APPENDIX N

CONSTRUCTION FIELD MONITORING – IRON WALL PROJECT

enviro**metal**
technologies
inc.

11 May 1998

Diane Clark
Stearns & Wheler, LLC
Environmental Engineers and Scientists
One Remington Park Drive
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Re: Full-Scale *In-Situ* Iron Wall Installation at the Howard Property, Sherburne, New York - 31036.30

Dear Diane:

A full-scale iron wall was installed on the Howard Property site in Sherburne, New York in December 1997, following a successful pilot-scale demonstration of this technology. During construction, EnviroMetal Technology Inc. (ETI) staff were present to provide on-site assistance and document construction activities. This letter provides Stearns & Wheler with ETI's observations and comments on construction.

1.0 INTRODUCTION

The full-scale treatment wall is located on the Howard Farm adjacent to the former General Instrument Corp. (GIC) property, at the site of the pilot-scale system (S&W, 1997). The system consists of two parallel continuous permeable walls orientated in approximately a north-south direction perpendicular to groundwater flow. One wall, 370 ft long, is intended to capture and treat the entire plume. The second wall provides additional residence time in granular iron for degradation of higher VOC concentrations in the core of the plume and is 120 ft in length.

Based on results from the pilot-scale test, a reactive wall thickness of 2 ft is considered sufficient to enable degradation of the VOCs requiring treatment to required effluent criteria.

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The design assumed a velocity through the system of about 1 ft/day, and used the highest observed VOC concentrations on-site to date in determination of residence time requirements.

To ensure that no groundwater flows beneath the wall, the iron wall was extended a few feet into the clay aquitard. Similarly, to prevent groundwater from overflowing the treatment system the top of the wall was constructed above the expected high water table. The design vertical thickness of the wall was 18 ft, from 3 ft below ground surface (bgs) to 21 ft bgs.

Construction was performed by Horizontal Technologies, Inc. (HTI) using a one pass continuous trencher. The continuous trenching equipment is similar to a large "Ditch Witch". It utilizes a large cutting chain excavator system combined with a trench box and loading hopper. To install the permeable wall, the cutting chain removes the native soil along the trench line. As the trenching machine moves along this line, the granular iron flows through the hopper and trench box into the excavated trench. The trench box wall extend to the width and depth of the trench. The iron used in the treatment wall was obtained by HTI from Connelly-GPM of Chicago, Illinois.

2.0 CONTINUOUS PERMEABLE WALL INSTALLATION

2.1 First Wall (120 ft)

Construction of the 120 ft wall section was initiated on December 10, 1997, beginning at the south end of the line of installation. Granular iron was delivered in bulk to a temporary storage bin on-site, and then added with a backhoe bucket to the hopper of the trencher. The trencher sat in a bench cut about 3 feet bgs. As a means of gauging the volume of iron emplaced in the excavation, the bucket volume (40 ft^3) was estimated, and the number of buckets added to the hopper for a specified length (usually every 10 ft) of travel along the line of installation was monitored. As a second check on the volume emplaced, the number of truckloads of iron (9 yd^3 or 243 ft^3 per truck) brought to the site during trenching operations was also documented.

About 50 ft of trench was completed on December 10, prior to equipment breakdown. Due to concurrent discussions with the site contractor, ETI's bucket count is incomplete for the first 17 ft (Table 1). The last ± 70 ft of the first trench were completed on December 11. Bucket volumes documented during trencher operation are presented in Table 1.

Although inflowing saturated sediments made accurate observations difficult, at least 2 ft of the trench below grade (i.e., from 3 to 5 ft bgs) contained little iron following the pass of the trencher. In places, the upper part of the trench was significantly wider than 1 ft, due to sloughing of the saturated materials. Consequently, on December 12, sediment infilling this upper part of the trench was removed and the trench backfilled with iron to elevation of the bench. The iron volume used to backfill the upper part of the trench is not included in Table 1. Field observations made during the backfilling of the trench to grade with the backhoe include the following:

1. along most of the trench, a distinct "strip" of iron could be exposed with the backhoe about 2 to 3 ft below grade. Due to saturated soils, the width of this strip could not be measured;

