Environmental Resources Management

475 Park Avenue South
29th Floor
New York, NY 10016
(212) 447-1900
(212) 447-1904 (Fax)

1 September 1999

Robert C. Knizek, P.E.
Chief, Eastern Field Services
Bureau of Construction Services
Division of Environmental Remediation
New York Department of Environmental Conservation
50 Wolf Road
Albany, NY 12233-7010

ERM

Re: Metro-North Commuter Railroad Company
Harmon Railroad Yard, Croton-on-Hudson, NY
Final Operable Unit I Operations and Maintenance Plan

Dear Mr. Knizek,

We are in receipt of your 10 August 1999 approval letter regarding the drafl Operable Unit I (OU-I) Operations and Maintenance (O&M) Plan for the Harmon Railroad Yard located in Croton-on-Hudson, New York. In accordance with your letter, enclosed find five (5) copies of the final certified OU-I O&M Plan. The draft OU-I O&M Plan, dated 7 July 1999, has been revised to include a certification page. This was the only change made to the document.

Please contact me if you have any questions.

Sincerely,

Carla Weinpahl
Project Manager

cc: Al Klauss, P.E., NYSDEC
John Seaboldt, Metro-North
Mukesh Mehta, Metro-North
Karen Timko, Metro-North
Ken McHale, Metro-North
Rob Rivera, ERM

ENVIRONMENTAL RESOURCES MANAGEMENT

OPERABLE UNIT I
OPERATIONS & MAINTENANCE PLAN

Harmon Railroad Yard
Croton-On-Hudson, New York

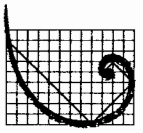
7 July 1999
Revised: August 1999 to include Certification

Prepared For:

METRO-NORTH COMMUTER RAILROAD
347 Madison Avenue
New York, NY 10017

Prepared By:

ENVIRONMENTAL RESOURCES MANAGEMENT
475 Park Avenue South, 29th Floor
New York, NY 10016



ERM

DRAFT
OPERABLE UNIT I
OPERATIONS & MAINTENANCE PLAN

Harmon Railroad Yard
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475 Park Avenue South, 29th Floor
New York, NY 10016

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1.0 *INTRODUCTION*

On behalf of the Metro-North Commuter Railroad Company (Metro-North), Environmental Resources Management (ERM) has prepared this Operations and Maintenance (O&M) Plan for the Harmon Railroad Yard Wastewater Treatment Area, Operable Unit I (i.e., OU-I) remedy. Construction of the OU-I remedial action was completed in September 1996.

The Harmon Railroad Yard (i.e., "Yard") is located in the Village of Croton-on-Hudson, New York, and is bounded by Route 9 on the east and Croton Point Park to the west. The Yard is approximately 100 acres in size, and has been an active rail yard for over 100 years.

The OU-I remedial action addressed remediation and closure of the former wastewater treatment plant lagoon and excavation of surface soil from specific areas around the lagoon. Remediation and closure of the lagoon and the areas surrounding the lagoon entailed the following key items:

- excavation of Zone A soil surrounding the wastewater treatment plant lagoon;
- installation of permanent sheeting around the lagoon perimeter;
- water removal from the wastewater treatment plant lagoon;
- removal of sludge from within the lagoon;
- placement of a lower backfill layer, consisting of 3.5 feet of clean backfill, over the native soil at the bottom of the lagoon;
- installation of a high density polyethylene (HDPE) geomembrane liner over the lower backfill layer;
- placement of a middle backfill layer, consisting of a one foot layer of clean fill overlain by a 10-inch layer of Zone A soil having polychlorinated biphenyl (PCB) concentrations up to 10 PPM, overlain by a two to five foot thick layer of clean backfill, over the HDPE liner;

- installation of an HDPE geomembrane cap over the middle backfill layer;
- installation of a geocomposite drainage net over the HDPE geomembrane cap;
- placement of a top backfill layer, consisting of a one foot thick sand drainage layer and one foot of clean backfill, over the drainage net;
- installation of a reinforcement geotextile, overlain by a 6.5-inch thick asphalt cover at the final surface;
- installation of a riprap-lined drainage channel along the northern edge of the asphalt cover;
- installation of a system of manholes and pipes to carry storm water from the drainage channel to the existing Harmon Yard storm sewer system;
- transport and off-site disposal of all excavated sludge, and Zone A soil containing PCBs at concentrations greater than 10 PPM (i.e., Zone A1 soil); and
- decontamination and demolition of the Old Wastewater Treatment Plant.

In addition to these measures, piping and wells for an air sparge/soil vapor extraction system were installed into and below the lower backfill soil layer to address petroleum related compounds in soil beneath the lower backfill layer. Prior to implementation of the OU-I remedy, regulation of this soil (i.e., soil located beneath the lower backfill soil layer containing petroleum related compounds) was transferred by NYSDEC, from the Division of Inactive Hazardous Waste Disposal Sites to the Bureau of Spill Prevention and Response. As such, operation and maintenance of the air sparge/soil vapor extraction system, if required, is not a component of the OU-I remedy and therefore is not included in this O&M Plan.

The OU-I remedy, described above, incorporates components that require periodic inspection and maintenance. Ongoing maintenance of the following features is therefore required for the successful implementation of the Remedial Program:

- Asphalt cover over the geocomposite cap;
- Vegetated slopes around the asphalt cover;
- Drainage channel; and
- Perimeter fencing.

The locations of these features are provided in Figure 1-1.

Specific inspection and maintenance procedures regarding these components are discussed below and summarized in Table 2-1. All inspection findings and maintenance performed with regard to these components will be recorded on the OU-I Remedy Inspection Form. A copy of this form is provided as Table 2-2.

2.0 SITE MAINTENANCE

2.1 ASPHALT COVER

As discussed above, the lagoon cap is comprised of many layers. The geomembrane cap, which underlies the drainage layer and the asphalt pavement, provides the impermeable cap for the lagoon. Consequently, the asphalt cover was not designed to serve as the impermeable cover for the lagoon. The purpose of the asphalt layer is to control erosion of the backfill materials over the cap. The ability of the asphalt cover to provide the required measure of protection for the underlying soils will be maintained, as needed, through inspections and repairs.

Initially, the pavement surface will be resurveyed, to accurately quantify any settling that may have occurred from the time of installation. Thereafter, the asphalt cover will be visually inspected semi-annually, to document the condition of the asphalt cover. During these inspections, the condition of the asphalt cover, surface water ponding, surface depressions, etc., will be noted and the OU-I Remedy Inspection Form (see Table 2-2) will be completed. A copy of the completed OU-I Remedy Inspection Form will be transmitted to Metro-North's Department of Environmental Compliance and Services.

The asphalt cover will also be resurveyed on a periodic basis over the 30-year lifetime of this remedy to determine whether any settling has occurred. Since settling is expected to decrease with time, the frequency of resurveying will also decrease with time. The asphalt pavement will be resurveyed in years 2004, 2012 and 2025. Additional surveys may be performed if unexpected settling or damage occurs to the asphalt cover. Any survey work conducted will be documented and maintained in Metro-North's Department of Environmental Compliance and Services files.

Following the initial survey described above, any necessary repairs to the asphalt cover will be implemented to restore the desired grades, and the repaired surfaces will then be surveyed again to document the actual repairs. Documentation of the work conducted will be maintained in Metro-North's files. Thereafter, the asphalt cover will undergo repairs as necessary. Repairs may include: patching, sealing of cracks, and repaving. The need for repairs will be determined during the semi-annual inspection and noted on the OU-I Remedy Inspection Form.

Areas in the vicinity of the cap will also be maintained to ensure that all existing wells remain visible and easily accessible. In addition, the aboveground piping installed for the air sparge/SVE system, located in the southeast area of the asphalt cover, will be maintained and protected from damage.

2.2 *VEGETATED SLOPES AROUND THE ASPHALT COVER*

The final vegetated surface of the slopes that surround the cap/asphalt cover will be inspected regularly to ensure that the underlying soil on these slopes is properly protected against erosion. This is important because erosion of these slopes could undermine the portion of the asphalt cover that is not located over the sheeting wall left in place around the former lagoon area. It is recommended that the vegetated slope surfaces be visually inspected semi-annually, and following major storm events.

The protection provided by the vegetative cover should normally be complete, with no visible bare soil spots. The inspector should look for erosion rivulets on slopes, and any indication of settling. In addition, any washouts or soil slides will be noted immediately. If inspections reveal that the integrity of the slopes may be compromised in any way,

appropriate mitigative actions will be implemented. Repairs to bare soil areas may include reseeding, fertilizer application and soil conditioning, if applicable. Erosion may be reduced by improving vegetation and altering contours (if appropriate) to minimize stormwater run-off velocities. Sections of the slopes that have subsided will be backfilled, regraded and reseeded if necessary.

3.3 *DRAINAGE CHANNEL*

The drainage channel along the northern edge of the asphalt cover will be inspected semi-annually and after major storm events, to ensure that the channel is capable of diverting stormwater away from the site without a loss of efficiency and without sustaining damage.

The riprap within the channel will be inspected to ensure that the riprap is not being washed out and that the underlying geotextile, if exposed, is not damaged. The contours of the riprap are to be maintained as shown on the Record Drawings, and major washouts corrected if they occur. Any debris or significant sediment buildup in the channel will also be removed as it accumulates.

A series of storm sewer pipes and manholes were installed to connect the drainage channel to the Metro-North storm sewer system. The pipes and manholes will be inspected semi-annually to ensure that they remain functional. It is recommended that at least one of the two semi-annual inspections be conducted during a storm event, if possible, to visually verify that storm water is being carried by the new piping system. Any sediment and debris that may be accumulating will be removed from the system. Removal methods may include high volume water flushing, or use of a vacuum truck.

2.4 *PERIMETER FENCING*

Entry and access to the Metro-North Wastewater Treatment Area is controlled by perimeter fencing with gates. It is recommended that the perimeter fencing around the Metro-North Wastewater Treatment Area be inspected semi-annually for tears or breaks. Any damaged sections will be repaired as soon as possible, to prevent unauthorized entry to this area.

Brush and trees close to the exterior of the fence should also be removed to eliminate a means for access to the Site over the fence. The locks on the gates will be inspected and lubricated regularly, and replaced if necessary due to rusting or other damage.

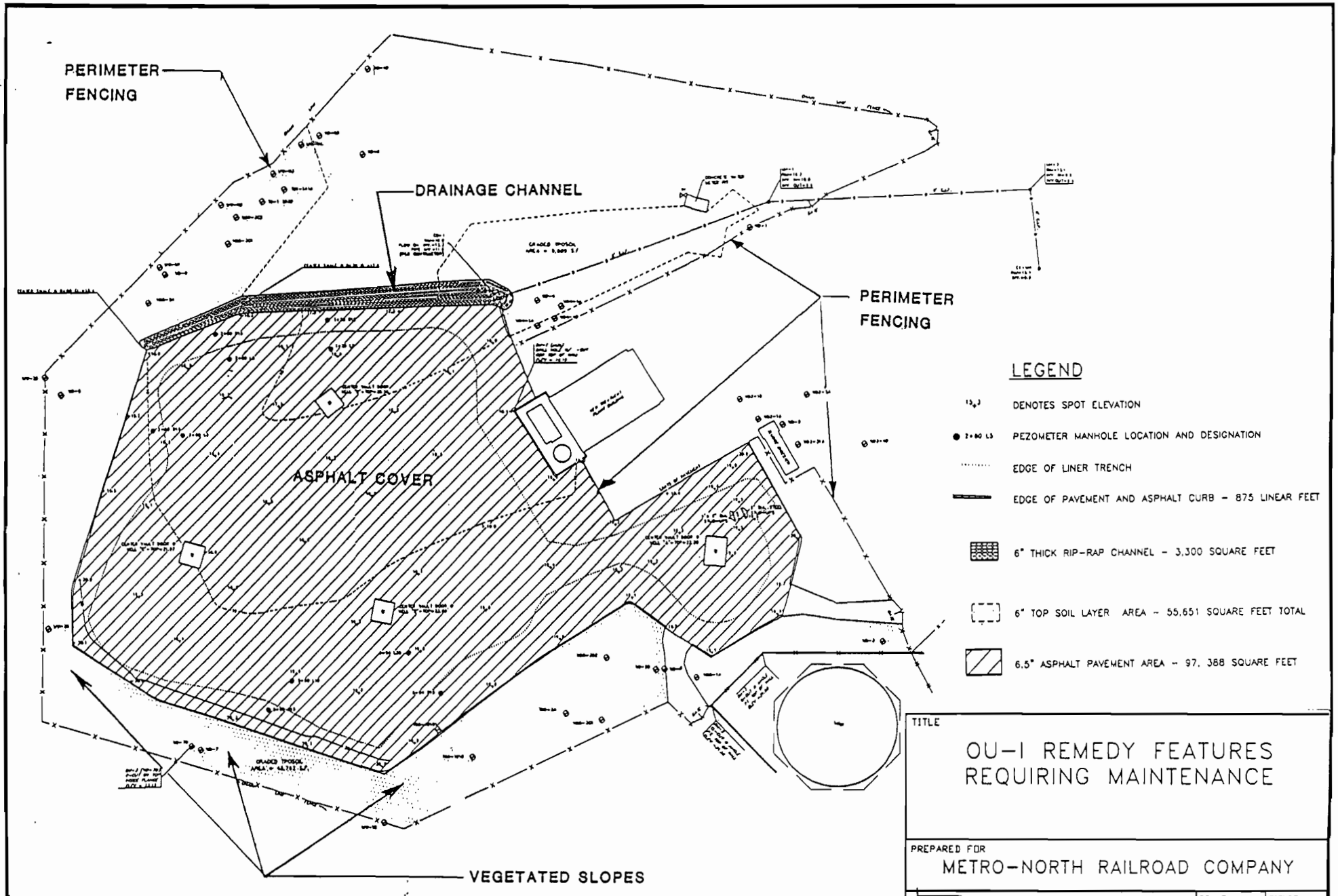
3.0 *CERTIFICATION*

This certification applies to the "Operation and Maintenance Manual" prepared for the Harmon Yard Operable Unit I, located in Croton-on-Hudson, New York.

I certify under penalty of law that I have personally examined, and am familiar with, all information submitted in this Plan as the information pertains to the practice of engineering. The practice of engineering means the performance of a professional service such as consultation, investigation, evaluation, planning, and design in connection with any utilities, structures, buildings, machines, equipment, processes, works or projects wherein the safeguarding of life, health and property is concerned, when such service or work requires the application of engineering principals and data. Based on my inquiry of all individuals with primary responsibility for obtaining such information, I certify that the information presented in this Plan is to the best of my knowledge and belief, true, accurate and complete.

Robert J. Rivera, P.E.
ERM Project Manager
Date: August 27, 1999

FIGURES



SOURCE: CHAS. H. SELLS INC. "AS-BUILT - FINAL GRADING & DRAINAGE". DATED APRIL 29, 1996.

TITLE

OU-1 REMEDY FEATURES REQUIRING MAINTENANCE

PREPARED FOR

METRO-NORTH RAILROAD COMPANY

ERM Environmental Resources Management			SCALE N.T.S.	FIGURE 1-1
DRAWN: G.G.	JOB NO.: 680.010.2	FILE NAME: MANUAL	DATE 6/30/99	

TABLES

Table 2-1
OU-I Remedy Inspection Schedule
Harmon Railroad Yard, Croton-On-Hudson, NY

Semi-Annually

- Visually inspect the condition of the following OU-I remedy components:
  - asphalt cover
  - vegetated slopes around the asphalt cover
  - drainage channels
  - perimeter fencing
- complete the OU-I Remedy Inspection Form; and
- complete any required maintenance to the above OU-I remedy components

Years 2004, 2012 and 2025

- Survey the surface of the asphalt cover;
- implement any necessary repairs to restore the desired grades; and
- resurvey the repaired asphalt cover surface.

Table 2-2
OU-I Remedy Inspection Form
Harmon Railroad Yard, Croton-On-Hudson, NY

Note the location(s) of any the inspection findings described below on Figure 1-1 (attached).

	Yes	No	Corrective Action Needed?
Asphalt Cover			
Are there any cracks in the asphalt cover?	☐	☐	☐
Is there any surface water ponding on the asphalt cover?	☐	☐	☐
Is there any evidence of settlement?	☐	☐	☐
Is there any elevation difference at the grouted manhole covers?	☐	☐	☐

Specify Correction Actions Needed:

_____

_____

_____

Vegetative Slopes Around the Asphalt Cover

Are there any visible bare spots?	☐	☐	☐
Are there any erosion rivulets?	☐	☐	☐
Is there evidence of any washouts or soil slides?	☐	☐	☐

Specify Correction Actions Needed:

_____

_____

_____

Drainage Channels

Is there any exposed geotextile in the drainage channel?	☐	☐	☐
If so, is the exposed geotextile damaged?	☐	☐	☐
Is there significant sedimentation in the drainage channel?	☐	☐	☐

[Given the arrangement of the riprap channel adjacent to the asphalt cover, there should be minimal sedimentation occurring in the channel, and any significant sedimentation will be investigated to determine its source and cause.]

Specify Correction Actions Needed:

_____

_____

_____

Perimeter Fencing

Is there any damaged fencing?	☐	☐	☐
Is there any vegetation close to the exterior of the fence that should be removed to eliminate a means for access to the Site over the fence?	☐	☐	☐
Are the gate locks present and in good working condition?	☐	☐	☐

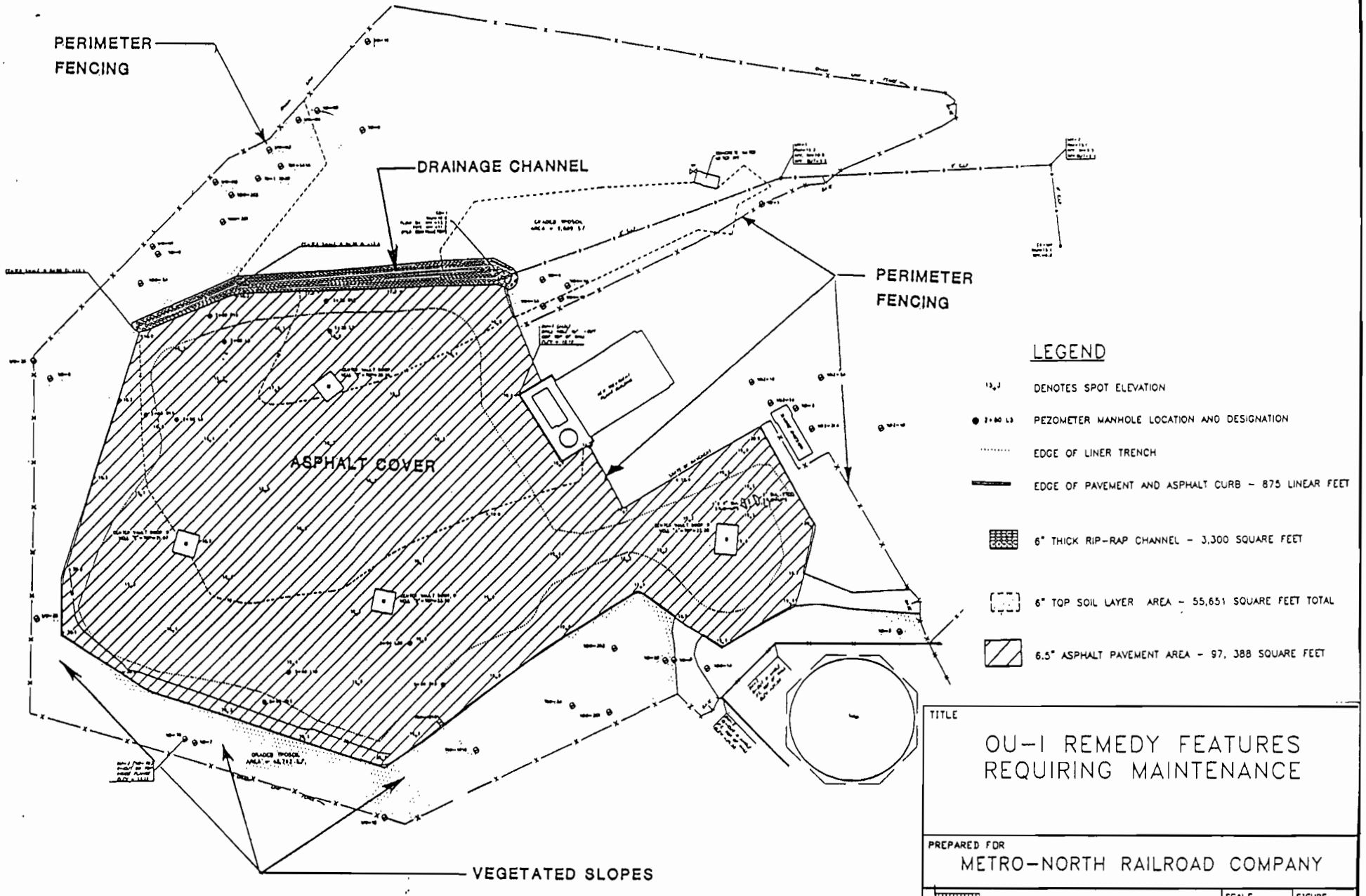
Specify Correction Actions Needed:

_____

_____

_____

cc: Metro-North Department of Environmental Compliance and Services



SOURCE: CHAS. H. SELLS INC. "AS-BUILT - FINAL GRADING & DRAINAGE". DATED APRIL 29, 1996.

