PERMANENT STORMWATER QUALITY REPORT

I-25 NORTH DESIGN BUILD

EL PASO COUNTY, COLORADO

prepared for

Colorado Department of Transportation, Region 2
1480 Quail Lake Loop, Suite A
Colorado Springs, Colorado 80906

August 2012

RESPEC
WATER & NATURAL RESOURCES
720 S. Colorado Blvd., Suite 410 S
Denver, Colorado 80246
303-757-3655

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1.0 INTRODUCTION

The Colorado Department of Transportation (CDOT) is planning a design build improvement project for Interstate Highway 25 (I-25) between Woodmen Road and State Highway 105 (Monument Interchange). The purpose of this conceptual design report is to provide the design build team with a starting point regarding the design of permanent stormwater quality facilities (PSQFs) for the project to meet the Municipal Separate Storm Sewer System (MS4) permit requirements.

2.0 GENERAL PROJECT LOCATION AND DESCRIPTION

The I-25 North Design Build improvement project in El Paso County will provide increased capacity for 10.8 miles of I-25 between the Woodmen Road interchange and the Monument Interchange. The majority of the project is in unincorporated El Paso County, CO within an easement on land owned by the U.S. Air Force Academy (USAFA). On the north end, 3 miles of I-25 between the Monument Interchange and the northern USAFA boundary (approximately 1.1 miles south of Baptist Road) is within CDOT right-of-way outside of USAFA land. On the south end, a small section of I-25 between the crossing of Pine Creek and Woodman Road is in CDOT right-of-way within the Colorado Springs, CO city limits. Figure 1, the Vicinity Map, illustrates the general location of the project.

The purpose of the project is to widen I-25 to accommodate additional lanes within the project limits. The project includes complete reconstruction of portions of the highway (including permanent storm drainage facilities) and just widening of the pavement section in other locations.

In general, the terrain in the area slopes from east to west toward I-25. Numerous cross culverts and bridges convey offsite runoff across I-25 before discharging to Monument Creek.

The Ultimate Configuration includes 3 through lanes with an auxiliary lane, HOV lane, 8-foot outside shoulder, and a 12-foot inside shoulder from the Woodmen to InterQuest Interchange. From InterQuest to Monument the Ultimate Configuration includes 3 lanes with 12-foot inside and outside shoulders. The calculations contained within this report are based on the Ultimate Configuration.

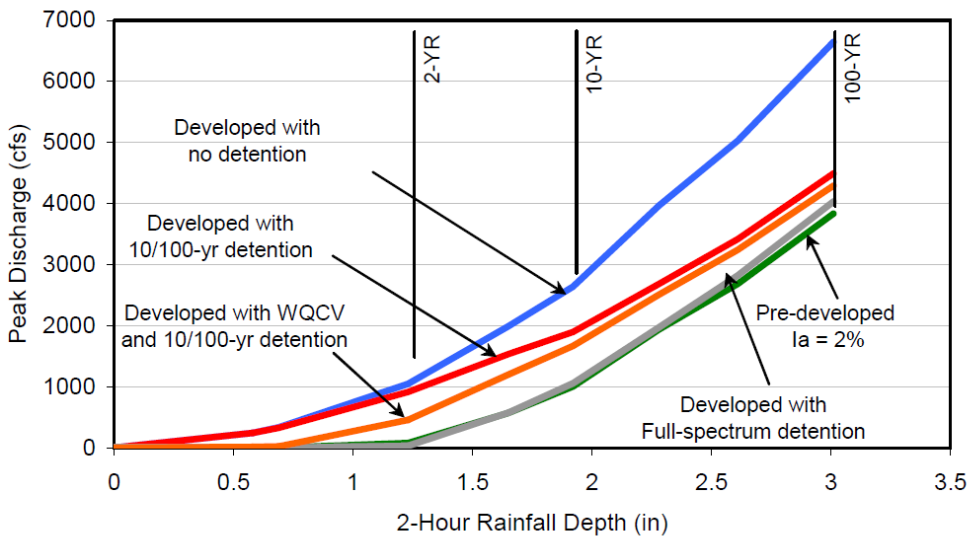
3.0 WATER QUALITY AND DETENTION APPROACH

Typically runoff from CDOT roadways must be treated to meet minimum water quality requirements as set forth in CDOT's MS4 permit. To comply with the MS4 permit, 100% of the project pavement area must be treated to meet either two of these requirements: capture and treat 100% of the water quality capture volume (WQCV) or provide another means of removing 80% of the total suspended solids (TSS). The WQCV is equivalent to 0.5-inch of rainfall from the impervious contributing area and is typically treated in an extended detention basin (EDB), releasing this volume over 40 hours. Examples of TSS removal facilities includes water quality vaults that remove sediment through proprietary vortex systems and sand filters that utilize pore spaces and slow release rates to remove pollutants.

As stated in the introduction, much of the project is within the boundaries of the USAFA. Our understanding is that the USAFA is concerned with erosion from increased runoff resulting from increased development upstream of USAFA property. Consequently, they have requested that CDOT provide 100-year detention facilities to reduce peak flow discharges from the additional pavement width.

In response to the USAFA concerns about the effect the added pavement width would have on the receiving drainageways, the concept of Full-Spectrum Detention (FSD) shall be provided for water quality and detention within the limits of the USAFA. FSD has been adopted by the Urban Drainage and Flood Control District and is a recommended treatment method in their Urban Storm Drainage Criteria Manual. FSD is a method of reducing urbanized peak flows for smaller storm events that more closely approximates the runoff peaks before urbanization occurred. The concept captures a volume of runoff defined as the Excess Urban Runoff Volume (EURV) and then releases it over 72 hours.

The chart below is from “Peak Flow Control for Full Spectrum of Design Storms” by Wulliman and Urbonas written in 2005. The chart illustrates that FSD produces release rates that most closely mimic pre-developed conditions.



Additionally, the design of the outlet structure for FSD is simplified because a separate 5- or 10-year orifice or weir is not necessary (UDFCD, T-5, EDB-6). UDFCD recommends a two-level control: EURV release control (over 72 hours) and 100-year release control.

To satisfy CDOT MS4 requirements, water quality treatment must be provided for the entire post-project pavement width. To satisfy USAFA detention requirements, 100-year detention volume is to be provided for the additional pavement width (post-project width minus the pre-project) for drainageways tributary to Monument Creek within the USAFA jurisdiction. The EURV is inclusive of the 100-year detention volume and is greater than the WQCV needed to treat the full pavement width.

Excerpts from the UDFCD Urban Storm Drainage Criteria Manual that discuss the concepts of EURV and Full Spectrum Detention have been included in the Appendix.

4.0 APPROACH

This section discusses the approach taken to develop conceptual locations of water quality treatment facilities to meet the MS4 permit requirements and USAFA expectations for water quality and detention.

4.1. Assumptions and Design Objectives

Only the pavement of the main line of I-25 was considered in the analysis. At interchanges where additional impervious area will be present due to ramps and overpasses, the treated volume will be higher and should be taken into account during final design. In general, the following design objectives were targeted:

1. Capture stormwater in EDBs to control peak outflows and provide water quality treatment. Provide treatment in water quality vaults where EDBs are not feasible.
2. The minimum total impervious area tributary to each PSQF is 2 acres.
3. Utilize FSD to treat runoff to tributaries of the USAFA and 100% WQCV elsewhere when EDBs are feasible.
4. In sizing and calculating the basin volumes, an existing pavement width of 72 feet for both directions of I-25 was used. An Ultimate Configuration pavement width of 160 ft from Woodmen to InterQuest and 120 ft from InterQuest to Monument was used.
5. Calculated volumes did not take into account additional volume for sediment accumulation.

4.2. Preble's Meadow Jumping Mouse Critical Habitat

Several of the drainageways within the project area have been identified in the 2003 programmatic biological assessment (PBA) as critical mouse habitat by the U.S. Fish and

Wildlife Service. Water quality treatment facilities cannot produce additional impacts to mouse habitat areas. All facilities must be constructed either beyond the identified mouse habitat areas, within one of the permanent impacts already identified as a result of the roadway construction, or in the 15-foot buffer along the pavement shoulders that are mowed regularly. For drainageways with critical mouse habitats, roadway runoff within the mouse habitat will be collected along the pavement edge and treated in water quality vaults. More detailed information regarding the critical habitat boundary from the USFWS is provided in the Appendix.

4.3. Treatment Facility Locations

The primary goal is to strategically place treatment facilities at locations where roadway runoff can be treated prior to mixing with offsite runoff. In some areas, the contributing area is too small or the terrain prohibits reasonable conveyance to an EDB. Water quality treatment for these areas is provided in an underground water quality vault.

Conceptual water quality locations were determined using mapping, aerial photography and site visits. Design survey of the existing condition from the Woodmen to Northgate interchange was provided by the CDOT for use in the analysis. Also, supplemental 2002 LIDAR was obtained from El Paso County along I-25 from Baptist road to Monument.

Feasible locations were determined based on available right-of-way, maximizing the tributary area to each facility and utilization of existing drainage patterns and roadside ditches to convey roadway runoff to treatment locations. Also, to minimize maintenance efforts, by maximizing the tributary area to each facility, the total number of treatment facilities should be minimized. Per UDFCD, It is recommended that the total contributing area to an EDB is not less than 2 impervious acres.

Consideration of the multiple cross drainage structures carrying off site flows and critical mouse habitat helped define tributary areas to potential treatment locations. Storm sewer may be necessary in some locations to convey roadway runoff to treatment facilities. Conveying to existing water quality treatment facilities was desirable as well as utilizing open space at major interchanges along the corridor for treatment facility locations.

4.4. Extended Detention Basin Volumes

For areas being treated beyond the USAFA influence area, WQCV was calculated to treat the entire contributing impervious area along the main line of I-25 for the Ultimate Configuration. WQCV equations take into account post-project imperviousness, but not soil infiltration losses. For areas within the USAFA influence area, EURV and 100-year detention volume requirements were calculated for the basins. The EURV and 100-year detention volume equations are dependent on the hydrologic soils types within the project area. Much of the project area has very porous native soils (Type A and B soils) that have high initial infiltration coefficients and produce less runoff than Type C/D soils. Consequently compensation for urban runoff is greater to produce similar peak flows to a pre-developed condition. Please refer to the RESPEC *Hydrology Report I-25 North Design Build* for more detailed soils information for the project area.

For a visual representation of the basins tributary to each facility and the recommended facility locations, refer to the I-25 Design Build Water Quality Facilities figures (Sheets 1 to 8). Table 1 summarizes each water quality facilities' total tributary area, the treatment area, and treatment volume. Detailed volume and conceptual footprint calculations are provided in the Appendix.

5.0 BMP DESIGN AND MAINTENANCE

5.1 Extended Detention Basins

EDBs are to be designed in accordance with CDOT and Urban Drainage criteria. The footprint of the EDBs conceptually sized assuming 4:1 side slopes, a 3-foot wide berm around the perimeter, 1 foot of freeboard, and an additional 6 inches of ponding depth for overflow weir control.

These assumptions were required to determine the conceptual footprint of the EDBs shown in the conceptual plan. Other design considerations during final design that should be taken into account include accessible maintenance access (typically a 10H:1V) down to the pond bottom, a 6-foot trickle channel (0.5% minimum slope), micropool, and forebay. All of which are discussed in the UDFCD criteria manuals. The outlet structures will be designed to meet water quality goal requirements and will require further analysis.

When the goal of 100% WQCV is being met, the EDB outfall structure should be retrofitted with an outlet structure to obtain a 40-hour drain time to formalize the MS4 requirements for water quality. When the goal of FSD is being met, the outfall of the pond should be designed to release the EURV over 72 hours and the orifice or weir to control the100-year should be designed to be in accordance with the allowable release rates as recommended by the UDFCD. A detail regarding the outlet structure for WQCV and FSD basins can be found in the Appendix.

The anticipated maintenance work that will be required to ensure effectiveness of the EDB facilities includes the following:

1. Mowing of the grass in the pond, and removal of vegetation that may clog the outlet structure.
2. Clearing of trash and debris from the trash rack and outlet structure grate.
3. Clearing of orifice holes on outlet structure for continued flow.
4. Removal of sediment from the EDB once levels have reached the lowest orifice hole or the forebay outlet pipe is blocked.
5. Disposal of all trash, debris and sediment offsite.
6. Reseeding as necessary to prevent erosion.
7. Continued maintenance of the outlet structure to keep structure in working order (i.e. tightening or replacing bolts, etc.)
8. Adding any additional erosion control BMP's as necessary.

Additional information regarding the design and maintenance of EDBs is included in the Appendix.

5.2 Water Quality Vaults

Water Quality Vaults such as hydrodynamic sand separators or proprietary manufactured systems are planned where runoff from impervious areas cannot reach a proposed EDB. These products are available in a variety of types and sizes depending upon the level of treatment required.

The Stormceptor System is one particular type of water quality vault that provides this type of treatment. For the purposes of this report, the computer program PCSWMM for Stormceptor was used to conceptually size the Water Quality Vaults based on the tributary impervious area. The results are shown in Table 1.

The following assumptions and input data were entered into PCSWMM to obtain the proper Stormceptor model to meet the MS4 permit water quality objective of 80% TSS Removal:

1. Impervious area tributary to basin
2. 100 % imperviousness
3. No upstream attenuation was assumed
4. Colorado Springs rainfall
5. Fine particle size distribution

More Information on Water Quality Vaults including Stormceptor manufacturer recommendations for maintenance is included in the Appendix.

6.0 CONCLUSION

Permanent Water Quality Facilities have been conceptually sized for the Ultimate Configuration and potential locations sited within this report. Additional analysis will be required during final design. It is recommended that EDBs be implemented for the I-25

North Design Build Project whenever possible for I-25 tributary areas greater than 2.0 acres. In selected locations when construction and maintenance of an EDB is not feasible, treatment should be provided with a Water Quality Vault. The total number of Permanent Water Quality Facilities should be minimized by maximizing the tributary area to each facility to reduce future maintenance efforts.

7.0 REFERENCES

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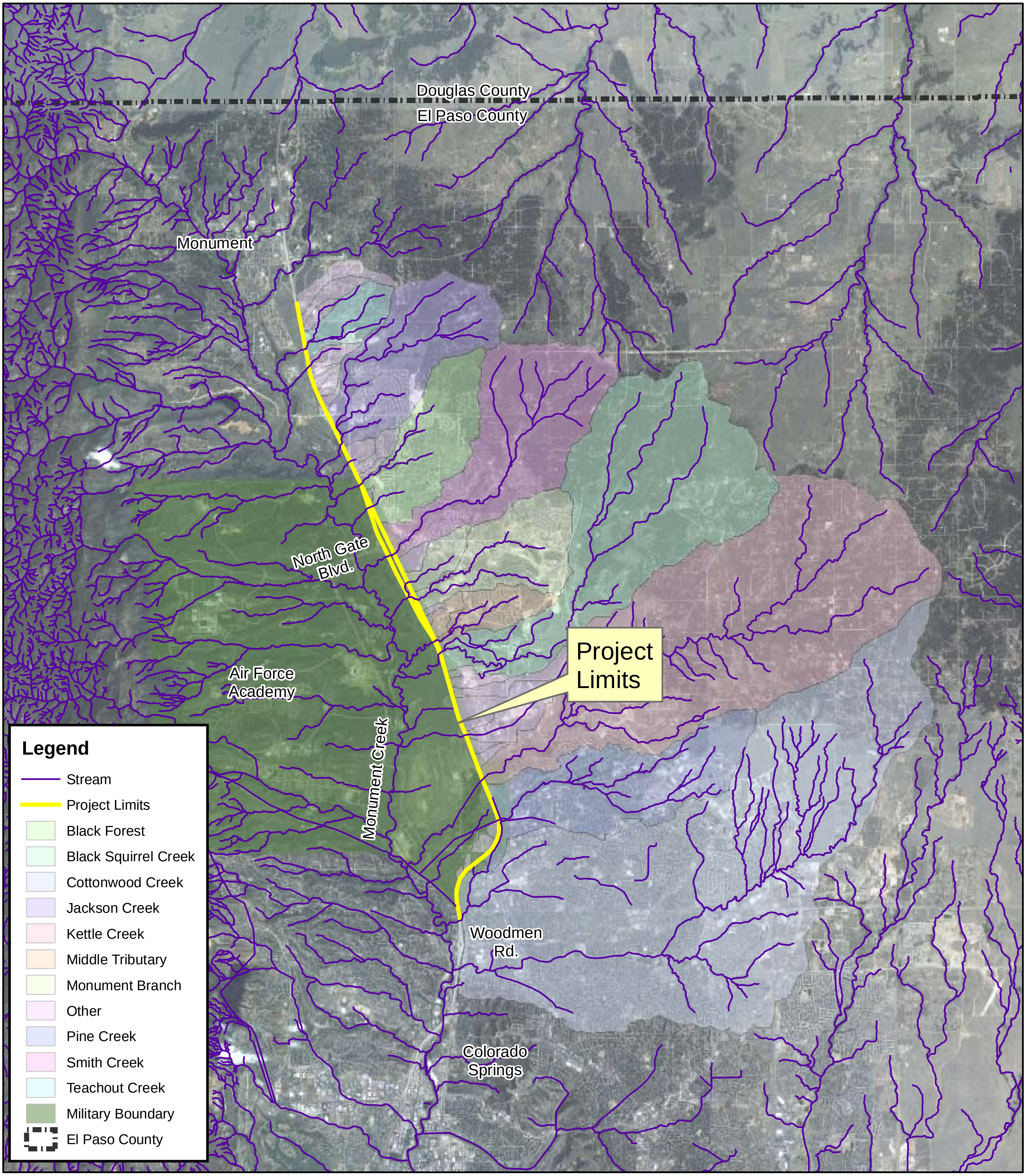

Figure 1 - Vicinity Map

I-25 North Design-Build

August 2012

0 0.5 1 2 3 4 Miles

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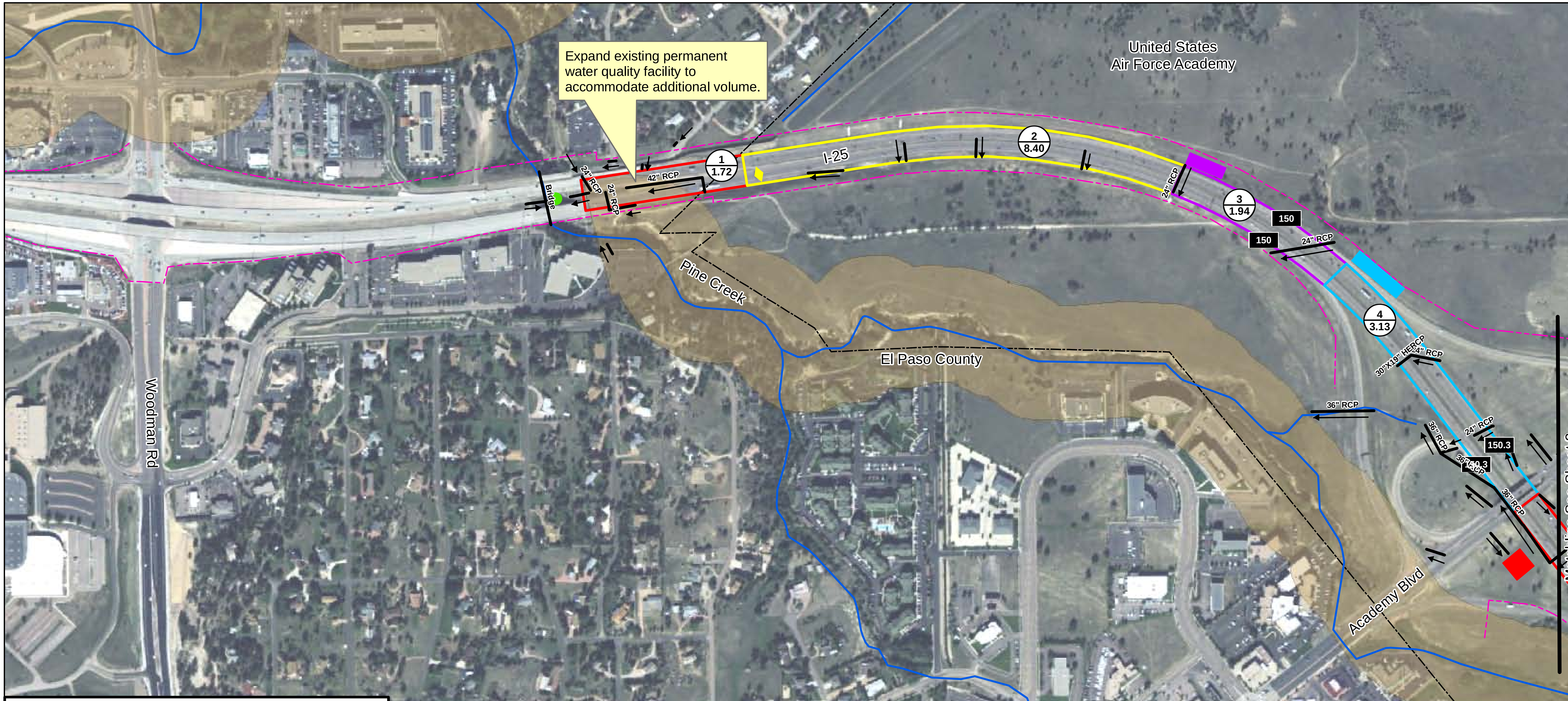
Table 1
Summary of Conceptual Permanent Stormwater Quality Facilities

BASIN ID	MILE MARKER		TYPE OF PERMANENT BMP	TOTAL IMPERVIOUS AREA TRIBUTARY TO BASIN (AC)	TREATED IMPERVIOUS AREA (AC)	TREATED VOLUME (AC-FT)		STORMCEPTOR[3]		GOAL
	FROM	TO				WQCV or EURV[1]	100-year Detention[1]	MODEL #	DIA (FT)	
1	149.3	149.4	EDB	3.12	1.72	0.13	N/A			100% WQCV
2	149.4	149.9	WQ VAULT	8.41	8.41	See note 4		STC 11000[5]	10.0	80% TSS REMOVAL
3	149.9	150.1	EDB	3.52	1.94	0.22	0.33			FSD
4	150.1	150.4	EDB	5.69	3.13	0.36	0.54			FSD
5	150.4	150.6	EDB	4.60	2.53	0.29	0.43			FSD
6	150.6	150.9	EDB	4.98	2.74	0.31	0.47			FSD
7	150.9	151.3	WQ VAULT	8.14	8.14	See note 4		STC 11000[5]	10.0	80% TSS REMOVAL
8	151.3	151.6	EDB	5.37	2.95	0.52	0.62			FSD
9	151.5	152.1	EDB	11.06	6.08	0.98	1.20			FSD
10	152.1	152.5	EDB	7.06	3.88	0.69	0.76			FSD
11	152.5	153.2	EDB	9.47	5.21	0.73	1.29			FSD
12	152.8	153.2	EDB	7.36	4.05	0.23	0.70			FSD
13	153.2	153.4	EDB	2.91	1.45	0.19	0.26			FSD
14	153.3	153.5	WQ VAULT	1.23	1.23	See note 4		STC 900	6.0	80% TSS REMOVAL
15	153.4	153.6	EDB	1.58[2]	0.63	0.09	0.11			FSD
16	153.5	153.6	WQ VAULT	1.07	1.07	See note 4		STC 900	6.0	80% TSS REMOVAL
17	153.6	153.8	EDB	2.76	1.11	0.14	0.20			FSD
18	153.8	154.0	WQ VAULT	1.35	1.35	See note 4		STC 900	6.0	80% TSS REMOVAL
19	153.8	154.0	WQ VAULT	1.33	1.33			STC 900	6.0	80% TSS REMOVAL
20	154.0	154.0	WQ VAULT	0.20	0.20			STC 450I	4.0	80% TSS REMOVAL
21	154.0	154.0	WQ VAULT	0.18	0.18			STC 450I	4.0	80% TSS REMOVAL
22	154.0	154.3	EDB	4.38	1.75	0.20	0.30			FSD
23	154.3	154.5	EDB	2.51	1.00	0.11	0.17			FSD
24	154.5	154.8	EDB	3.92	1.57	0.18	0.27			FSD
25	154.8	155.0	EDB	2.25	0.90	0.10	0.15			FSD
26	155.0	155.2	WQ VAULT	1.36	1.36	See note 4		STC 900	6.0	80% TSS REMOVAL
27	154.9	155.3	WQ VAULT	3.13	3.13			STC 3600	8.0	80% TSS REMOVAL
28	155.2	155.7	EDB	6.86	2.75	0.31	0.47			FSD
29	155.7	155.9	EDB	3.76	1.51	0.17	0.26			FSD
30	155.9	156.4	EDB	6.55	2.62	0.30	0.45			FSD
31	156.4	156.6	EDB	3.17	1.27	0.14	0.22			FSD
32	156.6	156.9	EDB	4.54	1.82	0.21	0.31			FSD
33	156.9	157.1	WQ VAULT	2.24	2.24	See note 4		STC 2400	8.0	80% TSS REMOVAL
34	157.1	157.3	EDB	2.53	1.01	0.11	0.17			FSD
35	157.3	157.6	EDB	5.25	2.10	0.24	0.36			FSD
36	157.6	158.1	WQ VAULT	6.95	6.95	See note 4		STC 7200	12.0	80% TSS REMOVAL
37	158.1	158.4	EDB	2.95	2.95	0.12	N/A			100% WQCV
38	158.2	158.6	EDB	4.09	4.09	0.17				100% WQCV
39	158.6	158.9	EDB	4.77	4.77	0.20				100% WQCV
40	158.9	159.3	EDB	5.63	5.63	0.23				100% WQCV
41	159.3	159.4	EDB	2.00	2.00	0.08				100% WQCV
42	159.4	160.1	EDB	9.81	9.81	0.41				100% WQCV

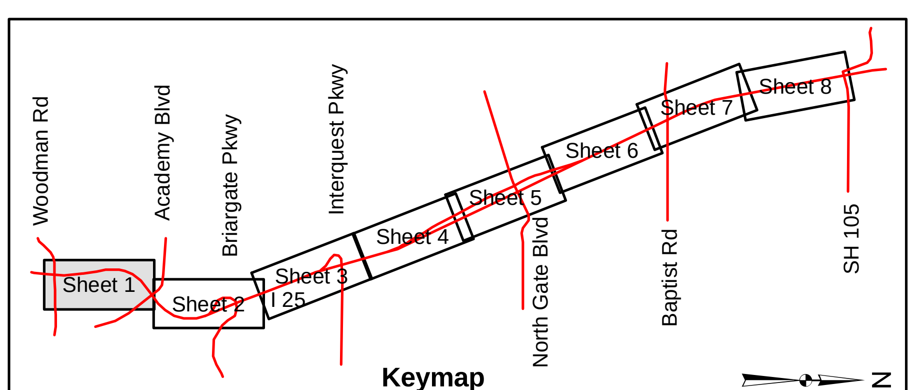
Notes:
1. EURV and 100-year detention volume based on additional imperviouis area only. WQCV is based on total tributary impervious area.
2. Tributary impervious area is less than 2 AC, but it is being conveyed to an existing permaent water quality facility.
3. Stormceptor or an approved equivalent are recommended as WQ Vaults to meet the goal of 80% TSS. Volume should adhere to manufactuers specifications.
4. Volume to comply with manufactuer's specificaitons.
5. Units are composed of two structures.

