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SYSTEMS ENGINEERING & RESEARCH

ENVIRONMENTAL DESIGN AND SYSTEMS ANALYSIS • INDUSTRIAL WASTE MANAGEMENT

Wastewater Collection System Study

For

Proposed

Destin Landing

760 Acre Development
Located in the

SW ¼ Sec. 10, T8N, R2W, IM
E ½ Sec. 15, T8N, R2W, IM
S. ½ Sec. 14, T8N, R2W, IM
Norman, OK

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January 21, 2015

Revised March 23, 2015

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Wastewater Collection Study
Proposed Destin Landing Development
in SE Norman, OK

Introduction

The purpose of this study is to determine the feasibility of providing a wastewater collection system to serve Destin Landing, a proposed 760 acre Residential/Commercial Development located in South East Norman, Oklahoma. Specifically the development is located in the SW ¼ Sec. 10, T8N, R2W; E ½ Sec. 15, T8N, R2W; and S. ½ Sec. 14, T8N, R2W, IM, Cleveland County. For exact location see Exhibit #1 – Developer Supplied Master Plan.

The development will contain single family homes, multi-family homes, service areas, parks, and commercial areas supporting the community. This development is divided into five natural drainage basins. Each of these five basins will need a method of transporting wastewater generated into the City of Norman's wastewater collection system. This study will develop a plan for transporting this waste water to the City of Norman's wastewater collection system.

Volume and Strength of Sewage

The first step will be to determine the volume and strength of the wastewater in each drainage basin. Since the proposed development is residential and commercial there will be no industrial or other high strength wastes. Constituent concentrations in the wastewater generated will be consistent with typical municipal sanitary wastewater. The City of Norman's Wastewater Treatment system will not be impacted by the concentration, pH or temperature of the wastewater generated in this development.

The drainage basins or service areas were defined by placing the Master Plan Land Uses on top of a 7.5 Min. USGS Topo map. The drainage basins were outlined in black and the land use in each tabulated. The resulting map is shown in Exhibit #2 – Drainage Area and Land Use Map. The map shows each drainage basin and the total area of each proposed land use in the basins.

The average daily wastewater flow for each drainage basin is based on the Land Uses provided by the Developer in the Master Plan (Exhibit #1). The average daily wastewater flow was calculated using the area of each land use in the basin, density of housing units and the average number of residents in each unit. The areas of each land uses is estimated on the Master Plan. The density of the housing units and the average number of residents in each unit were based on reference data and experience.

As an example the average wastewater flow for area #1 for Service Area Sec. 10 would be calculated as follows. Area #1 is 36.5 acres of Single Family – High Density homes. Reference data and experience tell us that the Unit Density is 3.5 units/ac and that an average of 3.0 people live in each home. The Oklahoma Department of Environmental Qualities' regulations dictate that all wastewater collection and treatment system will be designed based on a wastewater flow of 100 gallons/capita/day (gpcpd). The average daily wastewater flow for this one area would be 36.5 ac x 5 units/ac x 3.0 people per home x 100 gpcpd = 54,750 gpd. In Attachment #1 – Calculations of Average Daily Flows and Peak Hourly Flows, and the total average daily flow for each drainage basin/service area have been calculated.

The peak wastewater flow for each basin has been calculated using a Peaking Factor of 4.0. This factor was provided by the Norman Utilities Authority and is used throughout the City. This Peaking Factor establishes a ratio of Peak Hourly Flow to the Design Average Flow. At the bottom of each table in Attachment #1 the ratio has been determined for each service area and the peak hourly flow determined. Below is a summary table for the Average Daily Flow and Peak Hourly Flow for each service area.

Table #1 – Service Area Summary Table

Service Area	Approx. Total Area (ac)	Average Daily Flow (gpd)	Peaking Factor	Peak Hourly Flow (gpm)
Sec. 14	280	164,630	4.0	460
Sec. NE 15	100	114,085	4.0	320
Sec. 10	240	346,140	4.0	970
Subtotal	620	654,855		1,750
Sec S 15	90	83,690	4.0	240
Existing Post Oak LS	50	52,800	4.0	150
Total Development	760	761,345		2,140

After the development is fully constructed the average daily flow entering the City of Norman's wastewater collection system will be 761,345 gpd. The peak hourly flow will be 2,140 gpm.

gravity sewer. (Exhibit #3) The other two lift stations would be connected into this force main along this route. The total length of this force main is approximately 16,400 feet.

The profile for the proposed route is shown in Exhibit #4. Head loss and friction calculations are given in Appendix #2. The size of the force main was selected based on two criteria, a minimum flushing velocity of 2 ft/sec. and minimizing friction and head loss. An 8" force main was selected to run from LS Sec 15 NE to LS Sec 10 and the size was increased to a 12" from LS Sec 10 to the 24" gravity sewer.

The headloss for the force main is summarized in the table below.

Table 2 – Headloss Summary (ft)

Flow (gpm)	320	460	780	970	1290	1430	1750
LS Sec 14 to LS Sec 15 NE	NA	45.9	NA	NA	NA	NA	NA
LS Sec 15 NE to LS Sec 10	0.0	0.0	10.5	NA	NA	NA	NA
LS Sec 10 to 24" Gravity	18.3	21.5	32.2	40.8	58.8	68.1	92.2
Suction Lift	15.0	15.0	15.0	15.0	15.0	15.0	15.0
Total Head (ft)							
Sec. 14	NA	82.4	NA	NA	NA	NA	NA
Sec 14, and Sec 15NE	NA	NA	103.6	NA	NA	NA	NA
Sec 14, Sec 15 NE, and Sec 10	NA	NA	NA	NA	NA	NA	163.6
Sec 14, and Sec 10	NA	NA	NA	NA	NA	129.0	NA
Sec 10	NA	NA	NA	55.8	NA	NA	NA
Sec 10, Sec 15 NE	NA	NA	NA	NA	84.3	NA	NA
Sec 15 NE	33.3	NA	NA	NA	NA	NA	NA

The use of a common force main will require slightly larger pumps to insure the peak flows can be maintained. The use of variable frequency drives will allow the pumps to operate during non-peaks without overloading.

In order to maintain minimum flushing velocities in the common force main the lift stations must be constructed in the following order Lift Station Sec 10, Lift Station 15 NE and finally, Lift Station Sec 14. Lift Stations Sec 15NE and Sec14 will not have the flow to maintain the minimum flushing velocities in the 12 inch forcemain from Lift Station Sec 10 to the 24 inch gravity sewer.

All four lift stations will be of similar design. The stations will be standard duplex or triplex lift stations with variable frequency drives, submersible pumps, and emergency generators. A drawing of a typical triplex lift station is included in Exhibit #5. This Exhibit is for reference and only intended to show the type of lift station proposed for this development.

Project Cost Estimate

Pending

Conclusions and Recommendations

This development is a long term project that will be completed over several years. The wastewater collection system must be flexible and constructed on a as need basis. The proposed solution of four lift stations and a common force main will allow the system to be constructed as needed.

The recommended wastewater collection system is based on available information. Final designs will be based on updated and actual data.

Attachment #1

Calculations of Average Daily Flows and Peak Hourly Flows

Attachment #1-1 Service Area Sec. 14
Attachment #1-2 Service Area NE Sec. 15
Attachment #1-3 Service Area Sec. 10
Attachment #1-4 Service Area Sec. S. 15
Attachment #1-5 Service Area Existing Lift Station Post Oak Road

Basin Area and Usages (ac)

Drainage Basin #	Equestrian Facility	Service	Commerical / Mixed Use	Open Space	Multi-Family	Single Family Estate	Single Family Low	Single Family Med	Single Family High	Patio Homes	Total
Dwelling Density (units/acre)		13			15	1	3	4	5	6	
Dwelling Population (people/dwelling)		1.5			2.5	3	3	3	3	2.5	
PE/ac	5	19.5	10	0.5	37.5	3	9	12	15	15	
Flow per Person (gpdpc)		100			100	100	100	100	100	100	
Flow per Unit (gpd)	500	150	1000	50	250	300	300	300	300	250	
Flow per Acre (gpapd)	500	1950	1000	50	3750	300	900	1200	1500	1500	
Sec. 14 - 1	0.0	0.0	0.0	0.0	0.0	10.3	0.0	0.0	0.0	0.0	10.3
Sec. 14 - 2	0.0	0.0	0.0	0.0	0.0	7.1	0.0	0.0	0.0	0.0	7.1
Sec. 14 - 3	0.0	0.0	0.0	0.0	0.0	21.0	0.0	0.0	0.0	0.0	21.0
Sec. 14 - 4	0.0	0.0	0.0	0.0	0.0	20.4	0.0	0.0	0.0	0.0	20.4
Sec. 14 - 5	0.0	0.0	0.0	0.0	0.0	22.6	0.0	0.0	0.0	0.0	22.6
Sec. 14 - 6	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8
Sec. 14 - 7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.5	0.0	20.5
Sec. 14 - 8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.3	0.0	0.0	21.3
Sec. 14 - 9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.0	0.0	24.0
Sec. 14 - 10	0.0	0.0	0.0	0.0	5.8	0.0	0.0	0.0	0.0	0.0	5.8
Sec. 14 - 11	0.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0
Sec. 14 - 12	0.0	0.0	0.0	0.0	28.7	0.0	0.0	0.0	0.0	0.0	28.7
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	3.8	0.0	10.0	0.0	34.5	81.4	0.0	21.3	44.5	0.0	195.5
PE	19	0	100	0	1,294	244	0	256	668	0	2,580

