | ft ³ /s |

Cross Section Image



APPENDIX E – REFERENCED DOCUMENTS

Selected Pages from the Bennett Ranch

Drainage Basin Planning Study

MATCH LINE SHEET 3

REPLACE EXISTING 48" CMP (CUL-01)
WITH 30" (W) X 7' (H) RCB
PRIORITY: MEDIUM
ESTIMATED COST: \$365,400

SCALE: 1" = 1000'

WEST FORK
SQUIRREL CREEK

CONSTRUCT 9 CHECK
STRUCTURES (3' DROPS)
450' O.C. TO MAINTAIN A
MAXIMUM CHANNEL SLOPE OF
0.7 PERCENT
PRIORITY: LOW
ESTIMATED COST: \$65,250

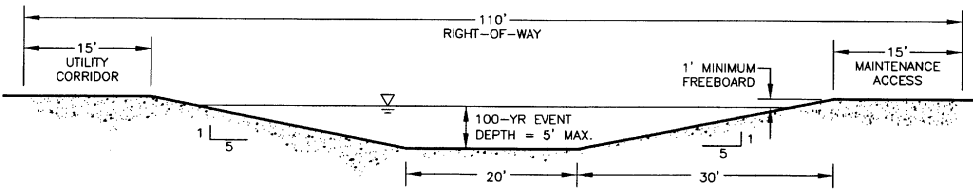
WATERSHED BOUNDS

FIGURE 7-1
SHEET 4



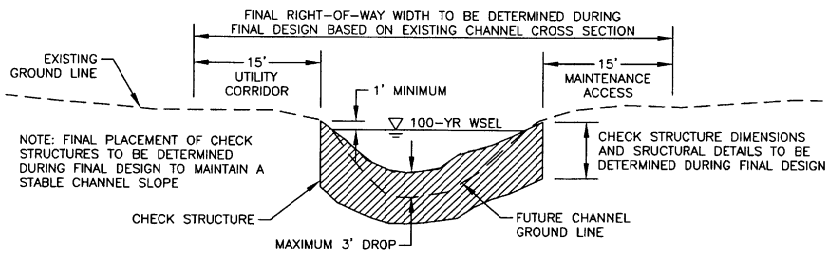
WATER
& ENVIRONMENTAL
CONSULTANTS, INC.
Engineering, Scientific, & Financial Specialists in Stormwater Management

drawn by: FAP, WCB
designed by: KKB
checked by: KKB
project no.: 2000-0818
drawing no.:
date: MAR 01
revisions:



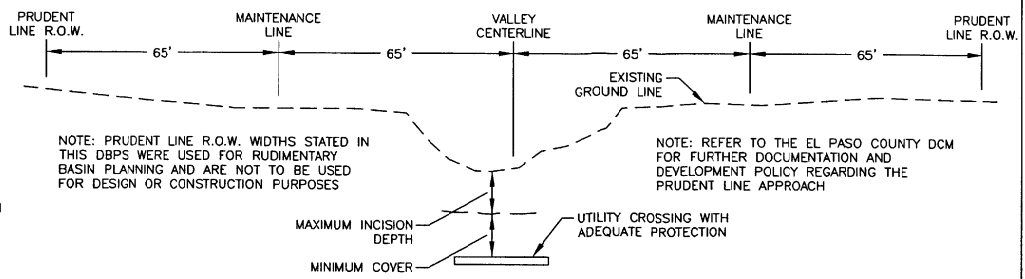
TYPICAL NEW CHANNEL CROSS SECTION

STAPLETON DRIVE TO DRAKE POND
SCALE: 1"=10'



TYPICAL EXISTING CHANNEL CROSS SECTION WITH CHECK STRUCTURES

SUNNYSLOPE DRIVE TO WEST FORK SQUIRREL CREEK
SCALE: 1"=10'



