Patel & Associates, Inc.

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July 20, 2022 Project No. V22088-12A

Tom Steeno
Steeno Design Studio, Inc.
11774 Hesperia Rd. Suite B
Hesperia, Ca 92345

Subject: **Infiltration Testing for Water Quality Treatment Areas, Proposed Commercial Development, Assessor's Parcel Number 0491-151-11-0000, Located on Highway 395, Barstow Area, San Bernardino County, California**

INTRODUCTION

Patel & Associates is pleased to present this infiltration feasibility report for the proposed commercial development, located on Highway 395, Assessor Parcel Number 0491-151-11, in the Barstow area of San Bernardino County, California. The purpose of our study was to determine the infiltration rates and physical characteristics of the subsurface earth materials at the approximate depth of the proposed WQMP area within the proposed development. This feasibility report provides the infiltration rates to be used for the design and the development of the water quality management plan, where applicable.

PROPERTY DESCRIPTION

The subject property is located on the east side of Highway 395 in the Barstow area of San Bernardino County, California. The approximate location of the site is shown on the Vicinity Map, Figure 1.

The subject property is comprised of an undeveloped parcel of land. Topographic relief at the subject property is relatively low with the terrain being generally flat. Elevations at the site range from approximately 2450 to 2460 feet above mean sea level (msl), for a difference of about 10± feet across the entire site. Drainage within the subject property generally flows to the north.

The site is currently bordered by vacant property and highway 395 to the west. Most of the vegetation on the site consists of moderate to dense amounts of annual weeds/grasses, along with small native shrubs throughout the subject site.

PROPOSED CONSTRUCTION

Based on the provided information the proposed development will consist of a commercial development complete with interior streets, utilities, driveways, and an onsite water quality treatment area.

SUBSURFACE EXPLORATION

Subsurface Exploration

Subsurface exploration within the subject site was performed on May 17, 2022 for the exploratory excavations. A truck mounted hollow-stem-auger drill rig was utilized to drill four (4) borings throughout the site to a maximum depth of 16 feet. The exploratory holes were excavated for geotechnical evaluation purposes with respect to the proposed developments and to interpret whether groundwater or impermeable soil layers were present. An underground utilities clearance was obtained from Underground Service Alert of Southern California, prior to the subsurface exploration. The approximate locations of the exploratory excavations are shown on the attached Infiltration Location Map, Plate 1 and descriptive logs are presented in Appendix A.

Earth materials encountered during exploration were classified and logged in general accordance with the Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) of ASTM D 2488. Upon completion of laboratory testing, exploratory logs and sample descriptions may have been reconciled to reflect laboratory test results with regard to ASTM D 2487.

Earth Materials

A general description of the earth materials observed on site is provided below.

> Quaternary Alluvium (Qa): Quaternary alluvial materials were encountered directly from the surface to a maximum depth explored. These materials were noted to consist predominately brown to reddish brown clayey sand in a slightly moist and very dense state.

INFILTRATION TESTING

The double ring infiltrometer test method was utilized to perform a total of two (2) infiltration tests on April 8, 2022 to evaluate near surface infiltration rates in order to estimate the amount of storm water runoff that can infiltrate into the onsite water quality treatment plan areas. The infiltration tests were performed in general accordance with the San Bernardino County Technical Guidance Document for Water Quality Management plans requirements.

The infiltration tests were performed using double ring infiltrometer and Mariotte tubes at a depth of 5 feet below existing grades. The locations of the infiltration tests are indicated on the attached infiltration Location Map, Plate 1. The double ring infiltrometer tests were located by property boundary measurement on the site plan and by using geographic features. Infiltration test data recorded in the field are summarized in the following table and is included within Appendix B including the graph of Infiltration Rate versus Elapsed Time.

Infiltration Test Summary

TEST NUMBER	INFILTRATION HOLE DEPTH (ft.)	INFILTRATION RATE (in/hr)	DESCRIPTION
DR-1	5	0.60	Clayey SAND
DR-2	5	0.32	Clayey SAND

The infiltration test rates ranged from 0.32 to 0.60 inches per hour (in/hr).

CONCLUSIONS AND RECOMMENDATIONS

General

From geotechnical and engineering geologic points of view, the proposed WQMP areas, where tested, is considered suitable for infiltration for the proposed development, provided the following conclusions and recommendations are incorporated into the plans and are implemented during construction.

Groundwater

Groundwater was not observed during our subsurface exploration to a total depth of 16 feet. Local well data indicates local groundwater levels at depths greater than 100 feet below existing surface, which meets the minimum separation of 10 feet from the bottom of infiltration facility to the groundwater mark. Potential groundwater impact is considered very low.

