Kimley»Horn

May 10, 2023

City of Lone Tree
Attn: Jacob James, City Engineer
Public Works Department
9220 Kimmer Drive, Suite 100
Lone Tree, CO 80124

RE: ***Floor & Decor – Lone Tree***
Lot 1A, Block 2, of the Parkway Subdivision Filing No. 3
Final Drainage Conformance Letter

The following letter is intended to serve as a final drainage conformance letter for Floor & Decor – Lone Tree, "The Project," which is located on Lot 1A, Block 2 of the Parkway Subdivision Filing No. 3, 3rd Amendment site. The Project falls within the overall Parkway Subdivision Filing No. 3 development. The storm design for this site was previously approved under the *Phase III Drainage Study, Project Majestic (December 1994)*, (the Phase III Report). Excerpts from the Phase III Report are attached. As such, the project described herein is subject to meeting the criteria and expected design flows as outlined in the Phase III drainage Report.

PROJECT DESCRIPTION

The Project consists of expanding the existing building located within Lot 1A, Block 2 of the Filing No. 3 site, and will add customer pick up on the northeast corner of the building, as well as adding to the sidewalk along the east of the building. The existing detention pond will be retrofitted to provide water quality for the site as well.

The site is served by existing permanent stormwater infrastructure as designed and constructed with the Phase III Report. The site currently conveys stormwater via a network of existing surface inlets routed to an underground storm sewer system. This storm sewer system conveys runoff to existing detention pond located in the western corner of the site. The total area of disturbance for the Project is approximately 0.87 acres.

Runoff produced by the proposed improvements during the minor (10-year) and major (100-year) storm events is less than what the site was designed for, and the percent imperviousness for the site is less than what was assumed for the ultimate condition in the Phase III Report. Therefore, it is not anticipated that the proposed improvements will negatively impact the existing storm infrastructure. A detailed comparison is listed in the Proposed Drainage Conditions section of this letter.

DESIGN CRITERIA AND APPROACH

The project is subject to the design criteria as stated in the Phase III Report, as well as City water quality criteria that has been developed since the original pond was construction. The previous Phase III Report accounted for 16.34 acres of area in Basins A, B, C, D, E, F, G, H, I, and J, producing runoff that flowed downstream through a proposed storm sewer system to the existing detention pond in the western corner of the site. The pond was sized to provide detention for the site, but not water quality, and ultimately discharges to another existing detention pond via swale. This existing detention pond was designed with the Parkway Master Drainage Study, by Costin Engineering Company in July 1984.

The Phase III Report states that the pond was sized assuming the ultimate buildout for the site to be 80% impervious. Based on the survey of the existing conditions and with our proposed improvements, the site is 3% below the maximum allowable percent impervious. Detention is provided on site via an existing detention pond designed with the previously approved Phase III Report. A description of basin modifications is provided in the Proposed Drainage Conditions of this conformance letter. There are no anticipated impacts to existing irrigation facilities.

PROPOSED DRAINAGE CONDITIONS

The Project will include the expansion of the existing building along the northeast corner and will add 14,469 sf, sidewalk and entrance along the east of the building, new curb and gutter along the northern landscape island, customer pickup, and associated utilities. The existing pond discharge structure will be removed and replaced with a parallel wall outlet structure consisting of and orifice plate, trash grate, and discharge pipe. The pond already has and existing trickle channel, and the new discharge structure has been designed to match the existing elevations. This retrofit enables the existing EDB to provide the required water quality capture volume (WQCV) based on the assumed 80% ultimate build out condition in the original Phase III report. The design calculations for the WQCV can be found in **Attachment 3.**

The site evaluation and proposed retrofit assumed the detention pond has been restored to the original approved condition (remediated). This will be completed by the current property owner before completion of the proposed retrofit, and project close out will not be issued by the City of Lone Tree until remediation and retrofit are complete and accepted by the City.

Existing drainage patterns will be maintained with the site improvements. The basins from the previous Phase III design that are impacted by the proposed improvements are D, F, G, H, and I. Basins with the " ' " designation represent a change in basin area. The revisions consist of land use changes, grading adjustments, and adjustment to basin boundaries. The differences in C values can be attributed to the previous Phase III Report using outdated criteria from Mile High Flood District, and the criteria used for the calculations in this letter being current. Full rational calculation for the site can be found in **Attachment 3**. The proposed modification within each basin are as follows:

Basin C

Basin C drainage area, inflow, and discharge will all remain the same as defined in the original Phase III report. The only proposed modification within this basin is to remove the existing discharge structure and replace it with a parallel wall outlet structure with an orifice plate and trash grate. The existing discharge pipe will remain as well as the existing trickle channel. The proposed discharge structure will match the existing inverts for both elements. The overflow spillway will be widened slightly to provide adequate flood control. These improvements enable the existing detention pond to provide water quality for the ultimate condition assumed in the original Phase III report.

Basin D

As it exists, the concrete in Basin D near the existing inlet at Design Point 3 has a depression that is preventing stormwater from the east to reach the inlet. This depression was noticed while in the field and will be filled in as part of the site improvements. This will not impact the imperviousness or existing drainage patterns in the basin, and stormwater runoff will still flow to the inlet at Design Point 3.

Basin F'

Previously Basin F consisted of 1.76 acres of building on the site. Basin F' proposes a building expansion of 14,469 sf to the north and east, giving the basin a total roof area of 2.14 acres. **Attachment 2** depicts this area visually. The percent impervious for this basin will remain the same, and runoff will still flow to Design Point 11.

Basin G

While the delineated area of 0.45 acres for Basin G will not be impacted with the proposed improvements, the site will be adding 831 sf of sidewalk to the western side of the basin along the existing building. This improvement will not negatively impact existing drainage patterns and will still drain to the inlet at Design Point 6. Previously, Basin G had 0.19 acres of landscape area, 0.23 acres of pavement, and 0.03 acres of sidewalk. Based off of the survey of existing conditions and the sidewalk expansion, Basin G now has 0.19 acres of landscape area, 0.20 acres of pavement, and 0.06 acres of sidewalk, having a percent impervious of 57%.

Basin H'

Previously Basin H consisted of 0.64 total acres, with 0.33 acres of paving area, and 0.31 acres of landscape area. Basin H' will reduce to a total of 0.52 acres due to the building expansion and will add 1,854 sf of sidewalk. Based off the survey of existing conditions and the proposed improvements, Basin H' has 0.24 acres of paved area, 0.04 acres of sidewalk, and 0.24 acres of landscape area, having a precent imperviousness of 57%. The proposed improvements will not negatively impact the existing drainage patterns and the basin still drains to Design Point 7.

Basin I'

Previously Basin I consisted of 0.88 total acres, with 0.61 acres of paving area, and 0.27 acres of landscape area. Basin I' will reduce to a total of 0.68 acres due to the building expansion andp will reduce landscape area based off of the needed with of the drive aisle along the north of the building. Based off of the survey of existing conditions and the proposed improvements, Basin I' has 0.48 acres of paved area, 0.01 acres of sidewalk, and 0.19 acres of landscape area, having a precent imperviousness of 72%. The proposed improvements will not negatively impact the existing drainage patterns and the basin still drains to Design Point 8.

The previous Phase III drainage Report assumed the ultimate condition for the site to be 80% impervious. Based on the survey of the existing conditions, as well as the proposed improvements for the site, the proposed site is to be 77% impervious, 3% below the maximum impervious percentage of the original design. The Phase III Report calculated the total runoff for the 5-year event to be 58.02 cfs, and the 100-year event to be 109.18 cfs. The proposed site produces 47.87 cfs for the 5-year event, and 107.64 cfs for the 100-year event, reducing the overall flow going to the existing detention pond for the site. Time of concentration values used for the rational calculation in basins not impacted by the proposed improvements were the same values used in the Phase III Report. This was done for consistency and lack of existing topography for the southern and eastern portions of the site. See **Attachment 1 – Runoff Comparison Table** for a direct runoff comparison.

Attachment 2 – Proposed Drainage Condition Map, illustrates the modified basin map for our proposed site, and **Attachment 4** contains pages from the previous Phase III Drainage Report.

DETENTION & WATER QUALITY

In the previous Phase III Report for the site, a detention pond was designed and located in the western corner of the site. The pond used the assumption of 80% impervious when calculating the required volume for the pond. The pond was designed to have a total volume of 2.08 ac-ft for the 100-year storm event, and 1.22 ac-ft for the 10-year event. The pond volume does not account for Basin J, as this basin flows offsite to the east into S. Yosemite St. The pond volume and existing design also does not account for water quality.

The existing pond will be retrofitted to include water quality for the site. Water quality evaluation was completed based on City and MHFD criteria. The existing discharge structure will be removed and replaced with a new parallel wall outlet structure with an orifice plate and trash grate. The existing emergency overflow spillway will be widened to provide adequate flood control. Design calculations for the new discharge structure and spillway are included in **Attachment 3**.

With the proposed improvements for this project, site has a percent impervious of 77%, and using the same volume calculation as the Phase III Report, requires 1.97 ac-ft of detention volume, which complies with the original pond design.

The detention pond discharges to a swale designed with the Phase III Report, and ultimately outfalls into an existing detention pond downstream. See **Attachment 3** for proposed condition calculation and **Attachment 4** for pond calculations from the Phase III Report, as well as other relevant experts.

The Property Owner is aware that the pond on site is currently not maintained and operating as designed. The Property Owner is aware that the pond needs to be brought into compliance as part of this project.

CONCLUSIONS

Based on being below the maximum percent imperviousness for the site, the retrofitting of the pond for water quality, as well as reducing the overall runoff produced by the site for both the minor and major storm events, the proposed improvements associated with this Project are in conformance with *Phase III Drainage Study, Project Majestic (December 1994)* and are in compliance with City of Lone Tree requirements.

Should you have any questions or concerns, please do not hesitate to contact me at (303) 228-2300.

Sincerely,
KIMLEY-HORN

Shannon Petersen, P.E.
Project Manager

References:

Phase III Drainage Study, Project Majestic (December 1994) by Martin/Martin

Attachments:

- Attachment 1: Runoff Comparison Table
- Attachment 2: Proposed Drainage Condition Map
- Attachment 3: Rational and Water Quality Calculations
- Attachment 4: Pages from Approved *Phase III Drainage Study, Project Majestic (December 1994)*

ATTACHMENT 1: RUNOFF COMPARISON TABLE

Phase III Report					
Basin	**Area (ac)**	**C5**	**C100**	**Q5 (cfs)**	**Q100 (cfs)**
A	6.01	0.81	0.87	21.92	40.1
B	1.99	0.82	0.88	8	15.76
C	1.08	0.01	0.2	0.48	1.75
D	1.49	0.67	0.75	4.9	10.08
E	1.76	0.85	0.9	7.35	14.22
F	1.76	0.85	0.9	7.35	14.22
G	0.45	0.51	0.62	1.68	2.24
H	0.64	0.46	0.58	2.16	2.89
I	0.88	0.61	0.71	2.65	5.58
J	0.28	0.88	0.93	1.23	2.34
Total	**16.34**	**--**	**--**	**57.72**	**109.18**

Proposed Improvements					
Basin	**Area (ac)**	**C5**	**C100**	**Q5 (cfs)**	**Q100 (cfs)**
A	6.01	0.71	0.82	17.43	37.76
B	1.99	0.76	0.85	7.13	14.83
C	1.08	0.05	0.49	0.04	3.31
D	1.49	0.62	0.77	4.26	10.20
E	1.76	0.77	0.85	6.32	13.20
F'	2.14	0.77	0.85	7.68	16.04
G	0.45	0.50	0.71	0.95	2.63
H'	0.52	0.50	0.71	1.02	2.83
I'	0.68	0.63	0.78	1.99	4.69
J	0.28	0.80	0.86	1.05	2.14
Total	**16.40**	**--**	**--**	**47.87**	**107.64**

ATTACHMENT 2: PROPOSED DRAINAGE CONDTION MAP

PARKWAY SUBDIVISION FILING NO. 3, THIRD AMENDMENT, LOT 1A, BLOCK 2

LOCATED IN THE NORTHWEST QUARTER OF SECTION 3, TOWNSHIP 6 SOUTH, RANGE 67 WEST OF THE 6TH P.M. CITY OF LONE TREE, COUNTY OF DOUGLAS, STATE OF COLORADO

811 Know what's below. Call before you dig.

LEGEND

- PROPERTY LINE
- EASEMENT LINE
- BASIN BOUNDARY
- PROP. MAJOR CONTOUR
- PROP. MINOR CONTOUR
- PROP. CURB & GUTTER
- PROP. OUTLET STRUCTURE
- PROP. EMERGENCY SPILLWAY
- EX. RIPRAP
- EX. CONTOUR
- EX. ASPHALT
- EX. STORM SEWER
- EX. STORM STRUCTURE
- EX. WATER LINE
- EX. SANITARY LINE
- EX. GAS LINE
- EX. FIRE HYDRANT
- EX. WATER FIXTURE
- EX. SS MANHOLE
- EX. RIGHT OF WAY
- 4:1 1.00% PROPOSED SLOPE ARROW
- PROPOSED FLOW ARROW
- EXISTING FLOW ARROW
- PROPOSED 6" CONCRETE SIDEWALK
- EXISTING CONCRETE
- PROPOSED 6" PCCP HEAVY-DUTY CONCRETE RECONSTRUCTION

A – DRAINAGE BASIN
B – BASIN ACREAGE
C – 5-YEAR RUNOFF COEFFICIENT
D – 100-YEAR RUNOFF COEFFICIENT

A1 DESIGN POINT

Kimley»Horn

PROJECT NAME: Floor & Décor DATE: 2/7/2023
PROJECT NUMBER: 96198011
CALCULATED BY: SWH
CHECKED BY: SLP

RATIONAL CALCULATIONS SUMMARY

DESIGN POINT	TRIBUTARY BASINS	TRIBUTARY AREA (AC)	PEAK FLOWS (CFS)	
			Q5	Q100
On-Site Basins				
1, 1A	A	6.01	17.43	37.76
2, 2A	B	1.99	7.13	14.83
9	C	1.08	0.04	3.31
3	D	1.49	4.26	10.20
4	E	1.76	6.32	13.20
5	F'	2.14	7.68	16.04
6	G	0.45	0.95	2.63
7	H'	0.52	1.23	3.10
8	I'	0.68	1.99	4.69
10	J	0.28	1.05	2.14
TOTAL		**16.40**	**48.08**	**107.91**

NORTH

GRAPHIC SCALE IN FEET
0 20 40 80

CITY OF LONE TREE

DATE

THESE CONSTRUCTION PLANS HAVE BEEN REVIEWED BY THE CITY OF LONE TREE FOR STREET AND DRAINAGE IMPROVEMENTS ONLY.

ENGINEERING DIVISION ACCEPTANCE BLOCK

REVISION	BY	DATE	APPR.

Kimley»Horn

KIMLEY-HORN AND ASSOCIATES, INC.
6200 South Syracuse Way, Suite 300
Greenwood Village, Colorado 80111 (303) 228-2300

DESIGNED BY: SLP
DRAWN BY: JAQ
CHECKED BY: SLP
DATE: 04/28/2023

PARKWAY SUBDIVISION FILING NO. 3, THIRD AMENDMENT, LOT 1A, BLOCK 2
CITY OF LONE TREE, COUNTY OF DOUGLAS
CONSTRUCTION DOCUMENTS
DRAINAGE PLAN

PRELIMINARY
FOR REVIEW ONLY
NOT FOR CONSTRUCTION
Kimley»Horn
Kimley-Horn and Associates, Inc.

PROJECT NO. 096198011

DRAWING NAME 096198011_DRAINAGE.DWG

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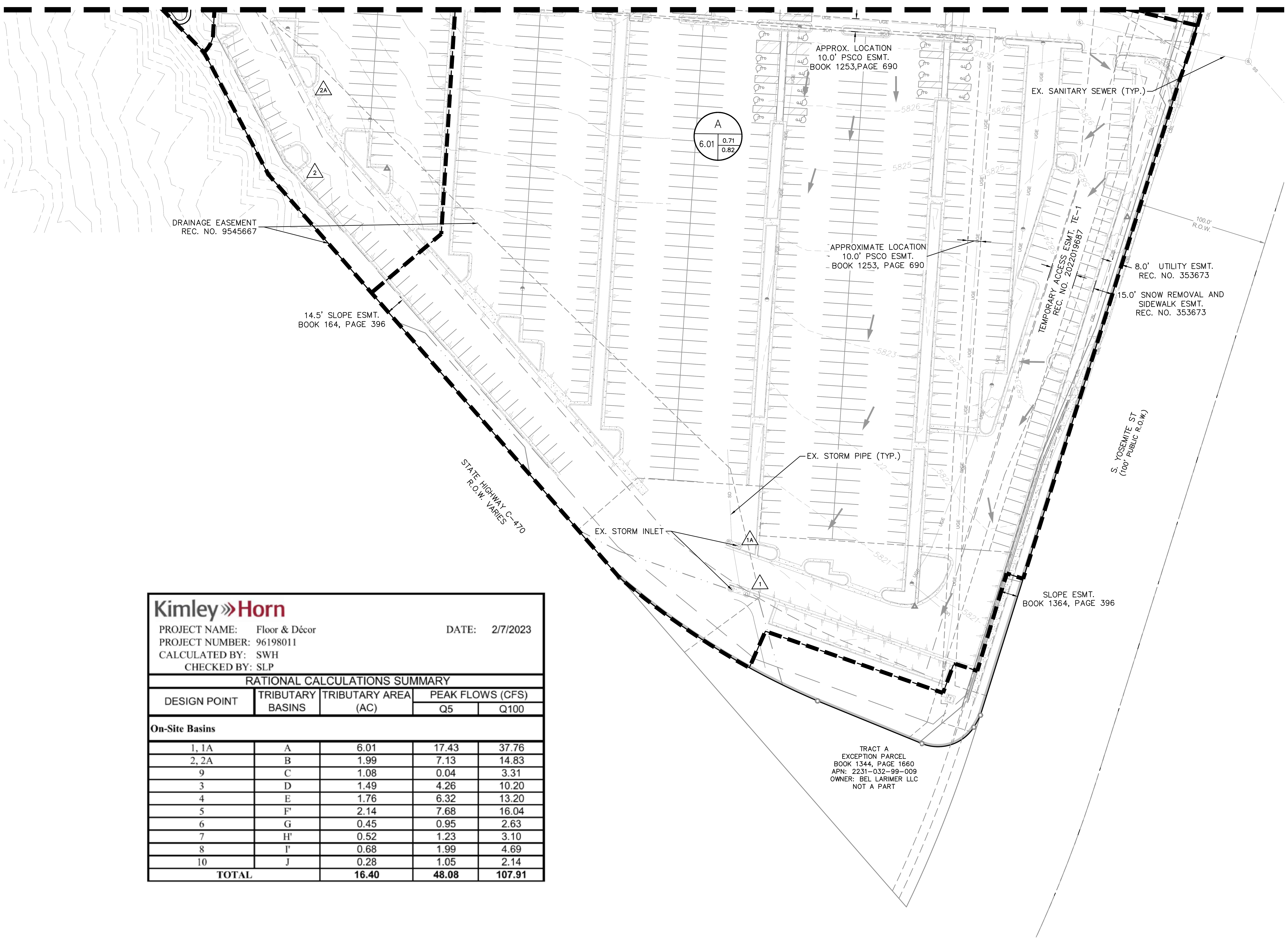
LOCATED IN THE NORTHWEST QUARTER OF SECTION 3, TOWNSHIP 6 SOUTH, RANGE 67 WEST OF THE 6TH P.M. CITY OF LONE TREE, COUNTY OF DOUGLAS, STATE OF COLORADO

811 Know what's below. Call before you dig.

MATCHLINE – SEE SHEET 12



Kimley»Horn

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9	C	1.08	0.04	3.31
3	D	1.49	4.26	10.20
4	E	1.76	6.32	13.20
5	F'	2.14	7.68	16.04
6	G	0.45	0.95	2.63
7	H'	0.52	1.23	3.10
8	I'	0.68	1.99	4.69
10	J	0.28	1.05	2.14
TOTAL		**16.40**	**48.08**	**107.91**

LEGEND

PROPERTY LINE
EASEMENT LINE
BASIN BOUNDARY
PROP. MAJOR CONTOUR
PROP. MINOR CONTOUR
PROP. CURB & GUTTER
PROP. OUTLET STRUCTURE
PROP. EMERGENCY SPILLWAY
EX. RIPRAP
EX. CONTOUR
EX. ASPHALT
EX. STORM SEWER
EX. STORM STRUCTURE
EX. WATER LINE
EX. SANITARY LINE
EX. GAS LINE
EX. FIRE HYDRANT
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A – DRAINAGE BASIN
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C – 5-YEAR RUNOFF COEFFICIENT
D – 100-YEAR RUNOFF COEFFICIENT

A1 DESIGN POINT

NORTH

GRAPHIC SCALE IN FEET 0 20 40 80

CITY OF LONE TREE

DATE

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DRAINAGE PLAN

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Kimley-Horn and Associates, Inc.

PROJECT NO. 096198011

DRAWING NAME 096198011_DRAINAGE.DWG

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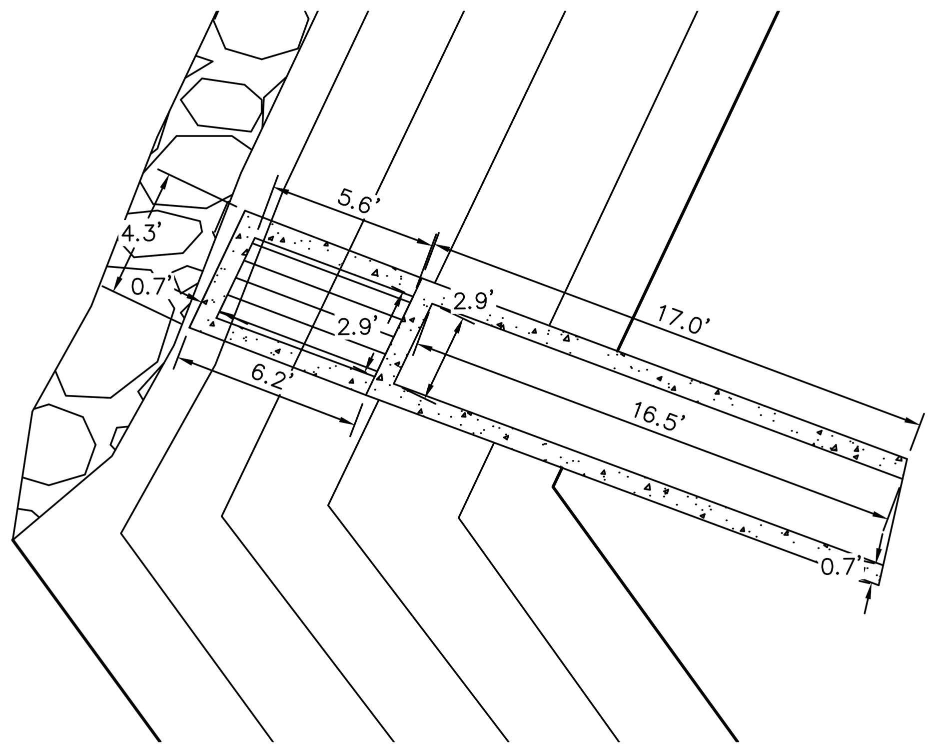
Know what's below. Call before you dig.