TITLE

OU-1 REMEDY FEATURES REQUIRING MAINTENANCE

PREPARED FOR

METRO-NORTH RAILROAD COMPANY

ERM Environmental Resources Management			SCALE N.T.S.	FIGURE 1-1
DRAWN G.G.	JOB NO. 680.010.2	FILE NAME MANUAL	DATE 6/30/99	

Transmittal

Environmental Resources Management

475 Park Avenue South
New York, NY
(212) 447-1900
(212) 447-1904 (fax)

ERM

TO:	Gerard Burke (NYSDEC)
FROM:	Carla Weinpahl (ERM)
CC without enclosures:	Mukesh Mehta (Metro-North) Karen Timko (Metro-North)
SUBJECT:	Metro-North Commuter Railroad Harmon Yard Operable Unit II (OU-II)
DATE:	11 January 2001

As per your request, enclosed are ERM's original cost estimate and change orders for the design, construction and operation of the selected remedy for the Operable Unit II (OU-II) at the Harmon Railroad Yard located in Croton-on-Hudson, New York. It is my understanding that these documents will be used solely by NYSDEC in relation to the OU-II project. Under no circumstances should these documents be revealed to third parties without the permission of ERM.

The enclosed documents are:

(1) ERM's original proposal for Contract No. 9403, "Proposed Scope of Work and Costs for Additional Services at Harmon Yard", dated 19 June 1998, which included, but was not limited to work related to the design, construction and operation of the selected OU-II remedy.

4577743.

(2) Contract No. 9403, Change Order No. 1, dated 3 February 2000;

(3) Contract No. 9403, Change Order No. 2, dated 7 March 2000; and

(4) Letter from ERM to Metro-North, "Justification for Overrun of OU-II Design Budget", dated 3 November 2000.

Included in these documents are cost estimates for ERM's participation in three (3) different environmental projects at the Harmon Yard Site. A list of these projects, the tasks within each project, as well as the NYSDEC oversight jurisdiction for these three projects follows.

Project	Tasks	NYSDEC Oversight Jurisdiction
OU-II	1. Project Management 2. Preparation of Pre-Design Work Plan 3. Implementation of Pre-Design Study 4. Design 5. Bidding Assistance 6. Construction Assistance 7. Start-Up and O&M Assistance 8. OU-II Closure Report	Division of Environmental Remediation
Harmon Yard Phase II	9. NAPL Volume Estimate (Yard) 10. Additional Yard Phase II Technical Assistance	Division of Spill Prevention and Response (Region 3)
OU-I	11. OU-I Closure Report and O&M Plan	Division of Environmental Remediation

It is our understanding that capital costs incurred in connection with the OU-I and OU-II remedial actions are eligible for Environmental Quality Bond Act (EQBA) reimbursement. Consequently, costs related to Task Nos. 1-6, part of 7, 8 and 11 have been included in the cost estimates provided to you for ERM work that is reimbursable under EQBA. Task Nos. 9 and 10 and the O&M portion of Task No. 7 have been identified as non-reimbursable under EQBA since they are either (1) costs related to a Division of Spill Prevention and Response project; or (2) O&M costs.

To assist you in reviewing these documents, we have prepared the attached table. This table contains the following information:

- The original budget for each of the above tasks as documented in the 19 June 1998 ERM proposal;
- The task budget increases resulting from execution of Change Order Nos. 1 and 2;
- The anticipated additional costs associated with OU-II; and
- Identification of EQBA reimbursable costs and non-reimbursable costs.

Please contact me at the above number if you have any questions.

Harmon Yard Operable Unit II & OU-I Closure Costs
ERM Costs (Design through Closure)

EQBA Fundable	Proposal Task Number	*OU-II CAPITAL COSTS*	Original Budget	CO #1	CO #2	ERM Costs	Additional Costs	
		ERM Capital Costs						
x	1	Project Management	$64,955		$32,150	$97,105		
x	2	Preparation of Pre-Design Work Plan	$47,665			$47,665		
x	3	Implementation of Pre-Design Study	$162,499		$124,261	$286,760		
x	4	Design	$123,897		$46,125	$170,022	$57,100 *	
x	5	Bidding Assistance	$9,354			$9,354		
x	6	Construction Assistance	$67,051		$24,981	$92,032		
x	7	Start-Up Assistance	$12,321		$11,050	$23,371		assumes startup requires 1/3 of the O&M task budget
x	8	OU-II Closure Report	$20,753		$0	$20,753		
		Total OU-II ERM Capital Costs	$508,495		$238,567	$747,062	$57,100	
		Remaining OU-I Costs						
x	11	Closure Report & O&M Plan	$29,364	$10,733		$40,097		
		OU-II O&M Costs (assumes an additional 2 years plus 10 months)						
	7	ERM O&M Tech Assistance Costs	$24,642		$22,100	$46,742		assumes O&M tech asst costs 2/3 of the O&M task budget
		Total O&M Costs				$46,742		
		ERM's Phase II Spills Division Costs						
	9&10	Phase II Technical Assistance	$48,383	$44,193		$92,576		
		Total Costs	$610,884	$54,926	$238,567	$926,477	$57,100	
		Total EQBA Reimbursable ERMCosts				$787,158	$57,100	$844,258
		Total Non-Reimbursable Costs (i.e., O&M, Phase II)				$139,318		

* Projected costs, not yet formally approved as a change order by Metro-North.

Fax cover sheet

Date: 5/7/2001

TO: Gerard Burke

FROM: M. L. Mehta.

RE: EQBA Costs.

Number of page(s): 1+3

Number of sending fax: 212-499-4420

Number of receiving fax: 518 457 7743

If any problems occur please call: 212-499-4415.

FAX TRANSMITTAL

JUL 25

Karen L. Timko
Director
MTA Metro-North Railroad
Department of Environmental Compliance & Services
347 Madison Avenue - 12th Floor
New York, NY 10017
Tel #: (212) 340-3322
Fax #: (212) 340-3460

Date: 7/25/01

To: M. Mehta / G. Burke

Fax #: 4420 518-402-9819

No. of pages including this page: 5

Mukesh / Gerard,

Attached is the information on the PCB kits our contractor, Fleet, would use. Please call either me (212-340-3322) or Mukesh (212-499-4415) + let us know if they meet your requirements/standards

- Karen

Fleet Environmental Services LLC

"Earning the confidence of our customers by consistently providing reliable and cost effective services"

Transmission To: Karen Timko

Company: METRO North

Date of Transmission: 7/25/01

Author of Document: Jay

Total Pages (including this cover): 3

Comments Sorry for the delay

Jay

For 24-Hour Emergency Response in Connecticut 1-800-562-7611

Connecticut Response Centers

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Fax (203) 794-0535

390 W. Thames Street
Norwich CT 06360
(860) 887-1932
Fax (860) 887-1933

708 Higganum Road
Durham CT 06422
(860) 349-9951
Fax (860) 349-9959

Corporate Office

59 Longwater Drive
Norwell MA 02061
(781) 982-7200
Fax (781) 982-4008

Other Offices

898 Fernhill Road
Westchester PA 19380
(610) 436-7540
Fax (610) 436-7542

935 E. First Street
S Boston MA 02127
(617) 268-4933
Fax (617) 268-4874

45 Water Street
E Providence RI 02914
(401) 431-9514
Fax (401) 431-9521

37 Custom House Warf
Portland ME 04101
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Fax (207) 774-7240

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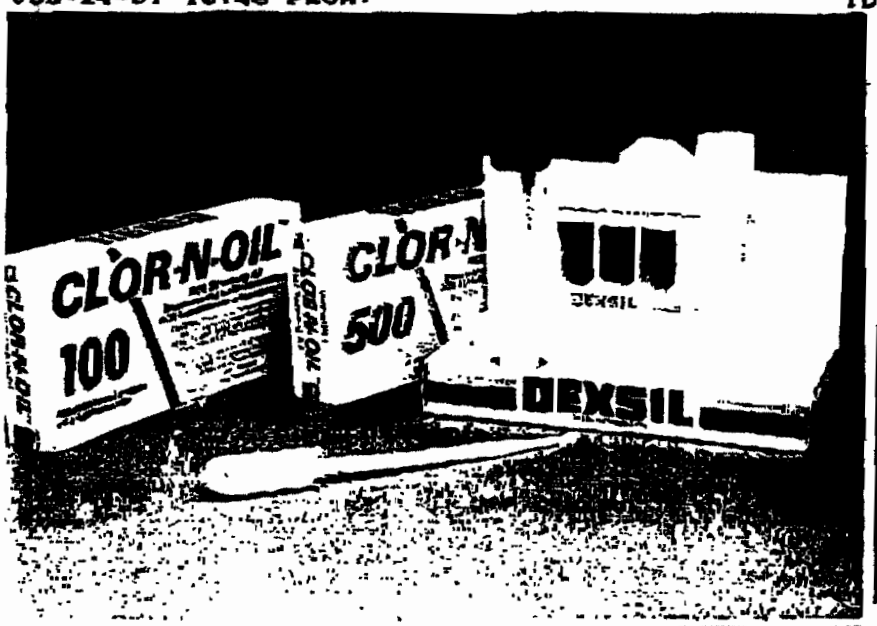
◆ Full & Selective Demolition Services ◆ Plant Maintenance ◆ Supplies & Equipment Sales ◆ Training ◆



CLOR-N-OIL

PCB Screening Kits For Electrical Insulating Fluid

Clor-N-Oil PCB Screening Kits are proven and accurate methods to test insulating fluid from electrical equipment for the presence of polychlorinated biphenyls (PCB). Clor-N-Oil kits are available to test PCB at 50, 100, 500 ppm.

Each kit is pocket-sized and self-contained with everything necessary to perform the procedure on-site. It is simple to use, takes less than 5 minutes to perform, and requires no mixing or measuring of reagents.

The Clor-N-Oil kits have been proven in hundreds of thousands of field uses throughout the world to be safe, accurate and economical methods to screen electrical equipment for PCB.

	CL-020 Catalog #
Clor-N-Oil 20 ppm	
Clor-N-Oil 50 ppm	CL-050
Clor-N-Oil 100 ppm	CL-100
Clor-N-Oil 500 ppm	CL-500

Packaged 20 kits to a shelf pack, 80 kits per case. Minimum order of 10 kits. Orders greater than 10 kits must be in multiples of 20.

CLOR-N-SOIL

PCB Screening Kit For Soil

The Clor-N-Soil PCB Screening Kit is an accurate and economical method for determining the presence of polychlorinated biphenyls (PCB) in soil at 50 ppm. This kit can be used to detect PCB either at a spill site or as part of a routine area check. The kit works on virually any type of soil including, sand, topsoil, sediment and clay.

Clor-N-Soil has been proven invaluable in many spill site remediation situations by aiding clean-up crews in quickly determining the presence of PCB and mapping out the spill's boundaries. The kit is simple to use, takes only 10 minutes to perform, and requires no mixing or measuring of reagents.

	Catalog #
Clor-N-Soil 50	CS-OIL

Packaged 12 kits to a shelf pack, 48 kits per case. Minimum order of 6 kits. Orders greater than 6 kits must be in multiples of 12.

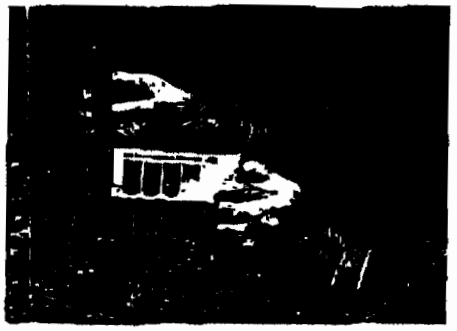
About The Kit

The Clor-N-Soil kit was developed to aid electrical utilities and environmental contractors in the on-site detection of PCB in soil. The kit works on all types of soil including sand, topsoil, sediment and clay. By using the kit as a screening test at a spill site the Clor-N-Soil kit can greatly reduce the costs associated with spill site cleanup.

Once cleanup procedures are under way and a crew is on site and removing soil, Clor-N-Soil kits can be run periodically to determine how much excavation is necessary. This results in savings of man-hours and disposal costs, and reduces the number of samples requiring costly laboratory analysis. The Clor-N-Soil kit does not eliminate the need for all laboratory analysis, but it can significantly reduce the number of samples which must be sent to the lab.

Clor-N-Soil is a portable and simple to use kit designed for use in the field by non-technical personnel. The kit is easy to use; no instruments, equipment or special training are required. Each kit contains everything necessary for one test.

The Clor-N-Soil 50 kit gives a positive or negative colorimetric result. If the resulting color is yellow, then the sample contains greater than 50 ppm; if the color is purple the sample contains less than 50 ppm. When the kit registers under 50 ppm, the darker the purple color the closer the PCB concentration is to zero. A color chart is included with each kit for comparison. The kit works on the principal of total organic chlorine detection, so soil contaminated with chlorinated solvents or pesticides can give "false positive" results.



Clor-N-Soil ADVANTAGES

It's Portable: The 5 oz. Clor-N-Soil Kit (pictured next page) is easily carried to any spill site.

It's Quick: Complete analysis time is about 10 minutes. Results are determined on the spot.

It's Easy to Use: The simple step-by-step procedure can be performed by anyone at the spill site, in the lab, or in the maintenance shop.

DEXSIL CORPORATION

One Hamden Park Drive
Hamden, CT 06517

TEL: (203) 288-3509
FAX: (203) 248-6523

TRANSMITTAL COVER SHEET

Date: 7.24.01

To: Jay Brundage

Company: Fleet Environmental

Sent by: Gina

Number of pages 9 **including cover sheet**

If you do not receive all pages, please notify the sender as soon as possible.

ATTACHMENT A

REQUIRED CHANGES FOR CONSTRUCTION OF VACUUM ENHANCED NAPL RECOVERY SYSTEM AT OU-II

METRO-NORTH COMMUTER RAILROAD
CONTRACT NO. 9464
HARMON LAGOON REMEDIATION
CROTON, NEW YORK

Contractor:	Envirotrac Environmental Services, Inc.
Site:	Harmon Yard
Date:	August 17, 2001

SUMMARY

Certain changes to the design are required based upon recent pneumatic and oxygen testing conducted by ERM in NAPL Area L4 of OU-II in Harmon Yard. The changes for NAPL Area L4 will include furnishing and installing a larger vacuum blower, moisture separator, carbon vessels, increasing the size of selected yard piping, and changing associated instrumentation. No additional extraction wells will be required. Specification Section 11374, "Soil Gas Extraction Equipment" has been revised. All changes have been "tracked" and red-lined (see attached document).

REQUIRED CHANGES (subject to DEC and MN approval)

- Vacuum Blower Assembly: Replace AMETEK Rotron Blower Model EN707 (EN707F72MXL) X.P., 5HP, 3ph, 460V for Area L4, with AMETEK Rotron Model **EN858BA72WL, X.P., 7.5 HP**, 3ph, 460V, (design flow: 220 cfm @ 70 inches w.c. maximum flow 400 cfm @ 0 inches of w.c.) or approved equal. See Paragraph 2.01A and 2.02C of the revised Specification Section 11374.

- Vapor/Liquid Separator: Assembly for Area L4 shall be equipped with separator Model **GX-60** rated for 500 cfm, 4-inch diameter inlet and outlet. Separator unit has diameter of 20 inches and height of 57 inches. *{NOTE: Paragraph 2.01 of Contract Specification Section 11374 states that GX-60 unit is to be provided. However, the Equipment List included at the end of Specification*

Section 01010 indicates the GX-30 unit}. The separator unit shall be skid-mounted, equipped with level control for the auto drain, with access port, sight gauge and in-line filter. The separator shall be manufactured by J.E. Gasho & Associates or approved equal. See Paragraph 2.01 and 2.04 of the revised Specification Section 11374.

- Carbon Vessels: Replace the two (2) Carbtrol model G-2S units (rated up to 300 cfm) for Area L4 with the Carbtrol model **G-3S**, (rated up to 500 cfm) or approved equal. The G-3S shall be furnished with 140 pounds of carbon. See Paragraph 2.05 of the revised Specification Section 11374.

- Process Piping: Increase the diameter of the underground portion of the PVC piping from 2" to 3" only for wells VE4-10, VE4-11 and VE4-12. The soil gas extraction (SGE) inlet piping inside the building will remain 2" diameter. The 2"X3" pipe reducers should be installed just outside the building foundation. The piping for the three designated wells shall be 3" diameter for the section from the reducer to the wellhead. Section A-A on Contract Drawing C-5 calls for 3" piping inside the vaults in Area L4. Piping for the remaining wells shall be 2" diameter.

- Instrumentation: For Area L4, replace the thirteen (13) Magnehelic Differential Pressure Gauges (range 0-0.25 inches of water column) Model 2000-00AV, manufactured by Dwyer Instruments Inc. (used as Flow Indicator for DS300 Flow Sensor) with thirteen (13) Magnehelic Gauges (range 0–2 inches of water column) Model 2002AV or approved equal. See Instrument List in Specification Section 13420. The Flow Indicators shall be mounted on SGE piping manifold inside building. In addition, supply the following as spare units: two (2) (range 0-5 inches of water column) Model 2005 gauges and two (2) (range 0-0.25 inches of water column) Model 2000-00AV gauges or approved equal. These additional four (4) Magnehelic Gauges need to be supplied for flow measurement under varying operating conditions.

- Instrumentation: For Area L4, replace the sixteen (16) vacuum gauges (range 0-40 inches water column) by Dwyer Instruments, Inc. with thirteen (13) vacuum gauges (range 0-60 inches water column) and two (2) vacuum gauges (range 0-100 inches water column). The two (2) gauges with the 0-100 inch range shall be installed on the suction side of the blower assembly as shown on Drawing PID-4. In addition, supply the following as spare units: four (4) vacuum gauges (range 0-100 inches water column).

- Instrumentation: For Area L1/L2, replace the fifteen (15) vacuum gauges (range 0-40 inches water column) by Dwyer Instruments, Inc. with twelve (12) vacuum gauges (range 0-60 inches water column) and four (4)

vacuum gauges (range 0-100 inches water column). The four (4) gauges with the 0-100 inch range shall be installed on the suction side of the blower assembly as shown on Drawing PID-2.

JUSTIFICATION:

The changes described above are required to optimize the remediation of NAPL Area L4. Results of recent pneumatic and oxygen testing demonstrate that higher airflow rates and vacuums are needed at selected L4 wells. These changes are expected to enhance the biodegradation of the petroleum compounds that are present in the subsurface soils of OU-II. The associated instrumentation is needed for the larger blower and to measure operating parameters under varying flow conditions.