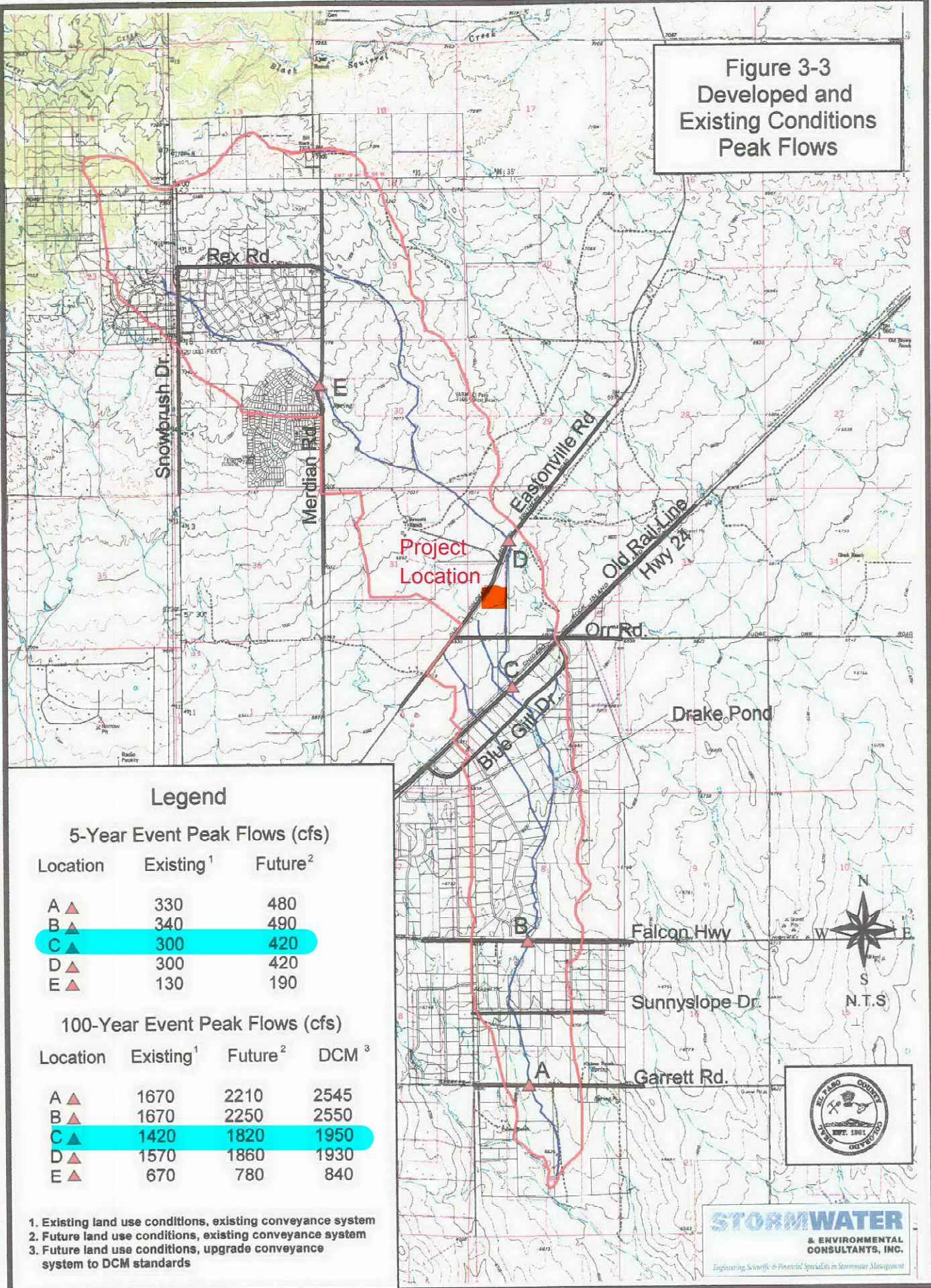
NOTE: PRUDENT LINE R.O.W. WIDTHS STATED IN THIS DBPS WERE USED FOR RUDIMENTARY BASIN PLANNING AND ARE NOT TO BE USED FOR DESIGN OR CONSTRUCTION PURPOSES

NOTE: REFER TO THE EL PASO COUNTY DCM FOR FURTHER DOCUMENTATION AND DEVELOPMENT POLICY REGARDING THE PRUDENT LINE APPROACH

TYPICAL PRUDENT LINE CHANNEL
SNOWBRUSH DRIVE TO MERIDIAN ROAD
NOT TO SCALE

DRAFT BENNETT
RANCH PILOT PROJECT

**Figure 3-3
Developed and
Existing Conditions
Peak Flows**



FEMA Flood Maps

URBAN DRAINAGE FLOOD CONTROL DISTRICT STANDARDS

Table EDB-4. EDB component criteria

| | On-Site EDBs for Watersheds up to 1 Impervious Acre ¹ | EDBs with Watersheds between 1 and 2 Impervious Acres ¹ | EDBs with Watersheds up to 5 Impervious Acres | EDBs with Watersheds over 5 Impervious Acres | EDBs with Watersheds over 20 Impervious Acres |
|-----------------------------------|--|---|---|---|---|
| Forebay Release and Configuration | EDBs should not be used for watersheds with less than 1 impervious acre. | Release 2% of the undetained 100-year peak discharge by way of a wall/notch configuration | Release 2% of the undetained 100-year peak discharge by way of a wall/notch configuration | Release 2% of the undetained 100-year peak discharge by way of a wall/notch configuration | Release 2% of the undetained 100-year peak discharge by way of a wall/notch or berm/pipe ² configuration |
| Minimum Forebay Volume | | 1% of the WQCV | 2% of the WQCV | 3% of the WQCV | 3% of the WQCV |
| Maximum Forebay Depth | | 12 inches | 18 inches | 18 inches | 30 inches |
| Trickle Channel Capacity | | ≥ the maximum possible forebay outlet capacity | ≥ the maximum possible forebay outlet capacity | ≥ the maximum possible forebay outlet capacity | ≥ the maximum possible forebay outlet capacity |
| Micropool | | Area ≥ 10 ft ² | Area ≥ 10 ft ² | Area ≥ 10 ft ² | Area ≥ 10 ft ² |
| Initial Surge Volume | | Depth ≥ 4 inches | Depth ≥ 4 inches | Depth ≥ 4 in. Volume ≥ 0.3% WQCV | Depth ≥ 4 in. Volume ≥ 0.3% WQCV |

¹ EDBs are not recommended for sites with less than 2 impervious acres. Consider a sand filter or rain garden.

² Round up to the first standard pipe size (minimum 8 inches).

5. **Forebay Design:** The forebay provides an opportunity for larger particles to settle out in an area that can be easily maintained. The length of the flow path through the forebay should be maximized, and the slope minimized to encourage settling. The appropriate size of the forebay may be as much a function of the level of development in the tributary area as it is a percentage of the WQCV. When portions of the watershed may remain disturbed for an extended period of time, the forebay size will need to be increased due to the potentially high sediment load. Refer to Table EDB-4 for a design criteria summary. When using this table, the designer should consider increasing the size of the forebay if the watershed is not fully developed.

