



February 20, 2019

Project No. G19-1691-20

Mr. Patrick Diaz
Crestwood Corporation
510 Citrus Edge Street
Glendora, California 91741

Subject: *Preliminary Infiltration Testing Investigation for Onsite Storm Water Infiltration Devices for the Proposed 42 Lot Residential Project, 5553 Mission Boulevard, Montclair Area, County of San Bernardino, California.*

Reference: *Crestwood Communities, Conceptual Site Plan, 5553 Mission Blvd., San Bernardino County, California, Scale: 1" = 40", Dated October 3, 2018.*

1.0 INTRODUCTION

LGC Geo-Environmental, Inc. (LGC) is pleased to present this preliminary infiltration testing investigation for the proposed onsite storm water infiltration devices relative to the storm water Best Management Practice (BMP) for the proposed 42 lot residential project, located at 5553 Mission Boulevard, Montclair Area, San Bernardino County, California. The purpose of our study was to determine the vertical infiltration rates and physical characteristics of the subsurface soils in selected areas of proposed onsite storm water infiltration BMP devices within specific portions of the subject property.

2.0 PROPERTY LOCATIONS AND DESCRIPTION

The subject site proposed to be developed is located on the south side of Mission Boulevard and west of Vernon Avenue in the Montclair area of County of San Bernardino, California. The site is currently bounded on the north by Mission Boulevard, on the west by existing single-family residential development and a car wash facility, on the south by existing single-family residential development on the east by a mobile home park and a vacant land. The general location and configuration of the site are shown on the Site Location Map (Figure 1).

The topography of the site is relatively level. Elevations range from approximately 939 feet above mean sea level (msl) in the northern portion of the site to approximately 931 feet msl in the southern portion of the site.

3.0 PROPOSED CONSTRUCTION

Based on the referenced conceptual site plan and information provided, as well as conversations with the project civil engineer, approximately 2 locations on the site are being considered for proposed storm water infiltration devices, possibly up about 4 feet to 5 feet deep.

4.0 SUBSURFACE EXPLORATION AND INFILTRATION TESTING

4.1 Subsurface Exploration

Subsurface exploration of the subject site consisted of excavating four (4) infiltration test trench locations, numbered IT-1 through IT-4, utilizing a backhoe, on January 29, 2019 within the proposed onsite storm water infiltration BMP location, at depths of approximately five (5) feet below existing grade. In addition, initial subsurface exploration at the subject site consisted of drilling four (4) exploratory borings (B-1 thru B-4) utilizing an 8-inch diameter hollow-stem auger drill rig on November 26, 2018, as part of an in progress geotechnical/geologic investigation for the site. Boring B-4 was drilled within close proximity of the proposed onsite storm water infiltration system location area to an approximate depth of 26.5 feet below existing grade. This boring was used to document subsurface material and depth to groundwater.

Earth materials encountered within the locations were classified in general accordance with the visual manual procedures of the Unified Soil Classification System (USCS). Logs of the infiltration test trenches are presented in Appendix A, and their approximate locations are depicted on the Infiltration Test Trench Location Map (Plate 1).

Prior to the subsurface exploration work, an underground utilities clearance was obtained from Underground Service Alert of Southern California. At the conclusion of the subsurface exploration, all the test trenches were backfilled with existing materials with some compactive effort. Minor settlement of the backfill soils may occur over time.

4.2 Infiltration Testing

On January 29, 2019 four (4) shallow percolation method infiltration test trenches, numbered IT-1, IT-2, IT-3, and IT-4, were excavated. Infiltration tests holes were prepared within these trenches by digging 8-inch diameter by 14-inch deep holes and placing approximately two inches of ¾-inch gravel and a 12-inch long plastic liner with perforations along the bottom. At least eight (8) inches of clean water was filled within each of the test plastic liners. From a fixed test point, the drop-in water level, in inches, was measured and recorded at consistent intervals over a period of at least six (6) readings or until the rate for two consecutive readings was within a five percent variation. The field percolation rates were reduced per the Porchet Method utilizing reduction factors of the actual field test rates. This testing methodology, utilizing reduction factor of 2.25 to 2.70, was applied to the field test rates. The results of percolation method infiltration tests are presented in the following table in section 5.3. The infiltration test data sheets are presented in Appendix A.