I-25 North Design-Build
Permanent Stormwater Quality Facilities



Legend

- Extended Detention Basin and Tributary Area
- Water Quality Vault and Tributary Area
- Basin ID/ Total Tributary Area
- Flow Arrow
- High Point in Profile
- Easement/ROW
- Low Point in Profile
- Stream
- Mile Marker
- Military Boundary
- Existing Storm Pipe
- PMJM Critical Habitat



Disclaimer:
Location of drainage structures and Right-of-Way is for illustrative purposes only.

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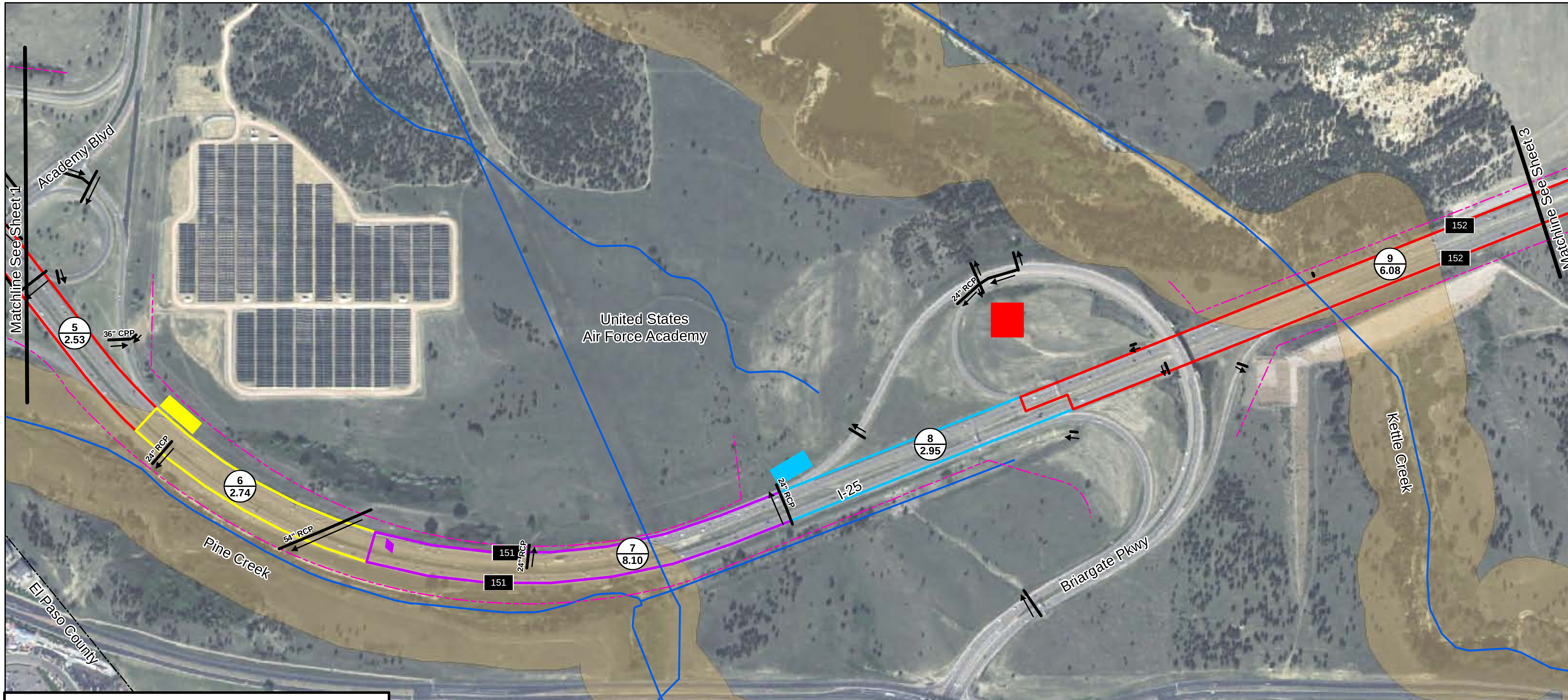

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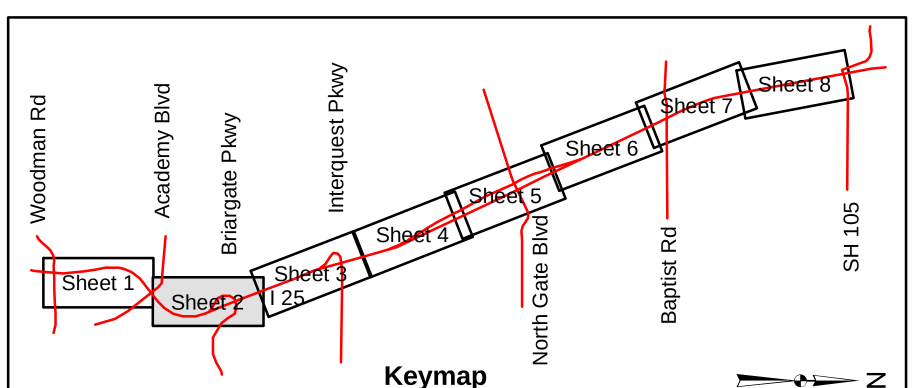

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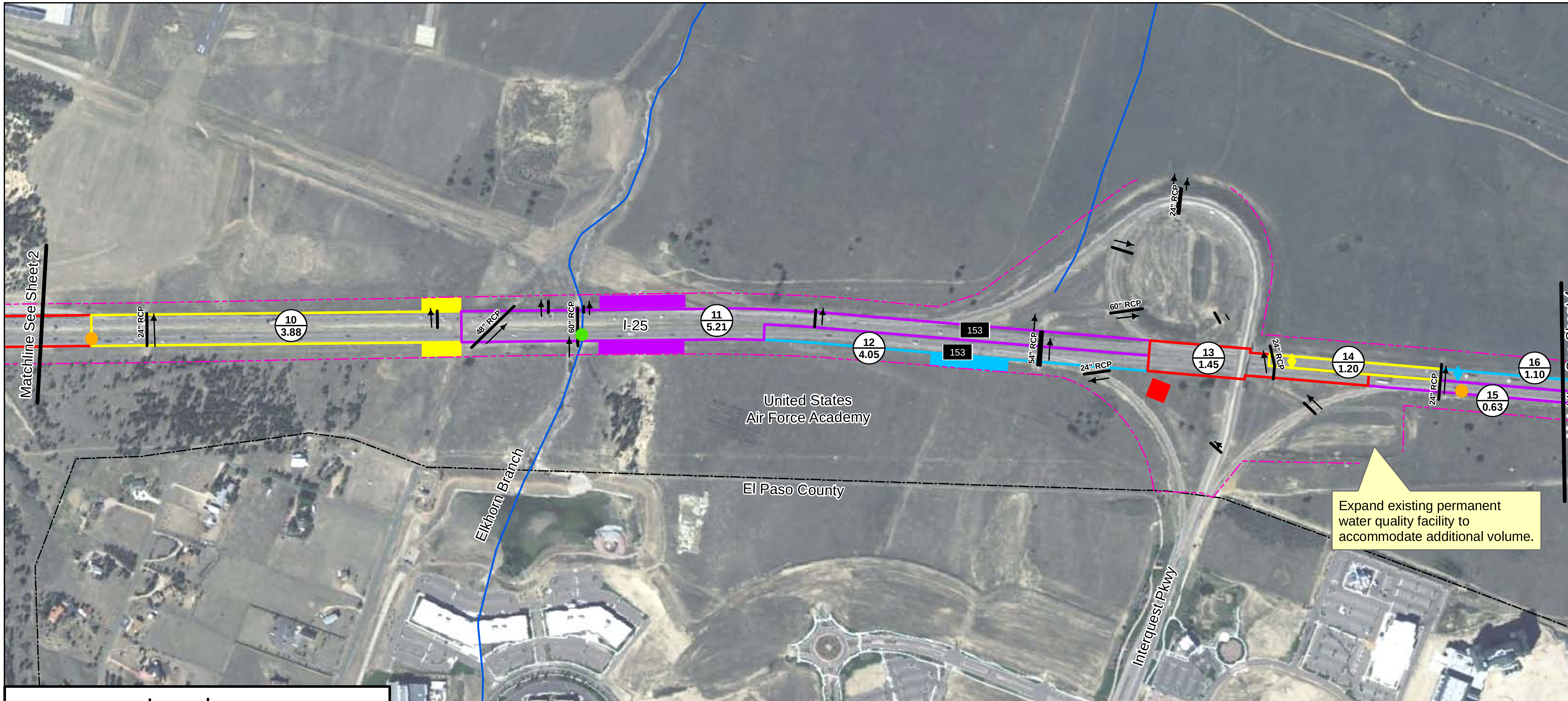

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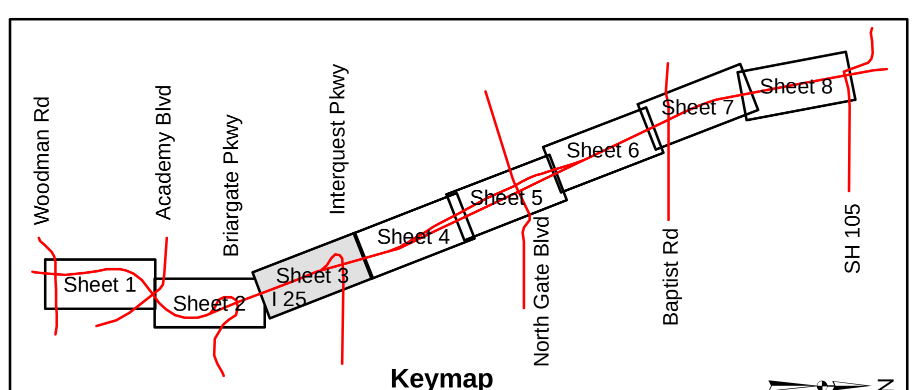

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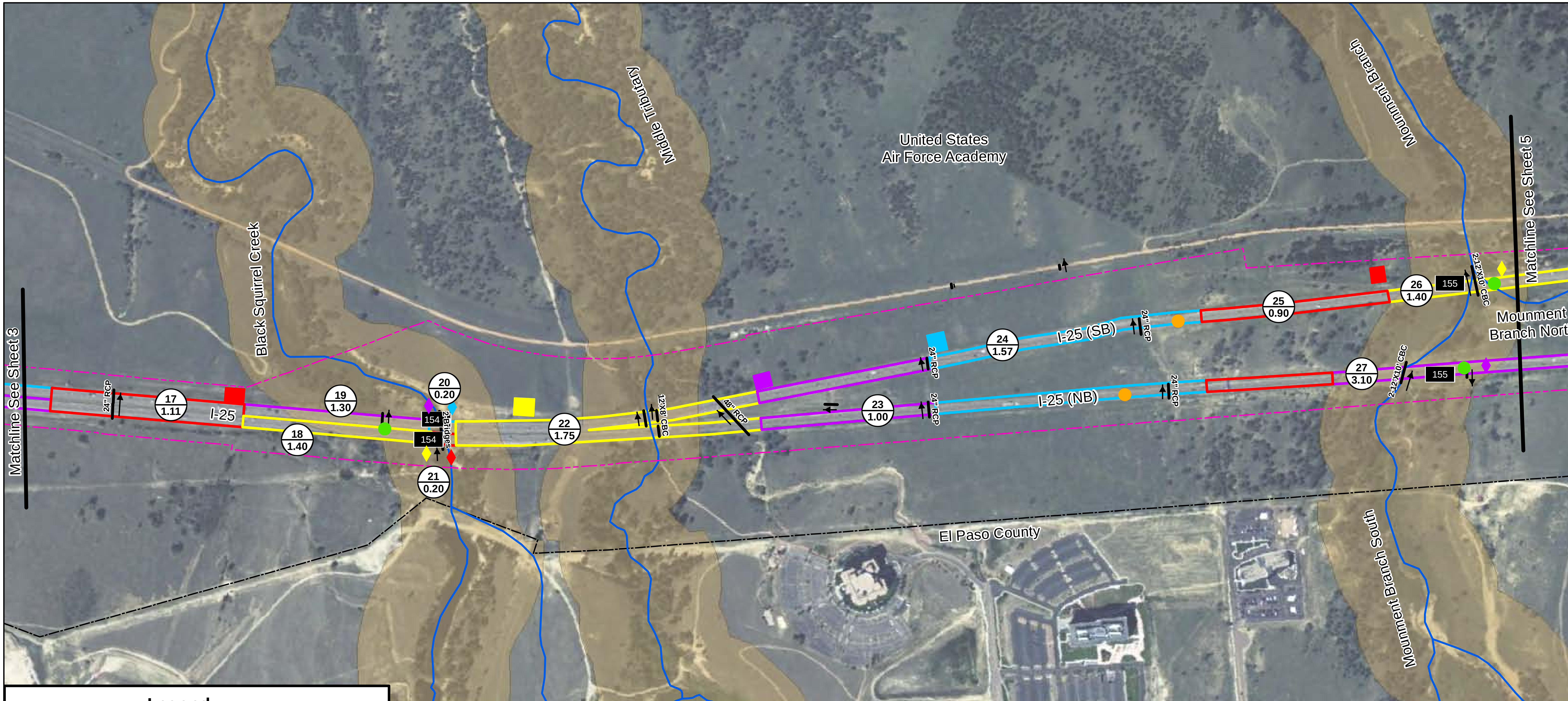

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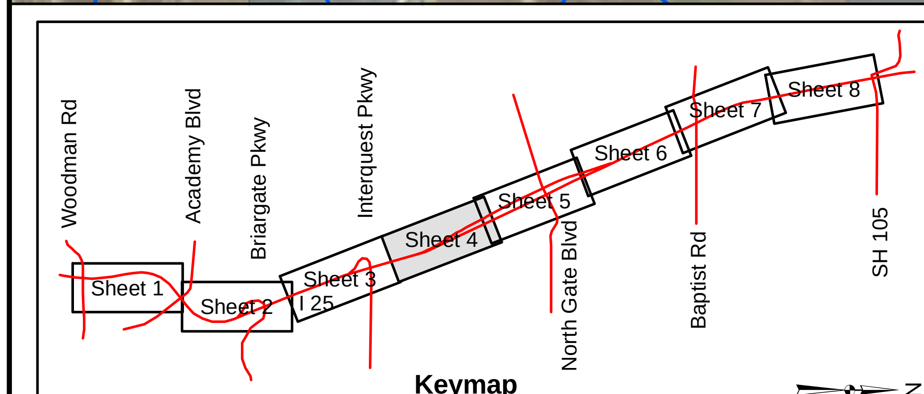

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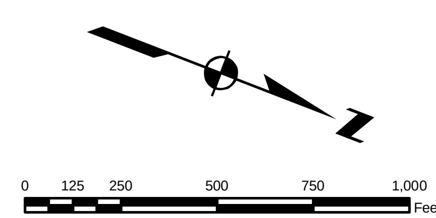

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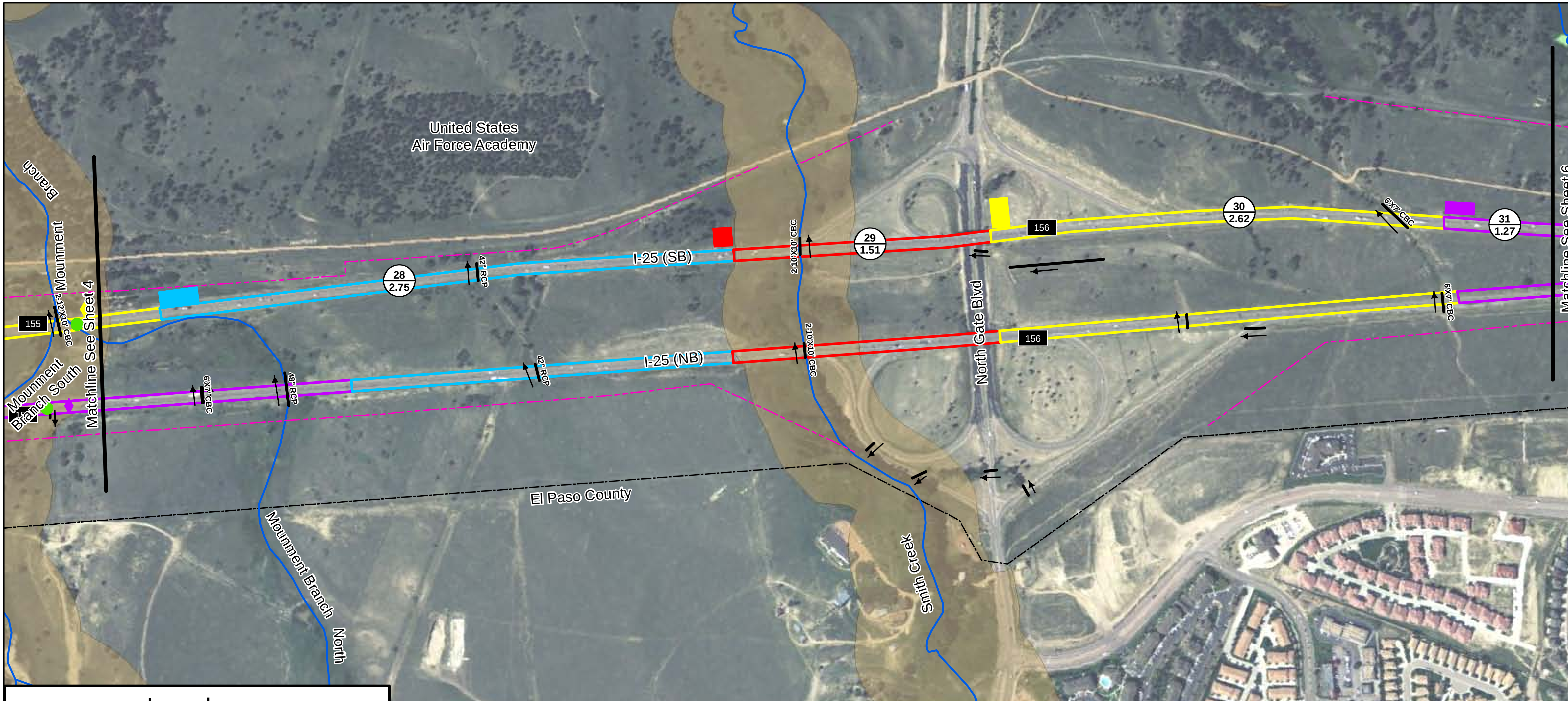

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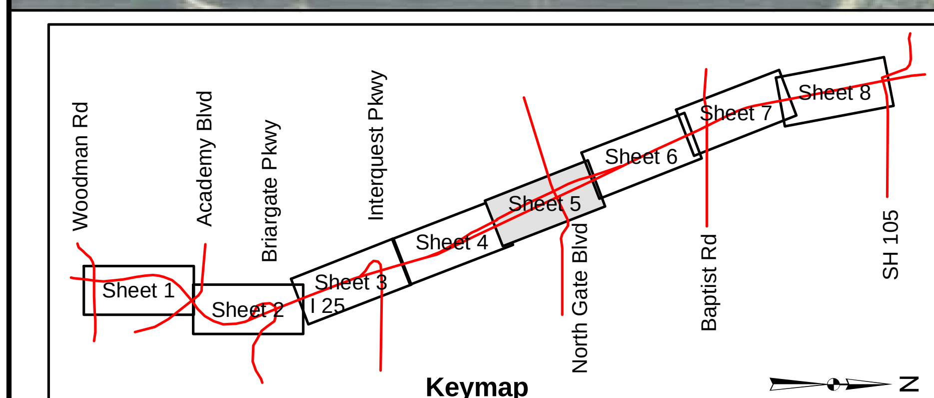

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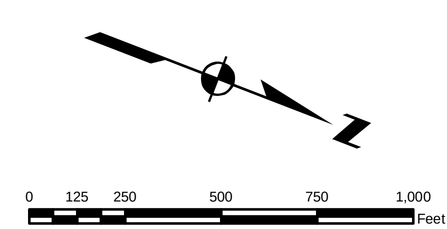

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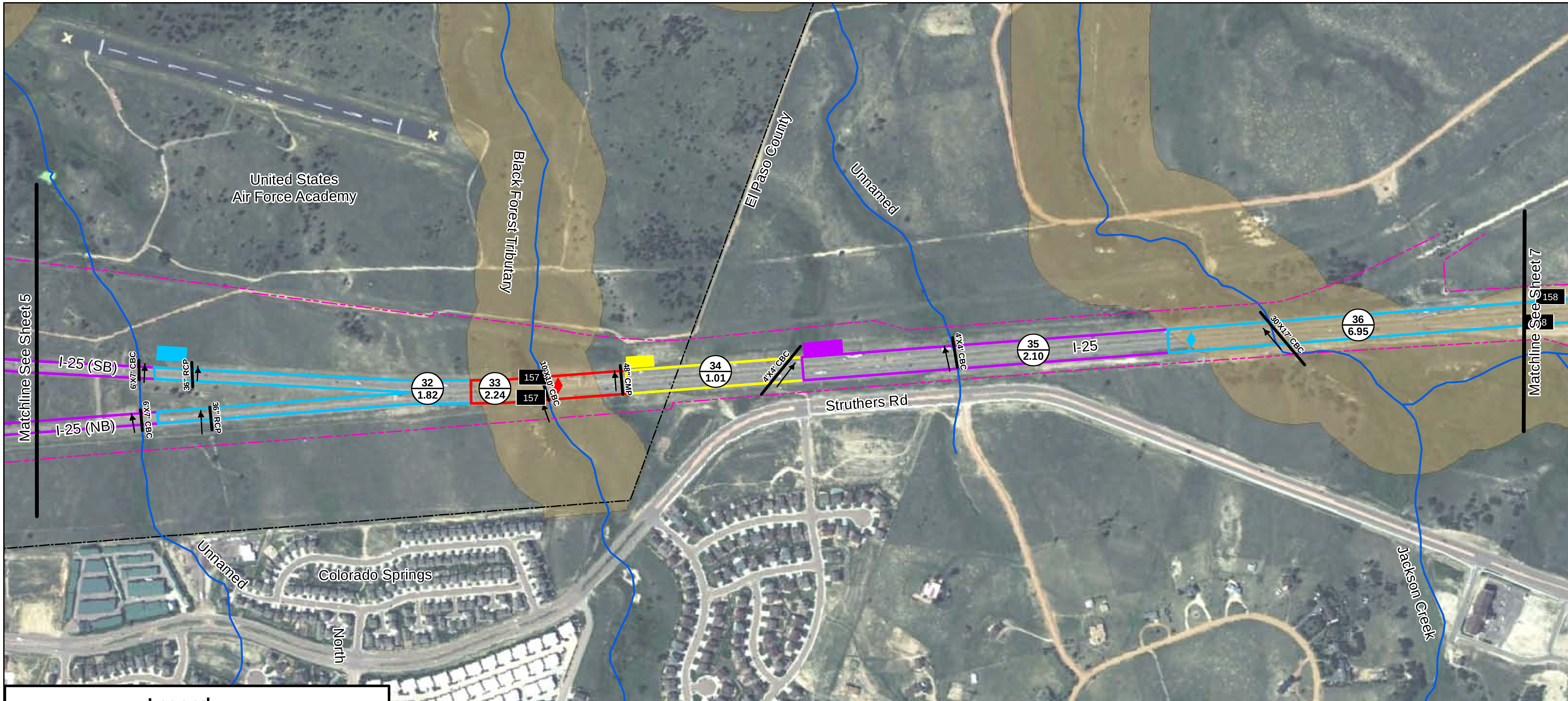

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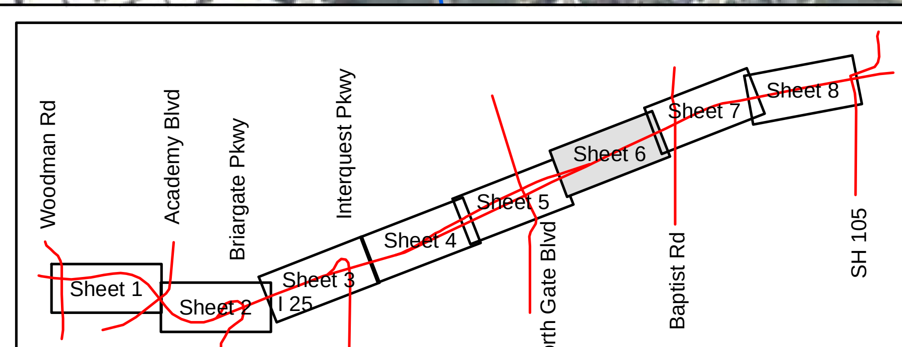
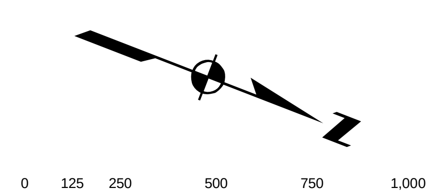


Keymap

Disclaimer:
Location of drainage structures and Right-of-Way is for illustrative purposes only.



