realigned

south of Arroya Lane and east of Vollmer Road are mainly covered with native grasses with few or no pine trees. The Sand Creek channel bisects this part of the property from north-south with various natural ravine tributary fingers. A wetlands delineation has been prepared for the property (See Appendix) and reflects some wetlands throughout the Sand Creek channel. Upon determination of exact channel improvements as a part of development and final platting of the site, the appropriate permitting will be prepared for and reviewed/approved by US Fish and Wildlife. Arroya Lane exists along the northern portion of the site. The westerly portion of this road is public ROW with the remainder of the road heading further east being private. A portion of this existing ROW may need to be vacated with the final plat in this area given the planned re-alignment of the Arroya Lane and Vollmer intersection. An existing 60" CMP culvert currently conveys the low flows from Sand Creek under Arroya Lane.

Portions of this site have been previously studied in the "Sand Creek Drainage Basin Planning Study" (DBPS) prepared by Kiowa Engineering Corporation, March 1996. The portion of Sand Creek that traverses the site is defined as Reach SC-9 in the DBPS. Approximately 1000+ acres north of this property is tributary to this reach of the channel. (See Off-site Drainage Map in Appendix) According to the DBPS, this reach of Sand Creek all contained within the channel has the following flow characteristics: Q_{10} = 630 cfs Q_{100} = 2170 cfs. However, the 100 yr. flow recognized by FEMA in the LOMR 08-08-0541P with effective date of July 23, 2009, equals nearly Q_{100} = 2600 cfs. The majority of these off-site flows enter the property at the north end of the site conveying flows from the northwest (Black Forest area) and the off-site stock ponds to the north (both tributary to hundreds of acres of property in Black Forest). There are multiple existing culvert crossings of Vollmer Rd. just north of Arroya Lane to facilitate these historic flow patterns. The following are the few key culverts that directly feed the Sand Creek channel north of Arroya Lane: Approximately 1,000 feet north of Arroya Lane, an existing 36" CMP crosses Vollmer Road (Basin SC-1 on Off-site Drainage Map). A small basin and natural ravine just west of Vollmer feeds this facility. From a recent field visit, this small facility seems to be in good working condition, however, not labeled in the DBPS. Another 700 feet+ north along Vollmer a much larger basin exists west of the roadway. This off-site basin is approximately 350+ acres northwest of Vollmer Road (Basin SC-2 on Off-site Drainage Map). As shown within the DBPS, this existing crossing is a 60" CMP with some very dense and tall vegetation at both the entrance and exit of this facility. But, based on a recent field visit this facility seems to be in good working condition. The DBPS depicts this facility and recommends an additional 60" CMP at this location. However, there are no signs of erosion or over topping the road at this location at this time based on the current development within the tributary area to this facility. Based on the existing surrounding topography and roadway configuration, the 100 yr. historic flows at this location would appear to spill over the roadway and continue in their historic drainage pattern downstream within the upper reach of Sand Creek.

The following descriptions represent the pre-development flow design points for the property excluding the major off-site flows within Sand Creek just described:

EX DP-1 (Q_2 = 5.6 cfs Q_5 = 36.0 cfs, Q_{100} = 281.7 cfs) This does not include the major off-site channel flows but reflects only the on-site and off-site flows that travel across the property and have a direct effect on the development. This total represents the allowed developed release off-site at this location. This total pre-development flow includes the flowing basins: EX-1, EX-4, OS-1, OS-3, OS-4 and OS-5. Basin EX-1 (Q_2 = 2.6 cfs Q_5 = 17.7 cfs, Q_{100} = 140.3 cfs) consists of the majority of the site proposed for development. This basin contains areas of sheet flow that eventually travel within various natural ravines created within the site. These ravines then route the predevelopment flows directly into Sand Creek in the form of concentrated flows at multiple locations along the Creek. Basins OS-4 (Q_2 = 0.6 cfs Q_5 = 3.4 cfs, Q_{100} = 20.7 cfs) and EX-4 (Q_2 = 1.3 cfs Q_5 = 6.9 cfs, Q_{100} = 41.8 cfs) consists of the northeasterly portion of the property north of Arroya Lane that drains in a southwesterly direction into Sand Creek. These combined flows total (Q_2 = 1.6 cfs Q_5 = 9.8 cfs, Q_{100} = 60.1 cfs) and travel directly towards the existing 60" CMP under Arroya Lane. Details for these basins and Pond A are part of the Preliminary Drainage Report for north of Arroya Lane, prepared by Terra Nova Engineering. Basin EX-5 is not used in this report. Basin OS-5 (Q_2 = 1.0 cfs Q_5 = 5.2 cfs, Q_{100} = 32.1 cfs) consists off-site property northwest of Vollmer Road that drains under Vollmer through an existing 48" CMP culvert directly on-site. Basin OS-1 (Q_2 = 0.9 cfs Q_5 = 7.0 cfs, Q_{100} = 53.9 cfs) consists of an off-site basin to the east within the Sterling Ranch property that sheet flows directly on-site. Basin OS-3 (Q_2 = 0.6 cfs Q_5 = 2.1 cfs, Q_{100} = 9.9 cfs) consists of the public ROW portion of Arroya Lane that sheet flows directly on-site.

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this location. Thus, moving the junction point for these flows to intercept Sand Creek further north within the property will have no significant impact to Sand Creek.

Basin OS-3 (Q_2 = 1 cfs Q_5 = 2 cfs, Q_{100} = 11 cfs) represents the north half of the proposed re-alignment and improvements to Arroya Lane along with the undeveloped property north of the roadway. These flows will continue to travel in a side road ditch to be collected by a proposed 24" RCP culvert crossing of Arroya Lane just west of Sand Creek. These flows will then enter Basin A-1 and travel towards Design Point 3. Basins A1 (Q_2 = 1.8 cfs Q_5 = 5 cfs, Q_{100} = 25 cfs), A2 (Q_2 = 1.0 cfs Q_5 = 3 cfs, Q_{100} = 14 cfs), A3 (Q_2 = 0.8 cfs Q_5 = 2 cfs, Q_{100} = 11 cfs) and A4 (Q_2 = 0.7 cfs Q_5 = 1 cfs, Q_{100} = 5 cfs) are all tributary to the proposed Pond B. These basins collect flows from a portion of the rural 2.5 ac. lot development on the property with various culvert crossings designed to convey the proposed ditch flows towards Pond B. **Design Point 6 (Q_5 = 13 cfs, Q_{100} = 60 cfs)** represents the total developed flows entering **Pond B.** A proposed full-spectrum EDB is proposed at this location to release less than the pre-development flows currently seen. (See UD Detention Spreadsheet – Pond B for anticipated outlet structure and release levels) At this point, we have also shown a possible alternate/additional location for this facility. (See Drainage Map) With the Final Plat and Drainage Report it will be determined which or both locations work best from a lotting and development standpoint. Maintenance access to this facility will be directly from the adjacent public roadway.

one?

Basins B1 (Q_2 = 2.2 cfs Q_5 = 6 cfs, Q_{100} = 30 cfs), B2 (Q_2 = 1.2 cfs Q_5 = 3 cfs, Q_{100} = 17 cfs) and B3 (Q_2 = 2.8 cfs Q_5 = 5 cfs, Q_{100} = 14 cfs) are tributary to the proposed Pond C. These basins collect flows from the rest of the portion of the rural 2.5 ac. lot development west of Sand Creek with various culvert crossings designed to convey the proposed ditch flows towards Pond C. **Design Point 9 (Q_5 = 12 cfs, Q_{100} = 52 cfs)** represents the total developed flows entering **Pond C.** A proposed full-spectrum EDB is proposed at this location to release less than the pre-development flows currently seen. (See UD Detention Spreadsheet – Pond C for anticipated outlet structure and release levels) Maintenance access to this facility will be directly from the adjacent public roadway. Basins A5 (Q_2 = 0.8 cfs Q_5 = 2 cfs, Q_{100} = 12 cfs) and B4 (Q_2 = 1.9 cfs Q_5 = 6 cfs, Q_{100} = 27 cfs) represent portions of the rural 2.5 ac. lots west of Sand Creek outside the proposed roadway improvements that cannot reasonably be collected into the two facilities just described. With the minimal impervious areas anticipated on these large lots, these basins will continue to sheet flow towards Sand Creek. Per the ECM Section I.7.1.B, WQCV is not required for these lots given their size (2.5 Ac.). Also, the City owned regional facility downstream of this property (Sand Creek #3) is an in-line facility that provides stormwater quality. Basin H (Q_2 = 0.8 cfs Q_5 = 2 cfs, Q_{100} = 11 cfs) is proposed for two large lots averaging 3.5 ac. each west of Vollmer. Again, per the ECM Section I.7.1.B, WQCV is not required for these lots given their size (2.5 Ac. +). However, sediment control will be provided on each individual lot. After this sediment control, the minimal developed flow from these lots will be allowed to continue to sheet flow directly into the side road ditch along Vollmer Road.

as appropriate Added

The following represent the basins east of Sand Creek:

Basins OS-4 and EX-4 calculations are included in this report but details for these basins and Pond A are part of the Preliminary Drainage Report for north of Arroya Lane, prepared by Terra Nova Engineering.

Basins C1 (Q_2 = 2.7 cfs Q_5 = 6 cfs, Q_{100} = 26 cfs) and OS-1A (Q_2 = 0.4 cfs Q_5 = 1 cfs, Q_{100} = 9 cfs) are tributary to the Design Point 10. These basins represent on-site 2.5 ac. – 1.0 ac. lots and off-site future Sterling Ranch development which is planned to continue to sheet flow on-site through the proposed lots. A 30" RCP culvert will collect the flows at this location and route them further downstream within the on-site storm system. Basins C2 (Q_2 = 1.4 cfs Q_5 = 3 cfs, Q_{100} = 11 cfs) and OS-1B (Q_2 = 1.6 cfs Q_5 = 6 cfs, Q_{100} = 41 cfs) are tributary to the Design Point 11 and the on-site storm system. These basins represent on-site 1.0 ac. lots and off-site future Sterling Ranch development. A 30" RCP storm stub is proposed to collect the future off-site flows at this location. In the interim, prior to on-site development in this phase (Phase 4 as shown on the Preliminary Plan), the existing on-site stock pond will remain in place and continue to act as a sediment facility for the off-site flows. Upon development in this phase, the stock pond will be removed and storm system provided to handle these off-site flows. Off-site grading will be required to allow for the capture of these off-site flows within the proposed storm sewer system. An off-site easement to

Basins D5 (Q_2 = 5.6 cfs Q_5 = 10 cfs, Q_{100} = 31 cfs) and OS-2E (Q_2 = 0.2 cfs Q_5 = 0.9 cfs, Q_{100} = 6 cfs) are tributary to the Design Point 15. These basins represent on-site 1/3 ac. – 1/4 ac. lots and off-site future Sterling Ranch development which is planned to continue to sheet flow on-site through the proposed lots. At this location, assuming an even split of flows at this time, 10' Type R sump inlets will collect the developed flows and route them along with the upstream flows directly into Pond D. The Final Drainage Report will further detail the exact inlet design.

Basin D4 (Q_2 = 3.6 cfs Q_5 = 6 cfs, Q_{100} = 18 cfs) is tributary to Design Point 16. This basin represents on-site 1/4 ac. lots. At this location, assuming an even split of flows at this time, 5' Type R sump inlets will collect the developed flows and route them further downstream in a 24" RCP storm system. The Final Drainage Report will further detail the exact inlet design.

Basin D6 (Q_2 = 6.5 cfs Q_5 = 11 cfs, Q_{100} = 36 cfs) is tributary to Design Point 17. This basin represents on-site 1/4 ac. lots. At this location, assuming an even split of flows at this time, 10' Type R sump inlets will collect the developed flows and route them along with the upstream flows directly into Pond D. The Final Drainage Report will further detail the exact inlet design.

Design Point 18 (Q_5 = 59 cfs, Q_{100} = 237 cfs) represents the total developed flows entering **Pond D.** A proposed full-spectrum EDB is proposed at this location to release less than the pre-development flows currently seen. (See UD Detention Spreadsheet – Pond D for anticipated outlet structure and release levels) Maintenance access to this facility will be directly from the adjacent public roadway.

Basin D10 (Q_2 = 1.1 cfs Q_5 = 2 cfs, Q_{100} = 6 cfs) represents the rear yards of proposed lots that cannot reasonably be collected by the proposed Pond D and will then continue to sheet flow off-site. Basins C3 (Q_2 = 2.1 cfs Q_5 = 5 cfs, Q_{100} = 21 cfs), D8 (Q_2 = 1.3 cfs Q_5 = 2 cfs, Q_{100} = 7 cfs) and D9 (Q_2 = 1.0 cfs Q_5 = 2 cfs, Q_{100} = 5 cfs) represent portions of the rear yards that are adjacent to Sand Creek that cannot reasonably be collected into the proposed Pond D just described. With the minimal impervious areas anticipated on the rear of these lots, these basins will continue to sheet flow towards Sand Creek. However, ss mentioned earlier, the City owned regional facility

Address basin E including WQCV

Added

WQCV is required prior to flows entering waters of the state.

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downstream of this property (Sand Creek #3) is an in-line facility that provides stormwater quality for this minimal area. Basins F1 (Q_2 = 1.0 cfs Q_5 = 4 cfs, Q_{100} = 24 cfs) and F2 (Q_2 = 0.3 cfs Q_5 = 1 cfs, Q_{100} = 8 cfs) represent the Sand Creek Channel corridor. This area will not have any development take place in it other than the required channel improvements per the DBPS and the proposed roadway crossings.

Both the Poco Road extension and Arroya Lane are proposed to cross Sand Creek. At both these locations a triple cell 6'x12' CBC is proposed to handle the 100 yr. off-site flows. (See culvert calculations in Appendix) Both locations will require the acquisition of off-site easements for grading and construction of these facilities. These easements will be required prior to construction.

Address sizing of culverts needed to meet DCM bridge criteria for FEMA flows or LOMR to reduce flows.

DETENTION FACILITIES / STORMWATER QUALITY

Final design of these recommended facilities that include planning for water quality management of storm water runoff features will be designed during final platting of this development. As required, storm water quality measures will be utilized in order to reduce the amount of sediment, debris and pollutants that are allowed to enter Sand Creek. These features include but are not limited to the multiple Full Spectrum Extended Detention Basins. Site Planning and design techniques for the large lot, rural areas should limit impervious area, minimize directly impervious area, lengthen time of travel and increase infiltration in order to decrease the rate and volume of stormwater runoff. Urban areas that require detention will provide a Water Quality Capture Volume (WQCV) and Excess Urban Runoff Volume (EURV) in the lower portion of the facility storage volume that will release the more frequent storms at a slower rate to help minimize the effects of development of the property. These measures will be taken into consideration upon final design of the individual detention facilities as well as the development of the individual land uses within the site.

MAINTENANCE

The proposed detention/SWQ facilities are to be private facilities with ownership and maintenance by the local Metropolitan District or Homeowners Association. After completion of construction and upon the Board of County Commissioners acceptance, the Sand Creek channel will be owned and maintained by the El Paso County along with all drainage facilities within the public Right of Way.

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type of drop concrete, riprap, or TBD?

SAND CREEK CHANNEL IMPROVEMENTS

As stated in the Sand Creek DBPS, this Reach SC-9 is recommended as a floodplain preservation design concept. Given the fact of the current requirements for detention/SWQ facilities planned for the property with designed release below pre-development flows, the existing Sand Creek drainageway is expected to remain stable. However, localized channel improvements are proposed in any steeply incised channel locations and to limit erosion caused by flow concentrations at culverts and storm sewers outfalls. Existing FEMA FIS channel velocities as found in the LOMR 08-080541P seem to exceed recommended allowable velocities. Although, based on the findings from the CORE Consultants, Inc. Impact Identification Report, no significant erosion or channel degradation through this property currently exists at this time. Specifically located grade control and/or drop structures (See Appendix) were specified in the DBPS through this reach in order to slow the cannel velocity to the DBPS recommended 7 feet per second and to prevent localized and long-term stream degradation from affecting channel linings and overbanks. The allowable velocity will vary depending upon the existing riparian vegetation found within the bankfull channel and floodplain terrace areas. Where channel velocities exceed the recommended allowable velocities, 36" vertical drop structures will be installed based on Urban Drainage Criteria Manual Vol. 2. (See Appendix) These facilities will incorporate and help protect the native wetland vegetation from detrimental effects of stream invert head cutting. Concept locations for these facilities are shown on the developed drainage map as recommended in the DBPS. Revegetation would occur wherever the native vegetation is disturbed by channel construction. Selectively located rip-rap bank protection will be installed in steeply incised areas, outside bends or the natural channel and detention pond/culvert outlets. (See Appendix) Also, based on the wetland delineations prepared by CORE Consultants, Inc., likely impacts to jurisdictional waters would trigger permitting under Section 404 of the Clean Water Act. This coordination and permitting would be completed along with the approval process of the final construction plans for the associated channel improvements.

Per the approved DBPS, the anticipated developed flows just upstream of this project are $Q_{10} = 630$ cfs and $Q_{100} = 2170$ cfs as depicted within segment no. 171. The anticipated developed flows exiting this property are $Q_{10} = 670$ cfs and $Q_{100} = 2260$ cfs as depicted within segment no. 170. The FEMA FIS flows appear to be slightly higher than those presented in the DBPS. However, given the

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. — Tuesday, Mar 14 2017

Box Culvert (Arroya Lane & prop. collector Rd.)

Invert Elev Dn (ft)	= 7233.50
Pipe Length (ft)	= 115.00
Slope (%)	= 1.00
Invert Elev Up (ft)	= 7234.65
Rise (in)	= 72.0
Shape	= Box
Span (in)	= 144.0
No. Barrels	= 3
n-Value	= 0.013
Culvert Type	= Flared Wingwalls
Culvert Entrance	= 30D to 75D wingwall flares
Coeff. K,M,c,Y,k	= 0.026, 1, 0.0347, 0.81, 0.4

Embankment

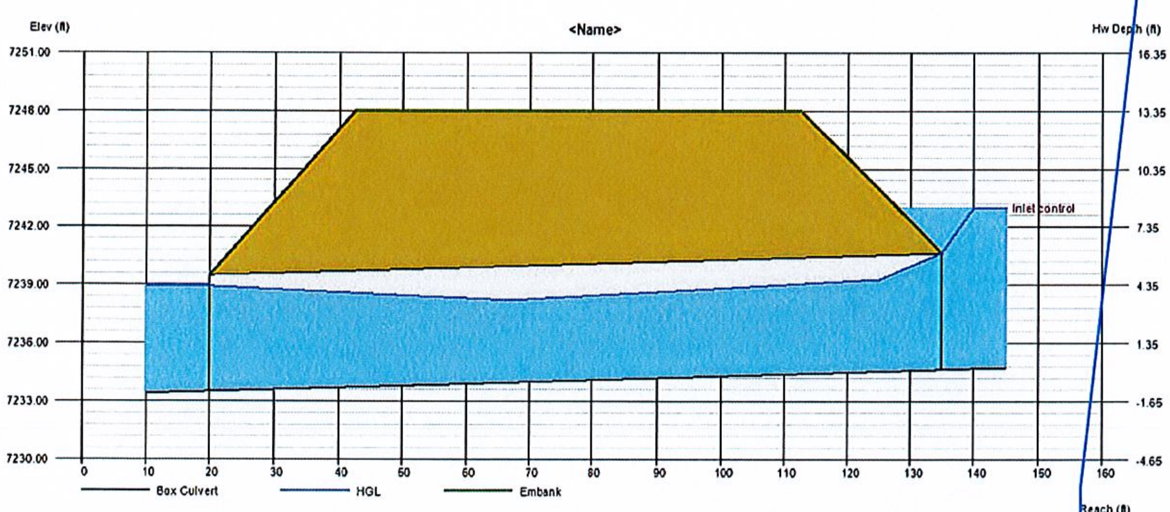
Top Elevation (ft)	= 7248.00
Top Width (ft)	= 70.00
Crest Width (ft)	= 70.00

Calculations

Qmin (cfs)	= 630.00
Qmax (cfs)	= 2170.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 2170.00
Qpipe (cfs)	= 2170.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 11.13
Veloc Up (ft/s)	= 12.49
HGL Dn (ft)	= 7238.91
HGL Up (ft)	= 7239.48
Hw Elev (ft)	= 7242.98
Hw/D (ft)	= 1.39
Flow Regime	= Inlet Control



Flow include both culvert designs

This needs to be for FEMA flows unless there is a LOMR reducing the flows. Provide for both.

PRELIMINARY DRAINAGE REPORT - BASIN RUNOFF SUMMARY

BASIN	WEIGHTED CA(2)	CA(5)	CA(100)	OVERLAND C(5)	Length (ft)	Height (ft)	Tc (min)	STREET / CHANNEL FLOW Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	Tc TOTAL (min)	INTENSITY I(2) (in/hr)	I(5) (in/hr)	I(100) (in/hr)	TOTAL FLOWS Q(2) (cfs)	Q(5) (cfs)	Q(100) (cfs)
A1	0.77	1.79	5.12	0.14	120	2.4	15.1	740	2.5%	1.6	7.8	22.9	2.31	2.89	4.84	1.8	5	25
A2	0.41	0.97	2.76	0.14	300	12	19.0	400	4.0%	2.0	3.3	22.3	2.34	2.92	4.91	1.0	3	14
A3	0.35	0.83	2.36	0.14	300	8	21.7	400	3.0%	1.7	3.6	25.6	2.18	2.72	4.57	0.8	2	11
A4	0.25	0.42	0.92	0.20	180	8	13.3	180	4.0%	2.0	1.5	14.8	2.83	3.54	5.94	0.7	1	5
A5	0.33	0.77	2.20	0.14	280	10	19.1					19.1	2.53	3.16	5.31	0.8	2	12
B1	1.13	2.63	7.52	0.14	300	10.5	19.9	1280	3.2%	1.8	11.9	31.8	1.92	2.39	4.02	2.2	6	30
B2	0.48	1.12	3.20	0.14	300	10.5	19.9					19.9	2.48	3.10	5.20	1.2	3	17
B3	1.28	1.69	3.06	0.14	300	10.5	19.9	370	1.5%	1.2	5.0	24.9	2.21	2.76	4.63	2.8	5	14
B4	0.78	1.82	5.20	0.14	300	10.5	19.9					19.9	2.48	3.10	5.20	1.9	6	27
C1	1.13	2.13	5.25	0.17	300	12	18.4	600	2.0%	2.8	3.5	21.9	2.38	2.98	4.98	2.7	6	26
C2	0.52	0.86	1.86	0.20	300	14	16.9					16.9	2.67	3.34	5.61	1.4	3	11
C3	0.77	1.46	3.61	0.17	300	17	16.4					16.4	2.71	3.39	5.68	2.1	5	21
D1	1.02	1.28	2.72	0.21	200	4	18.0	600	2.0%	2.8	3.5	21.6	2.38	2.98	5.00	2.4	4	14
D2	2.54	3.53	6.63	0.25	150	3	15.0	900	3.0%	3.5	4.3	19.3	2.51	3.14	5.28	6.4	11	35
D3	0.69	0.85	1.81	0.21	150	3	15.6	375	2.0%	2.8	2.2	17.8	2.61	3.26	5.48	1.8	3	10
D4	1.36	1.84	3.30	0.27	150	3	14.6	600	3.5%	3.7	2.7	17.3	2.64	3.31	5.56	3.6	6	18
D5	2.30	3.20	6.02	0.25	150	3	15.0	1050	2.5%	3.2	5.5	20.5	2.44	3.05	5.13	5.6	10	31
D6	2.75	3.83	7.19	0.25	150	3	15.0	1200	2.0%	2.8	7.1	22.0	2.36	2.94	4.94	6.5	11	36
D7	0.19	0.43	1.11	0.16	150	3	16.5					16.5	2.70	3.37	5.67	0.5	1	6
D8	0.38	0.53	0.99	0.25	70	2.8	8.1					8.1	3.54	4.44	7.46	1.3	2	7
D9	0.27	0.38	0.71	0.25	70	2.8	8.1					8.1	3.54	4.44	7.46	1.0	2	5
D10	0.31	0.43	0.80	0.25	80	3.2	8.7					8.7	3.46	4.34	7.29	1.1	2	6
E	1.51	1.50	1.49	0.25	30	7.5	2.9	400	5.0%	2.2	3.0	5.9	3.59	4.92	8.27	5.9	7	12
F1	0.54	1.63	6.52	0.09	60	3	8.3	2400	2.0%	1.4	28.3	36.6	1.75	2.18	3.66	1.0	4	24
F2	0.14	0.41	1.66	0.09	60	6	6.6	1200	2.0%	1.4	14.1	20.7	2.43	3.03	5.09	0.3	1	8
H	0.40	0.94	2.68	0.14	300	11	19.6	900	2.0%	1.4	10.5	30.2	1.98	2.47	4.15	0.8	2	11
OS-1A	0.14	0.43	1.73	0.09	300	15	18.6	400	5.0%	4.5	1.5	20.1	2.47	3.08	5.18	0.4	1	9
OS-1B	0.70	2.11	8.42	0.09	300	15	18.6	1200	5.0%	4.5	4.5	23.0	2.30	2.88	4.83	1.6	6	41
OS-2A	0.06	0.18	0.72	0.09	300	12	20.0					20.0	2.47	3.09	5.19	0.1	0.6	4
OS-2B	0.07	0.21	0.80	0.09	300	12	20.0					20.0	2.47	3.09	5.19	0.2	0.6	4
OS-2C	0.45	1.34	5.36	0.09	300	12	20.0	1000	3.0%	3.5	4.8	24.8	2.21	2.77	4.64	1.0	4	25
OS-2D	0.03	0.08	0.31	0.09	250	12	17.2					17.2	2.65	3.32	5.57	0.07	0.3	2
OS-2E	0.09	0.28	1.12	0.09	300	12	20.0					20.0	2.47	3.09	5.19	0.2	0.9	6
OS-3	0.42	0.74	2.21	0.08	300	10	21.4	250	3.0%	3.5	1.2	22.6	2.32	2.90	4.87	1	2	11
OS-5	0.55	2.21	9.66	0.06	300	12	20.2	1800	3.0%	3.5	7.2	27.4	2.10	2.62	4.39	1	6	42

PRELIMINARY DRAINAGE REPORT - BASIN RUNOFF COEFFICIENT SUMMARY

BASIN	TOTAL AREA (AC)	IMPERVIOUS AREA / STREETS AREA (AC)	C(2)	C(5)	C(100)	LANDSCAPE / DEVELOPED AREAS AREA (AC)	C(2)	C(5)	C(100)	WEIGHTED C(2)	C(5)	C(100)	WEIGHTED CA CA(2)	CA(5)	CA(100)
A1	12.8	0.00	0.89	0.95	0.96	12.80	0.06	0.14	0.40	0.06	0.14	0.40	0.77	1.79	5.12
A2	6.9	0.00	0.89	0.95	0.96	6.90	0.06	0.14	0.40	0.06	0.14	0.40	0.41	0.97	2.76
A3	5.9	0.00	0.89	0.95	0.96	5.90	0.06	0.14	0.40	0.06	0.14	0.40	0.35	0.83	2.36
A4	2.1	0.00	0.89	0.95	0.96	2.10	0.12	0.20	0.44	0.12	0.20	0.44	0.25	0.42	0.92
A5	5.5	0.00	0.89	0.95	0.96	5.50	0.06	0.14	0.40	0.06	0.14	0.40	0.33	0.77	2.20
B1	18.8	0.00	0.89	0.95	0.96	18.80	0.06	0.14	0.40	0.06	0.14	0.40	1.13	2.63	7.52
B2	8.0	0.00	0.89	0.95	0.96	8.00	0.06	0.14	0.40	0.06	0.14	0.40	0.48	1.12	3.20
B3	6.10	1.10	0.89	0.95	0.96	5.00	0.06	0.14	0.40	0.21	0.28	0.50	1.28	1.69	3.06
B4	13.0	0.00	0.89	0.95	0.96	13.00	0.06	0.14	0.40	0.06	0.14	0.40	0.78	1.82	5.20
C1	12.5	0.00	0.89	0.95	0.96	12.50	0.09	0.17	0.42	0.09	0.17	0.42	1.13	2.13	5.25
C2	4.3	0.00	0.89	0.95	0.96	4.30	0.12	0.20	0.44	0.12	0.20	0.44	0.52	0.86	1.89
C3	8.6	0.00	0.89	0.95	0.96	8.60	0.09	0.17	0.42	0.09	0.17	0.42	0.77	1.46	3.61
D1	6.0	0.00	0.89	0.95	0.96	6.00	0.17	0.21	0.45	0.17	0.21	0.45	1.02	1.28	2.72
D2	14.1	0.00	0.89	0.95	0.96	14.10	0.18	0.25	0.47	0.18	0.25	0.47	2.54	3.53	6.63
D3	4.0	0.00	0.89	0.95	0.96	4.00	0.17	0.21	0.45	0.17	0.21	0.45	0.68	0.85	1.81
D4	6.8	0.00	0.89	0.95	0.96	6.80	0.20	0.27	0.49	0.20	0.27	0.49	1.36	1.84	3.30
D5	12.8	0.00	0.89	0.95	0.96	12.80	0.18	0.25	0.47	0.18	0.25	0.47	2.30	3.20	6.02
D6	15.3	0.00	0.89	0.95	0.96	15.30	0.18	0.25	0.47	0.18	0.25	0.47	2.75	3.83	7.19
D7	2.7	0.00	0.89	0.95	0.96	2.70	0.07	0.16	0.41	0.07	0.16	0.41	0.19	0.43	1.11
D8	2.1	0.00	0.89	0.95	0.96	2.10	0.18	0.25	0.47	0.18	0.25	0.47	0.38	0.53	0.99
D9	1.5	0.00	0.89	0.95	0.96	1.50	0.18	0.25	0.47	0.18	0.25	0.47	0.27	0.38	0.71
D10	1.7	0.00	0.89	0.95	0.96	1.70	0.18	0.25	0.47	0.18	0.25	0.47	0.31	0.43	0.80
E	1.3	1.80	0.89	0.95	0.96	-0.50	0.18	0.25	0.47	1.16	1.15	1.15	1.51	1.50	1.49
F1	18.1	0.00	0.89	0.95	0.96	18.10	0.03	0.09	0.36	0.03	0.09	0.36	0.54	1.63	6.52
F2	4.6	0.00	0.89	0.95	0.96	4.60	0.03	0.09	0.36	0.03	0.09	0.36	0.14	0.41	1.66
H	6.7	0.00	0.89	0.95	0.96	6.70	0.06	0.14	0.40	0.06	0.14	0.40	0.40	0.94	2.66
OS-1A	4.8	0.00	0.89	0.95	0.96	4.80	0.03	0.09	0.36	0.03	0.09	0.36	0.14	0.43	1.73
OS-1B	23.4	0.00	0.89	0.95	0.96	23.40	0.03	0.09	0.36	0.03	0.09	0.36	0.70	2.11	8.42
OS-2A	2.0	0.00	0.89	0.95	0.96	2.00	0.03	0.09	0.36	0.03	0.09	0.36	0.06	0.18	0.72
OS-2B	2.3	0.00	0.89	0.95	0.96	2.30	0.03	0.09	0.36	0.03	0.09	0.36	0.07	0.21	0.83
OS-2C	14.9	0.00	0.89	0.95	0.96	14.90	0.03	0.09	0.36	0.03	0.09	0.36	0.45	1.34	5.36
OS-2D	0.85	0.00	0.89	0.95	0.96	0.85	0.03	0.09	0.36	0.03	0.09	0.36	0.03	0.08	0.31
OS-2E	3.1	0.00	0.89	0.95	0.96	3.10	0.03	0.09	0.36	0.03	0.09	0.36	0.09	0.28	1.12
OS-3	5.7	0.35	0.89	0.95	0.96	5.35	0.02	0.08	0.35	0.07	0.13	0.39	0.42	0.74	2.21
OS-5	27.6	0.00	0.89	0.95	0.96	27.60	0.02	0.08	0.35	0.02	0.08	0.36	0.55	2.21	9.66

negative?

fixed

PRELIMINARY DRAINAGE REPORT – SURFACE ROUTING SUMMARY

Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity I(5)	I(100)	Flow Q(5)	Q(100)	Culvert / Inlet Size
1	OS-5	2.21	9.66	27.4	2.62	4.39	6	42	EX. 48" CMP
2	OS-3	0.74	2.21	22.6	2.90	4.87	2	11	24" RCP
3	DP-2, A-1	2.54	7.33	23.6	2.84	4.76	7	35	30" RCP
4	A2	0.97	2.76	22.3	2.92	4.91	3	14	24" RCP
5	DP-3, DP-4, A3	4.33	12.45	25.6	2.72	4.57	12	57	DUAL 30" RCP CULVERTS
6	OS-3, A1, A2, A3 and A4 (POND B INFLOW)	4.75	13.37	26.6	2.68	4.47	13	60	
7	B1	2.63	7.52	31.8	2.39	4.02	6	30	30" RCP
8	B3	1.69	3.06	24.9	2.76	4.63	5	14	5' Type R sump inlets
9	B1, B2 and B3 (POND C INFLOW)	5.44	13.78	34.6	2.28	3.79	12	52	
10	C1, OS-1A	2.56	6.98	23.4	2.85	4.79	7	33	30" RCP
11	C2	0.86	1.89	16.9	3.34	5.61	3	11	5' Type R sump inlets
12	D2, OS-2A	3.71	7.35	20.0	3.09	5.19	11	38	10' Type R sump inlets
13	D1, OS-2B	1.49	3.56	21.6	2.98	5.00	4	18	5' Type R sump inlets
14	D3, OS-2D	0.93	2.12	17.8	3.26	5.48	3	12	5' Type R sump inlets
15	D5, OS-2E	3.48	7.13	20.5	3.05	5.13	11	37	10' Type R sump inlets
16	D4	1.84	3.30	17.3	3.31	5.56	6	18	5' Type R sump inlets
17	D6	3.83	7.19	22.0	2.94	4.94	11	36	10' Type R sump inlets
18	DP-10 Thru DP-17 and OS-1B, OS-2C, D7 (POND D INFLOW)	22.55	54.40	27.8	2.60	4.36	59	237	

provide contributing acreage column

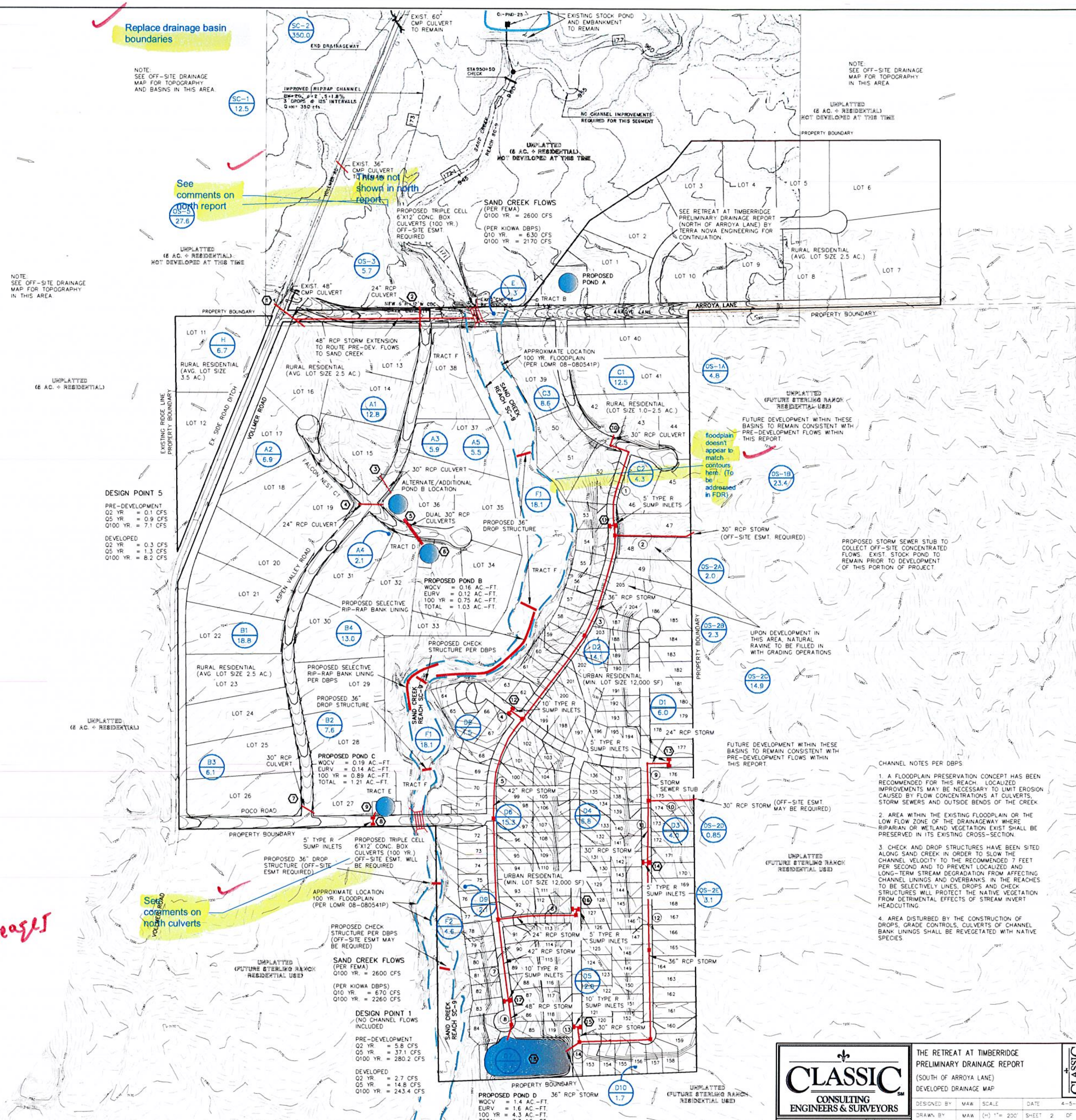
Added acreages

LEGEND

DESCRIPTION	SYMBOL
EXISTING GROUND CONTOUR	6910
PROPOSED FINISHED CONTOUR	6910
BASIN BOUNDARY	
BASIN IDENTIFIER / AREA IN ACRES	B3 / 10.0
DESIGN POINT	1
EXISTING DIRECTION OF FLOW	
PROPOSED DIRECTION OF FLOW	
PROPOSED DRAINAGE IMPROVEMENTS	
PROPOSED DETENTION/SWQ POND	

N

SCALE: 1" = 200'



CHANNEL NOTES PER DBPS

1. A FLOODPLAIN PRESERVATION CONCEPT HAS BEEN RECOMMENDED FOR THIS REACH. LOCALIZED IMPROVEMENTS MAY BE NECESSARY TO LIMIT EROSION CAUSED BY FLOW CONCENTRATIONS AT CULVERTS, STORM SEWERS AND OUTSIDE BENDS OF THE CREEK.

2. AREA WITHIN THE EXISTING FLOODPLAIN OR THE LOW FLOW ZONE OF THE DRAINAGEWAY WHERE RIPARIAN OR WETLAND VEGETATION EXIST SHALL BE PRESERVED IN ITS EXISTING CROSS-SECTION.

3. CHECK AND DROP STRUCTURES HAVE BEEN SITED ALONG SAND CREEK IN ORDER TO SLOW THE CHANNEL VELOCITY TO THE RECOMMENDED 7 FEET PER SECOND AND TO PREVENT LOCALIZED AND LONG-TERM STREAM DEGRADATION FROM AFFECTING CHANNEL LININGS AND OVERBANKS IN THE REACHES TO BE SELECTIVELY LINED. DROPS AND CHECK STRUCTURES WILL PROTECT THE NATIVE VEGETATION FROM DETRIMENTAL EFFECTS OF STREAM INVERT HEADCUTTING.

4. AREA DISTURBED BY THE CONSTRUCTION OF DROPS, GRADE CONTROLS, CULVERTS OF CHANNEL BANK LININGS SHALL BE REVEGETATED WITH NATIVE SPECIES.

CLASSIC CONSULTING ENGINEERS & SURVEYORS
619 N. Cascade Avenue, Suite 200, Colorado Springs, Colorado 80903 (719)785-0790 (719)785-0799 (Fax)

THE RETREAT AT TIMBERRIDGE
PRELIMINARY DRAINAGE REPORT
(SOUTH OF ARROYA LANE)
DEVELOPED DRAINAGE MAP

DESIGNED BY	MAW	SCALE		DATE	4-5-18
DRAWN BY	MAW	(H) 1" = 200'		SHEET 2	OF 2
CHECKED BY		(V) 1" = N/A		JOB NO.	2520.00

INNOVATIVE DESIGN. **CLASSIC RESULTS.**

PRELIMINARY DRAINAGE REPORT

FOR

THE RETREAT AT TIMBERRIDGE PRELIMINARY PLAN

(SOUTH OF ARROYA LANE)

Prepared for:
ARROYA INVESTMENTS LLC
1283 KELLY JOHNSON BLVD.
COLORADO SPRINGS CO 80920
(719) 447-8773

Prepared by:
CLASSIC CONSULTING ENGINEERS & SURVEYORS
619 N. CASCADE AVE SUITE 200
COLORADO SPRINGS CO 80903
(719) 785-0790

SP-18-002

Job No. 2520.20

PRELIMINARY DRAINAGE REPORT FOR

THE RETREAT AT TIMBERRIDGE PRELIMINARY PLAN

(SOUTH OF ARROYA LANE)

ENGINEER'S STATEMENT:

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the applicable master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors, or omissions on my part in preparing this report.

____ __________________

Marc A. Whorton Colorado P.E. #37155 Date

DEVELOPER'S STATEMENT:

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

Business Name: ARROYA INVESTMENTS LLC

By: __________________________________

Title: __________________________________

Address: 1271 Kelly Johnson Blvd., Suite 100

Colorado Springs, CO 80920

EL PASO COUNTY:

Filed in accordance with the requirements of the Drainage Criteria Manual, Volumes 1 and 2, El Paso County Engineering Criteria Manual and Land Development Code as amended.

______________________________ __________________

Jennifer Irvine, El Paso County Engineer Date

Conditions:

CLASSIC CONSULTING ENGINEERS & SURVEYORS

PRELIMINARY DRAINAGE REPORT FOR
THE RETREAT AT TIMBERRIDGE PRELIMINARY PLAN
(SOUTH OF ARROYA LANE)

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SOILS MAP (WEB SOIL SURVEY)

F.E.M.A. MAP / LOMR (08-08-0541P)

RECOMMENDATIONS PER SAND CREEK DBPS

PRELIMINARY WETLANDS MAPPING

HYDROLOGIC CALCULATIONS

STORMWATER QUALITY CALCULATIONS

DETENTION POND CALCULATIONS

DRAINAGE MAPS

PURPOSE

The purpose of this Preliminary Drainage Report, as part of the Retreat at TimberRidge Preliminary Plan, is to identify specific drainage features and facilities and to estimate peak rates of stormwater runoff, from on-site and off-site sources. Also the purpose is to outline the necessary improvements to safely route developed storm water runoff to adequate outfall facilities. The drainage improvements proposed in this report are preliminary in nature and final drainage reports are required upon any development within the site that detail the 'to be constructed' drainage systems and detention/SWQ ponds. This report covers the major portion of the Preliminary Plan area south of Arroya Lane. The 10 lots north of Arroya Lane can be found in "Preliminary Drainage Report for TimberRidge Estates Preliminary Plan (North of Arroya Lane)" prepared by Terra Nova Engineering, Inc., dated April 2018.

GENERAL DESCRIPTION

The Retreat at TimberRidge entire development is a 234.1-acre site located in portions sections 21, 22, 27 and 28, township 12 south, range 65 west of the sixth principal meridian. This specific report covers 196.7 acres and does not include Arroya Lane or the 10 residential lots north of Arroya Lane. The site is bounded on the north by various unplatted parcels (zoned for 5 ac. residential), to the south and east by Sterling Ranch property (zoned for future urban development) and to the west by Vollmer Road and unplatted parcels (zoned for 5 ac. residential). The site is in the upper portion of the Sand Creek Drainage Basin. Both large lot rural single family residential and urban single family residential are proposed in the Preliminary Plan for this site.

The average soil condition reflects Hydrologic Group "B" (Pring coarse sandy loam and Kettle gravelly loamy sand) as determined by the "Web Soil Survey of El Paso County Area," prepared by the Natural Resources Conservation Service (see map in Appendix).

EXISTING DRAINAGE CONDITIONS

The Retreat at TimberRidge property is located in the upper portion of the Sand Creek drainage basin on the south edge of Black Forest. The overall property was recently acquired in numerous parcels. The parcels west of Vollmer Road are on the fringe of Black Forest and contains some sparsely scattered pine trees with the majority of the parcel being native grasses. The northeast parcel, north of Arroya Lane again is on the fringe of Black Forest and contains some sparsely scattered pine trees with the majority of the parcel being native grasses. The parcel at the southeast corner of Vollmer Road and Arroya Lane also contains some sparsely scattered pine trees with native grasses and natural ravines tributary to the Sand Creek channel. The remaining larger parcels south of Arroya Lane and east of Vollmer Road are mainly covered with native grasses with few or no pine trees. The Sand Creek channel bisects this part of the property from north-south with various natural ravine tributary fingers. A wetlands delineation has been prepared for the property (See Appendix) and reflects some wetlands throughout the Sand Creek channel. Upon determination of exact channel improvements as a part of development and final platting of the site, the appropriate permitting will be prepared for and reviewed/approved by US Fish and Wildlife. Arroya Lane exists along the northern portion of the site. The westerly portion of this road is public ROW with the remainder of the road heading further east being private. A portion of this existing ROW may need to be realigned with the final plat in this area given the planned re-alignment of the Arroya Lane and Vollmer intersection. An existing 60" CMP culvert currently conveys the low flows from Sand Creek under Arroya Lane.

Portions of this site have been previously studied in the "Sand Creek Drainage Basin Planning Study" (DBPS) prepared by Kiowa Engineering Corporation, March 1996. The portion of Sand Creek that traverses the site is defined as Reach SC-9 in the DBPS. Approximately 1000+ acres north of this property is tributary to this reach of the channel. (See Off-site Drainage Map in Appendix) According to the DBPS, this reach of Sand Creek all contained within the channel has the following flow characteristics: Q_{10} = 630 cfs Q_{100} = 2170 cfs. However, the 100 yr. flow recognized by FEMA in the LOMR 08-08-0541P with effective date of July 23, 2009, equals nearly Q_{100} = 2600 cfs. Also, Sterling Ranch is in the process of finalizing their MDDP which includes modeling of this property as well as the large acreage north up to the top of the Sand Creek Basin. M&S Civil Consultants, Inc. is currently addressing County comments on this MDDP and it will likely be approved prior to submittal of any Final Drainage Reports on the TimberRidge property. The MDDP proposes developed flows within Sand Creek that are significantly lower than both the DBPS and FEMA currently show. These flows are as follows: At Arroya Lane crossing Q_{10} = 430 cfs Q_{100} = 1487 cfs and TimberRidge south property line Q_{10} = 452 cfs Q_{100} = 1523 cfs. Even with the anticipated County approval of the MDDP and these adjusted flows, a CLOMR/LOMR will be required to be prepared, submitted and approved by FEMA prior to utilizing these flows in any Final Drainage Reports within this development.

