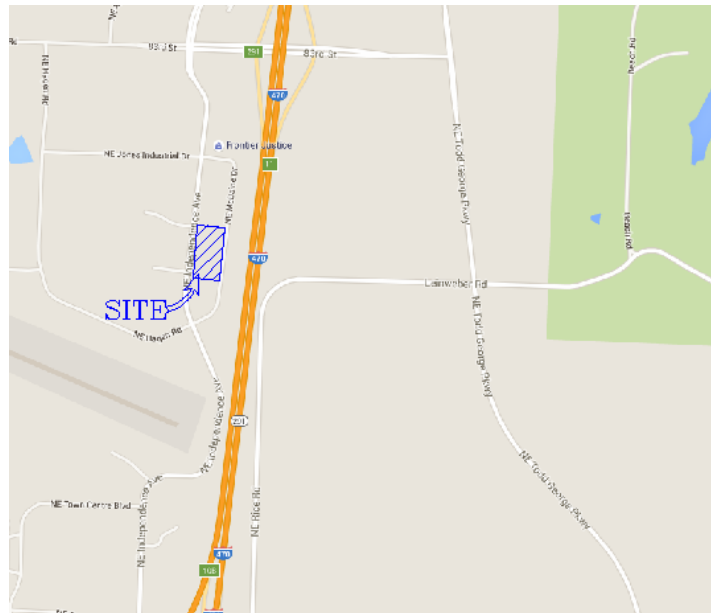


MICRO STORM WATER DRAINAGE STUDY

For:
I-470 Business and Technology Center Lot 13A
a Re plat of lots 13, 14, 21, & 22 in I-470 Business and Technology
Center Lots 1 thru 22 and Tracts A and B
Lee's Summit, Jackson County, Missouri

*Water Sheds:
May Brook branch
to Lakewood Lake*



PREPARED 6-18-19

REV-7-24-19

REV-8-7-19

PREPARED BY:

Quist Engineering Inc.

821 NE Columbus St.

Lee's Summit, MO 64063

Phone: (816) 550-5675



Robert Walquist, PE

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- 8. Exhibit List**

3. GENERAL INFORMATION

This study is to evaluate the proposed development on a 4.12 acres site for an industrial warehouse building and parking lot on “I-470 Business and Technology Center Lot 13A a Re plat of lots 13, 14, 21, & 22 in I-470 Business and Technology Center Lots 1 thru 22 and Tracts A and B” a subdivision in Lee’s Summit, Jackson County, Missouri.

- land is not in FEMA flood map.see firmet map
- No wet lands exist on site.
- Soils

Jackson County, Missouri (MO095)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
10024	Greenton-Urban land complex, 5 to 9 percent slopes	3.1	92.4%
10136	Sibley-Urban land complex, 2 to 5 percent slopes	0.3	7.6%
Totals for Area of Interest		3.4	100.0%

4. EXISTING CONDITION ANALYSIS

All calculation were calculated using the rational method.

The land currently is a hay field with no trees. The land drains to the west to a public storm convaince system that runs along the west property line from south to north. The existing storm systems runs parallel to NE Independence Ave. This system is the outfall to 11.54 acres to the south and west of this site. This system then continues to a regional detention / BMP Basin located on “Lakewood Business Center on I-470 Plat Q”. This property has little impervious material on it currently.

Summery of comprehensive control requirements

The control requirements for this site as follows

- Convey the 25yr storm into the existing public system.
- all Detention and BMP requirements are included and mitedated by a regional detention / BMP Basin located on “Lakewood Business Center on I-470 Plat Q”.

Area summery

B-1 – pre development area of 0.25ac running in an existing public curb inlet

B-2 – pre development area of 3.03 ac running in an existing public field inlet

B-3 – pre development area of 0.83ac running in an existing public curb inlet

For full public system design and calculations see “I-470 Business and Technology Center plans”

(See attached public improvement plan and the site drainage plan)

5. PROPOSED CONDISION ANALYSIS

This storm drainage study was preformed to evaluate the effects of the proposed development of an industrial warehouse building and parking lot.

The proposed building and parking lot will increase the impervious surface of the site which in turn will increase the storm water runoff of the site. The total impervious area proposed is

PERVIOUS VS IMPERVIOUS CALCULATIONS

LOT SIZE 179,505 SF

IMPERVIOUS SURFACES

BUILDING 67,575 SF

DRIVES/PARKING

WALKS/MISC. 78,310SF

TOTAL 145,885SF

CALCULATIONS

-/- = 81% IMPERVIOUS

19% PERVIOUS (GREEN)

We have proposed to route all of the proposed impervious area into a private storm system which then will connect the existing public storm system along Independence avenue. (See The Drainage area map.)

The existing storm system was designed for the 100yr storm with a C of 0.80 for these lots. At our point of connection storm system the capacity of the pipe is 120.50cfs and the design flow is 108cfs.

On Site	C
Pre Development	0.3
Post Development	0.80

Area summery

A-1 – post development area of 0.29ac running into proposed CI-1-6

A-2b – post development area of 0.17ac running into proposed CI-1-5

A-2a – post development area of 0.20ac running in a down spout collection system that ties into proposed CI-1-5

A-3b – post development area of 0.20ac running into proposed CI-1-4

A-3a – post development area of 0.21ac running in a down spout collection system that ties into proposed CI-1-4

A-4b – post development area of 0.19ac running into proposed CI-1-3

A-4a – post development area of 0.15ac running in a down spout collection system that ties into proposed CI-1-3

A-5 – post development area of 0.02ac running into proposed AI-1-2

A-6 – post development area of 0.28ac running into proposed CI-1-1

A-7 – post development area of 0.24ac running into proposed EX-CI

A-8 – post development area of 0.26ac running into proposed CI-3-1

A-9a – post development area of 0.20ac running in a down spout collection system that ties into proposed CI-1-6

A-9b – post development area of 0.04ac running into proposed AI-3-4

A-10 – post development area of 0.13ac running into proposed AI-3-3

A-11 – post development area of 0.26ac running in an proposed C-3-2

- A-12c – post development area of 0.18ac running in a down spout collection system that ties into proposed EX-FI
- A-12b – post development area of 0.18ac running in a down spout collection system that ties into proposed EX-FI
- A-12a – post development area of 0.13ac running in a down spout collection system that ties into proposed EX-FI
- A-13c – post development area of 0.183c running in a down spout collection system that ties into proposed EX-FI
- A-13b – post development area of 0.13ac running in a down spout collection system that ties into proposed EX-FI
- A-13a – post development area of 0.12ac running in a down spout collection system that ties into proposed EX-FI

6. Future Conditions Analysis

This site will be in one phase.