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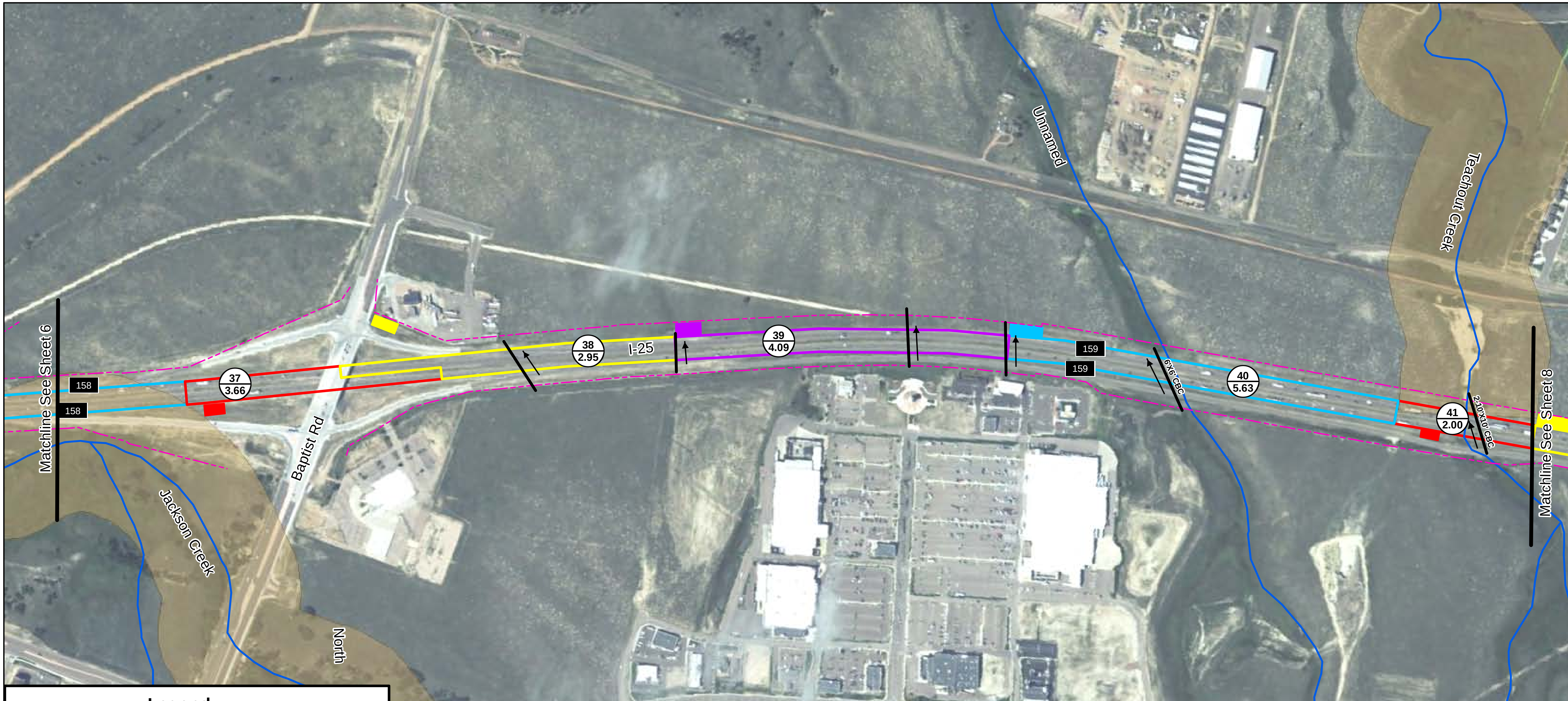
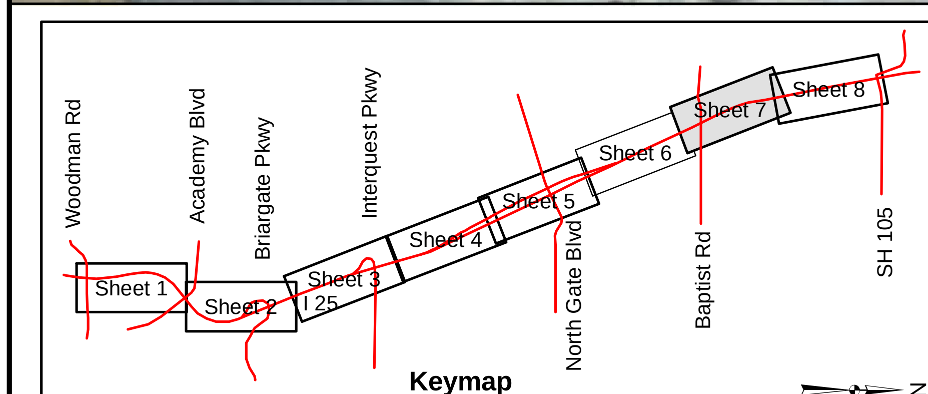
Sheet 6

I-25 North Design-Build
Permanent Stormwater Quality Facilities



Legend

- Extended Detention Basin and Tributary Area
- Water Quality Vault and Tributary Area
- Basin ID/ Total Tributary Area (Basin ID, Area (AC))
- Flow Arrow
- High Point in Profile
- Easement/ROW
- Low Point in Profile
- Stream
- Mile Marker
- Military Boundary
- Existing Storm Pipe
- PMJM Critical Habitat



Keymap

Disclaimer:
Location of drainage structures and Right-of-Way is for illustrative purposes only.

0 125 250 500 750 1,000 Feet

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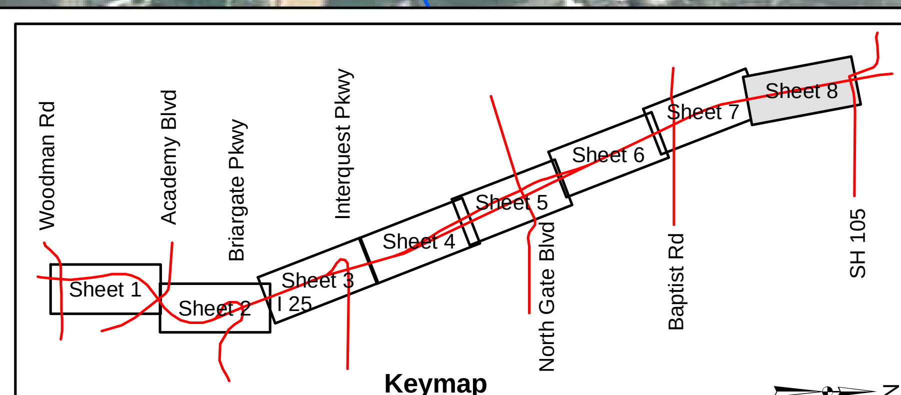
Sheet 7

I-25 North Design-Build
Permanent Stormwater Quality Facilities

Legend

- Extended Detention Basin and Tributary Area
- Water Quality Vault and Tributary Area
- Basin ID/ Total Tributary Area
- Flow Arrow
- High Point in Profile
- Easement/ROW
- Low Point in Profile
- Stream
- Mile Marker
- Military Boundary
- Existing Storm Pipe
- PMJM Critical Habitat



Disclaimer:
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0 125 250 500 750 1,000 Feet

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Sheet 8

APPENDIX A
REFERENCE MATERIALS

Federation and American Society of Civil Engineers (1998) that stormwater quality treatment facilities (i.e., post-construction BMPs) be based on the capture and treatment of runoff from storms ranging in size from "mean" to "maximized[1]" storms. The "mean" and "maximized" storm events represent the 70th and 90th percentile storms, respectively. As a result of these studies, water quality facilities for the Colorado Front Range are recommended to capture and treat the 80th percentile runoff event. Capturing and properly treating this volume should remove between 80 and 90% of the annual TSS load, while doubling the capture volume was estimated to increase the removal rate by only 1 to 2%.

2.3 Attenuation of the WQCV (BMP Drain Time)

The WQCV must be released over an extended period to provide effective pollutant removal for post-construction BMPs that use sedimentation (i.e., extended detention basin, retention ponds and constructed wetland ponds). A field study of basins with extended detention in the Washington, D.C. area identified an average drain time of 24 hours to be effective for extended detention basins. This generally equates to a 40-hour drain time for the brim-full basin. Retention ponds and constructed wetland basins have reduced drain times (12 hours and 24 hours, respectively) because the hydraulic residence time of the effluent is essentially increased due to the mixing of the inflow with the permanent pool.

When pollutant removal is achieved primarily through filtration such as in a sand filter or rain garden BMP, an extended drain time is still recommended to promote stability of downstream drainageways, but it can be reduced because it is not needed for effective pollutant removal. In addition to counteracting hydromodification, attenuation in filtering BMPs can also improve pollutant removal by increasing contact time, which can aid adsorption/absorption processes depending on the media. The minimum recommended drain time for a post-construction BMP is 12 hours; however, this minimum value should only be used for BMPs that do not rely fully or partially on sedimentation for pollutant removal.

2.4 Excess Urban Runoff Volume (EURV) and Full Spectrum Detention

The EURV represents the difference between the developed and pre-developed runoff volume for the range of storms that produce runoff from pervious land surfaces (generally greater than the 2-year event). The EURV is relatively constant for a given imperviousness over a wide range of storm events. This is a companion concept to the WQCV. The EURV is a greater volume than the WQCV and is detained over a longer time. It typically allows for the recommended drain time of the WQCV and is used to better replicate peak discharge in receiving waters for runoff events exceeding the WQCV. The EURV is associated with Full Spectrum Detention, a simplified sizing method for both water quality and flood control detention. Designing a detention basin to capture the EURV and release it slowly (at a rate similar to WQCV release) results in storms smaller than the 2-year event being reduced to flow rates much less than the threshold value for erosion in most drainageways. In addition, by incorporating an outlet structure designed per the criteria in this manual including an orifice or weir that limits 100-year runoff to the allowable release rate, the storms greater than the 2-year event will be reduced to discharge rates and hydrograph shapes that approximate pre-developed conditions. This reduces the likelihood that runoff hydrographs from multiple basins will combine to produce greater discharges than pre-developed conditions.

For additional information on the EURV and Full Spectrum Detention, including calculation procedures, please refer to the *Storage* chapter of Volume 2.

---

[1] The term "maximized storm" refers to the optimization of the storage volume of a BMP. The WQCV for the "maximized" storm represents the point of diminishing returns in terms of the number of storm events and volume of runoff fully treated versus the storage volume provided.

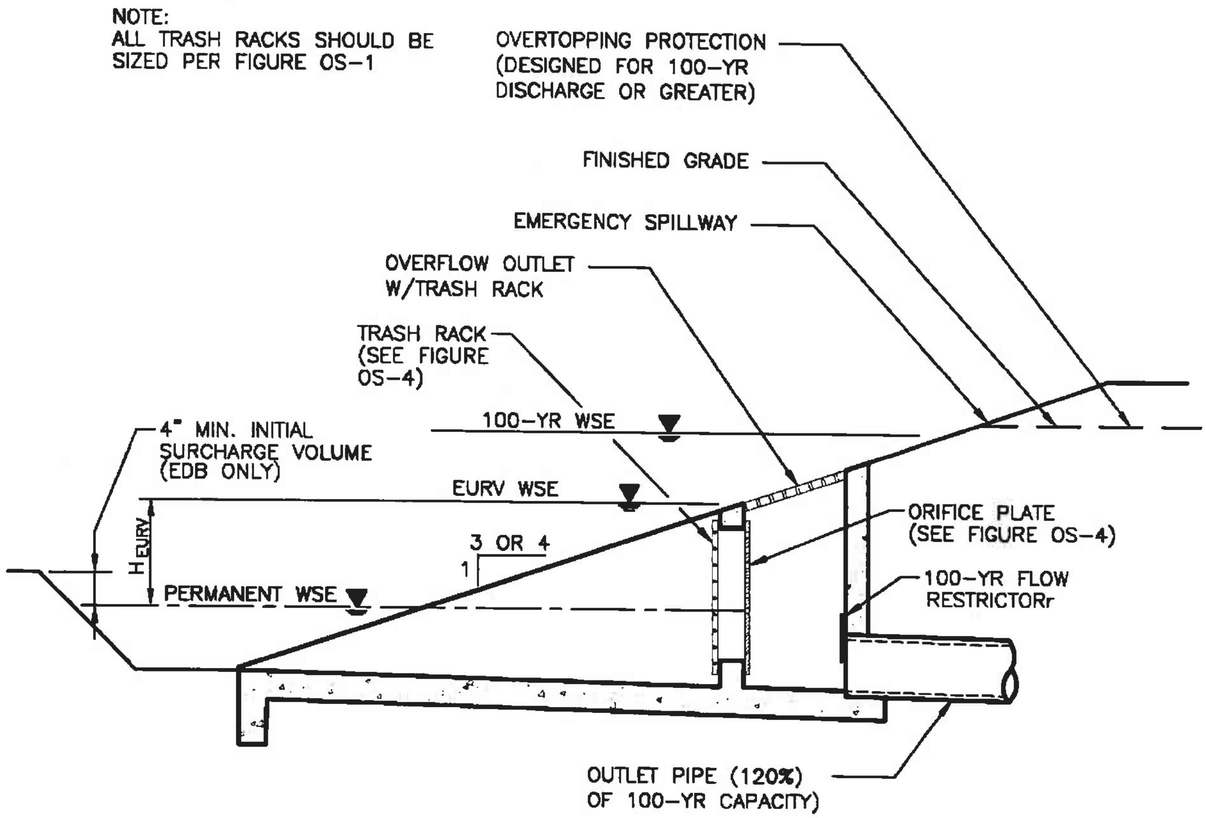


Figure OS-2. Typical Outlet Structure for Full Spectrum Detention

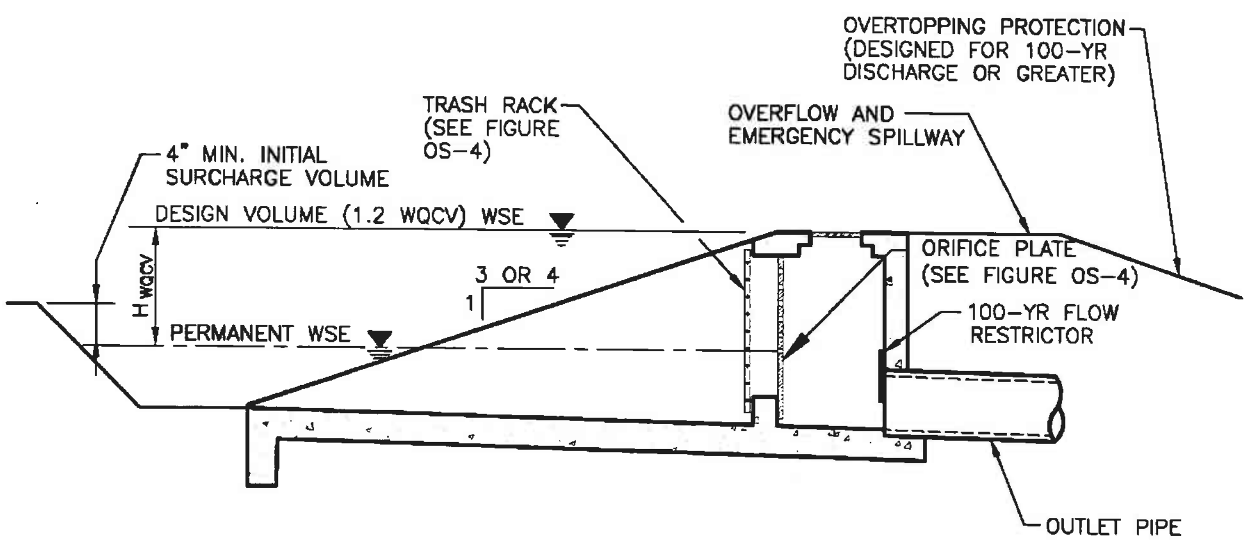


Figure OS-3. Typical Outlet Structure for WQCV Treatment and Attenuation

the calculated 100-year volume. Others require that the 100-year volume be added to the WQCV. All jurisdictions require the WQCV be added to the 5- or 10-year volume. When clear written local criteria on this matter are absent, the District recommends that no less than 50% of the WQCV be added to the calculated 100-year volume for 100-year volumes obtained using empirical equations and the FAA Method. However, unless the local jurisdiction requires adding all or part of the WQCV to the 100-year volume obtained using the simplified *Full Spectrum Detention* design; District does not recommend adding any part of the WQCV to the 100-year volume. When the analysis is done using hydrograph routing methods, each level of controls needs to be accounted for and the resultant 100-year control volume used in final design.

3.2 Sizing of On-Site Detention Facilities

3.2.1 Maximum Allowable Unit Release Rates for On-Site Facilities

The maximum allowable unit release rates in the Denver area per acre of tributary catchment for on-site detention facilities for various design return periods are listed in Table SO-1. These maximum releases rates will apply for all on-site detention facilities unless other rates are recommended in a District-approved master plan. For regional facilities see Section 3.2.5.

Allowable unit release rates in Table SO-1 for each a soil group in the tributary catchment shall be area-weighted to composite the allowable unit release rate for the total catchment. Multiply this rate by the total tributary catchment's area to obtain the design release rates in cubic feet per second (cfs). Whenever Natural Resources Conservation Service (NRCS) soil surveys are not available, approximate their equivalent types using results of detailed soil investigations at the site.

Table SO-1—Maximum Unit Flow Release Rates (cfs/acre) from On-Site Detention Facilities

Design Return Period (Years)	NRCS Hydrologic Soil Group		
	A	B	C & D
2	0.02	0.03	0.04
5	0.07	0.13	0.17
10	0.13	0.23	0.30
25	0.24	0.41	0.52
50	0.33	0.56	0.68
100	0.50	0.85	1.00

3.2.2 Empirical Equations for the Sizing of On-Site Detention Storage Volumes

Urbonas and Glidden (1983), as part of the District's ongoing hydrologic research, conducted studies that evaluated peak storm runoff flows along major drainageways. The following set of empirical equations provided preliminary estimates of on-site detention facility sizing for areas within the District. They are intended for single return period control and not for use when off-site inflows are present or when multi-stage controls are to be used (e.g., 10- and 100-year peak control). In addition, these equations are not intended to replace detailed hydrologic and flood routing analysis, or even the analysis using the Rational Formula-based FAA method for the sizing of detention storage volumes. The District does not promote the use of these empirical equations. It does not object, however, to their use by local governments who have adopted them or want to adopt them as minimum requirements for the sizing of on-site detention for small catchments within their jurisdiction. If the District has a master plan that contains specific guidance for detention storage or sizing of on-site detention facilities, those guidelines should be followed instead. The empirical equations for NRCS Soil types B, C and D are as follows:

$$V_i = K_i A \qquad \text{(SO-1)}$$

for the 100-year:

$$K_{100} = \frac{(1.78\,I - 0.002\,I^2 - 3.56)}{900} \qquad \text{(SO-2)}$$

for the 10-year:

$$K_{10} = \frac{(0.95\,I - 1.90)}{1{,}000} \qquad \text{(SO-3)}$$

for the 5-year:

$$K_5 = \frac{(0.77\,I - 2.65)}{1{,}000} \qquad \text{(SO-4)}$$

For Soil Type A, Equations SO-1 and SO-2 tend to underestimate the needed 100-year detention volume. Instead, Equation SO-5 needs to be used to estimate the 100-year detention volume for Type A Soils (i.e., V_{100A}):

$$V_{100A} = \left(-0.00005501 \cdot I^2 + 0.030148 \cdot I - 0.12\right) \cdot \frac{A}{12} \qquad \text{(SO-5)}$$

in which:

V_i = required volume where subscript i = 100-, 10- or 5-year storm, as appropriate (acre-feet)

K_i = empirical volume coefficient where subscript i = 100-, 10- or 5-year storm, as appropriate

I = fully developed tributary catchment imperviousness (%)

A = tributary catchment area (acres)

6. The calculated outflow volume, V_o, (cubic feet), during the given duration and the adjustment factor at that duration calculated using the equation:

$$V_o = Q_{av}(60T) \tag{SO-9}$$

7. The required storage volume, V_s (cubic feet), calculated using the equation:

$$V_s = V_i - V_o \tag{SO-10}$$

The value of V_s increases with time, reaches a maximum value, and then starts to decrease. The maximum value of V_s is the required storage volume for the detention facility. Sample calculations using this procedure are presented in Design Example 6.2. The modified *FAA Worksheet* of the UD-Detention Spreadsheet performs these calculations.

3.2.4 Simplified Full-Spectrum Detention Sizing (Excess Urban Runoff Flow Control)

With urbanization, the runoff volume increases. Percentage-wise, this increase is much more noticeable for the smaller storm events than for the very big ones, such as the 100-year storm. Wulliman and Urbonas (2005) suggested a concept they termed *Full Spectrum Detention*. This concept was studied using extensive modeling, including continuous simulations of a calibrated watershed. Based on this modeling the original set of equations was slightly modified to increase the EURV by 10%. The protocol that resulted and that is described below reduced runoff peak flows from urbanized areas to more closely approximate the runoff peaks along major drainageways before urbanization occurred.

This concept captures a volume of runoff defined as the *Excess Urban Runoff Volume*" (EURV) and then releases it over approximately 72-hours. EURV is larger than the Water Quality Capture Volume (WQCV) defined in Volume 3 of this *Manual* and varies with the type of NRCS soil group upon which urbanization occurs. EURV includes within its volume the WQCV, which then makes it unnecessary to deal with it separately when the *Full Spectrum Detention* design is used. *Full Spectrum Detention* Equations SO-11, -12 and -13 may by used to find the EURV depths in watershed inches. They were developed using the hydrologic methods described in this *Manual*.

NRCS Soil Group A: $$EURV_A = 1.1 \cdot (2.0491 \cdot i - 0.1113) \tag{SO-11}$$

NRCS Soil Group B: $$EURV_B = 1.1 \cdot (1.2846 \cdot i - 0.0461) \tag{SO-12}$$

NRCS Soil Group C/D: $$EURV_{CD} = 1.1 \cdot (1.1381 \cdot i - 0.0339) \tag{SO-13}$$

in which, $EURV_K$ = Excess Urban Runoff Volume in watershed inches ($K = A, B$ *or* CD),

i = Imperviousness ratio (I/100)

By combining the capture and slow release of the EURV with the 100-year control volumes for Soil Types B, C and D recommended by Equations SO-1 and SO-2 or for Soil Type A recommended by Equation SO-5 with the 100-year release rates based on recommendations in Table SO-1, this concept was found to be more effective in controlling peak flow along major drainageways for almost all levels of storms than provided by the simplified equations or the FAA Method, even for relatively large urban catchments.

The EURV is found using volumes obtained for each soil type, which are then area weighted in proportion to the total catchment's area. The watershed inches of EURV are then converted to cubic feet or acre-feet. The total 100-year detention basin volume is found using Equations SO-1 and SO-2 for Type B, C and D soils or Equation SO-5 for Type A soils, which are also area-weighted by soil types and converted to cubic feet or acre feet. The outlet is designed to empty the EURV in approximately 72 hours. Volumes exceeding EURV are controlled by an outlet designed for a composite maximum 100-year release rate based on unit rates recommended in Table SO-1.

Equation 13a was developed to assist in the sizing of the openings of the perforated plate outlet to drain the EURV in 72 hours, provided the outlet follows the standardized design developed originally with the WQCV outlet for an Extended Detention Basin (EDB) described in Volume 3, namely the perforations are spaced vertically on 4" centers. Figure SO-8 depicts the results of this equation in graphical form. The equation and the figure are only applicable for water depths in the basin between one and eight feet and designers should not extrapolate beyond this range. Outlets needing greater or lesser depths than these need to be designed individually using ether EPA SWMM, UD-Detention spreadsheet or other appropriate software. The *Full-Spectrum Worksheet* of the UD-Detention Spreadsheet performs all of these calculations for the standardized designs, including adjustments for imperviousness due to Level 1 and 2 of MDCIA, accounts for the effects of various soil type distributions in the tributary catchment and has a provision for selecting the local government's policy in how the WQCV is treated as part of the 100-year volume, although the District does not recommend adding any portion of the WQCV to the 100-year volume calculated using this spreadsheet.

$$A = \left[\frac{EURV}{0.00528 \cdot H^2 + 0.0655 \cdot H + 0.0492}\right]^{\frac{1}{-0.0018 \cdot H^2 - 0.0068 \cdot H + 1.0015}} \qquad \text{SO-13a}$$

In which, A = open area per row of perforations, in square inches
H = maximum water depth in basin above the bottom of lowest perforation, in feet
$EURV$ = excess urban runoff volume, in acre feet

Whenever possible, it is suggested that circular orifice openings be used, beveled on the downstream side. The goal is to find a commonly available drill-bit size that will match the needed area with as few columns of perforations as possible. To achieve this, the designer should seek a drill bit size that will deliver an area within +5% and -10% of the one calculated using Equation SO-13a or Figure SO-8.

3.2.5 Excess Urban Runoff Flow Control at Regional Facilities

The simplified full-spectrum detention concept described above is appropriate for volume and outlet sizing of detention facilities serving on-site watersheds of up to 160 acres. For full-spectrum basins serving larger watersheds, the EURV portion of the basin still needs to be sized using Equations SO-10 through SO-12 and the outlet designed to empty this volume in approximately 72-hours. The 100-year peak flow control volume above the EURV has to be sized, and its outlet designed, using full hydrograph routing protocols. The hydrograph routing option is also available for smaller sub-watersheds as well. Regardless of which 100-year sizing and outlet design option is used for regional facilities, the maximum 100-year release rates cannot exceed the release rates based on unit discharges recommended in Table SO-1 or pre-developed peak 100-year flow rates for the tributary watershed, whichever are less, or those recommended in a District accepted master plan.

