HILGARTWILSON
ENGINEER | PLAN | SURVEY | MANAGE

PRELIMINARY WATER REPORT

FOR

LAKIN – PHASE 1

GOODYEAR, ARIZONA

CITY OF Goodyear

Approved by City of Goodyear

10/27/2020

20-60000021 - LAKIN PARK PHASE 1

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May 2020
Project No. 1981.02

PRELIMINARY WATER REPORT
FOR
LAKIN – PHASE 1

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1.0 INTRODUCTION

1.1 Background & Project Location

Lakin – Phase 1 (the Project) is a proposed industrial site located along Cotton Lane, south of Maricopa County Route 85 (MC-85) and the Union Pacific Railroad (UPRR) in Goodyear, Arizona. The Project consists of approximately 89.0 gross acres in a portion of Section 26 of Township 1 North, Range 2 West of the Gila and Salt River Baseline and Meridian. The property is bound by MC-85 and the UPRR to the north, the Buckeye Canal to the south, Cotton Road to the east, and undeveloped agricultural land to the west. Figure 1 in Appendix A provides a vicinity map for the Project.

1.2 General Description

At build-out, the Project will consist of approximately 1.26 million square feet of building area across two buildings to be developed in one phase. The Project will also contain approximately 5.7 acres of non-residential use, comprised of commercial and/or public safety (fire station) properties as well as a wastewater lift station. The commercial and/or public safety portion of the site are not anticipated to develop at this time and are therefore not included in this report.

The Project is located within the City of Goodyear water service area and is situated within the Central Planning Area Pressure Zone of the City's Water Planning Area 2 (WPA2). City of Goodyear maintains a 100-year designation of assured water supply that demonstrates the City's ability to provide continuous availability of physical water resources and the legal right to use them to serve the City's customers. The water system infrastructure required for the Project and discussed in this report will tie into existing City of Goodyear water system infrastructure and will be owned and operated by the City of Goodyear.

1.3 Purpose of Report

This Preliminary Water Report has been prepared in support of the preliminary plat prepared for the Project. All development projects shall be responsible for determining their specific water system needs. Services for proposed developments shall not be provided at the expense of existing customers.

The purpose of this Preliminary Water Report is to identify and evaluate the proposed water system infrastructure for serving the Project in accordance with the design criteria established in the City of Goodyear *2016 Integrated Water Master Plan* (Carollo 2016) and Chapter 5 of the City of Goodyear *Engineering Design Standards and Policies Manual* (Goodyear 2017). This Preliminary Water Report discusses the existing water infrastructure within the Project vicinity and identifies anticipated demands for average day, maximum day, peak hour, and maximum day plus fire flow conditions. It also identifies anticipated water line sizes and alignments for the Project and presents results from a hydraulic model of the proposed water infrastructure.

In February 2019, HILGARTWILSON prepared the Master Water Report for Lakin (HILGARTWILSON 2019), which is currently being reviewed by the City of Goodyear.

The Master Water Report discussed general water service concepts, potential phasing, and identified preliminary water line sizing for the overall Lakin community.

1.4 Existing Conditions

The Project site is currently undeveloped agricultural land that is actively being farmed. The site and surrounding area generally slope to the south-southwest at a rate of 0.2 percent. The site contains an existing Flood Control District of Maricopa County (FCDMC) drainage structure, irrigation canals, a natural gas line, as well as various easements for electrical, drainage, and other utilities throughout the Project. There is also an existing 96-inch regional effluent line parallel to the Buckeye Canal, which serves the Palo Verde Nuclear Generating Station.

2.0 PROJECTED SYSTEM DEMANDS

2.1 City of Goodyear Water Demand Criteria

The proposed water distribution system for the Project has been prepared consistent with the design criteria provided in the City of Goodyear *2016 Integrated Water Master Plan* (Carollo 2016) and Chapter 5 of the City of Goodyear *Engineering Design Standards and Policies Manual* (Goodyear 2017). A summary of the water demand factors and the peaking factors from the design criteria are shown in Table 1 below.

TABLE 1
WATER DEMAND FACTORS[1]

Category		Value	Unit
Average Day Water Demand			
	General Industrial	0.16	gpd/sq.ft.
	Low Water Use Irrigation (Open Space)[2]	1,700	gpd/acre
Peaking Factors (Domestic)			
	Maximum Day	1.70	x Average Day
	Peak Hour	2.90	x Average Day
Peaking Factors (Irrigation)			
	Maximum Day/Peak Hour	1.80	x Average Day
Fire Flow Demand			
	Building A	3,500	gpm for 3 hours
	Building B	3,500	gpm for 3 hours

Notes:
1. Demand criteria based on the City of Goodyear *2016 Integrated Water Master Plan* (Carollo 2016) and the City of Goodyear *Engineering Design Standards and Policies Manual* (Goodyear 2017).
2. Irrigation demands are included as it is anticipated that a reclaimed water system will not be constructed within the Project.

2.2 Water Demand Calculations

Anticipated water demands for the Project have been calculated in accordance with the design criteria listed in Table 1. The projected water demands for the Project are summarized by parcel in Table 2 below. The demands shown in the Table 2 include irrigation demands as it is anticipated that the Project will not have a separate reclaimed water system to serve the irrigation demands throughout the Project. Table B.1 in Appendix B presents more detailed water demand calculations for the Project.

TABLE 2
TOTAL WATER DEMAND SUMMARY

Building	Building Area	Average Day Demand		Maximum Day Demand		Peak Hour Demand	
	(sq.ft.)	gpd	gpm	gpd	gpm	gpd	gpm
A	730,502	124,530	86.5	212,467	147.5	352,723	244.9
B	531,758	92,731	64.4	158,408	110.0	260,506	180.9
Total:	**1,262,260**	**217,262**	**150.9**	**370,875**	**257.6**	**613,229**	**425.9**

3.0 EXISTING DISTRIBUTION SYSTEM

3.1 Existing Water Distribution System Infrastructure

The existing water system is located within the Central Planning Area Pressure Zone, as identified in Figure 3.1 of the City of Goodyear *2016 Integrated Water Master Plan* (Carollo 2016). The City's pressure zone boundaries are set to provide water service pressures that generally range between 40 and 80 psi for typical operating conditions. Existing water infrastructure immediately adjacent to the Project includes a 16-inch water line located north of, and parallel to, MC-85 and the UPRR east of Cotton Lane as well as 30-inch and 20-inch water lines along Cotton Lane south of the UPRR. The existing 30-inch water line downsizes to 20-inches just south of the Buckeye Canal and serves the Estrella Mountain Ranch community located south of the Project. There are also existing 12-inch water line stub-outs extending east and west from the existing 30-inch main, located just north of the Buckeye Canal. The existing water lines near the Project are shown in Figure 2 in Appendix A. Proposed water lines anticipated to serve the Project and connect to the City's existing system are discussed in greater detail in Section 4.2 of this report.

3.2 Existing Water Storage and Pumping Facilities

The nearest existing storage and booster facilities anticipated to serve the Project include Sites 7 and 12 of the City of Goodyear water system. Site 7 is located along Eddie Albert Way, east of Sarival Avenue, while Site 12 is located along 173rd Avenue, south of Lower Buckeye Road. Table 3 below summarizes the storage and pumping capacities of these facilities as identified in the City of Goodyear *2016 Integrated Water Master Plan* (Carollo 2016).

TABLE 3 EXISTING STORAGE AND PUMPING FACILITIES				
Site	Storage Capacity		Booster Pumping Capacity	
	Rated (MG)	Available (MG)	Total (gpm)	Firm (gpm)
7	0.75	0.68	1,500	1,000
12	2.0	1.5	2,000	1,000
TOTAL	**2.75**	**2.18**	**3,500**	**2,000**

The available capacities of these storage and pumping facilities to serve the Project are currently unknown. Based on the Project's anticipated demands and fire flows, upgrades to one or both pump stations may be required. Offsite improvements to the existing Sites 7 and 12 required to serve the Project need to be determined with the City of Goodyear as the Project develops.