(as may be revised as the MDDP is reviewed and approved)

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The majority of these off-site flows enter the property at the north end of the site conveying flows from the northwest (Black Forest area) and the off-site stock ponds to the north (both tributary to hundreds of acres of property in Black Forest). There are multiple existing culvert crossings of Vollmer Rd. just north of Arroya Lane to facilitate these historic flow patterns. The following are the few key culverts that directly feed the Sand Creek channel north of Arroya Lane: Approximately 1,000 feet north of Arroya Lane, an existing 36" CMP crosses Vollmer Road (Basin SC-1 on Off-site Drainage Map). A small basin and natural ravine just west of Vollmer feeds this facility. From a recent field visit, this small facility seems to be in good working condition, however, not labeled in the DBPS. Another 700 feet+ north along Vollmer a much larger basin exists west of the roadway. This off-site basin is approximately 350+ acres northwest of Vollmer Road (Basin SC-2 on Off-site Drainage Map). As shown within the DBPS, this existing crossing is a 60" CMP with some very dense and tall vegetation at both the entrance and exit of this facility. But, based on a recent field visit this facility seems to be in good working condition. The DBPS depicts this facility and recommends an additional 60" CMP at this location. However, there are no signs of erosion or over topping the road at this location at this time based on the current development within the tributary area to this facility. Based on the existing surrounding topography and roadway configuration, the 100 yr. historic flows at this location would appear to spill over the roadway and continue in their historic drainage pattern downstream within the upper reach of Sand Creek.

The following descriptions represent the pre-development flow design points for the property excluding the major off-site flows within Sand Creek just described:

EX DP-1 (Q_2 = 5.6 cfs Q_5 = 36.0 cfs, Q_{100} = 281.7 cfs) This does not include the major off-site channel flows but reflects only the on-site and off-site flows that travel across the property and have a direct effect on the development. This total represents the allowed developed release off-site at this location. This total pre-development flow includes the flowing basins: EX-1, EX-4, OS-1, OS-3, OS-4 and OS-5. Basin EX-1 (Q_2 = 2.6 cfs Q_5 = 17.7 cfs, Q_{100} = 140.3 cfs) consists of the majority of the site proposed for development. This basin contains areas of sheet flow that eventually travel within various natural ravines created within the site. These ravines then route the predevelopment flows directly into Sand Creek in the form of concentrated flows at multiple locations along the Creek.

Basins OS-4 (Q_2 = 0.6 cfs Q_5 = 3.4 cfs, Q_{100} = 20.7 cfs) and EX-4 (Q_2 = 1.3 cfs Q_5 = 6.9 cfs, Q_{100} = 41.8 cfs) consists of the northeasterly portion of the property north of Arroya Lane that drains in a southwesterly direction into Sand Creek. These combined flows total (Q_2 = 1.6 cfs Q_5 = 9.8 cfs, Q_{100} = 60.1 cfs) and travel directly towards the existing 60" CMP under Arroya Lane. Details for these basins and Pond A are part of the Preliminary Drainage Report for north of Arroya Lane, prepared by Terra Nova Engineering. Basin EX-5 is not used in this report. Basin OS-5 (Q_2 = 1.0 cfs Q_5 = 5.2 cfs, Q_{100} = 32.1 cfs) consists off-site property northwest of Vollmer Road that drains under Vollmer through an existing 48" CMP culvert directly on-site. Basin OS-1 (Q_2 = 0.9 cfs Q_5 = 7.0 cfs, Q_{100} = 53.9 cfs) consists of an off-site basin to the east within the Sterling Ranch property that sheet flows directly on-site. Basin OS-3 (Q_2 = 0.6 cfs Q_5 = 2.1 cfs, Q_{100} = 9.9 cfs) consists of the public ROW portion of Arroya Lane that sheet flows directly on-site.

EX DP-2 (Q_2 = 0.2 cfs Q_5 = 2.0 cfs, Q_{100} = 14.7 cfs) consists of combined flows from on-site Basin EX-2 (Q_2 = 0.2 cfs Q_5 = 1.7 cfs, Q_{100} = 12.2 cfs) and Basin OS-2 (Q_2 = 0.04 cfs Q_5 = 0.3 cfs, Q_{100} = 2.5 cfs). These combined pre-development flows travel off-site directly onto Sterling Ranch property prior to eventually entering the Sand Creek channel.

EX DP-3 (Q_2 = 0.4 cfs Q_5 = 3.0 cfs, Q_{100} = 23.7 cfs) consists of flows from on-site Basin EX-3 that travel off-site directly onto Sterling Ranch property prior to eventually entering the Sand Creek channel.

EX DP-4 (Q_2 = 0.1 cfs Q_5 = 0.9 cfs, Q_{100} = 7.1 cfs) consists of on-site flows from Basin EX-6 that travel in a southeasterly direction towards the existing roadside ditch along the north side of Vollmer Road. These flows will travel in a southerly direction within the roadside ditch to a release point at the corner of the property. This to flow represents the allowed developed release at this location.

PROPOSED DRAINAGE CONDITIONS

Proposed development within the Retreat at TimberRidge will consist of a variety of different residential lot sizes ranging from 1.0 – 2.5 acre large rural lots to 12,000 SF min. urban lots. The rural lots will have paved streets and roadside ditches while the urban lots paved streets with County standard curb, gutter and sidewalk. Development of the urban lots proposed will consist of overlot grading for the planned roadways and lots. Development of rural lots proposed within the site will be limited to roadways and building pads, conserving the natural feature areas. Individual home sites on these lots are to be left generally in their natural condition with minimal disturbance to existing conditions per individual lot construction. Per the El Paso County ECM, Section I.7.1.B, rural lots of 2.5 ac. and larger are not required to provide Water Quality Capture Volume (WQCV). However, based on the current County/Urban Drainage stormwater quality standards, a WQCV component is automatically built into the UD Detention spreadsheet utilized in the detention basin design. Thus, the proposed facilities within both the rural and urban portions of this development will provide WQCV along with an Excess Urban Runoff Volume (EURV) in the lower portion of the facility storage volume with an outlet control device. Frequent and infrequent inflows are released at rates approximating undeveloped conditions. This concept provides some mitigation of increased runoff volume by releasing a portion of the increased runoff at a low rate over an extended period of time, up to 72 hours. This means that frequent storms, smaller than the 2 year event, will be reduced to very low flows near or below the sediment carrying threshold value for downstream drainage ways. Also, by incorporating an outlet structure that limits the 100-year runoff to the undeveloped condition rate, the discharge hydrograph for storms between the 2 year and the 100 year event will approximate the hydrograph for the undeveloped conditions and will help effectively mitigate the effects of development. Prior to development within the Retreat at TimberRidge property, final drainage reports and construction plans will be required detailing the requirements and specifics of proposed facilities. To the greatest extent possible, WQCV will be provided for all new roads and urban lots.

The following describes how this development proposes to handle both the off-site and on-site drainage conditions:

As mentioned previously, the majority of the off-site flows are already within the Sand Creek channel prior to entering the property. However the few off-site basins that must travel through the proposed site development areas prior to entering Sand Creek have been accounted for.

The following represent the basins west of Sand Creek:

Basin OS-5 (Q_2 = 1 cfs Q_5 = 6 cfs, Q_{100} = 42 cfs) represents off-site semi-forested, undeveloped property zoned for 5 ac. residential that is currently tributary to this site via an existing 48" CMP culvert under Vollmer. If future development occurs on this property, any developed flows must be detained beyond this pre-development quantity. A 48" RCP extension of this culvert is planned with the improvements of Arroya Lane to route these off-site pre-development flows directly to Sand Creek and by-pass the proposed development. These flows are anticipated to tie directly into the proposed triple cell box culvert crossing of Arroya Lane. These pre-developed off-site flows historically reached Sand Creek via a natural channel through the proposed development approximately 2,000 LF south of Arroya Lane. Channel improvements are proposed within this stretch of Sand Creek and these flows are only less than 2% of the overall flow within Sand Creek at this location. Thus, moving the junction point for these flows to intercept Sand Creek further north within the property will have no significant impact to Sand Creek.

Basin OS-3 (Q_2 = 1 cfs Q_5 = 2 cfs, Q_{100} = 11 cfs) represents the north half of the proposed re-alignment and improvements to Arroya Lane along with the undeveloped property north of the roadway. These flows will continue to travel in a side road ditch to be collected by a proposed 24" RCP culvert crossing of Arroya Lane just west of Sand Creek. These flows will then enter Basin A-1 and travel towards Design Point 3. Basins A1 (Q_2 = 1.8 cfs Q_5 = 5 cfs, Q_{100} = 25 cfs), A2 (Q_2 = 1.0 cfs Q_5 = 3 cfs, Q_{100} = 14 cfs), A3 (Q_2 = 0.8 cfs Q_5 = 2 cfs, Q_{100} = 11 cfs) and A4 (Q_2 = 0.7 cfs Q_5 = 1 cfs, Q_{100} = 5 cfs) are all tributary to the proposed Pond B. These basins collect flows from a portion of the rural 2.5 ac. lot development on the property with various culvert crossings designed to convey the proposed ditch flows towards Pond B. **Design Point 6 (Q_5 = 13 cfs, Q_{100} = 60 cfs)** represents the total developed flows entering **Pond B.** A proposed full-spectrum EDB is proposed at this location to release less than the pre-development flows currently seen. (See UD Detention Spreadsheet – Pond B for anticipated outlet structure and release levels) At this point, we have also shown a possible alternate/additional location for this facility. (See Drainage Map) With the Final Plat and Drainage Report it will be determined which or both locations work best from a lotting and development standpoint. Maintenance access to this facility will be directly from the adjacent public roadway.

Basins B1 (Q_2 = 2.2 cfs Q_5 = 6 cfs, Q_{100} = 30 cfs), B2 (Q_2 = 1.2 cfs Q_5 = 3 cfs, Q_{100} = 17 cfs) and B3 (Q_2 = 2.8 cfs Q_5 = 5 cfs, Q_{100} = 14 cfs) are tributary to the proposed Pond C. These basins collect flows from the rest of the portion of the rural 2.5 ac. lot development west of Sand Creek with various culvert crossings designed to convey the proposed ditch flows towards Pond C. **Design Point 9 (Q_5 = 12 cfs, Q_{100} = 52 cfs)** represents the total developed flows entering **Pond C.** A proposed full-spectrum EDB is proposed at this location to release less than the pre-development flows currently seen. (See UD Detention Spreadsheet – Pond C for anticipated outlet structure and release levels) Maintenance access to this facility will be directly from the adjacent public roadway. Basins A5 (Q_2 = 0.8 cfs Q_5 = 2 cfs, Q_{100} = 12 cfs) and B4 (Q_2 = 1.9 cfs Q_5 = 6 cfs, Q_{100} = 27 cfs) represent portions of the rural 2.5 ac. lots west of Sand Creek outside the proposed roadway improvements that cannot reasonably be collected into the two facilities just described. With the minimal impervious areas anticipated on these large lots, these basins will continue to sheet flow towards Sand Creek. Per the ECM Section I.7.1.B, WQCV is not required for these lots given their size (2.5 Ac.). Also, the City owned regional facility downstream of this property (Sand Creek #3) is an in-line facility that provides stormwater quality. Basin H (Q_2 = 0.8 cfs Q_5 = 2 cfs, Q_{100} = 11 cfs) is proposed for two large lots averaging 3.5 ac. each west of Vollmer. Again, per the ECM Section I.7.1.B, WQCV is not required for these lots given their size (2.5 Ac. +). However, sediment control will be provided on each individual lot, as appropriate. After this sediment control, the minimal developed flow from these lots will be allowed to continue to sheet flow directly into the side road ditch along Vollmer Road.

The following represent the basins east of Sand Creek:

Basins OS-4 and EX-4 calculations are included in this report but details for these basins and Pond A are part of the Preliminary Drainage Report for north of Arroya Lane, prepared by Terra Nova Engineering.

Basins C1 (Q_2 = 2.7 cfs Q_5 = 6 cfs, Q_{100} = 26 cfs) and OS-1A (Q_2 = 0.4 cfs Q_5 = 1 cfs, Q_{100} = 9 cfs) are tributary to the Design Point 10. These basins represent on-site 2.5 ac. – 1.0 ac. lots and off-site future Sterling Ranch development which is planned to continue to sheet flow on-site through the proposed lots. A 30" RCP culvert will collect the flows at this location and route them further downstream within the on-site storm system. Basins C2 (Q_2 = 1.4 cfs Q_5 = 3 cfs, Q_{100} = 11 cfs) and OS-1B (Q_2 = 1.6 cfs Q_5 = 6 cfs, Q_{100} = 41 cfs) are tributary to the Design Point 11 and the on-site storm system. These basins represent on-site 1.0 ac. lots and off-site future Sterling Ranch development. A 30" RCP storm stub is proposed to collect the future off-site flows at this location. In the interim, prior to on-site development in this phase (Phase 4 as shown on the Preliminary Plan), the existing on-site stock pond will remain in place and continue to act as a sediment facility for the off-site flows. Upon development in this phase, the stock pond will be removed and storm system provided to handle these off-site flows. Off-site grading will be required to allow for the capture of these off-site flows within the proposed storm sewer system. An off-site easement to allow for this grading and storm construction will be acquired prior to construction in this area. Future off-site Sterling Ranch development in this basin will need to meet these pre-development flows at this location.

At Design Point 11, assuming an even split of flows at this time, 5' Type R sump inlets will collect the developed flows and route them further downstream in a 36" RCP storm system. The Final Drainage Report will further detail the exact inlet design. Basins D2 (Q_2 = 6.4 cfs Q_5 = 11 cfs, Q_{100} = 35 cfs) and OS-2A (Q_2 = 0.1 cfs Q_5 = 0.6 cfs, Q_{100} = 4 cfs) are tributary to the Design Point 12. These basins represent on-site 1.0 ac. – 1/3 ac. lots and off-site future Sterling Ranch development which is planned to continue to sheet flow on-site through the proposed lots. At this location, assuming an even split of flows at this time, 10' Type R sump inlets will collect the developed flows and route them further downstream in a 42" RCP storm system. The Final Drainage Report will further detail the exact inlet design.

Basins D1 (Q_2 = 2.4 cfs Q_5 = 4 cfs, Q_{100} = 14 cfs) and OS-2B (Q_2 = 0.2 cfs Q_5 = 0.6 cfs, Q_{100} = 4 cfs) are tributary to the Design Point 13. These basins represent on-site 1/3 ac. lots and off-site future Sterling Ranch development which is planned to continue to sheet flow on-site through the proposed lots. At this location, assuming an even split of flows at this time, 5' Type R sump inlets will collect the developed flows and route them further downstream in a 24" RCP storm system. The Final Drainage Report will further detail the exact inlet design.

Basins D3 (Q_2 = 1.8 cfs Q_5 = 3 cfs, Q_{100} = 10 cfs), OS-2C (Q_2 = 1 cfs Q_5 = 4 cfs, Q_{100} = 25 cfs) and OS-2D (Q_2 = 0.07 cfs Q_5 = 0.3 cfs, Q_{100} = 2 cfs) are tributary to the Design Point 14 and the on-site storm system. These basins represent on-site 1/3 ac. lots and off-site future Sterling Ranch development. A 30" RCP storm stub is proposed to collect the future off-site flows at this location. Future off-site Sterling Ranch development in this basin will need to meet these pre-development flows at this location. At Design Point 14, assuming an even split of flows at this time, 5' Type R sump inlets will collect the developed flows and route them further downstream in a 36" RCP storm system. The Final Drainage Report will further detail the exact inlet design.

Basins D5 (Q_2 = 5.6 cfs Q_5 = 10 cfs, Q_{100} = 31 cfs) and OS-2E (Q_2 = 0.2 cfs Q_5 = 0.9 cfs, Q_{100} = 6 cfs) are tributary to the Design Point 15. These basins represent on-site 1/3 ac. – 1/4 ac. lots and off-site future Sterling Ranch development which is planned to continue to sheet flow on-site through the proposed lots. At this location, assuming an even split of flows at this time, 10' Type R sump inlets will collect the developed flows and route them along with the upstream flows directly into Pond D. The Final Drainage Report will further detail the exact inlet design.

Basin D4 (Q_2 = 3.6 cfs Q_5 = 6 cfs, Q_{100} = 18 cfs) is tributary to Design Point 16. This basin represents on-site 1/4 ac. lots. At this location, assuming an even split of flows at this time, 5' Type R sump inlets will collect the developed flows and route them further downstream in a 24" RCP storm system. The Final Drainage Report will further detail the exact inlet design.

Basin D6 (Q_2 = 6.5 cfs Q_5 = 11 cfs, Q_{100} = 36 cfs) is tributary to Design Point 17. This basin represents on-site 1/4 ac. lots. At this location, assuming an even split of flows at this time, 10' Type R sump inlets will collect the developed flows and route them along with the upstream flows directly into Pond D. The Final Drainage Report will further detail the exact inlet design.

Design Point 18 (Q_5 = 59 cfs, Q_{100} = 237 cfs) represents the total developed flows entering **Pond D.** A proposed full-spectrum EDB is proposed at this location to release less than the pre-development flows currently seen. (See UD Detention Spreadsheet – Pond D for anticipated outlet structure and release levels) Maintenance access to this facility will be directly from the adjacent public roadway.

Basin D10 (Q_2 = 1.1 cfs Q_5 = 2 cfs, Q_{100} = 6 cfs) represents the rear yards of proposed lots that cannot reasonably be collected by the proposed Pond D and will then continue to sheet flow off-site. Basins C3 (Q_2 = 2.1 cfs Q_5 = 5 cfs, Q_{100} = 21 cfs), D8 (Q_2 = 1.3 cfs Q_5 = 2 cfs, Q_{100} = 7 cfs) and D9 (Q_2 = 1.0 cfs Q_5 = 2 cfs, Q_{100} = 5 cfs) represent portions of the rear yards that are adjacent to Sand Creek that cannot reasonably be collected into the proposed Pond D just described. With the minimal impervious areas anticipated on the rear of these lots, these basins will continue to sheet flow towards Sand Creek. However, ss mentioned earlier, the City owned regional facility downstream of this property (Sand Creek #3) is an in-line facility that provides stormwater quality for this minimal area. Basins F1 (Q_2 = 1.0 cfs Q_5 = 4 cfs, Q_{100} = 24 cfs) and F2 (Q_2 = 0.3 cfs Q_5 = 1 cfs, Q_{100} = 8 cfs) represent the Sand Creek Channel corridor. This area will not have any development take place in it other than the required channel improvements per the DBPS and the proposed roadway crossings. Basin E (Q_2 = 4.5 cfs Q_5 = 6 cfs, Q_{100} = 10 cfs) represents a small portion of the proposed improved Arroya Lane near the lowpoint of the roadway. These minor flows will be captured in a small SWQ facility north of Arroya Lane and be treated prior to release into Sand Creek. This facility would likely be incorporated into the box culvert crossing design.

Both the Poco Road extension and Arroya Lane are proposed to cross Sand Creek. Timing of the design and construction of these facilities will determine what developed flows will be used. If construction of these facilities is proposed prior to the CLOMR/LOMR being approved by FEMA, then the higher FEMA flows will be used. However, if the construction is proposed after the CLOMR/LOMR approval, then the anticipated lower Sterling Ranch MDDP flows will likely be utilized for road crossing design. At this stage, this report provides all three preliminary design scenarios for the road crossing to include developed flows from the DBPS, FEMA and Sterling Ranch MDDP. The future Final Drainage Reports will provide the design using the appropriate

Address whether a deviation will be requested if FEMA flows are required and/or if freeboard requirements are not met.

developed flow quantities as approved by County. (See culvert calculations for both in Appendix) Both locations will require the acquisition of off-site easements for grading and construction of these facilities. These easements will be required prior to construction.

DETENTION FACILITIES / STORMWATER QUALITY

Final design of these recommended facilities that include planning for water quality management of storm water runoff features will be designed during final platting of this development. As required, storm water quality measures will be utilized in order to reduce the amount of sediment, debris and pollutants that are allowed to enter Sand Creek. These features include but are not limited to the multiple Full Spectrum Extended Detention Basins. Site Planning and design techniques for the large lot, rural areas should limit impervious area, minimize directly impervious area, lengthen time of travel and increase infiltration in order to decrease the rate and volume of stormwater runoff. Urban areas that require detention will provide a Water Quality Capture Volume (WQCV) and Excess Urban Runoff Volume (EURV) in the lower portion of the facility storage volume that will release the more frequent storms at a slower rate to help minimize the effects of development of the property. These measures will be taken into consideration upon final design of the individual detention facilities as well as the development of the individual land uses within the site.

MAINTENANCE

The proposed detention/SWQ facilities are to be private facilities with ownership and maintenance by the local Metropolitan District or Homeowners Association. After completion of construction and upon the Board of County Commissioners acceptance, the Sand Creek channel will be owned and maintained by the El Paso County along with all drainage facilities within the public Right of Way.

SAND CREEK CHANNEL IMPROVEMENTS

As stated in the Sand Creek DBPS, this Reach SC-9 is recommended as a floodplain preservation design concept. Given the fact of the current requirements for detention/SWQ facilities planned for the property with designed release below pre-development flows, the existing Sand Creek drainageway is expected to remain stable. However, localized channel improvements are proposed in any steeply incised channel locations and to limit erosion caused by flow concentrations at culverts and storm

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sewers outfalls. Existing FEMA FIS channel velocities as found in the LOMR 08-080541P seem to exceed recommended allowable velocities. Although, based on the findings from the CORE Consultants, Inc. Impact Identification Report, no significant erosion or channel degradation through this property currently exists at this time. Specifically located grade control and/or drop structures (See Appendix) were specified in the DBPS through this reach in order to slow the cannel velocity to the DBPS recommended 7 feet per second and to prevent localized and long-term stream degradation from affecting channel linings and overbanks. The allowable velocity will vary depending upon the existing riparian vegetation found within the bankfull channel and floodplain terrace areas. Where channel velocities exceed the recommended allowable velocities, 36" vertical drop structures (specific design to be determined with Final Drainage Report) will be installed based on Urban Drainage Criteria Manual Vol. 2. (See Appendix) These facilities will incorporate and help protect the native wetland vegetation from detrimental effects of stream invert head cutting. Concept locations for these facilities are shown on the developed drainage map as recommended in the DBPS. Revegetation would occur wherever the native vegetation is disturbed by channel construction. Selectively located rip-rap bank protection will be installed in steeply incised areas, outside bends or the natural channel and detention pond/culvert outlets. (See Appendix) Also, based on the wetland delineations prepared by CORE Consultants, Inc., likely impacts to jurisdictional waters would trigger permitting under Section 404 of the Clean Water Act. This coordination and permitting would be completed along with the approval process of the final construction plans for the associated channel improvements.

Per the approved DBPS, the anticipated developed flows just upstream of this project are Q_{10} = 630 cfs and Q_{100} = 2170 cfs as depicted within segment no. 171. The anticipated developed flows exiting this property are Q_{10} = 670 cfs and Q_{100} = 2260 cfs as depicted within segment no. 170. As discussed earlier, the FEMA FIS flows appear to be higher than those presented in the DBPS and the Sterling Ranch MDDP flows proposed are lower. At this stage, we have utilized the flows as determined by the DBPS and have followed that reports preliminary design for Sand Creek improvements with the understanding that the ultimate design flows will likely be adjusted based on the anticipated Sterling Ranch MDDP and CLOMR/LOMR approvals. The northern portion of Sterling Ranch is immediately downstream of this property. This portion of their development appears to be in the later phases and as such has not yet been analyzed for specific channel improvements. However, per the approved DBPS, similar grade control and check structures are shown in Sterling Ranch within Reach SC-8 as are recommended in Reach SC-9 through the TimberRidge property. Based on these anticipated flows, two proposed roadway crossings of Sand Creek are planned for this site. (Arroya Lane and the proposed east-west connector road) The current crossing of Arroya Lane is with a 60" CMP culvert. Upon development, the proposed crossing may consist of a triple cell 6'x12' CBC to facilitate the conveyance of the 100 yr. flow. This same structure is proposed at the crossing with the collector roadway as well. These facilities, along with all proposed channel improvements would be designed to continue to contain the 100 yr. flows within the current floodplain as defined by the LOMR 08-080541P, unless updated as proposed in the Sterling Ranch MDDP and associated CLOMR/LOMR. Upon final design of these culvert crossings and anticipated channel improvements, further floodplain analysis will be required to either suggest a no-rise certification or prepare an updated CLOMR/LOMR for associated improvements affecting the current 100 yr. floodplain. The Arroya Lane proposed culvert crossing is described in the DBPS as a single 6'x12' concrete box culvert (10 yr.) design. However, based on the DBPS flows, a triple cell 6'x12' box culvert at this location, designed to convey the 100 yr. developed flows. Based on the proposed 100 yr. design we would request this facility be eligible towards this developments drainage fee obligation. (Reference the Drainage and Bridge Fees)

DRAINAGE CRITERIA

Hydrologic calculations were performed using the City of Colorado Springs/El Paso County Drainage Criteria Manual, as revised in November 1991 and October 1994 with County adopted Chapter 6 and Section 3.2.1 of Chapter 13 of the City of Colorado Springs/El Paso County Drainage Criteria Manual as revised in May 2014. The overall pre-development design model was calculated using PondPack V8i with time of concentrations estimated using NRCS Unit Hydrograph procedures described in the DCM based upon the hydrologic soil type and runoff ARC II curve numbers (CN) chart (Table 6-10) with a 24 hour NRCS Type II distribution. Individual on-site developed basin design used for inlet sizing and storm system routing was calculated using the Rational Method. Runoff Coefficients are based on the imperviousness of the particular land use and the hydrologic soil type in accordance with Table 6-6. The average rainfall intensity, by recurrence interval found in the Intensity-Duration-Frequency (IDF) curves in Figure 6-5. (See Appendix)

FLOODPLAIN STATEMENT

Portions of this site are located within a floodplain as determined by the Flood Insurance Rate Maps (F.I.R.M.) Map Number 08041C 0535F and the previously mentioned LOMR 08-08-0541P both with effective date of July 23, 2009. (See Appendix).

DRAINAGE AND BRIDGE FEES

Any applicable fees shall be provided in the Final Drainage Report(s) prior to final plat recordation of any development within this site. The following represents the anticipated overall fees for this site:

Sand Creek Drainage Basin

This site lies entirely within the Sand Creek Drainage Basin boundaries.

The fees are calculated using the following impervious acreage method approved by El Paso County. The Retreat at TimberRidge site has a total area of 234.1 acres (including the 10 lots north of Arroya Lane which are not a part of this report) with the following different land uses proposed:

22.4 Ac.	Sand Creek Drainage corridor – Basins F1 and F2)
94.8 Ac.	2.5 Ac. lots
13.4 Ac.	1.0 Ac. lots
42.8 Ac.	1/3 Ac. lots
24.4 Ac.	1/4 Ac. lots

The percent imperviousness for this subdivision is calculated as follows:

Fees for Sand Creek Drainage Corridor

(Per El Paso County Percent Impervious Chart: 2%)

22.4 Ac. x 2% = **0.45 Impervious Ac.**

Fees for 2.5 Ac. lots

(Per El Paso County Percent Impervious Chart: 11% with 25% fee reduction for 2.5 ac. lots planned)

94.8 Ac. x 11% x 75% = **7.82 Impervious Ac.**

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Fees for 1.0 Ac. lots

(Per El Paso County Percent Impervious Chart: 20%)

13.4 Ac. x 20% = **2.68 Impervious Ac.**

Fees for 1/3 Ac. lots

(Per El Paso County Percent Impervious Chart: 30%)

42.8 Ac. x 30% = **12.84 Impervious Ac.**

Fees for 1/4 Ac. lots

(Per El Paso County Percent Impervious Chart: 40%)

24.4 Ac. x 40% = **9.76 Impervious Ac.**

Total Impervious Acreage: 33.55 Imp. Ac.

The following calculations are based on the 2018 drainage/bridge fees:

ESTIMATED FEE TOTALS (prior to reduction):

Bridge Fees

$ 5,210.00 x 33.55 Impervious Ac. = $ 174,795.50

Drainage Fees

$ 17,197.00 x 33.55 Impervious Ac. = $ 576,959.35

Per the ECM 3.10.4a and 3.10.5.a, this development requests a reduction of drainage fees based on the on-site full spectrum detention/SWQ facilities and regional channel improvements for this stretch of Sand Creek as shown in the DBPS. The following facilities within the Sand Creek Drainage Basin seem to meet the criteria for this reduction:

Detention Pond B	5.3 ac-ft. full spectrum	$ 50,000 x 50% =	$ 25,000.00
Detention Pond C	5.3 ac-ft. full spectrum	$ 50,000 x 50% =	$ 25,000.00
Detention Pond D	5.3 ac-ft. full spectrum	$ 90,000 x 50% =	$ 45,000.00
Triple Cell 6'x12' CBC Crossing Arroya Lane		$ 250,000 =	$ 250,000.00
Sand Creek Channel Improvements per DBPS		$ 175,000 =	$ 175,000.00

(Exact facility costs provided with final drainage report(s))

ESTIMATED FEE TOTALS (with reduction):

Bridge Fees

$ 5,210.00 x 33.55 Impervious Ac. = $ 174,795.50

Drainage Fees

$ 576,959.35 - 520,000.00 = $ 56,959.35

SUMMARY

The proposed Retreat at TimberRidge Preliminary Plan is within the Sand Creek Drainage Basin. Recommendations are made within this report concerning necessary improvements that may be required as a result of development of this property. The points of storm water release from the proposed site are required to be at or below the calculated historic flow quantities. The development of the proposed site does not significantly impact any downstream facility or property to an extent greater than that which currently exists in the 'historic' conditions. All drainage facilities within this report were sized according to the Drainage Criteria Manuals and the full-spectrum storm water quality requirements. Upon development of the individual parcels within the site, separate Final Drainage Reports will be required to be submitted and approved by El Paso County that details all storm systems, pond design and fee calculation.

PREPARED BY:

Classic Consulting Engineers & Surveyors, LLC

Marc A. Whorton, P.E.
Project Manager

maw/252000/MDDP.doc

REFERENCES

1. City of Colorado Springs/County of El Paso Drainage Criteria Manual as revised in November 1991 and October 1994 with County adopted Chapter 6 and Section 3.2.1 of Chapter 13 of the City of Colorado Springs/El Paso County Drainage Criteria Manual as revised in May 2014.

2. "Urban Storm Drainage Criteria Manual Volume 1, 2 & 3" Urban Drainage and Flood Control District, dated January 2016.

3. "Final Drainage Report for Forest Gate Subdivision" Law & Mariotti Consultants, Inc. dated October 2004.

4. "Sand Creek Drainage Basin Planning Study," Kiowa Engineering Corporation, dated March 1996.

5. "Master Development Drainage Plan for The Retreat at TimberRidge", Classic Consulting, approved March 2018.

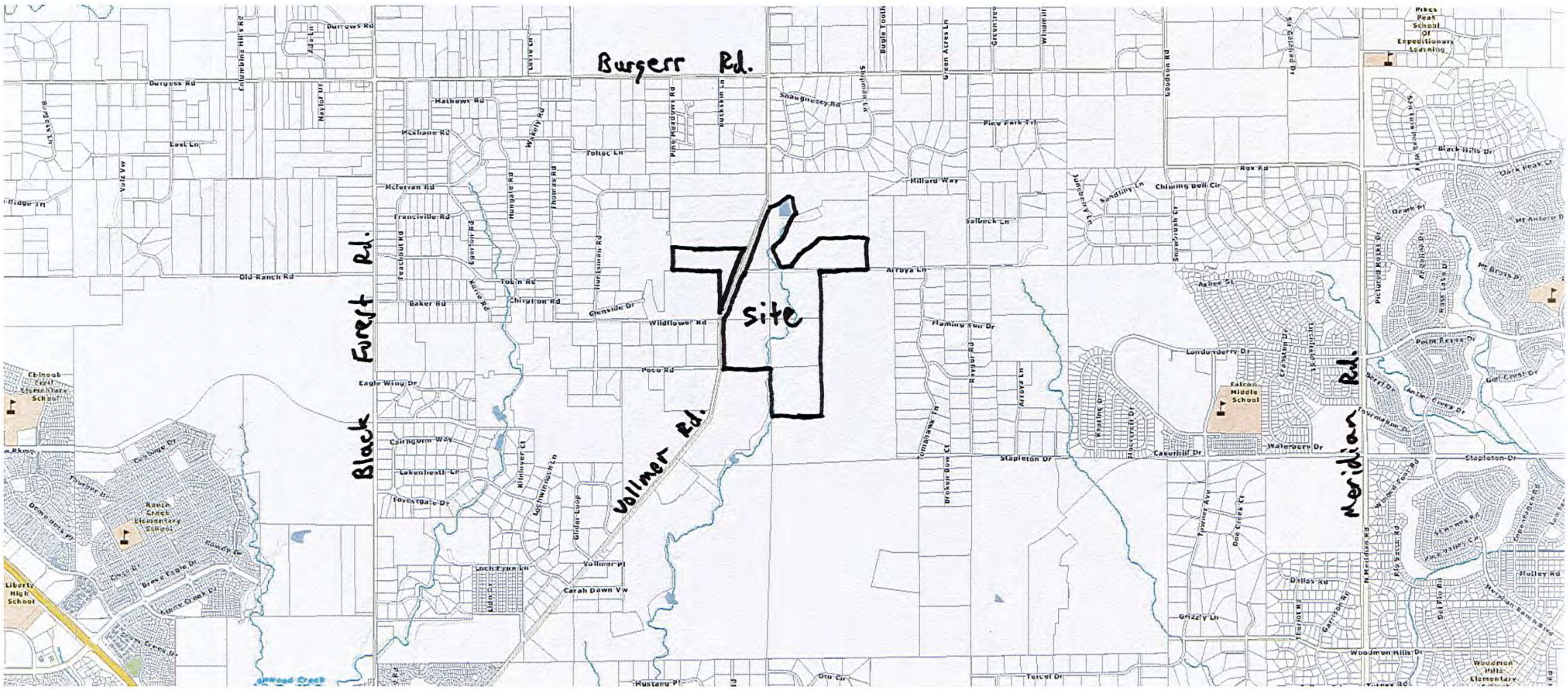
6. "2018 Sterling Ranch MDDP", M&S Civil Consultants, Inc., June 2018

APPENDIX

VICINITY MAP

El Paso County Assessor's Office

Vicinity Map



SOILS MAP (S.C.S SURVEY)

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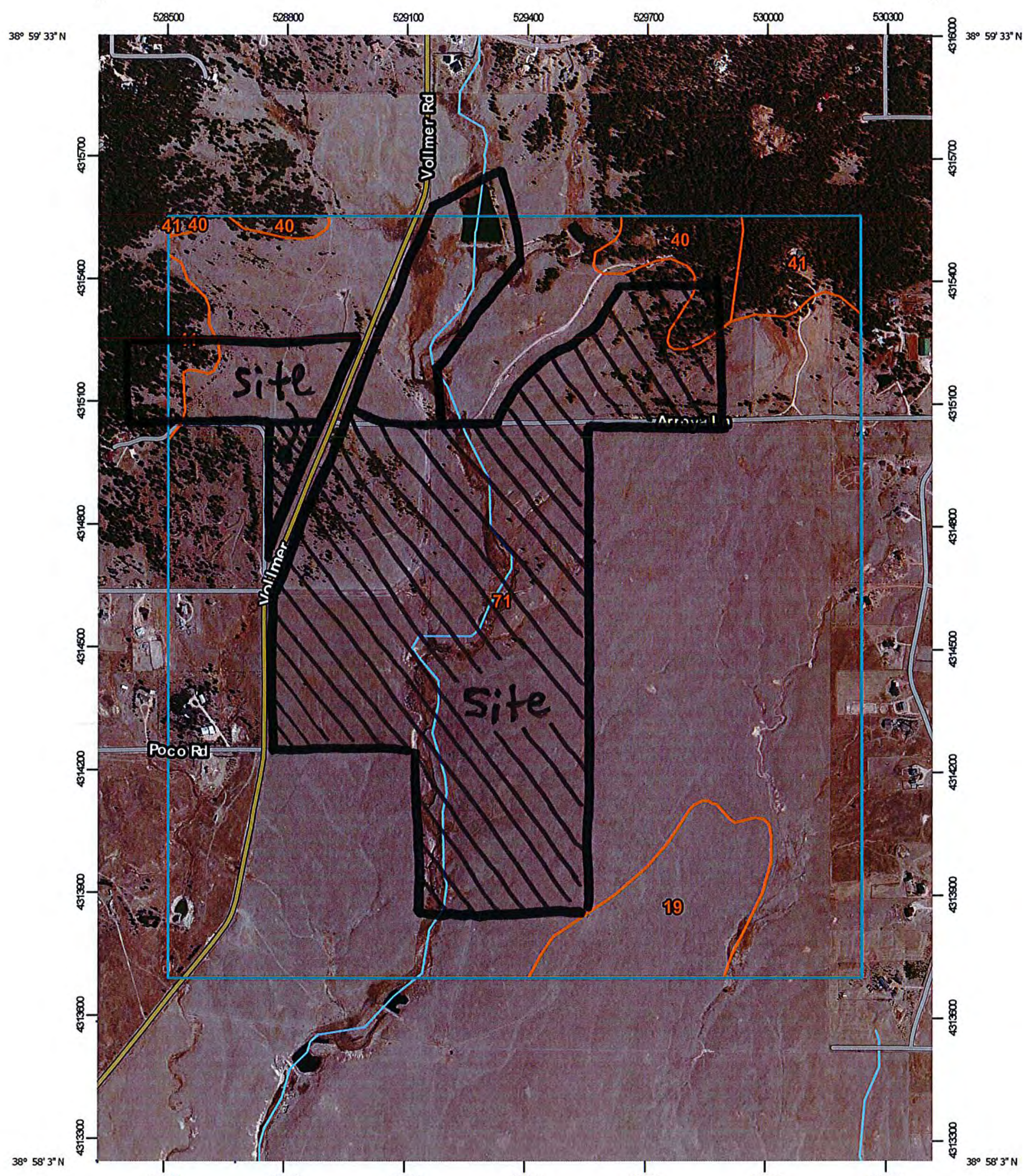
Soil Map—El Paso County Area, Colorado



Map Scale: 1:13,400 if printed on A portrait (8.5" x 11") sheet.

N

0 150 300 600 900 Meters

0 500 1000 2000 3000 Feet

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 14, Sep 23, 2016

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 15, 2011—Sep 22, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

El Paso County Area, Colorado (CO625)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	36.5	4.6%
40	Kettle gravelly loamy sand, 3 to 8 percent slopes	19.0	2.4%
41	Kettle gravelly loamy sand, 8 to 40 percent slopes	24.8	3.1%
71	Pring coarse sandy loam, 3 to 8 percent slopes	719.1	90.0%
Totals for Area of Interest		**799.4**	**100.0%**

El Paso County Area, Colorado

71—Pring coarse sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 369k
Elevation: 6,800 to 7,600 feet
Farmland classification: Not prime farmland

Map Unit Composition

Pring and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pring

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Arkosic alluvium derived from sedimentary rock

Typical profile

A - 0 to 14 inches: coarse sandy loam
C - 14 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Loamy Park (R048AY222CO)
Hydric soil rating: No

Minor Components

Pleasant

Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes

Other soils

Percent of map unit:

Hydric soil rating: No

Data Source Information

Soil Survey Area: El Paso County Area, Colorado

Survey Area Data: Version 14, Sep 23, 2016

El Paso County Area, Colorado

40—Kettle gravelly loamy sand, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 368g
Elevation: 7,000 to 7,700 feet
Farmland classification: Not prime farmland

Map Unit Composition

Kettle and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kettle

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium derived from arkose

Typical profile

E - 0 to 16 inches: gravelly loamy sand
Bt - 16 to 40 inches: gravelly sandy loam
C - 40 to 60 inches: extremely gravelly loamy sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

Pleasant

Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 14, Sep 23, 2016

El Paso County Area, Colorado

41—Kettle gravelly loamy sand, 8 to 40 percent slopes

Map Unit Setting

National map unit symbol: 368h
Elevation: 7,000 to 7,700 feet
Farmland classification: Not prime farmland

Map Unit Composition

Kettle and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kettle

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium derived from arkose

Typical profile

E - 0 to 16 inches: gravelly loamy sand
Bt - 16 to 40 inches: gravelly sandy loam
C - 40 to 60 inches: extremely gravelly loamy sand

Properties and qualities

Slope: 8 to 40 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

Pleasant

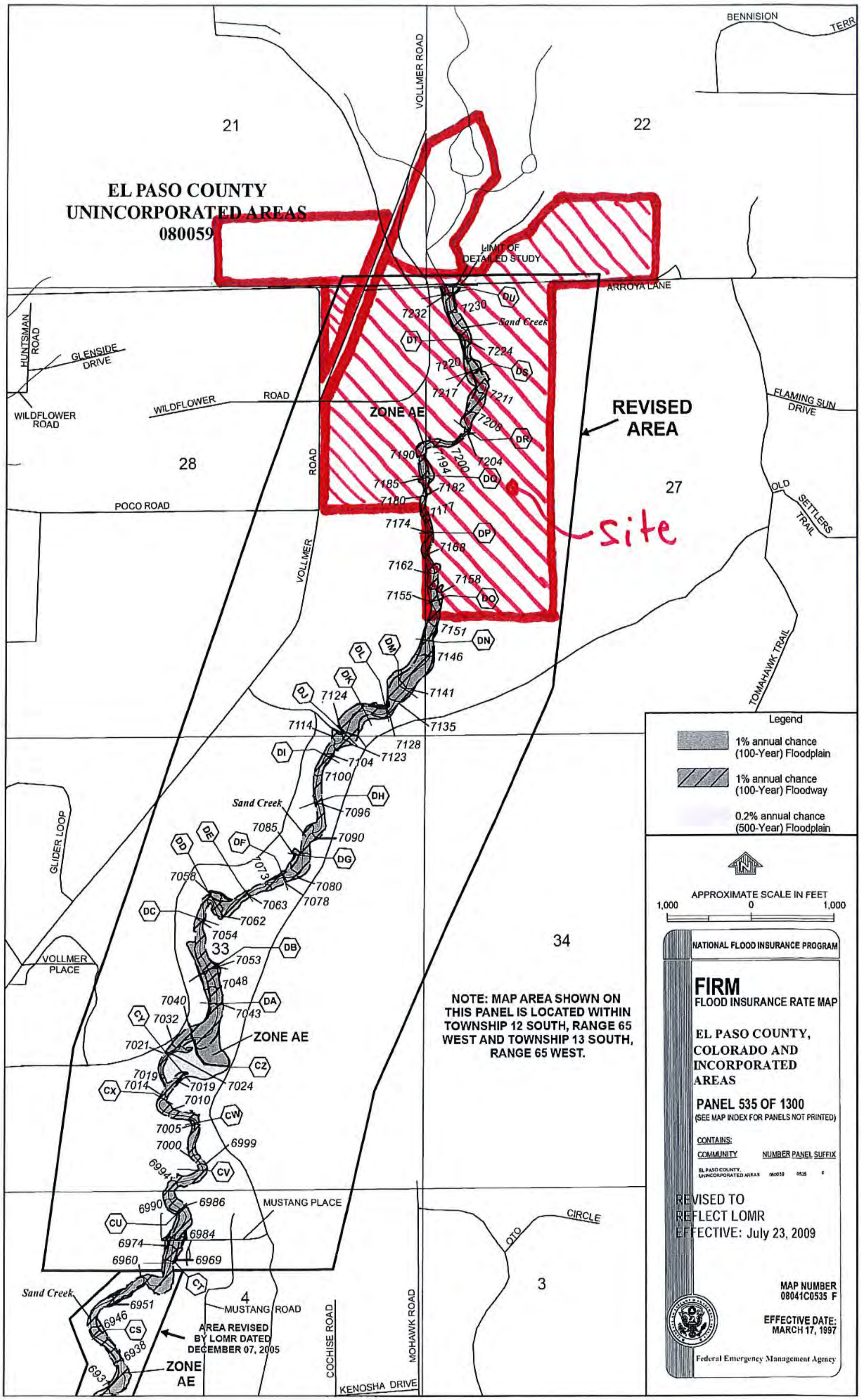
Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 14, Sep 23, 2016

F.E.M.A. MAP / LOMR (08-08-0541P)

CLASSIC
CONSULTING
ENGINEERS & SURVEYORS



BENNISION
TERR
VOLLMER ROAD
21
22
EL PASO COUNTY
UNINCORPORATED AREAS
080059
LIMIT OF DETAILED STUDY
ARROYA LANE
HUNTSMAN ROAD
GLENSIDE DRIVE
WILDFLOWER ROAD
WILDFLOWER ROAD
ZONE AE
REVISED AREA
FLAMING SUN DRIVE
28
27
POCO ROAD
OLD SETTLERS TRAIL
site
Sand Creek
VOLLMER ROAD
TOMAHAWK TRAIL
GLIDER LOOP
VOLLMER PLACE
33
34
ZONE AE
NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 12 SOUTH, RANGE 65 WEST AND TOWNSHIP 13 SOUTH, RANGE 65 WEST.
MUSTANG PLACE
OTO CIRCLE
4
3
MUSTANG ROAD
AREA REVISED BY LOMR DATED DECEMBER 07, 2005
ZONE AE
COCHISE ROAD
MOHAWK ROAD
KENOSHA DRIVE
Legend
1% annual chance (100-Year) Floodplain
1% annual chance (100-Year) Floodway
0.2% annual chance (500-Year) Floodplain
APPROXIMATE SCALE IN FEET
1,000 0 1,000
NATIONAL FLOOD INSURANCE PROGRAM
FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO AND INCORPORATED AREAS
PANEL 535 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)
CONTAINS:
COMMUNITY NUMBER PANEL SUFFIX
EL PASO COUNTY, UNINCORPORATED AREAS 080059 0535 F
REVISED TO REFLECT LOMR
EFFECTIVE: July 23, 2009
MAP NUMBER 08041C0535 F
EFFECTIVE DATE: MARCH 17, 1997
Federal Emergency Management Agency

 | Issue Date: March 6, 2009 | Effective Date: July 23, 2009 | Case No.: 08-08-0541P | LOMR-APP

Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION DETERMINATION DOCUMENT

COMMUNITY AND REVISION INFORMATION		PROJECT DESCRIPTION	BASIS OF REQUEST
COMMUNITY	**El Paso County Colorado (Unincorporated Areas)** **COMMUNITY NO.: 080059**	**NO PROJECT**	**HYDRAULIC ANALYSIS** **NEW TOPOGRAPHIC DATA**
IDENTIFIER	Sand Creek Letter of Map Revision, Mustang Place to Arroya Lane	**APPROXIMATE LATITUDE & LONGITUDE: 38.971, -104.668** **SOURCE:** USGS QUADRANGLE **DATUM:** NAD 27	

ANNOTATED MAPPING ENCLOSURES	ANNOTATED STUDY ENCLOSURES
TYPE: FIRM* NO.: 08041C0535 F DATE: March 17, 1997	DATE OF EFFECTIVE FLOOD INSURANCE STUDY: August 23, 1999 PROFILE(S): 204P(a), 204P(b), 204P(c) AND 204P(d) FLOODWAY DATA TABLE: 5

Enclosures reflect changes to flooding sources affected by this revision.
* FIRM - Flood Insurance Rate Map; ** FBFM - Flood Boundary and Floodway Map; *** FHBM - Flood Hazard Boundary Map

FLOODING SOURCE(S) & REVISED REACH(ES)

Sand Creek - from approximately 360 feet downstream of Mustang Place to just downstream of Arroya Lane

SUMMARY OF REVISIONS

Flooding Source	Effective Flooding	Revised Flooding	Increases	Decreases
Sand Creek	Zone A	Zone AE	YES	YES
	No BFEs*	BFEs	YES	NONE
	No Floodway	Floodway	YES	NONE

* BFEs - Base Flood Elevations

DETERMINATION

This document provides the determination from the Department of Homeland Security's Federal Emergency Management Agency (FEMA) regarding a request for a Letter of Map Revision (LOMR) for the area described above. Using the information submitted, we have determined that a revision to the flood hazards depicted in the Flood Insurance Study (FIS) report and/or National Flood Insurance Program (NFIP) map is warranted. This document revises the effective NFIP map, as indicated in the attached documentation. Please use the enclosed annotated map panels revised by this LOMR for floodplain management purposes and for all flood insurance policies and renewals in your community.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

David N. Bascom

David N. Bascom, Program Specialist
Engineering Management Branch
Mitigation Directorate

Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION DETERMINATION DOCUMENT (CONTINUED)

COMMUNITY INFORMATION

APPLICABLE NFIP REGULATIONS/COMMUNITY OBLIGATION

We have made this determination pursuant to Section 206 of the Flood Disaster Protection Act of 1973 (P.L. 93-234) and in accordance with the National Flood Insurance Act of 1968, as amended (Title XIII of the Housing and Urban Development Act of 1968, P.L. 90-448), 42 U.S.C. 4001-4128, and 44 CFR Part 65. Pursuant to Section 1361 of the National Flood Insurance Act of 1968, as amended, communities participating in the NFIP are required to adopt and enforce floodplain management regulations that meet or exceed NFIP criteria. These criteria, including adoption of the FIS report and FIRM, and the modifications made by this LOMR, are the minimum requirements for continued NFIP participation and do not supersede more stringent State/Commonwealth or local requirements to which the regulations apply.