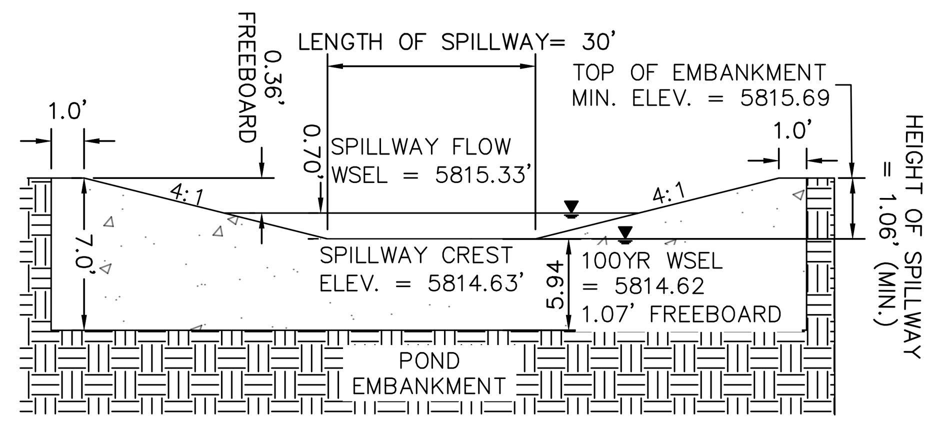
PARKWAY SUBDIVISION FILING NO. 3, THIRD AMENDMENT, LOT 1A, BLOCK 2

LOCATED IN THE NORTHWEST QUARTER OF SECTION 3, TOWNSHIP 6 SOUTH, RANGE 67 WEST OF THE 6TH P.M. CITY OF LONE TREE, COUNTY OF DOUGLAS, STATE OF COLORADO

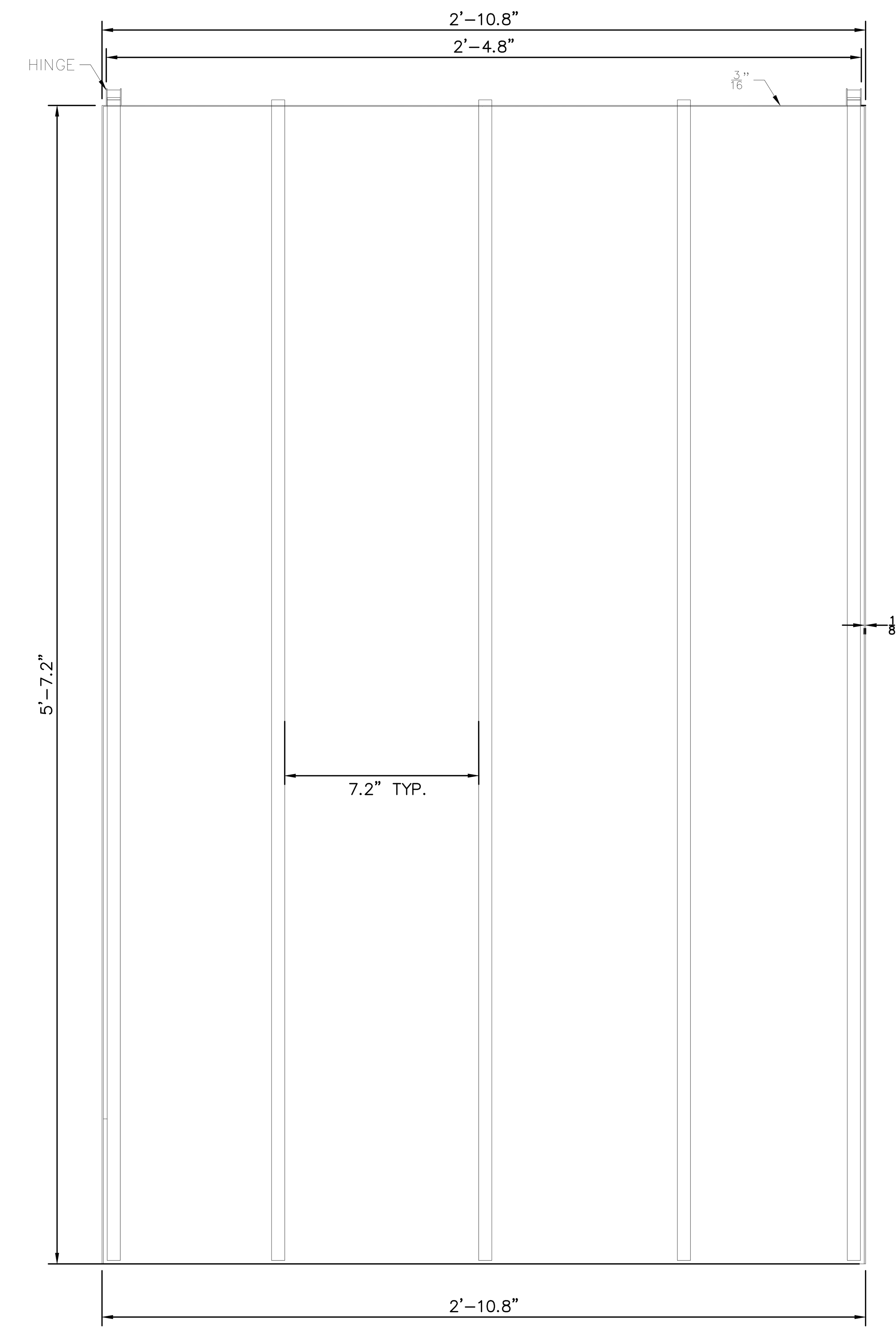


1 **OUTLET STRUCTURE DIMENSIONS**
N.T.S.

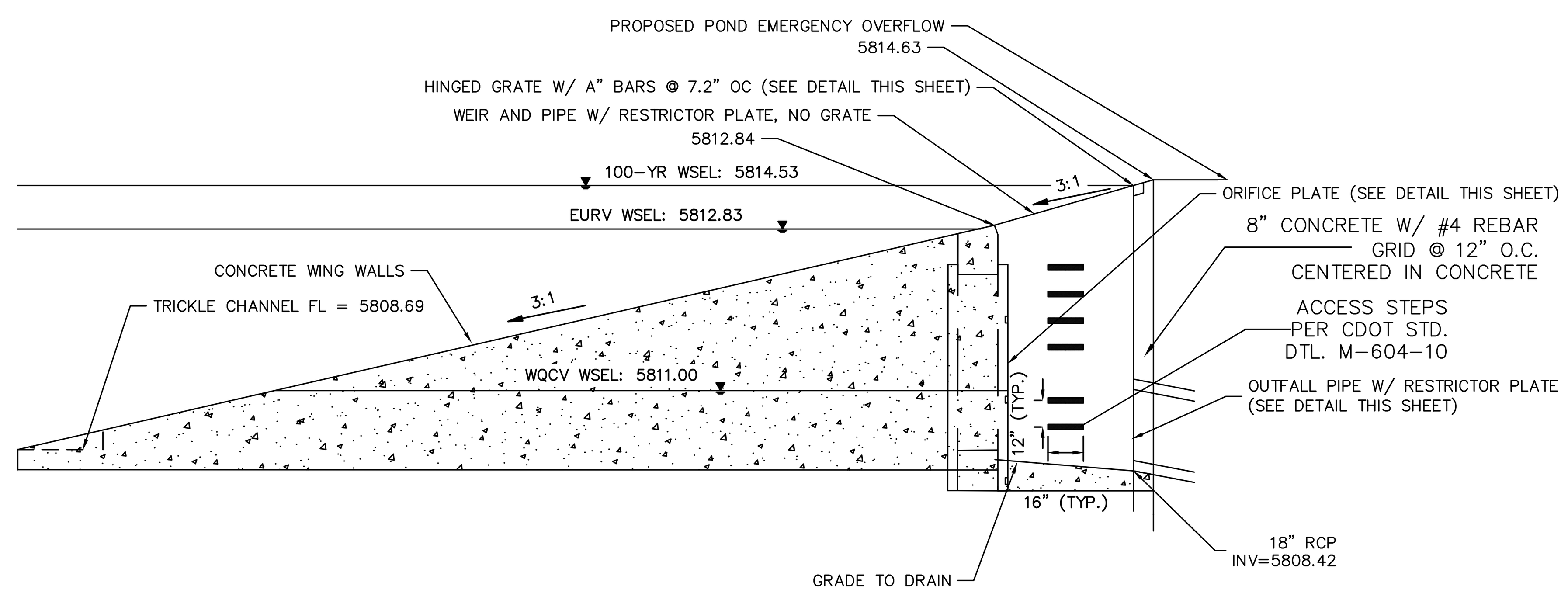
NOTE: CONTRACTOR TO ENSURE ACCESSIBILITY TO BOTH SECTIONS OF OUTLET STRUCTURE.



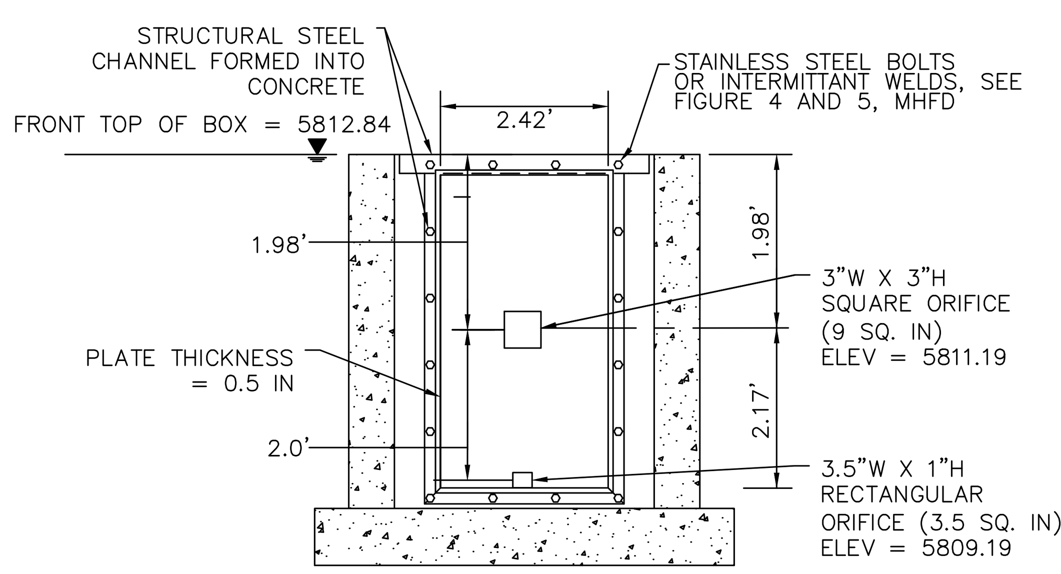
5 **EMERGENCY SPILLWAY**
N.T.S.



6 **TRASH RACK**
N.T.S.



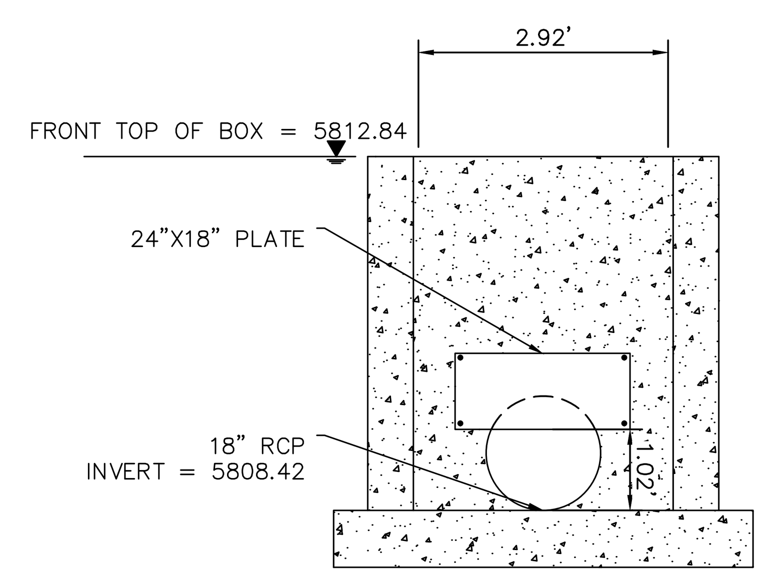
2 **OUTLET STRUCTURE CROSS SECTION**
N.T.S.



3 **ORIFICE PLATE DETAIL**
N.T.S.

ORIFICE PLATE NOTES

1. PROVIDE CONTINUOUS NEOPRENE GASKET MATERIAL BETWEEN THE ORIFICE PLATE AND CONCRETE.
2. BOLT PLATE TO CONCRETE 12" MAX. ON CENTER.



4 **OUTFALL PIPE RESTRICTOR PLATE DETAIL**
N.T.S.

CITY OF LONE TREE

DATE

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CONSTRUCTION DOCUMENTS
STANDARD DETAILS

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Kimley-Horn and Associates, Inc.

PROJECT NO.
096198011

DRAWING NAME
096198011_STD DETAILS.DWG

ATTACHMENT 3: RATIONAL AND WATER QUALITY CALCULATIONS

Kimley»Horn

STANDARD FORM SF-1
RUNOFF COEFFICIENTS - IMPERVIOUS CALCULATION

PROJECT NAME: Floor & Décor
PROJECT NUMBER: 96198011
CALCULATED BY: SWH
CHECKED BY: SLP

DATE: 2/7/2023

SOIL: C/D

LAND USE:	PAVED AREA	ROOF AREA	LANDSCAPE AREA	CONCRETE AREA
2-YEAR COEFF.	0.83	0.74	0.01	0.74
5-YEAR COEFF.	0.85	0.77	0.05	0.77
10-YEAR COEFF.	0.87	0.79	0.15	0.79
100-YEAR COEFF.	0.89	0.85	0.49	0.85
IMPERVIOUS %	100%	90%	2%	90%

DESIGN BASIN	DESIGN POINT	PAVED AREA (AC)	ROOF AREA (AC)	LANDSCAPE AREA (AC)	CONCRETE AREA (AC)	TOTAL AREA (AC)	C(2)	C(5)	C(10)	C(100)	Imp %
On-Site Basins											
A	1, 1A	4.73	0.03	1.00	0.24	**6.01**	0.69	0.71	0.75	0.82	83%
B	2, 2A	1.58	0.00	0.19	0.21	**1.99**	0.74	0.76	0.79	0.85	89%
C	9	0.00	0.00	1.08	0.00	**1.08**	0.01	0.05	0.15	0.49	2%
D	3	0.21	0.00	0.34	0.95	**1.49**	0.59	0.62	0.66	0.77	72%
E	4	0.00	1.76	0.00	0.00	**1.76**	0.74	0.77	0.79	0.85	90%
F'	5	0.00	2.14	0.00	0.00	**2.14**	0.74	0.77	0.79	0.85	90%
G	6	0.20	0.00	0.19	0.06	**0.45**	0.47	0.50	0.55	0.71	57%
H'	7	0.30	0.00	0.18	0.04	**0.52**	0.54	0.57	0.62	0.75	66%
I'	8	0.48	0.00	0.19	0.01	**0.68**	0.60	0.63	0.67	0.78	73%
J	10	0.21	0.00	0.01	0.05	**0.28**	0.77	0.80	0.82	0.86	93%
		7.71	**3.93**	**3.19**	**1.57**	**16.40**	**0.64**	**0.67**	0.70	**0.80**	**78%**
BASIN SUBTOTAL		**47%**	**24%**	**19%**	**10%**	**100%**					

Kimley»Horn

STANDARD FORM SF-2
Time of Concentration

PROJECT NAME: Floor & Décor
PROJECT NUMBER: 96198011
CALCULATED BY: SWH
CHECKED BY: SLP

DATE: 2/7/2023

SUB-BASIN DATA			INITIAL TIME (T_i)			TRAVEL TIME (T_t)					Tc CHECK (URBANIZED BASINS)					FINAL Tc
DESIGN BASIN (1)	AREA Ac (2)	C5 (3)	LENGTH Ft (4)	SLOPE % (5)	T_i Min. (6)	LENGTH Ft. (7)	SLOPE % (8)	C_v (9)	VEL fps (11)	T_t Min. (12)	COMP. tc (13)	TOTAL LENGTH (14)	TOTAL SLOPE (15)	TOTAL IMP. (16)	Tc Min. (17)	Min.
On-Site Basins																
A	6.01	0.71	30	2.0%	3.1	720	1.5%	20.0	2.4	4.9	8.0	750	1.5%	83%	16.8	8.0
B	1.99	0.76				380	2.5%	20.0	3.1	2.0	2.0	380	2.5%	89%	12.7	5.0
C	1.08	0.05	60	2.0%	11.8	300	3.3%	20.0	3.6	1.4	13.2	360	3.1%	2%	29.3	13.2
D	1.49	0.62	40	15.0%	2.3	330	1.3%	20.0	2.3	2.4	4.7	370	2.8%	72%	15.8	5.0
E	1.76	0.77				200	2.0%	20.0	2.8	1.2	1.2	200	2.0%	90%	11.8	5.0
F'	2.14	0.77				200	2.0%	20.0	2.8	1.2	1.2	200	2.0%	90%	11.8	5.0
G	0.45	0.50	55	2.0%	6.5	135	50.0%	20.0	14.1	0.2	6.6	190	36.1%	57%	16.6	6.6
H'	0.52	0.57	55	2.0%	5.7	160	1.0%	20.0	2.0	1.3	7.0	215	1.3%	66%	16.6	7.0
I'	0.68	0.63	45	8.2%	2.9	233	1.6%	20.0	2.5	1.5	4.4	278	2.7%	73%	15.1	5.0
J	0.28	0.80				230	4.0%	20.0	4.0	1.0	1.0	230	4.0%	93%	11.0	5.0

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

$$t_t = \frac{L_t}{60K\sqrt{S_o}} = \frac{L_t}{60V_t}$$

$$t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$

Kimley»Horn

STANDARD FORM SF-3
STORM DRAINAGE DESIGN - RATIONAL METHOD 5 YEAR EVENT

PROJECT NAME: Floor & Décor
PROJECT NUMBER: 96198011
CALCULATED BY: SWH
CHECKED BY: SLP

P_1 **(1-Hour Rainfall) =** **1.43**

DATE: 2/7/2023

		DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
STORM LINE	DESIGN POINT	DESIGN BASIN	AREA (AC)	RUNOFF COEFF	tc (min)	C*A(ac)	I (in/hr)	Q (cfs)	tc(max)	S(C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs)	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY	tt (min)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
On-Site Basins																					
	1, 1A	A	6.01	0.69	7.98	4.14	4.21	17.43													
	2, 2A	B	1.99	0.74	5.00	1.47	4.85	7.13													
	9	C	1.08	0.01	13.21	0.01	3.44	0.04													
	3	D	1.49	0.59	5.00	0.88	4.85	4.26													
	4	E	1.76	0.74	5.00	1.30	4.85	6.32													
	5	F'	2.14	0.74	5.00	1.58	4.85	7.68													
	6	G	0.45	0.47	6.65	0.21	4.47	0.95													
	7	H'	0.52	0.54	7.04	0.28	4.39	1.23													
	8	I'	0.68	0.60	5.00	0.41	4.85	1.99													
	10	J	0.28	0.77	5.00	0.22	4.85	1.05													

Kimley»Horn

STANDARD FORM SF-3
STORM DRAINAGE DESIGN - RATIONAL METHOD 100 YEAR EVENT

PROJECT NAME: Floor & Décor
PROJECT NUMBER: 96198011
CALCULATED BY: SWH
CHECKED BY: SLP

DATE: 2/7/2023

P_1 (1-Hour Rainfall) = **2.6**

		DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
STORM LINE	DESIGN POINT	DESIGN BASIN	AREA (AC)	RUNOFF COEFF	tc (min)	C*A(ac)	I (in/hr)	Q (cfs)	tc(max)	S(C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY	tt (min)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
On-Site Basins																					
	1, 1A	A	6.01	0.82	7.98	4.94	7.65	37.76													
	2, 2A	B	1.99	0.85	5.00	1.68	8.82	14.83													
	9	C	1.08	0.49	13.21	0.53	6.26	3.31													
	3	D	1.49	0.77	5.00	1.16	8.82	10.20													
	4	E	1.76	0.85	5.00	1.50	8.82	13.20													
	5	F'	2.14	0.85	5.00	1.82	8.82	16.04													
	6	G	0.45	0.71	6.65	0.32	8.13	2.63													
	7	H'	0.52	0.75	7.04	0.39	7.98	3.10													
	8	I'	0.68	0.78	5.00	0.53	8.82	4.69													
	10	J	0.28	0.86	5.00	0.24	8.82	2.14													

Kimley»Horn

PROJECT NAME: Floor & Décor DATE: 2/7/2023
PROJECT NUMBER: 96198011
CALCULATED BY: SWH
CHECKED BY: SLP

RATIONAL CALCULATIONS SUMMARY

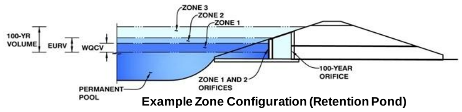
DESIGN POINT	TRIBUTARY BASINS	TRIBUTARY AREA (AC)	PEAK FLOWS (CFS)	
			Q5	Q100
On-Site Basins				
1, 1A	A	6.01	17.43	37.76
2, 2A	B	1.99	7.13	14.83
9	C	1.08	0.04	3.31
3	D	1.49	4.26	10.20
4	E	1.76	6.32	13.20
5	F'	2.14	7.68	16.04
6	G	0.45	0.95	2.63
7	H'	0.52	1.23	3.10
8	I'	0.68	1.99	4.69
10	J	0.28	1.05	2.14
TOTAL		**16.40**	**48.08**	**107.91**