4.0 SYSTEM IMPROVEMENTS

4.1 City of Goodyear Water System Design Criteria

The water system design criteria is presented in Table 4 below and is based on the design criteria provided in the City of Goodyear *2016 Integrated Water Master Plan* (Carollo 2016) and Chapter 5 of the City of Goodyear *Engineering Design Standards and Policies Manual* (Goodyear 2017).

TABLE 4
WATER SYSTEM DESIGN CRITERIA[1]

Category		Value	Unit
Average Day and Maximum Day System Performance			
	Minimum Pressure	40	psi
	Maximum Pressure[2]	100	psi
	Maximum Head loss (Maximum Day)	8	ft/1,000 ft
Peak Hour System Performance			
	Minimum Pressure	40	psi
	Maximum Pressure[2]	100	psi
	Maximum Velocity	10	fps
	Maximum Head loss	10	ft/1,000 ft
Maximum Day + Fire Flow System Performance			
	Minimum Pressure	20	psi
	Maximum Velocity	10	fps
Fire Flow Requirements			
	Single-Family Residential	1,500	gpm for 2 hours
	Commercial	3,500	gpm for 3 hours
Storage Requirements			
	Greater of One Average Day Demand, or 25% of Maximum Day Demand plus Three Hours Fire Flow Reserve.		
Minimum Pipe Diameter		8	inches
Hazen Williams 'C' Factor		130	

Notes:
1. Demand criteria based on the City of Goodyear *2016 Integrated Water Master Plan* (Carollo 2016) and the City of Goodyear *Engineering Design Standards and Policies Manual* (Goodyear 2017).
2. Any structure experiencing pressures greater than 80 psi shall have an individual PRV.

4.2 Proposed Water System Improvements

The proposed water system for the Project is shown in Figure 2 in Appendix A. The system layout is designed using parcel boundaries, proposed collector roadway alignments, potential local roadway alignments, elevation data from an aerial topo, recent survey data, and City of Goodyear quarter section maps that identified existing water infrastructure in the vicinity of the Project area. As shown in Figure 2 in Appendix A, the Project will be served by a network of looped 10-inch and 12-inch dedicated fire lines as well as the existing 20-inch and 30-inch water lines along Cotton Lane. Domestic water service will be provided by a looped 2.5-inch water line that generally parallels the 10-inch and 12-inch fire lines. The 2.5-inch domestic water line will be connected to the 12-inch water mains coming into the site at both offsite water main connections and have separate water meters. The small diameter domestic service line is not shown in Figure 2 in Appendix A.

A previous iteration of the City's Master Plan, the *2007 Integrated Water Master Plan* (Black & Veatch 2008), showed a future 24-inch water line along the Project's

northern boundary, south of MC-85, which would connect to the existing 30-inch water line at Cotton Lane. While this future water line will generally enhance operations within the surrounding region of the City's water system, it is not needed to serve the water demands and fire flows for the Project. Preliminary discussions have been held with the City regarding the timing and potential cost sharing opportunities for the regional water line. Since these discussions are ongoing with the City, the future 24-inch water line identified in the previous *2007 Integrated Water Master Plan* has not been included as part of the Project at this time. However, discussions with the City required a 16-inch water line along this alignment at this time and is shown on Figure 2 in Appendix A. The water system shown in Figure 2 in Appendix A will adequately serve the Project in accordance with City of Goodyear design criteria as identified in Table 4.

4.3 Storage Requirements

As noted in Table 4 of this report, the storage requirements for the Project shall exceed each of the following criteria:

- One Average Day Demand, or
- 25% of Maximum Day Demand, plus three hours of fire flow reserve.

Since the Project is comprised of large industrial buildings, the industrial fire flow of 3,500 gpm for 3 hours was used to calculate the required storage capacity. The storage requirement for the Project is presented in Table 5 below. Table B.2 in Appendix B presents more detailed storage calculations.

TABLE 5
STORAGE REQUIREMENTS

Parcel	Average Day Demand (MG)	25% of Maximum Day Demand plus Fire Flow (MG)	Storage Requirement (MG)
Lakin – Phase 1	0.22	0.72	0.72

4.4 Water Source

The Project is located in the City of Goodyear central service area, WPA2. All potable water will be supplied by the City. As mentioned previously, water is anticipated to be provided to the Project from reservoir and pump station sites 7 and 12 of the City's water system. The available storage and pumping capacities of these sites are summarized in Table 3 in Section 3.2 of this report. Offsite improvements to these facilities required to serve the Project need to be determined with the City of Goodyear as the project develops.

Due to high pressures observed within the immediate area of the Project, the City of Goodyear *2016 Integrated Water Master Plan* (Carollo 2016) recommends the implementation of a future water system pressure zone boundary within the southern portion of the Central Planning Area Pressure Zone located near the Gila River. This proposed pressure zone boundary would begin along Lower Buckeye Road to serve development both in West Goodyear and north of the Gila River, which includes the Project area. This pressure zone break would be achieved by the installation of

pressure reducing valve stations (PRVs) along Lower Buckeye Road. For the purposes of this Preliminary Water Report and until such time as the City of Goodyear implements this pressure zone break, the hydraulic model discussed in the following section of the proposed water system does not include this new pressure zone boundary to simulate a worst-case scenario. Furthermore, any area within the Project that is predicted to exceed 80 psi shall have an individual service line PRV, in accordance with the City's adopted plumbing code.

5.0 WATER MODEL

5.1 Design Methodology

The proposed water system infrastructure for the Project is shown in Figure 2 of Appendix A. The proposed system was modeled using WaterCAD V8i by Bentley Systems, Inc. Four scenarios were modeled: average day, maximum day, peak hour, and fire flow during maximum day conditions. For the fire flow analysis, the maximum fire flow required for the project (3,500 gpm) was distributed evenly to two junctions, J-24 and J-25, representing a worst case fire flow scenario along one side of the furthest building away from the water source. The small diameter 2.5-inch domestic water lines are not modeled. However, the domestic demands (building demands and open space irrigation demands) are attributed to those nodes at the two tie-in locations to the offsite infrastructure at the location of the proposed water service meters (Junctions J-9 and J-21).

A hydrant flow test was performed on October 9, 2018 by EJ Flow Tests, LLC along Cotton Lane, north of MC-85. The flow test results at this location show a static pressure of 93 psi and a residual pressure of 84 psi at a total flow of 2,123 gpm. A pump curve was developed based on the hydrant flow test results and used in the hydraulic model for the proposed water system infrastructure. The flow test results and associated pump curve are provided in Appendix C of this report.

The proposed water system infrastructure for the Project was modeled using a reservoir and pump located along Cotton Lane, north of MC-85, near the hydrant flow test location and the proposed tie-in point for the system. A pump curve based on the hydrant flow test performed by EJ Flow Tests, LLC (see Appendix C) was used to establish the boundary condition for the system.

5.2 Model Results

Detailed hydraulic model results for the proposed system are provided in Appendix D. A summary of the results are shown in Table 6 below. As shown in the table and results, pressures throughout the modeled area remain between 91.6 psi and 98.7 psi for the domestic scenarios modeled, well above the minimum 40 psi pressure requirement. As mentioned previously, the City's *2016 Integrated Water Master Plan* (Carollo 2016) predicted higher operating pressures within the Project vicinity due to its lower elevation near the Gila River. The results in Table 7 represent actual operating pressures within the City's existing water system as a worst-case scenario until such time as the City implements a new pressure zone within the water system. Any structure that experiences pressures greater than 80 psi as the Project develops

shall have an individual service line PRV, in accordance with the City's adopted plumbing code.

Velocities and head losses for the maximum day and peak hour scenarios fall within the allowable limits presented in Table 4. Furthermore, the fire flow analysis demonstrates that the proposed system can adequately provide the required fire flow to the Project while maintaining a residual pressure of at least 20 psi and a maximum velocity of less than 10 feet per second.