Basin Ultimate Flows (gpd)

Drainage Basin #	Equestrian Facility	Service	Commerical / Mixed Use	Open Space	Multi-Family	Single Family Estate	Single Family Low	Single Family Med	Single Family High	Patio Homes High	Total Flow per Basin (gpd)
Sec. 14 - 1	0	0	0	0	0	3,090	0	0	0	0	3,090
Sec. 14 - 2	0	0	0	0	0	2,130	0	0	0	0	2,130
Sec. 14 - 3	0	0	0	0	0	6,300	0	0	0	0	6,300
Sec. 14 - 4	0	0	0	0	0	6,120	0	0	0	0	6,120
Sec. 14 - 5	0	0	0	0	0	6,780	0	0	0	0	6,780
Sec. 14 - 6	1,900	0	0	0	0	0	0	0	0	0	1,900
Sec. 14 - 7	0	0	0	0	0	0	0	0	30,750	0	30,750
Sec. 14 - 8	0	0	0	0	0	0	0	25,560	0	0	25,560
Sec. 14 - 9	0	0	0	0	0	0	0	0	36,000	0	36,000
Sec. 14 - 10	0	0	0	0	0	0	0	0	36,000	0	36,000
Sec. 14 - 11	0	0	10,000	0	0	0	0	0	0	0	10,000
Sec. 14 - 12	0	0	0	0	107,625	0	0	0	0	0	107,625
0	0	0	0	0	0	0	0	0	0	0	0
Total	1,900	0	10,000	0	0	24,420	0	25,560	102,750	0	164,630

Flow Peaking Factor, includes I&I	4.0
Peak Flow (gpm)	457
Design Flow	460

Basin Area and Usages (ac)

Drainage Basin #	Equestrian Facility	Service	Commerical / Mixed Use	Open Space	Multi-Family	Single Family Estate	Single Family Low	Single Family Med	Single Family High	Patio Homes	Total
Dwelling Density (units/acre)		13			15	1	3	4	5	6	
Dwelling Population (people/dwelling)		1.5			2.5	3	3	3	3	2.5	
PE/ac	5	19.5	10	0.5	37.5	3	9	12	15	15	
Flow per Person (gpdpc)		100			100	100	100	100	100	100	
Flow per Unit (gpd)	500	150	1000	50	250	300	300	300	300	250	
Flow per Acre (gpapd)	500	1950	1000	50	3750	300	900	1200	1500	1500	
Sec. 15 NE - 1	0.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0
Sec. 15 NE - 2	0.0	0.0	4.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.1
Sec. 15 NE - 3	0.0	0.0	0.0	0.0	9.2	0.0	0.0	0.0	0.0	0.0	9.2
Sec. 15 NE - 4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	2.2
Sec. 15 NE - 5	0.0	8.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.7
Sec. 15 NE - 6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.2	11.2
Sec. 15 NE - 7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.5	0.0	10.5
Sec. 15 NE - 8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.3	0.0	8.3
Sec. 15 NE - 9	0.0	0.0	0.0	4.4	0.0	0.0	0.0	0.0	0.0	0.0	4.4
Total	0.0	8.7	14.1	4.4	9.2	0.0	0.0	0.0	18.8	13.4	68.6
PE	0	170	141	2	345	0	0	0	282	201	1,141

Basin Ultimate Flows (gpd)

Drainage Basin #	Equestrian Facility	Service	Commerical / Mixed Use	Open Space	Multi-Family	Single Family Estate	Single Family Low	Single Family Med	Single Family High	Patio Homes High	Total Flow per Basin (gpd)
Sec. 15 NE - 1	0	0	10,000	0	0	0	0	0	0	0	10,000
Sec. 15 NE - 2	0	0	4,100	0	0	0	0	0	0	0	4,100
Sec. 15 NE - 3	0	0	0	0	34,500	0	0	0	0	0	34,500
Sec. 15 NE - 4	0	0	0	0	0	0	0	0	0	3,300	3,300
Sec. 15 NE - 5	0	16,965	0	0	0	0	0	0	0	0	16,965
Sec. 15 NE - 6	0	0	0	0	0	0	0	0	0	16,800	16,800
Sec. 15 NE - 7	0	0	0	0	0	0	0	0	15,750	0	15,750
Sec. 15 NE - 8	0	0	0	0	0	0	0	0	12,450	0	12,450
Sec. 15 NE - 9	0	0	0	220	0	0	0	0	0	0	220
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
Total	0	16,965	14,100	220	34,500	0	0	0	28,200	20,100	114,085

Flow Peaking Factor, includes I&I	4.0
Peak Flow (gpm)	317
Design Flow	320

Basin Area and Usages (ac)

Drainage Basin #	Equestrian Facility	Service	Commerical / Mixed Use	Open Space	Multi-Family	Single Family Estate	Single Family Low	Single Family Med	Single Family High	Patio Homes	Total
Dwelling Density (units/acre)		13			15	1	3	4	5	6	
Dwelling Population (people/dwelling)		1.5			2.5	3	3	3	3	2.5	
PE/ac	5	19.5	10	0.5	37.5	3	9	12	15	15	
Flow per Person (gpdpc)		100			100	100	100	100	100	100	
Flow per Unit (gpd)	500	150	1000	50	250	300	300	300	300	250	
Flow per Acre (gpapd)	500	1950	1000	50	3750	300	900	1200	1500	1500	
Sec. 10 - 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.5	0.0	36.5
Sec. 10 - 2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.0	0.0	11.0
Sec. 10 - 3	0.0	0.0	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.2
Sec. 10 - 4	0.0	0.0	0.0	5.3	0.0	0.0	0.0	0.0	0.0	0.0	5.3
Sec. 10 - 5	0.0	0.0	0.0	0.0	17.8	0.0	0.0	0.0	0.0	0.0	17.8
Sec. 10 - 6	0.0	0.0	0.0	0.0	12.2	0.0	0.0	0.0	0.0	0.0	12.2
Sec. 10 - 7	0.0	0.0	0.0	0.0	8.5	0.0	0.0	0.0	0.0	0.0	8.5
Sec. 10 - 8	0.0	0.0	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8
Sec. 10 - 9	0.0	0.0	0.0	0.0	16.1	0.0	0.0	0.0	0.0	0.0	16.1
Sec. 10 - 10	0.0	0.0	0.0	0.0	11.4	0.0	0.0	0.0	0.0	0.0	11.4
Sec. 10 - 11	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5
Sec. 10 - 12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.9	13.9
Sec. 10 - 13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.5	0.0	25.5
Total	0.0	0.0	9.5	5.3	66.0	0.0	0.0	0.0	73.0	13.9	167.7
PE	0	0	95	3	2,475	0	0	0	1,095	209	3,876

Basin Ultimate Flows (gpd)

Drainage Basin #	Equestrian Facility	Service	Commerical / Mixed Use	Open Space	Multi-Family	Single Family Estate	Single Family Low	Single Family Med	Single Family High	Patio Homes High	Total Flow per Basin (gpd)
Sec. 10 - 1	0	0	0	0	0	0	0	0	54,750	0	54,750
Sec. 10 - 2	0	0	0	0	0	0	0	0	16,500	0	16,500
Sec. 10 - 3	0	0	3,200	0	0	0	0	0	0	0	3,200
Sec. 10 - 4	0	0	0	265	0	0	0	0	0	0	265
Sec. 10 - 5	0	0	0	0	66,750	0	0	0	0	0	66,750
Sec. 10 - 6	0	0	0	0	45,750	0	0	0	0	0	45,750
Sec. 10 - 7	0	0	0	0	31,875	0	0	0	0	0	31,875
Sec. 10 - 8	0	0	3,800	0	0	0	0	0	0	0	3,800
Sec. 10 - 9	0	0	0	0	60,375	0	0	0	0	0	60,375
Sec. 10 - 10	0	0	0	0	60,375	0	0	0	0	0	60,375
Sec. 10 - 11	0	0	2,500	0	0	0	0	0	0	0	2,500
Sec. 10 - 12	0	0	0	0	0	0	0	0	0	20,850	20,850
Sec. 10 - 13	0	0	0	0	0	0	0	0	38,220	0	38,220
Total	0	0	9,500	265	265,125	0	0	0	71,250	0	346,140

Flow Peaking Factor, includes I&I	4.0
Peak Flow (gpm)	962
Design Flow	970

Basin Area and Usages (ac)

Drainage Basin #	Equestrian Facility	Service	Commerical / Mixed Use	Open Space	Multi-Family	Single Family Estate	Single Family Low	Single Family Med	Single Family High	Patio Homes	Total
Dwelling Density (units/acre)		13			15	1	3	4	5	6	
Dwelling Population (people/dwelling)		1.5			2.5	3	3	3	3	2.5	
PE/ac	5	19.5	10	0.5	37.5	3	9	12	15	15	
Flow per Person (gpdpc)		100			100	100	100	100	100	100	
Flow per Unit (gpd)	500	150	1000	50	250	300	300	300	300	250	
Flow per Acre (gpapd)	500	1950	1000	50	3750	300	900	1200	1500	1500	
Sec. 15 S - 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.7	0.0	0.0	18.7
Sec. 15 S - 2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.9	0.0	14.9
Sec. 15 S - 3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.8	22.8
Sec. 15 S - 4	0.0	0.0	4.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.7
Total	0.0	0.0	4.7	0.0	0.0	0.0	0.0	18.7	14.9	22.8	61.1
PE	0	0	47	0	0	0	0	224	224	342	837