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: ______________________

Basin ID: ______________________



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB			
Watershed Area =	16.53	acres		
Watershed Length =	985	ft		
Watershed Length to Centroid =	493	ft		
Watershed Slope =	0.005	ft/ft		
Watershed Imperviousness =	80.00%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	0.0%	percent		
Percentage Hydrologic Soil Groups C/D =	100.0%	percent		
Target WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	Lone Tree - Municipal Court			

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.452	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	1.299	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.06 in.) =	1.151	acre-feet	1.06	inches
5-yr Runoff Volume (P1 = 1.43 in.) =	1.663	acre-feet	1.43	inches
10-yr Runoff Volume (P1 = 1.66 in.) =	1.990	acre-feet	1.66	inches
25-yr Runoff Volume (P1 = 1.68 in.) =	2.035	acre-feet		inches
50-yr Runoff Volume (P1 = 2.26 in.) =	2.873	acre-feet	2.26	inches
100-yr Runoff Volume (P1 = 2.6 in.) =	3.385	acre-feet	2.60	inches
500-yr Runoff Volume (P1 = 3.07 in.) =	4.069	acre-feet		inches
Approximate 2-yr Detention Volume =	1.048	acre-feet		
Approximate 5-yr Detention Volume =	1.527	acre-feet		
Approximate 10-yr Detention Volume =	1.750	acre-feet		
Approximate 25-yr Detention Volume =	1.642	acre-feet		
Approximate 50-yr Detention Volume =	2.011	acre-feet		
Approximate 100-yr Detention Volume =	2.183	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.452	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.847	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.884	acre-feet
Total Detention Basin Volume =	2.183	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	user	acre-feet

Depth Increement = ____ ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	3,610	0.083		
5809.69	--	1.00	--	--	--	7,220	0.166	5,415	0.124
5810.69	--	2.00	--	--	--	12,860	0.295	15,455	0.355
5811.69	--	3.00	--	--	--	20,066	0.461	31,918	0.733
5812.69	--	4.00	--	--	--	22,970	0.527	53,436	1.227
5813.69	--	5.00	--	--	--	25,970	0.596	77,906	1.788
5814.69	--	6.00	--	--	--	29,271	0.672	105,527	2.423
5815.69	--	7.00	--	--	--	32,426	0.744	136,375	3.131
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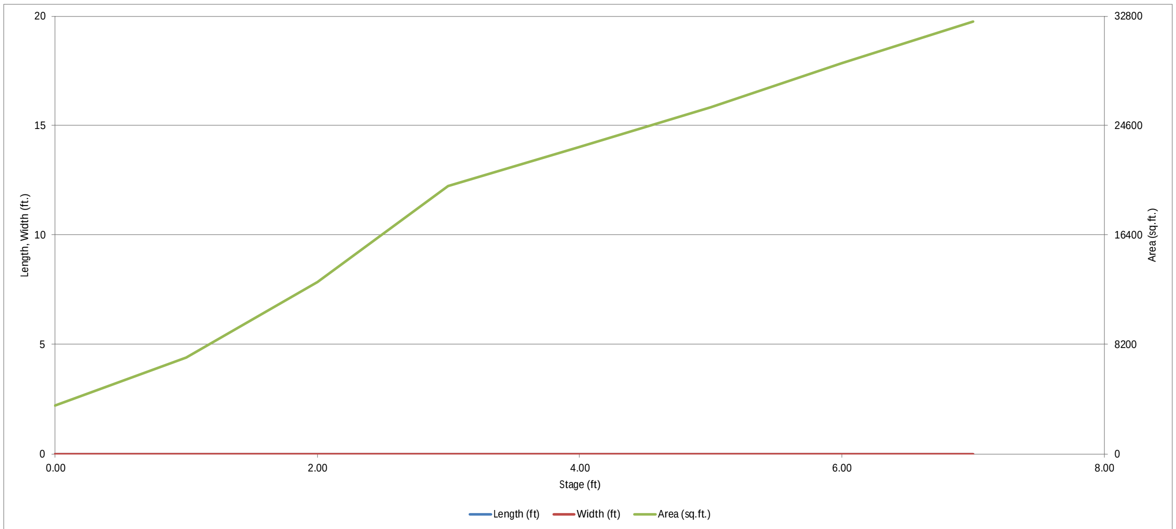
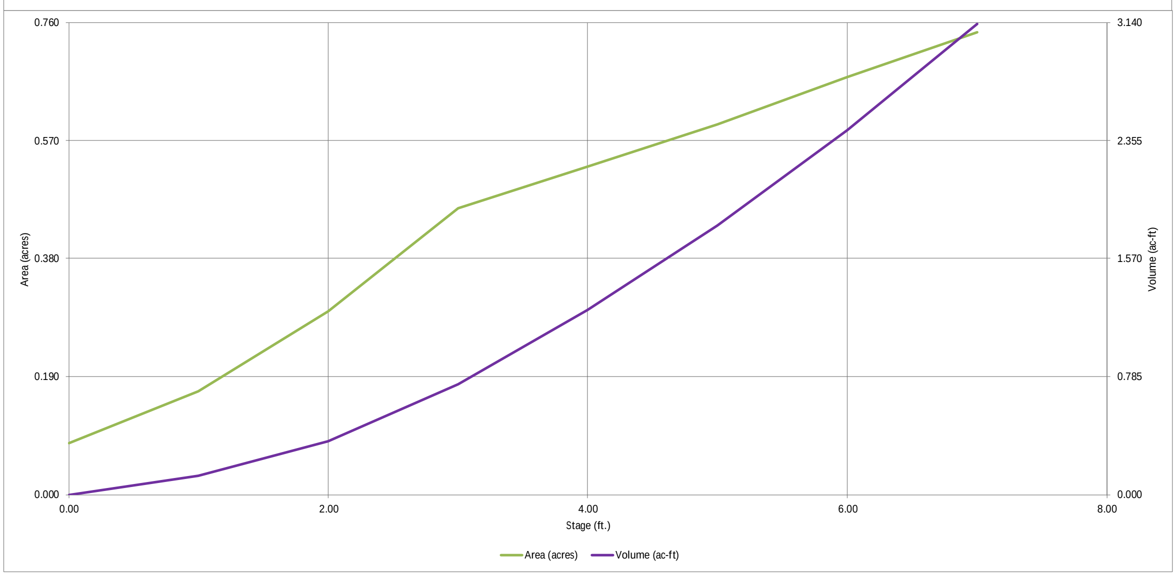
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)



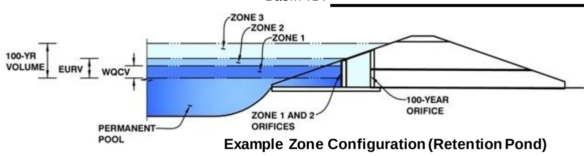


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project:

Basin ID:



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.31	0.452	Orifice Plate
Zone 2 (EURV)	4.14	0.847	Orifice Plate
Zone 3 (100-year)	5.64	0.884	Weir&Pipe (Restrict)
Total (all zones)		2.183	

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	4.15	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	N/A	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

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

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	2.00						
Orifice Area (sq. inches)	3.50	9.00						

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir (and No Outlet Pipe)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.15	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	2.92	N/A	feet
Overflow Weir Grate Slope =	3.00	N/A	H:V
Horiz. Length of Weir Sides =	5.55	N/A	feet
Overflow Grate Type =	No Grate	N/A	
Debris Clogging % =	0%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	6.00	N/A	feet
Overflow Weir Slope Length =	5.85	N/A	feet
Grate Open Area / 100-yr Orifice Area =	13.34	N/A	
Overflow Grate Open Area w/o Debris =	17.08	N/A	ft^2
Overflow Grate Open Area w/ Debris =	17.08	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.27	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	12.25		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	1.28	N/A	ft^2
Outlet Orifice Centroid =	0.57	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.94	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.94	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	30.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	0.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.70	feet
Stage at Top of Freeboard =	6.64	feet
Basin Area at Top of Freeboard =	0.72	acres
Basin Volume at Top of Freeboard =	2.87	acre-ft

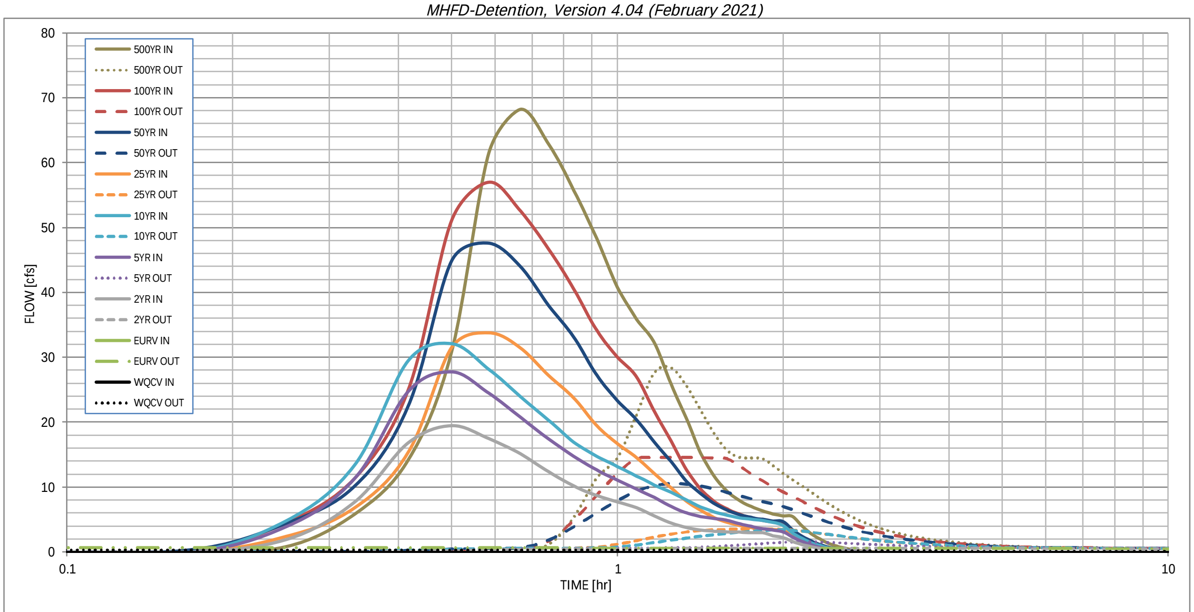
Routed Hydrograph Results

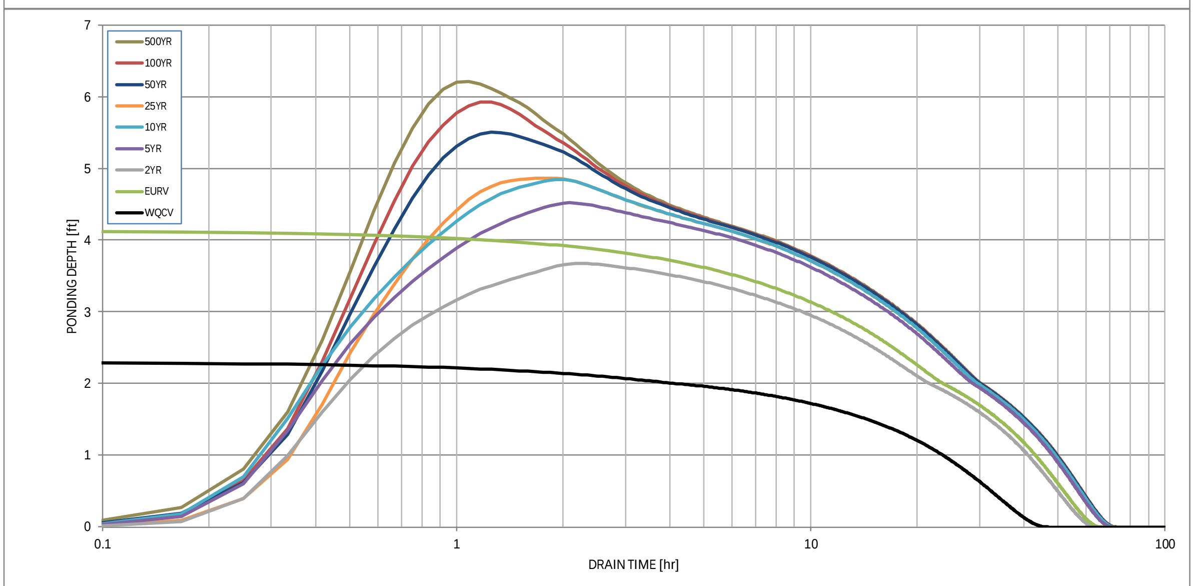
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

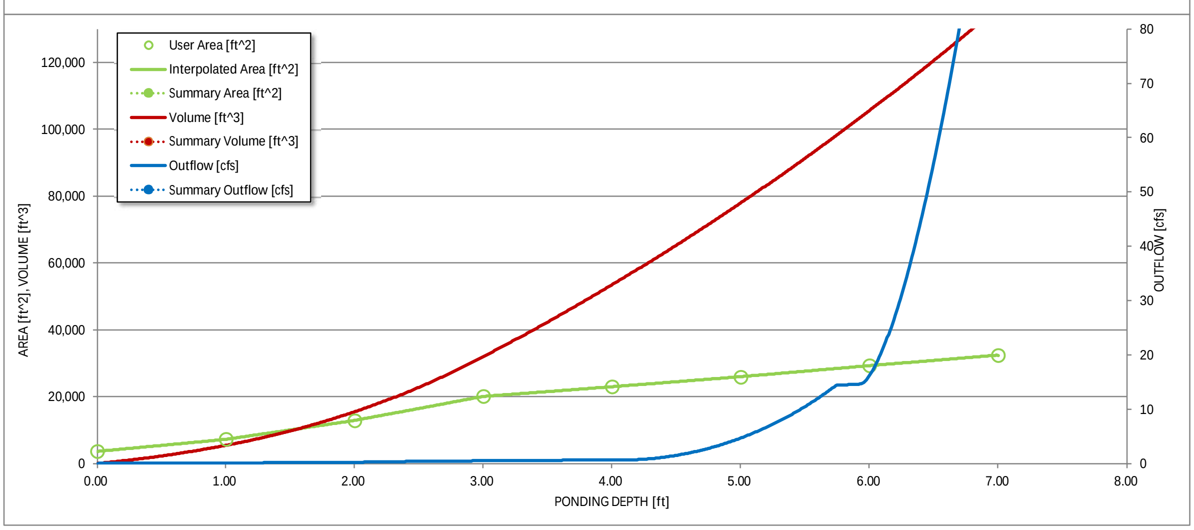
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.06	1.43	1.66	1.68	2.26	2.60	3.07
CUHP Runoff Volume (acre-ft) =	0.452	1.299	1.151	1.663	1.990	2.035	2.873	3.385	4.069
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	1.151	1.663	1.990	2.035	2.873	3.385	4.069
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	1.5	5.5	7.7	9.7	17.0	22.2	28.3
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.09	0.33	0.46	0.59	1.03	1.34	1.71
Peak Inflow Q (cfs) =	N/A	N/A	19.5	27.8	32.2	33.9	47.6	57.0	68.3
Peak Outflow Q (cfs) =	0.3	0.7	0.6	1.6	3.4	3.6	10.6	14.6	28.4
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.3	0.4	0.4	0.6	0.7	1.0
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.1	0.2	0.2	0.6	0.8	0.8
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	40	54	53	57	57	57	54	52	50
Time to Drain 99% of Inflow Volume (hours) =	43	59	58	63	63	63	62	61	60
Maximum Ponding Depth (ft) =	2.31	4.14	3.68	4.52	4.85	4.87	5.51	5.93	6.22
Area at Maximum Ponding Depth (acres) =	0.35	0.54	0.51	0.56	0.59	0.59	0.63	0.67	0.69
Maximum Volume Stored (acre-ft) =	0.454	1.301	1.056	1.510	1.694	1.706	2.096	2.369	2.565

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.31	0.15	0.84
	0:15:00	0.00	0.00	1.94	3.91	4.83	2.39	4.43	4.55	5.90
	0:20:00	0.00	0.00	7.81	11.36	13.49	6.88	10.21	11.43	14.21
	0:25:00	0.00	0.00	16.84	24.71	29.51	15.34	22.44	24.97	30.81
	0:30:00	0.00	0.00	19.48	27.80	32.18	31.50	44.92	51.10	61.47
	0:35:00	0.00	0.00	17.48	24.50	28.23	33.85	47.62	57.04	68.25
	0:40:00	0.00	0.00	15.15	20.81	23.99	31.48	44.02	52.54	62.80
	0:45:00	0.00	0.00	12.37	17.42	20.34	27.19	37.98	46.67	55.75
	0:50:00	0.00	0.00	10.18	14.74	16.93	23.76	33.12	40.49	48.34
	0:55:00	0.00	0.00	8.76	12.65	14.80	19.53	27.25	34.19	40.83
	1:00:00	0.00	0.00	7.75	11.11	13.23	16.72	23.36	30.07	35.91
	1:05:00	0.00	0.00	6.82	9.72	11.75	14.56	20.36	26.97	32.21
	1:10:00	0.00	0.00	5.54	8.44	10.37	12.08	16.92	21.67	25.91
	1:15:00	0.00	0.00	4.48	7.08	9.25	9.93	13.93	17.18	20.57
	1:20:00	0.00	0.00	3.80	6.05	8.06	7.82	10.96	12.73	15.26
	1:25:00	0.00	0.00	3.44	5.49	6.96	6.43	9.01	9.68	11.62
	1:30:00	0.00	0.00	3.25	5.16	6.22	5.34	7.48	7.80	9.38
	1:35:00	0.00	0.00	3.15	4.94	5.70	4.63	6.48	6.64	7.99
	1:40:00	0.00	0.00	3.08	4.39	5.33	4.15	5.80	5.84	7.02
	1:45:00	0.00	0.00	3.02	3.96	5.07	3.84	5.36	5.30	6.37
	1:50:00	0.00	0.00	2.98	3.66	4.89	3.62	5.05	4.92	5.91
	1:55:00	0.00	0.00	2.57	3.43	4.61	3.48	4.84	4.66	5.61
	2:00:00	0.00	0.00	2.25	3.16	4.12	3.38	4.71	4.55	5.47
	2:05:00	0.00	0.00	1.64	2.30	2.97	2.46	3.41	3.31	3.98
	2:10:00	0.00	0.00	1.15	1.62	2.09	1.73	2.41	2.34	2.82
	2:15:00	0.00	0.00	0.80	1.12	1.46	1.22	1.69	1.66	1.99
	2:20:00	0.00	0.00	0.55	0.76	1.00	0.84	1.16	1.14	1.37
	2:25:00	0.00	0.00	0.37	0.50	0.67	0.56	0.78	0.77	0.92
	2:30:00	0.00	0.00	0.24	0.33	0.45	0.38	0.53	0.52	0.63
	2:35:00	0.00	0.00	0.14	0.21	0.27	0.24	0.34	0.33	0.40
	2:40:00	0.00	0.00	0.07	0.11	0.14	0.13	0.18	0.18	0.22
	2:45:00	0.00	0.00	0.03	0.05	0.05	0.06	0.08	0.07	0.09
	2:50:00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.01	0.02
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Summary Stage-Area-Volume-Discharge Relationships

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

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

Stage - Storage Description	Stage [ft]	Area [ft ^{2}]	Area [acres]	Volume [ft ^{3}]	Volume [ac-ft]	Total Outflow [cfs]

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

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

ATTACHMENT 4: PAGES FROM APPROVED *PHASE III DRAINAGE STUDY, PROJECT MAJESTIC (DECEMBER 1994)*

MARTIN/MARTIN

PHASE III DRAINAGE STUDY
PROJECT MAJESTIC
DOUGLAS COUNTY, COLORADO
OCTOBER 1994
REV. DECEMBER 1994

DV 94-184

II DESIGN CRITERIA

On-site flows were calculated using the Rational Method as described in the Urban Drainage Flood Control District's "Urban Storm Drainage Manual, Volume 1", revised May 1984. Runoff flows were calculated for the 5-year and 100-year design storms. A minimum time of concentration (Tc) of five minutes was used when applicable. Street and gutter capacity was done in accordance with Douglas County Drainage Criteria Manual. It was determined that no off-site flows would enter the site. Detention will be provided on-site. The proposed detention pond will release into a proposed swale that flows to an existing detention pond that was designed and detailed in a previous Drainage Study entitled "Parkway Master Drainage Study", prepared by Costin Engineering Company, July 1984.

concentration (Tc) of 5:00 minutes with a minor and major runoff flow of 7.35 cfs and 14.22 cfs. Runoff flows east where it is captured by roof drains and routed through pipes to the detention pond. Basin G has a time of concentration (Tc) of 7.75 minutes with a minor and major flow of 1.68 cfs and 2.24 cfs. Runoff flows southeast to Inlet HH (Design Point 6) which is located in a sump on the southwest side of Basin G. Runoff captured then flows through pipes to the detention pond. Basin H has a concentration time (Tc) of 7.58 minutes with minor and major runoff flow of 2.16 cfs and 2.89 cfs. Runoff flows north to Inlet GG (Design Point 7) which is located in a sump on the north side of Basin H. Runoff captured then flows through pipes to the detention pond. Basin I has a time of concentration (Tc) of 5:00 minutes with a minor and major runoff flow of 2.65 cfs and 5.58 cfs. Runoff flows north to Inlet FF (Design Point 8) which is located in a sump on the north side of Basin I. Runoff captured then flows the detention pond. Basin J has a concentration time (Tc) of 5.00 minutes with a minor and major runoff flow of 1.23 cfs and 2.34 cfs. Runoff flows undetained northeast to South Yosemite Street.

Detention for the site will be provided on the site. It was determined that the detention volume needed for the 10-year storm was 1.22 acre ft. and 2.08 acre ft. for the 100-year storm. The detention pond will release at a rate of 3.61 cfs for the minor storm and 14.47 cfs for the major storm.

None of the developed or historic flows outlined above exceed the street/gutter capacities outlined in the Douglas County Storm Drainage and Technical Criteria Manual (see Appendix B).