TABLE 6
HYDRAULIC MODELING SUMMARY – LAKIN PHASE 1

	Average Day		Maximum Day		Peak Hour	
	Value	Location	Value	Location	Value	Location
Minimum Pressure (psi)	92.0	J-2	91.8	J-2	91.6	J-2
Maximum Pressure (psi)	98.7	J-18	98.5	J-18 & J-19	98.2	J-18 & J-19
Maximum Velocity (fps)	0.29	P-8	0.49	P-8	0.82	P-8
Maximum Head loss (feet/1,000 feet of pipe)	0.037	P-8	0.100	P-8	0.254	P-8

Maximum Day Demand + Fire Flow - Pressure Analysis			
	Value	Location	Fire Flow Location and Flow
Minimum Residual Pressure (psi)	61.5	J-25	J-24 @ 1,750 gpm J-25 @ 1,750 gpm
Maximum Velocity (fps)	8.14	P-26 & P-27	J-24 @ 1,750 gpm J-25 @ 1,750 gpm

Notes:
Full model results are provided in Appendix D.

5.3 System Phasing

It is anticipated that the water system for the Project will be constructed in a single phase.

6.0 CONCLUSIONS

The proposed water system will adequately serve the Project. This Preliminary Water Report has determined that:

- The average day, maximum day and peak hour demands for the Project are 217,262 gpd (150.9 gpm), 370,875 gpd (257.6 gpm), and 613,229 gpd (425.9 gpm), respectively.
- The hydraulic model shows that the Project can be adequately served by the proposed system of onsite 10-inch and 12-inch looped fire lines, offsite 16-inch water mains, and the existing 30-inch and 20-inch water mains along Cotton Lane.

- Hydraulic model results show that the proposed system will provide for velocities and head losses within the allowable limits as specified in Table 4 of this report during the domestic scenarios modeled.
- The proposed system for the Project can provide the required fire flow of 3,500 gpm while maintaining the minimum required residual pressure of 20 psi and a maximum velocity of less than 10 feet per second.
- The Project is anticipated to be developed in a single phase.

7.0 REFERENCES

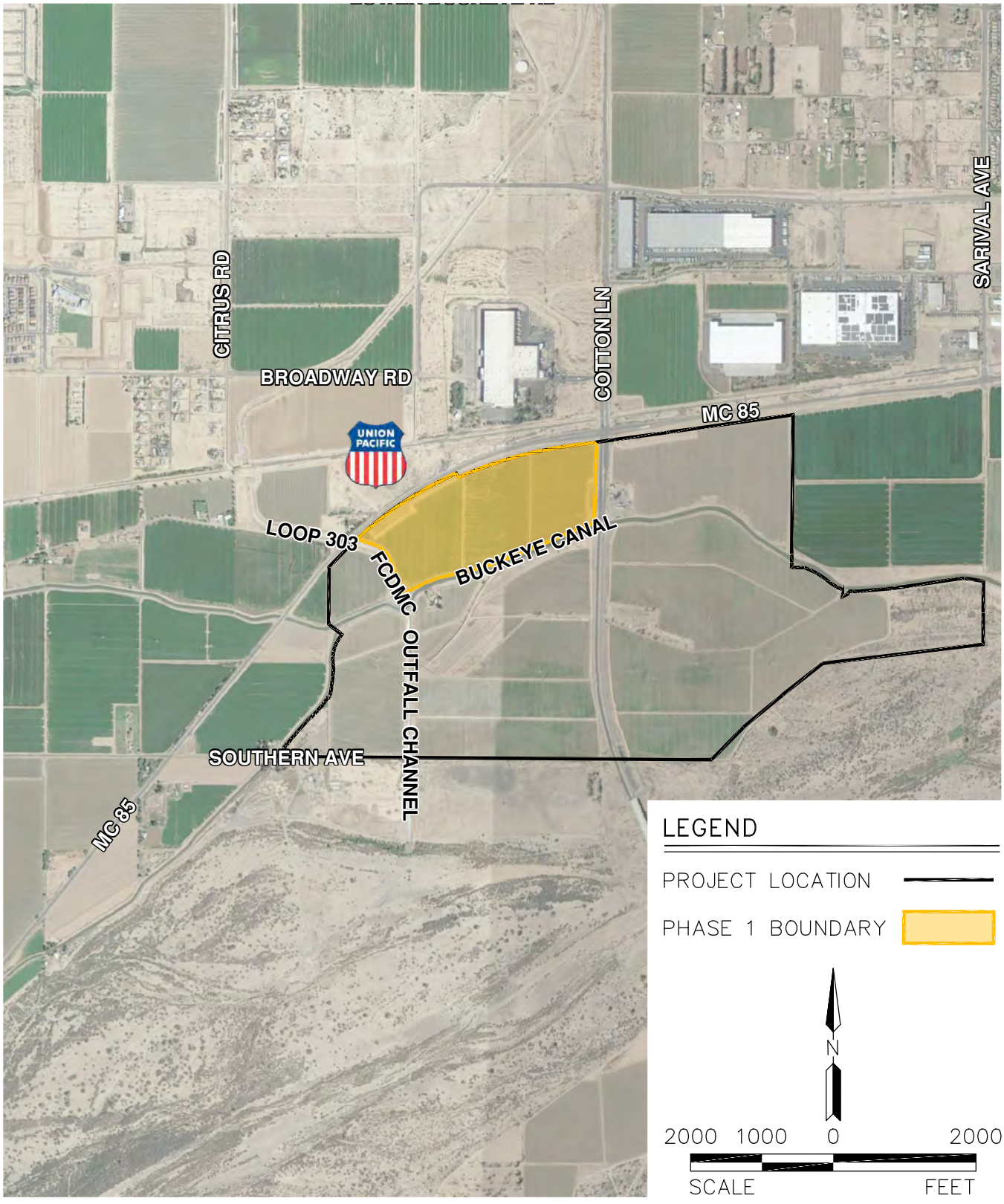
Carollo Engineers (2016). *City of Goodyear 2016 Integrated Water Master Plan.* November 2016, Goodyear, AZ.

City of Goodyear (2017). *City of Goodyear Engineering Design Standards and Policies Manual.* August 2017, Goodyear, AZ.

Black & Veatch (2008). *City of Goodyear 2007 Integrated Water Master Plan*. June 2008, Goodyear, AZ.

HILGARTWILSON, LLC (2019). *Master Water Report for Lakin*. February 2019. Phoenix, AZ.