5.0 FINDINGS

5.1 Earth Materials

Based on our review of the data from the in progress geotechnical/geologic investigation and current exploration of the earth materials underlying the proposed onsite storm water infiltration BMP area, the materials encountered to the depths explored include topsoil and alluvial fan deposits. A description of the earth material soils encountered is described below:

Topsoil: The topsoil is comprised of silty sand and clayey sand, which is very fine to medium-grained, brown, damp to moist, loose to medium dense, with occasional coarse grains and gravel and some roots and rootlets. The topsoil, where observed in the exploratory trenches, are approximately 0.5 foot to 2.0 feet thick.

Alluvial Fan Deposits (Qf): Holocene age alluvial fan deposits were encountered below the topsoil and are comprised of poorly graded sand, with some silt, which are fine to coarse grained, reddish brown, yellowish brown and orange brown, dry to damp, medium dense to dense, with some gravel and cobbles. The alluvial fan deposits where observed in the exploratory trench, to be loose to medium dense locally in the upper 2.5 feet to and 3.5 feet. Based on previous exploration these materials are approximately 13.0 feet to 14.5 feet thick.

Older Alluvial Fan Deposits: Pleistocene age older alluvial fan deposits was present below the alluvial fan deposits, at depth of about 15.0 feet. These materials were alternating layers of silty sand, clayey silt and silty clay, which are generally very fine to medium grained, various shades of olive, grey and brown, damp to very moist, medium dense to

dense and firm to stiff, with some pinhole pores and caliche.

5.2 Groundwater

Groundwater was not encountered during the infiltration testing and previous exploratory drilling to depths of up to 26.5 feet. A review of the Chino Basin Watermaster "Depth to Groundwater Contour Map, Summer 2016" and California Department of Water Resources, Water Data Library 2017 online database (Well ID: Station 340615N1176887W001), indicates groundwater in the general site area is about 300 to 360 feet below the existing ground surface.

California Department of Water Resources, Water Data Library 2017 online database indicates groundwater in the general site area is about 360 feet below the existing ground surface (Well ID: Station 340615N1176887W001).

5.3 Infiltration Testing Results

The shallow infiltration testing rates for design considerations for each of proposed drainage device areas which were tested are presented in the table below.

Infiltration Design Rates

TEST NO.	TEST DEPTH (Feet)	INFILTRATION RATES		SOIL DESCRIPTION (USCS)
		FIELD PERCOLATION RATE (INCHES/HOUR)	DESIGN INFILTRATION RATE (INCHES/HOUR)	
IT-1	5.0	60.00	26.67	SP
IT-2	4.5	60.00	26.67	SP
IT-3	5.0	60.00	26.67	SP
IT-4	5.0	38.21	14.15	SP/SM

6.0 CONCLUSIONS AND RECOMMENDATIONS

Shallow infiltration testing for the proposed drainage devices indicated design rates of approximately 26.67, 26.67, 38.10, and 14.15 inches/hour, after applying a reduction factor of 2.25 or 2.70, per the Porchet Method, at depths of approximately 4.5 feet to 5.0 feet below the existing ground surface as presented in the above infiltration design rate table, Section 5.3. Composite average design rates representing the infiltration devices proposed to be installed on LOTS 1 and 2 should be utilized for the proposed infiltration device location, as indicated on Infiltration Test Trench Location Map (Plate 1). The composite average design rate for **Lot 1 is 26.67 inches/hour** represented by testing from infiltration test trenches IT-1 and IT-2 and the composite average design rate for **Lot 2 is 20.41 inches/hour** represented by testing from infiltration test trenches IT-3 and IT-4.

The proposed infiltration devices should be placed at least five (5) feet horizontally away from or beyond a 1:1 (horizontal to vertical) projection from the base of any proposed or existing structures or walls, whichever is greater. The project geologist or engineer should observe infiltration device excavations during trenching to verify the anticipated soil units and geotechnical conditions. Since the proposed infiltration devices may be within and/or adjacent to proposed roadways, parking areas and/or sidewalks (within 5 feet) and may be up to approximately five (5) feet deep, any gravel backfill should be densified or any soil backfill should be compacted to at least 90% of the maximum dry density during placement. The project geologist or engineer should observe infiltration device excavations during trenching to verify the anticipated soil units and geotechnical conditions as well as observe, probe and/or test any densification or compaction of the infiltration trench and pit gravel and/or soil backfill.