TABLE A

PROPOSED BASIN SUMMARY

BASIN DESIGNATION	AREA (AC)	C_5	C_{100}	Tc (MIN)	Q_5 (CFS)	Q_{100} (CFS)
A	6.01	.81	.87	7.27	21.92	40.10
B	1.99	.82	.88	5.00	8.00	15.76
C	1.08	.01	.20	7.33	0.48	1.75
D	1.49	.67	.75	5.00	4.90	10.08
E	1.76	.85	.90	5.00	7.35	14.22
F	1.76	.85	.90	5.00	7.35	14.22
G	0.45	.51	.62	7.75	1.68	2.24
H	0.64	.46	.58	7.58	2.16	2.89
I	0.88	.61	.71	5.00	2.65	5.58
J	0.28	.88	.93	5.00	1.23	2.34

TABLE B

DESIGN POINT SUMMARY

DESIGN POINT	CONTRIBUTING BASINS	AREA (AC)	Q_5 (CFS)	Q_{100} (CFS)
1A	A	6.01	2.50	2.50
1	A	6.01	19.42	37.60
2A	B	1.99	2.50	2.50
2	B	1.99	5.50	13.26
3	D	1.49	4.90	10.08
4	E	1.76	7.35	14.22
5	F	1.76	7.35	14.22
6	G	0.45	1.68	2.24
7	H	0.64	2.16	2.89
8	I	0.88	2.65	5.58

TABLE C

INLET DESIGN INFORMATION

INLET	DESIGN POINT	STREET SLOPE %	INLET SIZE	INLET CAP	GUTTER CAP	Q_{CO} (PREV)	Q_{ST}	Q_D	Q_I	Q_{CO}	DESIGN STORM
AA	2	SUMP	5' TYPE R	12.0	1.0' POND	5.50	5.50	5.50	5.50	0	5 YR
BB	2A	SUMP	SINGLE NO.16	2.5	.17'POND	0	8.00	8.00	2.50	5.50	5 YR
CC	1	SUMP	15' TYPE R	38.0	1.0' POND	19.42	19.42	19.42	6.06	0	5 YR
DD	1A	SUMP	SINGLE NO.16	2.5	.17' POND	0	21.92	21.92	8.88	19.42	5 YR
EE	3	SUMP	10' TYPE R	10.50	0.5' POND	0	4.90	4.90	4.90	0	5 YR
FF	8	SUMP	10' TYPE R	10.50	0.5' POND	0	2.65	2.65	2.65	0	5 YR
GG	7	SUMP	5' TYPE R	12.0	1.0' POND	0	2.16	2.16	2.16	0	5 YR
HH	6	SUMP	5' TYPE R	12.0	1.0' POND	0	1.68	1.68	1.68	0	5 YR
AA	2	SUMP	5' TYPE R	12.0	1.0' POND	13.26	13.26	13.26	13.26	0	100 YR
BB	2A	SUMP	SINGLE NO.16	2.5	.17' POND	0	15.76	15.76	2.50	13.26	100 YR
CC	1	SUMP	15' TYPE R	38.0	1.0' POND	37.60	37.60	37.60	37.60	0	100 YR
DD	1A	SUMP	SINGLE NO.16	2.5	.17' POND	0	40.10	40.10	2.50	37.60	100 YR
EE	3	SUMP	10'TYPE R	10.50	0.5' POND	0	10.08	10.08	10.08	0	100 YR
FF	8	SUMP	10' TYPE R	10.50	0.5' POND	0	5.58	5.58	5.58	0	100 YR
GG	7	SUMP	5' TYPE R	12.0	1.0' POND	0	2.89	2.89	2.89	0	100 YR
HH	6	SUMP	5' TYPE R	12.0	1.0' POND	0	2.24	2.24	2.24	0	100 YR

STANDARD FORM SF-2

TIME OF CONCENTRATION

SUBDIVISION MAJESTIC (TANDY) REV 12-19-94

CALCULATED BY D LOVATO **DATE** 8-19-94

$t_c = t_i + t_t$

SUB-BASIN DATA			INITIAL/OVERLAND TIME (t_i)			TRAVEL TIME (t_t)				t_c CHECK (URBANIZED BASINS)		FINAL t_c	REMARKS
DESIG: (1)	C_5 (2)	AREA Ac (3)	LENGTH Ft (4)	SLOPE % (5)	t_i Min (6)	LENGTH Ft (7)	SLOPE % (8)	VEL. FPS (9)	t_t Min (10)	TOTAL LENGTH Ft (11)	$t_c = (L/180) + 10$ Min (12)	Min (13)	
A	0.81	6.01	30	2.00	2.27	720	1.50	2.40	5.00	750	14.17	7.27	
B	0.82	1.99	–	–	–	380	2.45	3.30	2.11	380	12.11	5.00	USE MIN Tc=5.0
C	0.30	1.08	60	2.00	5.98	300	3.33	3.70	1.35	360	12.00	7.33	
D	0.67	1.49	40	15.00	1.98	330	1.30	2.30	2.39	370	12.06	5.00	USE MIN Tc=5.0
E	0.85	1.76	–	–	–	200	2.00	2.90	1.15	200	11.11	5.00	USE MIN Tc=5.0
F	0.85	1.76	–	–	–	200	2.00	2.90	1.15	200	11.11	5.00	USE MIN Tc=5.0
G	0.51	0.45	55	2.00	6.25	135	0.50	1.50	1.50	190	11.06	7.75	
H	0.46	0.64	55	2.00	6.25	160	1.00	2.00	1.33	215	11.19	7.58	
I	0.61	0.88	35	6.67	2.77	190	2.34	3.20	0.99	225	11.25	5.00	USE MIN Tc=5.0
J	0.88	0.28	–	–	–	230	4.00	4.00	0.96	230	11.27	5.00	USE MIN Tc=5.0

CALCULATED BY D LOVATO

DATE 8-19-94 REV 12-19-94

CHECKED BY ____________

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN (RATIONAL METHOD PROCEDURE)

JOB NO ____________

PROJECT MAJESTIC (TANL

DESIGN STORM 5YR

	STREET	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
			AREA DESIGN	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C·A (AC)	I IN/HR	Q (CFS)	t_c (MIN)	Σ(C·A) (AC)	I (IN/HR)	Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE	LENGTH (FT)	VELOCITY (FPS)	t_t (MIN)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
1	A	1		6.01	.81	7.27	4.87	4.50	21.92													
2	B	2		1.99	.82	5.00	1.63	4.90	8.00													
3	C			1.08	.01	7.33	.01	4.48	0.48													
4	D	3		1.49	.67	5.00	1.00	4.90	4.90													
5	E	4		1.76	.85	5.00	1.50	4.90	7.35													
6	F	5		1.76	.85	5.00	1.50	4.90	7.35													
7	G	6		0.45	.51	7.75	.23	7.30	1.68													
8	H	7		0.64	.46	7.58	.29	7.35	2.16													
9	I	8		0.88	.61	5.00	.54	4.90	2.65													
10	J			0.28	.88	5.00	.25	4.90	1.23													
11																						

CALCULATED BY D LOVATO

DATE 8-19-94 REV 12-19-94

CHECKED BY ____________

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN (RATIONAL METHOD PROCEDURE)

JOB NO ____________

PROJECT MAJESTIC GALL[illegible]

DESIGN STORM 100 YR

	BASIN	DESIGN POINT	DIRECT RUNOFF: AREA DESIGN	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C·A (AC)	I IN/HR	Q (CFS)	TOTAL RUNOFF: t_c (MIN)	Σ(C·A) (AC)	I (IN/HR)	Q (CFS)	STREET: SLOPE (%)	STREET FLOW (CFS)	PIPE: DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE	TRAVEL TIME: LENGTH (FT)	VELOCITY (FPS)	t_t (MIN)	REMARKS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
1	A	1		6.01	.87	7.27	5.23	8.05	40.10													
2	B	2		1.99	.88	5.00	1.75	9.00	15.76													
3	C			1.08	.20	7.33	.22	7.95	1.75													
4	D	3		1.49	.75	5.00	1.12	9.00	10.08													
5	E	4		1.76	.90	5.00	1.58	9.00	14.22													
6	F	5		1.76	.90	5.00	1.58	9.00	14.22													
7	G	6		0.45	.62	7.75	.29	7.75	2.24													
8	H	7		0.64	.58	7.58	.37	7.80	2.89													
9	I	8		0.88	.71	5.00	.62	9.00	5.58													
10	J			0.28	.93	5.00	.26	9.00	2.34													
11																						

BASIN A

$A_T = 6.01$ AC

$A_{SW} = 0.30$ AC	$C_5 = 0.87$	$C_{100} = 0.89$
$A_L = 0.44$ AC	$C_5 = 0.01$	$C_{100} = 0.20$
$A_P = 5.27$ AC	$C_5 = 0.88$	$C_{100} = 0.93$

$$C_5 = \frac{(0.87)(0.30) + (0.01)(0.44) + (0.88)(5.27)}{6.01} = \underline{\underline{0.81}}$$

$$C_{100} = \frac{(0.89)(0.30) + (0.20)(0.44) + (0.93)(5.27)}{6.01} = \underline{\underline{0.87}}$$

BASIN B

$A_T = 1.99$ AC

$A_{SW} = 0.05$ AC	$C_5 = 0.87$	$C_{100} = 0.89$
$A_L = 0.12$ AC	$C_5 = 0.01$	$C_{100} = 0.20$
$A_P = 1.82$ AC	$C_5 = 0.88$	$C_{100} = 0.93$

$$C_5 = \frac{(0.87)(0.05) + (0.01)(0.12) + (0.88)(1.82)}{1.99} = \underline{\underline{0.82}}$$

$$C_{100} = \frac{(0.89)(0.05) + (0.20)(0.12) + (0.93)(1.82)}{1.99} = \underline{\underline{0.88}}$$

BASIN C

A_T = 1.08 AC
A_L = 1.08 AC C_5 = 0.01 C_{100} = 0.20
A_P = 0.00 AC C_5 = 0.88 C_{100} = 0.93

$$C_5 = \frac{(.01)(1.08)}{1.08} = \underline{\underline{0.01}}$$

$$C_{100} = \frac{(.20)(1.08)}{1.08} = \underline{\underline{0.20}}$$

BASIN D

A_T = 1.49 AC

A_L = 0.36 AC C_5 = 0.01 C_{100} = 0.20
A_P = 1.13 AC C_5 = 0.88 C_{100} = 0.93

$$C_5 = \frac{(0.01)(0.36) + (0.88)(1.13)}{1.49} = \underline{\underline{0.67}}$$

$$C_{100} = \frac{(0.20)(0.36) + (0.93)(1.13)}{1.49} = \underline{\underline{0.75}}$$

BASIN E

A_T = 1.76 AC $\underline{\underline{C_5 = 0.85}}$
A_R = 1.76 AC $\underline{\underline{C_{100} = 0.90}}$

BASIN F

A_T = 1.76 AC $\underline{C_5 = 0.85}$
A_R = 1.76 AC $\underline{\underline{C_{100} = 0.90}}$

MARTIN/MARTIN
Consulting Engineers

REV 12-19-94

Title [illegible] Date [illegible] Job no.

Subject [illegible] By [illegible]

BASIN G

$A_T = 0.45$ AC

$A_L = 0.19$ AC $C_5 = 0.01$ $C_{100} = 0.20$

$A_P = 0.23$ AC $C_5 = 0.88$ $C_{100} = 0.93$

$A_{SW} = 0.03$ AC $C_5 = 0.87$ $C_{100} = 0.89$

$$C_5 = \frac{(0.01)(0.19) + (0.88)(0.23) + (0.87)(0.03)}{0.45} = \underline{\underline{0.51}}$$

$$C_{100} = \frac{(0.20)(0.19) + (0.93)(0.23) + (0.89)(0.03)}{0.45} = \underline{\underline{0.62}}$$

BASIN H

$A_T = 0.64$ AC

$A_L = 0.31$ AC $C_5 = 0.01$ $C_{100} = 0.20$

$A_P = 0.33$ AC $C_5 = 0.88$ $C_{100} = 0.93$

$$C_5 = \frac{(0.01)(0.31) + (0.88)(0.33)}{0.64} = \underline{\underline{0.46}}$$

$$C_{100} = \frac{(0.20)(0.31) + (0.93)(0.33)}{0.64} = \underline{\underline{0.58}}$$

BASIN I

A_T [illegible]88 AC

A_L [illegible]27 AC $C_5 = 0.01$ $C_{100} = 0.20$

$A_P = 0.61$ AC $C_5 = 0.88$ $C_{100} = 0.93$

$$C_5 = \frac{(0.01)(0.27) + (0.88)(0.61)}{0.88} = \underline{\underline{0.61}}$$

$$C_{100} = \frac{(0.20)(0.27) + (0.93)(0.61)}{0.88} = \underline{\underline{0.71}}$$

BASIN J $\underline{\underline{C_5 = 0.88}}$ $\underline{\underline{C_{100} = 0.93}}$

INLET DD (DESIGN POINT 1A)

TOTAL FLOW IS RUNOFF TO DESIGN POINT 1.
INLET IN PAN WILL CAPTURE MINIMAL FLOW

$Q_5 = 21.92$ CAN POND TO PAN DEPTH OF 0.17 FT
$Q_{100} = 40.10$

USE TYPE 16 COMBINATION

$Q_A = 2.5$ CFS *

$Q_{CO5} = 21.92 - 2.5 = 19.42$ CFS

$Q_{CO100} = 40.10 - 2.5 = 37.60$ CFS

CARRY OVER TO D.P. 1 INLET CC

INLET CC (DESIGN POINT 1)

CARRY OVER FLOW FROM INLET DD

$Q_5 = 19.42$ CFS
$Q_{100} = 37.60$ CFS

PONDING DEPTH = 1.0' (SUMP CONDITION)

USE [redacted] R

Q_A = [redacted] CFS

$Q_{IN5} = 19.42$ CFS *
$Q_{IN100} = 37.60$ CFS *

NO CARRYOVER

FLOW @ ST MH 3

→ $Q_5 = 19.42 + 2.50 = 21.92$ CFS
→ $Q_{100} = 37.60 + 2.50 = 40.10$ CFS

INLET BB (DESIGN POINT 2A)

TOTAL FLOW IS RUNOFF TO DESIGN POINT 2A
INLET IN PAN WILL CAPTURE MINIMAL FLOW

Q_5 = 8.00 CFS   CAN POND TO PAN DEPTH OF 0.17'
Q_{100} = 15.76 CFS

USE TYPE 16 COMBINATION

Q_A = 2.5 CFS *

Q_{CO5} = 8.00 − 2.5 = 5.50 CFS

Q_{CO100} = 15.76 − 2.5 = 13.26 CFS

CARRY OVER TO D.P. 2 INLET AA

INLET AA (DESIGN POINT 2)

CARRY OVER FLOW FROM INLET BB

Q_5 = 5.50 CFS
Q_{100} = 13.26 CFS

PONDING DEPTH = 1.0'± (SUMP CONDITION)

USE 5' TYPE R

Q_A = 12[redacted]FS

Q_{IN5} = [redacted]CFS *

Q_{IN100} = 13.26 CFS *

FLOW @ ST MH 1

→ Q_5 = 21.92 + 2.5 + 5.50 = 29.92

→ Q_{100} = 40.10 + 2.5 + 13.26 = 55.86

FLOW INTO POND

INLET EE (DESIGN POINT 3)

Q_5 = 4.90 CFS

Q_{100} = 10.08 CFS

PONDING DEPTH = 0.5' (SUMP CONDITION)
HEIGHT OF CURB

USE 10' TYPE R

Q_A = 10.50 CFS

Q_{IN5} = 4.90 CFS *

Q_{IN100} = 10.08 CFS *

NO CARRY OVER

FLOW @ ST MH 4

Q_5 = 13.85 + 4.90 + 7.35 = 26.10 CFS

Q_{100} = 24.93 + 10.08 + 14.22 = 49.23 CFS

FLOW INTO POND

INLET FF (DESIGN POINT 8)

Q_5 = 2.65 CFS

Q_{100} = 5.58 CFS

PONDING DEPTH = 0.5' (SUMP CONDITION)
HEIGHT OF CURB

USE 10' TYPE R

Q_A = [illegible] CFS

Q_{IN5} = [illegible] CFS *

Q_{IN100} = 5.58 CFS *

NO CARRY OVER

FLOW @ ST MH 7

→ Q_5 = 11.20 + 2.65 = 13.85 CFS

→ Q_{100} = 19.35 + 5.58 = 24.93 CFS

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Consulting Engineers

Title [illegible] Date 12-20-94 Job no.

Subject INLET SIZING By D LOVATO

INLET GG (DESIGN POINT 7)

Q_5 = 2.16 CFS
Q_{100} = 2.89 CFS

PONDING DEPTH = 1.0' (SUMP CONDITION)

USE 5' TYPE R

Q_A = 12.0 CFS

Q_{IN5} = 2.16 CFS *
Q_{IN100} = 2.89 CFS *

NO CARRYOVER

FLOW @ ST MH 9

→ Q_5 = 5.36 + 2.16 + 3.68 = 11.20 CFS
→ Q_{100} = 9.35 + 2.89 + 7.11 = 19.35 CFS

INLET HH (DESIGN POINT 6)

Q_5 = 1.68 CFS
Q_{100} = 2.24 CFS

PONDING DEPTH = 1.0 (SUMP CONDITION)

USE 5' TYPE R

Q_A = 12.0 CFS

Q_{IN5} = [illegible] CFS *
Q_{IN100} = 2.24 CFS *

NO CARRY OVER

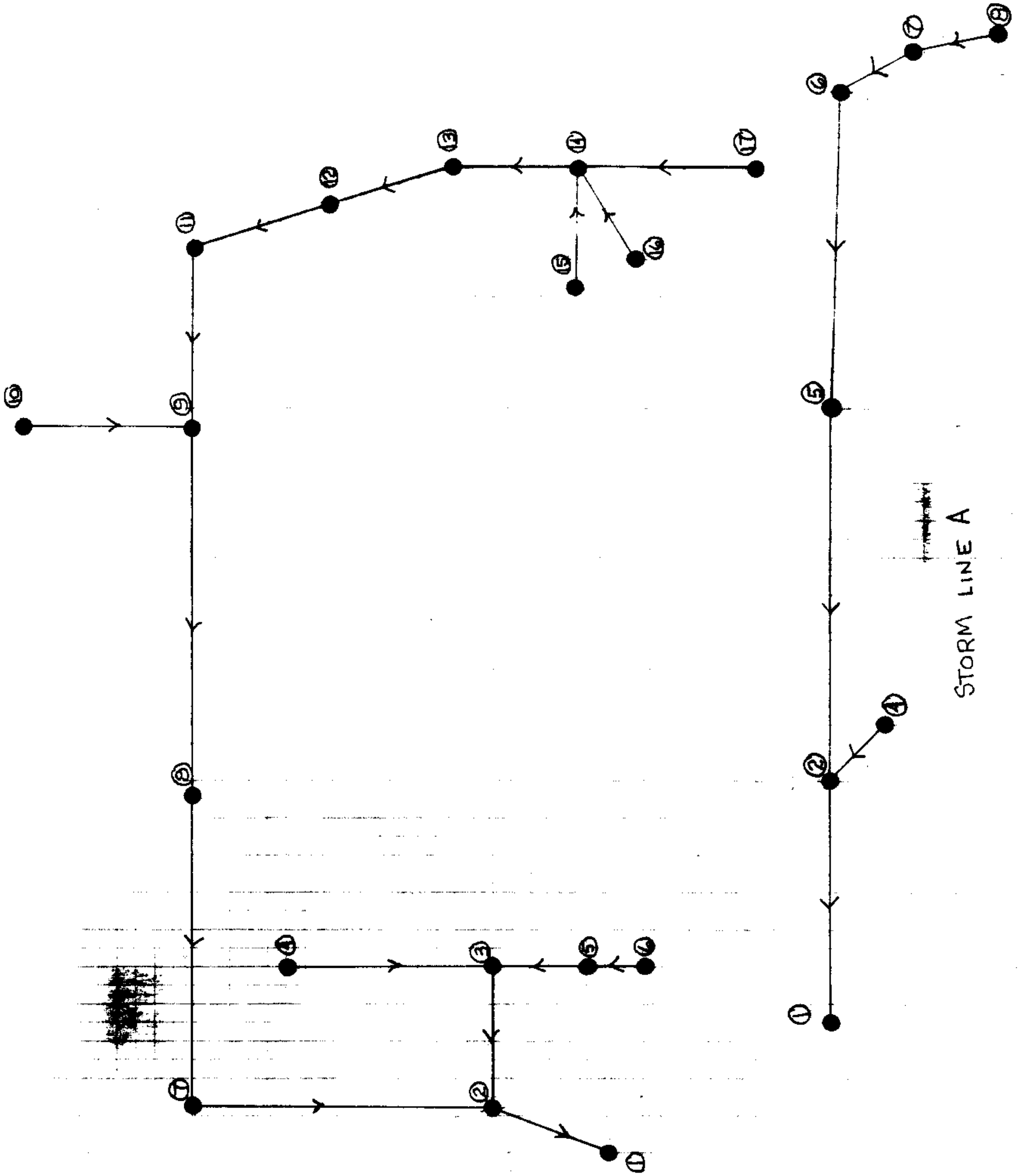
FLOW @ ST MH 10

→ Q_5 = 1.68 + 3.68 = 5.36 CFS
→ Q_{100} = 2.24 + 7.11 = 9.35 CFS

MARTIN/MARTIN
Consulting Engineers

Title MAJESTIC TANDY — REV 1-9-95 — Date 12-20-94 — Job no.