7. Conclusion & Recommendations

We feel that the proposed grading of this site in combination with the proposed conveyance system will effectively reduce the storm water runoff from this site. We also feel that we will not negatively affect the down stream properties

8. Exhibits:

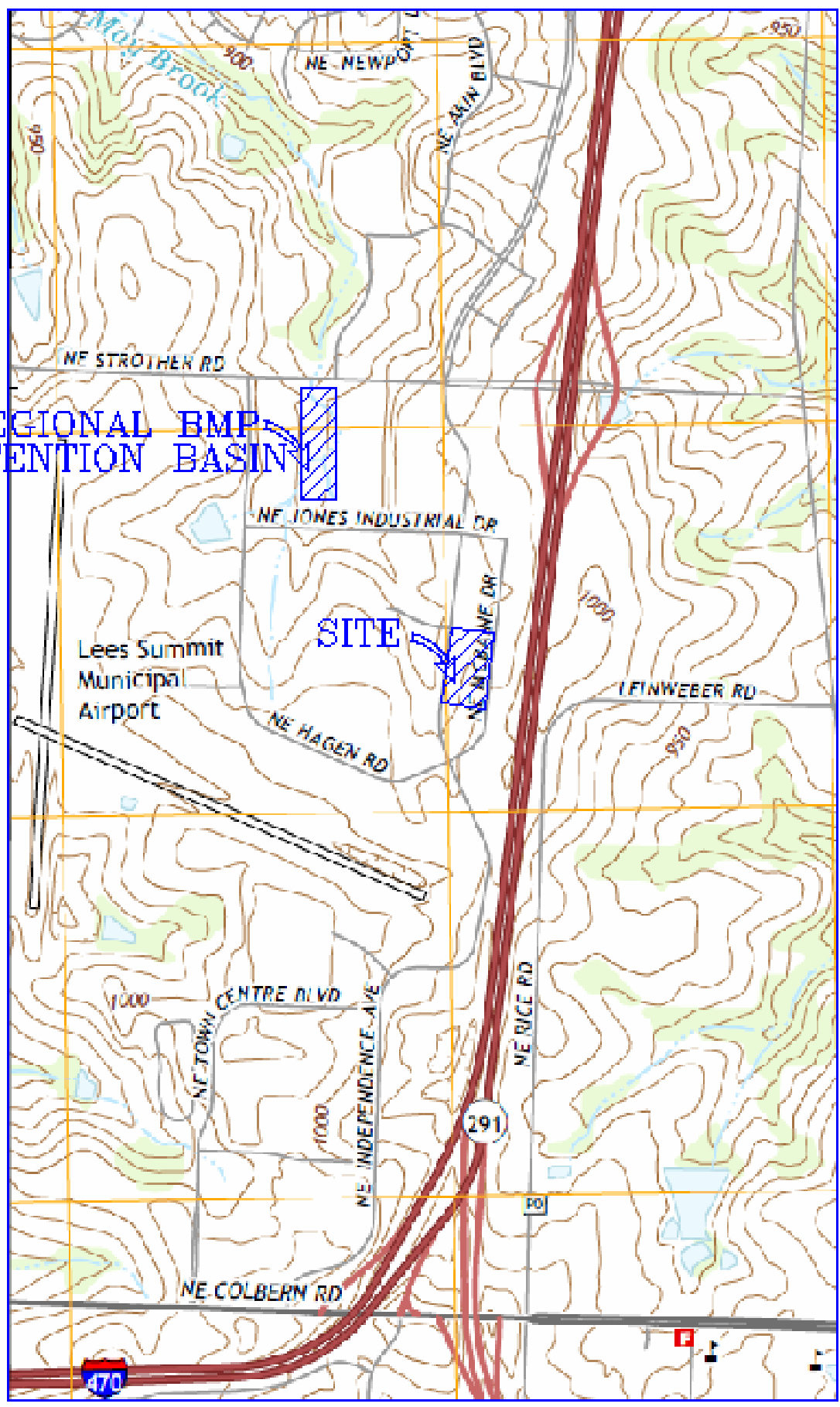
- **SITE LOCATION MAP**
- **USGS MAP**
- **AERIAL VIEW**
- **FIRMET MAP**
- **STORM DRAINAGE MAP & EXISTING SYSTEM**

SITE LOCATION MAP



USGS MAP

REGIONAL BMP
DETENTION BASIN



AERIAL VIEW



FIRM MAP & PANEL NUMBER



City of Lee's
29013



MAP SCALE 1" = 1000'



NFIP

PANEL 0430G

FIRM

FLOOD INSURANCE RATE MAP
JACKSON COUNTY,
MISSOURI
AND INCORPORATED AREAS

PANEL 430 OF 625
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

COORDINATES

COMMUNITY	NUMBER	PANEL	SUFFIX
JACKSON COUNTY	29040	0430	G
LEE'S SUMMIT CITY OF	29174	0430	G

NOTICE TO USER: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

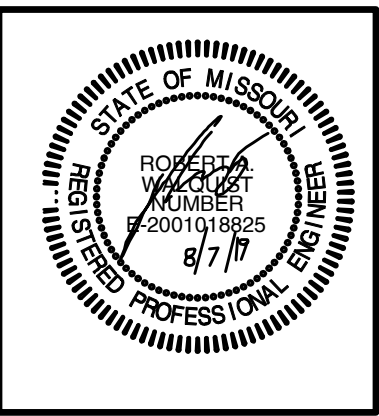


MAP NUMBER
2909SC0430G
MAP REVISED
JANUARY 20, 2017

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT on-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

STORM DRAINAGE MAP & EXISTING SYSTEM



I-470 LOT 13A

LEE'S SUMMIT, JACKSON COUNTY, MISSOURI

Quist Engineering, Inc
 Civil Engineering for Residential &
 Commercial Site Development
 824 W. Columbus St.
 Lee's Summit, Missouri 64063
 Phone: (816) 550-5675
 email: wquist@quistengineering.com

