REVISED WOODSIDE RIDGE MACRO AND FIRST PLAT MICRO DRAINAGE STUDY

Prepared for:

Clayton Properties Group, INC. dba Summit Homes

Lee's Summit, Missouri

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1. GENERAL INFORMATION

Woodside Ridge is a proposed 198-lot single family residential development on approximately 112 acres, including a pool and amenity tract and approximately 23 acres which will be reserved for open space and detention. The Woodside Ridge First Plat consists of 143 single family residential lots, two detention facilities, and one existing pond. The project is located west of and adjacent to Pryor Road, between Ashurst Drive and SW 1st Street, which lies in the east half of Section 2, Township 47N, Range 32W, Lee's Summit, Jackson County, Missouri (Figure 1).

Stormwater from Woodside Ridge is conveyed into the Cedar Creek Watershed, primarily via two unnamed tributaries which flow east to west through the property. This drainage study is an update to the previously approved preliminary drainage study and will evaluate the hydrologic impact generated by the construction of the Woodside Ridge First Plat (proposed conditions). This study will also evaluate the future conditions which includes the full build-out of the Woodside Ridge property. For the future condition's analysis, there are no major changes from the previously approved preliminary drainage study, only minor adjustments in ridgelines to accommodate future detention facilities and anticipated grading activities. The existing pond spillway was updated in each of the models to reflect field-surveyed data.

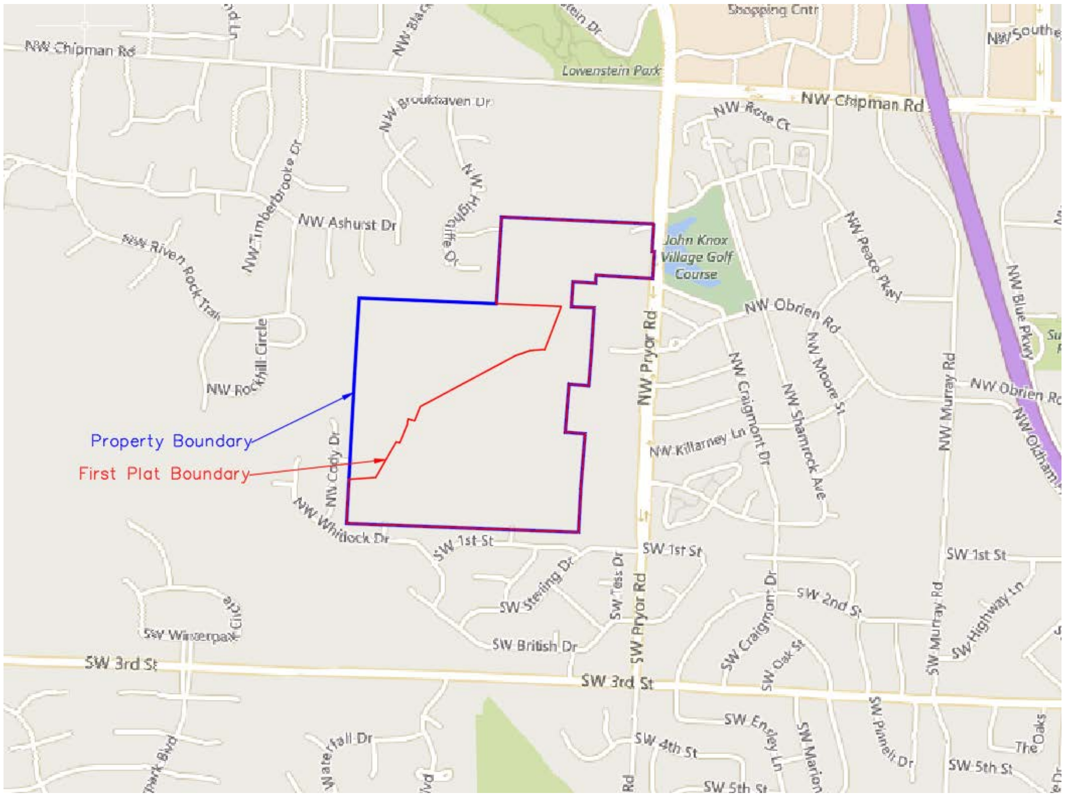

Figure 1. Woodside Ridge Location Map.

1.1. Federal Emergency Management Agency Floodplain Classification

The Federal Emergency Management Agency (FEMA) Flood Boundary and Floodway Map Community Panel Number 29095C0416G classifies the Woodside Ridge property as unshaded "Zone X" Area. Refer to Appendix A for location of site in relation to FEMA flood boundaries.

1.2. Soil Classifications

Soil maps published on the Natural Resources Conservation Service (NRCS) Web Soil Survey categorize soils on the Woodside Ridge property as shown in Table 1. Refer to Appendix B for a map of soils on the property.

Table 1. Soil Classifications.

Symbol	Name	Slopes	Hydrologic Soil Group
10128	Sharpsburg Urban land complex	2-5%	D
10141	Snead Rock outcrop complex	14-30%	D
10142	Snead Rock outcrop complex	5-14%	D
10143	Snead Urban land complex	9-30%	D
10128	Sharpsburg Urban land complex	2-5%	D

2. METHODOLOGY

This drainage study has been prepared to evaluate the hydrologic impact generated by development of Woodside Ridge. The base data for the models prepared for this report has been obtained from available online maps and aerial imagery. Stormwater quantity management is based upon methods and objectives defined in the Kansas City Metropolitan Chapter of the American Public Works Association (KC-APWA) "Section 5600 Storm Drainage Systems & Facilities" (2011).

The following methods were used in this study to model existing, proposed (micro) and future (macro) conditions for stormwater runoff:

- Haestad Methods, Inc. "PondPack" v8i
    - TR55 Unit Hydrograph Method
        - 2-year, 10-year, and 100-year return frequency storms
        - Antecedent runoff condition (ARC) II soil moisture conditions
        - 24-Hour Soil Conservation Service (SCS) Type II rainfall distribution
        - SCS runoff curve numbers per SCS TR-55 (Tables 2-2a – 2-2c)
        - SCS TR-55 methods for determination of time of concentration and travel time. Where specific data pertaining to channel geometry is not available, "length & velocity" estimates for channel flow travel time is used per Section 5600, Kansas City APWA Standard Specifications and Design Criteria.

Stormwater runoff models were created for the 2-, 10- and 100-year design storm events. The precipitation depths used in the analysis have been interpolated from the "Technical Paper No. 40 Rainfall Frequency Atlas of the United States" (TP-40) isopluvial maps (United States Weather Bureau 1961). Table 2 summarizes the rainfall depths used in this analysis:

Table 2. Precipitation Depths.

Return Period	24-Hour Precipitation Depth (in.)
2-Year (50% Storm)	3.60
10-Year (10% Storm)	5.34
100-Year (1% Storm)	7.90

3. EXISTING CONDITIONS ANALYSIS

To quantify the effects of this project, the following areas and points of interest have been used for existing and future conditions analyses. Refer to Appendix C for the existing conditions drainage area map.

Watershed A discharges to the west to an unnamed tributary to Cedar Creek. Total area modeled within this watershed is approximately 434 acres, less than 13% of which is within the Woodside Ridge overall property boundary and considered "onsite". Where development occurs along the ridgeline between this watershed and Watersheds B and C, less than one acre is expected to be redirected toward the adjacent watersheds.

The unnamed tributary into which Watershed A will discharge generally follows the northwest property line, and discharges from the property approximately 350' south of the NW property corner. Point A1 is a point approximately 450' downstream, where all of the onsite property discharging directly to this tributary converges. The majority of Watershed A is offsite and upstream of the property. Point A3 is a point approximately 250' upstream of Point A1, within a side tributary which collects only stormwater from an approximately 10-acre portion of Watershed A. This is the only other defined point within Watershed A where stormwater discharges from the property.

As runoff enters the property from the east, it is collected by an existing pond in the northeast corner of the site. The outlet from the pond is a defined spillway in the northwest corner. The spillway is defined in the model as an ogee weir, with a cross section based on field-surveyed data and visual inspection. The "bottom" of the modeled pond is defined by the normal pool elevation of 928 ft. The spillway elevation has been updated to 929 ft. Modeled flow into and out of the pond is defined below in Table 6. This pond will remain unchanged with development.

Watershed B discharges to the west to an existing underground storm sewer system leading to Cedar Creek. Total area modeled within this watershed is approximately 7 acres, about 90% of which is within the Woodside Ridge overall property boundary and considered "onsite". Where development occurs along the ridgeline between this watershed and Watershed C, less than one acre is expected to be redirected toward the adjacent watershed to the south.

Watershed B will discharge from the site via Point B1, approximately 200' north of the SW property corner, directly to an existing field inlet. The outfall of the future detention facility for Watershed B will connect directly to this inlet, so only a small portion of the runoff from Watershed B will continue to flow overland to the existing inlet. The downstream system was analyzed for capacity to ensure the adequacy of the detention facility installed with Woodside Ridge First Plat. The capacity of the existing 15" corrugated metal pipe (CMP) is 6.3 cfs; the future conditions peak flow from the proposed detention facility is 5.74 cfs.

Watershed C discharges to the south to an unnamed tributary to Cedar Creek. Total area modeled within this watershed is approximately 71 acres, approximately 80% of which is considered "onsite". A portion of this "onsite" area does not lie within the project boundary. However, it has been considered onsite area for the purposes of this study. The additional area included is a piece of land between Woodside Ridge and Pryor Road, which will discharge to the future detention within Watershed C. To ensure that this detention is appropriately sized, this additional tributary area will be considered "onsite" for the allowable release rate calculations presented below. In this way, the detention designed for this watershed will account not only for Woodside Ridge, but also the future commercial development bounded by Woodside Ridge, Pryor Road, O'Brien Road and Shamrock Avenue.

Watershed C will discharge from the site via Point C1, on the southwest side of the site. As a result of development, Watershed C is expected to increase by approximately 6 acres. Ridgeline shifts include those in relation to Watersheds A and B and a shift in areas to the south of Watershed C, not modeled with the existing Conditions. Some onsite area will be redirected from the south into Watershed C. The remaining area is assumed to decrease in peak flow rate, as no development will occur in those areas, and the drainage area is reduced.

To provide a direct comparison between the existing and future conditions models, efforts have been made to ensure that the points of interest are as consistent as practical throughout the analysis. Although additional points of interest are included in the hydrologic models, these junctions are of secondary interest.

The following tables summarize the results of the existing conditions analysis. The proposed and future conditions data will be compared to these results in Sections 4 and 5 of this report. Refer to Appendix D for output from and a schematic of the existing conditions PondPack model.

Curve numbers were assumed as follows and remain the same in all models.

Table 3. Curve Numbers.

Land Use	Hydrologic Soil Group	Curve Number
Open Space	D	80
Park	D	85
Single-Family Residential	D	87
Multi-Family Residential	D	92
Commercial	D	95
Crop/Community Gardens	D	89
Open Graded/Rock Rubble	D	94
Water Surface	D	100

Table 4 contains a summary of input data used for the existing conditions analysis for the drainage areas, time of concentrations (T_C), and curve numbers. Table 5 contains a summary of peak flow rates for each subarea for the 2-, 10-, and 100-year events. Table 6 provides a summary of the existing conditions for the pond onsite, including the peak flow rates in and out of the pond, the time that the peak flow rates in and out occur, the volume of flow routed through the pond (V_R), the peak water surface elevation, and the maximum storage volumes for the 2-, 10-, and 100-year events. Table 7 summarizes the computed results from the PondPack model for existing conditions for the peak flow rates (Q) for the 2-, 10-, and 100-year events.

Table 4. Woodside Ridge Existing Conditions Subarea Data.

Subarea	On-site Area (acres)	Off-site Area (acres)	Total Area (acres)	T_C (hours)	Weighted Curve Number
A1	0.14	12.44	12.58	0.140	86
A2	7.42	1.80	9.22	0.126	80
A3	10.38	0.08	10.46	0.187	81
A4	0.21	177.43	177.64	0.237	87
A5	5.02	0.77	5.79	0.120	80
A6	0.32	3.56	3.88	0.121	87
A7	5.86	0.22	6.08	0.141	81
A8	15.73	4.09	19.82	0.100	84
A9	11.51	176.80	188.31	0.260	91
Total A	**56.59**	**377.19**	**433.78**		
B1	6.70	0.55	7.25	0.119	80
Total B	**6.70**	**0.55**	**7.25**		
C1	56.38	14.44	70.82	0.252	84
Total C	**56.38**	**14.44**	**70.82**		
Total	**119.67**	**392.18**	**511.85**		

Table 5. Woodside Ridge Existing Conditions Runoff Data: Subarea Peak Flow Rates.

Subarea	Q_2 (cfs)	Q_{10} (cfs)	Q_{100} (cfs)
A1	39	66	106
A2	23	42	73
A3	25	45	76
A4	493	822	1,323
A5	15	27	46
A6	13	21	34
A7	15	28	48
A8	61	106	175
A9	574	910	1,416
B1	18	34	58
C1	173	299	493

* cfs – cubic feet per second

Table 6.Woodside Ridge Existing Conditions: Pond Flow and Volume Data.

	Peak Q In (cfs)	T_P In (hr.)	Peak Q Out (cfs)	T_P Out (hr.)	V_R (ac-ft)	Peak W.S.E. (ft)	Stored Volume (ac-ft)
Existing Pond							
2-Year	574	12.03	453	12.14	41.24	931.83	8.27
10-Year	910	12.03	739	12.13	66.88	932.94	11.41
100-Year	1,416	12.03	1,176	12.12	106.84	934.36	15.87

* cfs = cubic feet per second; hr = hour; ac-ft = acre-feet

Table 7. Woodside Ridge Existing Conditions Runoff Data: Point of Interest Peak Flow Rates.

Point of Interest	Q_2 (cfs)	Q_{10} (cfs)	Q_{100} (cfs)
A1	953	1606	2606
A3	25	45	76
B1	18	34	58
C1	173	299	493

* cfs = cubic feet per second

Per APWA Section 5608.4 and City of Lee's Summit criteria, the performance criteria for comprehensive control is to provide detention to limit peak flow rates at downstream points of interest to maximum release rates:

- 50% storm peak rate less than or equal to 0.5 cfs per site acre
- 10% storm peak rate less than or equal to 2.0 cfs per site acre
- 1% storm peak rate less than or equal to 3.0 cfs per site acre

Allowable release rates were calculated for the points of interest, allowing that off-site peak discharges would be permitted to bypass the detention. Off-site bypass peak flow rates were calculated as a percentage of the existing conditions, relating to the percentage of off-site area flowing to each point. The release rates for the proposed development on the development site were calculated based on the detention criteria. The development release rates were added to the bypass peak flow rates to calculate an allowable peak flow rate for each point of interest as follows.

Table 8. Woodside Ridge Point of Interest Onsite Area.

Point of Interest	Total Area (acres)	Onsite Area (acres)	Percent Onsite
A1	433.78	56.59	13.0%
A3	10.46	10.38	99.2%
B1	7.25	6.70	92.4%
C1	70.82	56.38	79.6%

Table 9. Woodside Ridge Point of Interest Allowable Peak Flow Rates.

Point of Interest	Allowable Q_2 (cfs)	Allowable Q_{10} (cfs)	Allowable Q_{100} (cfs)
A1	881	1525	2437
A3	5	21	32
B1	5	16	25
C1	68	178	274

* cfs = cubic feet per second

3.1. Stream Buffer

The two main channels flowing through the Woodside Ridge property fall within the requirements of APWA Section 5605.3 Stream Preservation and Buffers Zones. Designating the stream buffer width includes defining the Ordinary High-Water Mark (OHM) and defining a width of preservation zone from the OHM on either side of the channel. The OHM for each channel was roughly defined using GIS contours, aerial data, and contributing drainage area.

The channel within Watershed A flows into the site on the eastern property boundary with approximately 190 acres of contributing area and increases to approximately 430 acres. Per APWA Table 5605-1, the stream buffer width for this channel is defined as 100 feet measured from each side of the OHM.

The channel within Watershed C flows into the site on the eastern property boundary with approximately 14 acres of contributing area and increases to approximately 70 acres. Due to the size of the contributing area at the point where the channel leaves the site, a stream buffer of 60 feet from the OHM has been assigned to this channel.

4. PROPOSED CONDITIONS ANALYSIS

The proposed conditions section of analysis assumes completion of only Woodside Ridge First Plat, including construction of two new detention facilities in Watersheds B and C. The difference between the existing conditions model and the proposed conditions model is a direct result of the construction of Woodside Ridge First Plat. Refer to Appendix E for the proposed conditions drainage area map.

Due to a shift of the ridgelines along the south side of Watershed C, modeled stormwater drainage area has increased to approximately 516 acres overall, approximately 73 acres of which is considered "onsite". Approximately 16 acres of this "onsite" area is the future commercial area discussed in Section 3. The modeled subareas and points of interest are similar to, if not exactly the same as, the existing conditions model. However, throughout the site, some shifting of ridgelines has occurred accommodating future detention facilities and anticipated grading activities.

The spillway on the existing pond within Watershed C needs maintenance as half of the spillway weir has deteriorated. With the proposed development, the spillway will be replaced in kind.

4.1. Effects of Development

The analysis provided in Section 3 established the pre-development condition of the watershed, and analysis in this section will provide guidance for configuration of detention to meet the objectives established in Section 3 for development of Woodside Ridge First Plat. Refer to Appendix E for the proposed conditions drainage area map.

Runoff curve numbers, times of concentration, routings, and tributary regions that are outside the First Plat property boundary remain the same as in Section 3. Table 10 contains input data for proposed conditions and Table 11 and Table 12 summarize the computed results from the PondPack model. After the results of this proposed conditions model are presented, they will be compared to the existing condition results in Table 14. Refer to Appendix F for output from and a schematic of the proposed conditions PondPack model.

Table 10. Woodside Ridge Proposed Conditions Subarea Data.

Subarea	Onsite Area (acres)	Offsite Area (acres)	Total Area (acres)	T_C (hours)	Weighted CN
A1	0.00	12.58	12.58	0.140	86
A2	0.00	8.49	8.49	0.126	80
A3	1.98	9.04	11.02	0.100	82
A4	0.07	177.50	177.57	0.237	87
A5	0.00	5.19	5.19	0.120	80
A6	0.25	3.55	3.80	0.121	87
A7	0.77	9.57	10.34	0.139	81
A8	9.03	6.93	15.96	0.100	87
A9	12.27	176.79	189.06	0.260	91
Total A	**24.37**	**409.63**	**434.00**		
B1	2.95	2.47	5.42	0.100	83
B1a	0.24	0.36	0.61	0.100	87
Total B	**3.20**	**2.83**	**6.03**		
C1	44.57	30.54	75.11	0.252	88
C1a	0.99	0.20	1.19	0.100	81
Total C	**45.56**	**30.74**	**76.30**		
Total	**73.13**	**443.20**	**516.33**		

Table 11. Woodside Ridge Proposed Conditions Runoff Data: Subarea Peak Discharge Rates.

Subarea	Q_2 (cfs)	Q_{10} (cfs)	Q_{100} (cfs)
A1	39	66	106
A2	21	39	67
A3	31	56	94
A4	493	822	1,322
A5	13	24	41
A6	13	21	34
A7	26	48	81
A8	55	91	146
A9	576	913	1,421
B1	16	28	47
B1a	2	4	6
C1	211	346	551
C1a	3	6	10

* cfs – cubic feet per second

Table 12. Woodside Ridge Proposed Conditions Runoff Data: Point of Interest Peak Flow Rates.

Point of Interest	Q_2 (cfs)	Q_{10} (cfs)	Q_{100} (cfs)
A1	951	1,600	2,593
A3	31	56	94
B1	3	4	8
C1	47	119	208

4.2 Proposed Detention Facilities

A detention requirements waiver was granted for Watershed A, relating specifically to Point A1, and is provided in Appendix G. the future peak flow rates will be reduced to less than existing conditions. This waiver was requested due to several challenges in relation to detention design, as outlined in the preliminary drainage study. Dry detention will not be provided within Watershed A with the development of Woodside Ridge First Plat since the subarea A3 is not being fully developed with the First Plat. Detention within subarea A3 will be provided with future development upstream of Point A3.

A dry detention basin will be constructed within Watersheds B, upstream of Point B1, and is designed to capture and treat runoff for anticipated future development within Watershed B. Detention is provided within the onsite channel in Watershed C via the construction of a dam upstream of Point C1. The facility located within the channel includes a multi-stage outfall structure to meet the requirements outlined in Section 3 of this study, and will drain completely within 24 hours, per Army Corps of Engineers permit requirements to detain within jurisdictional channels. Table 13 summarizes the computed detention facilities results from the PondPack model for proposed conditions. Both basins are designed with emergency spillways per APWA criteria. Due to high velocities exiting Basin C1, a plunge pool designed per HEC 14 is to be installed at the downstream outlet.

The design of the Basin C1 dam was evaluated against NRCS TR-60. Not all requirements listed in NRCS TR-60 are applicable to the design of the dam. A supplemental report detailing this analysis is included in Appendix L. The design hydrographs TR-60 recommends routing through the basin and auxiliary spillway could not be developed due to the short time of concentration within the watershed draining to Basin C1. Therefore, Basin C1 was evaluated against both APWA criteria and Missouri Department of Natural Resources (MDNR) criteria. According to the MDNR Dam Safety Publication No. 3, "Rules and Regulations of the Missouri Dam and Reservoir Safety Council", it is assumed Basin C1 has a class II downstream environmental zone. For a new dam less than 50 feet in height and designated as an Environmental Class II, the spillway design flood precipitation value to be used is half of the Probable Maximum Precipitation (0.5PMP) per table 5 in the MDNR publication. A 0.5PMP rainfall depth of 13.75 inches, determined from "Hydrometeorological Report No. 51" (HMR 51), was routed through the watershed using a NRCS type II distribution to determine the peak elevation of the storm in the basin in relation to the crest of the dam. The peak elevation is 928.43 ft for the 0.5PMP event. The top of the dam is set at an elevation of 929.5 ft, providing 1.07 ft of freeboard for the 0.5PMP event. Refer to Appendix K for the 0.5PMP analysis.

Table 13.Woodside Ridge Proposed Conditions Detention Basin Data

	Peak Q In (cfs)	T_P In (hr.)	Peak Q Out (cfs)	T_P Out (hr.)	V_R (ac-ft)	Peak W.S.E. (ft)	Stored Volume (ac-ft)
Existing Pond							
2-Year	576	12.03	455	12.14	41.41	931.84	8.29
10-Year	913	12.03	742	12.13	67.15	932.95	11.45
100-Year	1,421	12.03	1,181	12.12	107.26	934.38	15.91
Basin B1							
2-Year	16	11.93	0.9	13.31	0.88	922.78	0.49
10-Year	28	11.93	1.2	13.55	1.56	924.68	0.93
100-Year	47	11.93	5.2	12.38	2.65	926.48	1.44
Basin C1 (In-Stream Detention)							
2-Year	211	12.05	46	12.40	14.73	921.58	4.72
10-Year	346	12.05	118	12.28	24.68	923.65	7.81
100-Year	551	12.02	206	12.26	40.39	925.96	12.45

* cfs = cubic feet per second; hr = hour; ac-ft = acre-feet

In addition to mitigation of peak flow rates, APWA Section 5608.4 also requires 40 hour extended detention of runoff from the local 90% mean annual event (1.37"/24-hour rainfall). The dry detention facility in B1 will release the water quality event over a period of 40-72 hours. See Appendix H for water quality volume calculations and for the PondPack Time vs. Volume graph for the water quality event. The water quality volume is released in approximately 70 hours from Basin B1.

Points B1 and C1 see a decrease in flow rates from existing to proposed as a result of the construction of two new detention facilities. Table 14 provides a comparison of runoff data between existing and proposed conditions for Woodside Ridge First Plat. Point A1 does not meet detention criteria but the peak rates are kept at less than existing conditions, as was found acceptable with the above-mentioned Point A1 waiver request. Under proposed conditions, Point A3 does not meet detention criteria or has peak rates less than existing conditions; however, this is addressed with planned detention as shown in Table 19 in Section 5 of this report.

Table 14. Woodside Ridge Proposed Conditions Point of Interest Discharge Comparison.

Point of Interest		Q_2 (cfs)	Q_{10} (cfs)	Q_{100} (cfs)
A1	Proposed	951	1,600	2,593
	Existing	953	1606	2606
	Difference Proposed vs Existing	-2	-6	-13
	Allowable	881	1525	2437
	Difference Proposed vs Allowable	70	75	156
A3	Proposed	31	56	94
	Existing	25	45	76
	Difference Proposed vs Existing	6	11	18
	Allowable	5	21	32
	Difference Proposed vs Allowable	26	35	62
B1	Proposed	3	4	8
	Existing	18	34	58
	Difference Proposed vs Existing	-15	-30	-50
	Allowable	5	16	25
	Difference Proposed vs Allowable	-2	-12	-17
C1	Proposed	47	119	208
	Existing	173	299	493
	Difference Proposed vs Existing	-126	-180	-285
	Allowable	68	178	274
	Difference Proposed vs Allowable	-21	-59	-66

4.3. Impacts to Stream Buffer

Much of the defined stream buffer is not impacted by development. However, a few encroachments have been made accommodating the proposed layout.

In Watershed C, a detention basin will be constructed, as noted above, within this channel. This impact to the channel will be permitted by the USACE at the time of construction and is therefore not considered a "stream buffer" impact, since the channel will no longer exist where the dam is constructed. Upstream of the dam, there are a few other minor impacts, where grading and lots encroach into the defined buffer, or utilities will be constructed. Where encroachment occurs for lot construction, a minimum of 25' of the buffer will be preserved, and an equal or greater area of native vegetation adjacent to the stream buffer will be designated as preserved stream buffer, to mitigate for the impacts. Where encroachments occur to install storm and sanitary sewers, the area will be planted with native grasses to restore the vegetation as much as possible.

Impacts to the stream buffer within Watershed A will be larger in scope, but similar in the type of impact and mitigation. Due to the location of the stream and existing pond on the site, lots north of the pond will only be possible with some impact to the stream buffer. As within Watershed C, a minimum of 25' width of the stream buffer will remain undisturbed, and an equal or greater area of native vegetation adjacent to the stream buffer will be designated as preserved stream buffer, to mitigate for the impacts. Small encroachments for installation of storm and sanitary sewers will be planted with native grasses to restore the vegetation as much as possible. Impacts to the stream buffer and rehabilitation to the buffer can be seen on the development plans.

5. FUTURE CONDITIONS ANALYSIS

The future conditions section of analysis assumes completion of the entire Woodside Ridge development, including construction of two new detention facilities in Watershed A. The difference between the existing conditions model and the future conditions model is a result of the complete development of Woodside Ridge.

5.1 Effects of Development

The analysis provided in Section 3 established the pre-development condition of the watershed, and analysis in this section will provide guidance for a possible configuration of detention to meet the objectives established in Section 3. Refer to Appendix I for the future conditions drainage area map.

Runoff curve numbers, times of Concentration, routings, and tributary regions that are outside the property boundary remain the same as in Section 3. Table 15 contains input data for future conditions and Table 16 and Table 17 summarize the computed results from the PondPack model. After the results of this future conditions model are presented, they will be compared to the existing condition results in Table 19. Refer to Appendix J for output from and a schematic of the future conditions PondPack model.

Table 15. Future Conditions Subarea Data.

Subarea	Onsite Area (ac.)	Offsite Area (ac.)	Total Area (ac.)	T_C (hr.)	Weighted CN
A1	0.13	12.44	12.58	0.140	86
A2	6.69	1.80	8.49	0.126	82
A3	9.98	0.00	9.98	0.100	86
A3a	0.96	0.08	1.04	0.120	81
A4	0.12	177.45	177.57	0.237	87
A5	4.42	0.77	5.19	0.120	81
A6	0.25	3.55	3.80	0.121	87
A7	9.00	0.00	9.00	0.140	86
A7a	1.12	0.22	1.34	0.100	81
A8	11.52	4.43	15.96	0.100	87
A9	12.27	176.79	189.06	0.260	91
Total A	**56.46**	**377.54**	**434.00**		
B1	5.24	0.19	5.42	0.100	86
B1a	0.24	0.36	0.61	0.100	87
Total B	**5.48**	**0.55**	**6.03**		
C1	44.57	30.54	75.11	0.252	88
C1a	0.99	0.20	1.19	0.100	81
Total C	45.56	30.74	76.3		
Total	**107.50**	**408.83**	**516.33**		

Table 16. Woodside Ridge Future Conditions Runoff Data: Subarea Peak Discharge Rates.

Subarea	Q_2 (cfs)	Q_{10} (cfs)	Q_{100} (cfs)
A1	39	66	106
A2	23	41	69
A3	33	56	90
A3a	3	5	8
A4	493	822	1,322
A5	14	25	42
A6	13	21	34
A7	28	47	76
A7a	4	7	11
A8	55	91	146
A9	576	913	1,421
B1	18	30	49
B1a	2	4	6
C1	211	346	551
C1a	3	6	10

* cfs – cubic feet per second

Table 17. Woodside Ridge Future Conditions Runoff Data: Point of Interest Peak Flow Rates.

Point of Interest	Q_2 (cfs)	Q_{10} (cfs)	Q_{100} (cfs)
A1	918	1,550	2,526
A3	4	19	32
B1	3	4	9
C1	47	119	208

5.2. Future Detention Facilities

With the full development of Woodside Ridge, two new dry detention basins will be constructed within Watershed A, with one upstream of Point A3 and one upstream of Point A7. These two future detention facilities will release the water quality event over a period of 40-72 hours, per APWA Section 5608.4 requirements. Table 18 summarizes the computed detention facilities results from the PondPack model for future conditions.

Table 18. Woodside Ridge Future Conditions Detention Basin Data

	Peak Q In (cfs)	T_P In (hr.)	Peak Q Out (cfs)	T_P Out (hr.)	V_R (ac-ft)	Peak W.S.E. (ft)	Stored Volume (ac-ft)
Existing Pond							
2-Year	576	12.03	455	12.14	41.41	931.84	8.29
10-Year	913	12.03	742	12.13	67.15	932.95	11.45
100-Year	1,421	12.03	1,181	12.12	107.26	934.38	15.91
Basin A3							
2-Year	33	11.93	1	13.87	1.82	923.96	1.07
10-Year	56	11.93	16	12.11	3.11	925.06	1.46
100-Year	90	11.93	25	12.11	5.18	927.19	2.34
Basin A7							
2-Year	28	11.96	1	15.02	1.64	934.38	1.03
10-Year	47	11.95	9	12.22	2.81	935.58	1.43
100-Year	76	11.95	20	12.17	4.67	937.53	2.21
Basin B1							
2-Year	18	11.93	0.9	13.25	0.99	923.14	0.57
10-Year	30	11.93	1.4	13.44	1.69	925.05	1.03
100-Year	49	11.93	6	12.35	2.81	926.76	1.53
Basin C1							
2-Year	211	12.05	46	12.40	14.73	921.58	4.72
10-Year	346	12.05	118	12.28	24.68	923.65	7.81
100-Year	551	12.02	206	12.26	40.39	925.96	12.45

* cfs = cubic feet per second; hr = hour; ac-ft = acre-feet

Table 19 provides a comparison of runoff data between existing and future conditions for Woodside Ridge. With the future detention planned within Watershed A, all points of interest see a decrease in flow rates from existing to future conditions. With the exception of Point A1, which was granted a waiver on detention requirements, all remaining points of interest meet detention criteria.

Table 19. Woodside Ridge Future Conditions Point of Interest Discharge Comparison

Point of Interest		Q_2 (cfs)	Q_{10} (cfs)	Q_{100} (cfs)
A1	Future	918	1,550	2,526
	Existing	953	1606	2606
	Difference Future vs Existing	-35	-56	-80
	Allowable	881	1525	2437
	Difference Future vs Allowable	37	25	89
A3	Future	4	19	32
	Existing	25	45	76
	Difference Future vs Existing	-21	-26	-44
	Allowable	5	21	32
	Difference Future vs Allowable	-1	-2	0
B1	Future	3	4	9
	Existing	18	34	58
	Difference Future vs Existing	-15	-30	-49
	Allowable	5	16	25
	Difference Future vs Allowable	-2	-12	-16
C1	Future	47	119	208
	Existing	173	299	493
	Difference Future vs Existing	-126	-180	-285
	Allowable	68	178	274
	Difference Future vs Allowable	-21	-59	-66

6. SUMMARY

This stormwater drainage study has been prepared to evaluate the hydrologic impact generated by the proposed development of Woodside Ridge First Plat and future complete development of Woodside Ridge and to provide recommendations for a comprehensive stormwater management plan. Section 3 of this report determined the baseline conditions reflecting the existing conditions for the project site. Section 4 analyzes the site with the construction of the First Plat and two detention facilities in Watersheds B and C. Section 5 analyzes the site under fully developed conditions. Proposed and future conditions flow rates were also compared to the allowable maximum release rates per APWA Section 5600. Basin C1 was also evaluated with a 0.5PMP rainfall storm event.

Increases in peak flow rates caused by development will be mitigated using dry detention facilities including one within an existing channel. An existing pond will have maintenance actions completed on the spillway but is largely unaffected from the development. Stream buffers will be designated based on watershed size, per APWA standards. Where encroachments are necessary, the impacts will be mitigated with preservation of adjacent native vegetation elsewhere on the site, and within the same watershed.

7. CONCLUSIONS AND RECOMMENDATIONS

Woodside Ridge is proposed as a 198-lot single family residential development on approximately 112 acres, including a pool and amenity tract, with approximately 23 acres reserved for open space and detention.

This proposed stormwater management plan was designed to achieve compliance with current design criteria in effect for the City of Lee's Summit, Missouri, with a granted waiver requested for Point of Interest A1. Two detention facilities will be constructed in conjunction with development of Woodside Ridge First Plat to reduce peak discharge rates, and two additional detention facilities will be constructed with future full development of Woodside Ridge.

The results of the analysis demonstrate that the future stormwater management plan for the project achieves compliance with design criteria or the requested waiver. It is therefore requested that Lee's Summit, Missouri approve this "Woodside Ridge Macro and First Plat Micro Drainage Study".

8. REFERENCES

KC-APWA (Kansas City Metropolitan Chapter of the American Public Works Association). (2011). "Section 5600 Storm Drainage & Facilities."

Missouri Department of Natural Resources. "Dam Safety Publication No. 3 Rules and Regulations of the Missouri Dam and Reservoir Safety Council". Missouri Department of Natural Resources, Rolla, MO.

National Weather Service. "Hydrometeorological Report No. 51 Probable Maximum Precipitation Estimates, United States East of the 105th Meridian" (1978). Department of Commerce, Washington, D.C.

United States Weather Bureau. "Technical Paper No. 40 Rainfall Frequency Atlas of the United States" (1961). Department of Commerce, Washington, D.C.

APPENDIX A

Floodplain Map

WOODSIDE RIDGE
FLOODPLAIN MAP

LEGEND

- 🟨 FIRST PLAT BOUNDARY
- 🟥 PROPERTY BOUNDARY
- ▨ FLOODWAY
- 🟦 ZONE AE - 100-YEAR FLOODPLAIN

Source:
FEMA Flood Boundary & Floodway Map
29095C0416G

Effective Date: 01/20/2017

N

0 400 800
Feet
1 ' = 400 "

Drawn: jwitzke 11/28/2018

olsson

Location: \\oa.ad.oaconsulting.com\lte-ns1\projects\2018\1001-1500\018-1140\40-Design\Exhibits\2018 06-20 Storm Drainage Study Exhibits\018-1140 Floodplain Map.mxd

APPENDIX B

Soils Map

WOODSIDE RIDGE

SOIL MAP

LEGEND

FIRST PLAT BOUNDARY

PROPERTY BOUNDARY

10128
SHARPSBURG-URBAN LAND COMPLEX
2 to 5% SLOPES

10141
SNEAD-ROCK OUTCROP COMPLEX
14 to 30% SLOPES

10142
SNEAD-ROCK OUTCROP COMPLEX
5 to 14% SLOPES

10143
SNEAD-URBAN LAND COMPLEX
9 to 30% SLOPES

Source:
Soil Survey of Jackson County, Missouri

N

0 400 800
Feet

1 ' = 400 "

Drawn: jwitzke 11/28/2018

olsson

Location: \\oa.ad.oaconsulting.com\lte-ns1\projects\2018\1001-1500\018-1140\40-Design\Exhibits\2018 06-20 Storm Drainage Study Exhibits\018-1140 Soils Map.mxd

APPENDIX C

Existing Conditions Drainage Area and Land Use Exhibits

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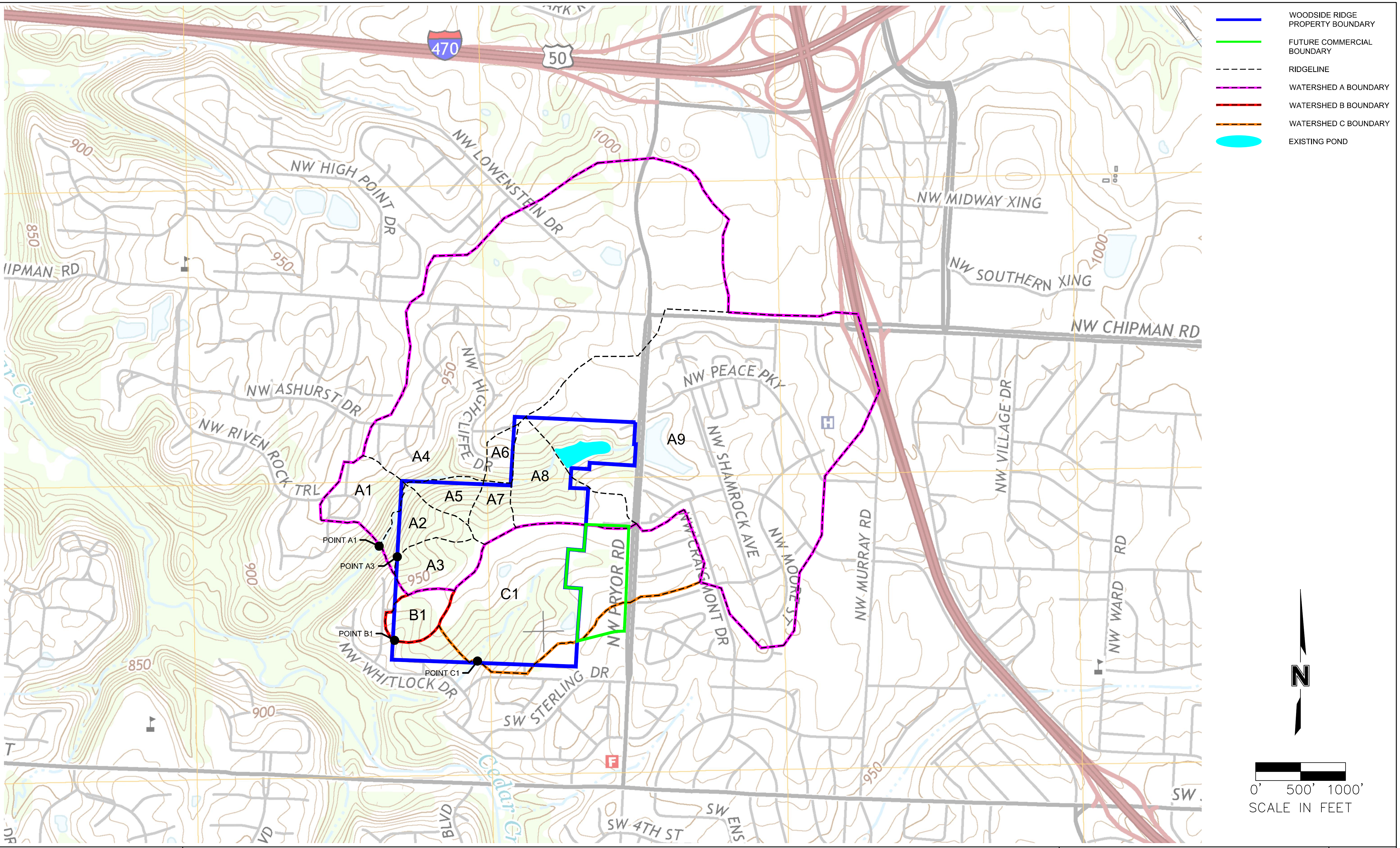

PROJECT NO:	A18-1140
DRAWN BY:	JJL
DATE:	11/28/2018

EXISTING CONDITIONS DRAINAGE AREA MAP

olsson
7301 West 133rd Street
Suite 200
Overland Park, KS 66213-4750
TEL 913.381.1170
FAX 913.381.1174

EXHIBIT
1

DWG: F:\2018\1001-1500\018-1140-A\40-Design\Calcs\WTRS\Final Macro and First Plat SDS\CAD\ExLandUse.dwg USER: jlay
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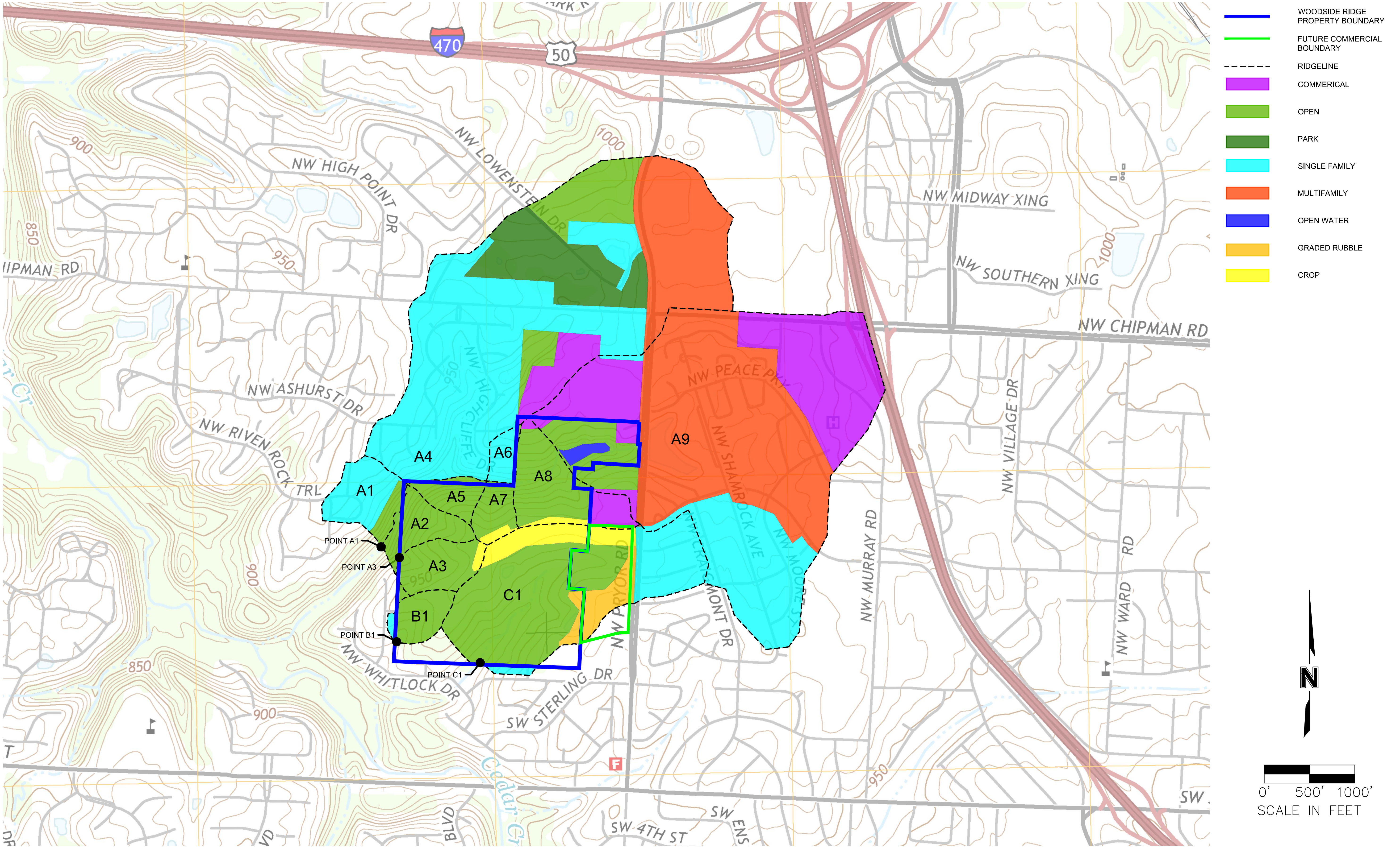

PROJECT NO: A18-1140
DRAWN BY: JJL
DATE: 11/30/2018

EXISTING CONDITIONS LAND USE MAP

olsson

7301 West 133rd Street
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Overland Park, KS 66213-4750
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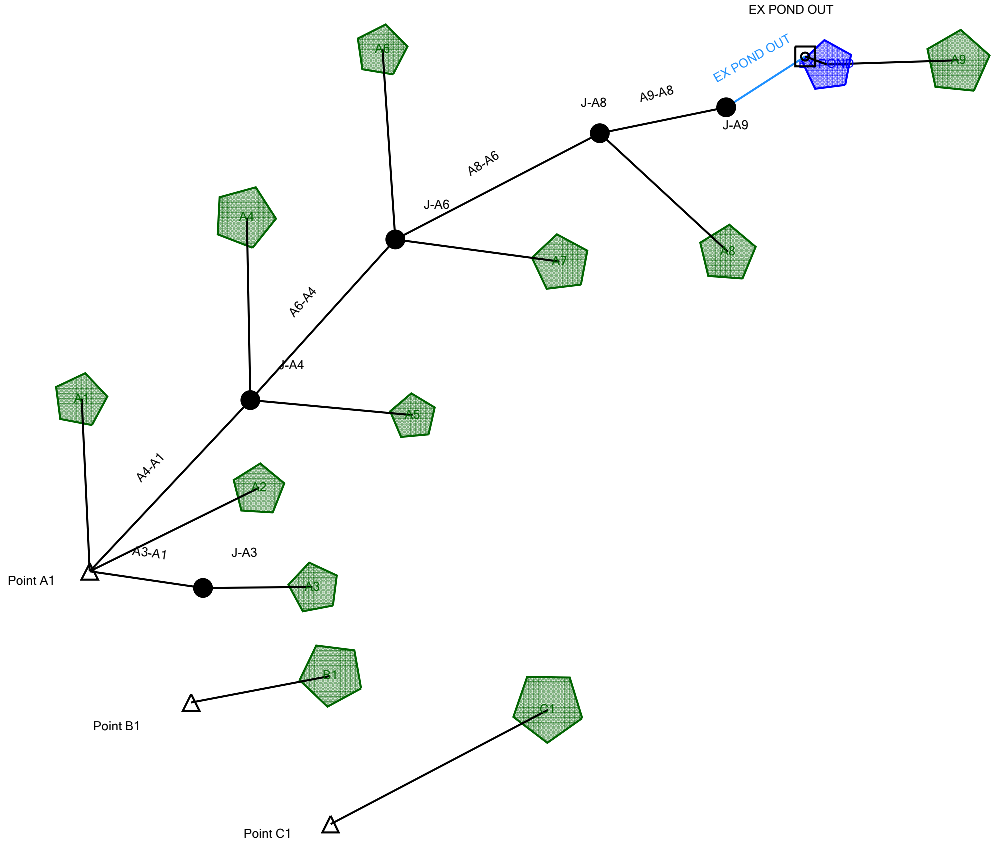
EXHIBIT
1A

APPENDIX D

Existing Conditions PondPack Model Input and Results

Existing Conditions PondPack Schematic



Existing Conditions Curve Number Calculations

	Offsite					Onsite								
	80 Open Space (ac.)	85 Park (ac.)	87 SFR (ac.)	92 MFR (ac.)	95 Commercial (ac.)	80 Open Space (ac.)	95 Commercial (ac.)	89 Crop (ac.)	94 Open Graded (ac.)	100 Pond (ac.)	Total Offsite (ac.)	Total Onsite (ac.)	Total (ac.)	Total CN
A1	2.47	0.00	9.97	0.00	0.00	0.13	0.00	0.00	0.00	0.00	12.44	0.135	12.58	86
A2	1.80	0.00	0.00	0.00	0.00	7.42	0.00	0.00	0.00	0.00	1.80	7.420	9.22	80
A3	0.08	0.00	0.00	0.00	0.00	9.70	0.00	0.68	0.00	0.00	0.08	10.382	10.46	81
A4	18.65	25.96	88.37	35.84	8.61	0.05	0.16	0.00	0.00	0.00	177.43	0.216	177.64	87
A5	0.77	0.00	0.00	0.00	0.00	5.02	0.00	0.00	0.00	0.00	0.77	5.021	5.79	80
A6	0.00	0.00	3.55	0.00	0.00	0.27	0.05	0.00	0.00	0.00	3.55	0.324	3.88	87
A7	0.22	0.00	0.00	0.00	0.00	5.00	0.00	0.85	0.00	0.00	0.22	5.854	6.08	81
A8	0.34	0.00	0.00	0.04	3.72	14.11	0.36	1.26	0.00	0.00	4.09	15.728	19.82	84
A9	4.44	0.00	33.55	88.06	50.75	8.08	1.86	0.00	0.00	1.57	176.80	11.508	188.31	91
TOTAL A	28.76	25.96	135.45	123.93	63.08	49.80	2.43	2.79	0.00	1.57	377.18	56.590	433.77	88
B1	0.55	0.00	0.00	0.00	0.00	6.70	0.00	0.00	0.00	0.00	0.55	6.70	7.25	80
TOTAL B	0.55	0.00	0.00	0.00	0.00	6.70	0.00	0.00	0.00	0.00	0.55	6.70	7.25	80
C1	0.00	0.00	14.41	0.02	0.00	40.42	0.00	8.35	7.61	0.00	14.44	56.38	70.82	84
TOTAL C	0.00	0.00	14.41	0.02	0.00	40.42	0.00	8.35	7.61	0.00	14.44	56.38	70.82	84

Existing Conditions

Project Summary

Title	Woodside Ridge - Existing Conditions
Engineer	JJL
Company	Olsson
Date	11/28/2018

Notes

Existing Conditions

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
A3	2-Year	2	1.556	12.010	24.93
A3	10-Year	10	2.828	12.010	44.87
A3	100-Year	100	4.913	11.990	76.40
B1	2-Year	2	1.035	11.950	18.25
B1	10-Year	10	1.904	11.950	33.51
B1	100-Year	100	3.337	11.940	57.78
C1	2-Year	2	11.895	12.050	172.71
C1	10-Year	10	20.863	12.050	298.47
C1	100-Year	100	35.307	12.050	492.77
A1	2-Year	2	2.289	11.960	38.93
A1	10-Year	10	3.923	11.960	65.59
A1	100-Year	100	6.526	11.960	106.37
A2	2-Year	2	1.316	11.960	22.93
A2	10-Year	10	2.421	11.950	42.16
A2	100-Year	100	4.244	11.950	72.67
A4	2-Year	2	33.541	12.040	493.42
A4	10-Year	10	56.848	12.020	821.84
A4	100-Year	100	93.800	12.020	1,322.87
A5	2-Year	2	0.827	11.950	14.52
A5	10-Year	10	1.520	11.950	26.67
A5	100-Year	100	2.665	11.940	46.04
A6	2-Year	2	0.734	11.950	12.85
A6	10-Year	10	1.243	11.950	21.33
A6	100-Year	100	2.051	11.940	34.29
A7	2-Year	2	0.905	11.970	15.40
A7	10-Year	10	1.645	11.960	27.89
A7	100-Year	100	2.857	11.960	47.57
A8	2-Year	2	3.336	11.930	60.89
A8	10-Year	10	5.850	11.930	105.52
A8	100-Year	100	9.898	11.930	174.45
A9	2-Year	2	41.242	12.030	574.03
A9	10-Year	10	66.882	12.030	909.45
A9	100-Year	100	106.835	12.030	1,415.77

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
Point A1	2-Year	2	83.823	12.080	953.05
Point A1	10-Year	10	141.125	12.070	1,605.57
Point A1	100-Year	100	231.584	12.070	2,606.13
Point B1	2-Year	2	1.035	11.950	18.25
Point B1	10-Year	10	1.904	11.950	33.51

Existing Conditions

Subsection: Master Network Summary

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
Point B1	100-Year	100	3.337	11.940	57.78
Point C1	2-Year	2	11.895	12.050	172.71
Point C1	10-Year	10	20.863	12.050	298.47
Point C1	100-Year	100	35.307	12.050	492.77
J-A3	2-Year	2	1.556	12.010	24.93
J-A3	10-Year	10	2.828	12.010	44.87
J-A3	100-Year	100	4.913	11.990	76.40
J-A4	2-Year	2	78.687	12.080	895.35
J-A4	10-Year	10	131.992	12.070	1,497.91
J-A4	100-Year	100	215.960	12.060	2,420.63
J-A6	2-Year	2	44.341	12.160	473.71
J-A6	10-Year	10	73.655	12.150	775.86
J-A6	100-Year	100	119.543	12.140	1,240.15
J-A8	2-Year	2	42.709	12.150	465.54
J-A8	10-Year	10	70.777	12.140	761.00
J-A8	100-Year	100	114.650	12.130	1,213.71
J-A9	2-Year	2	39.385	12.140	452.87
J-A9	10-Year	10	64.946	12.130	738.60
J-A9	100-Year	100	104.779	12.120	1,175.89

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
EX POND (IN)	2-Year	2	41.242	12.030	574.03	(N/A)	(N/A)
EX POND (OUT)	2-Year	2	39.385	12.140	452.87	931.83	8.268
EX POND (IN)	10-Year	10	66.882	12.030	909.45	(N/A)	(N/A)
EX POND (OUT)	10-Year	10	64.946	12.130	738.60	932.94	11.411
EX POND (IN)	100-Year	100	106.835	12.030	1,415.77	(N/A)	(N/A)
EX POND (OUT)	100-Year	100	104.779	12.120	1,175.89	934.36	15.866

Existing Conditions

Subsection: Time-Depth Curve	Return Event: 100 years
Label: KCMO TR-55	Storm Event: 100-YEAR

Time-Depth Curve: 100-YEAR

Label	100-YEAR
Start Time	0.000 hours
Increment	0.100 hours
End Time	24.000 hours
Return Event	100 years

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.100 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
0.500	0.0	0.0	0.1	0.1	0.1
1.000	0.1	0.1	0.1	0.1	0.1
1.500	0.1	0.1	0.1	0.2	0.2
2.000	0.2	0.2	0.2	0.2	0.2
2.500	0.2	0.2	0.2	0.3	0.3
3.000	0.3	0.3	0.3	0.3	0.3
3.500	0.3	0.3	0.3	0.4	0.4
4.000	0.4	0.4	0.4	0.4	0.4
4.500	0.4	0.4	0.5	0.5	0.5
5.000	0.5	0.5	0.5	0.5	0.5
5.500	0.6	0.6	0.6	0.6	0.6
6.000	0.6	0.6	0.7	0.7	0.7
6.500	0.7	0.7	0.7	0.8	0.8
7.000	0.8	0.8	0.8	0.8	0.8
7.500	0.9	0.9	0.9	0.9	0.9
8.000	0.9	1.0	1.0	1.0	1.0
8.500	1.0	1.1	1.1	1.1	1.1
9.000	1.2	1.2	1.2	1.2	1.3
9.500	1.3	1.3	1.3	1.4	1.4
10.000	1.4	1.5	1.5	1.5	1.6
10.500	1.6	1.7	1.7	1.7	1.8
11.000	1.9	1.9	2.0	2.1	2.1
11.500	2.2	2.4	2.8	3.4	4.5
12.000	5.2	5.4	5.5	5.6	5.7
12.500	5.8	5.9	5.9	6.0	6.0
13.000	6.1	6.1	6.2	6.2	6.3
13.500	6.3	6.3	6.4	6.4	6.4
14.000	6.5	6.5	6.5	6.6	6.6
14.500	6.6	6.6	6.7	6.7	6.7
15.000	6.7	6.8	6.8	6.8	6.8
15.500	6.9	6.9	6.9	6.9	6.9
16.000	7.0	7.0	7.0	7.0	7.0
16.500	7.0	7.1	7.1	7.1	7.1

Existing Conditions

Subsection: Time-Depth Curve Return Event: 100 years
Label: KCMO TR-55 Storm Event: 100-YEAR

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.100 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
17.000	7.1	7.1	7.2	7.2	7.2
17.500	7.2	7.2	7.2	7.2	7.3
18.000	7.3	7.3	7.3	7.3	7.3
18.500	7.3	7.4	7.4	7.4	7.4
19.000	7.4	7.4	7.4	7.4	7.5
19.500	7.5	7.5	7.5	7.5	7.5
20.000	7.5	7.5	7.5	7.6	7.6
20.500	7.6	7.6	7.6	7.6	7.6
21.000	7.6	7.6	7.6	7.7	7.7
21.500	7.7	7.7	7.7	7.7	7.7
22.000	7.7	7.7	7.7	7.7	7.8
22.500	7.8	7.8	7.8	7.8	7.8
23.000	7.8	7.8	7.8	7.8	7.8
23.500	7.9	7.9	7.9	7.9	7.9
24.000	7.9	(N/A)	(N/A)	(N/A)	(N/A)

Existing Conditions

Subsection: Time-Depth Curve

Label: KCMO TR-55

Return Event: 10 years

Storm Event: 10-YEAR

Time-Depth Curve: 10-YEAR	
Label	10-YEAR
Start Time	0.000 hours
Increment	0.100 hours
End Time	24.000 hours
Return Event	10 years

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.100 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
0.500	0.0	0.0	0.0	0.0	0.0
1.000	0.1	0.1	0.1	0.1	0.1
1.500	0.1	0.1	0.1	0.1	0.1
2.000	0.1	0.1	0.1	0.1	0.1
2.500	0.1	0.2	0.2	0.2	0.2
3.000	0.2	0.2	0.2	0.2	0.2
3.500	0.2	0.2	0.2	0.2	0.2
4.000	0.3	0.3	0.3	0.3	0.3
4.500	0.3	0.3	0.3	0.3	0.3
5.000	0.3	0.3	0.4	0.4	0.4
5.500	0.4	0.4	0.4	0.4	0.4
6.000	0.4	0.4	0.4	0.5	0.5
6.500	0.5	0.5	0.5	0.5	0.5
7.000	0.5	0.5	0.5	0.6	0.6
7.500	0.6	0.6	0.6	0.6	0.6
8.000	0.6	0.6	0.7	0.7	0.7
8.500	0.7	0.7	0.7	0.7	0.8
9.000	0.8	0.8	0.8	0.8	0.8
9.500	0.9	0.9	0.9	0.9	0.9
10.000	1.0	1.0	1.0	1.0	1.1
10.500	1.1	1.1	1.1	1.2	1.2
11.000	1.2	1.3	1.3	1.4	1.4
11.500	1.5	1.6	1.9	2.3	3.0
12.000	3.5	3.6	3.7	3.8	3.8
12.500	3.9	3.9	4.0	4.0	4.1
13.000	4.1	4.1	4.2	4.2	4.2
13.500	4.2	4.3	4.3	4.3	4.3
14.000	4.3	4.4	4.4	4.4	4.4
14.500	4.4	4.5	4.5	4.5	4.5
15.000	4.5	4.5	4.6	4.6	4.6
15.500	4.6	4.6	4.6	4.6	4.7
16.000	4.7	4.7	4.7	4.7	4.7
16.500	4.7	4.7	4.7	4.8	4.8

Existing Conditions

Subsection: Time-Depth Curve
Label: KCMO TR-55

Return Event: 10 years
Storm Event: 10-YEAR

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.100 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
17.000	4.8	4.8	4.8	4.8	4.8
17.500	4.8	4.8	4.9	4.9	4.9
18.000	4.9	4.9	4.9	4.9	4.9
18.500	4.9	4.9	4.9	5.0	5.0
19.000	5.0	5.0	5.0	5.0	5.0
19.500	5.0	5.0	5.0	5.0	5.0
20.000	5.0	5.1	5.1	5.1	5.1
20.500	5.1	5.1	5.1	5.1	5.1
21.000	5.1	5.1	5.1	5.1	5.1
21.500	5.1	5.2	5.2	5.2	5.2
22.000	5.2	5.2	5.2	5.2	5.2
22.500	5.2	5.2	5.2	5.2	5.2
23.000	5.2	5.2	5.3	5.3	5.3
23.500	5.3	5.3	5.3	5.3	5.3
24.000	5.3	(N/A)	(N/A)	(N/A)	(N/A)

Time-Depth Curve: 2-YEAR	
Label	2-YEAR
Start Time	0.000 hours
Increment	0.100 hours
End Time	24.000 hours
Return Event	2 years

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.100 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
0.500	0.0	0.0	0.0	0.0	0.0
1.000	0.0	0.0	0.0	0.0	0.1
1.500	0.1	0.1	0.1	0.1	0.1
2.000	0.1	0.1	0.1	0.1	0.1
2.500	0.1	0.1	0.1	0.1	0.1
3.000	0.1	0.1	0.1	0.1	0.1
3.500	0.1	0.2	0.2	0.2	0.2
4.000	0.2	0.2	0.2	0.2	0.2
4.500	0.2	0.2	0.2	0.2	0.2
5.000	0.2	0.2	0.2	0.2	0.3
5.500	0.3	0.3	0.3	0.3	0.3
6.000	0.3	0.3	0.3	0.3	0.3
6.500	0.3	0.3	0.3	0.3	0.3
7.000	0.4	0.4	0.4	0.4	0.4
7.500	0.4	0.4	0.4	0.4	0.4
8.000	0.4	0.4	0.4	0.5	0.5
8.500	0.5	0.5	0.5	0.5	0.5
9.000	0.5	0.5	0.6	0.6	0.6
9.500	0.6	0.6	0.6	0.6	0.6
10.000	0.7	0.7	0.7	0.7	0.7
10.500	0.7	0.8	0.8	0.8	0.8
11.000	0.8	0.9	0.9	0.9	1.0
11.500	1.0	1.1	1.3	1.6	2.0
12.000	2.4	2.5	2.5	2.6	2.6
12.500	2.6	2.7	2.7	2.7	2.8
13.000	2.8	2.8	2.8	2.8	2.9
13.500	2.9	2.9	2.9	2.9	2.9
14.000	3.0	3.0	3.0	3.0	3.0
14.500	3.0	3.0	3.0	3.1	3.1
15.000	3.1	3.1	3.1	3.1	3.1
15.500	3.1	3.1	3.1	3.2	3.2
16.000	3.2	3.2	3.2	3.2	3.2
16.500	3.2	3.2	3.2	3.2	3.2

Existing Conditions

Subsection: Time-Depth Curve | Return Event: 2 years
Label: KCMO TR-55 | Storm Event: 2-YEAR

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.100 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
17.000	3.2	3.3	3.3	3.3	3.3
17.500	3.3	3.3	3.3	3.3	3.3
18.000	3.3	3.3	3.3	3.3	3.3
18.500	3.3	3.4	3.4	3.4	3.4
19.000	3.4	3.4	3.4	3.4	3.4
19.500	3.4	3.4	3.4	3.4	3.4
20.000	3.4	3.4	3.4	3.4	3.4
20.500	3.5	3.5	3.5	3.5	3.5
21.000	3.5	3.5	3.5	3.5	3.5
21.500	3.5	3.5	3.5	3.5	3.5
22.000	3.5	3.5	3.5	3.5	3.5
22.500	3.5	3.5	3.5	3.6	3.6
23.000	3.6	3.6	3.6	3.6	3.6
23.500	3.6	3.6	3.6	3.6	3.6
24.000	3.6	(N/A)	(N/A)	(N/A)	(N/A)

Existing Conditions

Subsection: Time of Concentration Calculations	Return Event: 2 years
Label: A1	Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.050 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.26 ft/s
Segment Time of Concentration	0.107 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	300.00 ft
Is Paved?	False
Slope	0.070 ft/ft
Average Velocity	4.27 ft/s
Segment Time of Concentration	0.020 hours

Segment #3: Length and Velocity	
Hydraulic Length	740.00 ft
Velocity	15.00 ft/s
Segment Time of Concentration	0.014 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.140 hours

Existing Conditions

Subsection: Time of Concentration Calculations — Return Event: 2 years

Label: A1 — Storm Event: 2-YEAR

==== User Defined Length & Velocity

Tc = (Lf / V) / 3600

Where:
Tc= Time of concentration, hours
Lf= Flow length, feet
V= Velocity, ft/sec

==== SCS Channel Flow

Tc =
R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc =
Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600

Where:
V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Existing Conditions

Subsection: Time of Concentration Calculations
Label: A2

Return Event: 2 years
Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow

Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.080 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.31 ft/s
Segment Time of Concentration	0.088 hours

Segment #2: TR-55 Shallow Concentrated Flow

Hydraulic Length	300.00 ft
Is Paved?	False
Slope	0.070 ft/ft
Average Velocity	4.27 ft/s
Segment Time of Concentration	0.020 hours

Segment #3: Length and Velocity

Hydraulic Length	970.00 ft
Velocity	15.00 ft/s
Segment Time of Concentration	0.018 hours

Time of Concentration (Composite)

Time of Concentration (Composite)	0.126 hours

Existing Conditions

Subsection: Time of Concentration Calculations Return Event: 2 years
Label: A2 Storm Event: 2-YEAR

==== User Defined Length & Velocity

Tc =	(Lf / V) / 3600
Where:	Tc= Time of concentration, hours Lf= Flow length, feet V= Velocity, ft/sec

==== SCS Channel Flow

Tc =	R = Qa / Wp V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n (Lf / V) / 3600
Where:	R= Hydraulic radius Aq= Flow area, square feet Wp= Wetted perimeter, feet V= Velocity, ft/sec Sf= Slope, ft/ft n= Manning's n Tc= Time of concentration, hours Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc =	Unpaved surface: V = 16.1345 * (Sf**0.5) Paved Surface: V = 20.3282 * (Sf**0.5) (Lf / V) / 3600
Where:	V= Velocity, ft/sec Sf= Slope, ft/ft Tc= Time of concentration, hours Lf= Flow length, feet

Existing Conditions

Subsection: Time of Concentration Calculations
Label: A3

Return Event: 2 years
Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.020 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.18 ft/s
Segment Time of Concentration	0.154 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	300.00 ft
Is Paved?	False
Slope	0.060 ft/ft
Average Velocity	3.95 ft/s
Segment Time of Concentration	0.021 hours

Segment #3: Length and Velocity	
Hydraulic Length	640.00 ft
Velocity	15.00 ft/s
Segment Time of Concentration	0.012 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.187 hours

Existing Conditions

Subsection: Time of Concentration Calculations
Label: A3

Return Event: 2 years
Storm Event: 2-YEAR

==== User Defined Length & Velocity

Tc = (Lf / V) / 3600

Where:
Tc= Time of concentration, hours
Lf= Flow length, feet
V= Velocity, ft/sec

==== SCS Channel Flow

Tc =
R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc =
Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600

Where:
V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Existing Conditions

Subsection: Time of Concentration Calculations
Label: A4

Return Event: 2 years
Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.011
Slope	0.020 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	1.46 ft/s
Segment Time of Concentration	0.019 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	300.00 ft
Is Paved?	True
Slope	0.020 ft/ft
Average Velocity	2.87 ft/s
Segment Time of Concentration	0.029 hours

Segment #3: Length and Velocity	
Hydraulic Length	4,750.00 ft
Velocity	7.00 ft/s
Segment Time of Concentration	0.188 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.237 hours

Existing Conditions

Subsection: Time of Concentration Calculations Return Event: 2 years
Label: A4 Storm Event: 2-YEAR

==== User Defined Length & Velocity

Tc = (Lf / V) / 3600
Where: Tc= Time of concentration, hours
Lf= Flow length, feet
V= Velocity, ft/sec

==== SCS Channel Flow

Tc = R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600
Where: R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc = Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600
Where: V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Existing Conditions

Subsection: Time of Concentration Calculations
Label: A5

Return Event: 2 years
Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.080 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.31 ft/s
Segment Time of Concentration	0.088 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	300.00 ft
Is Paved?	False
Slope	0.080 ft/ft
Average Velocity	4.56 ft/s
Segment Time of Concentration	0.018 hours

Segment #3: Length and Velocity	
Hydraulic Length	740.00 ft
Velocity	15.00 ft/s
Segment Time of Concentration	0.014 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.120 hours

Existing Conditions

Subsection: Time of Concentration Calculations
Label: A5

Return Event: 2 years
Storm Event: 2-YEAR

==== User Defined Length & Velocity

Tc = (Lf / V) / 3600

Where:
Tc= Time of concentration, hours
Lf= Flow length, feet
V= Velocity, ft/sec

==== SCS Channel Flow

Tc =
R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc =
Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600

Where:
V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Existing Conditions

Subsection: Time of Concentration Calculations
Label: A6

Return Event: 2 years
Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.070 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.30 ft/s
Segment Time of Concentration	0.093 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	300.00 ft
Is Paved?	False
Slope	0.070 ft/ft
Average Velocity	4.27 ft/s
Segment Time of Concentration	0.020 hours

Segment #3: Length and Velocity	
Hydraulic Length	440.00 ft
Velocity	15.00 ft/s
Segment Time of Concentration	0.008 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.121 hours

Existing Conditions

Subsection: Time of Concentration Calculations | Return Event: 2 years
Label: A6 | Storm Event: 2-YEAR

==== User Defined Length & Velocity

Tc = (Lf / V) / 3600

Where:
Tc= Time of concentration, hours
Lf= Flow length, feet
V= Velocity, ft/sec

==== SCS Channel Flow

Tc =
R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc =
Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600

Where:
V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Existing Conditions

Subsection: Time of Concentration Calculations
Label: A7

Return Event: 2 years
Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.040 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.24 ft/s
Segment Time of Concentration	0.117 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	300.00 ft
Is Paved?	False
Slope	0.080 ft/ft
Average Velocity	4.56 ft/s
Segment Time of Concentration	0.018 hours

Segment #3: Length and Velocity	
Hydraulic Length	330.00 ft
Velocity	15.00 ft/s
Segment Time of Concentration	0.006 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.141 hours

Existing Conditions

Subsection: Time of Concentration Calculations — Return Event: 2 years

Label: A7 — Storm Event: 2-YEAR

==== User Defined Length & Velocity

Tc = (Lf / V) / 3600

Where:
Tc= Time of concentration, hours
Lf= Flow length, feet
V= Velocity, ft/sec

==== SCS Channel Flow

Tc =
R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc =
Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600

Where:
V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Existing Conditions

Subsection: Time of Concentration Calculations
Label: A8

Return Event: 2 years
Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow

Hydraulic Length	100.00 ft
Manning's n	0.011
Slope	0.020 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	1.46 ft/s
Segment Time of Concentration	0.019 hours

Segment #2: TR-55 Shallow Concentrated Flow

Hydraulic Length	260.00 ft
Is Paved?	True
Slope	0.030 ft/ft
Average Velocity	3.52 ft/s
Segment Time of Concentration	0.021 hours

Segment #3: Length and Velocity

Hydraulic Length	1,010.00 ft
Velocity	10.00 ft/s
Segment Time of Concentration	0.028 hours

Time of Concentration (Composite)

Time of Concentration (Composite)	0.100 hours

Existing Conditions

Subsection: Time of Concentration Calculations
Label: A8

Return Event: 2 years
Storm Event: 2-YEAR

==== User Defined Length & Velocity

Tc = (Lf / V) / 3600

Where:
Tc= Time of concentration, hours
Lf= Flow length, feet
V= Velocity, ft/sec

==== SCS Channel Flow

Tc =
R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc =
Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600

Where:
V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Existing Conditions

Subsection: Time of Concentration Calculations
Label: A9

Return Event: 2 years
Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.030 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.21 ft/s
Segment Time of Concentration	0.131 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	300.00 ft
Is Paved?	False
Slope	0.030 ft/ft
Average Velocity	2.79 ft/s
Segment Time of Concentration	0.030 hours

Segment #3: Length and Velocity	
Hydraulic Length	3,570.00 ft
Velocity	10.00 ft/s
Segment Time of Concentration	0.099 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.260 hours

Existing Conditions

Subsection: Time of Concentration Calculations
Label: A9

Return Event: 2 years
Storm Event: 2-YEAR

==== User Defined Length & Velocity

Tc = (Lf / V) / 3600

Where:
Tc= Time of concentration, hours
Lf= Flow length, feet
V= Velocity, ft/sec

==== SCS Channel Flow

Tc =
R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc =
Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600

Where:
V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Existing Conditions

Subsection: Time of Concentration Calculations
Label: B1

Return Event: 2 years
Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	50.00 ft
Manning's n	0.150
Slope	0.020 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.16 ft/s
Segment Time of Concentration	0.088 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	300.00 ft
Is Paved?	False
Slope	0.060 ft/ft
Average Velocity	3.95 ft/s
Segment Time of Concentration	0.021 hours

Segment #3: Length and Velocity	
Hydraulic Length	520.00 ft
Velocity	15.00 ft/s
Segment Time of Concentration	0.010 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.119 hours

==== User Defined Length & Velocity

Tc = (Lf / V) / 3600

Where:
Tc= Time of concentration, hours
Lf= Flow length, feet
V= Velocity, ft/sec

==== SCS Channel Flow

Tc = R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc = Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600

Where:
V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Existing Conditions

Subsection: Time of Concentration Calculations
Label: C1

Return Event: 2 years
Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow

Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.020 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.18 ft/s
Segment Time of Concentration	0.154 hours

Segment #2: TR-55 Shallow Concentrated Flow

Hydraulic Length	120.00 ft
Is Paved?	False
Slope	0.020 ft/ft
Average Velocity	2.28 ft/s
Segment Time of Concentration	0.015 hours

Segment #3: Length and Velocity

Hydraulic Length	3,020.00 ft
Velocity	10.00 ft/s
Segment Time of Concentration	0.084 hours

Time of Concentration (Composite)

Time of Concentration (Composite)	0.252 hours

Existing Conditions

Subsection: Time of Concentration Calculations	Return Event: 2 years
Label: C1	Storm Event: 2-YEAR

==== User Defined Length & Velocity

Tc = (Lf / V) / 3600
Where: Tc= Time of concentration, hours
Lf= Flow length, feet
V= Velocity, ft/sec

==== SCS Channel Flow

Tc = R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600
Where: R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc = Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600
Where: V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Existing Conditions

Subsection: Channel Routing Summary	Return Event: 2 years
Label: A3-A1	Storm Event: 2-YEAR

Infiltration	
Infiltration Method	No Infiltration

Translation Routing Summary	
Flow (Base)	0.00 ft³/s
Translate	0.010 hours

	Inflow Hydrograph	Outflow Hydrograph
Time Start (hours)...	0.000	0.020
Time Step (hours)...	0.010	0.010
Time End (hours)...	24.000	24.020
Peak Time (hours)...	12.140	12.160
Peak Flow (ft³/s)...	452.87	452.87

Inflow/Outflow Volumes	
Volume (Routing, Inflow)	1.556 ac-ft
Volume (Routing, Unrouted)	0.000 ac-ft
Volume (Routing, Base Flow)	0.000 ac-ft
Volume (Routing, Infiltration)	0.000 ac-ft
Volume (Routing, Outflow)	1.556 ac-ft

Existing Conditions

Subsection: Channel Routing Summary	Return Event: 2 years
Label: A4-A1	Storm Event: 2-YEAR

