The Moorings Condominiums
Building 1

302 - 316 Moorings Cove Drive
Tarpon Springs, FL 34689
B.A.S.I.C. File No.: B2020-018

April 22nd, 2021

FINAL REPORT

BASIC ENGINEERING

Bay Area Sinkhole Investigation & Civil Engineering
2601 E. 7th Avenue, Tampa, FL 33605
Ph: (813) 885-4144 | Fx: (813) 885-4166
www.basic-engineering.com

BAY AREA SINKHOLE INVESTIGATION & CIVIL ENGINEERING

2601 East 7th Avenue • Tampa, Florida 33605
Ph: 813-885-4144 • Fx: 813-885-4166

To: The Moorings Condominiums Association
Attn: Karen Cleary, President
450 Moorings Cove Drive
Tarpon Springs, FL 34689

Date: 04/22/2021
Project # B2020-018

Subject: Injection Pin Pile, Compaction and Chemical Grouting
The Moorings Condominiums | Building 1
302 – 316 Moorings Cove Drive, Tarpon Springs, FL 34689

Dear Ms. Cleary,

We have reviewed a Structural Damage Evaluation and Subsidence Investigation report by SDII Global, (SDII), dated March 22nd, 2018, a Geologic/Geotechnical Testing and Evaluation report by Applied Engineering & Geosciences (AEG), dated September 22nd, 2018, a Sinkhole Loss Determination report by Structural Engineering and Inspections, Inc, (SEI), dated November 28th, 2018, a Peer Review report by SDII GlobaI, (SDII), dated January 11th, 2019, a Neutral Evaluation report by Andreyev Engineering, Inc., (AEI), dated March 16th, 2020 and field work and engineering design performed by B.A.S.I.C. Engineering.

Based on the aforementioned reports, you have asked us to recommend and monitor a remediation program. B.A.S.I.C. Engineering recommended utilizing a combination of injection pin piles, compaction grouting and chemical grouting points. We have provided you with a Site Plan indicating the location of the injection pin piles, compaction grout and chemical grouting points and their estimated depths of installation. However, we were unable to accurately predict the amount of grout that would be required prior to actual field installation.

Injection Pin Piles are recommended in similar situations whereby the property requires lifting or other foundation support in addition to sealing off the limestone interface to prevent future sinkhole activity from occurring. The installation of the Injection Pin Piles is a process whereby high carbon steel pilings are hydraulically driven into the ground until a predetermined pressure reading is attained, or refusal occurs where lifting of the structure takes place. The Injection Pin Piles are then grouted through a patented process allowing grout to be pumped directly at the limestone interface.

In addition to the installation of the Injection Pin Piles, a high slump pressure grouting program is recommended as a means of sealing deep openings into underlying cavernous zones, fill in void zones, consolidate/densify the loose soils, prevent downward migration of soil particles and also to provide greater lateral stability to the steel pilings. A 4-6 inch slump grout is recommended by B.A.S.I.C. Engineering so that it may be accurately pumped below the structure and it may flow through the grout holes and densify soil voids with greatest efficiency.

Compaction grouting is the injection of grout into the soil to improve bearing capacity. This is accomplished by using a very viscous (low-mobility), aggregate under high pressure to form grout bulbs, which displace and densify the surrounding soils in a controlled manner through an injection pipe. The upward component of force causing heaving at the surface during compaction grouting usually limits the degree which soil can be compacted, making compaction grouting ineffective for stabilizing upper level soils (approximately the top 15 feet). Therefore, in order to stabilize the uppermost subsurface soils, chemical grouting has also been recommended.

Chemical grouting is a process whereupon a polyurethane grout is injected to fill void spaces and improve the strength of granular soils. Chemical grout behaves like a fluid but reacts with an agent and water and within sixty seconds forms a solid, expanding to compact the soils similarly to standard compaction grouting but in a more controlled manner.

MONITORING

As requested, we have completed the monitoring of the subsurface injection pin piles, compaction grouting and chemical grouting operations as conducted by Helicon Foundation Repair Systems, Inc., (Helicon). This work was completed utilizing the TMG Injection Pier System, Compaction Grouting and Chemical Grouting. The remediation was started on February 19th, 2021 and completed on April 21st, 2021. A technician from our firm was present during the remediation operations to monitor operations and perform applicable grout slump tests.