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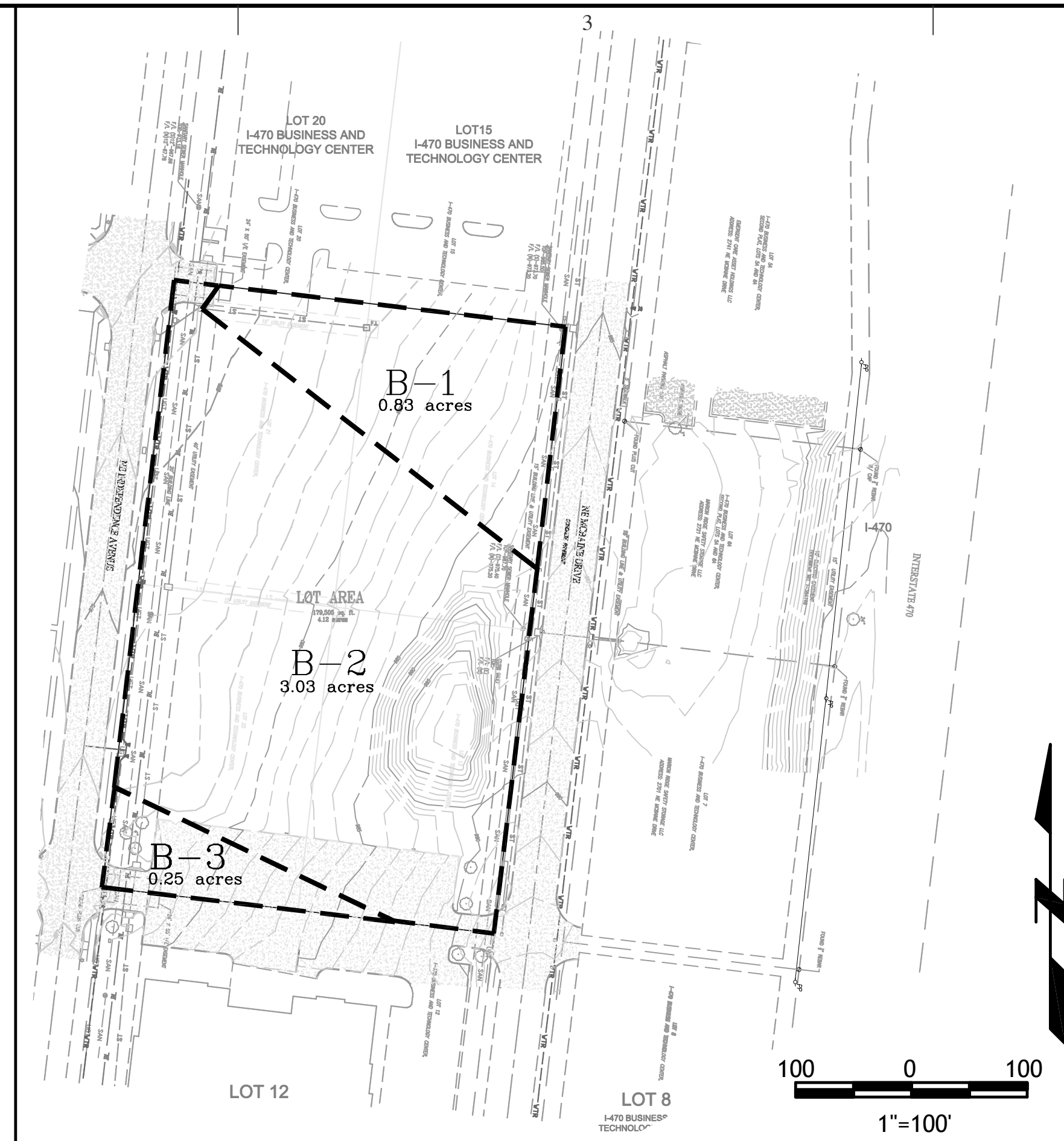
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6-20-19

REVISIONS
7-24-19
8-7-19

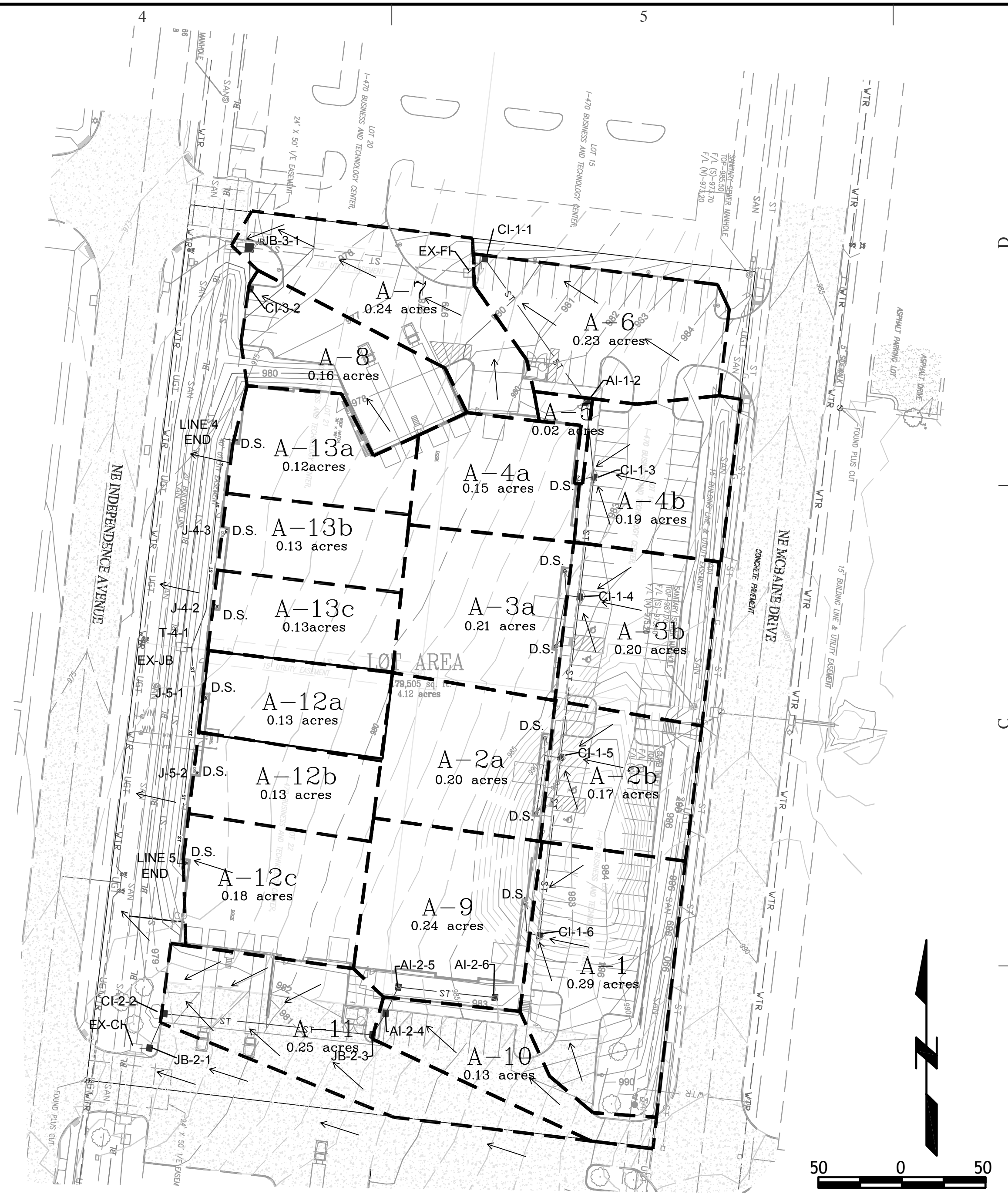
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PRE-DEVELOPMENT

