



The Moorings Condominiums
Building 9

373 - 387 Moorings Cove Drive
Tarpon Springs, FL 34689
B.A.S.I.C. File No.: B2020-018

March 1st, 2021



FINAL REPORT



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

To: The Moorings Condominiums Association Date: 03/01/2021
Attn: Karen Cleary, President Project # B2020-018
450 Moorings Cove Drive
Tarpon Springs, FL 34689

Subject: Injection Pin Pile, Compaction and Chemical Grouting
The Moorings Condominiums | Building 9
373-387 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 May 20th, 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 Global, (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 (Figure 9a).

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 December 8th, 2020 and completed on February 12th, 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 67 injection pin piles around the property as per our site plan recommendations, as shown in figure 9a. Due to the site conditions, two (2) points were omitted from our original recommendations. (Injection Pin Pile Numbers 33 and 57). The depths of installation ranged from a low of 15 feet to a high of 115 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 9b). The contractor then accepted delivery of a 1500-psi pressure grout from Preferred Materials, Inc and Pasco Ready Mix. The grout was a high slump 4-6 inch pressure grout. A grout gun was connected to each of the 67 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 9b). A total of 167.8 cubic yards of grout was pumped in various quantities through 67 injection pin piles points.

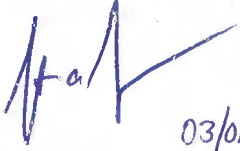
Helicon then staked the compaction grout point locations as shown in Figure 9d in accordance with B.A.S.I.C. Engineering's recommendations. Angled compaction grout points were installed to refusal (hard limestone bedrock) at depths ranging from 29 to 52 feet below existing grade. A total of 249 feet of grout casing was installed at the 6 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 119.3 cubic yards of grout was pumped in various quantities through 6 compaction grout points on the subject property, ranging from a minimum of 0.52 cubic yards on point #4 to a maximum of 37.19 cubic yards on point #1.

Lastly, a total of 2,269.5 lbs. of chemical grout was injected through 59 chemical grout points by Helicon as shown in Figures 9e, 9g and 9h. Vertical points were pumped at depth ranges between 8', 6', 4' and 2 feet below ground surface until lift of the slab/ground refusal was achieved. Angled points were pumped at depth ranges between 12', 10', 8', 6', 4' and 2 feet below ground surface until lift of the slab/ground refusal was achieved.

It is our opinion that the injection pin piles, compaction grout and chemical grout were installed in accordance with industry standards and are an effective method to fill voids, cracks, fractures and cavities and to stabilize granular material, thus improving the physical properties of soil and rock at The Moorings Condominiums | Building #9. The proven technology utilized by the pier manufacturer and the ability to solve foundation settlement problems using a combination of injection pin piles, compaction grout and chemical grout, has demonstrated success without additional settlement. This report is not a guarantee that sinkhole activity will not continue to exist at the subject property but rather a summary and certification of the work completed by Helicon Foundation Repair Systems, Inc.

We thank you for the opportunity to provide the services to you on this project. We trust that the information provided in this letter is satisfactory. Should you have any questions, or require additional assistance, please do not hesitate to call.