3.2.6 Multi-Level Control

The District recommends that no more than two levels of controls, in addition to the WQCV controls, be used for on-site detention facilities. These levels can be the 10- or 100-year storm, in combination with the 2-, 5- or the 10-year storm, as appropriate. More levels of control may appear to provide increased protection, but the added complexity of design and the questionable accuracy of results rarely justifies it. As an alternative to this three-level control recommended above, one can chose the two-level control offered by Sections 3.2.4 and 3.2.5 above to achieve broader levels of peak runoff control and possibly less expensive outlet design.

3.2.7 On-Site Detention and UDFCD 100-year Floodplain Management Policy

While UDFCD has confidence in the ability of many on-site detention basins to control peak flow rates to predevelopment level for small urban catchments, this is not the case for larger watersheds. The complexities of predicting where each on-site detention basin is going to be installed as areas urbanize, how each is going to be designed and built, and then applying the detention routing technology on an evolving and diffuse system of control facilities is beyond anyone's ability to assess or predict. In addition, the UDFCD has no ability or power to insure that all on-site detention facilities will continue to be maintained and their function will not deteriorate over time. In fact, evidence suggests to the contrary (Prommersberger, 1984) that many on-site detention facilities do not receive needed maintenance and do not provide the original design function over time. Prommersberger (1984) found that many, in fact, have never been built as designed. In response to these complexities of implementation and future maintenance uncertaities, the UDFCD adheres to the following policies when developing hydrology for the delineation and regulation of the 100-year flood hazard zones within its boundaries:

1. Hydrology has to be based on fully developed watershed condition as estimated to occur, at a minimum, over the next 50 years.
2. No on-site detention basin will be recognized in the development of hydrology unless:

3.0 Calculation of the WQCV

The first step in estimating the magnitude of runoff from a site is to estimate the site's total imperviousness. The total imperviousness of a site is the weighted average of individual areas of like imperviousness. For instance, according to Table RO-3 in the *Runoff* chapter of Volume 1 of this manual, paved streets (and parking lots) have an imperviousness of 100%; drives, walks and roofs have an imperviousness of 90%; and lawn areas have an imperviousness of 0%. The total imperviousness of a site can be determined taking an area-weighted average of all of the impervious and pervious areas. When measures are implemented minimize directly connected impervious area (MDCIA), the imperviousness used to calculate the WQCV is the "effective imperviousness." Sections 4 and 5 of this chapter provide guidance and examples for calculating effective imperviousness and adjusting the WQCV to reflect decreases in effective imperviousness.

The WQCV is calculated as a function of imperviousness and BMP drain time using Equation 3-1, and as shown in Figure 3-2:

$$\mathrm{WQCV} = a(0.91I^3 - 1.19I^2 + 0.78I) \qquad \text{Equation 3-1}$$

Where:

WQCV = Water Quality Capture Volume (watershed inches)

a = Coefficient corresponding to WQCV drain time (Table 3-2)

I = Imperviousness (%/100) (see Figures 3-3 through 3-5 [single family land use] and /or the *Runoff* chapter of Volume 1[other typical land uses])

Table 3-2. Drain Time Coefficients for WQCV Calculations

Drain Time (hrs)	Coefficient, a
12 hours	0.8
24 hours	0.9
40 hours	1.0

Figure 3-2, which illustrates the relationship between imperviousness and WQCV for various drain times, is appropriate for use in Colorado's high plains near the foothills. For other portions of Colorado or United States, the WQCV obtained from this figure can be adjusted using the following relationships:

$$\mathrm{WQCV}_{\mathrm{other}} = d_6\left(\frac{\mathrm{WQCV}}{0.43}\right) \qquad \text{Equation 3-2}$$

Where:

WQCV = WQCV calculated using Equation 3-1 or Figure 3-2 (watershed inches)

$\mathrm{WQCV}_{\mathrm{other}}$ = WQCV outside of Denver region (watershed inches)

d_6 = depth of average runoff producing storm from Figure 3-1 (watershed inches)

Once the WQCV in watershed inches is found from Figure 3-2 or using Equation 3-1 and/or 3-2, the required BMP storage volume in acre-feet can be calculated as follows:

$$V = \left(\frac{\text{WQCV}}{12}\right) A \qquad \text{Equation 3-3}$$

Where:

V = required storage volume (acre-ft)

A = tributary catchment area upstream (acres)

WQCV = Water Quality Capture Volume (watershed inches)

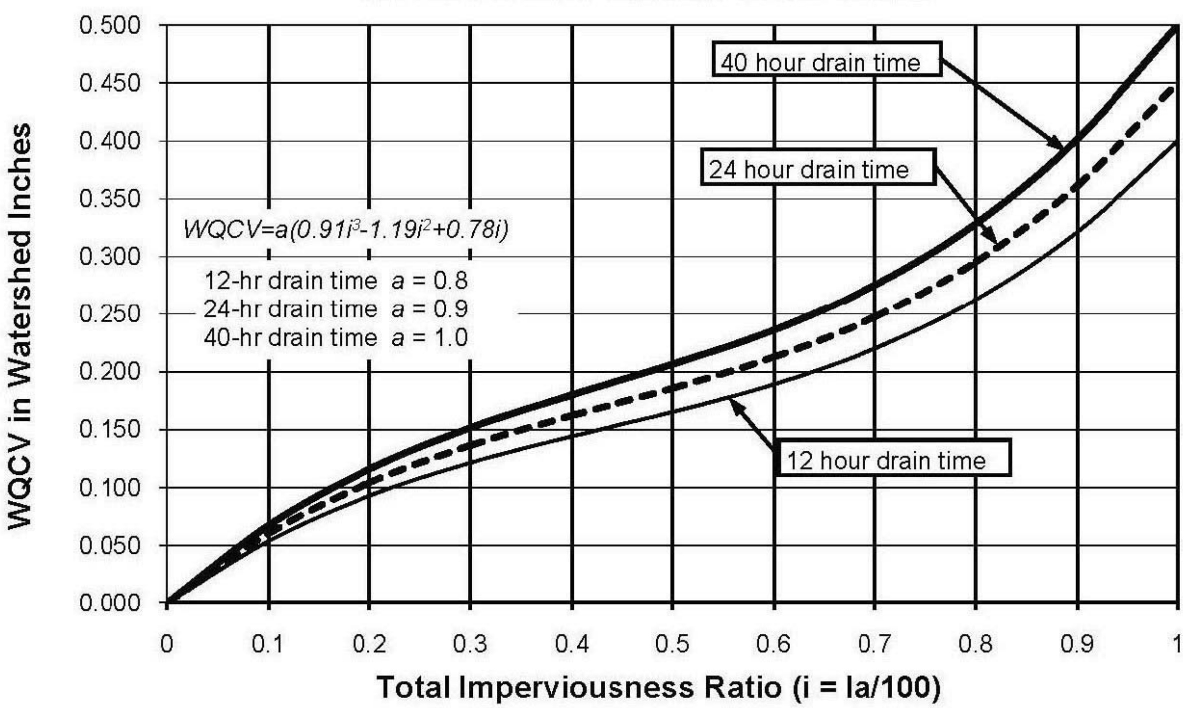


Figure 3-2. Water Quality Capture Volume (WQCV) Based on BMP Drain Time

Description

Photograph EDB-1: This EDB includes a concrete trickle channel and a micropool with a concrete bottom and grouted boulder sideslopes. The vegetation growing in the sediment of the micropool adds to the natural look of this facility and ties into the surrounding landscape.

An extended detention basin (EDB) is a sedimentation basin designed to detain stormwater for many hours after storm runoff ends. This BMP is similar to a detention basin used for flood control, however; the EDB uses a much smaller outlet that extends the emptying time of the more frequently occurring runoff events to facilitate pollutant removal. The EDB's 40-hour drain time for the water quality capture volume (WQCV) is recommended to remove a significant portion of total suspended solids (TSS). Soluble pollutant removal is enhanced by providing a small wetland marsh or "micropool" at the outlet to promote biological uptake. The basins are sometimes called "dry ponds" because they are designed not to have a significant permanent pool of water remaining between storm runoff events.

An extended detention basin can also be designed to provide Full Spectrum Detention. In this case, the EDB is sized for 100-year peak reduction and the excess urban runoff volume (EURV) is used instead of the WQCV. The EURV is designed with a drain time of approximately 72 hours. Widespread use of Full Spectrum Detention is anticipated to reduce impacts on major drainageways by reducing post-development peak discharges to better resemble pre-development peaks. Refer to the *Storage* chapter of Volume 2 for additional information on Full Spectrum Detention.

Extended Detention Basin	
Functions	
LID/Volume Red.	Somewhat
WQCV Capture	Yes
WQCV+Flood Control	Yes
Fact Sheet Includes EURV Guidance	Yes
Typical Effectiveness for Targeted Pollutants[3]	
Sediment/Solids	Good
Nutrients	Moderate
Total Metals	Moderate
Bacteria	Poor
Other Considerations	
Life-cycle Costs[4]	Moderate

[3] Based primarily on data from the International Stormwater BMP Database (www.bmpdatabase.org).

[4] Based primarily on BMP-REALCOST available at www.udfcd.org. Analysis based on a single installation (not based on the maximum recommended watershed tributary to each BMP).

Site Selection

EDBs are well suited for watersheds with at least five impervious acres up to approximately one square mile of watershed. Smaller watersheds can result in an orifice size prone to clogging. Larger watersheds and watersheds with baseflows can complicate the design and reduce the level of treatment provided. EBDs are also well suited where flood detention is incorporated into the same basin.

> Use the WQCV (or the EURV) when designing an EDB only for water quality. Use the EURV when incorporating water quality into a flood control facility.

The depth of groundwater should be investigated. Groundwater depth should be 2 or more feet below the bottom of the basin in order to keep this area dry and maintainable.

Designing for Maintenance

Recommended maintenance practices for all BMPs are provided in the BMP Maintenance chapter of this manual. During design the following should be considered to ensure ease of maintenance over the long-term:

- Always provide a micropool (see step 7).
- Provide a design slope of at least 3% in the vegetated bottom of the basin (either toward the trickle channel or toward the micropool). This will help maintain the appearance of the turf grass in the bottom of the basin and reduce the possibility of saturated areas that may produce unwanted species of vegetation and mosquito breeding conditions. Verify slopes during construction, prior to vegetation.
- Follow trash rack sizing recommendations to determine the minimum area for the trash rack (see design step 9).
- Provide adequate initial surcharge volume for frequent inundation (see design step 3).
- Provide stabilized access to the forebay, outlet, spillway, and micropool for maintenance purposes.
- Provide access to the well screen. The well screen requires maintenance more often than any other EDB component. Ensure that the screen can be reached from a point outside of the micropool. When the well screen is located inside the outlet structure, provide an access port within the trash rack or use a sloped trash rack that consists of bearing bars (not horizontal) that are 6 inches on center.
- Provide a hard-bottom forebay that allows for removal of sediment.
- Where baseflows are anticipated, consider providing a flow-measuring device (e.g. weir or flume with staff gage and rating curve) at the forebay to assist with future modifications of the water quality plate. Typically, the baseflow will increase as the watershed develops. It is important that the water quality plate continue to function, passing the baseflow while draining the WQCV over approximately 40 hours. Measuring the actual baseflow can be helpful in determining if and when the orifice place should be replaced.

Benefits

- The relatively simple design can make EDBs less expensive to construct than other BMPs, especially for larger basins.
- Maintenance requirements are straightforward.
- The facility can be designed for multiple uses.

Limitations

- Ponding time and depths may generate safety concerns.
- Best suited for tributary areas of 5 impervious acres or more. EDBs are not recommended for sites less than 2 impervious acres.
- Although ponds do not require more total area compared to other BMPs, they typically require a relatively large continuous area.

EDBs providing combined water quality and flood control functions can serve multiple uses such as playing fields or picnic areas. These uses are best located at higher elevation within the basin, above the WQCV pool level.

Design Procedure and Criteria

The following steps outline the design procedure and criteria for an EDB:

1. **Basin Storage Volume**: Provide a design volume equal to 120% of the WQCV or 100% of the EURV. This volume begins at the lowest orifice in the outlet structure. The additional 20% for the WQCV is for sediment accumulation and the resultant loss in storage volume. Additional volume for sediment storage is not necessary when designing for the EURV, as the water quality perforations extend above the depth of the WQCV.

   - Determine the imperviousness of the watershed (or effective imperviousness where LID elements are used upstream).

   - Find the required storage volume. Determine the required WQCV or EURV (watershed inches of runoff) using Figure 3-2 located in Chapter 3 of this manual (for WQCV) or equations provided in the *Storage* chapter of Volume 2 (for EURV).

   - Calculate the design volume as follows:

   For WQCV:

   $$V = \left[\frac{\mathrm{WQCV}}{12}\right] 1.2\, A \qquad \text{Equation EDB-1}$$

   For EURV:

   $$V = \left[\frac{\mathrm{EURV}}{12}\right] A \qquad \text{Equation EDB-2}$$

   Where:

   V = design volume (acre ft)

   A = watershed area tributary to the extended detention basin (acres)

   1.2 factor = multiplier to accommodate sediment accumulation

2. **Basin Shape**: Always maximize the distance between the inlet and the outlet. It is best to have a basin length (measured along the flow path from inlet to outlet) to width ratio of at least 2:1. A longer flow path from inlet to outlet will minimize short circuiting and improve reduction of TSS. To achieve this ratio, it may be necessary to modify the inlet and outlet points through the use of pipes or swales.

3. **Basin Side Slopes**: Basin side slopes should be stable and gentle to facilitate maintenance and access. Slopes that are 4:1or flatter should be used to allow for conventional maintenance equipment and for improved safety, maintenance, and aesthetics. Side slopes should be no steeper than 3:1. The use of walls is highly discouraged due to maintenance constraints.

4. **Inlet**: Dissipate flow energy at concentrated points of inflow. This will limit erosion and promote particle sedimentation. Inlets should be designed in accordance with UDFCD drop structure criteria

for inlets above the invert of the forebay, impact basin outlet details for at grade inlets, or other types of energy dissipating structures.

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 though 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 is often inadvertently removed during maintenance operations.

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

   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. This can be done through an orifice plate as detailed in BMP Fact Sheet T-12. Use reservoir routing calculations as discussed in the *Storage* Chapter of Volume 2 or use equation EDB-3, a simplified orifice sizing equation (see Technical Memorandum dated July 13, 2010 available at www.udfcd.org).

$$A_O = \frac{88V^{\left(0.95/H^{0.085}\right)}}{T_D\, S^{0.09}\, H^{\left(2.6S^{0.3}\right)}} \qquad \text{Equation EDB-3}$$

   Where:

   A_O = area per row of orifices spaced on 4" centers (in^2)

   V = design volume (WQCV or EURV, acre ft)

   T_D = time to drain the prescribed volume (hrs) (i.e., 40 hours for WQCV or 72 hours for EURV)

   H = depth of volume (ft)

   S = slope (ft/ft)

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

Additional Guidelines for Incorporating Flood Control:

When designing for flood control using Full Spectrum Detention, the outlet is typically designed to drain the EURV in 72 hours. However, the owner may want to modify the design (reduce the EURV drain time) for a number of reasons including wanting to provide larger orifices for maintenance purposes or, when designing BMPs in series, to ensure that the maximum detention time for the system does not exceed 72 hours. Modifications can be permitted as long as the outlet drains the WQCV (not the EURV) over a period of at least 40 hours. The *UD-BMP* workbook can be used to ensure this condition is met while adjusting the drain time for the EURV.

When using Full Spectrum Detention a separate 5- or 10-year orifice or weir is not necessary. In order to best replicate historic release rates, design the outlet structure to overtop at the EURV elevation. The velocity of flows into the structure at the 100-year peak discharge should not exceed a velocity of 2 feet per second. This criterion is a safety precaution, limiting the risk of pinning. Use the continuity equation to ensure this criterion:

$$V = \frac{Q_{100}}{A} \leq 2$$

Equation EDB-4

Where:

V = velocity of flow through the trash rack (ft/s)

Q_{100} = peak discharge through the outlet structure (cfs)

A = open area of the trash rack (ft^2)

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.

8. **Initial Surcharge Volume**: Providing a surcharge volume above the micropool for frequently occurring runoff minimizes standing water and sediment deposition in the remainder of the basin. This is critical to turf maintenance and mosquito abatement in the basin bottom. The initial surcharge volume is not provided in the micropool nor does it include the micropool volume. It is the available storage volume that begins at the water surface elevation of the micropool and extends upward to a grade break within the basin (typically the invert of the trickle channel).

Photograph EDB-2. The initial surcharge volume of this EDB is contained within the boulders that surround the micropool.

The area of the initial surcharge volume, when full, is typically the same or slightly larger than that of the micropool. The initial surcharge volume should have a depth of at least 4 inches. For watersheds of at least 5 impervious acres, the initial surcharge volume should also be at least 0.3% of the WQCV. The initial surcharge volume is considered a part of the WQCV and does not need to be provided in addition to the WQCV. It is recommended that this area be shown on the grading plan or in a profile for the EDB. When baseflows are anticipated, it is recommended that the initial surcharge volume be increased. See the inset on page EDB-9 for additional guidelines for designing for baseflows.

9. **Trash Rack**: Provide a trash rack (or screen) of sufficient size at the outlet to provide hydraulic capacity while the rack is partially clogged. Openings should be small enough to limit clogging of the individual orifices. For this reason, it is recommended that a well screen be used when circular orifices are used. Size any overflow trash rack so it does not interfere with the hydraulic capacity of the outlet pipe. See BMP Fact Sheet T-12 for detailed trash rack design guidance.

Photograph EDB-3. Although walls may complicate maintenance access, this outlet structure is relatively hidden from public view. This photo was taken shortly following a storm event.

Photograph EDB-4. A series of landscape islands connected by culverts provide water quality and flood control for this site.

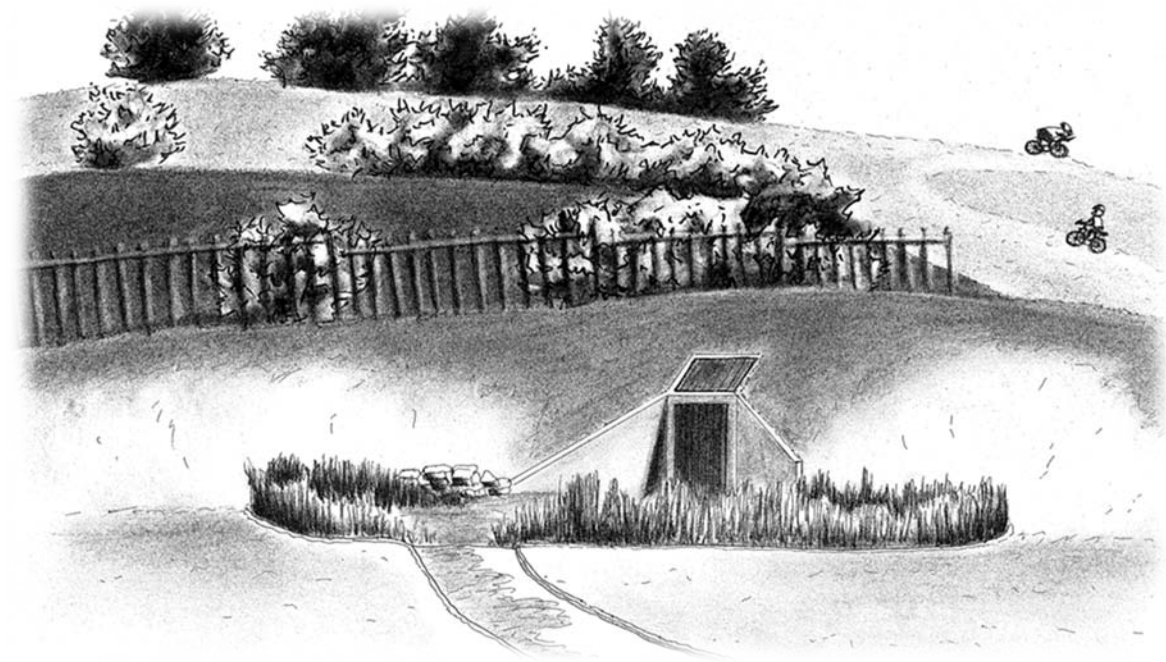


Figure EDB-1. Flared Wall Outlet Structure Configuration. Graphic by Adia Davis.

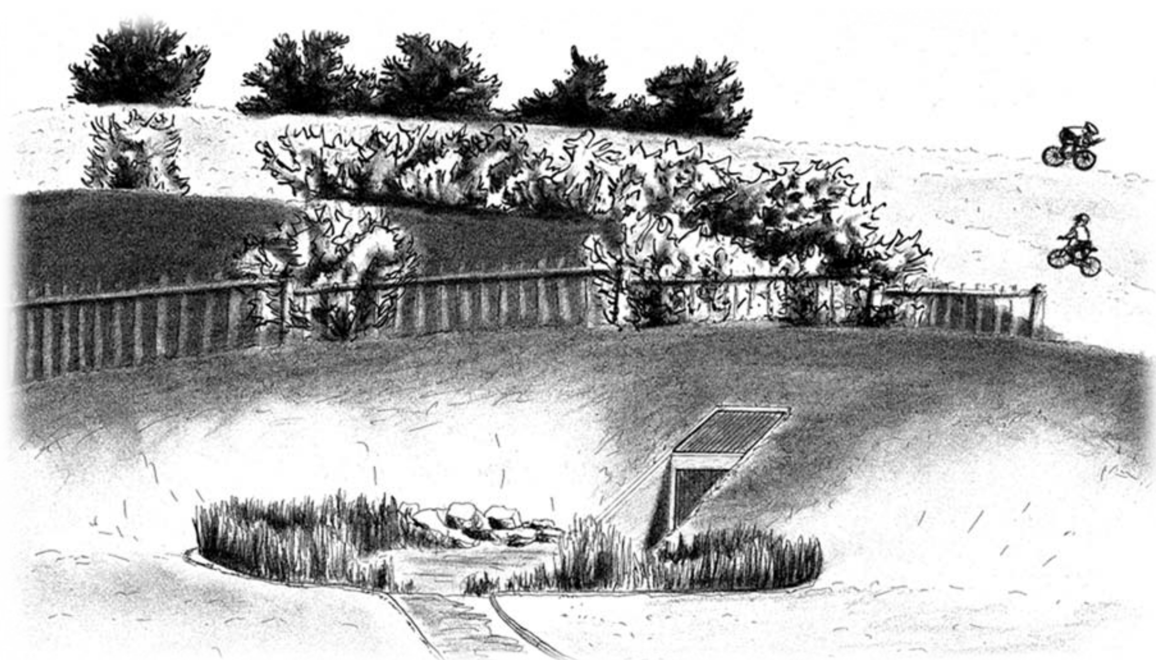


Figure EDB-2. Parallel Wall Outlet Structure Configuration. Graphic by Adia Davis.

10. **Overflow Embankment:** Design the embankment to withstand the 100-year storm at a minimum. If the embankment falls under the jurisdiction of the State Engineer's Office, it must be designed to meet the requirements of the State Engineer's Office. The overflow should be located at a point where waters can best be conveyed downstream. Slopes that are 4:1 or flatter should be used to allow for conventional maintenance equipment and for improved safety, maintenance, and aesthetics. Side slopes should be no steeper than 3:1 and should be planted with turf forming grasses. Poorly compacted native soils should be excavated and replaced. Embankment soils should be compacted to 95% of maximum dry density for ASTM D698 (Standard Proctor) or 90% for ASTM D1557 (Modified Proctor). Spillway structures and overflows should be designed in accordance with the *Storage* Chapter of Volume 2 as well as any local drainage criteria. Buried soil riprap or reinforced turf mats installed per manufacturer's recommendations can provide an attractive and less expensive alternative to concrete.

11. **Vegetation:** Vegetation provides erosion control and sediment entrapment. Basin bottom, berms, and side slopes should be planted with turf grass, which is a general term for any grasses that will form a turf or mat, as opposed to bunch grass which will grow in clumplike fashion. Xeric grasses with temporary irrigation are recommended to reduce maintenance requirements, including maintenance of the irrigation system as well as frequency of mowing. Where possible, place irrigation heads outside the basin bottom because irrigation heads in an EDB can become buried with sediment over time.

12. **Access:** Provide appropriate maintenance access to the forebay and outlet works. For larger basins, this means stabilized access for maintenance vehicles. If stabilized access is not provided, the maintenance plan should provide detail, including recommended equipment, on how sediment and trash will be removed from the outlet structure and micropool. Some communities may require vehicle access to the bottom of the basin regardless of the size of the watershed. Grades

Designing for Baseflows

Baseflows should be anticipated for large tributary areas and can be accommodated in a variety of ways. Consider the following:

- If water rights are available, consider alternate BMPs such as a constructed wetland pond or retention pond.
- Anticipate future modifications to the outlet structure. Following construction, baseflows should be monitored periodically. Intermittent flows can become perennial and perennial flows can increase over time. It may be determined that outlet modifications are necessary long after construction of the BMP is complete.
- Design foundation drains and other groundwater drains to bypass the water quality plate directing these drains to a conveyance element downstream of the EDB. This will reduce baseflows and help preserve storage for the WQCV.
- When the basin is fully developed and an existing baseflow can be approximated prior to design, the water quality orifices should be increased to drain the WQCV in 40 hours (or EURV in 72 hours) while also draining the baseflow. This requires reservoir routing using an inflow hydrograph that includes the baseflow. The *UD-Detention* workbook available at www.udfcd.org may be used for this purpose.
- Increase the initial surcharge volume of the pond to provide some flexibility when baseflows are known or anticipated. Baseflows are difficult to approximate and will continue to increase as the watershed develops. Increasing the initial surcharge volume will accommodate a broader range of flows.

should not exceed 10% for haul road surfaces and 20% for skid-loader and backhoe access. Stabilized access includes gravel, concrete, articulated concrete block, concrete grid pavement, or reinforced grass pavement. The recommended cross slope is 2%.