Furthermore, based on the data presented from the California Department of Water Resources, Water Data Library well data, groundwater should be approximately 360.0 feet below the existing ground surface and should not be present within the current allowable limit of within 10 feet of the bottom of testing and/or drainage devices as set forth by the City of San Bernardino, County of San Bernardino, and California State requirements.

7.0 PLAN REVIEWS AND CONSTRUCTION SERVICES

This report was prepared for the exclusive use of **Crestwood Corporation** to assist the project civil engineer in the design of the proposed infiltration systems for the proposed development. It is recommended that LGC be engaged to review infiltration device plans, grading plans, foundation plans and the final infiltration design drawings and specifications prior to construction. This is to document that the recommendations contained in this report were properly interpreted and incorporated into the project plans and specifications from a geotechnical standpoint. Plans should be forwarded to the project geotechnical engineer and/or engineering geologist for LGC for review and comments, as deemed necessary. LGC's review of infiltration device plans, grading plans, foundation plans and the final infiltration design drawings and specifications may indicate that additional subsurface exploration, laboratory testing and analysis should be performed to address areas of concern. If LGC is not accorded the opportunity to review these documents, we cannot take responsibility for misinterpretation of our recommendations.

If the project plans change significantly (e.g., location and type of infiltration devices), LGC should be retained to review our original design recommendations and applicability to the revised construction. If conditions are encountered during construction that appears to be different from those indicated in this report, this office should be notified immediately. Design and construction revisions may be required.

The preliminary conclusions and recommendations provided in this report are based on review of previous geotechnical reports, infiltration testing, geologic field mapping, and geotechnical/geologic analyses to date. A representative of LGC should observe the interpolated subsurface conditions in the field during construction.

We recommend that LGC be retained to provide geotechnical engineering services during future grading, infiltration device excavations, installation of infiltration materials, backfill of infiltration devices, or when an unusual soil condition is encountered at the site. This is to document compliance with the design, specifications or recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to start of construction.

8.0 INVESTIGATION LIMITATIONS

This report is based upon information provided by the client and the project civil engineer, a limited number of subsurface excavations, field observations and percolation/infiltration tests to which we applied various methods of analysis and interpretation. The materials encountered and tested in the field on the project site are believed representative of the project area, and the conclusions and recommendations contained herein are presented on that basis. However, soil materials can vary in characteristics between points of exploration, both laterally and vertically, and those variations could affect the conclusions, recommendations, and performance of the proposed storm water infiltration device BMP systems. Fluctuations in the level of groundwater may occur due to variations in rainfall, irrigation, and the other factors not in evidence at the time measurements were made. If this occurs, the changed conditions must be evaluated by the project geotechnical engineer and engineering geologist and design(s) adjusted as required or alternate design(s) recommended.

This report is issued with the understanding that it is the responsibility of the owner, or of his/her representative, to ensure that the information and recommendations contained herein are brought to the attention of the project engineer and incorporated into the plans, and the necessary steps are taken to see that the contractor and/or subcontractor properly implements the recommendations in the field.

The conclusions and opinions contained in this report are based on the results of the described geotechnical evaluations and represent our professional judgment. The findings, conclusions and recommendations contained in this report are to be considered tentative only and subject to confirmation by the undersigned during the construction process. Without this confirmation, this report is to be considered incomplete and LGC or the undersigned professionals assume no responsibility for its use.

The conclusions and opinions contained in this report are valid up to a period of 2 years from the date of this report. Changes in the conditions of a property can and do occur with the passage of time, whether they be because of natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate codes or standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, if any of the above-mentioned situations occur, an update of this report should be completed.

This report has not been prepared for use by parties or projects other than those named or designed above. It may not contain sufficient information for other parties or other purposes.