Basin Ultimate Flows (gpd)

Drainage Basin #	Equestrian Facility	Service	Commerical / Mixed Use	Open Space	Multi-Family	Single Family Estate	Single Family Low	Single Family Med	Single Family High	Patio Homes High	Total Flow per Basin (gpd)
Sec. 15 S - 1	0	0	0	0	0	0	0	22,440	0	0	22,440
Sec. 15 S - 2	0	0	0	0	0	0	0	0	22,350	0	22,350
Sec. 15 S - 3	0	0	0	0	0	0	0	0	0	34,200	34,200
Sec. 15 S - 4	0	0	4,700	0	0	0	0	0	0	0	4,700
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	4,700	0	0	0	0	22,440	22,350	34,200	83,690

Flow Peaking Factor, includes I&I	4.0
Peak Flow (gpm)	232
Design Flow	240

Basin Area and Usages (ac)

Drainage Basin #	Equestrian Facility	Service	Commerical / Mixed Use	Open Space	Multi-Family	Single Family Estate	Single Family Low	Single Family Med	Single Family High	Patio Homes	Total
Dwelling Density (units/acre)		13			15	1	3	4	5	6	
Dwelling Population (people/dwelling)		1.5			2.5	3	3	3	3	2.5	
PE/ac	5	19.5	10	0.5	37.5	3	9	12	15	15	
Flow per Person (gpdpc)		100			100	100	100	100	100	100	
Flow per Unit (gpd)	500	150	1000	50	250	300	300	300	300	250	
Flow per Acre (gpapd)	500	1950	1000	50	3750	300	900	1200	1500	1500	
Ex. Post Oak - 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.9	0.0	9.9
Ex. Post Oak - 2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.3	0.0	25.3
Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.2	0.0	35.2
PE	0	0	0	0	0	0	0	0	528	0	528

Basin Ultimate Flows (gpd)

Drainage Basin #	Equestrian Facility	Service	Commerical / Mixed Use	Open Space	Multi-Family	Single Family Estate	Single Family Low	Single Family Med	Single Family High	Patio Homes High	Total Flow per Basin (gpd)
Ex. Post Oak - 1	0	0	0	0	0	0	0	0	14,850	0	14,850
Ex. Post Oak - 2	0	0	0	0	0	0	0	0	37,950	0	37,950
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	52,800	0	52,800

Flow Peaking Factor, includes I&I	4.0
Peak Flow (gpm)	147
Design Flow	150

Attachment #2

Pressure Loss and System Curve Calculations

Attachment #2-1 8" PVC Force Main LS Sec. 14 to LS NE Sec. 15 - NA
Attachment #2-2 8" PVC Force Main LS NE Sec. 15 to LS NE Sec. 10
Attachment #2-3 12" PVC Force Main LS Sec. 10 to 24" Gravity Sewer- NA

System Curve
LS Sec. 14 - LS Sec. 15 NE
Norman, Oklahoma

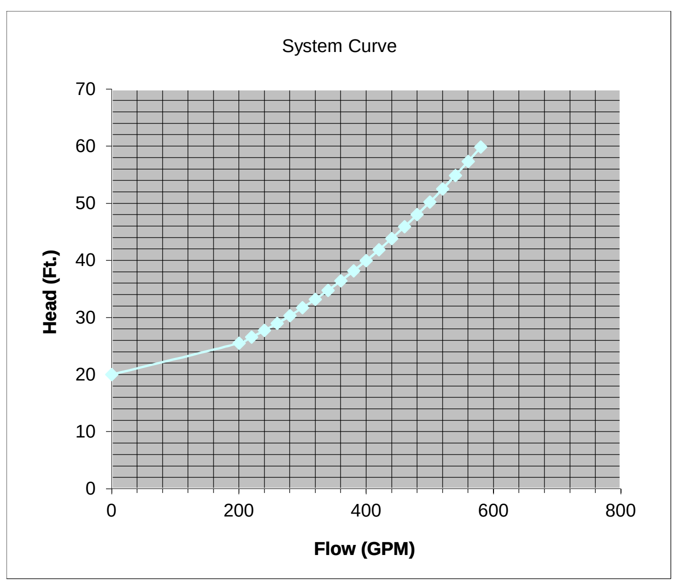
AWWA D900 - DR 14 - Class 200 PVC

Nominal Pipe Size	8		
ID (in.)	7.758	Suction Head	1105
OD (in.)	9.05	Discharge Head	1125
SDR	12.01	Other	0
Area (ft^2)	0.33	Static Head	20
Chw	140.00		
# of Heads	0		
Increment	20.00		

Flow (gpm)	Flow (ft^3/s)	Velocity (ft/s)	Velocity Head (ft)	Friction Loss (ft/100ft.)	Total Friction Loss (ft/100ft.)	Minor Losses (ft)	Total Dynamic Head (ft)	System Curve (ft)
0								20
200.00	0.4456	1.358	0.029	0.094	5.35	0.17	5.5	25.5
220.00	0.4902	1.493	0.035	0.112	6.38	0.21	6.6	26.6
240.00	0.5348	1.629	0.041	0.132	7.49	0.25	7.7	27.7
260.00	0.5793	1.765	0.048	0.153	8.69	0.29	9.0	29.0
280.00	0.6239	1.901	0.056	0.175	9.97	0.34	10.3	30.3
300.00	0.6684	2.036	0.064	0.199	11.33	0.39	11.7	31.7
320.00	0.7130	2.172	0.073	0.224	12.76	0.44	13.2	33.2
340.00	0.7576	2.308	0.083	0.251	14.28	0.50	14.8	34.8
360.00	0.8021	2.444	0.093	0.279	15.87	0.56	16.4	36.4
380.00	0.8467	2.579	0.103	0.308	17.55	0.62	18.2	38.2
400.00	0.8913	2.715	0.114	0.339	19.29	0.69	20.0	40.0
420.00	0.9358	2.851	0.126	0.371	21.12	0.76	21.9	41.9
440.00	0.9804	2.987	0.139	0.405	23.02	0.83	23.9	43.9
460.00	1.0250	3.122	0.151	0.439	24.99	0.91	25.9	45.9
480.00	1.0695	3.258	0.165	0.475	27.04	0.99	28.0	48.0
500.00	1.1141	3.394	0.179	0.513	29.17	1.07	30.2	50.2
520.00	1.1586	3.530	0.193	0.551	31.37	1.16	32.5	52.5
540.00	1.2032	3.665	0.209	0.591	33.64	1.25	34.9	54.9
560.00	1.2478	3.801	0.224	0.632	35.98	1.35	37.3	57.3
580.00	1.2923	3.937	0.241	0.675	38.39	1.44	39.8	59.8

Length of Line 5690

Minor Losses	K	Number	
90 deg. bend	0.3	4	1.20
45 deg. Bend	0.17	0	0.00
22.5 deg. Bend	0.1	0	0.00
Gate Valve	0.1	2	0.20
Check Valve	2	1	2.00
Tee side	0.6	1	0.60
Tee Through	0.15	0	0.00
Entrance	1	1	1.00
Exit	1	1	1.00
Foot Valve	0.8	0	0.00
Basket Strainer	1	0	0.00
			6.00



System Curve
LS Sec. 15 NE - LS Sec. 10
Norman, Oklahoma

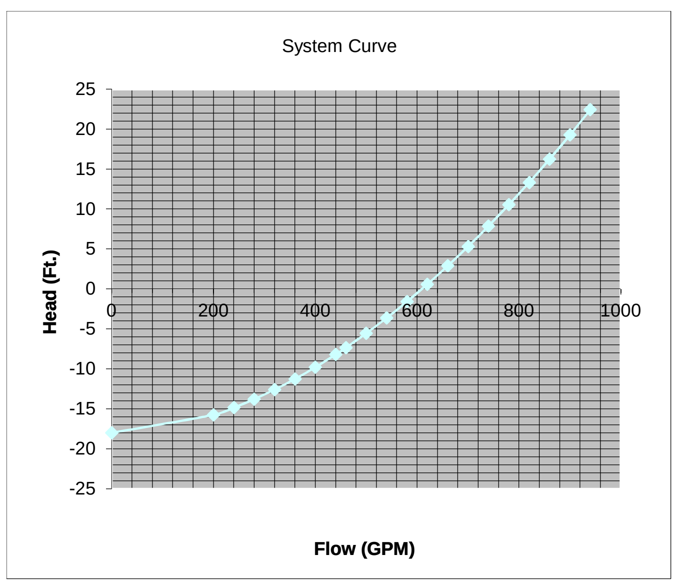
AWWA D900 - DR 14 - Class 200 PVC

Nominal Pipe Size	8		
ID (in.)	7.758	Suction Head	1138
OD (in.)	9.05	Discharge Head	1120
SDR	12.01	Other	0
Area (ft^2)	0.33	Static Head	-18
Chw	140.00		
# of Heads	0		
Increment	40.00		