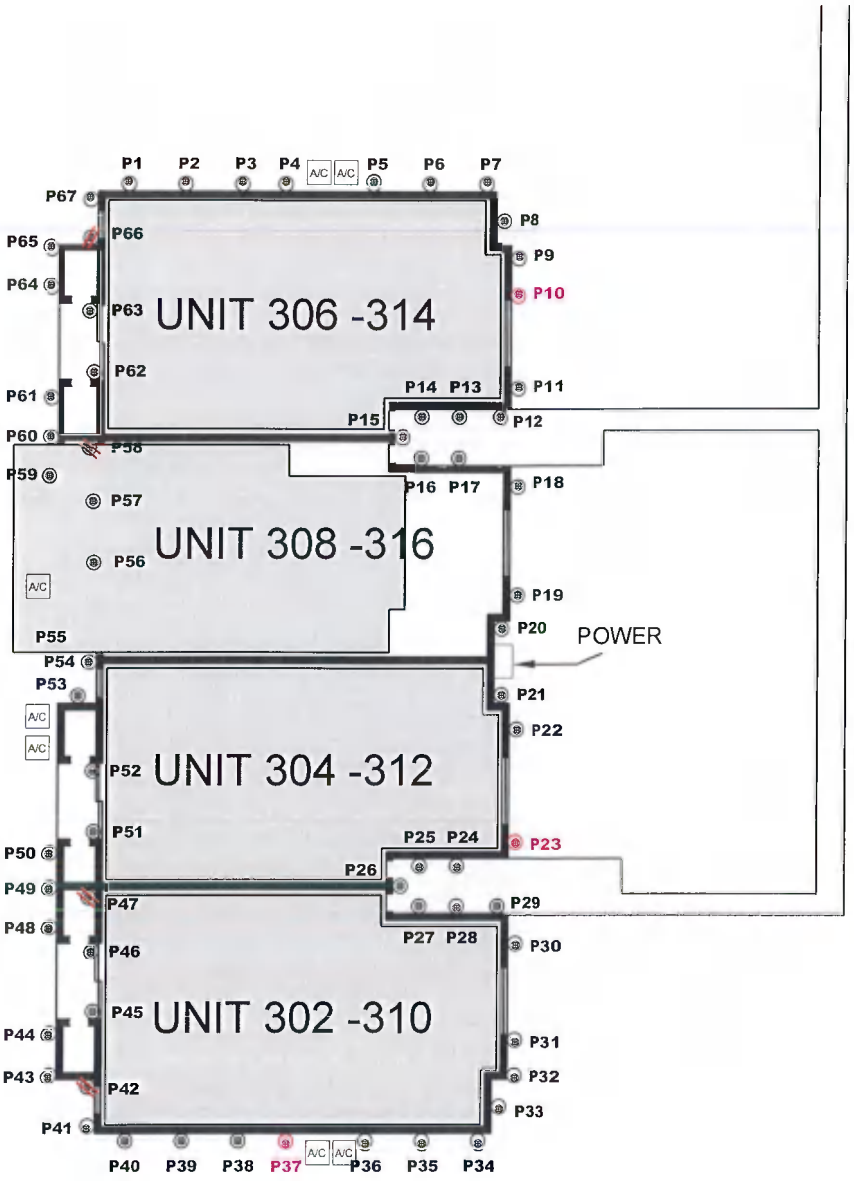
Helicon installed a total of 64 injection pin piles around the property as per our site plan recommendations, as shown in figure 1a. Due to the site conditions, three (3) points were omitted from our original recommendations. (Injection Pin Pile Numbers 10, 23 and 37). The depths of installation ranged from a low of 18 feet to a high of 70 feet below grade. Each pin pile was hydraulically driven into the soil until enough pressure was reached for refusal. The hydraulic gauge reading (psi) was recorded for each injection pin pile along with the installed depth (Figure 1b). The contractor then accepted delivery of a 1500-psi pressure grout from Pasco Ready Mix. The grout was a high slump 4-6 inch pressure grout. A grout gun was connected to each of the 64 injection pin piles pumped by Helicon, utilizing a TK-40 pump. The grout was pumped until a pressure gauge reading of up to 400-psi was reached on the in-line gauge. The amount of grout pumped for each injection pin pile was recorded (Figure 1b). A total of 39.6 cubic yards of grout was pumped in various quantities through 64 injection pin piles.