The opportunity to be of service is appreciated. Should you have any questions regarding the content of this report, or should you require additional information, please do not hesitate to contact this office at your earliest convenience. Our services were performed using the degree of care and skill ordinarily exercised, under similar circumstances, by engineers and geologists practicing in this or other localities. The contents of this report are professional opinions and as such, are not to be considered a guarantee or warranty.

The opportunity to be of service is appreciated. Should you have any questions regarding the content of this report, or should you require additional information, please do not hesitate to contact this office at your earliest convenience.

Respectfully submitted,

LGC Geo-Environmental, Inc.


Robert L. Gregorek II
Certified Engineering Geologist



RGG/RLG

Distribution: (4) Addressee

Attachments: Site Location Map – Figure 1 (*Rear of Text*)
 Appendix A – Infiltration Test Trench Logs and Exploratory Boring Log (*Rear of Text*)
 Appendix B – Infiltration Test Results (*Rear of Text*)
 Plate 1 – Infiltration Test Trench Location Map (*Pocket Enclosure*)



APPENDIX A

INFILTRATION TEST TRENCH LOGS AND EXPLORATORY BORING LOG

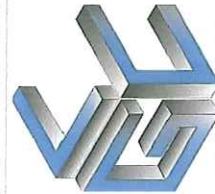


Project Name: CrestWood Corporation			Logged by: RS		LOG OF TEST TRENCH IT-1			
Project Number: G18-1691-20			Elevation:		Engineering Properties			
Equipment: BACKHOE			Location/Grid: SEE PLATE 1		USCS	Sample No.	Moisture (%)	Dry Density (pcf)
Depth (ft)	Date: 1/29/2019	Description:	Geologic Unit					
0.0'-2.0'	<p><u>A TOPSOIL:</u> Clayey SAND; brown, damp to moist, loose to medium dense, very fine- to medium-grained, roots and rootlets, occasional coarse grains and gravel</p>		SC					
2.0'-5.0'	<p><u>B ALLUVIAL FAN DEPOSITS:</u> Poorly Graded SAND; yellowish brown, damp, medium dense, fine- to coarse-grained, with gravel and occasional cobbles</p>		Qfc		SP			
Total Depth 5.0 Feet								
GRAPHICAL REPRESENTATION: East Wall			SCALE: 1" = 5'		SURFACE SLOPE:		TREND: N10W	
			<p>TOTAL DEPTH = 5.0 FEET NO GROUNDWATER ENCOUNTERED</p>					



Project Name: CrestWood Corporation			Logged by: RS		LOG OF TEST TRENCH IT-2			
Project Number: G18-1691-20			Elevation:		Engineering Properties			
Equipment: BACKHOE			Location/Grid: SEE PLATE 1					
Depth (ft)	Date: 1/29/2019	Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)	
0.0'-1.5'		A <u>TOPSOIL</u> : Silty SAND; brown, damp to moist, loose to medium dense, fine-grained, trace clay with some gravel		SM				
1.5'-4.5'		B <u>ALLUVIAL FAN DEPOSITS</u> : Poorly Graded SAND; yellowish brown, damp, medium dense, fine- to coarse-grained with gravel and cobbles, micaceous	Qfc	SP				
Total Depth 4.5 Feet								
GRAPHICAL REPRESENTATION: East Wall			SCALE: 1" = 5'		SURFACE SLOPE:		TREND: N15W	
							TOTAL DEPTH = 4.5 FEET NO GROUNDWATER ENCOUNTERED	
								

Project Name: CrestWood Corporation				Logged by: RS		LOG OF TEST TRENCH IT-3					
Project Number: G18-1691-20				Elevation:		Engineering Properties					
Equipment: Backhoe		Date: 1/29/2019		Location/Grid: SEE PLATE 1		USCS			Sample No.	Moisture (%)	Dry Density (pcf)
Depth (ft)	Description:	Geologic Unit									
0.0'-1.5'	A TOPSOIL: Silty SAND; brown, moist, loose, very fine- to fine-grained, trace amounts of clay, roots and rootlets			SM							
1.5'-4.0'	B ALLUVIAL FAN DEPOSITIS: Poorly graded SAND; reddish brown, damp, loose to medium dense, fine-grained with some gravel, rootlets @ 4.5"; yellowish brown, damp, medium dense to dense, fine to medium-grained with some gravel and cobbles, micaceous	Qfc		SP							
Total Depth 5.0 Feet											
GRAPHICAL REPRESENTATION: East Wall				SCALE: 1" = 5'		SURFACE SLOPE:		TREND: N5W			
TOTAL DEPTH = 5.0 FEET NO GROUNDWATER ENCOUNTERED											