Infiltration

Infiltration Method	No Infiltration

Translation Routing Summary

Flow (Base)	0.00 ft³/s
Translate	0.020 hours

	Inflow Hydrograph	Outflow Hydrograph
Time Start (hours)...	0.000	0.020
Time Step (hours)...	0.010	0.010
Time End (hours)...	24.000	24.020
Peak Time (hours)...	12.140	12.160
Peak Flow (ft³/s)...	452.87	452.87

Inflow/Outflow Volumes

Volume (Routing, Inflow)	78.687 ac-ft
Volume (Routing, Unrouted)	0.000 ac-ft
Volume (Routing, Base Flow)	0.000 ac-ft
Volume (Routing, Infiltration)	0.000 ac-ft
Volume (Routing, Outflow)	78.687 ac-ft

Existing Conditions

Subsection: Channel Routing Summary	Return Event: 2 years
Label: A6-A4	Storm Event: 2-YEAR

Infiltration	
Infiltration Method	No Infiltration

Translation Routing Summary	
Flow (Base)	0.00 ft³/s
Translate	0.030 hours

	Inflow Hydrograph	Outflow Hydrograph
Time Start (hours)...	0.000	0.020
Time Step (hours)...	0.010	0.010
Time End (hours)...	24.000	24.020
Peak Time (hours)...	12.140	12.160
Peak Flow (ft³/s)...	452.87	452.87

Inflow/Outflow Volumes	
Volume (Routing, Inflow)	44.341 ac-ft
Volume (Routing, Unrouted)	0.000 ac-ft
Volume (Routing, Base Flow)	0.000 ac-ft
Volume (Routing, Infiltration)	0.000 ac-ft
Volume (Routing, Outflow)	44.341 ac-ft

Existing Conditions

Subsection: Channel Routing Summary	Return Event: 2 years
Label: A8-A6	Storm Event: 2-YEAR

Infiltration	
Infiltration Method	No Infiltration

Translation Routing Summary	
Flow (Base)	0.00 ft³/s
Translate	0.010 hours

	Inflow Hydrograph	Outflow Hydrograph
Time Start (hours)...	0.000	0.020
Time Step (hours)...	0.010	0.010
Time End (hours)...	24.000	24.020
Peak Time (hours)...	12.140	12.160
Peak Flow (ft³/s)...	452.87	452.87

Inflow/Outflow Volumes	
Volume (Routing, Inflow)	42.709 ac-ft
Volume (Routing, Unrouted)	0.000 ac-ft
Volume (Routing, Base Flow)	0.000 ac-ft
Volume (Routing, Infiltration)	0.000 ac-ft
Volume (Routing, Outflow)	42.709 ac-ft

Existing Conditions

Subsection: Channel Routing Summary	Return Event: 2 years
Label: A9-A8	Storm Event: 2-YEAR

Infiltration	
Infiltration Method	No Infiltration

Translation Routing Summary	
Flow (Base)	0.00 ft³/s
Translate	0.020 hours

	Inflow Hydrograph	Outflow Hydrograph
Time Start (hours)...	0.000	0.020
Time Step (hours)...	0.010	0.010
Time End (hours)...	24.000	24.020
Peak Time (hours)...	12.140	12.160
Peak Flow (ft³/s)...	452.87	452.87

Inflow/Outflow Volumes	
Volume (Routing, Inflow)	39.385 ac-ft
Volume (Routing, Unrouted)	0.000 ac-ft
Volume (Routing, Base Flow)	0.000 ac-ft
Volume (Routing, Infiltration)	0.000 ac-ft
Volume (Routing, Outflow)	39.385 ac-ft

Existing Conditions

Subsection: Elevation-Area Volume Curve — Return Event: 2 years

Label: EX POND — Storm Event: 2-YEAR

Elevation (ft)	Planimeter (ft²)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
928.00	0.0	1.487	0.000	0.000	0.000
929.00	0.0	1.929	5.110	1.703	1.703
930.00	0.0	2.218	6.215	2.072	3.775
931.00	0.0	2.466	7.023	2.341	6.116
932.00	0.0	2.756	7.829	2.610	8.726
933.00	0.0	2.981	8.603	2.868	11.593
934.00	0.0	3.199	9.268	3.089	14.683
935.00	0.0	3.454	9.977	3.326	18.008

Existing Conditions

Subsection: Outlet Input Data
Label: Existing Ogee Spillway

Return Event: 2 years
Storm Event: 2-YEAR

Requested Pond Water Surface Elevations	
Minimum (Headwater)	928.00 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	935.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
User Defined Table	Existing Ogee Rating Table	Forward	TW	0.00	935.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

Existing Conditions

Subsection: Outlet Input Data	Return Event: 2 years
Label: Existing Ogee Spillway	Storm Event: 2-YEAR

Structure ID: Existing Ogee Rating Table
Structure Type: User Defined Table

Elevation (ft)	Flow (ft³/s)
928.00	0.00
929.00	0.00
930.00	94.40
931.00	266.90
932.00	490.30
933.00	754.80
934.00	1,054.90
935.00	1,386.70

Structure ID: TW
Structure Type: TW Setup, DS Channel

Tailwater Type	Free Outfall

Convergence Tolerances

Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft³/s
Flow Tolerance (Maximum)	10.000 ft³/s

APPENDIX E

Proposed Conditions Drainage Area and Land Use Exhibits

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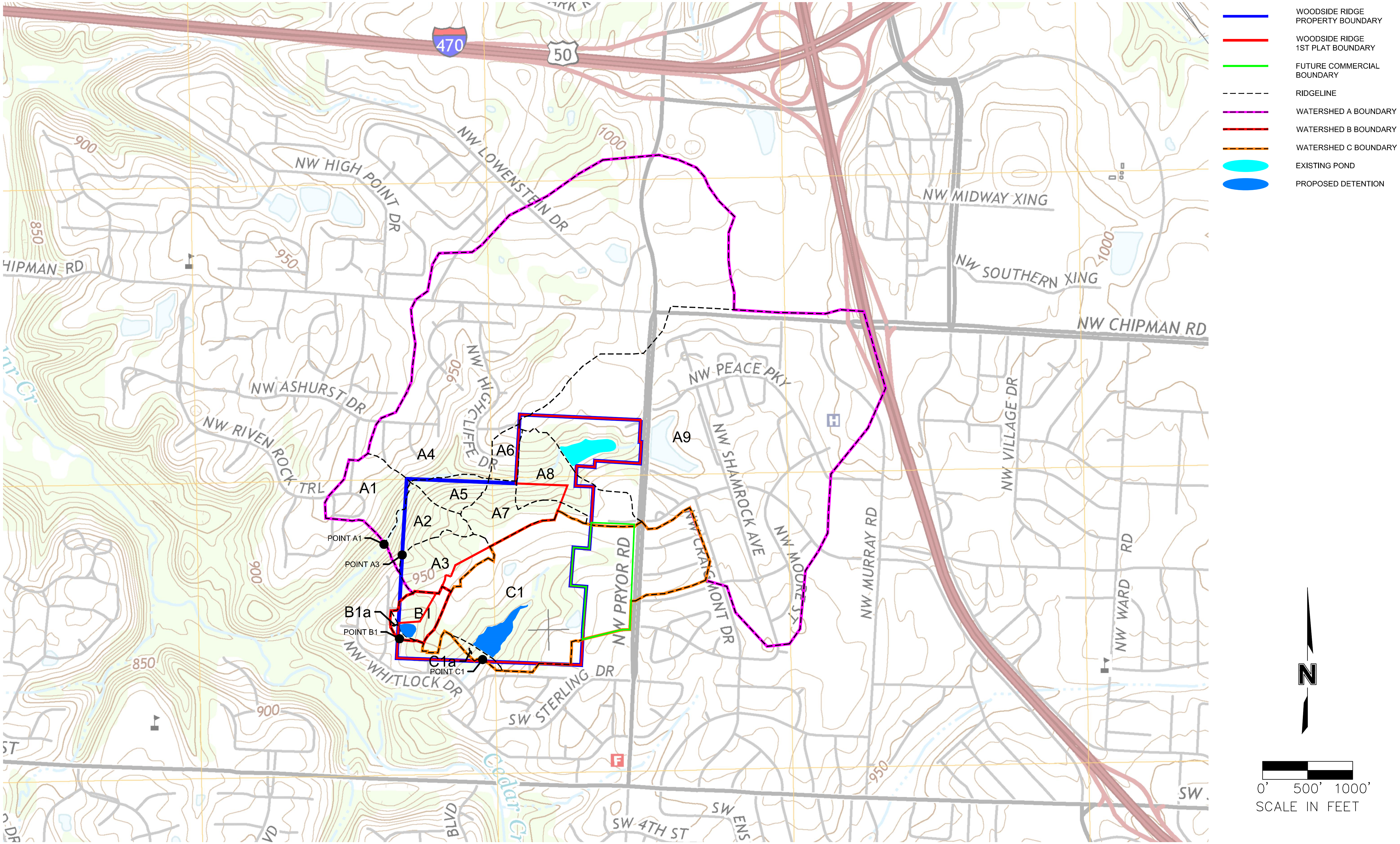

PROJECT NO: A18-1140
DRAWN BY: JJL
DATE: 03/14/2019

REVISED PROPOSED CONDITIONS DRAINAGE AREA MAP

olsson

7301 West 133rd Street
Suite 200
Overland Park, KS 66213-4750
TEL 913.381.1170
FAX 913.381.1174

EXHIBIT
2

DWG: F:\2018\1001-1500\018-1140-A\40-Design\Calcs\WTRS\Final Macro and First Plat SDS\CAD\PrLandUse.dwg USER: jlay
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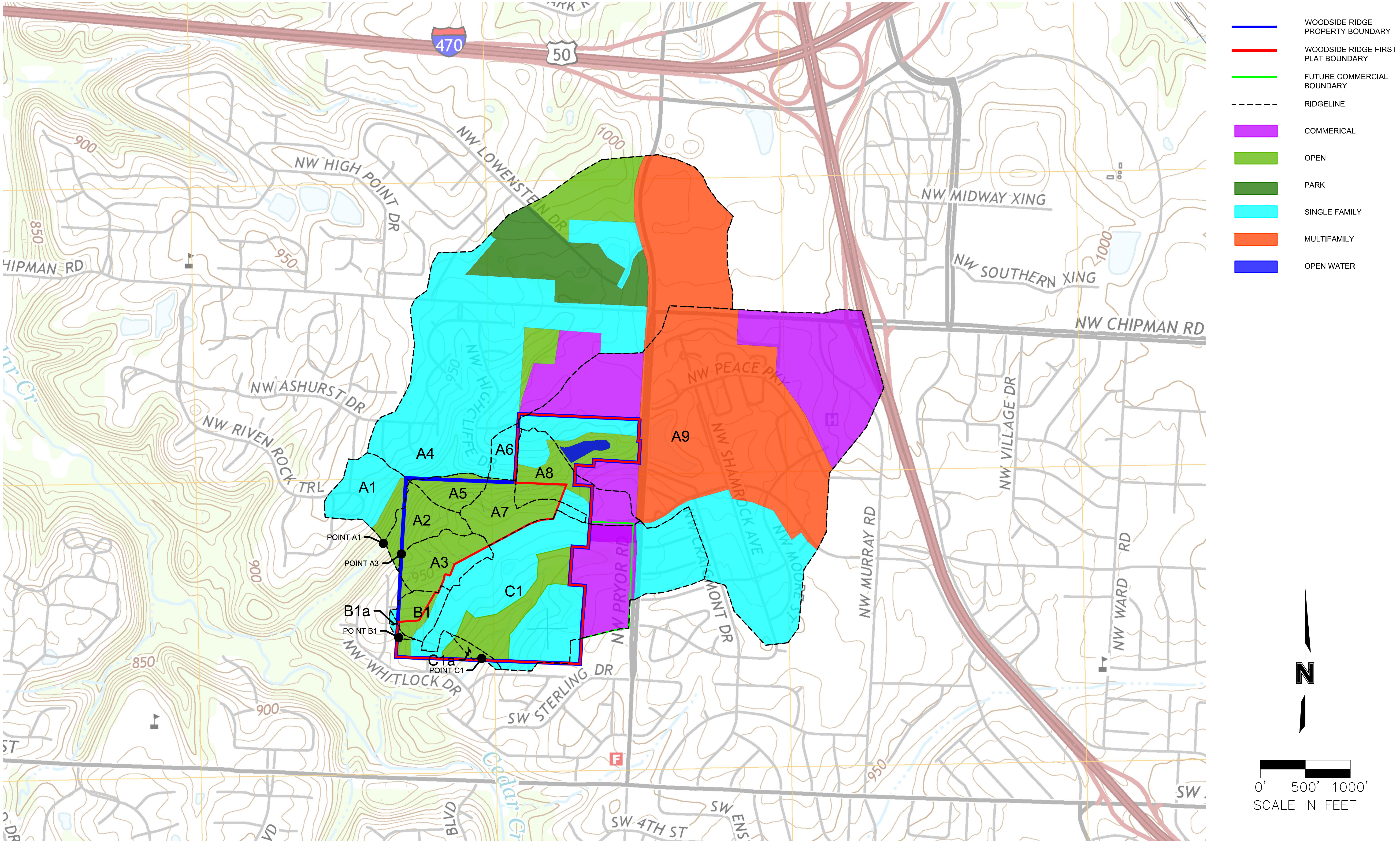


PROJECT NO:	A18-1140
DRAWN BY:	JJL
DATE:	03/14/2019

REVISED PROPOSED CONDITIONS LAND USE MAP

olsson

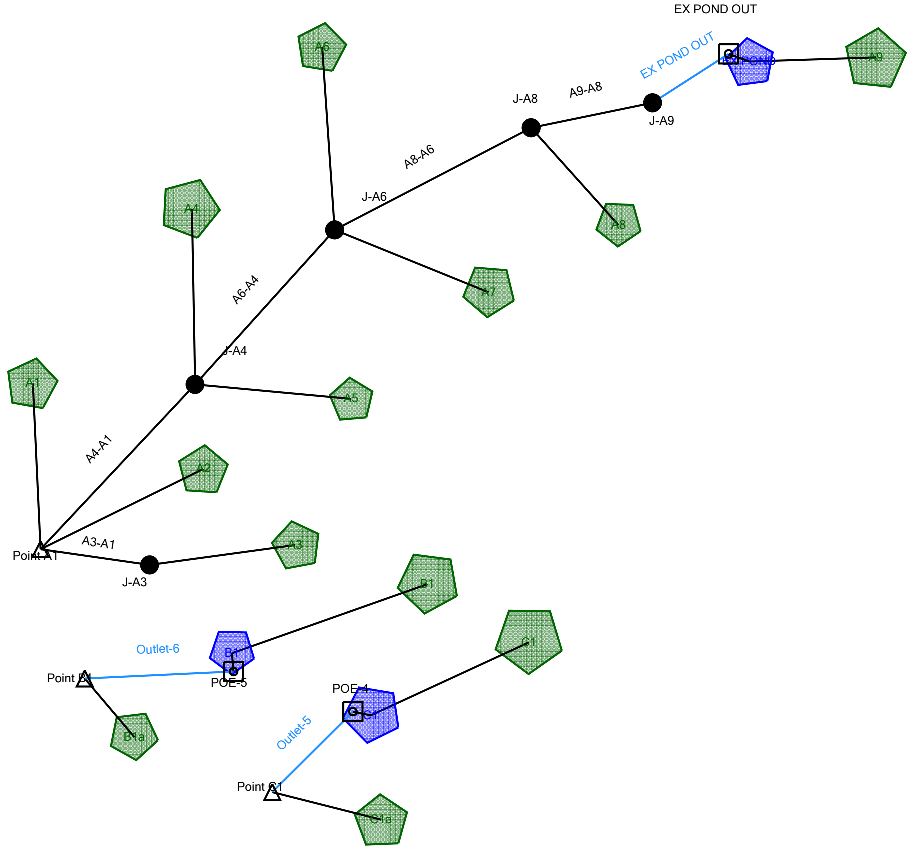
7301 West 133rd Street
Suite 200
Overland Park, KS 66213-4750
TEL 913.381.1170
FAX 913.381.1174

EXHIBIT
2A

APPENDIX F

Proposed Conditions PondPack Model Input and Results

Proposed Conditions PondPack Schematic



Revised Proposed Conditions Curve Number Calculations

	Offsite					Onsite (1st Plat)								
	80	85	87	92	95	80	95	87	92	100	Total	Total		
	Open Space	Park	SFR	MFR	Commercial	Open Space	Commercial	SFR	MFR	Pond	Offsite	Onsite	Total	Total
	(ac.)	(ac.)	(ac.)	(ac.)	(ac.)	(ac.)	(ac.)	(ac.)	(ac.)	(ac.)	(ac.)	(ac.)	(ac.)	CN
A1	2.61	0.00	9.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.58	0.00	12.58	86
A2	8.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.49	0.00	8.49	80
A3	9.04	0.00	0.00	0.00	0.00	0.00	0.00	1.98	0.00	0.00	9.04	1.98	11.02	82
A4	18.72	25.96	88.37	35.84	8.61	0.00	0.00	0.07	0.00	0.00	177.50	0.07	177.57	87
A5	5.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.19	0.00	5.19	80
A6	0.00	0.00	3.55	0.00	0.00	0.00	0.00	0.25	0.00	0.00	3.55	0.25	3.80	87
A7	9.57	0.00	0.00	0.00	0.00	0.00	0.00	0.77	0.00	0.00	9.57	0.77	10.34	81
A8	3.18	0.00	0.00	0.04	3.72	7.67	0.00	1.36	0.00	0.00	6.93	9.03	15.96	87
A9	4.43	0.00	33.55	88.06	50.75	5.56	0.00	5.14	0.00	1.57	176.79	12.27	189.06	91
TOTAL A	61.23	25.96	135.45	123.93	63.08	13.23	0.00	9.57	0.00	1.57	409.63	24.37	434.00	88
B1	1.95	0.00	0.52	0.00	0.00	1.48	0.00	1.47	0.00	0.00	2.47	2.95	5.42	83
B1a	0.00	0.00	0.36	0.00	0.00	0.03	0.00	0.21	0.00	0.00	0.36	0.24	0.61	85
TOTAL B	1.95	0.00	0.88	0.00	0.00	1.51	0.00	1.68	0.00	0.00	2.83	3.20	6.03	83
C1	0.00	0.00	14.40	0.00	16.14	10.30	0.00	34.27	0.00	0.00	30.54	44.57	75.11	88
C1a	0.00	0.00	0.20	0.00	0.00	0.96	0.00	0.03	0.00	0.00	0.20	0.99	1.19	81
TOTAL C	0.00	0.00	14.60	0.00	16.14	11.26	0.00	34.30	0.00	0.00	30.74	45.56	76.30	88

Revised Proposed Conditions

Project Summary

Title	Woodside Ridge - Revised Proposed Conditions
Engineer	JJL
Company	Olsson
Date	3/14/2019

Notes

Revised Proposed Conditions

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
A3	2-Year	2	1.711	11.930	31.23
A3	10-Year	10	3.071	11.930	55.73
A3	100-Year	100	5.288	11.930	94.05
B1	2-Year	2	0.876	11.930	16.00
B1	10-Year	10	1.555	11.930	28.14
B1	100-Year	100	2.654	11.930	46.99
C1	2-Year	2	14.726	12.050	211.24
C1	10-Year	10	24.682	12.050	346.01
C1	100-Year	100	40.393	12.020	551.31
A1	2-Year	2	2.289	11.960	38.93
A1	10-Year	10	3.923	11.960	65.59
A1	100-Year	100	6.526	11.960	106.37
A2	2-Year	2	1.212	11.960	21.11
A2	10-Year	10	2.229	11.950	38.82
A2	100-Year	100	3.908	11.950	66.92
A4	2-Year	2	33.528	12.040	493.22
A4	10-Year	10	56.826	12.020	821.51
A4	100-Year	100	93.763	12.020	1,322.35
A5	2-Year	2	0.741	11.950	13.02
A5	10-Year	10	1.363	11.950	23.91
A5	100-Year	100	2.389	11.940	41.27
A6	2-Year	2	0.719	11.950	12.58
A6	10-Year	10	1.218	11.950	20.89
A6	100-Year	100	2.009	11.940	33.59
A9	2-Year	2	41.407	12.030	576.32
A9	10-Year	10	67.148	12.030	913.07
A9	100-Year	100	107.260	12.030	1,421.40
A7	2-Year	2	1.539	11.970	26.29
A7	10-Year	10	2.797	11.960	47.55
A7	100-Year	100	4.859	11.960	81.07
A8	2-Year	2	3.019	11.930	54.78
A8	10-Year	10	5.116	11.930	91.06
A8	100-Year	100	8.440	11.930	146.31
C1a	2-Year	2	0.177	11.940	3.23
C1a	10-Year	10	0.322	11.930	5.86
C1a	100-Year	100	0.559	11.930	9.99
B1a	2-Year	2	0.115	11.930	2.09
B1a	10-Year	10	0.196	11.930	3.48
B1a	100-Year	100	0.323	11.930	5.59

Node Summary

Revised Proposed Conditions

Subsection: Master Network Summary

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
Point A1	2-Year	2	84.240	12.070	951.08
Point A1	10-Year	10	141.655	12.070	1,600.03
Point A1	100-Year	100	232.236	12.070	2,593.00
Point B1	2-Year	2	0.772	11.940	2.55
Point B1	10-Year	10	1.293	11.930	4.34
Point B1	100-Year	100	2.291	12.040	7.95
Point C1	2-Year	2	14.901	12.370	46.73
Point C1	10-Year	10	25.000	12.280	118.77
Point C1	100-Year	100	40.943	12.250	207.49
J-A3	2-Year	2	1.711	11.930	31.23
J-A3	10-Year	10	3.071	11.930	55.73
J-A3	100-Year	100	5.288	11.930	94.05
J-A4	2-Year	2	79.054	12.080	899.38
J-A4	10-Year	10	132.470	12.070	1,502.74
J-A4	100-Year	100	216.573	12.060	2,426.02
J-A6	2-Year	2	44.807	12.160	477.15
J-A6	10-Year	10	74.313	12.140	781.49
J-A6	100-Year	100	120.468	12.140	1,249.06
J-A8	2-Year	2	42.555	12.150	465.70
J-A8	10-Year	10	70.309	12.140	760.35
J-A8	100-Year	100	113.616	12.140	1,212.01
J-A9	2-Year	2	39.549	12.140	454.72
J-A9	10-Year	10	65.211	12.130	741.59
J-A9	100-Year	100	105.203	12.120	1,180.76

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
EX POND (IN)	2-Year	2	41.407	12.030	576.32	(N/A)	(N/A)
EX POND (OUT)	2-Year	2	39.549	12.140	454.72	931.84	8.290
EX POND (IN)	10-Year	10	67.148	12.030	913.07	(N/A)	(N/A)
EX POND (OUT)	10-Year	10	65.211	12.130	741.59	932.95	11.445
EX POND (IN)	100-Year	100	107.260	12.030	1,421.40	(N/A)	(N/A)
EX POND (OUT)	100-Year	100	105.203	12.120	1,180.76	934.38	15.914
C1 (IN)	2-Year	2	14.726	12.050	211.24	(N/A)	(N/A)

Revised Proposed Conditions

Subsection: Master Network Summary

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
C1 (OUT)	2-Year	2	14.724	12.400	46.32	921.58	4.715
C1 (IN)	10-Year	10	24.682	12.050	346.01	(N/A)	(N/A)
C1 (OUT)	10-Year	10	24.678	12.280	117.95	923.65	7.805
C1 (IN)	100-Year	100	40.393	12.020	551.31	(N/A)	(N/A)
C1 (OUT)	100-Year	100	40.384	12.260	206.10	925.96	12.448
B1 (IN)	2-Year	2	0.876	11.930	16.00	(N/A)	(N/A)
B1 (OUT)	2-Year	2	0.657	13.310	0.85	922.78	0.489
B1 (IN)	10-Year	10	1.555	11.930	28.14	(N/A)	(N/A)
B1 (OUT)	10-Year	10	1.098	13.550	1.22	924.68	0.931
B1 (IN)	100-Year	100	2.654	11.930	46.99	(N/A)	(N/A)
B1 (OUT)	100-Year	100	1.968	12.380	5.22	926.48	1.443

Revised Proposed Conditions

Subsection: Time-Depth Curve	Return Event: 100 years
Label: KCMO TR-55	Storm Event: 100-YEAR

Time-Depth Curve: 100-YEAR	
Label	100-YEAR
Start Time	0.000 hours
Increment	0.100 hours
End Time	24.000 hours
Return Event	100 years

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.100 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
0.500	0.0	0.0	0.1	0.1	0.1
1.000	0.1	0.1	0.1	0.1	0.1
1.500	0.1	0.1	0.1	0.2	0.2
2.000	0.2	0.2	0.2	0.2	0.2
2.500	0.2	0.2	0.2	0.3	0.3
3.000	0.3	0.3	0.3	0.3	0.3
3.500	0.3	0.3	0.3	0.4	0.4
4.000	0.4	0.4	0.4	0.4	0.4
4.500	0.4	0.4	0.5	0.5	0.5
5.000	0.5	0.5	0.5	0.5	0.5
5.500	0.6	0.6	0.6	0.6	0.6
6.000	0.6	0.6	0.7	0.7	0.7
6.500	0.7	0.7	0.7	0.8	0.8
7.000	0.8	0.8	0.8	0.8	0.8
7.500	0.9	0.9	0.9	0.9	0.9
8.000	0.9	1.0	1.0	1.0	1.0
8.500	1.0	1.1	1.1	1.1	1.1
9.000	1.2	1.2	1.2	1.2	1.3
9.500	1.3	1.3	1.3	1.4	1.4
10.000	1.4	1.5	1.5	1.5	1.6
10.500	1.6	1.7	1.7	1.7	1.8
11.000	1.9	1.9	2.0	2.1	2.1
11.500	2.2	2.4	2.8	3.4	4.5
12.000	5.2	5.4	5.5	5.6	5.7
12.500	5.8	5.9	5.9	6.0	6.0
13.000	6.1	6.1	6.2	6.2	6.3
13.500	6.3	6.3	6.4	6.4	6.4
14.000	6.5	6.5	6.5	6.6	6.6
14.500	6.6	6.6	6.7	6.7	6.7
15.000	6.7	6.8	6.8	6.8	6.8
15.500	6.9	6.9	6.9	6.9	6.9
16.000	7.0	7.0	7.0	7.0	7.0
16.500	7.0	7.1	7.1	7.1	7.1

Revised Proposed Conditions

Subsection: Time-Depth Curve
Label: KCMO TR-55

Return Event: 100 years
Storm Event: 100-YEAR

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.100 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
17.000	7.1	7.1	7.2	7.2	7.2
17.500	7.2	7.2	7.2	7.2	7.3
18.000	7.3	7.3	7.3	7.3	7.3
18.500	7.3	7.4	7.4	7.4	7.4
19.000	7.4	7.4	7.4	7.4	7.5
19.500	7.5	7.5	7.5	7.5	7.5
20.000	7.5	7.5	7.5	7.6	7.6
20.500	7.6	7.6	7.6	7.6	7.6
21.000	7.6	7.6	7.6	7.7	7.7
21.500	7.7	7.7	7.7	7.7	7.7
22.000	7.7	7.7	7.7	7.7	7.8
22.500	7.8	7.8	7.8	7.8	7.8
23.000	7.8	7.8	7.8	7.8	7.8
23.500	7.9	7.9	7.9	7.9	7.9
24.000	7.9	(N/A)	(N/A)	(N/A)	(N/A)

Revised Proposed Conditions

Subsection: Time-Depth Curve	Return Event: 10 years
Label: KCMO TR-55	Storm Event: 10-YEAR

Time-Depth Curve: 10-YEAR

Label	10-YEAR
Start Time	0.000 hours
Increment	0.100 hours
End Time	24.000 hours
Return Event	10 years

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.100 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
0.500	0.0	0.0	0.0	0.0	0.0
1.000	0.1	0.1	0.1	0.1	0.1
1.500	0.1	0.1	0.1	0.1	0.1
2.000	0.1	0.1	0.1	0.1	0.1
2.500	0.1	0.2	0.2	0.2	0.2
3.000	0.2	0.2	0.2	0.2	0.2
3.500	0.2	0.2	0.2	0.2	0.2
4.000	0.3	0.3	0.3	0.3	0.3
4.500	0.3	0.3	0.3	0.3	0.3
5.000	0.3	0.3	0.4	0.4	0.4
5.500	0.4	0.4	0.4	0.4	0.4
6.000	0.4	0.4	0.4	0.5	0.5
6.500	0.5	0.5	0.5	0.5	0.5
7.000	0.5	0.5	0.5	0.6	0.6
7.500	0.6	0.6	0.6	0.6	0.6
8.000	0.6	0.6	0.7	0.7	0.7
8.500	0.7	0.7	0.7	0.7	0.8
9.000	0.8	0.8	0.8	0.8	0.8
9.500	0.9	0.9	0.9	0.9	0.9
10.000	1.0	1.0	1.0	1.0	1.1
10.500	1.1	1.1	1.1	1.2	1.2
11.000	1.2	1.3	1.3	1.4	1.4
11.500	1.5	1.6	1.9	2.3	3.0
12.000	3.5	3.6	3.7	3.8	3.8
12.500	3.9	3.9	4.0	4.0	4.1
13.000	4.1	4.1	4.2	4.2	4.2
13.500	4.2	4.3	4.3	4.3	4.3
14.000	4.3	4.4	4.4	4.4	4.4
14.500	4.4	4.5	4.5	4.5	4.5
15.000	4.5	4.5	4.6	4.6	4.6
15.500	4.6	4.6	4.6	4.6	4.7
16.000	4.7	4.7	4.7	4.7	4.7
16.500	4.7	4.7	4.7	4.8	4.8

Revised Proposed Conditions

Subsection: Time-Depth Curve
Label: KCMO TR-55

Return Event: 10 years
Storm Event: 10-YEAR

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.100 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
17.000	4.8	4.8	4.8	4.8	4.8
17.500	4.8	4.8	4.9	4.9	4.9
18.000	4.9	4.9	4.9	4.9	4.9
18.500	4.9	4.9	4.9	5.0	5.0
19.000	5.0	5.0	5.0	5.0	5.0
19.500	5.0	5.0	5.0	5.0	5.0
20.000	5.0	5.1	5.1	5.1	5.1
20.500	5.1	5.1	5.1	5.1	5.1
21.000	5.1	5.1	5.1	5.1	5.1
21.500	5.1	5.2	5.2	5.2	5.2
22.000	5.2	5.2	5.2	5.2	5.2
22.500	5.2	5.2	5.2	5.2	5.2
23.000	5.2	5.2	5.3	5.3	5.3
23.500	5.3	5.3	5.3	5.3	5.3
24.000	5.3	(N/A)	(N/A)	(N/A)	(N/A)

Revised Proposed Conditions

Subsection: Time-Depth Curve | Return Event: 2 years
Label: KCMO TR-55 | Storm Event: 2-YEAR

Time-Depth Curve: 2-YEAR	
Label	2-YEAR
Start Time	0.000 hours
Increment	0.100 hours
End Time	24.000 hours
Return Event	2 years

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.100 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
0.500	0.0	0.0	0.0	0.0	0.0
1.000	0.0	0.0	0.0	0.0	0.1
1.500	0.1	0.1	0.1	0.1	0.1
2.000	0.1	0.1	0.1	0.1	0.1
2.500	0.1	0.1	0.1	0.1	0.1
3.000	0.1	0.1	0.1	0.1	0.1
3.500	0.1	0.2	0.2	0.2	0.2
4.000	0.2	0.2	0.2	0.2	0.2
4.500	0.2	0.2	0.2	0.2	0.2
5.000	0.2	0.2	0.2	0.2	0.3
5.500	0.3	0.3	0.3	0.3	0.3
6.000	0.3	0.3	0.3	0.3	0.3
6.500	0.3	0.3	0.3	0.3	0.3
7.000	0.4	0.4	0.4	0.4	0.4
7.500	0.4	0.4	0.4	0.4	0.4
8.000	0.4	0.4	0.4	0.5	0.5
8.500	0.5	0.5	0.5	0.5	0.5
9.000	0.5	0.5	0.6	0.6	0.6
9.500	0.6	0.6	0.6	0.6	0.6
10.000	0.7	0.7	0.7	0.7	0.7
10.500	0.7	0.8	0.8	0.8	0.8
11.000	0.8	0.9	0.9	0.9	1.0
11.500	1.0	1.1	1.3	1.6	2.0
12.000	2.4	2.5	2.5	2.6	2.6
12.500	2.6	2.7	2.7	2.7	2.8
13.000	2.8	2.8	2.8	2.8	2.9
13.500	2.9	2.9	2.9	2.9	2.9
14.000	3.0	3.0	3.0	3.0	3.0
14.500	3.0	3.0	3.0	3.1	3.1
15.000	3.1	3.1	3.1	3.1	3.1
15.500	3.1	3.1	3.1	3.2	3.2
16.000	3.2	3.2	3.2	3.2	3.2
16.500	3.2	3.2	3.2	3.2	3.2

Revised Proposed Conditions

Subsection: Time-Depth Curve
Label: KCMO TR-55

Return Event: 2 years
Storm Event: 2-YEAR

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.100 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
17.000	3.2	3.3	3.3	3.3	3.3
17.500	3.3	3.3	3.3	3.3	3.3
18.000	3.3	3.3	3.3	3.3	3.3
18.500	3.3	3.4	3.4	3.4	3.4
19.000	3.4	3.4	3.4	3.4	3.4
19.500	3.4	3.4	3.4	3.4	3.4
20.000	3.4	3.4	3.4	3.4	3.4
20.500	3.5	3.5	3.5	3.5	3.5
21.000	3.5	3.5	3.5	3.5	3.5
21.500	3.5	3.5	3.5	3.5	3.5
22.000	3.5	3.5	3.5	3.5	3.5
22.500	3.5	3.5	3.5	3.6	3.6
23.000	3.6	3.6	3.6	3.6	3.6
23.500	3.6	3.6	3.6	3.6	3.6
24.000	3.6	(N/A)	(N/A)	(N/A)	(N/A)

Revised Proposed Conditions

Subsection: Time of Concentration Calculations	Return Event: 2 years
Label: A1	Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.050 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.26 ft/s
Segment Time of Concentration	0.107 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	300.00 ft
Is Paved?	False
Slope	0.070 ft/ft
Average Velocity	4.27 ft/s
Segment Time of Concentration	0.020 hours

Segment #3: Length and Velocity	
Hydraulic Length	740.00 ft
Velocity	15.00 ft/s
Segment Time of Concentration	0.014 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.140 hours

Revised Proposed Conditions

Subsection: Time of Concentration Calculations — Return Event: 2 years
Label: A1 — Storm Event: 2-YEAR

==== User Defined Length & Velocity

Tc = (Lf / V) / 3600

Where:
Tc= Time of concentration, hours
Lf= Flow length, feet
V= Velocity, ft/sec

==== SCS Channel Flow

Tc =
R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc =
Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600

Where:
V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Revised Proposed Conditions

Subsection: Time of Concentration Calculations | Return Event: 2 years

Label: A2 | Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.080 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.31 ft/s
Segment Time of Concentration	0.088 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	300.00 ft
Is Paved?	False
Slope	0.070 ft/ft
Average Velocity	4.27 ft/s
Segment Time of Concentration	0.020 hours

Segment #3: Length and Velocity	
Hydraulic Length	970.00 ft
Velocity	15.00 ft/s
Segment Time of Concentration	0.018 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.126 hours

Revised Proposed Conditions

Subsection: Time of Concentration Calculations — Return Event: 2 years
Label: A2 — Storm Event: 2-YEAR

==== User Defined Length & Velocity

Tc = (Lf / V) / 3600

Where:
Tc= Time of concentration, hours
Lf= Flow length, feet
V= Velocity, ft/sec

==== SCS Channel Flow

Tc =
R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc =
Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600

Where:
V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Revised Proposed Conditions

Subsection: Time of Concentration Calculations
Label: A3

Return Event: 2 years
Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	25.00 ft
Manning's n	0.150
Slope	0.030 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.16 ft/s
Segment Time of Concentration	0.043 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	90.00 ft
Is Paved?	True
Slope	0.020 ft/ft
Average Velocity	2.87 ft/s
Segment Time of Concentration	0.009 hours

Segment #3: Length and Velocity	
Hydraulic Length	880.00 ft
Velocity	15.00 ft/s
Segment Time of Concentration	0.016 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.100 hours

Revised Proposed Conditions

Subsection: Time of Concentration Calculations
Label: A3

Return Event: 2 years
Storm Event: 2-YEAR

==== User Defined Length & Velocity

Tc = (Lf / V) / 3600

Where:
Tc= Time of concentration, hours
Lf= Flow length, feet
V= Velocity, ft/sec

==== SCS Channel Flow

Tc =
R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc =
Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600

Where:
V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Revised Proposed Conditions

Subsection: Time of Concentration Calculations

Label: A4

Return Event: 2 years

Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.011
Slope	0.020 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	1.46 ft/s
Segment Time of Concentration	0.019 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	300.00 ft
Is Paved?	True
Slope	0.020 ft/ft
Average Velocity	2.87 ft/s
Segment Time of Concentration	0.029 hours

Segment #3: Length and Velocity	
Hydraulic Length	4,750.00 ft
Velocity	7.00 ft/s
Segment Time of Concentration	0.188 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.237 hours

Revised Proposed Conditions

Subsection: Time of Concentration Calculations — Return Event: 2 years
Label: A4 — Storm Event: 2-YEAR

==== User Defined Length & Velocity

Tc = (Lf / V) / 3600

Where:
Tc= Time of concentration, hours
Lf= Flow length, feet
V= Velocity, ft/sec

==== SCS Channel Flow

Tc =
R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc =
Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600

Where:
V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Revised Proposed Conditions

Subsection: Time of Concentration Calculations	Return Event: 2 years
Label: A5	Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.080 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.31 ft/s
Segment Time of Concentration	0.088 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	300.00 ft
Is Paved?	False
Slope	0.080 ft/ft
Average Velocity	4.56 ft/s
Segment Time of Concentration	0.018 hours

Segment #3: Length and Velocity	
Hydraulic Length	740.00 ft
Velocity	15.00 ft/s
Segment Time of Concentration	0.014 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.120 hours

==== User Defined Length & Velocity

Tc = (Lf / V) / 3600
Where: Tc= Time of concentration, hours
Lf= Flow length, feet
V= Velocity, ft/sec

==== SCS Channel Flow

Tc = R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600
Where: R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc = Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600
Where: V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Revised Proposed Conditions

Subsection: Time of Concentration Calculations	Return Event: 2 years
Label: A6	Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.070 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.30 ft/s
Segment Time of Concentration	0.093 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	300.00 ft
Is Paved?	False
Slope	0.070 ft/ft
Average Velocity	4.27 ft/s
Segment Time of Concentration	0.020 hours

Segment #3: Length and Velocity	
Hydraulic Length	440.00 ft
Velocity	15.00 ft/s
Segment Time of Concentration	0.008 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.121 hours

Revised Proposed Conditions

Subsection: Time of Concentration Calculations | Return Event: 2 years
Label: A6 | Storm Event: 2-YEAR

==== User Defined Length & Velocity

Tc = (Lf / V) / 3600

Where:
Tc= Time of concentration, hours
Lf= Flow length, feet
V= Velocity, ft/sec

==== SCS Channel Flow

Tc =
R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc =
Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600

Where:
V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Revised Proposed Conditions

Subsection:	Time of Concentration Calculations	Return Event:	2 years
Label:	A7	Storm Event:	2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow

Hydraulic Length	65.00 ft
Manning's n	0.150
Slope	0.030 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.19 ft/s
Segment Time of Concentration	0.093 hours

Segment #2: TR-55 Shallow Concentrated Flow

Hydraulic Length	275.00 ft
Is Paved?	True
Slope	0.030 ft/ft
Average Velocity	3.52 ft/s
Segment Time of Concentration	0.022 hours

Segment #3: Length and Velocity

Hydraulic Length	880.00 ft
Velocity	10.00 ft/s
Segment Time of Concentration	0.024 hours

Time of Concentration (Composite)

Time of Concentration (Composite)	0.139 hours

Revised Proposed Conditions

Subsection: Time of Concentration Calculations
Label: A7

Return Event: 2 years
Storm Event: 2-YEAR

==== User Defined Length & Velocity

Tc = (Lf / V) / 3600

Where:
Tc= Time of concentration, hours
Lf= Flow length, feet
V= Velocity, ft/sec

==== SCS Channel Flow

Tc =
R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc =
Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600

Where:
V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Revised Proposed Conditions

Subsection: Time of Concentration Calculations
Label: A8

Return Event: 2 years
Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.128 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.38 ft/s
Segment Time of Concentration	0.073 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	200.00 ft
Is Paved?	False
Slope	0.150 ft/ft
Average Velocity	6.25 ft/s
Segment Time of Concentration	0.009 hours

Segment #3: Length and Velocity	
Hydraulic Length	640.00 ft
Velocity	10.00 ft/s
Segment Time of Concentration	0.018 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.100 hours

Revised Proposed Conditions

Subsection: Time of Concentration Calculations
Label: A8

Return Event: 2 years
Storm Event: 2-YEAR

==== User Defined Length & Velocity

Tc = (Lf / V) / 3600

Where:
Tc= Time of concentration, hours
Lf= Flow length, feet
V= Velocity, ft/sec

==== SCS Channel Flow

Tc =
R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc =
Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600

Where:
V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Revised Proposed Conditions

Subsection: Time of Concentration Calculations
Label: A9

Return Event: 2 years
Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.030 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.21 ft/s
Segment Time of Concentration	0.131 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	300.00 ft
Is Paved?	False
Slope	0.030 ft/ft
Average Velocity	2.79 ft/s
Segment Time of Concentration	0.030 hours

Segment #3: Length and Velocity	
Hydraulic Length	3,570.00 ft
Velocity	10.00 ft/s
Segment Time of Concentration	0.099 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.260 hours

Revised Proposed Conditions

Subsection: Time of Concentration Calculations
Return Event: 2 years
Label: A9
Storm Event: 2-YEAR

==== User Defined Length & Velocity

Tc = (Lf / V) / 3600

Where:
Tc= Time of concentration, hours
Lf= Flow length, feet
V= Velocity, ft/sec

==== SCS Channel Flow

Tc =
R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc =
Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600

Where:
V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Revised Proposed Conditions

Subsection: Time of Concentration Calculations	Return Event: 2 years
Label: B1	Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.120 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.37 ft/s
Segment Time of Concentration	0.075 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	90.00 ft
Is Paved?	False
Slope	0.080 ft/ft
Average Velocity	4.56 ft/s
Segment Time of Concentration	0.005 hours

Segment #3: Length and Velocity	
Hydraulic Length	550.00 ft
Velocity	15.00 ft/s
Segment Time of Concentration	0.010 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.100 hours

Revised Proposed Conditions

Subsection: Time of Concentration Calculations	Return Event: 2 years
Label: B1	Storm Event: 2-YEAR

==== User Defined Length & Velocity

Tc = (Lf / V) / 3600

Where:
Tc= Time of concentration, hours
Lf= Flow length, feet
V= Velocity, ft/sec

==== SCS Channel Flow

Tc =
R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc =
Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600

Where:
V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Revised Proposed Conditions

Subsection: Time of Concentration Calculations

Return Event: 2 years

Label: B1a

Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.120 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.37 ft/s
Segment Time of Concentration	0.075 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	190.00 ft
Is Paved?	False
Slope	0.120 ft/ft
Average Velocity	5.59 ft/s
Segment Time of Concentration	0.009 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.100 hours

Revised Proposed Conditions

Subsection: Time of Concentration Calculations	Return Event: 2 years
Label: B1a	Storm Event: 2-YEAR

==== SCS Channel Flow

Tc =
R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc =
Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600

Where:
V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Revised Proposed Conditions

Subsection: Time of Concentration Calculations
Return Event: 2 years
Label: C1
Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.020 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.18 ft/s
Segment Time of Concentration	0.154 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	120.00 ft
Is Paved?	False
Slope	0.020 ft/ft
Average Velocity	2.28 ft/s
Segment Time of Concentration	0.015 hours

Segment #3: Length and Velocity	
Hydraulic Length	3,020.00 ft
Velocity	10.00 ft/s
Segment Time of Concentration	0.084 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.252 hours

Revised Proposed Conditions

Subsection: Time of Concentration Calculations	Return Event: 2 years
Label: C1	Storm Event: 2-YEAR

==== User Defined Length & Velocity

Tc =	(Lf / V) / 3600
Where:	Tc= Time of concentration, hours Lf= Flow length, feet V= Velocity, ft/sec

==== SCS Channel Flow

Tc =	R = Qa / Wp V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n (Lf / V) / 3600
Where:	R= Hydraulic radius Aq= Flow area, square feet Wp= Wetted perimeter, feet V= Velocity, ft/sec Sf= Slope, ft/ft n= Manning's n Tc= Time of concentration, hours Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc =	Unpaved surface: V = 16.1345 * (Sf**0.5) Paved Surface: V = 20.3282 * (Sf**0.5) (Lf / V) / 3600
Where:	V= Velocity, ft/sec Sf= Slope, ft/ft Tc= Time of concentration, hours Lf= Flow length, feet

Revised Proposed Conditions

Subsection: Time of Concentration Calculations	Return Event: 2 years
Label: C1a	Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.120 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.37 ft/s
Segment Time of Concentration	0.075 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	300.00 ft
Is Paved?	False
Slope	0.120 ft/ft
Average Velocity	5.59 ft/s
Segment Time of Concentration	0.015 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.100 hours

Revised Proposed Conditions

Subsection: Time of Concentration Calculations | Return Event: 2 years
Label: C1a | Storm Event: 2-YEAR

==== SCS Channel Flow

Tc = R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc = Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600

Where:
V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Revised Proposed Conditions

Subsection: Channel Routing Summary	Return Event: 2 years
Label: A3-A1	Storm Event: 2-YEAR

Infiltration	
Infiltration Method	No Infiltration

Translation Routing Summary	
Flow (Base)	0.00 ft³/s
Translate	0.010 hours

	Inflow Hydrograph	Outflow Hydrograph
Time Start (hours)...	0.000	0.020
Time Step (hours)...	0.010	0.010
Time End (hours)...	24.000	24.020
Peak Time (hours)...	12.140	12.160
Peak Flow (ft³/s)...	454.72	454.72

Inflow/Outflow Volumes	
Volume (Routing, Inflow)	1.711 ac-ft
Volume (Routing, Unrouted)	0.000 ac-ft
Volume (Routing, Base Flow)	0.000 ac-ft
Volume (Routing, Infiltration)	0.000 ac-ft
Volume (Routing, Outflow)	1.711 ac-ft

Revised Proposed Conditions

Subsection: Channel Routing Summary
Label: A4-A1

Return Event: 2 years
Storm Event: 2-YEAR

Infiltration	
Infiltration Method	No Infiltration

Translation Routing Summary	
Flow (Base)	0.00 ft³/s
Translate	0.020 hours

	Inflow Hydrograph	Outflow Hydrograph
Time Start (hours)...	0.000	0.020
Time Step (hours)...	0.010	0.010
Time End (hours)...	24.000	24.020
Peak Time (hours)...	12.140	12.160
Peak Flow (ft³/s)...	454.72	454.72

Inflow/Outflow Volumes	
Volume (Routing, Inflow)	79.054 ac-ft
Volume (Routing, Unrouted)	0.000 ac-ft
Volume (Routing, Base Flow)	0.000 ac-ft
Volume (Routing, Infiltration)	0.000 ac-ft
Volume (Routing, Outflow)	79.054 ac-ft

Revised Proposed Conditions

Subsection: Channel Routing Summary — Return Event: 2 years

Label: A6-A4 — Storm Event: 2-YEAR

Infiltration	
Infiltration Method	No Infiltration

Translation Routing Summary	
Flow (Base)	0.00 ft³/s
Translate	0.030 hours

	Inflow Hydrograph	Outflow Hydrograph
Time Start (hours)...	0.000	0.020
Time Step (hours)...	0.010	0.010
Time End (hours)...	24.000	24.020
Peak Time (hours)...	12.140	12.160
Peak Flow (ft³/s)...	454.72	454.72

Inflow/Outflow Volumes	
Volume (Routing, Inflow)	44.807 ac-ft
Volume (Routing, Unrouted)	0.000 ac-ft
Volume (Routing, Base Flow)	0.000 ac-ft
Volume (Routing, Infiltration)	0.000 ac-ft
Volume (Routing, Outflow)	44.807 ac-ft

Revised Proposed Conditions

Subsection: Channel Routing Summary	Return Event: 2 years

Label: A8-A6	Storm Event: 2-YEAR

Infiltration	
Infiltration Method	No Infiltration

Translation Routing Summary	
Flow (Base)	0.00 ft³/s
Translate	0.010 hours

	Inflow Hydrograph	Outflow Hydrograph
Time Start (hours)...	0.000	0.020
Time Step (hours)...	0.010	0.010
Time End (hours)...	24.000	24.020
Peak Time (hours)...	12.140	12.160
Peak Flow (ft³/s)...	454.72	454.72

Inflow/Outflow Volumes	
Volume (Routing, Inflow)	42.555 ac-ft
Volume (Routing, Unrouted)	0.000 ac-ft
Volume (Routing, Base Flow)	0.000 ac-ft
Volume (Routing, Infiltration)	0.000 ac-ft
Volume (Routing, Outflow)	42.555 ac-ft

Revised Proposed Conditions

Subsection: Channel Routing Summary
Label: A9-A8

Return Event: 2 years
Storm Event: 2-YEAR

Infiltration	
Infiltration Method	No Infiltration

Translation Routing Summary	
Flow (Base)	0.00 ft³/s
Translate	0.020 hours

	Inflow Hydrograph	Outflow Hydrograph
Time Start (hours)...	0.000	0.020
Time Step (hours)...	0.010	0.010
Time End (hours)...	24.000	24.020
Peak Time (hours)...	12.140	12.160
Peak Flow (ft³/s)...	454.72	454.72

Inflow/Outflow Volumes	
Volume (Routing, Inflow)	39.549 ac-ft
Volume (Routing, Unrouted)	0.000 ac-ft
Volume (Routing, Base Flow)	0.000 ac-ft
Volume (Routing, Infiltration)	0.000 ac-ft
Volume (Routing, Outflow)	39.549 ac-ft

Revised Proposed Conditions

Subsection: Elevation-Area Volume Curve
Label: B1

Return Event: 2 years
Storm Event: 2-YEAR

Elevation (ft)	Planimeter (ft²)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
920.00	0.0	0.145	0.000	0.000	0.000
930.00	0.0	0.427	0.821	2.736	2.736

Revised Proposed Conditions

Subsection: Elevation-Area Volume Curve
Return Event: 2 years
Label: C1
Storm Event: 2-YEAR

Elevation (ft)	Planimeter (ft^2)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
910.00	0.0	0.000	0.000	0.000	0.000
911.00	0.0	0.014	0.014	0.005	0.005
912.00	0.0	0.035	0.071	0.024	0.028
913.00	0.0	0.073	0.159	0.053	0.081
914.00	0.0	0.134	0.306	0.102	0.183
915.00	0.0	0.206	0.506	0.169	0.352
916.00	0.0	0.288	0.738	0.246	0.598
917.00	0.0	0.415	1.049	0.350	0.947
918.00	0.0	0.575	1.478	0.493	1.440
919.00	0.0	0.754	1.987	0.662	2.103
920.00	0.0	0.949	2.549	0.850	2.952
921.00	0.0	1.158	3.155	1.052	4.004
922.00	0.0	1.367	3.783	1.261	5.265
923.00	0.0	1.575	4.409	1.470	6.735
924.00	0.0	1.803	5.063	1.688	8.423
925.00	0.0	2.057	5.786	1.929	10.351
926.00	0.0	2.337	6.587	2.196	12.547
927.00	0.0	2.652	7.479	2.493	15.040
928.00	0.0	3.001	8.474	2.825	17.864
929.00	0.0	3.370	9.551	3.184	21.048

Revised Proposed Conditions

Subsection: Elevation-Area Volume Curve
Return Event: 2 years
Label: EX POND
Storm Event: 2-YEAR

Elevation (ft)	Planimeter (ft²)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
928.00	0.0	1.487	0.000	0.000	0.000
929.00	0.0	1.929	5.109	1.703	1.703
930.00	0.0	2.218	6.215	2.072	3.775
931.00	0.0	2.466	7.023	2.341	6.115
932.00	0.0	2.756	7.830	2.610	8.725
933.00	0.0	2.981	8.604	2.868	11.593
934.00	0.0	3.199	9.269	3.090	14.683
935.00	0.0	3.454	9.976	3.325	18.008

Revised Proposed Conditions

Subsection: Outlet Input Data | Return Event: 2 years

Label: Basin B1 | Storm Event: 2-YEAR

Requested Pond Water Surface Elevations	
Minimum (Headwater)	920.00 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	930.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Orifice-Circular	WQv Orifice 1	Forward	Culvert - 15" RCP	920.00	930.00
Orifice-Circular	WQv Orifice 2	Forward	Culvert - 15" RCP	920.33	930.00
Orifice-Circular	WQv Orifice 3	Forward	Culvert - 15" RCP	920.67	930.00
Orifice-Circular	WQv Orifice 4	Forward	Culvert - 15" RCP	921.00	930.00
Orifice-Circular	WQv Orifice 5	Forward	Culvert - 15" RCP	921.33	930.00
Orifice-Circular	WQv Orifice 6	Forward	Culvert - 15" RCP	921.67	930.00
Orifice-Circular	Secondary Orifice	Forward	Culvert - 15" RCP	925.00	930.00
Culvert-Circular	Culvert - 15" RCP	Forward	TW	918.00	930.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

Structure ID: Culvert - 15" RCP
Structure Type: Culvert-Circular

Number of Barrels	1
Diameter	15.0 in
Length	100.00 ft
Length (Computed Barrel)	100.15 ft
Slope (Computed)	0.055 ft/ft

Outlet Control Data

Manning's n	0.013
Ke	0.500
Kb	0.023
Kr	0.000
Convergence Tolerance	0.00 ft

Inlet Control Data

Equation Form	Form 1
K	0.0098
M	2.0000
C	0.0398
Y	0.6700
T1 ratio (HW/D)	1.133
T2 ratio (HW/D)	1.279
Slope Correction Factor	-0.500

Use unsubmerged inlet control 0 equation below T1 elevation.
Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

T1 Elevation	919.42 ft	T1 Flow	4.80 ft³/s
T2 Elevation	919.60 ft	T2 Flow	5.49 ft³/s

Revised Proposed Conditions

Subsection: Outlet Input Data — Return Event: 2 years
Label: Basin B1 — Storm Event: 2-YEAR

Structure ID: WQv Orifice 1
Structure Type: Orifice-Circular

Number of Openings	1
Elevation	920.00 ft
Orifice Diameter	2.0 in
Orifice Coefficient	0.600

Structure ID: WQv Orifice 2
Structure Type: Orifice-Circular

Number of Openings	1
Elevation	920.33 ft
Orifice Diameter	2.0 in
Orifice Coefficient	0.600

Structure ID: WQv Orifice 3
Structure Type: Orifice-Circular

Number of Openings	1
Elevation	920.67 ft
Orifice Diameter	2.0 in
Orifice Coefficient	0.600

Structure ID: WQv Orifice 4
Structure Type: Orifice-Circular

Number of Openings	1
Elevation	921.00 ft
Orifice Diameter	2.0 in
Orifice Coefficient	0.600

Structure ID: WQv Orifice 5
Structure Type: Orifice-Circular

Number of Openings	1
Elevation	921.33 ft
Orifice Diameter	2.0 in
Orifice Coefficient	0.600

Structure ID: WQv Orifice 6
Structure Type: Orifice-Circular

Number of Openings	1
Elevation	921.67 ft
Orifice Diameter	2.0 in
Orifice Coefficient	0.600

Structure ID: Secondary Orifice

Structure Type: Orifice-Circular

Number of Openings	1
Elevation	925.00 ft
Orifice Diameter	12.0 in
Orifice Coefficient	0.600

Structure ID: TW
Structure Type: TW Setup, DS Channel

Tailwater Type	Free Outfall

Convergence Tolerances

Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft³/s
Flow Tolerance (Maximum)	10.000 ft³/s

Revised Proposed Conditions

Subsection: Outlet Input Data	Return Event: 2 years
Label: Existing Pond Ogee Spillway	Storm Event: 2-YEAR

Requested Pond Water Surface Elevations	
Minimum (Headwater)	928.00 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	935.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
User Defined Table	Existing Pond Ogee Rating Table	Forward	TW	0.00	935.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

Revised Proposed Conditions

Subsection: Outlet Input Data | Return Event: 2 years

Label: Existing Pond Ogee Spillway | Storm Event: 2-YEAR

Structure ID: Existing Pond Ogee Rating Table
Structure Type: User Defined Table

Elevation (ft)	Flow (ft^3/s)
928.00	0.00
929.00	0.00
930.00	94.40
931.00	266.90
932.00	490.30
933.00	754.80
934.00	1,054.90
935.00	1,386.70

Structure ID: TW
Structure Type: TW Setup, DS Channel

Tailwater Type	Free Outfall

Convergence Tolerances

Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft^3/s
Flow Tolerance (Maximum)	10.000 ft^3/s

Revised Proposed Conditions

Subsection: Outlet Input Data
Label: Revised Basin C1

Return Event: 2 years
Storm Event: 2-YEAR

Requested Pond Water Surface Elevations	
Minimum (Headwater)	910.00 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	929.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Orifice-Area	Orifice - 3	Forward	Culvert - 1	922.25	929.00
Inlet Box	Riser - 1	Forward	Culvert - 1	924.00	929.00
Orifice-Circular	Orifice - 1	Forward	Culvert - 1	910.00	929.00
Culvert-Circular	Culvert - 1	Forward	TW	909.00	929.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

Revised Proposed Conditions

Subsection: Outlet Input Data	Return Event: 2 years
Label: Revised Basin C1	Storm Event: 2-YEAR

Structure ID: Culvert - 1
Structure Type: Culvert-Circular

Number of Barrels	1
Diameter	42.0 in
Length	118.00 ft
Length (Computed Barrel)	118.00 ft
Slope (Computed)	0.008 ft/ft

Outlet Control Data

Manning's n	0.013
Ke	0.200
Kb	0.006
Kr	1.000
Convergence Tolerance	0.00 ft

Inlet Control Data

Equation Form	Form 1
K	0.0045
M	2.0000
C	0.0317
Y	0.6900
T1 ratio (HW/D)	1.091
T2 ratio (HW/D)	1.193
Slope Correction Factor	-0.500

Use unsubmerged inlet control 0 equation below T1 elevation.
Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

T1 Elevation	912.82 ft	T1 Flow	63.00 ft³/s
T2 Elevation	913.18 ft	T2 Flow	72.00 ft³/s

Revised Proposed Conditions

Subsection: Outlet Input Data	Return Event: 2 years
Label: Revised Basin C1	Storm Event: 2-YEAR

Structure ID: Orifice - 1
Structure Type: Orifice-Circular

Number of Openings	1
Elevation	910.00 ft
Orifice Diameter	24.0 in
Orifice Coefficient	0.600

Structure ID: Riser - 1
Structure Type: Inlet Box

Number of Openings	1
Elevation	924.00 ft
Orifice Area	64.0 ft²
Orifice Coefficient	0.600
Weir Length	32.00 ft
Weir Coefficient	3.00 (ft^0.5)/s
K Reverse	1.000
Manning's n	0.000
Kev, Charged Riser	0.000
Weir Submergence	False
Orifice H to crest	False

Structure ID: Orifice - 3
Structure Type: Orifice-Area

Number of Openings	3
Elevation	922.25 ft
Orifice Area	4.5 ft²
Top Elevation	923.00 ft
Datum Elevation	922.25 ft
Orifice Coefficient	0.600

Structure ID: TW
Structure Type: TW Setup, DS Channel

Tailwater Type	Free Outfall

Convergence Tolerances

Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft

Revised Proposed Conditions

Subsection: Outlet Input Data | Return Event: 2 years

Label: Revised Basin C1 | Storm Event: 2-YEAR

Convergence Tolerances	
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft³/s
Flow Tolerance (Maximum)	10.000 ft³/s

Revised Proposed Conditions Emergency Spillways

Project Summary

Title	Woodside Ridge - Proposed Conditions Emergency Spillway Designs
Engineer	JJL
Company	Olsson
Date	5/9/2019

Notes

Table of Contents

Revised Proposed Conditions Emergency Spillways

Subsection: Outlet Input Data
Label: APWA Basin C1 Emergency Spillway
Scenario: 100-Year

Return Event: 100 years
Storm Event: 100-YEAR

Requested Pond Water Surface Elevations	
Minimum (Headwater)	925.96 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	929.50 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Irregular Weir	Emergency Spillway Weir	Forward	TW	926.50	929.50
Tailwater Settings	Tailwater			(N/A)	(N/A)

Revised Proposed Conditions Emergency Spillways

Subsection: Outlet Input Data	Return Event: 100 years
Label: APWA Basin C1 Emergency Spillway	Storm Event: 100-YEAR
Scenario: 100-Year	

Structure ID: Emergency Spillway Weir
Structure Type: Irregular Weir

Station (ft)	Elevation (ft)
0.00	3.00
9.00	0.00
139.00	0.00
148.00	3.00

Lowest Elevation	926.50 ft
Weir Coefficient	3.10 (ft^0.5)/s

Structure ID: TW
Structure Type: TW Setup, DS Channel

Tailwater Type	Free Outfall

Convergence Tolerances

Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft³/s
Flow Tolerance (Maximum)	10.000 ft³/s

Revised Proposed Conditions Emergency Spillways

Subsection: Individual Outlet Curves	Return Event: 100 years
Label: APWA Basin C1 Emergency Spillway	Storm Event: 100-YEAR
Scenario: 100-Year	

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Emergency Spillway Weir (Irregular Weir)

Upstream ID = (Pond Water Surface)
Downstream ID = Tailwater (Pond Outfall)

Water Surface Elevation (ft)	Flow (ft³/s)	Tailwater Elevation (ft)	Convergence Error (ft)
925.96	0.00	(N/A)	0.00
926.46	0.00	(N/A)	0.00
926.50	0.00	(N/A)	0.00
926.96	126.67	(N/A)	0.00
927.46	385.00	(N/A)	0.00
927.96	727.88	(N/A)	0.00
928.46	1,141.20	(N/A)	0.00
928.96	1,617.34	(N/A)	0.00
929.46	2,151.44	(N/A)	0.00
929.50	2,196.56	(N/A)	0.00

Computation Messages
E < Y min=926.50
E < Y min=926.50
E = Y min=926.50
Max.H=.46; Max.Htw=free out;; W(ft) =132.76
Max.H=.96; Max.Htw=free out;; W(ft) =135.76
Max.H=1.46; Max.Htw=free out;; W(ft) =138.76
Max.H=1.96; Max.Htw=free out;; W(ft) =141.76
Max.H=2.46; Max.Htw=free out;; W(ft) =144.76
Max.H=2.96; Max.Htw=free out;; W(ft) =147.76
Max.H=3.00; Max.Htw=free out;; W(ft) =148.00

Revised Proposed Conditions Emergency Spillways

Subsection: Composite Rating Curve
Label: APWA Basin C1 Emergency Spillway
Scenario: 100-Year

Return Event: 100 years
Storm Event: 100-YEAR

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft³/s)	Tailwater Elevation (ft)	Convergence Error (ft)
925.96	0.00	(N/A)	0.00
926.46	0.00	(N/A)	0.00
926.50	0.00	(N/A)	0.00
926.96	126.67	(N/A)	0.00
927.46	385.00	(N/A)	0.00
927.96	727.88	(N/A)	0.00
928.46	1,141.20	(N/A)	0.00
928.96	1,617.34	(N/A)	0.00
929.46	2,151.44	(N/A)	0.00
929.50	2,196.56	(N/A)	0.00

Contributing Structures
None Contributing
None Contributing
Emergency Spillway Weir
Emergency Spillway Weir
Emergency Spillway Weir
Emergency Spillway Weir
Emergency Spillway Weir
Emergency Spillway Weir
Emergency Spillway Weir
Emergency Spillway Weir

Revised Proposed Conditions Emergency Spillways

Subsection: Outlet Input Data
Label: Basin B1 Emergency Spillway
Scenario: 100-Year

Return Event: 100 years
Storm Event: 100-YEAR

Requested Pond Water Surface Elevations	
Minimum (Headwater)	926.80 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	940.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Rectangular Weir	Emergency Spillway Weir	Forward	TW	927.30	940.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

Revised Proposed Conditions Emergency Spillways

Subsection: Outlet Input Data
Label: Basin B1 Emergency Spillway
Scenario: 100-Year

Return Event: 100 years
Storm Event: 100-YEAR

Structure ID: Emergency Spillway Weir
Structure Type: Rectangular Weir

Number of Openings	1
Elevation	927.30 ft
Weir Length	10.00 ft
Weir Coefficient	2.64 (ft^0.5)/s

Structure ID: TW
Structure Type: TW Setup, DS Channel

Tailwater Type	Free Outfall

Convergence Tolerances

Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft³/s
Flow Tolerance (Maximum)	10.000 ft³/s

Revised Proposed Conditions Emergency Spillways

Subsection: Individual Outlet Curves	Return Event: 100 years
Label: Basin B1 Emergency Spillway	Storm Event: 100-YEAR
Scenario: 100-Year	

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Emergency Spillway Weir (Rectangular Weir)

Upstream ID = (Pond Water Surface)
Downstream ID = Tailwater (Pond Outfall)

Water Surface Elevation (ft)	Flow (ft^3/s)	Tailwater Elevation (ft)	Convergence Error (ft)
926.80	0.00	(N/A)	0.00
927.30	0.00	(N/A)	0.00
927.80	9.24	(N/A)	0.00
928.30	25.87	(N/A)	0.00
928.80	47.04	(N/A)	0.00
929.30	71.68	(N/A)	0.00
929.80	99.14	(N/A)	0.00
930.30	128.95	(N/A)	0.00
930.80	160.76	(N/A)	0.00
931.30	194.30	(N/A)	0.00
931.80	229.33	(N/A)	0.00
932.30	265.64	(N/A)	0.00
932.80	303.07	(N/A)	0.00
933.30	341.44	(N/A)	0.00
933.80	380.62	(N/A)	0.00
934.30	420.48	(N/A)	0.00
934.80	460.91	(N/A)	0.00
935.30	501.79	(N/A)	0.00
935.80	543.01	(N/A)	0.00
936.30	584.50	(N/A)	0.00
936.80	626.14	(N/A)	0.00
937.30	667.87	(N/A)	0.00
937.80	709.60	(N/A)	0.00
938.30	751.26	(N/A)	0.00
938.80	792.76	(N/A)	0.00
939.30	834.04	(N/A)	0.00
939.80	875.04	(N/A)	0.00
940.00	891.35	(N/A)	0.00

Computation Messages
HW & TW below Inv.El.=927.300
H=.00; Htw=.00; Qfree=.00;
H=.50; Htw=.00; Qfree=9.24;
H=1.00; Htw=.00; Qfree=25.87;

Revised Proposed Conditions Emergency Spillways

Subsection: Individual Outlet Curves	Return Event: 100 years
Label: Basin B1 Emergency Spillway	Storm Event: 100-YEAR
Scenario: 100-Year	

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Emergency Spillway Weir (Rectangular Weir)

Upstream ID = (Pond Water Surface)
Downstream ID = Tailwater (Pond Outfall)

Computation Messages
H=1.50; Htw=.00; Qfree=47.04;
H=2.00; Htw=.00; Qfree=71.68;
H=2.50; Htw=.00; Qfree=99.14;
H=3.00; Htw=.00; Qfree=128.95;
H=3.50; Htw=.00; Qfree=160.76;
H=4.00; Htw=.00; Qfree=194.30;
H=4.50; Htw=.00; Qfree=229.33;
H=5.00; Htw=.00; Qfree=265.64;
H=5.50; Htw=.00; Qfree=303.07;
H=6.00; Htw=.00; Qfree=341.44;
H=6.50; Htw=.00; Qfree=380.62;
H=7.00; Htw=.00; Qfree=420.48;
H=7.50; Htw=.00; Qfree=460.91;
H=8.00; Htw=.00; Qfree=501.79;
H=8.50; Htw=.00; Qfree=543.01;
H=9.00; Htw=.00; Qfree=584.50;
H=9.50; Htw=.00; Qfree=626.14;
H=10.00; Htw=.00; Qfree=667.87;
H=10.50; Htw=.00; Qfree=709.60;
H=11.00; Htw=.00; Qfree=751.26;

Revised Proposed Conditions Emergency Spillways

Subsection: Individual Outlet Curves
Label: Basin B1 Emergency Spillway
Scenario: 100-Year

Return Event: 100 years
Storm Event: 100-YEAR

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Emergency Spillway Weir (Rectangular Weir)

Upstream ID = (Pond Water Surface)
Downstream ID = Tailwater (Pond Outfall)

Computation Messages
H=11.50; Htw=.00; Qfree=792.76;
H=12.00; Htw=.00; Qfree=834.04;
H=12.50; Htw=.00; Qfree=875.04;
H=12.70; Htw=.00; Qfree=891.35;

Revised Proposed Conditions Emergency Spillways

Subsection: Composite Rating Curve	Return Event: 100 years
Label: Basin B1 Emergency Spillway	Storm Event: 100-YEAR
Scenario: 100-Year	

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft³/s)	Tailwater Elevation (ft)	Convergence Error (ft)
926.80	0.00	(N/A)	0.00
927.30	0.00	(N/A)	0.00
927.80	9.24	(N/A)	0.00
928.30	25.87	(N/A)	0.00
928.80	47.04	(N/A)	0.00
929.30	71.68	(N/A)	0.00
929.80	99.14	(N/A)	0.00
930.30	128.95	(N/A)	0.00
930.80	160.76	(N/A)	0.00
931.30	194.30	(N/A)	0.00
931.80	229.33	(N/A)	0.00
932.30	265.64	(N/A)	0.00
932.80	303.07	(N/A)	0.00
933.30	341.44	(N/A)	0.00
933.80	380.62	(N/A)	0.00
934.30	420.48	(N/A)	0.00
934.80	460.91	(N/A)	0.00
935.30	501.79	(N/A)	0.00
935.80	543.01	(N/A)	0.00
936.30	584.50	(N/A)	0.00
936.80	626.14	(N/A)	0.00
937.30	667.87	(N/A)	0.00
937.80	709.60	(N/A)	0.00
938.30	751.26	(N/A)	0.00
938.80	792.76	(N/A)	0.00
939.30	834.04	(N/A)	0.00
939.80	875.04	(N/A)	0.00
940.00	891.35	(N/A)	0.00

Contributing Structures
None Contributing
Emergency Spillway Weir
Emergency Spillway Weir
Emergency Spillway Weir
Emergency Spillway Weir
Emergency Spillway Weir
Emergency Spillway Weir
Emergency Spillway Weir
Emergency Spillway Weir
Emergency Spillway Weir
Emergency Spillway Weir
Emergency Spillway Weir
Emergency Spillway Weir

Revised Proposed Conditions Emergency Spillways

Subsection: Composite Rating Curve
Label: Basin B1 Emergency Spillway
Scenario: 100-Year

Return Event: 100 years
Storm Event: 100-YEAR

Composite Outflow Summary

Contributing Structures
Emergency Spillway Weir
Emergency Spillway Weir
Emergency Spillway Weir
Emergency Spillway Weir
Emergency Spillway Weir
Emergency Spillway Weir
Emergency Spillway Weir
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Emergency Spillway Weir
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Emergency Spillway Weir

Revised Proposed Conditions Emergency Spillways

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APPENDIX G

Proposed Conditions Waiver for Point A1

LEE'S SUMMIT
MISSOURI

Aug. 21, 2018

Melissa DeGonia, P.E.
Olsson Associates
1301 Burlington St.
North Kansas City, MO 64116

RE: Request for Waiver – Woodside Ridge Preliminary Development Plan - PL2018-103
City Engineer Approval of Specified Items

References: a) Woodside Ridge Preliminary Stormwater Drainage Study dated June 2018
b) Letter dated June 22, 2018 from Olsson Associates

The City of Lee's Summit approves your request for the design exceptions listed below based on the request in the referenced letter dated June 22, 2018. Specifically, 5608.4(C)1 of the Design and Construction Manual is waived in terms of the requirement that the applicant provide detention in accordance with the Comprehensive Control Strategy at Point A1 shown on Exhibit A of the waiver request dated June 22, 2018. These exceptions may be incorporated into subsequent submittals necessary to complete the standard review and approval of construction plans by City Staff.

1. The request is a waiver to the peak rate control during the 2, 10, and 100 year storm events, and 40 hour extended detention for the 90% mean annual event to Point of Interest A1 shown on Exhibit 4 of the "Preliminary Stormwater Drainage Study" dated June 2018, and Point A1 shown on Exhibit A (attached) of the letter dated June 22, 2018 (attached).
2. Future peak flow rates to the above-referenced Point of Interest A1 shall be less than the existing peak flow rates to Point A1. In summary, the future peak flow rates will be reduced by 35 cfs for the 2 year event, 55 cfs for the 10 year event, and 76 cfs for the 100 year event.
3. The waiver is based on the findings contained in the "Woodside Ridge Preliminary Stormwater Drainage Study" dated June 2018.

SIGNED:

George M. Binger III, P.E.
City Engineer / Deputy Director of Public Works

Cvwaiver_Detentiona1.Docx

OLSSON®
ASSOCIATES

MEMO

☐ Overnight
☐ Regular Mail
☐ Hand Delivery
☐ Other: ________

TO: City of Lee's Summit
Development Center

FROM: Melissa G. DeGonia, PE

RE: Woodside Ridge Detention Requirements

DATE: June 22, 2018

OA PROJECT #: 018-1140
PHASE: 400
TASK: 400006

STATE OF MISSOURI
MELISSA G. DEGONIA
NUMBER
PE-2011000892
7-24-18
PROFESSIONAL ENGINEER

The following is a request for A waiver for detention requirements within Watershed A, relating specifically to Point A1. Refer to attached exhibit for watershed characteristics in relation to the property and proposed improvements.

Per APWA Section 5608.4 and City of Lee's Summit criteria, the performance criteria for detention is to provide detention to limit peak flow rates at downstream points of interest to maximum release rates:

- 50% storm peak rate less than or equal to 0.5 cfs per site acre
- 10% storm peak rate less than or equal to 2.0 cfs per site acre
- 1% storm peak rate less than or equal to 3.0 cfs per site acre

In lieu of matching these "allowable" release rates, the Future Conditions peak flow rates will be reduced to less than the Existing Conditions.

This waiver is requested due to several challenges in relation to detention design, described below. Due to these limitations, it is not possible to collect and detain as much runoff as would be necessary to reduce the peak flow rates fully to the standard onsite release rates.

- The watershed consists of steep slopes which are heavily vegetated, making detention basins difficult to construct.
- The tributary flowing through Watershed A generally follows the property line, which results in stormwater generally sheet flowing directly to the tributary, instead of channelizing to create points of discharge where detention can be effective.