Flow (gpm)	Flow (ft^3/s)	Velocity (ft/s)	Velocity Head (ft)	Friction Loss (ft/100ft.)	Total Friction Loss (ft/100ft.)	Minor Losses (ft)	Total Dynamic Head (ft)	System Curve (ft)
0								-18
200.00	0.4456	1.358	0.029	0.094	2.09	0.17	2.3	-15.7
240.00	0.5348	1.629	0.041	0.132	2.92	0.25	3.2	-14.8
280.00	0.6239	1.901	0.056	0.175	3.89	0.34	4.2	-13.8
320.00	0.7130	2.172	0.073	0.224	4.98	0.44	5.4	-12.6
360.00	0.8021	2.444	0.093	0.279	6.19	0.56	6.7	-11.3
400.00	0.8913	2.715	0.114	0.339	7.53	0.69	8.2	-9.8
440.00	0.9804	2.987	0.139	0.405	8.98	0.83	9.8	-8.2
460.00	1.0250	3.122	0.151	0.439	9.75	0.91	10.7	-7.3
500.00	1.1141	3.394	0.179	0.513	11.38	1.07	12.5	-5.5
540.00	1.2032	3.665	0.209	0.591	13.12	1.25	14.4	-3.6
580.00	1.2923	3.937	0.241	0.675	14.98	1.44	16.4	-1.6
620.00	1.3815	4.208	0.275	0.763	16.95	1.65	18.6	0.6
660.00	1.4706	4.480	0.312	0.857	19.03	1.87	20.9	2.9
700.00	1.5597	4.751	0.351	0.956	21.22	2.10	23.3	5.3
740.00	1.6488	5.023	0.392	1.059	23.52	2.35	25.9	7.9
780.00	1.7380	5.294	0.435	1.168	25.93	2.61	28.5	10.5
820.00	1.8271	5.566	0.481	1.281	28.44	2.89	31.3	13.3
860.00	1.9162	5.837	0.529	1.399	31.07	3.17	34.2	16.2
900.00	2.0053	6.109	0.579	1.522	33.80	3.48	37.3	19.3
940.00	2.0945	6.380	0.632	1.650	36.63	3.79	40.4	22.4

Length of Line 2220

Minor Losses	K	Number	
90 deg. bend	0.3	4	1.20
45 deg. Bend	0.17	0	0.00
22.5 deg. Bend	0.1	0	0.00
Gate Valve	0.1	2	0.20
Check Valve	2	1	2.00
Tee side	0.6	1	0.60
Tee Through	0.15	0	0.00
Entrance	1	1	1.00
Exit	1	1	1.00
Foot Valve	0.8	0	0.00
Basket Strainer	1	0	0.00
			6.00



System Curve
LS Sec. 10 - MH
Norman, Oklahoma

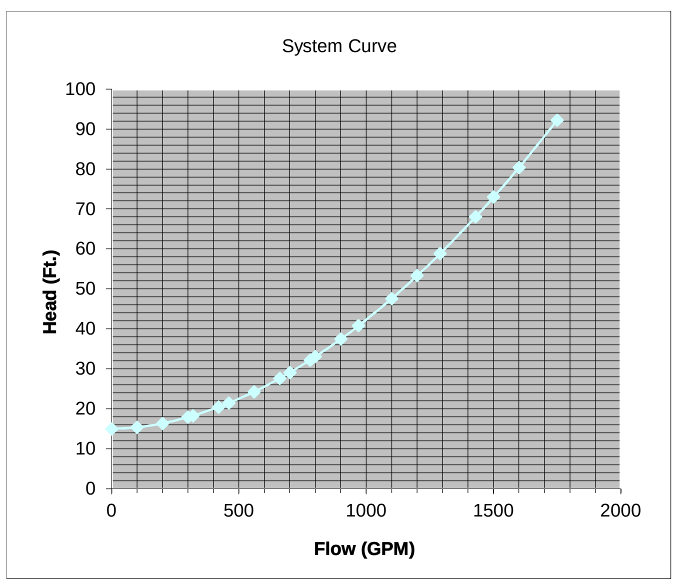
AWWA D900 - DR 14 - Class 200 PVC

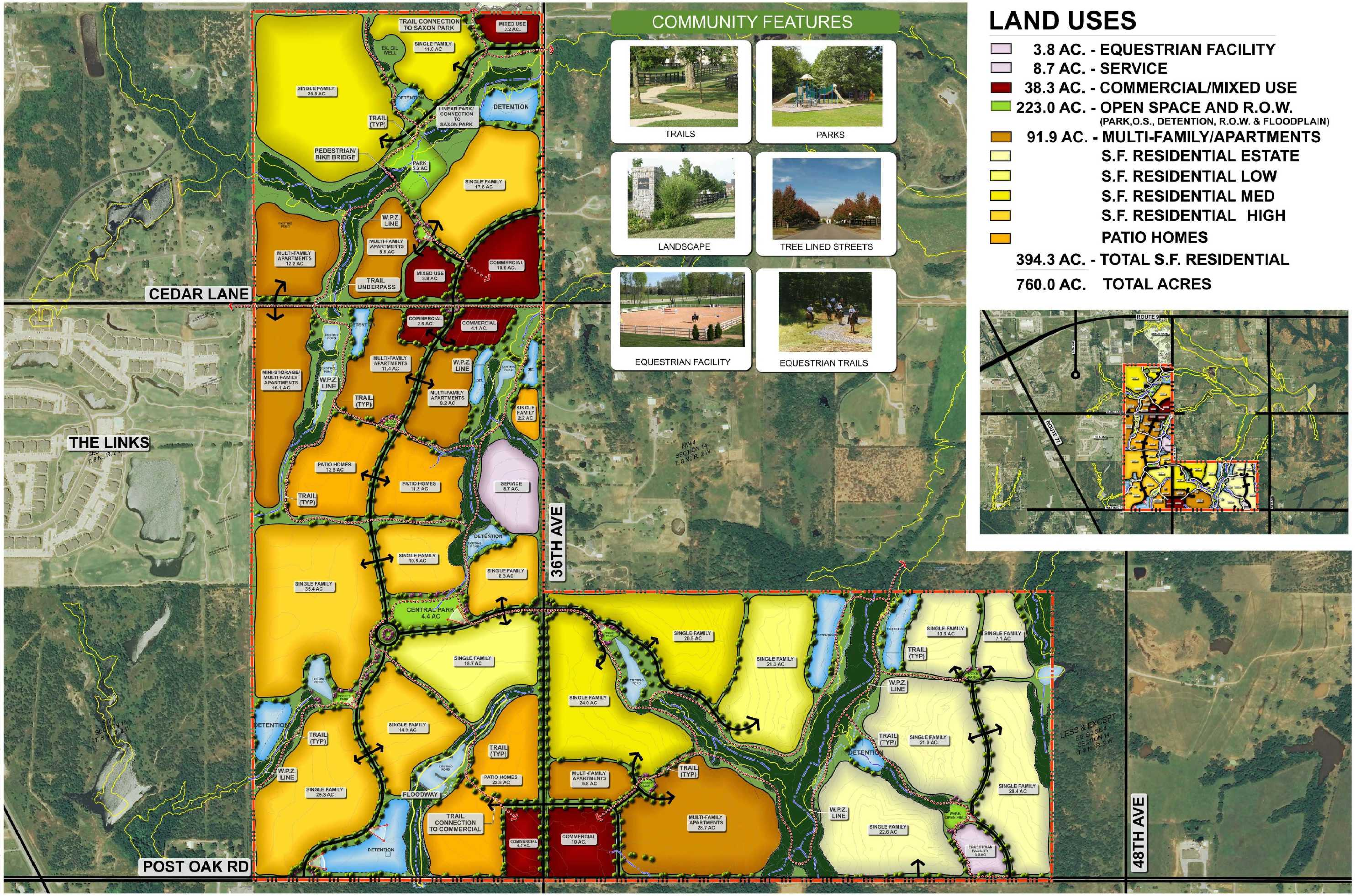
Nominal Pipe Size	12		
ID (in.)	11.314	Suction Head	1110
OD (in.)	13.2	Discharge Head	1125
SDR	12.00	Other	0
Area (ft^2)	0.70	Static Head	15
Chw	140.00		
# of Heads	0		
Increment	100.00		

Flow (gpm)	Flow (ft^3/s)	Velocity (ft/s)	Velocity Head (ft)	Friction Loss (ft/100ft.)	Total Friction Loss (ft/100ft.)	Minor Losses (ft)	Total Dynamic Head (ft)	System Curve (ft)
0								15
100.00	0.2228	0.319	0.002	0.004	0.37	0.01	0.4	15.4
200.00	0.4456	0.638	0.006	0.015	1.34	0.04	1.4	16.4
300.00	0.6684	0.957	0.014	0.032	2.84	0.09	2.9	17.9
320.00	0.7130	1.021	0.016	0.036	3.20	0.10	3.3	18.3
420.00	0.9358	1.340	0.028	0.059	5.29	0.17	5.5	20.5
460.00	1.0250	1.468	0.033	0.070	6.26	0.20	6.5	21.5
560.00	1.2478	1.787	0.050	0.101	9.01	0.30	9.3	24.3
660.00	1.4706	2.106	0.069	0.136	12.21	0.41	12.6	27.6
700.00	1.5597	2.234	0.077	0.152	13.62	0.46	14.1	29.1
780.00	1.7380	2.489	0.096	0.186	16.64	0.58	17.2	32.2
800.00	1.7825	2.553	0.101	0.195	17.44	0.61	18.0	33.0
900.00	2.0053	2.872	0.128	0.242	21.69	0.77	22.5	37.5
970.00	2.1613	3.096	0.149	0.278	24.92	0.89	25.8	40.8
1100.00	2.4510	3.511	0.191	0.351	31.45	1.15	32.6	47.6
1200.00	2.6738	3.830	0.228	0.413	36.95	1.37	38.3	53.3
1290.00	2.8743	4.117	0.263	0.472	42.25	1.58	43.8	58.8
1430.00	3.1863	4.564	0.323	0.571	51.13	1.94	53.1	68.1
1500.00	3.3422	4.787	0.356	0.624	55.86	2.14	58.0	73.0
1600.00	3.5651	5.106	0.405	0.703	62.95	2.43	65.4	80.4
1750.00	3.8993	5.585	0.484	0.830	74.31	2.91	77.2	92.2