Subject STORM DRAIN ANALYSIS — By D LOVATO — Sheet 1 of



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REPORT OF STORM SEWER SYSTEM DESIGN

USING UDSEWER-MODEL July-2-1993
DEVELOPED
BY
JAMES C.Y. GUO ,PHD, PE
DEPARTMENT OF CIVIL ENGINEERING, UNIVERSITY OF COLORADO AT DENVER
IN COOPERATION WITH
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
DENVER, COLORADO

==

*** EXECUTED BY Martin-Martin..
ON DATA 01-09-1995 AT TIME 10:06:05

*** PROJECT TITLE :

MAJESTIC TANDY STORM LINE A

*** RETURN PERIOD OF FLOOD IS 5 YEARS

RAINFALL INTENSITY FORMULA IS GIVEN

*** SUMMARY OF SUBBASIN RUNOFF PREDICTIONS

		TIME OF CONCENTRATION				
MANHOLE ID NUMBER	BASIN AREA * C	OVERLAND To (MIN)	GUTTER Tf (MIN)	BASIN Tc (MIN)	RAIN I INCH/HR	PEAK FLOW CFS
1.00	1.80	0.00	0.00	0.00	4.75	8.55
2.00	6.00	0.00	0.00	0.00	4.75	28.49
4.00	6.00	0.00	0.00	29.69	2.21	13.26
5.00	6.00	0.00	0.00	0.00	4.75	28.49
6.00	6.00	0.00	0.00	0.00	4.75	28.49
7.00	6.00	0.00	0.00	0.00	4.75	28.49
8.00	6.00	0.00	0.00	14.43	3.24	19.42

THE SHORTEST DESIGN RAINFALL DURATION IS FIVE MINUTES

FOR RURAL AREA, BASIN TIME OF CONCENTRATION =>10 MINUTES
FOR URBAN AREA, BASIN TIME OF CONCENTRATION =>5 MINUTES
AT THE 1ST DESIGN POINT, TC <=(10+TOTAL LENGTH/180) IN MINUTES
WHEN WEIGHTED RUNOFF COEFF=> .2 , THE BASIN IS CONSIDERED TO BE URBANIZED
WHEN TO+TF<>TC, IT INDICATES THE ABOVE DESIGN CRITERIA SUPERCEDES COMPUTATIONS

*** SUMMARY OF HYDRAULICS AT MANHOLES

MANHOLE ID NUMBER	CNTRBTING AREA * C	RAINFALL DURATION MINUTES	RAINFALL INTENSITY INCH/HR	DESIGN PEAK FLOW CFS	GROUND ELEVATION FEET	WATER ELEVATION FEET	COMMENTS
1.00	0.00	0.00	0.00	29.90	11.60	8.21	OK
2.00	0.00	29.87	0.00	29.90	17.76	9.15	OK
4.00	6.00	29.69	2.21	13.26	16.61	9.99	OK
5.00	0.00	15.44	0.00	21.92	19.49	9.92	OK
6.00	0.00	14.80	0.00	21.92	17.60	11.22	OK
7.00	0.00	14.56	0.00	21.92	16.07	11.77	OK
8.00	6.00	14.43	3.24	19.42	15.00	12.09	OK

OK MEANS WATER ELEVATION IS LOWER THAN GROUND ELEVATION

*** SUMMARY OF SEWER HYDRAULICS

NOTE: THE GIVEN FLOW DEPTH-TO-SEWER SIZE RATIO= .8

SEWER ID NUMBER	MAMHOLE NUMBER UPSTREAM ID NO.	DNSTREAM ID NO.	SEWER SHAPE	REQUIRED DIA(HIGH) (IN) (FT)	SUGGESTED DIA(HIGH) (IN) (FT)	EXISTING DIA(HIGH) (IN) (FT)	WIDTH (FT)
21.00	2.00	1.00	ROUND	31.20	33.00	36.00	0.00
42.00	4.00	2.00	ROUND	23.00	24.00	24.00	0.00
52.00	5.00	2.00	ROUND	27.78	30.00	36.00	0.00
65.00	6.00	5.00	ROUND	27.78	30.00	36.00	0.00
76.00	7.00	6.00	ROUND	27.78	30.00	36.00	0.00
87.00	8.00	7.00	ROUND	26.54	27.00	36.00	0.00

DIMENSION UNITS FOR ROUND AND ARCH SEWER ARE IN INCHES
DIMENSION UNITS FOR BOX SEWER ARE IN FEET
REQUIRED DIAMETER WAS DETERMINED BY SEWER HYDRAULIC CAPACITY.
SUGGESTED DIAMETER WAS DETERMINED BY COMMERCIALLY AVAILABLE SIZE.
FOR A NEW SEWER, FLOW WAS ANALYZED BY THE SUGGESTED SEWER SIZE; OTHERWISE, EXISITNG SIZE WAS USED

SEWER ID NUMBER	DESIGN FLOW Q CFS	FLOW FULL Q CFS	NORMAL DEPTH FEET	NORAML VLCITY FPS	CRITIC DEPTH FEET	CRITIC VLCITY FPS	FULL VLCITY FPS	FROUDE NO.	COMMENT
21.0	29.9	43.9	1.82	6.68	1.77	6.90	4.23	0.95	V-OK
42.0	13.3	14.9	1.47	5.36	1.31	13.74	4.22	0.80	V-OK
52.0	21.9	43.9	1.50	6.21	1.54	3.64	3.10	1.01	V-OK
65.0	21.9	43.9	1.50	6.21	1.54	6.02	3.10	1.01	V-OK
76.0	21.9	43.9	1.50	6.21	1.54	6.02	3.10	1.01	V-OK
87.0	19.4	43.9	1.40	6.02	1.47	6.37	2.75	1.02	V-OK

FROUDE NUMBER=0 INDICATES THAT A PRESSURED FLOW OCCURS

SEWER ID NUMBER	SLOPE %	INVERT ELEVATION UPSTREAM (FT)	INVERT ELEVATION DNSTREAM (FT)	BURIED DEPTH UPSTREAM (FT)	BURIED DEPTH DNSTREAM (FT)	COMMENTS
21.00	0.50	7.28	6.60	7.48	2.00	OK
42.00	0.50	7.67	7.39	6.94	8.38	OK
52.00	0.50	8.38	7.38	8.11	7.38	OK
65.00	0.50	9.68	8.48	4.92	8.01	OK
76.00	0.50	10.23	9.78	2.84	4.82	OK
87.00	0.50	10.57	10.34	1.43	2.73	NO

OK MEANS BURIED DEPTH IS GREATER THAN REQUIRED SOIL COVER OF 1.5 FEET

*** SUMMARY OF HYDRAULIC GRADIENT LINE ALONG SEWERS

SEWER ID NUMBER	SEWER LENGTH FEET	SURCHARGED LENGTH FEET	CROWN ELEVATION UPSTREAM FEET	CROWN ELEVATION DNSTREAM FEET	WATER ELEVATION UPSTREAM FEET	WATER ELEVATION DNSTREAM FEET	FLOW CONDITION
21.00	136.00	0.00	10.28	9.60	9.15	8.21	SUBCR
42.00	57.00	57.00	9.67	9.39	9.99	9.15	PRSS'ED
52.00	200.00	0.00	11.38	10.38	9.92	9.15	JUMP
65.00	240.00	0.00	12.68	11.48	11.22	9.92	JUMP
76.00	89.00	0.00	13.23	12.78	11.77	11.22	JUMP
87.00	47.00	0.00	13.57	13.34	12.09	11.77	JUMP

PRSS'ED=PRESSURED FLOW; JUMP=POSSIBLE HYDRAULIC JUMP; SUBCR=SUBCRITICAL FLOW

*** SUMMARY OF ENERGY GRADIENT LINE ALONG SEWERS

SEWER ID NO	UPST MANHOLE ID NO.	MANHOLE ENERGY ELEV FT	SEWER FRCTION FT	BEND K COEF	BEND LOSS FT	JUNCTURE LOSSES LATERAL K COEF	JUNCTURE LOSSES LATERAL LOSS FT	DOWNST MANHOLE ID	MANHOLE ENERGY FT
21.0	2.00	9.43	1.15	0.05	0.01	0.05	0.05	1.00	8.21
42.0	4.00	10.26	0.23	1.25	0.35	0.05	0.26	2.00	9.43
52.0	5.00	10.06	0.36	0.05	0.01	0.05	0.27	2.00	9.43
65.0	6.00	11.36	1.15	0.05	0.01	0.05	0.14	5.00	10.06
76.0	7.00	11.91	0.22	1.25	0.19	0.05	0.14	6.00	11.36
87.0	8.00	12.20	0.00	1.25	0.15	0.05	0.14	7.00	11.91

BEND LOSS =BEND K* FLOWING FULL VHEAD IN SEWER.
LATERAL LOSS= OUTFLOW FULL VHEAD-JCT LOSS K*INFLOW FULL VHEAD
FRICTION LOSS=0 MEANS IT IS NEGLIGIBLE OR POSSIBLE ERROR DUE TO JUMP.
FRICTION LOSS INCLUDES SEWER INVERT DROP AT MANHOLE
NOTICE: VHEAD DENOTES THE VELOCITY HEAD OF FULL FLOW CONDITION.
A MINIMUM JUCTION LOSS OF 0.05 FT WOULD BE INTRODUCED UNLESS LATERAL K

FRICTION LOSS WAS ESTIMATED BY BACKWATER CURVE COMPUTATIONS.

*** SUMMARY OF EARTH EXCAVATION VOLUME FOR COST ESTIMATE.

THE TRENCH SIDE SLOPE = 1

MANHOLE ID NUMBER	GROUND ELEVATION FT	INVERT ELEVATION FT	MANHOLE HEIGHT FT
1.00	11.60	6.60	5.00
2.00	17.76	7.28	10.48
4.00	16.61	7.67	8.94
5.00	19.49	8.38	11.11
6.00	17.60	9.68	7.92
7.00	16.07	10.23	5.84
8.00	15.00	10.57	4.43

SEWER ID NUMBER	UPST TRENCH WIDTH ON GROUND FT	AT INVERT FT	DNST TRENCH WIDTH ON GROUND FT	AT INVERT FT	TRENCH LENGTH FT	WALL THICKNESS INCHES	EARTH VOLUME CUBIC YD
21.00	19.29	5.67	8.33	5.67	136.00	4.00	370.9
42.00	17.38	4.50	20.25	4.50	57.00	3.00	210.5
52.00	20.55	5.67	19.09	5.67	200.00	4.00	865.1
65.00	14.17	5.67	20.35	5.67	240.00	4.00	847.2
76.00	10.01	5.67	13.96	5.67	89.00	4.00	182.4
87.00	7.19	5.67	9.80	5.67	47.00	4.00	64.2

TOTAL EARTH VOLUME FOR SEWER TRENCHES = 2540.243 CUBIC YARDS
SEWER FLOW LINE IS DETERMINED BY THE USER

EARTH VOLUME WAS ESTIMATED TO HAVE
BOTTOM WIDTH=DIAMETER OR WIDTH OF SEWER + 2 * B
B=ONE FEET WHEN DIAMETER OR WIDTH <=48 INCHES
B=TWO FEET WHEN DIAMETER OR WIDTH >48 INCHES
IF BOTTOM WIDTH <MINIMUM WIDTH, 2 FT, THE MINIMUM WIDTH WAS USED.
BACKFILL DEPTH UNDER SEWER WAS ASSUMED TO BE ONE FOOT
SEWER WALL THICKNESS=EQIVLNT DIAMATER IN INCH/12 +1 IN INCHES

CIRCULAR CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

December 21, 1994

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second)......................	29.9
Channel Bottom Slope (feet per foot)....................	0.0063
Manning`s Roughness Coefficient (n-value)...............	0.0130
Channel Diameter (feet).................................	3.00

PROGRAM RESULTS:

DESCRIPTION	VALUE
Normal Depth (feet).....................................	1.61
Flow Velocity (feet per second).........................	7.72
Froude Number (Flow is Super-Critical)..................	1.196
Velocity Head (feet)....................................	0.93
Energy Head (feet)......................................	2.54
Cross-Sectional Area of Flow (square feet)..............	3.87
Top Width of Flow (feet)................................	2.99

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REPORT OF STORM SEWER SYSTEM DESIGN

USING UDSEWER-MODEL July-2-1993
DEVELOPED
BY
JAMES C.Y. GUO ,PHD, PE
DEPARTMENT OF CIVIL ENGINEERING, UNIVERSITY OF COLORADO AT DENVER
IN COOPERATION WITH
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
DENVER, COLORADO

==

*** EXECUTED BY Martin-Martin...
ON DATA 01-09-1995 AT TIME 09:18:21

*** PROJECT TITLE :

MAJESTIC TANDY STORM LINE A

*** RETURN PERIOD OF FLOOD IS 100 YEARS

RAINFALL INTENSITY FORMULA IS GIVEN

*** SUMMARY OF SUBBASIN RUNOFF PREDICTIONS

MANHOLE ID NUMBER	BASIN AREA * C	TIME OF CONCENTRATION OVERLAND To (MIN)	GUTTER Tf (MIN)	BASIN Tc (MIN)	RAIN I INCH/HR	PEAK FLOW CFS
1.00	6.00	0.00	0.00	0.00	4.75	28.49
2.00	6.00	0.00	0.00	0.00	4.75	28.49
4.00	6.00	0.00	0.00	29.69	2.21	13.26
5.00	6.00	0.00	0.00	0.00	4.75	28.49
6.00	6.00	0.00	0.00	0.00	4.75	28.49
7.00	6.00	0.00	0.00	0.00	4.75	28.49
8.00	6.00	0.00	0.00	5.00	6.27	37.60

THE SHORTEST DESIGN RAINFALL DURATION IS FIVE MINUTES

FOR RURAL AREA, BASIN TIME OF CONCENTRATION =>10 MINUTES
FOR URBAN AREA, BASIN TIME OF CONCENTRATION =>5 MINUTES
AT THE 1ST DESIGN POINT, TC <=(10+TOTAL LENGTH/180) IN MINUTES
WHEN WEIGHTED RUNOFF COEFF=> .2 , THE BASIN IS CONSIDERED TO BE URBANIZED
WHEN TO+TF<>TC, IT INDICATES THE ABOVE DESIGN CRITERIA SUPERCEDES COMPUTATIONS

*** SUMMARY OF HYDRAULICS AT MANHOLES

MANHOLE ID NUMBER	CNTRBTING AREA * C	RAINFALL DURATION MINUTES	RAINFALL INTENSITY INCH/HR	DESIGN PEAK FLOW CFS	GROUND ELEVATION FEET	WATER ELEVATION FEET	COMMENTS
1.00	0.00	0.00	0.00	55.86	11.60	9.04	OK
2.00	0.00	29.87	0.00	55.86	17.76	9.09	OK
4.00	6.00	29.69	2.21	13.26	16.61	11.31	OK
5.00	0.00	5.89	0.00	40.10	19.49	12.20	OK
6.00	0.00	5.32	0.00	40.10	17.60	13.70	OK
7.00	0.00	5.11	0.00	40.10	16.07	15.17	OK
8.00	6.00	5.00	6.27	37.60	15.00	16.43	NO

OK MEANS WATER ELEVATION IS LOWER THAN GROUND ELEVATION

*** SUMMARY OF SEWER HYDRAULICS

NOTE: THE GIVEN FLOW DEPTH-TO-SEWER SIZE RATIO= .8

SEWER ID NUMBER	MAMHOLE NUMBER UPSTREAM ID NO.	DNSTREAM ID NO.	SEWER SHAPE	REQUIRED DIA(HIGH) (IN) (FT)	SUGGESTED DIA(HIGH) (IN) (FT)	EXISTING DIA(HIGH) (IN) (FT)	WIDTH (FT)
21.00	2.00	1.00	ROUND	39.45	42.00	36.00	0.00
42.00	4.00	2.00	ROUND	23.00	24.00	24.00	0.00
52.00	5.00	2.00	ROUND	34.84	36.00	36.00	0.00
65.00	6.00	5.00	ROUND	34.84	36.00	36.00	0.00
76.00	7.00	6.00	ROUND	34.84	36.00	36.00	0.00
87.00	8.00	7.00	ROUND	34.00	36.00	36.00	0.00

DIMENSION UNITS FOR ROUND AND ARCH SEWER ARE IN INCHES
DIMENSION UNITS FOR BOX SEWER ARE IN FEET
REQUIRED DIAMETER WAS DETERMINED BY SEWER HYDRAULIC CAPACITY.
SUGGESTED DIAMETER WAS DETERMINED BY COMMERCIALLY AVAILABLE SIZE.
FOR A NEW SEWER, FLOW WAS ANALYZED BY THE SUGGESTED SEWER SIZE; OTHERWISE, EXISITNG SIZE WAS USED

SEWER ID NUMBER	DESIGN FLOW Q CFS	FLOW FULL Q CFS	NORMAL DEPTH FEET	NORAML VLCITY FPS	CRITIC DEPTH FEET	CRITIC VLCITY FPS	FULL VLCITY FPS	FROUDE NO.	COMMENT
21.0	55.9	43.9	3.00	7.90	2.42	9.15	7.90	0.00	V-OK
42.0	13.3	14.9	1.47	5.36	1.31	25.67	4.22	0.80	V-OK
52.0	40.1	43.9	2.25	7.04	2.12	2.48	5.67	0.84	V-OK
65.0	40.1	43.9	2.25	7.04	2.12	7.49	5.67	0.84	V-OK
76.0	40.1	43.9	2.25	7.04	2.12	7.49	5.67	0.84	V-OK
87.0	37.6	43.9	2.14	6.98	1.99	8.05	5.32	0.87	V-OK

FROUDE NUMBER=0 INDICATES THAT A PRESSURED FLOW OCCURS

SEWER ID NUMBER	SLOPE %	INVERT ELEVATION UPSTREAM (FT)	INVERT ELEVATION DNSTREAM (FT)	BURIED DEPTH UPSTREAM (FT)	BURIED DEPTH DNSTREAM (FT)	COMMENTS
21.00	0.50	7.28	6.60	7.48	2.00	OK
42.00	0.50	7.67	7.39	6.94	8.38	OK
52.00	0.50	8.38	7.38	8.11	7.38	OK
65.00	0.50	9.68	8.48	4.92	8.01	OK
76.00	0.50	10.23	9.78	2.84	4.82	OK
87.00	0.50	10.57	10.34	1.43	2.73	NO

OK MEANS BURIED DEPTH IS GREATER THAN REQUIRED SOIL COVER OF 1.5 FEET

*** SUMMARY OF HYDRAULIC GRADIENT LINE ALONG SEWERS

SEWER ID NUMBER	SEWER LENGTH FEET	SURCHARGED LENGTH FEET	CROWN ELEVATION UPSTREAM FEET	CROWN ELEVATION DNSTREAM FEET	WATER ELEVATION UPSTREAM FEET	WATER ELEVATION DNSTREAM FEET	FLOW CONDITION
21.00	136.00	0.00	10.28	9.60	9.09	9.04	PRSS'ED
42.00	57.00	57.00	9.67	9.39	11.31	9.09	PRSS'ED
52.00	200.00	30.36	11.38	10.38	12.20	9.09	SUBCR
65.00	240.00	240.00	12.68	11.48	13.70	12.20	PRSS'ED
76.00	89.00	89.00	13.23	12.78	15.17	13.70	PRSS'ED
87.00	47.00	47.00	13.57	13.34	16.43	15.17	PRSS'ED

PRSS'ED=PRESSURED FLOW; JUMP=POSSIBLE HYDRAULIC JUMP; SUBCR=SUBCRITICAL FLOW

*** SUMMARY OF ENERGY GRADIENT LINE ALONG SEWERS

SEWER ID NO	UPST MANHOLE ID NO.	MANHOLE ENERGY ELEV FT	SEWER FRCTION FT	BEND K COEF	JUNCTURE LOSSES BEND LOSS FT	LATERAL K COEF	LATERAL LOSS FT	DOWNST MANHOLE ID	MANHOLE ENERGY FT
21.0	2.00	10.06	0.92	0.05	0.05	0.05	0.05	1.00	9.04
42.0	4.00	11.59	0.23	1.25	0.35	0.05	0.96	2.00	10.06
52.0	5.00	12.70	1.67	0.05	0.02	0.05	0.94	2.00	10.06
65.0	6.00	14.20	1.00	0.05	0.02	0.05	0.47	5.00	12.70
76.0	7.00	15.67	0.37	1.25	0.62	0.05	0.47	6.00	14.20
87.0	8.00	16.87	0.17	1.25	0.55	0.05	0.48	7.00	15.67

BEND LOSS =BEND K* FLOWING FULL VHEAD IN SEWER.
LATERAL LOSS= OUTFLOW FULL VHEAD-JCT LOSS K*INFLOW FULL VHEAD
FRICTION LOSS=0 MEANS IT IS NEGLIGIBLE OR POSSIBLE ERROR DUE TO JUMP.
FRICTION LOSS INCLUDES SEWER INVERT DROP AT MANHOLE
NOTICE: VHEAD DENOTES THE VELOCITY HEAD OF FULL FLOW CONDITION.
A MINIMUM JUCTION LOSS OF 0.05 FT WOULD BE INTRODUCED UNLESS LATERAL K

FRICTION LOSS WAS ESTIMATED BY BACKWATER CURVE COMPUTATIONS.