Sincerely,



03/01/2021

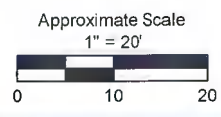
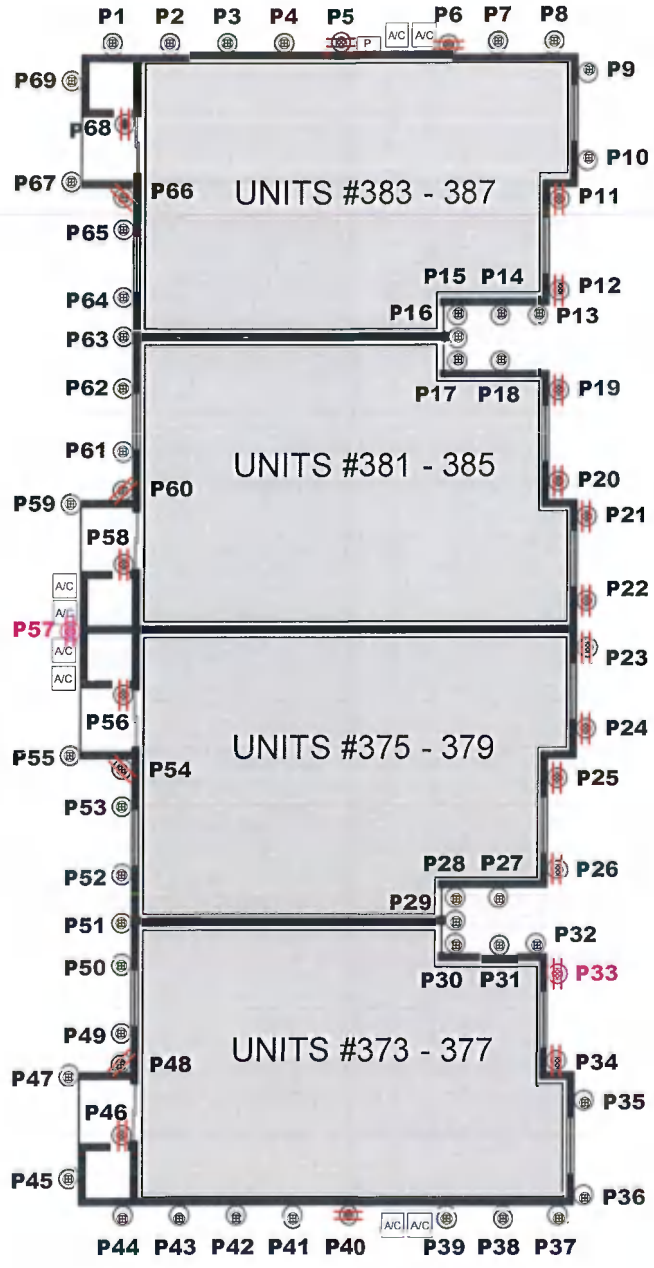
Justin D. James, P.E.
Florida P.E. # 60886
C.O.A. # 25869
Attachments

TECHNICAL NOTES:

- ⊗ - INJECTION PIN PILE
- ⊗ - SPREADER BEAM
- SEE FIGURE 9c FOR PIN PILE DETAIL
- ⊗ - DELETED POINTS
- NOT FOR PERMITTING



TWO STORY
WOOD FRAME
BUILDING #9



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CONSTRUCTION INJECTION PLAN

FIGURE NO.: 9a

FILE NO.: B2020-018

DATE: 03/01/2021

CHECKED BY: JJ

TECHNICAL NOTES:

- INJECTION PIN PILE SUMMARY POINTS

Points #	PSI	Depth (ft)	Strokes	Actual Grout (cy)
1	2500	49.0	245	4.54
2	2700	48.0	2	0.04
3	2800	48.0	452	7.98
4	2600	46.0	3	0.05
5	2800	40.0	373	6.59
6	2700	47.0	431	8.4
7	2700	40.0	542	10.2
8	2600	50.0	2	0.04
9	2600	45.0	584	10.40
10	2500	37.0	41	0.70
11	2700	28.0	193	3.32
12	2600	32.0	120	2.06
13	2700	38.0	17	0.29
14	2800	51.0	5	0.09
15	2900	53.0	4	0.07
16	2700	38.0	2	0.03
17	2700	45.0	3	0.05
18	2800	42.0	154	2.65
19	2600	45.0	452	8.46
20	2800	38.0	40	0.75
21	2600	35.0	40	0.75
22	2800	42.0	348	5.79
23	2700	48.0	42	0.70
24	2800	84.0	6	0.10
25	2900	79.0	41	0.68
26	2600	98.0	7	0.12
27	2800	115.0	7	0.12
28	2800	85.0	6	0.10
29	2700	90.0	10	0.17
30	2900	74.0	5	0.08
31	2800	78.0	129	2.14
32	2800	63.0	533	10.42
33	-	-	-	-
34	2800	62.0	440	8.07
35	2700	68.0	3	0.06