The forebay outlet should be sized to release 2% of the undetained peak 100-year discharge. A soil riprap berm with 3:1 sideslopes (or flatter) and a pipe outlet or a concrete wall with a notch outlet should be constructed between the forebay and the main EDB. It is recommended that the berm/pipe configuration be reserved for watersheds in excess of 20 impervious acres to accommodate the minimum recommended pipe diameter of 8 inches. When using the berm/pipe configuration, round up to the nearest standard pipe size and use a minimum diameter of 8 inches. The floor of the forebay should be concrete or lined with grouted boulders to define sediment removal limits. With either configuration, soil riprap should also be provided on the downstream side of the forebay berm or wall if the downstream grade is lower than the top of the berm or wall. The forebay will overtop frequently so this protection is necessary for erosion control. All soil riprap in the area of the forebay should be seeded and erosion control fabric should be placed to retain the seed in this high flow area.

6. **Trickle Channel:** Convey low flows from the forebay to the micropool with a trickle channel. The trickle channel should have a minimum flow capacity equal to the maximum release from the forebay outlet.
- **Concrete Trickle Channels:** A concrete trickle channel will help to establish the bottom of the basin long-term and may also facilitate regular sediment removal. It can be a "V" shaped concrete drain pan or a concrete channel with curbs. A flat-bottom channel facilitates maintenance. A slope between 0.4% - 1% is recommended to encourage settling while reducing the potential for low points within the pan.
 - **Soft-bottom Trickle Channels:** When designed and maintained properly, soft-bottom trickle channels can allow for an attractive alternative to concrete. They can also improve water quality. However, they are not appropriate for all sites. Be aware, maintenance of soft bottom trickle channels requires mechanical removal of sediment and vegetation. Additionally, this option provides mosquito habitat. For this reason, UDFCD recommends that they be considered on a case-by-case basis and with the approval of the local jurisdiction. It is recommended that soft bottom trickle channels be designed with a consistent longitudinal slope from forebay to micropool and that they not meander. This geometry will allow for reconstruction of the original design when sediment removal in the trickle channel is necessary. The trickle channel may also be located along the toe of the slope if a straight channel is not desired. The recommended minimum depth of a soft bottom trickle channel is 1.5 feet. This depth will help limit potential wetland growth to the trickle channel, preserving the bottom of the basin.

Riprap and soil riprap lined trickle channels are not recommended due to past maintenance experiences, where the riprap was inadvertently removed along with the sediment during maintenance.

7. **Micropool and Outlet Structure:** Locate the outlet structure in the embankment of the EDB and provide a permanent micropool directly in front of the structure. Submerge the well screen to the bottom of the micropool. This will reduce clogging of the well screen because it allows water to flow through the well screen below the elevation of the lowest orifice even when the screen above the water surface is plugged. This will prevent shallow ponding in front of the structure, which provides a breeding ground for mosquitoes (large shallow puddles tend to produce more mosquitoes than a smaller, deeper permanent pond).

Micropool side slopes may be vertical walls or stabilized slopes of 3:1 (horizontal:vertical). For watersheds with less than 5 impervious acres, the micropool can be located inside the outlet structure (refer to Figures OS-7 and OS-8 provided in Fact Sheet T-12). The micropool should be at least 2.5 feet in depth with a minimum surface area of 10 square feet. The bottom should be concrete unless a baseflow is present or anticipated or if groundwater is anticipated. Riprap is not recommended because it complicates maintenance operations.

Where possible, place the outlet in an inconspicuous location as shown in Photo EDB-3. This urban EDB utilizes landscaped parking lot islands connected by a series of culverts (shown in Photo EDB-4) to provide the required water quality and flood control volumes.

The outlet should be designed to release the WQCV over a 40-hour period. Draining a volume of water over a specified time can be done through an orifice plate as detailed in Fact Sheet T-12. Use reservoir routing calculations as discussed in the *Storage* Chapter of Volume 2 to assist in the design. Two workbooks tools have been developed by UDFCD for this purpose, UD-FSD and UD-Detention. Both are available at www.udfcd.org. UD-FSD is recommended for a typical EDB full spectrum detention design. UD-Detention uses the same methodology and can be used for a full spectrum detention basin or a WQCV only design. It also allows for a wider range of outlet controls should the user want to specify something beyond what is shown in Fact Sheet T-12.

Refer to BMP Fact Sheet T-12 for schematics pertaining to structure geometry, grates, trash racks, orifice plate, and all other necessary components.

The outlet may have flared or parallel wing walls as shown in Figures EDB-1 and EDB-2, respectively. Either configuration should be recessed into the embankment to minimize its profile. Additionally, the trash rack should be sloped with the basin side-slopes.

Basins with micropools have fewer mosquitoes. Micropools reduce shallow wet areas where breeding is most favorable.

Off-site Drainageway Analysis

From UDFCD, Volume 1:

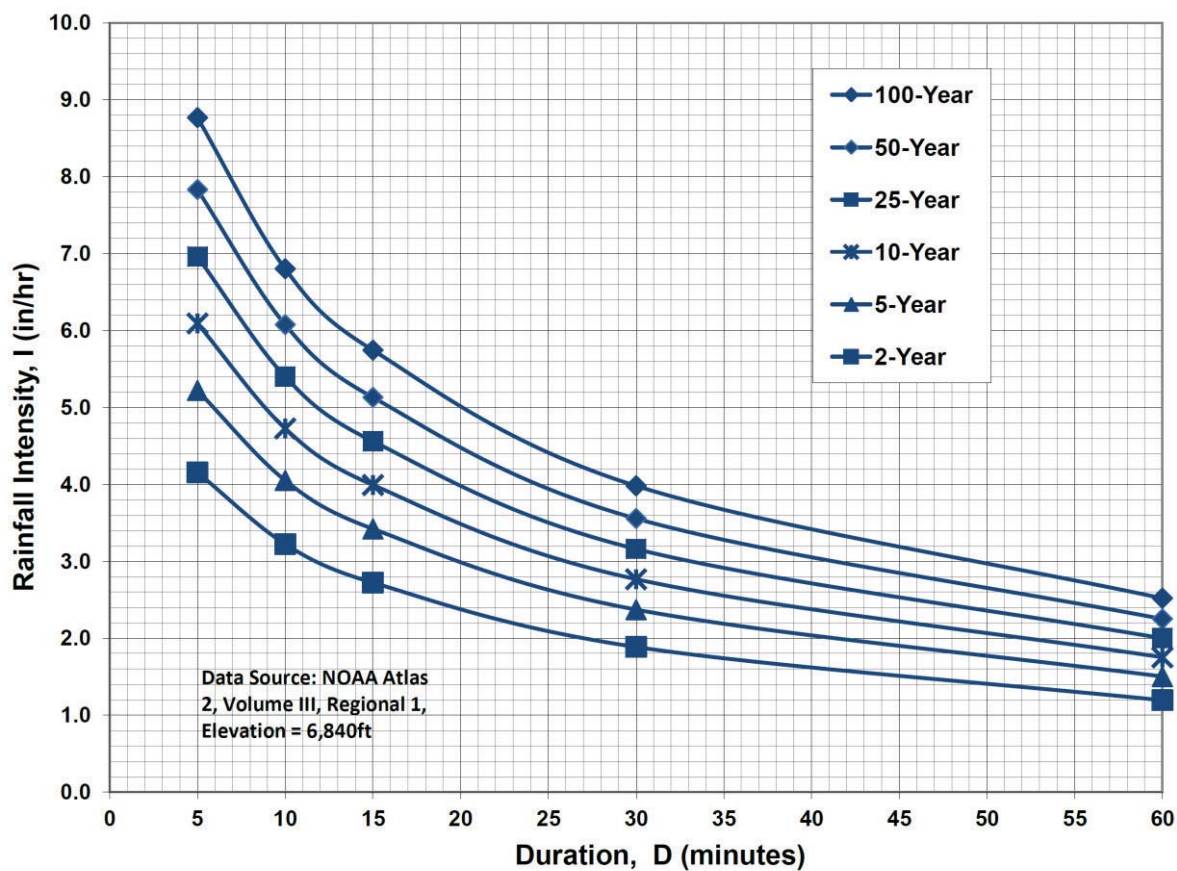
Table 8-5. Recommended roughness values

| Location and Cover | When Assessing Velocity, Froude No., Shear Stress | When Assessing Water Surface Elevation and Water Depth |
|---|--|---|
| <u>Main Channel (bankfull channel)</u> | | |
| Sand or clay bed | 0.03 | 0.04 |
| Gravel or cobble bed | 0.035 | 0.07 |
| <u>Vegetated Overbanks</u> | | |
| Turfgrass sod | 0.03 | 0.04 |
| Native grasses | 0.032 | 0.05 |
| Herbaceous wetlands (few or no willows) | 0.06 | 0.12 |
| Willow stands, woody shrubs | 0.07 | 0.16 |

(Source: Chow 1959, USDA 1954, Barnes 1967, Arcement and Schneider 1989, Jarrett 1985)

El Paso County Drainage Criteria Manual

Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

$$I_{100} = -2.52 \ln(D) + 12.735$$

$$I_{50} = -2.25 \ln(D) + 11.375$$

$$I_{25} = -2.00 \ln(D) + 10.111$$

$$I_{10} = -1.75 \ln(D) + 8.847$$

$$I_5 = -1.50 \ln(D) + 7.583$$

$$I_2 = -1.19 \ln(D) + 6.035$$

Note: Values calculated by equations may not precisely duplicate values read from figure.

APPENDIX F – MAINTENANANCE AGREEMENT

Remove from the drainage report and submit as upload as a standalone document.

Appendix G Stormwater BMP Maintenance Agreements
Adopted: 12/23/2004
Revised: 12/13/2016
REVISION 6

This document has been removed and is submitted as a separate document.

**PRIVATE DETENTION BASIN /
STORMWATER QUALITY BEST MANAGEMENT PRACTICE
MAINTENANCE AGREEMENT AND EASEMENT**

This PRIVATE DETENTION BASIN / STORMWATER QUALITY BEST MANAGEMENT PRACTICE MAINTENANCE AGREEMENT AND EASEMENT (Agreement) is made by and between EL PASO COUNTY by and through THE BOARD OF COUNTY COMMISSIONERS OF EL PASO COUNTY, COLORADO (Board or County) and Liberty Tree Academy (Owner or Developer). The above may occasionally be referred to herein singularly as "Party" and collectively as "Parties."