Geologic/ Geotechnical Screening

The proposed WQMP areas (see Plate 1) should be located away from and at a lower elevation than the proposed structures in competent native earth materials. The proposed structures will be supported by compacted fill and competent earth materials, with no shallow groundwater.

Therefore, infiltration within the proposed WQMP areas will not encroach on any proposed structures and will not increase the risk of geologic hazards.

Recommended Factor of Safety/Design Rate

In accordance with Worksheet H, the Suitability Assessment Safety Factor was calculated to be 1.0. The recommended factor of safety for the infiltration design is 2.

Based on the data presented in this report and the recommendations set forth herein, it is the opinion of Patel & Associates that the WQMP area can be designed for an infiltration rate of 0.25 inches per hour in the vicinity of DR-1 and DR-2.

GRADING PLAN REVIEW AND CONSTRUCTION SERVICES

This report has been prepared for the exclusive use of **Steeno Design Studio, Inc** and their authorized representative. It likely does not contain sufficient information for other parties or other uses. Patel & Associates should be engaged to review the final design plans and specifications prior to construction. This is to verify that the recommendations contained in this report have been properly incorporated into the project plans and specifications. Should Patel & Associates not be accorded the opportunity to review the project plans and specifications, we are not responsibility for misinterpretation of our recommendations.

Patel & Associates should be retained to provide observations during construction to validate this report. In order to allow for design changes in the event that the subsurface conditions differ from those anticipated prior to construction.

Patel & Associates should review any changes in the project and modify and approve in writing the conclusions and recommendations of this report. This report and the drawings contained within are intended for design input purposes only and are not intended to act as construction drawings or specifications. In the event that conditions encountered during grading or construction operations appear to be different than those indicated in this report, this office should be notified immediately, as revisions may be required.

REPORT LIMITATIONS

Our services were performed using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable soils engineers and geologists, practicing at the time and location this report was prepared. No other warranty, expressed or implied, is made as to the conclusions and professional advice included in this report.

Earth materials vary in type, strength, and other geotechnical properties between points of observation and exploration. Groundwater and moisture conditions can also vary due to natural processes or the works of man on this or adjacent properties. As a result, we do not and cannot have complete knowledge of the subsurface conditions beneath the subject property. No practical study can completely eliminate uncertainty with regard to the anticipated geotechnical conditions in connection with a subject property.

The conclusions and recommendations within this report are based upon the findings at the points of observation and are subject to confirmation by Patel & Associates during construction. This report is considered valid for a period of one year from the time the report was issued.

This report was prepared with the understanding that it is the responsibility of the owner or their representative, to ensure that the conclusions and recommendations contained herein are brought to the attention of the other project consultants and are incorporated into the plans and specifications. The owners' contractor should properly implement the conclusions and recommendations during grading and construction, and notify the owner if they consider any of the recommendations presented herein to be unsafe or unsuitable.

Respectfully submitted,

PATEL & ASSOCIATES, INC.