We provide the floodway designation to your community as a tool to regulate floodplain development. Therefore, the floodway revision we have described in this letter, while acceptable to us, must also be acceptable to your community and adopted by appropriate community action, as specified in Paragraph 60.3(d) of the NFIP regulations.

COMMUNITY REMINDERS

We based this determination on the 1-percent-annual-chance flood discharges computed in the FIS for your community without considering subsequent changes in watershed characteristics that could increase flood discharges. Future development of projects upstream could cause increased flood discharges, which could cause increased flood hazards. A comprehensive restudy of your community's flood hazards would consider the cumulative effects of development on flood discharges subsequent to the publication of the FIS report for your community and could, therefore, establish greater flood hazards in this area.

Your community must regulate all proposed floodplain development and ensure that permits required by Federal and/or State/Commonwealth law have been obtained. State/Commonwealth or community officials, based on knowledge of local conditions and in the interest of safety, may set higher standards for construction or may limit development in floodplain areas. If your State/Commonwealth or community has adopted more restrictive or comprehensive floodplain management criteria, those criteria take precedence over the minimum NFIP requirements.

We will not print and distribute this LOMR to primary users, such as local insurance agents or mortgage lenders; instead, the community will serve as a repository for the new data. We encourage you to disseminate the information in this LOMR by preparing a news release for publication in your community's newspaper that describes the revision and explains how your community will provide the data and help interpret the NFIP maps. In that way, interested persons, such as property owners, insurance agents, and mortgage lenders, can benefit from the information.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

David N. Bascom

David N. Bascom, Program Specialist
Engineering Management Branch
Mitigation Directorate

Federal Emergency Management Agency
Washington, D.C. 20472

LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

We have designated a Consultation Coordination Officer (CCO) to assist your community. The CCO will be the primary liaison between your community and FEMA. For information regarding your CCO, please contact:

Ms. Jeanine D. Petterson
Director, Mitigation Division
Federal Emergency Management Agency, Region VIII
Denver Federal Center, Building 710
P.O. Box 25267
Denver, CO 80225-0267
(303) 235-4830

STATUS OF THE COMMUNITY NFIP MAPS

We will not physically revise and republish the FIRM and FIS report for your community to reflect the modifications made by this LOMR at this time. When changes to the previously cited FIRM panel(s) and FIS report warrant physical revision and republication in the future, we will incorporate the modifications made by this LOMR at that time.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

David N. Bascom

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Engineering Management Branch
Mitigation Directorate

Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION DETERMINATION DOCUMENT (CONTINUED)

PUBLIC NOTIFICATION OF REVISION

PUBLIC NOTIFICATION

FLOODING SOURCE	LOCATION OF REFERENCED ELEVATION	BFE (FEET NGVD 29)		MAP PANEL NUMBER(S)
		EFFECTIVE	REVISED	
Sand Creek	Just upstream of Mustang Place	None	6,984	08041C0535 F
	Just downstream of Arroya Lane	None	7,238	08041C0535 F

Within 90 days of the second publication in the local newspaper, a citizen may request that we reconsider this determination. Any request for reconsideration must be based on scientific or technical data. Therefore, this letter will be effective only after the 90-day appeal period has elapsed and we have resolved any appeals that we receive during this appeal period. Until this LOMR is effective, the revised BFEs presented in this LOMR may be changed.

A notice of changes will be published in the *Federal Register*. A short notice also will be published in your local newspaper on or about the dates listed below. Please refer to FEMA's website at https://www.floodmaps.fema.gov/fhm/Scripts/bfe_main.asp for a more detailed description of proposed BFE changes, which will be posted within a week of the date of this letter.

LOCAL NEWSPAPER Name: *El Paso County News*
Dates: 03/18/09 03/25/09

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

David N. Bascom

David N. Bascom, Program Specialist
Engineering Management Branch
Mitigation Directorate

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					FEET (NGVD)			
Sand Creek (cont'd)								
CA	65,292	164	427	6.1	6,748.7	6,748.7	6,749.4	0.7
CB	66,092	41	223	11.7	6,761.2	6,761.2	6,762.2	1.0
CC	66,247	90	270	9.6	6,773.6	6,773.6	6,773.7	0.1
CD	67,647	50	218	11.9	6,782.6	6,782.6	6,783.3	0.7
CE	68,297	65	284	8.8	6,793.9	6,793.9	6,794.4	0.5
CF	69,147	50	213	11.7	6,804.5	6,804.5	6,804.5	0.0
CG	70,157	50	213	11.7	6,815.1	6,815.1	6,815.3	0.2
CH	70,577	205	347	7.2	6,823.9	6,823.9	6,824.5	0.6
CI	70,627	180	267	9.4	6,826.7	6,826.7	6,827.7	1.0
CJ	70,727	210	340	7.3	6,831.1	6,831.1	6,831.1	0.0
CK	70,807	195	334	7.5	6,832.5	6,832.5	6,832.5	0.0
CL	71,162	90	255	9.8	6,838.0	6,838.0	6,839.0	1.0
CM	71,977	226	503	5.2	6,847.4	6,847.4	6,848.3	0.9
CN	73,052	174	328	7.9	6,861.1	6,861.1	6,861.2	0.1
CO	73,644	237	364	7.1	6,870.2	6,870.2	6,870.2	0.0
CP	75,142	172	324	8.0	6,888.5	6,888.5	6,888.7	0.2
CQ	76,161	109	283	9.2	6,903.5	6,903.5	6,903.7	0.2
CR	77,846	100	272	9.6	6,926.1	6,926.1	6,926.7	0.6
CS	79,187	117	287	9.1	6,944.1	6,944.1	6,944.1	0.0
CT	80,808	142	310	8.4	6,969.2	6,969.2	6,969.2	0.0
CU	81,501	120	342	7.6	6,986.1	6,986.1	6,986.5	0.4
CV	82,281	124	295	8.8	6,997.4	6,997.4	6,997.4	0.0
CW	82,897	64	237	11.0	7,005.3	7,005.3	7,006.1	0.8
CX	83,517	90	266	9.8	7,013.9	7,013.9	7,013.9	0.0
CY	84,087	70	244	10.7	7,024.3	7,024.3	7,024.3	0.0
CZ	84,473	160	322	8.1	7,040.2	7,040.2	7,040.2	0.0

Revised Data From LOMR Dated Dec. 7, 2005

Revised Data

[1] Feet Above Confluence With Fountain Creek

REVISED TO
REFLECT LOMR
EFFECTIVE: July 23, 2009

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY
EL PASO COUNTY, CO
AND INCORPORATED AREAS

FLOODWAY DATA

SAND CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					FEET (NGVD)			
Sand Creek (cont'd)								
DA	85,073	139	456	5.7	7,043.0	7,043.0	7,043.1	0.1
DB	85,483	170	328	7.9	7,053.4	7,053.4	7,053.5	0.1
DC	86,103	100	274	9.5	7,054.4	7,054.4	7,054.4	0.0
DD	86,673	197	434	6.0	7,061.7	7,061.7	7,062.0	0.3
DE	87,073	83	270	9.6	7,068.2	7,068.2	7,068.3	0.1
DF	87,573	98	325	8.0	7,077.7	7,077.7	7,077.9	0.2
DG	88,003	135	304	8.6	7,085.1	7,085.1	7,085.1	0.0
DH	88,738	89	263	9.9	7,096.9	7,096.9	7,096.9	0.0
DI	89,303	74	249	10.4	7,104.1	7,104.1	7,104.3	0.2
DJ	89,663	143	309	8.4	7,123.2	7,123.2	7,123.2	0.0
DK	90,058	140	426	6.1	7,125.1	7,125.1	7,125.2	0.1
DL	90,348	102	276	9.4	7,127.6	7,127.6	7,127.8	0.2
DM	90,698	300	398	6.5	7,141.0	7,141.0	7,141.0	0.0
DN	91,388	120	292	8.9	7,148.5	7,148.5	7,148.6	0.1
DO	91,868	105	313	8.3	7,155.2	7,155.2	7,155.9	0.7
DP	92,748	65	239	10.9	7,173.8	7,173.8	7,173.8	0.0
DQ	93,468	117	288	9.0	7,184.6	7,184.6	7,184.6	0.0
DR	94,448	81	260	10.0	7,204.5	7,204.5	7,204.6	0.1
DS	95,343	100	274	9.5	7,216.8	7,216.8	7,217.2	0.4
DT	95,723	77	252	10.3	7,224.2	7,224.2	7,224.3	0.1
DU	96,333	90	266	9.8	7,232.5	7,232.5	7,233.0	0.5

[1] Feet Above Confluence With Fountain Creek

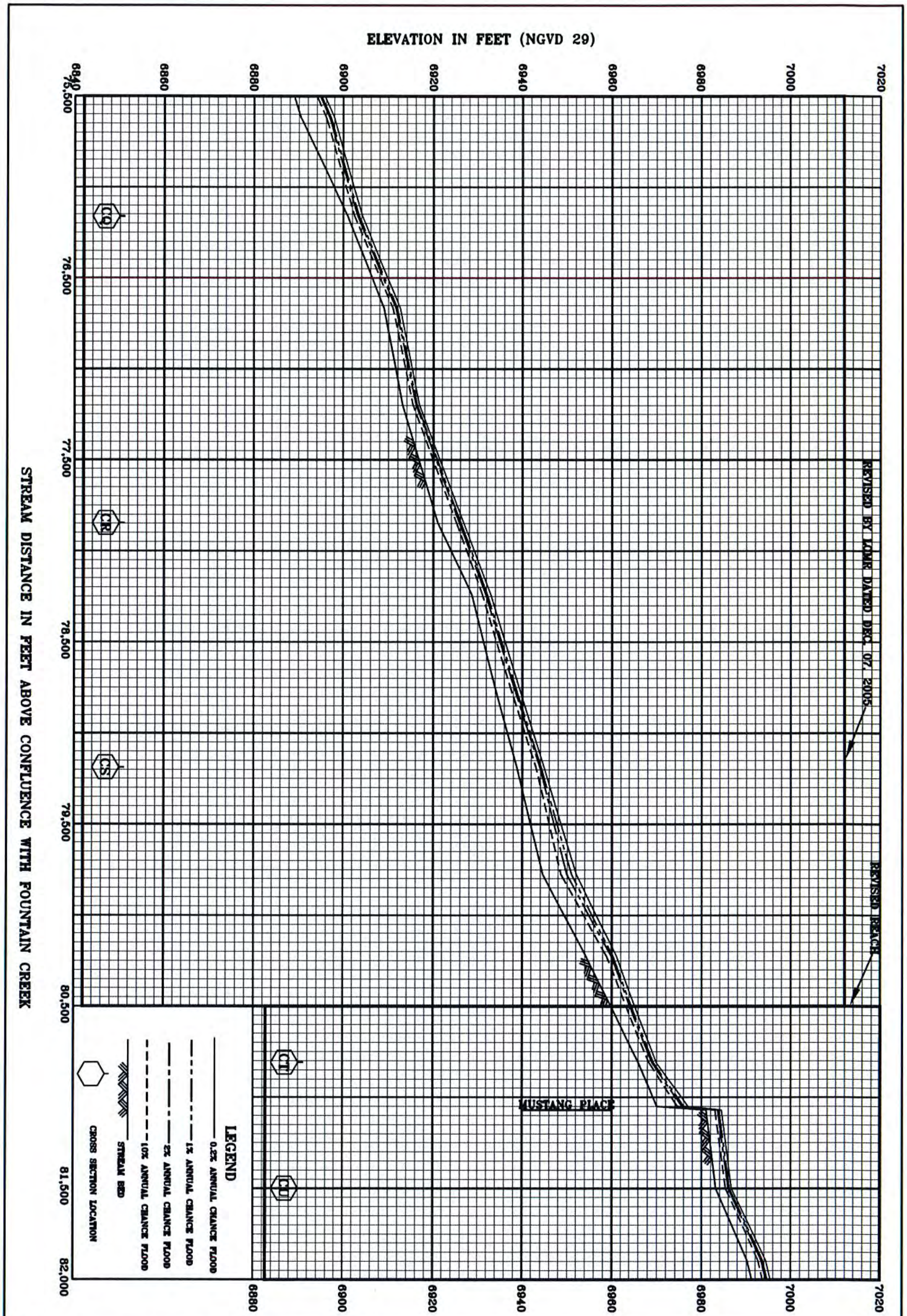
REVISED TO
REFLECT LOMR
EFFECTIVE: July 23, 2009

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY
EL PASO COUNTY, CO
AND INCORPORATED AREAS

FLOODWAY DATA

SAND CREEK



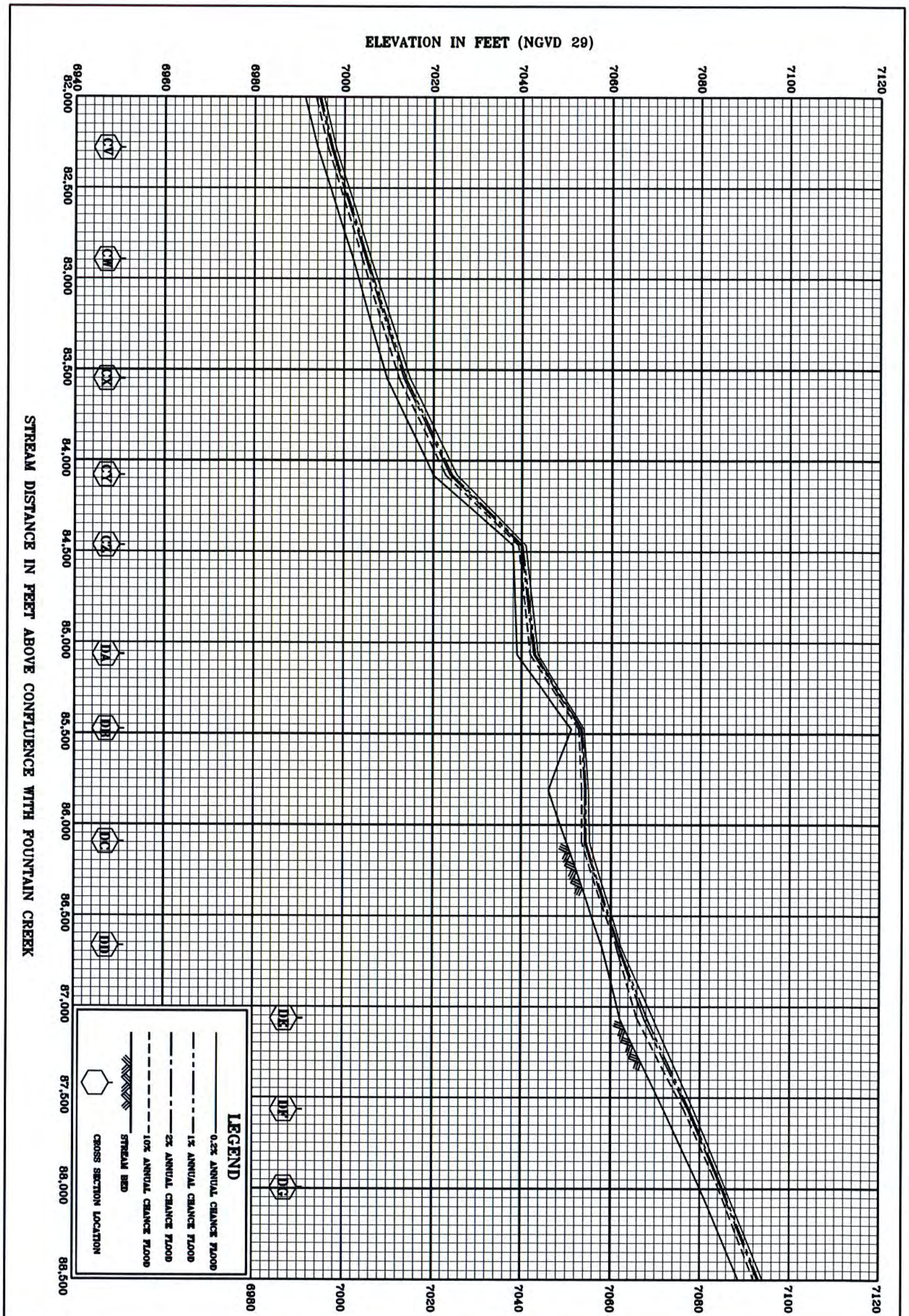
FEDERAL EMERGENCY MANAGEMENT AGENCY

EL PASO COUNTY, CO
AND INCORPORATED AREAS

REVISED TO
REFLECT LOMR
EFFECTIVE: July 23, 2009

FLOOD PROFILES

SAND CREEK



FEDERAL EMERGENCY MANAGEMENT AGENCY

EL PASO COUNTY, CO
AND INCORPORATED AREAS

FLOOD PROFILES

REVISED TO
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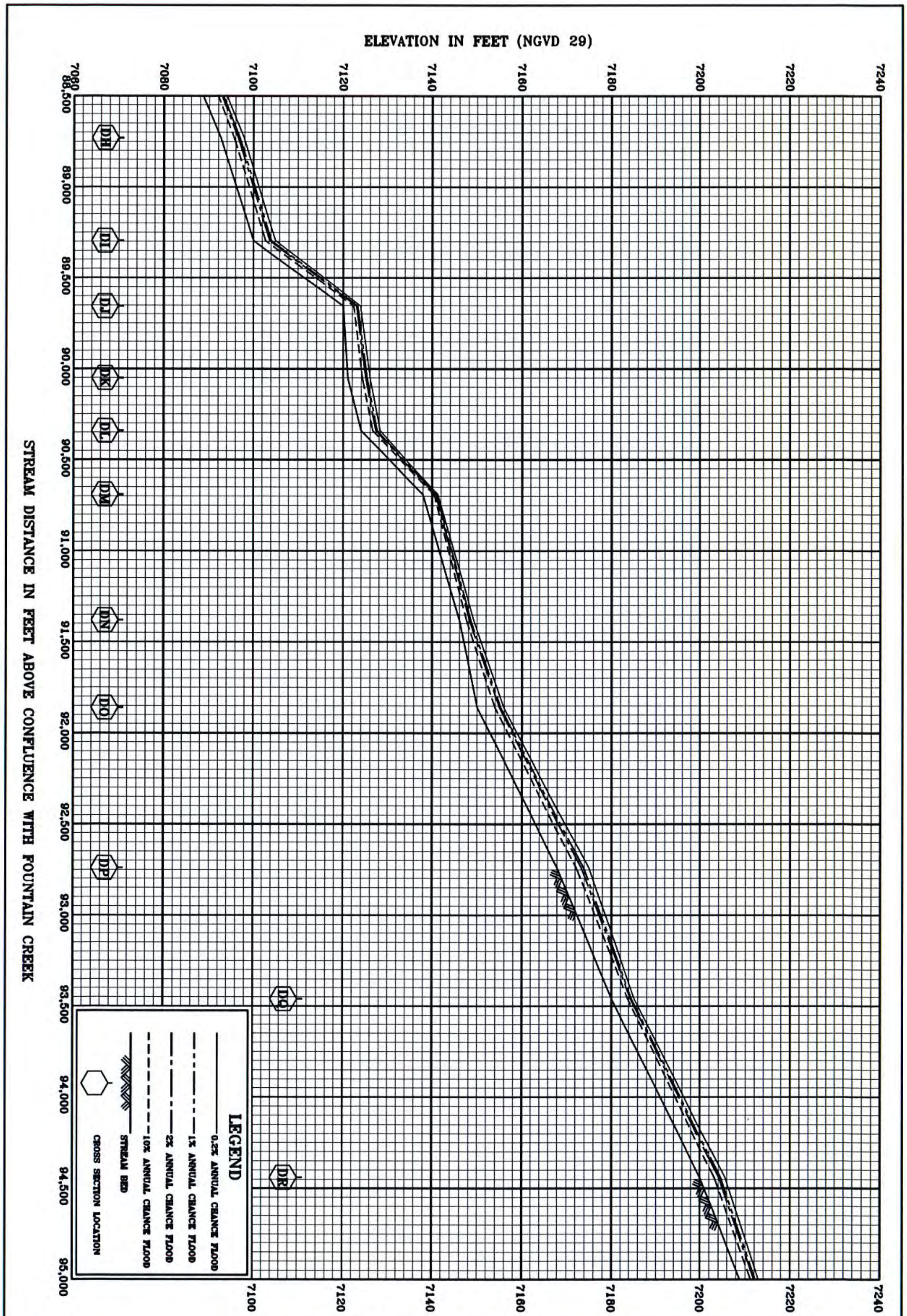
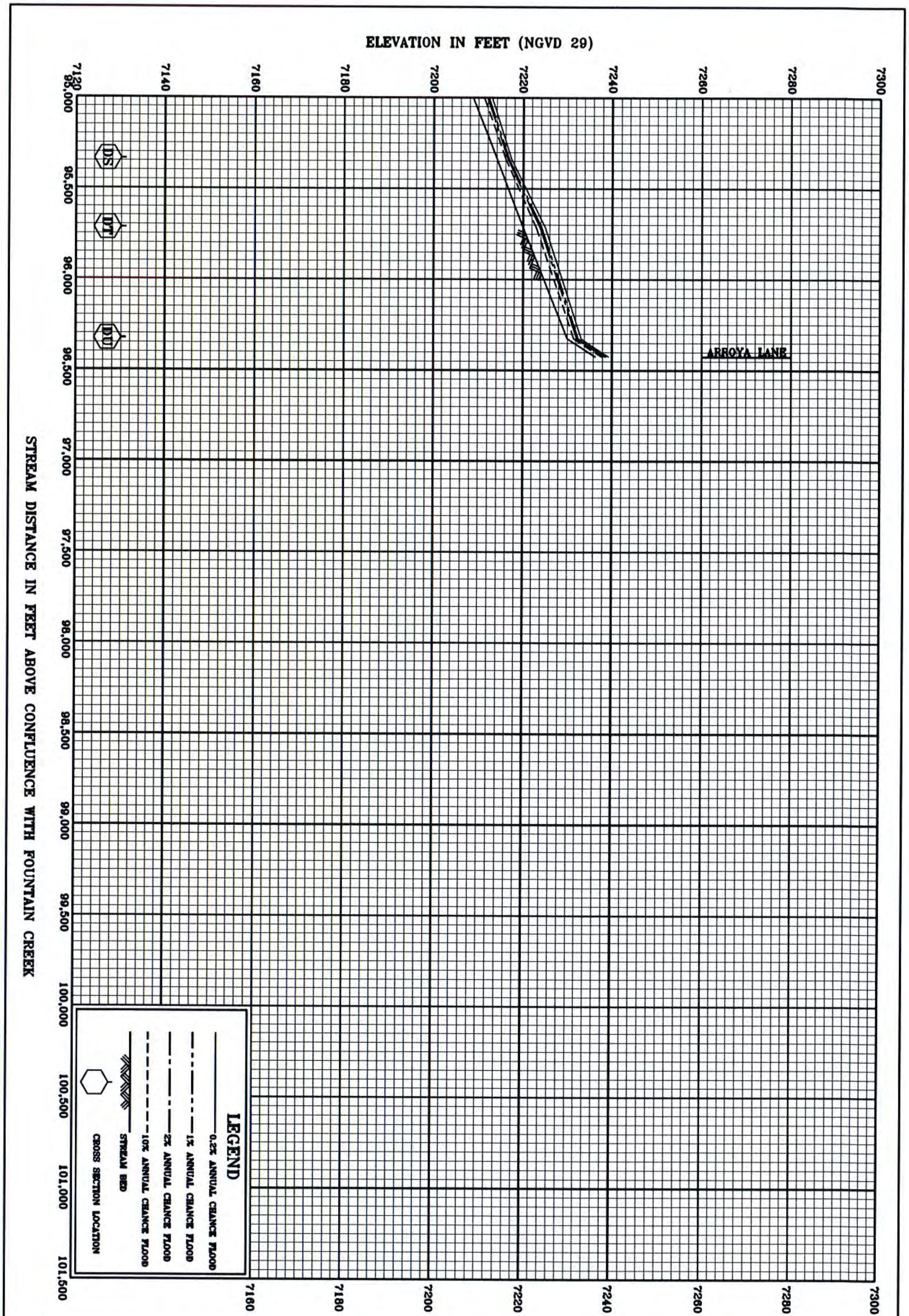
EFFECTIVE: July 23, 2009

SAND CREEK

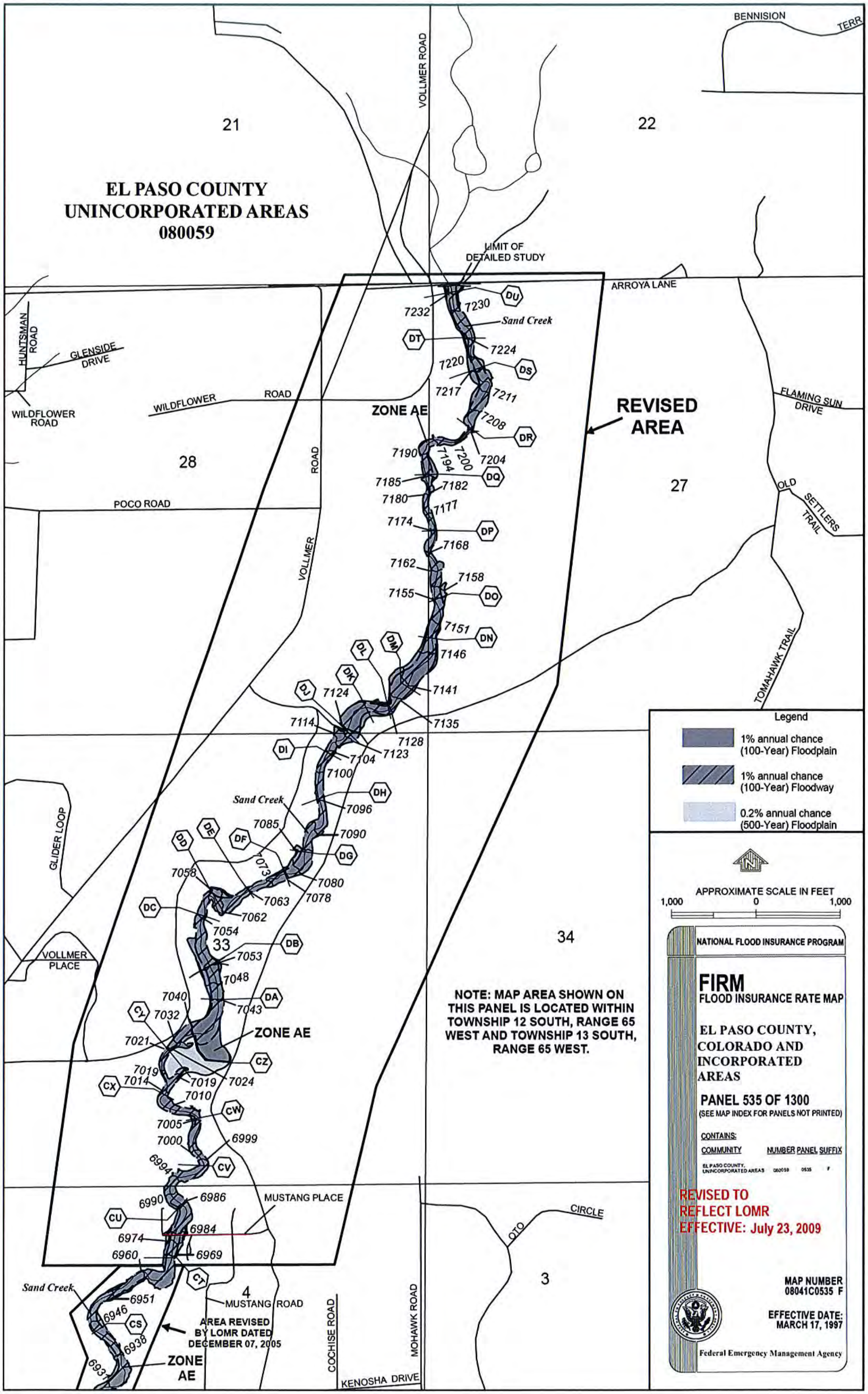


FEDERAL EMERGENCY MANAGEMENT AGENCY EL PASO COUNTY, CO AND INCORPORATED AREAS	REVISED TO REFLECT LOMR EFFECTIVE: July 23, 2009	FLOOD PROFILES SAND CREEK

204P(c)



FEDERAL EMERGENCY MANAGEMENT AGENCY	FLOOD PROFILES
EL PASO COUNTY, CO AND INCORPORATED AREAS	REVISED TO REFLECT LOMR EFFECTIVE: July 23, 2009 — SAND CREEK


EL PASO COUNTY
UNINCORPORATED AREAS
080059
21
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VOLLMER ROAD
BENNISION TERR
LIMIT OF DETAILED STUDY
ARROYA LANE
HUNTSMAN ROAD
GLENSIDE DRIVE
WILDFLOWER ROAD
WILDFLOWER ROAD
FLAMING SUN DRIVE
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VOLLMER ROAD
TOMAHAWK TRAIL
GLIDER LOOP
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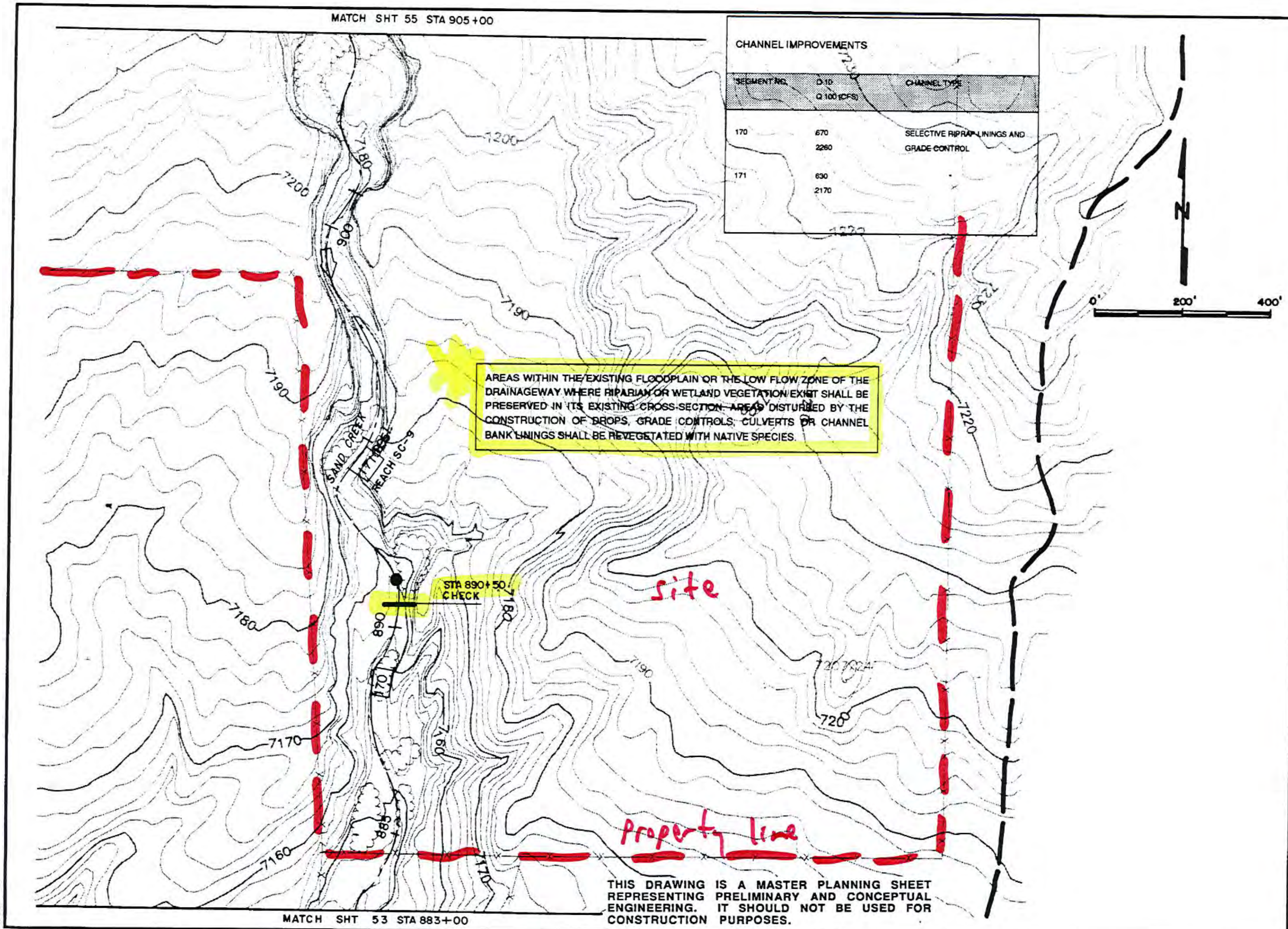
MOHAWK ROAD
KENOSHA DRIVE
OTO CIRCLE
Sand Creek
ZONE AE
REVISED AREA
AREA REVISED BY LOMR DATED DECEMBER 07, 2005
NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 12 SOUTH, RANGE 65 WEST AND TOWNSHIP 13 SOUTH, RANGE 65 WEST.
Legend
1% annual chance (100-Year) Floodplain
1% annual chance (100-Year) Floodway
0.2% annual chance (500-Year) Floodplain
APPROXIMATE SCALE IN FEET
1,000 0 1,000
NATIONAL FLOOD INSURANCE PROGRAM
FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO AND INCORPORATED AREAS
PANEL 535 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)
CONTAINS:
COMMUNITY NUMBER PANEL SUFFIX
REVISED TO REFLECT LOMR EFFECTIVE: July 23, 2009
MAP NUMBER 08041C0535 F
EFFECTIVE DATE: MARCH 17, 1997
Federal Emergency Management Agency

RECOMMENDATIONS PER SAND CREEK DBPS

CLASSIC
CONSULTING
ENGINEERS & SURVEYORS



CHANNEL IMPROVEMENTS

SEGMENT NO.	D 10 / Q 100 (CFS)	CHANNEL TYPE
170	670 / 2260	SELECTIVE RIPRAP LININGS AND GRADE CONTROL
171	630 / 2170	

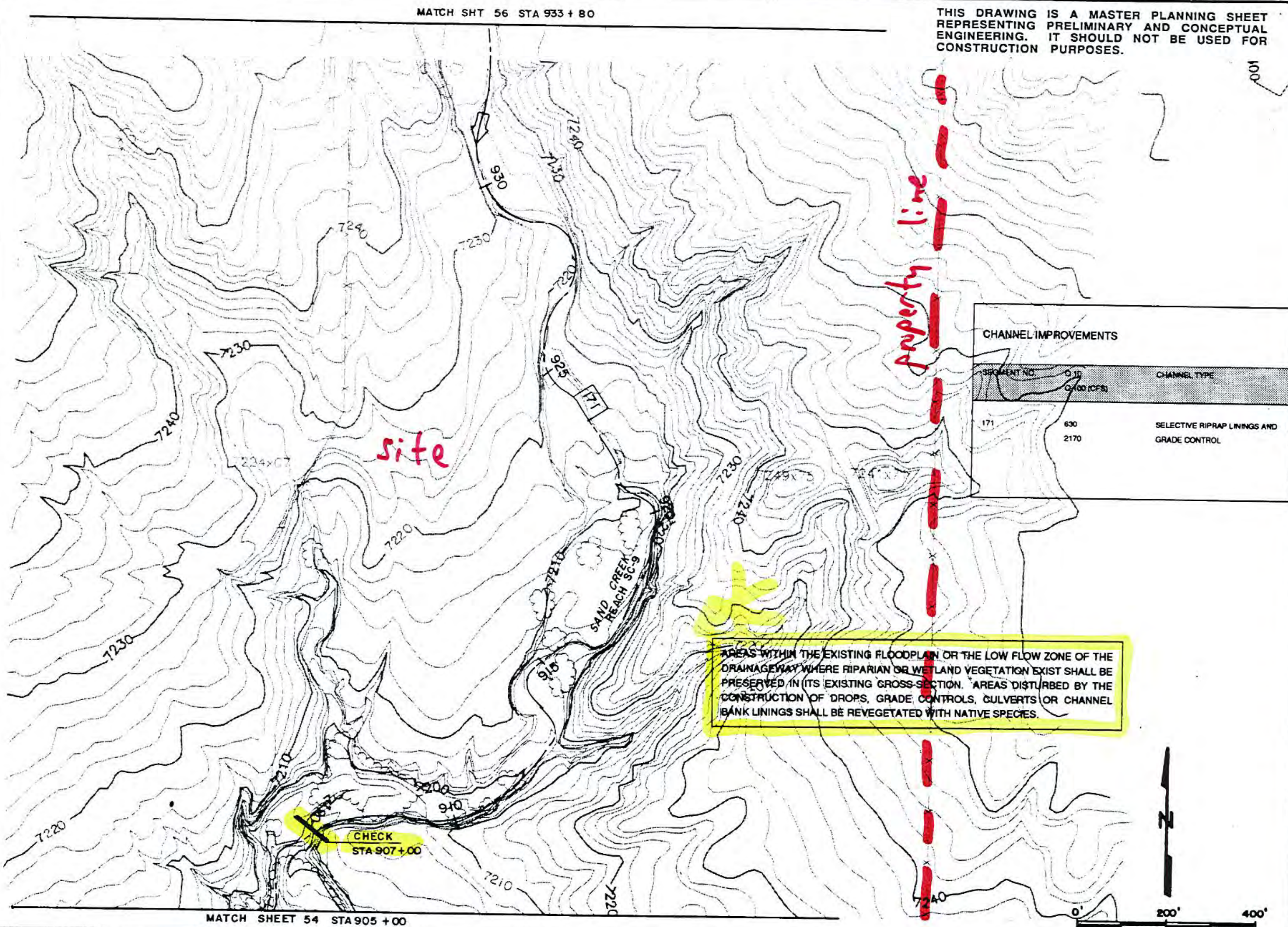
Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308

SAND CREEK DRAINAGE BASIN PLANNING STUDY

PRELIMINARY DESIGN PLANS

Project No.	90-04-09
Date:	9/92
Design:	RNW
Drawn:	EAK
Check:	RNW
Revisions:	

THIS DRAWING IS A MASTER PLANNING SHEET REPRESENTING PRELIMINARY AND CONCEPTUAL ENGINEERING. IT SHOULD NOT BE USED FOR CONSTRUCTION PURPOSES.



CHANNEL IMPROVEMENTS

SEGMENT NO.	Q 10 / Q 100 (CFS)	CHANNEL TYPE
171	630 2170	SELECTIVE RIPRAP LININGS AND GRADE CONTROL

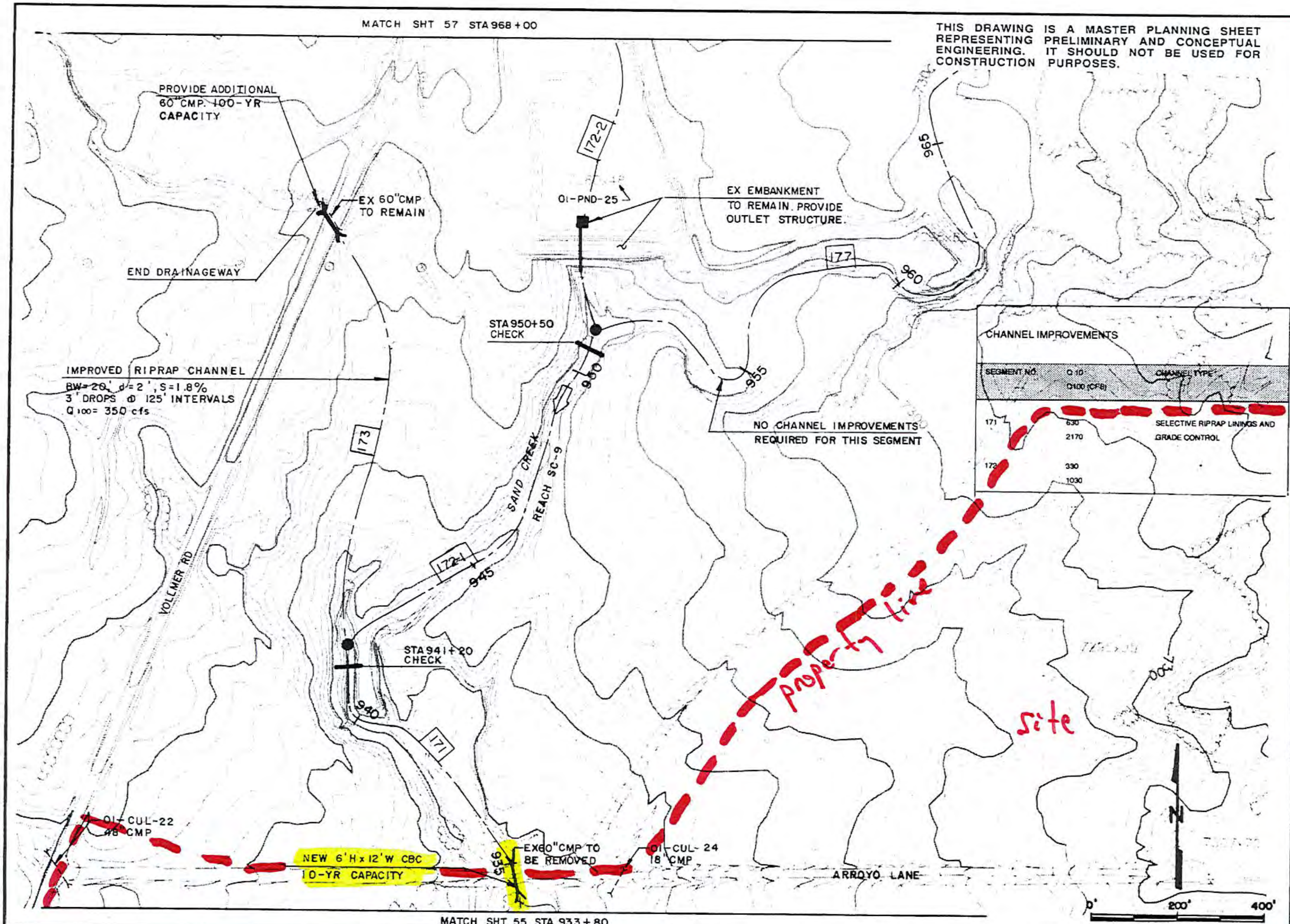
AREAS WITHIN THE EXISTING FLOODPLAIN OR THE LOW FLOW ZONE OF THE DRAINAGEWAY WHERE RIPARIAN OR WETLAND VEGETATION EXIST SHALL BE PRESERVED IN ITS EXISTING CROSS-SECTION. AREAS DISTURBED BY THE CONSTRUCTION OF DROPS, GRADE CONTROLS, CULVERTS OR CHANNEL BANK LININGS SHALL BE REVEGETATED WITH NATIVE SPECIES.

Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308

SAND CREEK DRAINAGE BASIN PLANNING STUDY
PRELIMINARY DESIGN PLANS

Project No. 90-04-09
Date: 9/92
Design: RNW
Drawn: EAK
Check: RNW
Revisions:

55



Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308

SAND CREEK DRAINAGE
BASIN PLANNING STUDY
PRELIMINARY DESIGN PLANS

Project No 90-04-09
Date: 9/92
Design: RNW
Drawn: EAK
Check: RNW
Revisions:

56

VI. DEVELOPMENT OF ALTERNATIVES AND RECOMMENDED PLAN

The concepts which are available for handling stormwater runoff within the Sand Creek basin have been presented and discussed in detail in the Sand Creek Drainage Basin Planning Study Development of Alternatives Report and the draft East Fork Sand Creek Drainage Basin Planning Study. The process of combining the various channel treatment options, detention schemes and roadway crossing structures into a contiguous plan for all of the reaches is presented in this chapter of the report. As a result of the evaluation of the flood control, environmental, open space, operations and maintenance, and implementation concerns within the Sand Creek basin, the following concepts were identified as having sufficient feasibility to warrant further evaluation and review:

Channel Concepts:	Floodplain Preservation Channelization, 10- or 100-year Selective Improvements
Detention:	Regional detention systems

Channel Concepts: The channel concepts listed above have been evaluated with respect to the parameters listed in the previous chapter. A concept's feasibility depends upon its impact, positive or negative, upon the evaluation parameters. ***The floodplain preservation*** concept has been considered to be the same as the ***"do-nothing"*** alternative. The floodplain preservation concept would involve the regulation of the floodplain limits, generally as depicted on the effective City of Colorado Springs and El Paso County Flood Insurance Rate Maps. Regulation of the floodplain so that future encroachments are minimized and the floodproofing of structures which are currently within the 100-year floodplain would presumably be the methods used to address the flood hazard concerns along Sand Creek. In the upper reaches of Sand Creek, the ownership or easements associated with the 100-year floodplain (or greater limits to allow for an erosion buffer zone) would be a primary issue in regards to implementation of such a concept. Detention in the upper reaches of the basin Sand Creek basin and in the East Fork Sand Creek basin will maintain the 100-year floodplain at existing limits within the lower reaches of Sand Creek. The "do-nothing" concept is feasible wherever the existing drainageway improvements are of adequate capacity to convey flood flows. ***Channelization*** would involve the lining of the Creek into a more confined flow area, and could be done for either the ***100-year or 10-year*** flood discharges. Several typical channel concepts have been presented. The primary bank lining material would probably be riprap. Grade control and/or drop structures would be required in a channelization concept so that the flood velocities could be controlled to a level requiring medium to heavy riprap. Soil cement offers an alternative to riprap and concrete for the construction of drops or grade control structures. Revegetation would occur wherever the native vegetation was disturbed by the channel construction. Willows at the toe of the riprap banks would be a minimum replacement. ***Selective linings*** would involve the construction of grade controls, drop structures, bank linings, storm sewer outlet control structures selectively sited to resist stream erosion or to reduce potential flooding damages. Areas of future concern such as at the outside bends of the creek, or at the outlets of bridges or culverts which will cross the drainageway would be subject to selective improvements.