APPENDIX A
FIGURES



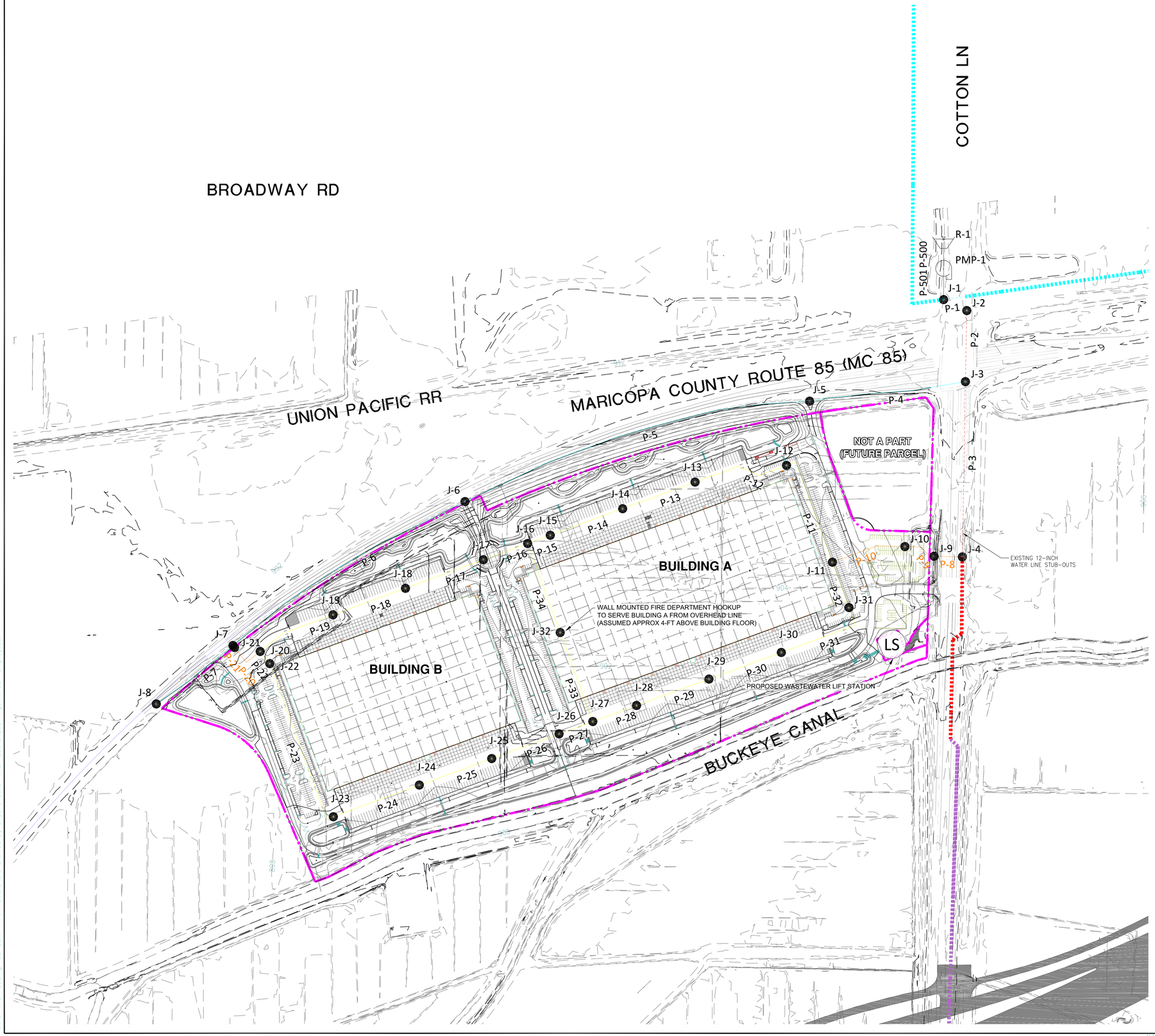
PROJ.NO.:	1981
DATE:	MAY 2020
SCALE:	1" = 2,000'
DRAWN BY:	SL
CHECKED BY:	AT

LAKIN PROPERTY

CITY OF GOODYEAR, ARIZONA

FIG 1: VICINITY MAP

HILGARTWILSON
2141 E. HIGHLAND AVE., STE. 250
PHOENIX, AZ 85016
P: 602.490.0535 / F: 602.368.2436



LEGEND

- PROPERTY BOUNDARY
- PROPOSED WATER LINE
- EXISTING WATER LINE
- JUNCTION
- RESERVOIR
- PUMP

PIPE DIAMETER (IN)

	=	8.0
	=	10.0
	=	12.0
	=	16.0
	=	20.0
	=	30.0

NOTES:

1. ENTIRE PROJECT IS LOCATED WITHIN CENTRAL PLANNING AREA PRESSURE ZONE.
2. ALL CONNECTIONS TO EXISTING WATER LINES TO BE CONFIRMED WITH CITY OF GOODYEAR.

NOT FOR CONSTRUCTION
FEBRUARY 2019

N

200 100 0 200 400
SCALE FEET

REV.:

HILGARTWILSON
ENGINEER | PLAN | SURVEY | MANAGE
2141 E. HIGHLAND AVE., STE. 250 |P: 602.490.0535 / F: 602.368.2436
PHOENIX, AZ 85016
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LAKIN - PHASE 1

COTTON LANE & MARICOPA COUNTY ROUTE 85 (MC-85)
GOODYEAR, ARIZONA

FIG 2: WATER SYSTEM IMPROVEMENTS

HILGARTWILSON
PROJ NO.: 1981
DATE: MAY 2020
SCALE: 1"=200'
DRAWN: MAJ
DESIGNED: MAJ
APPROVED: ZS
DWG. NO.
SHT. OF

APPENDIX B
TABLES

Table B.1 - Water Demand Calculations

LAKIN - Phase 1

Goodyear, Arizona
May, 2020

HILGARTWILSON
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Phase	Building	Land Use	Gross Area	Building Size	Projected Open Space[2]	Average Day Demand				Maximum Day Demand		Peak Hour Demand	
						Land Use/Domestic	Open Space/Irrigation[3]	Total					
			(ac)	(sq.ft.)	(ac)	(gpd)	(gpd)	(gpd)	(gpm)	(gpd)	(gpm)	(gpd)	(gpm)
I	A	Industrial	88.7	730,502	4.5	116,880	7,650	124,530	86.5	212,467	147.5	352,723	244.9
	B	Industrial		531,758	4.5	85,081	7,650	92,731	64.4	158,408	110.0	260,506	180.9
GRAND TOTAL			**88.7**	**1,262,260**	**9.0**	**201,962**	**15,300**	**217,262**	**150.9**	**370,875**	**257.6**	**613,229**	**425.9**

Notes:

1. Design criteria based on City of Goodyear's *Engineering Design Standards and Policies Manual - 2017 Edition*
2. Assumes that approximatley 5% of the parcel acreage will be developed open space/low water use irrigation.
3. Irrigation demands are included as it is anticipated that a reclaimed water system will not be constructed within the Project.

Demand Factors:

General Industrial:	0.16	gpd/sf
Low Water Use Irrigation (Open Space):	1,700	gpd/acre

Peaking Factors:

Maximum Day Demand (Domestic):	1.7	x Average Day Demand
Maximum Day/Peak Hour Demand (Irrigation):	1.8	x Average Day Demand
Peak Hour Demand (Domestic):	2.9	x Average Day Demand

Fire Flow Demand:

Building A:	3,500	gpm for 3 hours
Building B:	3,500	gpm for 3 hours

Table B.2 - Storage Requirement Calculations

LAKIN - Phase 1

Goodyear, Arizona

May, 2020

HILGARTWILSON
ENGINEER | PLAN | SURVEY | MANAGE

Storage Requirements

Storage facilities shall meet or exceed each of the following criteria:

- Three hours Fire Flow Reserve + 25% of Maximum Day Demand

- One Average Day Demand

Average Day Demand

100% of Average Day Demand:	217,262	gallons
Storage Requirement:	217,262	gallons
	0.22	MG

Fire Flow

25% fo Maximum Day Demand:	92,719	gallons
Fire Flow Reserve:	630,000	gallons (3,500 gpm for 3 hours)
Storage Requirement:	722,719	gallons
	0.72	MG

Lakin Storage Requirement: 0.72 MG

APPENDIX C
HYDRANT FLOW TEST AND PUMP CURVE

Flow Test Summary

Project Name:	EJFT 20197
Project Address:	4750 S Cotton Ln, Goodyear, AZ 85338
Date of Flow Test:	2020-07-16
Time of Flow Test:	6:00 AM
Data Reliable Until:	2021-01-16
Conducted By:	Steven Saethre & Eder Cueva (EJ Flow Tests) 602.999.7637
City Forces Contacted:	City of Goodyear (623.882.7506)

Raw Flow Test Data

Static Pressure:	80.0 PSI
Residual Pressure:	73.0 PSI
Flowing GPM:	2,110
GPM @ 20 PSI:	6,731

Data with a 10 % Safety Factor

Static Pressure:	72.0 PSI
Residual Pressure:	65.0 PSI
Flowing GPM:	2,110
GPM @ 20 PSI:	6,231

Hydrant F_1

Pitot Pressure (1):	39	PSI
Coefficient of Discharge (1):	0.9	
Hydrant Orifice Diameter (1):	2.5	inches
Pitot Pressure (2):	40	PSI
Coefficient of Discharge (2):	0.9	
Hydrant Orifice Diameter (2):	2.5	inches

Static-Residual Hydrant

Flow Hydrant

Distance Between F_1 and R
144 ft (measured linearly)