Stephen M. Poole

Stephen M. Poole, PE 40219
President
Principal Engineer

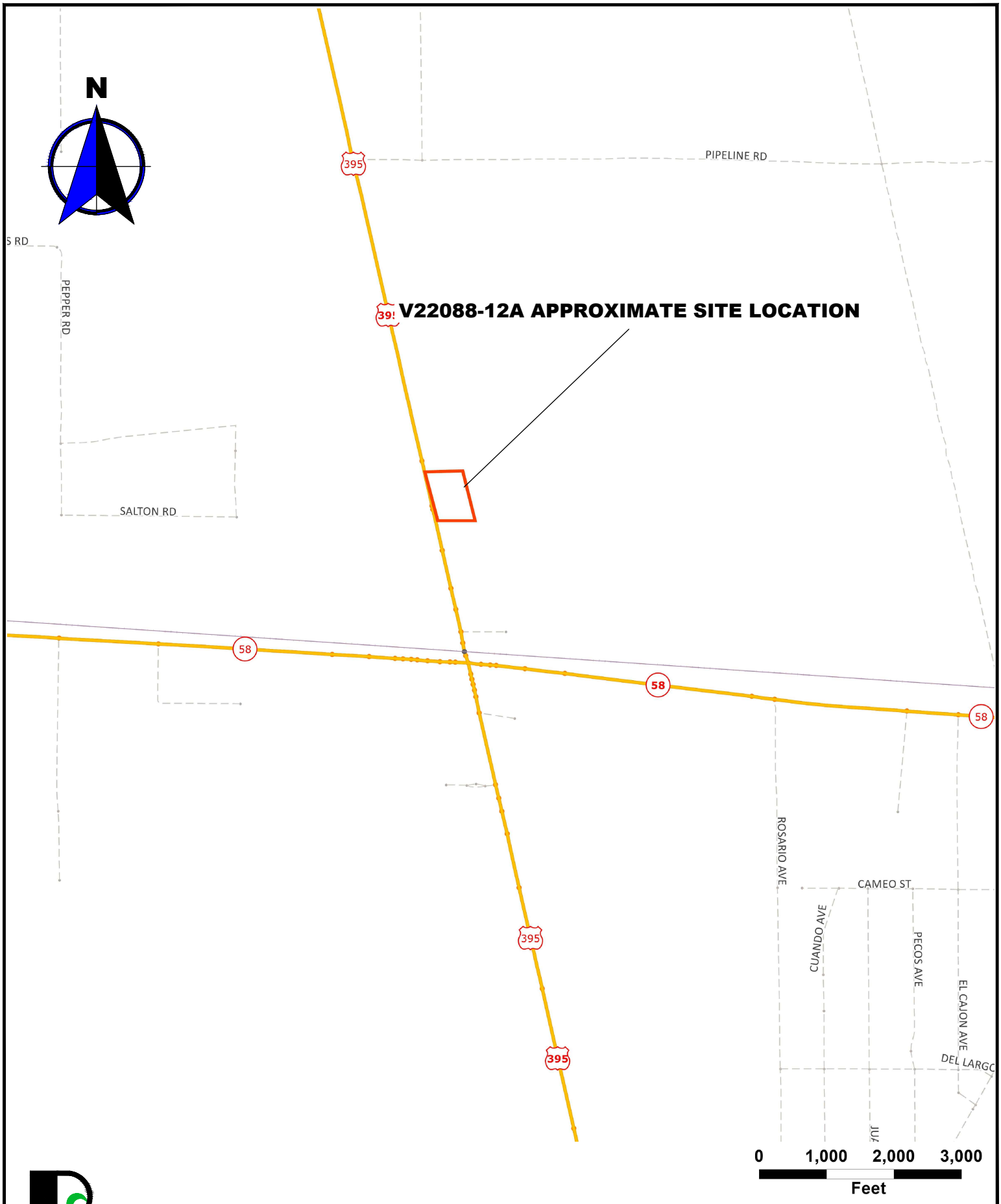
SMP/sez

Distribution: (1) Addressee

Attachments: Figure 1 – Vicinity Map *(Rear of Text)*
Appendix A – Exploratory Logs *(Rear of Text)*
Appendix B – Infiltration Test Sheets *(Rear of Text)*
Plate 1 – Infiltration Location Map *(Rear of Text)*

FIGURE 1

VICINITY MAP



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PROPOSED COMMERCIAL DEVELOPMENT		V22088-12A
VICINITY MAP	SEE BAR SCALE	
	OCT 2022	FIGURE 1

APPENDIX A

EXPLORATORY LOGS

Geotechnical Boring Log B-1

Date: 5/17/2022	**Project Name: Kramer Junction** **Page: 1 of 1**
Project Number: V22088-10A	**Logged By: MWG**
Drilling Company: GP	**Type of Rig: B61**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft): See Map	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Depth	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Quaternary Alluvium (Qa)**
					SM	Silty SAND; tan, slightly moist, medium dense, silty clayey sand
5					SM	Silty SAND; reddish brown, slightly moist, dense, silty clayey sand
10	50/6				SC	Clayey SAND; reddish brown, slightly moist, dense, caliche
15	143/3				SC	Clayey SAND; reddish brown, very dense
20						
25						Total Depth 25 feet No Groundwater
30						

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Geotechnical Boring Log B-2

Date: 5/17/2022	**Project Name: Kramer Junction** **Page: 1 of 1**
Project Number: V22088-10A	**Logged By: MWG**
Drilling Company: GP	**Type of Rig: B61**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft): See Map	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Depth	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Quaternary Alluvium (Qa)**
					SC	Clayey SAND; brown, slightly moist, dense
	50/6					
5	50/6					
	50/6					
10	50/6					
15	50/6					
						Total Depth 16 feet
						No Groundwater
20						
25						
30						