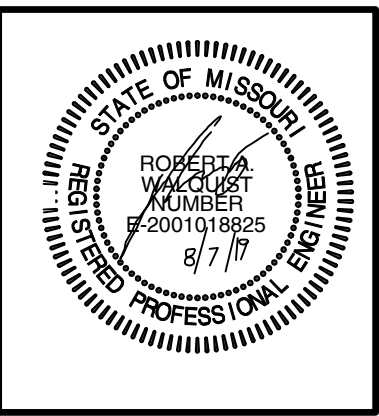


POST-DEVELOPMENT

STORM SEWER CALCULATIONS TABLE

Line	Sewer Location		Drainage Area to Inlet			Time of Flow TC	Rainfall Runoff Flow										Elevation			Sewer Characteristics										Velocity stats	
	From	To	Designation	Area	Coef		1100 Intensity	125 Intensity	110 Intensity	Inlet 100yr K*1*C*A	Inlet 25yr K*1*C*A	Inlet 10yr K*1*C*A	Additional Flow Lines	Additional cfs	In-pipe 100yr K*1*C*A	In-pipe 25yr K*1*C*A	In-pipe 10yr K*1*C*A	Inlet	Top elevation	Coverage	Pipe Size (in)	FL in	FL out	segment length	slope	pipe area	Pipe Capacity (cfs)	100yr overflow	V 10ys	V 100 yr	
LINE 1	CI-1-6	CI-1-5	A-1, A-9	0.49	0.60	5.00	10.32	8.53	7.35	3.79	2.76	2.16			3.79	2.76	2.16	CI-1-6	982.00	1.20	12.00	979.80	978.70	107.54	1.02	0.79	3.60	YES	2.75	4.83	
	CI-1-5	CI-1-4	A-2b, A-2a	0.37	0.60	5.00	10.32	8.53	7.35	2.86	2.08	1.63			6.66	4.84	3.79	CI-1-5	982.70	2.95	15.00	978.50	977.80	96.62	0.72	1.23	5.50	YES	3.09	5.43	
	CI-1-4	CI-1-3	A-3b, A-3a	0.41	0.60	5.00	10.32	8.53	7.35	3.17	2.31	1.81			9.83	7.15	5.60	CI-1-4	982.60	3.60	18.00	977.50	976.60	72.09	1.25	1.77	11.73	NO	3.17	5.57	
	CI-1-3	AI-1-2	A-4b, A-4a	0.34	0.60	5.00	10.32	8.53	7.35	2.63	1.91	1.50			12.46	9.06	7.10	CI-1-3	982.70	4.60	24.00	976.10	975.50	44.85	1.34	3.14	26.15	NO	2.26	3.97	
	AI-1-2	CI-1-1	A-5	0.02	0.60	5.00	10.32	8.53	7.35	0.15	0.11	0.09			12.62	9.18	7.19	AI-1-2	982.40	5.20	24.00	975.20	974.50	105.32	0.66	3.14	18.43	NO	2.29	4.02	
LINE 2	CI-1-1	EX-FL	A-6	0.23	0.60	5.00	10.32	8.53	7.35	1.78	1.29	1.01			14.40	10.47	8.21	CI-1-1	979.40	3.10	24.00	974.30	974.00	13.32	2.25	3.14	33.93	NO	2.61	4.59	
	AI-2-6	AI-2-5	A-9b	0.04	0.60	10.00		8.59	7.05	6.08	0.26	0.19	0.15			0.26	0.19	0.15	AI-2-6	982.00	2.00	12.00	979.00	978.20	58.14	1.38	0.79	4.18	NO	0.19	0.33
	AI-2-5	AI-2-4	N/A	0.00	0.60	5.00	10.32	8.53	7.35	0.00	0.00	0.00			0.26	0.19	0.15	AI-2-5	982.33	3.33	12.00	978.00	977.70	17.45	1.72	0.79	4.67	NO	0.19	0.33	
	AI-2-4	JB-2-3	A-10	0.13	0.60	5.00	10.32	8.53	7.35	1.01	0.73	0.57			1.26	0.92	0.72	AI-2-4	982.29	3.79	12.00	977.50	977.20	15.09	1.99	0.79	5.02	NO	0.92	1.61	
	JB-2-3	CI-2-2	N/A	0.00	0.60	5.00	10.32	8.53	7.35	0.00	0.00	0.00			1.26	0.92	0.72	JB-2-3	983.20	5.20	12.00	977.00	973.20	125.08	3.04	0.79	6.21	NO	0.92	1.61	
LINE 3	CI-2-2	JB-2-1	A-11	0.25	0.60	5.00	10.32	8.53	7.35	1.94	1.41	1.10			3.20	2.33	1.82	CI-2-2	977.40	3.40	12.00	973.00	972.70	22.48	1.33	0.79	4.11	NO	2.32	4.08	
	JB-2-1	EX-CI	N/A	0.00	0.60	5.00	10.32	8.53	7.35	0.00	0.00	0.00			3.20	2.33	1.82	JB-2-1	978.00	4.50	12.00	972.50	972.00	5.72	8.74	0.79	10.53	NO	2.32	4.08	
	CI-3-2	JB-3-1	A-8	0.16	0.85	7.00	9.55	7.87	6.78	1.62	1.18	0.92			1.62	1.18	0.92	CI-3-1	974.30	2.30	12.00	971.00	968.00	24.60	12.20	0.79	12.44	NO	1.18	2.07	
	LINE 4	END	J-4-2	A-13a,	0.12	0.60	5.00	10.32	8.53	7.35	0.93	0.68	0.53			0.93	0.68	0.53	END	982.00	3.33	8.00	978.00	977.20	61.89	1.29	0.35	1.37	NO	1.52	2.66
	J-4-2	T-4-1	A-13b, A-13c	0.26	0.60	5.00	10.32	8.53	7.35	2.01	1.46	1.15			2.94	2.14	1.68	J-4-2	982.00	3.80	12.00	977.20	976.55	78.45	0.83	0.79	3.24	NO	2.14	3.75	
LINE 5	T-4-1	EX-FI	N/A		0.60	5.00	10.32	8.53	7.35	0.00	0.00	0.00	LINE 5 25yr	1.46	4.40	3.60	3.14	J-4-1	982.00	4.45	12.00	976.55	976.50	4.63	1.08	0.79	3.70	YES	4.00	5.61	
	END	J-5-1	A-12c	0.18	0.60	5.00	10.32	8.53	7.35	1.39	1.01	0.79			1.39	1.01	0.79	END	982.00	3.33	8.00	978.00	977.30	59.23	1.18	0.35	1.31	YES	2.28	3.99	
J-5-1	J-4-1	A-12a, A-12b	0.26	0.60	5.00	10.32	8.53	7.35	2.01	1.46	1.15			3.41	2.48	1.94	J-5-1	982.00	3.70	12.00	977.30	976.55	76.04	0.99	0.79	3.54	NO	2.47	4.34		