Helicon then staked the compaction grout point locations as shown in Figure 1d in accordance with B.A.S.I.C. Engineering's recommendations. Angled compaction grout points were installed to refusal (hard limestone bedrock) at depths ranging from 34 to 45 feet below existing grade. A total of 404 feet of grout casing was installed at the 10 compaction grout points. After the grout casing was installed, a TK-40 pump was used to inject a mixture of cement, fly ash, sand, water, and other admixtures into the loose soils and voids in the limestone and overlying sand strata. Pumping continued until a grout pressure of 200 to 400 psi was achieved (over that required to initiate grout take) or lifting of the structure was observed (via a surveyor's level). The grout casing was then extracted upward four to five feet and pumping resumed. A total of 50.4 cubic yards of grout was pumped in various quantities through 10 compaction grout points on the subject property, ranging from a minimum of 0.84 cubic yards on point #4 to a maximum of 13.27 cubic yards on point #2.

TECHNICAL NOTES:

- INJECTION PIN PILE
- SPREADER BEAM
- SEE FIGURE 1c FOR PIN PILE DETAIL
- NOT FOR PERMITTING

TWO STORY
WOOD FRAME
BUILDING #1



Approximate Scale
1" = 20'

0 10 20

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PINELLAS COUNTY

CONSTRUCTION INJECTION PLAN

FIGURE NO.: 1a
FILE NO.: B2020-018
DATE: 04/22/2021
CHECKED BY: JJ

TECHNICAL NOTES:

- INJECTION PIN PILE SUMMARY POINTS

Points #	PSI	Depth (ft)	Strokes	Actual Grout (cy)
1	2500	35.0	6	0.10
2	2700	53.0	4	0.07
3	2600	50.0	6	0.10
4	2600	66.0	107	1.80
5	2700	52.0	2	0.03
6	2700	47.0	77	1.30
7	2700	51.0	31	0.52
8	2600	51.0	20	0.34
9	2600	40.0	27	0.45
10	-	-	-	-
11	2500	40.0	51	0.86
12	2600	42.0	36	0.61
13	2700	40.0	36	0.61
14	2600	39.0	4	0.07
15	2600	41.0	2	0.03
16	2400	45.0	61	1.03
17	2700	48.0	67	1.13
18	2500	45.0	8	0.13
19	2600	52.0	3	0.05
20	2700	45.0	43	0.72
21	2600	47.0	3	0.05
22	2600	45.0	200	3.50
23	-	-	-	-
24	2700	52.0	2	0.04
25	2600	40.0	28	0.50
26	2700	45.0	22	0.39
27	2600	40.0	124	2.21
28	2700	57.0	2	0.04
29	2500	59.0	2	0.04
30	2400	45.0	2	0.04
31	2600	50.0	3	0.05
32	2500	44.0	52	0.93
33	2600	35.0	31	0.55
34	2600	50.0	3	0.05
35	2700	49.0	64	1.14
36	2600	37.0	84	1.50
37	-	-	-	-
38	2700	32.0	2	0.04
39	2700	33.0	35	0.61
40	2500	35.0	83	1.44
41	2400	18.0	2	0.03
42	2600	22.0	25	0.43
43	2300	23.0	2	0.03
44	2400	42.0	121	2.10
45	2500	36.0	2	0.03
46	2600	42.0	26	0.45
47	2500	37.0	-	-
48	2500	35.0	7	0.12
49	2600	35.0	17	0.30
50	2600	45.0	46	0.80
51	2700	29.0	71	1.23
52	2700	43.0	40	0.70
53	2600	45.0	2	0.03
54	2700	43.0	8	0.14
55	2300	30.0	38	0.66
56	2700	53.0	7	0.12
57	2600	45.0	116	2.02
58	2600	45.0	4	0.07
59	2300	30.0	31	0.54
60	2600	38.0	22	0.38
61	2600	52.0	57	0.99
62	2300	70.0	6	0.10
63	2600	50.0	156	2.72
64	2500	42.0	123	2.14
65	2500	33.0	7	0.12
66	2400	42.0	6	0.10
67	2500	33.0	10	0.17
TOTALS:		**2735.0**	**2285.0**	**39.6**