- For several reasons, detention within the channel is not feasible or advisable.
    - The channel is protected by a stream setback zone, and should therefore not be disturbed without necessity.
    - The onsite area is a small portion of the watershed, so there is a significant amount of offsite bypass contributing to the main tributary.
    - Constructing a dam would capture most of the offsite runoff which would excessively cut back peak flow rates in the channel, possibly resulting in increased erosion in the channel and diminution of the existing natural habitat.
    - The channel straddles the property line in most places, so detention would be partially offsite, on several existing lots.
    - An existing sanitary sewer trunk main follows the channel, and would be located underneath any new detention facility in the channel.

While the "allowable" release rates will not be met at Point A1, peak flow rates will be reduced significantly from the Existing Conditions rates in all storm events. Additionally, over 90% of the paved areas within Watershed A are captured and diverted to a detention facility or the existing pond, providing runoff control for most of the new developed area in the watershed, and water quality treatment for most of the proposed streets.

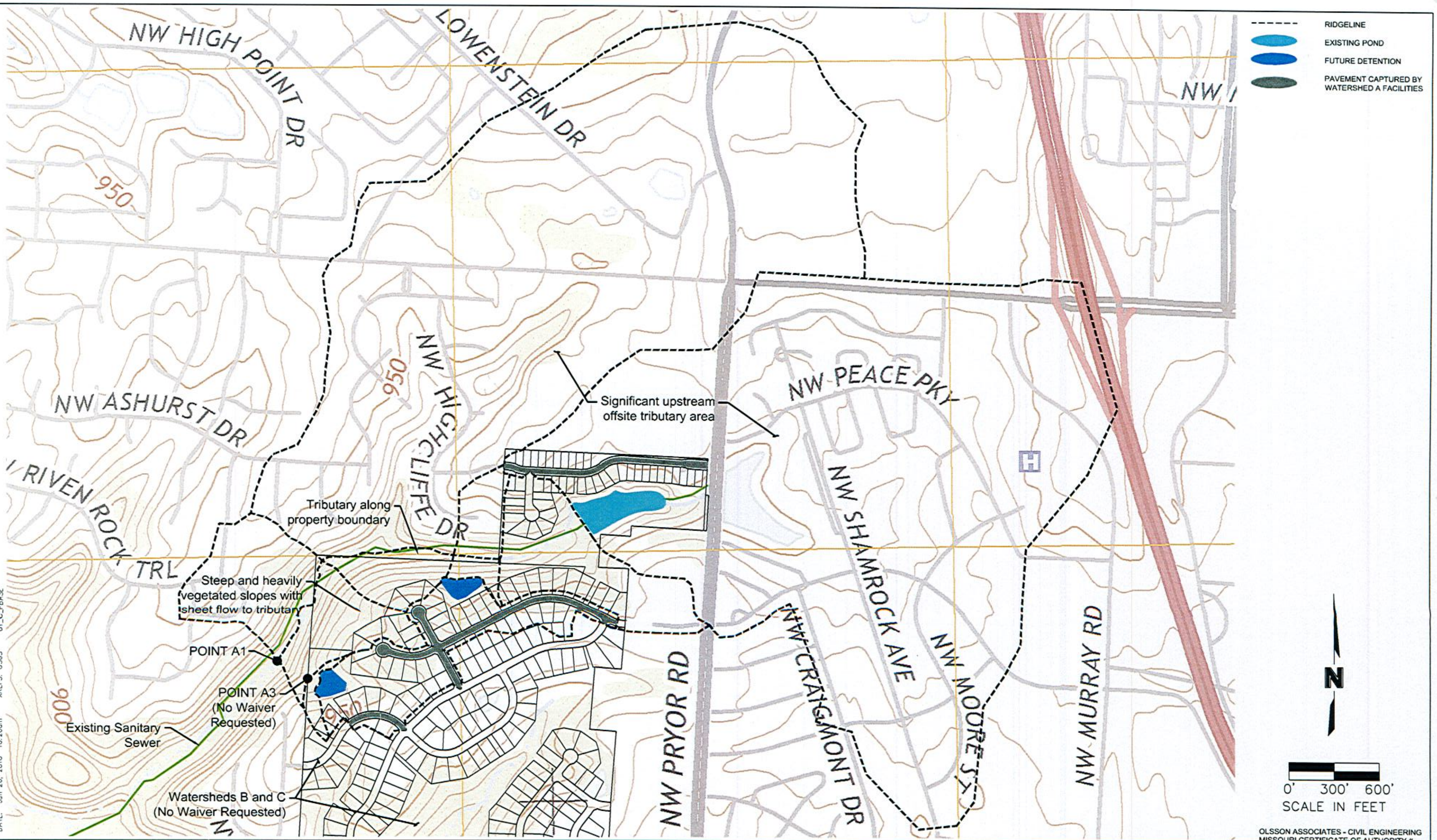
Below is a summary of proposed flow rates in relation to existing and the "allowable" release rates. For more information, reference the Woodside Ridge Preliminary Stormwater Drainage Study.

Table 1. Future vs. Allowable Release Rates

	Q_1 (cfs)	Q_{10} (cfs)	Q_{100} (cfs)
Future	898.31	1528.00	2519.41
Allowable	839.45	1489.65	2426.53
Difference	58.86	38.35	92.88

Table 2. Future vs. Existing Release Rates

	Q_1 (cfs)	Q_{10} (cfs)	Q_{100} (cfs)
Future	898.31	1528.00	2519.41
Existing	932.86	1582.99	2595.35
Difference	-34.55	-54.99	-75.94



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DATE: Jun 20, 2018 10:20am XREFS: USGS 01_C_PBASE

PROJECT NO:	018-1140
DRAWN BY:	MGD
DATE:	06/20/2018

POINT A1 WAIVER REQUEST

OLSSON ASSOCIATES

OLSSON ASSOCIATES - CIVIL ENGINEERING
MISSOURI CERTIFICATE OF AUTHORITY #

1301 Burlington Street
North Kansas City, MO 64116
TEL 816.587.4320
FAX 816.587.1393

EXHIBIT
A

APPENDIX H

Proposed Conditions Water Quality Event Calculations

Design Procedure Form: Extended Dry Detention Basin (EDDB)
Main Worksheet - Basin B1

Project: Woodside Ridge 1st Plat
Location: Lee's Summit, MO
Designer: JJL

Date: 11/26/18
Company: Olsson
Checked: BHL

I. Basin Water Quality Volume

Step 1: Tributary area to EDDB, A_T (ac.) A_T (ac) = 5.42

Step 2: Calculate WQ_V using methodology in Section 6 WQ_V (ac-ft) = 0.24

Step 3: Add 20 percent to account for silt and sediment deposition in the basin V_{DESIGN} (ac-ft) = 0.29

IIa. Water Quality Outlet Type

Step 1: Set water quality outlet type: Outlet Type = 2

Type 1 = Single Orifice
Type 2 = Perforated Riser or Plate
Type 3 = V-Notch Weir

Step 2: Proceed to part IIb, IIc, or IId based on water quality outlet type selected

---

IIb. Water Quality Pool Outlet, Single Orifice

Step 1: Depth of water quality volume at outlet, Z_{WQ} (ft) Z_{WQ} (ft) = 2.00

Step 2: Average head of water quality volume over invert of orifice, H_{WQ} (ft) H_{WQ} (ft) = 1.00

$H_{WQ} = 0.5 * Z_{WQ}$

Step 3: Average water quality outflow rate, Q_{WQ} (cfs) Q_{WQ} (cfs) = 0.07

$Q_{WQ} = (WQ_V * 43{,}560) / (40*3{,}600)$

Step 4: Set value of orifice discharge coefficient, C_O C_O = 0.66

$C_O = 0.66$ when thickness of riser/weir plate is = or < orifice diameter
$C_O = 0.80$ when thickness of riser/weir plate is > orifice diameter

Step 5: Water quality outlet orifice diameter (minimum of 1/2 inch), D_O (in) D_O (in) = 1.59

Use Type 2

$D_O = 12 * 2 (Q_{WQ} / (C_O * p * (2 * g * H_{WQ})^{0.5}))^{0.5}$

(if orifice diameter < 4 inches use outlet type 2 or 3)

Step 6: To size outlet orifice for EDDB with an irregular stage-volume relationship use the Single Orifice Worksheet

Design Procedure Form: Extended Dry Detention Basin (EDDB)
Main Worksheet - Basin B1

Project: Woodside Ridge 1st Plat
Location: Lee's Summit, MO
Designer: JJL

Date: 11/26/18
Company: Olsson
Checked: BHL

IIc. Water Quality Outlet, Peforated Riser (Continued)

Note: Needed 2" perforations to have basin drain within 72 hours.

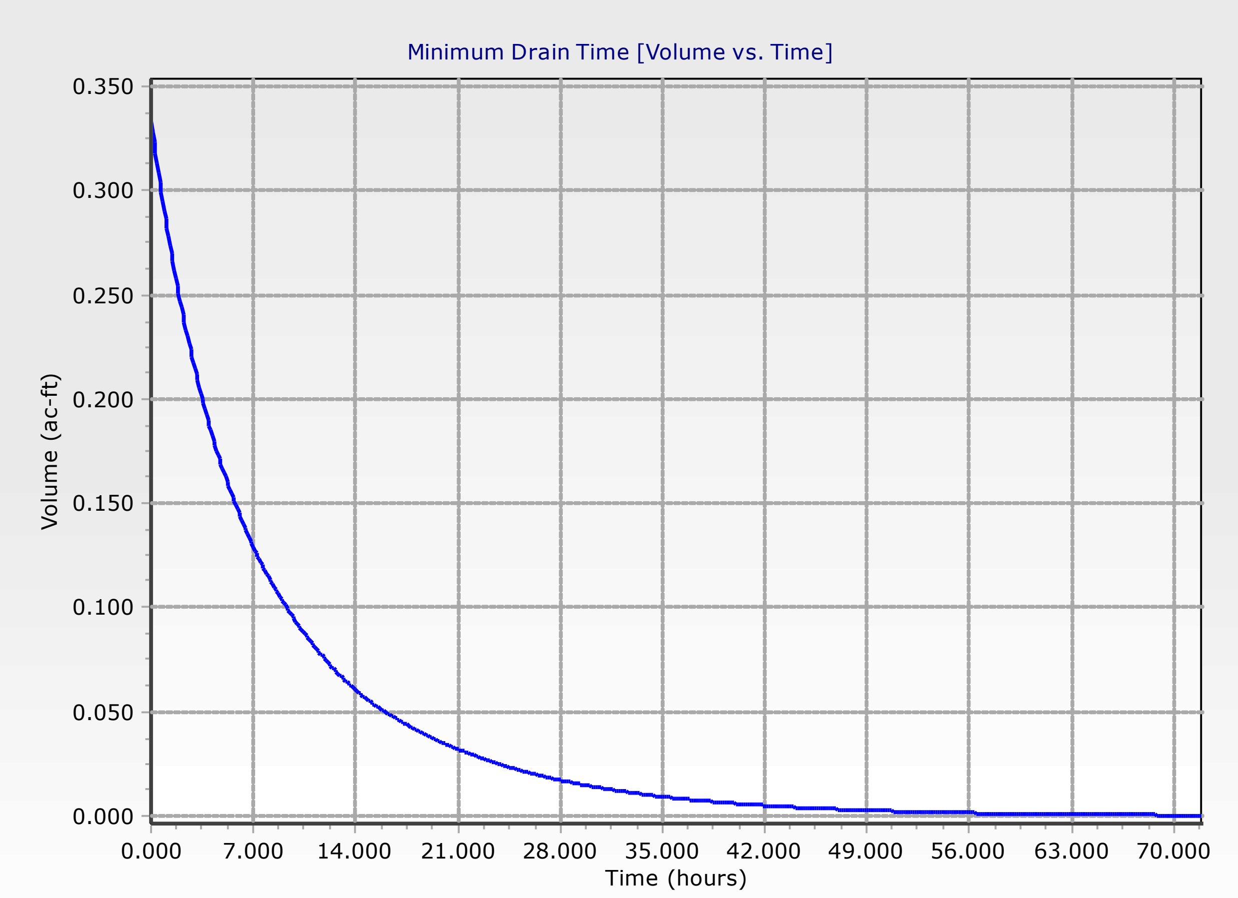
Step 1:	Depth of water quality volume at outlet, Z_{WQ} (ft)	Z_{WQ} (ft) = 2.00
Step 2:	Recommended maximum outlet area per row, A_O (in^2) $A_O = WQ_V / (0.013 * Z_{WQ}^2 + 0.22 * Z_{WQ} - 0.10)$	A_O (in^2) = 0.62
Step 3:	Circular perforation diameter per row assuming a single column, D_l (in)	D_l (in) = 0.89 Use 1"
Step 4:	Numbers of columns, n_c	n_c = 1.00
Step 5:	Design circular perforation diameter (from 1 to 2 inches), D_{Perf} (in)	D_{Perf} (in) = 0.89 Use 1"
Step 6:	Horizontal perforation column spacing when $n_c > 1$, center to center, S_c If D_{Perf} is not < or = 1, $S_c = 4$	S_c =
Step 7:	Number of rows, 4" vertical spacing between perforations, center to center,	n_r = 6.00

IIc. Water Quality Outlet, V-Notch Weir

Step 1:	Depth of water quality volume above permanent pool, Z_{WQ} (ft)	Z_{WQ} (ft) = N/A
Step 2:	Average head of water quality pool volume over invert of v-notch H_{WQ} (ft) $H_{WQ} = 0.5 * Z_{WQ}$	H_{WQ} (ft) = N/A
Step 3:	Average water quality pool outflow rate, Q_{WQ} (cfs) $Q_{WQ} = (WQ_V * 43{,}560) / (40*3{,}600)$	Q_{WQ} (cfs) = N/A
Step 4	V-notch weir coefficient, C_v	C_v = N/A
Step 5:	V-notch weir angle, q (deg) $\theta = 2 *(180/ \pi)*\arctan(Q_{WQ} / (C_v * H_{WQ}^{5.2}))$ V-notch angle should be at least 20 degrees. Set to 20 degrees if calculated angle is smaller.	q (deg) = N/A
Step 6:	V-notch weir top width, W_v (ft) $W_v = 2 * Z_{WQ} * TAN(\theta/2)$	W_v (ft) = N/A

Step 7: To calculate v-notch angle for EDW with an irregular stage-volume relationship, use th
V-notch Weir Worksheet

Minimum Drain Time Detailed Report: Basin B1 WQv Detention Time



APPENDIX I

Future Conditions Drainage Area and Land Use Exhibits

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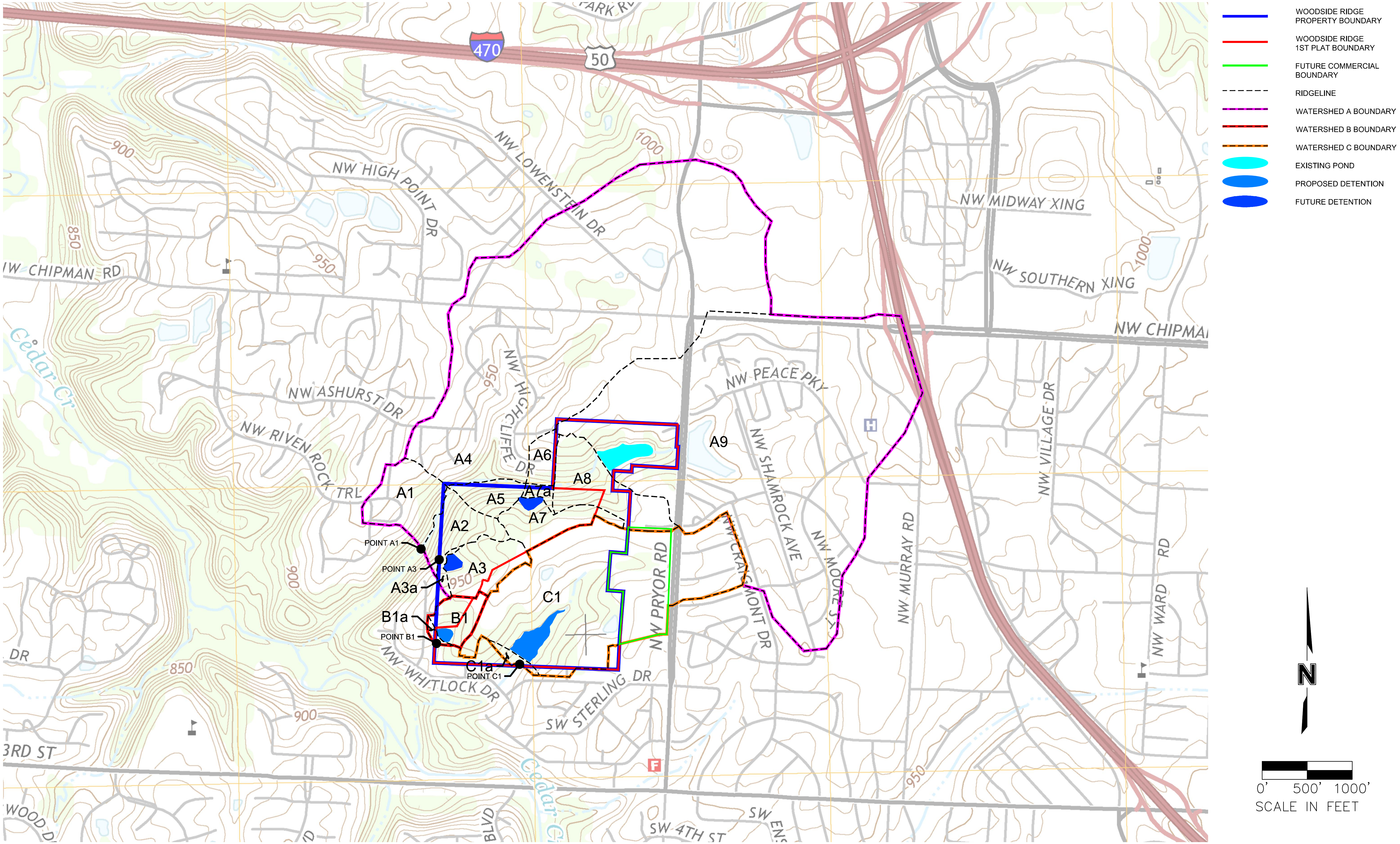
DATE: Mar 14, 2019 1:32pm XREFS: usgs



PROJECT NO:	A18-1140
DRAWN BY:	JJL
DATE:	03/14/2019

REVISED FUTURE CONDITIONS DRAINAGE AREA MAP

olsson

7301 West 133rd Street
Suite 200
Overland Park, KS 66213-4750
TEL 913.381.1170
FAX 913.381.1174

EXHIBIT
3

DWG: F:\2018\1001-1500\018-1140-A\40-Design\Calcs\WTRS\Final Macro and First Plat SDS\CAD\FtLandUse.dwg

DATE: Mar 14, 2019 1:36pm

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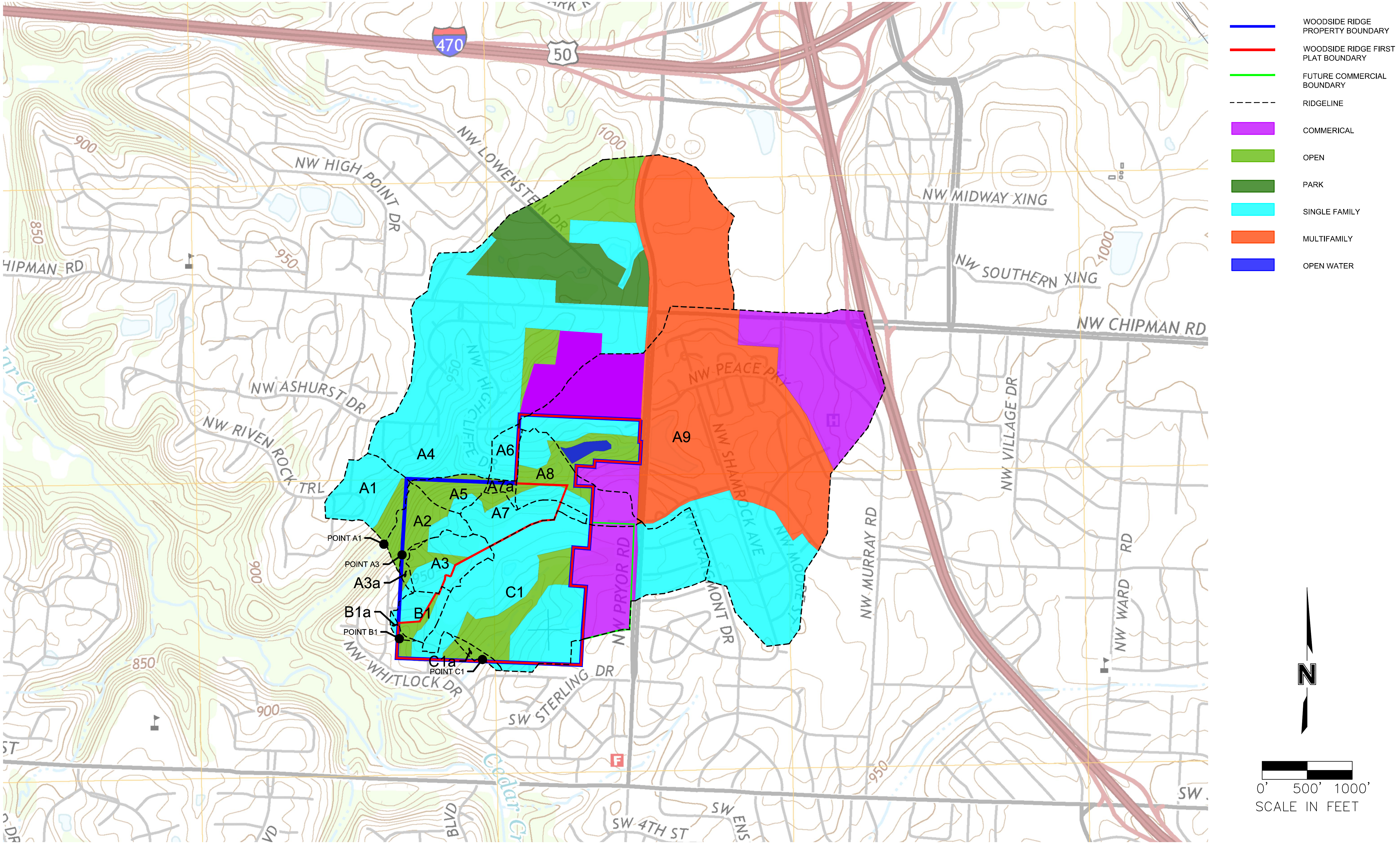
USER: jlay



PROJECT NO: A18-1140

DRAWN BY: JJL

DATE: 03/14/2019

REVISED FUTURE LAND USE MAP

olsson

7301 West 133rd Street
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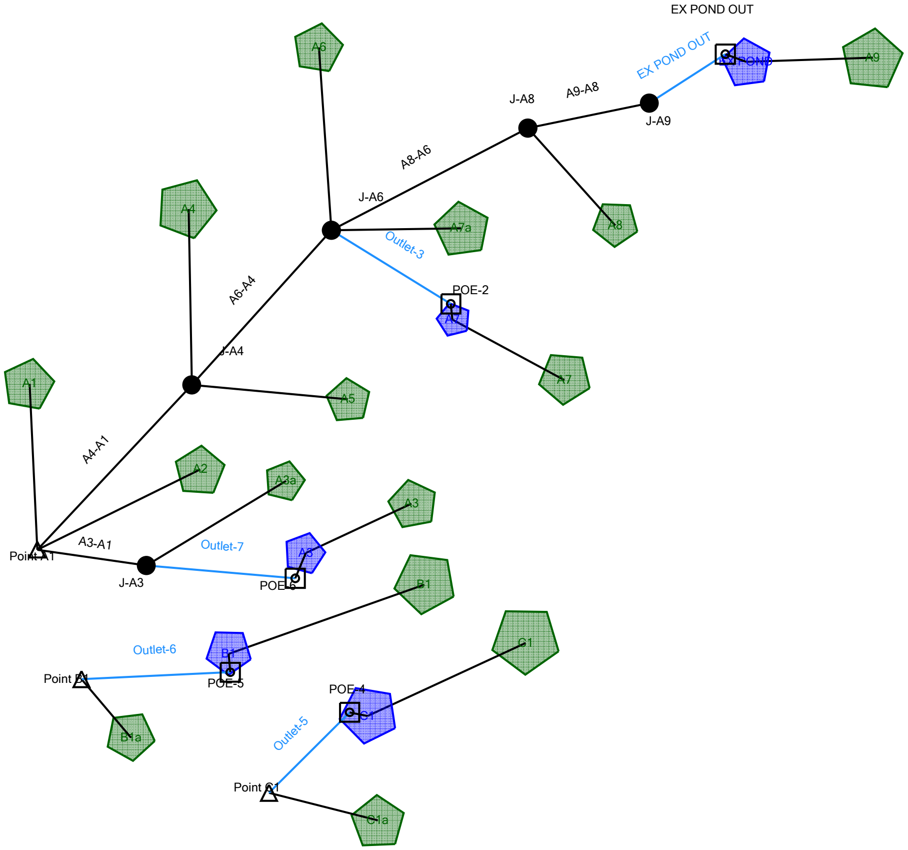
EXHIBIT

3A

APPENDIX J

Future Conditions PondPack Model Input and Results

Future Conditions PondPack Schematic



Revised Future Conditions Curve Number Calculations

	Offsite					Onsite								
	80 Open Space (ac.)	85 Park (ac.)	87 SFR (ac.)	92 MFR (ac.)	95 Commercial (ac.)	80 Open Space (ac.)	95 Commercial (ac.)	87 SFR (ac.)	92 MFR (ac.)	100 Pond (ac.)	Total Offsite (ac.)	Total Onsite (ac.)	Total (ac.)	Weighted CN
A1	2.47	0.00	9.97	0.00	0.00	0.13	0.00	0.00	0.00	0.00	12.44	0.13	12.57	86
A2	1.80	0.00	0.00	0.00	0.00	4.74	0.00	1.96	0.00	0.00	1.80	6.69	8.49	82
A3	0.00	0.00	0.00	0.00	0.00	2.57	0.00	7.41	0.00	0.00	0.00	9.98	9.98	86
A3a	0.08	0.00	0.00	0.00	0.00	0.76	0.00	0.20	0.00	0.00	0.08	0.96	1.04	81
A4	18.67	25.96	88.37	35.84	8.61	0.05	0.00	0.07	0.00	0.00	177.45	0.12	177.57	87
A5	0.77	0.00	0.00	0.00	0.00	3.56	0.00	0.86	0.00	0.00	0.77	4.42	5.19	81
A6	0.00	0.00	3.55	0.00	0.00	0.00	0.00	0.25	0.00	0.00	3.55	0.25	3.80	87
A7	0.00	0.00	0.00	0.00	0.00	1.01	0.00	7.99	0.00	0.00	0.00	9.00	9.00	86
A7a	0.22	0.00	0.00	0.00	0.00	0.96	0.00	0.15	0.00	0.00	0.22	1.12	1.34	81
A8	0.67	0.00	0.00	0.04	3.72	4.94	0.34	6.24	0.00	0.00	4.43	11.52	15.96	87
A9	4.43	0.00	33.55	88.06	50.75	5.56	0.00	5.14	0.00	1.57	176.79	12.27	189.06	91
TOTAL A	29.11	25.96	135.44	123.94	63.08	24.29	0.34	30.26	0.00	1.57	377.54	56.46	434.00	89
B1	0.00	0.00	0.19	0.00	0.00	0.96	0.00	4.28	0.00	0.00	0.19	5.24	5.42	86
B1a	0.00	0.00	0.36	0.00	0.00	0.02	0.00	0.22	0.00	0.00	0.36	0.24	0.60	87
TOTAL B	0.00	0.00	0.55	0.00	0.00	0.98	0.00	4.50	0.00	0.00	0.55	5.48	6.02	86
C1	0.00	0.00	14.40	0.00	16.14	10.30	0.00	34.27	0.00	0.00	30.54	44.57	75.11	88
C1a	0.00	0.00	0.20	0.00	0.00	0.96	0.00	0.03	0.00	0.00	0.20	0.99	1.19	81
TOTAL C	0.00	0.00	14.60	0.00	16.14	11.26	0.00	34.30	0.00	0.00	30.74	45.56	76.30	88

Revised Future Conditions

Project Summary

Title	Woodside Ridge - Revised Future Conditions
Engineer	JJL
Company	Olsson
Date	3/14/2019

Notes

Revised Future Conditions

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
A3	2-Year	2	1.817	11.930	33.06
A3	10-Year	10	3.113	11.930	55.70
A3	100-Year	100	5.179	11.930	90.33
B1	2-Year	2	0.987	11.930	17.95
B1	10-Year	10	1.691	11.930	30.25
B1	100-Year	100	2.813	11.930	49.06
C1	2-Year	2	14.726	12.050	211.24
C1	10-Year	10	24.682	12.050	346.01
C1	100-Year	100	40.393	12.020	551.31
A1	2-Year	2	2.289	11.960	38.93
A1	10-Year	10	3.923	11.960	65.59
A1	100-Year	100	6.526	11.960	106.37
A2	2-Year	2	1.318	11.950	22.99
A2	10-Year	10	2.366	11.950	41.02
A2	100-Year	100	4.073	11.950	69.21
A4	2-Year	2	33.528	12.040	493.22
A4	10-Year	10	56.826	12.020	821.51
A4	100-Year	100	93.763	12.020	1,322.35
A5	2-Year	2	0.773	11.950	13.59
A5	10-Year	10	1.404	11.940	24.58
A5	100-Year	100	2.439	11.940	42.00
A6	2-Year	2	0.719	11.950	12.58
A6	10-Year	10	1.218	11.950	20.89
A6	100-Year	100	2.009	11.940	33.59
A7a	2-Year	2	0.200	11.940	3.64
A7a	10-Year	10	0.363	11.930	6.60
A7a	100-Year	100	0.630	11.930	11.25
A9	2-Year	2	41.407	12.030	576.32
A9	10-Year	10	67.148	12.030	913.07
A9	100-Year	100	107.260	12.030	1,421.40
A7	2-Year	2	1.637	11.960	27.78
A7	10-Year	10	2.806	11.950	46.84
A7	100-Year	100	4.669	11.950	76.13
A8	2-Year	2	3.019	11.930	54.78
A8	10-Year	10	5.116	11.930	91.06
A8	100-Year	100	8.440	11.930	146.31
C1a	2-Year	2	0.177	11.940	3.23
C1a	10-Year	10	0.322	11.930	5.86
C1a	100-Year	100	0.559	11.930	9.99
B1a	2-Year	2	0.115	11.930	2.09
B1a	10-Year	10	0.196	11.930	3.48
B1a	100-Year	100	0.323	11.930	5.59
A3a	2-Year	2	0.155	11.950	2.72

Revised Future Conditions

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
A3a	10-Year	10	0.281	11.940	4.93
A3a	100-Year	100	0.489	11.940	8.43

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
Point A1	2-Year	2	83.563	12.090	917.93
Point A1	10-Year	10	140.663	12.070	1,550.08
Point A1	100-Year	100	231.097	12.070	2,525.60
Point B1	2-Year	2	0.859	11.950	2.68
Point B1	10-Year	10	1.374	11.930	4.42
Point B1	100-Year	100	2.442	12.020	8.83
Point C1	2-Year	2	14.900	12.370	46.73
Point C1	10-Year	10	24.999	12.280	118.77
Point C1	100-Year	100	40.943	12.250	207.49
J-A3	2-Year	2	1.372	11.960	3.71
J-A3	10-Year	10	2.609	12.060	19.14
J-A3	100-Year	100	4.700	12.000	31.84
J-A4	2-Year	2	78.611	12.080	880.50
J-A4	10-Year	10	131.805	12.080	1,467.58
J-A4	100-Year	100	215.858	12.070	2,383.05
J-A6	2-Year	2	44.333	12.160	470.36
J-A6	10-Year	10	73.608	12.150	775.93
J-A6	100-Year	100	119.704	12.140	1,243.44
J-A8	2-Year	2	42.555	12.150	465.70
J-A8	10-Year	10	70.309	12.140	760.35
J-A8	100-Year	100	113.616	12.140	1,212.01
J-A9	2-Year	2	39.549	12.140	454.72
J-A9	10-Year	10	65.211	12.130	741.59
J-A9	100-Year	100	105.203	12.120	1,180.76

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
EX POND (IN)	2-Year	2	41.407	12.030	576.32	(N/A)	(N/A)
EX POND (OUT)	2-Year	2	39.549	12.140	454.72	931.84	8.290

Revised Future Conditions

Subsection: Master Network Summary

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
EX POND (IN)	10-Year	10	67.148	12.030	913.07	(N/A)	(N/A)
EX POND (OUT)	10-Year	10	65.211	12.130	741.59	932.95	11.445
EX POND (IN)	100-Year	100	107.260	12.030	1,421.40	(N/A)	(N/A)
EX POND (OUT)	100-Year	100	105.203	12.120	1,180.76	934.38	15.914
A7 (IN)	2-Year	2	1.637	11.960	27.78	(N/A)	(N/A)
A7 (OUT)	2-Year	2	0.866	15.020	0.86	934.38	1.032
A7 (IN)	10-Year	10	2.806	11.950	46.84	(N/A)	(N/A)
A7 (OUT)	10-Year	10	1.729	12.220	9.37	935.58	1.434
A7 (IN)	100-Year	100	4.669	11.950	76.13	(N/A)	(N/A)
A7 (OUT)	100-Year	100	3.464	12.170	20.16	937.53	2.213
C1 (IN)	2-Year	2	14.726	12.050	211.24	(N/A)	(N/A)
C1 (OUT)	2-Year	2	14.723	12.400	46.32	921.58	4.715
C1 (IN)	10-Year	10	24.682	12.050	346.01	(N/A)	(N/A)
C1 (OUT)	10-Year	10	24.677	12.280	117.95	923.65	7.806
C1 (IN)	100-Year	100	40.393	12.020	551.31	(N/A)	(N/A)
C1 (OUT)	100-Year	100	40.383	12.260	206.10	925.96	12.449
B1 (IN)	2-Year	2	0.987	11.930	17.95	(N/A)	(N/A)
B1 (OUT)	2-Year	2	0.743	13.250	0.93	923.14	0.566
B1 (IN)	10-Year	10	1.691	11.930	30.25	(N/A)	(N/A)
B1 (OUT)	10-Year	10	1.178	13.440	1.35	925.05	1.028
B1 (IN)	100-Year	100	2.813	11.930	49.06	(N/A)	(N/A)
B1 (OUT)	100-Year	100	2.119	12.350	5.74	926.76	1.532
A3 (IN)	2-Year	2	1.817	11.930	33.06	(N/A)	(N/A)
A3 (OUT)	2-Year	2	1.217	13.870	1.27	923.96	1.074
A3 (IN)	10-Year	10	3.113	11.930	55.70	(N/A)	(N/A)
A3 (OUT)	10-Year	10	2.328	12.110	16.30	925.06	1.464
A3 (IN)	100-Year	100	5.179	11.930	90.33	(N/A)	(N/A)
A3 (OUT)	100-Year	100	4.211	12.110	25.05	927.19	2.339

Revised Future Conditions

Subsection: Time-Depth Curve | Return Event: 100 years
Label: KCMO TR-55 | Storm Event: 100-YEAR

Time-Depth Curve: 100-YEAR	
Label	100-YEAR
Start Time	0.000 hours
Increment	0.100 hours
End Time	24.000 hours
Return Event	100 years

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.100 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
0.500	0.0	0.0	0.1	0.1	0.1
1.000	0.1	0.1	0.1	0.1	0.1
1.500	0.1	0.1	0.1	0.2	0.2
2.000	0.2	0.2	0.2	0.2	0.2
2.500	0.2	0.2	0.2	0.3	0.3
3.000	0.3	0.3	0.3	0.3	0.3
3.500	0.3	0.3	0.3	0.4	0.4
4.000	0.4	0.4	0.4	0.4	0.4
4.500	0.4	0.4	0.5	0.5	0.5
5.000	0.5	0.5	0.5	0.5	0.5
5.500	0.6	0.6	0.6	0.6	0.6
6.000	0.6	0.6	0.7	0.7	0.7
6.500	0.7	0.7	0.7	0.8	0.8
7.000	0.8	0.8	0.8	0.8	0.8
7.500	0.9	0.9	0.9	0.9	0.9
8.000	0.9	1.0	1.0	1.0	1.0
8.500	1.0	1.1	1.1	1.1	1.1
9.000	1.2	1.2	1.2	1.2	1.3
9.500	1.3	1.3	1.3	1.4	1.4
10.000	1.4	1.5	1.5	1.5	1.6
10.500	1.6	1.7	1.7	1.7	1.8
11.000	1.9	1.9	2.0	2.1	2.1
11.500	2.2	2.4	2.8	3.4	4.5
12.000	5.2	5.4	5.5	5.6	5.7
12.500	5.8	5.9	5.9	6.0	6.0
13.000	6.1	6.1	6.2	6.2	6.3
13.500	6.3	6.3	6.4	6.4	6.4
14.000	6.5	6.5	6.5	6.6	6.6
14.500	6.6	6.6	6.7	6.7	6.7
15.000	6.7	6.8	6.8	6.8	6.8
15.500	6.9	6.9	6.9	6.9	6.9
16.000	7.0	7.0	7.0	7.0	7.0
16.500	7.0	7.1	7.1	7.1	7.1

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.100 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
17.000	7.1	7.1	7.2	7.2	7.2
17.500	7.2	7.2	7.2	7.2	7.3
18.000	7.3	7.3	7.3	7.3	7.3
18.500	7.3	7.4	7.4	7.4	7.4
19.000	7.4	7.4	7.4	7.4	7.5
19.500	7.5	7.5	7.5	7.5	7.5
20.000	7.5	7.5	7.5	7.6	7.6
20.500	7.6	7.6	7.6	7.6	7.6
21.000	7.6	7.6	7.6	7.7	7.7
21.500	7.7	7.7	7.7	7.7	7.7
22.000	7.7	7.7	7.7	7.7	7.8
22.500	7.8	7.8	7.8	7.8	7.8
23.000	7.8	7.8	7.8	7.8	7.8
23.500	7.9	7.9	7.9	7.9	7.9
24.000	7.9	(N/A)	(N/A)	(N/A)	(N/A)

Revised Future Conditions

Subsection: Time-Depth Curve — Return Event: 10 years
Label: KCMO TR-55 — Storm Event: 10-YEAR

Time-Depth Curve: 10-YEAR	
Label	10-YEAR
Start Time	0.000 hours
Increment	0.100 hours
End Time	24.000 hours
Return Event	10 years

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.100 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
0.500	0.0	0.0	0.0	0.0	0.0
1.000	0.1	0.1	0.1	0.1	0.1
1.500	0.1	0.1	0.1	0.1	0.1
2.000	0.1	0.1	0.1	0.1	0.1
2.500	0.1	0.2	0.2	0.2	0.2
3.000	0.2	0.2	0.2	0.2	0.2
3.500	0.2	0.2	0.2	0.2	0.2
4.000	0.3	0.3	0.3	0.3	0.3
4.500	0.3	0.3	0.3	0.3	0.3
5.000	0.3	0.3	0.4	0.4	0.4
5.500	0.4	0.4	0.4	0.4	0.4
6.000	0.4	0.4	0.4	0.5	0.5
6.500	0.5	0.5	0.5	0.5	0.5
7.000	0.5	0.5	0.5	0.6	0.6
7.500	0.6	0.6	0.6	0.6	0.6
8.000	0.6	0.6	0.7	0.7	0.7
8.500	0.7	0.7	0.7	0.7	0.8
9.000	0.8	0.8	0.8	0.8	0.8
9.500	0.9	0.9	0.9	0.9	0.9
10.000	1.0	1.0	1.0	1.0	1.1
10.500	1.1	1.1	1.1	1.2	1.2
11.000	1.2	1.3	1.3	1.4	1.4
11.500	1.5	1.6	1.9	2.3	3.0
12.000	3.5	3.6	3.7	3.8	3.8
12.500	3.9	3.9	4.0	4.0	4.1
13.000	4.1	4.1	4.2	4.2	4.2
13.500	4.2	4.3	4.3	4.3	4.3
14.000	4.3	4.4	4.4	4.4	4.4
14.500	4.4	4.5	4.5	4.5	4.5
15.000	4.5	4.5	4.6	4.6	4.6
15.500	4.6	4.6	4.6	4.6	4.7
16.000	4.7	4.7	4.7	4.7	4.7
16.500	4.7	4.7	4.7	4.8	4.8

Revised Future Conditions

Subsection: Time-Depth Curve
Label: KCMO TR-55

Return Event: 10 years
Storm Event: 10-YEAR

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.100 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
17.000	4.8	4.8	4.8	4.8	4.8
17.500	4.8	4.8	4.9	4.9	4.9
18.000	4.9	4.9	4.9	4.9	4.9
18.500	4.9	4.9	4.9	5.0	5.0
19.000	5.0	5.0	5.0	5.0	5.0
19.500	5.0	5.0	5.0	5.0	5.0
20.000	5.0	5.1	5.1	5.1	5.1
20.500	5.1	5.1	5.1	5.1	5.1
21.000	5.1	5.1	5.1	5.1	5.1
21.500	5.1	5.2	5.2	5.2	5.2
22.000	5.2	5.2	5.2	5.2	5.2
22.500	5.2	5.2	5.2	5.2	5.2
23.000	5.2	5.2	5.3	5.3	5.3
23.500	5.3	5.3	5.3	5.3	5.3
24.000	5.3	(N/A)	(N/A)	(N/A)	(N/A)

Revised Future Conditions

Subsection: Time-Depth Curve
Label: KCMO TR-55

Return Event: 2 years
Storm Event: 2-YEAR

Time-Depth Curve: 2-YEAR

Label	2-YEAR
Start Time	0.000 hours
Increment	0.100 hours
End Time	24.000 hours
Return Event	2 years

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.100 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
0.500	0.0	0.0	0.0	0.0	0.0
1.000	0.0	0.0	0.0	0.0	0.1
1.500	0.1	0.1	0.1	0.1	0.1
2.000	0.1	0.1	0.1	0.1	0.1
2.500	0.1	0.1	0.1	0.1	0.1
3.000	0.1	0.1	0.1	0.1	0.1
3.500	0.1	0.2	0.2	0.2	0.2
4.000	0.2	0.2	0.2	0.2	0.2
4.500	0.2	0.2	0.2	0.2	0.2
5.000	0.2	0.2	0.2	0.2	0.3
5.500	0.3	0.3	0.3	0.3	0.3
6.000	0.3	0.3	0.3	0.3	0.3
6.500	0.3	0.3	0.3	0.3	0.3
7.000	0.4	0.4	0.4	0.4	0.4
7.500	0.4	0.4	0.4	0.4	0.4
8.000	0.4	0.4	0.4	0.5	0.5
8.500	0.5	0.5	0.5	0.5	0.5
9.000	0.5	0.5	0.6	0.6	0.6
9.500	0.6	0.6	0.6	0.6	0.6
10.000	0.7	0.7	0.7	0.7	0.7
10.500	0.7	0.8	0.8	0.8	0.8
11.000	0.8	0.9	0.9	0.9	1.0
11.500	1.0	1.1	1.3	1.6	2.0
12.000	2.4	2.5	2.5	2.6	2.6
12.500	2.6	2.7	2.7	2.7	2.8
13.000	2.8	2.8	2.8	2.8	2.9
13.500	2.9	2.9	2.9	2.9	2.9
14.000	3.0	3.0	3.0	3.0	3.0
14.500	3.0	3.0	3.0	3.1	3.1
15.000	3.1	3.1	3.1	3.1	3.1
15.500	3.1	3.1	3.1	3.2	3.2
16.000	3.2	3.2	3.2	3.2	3.2
16.500	3.2	3.2	3.2	3.2	3.2

Revised Future Conditions

Subsection: Time-Depth Curve
Label: KCMO TR-55

Return Event: 2 years
Storm Event: 2-YEAR

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.100 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
17.000	3.2	3.3	3.3	3.3	3.3
17.500	3.3	3.3	3.3	3.3	3.3
18.000	3.3	3.3	3.3	3.3	3.3
18.500	3.3	3.4	3.4	3.4	3.4
19.000	3.4	3.4	3.4	3.4	3.4
19.500	3.4	3.4	3.4	3.4	3.4
20.000	3.4	3.4	3.4	3.4	3.4
20.500	3.5	3.5	3.5	3.5	3.5
21.000	3.5	3.5	3.5	3.5	3.5
21.500	3.5	3.5	3.5	3.5	3.5
22.000	3.5	3.5	3.5	3.5	3.5
22.500	3.5	3.5	3.5	3.6	3.6
23.000	3.6	3.6	3.6	3.6	3.6
23.500	3.6	3.6	3.6	3.6	3.6
24.000	3.6	(N/A)	(N/A)	(N/A)	(N/A)

Revised Future Conditions

Subsection: Time of Concentration Calculations
Label: A1

Return Event: 2 years
Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.050 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.26 ft/s
Segment Time of Concentration	0.107 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	300.00 ft
Is Paved?	False
Slope	0.070 ft/ft
Average Velocity	4.27 ft/s
Segment Time of Concentration	0.020 hours

Segment #3: Length and Velocity	
Hydraulic Length	740.00 ft
Velocity	15.00 ft/s
Segment Time of Concentration	0.014 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.140 hours

Revised Future Conditions

Subsection: Time of Concentration Calculations | Return Event: 2 years
Label: A1 | Storm Event: 2-YEAR

==== User Defined Length & Velocity

Tc = (Lf / V) / 3600

Where:
Tc= Time of concentration, hours
Lf= Flow length, feet
V= Velocity, ft/sec

==== SCS Channel Flow

Tc =
R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc =
Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600

Where:
V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Revised Future Conditions

Subsection: Time of Concentration Calculations
Label: A2

Return Event: 2 years
Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.080 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.31 ft/s
Segment Time of Concentration	0.088 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	300.00 ft
Is Paved?	False
Slope	0.070 ft/ft
Average Velocity	4.27 ft/s
Segment Time of Concentration	0.020 hours

Segment #3: Length and Velocity	
Hydraulic Length	970.00 ft
Velocity	15.00 ft/s
Segment Time of Concentration	0.018 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.126 hours

Revised Future Conditions

Subsection: Time of Concentration Calculations — Return Event: 2 years
Label: A2 — Storm Event: 2-YEAR

==== User Defined Length & Velocity

Tc = (Lf / V) / 3600

Where:
Tc= Time of concentration, hours
Lf= Flow length, feet
V= Velocity, ft/sec

==== SCS Channel Flow

Tc =
R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc =
Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600

Where:
V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Revised Future Conditions

Subsection: Time of Concentration Calculations	Return Event: 2 years
Label: A3	Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	25.00 ft
Manning's n	0.150
Slope	0.030 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.16 ft/s
Segment Time of Concentration	0.043 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	90.00 ft
Is Paved?	True
Slope	0.020 ft/ft
Average Velocity	2.87 ft/s
Segment Time of Concentration	0.009 hours

Segment #3: Length and Velocity	
Hydraulic Length	880.00 ft
Velocity	15.00 ft/s
Segment Time of Concentration	0.016 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.100 hours

Revised Future Conditions

Subsection: Time of Concentration Calculations
Label: A3

Return Event: 2 years
Storm Event: 2-YEAR

==== User Defined Length & Velocity

Tc = (Lf / V) / 3600

Where:
Tc= Time of concentration, hours
Lf= Flow length, feet
V= Velocity, ft/sec

==== SCS Channel Flow

Tc =
R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc =
Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600

Where:
V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Revised Future Conditions

Subsection: Time of Concentration Calculations
Label: A3a

Return Event: 2 years
Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.050 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.26 ft/s
Segment Time of Concentration	0.107 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	300.00 ft
Is Paved?	False
Slope	0.150 ft/ft
Average Velocity	6.25 ft/s
Segment Time of Concentration	0.013 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.120 hours

Revised Future Conditions

Subsection: Time of Concentration Calculations
Label: A3a

Return Event: 2 years
Storm Event: 2-YEAR

==== SCS Channel Flow

Tc = R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc = Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600

Where:
V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Revised Future Conditions

Subsection: Time of Concentration Calculations
Label: A4

Return Event: 2 years
Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.011
Slope	0.020 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	1.46 ft/s
Segment Time of Concentration	0.019 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	300.00 ft
Is Paved?	True
Slope	0.020 ft/ft
Average Velocity	2.87 ft/s
Segment Time of Concentration	0.029 hours

Segment #3: Length and Velocity	
Hydraulic Length	4,750.00 ft
Velocity	7.00 ft/s
Segment Time of Concentration	0.188 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.237 hours

Revised Future Conditions

Subsection: Time of Concentration Calculations
Label: A4

Return Event: 2 years
Storm Event: 2-YEAR

==== User Defined Length & Velocity

Tc = (Lf / V) / 3600

Where:
Tc= Time of concentration, hours
Lf= Flow length, feet
V= Velocity, ft/sec

==== SCS Channel Flow

Tc =
R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc =
Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600

Where:
V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Revised Future Conditions

Subsection: Time of Concentration Calculations
Label: A5

Return Event: 2 years
Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.080 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.31 ft/s
Segment Time of Concentration	0.088 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	300.00 ft
Is Paved?	False
Slope	0.080 ft/ft
Average Velocity	4.56 ft/s
Segment Time of Concentration	0.018 hours

Segment #3: Length and Velocity	
Hydraulic Length	740.00 ft
Velocity	15.00 ft/s
Segment Time of Concentration	0.014 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.120 hours

==== User Defined Length & Velocity

Tc = (Lf / V) / 3600

Where:

Tc= Time of concentration, hours

Lf= Flow length, feet

V= Velocity, ft/sec

==== SCS Channel Flow

Tc =

R = Qa / Wp

V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:

R= Hydraulic radius

Aq= Flow area, square feet

Wp= Wetted perimeter, feet

V= Velocity, ft/sec

Sf= Slope, ft/ft

n= Manning's n

Tc= Time of concentration, hours

Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc =

Unpaved surface:

V = 16.1345 * (Sf**0.5)

Paved Surface:

V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600

Where:

V= Velocity, ft/sec

Sf= Slope, ft/ft

Tc= Time of concentration, hours

Lf= Flow length, feet

Revised Future Conditions

Subsection: Time of Concentration Calculations
Label: A6

Return Event: 2 years
Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.070 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.30 ft/s
Segment Time of Concentration	0.093 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	300.00 ft
Is Paved?	False
Slope	0.070 ft/ft
Average Velocity	4.27 ft/s
Segment Time of Concentration	0.020 hours

Segment #3: Length and Velocity	
Hydraulic Length	440.00 ft
Velocity	15.00 ft/s
Segment Time of Concentration	0.008 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.121 hours

Revised Future Conditions

Subsection: Time of Concentration Calculations Return Event: 2 years
Label: A6 Storm Event: 2-YEAR

==== User Defined Length & Velocity

Tc = (Lf / V) / 3600
Where: Tc= Time of concentration, hours
Lf= Flow length, feet
V= Velocity, ft/sec

==== SCS Channel Flow

Tc = R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600
Where: R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc = Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600
Where: V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Revised Future Conditions

Subsection: Time of Concentration Calculations
Label: A7

Return Event: 2 years
Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	65.00 ft
Manning's n	0.150
Slope	0.030 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.19 ft/s
Segment Time of Concentration	0.093 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	300.00 ft
Is Paved?	True
Slope	0.030 ft/ft
Average Velocity	3.52 ft/s
Segment Time of Concentration	0.024 hours

Segment #3: Length and Velocity	
Hydraulic Length	850.00 ft
Velocity	10.00 ft/s
Segment Time of Concentration	0.024 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.140 hours

==== User Defined Length & Velocity

Tc = (Lf / V) / 3600

Where:
Tc= Time of concentration, hours
Lf= Flow length, feet
V= Velocity, ft/sec

==== SCS Channel Flow

Tc =
R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc =
Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600

Where:
V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Revised Future Conditions

Subsection: Time of Concentration Calculations
Label: A7a

Return Event: 2 years
Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.120 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.37 ft/s
Segment Time of Concentration	0.075 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	220.00 ft
Is Paved?	False
Slope	0.180 ft/ft
Average Velocity	6.85 ft/s
Segment Time of Concentration	0.009 hours

Segment #3: Length and Velocity	
Hydraulic Length	220.00 ft
Velocity	7.00 ft/s
Segment Time of Concentration	0.009 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.100 hours

==== User Defined Length & Velocity

Tc = (Lf / V) / 3600

Where:
Tc= Time of concentration, hours
Lf= Flow length, feet
V= Velocity, ft/sec

==== SCS Channel Flow

Tc =
R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc =
Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600

Where:
V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Revised Future Conditions

Subsection: Time of Concentration Calculations — Return Event: 2 years
Label: A8 — Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.128 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.38 ft/s
Segment Time of Concentration	0.073 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	200.00 ft
Is Paved?	False
Slope	0.150 ft/ft
Average Velocity	6.25 ft/s
Segment Time of Concentration	0.009 hours

Segment #3: Length and Velocity	
Hydraulic Length	640.00 ft
Velocity	10.00 ft/s
Segment Time of Concentration	0.018 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.100 hours

==== User Defined Length & Velocity

Tc = (Lf / V) / 3600

Where:
Tc= Time of concentration, hours
Lf= Flow length, feet
V= Velocity, ft/sec

==== SCS Channel Flow

Tc =
R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc =
Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600

Where:
V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Revised Future Conditions

Subsection: Time of Concentration Calculations	Return Event: 2 years
Label: A9	Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.030 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.21 ft/s
Segment Time of Concentration	0.131 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	300.00 ft
Is Paved?	False
Slope	0.030 ft/ft
Average Velocity	2.79 ft/s
Segment Time of Concentration	0.030 hours

Segment #3: Length and Velocity	
Hydraulic Length	3,570.00 ft
Velocity	10.00 ft/s
Segment Time of Concentration	0.099 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.260 hours

Revised Future Conditions

Subsection: Time of Concentration Calculations
Label: A9

Return Event: 2 years
Storm Event: 2-YEAR

==== User Defined Length & Velocity

Tc = (Lf / V) / 3600

Where:
Tc= Time of concentration, hours
Lf= Flow length, feet
V= Velocity, ft/sec

==== SCS Channel Flow

Tc =
R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc =
Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600

Where:
V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Revised Future Conditions

Subsection: Time of Concentration Calculations
Label: B1

Return Event: 2 years
Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.120 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.37 ft/s
Segment Time of Concentration	0.075 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	90.00 ft
Is Paved?	False
Slope	0.080 ft/ft
Average Velocity	4.56 ft/s
Segment Time of Concentration	0.005 hours

Segment #3: Length and Velocity	
Hydraulic Length	550.00 ft
Velocity	15.00 ft/s
Segment Time of Concentration	0.010 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.100 hours

Revised Future Conditions

Subsection: Time of Concentration Calculations Return Event: 2 years
Label: B1 Storm Event: 2-YEAR

==== User Defined Length & Velocity

Tc = (Lf / V) / 3600
Where: Tc= Time of concentration, hours
Lf= Flow length, feet
V= Velocity, ft/sec

==== SCS Channel Flow

Tc = R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600
Where: R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc = Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600
Where: V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Revised Future Conditions

Subsection: Time of Concentration Calculations
Label: B1a

Return Event: 2 years
Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.120 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.37 ft/s
Segment Time of Concentration	0.075 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	190.00 ft
Is Paved?	False
Slope	0.120 ft/ft
Average Velocity	5.59 ft/s
Segment Time of Concentration	0.009 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.100 hours

Revised Future Conditions

Subsection: Time of Concentration Calculations	Return Event: 2 years
Label: B1a	Storm Event: 2-YEAR

==== SCS Channel Flow

Tc =
R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc =
Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600

Where:
V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Revised Future Conditions

Subsection: Time of Concentration Calculations
Label: C1

Return Event: 2 years
Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow

Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.020 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.18 ft/s
Segment Time of Concentration	0.154 hours

Segment #2: TR-55 Shallow Concentrated Flow

Hydraulic Length	120.00 ft
Is Paved?	False
Slope	0.020 ft/ft
Average Velocity	2.28 ft/s
Segment Time of Concentration	0.015 hours

Segment #3: Length and Velocity

Hydraulic Length	3,020.00 ft
Velocity	10.00 ft/s
Segment Time of Concentration	0.084 hours

Time of Concentration (Composite)

Time of Concentration (Composite)	0.252 hours

Revised Future Conditions

Subsection: Time of Concentration Calculations | Return Event: 2 years
Label: C1 | Storm Event: 2-YEAR

==== User Defined Length & Velocity

Tc = (Lf / V) / 3600

Where:
Tc= Time of concentration, hours
Lf= Flow length, feet
V= Velocity, ft/sec

==== SCS Channel Flow

Tc =
R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc =
Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600

Where:
V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Revised Future Conditions

Subsection: Time of Concentration Calculations
Label: C1a

Return Event: 2 years
Storm Event: 2-YEAR

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.120 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.37 ft/s
Segment Time of Concentration	0.075 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	300.00 ft
Is Paved?	False
Slope	0.120 ft/ft
Average Velocity	5.59 ft/s
Segment Time of Concentration	0.015 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.100 hours

==== SCS Channel Flow

Tc =

R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:

R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc =

Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600

Where:

V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Revised Future Conditions

Subsection: Channel Routing Summary
Label: A3-A1

Return Event: 2 years
Storm Event: 2-YEAR

Infiltration	
Infiltration Method	No Infiltration

Translation Routing Summary	
Flow (Base)	0.00 ft³/s
Translate	0.010 hours

	Inflow Hydrograph	Outflow Hydrograph
Time Start (hours)...	0.000	0.020
Time Step (hours)...	0.010	0.010
Time End (hours)...	24.000	24.020
Peak Time (hours)...	12.140	12.160
Peak Flow (ft³/s)...	454.72	454.72

Inflow/Outflow Volumes	
Volume (Routing, Inflow)	1.372 ac-ft
Volume (Routing, Unrouted)	0.000 ac-ft
Volume (Routing, Base Flow)	0.000 ac-ft
Volume (Routing, Infiltration)	0.000 ac-ft
Volume (Routing, Outflow)	1.372 ac-ft

Revised Future Conditions

Subsection: Channel Routing Summary	Return Event: 2 years
Label: A4-A1	Storm Event: 2-YEAR

Infiltration	
Infiltration Method	No Infiltration

Translation Routing Summary	
Flow (Base)	0.00 ft³/s
Translate	0.020 hours

	Inflow Hydrograph	Outflow Hydrograph
Time Start (hours)...	0.000	0.020
Time Step (hours)...	0.010	0.010
Time End (hours)...	24.000	24.020
Peak Time (hours)...	12.140	12.160
Peak Flow (ft³/s)...	454.72	454.72

Inflow/Outflow Volumes	
Volume (Routing, Inflow)	78.611 ac-ft
Volume (Routing, Unrouted)	0.000 ac-ft
Volume (Routing, Base Flow)	0.000 ac-ft
Volume (Routing, Infiltration)	0.000 ac-ft
Volume (Routing, Outflow)	78.611 ac-ft

Revised Future Conditions

Subsection:	Channel Routing Summary	Return Event:	2 years
Label:	A6-A4	Storm Event:	2-YEAR

Infiltration	
Infiltration Method	No Infiltration

Translation Routing Summary	
Flow (Base)	0.00 ft³/s
Translate	0.030 hours

	Inflow Hydrograph	Outflow Hydrograph
Time Start (hours)...	0.000	0.020
Time Step (hours)...	0.010	0.010
Time End (hours)...	24.000	24.020
Peak Time (hours)...	12.140	12.160
Peak Flow (ft³/s)...	454.72	454.72

Inflow/Outflow Volumes	
Volume (Routing, Inflow)	44.333 ac-ft
Volume (Routing, Unrouted)	0.000 ac-ft
Volume (Routing, Base Flow)	0.000 ac-ft
Volume (Routing, Infiltration)	0.000 ac-ft
Volume (Routing, Outflow)	44.333 ac-ft

Revised Future Conditions

Subsection: Channel Routing Summary	Return Event: 2 years
Label: A8-A6	Storm Event: 2-YEAR

Infiltration	
Infiltration Method	No Infiltration

Translation Routing Summary	
Flow (Base)	0.00 ft³/s
Translate	0.010 hours

	Inflow Hydrograph	Outflow Hydrograph
Time Start (hours)...	0.000	0.020
Time Step (hours)...	0.010	0.010
Time End (hours)...	24.000	24.020
Peak Time (hours)...	12.140	12.160
Peak Flow (ft³/s)...	454.72	454.72

Inflow/Outflow Volumes	
Volume (Routing, Inflow)	42.555 ac-ft
Volume (Routing, Unrouted)	0.000 ac-ft
Volume (Routing, Base Flow)	0.000 ac-ft
Volume (Routing, Infiltration)	0.000 ac-ft
Volume (Routing, Outflow)	42.555 ac-ft

Revised Future Conditions

Subsection: Channel Routing Summary	Return Event: 2 years
Label: A9-A8	Storm Event: 2-YEAR

Infiltration	
Infiltration Method	No Infiltration

Translation Routing Summary	
Flow (Base)	0.00 ft³/s
Translate	0.020 hours

	Inflow Hydrograph	Outflow Hydrograph
Time Start (hours)...	0.000	0.020
Time Step (hours)...	0.010	0.010
Time End (hours)...	24.000	24.020
Peak Time (hours)...	12.140	12.160
Peak Flow (ft³/s)...	454.72	454.72

Inflow/Outflow Volumes	
Volume (Routing, Inflow)	39.549 ac-ft
Volume (Routing, Unrouted)	0.000 ac-ft
Volume (Routing, Base Flow)	0.000 ac-ft
Volume (Routing, Infiltration)	0.000 ac-ft
Volume (Routing, Outflow)	39.549 ac-ft

Revised Future Conditions

Subsection: Elevation-Area Volume Curve
Return Event: 2 years
Label: A3
Storm Event: 2-YEAR

Elevation (ft)	Planimeter (ft²)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
920.00	0.0	0.213	0.000	0.000	0.000
930.00	0.0	0.571	1.133	3.776	3.776

Subsection: Volume Equations Return Event: 2 years
Label: A3 Storm Event: 2-YEAR

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

Volume = (1/3) * (EL2 - El1) * (Area1 + Area2 + sqr(Area1 * Area2))

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

Revised Future Conditions

Subsection: Elevation-Area Volume Curve
Label: A7

Return Event: 2 years
Storm Event: 2-YEAR

Elevation (ft)	Planimeter (ft²)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
930.00	0.0	0.167	0.000	0.000	0.000
940.00	0.0	0.562	1.035	3.451	3.451

Revised Future Conditions

Subsection: Volume Equations | Return Event: 2 years

Label: A7 | Storm Event: 2-YEAR

Pond Volume Equations

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

Volume = (1/3) * (EL2 - El1) * (Area1 + Area2 + sqr(Area1 * Area2))

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

Revised Future Conditions

Subsection: Elevation-Area Volume Curve
Label: B1

Return Event: 2 years
Storm Event: 2-YEAR

Elevation (ft)	Planimeter (ft²)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
920.00	0.0	0.145	0.000	0.000	0.000
930.00	0.0	0.427	0.821	2.736	2.736

Revised Future Conditions

Subsection: Volume Equations	Return Event: 2 years
Label: B1	Storm Event: 2-YEAR

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

Volume = (1/3) * (EL2 - El1) * (Area1 + Area2 + sqr(Area1 * Area2))

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

Revised Future Conditions

Subsection: Elevation-Area Volume Curve Return Event: 2 years

Label: C1 Storm Event: 2-YEAR

Elevation (ft)	Planimeter (ft²)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
910.00	0.0	0.000	0.000	0.000	0.000
911.00	0.0	0.014	0.015	0.005	0.005
912.00	0.0	0.035	0.071	0.024	0.029
913.00	0.0	0.073	0.159	0.053	0.082
914.00	0.0	0.134	0.306	0.102	0.184
915.00	0.0	0.206	0.506	0.169	0.353
916.00	0.0	0.288	0.738	0.246	0.599
917.00	0.0	0.415	1.050	0.350	0.949
918.00	0.0	0.575	1.479	0.493	1.441
919.00	0.0	0.754	1.987	0.662	2.104
920.00	0.0	0.949	2.549	0.850	2.953
921.00	0.0	1.158	3.156	1.052	4.005
922.00	0.0	1.367	3.783	1.261	5.266
923.00	0.0	1.575	4.408	1.469	6.736
924.00	0.0	1.803	5.063	1.688	8.423
925.00	0.0	2.057	5.786	1.929	10.352
926.00	0.0	2.337	6.587	2.196	12.548
927.00	0.0	2.652	7.478	2.493	15.040
928.00	0.0	3.001	8.473	2.824	17.864
929.00	0.0	3.370	9.551	3.184	21.048

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

Volume = (1/3) * (EL2 - El1) * (Area1 + Area2 + sqr(Area1 * Area2))

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

Revised Future Conditions

Subsection: Elevation-Area Volume Curve
Return Event: 2 years

Label: EX POND
Storm Event: 2-YEAR

Elevation (ft)	Planimeter (ft²)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
928.00	0.0	1.487	0.000	0.000	0.000
929.00	0.0	1.929	5.109	1.703	1.703
930.00	0.0	2.218	6.215	2.072	3.775
931.00	0.0	2.466	7.023	2.341	6.115
932.00	0.0	2.756	7.830	2.610	8.725
933.00	0.0	2.981	8.604	2.868	11.593
934.00	0.0	3.199	9.269	3.090	14.683
935.00	0.0	3.454	9.976	3.325	18.008

Revised Future Conditions

Subsection: Volume Equations	Return Event: 2 years
Label: EX POND	Storm Event: 2-YEAR

Pond Volume Equations

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

Volume = (1/3) * (EL2 - El1) * (Area1 + Area2 + sqr(Area1 * Area2))

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

Revised Future Conditions

Subsection: Outlet Input Data
Label: Basin A3

Return Event: 2 years
Storm Event: 2-YEAR

Requested Pond Water Surface Elevations	
Minimum (Headwater)	920.00 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	930.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Orifice-Circular	Orifice - 1	Forward	Culvert - 1	920.00	930.00
Orifice-Area	Orifice - 2	Forward	Culvert - 1	924.00	930.00
Culvert-Circular	Culvert - 1	Forward	TW	914.00	930.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

Revised Future Conditions

Subsection: Outlet Input Data	Return Event: 2 years
Label: Basin A3	Storm Event: 2-YEAR

Structure ID: Culvert - 1
Structure Type: Culvert-Circular

Number of Barrels	1
Diameter	18.0 in
Length	110.00 ft
Length (Computed Barrel)	110.02 ft
Slope (Computed)	0.018 ft/ft

Outlet Control Data

Manning's n	0.013
Ke	0.500
Kb	0.018
Kr	1.000
Convergence Tolerance	0.00 ft

Inlet Control Data

Equation Form	Form 1
K	0.0078
M	2.0000
C	0.0379
Y	0.6900
T1 ratio (HW/D)	1.127
T2 ratio (HW/D)	1.287
Slope Correction Factor	-0.500

Use unsubmerged inlet control 0 equation below T1 elevation.
Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

T1 Elevation	915.69 ft	T1 Flow	7.58 ft³/s
T2 Elevation	915.93 ft	T2 Flow	8.66 ft³/s

Revised Future Conditions

Subsection: Outlet Input Data
Label: Basin A3

Return Event: 2 years
Storm Event: 2-YEAR

Structure ID: Orifice - 1
Structure Type: Orifice-Circular

Number of Openings	1
Elevation	920.00 ft
Orifice Diameter	5.0 in
Orifice Coefficient	0.600

Structure ID: Orifice - 2
Structure Type: Orifice-Area

Number of Openings	1
Elevation	924.00 ft
Orifice Area	3.0 ft²
Top Elevation	925.00 ft
Datum Elevation	924.00 ft
Orifice Coefficient	0.600

Structure ID: TW
Structure Type: TW Setup, DS Channel

Tailwater Type	Free Outfall

Convergence Tolerances

Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft³/s
Flow Tolerance (Maximum)	10.000 ft³/s

Revised Future Conditions

Subsection: Outlet Input Data
Label: Basin A7

Return Event: 2 years
Storm Event: 2-YEAR

Requested Pond Water Surface Elevations	
Minimum (Headwater)	930.00 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	940.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Orifice-Circular	Orifice - 1	Forward	Culvert - 1	930.00	940.00
Orifice-Area	Orifice - 2	Forward	Culvert - 1	935.00	940.00
Culvert-Circular	Culvert - 1	Forward	TW	928.00	940.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

Revised Future Conditions

Subsection: Outlet Input Data
Label: Basin A7

Return Event: 2 years
Storm Event: 2-YEAR

Structure ID: Culvert - 1
Structure Type: Culvert-Circular

Number of Barrels	1
Diameter	18.0 in
Length	140.00 ft
Length (Computed Barrel)	140.01 ft
Slope (Computed)	0.014 ft/ft

Outlet Control Data

Manning's n	0.013
Ke	0.500
Kb	0.018
Kr	0.000
Convergence Tolerance	0.00 ft

Inlet Control Data

Equation Form	Form 1
K	0.0078
M	2.0000
C	0.0379
Y	0.6900
T1 ratio (HW/D)	1.129
T2 ratio (HW/D)	1.289
Slope Correction Factor	-0.500

Use unsubmerged inlet control 0 equation below T1 elevation.
Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

T1 Elevation	929.69 ft	T1 Flow	7.58 ft³/s
T2 Elevation	929.93 ft	T2 Flow	8.66 ft³/s

Revised Future Conditions

Subsection: Outlet Input Data
Label: Basin A7

Return Event: 2 years
Storm Event: 2-YEAR

Structure ID: Orifice - 1
Structure Type: Orifice-Circular

Number of Openings	1
Elevation	930.00 ft
Orifice Diameter	4.0 in
Orifice Coefficient	0.600

Structure ID: Orifice - 2
Structure Type: Orifice-Area

Number of Openings	1
Elevation	935.00 ft
Orifice Area	3.0 ft²
Top Elevation	936.00 ft
Datum Elevation	935.00 ft
Orifice Coefficient	0.600

Structure ID: TW
Structure Type: TW Setup, DS Channel

Tailwater Type	Free Outfall

Convergence Tolerances

Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft³/s
Flow Tolerance (Maximum)	10.000 ft³/s

Revised Future Conditions

Subsection: Outlet Input Data	Return Event: 2 years
Label: Basin B1	Storm Event: 2-YEAR

Requested Pond Water Surface Elevations	
Minimum (Headwater)	920.00 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	930.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Orifice-Circular	WQv Orifice 1	Forward	Culvert - 15" RCP	920.00	930.00
Orifice-Circular	WQv Orifice 2	Forward	Culvert - 15" RCP	920.33	930.00
Orifice-Circular	WQv Orifice 3	Forward	Culvert - 15" RCP	920.67	930.00
Orifice-Circular	WQv Orifice 4	Forward	Culvert - 15" RCP	921.00	930.00
Orifice-Circular	WQv Orifice 5	Forward	Culvert - 15" RCP	921.33	930.00
Orifice-Circular	WQv Orifice 6	Forward	Culvert - 15" RCP	921.66	930.00
Orifice-Circular	Secondary Orifice	Forward	Culvert - 15" RCP	925.00	930.00
Culvert-Circular	Culvert - 15" RCP	Forward	TW	918.00	930.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

Structure ID: Culvert - 15" RCP Structure Type: Culvert-Circular	
Number of Barrels	1
Diameter	15.0 in
Length	100.00 ft
Length (Computed Barrel)	100.15 ft
Slope (Computed)	0.055 ft/ft

Outlet Control Data	
Manning's n	0.013
Ke	0.500
Kb	0.023
Kr	0.000
Convergence Tolerance	0.00 ft

Inlet Control Data	
Equation Form	Form 1
K	0.0098
M	2.0000
C	0.0398
Y	0.6700
T1 ratio (HW/D)	1.133
T2 ratio (HW/D)	1.279
Slope Correction Factor	-0.500

Use unsubmerged inlet control 0 equation below T1 elevation.
Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

T1 Elevation	919.42 ft	T1 Flow	4.80 ft³/s
T2 Elevation	919.60 ft	T2 Flow	5.49 ft³/s

Revised Future Conditions

Subsection: Outlet Input Data
Label: Basin B1

Return Event: 2 years
Storm Event: 2-YEAR

Structure ID: Secondary Orifice
Structure Type: Orifice-Circular

Number of Openings	1
Elevation	925.00 ft
Orifice Diameter	12.0 in
Orifice Coefficient	0.600

Structure ID: WQv Orifice 1
Structure Type: Orifice-Circular

Number of Openings	1
Elevation	920.00 ft
Orifice Diameter	2.0 in
Orifice Coefficient	0.600

Structure ID: WQv Orifice 2
Structure Type: Orifice-Circular

Number of Openings	1
Elevation	920.33 ft
Orifice Diameter	2.0 in
Orifice Coefficient	0.600

Structure ID: WQv Orifice 3
Structure Type: Orifice-Circular

Number of Openings	1
Elevation	920.67 ft
Orifice Diameter	2.0 in
Orifice Coefficient	0.600

Structure ID: WQv Orifice 4
Structure Type: Orifice-Circular

Number of Openings	1
Elevation	921.00 ft
Orifice Diameter	2.0 in
Orifice Coefficient	0.600

Structure ID: WQv Orifice 5
Structure Type: Orifice-Circular

Number of Openings	1
Elevation	921.33 ft
Orifice Diameter	2.0 in
Orifice Coefficient	0.600

Structure ID: WQv Orifice 6

Revised Future Conditions

Subsection: Outlet Input Data	Return Event: 2 years
Label: Basin B1	Storm Event: 2-YEAR

Structure Type: Orifice-Circular

Number of Openings	1
Elevation	921.66 ft
Orifice Diameter	2.0 in
Orifice Coefficient	0.600

Structure ID: TW
Structure Type: TW Setup, DS Channel

Tailwater Type	Free Outfall

Convergence Tolerances

Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft³/s
Flow Tolerance (Maximum)	10.000 ft³/s

Revised Future Conditions

Subsection: Outlet Input Data	Return Event: 2 years
Label: Existing Pond Ogee Spillway	Storm Event: 2-YEAR

Requested Pond Water Surface Elevations	
Minimum (Headwater)	928.00 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	935.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
User Defined Table	Existing Pond Ogee Rating Table	Forward	TW	0.00	935.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

Structure ID: Existing Pond Ogee Rating Table
Structure Type: User Defined Table

Elevation (ft)	Flow (ft³/s)
928.00	0.00
929.00	0.00
930.00	94.40
931.00	266.90
932.00	490.30
933.00	754.80
934.00	1,054.90
935.00	1,386.70

Structure ID: TW
Structure Type: TW Setup, DS Channel

Tailwater Type	Free Outfall

Convergence Tolerances

Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft³/s
Flow Tolerance (Maximum)	10.000 ft³/s

Revised Future Conditions

Subsection: Outlet Input Data | Return Event: 2 years
Label: Revised Basin C1 | Storm Event: 2-YEAR

Requested Pond Water Surface Elevations	
Minimum (Headwater)	910.00 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	929.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Orifice-Area	Orifice - 3	Forward	Culvert - 1	922.25	929.00
Inlet Box	Riser - 1	Forward	Culvert - 1	924.00	929.00
Orifice-Circular	Orifice - 1	Forward	Culvert - 1	910.00	929.00
Culvert-Circular	Culvert - 1	Forward	TW	909.00	929.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

Revised Future Conditions

Subsection: Outlet Input Data	Return Event: 2 years
Label: Revised Basin C1	Storm Event: 2-YEAR

Structure ID: Culvert - 1
Structure Type: Culvert-Circular

Number of Barrels	1
Diameter	42.0 in
Length	118.00 ft
Length (Computed Barrel)	118.00 ft
Slope (Computed)	0.008 ft/ft

Outlet Control Data

Manning's n	0.013
Ke	0.200
Kb	0.006
Kr	1.000
Convergence Tolerance	0.00 ft

Inlet Control Data

Equation Form	Form 1
K	0.0045
M	2.0000
C	0.0317
Y	0.6900
T1 ratio (HW/D)	1.091
T2 ratio (HW/D)	1.193
Slope Correction Factor	-0.500

Use unsubmerged inlet control 0 equation below T1 elevation.
Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

T1 Elevation	912.82 ft	T1 Flow	63.00 ft³/s
T2 Elevation	913.18 ft	T2 Flow	72.00 ft³/s

Revised Future Conditions

Subsection: Outlet Input Data
Label: Revised Basin C1

Return Event: 2 years
Storm Event: 2-YEAR

Structure ID: Orifice - 1
Structure Type: Orifice-Circular

Number of Openings	1
Elevation	910.00 ft
Orifice Diameter	24.0 in
Orifice Coefficient	0.600

Structure ID: Riser - 1
Structure Type: Inlet Box

Number of Openings	1
Elevation	924.00 ft
Orifice Area	64.0 ft²
Orifice Coefficient	0.600
Weir Length	32.00 ft
Weir Coefficient	3.00 (ft^0.5)/s
K Reverse	1.000
Manning's n	0.000
Kev, Charged Riser	0.000
Weir Submergence	False
Orifice H to crest	False

Structure ID: Orifice - 3
Structure Type: Orifice-Area

Number of Openings	3
Elevation	922.25 ft
Orifice Area	4.5 ft²
Top Elevation	923.00 ft
Datum Elevation	922.25 ft
Orifice Coefficient	0.600

Structure ID: TW
Structure Type: TW Setup, DS Channel

Tailwater Type	Free Outfall

Convergence Tolerances

Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft

Revised Future Conditions

Subsection: Outlet Input Data
Label: Revised Basin C1

Return Event: 2 years
Storm Event: 2-YEAR

Convergence Tolerances	
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft³/s
Flow Tolerance (Maximum)	10.000 ft³/s

APPENDIX K

Basin C1 0.5PMP Analysis

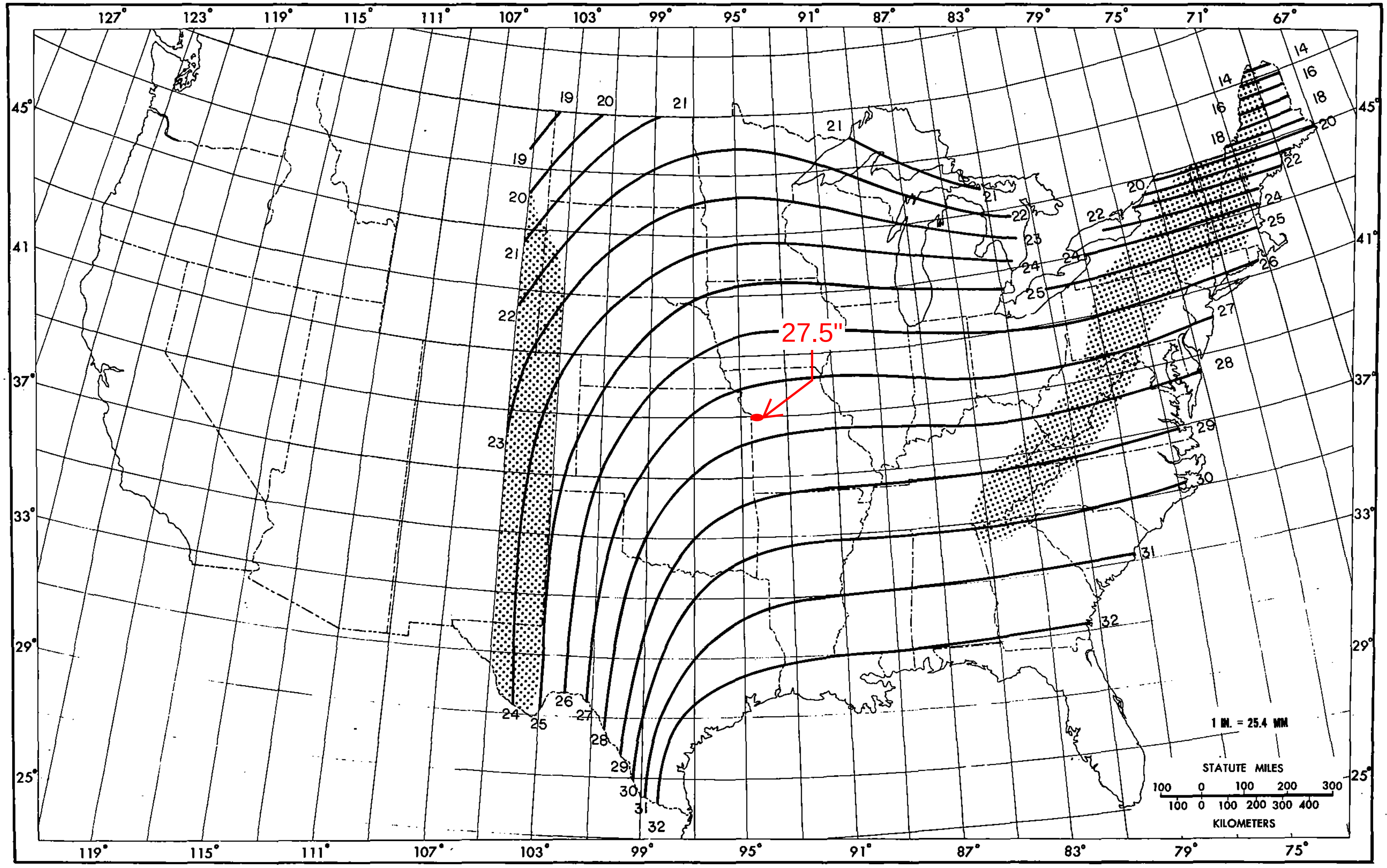


Figure 18.--All-season PMP (in.) for 6 hr 10 mi^2 (26 km^2).