Detention Concepts: The two general detention concepts evaluated were onsite versus regional detention. During the evaluation process, it was determined that the onsite detention concept has a low feasibility relative to a regional concept. This is because, (1) onsite detention has a unpredictable impact upon lowering peak discharges from urbanized areas to historic conditions (reference, Urbonas and Glidden, "Effect of Detention on Flows in Major Drainageways" ASCE Water Forum '81, 1981), (2) an onsite concept has little impact upon maintaining or enhancing water quality, (3) the number of onsite detention basins, their locations and size cannot be accurately determined in the undeveloped portions of the basin at this time, and (4) onsite detention would present a substantial maintenance responsibility to the jurisdictions involved. For these reasons the onsite detention concept was eliminated and regional detention basin concepts were developed. In the analysis of the channel concepts, regional detention facilities were assumed to be in place.

Channel Alternatives

Presented on Table VI-1 is a matrix of channel alternatives which were evaluated. All reaches of Sand Creek and the East Fork of Sand Creek had at least three alternatives analyzed. Presented on Tables VI-2 through VI-6 are comparative evaluations of the floodplain preservation (do-nothing), channelization and selective lining concepts, for the mainstem Sand Creek basin, by reach. The purpose of the evaluation process was to identify the relative advantages and disadvantages of each concept within each reach.

100-year peak discharge to levels. This will allow for the channel improvements to be constructed within the existing right-of way.

Reaches SC-5 and SC-6: A selective channel improvement concept has been recommended for these reaches. Detention in Reach SC-8 of the basin will maintain flows to historic peak discharge levels, however the low flows will increase in frequency and volume. For this reason it has been recommended to provide riprap channel linings at selective locations to at least the 10-year water surface and install grade controls. This will prevent the long-term degradation of the invert. A residual 100-year floodplain will remain and will offer opportunities for habitat replacement and open space preservation. Land adjacent to the drainageway is currently undeveloped or unplatted at this time which makes the feasibility of implementing this concept greater in comparison to the urbanized reaches of the creek.

Reaches SC-7 and SC-8: A selective improvement concept involving the localized lining of channel banks and grade control construction has been recommended for these reaches. The feasibility of this concept stems from the fact that flows will be reduced because of detention. Numerous individual rural ownerships cross the drainageway, however no habitable structures lie within the 100-year floodplain. Because of this, the economic feasibility of channelization concepts is low. Non-structural measures can be used to limit encroachments into floodprone areas. Additionally, the City of Colorado Springs Comprehensive plan recommends that the floodplains be maintained as open space. Potential habitat disturbances can be avoided with a selective plan, or simply replaced as part of the particular construction activity which caused the disturbance.

Reach SC-9: A floodplain preservation concept has been recommended for this reach. Little increase in urbanization is anticipated in this reach, and for this reason the existing drainageway is expected to remain stable. Localized improvements may be necessary to limit erosion caused by flow concentrations at culverts or storm sewers. Private ownership of the drainageway is anticipated to continue which lower the feasibility of channel concepts which require permanent right-of-ways or easements for construction and maintenance.

Reaches WF-1 through WF-3: A 100-year channel concept has been recommended for these reaches primarily because of the potential for flooding damages. Several roadway crossings are in need of replacement because of the flood hazard the constrictions create. Some open space enhancement potential exists for this concept since these reaches have been degraded visually by debris accumulation, bank sloughing and sedimentation. Little opportunity exists for widening the drainageway because the

Development of the Recommended Plan

Presented on Table VI-7 is a matrix representing the recommended plan for each major drainageway reach. The selection of a recommended channel treatment scheme has been based upon the qualitative and quantitative information presented in the Sand Creek Drainage Basin Planning Study Development of Alternatives report and the draft East Fork Sand Creek Drainage Basin Planning Study. Contained within the Technical Addendum to the Sand Creek Drainage Basin Planning Study Development of Alternatives report, is the alternative hydrologic, hydraulic and conceptual cost data used in the evaluation and comparison of each of the alternatives within the mainstem Sand Creek basin.

Discussion of Recommended Plan

The recommendation of a particular channel treatment or detention scheme has been based upon the qualitative and quantitative data presented. For each reach the flood hazard, environmental, cost, operations and maintenance and open space aspects of the drainageway were weighed for each alternative concept.

Reach SC-1: For this reach a 10-year channel section was recommended for further evaluation. With the implementation of regional detention in the upper basin, the 100-year floodplain will generally be confined within the existing banks, excepting at roadway crossings lacking 100-year capacity. It is recommended that a 10-year low flow channel be constructed within the invert of the existing channel through the construction of benches and sand bars. As urbanization continues towards the full development scenario, the base flow and annual flows will increase in volume and frequency. For this reason, the low flow area must be stabilized to protect the existing channel banks from undermining and subsequent bank sloughing. The benched areas offer an opportunity for habitat replacement and enhancement. At some locations within this reach, a residual 100-year floodplain will remain which will have to be regulated. The residual 100-year floodplain offers some potential for open space preservation and enhancement. This is particularly true in the portion of the reach downstream of Hancock Expressway.

Reaches SC-2 through SC-4: A 100-year channel concept has been recommended primarily because of the potential for flooding damages which exists in these reaches. Habitat disturbed by the construction of channel linings and grade control structures could be replaced along the channel toes and on the overbanks. The replacement of the Waynoka Road crossing will reduce the potential for flood damages in areas adjacent to these roadways. The detention within the upper reaches will limit the

VII. PRELIMINARY DESIGN

The results of the preliminary design analysis are summarized in this section. The alternative improvements have been quantitatively and qualitatively evaluated, and presented to the City of Colorado Springs and other interested agencies and individuals. Field review of specific areas of concern have been conducted in order to refine the channel treatments suggested for use along Sand Creek, East Fork Sand Creek and their major tributaries. The preliminary plan for the recommended alternative is shown on the drawings contained at the rear of this report.

Criteria

The City of Colorado Springs, El Paso County Drainage Criteria Manual was used in the development of the typical sections and plans for the major drainageways within the Basin. The City/County manual was supplemented by various criteria manuals with more specific application. These were:

1. "Design Guidelines and Criteria for Channels and Hydraulic Structures on Sandy Soils," prepared by Simons, Li & Associates, Inc., 1981.

2. Urban Storm Drainage Criteria Manual, Volumes I, II, and III, prepared by the Urban Drainage and Flood Control District.

Various design plans for roadway and channel improvement projects, either proposed or already constructed were reviewed in order to prepare the preliminary design plans. Specifically, the project design plans for the Las Vegas Street and Galley Road bridge replacement projects were reviewed and the improvements incorporated in the preliminary design. The **proposed** Sand Creek Stabilization Project, AT&SF Railroad to Hancock Expressway and the **proposed** Sand Creek Stabilization Project at Fountain Boulevard design plans have been reviewed and incorporated into the preliminary design plan and profiles.

Hydrology

Presented on Table VII-1 is selected hydrologic data to be used for the sizing of major drainageway improvements within the Basin. **Peak flow rates for the 10- and 100-year frequency incorporating and the selected detention alternatives for the Sand Creek and East Fork Sand Creek Basin are summarized for key points along the major drainageways.** Contained within the The technical addenda of this report contains a complete listing of peak discharges for all the sub-basins, stream segments and design points shown on Exhibit 1.

The sizing the drainageway improvements for the tributaries will need to be verified during the final design and layout of the proposed drainageway facilities. Land development activities may alter the location of design points along the tributaries, and therefore slight alteration in a sub-basin's length, slope and area may occur. The methods outlined in the City/County Drainage Criteria Manual should be applied during final design analysis. The rational method should be used to check the peak flow rates for all tributary drainageways and storm sewers draining areas less than 100 acres in size.

Channels

The recommended channel sections for each reach of drainageway has been outlined in Section VI of this report. In general, the banks of Sand Creek channel, from the confluence with Fountain Creek to the proposed Sand Creek Detention Basin No. 2 are to be lined, or in some cases relined, with riprap to either a 10-year or 100-year flow depth, as shown on the preliminary design plans. Above the Sand Creek Detention Basin No. 2, selectively located riprap bank protection such as at outside bends, at bridge or culvert outlets, and at confluences with side tributaries have been recommended. In conjunction with the selective improvement measures, and the 10-year low flow concept, the 100-year floodplain should be preserved and regulated. Wherever existing bank linings were judged to be adequate, no improvements have been recommended at this time.

For the West Fork Sand Creek, 100-year riprap bank linings have been recommended in order to address the 100-year flooding hazard which exists at numerous locations along the West Fork. The final design improvements shown in the Palmer Park Bridge Replacement project drawings have been incorporated into the preliminary design plans. In the uppermost reaches of the West Fork, a short segment of rectangular concrete channel has been recommended because of right-of-way constraints.

For the Center Tributary of Sand Creek, 100-year riprap lined channels have been recommended from the confluence with East Fork to Platte Avenue. Above Platte Avenue, the existing concrete channels have adequate capacity except where the drainageway channel has yet to be improved. The final design plans for the US 24 Bypass Project, Phase II have been incorporated into the plans. As part of the bypass construction, it is proposed to line the Center Tributary using riprap. The location of the proposed roadway, new crossings, drops and channel as shown on the Phase II Bypass plans have been reflected on the preliminary design drawings.

For the East Fork Sand Creek drainageway, riprap lined channel banks have been recommended for the majority of the reaches. This is mainly because of the high level of development predicted for the basin in the area known as the Banning-Lewis Ranch development. Open space to accommodate the 100-year floodplains should be allowed for as the East Fork Sand Creek drainageways develop. This is consistent with the Banning-Lewis Ranch master development plan which was approved at the time of annexation of this property. Above Woodmen Road, selective channel lining improvements and grade control structures have been recommended.

For the most part the side tributaries have been recommended to be lined with riprap, however there are some locations in the upper basin which have been proposed to be grasslined. The location of the side drainageways should be considered approximate and may very likely be modified in the future because of land development.

The primary criteria used when sizing the proposed channel sections has been velocity. For all riprap lined channels, the average design velocity should be no greater than 9 feet per second. This criteria allows for the use of Type H riprap within the main flow area of the drainageway. For the case of a 10-year channel with an overall floodplain section, limiting the main channel velocity to 9 feet per second will result in overbank velocities in the five feet per second range. At this level of overbank velocity, native vegetation will be able to withstand the erosive forces which might result in a 100-year flow event. Velocities approaching 10 feet per second could occur at constrictions such as at roadway crossings and at culvert outlets.

Drop Structures and Check Structures

Drop and check structures have been sited along Sand Creek in order to slow the channel velocity to the recommended 7 feet per second, and to prevent localized and long-term stream degradation from affecting channel linings and overbanks. In the reaches to be selectively lined, drops and check structures will protect the native vegetation from the detrimental effects of stream invert headcutting. Several types of structures could be considered for the Sand Creek Basin. For channel bottom widths in excess of fifty feet, soil cement or sheet piling drops/checks are feasible. For channels narrower than this, reinforced concrete structures are probably the best alternative. **A maximum drop height of three feet is recommended. The methodology recommended for use when designing vertical structures is contained with Volume II of the Urban Storm Drainage Criteria Manual.**

Detention

The recommended plan calls for the construction of six regional detention basins within the Sand Creek basin, and six regional basins within the East Fork Sand Creek basin. The purpose of the Sand Creek detention basins is to limit peak discharges at Powers Boulevard to existing development condition levels. The detention basins in the upper portions of the Sand Creek basin will keep the majority of the existing channel sections and bridges below Powers Boulevard with adequate flow capacity in the future development condition. The detention basins within the East Fork Sand Creek basin have been sized to maintain the flow outfalling from the Banning-Lewis Ranch property at existing levels. This in turn will help to reduce flow to the mainstem of Sand Creek. The detention basins have been designed to accommodate the 100-year future condition volume without overtopping the overflow spillway. Sand Creek Basin Nos. 2 and 6, and East Fork Sand Creek Basin Nos. 1, 2, and 3 will be classified as jurisdictional structures, and their design and operation would be subject to State Engineer's office criteria. Sand Creek basins number 1 and 3 should be designed so as to take advantage of the adjacent roadway embankments, and therefore classifying as incidental storage and not subject State Engineer's regulations.

At Stetson Hills Boulevard, the roadway embankment has created a 2 acre open water wetland which was identified during the environmental review of the basin. It is recommended that this wetland be preserved. Accordingly, an outlet control structure will have to be constructed to pass the 100-year discharge to the downstream channel without overtopping the roadway. No floodwater storage or routing has been accounted for in the hydrology modelling at this roadway for the selected detention plan.

For the East Fork Sand Creek detention basin numbers 2, and 3, the existing embankment and outlet structure act to maintain a permanent pool at this time. It is recommended that the design of these detention basins be directed at maintaining the permanent pool when the flood control storage is to be added. The existence of a permanent pool may enhance the water quality aspects of these basins, and offer the opportunity of open space development conducive with open water.

Water Quality

Improvement of urban stormwater quality has become and important issue in drainage basin planning. Many pollutants are naturally associated with sediments that enter sensitive receiving waters. The pollutants are naturally occurring compounds that are carried to the drainageways in storm runoff. Other pollutants are the result of urbanization such as lawn chemicals, oil and grease, pet feces, lawn clippings and other items. Many pollutants can be limited by programs such as erosion control at construction sites, educational programs to inform the public as to the proper use of lawn chemicals, oil recycling programs and street sweeping programs. Even with these programs in place, erosion along the drainageways can generate large quantities of sediment that can settle out along the downstream channel bottoms.

Table VI-7: Matrix of Channel Alternatives
Sand Creek Drainage Basin Planning Study

Reach	Floodplain Preservation	Channelization 100-year	10-year	Selected Improvements	Comments
	Channel Alternative				
Sand Creek					
1			•		
2		•			
3		•			
4		•			
5				•	
6				•	
7				•	100-year channelization not feasible in this reach
8				•	"
9	•			•	"
West Fork Sand Creek					
1		•			Majority of Reach confined by narrow existing ROW
2		•			"
3		•			"
Center Tributary					
1		•			
2		•			Majority of Reach confined by narrow existing ROW
East Fork Sand Creek					
1		•			
2		•			
3			•		
4			•		
5			•		
6			•		
7		•			
8				•	
East Fork Subtributary					
1		•			
2		•			
Toy Ranches Tributary					
1				•	
2				•	
3				•	
East Bierstadt Creek					
1			•		
2		•			
West Bierstadt					
1		•			
2		•			

TABLE VIII-2: SAND CREEK DRAINAGE BASIN PLANNING STUDY
DRAINAGEWAY CONVEYANCE COST ESTIMATE
WITH SELECTED DETENTION ALTERNATIVES

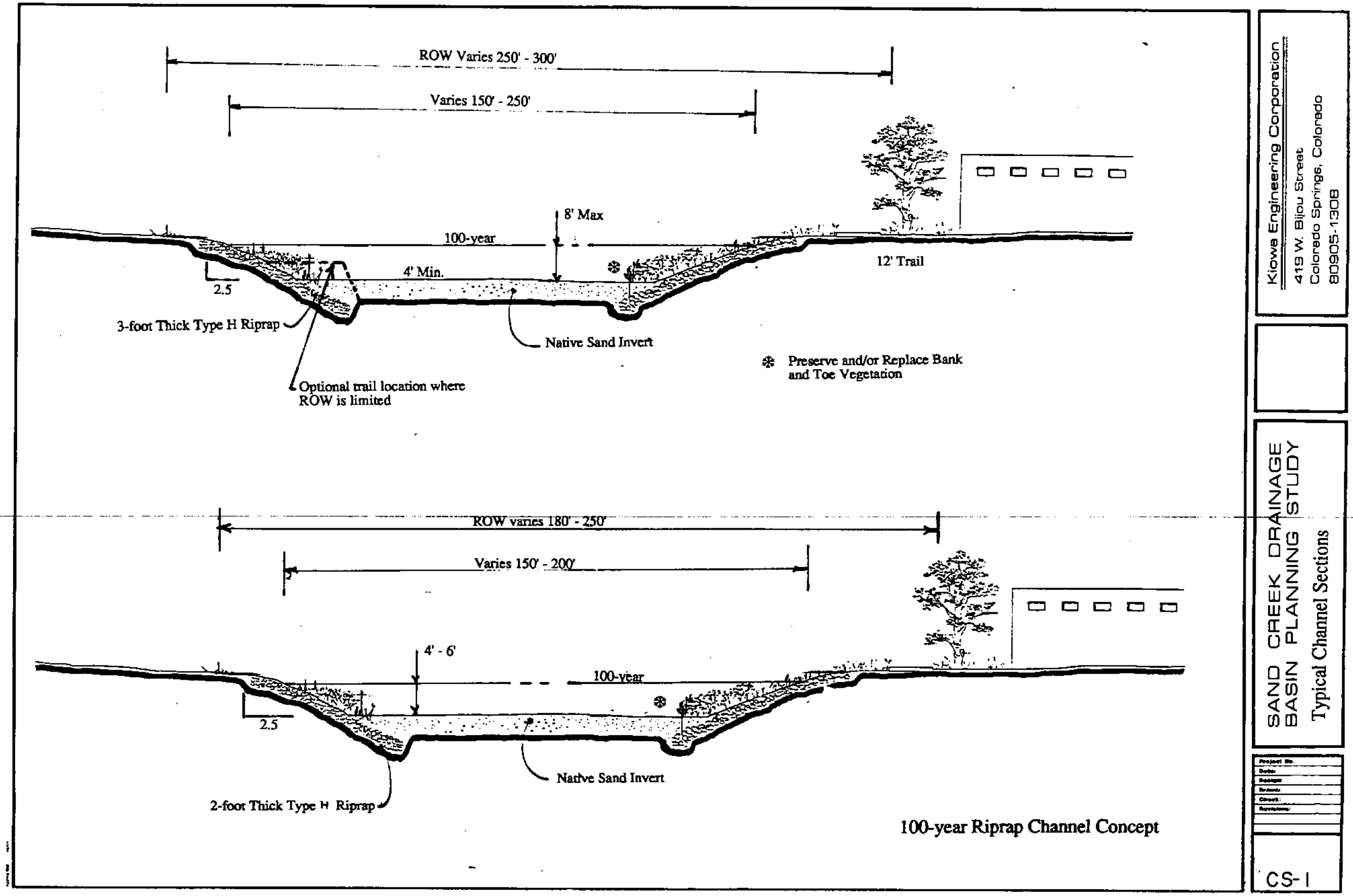
SEGMENT NUMBER	REACH NUMBER	SEGMENT LENGTH (FT)	IMPROVEMENT TYPE	IMP. LENGTH (FT)	UNIT COST ($/LF)	NUMBER OF GRADE CONTROLS	GRADE CONTROL LENGTH (FT)	TOTAL REIMBURSABL COSTS	TOTAL COST
148-2	"	2600	"	2150	127	5	620	$384,650	$384,650
151	SC-8	1700	10-YEAR RIPRAP	500	238	3	250	$164,000	$164,000
160	"	5100	SEL. LININGS (1 SIDE)	4400	127	6	720	$688,400	$688,400
			10-YR RIPRAP	600	238	0	0	$142,800	$142,800
	"								
163	"	6300	SEL. LININGS (1 SIDE)	2600	127	15	1200	$546,200	$546,200
			10-YR RIPRAP	350	238	0	0	$83,300	$83,300
187	"	1200	SEL. LININGS (1 SIDE)	0	0	2	160	$28,800	$28,800
170	SC-9	3200	"	0	0	4	320	$57,600	$57,600
171	"	5000	"	0	0	2	170	$30,600	$30,600
172	"	3650	"	0	0	2	150	$27,000	$27,000
TOTAL SAND CREEK DRAINAGEWAY								$15,560,220	$18,279,420

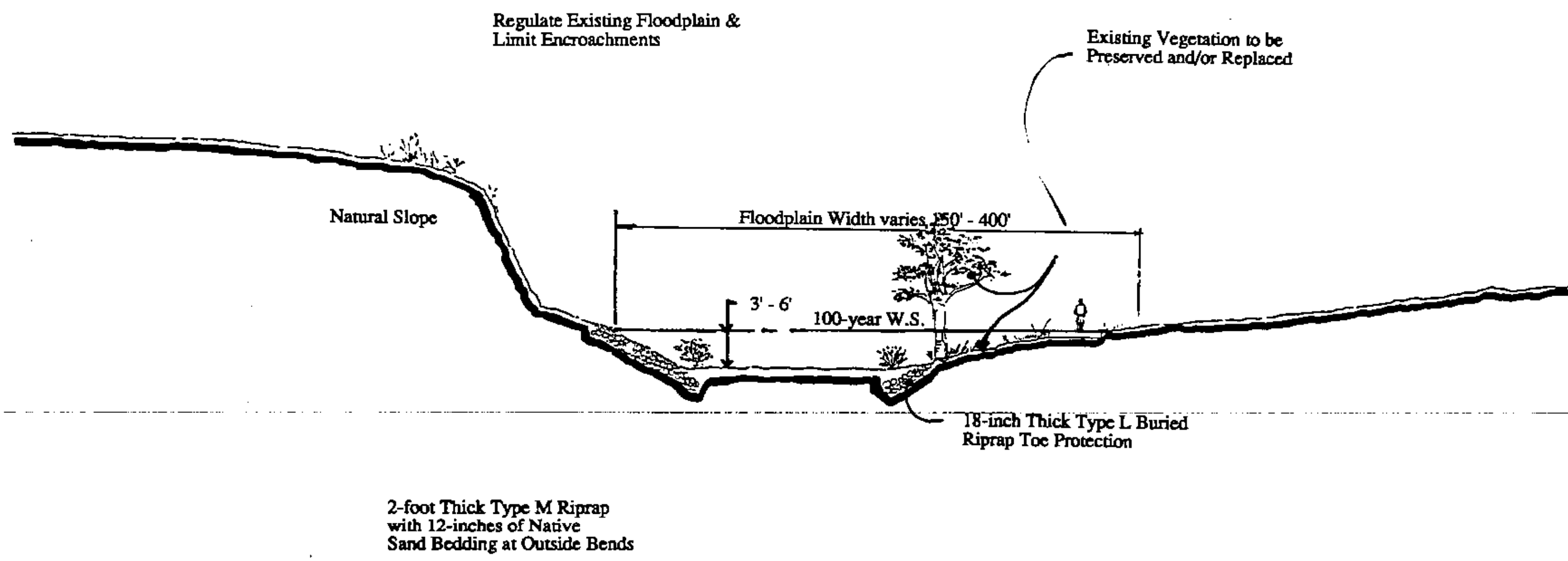
TABLE VIII-3: SAND CREEK DRAINAGE BASIN PLANNING STUDY
TRIBUTARY DRAINAGEWAY CONVEYANCE COST ESTIMATE
SAND CREEK, CENTER TRIBUTARY AND WEST FORK SAND CREEK

SEGMENT NUMBER	REACH NUMBER	IMPROVEMENT TYPE	IMP. LENGTH (FT)	UNIT COST ($/LF)	NUMBER OF GRADE CONTROLS	LENGTH OF GRADE CONTROL (FT)	TOTAL REIMBURSABLE COSTS	TOTAL COST
147-2	"	"	1150	200	1	30	$235,400	$235,400
153-1	"	"	600	150	0	0	$90,000	$90,000
153-2	"	"	450	150	0	0	$67,500	$67,500
152-1	SC-7	100-YEAR GRASSLINED	1650	150	0	0	$247,500	$247,500
152-2	"	"	800	150	2	100	$138,000	$138,000
150-1	"	100-YEAR STORM SEWER 36" RCP	800	58	0	0	$46,400	$46,400
150-2	"	100-YEAR RIPRAP	2400	200	0	0	$480,000	$480,000
161-1	"	100-YEAR GRASSLINED	550	150	0	0	$82,500	$82,500
154	SC-8	"	2100	200	10	600	$528,000	$528,000
157	"	"	2400	200	13	520	$573,600	$573,600
155-1	"	100-YEAR GRASSLINED	550	175	4	140	$121,450	$121,450
159	"	100-YEAR RIPRAP	3450	200	14	840	$841,200	$841,200
164	"	"	1350	200	5	200	$306,000	$306,000
186	"	"	2250	200	5	200	$486,000	$486,000
169	"	"	650	175	1	40	$120,950	$120,950
173	SC-9	"	950	175	8	320	$223,850	$223,850
WEST FORK SAND CREEK								
154-1	WF-1	100-YEAR RIPRAP	1550	223	2	100	$0	$363,650
161	"	"	600	223	2	80	$0	$148,200
164-2	"	100-YEAR GRASSLINED	500	150	0	0	$0	$75,000
164-4	"	100-YEAR RIPRAP	2500	175	9	280	$0	$487,900
165-1	"	"	1350	175	0	0	$0	$236,250
TOTAL SAND CREEK TRIBUTARY DRAINAGEWAYS							$7,420,650	$12,543,750

TABLE VIII-4: SAND CREEK DRAINAGE BASIN PLANNING STUDY
ROADWAY CULVERT CROSSING COST ESTIMATE
SAND CREEK BASINS

ROADWAY	REACH NUMBER	DRAINAGEWAY SEGMENT	CROSSING TYPE	LENGTH	UNIT	UNIT COST	TOTAL COST	TOTAL REIMBURSABLE COST
BANNING-LEWIS PRKW	SC-8	186	6'Hx10'W CBC	120	LF	$390	$46,800	$46,800
ARROYO LANE	SC-9	171	6'Hx12'W CBC	80	LF	$510	$40,800	$0
VOLLMER ROAD	SC-8	169	60-INCH CMP	80	LF	$120	$9,600	$0
"	SC-9	173	"	80	LF	$120	$9,600	$0
BURGESS ROAD	SC-9	176	42-INCH CMP	80	LF	$75	$6,000	$0
"	SC-9	178	2-42-INCH CMP	80	LF	$150	$12,000	$0
		CENTER TRIBUTARY						
TERMINAL AVENUE	CT-2	144	4-5'Hx8'W CBC	60	LF	$1,200	$72,000	$0
OMAHA BOULEVARD	CT-2	146-2	3-4'Hx9'W CBC	80	LF	$900	$72,000	$0
		WEST FORK SAND CREEK						
WOOTEN ROAD	WF-1	153	2-4'Hx6'W CBC	100	LF	$480	$48,000	$0
EDISON AVENUE	WF-1	153	2-4'Hx6'W CBC	60	LF	$240	$14,400	$0
PALMER PARK BLVD.	WF-1	154-2	2-4'Hx10'W CBC	80	LF	$540	$43,200	$0
CHICAGO RI RR	WF-1	165-1	4'Hx8'W CBC	220	LF	$270	$59,400	$0
HALF MOON DRIVE	WF-1	165-2	4'Hx6'W CBC	60	LF	$240	$14,400	$0
TOTAL CULVERT CONSTRUCTION COSTS, SAND CREEK							$1,902,600	$1,111,000


ROW Varies 250' - 300'
Varies 150' - 250'
8' Max
100-year
4' Min.
2.5
12' Trail
3-foot Thick Type H Riprap
Native Sand Invert
Optional trail location where ROW is limited
❊ Preserve and/or Replace Bank and Toe Vegetation
ROW varies 180' - 250'
Varies 150' - 200'
4' - 6'
100-year
2.5
Native Sand Invert
2-foot Thick Type H Riprap
100-year Riprap Channel Concept
Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308
SAND CREEK DRAINAGE BASIN PLANNING STUDY
Typical Channel Sections
CS-1



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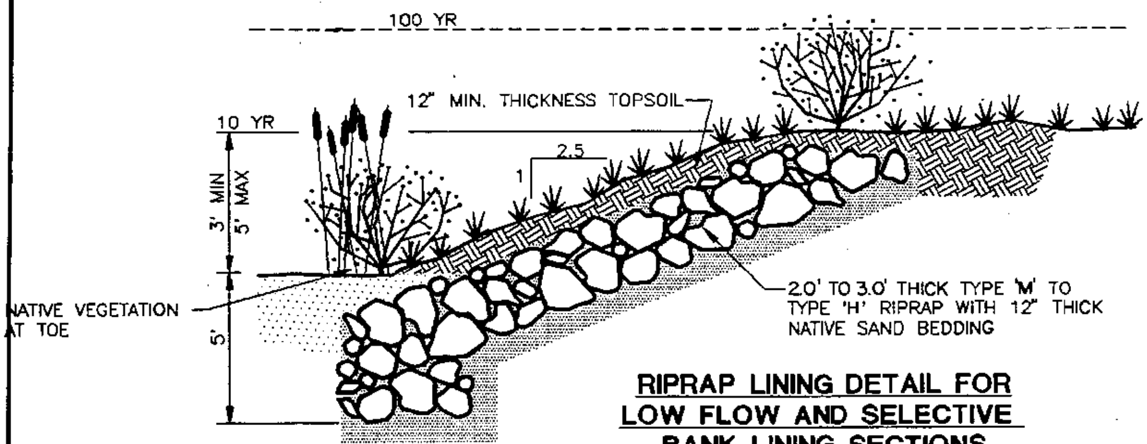
80905-1308

SAND CREEK DRAINAGE BASIN PLANNING STUDY

Typical Channel Sections

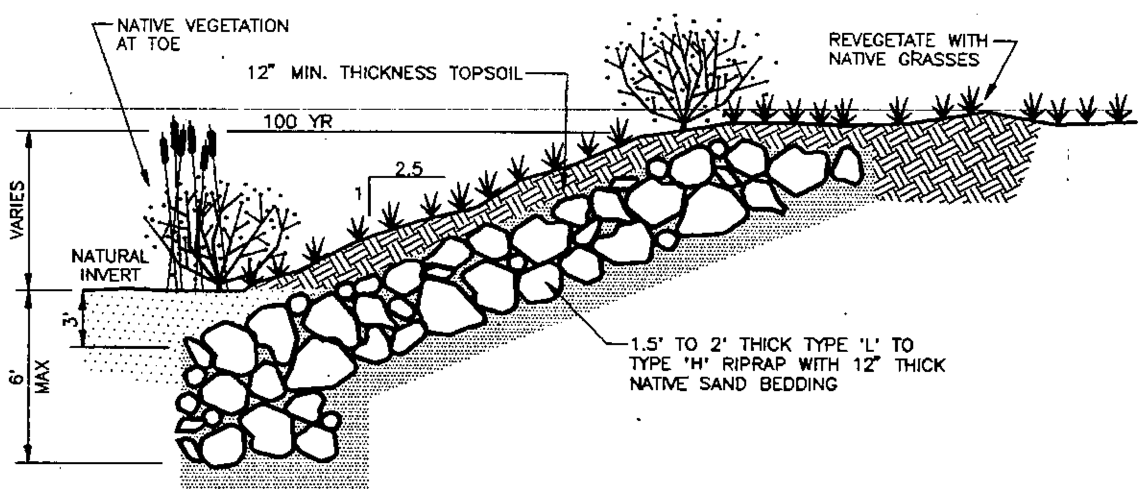
Project No.
Date:
Design:
Drawn:
Check:
Revisions:

CS-3



RIPRAP LINING DETAIL FOR LOW FLOW AND SELECTIVE BANK LINING SECTIONS

NTS



RIPRAP LINING DETAIL FOR 100 YR CHANNEL SECTIONS

NTS

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80905-1308

SAND CREEK DRAINAGE BASIN PLANNING STUDY

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Drawn:
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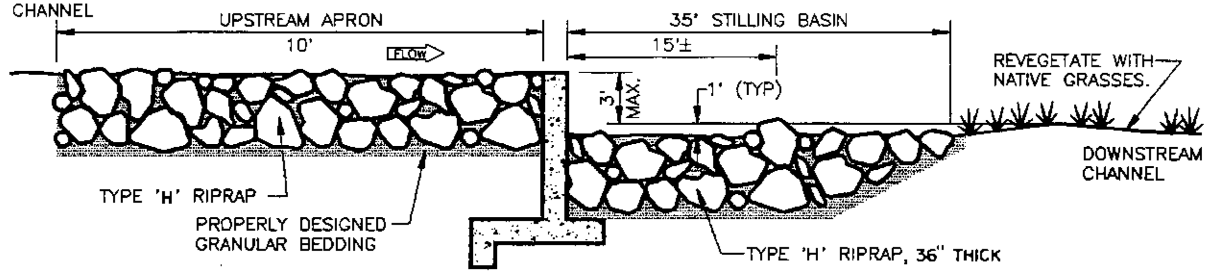
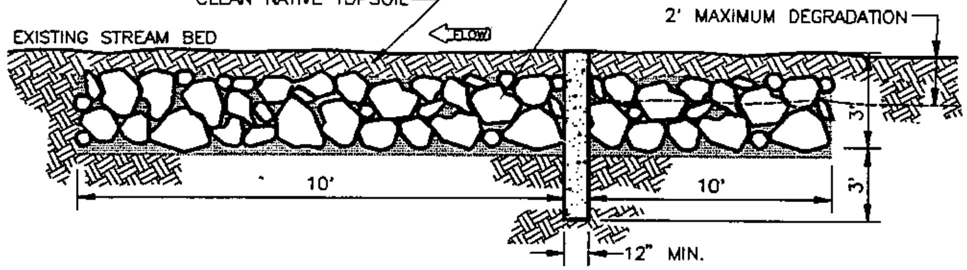
Revisions:

CS-6



NOTE: DIMENSIONS OF APRON, STILLING BASIN, RIPRAP, AND CHECK STRUCTURE IS TO BE DETERMINED DURING FINAL DESIGN.

TYPICAL DROP STRUCTURE
GENERALIZED PROFILE
NTS



TYPICAL EROSION CONTROL
CHECK PROFILE
NTS

Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308

SAND CREEK DRAINAGE
BASIN PLANNING STUDY

Project No:
Date:
Design:
Drawn:
Check:
Revisions:

CS-7

PRELIMINARY WETLANDS MAPPING

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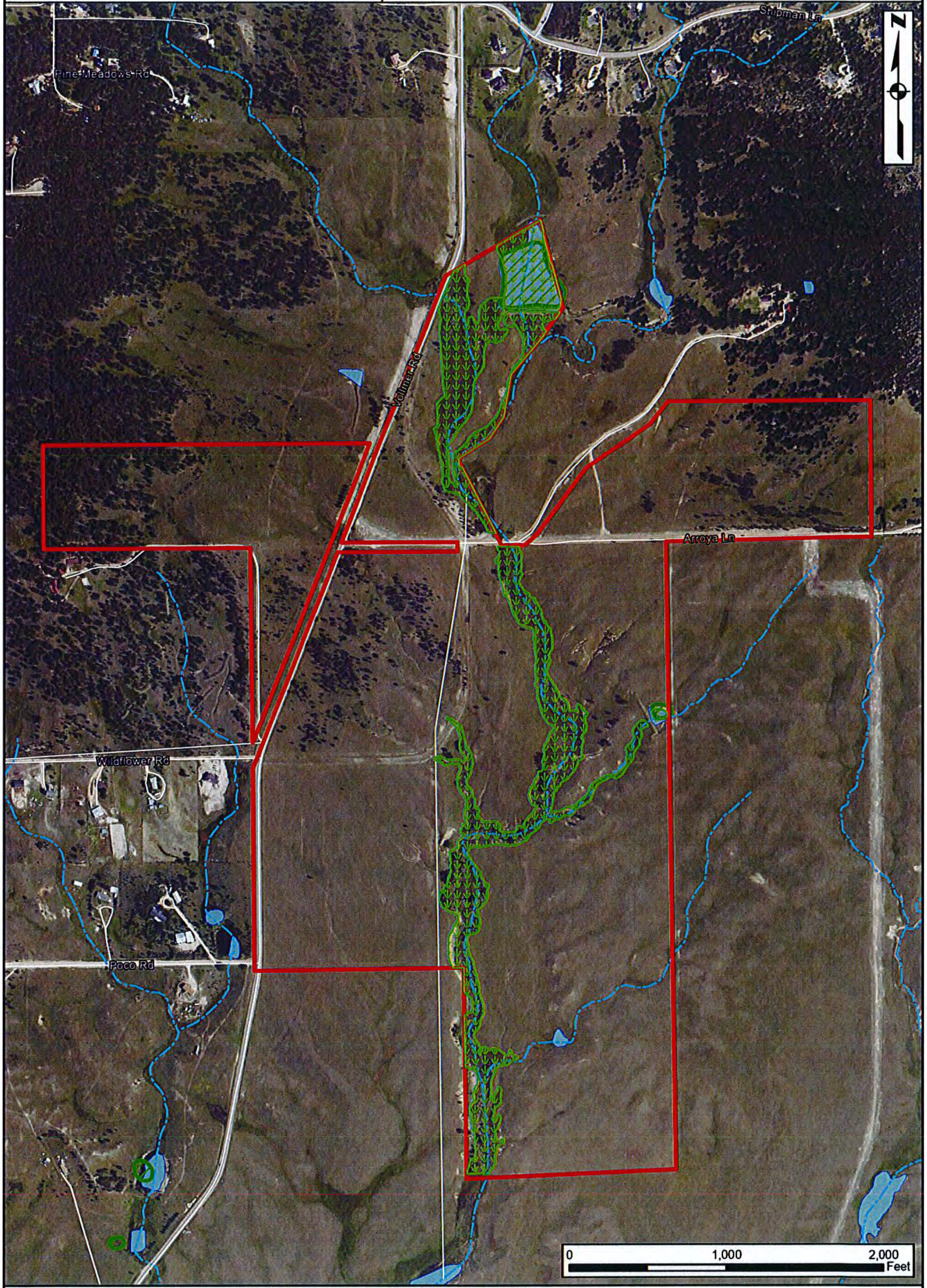
CIVIL ENGINEERING
DEVELOPMENT CONSULTING
NATURAL RESOURCES CONSULTING
LAND SURVEYING
303.703.4444
1950 W. Littleton Blvd., Ste. 109
Littleton, CO 80120

Trails at Timber Ridge

Maximum Extent of Wetlands Map

El Paso County, Colorado



- Project Boundary
- NHD Watercourse
- NHD Waterbody
- NWI Wetland
- Preliminary Wetland

Date: 4/3/2017

CORE Project #: 16-059

HYDROLOGIC CALCULATIONS

CLASSIC
CONSULTING
ENGINEERS & SURVEYORS

For Colorado Springs and much of the Fountain Creek watershed, the 1-hour depths are fairly uniform and are summarized in Table 6-2. Depending on the location of the project, rainfall depths may be calculated using the described method and the NOAA Atlas maps shown in Figures 6-6 through 6-17.

Table 6-2. Rainfall Depths for Colorado Springs

Return Period	1-Hour Depth	6-Hour Depth	24-Hour Depth
2	1.19	1.70	2.10
5	1.50	2.10	2.70
10	1.75	2.40	3.20
25	2.00	2.90	3.60
50	2.25	3.20	4.20
100	2.52	3.50	4.60

Where Z= 6,840 ft/100

These depths can be applied to the design storms or converted to intensities (inches/hour) for the Rational Method as described below. However, as the basin area increases, it is unlikely that the reported point rainfalls will occur uniformly over the entire basin. To account for this characteristic of rain storms an adjustment factor, the Depth Area Reduction Factor (DARF) is applied. This adjustment to rainfall depth and its effect on design storms is also described below. The UDFCD UD-Rain spreadsheet, available on UDFCD's website, also provides tools to calculate point rainfall depths and Intensity-Duration-Frequency curves[2] and should produce similar depth calculation results.

2.2 Design Storms

Design storms are used as input into rainfall/runoff models and provide a representation of the typical temporal distribution of rainfall events when the creation or routing of runoff hydrographs is required. It has long been observed that rainstorms in the Front Range of Colorado tend to occur as either short-duration, high-intensity, localized, convective thunderstorms (cloud bursts) or longer-duration, lower-intensity, broader, frontal (general) storms. The significance of these two types of events is primarily determined by the size of the drainage basin being studied. Thunderstorms can create high rates of runoff within a relatively small area, quickly, but their influence may not be significant very far downstream. Frontal storms may not create high rates of runoff within smaller drainage basins due to their lower intensity, but tend to produce larger flood flows that can be hazardous over a broader area and extend further downstream.

- **Thunderstorms**: Based on the extensive evaluation of rain storms completed in the Carlton study (Carlton 2011), it was determined that typical thunderstorms have a duration of about 2 hours. The study evaluated over 300,000 storm cells using gage-adjusted NEXRAD data, collected over a 14-year period (1994 to 2008). Storms lasting longer than 3 hours were rarely found. Therefore, the results of the Carlton study have been used to define the shorter duration design storms.

  To determine the temporal distribution of thunderstorms, 22 gage-adjusted NEXRAD storm cells were studied in detail. Through a process described in a technical memorandum prepared by the City of Colorado Springs (City of Colorado Springs 2012), the results of this analysis were interpreted and normalized to the 1-hour rainfall depth to create the distribution shown in Table 6-3 with a 5 minute time interval for drainage basins up to 1 square mile in size. This distribution represents the rainfall

Table 6-6. Runoff Coefficients for Rational Method

(Source: UDFCD 2001)

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients											
		2-year		5-year		10-year		25-year		50-year		100-year	
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Business													
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential													
1/8 Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
1/4 Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
1/3 Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
1/2 Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
Undeveloped Areas													
Historic Flow Analysis-- Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
Streets													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

3.2 Time of Concentration

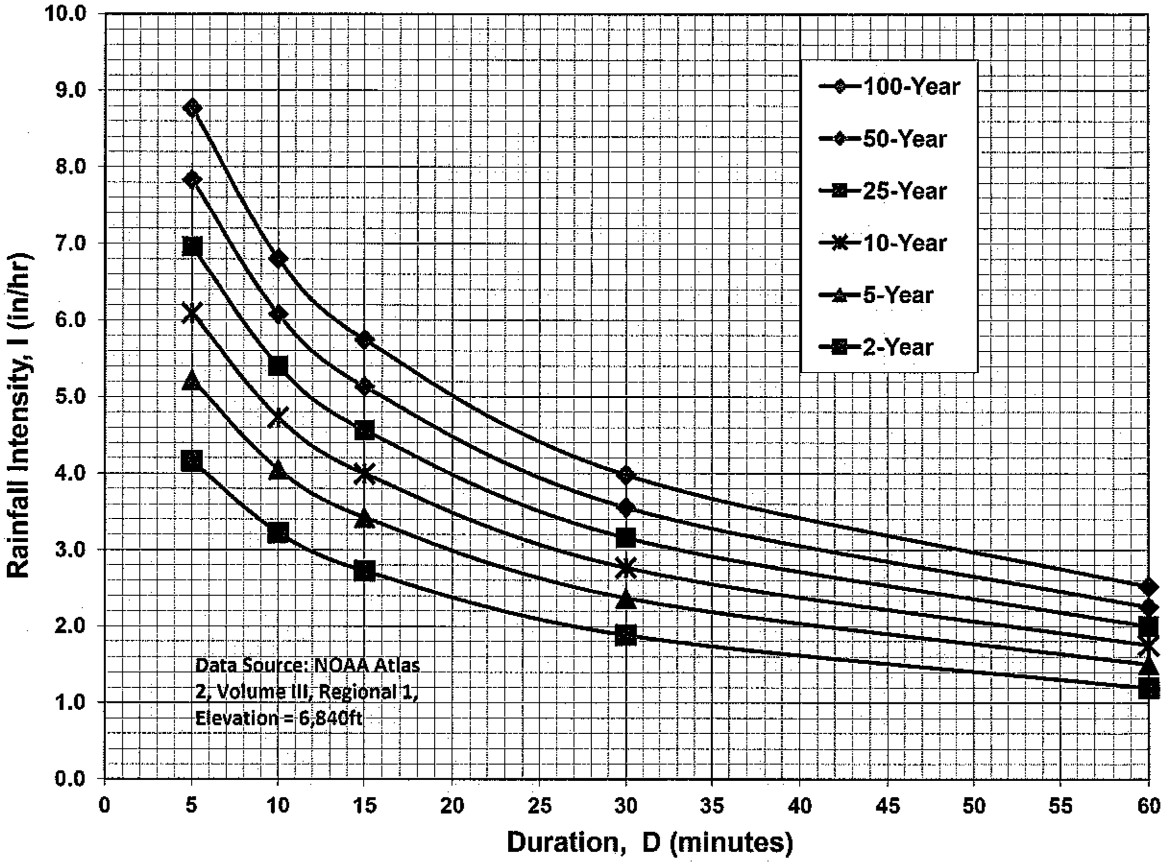
One of the basic assumptions underlying the Rational Method is that runoff is a function of the average rainfall rate during the time required for water to flow from the hydraulically most remote part of the drainage area under consideration to the design point. However, in practice, the time of concentration can be an empirical value that results in reasonable and acceptable peak flow calculations.

For urban areas, the time of concentration (t_c) consists of an initial time or overland flow time (t_i) plus the travel time (t_t) in the storm sewer, paved gutter, roadside drainage ditch, or drainage channel. For non-urban areas, the time of concentration consists of an overland flow time (t_i) plus the time of travel in a concentrated form, such as a swale or drainageway. The travel portion (t_t) of the time of concentration can be estimated from the hydraulic properties of the storm sewer, gutter, swale, ditch, or drainageway. Initial time, on the other hand, will vary with surface slope, depression storage, surface cover, antecedent rainfall, and infiltration capacity of the soil, as well as distance of surface flow. The time of concentration is represented by Equation 6-7 for both urban and non-urban areas.