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DATE: 20 August 2001 **FILE NO.:** 0885001

TO: Memo to File

FROM: John Thornburg

SUBJECT: Revised Undocumented Well List
MNR Harmon Lagoon OU-II

As of 20 August 2001, fourteen undocumented wells or suspected wells were located during the well installation phase and markout of the building and piping locations in the project area. The undocumented wells were field measured off of new well locations.

Area L1 (Two Wells)

2" PVC well with cap. No protective casing. Appears to be in good condition.
Located 16-ft from AI1-6 and 12.5-ft from VE1-4.

2" PVC well with cap. No protective casing. Had been covered with a steel plate. Cap is mashed down into the well casing, but appears to be repairable.
Located 22-ft from VE1-8 and 34-ft from AI1-6

Area L2 (Four Wells)

3" diameter pipe filled with water. Probably a bollard but possibly a protective casing for a well.
Located 39.5-ft from AI2-1 and 16-ft from AI2-2.

2" Stainless Steel (WB-4) well with cap and protective casing. The top of the protective casing is damaged and the well is not locked.
Located 24-ft from AI2-1 and 22.5-ft from AI2-2.

2" PVC well with manhole. The well is not locked.
Located 13.5-ft from VE2-1 and 26.5-ft from AI2-2.

2" PVC well with manhole. The well is not locked.
Located 12-ft from VE2-1 and 36-ft from AI2-2.

Area L3 (Four Wells)

2" PVC well broken off at the ground surface.
Located 3-ft west of VE3-2

2" stainless steel well (WB-2D) with 4"protective casing. The protective casing is damaged and the well is not locked.
Located 25-ft from the SW corner of the concrete slab and 29-ft from VE3-2.

2" stainless steel well (WB-2) with 6" protective casing. The protective casing is damaged and the well is not locked.
Located 25-ft from the SW corner of the concrete slab and 25-ft from VE3-2.

2" PVC well with cap. Well appears to be in good condition.
Located 41.5 from the SW corner of the concrete slab and 36-ft from VE3-2.

Area L4 (Four Wells)

2" PVC well that had a manhole and cap that was buried about 1.5-ft below grade within a drum that had been cut in half. The well appears to be in good condition.
Located 21.5-ft from VE4-8 and 22-ft from FA4-17

2" PVC well with 6-in. protective casing and royer type cover that is broken.
Located 2.5-ft west of FA4-20.

2" stainless steel well (WB-3) in 4" protective casing. The protective casing is damaged and the well is not locked. The casing is cocked to the side and the well is slightly bent.
Located 28-ft from FA4-25 and 52-ft from FA4-24.

2" PVC well with manhole. The well is not locked. Addressed in RFI 5.
Located 25-ft from AI4-12 and 40-ft from AI4-14.

Metro-North Commuter Railroad Company
Harmon Railroad Yard, Operable Unit II
DEC Site # 360010
In-Field Testing for NAPL Areas L2 and L4
22 August 2001

Introduction

Construction of the Metro-North Commuter Railroad Company (Metro-North) Harmon Railroad Yard ("Yard") Operable Unit II (OU-II) remedy is currently underway. This remedy entails removal of non-aqueous phase liquid (NAPL) utilizing a vacuum enhanced NAPL removal (VENR) technology. Prior to design and construction of this remedy, pilot testing was conducted at the Yard to determine spacing for the vacuum extraction and air inlet wells to be installed as part of the remedy.

As indicated in Section 2.1.1 of the NYSDEC-approved *Final, 60% Submittal, Engineer's Report, Operable Unit II Remedial Design, Metro-North Harmon Yard,* dated 12 July 2000 *("60% Submittal"):*

- sufficient pilot testing information was obtained to locate wells in NAPL Areas L1 and L3;
- due to the limited number of observation wells available during pilot testing in NAPL Area L2, additional testing was needed after additional wells were installed to confirm well spacing in this area; and
- due to the heterogeneous subsurface conditions in NAPL Area L4, additional testing was needed after additional wells were installed to confirm well spacing in this area.

To allow the Remedial Design to proceed, conservative spacing was assumed for the wells located in NAPL Area L2 and L4 and additional in-field testing was planned after well installation to confirm that wells spacing was adequate in these NAPL Areas. This document presents the results of this testing, interpretation of the results and recommendations regarding the need for additional wells.

Scope

As discussed in NYSDEC-approved *Operable Unit II Effectiveness Monitoring Plan, Harmon Railroad Yard Operable Unit II,* dated 2 November 2000, OU-II NAPL is distributed between two general locations:

- free-phase NAPL located at or near the current water table surface; and
- residual NAPL within the historical water table fluctuation zone (i.e., the smear zone).

As discussed in that report, the majority of OU-II NAPL is comprised of residual NAPL and limited free-phase NAPL is present.

As discussed in the *60% Submittal and EMP,* air, which is supplied to the formation through air inlet wells, will be drawn through subsurface soil using a series of vacuum wells. This induced air flow will: (1) remove NAPL by promoting biodegradation of residual and free phase NAPL; and (2) transport free-phase NAPL towards the recovery wells by inducing a pressure gradient. Although VENR also promotes volatilization, due to the limited minimal volatile content of the OU-II NAPL, removal through volatilization would be minimal. Vacuum extraction wells and

air inlet wells must be properly spaced to ensure that sufficient air flow is supplied to the subsurface to induce a pressure gradient in areas of free-phase NAPL and provide sufficient oxygen in areas of free phase and residual NAPL.

If the pneumatic response at a well located near an operating extraction well is equal to or greater than 0.1-inch water column (w.c.), a pressure gradient sufficient to enhance NAPL removal is present at that location. The distance at which the pneumatic response is equal to 0.1-inch w.c. is called the pneumatic radius of influence. In contrast, if the observation well exhibits an increasing soil gas oxygen concentration and a soil gas oxygen concentration greater than 5% during VENR operation, the well is within the oxygen radius of influence of the extraction well. As discussed in *Addendum No. 1, Pilot Test Results Report, Metro-North Harmon Yard*, dated 18 October 1999, the oxygen radius of influence in a formation is generally greater than the pneumatic radius of influence.

Since pneumatic response is more conservative and easier to test, the wells located in NAPL Areas L2 and L4 were first evaluated for pneumatic response and then evaluated for oxygen radius of influence, where needed. Provided the extraction well exhibited acceptable pneumatic radius of influence, it would automatically exhibit acceptable oxygen response.

Following is a discussion of the in-field testing results.

Findings

Pneumatic testing of all the extraction wells located in NAPL Areas L2 and L4 was conducted from 17 to 19 July 2001. The results of the pneumatic testing are provided in Table 1. The VENR system was operated at a number of vacuums at each extraction well and the pneumatic response was recorded at the surrounding wells. The VENR system operating conditions and the pneumatic responses are presented in Table 1.

The information provided in this table was then reviewed to determine the pneumatic response at 20 inches w.c. of applied vacuum (the design condition) and the corresponding air flow rate at this pressure. As shown in Table 1, an acceptable pneumatic response was observed under these conditions in the NAPL Area L2 vacuum extraction well, VE2-1, and the eastern and central NAPL Area L4 vacuum extraction wells (i.e., VE4-5, VE4-6, VE4-8 through VE4-13). Acceptable pneumatic responses were also observed at lower vacuums in some of these wells.

As shown in Table 1, an acceptable pneumatic response was not observed in the five (5) western wells and one central well in NAPL Area L4 (i.e., VE4-1 through VE4-4 and VE4-7). Oxygen response testing was therefore performed for a representative number of these wells. Wells VE4-2, VE4-4 and VE4-7 were selected for testing. During the oxygen response testing: (1) one adjacent air inlet well was closed so that representative soil gas conditions could be measured; and (2) three air injection wells remained open to allow air introduction into the subsurface. This in-field testing results are considered to be a conservative estimation of operating conditions since: (1) all air injection wells will be open during full scale operation; and (2) forced air will be supplied into all of the air injection wells during full scale operation. The VENR system was operated for 2.5 to 4 hours. During that time, soil gas samples were periodically collected from the opened and closed air inlet wells and monitored for oxygen concentrations.

The results of this testing are presented in Table 2. As shown in this table, the oxygen concentrations in both the open and closed wells surrounding VE4-7 steadily increased during VENR operation, and the soil gas oxygen concentration was greater than 5% (the lower limit for biodegradation). These factors indicate an acceptable oxygen influence. The results for the other two wells were not as definitive. Soil gas oxygen concentrations in the closed wells surrounding VE4-2 and VE4-4 initially decreased, but then began to increase. The soil gas oxygen concentration in VE4-2 increased above the threshold of 5%. It appears that VE4-4 may have reached the threshold concentration had it been operated longer. Although the results for VE4-2 and VE4-4 were not as definitive as VE4-7, there was an oxygen influence in the closed wells and they reached or likely would have reached the threshold oxygen limit. Thus, the oxygen response is likely adequate for the NAPL L4 western wells.

To confirm that the wells were adequately spaced to address OU-II NAPL in the NAPL Area L4, additional data was collected from all NAPL Area L4 vacuum extraction and air inlet wells. This included: NAPL thickness measurements and soil gas oxygen concentrations and soil gas combustibility (i.e., % of LEL) under non-VENR conditions. This information is provided in Table 3. Measurable NAPL thickness in a well indicates that free phase NAPL is present in the subsurface at some thickness. Due to the consumption of oxygen to biodegrade NAPL, low soil gas oxygen concentrations and elevated LEL readings were observed in most of the wells containing free phase NAPL. Residual NAPL is also assumed to be present in all areas containing free phase NAPL. In the absence of measurable NAPL thickness in a well, low oxygen concentrations and/or elevated LEL readings are believed to be an indication that residual NAPL is present in subsurface soil adjacent to these wells.

Review of Tables 1, 2 and 3 indicate that sufficient pneumatic influence and/or oxygen influence is present around wells containing free-phase or residual NAPL to promote NAPL removal through VENR.

Conclusion

The in-field VENR testing results demonstrate that the constructed VENR extraction well spacing for NAPL Areas L2 and L4 is adequate and that no changes to the number or spacing of vacuum extraction or air inlet wells are needed. As a result, neither additional wells nor changes to well locations are needed.

In addition to evaluating the well spacing, the air flow rates observed during the pilot study were also reviewed to confirm the blower sizing (see Table 1). Air flow rates observed during the recent in-field testing were, in general, higher than those observed in the NAPL Area L4 pilot test well. Consequently, the design has been modified to increase the size of the blower and associated equipment and piping. These changes are summarized in Attachment A.

Table 1
Vacuum Test Log Sheets
Metro-North OU-II, Croton-on-Hudson, New York

EXTRACTION WELL	VE2-1				VE4-1					VE4-2				VE4-3			
OBSERVATION POINT/ DISTANCE/ CONDITION #	O.P.	DIST.	#1	#2	O.P.	DIST.	#1	#2	#3	O.P.	DIST.	#1	#2	O.P.	DIST.	#1	#2
Applied vacuum at wellhead (inches w.c.) ⇒			20	11			3	20	33			8	26			20	2.3
Applied vacuum at blower (inches w.c.) ⇒			23	21			25	26	43			9	21			27	9
Velocity (ft/min) ⇒			475	225			600	2500	3600			450	850			2900	470
Flow (cfm) ⇒			10.4	4.9			13.1	54.5	78.5			9.8	18.5			63.2	10.2
PID at carbon inlet (ppmv) ⇒			20.7	11.4			0.0	0.0	0.0			0.0	0.0			0.0	0.0
PID at carbon outlet (ppmv) ⇒			0.0	0.0			0.0	0.0	0.0			0.0	0.0			0.0	0.0
Observation Point/ Distance&Direction/ Observed Vaccuum	AI2-1	27' NW	3.70	2.50	FA4-1	27' NW	0.0	0.00	0.02	FA4-2	31' SW	0.00	0.02	FA4-4	43' NW	0.00	0.00
Observation Point/ Distance&Direction/ Observed Vaccuum	AI2-2	27' NE	1.00	0.68	FA4-2	17' SW	0.0	0.00	0.00	FA4-3	21' W	0.00	0.02	FA4-5	20' W	0.00	0.00
Observation Point/ Distance&Direction/ Observed Vaccuum	AI2-3	30' SE	0.36	0.28	FA4-3	15' E	0.0	0.06	0.09	FA4-4	19' N	0.02	0.02	FA4-6	20' N	0.12	0.02
Observation Point/ Distance&Direction/ Observed Vaccuum					FA4-4	40' NE	0.0	0.08	0.12	FA4-5	20' E	0.00	0.00	FA4-7	22' E	0.00	0.00
Observation Point/ Distance&Direction/ Observed Vaccuum										FA4-6	44' NE	0.00	0.00	FA4-8	45' NE	0.00	0.00
Observation Point/ Distance&Direction/ Observed Vaccuum										FA4-6	44' NE	0.00	0.00	FA4-8	45' NE	0.00	0.00

*The vaccum gauge on the blower was not working properly. The screw was removed and ERM's vacuum gauge was later used to obtain reading

NR-no reading was taken

(1) Not tested. Wasps present.

O.P.: Observation Point

DIST.: distance from extraction well as measured in the field. May not correlate exactly to the design spacing presented in Figure 1.

Table 1
Vacuum Test Log Sheets
Metro-North OU-II, Croton-on-Hudson, New York

EXTRACTION WELL	VE4-4				VE4-5				VE4-6				VE4-7			
OBSERVATION POINT/ DISTANCE/ CONDITION #	O.P.	DIST.	#1	#2	O.P.	DIST.	#1	#2	O.P.	DIST.	#1	#2	O.P.	DIST.	#1	#2
Applied vacuum at wellhead (inches w.c.) ⇒			8	21			10	20			2.9	28			21	1.8
Applied vacuum at blower (inches w.c.) ⇒			11.5	20			11	20			10	21			33	10
Velocity (ft/min) ⇒			400	600			400	750			600	3050			3000	500
Flow (cfm) ⇒			8.7	13.1			8.7	16.4			13.1	66.5			65.4	10.9
PID at carbon inlet (ppmv) ⇒			0.0	0.0			0.0	0.0			0.9	8.8			4.9	0.0
PID at carbon outlet (ppmv) ⇒			0.0	0.0			0.0	0.0			0.0	0.0			0.0	0.0
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-6	41' NW	0.10	0.02	FA4-7	46' W	0.00	0.00	FA4-10	34' W	0.05	0.21	FA4-12	45' W	0.00	0.00
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-7	19' W	0.00	0.00	FA4-8	32' NW	0.18	0.25	FA4-12	22' NW	0.05	0.22	FA4-14	21' NW	0.06	0.00
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-8	23' N	0.02	0.02	FA4-10	22' N	0.20	0.26	FA4-13	13' NE	0.42	2.50	FA4-15	23' NE	0.02	0.00
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-10	42' N	0.00	0.00	OW-2	23' W	0.00	0.00	FA4-9	Note (1)			FA4-17	57' NE	0.00	0.00
Observation Point/ Distance&Direction/ Observed Vaccuum	OW-2	5 E	0.00	0.00	FA4-9	Note (1)			FA4-11	Note (1)						
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-9	Note (1)			FA4-11	Note (1)										

*The vaccum gauge on the blower was not working properly. T

NR-no reading was taken

(1) Not tested. Wasps present.

O.P.: Observation Point

DIST.: distance from extraction well as measured in the field. N

Table 1
Vacuum Test Log Sheets
Metro-North OU-II, Croton-on-Hudson, New York

EXTRACTION WELL	VE4-8				VE4-9					VE4-10				VE4-11			
OBSERVATION POINT/ DISTANCE/ CONDITION #	O.P.	DIST.	#1	#2	O.P.	DIST.	#1	#2	#3	O.P.	DIST.	#1	#2	O.P.	DIST.	#1	#2
Applied vacuum at wellhead (inches w.c.) ⇒			2.8	21			7	20	5			15	4			20	5.5
Applied vacuum at blower (inches w.c.) ⇒			7	27			8.5	26.5	6			32.5	7.5			20	7.5
Velocity (ft/min) ⇒			500	2350			980	2250	890			4800	2100			3800	1600
Flow (cfm) ⇒			10.9	51.2			21.4	49.1	19.8			104.6	45.8			82.8	34.9
PID at carbon inlet (ppmv) ⇒			0.0	0.0			2.4	5.5	NR			0.0	0.0			30.1	13.4
PID at carbon outlet (ppmv) ⇒			0.0	0.0			0.0	0.0	NR			0.0	0.0			0.0	0.0
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-15	18' SW	0.01	0.08	FA4-15	55' SW	0.00	0.04	0.00	FA4-16	52' SW	0.09	0.06	FA4-17	NR	0.00	NR
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-16	35' N	0.00	0.06	FA4-16	45' W	0.00	0.01	0.01	FA4-18	25' N	4.50	1.50	FA4-18	NR	0.22	0.10
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-17	17' NE	0.01	0.10	FA4017	23' SW	0.01	0.04	0.03	FA4-19	22' S	1.50	0.52	FA4-19	49' NW	1.30	0.35
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-18		0.00	0.03	FA4-18	20' N	0.06	0.22	0.11	FA4-20	21' E	2.10	0.62	FA4-20	19' SW	2.20	0.06
Observation Point/ Distance&Direction/ Observed Vaccuum					FA4-20	50' NE	0.01	0.02	0.01	FA4-22	61' E	0.30	0.10	FA4-21	23' NE	1.75	0.46
Observation Point/ Distance&Direction/ Observed Vaccuum														FA4-22	25' SE	1.95	0.57

*The vaccum gauge on the blower was not working properly. T

NR-no reading was taken

(1) Not tested. Wasps present.

O.P.: Observation Point

DIST.: distance from extraction well as measured in the field. M

Table 1
Vacuum Test Log Sheets
Metro-North OU-II, Croton-on-Hudson, New York

EXTRACTION WELL	VE4-12					VE4-13			
OBSERVATION POINT/ DISTANCE/ CONDITION #	O.P.	DIST.	#1	#2	#3	O.P.	DIST.	#1	#2
Applied vacuum at wellhead (inches w.c.) ⇒			20	6.5	21			20	8
Applied vacuum at blower (inches w.c.) ⇒			*	*	*			*	*
Velocity (ft/min) ⇒			3600	1500	3600			1000	580
Flow (cfm) ⇒			78.5	32.7	78.5			21.8	12.6
PID at carbon inlet (ppmv) ⇒			17.5	0.0	30.1			1.6	0.0
PID at carbon outlet (ppmv) ⇒			0.0	0.0	0.0			0.0	0.0
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-21	60' NNE	0.23	0.15	0.23	FA4-21	NR	0.00	NR
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-22	24' NNE	2.40	0.74	2.40	FA4-23	NR	0.22	0.10
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-23	22' NNW	3.30	1.40	3.60	FA4-24	49' NW	1.30	0.35
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-24	25' SSW	1.30	0.42	1.40	FA4-25	19' SW	2.20	0.06
Observation Point/ Distance&Direction/ Observed Vaccuum									
Observation Point/ Distance&Direction/ Observed Vaccuum									

*The vaccum gauge on the blower was not working properly. T

NR-no reading was taken

(1) Not tested. Wasps present.