*** SUMMARY OF EARTH EXCAVATION VOLUME FOR COST ESTIMATE.

THE TRENCH SIDE SLOPE = 1

MANHOLE ID NUMBER	GROUND ELEVATION FT	INVERT ELEVATION FT	MANHOLE HEIGHT FT
1.00	11.60	6.60	5.00
2.00	17.76	7.28	10.48
4.00	16.61	7.67	8.94
5.00	19.49	8.38	11.11
6.00	17.60	9.68	7.92
7.00	16.07	10.23	5.84
8.00	15.00	10.57	4.43

SEWER ID NUMBER	UPST TRENCH WIDTH ON GROUND FT	UPST TRENCH WIDTH AT INVERT FT	DNST TRENCH WIDTH ON GROUND FT	DNST TRENCH WIDTH AT INVERT FT	TRENCH LENGTH FT	WALL THICKNESS INCHES	EARTH VOLUME CUBIC YD
21.00	19.29	5.67	8.33	5.67	136.00	4.00	370.9
42.00	17.38	4.50	20.25	4.50	57.00	3.00	210.5
52.00	20.55	5.67	19.09	5.67	200.00	4.00	865.1
65.00	14.17	5.67	20.35	5.67	240.00	4.00	847.2
76.00	10.01	5.67	13.96	5.67	89.00	4.00	182.4
87.00	7.19	5.67	9.80	5.67	47.00	4.00	64.2

TOTAL EARTH VOLUME FOR SEWER TRENCHES = 2540.243 CUBIC YARDS
SEWER FLOW LINE IS DETERMINED BY THE USER

EARTH VOLUME WAS ESTIMATED TO HAVE
BOTTOM WIDTH=DIAMETER OR WIDTH OF SEWER + 2 * B
B=ONE FEET WHEN DIAMETER OR WIDTH <=48 INCHES
B=TWO FEET WHEN DIAMETER OR WIDTH >48 INCHES
IF BOTTOM WIDTH <MINIMUM WIDTH, 2 FT, THE MINIMUM WIDTH WAS USED.
BACKFILL DEPTH UNDER SEWER WAS ASSUMED TO BE ONE FOOT
SEWER WALL THICKNESS=EQIVLNT DIAMATER IN INCH/12 +1 IN INCHES

CIRCULAR CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

December 21, 1994

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PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second)........................	55.6
Channel Bottom Slope (feet per foot).....................	0.0063
Manning's Roughness Coefficient (n-value)...............	0.0130
Channel Diameter (feet)..................................	3.00

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PROGRAM RESULTS:

DESCRIPTION	VALUE
Normal Depth (feet)......................................	2.44
Flow Velocity (feet per second)..........................	9.04
Froude Number (Flow is Sub-Critical).....................	0.983
Velocity Head (feet).....................................	1.27
Energy Head (feet).......................................	3.71
Cross-Sectional Area of Flow (square feet)...............	6.15
Top Width of Flow (feet).................................	2.34

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REPORT OF STORM SEWER SYSTEM DESIGN

USING UDSEWER-MODEL July-2-1993
DEVELOPED
BY
JAMES C.Y. GUO ,PHD, PE
DEPARTMENT OF CIVIL ENGINEERING, UNIVERSITY OF COLORADO AT DENVER
IN COOPERATION WITH
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
DENVER, COLORADO

==

*** EXECUTED BY Martin-Martin..
ON DATA 12-21-1994 AT TIME 09:57:20

*** PROJECT TITLE :

MAJESTIC TANDY STORM LINE B

*** RETURN PERIOD OF FLOOD IS 5 YEARS

RAINFALL INTENSITY FORMULA IS GIVEN

*** SUMMARY OF SUBBASIN RUNOFF PREDICTIONS

MANHOLE ID NUMBER	BASIN AREA * C	TIME OF CONCENTRATION OVERLAND To (MIN)	GUTTER Tf (MIN)	BASIN Tc (MIN)	RAIN I INCH/HR	PEAK FLOW CFS
1.00	6.00	0.00	0.00	0.00	4.75	28.49
2.00	6.00	0.00	0.00	0.00	4.75	28.49
3.00	6.00	0.00	0.00	0.00	4.75	28.49
4.00	6.00	0.00	0.00	330.21	0.41	2.45
5.00	6.00	0.00	0.00	0.00	4.75	28.49
6.00	6.00	0.00	0.00	330.21	0.41	2.45
7.00	6.00	0.00	0.00	0.00	4.75	28.49
8.00	6.00	0.00	0.00	0.00	4.75	28.49
9.00	6.00	0.00	0.00	0.00	4.75	28.49
10.00	6.00	0.00	0.00	297.89	0.44	2.65
11.00	6.00	0.00	0.00	0.00	4.75	28.49
12.00	6.00	0.00	0.00	0.00	4.75	28.49
13.00	6.00	0.00	0.00	0.00	4.75	28.49
14.00	6.00	0.00	0.00	0.00	4.75	28.49
15.00	6.00	0.00	0.00	479.73	0.31	1.84
16.00	6.00	0.00	0.00	479.73	0.31	1.84

17.00	6.00	0.00	0.00	539.82	0.28	1.68

THE SHORTEST DESIGN RAINFALL DURATION IS FIVE MINUTES

FOR RURAL AREA, BASIN TIME OF CONCENTRATION =>10 MINUTES
FOR URBAN AREA, BASIN TIME OF CONCENTRATION =>5 MINUTES
AT THE 1ST DESIGN POINT, TC <=(10+TOTAL LENGTH/180) IN MINUTES
WHEN WEIGHTED RUNOFF COEFF=> .2 , THE BASIN IS CONSIDERED TO BE URBANIZED
WHEN TO+TF<>TC, IT INDICATES THE ABOVE DESIGN CRITERIA SUPERCEDES COMPUTATIONS

*** SUMMARY OF HYDRAULICS AT MANHOLES

MANHOLE ID NUMBER	CNTRBTING AREA * C	RAINFALL DURATION MINUTES	RAINFALL INTENSITY INCH/HR	DESIGN PEAK FLOW CFS	GROUND ELEVATION FEET	WATER ELEVATION FEET	COMMENTS
1.00	0.00	0.00	0.00	26.10	13.40	9.95	OK
2.00	0.00	544.03	0.00	49.23	17.30	11.23	OK
3.00	0.00	330.65	0.00	7.35	21.50	15.86	OK
4.00	6.00	330.21	0.41	2.45	21.35	18.61	OK
5.00	0.00	330.34	0.00	4.90	24.67	18.07	OK
6.00	6.00	330.21	0.41	2.45	24.65	18.89	OK
7.00	0.00	543.43	0.00	18.75	16.20	12.78	OK
8.00	0.00	542.87	0.00	13.85	18.69	13.11	OK
9.00	0.00	542.15	0.00	13.85	22.63	14.21	OK
10.00	6.00	297.89	0.44	2.65	16.95	14.29	OK
11.00	0.00	541.85	0.00	11.20	19.00	14.90	OK
12.00	0.00	541.43	0.00	11.20	22.36	15.06	OK
13.00	0.00	541.12	0.00	7.52	22.67	16.18	OK
14.00	0.00	540.82	0.00	5.36	23.54	16.54	OK
15.00	6.00	479.73	0.31	1.84	26.00	16.82	OK
16.00	6.00	479.73	0.31	1.84	26.00	16.67	OK
17.00	6.00	539.82	0.28	1.68	23.29	17.95	OK

OK MEANS WATER ELEVATION IS LOWER THAN GROUND ELEVATION

*** SUMMARY OF SEWER HYDRAULICS

NOTE: THE GIVEN FLOW DEPTH-TO-SEWER SIZE RATIO= .8

SEWER ID NUMBER	MAMHOLE NUMBER UPSTREAM ID NO.	DNSTREAM ID NO.	SEWER SHAPE	REQUIRED DIA(HIGH) (IN) (FT)	SUGGESTED DIA(HIGH) (IN) (FT)	EXISTING DIA(HIGH) (IN) (FT)	WIDTH (FT)
21.00	2.00	1.00	ROUND	37.62	42.00	36.00	0.00
32.00	3.00	2.00	ROUND	12.06	18.00	18.00	0.00
43.00	4.00	3.00	ROUND	9.45	18.00	18.00	0.00
53.00	5.00	3.00	ROUND	12.21	18.00	18.00	0.00
65.00	6.00	5.00	ROUND	9.42	18.00	18.00	0.00
72.00	7.00	2.00	ROUND	26.19	27.00	36.00	0.00
87.00	8.00	7.00	ROUND	22.26	24.00	30.00	0.00
98.00	9.00	8.00	ROUND	23.38	24.00	30.00	0.00
109.00	10.00	9.00	ROUND	12.58	18.00	24.00	0.00

119.00	11.00	9.00	ROUND	21.59	24.00	24.00	0.00
1211.00	12.00	11.00	ROUND	21.59	24.00	24.00	0.00
1312.00	13.00	12.00	ROUND	18.60	21.00	24.00	0.00
1413.00	14.00	13.00	ROUND	16.38	18.00	24.00	0.00
1514.00	15.00	14.00	ROUND	10.97	18.00	15.00	0.00
1614.00	16.00	14.00	ROUND	10.97	18.00	18.00	0.00
1714.00	17.00	14.00	ROUND	9.78	18.00	24.00	0.00

DIMENSION UNITS FOR ROUND AND ARCH SEWER ARE IN INCHES
DIMENSION UNITS FOR BOX SEWER ARE IN FEET
REQUIRED DIAMETER WAS DETERMINED BY SEWER HYDRAULIC CAPACITY.
SUGGESTED DIAMETER WAS DETERMINED BY COMMERCIALLY AVAILABLE SIZE.
FOR A NEW SEWER, FLOW WAS ANALYZED BY THE SUGGESTED SEWER SIZE; OTHERWISE, EXISITNG SIZE WAS USED

SEWER ID NUMBER	DESIGN FLOW Q CFS	FLOW FULL Q CFS	NORMAL DEPTH FEET	NORAML VLCITY FPS	CRITIC DEPTH FEET	CRITIC VLCITY FPS	FULL VLCITY FPS	FROUDE NO.	COMMENT
21.0	49.2	43.9	3.00	6.96	2.29	4.52	6.96	0.00	V-OK
32.0	7.3	21.4	0.61	10.99	1.06	36.80	4.16	2.87	V-OK
43.0	2.5	13.7	0.43	5.86	0.61	10.86	1.39	1.86	V-OK
53.0	4.9	13.8	0.62	7.15	0.85	2.37	2.77	1.85	V-OK
65.0	2.5	13.8	0.43	5.90	0.61	7.24	1.39	1.88	V-OK
72.0	18.8	43.9	1.37	5.97	1.39	0.76	2.65	1.03	V-OK
87.0	13.9	30.8	1.18	6.10	1.28	7.43	2.82	1.13	V-OK
98.0	13.9	27.0	1.27	5.54	1.28	5.49	2.82	0.98	V-OK
109.0	2.7	14.9	0.57	3.58	0.59	17.71	0.84	0.99	V-OK
119.0	11.2	14.9	1.29	5.21	1.20	1.35	3.57	0.87	V-OK
1211.0	11.2	14.9	1.29	5.21	1.20	5.71	3.57	0.87	V-OK
1312.0	7.5	14.9	1.01	4.75	1.00	7.11	2.39	0.94	V-OK
1413.0	5.4	14.9	0.83	4.35	0.84	6.05	1.71	0.97	V-OK
1514.0	1.8	4.3	0.57	3.34	0.55	10.41	1.50	0.89	V-OK
1614.0	1.8	6.9	0.53	3.31	0.53	3.32	1.04	0.94	V-OK
1714.0	1.7	18.5	0.41	3.66	0.49	3.06	0.53	1.21	V-OK

FROUDE NUMBER=0 INDICATES THAT A PRESSURED FLOW OCCURS

SEWER ID NUMBER	SLOPE %	INVERT ELEVATION UPSTREAM (FT)	INVERT ELEVATION DNSTREAM (FT)	BURIED DEPTH UPSTREAM (FT)	BURIED DEPTH DNSTREAM (FT)	COMMENTS
21.00	0.50	8.60	8.40	5.70	2.00	OK
32.00	4.80	14.80	8.80	5.20	7.00	OK
43.00	1.96	18.00	15.02	1.85	4.98	OK
53.00	2.00	17.22	15.00	5.95	5.00	OK
65.00	2.00	18.28	17.42	4.87	5.75	OK
72.00	0.50	9.88	8.81	3.32	5.49	OK
87.00	0.65	11.42	10.09	4.77	3.61	OK
98.00	0.50	12.82	11.62	7.31	4.57	OK
109.00	0.50	13.45	12.99	1.50	7.63	OK
119.00	0.50	13.48	13.02	3.52	7.61	OK
1211.00	0.50	14.34	13.68	6.02	3.32	OK
1312.00	0.50	14.98	14.54	5.69	5.82	OK
1413.00	0.50	15.57	15.18	5.97	5.49	OK

1514.00	0.50	16.20	15.77	8.55	6.52	OK
1614.00	0.50	16.10	15.77	8.40	6.27	OK
1714.00	0.77	17.46	15.77	3.83	5.77	OK

OK MEANS BURIED DEPTH IS GREATER THAN REQUIRED SOIL COVER OF 1.5 FEET

*** SUMMARY OF HYDRAULIC GRADIENT LINE ALONG SEWERS

SEWER ID NUMBER	SEWER LENGTH FEET	SURCHARGED LENGTH FEET	CROWN ELEVATION UPSTREAM FEET	CROWN ELEVATION DNSTREAM FEET	WATER ELEVATION UPSTREAM FEET	WATER ELEVATION DNSTREAM FEET	FLOW CONDITION
21.00	40.00	0.00	11.60	11.40	11.23	9.95	PRSS'ED
32.00	125.00	45.17	16.30	10.30	15.86	11.23	JUMP
43.00	152.00	0.00	19.50	16.52	18.61	15.86	JUMP
53.00	111.00	0.00	18.72	16.50	18.07	15.86	JUMP
65.00	43.00	0.00	19.78	18.92	18.89	18.07	JUMP
72.00	215.00	164.53	12.88	11.81	12.78	11.23	JUMP
87.00	205.00	66.66	13.92	12.59	13.11	12.78	JUMP
98.00	240.00	0.00	15.32	14.12	14.21	13.11	SUBCR
109.00	91.00	0.00	15.45	14.99	14.29	14.21	SUBCR
119.00	92.00	0.00	15.48	15.02	14.90	14.21	SUBCR
1211.00	133.00	0.00	16.34	15.68	15.06	14.90	SUBCR
1312.00	87.00	0.00	16.98	16.54	16.18	15.06	SUBCR
1413.00	78.00	0.00	17.57	17.18	16.54	16.18	SUBCR
1514.00	86.00	0.00	17.45	17.02	16.82	16.54	SUBCR
1614.00	66.00	0.00	17.60	17.27	16.67	16.54	SUBCR
1714.00	220.00	0.00	19.46	17.77	17.95	16.54	JUMP

PRSS'ED=PRESSURED FLOW; JUMP=POSSIBLE HYDRAULIC JUMP; SUBCR=SUBCRITICAL FLOW

*** SUMMARY OF ENERGY GRADIENT LINE ALONG SEWERS

SEWER ID NO	UPST MANHOLE ID NO.	MANHOLE ENERGY ELEV FT	SEWER FRCTION FT	BEND K COEF	JUNCTURE LOSSES BEND LOSS FT	LATERAL K COEF	LATERAL LOSS FT	DOWNST MANHOLE ID	MANHOLE ENERGY FT
21.0	2.00	11.98	1.95	0.05	0.04	0.05	0.05	1.00	9.95
32.0	3.00	16.13	3.39	0.05	0.01	0.05	0.74	2.00	11.98
43.0	4.00	18.64	2.21	1.25	0.04	0.05	0.27	3.00	16.13
53.0	5.00	18.19	1.65	1.25	0.15	0.05	0.26	3.00	16.13
65.0	6.00	18.92	0.58	1.25	0.04	0.05	0.12	5.00	18.19
72.0	7.00	12.89	0.15	0.05	0.01	0.05	0.75	2.00	11.98
87.0	8.00	13.23	0.09	1.25	0.15	0.05	0.10	7.00	12.89
98.0	9.00	14.34	0.98	0.05	0.01	0.05	0.12	8.00	13.23
109.0	10.00	14.30	0.00	0.05	0.00	0.05	0.12	9.00	14.34
119.0	11.00	15.10	0.64	0.05	0.01	0.05	0.11	9.00	14.34
1211.0	12.00	15.26	0.00	0.05	0.01	0.05	0.19	11.00	15.10
1312.0	13.00	16.27	0.82	0.05	0.00	0.05	0.19	12.00	15.26
1413.0	14.00	16.59	0.18	1.25	0.06	0.05	0.09	13.00	16.27

1514.0	15.00	16.85	0.22	0.05	0.00	0.05	0.04	14.00	16.59
1614.0	16.00	16.69	0.06	0.05	0.00	0.05	0.04	14.00	16.59
1714.0	17.00	17.96	1.32	1.25	0.01	0.05	0.04	14.00	16.59

BEND LOSS =BEND K* FLOWING FULL VHEAD IN SEWER.
LATERAL LOSS= OUTFLOW FULL VHEAD-JCT LOSS K*INFLOW FULL VHEAD
FRICTION LOSS=0 MEANS IT IS NEGLIGIBLE OR POSSIBLE ERROR DUE TO JUMP.
FRICTION LOSS INCLUDES SEWER INVERT DROP AT MANHOLE
NOTICE: VHEAD DENOTES THE VELOCITY HEAD OF FULL FLOW CONDITION.
A MINIMUM JUCTION LOSS OF 0.05 FT WOULD BE INTRODUCED UNLESS LATERAL K
FRICTION LOSS WAS ESTIMATED BY BACKWATER CURVE COMPUTATIONS.

*** SUMMARY OF EARTH EXCAVATION VOLUME FOR COST ESTIMATE.

THE TRENCH SIDE SLOPE = 1

MANHOLE ID NUMBER	GROUND ELEVATION FT	INVERT ELEVATION FT	MANHOLE HEIGHT FT
1.00	13.40	8.40	5.00
2.00	17.30	8.60	8.70
3.00	21.50	14.80	6.70
4.00	21.35	18.00	3.35
5.00	24.67	17.22	7.45
6.00	24.65	18.28	6.37
7.00	16.20	9.88	6.32
8.00	18.69	11.42	7.27
9.00	22.63	12.82	9.81
10.00	16.95	13.45	3.50
11.00	19.00	13.48	5.52
12.00	22.36	14.34	8.02
13.00	22.67	14.98	7.69
14.00	23.54	15.57	7.97
15.00	26.00	16.20	9.80
16.00	26.00	16.10	9.90
17.00	23.29	17.46	5.83

SEWER ID NUMBER	UPST TRENCH WIDTH ON GROUND FT	UPST TRENCH WIDTH AT INVERT FT	DNST TRENCH WIDTH ON GROUND FT	DNST TRENCH WIDTH AT INVERT FT	TRENCH LENGTH FT	WALL THICKNESS INCHES	EARTH VOLUME CUBIC YD
21.00	15.73	5.67	8.33	5.67	40.00	4.00	86.0
32.00	13.48	3.92	17.08	3.92	125.00	2.50	309.2
43.00	6.78	3.92	13.04	3.92	152.00	2.50	194.8
53.00	14.98	3.92	13.08	3.92	111.00	2.50	234.5
65.00	12.82	3.92	14.58	3.92	43.00	2.50	87.2
72.00	10.97	5.67	15.32	5.67	215.00	4.00	500.2
87.00	13.46	5.08	11.14	5.08	205.00	3.50	398.2
98.00	18.54	5.08	13.06	5.08	240.00	3.50	698.3
109.00	6.50	4.50	18.77	4.50	91.00	3.00	202.2
119.00	10.54	4.50	18.72	4.50	92.00	3.00	233.0
1211.00	15.54	4.50	10.15	4.50	133.00	3.00	264.8
1312.00	14.88	4.50	15.13	4.50	87.00	3.00	215.8
1413.00	15.44	4.50	14.48	4.50	78.00	3.00	192.7

1514.00	19.97	3.63	15.92	3.63	86.00	2.25	279.6
1614.00	19.88	3.92	15.62	3.92	66.00	2.50	213.9
1714.00	11.16	4.50	15.05	4.50	220.00	3.00	444.6

TOTAL EARTH VOLUME FOR SEWER TRENCHES = 4555.006 CUBIC YARDS
SEWER FLOW LINE IS DETERMINED BY THE USER

EARTH VOLUME WAS ESTIMATED TO HAVE
BOTTOM WIDTH=DIAMETER OR WIDTH OF SEWER + 2 * B
B=ONE FEET WHEN DIAMETER OR WIDTH <=48 INCHES
B=TWO FEET WHEN DIAMETER OR WIDTH >48 INCHES
IF BOTTOM WIDTH <MINIMUM WIDTH, 2 FT, THE MINIMUM WIDTH WAS USED.
BACKFILL DEPTH UNDER SEWER WAS ASSUMED TO BE ONE FOOT
SEWER WALL THICKNESS=EQIVLNT DIAMATER IN INCH/12 +1 IN INCHES

CIRCULAR CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

December 21, 1994

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second)	26.1
Channel Bottom Slope (feet per foot)	0.0050
Manning's Roughness Coefficient (n-value)	0.0130
Channel Diameter (feet)	3.00

PROGRAM RESULTS:

DESCRIPTION	VALUE
Normal Depth (feet)	1.55
Flow Velocity (feet per second)	7.10
Froude Number (Flow is Super-Critical)	1.131
Velocity Head (feet)	0.78
Energy Head (feet)	2.33
Cross-Sectional Area of Flow (square feet)	3.67
Top Width of Flow (feet)	3.00

==

REPORT OF STORM SEWER SYSTEM DESIGN

USING UDSEWER-MODEL July-2-1993
DEVELOPED
BY
JAMES C.Y. GUO ,PHD, PE
DEPARTMENT OF CIVIL ENGINEERING, UNIVERSITY OF COLORADO AT DENVER
IN COOPERATION WITH
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
DENVER, COLORADO

==

*** EXECUTED BY Martin-Martin...
ON DATA 12-21-1994 AT TIME 09:41:32

*** PROJECT TITLE :

MAJESTIC TANDY STORM LINE B

*** RETURN PERIOD OF FLOOD IS 100 YEARS

RAINFALL INTENSITY FORMULA IS GIVEN

*** SUMMARY OF SUBBASIN RUNOFF PREDICTIONS

		TIME OF CONCENTRATION				
MANHOLE ID NUMBER	BASIN AREA * C	OVERLAND To (MIN)	GUTTER Tf (MIN)	BASIN Tc (MIN)	RAIN I INCH/HR	PEAK FLOW CFS
1.00	6.00	0.00	0.00	0.00	4.75	28.49
2.00	6.00	0.00	0.00	0.00	4.75	28.49
3.00	6.00	0.00	0.00	0.00	4.75	28.49
4.00	6.00	0.00	0.00	136.93	0.79	4.74
5.00	6.00	0.00	0.00	0.00	4.75	28.49
6.00	6.00	0.00	0.00	136.93	0.79	4.74
7.00	6.00	0.00	0.00	0.00	4.75	28.49
8.00	6.00	0.00	0.00	0.00	4.75	28.49
9.00	6.00	0.00	0.00	0.00	4.75	28.49
10.00	6.00	0.00	0.00	109.39	0.93	5.58
11.00	6.00	0.00	0.00	0.00	4.75	28.49
12.00	6.00	0.00	0.00	0.00	4.75	28.49
13.00	6.00	0.00	0.00	0.00	4.75	28.49
14.00	6.00	0.00	0.00	0.00	4.75	28.49
15.00	6.00	0.00	0.00	201.49	0.59	3.56
16.00	6.00	0.00	0.00	202.25	0.59	3.55

17.00	6.00	0.00	0.00	371.30	0.37	2.24

THE SHORTEST DESIGN RAINFALL DURATION IS FIVE MINUTES

FOR RURAL AREA, BASIN TIME OF CONCENTRATION =>10 MINUTES
FOR URBAN AREA, BASIN TIME OF CONCENTRATION =>5 MINUTES
AT THE 1ST DESIGN POINT, TC <=(10+TOTAL LENGTH/180) IN MINUTES
WHEN WEIGHTED RUNOFF COEFF=> .2 , THE BASIN IS CONSIDERED TO BE URBANIZED
WHEN TO+TF<>TC, IT INDICATES THE ABOVE DESIGN CRITERIA SUPERCEDES COMPUTATIONS