Geotechnical Boring Log B-3

Date: 5/17/2022	**Project Name: Kramer Junction** **Page: 1 of 1**
Project Number: V22088-10A	**Logged By: MWG**
Drilling Company: GP	**Type of Rig: B61**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft): See Map	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Depth	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Quaternary Alluvium (Qa)**
					SC	Clayey SAND, brown, slightly moist, dense, caliche
	50/6	2.5	109.1	1.2		
5	50/6	5	109.4	3.2		
	83	7.5	118.4	2.8		
10	91/12	10	117.2	3.1		
15	50/5	15	117.0	4.6		
						Total Depth 16 feet
						No Groundwater
20						
25						
30						

Geotechnical Boring Log B-4

Date: 5/17/2022	**Project Name: Kramer Junction** **Page: 1 of 1**
Project Number: V22088-10A	**Logged By: MWG**
Drilling Company: GP	**Type of Rig: B61**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft): See Map	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Depth	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Quaternary Alluvium (Qa)**
					SC	Clayey SAND, brown, slightly moist, dense, caliche
	50/5	2.5	115.9	2.6		
5	50/5	5	113.0	1.7		
	50/6	7.5	110.3	1.6		
10	84/12	10	122.8	3.6		
15	50/4	15	112.3	9.8		
						Total Depth 16 feet
						No Groundwater
20						
25						
30						

Geotechnical Boring Log B-5

Date: 5/17/2022	**Project Name: Kramer Junction** **Page: 1 of 1**
Project Number: V22088-10A	**Logged By: MWG**
Drilling Company: GP	**Type of Rig: B61**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft): See Map	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Depth	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Quaternary Alluvium (Qa)**
					SC	Clayey SAND; brown, slighlty moist, very dense
	50/6					
5	50/6					
	50/6					
10	50/6					
15	50/6					
						Total Depth 16 feet
						No Groundwater
20						
25						
30						

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Geotechnical Boring Log B-6

Date: 5/17/2022	**Project Name: Kramer Junction** **Page: 1 of 1**
Project Number: V22088-10A	**Logged By: MWG**
Drilling Company: GP	**Type of Rig: B61**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft): See Map	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Depth	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Quaternary Alluvium (Qa)**
					SC	Clayey SAND, reddish brown, slightly moist, dense, clayey silty
	50/6	2.5				sand and caliche
5	50/4	5				
	50/6	7.5				
10	50/6	10				
15	50/5	15				
						Total Depth 16 feet
						No Groundwater
20						
25						
30						

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Geotechnical Boring Log B-7

Date: 5/17/2022	**Project Name: Kramer Junction** **Page: 1 of 1**
Project Number: V22088-10A	**Logged By: MWG**
Drilling Company: GP	**Type of Rig: B61**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft): See Map	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Depth	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Quaternary Alluvium (Qa)**
					SC	Clayey SAND, reddish brown, slightly moist, very dense, caliche
	50/5	2.5				
5	50/6	5				
	50/4	7.5				
10	50/4	10				
15	50/5	15				
						Total Depth 16 feet
						No Groundwater
20						
25						
30						

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APPENDIX B

INFILTRATION TEST SHEETS

Test No.	DR-1	Location	See Map	Turf-Tec International - Record Chart for IN10-W - (12 & 24 Inch Infiltration Rings)																
Project Identification:	V22088-12A					Constants		Area cm2	Depth of Liquid (cm)	Liquid Container Number		Marriotte Tube Volume								
Test Location:	DR-1					Inner Ring		729	10.0	1		3000								
Liquid Used:	TAP WATE	pH:	8.0			Annular Ring		2189	10.0	2		10000								
Tested By:	MWG		Date	4/8/2022		Liquid level maintained		(X) Flow Valve	( ) Float Valve	( ) Mariotte Tubes										
Depth to water table:			Depth of Test	4.5'		Penetration Depth of Outer Ring:		9 cm	Other											