O.P.: Observation Point

DIST.: distance from extraction well as measured in the field. M

TABLE 2
AIR RADIUS OF INFLUENCE MEASUREMENTS
METRO-NORTH OU-II, HARMON YARD, NEW YORK

EXTRACTION WELL VE4-2											
Extraction Well			Open Observation Well			Closed Observation Well			Open Observation Well		
VE4-2 (Extraction Well)			FA4-3			FA4-4			FA4-5		
TIME	LEL	O_2	TIME	LEL	O_2	TIME	LEL	O_2	TIME	LEL	O_2
11:00	*0.0%*	*19.5%*	*10:42*	*0.0%*	*13.9%*	*10:49*	*0.0%*	*5.9%*	*10:34*	*0.0%*	*15.6%*
11:25	0.0%	20.0%	11:22	0.0%	16.3%	11:40	0.0%	7.0%	11:32	0.0%	18.1%
13:01	0.0%	19.6%	12:45	0.0%	18.9%	12:52	0.0%	12.2%	12:58	0.0%	17.3%
13:37	0.0%	20.2%	13:25	0.0%	18.9%	13:31	0.0%	6.4%	13:35	0.0%	17.0%
14:15	0.0%	20.4%	14:02	0.0%	19.3%	14:08	0.0%	6.2%	14:13	0.0%	17.6%
14:49	0.0%	20.6%	14:35	0.0%	19.8%	14:42	0.0%	6.3%	14:47	0.0%	17.7%

EXTRACTION WELL VE4-4											
Extraction Well			Closed Observation Well			Open Observation Well			Open Observation Well		
VE4-4 (Extraction Well)			FA4-7			FA4-8			FA4-9		
TIME	LEL	O_2	TIME	LEL	O_2	TIME	LEL	O_2	TIME	LEL	O_2
11:59	*0.0%*	*20.3%*	*11:51*	*0.0%*	*18.3%*	*12:03*	*>100%*	*9.8%*	*12:11*	*>100%*	*19.1%*
13:30	0.0%	20.8%	13:27	0.0%	15.1%	13:24	>100%	9.6%	13:05	>100%	16.6%
13:55	0.0%	20.6%	13:59	0.0%	14.4%	13:41	>100%	7.9%	13:40	>100%	18.3%
14:24	0.0%	20.6%	14:29	0.0%	15.2%	14:00	>100%	4.6%	14:04	>100%	18.5%
14:57	0.0%	20.7%	14:53	0.0%	14.2%	14:34	>100%	4.5%	14:26	81.0%	19.0%

EXTRACTION WELL VE4-7											
Extraction Well			Closed Observation Well			Open Observation Well			Open Observation Well		
VE4-7			FA4-13			FA4-14			FA4-15		
TIME	LEL	O_2	TIME	LEL	O_2	TIME	LEL	O_2	TIME	LEL	O_2
9:00	*33*	*18.0%*	*9:01*	*>100%*	*3.9%*	*8:50*	*>100%*	*14.2%*	*8:58*	*20.0%*	*12.2%*
9:41	11.0%	19.1%	9:40	>100%	4.5%	9:37	4.0%	20.5%	9:44	0.0%	17.4%
10:11	9.0%	19.5%	10:18	>100%	3.2%	10:14	0.0%	20.5%	10:21	2.0%	15.6%
10:52	2.0%	20.2%	11:01	>100%	3.2%	10:59	0.0%	20.7%	11:03	4.0%	15.1%
11:22	2.0%	20.4%	11:37	>100%	6.6%	11:26	0.0%	20.7%	11:30	2.0%	16.9%

Table 3
Area 4 Testing - NAPL Thickness, LEL, and Oxygen Content
Metro-North OU-II Harmon Yard, Croton-on-Hudson, New York

Monitoring Point	Depth to Water (ft)	Depth to Product (ft)	Product Thickness (ft)	LEL (%)	O_2 (%)	Free-Phase NAPL (1)	Residual NAPL (2)	Comments
VE4-1	9.21	-	-	1.0	9.2		x	
VE4-2	8.38	-	-	0.0	15.1			
VE4-3	9.32	-	-	0.0	14.8			
VE4-4	8.20	-	-	5.0	16.3			
VE4-5	12.30	8.88	3.42	4.0	19.9	x	x	bad seal on well
VE4-6	10.53	8.05	2.48	99.0	9.6	x	x	
VE4-7	7.61	-	-	30.0	2.0		x	
VE4-8	7.77	-	-	2.0	9.2		x	
VE4-9	8.24	-	-	16.0	17.9		x	
VE4-10	12.26	-	-	17.0	10.4		x	
VE4-11	14.93	-	-	4.0	8.5		x	
VE4-12	13.55	-	-	5.0	8.9		x	some odor detected
VE4-13	11.27	-	-	0.0	18.1			
FA4-1	7.02	-	-	0.0	19.3			
FA4-2	12.85	-	-	2.0	19.5			
FA4-3	9.15	-	-	0.0	16.5			
FA4-4	NA			NA	NA			
FA4-5	8.13	-	-	0.0	16.5			
FA4-6	13.95	-	-	3.0	16.5			
FA4-7	9.11	-	-	40.0	14.2		x	
FA4-8	17.25	14.10	3.15	36.0	2.8	x	x	product to bottom of well
FA4-9	11.70	8.27	3.43	94.0	17.5	x	x	
FA4-10	14.86	12.02	2.84	97.0	8.3	x	x	
FA4-11	12.25	8.95	3.30	56.0	4.8	x	x	
FA4-12	14.88	12.48	2.40	>100	12.6	x	x	
FA4-13	12.30	9.25	3.05	55.0	4.5	x	x	
FA4-14	11.71	10.64	1.07	66.0	5.9	x	x	
FA4-15	7.82	-	-	75.0	6.1		x	
FA4-16	11.89	11.33	0.56	39.0	3.2	x	x	
FA4-17	8.14	-	-	3.0	10.8		x	
FA4-18	11.35	9.86	1.49	50.0	4.0	x	x	strong odor detected
FA4-19	15.90	13.89	2.01	56.0	4.6	x	x	strong odor detected
FA4-20	12.37	-	-	66.0	5.3		x	
FA4-21	13.35	-	-	14.0	11.2		x	
FA4-22	12.93	-	-	3.0	6.6		x	
FA4-23	13.01	-	-	23.0	5.4		x	
FA4-24	11.51	-	-	12.0	6.2		x	
FA4-25	12.02	-	-	0.0	17.5			
OW-2	8.30	-	-	0.0	7.5		x	
OW-4	11.58	8.4	-	50.0	4.0	x	x	

LETTER OF TRANSMITTAL
ENVIRONMENTAL RESOURCES MANAGEMENT, INC.

475 Park Avenue South 29th Floor New York, New York 10016 phone (212) 447-1900
fax: (212) 447-1904

TO:	Robert C. Knizek, P.E. (NYSDEC)	**DATE:**	18 September, 2001
CC:	See Copy List	**PROJECT NO:**	X7602.06.01
FROM:	Carla Weinpahl (ERM)	**RE:**	Metro-North Commuter Railroad Harmon Yard Operable Unit II

Copy List:
Robert Cozzi (NYSDEC)
Gerard Burke (NYSDEC)
Tom Gibbons (NYSDEC)
Karen Timko (Metro-North)
John Seaboldt (Metro-North)
Mukesh Mehta (Metro-North)
Brian Morrissey (ERM)
John Iannone (Cody Ehlers Group)

SEP 2 4

Enclosed please find the following items:

☐	Shop Drawings	☐	Prints	☐	Plans	☐	Samples	☐	Other
☐	Copy of Letter	☐	Change Order	☒	Reports	☐	Specifications	☐	

Copies	Date	Description
1	18 September 2001	Metro-North Commuter Railroad Company, Harmon Railroad Yard, Operable Unit II, DEC Site # 360010, In-Field Testing for NAPL Areas L2 and L4

These are transmitted as checked below:

x	For approval	☐	Approved as submitted	☐	Resubmit ___ copies for approval
☐	For payment	☐	Approved as noted	☐	Submit ___ copies for distribution
☐	As requested	☐	Returned for corrections	☐	Returned ___ corrected prints
☐	For review	x	For your records	☐	

COMMENTS:

Attached is the final version of the above-referenced document. A draft form of this document was submitted to Gerard Burke, NYSDEC on 23 August 2001. Mr. Burke verbally notified Brian Morrissey, ERM, that NYSDEC had no comments on this document. This report is therefore being issued final and constructions decisions have proceeded based upon the conclusions of this report. Please provide ERM and Metro-North with a formal approval letter at your earliest convenience.

SIGNED: _____

F:\MNOUII\CONSTRUCTION\transmittal of well testing results.doc

Metro-North Commuter Railroad Company
Harmon Railroad Yard, Operable Unit II
DEC Site # 360010
In-Field Testing for NAPL Areas L2 and L4
18 September 2001

Introduction

Construction of the Metro-North Commuter Railroad Company (Metro-North) Harmon Railroad Yard ("Yard") Operable Unit II (OU-II) remedy is currently underway. This remedy entails removal of non-aqueous phase liquid (NAPL) utilizing a vacuum enhanced NAPL removal (VENR) technology. Prior to design and construction of this remedy, pilot testing was conducted at the Yard to determine spacing for the vacuum extraction and air inlet wells to be installed as part of the remedy.

As indicated in Section 2.1.1 of the NYSDEC-approved *Final, 60% Submittal, Engineer's Report, Operable Unit II Remedial Design, Metro-North Harmon Yard*, dated 12 July 2000 *("60% Submittal"):*

- sufficient pilot testing information was obtained to locate wells in NAPL Areas L1 and L3;
- due to the limited number of observation wells available during pilot testing in NAPL Area L2, additional testing was needed after additional wells were installed to confirm well spacing in this area; and
- due to the heterogeneous subsurface conditions in NAPL Area L4, additional testing was needed after additional wells were installed to confirm well spacing in this area.

To allow the Remedial Design to proceed, conservative spacing was assumed for the wells located in NAPL Area L2 and L4 and additional in-field testing was planned after well installation to confirm that wells spacing was adequate in these NAPL Areas. This document presents the results of this testing, interpretation of the results and recommendations regarding the need for additional wells.

Scope

As discussed in NYSDEC-approved *Operable Unit II Effectiveness Monitoring Plan, Harmon Railroad Yard Operable Unit II*, dated 2 November 2000, OU-II NAPL is distributed between two general locations:

- free-phase NAPL located at or near the current water table surface; and
- residual NAPL within the historical water table fluctuation zone (i.e., the smear zone).

As discussed in that report, the majority of OU-II NAPL is comprised of residual NAPL and limited free-phase NAPL is present.

As discussed in the *60% Submittal and EMP*, air, which is supplied to the formation through air inlet wells, will be drawn through subsurface soil using a series of vacuum wells. This induced air flow will: (1) remove NAPL by promoting biodegradation of residual and free phase NAPL; and (2) transport free-phase NAPL towards the recovery wells by inducing a pressure gradient. Although VENR also promotes volatilization, due to the limited minimal volatile content of the OU-II NAPL, removal through volatilization would be minimal. Vacuum extraction wells and

air inlet wells must be properly spaced to ensure that sufficient air flow is supplied to the subsurface to induce a pressure gradient in areas of free-phase NAPL and provide sufficient oxygen in areas of free phase and residual NAPL.

If the pneumatic response at a well located near an operating extraction well is equal to or greater than 0.1-inch water column (w.c.), a pressure gradient sufficient to enhance NAPL removal is present at that location. The distance at which the pneumatic response is equal to 0.1-inch w.c. is called the pneumatic radius of influence. In contrast, if the observation well exhibits an increasing soil gas oxygen concentration and a soil gas oxygen concentration greater than 5% during VENR operation, the well is within the oxygen radius of influence of the extraction well. As discussed in *Addendum No. 1, Pilot Test Results Report, Metro-North Harmon Yard*, dated 18 October 1999, the oxygen radius of influence in a formation is generally greater than the pneumatic radius of influence.

Since pneumatic response is more conservative and easier to test, the wells located in NAPL Areas L2 and L4 were first evaluated for pneumatic response and then evaluated for oxygen radius of influence, where needed. Provided the extraction well exhibited acceptable pneumatic radius of influence, it would automatically exhibit acceptable oxygen response.

Following is a discussion of the in-field testing results.

Findings

Pneumatic testing of all the extraction wells located in NAPL Areas L2 and L4 was conducted from 17 to 19 July 2001. The results of the pneumatic testing are provided in Table 1. The VENR system was operated at a number of vacuums at each extraction well and the pneumatic response was recorded at the surrounding wells. The VENR system operating conditions and the pneumatic responses are presented in Table 1.

The information provided in this table was then reviewed to determine the pneumatic response at 20 inches w.c. of applied vacuum (the design condition) and the corresponding air flow rate at this pressure. As shown in Table 1, an acceptable pneumatic response was observed under these conditions in the NAPL Area L2 vacuum extraction well, VE2-1, and the eastern and central NAPL Area L4 vacuum extraction wells (i.e., VE4-5, VE4-6, VE4-8 through VE4-13). Acceptable pneumatic responses were also observed at lower vacuums in some of these wells.

As shown in Table 1, an acceptable pneumatic response was not observed in the five (5) western wells and one central well in NAPL Area L4 (i.e., VE4-1 through VE4-4 and VE4-7). Oxygen response testing was therefore performed for a representative number of these wells. Wells VE4-2, VE4-4 and VE4-7 were selected for testing. During the oxygen response testing: (1) one adjacent air inlet well was closed so that representative soil gas conditions could be measured; and (2) three air injection wells remained open to allow air introduction into the subsurface. This in-field testing results are considered to be a conservative estimation of operating conditions since: (1) all air injection wells will be open during full scale operation; and (2) forced air will be supplied into all of the air injection wells during full scale operation. The VENR system was operated for 2.5 to 4 hours. During that time, soil gas samples were periodically collected from the opened and closed air inlet wells and monitored for oxygen concentrations.

The results of this testing are presented in Table 2. As shown in this table, the oxygen concentrations in both the open and closed wells surrounding VE4-7 steadily increased during VENR operation, and the soil gas oxygen concentration was greater than 5% (the lower limit for biodegradation). These factors indicate an acceptable oxygen influence. The results for the other two wells were not as definitive. Soil gas oxygen concentrations in the closed wells surrounding VE4-2 and VE4-4 initially decreased, but then began to increase. The soil gas oxygen concentration in VE4-2 increased above the threshold of 5%. It appears that VE4-4 may have reached the threshold concentration had it been operated longer. Although the results for VE4-2 and VE4-4 were not as definitive as VE4-7, there was an oxygen influence in the closed wells and they reached or likely would have reached the threshold oxygen limit. Thus, the oxygen response is likely adequate for the NAPL L4 western wells.

To confirm that the wells were adequately spaced to address OU-II NAPL in the NAPL Area L4, additional data was collected from all NAPL Area L4 vacuum extraction and air inlet wells. This included: NAPL thickness measurements and soil gas oxygen concentrations and soil gas combustibility (i.e., % of LEL) under non-VENR conditions. This information is provided in Table 3. Measurable NAPL thickness in a well indicates that free phase NAPL is present in the subsurface at some thickness. Due to the consumption of oxygen to biodegrade NAPL, low soil gas oxygen concentrations and elevated LEL readings were observed in most of the wells containing free phase NAPL. Residual NAPL is also assumed to be present in all areas containing free phase NAPL. In the absence of measurable NAPL thickness in a well, low oxygen concentrations and/or elevated LEL readings are believed to be an indication that residual NAPL is present in subsurface soil adjacent to these wells.

Review of Tables 1, 2 and 3 indicate that sufficient pneumatic influence and/or oxygen influence is present around wells containing free-phase or residual NAPL to promote NAPL removal through VENR.

Conclusion

The in-field VENR testing results demonstrate that the constructed VENR extraction well spacing for NAPL Areas L2 and L4 is adequate and that no changes to the number or spacing of vacuum extraction or air inlet wells are needed. As a result, neither additional wells nor changes to well locations are needed.

In addition to evaluating the well spacing, the air flow rates observed during the pilot study were also reviewed to confirm the blower sizing (see Table 1). Air flow rates observed during the recent in-field testing were, in general, higher than those observed in the NAPL Area L4 pilot test well. Consequently, the design has been modified to increase the size of the blower and associated equipment and piping. These changes are summarized in Attachment A.

Table 1
Vacuum Test Log Sheets
Metro-North OU-II, Croton-on-Hudson, New York

EXTRACTION WELL	VE2-1				VE4-1					VE4-2				VE4-3			
OBSERVATION POINT/ DISTANCE/ CONDITION #	O.P.	DIST.	#1	#2	O.P.	DIST.	#1	#2	#3	O.P.	DIST.	#1	#2	O.P.	DIST.	#1	#2
Applied vacuum at wellhead (inches w.c.) ⇒			20	11			3	20	33			8	26			20	2.3
Applied vacuum at blower (inches w.c.) ⇒			23	21			25	26	43			9	21			27	9
Velocity (ft/min) ⇒			475	225			600	2500	3600			450	850			2900	470
Flow (cfm) ⇒			10.4	4.9			13.1	54.5	78.5			9.8	18.5			63.2	10.2
PID at carbon inlet (ppmv) ⇒			20.7	11.4			0.0	0.0	0.0			0.0	0.0			0.0	0.0
PID at carbon outlet (ppmv) ⇒			0.0	0.0			0.0	0.0	0.0			0.0	0.0			0.0	0.0
Observation Point/ Distance&Direction/ Observed Vaccuum	AI2-1	27' NW	3.70	2.50	FA4-1	27' NW	0.0	0.00	0.02	FA4-2	31' SW	0.00	0.02	FA4-4	43' NW	0.00	0.00
Observation Point/ Distance&Direction/ Observed Vaccuum	AI2-2	27' NE	1.00	0.68	FA4-2	17' SW	0.0	0.00	0.00	FA4-3	21' W	0.00	0.02	FA4-5	20' W	0.00	0.00
Observation Point/ Distance&Direction/ Observed Vaccuum	AI2-3	30' SE	0.36	0.28	FA4-3	15' E	0.0	0.06	0.09	FA4-4	19' N	0.02	0.02	FA4-6	20' N	0.12	0.02
Observation Point/ Distance&Direction/ Observed Vaccuum					FA4-4	40' NE	0.0	0.08	0.12	FA4-5	20' E	0.00	0.00	FA4-7	22' E	0.00	0.00
Observation Point/ Distance&Direction/ Observed Vaccuum										FA4-6	44' NE	0.00	0.00	FA4-8	45' NE	0.00	0.00
Observation Point/ Distance&Direction/ Observed Vaccuum										FA4-6	44' NE	0.00	0.00	FA4-8	45' NE	0.00	0.00

*The vaccum gauge on the blower was not working properly. The screw was removed and ERM's vacuum gauge was later used to obtain reading

NR-no reading was taken

(1) Not tested. Wasps present.

O.P.: Observation Point

DIST.: distance from extraction well as measured in the field. May not correlate exactly to the design spacing presented in Figure 1.

Table 1
Vacuum Test Log Sheets
Metro-North OU-II, Croton-on-Hudson, New York

EXTRACTION WELL	VE4-4				VE4-5				VE4-6				VE4-7			
OBSERVATION POINT/ DISTANCE/ CONDITION #	O.P.	DIST.	#1	#2	O.P.	DIST.	#1	#2	O.P.	DIST.	#1	#2	O.P.	DIST.	#1	#2
Applied vacuum at wellhead (inches w.c.) ⇒			8	21			10	20			2.9	28			21	1.8
Applied vacuum at blower (inches w.c.) ⇒			11.5	20			11	20			10	21			33	10
Velocity (ft/min) ⇒			400	600			400	750			600	3050			3000	500
Flow (cfm) ⇒			8.7	13.1			8.7	16.4			13.1	66.5			65.4	10.9
PID at carbon inlet (ppmv) ⇒			0.0	0.0			0.0	0.0			0.9	8.8			4.9	0.0
PID at carbon outlet (ppmv) ⇒			0.0	0.0			0.0	0.0			0.0	0.0			0.0	0.0
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-6	41' NW	0.10	0.02	FA4-7	46' W	0.00	0.00	FA4-10	34' W	0.05	0.21	FA4-12	45' W	0.00	0.00
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-7	19' W	0.00	0.00	FA4-8	32' NW	0.18	0.25	FA4-12	22' NW	0.05	0.22	FA4-14	21' NW	0.06	0.00
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-8	23' N	0.02	0.02	FA4-10	22' N	0.20	0.26	FA4-13	13' NE	0.42	2.50	FA4-15	23' NE	0.02	0.00
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-10	42' N	0.00	0.00	OW-2	23' W	0.00	0.00	FA4-9	Note (1)			FA4-17	57' NE	0.00	0.00
Observation Point/ Distance&Direction/ Observed Vaccuum	OW-2	5 E	0.00	0.00	FA4-9	Note (1)			FA4-11	Note (1)						
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-9	Note (1)			FA4-11	Note (1)										

*The vaccum gauge on the blower was not working properly. T

NR-no reading was taken

(1) Not tested. Wasps present.