SITE STORM DRAINAGE PLAN AND CALCULATIONS



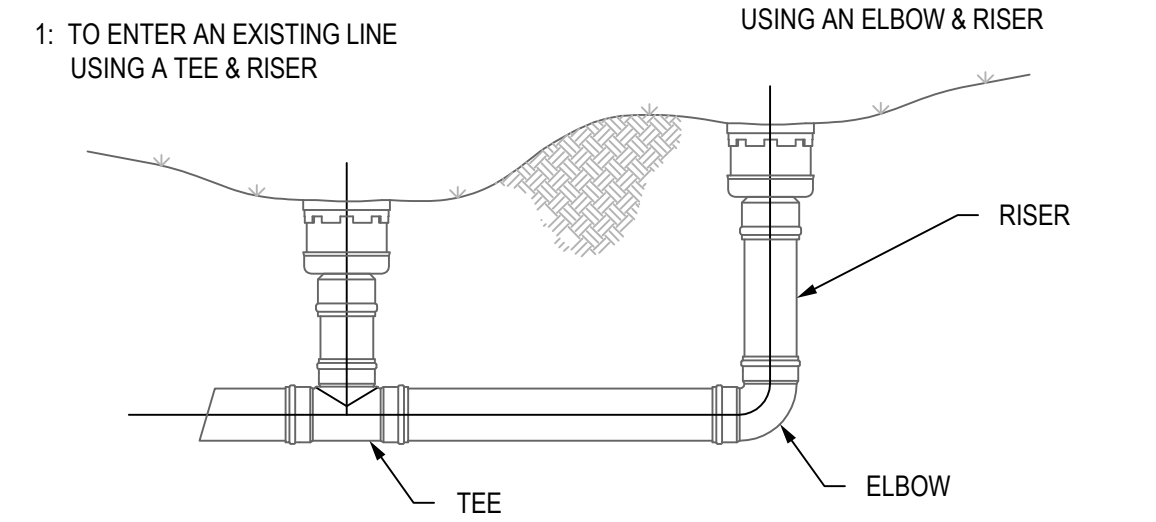
I-470 LOT 13A
LEE'S SUMMIT, JACKSON COUNTY, MISSOURI

Quist Engineering, Inc
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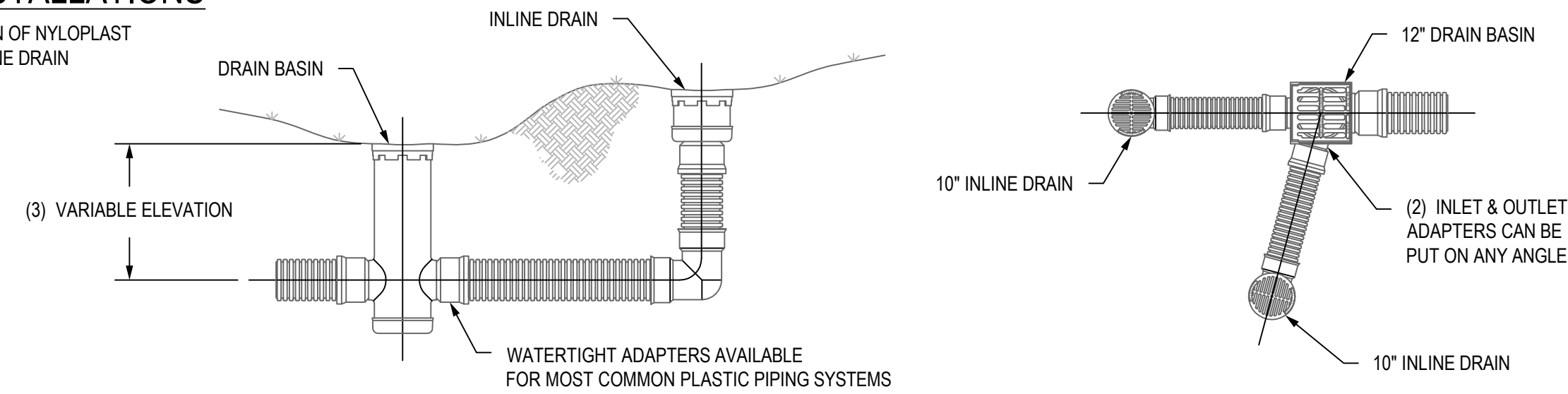
WHEN ARE INLINE DRAINS USED?