Project Name: CrestWood Corporation			Logged by: RS		LOG OF TEST TRENCH IT-4			
Project Number: G18-1691-20			Elevation:		Engineering Properties			
Equipment: Backhoe			Location/Grid: SEE PLATE 1					
Depth (ft)	Date: 1/29/2019	Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)	
0.0'-1.0'		A <u>TOPSOIL:</u> Silty SAND; brown, moist, loose, very fine- to fine-grained, trace clay, roots		SM				
1.0'-4.5'		B <u>ALLUVIAL FAN DEPOSITS:</u> Poorly graded SAND; reddish brown, damp, loose to medium dense, fine-grained, occasional gravel, rootlets @4.5'; some silt, yellowish brown, damp, medium dense to dense, fine- to medium-grained with gravels and cobbles, micaceous	Qfc	SP				
Total Depth 5.0 Feet								
GRAPHICAL REPRESENTATION: East Wall			SCALE: 1" = 5'		SURFACE SLOPE:		TREND: N18W	
							TOTAL DEPTH = 5.0 FEET NO GROUNDWATER ENCOUNTERED	



Geotechnical Boring Log B-4

Date: 11-26-18	Project Name: Crestwood	Page 1 of 1
Project Number: G18-1691-10	Logged By: RS	
Drilling Company: 2R	Type of Rig: CME-55	
Drive Weight (lbs.): 140	Drop (in.): 30	Hole Dia. (in.): 8
Top of Hole Elevation (ft):	Hole Location: See Geotechnical Map	

Elevation (MSL) and Depth (ft.)	Blow Count / 6"	Sample No.	Soil Graphic	Geologic / Group Symbol	DESCRIPTION	In-Situ Moist. (%)	Dry Density (pcf)	Standard Penetration Test			Type of Test			
								SPT		CURVE				
								Depth	N					
										10	30	50		
0	6 13 21	R1		SP Qf SM	Topsoil Poorly Graded SAND; dark brown, dry, loose, fine to medium grained, trace gravels, roots.	1.5	122.1	1.0-2.5	23					Bulk @ 2'-4'
5	7 14 20	R2		SP	Alluvial Fan Deposits Silty SAND; orange brown, dry to damp, dense, fine to coarse grained, with gravels and cobbles, friable	1.5	125.8	4.0-5.5	23					
	17 23 42	R3		SP	Poorly Graded SAND; orange brown, dry, dense, medium to coarse grained, coarse gravel, some cobbles, friable @ 7'; dark orange brown, very dense	1.9	118.9	7.0-8.5	44					
10	8 15 20	R4		SP-SM	Poorly Graded SAND/Silty SAND; orange brown, damp, dense, fine to medium grained	4.5	117.1	10.0-11.5	24					
15	3 4 5	S1		Qof ML	Older Alluvial Fan Deposits Clayey SILT; olive brown, moist to very moist, firm, very fine grained	18.5		15.0-16.5	9					
20	7 13 17	R5		SM	Silty SAND; greyish brown, damp to moist, medium dense to dense, fine to medium grained, pinhole pores	6.5	102.7	20.0-21.5	20					
25	3 7 5	S2		CL	Silty CLAY; olive brown, moist to very moist, stiff, very fine grained, caliche stringers	18.3		25.0-26.5	12					
Total Depth: 26.5' No Groundwater														
30														

Sample Legend

- ▣ SPT
- ▣ Ring Sample (CA modified)

Geotechnical Consulting



Project:	5553 Mission Blvd.	Job No.:	G18-1691-20
Test Hole No.:	IT-1	Date Excavated:	1/29/2019
Depth of Test Hole:	14" / Trench Depth: 5.0'	Soil Classification:	SP
Check for Sandy Soil Criteria By:	JW	Date of Perc Test:	1/29/2019
		Diameter:	8 inches