O.P.: Observation Point

DIST.: distance from extraction well as measured in the field. M

Table 1
Vacuum Test Log Sheets
Metro-North OU-II, Croton-on-Hudson, New York

EXTRACTION WELL	VE4-8				VE4-9					VE4-10				VE4-11			
OBSERVATION POINT/ DISTANCE/ CONDITION #	O.P.	DIST.	#1	#2	O.P.	DIST.	#1	#2	#3	O.P.	DIST.	#1	#2	O.P.	DIST.	#1	#2
Applied vacuum at wellhead (inches w.c.) ⇒			2.8	21			7	20	5			15	4			20	5.5
Applied vacuum at blower (inches w.c.) ⇒			7	27			8.5	26.5	6			32.5	7.5			20	7.5
Velocity (ft/min) ⇒			500	2350			980	2250	890			4800	2100			3800	1600
Flow (cfm) ⇒			10.9	51.2			21.4	49.1	19.8			104.6	45.8			82.8	34.9
PID at carbon inlet (ppmv) ⇒			0.0	0.0			2.4	5.5	NR			0.0	0.0			30.1	13.4
PID at carbon outlet (ppmv) ⇒			0.0	0.0			0.0	0.0	NR			0.0	0.0			0.0	0.0
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-15	18' SW	0.01	0.08	FA4-15	55' SW	0.00	0.04	0.00	FA4-16	52' SW	0.09	0.06	FA4-17	NR	0.00	NR
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-16	35' N	0.00	0.06	FA4-16	45' W	0.00	0.01	0.01	FA4-18	25' N	4.50	1.50	FA4-18	NR	0.22	0.10
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-17	17' NE	0.01	0.10	FA4017	23' SW	0.01	0.04	0.03	FA4-19	22' S	1.50	0.52	FA4-19	49' NW	1.30	0.35
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-18		0.00	0.03	FA4-18	20' N	0.06	0.22	0.11	FA4-20	21' E	2.10	0.62	FA4-20	19' SW	2.20	0.06
Observation Point/ Distance&Direction/ Observed Vaccuum					FA4-20	50' NE	0.01	0.02	0.01	FA4-22	61' E	0.30	0.10	FA4-21	23' NE	1.75	0.46
Observation Point/ Distance&Direction/ Observed Vaccuum														FA4-22	25' SE	1.95	0.57

*The vaccum gauge on the blower was not working properly. T

NR-no reading was taken

(1) Not tested. Wasps present.

O.P.: Observation Point

DIST.: distance from extraction well as measured in the field. M

Table 1
Vacuum Test Log Sheets
Metro-North OU-II, Croton-on-Hudson, New York

EXTRACTION WELL	VE4-12					VE4-13			
OBSERVATION POINT/ DISTANCE/ CONDITION #	O.P.	DIST.	#1	#2	#3	O.P.	DIST.	#1	#2
Applied vacuum at wellhead (inches w.c.) ⇒			20	6.5	21			20	8
Applied vacuum at blower (inches w.c.) ⇒			*	*	*			*	*
Velocity (ft/min) ⇒			3600	1500	3600			1000	580
Flow (cfm) ⇒			78.5	32.7	78.5			21.8	12.6
PID at carbon inlet (ppmv) ⇒			17.5	0.0	30.1			1.6	0.0
PID at carbon outlet (ppmv) ⇒			0.0	0.0	0.0			0.0	0.0
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-21	60' NNE	0.23	0.15	0.23	FA4-21	NR	0.00	NR
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-22	24' NNE	2.40	0.74	2.40	FA4-23	NR	0.22	0.10
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-23	22' NNW	3.30	1.40	3.60	FA4-24	49' NW	1.30	0.35
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-24	25' SSW	1.30	0.42	1.40	FA4-25	19' SW	2.20	0.06
Observation Point/ Distance&Direction/ Observed Vaccuum									
Observation Point/ Distance&Direction/ Observed Vaccuum									

*The vaccum gauge on the blower was not working properly. T

NR-no reading was taken

(1) Not tested. Wasps present.

O.P.: Observation Point

DIST.: distance from extraction well as measured in the field. M

TABLE 2
AIR RADIUS OF INFLUENCE MEASUREMENTS
METRO-NORTH OU-II, HARMON YARD, NEW YORK

EXTRACTION WELL VE4-2											
Extraction Well			Open Observation Well			Closed Observation Well			Open Observation Well		
VE4-2 (Extraction Well)			FA4-3			FA4-4			FA4-5		
TIME	LEL	O_2	TIME	LEL	O_2	TIME	LEL	O_2	TIME	LEL	O_2
11:00	*0.0%*	*19.5%*	*10:42*	*0.0%*	*13.9%*	*10:49*	*0.0%*	*5.9%*	*10:34*	*0.0%*	*15.6%*
11:25	0.0%	20.0%	11:22	0.0%	16.3%	11:40	0.0%	7.0%	11:32	0.0%	18.1%
13:01	0.0%	19.6%	12:45	0.0%	18.9%	12:52	0.0%	12.2%	12:58	0.0%	17.3%
13:37	0.0%	20.2%	13:25	0.0%	18.9%	13:31	0.0%	6.4%	13:35	0.0%	17.0%
14:15	0.0%	20.4%	14:02	0.0%	19.3%	14:08	0.0%	6.2%	14:13	0.0%	17.6%
14:49	0.0%	20.6%	14:35	0.0%	19.8%	14:42	0.0%	6.3%	14:47	0.0%	17.7%

EXTRACTION WELL VE4-4											
Extraction Well			Closed Observation Well			Open Observation Well			Open Observation Well		
VE4-4 (Extraction Well)			FA4-7			FA4-8			FA4-9		
TIME	LEL	O_2	TIME	LEL	O_2	TIME	LEL	O_2	TIME	LEL	O_2
11:59	*0.0%*	*20.3%*	*11:51*	*0.0%*	*18.3%*	*12:03*	*>100%*	*9.8%*	*12:11*	*>100%*	*19.1%*
13:30	0.0%	20.8%	13:27	0.0%	15.1%	13:24	>100%	9.6%	13:05	>100%	16.6%
13:55	0.0%	20.6%	13:59	0.0%	14.4%	13:41	>100%	7.9%	13:40	>100%	18.3%
14:24	0.0%	20.6%	14:29	0.0%	15.2%	14:00	>100%	4.6%	14:04	>100%	18.5%
14:57	0.0%	20.7%	14:53	0.0%	14.2%	14:34	>100%	4.5%	14:26	81.0%	19.0%

EXTRACTION WELL VE4-7											
Extraction Well			Closed Observation Well			Open Observation Well			Open Observation Well		
VE4-7			FA4-13			FA4-14			FA4-15		
TIME	LEL	O_2	TIME	LEL	O_2	TIME	LEL	O_2	TIME	LEL	O_2
9:00	*33*	*18.0%*	*9:01*	*>100%*	*3.9%*	*8:50*	*>100%*	*14.2%*	*8:58*	*20.0%*	*12.2%*
9:41	11.0%	19.1%	9:40	>100%	4.5%	9:37	4.0%	20.5%	9:44	0.0%	17.4%
10:11	9.0%	19.5%	10:18	>100%	3.2%	10:14	0.0%	20.5%	10:21	2.0%	15.6%
10:52	2.0%	20.2%	11:01	>100%	3.2%	10:59	0.0%	20.7%	11:03	4.0%	15.1%
11:22	2.0%	20.4%	11:37	>100%	6.6%	11:26	0.0%	20.7%	11:30	2.0%	16.9%

Table 3
Area 4 Testing - NAPL Thickness, LEL, and Oxygen Content
Metro-North OU-II Harmon Yard, Croton-on-Hudson, New York

Monitoring Point	Depth to Water (ft)	Depth to Product (ft)	Product Thickness (ft)	LEL (%)	O_2 (%)	Free-Phase NAPL (1)	Residual NAPL (2)	Comments
VE4-1	9.21	-	-	1.0	9.2		x	
VE4-2	8.38	-	-	0.0	15.1			
VE4-3	9.32	-	-	0.0	14.8			
VE4-4	8.20	-	-	5.0	16.3			
VE4-5	12.30	8.88	3.42	4.0	19.9	x	x	bad seal on well
VE4-6	10.53	8.05	2.48	99.0	9.6	x	x	
VE4-7	7.61	-	-	30.0	2.0		x	
VE4-8	7.77	-	-	2.0	9.2		x	
VE4-9	8.24	-	-	16.0	17.9		x	
VE4-10	12.26	-	-	17.0	10.4		x	
VE4-11	14.93	-	-	4.0	8.5		x	
VE4-12	13.55	-	-	5.0	8.9		x	some odor detected
VE4-13	11.27	-	-	0.0	18.1			
FA4-1	7.02	-	-	0.0	19.3			
FA4-2	12.85	-	-	2.0	19.5			
FA4-3	9.15	-	-	0.0	16.5			
FA4-4	NA			NA	NA			
FA4-5	8.13	-	-	0.0	16.5			
FA4-6	13.95	-	-	3.0	16.5			
FA4-7	9.11	-	-	40.0	14.2		x	
FA4-8	17.25	14.10	3.15	36.0	2.8	x	x	product to bottom of well
FA4-9	11.70	8.27	3.43	94.0	17.5	x	x	
FA4-10	14.86	12.02	2.84	97.0	8.3	x	x	
FA4-11	12.25	8.95	3.30	56.0	4.8	x	x	
FA4-12	14.88	12.48	2.40	>100	12.6	x	x	
FA4-13	12.30	9.25	3.05	55.0	4.5	x	x	
FA4-14	11.71	10.64	1.07	66.0	5.9	x	x	
FA4-15	7.82	-	-	75.0	6.1		x	
FA4-16	11.89	11.33	0.56	39.0	3.2	x	x	
FA4-17	8.14	-	-	3.0	10.8		x	
FA4-18	11.35	9.86	1.49	50.0	4.0	x	x	strong odor detected
FA4-19	15.90	13.89	2.01	56.0	4.6	x	x	strong odor detected
FA4-20	12.37	-	-	66.0	5.3		x	
FA4-21	13.35	-	-	14.0	11.2		x	
FA4-22	12.93	-	-	3.0	6.6		x	
FA4-23	13.01	-	-	23.0	5.4		x	
FA4-24	11.51	-	-	12.0	6.2		x	
FA4-25	12.02	-	-	0.0	17.5			
OW-2	8.30	-	-	0.0	7.5		x	
OW-4	11.58	8.4	-	50.0	4.0	x	x	

Metro-North Commuter Railroad Company
Harmon Railroad Yard, Operable Unit II
DEC Site # 360010
In-Field Testing for NAPL Areas L2 and L4
18 September 2001

Introduction

Construction of the Metro-North Commuter Railroad Company (Metro-North) Harmon Railroad Yard ("Yard") Operable Unit II (OU-II) remedy is currently underway. This remedy entails removal of non-aqueous phase liquid (NAPL) utilizing a vacuum enhanced NAPL removal (VENR) technology. Prior to design and construction of this remedy, pilot testing was conducted at the Yard to determine spacing for the vacuum extraction and air inlet wells to be installed as part of the remedy.

As indicated in Section 2.1.1 of the NYSDEC-approved *Final, 60% Submittal, Engineer's Report, Operable Unit II Remedial Design, Metro-North Harmon Yard,* dated 12 July 2000 *("60% Submittal"):*

- sufficient pilot testing information was obtained to locate wells in NAPL Areas L1 and L3;
- due to the limited number of observation wells available during pilot testing in NAPL Area L2, additional testing was needed after additional wells were installed to confirm well spacing in this area; and
- due to the heterogeneous subsurface conditions in NAPL Area L4, additional testing was needed after additional wells were installed to confirm well spacing in this area.

To allow the Remedial Design to proceed, conservative spacing was assumed for the wells located in NAPL Area L2 and L4 and additional in-field testing was planned after well installation to confirm that wells spacing was adequate in these NAPL Areas. This document presents the results of this testing, interpretation of the results and recommendations regarding the need for additional wells.

Scope

As discussed in NYSDEC-approved *Operable Unit II Effectiveness Monitoring Plan, Harmon Railroad Yard Operable Unit II,* dated 2 November 2000, OU-II NAPL is distributed between two general locations:

- free-phase NAPL located at or near the current water table surface; and
- residual NAPL within the historical water table fluctuation zone (i.e., the smear zone).

As discussed in that report, the majority of OU-II NAPL is comprised of residual NAPL and limited free-phase NAPL is present.

As discussed in the *60% Submittal and EMP,* air, which is supplied to the formation through air inlet wells, will be drawn through subsurface soil using a series of vacuum wells. This induced air flow will: (1) remove NAPL by promoting biodegradation of residual and free phase NAPL; and (2) transport free-phase NAPL towards the recovery wells by inducing a pressure gradient. Although VENR also promotes volatilization, due to the limited minimal volatile content of the OU-II NAPL, removal through volatilization would be minimal. Vacuum extraction wells and

air inlet wells must be properly spaced to ensure that sufficient air flow is supplied to the subsurface to induce a pressure gradient in areas of free-phase NAPL and provide sufficient oxygen in areas of free phase and residual NAPL.

If the pneumatic response at a well located near an operating extraction well is equal to or greater than 0.1-inch water column (w.c.), a pressure gradient sufficient to enhance NAPL removal is present at that location. The distance at which the pneumatic response is equal to 0.1-inch w.c. is called the pneumatic radius of influence. In contrast, if the observation well exhibits an increasing soil gas oxygen concentration and a soil gas oxygen concentration greater than 5% during VENR operation, the well is within the oxygen radius of influence of the extraction well. As discussed in *Addendum No. 1, Pilot Test Results Report, Metro-North Harmon Yard*, dated 18 October 1999, the oxygen radius of influence in a formation is generally greater than the pneumatic radius of influence.

Since pneumatic response is more conservative and easier to test, the wells located in NAPL Areas L2 and L4 were first evaluated for pneumatic response and then evaluated for oxygen radius of influence, where needed. Provided the extraction well exhibited acceptable pneumatic radius of influence, it would automatically exhibit acceptable oxygen response.

Following is a discussion of the in-field testing results.

Findings

Pneumatic testing of all the extraction wells located in NAPL Areas L2 and L4 was conducted from 17 to 19 July 2001. The results of the pneumatic testing are provided in Table 1. The VENR system was operated at a number of vacuums at each extraction well and the pneumatic response was recorded at the surrounding wells. The VENR system operating conditions and the pneumatic responses are presented in Table 1.

The information provided in this table was then reviewed to determine the pneumatic response at 20 inches w.c. of applied vacuum (the design condition) and the corresponding air flow rate at this pressure. As shown in Table 1, an acceptable pneumatic response was observed under these conditions in the NAPL Area L2 vacuum extraction well, VE2-1, and the eastern and central NAPL Area L4 vacuum extraction wells (i.e., VE4-5, VE4-6, VE4-8 through VE4-13). Acceptable pneumatic responses were also observed at lower vacuums in some of these wells.

As shown in Table 1, an acceptable pneumatic response was not observed in the five (5) western wells and one central well in NAPL Area L4 (i.e., VE4-1 through VE4-4 and VE4-7). Oxygen response testing was therefore performed for a representative number of these wells. Wells VE4-2, VE4-4 and VE4-7 were selected for testing. During the oxygen response testing: (1) one adjacent air inlet well was closed so that representative soil gas conditions could be measured; and (2) three air injection wells remained open to allow air introduction into the subsurface. This in-field testing results are considered to be a conservative estimation of operating conditions since: (1) all air injection wells will be open during full scale operation; and (2) forced air will be supplied into all of the air injection wells during full scale operation. The VENR system was operated for 2.5 to 4 hours. During that time, soil gas samples were periodically collected from the opened and closed air inlet wells and monitored for oxygen concentrations.

The results of this testing are presented in Table 2. As shown in this table, the oxygen concentrations in both the open and closed wells surrounding VE4-7 steadily increased during VENR operation, and the soil gas oxygen concentration was greater than 5% (the lower limit for biodegradation). These factors indicate an acceptable oxygen influence. The results for the other two wells were not as definitive. Soil gas oxygen concentrations in the closed wells surrounding VE4-2 and VE4-4 initially decreased, but then began to increase. The soil gas oxygen concentration in VE4-2 increased above the threshold of 5%. It appears that VE4-4 may have reached the threshold concentration had it been operated longer. Although the results for VE4-2 and VE4-4 were not as definitive as VE4-7, there was an oxygen influence in the closed wells and they reached or likely would have reached the threshold oxygen limit. Thus, the oxygen response is likely adequate for the NAPL L4 western wells.

To confirm that the wells were adequately spaced to address OU-II NAPL in the NAPL Area L4, additional data was collected from all NAPL Area L4 vacuum extraction and air inlet wells. This included: NAPL thickness measurements and soil gas oxygen concentrations and soil gas combustibility (i.e., % of LEL) under non-VENR conditions. This information is provided in Table 3. Measurable NAPL thickness in a well indicates that free phase NAPL is present in the subsurface at some thickness. Due to the consumption of oxygen to biodegrade NAPL, low soil gas oxygen concentrations and elevated LEL readings were observed in most of the wells containing free phase NAPL. Residual NAPL is also assumed to be present in all areas containing free phase NAPL. In the absence of measurable NAPL thickness in a well, low oxygen concentrations and/or elevated LEL readings are believed to be an indication that residual NAPL is present in subsurface soil adjacent to these wells.

Review of Tables 1, 2 and 3 indicate that sufficient pneumatic influence and/or oxygen influence is present around wells containing free-phase or residual NAPL to promote NAPL removal through VENR.

Conclusion

The in-field VENR testing results demonstrate that the constructed VENR extraction well spacing for NAPL Areas L2 and L4 is adequate and that no changes to the number or spacing of vacuum extraction or air inlet wells are needed. As a result, neither additional wells nor changes to well locations are needed.

In addition to evaluating the well spacing, the air flow rates observed during the pilot study were also reviewed to confirm the blower sizing (see Table 1). Air flow rates observed during the recent in-field testing were, in general, higher than those observed in the NAPL Area L4 pilot test well. Consequently, the design has been modified to increase the size of the blower and associated equipment and piping. These changes are summarized in Attachment A.

Table 1
Vacuum Test Log Sheets
Metro-North OU-II, Croton-on-Hudson, New York

EXTRACTION WELL	VE2-1				VE4-1					VE4-2				VE4-3			
OBSERVATION POINT/ DISTANCE/ CONDITION #	O.P.	DIST.	#1	#2	O.P.	DIST.	#1	#2	#3	O.P.	DIST.	#1	#2	O.P.	DIST.	#1	#2
Applied vacuum at wellhead (inches w.c.) ⇒			20	11			3	20	33			8	26			20	2.3
Applied vacuum at blower (inches w.c.) ⇒			23	21			25	26	43			9	21			27	9
Velocity (ft/min) ⇒			475	225			600	2500	3600			450	850			2900	470
Flow (cfm) ⇒			10.4	4.9			13.1	54.5	78.5			9.8	18.5			63.2	10.2
PID at carbon inlet (ppmv) ⇒			20.7	11.4			0.0	0.0	0.0			0.0	0.0			0.0	0.0
PID at carbon outlet (ppmv) ⇒			0.0	0.0			0.0	0.0	0.0			0.0	0.0			0.0	0.0
Observation Point/ Distance&Direction/ Observed Vaccuum	AI2-1	27' NW	3.70	2.50	FA4-1	27' NW	0.0	0.00	0.02	FA4-2	31' SW	0.00	0.02	FA4-4	43' NW	0.00	0.00
Observation Point/ Distance&Direction/ Observed Vaccuum	AI2-2	27' NE	1.00	0.68	FA4-2	17' SW	0.0	0.00	0.00	FA4-3	21' W	0.00	0.02	FA4-5	20' W	0.00	0.00
Observation Point/ Distance&Direction/ Observed Vaccuum	AI2-3	30' SE	0.36	0.28	FA4-3	15' E	0.0	0.06	0.09	FA4-4	19' N	0.02	0.02	FA4-6	20' N	0.12	0.02
Observation Point/ Distance&Direction/ Observed Vaccuum					FA4-4	40' NE	0.0	0.08	0.12	FA4-5	20' E	0.00	0.00	FA4-7	22' E	0.00	0.00
Observation Point/ Distance&Direction/ Observed Vaccuum										FA4-6	44' NE	0.00	0.00	FA4-8	45' NE	0.00	0.00
Observation Point/ Distance&Direction/ Observed Vaccuum										FA4-6	44' NE	0.00	0.00	FA4-8	45' NE	0.00	0.00

*The vaccum gauge on the blower was not working properly. The screw was removed and ERM's vacuum gauge was later used to obtain reading

NR-no reading was taken

(1) Not tested. Wasps present.