- 2708AG __X
- 2710AG __X
- 2712AG __X
- 2715AG __X
- 2718AG __X
- 2724AG __X
- 2730AG __X



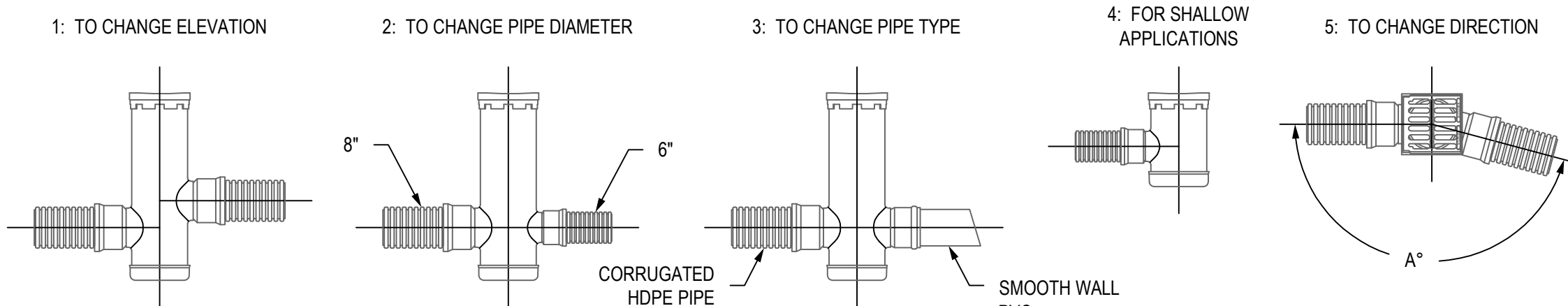
TYPICAL INSTALLATIONS

TYPICAL INSTALLATION OF NYLOPLAST DRAIN BASIN AND INLINE DRAIN



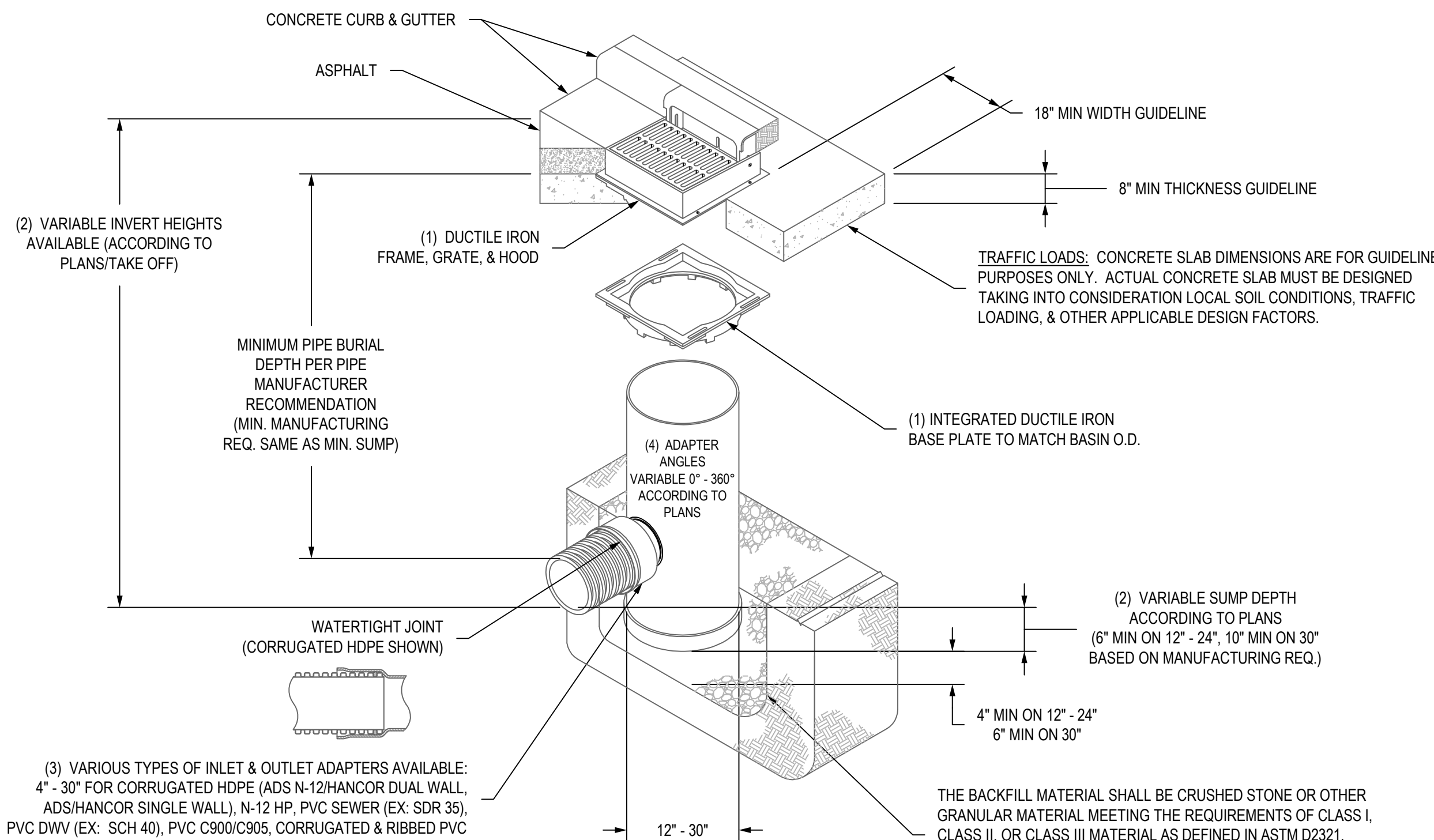
WHEN ARE DRAIN BASINS USED?

- 2808AG __X
- 2810AG __X
- 2812AG __X
- 2815AG __X
- 2818AG __X
- 2824AG __X
- 2830AG __X
- 2836AG __X



- 1 - STRUCTURES & ADAPTERS AVAILABLE IN SIZES 8" - 36"
- 2 - ADAPTERS CAN BE MOUNTED ON ANY ANGLE 0° TO 360°, TO DETERMINE MINIMUM ANGLE BETWEEN ADAPTERS SEE DRAWING NO. 7001-110-012
- 3 - DRAIN BASIN TO BE CUSTOM MANUFACTURED ACCORDING TO PLAN DETAILS. RISERS ARE NEEDED FOR BASINS OVER 84" DUE TO SHIPPING RESTRICTIONS. SEE DRAWING NO. 7001-110-065
- 4 - REDUCING CONES DOWN TO 30" DIAMETER WILL BE REQUIRED FOR 36" DRAIN BASINS.