Recitals

A. WHEREAS, Developer is the owner of certain real estate (the Property or Subdivision) in El Paso County, Colorado, which Property is legally described in Exhibit A attached hereto and incorporated herein by this reference; and

B. WHEREAS, Developer desires to plat and develop on the Property a subdivision/land use to be known as Liberty Tree Academy; and

C. WHEREAS, the development of this Property will substantially increase the volume of water runoff and will decrease the quality of the stormwater runoff from the Property, and, therefore, it is in the best interest of public health, safety and welfare for the County to condition approval of this subdivision/land use on Developer's promise to construct adequate drainage, water runoff control facilities, and stormwater quality structural Best Management Practices ("BMPs") for the subdivision/land use; and

D. WHEREAS, Chapter 8, Section 8.4.5 of the El Paso County Land Development Code, as periodically amended, promulgated pursuant to Section 30-28-133(1), Colorado Revised Statutes (C.R.S.), requires the County to condition approval of all subdivisions on a developer's promise to so construct adequate drainage, water runoff control facilities, and BMPs in subdivisions; and

E. WHEREAS, the Drainage Criteria Manual, Volume 2, as amended by Appendix I of the El Paso County Engineering Criteria Manual (ECM), as each may be periodically amended, promulgated pursuant to the County's Colorado Discharge Permit System General Permit (MS4 Permit) as required by Phase II of the National Pollutant Discharge Elimination System (NPDES), which MS4 Permit requires that the County take measures to protect the quality of stormwater from sediment and other contaminants, requires subdividers, developers, landowners, and owners of facilities located in the County's rights-of-way or easements to

provide adequate permanent stormwater quality BMPs with new development or significant redevelopment; and

F. WHEREAS, Section 2.9 of the El Paso County Drainage Criteria Manual provides for a developer's promise to maintain a subdivision's drainage facilities in the event the County does not assume such responsibility; and

G. WHEREAS, developers in El Paso County have historically chosen water runoff detention basins as a means to provide adequate drainage and water runoff control in subdivisions, which basins, while effective, are less expensive for developers to construct than other methods of providing drainage and water runoff control; and

H. WHEREAS, Developer desires to construct for the subdivision/land use one (1) detention basin/stormwater quality BMP(s) ("detention basin/BMP(s)") as the means for providing adequate drainage and stormwater runoff control and to meet requirements of the County's MS4 Permit, and to operate, clean, maintain and repair such detention basin/BMP(s); and

I. WHEREAS, Developer desires to construct the detention basin/BMP(s) on property that is or will be platted as Woodman Hills Filing No. 10, Plat # 10942, as indicated on the final plat of the subdivision, and as set forth on Exhibit B attached hereto; and

J. WHEREAS, Developer shall be charged with the duties of constructing, operating, maintaining and repairing the detention basin/BMP(s) on the Property described in Exhibit B; and

K. WHEREAS, it is the County's experience that subdivision developers and property owners historically have not properly cleaned and otherwise not properly maintained and repaired these detention basins/BMPs, and that these detention basins/BMPs, when not so properly cleaned, maintained, and repaired, threaten the public health, safety and welfare; and

L. WHEREAS, the County, in order to protect the public health, safety and welfare, has historically expended valuable and limited public resources to so properly clean, maintain, and repair these detention basins/BMPs when developers and property owners have failed in their responsibilities, and therefore, the County desires the means to recover its costs incurred in the event the burden falls on the County to so clean, maintain and repair the detention basin/BMP(s) serving this subdivision/land use due to the Developer/Owner's failure to meet its obligations to do the same; and

M. WHEREAS, the County conditions approval of this subdivision/land use on the Developer's promise to so construct the detention basin/BMP(s), and conditions approval on the Owner's promise to reimburse the County in the event the burden falls upon the County to so clean, maintain and/or repair the detention basin/BMP(s) serving this Subdivision; and

N. WHEREAS, the County could condition subdivision/land use approval on the Developer's promise to construct a different and more expensive drainage, water runoff control system and BMPs than those proposed herein, which more expensive system would not create the possibility of the burden of cleaning, maintenance and repair expenses falling on the County; however, the County is willing to forego such right upon the performance of Developer/Owner's promises contained herein; and

O. WHEREAS, the County, in order to secure performance of the promises contained herein, conditions approval of this subdivision/land use upon the Developer's grant herein of a perpetual Easement over a portion of the Property for the purpose of allowing the County to periodically access, inspect, and, when so necessary, to clean, maintain and/or repair the detention basin/BMP(s); and

Agreement

NOW, THEREFORE, in consideration of the mutual Promises contained herein, the sufficiency of which are hereby acknowledged, the Parties agree as follows:

1. Incorporation of Recitals: The Parties incorporate the Recitals above into this Agreement.

2. Covenants Running with the Land: Developer/Owner agrees that this entire Agreement and the performance thereof shall become a covenant running with the land, which land is legally described in Exhibit A attached hereto, and that this entire Agreement and the performance thereof shall be binding upon itself, its successors and assigns.

3. Construction: Developer shall construct on that portion of the Property described in Exhibit B attached hereto and incorporated herein by this reference, one (1) detention basin/BMP(s). Developer shall not commence construction of the detention basin/BMP(s) until the El Paso County Development Services Department (DSD) has approved in writing the plans and specifications for the detention basin/BMP(s) and this Agreement has been signed by all Parties and returned to the DSD. Developer shall complete construction of the detention basin/BMP(s) in substantial compliance with the County-approved plans and specifications for the detention basin/BMP(s). Failure to meet these requirements shall be a material breach of this Agreement, and shall entitle the County to pursue any remedies available to it at law or in equity to enforce the same. Construction of the detention basin/BMP(s) shall be substantially completed within one (1) year (defined as 365 days), which one year period will commence to run on the date the approved plat of this Subdivision is recorded in the records of the El Paso County Clerk and Recorder. In cases where a subdivision is not required, the one year period will commence to run on the date the Erosion and Stormwater Quality Control Permit (ESQCP) is issued. Rough grading of the detention

basin/BMP(s) must be completed and inspected by the El Paso County Development Services Department prior to commencing road construction.