SANDY SOIL CRITERIA TEST

<i>TIME</i>	Time Interval (minutes)	Initial Water Level (feet)	Final Water Level (feet)	Change In Water Level (feet)

PRESOAK PERIOD

Date		Time	Interval	Amount of Water Used
Start	1/29/2019	8:50 AM	8 minutes	5 gallons
Stop	1/29/2019	8:58 AM		

TEST PERIOD	
1	2
3	4
5	6
7	8
9	10
11	12
13	14
15	16
17	18
19	20
21	22
23	24
25	26
27	28
29	30
31	32
33	34
35	36
37	38
39	40
41	42
43	44
45	46
47	48
49	50
51	52
53	54
55	56
57	58
59	60
61	62
63	64
65	66
67	68
69	70
71	72
73	74
75	76
77	78
79	80
81	82
83	84
85	86
87	88
89	90
91	92
93	94
95	96
97	98
99	100

[illegible]

Reduction Factor:	2.25
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Design Infiltration Rate (in/hr):	26.67
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LGC GEO-ENVIRONMENTAL, INC.

Project:	5553 Mission Blvd.	Job No.:	G18-1691-20
Test Hole No.:	IT-2	Date Excavated:	1/29/2019
Depth of Test Hole:	14" / Trench Depth: 4.5'	Soil Classification:	SP
Check for Sandy Soil Criteria By:	JW	Date of Perc Test:	1/29/2019
		Diameter:	8 inches

SANDY SOIL CRITERIA TEST

<i>TIME</i>	Time Interval (minutes)	Initial Water Level (feet)	Final Water Level (feet)	Change In Water Level (feet)

PRESOAK PERIOD

	Date	Time	Interval	Amount of Water Used
Start	1/29/2019	9:00 AM	14 minutes	5 gallons
Stop	1/29/2019	9:14 AM		

TEST PERIOD

[illegible]

Reduction Factor:	2.25
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Design Infiltration Rate (in/hr):	26.67
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LGC GEO-ENVIRONMENTAL, INC.

<i>TIME</i>	Time Interval (minutes)	Initial Water Level (feet)	Final Water Level (feet)	Change In Water Level (feet)

<i>TIME</i>	Time Interval (minutes)	Initial Water Level (feet)	Final Water Level (feet)	Change In Water Level (feet)