*** SUMMARY OF HYDRAULICS AT MANHOLES

MANHOLE ID NUMBER	CNTRBTING AREA * C	RAINFALL DURATION MINUTES	RAINFALL INTENSITY INCH/HR	DESIGN PEAK FLOW CFS	GROUND ELEVATION FEET	WATER ELEVATION FEET	COMMENTS
1.00	0.00	0.00	0.00	49.23	13.40	11.00	OK
2.00	0.00	375.02	0.00	49.23	17.30	11.15	OK
3.00	0.00	137.29	0.00	14.22	21.50	16.16	OK
4.00	6.00	136.93	0.79	4.74	21.35	18.84	OK
5.00	0.00	137.03	0.00	9.48	24.67	19.09	OK
6.00	6.00	136.93	0.79	4.74	24.65	20.11	OK
7.00	0.00	374.50	0.00	35.01	16.20	13.58	OK
8.00	0.00	374.01	0.00	24.93	18.69	15.30	OK
9.00	0.00	373.37	0.00	24.93	22.63	16.72	OK
10.00	6.00	109.39	0.93	5.58	16.95	17.45	NO
11.00	0.00	373.12	0.00	19.35	19.00	17.71	OK
12.00	0.00	372.76	0.00	19.35	22.36	19.42	OK
13.00	0.00	372.48	0.00	16.46	22.67	20.70	OK
14.00	0.00	372.22	0.00	9.35	23.54	21.74	OK
15.00	6.00	201.49	0.59	3.56	26.00	22.18	OK
16.00	6.00	202.25	0.59	3.55	26.00	22.04	OK
17.00	6.00	371.30	0.37	2.24	23.29	22.04	OK

OK MEANS WATER ELEVATION IS LOWER THAN GROUND ELEVATION

*** SUMMARY OF SEWER HYDRAULICS

NOTE: THE GIVEN FLOW DEPTH-TO-SEWER SIZE RATIO= .8

SEWER ID NUMBER	MAMHOLE NUMBER UPSTREAM ID NO.	DNSTREAM ID NO.	SEWER SHAPE	REQUIRED DIA(HIGH) (IN) (FT)	SUGGESTED DIA(HIGH) (IN) (FT)	EXISTING DIA(HIGH) (IN) (FT)	WIDTH (FT)
21.00	2.00	1.00	ROUND	37.62	42.00	36.00	0.00
32.00	3.00	2.00	ROUND	15.45	18.00	18.00	0.00
43.00	4.00	3.00	ROUND	12.11	18.00	18.00	0.00
53.00	5.00	3.00	ROUND	15.64	18.00	18.00	0.00
65.00	6.00	5.00	ROUND	12.06	18.00	18.00	0.00
72.00	7.00	2.00	ROUND	33.11	36.00	36.00	0.00
87.00	8.00	7.00	ROUND	27.75	30.00	30.00	0.00
98.00	9.00	8.00	ROUND	29.15	30.00	30.00	0.00
109.00	10.00	9.00	ROUND	16.63	18.00	24.00	0.00

119.00	11.00	9.00	ROUND	26.51	27.00	24.00	0.00
1211.00	12.00	11.00	ROUND	26.51	27.00	24.00	0.00
1312.00	13.00	12.00	ROUND	24.95	27.00	24.00	0.00
1413.00	14.00	13.00	ROUND	20.18	21.00	24.00	0.00
1514.00	15.00	14.00	ROUND	14.05	18.00	15.00	0.00
1614.00	16.00	14.00	ROUND	14.03	18.00	18.00	0.00
1714.00	17.00	14.00	ROUND	10.89	18.00	24.00	0.00

DIMENSION UNITS FOR ROUND AND ARCH SEWER ARE IN INCHES
DIMENSION UNITS FOR BOX SEWER ARE IN FEET
REQUIRED DIAMETER WAS DETERMINED BY SEWER HYDRAULIC CAPACITY.
SUGGESTED DIAMETER WAS DETERMINED BY COMMERCIALLY AVAILABLE SIZE.
FOR A NEW SEWER, FLOW WAS ANALYZED BY THE SUGGESTED SEWER SIZE; OTHERWISE,
EXISITNG SIZE WAS USED

SEWER ID NUMBER	DESIGN FLOW Q CFS	FLOW FULL Q CFS	NORMAL DEPTH FEET	NORAML VLCITY FPS	CRITIC DEPTH FEET	CRITIC VLCITY FPS	FULL VLCITY FPS	FROUDE NO.	COMMENT
21.0	49.2	43.9	3.00	6.96	2.29	8.52	6.96	0.00	V-OK
32.0	14.2	21.4	0.89	12.97	1.36	29.16	8.05	2.65	V-OK
43.0	4.7	13.7	0.61	7.04	0.84	14.01	2.68	1.84	V-OK
53.0	9.5	13.8	0.91	8.43	1.19	3.16	5.36	1.70	V-OK
65.0	4.7	13.8	0.61	7.09	0.84	9.34	2.68	1.85	V-OK
72.0	35.0	43.9	2.02	6.90	1.92	0.99	4.95	0.90	V-OK
87.0	24.9	30.8	1.71	6.98	1.70	9.86	5.08	0.99	V-OK
98.0	24.9	27.0	1.90	6.24	1.70	7.02	5.08	0.81	V-OK
109.0	5.6	14.9	0.85	4.40	0.85	19.63	1.78	0.97	V-OK
119.0	19.4	14.9	2.00	6.16	1.58	2.10	6.16	0.00	V-OK
1211.0	19.4	14.9	2.00	6.16	1.58	7.27	6.16	0.00	V-OK
1312.0	16.5	14.9	2.00	5.24	1.46	7.86	5.24	0.00	V-OK
1413.0	9.4	14.9	1.15	5.01	1.10	9.33	2.98	0.91	V-OK
1514.0	3.6	4.3	0.87	3.88	0.76	11.99	2.90	0.76	V-OK
1614.0	3.6	6.9	0.76	3.94	0.74	4.08	2.01	0.90	V-OK
1714.0	2.2	18.5	0.47	3.98	0.56	4.90	0.71	1.22	V-OK

FROUDE NUMBER=0 INDICATES THAT A PRESSURED FLOW OCCURS

SEWER ID NUMBER	SLOPE %	INVERT ELEVATION UPSTREAM (FT)	INVERT ELEVATION DNSTREAM (FT)	BURIED DEPTH UPSTREAM (FT)	BURIED DEPTH DNSTREAM (FT)	COMMENTS
21.00	0.50	8.60	8.40	5.70	2.00	OK
32.00	4.80	14.80	8.80	5.20	7.00	OK
43.00	1.96	18.00	15.02	1.85	4.98	OK
53.00	2.00	17.22	15.00	5.95	5.00	OK
65.00	2.00	18.28	17.42	4.87	5.75	OK
72.00	0.50	9.88	8.81	3.32	5.49	OK
87.00	0.65	11.42	10.09	4.77	3.61	OK
98.00	0.50	12.82	11.62	7.31	4.57	OK
109.00	0.50	13.45	12.99	1.50	7.63	OK
119.00	0.50	13.48	13.02	3.52	7.61	OK
1211.00	0.50	14.34	13.68	6.02	3.32	OK
1312.00	0.50	14.98	14.54	5.69	5.82	OK
1413.00	0.50	15.57	15.18	5.97	5.49	OK

1514.00	0.50	16.20	15.77	8.55	6.52	OK
1614.00	0.50	16.10	15.77	8.40	6.27	OK
1714.00	0.77	17.46	15.77	3.83	5.77	OK

OK MEANS BURIED DEPTH IS GREATER THAN REQUIRED SOIL COVER OF 1.5 FEET

*** SUMMARY OF HYDRAULIC GRADIENT LINE ALONG SEWERS

SEWER ID NUMBER	SEWER LENGTH FEET	SURCHARGED LENGTH FEET	CROWN ELEVATION UPSTREAM FEET	CROWN ELEVATION DNSTREAM FEET	WATER ELEVATION UPSTREAM FEET	WATER ELEVATION DNSTREAM FEET	FLOW CONDITION
21.00	40.00	0.00	11.60	11.40	11.15	11.00	PRSS'ED
32.00	125.00	28.15	16.30	10.30	16.16	11.15	JUMP
43.00	152.00	85.59	19.50	16.52	18.84	16.16	JUMP
53.00	111.00	88.26	18.72	16.50	19.09	16.16	JUMP
65.00	43.00	43.00	19.78	18.92	20.11	19.09	PRSS'ED
72.00	215.00	94.11	12.88	11.81	13.58	11.15	SUBCR
87.00	205.00	205.00	13.92	12.59	15.30	13.58	PRSS'ED
98.00	240.00	240.00	15.32	14.12	16.72	15.30	PRSS'ED
109.00	91.00	91.00	15.45	14.99	17.54	16.72	PRSS'ED
119.00	92.00	92.00	15.48	15.02	17.71	16.72	PRSS'ED
1211.00	133.00	133.00	16.34	15.68	19.42	17.71	PRSS'ED
1312.00	87.00	87.00	16.98	16.54	20.70	19.42	PRSS'ED
1413.00	78.00	78.00	17.57	17.18	21.74	20.70	PRSS'ED
1514.00	86.00	86.00	17.45	17.02	22.18	21.74	PRSS'ED
1614.00	66.00	66.00	17.60	17.27	22.04	21.74	PRSS'ED
1714.00	220.00	220.00	19.46	17.77	22.04	21.74	PRSS'ED

PRSS'ED=PRESSURED FLOW; JUMP=POSSIBLE HYDRAULIC JUMP; SUBCR=SUBCRITICAL FLOW

*** SUMMARY OF ENERGY GRADIENT LINE ALONG SEWERS

SEWER ID NO	UPST MANHOLE ID NO.	MANHOLE ENERGY ELEV FT	SEWER FRCTION FT	BEND K COEF	JUNCTURE LOSSES BEND LOSS FT	LATERAL K COEF	LATERAL LOSS FT	DOWNST MANHOLE ID	MANHOLE ENERGY FT
21.0	2.00	11.90	0.82	0.05	0.04	0.05	0.05	1.00	11.00
32.0	3.00	17.17	4.51	0.05	0.05	0.05	0.70	2.00	11.90
43.0	4.00	18.95	0.64	1.25	0.14	0.05	1.00	3.00	17.17
53.0	5.00	19.54	0.83	1.25	0.56	0.05	0.98	3.00	17.17
65.0	6.00	20.22	0.10	1.25	0.14	0.05	0.44	5.00	19.54
72.0	7.00	13.97	1.31	0.05	0.02	0.05	0.73	2.00	11.90
87.0	8.00	15.70	0.87	1.25	0.50	0.05	0.36	7.00	13.97
98.0	9.00	17.12	1.02	0.05	0.02	0.05	0.38	8.00	15.70
109.0	10.00	17.59	0.06	0.05	0.00	0.05	0.40	9.00	17.12
119.0	11.00	18.30	0.78	0.05	0.03	0.05	0.37	9.00	17.12
1211.0	12.00	20.01	1.12	0.05	0.03	0.05	0.56	11.00	18.30
1312.0	13.00	21.13	0.53	0.05	0.02	0.05	0.57	12.00	20.01
1413.0	14.00	21.88	0.15	1.25	0.17	0.05	0.42	13.00	21.13

1514.0	15.00	22.31	0.30	0.05	0.01	0.05	0.13	14.00	21.88
1614.0	16.00	22.10	0.09	0.05	0.00	0.05	0.13	14.00	21.88
1714.0	17.00	22.05	0.02	1.25	0.01	0.05	0.14	14.00	21.88

BEND LOSS =BEND K* FLOWING FULL VHEAD IN SEWER.
LATERAL LOSS= OUTFLOW FULL VHEAD-JCT LOSS K*INFLOW FULL VHEAD
FRICTION LOSS=0 MEANS IT IS NEGLIGIBLE OR POSSIBLE ERROR DUE TO JUMP.
FRICTION LOSS INCLUDES SEWER INVERT DROP AT MANHOLE
NOTICE: VHEAD DENOTES THE VELOCITY HEAD OF FULL FLOW CONDITION.
A MINIMUM JUCTION LOSS OF 0.05 FT WOULD BE INTRODUCED UNLESS LATERAL K
FRICTION LOSS WAS ESTIMATED BY BACKWATER CURVE COMPUTATIONS.

*** SUMMARY OF EARTH EXCAVATION VOLUME FOR COST ESTIMATE.

THE TRENCH SIDE SLOPE = 1

MANHOLE ID NUMBER	GROUND ELEVATION FT	INVERT ELEVATION FT	MANHOLE HEIGHT FT
1.00	13.40	8.40	5.00
2.00	17.30	8.60	8.70
3.00	21.50	14.80	6.70
4.00	21.35	18.00	3.35
5.00	24.67	17.22	7.45
6.00	24.65	18.28	6.37
7.00	16.20	9.88	6.32
8.00	18.69	11.42	7.27
9.00	22.63	12.82	9.81
10.00	16.95	13.45	3.50
11.00	19.00	13.48	5.52
12.00	22.36	14.34	8.02
13.00	22.67	14.98	7.69
14.00	23.54	15.57	7.97
15.00	26.00	16.20	9.80
16.00	26.00	16.10	9.90
17.00	23.29	17.46	5.83

SEWER ID NUMBER	UPST TRENCH WIDTH ON GROUND FT	AT INVERT FT	DNST TRENCH WIDTH ON GROUND FT	AT INVERT FT	TRENCH LENGTH FT	WALL THICKNESS INCHES	EARTH VOLUME CUBIC YD
21.00	15.73	5.67	8.33	5.67	40.00	4.00	86.0
32.00	13.48	3.92	17.08	3.92	125.00	2.50	309.2
43.00	6.78	3.92	13.04	3.92	152.00	2.50	194.8
53.00	14.98	3.92	13.08	3.92	111.00	2.50	234.5
65.00	12.82	3.92	14.58	3.92	43.00	2.50	87.2
72.00	10.97	5.67	15.32	5.67	215.00	4.00	500.2
87.00	13.46	5.08	11.14	5.08	205.00	3.50	398.2
98.00	18.54	5.08	13.06	5.08	240.00	3.50	698.3
109.00	6.50	4.50	18.77	4.50	91.00	3.00	202.2
119.00	10.54	4.50	18.72	4.50	92.00	3.00	233.0
1211.00	15.54	4.50	10.15	4.50	133.00	3.00	264.8
1312.00	14.88	4.50	15.13	4.50	87.00	3.00	215.8
1413.00	15.44	4.50	14.48	4.50	78.00	3.00	192.7

1514.00	19.97	3.63	15.92	3.63	86.00	2.25	279.6
1614.00	19.88	3.92	15.62	3.92	66.00	2.50	213.9
1714.00	11.16	4.50	15.05	4.50	220.00	3.00	444.6

TOTAL EARTH VOLUME FOR SEWER TRENCHES = 4555.006 CUBIC YARDS
SEWER FLOW LINE IS DETERMINED BY THE USER

EARTH VOLUME WAS ESTIMATED TO HAVE
BOTTOM WIDTH=DIAMETER OR WIDTH OF SEWER + 2 * B
B=ONE FEET WHEN DIAMETER OR WIDTH <=48 INCHES
B=TWO FEET WHEN DIAMETER OR WIDTH >48 INCHES
IF BOTTOM WIDTH <MINIMUM WIDTH, 2 FT, THE MINIMUM WIDTH WAS USED.
BACKFILL DEPTH UNDER SEWER WAS ASSUMED TO BE ONE FOOT
SEWER WALL THICKNESS=EQIVLNT DIAMATER IN INCH/12 +1 IN INCHES

CIRCULAR CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

December 21, 1994

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second)	49.2
Channel Bottom Slope (feet per foot)	0.0050
Manning`s Roughness Coefficient (n-value)	0.0130
Channel Diameter (feet)	3.00

PROGRAM RESULTS:

DESCRIPTION	VALUE
Normal Depth (feet)	2.60
Flow Velocity (feet per second)	7.57
Froude Number (Flow is Sub-Critical)	0.747
Velocity Head (feet)	0.89
Energy Head (feet)	3.49
Cross-Sectional Area of Flow (square feet)	6.51
Top Width of Flow (feet)	2.04

BASIN J NOT DETAINED, FLOWS OFFSITE (A = 0.28 AC)

$A_T = 16.81 - 0.28$

$A_T = 16.53$ AC

100 YEAR -

$V_{100} = K_{100} A_T$

$K_{100} = (1.78 I - 0.002 I^2 - 3.56)/100$

$I = 80\%$ IMPERVIOUS

$K_{100} = 0.126$

$A_T = 16.53$ AC

$V_{100} = (0.126)(16.53)$

$V_{100} = 2.08$ AC·FT (90605 CF)

10 YEAR -

$V_{10} = K_{10} A_T$

$K_{10} = (0.95 I - 1.90)/1000$

$I = 80\%$

$K_{10} = 0.074$

$A_T = 16.53$

$V_{10} = (0.074)(16.53)$

$V_{10} = 1.22$ AC·FT (53143 CF)

MARTIN/MARTIN
Consulting Engineers

Title MAJESTIC TRAIL Date [illegible] Job no.

Subject DETENTION VOLUME By D LOVATO Sheet 2 of 2

V_{100} = 90605 CF V_{10} = 53143 CF

ELEV (FT)	AREA (SF)	VOLUME (CF)	Σ VOLUME (CF)
6	0		
		3610	3610
7	7220		
		10040	13650
8	12860		
		16463	30113
9	20,066		
		21518	51631
10	22,970		
		24440	76071
11	25884		

10	51,631
10.1	54075
10.09	53831
10.07	53343
* 10.06	

10 YR POND ELEV

11	76071
11.6	92136
11.1	78749
11.2	81427
11.4	86783
11.5	89461
* 11.54	

100 YR POND ELEV

BASIN J NOT DETAINED

$Q_{10} = 1.43$ CFS

$Q_{100} = 2.34$ CFS

$A_T = 16.81$

=> FROM DOUGLAS COUNTY STORM DRAINAGE DESIGN AND TECHNICAL CRITERIA

$Q_{100R} = 1.0$ CFS/AC

$Q_{10R} = 0.30$ CFS/AC

100YR - $Q_R = (1.0)(16.81) - 2.34$

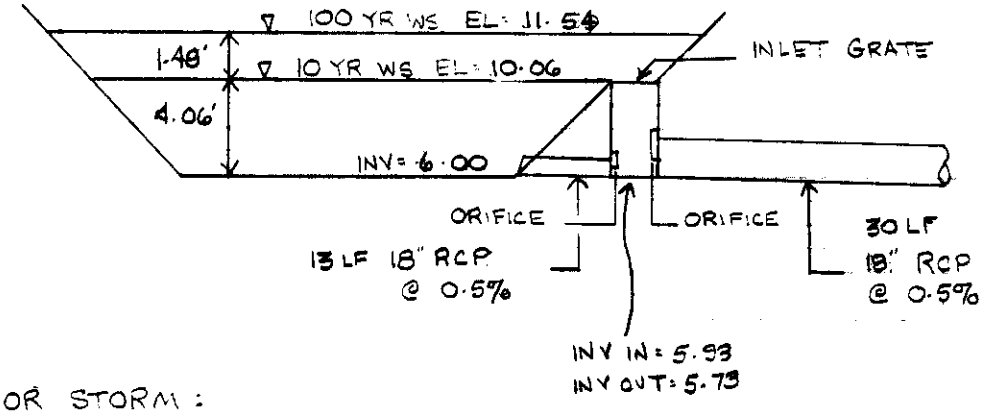
$Q_{100R} = 14.47$ CFS *

10 YR - $Q_R = (.30)(16.81) - 1.43$

$= 3.61$ CFS *

* NOTE

BASIN J DEVELOPED RUNOFF SUBTRACTED FROM RELEASE RATE FOR TOTAL AREA.



MINOR STORM:

$Q_{10R} = 3.61$ CFS

FLOW THROUGH 18 RCP

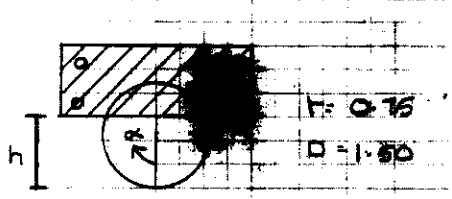
$A = 1.76$ SF
$C = 0.65$
$H = 3.38$

$Q = CA\sqrt{2gh}$

$= (0.65)(1.76)\sqrt{64.4(3.31)}$

$= 14.70 \text{ CFS} > 3.61 \text{ CFS}$

⇒ USE ORIFICE PLATE



h (FT)	α (RAD)	AREA (FT²)	H (FT)	Q (CFS)
1.50	3.14	1.77	3.31	16.77
1.25	2.30	1.57	3.31	14.93
0.5	1.23	0.52	3.38	4.95
0.4	1.08	0.38	3.77	3.83
0.3	0.92	0.25	3.77	2.55
0.39	1.07	0.37	3.77	3.70

$\alpha = \cos^{-1}\left[\frac{0.75 - h}{0.75}\right]$

$A = r^2(\alpha - \sin\alpha\cos\alpha)$

$H = 3.31 + 2/3\, r\left[\frac{\sin\alpha^3}{\alpha - \sin\alpha\cos\alpha}\right]$

h = 0.39

MAJOR STORM

Q_{100R} = 14.47 CFS

FLOW IN 18" (MINOR STORM)

A = 0.37
H = 3.77 + 1.48 = 5.25'

$Q = CA\sqrt{2gh}$

Q = 4.42 CFS GRATE NEEDS TO BE SIZED FOR A FLOW Q = 14.47 − 4.42

Q = 10.05 (SEE SHT 4 OF 6

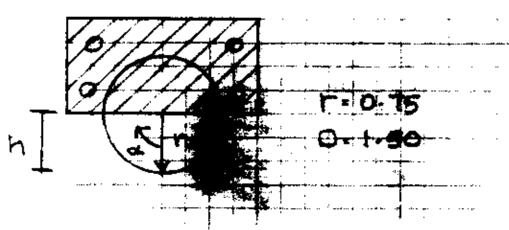
FLOW THROUGH 18" (MAJOR STORM)

A = 1.77 SF
C = 0.65
H = 5.06

$Q = CA\sqrt{2gh}$
$= (0.65)(1.77)\sqrt{64.4\,(5.06)}$

Q = 20.77 CFS > 14.47 CFS

⇒ USE ORIFICE PLATE



h (FT)	α (RAD)	AREA (FT²)	H (FT)	Q (CFS)
1.50	3.14	1.77	5.06	20.77
1.00	1.91	1.25	5.24	14.78
0.99	1.89	1.23	5.25	14.70
0.96	1.85	1.18	5.27	14.13
0.97	1.86	1.20	5.26	14.35 *

$\alpha = \cos^{-1}\left[\frac{0.75 - h}{0.75}\right]$

$A = r^2(\alpha - \sin\alpha\cos\alpha)$

USE h = 0.97'

$H = 5.06 + 2/3\, r \left[\frac{\sin\alpha^3}{\alpha - \sin\alpha\cos\alpha}\right]$

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Consulting Engineers

Title | Date | Job no.
Subject OUTLET STRUCTURE | By | Sheet 4 of 5

SIZE INLET GRATE

Q = 10.05 CFS
H = 1.48
C = 0.65

$$A = \frac{Q}{C\sqrt{2gh}}$$

AREA NEEDED

A = 1.58 SF

TRY 2 x 2.5 W/ 1" BARS ON 3" CENTERS

AREA = 4 SF

OF BARS $\frac{30}{3}$ = 10

AREA OF BARS 1/12 x 2 x 10 = 1.67 SF

AREA OPEN = 4.0 - 1.67
= 2.33

FLOW THROUGH INLET

Q = 14.78 CFS > 10.05 OK

=> ORIFICE PLATE WILL CONTROL OUTLET FLOW.