In the event construction is not substantially completed within the one (1) year period, then the County may exercise its discretion to complete the project, and shall have the right to seek reimbursement from the Developer/Owner and its successors and assigns, for its actual costs and expenses incurred in the process of completing construction. The term actual costs and expenses shall be liberally construed in favor of the County, and shall include, but shall not be limited to, labor costs, tool and equipment costs, supply costs, and engineering and design costs, regardless of whether the County uses its own personnel, tools, equipment and supplies, etc. to correct the matter. In the event the County initiates any litigation or engages the services of legal counsel in order to enforce the Provisions arising herein, the County shall be entitled to its damages and costs, including reasonable attorney fees, regardless of whether the County contracts with outside legal counsel or utilizes in-house legal counsel for the same.

4. Maintenance: The Developer/Owner agrees for itself and its successors and assigns, that it will regularly and routinely inspect, clean and maintain the detention basin/BMP(s), and otherwise keep the same in good repair, all at its own cost and expense. No trees or shrubs that will impair the structural integrity of the detention basin/BMP(s) shall be planted or allowed to grow on the detention basin/BMP(s).

5. Creation of Easement: Developer/Owner hereby grants the County a non-exclusive perpetual easement upon and across that portion of the Property described in Exhibit B. The purpose of the easement is to allow the County to access, inspect, clean, repair and maintain the detention basin/BMP(s); however, the creation of the easement does not expressly or implicitly impose on the County a duty to so inspect, clean, repair or maintain the detention basin/BMP(s).

6. County's Rights and Obligations: Any time the County determines, in the sole exercise of its discretion, that the detention basin/BMP(s) is not properly cleaned, maintained and/or otherwise kept in good repair, the County shall give reasonable notice to the Developer/Owner and its successors and assigns, that the detention basin/BMP(s) needs to be cleaned, maintained and/or otherwise repaired. The notice shall provide a reasonable time to correct the problem(s). Should the responsible parties fail to correct the specified problem(s), the County may enter upon the Property to so correct the specified problem(s). Notice shall be effective to the above by the County's deposit of the same into the regular United States mail, postage pre-paid. Notwithstanding the foregoing, this Agreement does not expressly or implicitly impose on the County a duty to so inspect, clean, repair or maintain the detention basin/BMP(s).

7. Reimbursement of County's Costs / Covenant Running With the Land: The Developer/Owner agrees and covenants, for itself, its successors and assigns, that it will reimburse the County for its costs and expenses incurred in the process of completing construction of, cleaning, maintaining, and/or repairing the detention basin/BMP(s) pursuant to the provisions of this Agreement.

The term “actual costs and expenses” shall be liberally construed in favor of the County, and shall include, but shall not be limited to, labor costs, tools and equipment costs, supply costs, and engineering and design costs, regardless of whether the County uses its own personnel, tools, equipment and supplies, etc. to correct the matter. In the event the County initiates any litigation or engages the services of legal counsel in order to enforce the provisions arising herein, the County shall be entitled to its damages and costs, including reasonable attorney’s fees, regardless of whether the County contracts with outside legal counsel or utilizes in-house legal counsel for the same.

8. Contingencies of Land Use/Land Disturbance Approval: Developer/Owner’s execution of this Agreement is a condition of land use/land disturbance approval.

The County shall have the right, in the sole exercise of its discretion, to approve or disapprove any documentation submitted to it under the conditions of this Paragraph, including but not limited to, any separate agreement or amendment, if applicable, identifying any specific maintenance responsibilities not addressed herein. The County’s rejection of any documentation submitted hereunder shall mean that the appropriate condition of this Agreement has not been fulfilled.

9. Agreement Monitored by El Paso County Development Services Department and/or El Paso County Public Services Department: Any and all actions and decisions to be made hereunder by the County shall be made by the Director of the El Paso County Development Services Department and/or the Director of the El Paso County Public Services Department. Accordingly, any and all documents, submissions, plan approvals, inspections, etc. shall be submitted to and shall be made by the Director of the Development Services Department and/or the Director of the El Paso County Public Services Department.

10. Indemnification and Hold Harmless: To the extent authorized by law, Developer/Owner agrees, for itself, its successors and assigns, that it will indemnify, defend, and hold the County harmless from any and all loss, costs, damage, injury, liability, claim, lien, demand, action and causes of action whatsoever, whether at law or in equity, arising from or related to its intentional or negligent acts, errors or omissions or that of its agents, officers, servants, employees, invitees and licensees in the construction, operation, inspection, cleaning (including analyzing and disposing of any solid or hazardous wastes as defined by State and/or Federal environmental laws and regulations), maintenance, and repair of the detention basin/BMP(s), and such obligation arising under this Paragraph shall be joint and several. Nothing in this Paragraph shall be deemed to waive or otherwise limit the defense available to the County pursuant to the Colorado Governmental Immunity Act, Sections 24-10-101, *et seq.* C.R.S., or as otherwise provided by law.

11. Severability: In the event any Court of competent jurisdiction declares any part of this Agreement to be unenforceable, such declaration shall not affect the enforceability of the remaining parts of this Agreement.

12. Third Parties: This Agreement does not and shall not be deemed to confer upon or grant to any third party any right to claim damages or to bring any lawsuit, action or other proceeding against either the County, the Developer/Owner, or their respective successors and assigns, because of any breach hereof or because of any terms, covenants, agreements or conditions contained herein.