Points #	PSI	Depth (ft)	Strokes	Actual Grout (cy)
36	2600	39.0	262	5.03
37	2700	43.0	178	3.50
38	2700	42.0	147	2.89
39	2800	37.0	224	4.38
40	2700	39.0	81	1.58
41	2800	70.0	5	0.10
42	2500	33.0	67	1.31
43	2500	33.0	130	2.54
44	1500	15.0	5	0.10
45	1700	24.0	122	2.23
46	2600	30.0	151	2.76
47	2300	23.0	2	0.04
48	2800	28.0	105	1.92
49	2800	52.0	7	0.13
50	2800	37.0	50	0.91
51	2700	42.0	194	3.67
52	2600	45.0	27	0.54
53	2800	33.0	2	0.04
54	2900	31.0	39	0.77
55	2300	31.0	349	6.92
56	2700	42.0	7	0.14
57	-	-	-	-
58	2000	45.0	293	5.53
59	2400	35.0	166	2.98
60	2800	43.0	81	1.43
61	1900	30.0	93	1.64
62	2000	32.0	91	1.60
63	1900	28.0	5	0.09
64	1000	37.0	308	5.43
65	1900	37.0	563	10.00
66	2000	40.0	2	0.04
67	1800	35.0	36	0.67
68	2000	40.0	2	0.04
69	1900	38.0	44	0.81
TOTALS:		3090.0	9120	167.8