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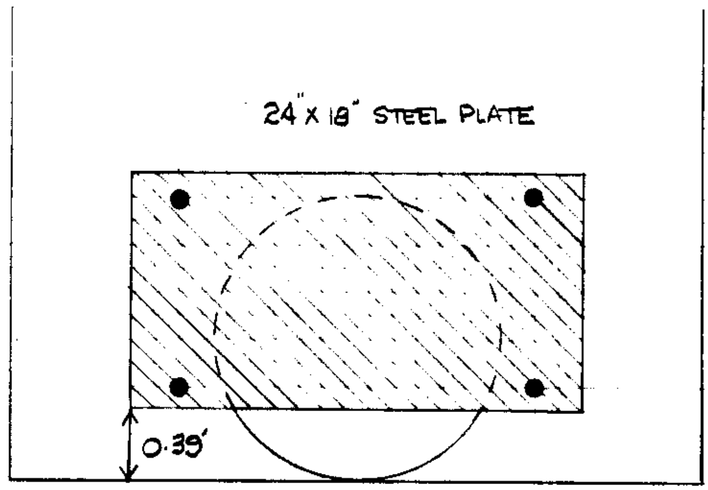
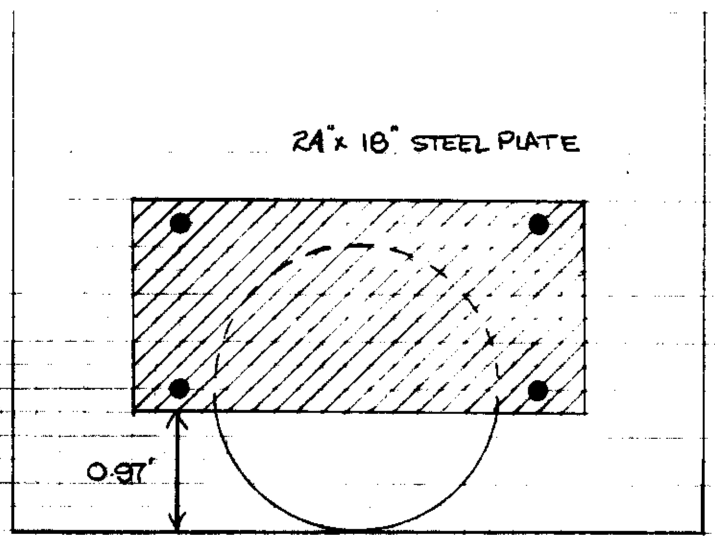
Consulting Engineers

Title MAJESTIC TANK Date 12-22-94 Job no.

Subject OUTLET STRUCTURE By D LOVATO Sheet 5 of 5



MINOR STORM CONTROL ORIFICE PLATE



MAJOR STORM CONTROL ORIFICE PLATE

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Consulting Engineers

Title MAJESTIC TANK Date 2-22-95 Job no.

Subject EMERGENCY [illegible] By D LOVATO Sheet 1 of 1

OVERFLOW WEIR CALC. (DETENTION POND)

$Q_O = 14.47$ CFS

1.0' FREE BOARD

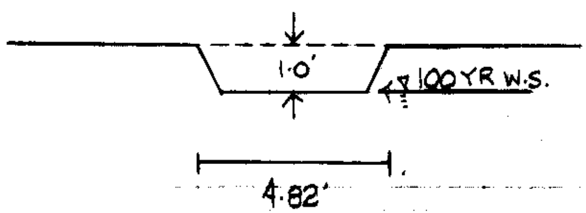
$Q = CLH^{3/2}$

$C = 3.0$

$L = \frac{Q}{CH^{3/2}} = \frac{14.47}{(3.00)(1.0)^{3/2}}$

$L = 4.82'$

LENGTH MUST NOT BE LESS THAN 4.82'



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Consulting Engineers

Title: MAJESTIC TANK   Date: 12-21-94   Job no.

Subject: RIPRAP DESIGN   By: D LOVATO   Sheet 1 of 3

SIZING INTO POND FROM STORM LINE A

$Q_D = 55.86$ CFS
$S_o = 0.63\%$
$n = .013$
$D = 36''$

DETERMINE CRITICAL DEPTH:

$$Z = \frac{Q}{\sqrt{g}} = \frac{55.86}{\sqrt{32.2}} = 9.84 \qquad \frac{Z}{D^{2.5}} = \frac{9.84}{3^{2.5}} = 0.63$$

FIG 2-3 $Y_c/d = 0.80$ $\quad Y_c = 0.80(3) = 2.4'$

DETERMINE NORMAL DEPTH:

$$AR^{2/3} = \frac{nQ}{1.49\sqrt{S}} = \frac{(.013)(55.86)}{1.49\sqrt{.0063}} = 6.14 \qquad \frac{AR^{2/3}}{D^{8/3}} = \frac{6.14}{18.72} = 0.32$$

FIG 2-2 $Y_n/d = 0.84$ $\quad Y_n = 0.84(3) = 2.52$

$Y_n > Y_c$ SUBCRITICAL

$D_a = 1/2(D + Y_n) = 2.76 \qquad \frac{Q}{D_a^{1.5}} = 12.18 \qquad$ ASSUME $Y_T/d = 0.40$

⇒ FIG 5-7 USE TYPE M $\phi = 12''$

DETERMINE LENGTH:

$$L = \left(\frac{1}{2\tan\theta}\right)\left(\frac{A_T}{Y_T} - W\right) \qquad \frac{Q}{D_a^{2.5}} = \frac{55.86}{2.76^{2.5}} = 4.41 \qquad \frac{Y_T}{H} = .40 \qquad \text{FIG 5-9} = \frac{1}{2\tan\phi} = 3.0$$

$A = 7.06 \quad Y_T = .40(3) = 1.20$

$$L = 3.0\left(\frac{7.07}{1.20} - 3\right) = 8.66$$

USE 9 LF TYPE M RIPRAP $\phi = 12''$

SIZING INTO POND FROM STORM LINE B

$Q_D = 49.23$ CFS
$S_0 = 0.50\%$
$n = .013$
$D = 36''$

DETERMINE CRITICAL DEPTH:

$Z = \frac{Q}{\sqrt{g}} = \frac{49.23}{\sqrt{32.2}} = 8.67 \qquad \frac{Z}{d_0^{2.5}} = \frac{8.67}{3^{2.5}} = 0.55$

FIG 2-3 $Y_c/d = 0.75 \qquad Y_c = 0.75(3) = 2.25'$

DETERMINE NORMAL DEPTH:

$AR^{2/3} = \frac{nQ}{1.49\sqrt{S}} = \frac{(.013)(49.23)}{1.49\sqrt{0.005}} = 6.07 \qquad \frac{AR^{2/3}}{D^{8/3}} = \frac{6.07}{18.72} = 0.32$

FIG 2-2 $Y_n/d = 0.84 \qquad Y_n = 0.84(3.0) = 2.52$

$Y_n > Y_c$ => SUBCRITICAL

$D_a = 1/2(D+Y_n) = 2.76 \qquad \frac{Q}{D_a^{1.5}} = 10.73$ ASSUME $Y_t/d = .40$

=> FIG 5-7 USE TYPE M RIPRAP $\phi = 12''$

DETERMINE LENGTH:

$L = \left(\frac{1}{2TAN\phi}\right)\left(\frac{A_T}{Y_T} - W\right) \qquad \frac{Q}{D_a^{2.5}} = \frac{49.23}{12.65} = 3.89 \qquad \frac{Y_T}{H} = 0.40$

FIG 5-9 $\frac{1}{2TAN\phi} = 3.90$

$A = 7.06 \qquad Y_T = 0.40(3) = 1.20$

$L = 3.90\left(\frac{7.06}{1.20} - 3\right) = 11.25$

<u>USE 12 LF TYPE M RIPRAP $\phi = 12''$</u>

SIZING OUT OF POND

$Q_D = 14.47$ CFS

$S_o = 0.5\%$

$n = .013$

$D = 18''$

DETERMINE CRITICAL DEPTH:

$Z = \frac{Q}{\sqrt{g}} = \frac{14.47}{\sqrt{32.2}} = 2.55 \qquad \frac{Z}{D^{2.5}} = \frac{2.55}{1.5^{2.5}} = 0.92$

FIG 2-3 $\quad Y_c/d = 0.94 \qquad Y_c = 0.94(1.5) = 1.41$

DETERMINE NORMAL DEPTH:

$AR^{2/3} = \frac{nQ}{1.49\sqrt{S}} = \frac{(.013)(14.47)}{1.49\sqrt{0.005}} = 1.78 \qquad \frac{AR^{2/3}}{D^{8/3}} = \frac{1.78}{1.5^{8/3}} = 0.60$

FIG 2-2 $\quad Y_n/d = 1.0 \qquad Y_n = 1.0(1.5) = 1.50$

$Y_n > Y_c$

$D_a = 1/2(D + Y_n) = 1.50 \qquad Q/D_a^{1.5} = 7.88$ $\quad$ ASSUME $Y_T/d = 0.40$

=> FIG 5-7 USE TYPE L $\phi = 9''$

DETERMINE LENGTH:

$L = \left(\frac{1}{2\tan\phi}\right)\left(\frac{A_T}{Y_T} - W\right) \qquad \frac{Q}{D_a^{2.5}} = 5.25 \qquad Y_T/H = 0.40$ $\quad$ FIG 5-9 $\frac{1}{2\tan\phi} = 2.20$

$A = 1.77 \qquad Y_T = 0.40(1.5) = 0.60$

$L = (2.20)\left(\frac{1.77}{.60} - 1.5\right) = 3.19$

USE 5 LF TYPE L RIPRAP $\phi = 9''$

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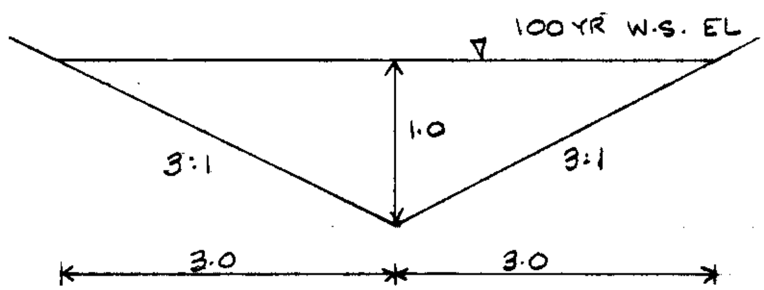
REV 2-22-95

Title: MAJES[illegible] TA[illegible] | Date: [illegible] | Job no.

Subject: SWALE DESIGN | By: D LOV[illegible] | Sheet 1 of 1

SWALE BELOW DETENTION POND
SECTION AA ON DRAINAGE PLAN

Q_D = 14.47
S_o = 4.31%
n = .035

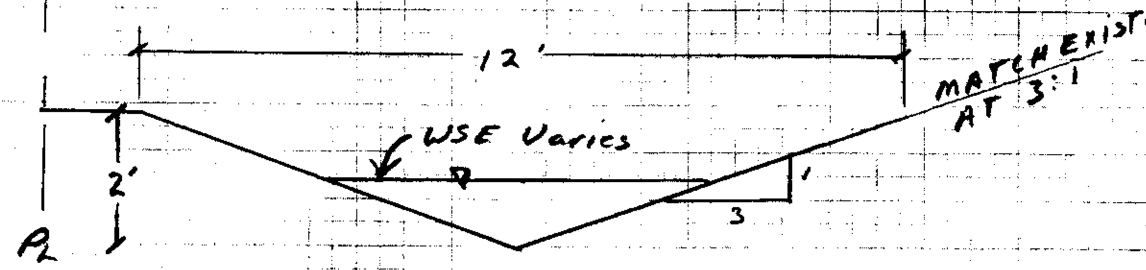


A = 3.0 SF
WP = 6.32

Q = 16.14 CFS > 14.47 CFS OK

* NOTE
SWALE WILL BE TEMPORARY
AND WILL FLOW DOWN TO
DETENTION POND FROM MASTER
DRAINAGE STUDY

Q req'd = 14.47 CFS
Length of swale = 908 LF
Change in Elevation = 38'
S_{Avg} = 4.19%



Channel Cross Section

S_{Avg} = 4.19%
$n = 0.035$
$V = 1.49/n \, R_h^{2/3} S^{1/2}$
$A = 2.80$
$W_p = 6.11$
$R_h = 0.458$
$V = 5.18$ FPS
$D = 0.97'$

S_{max} = 6.32%
$n = 0.035$
$A = 2.40$
$W_p = 5.66$
$R_h = 0.424$
$V = 6.04$ FPS
$D = 0.89$ FEET

S_{min} = 1.00%
$n = 0.035$
$A = 4.79$
$W_p = 7.97$
$R_h = 0.60$
$V = 3.02$ FPS
$D = 1.26$ FEET

Maximum Velocity = 6.0 FPS
Minimum Freeboard = 0.74'

TABLE 3-1 (42)

RECOMMENDED RUNOFF COEFFICIENTS AND PERCENT IMPERVIOUS

LAND USE OR SURFACE CHARACTERISTICS	PERCENT IMPERVIOUS	FREQUENCY 2	5	10	100
Business:					
Commercial Areas	95	.87	.87	.88	.89
Neighborhood Areas	70	.60	.65	.70	.80
Residential:					
Single-Family	*	.40	.45	.50	.60
Multi-Unit (detached)	50	.45	.50	.60	.70
Multi-Unit (attached)	70	.60	.65	.70	.80
1/2 Acre Lot or Larger	*	.30	.35	.40	.60
Apartments	70	.65	.70	.70	.80
Industrial:					
Light Areas	80	.71	.72	.76	.82
Heavy Acres	90	.80	.80	.85	.90
Parks, Cemetaries:	7	.10	.18	.25	.45
Playgrounds:	13	.15	.20	.30	.50
Schools:	50	.45	.50	.60	.70
Railroad Yard Areas	20	.20	.25	.35	.45
Undeveloped Areas:					
Historic Flow Analysis- Greenbelts, Agricultural	2	(See "Lawns")			
Offsite Flow Analysis (when land use not defined)	45	.43	.47	.55	.65
Streets:					
Paved	100	.87	.88	.90	.93
Gravel (Packed)	40	.40	.45	.50	.60
Drive and Walks:	96	.87	.87	.88	.89
Roofs:	90	.80	.85	.90	.90
Lawns, Sandy Soil	0	.00	.01	.05	.20
Lawns, Clayey Soil	0	.05	.15	.25	.50

NOTE: These Rational Formula coefficients may not be valid for large basins.

*See Figure 2-1 for percent impervious.

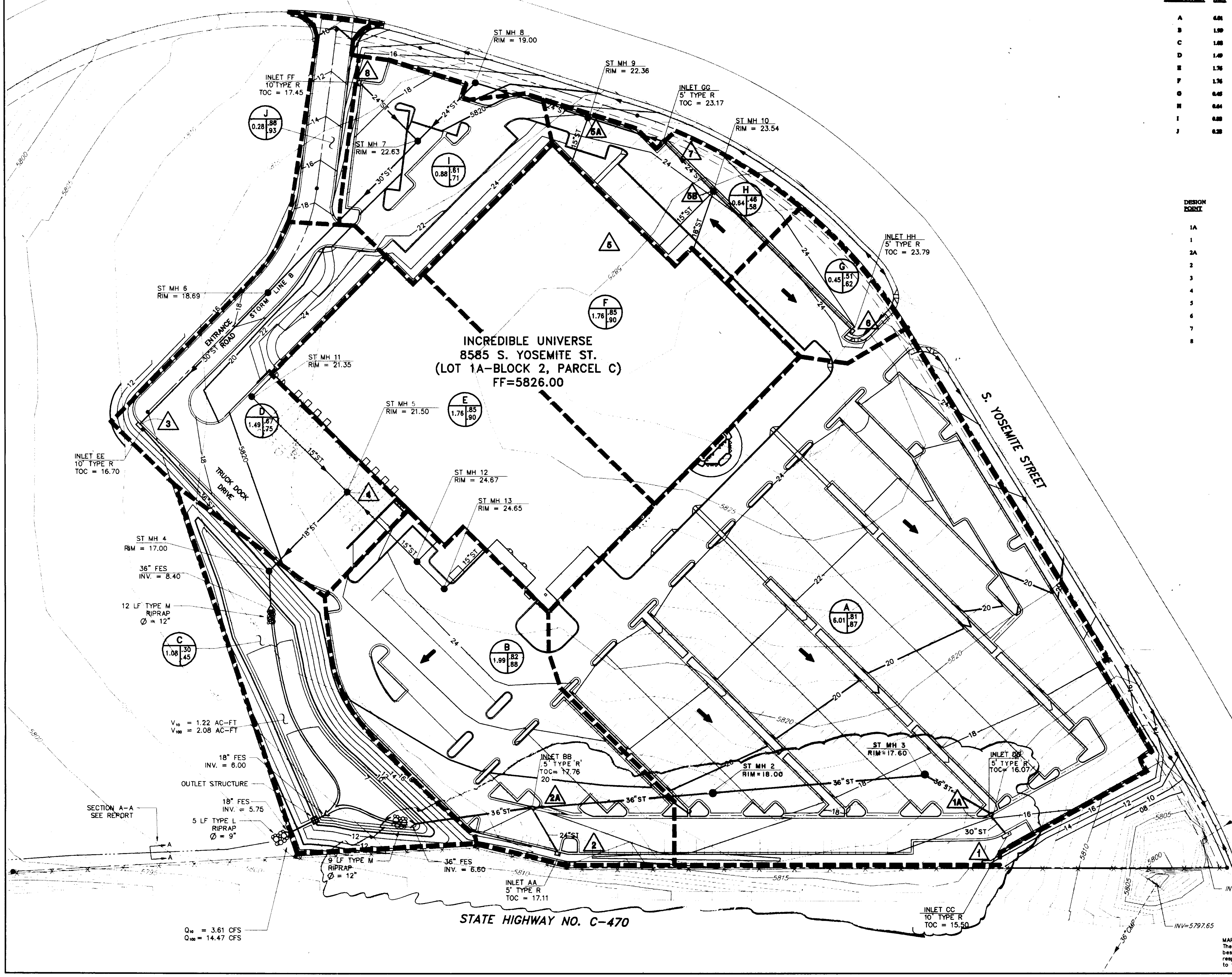


TABLE A

PROPOSED BASIN SUMMARY

BASIN DESIGNATION	AREA (AC)	C_5	C_{100}	Tc (MIN)	Q_5 (CFS)	Q_{100} (CFS)
A	6.01	.81	.87	7.27	21.58	40.10
B	1.99	.82	.88	5.00	8.60	15.76
C	1.08	.01	.30	7.38	0.48	1.75
D	1.49	.67	.75	5.00	4.90	10.08
E	1.76	.85	.90	5.00	7.35	14.22
F	1.76	.85	.90	5.00	7.35	14.22
G	0.45	.51	.62	7.75	1.68	2.34
H	0.64	.46	.58	7.50	2.16	2.89
I	0.88	.61	.71	5.00	2.65	3.58
J	0.28	.88	.93	5.00	1.23	2.34

TABLE B

DESIGN POINT SUMMARY

DESIGN POINT	CONTRIBUTING BASINS	AREA (AC)	Q_5 (CFS)	Q_{100} (CFS)
1A	A	6.01	2.50	2.50
1	A	6.01	19.42	37.60
2A	B	1.99	2.50	2.50
2	B	1.99	5.50	13.26
3	D	1.49	4.90	10.08
4	E	1.76	7.35	14.22
5	F	1.76	7.35	14.22
6	G	0.45	1.68	2.34
7	H	0.64	2.16	2.89
8	I	0.88	2.65	3.58

N

50 0 50 100
SCALE 1" = 50'

LEGEND

- PROP. CONTOUR — 5510
- EXIST. CONTOUR — 5500
- BASIN BOUNDARY
- SUB-BASIN BOUNDARY
- DIRECTION OF FLOW
- DESIGN POINT
- BASIN — B; AREA IN ACRES — 1.25; C5 CFS — .88; C100 CFS — .93

COUNTY ENGINEER

DATE

THESE CONSTRUCTION PLANS HAVE BEEN REVIEWED BY DOUGLAS COUNTY FOR STREET AND DRAINAGE IMPROVEMENTS ONLY.

ENGINEERING DIVISION ACCEPTANCE BLOCK

MARTIN/MARTIN assumes no responsibility for utility locations. The utilities shown on this drawing have been plotted from the best available information. It is, however, the contractors responsibility to field verify the location of all utilities prior to the commencement of any construction.

MARTIN/MARTIN

Consulting Engineers

4251 Kipling St.
Wheat Ridge, Co.
(303) 431-6100

PROJECT MAJESTIC

DRAINAGE PLAN

no	description of revisions	date	name
1	DETENTION POND RELOCATION	12-13-94	DAL
2	REVISED PER COUNTY COMMENTS	02-22-95	JCM

date AUGUST 24, 1994
job number 12426.01
design by A.KELLY
drawn by A. KELLY
checked by G.THOMAS

sheet number **D1**

project C:\PROJECTS\TANDY
project manager GT
designed by AK
drawn by AJE
job no. 12426.01
sheet no. D1

cad information
model space M-SHEET
main file DRAINAGE.DWG
plot date 12/22/94 A. KELLY
paper space P-D1
xreference BASE.DWG