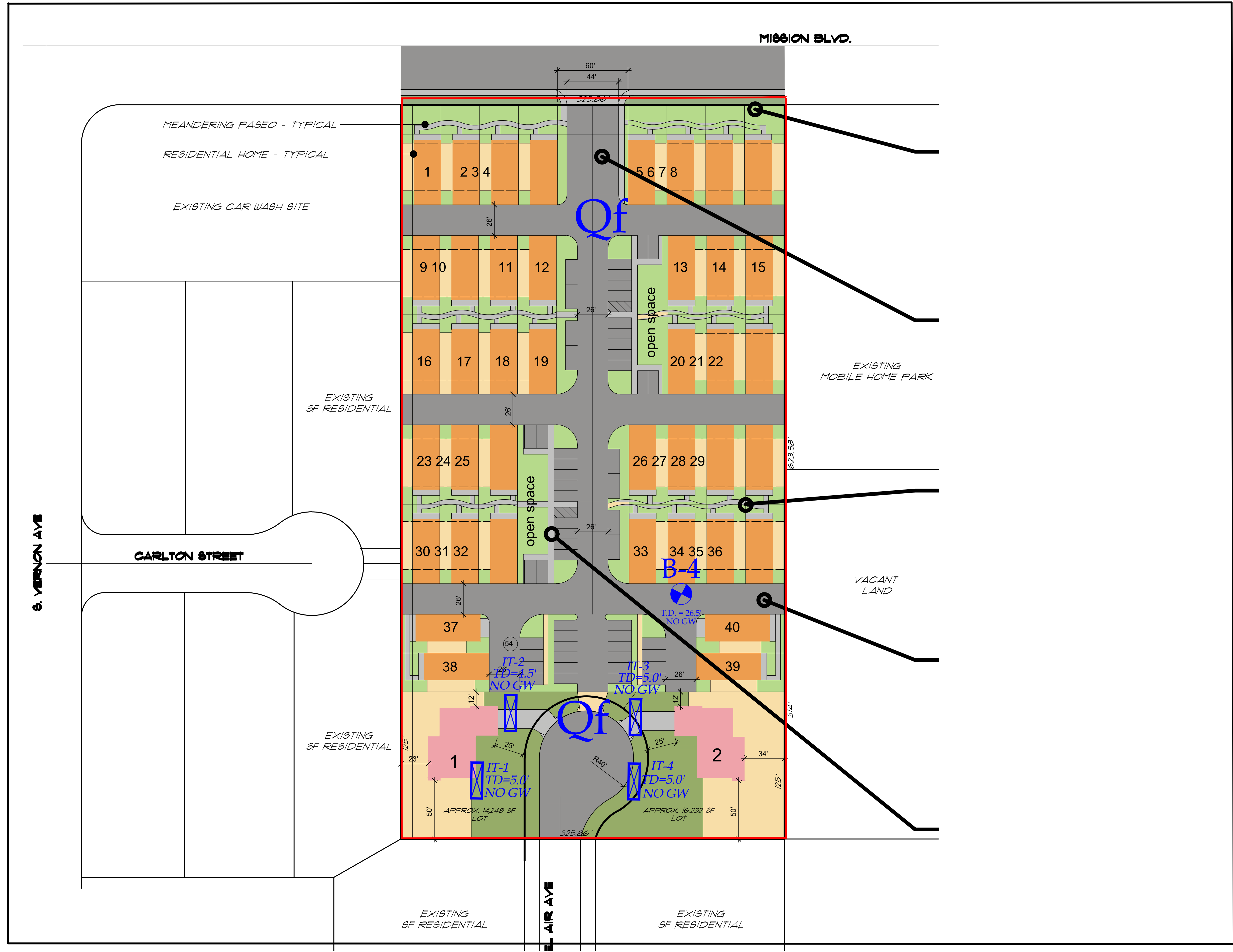
Date		Time	Interval	Amount of Water Used
Start	1/29/2019	9:31 AM	39 minutes	5 gallons
Stop	1/29/2019	10:10 AM		

[illegible]

Design Infiltration Rate (in/hr):	14.15
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LGC GEO-ENVIRONMENTAL, INC.



LEGEND
(Locations are Approximate)

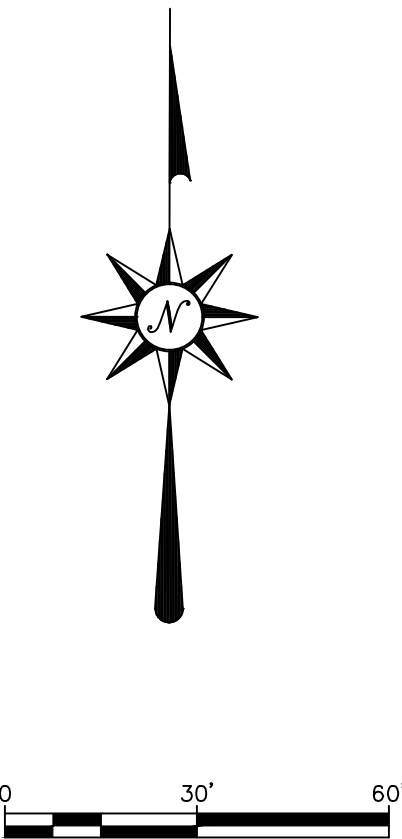
Symbols

- Limits of This Report

- Alluvial Fan Deposits

B-4
T.D. = 26.5'
NO GW
Exploratory Boring

IT-4
TD=5.0'
NO GW
Infiltration Trench Location



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Robert L. Gregorek, II
Engineering Geologist

INFILTRATION TEST TRENCH LOCATION MAP

5553 Mission Boulevard
City of San Bernardino, County of San Bernardino, California

Name:	CrestWood Corporation
Project No.	G18-1691-20
Client:	Mr. Patrick Diaz
Scale:	1" = 30'
Date:	February 2019
Reference:	CrestWood Communities, Conceptual Site Plan - 5553 Mission Blvd., San Bernardino, California
Plate No.	1 OF 1