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PINELLAS COUNTY

INJECTION PIN PILE SUMMARY POINTS

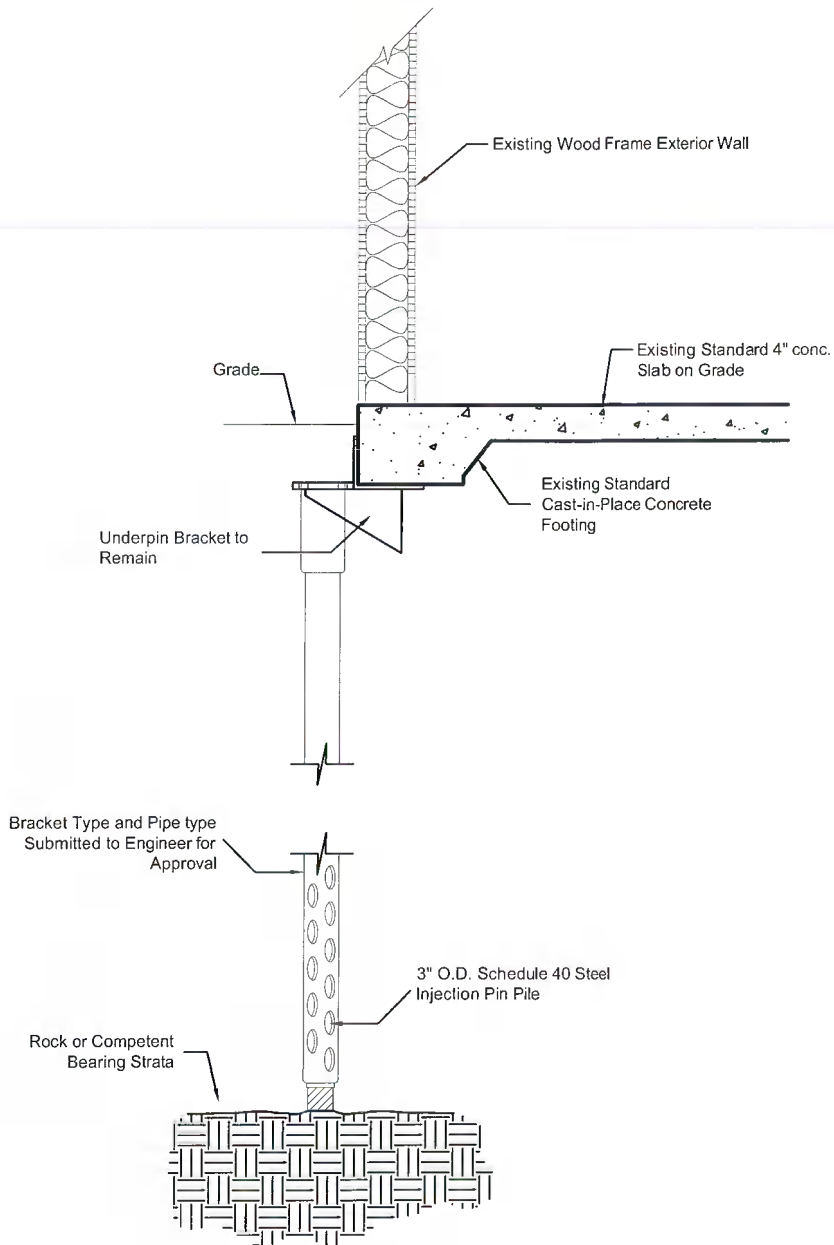
FIGURE NO.: 9b

FILE NO.: B2020-018

DATE: 03/01/2021

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.: 9c

FILE NO.: B2020-018

DATE: 03/01/2021

CHECKED BY: JJ

TECHNICAL NOTES:

- INSTALLED POINTS DEPTH: 29' - 52'

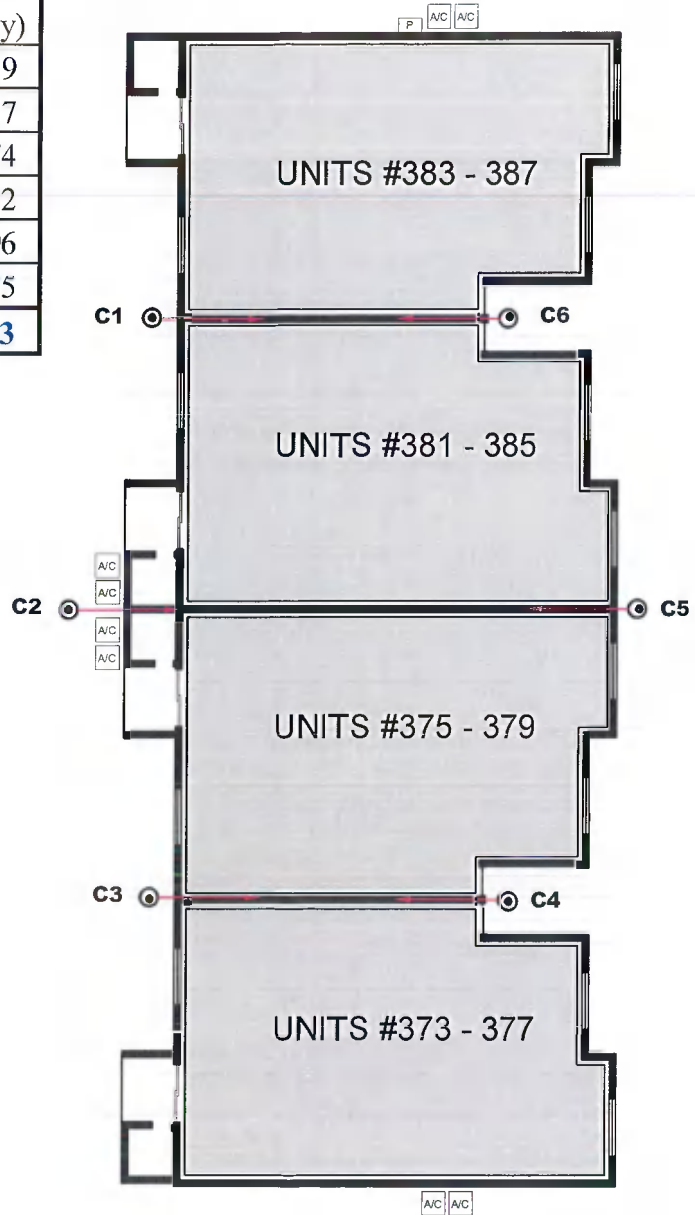
← ⊙ - ANGLED COMPACTION GROUT POINTS

- NOT FOR PERMITTING



Points #	Depth (ft)	Strokes	Actual Grout (cy)
1	45	2,018	37.19
2	52	2,034	37.17
3	51	2,136	38.74
4	33	29	0.52
5	29	54	0.96
6	39	266	4.75
Total:	249	Total:	119.3