Trial #	Start / End	Date MM/DD/YY	Time HR:MIN	Time Increment /(Total)	Elapsed Time (Min)	Flow Readings				Liquid Temp °F	Infiltration Rates				Ground Temperature		Remarks
						Inner Ring Reading cm	Inner Maroitte Tube Flow (ml)	Annular Space Reading cm	Annular Space Marriotte Tube Flow (ml)		Inner Infiltration Rate cm/h	Inner Infiltration Rate In/h	Annular Infiltration Rate cm/h	Annular Infiltration Rate In/h	Ground Temp Depth (cm)	Temp at Depth (c)	Weather conditions Etc...
	Start Test	4/8/2022	11:18	0:30													
1	End Test	4/8/2022	11:48	0:30	30	6.00	900	6.00	7700		2.47	**0.97**	7.04	**2.77**			
	Start Test	4/8/2022	11:48	0:30													
2	End Test	4/8/2022	12:18	1:00	60	6.00	600	6.00	2400		1.65	**0.65**	2.19	**0.86**			
	Start Test	4/8/2022	12:18	0:30													
3	End Test	4/8/2022	12:48	1:30	90	6.00	800	6.00	1000		2.19	**0.86**	0.91	**0.36**			
	Start Test	4/8/2022	12:48	0:30													
4	End Test	4/8/2022	13:18	2:00	120	6.00	600	6.00	2000		1.65	**0.65**	1.83	**0.72**			
	Start Test	4/8/2022	13:18	0:30													
5	End Test	4/8/2022	13:48	2:30	150	6.00	200	6.00	1700		0.55	**0.22**	1.55	**0.61**			
	Start Test	4/8/2022	13:48	0:30													
6	End Test	4/8/2022	14:18	3:00	180	6.00	800	6.00	2600		2.19	**0.86**	2.38	**0.94**			
	Start Test	4/8/2022	14:18	0:30													
7	End Test	4/8/2022	14:48	3:30	210	6.00	300	6.00	3000		0.82	**0.32**	2.74	**1.08**			
	Start Test	4/8/2022	14:48	0:30													
8	End Test	4/8/2022	15:18	4:00	240	6.00	500	6.00	2400		1.37	**0.54**	2.19	**0.86**			
	Start Test	4/8/2022	15:18	0:30													
9	End Test	4/8/2022	15:48	4:00	270	6.00	500	6.00	3200		1.37	**0.54**	2.92	**1.15**			
	Start Test	4/8/2022	15:48	0:30													
9	End Test	4/8/2022	16:18	4:00	300	6.00	560	6.00	2400		1.54	**0.60**	2.19	**0.86**			

Project Identification:	V22088-12A		
Test Location:	DR-1		
Liquid Used:	TAP WATE	**pH:**	8.0
Tested By:	MWG		
Depth to water table:	0		

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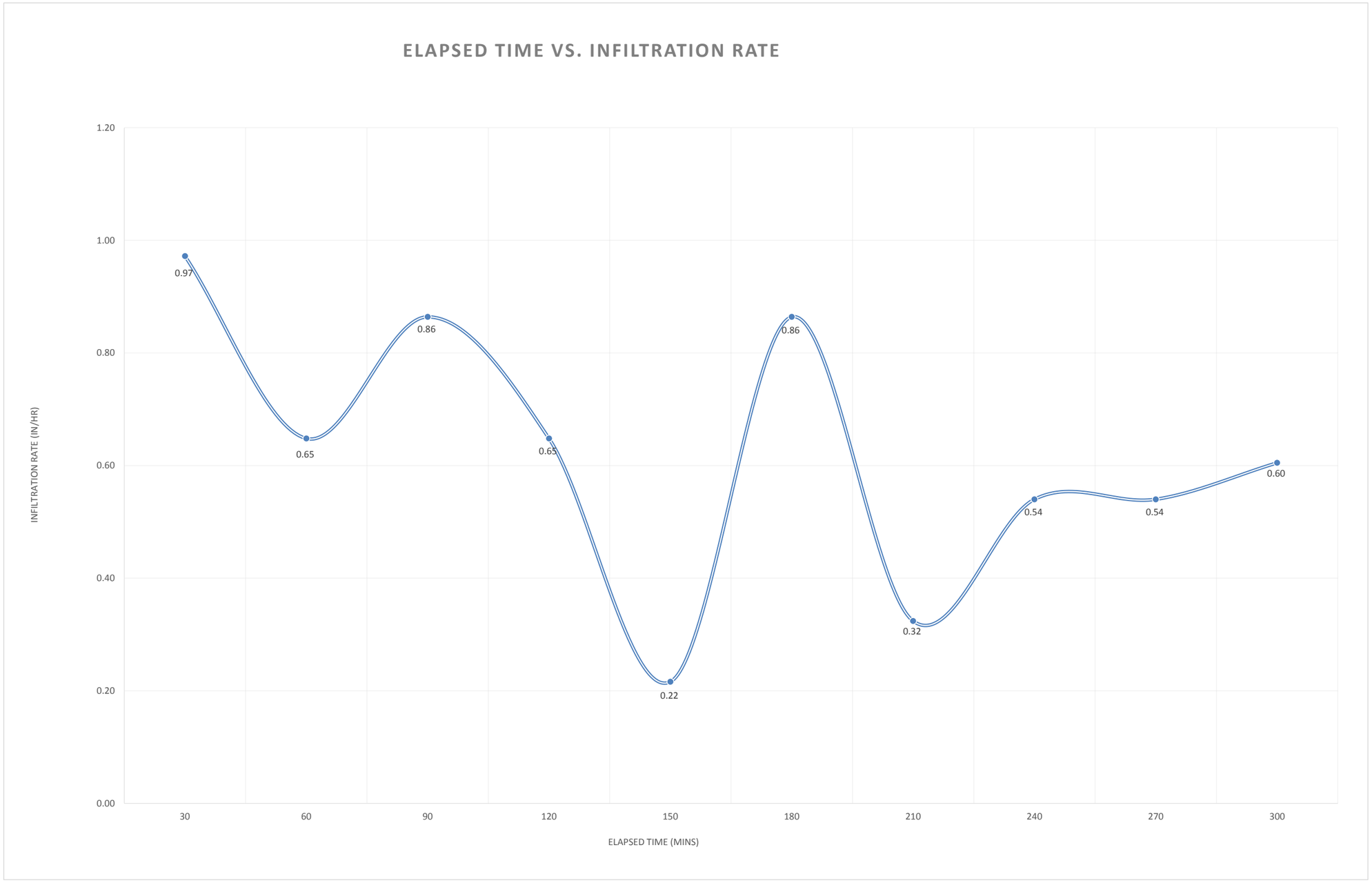