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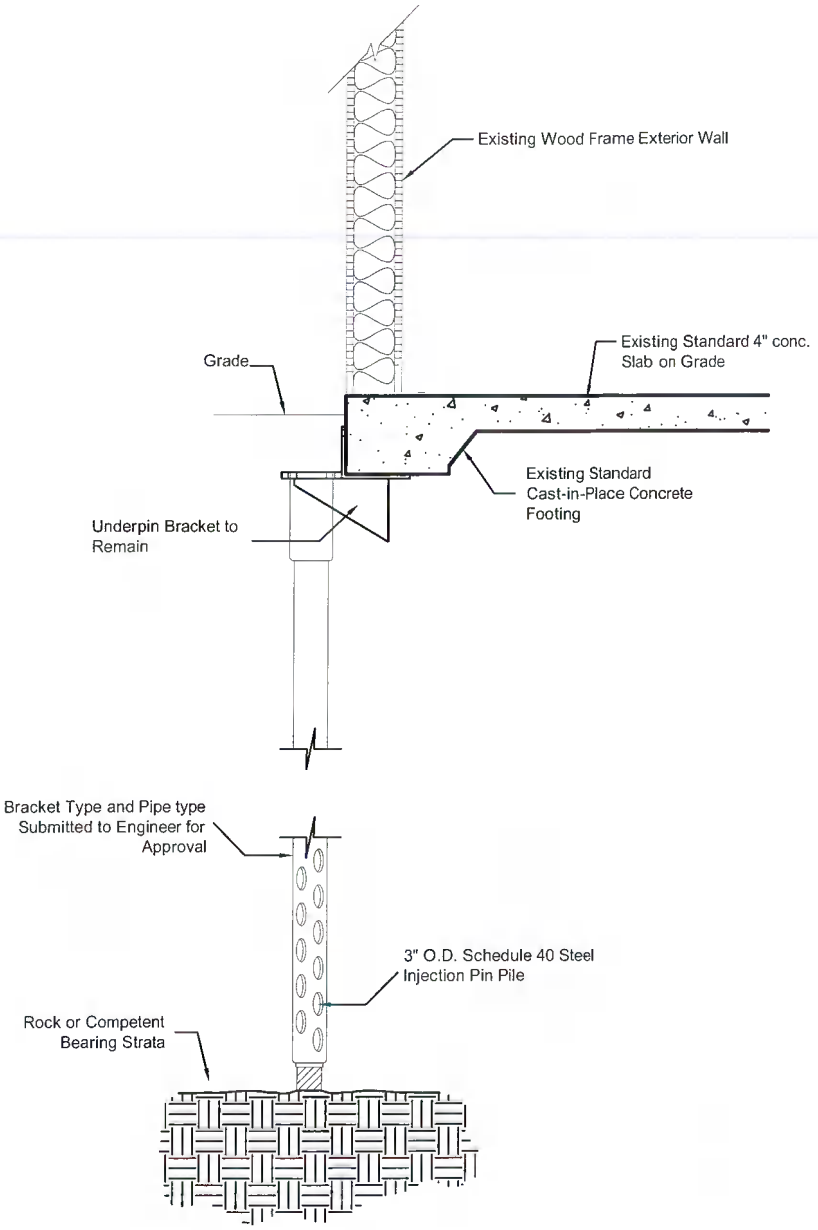
INJECTION PIN PILE SUMMARY POINTS

FIGURE NO.: 1b
FILE NO.: B2020-018
DATE: 04/22/2021
CHECKED BY: JJ

Wood Frame on Spread Footer:

Injection Pin Pile Detail
(NOT FOR PERMITTING)



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INJECTION PIN PILE DETAIL PLAN