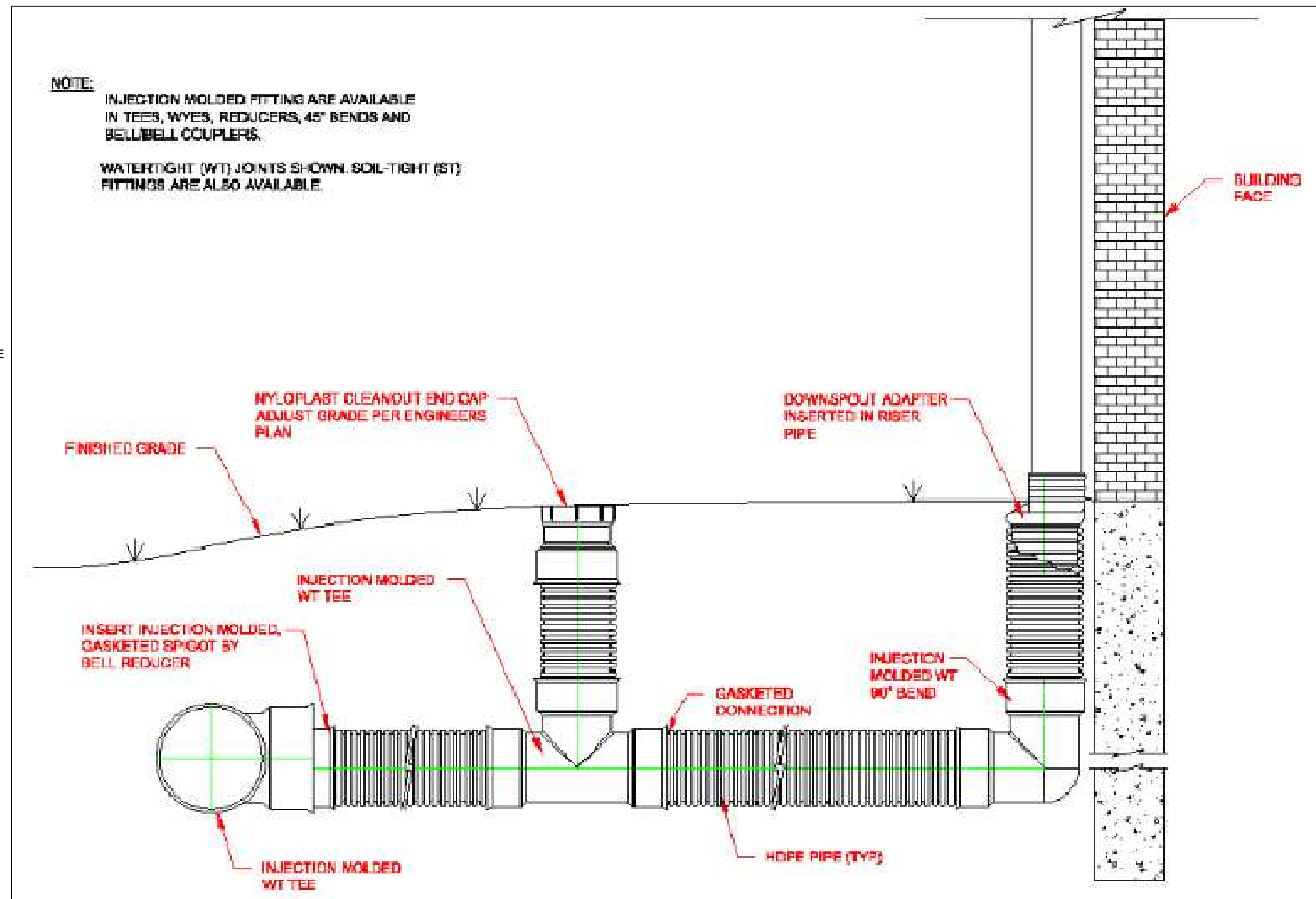
NYLOPLAST 2 FT X 2FT CURB INLET STRUCTURE: 30 __ AGS __ X



- 1 - 12" - 30" FRAMES, GRATES, HOODS, & BASE PLATES SHALL BE DUCTILE IRON PER ASTM A536 GRADE 70-50-05.
- 2 - DRAIN BASIN TO BE CUSTOM MANUFACTURED ACCORDING TO PLAN DETAILS.
- 3 - DRAINAGE CONNECTION STUB JOINT TIGHTNESS SHALL CONFORM TO ASTM D3212 FOR CORRUGATED HDPE (ADS N-12/HANCOR DUAL WALL, N-12 HP, & PVC SEWER (4" - 24").
- 4 - ADAPTERS CAN BE MOUNTED ON ANY ANGLE 0° TO 360°. TO DETERMINE MINIMUM ANGLE BETWEEN ADAPTERS SEE DRAWING NO. 7001-110-012.
- 5 - ALL CURB INLET GRATE OPTIONS (STANDARD & DIAGONAL) SHALL MEET H-20 LOAD RATING

NOTE: INJECTION MOLDED FITTINGS ARE AVAILABLE IN TEES, WYES, REDUCERS, 45° BENDS AND BELLEBELL COUPLERS.

WATERTIGHT (WT) JOINTS SHOWN. SOIL-TIGHT (ST) FITTINGS ARE ALSO AVAILABLE.



STORM LINE DETAILS



I-470 LOT 13A

LEE'S SUMMIT, JACKSON COUNTY, MISSOURI

Quist Engineering, Inc
 Civil Engineering for Residential &
 Commercial Site Development
 821 NE Columbus St
 Lee's Summit, Missouri 64063
 Phone: (816) 550-5675
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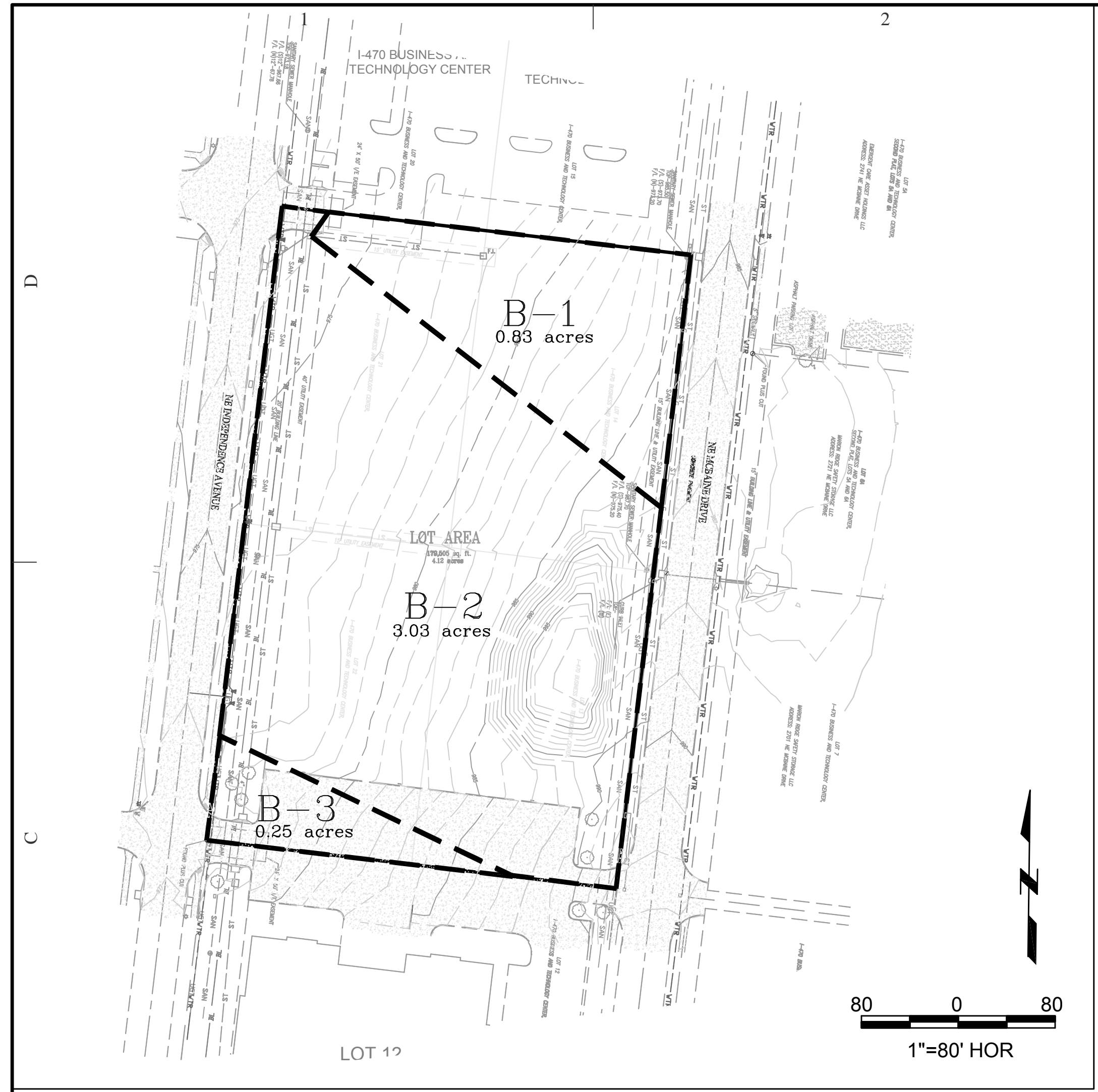
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SHEET NO.