Aesthetic Design

Since all land owners and managers wish to use land in the most efficient manner possible, it is important that EDBs become part of a multi-use system. This encourages the design of EDBs as an aesthetic part of a naturalized environment or to include passive and/or active open space. Within each scenario, the EDB can begin to define itself as more than just a drainage facility. When this happens, the basin becomes a public amenity. This combination of public amenity and drainage facility is of much greater value to a landowner. Softened and varied slopes, interspersed irrigated fields, planting areas and wetlands can all be part of an EDB.

The design should be aesthetic whether it is considered to be an architectural or naturalized basin. Architectural basins incorporate design borrowed or reflective of the surrounding architecture or urban forms. An architectural basin is intended to appear as part of the built environment, rather than hiding the cues that identify it as a stormwater structure. A naturalized basin is designed to appear as though it is a natural part of the landscape. This section provides suggestions for designing a naturalized basin. The built environment, in contrast to the natural environment, does not typically contain the randomness of form inherent in nature. Constructed slopes typically remain consistent, as do slope transitions. Even dissipation structures are usually a hard form and have edges seldom seen in nature. If the EDB is to appear as though it is a natural part of the landscape, it is important to minimize shapes that provide visual cues indicating the presence of a drainage structure. For example, the side sides should be shaped more naturally and with varying slopes for a naturalized basin.

Suggested Methods for a Naturalized Basin

- Create a flowing form that looks like it was shaped by water.
- Extend one side of the basin higher than the other. This may require a berm.
- Shape the bottom of the basin differently than the top.
- Slope of one side of the basin more mildly than the opposing side.
- Vary slope transitions both at the top of the bank and at the toe.
- Use a soft-surface trickle channel if appropriate and approved.
- When using rock for energy dissipation, the rock should graduate away from the area of hard edge into the surrounding landscape. Other non-functional matching rock should occur in other areas of the basin to prevent the actual energy dissipation from appearing out of context.
- Design ground cover to reflect the type of water regime expected for their location within the basin.

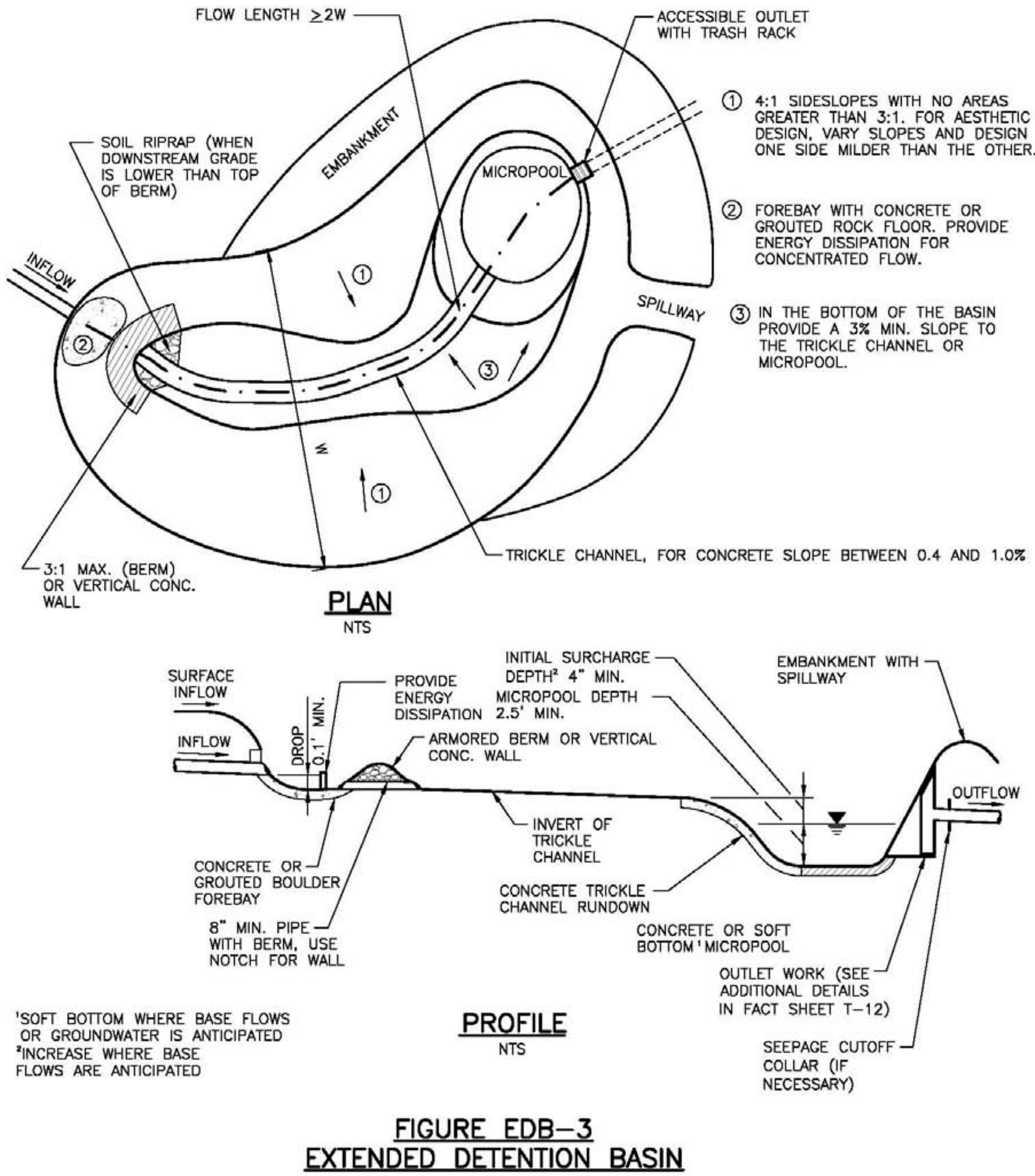


Figure EDB-3. Extended Detention Basin (EDB) Plan and Profile

Additional Details are provided in BMP Fact Sheet T-12. This includes outlet structure details including orifice plates and trash racks.

Table EDB-4. EDB Component Criteria

	On-Site EDBs for Watersheds up to 1 Impervious Acre[1]	EDBs with Watersheds up to 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	A forebay and trickle channel may not be necessary for this size site. Specific site operations should be considered to determine if a forebay will serve to reduce the maintenance requirements.	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	Area ≥ 10 ft^2
Initial Surcharge Volume	Depth ≥ 4 inches	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).

Design Example

The *UD-BMP* workbook, designed as a tool for both designer and reviewing agency is available at www.udfcd.org. This section provides a completed design form from this workbook as an example.

Design Procedure Form: Extended Detention Basin (EDB)

Sheet 1 of 4

Designer:	**H. Dauel**
Company:	**BMP, Inc.**
Date:	**November 29, 2010**
Project:	**Subdivison D**
Location:	**NE Corner of 34th Ave. and 83rd St.**

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 75.0 %
B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	i = 0.750
C) Contributing Watershed Area	Area = 17.000 ac
D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = ______ in
E) Design Concept (Select EURV when also designing for flood control)	Choose One: ○ Water Quality Capture Volume (WQCV) ◉ Excess Urban Runoff Volume (EURV)
F) Design Volume (1.2 WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area * 1.2)$	V_{DESIGN}= 0.509 ac-ft
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6*(V_{DESIGN}/0.43))$	$V_{DESIGN\ OTHER}$= ______ ac-ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{DESIGN\ USER}$= ______ ac-ft
I) Predominant Watershed NRCS Soil Group	Choose One: ○ A ○ B ◉ C / D
J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: EURVA = (0.1878i - 0.0104)*Area For HSG B: $EURV_B$ = (0.1178i - 0.0042)*Area For HSG C/D: $EURV_{C/D}$ = (0.1043i - 0.0031)*Area	EURV = 1.277 ac-f t
2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.)	L : W = 2.0 : 1
3. Basin Side Slopes	
A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred)	Z = 4.00 ft / ft
4. Inlet	
A) Describe means of providing energy dissipation at concentrated inflow locations:	Based on UDFCD detail for modified impact stilling basin for conduits 18 to 48 inches.

Design Procedure Form: Extended Detention Basin (EDB)

Sheet 2 of 4

Designer:	**H. Dauel**
Company:	**BMP, Inc.**
Date:	**November 29, 2010**
Project:	**Subdivison D**
Location:	**NE Corner of 34th Ave. and 83rd St.**

5. Forebay	
A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV)	V_{FMIN} = 0.013 ac-ft
B) Actual Forebay Volume	V_F = 0.015 ac-ft
C) Forebay Depth (D_F = 18 inch maximum)	D_F = 12.0 in
D) Forebay Discharge	
i) Undetained 100-year Peak Discharge	Q_{100} = 50.00 cfs
ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)	Q_F = 1.00 cfs
E) Forebay Discharge Design	Choose One: ○ Berm With Pipe; ◉ Wall with Rect. Notch; ○ Wall with V-Notch Weir — (flow too small for berm w/ pipe)
F) Discharge Pipe Size (minimum 8-inches)	Calculated D_P = in
G) Rectangular Notch Width	Calculated W_N = 6.0 in
6. Trickle Channel	
A) Type of Trickle Channel	Choose One: ◉ Concrete; ○ Soft Bottom
F) Slope of Trickle Channel	S = 0.0100 ft / ft
7. Micropool and Outlet Structure	
A) Depth of Micropool (2.5-feet minimum)	D_M = 2.5 ft
B) Surface Area of Micropool (10 ft^2 minimum)	A_M = 125 sq ft
C) Outlet Type	Choose One: ◉ Orifice Plate; ○ Other (Describe):
D) Depth of Design Volume (EURV or 1.2 WQCV) Based on the Design Concept Chosen Under 1.E.	H = 2.30 feet
E) Volume to Drain Over Prescribed Time	EURV = 1.277 ac-ft
F) Drain Time (Min T_D for WQCV= 40 hours; Max T_D for EURV= 72 hours)	T_D = 72 hours
G) Recommended Maximum Outlet Area per Row, (A_o)	A_o = 1.3 square inches
H) Orifice Dimensions: i) Circular Orifice Diameter or ii) Width of 2" High Rectangular Orifice	$D_{orifice}$ = 1 - 5 / 16 inch inches; $W_{orifice}$ = inches
I) Number of Columns	n_c = 1 number
J) Actual Design Outlet Area per Row (A_o)	A_o = 1.4 square inches
K) Number of Rows (nr)	n_r = 6 number
L) Total Outlet Area (A_{ot})	A_{ot} = 9.3 square inches
M) Depth of WQCV (H_{WQCV}) (Estimate using actual stage-area-volume relationship and V_{WQCV})	H_{WQCV} = 0.8 feet
N) Ensure Minimum 40 Hour Drain Time for WQCV	$T_{D\ WQCV}$ = 49.7 hours

Design Procedure Form: Extended Detention Basin (EDB)

Sheet 3 of 4

Designer:	**H. Dauel**
Company:	**BMP, Inc.**
Date:	**November 29, 2010**
Project:	**Subdivison D**
Location:	**NE Corner of 34th Ave. and 83rd St.**

8. Initial Surcharge Volume	
A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches)	D_{IS} = 6.0 in
B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV)	V_{IS} = 55.5 cu ft
C) Initial Surcharge Provided Above Micropool	V_s= 62.5 cu ft
9. Trash Rack	Choose One ◉ Circular (up to 2" diameter) ○ Rectangular (2" high)
A) Type of Water Quality Orifice Used	
B) Water Quality Screen Open Area: $A_t = 38.5*(e^{-0.095D})*A_{ot}$	A_t = 317 square inches
C) For 2", or Smaller, **Circular Opening** (See Fact Sheet T-12):	
i) Width of Water Quality Screen and Concrete Opening ($W_{opening}$)	$W_{opening}$ = 12.0 inches
ii) Height of Water Quality Screen (H_{TR})	H_{TR} = 55.6 inches
iii) Type of Screen, Describe if "Other"	Choose One ◉ S.S. Well Screen with 60% Open Area* ○ Other (Describe):
D) For 2" High **Rectangular Opening**:	
i) Width of Rectangular Opening ($W_{orifice}$)	W = inches
ii) Width of Water Quality Screen Opening ($W_{opening}$)	$W_{opening}$ = ft
iii) Height of Water Quality Screen (H_{TR})	H_{TR} = ft
iv) Type of Screen, Describe if "Other"	Choose One ○ Aluminum Amico-Klemp SR Series (or equal) ○ Other (Describe):
v) Cross-bar Spacing	inches
vi) Minimum Bearing Bar Size	

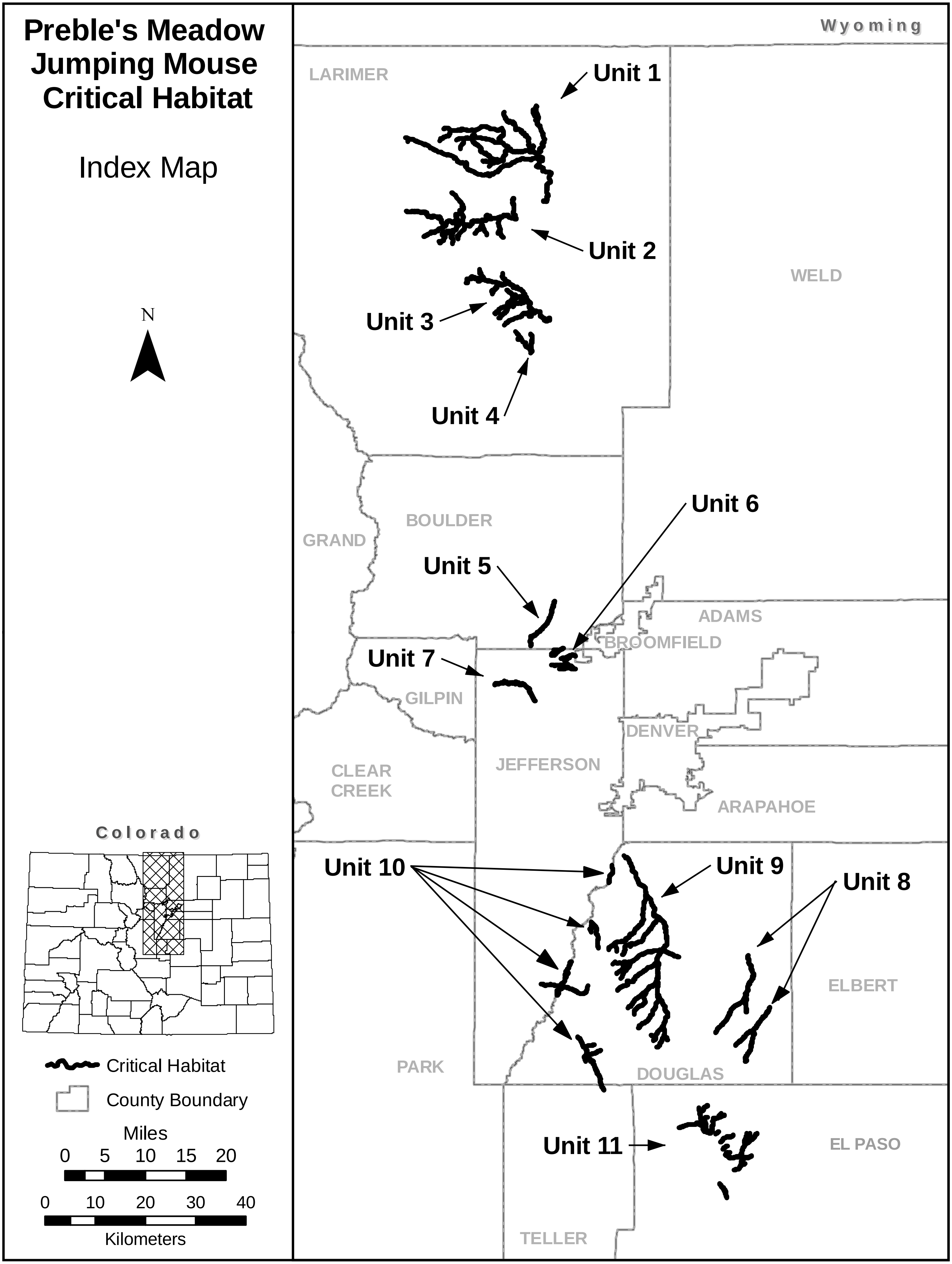
Design Procedure Form: Extended Detention Basin (EDB)

Sheet 4 of 4

Designer:	**H. Dauel**
Company:	**BMP, Inc.**
Date:	**November 29, 2010**
Project:	**Subdivison D**
Location:	**NE Corner of 34th Ave. and 83rd St.**

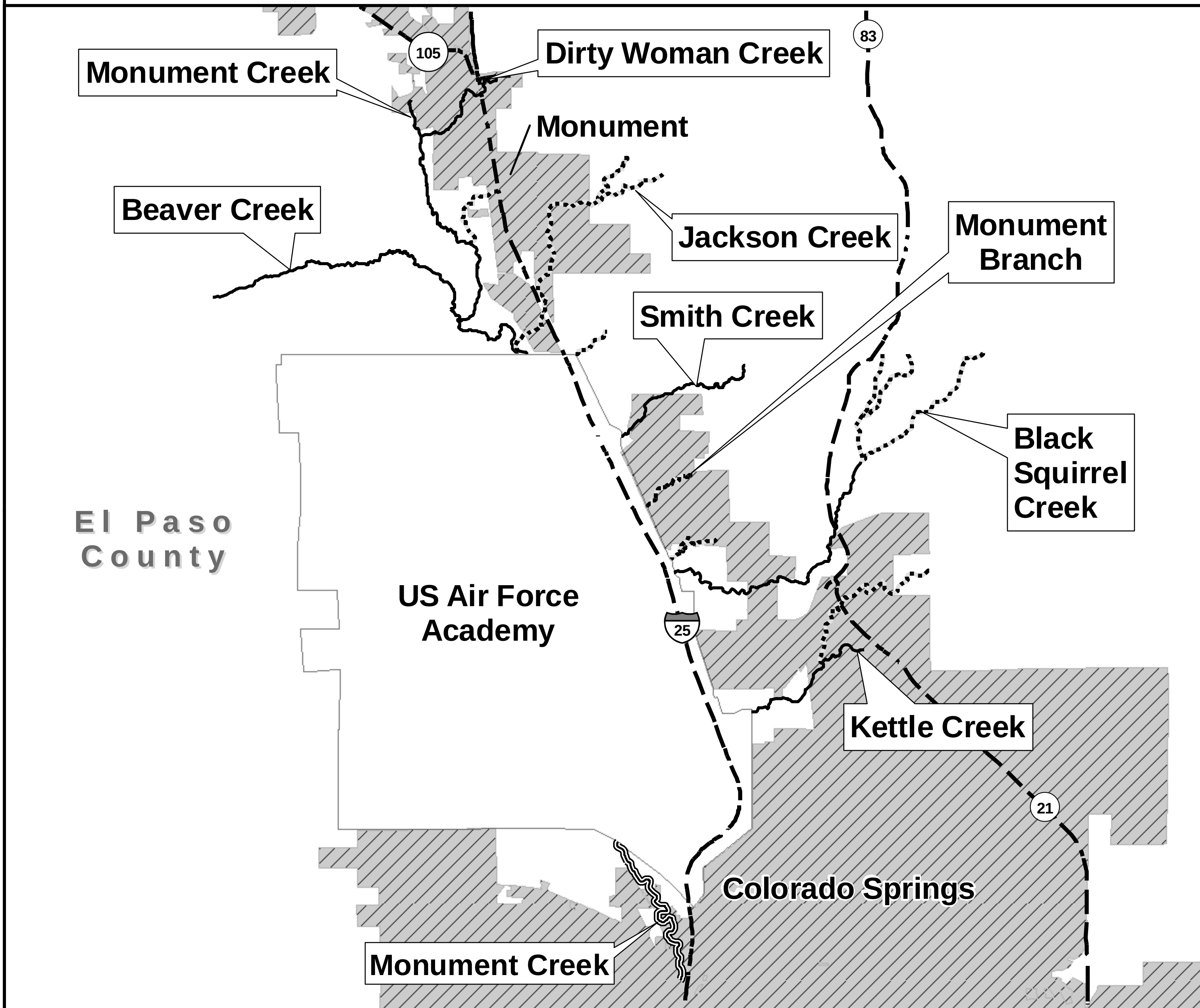
10. Overflow Embankment	
A) Describe embankment protection for 100-year and greater overtopping:	Buried soil riprap at SE corner. Overflow is 12 feet wide and 12 inches lower than the surrounding embankment. Undetained peak velociies are less than 5 fps.
B) Slope of Overflow Embankment (Horizontal distance per unit vertical, 4:1 or flatter preferred)	Z_E = 4.00 ft / ft
11. Vegetation	Choose One ○ Irrigated ◉ Not Irrigated
12. Access	
A) Describe Sediment Removal Procedures	Aggregate turf pavement access at SE corner of basin allows access to the bottom of the basin for all standard maintenance.

Notes:


Preble's Meadow Jumping Mouse Critical Habitat
Index Map
N
Colorado
Critical Habitat
County Boundary
Miles
0 5 10 15 20
0 10 20 30 40
Kilometers
Wyoming
LARIMER
WELD
GRAND
BOULDER
ADAMS
BROOMFIELD
GILPIN
DENVER
CLEAR CREEK
JEFFERSON
ARAPAHOE
PARK
DOUGLAS
ELBERT
TELLER
EL PASO
Unit 1
Unit 2
Unit 3
Unit 4
Unit 5
Unit 6
Unit 7
Unit 8
Unit 9
Unit 10
Unit 11

Critical Habitat for the Preble's Meadow Jumping Mouse

Unit 11 - Monument Creek



Critical habitat equals the stream plus the following distance outward on each side.

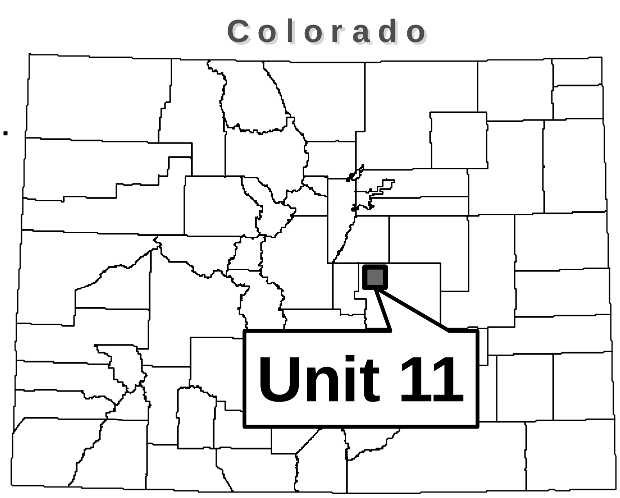
110 meters (361 ft)

120 meters (394 ft)

140 meters (459 ft)

Major Roads

Municipal Lands



0 1 2 3

Miles

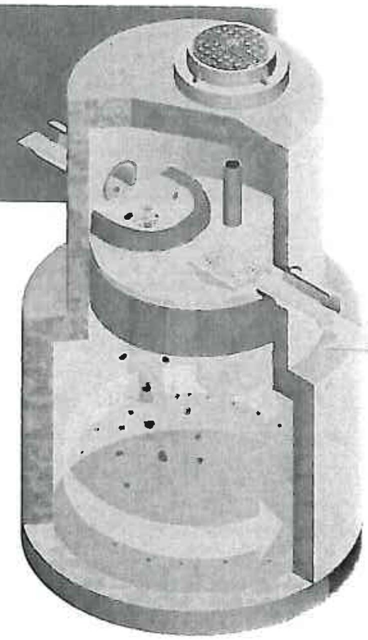
N

0 1 2 3 4 5

Kilometers

Note: Critical Habitat without name labels are unnamed tributaries.

Stormceptor® STC



The calm *during* the storm

When it rains, oils, sediment and other contaminants are washed from paved surfaces directly into our storm drains and waterways. Non-point source pollution such as stormwater now accounts for 80% of water pollution in North America and governments are responding with demanding regulations to protect our water resources.

Removing more pollutants

Stormceptor removes more pollutants from stormwater than any other separator.

- Maintains continuous positive treatment of total suspended solids (TSS) year-round, regardless of flow rate
- Designed to remove a wide range of particle sizes (from 20 to 2,000 microns), as well as free oils, heavy metals and nutrients that attach to fine sediment
- Can be designed to remove a specific particle size distribution (PSD)

A calm treatment environment

- Stormceptor slows incoming stormwater to create a non-turbulent treatment environment, allowing free oils and debris to rise, and sediment to settle
- Patented scour prevention technology ensures pollutants are captured and contained during all rainfall events, even extreme storms

PCSWMM for Stormceptor – leading the industry

The most accurate, easy to use design tool available.