2. little to no iron appeared to have been placed to about 5 ft below grade at two locations, a 5 ft section about 15 ft from the north end of the installation, and a 10 ft section adjacent to well MW-19 in the central portion of the trench. These locations were backfilled with iron to a depth of ± 5 ft using the backhoe;

3. the installation passed through the location of the pilot-scale system. In this area, there appeared to be some movement of the iron laterally into the coarse pea gravel, at least to the depth (±4 ft) exposed by the backhoe;

4. a slight petroleum sheen was visible on ponded groundwater at the south end of the trench;

5. there appeared to be some solidification of the iron at the back of the boot and hopper of the continuous trencher when it was removed.

As shown in Table 1, there was some variability in the estimated volume of iron added along the line of installation using the continuous trencher. The overall volume estimate is 90% of the design objective. As mentioned previously, a second estimate of emplaced iron was derived from the truckloads of iron brought to the installation. After subtracting the material left in the temporary storage area, there appeared to have been about 62 yd^3 of iron placed in the hopper. This represents 87% of the 1,920 ft^3 which would have been placed in a 16 ft deep, 120 ft long trench by the trencher. We feel the close agreement between these two estimates is somewhat fortuitous, as the method of estimating probably involves inaccuracies of at least 10%.

2.2 Second Wall (370 ft)

After completion of the first wall, the bench was further excavated to the west and extended to allow the trencher to complete the 370 ft long wall. The bench was completed to about 2.5 ft bgs. The second trench was placed parallel to the first wall and set 10 ft to the west (downgradient) of the first.

Trenching began on December 15th, starting at the south end of the wall. However, due to difficulties in freeing the pipe from the back of the trenching boot, trenching was halted. The pipe is used to prevent soil from entering, and iron from leaving, the boot during the time required to get the cutting boom in a vertical position in the ground. The cutting boom was removed from the ground, repaired, the pipe reattached and positioned at the start. Seventeen loads of iron in an excavator bucket (about 510 ft^3) were used during this first attempt.

A successful attempt was made December 16 and 17. As with installation of the first wall, the amount of iron placed in each 10 ft section of the trench was monitored. These results are shown in Table 2. From estimates of the volume of iron placed in the trench, a total of 4,500 ft^3 was installed. This is 74% of the volume expected if the dimensions of the trench were 18 ft deep and 1 ft in thickness along its entire length. However, the installed iron settled below the final depth required as the trencher moved along. Assuming that on average the wall completed by the trencher was 15 ft in height the volume of iron added during trenching would be 86% of the expected volume. Additional iron was added after trenching to bring the iron up to about 3 ft bgs. This additional iron is not included in Table 2.

During installation, trenching was interrupted at 70, 90, 130 and 270 ft. The first three interruptions were for short periods. At 270 ft, trenching was stopped until noon the next day (20 hr) to obtain a replacement conveyor belt. During this time the iron may have compacted and/or slightly cemented in the boot. If this were the case, some time and vibration may have been needed to start the iron flowing again. As can be seen from Table 2, this may have been the situation, as the amount of iron added between 270 and 300 ft was only 50% that expected. Furthermore, after trenching, when iron was placed with the excavator, considerably more iron was added in this section. The iron placed with the trencher in this section was estimated to be about 6 to 8 ft below the desired height.

3.0 SUMMARY

Iron installation in the two permeable walls was completed on 18 December 1997. Estimates of the volume of iron installed with the trencher are about 90% and 74% of the expected volume for the 120 ft and 370 ft walls respectively.

As noted in Tables 1 and 2, there are some sections of both walls where volumetric measurements indicate that less than the design thickness of 100% iron was installed with the trencher. While there are various ways of evaluating the integrity of these sections, this is probably not warranted unless monitoring well data indicate that insufficient degradation is occurring in groundwater passing through these sections of the wall.

Please call us with any questions regarding this report.

Sincerely,

EnviroMetal Technologies Inc.

John Vogan, M.Sc.
Manager

Robert Focht, M.Sc., P.Eng.
Remediation Engineer

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REFERENCES:

ETI, 1997. Summary Report – Field Performance of Pilot-Scale Granular Iron In-Situ Treatment System, Sherburne, New York. EnviroMetal Technologies Inc, Guelph, Ontario, Canada. February.