0.5PMP Specified Hyetograph

PMP Depth (6-Hour)	27.5	inches
0.5 PMP	13.75	inches

time (hours)	type II 24-hour	type II 6-hour	type II 12-hour	type II 18-hour
0.0	0.00000	0.00000	0.00000	0.00000
0.1	0.00101	0.00446	0.00215	0.00137
0.2	0.00202	0.00899	0.00433	0.00275
0.3	0.00305	0.01352	0.00653	0.00414
0.4	0.00408	0.01804	0.00875	0.00555
0.5	0.00513	0.02257	0.01100	0.00695
0.6	0.00618	0.02710	0.01327	0.00838
0.7	0.00725	0.03174	0.01556	0.00981
0.8	0.00832	0.03661	0.01788	0.01126
0.9	0.00941	0.04171	0.02023	0.01272
1.0	0.01050	0.04703	0.02259	0.01419
1.1	0.01161	0.05257	0.02498	0.01566
1.2	0.01272	0.05840	0.02740	0.01716
1.3	0.01385	0.06458	0.02983	0.01865
1.4	0.01498	0.07108	0.03229	0.02016
1.5	0.01613	0.07793	0.03478	0.02170
1.6	0.01728	0.08512	0.03729	0.02326
1.7	0.01845	0.09277	0.03982	0.02484
1.8	0.01962	0.10097	0.04238	0.02644
1.9	0.02081	0.10975	0.04496	0.02807
2.0	0.02200	0.11909	0.04756	0.02971
2.1	0.02321	0.12899	0.05024	0.03138
2.2	0.02442	0.13986	0.05303	0.03306
2.3	0.02565	0.15209	0.05595	0.03477
2.4	0.02688	0.16568	0.05898	0.03650
2.5	0.02813	0.18062	0.06213	0.03826
2.6	0.02938	0.19692	0.06540	0.04003
2.7	0.03065	0.23066	0.06879	0.04182
2.8	0.03192	0.29791	0.07229	0.04364
2.9	0.03321	0.40607	0.07592	0.04548
3.0	0.03450	0.60005	0.07967	0.04734
3.1	0.03581	0.73469	0.08347	0.04922
3.2	0.03712	0.76153	0.08728	0.05112
3.3	0.03845	0.78513	0.09108	0.05305
3.4	0.03978	0.80551	0.09489	0.05499
3.5	0.04113	0.82266	0.09869	0.05696
3.6	0.04248	0.83659	0.10259	0.05895
3.7	0.04385	0.84853	0.10668	0.06096
3.8	0.04522	0.85974	0.11096	0.06299
3.9	0.04661	0.87021	0.11543	0.06504
4.0	0.04800	0.87995	0.12010	0.06712
4.1	0.04941	0.88895	0.12499	0.06921
4.2	0.05084	0.89738	0.13018	0.07133
4.3	0.05229	0.90542	0.13565	0.07347
4.4	0.05376	0.91307	0.14140	0.07563
4.5	0.05525	0.92031	0.14744	0.07781

time (mins)	Type II 6-hour
0	0.00
6	0.06
12	0.12
18	0.19
24	0.25
30	0.31
36	0.37
42	0.44
48	0.50
54	0.57
60	0.65
66	0.72
72	0.80
78	0.89
84	0.98
90	1.07
96	1.17
102	1.28
108	1.39
114	1.51
120	1.64
126	1.77
132	1.92
138	2.09
144	2.28
150	2.48
156	2.71
162	3.17
168	4.10
174	5.58
180	8.25
186	10.10
192	10.47
198	10.80
204	11.08
210	11.31
216	11.50
222	11.67
228	11.82
234	11.97
240	12.10
246	12.22
252	12.34
258	12.45
264	12.55
270	12.65

0.5PMP Specified Hyetograph

PMP Depth (6-Hour)	27.5	inches
0.5 PMP	13.75	inches

time (hours)	type II 24-hour	type II 6-hour	type II 12-hour	type II 18-hour
4.6	0.05676	0.92716	0.15386	0.08001
4.7	0.05829	0.93367	0.16076	0.08224
4.8	0.05984	0.93990	0.16813	0.08449
4.9	0.06141	0.94584	0.17598	0.08675
5.0	0.06300	0.95150	0.18430	0.08904
5.1	0.06461	0.95688	0.19344	0.09135
5.2	0.06624	0.96207	0.20371	0.09369
5.3	0.06789	0.96715	0.21512	0.09604
5.4	0.06956	0.97215	0.22768	0.09846
5.5	0.07125	0.97703	0.24138	0.10099
5.6	0.07296	0.98183	0.26973	0.10362
5.7	0.07469	0.98651	0.32623	0.10636
5.8	0.07644	0.99111	0.41711	0.10921
5.9	0.07821	0.99560	0.58010	0.11216
6.0	0.08000	1.00000	0.69322	0.11523
6.1	0.08181		0.71577	0.11840
6.2	0.08364		0.73560	0.12168
6.3	0.08549		0.75272	0.12506
6.4	0.08736		0.76713	0.12850
6.5	0.08925		0.77883	0.13194
6.6	0.09116		0.78887	0.13538
6.7	0.09309		0.79829	0.13882
6.8	0.09504		0.80709	0.14226
6.9	0.09701		0.81527	0.14579
7.0	0.09900		0.82283	0.14948
7.1	0.10101		0.82992	0.15335
7.2	0.10304		0.83667	0.15740
7.3	0.10509		0.84309	0.16161
7.4	0.10716		0.84918	0.16604
7.5	0.10925		0.85493	0.17072
7.6	0.11136		0.86040	0.17567
7.7	0.11349		0.86564	0.18087
7.8	0.11564		0.87063	0.18633
7.9	0.11781		0.87539	0.19214
8.0	0.12000		0.87990	0.19837
8.1	0.12225		0.88427	0.20503
8.2	0.12460		0.88854	0.21213
8.3	0.12705		0.89273	0.21965
8.4	0.12960		0.89684	0.22791
8.5	0.13225		0.90087	0.23720
8.6	0.13500		0.90480	0.24751
8.7	0.13785		0.90867	0.25887
8.8	0.14080		0.91244	0.27125
8.9	0.14385		0.91614	0.29687
9.0	0.14700		0.91974	0.34795
9.1	0.15020		0.92327	0.43011

time (mins)	Type II 6-hour
276	12.75
282	12.84
288	12.92
294	13.01
300	13.08
306	13.16
312	13.23
318	13.30
324	13.37
330	13.43
336	13.50
342	13.56
348	13.63
354	13.69
360	13.75

0.5PMP Specified Hyetograph

PMP Depth (6-Hour)	27.5	inches
0.5 PMP	13.75	inches

time (hours)	type II 24-hour	type II 6-hour	type II 12-hour	type II 18-hour
9.2	0.15340		0.92671	0.57744
9.3	0.15660		0.93007	0.67971
9.4	0.15980		0.93334	0.70008
9.5	0.16300		0.93654	0.71801
9.6	0.16628		0.93964	0.73349
9.7	0.16972		0.94268	0.74652
9.8	0.17332		0.94561	0.75710
9.9	0.17708		0.94848	0.76617
10.0	0.18100		0.95125	0.77468
10.1	0.18512		0.95397	0.78264
10.2	0.18948		0.95666	0.79003
10.3	0.19408		0.95932	0.79687
10.4	0.19892		0.96195	0.80327
10.5	0.20400		0.96455	0.80938
10.6	0.20940		0.96712	0.81518
10.7	0.21520		0.96967	0.82069
10.8	0.22140		0.97218	0.82589
10.9	0.22800		0.97466	0.83083
11.0	0.23500		0.97711	0.83556
11.1	0.24268		0.97954	0.84008
11.2	0.25132		0.98193	0.84438
11.3	0.26092		0.98429	0.84846
11.4	0.27148		0.98662	0.85241
11.5	0.28300		0.98893	0.85627
11.6	0.30684		0.99120	0.86006
11.7	0.35436		0.99345	0.86377
11.8	0.43079		0.99566	0.86741
11.9	0.56786		0.99785	0.87097
12.0	0.66300		1.00000	0.87446
12.1	0.68196			0.87787
12.2	0.69864			0.88121
12.3	0.71304			0.88447
12.4	0.72516			0.88766
12.5	0.73500			0.89077
12.6	0.74344			0.89381
12.7	0.75136			0.89677
12.8	0.75876			0.89966
12.9	0.76564			0.90246
13.0	0.77200			0.90521
13.1	0.77796			0.90786
13.2	0.78364			0.91045
13.3	0.78904			0.91296
13.4	0.79416			0.91542
13.5	0.79900			0.91785
13.6	0.80360			0.92025
13.7	0.80800			0.92263

time (mins)	Type II 6-hour

0.5PMP Specified Hyetograph

PMP Depth (6-Hour)	27.5	inches
0.5 PMP	13.75	inches

time (hours)	type II 24-hour	type II 6-hour	type II 12-hour	type II 18-hour
13.8	0.81220			0.92498
13.9	0.81620			0.92731
14.0	0.82000			0.92961
14.1	0.82367			0.93187
14.2	0.82726			0.93412
14.3	0.83079			0.93633
14.4	0.83424			0.93853
14.5	0.83763			0.94069
14.6	0.84094			0.94283
14.7	0.84419			0.94493
14.8	0.84736			0.94702
14.9	0.85047			0.94907
15.0	0.85350			0.95110
15.1	0.85647			0.95310
15.2	0.85936			0.95508
15.3	0.86219			0.95703
15.4	0.86494			0.95895
15.5	0.86763			0.96084
15.6	0.87024			0.96271
15.7	0.87279			0.96455
15.8	0.87526			0.96637
15.9	0.87767			0.96815
16.0	0.88000			0.96991
16.1	0.88229			0.97164
16.2	0.88455			0.97335
16.3	0.88679			0.97503
16.4	0.88900			0.97669
16.5	0.89119			0.97831
16.6	0.89335			0.97991
16.7	0.89549			0.98148
16.8	0.89760			0.98303
16.9	0.89969			0.98454
17.0	0.90175			0.98604
17.1	0.90379			0.98750
17.2	0.90580			0.98894
17.3	0.90779			0.99035
17.4	0.90975			0.99174
17.5	0.91169			0.99313
17.6	0.91360			0.99452
17.7	0.91549			0.99589
17.8	0.91735			0.99727
17.9	0.91919			0.99863
18.0	0.92100			1.00000
18.1	0.92279			
18.2	0.92455			
18.3	0.92629			

time (mins)	Type II 6-hour

0.5PMP Specified Hyetograph

PMP Depth (6-Hour)	27.5	inches
0.5 PMP	13.75	inches

time (hours)	type II 24-hour	type II 6-hour	type II 12-hour	type II 18-hour
18.4	0.92800			
18.5	0.92969			
18.6	0.93135			
18.7	0.93299			
18.8	0.93460			
18.9	0.93619			
19.0	0.93775			
19.1	0.93929			
19.2	0.94080			
19.3	0.94229			
19.4	0.94375			
19.5	0.94519			
19.6	0.94660			
19.7	0.94799			
19.8	0.94935			
19.9	0.95069			
20.0	0.95200			
20.1	0.95330			
20.2	0.95459			
20.3	0.95588			
20.4	0.95716			
20.5	0.95844			
20.6	0.95971			
20.7	0.96098			
20.8	0.96224			
20.9	0.96350			
21.0	0.96475			
21.1	0.96600			
21.2	0.96724			
21.3	0.96848			
21.4	0.96971			
21.5	0.97094			
21.6	0.97216			
21.7	0.97338			
21.8	0.97459			
21.9	0.97580			
22.0	0.97700			
22.1	0.97820			
22.2	0.97939			
22.3	0.98058			
22.4	0.98176			
22.5	0.98294			
22.6	0.98411			
22.7	0.98528			
22.8	0.98644			
22.9	0.98760			

time (mins)	Type II 6-hour

0.5PMP Specified Hyetograph

PMP Depth (6-Hour)	27.5	inches
0.5 PMP	13.75	inches

time (hours)	type II 24-hour	type II 6-hour	type II 12-hour	type II 18-hour
23.0	0.98875			
23.1	0.98990			
23.2	0.99104			
23.3	0.99218			
23.4	0.99331			
23.5	0.99444			
23.6	0.99556			
23.7	0.99668			
23.8	0.99779			
23.9	0.99890			
24.0	1.0000			

time (mins)	Type II 6-hour

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Project Summary

Title	Woodside Ridge - 0.5PMP Analysis
Engineer	JJL
Company	Olsson
Date	5/9/2019

Notes	Revised to represent new top of dam and spillway grading.

Table of Contents

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Time vs. Elevation
Label: C1 (OUT)
Scenario: 6-HR PMP

Return Event: 10,000 years
Storm Event: 6-Hr PMP

Time vs. Elevation (ft)

Output Time increment = 0.010 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
0.000	910.00	910.00	910.00	910.00	910.00
0.050	910.00	910.00	910.00	910.00	910.00
0.100	910.00	910.00	910.00	910.00	910.00
0.150	910.00	910.00	910.00	910.00	910.00
0.200	910.00	910.00	910.00	910.00	910.00
0.250	910.00	910.00	910.00	910.00	910.00
0.300	910.00	910.00	910.00	910.00	910.00
0.350	910.00	910.00	910.00	910.00	910.00
0.400	910.00	910.00	910.00	910.00	910.00
0.450	910.00	910.00	910.00	910.01	910.01
0.500	910.02	910.03	910.04	910.06	910.08
0.550	910.11	910.15	910.18	910.23	910.29
0.600	910.35	910.41	910.49	910.52	910.54
0.650	910.57	910.60	910.64	910.68	910.73
0.700	910.77	910.82	910.87	910.92	910.97
0.750	911.01	911.04	911.07	911.10	911.14
0.800	911.17	911.21	911.24	911.27	911.31
0.850	911.34	911.37	911.41	911.44	911.48
0.900	911.51	911.53	911.56	911.58	911.61
0.950	911.64	911.67	911.70	911.74	911.77
1.000	911.80	911.84	911.88	911.91	911.95
1.050	911.99	912.02	912.05	912.08	912.12
1.100	912.15	912.19	912.23	912.28	912.32
1.150	912.36	912.40	912.45	912.49	912.52
1.200	912.56	912.59	912.63	912.67	912.72
1.250	912.76	912.81	912.86	912.91	912.97
1.300	913.02	913.07	913.12	913.17	913.22
1.350	913.28	913.34	913.40	913.47	913.53
1.400	913.58	913.63	913.69	913.74	913.80
1.450	913.86	913.93	913.99	914.04	914.09
1.500	914.14	914.20	914.25	914.30	914.36
1.550	914.42	914.47	914.53	914.57	914.62
1.600	914.68	914.73	914.78	914.84	914.89
1.650	914.95	915.01	915.06	915.11	915.16
1.700	915.22	915.28	915.33	915.39	915.46
1.750	915.52	915.57	915.63	915.68	915.74
1.800	915.80	915.86	915.92	915.99	916.04
1.850	916.09	916.15	916.21	916.26	916.32
1.900	916.38	916.44	916.50	916.55	916.60
1.950	916.66	916.71	916.77	916.82	916.88

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Time vs. Elevation	Return Event: 10,000 years
Label: C1 (OUT)	Storm Event: 6-Hr PMP
Scenario: 6-HR PMP	

Time vs. Elevation (ft)

Output Time increment = 0.010 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
2.000	916.94	917.00	917.05	917.10	917.16
2.050	917.21	917.27	917.32	917.38	917.44
2.100	917.50	917.55	917.60	917.65	917.70
2.150	917.75	917.81	917.86	917.92	917.98
2.200	918.03	918.08	918.13	918.18	918.23
2.250	918.29	918.34	918.40	918.46	918.52
2.300	918.57	918.62	918.68	918.74	918.79
2.350	918.85	918.91	918.98	919.03	919.09
2.400	919.15	919.21	919.27	919.33	919.40
2.450	919.46	919.52	919.58	919.65	919.71
2.500	919.77	919.83	919.90	919.97	920.03
2.550	920.09	920.15	920.22	920.28	920.35
2.600	920.41	920.48	920.55	920.61	920.68
2.650	920.75	920.82	920.89	920.97	921.05
2.700	921.13	921.21	921.30	921.40	921.50
2.750	921.61	921.72	921.83	921.96	922.10
2.800	922.24	922.38	922.53	922.68	922.83
2.850	923.00	923.16	923.33	923.51	923.69
2.900	923.89	924.09	924.29	924.50	924.71
2.950	924.93	925.15	925.39	925.63	925.88
3.000	926.14	926.41	926.68	926.94	927.17
3.050	927.38	927.57	927.73	927.86	927.99
3.100	928.09	928.17	928.24	928.30	928.35
3.150	928.38	928.41	928.43	928.43	928.43
3.200	928.42	928.40	928.37	928.33	928.29
3.250	928.25	928.20	928.15	928.10	928.04
3.300	927.99	927.93	927.87	927.81	927.75
3.350	927.69	927.64	927.59	927.54	927.49
3.400	927.44	927.39	927.35	927.31	927.27
3.450	927.23	927.19	927.15	927.12	927.09
3.500	927.06	927.03	927.01	926.98	926.95
3.550	926.92	926.90	926.87	926.84	926.82
3.600	926.79	926.77	926.74	926.72	926.69
3.650	926.67	926.65	926.63	926.61	926.59
3.700	926.57	926.55	926.53	926.51	926.50
3.750	926.48	926.46	926.44	926.42	926.39
3.800	926.37	926.35	926.32	926.30	926.27
3.850	926.25	926.22	926.19	926.16	926.14
3.900	926.11	926.08	926.05	926.02	925.99
3.950	925.96	925.93	925.89	925.86	925.83
4.000	925.80	925.76	925.73	925.69	925.66

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Time vs. Elevation
Label: C1 (OUT)
Scenario: 6-HR PMP

Return Event: 10,000 years
Storm Event: 6-Hr PMP

Time vs. Elevation (ft)

Output Time increment = 0.010 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
4.050	925.63	925.59	925.56	925.52	925.48
4.100	925.45	925.41	925.37	925.33	925.30
4.150	925.26	925.22	925.18	925.15	925.11
4.200	925.07	925.03	925.00	924.96	924.92
4.250	924.88	924.85	924.81	924.77	924.74
4.300	924.70	924.67	924.64	924.60	924.57
4.350	924.54	924.51	924.48	924.44	924.41
4.400	924.38	924.35	924.32	924.29	924.26
4.450	924.24	924.21	924.18	924.16	924.13
4.500	924.11	924.08	924.06	924.04	924.02
4.550	923.99	923.97	923.95	923.93	923.90
4.600	923.88	923.86	923.84	923.81	923.79
4.650	923.77	923.75	923.73	923.71	923.69
4.700	923.66	923.64	923.62	923.60	923.58
4.750	923.56	923.54	923.52	923.50	923.48
4.800	923.45	923.43	923.41	923.39	923.37
4.850	923.34	923.32	923.30	923.28	923.26
4.900	923.24	923.22	923.20	923.18	923.16
4.950	923.14	923.12	923.10	923.08	923.06
5.000	923.04	923.02	923.00	922.98	922.96
5.050	922.94	922.93	922.91	922.89	922.87
5.100	922.86	922.84	922.82	922.81	922.79
5.150	922.78	922.77	922.75	922.74	922.73
5.200	922.71	922.70	922.69	922.68	922.67
5.250	922.66	922.65	922.64	922.63	922.62
5.300	922.61	922.60	922.59	922.58	922.57
5.350	922.56	922.55	922.55	922.54	922.53
5.400	922.52	922.52	922.51	922.50	922.49
5.450	922.49	922.48	922.47	922.47	922.46
5.500	922.46	922.45	922.44	922.44	922.43
5.550	922.43	922.42	922.42	922.41	922.40
5.600	922.40	922.39	922.39	922.39	922.38
5.650	922.38	922.37	922.37	922.37	922.36
5.700	922.36	922.35	922.35	922.35	922.34
5.750	922.34	922.34	922.34	922.33	922.33
5.800	922.33	922.32	922.32	922.32	922.32
5.850	922.32	922.31	922.31	922.31	922.31
5.900	922.31	922.31	922.30	922.30	922.30
5.950	922.30	922.30	922.30	922.29	922.29
6.000	922.29	922.29	922.29	922.28	922.28
6.050	922.28	922.28	922.27	922.27	922.26

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Time vs. Elevation | Return Event: 10,000 years
Label: C1 (OUT) | Storm Event: 6-Hr PMP
Scenario: 6-HR PMP

Time vs. Elevation (ft)

Output Time increment = 0.010 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
6.100	922.26	922.25	922.24	922.24	922.23
6.150	922.22	922.20	922.19	922.18	922.16
6.200	922.15	922.13	922.11	922.09	922.07
6.250	922.05	922.03	922.01	921.98	921.96
6.300	921.93	921.91	921.88	921.86	921.83
6.350	921.80	921.78	921.75	921.72	921.70
6.400	921.67	921.64	921.61	921.58	921.56
6.450	921.53	921.50	921.47	921.44	921.41
6.500	921.38	921.35	921.31	921.28	921.25
6.550	921.22	921.19	921.16	921.13	921.10
6.600	921.07	921.04	921.01	920.97	920.94
6.650	920.91	920.87	920.84	920.81	920.77
6.700	920.74	920.71	920.67	920.64	920.61
6.750	920.57	920.54	920.51	920.47	920.43
6.800	920.40	920.36	920.33	920.29	920.25
6.850	920.22	920.18	920.15	920.11	920.08
6.900	920.04	920.00	919.96	919.93	919.89
6.950	919.85	919.81	919.77	919.73	919.69
7.000	919.65	919.61	919.58	919.54	919.50
7.050	919.46	919.41	919.37	919.33	919.28
7.100	919.24	919.20	919.16	919.12	919.07
7.150	919.03	918.99	918.94	918.89	918.85
7.200	918.80	918.75	918.71	918.66	918.62
7.250	918.57	918.52	918.47	918.42	918.37
7.300	918.32	918.27	918.22	918.16	918.11
7.350	918.06	918.01	917.95	917.90	917.84
7.400	917.78	917.72	917.66	917.61	917.55
7.450	917.49	917.43	917.36	917.29	917.23
7.500	917.16	917.10	917.03	916.96	916.89
7.550	916.81	916.74	916.66	916.59	916.52
7.600	916.43	916.35	916.26	916.18	916.09
7.650	916.01	915.91	915.81	915.71	915.62
7.700	915.52	915.41	915.30	915.19	915.08
7.750	914.97	914.85	914.72	914.60	914.47
7.800	914.32	914.18	914.04	913.87	913.69
7.850	913.52	913.31	913.10	912.86	912.59
7.900	912.28	911.96	911.59	911.25	910.98
7.950	910.64	910.37	910.02	910.00	910.00
8.000	910.00	910.00	910.00	910.00	910.00
8.050	910.00	910.00	910.00	910.00	910.00
8.100	910.00	910.00	910.00	910.00	910.00

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Time vs. Elevation
Label: C1 (OUT)
Scenario: 6-HR PMP

Return Event: 10,000 years
Storm Event: 6-Hr PMP

Time vs. Elevation (ft)

Output Time increment = 0.010 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
8.150	910.00	910.00	910.00	910.00	910.00
8.200	910.00	910.00	910.00	910.00	910.00
8.250	910.00	910.00	910.00	910.00	910.00
8.300	910.00	910.00	910.00	910.00	910.00
8.350	910.00	910.00	910.00	910.00	910.00
8.400	910.00	910.00	910.00	910.00	910.00
8.450	910.00	910.00	910.00	910.00	910.00
8.500	910.00	910.00	910.00	910.00	910.00
8.550	910.00	910.00	910.00	910.00	910.00
8.600	910.00	910.00	910.00	910.00	910.00
8.650	910.00	910.00	910.00	910.00	910.00
8.700	910.00	910.00	910.00	910.00	910.00
8.750	910.00	910.00	910.00	910.00	910.00
8.800	910.00	910.00	910.00	910.00	910.00
8.850	910.00	910.00	910.00	910.00	910.00
8.900	910.00	910.00	910.00	910.00	910.00
8.950	910.00	910.00	910.00	910.00	910.00
9.000	910.00	910.00	910.00	910.00	910.00
9.050	910.00	910.00	910.00	910.00	910.00
9.100	910.00	910.00	910.00	910.00	910.00
9.150	910.00	910.00	910.00	910.00	910.00
9.200	910.00	910.00	910.00	910.00	910.00
9.250	910.00	910.00	910.00	910.00	910.00
9.300	910.00	910.00	910.00	910.00	910.00
9.350	910.00	910.00	910.00	910.00	910.00
9.400	910.00	910.00	910.00	910.00	910.00
9.450	910.00	910.00	910.00	910.00	910.00
9.500	910.00	910.00	910.00	910.00	910.00
9.550	910.00	910.00	910.00	910.00	910.00
9.600	910.00	910.00	910.00	910.00	910.00
9.650	910.00	910.00	910.00	910.00	910.00
9.700	910.00	910.00	910.00	910.00	910.00
9.750	910.00	910.00	910.00	910.00	910.00
9.800	910.00	910.00	910.00	910.00	910.00
9.850	910.00	910.00	910.00	910.00	910.00
9.900	910.00	910.00	910.00	910.00	910.00
9.950	910.00	910.00	910.00	910.00	910.00
10.000	910.00	910.00	910.00	910.00	910.00
10.050	910.00	910.00	910.00	910.00	910.00
10.100	910.00	910.00	910.00	910.00	910.00
10.150	910.00	910.00	910.00	910.00	910.00

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Time vs. Elevation Return Event: 10,000 years
Label: C1 (OUT) Storm Event: 6-Hr PMP
Scenario: 6-HR PMP

Time vs. Elevation (ft)

Output Time increment = 0.010 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
10.200	910.00	910.00	910.00	910.00	910.00
10.250	910.00	910.00	910.00	910.00	910.00
10.300	910.00	910.00	910.00	910.00	910.00
10.350	910.00	910.00	910.00	910.00	910.00
10.400	910.00	910.00	910.00	910.00	910.00
10.450	910.00	910.00	910.00	910.00	910.00
10.500	910.00	910.00	910.00	910.00	910.00
10.550	910.00	910.00	910.00	910.00	910.00
10.600	910.00	910.00	910.00	910.00	910.00
10.650	910.00	910.00	910.00	910.00	910.00
10.700	910.00	910.00	910.00	910.00	910.00
10.750	910.00	910.00	910.00	910.00	910.00
10.800	910.00	910.00	910.00	910.00	910.00
10.850	910.00	910.00	910.00	910.00	910.00
10.900	910.00	910.00	910.00	910.00	910.00
10.950	910.00	910.00	910.00	910.00	910.00
11.000	910.00	910.00	910.00	910.00	910.00
11.050	910.00	910.00	910.00	910.00	910.00
11.100	910.00	910.00	910.00	910.00	910.00
11.150	910.00	910.00	910.00	910.00	910.00
11.200	910.00	910.00	910.00	910.00	910.00
11.250	910.00	910.00	910.00	910.00	910.00
11.300	910.00	910.00	910.00	910.00	910.00
11.350	910.00	910.00	910.00	910.00	910.00
11.400	910.00	910.00	910.00	910.00	910.00
11.450	910.00	910.00	910.00	910.00	910.00
11.500	910.00	910.00	910.00	910.00	910.00
11.550	910.00	910.00	910.00	910.00	910.00
11.600	910.00	910.00	910.00	910.00	910.00
11.650	910.00	910.00	910.00	910.00	910.00
11.700	910.00	910.00	910.00	910.00	910.00
11.750	910.00	910.00	910.00	910.00	910.00
11.800	910.00	910.00	910.00	910.00	910.00
11.850	910.00	910.00	910.00	910.00	910.00
11.900	910.00	910.00	910.00	910.00	910.00
11.950	910.00	910.00	910.00	910.00	910.00
12.000	910.00	910.00	910.00	910.00	910.00
12.050	910.00	910.00	910.00	910.00	910.00
12.100	910.00	910.00	910.00	910.00	910.00
12.150	910.00	910.00	910.00	910.00	910.00
12.200	910.00	910.00	910.00	910.00	910.00

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Time vs. Elevation
Label: C1 (OUT)
Scenario: 6-HR PMP

Return Event: 10,000 years
Storm Event: 6-Hr PMP

Time vs. Elevation (ft)

Output Time increment = 0.010 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
12.250	910.00	910.00	910.00	910.00	910.00
12.300	910.00	910.00	910.00	910.00	910.00
12.350	910.00	910.00	910.00	910.00	910.00
12.400	910.00	910.00	910.00	910.00	910.00
12.450	910.00	910.00	910.00	910.00	910.00
12.500	910.00	910.00	910.00	910.00	910.00
12.550	910.00	910.00	910.00	910.00	910.00
12.600	910.00	910.00	910.00	910.00	910.00
12.650	910.00	910.00	910.00	910.00	910.00
12.700	910.00	910.00	910.00	910.00	910.00
12.750	910.00	910.00	910.00	910.00	910.00
12.800	910.00	910.00	910.00	910.00	910.00
12.850	910.00	910.00	910.00	910.00	910.00
12.900	910.00	910.00	910.00	910.00	910.00
12.950	910.00	910.00	910.00	910.00	910.00
13.000	910.00	910.00	910.00	910.00	910.00
13.050	910.00	910.00	910.00	910.00	910.00
13.100	910.00	910.00	910.00	910.00	910.00
13.150	910.00	910.00	910.00	910.00	910.00
13.200	910.00	910.00	910.00	910.00	910.00
13.250	910.00	910.00	910.00	910.00	910.00
13.300	910.00	910.00	910.00	910.00	910.00
13.350	910.00	910.00	910.00	910.00	910.00
13.400	910.00	910.00	910.00	910.00	910.00
13.450	910.00	910.00	910.00	910.00	910.00
13.500	910.00	910.00	910.00	910.00	910.00
13.550	910.00	910.00	910.00	910.00	910.00
13.600	910.00	910.00	910.00	910.00	910.00
13.650	910.00	910.00	910.00	910.00	910.00
13.700	910.00	910.00	910.00	910.00	910.00
13.750	910.00	910.00	910.00	910.00	910.00
13.800	910.00	910.00	910.00	910.00	910.00
13.850	910.00	910.00	910.00	910.00	910.00
13.900	910.00	910.00	910.00	910.00	910.00
13.950	910.00	910.00	910.00	910.00	910.00
14.000	910.00	910.00	910.00	910.00	910.00
14.050	910.00	910.00	910.00	910.00	910.00
14.100	910.00	910.00	910.00	910.00	910.00
14.150	910.00	910.00	910.00	910.00	910.00
14.200	910.00	910.00	910.00	910.00	910.00
14.250	910.00	910.00	910.00	910.00	910.00

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Time vs. Elevation　Return Event: 10,000 years
Label: C1 (OUT)　Storm Event: 6-Hr PMP
Scenario: 6-HR PMP

Time vs. Elevation (ft)

Output Time increment = 0.010 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
14.300	910.00	910.00	910.00	910.00	910.00
14.350	910.00	910.00	910.00	910.00	910.00
14.400	910.00	910.00	910.00	910.00	910.00
14.450	910.00	910.00	910.00	910.00	910.00
14.500	910.00	910.00	910.00	910.00	910.00
14.550	910.00	910.00	910.00	910.00	910.00
14.600	910.00	910.00	910.00	910.00	910.00
14.650	910.00	910.00	910.00	910.00	910.00
14.700	910.00	910.00	910.00	910.00	910.00
14.750	910.00	910.00	910.00	910.00	910.00
14.800	910.00	910.00	910.00	910.00	910.00
14.850	910.00	910.00	910.00	910.00	910.00
14.900	910.00	910.00	910.00	910.00	910.00
14.950	910.00	910.00	910.00	910.00	910.00
15.000	910.00	910.00	910.00	910.00	910.00
15.050	910.00	910.00	910.00	910.00	910.00
15.100	910.00	910.00	910.00	910.00	910.00
15.150	910.00	910.00	910.00	910.00	910.00
15.200	910.00	910.00	910.00	910.00	910.00
15.250	910.00	910.00	910.00	910.00	910.00
15.300	910.00	910.00	910.00	910.00	910.00
15.350	910.00	910.00	910.00	910.00	910.00
15.400	910.00	910.00	910.00	910.00	910.00
15.450	910.00	910.00	910.00	910.00	910.00
15.500	910.00	910.00	910.00	910.00	910.00
15.550	910.00	910.00	910.00	910.00	910.00
15.600	910.00	910.00	910.00	910.00	910.00
15.650	910.00	910.00	910.00	910.00	910.00
15.700	910.00	910.00	910.00	910.00	910.00
15.750	910.00	910.00	910.00	910.00	910.00
15.800	910.00	910.00	910.00	910.00	910.00
15.850	910.00	910.00	910.00	910.00	910.00
15.900	910.00	910.00	910.00	910.00	910.00
15.950	910.00	910.00	910.00	910.00	910.00
16.000	910.00	910.00	910.00	910.00	910.00
16.050	910.00	910.00	910.00	910.00	910.00
16.100	910.00	910.00	910.00	910.00	910.00
16.150	910.00	910.00	910.00	910.00	910.00
16.200	910.00	910.00	910.00	910.00	910.00
16.250	910.00	910.00	910.00	910.00	910.00
16.300	910.00	910.00	910.00	910.00	910.00

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Time vs. Elevation | Return Event: 10,000 years
Label: C1 (OUT) | Storm Event: 6-Hr PMP
Scenario: 6-HR PMP

Time vs. Elevation (ft)

Output Time increment = 0.010 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
16.350	910.00	910.00	910.00	910.00	910.00
16.400	910.00	910.00	910.00	910.00	910.00
16.450	910.00	910.00	910.00	910.00	910.00
16.500	910.00	910.00	910.00	910.00	910.00
16.550	910.00	910.00	910.00	910.00	910.00
16.600	910.00	910.00	910.00	910.00	910.00
16.650	910.00	910.00	910.00	910.00	910.00
16.700	910.00	910.00	910.00	910.00	910.00
16.750	910.00	910.00	910.00	910.00	910.00
16.800	910.00	910.00	910.00	910.00	910.00
16.850	910.00	910.00	910.00	910.00	910.00
16.900	910.00	910.00	910.00	910.00	910.00
16.950	910.00	910.00	910.00	910.00	910.00
17.000	910.00	910.00	910.00	910.00	910.00
17.050	910.00	910.00	910.00	910.00	910.00
17.100	910.00	910.00	910.00	910.00	910.00
17.150	910.00	910.00	910.00	910.00	910.00
17.200	910.00	910.00	910.00	910.00	910.00
17.250	910.00	910.00	910.00	910.00	910.00
17.300	910.00	910.00	910.00	910.00	910.00
17.350	910.00	910.00	910.00	910.00	910.00
17.400	910.00	910.00	910.00	910.00	910.00
17.450	910.00	910.00	910.00	910.00	910.00
17.500	910.00	910.00	910.00	910.00	910.00
17.550	910.00	910.00	910.00	910.00	910.00
17.600	910.00	910.00	910.00	910.00	910.00
17.650	910.00	910.00	910.00	910.00	910.00
17.700	910.00	910.00	910.00	910.00	910.00
17.750	910.00	910.00	910.00	910.00	910.00
17.800	910.00	910.00	910.00	910.00	910.00
17.850	910.00	910.00	910.00	910.00	910.00
17.900	910.00	910.00	910.00	910.00	910.00
17.950	910.00	910.00	910.00	910.00	910.00
18.000	910.00	910.00	910.00	910.00	910.00
18.050	910.00	910.00	910.00	910.00	910.00
18.100	910.00	910.00	910.00	910.00	910.00
18.150	910.00	910.00	910.00	910.00	910.00
18.200	910.00	910.00	910.00	910.00	910.00
18.250	910.00	910.00	910.00	910.00	910.00
18.300	910.00	910.00	910.00	910.00	910.00
18.350	910.00	910.00	910.00	910.00	910.00

Subsection: Time vs. Elevation
Label: C1 (OUT)
Scenario: 6-HR PMP

Return Event: 10,000 years
Storm Event: 6-Hr PMP

Time vs. Elevation (ft)

Output Time increment = 0.010 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
18.400	910.00	910.00	910.00	910.00	910.00
18.450	910.00	910.00	910.00	910.00	910.00
18.500	910.00	910.00	910.00	910.00	910.00
18.550	910.00	910.00	910.00	910.00	910.00
18.600	910.00	910.00	910.00	910.00	910.00
18.650	910.00	910.00	910.00	910.00	910.00
18.700	910.00	910.00	910.00	910.00	910.00
18.750	910.00	910.00	910.00	910.00	910.00
18.800	910.00	910.00	910.00	910.00	910.00
18.850	910.00	910.00	910.00	910.00	910.00
18.900	910.00	910.00	910.00	910.00	910.00
18.950	910.00	910.00	910.00	910.00	910.00
19.000	910.00	910.00	910.00	910.00	910.00
19.050	910.00	910.00	910.00	910.00	910.00
19.100	910.00	910.00	910.00	910.00	910.00
19.150	910.00	910.00	910.00	910.00	910.00
19.200	910.00	910.00	910.00	910.00	910.00
19.250	910.00	910.00	910.00	910.00	910.00
19.300	910.00	910.00	910.00	910.00	910.00
19.350	910.00	910.00	910.00	910.00	910.00
19.400	910.00	910.00	910.00	910.00	910.00
19.450	910.00	910.00	910.00	910.00	910.00
19.500	910.00	910.00	910.00	910.00	910.00
19.550	910.00	910.00	910.00	910.00	910.00
19.600	910.00	910.00	910.00	910.00	910.00
19.650	910.00	910.00	910.00	910.00	910.00
19.700	910.00	910.00	910.00	910.00	910.00
19.750	910.00	910.00	910.00	910.00	910.00
19.800	910.00	910.00	910.00	910.00	910.00
19.850	910.00	910.00	910.00	910.00	910.00
19.900	910.00	910.00	910.00	910.00	910.00
19.950	910.00	910.00	910.00	910.00	910.00
20.000	910.00	910.00	910.00	910.00	910.00
20.050	910.00	910.00	910.00	910.00	910.00
20.100	910.00	910.00	910.00	910.00	910.00
20.150	910.00	910.00	910.00	910.00	910.00
20.200	910.00	910.00	910.00	910.00	910.00
20.250	910.00	910.00	910.00	910.00	910.00
20.300	910.00	910.00	910.00	910.00	910.00
20.350	910.00	910.00	910.00	910.00	910.00
20.400	910.00	910.00	910.00	910.00	910.00

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Time vs. Elevation
Label: C1 (OUT)
Scenario: 6-HR PMP

Return Event: 10,000 years
Storm Event: 6-Hr PMP

Time vs. Elevation (ft)

Output Time increment = 0.010 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
20.450	910.00	910.00	910.00	910.00	910.00
20.500	910.00	910.00	910.00	910.00	910.00
20.550	910.00	910.00	910.00	910.00	910.00
20.600	910.00	910.00	910.00	910.00	910.00
20.650	910.00	910.00	910.00	910.00	910.00
20.700	910.00	910.00	910.00	910.00	910.00
20.750	910.00	910.00	910.00	910.00	910.00
20.800	910.00	910.00	910.00	910.00	910.00
20.850	910.00	910.00	910.00	910.00	910.00
20.900	910.00	910.00	910.00	910.00	910.00
20.950	910.00	910.00	910.00	910.00	910.00
21.000	910.00	910.00	910.00	910.00	910.00
21.050	910.00	910.00	910.00	910.00	910.00
21.100	910.00	910.00	910.00	910.00	910.00
21.150	910.00	910.00	910.00	910.00	910.00
21.200	910.00	910.00	910.00	910.00	910.00
21.250	910.00	910.00	910.00	910.00	910.00
21.300	910.00	910.00	910.00	910.00	910.00
21.350	910.00	910.00	910.00	910.00	910.00
21.400	910.00	910.00	910.00	910.00	910.00
21.450	910.00	910.00	910.00	910.00	910.00
21.500	910.00	910.00	910.00	910.00	910.00
21.550	910.00	910.00	910.00	910.00	910.00
21.600	910.00	910.00	910.00	910.00	910.00
21.650	910.00	910.00	910.00	910.00	910.00
21.700	910.00	910.00	910.00	910.00	910.00
21.750	910.00	910.00	910.00	910.00	910.00
21.800	910.00	910.00	910.00	910.00	910.00
21.850	910.00	910.00	910.00	910.00	910.00
21.900	910.00	910.00	910.00	910.00	910.00
21.950	910.00	910.00	910.00	910.00	910.00
22.000	910.00	910.00	910.00	910.00	910.00
22.050	910.00	910.00	910.00	910.00	910.00
22.100	910.00	910.00	910.00	910.00	910.00
22.150	910.00	910.00	910.00	910.00	910.00
22.200	910.00	910.00	910.00	910.00	910.00
22.250	910.00	910.00	910.00	910.00	910.00
22.300	910.00	910.00	910.00	910.00	910.00
22.350	910.00	910.00	910.00	910.00	910.00
22.400	910.00	910.00	910.00	910.00	910.00
22.450	910.00	910.00	910.00	910.00	910.00

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Time vs. Elevation
Label: C1 (OUT)
Scenario: 6-HR PMP

Return Event: 10,000 years
Storm Event: 6-Hr PMP

Time vs. Elevation (ft)

Output Time increment = 0.010 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
22.500	910.00	910.00	910.00	910.00	910.00
22.550	910.00	910.00	910.00	910.00	910.00
22.600	910.00	910.00	910.00	910.00	910.00
22.650	910.00	910.00	910.00	910.00	910.00
22.700	910.00	910.00	910.00	910.00	910.00
22.750	910.00	910.00	910.00	910.00	910.00
22.800	910.00	910.00	910.00	910.00	910.00
22.850	910.00	910.00	910.00	910.00	910.00
22.900	910.00	910.00	910.00	910.00	910.00
22.950	910.00	910.00	910.00	910.00	910.00
23.000	910.00	910.00	910.00	910.00	910.00
23.050	910.00	910.00	910.00	910.00	910.00
23.100	910.00	910.00	910.00	910.00	910.00
23.150	910.00	910.00	910.00	910.00	910.00
23.200	910.00	910.00	910.00	910.00	910.00
23.250	910.00	910.00	910.00	910.00	910.00
23.300	910.00	910.00	910.00	910.00	910.00
23.350	910.00	910.00	910.00	910.00	910.00
23.400	910.00	910.00	910.00	910.00	910.00
23.450	910.00	910.00	910.00	910.00	910.00
23.500	910.00	910.00	910.00	910.00	910.00
23.550	910.00	910.00	910.00	910.00	910.00
23.600	910.00	910.00	910.00	910.00	910.00
23.650	910.00	910.00	910.00	910.00	910.00
23.700	910.00	910.00	910.00	910.00	910.00
23.750	910.00	910.00	910.00	910.00	910.00
23.800	910.00	910.00	910.00	910.00	910.00
23.850	910.00	910.00	910.00	910.00	910.00
23.900	910.00	910.00	910.00	910.00	910.00
23.950	910.00	910.00	910.00	910.00	910.00
24.000	910.00	910.00	910.00	910.00	910.00
24.050	910.00	910.00	910.00	910.00	910.00
24.100	910.00	910.00	910.00	910.00	910.00
24.150	910.00	910.00	910.00	910.00	910.00
24.200	910.00	910.00	910.00	910.00	910.00
24.250	910.00	910.00	910.00	910.00	910.00
24.300	910.00	910.00	910.00	910.00	910.00
24.350	910.00	910.00	910.00	910.00	910.00
24.400	910.00	910.00	910.00	910.00	910.00
24.450	910.00	910.00	910.00	910.00	910.00
24.500	910.00	910.00	910.00	910.00	910.00

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Time vs. Elevation
Return Event: 10,000 years
Label: C1 (OUT)
Storm Event: 6-Hr PMP
Scenario: 6-HR PMP

Time vs. Elevation (ft)

Output Time increment = 0.010 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
24.550	910.00	910.00	910.00	910.00	910.00
24.600	910.00	910.00	910.00	910.00	910.00
24.650	910.00	910.00	910.00	910.00	910.00
24.700	910.00	910.00	910.00	910.00	910.00
24.750	910.00	910.00	910.00	910.00	910.00
24.800	910.00	910.00	910.00	910.00	910.00
24.850	910.00	910.00	910.00	910.00	910.00
24.900	910.00	910.00	910.00	910.00	910.00
24.950	910.00	910.00	910.00	910.00	910.00
25.000	910.00	910.00	910.00	910.00	910.00
25.050	910.00	910.00	910.00	910.00	910.00
25.100	910.00	910.00	910.00	910.00	910.00
25.150	910.00	910.00	910.00	910.00	910.00
25.200	910.00	910.00	910.00	910.00	910.00
25.250	910.00	910.00	910.00	910.00	910.00
25.300	910.00	910.00	910.00	910.00	910.00
25.350	910.00	910.00	910.00	910.00	910.00
25.400	910.00	910.00	910.00	910.00	910.00
25.450	910.00	910.00	910.00	910.00	910.00
25.500	910.00	910.00	910.00	910.00	910.00
25.550	910.00	910.00	910.00	910.00	910.00
25.600	910.00	910.00	910.00	910.00	910.00
25.650	910.00	910.00	910.00	910.00	910.00
25.700	910.00	910.00	910.00	910.00	910.00
25.750	910.00	910.00	910.00	910.00	910.00
25.800	910.00	910.00	910.00	910.00	910.00
25.850	910.00	910.00	910.00	910.00	910.00
25.900	910.00	910.00	910.00	910.00	910.00
25.950	910.00	910.00	910.00	910.00	910.00
26.000	910.00	910.00	910.00	910.00	910.00
26.050	910.00	910.00	910.00	910.00	910.00
26.100	910.00	910.00	910.00	910.00	910.00
26.150	910.00	910.00	910.00	910.00	910.00
26.200	910.00	910.00	910.00	910.00	910.00
26.250	910.00	910.00	910.00	910.00	910.00
26.300	910.00	910.00	910.00	910.00	910.00
26.350	910.00	910.00	910.00	910.00	910.00
26.400	910.00	910.00	910.00	910.00	910.00
26.450	910.00	910.00	910.00	910.00	910.00
26.500	910.00	910.00	910.00	910.00	910.00
26.550	910.00	910.00	910.00	910.00	910.00

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Time vs. Elevation
Label: C1 (OUT)
Scenario: 6-HR PMP

Return Event: 10,000 years
Storm Event: 6-Hr PMP

Time vs. Elevation (ft)

Output Time increment = 0.010 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
26.600	910.00	910.00	910.00	910.00	910.00
26.650	910.00	910.00	910.00	910.00	910.00
26.700	910.00	910.00	910.00	910.00	910.00
26.750	910.00	910.00	910.00	910.00	910.00
26.800	910.00	910.00	910.00	910.00	910.00
26.850	910.00	910.00	910.00	910.00	910.00
26.900	910.00	910.00	910.00	910.00	910.00
26.950	910.00	910.00	910.00	910.00	910.00
27.000	910.00	910.00	910.00	910.00	910.00
27.050	910.00	910.00	910.00	910.00	910.00
27.100	910.00	910.00	910.00	910.00	910.00
27.150	910.00	910.00	910.00	910.00	910.00
27.200	910.00	910.00	910.00	910.00	910.00
27.250	910.00	910.00	910.00	910.00	910.00
27.300	910.00	910.00	910.00	910.00	910.00
27.350	910.00	910.00	910.00	910.00	910.00
27.400	910.00	910.00	910.00	910.00	910.00
27.450	910.00	910.00	910.00	910.00	910.00
27.500	910.00	910.00	910.00	910.00	910.00
27.550	910.00	910.00	910.00	910.00	910.00
27.600	910.00	910.00	910.00	910.00	910.00
27.650	910.00	910.00	910.00	910.00	910.00
27.700	910.00	910.00	910.00	910.00	910.00
27.750	910.00	910.00	910.00	910.00	910.00
27.800	910.00	910.00	910.00	910.00	910.00
27.850	910.00	910.00	910.00	910.00	910.00
27.900	910.00	910.00	910.00	910.00	910.00
27.950	910.00	910.00	910.00	910.00	910.00
28.000	910.00	910.00	910.00	910.00	910.00
28.050	910.00	910.00	910.00	910.00	910.00
28.100	910.00	910.00	910.00	910.00	910.00
28.150	910.00	910.00	910.00	910.00	910.00
28.200	910.00	910.00	910.00	910.00	910.00
28.250	910.00	910.00	910.00	910.00	910.00
28.300	910.00	910.00	910.00	910.00	910.00
28.350	910.00	910.00	910.00	910.00	910.00
28.400	910.00	910.00	910.00	910.00	910.00
28.450	910.00	910.00	910.00	910.00	910.00
28.500	910.00	910.00	910.00	910.00	910.00
28.550	910.00	910.00	910.00	910.00	910.00
28.600	910.00	910.00	910.00	910.00	910.00

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Time vs. Elevation
Label: C1 (OUT)
Scenario: 6-HR PMP

Return Event: 10,000 years
Storm Event: 6-Hr PMP

Time vs. Elevation (ft)

Output Time increment = 0.010 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
28.650	910.00	910.00	910.00	910.00	910.00
28.700	910.00	910.00	910.00	910.00	910.00
28.750	910.00	910.00	910.00	910.00	910.00
28.800	910.00	910.00	910.00	910.00	910.00
28.850	910.00	910.00	910.00	910.00	910.00
28.900	910.00	910.00	910.00	910.00	910.00
28.950	910.00	910.00	910.00	910.00	910.00
29.000	910.00	910.00	910.00	910.00	910.00
29.050	910.00	910.00	910.00	910.00	910.00
29.100	910.00	910.00	910.00	910.00	910.00
29.150	910.00	910.00	910.00	910.00	910.00
29.200	910.00	910.00	910.00	910.00	910.00
29.250	910.00	910.00	910.00	910.00	910.00
29.300	910.00	910.00	910.00	910.00	910.00
29.350	910.00	910.00	910.00	910.00	910.00
29.400	910.00	910.00	910.00	910.00	910.00
29.450	910.00	910.00	910.00	910.00	910.00
29.500	910.00	910.00	910.00	910.00	910.00
29.550	910.00	910.00	910.00	910.00	910.00
29.600	910.00	910.00	910.00	910.00	910.00
29.650	910.00	910.00	910.00	910.00	910.00
29.700	910.00	910.00	910.00	910.00	910.00
29.750	910.00	910.00	910.00	910.00	910.00
29.800	910.00	910.00	910.00	910.00	910.00
29.850	910.00	910.00	910.00	910.00	910.00
29.900	910.00	910.00	910.00	910.00	910.00
29.950	910.00	910.00	910.00	910.00	910.00
30.000	910.00	910.00	910.00	910.00	910.00
30.050	910.00	910.00	910.00	910.00	910.00
30.100	910.00	910.00	910.00	910.00	910.00
30.150	910.00	910.00	910.00	910.00	910.00
30.200	910.00	910.00	910.00	910.00	910.00
30.250	910.00	910.00	910.00	910.00	910.00
30.300	910.00	910.00	910.00	910.00	910.00
30.350	910.00	910.00	910.00	910.00	910.00
30.400	910.00	910.00	910.00	910.00	910.00
30.450	910.00	910.00	910.00	910.00	910.00
30.500	910.00	910.00	910.00	910.00	910.00
30.550	910.00	910.00	910.00	910.00	910.00
30.600	910.00	910.00	910.00	910.00	910.00
30.650	910.00	910.00	910.00	910.00	910.00

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Time vs. Elevation Return Event: 10,000 years
Label: C1 (OUT) Storm Event: 6-Hr PMP
Scenario: 6-HR PMP

Time vs. Elevation (ft)

Output Time increment = 0.010 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
30.700	910.00	910.00	910.00	910.00	910.00
30.750	910.00	910.00	910.00	910.00	910.00
30.800	910.00	910.00	910.00	910.00	910.00
30.850	910.00	910.00	910.00	910.00	910.00
30.900	910.00	910.00	910.00	910.00	910.00
30.950	910.00	910.00	910.00	910.00	910.00
31.000	910.00	910.00	910.00	910.00	910.00
31.050	910.00	910.00	910.00	910.00	910.00
31.100	910.00	910.00	910.00	910.00	910.00
31.150	910.00	910.00	910.00	910.00	910.00
31.200	910.00	910.00	910.00	910.00	910.00
31.250	910.00	910.00	910.00	910.00	910.00
31.300	910.00	910.00	910.00	910.00	910.00
31.350	910.00	910.00	910.00	910.00	910.00
31.400	910.00	910.00	910.00	910.00	910.00
31.450	910.00	910.00	910.00	910.00	910.00
31.500	910.00	910.00	910.00	910.00	910.00
31.550	910.00	910.00	910.00	910.00	910.00
31.600	910.00	910.00	910.00	910.00	910.00
31.650	910.00	910.00	910.00	910.00	910.00
31.700	910.00	910.00	910.00	910.00	910.00
31.750	910.00	910.00	910.00	910.00	910.00
31.800	910.00	910.00	910.00	910.00	910.00
31.850	910.00	910.00	910.00	910.00	910.00
31.900	910.00	910.00	910.00	910.00	910.00
31.950	910.00	910.00	910.00	910.00	910.00
32.000	910.00	910.00	910.00	910.00	910.00
32.050	910.00	910.00	910.00	910.00	910.00
32.100	910.00	910.00	910.00	910.00	910.00
32.150	910.00	910.00	910.00	910.00	910.00
32.200	910.00	910.00	910.00	910.00	910.00
32.250	910.00	910.00	910.00	910.00	910.00
32.300	910.00	910.00	910.00	910.00	910.00
32.350	910.00	910.00	910.00	910.00	910.00
32.400	910.00	910.00	910.00	910.00	910.00
32.450	910.00	910.00	910.00	910.00	910.00
32.500	910.00	910.00	910.00	910.00	910.00
32.550	910.00	910.00	910.00	910.00	910.00
32.600	910.00	910.00	910.00	910.00	910.00
32.650	910.00	910.00	910.00	910.00	910.00
32.700	910.00	910.00	910.00	910.00	910.00

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Time vs. Elevation
Label: C1 (OUT)
Scenario: 6-HR PMP

Return Event: 10,000 years
Storm Event: 6-Hr PMP

Time vs. Elevation (ft)

Output Time increment = 0.010 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
32.750	910.00	910.00	910.00	910.00	910.00
32.800	910.00	910.00	910.00	910.00	910.00
32.850	910.00	910.00	910.00	910.00	910.00
32.900	910.00	910.00	910.00	910.00	910.00
32.950	910.00	910.00	910.00	910.00	910.00
33.000	910.00	910.00	910.00	910.00	910.00
33.050	910.00	910.00	910.00	910.00	910.00
33.100	910.00	910.00	910.00	910.00	910.00
33.150	910.00	910.00	910.00	910.00	910.00
33.200	910.00	910.00	910.00	910.00	910.00
33.250	910.00	910.00	910.00	910.00	910.00
33.300	910.00	910.00	910.00	910.00	910.00
33.350	910.00	910.00	910.00	910.00	910.00
33.400	910.00	910.00	910.00	910.00	910.00
33.450	910.00	910.00	910.00	910.00	910.00
33.500	910.00	910.00	910.00	910.00	910.00
33.550	910.00	910.00	910.00	910.00	910.00
33.600	910.00	910.00	910.00	910.00	910.00
33.650	910.00	910.00	910.00	910.00	910.00
33.700	910.00	910.00	910.00	910.00	910.00
33.750	910.00	910.00	910.00	910.00	910.00
33.800	910.00	910.00	910.00	910.00	910.00
33.850	910.00	910.00	910.00	910.00	910.00
33.900	910.00	910.00	910.00	910.00	910.00
33.950	910.00	910.00	910.00	910.00	910.00
34.000	910.00	910.00	910.00	910.00	910.00
34.050	910.00	910.00	910.00	910.00	910.00
34.100	910.00	910.00	910.00	910.00	910.00
34.150	910.00	910.00	910.00	910.00	910.00
34.200	910.00	910.00	910.00	910.00	910.00
34.250	910.00	910.00	910.00	910.00	910.00
34.300	910.00	910.00	910.00	910.00	910.00
34.350	910.00	910.00	910.00	910.00	910.00
34.400	910.00	910.00	910.00	910.00	910.00
34.450	910.00	910.00	910.00	910.00	910.00
34.500	910.00	910.00	910.00	910.00	910.00
34.550	910.00	910.00	910.00	910.00	910.00
34.600	910.00	910.00	910.00	910.00	910.00
34.650	910.00	910.00	910.00	910.00	910.00
34.700	910.00	910.00	910.00	910.00	910.00
34.750	910.00	910.00	910.00	910.00	910.00

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Time vs. Elevation
Return Event: 10,000 years
Label: C1 (OUT)
Storm Event: 6-Hr PMP
Scenario: 6-HR PMP

Time vs. Elevation (ft)

Output Time increment = 0.010 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
34.800	910.00	910.00	910.00	910.00	910.00
34.850	910.00	910.00	910.00	910.00	910.00
34.900	910.00	910.00	910.00	910.00	910.00
34.950	910.00	910.00	910.00	910.00	910.00
35.000	910.00	910.00	910.00	910.00	910.00
35.050	910.00	910.00	910.00	910.00	910.00
35.100	910.00	910.00	910.00	910.00	910.00
35.150	910.00	910.00	910.00	910.00	910.00
35.200	910.00	910.00	910.00	910.00	910.00
35.250	910.00	910.00	910.00	910.00	910.00
35.300	910.00	910.00	910.00	910.00	910.00
35.350	910.00	910.00	910.00	910.00	910.00
35.400	910.00	910.00	910.00	910.00	910.00
35.450	910.00	910.00	910.00	910.00	910.00
35.500	910.00	910.00	910.00	910.00	910.00
35.550	910.00	910.00	910.00	910.00	910.00
35.600	910.00	910.00	910.00	910.00	910.00
35.650	910.00	910.00	910.00	910.00	910.00
35.700	910.00	910.00	910.00	910.00	910.00
35.750	910.00	910.00	910.00	910.00	910.00
35.800	910.00	910.00	910.00	910.00	910.00
35.850	910.00	910.00	910.00	910.00	910.00
35.900	910.00	910.00	910.00	910.00	910.00
35.950	910.00	910.00	910.00	910.00	910.00
36.000	910.00	910.00	910.00	910.00	910.00
36.050	910.00	910.00	910.00	910.00	910.00
36.100	910.00	910.00	910.00	910.00	910.00
36.150	910.00	910.00	910.00	910.00	910.00
36.200	910.00	910.00	910.00	910.00	910.00
36.250	910.00	910.00	910.00	910.00	910.00
36.300	910.00	910.00	910.00	910.00	910.00
36.350	910.00	910.00	910.00	910.00	910.00
36.400	910.00	910.00	910.00	910.00	910.00
36.450	910.00	910.00	910.00	910.00	910.00
36.500	910.00	910.00	910.00	910.00	910.00
36.550	910.00	910.00	910.00	910.00	910.00
36.600	910.00	910.00	910.00	910.00	910.00
36.650	910.00	910.00	910.00	910.00	910.00
36.700	910.00	910.00	910.00	910.00	910.00
36.750	910.00	910.00	910.00	910.00	910.00
36.800	910.00	910.00	910.00	910.00	910.00

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Time vs. Elevation | Return Event: 10,000 years
Label: C1 (OUT) | Storm Event: 6-Hr PMP
Scenario: 6-HR PMP

Time vs. Elevation (ft)

Output Time increment = 0.010 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
36.850	910.00	910.00	910.00	910.00	910.00
36.900	910.00	910.00	910.00	910.00	910.00
36.950	910.00	910.00	910.00	910.00	910.00
37.000	910.00	910.00	910.00	910.00	910.00
37.050	910.00	910.00	910.00	910.00	910.00
37.100	910.00	910.00	910.00	910.00	910.00
37.150	910.00	910.00	910.00	910.00	910.00
37.200	910.00	910.00	910.00	910.00	910.00
37.250	910.00	910.00	910.00	910.00	910.00
37.300	910.00	910.00	910.00	910.00	910.00
37.350	910.00	910.00	910.00	910.00	910.00
37.400	910.00	910.00	910.00	910.00	910.00
37.450	910.00	910.00	910.00	910.00	910.00
37.500	910.00	910.00	910.00	910.00	910.00
37.550	910.00	910.00	910.00	910.00	910.00
37.600	910.00	910.00	910.00	910.00	910.00
37.650	910.00	910.00	910.00	910.00	910.00
37.700	910.00	910.00	910.00	910.00	910.00
37.750	910.00	910.00	910.00	910.00	910.00
37.800	910.00	910.00	910.00	910.00	910.00
37.850	910.00	910.00	910.00	910.00	910.00
37.900	910.00	910.00	910.00	910.00	910.00
37.950	910.00	910.00	910.00	910.00	910.00
38.000	910.00	910.00	910.00	910.00	910.00
38.050	910.00	910.00	910.00	910.00	910.00
38.100	910.00	910.00	910.00	910.00	910.00
38.150	910.00	910.00	910.00	910.00	910.00
38.200	910.00	910.00	910.00	910.00	910.00
38.250	910.00	910.00	910.00	910.00	910.00
38.300	910.00	910.00	910.00	910.00	910.00
38.350	910.00	910.00	910.00	910.00	910.00
38.400	910.00	910.00	910.00	910.00	910.00
38.450	910.00	910.00	910.00	910.00	910.00
38.500	910.00	910.00	910.00	910.00	910.00
38.550	910.00	910.00	910.00	910.00	910.00
38.600	910.00	910.00	910.00	910.00	910.00
38.650	910.00	910.00	910.00	910.00	910.00
38.700	910.00	910.00	910.00	910.00	910.00
38.750	910.00	910.00	910.00	910.00	910.00
38.800	910.00	910.00	910.00	910.00	910.00
38.850	910.00	910.00	910.00	910.00	910.00

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Time vs. Elevation	Return Event: 10,000 years
Label: C1 (OUT)	Storm Event: 6-Hr PMP
Scenario: 6-HR PMP	

Time vs. Elevation (ft)

Output Time increment = 0.010 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
38.900	910.00	910.00	910.00	910.00	910.00
38.950	910.00	910.00	910.00	910.00	910.00
39.000	910.00	910.00	910.00	910.00	910.00
39.050	910.00	910.00	910.00	910.00	910.00
39.100	910.00	910.00	910.00	910.00	910.00
39.150	910.00	910.00	910.00	910.00	910.00
39.200	910.00	910.00	910.00	910.00	910.00
39.250	910.00	910.00	910.00	910.00	910.00
39.300	910.00	910.00	910.00	910.00	910.00
39.350	910.00	910.00	910.00	910.00	910.00
39.400	910.00	910.00	910.00	910.00	910.00
39.450	910.00	910.00	910.00	910.00	910.00
39.500	910.00	910.00	910.00	910.00	910.00
39.550	910.00	910.00	910.00	910.00	910.00
39.600	910.00	910.00	910.00	910.00	910.00
39.650	910.00	910.00	910.00	910.00	910.00
39.700	910.00	910.00	910.00	910.00	910.00
39.750	910.00	910.00	910.00	910.00	910.00
39.800	910.00	910.00	910.00	910.00	910.00
39.850	910.00	910.00	910.00	910.00	910.00
39.900	910.00	910.00	910.00	910.00	910.00
39.950	910.00	910.00	910.00	910.00	910.00
40.000	910.00	910.00	910.00	910.00	910.00
40.050	910.00	910.00	910.00	910.00	910.00
40.100	910.00	910.00	910.00	910.00	910.00
40.150	910.00	910.00	910.00	910.00	910.00
40.200	910.00	910.00	910.00	910.00	910.00
40.250	910.00	910.00	910.00	910.00	910.00
40.300	910.00	910.00	910.00	910.00	910.00
40.350	910.00	910.00	910.00	910.00	910.00
40.400	910.00	910.00	910.00	910.00	910.00
40.450	910.00	910.00	910.00	910.00	910.00
40.500	910.00	910.00	910.00	910.00	910.00
40.550	910.00	910.00	910.00	910.00	910.00
40.600	910.00	910.00	910.00	910.00	910.00
40.650	910.00	910.00	910.00	910.00	910.00
40.700	910.00	910.00	910.00	910.00	910.00
40.750	910.00	910.00	910.00	910.00	910.00
40.800	910.00	910.00	910.00	910.00	910.00
40.850	910.00	910.00	910.00	910.00	910.00
40.900	910.00	910.00	910.00	910.00	910.00

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Time vs. Elevation | Return Event: 10,000 years
Label: C1 (OUT) | Storm Event: 6-Hr PMP
Scenario: 6-HR PMP

Time vs. Elevation (ft)

Output Time increment = 0.010 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
40.950	910.00	910.00	910.00	910.00	910.00
41.000	910.00	910.00	910.00	910.00	910.00
41.050	910.00	910.00	910.00	910.00	910.00
41.100	910.00	910.00	910.00	910.00	910.00
41.150	910.00	910.00	910.00	910.00	910.00
41.200	910.00	910.00	910.00	910.00	910.00
41.250	910.00	910.00	910.00	910.00	910.00
41.300	910.00	910.00	910.00	910.00	910.00
41.350	910.00	910.00	910.00	910.00	910.00
41.400	910.00	910.00	910.00	910.00	910.00
41.450	910.00	910.00	910.00	910.00	910.00
41.500	910.00	910.00	910.00	910.00	910.00
41.550	910.00	910.00	910.00	910.00	910.00
41.600	910.00	910.00	910.00	910.00	910.00
41.650	910.00	910.00	910.00	910.00	910.00
41.700	910.00	910.00	910.00	910.00	910.00
41.750	910.00	910.00	910.00	910.00	910.00
41.800	910.00	910.00	910.00	910.00	910.00
41.850	910.00	910.00	910.00	910.00	910.00
41.900	910.00	910.00	910.00	910.00	910.00
41.950	910.00	910.00	910.00	910.00	910.00
42.000	910.00	910.00	910.00	910.00	910.00
42.050	910.00	910.00	910.00	910.00	910.00
42.100	910.00	910.00	910.00	910.00	910.00
42.150	910.00	910.00	910.00	910.00	910.00
42.200	910.00	910.00	910.00	910.00	910.00
42.250	910.00	910.00	910.00	910.00	910.00
42.300	910.00	910.00	910.00	910.00	910.00
42.350	910.00	910.00	910.00	910.00	910.00
42.400	910.00	910.00	910.00	910.00	910.00
42.450	910.00	910.00	910.00	910.00	910.00
42.500	910.00	910.00	910.00	910.00	910.00
42.550	910.00	910.00	910.00	910.00	910.00
42.600	910.00	910.00	910.00	910.00	910.00
42.650	910.00	910.00	910.00	910.00	910.00
42.700	910.00	910.00	910.00	910.00	910.00
42.750	910.00	910.00	910.00	910.00	910.00
42.800	910.00	910.00	910.00	910.00	910.00
42.850	910.00	910.00	910.00	910.00	910.00
42.900	910.00	910.00	910.00	910.00	910.00
42.950	910.00	910.00	910.00	910.00	910.00

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Time vs. Elevation	Return Event: 10,000 years
Label: C1 (OUT)	Storm Event: 6-Hr PMP
Scenario: 6-HR PMP	

Time vs. Elevation (ft)

Output Time increment = 0.010 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
43.000	910.00	910.00	910.00	910.00	910.00
43.050	910.00	910.00	910.00	910.00	910.00
43.100	910.00	910.00	910.00	910.00	910.00
43.150	910.00	910.00	910.00	910.00	910.00
43.200	910.00	910.00	910.00	910.00	910.00
43.250	910.00	910.00	910.00	910.00	910.00
43.300	910.00	910.00	910.00	910.00	910.00
43.350	910.00	910.00	910.00	910.00	910.00
43.400	910.00	910.00	910.00	910.00	910.00
43.450	910.00	910.00	910.00	910.00	910.00
43.500	910.00	910.00	910.00	910.00	910.00
43.550	910.00	910.00	910.00	910.00	910.00
43.600	910.00	910.00	910.00	910.00	910.00
43.650	910.00	910.00	910.00	910.00	910.00
43.700	910.00	910.00	910.00	910.00	910.00
43.750	910.00	910.00	910.00	910.00	910.00
43.800	910.00	910.00	910.00	910.00	910.00
43.850	910.00	910.00	910.00	910.00	910.00
43.900	910.00	910.00	910.00	910.00	910.00
43.950	910.00	910.00	910.00	910.00	910.00
44.000	910.00	910.00	910.00	910.00	910.00
44.050	910.00	910.00	910.00	910.00	910.00
44.100	910.00	910.00	910.00	910.00	910.00
44.150	910.00	910.00	910.00	910.00	910.00
44.200	910.00	910.00	910.00	910.00	910.00
44.250	910.00	910.00	910.00	910.00	910.00
44.300	910.00	910.00	910.00	910.00	910.00
44.350	910.00	910.00	910.00	910.00	910.00
44.400	910.00	910.00	910.00	910.00	910.00
44.450	910.00	910.00	910.00	910.00	910.00
44.500	910.00	910.00	910.00	910.00	910.00
44.550	910.00	910.00	910.00	910.00	910.00
44.600	910.00	910.00	910.00	910.00	910.00
44.650	910.00	910.00	910.00	910.00	910.00
44.700	910.00	910.00	910.00	910.00	910.00
44.750	910.00	910.00	910.00	910.00	910.00
44.800	910.00	910.00	910.00	910.00	910.00
44.850	910.00	910.00	910.00	910.00	910.00
44.900	910.00	910.00	910.00	910.00	910.00
44.950	910.00	910.00	910.00	910.00	910.00
45.000	910.00	910.00	910.00	910.00	910.00