Table 6-10. NRCS Curve Numbers for Frontal Storms & Thunderstorms for Developed Conditions (ARCII)

Fully Developed Urban Areas (vegetation established)[1]	Treatment	Hydrologic Condition	% I	Pre-Development CN			
				HSG A	HSG B	HSG C	HSG D
Open space (lawns, parks, golf courses, cemeteries, etc.):							
Poor condition (grass cover < 50%)	-----	-----	---	68	79	86	89
Fair condition (grass cover 50% to 75%)	-----	-----	---	49	69	79	84
Good condition (grass cover > 75%)	-----	-----	---	39	61	74	80
Impervious areas:							
Paved parking lots, roofs, driveways, etc. (excluding right-of-way	-----	-----	---	98	98	98	98
Streets and roads:							
Paved; curbs and storm sewers (excluding right-of-way)	-----	-----	---	98	98	98	98
Paved; open ditches (including right-of-way)	-----	-----	---	83	89	92	93
Gravel (including right-of-way)	-----	-----	---	76	85	89	91
Dirt (including right-of-way)	-----	-----	---	72	82	87	89
Western desert urban areas:							
Natural desert landscaping (pervious areas only)	-----	-----	---	63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)	-----	-----	---	96	96	96	96
Urban districts:							
Commercial and business	-----	-----	85	89	92	94	95
Industrial	-----	-----	72	81	88	91	93
Residential districts by average lot size:							
1/8 acre or less (town houses)	-----	-----	65	77	85	90	92
1/4 acre	-----	-----	38	61	75	83	87
1/3 acre	-----	-----	30	57	72	81	86
1/2 acre	-----	-----	25	54	70	80	85
1 acre	-----	-----	20	51	68	79	84
2 acres	-----	-----	12	46	65	77	82
Developing Urban Areas[1]	**Treatment[2]**	**Hydrologic Condition[3]**	**% I**	**HSG A**	**HSG B**	**HSG C**	**HSG D**
Newly graded areas (pervious areas only, no vegetation)	-----	-----	---	77	86	91	94
Cultivated Agricultural Lands[1]	**Treatment**	**Hydrologic Condition**	**% I**	**HSG A**	**HSG B**	**HSG C**	**HSG D**
Fallow	Bare soil	-----	---	77	86	91	94
	Crop residue cover (CR)	Poor	---	76	85	90	93
		Good	---	74	83	88	90
Row crops	Straight row (SR)	Poor	---	72	81	88	91
		Good	---	67	78	85	89
	SR + CR	Poor	---	71	80	87	90
		Good	---	64	75	82	85
	Contoured (C)	Poor	---	70	79	84	88
		Good	---	65	75	82	86
	C + CR	Poor	---	69	78	83	87
		Good	---	64	74	81	85
	Contoured & terraced (C&T)	Poor	---	66	74	80	82
		Good	---	62	71	78	81
	C&T+ CR	Poor	---	65	73	79	81
		Good	---	61	70	77	80
Small grain	SR	Poor	---	65	76	84	88
		Good	---	63	75	83	87
	SR + CR	Poor	---	64	75	83	86
		Good	---	60	72	80	84
	C	Poor	---	63	74	82	85
		Good	---	61	73	81	84
	C + CR Poor	Poor	---	62	73	81	84
		Good	---	60	72	80	83
	C&T	Poor	---	61	72	79	82
		Good	---	59	70	78	81
	C&T+ CR	Poor	---	60	71	78	81
		Good	---	58	69	77	80

Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

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

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

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

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

$I_{5} = -1.50 \ln(D) + 7.583$

$I_{2} = -1.19 \ln(D) + 6.035$

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

UNDEVELOPED LAND ASSUMED TO BE ONE OF THE FOLLOWING: PASTURE, GRASSLAND, RANGE - POOR
HERBACEOUS MIXTURE OF GRASS WEEDS AND LOW GROWING BRUSH WITH BRUSH MINOR ELELMENT - POOR
WOODS - GRASS COMBINATION - POOR

C_N VALUES - EXISTING CONDITIONS

BASIN (label)	BASIN AREA (Ac)	**SOIL TYPE B**		**WEIGHTED** C_N
		CN	AREA (Ac.)	
EX-1	156.9	61	156.9	61
EX-2	9.2	61	9.2	61
EX-3	24.9	61	24.9	61
EX-4	35.2	63	35.2	63
EX-6	6.7	61	6.7	61
SC-1	12.5	63	12.5	63
SC-2	350.0	63	350.0	63
OS-1	49.1	61	49.1	61
OS-2	2.1	61	2.1	61
OS-3	5.7	65	5.7	65
OS-4	16.1	63	16.1	63
OS-5	27.6	63	27.6	63

TIME OF CONCENTRATION - EXISTING CONDITIONS

BASIN	Cn	C(5)	OVERLAND Length (ft)	Height (ft)	Tc (min)	STREET / CHANNEL FLOW Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	Tc TOTAL (min)	Tc LAG (min)	Tc LAG (hr)
EX-1	61.0	0.08	300	8	23.1	1600	1.8%	1.3	20.5	43.6	26.2	0.44
EX-2	61.0	0.08	300	10	21.4					21.4	12.9	0.21
EX-3	61.0	0.08	300	8	23.1	1500	4.0%	1.5	16.7	39.7	23.8	0.40
EX-4	63.0	0.08	300	24	16.1	1900	6.0%	1.8	17.6	33.7	20.2	0.34
EX-6	61.0	0.08	300	14	19.2	800	1.0%	1.0	13.3	32.5	19.5	0.33
SC-1	63.0	0.08	200	6	18.1	500	2.0%	1.2	6.9	25.1	15.0	0.25
SC-2	63.0	0.08	300	12	20.2	3500	1.8%	1.3	44.9	65.1	39.0	0.65
OS-1	61.0	0.08	300	22	16.5	1300	4.0%	1.5	14.4	31.0	18.6	0.31
OS-2	61.0	0.08	300	12	20.2	550	5.0%	1.7	5.4	25.6	15.3	0.26
OS-3	65.0	0.08	300	10	21.4	250	3.0%	3.5	1.2	22.6	13.6	0.23
OS-4	63.0	0.08	300	22	16.5	1100	4.0%	1.4	13.1	29.6	17.8	0.30
OS-5	63.0	0.08	300	10	21.4	1300	3.0%	1.2	18.1	39.5	23.7	0.39

BASIN SUMMARY - EXISTING CONDITIONS

BASIN (label)	TOTAL BASIN AREA (acres)	WEIGHTED CN	TOTAL LAG TIME (hours)	Q 2 Yr. (cfs)	Q 5 Yr. (cfs)	Q 100 Yr. (cfs)
EX-1	156.9	61	0.44	2.6	17.7	140.3
EX-2	9.2	61	0.21	0.2	1.7	12.2
EX-3	24.9	61	0.40	0.4	3.0	23.7
EX-4	35.2	63	0.34	1.3	6.9	41.8
EX-6	6.7	61	0.33	0.1	0.9	7.1
SC-1	12.5	63	0.25	0.5	3.0	17.3
SC-2	350.0	63	0.65	9.9	44.2	275.3
OS-1	49.1	61	0.31	0.9	7.0	53.9
OS-2	2.1	61	0.26	0.04	0.3	2.5
OS-3	5.7	65	0.23	0.6	2.1	9.9
OS-4	16.1	63	0.30	0.6	3.4	20.7
OS-5	27.6	63	0.39	1.0	5.2	32.1

DESIGN POINTS SURFACE ROUTING SUMMARY - EXISTING CONDITIONS

Design Point (label)	**Contributing Basins**	**Q 2 Yr.** Q (cfs)	**Q 5 Yr.** Q (cfs)	**Q 100 Yr.** Q (cfs)
EX DP-1	BASINS OS-1, OS-3, OS-4, OS-5, EX-1, EX-4, EX-5, EX-6	5.6	36.0	281.7
EX DP-2	BASINS OS-2, EX-2	0.2	2.0	14.7
EX DP-3	BASIN EX-3	0.4	3.0	23.7
EX-DP-4	BASIN EX-6	0.1	1.0	7.1
Ex. 36" CMP at Vollmer	SC-1	0.5	3.0	17.3
Ex. 60" CMP at Vollmer	SC-2	9.88	44.2	275.3

JOB NAME: *The Retreat at TimberRidge (Preliminary Plan)*
JOB NUMBER: *2520.00*
DATE: *08/13/18*
CALCULATED BY: *MAW*

PRELIMINARY DRAINAGE REPORT ~ BASIN RUNOFF COEFFICIENT SUMMARY

		IMPERVIOUS AREA / STREETS				LANDSCAPE / DEVELOPED AREAS				WEIGHTED			WEIGHTED CA		
BASIN	TOTAL AREA (AC)	AREA (AC)	C(2)	C(50)	C(100)	AREA (AC)	C(2)	C(5)	C(100)	C(2)	C(5)	C(100)	**CA(2)**	**CA(5)**	**CA(100)**
A1	12.8	0.00	0.89	0.95	0.96	12.80	0.06	0.14	0.40	0.06	0.14	0.40	**0.77**	**1.79**	**5.12**
A2	6.9	0.00	0.89	0.95	0.96	6.90	0.06	0.14	0.40	0.06	0.14	0.40	**0.41**	**0.97**	**2.76**
A3	5.9	0.00	0.89	0.95	0.96	5.90	0.06	0.14	0.40	0.06	0.14	0.40	**0.35**	**0.83**	**2.36**
A4	2.1	0.00	0.89	0.95	0.96	2.10	0.12	0.20	0.44	0.12	0.20	0.44	**0.25**	**0.42**	**0.92**
A5	5.5	0.00	0.89	0.95	0.96	5.50	0.06	0.14	0.40	0.06	0.14	0.40	**0.33**	**0.77**	**2.20**
B1	18.8	0.00	0.89	0.95	0.96	18.80	0.06	0.14	0.40	0.06	0.14	0.40	**1.13**	**2.63**	**7.52**
B2	8.0	0.00	0.89	0.95	0.96	8.00	0.06	0.14	0.40	0.06	0.14	0.40	**0.48**	**1.12**	**3.20**
B3	6.10	1.10	0.89	0.95	0.96	5.00	0.06	0.14	0.40	0.21	0.28	0.50	**1.28**	**1.69**	**3.06**
B4	13.0	0.00	0.89	0.95	0.96	13.00	0.06	0.14	0.40	0.06	0.14	0.40	**0.78**	**1.82**	**5.20**
C1	12.5	0.00	0.89	0.95	0.96	12.50	0.09	0.17	0.42	0.09	0.17	0.42	**1.13**	**2.13**	**5.25**
C2	4.3	0.00	0.89	0.95	0.96	4.30	0.12	0.20	0.44	0.12	0.20	0.44	**0.52**	**0.86**	**1.89**
C3	8.6	0.00	0.89	0.95	0.96	8.60	0.09	0.17	0.42	0.09	0.17	0.42	**0.77**	**1.46**	**3.61**
D1	6.0	0.00	0.89	0.95	0.96	6.00	0.17	0.21	0.45	0.17	0.21	0.45	**1.02**	**1.28**	**2.72**
D2	14.1	0.00	0.89	0.95	0.96	14.10	0.18	0.25	0.47	0.18	0.25	0.47	**2.54**	**3.53**	**6.63**
D3	4.0	0.00	0.89	0.95	0.96	4.00	0.17	0.21	0.45	0.17	0.21	0.45	**0.68**	**0.85**	**1.81**
D4	6.8	0.00	0.89	0.95	0.96	6.80	0.20	0.27	0.49	0.20	0.27	0.49	**1.36**	**1.84**	**3.30**
D5	12.8	0.00	0.89	0.95	0.96	12.80	0.18	0.25	0.47	0.18	0.25	0.47	**2.30**	**3.20**	**6.02**
D6	15.3	0.00	0.89	0.95	0.96	15.30	0.18	0.25	0.47	0.18	0.25	0.47	**2.75**	**3.83**	**7.19**
D7	2.7	0.00	0.89	0.95	0.96	2.70	0.07	0.16	0.41	0.07	0.16	0.41	**0.19**	**0.43**	**1.11**
D8	1.6	0.00	0.89	0.95	0.96	1.60	0.18	0.25	0.47	0.18	0.25	0.47	**0.29**	**0.40**	**0.75**
D9	2.1	0.00	0.89	0.95	0.96	2.10	0.18	0.25	0.47	0.18	0.25	0.47	**0.38**	**0.53**	**0.99**
D10	1.7	0.00	0.89	0.95	0.96	1.70	0.18	0.25	0.47	0.18	0.25	0.47	**0.31**	**0.43**	**0.80**
E	1.3	1.30	0.89	0.95	0.96	0.00	0.18	0.25	0.47	0.89	0.90	0.96	**1.16**	**1.17**	**1.25**
F1	18.1	0.00	0.89	0.95	0.96	18.10	0.03	0.09	0.36	0.03	0.09	0.36	**0.54**	**1.63**	**6.52**
F2	4.6	0.00	0.89	0.95	0.96	4.60	0.03	0.09	0.36	0.03	0.09	0.36	**0.14**	**0.41**	**1.66**
H	6.7	0.00	0.89	0.95	0.96	6.70	0.06	0.14	0.40	0.06	0.14	0.40	**0.40**	**0.94**	**2.68**
OS-1A	4.8	0.00	0.89	0.95	0.96	4.80	0.03	0.09	0.36	0.03	0.09	0.36	**0.14**	**0.43**	**1.73**
OS-1B	23.4	0.00	0.89	0.95	0.96	23.40	0.03	0.09	0.36	0.03	0.09	0.36	**0.70**	**2.11**	**8.42**
OS-2A	2.0	0.00	0.89	0.95	0.96	2.00	0.03	0.09	0.36	0.03	0.09	0.36	**0.06**	**0.18**	**0.72**
OS-2B	2.3	0.00	0.89	0.95	0.96	2.30	0.03	0.09	0.36	0.03	0.09	0.36	**0.07**	**0.21**	**0.83**
OS-2C	14.9	0.00	0.89	0.95	0.96	14.90	0.03	0.09	0.36	0.03	0.09	0.36	**0.45**	**1.34**	**5.36**
OS-2D	0.85	0.00	0.89	0.95	0.96	0.85	0.03	0.09	0.36	0.03	0.09	0.36	**0.03**	**0.08**	**0.31**
OS-2E	3.1	0.00	0.89	0.95	0.96	3.10	0.03	0.09	0.36	0.03	0.09	0.36	**0.09**	**0.28**	**1.12**
OS-3	5.7	0.35	0.89	0.95	0.96	5.35	0.02	0.08	0.35	0.07	0.13	0.39	**0.42**	**0.74**	**2.21**
OS-5	27.6	0.00	0.89	0.95	0.96	27.60	0.02	0.08	0.35	0.02	0.08	0.35	**0.55**	**2.21**	**9.66**

JOB NAME:	*The Retreat at TimberRidge (Preliminary Plan)*
JOB NUMBER:	*2520.00*
DATE:	*08/13/18*
CALC'D BY:	*MAW*

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}}$$

$$V = C_v S_w^{0.5}$$

Tc=L/V

Table 6-7. Conveyance Coefficient, C_v

Type of Land Surface	C_v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)*	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

$$t_c = \frac{L}{180} + 10$$

*For buried riprap, select C_v value based on type of vegetative cover.

PRELIMINARY DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY

	WEIGHTED			OVERLAND				STREET / CHANNEL FLOW				Tc	INTENSITY			TOTAL FLOWS		
BASIN	CA(2)	CA(5)	CA(100)	C(5)	Length (ft)	Height (ft)	Tc (min)	Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	TOTAL (min)	I(2) (in/hr)	I(5) (in/hr)	I(100) (in/hr)	Q(2) (cfs)	Q(5) (cfs)	Q(100) (cfs)
A1	0.77	1.79	5.12	0.14	120	2.4	15.1	740	2.5%	1.6	7.8	22.9	2.31	2.89	4.84	1.8	5	25
A2	0.41	0.97	2.76	0.14	300	12	19.0	400	4.0%	2.0	3.3	22.3	2.34	2.92	4.91	1.0	3	14
A3	0.35	0.83	2.36	0.14	300	8	21.7	400	3.0%	1.7	3.8	25.6	2.18	2.72	4.57	0.8	2	11
A4	0.25	0.42	0.92	0.20	180	8	13.3	180	4.0%	2.0	1.5	14.8	2.83	3.54	5.94	0.7	1	5
A5	0.33	0.77	2.20	0.14	280	10	19.1					19.1	2.53	3.16	5.31	0.8	2	12
B1	1.13	2.63	7.52	0.14	300	10.5	19.9	1280	3.2%	1.8	11.9	31.8	1.92	2.39	4.02	2.2	6	30
B2	0.48	1.12	3.20	0.14	300	10.5	19.9					19.9	2.48	3.10	5.20	1.2	3	17
B3	1.28	1.69	3.06	0.14	300	10.5	19.9	370	1.5%	1.2	5.0	24.9	2.21	2.76	4.63	2.8	5	14
B4	0.78	1.82	5.20	0.14	300	10.5	19.9					19.9	2.48	3.10	5.20	1.9	6	27
C1	1.13	2.13	5.25	0.17	300	12	18.4	600	2.0%	2.8	3.5	21.9	2.36	2.95	4.95	2.7	6	26
C2	0.52	0.86	1.89	0.20	300	14	16.9					16.9	2.67	3.34	5.61	1.4	3	11
C3	0.77	1.46	3.61	0.17	300	17	16.4					16.4	2.71	3.39	5.68	2.1	5	21
D1	1.02	1.28	2.72	0.21	200	4	18.0	600	2.0%	2.8	3.5	21.6	2.38	2.98	5.00	2.4	4	14
D2	2.54	3.53	6.63	0.25	150	3	15.0	900	3.0%	3.5	4.3	19.3	2.51	3.14	5.28	6.4	11	35
D3	0.68	0.85	1.81	0.21	150	3	15.6	375	2.0%	2.8	2.2	17.8	2.61	3.26	5.48	1.8	3	10
D4	1.36	1.84	3.30	0.27	150	3	14.6	600	3.5%	3.7	2.7	17.3	2.64	3.31	5.56	3.6	6	18
D5	2.30	3.20	6.02	0.25	150	3	15.0	1050	2.5%	3.2	5.5	20.5	2.44	3.05	5.13	5.6	10	31
D6	2.75	3.83	7.19	0.25	150	3	15.0	1200	2.0%	2.8	7.1	22.0	2.36	2.94	4.94	6.5	11	36
D7	0.19	0.43	1.11	0.16	150	3	16.5					16.5	2.70	3.37	5.67	0.5	1	6
D8	0.29	0.40	0.75	0.25	70	2.8	8.1					8.1	3.54	4.44	7.46	1.0	2	6
D9	0.38	0.53	0.99	0.25	70	2.8	8.1					8.1	3.54	4.44	7.46	1.3	2	7
D10	0.31	0.43	0.80	0.25	80	3.2	8.7					8.7	3.46	4.34	7.29	1.1	2	6
E	1.16	1.17	1.25	0.25	30	7.5	2.9	400	5.0%	2.2	3.0	5.9	3.93	4.92	8.27	4.5	6	10
F1	0.54	1.63	6.52	0.09	60	3	8.3	2400	2.0%	1.4	28.3	36.6	1.75	2.18	3.66	1.0	4	24
F2	0.14	0.41	1.66	0.09	60	6	6.6	1200	2.0%	1.4	14.1	20.7	2.43	3.03	5.09	0.3	1	8
H	0.40	0.94	2.68	0.14	300	11	19.6	900	2.0%	1.4	10.6	30.2	1.98	2.47	4.15	0.8	2	11
OS-1A	0.14	0.43	1.73	0.09	300	15	18.6	400	5.0%	4.5	1.5	20.1	2.47	3.08	5.18	0.4	1	9
OS-1B	0.70	2.11	8.42	0.09	300	15	18.6	1200	5.0%	4.5	4.5	23.0	2.30	2.88	4.83	1.6	6	41
OS-2A	0.06	0.18	0.72	0.09	300	12	20.0					20.0	2.47	3.09	5.19	0.1	0.6	4
OS-2B	0.07	0.21	0.83	0.09	300	12	20.0					20.0	2.47	3.09	5.19	0.2	0.6	4
OS-2C	0.45	1.34	5.36	0.09	300	12	20.0	1000	3.0%	3.5	4.8	24.8	2.21	2.77	4.64	1.0	4	25
OS-2D	0.03	0.08	0.31	0.09	250	12	17.2					17.2	2.65	3.32	5.57	0.07	0.3	2
OS-2E	0.09	0.28	1.12	0.09	300	12	20.0					20.0	2.47	3.09	5.19	0.2	0.9	6
OS-3	0.42	0.74	2.21	0.08	300	10	21.4	250	3.0%	3.5	1.2	22.6	2.32	2.90	4.87	1	2	11
OS-5	0.55	2.21	9.66	0.08	300	12	20.2	1500	3.0%	3.5	7.2	27.4	2.10	2.62	4.39	1	6	42

JOB NAME: *The Retreat at TimberRidge (Preliminary Plan)*
JOB NUMBER: *2520.00*
DATE: *08/13/18*
CALCULATED BY: *MAW*

PRELIMINARY DRAINAGE REPORT ~ SURFACE ROUTING SUMMARY

Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity I(5)	Intensity I(100)	Flow Q(5)	Flow Q(100)	Culvert / Inlet Size
1	OS-5 (27.6 ac.)	2.21	9.66	27.4	2.62	4.39	6	42	EX. 48" CMP
2	OS-3 (5.7 ac.)	0.74	2.21	22.6	2.90	4.87	2	11	24" RCP
3	DP-2, A-1 (18.5 ac.)	2.54	7.33	23.6	2.84	4.76	7	35	30" RCP
4	A2 (6.9 ac.)	0.97	2.76	22.3	2.92	4.91	3	14	24" RCP
5	DP-3, DP-4, A3 (31.3 ac.)	4.33	12.45	25.6	2.72	4.57	12	57	DUAL 30" RCP CULVERTS
6	**OS-3, A1, A2, A3 and A4 (POND B INFLOW - 33.4 ac.)**	4.75	13.37	26.6	2.66	4.47	**13**	**60**	
7	B1 (18.8 ac.)	2.63	7.52	31.8	2.39	4.02	6	30	30" RCP
8	B3 (6.1 ac.)	1.69	3.06	24.9	2.76	4.63	5	14	5' Type R sump inlets
9	**B1, B2 and B3 (POND C INFLOW - 32.9ac.)**	5.44	13.78	34.8	2.26	3.79	**12**	**52**	
10	C1, OS-1A (17.3 ac.)	2.56	6.98	23.4	2.85	4.79	7	33	30" RCP
11	C2 (4.3 ac.)	0.86	1.89	16.9	3.34	5.61	3	11	5' Type R sump inlets
12	D2, OS-2A (16.1 ac.)	3.71	7.35	20.0	3.09	5.19	11	38	10' Type R sump inlets
13	D1, OS-2B (8.3 ac.)	1.49	3.55	21.6	2.98	5.00	4	18	5' Type R sump inlets
14	D3, OS-2D (4.85 ac.)	0.93	2.12	17.8	3.26	5.48	3	12	5' Type R sump inlets
15	D5, OS-2E (15.9 ac.)	3.48	7.13	20.5	3.05	5.13	11	37	10' Type R sump inlets
16	D4 6.8 ac.)	1.84	3.30	17.3	3.31	5.56	6	18	5' Type R sump inlets
17	D6 (15.3 ac.)	3.83	7.19	22.0	2.94	4.94	11	36	10' Type R sump inlets
18	**DP-10 Thru DP-17 and OS-1B, OS-2C, D7 (POND D INFLOW - 129.9 ac.)**	22.55	54.40	27.8	2.60	4.36	**59**	**237**	

JOB NAME: *The Retreat at TimberRidge (Preliminary Plan)*
JOB NUMBER: *2520.00*
DATE: *08/13/18*
CALCULATED BY: *MAW*

* PIPES ARE LISTED AT MAXIMUM SIZE REQUIRED TO ACCOMMODATE Q100 FLOWS AT MINIMUM GRADE.
REFER TO INDIVIDUAL PIPE SHEETS FOR HYDRAULIC INFORMATION.

PRELIMINARY DRAINAGE REPORT ~ PIPE ROUTING SUMMARY

Pipe Run	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		Pipe Size*
					I(5)	I(100)	Q(5)	Q(100)	
1	DP-10	2.56	6.98	23.4	2.85	4.79	7	33	30" RCP
2	OS-1B	2.11	8.42	23.0	2.88	4.83	6	41	30" RCP
3	PR-1, PR-2, DP-11	5.52	17.29	25.4	2.73	4.58	15	79	36" RCP
4	DP-12	3.71	7.35	20.0	3.09	5.19	11	38	30" RCP
5	PR-3, PR-4	9.23	24.64	27.1	2.63	4.42	24	109	42" RCP
6	DP-16	1.84	3.30	17.3	3.31	5.56	6	18	24" RCP
7	PR-5, PR-6	11.06	27.94	27.1	2.63	4.42	29	123	42" RCP
8	PR-7, DP-17	14.89	35.13	27.8	2.59	4.35	39	153	48" RCP
9	DP-13	1.49	3.55	21.6	2.98	5.00	4	18	24" RCP
10	OS-2C	1.34	5.36	24.8	2.77	4.64	4	25	30" RCP
11	PR-9, PR-10	2.83	8.91	25.3	2.74	4.59	8	41	30" RCP
12	PR-11, DP-14	3.75	11.03	27.3	2.62	4.40	10	49	36" RCP
13	DP-15	3.48	7.13	20.5	3.05	5.13	11	37	30" RCP
14	PR-12, PR-13	7.23	18.16	27.6	2.61	4.37	19	79	36" RCP

Culvert Report

Preliminary Box Culvert Design Crossings - Arroya and Poco (Triple 6'x16')

Invert Elev Dn (ft)	= 7233.50
Pipe Length (ft)	= 115.00
Slope (%)	= 1.00
Invert Elev Up (ft)	= 7234.65
Rise (in)	= 72.0
Shape	= Box
Span (in)	= 192.0
No. Barrels	= 3
n-Value	= 0.013
Culvert Type	= Flared Wingwalls
Culvert Entrance	= 30D to 75D wingwall flares
Coeff. K,M,c,Y,k	= 0.026, 1, 0.0347, 0.81, 0.4

Embankment

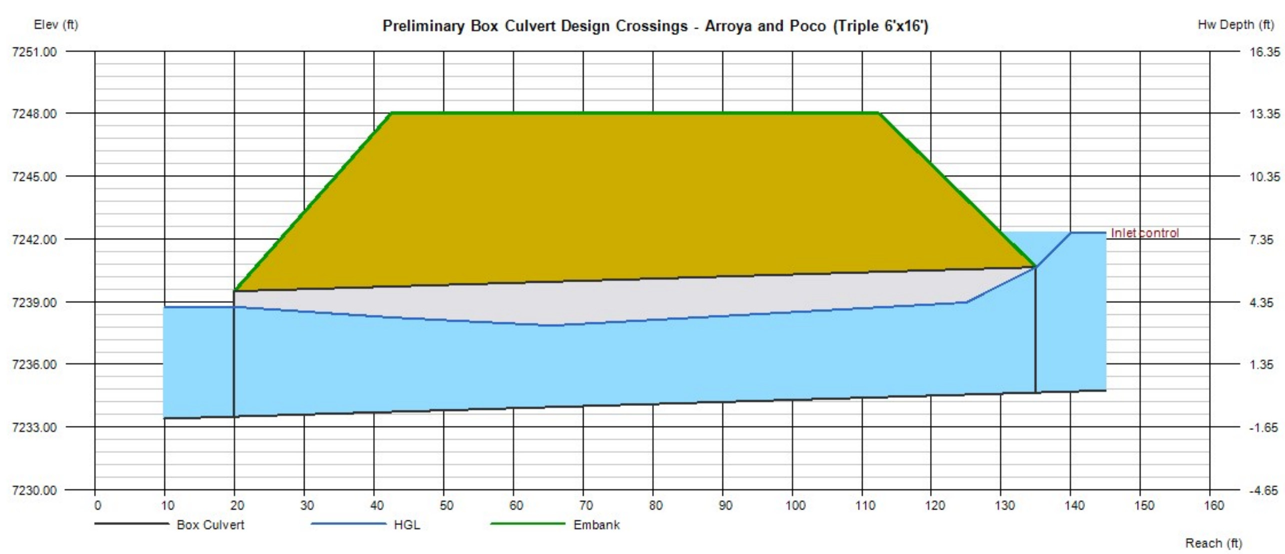
Top Elevation (ft)	= 7248.00
Top Width (ft)	= 70.00
Crest Width (ft)	= 70.00

Calculations

Qmin (cfs)	= 0.00
Qmax (cfs)	= 2600.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 2600.00
Qpipe (cfs)	= 2600.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 10.32
Veloc Up (ft/s)	= 12.05
HGL Dn (ft)	= 7238.75
HGL Up (ft)	= 7239.15
Hw Elev (ft)	= 7242.31
Hw/D (ft)	= 1.28
Flow Regime	= Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. — Friday, Aug 10 2018

Preliminary Box Culvert Design Crossings - Arroya and Poco (Triple 6'x12')

Invert Elev Dn (ft)	=	7233.50
Pipe Length (ft)	=	115.00
Slope (%)	=	1.00
Invert Elev Up (ft)	=	7234.65
Rise (in)	=	72.0
Shape	=	Box
Span (in)	=	144.0
No. Barrels	=	3
n-Value	=	0.013
Culvert Type	=	Flared Wingwalls
Culvert Entrance	=	30D to 75D wingwall flares
Coeff. K,M,c,Y,k	=	0.026, 1, 0.0347, 0.81, 0.4

Embankment

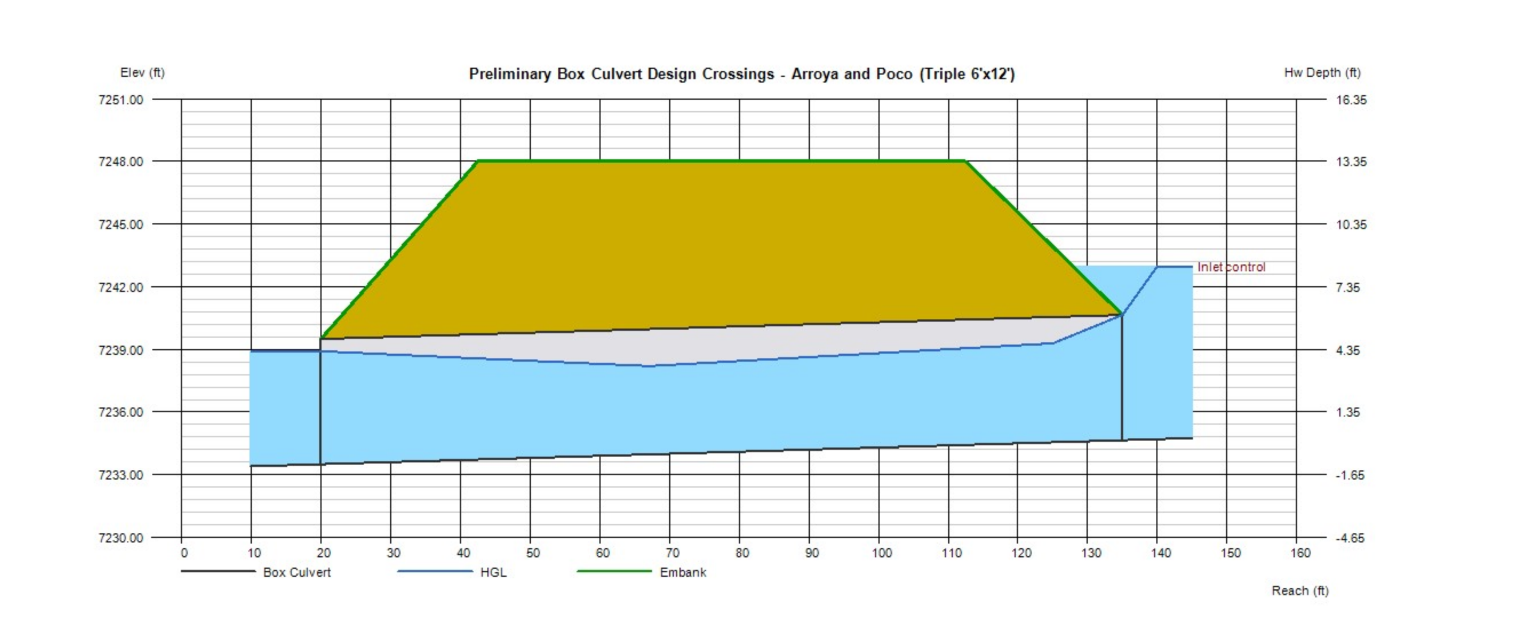
Top Elevation (ft)	=	7248.00
Top Width (ft)	=	70.00
Crest Width (ft)	=	70.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	2170.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	2170.00
Qpipe (cfs)	=	2170.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	11.13
Veloc Up (ft/s)	=	12.49
HGL Dn (ft)	=	7238.91
HGL Up (ft)	=	7239.48
Hw Elev (ft)	=	7242.98
Hw/D (ft)	=	1.39
Flow Regime	=	Inlet Control



Culvert Report

Exist. Culvert Crossing at DP 1

Invert Elev Dn (ft)	=	7258.00
Pipe Length (ft)	=	130.00
Slope (%)	=	3.00
Invert Elev Up (ft)	=	7261.90
Rise (in)	=	48.0
Shape	=	Circular
Span (in)	=	48.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

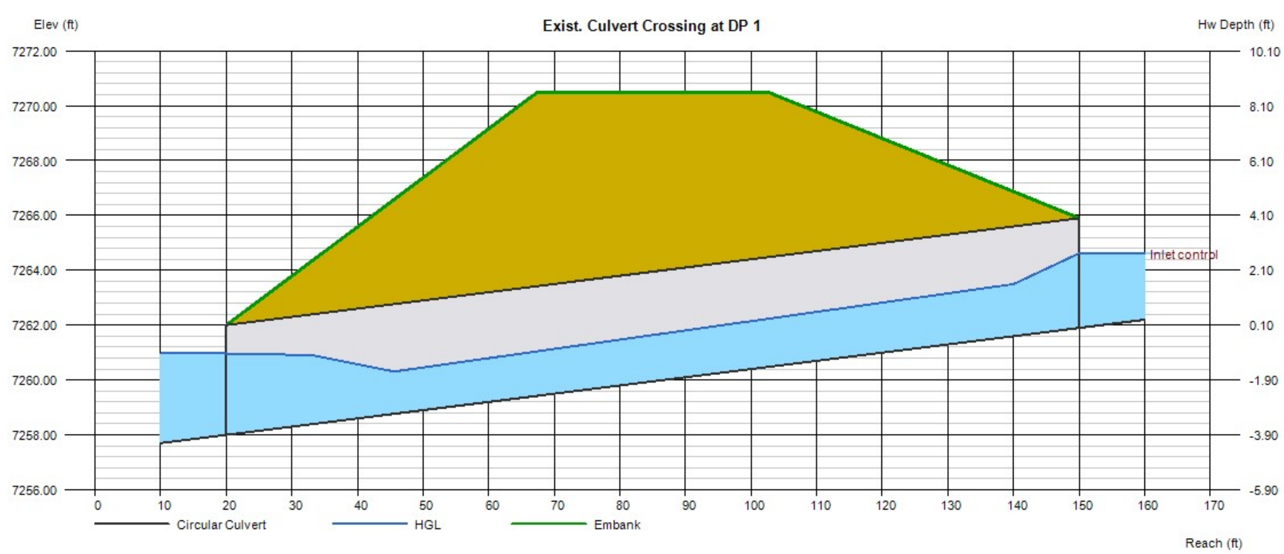
Top Elevation (ft)	=	7270.50
Top Width (ft)	=	35.00
Crest Width (ft)	=	150.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	42.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	42.00
Qpipe (cfs)	=	42.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	4.20
Veloc Up (ft/s)	=	6.98
HGL Dn (ft)	=	7260.97
HGL Up (ft)	=	7263.83
Hw Elev (ft)	=	7264.62
Hw/D (ft)	=	0.68
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Jun 21 2018

Culvert Crossing at DP 2

Invert Elev Dn (ft)	=	7250.00
Pipe Length (ft)	=	115.00
Slope (%)	=	1.00
Invert Elev Up (ft)	=	7251.15
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

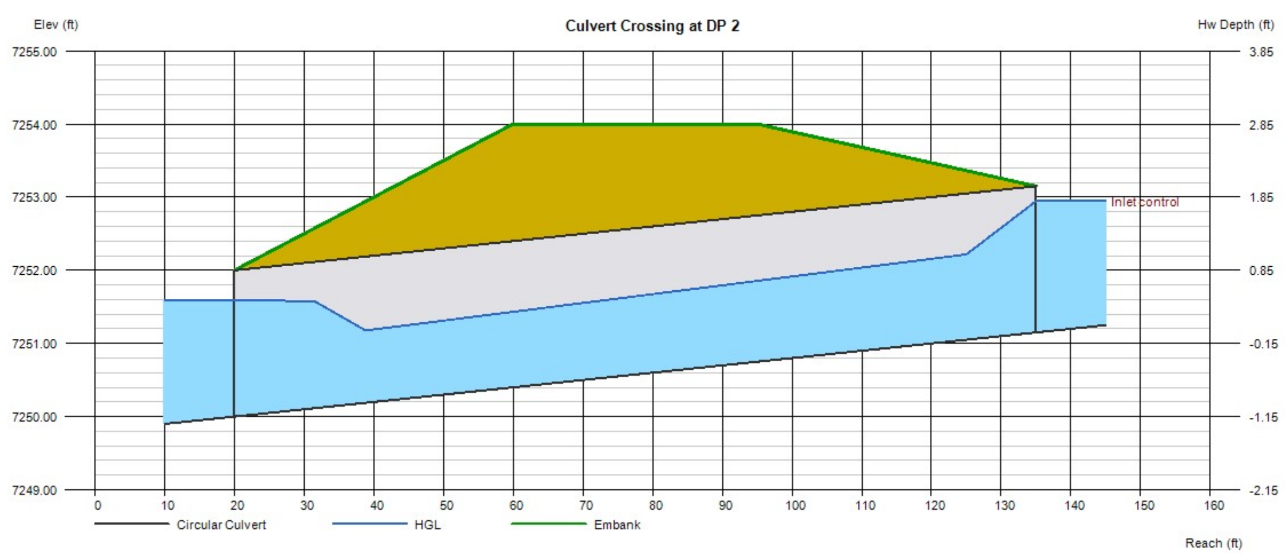
Top Elevation (ft)	=	7254.00
Top Width (ft)	=	35.00
Crest Width (ft)	=	150.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	11.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	11.00
Qpipe (cfs)	=	11.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	4.10
Veloc Up (ft/s)	=	5.66
HGL Dn (ft)	=	7251.59
HGL Up (ft)	=	7252.34
Hw Elev (ft)	=	7252.95
Hw/D (ft)	=	0.90
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Jun 21 2018

Culvert Crossing at DP 3

Invert Elev Dn (ft)	=	7228.00
Pipe Length (ft)	=	110.00
Slope (%)	=	1.00
Invert Elev Up (ft)	=	7229.10
Rise (in)	=	30.0
Shape	=	Circular
Span (in)	=	30.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

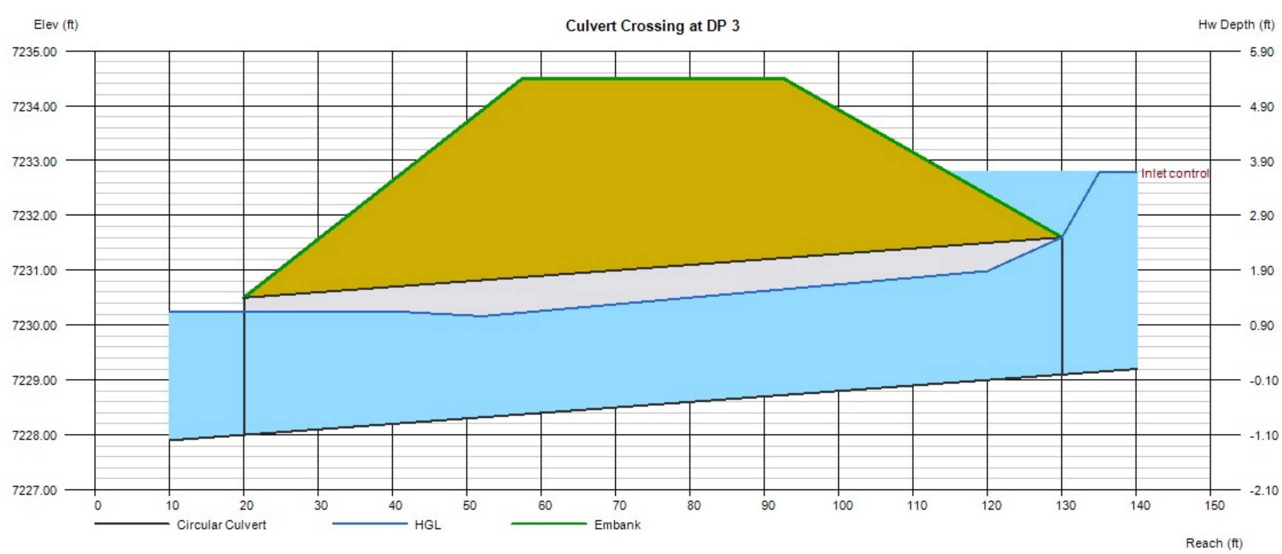
Top Elevation (ft)	=	7234.50
Top Width (ft)	=	35.00
Crest Width (ft)	=	150.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	35.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	35.00
Qpipe (cfs)	=	35.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	7.51
Veloc Up (ft/s)	=	8.28
HGL Dn (ft)	=	7230.25
HGL Up (ft)	=	7231.11
Hw Elev (ft)	=	7232.79
Hw/D (ft)	=	1.47
Flow Regime	=	Inlet Control



Culvert Report

Culvert Crossing at DP 4

Invert Elev Dn (ft)	=	7230.00
Pipe Length (ft)	=	140.00
Slope (%)	=	1.43
Invert Elev Up (ft)	=	7232.00
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

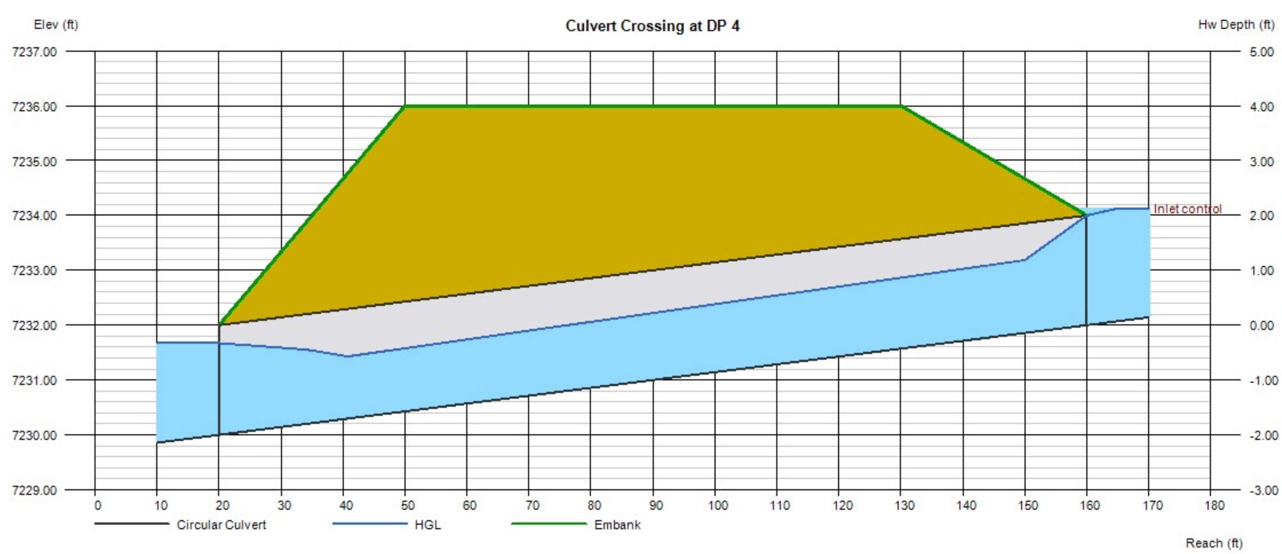
Top Elevation (ft)	=	7236.00
Top Width (ft)	=	80.00
Crest Width (ft)	=	150.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	14.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	14.00
Qpipe (cfs)	=	14.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	4.99
Veloc Up (ft/s)	=	6.22
HGL Dn (ft)	=	7231.67
HGL Up (ft)	=	7233.35
Hw Elev (ft)	=	7234.13
Hw/D (ft)	=	1.06
Flow Regime	=	Inlet Control



Culvert Report

Culvert Crossing at DP 5

Invert Elev Dn (ft)	=	7220.00
Pipe Length (ft)	=	160.00
Slope (%)	=	1.25
Invert Elev Up (ft)	=	7222.00
Rise (in)	=	30.0
Shape	=	Circular
Span (in)	=	30.0
No. Barrels	=	2
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

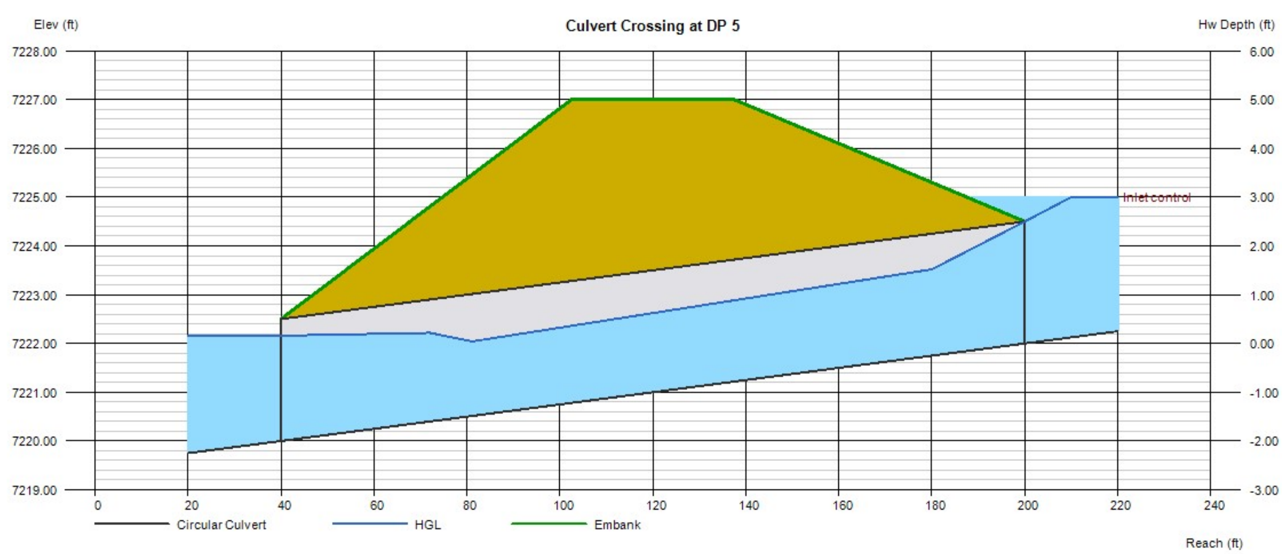
Top Elevation (ft)	=	7227.00
Top Width (ft)	=	35.00
Crest Width (ft)	=	50.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	57.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	57.00
Qpipe (cfs)	=	57.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	6.32
Veloc Up (ft/s)	=	7.45
HGL Dn (ft)	=	7222.16
HGL Up (ft)	=	7223.82
Hw Elev (ft)	=	7225.00
Hw/D (ft)	=	1.20
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Jun 21 2018

Culvert Crossing at DP 7

Invert Elev Dn (ft)	=	7195.20
Pipe Length (ft)	=	80.00
Slope (%)	=	1.00
Invert Elev Up (ft)	=	7196.00
Rise (in)	=	30.0
Shape	=	Circular
Span (in)	=	30.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