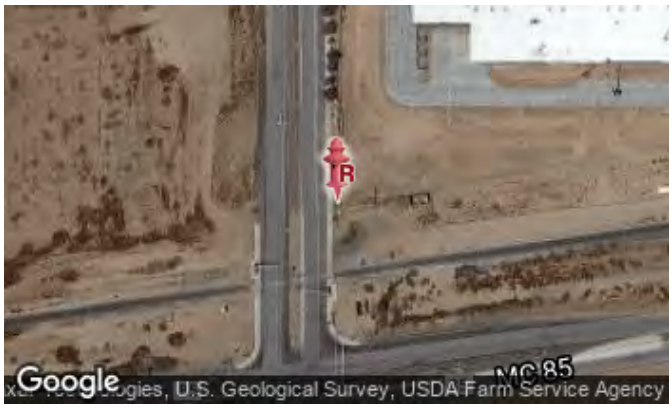
Static-Residual Elevation
912 ft (above sea level)

Flow Hydrant (F_1) Elevation
912 ft (above sea level)

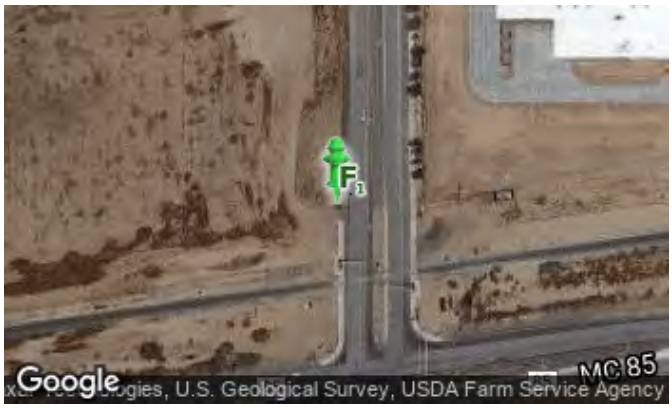
Elevation & distance values are approximate

Flow Test Summary

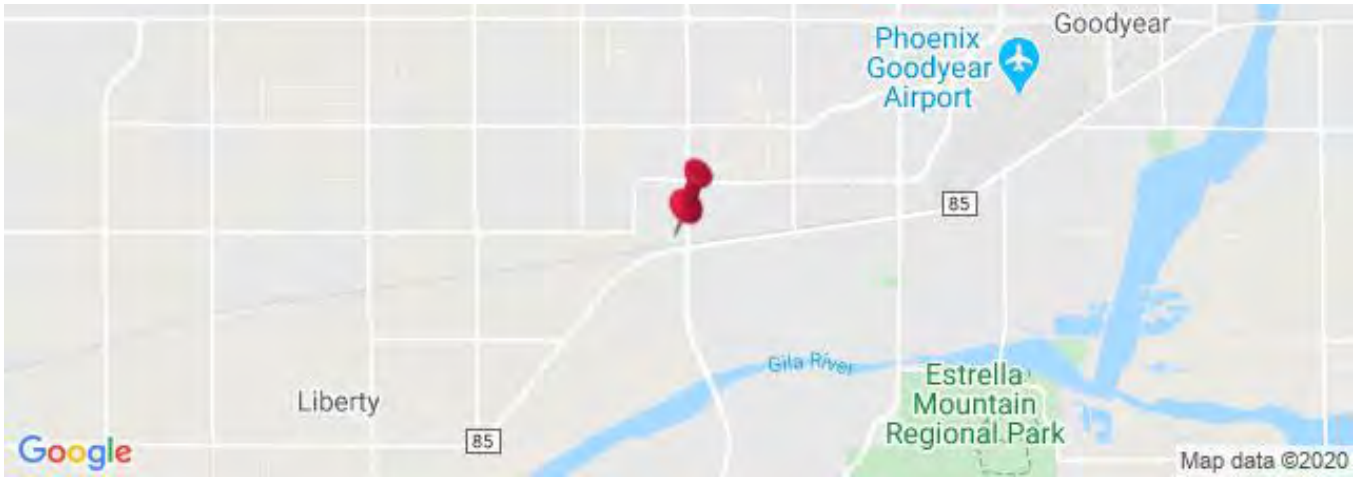
Static-Residual Hydrant



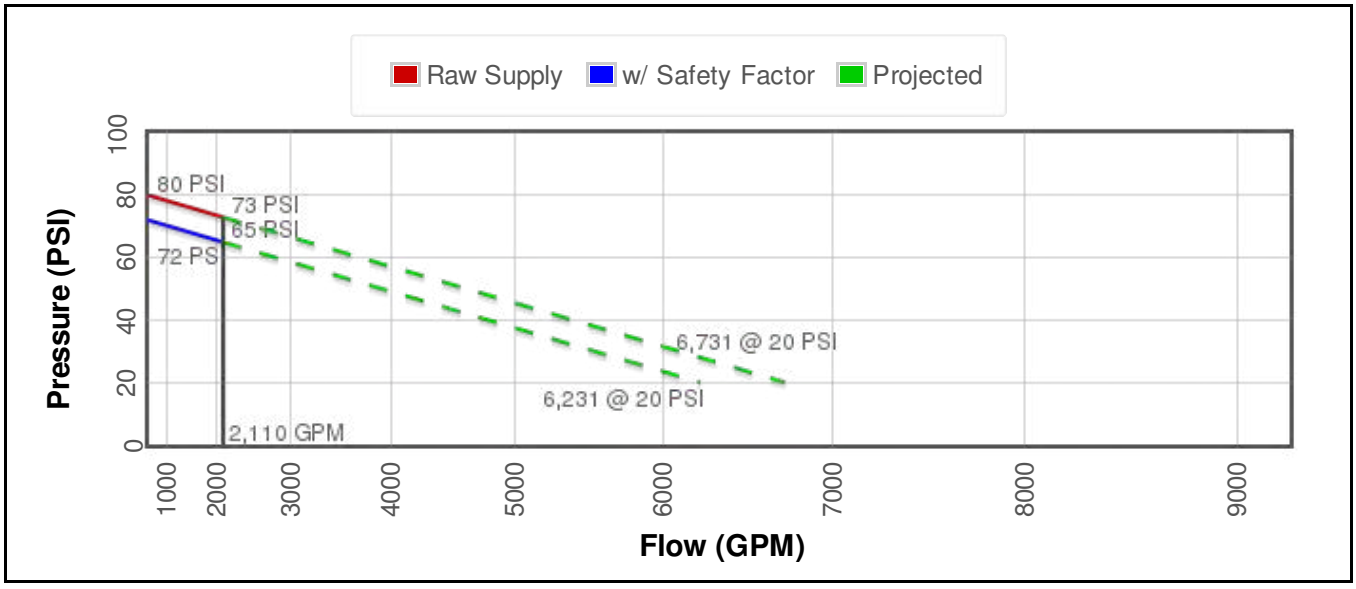
Flow Hydrant (only hydrant F1 shown for clarity)



Approximate Project Site



Water Supply Curve $N^{1.85}$ Graph



FLOW TEST PUMP CURVE
LAKIN
Goodyear, Arizona
Flow Test Date: October 9, 2018 (7:35 AM)