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Time vs. Elevation
Return Event: 10,000 years
Label: C1 (OUT)
Storm Event: 6-Hr PMP
Scenario: 6-HR PMP

Time vs. Elevation (ft)

Output Time increment = 0.010 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
45.050	910.00	910.00	910.00	910.00	910.00
45.100	910.00	910.00	910.00	910.00	910.00
45.150	910.00	910.00	910.00	910.00	910.00
45.200	910.00	910.00	910.00	910.00	910.00
45.250	910.00	910.00	910.00	910.00	910.00
45.300	910.00	910.00	910.00	910.00	910.00
45.350	910.00	910.00	910.00	910.00	910.00
45.400	910.00	910.00	910.00	910.00	910.00
45.450	910.00	910.00	910.00	910.00	910.00
45.500	910.00	910.00	910.00	910.00	910.00
45.550	910.00	910.00	910.00	910.00	910.00
45.600	910.00	910.00	910.00	910.00	910.00
45.650	910.00	910.00	910.00	910.00	910.00
45.700	910.00	910.00	910.00	910.00	910.00
45.750	910.00	910.00	910.00	910.00	910.00
45.800	910.00	910.00	910.00	910.00	910.00
45.850	910.00	910.00	910.00	910.00	910.00
45.900	910.00	910.00	910.00	910.00	910.00
45.950	910.00	910.00	910.00	910.00	910.00
46.000	910.00	910.00	910.00	910.00	910.00
46.050	910.00	910.00	910.00	910.00	910.00
46.100	910.00	910.00	910.00	910.00	910.00
46.150	910.00	910.00	910.00	910.00	910.00
46.200	910.00	910.00	910.00	910.00	910.00
46.250	910.00	910.00	910.00	910.00	910.00
46.300	910.00	910.00	910.00	910.00	910.00
46.350	910.00	910.00	910.00	910.00	910.00
46.400	910.00	910.00	910.00	910.00	910.00
46.450	910.00	910.00	910.00	910.00	910.00
46.500	910.00	910.00	910.00	910.00	910.00
46.550	910.00	910.00	910.00	910.00	910.00
46.600	910.00	910.00	910.00	910.00	910.00
46.650	910.00	910.00	910.00	910.00	910.00
46.700	910.00	910.00	910.00	910.00	910.00
46.750	910.00	910.00	910.00	910.00	910.00
46.800	910.00	910.00	910.00	910.00	910.00
46.850	910.00	910.00	910.00	910.00	910.00
46.900	910.00	910.00	910.00	910.00	910.00
46.950	910.00	910.00	910.00	910.00	910.00
47.000	910.00	910.00	910.00	910.00	910.00
47.050	910.00	910.00	910.00	910.00	910.00

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Time vs. Elevation
Label: C1 (OUT)
Scenario: 6-HR PMP

Return Event: 10,000 years
Storm Event: 6-Hr PMP

Time vs. Elevation (ft)

Output Time increment = 0.010 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
47.100	910.00	910.00	910.00	910.00	910.00
47.150	910.00	910.00	910.00	910.00	910.00
47.200	910.00	910.00	910.00	910.00	910.00
47.250	910.00	910.00	910.00	910.00	910.00
47.300	910.00	910.00	910.00	910.00	910.00
47.350	910.00	910.00	910.00	910.00	910.00
47.400	910.00	910.00	910.00	910.00	910.00
47.450	910.00	910.00	910.00	910.00	910.00
47.500	910.00	910.00	910.00	910.00	910.00
47.550	910.00	910.00	910.00	910.00	910.00
47.600	910.00	910.00	910.00	910.00	910.00
47.650	910.00	910.00	910.00	910.00	910.00
47.700	910.00	910.00	910.00	910.00	910.00
47.750	910.00	910.00	910.00	910.00	910.00
47.800	910.00	910.00	910.00	910.00	910.00
47.850	910.00	910.00	910.00	910.00	910.00
47.900	910.00	910.00	910.00	910.00	910.00
47.950	910.00	910.00	910.00	910.00	910.00
48.000	910.00	910.00	910.00	910.00	910.00
48.050	910.00	910.00	910.00	910.00	910.00
48.100	910.00	910.00	910.00	910.00	910.00
48.150	910.00	910.00	910.00	910.00	910.00
48.200	910.00	910.00	910.00	910.00	910.00
48.250	910.00	910.00	910.00	910.00	910.00
48.300	910.00	910.00	910.00	910.00	910.00
48.350	910.00	910.00	910.00	910.00	910.00
48.400	910.00	910.00	910.00	910.00	910.00
48.450	910.00	910.00	910.00	910.00	910.00
48.500	910.00	910.00	910.00	910.00	910.00
48.550	910.00	910.00	910.00	910.00	910.00
48.600	910.00	910.00	910.00	910.00	910.00
48.650	910.00	910.00	910.00	910.00	910.00
48.700	910.00	910.00	910.00	910.00	910.00
48.750	910.00	910.00	910.00	910.00	910.00
48.800	910.00	910.00	910.00	910.00	910.00
48.850	910.00	910.00	910.00	910.00	910.00
48.900	910.00	910.00	910.00	910.00	910.00
48.950	910.00	910.00	910.00	910.00	910.00
49.000	910.00	910.00	910.00	910.00	910.00
49.050	910.00	910.00	910.00	910.00	910.00
49.100	910.00	910.00	910.00	910.00	910.00

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Time vs. Elevation
Label: C1 (OUT)
Scenario: 6-HR PMP

Return Event: 10,000 years
Storm Event: 6-Hr PMP

Time vs. Elevation (ft)

Output Time increment = 0.010 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
49.150	910.00	910.00	910.00	910.00	910.00
49.200	910.00	910.00	910.00	910.00	910.00
49.250	910.00	910.00	910.00	910.00	910.00
49.300	910.00	910.00	910.00	910.00	910.00
49.350	910.00	910.00	910.00	910.00	910.00
49.400	910.00	910.00	910.00	910.00	910.00
49.450	910.00	910.00	910.00	910.00	910.00
49.500	910.00	910.00	910.00	910.00	910.00
49.550	910.00	910.00	910.00	910.00	910.00
49.600	910.00	910.00	910.00	910.00	910.00
49.650	910.00	910.00	910.00	910.00	910.00
49.700	910.00	910.00	910.00	910.00	910.00
49.750	910.00	910.00	910.00	910.00	910.00
49.800	910.00	910.00	910.00	910.00	910.00
49.850	910.00	910.00	910.00	910.00	910.00
49.900	910.00	910.00	910.00	910.00	910.00
49.950	910.00	910.00	910.00	910.00	910.00
50.000	910.00	910.00	910.00	910.00	910.00
50.050	910.00	910.00	910.00	910.00	910.00
50.100	910.00	910.00	910.00	910.00	910.00
50.150	910.00	910.00	910.00	910.00	910.00
50.200	910.00	910.00	910.00	910.00	910.00
50.250	910.00	910.00	910.00	910.00	910.00
50.300	910.00	910.00	910.00	910.00	910.00
50.350	910.00	910.00	910.00	910.00	910.00
50.400	910.00	910.00	910.00	910.00	910.00
50.450	910.00	910.00	910.00	910.00	910.00
50.500	910.00	910.00	910.00	910.00	910.00
50.550	910.00	910.00	910.00	910.00	910.00
50.600	910.00	910.00	910.00	910.00	910.00
50.650	910.00	910.00	910.00	910.00	910.00
50.700	910.00	910.00	910.00	910.00	910.00
50.750	910.00	910.00	910.00	910.00	910.00
50.800	910.00	910.00	910.00	910.00	910.00
50.850	910.00	910.00	910.00	910.00	910.00
50.900	910.00	910.00	910.00	910.00	910.00
50.950	910.00	910.00	910.00	910.00	910.00
51.000	910.00	910.00	910.00	910.00	910.00
51.050	910.00	910.00	910.00	910.00	910.00
51.100	910.00	910.00	910.00	910.00	910.00
51.150	910.00	910.00	910.00	910.00	910.00

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Time vs. Elevation	Return Event: 10,000 years
Label: C1 (OUT)	Storm Event: 6-Hr PMP
Scenario: 6-HR PMP	

Time vs. Elevation (ft)

Output Time increment = 0.010 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
51.200	910.00	910.00	910.00	910.00	910.00
51.250	910.00	910.00	910.00	910.00	910.00
51.300	910.00	910.00	910.00	910.00	910.00
51.350	910.00	910.00	910.00	910.00	910.00
51.400	910.00	910.00	910.00	910.00	910.00
51.450	910.00	910.00	910.00	910.00	910.00
51.500	910.00	910.00	910.00	910.00	910.00
51.550	910.00	910.00	910.00	910.00	910.00
51.600	910.00	910.00	910.00	910.00	910.00
51.650	910.00	910.00	910.00	910.00	910.00
51.700	910.00	910.00	910.00	910.00	910.00
51.750	910.00	910.00	910.00	910.00	910.00
51.800	910.00	910.00	910.00	910.00	910.00
51.850	910.00	910.00	910.00	910.00	910.00
51.900	910.00	910.00	910.00	910.00	910.00
51.950	910.00	910.00	910.00	910.00	910.00
52.000	910.00	910.00	910.00	910.00	910.00
52.050	910.00	910.00	910.00	910.00	910.00
52.100	910.00	910.00	910.00	910.00	910.00
52.150	910.00	910.00	910.00	910.00	910.00
52.200	910.00	910.00	910.00	910.00	910.00
52.250	910.00	910.00	910.00	910.00	910.00
52.300	910.00	910.00	910.00	910.00	910.00
52.350	910.00	910.00	910.00	910.00	910.00
52.400	910.00	910.00	910.00	910.00	910.00
52.450	910.00	910.00	910.00	910.00	910.00
52.500	910.00	910.00	910.00	910.00	910.00
52.550	910.00	910.00	910.00	910.00	910.00
52.600	910.00	910.00	910.00	910.00	910.00
52.650	910.00	910.00	910.00	910.00	910.00
52.700	910.00	910.00	910.00	910.00	910.00
52.750	910.00	910.00	910.00	910.00	910.00
52.800	910.00	910.00	910.00	910.00	910.00
52.850	910.00	910.00	910.00	910.00	910.00
52.900	910.00	910.00	910.00	910.00	910.00
52.950	910.00	910.00	910.00	910.00	910.00
53.000	910.00	910.00	910.00	910.00	910.00
53.050	910.00	910.00	910.00	910.00	910.00
53.100	910.00	910.00	910.00	910.00	910.00
53.150	910.00	910.00	910.00	910.00	910.00
53.200	910.00	910.00	910.00	910.00	910.00

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Time vs. Elevation | Return Event: 10,000 years
Label: C1 (OUT) | Storm Event: 6-Hr PMP
Scenario: 6-HR PMP

Time vs. Elevation (ft)

Output Time increment = 0.010 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
53.250	910.00	910.00	910.00	910.00	910.00
53.300	910.00	910.00	910.00	910.00	910.00
53.350	910.00	910.00	910.00	910.00	910.00
53.400	910.00	910.00	910.00	910.00	910.00
53.450	910.00	910.00	910.00	910.00	910.00
53.500	910.00	910.00	910.00	910.00	910.00
53.550	910.00	910.00	910.00	910.00	910.00
53.600	910.00	910.00	910.00	910.00	910.00
53.650	910.00	910.00	910.00	910.00	910.00
53.700	910.00	910.00	910.00	910.00	910.00
53.750	910.00	910.00	910.00	910.00	910.00
53.800	910.00	910.00	910.00	910.00	910.00
53.850	910.00	910.00	910.00	910.00	910.00
53.900	910.00	910.00	910.00	910.00	910.00
53.950	910.00	910.00	910.00	910.00	910.00
54.000	910.00	910.00	910.00	910.00	910.00
54.050	910.00	910.00	910.00	910.00	910.00
54.100	910.00	910.00	910.00	910.00	910.00
54.150	910.00	910.00	910.00	910.00	910.00
54.200	910.00	910.00	910.00	910.00	910.00
54.250	910.00	910.00	910.00	910.00	910.00
54.300	910.00	910.00	910.00	910.00	910.00
54.350	910.00	910.00	910.00	910.00	910.00
54.400	910.00	910.00	910.00	910.00	910.00
54.450	910.00	910.00	910.00	910.00	910.00
54.500	910.00	910.00	910.00	910.00	910.00
54.550	910.00	910.00	910.00	910.00	910.00
54.600	910.00	910.00	910.00	910.00	910.00
54.650	910.00	910.00	910.00	910.00	910.00
54.700	910.00	910.00	910.00	910.00	910.00
54.750	910.00	910.00	910.00	910.00	910.00
54.800	910.00	910.00	910.00	910.00	910.00
54.850	910.00	910.00	910.00	910.00	910.00
54.900	910.00	910.00	910.00	910.00	910.00
54.950	910.00	910.00	910.00	910.00	910.00
55.000	910.00	910.00	910.00	910.00	910.00
55.050	910.00	910.00	910.00	910.00	910.00
55.100	910.00	910.00	910.00	910.00	910.00
55.150	910.00	910.00	910.00	910.00	910.00
55.200	910.00	910.00	910.00	910.00	910.00
55.250	910.00	910.00	910.00	910.00	910.00

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Time vs. Elevation
Label: C1 (OUT)
Scenario: 6-HR PMP

Return Event: 10,000 years
Storm Event: 6-Hr PMP

Time vs. Elevation (ft)

Output Time increment = 0.010 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
55.300	910.00	910.00	910.00	910.00	910.00
55.350	910.00	910.00	910.00	910.00	910.00
55.400	910.00	910.00	910.00	910.00	910.00
55.450	910.00	910.00	910.00	910.00	910.00
55.500	910.00	910.00	910.00	910.00	910.00
55.550	910.00	910.00	910.00	910.00	910.00
55.600	910.00	910.00	910.00	910.00	910.00
55.650	910.00	910.00	910.00	910.00	910.00
55.700	910.00	910.00	910.00	910.00	910.00
55.750	910.00	910.00	910.00	910.00	910.00
55.800	910.00	910.00	910.00	910.00	910.00
55.850	910.00	910.00	910.00	910.00	910.00
55.900	910.00	910.00	910.00	910.00	910.00
55.950	910.00	910.00	910.00	910.00	910.00
56.000	910.00	910.00	910.00	910.00	910.00
56.050	910.00	910.00	910.00	910.00	910.00
56.100	910.00	910.00	910.00	910.00	910.00
56.150	910.00	910.00	910.00	910.00	910.00
56.200	910.00	910.00	910.00	910.00	910.00
56.250	910.00	910.00	910.00	910.00	910.00
56.300	910.00	910.00	910.00	910.00	910.00
56.350	910.00	910.00	910.00	910.00	910.00
56.400	910.00	910.00	910.00	910.00	910.00
56.450	910.00	910.00	910.00	910.00	910.00
56.500	910.00	910.00	910.00	910.00	910.00
56.550	910.00	910.00	910.00	910.00	910.00
56.600	910.00	910.00	910.00	910.00	910.00
56.650	910.00	910.00	910.00	910.00	910.00
56.700	910.00	910.00	910.00	910.00	910.00
56.750	910.00	910.00	910.00	910.00	910.00
56.800	910.00	910.00	910.00	910.00	910.00
56.850	910.00	910.00	910.00	910.00	910.00
56.900	910.00	910.00	910.00	910.00	910.00
56.950	910.00	910.00	910.00	910.00	910.00
57.000	910.00	910.00	910.00	910.00	910.00
57.050	910.00	910.00	910.00	910.00	910.00
57.100	910.00	910.00	910.00	910.00	910.00
57.150	910.00	910.00	910.00	910.00	910.00
57.200	910.00	910.00	910.00	910.00	910.00
57.250	910.00	910.00	910.00	910.00	910.00
57.300	910.00	910.00	910.00	910.00	910.00

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Time vs. Elevation | Return Event: 10,000 years
Label: C1 (OUT) | Storm Event: 6-Hr PMP
Scenario: 6-HR PMP

Time vs. Elevation (ft)

Output Time increment = 0.010 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
57.350	910.00	910.00	910.00	910.00	910.00
57.400	910.00	910.00	910.00	910.00	910.00
57.450	910.00	910.00	910.00	910.00	910.00
57.500	910.00	910.00	910.00	910.00	910.00
57.550	910.00	910.00	910.00	910.00	910.00
57.600	910.00	910.00	910.00	910.00	910.00
57.650	910.00	910.00	910.00	910.00	910.00
57.700	910.00	910.00	910.00	910.00	910.00
57.750	910.00	910.00	910.00	910.00	910.00
57.800	910.00	910.00	910.00	910.00	910.00
57.850	910.00	910.00	910.00	910.00	910.00
57.900	910.00	910.00	910.00	910.00	910.00
57.950	910.00	910.00	910.00	910.00	910.00
58.000	910.00	910.00	910.00	910.00	910.00
58.050	910.00	910.00	910.00	910.00	910.00
58.100	910.00	910.00	910.00	910.00	910.00
58.150	910.00	910.00	910.00	910.00	910.00
58.200	910.00	910.00	910.00	910.00	910.00
58.250	910.00	910.00	910.00	910.00	910.00
58.300	910.00	910.00	910.00	910.00	910.00
58.350	910.00	910.00	910.00	910.00	910.00
58.400	910.00	910.00	910.00	910.00	910.00
58.450	910.00	910.00	910.00	910.00	910.00
58.500	910.00	910.00	910.00	910.00	910.00
58.550	910.00	910.00	910.00	910.00	910.00
58.600	910.00	910.00	910.00	910.00	910.00
58.650	910.00	910.00	910.00	910.00	910.00
58.700	910.00	910.00	910.00	910.00	910.00
58.750	910.00	910.00	910.00	910.00	910.00
58.800	910.00	910.00	910.00	910.00	910.00
58.850	910.00	910.00	910.00	910.00	910.00
58.900	910.00	910.00	910.00	910.00	910.00
58.950	910.00	910.00	910.00	910.00	910.00
59.000	910.00	910.00	910.00	910.00	910.00
59.050	910.00	910.00	910.00	910.00	910.00
59.100	910.00	910.00	910.00	910.00	910.00
59.150	910.00	910.00	910.00	910.00	910.00
59.200	910.00	910.00	910.00	910.00	910.00
59.250	910.00	910.00	910.00	910.00	910.00
59.300	910.00	910.00	910.00	910.00	910.00
59.350	910.00	910.00	910.00	910.00	910.00

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Time vs. Elevation	Return Event: 10,000 years
Label: C1 (OUT)	Storm Event: 6-Hr PMP
Scenario: 6-HR PMP

Time vs. Elevation (ft)

Output Time increment = 0.010 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
59.400	910.00	910.00	910.00	910.00	910.00
59.450	910.00	910.00	910.00	910.00	910.00
59.500	910.00	910.00	910.00	910.00	910.00
59.550	910.00	910.00	910.00	910.00	910.00
59.600	910.00	910.00	910.00	910.00	910.00
59.650	910.00	910.00	910.00	910.00	910.00
59.700	910.00	910.00	910.00	910.00	910.00
59.750	910.00	910.00	910.00	910.00	910.00
59.800	910.00	910.00	910.00	910.00	910.00
59.850	910.00	910.00	910.00	910.00	910.00
59.900	910.00	910.00	910.00	910.00	910.00
59.950	910.00	910.00	910.00	910.00	910.00
60.000	910.00	910.00	910.00	910.00	910.00
60.050	910.00	910.00	910.00	910.00	910.00
60.100	910.00	910.00	910.00	910.00	910.00
60.150	910.00	910.00	910.00	910.00	910.00
60.200	910.00	910.00	910.00	910.00	910.00
60.250	910.00	910.00	910.00	910.00	910.00
60.300	910.00	910.00	910.00	910.00	910.00
60.350	910.00	910.00	910.00	910.00	910.00
60.400	910.00	910.00	910.00	910.00	910.00
60.450	910.00	910.00	910.00	910.00	910.00
60.500	910.00	910.00	910.00	910.00	910.00
60.550	910.00	910.00	910.00	910.00	910.00
60.600	910.00	910.00	910.00	910.00	910.00
60.650	910.00	910.00	910.00	910.00	910.00
60.700	910.00	910.00	910.00	910.00	910.00
60.750	910.00	910.00	910.00	910.00	910.00
60.800	910.00	910.00	910.00	910.00	910.00
60.850	910.00	910.00	910.00	910.00	910.00
60.900	910.00	910.00	910.00	910.00	910.00
60.950	910.00	910.00	910.00	910.00	910.00
61.000	910.00	910.00	910.00	910.00	910.00
61.050	910.00	910.00	910.00	910.00	910.00
61.100	910.00	910.00	910.00	910.00	910.00
61.150	910.00	910.00	910.00	910.00	910.00
61.200	910.00	910.00	910.00	910.00	910.00
61.250	910.00	910.00	910.00	910.00	910.00
61.300	910.00	910.00	910.00	910.00	910.00
61.350	910.00	910.00	910.00	910.00	910.00
61.400	910.00	910.00	910.00	910.00	910.00

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Time vs. Elevation | Return Event: 10,000 years
Label: C1 (OUT) | Storm Event: 6-Hr PMP
Scenario: 6-HR PMP

Time vs. Elevation (ft)

Output Time increment = 0.010 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
61.450	910.00	910.00	910.00	910.00	910.00
61.500	910.00	910.00	910.00	910.00	910.00
61.550	910.00	910.00	910.00	910.00	910.00
61.600	910.00	910.00	910.00	910.00	910.00
61.650	910.00	910.00	910.00	910.00	910.00
61.700	910.00	910.00	910.00	910.00	910.00
61.750	910.00	910.00	910.00	910.00	910.00
61.800	910.00	910.00	910.00	910.00	910.00
61.850	910.00	910.00	910.00	910.00	910.00
61.900	910.00	910.00	910.00	910.00	910.00
61.950	910.00	910.00	910.00	910.00	910.00
62.000	910.00	910.00	910.00	910.00	910.00
62.050	910.00	910.00	910.00	910.00	910.00
62.100	910.00	910.00	910.00	910.00	910.00
62.150	910.00	910.00	910.00	910.00	910.00
62.200	910.00	910.00	910.00	910.00	910.00
62.250	910.00	910.00	910.00	910.00	910.00
62.300	910.00	910.00	910.00	910.00	910.00
62.350	910.00	910.00	910.00	910.00	910.00
62.400	910.00	910.00	910.00	910.00	910.00
62.450	910.00	910.00	910.00	910.00	910.00
62.500	910.00	910.00	910.00	910.00	910.00
62.550	910.00	910.00	910.00	910.00	910.00
62.600	910.00	910.00	910.00	910.00	910.00
62.650	910.00	910.00	910.00	910.00	910.00
62.700	910.00	910.00	910.00	910.00	910.00
62.750	910.00	910.00	910.00	910.00	910.00
62.800	910.00	910.00	910.00	910.00	910.00
62.850	910.00	910.00	910.00	910.00	910.00
62.900	910.00	910.00	910.00	910.00	910.00
62.950	910.00	910.00	910.00	910.00	910.00
63.000	910.00	910.00	910.00	910.00	910.00
63.050	910.00	910.00	910.00	910.00	910.00
63.100	910.00	910.00	910.00	910.00	910.00
63.150	910.00	910.00	910.00	910.00	910.00
63.200	910.00	910.00	910.00	910.00	910.00
63.250	910.00	910.00	910.00	910.00	910.00
63.300	910.00	910.00	910.00	910.00	910.00
63.350	910.00	910.00	910.00	910.00	910.00
63.400	910.00	910.00	910.00	910.00	910.00
63.450	910.00	910.00	910.00	910.00	910.00

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Time vs. Elevation — Return Event: 10,000 years
Label: C1 (OUT) — Storm Event: 6-Hr PMP
Scenario: 6-HR PMP

Time vs. Elevation (ft)

Output Time increment = 0.010 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
63.500	910.00	910.00	910.00	910.00	910.00
63.550	910.00	910.00	910.00	910.00	910.00
63.600	910.00	910.00	910.00	910.00	910.00
63.650	910.00	910.00	910.00	910.00	910.00
63.700	910.00	910.00	910.00	910.00	910.00
63.750	910.00	910.00	910.00	910.00	910.00
63.800	910.00	910.00	910.00	910.00	910.00
63.850	910.00	910.00	910.00	910.00	910.00
63.900	910.00	910.00	910.00	910.00	910.00
63.950	910.00	910.00	910.00	910.00	910.00
64.000	910.00	910.00	910.00	910.00	910.00
64.050	910.00	910.00	910.00	910.00	910.00
64.100	910.00	910.00	910.00	910.00	910.00
64.150	910.00	910.00	910.00	910.00	910.00
64.200	910.00	910.00	910.00	910.00	910.00
64.250	910.00	910.00	910.00	910.00	910.00
64.300	910.00	910.00	910.00	910.00	910.00
64.350	910.00	910.00	910.00	910.00	910.00
64.400	910.00	910.00	910.00	910.00	910.00
64.450	910.00	910.00	910.00	910.00	910.00
64.500	910.00	910.00	910.00	910.00	910.00
64.550	910.00	910.00	910.00	910.00	910.00
64.600	910.00	910.00	910.00	910.00	910.00
64.650	910.00	910.00	910.00	910.00	910.00
64.700	910.00	910.00	910.00	910.00	910.00
64.750	910.00	910.00	910.00	910.00	910.00
64.800	910.00	910.00	910.00	910.00	910.00
64.850	910.00	910.00	910.00	910.00	910.00
64.900	910.00	910.00	910.00	910.00	910.00
64.950	910.00	910.00	910.00	910.00	910.00
65.000	910.00	910.00	910.00	910.00	910.00
65.050	910.00	910.00	910.00	910.00	910.00
65.100	910.00	910.00	910.00	910.00	910.00
65.150	910.00	910.00	910.00	910.00	910.00
65.200	910.00	910.00	910.00	910.00	910.00
65.250	910.00	910.00	910.00	910.00	910.00
65.300	910.00	910.00	910.00	910.00	910.00
65.350	910.00	910.00	910.00	910.00	910.00
65.400	910.00	910.00	910.00	910.00	910.00
65.450	910.00	910.00	910.00	910.00	910.00
65.500	910.00	910.00	910.00	910.00	910.00

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Time vs. Elevation
Label: C1 (OUT)
Scenario: 6-HR PMP

Return Event: 10,000 years
Storm Event: 6-Hr PMP

Time vs. Elevation (ft)

Output Time increment = 0.010 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
65.550	910.00	910.00	910.00	910.00	910.00
65.600	910.00	910.00	910.00	910.00	910.00
65.650	910.00	910.00	910.00	910.00	910.00
65.700	910.00	910.00	910.00	910.00	910.00
65.750	910.00	910.00	910.00	910.00	910.00
65.800	910.00	910.00	910.00	910.00	910.00
65.850	910.00	910.00	910.00	910.00	910.00
65.900	910.00	910.00	910.00	910.00	910.00
65.950	910.00	910.00	910.00	910.00	910.00
66.000	910.00	910.00	910.00	910.00	910.00
66.050	910.00	910.00	910.00	910.00	910.00
66.100	910.00	910.00	910.00	910.00	910.00
66.150	910.00	910.00	910.00	910.00	910.00
66.200	910.00	910.00	910.00	910.00	910.00
66.250	910.00	910.00	910.00	910.00	910.00
66.300	910.00	910.00	910.00	910.00	910.00
66.350	910.00	910.00	910.00	910.00	910.00
66.400	910.00	910.00	910.00	910.00	910.00
66.450	910.00	910.00	910.00	910.00	910.00
66.500	910.00	910.00	910.00	910.00	910.00
66.550	910.00	910.00	910.00	910.00	910.00
66.600	910.00	910.00	910.00	910.00	910.00
66.650	910.00	910.00	910.00	910.00	910.00
66.700	910.00	910.00	910.00	910.00	910.00
66.750	910.00	910.00	910.00	910.00	910.00
66.800	910.00	910.00	910.00	910.00	910.00
66.850	910.00	910.00	910.00	910.00	910.00
66.900	910.00	910.00	910.00	910.00	910.00
66.950	910.00	910.00	910.00	910.00	910.00
67.000	910.00	910.00	910.00	910.00	910.00
67.050	910.00	910.00	910.00	910.00	910.00
67.100	910.00	910.00	910.00	910.00	910.00
67.150	910.00	910.00	910.00	910.00	910.00
67.200	910.00	910.00	910.00	910.00	910.00
67.250	910.00	910.00	910.00	910.00	910.00
67.300	910.00	910.00	910.00	910.00	910.00
67.350	910.00	910.00	910.00	910.00	910.00
67.400	910.00	910.00	910.00	910.00	910.00
67.450	910.00	910.00	910.00	910.00	910.00
67.500	910.00	910.00	910.00	910.00	910.00
67.550	910.00	910.00	910.00	910.00	910.00

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Time vs. Elevation
Return Event: 10,000 years
Label: C1 (OUT)
Storm Event: 6-Hr PMP
Scenario: 6-HR PMP

Time vs. Elevation (ft)

Output Time increment = 0.010 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
67.600	910.00	910.00	910.00	910.00	910.00
67.650	910.00	910.00	910.00	910.00	910.00
67.700	910.00	910.00	910.00	910.00	910.00
67.750	910.00	910.00	910.00	910.00	910.00
67.800	910.00	910.00	910.00	910.00	910.00
67.850	910.00	910.00	910.00	910.00	910.00
67.900	910.00	910.00	910.00	910.00	910.00
67.950	910.00	910.00	910.00	910.00	910.00
68.000	910.00	910.00	910.00	910.00	910.00
68.050	910.00	910.00	910.00	910.00	910.00
68.100	910.00	910.00	910.00	910.00	910.00
68.150	910.00	910.00	910.00	910.00	910.00
68.200	910.00	910.00	910.00	910.00	910.00
68.250	910.00	910.00	910.00	910.00	910.00
68.300	910.00	910.00	910.00	910.00	910.00
68.350	910.00	910.00	910.00	910.00	910.00
68.400	910.00	910.00	910.00	910.00	910.00
68.450	910.00	910.00	910.00	910.00	910.00
68.500	910.00	910.00	910.00	910.00	910.00
68.550	910.00	910.00	910.00	910.00	910.00
68.600	910.00	910.00	910.00	910.00	910.00
68.650	910.00	910.00	910.00	910.00	910.00
68.700	910.00	910.00	910.00	910.00	910.00
68.750	910.00	910.00	910.00	910.00	910.00
68.800	910.00	910.00	910.00	910.00	910.00
68.850	910.00	910.00	910.00	910.00	910.00
68.900	910.00	910.00	910.00	910.00	910.00
68.950	910.00	910.00	910.00	910.00	910.00
69.000	910.00	910.00	910.00	910.00	910.00
69.050	910.00	910.00	910.00	910.00	910.00
69.100	910.00	910.00	910.00	910.00	910.00
69.150	910.00	910.00	910.00	910.00	910.00
69.200	910.00	910.00	910.00	910.00	910.00
69.250	910.00	910.00	910.00	910.00	910.00
69.300	910.00	910.00	910.00	910.00	910.00
69.350	910.00	910.00	910.00	910.00	910.00
69.400	910.00	910.00	910.00	910.00	910.00
69.450	910.00	910.00	910.00	910.00	910.00
69.500	910.00	910.00	910.00	910.00	910.00
69.550	910.00	910.00	910.00	910.00	910.00
69.600	910.00	910.00	910.00	910.00	910.00

Time vs. Elevation (ft)

Output Time increment = 0.010 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
69.650	910.00	910.00	910.00	910.00	910.00
69.700	910.00	910.00	910.00	910.00	910.00
69.750	910.00	910.00	910.00	910.00	910.00
69.800	910.00	910.00	910.00	910.00	910.00
69.850	910.00	910.00	910.00	910.00	910.00
69.900	910.00	910.00	910.00	910.00	910.00
69.950	910.00	910.00	910.00	910.00	910.00
70.000	910.00	910.00	910.00	910.00	910.00
70.050	910.00	910.00	910.00	910.00	910.00
70.100	910.00	910.00	910.00	910.00	910.00
70.150	910.00	910.00	910.00	910.00	910.00
70.200	910.00	910.00	910.00	910.00	910.00
70.250	910.00	910.00	910.00	910.00	910.00
70.300	910.00	910.00	910.00	910.00	910.00
70.350	910.00	910.00	910.00	910.00	910.00
70.400	910.00	910.00	910.00	910.00	910.00
70.450	910.00	910.00	910.00	910.00	910.00
70.500	910.00	910.00	910.00	910.00	910.00
70.550	910.00	910.00	910.00	910.00	910.00
70.600	910.00	910.00	910.00	910.00	910.00
70.650	910.00	910.00	910.00	910.00	910.00
70.700	910.00	910.00	910.00	910.00	910.00
70.750	910.00	910.00	910.00	910.00	910.00
70.800	910.00	910.00	910.00	910.00	910.00
70.850	910.00	910.00	910.00	910.00	910.00
70.900	910.00	910.00	910.00	910.00	910.00
70.950	910.00	910.00	910.00	910.00	910.00
71.000	910.00	910.00	910.00	910.00	910.00
71.050	910.00	910.00	910.00	910.00	910.00
71.100	910.00	910.00	910.00	910.00	910.00
71.150	910.00	910.00	910.00	910.00	910.00
71.200	910.00	910.00	910.00	910.00	910.00
71.250	910.00	910.00	910.00	910.00	910.00
71.300	910.00	910.00	910.00	910.00	910.00
71.350	910.00	910.00	910.00	910.00	910.00
71.400	910.00	910.00	910.00	910.00	910.00
71.450	910.00	910.00	910.00	910.00	910.00
71.500	910.00	910.00	910.00	910.00	910.00
71.550	910.00	910.00	910.00	910.00	910.00
71.600	910.00	910.00	910.00	910.00	910.00
71.650	910.00	910.00	910.00	910.00	910.00

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Time vs. Elevation
Label: C1 (OUT)
Scenario: 6-HR PMP

Return Event: 10,000 years
Storm Event: 6-Hr PMP

Time vs. Elevation (ft)

Output Time increment = 0.010 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
71.700	910.00	910.00	910.00	910.00	910.00
71.750	910.00	910.00	910.00	910.00	910.00
71.800	910.00	910.00	910.00	910.00	910.00
71.850	910.00	910.00	910.00	910.00	910.00
71.900	910.00	910.00	910.00	910.00	910.00
71.950	910.00	910.00	910.00	910.00	910.00
72.000	910.00	(N/A)	(N/A)	(N/A)	(N/A)

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Outlet Input Data	Return Event: 10,000 years
Label: Basin C1 0.5PMP w/ emergency	Storm Event: 6-Hr PMP
Scenario: 6-HR PMP	

Requested Pond Water Surface Elevations	
Minimum (Headwater)	910.00 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	929.50 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Orifice-Area	Orifice - 3	Forward	Culvert - 1	922.25	929.50
Inlet Box	Riser - 1	Forward	Culvert - 1	924.00	929.50
Orifice-Circular	Orifice - 1	Forward	Culvert - 1	910.00	929.50
Culvert-Circular	Culvert - 1	Forward	TW	909.00	929.50
Irregular Weir	Weir - 1	Forward	TW	926.50	929.50
Tailwater Settings	Tailwater			(N/A)	(N/A)

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Outlet Input Data	Return Event: 10,000 years
Label: Basin C1 0.5PMP w/ emergency	Storm Event: 6-Hr PMP
Scenario: 6-HR PMP	

Structure ID: Culvert - 1
Structure Type: Culvert-Circular

Number of Barrels	1
Diameter	42.0 in
Length	110.00 ft
Length (Computed Barrel)	110.00 ft
Slope (Computed)	0.009 ft/ft

Outlet Control Data

Manning's n	0.013
Ke	0.200
Kb	0.006
Kr	1.000
Convergence Tolerance	0.00 ft

Inlet Control Data

Equation Form	Form 1
K	0.0045
M	2.0000
C	0.0317
Y	0.6900
T1 ratio (HW/D)	1.091
T2 ratio (HW/D)	1.193
Slope Correction Factor	-0.500

Use unsubmerged inlet control 0 equation below T1 elevation.
Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

T1 Elevation	912.82 ft	T1 Flow	63.00 ft³/s
T2 Elevation	913.17 ft	T2 Flow	72.00 ft³/s

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

Subsection: Outlet Input Data	Return Event: 10,000 years
Label: Basin C1 0.5PMP w/ emergency	Storm Event: 6-Hr PMP
Scenario: 6-HR PMP	

Structure ID: Orifice - 1
Structure Type: Orifice-Circular

Number of Openings	1
Elevation	910.00 ft
Orifice Diameter	24.0 in
Orifice Coefficient	0.600

Structure ID: Riser - 1
Structure Type: Inlet Box

Number of Openings	1
Elevation	924.00 ft
Orifice Area	64.0 ft²
Orifice Coefficient	0.600
Weir Length	32.00 ft
Weir Coefficient	3.00 (ft^0.5)/s
K Reverse	1.000
Manning's n	0.000
Kev, Charged Riser	0.000
Weir Submergence	False
Orifice H to crest	False

Structure ID: Orifice - 3
Structure Type: Orifice-Area

Number of Openings	3
Elevation	922.25 ft
Orifice Area	4.5 ft²
Top Elevation	923.00 ft
Datum Elevation	922.25 ft
Orifice Coefficient	0.600

Structure ID: Weir - 1
Structure Type: Irregular Weir

Station (ft)	Elevation (ft)
0.00	3.00
9.00	0.00
139.00	0.00
148.00	3.00

Lowest Elevation	926.50 ft
Weir Coefficient	3.10 (ft^0.5)/s

Structure ID: TW

Subsection: Outlet Input Data

Label: Basin C1 0.5PMP w/ emergency

Scenario: 6-HR PMP

Return Event: 10,000 years

Storm Event: 6-Hr PMP

Structure Type: TW Setup, DS Channel

Tailwater Type	Free Outfall

Convergence Tolerances

Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft³/s
Flow Tolerance (Maximum)	10.000 ft³/s

Revised 0.5PMP Analysis for In-Stream Detention Basin C1

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APPENDIX L

Woodside Ridge TR-60 Analysis

WOODSIDE RIDGE
TR-60 ANALYSIS

Prepared for:

Clayton Properties Group, INC. dba Summit Homes

Lee's Summit, MO

STATE OF MISSOURI
BRIAN H.
LADD
NUMBER
PE-2014012020
5-16-19
PROFESSIONAL ENGINEER

May 2019

Olsson Project No. A18-1140

olsson

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APPENDICES

1. INTRODUCTION

The Woodside Ridge First Plat consists of 143 single family residential lots, two detention facilities, and one existing pond. The project is located west of and adjacent to Pryor Road, between Ashurst Drive and SW 1st Street, which lies in the east half of Section 2, Township 47N, Range 32W, Lee's Summit, Jackson County, Missouri. Stormwater from Woodside Ridge is conveyed into the Cedar Creek Watershed, primarily via two unnamed tributaries which flow east to west through the property. The "Revised Woodside Ridge Macro and First Plat Micro Drainage Study" (March 2019) evaluated the hydrologic impact generated by the construction of the Woodside Ridge First Plat as well as evaluated the future conditions that includes the full build-out of the Woodside Ridge property.

The purpose of this report is to provide supplementary information and discussions regarding the applicability of the March 2019 edition of National Resources Conservation Society (NRCS) Technical Release 210-60 (TR-60) to the proposed in-stream detention (Basin C1) provided within the First Plat onsite channel in Watershed C.

1.1 KC-APWA Section 5600

In the drainage study, the stormwater quantity management was based upon methods and objectives for comprehensive detention defined in the Kansas City Metropolitan Chapter of the American Public Works Association (KC-APWA) "Section 5600 Storm Drainage Systems & Facilities" (2011). Section 5608 Stormwater Detention and Retention governs the requirements and design of stormwater detention and retention facilities. Per Section 5608.4(A)(2), it states "Dams which are greater than 10 feet in height but do not fall into State or Federal requirement categories shall be designed in accordance with latest edition of SCS Technical Release No. 60, "Earth Dams and Reservoirs", as Class "C" structures", where Class "C" structures are considered high hazard class dams per NRCS TR-60 (2005). Section 2 through Section 8 address requirements listed in TR-60 and whether they apply to Basin C1.

2. GENERAL (TR-60 PART 1)

2.2 Classes of Dams

The effective height of the dam, as defined by TR-60, for Basin C1 is designed to be 17.6 feet, where the elevation of the lowest open-channel auxiliary spillway crest is 926.50 feet and the lowest point in the original cross section on the centerline of the dam is 908.87 feet. According to KC-APWA 5600, the dam for Basin C1 is classified as a "High Hazard Potential" dam, which is defined by TR-60 as "dams where failure may cause loss of life or serious damage to homes, industrial and commercial buildings, important public utilities, main highways, or railroads."

2.3 Peak Breach Discharge Criteria

The purpose of performing a breach analysis is to help delineate the area potentially impacted by inundation should a dam fail and to aid in the dam hazard potential classification. There are six homes located Downstream of Basin C1 that may be potentially impact if the dam were to fail and are listed below in Table 1.

Table 1. Homes Downstream of Basin C1.

Address
105 SW Whitlock Drive
104 NW Whitlock Drive
100 NW Whitlock Drive
2132 SW 1 Street
2136 SW 1 Street
2140 SW 1 Street

Basin C1 is designed as a dry dam with no permanent pool. TR-60 defines a dry dam as "a dam that has an ungated outlet positioned that allows the drainage of essentially all water from the reservoir by gravity. The reservoir will normally remain dry." If the dam were to breach when retaining the 100-year event, it is likely that these four properties and Whitlock Drive will be impacted by inundation. Downstream of Whitlock Drive the channel flows through undeveloped area and enters Cedar Creek. Per KC-APWA 5600, the dam is classified as a high hazard potential dam, the highest level of dam hazard potential classification. A breach analysis was not performed on Basin C1 as the result would not change the dam classification and the downstream impacts were identified as the four homes and SW Whitlock Drive. The requirements listed in this section of TR-60 do not apply.

2.4 Cut Slope Stability

See Section 5 for discussions regarding the geotechnical investigation plan and Section 6 regarding stability evaluation of constructed slopes.

2.5 Reservoir Conservation Storage

Basin C1 is designed as a dry dam and is not designed to provide conservation storage. Requirements listed in this section of TR-60 do not apply.

2.6 Joint Use of Reservoir Capacity

Basin C1 is designed as a dry dam and not as a joint-use storage dam. Requirements listed in this section of TR-60 do not apply.

2.7 Visual Resource Design

Basin C1 is designed as a dry dam with no permanent pool. When water is present behind the dam, the water is screened from the view by existing trees and vegetation that are to remain within the development. Requirements listed in this section of TR-60 do not apply.

2.8 Safety and Protection

There is no need to provide fences or other barriers to protect the dam from livestock, foot traffic, or vehicular traffic due to the Basin C1's proposed location within a detention tract with no planned future development. The riser for Basin C1 is approximately 14 feet tall and will have a trash rack attached to the open top and to the other openings, preventing access by the public. The side slopes of the dam are at a 3:1 slope. The plunge pool is designed to be approximately 4 feet deep, with 3:1 side slopes, allowing for safe access for operation and maintenance (O&M) personnel.

2.9 Water Supply Pipes

Basin C1 will not have any water supply pipes or conduits for other purposes installed under any part of the embankment. Requirements listed in this section of TR-60 do not apply.

2.10 Utility Cables and Pipelines

Basin C1 will not have any utility cables or conduits (existing or proposed) located under any part of the embankment. Requirements listed in this section of TR-60 do not apply.

2.11 Streamflow Diversion During Construction

The contractor is to maintain streamflow using diversion techniques throughout the construction of the dam, as indicated on the plans.

3. HYDROLOGY (TR-60 PART 2)

Title 210, National Engineering Handbook, Part 630, Chapter 21, "Design Hydrographs" (210-NEH-630-21) details the process for developing the principal spillway, auxiliary spillway, and freeboard design hydrographs for TR-60. TR-60 recommends obtaining precipitation data from the most recent National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) reference when creating the hydrographs. At the direction of the City of Lee's Summit, "Technical Paper No. 40 Rainfall Frequency Atlas of the United States" (TP-40) precipitation depths were used in lieu of NOAA Atlas 14 precipitation depths.

3.1 Principal Spillway Design Hydrographs

TR-60 requires sizing the principal spillway using runoff from a storm duration of not less than 10 days. According to Figure 2-1 in TR-60, for a high hazard class of dam, the precipitation data to be used in the analysis is from the 100-year return period.

Developing the principal spillway hydrograph (PSH) requires three main parts: (1) development of the principal spillway mass curve, (2) development of the unit hydrograph, and (3) development of the PSH. In developing the PSH, it was discovered that the TR-60 method could not be utilized due to the short time of concentration (0.252 hours) within the watershed draining to Basin C1. This time of concentration results in the unit hydrograph peaking at 0.17 hours. The time step for the composite PSH is one hour (for a total duration of 240 hours, or 10 days). When applying the unit hydrograph to the developed incremental runoff volume of the principal spillway mass curve, there was no impact from the unit hydrograph on the composite PSH.

Therefore, the principal spillway for Basin C1 was designed based on routing the 100-year return period storm. Due to the capacity limitations of an existing 54" corrugated metal pipe (CMP) crossing underneath SW Whitlock Drive and located downstream of the dam, Basin C1's principal spillway was designed to reduce the outgoing flows to below the as-built 100-year design of the 54" CMP.

3.2 Auxiliary Spillway and Freeboard Hydrographs

TR-60 requires sizing the auxiliary spillway and freeboard hydrographs following procedures outlined in 210-NEH-630-21. The recommended procedures could not be utilized due to the short time of concentration, as described above in Section 3.1. Therefore, the auxiliary spillway is designed following both KC-APWA 5600 and the Missouri Department of Natural Resources (MDNR) Dam Safety Publication No. 3, "Rules and Regulations of the Missouri Dam and Reservoir Safety Council". A freeboard hydrograph was not developed for Basin C1.

Per KC-APWA 5600 requirements, the 100-year hydrograph was routed through the auxiliary spillway assuming zero available storage in the basin and zero flow through the primary outlet.

Table 5 in the MDNR publication requires that for a new dam less than 50 feet in height and designated as an Environmental Class II (Class II downstream environment zone contains 1-9 permanent dwellings), the spillway design flood precipitation value to be used is half of the Probable Maximum Precipitation (0.5PMP). Figure 2-2 in TR-60 lists the minimum precipitation data requirement for the auxiliary spillway hydrograph of a high hazard class of dam to be:

$$P_{100}+0.26(PMP-P_{100}),$$

where P_{100} is the precipitation for the 100-year return period and PMP is the probable maximum precipitation. Given a P_{100} of 7.90 inches and a PMP of 27.5 inches, the resultant minimum precipitation value per TR-60 is 13 inches. A 6-hour 0.5PMP rainfall depth of 13.75 inches, determined from "Hydrometeorological Report No. 51" (HMR 51), was routed through the watershed using a NRCS type II distribution to determine the peak elevation of the storm in the basin in relation to the crest of the dam. The 6-hour 0.5PMP hydrograph was routed through the auxiliary spillway assuming the principal spillway was also in use.

Both the 100-year and the 0.5PMP hydrographs were used in designing the auxiliary spillway, see Section 8 for additional details.

3.3 Dams in Series (Upper Dam and Lower Dam)

Basin C1 consists of only one dam. Requirements listed in this section of TR-60 do not apply.

3.4 Large Drainage Areas

The watershed contributing to Basin C1 is 75.11 acres (0.12 square miles) in size and the time of concentration is 0.252 hours. Requirements listed in this section of TR-60 do not apply.

4. SEDIMENTATION (TR-60 PART 3)

Basin C1 is designed as a dry dam and not as a reservoir used to store water. The removal of any sediment accumulation within the basin that could affect the principal spillway or storage capacity will be addressed through regular O&M of the Basin C1. Requirements listed in this section of TR-60 regarding determining the volume of required for sediment accumulation and its allocation in the reservoir do not apply.

5. GEOLOGIC AND GEOTECHNICAL CONSIDERATIONS (TR-60 PART 4)

TR-60 requires a geotechnical report with the following minimum requirements: description of key geotechnical and geologic issues at the site, anticipated design, preliminary profiles and cross sections, drill holes in stick figure format with field classifications and in-situ test results, and field and laboratory classifications. A Geotechnical Engineering Report for the project "Woodside Ridge, 1st Plat" is included in Appendix B. Not all of the specific requirements of TR-60 relates to a dry detention basin. A dry detention basin does not have a permanent pool and is primarily used to enable particulate pollutants to settle out during rain events as well as to reduce the maximum peak discharge to the downstream channel. By reducing the discharge, the effective shear stress on the downstream banks is reduced significantly.

5.1 Soils with Dispersive Clays

Exposed slopes with dispersive clays can cause severe erosion. The erosion can result in riling and gullying of the embankments. Clay liners constructed from dispersive clay soils may erode rapidly and lose effectiveness. Based on the geotechnical exploration of the site, the site is generally characterized by moderately high to high plasticity clay soils, while dispersive clays are generally described as being low to medium plasticity. As such, dispersive clays are not anticipated at this time. A pinhole test can be performed to confirm this assumption. This section of TR-60 does not apply.

5.2 Karst

Based on the Missouri Center for Applied Research and Engagement Systems (CARES), Basin C1 is not located within a karstic region. This section of TR-60 does not apply.

5.3 Collapsible Soils

Collapsible soils are typically found in arid or semiarid region and have a loose structure, i.e. large void ratio. They are found in soil deposits that are eolian, loessial, subaerial, mudflows, alluvial, or fills. The site does not have collapsible soils as the native clay soils at this site consist of residual clays derived from the erosion of the parent bedrock material, i.e. natural erosion and sedimentation. This section of TR-60 does not apply.

5.4 Liquefaction Susceptibility

Liquefaction takes place when loosely packed, water-logged sediments at or near the ground surface lose their strength in response to strong ground shaking. As this site is not located within a seismically active zone and consists of native fat clay soils that are not hydraulically bonded, liquefaction potential is not susceptible. This section of TR-60 does not apply.

5.5 Seismicity and Earthquake Loading

According to the CARES website, the site is not located within a seismically active area. In conjunction with TR-60, the site is not located in Zones 3 or 4, nor are there any active faults near the area. Therefore, the stability of the embankment does not need to account for horizontal accelerations. This section of TR-60 does not apply.

5.6 Auxiliary Spillways

TR-60 indicates that large dams with auxiliary spillways in soft rock or cemented soil materials cannot be classified as soil as defined in NEH -628, Chapter 52, or as rock as generally defined for engineering purposes. Spillways in rocks with extraordinary defects require a special individual evaluation. The Basin C1 dam is not a large dam nor is the spillway excavated into rock. This section of TR-60 does not apply.

5.7 Mass Movements

TR-60 recommends evaluating for landslides and landslide potential at dam and reservoir sites, especially those in shales and where unfavorable dip-slope or other adverse rock attitudes occur. There is no history of mass movement in the project area. Auxiliary spillway cuts and reservoir effects will be given careful consideration and are evaluated with the slope stability analysis in Section 6 of this report.

5.8 Subsidence

Basin C1 is designed as a dry dam within a single family home residential development. The Woodside Ridge development has no past or future solid, liquid (including groundwater) or gaseous mineral extraction planned that could cause potential surface subsidence. This section of TR-60 does not apply.

5.9 Multipurpose and Water Retention Dams

Basin C1 is designed as a dry dam and not as a reservoir used to store water. The following requirements listed in this section of TR-60 do not apply: investigate and evaluate the groundwater regime and hydraulic characteristics of the entire reservoir area of water storage for potential leakage; develop and analyze water budgets to assure the adequacy of the site to accomplish the intent of the project.

5.10 Other

No other special studies and evaluations were considered necessary for the construction of Basin C1.

6. EARTH EMBANKMENT AND FOUNDATIONS (TR-60 PART 5)

6.1. Height

The crest of the earth dam embankment is set to provide one foot of freeboard for the 6-hour 0.5 PMP hydrograph. The TR-60 freeboard hydrograph could not be developed, as described in Section 3 of this report. The effects of wave action and frost conditions were not evaluated since Basin C1 is a dry dam and will drain within 24 hours.

6.2. Top Width

The top width of Basin C1's embankment meets the minimum top width requirement listed in Figure 5-1 in TR-60. The overall height of the embankment is 17.6 feet. Per Figure 5-1, for an overall height of embankment greater than 15 feet but less than 19.9 feet, the minimum top width for all dams is 10 feet. The embankment will not serve as a public roadway.

6.3. Embankment Slope Stability

The embankment slope stability was evaluated under both drained (effective) and undrained (end-of-construction) conditions. A description of this analysis can be found in the Geotechnical Engineering Report in Appendix B. Table 2 provides a summary of the global stability analysis results. The calculated factor of safety exceeds the required factor of safety for each condition.

Table 2. Global Stability Analysis Results.

	Factor of Safety (Calculated)	Factor of Safety (Required)
End of Construction (Total Stress)	3.0	1.4
End of Construction (Effective Stress)	2.0	1.4
Full Reservoir	2.3	1.5

6.4. Static Stability

The total and effective strength parameters for the Basin C1 dam were both found to meet the factor of safety requirements.

6.4.1 Stability During Construction

Embankment and foundation soils will not develop significant pore pressures during embankment construction. The stability during construction is equivalent to the static stability. The total and effective strength parameters for the Basin C1 dam were both found to meet the factor of safety requirements.

6.4.2 Rapid Drawdown

Basin C1 is designed as a dry dam to be drained within 24-hours after a storm event. There is no normal pool level associated with the dam and the 24 hours does not allow for the embankment soils to become saturated enough to require a rapid drawdown condition. This TR-60 design condition does not apply.

6.4.3 Steady Seepage

Basin C1 is designed as a dry dam to be drained within 24-hours after a storm event. There is no normal pool level associated with the dam. As such, seepage paths do not have enough time to develop. The requirements listed in this section of TR-60 do not apply.

6.4.4 Flood Surcharge

TR-60 requires the analysis of the downstream slope stability of new or previously constructed dams under flood detention conditions. Basin C1 is designed to be a dry dam, with no permanent pool. A phreatic surface does not develop within the limited time (<24 hours) water is stored in the basin; the requirement of developing a phreatic surface resulting from the maximum reservoir elevation does not apply. Seepage is a long-term condition that is only present in permanent pool situations; the requirements of performing a seepage analysis and evaluating seepage conditions that could develop do not apply.

The stability of the dam was evaluated for a full-reservoir condition, assuming a plugged drainage system. The calculated factor of safety under this condition is 2.3, whereas the required factor of safety is 1.5, as shown in Table 2. The calculated factor of safety exceeds the required factor of safety for this condition.

The following requirements listed in this section of TR-60 do not apply: Evaluating the potential for increase in pore pressures in the normally saturated portion of the foundation or embankment that may result from the higher reservoir loading; evaluating a range of potential seepage conditions to determine the sensitivity of flood storage stability to potential seepage conditions.

6.5 Dynamic Stability

The effects of earthquake loadings for Basin C1 were not considered. The site is not located in a seismically active zone nor are there any active faults near the site as listed in Section 5.5. Requirements listed in this section of TR-60 do not apply.

6.5.1 Analysis (Seismic)

Requirements listed in this section of TR-60 do not apply.

6.5.2 Sites with Limited Loss of Strength Under Earthquake Loading

Requirements listed in this section of TR-60 do not apply.

6.5.3 Sites with the Potential for Significant Loss of Strength Under Earthquake Loading

Requirements listed in this section of TR-60 do not apply.

6.6 Seepage

Basin C1 is designed as a dry dam to be drained within 24-hours after a storm event. Therefore, seepage paths do not have time to develop. The effects of seepage were not evaluated. Requirements listed in this section of TR-60 do not apply.

6.6.1 Analysis (Seepage)

Requirements listed in this section of TR-60 do not apply.

6.6.2 Material Properties

Requirements listed in this section of TR-60 do not apply.

6.6.3 Design Requirements

Requirements listed in this section of TR-60 do not apply.

6.7 Geosynthetics

Geosynthetics will not be used in the construction of the dam for Basin C1. Requirements listed in this section of TR-60 do not apply.

6.8 Zoning

Basin C1 is designed as a dry dam to be drained within 24-hours after a storm event. Zoning embankments to control seepage in a safe manner does not apply. Requirements listed in this section of TR-60 do not apply.

6.9 Surface Protection

The embankment surface will be protected against surface erosion through the use of vegetative protection and the use of Flexamat® Plus on the auxiliary spillway.

6.9.1 Vegetative Protection

The vegetative protection on the embankment surface will meet the following conditions outlined in TR-60: inundation of the surfaces is of such frequency that will not inhibit vegetative growth; vigorous growth sustainable under average climatic conditions by normal maintenance without irrigation. The TR-60 design condition of providing stable protection in accordance with TR 210-56, "A Guide for Design and Layout of Vegetative Wave Protection for Earth Dam Embankments" erosion does not apply.

6.9.2 Structural Protection

Basin C1 is designed as a dry dam to be drained within 24-hours after a storm event. There is no normal pool level associated with the dam. The TR-60 design condition of providing protection against wave erosion does not apply.

6.10 Observation and Instrumentation

Basin C1 is designed as a dry dam to be drained within 24-hours after a storm event. The inclusion of instrumentation to monitor surface movement of embankment and structures and to measure pore pressures is considered unnecessary for this dam. Requirements listed in this section of TR-60 do not apply.

6.11 Parapet Walls

Basin C1 design does not include the use of parapet walls. Requirements listed in this section of TR-60 regarding the design of parapet walls do not apply.

7. PRINCIPAL SPILLWAYS (TR-60 PART 6)

TR-60 states that the structural design and detailing of principal spillways must conform to the recommendations of 210-NEM-636, "Structural Design" (210-NEM-536, "Structural Engineering"), and NRCS standard drawings. The design of the principal spillway is detailed in the construction plans, with a requirement for the contractor to submit shop drawings detailing the structure dimensions, inverts, and structural reinforcement details.

7.4 Capacity of Principal Spillways

Basin C1 is designed with a multiple-stage principal spillway. The requirement of the principal spillway capacity emptying at least 85% of the principal spillway hydrograph routed through the retarding pool in 10 days or less does not apply to Basin C1. Basin C1 is designed as a dry dam to be drained within 24-hours after a storm event. The principal spillway hydrograph was not developed for reasons stated in Section 3.1 of this report.

7.5 Elevation of Principal Spillways

7.5.1 Single Purposed Floodwater-Retarding Dam

Basin C1 is designed as a single-purpose floodwater-retarding dry dam. The elevation of the principal spillway is established to allow for Basin C1 to drain within 24 hours.

7.5.2 Other Dams

Basin C1 is not designed to provide conservation storage. Requirements listed in the "Other Dams" section of TR-60 do not apply.

7.6 Routing of Principal Spillway Hydrographs

The principal spillway hydrograph routed through the dam is based on routing the 100-year storm, as described in Section 3 of this report. The anticipated accumulation of sediment was not included in the routing analysis; see Section 4 of this report. The initial reservoir stage for the 100-year storm corresponds with the crest of the lowest ungated inlet. The dam does not have significant base flow, is not designed for joint-use storage capacity, and is not a single-purpose low hazard class irrigation dam – the TR-60 requirements listed for these conditions do not apply.

7.7 Design of Principal Spillways

7.7.1 Hydraulics

The principal spillway is designed to carry the 100-year storm event per KC-APWA 5600.

7.7.2 Risers

The principal spillway is designed using PondPack v8i, and consists of the following:

- 24" orifice at an elevation of 910 feet
- Three (3) 6" x 9" orifice openings at an elevation of 922.25 feet
- 8' x 8' open top opening at an elevation of 924.00 feet
- 42" RCP outlet at 909.00 feet.

The riser meets the requirement of having a larger cross-sectional area than the conduit openings. The riser will be fitted with an angled trash rack to exclude large trash from passing freely through the outlet structure. A NRCS standard covered riser (risers with an inside width equal to the width diameter of the conduit and an inside length equal to three times the width D of the conduit), although encouraged by NRCS, is not applicable to this dam. The riser was designed to allow Basin C1 to drain within 24 hours. The maximum conduit velocity through the outlet structure does not exceed 30 feet per second nor does the spillway have a conduit larger than 48 inches in width or diameter; therefore, the design requirements for a special elbow and transition at the junction of the riser and conduit do not apply.

7.7.3 Conduits

The 42" conduit passing through the dam is designed to be straight in alignment. Thrust blocks are not required as there are no elbows. The conduit will withstand the internal hydraulic pressures without leakage under full external load and settlement and convey water at the design velocity without damage to the interior surface of the conduit. The conduit is designed as a positive projecting conduit.

7.7.4 Cast-in-Place Reinforced Concrete Conduits

The conduit for Basin C1 will be a precast conduit. This section of TR-60 does not apply.

7.7.5 Reinforced Concrete Pressure Pipe Conduits

The conduit for Basin C1 will be reinforced concrete pipe that uses a safety of factor of at least 1.33 when conducting the 3-edge bearing strength test. The maximum height of fill over the reinforced concrete pipe will be 14.5 feet. For a 42" RCP, with a fill height of 15 feet, a minimum of a Class II reinforced concrete pipe will be used in order to meet the TR-60 requirement of the conduit being designed to support at least 12 feet of earth fill above the pipe at all points along the conduit.

7.7.6 Conduit Diameter

The conduit diameter meets hydraulic requirements and facilitates inspection, cleaning, and repair (greater than 36 inches in diameter for personnel entry) and reduces plugging potential. Basin C1 meets the TR-60 minimum conduit diameter requirements of 30 inches for high hazard potential dams with yielding foundations. The diameter of the principal spillway conduit is 42 inches.

7.7.7 Corrugated Steel Pipe or Welded Steel Pipe Conduits

Corrugated steel pipe or welded steel pipe conduits will not be used on the Basin C1 dam. The requirements listed in this section of TR-60 do not apply.

7.7.8 Joints

Joints incorporating a round rubber gasket set in a positive groove that will prevent its displacement from either internal or external pressures under the required joint extensibility will be used. The precast concrete pipe conduit will have steel joint rings providing rubber-to-seal contact in the joint. The conduit will be placed on concrete cradles with tapered sides that extend, as a minimum, to the spring line of the pipe to facilitate compaction around the conduit.

7.7.9 Replacement of Installation of Conduits in Existing Embankments

The Basin C1 dam will be a newly constructed dam. The requirements listed in this section of TR-60 do not apply.

7.7.10 Conduit Abandonment

The Basin C1 dam will be a newly constructed dam. The requirements listed in this section of TR-60 do not apply.

7.7.11 Conduit Filters

Conduit filters are not required, see Section 6 of this report. The requirements listed in this subsection of TR-60 do not apply.

7.8 Outlets

The outlet on Basin C1 requires the installation of a stilling basin. In accordance with KC-APWA 5600 recommendations, the stilling basin is designed using Hydraulic Energy Circular No. 14, Third Edition (HEC-14). TR-60 recommends using NRCS TN 210-DN-6, "Riprap Lined Plunge Pool for Cantilever Outlet" to design plunge pools. The outlet structure on Basin C1 is designed using a straight apron and not a cantilever outlet. The requirements listed in this section of TR-60 regarding plunge pool and cantilever outlets do not apply.

7.9 Trash Racks

A trash rack will be installed on each opening on the riser for Basin C1. Because Basin C1 must drain within 24 hours to meet environmental permitting requirements, the TR-60 requirement of the average velocity of flow through a clean trash rack not exceeding 2.5 feet per second under the full range of stage and discharge does not apply.

7.10 Antivortex Devices

TR-60 states that all closed-conduit spillways designed for pressure flow must have adequate antivortex devices. There are no concerns of a vortex forming in the riser due to the rectangular shape of the riser opening. The requirement of an anti-vortex device does not apply.

8. AUXILIARY SPILLWAYS (TR-60 PART 7)

8.4 Closed-Conduit Auxiliary Spillways

The design of Basin C1 does not include a closed-conduit auxiliary spillway. This section of TR-60 does not apply.

8.5 Spillway Requirements

8.5.1 Capacity of Auxiliary Spillways

The auxiliary spillway has adequate capacity to pass the 100-year storm, assuming zero available storage in the basin and zero flow through the primary outlet and maintains a minimum of 1 foot of freeboard from the design stage (100-year) to the top of the dam per KC-APWA 5600 requirements. In routing the 0.5PMP event, the auxiliary spillway maintains 1 foot of freeboard from the top of the dam. The principal spillway is in use with the auxiliary spillway when routing the 0.5PMP event.

Per TR-60, the minimum required auxiliary spillway capacity is the greater of 200 ft^3/s or $237DA^{0.493}$ (82 ft^3/s), where DA is the drainage area in square miles. The auxiliary spillway was evaluated for providing capacity for 551 ft^3/s (100-year event), assuming the principal spillway was clogged and zero storage in the basin. The auxiliary spillway was also evaluated for providing capacity for the 0.5PMP event (where the peak flow out of the dam is 1,343 ft^3/s), assuming use of the principal spillway (206 ft^3/s) in conjunction with the auxiliary spillway (1,137 ft^3/s) and maintaining 1 foot of freeboard from the top of the dam.

Per KC-APWA 5600, the crest elevation for the auxiliary spillway is 0.5 feet or more above the maximum water surface elevation (925.96 feet) and is set at 926.50 feet. TR-60 requires providing a minimum of 3 feet difference in elevation between the crest of the auxiliary spillway and the settled top of dam. The top of dam elevation for Basin C1 is 929.50 feet, resulting in a difference in elevation of 3.0 feet.

8.5.2 Elevation of the Crest of the Auxiliary Spillway

Figure 2-1 in TR-60 states that for a high hazard class of dam, precipitation data for the 100-year storm must be used for both an earth and vegetated spillway. Setting the crest elevation by routing the principal spillway hydrograph and providing adequate storage and requirements for the associated principal spillway discharge to meet 10-day drawdown requirements does not apply to Basin C1. Basin is designed to drain within 24 hours and a TR-60 principal spillway hydrograph could not be developed as discussed in Section 3 of this report.

The crest elevation of the auxiliary spillway is set based on meeting KC-APWA 5600 requirements. KC-APWA requires auxiliary (emergency) spillways to be designed with the crest elevation 0.5 feet or more above the maximum water surface elevation in the detention facility attained by the maximum design storm for the facility. The auxiliary crest elevation is set at an elevation of 926.50 feet, which is 0.54 feet above the maximum water surface elevation detained in Basin C1 during the 100-year return period storm (water surface elevation 925.96 feet).

8.6 Auxiliary Spillway Routings

The 100-year and the 0.5PMP hydrograph were both routed through the auxiliary spillway. Per KC-APWA 5600 requirements, when routing the 100-year hydrograph through the auxiliary spillway, it was assumed that there was zero available storage in the basin and zero flow through the primary outlet. In routing the 0.5PMP storm, it was assumed that the principal spillway was used in conjunction with the auxiliary spillway, per TR-60. A freeboard of 1.80 feet is provided when routing the 100-year hydrograph and a freeboard of 1.07 feet is provided when routing the 0.5PMP hydrograph through the auxiliary spillway.

TR-60 states that the stability design and freeboard hydrographs are to be routed through the reservoir starting with the water surface at the highest of (1) the elevation of the lowest ungated principal spillway inlet, (2) anticipated elevation of the sediment storage, (3) elevation of the water surface associated with significant base flow, or (4) pool elevation after 10 days of drawdown from the maximum stage attained when routing the principal spillway hydrograph. These requirements listed in this section of TR-60 do not apply.

8.7 Hydraulic Design

Appendix A contains the PondPack output of the stage discharge relationship for the auxiliary spillway during the 100-year storm event and for the 0.5PMP event. See Appendix A for the complete PondPack output of these results. Table 3 and Table 4 provide information on the stage discharge relationship developed for the auxiliary spillway for selected stages. The discharge listed in Table 4 includes flows that passes through the primary spillway.

Table 3. Auxiliary Spillway Stage Discharge Relationship for the 100-year Storm.

Stage (Elevation, ft)	Discharge (cfs)
926.50	0
926.99	142.11
927.49	404.24
927.70	552.81

Table 4. Auxiliary Spillway and Principal Spillway Stage Discharge Relationship for the 0.5 PMP Storm.

Stage	Discharge
926.66	256.03
927.15	439.04
927.55	664.13
927.98	964.12
928.43	1342.17

Table 5 shows the depth of the water over the spillway and the depth in the exit channel for the 100-year and the 0.5 PMP events.

Table 5. Water Surface Depths for the 100-year and 0.5 PMP Storm.

Location	100-Yr Depth (ft)	0.5PMP Depth (ft)
Auxiliary Spillway Crest	1.22	1.96
Auxiliary Spillway Exit Channel	0.57	0.74

8.8 Structural Stability

Flexamat® Plus will be installed on the auxiliary spillway, providing stability during the passage of the design flows without blockage or breaching. See Section 8.9.6 for additional details regarding Flexamat® Plus.

8.9 Vegetated and Earth Auxiliary Spillways

The auxiliary spillway is designed as an armored vegetated spillway. The cross section is trapezoidal and will have Flexamat® Plus installed to provide armored protection. Flexamat® Plus allows for vegetation to grow up through the spacings between the concrete tiles while resisting erosion from auxiliary spillway flows.

8.9.1 Layout

The layout of the auxiliary spillway is placed over the top of the dam due to site limitations and cannot be located away from the dam. The exit channel is parallel to the direction of flow through the auxiliary spillway. The level crest is the same length as the exit channel, 130 feet. The auxiliary spillway meets the definition of a ramp spillway per TR-60, with the exception that the spillway will also be armored and not only vegetated. The auxiliary spillway and exit channel will be armored using Flexamat® Plus to protect against erosion.

8.9.2 Stability Design of Vegetated and Earth Spillways

The spillway on Basin C1 will be stabilized using Flexamat ® Plus. The maximum shear stress the exit channel would be subject to was calculated based on the use of Flexamat® Plus, assuming uniform flow conditions in the exit channel during the maximum discharge for both the 100-year and 0.5 PMP events. The spillway is anticipated to be used once in 100 years. AH-667 was not used to determine the allowable vegetal stress in vegetated spillways since the vegetated spillway will be armored using Flexamat® Plus. Table 6 lists the calculated shear stress on the spillway. Flexamat® is able to withstand 24 lb/ft^2 of shear stress based on ASTM 6460 testing performed by the manufacturer. See Appendix C for shear stress calculation details and Appendix D for Flexamat® testing information. See section 8.9.6 for more information on shear in the auxiliary spillway.

Table 6. Calculated Shear Stress on Auxiliary Spillway.

Storm Event	Shear Stress on Spillway (lb/ft^2)
100-Year	11.6
0.5 PMP	15.4

8.9.3 Integrity Design of Vegetated and Earth Spillways

The spillway is to be armored with Flexamat® Plus and will have riprap installed along the groin of the dam to protect against any potential headcut development. The spillway was not evaluated using procedures outlined in 210-NEH-628-51, "Earth Spillway Erosion Model" or 628-52, "Field Procedures Guide for the Headcut Erodibility Index".

8.9.4 Special Precautions for High Hazard Potential Dams

The auxiliary spillway channel is the same width as the auxiliary spillway located at the top of the dam. The area most susceptible to erosion is a considerable distance from the dam. Exit channel levees were deemed unnecessary for this dam. The spillway is to be armored with Flexamat® Plus and additional riprap installed at the groin of the dam to protect the spillway from breaching.

8.9.5 Barriers to Stop Headcut Progression in Earth Spillways

Flexmat® Plus and additional riprap at the groin of the dam are to be installed and act as barriers to stop headcut progression for Basin C1.

8.9.6 Armored Earth Auxiliary Spillways

The auxiliary spillway will have Flexamat® Plus installed to protect the spillway. The limiting shear stress is 24 lb/ft^2 for a non-vegetated condition and the limiting velocity is 30 ft/s for a non-vegetated condition. Table 7 below shows a summary of the shear conditions for both the 100-year event and the 0.5PMP event. See Appendix D for Flexamat® product literature.

Table 7. Shear Conditions on Auxiliary Spillway Exit Channel.

Event	Water Depth (ft)	Velocity (ft/s)	Shear Stress (lbs/ft^2)
100-Year	0.56	7.47	11.6
0.5PMP	0.74	11.6	15.4

8.10 In-Situ Rock Auxiliary Spillways

Basin C1 will not consist of an auxiliary spillway excavated into rock. This section of TR-60 does not apply.

8.11 Structural Auxiliary Spillways

Basin C1 will not consist of a structural auxiliary spillway. This section of TR-60 does not apply.

9. CONCLUSIONS AND RECOMMENDATIONS

Basin C1 is designed as a dry dam with no permanent pool and is designed to drain within 24-hours after a 100-year storm event. The design of the dam has been evaluated against the requirements listed out in TR-60. This report outlines what requirements in TR-60 are applicable, and which are not. Olsson respectfully requests for the City of Lee's Summit to accept the design of the Basin C1 dam based on the findings of this TR-60 analysis.

10. REFERENCES

Hydraulic Engineering Circular No. 14, Third Edition (2006). "Hydraulic Design of Energy Dissipators for Culverts and Channels". Federal Highway Administration.

KC-APWA (Kansas City Metropolitan Chapter of the American Public Works Association). (2011). "Section 5600 Storm Drainage & Facilities."

Missouri Department of Natural Resources. "Dam Safety Publication No. 3 Rules and Regulations of the Missouri Dam and Reservoir Safety Council". Missouri Department of Natural Resources, Rolla, MO.

National Resources Conservation Service. "Technical Release 210-60 Earth Dams and Reservoirs" (March 2019). United States Department of Agriculture.

National Resources Conservation Service. "Technical Release 210-60 Earth Dams and Reservoirs" (July 2005). United States Department of Agriculture.

National Weather Service. "Hydrometeorological Report No. 51 Probable Maximum Precipitation Estimates, United States East of the 105th Meridian" (1978). Department of Commerce, Washington, D.C.