Length of Line 8950

Minor Losses	K	Number	
90 deg. bend	0.3	4	1.20
45 deg. Bend	0.17	0	0.00
22.5 deg. Bend	0.1	0	0.00
Gate Valve	0.1	2	0.20
Check Valve	2	1	2.00
Tee side	0.6	1	0.60
Tee Through	0.15	0	0.00
Entrance	1	1	1.00
Exit	1	1	1.00
Foot Valve	0.8	0	0.00
Basket Strainer	1	0	0.00
			6.00





CONCEPT PLAN 'A'

760 ACRE SITE

NORMAN, OKLAHOMA

HRGreen

OCTOBER 8, 2014

WASTEWATER COLLECTION SYSTEM STUDY

Developer Supplied Master Plan

S.E. Development - Norman, Oklahoma

6730 Cedar Lane
Norman, OK 73026
TEL. (405)364-0900
Oklahoma C.A. No. 106 Renewal 6-30-15

SEARCH, INC.
SYSTEMS ENGINEERING AND RESEARCH

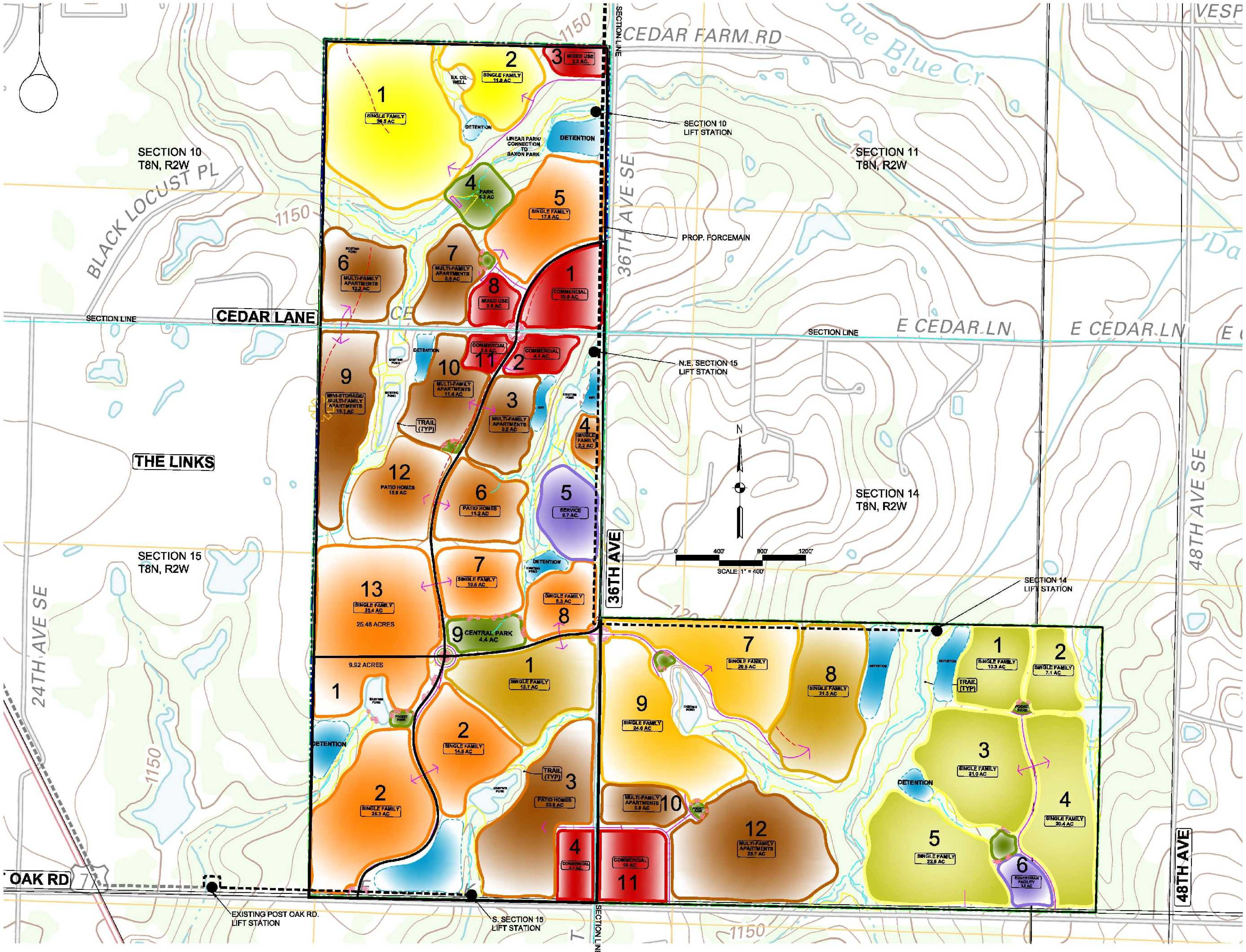
REV.	DATE	NAME

DESIGNED: P. Streebin
DRAWN: L. Brower
APPROVED: P. Streebin
DATE: 01/08/15

REGISTERED PROFESSIONAL ENGINEER PERRY L. STREEBIN 14623 OKLAHOMA

SHEET EX. 1

Drawing for Review only unless Signature and Date are Originals



WASTEWATER COLLECTION
SYSTEM STUDY

Drainage Area And Land Usage Map

S.E. Development - Norman, Oklahoma

6730 Cedar Lane
Norman, OK 73026
TEL. (405)364-0900
Oklahoma C.A. No. 106 Renewal 6-30-15

SEARCH, INC.
SYSTEMS ENGINEERING AND RESEARCH

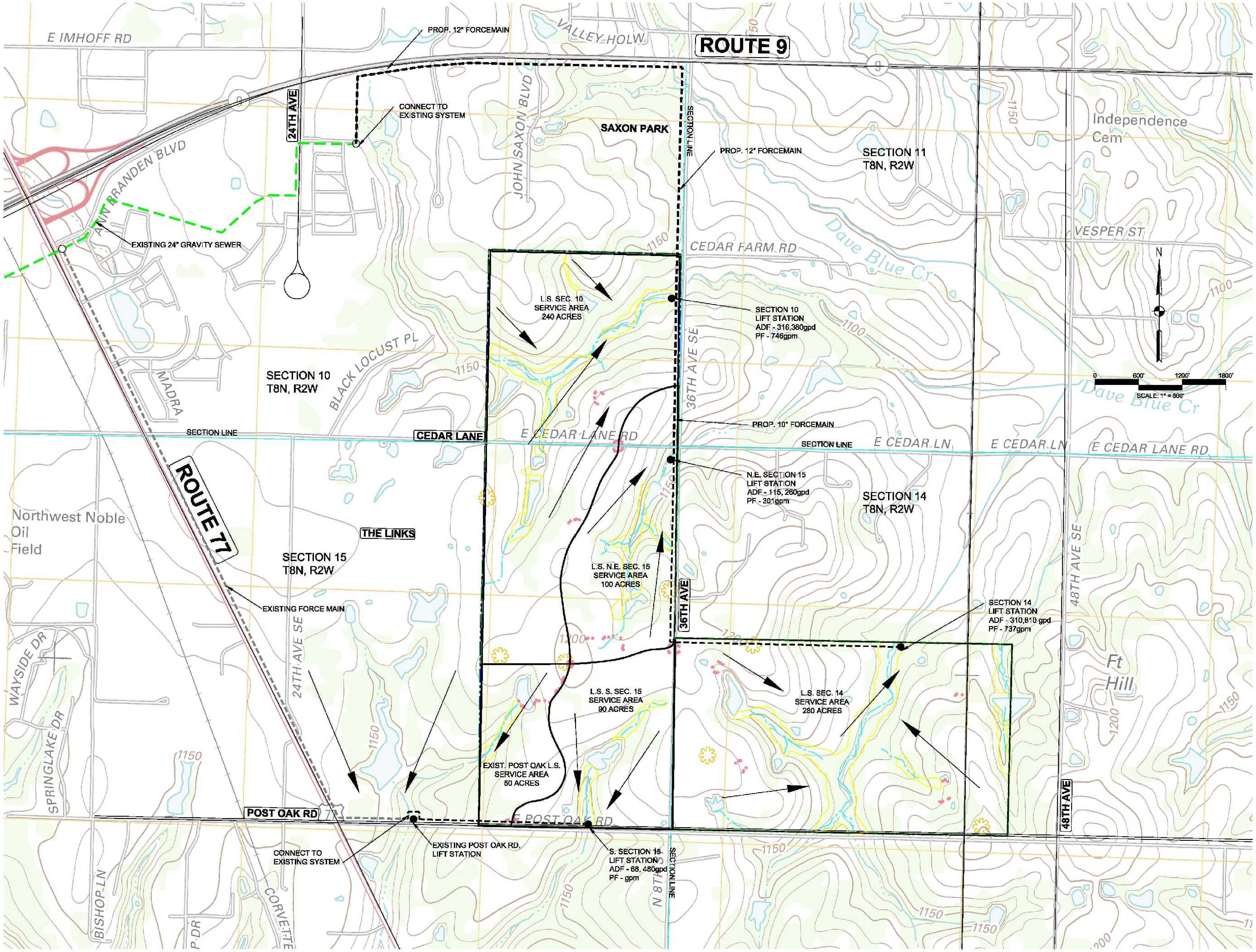
DESIGNED:	P. Streebin
DRAWN:	L. Brewer
APPROVED:	P. Streebin
DATE:	01/06/15