HILGARTWILSON
ENGINEER | PLAN | SURVEY | MANAGE

Fire Flow Test Results

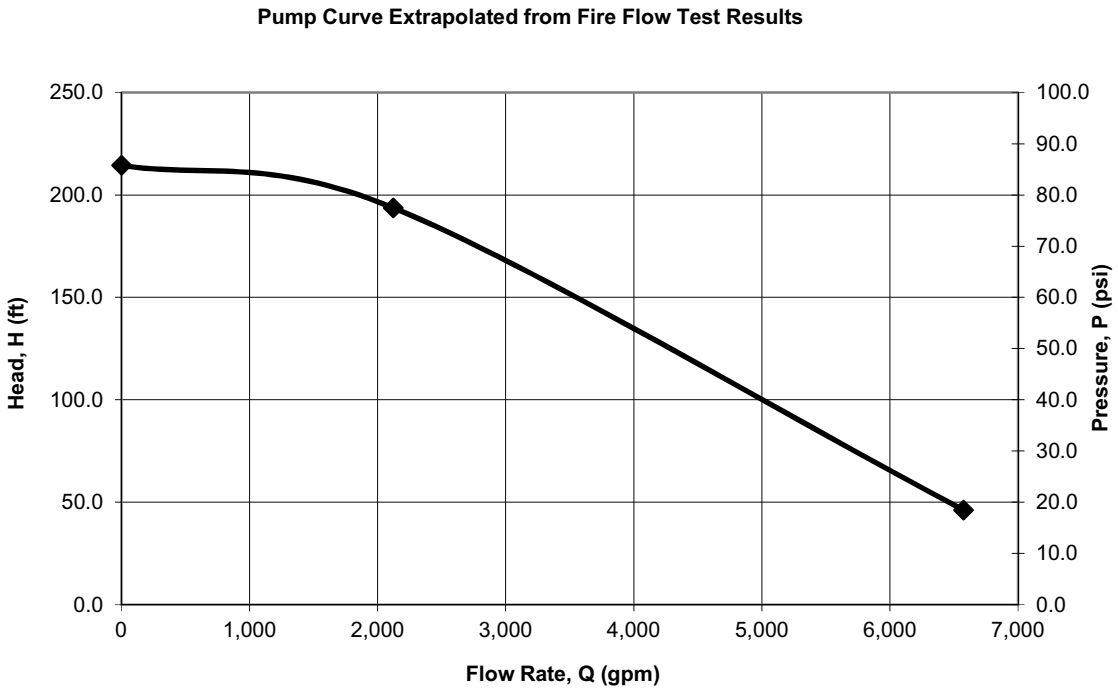
Static Pressure at Test Hydrant (psi)	93
Residual Pressure at Test Hydrant (psi)	84
Total Discharge at Flowed Hydrants, Qf (gpm)	2,123

Calculations

Desired Fire Flow Residual Pressure (psi)	20.0
Pressure Drop During Test, hf (psi)	9.0
Pressure Drop During Test (%)	10%
Pressure Drop at Desired Residual Pressure, hr (psi)	73.0
Available Flow at Desired Residual Pressure, Qr (gpm)	6,575

Pump Curve

Q (gpm)	P (psi)	H (ft)
0	93.0	214.5
2,123	84.0	193.7
6,575	20.0	46.1



APPENDIX D
HYDRAULIC MODEL RESULTS

AVERAGE DAY DEMAND

FlexTable: Junction Table

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-1	912.00	0.0	1,126.35	92.7
J-2	913.82	0.0	1,126.35	92.0
J-3	913.05	0.0	1,126.35	92.3
J-4	906.14	0.0	1,126.35	95.3
J-5	909.15	0.0	1,126.35	94.0
J-6	905.27	0.0	1,126.35	95.6
J-7	901.03	0.0	1,126.34	97.5
J-8	900.59	0.0	1,126.34	97.7
J-9	906.66	86.5	1,126.35	95.0
J-10	905.72	0.0	1,126.35	95.5
J-11	901.47	0.0	1,126.35	97.3
J-12	901.37	0.0	1,126.34	97.3
J-13	898.58	0.0	1,126.34	98.5
J-14	898.59	0.0	1,126.34	98.5
J-15	898.59	0.0	1,126.34	98.5
J-16	898.81	0.0	1,126.34	98.4
J-17	899.79	0.0	1,126.34	98.0
J-18	898.32	0.0	1,126.34	98.7
J-19	898.36	0.0	1,126.34	98.6
J-20	899.59	0.0	1,126.34	98.1
J-21	901.19	64.4	1,126.34	97.4
J-22	901.10	0.0	1,126.34	97.5
J-23	898.75	0.0	1,126.34	98.5
J-24	898.52	0.0	1,126.34	98.6
J-25	898.78	0.0	1,126.34	98.5
J-26	898.90	0.0	1,126.34	98.4
J-27	898.53	0.0	1,126.34	98.6
J-28	898.77	0.0	1,126.34	98.5
J-29	898.87	0.0	1,126.34	98.4
J-30	898.89	0.0	1,126.34	98.4
J-31	900.54	0.0	1,126.34	97.7
J-32	907.00	0.0	1,126.34	94.9

Label	Length (ft)	Start Node	Stop Node	Diameter (in)	Hazen-Williams C	Flow (Absolute) (gpm)	Velocity (ft/s)	Headloss Gradient (ft/1000ft)
P-1	163	J-1	J-2	16.0	130.0	150.9	0.24	0.019
P-2	310	J-2	J-3	30.0	130.0	150.9	0.07	0.001
P-3	764	J-3	J-4	30.0	130.0	102.2	0.05	0.000
P-4	685	J-3	J-5	16.0	130.0	48.7	0.08	0.002
P-5	1,577	J-5	J-6	16.0	130.0	48.7	0.08	0.002
P-6	1,194	J-6	J-7	16.0	130.0	48.7	0.08	0.002
P-7	420	J-7	J-8	16.0	130.0	0.0	0.00	0.000
P-8	123	J-4	J-9	12.0	130.0	102.2	0.29	0.037
P-9	145	J-9	J-10	12.0	130.0	15.7	0.04	0.001
P-10	328	J-10	J-11	12.0	130.0	15.7	0.04	0.001
P-11	507	J-11	J-12	10.0	130.0	7.6	0.03	0.001
P-12	428	J-12	J-13	10.0	130.0	7.6	0.03	0.001
P-13	336	J-13	J-14	10.0	130.0	7.6	0.03	0.001
P-14	336	J-14	J-15	10.0	130.0	7.6	0.03	0.001
P-15	105	J-15	J-16	10.0	130.0	7.6	0.03	0.001
P-16	206	J-16	J-17	10.0	130.0	8.8	0.04	0.001
P-17	362	J-17	J-18	10.0	130.0	8.8	0.04	0.001
P-18	336	J-18	J-19	10.0	130.0	8.8	0.04	0.001
P-19	360	J-19	J-20	10.0	130.0	8.8	0.04	0.001
P-20	160	J-20	J-21	12.0	130.0	15.7	0.04	0.001
P-21	11	J-21	J-7	12.0	130.0	48.7	0.14	0.011
P-22	67	J-20	J-22	10.0	130.0	6.9	0.03	0.002
P-23	752	J-22	J-23	10.0	130.0	6.9	0.03	0.000
P-24	399	J-23	J-24	10.0	130.0	6.9	0.03	0.001
P-25	336	J-24	J-25	10.0	130.0	6.9	0.03	0.001
P-26	312	J-25	J-26	10.0	130.0	6.9	0.03	0.001
P-27	156	J-26	J-27	10.0	130.0	6.9	0.03	0.000
P-28	203	J-27	J-28	10.0	130.0	8.1	0.03	0.001
P-29	336	J-28	J-29	10.0	130.0	8.1	0.03	0.001
P-30	336	J-29	J-30	10.0	130.0	8.1	0.03	0.001
P-31	426	J-30	J-31	10.0	130.0	8.1	0.03	0.001
P-32	210	J-31	J-11	10.0	130.0	8.1	0.03	0.001
P-33	413	J-27	J-32	10.0	130.0	1.2	0.00	0.000
P-34	413	J-32	J-16	10.0	130.0	1.2	0.00	0.000
P-500	111	R-1	PMP-1	48.0	130.0	150.9	0.03	0.000
P-501	136	PMP-1	J-1	48.0	130.0	150.9	0.03	0.001

FlexTable: Pump Table

Label	Elevation (ft)	Hydraulic Grade (Suction) (ft)	Hydraulic Grade (Discharge) (ft)	Flow (Total) (gpm)	Pump Head (ft)
PMP-1	912.00	912.01	1,126.35	150.9	214.34

FlexTable: Reservoir Table

Label	Elevation (ft)	Flow (Out net) (gpm)	Hydraulic Grade (ft)
R-1	912.01	150.9	912.01