APPENDIX A

PondPack Outputs

Auxiliary Spillway Stage Discharge - 100 YR (APWA 5600)

Project Summary	
Title	Woodside Ridge - Proposed Conditions Emergency Spillway Designs
Engineer	JJL
Company	Olsson
Date	5/9/2019

Notes

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APWA Basin C1 Emergency Spillway

Auxiliary Spillway Stage Discharge - 100 YR (APWA 5600)

Subsection: Outlet Input Data
Label: APWA Basin C1 Emergency Spillway
Scenario: 100-Year

Return Event: 100 years
Storm Event: 100-YEAR

Requested Pond Water Surface Elevations	
Minimum (Headwater)	925.96 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	929.50 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Irregular Weir	Emergency Spillway Weir	Forward	TW	926.50	929.50
Tailwater Settings	Tailwater			(N/A)	(N/A)

Auxiliary Spillway Stage Discharge - 100 YR (APWA 5600)

Subsection: Outlet Input Data	Return Event: 100 years
Label: APWA Basin C1 Emergency Spillway	Storm Event: 100-YEAR
Scenario: 100-Year	

Structure ID: Emergency Spillway Weir
Structure Type: Irregular Weir

Station (ft)	Elevation (ft)
0.00	3.00
9.00	0.00
139.00	0.00
148.00	3.00

Lowest Elevation	926.50 ft
Weir Coefficient	3.10 (ft^0.5)/s

Structure ID: TW
Structure Type: TW Setup, DS Channel

Tailwater Type	Free Outfall

Convergence Tolerances

Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft³/s
Flow Tolerance (Maximum)	10.000 ft³/s

Auxiliary Spillway Stage Discharge - 100 YR (APWA 5600)

Subsection: Individual Outlet Curves
Label: APWA Basin C1 Emergency Spillway
Scenario: 100-Year

Return Event: 100 years
Storm Event: 100-YEAR

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Emergency Spillway Weir (Irregular Weir)

Upstream ID = (Pond Water Surface)
Downstream ID = Tailwater (Pond Outfall)

Water Surface Elevation (ft)	Flow (ft³/s)	Tailwater Elevation (ft)	Convergence Error (ft)
925.96	0.00	(N/A)	0.00
926.46	0.00	(N/A)	0.00
926.50	0.00	(N/A)	0.00
926.96	126.67	(N/A)	0.00
927.46	385.00	(N/A)	0.00
927.96	727.88	(N/A)	0.00
928.46	1,141.20	(N/A)	0.00
928.96	1,617.34	(N/A)	0.00
929.46	2,151.44	(N/A)	0.00
929.50	2,196.56	(N/A)	0.00

Computation Messages
E < Y min=926.50
E < Y min=926.50
E = Y min=926.50
Max.H=.46; Max.Htw=free out;; W(ft) =132.76
Max.H=.96; Max.Htw=free out;; W(ft) =135.76
Max.H=1.46; Max.Htw=free out;; W(ft) =138.76
Max.H=1.96; Max.Htw=free out;; W(ft) =141.76
Max.H=2.46; Max.Htw=free out;; W(ft) =144.76
Max.H=2.96; Max.Htw=free out;; W(ft) =147.76
Max.H=3.00; Max.Htw=free out;; W(ft) =148.00

Auxiliary Spillway Stage Discharge - 100 YR (APWA 5600)

Subsection: Composite Rating Curve
Label: APWA Basin C1 Emergency Spillway
Scenario: 100-Year

Return Event: 100 years
Storm Event: 100-YEAR

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft³/s)	Tailwater Elevation (ft)	Convergence Error (ft)
925.96	0.00	(N/A)	0.00
926.46	0.00	(N/A)	0.00
926.50	0.00	(N/A)	0.00
926.96	126.67	(N/A)	0.00
927.46	385.00	(N/A)	0.00
927.96	727.88	(N/A)	0.00
928.46	1,141.20	(N/A)	0.00
928.96	1,617.34	(N/A)	0.00
929.46	2,151.44	(N/A)	0.00
929.50	2,196.56	(N/A)	0.00

Contributing Structures
None Contributing
None Contributing
Emergency Spillway Weir
Emergency Spillway Weir
Emergency Spillway Weir
Emergency Spillway Weir
Emergency Spillway Weir
Emergency Spillway Weir
Emergency Spillway Weir
Emergency Spillway Weir

Auxiliary Spillway Stage Discharge - 100 YR (APWA 5600)

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Auxiliary Spillway Stage Discharge - 0.5PMP

Project Summary

Title	Woodside Ridge - 0.5PMP Analysis
Engineer	JJL
Company	Olsson
Date	5/9/2019

Notes

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Basin C1 0.5PMP w/ emergency

Auxiliary Spillway Stage Discharge - 0.5PMP

Subsection: Outlet Input Data	Return Event: 10,000 years
Label: Basin C1 0.5PMP w/ emergency	Storm Event: 6-Hr PMP
Scenario: 6-HR PMP	

Requested Pond Water Surface Elevations	
Minimum (Headwater)	910.00 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	929.50 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Orifice-Area	Orifice - 3	Forward	Culvert - 1	922.25	929.50
Inlet Box	Riser - 1	Forward	Culvert - 1	924.00	929.50
Orifice-Circular	Orifice - 1	Forward	Culvert - 1	910.00	929.50
Culvert-Circular	Culvert - 1	Forward	TW	909.00	929.50
Irregular Weir	Weir - 1	Forward	TW	926.50	929.50
Tailwater Settings	Tailwater			(N/A)	(N/A)

Auxiliary Spillway Stage Discharge - 0.5PMP

Subsection: Outlet Input Data	Return Event: 10,000 years
Label: Basin C1 0.5PMP w/ emergency	Storm Event: 6-Hr PMP
Scenario: 6-HR PMP	

Structure ID: Culvert - 1
Structure Type: Culvert-Circular

Number of Barrels	1
Diameter	42.0 in
Length	110.00 ft
Length (Computed Barrel)	110.00 ft
Slope (Computed)	0.009 ft/ft

Outlet Control Data

Manning's n	0.013
Ke	0.200
Kb	0.006
Kr	1.000
Convergence Tolerance	0.00 ft

Inlet Control Data

Equation Form	Form 1
K	0.0045
M	2.0000
C	0.0317
Y	0.6900
T1 ratio (HW/D)	1.091
T2 ratio (HW/D)	1.193
Slope Correction Factor	-0.500

Use unsubmerged inlet control 0 equation below T1 elevation.
Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

T1 Elevation	912.82 ft	T1 Flow	63.00 ft³/s
T2 Elevation	913.17 ft	T2 Flow	72.00 ft³/s

Auxiliary Spillway Stage Discharge - 0.5PMP

Subsection: Outlet Input Data	Return Event: 10,000 years
Label: Basin C1 0.5PMP w/ emergency	Storm Event: 6-Hr PMP
Scenario: 6-HR PMP	

Structure ID: Orifice - 1
Structure Type: Orifice-Circular

Number of Openings	1
Elevation	910.00 ft
Orifice Diameter	24.0 in
Orifice Coefficient	0.600

Structure ID: Riser - 1
Structure Type: Inlet Box

Number of Openings	1
Elevation	924.00 ft
Orifice Area	64.0 ft²
Orifice Coefficient	0.600
Weir Length	32.00 ft
Weir Coefficient	3.00 (ft^0.5)/s
K Reverse	1.000
Manning's n	0.000
Kev, Charged Riser	0.000
Weir Submergence	False
Orifice H to crest	False

Structure ID: Orifice - 3
Structure Type: Orifice-Area

Number of Openings	3
Elevation	922.25 ft
Orifice Area	4.5 ft²
Top Elevation	923.00 ft
Datum Elevation	922.25 ft
Orifice Coefficient	0.600

Structure ID: Weir - 1
Structure Type: Irregular Weir

Station (ft)	Elevation (ft)
0.00	3.00
9.00	0.00
139.00	0.00
148.00	3.00

Lowest Elevation	926.50 ft
Weir Coefficient	3.10 (ft^0.5)/s

Structure ID: TW

Auxiliary Spillway Stage Discharge - 0.5PMP

Subsection: Outlet Input Data
Label: Basin C1 0.5PMP w/ emergency
Scenario: 6-HR PMP

Return Event: 10,000 years
Storm Event: 6-Hr PMP

Structure Type: TW Setup, DS Channel

Tailwater Type	Free Outfall

Convergence Tolerances

Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft³/s
Flow Tolerance (Maximum)	10.000 ft³/s

Auxiliary Spillway Stage Discharge - 0.5PMP

Subsection: Individual Outlet Curves	Return Event: 10,000 years
Label: Basin C1 0.5PMP w/ emergency	Storm Event: 6-Hr PMP
Scenario: 6-HR PMP	

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Culvert - 1 (Culvert-Circular)

Mannings open channel maximum capacity: 103.18 ft³/s
Upstream ID = Orifice - 3, Riser - 1, Orifice - 1
Downstream ID = Tailwater (Pond Outfall)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)	Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft³/s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
910.00	0.00	0.00	0.00	Free Outfall	0.00	0.00	(N/A)	0.00
910.50	1.16	0.00	Free Outfall	Free Outfall	0.00	0.00	(N/A)	0.00
911.00	4.33	909.88	Free Outfall	Free Outfall	0.00	0.00	(N/A)	0.00
911.50	9.00	910.29	Free Outfall	Free Outfall	0.00	0.01	(N/A)	0.00
912.00	15.11	910.70	Free Outfall	Free Outfall	0.00	0.01	(N/A)	0.00
912.50	18.53	910.90	Free Outfall	Free Outfall	0.00	0.01	(N/A)	0.00
913.00	21.14	911.04	Free Outfall	Free Outfall	0.00	0.01	(N/A)	0.00
913.50	23.20	911.15	Free Outfall	Free Outfall	0.00	0.02	(N/A)	0.00
914.00	25.12	911.25	Free Outfall	Free Outfall	0.00	0.02	(N/A)	0.00
914.50	26.88	911.33	Free Outfall	Free Outfall	0.00	0.02	(N/A)	0.00
915.00	28.61	911.42	Free Outfall	Free Outfall	0.00	0.02	(N/A)	0.00
915.50	30.25	911.49	Free Outfall	Free Outfall	0.00	0.01	(N/A)	0.00
916.00	31.83	911.57	Free Outfall	Free Outfall	0.00	0.01	(N/A)	0.00
916.50	33.32	911.64	Free Outfall	Free Outfall	0.00	0.02	(N/A)	0.00
917.00	34.78	911.70	Free Outfall	Free Outfall	0.00	0.03	(N/A)	0.00
917.50	36.19	911.76	Free Outfall	Free Outfall	0.00	0.03	(N/A)	0.00
918.00	37.56	911.82	Free Outfall	Free Outfall	0.00	0.02	(N/A)	0.00
918.50	38.90	911.88	Free Outfall	Free Outfall	0.00	0.00	(N/A)	0.00
919.00	40.16	911.94	Free Outfall	Free Outfall	0.00	0.03	(N/A)	0.00
919.50	41.41	911.99	Free Outfall	Free Outfall	0.00	0.02	(N/A)	0.00
920.00	42.63	912.04	Free Outfall	Free Outfall	0.00	0.02	(N/A)	0.00
920.50	43.81	912.09	Free Outfall	Free Outfall	0.00	0.03	(N/A)	0.00
921.00	45.00	912.14	Free Outfall	Free Outfall	0.00	0.01	(N/A)	0.00
921.50	46.14	912.19	Free Outfall	Free Outfall	0.00	0.01	(N/A)	0.00
922.00	47.23	912.23	Free Outfall	Free Outfall	0.00	0.02	(N/A)	0.00
922.25	47.79	912.26	Free Outfall	Free Outfall	0.00	0.01	(N/A)	0.00
922.50	65.38	912.97	Free Outfall	Free Outfall	0.00	0.06	(N/A)	0.00
923.00	99.54	914.79	Free Outfall	Free Outfall	0.00	0.05	(N/A)	0.00
923.50	114.44	915.88	Free Outfall	Free Outfall	0.00	0.07	(N/A)	0.00
924.00	126.39	916.87	Free Outfall	Free Outfall	0.00	0.05	(N/A)	0.00
924.50	162.08	920.39	Free Outfall	Free Outfall	0.00	0.03	(N/A)	0.00
925.00	189.13	923.65	Free Outfall	Free Outfall	0.00	0.02	(N/A)	0.00
925.50	202.18	925.40	Free Outfall	Free Outfall	0.00	0.08	(N/A)	0.00
926.00	206.48	926.00	Free Outfall	Free Outfall	0.00	65.05	(N/A)	0.00

Auxiliary Spillway Stage Discharge - 0.5PMP

Subsection: Individual Outlet Curves
Label: Basin C1 0.5PMP w/ emergency
Scenario: 6-HR PMP

Return Event: 10,000 years
Storm Event: 6-Hr PMP

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Culvert - 1 (Culvert-Circular)

Mannings open channel maximum capacity: 103.18 ft³/s
Upstream ID = Orifice - 3, Riser - 1, Orifice - 1
Downstream ID = Tailwater (Pond Outfall)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)	Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft³/s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
926.50	209.99	926.50	Free Outfall	Free Outfall	0.00	169.49	(N/A)	0.00
927.00	213.43	927.00	Free Outfall	Free Outfall	0.00	285.40	(N/A)	0.00
927.50	216.83	927.50	Free Outfall	Free Outfall	0.00	359.45	(N/A)	0.00
928.00	220.17	928.00	Free Outfall	Free Outfall	0.00	395.90	(N/A)	0.00
928.50	223.46	928.50	Free Outfall	Free Outfall	0.00	429.98	(N/A)	0.00
929.00	226.71	929.00	Free Outfall	Free Outfall	0.00	462.07	(N/A)	0.00
929.50	229.91	929.50	Free Outfall	Free Outfall	0.00	492.50	(N/A)	0.00

Message
WS below an invert; no flow.
CRIT.DEPTH CONTROL Vh= .109ft Dcr= .319ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .216ft Dcr= .623ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .322ft Dcr= .906ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .433ft Dcr= 1.184ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .488ft Dcr= 1.316ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .528ft Dcr= 1.410ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .559ft Dcr= 1.480ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .588ft Dcr= 1.542ft CRIT.DEPTH Hev= .00ft

Auxiliary Spillway Stage Discharge - 0.5PMP

Subsection: Individual Outlet Curves
Label: Basin C1 0.5PMP w/ emergency
Scenario: 6-HR PMP

Return Event: 10,000 years
Storm Event: 6-Hr PMP

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Culvert - 1 (Culvert-Circular)

Mannings open channel maximum capacity: 103.18 ft³/s
Upstream ID = Orifice - 3, Riser - 1, Orifice - 1
Downstream ID = Tailwater (Pond Outfall)

Message
CRIT.DEPTH CONTROL Vh= .614ft Dcr= 1.598ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .639ft Dcr= 1.651ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .662ft Dcr= 1.700ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .685ft Dcr= 1.745ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .706ft Dcr= 1.788ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .727ft Dcr= 1.828ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .747ft Dcr= 1.867ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .767ft Dcr= 1.903ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .786ft Dcr= 1.939ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .804ft Dcr= 1.971ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .822ft Dcr= 2.003ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .840ft Dcr= 2.034ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .857ft Dcr= 2.063ft CRIT.DEPTH Hev= .00ft

Auxiliary Spillway Stage Discharge - 0.5PMP

Subsection: Individual Outlet Curves
Label: Basin C1 0.5PMP w/ emergency
Scenario: 6-HR PMP

Return Event: 10,000 years
Storm Event: 6-Hr PMP

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Culvert - 1 (Culvert-Circular)

Mannings open channel maximum capacity: 103.18 ft³/s
Upstream ID = Orifice - 3, Riser - 1, Orifice - 1
Downstream ID = Tailwater (Pond Outfall)

Message
CRIT.DEPTH CONTROL Vh= .874ft Dcr= 2.092ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .891ft Dcr= 2.120ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .907ft Dcr= 2.146ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .915ft Dcr= 2.159ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= 1.193ft Dcr= 2.535ft CRIT.DEPTH Hev= .00ft
INLET CONTROL... Submerged: HW =5.79
INLET CONTROL... Submerged: HW =6.88
INLET CONTROL... Submerged: HW =7.87
INLET CONTROL... Submerged: HW =11.39
INLET CONTROL... Submerged: HW =14.65
INLET CONTROL... Submerged: HW =16.40
INLET CONTROL... Submerged: HW =17.00
INLET CONTROL... Submerged: HW =17.50
INLET CONTROL... Submerged: HW =18.00
INLET CONTROL... Submerged: HW =18.50
INLET CONTROL... Submerged: HW =19.00
INLET CONTROL... Submerged: HW =19.50
INLET CONTROL... Submerged: HW =20.00

Auxiliary Spillway Stage Discharge - 0.5PMP

Subsection: Individual Outlet Curves
Label: Basin C1 0.5PMP w/ emergency
Scenario: 6-HR PMP

Return Event: 10,000 years
Storm Event: 6-Hr PMP

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Culvert - 1 (Culvert-Circular)

Mannings open channel maximum capacity: 103.18 ft³/s
Upstream ID = Orifice - 3, Riser - 1, Orifice - 1
Downstream ID = Tailwater (Pond Outfall)

Message
INLET CONTROL... Submerged: HW =20.50

Auxiliary Spillway Stage Discharge - 0.5PMP

Subsection: Individual Outlet Curves
Label: Basin C1 0.5PMP w/ emergency
Scenario: 6-HR PMP

Return Event: 10,000 years
Storm Event: 6-Hr PMP

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Orifice - 1 (Orifice-Circular)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)	Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft³/s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
910.00	0.00	0.00	0.00	0.00	0.00	0.00	(N/A)	0.00
910.50	1.16	910.50	Free Outfall	0.00	0.00	0.00	(N/A)	0.00
911.00	4.33	911.00	Free Outfall	909.88	0.00	0.00	(N/A)	0.00
911.50	9.01	911.50	910.29	910.29	0.00	0.00	(N/A)	0.00
912.00	15.12	912.00	910.70	910.70	0.00	0.00	(N/A)	0.00
912.50	18.52	912.50	910.90	910.90	0.00	0.00	(N/A)	0.00
913.00	21.15	913.00	911.04	911.04	0.00	0.00	(N/A)	0.00
913.50	23.18	913.50	911.15	911.15	0.00	0.00	(N/A)	0.00
914.00	25.10	914.00	911.24	911.25	0.00	0.00	(N/A)	0.00
914.50	26.90	914.50	911.33	911.33	0.00	0.00	(N/A)	0.00
915.00	28.62	915.00	911.42	911.42	0.00	0.00	(N/A)	0.00
915.50	30.27	915.50	911.49	911.49	0.00	0.00	(N/A)	0.00
916.00	31.84	916.00	911.57	911.57	0.00	0.00	(N/A)	0.00
916.50	33.35	916.50	911.64	911.64	0.00	0.00	(N/A)	0.00
917.00	34.81	917.00	911.70	911.70	0.00	0.00	(N/A)	0.00
917.50	36.22	917.50	911.76	911.76	0.00	0.00	(N/A)	0.00
918.00	37.58	918.00	911.82	911.82	0.00	0.00	(N/A)	0.00
918.50	38.90	918.50	911.88	911.88	0.00	0.00	(N/A)	0.00
919.00	40.19	919.00	911.94	911.94	0.00	0.00	(N/A)	0.00
919.50	41.44	919.50	911.99	911.99	0.00	0.00	(N/A)	0.00
920.00	42.66	920.00	912.04	912.04	0.00	0.00	(N/A)	0.00
920.50	43.85	920.50	912.09	912.09	0.00	0.00	(N/A)	0.00
921.00	45.01	921.00	912.14	912.14	0.00	0.00	(N/A)	0.00
921.50	46.14	921.50	912.19	912.19	0.00	0.00	(N/A)	0.00
922.00	47.25	922.00	912.23	912.23	0.00	0.00	(N/A)	0.00
922.25	47.80	922.25	912.26	912.26	0.00	0.00	(N/A)	0.00
922.50	46.69	922.50	912.97	912.97	0.00	0.00	(N/A)	0.00
923.00	43.32	923.00	914.79	914.79	0.00	0.00	(N/A)	0.00
923.50	41.73	923.50	915.88	915.88	0.00	0.00	(N/A)	0.00
924.00	40.38	924.00	916.87	916.87	0.00	0.00	(N/A)	0.00
924.50	30.64	924.50	920.39	920.39	0.00	0.00	(N/A)	0.00
925.00	17.58	925.00	923.65	923.65	0.00	0.00	(N/A)	0.00
925.50	4.86	925.50	925.40	925.40	0.00	0.00	(N/A)	0.00
926.00	0.00	926.00	926.00	926.00	0.00	0.00	(N/A)	0.00
926.50	0.00	926.50	926.50	926.50	0.00	0.00	(N/A)	0.00

Auxiliary Spillway Stage Discharge - 0.5PMP

Subsection: Individual Outlet Curves	Return Event: 10,000 years
Label: Basin C1 0.5PMP w/ emergency	Storm Event: 6-Hr PMP
Scenario: 6-HR PMP	

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Orifice - 1 (Orifice-Circular)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)	Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft³/s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
927.00	0.00	927.00	927.00	927.00	0.00	0.00	(N/A)	0.00
927.50	0.00	927.50	927.50	927.50	0.00	0.00	(N/A)	0.00
928.00	0.00	928.00	928.00	928.00	0.00	0.00	(N/A)	0.00
928.50	0.00	928.50	928.50	928.50	0.00	0.00	(N/A)	0.00
929.00	0.00	929.00	929.00	929.00	0.00	0.00	(N/A)	0.00
929.50	0.00	929.50	929.50	929.50	0.00	0.00	(N/A)	0.00

Message
WS below an invert; no flow.
CRIT.DEPTH CONTROL Vh= .129ft Dcr= .371ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .270ft Dcr= .731ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .429ft Dcr= 1.071ft CRIT.DEPTH Hev= .00ft
H =1.00
H =1.50
H =1.96
H =2.35
H =2.76
H =3.17
H =3.58
H =4.01
H =4.43
H =4.86
H =5.30
H =5.74
H =6.18
H =6.62
H =7.06
H =7.51
H =7.96
H =8.41

Auxiliary Spillway Stage Discharge - 0.5PMP

Subsection: Individual Outlet Curves
Label: Basin C1 0.5PMP w/ emergency
Scenario: 6-HR PMP

Return Event: 10,000 years
Storm Event: 6-Hr PMP

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Orifice - 1 (Orifice-Circular)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Message
H =8.86
H =9.31
H =9.77
H =9.99
H =9.53
H =8.21
H =7.62
H =7.13
H =4.11
H =1.35
H =.10
FLOW PRECEDENCE SET TO DOWNSTREAM CONTROLLING STRUCTURE
FLOW PRECEDENCE SET TO DOWNSTREAM CONTROLLING STRUCTURE
FLOW PRECEDENCE SET TO DOWNSTREAM CONTROLLING STRUCTURE
FLOW PRECEDENCE SET TO DOWNSTREAM CONTROLLING STRUCTURE
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FLOW PRECEDENCE SET TO DOWNSTREAM CONTROLLING STRUCTURE

Auxiliary Spillway Stage Discharge - 0.5PMP

Subsection: Individual Outlet Curves
Label: Basin C1 0.5PMP w/ emergency
Scenario: 6-HR PMP

Return Event: 10,000 years
Storm Event: 6-Hr PMP

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Orifice - 1 (Orifice-Circular)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Message
FLOW PRECEDENCE SET TO DOWNSTREAM CONTROLLING STRUCTURE

Auxiliary Spillway Stage Discharge - 0.5PMP

Subsection: Individual Outlet Curves	Return Event: 10,000 years
Label: Basin C1 0.5PMP w/ emergency	Storm Event: 6-Hr PMP
Scenario: 6-HR PMP	

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Riser - 1 (Inlet Box)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)	Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft³/s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
910.00	0.00	0.00	0.00	0.00	0.00	0.00	(N/A)	0.00
910.50	0.00	0.00	0.00	0.00	0.00	0.00	(N/A)	0.00
911.00	0.00	0.00	0.00	909.88	0.00	0.00	(N/A)	0.00
911.50	0.00	0.00	0.00	910.29	0.00	0.00	(N/A)	0.00
912.00	0.00	0.00	0.00	910.70	0.00	0.00	(N/A)	0.00
912.50	0.00	0.00	0.00	910.90	0.00	0.00	(N/A)	0.00
913.00	0.00	0.00	0.00	911.04	0.00	0.00	(N/A)	0.00
913.50	0.00	0.00	0.00	911.15	0.00	0.00	(N/A)	0.00
914.00	0.00	0.00	0.00	911.25	0.00	0.00	(N/A)	0.00
914.50	0.00	0.00	0.00	911.33	0.00	0.00	(N/A)	0.00
915.00	0.00	0.00	0.00	911.42	0.00	0.00	(N/A)	0.00
915.50	0.00	0.00	0.00	911.49	0.00	0.00	(N/A)	0.00
916.00	0.00	0.00	0.00	911.57	0.00	0.00	(N/A)	0.00
916.50	0.00	0.00	0.00	911.64	0.00	0.00	(N/A)	0.00
917.00	0.00	0.00	0.00	911.70	0.00	0.00	(N/A)	0.00
917.50	0.00	0.00	0.00	911.76	0.00	0.00	(N/A)	0.00
918.00	0.00	0.00	0.00	911.82	0.00	0.00	(N/A)	0.00
918.50	0.00	0.00	0.00	911.88	0.00	0.00	(N/A)	0.00
919.00	0.00	0.00	0.00	911.94	0.00	0.00	(N/A)	0.00
919.50	0.00	0.00	0.00	911.99	0.00	0.00	(N/A)	0.00
920.00	0.00	0.00	0.00	912.04	0.00	0.00	(N/A)	0.00
920.50	0.00	0.00	0.00	912.09	0.00	0.00	(N/A)	0.00
921.00	0.00	0.00	0.00	912.14	0.00	0.00	(N/A)	0.00
921.50	0.00	0.00	0.00	912.19	0.00	0.00	(N/A)	0.00
922.00	0.00	0.00	0.00	912.23	0.00	0.00	(N/A)	0.00
922.25	0.00	0.00	0.00	912.26	0.00	0.00	(N/A)	0.00
922.50	0.00	0.00	0.00	912.97	0.00	0.00	(N/A)	0.00
923.00	0.00	0.00	0.00	914.79	0.00	0.00	(N/A)	0.00
923.50	0.00	0.00	0.00	915.88	0.00	0.00	(N/A)	0.00
924.00	0.00	0.00	0.00	916.87	0.00	0.00	(N/A)	0.00
924.50	33.94	924.50	Free Outfall	920.39	0.00	0.00	(N/A)	0.00
925.00	96.00	925.00	Free Outfall	923.65	0.00	0.00	(N/A)	0.00
925.50	176.36	925.50	925.40	925.40	0.00	0.00	(N/A)	0.00
926.00	271.53	926.00	926.00	926.00	0.00	0.00	(N/A)	0.00
926.50	379.47	926.50	926.50	926.50	0.00	0.00	(N/A)	0.00

Auxiliary Spillway Stage Discharge - 0.5PMP

Subsection: Individual Outlet Curves
Label: Basin C1 0.5PMP w/ emergency
Scenario: 6-HR PMP

Return Event: 10,000 years
Storm Event: 6-Hr PMP

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Riser - 1 (Inlet Box)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)	Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft³/s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
927.00	498.83	927.00	927.00	927.00	0.00	0.00	(N/A)	0.00
927.50	576.28	927.50	927.50	927.50	0.00	0.00	(N/A)	0.00
928.00	616.07	928.00	928.00	928.00	0.00	0.00	(N/A)	0.00
928.50	653.44	928.50	928.50	928.50	0.00	0.00	(N/A)	0.00
929.00	688.79	929.00	929.00	929.00	0.00	0.00	(N/A)	0.00
929.50	722.40	929.50	929.50	929.50	0.00	0.00	(N/A)	0.00

Message
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.

Auxiliary Spillway Stage Discharge - 0.5PMP

Subsection: Individual Outlet Curves	Return Event: 10,000 years
Label: Basin C1 0.5PMP w/ emergency	Storm Event: 6-Hr PMP
Scenario: 6-HR PMP	

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Riser - 1 (Inlet Box)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Message
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
Weir: H =0.5ft
Weir: H =1ft
FULLY CHARGED RISER: ADJUSTED TO WEIR: H =1.5ft
FULLY CHARGED RISER, DOWNSTREAM CONTROL: Kev=0. Hev=0.000

Auxiliary Spillway Stage Discharge - 0.5PMP

Subsection: Individual Outlet Curves
Label: Basin C1 0.5PMP w/ emergency
Scenario: 6-HR PMP

Return Event: 10,000 years
Storm Event: 6-Hr PMP

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Riser - 1 (Inlet Box)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Message
FULLY CHARGED RISER, DOWNSTREAM CONTROL: Kev=0. Hev=0.000
FULLY CHARGED RISER, DOWNSTREAM CONTROL: Kev=0. Hev=0.000
FULLY CHARGED RISER, DOWNSTREAM CONTROL: Kev=0. Hev=0.000
FULLY CHARGED RISER, DOWNSTREAM CONTROL: Kev=0. Hev=0.000
FULLY CHARGED RISER, DOWNSTREAM CONTROL: Kev=0. Hev=0.000
FULLY CHARGED RISER, DOWNSTREAM CONTROL: Kev=0. Hev=0.000
FULLY CHARGED RISER, DOWNSTREAM CONTROL: Kev=0. Hev=0.000

Auxiliary Spillway Stage Discharge - 0.5PMP

Subsection: Individual Outlet Curves
Label: Basin C1 0.5PMP w/ emergency
Scenario: 6-HR PMP

Return Event: 10,000 years
Storm Event: 6-Hr PMP

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Orifice - 3 (Orifice-Area)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)	Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft³/s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
910.00	0.00	0.00	0.00	0.00	0.00	0.00	(N/A)	0.00
910.50	0.00	0.00	0.00	0.00	0.00	0.00	(N/A)	0.00
911.00	0.00	0.00	0.00	909.88	0.00	0.00	(N/A)	0.00
911.50	0.00	0.00	0.00	910.29	0.00	0.00	(N/A)	0.00
912.00	0.00	0.00	0.00	910.70	0.00	0.00	(N/A)	0.00
912.50	0.00	0.00	0.00	910.90	0.00	0.00	(N/A)	0.00
913.00	0.00	0.00	0.00	911.04	0.00	0.00	(N/A)	0.00
913.50	0.00	0.00	0.00	911.15	0.00	0.00	(N/A)	0.00
914.00	0.00	0.00	0.00	911.25	0.00	0.00	(N/A)	0.00
914.50	0.00	0.00	0.00	911.33	0.00	0.00	(N/A)	0.00
915.00	0.00	0.00	0.00	911.42	0.00	0.00	(N/A)	0.00
915.50	0.00	0.00	0.00	911.49	0.00	0.00	(N/A)	0.00
916.00	0.00	0.00	0.00	911.57	0.00	0.00	(N/A)	0.00
916.50	0.00	0.00	0.00	911.64	0.00	0.00	(N/A)	0.00
917.00	0.00	0.00	0.00	911.70	0.00	0.00	(N/A)	0.00
917.50	0.00	0.00	0.00	911.76	0.00	0.00	(N/A)	0.00
918.00	0.00	0.00	0.00	911.82	0.00	0.00	(N/A)	0.00
918.50	0.00	0.00	0.00	911.88	0.00	0.00	(N/A)	0.00
919.00	0.00	0.00	0.00	911.94	0.00	0.00	(N/A)	0.00
919.50	0.00	0.00	0.00	911.99	0.00	0.00	(N/A)	0.00
920.00	0.00	0.00	0.00	912.04	0.00	0.00	(N/A)	0.00
920.50	0.00	0.00	0.00	912.09	0.00	0.00	(N/A)	0.00
921.00	0.00	0.00	0.00	912.14	0.00	0.00	(N/A)	0.00
921.50	0.00	0.00	0.00	912.19	0.00	0.00	(N/A)	0.00
922.00	0.00	0.00	0.00	912.23	0.00	0.00	(N/A)	0.00
922.25	0.00	0.00	0.00	912.26	0.00	0.00	(N/A)	0.00
922.50	18.76	922.50	Free Outfall	912.97	0.00	0.00	(N/A)	0.00
923.00	56.27	923.00	Free Outfall	914.79	0.00	0.00	(N/A)	0.00
923.50	72.65	923.50	Free Outfall	915.88	0.00	0.00	(N/A)	0.00
924.00	85.96	924.00	Free Outfall	916.87	0.00	0.00	(N/A)	0.00
924.50	97.46	924.50	Free Outfall	920.39	0.00	0.00	(N/A)	0.00
925.00	75.53	925.00	923.65	923.65	0.00	0.00	(N/A)	0.00
925.50	20.88	925.50	925.40	925.40	0.00	0.00	(N/A)	0.00
926.00	0.00	926.00	926.00	926.00	0.00	0.00	(N/A)	0.00
926.50	0.00	926.50	926.50	926.50	0.00	0.00	(N/A)	0.00

Auxiliary Spillway Stage Discharge - 0.5PMP

Subsection: Individual Outlet Curves	Return Event: 10,000 years
Label: Basin C1 0.5PMP w/ emergency	Storm Event: 6-Hr PMP
Scenario: 6-HR PMP	

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Orifice - 3 (Orifice-Area)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)	Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft³/s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
927.00	0.00	927.00	927.00	927.00	0.00	0.00	(N/A)	0.00
927.50	0.00	927.50	927.50	927.50	0.00	0.00	(N/A)	0.00
928.00	0.00	928.00	928.00	928.00	0.00	0.00	(N/A)	0.00
928.50	0.00	928.50	928.50	928.50	0.00	0.00	(N/A)	0.00
929.00	0.00	929.00	929.00	929.00	0.00	0.00	(N/A)	0.00
929.50	0.00	929.50	929.50	929.50	0.00	0.00	(N/A)	0.00

Message
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.

Auxiliary Spillway Stage Discharge - 0.5PMP

Subsection: Individual Outlet Curves
Label: Basin C1 0.5PMP w/ emergency
Scenario: 6-HR PMP

Return Event: 10,000 years
Storm Event: 6-Hr PMP

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Orifice - 3 (Orifice-Area)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Message
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
Hi=.25; Ht=.75; Qt=18.76
H =.75
H =1.25
H =1.75
H =2.25
H =1.35
H =.10
FLOW PRECEDENCE SET TO DOWNSTREAM CONTROLLING STRUCTURE
FLOW PRECEDENCE SET TO DOWNSTREAM CONTROLLING STRUCTURE

Auxiliary Spillway Stage Discharge - 0.5PMP

Subsection: Individual Outlet Curves
Label: Basin C1 0.5PMP w/ emergency
Scenario: 6-HR PMP

Return Event: 10,000 years
Storm Event: 6-Hr PMP

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Orifice - 3 (Orifice-Area)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Message
FLOW PRECEDENCE SET TO DOWNSTREAM CONTROLLING STRUCTURE
FLOW PRECEDENCE SET TO DOWNSTREAM CONTROLLING STRUCTURE
FLOW PRECEDENCE SET TO DOWNSTREAM CONTROLLING STRUCTURE
FLOW PRECEDENCE SET TO DOWNSTREAM CONTROLLING STRUCTURE
FLOW PRECEDENCE SET TO DOWNSTREAM CONTROLLING STRUCTURE
FLOW PRECEDENCE SET TO DOWNSTREAM CONTROLLING STRUCTURE

Auxiliary Spillway Stage Discharge - 0.5PMP

Subsection: Individual Outlet Curves
Label: Basin C1 0.5PMP w/ emergency
Scenario: 6-HR PMP

Return Event: 10,000 years
Storm Event: 6-Hr PMP

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Weir - 1 (Irregular Weir)

Upstream ID = (Pond Water Surface)
Downstream ID = Tailwater (Pond Outfall)

Water Surface Elevation (ft)	Flow (ft³/s)	Tailwater Elevation (ft)	Convergence Error (ft)
910.00	0.00	(N/A)	0.00
910.50	0.00	(N/A)	0.00
911.00	0.00	(N/A)	0.00
911.50	0.00	(N/A)	0.00
912.00	0.00	(N/A)	0.00
912.50	0.00	(N/A)	0.00
913.00	0.00	(N/A)	0.00
913.50	0.00	(N/A)	0.00
914.00	0.00	(N/A)	0.00
914.50	0.00	(N/A)	0.00
915.00	0.00	(N/A)	0.00
915.50	0.00	(N/A)	0.00
916.00	0.00	(N/A)	0.00
916.50	0.00	(N/A)	0.00
917.00	0.00	(N/A)	0.00
917.50	0.00	(N/A)	0.00
918.00	0.00	(N/A)	0.00
918.50	0.00	(N/A)	0.00
919.00	0.00	(N/A)	0.00
919.50	0.00	(N/A)	0.00
920.00	0.00	(N/A)	0.00
920.50	0.00	(N/A)	0.00
921.00	0.00	(N/A)	0.00
921.50	0.00	(N/A)	0.00
922.00	0.00	(N/A)	0.00
922.25	0.00	(N/A)	0.00
922.50	0.00	(N/A)	0.00
923.00	0.00	(N/A)	0.00
923.50	0.00	(N/A)	0.00
924.00	0.00	(N/A)	0.00
924.50	0.00	(N/A)	0.00
925.00	0.00	(N/A)	0.00
925.50	0.00	(N/A)	0.00
926.00	0.00	(N/A)	0.00
926.50	0.00	(N/A)	0.00
927.00	143.64	(N/A)	0.00
927.50	409.58	(N/A)	0.00

Auxiliary Spillway Stage Discharge - 0.5PMP

Subsection: Individual Outlet Curves
Label: Basin C1 0.5PMP w/ emergency
Scenario: 6-HR PMP

Return Event: 10,000 years
Storm Event: 6-Hr PMP

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Weir - 1 (Irregular Weir)

Upstream ID = (Pond Water Surface)
Downstream ID = Tailwater (Pond Outfall)

Water Surface Elevation (ft)	Flow (ft³/s)	Tailwater Elevation (ft)	Convergence Error (ft)
928.00	758.48	(N/A)	0.00
928.50	1,177.06	(N/A)	0.00
929.00	1,657.98	(N/A)	0.00
929.50	2,196.56	(N/A)	0.00

Computation Messages
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.

Auxiliary Spillway Stage Discharge - 0.5PMP

Subsection: Individual Outlet Curves	Return Event: 10,000 years
Label: Basin C1 0.5PMP w/ emergency	Storm Event: 6-Hr PMP
Scenario: 6-HR PMP	

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Weir - 1 (Irregular Weir)

Upstream ID = (Pond Water Surface)
Downstream ID = Tailwater (Pond Outfall)

Computation Messages
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
Max.H=.50; Max.Htw=free out;; W(ft) =133.00
Max.H=1.00; Max.Htw=free out;; W(ft) =136.00

Auxiliary Spillway Stage Discharge - 0.5PMP

Subsection: Individual Outlet Curves	Return Event: 10,000 years
Label: Basin C1 0.5PMP w/ emergency	Storm Event: 6-Hr PMP
Scenario: 6-HR PMP	

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Weir - 1 (Irregular Weir)

Upstream ID = (Pond Water Surface)
Downstream ID = Tailwater (Pond Outfall)

Computation Messages
Max.H=1.50; Max.Htw=free out;; W(ft) =139.00
Max.H=2.00; Max.Htw=free out;; W(ft) =142.00
Max.H=2.50; Max.Htw=free out;; W(ft) =145.00
Max.H=3.00; Max.Htw=free out;; W(ft) =148.00

Auxiliary Spillway Stage Discharge - 0.5PMP

Subsection: Composite Rating Curve
Label: Basin C1 0.5PMP w/ emergency
Scenario: 6-HR PMP

Return Event: 10,000 years
Storm Event: 6-Hr PMP

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft³/s)	Tailwater Elevation (ft)	Convergence Error (ft)
910.00	0.00	(N/A)	0.00
910.50	1.16	(N/A)	0.00
911.00	4.33	(N/A)	0.00
911.50	9.00	(N/A)	0.00
912.00	15.11	(N/A)	0.00
912.50	18.53	(N/A)	0.00
913.00	21.14	(N/A)	0.00
913.50	23.20	(N/A)	0.00
914.00	25.12	(N/A)	0.00
914.50	26.88	(N/A)	0.00
915.00	28.61	(N/A)	0.00
915.50	30.25	(N/A)	0.00
916.00	31.83	(N/A)	0.00
916.50	33.32	(N/A)	0.00
917.00	34.78	(N/A)	0.00
917.50	36.19	(N/A)	0.00
918.00	37.56	(N/A)	0.00
918.50	38.90	(N/A)	0.00
919.00	40.16	(N/A)	0.00
919.50	41.41	(N/A)	0.00
920.00	42.63	(N/A)	0.00
920.50	43.81	(N/A)	0.00
921.00	45.00	(N/A)	0.00
921.50	46.14	(N/A)	0.00
922.00	47.23	(N/A)	0.00
922.25	47.79	(N/A)	0.00
922.50	65.38	(N/A)	0.00
923.00	99.54	(N/A)	0.00
923.50	114.44	(N/A)	0.00
924.00	126.39	(N/A)	0.00
924.50	162.08	(N/A)	0.00
925.00	189.13	(N/A)	0.00
925.50	202.18	(N/A)	0.00
926.00	206.48	(N/A)	0.00
926.50	209.99	(N/A)	0.00
927.00	357.08	(N/A)	0.00
927.50	626.41	(N/A)	0.00
928.00	978.65	(N/A)	0.00
928.50	1,400.51	(N/A)	0.00
929.00	1,884.70	(N/A)	0.00
929.50	2,426.47	(N/A)	0.00

Contributing Structures

Auxiliary Spillway Stage Discharge - 0.5PMP

Subsection: Composite Rating Curve	Return Event: 10,000 years
Label: Basin C1 0.5PMP w/ emergency	Storm Event: 6-Hr PMP
Scenario: 6-HR PMP	

Composite Outflow Summary

Contributing Structures
(no Q: Orifice - 3,Riser - 1,Orifice - 1,Culvert - 1,Weir - 1)
Orifice - 1,Culvert - 1 (no Q: Orifice - 3,Riser - 1,Weir - 1)
Orifice - 1,Culvert - 1 (no Q: Orifice - 3,Riser - 1,Weir - 1)
Orifice - 1,Culvert - 1 (no Q: Orifice - 3,Riser - 1,Weir - 1)
Orifice - 1,Culvert - 1 (no Q: Orifice - 3,Riser - 1,Weir - 1)
Orifice - 1,Culvert - 1 (no Q: Orifice - 3,Riser - 1,Weir - 1)
Orifice - 1,Culvert - 1 (no Q: Orifice - 3,Riser - 1,Weir - 1)
Orifice - 1,Culvert - 1 (no Q: Orifice - 3,Riser - 1,Weir - 1)
Orifice - 1,Culvert - 1 (no Q: Orifice - 3,Riser - 1,Weir - 1)
Orifice - 1,Culvert - 1 (no Q: Orifice - 3,Riser - 1,Weir - 1)
Orifice - 1,Culvert - 1 (no Q: Orifice - 3,Riser - 1,Weir - 1)
Orifice - 1,Culvert - 1 (no Q: Orifice - 3,Riser - 1,Weir - 1)
Orifice - 1,Culvert - 1 (no Q: Orifice - 3,Riser - 1,Weir - 1)
Orifice - 1,Culvert - 1 (no Q: Orifice - 3,Riser - 1,Weir - 1)
Orifice - 1,Culvert - 1 (no Q: Orifice - 3,Riser - 1,Weir - 1)
Orifice - 1,Culvert - 1 (no Q: Orifice - 3,Riser - 1,Weir - 1)

Auxiliary Spillway Stage Discharge - 0.5PMP

Subsection: Composite Rating Curve
Label: Basin C1 0.5PMP w/ emergency
Scenario: 6-HR PMP

Return Event: 10,000 years
Storm Event: 6-Hr PMP

Composite Outflow Summary

Contributing Structures
Orifice - 1,Culvert - 1 (no Q: Orifice - 3,Riser - 1,Weir - 1)
Orifice - 1,Culvert - 1 (no Q: Orifice - 3,Riser - 1,Weir - 1)
Orifice - 1,Culvert - 1 (no Q: Orifice - 3,Riser - 1,Weir - 1)
Orifice - 1,Culvert - 1 (no Q: Orifice - 3,Riser - 1,Weir - 1)
Orifice - 1,Culvert - 1 (no Q: Orifice - 3,Riser - 1,Weir - 1)
Orifice - 1,Culvert - 1 (no Q: Orifice - 3,Riser - 1,Weir - 1)
Orifice - 1,Culvert - 1 (no Q: Orifice - 3,Riser - 1,Weir - 1)
Orifice - 1,Culvert - 1 (no Q: Orifice - 3,Riser - 1,Weir - 1)
Orifice - 1,Culvert - 1 (no Q: Orifice - 3,Riser - 1,Weir - 1)
Orifice - 1,Culvert - 1 (no Q: Orifice - 3,Riser - 1,Weir - 1)
Orifice - 3,Orifice - 1,Culvert - 1 (no Q: Riser - 1,Weir - 1)
Orifice - 3,Orifice - 1,Culvert - 1 (no Q: Riser - 1,Weir - 1)
Orifice - 3,Orifice - 1,Culvert - 1 (no Q: Riser - 1,Weir - 1)
Orifice - 3,Orifice - 1,Culvert - 1 (no Q: Riser - 1,Weir - 1)
Orifice - 3,Riser - 1,Orifice - 1,Culvert - 1 (no Q: Weir - 1)
Orifice - 3,Riser - 1,Orifice - 1,Culvert - 1 (no Q: Weir - 1)

Auxiliary Spillway Stage Discharge - 0.5PMP

Subsection: Composite Rating Curve
Label: Basin C1 0.5PMP w/ emergency
Scenario: 6-HR PMP

Return Event: 10,000 years
Storm Event: 6-Hr PMP

Composite Outflow Summary

Contributing Structures
Orifice - 3,Riser - 1,Orifice - 1,Culvert - 1 (no Q: Weir - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 3,Orifice - 1,Weir - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 3,Orifice - 1,Weir - 1)
Riser - 1,Culvert - 1,Weir - 1 (no Q: Orifice - 3,Orifice - 1)
Riser - 1,Culvert - 1,Weir - 1 (no Q: Orifice - 3,Orifice - 1)
Riser - 1,Culvert - 1,Weir - 1 (no Q: Orifice - 3,Orifice - 1)
Riser - 1,Culvert - 1,Weir - 1 (no Q: Orifice - 3,Orifice - 1)
Riser - 1,Culvert - 1,Weir - 1 (no Q: Orifice - 3,Orifice - 1)
Riser - 1,Culvert - 1,Weir - 1 (no Q: Orifice - 3,Orifice - 1)

Auxiliary Spillway Stage Discharge - 0.5PMP

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APPENDIX B

Geotechnical Engineering Report

May 15, 2019

Summit Homes
Attn: David Price
120 SE 30th Street
Lee's Summit, Missouri 64082

RE: Geotechnical Engineering Report
Woodside Ridge 1st Plat
Lee's Summit, Missouri
Project No. 018-1140

Dear Mr. Price:

In general accordance with our Agreement for Professional Services, Olsson, Inc. (***Olsson***) has completed our geotechnical exploration for the referenced project. As part of this exploration, ***Olsson*** completed twelve borings along the proposed roadway alignments to evaluate the soils located within the planned pavement subgrade. This letter discusses the soil conditions encountered at the borings and, based on these conditions, provides our opinions regarding stabilization of the public roadway subgrade soils.

Project Description

Woodside Ridge is planned to be located approximately 0.25 miles south of the intersection of NW Chipman Road and Northwest Pryor Road in Lee's Summit, Missouri. The project will include public streets as shown in Figure 1. We understand up to 20 feet of cut and 30 feet of fill is planned along the street alignments. A dry detention basin is planned on the south side of the site.

At the time of our exploration, the site was generally grass covered and interspersed with wooded areas. Stockpiles of material were located throughout the site as shown in Figure 2. A community garden with several small structures was located near the intersection of NW Pryor Road and NW O'Brien Road. Gravel roads encircled the garden areas and extended west into the central portion of the site near the stockpiled material. Gravel roads were also located in the southeast portion of the site near other stockpiles of material. Two existing ponds were located on the northeast portion and central portion of the site. We understand the pond on the northeast portion will remain in place. The pond in the central portion of the site will be filled.

From our review of aerial images obtained from Google Earth dating back to 1990, grading operations appeared to have taken place in the southwest and southeast portions of the site prior to 1990. A third pond was located on the southeast portion of the site (Figure 3). The pond appeared to have been filled in 2002 and/or 2003. We have not been provided any information about the fill placement. The stockpiled material located on the southeast portion of the site was apparently placed beginning in 2002 around the time the former pond was filled. Stockpiled material in other areas was apparently placed beginning in 2012 and continued until the most recent imagery in 2018. We have not been provided any information regarding the materials contained in the stockpiles.

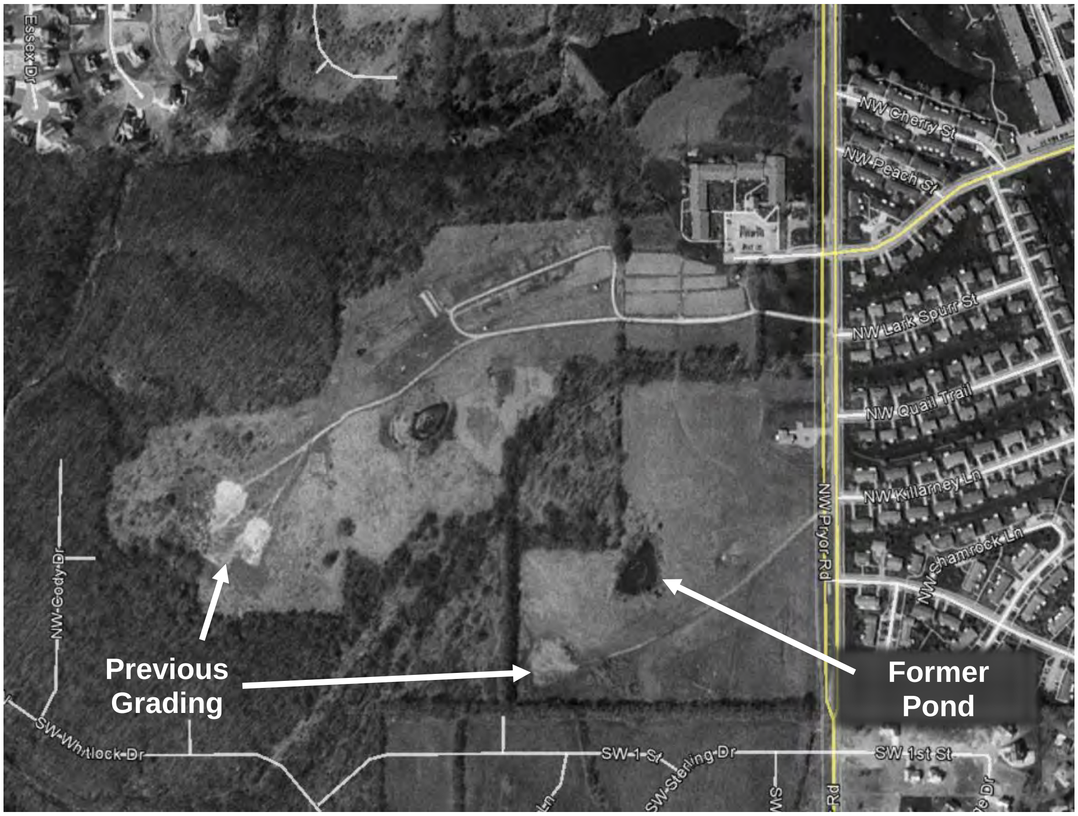
Figure 1: Site Location

Planned Dry Detention Basin

Figure 2: Existing Conditions

(Google Earth 2018)

Figure 3: Previous Conditions



(Google Earth 1990)

Field Exploration and Laboratory Testing

The drill crew used a truck mounted drill rig to complete 13 borings (B-1 through B-12 and B-12A) along the anticipated roadway alignments. ***Olsson*** personnel surveyed and staked the locations for B-1 through B-12 on the site prior to our subsurface exploration. Boring B-12 encountered practical auger refusal in existing fill material. Boring B-12A was offset approximately 5 feet south of the location of boring B-12. Two additional hand auger locations (B-101 and B-102) were completed near the planned dry detention basin. B-101 and B-102 were located in the field using a handheld GPS. The approximate locations of the borings are shown on the attached Boring Location Map and the elevations (reported to the nearest tenth of a foot) are shown on the attached boring logs.

The drill crew obtained samples of the subsurface soils at borings B-1, B-3, B-4, B-7, B-9, B-12 and B-12A using thin walled tubes and split barrel samplers during performance of the Standard Penetration Tests (SPT). Grab samples were obtained at B-101 and B-102. The drill crew prepared a field log of the material encountered at each boring. The field logs also included the driller's interpretation of the conditions between samples. Water level observations were made in the borings at the times and under the conditions noted on the boring logs.

The samples were sealed and returned to the laboratory for testing and classification. At our laboratory, we visually classified each sample in general accordance with the Unified Soil Classification System (USCS). We performed moisture content tests on the samples. Dry density and unconfined compressive strength tests were performed on select samples obtained from the thin-walled tubes. Three Atterberg limits tests were performed to aid in the classification of the soils. The attached boring logs represent the engineer's interpretation of the field logs based on visual classification and laboratory tests of the samples. The respective test results are presented on the boring logs.

Soil and Bedrock Stratigraphy

The information shown on the boring logs represent soil and bedrock conditions at the specific boring locations; however, variations may occur between or beyond the borings. The stratification lines represent the approximate boundary between soil and bedrock types but the actual transition between materials may be gradual.

We encountered existing fill material at borings B-1, B-8, B-12 and B-12A. Fill material may also be encountered in other areas we did not explore. The fill generally consisted of clay soils with gravel, shale, organics and construction debris (concrete, rebar, and brick fragments). Boring B-12 encountered practical auger refusal in the fill on a possible boulder at a depth of about 2 feet. The existing fill at borings B-1, B-8, and B-12A extended to depths ranging from about 2 feet to 14.5 feet below the existing ground surface.

Beneath the existing fill at borings B-1, B-8, and B-12A and beneath the surficial materials at borings B-2 through B-7, B-9 through B-11, B-101 and B-102 we encountered lean to fat clay soils with varying amounts of silt and gravel. Weathered shale and limestone fragments were encountered in the clay soils at greater depths near the clay/bedrock interface. The apparent native clay soils ranged from stiff to hard in consistency and were generally dry to moist. Boring

B-12 terminated in the clay soils at a depth of 15 feet. Borings B-101 and B-102 encountered hand auger refusal on limestone bedrock at depths of about 1.5 feet and 6 inches, respectively. The clay soils in the remaining borings were underlain by shale and/or limestone bedrock at depths ranging from about 6.5 feet to 16 feet. Borings B-1 and B-6 terminated in shale bedrock at a depth of 20 feet. Borings B-2 through B-5 and B-7 through B-11 encountered practical auger refusal on limestone bedrock at depths ranging from about 11 feet to 17 feet.

Groundwater Observations

The drill crew monitored the borings while drilling and immediately after completion for the presence and level of groundwater. Water was observed at boring B-1 at 6 feet (while drilling) and about 13 feet (immediately after drilling). Water was not observed in the remaining borings. These water level readings provide an approximate indication of the groundwater condition existing on the site at the time the borings were drilled.

Variations and uncertainties exist with relatively short-term water level observations in boreholes. Water levels can and should be anticipated to vary between boring locations, as well as with time within specific borings. Groundwater levels may be expected to fluctuate with variations in precipitation, site grading, drainage and adjacent land use. Groundwater may also be encountered near the soil and bedrock interface and can be perched within existing fill materials. Long term monitoring with piezometers generally provides a more representative indication of the potential range of groundwater conditions.

Pavement Subgrade Preparation

We encountered existing fill material at borings B-1, B-8, B-12 and B-12A. We observed construction debris and organics in the samples of fill material at our borings. Material stockpiles were observed in the central and southeast portions of the site. Fill material may also be encountered in areas we did not explore. In addition to the variable nature of the existing fill, the material was likely not placed with strict moisture and density control. In our opinion, all existing fill material should be entirely removed and replaced with structural fill. It may be possible to reuse portions of the existing fill material or stockpiled material provided any construction debris, organics, or other unsuitable material is removed. However, depending on the makeup of the fill and/or stockpiles, the separation of suitable and unsuitable material may be difficult. Test pits can be used to further document the depth and composition of existing fill material present at the site.

In addition to the removal of the existing fill, preparation of pavement subgrades should also include the stripping of all vegetation, root systems, organic soils (organic content greater than 5 percent), gravel and any loose, soft or otherwise unsuitable material from beneath new pavements. Stripping depths will likely vary and should be adjusted as necessary. The former garden areas may contain deeper organic deposits that may require removal and may require additional moisture conditioning and recompaction of the soils. These materials should be carefully separated to avoid incorporation of organic materials into new fill sections in new pavement areas.

Based on the available site plan, we anticipate the existing pond located in the middle of the site will be filled. After the pond is drained, all lower consistency soils identified during site preparation should be undercut prior to placement of new fill. During undercutting and removal of the soft sediment in the pond, additional drainage measures may be required to control water seepage within the undercut area. Pumping of water from the excavation or installation of a drainage system may be required. The base of the undercut area should be thoroughly evaluated by a representative of ***Olsson*** prior to placement of fill. Temporary dewatering should be the responsibility of the contractor.

Any required tree removal should also be accomplished at this time. Care should be taken to thoroughly removal all root systems. Materials disturbed during removal of stumps should be undercut and replaced with structural fill. A zone of desiccated soils may exist in the vicinity of the trees. The desiccated soils should be moisture conditioned and/or undercut and replaced with structural fill prior to placement of new fill. Site clearing, grubbing and stripping should be performed during dry weather conditions.

Any existing structures, such as those near the garden areas, and existing pavements should be demolished and removed from the proposed construction areas. Demolition of the existing structures should include removal of footings, slabs, sidewalks, and any other below grade features that will conflict with the planned construction. All broken concrete, broken asphaltic concrete and other demolition debris should be removed from the site. Prior to placement of fill, a representative of ***Olsson*** should evaluate areas disturbed during demolition operations. All disturbed soils should be undercut prior to placement of fill.

Following stripping and removal of existing fill, the pavement subgrade should be proofrolled. Proofrolling may be accomplished with a fully loaded, tandem-axle dump truck or other equipment with minimum gross weight of 20 tons. Unsuitable areas observed at this time should be improved by compaction or by undercutting and placement of suitable compacted fill.

Following proofrolling and prior to placement of any new fill, the moisture content of the exposed subgrade should be checked. Where moisture content is outside the ranges recommended for fill placement and compaction, the soils should be scarified, moisture conditioned and recompacted.

We understand up to 20 feet of cut and 30 feet of fill will be across the site. All structural fill and backfill placed within pavement areas should consist of inorganic cohesive soils or well-graded granular materials placed with strict moisture and density control. Structural fill soils should be relatively free of organic materials (less than about 5 percent by weight) or other unsuitable materials and should not contain particle sizes larger than 3 inches. Samples of all proposed fill materials should be submitted to ***Olsson*** for testing and approval prior to use.

Suitable fill should be placed in loose lifts of 9 inches or less. In general, structural fill should be compacted to a minimum of 95% of the standard Proctor's maximum dry density. The moisture content of structural fill should generally be between optimum and 4 percent above optimum. More stringent moisture limits may be necessary with certain soils and some adjustments to moisture contents may be necessary to achieve the specified compaction.

Where fill depths exceed 10 feet in depth, new structural fills should be compacted to a minimum of 98% of the standard Proctor's maximum dry density. The weight of the new fill will cause the underlying clay soils to consolidate. We anticipate some of the settlement will occur during fill placement. Where fill depths exceed 10 feet, settlement plates should be installed in the fill areas prior to fill placement with elevations measured regularly by the project surveyor during and following fill construction. Once the data is reviewed by ***Olsson*** and indicates consolidation is substantially complete, construction of settlement sensitive elements could begin. In our experience, we anticipate approximately 2 to 4 months would be required for most of the consolidation to occur after the fill has been placed for fill depths of up to 30 feet, although some variation in this time should be anticipated.

The soil should be compacted using equipment that is the appropriate type and properly sized for the job. Within small excavations, such as utility trenches, or around manholes, vibrating plate compactors, walk behind rollers or jumping jacks can be used to achieve the specified compaction. Lift thicknesses should be reduced to 4 inches in fill areas requiring small compaction equipment.

The City of Lee's Summit requires soils located beneath new asphaltic concrete (AC) pavements be supported on a minimum of 6 inches of chemically stabilized subgrade. In our opinion, the existing soils could be stabilized with Class "C" fly ash, soil cement, hydrated lime, or lime kiln dust (LKD or Code L lime). We estimate 15 percent Class "C" fly ash, 5 percent lime, and 6 percent lime kiln dust or soil cement (based on dry weights) would be required.

We recommend that the prepared subgrade extend a minimum of 2-feet outside the pavements, where feasible. ***Olsson*** should be present during subgrade preparation to observe, document, and test compaction of the materials at the time of placement. As recommended for all prepared soil subgrades, heavy, repetitive construction traffic should be controlled, especially during periods of wet weather, to minimize disturbance. The final prepared subgrade should be observed immediately prior to placement of new pavements. Areas that have become disturbed should be repaired as required.

All existing slopes steeper than 5(H):1(V) should be benched prior to the placement of new fill. Benching of the slope provides interlocking between the fill and natural soils and facilitates compaction of the fill. Benches should be cut as the fill progresses and should have a maximum bench height of 3 feet. In general, final slopes should be no steeper than 3(H):1(V) to maintain long-term stability, reduce erosion and to provide ease of maintenance. We recommend that permanent slopes be vegetated as soon as practical to minimize the potential for erosion. If final slopes are planned to be steeper than 3(H):1(V), stability analyses should be performed.

Rock Excavation

We encountered bedrock at depths ranging from 6 inches to 16 feet below the existing ground surface. With cut depths of up to 20 feet, excavations may encounter shale and/or limestone bedrock. Experience has indicated that conventional heavy-duty excavation equipment such as backhoes equipped with rock teeth or bulldozers equipped with ripping attachments can sometimes excavate bedrock materials which were penetrated with flight augers in the exploratory borings.

Hard rock removal techniques are typically required in confined excavations or below the depth of auger refusal.

Detention Basin

We understand a dry detention reservoir will be constructed in the south central portion of the site. The planned detention basin will have 3:1 (H:V) slopes and a maximum height of 19.5 feet. To evaluate the detention embankments, we performed slope stability analyses using the computer program SLOPE/W 2007, developed by GEO-SLOPE International. The stability included evaluation of failure surfaces based upon the modified Bishops method. The subsurface profile was based on the results of hand augers performed at the site. The strength parameters we used in the analysis are summarized in Table 1 and are based on correlations with similar soil types and our experience in the area. We evaluated the embankments using both drained (effective) and undrained (end-of-construction) strength parameters based on the final cross section.

Table 1: Strength Parameters

Material Properties		Effective Stress Parameters		Undrained Parameters End-of-Construction (E.O.C.)	
Material	**Wet Density, pcf**	**ϕ, degrees**	**c, psf**	**ϕ, degrees**	**c, psf**
Fat Clay Soils/Fill	120	24	100	0	750

The results of the stability analyses are summarized in Table 2, and the critical failure surfaces generated by the computer program are shown in Figures 4, 5, and 6. Table 2 also includes the minimum required factor of safety.

Table 2: Global Stability Results

	Factor of Safety (Calculated)	Factor of Safety (Required)
E.O.C (Total Stress)	3.0	1.4
E.O.C. (Effective Stress)	2.0	1.4
Full Reservoir	2.3	1.5

Figure 4: E.O.C. (Total Stress) Results

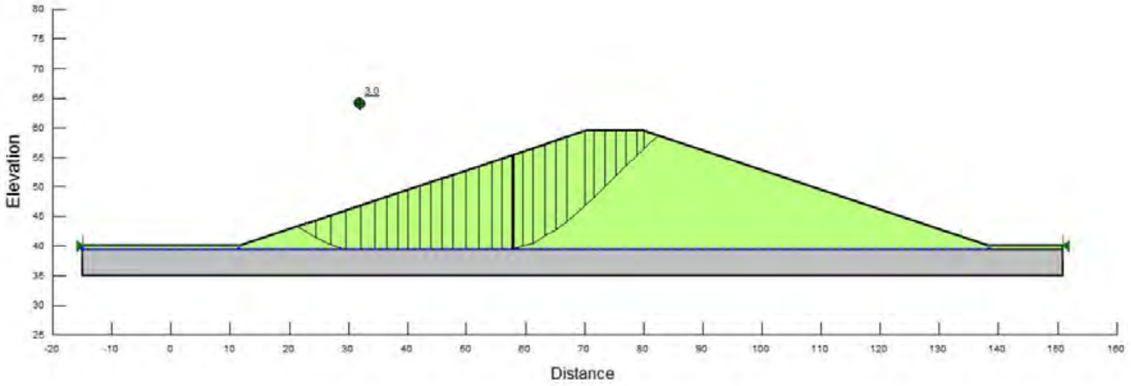


Figure 5: E.O.C. (Effective Stress) Results

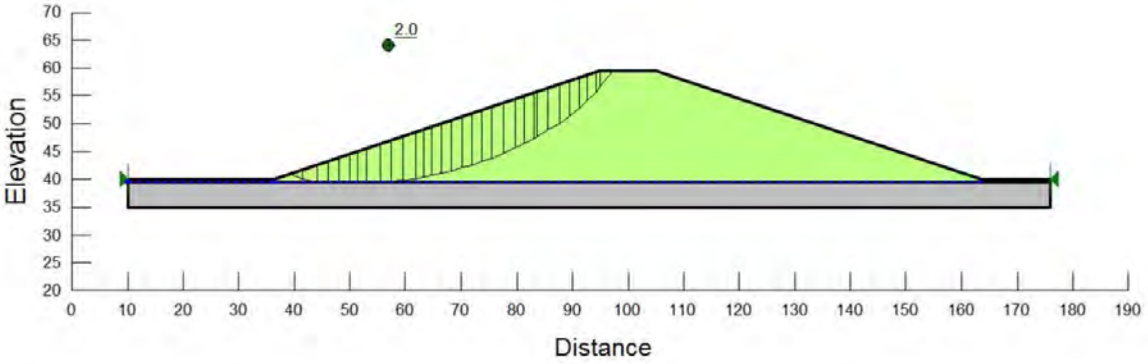
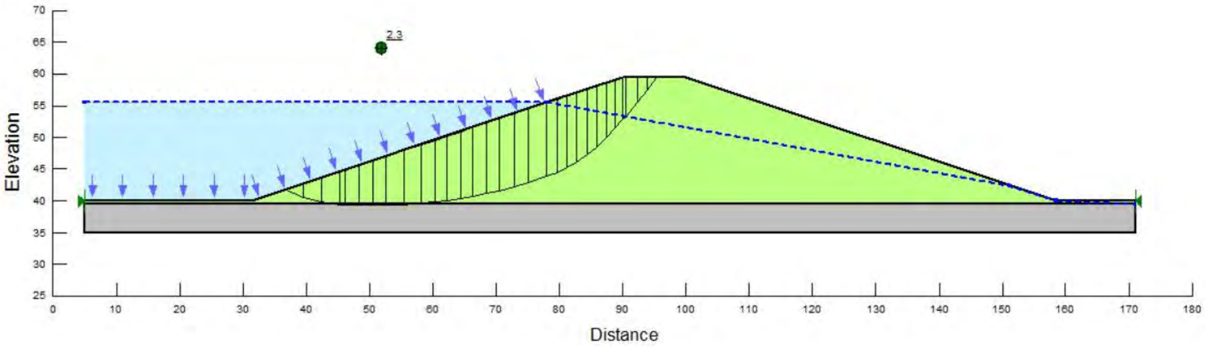


Figure 6: Full Reservoir Results



Closing

The conclusions and recommendations presented in this report are based on the information available regarding the proposed construction, the results obtained from our borings and sampling procedures, the results of the laboratory testing program, and our experience with similar projects. The borings represent a very small statistical sampling of subsurface soils and it is possible that conditions may be encountered during construction that are substantially different from those indicated by the borings. In these instances, adjustments to design and construction may be necessary. This geotechnical report is based on the information provided to ***Olsson*** and our understanding of the project as noted in this report. Changes in the location or design could significantly affect the conclusions and recommendations presented in this letter. ***Olsson*** should be contacted in the event of such changes to determine if the recommendations of this report remain appropriate for the revised design.

This report was prepared under the direction and supervision of a Professional Engineer registered in the State of Missouri with the firm of **Olsson, Inc.** The conclusions and recommendations contained herein are based on generally accepted, professional geotechnical engineering practices at the time of this report, within this geographic area. No warranty, express or implied, is intended or made. This report has been prepared for the exclusive use of **Summit Homes** and their authorized representatives for specific application to the proposed project.

We appreciate the opportunity to work with you on this project. If you have any questions regarding this report, or if we may be of further service to you, please contact us.

Sincerely,
Olsson, Inc.

CHRISTY
LYNN
WILSON
NUMBER
PE-2018000298

Christy Wilson, PE 5/15/19

James M. Landrum, PE

NORTH

olsson

Scale: nts
Project No 018-1140
Approved by: CLW
Date: 5/13/19

Boring Location Plan

Woodside Ridge
Lee's Summit, Missouri

SYMBOLS AND NOMENCLATURE

DRILLING NOTES

DRILLING AND SAMPLING SYMBOLS

SS: Split-Spoon Sample (1.375” ID, 2.0” OD)
U: Thin-Walled Tube Sample (3.0” OD)
CS: Continuous Sample
BS: Bulk Sample
MC: Modified California Sampler
GB: Grab Sample
SPT: Standard Penetration Test Blows per 6.0”

HSA: Hollow Stem Auger
CFA: Continuous Flight Auger
HA: Hand Auger
CPT: Cone Penetration Test
WB: Wash Bore
FT: Fish Tail Bit
RB: Rock Bit

NE: Not Encountered
NP: Not Performed
NA: Not Applicable
% Rec: Percent of Recovery
WD: While Drilling
IAD: Immediately After Drilling
AD: After Drilling
CI: Cave-In

DRILLING PROCEDURES

Soil samples designated as “U” samples on the boring logs were obtained in using Thin-Walled Tube Sampling techniques. Soil samples designated as “SS” samples were obtained during Penetration Test using a Split-Spoon Barrel sampler. The standard penetration resistance ‘N’ value is the number of blows of a 140 pound hammer falling 30 inches to drive the Split-Spoon sampler one foot. Soil samples designated as “MC” were obtained in using Thick-Walled, Ring-Lined, Split-Barrel Drive sampling techniques. Recovered samples were sealed in containers, labeled, and protected for transportation to the laboratory for testing.

WATER LEVEL MEASUREMENTS

Water levels indicated on the boring logs are levels measured in the borings at the times indicated. In relatively high permeable materials, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels is not possible with only short-term observations.

SOIL PROPERTIES & DESCRIPTIONS

Descriptions of the soils encountered in the soil test borings were prepared using Visual-Manual Procedures for Descriptions and Identification of Soils.