S&W, 1997. Bid Documents for Continuous Permeable Reaction Wall Installation Contract No. 3, Howard Property, Sherburne, NY, General Instrument Corporation. S&W Services, Inc., Cazenovia, New York. May.

Table 1: Amount of Iron Installed in 120 Foot Long Permeable Wall by Continuous Trencher

Distance (ft)[a]	Number of Buckets[b]	Estimated Volume of Iron (ft^3)[c]	Percent of Expected Volume[d]
0 -17	ND[e]	ND	ND
17 - 25	4	120	94
25 - 32	4	120	107
32 – 42	5	150	94
42 – 52	5	150	94
52 – 64	5.5	165	86
64 – 69	1.5[e]	45	56
69 – 75	4	120	125
75 – 85	5	150	94
85 – 95	5	150	94
95 – 106	4.5	135	78
106 – 120	6	180	80
TOTAL	**49.5**	**1,485**	**90**

ND = Not Determined

[a] Distance along wall starting at the south end.

[b] Number of excavator buckets of iron placed in trencher hopper.

[c] Excavator bucket was estimated to be filled to 75% capacity (30 ft^3).

[d] Expected volume assumes 16 ft depth and 1 ft width (or 160 ft^3 per ten linear feet of wall).

[e] Accurate count was not obtained.

Table 2: Amount of Iron Installed in 370 Foot Long Permeable Wall by Continuous Trencher

Distance (ft)[a]	Number of Buckets[b]	Estimated Volume of Iron (ft^3)[c]	Percent of Expected Volume[d]
Start-Up	11	ND	ND
0 - 10	5	150	100
10 - 20	5	150	100
20 - 30	3	90	60
30 - 40	6	180	120
40 - 50	3	90	60
50 - 60	5	150	100
60 - 70	4	120	80
70 - 80	4	120	80
80 - 90	6	180	120
90 - 100	7	210	140
100 - 110	3	90	60
110 - 120	3	90	60
120 - 130	2	60	40
130 - 140	3	90	60
140 – 150	4	120	80
150 – 160	6	180	120
160 – 170	5	150	100
170 – 180	7	210	140
Sub-Total	**81**	**2,430**	**90**

ND = Not Determined

[a] Distance along wall starting at the south end.

[b] Number of excavator buckets of iron placed in trencher hopper.

[c] Excavator bucket was estimated to be filled to 75% capacity (30 ft^3).

[d] Expected volume assumes 15 ft depth and 1 ft width (or 150 ft^3 per ten linear feet of wall).

e Accurate count was not obtained.

f Not including sections 200, 360 and 370.

Table 2: Amount of Iron Installed in 370 Foot Long Permeable Wall by Continuous Trencher - Continued

Distance (ft)[a]	Number of Buckets[b]	Estimated Volume of Iron (ft^3)[c]	Percent of Expected Volume[d]
180 - 190	4	120	80
190 - 200	>1[e]	>30	>20
200 - 210	3	90	60
210 - 220	3	90	60
220 - 230	4	120	80
230 - 240	7	210	140
240 - 250			
250 - 260	4	120	80
260 - 270	3	90	60
270 - 280	3	90	60
280 - 290	3	90	60
290 - 300	3	90	60
300 - 310	4	120	80
310 - 320	6	180	120
320 - 330	6	180	120
330 - 340	13	390	260
340 - 350	3	90	60
350 - 360	>1[e]	>30	>20
360 - 370	>1[e]	>30	>20
Sub-Total	**69**	**2,070[f]**	**82[f]**
TOTAL	**150**	**4,500[f]**	**86[f]**

ND = Not Determined

[a] Distance along wall starting at the south end.

[b] Number of excavator buckets of iron placed in trencher hopper.

[c] Excavator bucket was estimated to be filled to 75% capacity (30 ft^3).

[d] Expected volume assumes 15 ft depth and 1 ft width (or 150 ft^3 per ten linear feet of wall).

[e] Accurate count was not obtained.

[f] Not including sections 200, 360 and 370.