MAXIMUM DAY DEMAND

FlexTable: Junction Table

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-1	912.00	0.0	1,126.09	92.6
J-2	913.82	0.0	1,126.08	91.8
J-3	913.05	0.0	1,126.08	92.2
J-4	906.14	0.0	1,126.08	95.2
J-5	909.15	0.0	1,126.08	93.9
J-6	905.27	0.0	1,126.07	95.5
J-7	901.03	0.0	1,126.06	97.4
J-8	900.59	0.0	1,126.06	97.6
J-9	906.66	147.5	1,126.07	94.9
J-10	905.72	0.0	1,126.07	95.3
J-11	901.47	0.0	1,126.07	97.2
J-12	901.37	0.0	1,126.07	97.2
J-13	898.58	0.0	1,126.06	98.4
J-14	898.59	0.0	1,126.06	98.4
J-15	898.59	0.0	1,126.06	98.4
J-16	898.81	0.0	1,126.06	98.3
J-17	899.79	0.0	1,126.06	97.9
J-18	898.32	0.0	1,126.06	98.5
J-19	898.36	0.0	1,126.06	98.5
J-20	899.59	0.0	1,126.06	98.0
J-21	901.19	110.0	1,126.06	97.3
J-22	901.10	0.0	1,126.06	97.3
J-23	898.75	0.0	1,126.06	98.3
J-24	898.52	0.0	1,126.06	98.4
J-25	898.78	0.0	1,126.06	98.3
J-26	898.90	0.0	1,126.06	98.3
J-27	898.53	0.0	1,126.06	98.4
J-28	898.77	0.0	1,126.06	98.3
J-29	898.87	0.0	1,126.06	98.3
J-30	898.89	0.0	1,126.06	98.3
J-31	900.54	0.0	1,126.07	97.6
J-32	907.00	0.0	1,126.06	94.8

Label	Length (ft)	Start Node	Stop Node	Diameter (in)	Hazen-Williams C	Flow (Absolute) (gpm)	Velocity (ft/s)	Headloss Gradient (ft/1000ft)
P-1	163	J-1	J-2	16.0	130.0	257.6	0.41	0.051
P-2	310	J-2	J-3	30.0	130.0	257.6	0.12	0.002
P-3	764	J-3	J-4	30.0	130.0	174.4	0.08	0.001
P-4	685	J-3	J-5	16.0	130.0	83.2	0.13	0.006
P-5	1,577	J-5	J-6	16.0	130.0	83.2	0.13	0.006
P-6	1,194	J-6	J-7	16.0	130.0	83.2	0.13	0.006
P-7	420	J-7	J-8	16.0	130.0	0.0	0.00	0.000
P-8	123	J-4	J-9	12.0	130.0	174.4	0.49	0.100
P-9	145	J-9	J-10	12.0	130.0	26.9	0.08	0.003
P-10	328	J-10	J-11	12.0	130.0	26.9	0.08	0.003
P-11	507	J-11	J-12	10.0	130.0	13.0	0.05	0.002
P-12	428	J-12	J-13	10.0	130.0	13.0	0.05	0.002
P-13	336	J-13	J-14	10.0	130.0	13.0	0.05	0.002
P-14	336	J-14	J-15	10.0	130.0	13.0	0.05	0.002
P-15	105	J-15	J-16	10.0	130.0	13.0	0.05	0.002
P-16	206	J-16	J-17	10.0	130.0	15.1	0.06	0.002
P-17	362	J-17	J-18	10.0	130.0	15.1	0.06	0.003
P-18	336	J-18	J-19	10.0	130.0	15.1	0.06	0.003
P-19	360	J-19	J-20	10.0	130.0	15.1	0.06	0.002
P-20	160	J-20	J-21	12.0	130.0	26.9	0.08	0.004
P-21	11	J-21	J-7	12.0	130.0	83.2	0.24	0.033
P-22	67	J-20	J-22	10.0	130.0	11.8	0.05	0.000
P-23	752	J-22	J-23	10.0	130.0	11.8	0.05	0.002
P-24	399	J-23	J-24	10.0	130.0	11.8	0.05	0.002
P-25	336	J-24	J-25	10.0	130.0	11.8	0.05	0.002
P-26	312	J-25	J-26	10.0	130.0	11.8	0.05	0.002
P-27	156	J-26	J-27	10.0	130.0	11.8	0.05	0.002
P-28	203	J-27	J-28	10.0	130.0	13.8	0.06	0.002
P-29	336	J-28	J-29	10.0	130.0	13.8	0.06	0.002
P-30	336	J-29	J-30	10.0	130.0	13.8	0.06	0.002
P-31	426	J-30	J-31	10.0	130.0	13.8	0.06	0.002
P-32	210	J-31	J-11	10.0	130.0	13.8	0.06	0.002
P-33	413	J-27	J-32	10.0	130.0	2.0	0.01	0.000
P-34	413	J-32	J-16	10.0	130.0	2.0	0.01	0.000
P-500	111	R-1	PMP-1	48.0	130.0	257.6	0.05	0.000
P-501	136	PMP-1	J-1	48.0	130.0	257.6	0.05	0.000

FlexTable: Pump Table

Label	Elevation (ft)	Hydraulic Grade (Suction) (ft)	Hydraulic Grade (Discharge) (ft)	Flow (Total) (gpm)	Pump Head (ft)
PMP-1	912.00	912.01	1,126.09	257.6	214.08

FlexTable: Reservoir Table

Label	Elevation (ft)	Flow (Out net) (gpm)	Hydraulic Grade (ft)
R-1	912.01	257.6	912.01

PEAK HOUR DEMAND

FlexTable: Junction Table

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-1	912.00	0.0	1,125.44	92.3
J-2	913.82	0.0	1,125.42	91.6
J-3	913.05	0.0	1,125.42	91.9
J-4	906.14	0.0	1,125.42	94.9
J-5	909.15	0.0	1,125.41	93.6
J-6	905.27	0.0	1,125.39	95.2
J-7	901.03	0.0	1,125.37	97.1
J-8	900.59	0.0	1,125.37	97.3
J-9	906.66	244.9	1,125.39	94.6
J-10	905.72	0.0	1,125.39	95.0
J-11	901.47	0.0	1,125.39	96.9
J-12	901.37	0.0	1,125.38	96.9
J-13	898.58	0.0	1,125.38	98.1
J-14	898.59	0.0	1,125.38	98.1
J-15	898.59	0.0	1,125.38	98.1
J-16	898.81	0.0	1,125.38	98.0
J-17	899.79	0.0	1,125.38	97.6
J-18	898.32	0.0	1,125.37	98.2
J-19	898.36	0.0	1,125.37	98.2
J-20	899.59	0.0	1,125.37	97.7
J-21	901.19	180.9	1,125.37	97.0
J-22	901.10	0.0	1,125.37	97.0
J-23	898.75	0.0	1,125.37	98.0
J-24	898.52	0.0	1,125.37	98.1
J-25	898.78	0.0	1,125.37	98.0
J-26	898.90	0.0	1,125.38	98.0
J-27	898.53	0.0	1,125.38	98.1
J-28	898.77	0.0	1,125.38	98.0
J-29	898.87	0.0	1,125.38	98.0
J-30	898.89	0.0	1,125.38	98.0
J-31	900.54	0.0	1,125.38	97.3
J-32	907.00	0.0	1,125.38	94.5