REV.	DATE	NAME

REGISTERED PROFESSIONAL ENGINEER
PERRY L. STREEBIN
14623
OKLAHOMA

SHEET
EX. 2

Drawing for Review only unless Signature and Date are Originals



WASTEWATER COLLECTION SYSTEM STUDY

Overall Layout

S.E. Development, Norman, Oklahoma

6730 Cedar Lane
Norman, OK 73026
TEL. (405)364-0900
Oklahoma C.A. No. 106 Renewal 6-30-15

SEARCH, INC.
SYSTEMS ENGINEERING AND RESEARCH

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DESIGNED: P. Streebin
DRAWN: L. Brewer
APPROVED: P. Streebin
DATE: 01/08/15

REGISTERED PROFESSIONAL ENGINEER
PERRY L. STREEBIN
14623
OKLAHOMA

SHEET
EX. 3

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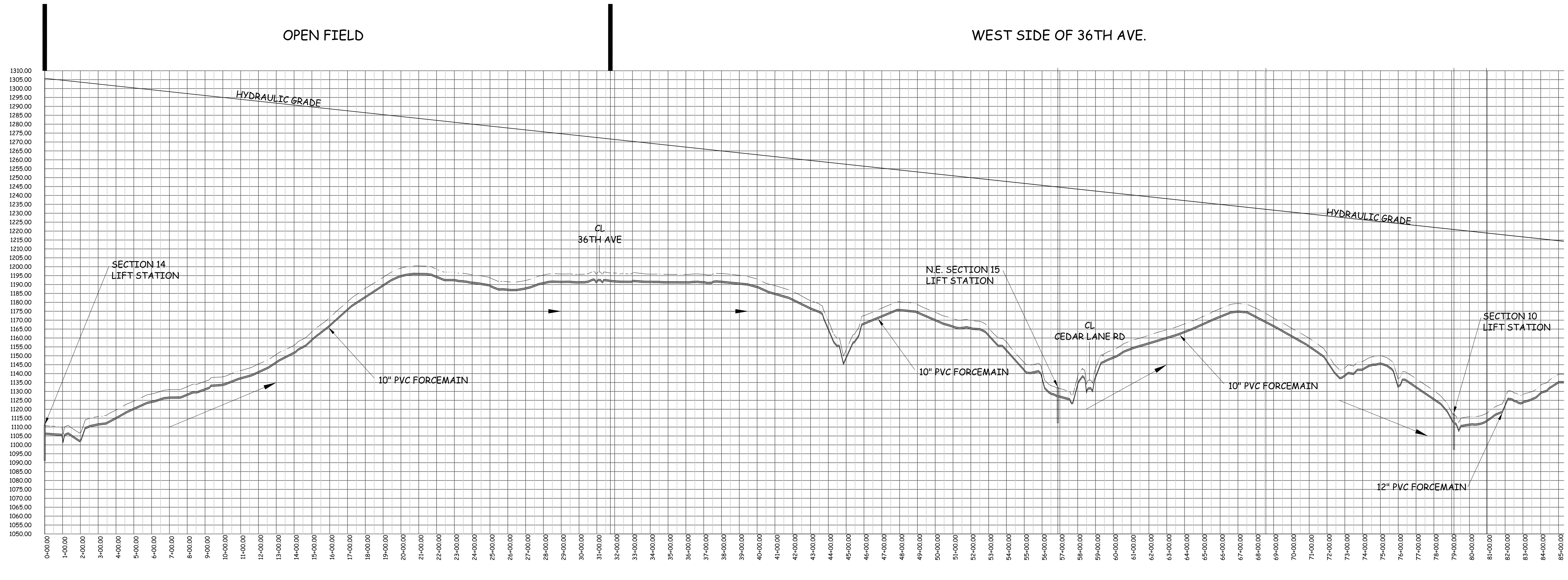
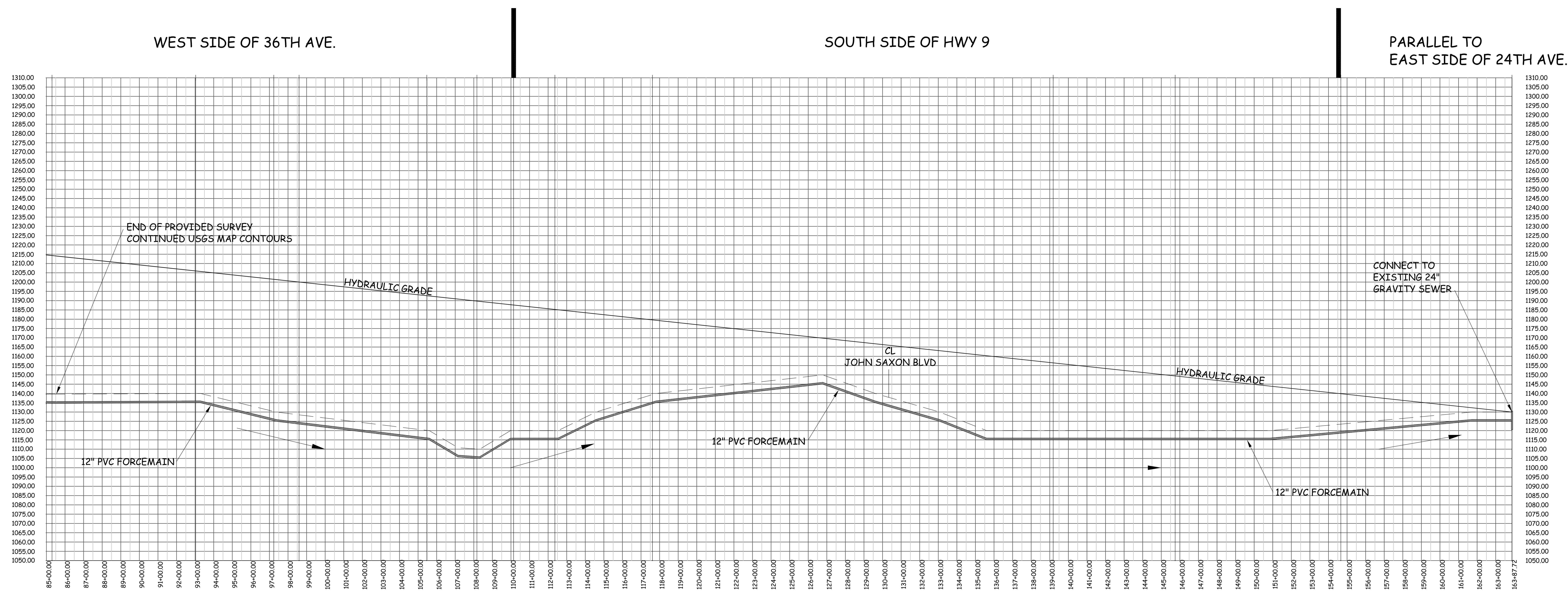




WASTEWATER COLLECTION
SYSTEM STUDY

Preliminary Force Main and Hydraulic Profile
S.E. Development - Norman , Oklahoma