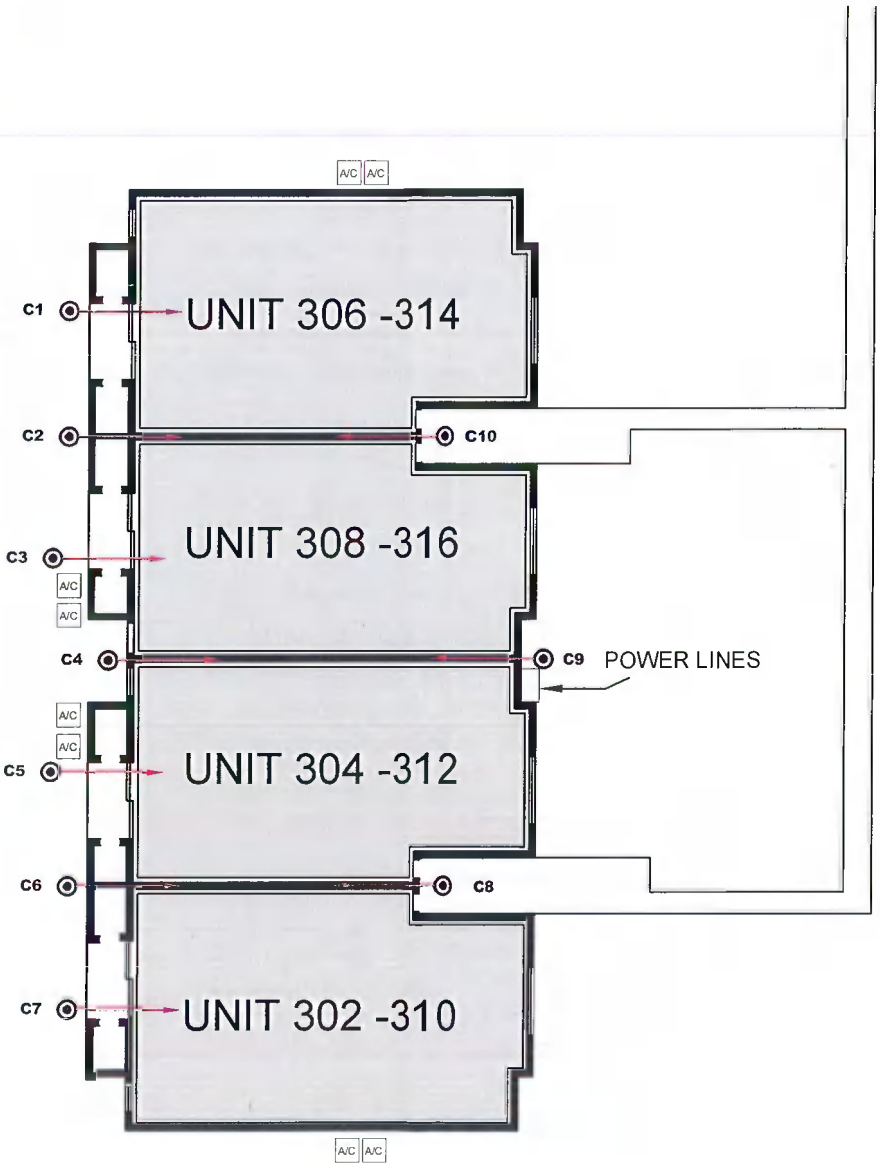
FIGURE NO.: 1c
FILE NO.: B2020-018
DATE: 04/22/2021
CHECKED BY: JJ

TECHNICAL NOTES:

- INSTALLED POINTS DEPTH: 34' - 45'
- ANGLED COMPACTION GROUT POINTS
- NOT FOR PERMITTING

Points #	Depth (ft)	Strokes	Actual Grout (cy)
1	40	449	8.82
2	44	736	13.27
3	40	402	7.18
4	34	47	0.84
5	40	118	1.92
6	36	416	6.76
7	35	177	2.99
8	45	96	1.60
9	45	204	3.41
10	45	216	3.61
Total:	**404**	**Total:**	**50.4**

TWO STORY
WOOD FRAME
BUILDING #1



Approximate Scale
1" = 20'