- This continuous simulation modeling software combines up-to-date local rainfall data from hundreds of stations across North America with a selection of particle sizes to design the best system for your site
- Developed with Computational Hydraulics International (CHI), internationally acclaimed expert, Dr. Bill James and Imbrium Systems

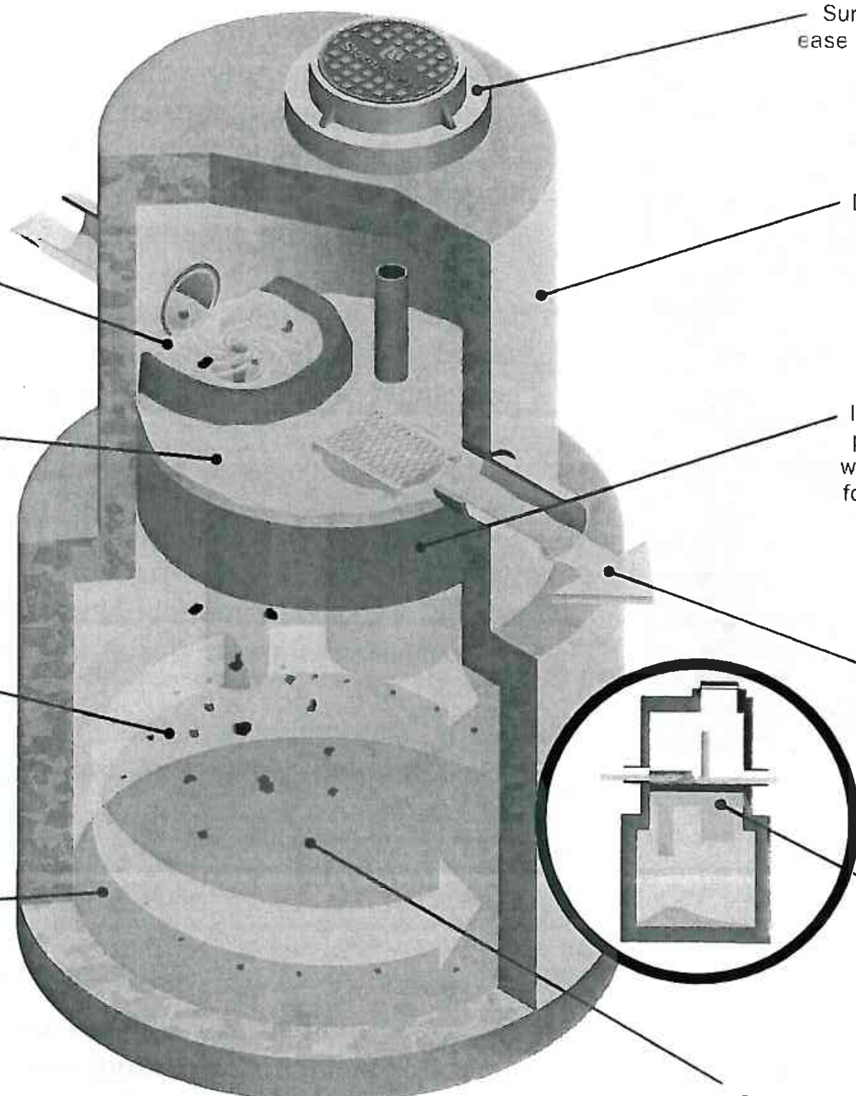
Proven performance

- Recent tests conducted for the New Jersey Department of Environmental Protection (NJDEP) found Stormceptor has the highest TSS removal rate of seven stormwater treatment technologies tested
- Stormceptor STC has been verified not to resuspend previously captured pollutants by NJCAT and an independent testing body
- Stormceptor STC is entering into Tier II of the TARP Program (administered by NJDEP)
- Stormceptor's performance is backed by Canada's stringent Environmental Technology Verification (ETV) Program

With over 25,000 units operating worldwide, Stormceptor performs and protects every day, in every storm.

Stormceptor® STC

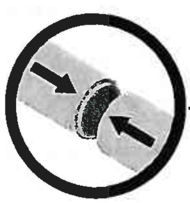
The calm *during* the storm



** Fiberglass construction is an option*

Easy to install

Small footprint saves time and money with limited disruption to your site.



Seamless

Minimal drop between inlet and outlet pipes makes Stormceptor ideal for retrofits and new development projects.

Flexible

Multiple inlets can connect to a single unit.

Can be used as a bend structure.

Inspection and Maintenance. Easy. Convenient.

When it rains, oils, sediment and other contaminants are captured and contained by over 20,000 Stormceptor units operating worldwide. While Stormceptor's patented scour prevention technology ensures captured pollutants remain in the unit during all rainfall events, the accumulated pollutants must eventually be removed as part of a regular maintenance program.

If neglected, oil and sediment gradually build up and diminish any BMP's efficiency, harming the environment and leaving owners and operators vulnerable to fines, surcharges and bad publicity.

Maintenance is a must

Ease, frequency and cost of maintenance are often overlooked by specifiers when considering the merits of a stormwater treatment system. In reality, maintenance is fundamental to the long-term performance of any stormwater quality treatment device.

While regular maintenance is crucial, it shouldn't be complicated. An ongoing maintenance program with Stormceptor is convenient and practically effortless. With virtually no disruptions, you can concentrate on your core business.

Quick inspections

Inspections are easily carried out above ground from any standard surface access cover through a visual inspection of the orifice and drop tee components. A sludge judge and oil dip-stick are all that are needed for sediment and oil depth measurements.

Easy unit access

Maintenance is typically conducted from the same surface access cover, eliminating the need for confined space entry into the unit. Your site remains undisturbed, saving you time and money.

No muss, no fuss and fast

Maintenance is performed quickly and inexpensively with a standard vacuum truck. Servicing usually takes less than two hours, with no disruption to your site.

A complete stormwater management plan for Stormceptor extends beyond installation and performance to regular maintenance. It's the smart, cost-effective way to ensure your unit continues to remove more pollutants than any other separator for decades to come.

Stormceptor maintenance recommendations

- Units should be inspected post-construction, prior to being put into service.
- Inspect every six months for the first year of operation to determine the oil and sediment accumulation rate.
- In subsequent years, inspections can be based on first-year observations or local requirements.
- Cleaning is required once the sediment depth reaches 15% of storage capacity, (generally taking one year or longer). Local regulations for maintenance frequency may vary.
- Inspect the unit immediately after an oil, fuel or chemical spill.
- A licensed waste management company should remove captured petroleum waste products from any oil, chemical or fuel spills and dispose responsibly.

With over 20,000 units operating worldwide, Stormceptor performs and protects every day, in every storm.

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USA: (888) 279 8826
CANADA: (800) 565 4801

Stormceptor Capacities Table							
Model #	Sediment (ft3)	Oil (gal)(a)	Total Volume (gal)	Diameter (ft)	Depth (in)(d)	Empty Weight (ton)	Full Weight (ton)
STC 450i	44	86	470	48	68		
STC 900	78	251	952	72	63		
STC 1200	115	251	1234	72	79		
STC 1800	196	251	1833	72	113		
STC 2400	184	840	2462	72/96	104		
STC 3600	352	840	3715	72/96	144		
STC 4800	511	909	5059	72/120	140		
STC 6000	654	909	6136	72/120	162		
STC 7200	792	1059	7420	72/144	148		
STC 11000	**1021	**2797	**11194	*96/120	140		
STC 13000	**1309	**2797	**13348	*96/120	162		
STC 16000	**1583	**3055	**15918	*96/144	148		

Notes:
Sediment and Oil volumes are maximum capacities
Depth = Depth of tank from the invert of the pipe to the bottom of the structure
Diameter = Diameter of the lower tank below the invert of the pipe
Empty Weight = Weight of the Concrete Structure
Full Weight = Weight of the Concrete Structure when it is full of water

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APPENDIX B
BACKUP CALCULATIONS

Water Quality Facility Sizing
RESPEC Water and Natural Resources

Project Identifier: I-25 Design Build
Section ID: Basin 1
Date: 8/10/2012
Completed by: THT
Checked by:

CONCEPTUAL PLAN GOAL: 100% WQCV
FACILITY SIZED BASED ON: WQCV

Basin Parameters

Total Length	849.12	ft	
Width	160	ft	
Tributary Area	3.12	acres	
Impervious ratio	1	(I/100)	
Added Width	88	ft	*Existing pavement width is 72ft, new pavement width is 160ft
	1.72	acres	*Treated Area
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	0	0.00	0.00	2.13	0.00		
Type B	849.12	100.00	1.72	1.36	0.19		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	0.19	ac-ft	*Based on added pavement
				EURV Total =	0.35	ac-ft	*For information purposes only

WQCV

Required WQCV = 0.13 ac-ft *Based on total pavement, no increase for sedimentation
*For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)			
Type A	0.00	0.00	0.00			
Type B	1.72	0.16	0.29			
Type C/D	0.00	0.00	0.00			
			10-year Volume =	0.16	ac-ft	*Based on added pavement
			100-year Volume =	0.29	ac-ft	*Based on added pavement
			100-year Volume + WQCV =	0.42	ac-ft	

Number of PSQF	1.00		Depth	2.50	ft
Volume	0.13	ac-ft	H:V	4	:1
			Additional	20	ft

Sizing

Depth	3.00	ft
Bottom Slope	0.005	ft/ft
Average Depth	2.50	ft
A1+A2	4529	sq ft

A1 "Bottom"

L=	200	ft
W=	0	ft

A2 "Top"

L=	220	ft
W=	20	ft

6" weir + 1 ft freeboard + 3 ft berm

L=	238	ft
W=	38	ft

Water Quality Facility Sizing
RESPEC Water and Natural Resources

Project Identifier: I-25 Design Build
Section ID: Basin 2
Date: 8/10/2012
Completed by: THT
Checked by:

CONCEPTUAL PLAN GOAL: 80% TSS REMOVAL
FACILITY SIZED BASED ON: Stormceptor, Tributary Area

Basin Parameters

Total Length	2288.4	ft	
Width	160	ft	
Tributary Area	8.41	acres	
Impervious ratio	1	(I/100)	
Added Width	88	ft	*Existing pavement width is 72ft, new pavement width is 160ft
	8.41	acres	*Treated Area
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	0	0.00	0.00	2.13	0.00		
Type B	2288.4	100.00	4.62	1.36	0.52		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	0.52	ac-ft	*Based on added pavement
				EURV Total =	0.95	ac-ft	*For information purposes only

WQCV

Required WQCV = 0.35 ac-ft *Based on total pavement, no increase for sedimentation
*For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)			
Type A	0.00	0.00	0.00			
Type B	4.62	0.43	0.79			
Type C/D	0.00	0.00	0.00			
			10-year Volume =	0.43	ac-ft	*Based on added pavement
			100-year Volume =	0.79	ac-ft	*Based on added pavement
			100-year Volume + WQCV =	1.14	ac-ft	

Water Quality Facility Sizing
RESPEC Water and Natural Resources

Project Identifier:	I-25 Design Build	CONCEPTUAL PLAN GOAL:	FSD
Section ID:	Basin 3	FACILITY SIZED BASED ON:	100-year Volume
Date:	8/10/2012		
Completed by:	THT		
Checked by:			

Basin Parameters

Total Length	959.28	ft	
Width	160	ft	
Tributary Area	3.52	acres	
Impervious ratio	1	(I/100)	
Added Width	88	ft	*Existing pavement width is 72ft, new pavement width is 160ft
	1.94	acres	*Treated Area
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	0	0.00	0.00	2.13	0.00		
Type B	959.28	100.00	1.94	1.36	0.22		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	0.22	ac-ft	*Based on added pavement
				EURV Total =	0.40	ac-ft	*For information purposes only

WQCV

Required WQCV =	0.15	ac-ft	*Based on total pavement, no increase for sedimentation *For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)			
Type A	0.00	0.00	0.00			
Type B	1.94	0.18	0.33			
Type C/D	0.00	0.00	0.00			
			10-year Volume =	0.18	ac-ft	*Based on added pavement
			100-year Volume =	0.33	ac-ft	*Based on added pavement
			100-year Volume + WQCV =	0.48	ac-ft	

Number of PSQF	1.00		Depth	2.60	ft
Volume	0.33	ac-ft	H:V	4	:1
			Additional	20.7755102	ft

Sizing

Depth	3.00	ft
Bottom Slope	0.005	ft/ft
Average Depth	2.60	ft
A1+A2	11156	sq ft

A1 "Bottom"

L=	161.22449	ft
W=	21	ft

A2 "Top"

L=	182	ft
W=	42	ft

6" weir + 1 ft freeboard + 3 ft berm

L=	200	ft
W=	60	ft

Water Quality Facility Sizing
RESPEC Water and Natural Resources

Project Identifier: I-25 Design Build
Section ID: Basin 4
Date: 8/10/2012
Completed by: THT
Checked by:

CONCEPTUAL PLAN GOAL: FSD
FACILITY SIZED BASED ON: 100-year Volume

Basin Parameters

Total Length	1550.09	ft	
Width	160	ft	
Tributary Area	5.69	acres	
Impervious ratio	1	(I/100)	
Added Width	88	ft	*Existing pavement width is 72ft, new pavement width is 160ft
	3.13	acres	*Treated Area
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	0	0.00	0.00	2.13	0.00		
Type B	1550.09	100.00	3.13	1.36	0.36		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	0.36	ac-ft	*Based on added pavement
				EURV Total =	0.65	ac-ft	*For information purposes only

WQCV

Required WQCV =	0.24	ac-ft	*Based on total pavement, no increase for sedimentation *For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)		
Type A	0.00	0.00	0.00		
Type B	3.13	0.29	0.54		
Type C/D	0.00	0.00	0.00		
			10-year Volume = 0.29	ac-ft	*Based on added pavement
			100-year Volume = 0.54	ac-ft	*Based on added pavement
			100-year Volume + WQCV = 0.77	ac-ft	

Number of PSQF	1.00		Depth	2.34	ft
Volume	0.54	ac-ft	H:V	4	:1
			Additional	18.73469388	ft

Sizing

Depth	3.00	ft
Bottom Slope	0.005	ft/ft
Average Depth	2.34	ft
A1+A2	19991	sq ft

A1 "Bottom"

L=	263.265306	ft
W=	27	ft

A2 "Top"

L=	282	ft
W=	46	ft

6" weir + 1 ft freeboard + 3 ft berm

L=	300	ft
W=	64	ft

Water Quality Facility Sizing
RESPEC Water and Natural Resources

Project Identifier: I-25 Design Build — CONCEPTUAL PLAN GOAL: FSD
Section ID: Basin 5 — FACILITY SIZED BASED ON: 100-year Volume
Date: 8/10/2012
Completed by: THT
Checked by:

Basin Parameters

Total Length	1251.51	ft	
Width	160	ft	
Tributary Area	4.60	acres	
Impervious ratio	1	(I/100)	
Added Width	88	ft	*Existing pavement width is 72ft, new pavement width is 160ft
	2.53	acres	*Treated Area
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	0	0.00	0.00	2.13	0.00		
Type B	1251.51	100.00	2.53	1.36	0.29		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	0.29	ac-ft	*Based on added pavement
				EURV Total =	0.52	ac-ft	*For information purposes only

WQCV

Required WQCV = 0.19 ac-ft *Based on total pavement, no increase for sedimentation
*For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)			
Type A	0.00	0.00	0.00			
Type B	2.53	0.24	0.43			
Type C/D	0.00	0.00	0.00			
			10-year Volume =	0.24	ac-ft	*Based on added pavement
			100-year Volume =	0.43	ac-ft	*Based on added pavement
			100-year Volume + WQCV =	0.63	ac-ft	

Number of PSQF	1.00		Depth	2.83	ft
Volume	0.43	ac-ft	H:V	4	:1
			Additional	22.6122449	ft

Sizing

Depth	3.00	ft
Bottom Slope	0.005	ft/ft
Average Depth	2.83	ft
A1+A2	13372	sq ft

A1 "Bottom"

L=	69.3877551	ft
W=	70	ft

A2 "Top"

L=	92	ft
W=	93	ft

6" weir + 1 ft freeboard + 3 ft berm

L=	110	ft
W=	111	ft

Water Quality Facility Sizing
RESPEC Water and Natural Resources

Project Identifier:	I-25 Design Build	CONCEPTUAL PLAN GOAL:	FSD
Section ID:	Basin 6	FACILITY SIZED BASED ON:	100-year Volume
Date:	8/10/2012		
Completed by:	THT		
Checked by:			

Basin Parameters

Total Length	1356.31	ft	
Width	160	ft	
Tributary Area	4.98	acres	
Impervious ratio	1	(I/100)	
Added Width	88	ft	*Existing pavement width is 72ft, new pavement width is 160ft
	2.74	acres	*Treated Area
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	0	0.00	0.00	2.13	0.00		
Type B	1356.31	100.00	2.74	1.36	0.31		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	0.31	ac-ft	*Based on added pavement
				EURV Total =	0.57	ac-ft	*For information purposes only

WQCV

Required WQCV =	0.21	ac-ft	*Based on total pavement, no increase for sedimentation *For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)			
Type A	0.00	0.00	0.00			
Type B	2.74	0.26	0.47			
Type C/D	0.00	0.00	0.00			
			10-year Volume =	0.26	ac-ft	*Based on added pavement
			100-year Volume =	0.47	ac-ft	*Based on added pavement
			100-year Volume + WQCV =	0.68	ac-ft	

Number of PSQF	1.00		Depth	2.55	ft
Volume	0.47	ac-ft	H:V	4	:1
			Additional	20.41280134	ft

Sizing

Depth	3.00	ft
Bottom Slope	0.005	ft/ft
Average Depth	2.55	ft
A1+A2	16054	sq ft

A1 "Bottom"

L=	179.359933	ft
W=	32	ft

A2 "Top"

L=	199.772735	ft
W=	52	ft

6" weir + 1 ft freeboard + 3 ft berm

L=	218	ft
W=	70	ft

Water Quality Facility Sizing
RESPEC Water and Natural Resources

Project Identifier:	I-25 Design Build	CONCEPTUAL PLAN GOAL:	80% TSS REMOVAL
Section ID:	Basin 7	FACILITY SIZED BASED ON:	Stormceptor, Tributary Area
Date:	8/10/2012		
Completed by:	THT		
Checked by:			

Basin Parameters

Total Length	2215.17	ft	
Width	160	ft	
Tributary Area	8.14	acres	
Impervious ratio	1	(I/100)	
Added Width	88	ft	*Existing pavement width is 72ft, new pavement width is 160ft
	8.14	acres	*Treated Area
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	1114.34	50.30	2.25	2.13	0.40		
Type B	405.47	18.30	0.82	1.36	0.09		
Type C/D	695.36	31.39	1.40	1.21	0.14		
				EURV =	0.64	ac-ft	*Based on added pavement
				EURV Total =	1.15	ac-ft	*For information purposes only

WQCV

Required WQCV =	0.34	ac-ft	*Based on total pavement, no increase for sedimentation *For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)			
Type A	2.25	0.21	0.44			
Type B	0.82	0.08	0.14			
Type C/D	1.40	0.13	0.24			
			10-year Volume =	0.42	ac-ft	*Based on added pavement
			100-year Volume =	0.82	ac-ft	*Based on added pavement
			100-year Volume + WQCV =	1.16	ac-ft	

Water Quality Facility Sizing

RESPEC Water and Natural Resources

Project Identifier:	I-25 Design Build	CONCEPTUAL PLAN GOAL:	FSD
Section ID:	Basin 8	FACILITY SIZED BASED ON:	100-year Volume
Date:	8/10/2012		
Completed by:	THT		
Checked by:			

Basin Parameters

Total Length	1577.19	ft	
Width	160	ft	
Tributary Area	5.37	acres	
Impervious ratio	1	(I/100)	
Added Width	88	ft	*Existing pavement width is 72ft, new pavement width is 160ft
	2.95	acres	*Treated Area
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	1577.19	100.00	2.95	2.13	0.52		
Type B	0	0.00	0.00	1.36	0.00		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	0.52	ac-ft	*Based on added pavement
				EURV Total =	1.03	ac-ft	*For information purposes only

WQCV

Required WQCV =	0.22	ac-ft	*Based on total pavement, no increase for sedimentation
			*For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)			
Type A	3.19	0.30	0.62			
Type B	0.00	0.00	0.00			
Type C/D	0.00	0.00	0.00			
			10-year Volume =	0.30	ac-ft	*Based on added pavement
			100-year Volume =	0.62	ac-ft	*Based on added pavement
			100-year Volume + WQCV =	0.85	ac-ft	

Number of PSQF	1.00		Depth	2.61	ft
Volume	0.62	ac-ft	H:V	4	:1
			Additional	20.86651817	ft

Sizing

Depth	3.00	ft
Bottom Slope	0.005	ft/ft
Average Depth	2.61	ft
A1+A2	20794	sq ft

A1 "Bottom"

L=	156.674092	ft
W=	51	ft

A2 "Top"

L=	177.54061	ft
W=	72	ft

6" weir + 1 ft freeboard + 3 ft berm

L=	196	ft
W=	90	ft

Water Quality Facility Sizing
RESPEC Water and Natural Resources

Project Identifier:	I-25 Design Build	**CONCEPTUAL PLAN GOAL:**	FSD
Section ID:	Basin 9	**FACILITY SIZED BASED ON:**	100-year Volume
Date:	8/10/2012		
Completed by:	THT		
Checked by:			

Basin Parameters

Total Length	3126.74	ft	
Width	160	ft	
Tributary Area	11.06	acres	
Impervious ratio	1	(I/100)	
Added Width	88	ft	*Existing pavement width is 72ft, new pavement width is 160ft
	6.08	acres	*Treated Area
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	2338.07	74.78	4.49	2.13	0.80		
Type B	788.67	25.22	1.59	1.36	0.18		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	**0.98**	**ac-ft**	*Based on added pavement
				EURV Total =	**1.85**	**ac-ft**	*For information purposes only

WQCV

Required WQCV =	**0.46**	**ac-ft**	*Based on total pavement, no increase for sedimentation *For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)			
Type A	4.72	0.44	0.92			
Type B	1.59	0.15	0.27			
Type C/D	0.00	0.00	0.00			
			10-year Volume =	**0.59**	**ac-ft**	*Based on added pavement
			100-year Volume =	**1.20**	**ac-ft**	*Based on added pavement
			100-year Volume + WQCV =	**1.66**	**ac-ft**	

Number of PSQF	1.00		Depth	2.67	ft
Volume	1.20	ac-ft	H:V	4	:1
			Additional	21.36	ft

Sizing

Depth	3.00	ft
Bottom Slope	0.005	ft/ft
Average Depth	2.67	ft
A1+A2	39035	sq ft

A1 "Bottom"

L=	132	ft
W=	125	ft

A2 "Top"

L=	153.36	ft
W=	147	ft

6" weir + 1 ft freeboard + 3 ft berm

L=	171	ft
W=	165	ft

Water Quality Facility Sizing
RESPEC Water and Natural Resources

Project Identifier:	I-25 Design Build	**CONCEPTUAL PLAN GOAL:**	FSD
Section ID:	Basin 10	**FACILITY SIZED BASED ON:**	100-year Volume
Date:	8/10/2012		
Completed by:	THT		
Checked by:			

Basin Parameters

Total Length	1922.96	ft	
Width	160	ft	
Tributary Area	7.06	acres	
Impervious ratio	1	(I/100)	
Added Width	88	ft	*Existing pavement width is 72ft, new pavement width is 160ft
	3.88	acres	*Treated Area
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	1922.96	100.00	3.88	2.13	0.69		
Type B	0	0.00	0.00	1.36	0.00		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	**0.69**	**ac-ft**	*Based on added pavement
				EURV Total =	**1.25**	**ac-ft**	*For information purposes only

WQCV

Required WQCV =	**0.29**	**ac-ft**	*Based on total pavement, no increase for sedimentation *For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)			
Type A	3.88	0.36	0.76			
Type B	0.00	0.00	0.00			
Type C/D	0.00	0.00	0.00			
			10-year Volume =	**0.36**	**ac-ft**	*Based on added pavement
			100-year Volume =	**0.76**	**ac-ft**	*Based on added pavement
			100-year Volume + WQCV =	**1.05**	**ac-ft**	

Number of PSQF	2.00		Depth	2.60	ft
Volume	0.38	ac-ft	H:V	4	:1
			Additional	20.7755102	ft

Sizing

Depth	3.00	ft
Bottom Slope	0.005	ft/ft
Average Depth	2.60	ft
A1+A2	12732	sq ft

A1 "Bottom"

L=	161.22449	ft
W=	26	ft

A2 "Top"

L=	182	ft
W=	47	ft

6" weir + 1 ft freeboard + 3 ft berm

L=	200	ft
W=	65	ft

Water Quality Facility Sizing
RESPEC Water and Natural Resources

Project Identifier:	I-25 Design Build	**CONCEPTUAL PLAN GOAL:**	FSD
Section ID:	Basin 11	**FACILITY SIZED BASED ON:**	100-year Volume
Date:	8/10/2012		
Completed by:	THT		
Checked by:			

Basin Parameters

Total Length	3580.58	ft	
Width	160	ft	
Tributary Area	9.47	acres	
Impervious ratio	1	(I/100)	
Added Width	88	ft	*Existing pavement width is 72ft, new pavement width is 160ft
	5.21	acres	*Treated Area
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	1051.63	29.37	2.12	2.13	0.38		
Type B	2528.95	70.63	3.08	1.36	0.35		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	**0.73**	**ac-ft**	*Based on added pavement
				EURV Total =	**1.74**	**ac-ft**	*For information purposes only

WQCV

Required WQCV =	**0.39**	**ac-ft**	*Based on total pavement, no increase for sedimentation *For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)			
Type A	2.12	0.20	0.42			
Type B	5.11	0.48	0.88			
Type C/D	0.00	0.00	0.00			
			10-year Volume =	**0.67**	**ac-ft**	*Based on added pavement
			100-year Volume =	**1.29**	**ac-ft**	*Based on added pavement
			100-year Volume + WQCV =	**1.69**	**ac-ft**	

Number of PSQF	2.00		Depth	1.98	ft
Volume	0.65	ac-ft	H:V	4	:1
			Additional	15.86759755	ft

Sizing

Depth	3.00	ft
Bottom Slope	0.005	ft/ft
Average Depth	1.98	ft
A1+A2	28370	sq ft

A1 "Bottom"

L=	406.620123	ft
W=	26	ft

A2 "Top"

L=	422.48772	ft
W=	42	ft

6" weir + 1 ft freeboard + 3 ft berm

L=	440	ft
W=	60	ft

Water Quality Facility Sizing
RESPEC Water and Natural Resources

Project Identifier:	I-25 Design Build	**CONCEPTUAL PLAN GOAL:**	FSD
Section ID:	Basin 12	**FACILITY SIZED BASED ON:**	100-year Volume
Date:	8/10/2012		
Completed by:	THT		
Checked by:			