Test No.	DR-2	Location	See Map	Turf-Tec International - Record Chart for IN10-W - (12 & 24 Inch Infiltration Rings)

Project Identification:	V22088-12A			**Constants**	**Area cm2**	**Depth of Liquid (cm)**	**Liquid Container Number**		**Marriotte Tube Volume**	PATEL & ASSOCIATES, INC.	
Test Location:	DR-2			**Inner Ring**	729	10.0	1		3000		
Liquid Used:	TAP WATE	**pH:**	8.0	**Annular Ring**	2189	10.0	2		10000		
Tested By:	MWG	**Date**	4/8/2022	**Liquid level maintained**	(X) Flow Valve	( ) Float Valve	( ) Mariotte Tubes				
Depth to water table:		**Depth of Test**	4.5'	**Penetration Depth of Outer Ring:**	9 cm	**Other**					

Trial #	Start / End	Date MM/DD/YY	Time HR:MIN	Time Increment /(Total)	Elapsed Time (Min)	Flow Readings: Inner Ring Reading cm	Inner Maroitte Tube Flow (ml)	Annular Space Reading cm	Annular Space Marriotte Tube Flow (ml)	Liquid Temp ºF	Infiltration Rates: Inner Infiltration Rate cm/h	Inner Infiltration Rate In/h	Annular Infiltration Rate cm/h	Annular Infiltration Rate In/h	Ground Temperature: Ground Temp Depth (cm)	Temp at Depth (c)	Remarks: Weather conditions Etc...
1	Start Test	4/8/2022	11:25	0:30	30												
	End Test	4/8/2022	11:55	0:30		6.00	1000	6.00	7500		2.74	**1.08**	6.85	**2.70**			
2	Start Test	4/8/2022	11:55	0:30	60												
	End Test	4/8/2022	12:25	1:00		6.00	450	6.00	1900		1.23	**0.49**	1.74	**0.68**			
3	Start Test	4/8/2022	12:25	0:30	90												
	End Test	4/8/2022	12:55	1:30		6.00	700	6.00	1100		1.92	**0.76**	1.01	**0.40**			
4	Start Test	4/8/2022	12:55	0:30	120												
	End Test	4/8/2022	13:25	2:00		6.00	300	6.00	900		0.82	**0.32**	0.82	**0.32**			
5	Start Test	4/8/2022	13:25	0:30	150												
	End Test	4/8/2022	13:55	2:30		6.00	300	6.00	1000		0.82	**0.32**	0.91	**0.36**			
6	Start Test	4/8/2022	13:55	0:30	180												
	End Test	4/8/2022	14:25	3:00		6.00	200	6.00	1400		0.55	**0.22**	1.28	**0.50**			
7	Start Test	4/8/2022	14:25	0:30	210												
	End Test	4/8/2022	14:55	3:30		6.00	300	6.00	1900		0.82	**0.32**	1.74	**0.68**			
8	Start Test	4/8/2022	14:55	0:30	240												
	End Test	4/8/2022	15:25	4:00		6.00	300	6.00	2400		0.82	**0.32**	2.19	**0.86**			
9	Start Test	4/8/2022	15:25	0:30	270												
	End Test	4/8/2022	15:55	4:00		6.00	400	6.00	2000		1.10	**0.43**	1.83	**0.72**			
10	Start Test	4/8/2022	15:55	0:30	300												
	End Test	4/8/2022	16:25	4:00		6.00	300	6.00	2100		0.82	**0.32**	1.92	**0.76**			