TWO STORY
WOOD FRAME
BUILDING #9



Approximate Scale
1" = 20'



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COMPACTION GROUT PLAN

FIGURE NO.: 9d

FILE NO.: B2020-018

DATE: 03/01/2021

CHECKED BY: JJ

TECHNICAL NOTES:

- INSTALLED DEPTH:

✗ - VERTICAL POINTS: 8', 6', 4' & 2' BGS

✗ - ANGLED POINTS: 12', 10', 8', 6', 4' & 2' BGS

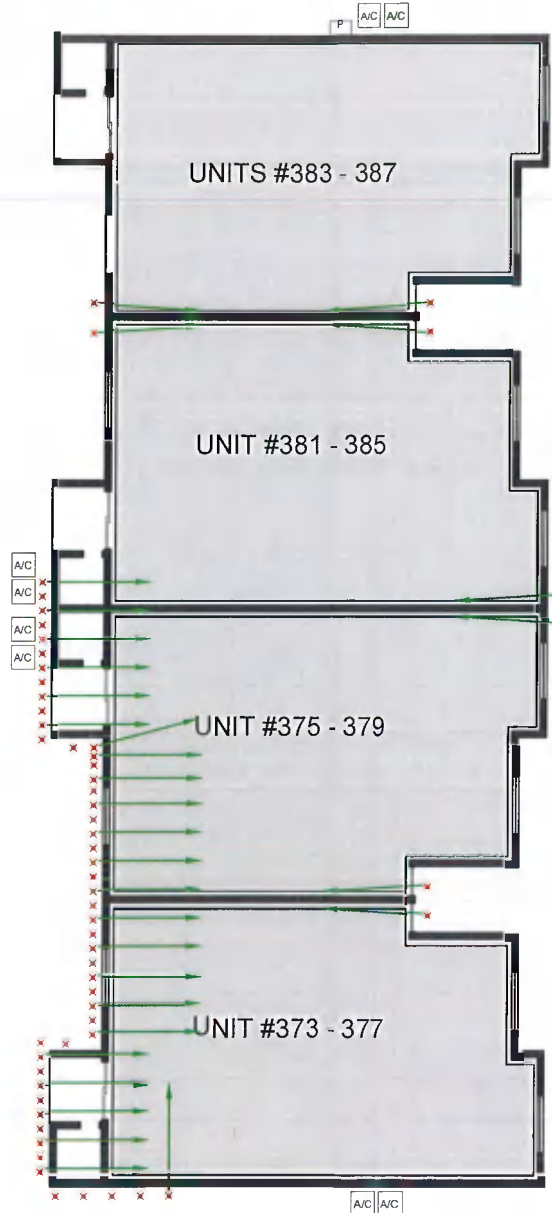
- INSTALLED EXTERIOR CHEMICAL GROUT POINTS = 59

- INSTALLED EXTERIOR CHEMICAL GROUT QUANTITY = 2,269.5 LBS

- NOT FOR PERMITTING



TWO STORY
WOOD FRAME
BUILDING #9



Approximate Scale

1" = 20'



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CHEMICAL GROUT PLAN

FIGURE NO.: 9e

FILE NO.: B2020-018

DATE: 03/01/2021

CHECKED BY: JJ

TECHNICAL NOTES:

- CHEMICAL GROUT SUMMARY POINTS

Point #s	Depth (ft)	PSI	Lbs.
1	12	1200	15.1
	10	1200	8.8
	8	1200	7.0
	6	1200	4.9
	4	1200	4.2
	2	1200	2.1
2	8	1200	20.1
	6	1200	9.8
	4	1200	6.3
3	2	-	-
	8	1200	20.1
	6	1200	9.8
	4	1200	8.1
4	2	1200	2.8
	8	1200	20.1
	6	1200	9.8
	4	1200	7.4
5	2	-	-
	8	1200	20.1
	6	1200	9.8
	4	1200	2.1
6	12	1200	15.1
	10	1200	8.8
	8	1200	7.0
	6	1200	4.9
	4	1200	4.2
	2	1200	2.1
	8	1200	20.1
7	6	1200	9.8
	4	1200	8.1
	2	1200	4.2
	12	1200	15.1
8	10	1200	8.8
	8	1200	7.0
	6	1200	4.9
	4	1200	4.2
	2	1200	2.1
	8	1200	20.1
9	6	1200	9.8
	4	1200	8.1
	2	1200	1.8
	12	1200	15.1
10	10	1200	8.8
	8	-	-
	6	1200	4.9
	4	1200	4.2
	2	1200	2.1
11	8	1200	20.1
	6	1200	9.8

Point #s	Depth (ft)	PSI	Lbs.
11	4	1200	3.2
	2	-	-
12	12	1200	15.1
	10	1200	8.8
	8	1200	7.0
	6	1200	4.9
	4	1200	4.2
	2	1200	2.1
13	8	1200	20.1
	6	1200	9.8
	4	1200	7.0
14	2	-	-
	12	1200	15.1
	10	1200	7.7
	8	-	-
15	6	1200	4.9
	4	1200	4.2
	2	1200	2.1
	8	1200	20.1
	6	1200	9.8
16	4	1100	5.6
	2	-	-
	8	1100	17.9
	6	-	-
17	4	1100	7.7
	2	-	-
	12	1100	15.1
	10	1100	8.8
	8	1100	2.8
18	6	1100	4.9
	4	1100	4.2
	2	1100	2.1
	8	1200	20.1
19	6	1200	9.8
	4	1200	8.1
	2	1200	4.2
	12	1200	15.1
	10	1200	8.8
	8	1200	7.0
20	6	1200	4.9
	4	1200	4.2
	2	1200	2.1
	8	1200	20.1
	6	1200	9.8
21	4	1200	8.1
	2	1200	4.2
	12	1200	15.1
21	10	1200	8.8
	8	1200	7.0
	6	1200	4.9

Point #s	Depth (ft)	PSI	Lbs.
21	4	1200	4.2
	2	1200	2.1
22	8	1200	20.1
	6	1200	9.8
	4	1200	7.0
	2	-	-
23	12	1200	15.1
	10	1200	8.8
	8	1200	7.0
	6	1200	4.9
	4	1200	1.1
24	2	-	-
	8	1200	20.1
	6	-	-
	4	1200	8.1
	2	1200	4.2
	12	1200	15.1
25	10	1200	8.8
	8	1200	7.0
	6	1200	7.0
	4	-	-
26	2	-	-
	8	1200	20.1
	6	1200	9.8
	4	1200	8.1
	2	1200	4.2
27	12	1200	15.1
	10	1200	8.8
	8	1200	4.2
	6	1200	4.9
	4	1200	1.1
	2	-	-
28	8	1200	20.1
	6	1200	9.8
	4	1200	8.1
	2	1200	4.2
29	12	1200	15.1
	10	1200	6.3
	8	-	-
	6	1200	4.9
	4	1200	1.4
	2	-	-
30	8	1200	20.1
	6	1200	9.8
	4	1200	8.1
	2	1200	2.5
31	12	1200	15.1
	10	1200	8.8
	8	1200	7.0
31	6	1200	4.9



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CHEMICAL GROUT SUMMARY POINTS

FIGURE NO.: 9f

FILE NO.: B2020-018

DATE: 03/01/2021

CHECKED BY: JJ

TECHNICAL NOTES:

- CHEMICAL GROUT SUMMARY POINTS

Point #s	Depth (ft)	PSI	Lbs.
32	4	1200	4.2
	2	1200	2.1
	8	1200	20.1
	6	1200	9.8
	4	1200	8.1
	2	1200	4.2
33	12	1200	15.1
	10	1200	8.8
	8	1200	7.0
	6	1200	4.9
	4	1200	1.1
	2	-	-
34	8	1150	20.1
	6	1150	9.8
	4	1150	6.0
	2	-	-
35	12	1100	15.1
	10	1100	8.8
	8	1100	7.0
	6	1100	4.9
	4	1100	4.2
	2	1100	2.1
36	8	1200	20.1
	6	1200	9.8
	4	1200	7.0
	2	-	-
37	12	1200	15.1
	10	1200	8.8
	8	1200	7.0
	6	1200	4.9
	4	1200	4.2
	2	1200	2.1
38	12	1200	15.1
	10	1200	8.8
	8	1200	7.0
	6	1200	4.9
	4	1200	4.2
	2	1200	2.1
39	8	1200	20.1
	6	1200	9.8
	4	1200	8.1
	2	1200	4.2
40	8	1200	20.1
	6	1200	9.8
	4	1200	4.2
	2	1200	0.3
41	12	1200	15.1
	10	1200	8.8
	8	1200	4.9
	6	1200	4.9

Point #s	Depth (ft)	PSI	Lbs.
42	4	1200	4.2
	2	1200	2.1
	8	1200	20.1
	6	1200	9.8
	4	1200	8.1
	2	1200	4.2
43	12	1200	14.1
	10	-	-
	8	-	-
	6	1200	4.9
	4	1200	1.4
	2	-	-
44	8	1200	20.1
	6	1200	9.8
	4	1200	4.6
	2	-	-
45	12	1200	15.1
	10	1200	8.8
	8	1200	7.0
	6	1200	4.9
	4	1200	4.2
	2	1200	1.1
46	8	1200	20.1
	6	1200	9.8
	4	1200	7.0
	2	-	-
47	12	1200	15.1
	10	1200	8.8
	8	1200	7.0
	6	1200	4.9
	4	1200	4.2
	2	-	-
48	8	1200	20.1
	6	1200	9.8
	4	1200	8.1
	2	1200	4.2
49	12	1200	15.1
	10	1200	8.8
	8	1200	7.0
	6	1200	4.9
	4	1200	4.2
	2	1200	2.1
50	8	1200	20.1
	6	1200	9.8
	4	1200	6.3
	2	-	-
51	12	1200	15.1
	10	1200	8.8
	8	1200	7.0
	6	1200	4.9
4	1200	4.2	

Point #s	Depth (ft)	PSI	Lbs.
51	2	1200	2.1
52	12	1100	15.1
	10	1100	8.8
	8	1100	7.0
	6	1100	4.9
	4	1100	4.2
	2	1100	2.1
53	12	1100	15.1
	10	1100	1.8
	8	-	-
	6	1100	4.9
	4	1100	4.2
	2	-	-
54	12	1200	15.1
	10	1200	8.8
	8	1200	7.0
	6	1200	4.9
	4	1200	4.2
	2	1200	2.1
55	12	1200	15.1
	10	1200	8.8
	8	1200	7.0
	6	1200	4.9
	4	1200	4.2
	2	1200	2.1
56	12	1200	15.1
	10	1200	8.8
	8	1200	7.0
	6	1200	4.9
	4	1200	4.2
	2	1200	2.1
57	12	1200	15.1
	10	1200	8.8
	8	1200	7.0
	6	1200	4.9
	4	1200	4.2
	2	1200	2.1
58	12	1200	15.1
	10	1200	8.8
	8	1200	7.0
	6	1200	4.9
	4	1200	4.2
	2	1200	2.1
59	12	1200	15.1
	10	1200	8.8
	8	1200	7.0
	6	1200	4.9
	4	1200	4.2
	2	1200	2.1
Total:			2269.5



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373-387 MOORINGS COVE DRIVE, TARPON SPRINGS, FL 34689
PINELLAS COUNTY

CHEMICAL GROUT SUMMARY POINTS

FIGURE NO.: 9g

FILE NO.: B2020-018

DATE: 03/01/2021

CHECKED BY: JJ