O.P.: Observation Point

DIST.: distance from extraction well as measured in the field. May not correlate exactly to the design spacing presented in Figure 1.

Table 1
Vacuum Test Log Sheets
Metro-North OU-II, Croton-on-Hudson, New York

EXTRACTION WELL	VE4-4				VE4-5				VE4-6				VE4-7			
OBSERVATION POINT/ DISTANCE/ CONDITION #	O.P.	DIST.	#1	#2	O.P.	DIST.	#1	#2	O.P.	DIST.	#1	#2	O.P.	DIST.	#1	#2
Applied vacuum at wellhead (inches w.c.) ⇒			8	21			10	20			2.9	28			21	1.8
Applied vacuum at blower (inches w.c.) ⇒			11.5	20			11	20			10	21			33	10
Velocity (ft/min) ⇒			400	600			400	750			600	3050			3000	500
Flow (cfm) ⇒			8.7	13.1			8.7	16.4			13.1	66.5			65.4	10.9
PID at carbon inlet (ppmv) ⇒			0.0	0.0			0.0	0.0			0.9	8.8			4.9	0.0
PID at carbon outlet (ppmv) ⇒			0.0	0.0			0.0	0.0			0.0	0.0			0.0	0.0
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-6	41' NW	0.10	0.02	FA4-7	46' W	0.00	0.00	FA4-10	34' W	0.05	0.21	FA4-12	45' W	0.00	0.00
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-7	19' W	0.00	0.00	FA4-8	32' NW	0.18	0.25	FA4-12	22' NW	0.05	0.22	FA4-14	21' NW	0.06	0.00
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-8	23' N	0.02	0.02	FA4-10	22' N	0.20	0.26	FA4-13	13' NE	0.42	2.50	FA4-15	23' NE	0.02	0.00
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-10	42' N	0.00	0.00	OW-2	23' W	0.00	0.00	FA4-9	Note (1)			FA4-17	57' NE	0.00	0.00
Observation Point/ Distance&Direction/ Observed Vaccuum	OW-2	5 E	0.00	0.00	FA4-9	Note (1)			FA4-11	Note (1)						
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-9	Note (1)			FA4-11	Note (1)										

*The vaccum gauge on the blower was not working properly. T

NR-no reading was taken

(1) Not tested. Wasps present.

O.P.: Observation Point

DIST.: distance from extraction well as measured in the field. M

Table 1
Vacuum Test Log Sheets
Metro-North OU-II, Croton-on-Hudson, New York

EXTRACTION WELL	VE4-8				VE4-9					VE4-10				VE4-11			
OBSERVATION POINT/ DISTANCE/ CONDITION #	O.P.	DIST.	#1	#2	O.P.	DIST.	#1	#2	#3	O.P.	DIST.	#1	#2	O.P.	DIST.	#1	#2
Applied vacuum at wellhead (inches w.c.) ⇒			2.8	21			7	20	5			15	4			20	5.5
Applied vacuum at blower (inches w.c.) ⇒			7	27			8.5	26.5	6			32.5	7.5			20	7.5
Velocity (ft/min) ⇒			500	2350			980	2250	890			4800	2100			3800	1600
Flow (cfm) ⇒			10.9	51.2			21.4	49.1	19.8			104.6	45.8			82.8	34.9
PID at carbon inlet (ppmv) ⇒			0.0	0.0			2.4	5.5	NR			0.0	0.0			30.1	13.4
PID at carbon outlet (ppmv) ⇒			0.0	0.0			0.0	0.0	NR			0.0	0.0			0.0	0.0
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-15	18' SW	0.01	0.08	FA4-15	55' SW	0.00	0.04	0.00	FA4-16	52' SW	0.09	0.06	FA4-17	NR	0.00	NR
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-16	35' N	0.00	0.06	FA4-16	45' W	0.00	0.01	0.01	FA4-18	25' N	4.50	1.50	FA4-18	NR	0.22	0.10
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-17	17' NE	0.01	0.10	FA4017	23' SW	0.01	0.04	0.03	FA4-19	22' S	1.50	0.52	FA4-19	49' NW	1.30	0.35
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-18		0.00	0.03	FA4-18	20' N	0.06	0.22	0.11	FA4-20	21' E	2.10	0.62	FA4-20	19' SW	2.20	0.06
Observation Point/ Distance&Direction/ Observed Vaccuum					FA4-20	50' NE	0.01	0.02	0.01	FA4-22	61' E	0.30	0.10	FA4-21	23' NE	1.75	0.46
Observation Point/ Distance&Direction/ Observed Vaccuum														FA4-22	25' SE	1.95	0.57

*The vaccum gauge on the blower was not working properly. T

NR-no reading was taken

(1) Not tested. Wasps present.

O.P.: Observation Point

DIST.: distance from extraction well as measured in the field. M

Table 1
Vacuum Test Log Sheets
Metro-North OU-II, Croton-on-Hudson, New York

EXTRACTION WELL	VE4-12					VE4-13			
OBSERVATION POINT/ DISTANCE/ CONDITION #	O.P.	DIST.	#1	#2	#3	O.P.	DIST.	#1	#2
Applied vacuum at wellhead (inches w.c.) ⇒			20	6.5	21			20	8
Applied vacuum at blower (inches w.c.) ⇒			*	*	*			*	*
Velocity (ft/min) ⇒			3600	1500	3600			1000	580
Flow (cfm) ⇒			78.5	32.7	78.5			21.8	12.6
PID at carbon inlet (ppmv) ⇒			17.5	0.0	30.1			1.6	0.0
PID at carbon outlet (ppmv) ⇒			0.0	0.0	0.0			0.0	0.0
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-21	60' NNE	0.23	0.15	0.23	FA4-21	NR	0.00	NR
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-22	24' NNE	2.40	0.74	2.40	FA4-23	NR	0.22	0.10
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-23	22' NNW	3.30	1.40	3.60	FA4-24	49' NW	1.30	0.35
Observation Point/ Distance&Direction/ Observed Vaccuum	FA4-24	25' SSW	1.30	0.42	1.40	FA4-25	19' SW	2.20	0.06
Observation Point/ Distance&Direction/ Observed Vaccuum									
Observation Point/ Distance&Direction/ Observed Vaccuum									

*The vaccum gauge on the blower was not working properly. T

NR-no reading was taken

(1) Not tested. Wasps present.

O.P.: Observation Point

DIST.: distance from extraction well as measured in the field. M

TABLE 2
AIR RADIUS OF INFLUENCE MEASUREMENTS
METRO-NORTH OU-II, HARMON YARD, NEW YORK

EXTRACTION WELL VE4-2											
Extraction Well			Open Observation Well			Closed Observation Well			Open Observation Well		
VE4-2 (Extraction Well)			FA4-3			FA4-4			FA4-5		
TIME	LEL	O_2	TIME	LEL	O_2	TIME	LEL	O_2	TIME	LEL	O_2
11:00	*0.0%*	*19.5%*	*10:42*	*0.0%*	*13.9%*	*10:49*	*0.0%*	*5.9%*	*10:34*	*0.0%*	*15.6%*
11:25	0.0%	20.0%	11:22	0.0%	16.3%	11:40	0.0%	7.0%	11:32	0.0%	18.1%
13:01	0.0%	19.6%	12:45	0.0%	18.9%	12:52	0.0%	12.2%	12:58	0.0%	17.3%
13:37	0.0%	20.2%	13:25	0.0%	18.9%	13:31	0.0%	6.4%	13:35	0.0%	17.0%
14:15	0.0%	20.4%	14:02	0.0%	19.3%	14:08	0.0%	6.2%	14:13	0.0%	17.6%
14:49	0.0%	20.6%	14:35	0.0%	19.8%	14:42	0.0%	6.3%	14:47	0.0%	17.7%

EXTRACTION WELL VE4-4											
Extraction Well			Closed Observation Well			Open Observation Well			Open Observation Well		
VE4-4 (Extraction Well)			FA4-7			FA4-8			FA4-9		
TIME	LEL	O_2	TIME	LEL	O_2	TIME	LEL	O_2	TIME	LEL	O_2
11:59	*0.0%*	*20.3%*	*11:51*	*0.0%*	*18.3%*	*12:03*	*>100%*	*9.8%*	*12:11*	*>100%*	*19.1%*
13:30	0.0%	20.8%	13:27	0.0%	15.1%	13:24	>100%	9.6%	13:05	>100%	16.6%
13:55	0.0%	20.6%	13:59	0.0%	14.4%	13:41	>100%	7.9%	13:40	>100%	18.3%
14:24	0.0%	20.6%	14:29	0.0%	15.2%	14:00	>100%	4.6%	14:04	>100%	18.5%
14:57	0.0%	20.7%	14:53	0.0%	14.2%	14:34	>100%	4.5%	14:26	81.0%	19.0%

EXTRACTION WELL VE4-7											
Extraction Well			Closed Observation Well			Open Observation Well			Open Observation Well		
VE4-7			FA4-13			FA4-14			FA4-15		
TIME	LEL	O_2	TIME	LEL	O_2	TIME	LEL	O_2	TIME	LEL	O_2
9:00	*33*	*18.0%*	*9:01*	*>100%*	*3.9%*	*8:50*	*>100%*	*14.2%*	*8:58*	*20.0%*	*12.2%*
9:41	11.0%	19.1%	9:40	>100%	4.5%	9:37	4.0%	20.5%	9:44	0.0%	17.4%
10:11	9.0%	19.5%	10:18	>100%	3.2%	10:14	0.0%	20.5%	10:21	2.0%	15.6%
10:52	2.0%	20.2%	11:01	>100%	3.2%	10:59	0.0%	20.7%	11:03	4.0%	15.1%
11:22	2.0%	20.4%	11:37	>100%	6.6%	11:26	0.0%	20.7%	11:30	2.0%	16.9%

Table 3
Area 4 Testing - NAPL Thickness, LEL, and Oxygen Content
Metro-North OU-II Harmon Yard, Croton-on-Hudson, New York

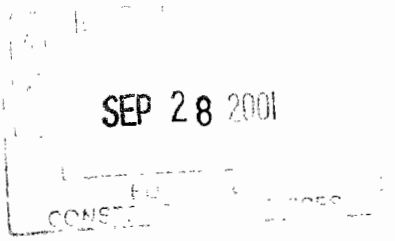
Monitoring Point	Depth to Water (ft)	Depth to Product (ft)	Product Thickness (ft)	LEL (%)	O_2 (%)	Free-Phase NAPL (1)	Residual NAPL (2)	Comments
VE4-1	9.21	-	-	1.0	9.2		x	
VE4-2	8.38	-	-	0.0	15.1			
VE4-3	9.32	-	-	0.0	14.8			
VE4-4	8.20	-	-	5.0	16.3			
VE4-5	12.30	8.88	3.42	4.0	19.9	x	x	bad seal on well
VE4-6	10.53	8.05	2.48	99.0	9.6	x	x	
VE4-7	7.61	-	-	30.0	2.0		x	
VE4-8	7.77	-	-	2.0	9.2		x	
VE4-9	8.24	-	-	16.0	17.9		x	
VE4-10	12.26	-	-	17.0	10.4		x	
VE4-11	14.93	-	-	4.0	8.5		x	
VE4-12	13.55	-	-	5.0	8.9		x	some odor detected
VE4-13	11.27	-	-	0.0	18.1			
FA4-1	7.02	-	-	0.0	19.3			
FA4-2	12.85	-	-	2.0	19.5			
FA4-3	9.15	-	-	0.0	16.5			
FA4-4	NA			NA	NA			
FA4-5	8.13	-	-	0.0	16.5			
FA4-6	13.95	-	-	3.0	16.5			
FA4-7	9.11	-	-	40.0	14.2		x	
FA4-8	17.25	14.10	3.15	36.0	2.8	x	x	product to bottom of well
FA4-9	11.70	8.27	3.43	94.0	17.5	x	x	
FA4-10	14.86	12.02	2.84	97.0	8.3	x	x	
FA4-11	12.25	8.95	3.30	56.0	4.8	x	x	
FA4-12	14.88	12.48	2.40	>100	12.6	x	x	
FA4-13	12.30	9.25	3.05	55.0	4.5	x	x	
FA4-14	11.71	10.64	1.07	66.0	5.9	x	x	
FA4-15	7.82	-	-	75.0	6.1		x	
FA4-16	11.89	11.33	0.56	39.0	3.2	x	x	
FA4-17	8.14	-	-	3.0	10.8		x	
FA4-18	11.35	9.86	1.49	50.0	4.0	x	x	strong odor detected
FA4-19	15.90	13.89	2.01	56.0	4.6	x	x	strong odor detected
FA4-20	12.37	-	-	66.0	5.3		x	
FA4-21	13.35	-	-	14.0	11.2		x	
FA4-22	12.93	-	-	3.0	6.6		x	
FA4-23	13.01	-	-	23.0	5.4		x	
FA4-24	11.51	-	-	12.0	6.2		x	
FA4-25	12.02	-	-	0.0	17.5			
OW-2	8.30	-	-	0.0	7.5		x	
OW-4	11.58	8.4	-	50.0	4.0	x	x	

LETTER OF TRANSMITTAL
ENVIRONMENTAL RESOURCES MANAGEMENT, INC.

475 Park Avenue South 29th Floor New York, New York 10016 phone (212) 447-1900
fax: (212) 447-1904

TO:	Robert C. Knizek, P.E. (NYSDEC)	**DATE:**	25 September, 2001
CC:	See Copy List	**PROJECT NO:**	X7602.06.01
FROM:	Carla Weinpahl (ERM)	**RE:**	Metro-North Commuter Railroad Harmon Yard Operable Unit II

Copy List:
Robert Cozzi (NYSDEC)
Gerard Burke (NYSDEC)
Tom Gibbons (NYSDEC)
Karen Timko (Metro-North)
John Seaboldt (Metro-North)
Mukesh Mehta (Metro-North)
Brian Morrissey (ERM)
John Iannone (Cody Ehlers Group)



Enclosed please find the following items:

☐	Shop Drawings	☐	Prints	☐	Plans	☐	Samples	☐	Other
☐	Copy of Letter	☐	Change Order	☒	Reports	☐	Specifications	☐	

Copies	Date	Description
1	17 August 2001	Attachment A to In-Field Testing for NAPL Areas L2 and L4, Metro-North Commuter Railroad Company, Harmon Railroad Yard, Operable Unit II, DEC Site # 360010, submitted to NYSDEC on 18 September 2001

These are transmitted as checked below:

☐	For approval	☐	Approved as submitted	☐	Resubmit ___ copies for approval
☐	For payment	☐	Approved as noted	☐	Submit ___ copies for distribution
☐	As requested	☐	Returned for corrections	☐	Returned ___ corrected prints
☐	For review	☒	For your records	☐	

COMMENTS:

On 18 September 2001, I transmitted the final version of report documenting "In-Field Testing for NAPL Areas L2 and L4, Metro-North Commuter Railroad Company, Harmon Railroad Yard, Operable Unit II, DEC Site # 360010" to your office. In that transmittal, I inadvertently omitted Attachment A to the report. Enclosed please find Attachment A. Please attach this to the 18 September 2001 transmittal.

SIGNED: _____

F:\MNOUII\CONSTRUCTION\transmittal of attachment A to well testing results.doc

ATTACHMENT A

REQUIRED CHANGES FOR CONSTRUCTION OF VACUUM ENHANCED NAPL RECOVERY SYSTEM AT OU-II

METRO-NORTH COMMUTER RAILROAD
CONTRACT NO. 9464
HARMON LAGOON REMEDIATION
CROTON, NEW YORK

Contractor:	Envirotrac Environmental Services, Inc.
Site:	Harmon Yard
Date:	August 17, 2001

SUMMARY

Certain changes to the design are required based upon recent pneumatic and oxygen testing conducted by ERM in NAPL Area L4 of OU-II in Harmon Yard. The changes for NAPL Area L4 will include furnishing and installing a larger vacuum blower, moisture separator, carbon vessels, increasing the size of selected yard piping, and changing associated instrumentation. No additional extraction wells will be required. Specification Section 11374, "Soil Gas Extraction Equipment" has been revised. All changes have been "tracked" and red-lined (see attached document).

REQUIRED CHANGES (subject to DEC and MN approval)

- Vacuum Blower Assembly: Replace AMETEK Rotron Blower Model EN707 (EN707F72MXL) X.P., 5HP, 3ph, 460V for Area L4, with AMETEK Rotron Model **EN858BA72WL, X.P., 7.5 HP**, 3ph, 460V, (design flow: 220 cfm @ 70 inches w.c. maximum flow 400 cfm @ 0 inches of w.c.) or approved equal. See Paragraph 2.01A and 2.02C of the revised Specification Section 11374.

- Vapor/Liquid Separator: Assembly for Area L4 shall be equipped with separator Model **GX-60** rated for 500 cfm, 4-inch diameter inlet and outlet. Separator unit has diameter of 20 inches and height of 57 inches. *{NOTE: Paragraph 2.01 of Contract Specification Section 11374 states that GX-60 unit is to be provided. However, the Equipment List included at the end of Specification*

Section 01010 indicates the GX-30 unit}. The separator unit shall be skid-mounted, equipped with level control for the auto drain, with access port, sight gauge and in-line filter. The separator shall be manufactured by J.E. Gasho & Associates or approved equal. See Paragraph 2.01 and 2.04 of the revised Specification Section 11374.

- Carbon Vessels: Replace the two (2) Carbtrol model G-2S units (rated up to 300 cfm) for Area L4 with the Carbtrol model **G-3S**, (rated up to 500 cfm) or approved equal. The G-3S shall be furnished with 140 pounds of carbon. See Paragraph 2.05 of the revised Specification Section 11374.

- Process Piping: Increase the diameter of the underground portion of the PVC piping from 2" to 3" only for wells VE4-10, VE4-11 and VE4-12. The soil gas extraction (SGE) inlet piping inside the building will remain 2" diameter. The 2"X3" pipe reducers should be installed just outside the building foundation. The piping for the three designated wells shall be 3" diameter for the section from the reducer to the wellhead. Section A-A on Contract Drawing C-5 calls for 3" piping inside the vaults in Area L4. Piping for the remaining wells shall be 2" diameter.

- Instrumentation: For Area L4, replace the thirteen (13) Magnehelic Differential Pressure Gauges (range 0-0.25 inches of water column) Model 2000-00AV, manufactured by Dwyer Instruments Inc. (used as Flow Indicator for DS300 Flow Sensor) with thirteen (13) Magnehelic Gauges (range 0–2 inches of water column) Model 2002AV or approved equal. See Instrument List in Specification Section 13420. The Flow Indicators shall be mounted on SGE piping manifold inside building. In addition, supply the following as spare units: two (2) (range 0-5 inches of water column) Model 2005 gauges and two (2) (range 0-0.25 inches of water column) Model 2000-00AV gauges or approved equal. These additional four (4) Magnehelic Gauges need to be supplied for flow measurement under varying operating conditions.