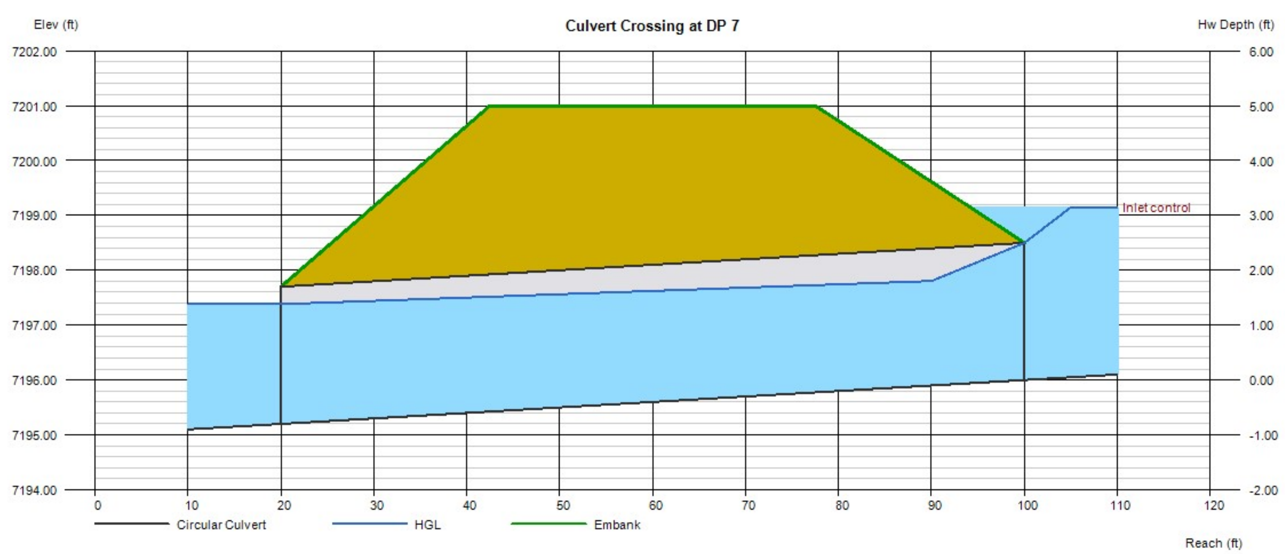
Top Elevation (ft)	=	7201.00
Top Width (ft)	=	35.00
Crest Width (ft)	=	50.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	30.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	30.00
Qpipe (cfs)	=	30.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	6.60
Veloc Up (ft/s)	=	7.64
HGL Dn (ft)	=	7197.38
HGL Up (ft)	=	7197.87
Hw Elev (ft)	=	7199.15
Hw/D (ft)	=	1.26
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Jun 21 2018

Culvert Crossing at DP 10

Invert Elev Dn (ft)	=	7244.00
Pipe Length (ft)	=	100.00
Slope (%)	=	1.00
Invert Elev Up (ft)	=	7245.00
Rise (in)	=	30.0
Shape	=	Circular
Span (in)	=	30.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

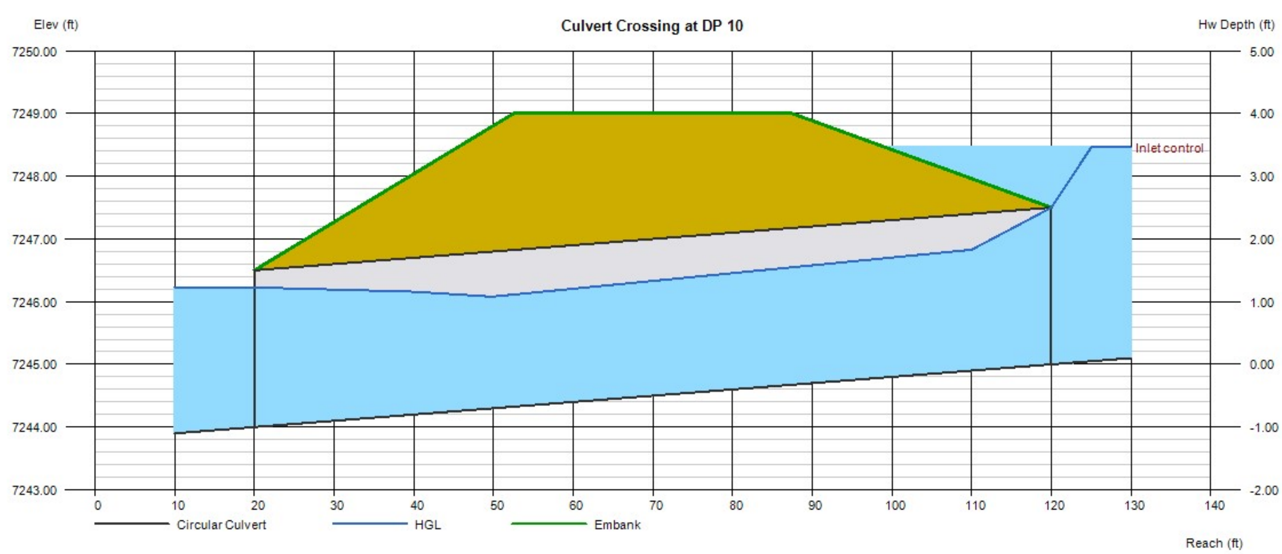
Top Elevation (ft)	=	7249.00
Top Width (ft)	=	35.00
Crest Width (ft)	=	50.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	33.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	33.00
Qpipe (cfs)	=	33.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	7.15
Veloc Up (ft/s)	=	8.02
HGL Dn (ft)	=	7246.23
HGL Up (ft)	=	7246.95
Hw Elev (ft)	=	7248.46
Hw/D (ft)	=	1.38
Flow Regime	=	Inlet Control



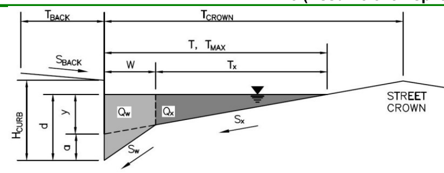
Version 4.05 Released March 2017

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

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

Project: THE RETREAT AT TIMBERRIDGE PRELIMINARY DRAINAGE REPORT (South of Arroya Lane)

Inlet ID: DP-8 (Assume even split of flows)



Gutter Geometry (Enter data in the blue cells)

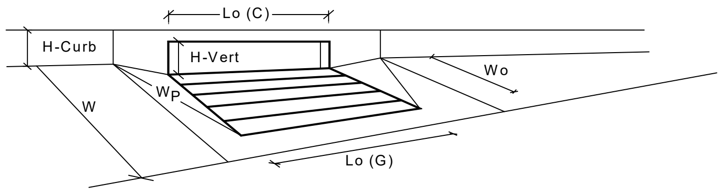
Parameter	Symbol	Value	Units
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.010	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	14.0	14.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	8.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet: CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	12.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.77	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**5.4**	**12.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	3.0	7.0	cfs

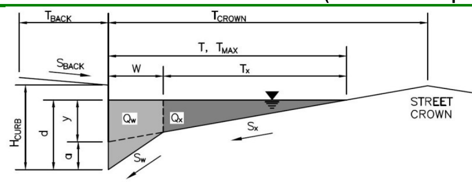
Version 4.05 Released March 2017

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

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

Project: THE RETREAT AT TIMBERRIDGE PRELIMINARY DRAINAGE REPORT (South of Arroya Lane)

Inlet ID: DP-11 (Assume even split of flows)



Gutter Geometry (Enter data in the blue cells)

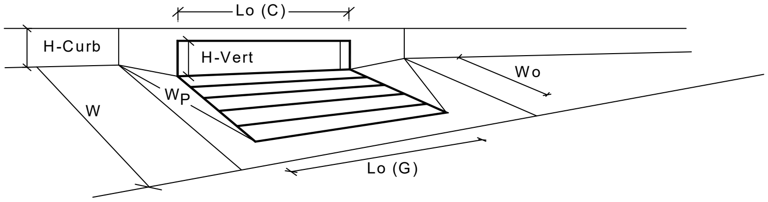
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.010	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	8.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet — CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	12.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.77	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**5.4**	**12.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	2.0	6.0	cfs

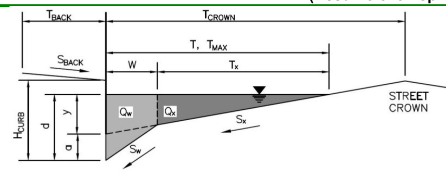
Version 4.05 Released March 2017

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

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

Project: THE RETREAT AT TIMBERRIDGE PRELIMINARY DRAINAGE REPORT (South of Arroya Lane)

Inlet ID: DP-12 (Assume even split of flows)



Gutter Geometry (Enter data in the blue cells)

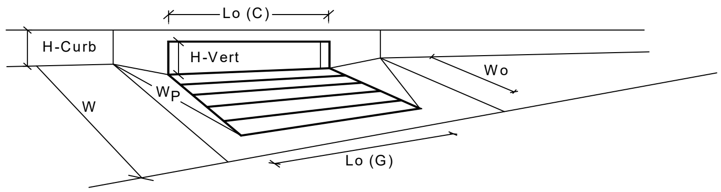
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	12.0	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.57	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.93	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**8.3**	**25.5**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	6.0	16.0	cfs

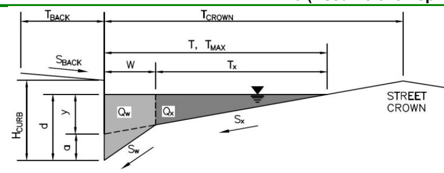
Version 4.05 Released March 2017

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

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

Project: THE RETREAT AT TIMBERRIDGE PRELIMINARY DRAINAGE REPORT (South of Arroya Lane)

Inlet ID: DP-13 (Assume even split of flows)



Gutter Geometry (Enter data in the blue cells)

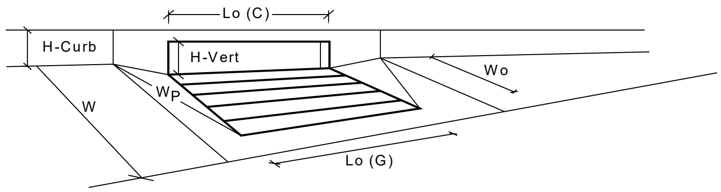
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	12.0	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.77	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**5.4**	**12.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	2.0	9.0	cfs

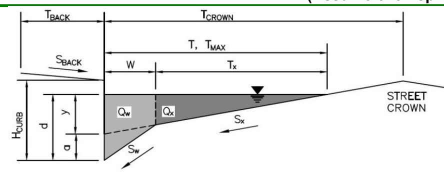
Version 4.05 Released March 2017

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

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

Project: THE RETREAT AT TIMBERRIDGE PRELIMINARY DRAINAGE REPORT (South of Arroya Lane)

Inlet ID: DP-14 (Assume even split of flows)



Gutter Geometry (Enter data in the blue cells)

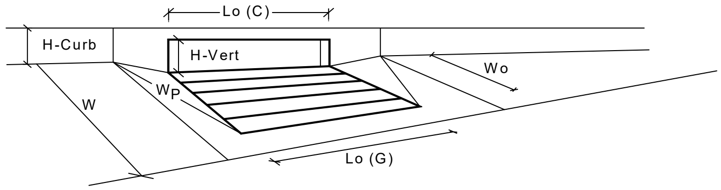
Description	Parameter	Value	Units
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLEΤ IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	12.0	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.77	1.00	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		Q_a =	**5.4**	**12.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	2.0	6.0	cfs

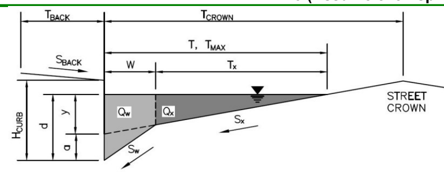
Version 4.05 Released March 2017

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

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

Project: THE RETREAT AT TIMBERRIDGE PRELIMINARY DRAINAGE REPORT (South of Arroya Lane)

Inlet ID: DP-15 (Assume even split of flows)

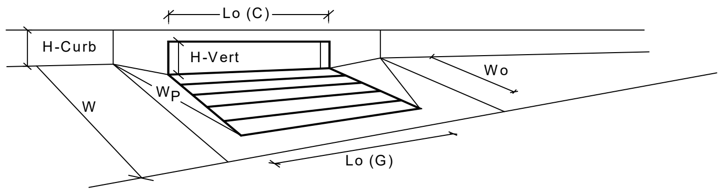


Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.020		ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083		ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	12.0	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.57	1.00	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.93	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		Q_a =	**8.3**	**25.5**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	6.0	16.0	cfs

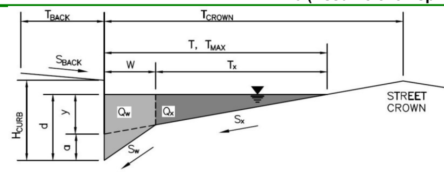
Version 4.05 Released March 2017

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

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

Project: THE RETREAT AT TIMBERRIDGE PRELIMINARY DRAINAGE REPORT (South of Arroya Lane)

Inlet ID: DP-16 (Assume even split of flows)



Gutter Geometry (Enter data in the blue cells)

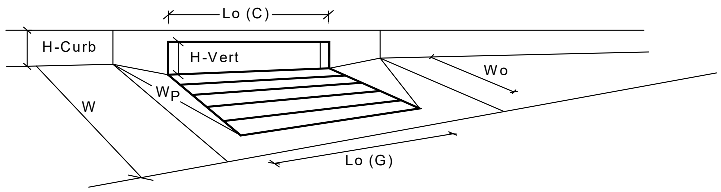
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLEET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening	
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	12.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.77	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**5.4**	**12.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	3.0	9.0	cfs

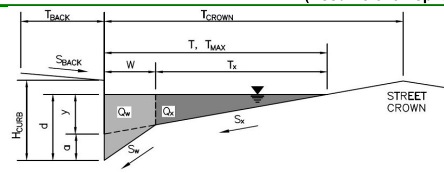
Version 4.05 Released March 2017

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

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

Project: THE RETREAT AT TIMBERRIDGE PRELIMINARY DRAINAGE REPORT (South of Arroya Lane)

Inlet ID: DP17 (Assume even split of flows)



Gutter Geometry (Enter data in the blue cells)

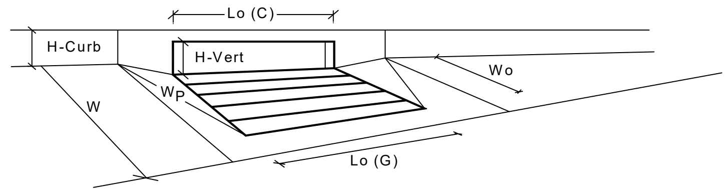
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	17.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	8.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	22.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	20.0	20.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	8.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLEET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	1.00	1.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	8.0	12.0	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.50	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.75	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**16.0**	**23.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	6.0	18.0	cfs

Pre-Dev 2 Year Routing

Project Summary	
Title	Retreat at TimberRidge Preliminary Drainage Report (South of Arroya Lane)
Engineer	MAW
Company	CCES
Date	6/20/2018

Notes	Pre-Dev 2 year SCS Model

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Pre-Dev 2 Year Routing

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
EX-1	Pre-Development 2 YEAR	2	1.203	12.650	2.61
EX-2	Pre-Development 2 YEAR	2	0.071	12.300	0.17
EX-3	Pre-Development 2 YEAR	2	0.191	12.600	0.42
EX-4	Pre-Development 2 YEAR	2	0.366	12.250	1.29
EX-6	Pre-Development 2 YEAR	2	0.052	12.450	0.12
OS-1	Pre-Development 2 YEAR	2	0.379	12.400	0.86
OS-2	Pre-Development 2 YEAR	2	0.016	12.350	0.04
OS-3	Pre-Development 2 YEAR	2	0.077	12.100	0.55
OS-4	Pre-Development 2 YEAR	2	0.167	12.200	0.62
OS-5	Pre-Development 2 YEAR	2	0.287	12.300	0.97
SC-1	Pre-Development 2 YEAR	2	0.130	12.150	0.53
SC-2	Pre-Development 2 YEAR	2	3.593	12.550	9.88

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
EX DP-1	Pre-Development 2 YEAR	2	2.456	12.600	5.61
EX DP-2	Pre-Development 2 YEAR	2	0.087	12.350	0.21
EX DP-3	Pre-Development 2 YEAR	2	0.191	12.600	0.42
EX DP-4	Pre-Development 2 YEAR	2	0.052	12.450	0.12
EX. 60" CMP at Arroya	Pre-Development 2 YEAR	2	0.610	12.200	2.24
Ex. 36" CMP at Vollmer	Pre-Development 2 YEAR	2	0.130	12.150	0.53
Ex. 60" CMP at Vollmer	Pre-Development 2 YEAR	2	3.593	12.550	9.88

Pre-Dev 2 Year Routing

Subsection: Time-Depth Curve | Return Event: 2 years
Label: Colo Springs 2015 | Storm Event: TYPE II 24 HOUR

Time-Depth Curve: TYPE II 24 HOUR	
Label	TYPE II 24 HOUR
Start Time	0.000 hours
Increment	0.250 hours
End Time	24.000 hours
Return Event	2 years

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.250 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
0.000	0.0	0.0	0.0	0.0	0.0
1.250	0.0	0.0	0.0	0.0	0.1
2.500	0.1	0.1	0.1	0.1	0.1
3.750	0.1	0.1	0.1	0.1	0.1
5.000	0.1	0.1	0.2	0.2	0.2
6.250	0.2	0.2	0.2	0.2	0.2
7.500	0.2	0.2	0.3	0.3	0.3
8.750	0.3	0.3	0.3	0.3	0.4
10.000	0.4	0.4	0.4	0.5	0.5
11.250	0.5	0.6	0.8	1.4	1.5
12.500	1.5	1.6	1.6	1.7	1.7
13.750	1.7	1.7	1.8	1.8	1.8
15.000	1.8	1.8	1.8	1.9	1.9
16.250	1.9	1.9	1.9	1.9	1.9
17.500	1.9	1.9	1.9	1.9	2.0
18.750	2.0	2.0	2.0	2.0	2.0
20.000	2.0	2.0	2.0	2.0	2.0
21.250	2.0	2.0	2.0	2.1	2.1
22.500	2.1	2.1	2.1	2.1	2.1
23.750	2.1	2.1	(N/A)	(N/A)	(N/A)

Pre-Dev 2 Year Routing

Subsection: Addition Summary | Return Event: 2 years
Label: EX DP-1 | Storm Event: TYPE II 24 HOUR

Summary for Hydrograph Addition at 'EX DP-1'

Upstream Link	Upstream Node
REACH SC-9	EX. 60" CMP at Arroya
<Catchment to Outflow Node>	EX-1
<Catchment to Outflow Node>	OS-1
<Catchment to Outflow Node>	OS-5

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft^3/s)
Flow (From)	REACH SC-9	0.587	12.750	1.46
Flow (From)	EX-1	1.203	12.650	2.61
Flow (From)	OS-1	0.379	12.400	0.86
Flow (From)	OS-5	0.287	12.300	0.97
Flow (In)	EX DP-1	2.456	12.600	5.61

Pre-Dev 2 Year Routing

Subsection: Addition Summary Return Event: 2 years
Label: EX DP-2 Storm Event: TYPE II 24 HOUR

Summary for Hydrograph Addition at 'EX DP-2'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	EX-2
<Catchment to Outflow Node>	OS-2

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft^3/s)
Flow (From)	EX-2	0.071	12.300	0.17
Flow (From)	OS-2	0.016	12.350	0.04
Flow (In)	EX DP-2	0.087	12.350	0.21

Pre-Dev 2 Year Routing

Subsection: Addition Summary
Label: EX DP-3

Return Event: 2 years
Storm Event: TYPE II 24 HOUR

Summary for Hydrograph Addition at 'EX DP-3'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	EX-3

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft^3/s)
Flow (From)	EX-3	0.191	12.600	0.42
Flow (In)	EX DP-3	0.191	12.600	0.42

Pre-Dev 2 Year Routing

Subsection: Addition Summary
Label: EX DP-4

Return Event: 2 years
Storm Event: TYPE II 24 HOUR

Summary for Hydrograph Addition at 'EX DP-4'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	EX-6

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft^3/s)
Flow (From)	EX-6	0.052	12.450	0.12
Flow (In)	EX DP-4	0.052	12.450	0.12

Pre-Dev 2 Year Routing

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Pre-Dev 5 Year Routing

Project Summary	
Title	Retreat at TimberRidge Preliminary Drainage Report (South of Arroya Lane)
Engineer	MAW
Company	CCES
Date	6/20/2018

Notes	Pre-Dev 5 year SCS Model

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Pre-Dev 5 Year Routing

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)
EX-1	Pre-Development 5 YEAR	5	3.342	12.250	17.71
EX-2	Pre-Development 5 YEAR	5	0.197	12.100	1.70
EX-3	Pre-Development 5 YEAR	5	0.531	12.250	2.97
EX-4	Pre-Development 5 YEAR	5	0.916	12.150	6.87
EX-6	Pre-Development 5 YEAR	5	0.143	12.150	0.91
OS-1	Pre-Development 5 YEAR	5	1.050	12.150	7.03
OS-2	Pre-Development 5 YEAR	5	0.045	12.100	0.33
OS-3	Pre-Development 5 YEAR	5	0.178	12.050	2.07
OS-4	Pre-Development 5 YEAR	5	0.419	12.150	3.41
OS-5	Pre-Development 5 YEAR	5	0.717	12.200	5.15
SC-1	Pre-Development 5 YEAR	5	0.326	12.100	3.04
SC-2	Pre-Development 5 YEAR	5	9.021	12.400	44.17

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)
EX DP-1	Pre-Development 5 YEAR	5	6.589	12.250	36.03
EX DP-2	Pre-Development 5 YEAR	5	0.242	12.100	2.04
EX DP-3	Pre-Development 5 YEAR	5	0.531	12.250	2.97
EX DP-4	Pre-Development 5 YEAR	5	0.143	12.150	0.91
EX. 60" CMP at Arroya	Pre-Development 5 YEAR	5	1.513	12.150	11.81
Ex. 36" CMP at Vollmer	Pre-Development 5 YEAR	5	0.326	12.100	3.04
Ex. 60" CMP at Vollmer	Pre-Development 5 YEAR	5	9.021	12.400	44.17

Pre-Dev 5 Year Routing

Subsection: Time-Depth Curve — Return Event: 5 years

Label: Colo Springs 2015 — Storm Event: TYPE II 24 HOUR

Time-Depth Curve: TYPE II 24 HOUR	
Label	TYPE II 24 HOUR
Start Time	0.000 hours
Increment	0.250 hours
End Time	24.000 hours
Return Event	5 years

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.250 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
0.000	0.0	0.0	0.0	0.0	0.0
1.250	0.0	0.0	0.1	0.1	0.1
2.500	0.1	0.1	0.1	0.1	0.1
3.750	0.1	0.1	0.1	0.2	0.2
5.000	0.2	0.2	0.2	0.2	0.2
6.250	0.2	0.2	0.3	0.3	0.3
7.500	0.3	0.3	0.3	0.3	0.4
8.750	0.4	0.4	0.4	0.4	0.5
10.000	0.5	0.5	0.5	0.6	0.6
11.250	0.7	0.8	1.0	1.8	1.9
12.500	2.0	2.0	2.1	2.1	2.2
13.750	2.2	2.2	2.3	2.3	2.3
15.000	2.3	2.3	2.3	2.4	2.4
16.250	2.4	2.4	2.4	2.4	2.5
17.500	2.5	2.5	2.5	2.5	2.5
18.750	2.5	2.5	2.5	2.6	2.6
20.000	2.6	2.6	2.6	2.6	2.6
21.250	2.6	2.6	2.6	2.6	2.6
22.500	2.7	2.7	2.7	2.7	2.7
23.750	2.7	2.7	(N/A)	(N/A)	(N/A)

Pre-Dev 5 Year Routing

Subsection: Addition Summary | Return Event: 5 years
Label: EX DP-1 | Storm Event: TYPE II 24 HOUR

Summary for Hydrograph Addition at 'EX DP-1'

Upstream Link	Upstream Node
REACH SC-9	EX. 60" CMP at Arroya
<Catchment to Outflow Node>	EX-1
<Catchment to Outflow Node>	OS-1
<Catchment to Outflow Node>	OS-5

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft^3/s)
Flow (From)	REACH SC-9	1.479	12.300	7.91
Flow (From)	EX-1	3.342	12.250	17.71
Flow (From)	OS-1	1.050	12.150	7.03
Flow (From)	OS-5	0.717	12.200	5.15
Flow (In)	EX DP-1	6.589	12.250	36.03

Pre-Dev 5 Year Routing

Subsection: Addition Summary — Return Event: 5 years
Label: EX DP-2 — Storm Event: TYPE II 24 HOUR

Summary for Hydrograph Addition at 'EX DP-2'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	EX-2
<Catchment to Outflow Node>	OS-2

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft^3/s)
Flow (From)	EX-2	0.197	12.100	1.70
Flow (From)	OS-2	0.045	12.100	0.33
Flow (In)	EX DP-2	0.242	12.100	2.04

Pre-Dev 5 Year Routing

Subsection: Addition Summary — Return Event: 5 years
Label: EX DP-3 — Storm Event: TYPE II 24 HOUR

Summary for Hydrograph Addition at 'EX DP-3'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	EX-3

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft^3/s)
Flow (From)	EX-3	0.531	12.250	2.97
Flow (In)	EX DP-3	0.531	12.250	2.97

Pre-Dev 5 Year Routing

Subsection: Addition Summary — Return Event: 5 years
Label: EX DP-4 — Storm Event: TYPE II 24 HOUR

Summary for Hydrograph Addition at 'EX DP-4'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	EX-6

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft^3/s)
Flow (From)	EX-6	0.143	12.150	0.91
Flow (In)	EX DP-4	0.143	12.150	0.91

Pre-Dev 5 Year Routing

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Pre-Dev 100 Year Routing

Project Summary	
Title	Retreat at TimberRidge Preliminary Drainage Report (South of Arroya Lane)
Engineer	MAW
Company	CCES
Date	6/20/2018

Notes	Pre-Dev 100 year SCS Model

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Pre-Dev 100 Year Routing

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
EX-1	Pre-Development 100 YEAR	100	14.733	12.200	140.28
EX-2	Pre-Development 100 YEAR	100	0.868	12.050	12.19
EX-3	Pre-Development 100 YEAR	100	2.340	12.150	23.71
EX-4	Pre-Development 100 YEAR	100	3.684	12.100	41.75
EX-6	Pre-Development 100 YEAR	100	0.631	12.100	7.12
OS-1	Pre-Development 100 YEAR	100	4.622	12.100	53.88
OS-2	Pre-Development 100 YEAR	100	0.198	12.100	2.53
OS-3	Pre-Development 100 YEAR	100	0.660	12.050	9.91
OS-4	Pre-Development 100 YEAR	100	1.685	12.100	20.68
OS-5	Pre-Development 100 YEAR	100	2.887	12.150	32.06
SC-1	Pre-Development 100 YEAR	100	1.309	12.100	17.33
SC-2	Pre-Development 100 YEAR	100	36.376	12.300	275.26

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
EX DP-1	Pre-Development 100 YEAR	100	28.208	12.150	281.74
EX DP-2	Pre-Development 100 YEAR	100	1.065	12.050	14.65
EX DP-3	Pre-Development 100 YEAR	100	2.340	12.150	23.71
EX DP-4	Pre-Development 100 YEAR	100	0.631	12.100	7.12
EX. 60" CMP at Arroya	Pre-Development 100 YEAR	100	6.029	12.100	71.16
Ex. 36" CMP at Vollmer	Pre-Development 100 YEAR	100	1.309	12.100	17.33
Ex. 60" CMP at Vollmer	Pre-Development 100 YEAR	100	36.376	12.300	275.26

Pre-Dev 100 Year Routing

Subsection: Time-Depth Curve | Return Event: 100 years
Label: Colo Springs 2015 | Storm Event: TYPE II 24 HOUR

Time-Depth Curve: TYPE II 24 HOUR	
Label	TYPE II 24 HOUR
Start Time	0.000 hours
Increment	0.250 hours
End Time	24.000 hours
Return Event	100 years

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.250 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
0.000	0.0	0.0	0.0	0.0	0.1
1.250	0.1	0.1	0.1	0.1	0.1
2.500	0.1	0.1	0.2	0.2	0.2
3.750	0.2	0.2	0.2	0.3	0.3
5.000	0.3	0.3	0.3	0.3	0.4
6.250	0.4	0.4	0.4	0.5	0.5
7.500	0.5	0.5	0.6	0.6	0.6
8.750	0.6	0.7	0.7	0.7	0.8
10.000	0.8	0.9	0.9	1.0	1.1
11.250	1.2	1.3	1.8	3.0	3.3
12.500	3.4	3.5	3.6	3.6	3.7
13.750	3.7	3.8	3.8	3.9	3.9
15.000	3.9	4.0	4.0	4.0	4.1
16.250	4.1	4.1	4.1	4.2	4.2
17.500	4.2	4.2	4.2	4.3	4.3
18.750	4.3	4.3	4.3	4.4	4.4
20.000	4.4	4.4	4.4	4.4	4.4
21.250	4.5	4.5	4.5	4.5	4.5
22.500	4.5	4.5	4.5	4.6	4.6
23.750	4.6	4.6	(N/A)	(N/A)	(N/A)

Pre-Dev 100 Year Routing

Subsection: Addition Summary | Return Event: 100 years
Label: EX DP-1 | Storm Event: TYPE II 24 HOUR

Summary for Hydrograph Addition at 'EX DP-1'

Upstream Link	Upstream Node
REACH SC-9	EX. 60" CMP at Arroya
<Catchment to Outflow Node>	EX-1
<Catchment to Outflow Node>	OS-1
<Catchment to Outflow Node>	OS-5

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft^3/s)
Flow (From)	REACH SC-9	5.967	12.200	61.74
Flow (From)	EX-1	14.733	12.200	140.28
Flow (From)	OS-1	4.622	12.100	53.88
Flow (From)	OS-5	2.887	12.150	32.06
Flow (In)	EX DP-1	28.208	12.150	281.74

Pre-Dev 100 Year Routing

Subsection: Addition Summary | Return Event: 100 years
Label: EX DP-2 | Storm Event: TYPE II 24 HOUR

Summary for Hydrograph Addition at 'EX DP-2'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	EX-2
<Catchment to Outflow Node>	OS-2

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft^3/s)
Flow (From)	EX-2	0.868	12.050	12.19
Flow (From)	OS-2	0.198	12.100	2.53
Flow (In)	EX DP-2	1.065	12.050	14.65

Pre-Dev 100 Year Routing

Subsection: Addition Summary — Return Event: 100 years
Label: EX DP-3 — Storm Event: TYPE II 24 HOUR

Summary for Hydrograph Addition at 'EX DP-3'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	EX-3

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft^3/s)
Flow (From)	EX-3	2.340	12.150	23.71
Flow (In)	EX DP-3	2.340	12.150	23.71

Pre-Dev 100 Year Routing

Subsection: Addition Summary — Return Event: 100 years
Label: EX DP-4 — Storm Event: TYPE II 24 HOUR

Summary for Hydrograph Addition at 'EX DP-4'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	EX-6

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft^3/s)
Flow (From)	EX-6	0.631	12.100	7.12
Flow (In)	EX DP-4	0.631	12.100	7.12

Pre-Dev 100 Year Routing

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STORMWATER QUALITY CALCULATIONS

CLASSIC
CONSULTING
ENGINEERS & SURVEYORS

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.06, November 2016)

Designer:	**Marc A. Whorton, P.E.**
Company:	**CCES**
Date:	**June 22, 2018**
Project:	**The Retreat at TimberRidge Preliminary Drainage Report - Pond B**
Location:	**El Paso County**

1. Basin Storage Volume

A) Effective Imperviousness of Tributary Area, I_a — I_a = 11.0 %

B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$) — i = 0.110

C) Contributing Watershed Area — Area = 33.400 ac

D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm — d_6 = 0.42 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 (WQCV) Based on 40-hour Drain Time
($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area)$ — V_{DESIGN}= 0.202 ac-ft

G) For Watersheds Outside of the Denver Region,
Water Quality Capture Volume (WQCV) Design Volume
($V_{WQCV\ OTHER} = (d_6*(V_{DESIGN}/0.43))$ — $V_{DESIGN\ OTHER}$= 0.197 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: $EURV_A = 1.68 * i^{1.28}$
For HSG B: $EURV_B = 1.36 * i^{1.08}$
For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$
— EURV = 0.349 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: — Rip-Rap Forebays

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**Marc A. Whorton, P.E.**
Company:	**CCES**
Date:	**June 22, 2018**
Project:	**The Retreat at TimberRidge Preliminary Drainage Report - Pond B**
Location:	**El Paso County**

5. Forebay

A) Minimum Forebay Volume (V_{FMIN} = 2% of the WQCV) — V_{FMIN} = 0.004 ac-ft

B) Actual Forebay Volume — V_F = 0.004 ac-ft

C) Forebay Depth (D_F = 18 inch maximum) — D_F = 8.0 in

D) Forebay Discharge

i) Undetained 100-year Peak Discharge — Q_{100} = 60.00 cfs

ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$) — Q_F = 1.20 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 = 9.5 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 = 10 sq ft

C) Outlet Type

Choose One
- ● Orifice Plate
- ○ Other (Describe):

D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention) — $D_{orifice}$ = 0.93 inches

E) Total Outlet Area — A_{ot} = 2.04 square inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**Marc A. Whorton, P.E.**
Company:	**CCES**
Date:	**June 22, 2018**
Project:	**The Retreat at TimberRidge Preliminary Drainage Report - Pond B**
Location:	**El Paso County**

8. Initial Surcharge Volume	
A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches)	D_{IS} = 6 in
B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV)	V_{IS} = cu ft
C) Initial Surcharge Provided Above Micropool	V_s= 5.0 cu ft
9. Trash Rack	
A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$	A_t = 72 square inches
B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open are to the total screen are for the material specified.)	*S.S. Well Screen with 60% Open Area*
Other (Y/N): N	
C) Ratio of Total Open Area to Total Area (only for type 'Other')	User Ratio =
D) Total Water Quality Screen Area (based on screen type)	A_{total} = 120 sq. in.
E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)	H= 3.25 feet
F) Height of Water Quality Screen (H_{TR})	H_{TR}= 67 inches
G) Width of Water Quality Screen Opening ($W_{opening}$) (Minimum of 12 inches is recommended)	$W_{opening}$ = 12.0 inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Marc A. Whorton, P.E.
Company: CCES
Date: June 22, 2018
Project: The Retreat at TimberRidge Preliminary Drainage Report - Pond B
Location: El Paso County

10. Overflow Embankment	
A) Describe embankment protection for 100-year and greater overtopping:	Erosion Control Blanket
B) Slope of Overflow Embankment (Horizontal distance per unit vertical, 4:1 or flatter preferred)	4.00
11. Vegetation	Choose One ○ Irrigated ◉ Not Irrigated
12. Access	
A) Describe Sediment Removal Procedures	Per IM Plan

Notes:

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Marc A. Whorton, P.E.
Company: CCES
Date: August 13, 2018
Project: The Retreat at TimberRidge Preliminary Drainage Report - Pond C
Location: El Paso County

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 11.0 %
B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	i = 0.110
C) Contributing Watershed Area	Area = 32.900 ac
D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = 0.42 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 (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area)$)	V_{DESIGN}= 0.199 ac-ft
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6*(V_{DESIGN}/0.43))$)	$V_{DESIGN\ OTHER}$= 0.194 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: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$	EURV = 0.344 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	Rip-Rap Forebays
A) Describe means of providing energy dissipation at concentrated inflow locations:	

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**Marc A. Whorton, P.E.**
Company:	**CCES**
Date:	**August 13, 2018**
Project:	**The Retreat at TimberRidge Preliminary Drainage Report - Pond C**
Location:	**El Paso County**

5. Forebay

A) Minimum Forebay Volume (V_{FMIN} = 2% of the WQCV) — V_{FMIN} = 0.004 ac-ft

B) Actual Forebay Volume — V_F = 0.004 ac-ft

C) Forebay Depth (D_F = 18 inch maximum) — D_F = 8.0 in

D) Forebay Discharge

i) Undetained 100-year Peak Discharge — Q_{100} = 52.00 cfs

ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$) — Q_F = 1.04 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 = 8.5 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 = 10 sq ft

C) Outlet Type

Choose One
- ◉ Orifice Plate
- ○ Other (Describe):

D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention) — $D_{orifice}$ = 0.94 inches

E) Total Outlet Area — A_{ot} = 2.04 square inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**Marc A. Whorton, P.E.**
Company:	**CCES**
Date:	**August 13, 2018**
Project:	**The Retreat at TimberRidge Preliminary Drainage Report - Pond C**
Location:	**El Paso County**

8. Initial Surcharge Volume

A) Depth of Initial Surcharge Volume
(Minimum recommended depth is 4 inches)
D_{IS} = 6 in

B) Minimum Initial Surcharge Volume
(Minimum volume of 0.3% of the WQCV)
V_{IS} = ______ cu ft

C) Initial Surcharge Provided Above Micropool
V_s= 5.0 cu ft

9. Trash Rack

A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$
A_t = 72 square inches

B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open are to the total screen are for the material specified.)
S.S. Well Screen with 60% Open Area

Other (Y/N): N

C) Ratio of Total Open Area to Total Area (only for type 'Other')
User Ratio =

D) Total Water Quality Screen Area (based on screen type)
A_{total} = 120 sq. in.

E) Depth of Design Volume (EURV or WQCV)
(Based on design concept chosen under 1E)
H= 3.25 feet

F) Height of Water Quality Screen (H_{TR})
H_{TR}= 67 inches

G) Width of Water Quality Screen Opening ($W_{opening}$)
(Minimum of 12 inches is recommended)
$W_{opening}$ = 12.0 inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**Marc A. Whorton, P.E.**
Company:	**CCES**
Date:	**August 13, 2018**
Project:	**The Retreat at TimberRidge Preliminary Drainage Report - Pond C**
Location:	**El Paso County**

10. Overflow Embankment A) Describe embankment protection for 100-year and greater overtopping:	Erosion Control Blanket
B) Slope of Overflow Embankment (Horizontal distance per unit vertical, 4:1 or flatter preferred)	4.00
11. Vegetation	Choose One ○ Irrigated ◉ Not Irrigated
12. Access A) Describe Sediment Removal Procedures	Per IM Plan

Notes:

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.06, November 2016)

Designer:	**Marc A. Whorton, P.E.**
Company:	**CCES**
Date:	**August 13, 2018**
Project:	**The Retreat at TimberRidge Preliminary Drainage Report - Pond D**
Location:	**El Paso County**

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 23.0 %
B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	i = 0.230
C) Contributing Watershed Area	Area = 129.900 ac
D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = 0.42 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 (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area$)	V_{DESIGN}= 1.380 ac-ft
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6 * (V_{DESIGN}/0.43))$	$V_{DESIGN\ OTHER}$= 1.348 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: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$	EURV = 3.010 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:	Rip-Rap Forebays

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**Marc A. Whorton, P.E.**
Company:	**CCES**
Date:	**August 13, 2018**
Project:	**The Retreat at TimberRidge Preliminary Drainage Report - Pond D**
Location:	**El Paso County**

5. Forebay

A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV) — V_{FMIN} = 0.040 ac-ft

B) Actual Forebay Volume — V_F = 0.041 ac-ft

C) Forebay Depth (D_F = 30 inch maximum) — D_F = 18.0 in

D) Forebay Discharge

i) Undetained 100-year Peak Discharge — Q_{100} = 237.00 cfs

ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$) — Q_F = 4.74 cfs

E) Forebay Discharge Design

Choose One
- ○ Berm With Pipe
- ● Wall with Rect. Notch
- ○ Wall with V-Notch Weir

F) Discharge Pipe Size (minimum 8-inches) — Calculated D_P = ______ in

G) Rectangular Notch Width — Calculated W_N = 12.9 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 = 100 sq ft

C) Outlet Type

Choose One
- ● Orifice Plate
- ○ Other (Describe):

D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention) — $D_{orifice}$ = 2.45 inches

E) Total Outlet Area — A_{ot} = 14.19 square inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Marc A. Whorton, P.E.
Company: CCES
Date: August 13, 2018
Project: The Retreat at TimberRidge Preliminary Drainage Report - Pond D
Location: El Paso County

8. Initial Surcharge Volume

A) Depth of Initial Surcharge Volume
(Minimum recommended depth is 4 inches)
D_{IS} = 6 in

B) Minimum Initial Surcharge Volume
(Minimum volume of 0.3% of the WQCV)
V_{IS} = 176.2 cu ft

C) Initial Surcharge Provided Above Micropool
V_s = 50.0 cu ft

9. Trash Rack

A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$
A_t = 433 square inches

B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open are to the total screen are for the material specified.)
Aluminum Amico-Klemp SR Series with Cross Rods 2" O.C.

Other (Y/N): N

C) Ratio of Total Open Area to Total Area (only for type 'Other')
User Ratio =

D) Total Water Quality Screen Area (based on screen type)
A_{total} = 610 sq. in.