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JOB NO.

E18-337



STORM SEWER CALCULATIONS																		
I-470 BUSINESS AND TECHNOLOGY CENTER																		
PROJECT NO. 04-057																		
STORM SEWER NO.	SEWER LOCATION		TRIBUTARY AREA (AC.)		COMPOSITE RUNOFF COEFFICIENT	TIME OF FLOW			DESIGN		10 YEAR STORM							
	FROM STRUCTURE NO.	TO STRUCTURE NO.	AREA DESIGNATION	TOTAL ACRES		T _i	T _t	T _c	INTENSITY [in/hr] [100]	RUNOFF [cfs]		GUTTER INLET SLOPE [%]	GUTTER CAPACITY [cfs]	INLET CAPACITY [cfs]	80% INLET CAPACITY [cfs]	10 YEAR BY PASS [cfs]	Gutter Inlet Length	
	AREA	TOTAL	AREA	TOTAL		Q[10]	Q[10] T											
LINE 1	CB 1H	CB 1G	1K	1.38	7.96	0.8	5.0	0.0	5.0	7.35	8.1	45.8	2.00	4.8	7.0	5.6	0	6
LINE 1	CB 1G	FI 1F	-	0.00	7.96	0.8	5.0	0.0	5.0	7.35	0.0	45.8	2.00	4.8	7.0	5.6	0	6
LINE 1	FI 1F	CB 1E	1H	0.47	9.37	0.8	5.0	0.0	5.0	7.35	2.8	54.1	-	-	35.2	28.2	0	6x4x8'4
LINE 1	CB 1E	CB 1D	1G	1.23	11.54	0.8	5.0	0.0	5.0	7.35	7.2	66.8	2.00	4.8	7.8	6.2	0	6
LINE 1	CB 1D	FI 1C	-	0.00	11.54	0.8	5.0	0.0	5.0	7.35	0.0	66.8	2.00	4.8	7.8	6.2	0	7
LINE 1	FI 1C	CB 1B	1E	0.91	39.29	0.8	5.0	0.0	5.0	7.35	5.4	221.7	SUMP	-	49.2	39.4	0	7x7x8'4
LINE 1	CB 1B	CB 1A	13B	0.72	40.01	0.8	5.0	0.0	5.0	7.35	4.2	225.9	SUMP	-	11.8	9.4	0	8
LINE 1	CB 1A	FI 15G	13A	0.93	40.94	0.8	5.0	0.0	5.0	7.35	5.5	231.4	SUMP	-	11.8	9.4	0	8
LINE 9	JB 9A	CB 1E	9A	0.94	0.94	0.8	5.0	0.0	5.0	7.35	5.5	5.5	-	-	0.0	0.0	0	4x4
LINE 10	JB 10A	FI 1F	10A	0.94	0.94	0.8	5.0	0.0	5.0	7.35	5.5	5.5	-	-	0.0	0.0	0	4x4

STORM SEWER CALCULATIONS																								
I-470 BUSINESS AND TECHNOLOGY CENTER																								
PROJECT NO. 04-057																								
Pipe Size [in]	Pipe Slope [%]	Pipe Type	Rough Coef [MANNING]	Design Velocity [fps]	Depth Flow (inches) Q[10]	Full Velocity [fps]	Full Flow [cfs]	Cen-Cen Length [ft]	Pipe Drop [ft]	Invert Drop [ft]	Start Invert [ft]	Finish Invert [ft]	INTENSITY [in/hr] [100]	100 YEAR STORM										
														RUNOFF [cfs]		In Pipe Downstream [cfs]	By Pass Out [cfs]	In Pipe Upstream [cfs]	By Pass In [cfs]	TOTAL [cfs]				
														AREA	TOTAL									
48	0.60	HDPE	0.012	10.1	27.3	9.6	120.5	43.00	0.26	0.20	964.81	964.55	10.32	14.2	66.4	0.0	80.6	80.6	0.0					
48	0.60	HDPE	0.012	10.1	27.3	9.6	120.5	242.17	1.45	0.20	964.35	962.90	10.32	0.0	80.6	0.0	80.6	80.6	0.0					
48	0.60	HDPE	0.012	10.5	30.7	9.6	120.5	242.17	1.45	0.20	962.70	961.25	10.32	4.9	90.3	0.0	95.2	95.2	0.0					
48	0.60	HDPE	0.012	10.9	36.4	9.6	120.5	43.00	0.26	0.20	961.05	960.79	10.32	12.7	108.5	0.0	121.3	121.3	0.0					
66	1.00	SCOR	0.012	13.5	25.0	15.3	363.8	123.10	1.23	0.20	960.59	959.36	10.32	0.0	121.3	0.0	121.3	121.3	0.0					
72	0.80	SCOR	0.012	16.0	47.7	14.5	410.3	35.12	0.28	0.50	958.86	958.58	10.32	9.4	328.9	0.0	338.3	338.3	0.0					
72	0.80	SCOR	0.012	16.1	48.5	14.5	410.3	42.74	0.34	1.00	957.58	957.24	10.32	7.4	338.3	0.0	345.7	345.7	0.0					
72	0.80	SCOR	0.012	16.2	49.6	14.5	410.3	43.00	0.34	0.20	957.04	956.70	10.32	9.6	345.7	0.0	355.3	355.3	0.0					
24	5.00	CMP	0.023	6.2	9.6	9.1	28.6	144.00	7.20	0.00	971.95	964.75	10.32	9.7	0.0	0.0	9.7	9.7	0.0					
24	5.00	CMP	0.023	6.2	9.6	9.1	28.6	143.64	7.18	0.00	973.58	966.40	10.32	9.7	0.0	0.0	9.7	9.7	0.0					

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