13. Solid Waste or Hazardous Materials: Should any refuse from the detention basin/BMP(s) be suspected or identified as solid waste or petroleum products, hazardous substances or hazardous materials (collectively referred to herein as "hazardous materials"), the Developer/Owner shall take all necessary and proper steps to characterize the solid waste or hazardous materials and properly dispose of it in accordance with applicable State and/or Federal environmental laws and regulations, including, but not limited to, the following: Solid Wastes Disposal Sites and Facilities Acts, §§ 30-20-100.5 – 30-20-119, C.R.S., Colorado Regulations Pertaining to Solid Waste Disposal Sites and Facilities, 6 C.C.R. 1007-2, *et seq.*, Solid Waste Disposal Act, 42 U.S.C. §§ 6901-6992k, and Federal Solid Waste Regulations 40 CFR Ch. I. The County shall not be responsible or liable for identifying, characterizing, cleaning up, or disposing of such solid waste or hazardous materials. Notwithstanding the previous sentence, should any refuse cleaned up and disposed of by the County be determined to be solid waste or hazardous materials, the Developer/Owner, but not the County, shall be responsible and liable as the owner, generator, and/or transporter of said solid waste or hazardous materials.

14. Applicable Law and Venue: The laws, rules, and regulations of the State of Colorado and El Paso County shall be applicable in the enforcement, interpretation, and execution of this Agreement, except that Federal law may be applicable regarding solid waste or hazardous materials. Venue shall be in the El Paso County District Court.

IN WITNESS WHEREOF, the Parties affix their signatures below.

Executed this 9th day of August, 2018, by:

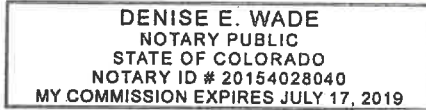
Liberty Tree Academy

By: 
BOARD SECRETARY

The foregoing instrument was acknowledged before me this 9th day of August, 2018, by Michael E. Peterson,
Board Secretary, Liberty Tree Academy.

Witness my hand and official seal.

My commission expires: 17 July 2019



Denise Wade

Notary Public

Executed this _____ day of _____, 20____, by:

BOARD OF COUNTY COMMISSIONERS
OF EL PASO COUNTY, COLORADO

By: _____

_____, Chair

Attest:

County Clerk and Recorder

The foregoing instrument was acknowledged before me this _____ day of _____, 20____, by _____, Chair of the Board of County Commissioners of El Paso County, Colorado, as Attested to by _____, County Clerk and Recorder.

Witness my hand and official seal.

My commission expires: _____

Notary Public

Approved as to Content and Form:

Assistant County Attorney

Public Record Property Information

Friday, August 03, 2018 Time: 4:32:26 PM

Personal Information

Schedule No: 4232302001

Owner Name: GATHERING STONES COMM CHURCH INC

Location: 8579 EASTONVILLE RD

Mailing Address: PO BOX 63541
COLORADO SPRINGS CO 80962-3541

Previous Parcel

Replaced Parcel

Legal Description

LOT 1178 WOODMEN HILLS FIL NO 10

Market Information (2018 Values)

Levy Year: 2017 Mill Levy: 65.102 Exempt Status: Fully Exempt

| Table | Use Code | 2018 Market Value | 2018 Assessed Value | Exempt |
|-------|--------------------|-------------------|---------------------|--------|
| Land | RELIGIOUS WORSHIP | \$59,500 | \$0 | EX |
| | Total Value | \$59,500 | \$0 | |

Estimated Taxes Payable in 2019: \$0.00

Tax Entity and Levy Information

(District: SB9)

| Taxing Entity | Contact Name | Contact Phone |
|-------------------------------------|------------------------|----------------|
| EL PASO COUNTY | FINANCIAL SERVICES | (719) 520-6498 |
| EPC ROAD & BRIDGE (UNSHARED) | | (719) 520-6498 |
| UPPER BLK SQUIRREL CRK GROUND WATER | TRACY DORAN | (719) 347-0704 |
| PIKES PEAK LIBRARY | MIKE VARNET | (719) 531-6333 |
| WOODMEN HILLS METROPOLITAN | CAROLYNNE C WHITE, ESQ | (303) 223-1197 |
| EL PASO COUNTY CONSERVATION | PAMELA DAVISON | (719) 632-9598 |
| EL PASO COUNTY SCHOOL NO 49 | BRETT RIDGWAY | (719) 495-1130 |
| FALCON FIRE PROTECTION | TRENT HARWIG | (719) 495-4050 |

Sale Information

| Sale Date | Sale Price | Sale Type |
|------------|------------|-----------|
| 07/13/2001 | \$0 - | |

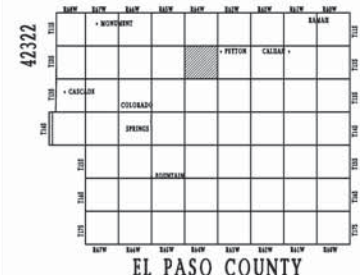
| | | |
|------------|-----------|---|
| 07/22/2002 | \$10,000 | Family/In-House transfer Vacant land |
| 03/18/2003 | \$105,000 | Good sale; verified Vacant land |
| 07/11/2006 | \$290,000 | Good sale; verified Vacant land |
| 06/24/2014 | \$0 | - |
| 08/12/2014 | \$140,000 | Vacant land Exempt or Partially Exempt |
| 09/08/2014 | \$0 | - |

Land Information

| Seq # | Use | Exempt | Area |
|-------|-------------------|--------|-------------|
| 1 | RELIGIOUS WORSHIP | EX | 10.71 acres |

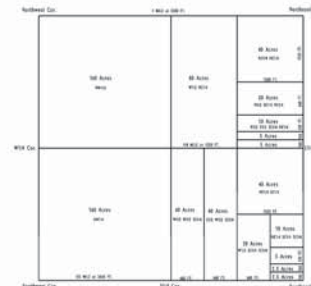
Residential Information

Commercial Information



| | | | | | |
|----|----|----|----|----|----|
| 6 | 5 | 4 | 3 | 2 | 1 |
| 7 | 8 | 9 | 10 | 11 | 12 |
| 18 | 17 | 16 | 15 | 14 | 13 |
| 19 | 20 | 21 | 22 | 23 | 24 |
| 30 | 29 | 28 | 27 | 26 | 25 |
| 31 | 32 | 33 | 34 | 35 | 36 |