PARTICLE SIZE

Boulders	12 in. +	Coarse Sand	4.75mm-2.0mm	Silt	0.075mm-0.005mm
Cobbles	12 in.-3 in.	Medium Sand	2.0mm-0.425mm	Clay	<0.005mm
Gravel	3 in.-4.75mm	Fine Sand	0.425mm-0.075mm		

COHESIVE SOILS

Consistency	Unconfined Compressive Strength (Qu) (tsf)
Very Soft	<0.25
Soft	0.25 – 0.5
Firm	0.5 – 1.0
Stiff	1.0 – 2.0
Very Stiff	2.0 – 4.0
Hard	> 4.0

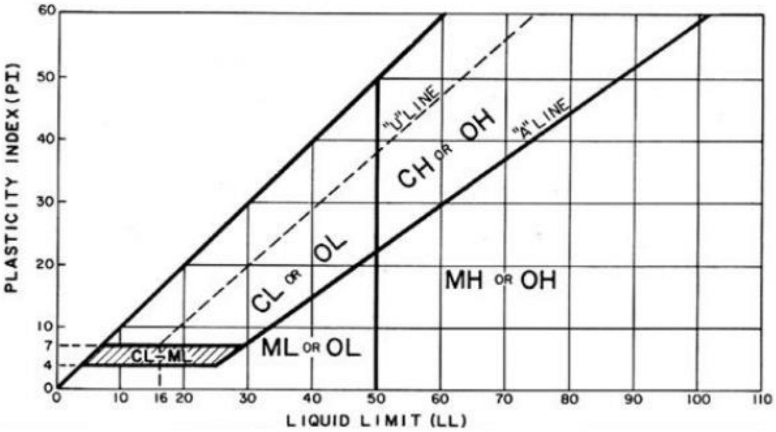
COHESIONLESS SOILS

Relative Density	‘N’ Value
Very Loose	0 – 3
Loose	4 – 9
Medium Dense	10 – 29
Dense	30 – 49
Very Dense	≥ 50

COMPONENT %

Description	Percent (%)
Trace	<5
Few	5 - 10
Little	15 - 25
Some	30 - 45
Mostly	50 - 100

PLASTICITY CHART



ROCK QUALITY DESIGNATION (RQD)

Description	RQD (%)
Very Poor	0 – 25
Poor	25 – 50
Fair	50 – 75
Good	75 – 90
Excellent	90 – 100

BOREHOLE REPORT NO. B-1

Sheet 1 of 1

PROJECT NAME **Clayton Properties Woodside Ridge 1st Plat**	CLIENT **Summit Homes**
PROJECT NUMBER **018-1140**	LOCATION **Lee's Summit, Missouri**

■ Shelby Tube ☒ Split Spoon

ELEVATION (ft)	MATERIAL DESCRIPTION	GRAPHIC LOG	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
950	**APPROX. SURFACE ELEV. (ft):** 950.1		0								
	ASPHALT ***0.7'***	■									
	FILL *Moist, dark brown with olive and red, fat clay, sand and gravel*			■ U 1	CH		1.6	26.5	97.9	63/42	
				■ U 2				25.6	99.5		PP = 2.5
945			5								
	▽										
	9.0'										
	Brown with dark gray, gravel and clay			☒ SS 3		9-2-8 N=10		13.0			
940			10								
	12.0'										
	Dark brown, clay, gravel, trace organics										
	▼										
				☒ SS 4		1-1-1 N=2		31.2			
	14.5'										
935	***FAT CLAY*** *Very moist, yellowish brown with gray* ***16.0'***		15								
	WEATHERED SHALE *Gray*										
	19.9'			☒ SS 5		12-30- 50/5"		14.6			

BASE OF BORING AT 19.9 FEET

WATER LEVEL OBSERVATIONS	
WD	▽ 6.0 ft
IAD	▼ 13.2 ft after 0 Hrs
AD	▼ Not Performed

OLSSON ASSOCIATES
1700 E. 123RD STREET
OLATHE, KANSAS 66061

STARTED:	11/29/18	FINISHED:	11/29/18
DRILL CO.:	OLSSON	DRILL RIG:	CME 45
DRILLER:	K. PATTERSON	LOGGED BY:	STEVEN
METHOD: CONTINUOUS FLIGHT AUGER			

olsson

BOREHOLE REPORT NO. B-2

Sheet 1 of 1

PROJECT NAME **Clayton Properties Woodside Ridge 1st Plat**	CLIENT **Summit Homes**
PROJECT NUMBER **018-1140**	LOCATION **Lee's Summit, Missouri**

ELEVATION (ft)	MATERIAL DESCRIPTION	GRAPHIC LOG	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
	APPROX. SURFACE ELEV. (ft): 973.5		0								
	ROOT ZONE ***0.3'***										
	FAT CLAY *Dark brown to reddish brown, with silt*										
970											
			5								
965											
			10								
	11.0'										
	Yellowish brown										
	12.2'										
	LIMESTONE ***12.5'***										
	REFUSAL AT 12.5 FEET										

WATER LEVEL OBSERVATIONS	
WD	▽ Not Encountered
IAD	▼ Not Encountered
AD	▼ Not Performed

OLSSON ASSOCIATES
1700 E. 123RD STREET
OLATHE, KANSAS 66061

STARTED:	11/29/18	FINISHED:	11/29/18
DRILL CO.:	OLSSON	DRILL RIG:	CME 45
DRILLER:	K. PATTERSON	LOGGED BY:	STEVEN
METHOD: CONTINUOUS FLIGHT AUGER			

olsson

BOREHOLE REPORT NO. B-3

Sheet 1 of 1

PROJECT NAME **Clayton Properties Woodside Ridge 1st Plat**	CLIENT **Summit Homes**
PROJECT NUMBER **018-1140**	LOCATION **Lee's Summit, Missouri**

■ Shelby Tube ☒ Split Spoon

ELEVATION (ft)	MATERIAL DESCRIPTION	GRAPHIC LOG	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
	APPROX. SURFACE ELEV. (ft): 972.3		0								
	ROOT ZONE *0.3'*										
970	***FAT CLAY*** *Very stiff, moist, brown, trace gray, with silt*			■ U 1	CH			28.9	94.2	61/38	PP = 2.25
			5	■ U 2			2.0	24.8	100.9		
	6.5'										
965	***WEATHERED SHALE*** *Yellowish brown, with weathered limestone*										
	8.8'			☒ SS 3		50/5"		21.0			
	LIMESTONE *With shale seams*		10								
	11.1'										

REFUSAL AT 11.1 FEET

WATER LEVEL OBSERVATIONS	
WD	▽ Not Encountered
IAD	▼ Not Encountered
AD	▼ Not Performed

OLSSON ASSOCIATES
1700 E. 123RD STREET
OLATHE, KANSAS 66061

STARTED:	11/30/18	FINISHED:	11/30/18
DRILL CO.:	OLSSON	DRILL RIG:	CME 45
DRILLER:	K. PATTERSON	LOGGED BY:	STEVEN
METHOD: CONTINUOUS FLIGHT AUGER			

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BOREHOLE REPORT NO. B-4

Sheet 1 of 1

PROJECT NAME
Clayton Properties Woodside Ridge 1st Plat

CLIENT
Summit Homes

PROJECT NUMBER
018-1140

LOCATION
Lee's Summit, Missouri

■ Shelby Tube

APPROX. SURFACE ELEV. (ft): 973.0

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
		0								
	ROOT ZONE 0.3'									
	FAT CLAY *Very stiff to hard, moist, brown with gray, trace organics and silt*		■ U 1				26.2	99.3		PP = 4.0
970										
	4.0' *Hard, dry to moist, yellowish brown*		■ U 2			5.3	13.9	104.2		
		5								
965	8.0'									
	WEATHERED SHALE *Yellowish brown, with weathered limestone*		■ U 3				31.2	79.8		
	9.9'	10								
	WEATHERED LIMESTONE *With shale seams*									
	12.3'									

REFUSAL AT 12.3 FEET

WATER LEVEL OBSERVATIONS	
WD	▽ Not Encountered
IAD	▼ Not Encountered
AD	▼ Not Performed

OLSSON ASSOCIATES
1700 E. 123RD STREET
OLATHE, KANSAS 66061

STARTED:	11/30/18	FINISHED:	11/30/18
DRILL CO.:	OLSSON	DRILL RIG:	CME 45
DRILLER:	K. PATTERSON	LOGGED BY:	STEVEN

METHOD: CONTINUOUS FLIGHT AUGER

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BOREHOLE REPORT NO. B-5

Sheet 1 of 1

PROJECT NAME **Clayton Properties Woodside Ridge 1st Plat**	CLIENT **Summit Homes**
PROJECT NUMBER **018-1140**	LOCATION **Lee's Summit, Missouri**

ELEVATION (ft)	MATERIAL DESCRIPTION	GRAPHIC LOG	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
	APPROX. SURFACE ELEV. (ft): 976.7		0								
	ROOT ZONE ***0.3'***										
975	***FAT CLAY*** *Dark brown, with gray, silty*	▨									
		▨	5								
970		▨									
	8.0' *Yellowish brown*	▨									
		▨	10								
965	***12.3'***	▨									
	WEATHERED SHALE *Yellowish brown* ***13.9'***	☰									
	WEATHERED LIMESTONE ***14.4'***	▦									

REFUSAL AT 14.4 FEET

WATER LEVEL OBSERVATIONS	
WD	▽ Not Encountered
IAD	▼ Not Encountered
AD	▼ Not Performed

OLSSON ASSOCIATES
1700 E. 123RD STREET
OLATHE, KANSAS 66061

STARTED:	11/30/18	FINISHED:	11/30/18
DRILL CO.:	OLSSON	DRILL RIG:	CME 45
DRILLER:	K. PATTERSON	LOGGED BY:	STEVEN
METHOD: CONTINUOUS FLIGHT AUGER			

BOREHOLE REPORT NO. B-6

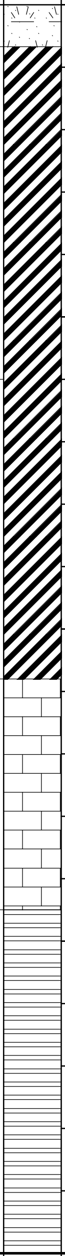
Sheet 1 of 1

PROJECT NAME
Clayton Properties Woodside Ridge 1st Plat

CLIENT
Summit Homes

PROJECT NUMBER
018-1140

LOCATION
Lee's Summit, Missouri

ELEVATION (ft)	MATERIAL DESCRIPTION	GRAPHIC LOG	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
	APPROX. SURFACE ELEV. (ft): 970.7		0								
970	***ROOT ZONE*** **0.7'**										
	FAT CLAY *Dark brown with gray, trace silt and gravel*		5								
965	**6.0'**										
	Light brown, with limestone fragments		10								
960	**10.8'**										
	WEATHERED LIMESTONE *With clay seams* **14.5'**		15								
955	***WEATHERED SHALE*** *Olive brown to gray*										
	20.0'		20								
	BASE OF BORING AT 20.0 FEET										

WATER LEVEL OBSERVATIONS	
WD	▽ Not Encountered
IAD	▼ Not Encountered
AD	▼ Not Performed

OLSSON ASSOCIATES
1700 E. 123RD STREET
OLATHE, KANSAS 66061

STARTED:	11/29/18	FINISHED:	11/29/18
DRILL CO.:	OLSSON	DRILL RIG:	CME 45
DRILLER	K. PATTERSON	LOGGED BY:	STEVEN
METHOD: CONTINUOUS FLIGHT AUGER			

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BOREHOLE REPORT NO. B-7

Sheet 1 of 1

PROJECT NAME **Clayton Properties Woodside Ridge 1st Plat**	CLIENT **Summit Homes**
PROJECT NUMBER **018-1140**	LOCATION **Lee's Summit, Missouri**

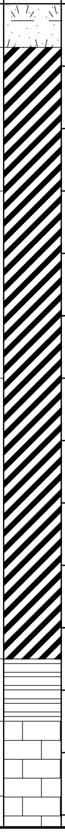
■ Shelby Tube

APPROX. SURFACE ELEV. (ft): 973.6

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)
	ROOT ZONE	0.7'
	FAT CLAY *Very stiff, moist, yellowish brown with gray, trace silt and organics*	3.0'
970	*Very stiff, moist, brown with gray, trace red, with silt*	6.0'
965	*Hard, moist, brown with gray and red, shaley, trace limestone fragments*	10.5'
	SHALE *Reddish brown, silty*	11.5'
	WEATHERED LIMESTONE *Grayish brown, with shale layers*	12.7'
	LIMESTONE *Gray*	13.2'

REFUSAL AT 13.2 FEET

GRAPHIC LOG



DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
0								
	U 1				27.6	95.0		PP = 2.25
5	U 2			2.1	25.9	98.5		
10	U 3				25.9	99.2		PP = 4.25

WATER LEVEL OBSERVATIONS	
WD	▽ Not Encountered
IAD	▼ Not Encountered
AD	▼ Not Performed

OLSSON ASSOCIATES
1700 E. 123RD STREET
OLATHE, KANSAS 66061

STARTED:	2/13/19	FINISHED:	2/13/19
DRILL CO.: RC DRILLING		DRILL RIG:	RC 550X
DRILLER:	RON	LOGGED BY:	ZACH
METHOD: CONTINUOUS FLIGHT AUGER			

olsson

BOREHOLE REPORT NO. B-8

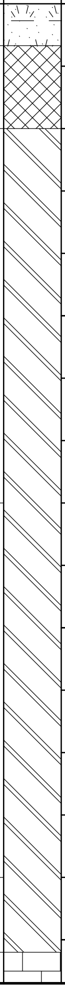
Sheet 1 of 1

PROJECT NAME
Clayton Properties Woodside Ridge 1st Plat

CLIENT
Summit Homes

PROJECT NUMBER
018-1140

LOCATION
Lee's Summit, Missouri



ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
	APPROX. SURFACE ELEV. (ft): 974.7	0								
	ROOT ZONE **0.7'**									
	FILL *Dark brown, clay, silt, trace organics* **2.0'**									
	LEAN TO FAT CLAY *Brown, trace reddish brown, with silt*									
970		5								
	8.0'									
	Brown, trace grayish brown									
965		10								
	14.0'									
960	*Brown with gray, trace red, trace limestone fragments* **15.2'**	15								
	LIMESTONE **15.7'** *Gray*									

REFUSAL AT 15.7 FEET

WATER LEVEL OBSERVATIONS	
WD	▽ Not Encountered
IAD	▼ Not Encountered
AD	▼ Not Performed

OLSSON ASSOCIATES
1700 E. 123RD STREET
OLATHE, KANSAS 66061

STARTED:	2/14/19	FINISHED:	2/14/19
DRILL CO.:	RC DRILLING	DRILL RIG:	RC 550X
DRILLER:	RON	LOGGED BY:	ZACH

METHOD: CONTINUOUS FLIGHT AUGER

olsson

BOREHOLE REPORT NO. B-9

Sheet 1 of 1

PROJECT NAME **Clayton Properties Woodside Ridge 1st Plat**	CLIENT **Summit Homes**
PROJECT NUMBER **018-1140**	LOCATION **Lee's Summit, Missouri**

■ Shelby Tube

APPROX. SURFACE ELEV. (ft): 962.9

ELEVATION (ft)	**MATERIAL DESCRIPTION**	**GRAPHIC LOG**	**DEPTH** (ft)	**SAMPLE TYPE NUMBER**	**CLASSIFICATION** (USCS)	**BLOWS/6" N-VALUE**	**UNC. STR.** (tsf)	**MOISTURE** (%)	**DRY DENSITY** (pcf)	**LL/PI** (%)	**ADDITIONAL DATA/ REMARKS**
	ROOT ZONE ***0.5'***		0								
	FAT CLAY *Very stiff, moist, brown, trace silt*			U 1				27.3	96.1		PP = 3.5
960	***3.0'***										
	Stiff, moist, brown to reddish brown, trace silt		5	U 2			1.9	24.4	100.0		
	6.0'										
955	*Hard, moist, reddish brown with brown and gray, with limestone fragments and weathered shale*										
			10	U 3				27.8	96.5		PP = 4.5+
	11.2'										
	LIMESTONE *Gray* ***11.5'***										

REFUSAL AT 11.5 FEET

WATER LEVEL OBSERVATIONS	
WD	▽ Not Encountered
IAD	▼ Not Encountered
AD	▼ Not Performed

OLSSON ASSOCIATES
1700 E. 123RD STREET
OLATHE, KANSAS 66061

STARTED:	2/14/19	FINISHED:	2/14/19
DRILL CO.: RC DRILLING		DRILL RIG:	RC 550X
DRILLER:	RON	LOGGED BY:	ZACH
METHOD: CONTINUOUS FLIGHT AUGER			

olsson

BOREHOLE REPORT NO. B-10

Sheet 1 of 1

PROJECT NAME
Clayton Properties Woodside Ridge 1st Plat

CLIENT
Summit Homes

PROJECT NUMBER
018-1140

LOCATION
Lee's Summit, Missouri

ELEVATION (ft)	MATERIAL DESCRIPTION	GRAPHIC LOG	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
	APPROX. SURFACE ELEV. (ft): 963.1		0								
	ROOT ZONE ***0.5'***										
	FAT CLAY *Brown, trace silt*										
960											
	4.5'										
	Brown to reddish brown, trace silt		5								
955	***8.5'***										
	Reddish brown, shaley		10								
	12.0'										
	WEATHERED LIMESTONE										
950	*Grayish brown, with clay and shale layers* ***13.3'***										
	LIMESTONE ***13.6'*** *Gray*										

REFUSAL AT 13.6 FEET

WATER LEVEL OBSERVATIONS	
WD	▽ Not Encountered
IAD	▼ Not Encountered
AD	▼ Not Performed

OLSSON ASSOCIATES
1700 E. 123RD STREET
OLATHE, KANSAS 66061

STARTED:	2/14/19	FINISHED:	2/14/19
DRILL CO.: RC DRILLING		DRILL RIG:	RC 550X
DRILLER:	RON	LOGGED BY:	ZACH

METHOD: CONTINUOUS FLIGHT AUGER

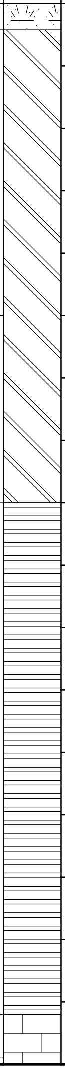
olsson

BOREHOLE REPORT NO. B-11

Sheet 1 of 1

PROJECT NAME **Clayton Properties Woodside Ridge 1st Plat**	CLIENT **Summit Homes**
PROJECT NUMBER **018-1140**	LOCATION **Lee's Summit, Missouri**

ELEVATION (ft)	MATERIAL DESCRIPTION	GRAPHIC LOG	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
	APPROX. SURFACE ELEV. (ft): 969.0		0								
	ROOT ZONE **0.4'**										
	LEAN TO FAT CLAY *Brown, trace silt*										
965											
	5.0'		5								
	Reddish brown, trace silt and gravel fragments										
	8.0'										
	WEATHERED SHALE *Brown to reddish brown, with gray, clayey*										
960											
			10								
955											
			15								
	16.2'										
	WEATHERED LIMESTONE *Brown to reddish brown* **16.9'**										
	LIMESTONE *Gray* **17.0'**										



REFUSAL AT 17.0 FEET

WATER LEVEL OBSERVATIONS	
WD	▽ Not Encountered
IAD	▼ Not Encountered
AD	▼ Not Performed

OLSSON ASSOCIATES
1700 E. 123RD STREET
OLATHE, KANSAS 66061

STARTED:	2/14/19	FINISHED:	2/14/19
DRILL CO.: RC DRILLING		DRILL RIG:	RC 550X
DRILLER:	RON	LOGGED BY:	ZACH
METHOD: CONTINUOUS FLIGHT AUGER			

olsson

BOREHOLE REPORT NO. B-12

Sheet 1 of 1

PROJECT NAME **Clayton Properties Woodside Ridge 1st Plat**	CLIENT **Summit Homes**
PROJECT NUMBER **018-1140**	LOCATION **Lee's Summit, Missouri**

■ Shelby Tube

ELEVATION (ft)	MATERIAL DESCRIPTION	GRAPHIC LOG	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
	APPROX. SURFACE ELEV. (ft): 978.3		0								
	FILL *Brown, with red and dark brown, clay, gravel, shale and organics* ***1.5'***	▨		■ U 1				34.0	86.4		
	Possible boulder ***2.0'***	▨									

REFUSAL AT 2.0 FEET

WATER LEVEL OBSERVATIONS	
WD	▽ Not Encountered
IAD	▼ Not Encountered
AD	▼ Not Performed

OLSSON ASSOCIATES
1700 E. 123RD STREET
OLATHE, KANSAS 66061

STARTED: 2/14/19	FINISHED: 2/14/19
DRILL CO.: RC DRILLING	DRILL RIG: RC 550X
DRILLER: RON	LOGGED BY: ZACH
METHOD: CONTINUOUS FLIGHT AUGER	

BOREHOLE REPORT NO. B-12A

Sheet 1 of 1

PROJECT NAME **Clayton Properties Woodside Ridge 1st Plat**	CLIENT **Summit Homes**
PROJECT NUMBER **018-1140**	LOCATION **Lee's Summit, Missouri**

☒ Split Spoon

APPROX. SURFACE ELEV. (ft): 978.2

ELEVATION (ft)	**MATERIAL DESCRIPTION**	**GRAPHIC LOG**	**DEPTH** (ft)	**SAMPLE TYPE NUMBER**	**CLASSIFICATION** (USCS)	**BLOWS/6" N-VALUE**	**UNC. STR.** (tsf)	**MOISTURE** (%)	**DRY DENSITY** (pcf)	**LL/PI** (%)	**ADDITIONAL DATA/ REMARKS**
	FILL *Dark brown with reddish brown, clay, shale, trace organics*	▩	0								
975	***3.5'***	▩									
	Moist, brown, clay, silt and brick fragments	▩	5	☒ SS 1		5-6-1 N=7		26.2			
	6.2'	▩									
	Concrete rubble, rebar	▩									
	7.3'	▩									
970	*Moist, brown with olive, trace red and gray, clay and gravel*	▩	10	☒ SS 2		6-8-10 N=18		22.8			
	10.5'	▩									
	FAT CLAY *Reddish brown, trace gravel*	▨									
965	***13.5'***	▨									
	Stiff, moist, reddish brown, shaley, with gravel	▨	15	☒ SS 3		5-6-8 N=14		29.9			
	15.0'	▨									

BASE OF BORING AT 15.0 FEET

WATER LEVEL OBSERVATIONS	
WD	▽ Not Encountered
IAD	▼ Not Encountered
AD	▼ Not Performed

OLSSON ASSOCIATES
1700 E. 123RD STREET
OLATHE, KANSAS 66061

STARTED: 2/14/19	FINISHED: 2/14/19
DRILL CO.: RC DRILLING	DRILL RIG: RC 550X
DRILLER: RON	LOGGED BY: ZACH
METHOD: CONTINUOUS FLIGHT AUGER	

BOREHOLE REPORT NO. B-101

Sheet 1 of 1

PROJECT NAME **Clayton Properties Woodside Ridge 1st Plat**	CLIENT **Summit Homes**
PROJECT NUMBER **018-1140**	LOCATION **Lee's Summit, Missouri**

Grab Sample

ELEVATION (ft)	MATERIAL DESCRIPTION	GRAPHIC LOG	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
			0								
	FAT CLAY *Very dark brown, with organics, trace silt* ***1.0'***	▨		GB 1				37.2			
	Brown to dark brown, with organics, trace silt, sand, and limestone fragments ***1.5'***	▨		GB 2	CH			38.8		71/46	

REFUSAL AT 1.5 FEET

WATER LEVEL OBSERVATIONS	
WD	▽ 1.5 ft
IAD	▼ 1.5 ft after 0 Hrs
AD	▼ Not Performed

OLSSON ASSOCIATES
1700 E. 123RD STREET
OLATHE, KANSAS 66061

STARTED:	5/7/19	FINISHED:	5/7/19
DRILL CO.:	OLSSON	DRILL RIG:	HAND AUGER
DRILLER:	P. OWEN	LOGGED BY	K.PATTERSON
METHOD: HAND AUGER			

BOREHOLE REPORT NO. B-102

Sheet 1 of 1

PROJECT NAME **Clayton Properties Woodside Ridge 1st Plat**	CLIENT **Summit Homes**
PROJECT NUMBER **018-1140**	LOCATION **Lee's Summit, Missouri**

Grab Sample

ELEVATION (ft)	MATERIAL DESCRIPTION		GRAPHIC LOG	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
				0								
	FAT CLAY *Very dark brown, trace silt and organics*	***0.5'***	▨		GB 1				41.4			

REFUSAL AT 0.5 FEET

WATER LEVEL OBSERVATIONS	
WD	▽ Not Encountered
IAD	▼ Not Encountered
AD	▼ Not Performed

OLSSON ASSOCIATES
1700 E. 123RD STREET
OLATHE, KANSAS 66061

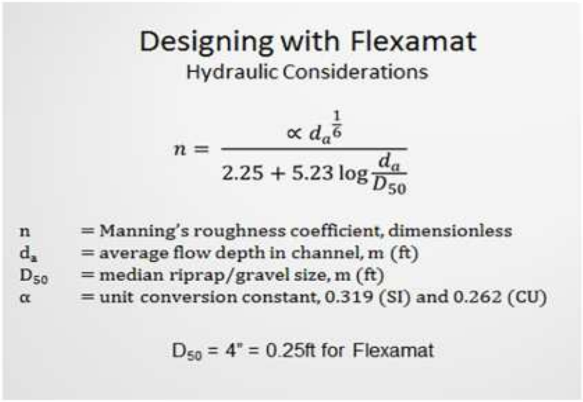
STARTED:	5/7/19	FINISHED:	5/7/19
DRILL CO.:	OLSSON	DRILL RIG:	HAND AUGER
DRILLER:	P. OWEN	LOGGED BY:	K. PATTERSON

METHOD: HAND AUGER

APPENDIX C

Shear Stress Calculations

Basin C1 Spillway Shear Stress Calcs



Designing with Flexamat

Hydraulic Considerations

$$n = \frac{\propto d_a^{\frac{1}{6}}}{2.25 + 5.23 \log \frac{d_a}{D_{50}}}$$

n = Manning's roughness coefficient, dimensionless

d_a = average flow depth in channel, m (ft)

D_{50} = median riprap/gravel size, m (ft)

α = unit conversion constant, 0.319 (SI) and 0.262 (CU)

D_{50} = 4" = 0.25ft for Flexamat

Flexamat "n" Calculation

numerator	0.2167
denominator	2.8107
Flexamat "n"	0.0771

Trapezoidal Channel	**APWA 100 Yr Event**	
Inputs	**Basin C1**	**units**
Bottom Width	130	ft
Side Slope	3	z:1
Total Depth	1.5	ft
Inv Elev	926.5	ft
Slope	33.3	%
Flexamat n-value	0.0771	
Q100	551	cfs
Hydraflow Results		
Depth	0.56	ft
Q100	551	cfs
Wetted Area	73.74	sqft
Velocity	7.47	ft/s
Shear Stress		
Specific Weight of Water	62.4	lb/cf
Max. Depth of Flow	0.56	ft
Energy Slope	0.333	ft/ft
Mean Boundary Shear Stress	11.6	lb/sqft

Flexamat "n" Calculation

numerator	0.2372
denominator	4.0409
Flexamat "n"	0.0587

Trapezoidal Channel	**0.5PMP Event**	
Inputs	**Basin C1**	**units**
Bottom Width	130	ft
Side Slope	3	z:1
Total Depth	1.5	ft
Inv Elev	926.5	ft
Slope	33.3	%
Flexamat n-value	0.0587	
Q100	1137	cfs
Hydraflow Results		
Depth	0.74	ft
Q100	1137	cfs
Wetted Area	97.84	sqft
Velocity	11.62	ft/s
Shear Stress		
Specific Weight of Water	62.4	lb/cf
Max. Depth of Flow	0.74	ft
Energy Slope	0.333	ft/ft
Mean Boundary Shear Stress	15.4	lb/sqft

APPENDIX D

Flexamat® Product Information

PERMANENT EROSION CONTROL SOLUTIONS

Erosion Prevention and Protection

Flexamat® Provides Permanent Erosion Control Solutions for a Wide Range of Applications Including:

AIRPORTS
DOT ROADSIDE
DRIVABLE SURFACES
ENERGY SECTOR

INLETS/OUTLETS
LANDFILL/MINE RECLAMATION
SHORELINE
STREAM AND RIVERBANK

Flexamat®
PERMANENT EROSION CONTROL

PERMANENT EROSION CONTROL SOLUTIONS

Erosion Prevention and Protection

OUR COMPANY

Motz Enterprises, Inc. is the manufacturer of **Flexamat®**. The company has been in business for over 30 years and is headquartered in Cincinnati, Ohio.

Flexamat® is sold throughout the United States and Canada with material available locally in most areas.

We take pride in our performance and specifying the right product for the right application. **Flexamat®** is an effective, long term solution. We look forward to working with you.


South Platte River, CO


Flexamat®.

Learn More About How Flexamat® Is The Best Permanent Erosion Solution!

ABOUT Flexamat®

Permanent Erosion Control

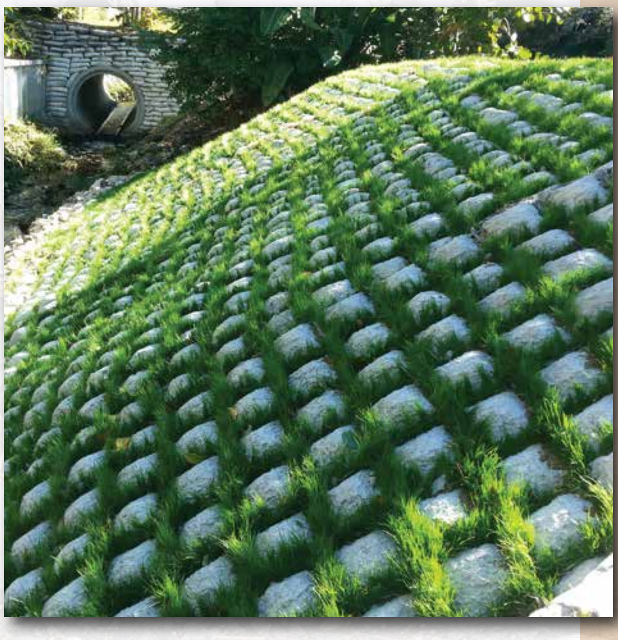
Flexamat® is a permanent erosion control mat utilized for stabilizing slopes, channels, low water crossings, inlet/outlet protection, and shorelines. Tied Concrete Block Mat is a generic term for **Flexamat®**. It consists of concrete blocks (6.5″ x 6.5″ with a 2.25″ profile) locked together and embedded into a high strength geogrid. There is 1.5″ spacing between the blocks that gives the mat flexibility and allows for optional vegetation growth. The mat is packaged in rolls, making transporting and installing **Flexamat®** efficient. It is manufactured with various underlayments, determined by onsite conditions.

Vegetated Solution

Flexamat® offers permanent, hard armor protection, with a natural vegetation. **Flexamat®** may be mowed over with commercial mowing equipment or left to grow wild. Besides grass, there are many other types of native plant species that can be planted to grow within the mat. For example, Willow stakes and other native plugs can be planted within **Flexamat®**.

Work With Nature, Not Against

Incorporating perennial vegetation into storm water treatment plans will encourage the benefits of phytoremediation which is the direct use of living green plants for the removal, degradation or containments of contaminants. The establishment of perennial vegetation increases infiltration of storm water runoff into the soil, increased removal of pollutants found in road and parking lots runoff (oils & grease, metals, break dust salt, garbage, nutrients) through filtration and phytoremediation. The perennial vegetation also reduces or eliminates the thermal impacts to storm water runoff by shading the concrete blocks from sunlight and aiding in infiltration and filtering of the runoff, unlike rip rap or other hard armor alternatives.



BENEFITS OF Flexamat®

HIGH PERFORMANCE
Un-vegetated capabilities, 30ft./sec. & 24 PSF

EASY MAINTENANCE
Safe to mow over

FAST INSTALLATION
Roll design makes installation efficient

SIMPLE INSTALLATION
Personnel can install with their own equipment

AESTHETICALLY PLEASING
Conforms to landscape

IMPROVES SAFETY
Safe for motorist to drive across

ENVIRONMENTALLY FRIENDLY
Safe for pedestrians and wildlife to walk across

REDUCES CONSTRUCTION COSTS
Low material cost, less labor and faster project completion.

DISCOURAGES GRAFFITI
Vegetated solution rather than poured in place concrete

IMPROVES WATER QUALITY
Offers phytoremediation and reduces thermal impact

LOW-IMPACT DEVELOPMENT (LID)
Helps achieve MS4 permit requirements

Departments of Transportation Roadways Protection

FEDERAL | STATE | MUNICIPAL

Flexamat®
PERMANENT EROSION CONTROL

Departments of Transportation Roadways Protection

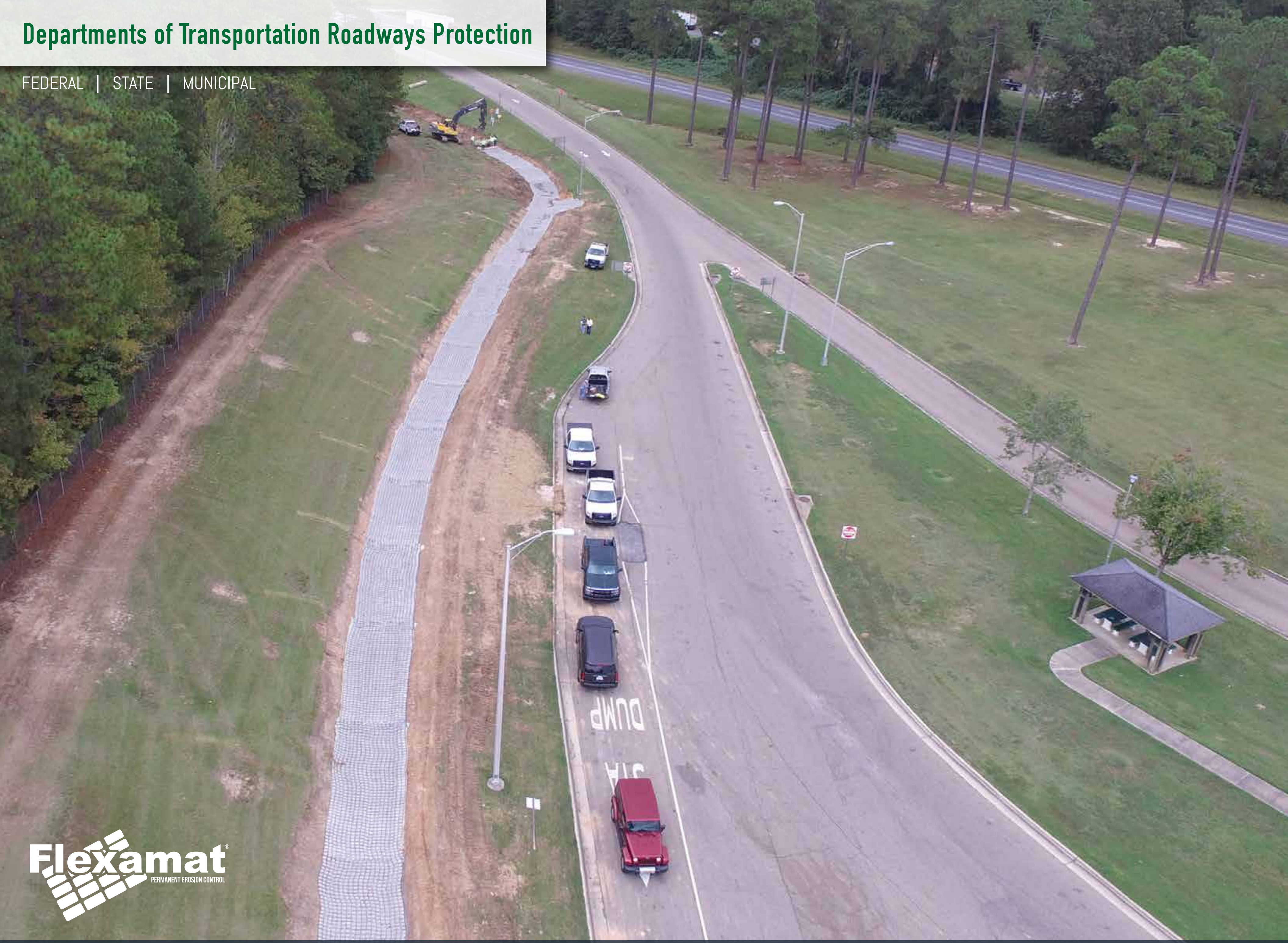
FEDERAL | STATE | MUNICIPAL

Three months after installation.

One year after installation.

Departments of Transportation Roadways Protection

FEDERAL | STATE | MUNICIPAL



Flexamat®
PERMANENT EROSION CONTROL

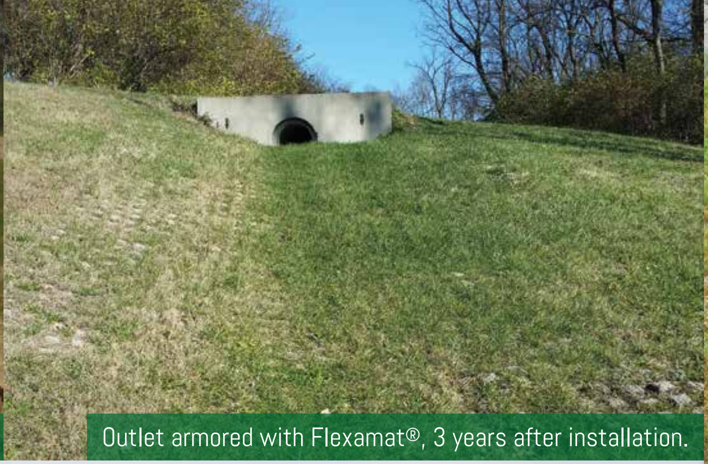
Departments of Transportation Roadways Protection

FEDERAL | STATE | MUNICIPAL

One year after installation.

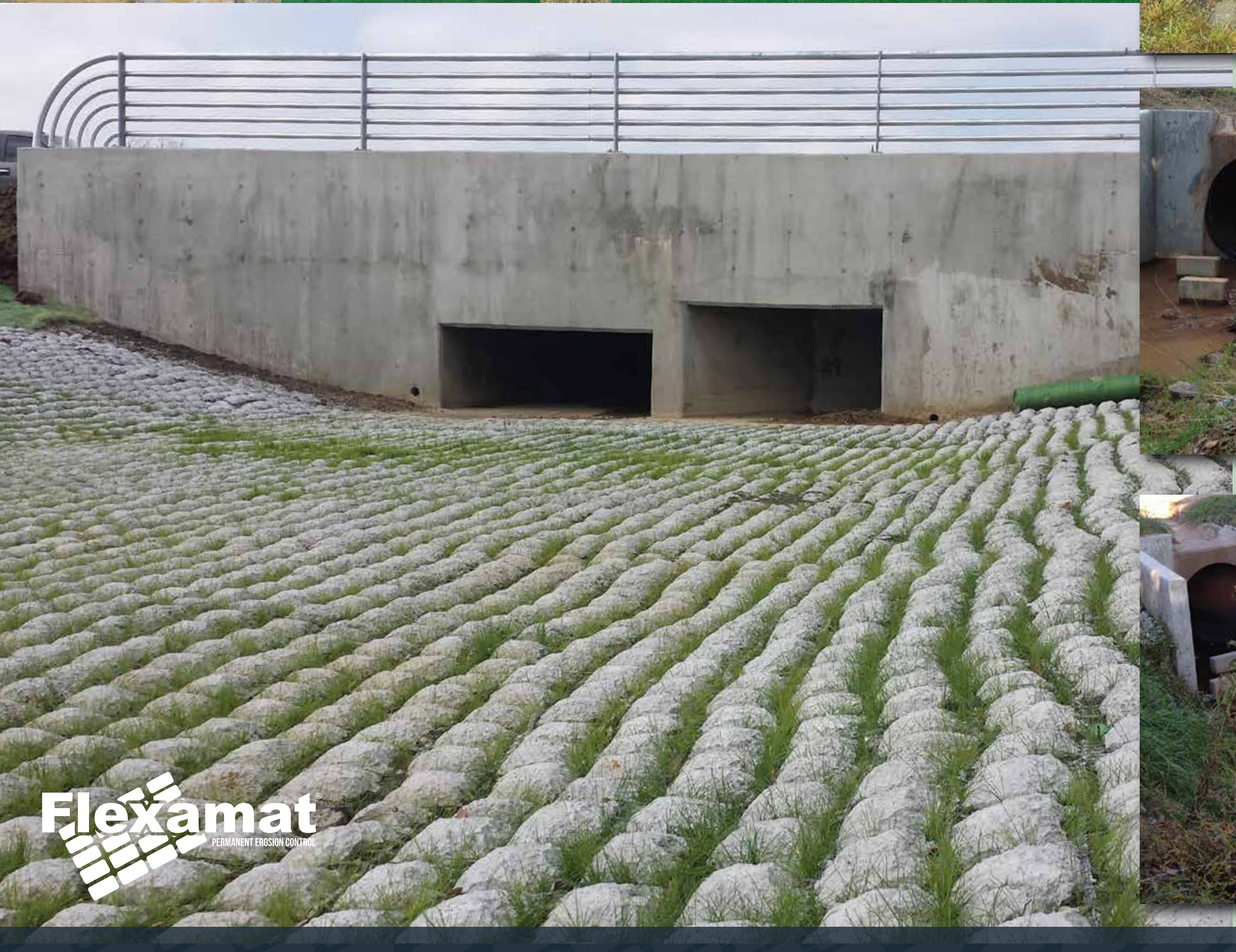
Inlet & Outlet Erosion Protection

Outlet with failing Rip Rap.



Outlet armored with Flexamat®, 3 years after installation.

Armored inlet.



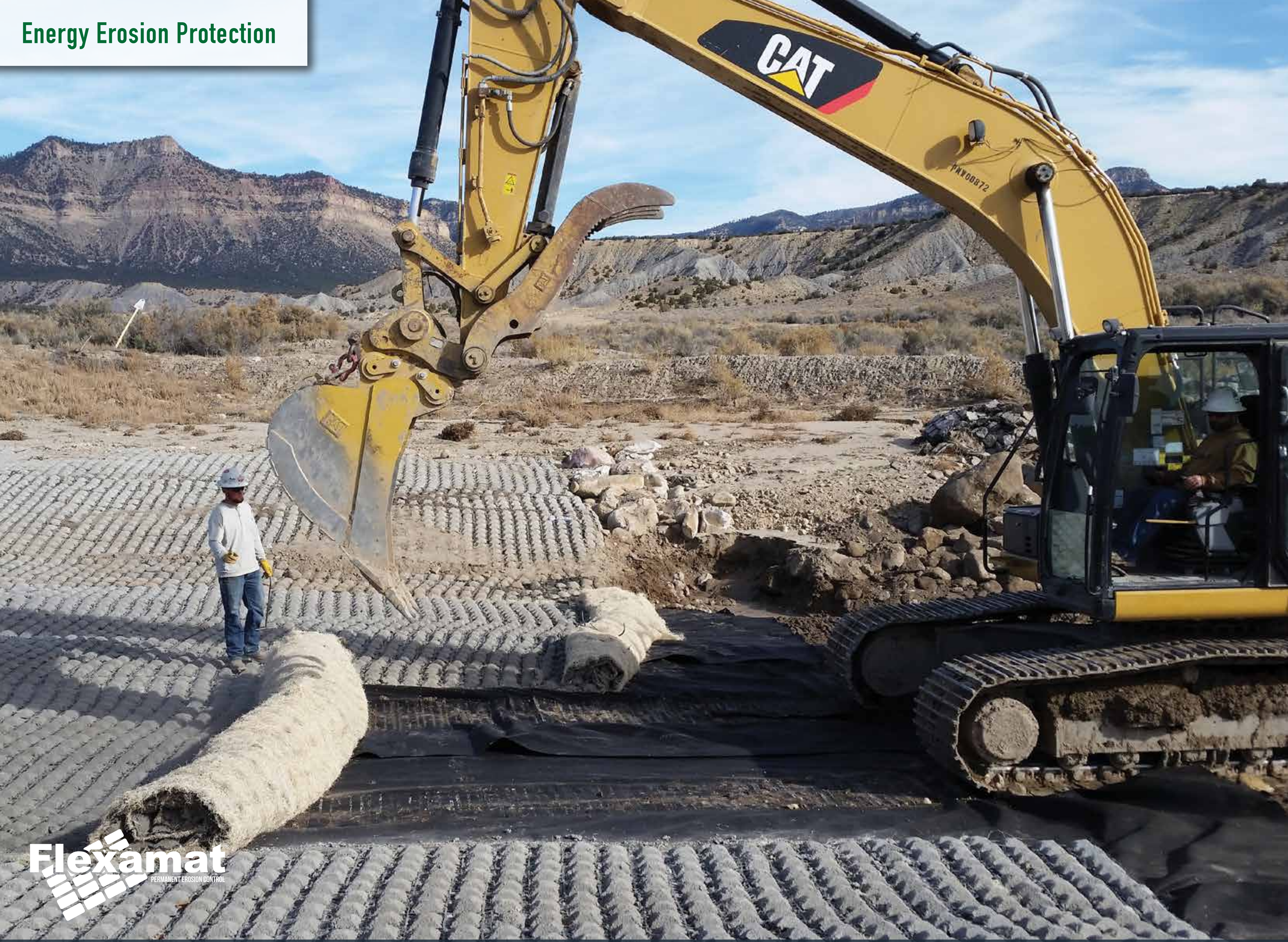
Griffin, GA - Eroded outlet.

Griffin, GA - Repaired outlet.

Landfill Erosion Protection

60' wide letdown just installed.

60' wide letdown 4 years after installation.


CAT
PNW00872

Exposed high pressure gas pipeline.

Flood Control

One year after installation.


Flexamat®
PERMANENT EROSION CONTROL

Canals

Three months after installation.

Percussion Anchors

Gas powered driver installation.

Loading anchor with Jack Jaw®

Cutting excess cable.

Flexamat®
PERMANENT EROSION CONTROL

UNITED
F

Shoreline Erosion Protection

Shoreline Erosion Protection


Flexamat®
PERMANENT EROSION CONTROL

Drivable Surfaces Erosion Protection


Boat ramp.


Gravel infill for residential driveway.


Access road to high school stadium.

Schools Erosion Protection

Flexamat®
PERMANENT EROSION CONTROL

Flexamat® Standard with Curlex II® backing

Flexamat® Plus with Curlex II® and Recyclex backing

Flexamat® with non-woven fabric backing

Flexamat® Project Check List:

Here are some suggestions for a successful **Flexamat®** installation:

Decide which **Flexamat®** option is best for the site.

1. Curlex II® 2. **Flexamat®** PLUS 3. Geotextile (10 oz.)

☐ Order **Flexamat®** (may need up to 5-7% waste factor)

☐ Have installation crew watch videos on **Flexamat®**'s YouTube Channel

☐ Plan staging area for **Flexamat®**

☐ Prepare work prior to installation – remove stumps, rocks, soil, etc – for smooth surface

☐ Seed and fertilizer, this needs to be done prior to installation of **Flexamat®**

☐ Clevis shackle of appropriate weight rating. (For connecting to D-ring on bucket.)

☐ Swivel and rigging with latched sling hooks of appropriate weight rating.

☐ 3-4 moving hooks (Used for adjusting **Flexamat®** as needed during installation.)

☐ Lifting straps for large rolls.

☐ Smooth (toothless) bucket on excavator (refer to install videos)

☐ May be needed - #3 rebar 18" U-Anchors or Cross Plate Percussion Anchors

☐ May be needed - Curlex II® or Recyclex® TRM for seams and edges

☐ Gloves

☐ Rakes & Shovels

☐ Clevis

☐ Swivel and rigging w/ latched sling hooks

☐ Chop saw if cutting is required


CASE
CX55B

HYDRAULIC DATA

Flume Testing

Non-vegetated testing on 30% slope over sandy loam soil: Permissible Shear = 24+ PSF.
Non-vegetated testing on 20% slope over loam soil: Velocity = 30+ Ft/Sec


Rectangular Channel Setup


Gravity Flow to Flume


Channel Flow Velocity Measurement (Typical)


Low Flow In Channel


Medium Flow In Channel


High Flow In Channel


Rectangular Channel After High Flow


Channel After Matting Removed (no apparent soil surface disruption)

ROLLS

CORE AND NO-CORE

Flexamat® Standard is delivered without a core. Cores can be added.


Standard **Flexamat®** (no core)


Flexamat® (with core added)

GENERAL COMPOSITION OF MATERIALS

Blocks	5000 PSI, Wet-cast Portland Cement
Interlocking Biaxial Geogrid	Fornit 30/30 Polypropylene Geogrid with 2,055 lb/ft biaxial strength
Underlayment Options	**Standard** - Curlex® II ECB & Leno Weave Five-Pick Netting **Plus** - Recyclex® TRM-V, Curlex® II ECB & Leno Weave Five-Pick Netting **Fabric** - 10 oz NW fabric *More options available upon request

MANUFACTURING VALUES

Flexamat® Properties	Values
Roll Width	4’ 5.5’ 8’ 10’ 12’ 16’
Roll Length	30’ 40’ 50’ /Custom
Material Weight	10 lbs./sf
Block Size	6.5” x 6.5” x 2.25”
Percentage Open Area (POA)	30% min.

PERFORMANCE

Test	Tested Value	Bed Slope	Soil Classification	Limiting Value
ASTM 6460	Shear Stress	30%	Sandy Loam (USDA)	24+PSF
ASTM 6460	Velocity	20%	Loam (USDA)	30+ ft/sec

Up to 4800 square feet of material can ship on one truckload.

Flexamat®
PERMANENT EROSION CONTROL

Motz Enterprises, Inc.
3153 Madison Road
Cincinnati, OH 45209

web: www.flexamat.com
email: info@flexamat.com
phone: 513-772-6689

TRI/ENVIRONMENTAL, INC.
A Texas Research International Company

Large-Scale Channel Erosion Testing (ASTM D 6460 modified)

of

Flexamat Channel Lining over Sandy Loam

February 2009

Submitted to:
Motz Enterprises, Inc.
9415 Montgomery Rd, Ste H
Cincinnati, Ohio 45242

Attn: Mr. Jim Motz

Submitted by:
TRI/Environmental, Inc.
9063 Bee Caves Road
Austin, TX 78733

C. Joel Sprague

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Project Manager

TRI/ENVIRONMENTAL, INC.
A Texas Research International Company

February 23, 2009

Mr. Jim Motz
Motz Enterprises, Inc.
9415 Montgomery Rd, Ste H
Cincinnati, Ohio 45241

E-mail: mmotz@flexamat.com

Subject: Channel Testing of Flexamat over Sandy Loam (Log #2278-01-34)

Dear Mr. Motz:

This letter report presents the results for large-scale channel erosion tests performed on Flexamat channel lining over Sandy loam. Included are data developed for target hydraulic shears ranging from 4 to 16 psf (0.2 to 0.8 kPa). All testing work was performed in general accordance with the ASTM D 6460, *Standard Test Method for Determination of Rolled Erosion Control Product (RECP) Performance in Protecting Earthen Channels from Stormwater-Induced Erosion,* except, the permissible shear was projected rather than interpolated. Generated results were used to develop the following permissible or limiting shear (τ_{limit}) and limiting velocity (V_{limit}) for the tested material:

$$\boldsymbol{\tau}_{\textbf{limit FLEXAMAT(std)}} = \textbf{24+ psf} \qquad \textbf{V}_{\textbf{limit FLEXAMAT(std)}} = \textbf{19+ ft/sec}$$

TRI is pleased to present this *final* report. Please feel free to call if we can answer any questions or provide any additional information.

Sincerely,

C. Joel Sprague

C. Joel Sprague, P.E.
Senior Engineer
Geosynthetics Services Division

Cc: Sam Allen, Jarrett Nelson - TRI

CHANNEL TESTING REPORT

FLEXAMAT over Sandy loam

TESTING EQUIPMENT AND PROCEDURES

Overview of Test and Apparatus

TRI/Environmental, Inc.'s (TRI's) large-scale channel erosion testing facility is located at the Denver Downs Research Farm in Anderson, SC. Testing oversight is provided by C. Joel Sprague, P.E. The large-scale testing was performed in a rectangular flume having a 30% slope using a loamy soil test section. The concentrated flow is produced by gravity from an adjacent pond. Four sequential, increasing flows are applied to each test section for 30 minutes each to achieve a range of hydraulic shear stresses in order to define the permissible, or limiting, shear stress, τ_{limit}, which is the shear stress necessary to cause an average of 0.5 inch of soil loss over the entire channel bottom. Testing is performed in accordance with ASTM D 6460 protocol, except the permissible shear was projected rather than interpolated. Tables and graphs of shear versus soil loss are generated from the accumulated data.

Erosion Control Product

The following index properties were determined from testing the FLEXAMAT Erosion Control Matting.

Table 1. Tested FLEXAMAT Index Properties

Index Property / Test	Units	Values
Flexamat Product	style	Flex-a-mat Standard
Block size	(length x width)	6.5 in x 5.5 in
Block weight	lbs	3.0
Block Ground Cover	%	75
Reinforcing Grid	style	Fornit 30/30
Underlayment	style	Fortrac 3D-30
Straw coverage rate	oz/sy	12 oz/sy

Test Soil

The test soil used in the test plots had the following characteristics.

Table 2. TRI-Loam Characteristics

Soil Characteristic	Test Method	Value
% Gravel	ASTM D 422	7
% Sand		60
% Silt		25
% Clay		8
Liquid Limit, %	ASTM D 4318	32
Plasticity Index, %		5
Soil Classification	USDA	Sandy Loam
Soil Classification	USCS	Silty Sand (SM)

Preparation of the Test Channels

The test channels undergo a “standard” preparation procedure prior to each test. First, any rills or depressions resulting from previous testing are filled in with test soil. The entire test channel is then tilled to a depth not less than four inches. The test channel is then raked and formed to create a channel bottom that is level side-to-side and at a smooth 30% slope top-to-bottom. Finally, a vibrating plate compactor is run over the channel to achieve 90% standard Proctor compaction. The submitted erosion control product is then installed as directed by the client.

Installation of Erosion Control Product in Test Channel

As noted, the submitted erosion control product is installed as directed by the client. For the tests reported herein, the erosion control product was installed as follows:

- Straw placed uniformly on soil surface;
- Underlayment matting placed overtop the straw;
- FLEXAMAT unrolled over the straw/matting.

Note that anchorage was provided at the top of the flume.

Specific Test Procedure

Immediately prior to testing, the black plastic is removed from the test channel and initial soil surface elevation readings are made at predetermined cross-sections. The channel is then exposed to sequential 30-minute flows having typical target hydraulic shear stresses of 4, 8, 12, and 16 psf. During the testing, flow depth and corresponding flow velocity measurements are taken at the predetermined cross-section locations. Between flow events, the flow is stopped and soil surface elevation measurements are made to facilitate calculation of soil loss. Flows are then increased to achieve the subsequent shear target in an attempt to create more than 0.5 inches of soil loss. ½-inch of soil loss was not accomplished prior to reaching maximum flow capacity. Pictures of channel testing are shown in Figures 1 thru 8.

Figure 1. Rectangular Channel Setup

Figure 2. Gravity Flow to Flume

Figure 3. Channel Flow Velocity Measurement (typical)

Figure 4. Low Flow in Channel

Figure 5. Medium Flow in Channel

Figure 6. High Flow in Channel

Figure 7. Rect. Channel After High Flow

Figure 8. Channel After Matting Removed
(no apparent soil surface disruption)

TEST RESULTS

Average soil loss and the associated hydraulic shear calculated from flow and depth measurements made during the testing are the principle data used to determine the performance of the product tested. This data is entered into a spreadsheet that transforms the flow depth and velocity into an hydraulic shear stress and the soil loss measurements into and average Clopper Soil Loss Index (CSLI). A graph of shear versus soil loss for the protected condition is shown in Figure 9. The associated velocities are plotted in Figure 10. The graphs include a polynomial regression line fit to the test data to facilitate a projection of the limiting shear stress, τ_{limit},, and limiting velocity, V_{limit},, since ½-inch of soil loss was not achieved during testing.

Table 3. Summary Data Table – Protected Test Reach

Test # (run # - target shear)	Flow depth (in)	Flow velocity (fps)	Flow (cfs)	Manning's roughness, n	Max Bed Shear Stress (psf)	CSLI (in)	Cumm. CSLI (in)
R1-4	3.79	6.56	4.13	0.058	5.82	-0.06	-0.06
R1-8	5.07	8.88	7.48	0.052	7.79	-0.05	-0.11
R1-12	6.99	11.06	12.87	0.051	10.74	-0.07	-0.18
R1-16	11.03	14.88	27.30	0.052	16.95	-0.11	-0.29
R2-4	3.61	6.38	3.82	0.058	5.55	-0.04	-0.04
R2-8	5.21	8.69	7.53	0.054	8.00	-0.05	-0.09
R2-12	7.10	10.81	12.77	0.053	10.92	-0.05	-0.14
R2-16	10.80	14.56	26.19	0.052	16.60	-0.11	-0.25
R3-4	3.53	6.31	3.70	0.057	5.42	-0.04	-0.04
R3-8	5.31	8.56	7.58	0.055	8.17	-0.07	-0.11
R3-12	6.88	10.63	12.17	0.053	10.57	-0.07	-0.17
R3-16	10.88	14.88	26.95	0.051	16.71	-0.13	-0.30

Using the test procedure and data evaluation technique described herein, the limiting shear stress shown in Table 4 was determined using the following equation:

$$\tau_{limit}, = \gamma \, d \, S$$

where: τ_{limit}, = limiting shear stress;
γ = unit weight of water, 62.4pcf;
d = depth of water, ft
S = channel slope, 0.30

Table 4. Overall C-Factor

Product	Limiting Shear, τ_{limit}	Limiting Velocity, V_{limit}
FLEXAMAT - standard	24+ psf	19+ ft/sec

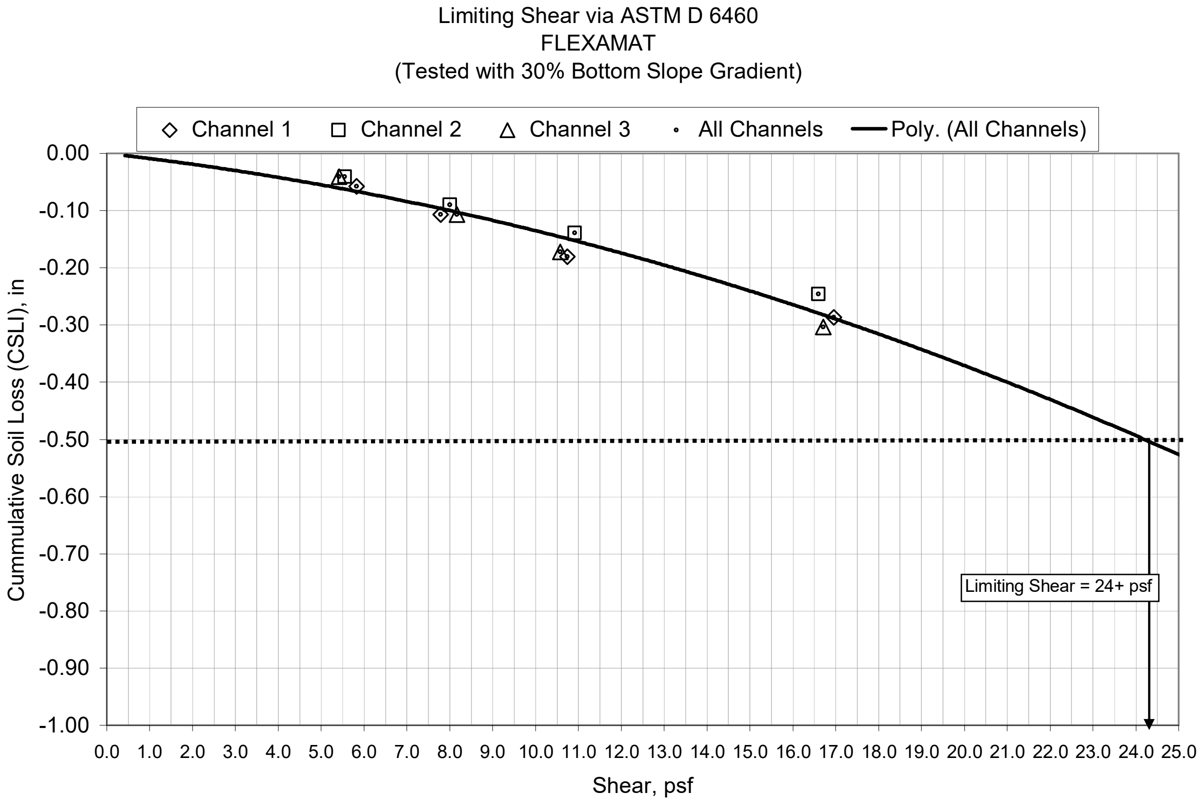


Figure 11. Shear Stress vs. Soil Loss – Tested Product

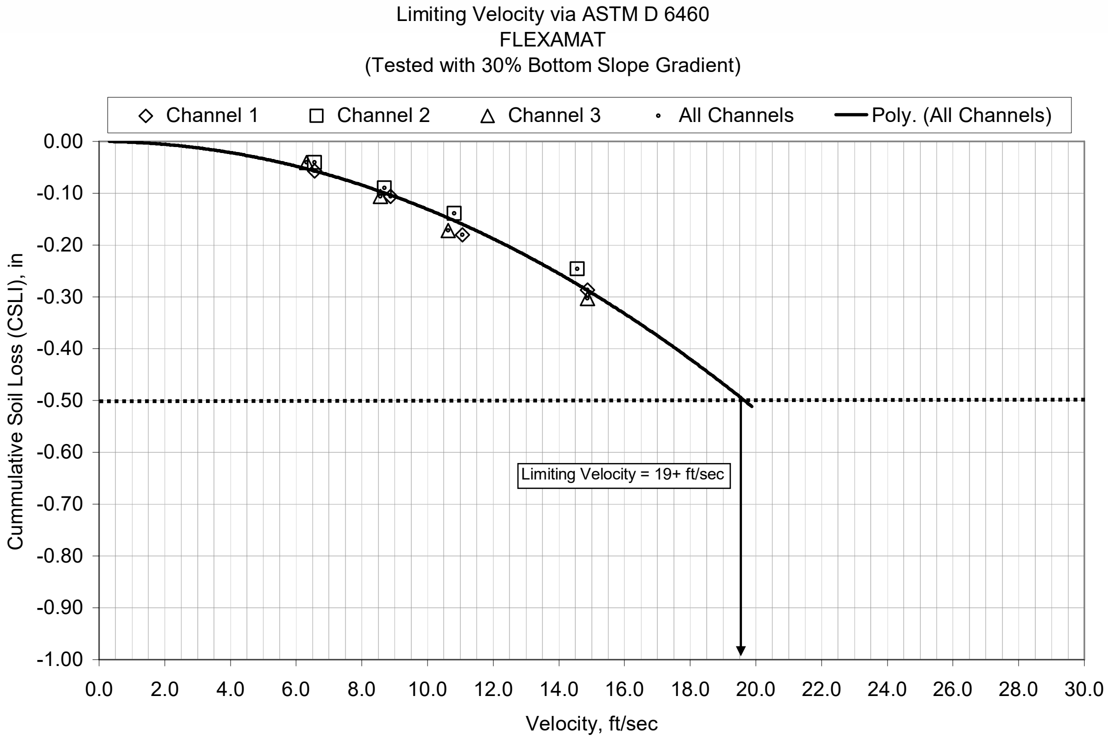


Figure 12. Velocity vs. Soil Loss – Tested Product

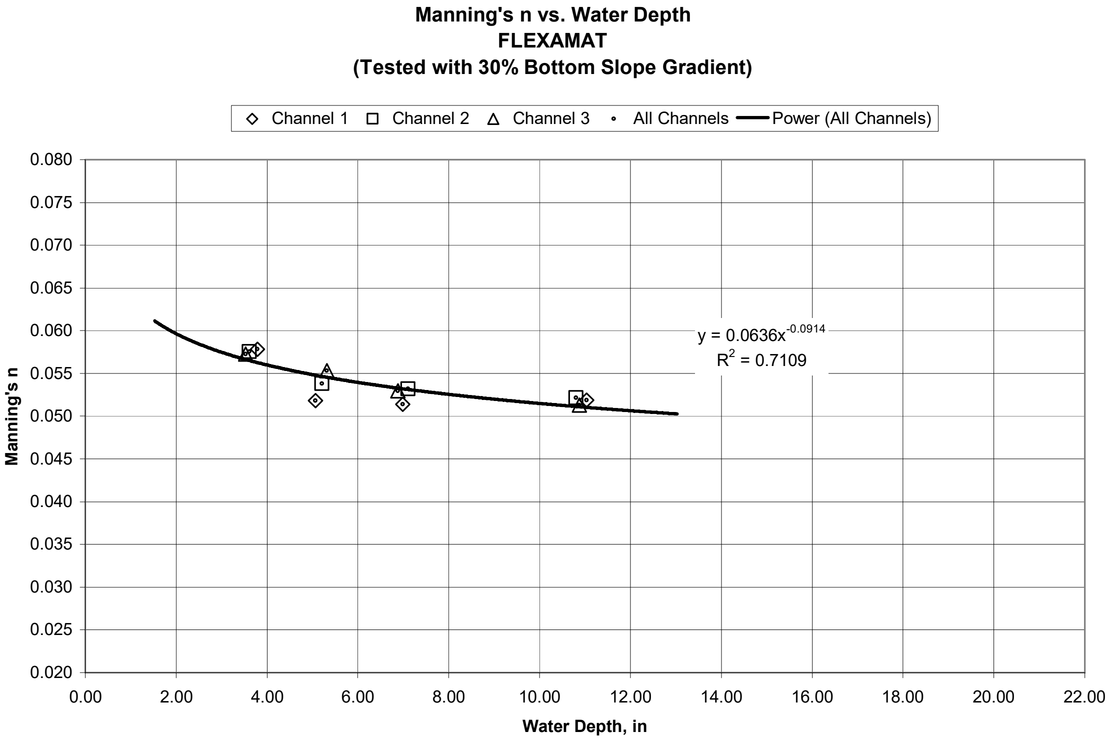


Figure 13. Roughness vs. Flow Depth – Tested Product

CONCLUSIONS

Rectangular (vertical wall) channel (flume) tests were performed in accordance with ASTM D 6460 using sandy loam soil protected with FLEXAMAT. Testing in a rectangular (vertical wall) channel was conducted to achieve increasing shear levels in an attempt to cause at least 0.5-inch of soil loss. In this testing, 0.5-inches of soil loss was not achieved before reaching the maximum available flows (i.e. shear stress and velocity). Figure 11 shows the maximum bottom shear stress and associated soil loss from each flow event along with a projection of the shear stress at which 0.5 inches of accumulated soil loss would be expected to occur. This projection shows an allowable shear stress for the standard FLEXAMAT system to be over 24 psf.

APPENDIX A – RECORDED DATA

Test Record Sheets

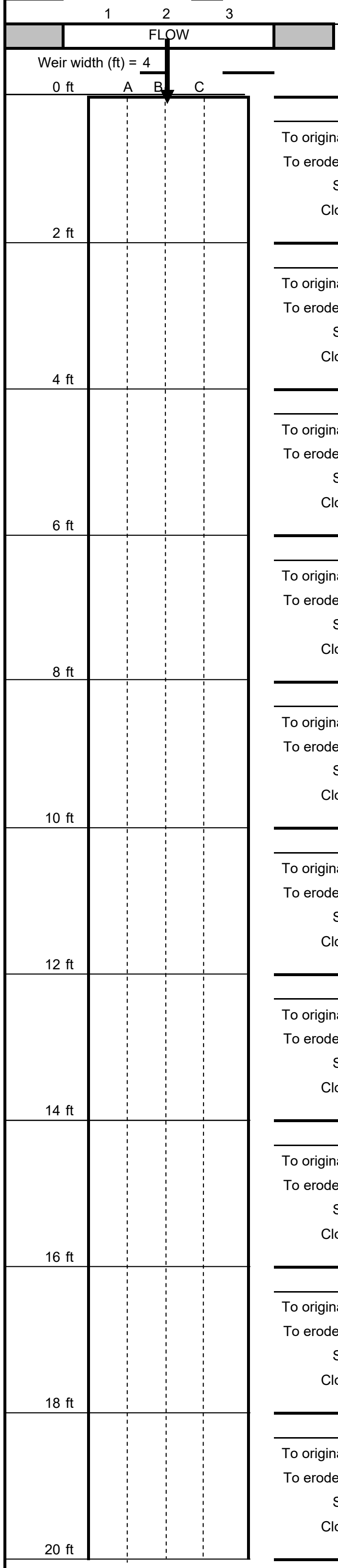
CHANNEL 1 - SHEAR STRESS 1

Date:	2/14/09	Start Time:	12:00 PM	End Time:	12:30 PM
Soil:	Loam	Target Shear (psf):	6.00	Slope:	30%

40	ft long flume	20	ft test section
	rpms	2	ft wide flume

Flexamat Permanent Channel Lining Mat

TEST DATA



Outlet Weir	1	2	3				
Water Depth, in		12.00					
Water Velocity, ft/s		3.00					
Flow Rate, cfs	0.00	12.00	0.00				

Cross-section 1	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	28.5	26.5	28		6		38.0
To eroded Surface Elev, cm	28	26.5	28	Vavg (fps) =	6.00	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	-0.5	0	0	navg =	0.067		Water Depth (in)
Clopper Soil Loss, cm	-0.5	0	0	Flow (cfs) =	4.13	6.35	4.13
	Avg Bottom Loss/Gain, in			-0.07		Avg Clopper Soil Loss, in	-0.07
Cross-section 2	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	28.5	28	30.5		6		39.0
To eroded Surface Elev, cm	28.5	28	30	Vavg (fps) =	6.00	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	0	-0.5	navg =	0.065		Water Depth (in)
Clopper Soil Loss, cm	0	0	-0.5	Flow (cfs) =	4.00	6.15	4.00
	Avg Bottom Loss/Gain, in			-0.07		Avg Clopper Soil Loss, in	-0.07
Cross-section 3	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	30	30	31		6.5		40.0
To eroded Surface Elev, cm	30	30	31	Vavg (fps) =	6.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	0	0	navg =	0.058		Water Depth (in)
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	4.12	5.85	3.81
	25.5ss/Gain, in			0.00		Avg Clopper Soil Loss, in	0.00
Cross-section 4	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	32	31	32.5		6.5		41.5
To eroded Surface Elev, cm	32	31	32	Vavg (fps) =	6.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	0	-0.5	navg =	0.059		Water Depth (in)
Clopper Soil Loss, cm	0	0	-0.5	Flow (cfs) =	4.19	5.95	3.87
	Avg Bottom Loss/Gain, in			-0.07		Avg Clopper Soil Loss, in	-0.07
Cross-section 5	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	33	31	32.5		6.5		41.5
To eroded Surface Elev, cm	33	31	32	Vavg (fps) =	6.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	0	-0.5	navg =	0.058		Water Depth (in)
Clopper Soil Loss, cm	0	0	-0.5	Flow (cfs) =	4.05	5.75	3.74
	Avg Bottom Loss/Gain, in			-0.07		Avg Clopper Soil Loss, in	-0.07
Cross-section 6	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	34	31	32		7		41.5
To eroded Surface Elev, cm	34	31	32	Vavg (fps) =	7.00	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	0	0	navg =	0.052		Water Depth (in)
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	4.21	5.55	3.61
	Avg Bottom Loss/Gain, in			0.00		Avg Clopper Soil Loss, in	0.00
Cross-section 7	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	36	35	34.5		7		44.0
To eroded Surface Elev, cm	35.5	34.5	34.5	Vavg (fps) =	7.00	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	-0.5	-0.5	0	navg =	0.052		Water Depth (in)
Clopper Soil Loss, cm	-0.5	-0.5	0	Flow (cfs) =	4.21	5.55	3.61
	Avg Bottom Loss/Gain, in			-0.13		Avg Clopper Soil Loss, in	-0.13
Cross-section 8	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	35	34	35		7		43.5
To eroded Surface Elev, cm	35	33.5	35	Vavg (fps) =	7.00	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	-0.5	0	navg =	0.052		Water Depth (in)
Clopper Soil Loss, cm	0	-0.5	0	Flow (cfs) =	4.13	5.45	3.54
	Avg Bottom Loss/Gain, in			-0.07		Avg Clopper Soil Loss, in	-0.07
Cross-section 9	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	35	35	36		7.5		44.0
To eroded Surface Elev, cm	35	35	36	Vavg (fps) =	7.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	0	0	navg =	0.047		Water Depth (in)
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	4.27	5.24	3.41
	Avg Bottom Loss/Gain, in			0.00		Avg Clopper Soil Loss, in	0.00
Cross-section 10	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	34	32	35		7.5		42.0
To eroded Surface Elev, cm	34	32	34.5	Vavg (fps) =	7.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	0	-0.5	navg =	0.046		Water Depth (in)
Clopper Soil Loss, cm	0	0	-0.5	Flow (cfs) =	4.18	5.14	3.35
	Avg Bottom Loss/Gain, in			-0.07		Avg Clopper Soil Loss, in	-0.07
Cross-section 11	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	31.5	30	31		7.5		39.0
To eroded Surface Elev, cm	31.5	30	31	Vavg (fps) =	7.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	0	0	navg =	0.045		Water Depth (in)
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	4.02	4.94	3.22
	Avg Bottom Loss/Gain, in			0.00		Avg Clopper Soil Loss, in	0.00
Soil Loss / Gain, in	-0.04	-0.04	-0.07	**Avg Bottom Loss/Gain per Cross-Section =**			**-0.05**
Clopper Soil Loss, in	-0.04	-0.04	-0.07	**Avg Clopper Soil Loss per Cross-Section =**			**-0.05**

CHANNEL 1 - SHEAR STRESS 2

Date: 2/14/09 Start Time: 1:00 PM End Time: 1:30 PM

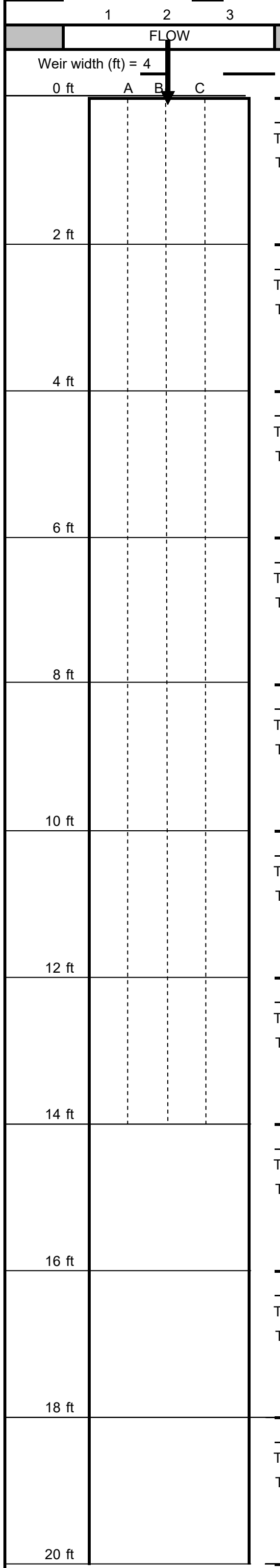
Soil: Loam Target Shear (psf): 10.00 Slope: 30%

40 ft long flume 20 ft test section

1500 rpms 2 ft wide flume

Flexamat Permanent Channel Lining Mat

TEST DATA



Inlet Weir	1	2	3
Water Depth, in		15.00	
Water Velocity, ft/s		4.50	
Flow Rate, cfs	0.00	22.50	0.00

Cross-section 1	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	28	26.5	28		8		42.0
To eroded Surface Elev, cm	28	26	28	Vavg (fps) =	8.00	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	-0.5	0	navg =	0.062		
Clopper Soil Loss, cm	0	-0.5	0	Flow (cfs) =	7.70	8.87	5.77
	Avg Bottom Loss/Gain, in			-0.07		Avg Clopper Soil Loss, in	-0.07
Cross-section 2	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	28.5	28	30		8.5		42.0
To eroded Surface Elev, cm	28	28	30	Vavg (fps) =	8.50	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	-0.5	0	0	navg =	0.055		
Clopper Soil Loss, cm	-0.5	0	0	Flow (cfs) =	7.44	8.07	5.25
	Avg Bottom Loss/Gain, in			-0.07		Avg Clopper Soil Loss, in	-0.07
Cross-section 3	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	30	30	31		9		43.0
To eroded Surface Elev, cm	30	30	31	Vavg (fps) =	9.00	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	0	0	navg =	0.050		
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	7.48	7.66	4.99
	Avg Bottom Loss/Gain, in			0.00		Avg Clopper Soil Loss, in	0.00
Cross-section 4	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	32	31	32		9		44.0
To eroded Surface Elev, cm	32	30.5	32	Vavg (fps) =	9.00	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	-0.5	0	navg =	0.050		
Clopper Soil Loss, cm	0	-0.5	0	Flow (cfs) =	7.38	7.56	4.92
	Avg Bottom Loss/Gain, in			-0.07		Avg Clopper Soil Loss, in	-0.07
Cross-section 5	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	33	31	32		9		44.5
To eroded Surface Elev, cm	33	31	32	Vavg (fps) =	9.00	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	0	0	navg =	0.050		
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	7.38	7.56	4.92
	Avg Bottom Loss/Gain, in			0.00		Avg Clopper Soil Loss, in	0.00
Cross-section 6	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	34	31	32		9		45.0
To eroded Surface Elev, cm	34	31	32	Vavg (fps) =	9.00	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	0	0	navg =	0.050		
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	7.48	7.66	4.99
	Avg Bottom Loss/Gain, in			0.00		Avg Clopper Soil Loss, in	0.00
Cross-section 7	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	35.5	34.5	34.5		9		47.0
To eroded Surface Elev, cm	34.5	34	34.5	Vavg (fps) =	9.00	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	-1	-0.5	0	navg =	0.050		
Clopper Soil Loss, cm	-1	-0.5	0	Flow (cfs) =	7.48	7.66	4.99
	Avg Bottom Loss/Gain, in			-0.20		Avg Clopper Soil Loss, in	-0.20
Cross-section 8	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	35	33.5	35		9.5		46.5
To eroded Surface Elev, cm	35	33.5	35	Vavg (fps) =	9.50	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	0	0	navg =	0.046		
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	7.48	7.26	4.72
	Avg Bottom Loss/Gain, in			0.00		Avg Clopper Soil Loss, in	0.00
Cross-section 9	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	35	35	36		9.5		47.5
To eroded Surface Elev, cm	35	35	36	Vavg (fps) =	9.50	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	0	0	navg =	0.046		
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	7.58	7.36	4.79
	Avg Bottom Loss/Gain, in			0.00		Avg Clopper Soil Loss, in	0.00
Cross-section 10	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	34	32	34.5		10		45.0
To eroded Surface Elev, cm	34	32	34.5	Vavg (fps) =	10.00	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	0	0	navg =	0.042		
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	7.55	6.96	4.53
	Avg Bottom Loss/Gain, in			0.00		Avg Clopper Soil Loss, in	0.00
Cross-section 11	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	31.5	30	31		10		42.0
To eroded Surface Elev, cm	31	30	31	Vavg (fps) =	10.00	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	-0.5	0	0	navg =	0.042		
Clopper Soil Loss, cm	-0.5	0	0	Flow (cfs) =	7.44	6.86	4.46
	Avg Bottom Loss/Gain, in			-0.07		Avg Clopper Soil Loss, in	-0.07
Soil Loss / Gain, in	-0.07	-0.05	0.00	**Avg Bottom Loss/Gain per Cross-Section =**			**-0.04**
Clopper Soil Loss, in	-0.07	-0.05	0.00	**Avg Clopper Soil Loss per Cross-Section =**			**-0.04**

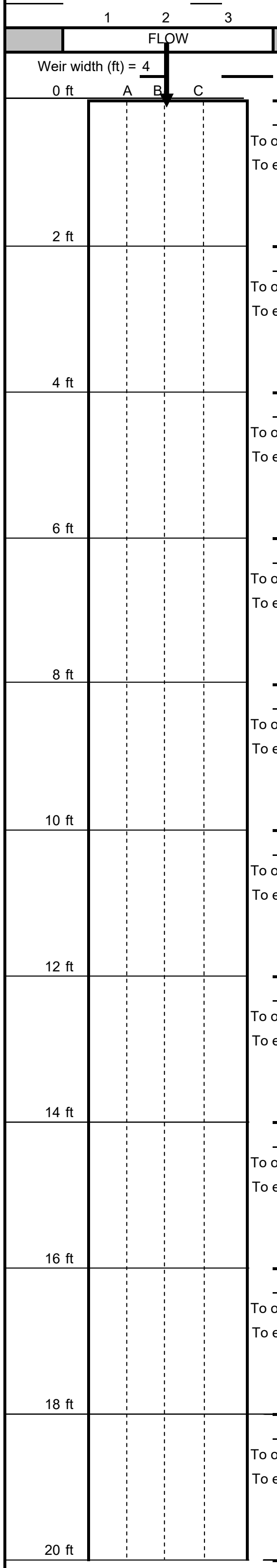
CHANNEL 1 - SHEAR STRESS 3	Date: 2/14/09	Start Time: 2:00 PM	End Time: 2:30 PM
	Soil: Loam	Target Shear (psf): 14.00	Slope: 30%

40 ft long flume 20 ft test section

rpms 2 ft wide flume

Flexamat Permanent Channel Lining Mat

TEST DATA



Inlet Weir	1	2	3
Water Depth, in		19.00	
Water Velocity, ft/s		6.00	
Flow Rate, cfs	0.00	38.00	0.00

Cross-section 1	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	28	26	28		10.5		46.0
To eroded Surface Elev, cm	28	26	28	Vavg (fps) =	10.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	0	0	navg =	0.056		Water Depth (in)
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	12.86	11.29	7.35
	Avg Bottom Loss/Gain, in			0.00		Avg Clopper Soil Loss, in	0.00

Cross-section 2	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	28	28	30		10.5		47.5
To eroded Surface Elev, cm	28	28	30	Vavg (fps) =	10.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	0	0	navg =	0.056		Water Depth (in)
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	12.98	11.39	7.41
	Avg Bottom Loss/Gain, in			0.00		Avg Clopper Soil Loss, in	0.00

Cross-section 3	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	30	30	31		11		48.0
To eroded Surface Elev, cm	30	29	31	Vavg (fps) =	11.00	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	-1	0	navg =	0.052		Water Depth (in)
Clopper Soil Loss, cm	0	-1	0	Flow (cfs) =	12.99	10.89	7.09
	Avg Bottom Loss/Gain, in			-0.13		Avg Clopper Soil Loss, in	-0.13

Cross-section 4	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	32	30.5	32		11		49.0
To eroded Surface Elev, cm	32	29.5	32	Vavg (fps) =	11.00	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	-1	0	navg =	0.052		Water Depth (in)
Clopper Soil Loss, cm	0	-1	0	Flow (cfs) =	12.87	10.79	7.02
	Avg Bottom Loss/Gain, in			-0.13		Avg Clopper Soil Loss, in	-0.13

Cross-section 5	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	33	31	32		11		49.5
To eroded Surface Elev, cm	33	30.5	32	Vavg (fps) =	11.00	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	-0.5	0	navg =	0.051		Water Depth (in)
Clopper Soil Loss, cm	0	-0.5	0	Flow (cfs) =	12.75	10.69	6.96
	Avg Bottom Loss/Gain, in			-0.07		Avg Clopper Soil Loss, in	-0.07

Cross-section 6	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	34	31	32		11.5		49.5
To eroded Surface Elev, cm	34	31	32	Vavg (fps) =	11.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	0	0	navg =	0.048		Water Depth (in)
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	12.95	10.39	6.76
	Avg Bottom Loss/Gain, in			0.00		Avg Clopper Soil Loss, in	0.00

Cross-section 7	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	34.5	34	34.5		11.5		50.5
To eroded Surface Elev, cm	34	33.5	34	Vavg (fps) =	11.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	-0.5	-0.5	-0.5	navg =	0.047		Water Depth (in)
Clopper Soil Loss, cm	-0.5	-0.5	-0.5	Flow (cfs) =	12.58	10.08	6.56
	Avg Bottom Loss/Gain, in			-0.20		Avg Clopper Soil Loss, in	-0.20

Cross-section 8	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	35	33.5	35		11.5		51.5
To eroded Surface Elev, cm	35	33	35	Vavg (fps) =	11.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	-0.5	0	navg =	0.048		Water Depth (in)
Clopper Soil Loss, cm	0	-0.5	0	Flow (cfs) =	12.95	10.39	6.76
	Avg Bottom Loss/Gain, in			-0.07		Avg Clopper Soil Loss, in	-0.07

Cross-section 9	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	35	35	36		11.5		51.5
To eroded Surface Elev, cm	35	34	36	Vavg (fps) =	11.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	-1	0	navg =	0.047		Water Depth (in)
Clopper Soil Loss, cm	0	-1	0	Flow (cfs) =	12.45	9.98	6.50
	Avg Bottom Loss/Gain, in			-0.13		Avg Clopper Soil Loss, in	-0.13

Cross-section 10	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	34	32	34.5		11.5		50.0
To eroded Surface Elev, cm	34	31.5	34.5	Vavg (fps) =	11.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	-0.5	0	navg =	0.047		Water Depth (in)
Clopper Soil Loss, cm	0	-0.5	0	Flow (cfs) =	12.58	10.08	6.56
	Avg Bottom Loss/Gain, in			-0.07		Avg Clopper Soil Loss, in	-0.07

Cross-section 11	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	31	30	31		11.5		47.0
To eroded Surface Elev, cm	30.5	29.5	30.5	Vavg (fps) =	11.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	-0.5	-0.5	-0.5	navg =	0.048		Water Depth (in)
Clopper Soil Loss, cm	-0.5	-0.5	-0.5	Flow (cfs) =	12.70	10.18	6.63
	Avg Bottom Loss/Gain, in			-0.20		Avg Clopper Soil Loss, in	-0.20

Soil Loss / Gain, in	-0.04	-0.20	-0.04	**Avg Bottom Loss/Gain per Cross-Section =**	**-0.09**
Clopper Soil Loss, in	-0.04	-0.20	-0.04	**Avg Clopper Soil Loss per Cross-Section =**	**-0.09**

CHANNEL 1 - SHEAR STRESS 4

Date:	2/14/09	Start Time:	3:00 PM	End Time:	3:30 PM
Soil:	Loam	Target Shear (psf):	18.00	Slope:	30%

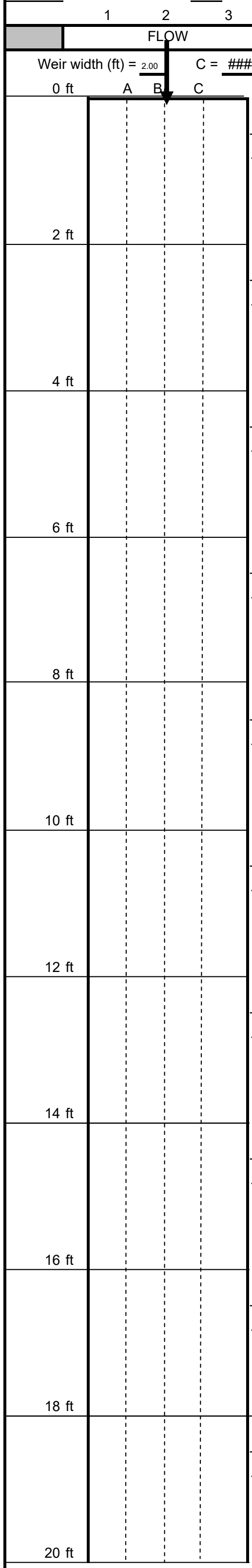
40 ft long flume
20 ft test section
1900 rpms
2 ft wide flume

Flexamat Permanent Channel Lining Mat

TEST DATA

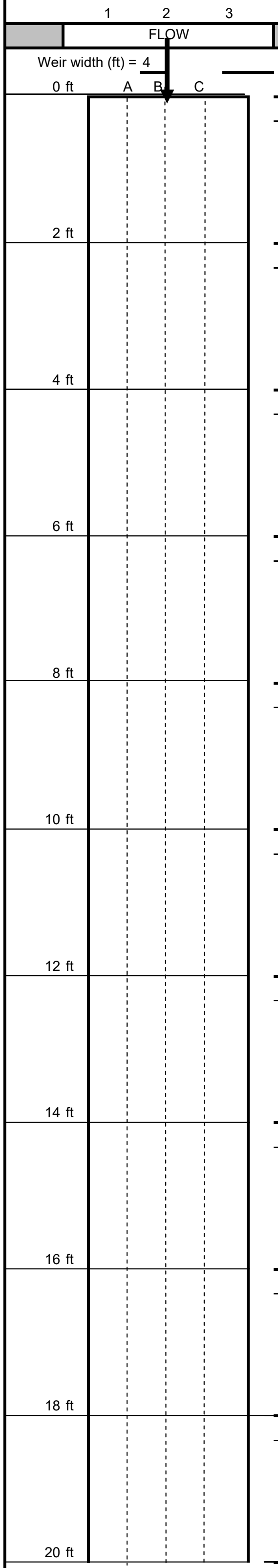
Inlet Weir	1	2	3
Water Depth, in			
Water Velocity, ft/s			
Flow Rate, cfs	#DIV/0!	0.00	#DIV/0!