E) Depth of Design Volume (EURV or WQCV)
(Based on design concept chosen under 1E)
H= 5 feet

F) Height of Water Quality Screen (H_{TR})
H_{TR}= 88 inches

G) Width of Water Quality Screen Opening ($W_{opening}$)
(Minimum of 12 inches is recommended)
$W_{opening}$ = 12.0 inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Marc A. Whorton, P.E.
Company: CCES
Date: August 13, 2018
Project: The Retreat at TimberRidge Preliminary Drainage Report - Pond D
Location: El Paso County

10. Overflow Embankment	
A) Describe embankment protection for 100-year and greater overtopping:	Erosion Control Blanket
B) Slope of Overflow Embankment (Horizontal distance per unit vertical, 4:1 or flatter preferred)	4.00
11. Vegetation	Choose One ○ Irrigated ● Not Irrigated
12. Access	
A) Describe Sediment Removal Procedures	Per IM Plan

Notes:

DETENTION POND CALCULATIONS

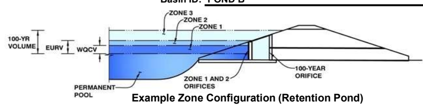
CLASSIC
CONSULTING
ENGINEERS & SURVEYORS

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: RETREAT AT TIMBER RIDGE - PRELIMINARY DRAINAGE REPORT

Basin ID: POND B



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	**EDB**			
Watershed Area =	33.40	acres		
Watershed Length =	1,650	ft		
Watershed Slope =	0.020	ft/ft		
Watershed Imperviousness =	11.00%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	100.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Desired WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			
Water Quality Capture Volume (WQCV) =	0.202	acre-feet	Optional User Override 1-hr Precipitation	
Excess Urban Runoff Volume (EURV) =	0.348	acre-feet		
2-yr Runoff Volume (P1 = 1.19 in.) =	0.241	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.373	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.813	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	2.066	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	2.851	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	3.877	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.85 in.) =	7.196	acre-feet	3.85	inches
Approximate 2-yr Detention Volume =	0.224	acre-feet		
Approximate 5-yr Detention Volume =	0.349	acre-feet		
Approximate 10-yr Detention Volume =	0.696	acre-feet		
Approximate 25-yr Detention Volume =	0.957	acre-feet		
Approximate 50-yr Detention Volume =	1.003	acre-feet		
Approximate 100-yr Detention Volume =	1.289	acre-feet		

Stage-Storage Calculation

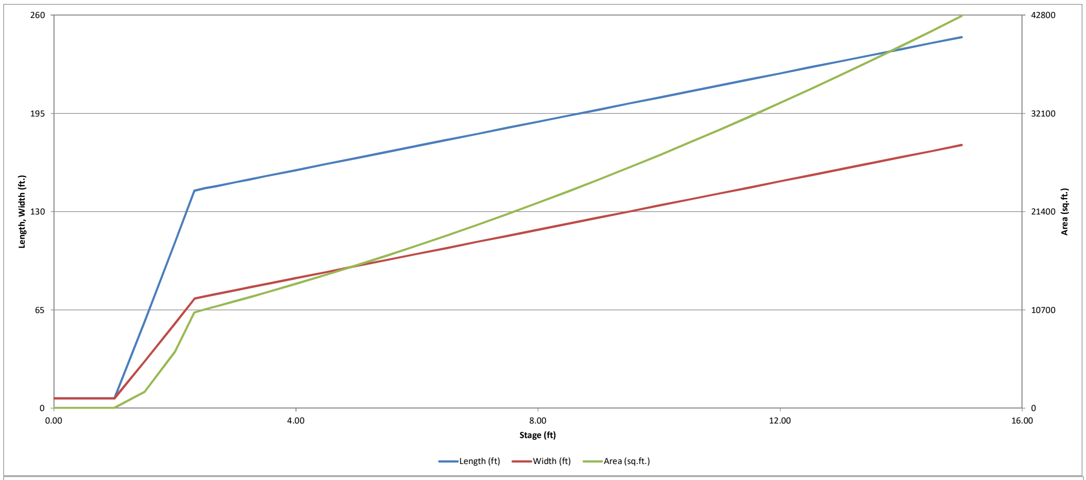
Zone 1 Volume (WQCV) =	0.202	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.146	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.941	acre-feet
Total Detention Basin Volume =	1.289	acre-feet
Initial Surcharge Volume (ISV) =	21	ft^3
Initial Surcharge Depth (ISD) =	0.50	ft
Total Available Detention Depth (H_{total}) =	6.00	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.010	ft/ft
Slopes of Main Basin Sides (S_{main}) =	4	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	2	
Initial Surcharge Area (A_{ISV}) =	42	ft^2
Surcharge Volume Length (L_{ISV}) =	6.5	ft
Surcharge Volume Width (W_{ISV}) =	6.5	ft
Depth of Basin Floor (H_{FLOOR}) =	1.32	ft
Length of Basin Floor (L_{FLOOR}) =	144.0	ft
Width of Basin Floor (W_{FLOOR}) =	72.6	ft
Area of Basin Floor (A_{FLOOR}) =	10,459	ft^2
Volume of Basin Floor (V_{FLOOR}) =	4,922	ft^3
Depth of Main Basin (H_{MAIN}) =	3.68	ft
Length of Main Basin (L_{MAIN}) =	173.4	ft
Width of Main Basin (W_{MAIN}) =	102.0	ft
Area of Main Basin (A_{MAIN}) =	17,699	ft^2
Volume of Main Basin (V_{MAIN}) =	51,199	ft^3
Calculated Total Basin Volume (V_{total}) =	**1.289**	acre-feet

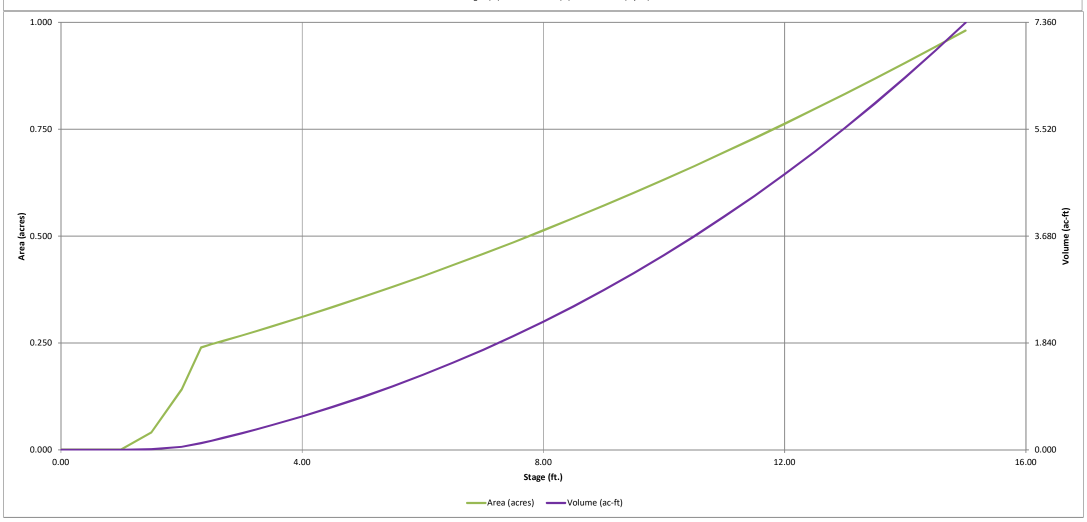
Depth Increment = 0.5 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	0.00		6.5	6.5	42		0.001		
ISV	0.50		6.5	6.5	42		0.001	21	0.000
	1.00		6.5	6.5	42		0.001	42	0.001
	1.50		57.5	31.0	1,782		0.041	387	0.009
	2.00		109.5	56.0	6,132		0.141	2,258	0.052
Floor	2.32		143.8	72.5	10,427		0.239	4,959	0.114
	2.50		145.4	74.0	10,769		0.247	6,869	0.158
Zone 1 (WQCV)	2.68		146.9	75.5	11,087		0.255	8,836	0.203
	3.00		149.4	78.0	11,663		0.268	12,475	0.286
Zone 2 (EURV)	3.23		151.3	79.9	12,085		0.277	15,206	0.349
	3.50		153.4	82.0	12,589		0.289	18,537	0.426
	4.00		157.4	86.0	13,547		0.311	25,070	0.576
	4.50		161.4	90.0	14,537		0.334	32,089	0.737
	5.00		165.4	94.0	15,559		0.357	39,612	0.909
	5.50		169.4	98.0	16,613		0.381	47,654	1.094
Zone 3 (100-year)	6.00		173.4	102.0	17,699		0.406	56,230	1.291
	6.50		177.4	106.0	18,817		0.432	65,358	1.500
	7.00		181.4	110.0	19,967		0.458	75,052	1.723
	7.50		185.4	114.0	21,149		0.486	85,330	1.959
	8.00		189.4	118.0	22,363		0.513	96,206	2.209
	8.50		193.4	122.0	23,609		0.542	107,698	2.472
	9.00		197.4	126.0	24,886		0.571	119,820	2.751
	9.50		201.4	130.0	26,196		0.601	132,589	3.044
	10.00		205.4	134.0	27,538		0.632	146,022	3.352
	10.50		209.4	138.0	28,912		0.664	160,133	3.676
	11.00		213.4	142.0	30,318		0.696	174,939	4.016
	11.50		217.4	146.0	31,756		0.729	190,457	4.372
	12.00		221.4	150.0	33,226		0.763	206,701	4.745
	12.50		225.4	154.0	34,728		0.797	223,688	5.135
	13.00		229.4	158.0	36,262		0.832	241,434	5.543
	13.50		233.4	162.0	37,828		0.868	259,955	5.968
	14.00		237.4	166.0	39,426		0.905	279,268	6.411
	14.50		241.4	170.0	41,056		0.943	299,387	6.873
	15.00		245.4	174.0	42,718		0.981	320,329	7.354

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



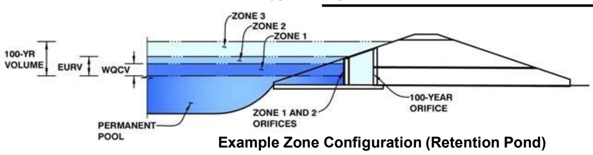


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: RETREAT AT TIMBER RIDGE - PRELIMINARY DRAINAGE REPORT

Basin ID: POND B



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.68	0.202	Orifice Plate
Zone 2 (EURV)	3.23	0.146	Orifice Plate
Zone 3 (100-year)	6.00	0.941	Weir&Pipe (Restrict)
		1.289	Total

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

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

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	3.25	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	13.00	inches
Orifice Plate: Orifice Area per Row =	0.68	sq. inches (diameter = 15/16 inch)

Calculated Parameters for Plate

WQ Orifice Area per Row =	4.722E-03	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.10	2.20					
Orifice Area (sq. inches)	0.68	0.68	0.68					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	N/A	feet

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.25	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00	N/A	feet
Overflow Weir Slope =	4.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Open Area % =	75%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	4.25	N/A	feet
Over Flow Weir Slope Length =	4.12	N/A	feet
Grate Open Area / 100-yr Orifice Area =	5.99	N/A	should be $\geq$ 4
Overflow Grate Open Area w/o Debris =	12.37	N/A	ft^2
Overflow Grate Open Area w/ Debris =	6.18	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	24.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	15.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	2.07	N/A	ft^2
Outlet Orifice Centroid =	0.71	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.82	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.25	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	20.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

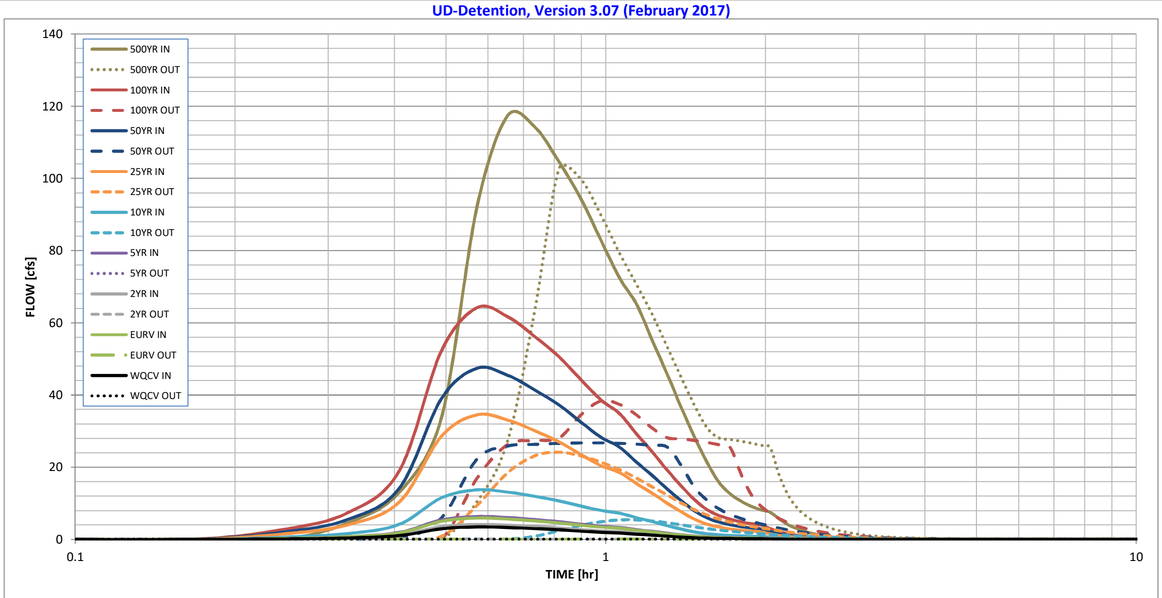
Spillway Design Flow Depth=	0.79	feet
Stage at Top of Freeboard =	8.04	feet
Basin Area at Top of Freeboard =	0.52	acres

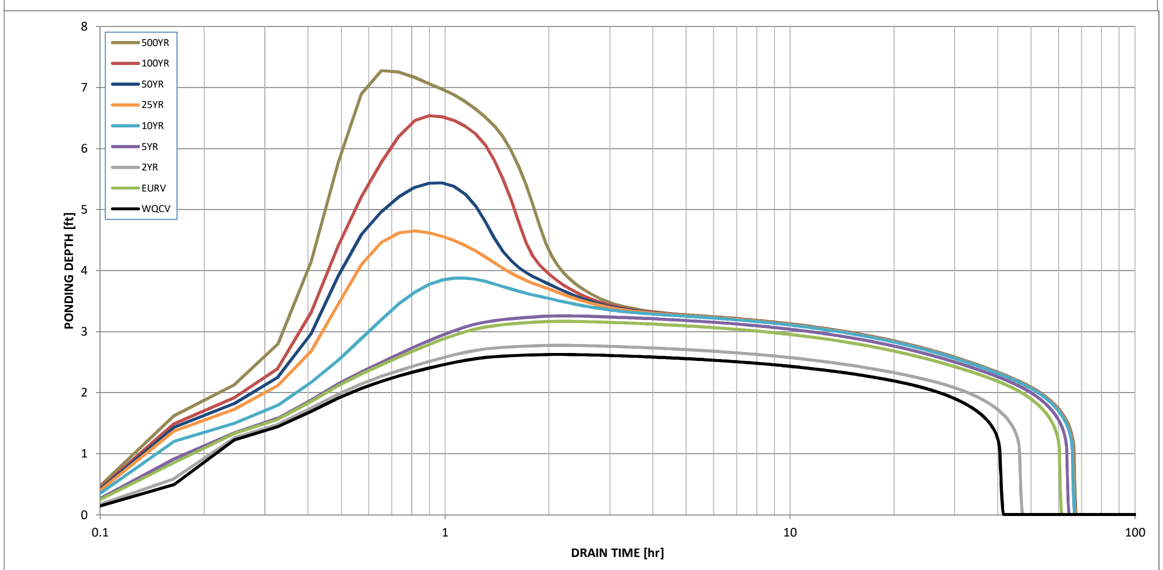
Routed Hydrograph Results

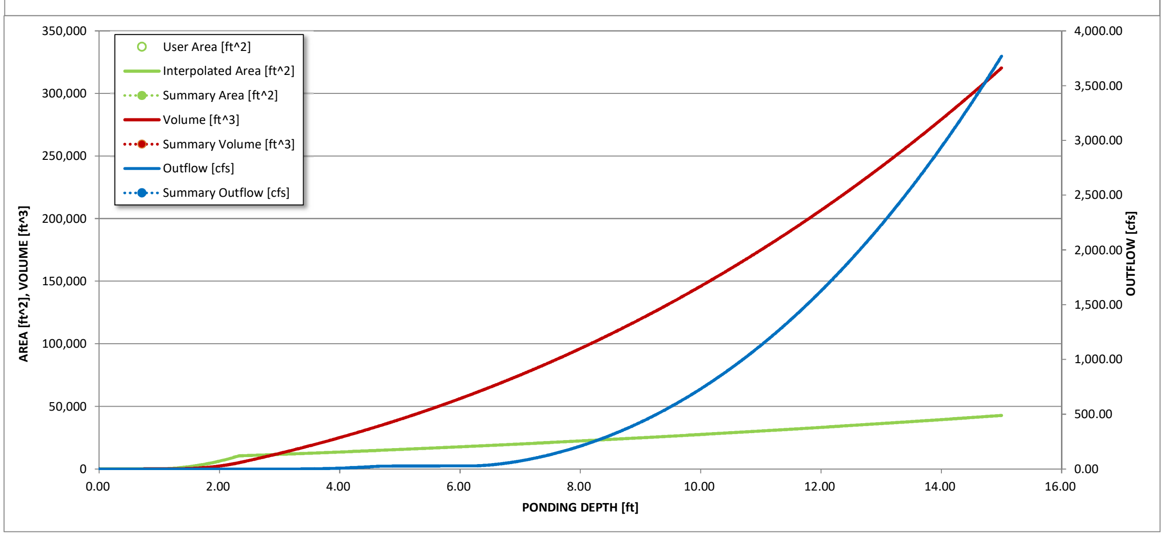
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.85
Calculated Runoff Volume (acre-ft) =	0.202	0.348	0.241	0.373	0.813	2.066	2.851	3.877	7.196
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.201	0.347	0.241	0.372	0.812	2.065	2.850	3.876	7.191
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.21	0.68	0.94	1.27	2.29
Predevelopment Peak Q (cfs) =	0.0	0.0	0.4	0.7	6.9	22.7	31.5	42.3	76.6
Peak Inflow Q (cfs) =	3.5	5.9	4.1	6.4	13.7	34.5	47.4	64.2	117.4
Peak Outflow Q (cfs) =	0.1	0.1	0.1	0.1	5.4	24.2	26.7	38.4	102.7
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.1	0.8	1.1	0.8	0.9	1.3
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Spillway	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.0	0.4	1.9	2.2	2.3	2.4
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	39	57	44	60	59	51	46	40	24
Time to Drain 99% of Inflow Volume (hours) =	**40**	60	46	63	64	60	59	56	49
Maximum Ponding Depth (ft) =	2.63	3.17	2.78	3.26	3.88	4.65	5.44	6.54	7.28
Area at Maximum Ponding Depth (acres) =	0.25	0.27	0.26	0.28	0.31	0.34	0.38	0.43	0.47
Maximum Volume Stored (acre-ft) =	0.188	0.330	0.226	0.355	0.535	0.787	1.067	1.513	1.849

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename:

Storm Inflow Hydrographs **UD-Detention, Version 3.07 (February 2017)**

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

Time Interval	Hydrograph Constant
4.90 min	1.020

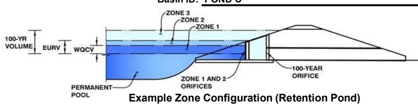
SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:04:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:09:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:14:42	0.16	0.27	0.19	0.28	0.61	1.48	2.01	2.68	4.57
0:19:36	0.42	0.71	0.50	0.76	1.63	4.05	5.53	7.42	13.09
0:24:30	1.08	1.83	1.28	1.96	4.20	10.40	14.21	19.05	33.62
0:29:24	2.96	5.04	3.52	5.39	11.53	28.55	38.98	52.25	92.02
0:34:18	3.46	5.93	4.13	6.35	13.73	34.51	47.42	64.17	117.38
0:39:12	3.29	5.65	3.93	6.05	13.11	33.05	45.47	61.68	114.23
0:44:06	3.00	5.14	3.57	5.51	11.94	30.08	41.38	56.15	104.53
0:49:00	2.66	4.58	3.18	4.90	10.67	27.02	37.22	50.57	94.27
0:53:54	2.28	3.93	2.72	4.22	9.23	23.49	32.46	44.22	82.80
0:58:48	1.99	3.43	2.38	3.68	8.04	20.42	28.28	38.59	72.44
1:03:42	1.80	3.11	2.15	3.33	7.28	18.51	25.58	34.85	65.11
1:08:36	1.47	2.55	1.76	2.74	6.02	15.44	21.38	29.19	54.96
1:13:30	1.19	2.07	1.42	2.22	4.93	12.73	17.67	24.18	45.66
1:18:24	0.89	1.58	1.08	1.70	3.81	9.99	13.93	19.14	36.49
1:23:18	0.65	1.16	0.79	1.25	2.85	7.62	10.69	14.77	28.39
1:28:12	0.48	0.85	0.58	0.91	2.06	5.61	7.92	11.02	21.41
1:33:06	0.38	0.66	0.45	0.71	1.59	4.25	5.98	8.27	15.91
1:38:00	0.31	0.54	0.37	0.59	1.31	3.46	4.84	6.66	12.68
1:42:54	0.26	0.46	0.32	0.50	1.11	2.92	4.08	5.60	10.64
1:47:48	0.23	0.41	0.28	0.44	0.97	2.55	3.56	4.88	9.23
1:52:42	0.21	0.37	0.25	0.39	0.88	2.29	3.18	4.36	8.23
1:57:36	0.20	0.34	0.23	0.37	0.81	2.10	2.92	4.00	7.52
2:02:30	0.14	0.25	0.17	0.27	0.59	1.55	2.16	2.98	5.70
2:07:24	0.10	0.18	0.13	0.20	0.43	1.13	1.57	2.16	4.11
2:12:18	0.08	0.13	0.09	0.14	0.32	0.83	1.16	1.59	3.05
2:17:12	0.06	0.10	0.07	0.11	0.23	0.62	0.86	1.19	2.27
2:22:06	0.04	0.07	0.05	0.07	0.17	0.45	0.63	0.87	1.67
2:27:00	0.03	0.05	0.03	0.05	0.12	0.32	0.45	0.62	1.21
2:31:54	0.02	0.03	0.02	0.04	0.09	0.23	0.33	0.45	0.87
2:36:48	0.01	0.02	0.01	0.02	0.06	0.16	0.23	0.31	0.62
2:41:42	0.01	0.01	0.01	0.01	0.03	0.10	0.14	0.20	0.41
2:46:36	0.00	0.01	0.00	0.01	0.02	0.05	0.08	0.12	0.24
2:51:30	0.00	0.00	0.00	0.00	0.01	0.02	0.03	0.05	0.11
2:56:24	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.04
3:01:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:06:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:11:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:16:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:20:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:25:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:30:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:35:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:40:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:45:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:50:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:55:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:00:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:09:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:14:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:19:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:24:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:29:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:34:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:39:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:44:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:49:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:54:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:58:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:03:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:08:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:13:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:18:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:23:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:28:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:33:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:38:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:43:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:47:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:52:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: RETREAT AT TIMBER RIDGE - PRELIMINARY DRAINAGE REPORT

Basin ID: POND C



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB				
Watershed Area =	32.90	acres			
Watershed Length =	2,250	ft			
Watershed Slope =	0.018	ft/ft			
Watershed Imperviousness =	11.00%	percent			
Percentage Hydrologic Soil Group A =	0.0%	percent			
Percentage Hydrologic Soil Group B =	100.0%	percent			
Percentage Hydrologic Soil Groups C/D =	0.0%	percent			
Desired WQCV Drain Time =	40.0	hours			
Location for 1-hr Rainfall Depths =	User Input				
Water Quality Capture Volume (WQCV) =	0.199	acre-feet	Optional User Override		
Excess Urban Runoff Volume (EURV) =	0.343	acre-feet	1-hr Precipitation		
2-yr Runoff Volume (P1 = 1.19 in.) =	0.238	acre-feet	1.19	inches	
5-yr Runoff Volume (P1 = 1.5 in.) =	0.367	acre-feet	1.50	inches	
10-yr Runoff Volume (P1 = 1.75 in.) =	0.801	acre-feet	1.75	inches	
25-yr Runoff Volume (P1 = 2 in.) =	2.035	acre-feet	2.00	inches	
50-yr Runoff Volume (P1 = 2.25 in.) =	2.809	acre-feet	2.25	inches	
100-yr Runoff Volume (P1 = 2.52 in.) =	3.819	acre-feet	2.52	inches	
500-yr Runoff Volume (P1 = 3.85 in.) =	7.088	acre-feet	3.85	inches	
Approximate 2-yr Detention Volume =	0.221	acre-feet			
Approximate 5-yr Detention Volume =	0.344	acre-feet			
Approximate 10-yr Detention Volume =	0.685	acre-feet			
Approximate 25-yr Detention Volume =	0.942	acre-feet			
Approximate 50-yr Detention Volume =	0.988	acre-feet			
Approximate 100-yr Detention Volume =	1.270	acre-feet			

Stage-Storage Calculation

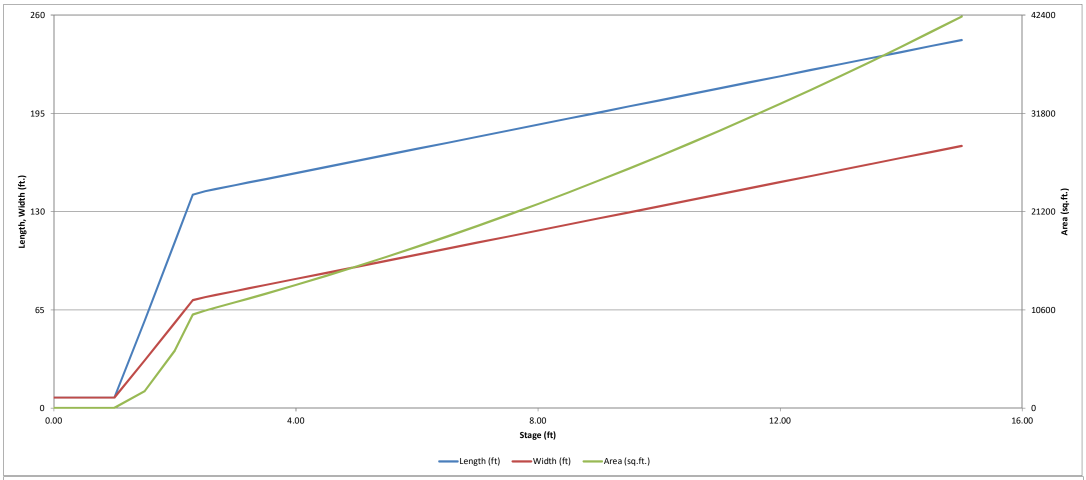
Zone 1 Volume (WQCV) =	0.199	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.144	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.927	acre-feet
Total Detention Basin Volume =	1.270	acre-feet
Initial Surcharge Volume (ISV) =	25	ft^3
Initial Surcharge Depth (ISD) =	0.50	ft
Total Available Detention Depth (H_{total}) =	6.00	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.010	ft/ft
Slopes of Main Basin Sides (S_{main}) =	4	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	2	
Initial Surcharge Area (A_{ISV}) =	50	ft^2
Surcharge Volume Length (L_{ISV}) =	7.0	ft
Surcharge Volume Width (W_{ISV}) =	7.0	ft
Depth of Basin Floor (H_{FLOOR}) =	1.30	ft
Length of Basin Floor (L_{FLOOR}) =	141.9	ft
Width of Basin Floor (W_{FLOOR}) =	71.9	ft
Area of Basin Floor (A_{FLOOR}) =	10,199	ft^2
Volume of Basin Floor (V_{FLOOR}) =	4,737	ft^3
Depth of Main Basin (H_{MAIN}) =	3.70	ft
Length of Main Basin (L_{MAIN}) =	171.5	ft
Width of Main Basin (W_{MAIN}) =	101.5	ft
Area of Main Basin (A_{MAIN}) =	17,411	ft^2
Volume of Main Basin (V_{MAIN}) =	50,533	ft^3
Calculated Total Basin Volume (V_{total}) =	**1.270**	acre-feet

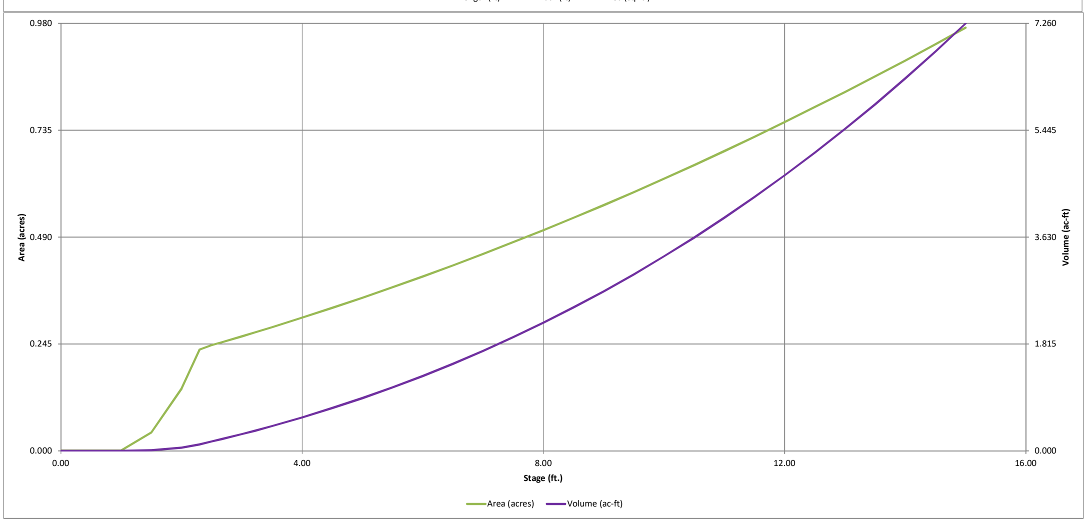
Depth Increment = 0.5 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	0.00		7.0	7.0	50		0.001		
ISV	0.50		7.0	7.0	50		0.001	24	0.001
	1.00		7.0	7.0	50		0.001	49	0.001
	1.50		58.0	31.5	1,830		0.042	408	0.009
	2.00		110.0	56.5	6,220		0.143	2,312	0.053
Floor	2.30		141.2	71.5	10,102		0.232	4,737	0.109
	2.50		143.5	73.5	10,550		0.242	6,914	0.159
Zone 1 (WQCV)	2.67		144.9	74.9	10,847		0.249	8,733	0.200
	3.00		147.5	77.5	11,434		0.262	12,408	0.285
Zone 2 (EURV)	3.22		149.3	79.3	11,833		0.272	14,968	0.344
	3.50		151.5	81.5	12,350		0.284	18,353	0.421
	4.00		155.5	85.5	13,298		0.305	24,764	0.568
	4.50		159.5	89.5	14,278		0.328	31,657	0.727
	5.00		163.5	93.5	15,290		0.351	39,047	0.896
	5.50		167.5	97.5	16,334		0.375	46,952	1.078
Zone 3 (100-year)	6.00		171.5	101.5	17,411		0.400	55,387	1.272
	6.50		175.5	105.5	18,519		0.425	64,368	1.478
	7.00		179.5	109.5	19,659		0.451	73,911	1.697
	7.50		183.5	113.5	20,831		0.478	84,032	1.929
	8.00		187.5	117.5	22,035		0.506	94,747	2.175
	8.50		191.5	121.5	23,271		0.534	106,073	2.435
	9.00		195.5	125.5	24,539		0.563	118,024	2.709
	9.50		199.5	129.5	25,839		0.593	130,617	2.999
	10.00		203.5	133.5	27,172		0.624	143,869	3.303
	10.50		207.5	137.5	28,536		0.655	157,794	3.622
	11.00		211.5	141.5	29,932		0.687	172,410	3.958
	11.50		215.5	145.5	31,360		0.720	187,731	4.310
	12.00		219.5	149.5	32,820		0.753	203,775	4.678
	12.50		223.5	153.5	34,312		0.788	220,557	5.063
	13.00		227.5	157.5	35,836		0.823	238,092	5.466
	13.50		231.5	161.5	37,392		0.858	256,398	5.886
	14.00		235.5	165.5	38,981		0.895	275,490	6.324
	14.50		239.5	169.5	40,601		0.932	295,384	6.781
	15.00		243.5	173.5	42,253		0.970	316,096	7.257

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



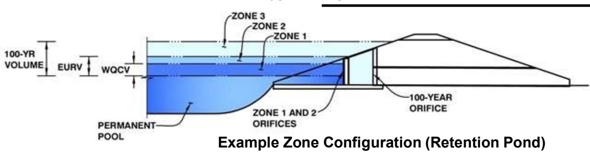


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: RETREAT AT TIMBER RIDGE - PRELIMINARY DRAINAGE REPORT

Basin ID: POND C



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.67	0.199	Orifice Plate
Zone 2 (EURV)	3.22	0.144	Orifice Plate
Zone 3 (100-year)	6.00	0.927	Weir&Pipe (Restrict)
		1.270	Total

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

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

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	3.25	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	13.00	inches
Orifice Plate: Orifice Area per Row =	0.68	sq. inches (diameter = 15/16 inch)

Calculated Parameters for Plate

WQ Orifice Area per Row =	4.722E-03	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.10	2.20					
Orifice Area (sq. inches)	0.68	0.68	0.68					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	N/A	feet

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.25	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00	N/A	feet
Overflow Weir Slope =	4.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Open Area % =	75%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	4.25	N/A	feet
Over Flow Weir Slope Length =	4.12	N/A	feet
Grate Open Area / 100-yr Orifice Area =	5.99	N/A	should be $\geq$ 4
Overflow Grate Open Area w/o Debris =	12.37	N/A	ft^2
Overflow Grate Open Area w/ Debris =	6.18	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	24.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	15.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	2.07	N/A	ft^2
Outlet Orifice Centroid =	0.71	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.82	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.25	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	20.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

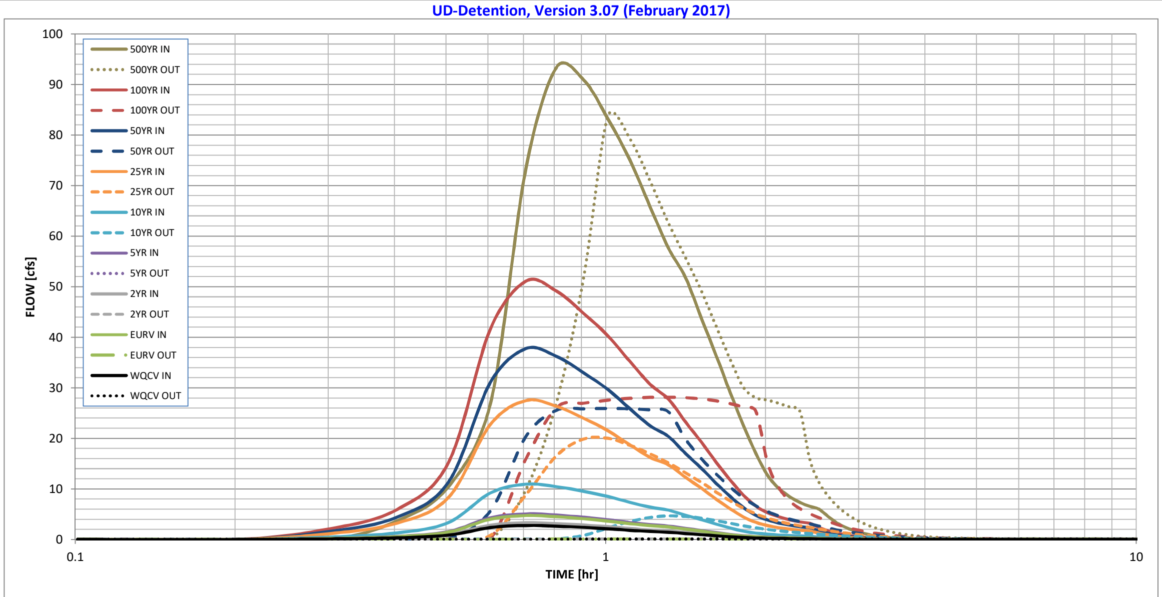
Spillway Design Flow Depth=	0.79	feet
Stage at Top of Freeboard =	8.04	feet
Basin Area at Top of Freeboard =	0.51	acres

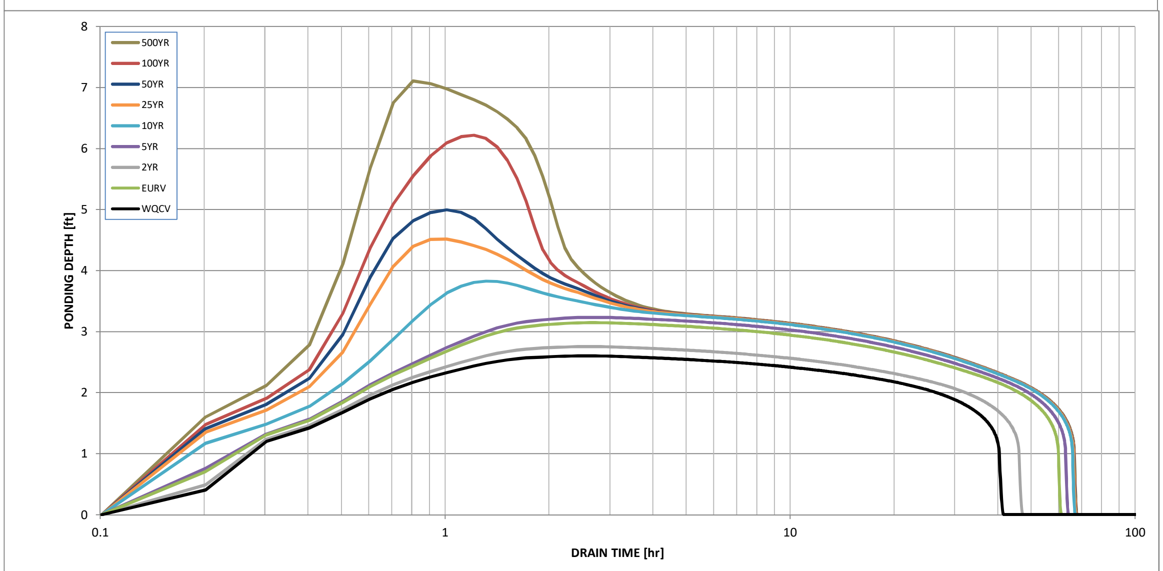
Routed Hydrograph Results

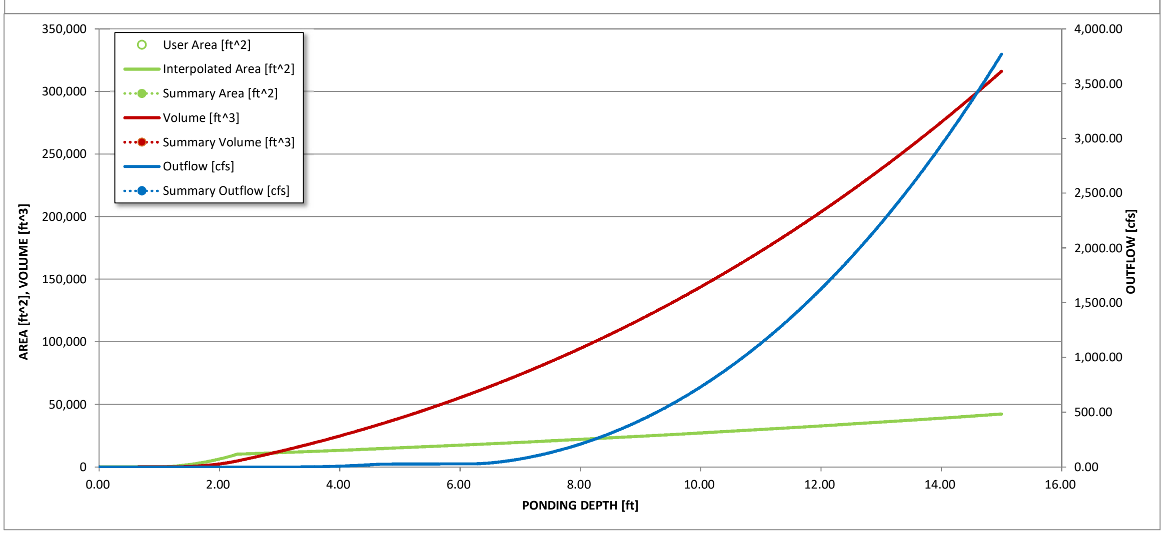
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.85
Calculated Runoff Volume (acre-ft) =	0.199	0.343	0.238	0.367	0.801	2.035	2.809	3.819	7.088
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.198	0.342	0.238	0.366	0.800	2.033	2.806	3.816	7.077
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.15	0.53	0.73	0.99	1.81
Predevelopment Peak Q (cfs) =	0.0	0.0	0.3	0.5	5.0	17.4	24.1	32.7	59.5
Peak Inflow Q (cfs) =	2.8	4.7	3.3	5.1	10.9	27.5	37.8	51.1	93.4
Peak Outflow Q (cfs) =	0.1	0.1	0.1	0.1	4.7	20.0	25.9	28.1	83.8
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.2	0.9	1.2	1.1	0.9	1.4
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.4	1.6	2.1	2.3	2.4
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	39	57	44	60	59	51	46	40	25
Time to Drain 99% of Inflow Volume (hours) =	40	59	46	62	64	61	59	57	49
Maximum Ponding Depth (ft) =	2.60	3.15	2.75	3.23	3.83	4.52	5.00	6.22	7.11
Area at Maximum Ponding Depth (acres) =	0.25	0.27	0.25	0.27	0.30	0.33	0.35	0.41	0.46
Maximum Volume Stored (acre-ft) =	0.183	0.322	0.221	0.346	0.514	0.730	0.893	1.357	1.742

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename:

Storm Inflow Hydrographs **UD-Detention, Version 3.07 (February 2017)**

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

Time Interval	6.06 min
Hydrograph Constant	0.825

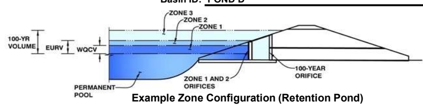
SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:06:04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:12:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:18:11	0.13	0.21	0.15	0.23	0.48	1.18	1.60	2.13	3.65
0:24:14	0.33	0.57	0.40	0.61	1.30	3.23	4.41	5.91	10.43
0:30:18	0.86	1.46	1.02	1.56	3.34	8.28	11.32	15.18	26.79
0:36:22	2.36	4.01	2.81	4.29	9.19	22.74	31.05	41.63	73.34
0:42:25	2.76	4.73	3.30	5.05	10.94	27.47	37.76	51.10	93.44
0:48:29	2.62	4.50	3.14	4.81	10.44	26.31	36.20	49.11	90.89
0:54:32	2.39	4.10	2.85	4.38	9.51	23.95	32.95	44.70	83.16
1:00:36	2.12	3.65	2.54	3.90	8.50	21.50	29.63	40.26	75.00
1:06:40	1.81	3.13	2.17	3.36	7.35	18.70	25.84	35.20	65.86
1:12:43	1.59	2.74	1.90	2.93	6.40	16.25	22.51	30.72	57.62
1:18:47	1.43	2.48	1.72	2.65	5.80	14.73	20.37	27.74	51.79
1:24:50	1.17	2.03	1.40	2.18	4.80	12.29	17.02	23.23	43.71
1:30:54	0.94	1.65	1.14	1.77	3.92	10.13	14.07	19.24	36.32
1:36:58	0.71	1.26	0.86	1.35	3.03	7.95	11.08	15.23	29.01
1:43:01	0.52	0.93	0.63	0.99	2.27	6.06	8.50	11.75	22.57
1:49:05	0.38	0.68	0.46	0.72	1.64	4.46	6.30	8.76	17.01
1:55:08	0.30	0.53	0.36	0.56	1.27	3.38	4.76	6.58	12.65
2:01:12	0.25	0.43	0.30	0.47	1.04	2.75	3.85	5.30	10.08
2:07:16	0.21	0.37	0.25	0.40	0.88	2.32	3.24	4.46	8.46
2:13:19	0.19	0.32	0.22	0.35	0.77	2.03	2.83	3.88	7.34
2:19:23	0.17	0.29	0.20	0.31	0.70	1.82	2.53	3.47	6.55
2:25:26	0.16	0.27	0.19	0.29	0.64	1.67	2.32	3.18	5.98
2:31:30	0.11	0.20	0.14	0.21	0.47	1.23	1.72	2.37	4.53
2:37:34	0.08	0.15	0.10	0.16	0.35	0.90	1.25	1.71	3.27
2:43:37	0.06	0.11	0.07	0.11	0.25	0.66	0.92	1.27	2.42
2:49:41	0.04	0.08	0.05	0.08	0.19	0.49	0.68	0.94	1.80
2:55:44	0.03	0.06	0.04	0.06	0.13	0.36	0.50	0.69	1.33
3:01:48	0.02	0.04	0.03	0.04	0.09	0.25	0.36	0.49	0.96
3:07:52	0.02	0.03	0.02	0.03	0.07	0.18	0.26	0.36	0.69
3:13:55	0.01	0.02	0.01	0.02	0.04	0.13	0.18	0.25	0.49
3:19:59	0.01	0.01	0.01	0.01	0.03	0.08	0.11	0.16	0.32
3:26:02	0.00	0.00	0.00	0.01	0.01	0.04	0.06	0.09	0.19
3:32:06	0.00	0.00	0.00	0.00	0.00	0.02	0.03	0.04	0.09
3:38:10	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.03
3:44:13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:50:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:56:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:02:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:08:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:14:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:20:35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:26:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:32:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:38:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:44:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:50:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:56:56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:03:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:09:04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:15:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:21:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:27:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:33:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:39:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:45:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:51:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:57:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:03:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:09:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:15:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:21:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:27:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:33:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:39:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:46:01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:52:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:58:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7:04:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7:10:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7:16:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: RETREAT AT TIMBER RIDGE - PRELIMINARY DRAINAGE REPORT

Basin ID: POND D



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	**EDB**	
Watershed Area =	129.90	acres
Watershed Length =	4,200	ft
Watershed Slope =	0.025	ft/ft
Watershed Imperviousness =	23.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

			Optional User Override 1-hr Precipitation	
Water Quality Capture Volume (WQCV) =	1.380	acre-feet		
Excess Urban Runoff Volume (EURV) =	3.002	acre-feet		
2-yr Runoff Volume (P1 = 1.19 in.) =	2.241	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	3.260	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	5.372	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	10.000	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	12.983	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	16.885	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.85 in.) =	30.147	acre-feet	3.85	inches
Approximate 2-yr Detention Volume =	2.089	acre-feet		
Approximate 5-yr Detention Volume =	3.057	acre-feet		
Approximate 10-yr Detention Volume =	4.755	acre-feet		
Approximate 25-yr Detention Volume =	5.748	acre-feet		
Approximate 50-yr Detention Volume =	6.069	acre-feet		
Approximate 100-yr Detention Volume =	7.367	acre-feet		

Stage-Storage Calculation

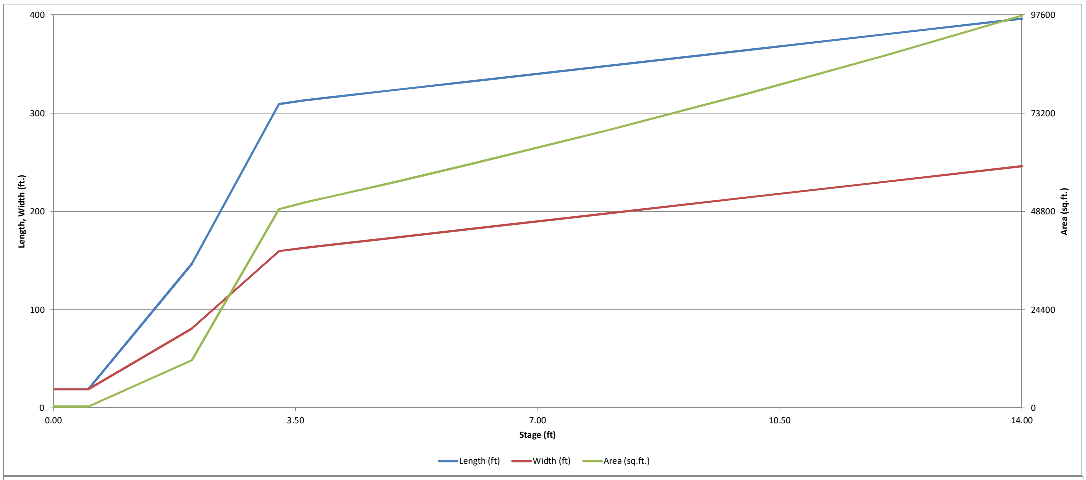
Zone 1 Volume (WQCV) =	1.380	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.621	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	4.365	acre-feet
Total Detention Basin Volume =	7.367	acre-feet
Initial Surcharge Volume (ISV) =	180	ft^3
Initial Surcharge Depth (ISD) =	0.50	ft
Total Available Detention Depth (H_{total}) =	8.00	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.008	ft/ft
Slopes of Main Basin Sides (S_{main}) =	4	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	2	
Initial Surcharge Area (A_{ISV}) =	359	ft^2
Surcharge Volume Length (L_{ISV}) =	19.0	ft
Surcharge Volume Width (W_{ISV}) =	19.0	ft
Depth of Basin Floor (H_{FLOOR}) =	2.26	ft
Length of Basin Floor (L_{FLOOR}) =	310.1	ft
Width of Basin Floor (W_{FLOOR}) =	160.0	ft
Area of Basin Floor (A_{FLOOR}) =	49,610	ft^2
Volume of Basin Floor (V_{FLOOR}) =	40,764	ft^3
Depth of Main Basin (H_{MAIN}) =	4.74	ft
Length of Main Basin (L_{MAIN}) =	348.0	ft
Width of Main Basin (W_{MAIN}) =	197.9	ft
Area of Main Basin (A_{MAIN}) =	68,887	ft^2
Volume of Main Basin (V_{MAIN}) =	279,784	ft^3
Calculated Total Basin Volume (V_{total}) =	**7.367**	acre-feet

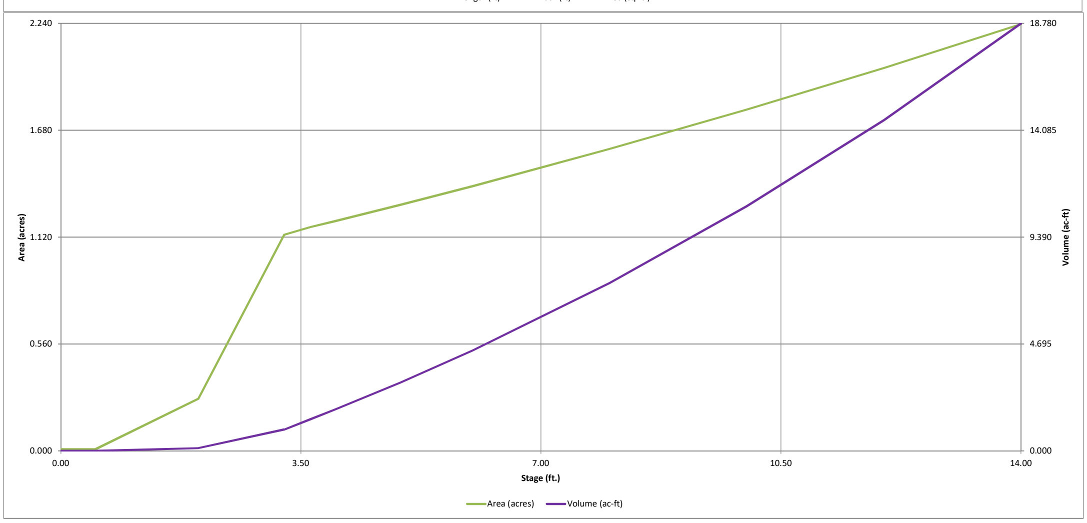
Depth Increment = 2 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	0.00		19.0	19.0	359		0.008		
ISV	0.50		19.0	19.0	359		0.008	176	0.004
	2.00		146.7	80.8	11,854		0.272	5,101	0.117
Floor	3.26		309.2	159.6	49,342		1.133	40,967	0.940
Zone 1 (WQCV)	3.64		313.1	163.1	51,060		1.172	60,591	1.391
	4.00		316.0	165.9	52,440		1.204	79,220	1.819
Zone 2 (EURV)	4.95		323.6	173.5	56,161		1.289	130,796	3.003
	6.00		332.0	181.9	60,407		1.387	191,982	4.407
Zone 3 (100-year)	8.00		348.0	197.9	68,887		1.581	321,191	7.374
	10.00		364.0	213.9	77,878		1.788	467,870	10.741
	12.00		380.0	229.9	87,381		2.006	633,044	14.533
	14.00		396.0	245.9	97,397		2.236	817,737	18.773

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



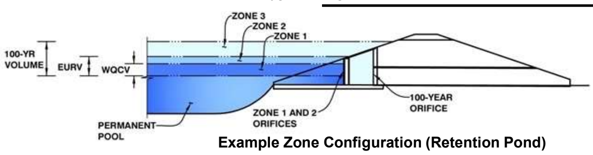


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: RETREAT AT TIMBER RIDGE - PRELIMINARY DRAINAGE REPORT

Basin ID: POND D



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.64	1.380	Orifice Plate
Zone 2 (EURV)	4.95	1.621	Orifice Plate
Zone 3 (100-year)	8.00	4.365	Weir&Pipe (Restrict)
		7.367	Total

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

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

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	5.00	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	20.00	inches
Orifice Plate: Orifice Area per Row =	4.73	sq. inches (use rectangular openings)