- Instrumentation: For Area L4, replace the sixteen (16) vacuum gauges (range 0-40 inches water column) by Dwyer Instruments, Inc. with thirteen (13) vacuum gauges (range 0-60 inches water column) and two (2) vacuum gauges (range 0-100 inches water column). The two (2) gauges with the 0-100 inch range shall be installed on the suction side of the blower assembly as shown on Drawing PID-4. In addition, supply the following as spare units: four (4) vacuum gauges (range 0-100 inches water column).

- Instrumentation: For Area L1/L2, replace the fifteen (15) vacuum gauges (range 0-40 inches water column) by Dwyer Instruments, Inc. with twelve (12) vacuum gauges (range 0-60 inches water column) and four (4)

vacuum gauges (range 0-100 inches water column). The four (4) gauges with the 0-100 inch range shall be installed on the suction side of the blower assembly as shown on Drawing PID-2.

JUSTIFICATION:

The changes described above are required to optimize the remediation of NAPL Area L4. Results of recent pneumatic and oxygen testing demonstrate that higher airflow rates and vacuums are needed at selected L4 wells. These changes are expected to enhance the biodegradation of the petroleum compounds that are present in the subsurface soils of OU-II. The associated instrumentation is needed for the larger blower and to measure operating parameters under varying flow conditions.

*****

FAX TRANSMISSION

NYSDEC
625 Broadway, 12th Floor
Albany, NY 12233-7013
518-402-9814
Fax: 518-402-9819

Erin M. Crotty
Commissioner

To:	Makesh Mehta	**Date:**	November 9, 2001
Fax #:	212-499-4420	**Pages:**	5, including cover
From:	Gerard Burke		
Subject:	MBE/WBE form		

COMMENTS:

Makesh,

Attached is the MBE/WBE forms for the EQBA program. Call me if you have any questions.

Gerard

ARTICLE 2(d)

M/WBE-EEO Utilization Plan

New York State Department of Environmental Conservation

(To be completed by each contractor/consultant and submitted to DEC for review)

Consultant/Contractor Name:		**Date:**
Address:	**City:**	**State:** **Zip:**
Name and Title of Authorized Representative:	**Signature of Authorized Representative:**	
Name and Title of M/WBE Representative:	**Signature of M/WBE Representative:**	
Contract Description:		**Contract Number:**

Projected M/WBE and EEO Summary

	Percent	*$ Amount*		*Percent*	*Number of Employees*	*Work Hours*
1. **Total Dollar value of the Prime Contract/product provided**	%		5. **Total No. Employees and work hours**	100%		
2. **MBE goal applied to the contract**	%		6. **Total goal for minority employees**	%		
3. **WBE goal applied to the contract**	%		7. **Total goal for female employees**	%		
4. **M/WBE combined totals**	%		8. **EEO combined totals**	%		

SECTION I - MBE INFORMATION **In order to achieve MBE goals, minority firms are expected to participate in the following manner:**

MBE Firm	*Description of Work to be Done by MBE*	*Projected Contact Amount & Award Date*	*Scheduled Contract Start Date*	*Contract Payment Schedule*	*Contract Completion Date*
Name *Address* *City* *ST/Zip* *Phone*		$ **Date:**			
Name *Address* *City* *ST/Zip* *Phone*					
Name *Address* *City* *ST/Zip* *Phone*					
Name *Address* *City* *ST/Zip* *Phone*		$ **Date:**			
Name *Address* *City* *ST/Zip* *Phone*		$ **Date:**			

SECTION II - WBE INFORMATION **In order to achieve WBE goals, minority firms are expected to participate in the following manner:**

WBE Firm	*Description of Work to be Done by MBE*	*Projected Contact Amount & Award Date*	*Scheduled Contract Start Date*	*Contract Payment Schedule*	*Contract Completion Date*
Name *Address* *City* *ST/Zip* *Phone*		**$** **Date:**			
Name *Address* *City* *ST/Zip* *Phone*		**$** **Date:**			
Name *Address* *City* *ST/Zip* *Phone*		**$** **Date:**			

SECTION III - EEO INFORMATION **In order to achieve the EEO goals minorities and females are expected to be employed in the following job categories for the specified amount of work hours:**

		All Employees		*Minority Employees*			
Job Categories	***Total Work Hours of Contract***	***Males***	***Females***	***Black***	***Asian***	***Native American***	***Hispanic***
Officials/Managers							
Professional							
Technicians							
Sales Workers							
Office/Clerical							
Craftsmen							
Laborers							
Service/Workers							
TOTALS							

Memorandum

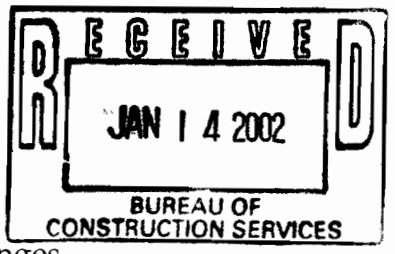
Environmental
Resources
Management

520 Broad Hollow Road
Suite 210
Melville, NY 11747
(631) 756-8900
(631) 756-8901 (fax)

To: Gerard Burke (NYSDEC)

CC: Mukesh L. Mehta, P.E. (Metro-North Commuter Railroad)
Karen L. Timko, Esq. (Metro-North Commuter Railroad)
Carla Weinpahl (ERM)
John Iannone (Cody Ehlers Group)

From: Brian P. Morrissey (ERM)



File number: X7602.06

Date: 9 January, 2002

Subject: Documentation of Minor Changes
NAPL Area L1 Sheeting Wall Location and Depth
Metro-North Harmon Yard Operable Unit II Site,
Croton, NY (#3-60-010)

INTRODUCTION

The information presented in this memorandum documents the minor changes to be made to the sheeting wall component of the remedy selected for the Metro-North Commuter Railroad ("Metro-North") Harmon Railroad Yard ("Harmon Yard") Operable Unit II Site (i.e., the "OU-II Site" or the "Site") in Croton, New York. The Site is listed on the New York State Department of Environmental Conservation ("NYSDEC") Registry of Inactive Hazardous Waste Disposal Sites (Site No. 3-60-010). The key environmental condition to be addressed by the remedy is the petroleum product present as non-aqueous phase liquid ("NAPL"). The NAPL is primarily comprised of petroleum product (i.e., diesel fuel) and is located in four areas around the former wastewater equalization lagoon in the wastewater treatment area of Harmon Yard. Polychlorinated biphenyls ("PCBs") have been detected in some of the NAPL found at the Site. The former wastewater equalization lagoon was remediated in 1996 as part of the phase of this remedial project referred to as Operable Unit I.

The remedy selected by the NYSDEC for the Operable Unit II phase of this remedial project is defined in the Record of Decision ("ROD") issued by the agency on March 27, 1998. The remedy for the OU-II Site primarily consists of the use of a technology referred to as vacuum enhanced NAPL removal to biodegrade, pump and otherwise remove NAPL from subsurface soil at the Site.

As part of the OU-II remedy, a sheeting wall is to be installed on the downgradient side of an area of NAPL located within several hundred feet of the Hudson River. This area is referred to as NAPL Area L1 and abuts the Harmon Yard property line in this area. Refer to Figure A, attached. The purpose of the sheeting wall is to prevent NAPL in Area L1 from migrating to the off-site properties adjacent to Harmon Yard.

This sheeting wall is described in Section 7.6.1.5 and Figure 7-9 of the *Remedial Investigation and Feasibility Study Report* ("RI/FS") for the OU-II Site (ERM; January 14, 1998). The need to install this sheeting wall as part of the remedy for the OU-II site was reiterated most recently in correspondence from Mr. Thomas Gibbons (NYSDEC) to Ms. Carla Weinpahl (ERM) dated November 18, 1999, which stated:

> "Steel sheeting will be installed downgradient of NAPL Area L1 to a depth of about 16 feet, to below the base of the NAPL layer. This sheeting will eliminate the potential for the westward migration of NAPL to the Hudson River."

The installation method, materials and other aspects of the sheeting wall were defined in the following sections of the final design for the OU-II Site, which were reviewed and approved by the NYSDEC:

- Specification Section 02300: Earthwork and Sheeting
- Drawing C-2: Site Plan With Location of Proposed Wells and Sheet Piling
- Drawing C-3: Underground Field Piping Layout, NAPL Areas L1, L2 and L3
- Drawing C-7: Sheet Piling and Miscellaneous Civil Details

The final design was completed in September 1998 and was used with other contract documents to select a remedial contractor (i.e., EnviroTrac Environmental Services, Inc.) to install and begin operation of the remedy for the OU-II Site. Field conditions encountered during the implementation of the remedy indicated that certain minor changes should be made to the design (i.e., the location and depth) of the sheeting wall for Area L1. This memorandum describes the minor changes that have been made to the design of the sheeting wall to address these field conditions.

The manner in which this document complies with NYSDEC requirements for changes to a remedial plan is described in the following section. The changes to be made to the location and depth of the sheeting wall are shown on Figure A and are described in subsequent sections of this document.

REGULATORY REQUIREMENTS

This memorandum has been prepared in accordance with the NYSDEC Technical and Guidance Memorandum ("TAGM") No. 4059 dated March 30, 1998 entitled *Making Changes to Selected Remedies*. As described in this NYSDEC TAGM, the agency's policy on changes to a remedy is consistent with the National Contingency Plan ("NCP") requirements for remedy changes [40 CFR 300.450(c)(2)]. It is also consistent with U.S. Environmental Protection Agency ("USEPA") guidance on this issue, as discussed in Section 8.6 ("Non-Significant Changes") of *Interim Final Guidance on Preparing Superfund Decision Documents* (OSWER Directive 9355.3-02; July 1989).

The NYSDEC classifies changes to a remedy as minor, significant or fundamental. Changes to a remedy are classified based on the following factors:

- The change to the scope of the remedy, such as the area, depth or volume of material.
- The change, if any, to the performance of the remedy, such as the ability to achieve the remedial goals.
- The change to the cost of the remedy.

As described below, the changes to the sheeting wall design are minor changes and will have little to no effect on the scope, performance and cost of the remedy for the OU-II Site. As discussed in TAGM #4059, the basis for a minor change to a remedy is to be documented in the project file. The TAGM also states that this documentation can take the form of a memorandum. This memorandum constitutes the OU-II project file documentation for the minor changes described below that have been made to the design of the OU-II sheeting wall in NAPL Area L1.

SHEETING WALL CONSTRUCTION CHANGES

The following describes the minor changes that will be made to the depth and location of the NAPL Area L1 sheeting wall at the OU-II Site, as shown on Figure A.

SHEETING WALL LOCATION CHANGES – The location of the OU-II sheeting wall identified in the RI/FS and in the final design was a straight-line installation along the northwest boundary of the Harmon Yard property boundary near NAPL Area L1. The sheeting wall was to have been installed between Harmon Yard and the road located near the perimeter of two properties adjacent to Harmon Yard. As shown on Figure A, this road is located next to Harmon Yard and at the edge (perimeter) of these two adjacent properties. Hence, it is referred to in this memorandum as the perimeter road. The sheeting wall, then, was to have been installed adjacent to the perimeter road and on these two adjacent properties.

This straight-line location was a reasonable approach that provided a physical barrier to NAPL migration along the entire extent of NAPL in this area. It also provided a 5-foot minimum distance from the water supply line located beneath the center of the perimeter road and the sheeting wall. This 5-foot minimum distance is needed to protect the water line during installation of the sheeting wall.

As part of its construction support work during this project, ERM verified the specific location of the water supply line in the area where the sheeting wall was to have been installed. In September 2001, ERM determined that the water supply line was installed beneath the center of the perimeter road except in the northern portion of the sheeting wall area. The water line was installed in this northern area across the perimeter road, i.e., from the center of the road to the edge (Harmon Yard or western side) of the perimeter road. This placed the water line in this northern area in the same location that was to be used to install the sheeting wall.

ERM addressed this conflict by altering the configuration of the sheeting wall in this northern area. As shown on Figure A, the northern 80-foot length of the 200-foot sheeting wall will be relocated about 20 feet closer to Harmon Yard. This 80-foot northern section of the sheeting wall will be installed on Harmon Yard property. The location of the southern 120-foot length of the sheeting wall will remain the same, i.e., at the edge of the perimeter road. This 120-foot southern section of the sheeting wall

will be installed on the adjacent off-site property. None of the OU-II sheeting wall will be installed on the adjacent property that is located in the northern section of the sheeting wall, although access to that property will probably be needed during installation. As shown on Figure A, two 60° angles and a 20-foot additional length of sheeting wall have been included in the new sheeting wall configuration to connect the southern and northern portions of the sheeting wall. The reconfigured sheeting wall will provide a continuous physical barrier to NAPL migration from Area L1.

SHEETING WALL DEPTH CHANGES – As discussed above, the configuration (horizontal location) of the OU-II sheeting wall was revised to address the presence of a water supply line in the northern (i.e., Half Moon Bay) area. In addition, there is a slight (i.e., 2-foot to 4-foot) rise in the topography (surface elevation) from Harmon Yard to the surface of the perimeter road. ERM collected information on the depth to groundwater along various sections of the sheeting wall to determine whether the depth of the sheeting wall should be modified to address the revised configuration and the elevation difference between Harmon Yard and the perimeter road. As defined on Drawings C-3 and C-7 of the final design (contract documents), the design called for the sheeting wall to be installed to a depth of 16′ below ground surface throughout its 200-foot length. ERM collected the following depth to groundwater information in September 2001 to determine whether the sheeting wall depth should be modified:

Well	Depth to Groundwater [1]	Discussion
MW-A	14.8′	This monitoring well is located immediately adjacent to the perimeter road on the adjacent property in the northern section of the sheeting wall. As a result, it measures the depth to groundwater at the perimeter road.
OW-11	7.9′	This well was installed within the Harmon Yard OU-II Site and measures the depth to groundwater in this area of Harmon Yard. See also well OW-12.
OW-12	8.0′	This well was installed within the Harmon Yard OU-II Site and measures the depth to groundwater in this area of Harmon Yard. See also well OW-11.
OS-N	10.0′	This well is located on the adjacent property in the southern section of the sheeting wall, several feet from the perimeter road. It measures the depth to groundwater near the perimeter in this southern section but it may not be as representative of groundwater depth conditions at the perimeter road as MW-A, which is located less than 1′ from the perimeter road.

1. Represents feet below ground surface.

Groundwater elevations are typically at their lowest levels in August and September and the amount of precipitation during August and September of 2001 was less than normal. As a result, the use of groundwater elevations from September 2001 was a reasonably conservative approach to this analysis. In addition, studies conducted at the OU-II Site and throughout Harmon Yard have determined that the rise and fall of surface water elevations in the Hudson River due to tidal action have little to no effect on groundwater elevations in these areas. Tidal fluctuations were studied during the OU-I Remedial Investigation in 1989, The Harmon Yard Field Investigation in 1994 and, most recently, during the OU-II Site pilot test conducted in 1999. All of these studies have demonstrated that changes in groundwater elevations due to tidal action ranged from no changes to a change of approximately 2 inches in

groundwater elevations. The most recent 1999 study (Section 2.1, *OU-II Pilot Test Results Report*; ERM; July 1999) reported that groundwater elevations in the OU-II NAPL Area L1 only fluctuated approximately 0.05 feet (0.6 inches) over a 26-hour period.

As a result, the September 2001 water table data collected by ERM and used in this analysis addresses the potential changes in water table elevations that may occur due to seasonal variations and tidal fluctuations.

As discussed above, the OU-II sheeting wall will be installed adjacent to the perimeter road in this southern section and on Harmon Yard property in the northern section. These two sections will be joined to form a continuous barrier. The September 2001 water level data was used to determine whether the 16-foot sheeting wall depth should be revised in the southern, northern or both sections of the sheeting wall. As discussed below, ERM concluded that the sheeting wall depth in the southern section should be increased to 18 feet below ground surface and the sheeting wall depth in the northern section should remain the same at 16 feet below ground surface (i.e., the current design depth). The depths of the southern and northern sections of the sheeting wall are discussed below.

Sheeting Wall Depth in the Southern Section – OU-II Sheeting Wall – The southern section of the sheeting wall is to be installed on the off-site property located immediately adjacent to the perimeter road. Well MW-A is located immediately adjacent to the perimeter road in the northern section. The depth to groundwater in this well was measured to be 14.8 feet below ground surface in September 2001. The elevation of the perimeter road in the southern section is slightly lower than the elevation of the perimeter road in the northern section. Nevertheless, ERM used the approximately 15-foot below ground surface MW-A depth to groundwater information as a worst case assumption for the depth to groundwater near the southern portion of the perimeter road. Depth to groundwater in this area is probably less than 15 feet, as indicated by the 10-foot depth to groundwater in well OS-N. Based on this conservative approach, the depth of the sheeting wall in this southern section adjacent to the perimeter road has been revised from 16 feet to 18 feet below ground surface. This 18-foot sheeting wall depth extends the sheeting wall to at least 3 feet below the water table elevations measured in this area in September 2001, when groundwater elevations are typically at

their lowest level. This sheeting depth, then, is more than adequate to address normal water table fluctuations and prevent the potential migration of NAPL to off-site areas in the future.

Sheeting Wall Depth in the Northern Section - OU-II Sheeting Wall – The northern section of the sheeting wall is to be installed on the NAPL Area L1 section of the Harmon Yard OU-II Site. The surface of NAPL Area L1 is relatively flat and the groundwater depth information collected from the on-site wells OW-11 and OW-12 are indicative of groundwater depth conditions across this area. As shown in the table presented earlier in this memorandum, the depth to groundwater in these two on-site monitoring wells measured in September 2001 was approximately 8.0 feet below ground surface. Based on this information, the depth of the sheeting wall in this northern section of the sheeting wall will remain at 16 feet below ground surface. This will extend the sheeting wall to at least 8 feet below the water table in this area. This sheeting depth is more than adequate to address normal water table fluctuations and prevent the potential migration of NAPL to off-site areas in the future. As stated above, the September 2001 water table data collected by ERM and used in this analysis addresses the potential changes in water table elevations that may occur due to seasonal variations and tidal fluctuations.

CLASSIFICATIONS: SHEETING WALL MODIFICATIONS AND MINOR CHANGES

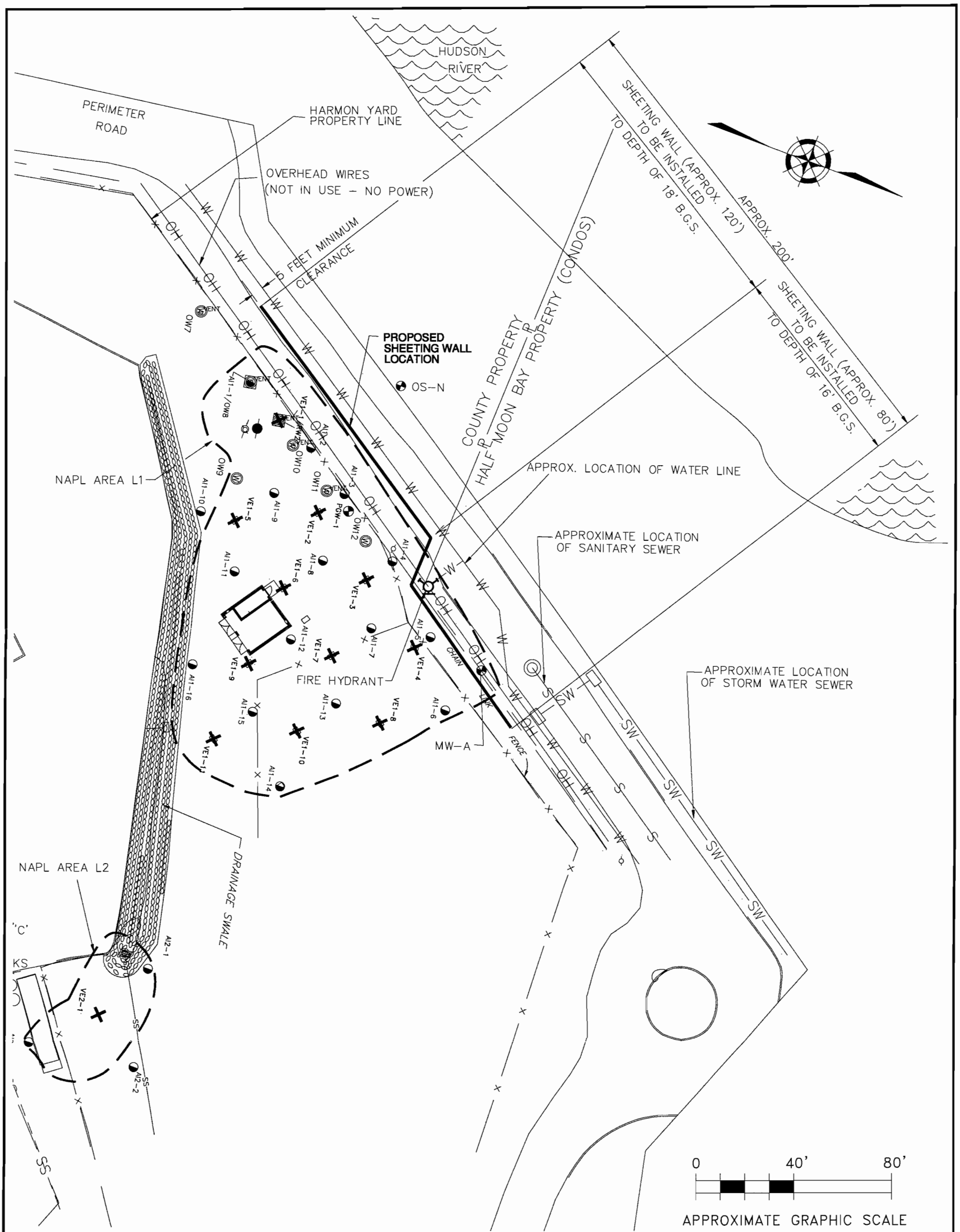
The changes to the depth and location of the OU-II sheeting wall are minor changes to the OU-II remedy. These changes were compared to the three criteria identified in the NYSDEC TAGM #4059 (i.e., scope, performance and cost) to demonstrate that these changes are minor and will have little or no effect on the OU-II remedy.