Basin Parameters

Total Length	2005.07	ft	
Width	160	ft	
Tributary Area	7.36	acres	
Impervious ratio	1	(I/100)	
Added Width	88	ft	*Existing pavement width is 72ft, new pavement width is 160ft
	4.05	acres	*Treated Area
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	0	0.00	0.00	2.13	0.00		
Type B	2005.07	100.00	2.03	1.36	0.23		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	**0.23**	**ac-ft**	*Based on added pavement
				EURV Total =	**0.84**	**ac-ft**	*For information purposes only

WQCV

Required WQCV =	**0.31**	**ac-ft**	*Based on total pavement, no increase for sedimentation *For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)			
Type A	0.00	0.00	0.00			
Type B	4.05	0.38	0.70			
Type C/D	0.00	0.00	0.00			
			10-year Volume =	**0.38**	**ac-ft**	*Based on added pavement
			100-year Volume =	**0.70**	**ac-ft**	*Based on added pavement
			100-year Volume + WQCV =	**1.00**	**ac-ft**	

Number of PSQF	1.00		Depth	2.09	ft
Volume	0.70	ac-ft	H:V	4	:1
			Additional	16.69606864	ft

Sizing

Depth	3.00	ft
Bottom Slope	0.005	ft/ft
Average Depth	2.09	ft
A1+A2	29016	sq ft

A1 "Bottom"

L=	365.196568	ft
W=	30	ft

A2 "Top"

L=	381.892637	ft
W=	47	ft

6" weir + 1 ft freeboard + 3 ft berm

L=	400	ft
W=	65	ft

Water Quality Facility Sizing
RESPEC Water and Natural Resources

Project Identifier:	I-25 Design Build	**CONCEPTUAL PLAN GOAL:**	FSD
Section ID:	Basin 13	**FACILITY SIZED BASED ON:**	100-year Volume
Date:	8/10/2012		
Completed by:	THT		
Checked by:			

Basin Parameters

Total Length	1147.91	ft	
Width	Varies	ft	
Tributary Area	2.91	acres	
Impervious ratio	1	(I/100)	
Added Width	Varies	ft	*Existing pavement width is 72ft, new pavement width is 160ft
	1.45	acres	*Treated Area
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	635.75	55.38	0.41	2.13	0.07		
Type B	512.16	44.62	1.03	1.36	0.12		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	**0.19**	**ac-ft**	*Based on added pavement
				EURV Total =	**0.40**	**ac-ft**	*For information purposes only

WQCV

Required WQCV =	**0.12**	**ac-ft**	*Based on total pavement, no increase for sedimentation *For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)		
Type A	0.41	0.04	0.08		
Type B	1.03	0.10	0.18		
Type C/D	0.00	0.00	0.00		
			10-year Volume =	**0.13**	**ac-ft** *Based on added pavement
			100-year Volume =	**0.26**	**ac-ft** *Based on added pavement
			100-year Volume + WQCV =	**0.38**	**ac-ft**

Number of PSQF	1.00		Depth	2.88	ft
Volume	0.26	ac-ft	H:V	4	:1
			Additional	23	ft

Sizing

Depth	3.00	ft
Bottom Slope	0.005	ft/ft
Average Depth	2.88	ft
A1+A2	7825	sq ft

A1 "Bottom"

L=	50	ft
W=	50	ft

A2 "Top"

L=	73	ft
W=	73	ft

6" weir + 1 ft freeboard + 3 ft berm

L=	91	ft
W=	91	ft

Water Quality Facility Sizing
RESPEC Water and Natural Resources

Project Identifier: I-25 Design Build
Section ID: Basin 14
Date: 8/10/2012
Completed by: THT
Checked by:

CONCEPTUAL PLAN GOAL: 80% TSS REMOVAL
FACILITY SIZED BASED ON: Stormceptor, Tributary Area

Basin Parameters

Total Length	894.50	ft	
Width	60	ft	
Tributary Area	1.23	acres	
Impervious ratio	1	(I/100)	
Added Width	24	ft	*Existing pavement width is 72ft, new pavement width is 120ft
	1.23	acres	*Treated Area
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	894.5	100.00	0.49	2.13	0.09		
Type B	0	0.00	0.00	1.36	0.00		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	**0.09**	**ac-ft**	*Based on added pavement
				EURV Total =	**0.22**	**ac-ft**	*For information purposes only

WQCV

Required WQCV =	**0.05**	**ac-ft**	*Based on total pavement, no increase for sedimentation *For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)			
Type A	0.49	0.05	0.10			
Type B	0.00	0.00	0.00			
Type C/D	0.00	0.00	0.00			
			10-year Volume =	**0.05**	**ac-ft**	*Based on added pavement
			100-year Volume =	**0.10**	**ac-ft**	*Based on added pavement
			100-year Volume + WQCV =	**0.15**	**ac-ft**	

Water Quality Facility Sizing
RESPEC Water and Natural Resources

Project Identifier:	I-25 Design Build	**CONCEPTUAL PLAN GOAL:**	FSD
Section ID:	Basin 15	**FACILITY SIZED BASED ON:**	100-year Volume
Date:	8/10/2012		
Completed by:	THT		
Checked by:			

Basin Parameters

Total Length	1149.66	ft	
Width	60	ft	
Tributary Area	1.58	acres	
Impervious ratio	1	(I/100)	
Added Width	24	ft	*Existing pavement width is 72ft, new pavement width is 120ft
	0.63	acres	*Treated Area
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	456.26	39.69	0.25	2.13	0.04		
Type B	693.4	60.31	0.38	1.36	0.04		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	**0.09**	**ac-ft**	*Based on added pavement
				EURV Total =	**0.22**	**ac-ft**	*For information purposes only

WQCV

Required WQCV =	**0.07**	**ac-ft**	*Based on total pavement, no increase for sedimentation *For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)			
Type A	0.25	0.02	0.05			
Type B	0.38	0.04	0.07			
Type C/D	0.00	0.00	0.00			
			10-year Volume =	**0.06**	**ac-ft**	*Based on added pavement
			100-year Volume =	**0.11**	**ac-ft**	*Based on added pavement
			100-year Volume + WQCV =	**0.18**	**ac-ft**	

Number of PSQF	1.00		Depth	2.90	ft
Volume	0.11	ac-ft	H:V	4	:1
			Additional	23.2	ft

Sizing

Depth	3.00	ft
Bottom Slope	0.005	ft/ft
Average Depth	2.90	ft
A1+A2	3445	sq ft

A1 "Bottom"

L=	40	ft
W=	19	ft

A2 "Top"

L=	63.2	ft
W=	42	ft

6" weir + 1 ft freeboard + 3 ft berm

L=	81	ft
W=	60	ft

Water Quality Facility Sizing
RESPEC Water and Natural Resources

Project Identifier:	I-25 Design Build	**CONCEPTUAL PLAN GOAL:**	80% TSS REMOVAL
Section ID:	Basin 16	**FACILITY SIZED BASED ON:**	Stormceptor, Tributary Area
Date:	8/10/2012		
Completed by:	THT		
Checked by:			

Basin Parameters

Total Length	777.47	ft	
Width	60	ft	
Tributary Area	1.07	acres	
Impervious ratio	1	(I/100)	
Added Width	24	ft	*Existing pavement width is 72ft, new pavement width is 120ft
	1.07	acres	*Treated Area
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

<u>EURV</u>

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	84.07	10.81	0.05	2.13	0.01		
Type B	693.4	89.19	0.38	1.36	0.04		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	**0.05**	**ac-ft**	*Based on added pavement
				EURV Total =	**0.13**	**ac-ft**	*For information purposes only

<u>WQCV</u>

Required WQCV =	**0.04**	**ac-ft**	*Based on total pavement, no increase for sedimentation *For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)			
Type A	0.05	0.00	0.01			
Type B	0.38	0.04	0.07			
Type C/D	0.00	0.00	0.00			
			10-year Volume =	**0.04**	**ac-ft**	*Based on added pavement
			100-year Volume =	**0.07**	**ac-ft**	*Based on added pavement
			100-year Volume + WQCV =	**0.12**	**ac-ft**	

Water Quality Facility Sizing
RESPEC Water and Natural Resources

Project Identifier:	I-25 Design Build	**CONCEPTUAL PLAN GOAL:**	FSD
Section ID:	Basin 17	**FACILITY SIZED BASED ON:**	100-year Volume
Date:	8/10/2012		
Completed by:	THT		
Checked by:			

Basin Parameters

Total Length	1003.04	ft	
Width	120	ft	
Tributary Area	2.76	acres	
Impervious ratio	1	(I/100)	
Added Width	48	ft	*Existing pavement width is 72ft, new pavement width is 120ft
	1.11	acres	*Treated Area
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	248.26	24.75	0.27	2.13	0.05		
Type B	754.78	75.25	0.83	1.36	0.09		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	**0.14**	**ac-ft**	*Based on added pavement
				EURV Total =	**0.36**	**ac-ft**	*For information purposes only

WQCV

Required WQCV =	**0.12**	**ac-ft**	*Based on total pavement, no increase for sedimentation *For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)			
Type A	0.27	0.03	0.05			
Type B	0.83	0.08	0.14			
Type C/D	0.00	0.00	0.00			
			10-year Volume =	**0.10**	**ac-ft**	*Based on added pavement
			100-year Volume =	**0.20**	**ac-ft**	*Based on added pavement
			100-year Volume + WQCV =	**0.31**	**ac-ft**	

Number of PSQF	1.00		Depth	2.85	ft
Volume	0.20	ac-ft	H:V	4	:1
			Additional	22.81600541	ft

Sizing

Depth	3.00	ft
Bottom Slope	0.005	ft/ft
Average Depth	2.85	ft
A1+A2	5993	sq ft

A1 "Bottom"

L=	59.1997293	ft
W=	29	ft

A2 "Top"

L=	82.0157347	ft
W=	52	ft

6" weir + 1 ft freeboard + 3 ft berm

L=	100	ft
W=	70	ft

Water Quality Facility Sizing

RESPEC Water and Natural Resources

Project Identifier:	I-25 Design Build	**CONCEPTUAL PLAN GOAL:**	FSD
Section ID:	Basin 18	**FACILITY SIZED BASED ON:**	100-year Volume
Date:	8/10/2012		
Completed by:	THT		
Checked by:			

Basin Parameters

Total Length	980.58	ft	
Width	60	ft	
Tributary Area	1.35	acres	
Impervious ratio	1	(I/100)	
Added Width	24	ft	*Existing pavement width is 72ft, new pavement width is 120ft
	1.35	acres	*Treated Area
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	178.32	18.19	0.10	2.13	0.02		
Type B	802.26	81.81	0.44	1.36	0.05		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	**0.07**	**ac-ft**	*Based on added pavement
				EURV Total =	**0.17**	**ac-ft**	*For information purposes only

WQCV

Required WQCV =	**0.06**	**ac-ft**	*Based on total pavement, no increase for sedimentation *For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)			
Type A	0.10	0.01	0.02			
Type B	0.44	0.04	0.08			
Type C/D	0.00	0.00	0.00			
			10-year Volume =	**0.05**	**ac-ft**	*Based on added pavement
			100-year Volume =	**0.10**	**ac-ft**	*Based on added pavement
			100-year Volume + WQCV =	**0.15**	**ac-ft**	

Water Quality Facility Sizing
RESPEC Water and Natural Resources

Project Identifier: I-25 Design Build
Section ID: Basin 19
Date: 8/10/2012
Completed by: THT
Checked by:

CONCEPTUAL PLAN GOAL: 80% TSS REMOVAL
FACILITY SIZED BASED ON: Stormceptor, Tributary Area

Basin Parameters

Total Length	966.52	ft	
Width	60	ft	
Tributary Area	1.33	acres	
Impervious ratio	1	(I/100)	
Added Width	24	ft	*Existing pavement width is 72ft, new pavement width is 120ft
	1.33	acres	*Treated Area
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	178.32	18.45	0.10	2.13	0.02		
Type B	788.2	81.55	0.43	1.36	0.05		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	**0.07**	**ac-ft**	*Based on added pavement
				EURV Total =	**0.17**	**ac-ft**	*For information purposes only

WQCV

Required WQCV =	**0.06**	**ac-ft**	*Based on total pavement, no increase for sedimentation *For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)			
Type A	0.10	0.01	0.02			
Type B	0.43	0.04	0.07			
Type C/D	0.00	0.00	0.00			
			10-year Volume =	**0.05**	**ac-ft**	*Based on added pavement
			100-year Volume =	**0.09**	**ac-ft**	*Based on added pavement
			100-year Volume + WQCV =	**0.15**	**ac-ft**	

Water Quality Facility Sizing
RESPEC Water and Natural Resources

Project Identifier: I-25 Design Build
Section ID: Basin 20
Date: 8/10/2012
Completed by: THT
Checked by:

CONCEPTUAL PLAN GOAL: 80% TSS REMOVAL
FACILITY SIZED BASED ON: Stormceptor, Tributary Area

Basin Parameters

Total Length	141.92	ft	
Width	60	ft	
Tributary Area	0.20	acres	
Impervious ratio	1	(I/100)	
Added Width	24	ft	*Existing pavement width is 72ft, new pavement width is 120ft
	0.20	acres	*Treated Area
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	0	0.00	0.00	2.13	0.00		
Type B	141.92	100.00	0.08	1.36	0.01		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	**0.01**	**ac-ft**	*Based on added pavement
				EURV Total =	**0.02**	**ac-ft**	*For information purposes only

WQCV

Required WQCV =	**0.01**	**ac-ft**	*Based on total pavement, no increase for sedimentation *For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)			
Type A	0.00	0.00	0.00			
Type B	0.08	0.01	0.01			
Type C/D	0.00	0.00	0.00			
			10-year Volume =	**0.01**	**ac-ft**	*Based on added pavement
			100-year Volume =	**0.01**	**ac-ft**	*Based on added pavement
			100-year Volume + WQCV =	**0.02**	**ac-ft**	

Water Quality Facility Sizing
RESPEC Water and Natural Resources

Project Identifier:	I-25 Design Build	**CONCEPTUAL PLAN GOAL:**	80% TSS REMOVAL
Section ID:	Basin 21	**FACILITY SIZED BASED ON:**	Stormceptor, Tributary Area
Date:	8/10/2012		
Completed by:	THT		
Checked by:			

Basin Parameters

Total Length	127.85	ft	
Width	60	ft	
Tributary Area	0.18	acres	
Impervious ratio	1	(I/100)	
Added Width	24	ft	*Existing pavement width is 72ft, new pavement width is 120ft
	0.18	acres	*Treated Area
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	0	0.00	0.00	2.13	0.00		
Type B	127.85	100.00	0.07	1.36	0.01		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	**0.01**	**ac-ft**	*Based on added pavement
				EURV Total =	**0.02**	**ac-ft**	*For information purposes only

WQCV

Required WQCV =	**0.01**	**ac-ft**	*Based on total pavement, no increase for sedimentation *For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)			
Type A	0.00	0.00	0.00			
Type B	0.07	0.01	0.01			
Type C/D	0.00	0.00	0.00			
			10-year Volume =	**0.01**	**ac-ft**	*Based on added pavement
			100-year Volume =	**0.01**	**ac-ft**	*Based on added pavement
			100-year Volume + WQCV =	**0.02**	**ac-ft**	

Water Quality Facility Sizing
RESPEC Water and Natural Resources

Project Identifier: I-25 Design Build
Section ID: Basin 22
Date: 8/10/2012
Completed by: THT
Checked by:

CONCEPTUAL PLAN GOAL: FSD
FACILITY SIZED BASED ON: 100-year Volume

Basin Parameters

Total Length	1591.22	ft	
Width	120	ft	
Tributary Area	4.38	acres	
Impervious ratio	1	(I/100)	
Added Width	48	ft	*Existing pavement width is 72ft, new pavement width is 120ft
	1.75	acres	*Treated Area
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	0	0.00	0.00	2.13	0.00		
Type B	1591.22	100.00	1.75	1.36	0.20		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	**0.20**	**ac-ft**	*Based on added pavement
				EURV Total =	**0.50**	**ac-ft**	*For information purposes only

WQCV

Required WQCV =	**0.18**	**ac-ft**	*Based on total pavement, no increase for sedimentation *For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)			
Type A	0.00	0.00	0.00			
Type B	1.75	0.16	0.30			
Type C/D	0.00	0.00	0.00			
			10-year Volume =	**0.16**	**ac-ft**	*Based on added pavement
			100-year Volume =	**0.30**	**ac-ft**	*Based on added pavement
			100-year Volume + WQCV =	**0.48**	**ac-ft**	

Number of PSQF	1.00		Depth	2.85	ft
Volume	0.30	ac-ft	H:V	4	:1
			Additional	22.76	ft

Sizing

Depth	3.00	ft
Bottom Slope	0.005	ft/ft
Average Depth	2.85	ft
A1+A2	9214	sq ft

A1 "Bottom"

L=	62	ft
W=	50	ft

A2 "Top"

L=	84.76	ft
W=	72	ft

6" weir + 1 ft freeboard + 3 ft berm

L=	103	ft
W=	90	ft

Water Quality Facility Sizing
RESPEC Water and Natural Resources

Project Identifier: I-25 Design Build
Section ID: Basin 23
Date: 8/10/2012
Completed by: THT
Checked by:

CONCEPTUAL PLAN GOAL: FSD
FACILITY SIZED BASED ON: 100-year Volume

Basin Parameters

Total Length	1821.69	ft	
Width	60	ft	
Tributary Area	2.51	acres	
Impervious ratio	1	(I/100)	
Added Width	24	ft	*Existing pavement width is 72ft, new pavement width is 120ft
	1.00	acres	*Treated Area
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	0	0.00	0.00	2.13	0.00		
Type B	1821.69	100.00	1.00	1.36	0.11		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	**0.11**	**ac-ft**	*Based on added pavement
				EURV Total =	**0.28**	**ac-ft**	*For information purposes only

WQCV

Required WQCV =	**0.10**	**ac-ft**	*Based on total pavement, no increase for sedimentation *For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)			
Type A	0.00	0.00	0.00			
Type B	1.00	0.09	0.17			
Type C/D	0.00	0.00	0.00			
			10-year Volume =	**0.09**	**ac-ft**	*Based on added pavement
			100-year Volume =	**0.17**	**ac-ft**	*Based on added pavement
			100-year Volume + WQCV =	**0.28**	**ac-ft**	

Number of PSQF	1.00		Depth	2.89	ft
Volume	0.17	ac-ft	H:V	4	:1
			Additional	23.14893085	ft

Sizing

Depth	3.00	ft
Bottom Slope	0.005	ft/ft
Average Depth	2.89	ft
A1+A2	5186	sq ft

A1 "Bottom"

L=	42.5534577	ft
W=	34	ft

A2 "Top"

L=	65.7023885	ft
W=	57	ft

6" weir + 1 ft freeboard + 3 ft berm

L=	84	ft
W=	75	ft

Water Quality Facility Sizing
RESPEC Water and Natural Resources

Project Identifier: I-25 Design Build
Section ID: Basin 24
Date: 8/10/2012
Completed by: THT
Checked by:

CONCEPTUAL PLAN GOAL: FSD
FACILITY SIZED BASED ON: 100-year Volume

Basin Parameters

Total Length	2845.02	ft	
Width	60	ft	
Tributary Area	3.92	acres	
Impervious ratio	1	(I/100)	
Added Width	24	ft	*Existing pavement width is 72ft, new pavement width is 120ft
	1.57	acres	*Treated Area
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	0	0.00	0.00	2.13	0.00		
Type B	2845.02	100.00	1.57	1.36	0.18		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	**0.18**	**ac-ft**	*Based on added pavement
				EURV Total =	**0.44**	**ac-ft**	*For information purposes only

WQCV

Required WQCV =	**0.16**	**ac-ft**	*Based on total pavement, no increase for sedimentation *For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)		
Type A	0.00	0.00	0.00		
Type B	1.57	0.15	0.27		
Type C/D	0.00	0.00	0.00		
			10-year Volume =	**0.15**	**ac-ft** *Based on added pavement
			100-year Volume =	**0.27**	**ac-ft** *Based on added pavement
			100-year Volume + WQCV =	**0.43**	**ac-ft**

Number of PSQF	1.00		Depth	2.87	ft
Volume	0.27	ac-ft	H:V	4	:1
			Additional	22.92	ft

Sizing

Depth	3.00	ft
Bottom Slope	0.005	ft/ft
Average Depth	2.87	ft
A1+A2	8179	sq ft

A1 "Bottom"
L= 54 ft
W= 49 ft

A2 "Top"
L= 76.92 ft
W= 72 ft

6" weir + 1 ft freeboard + 3 ft berm
L= 95 ft
W= 90 ft

Water Quality Facility Sizing
RESPEC Water and Natural Resources

Project Identifier:	I-25 Design Build	**CONCEPTUAL PLAN GOAL:**	FSD
Section ID:	Basin 25	**FACILITY SIZED BASED ON:**	100-year Volume
Date:	8/10/2012		
Completed by:	THT		
Checked by:			

Basin Parameters

Total Length	1634.94	ft	
Width	60	ft	
Tributary Area	2.25	acres	
Impervious ratio	1	(I/100)	
Added Width	24	ft	*Existing pavement width is 72ft, new pavement width is 120ft
	0.90	acres	*Treated Area
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	0	0.00	0.00	2.13	0.00		
Type B	1634.94	100.00	0.90	1.36	0.10		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	**0.10**	**ac-ft**	*Based on added pavement
				EURV Total =	**0.26**	**ac-ft**	*For information purposes only

WQCV

Required WQCV =	**0.09**	**ac-ft**	*Based on total pavement, no increase for sedimentation *For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)			
Type A	0.00	0.00	0.00			
Type B	0.90	0.08	0.15			
Type C/D	0.00	0.00	0.00			
			10-year Volume =	**0.08**	**ac-ft**	*Based on added pavement
			100-year Volume =	**0.15**	**ac-ft**	*Based on added pavement
			100-year Volume + WQCV =	**0.25**	**ac-ft**	

Number of PSQF	1.00		Depth	2.90	ft
Volume	0.15	ac-ft	H:V	4	:1
			Additional	23.22	ft

Sizing

Depth	3.00	ft
Bottom Slope	0.005	ft/ft
Average Depth	2.90	ft
A1+A2	4640	sq ft

A1 "Bottom"

L=	39	ft
W=	32	ft

A2 "Top"

L=	62.22	ft
W=	55	ft

6" weir + 1 ft freeboard + 3 ft berm

L=	80	ft
W=	73	ft

Water Quality Facility Sizing
RESPEC Water and Natural Resources

Project Identifier: I-25 Design Build
Section ID: Basin 26
Date: 8/10/2012
Completed by: THT
Checked by:

CONCEPTUAL PLAN GOAL: 80% TSS REMOVAL
FACILITY SIZED BASED ON: Stormceptor, Tributary Area

Basin Parameters

Total Length	989.42	ft	
Width	60	ft	
Tributary Area	1.36	acres	
Impervious ratio	1	(I/100)	
Added Width	24	ft	*Existing pavement width is 72ft, new pavement width is 120ft
	1.36	acres	*Treated Area
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	0	0.00	0.00	2.13	0.00		
Type B	989.42	100.00	0.55	1.36	0.06		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	**0.06**	**ac-ft**	*Based on added pavement
				EURV Total =	**0.15**	**ac-ft**	*For information purposes only

WQCV

Required WQCV =	**0.06**	**ac-ft**	*Based on total pavement, no increase for sedimentation *For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)		
Type A	0.00	0.00	0.00		
Type B	0.55	0.05	0.09		
Type C/D	0.00	0.00	0.00		
			10-year Volume =	**0.05**	**ac-ft** *Based on added pavement
			100-year Volume =	**0.09**	**ac-ft** *Based on added pavement
			100-year Volume + WQCV =	**0.15**	**ac-ft**

Water Quality Facility Sizing
RESPEC Water and Natural Resources

Project Identifier: I-25 Design Build
Section ID: Basin 27
Date: 8/10/2012
Completed by: THT
Checked by:

CONCEPTUAL PLAN GOAL: 80% TSS REMOVAL
FACILITY SIZED BASED ON: Stormceptor, Tributary Area

Basin Parameters

Total Length	2272.38	ft	
Width	60	ft	
Tributary Area	3.13	acres	
Impervious ratio	1	(I/100)	
Added Width	24	ft	*Existing pavement width is 72ft, new pavement width is 120ft
	3.13	acres	*Treated Area
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	0	0.00	0.00	2.13	0.00		
Type B	2272.38	100.00	1.25	1.36	0.14		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	**0.14**	**ac-ft**	*Based on added pavement
				EURV Total =	**0.36**	**ac-ft**	*For information purposes only

WQCV

Required WQCV =	**0.13**	**ac-ft**	*Based on total pavement, no increase for sedimentation *For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)		
Type A	0.00	0.00	0.00		
Type B	1.25	0.12	0.21		
Type C/D	0.00	0.00	0.00		
			10-year Volume =	**0.12**	**ac-ft** *Based on added pavement
			100-year Volume =	**0.21**	**ac-ft** *Based on added pavement
			100-year Volume + WQCV =	**0.35**	**ac-ft**

Water Quality Facility Sizing

RESPEC Water and Natural Resources

Project Identifier:	I-25 Design Build	**CONCEPTUAL PLAN GOAL:**	FSD
Section ID:	Basin 28	**FACILITY SIZED BASED ON:**	100-year Volume
Date:	8/10/2012		
Completed by:	THT		
Checked by:			

Basin Parameters

Total Length	4982.35	ft	
Width	60	ft	
Tributary Area	6.86	acres	
Impervious ratio	1	(I/100)	
Added Width	24	ft	*Existing pavement width is 72ft, new pavement width is 120ft
	2.75	acres	*Treated Area
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	0	0.00	0.00	2.13	0.00		
Type B	4982.35	100.00	2.75	1.36	0.31		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	**0.31**	**ac-ft**	*Based on added pavement
				EURV Total =	**0.78**	**ac-ft**	*For information purposes only