Turf-Tec International

Project Identification:	V22088-12A		
Test Location:	DR-2		
Liquid Used:	TAP WATE	**pH:**	8.0
Tested By:	MWG		
Depth to water table:	0		

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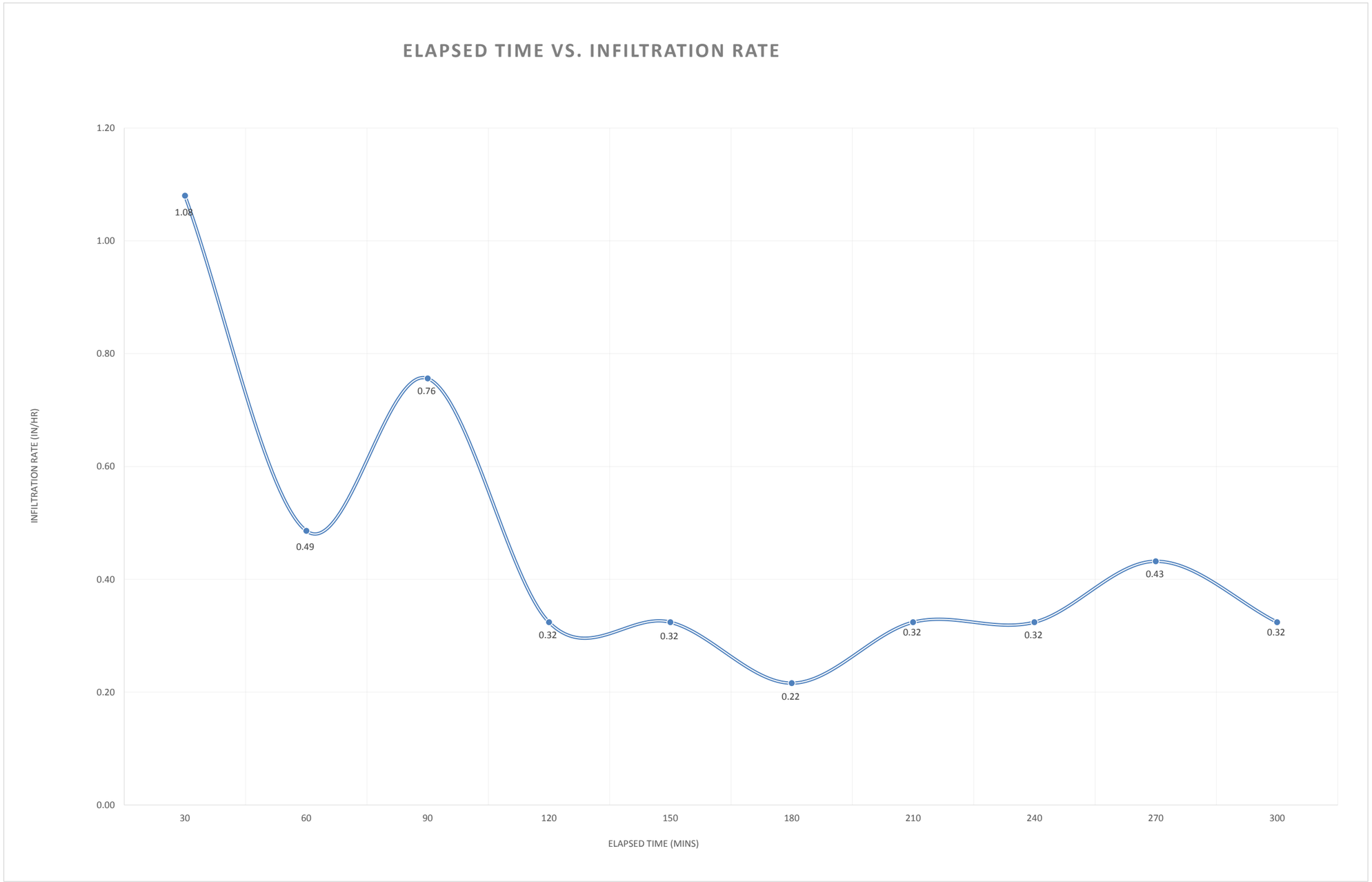