0 10 20

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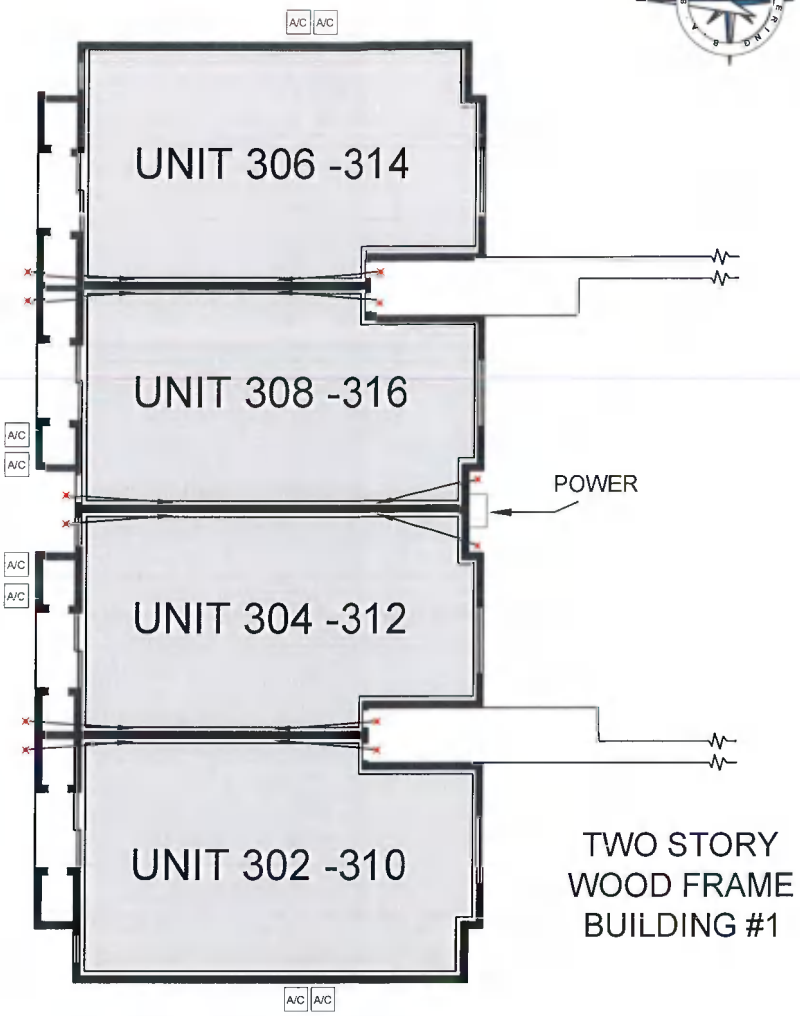
COMPACTION GROUT PLAN

FIGURE NO.: 1d
FILE NO.: B2020-018
DATE: 04/22/2021
CHECKED BY: JJ

TECHNICAL NOTES:

- INSTALLED DEPTH: 12', 10', 8', 6' & 4' BGS
- INSTALLED CHEMICAL GROUT POINTS = 12
- INSTALLED CHEMICAL QUANTITY = 746.4
- NOT FOR PERMITTING

Point #s	Depth (ft)	PSI	Lbs.
1	12	1200	39.8
	10	-	-
	8	-	-
	6	1200	13.0
	4	1200	7.0
2	12	1200	50.0
	10	1200	29.9
	8	-	-
	6	1200	13.0
	4	1200	7.0
3	12	1200	15.5
	10	-	-
	8	-	-
	6	1200	13.0
	4	1200	7.0
4	12	1200	50.0
	10	1200	19.7
	8	-	-
	6	1200	13.0
	4	1200	7.0
5	12	1200	25.3
	10	-	-
	8	-	-
	6	1200	13.0
	4	1200	7.0
6	12	1200	37.3
	10	-	-
	8	-	-
	6	1200	13.0
	4	1200	7.0
7	12	1200	28.1
	10	-	-
	8	-	-
	6	1200	13.0
	4	1200	7.0
8	12	1200	50.0
	10	1200	4.2
	8	-	-
	6	1200	13.0
	4	1200	7.0
9	12	1200	50.0
	10	1200	4.6
	8	-	-
	6	1200	13.0
	4	1200	7.0



Point #s	Depth (ft)	PSI	Lbs.
10	12	1200	26.0
	10	-	-
	8	-	-
	6	1200	13.0
	4	1200	7.0
11	12	1200	40.1
	10	-	-
	8	-	-
	6	1200	13.0
	4	1200	7.0
12	12	1200	35.9
	10		
	8		
	6	1200	13.0
	4	1200	7.0
Total:			**746.4**

Approximate Scale
1" = 20'

0 10 20

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CHEMICAL GROUT PLAN

FIGURE NO.: 1e
FILE NO.: B2020-018
DATE: 04/22/2021
CHECKED BY: JJ