Calculated Parameters for Plate

WQ Orifice Area per Row =	3.285E-02	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.70	3.40					
Orifice Area (sq. inches)	4.73	4.73	4.73					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	N/A	feet

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	5.00	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	10.00	N/A	feet
Overflow Weir Slope =	4.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Open Area % =	75%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	6.00	N/A	feet
Over Flow Weir Slope Length =	4.12	N/A	feet
Grate Open Area / 100-yr Orifice Area =	3.21	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	30.92	N/A	ft^2
Overflow Grate Open Area w/ Debris =	15.46	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	42.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	42.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	9.62	N/A	ft^2
Outlet Orifice Centroid =	1.75	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	8.25	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	80.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.96	feet
Stage at Top of Freeboard =	10.21	feet
Basin Area at Top of Freeboard =	1.81	acres

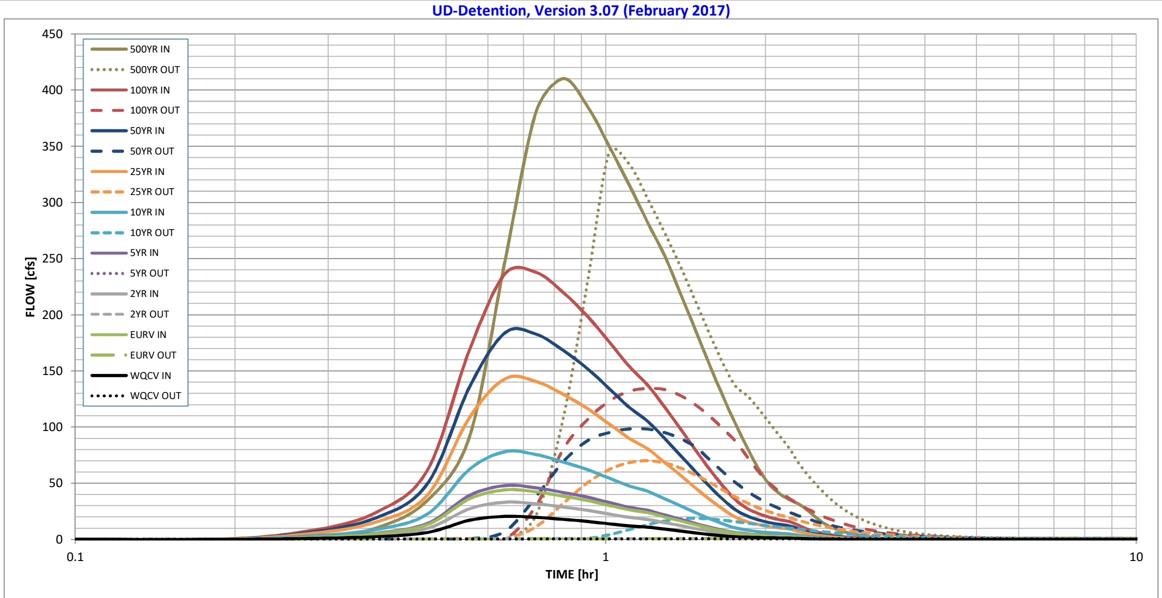
Routed Hydrograph Results

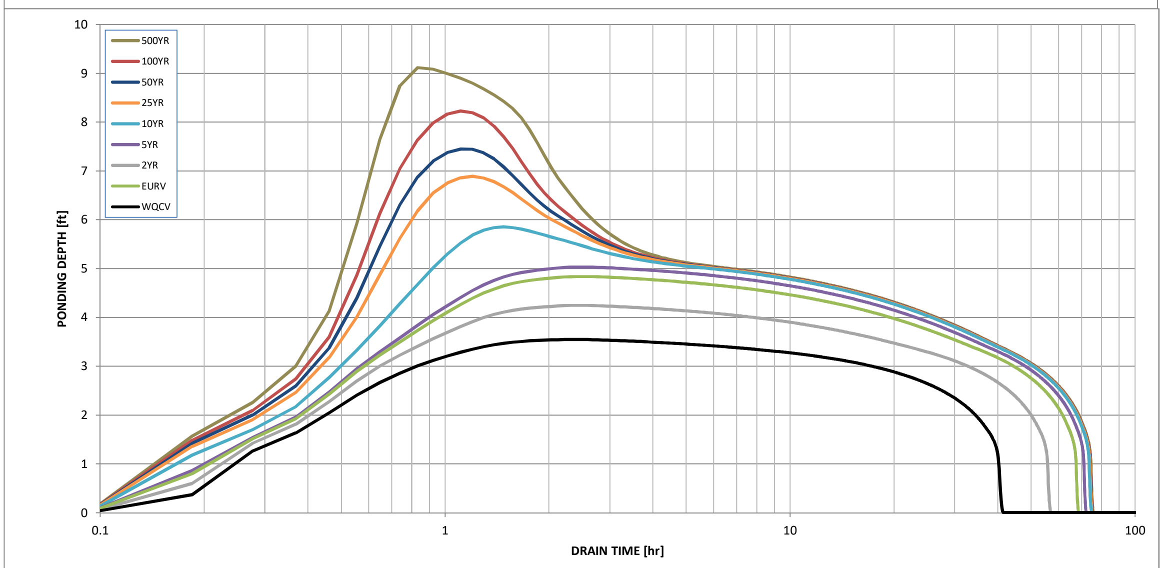
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.85
Calculated Runoff Volume (acre-ft) =	1.380	3.002	2.241	3.260	5.372	10.000	12.983	16.885	30.147
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	1.381	3.003	2.242	3.261	5.375	10.006	12.987	16.888	30.157
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.17	0.59	0.81	1.10	1.99
Predevelopment Peak Q (cfs) =	0.0	0.0	1.4	2.4	22.4	76.1	105.3	142.5	258.8
Peak Inflow Q (cfs) =	20.5	44.2	33.1	47.9	78.2	143.1	184.0	237.8	410.3
Peak Outflow Q (cfs) =	0.6	0.8	0.7	0.9	18.8	70.1	98.4	134.4	345.2
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.4	0.8	0.9	0.9	0.9	1.3
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.0	0.6	2.2	3.1	4.3	4.7
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	63	52	66	66	62	59	56	46
Time to Drain 99% of Inflow Volume (hours) =	40	66	55	70	71	69	68	67	63
Maximum Ponding Depth (ft) =	3.55	4.84	4.25	5.03	5.85	6.89	7.45	8.23	9.11
Area at Maximum Ponding Depth (acres) =	1.16	1.28	1.23	1.30	1.37	1.47	1.53	1.60	1.69
Maximum Volume Stored (acre-ft) =	1.274	2.849	2.110	3.106	4.200	5.665	6.504	7.724	9.191

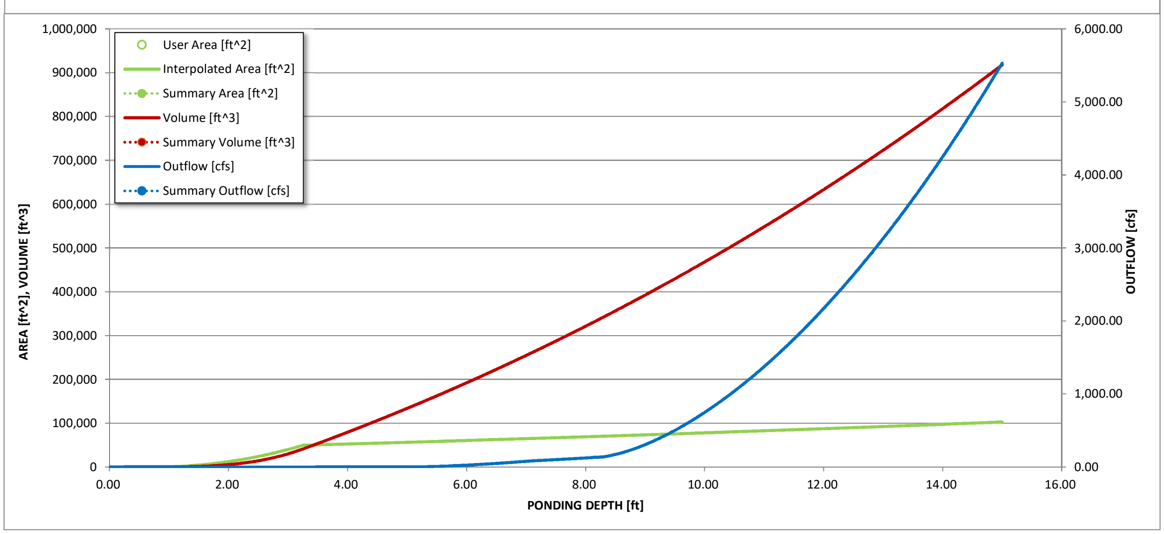
High velocity = potential safety issue.

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename:

Storm Inflow Hydrographs **UD-Detention, Version 3.07 (February 2017)**

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

Time Interval	Hydrograph Constant
5.54 min	0.903

SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:05:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:11:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:16:37	0.89	1.87	1.42	2.02	3.16	5.26	6.39	7.69	10.19
0:22:10	2.42	5.15	3.88	5.57	8.90	15.49	19.38	24.12	34.95
0:27:42	6.22	13.21	9.96	14.30	22.84	39.81	49.82	62.10	91.89
0:33:14	17.09	36.26	27.34	39.24	62.58	108.79	135.93	169.13	248.65
0:38:47	20.52	44.15	33.10	47.89	78.16	143.07	184.02	236.66	380.32
0:44:19	19.62	42.35	31.71	45.96	75.54	140.65	182.71	237.79	410.27
0:49:52	17.86	38.54	28.87	41.83	68.94	129.18	168.36	219.98	385.68
0:55:24	16.01	34.68	25.93	37.65	62.14	116.58	152.02	198.71	349.84
1:00:56	13.89	30.25	22.57	32.87	54.46	102.66	134.14	175.72	315.24
1:06:29	12.07	26.36	19.63	28.66	47.59	89.90	117.54	154.04	281.88
1:12:01	10.95	23.85	17.78	25.91	42.88	80.54	105.02	137.22	252.10
1:17:34	9.10	19.93	14.84	21.67	36.05	68.36	89.57	117.64	218.39
1:23:06	7.48	16.48	12.25	17.93	29.91	56.88	74.60	98.09	185.86
1:28:38	5.83	13.00	9.62	14.16	23.79	45.69	60.18	79.48	155.34
1:34:11	4.41	9.99	7.35	10.89	18.44	35.68	47.13	62.42	127.61
1:39:43	3.22	7.41	5.42	8.10	13.84	27.03	35.85	47.73	103.47
1:45:16	2.46	5.59	4.10	6.10	10.33	19.98	26.46	35.40	81.97
1:50:48	2.01	4.52	3.33	4.92	8.28	15.84	20.87	27.69	63.28
1:56:20	1.70	3.81	2.81	4.15	6.96	13.27	17.43	23.02	49.31
2:01:53	1.49	3.32	2.46	3.61	6.04	11.47	15.04	19.81	40.99
2:07:25	1.34	2.97	2.20	3.23	5.40	10.22	13.37	17.58	35.53
2:12:58	1.23	2.72	2.02	2.96	4.94	9.32	12.18	15.98	31.68
2:18:30	0.90	2.02	1.49	2.20	3.71	7.17	9.48	12.61	25.95
2:24:02	0.66	1.47	1.09	1.60	2.68	5.16	6.83	9.10	19.37
2:29:35	0.49	1.08	0.80	1.18	1.98	3.83	5.07	6.74	14.08
2:35:07	0.36	0.80	0.59	0.88	1.48	2.85	3.76	5.00	10.41
2:40:40	0.26	0.59	0.43	0.64	1.08	2.10	2.79	3.70	7.90
2:46:12	0.18	0.42	0.31	0.46	0.78	1.52	2.02	2.69	5.92
2:51:44	0.13	0.30	0.22	0.33	0.57	1.10	1.46	1.94	4.41
2:57:17	0.09	0.21	0.15	0.23	0.40	0.78	1.05	1.40	3.29
3:02:49	0.06	0.13	0.10	0.15	0.26	0.52	0.70	0.95	2.43
3:08:22	0.03	0.08	0.05	0.08	0.15	0.31	0.42	0.58	1.70
3:13:54	0.01	0.03	0.02	0.04	0.07	0.15	0.21	0.30	1.10
3:19:26	0.00	0.01	0.00	0.01	0.02	0.05	0.07	0.11	0.63
3:24:59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.29
3:30:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08
3:36:04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:41:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:47:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:52:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:58:13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:03:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:09:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:14:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:20:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:25:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:31:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:37:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:42:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:48:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:53:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:59:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:04:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:10:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:15:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:21:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:26:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:32:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:37:56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:43:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:49:01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:54:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:00:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:05:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:11:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:16:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:22:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:27:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:33:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:38:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DRAINAGE MAPS

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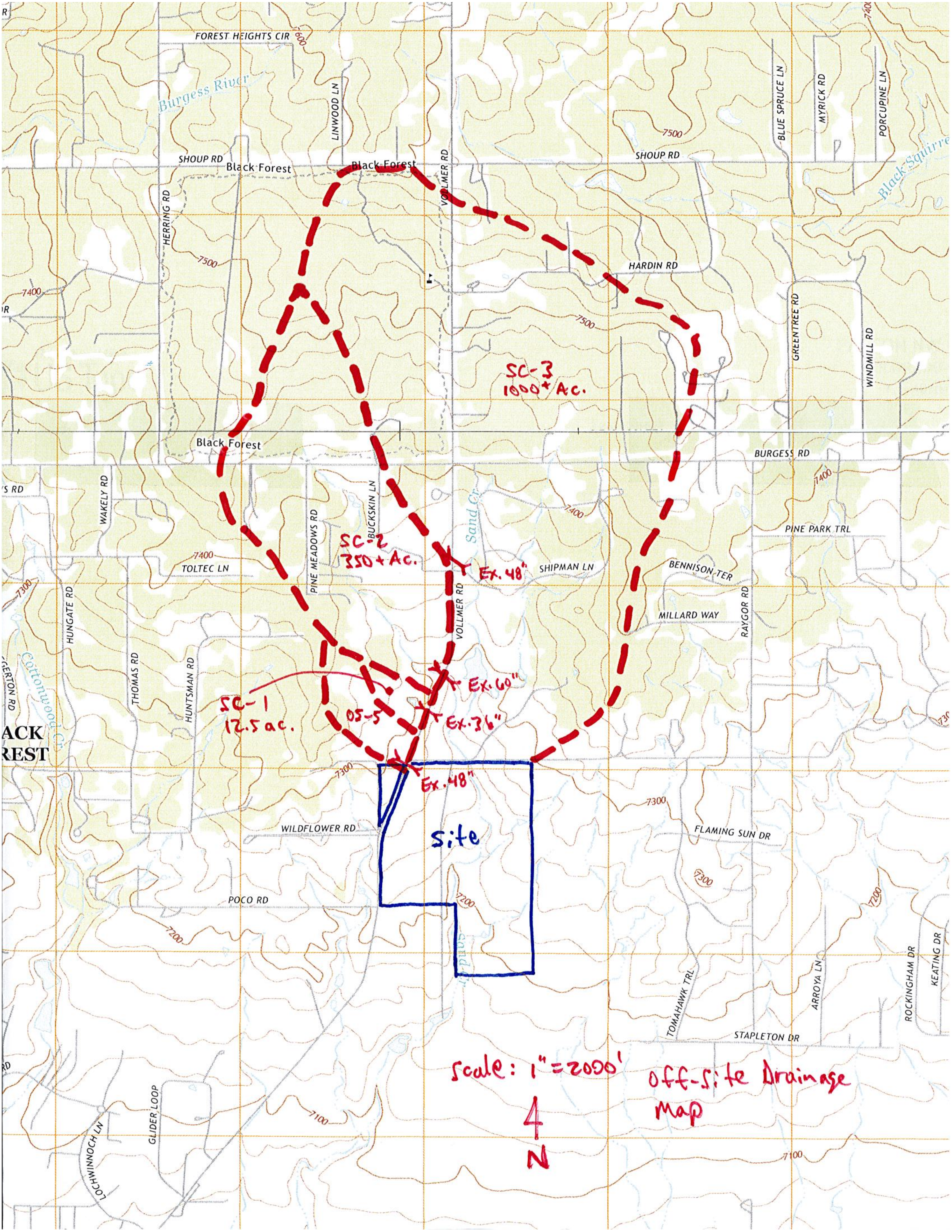


FOREST HEIGHTS CIR
Burgess River
LINWOOD LN
SHOUP RD
Black Forest
Black Forest
VOLLMER RD
BLUE SPRUCE LN
MYRICK RD
PORCUPINE LN
SHOUP RD
Black Squirrel
HERRING RD
HARDIN RD
GREENTREE RD
WINDMILL RD
SC-3
1000+ Ac.
Black Forest
BURGESS RD
WAKELY RD
BUCKSKIN LN
PINE MEADOWS RD
Sand Cr.
SC-2
350+ Ac.
PINE PARK TRL
TOLTEC LN
SHIPMAN LN
Ex. 48"
BENNISON TER
HUNGATE RD
VOLLMER RD
MILLARD WAY
RAYGOR RD
Cottonwood Cr.
THOMAS RD
HUNTSMAN RD
Ex. 60"
SC-1
12.5 ac.
OS-5
Ex. 36"
Ex. 48"
WILDFLOWER RD
Site
FLAMING SUN DR
POCO RD
TOMAHAWK TRL
ARROYA LN
ROCKINGHAM DR
KEATING DR
STAPLETON DR
Scale: 1" = 2000'
Off-Site Drainage Map
N
GLIDER LOOP
LOCHWINNOCH LN

CN VALUES - EXISTING CONDITIONS

BASIN (label)	BASIN AREA (Ac)	SOIL TYPE B CN	SOIL TYPE B AREA (Ac.)	WEIGHTED CN
EX-1	156.9	61	156.9	61
EX-2	9.2	61	9.2	61
EX-3	24.9	61	24.9	61
EX-4	35.2	63	35.2	63
EX-6	6.7	61	6.7	61
SC-1	12.5	63	12.5	63
SC-2	350.0	63	350.0	63
OS-1	49.1	61	49.1	61
OS-2	2.1	61	2.1	61
OS-3	5.7	65	5.7	65
OS-4	16.1	63	16.1	63
OS-5	27.6	63	27.6	63

TIME OF CONCENTRATION - EXISTING CONDITIONS

BASIN	Cn	C(5)	OVERLAND Length (ft)	OVERLAND Height (ft)	OVERLAND Tc (min)	STREET / CHANNEL FLOW Length (ft)	STREET / CHANNEL FLOW Slope (%)	STREET / CHANNEL FLOW Velocity (fps)	STREET / CHANNEL FLOW Tc (min)	Tc TOTAL (min)	Tc LAG (min)	Tc LAG (hr)
EX-1	61.0	0.08	300	8	23.1	1600	1.8%	1.3	20.5	43.6	26.2	0.44
EX-2	61.0	0.08	300	10	21.4					21.4	12.9	0.21
EX-3	61.0	0.08	300	8	23.1	1500	4.0%	1.5	16.7	39.7	23.8	0.40
EX-4	63.0	0.08	300	24	16.1	1900	6.0%	1.8	17.6	33.7	20.2	0.34
EX-6	61.0	0.08	300	14	19.2	800	1.0%	1.0	13.3	32.5	19.5	0.33
SC-1	63.0	0.08	200	6	18.1	500	2.0%	1.2	6.9	25.1	15.0	0.25
SC-2	63.0	0.08	300	12	20.2	3500	1.8%	1.3	44.9	65.1	39.0	0.65
OS-1	61.0	0.08	300	22	16.5	1300	4.0%	1.5	14.4	31.0	18.6	0.31
OS-2	61.0	0.08	300	12	20.2	550	5.0%	1.7	5.4	25.6	15.3	0.26
OS-3	65.0	0.08	300	10	21.4	250	3.0%	3.5	1.2	22.6	13.6	0.23
OS-4	63.0	0.08	300	22	16.5	1100	4.0%	1.4	13.1	29.6	17.8	0.30
OS-5	63.0	0.08	300	10	21.4	1300	3.0%	1.2	18.1	39.5	23.7	0.39

BASIN SUMMARY - EXISTING CONDITIONS

BASIN (label)	TOTAL BASIN AREA (acres)	WEIGHTED CN	TOTAL LAG TIME (hours)	Q 2 Yr. (cfs)	Q 5 Yr. (cfs)	Q 100 Yr. (cfs)
EX-1	156.9	61	0.44	2.6	17.7	140.3
EX-2	9.2	61	0.21	0.2	1.7	12.2
EX-3	24.9	61	0.40	0.4	3.0	23.7
EX-4	35.2	63	0.34	1.3	6.9	41.8
EX-6	6.7	61	0.33	0.1	0.9	7.1
SC-1	12.5	63	0.25	0.5	3.0	17.3
SC-2	350.0	63	0.65	9.9	44.2	275.3
OS-1	49.1	61	0.31	0.9	7.0	53.9
OS-2	2.1	61	0.26	0.04	0.3	2.5
OS-3	5.7	65	0.23	0.6	2.1	9.9
OS-4	16.1	63	0.30	0.6	3.4	20.7
OS-5	27.6	63	0.39	1.0	5.2	32.1

DESIGN POINTS SURFACE ROUTING SUMMARY - EXISTING CONDITIONS

Design Point (label)	Contributing Basins	Q 2 Yr. Q (cfs)	Q 5 Yr. Q (cfs)	Q 100 Yr. Q (cfs)
EX DP-1	BASINS OS-1, OS-3, OS-4, OS-5, EX-1, EX-4, EX-5, EX-6	5.6	36.0	281.7
EX DP-2	BASINS OS-2, EX-2	0.2	2.0	14.7
EX DP-3	BASIN EX-3	0.4	3.0	23.7
EX-DP-4	BASIN EX-6	0.1	1.0	7.1
Ex. 36" CMP at Vollmer	SC-1	0.5	3.0	17.3
Ex. 60" CMP at Vollmer	SC-2	9.88	44.2	275.3

Delete?

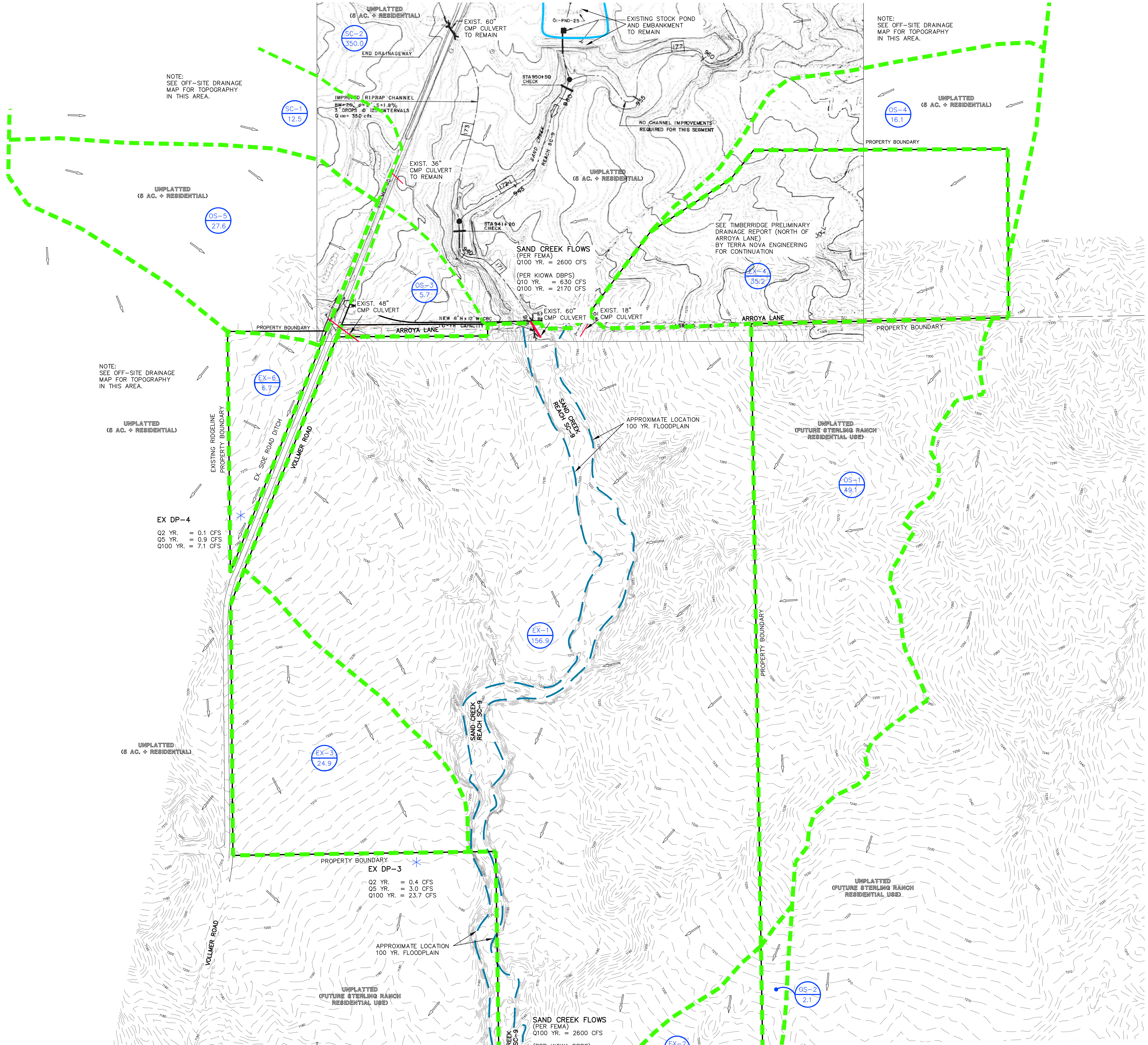
Provide column with design point contributing area

LEGEND

DESCRIPTION	SYMBOL
EXISTING GROUND CONTOUR	6910
PROPOSED FINISHED CONTOUR	6910
BASIN BOUNDARY	
DESIGN POINT	
BASIN IDENTIFIER / AREA IN ACRES	BB / 10.0
EXISTING DIRECTION OF FLOW	
STORM SEWER	

200 100 0 200 400

SCALE: 1" = 200'



CLASSIC CONSULTING ENGINEERS & SURVEYORS
619 N. Cascade Avenue, Suite 200
Colorado Springs, Colorado 80903
(719)785-0790
(719)785-0799 (Fax)

THE RETREAT AT TIMBERRIDGE
PRELIMINARY DRAIANGE REPORT
(SOUTH OF ARROYA LANE)
PRE-DEVELOPMENT DRAINAGE MAP

DESIGNED BY	MAW	SCALE	DATE 4-5-18
DRAWN BY	MAW	(H) 1"= 200'	SHEET 1 OF 2
CHECKED BY		(V) 1"= N/A	JOB NO. 2520.00

PRELIMINARY DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY

	WEIGHTED			OVERLAND				STREET / CHANNEL FLOW				Tc	INTENSITY			TOTAL FLOWS		
BASIN	CA(2)	CA(5)	CA(100)	C(5)	Length (ft)	Height (ft)	Tc (min)	Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	TOTAL (min)	I(2) (in/hr)	I(5) (in/hr)	I(100) (in/hr)	Q(2) (cfs)	Q(5) (cfs)	Q(100) (cfs)
A1	0.77	1.79	5.12	0.14	120	2.4	15.1	740	2.5%	1.6	7.8	22.9	2.31	2.89	4.84	1.8	5	25
A2	0.41	0.97	2.76	0.14	300	12	19.0	400	4.0%	2.0	3.3	22.3	2.34	2.92	4.91	1.0	3	14
A3	0.35	0.83	2.36	0.14	300	8	21.7	400	3.0%	1.7	3.8	25.6	2.18	2.72	4.57	0.8	2	11
A4	0.25	0.42	0.92	0.20	180	8	13.3	180	4.0%	2.0	1.5	14.8	2.83	3.54	5.94	0.7	1	5
A5	0.33	0.77	2.20	0.14	280	10	19.1					19.1	2.53	3.16	5.31	0.8	2	12
B1	1.13	2.63	7.52	0.14	300	10.5	19.9	1280	3.2%	1.8	11.9	31.8	1.92	2.39	4.02	2.2	6	30
B2	0.48	1.12	3.20	0.14	300	10.5	19.9					19.9	2.48	3.10	5.20	1.2	3	17
B3	1.28	1.69	3.06	0.14	300	10.5	19.9	370	1.5%	1.2	5.0	24.9	2.21	2.76	4.63	2.8	5	14
B4	0.78	1.82	5.20	0.14	300	10.5	19.9					19.9	2.48	3.10	5.20	1.9	6	27
C1	1.13	2.13	5.25	0.17	300	12	18.4	600	2.0%	2.8	3.5	21.9	2.36	2.95	4.95	2.7	6	26
C2	0.52	0.86	1.89	0.20	300	14	16.9					16.9	2.67	3.34	5.61	1.4	3	11
C3	0.77	1.46	3.61	0.17	300	17	16.4					16.4	2.71	3.39	5.68	2.1	5	21
D1	1.02	1.28	2.72	0.21	200	4	18.0	600	2.0%	2.8	3.5	21.6	2.38	2.98	5.00	2.4	4	14
D2	2.54	3.53	6.63	0.25	150	3	15.0	900	3.0%	3.5	4.3	19.3	2.51	3.14	5.28	6.4	11	35
D3	0.68	0.85	1.81	0.21	150	3	15.6	375	2.0%	2.8	2.2	17.8	2.61	3.26	5.48	1.8	3	10
D4	1.36	1.84	3.30	0.27	150	3	14.6	600	3.5%	3.7	2.7	17.3	2.64	3.31	5.56	3.6	6	18
D5	2.30	3.20	6.02	0.25	150	3	15.0	1050	2.5%	3.2	5.5	20.5	2.44	3.05	5.13	5.6	10	31
D6	2.75	3.83	7.19	0.25	150	3	15.0	1200	2.0%	2.8	7.1	22.0	2.36	2.94	4.94	6.5	11	36
D7	0.19	0.43	1.11	0.16	150	3	16.5					16.5	2.70	3.37	5.67	0.5	1	6
D8	0.29	0.40	0.75	0.25	70	2.8	8.1					8.1	3.54	4.44	7.46	1.0	2	6
D9	0.38	0.53	0.99	0.25	70	2.8	8.1					8.1	3.54	4.44	7.46	1.3	2	7
D10	0.31	0.43	0.80	0.25	80	3.2	8.7					8.7	3.46	4.34	7.29	1.1	2	6
E	1.16	1.17	1.25	0.25	30	7.5	2.9	400	5.0%	2.2	3.0	5.9	3.93	4.92	8.27	4.5	6	10
F1	0.54	1.63	6.52	0.09	60	3	8.3	2400	2.0%	1.4	28.3	36.6	1.75	2.18	3.66	1.0	4	24
F2	0.14	0.41	1.66	0.09	60	6	6.6	1200	2.0%	1.4	14.1	20.7	2.43	3.03	5.09	0.3	1	8
H	0.40	0.94	2.68	0.14	300	11	19.6	900	2.0%	1.4	10.6	30.2	1.98	2.47	4.15	0.8	2	11
OS-1A	0.14	0.43	1.73	0.09	300	15	18.6	400	5.0%	4.5	1.5	20.1	2.47	3.08	5.18	0.4	1	9
OS-1B	0.70	2.11	8.42	0.09	300	15	18.6	1200	5.0%	4.5	4.5	23.0	2.30	2.88	4.83	1.6	6	41
OS-2A	0.06	0.18	0.72	0.09	300	12	20.0					20.0	2.47	3.09	5.19	0.1	0.6	4
OS-2B	0.07	0.21	0.83	0.09	300	12	20.0					20.0	2.47	3.09	5.19	0.2	0.6	4
OS-2C	0.45	1.34	5.36	0.09	300	12	20.0	1000	3.0%	3.5	4.8	24.8	2.21	2.77	4.64	1.0	4	25
OS-2D	0.03	0.08	0.31	0.09	250	12	17.2					17.2	2.65	3.32	5.57	0.07	0.3	2
OS-2E	0.09	0.28	1.12	0.09	300	12	20.0					20.0	2.47	3.09	5.19	0.2	0.9	6
OS-3	0.42	0.74	2.21	0.08	300	10	21.4	250	3.0%	3.5	1.2	22.6	2.32	2.90	4.87	1	2	11
OS-5	0.55	2.21	9.66	0.08	300	12	20.2	1500	3.0%	3.5	7.2	27.4	2.10	2.62	4.39	1	6	42

PRELIMINARY DRAINAGE REPORT ~ BASIN RUNOFF COEFFICIENT SUMMARY

		IMPERVIOUS AREA / STREETS				LANDSCAPE / DEVELOPED AREAS				WEIGHTED			WEIGHTED CA		
BASIN	TOTAL AREA (AC)	AREA (AC)	C(2)	C(50)	C(100)	AREA (AC)	C(2)	C(5)	C(100)	C(2)	C(5)	C(100)	CA(2)	CA(5)	CA(100)
A1	12.8	0.00	0.89	0.95	0.96	12.80	0.06	0.14	0.40	0.06	0.14	0.40	0.77	1.79	5.12
A2	6.9	0.00	0.89	0.95	0.96	6.90	0.06	0.14	0.40	0.06	0.14	0.40	0.41	0.97	2.76
A3	5.9	0.00	0.89	0.95	0.96	5.90	0.06	0.14	0.40	0.06	0.14	0.40	0.35	0.83	2.36
A4	2.1	0.00	0.89	0.95	0.96	2.10	0.12	0.20	0.44	0.12	0.20	0.44	0.25	0.42	0.92
A5	5.5	0.00	0.89	0.95	0.96	5.50	0.06	0.14	0.40	0.06	0.14	0.40	0.33	0.77	2.20
B1	18.8	0.00	0.89	0.95	0.96	18.80	0.06	0.14	0.40	0.06	0.14	0.40	1.13	2.63	7.52
B2	8.0	0.00	0.89	0.95	0.96	8.00	0.06	0.14	0.40	0.06	0.14	0.40	0.48	1.12	3.20
B3	6.10	1.10	0.89	0.95	0.96	5.00	0.06	0.14	0.40	0.21	0.28	0.50	1.28	1.69	3.06
B4	13.0	0.00	0.89	0.95	0.96	13.00	0.06	0.14	0.40	0.06	0.14	0.40	0.78	1.82	5.20
C1	12.5	0.00	0.89	0.95	0.96	12.50	0.09	0.17	0.42	0.09	0.17	0.42	1.13	2.13	5.25
C2	4.3	0.00	0.89	0.95	0.96	4.30	0.12	0.20	0.44	0.12	0.20	0.44	0.52	0.86	1.89
C3	8.6	0.00	0.89	0.95	0.96	8.60	0.09	0.17	0.42	0.09	0.17	0.42	0.77	1.46	3.61
D1	6.0	0.00	0.89	0.95	0.96	6.00	0.17	0.21	0.45	0.17	0.21	0.45	1.02	1.28	2.72
D2	14.1	0.00	0.89	0.95	0.96	14.10	0.18	0.25	0.47	0.18	0.25	0.47	2.54	3.53	6.63
D3	4.0	0.00	0.89	0.95	0.96	4.00	0.17	0.21	0.45	0.17	0.21	0.45	0.68	0.85	1.81
D4	6.8	0.00	0.89	0.95	0.96	6.80	0.20	0.27	0.49	0.20	0.27	0.49	1.36	1.84	3.30
D5	12.8	0.00	0.89	0.95	0.96	12.80	0.18	0.25	0.47	0.18	0.25	0.47	2.30	3.20	6.02
D6	15.3	0.00	0.89	0.95	0.96	15.30	0.18	0.25	0.47	0.18	0.25	0.47	2.75	3.83	7.19
D7	2.7	0.00	0.89	0.95	0.96	2.70	0.07	0.16	0.41	0.07	0.16	0.41	0.19	0.43	1.11
D8	1.6	0.00	0.89	0.95	0.96	1.60	0.18	0.25	0.47	0.18	0.25	0.47	0.29	0.40	0.75
D9	2.1	0.00	0.89	0.95	0.96	2.10	0.18	0.25	0.47	0.18	0.25	0.47	0.38	0.53	0.99
D10	1.7	0.00	0.89	0.95	0.96	1.70	0.18	0.25	0.47	0.18	0.25	0.47	0.31	0.43	0.80
E	1.3	1.30	0.89	0.95	0.96	0.00	0.18	0.25	0.47	0.89	0.90	0.96	1.16	1.17	1.25
F1	18.1	0.00	0.89	0.95	0.96	18.10	0.03	0.09	0.36	0.03	0.09	0.36	0.54	1.63	6.52
F2	4.6	0.00	0.89	0.95	0.96	4.60	0.03	0.09	0.36	0.03	0.09	0.36	0.14	0.41	1.66
H	6.7	0.00	0.89	0.95	0.96	6.70	0.06	0.14	0.40	0.06	0.14	0.40	0.40	0.94	2.68
OS-1A	4.8	0.00	0.89	0.95	0.96	4.80	0.03	0.09	0.36	0.03	0.09	0.36	0.14	0.43	1.73
OS-1B	23.4	0.00	0.89	0.95	0.96	23.40	0.03	0.09	0.36	0.03	0.09	0.36	0.70	2.11	8.42
OS-2A	2.0	0.00	0.89	0.95	0.96	2.00	0.03	0.09	0.36	0.03	0.09	0.36	0.06	0.18	0.72
OS-2B	2.3	0.00	0.89	0.95	0.96	2.30	0.03	0.09	0.36	0.03	0.09	0.36	0.07	0.21	0.83
OS-2C	14.9	0.00	0.89	0.95	0.96	14.90	0.03	0.09	0.36	0.03	0.09	0.36	0.45	1.34	5.36
OS-2D	0.85	0.00	0.89	0.95	0.96	0.85	0.03	0.09	0.36	0.03	0.09	0.36	0.03	0.08	0.31
OS-2E	3.1	0.00	0.89	0.95	0.96	3.10	0.03	0.09	0.36	0.03	0.09	0.36	0.09	0.28	1.12
OS-3	5.7	0.35	0.89	0.95	0.96	5.35	0.02	0.08	0.35	0.07	0.13	0.39	0.42	0.74	2.21
OS-5	27.6	0.00	0.89	0.95	0.96	27.60	0.02	0.08	0.35	0.02	0.08	0.35	0.55	2.21	9.66

PRELIMINARY DRAINAGE REPORT ~ SURFACE ROUTING SUMMARY

					Intensity		Flow		
Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	I(5)	I(100)	Q(5)	Q(100)	Culvert / Inlet Size
1	OS-5 (27.6 ac.)	2.21	9.66	27.4	2.62	4.39	6	42	EX. 48" CMP
2	OS-3 (5.7 ac.)	0.74	2.21	22.6	2.90	4.87	2	11	24" RCP
3	DP-2, A-1 (18.5 ac.)	2.54	7.33	23.6	2.84	4.76	7	35	30" RCP
4	A2 (6.9 ac.)	0.97	2.76	22.3	2.92	4.91	3	14	24" RCP
5	DP-3, DP-4, A3 (31.3 ac.)	4.33	12.45	25.6	2.72	4.57	12	57	DUAL 30" RCP CULVERTS
6	**OS-3, A1, A2, A3 and A4 (POND B INFLOW - 33.4 ac.)**	4.75	13.37	26.6	2.66	4.47	**13**	**60**	
7	B1 (18.8 ac.)	2.63	7.52	31.8	2.39	4.02	6	30	30" RCP
8	B3 (6.1 ac.)	1.69	3.06	24.9	2.76	4.63	5	14	5' Type R sump inlets
9	**B1, B2 and B3 (POND C INFLOW - 32.9ac.)**	5.44	13.78	34.8	2.26	3.79	**12**	**52**	
10	C1, OS-1A (17.3 ac.)	2.56	6.98	23.4	2.85	4.79	7	33	30" RCP
11	C2 (4.3 ac.)	0.86	1.89	16.9	3.34	5.61	3	11	5' Type R sump inlets
12	D2, OS-2A (16.1 ac.)	3.71	7.35	20.0	3.09	5.19	11	38	10' Type R sump inlets
13	D1, OS-2B (8.3 ac.)	1.49	3.55	21.6	2.98	5.00	4	18	5' Type R sump inlets
14	D3, OS-2D (4.85 ac.)	0.93	2.12	17.8	3.26	5.48	3	12	5' Type R sump inlets
15	D5, OS-2E (15.9 ac.)	3.48	7.13	20.5	3.05	5.13	11	37	10' Type R sump inlets
16	D4 6.8 ac.)	1.84	3.30	17.3	3.31	5.56	6	18	5' Type R sump inlets
17	D6 (15.3 ac.)	3.83	7.19	22.0	2.94	4.94	11	36	10' Type R sump inlets
18	**DP-10 Thru DP-17 and OS-1B, OS-2C, D7 (POND D INFLOW - 129.9 ac.)**	22.55	54.40	27.8	2.60	4.36	**59**	**237**	

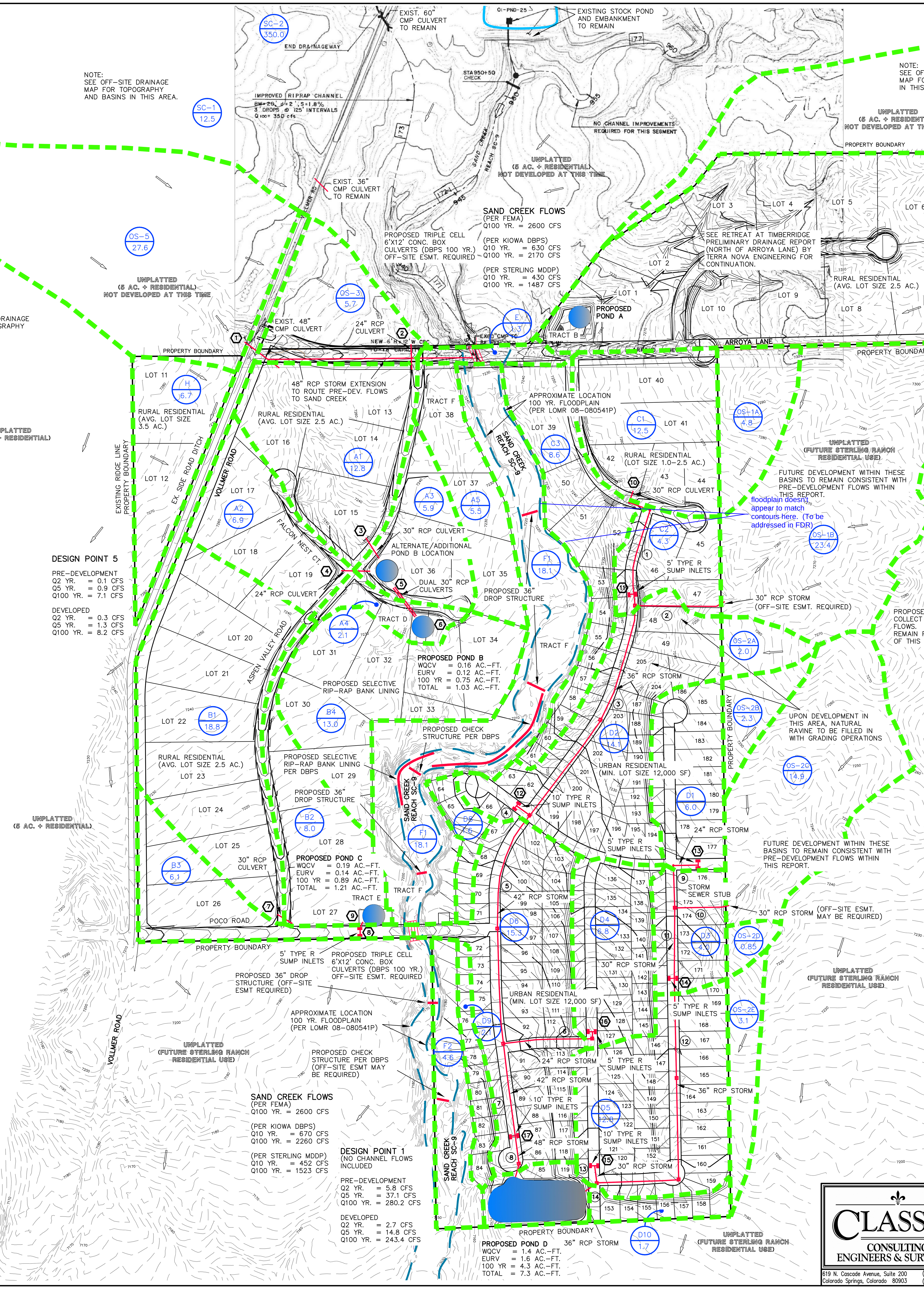
provide contributing acreage column

LEGEND

DESCRIPTION	SYMBOL
EXISTING GROUND CONTOUR	6910
PROPOSED FINISHED CONTOUR	6910
BASIN BOUNDARY	
BASIN IDENTIFIER / AREA IN ACRES	B8 / 10.0
DESIGN POINT	1
EXISTING DIRECTION OF FLOW	
PROPOSED DIRECTION OF FLOW	
PROPOSED DRAINAGE IMPROVEMENTS	
PROPOSED DETENTION/SWQ POND	

200 100 0 200 400

SCALE: 1" = 200'



CHANNEL NOTES PER DBPS:

1. A FLOODPLAIN PRESERVATION CONCEPT HAS BEEN RECOMMENDED FOR THIS REACH. LOCALIZED IMPROVEMENTS MAY BE NECESSARY TO LIMIT EROSION CAUSED BY FLOW CONCENTRATIONS AT CULVERTS, STORM SEWERS AND OUTSIDE BENDS OF THE CREEK.

2. AREA WITHIN THE EXISTING FLOODPLAIN OR THE LOW FLOW ZONE OF THE DRAINAGEWAY WHERE RIPARIAN OR WETLAND VEGETATION EXIST SHALL BE PRESERVED IN ITS EXISTING CROSS-SECTION.

3. CHECK AND DROP STRUCTURES HAVE BEEN SITED ALONG SAND CREEK IN ORDER TO SLOW THE CHANNEL VELOCITY TO THE RECOMMENDED 7 FEET PER SECOND AND TO PREVENT LOCALIZED AND LONG-TERM STREAM DEGRADATION FROM AFFECTING CHANNEL LININGS AND OVERBANKS. IN THE REACHES TO BE SELECTIVELY LINES, DROPS AND CHECK STRUCTURES WILL PROTECT THE NATIVE VEGETATION FROM DETRIMENTAL EFFECTS OF STREAM INVERT HEADCUTTING.

4. AREA DISTURBED BY THE CONSTRUCTION OF DROPS, GRADE CONTROLS, CULVERTS OF CHANNEL BANK LININGS SHALL BE REVEGETATED WITH NATIVE SPECIES.

CLASSIC CONSULTING ENGINEERS & SURVEYORS
619 N. Cascade Avenue, Suite 200 Colorado Springs, Colorado 80903
(719)785-0790 (719)785-0799 (Fax)

THE RETREAT AT TIMBERRIDGE
PRELIMINARY DRAINAGE REPORT
(SOUTH OF ARROYA LANE)
DEVELOPED DRAINAGE MAP

DESIGNED BY	MAW	SCALE		DATE	8-13-18
DRAWN BY	MAW	(H) 1"= 200'		SHEET 2	OF 2
CHECKED BY		(V) 1"= N/A		JOB NO.	2520.00