LEGEND

Locations are Approximate

Geologic Units

Qa - Quaternary Alluvium

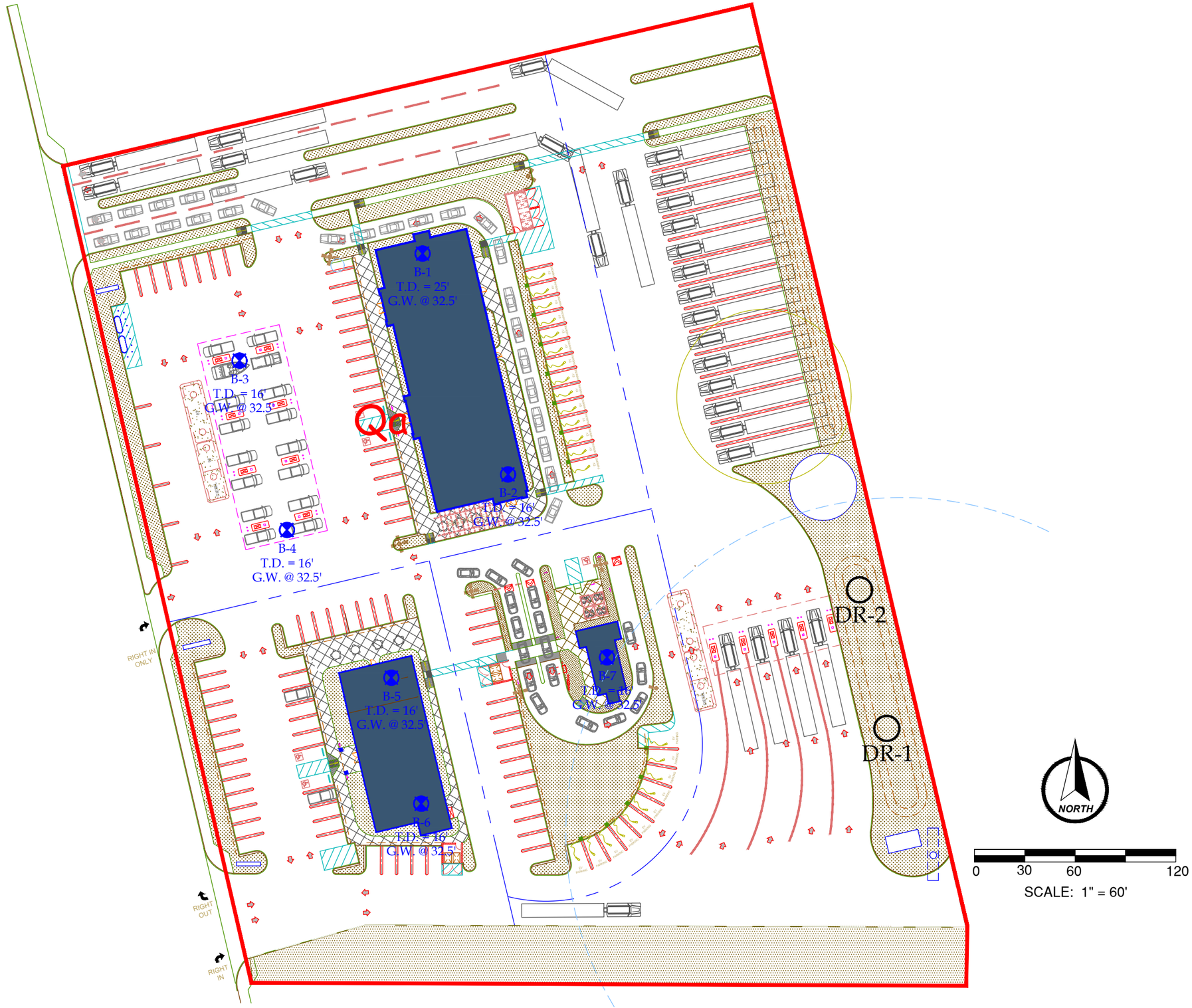
Symbols

- Limits of Report

B-7
T.D. = 16'
G.W. @ 32.5'
- Boring Location
Including Total Depth and Depth to Groundwater

DR-2 - Double Ring Test Location

Commitment of Excellence
through Engineered Solution



INFILTRATION MAP

LOCATED ON HIGHWAY US 395
KRAMER JUNCTION AREA, SAN BERNARDINO COUNTY, CALIFORNIA
APN 0491-151-11-0000

PROJECT	PROPOSED COMMERCIAL DEVELOPMENT		
CLIENT	MR. TOM STEENO		
PROJECT NO.	V22088-12A		
DATE	OCTOBER 2022		
SCALE	1:60		
DWG XREFS			
REVISION			
DRAWN BY	JDG	PLATE	1 OF 1