Label	Length (ft)	Start Node	Stop Node	Diameter (in)	Hazen-Williams C	Flow (Absolute) (gpm)	Velocity (ft/s)	Headloss Gradient (ft/1000ft)
P-1	163	J-1	J-2	16.0	130.0	425.9	0.68	0.128
P-2	310	J-2	J-3	30.0	130.0	425.9	0.19	0.006
P-3	764	J-3	J-4	30.0	130.0	288.8	0.13	0.003
P-4	685	J-3	J-5	16.0	130.0	137.0	0.22	0.016
P-5	1,577	J-5	J-6	16.0	130.0	137.0	0.22	0.016
P-6	1,194	J-6	J-7	16.0	130.0	137.0	0.22	0.016
P-7	420	J-7	J-8	16.0	130.0	0.0	0.00	0.000
P-8	123	J-4	J-9	12.0	130.0	288.8	0.82	0.254
P-9	145	J-9	J-10	12.0	130.0	43.9	0.12	0.008
P-10	328	J-10	J-11	12.0	130.0	43.9	0.12	0.008
P-11	507	J-11	J-12	10.0	130.0	21.3	0.09	0.005
P-12	428	J-12	J-13	10.0	130.0	21.3	0.09	0.005
P-13	336	J-13	J-14	10.0	130.0	21.3	0.09	0.005
P-14	336	J-14	J-15	10.0	130.0	21.3	0.09	0.005
P-15	105	J-15	J-16	10.0	130.0	21.3	0.09	0.005
P-16	206	J-16	J-17	10.0	130.0	24.6	0.10	0.007
P-17	362	J-17	J-18	10.0	130.0	24.6	0.10	0.006
P-18	336	J-18	J-19	10.0	130.0	24.6	0.10	0.007
P-19	360	J-19	J-20	10.0	130.0	24.6	0.10	0.006
P-20	160	J-20	J-21	12.0	130.0	43.9	0.12	0.008
P-21	11	J-21	J-7	12.0	130.0	137.0	0.39	0.056
P-22	67	J-20	J-22	10.0	130.0	19.3	0.08	0.004
P-23	752	J-22	J-23	10.0	130.0	19.3	0.08	0.004
P-24	399	J-23	J-24	10.0	130.0	19.3	0.08	0.004
P-25	336	J-24	J-25	10.0	130.0	19.3	0.08	0.004
P-26	312	J-25	J-26	10.0	130.0	19.3	0.08	0.004
P-27	156	J-26	J-27	10.0	130.0	19.3	0.08	0.005
P-28	203	J-27	J-28	10.0	130.0	22.6	0.09	0.005
P-29	336	J-28	J-29	10.0	130.0	22.6	0.09	0.005
P-30	336	J-29	J-30	10.0	130.0	22.6	0.09	0.005
P-31	426	J-30	J-31	10.0	130.0	22.6	0.09	0.005
P-32	210	J-31	J-11	10.0	130.0	22.6	0.09	0.006
P-33	413	J-27	J-32	10.0	130.0	3.3	0.01	0.000
P-34	413	J-32	J-16	10.0	130.0	3.3	0.01	0.000
P-500	111	R-1	PMP-1	48.0	130.0	425.9	0.08	0.001
P-501	136	PMP-1	J-1	48.0	130.0	425.9	0.08	0.001

FlexTable: Pump Table

Label	Elevation (ft)	Hydraulic Grade (Suction) (ft)	Hydraulic Grade (Discharge) (ft)	Flow (Total) (gpm)	Pump Head (ft)
PMP-1	912.00	912.01	1,125.45	425.9	213.44

FlexTable: Reservoir Table

Label	Elevation (ft)	Flow (Out net) (gpm)	Hydraulic Grade (ft)
R-1	912.01	425.9	912.01

MAXIMUM DAY PLUS FIRE FLOW

FlexTable: Junction Table

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-1	912.00	0.0	1,066.69	66.9
J-2	913.82	0.0	1,065.51	65.6
J-3	913.05	0.0	1,065.40	65.9
J-4	906.14	0.0	1,065.33	68.9
J-5	909.15	0.0	1,063.98	67.0
J-6	905.27	0.0	1,060.71	67.3
J-7	901.03	0.0	1,058.24	68.0
J-8	900.59	0.0	1,058.24	68.2
J-9	906.66	147.5	1,064.36	68.2
J-10	905.72	0.0	1,063.38	68.2
J-11	901.47	0.0	1,061.16	69.1
J-12	901.37	0.0	1,059.67	68.5
J-13	898.58	0.0	1,058.42	69.2
J-14	898.59	0.0	1,057.43	68.7
J-15	898.59	0.0	1,056.44	68.3
J-16	898.81	0.0	1,056.13	68.1
J-17	899.79	0.0	1,056.26	67.7
J-18	898.32	0.0	1,056.49	68.4
J-19	898.36	0.0	1,056.71	68.5
J-20	899.59	0.0	1,056.94	68.1
J-21	901.19	110.0	1,058.14	67.9
J-22	901.10	0.0	1,056.05	67.0
J-23	898.75	0.0	1,046.13	63.8
J-24	898.52	1,750.0	1,040.87	61.6
J-25	898.78	1,750.0	1,041.02	61.5
J-26	898.90	0.0	1,047.92	64.5
J-27	898.53	0.0	1,051.37	66.1
J-28	898.77	0.0	1,052.69	66.6
J-29	898.87	0.0	1,054.87	67.5
J-30	898.89	0.0	1,057.04	68.4
J-31	900.54	0.0	1,059.80	68.9
J-32	907.00	0.0	1,053.75	63.5

Label	Length (ft)	Start Node	Stop Node	Diameter (in)	Hazen-Williams C	Flow (Absolute) (gpm)	Velocity (ft/s)	Headloss Gradient (ft/1000ft)
P-1	163	J-1	J-2	16.0	130.0	3,757.6	6.00	7.245
P-2	310	J-2	J-3	30.0	130.0	3,757.6	1.71	0.339
P-3	764	J-3	J-4	30.0	130.0	1,845.5	0.84	0.091
P-4	685	J-3	J-5	16.0	130.0	1,912.1	3.05	2.073
P-5	1,577	J-5	J-6	16.0	130.0	1,912.1	3.05	2.073
P-6	1,194	J-6	J-7	16.0	130.0	1,912.1	3.05	2.073
P-7	420	J-7	J-8	16.0	130.0	0.0	0.00	0.000
P-8	123	J-4	J-9	12.0	130.0	1,845.5	5.24	7.883
P-9	145	J-9	J-10	12.0	130.0	1,697.9	4.82	6.756
P-10	328	J-10	J-11	12.0	130.0	1,697.9	4.82	6.756
P-11	507	J-11	J-12	10.0	130.0	670.6	2.74	2.939
P-12	428	J-12	J-13	10.0	130.0	670.6	2.74	2.939
P-13	336	J-13	J-14	10.0	130.0	670.6	2.74	2.939
P-14	336	J-14	J-15	10.0	130.0	670.6	2.74	2.939
P-15	105	J-15	J-16	10.0	130.0	670.6	2.74	2.939
P-16	206	J-16	J-17	10.0	130.0	294.0	1.20	0.638
P-17	362	J-17	J-18	10.0	130.0	294.0	1.20	0.639
P-18	336	J-18	J-19	10.0	130.0	294.0	1.20	0.638
P-19	360	J-19	J-20	10.0	130.0	294.0	1.20	0.638
P-20	160	J-20	J-21	12.0	130.0	1,802.1	5.11	7.544
P-21	11	J-21	J-7	12.0	130.0	1,912.1	5.42	8.419
P-22	67	J-20	J-22	10.0	130.0	1,508.1	6.16	13.183
P-23	752	J-22	J-23	10.0	130.0	1,508.1	6.16	13.184
P-24	399	J-23	J-24	10.0	130.0	1,508.1	6.16	13.183
P-25	336	J-24	J-25	10.0	130.0	241.9	0.99	0.445
P-26	312	J-25	J-26	10.0	130.0	1,991.9	8.14	22.073
P-27	156	J-26	J-27	10.0	130.0	1,991.9	8.14	22.072
P-28	203	J-27	J-28	10.0	130.0	1,027.3	4.20	6.476
P-29	336	J-28	J-29	10.0	130.0	1,027.3	4.20	6.476
P-30	336	J-29	J-30	10.0	130.0	1,027.3	4.20	6.476
P-31	426	J-30	J-31	10.0	130.0	1,027.3	4.20	6.476
P-32	210	J-31	J-11	10.0	130.0	1,027.3	4.20	6.476
P-33	413	J-27	J-32	10.0	130.0	964.6	3.94	5.763
P-34	413	J-32	J-16	10.0	130.0	964.6	3.94	5.762
P-500	111	R-1	PMP-1	48.0	130.0	3,757.6	0.67	0.034
P-501	136	PMP-1	J-1	48.0	130.0	3,757.6	0.67	0.034

FlexTable: Pump Table

Label	Elevation (ft)	Hydraulic Grade (Suction) (ft)	Hydraulic Grade (Discharge) (ft)	Flow (Total) (gpm)	Pump Head (ft)
PMP-1	912.00	912.01	1,066.69	3,757.6	154.69

FlexTable: Reservoir Table

Label	Elevation (ft)	Flow (Out net) (gpm)	Hydraulic Grade (ft)
R-1	912.01	3,757.6	912.01