ASSESSOR



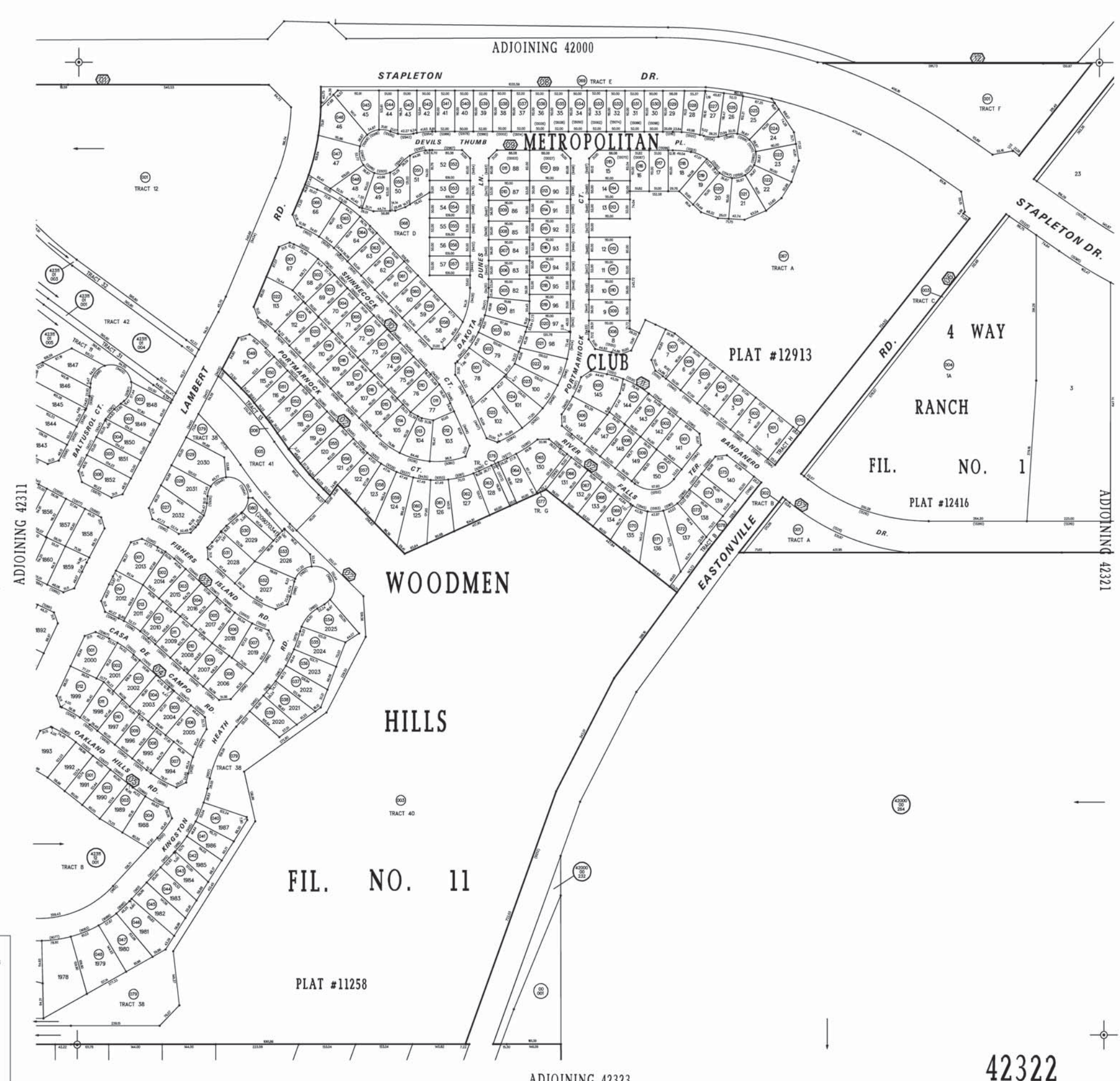
Rectangular Survey of One Section



December 28, 2017




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Copyright 2015 Colorado Springs Utilities
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This document is prepared for internal use only and El Paso County makes no claim as to the accuracy or completeness of this document.



42322

dsdlaforce (2)

Remove from the drainage report and submit as upload as a standalone document.

Subject: text box
Page Label: 83
Author: dsdlaforce
Date: 8/29/2018 3:44:02 PM
Color: 

Remove from the drainage report and submit as upload as a standalone document.

STORMWATER QU

V. DRAINAGE FEES

Rain Run flows through the Township Area for 100% of the Township Area. The Township Area is located within the Drainage Basin "A". (See Appendix A for proposed drainage studies).


Estimated annual cost of the sewer detention basin is \$61,000. Fee for the sewerage area is calculated as:

| | |
|---|--------------------------|
| 1.0 acres at 74.26% is 0.8 acres | at 2.26 impervious acres |
| 2.26 acres at \$14.45/acre of impervious area | = \$32.66 |

1.0 acre = \$14.45/acre
1.0 acre = \$14.45/acre x \$36 = \$520.60

Remove and replace with:

Drainage and Bridge fees were paid with the Woodmen Hills Filing #10 final plat, therefore no fees are due.

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Remove and replace with:

Drainage and Bridge fees were paid with the Woodmen Hills Filing # 10 final plat, therefore no fees are due.