6730 Cedar Lane
Norman, OK 73026
TEL. (405)364-0900
Oklahoma C.A. No. 106 Renewal 6-30-15

SEARCH, INC.
SYSTEMS ENGINEERING AND RESEARCH

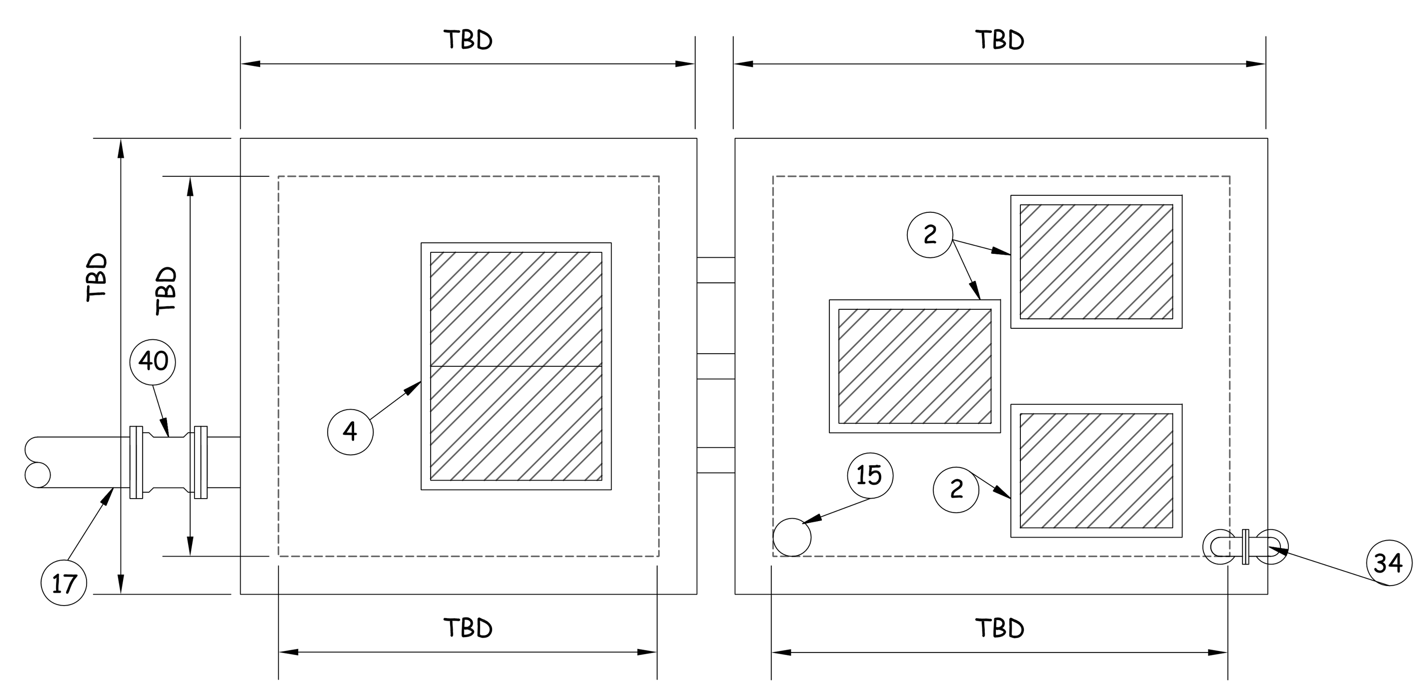
REV.	DATE	NAME

DESIGNED: P. Streebin
DRAWN: L. Brewer
APPROVED: P. Streebin
DATE: 01/08/15

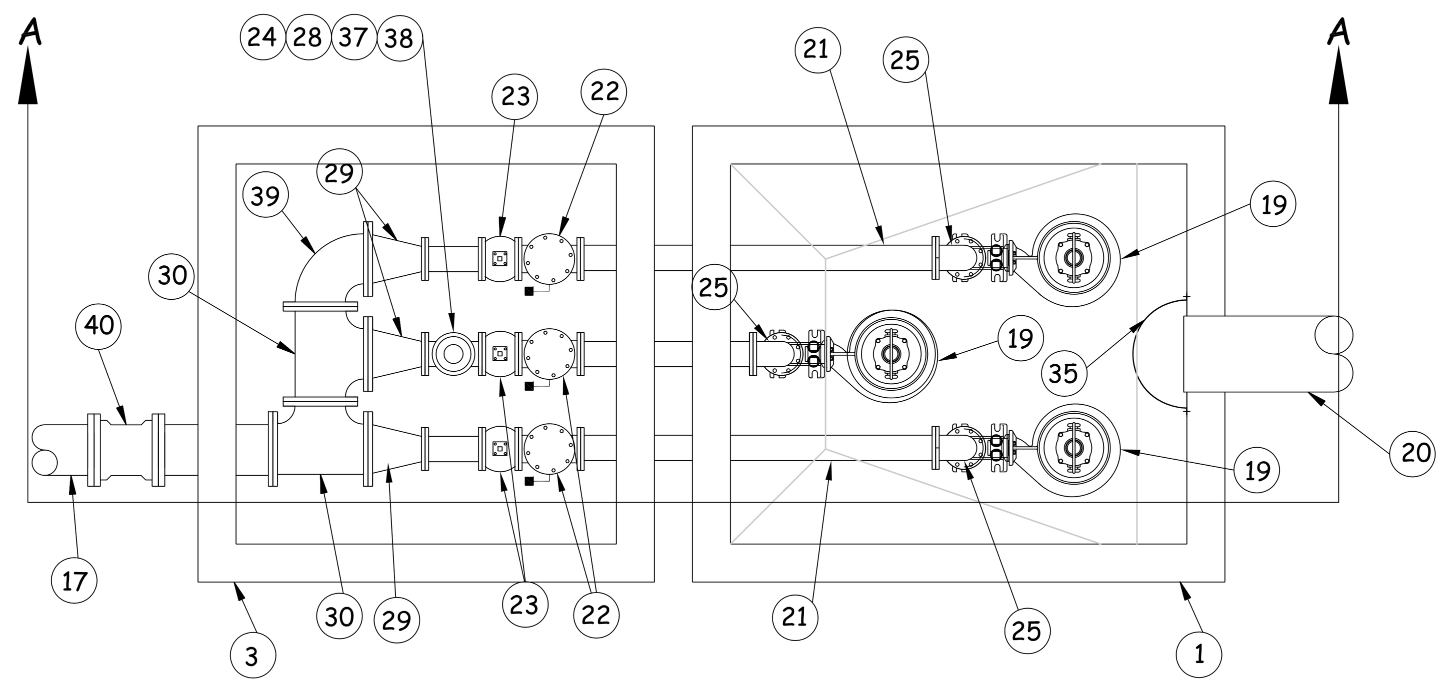
REGISTERED PROFESSIONAL ENGINEER
PERRY L. STREEBIN
14623
OKLAHOMA

Drawing for Review only unless Signature and Date are Originals

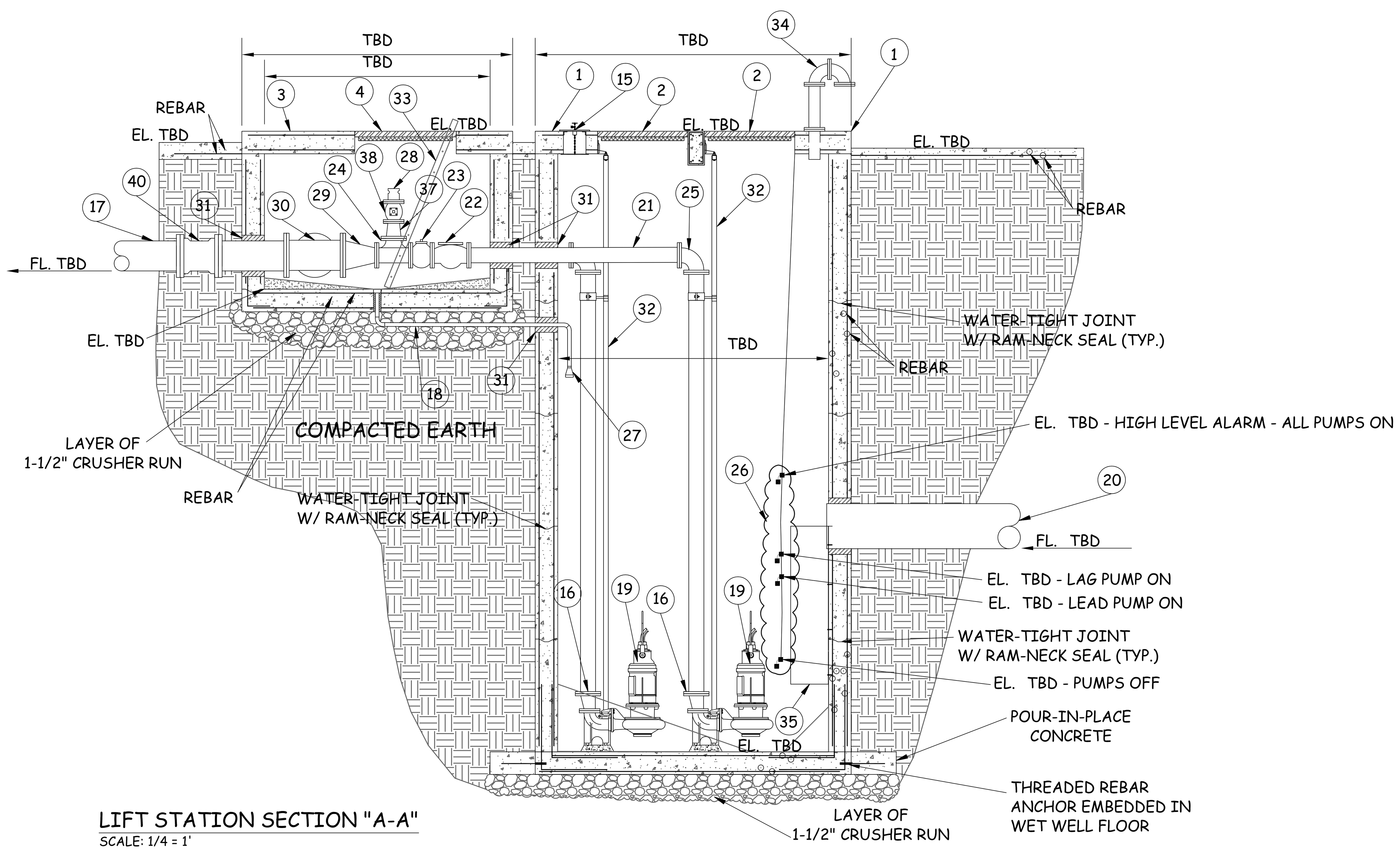
SHEET
EX. 4



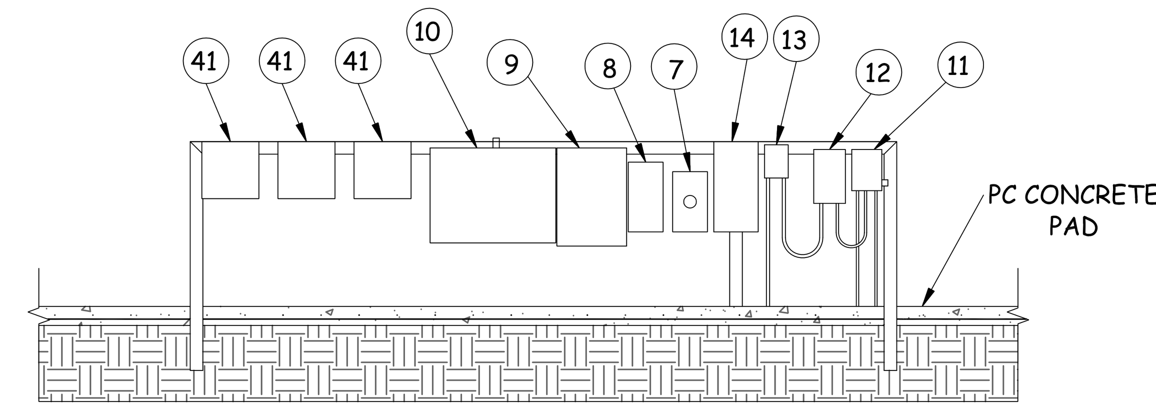
PLAN VIEW
SCALE: 1/4 = 1'



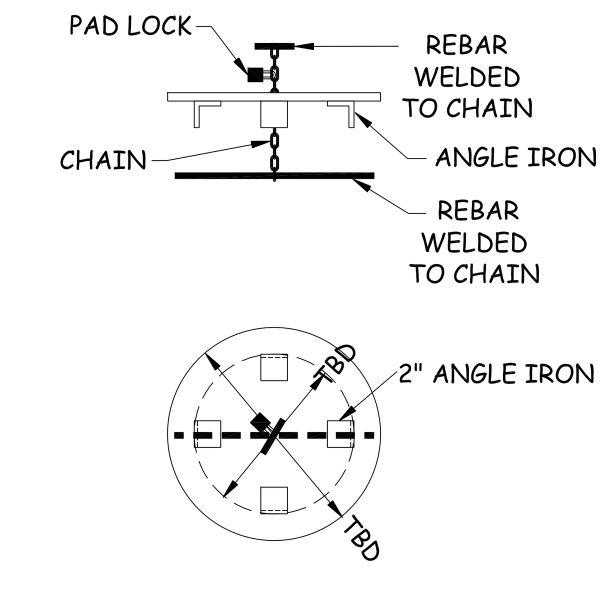
PIPING PLAN VIEW
SCALE: 1/4 = 1'



LIFT STATION SECTION "A-A"
SCALE: 1/4 = 1'



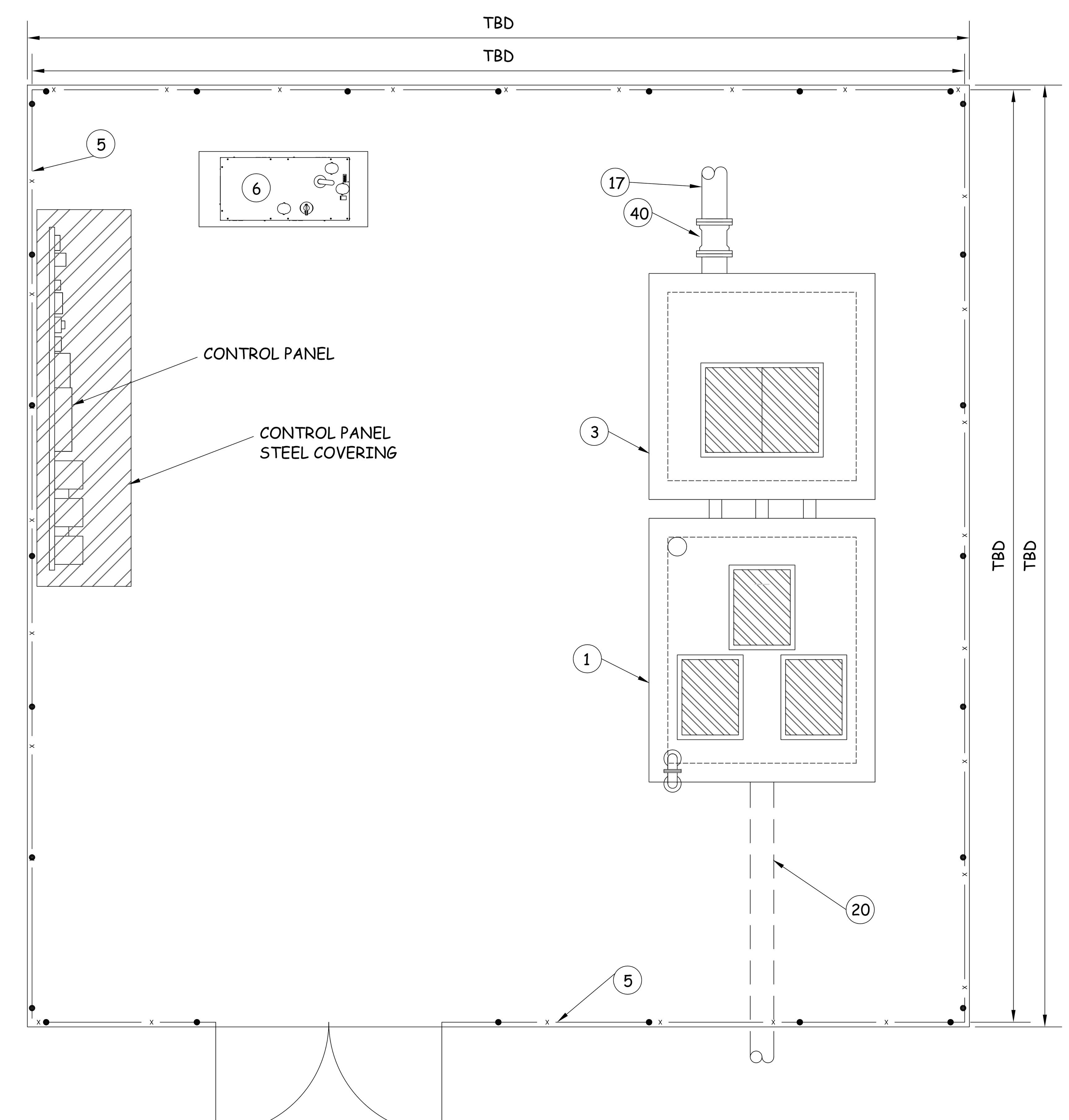
CONTROL PANEL DETAILS
SCALE: 1/4 = 1'



ACCESS HOLE COVER DETAIL
SCALE: 1" = 1'

KEYED NOTES

1. LIFT STATION
2. LIFT STATION ACCESS HATCH W/ ORANGE SAFETY GRATE
3. VALVE VAULT
4. VALVE VAULT ACCESS HATCH W/ ORANGE SAFETY GRATE
5. SECURITY FENCE
6. STANDBY GENERATOR
7. ELECTRICAL SERVICE MASTER METER
8. BREAKER BOX
9. AUTO TRANSFER SWITCH
10. CONTROL PANEL
11. 240 BREAKER PANEL