Weir width (ft) = 2.00
C = #####



Cross-section 1	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	28	26	28		14		57.0
To eroded Surface Elev, cm	28	26	27	Vavg (fps) =	14.00	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	0	-1	navg =	0.058		Water Depth (in)
Clopper Soil Loss, cm	0	0	-1	Flow (cfs) =	27.56	18.15	11.81
	Avg Bottom Loss/Gain, in			-0.13		Avg Clopper Soil Loss, in	-0.13
Cross-section 2	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	28	28	30		14.5		58.0
To eroded Surface Elev, cm	28	27.5	29.5	Vavg (fps) =	14.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	-0.5	-0.5	navg =	0.055		Water Depth (in)
Clopper Soil Loss, cm	0	-0.5	-0.5	Flow (cfs) =	28.23	17.95	11.68
	Avg Bottom Loss/Gain, in			-0.13		Avg Clopper Soil Loss, in	-0.13
Cross-section 3	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	30	29	31		14.5		58.0
To eroded Surface Elev, cm	30	28.5	30.5	Vavg (fps) =	14.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	-0.5	-0.5	navg =	0.053		Water Depth (in)
Clopper Soil Loss, cm	0	-0.5	-0.5	Flow (cfs) =	26.96	17.14	11.15
	Avg Bottom Loss/Gain, in			-0.13		Avg Clopper Soil Loss, in	-0.13
Cross-section 4	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	32	29.5	32		14.5		60.0
To eroded Surface Elev, cm	31.5	29	32	Vavg (fps) =	14.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	-0.5	-0.5	0	navg =	0.055		Water Depth (in)
Clopper Soil Loss, cm	-0.5	-0.5	0	Flow (cfs) =	27.75	17.65	11.48
	Avg Bottom Loss/Gain, in			-0.13		Avg Clopper Soil Loss, in	-0.13
Cross-section 5	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	33	30.5	32		15		59.0
To eroded Surface Elev, cm	33	30	32	Vavg (fps) =	15.00	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	-0.5	0	navg =	0.050		Water Depth (in)
Clopper Soil Loss, cm	0	-0.5	0	Flow (cfs) =	26.90	16.54	10.76
	Avg Bottom Loss/Gain, in			-0.07		Avg Clopper Soil Loss, in	-0.07
Cross-section 6	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	34	31	32		15.5		59.0
To eroded Surface Elev, cm	33.5	31	32	Vavg (fps) =	15.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	-0.5	0	0	navg =	0.048		Water Depth (in)
Clopper Soil Loss, cm	-0.5	0	0	Flow (cfs) =	27.29	16.23	10.56
	Avg Bottom Loss/Gain, in			-0.07		Avg Clopper Soil Loss, in	-0.07
Cross-section 7	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	34	33.5	34		15.5		60.0
To eroded Surface Elev, cm	34	32.5	34	Vavg (fps) =	15.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	-1	0	navg =	0.048		Water Depth (in)
Clopper Soil Loss, cm	0	-1	0	Flow (cfs) =	26.95	16.03	10.43
	Avg Bottom Loss/Gain, in			-0.13		Avg Clopper Soil Loss, in	-0.13
Cross-section 8	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	35	33	35		15.5		60.5
To eroded Surface Elev, cm	34.5	33	35	Vavg (fps) =	15.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	-0.5	0	0	navg =	0.048		Water Depth (in)
Clopper Soil Loss, cm	-0.5	0	0	Flow (cfs) =	26.78	15.93	10.37
	Avg Bottom Loss/Gain, in			-0.07		Avg Clopper Soil Loss, in	-0.07
Cross-section 9	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	35	34	36		15.5		61.0
To eroded Surface Elev, cm	35	34	35	Vavg (fps) =	15.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	0	-1	navg =	0.048		Water Depth (in)
Clopper Soil Loss, cm	0	0	-1	Flow (cfs) =	26.78	15.93	10.37
	Avg Bottom Loss/Gain, in			-0.13		Avg Clopper Soil Loss, in	-0.13
Cross-section 10	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	34	31.5	34.5		15.5		59.5
To eroded Surface Elev, cm	34	31	34	Vavg (fps) =	15.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	-0.5	-0.5	navg =	0.048		Water Depth (in)
Clopper Soil Loss, cm	0	-0.5	-0.5	Flow (cfs) =	26.95	16.03	10.43
	Avg Bottom Loss/Gain, in			-0.13		Avg Clopper Soil Loss, in	-0.13
Cross-section 11	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	30.5	29.5	30.5		16		55.5
To eroded Surface Elev, cm	30	29.5	30	Vavg (fps) =	16.00	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	-0.5	0	-0.5	navg =	0.045		Water Depth (in)
Clopper Soil Loss, cm	-0.5	0	-0.5	Flow (cfs) =	26.95	15.53	10.10
	Avg Bottom Loss/Gain, in			-0.13		Avg Clopper Soil Loss, in	-0.13
Soil Loss / Gain, in	-0.07	-0.13	-0.14	**Avg Bottom Loss/Gain per Cross-Section =**			**-0.11**
Clopper Soil Loss, in	-0.07	-0.13	-0.14	**Avg Clopper Soil Loss per Cross-Section =**			**-0.11**

CHANNEL 2 - SHEAR STRESS 1	Date: 2/14/09	Start Time: 12:00 PM	End Time: 12:30 PM		
	Soil: Loam	Target Shear (psf): 6.00	Slope: 30%		
40 ft long flume	20 ft test section	**Flexamat Permanent Channel Lining Mat**			
900 rpms	2 ft wide flume	**TEST DATA**			



Outlet Weir	1	2	3
Water Depth, in		12.00	
Water Velocity, ft/s		3.00	
Flow Rate, cfs	0.00	12.00	0.00

Cross-section 1	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	31	31	31		6		41.0
To eroded Surface Elev, cm	31	31	30.5	Vavg (fps) =	6.00	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	0	-0.5	navg =	0.065		
Clopper Soil Loss, cm	0	0	-0.5	Flow (cfs) =	4.00	6.15	4.00
		Avg Bottom Loss/Gain, in		-0.07	Avg Clopper Soil Loss, in		-0.07

Cross-section 2	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	31	30	31		6		40.5
To eroded Surface Elev, cm	31	30	31	Vavg (fps) =	6.00	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	0	0	navg =	0.064		
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	3.87	5.95	3.87
		Avg Bottom Loss/Gain, in		0.00	Avg Clopper Soil Loss, in		0.00

Cross-section 3	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	31	30	32		6		40.5
To eroded Surface Elev, cm	30.5	30	32	Vavg (fps) =	6.00	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	-0.5	0	0	navg =	0.063		
Clopper Soil Loss, cm	-0.5	0	0	Flow (cfs) =	3.81	5.85	3.81
		25.5	Loss/Gain, in	-0.07	Avg Clopper Soil Loss, in		-0.07

Cross-section 4	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	33	32	33		6.5		41.5
To eroded Surface Elev, cm	32.5	32	33	Vavg (fps) =	6.50	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	-0.5	0	0	navg =	0.056		
Clopper Soil Loss, cm	-0.5	0	0	Flow (cfs) =	3.84	5.45	3.54
		Avg Bottom Loss/Gain, in		-0.07	Avg Clopper Soil Loss, in		-0.07

Cross-section 5	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	32	32	33		6.5		41.0
To eroded Surface Elev, cm	32	32	32.5	Vavg (fps) =	6.50	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	0	-0.5	navg =	0.055		
Clopper Soil Loss, cm	0	0	-0.5	Flow (cfs) =	3.77	5.34	3.48
		Avg Bottom Loss/Gain, in		-0.07	Avg Clopper Soil Loss, in		-0.07

Cross-section 6	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	32.5	32	33		6.5		41.0
To eroded Surface Elev, cm	32.5	32	33	Vavg (fps) =	6.50	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	0	0	navg =	0.053		
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	3.63	5.14	3.35
		Avg Bottom Loss/Gain, in		0.00	Avg Clopper Soil Loss, in		0.00

Cross-section 7	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	33	32	32.5		6.5		41.0
To eroded Surface Elev, cm	33	31.5	32.5	Vavg (fps) =	6.50	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	-0.5	0	navg =	0.054		
Clopper Soil Loss, cm	0	-0.5	0	Flow (cfs) =	3.70	5.24	3.41
		Avg Bottom Loss/Gain, in		-0.07	Avg Clopper Soil Loss, in		-0.07

Cross-section 8	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	33	32	32		7		41.0
To eroded Surface Elev, cm	33	32	32	Vavg (fps) =	7.00	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	0	0	navg =	0.050		
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	3.98	5.24	3.41
		Avg Bottom Loss/Gain, in		0.00	Avg Clopper Soil Loss, in		0.00

Cross-section 9	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	32	31	32		7		40.0
To eroded Surface Elev, cm	32	30.5	32	Vavg (fps) =	7.00	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	-0.5	0	navg =	0.050		
Clopper Soil Loss, cm	0	-0.5	0	Flow (cfs) =	3.90	5.14	3.35
		Avg Bottom Loss/Gain, in		-0.07	Avg Clopper Soil Loss, in		-0.07

Cross-section 10	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	30	30	30		7		38.5
To eroded Surface Elev, cm	30	30	30	Vavg (fps) =	7.00	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	0	0	navg =	0.050		
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	3.90	5.14	3.35
		Avg Bottom Loss/Gain, in		0.00	Avg Clopper Soil Loss, in		0.00

Cross-section 11	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	30	31	31		7.5		39.0
To eroded Surface Elev, cm	30	31	31	Vavg (fps) =	7.50	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	0	0	navg =	0.046		
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	4.10	5.04	3.28
		Avg Bottom Loss/Gain, in		0.00	Avg Clopper Soil Loss, in		0.00

Soil Loss / Gain, in	-0.04	-0.04	-0.04	**Avg Bottom Loss/Gain per Cross-Section =**	**-0.04**
Clopper Soil Loss, in	-0.04	-0.04	-0.04	**Avg Clopper Soil Loss per Cross-Section =**	**-0.04**

CHANNEL 2 - SHEAR STRESS 2

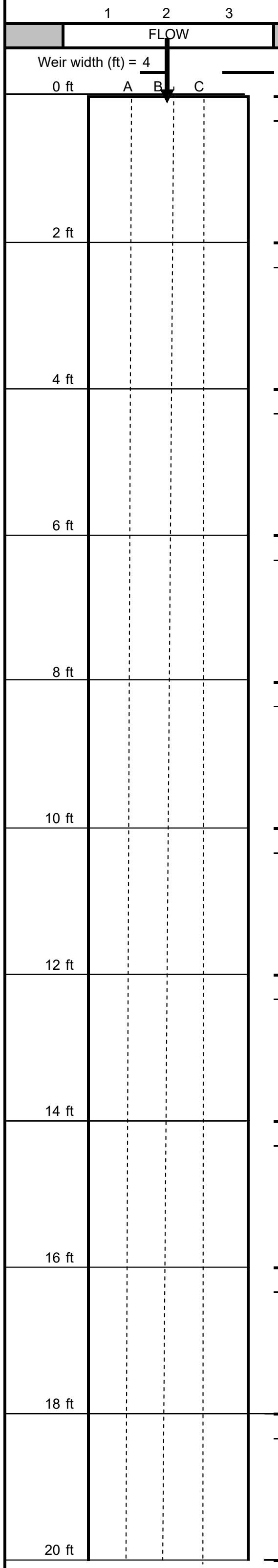
Date:	2/14/09	Start Time:	1:00 PM	End Time:	1:30 PM
Soil:	Loam	Target Shear (psf):	10.00	Slope:	30%

40 ft long flume 20 ft test section

rpms 2 ft wide flume

Flexamat Permanent Channel Lining Mat

TEST DATA



Inlet Weir	1	2	3
Water Depth, in		15.00	
Water Velocity, ft/s		4.50	
Flow Rate, cfs	0.00	22.50	0.00

Cross-section 1	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	31	31	30.5		8		45.0
To eroded Surface Elev, cm	31	31	30.5	Vavg (fps) =	8.00	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	0	0	navg =	0.061		Water Depth (in)
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	7.44	8.57	5.58
		Avg Bottom Loss/Gain, in		0.00		Avg Clopper Soil Loss, in	0.00

Cross-section 2	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	31	30	31		8.5		44.0
To eroded Surface Elev, cm	31	30	31	Vavg (fps) =	8.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	0	0	navg =	0.055		Water Depth (in)
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	7.44	8.07	5.25
		Avg Bottom Loss/Gain, in		0.00		Avg Clopper Soil Loss, in	0.00

Cross-section 3	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	30.5	30	32		8.5		44.0
To eroded Surface Elev, cm	30.5	30	31.5	Vavg (fps) =	8.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	0	-0.5	navg =	0.055		Water Depth (in)
Clopper Soil Loss, cm	0	0	-0.5	Flow (cfs) =	7.44	8.07	5.25
		Avg Bottom Loss/Gain, in		-0.07		Avg Clopper Soil Loss, in	-0.07

Cross-section 4	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	32.5	32	33		8.5		45.5
To eroded Surface Elev, cm	32.5	32	32.5	Vavg (fps) =	8.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	0	-0.5	navg =	0.055		Water Depth (in)
Clopper Soil Loss, cm	0	0	-0.5	Flow (cfs) =	7.34	7.97	5.18
		Avg Bottom Loss/Gain, in		-0.07		Avg Clopper Soil Loss, in	-0.07

Cross-section 5	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	32	32	32.5		9		45.0
To eroded Surface Elev, cm	32	32	32	Vavg (fps) =	9.00	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	0	-0.5	navg =	0.051		Water Depth (in)
Clopper Soil Loss, cm	0	0	-0.5	Flow (cfs) =	7.68	7.87	5.12
		Avg Bottom Loss/Gain, in		-0.07		Avg Clopper Soil Loss, in	-0.07

Cross-section 6	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	32.5	32	33		9		45.5
To eroded Surface Elev, cm	32.5	32	33	Vavg (fps) =	9.00	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	0	0	navg =	0.051		Water Depth (in)
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	7.68	7.87	5.12
		Avg Bottom Loss/Gain, in		0.00		Avg Clopper Soil Loss, in	0.00

Cross-section 7	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	33	31.5	32.5		9		45.0
To eroded Surface Elev, cm	33	31	32	Vavg (fps) =	9.00	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	-0.5	-0.5	navg =	0.051		Water Depth (in)
Clopper Soil Loss, cm	0	-0.5	-0.5	Flow (cfs) =	7.68	7.87	5.12
		Avg Bottom Loss/Gain, in		-0.13		Avg Clopper Soil Loss, in	-0.13

Cross-section 8	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	33	32	32		9		45.0
To eroded Surface Elev, cm	32.5	32	32	Vavg (fps) =	9.00	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	-0.5	0	0	navg =	0.051		Water Depth (in)
Clopper Soil Loss, cm	-0.5	0	0	Flow (cfs) =	7.58	7.76	5.05
		Avg Bottom Loss/Gain, in		-0.07		Avg Clopper Soil Loss, in	-0.07

Cross-section 9	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	32	30.5	32		9.5		43.5
To eroded Surface Elev, cm	31.5	30.5	31.5	Vavg (fps) =	9.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	-0.5	0	-0.5	navg =	0.047		Water Depth (in)
Clopper Soil Loss, cm	-0.5	0	-0.5	Flow (cfs) =	7.69	7.46	4.86
		Avg Bottom Loss/Gain, in		-0.13		Avg Clopper Soil Loss, in	-0.13

Cross-section 10	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	30	30	30		9.5		42.5
To eroded Surface Elev, cm	30	30	30	Vavg (fps) =	9.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	0	0	navg =	0.047		Water Depth (in)
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	7.79	7.56	4.92
		Avg Bottom Loss/Gain, in		0.00		Avg Clopper Soil Loss, in	0.00

Cross-section 11	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	30	31	31		10		43.0
To eroded Surface Elev, cm	30	31	31	Vavg (fps) =	10.00	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	0	0	navg =	0.045		Water Depth (in)
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	8.09	7.46	4.86
		Avg Bottom Loss/Gain, in		0.00		Avg Clopper Soil Loss, in	0.00

Soil Loss / Gain, in	-0.04	-0.02	-0.09	**Avg Bottom Loss/Gain per Cross-Section =**	**-0.05**
Clopper Soil Loss, in	-0.04	-0.02	-0.09	**Avg Clopper Soil Loss per Cross-Section =**	**-0.05**

CHANNEL 2 - SHEAR STRESS 3

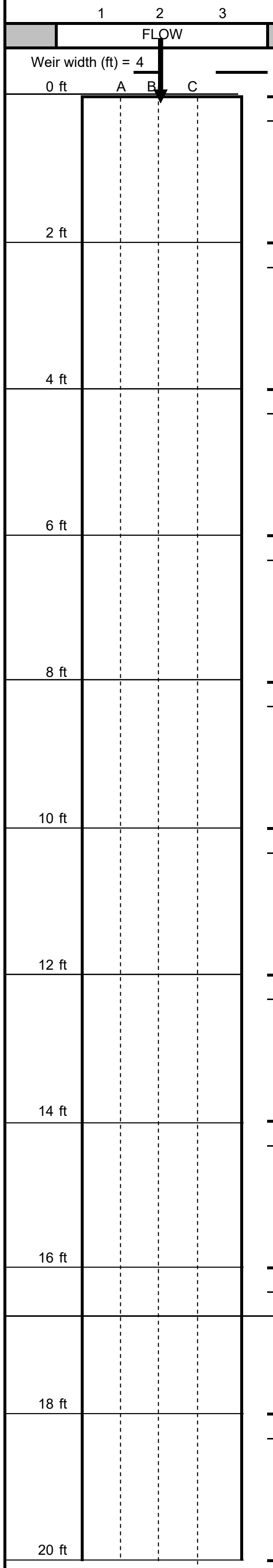
Date:	2/14/09	Start Time:	2:00 PM	End Time:	2:30 PM
Soil:	Loam	Target Shear (psf):	14.00	Slope:	30%

40 ft long flume — 20 ft test section

rpms — 2 ft wide flume

Flexamat Permanent Channel Lining Mat

TEST DATA



Inlet Weir	1	2	3
Water Depth, in		19.00	
Water Velocity, ft/s		6.00	
Flow Rate, cfs	0.00	38.00	0.00

Cross-section 1	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	31	31	30.5		10		50.5
To eroded Surface Elev, cm	31	31	30	Vavg (fps) =	10.00	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	0	-0.5	navg =	0.061		
Clopper Soil Loss, cm	0	0	-0.5	Flow (cfs) =	13.01	12.00	7.81
		Avg Bottom Loss/Gain, in		-0.07	Avg Clopper Soil Loss, in		-0.07

Cross-section 2	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	31	30	31		10.5		49.5
To eroded Surface Elev, cm	31	30	31	Vavg (fps) =	10.50	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	0	0	navg =	0.056		
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	12.98	11.39	7.41
		Avg Bottom Loss/Gain, in		0.00	Avg Clopper Soil Loss, in		0.00

Cross-section 3	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	30.5	30	31.5		10.5		49.5
To eroded Surface Elev, cm	30	30	31.5	Vavg (fps) =	10.50	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	-0.5	0	0	navg =	0.057		
Clopper Soil Loss, cm	-0.5	0	0	Flow (cfs) =	13.09	11.50	7.48
		Avg Bottom Loss/Gain, in		-0.07	Avg Clopper Soil Loss, in		-0.07

Cross-section 4	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	32.5	32	32.5		11		50.0
To eroded Surface Elev, cm	32	32	32	Vavg (fps) =	11.00	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	-0.5	0	-0.5	navg =	0.052		
Clopper Soil Loss, cm	-0.5	0	-0.5	Flow (cfs) =	12.99	10.89	7.09
		Avg Bottom Loss/Gain, in		-0.13	Avg Clopper Soil Loss, in		-0.13

Cross-section 5	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	32	32	32		11		49.5
To eroded Surface Elev, cm	32	32	32	Vavg (fps) =	11.00	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	0	0	navg =	0.051		
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	12.63	10.59	6.89
		Avg Bottom Loss/Gain, in		0.00	Avg Clopper Soil Loss, in		0.00

Cross-section 6	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	32.5	32	33		11		50.0
To eroded Surface Elev, cm	32	32	33	Vavg (fps) =	11.00	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	-0.5	0	0	navg =	0.051		
Clopper Soil Loss, cm	-0.5	0	0	Flow (cfs) =	12.75	10.69	6.96
		Avg Bottom Loss/Gain, in		-0.07	Avg Clopper Soil Loss, in		-0.07

Cross-section 7	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	33	31	32		11		49.5
To eroded Surface Elev, cm	33	31	32	Vavg (fps) =	11.00	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	0	0	navg =	0.051		
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	12.63	10.59	6.89
		Avg Bottom Loss/Gain, in		0.00	Avg Clopper Soil Loss, in		0.00

Cross-section 8	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	32.5	32	32		11.5		48.0
To eroded Surface Elev, cm	32	32	32	Vavg (fps) =	11.50	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	-0.5	0	0	navg =	0.046		
Clopper Soil Loss, cm	-0.5	0	0	Flow (cfs) =	12.07	9.68	6.30
		Avg Bottom Loss/Gain, in		-0.07	Avg Clopper Soil Loss, in		-0.07

Cross-section 9	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	31.5	30.5	31.5		11.5		48.0
To eroded Surface Elev, cm	31	30.5	31.5	Vavg (fps) =	11.50	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	-0.5	0	0	navg =	0.048		
Clopper Soil Loss, cm	-0.5	0	0	Flow (cfs) =	12.83	10.29	6.69
		Avg Bottom Loss/Gain, in		-0.07	Avg Clopper Soil Loss, in		-0.07

Cross-section 10	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	30	30	30		11.5		47.0
To eroded Surface Elev, cm	30	30	30	Vavg (fps) =	11.50	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	0	0	navg =	0.048		
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	12.83	10.29	6.69
		Avg Bottom Loss/Gain, in		0.00	Avg Clopper Soil Loss, in		0.00

Cross-section 11	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	30	31	31		11.5		47.5
To eroded Surface Elev, cm	30	31	30.5	Vavg (fps) =	11.50	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	0	-0.5	navg =	0.048		
Clopper Soil Loss, cm	0	0	-0.5	Flow (cfs) =	12.83	10.29	6.69
		Avg Bottom Loss/Gain, in		-0.07	Avg Clopper Soil Loss, in		-0.07

Soil Loss / Gain, in	-0.09	0.00	-0.05	**Avg Bottom Loss/Gain per Cross-Section =**	**-0.05**
Clopper Soil Loss, in	-0.09	0.00	-0.05	**Avg Clopper Soil Loss per Cross-Section =**	**-0.05**

CHANNEL 2 - SHEAR STRESS 4

Date:	2/14/09	Start Time:	4:00 PM	End Time:	4:30 PM
Soil:	Loam	Target Shear (psf):	18.00	Slope:	30%

40 ft long flume

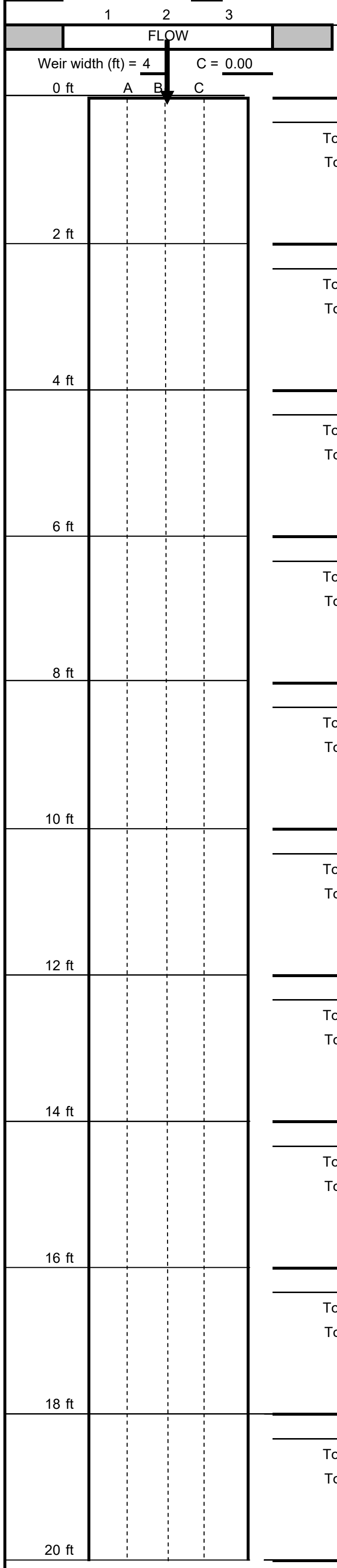
20 ft test section

rpms

2 ft wide flume

Flexamat Permanent Channel Lining Mat

TEST DATA



Inlet Weir	1	2	3
Water Depth, in		18.00	
Water Velocity, ft/s		4.50	
Flow Rate, cfs	0.00	27.00	0.00

Cross-section 1	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	31	31	30		14		60.0
To eroded Surface Elev, cm	30.5	31	30	Vavg (fps) =	14.00	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	-0.5	0	0	navg =	0.057		Water Depth (in)
Clopper Soil Loss, cm	-0.5	0	0	Flow (cfs) =	27.10	17.85	11.61
			Avg Bottom Loss/Gain, in	-0.07		Avg Clopper Soil Loss, in	-0.07

Cross-section 2	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	31	30	31		14		59.0
To eroded Surface Elev, cm	30.5	30	30.5	Vavg (fps) =	14.00	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	-0.5	0	-0.5	navg =	0.056		Water Depth (in)
Clopper Soil Loss, cm	-0.5	0	-0.5	Flow (cfs) =	26.33	17.34	11.29
			Avg Bottom Loss/Gain, in	-0.13		Avg Clopper Soil Loss, in	-0.13

Cross-section 3	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	30	30	31.5		14.5		57.5
To eroded Surface Elev, cm	29	29.5	31	Vavg (fps) =	14.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	-1	-0.5	-0.5	navg =	0.053		Water Depth (in)
Clopper Soil Loss, cm	-1	-0.5	-0.5	Flow (cfs) =	26.32	16.74	10.89
			Avg Bottom Loss/Gain, in	-0.26		Avg Clopper Soil Loss, in	-0.26

Cross-section 4	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	32	32	32		14.5		59.5
To eroded Surface Elev, cm	32	32	32	Vavg (fps) =	14.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	0	0	navg =	0.052		Water Depth (in)
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	26.16	16.64	10.83
			Avg Bottom Loss/Gain, in	0.00		Avg Clopper Soil Loss, in	0.00

Cross-section 5	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	32	32	32		14.5		59.0
To eroded Surface Elev, cm	32	31.5	32	Vavg (fps) =	14.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	-0.5	0	navg =	0.052		Water Depth (in)
Clopper Soil Loss, cm	0	-0.5	0	Flow (cfs) =	25.85	16.44	10.70
			Avg Bottom Loss/Gain, in	-0.07		Avg Clopper Soil Loss, in	-0.07

Cross-section 6	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	32	32	33		15		58.0
To eroded Surface Elev, cm	32	31.5	32	Vavg (fps) =	15.00	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	-0.5	-1	navg =	0.049		Water Depth (in)
Clopper Soil Loss, cm	0	-0.5	-1	Flow (cfs) =	25.75	15.83	10.30
			Avg Bottom Loss/Gain, in	-0.20		Avg Clopper Soil Loss, in	-0.20

Cross-section 7	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	33	31	32		15		58.5
To eroded Surface Elev, cm	32	31	32	Vavg (fps) =	15.00	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	-1	0	0	navg =	0.050		Water Depth (in)
Clopper Soil Loss, cm	-1	0	0	Flow (cfs) =	26.41	16.23	10.56
			Avg Bottom Loss/Gain, in	-0.13		Avg Clopper Soil Loss, in	-0.13

Cross-section 8	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	32	32	32		15		58.0
To eroded Surface Elev, cm	32	32	32	Vavg (fps) =	15.00	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	0	0	navg =	0.049		Water Depth (in)
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	25.59	15.73	10.24
			Avg Bottom Loss/Gain, in	0.00		Avg Clopper Soil Loss, in	0.00

Cross-section 9	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	31	30.5	31.5		15.5		56.5
To eroded Surface Elev, cm	31	30.5	31	Vavg (fps) =	15.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	0	-0.5	navg =	0.047		Water Depth (in)
Clopper Soil Loss, cm	0	0	-0.5	Flow (cfs) =	26.10	15.53	10.10
			Avg Bottom Loss/Gain, in	-0.07		Avg Clopper Soil Loss, in	-0.07

Cross-section 10	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	30	30	30		15.5		55.5
To eroded Surface Elev, cm	29	30	30	Vavg (fps) =	15.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	-1	0	0	navg =	0.047		Water Depth (in)
Clopper Soil Loss, cm	-1	0	0	Flow (cfs) =	26.27	15.63	10.17
			Avg Bottom Loss/Gain, in	-0.13		Avg Clopper Soil Loss, in	-0.13

Cross-section 11	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	30	31	30.5		15.5		56.0
To eroded Surface Elev, cm	30	31	30.5	Vavg (fps) =	15.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	0	0	navg =	0.047		Water Depth (in)
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	25.94	15.43	10.04
			Avg Bottom Loss/Gain, in	0.00		Avg Clopper Soil Loss, in	0.00

Soil Loss / Gain, in	-0.14	-0.05	-0.09	**Avg Bottom Loss/Gain per Cross-Section =**	**-0.10**
Clopper Soil Loss, in	-0.14	-0.05	-0.09	**Avg Clopper Soil Loss per Cross-Section =**	**-0.10**

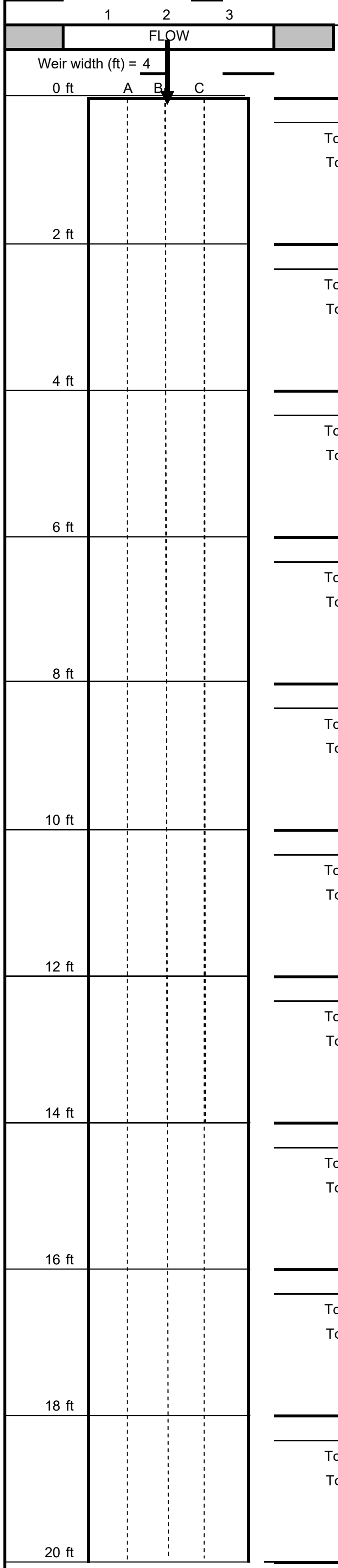
CHANNEL 3 - SHEAR STRESS 1

Date: 2/14/09 Start Time: 12:00 PM End Time: 12:30 PM
Soil: Loam Target Shear (psf): 6.00 Slope: 30%

40 ft long flume 20 ft test section
rpms 2 ft wide flume

Flexamat Permanent Channel Lining Mat

TEST DATA



Outlet Weir	1	2	3				
Water Depth, in		12.00					
Water Velocity, ft/s		3.50					
Flow Rate, cfs	0.00	14.00	0.00				

Cross-section 1	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	28	28	28		6		38.0
To eroded Surface Elev, cm	28	28	27.5	Vavg (fps) =	6.00	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	0	-0.5	navg =	0.065		
Clopper Soil Loss, cm	0	0	-0.5	Flow (cfs) =	4.00	6.15	4.00
		Avg Bottom Loss/Gain, in		-0.07	Avg Clopper Soil Loss, in		-0.07

Cross-section 2	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	30	30	30		6		39.5
To eroded Surface Elev, cm	30	30	30	Vavg (fps) =	6.00	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	0	0	navg =	0.062		
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	3.74	5.75	3.74
		Avg Bottom Loss/Gain, in		0.00	Avg Clopper Soil Loss, in		0.00

Cross-section 3	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	30	29	30		6		39.0
To eroded Surface Elev, cm	30	29	29.5	Vavg (fps) =	6.00	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	0	-0.5	navg =	0.062		
Clopper Soil Loss, cm	0	0	-0.5	Flow (cfs) =	3.74	5.75	3.74
		25.5 Loss/Gain, in		-0.07	Avg Clopper Soil Loss, in		-0.07

Cross-section 4	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	28	28	29		6		38.0
To eroded Surface Elev, cm	28	28	29	Vavg (fps) =	6.00	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	0	0	navg =	0.063		
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	3.81	5.85	3.81
		Avg Bottom Loss/Gain, in		0.00	Avg Clopper Soil Loss, in		0.00

Cross-section 5	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	31	30.5	31		6.5		39.0
To eroded Surface Elev, cm	30.5	30.5	31	Vavg (fps) =	6.50	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	-0.5	0	0	navg =	0.053		
Clopper Soil Loss, cm	-0.5	0	0	Flow (cfs) =	3.55	5.04	3.28
		Avg Bottom Loss/Gain, in		-0.07	Avg Clopper Soil Loss, in		-0.07

Cross-section 6	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	31	32	33		6.5		40.0
To eroded Surface Elev, cm	31	32	32.5	Vavg (fps) =	6.50	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	0	-0.5	navg =	0.052		
Clopper Soil Loss, cm	0	0	-0.5	Flow (cfs) =	3.48	4.94	3.22
		Avg Bottom Loss/Gain, in		-0.07	Avg Clopper Soil Loss, in		-0.07

Cross-section 7	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	34	33.5	33		6.5		41.5
To eroded Surface Elev, cm	34	33	33	Vavg (fps) =	6.50	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	-0.5	0	navg =	0.052		
Clopper Soil Loss, cm	0	-0.5	0	Flow (cfs) =	3.48	4.94	3.22
		Avg Bottom Loss/Gain, in		-0.07	Avg Clopper Soil Loss, in		-0.07

Cross-section 8	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	33	33	34		7		41.5
To eroded Surface Elev, cm	33	33	34	Vavg (fps) =	7.00	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	0	0	navg =	0.048		
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	3.75	4.94	3.22
		Avg Bottom Loss/Gain, in		0.00	Avg Clopper Soil Loss, in		0.00

Cross-section 9	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	33	33	33.5		7		41.0
To eroded Surface Elev, cm	32.5	33	33.5	Vavg (fps) =	7.00	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	-0.5	0	0	navg =	0.048		
Clopper Soil Loss, cm	-0.5	0	0	Flow (cfs) =	3.67	4.84	3.15
		Avg Bottom Loss/Gain, in		-0.07	Avg Clopper Soil Loss, in		-0.07

Cross-section 10	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	33.5	34	35.5		7.5		42.0
To eroded Surface Elev, cm	33	34	35.5	Vavg (fps) =	7.50	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	-0.5	0	0	navg =	0.044		
Clopper Soil Loss, cm	-0.5	0	0	Flow (cfs) =	3.85	4.74	3.08
		Avg Bottom Loss/Gain, in		-0.07	Avg Clopper Soil Loss, in		-0.07

Cross-section 11	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	34.5	34	34		7.5		42.0
To eroded Surface Elev, cm	34	34	34	Vavg (fps) =	7.50	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	-0.5	0	0	navg =	0.044		
Clopper Soil Loss, cm	-0.5	0	0	Flow (cfs) =	3.94	4.84	3.15
		Avg Bottom Loss/Gain, in		-0.07	Avg Clopper Soil Loss, in		-0.07

Soil Loss / Gain, in	-0.07	-0.02	-0.05	**Avg Bottom Loss/Gain per Cross-Section =**	**-0.05**
Clopper Soil Loss, in	-0.07	-0.02	-0.05	**Avg Clopper Soil Loss per Cross-Section =**	**-0.05**

CHANNEL 3 - SHEAR STRESS 2

Date: 2/14/09 Start Time: 1:00 PM End Time: 1:30 PM

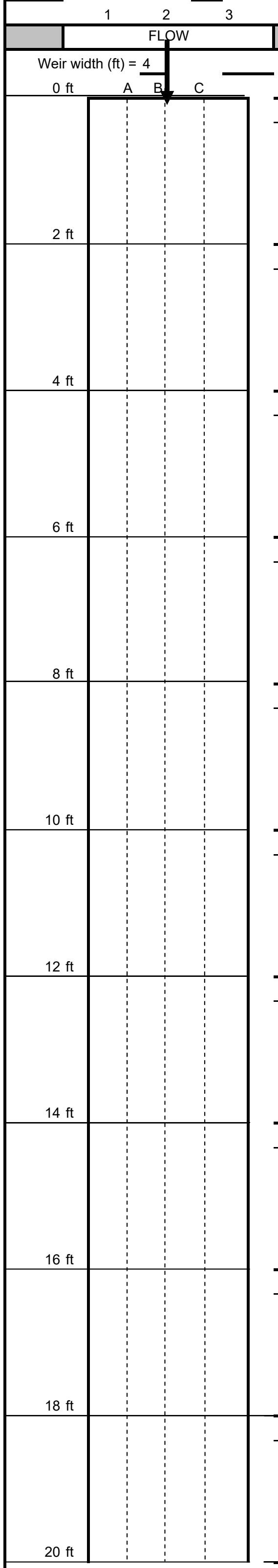
Soil: Loam Target Shear (psf): 10.00 Slope: 30%

40 ft long flume 20 ft test section

rpms 2 ft wide flume

Flexamat Permanent Channel Lining Mat

TEST DATA



Inlet Weir	1	2	3
Water Depth, in		15.00	
Water Velocity, ft/s		4.50	
Flow Rate, cfs	0.00	22.50	0.00

Cross-section 1	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	28	28	27.5		8		42.0
To eroded Surface Elev, cm	28	28	27	Vavg (fps) =	8.00	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	0	-0.5	navg =	0.062		Water Depth (in)
Clopper Soil Loss, cm	0	0	-0.5	Flow (cfs) =	7.52	8.67	5.64
		Avg Bottom Loss/Gain, in		-0.07	Avg Clopper Soil Loss, in		-0.07

Cross-section 2	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	30	30	30		8.5		43.5
To eroded Surface Elev, cm	30	30	30	Vavg (fps) =	8.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	0	0	navg =	0.056		Water Depth (in)
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	7.53	8.17	5.31
		Avg Bottom Loss/Gain, in		0.00	Avg Clopper Soil Loss, in		0.00

Cross-section 3	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	30	29	29.5		8.5		43.0
To eroded Surface Elev, cm	30	29	29	Vavg (fps) =	8.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	0	-0.5	navg =	0.056		Water Depth (in)
Clopper Soil Loss, cm	0	0	-0.5	Flow (cfs) =	7.62	8.27	5.38
		Avg Bottom Loss/Gain, in		-0.07	Avg Clopper Soil Loss, in		-0.07

Cross-section 4	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	28	28	29		8.5		42.0
To eroded Surface Elev, cm	28	28	28.5	Vavg (fps) =	8.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	0	-0.5	navg =	0.057		Water Depth (in)
Clopper Soil Loss, cm	0	0	-0.5	Flow (cfs) =	7.72	8.37	5.45
		Avg Bottom Loss/Gain, in		-0.07	Avg Clopper Soil Loss, in		-0.07

Cross-section 5	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	30.5	30.5	31		8.5		44.0
To eroded Surface Elev, cm	30	30.5	31	Vavg (fps) =	8.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	-0.5	0	0	navg =	0.056		Water Depth (in)
Clopper Soil Loss, cm	-0.5	0	0	Flow (cfs) =	7.53	8.17	5.31
		Avg Bottom Loss/Gain, in		-0.07	Avg Clopper Soil Loss, in		-0.07

Cross-section 6	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	31	32	32.5		8.5		45.0
To eroded Surface Elev, cm	31	32	32	Vavg (fps) =	8.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	0	-0.5	navg =	0.055		Water Depth (in)
Clopper Soil Loss, cm	0	0	-0.5	Flow (cfs) =	7.44	8.07	5.25
		Avg Bottom Loss/Gain, in		-0.07	Avg Clopper Soil Loss, in		-0.07

Cross-section 7	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	34	33	33		9		46.0
To eroded Surface Elev, cm	33.5	33	32.5	Vavg (fps) =	9.00	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	-0.5	0	-0.5	navg =	0.051		Water Depth (in)
Clopper Soil Loss, cm	-0.5	0	-0.5	Flow (cfs) =	7.68	7.87	5.12
		Avg Bottom Loss/Gain, in		-0.13	Avg Clopper Soil Loss, in		-0.13

Cross-section 8	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	33	33	34		9		46.0
To eroded Surface Elev, cm	33	33	33.5	Vavg (fps) =	9.00	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	0	-0.5	navg =	0.051		Water Depth (in)
Clopper Soil Loss, cm	0	0	-0.5	Flow (cfs) =	7.58	7.76	5.05
		Avg Bottom Loss/Gain, in		-0.07	Avg Clopper Soil Loss, in		-0.07

Cross-section 9	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	32.5	33	33.5		9.5		45.0
To eroded Surface Elev, cm	32	33	33	Vavg (fps) =	9.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	-0.5	0	-0.5	navg =	0.047		Water Depth (in)
Clopper Soil Loss, cm	-0.5	0	-0.5	Flow (cfs) =	7.69	7.46	4.86
		Avg Bottom Loss/Gain, in		-0.13	Avg Clopper Soil Loss, in		-0.13

Cross-section 10	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	33	34	35.5		9.5		46.0
To eroded Surface Elev, cm	33	34	35	Vavg (fps) =	9.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	0	-0.5	navg =	0.046		Water Depth (in)
Clopper Soil Loss, cm	0	0	-0.5	Flow (cfs) =	7.48	7.26	4.72
		Avg Bottom Loss/Gain, in		-0.07	Avg Clopper Soil Loss, in		-0.07

Cross-section 11	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	34	34	34		10		45.5
To eroded Surface Elev, cm	33.5	34	34	Vavg (fps) =	10.00	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	-0.5	0	0	navg =	0.043		Water Depth (in)
Clopper Soil Loss, cm	-0.5	0	0	Flow (cfs) =	7.66	7.06	4.59
		Avg Bottom Loss/Gain, in		-0.07	Avg Clopper Soil Loss, in		-0.07

Soil Loss / Gain, in	-0.07	0.00	-0.14	**Avg Bottom Loss/Gain per Cross-Section =**	**-0.07**
Clopper Soil Loss, in	-0.07	0.00	-0.14	**Avg Clopper Soil Loss per Cross-Section =**	**-0.07**

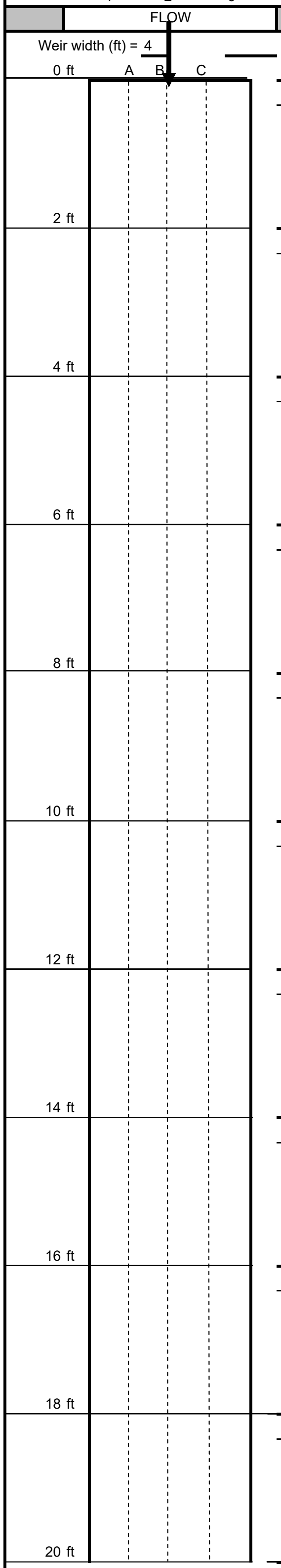
CHANNEL 3 - SHEAR STRESS 3

Date: 2/14/09 Start Time: 2:00 PM End Time: 2:30 PM
Soil: Loam Target Shear (psf): 14.00 Slope: 30%

40 ft long flume 20 ft test section
rpms 2 ft wide flume

Flexamat Permanent Channel Lining Mat

TEST DATA



Inlet Weir	1	2	3
Water Depth, in		19.00	
Water Velocity, ft/s		6.00	
Flow Rate, cfs	0.00	38.00	0.00

Cross-section 1	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	28	28	27		10		46.0
To eroded Surface Elev, cm	27.5	27.5	27	Vavg (fps) =	10.00	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	-0.5	-0.5	0	navg =	0.059		
Clopper Soil Loss, cm	-0.5	-0.5	0	Flow (cfs) =	12.25	11.29	7.35
		Avg Bottom Loss/Gain, in		-0.13	Avg Clopper Soil Loss, in		-0.13

Cross-section 2	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	30	30	30		10.5		47.5
To eroded Surface Elev, cm	30	30	30	Vavg (fps) =	10.50	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	0	0	navg =	0.054		
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	12.06	10.59	6.89
		Avg Bottom Loss/Gain, in		0.00	Avg Clopper Soil Loss, in		0.00

Cross-section 3	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	30	29	29		10.5		47.0
To eroded Surface Elev, cm	30	29	29	Vavg (fps) =	10.50	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	0	0	navg =	0.054		
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	12.17	10.69	6.96
		Avg Bottom Loss/Gain, in		0.00	Avg Clopper Soil Loss, in		0.00

Cross-section 4	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	28	28	28.5		10.5		45.5
To eroded Surface Elev, cm	28	28	28	Vavg (fps) =	10.50	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	0	-0.5	navg =	0.054		
Clopper Soil Loss, cm	0	0	-0.5	Flow (cfs) =	12.06	10.59	6.89
		Avg Bottom Loss/Gain, in		-0.07	Avg Clopper Soil Loss, in		-0.07

Cross-section 5	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	30	30.5	31		10.5		48.0
To eroded Surface Elev, cm	30	30	31	Vavg (fps) =	10.50	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	-0.5	0	navg =	0.054		
Clopper Soil Loss, cm	0	-0.5	0	Flow (cfs) =	12.17	10.69	6.96
		Avg Bottom Loss/Gain, in		-0.07	Avg Clopper Soil Loss, in		-0.07

Cross-section 6	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	31	32	32		11		48.5
To eroded Surface Elev, cm	31	31.5	32	Vavg (fps) =	11.00	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	-0.5	0	navg =	0.050		
Clopper Soil Loss, cm	0	-0.5	0	Flow (cfs) =	12.27	10.29	6.69
		Avg Bottom Loss/Gain, in		-0.07	Avg Clopper Soil Loss, in		-0.07

Cross-section 7	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	33.5	33	32.5		11		49.5
To eroded Surface Elev, cm	33	33	32	Vavg (fps) =	11.00	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	-0.5	0	-0.5	navg =	0.050		
Clopper Soil Loss, cm	-0.5	0	-0.5	Flow (cfs) =	12.15	10.18	6.63
		Avg Bottom Loss/Gain, in		-0.13	Avg Clopper Soil Loss, in		-0.13

Cross-section 8	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	33	33	33.5		11		50.0
To eroded Surface Elev, cm	33	33	33	Vavg (fps) =	11.00	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	0	-0.5	navg =	0.050		
Clopper Soil Loss, cm	0	0	-0.5	Flow (cfs) =	12.27	10.29	6.69
		Avg Bottom Loss/Gain, in		-0.07	Avg Clopper Soil Loss, in		-0.07

Cross-section 9	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	32	33	33		11		49.0
To eroded Surface Elev, cm	32	32	33	Vavg (fps) =	11.00	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	-1	0	navg =	0.049		
Clopper Soil Loss, cm	0	-1	0	Flow (cfs) =	12.03	10.08	6.56
		Avg Bottom Loss/Gain, in		-0.13	Avg Clopper Soil Loss, in		-0.13

Cross-section 10	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	33	34	35		11.5		50.0
To eroded Surface Elev, cm	33	33.5	35	Vavg (fps) =	11.50	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	0	-0.5	0	navg =	0.046		
Clopper Soil Loss, cm	0	-0.5	0	Flow (cfs) =	12.20	9.78	6.36
		Avg Bottom Loss/Gain, in		-0.07	Avg Clopper Soil Loss, in		-0.07

Cross-section 11	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	33.5	34	34		12		50.0
To eroded Surface Elev, cm	33	34	34	Vavg (fps) =	12.00	Bed Max Shear Stress (psf)	Water Depth (in)
Soil Loss / Gain, cm	-0.5	0	0	navg =	0.045		
Clopper Soil Loss, cm	-0.5	0	0	Flow (cfs) =	12.86	9.88	6.43
		Avg Bottom Loss/Gain, in		-0.07	Avg Clopper Soil Loss, in		-0.07

Soil Loss / Gain, in	-0.05	-0.11	-0.05	**Avg Bottom Loss/Gain per Cross-Section =**	**-0.07**
Clopper Soil Loss, in	-0.05	-0.11	-0.05	**Avg Clopper Soil Loss per Cross-Section =**	**-0.07**

CHANNEL 3 - SHEAR STRESS 4

Date: 2/14/09 Start Time: 5:00 PM End Time: 5:30 PM

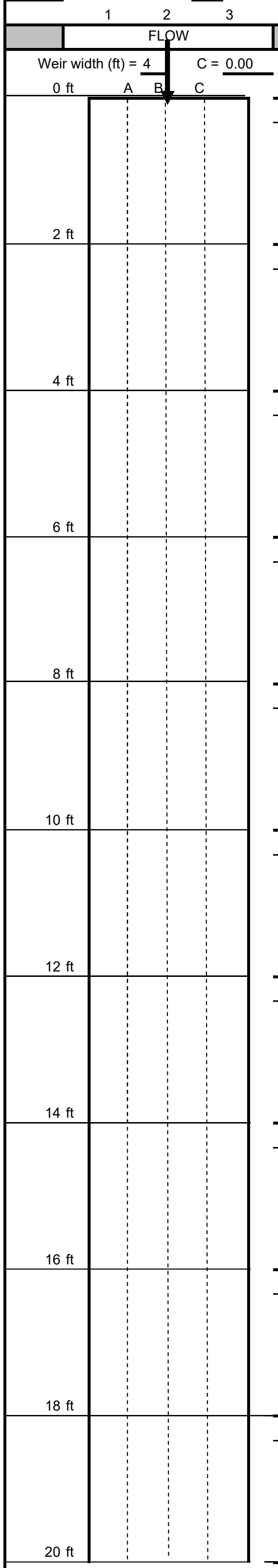
Soil: Loam Target Shear (psf): 18.00 Slope: 30%

40 ft long flume 20 ft test section

rpms 2 ft wide flume

Flexamat Permanent Channel Lining Mat

TEST DATA



Weir width (ft) = 4 C = 0.00

Inlet Weir	1	2	3
Water Depth, in		18.00	
Water Velocity, ft/s		4.50	
Flow Rate, cfs	0.00	27.00	0.00

Cross-section 1	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	27.5	27.5	27		14.5		55.5
To eroded Surface Elev, cm	27	27	27	Vavg (fps) =	14.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	-0.5	-0.5	0	navg =	0.054		Water Depth (in)
Clopper Soil Loss, cm	-0.5	-0.5	0	Flow (cfs) =	27.12	17.24	11.22
		Avg Bottom Loss/Gain, in		-0.13		Avg Clopper Soil Loss, in	-0.13

Cross-section 2	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	30	30	30		14.5		57.5
To eroded Surface Elev, cm	29	29	30	Vavg (fps) =	14.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	-1	-1	0	navg =	0.053		Water Depth (in)
Clopper Soil Loss, cm	-1	-1	0	Flow (cfs) =	26.80	17.04	11.09
		Avg Bottom Loss/Gain, in		-0.26		Avg Clopper Soil Loss, in	-0.26

Cross-section 3	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	30	29	29		14.5		57.0
To eroded Surface Elev, cm	29	29	28	Vavg (fps) =	14.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	-1	0	-1	navg =	0.053		Water Depth (in)
Clopper Soil Loss, cm	-1	0	-1	Flow (cfs) =	26.96	17.14	11.15
		Avg Bottom Loss/Gain, in		-0.26		Avg Clopper Soil Loss, in	-0.26

Cross-section 4	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	28	28	28		15		56.0
To eroded Surface Elev, cm	28	28	28	Vavg (fps) =	15.00	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	0	0	navg =	0.051		Water Depth (in)
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	27.56	16.94	11.02
		Avg Bottom Loss/Gain, in		0.00		Avg Clopper Soil Loss, in	0.00

Cross-section 5	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	30	30	31		15		57.5
To eroded Surface Elev, cm	30	30	30	Vavg (fps) =	15.00	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	0	-1	navg =	0.051		Water Depth (in)
Clopper Soil Loss, cm	0	0	-1	Flow (cfs) =	27.07	16.64	10.83
		Avg Bottom Loss/Gain, in		-0.13		Avg Clopper Soil Loss, in	-0.13

Cross-section 6	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	31	31.5	32		15		58.5
To eroded Surface Elev, cm	31	31	31.5	Vavg (fps) =	15.00	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	-0.5	-0.5	navg =	0.050		Water Depth (in)
Clopper Soil Loss, cm	0	-0.5	-0.5	Flow (cfs) =	26.90	16.54	10.76
		Avg Bottom Loss/Gain, in		-0.13		Avg Clopper Soil Loss, in	-0.13

Cross-section 7	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	33	33	32		15		59.5
To eroded Surface Elev, cm	32	33	32	Vavg (fps) =	15.00	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	-1	0	0	navg =	0.050		Water Depth (in)
Clopper Soil Loss, cm	-1	0	0	Flow (cfs) =	26.74	16.44	10.70
		Avg Bottom Loss/Gain, in		-0.13		Avg Clopper Soil Loss, in	-0.13

Cross-section 8	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	33	33	33		15.5		59.0
To eroded Surface Elev, cm	33	33	33	Vavg (fps) =	15.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	0	0	navg =	0.047		Water Depth (in)
Clopper Soil Loss, cm	0	0	0	Flow (cfs) =	26.44	15.73	10.24
		Avg Bottom Loss/Gain, in		0.00		Avg Clopper Soil Loss, in	0.00

Cross-section 9	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	32	32	33		15.5		58.0
To eroded Surface Elev, cm	32	32	32	Vavg (fps) =	15.50	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	0	-1	navg =	0.047		Water Depth (in)
Clopper Soil Loss, cm	0	0	-1	Flow (cfs) =	26.44	15.73	10.24
		Avg Bottom Loss/Gain, in		-0.13		Avg Clopper Soil Loss, in	-0.13

Cross-section 10	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	33	33.5	35		16		59.0
To eroded Surface Elev, cm	33	33	35	Vavg (fps) =	16.00	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	-0.5	0	navg =	0.045		Water Depth (in)
Clopper Soil Loss, cm	0	-0.5	0	Flow (cfs) =	26.60	15.33	9.97
		Avg Bottom Loss/Gain, in		-0.07		Avg Clopper Soil Loss, in	-0.07

Cross-section 11	A	B	C	V @ 0.2d	V @ 0.6d	V @ 0.8d	To Water Surf, cm
To original Surface Elev, cm	33	34	34		16		59.0
To eroded Surface Elev, cm	33	33.5	33.5	Vavg (fps) =	16.00	Bed Max Shear Stress (psf)	
Soil Loss / Gain, cm	0	-0.5	-0.5	navg =	0.045		Water Depth (in)
Clopper Soil Loss, cm	0	-0.5	-0.5	Flow (cfs) =	26.95	15.53	10.10
		Avg Bottom Loss/Gain, in		-0.13		Avg Clopper Soil Loss, in	-0.13

Soil Loss / Gain, in	-0.13	-0.11	-0.14	**Avg Bottom Loss/Gain per Cross-Section =**	**-0.13**
Clopper Soil Loss, in	-0.13	-0.11	-0.14	**Avg Clopper Soil Loss per Cross-Section =**	**-0.13**

APPENDIX B – TEST SOIL

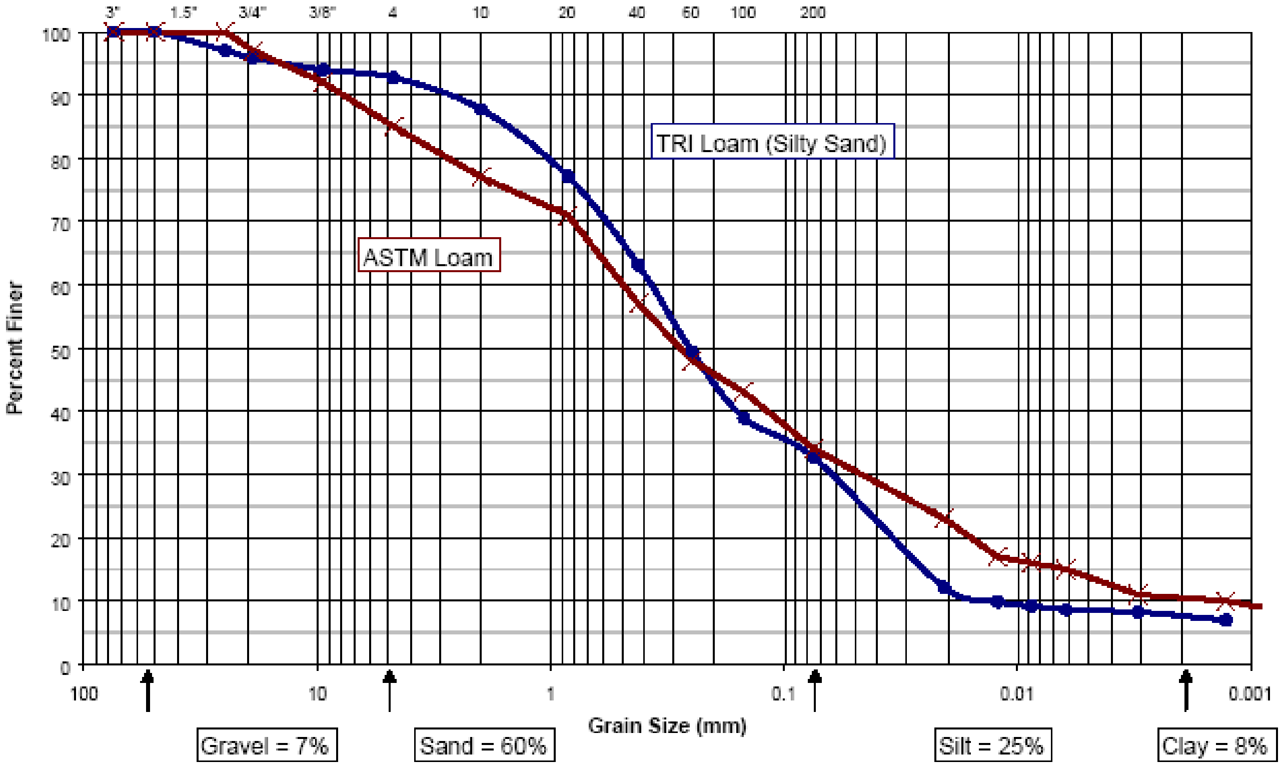
Test Soil Grain Size Distribution Curve

Compaction Curves

TRI/ENVIRONMENTAL, INC.
A Texas Research International Company

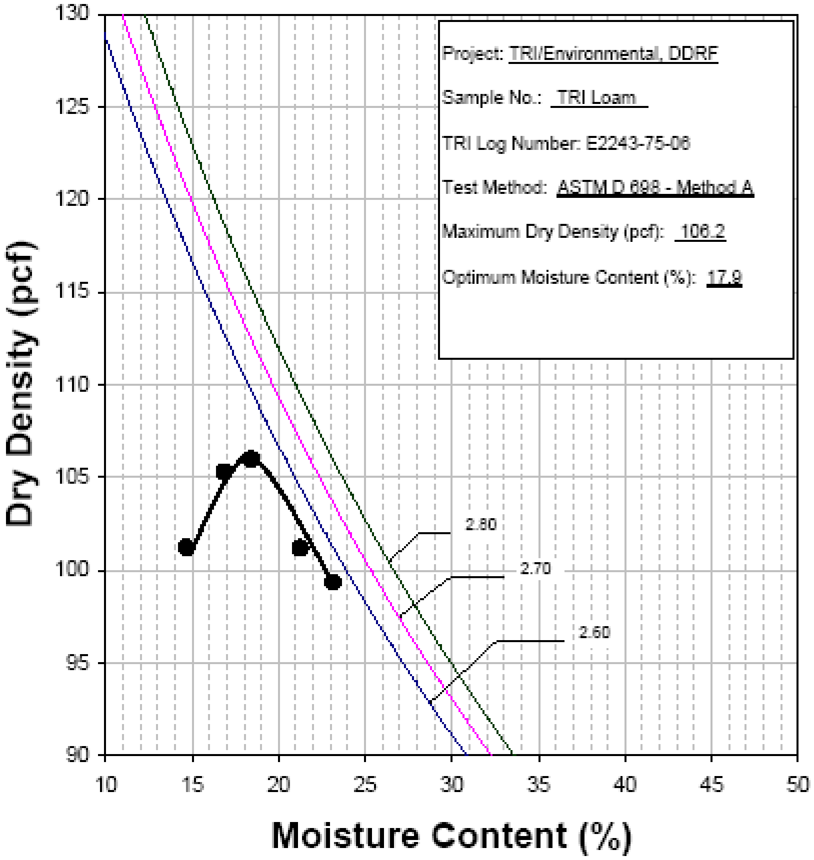
Grain Size Distribution - DDRF (October 2008)

~~Atterburg Limits~~
Liquid Limit = 32
Plastic Limit = 27
Plasticity Index = 5



TRI/ENVIRONMENTAL, INC.
A Texas Research International Company

Proctor Compaction Test



Project: TRI/Environmental, DDRF

Sample No.: TRI Loam

TRI Log Number: E2243-75-06

Test Method: ASTM D 698 - Method A

Maximum Dry Density (pcf): 106.2

Optimum Moisture Content (%): 17.9

John M. Allen, E.I.T 10/12/2006
Quality Review/Date

APPENDIX C – LABORATORY QUALIFICATIONS

Testing Expertise

TRI/Environmental (TRI) is a leading, accredited geosynthetic, plastic pipe, and erosion and sediment control product testing laboratory. TRI's large-scale erosion and sediment control testing facility in the upstate of South Carolina at the Denver Downs Research Farm (DDRF) is initially focused on the following full-scale erosion and sediment control performance tests:

- ASTM D 6459: Determination of Rolled Erosion Control Product (RECP) Performance in Protecting Hillslopes from Rainfall-Induced Erosion;
- ASTM D 6460: Determination of Rolled Erosion Control Product (RECP) Performance in Protecting Earthen Channels from Stormwater-Induced Erosion;
- ASTM D 7208: Determination of Temporary Ditch Check Performance in Protecting Earthen Channels from Stormwater-Induced Erosion.
- ASTM D 7351: Determination of Sediment Retention Device Effectiveness In Sheet Flow Applications.

Technical Oversight

Joel Sprague, P.E., TRI's Senior Engineer provides technical oversight of all of TRI's erosion and sediment control testing and can be contacted at:

Mr. C. Joel Sprague, Senior Engineer
PO Box 9192, Greenville, SC 29604
Ph: 864/242-2220; Fax 864/242-3107; jsprague@tri-env.com

Mr. Sprague has been involved with the design of erosion and sediment control systems and the research, development, and application of erosion and sediment control products/materials for many years. He was the lead consultant in the development of bench-scale testing procedures for the Erosion Control Technology Council. Mr. Sprague has authored numerous technical papers on his research and is readily available to assist clients with their research and testing needs.

Operations Management

Sam Allen, TRI's Division Vice President provides operational management of all TRI laboratories and can be contacted at:

Mr. Sam Allen, Vice President & Program Manager
9063 Bee Caves Road
Austin, TX 78733
Ph: 512/263-2101; Fax: 512/263-2558; sallen@tri-env.com

Mr. Allen pioneered the laboratory index testing of rolled erosion control products (RECPs) and has been actively involved in the development and standardization of testing protocol and apparatus for more than 10 years. He set up and oversees TRI's erosion and sediment control testing laboratories. His oversight responsibilities include test coordination, reporting, and failure resolution associated with the National Transportation Product Evaluation Program (NTPEP) for RECPs.

STATE OF MISSOURI
BRIAN H.
LADD
NUMBER
PE-2014012020
5-16-19
PROFESSIONAL ENGINEER

WOODSIDE RIDGE TR-60 ANALYSIS

Lee’s Summit, MO - 2019

May 2019

Olsson Project No. A18-1140

STATE OF MISSOURI
BRIAN H.
LADD
NUMBER
PE-2014012020
5-16-19
PROFESSIONAL ENGINEER

REVISED WOODSIDE RIDGE FINAL MACRO AND FIRST PLAT MICRO DRAINAGE STUDY

Lee's Summit, MO – 2019

Original Submittal November 2018
First Revision March 2019
Second Revision May 2019

Olsson Project No. A18-1140