WQCV

Required WQCV =	**0.29**	**ac-ft**	*Based on total pavement, no increase for sedimentation *For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)			
Type A	0.00	0.00	0.00			
Type B	2.75	0.26	0.47			
Type C/D	0.00	0.00	0.00			
			10-year Volume =	**0.26**	**ac-ft**	*Based on added pavement
			100-year Volume =	**0.47**	**ac-ft**	*Based on added pavement
			100-year Volume + WQCV =	**0.76**	**ac-ft**	

Number of PSQF	1.00		Depth	2.60	ft
Volume	0.47	ac-ft	H:V	4	:1
			Additional	20.8	ft

Sizing

Depth	3.00	ft
Bottom Slope	0.005	ft/ft
Average Depth	2.60	ft
A1+A2	15784	sq ft

A1 "Bottom"

L=	160	ft
W=	35	ft

A2 "Top"

L=	180.8	ft
W=	56	ft

6" weir + 1 ft freeboard + 3 ft berm

L=	199	ft
W=	74	ft

Water Quality Facility Sizing
RESPEC Water and Natural Resources

Project Identifier: I-25 Design Build
Section ID: Basin 29
Date: 8/10/2012
Completed by: THT
Checked by:

CONCEPTUAL PLAN GOAL: FSD
FACILITY SIZED BASED ON: 100-year Volume

Basin Parameters

Total Length	2731.62	ft	
Width	60	ft	
Tributary Area	3.76	acres	
Impervious ratio	1	(I/100)	
Added Width	24	ft	*Existing pavement width is 72ft, new pavement width is 120ft
	1.51	acres	*Treated Area
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	0	0.00	0.00	2.13	0.00		
Type B	2731.62	100.00	1.51	1.36	0.17		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	**0.17**	**ac-ft**	*Based on added pavement
				EURV Total =	**0.43**	**ac-ft**	*For information purposes only

WQCV

Required WQCV =	**0.16**	**ac-ft**	*Based on total pavement, no increase for sedimentation *For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)		
Type A	0.00	0.00	0.00		
Type B	1.51	0.14	0.26		
Type C/D	0.00	0.00	0.00		
			10-year Volume =	**0.14**	**ac-ft** *Based on added pavement
			100-year Volume =	**0.26**	**ac-ft** *Based on added pavement
			100-year Volume + WQCV =	**0.42**	**ac-ft**

Number of PSQF	1.00		Depth	2.88	ft
Volume	0.26	ac-ft	H:V	4	:1
			Additional	23	ft

Sizing

Depth	3.00	ft
Bottom Slope	0.005	ft/ft
Average Depth	2.88	ft
A1+A2	7826	sq ft

A1 "Bottom"

L=	50	ft
W=	50	ft

A2 "Top"

L=	73	ft
W=	73	ft

6" weir + 1 ft freeboard + 3 ft berm

L=	91	ft
W=	91	ft

Water Quality Facility Sizing
RESPEC Water and Natural Resources

Project Identifier:	I-25 Design Build	**CONCEPTUAL PLAN GOAL:**	FSD
Section ID:	Basin 30	**FACILITY SIZED BASED ON:**	100-year Volume
Date:	8/10/2012		
Completed by:	THT		
Checked by:			

Basin Parameters

Total Length	4751.83	ft	
Width	60	ft	
Tributary Area	6.55	acres	
Impervious ratio	1	(I/100)	
Added Width	24	ft	*Existing pavement width is 72ft, new pavement width is 120ft
	2.62	acres	*Treated Area
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	0	0.00	0.00	2.13	0.00		
Type B	4751.83	100.00	2.62	1.36	0.30		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	**0.30**	**ac-ft**	*Based on added pavement
				EURV Total =	**0.74**	**ac-ft**	*For information purposes only

WQCV

Required WQCV =	**0.27**	**ac-ft**	*Based on total pavement, no increase for sedimentation *For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)			
Type A	0.00	0.00	0.00			
Type B	2.62	0.24	0.45			
Type C/D	0.00	0.00	0.00			
			10-year Volume =	**0.24**	**ac-ft**	*Based on added pavement
			100-year Volume =	**0.45**	**ac-ft**	*Based on added pavement
			100-year Volume + WQCV =	**0.72**	**ac-ft**	

Number of PSQF	1.00		Depth	2.73	ft
Volume	0.45	ac-ft	H:V	4	:1
			Additional	21.8	ft

Sizing

Depth	3.00	ft
Bottom Slope	0.005	ft/ft
Average Depth	2.73	ft
A1+A2	14363	sq ft

A1 "Bottom"

L=	110	ft
W=	48	ft

A2 "Top"

L=	131.8	ft
W=	69	ft

6" weir + 1 ft freeboard + 3 ft berm

L=	150	ft
W=	87	ft

Water Quality Facility Sizing
RESPEC Water and Natural Resources

Project Identifier: I-25 Design Build
Section ID: Basin 31
Date: 8/10/2012
Completed by: THT
Checked by:

CONCEPTUAL PLAN GOAL: FSD
FACILITY SIZED BASED ON: 100-year Volume

Basin Parameters

Total Length	2301.81	ft	
Width	60	ft	
Tributary Area	3.17	acres	
Impervious ratio	1	(I/100)	
Added Width	24	ft	*Existing pavement width is 72ft, new pavement width is 120ft
	1.27	acres	*Treated Area
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	0	0.00	0.00	2.13	0.00		
Type B	2301.81	100.00	1.27	1.36	0.14		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	**0.14**	**ac-ft**	*Based on added pavement
				EURV Total =	**0.36**	**ac-ft**	*For information purposes only

WQCV

Required WQCV =	**0.13**	**ac-ft**	*Based on total pavement, no increase for sedimentation *For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)		
Type A	0.00	0.00	0.00		
Type B	1.27	0.12	0.22		
Type C/D	0.00	0.00	0.00		
			10-year Volume =	**0.12**	**ac-ft** *Based on added pavement
			100-year Volume =	**0.22**	**ac-ft** *Based on added pavement
			100-year Volume + WQCV =	**0.35**	**ac-ft**

Number of PSQF	1.00		Depth	2.73	ft
Volume	0.22	ac-ft	H:V	4	:1
			Additional	21.8	ft

Sizing

Depth	3.00	ft
Bottom Slope	0.005	ft/ft
Average Depth	2.73	ft
A1+A2	6958	sq ft

A1 "Bottom"

L=	110	ft
W=	17	ft

A2 "Top"

L=	131.8	ft
W=	39	ft

6" weir + 1 ft freeboard + 3 ft berm

L=	150	ft
W=	57	ft

Water Quality Facility Sizing

RESPEC Water and Natural Resources

Project Identifier:	I-25 Design Build	**CONCEPTUAL PLAN GOAL:**	FSD
Section ID:	Basin 32	**FACILITY SIZED BASED ON:**	100-year Volume
Date:	8/10/2012		
Completed by:	THT		
Checked by:			

Basin Parameters

Total Length	1647.34	ft	
Width	120	ft	
Tributary Area	4.54	acres	
Impervious ratio	1	(I/100)	
Added Width	48	ft	*Existing pavement width is 72ft, new pavement width is 120ft
	1.82	acres	*Treated Area
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	0	0.00	0.00	2.13	0.00		
Type B	1647.34	100.00	1.82	1.36	0.21		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	**0.21**	**ac-ft**	*Based on added pavement
				EURV Total =	**0.52**	**ac-ft**	*For information purposes only

WQCV

Required WQCV =	**0.19**	**ac-ft**	*Based on total pavement, no increase for sedimentation *For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)			
Type A	0.00	0.00	0.00			
Type B	1.82	0.17	0.31			
Type C/D	0.00	0.00	0.00			
			10-year Volume =	**0.17**	**ac-ft**	*Based on added pavement
			100-year Volume =	**0.31**	**ac-ft**	*Based on added pavement
			100-year Volume + WQCV =	**0.50**	**ac-ft**	

Number of PSQF	1.00		Depth	2.73	ft
Volume	0.31	ac-ft	H:V	4	:1
			Additional	21.8	ft

Sizing

Depth	3.00	ft
Bottom Slope	0.005	ft/ft
Average Depth	2.73	ft
A1+A2	9959	sq ft

A1 "Bottom"

L=	110	ft
W=	29	ft

A2 "Top"

L=	131.8	ft
W=	51	ft

6" weir + 1 ft freeboard + 3 ft berm

L=	150	ft
W=	69	ft

Water Quality Facility Sizing
RESPEC Water and Natural Resources

Project Identifier: I-25 Design Build
Section ID: Basin 33
Date: 8/10/2012
Completed by: THT
Checked by:

CONCEPTUAL PLAN GOAL: 80% TSS REMOVAL
FACILITY SIZED BASED ON: Stormceptor, Tributary Area

Basin Parameters

Total Length	811.41	ft	
Width	120	ft	
Tributary Area	2.24	acres	
Impervious ratio	1	(I/100)	
Added Width	48	ft	*Existing pavement width is 72ft, new pavement width is 120ft
	2.24	acres	*Treated Area
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	0	0.00	0.00	2.13	0.00		
Type B	811.41	100.00	0.89	1.36	0.10		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	**0.10**	**ac-ft**	*Based on added pavement
				EURV Total =	**0.25**	**ac-ft**	*For information purposes only

WQCV

Required WQCV =	**0.09**	**ac-ft**	*Based on total pavement, no increase for sedimentation *For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)		
Type A	0.00	0.00	0.00		
Type B	0.89	0.08	0.15		
Type C/D	0.00	0.00	0.00		
			10-year Volume =	**0.08**	**ac-ft** *Based on added pavement
			100-year Volume =	**0.15**	**ac-ft** *Based on added pavement
			100-year Volume + WQCV =	**0.25**	**ac-ft**

Water Quality Facility Sizing
RESPEC Water and Natural Resources

Project Identifier: I-25 Design Build
Section ID: Basin 34
Date: 8/10/2012
Completed by: THT
Checked by:

CONCEPTUAL PLAN GOAL: FSD
FACILITY SIZED BASED ON: 100-year Volume

Basin Parameters

Total Length	917.51	ft	
Width	120	ft	
Tributary Area	2.53	acres	
Impervious ratio	1	(I/100)	
Added Width	48	ft	*Existing pavement width is 72ft, new pavement width is 120ft
	1.01	acres	*Treated Area
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	0	0.00	0.00	2.13	0.00		
Type B	917.51	100.00	1.01	1.36	0.11		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	**0.11**	**ac-ft**	*Based on added pavement
				EURV Total =	**0.29**	**ac-ft**	*For information purposes only

WQCV

Required WQCV = 0.11 ac-ft *Based on total pavement, no increase for sedimentation
*For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)			
Type A	0.00	0.00	0.00			
Type B	1.01	0.09	0.17			
Type C/D	0.00	0.00	0.00			
			10-year Volume =	**0.09**	**ac-ft**	*Based on added pavement
			100-year Volume =	**0.17**	**ac-ft**	*Based on added pavement
			100-year Volume + WQCV =	**0.28**	**ac-ft**	

Number of PSQF	1.00		Depth	2.75	ft
Volume	0.17	ac-ft	H:V	4	:1
			Additional	22	ft

Sizing

Depth	3.00	ft
Bottom Slope	0.005	ft/ft
Average Depth	2.75	ft
A1+A2	5496	sq ft

A1 "Bottom"

L=	100	ft
W=	13	ft

A2 "Top"

L=	122	ft
W=	35	ft

6" weir + 1 ft freeboard + 3 ft berm

L=	140	ft
W=	53	ft

Water Quality Facility Sizing

RESPEC Water and Natural Resources

Project Identifier:	I-25 Design Build	**CONCEPTUAL PLAN GOAL:**	FSD
Section ID:	Basin 35	**FACILITY SIZED BASED ON:**	100-year Volume
Date:	8/10/2012		
Completed by:	THT		
Checked by:			

Basin Parameters

Total Length	1904.94	ft	
Width	120	ft	
Tributary Area	5.25	acres	
Impervious ratio	1	(I/100)	
Added Width	48	ft	*Existing pavement width is 72ft, new pavement width is 120ft
	2.10	acres	*Treated Area
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	0	0.00	0.00	2.13	0.00		
Type B	1904.94	100.00	2.10	1.36	0.24		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	**0.24**	**ac-ft**	*Based on added pavement
				EURV Total =	**0.60**	**ac-ft**	*For information purposes only

WQCV

Required WQCV =	**0.22**	**ac-ft**	*Based on total pavement, no increase for sedimentation *For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)			
Type A	0.00	0.00	0.00			
Type B	2.10	0.20	0.36			
Type C/D	0.00	0.00	0.00			
			10-year Volume =	**0.20**	**ac-ft**	*Based on added pavement
			100-year Volume =	**0.36**	**ac-ft**	*Based on added pavement
			100-year Volume + WQCV =	**0.58**	**ac-ft**	

Number of PSQF	1.00		Depth	2.60	ft
Volume	0.36	ac-ft	H:V	4	:1
			Additional	20.8	ft

Sizing

Depth	3.00	ft
Bottom Slope	0.005	ft/ft
Average Depth	2.60	ft
A1+A2	12070	sq ft

A1 "Bottom"

L=	160	ft
W=	24	ft

A2 "Top"

L=	180.8	ft
W=	45	ft

6" weir + 1 ft freeboard + 3 ft berm

L=	199	ft
W=	63	ft

Water Quality Facility Sizing
RESPEC Water and Natural Resources

Project Identifier:	I-25 Design Build	**CONCEPTUAL PLAN GOAL:**	80% TSS REMOVAL
Section ID:	Basin 36	**FACILITY SIZED BASED ON:**	Stormceptor, Tributary Area
Date:	8/10/2012		
Completed by:	THT		
Checked by:			

Basin Parameters

Total Length	2523.77	ft	
Width	120	ft	
Tributary Area	6.95	acres	
Impervious ratio	1	(I/100)	
Added Width	48	ft	*Existing pavement width is 72ft, new pavement width is 120ft
	6.95	acres	*Treated Area
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	0	0.00	0.00	2.13	0.00		
Type B	2523.77	100.00	2.78	1.36	0.32		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	**0.32**	**ac-ft**	*Based on added pavement
				EURV Total =	**0.79**	**ac-ft**	*For information purposes only

WQCV

Required WQCV =	**0.29**	**ac-ft**	*Based on total pavement, no increase for sedimentation *For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)		
Type A	0.00	0.00	0.00		
Type B	2.78	0.26	0.48		
Type C/D	0.00	0.00	0.00		
			10-year Volume =	**0.26**	**ac-ft** *Based on added pavement
			100-year Volume =	**0.48**	**ac-ft** *Based on added pavement
			100-year Volume + WQCV =	**0.77**	**ac-ft**

Water Quality Facility Sizing
RESPEC Water and Natural Resources

Project Identifier:	I-25 Design Build	**CONCEPTUAL PLAN GOAL:**	100% WQCV
Section ID:	Basin 37	**FACILITY SIZED BASED ON:**	WQCV
Date:	8/10/2012		
Completed by:	THT		
Checked by:			

Basin Parameters

Total Length	1329.88	ft	
Width	120	ft	
Tributary Area	2.95	acres	
Impervious ratio	1	(I/100)	
Added Width	48	ft	*Existing pavement width is 72ft, new pavement width is 120ft
	2.95	acres	*Treated Area 100%WQCV
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	0	0.00	0.00	2.13	0.00		
Type B	1329.88	100.00	1.18	1.36	0.13		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	**0.13**	**ac-ft**	*Based on added pavement
				EURV Total =	**0.42**	**ac-ft**	*For information purposes only

WQCV

Required WQCV =	**0.12**	**ac-ft**	*Based on total pavement, no increase for sedimentation *For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)		
Type A	0.00	0.00	0.00		
Type B	1.18	0.11	0.20		
Type C/D	0.00	0.00	0.00		
			10-year Volume =	**0.11**	**ac-ft** *Based on added pavement
			100-year Volume =	**0.20**	**ac-ft** *Based on added pavement
			100-year Volume + WQCV =	**0.33**	**ac-ft**

Number of PSQF	1.00		Depth	2.84	ft
Volume	0.12	ac-ft	H:V	4	:1
			Additional	22.72	ft

Sizing

Depth	3.00	ft
Bottom Slope	0.005	ft/ft
Average Depth	2.84	ft
A1+A2	3767	sq ft

A1 "Bottom"

L=	64	ft
W=	12	ft

A2 "Top"

L=	86.72	ft
W=	35	ft

6" weir + 1 ft freeboard + 3 ft berm

L=	105	ft
W=	53	ft

Water Quality Facility Sizing
RESPEC Water and Natural Resources

Project Identifier: I-25 Design Build
Section ID: Basin 38
Date: 8/10/2012
Completed by: THT
Checked by:

CONCEPTUAL PLAN GOAL: 100% WQCV
FACILITY SIZED BASED ON: WQCV

Basin Parameters

Total Length	1744.20	ft	
Width	120	ft	
Tributary Area	4.09	acres	
Impervious ratio	1	(I/100)	
Added Width	48	ft	*Existing pavement width is 72ft, new pavement width is 120ft
	4.09	acres	*Treated Area 100%WQCV
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	0	0.00	0.00	2.13	0.00		
Type B	1744.2	100.00	1.64	1.36	0.19		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	**0.19**	**ac-ft**	*Based on added pavement
				EURV Total =	**0.55**	**ac-ft**	*For information purposes only

WQCV

Required WQCV = 0.17 ac-ft *Based on total pavement, no increase for sedimentation
*For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)		
Type A	0.00	0.00	0.00		
Type B	1.64	0.15	0.28		
Type C/D	0.00	0.00	0.00		
		10-year Volume =	**0.15**	**ac-ft**	*Based on added pavement
		100-year Volume =	**0.28**	**ac-ft**	*Based on added pavement
		100-year Volume + WQCV =	**0.45**	**ac-ft**	

Number of PSQF	1.00		Depth	2.78	ft
Volume	0.17	ac-ft	H:V	4	:1
			Additional	22.2	ft

Sizing

Depth	3.00	ft
Bottom Slope	0.005	ft/ft
Average Depth	2.78	ft
A1+A2	5348	sq ft

A1 "Bottom"

L=	90	ft
W=	14	ft

A2 "Top"

L=	112.2	ft
W=	36	ft

6" weir + 1 ft freeboard + 3 ft berm

L=	130	ft
W=	54	ft

Water Quality Facility Sizing
RESPEC Water and Natural Resources

Project Identifier:	I-25 Design Build	**CONCEPTUAL PLAN GOAL:**	100% WQCV
Section ID:	Basin 39	**FACILITY SIZED BASED ON:**	WQCV
Date:	8/10/2012		
Completed by:	THT		
Checked by:			

Basin Parameters

Total Length	1731.57	ft	
Width	120	ft	
Tributary Area	4.77	acres	
Impervious ratio	1	(I/100)	
Added Width	48	ft	*Existing pavement width is 72ft, new pavement width is 120ft
	4.77	acres	*Treated Area 100%WQCV
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	0	0.00	0.00	2.13	0.00		
Type B	1731.57	100.00	1.91	1.36	0.22		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	**0.22**	**ac-ft**	*Based on added pavement
				EURV Total =	**0.54**	**ac-ft**	*For information purposes only

WQCV

Required WQCV =	**0.20**	**ac-ft**	*Based on total pavement, no increase for sedimentation *For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)			
Type A	0.00	0.00	0.00			
Type B	1.91	0.18	0.33			
Type C/D	0.00	0.00	0.00			
			10-year Volume =	**0.18**	**ac-ft**	*Based on added pavement
			100-year Volume =	**0.33**	**ac-ft**	*Based on added pavement
			100-year Volume + WQCV =	**0.53**	**ac-ft**	

Number of PSQF	1.00		Depth	2.78	ft
Volume	0.20	ac-ft	H:V	4	:1
			Additional	22.2	ft

Sizing

Depth	3.00	ft
Bottom Slope	0.005	ft/ft
Average Depth	2.78	ft
A1+A2	6240	sq ft

A1 "Bottom"

L=	90	ft
W=	19	ft

A2 "Top"

L=	112.2	ft
W=	41	ft

6" weir + 1 ft freeboard + 3 ft berm

L=	130	ft
W=	59	ft

Water Quality Facility Sizing

RESPEC Water and Natural Resources

Project Identifier: I-25 Design Build
Section ID: Basin 40
Date: 8/10/2012
Completed by: THT
Checked by:

CONCEPTUAL PLAN GOAL: 100% WQCV
FACILITY SIZED BASED ON: WQCV

Basin Parameters

Total Length	2044.72	ft	
Width	120	ft	
Tributary Area	5.63	acres	
Impervious ratio	1	(I/100)	
Added Width	48	ft	*Existing pavement width is 72ft, new pavement width is 120ft
	5.63	acres	*Treated Area 100%WQCV
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	0	0.00	0.00	2.13	0.00		
Type B	2044.72	100.00	2.25	1.36	0.26		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	**0.26**	**ac-ft**	*Based on added pavement
				EURV Total =	**0.64**	**ac-ft**	*For information purposes only

WQCV

Required WQCV =	**0.23**	**ac-ft**	*Based on total pavement, no increase for sedimentation *For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)			
Type A	0.00	0.00	0.00			
Type B	2.25	0.21	0.39			
Type C/D	0.00	0.00	0.00			
			10-year Volume =	**0.21**	**ac-ft**	*Based on added pavement
			100-year Volume =	**0.39**	**ac-ft**	*Based on added pavement
			100-year Volume + WQCV =	**0.62**	**ac-ft**	

Number of PSQF	1.00		Depth	2.68	ft
Volume	0.23	ac-ft	H:V	4	:1
			Additional	21.4	ft

Sizing

Depth	3.00	ft
Bottom Slope	0.005	ft/ft
Average Depth	2.68	ft
A1+A2	7644	sq ft

A1 "Bottom"

L=	130	ft
W=	16	ft

A2 "Top"

L=	151.4	ft
W=	37	ft

6" weir + 1 ft freeboard + 3 ft berm

L=	169	ft
W=	55	ft

Water Quality Facility Sizing
RESPEC Water and Natural Resources

Project Identifier: I-25 Design Build
Section ID: Basin 41
Date: 8/10/2012
Completed by: THT
Checked by:

CONCEPTUAL PLAN GOAL: 100% WQCV
FACILITY SIZED BASED ON: WQCV

Basin Parameters

Total Length	725.82	ft	
Width	120	ft	
Tributary Area	2.00	acres	
Impervious ratio	1	(I/100)	
Added Width	48	ft	*Existing pavement width is 72ft, new pavement width is 120ft
	2.00	acres	*Treated Area 100%WQCV
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

EURV

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	0	0.00	0.00	2.13	0.00		
Type B	725.82	100.00	0.80	1.36	0.09		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	**0.09**	**ac-ft**	*Based on added pavement
				EURV Total =	**0.23**	**ac-ft**	*For information purposes only

WQCV

Required WQCV =	**0.08**	**ac-ft**	*Based on total pavement, no increase for sedimentation *For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)			
Type A	0.00	0.00	0.00			
Type B	0.80	0.07	0.14			
Type C/D	0.00	0.00	0.00			
			10-year Volume =	**0.07**	**ac-ft**	*Based on added pavement
			100-year Volume =	**0.14**	**ac-ft**	*Based on added pavement
			100-year Volume + WQCV =	**0.22**	**ac-ft**	

Number of PSQF	1.00		Depth	2.85	ft
Volume	0.08	ac-ft	H:V	3.5	:1
			Additional	19.95	ft

Sizing

Depth	3.00	ft
Bottom Slope	0.005	ft/ft
Average Depth	2.85	ft
A1+A2	2547	sq ft

A1 "Bottom"

L=	60	ft
W=	7	ft

A2 "Top"

L=	79.95	ft
W=	27	ft

6" weir + 1 ft freeboard + 3 ft berm

L=	96	ft
W=	43	ft

Water Quality Facility Sizing

RESPEC Water and Natural Resources

Project Identifier:	I-25 Design Build	**CONCEPTUAL PLAN GOAL:**	100% WQCV
Section ID:	Basin 42	**FACILITY SIZED BASED ON:**	WQCV
Date:	8/10/2012		
Completed by:	THT		
Checked by:			

Basin Parameters

Total Length	3562.01	ft	
Width	120	ft	
Tributary Area	9.81	acres	
Impervious ratio	1	(I/100)	
Added Width	48	ft	*Existing pavement width is 72ft, new pavement width is 120ft
	9.81	acres	*Treated Area 100%WQCV
a	1.0	WQCV Coeff Drain Time (Table 3-2)	

<u>EURV</u>

Soil Type	Length (ft)	Length (%)	Area (acre)	$EURV_k$	$EURV_V$ (ac-ft)		
Type A	0	0.00	0.00	2.13	0.00		
Type B	3562.01	100.00	3.93	1.36	0.45		
Type C/D	0	0.00	0.00	1.21	0.00		
				EURV =	**0.45**	**ac-ft**	*Based on added pavement
				EURV Total =	**1.11**	**ac-ft**	*For information purposes only

<u>WQCV</u>

Required WQCV =	**0.41**	**ac-ft**	*Based on total pavement, no increase for sedimentation *For information purposes only

100-year Detention Volume

Soil Type	Area (acre)	V_{10} (ac-ft)	V_{100} (ac-ft)			
Type A	0.00	0.00	0.00			
Type B	3.93	0.37	0.67			
Type C/D	0.00	0.00	0.00			
			10-year Volume =	**0.37**	**ac-ft**	*Based on added pavement
			100-year Volume =	**0.67**	**ac-ft**	*Based on added pavement
			100-year Volume + WQCV =	**1.08**	**ac-ft**	

Number of PSQF	1.00		Depth	2.35	ft
Volume	0.41	ac-ft	H:V	4	:1
			Additional	18.8	ft

<u>Sizing</u>

Depth	3.00	ft
Bottom Slope	0.005	ft/ft
Average Depth	2.35	ft
A1+A2	15157	sq ft

A1 "Bottom"

L=	260	ft
W=	18	ft

A2 "Top"

L=	278.8	ft
W=	37	ft

6" weir + 1 ft freeboard + 3 ft berm

L=	297	ft
W=	55	ft