12. 480/240 TRANSFORMER
13. TRANSFORMER DISCONNECT
14. MASTER DISCONNECT
15. EMERGENCY ACCESS HOLE W/ GALVANIZED CHECKER PLATE COVER
16. ECCENTRIC REDUCER
17. FORCEMAIN
18. DRAIN PIPE W/ DRAIN
19. PUMPS
20. GRAVITY SEWER PIPE
21. D.I.P.
22. CHECK VALVE W/ LEVER AND WEIGHT
23. FLANGED PLUG VALVE
24. FLANGED D.I.P. TEE
25. FLANGED 90° BEND
26. LEVEL SENSOR
27. TIDEFLEX SERIES TF-2 CHECK VALVE
28. QUICK CONNECT FITTING
29. FLANGED REDUCER
30. FLANGED TEE
31. LINK SEAL - AROUND ALL PIPE OPENINGS
32. S.S. GUIDE RAIL PIPE
33. ALUMINUM LADDER
34. 90° ELL VENT PIPE W/ CORROSION RESISTANT #24 MESH
35. S.S. INFLUENT WEIR
36. OMITTED
37. FLANGED REDUCER
38. FLANGED PLUG VALVE
39. FLANGED 90° BEND
40. MJ TRANSITION SLEEVE
41. VARIBLE-FREQUENCY DRIVE



SITE PLAN
SCALE: 1" = 5'

WASTEWATER COLLECTION AND TREATMENT SYSTEM

Example of Typical Lift Station
S.E. Development - Norman, Oklahoma

6730 Cedar Lane
Norman, OK 73026
TEL. (405)364-0900
Oklahoma C.A. No. 106 Renewal 6-30-15

SEARCH, INC.
SYSTEMS ENGINEERING AND RESEARCH

REV.	DATE	NAME

DESIGNED: P. Streebin
DRAWN: P. Streebin
APPROVED: P. Streebin
DATE: P. Streebin

SHEET
EX. 4