SCOPE – These changes do not affect the scope of this component of the OU-II remedy. The reconfigured sheeting wall is still a 200-foot long physical barrier installed 3 to 8 feet below the water table that will provide a continuous barrier to NAPL migration from the OU-II Site. There are no changes to the concept or the technology involved in this component of the remedy.

PERFORMANCE – These changes will not affect the performance of the remedy. The NAPL in Area L1 will still encounter a physical barrier and will not be able to migrate to the Hudson River. The reconfigured sheeting wall will not adversely affect the vacuum enhanced NAPL removal system that has been installed to remove OU-II NAPL.

COST – The changes to the depth and location of the sheeting wall are estimated to cost an additional $20,000. This is only 1.5% of the total estimated capital construction cost of $1.4 million for the OU-II remedy presented in Appendix J-5 of the RI/FS.

SUMMARY: SHEETING WALL MODIFICATIONS ARE MINOR CHANGES – As discussed above, the depth and location changes to the OU-II sheeting wall will have little to no effect on the scope, performance and cost of the OU-II remedy. As a result, these sheeting wall modifications are minor changes to the OU-II remedy and need only be documented with a project file memorandum. This memorandum constitutes that documentation.



LEGEND:

——W—— WATER LINE
——OH—— OVERHEAD WIRES (NOT IN USE– NO POWER)
—— S —— SANITARY SEWER
——SW—— STORM WATER SEWER
—— ℄ —— PROPERTY LINE
B.G.S. BELOW GROUND SURFACE

SOURCE: PARTIAL PLAN BY L C ASSOCIATES
FAXED ON MAY 24, 2001
AND SURVEY DRAWINGS
(FILE NAME: X–B–109 AND X–B–110)
SENT BY METRO–NORTH ON JANUARY 31, 2001

TITLE

REVISED SHEETING WALL LOCATION AND DEPTH FOR OPERABLE UNIT II HARMON YARD, CROTON, NY (NYSDEC SITE NO.3–60–010)

PREPARED FOR

METRO–NORTH COMMUTER RAILROAD

Environmental Resources Management

SCALE	FIGURE
GRAPHIC	A

DRAWN:	JOB NO.:	FILE NAME:	DATE
Y.S.	X7602.06	XB108109tem6	12/21/01

LAWLER, MATUSKY & SKELLY ENGINEERS LLP
One Blue Hill Plaza, P.O. Box 1509, Pearl River NY 10965
845-735-8300, FAX:845-735-7466
E-MAIL: WEB: http://www.lmseng.com

FACSIMILE TRANSMISSION COVER PAGE

To: Gerard Burke	From: Edmund Lee
Company: NYSDEC	Date: 2-14-2002
Phone No.: (518) 402-9814	Job No.: 885001
Total Number of Pages including this cover page:	

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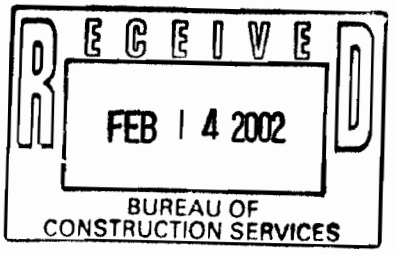

Lawler, Matusky & Skelly Engineers LLP
Environmental Science & Engineering Consultants
1 Blue Hill Plaza
Pearl River, New York 10965
845-735-8300
845-735-7466 fax

Memorandum

DATE: Feb 12, 2002 **FILE NO.** 885-001

TO: Dale Konas, Site Manager

FROM: John Thornburg, Resident

RE: **Deficiency List**

CC: Mukesh Mehta, MNR
Kerry Garo, MNR
Rose-Ellen Cupo, MNR
Brian Morrisey, ERM
Rob DeGiorgio, LMS

Area L1/L2

ANTICIPATED COMPLETION	
2/11/2002	• ~~Install 6" motorized valve (AV202) in the extraction line~~. completed.
2/22/2002	• Complete the electrical conduits
~~3/6/2002~~	• ~~Install the run time recorder (KQIR 201, KQIR 202) for motors~~ ← will be on PLC
3/6/2002	• Install flow, temperature and differential pressure transmitters (FT201, FE201, TT201, TE201, FE201, FT201, DPT 201, DPT 202)
completed	• ~~Finish the condensate drum piping~~
2/19/2002	• Install the manual louver
completed	• ~~Install manual hand pump (P202)~~
2/19/2002	• Seal all wall penetrations
2/20/2002	• Install sight glass in the moisture separator
2/18/2002	• Paint all steel pipings
2/18/02	• Install LEL detector (LEL 201)
2/19/02	• Pressure test interior pipings
3/11/02	• Calibrate instruments
3/11/02	• Certify equipment
2/25/02	• Tag instruments, equipment, valves & pipes as specified in section 01180
?	• Provide erosion control over the final grade ?

	• Finish all electrical wiring in the control room
2/18/02	a. circuit breakers
2/18/02	b. pull wires through conduits
2/27/02	c. terminate all instrument wires
2/19/02	• Seal between the steel door frame and the block.
2/19/02	• Secure and adjust the bottom of the door frame
2/19/02	• Secure the door stops
2/25/02	• Clean-Up
	Area L3
2/20/02	• Install temperature gauge in the suction line
	• ~~Install run time recorder (KQIR-301)~~ ← Will be on PLC
2/18/02	• Install manual hand pump (P302)
2/20/02	• Install sight glass in the moisture separator
2/14/02	• Install all heat tracings as indicated in the PID-3
3/6/02	• Install flow, differential pressure and temperature transmitters (TT301, TE301, FT 301, FE 301, DPT 301)
completed	• ~~Install control, motor starter panels~~
2/21/02	• Install transformer including all required switch gears
completed	• ~~Install all required conduits~~
2/19/02	• Pressure test interior pipings
3/11/02	• Calibrate instruments
3/11/02	• Certify equipment
2/25/02	• Tag instruments, equipment, valves & pipes as specified in section 01180
2/25/02	• Clean-Up
	Area L4
2/18/02	• Install after-cooler and related steel pipings
completed	• ~~Complete carbon canister connections~~
	• ~~Install the run time recorder (KQIR-401, KQIR-402) for motors~~
3/6/02	• Install flow, temperature and differential pressure transmitters ← will be on PLC. (FT401, FE401, FT402, FE402, TT401, TE401, TT402, TE402, DPT 401, DPT 402)
completed.	• ~~Install the condensate drum with containment~~
2/21/02	• Complete the electrical conduits
2/22/02	• Install vacuum relief valve (VRV 401)
2/18/02	• Install manual hand pump (P402)

2/19/02	Seal all wall penetrations
2/20/02	Install sight glass in the moisture separator
	~~Paint all steel pipings~~ No steel pipings
2/22/02	Install LEL detector (LEL 401)
2/20/02	All interior pipings need to be pressure tested
2/11/02	All instruments need to be calibrated
2/11/02	All equipment need factory certificates
2/26/02	Tag instrument, equipment, valves & pipes as specified in section 01180
?	Erosion control over the final grade ?
2/25/02	Verify the capacity of the containment in the product tank (specified as 1000 gal dike, section 13205-2.03-H.1)
	Paint the containment of the product tank with red primer on both the interior and exterior (section 13205-2.03-H.3)
2/22/02	Finish all electrical wiring in the control room
completed.	~~Complete air/product pipings~~
2/19/02	Seal between the steel door frame and the block.
2/19/02	Secure and adjust the bottom of the door frame
2/19/02	Secure the door stops
2/25/02	Clean-Up

This list may not be all inclusive and is subject to revision.

FAX COVER PAGE

LAWLER, MATUSKY & SKELLY ENGINEERS LLP
Metro-North Commuter Rail[illegible]d Station
Eastmon Lagoon Remediation[illegible] Area OU-II
Contract 9464
(914) 271-4875, FAX: 914-271-[illegible]89

To: GERARD BURKE Company: NYSDEC
Fax Phone: (518) 402-7819 Job No: 885-001
Company Phone: (518) 402-9814

From: Michael Sandler
Phone: 914-271-4875
E-Mail: msandler@lmse[illegible].com

Date: FEBRUARY 19 2002
Subject: METRO-NORTH DEFICIENCY LIST
Total Pages: 6 (INCL. COVER)

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Message:

PER YOUR REQUEST.

METRO-NORTH COMMUTER RAILROAD STATION
HARMON LAGOON REMEDIATION AT AREA OU-II
CONTRACT No. 9464

DEFICIENCY LIST

AREA	DESCRIPTION	TARGET COMPLETION DATE	STATUS				COMMENTS
			COMPLETED	IN PROGRESS	INACTIVE -	WAIVED	
L1/L2	Motor Operated Valve (AV202) - Install	02/11/02	X				
L1/L2	Electrical Conduits - Install	02/22/02		X			
L1/L2	Run Time Recorder (KQIRs) - Install	Not Applicable				X	Integrated into PLC
L1/L2	Transmitters (Flow, Temp., Diff.Press..) - Install	03/06/02			X		Ordered - 2-4 Week Delivery
L1/L2	Condensate Drum Piping - Install	02/11/02	X				
L1/L2	Manual Louver - Install	02/19/02			X		
L1/L2	Manual Hand Pump - Install	02/12/02	X				
L1/L2	Wall Penetration - Seal	02/19/02			X		
L1/L2	Separator Sight Glass - Install	02/20/02			X		
L1/L2	Steel Piping - Paint	02/18/02			X		
L1/L2	LEL Detector - Install	02/18/02			X		
L1/L2	Interior Piping - Pressure Test	02/19/02			X		
L1/L2	Instrument - Calibration	03/11/02			X		
L1/L2	Instrument - Identification	02/25/02			X		
L1/L2	Equipment - Certification	03/11/02			X		
L1/L2	Equipment - Identification	02/25/02			X		
L1/L2	Valves & Piping - Identification	02/25/02			X		Submittal Pending
L1/L2	Erosion Control - Site Stabilization	To Be Determined					
L1/L2	Circuit Breakers - Install	02/18/02		X			

METRO-NORTH COMMUTER RAILROAD STATION
HARMON LAGOON REMEDIATION AT AREA OU-II
CONTRACT No. 9464

DEFICIENCY LIST

AREA	DESCRIPTION	TARGET COMPLETION DATE	STATUS				COMMENTS
			COMPLETED	IN PROGRESS	INACTIVE -	WAIVED	
L1/L2	Wiring - Pull	02/18/02		X			
L1/L2	Voltage Dividers - Resolve	02/19/02					
L1/L2	Voltage Dividers - Install	To Be Determined					
L1/L2	Instrument - Terminate Wiring	02/27/02		X			Pending Volt. Divider Resolution
L1/L2	Steel Doors - Seal	02/19/02			X		
L1/L2	Steel Doors - Adjust Stops	02/19/02			X		
L1/L2	Steel Doors - Secure Stops	02/19/02			X		
L1/L2	Clean-Up - General	02/25/02			X		

METRO-NORTH COMMUTER RAILROAD STATION
HARMON LAGOON REMEDIATION AT AREA OU-II
CONTRACT No. 9464

DEFICIENCY LIST

AREA	DESCRIPTION	TARGET COMPLETION DATE	STATUS				COMMENTS
			COMPLETED	IN PROGRESS	INACTIVE -	WAIVED	
L3	Temperature Gauges (Suction Line) - Install	02/20/02			X		
L3	Run Time Recorder (KQIRs) - Install	Not Applicable				X	Integrated into PLC
L3	Transmitters (Flow, Temp., Diff.Press..) - Install	03/06/02					Ordered - 2-4 Week Delivery
L3	Heat Tracing - Install	02/14/02		X			
L3	Manual Hand Pump - Install	02/18/02			X		
L3	Control Panels - Install	02/09/02	X				
L3	Motor Started Panels - Install	02/09/02	X				
L3	Separator Sight Glass - Install	02/20/02			X		
L3	Interior Piping - Pressure Test	02/19/02			X		
L3	Instrument - Calibration	03/11/02			X		
L3	Instrument - Identification	02/25/02			X		Submittal Pending
L3	Equipment - Certification	03/11/02			X		
L3	Equipment - Identification	02/25/02			X		Submittal Pending
L3	Valves & Piping - Identification	02/25/02			X		Submittal Pending
L3	Wiring - Pull	To Be Determined					
L3	Instrument - Terminate Wiring	To Be Determined					Pending Transmitters Delivery
L3	Transformer - Install	02/21/02			X		Delivery Feb 21, 2002
L3	Switch Gear - Install	02/21/02			X		Delivery Feb 21, 2003
L3	Clean-Up - General	02/25/02			X		

METRO-NORTH COMMUTER RAILROAD STATION
HARMON LAGOON REMEDIATION AT AREA OU-II
CONTRACT No. 9464

DEFICIENCY LIST

AREA	DESCRIPTION	TARGET COMPLETION DATE	STATUS				COMMENTS
			COMPLETED	IN PROGRESS	INACTIVE	WAIVED	
L4	After Cooler - Install	02/18/02		X			
L4	Carbon Canister Piping - Install	02/11/02	X				
L4	Vacuum Relief Valve (VRV 401) - Install	02/22/02			X		
L4	Electrical Conduits - Install	02/21/02			X		
L4	Run Time Recorder (KQIRs) - Install	Not Applicable				X	Integrated into PLC
L4	Transmitters (Flow, Temp., Diff.Press..) - Install	03/06/02			X		Ordered - 2-4 Week Delivery
L4	Condensate Drum Piping - Install	02/11/02	X				
L4	Manual Hand Pump - Install	02/18/02			X		
L4	Wall Penetration - Seal	02/19/02			X		
L4	Separator Sight Glass - Install	02/20/02			X		
L4	LEL Detector - Install	02/22/02			X		
L4	Interior Piping - Pressure Test	02/20/02			X		
L4	Instrument - Calibration	03/11/02			X		
L4	Instrument - Identification	02/26/02			X		Submittal Pending
L4	Equipment - Certification	03/11/02			X		
L4	Equipment - Identification	02/26/02			X		Submittal Pending
L4	Valves & Piping - Identification	02/26/02			X		Submittal Pending
L4	Erosion Control - Site Stabilization	To Be Determined					
L4	Above Ground Storage Tank - Install	02/25/02			X		Delivery Wk Feb 25, 2002

METRO-NORTH COMMUTER RAILROAD STATION
HARMON LAGOON REMEDIATION AT AREA OU-II
CONTRACT No. 9464

DEFICIENCY LIST

AREA	DESCRIPTION	TARGET COMPLETION DATE	STATUS				COMMENTS
			COMPLETED	IN PROGRESS	INACTIVE *	WAIVED	
L4	Above Ground Storage Tank Piping - Install	02/25/02			X		Delivery Wk Feb 25, 2002
L4	AGST Containment - Paint (Red / Inside & Outside)	02/25/02			X		Delivery Wk Feb 25, 2002
L4	Voltage Dividers - Resolve	02/19/02					
L4	Voltage Dividers - Install	To Be Determined					
L4	Instrument - Terminate Wiring	02/22/02			X		Pending Volt. Divider Resolution
L4	Condensate Drum Level Float Switch - Install	To Be Determined					
L4	Conduit (Inj. Air Blower) - Safety Hazard / Raise	To Be Determined					
L4	Air Piping - Install	02/09/02	X				
L4	Product Piping - Install	02/09/02	X				
L4	Steel Doors - Seal	02/19/02			X		
L4	Steel Doors - Adjust Stops	02/19/02			X		
L4	Steel Doors - Secure Stops	02/19/02			X		
L4	Clean-Up - General	02/25/02			X		

* ***Inactive indicates no action performed to date, however, action is necessary to be deemed functionally complete***

From: Mike Sandler <MSandler@lmseng.com>
To: "Gerard Burke (E-mail)" <gwburke@gw.dec.state.ny.us>
Date: 2/28/02 10:14AM
Subject: Waste Disposal

Per your request the Disposal Sites are as follows:

Michigan Disposal Waste Treatment Plant
49350 North I-94 Service Drive
Belleville, MI 48111
Manifest # 8666202
12 -Drums Containing Solids

EQ Resource Recovery, Inc.
36345 Van Born Road
Romulus, MI 48174
Manifest # 8666203
2 - Drums Containing Oil and Water

Michael Sandler, Chief Inspector
Lawler, Matusky & Skelly Engineers LLP
One Blue Hill Plaza
Pearl River, New York 10965
Telephone: (845) 735-8300 / Facsimile: (845) 735-7466

CC: Rob DeGiorgio <RDeGiorgio@lmseng.com>, "Mukesh Mehta (E-mail)" <mehta@mnr.org>

New York State Department of Environmental Conservation
Division of Environmental Remediation
Bureau of Construction Services, 12th Floor
625 Broadway, Albany, New York 12233-7013
Phone: (518) 402-9814 • **FAX:** (518) 402-9819
Website: www.dec.state.ny.us

Erin M. Crotty
Commissioner

MAR - 6 2002

Ms. Karen Timko
Senior Environmental Counsel
Metro-North Commuter Railroad Co.
347 Madison Avenue, 12th Floor
New York, New York 10017-3739

Dear Ms Timko:

Re: Harmon Railroad Yard, Croton-on -Hudson
NYS Site No. 3-60-010

The New York State Department of Environmental Conservation (NYSDEC) has reviewed the Operation & Maintenance (O&M) Manual for Operable Unit 2 (OU-2) for the referenced site. Below are the DEC's comments:

1. Section 3.3: Vapor Treatment Systems - When sampling the off-gas using a PID, the air that is to be sampled should be collected in a tedlar bag then the PID should be inserted into the bag. Since a PID uses a calibrated flow of air past a bulb, sticking the PID into a flowing air stream will cause inaccurate sample results.

2. A copy of this document must be on-site for as long as the system is operating.

If you have any questions, please contact Gerard Burke at (518) 457-9285.

Sincerely,

Robert C. Knizek, P.E.
Chief, Eastern Field Services Section
Bureau of Construction Services
Division of Environmental Remediation

cc: C. Manfredi, Region 3

GB\mj
bcc: R. Knizek/G. Burke
Dayfile
burke 5/00:MNRR_O&M.wpd

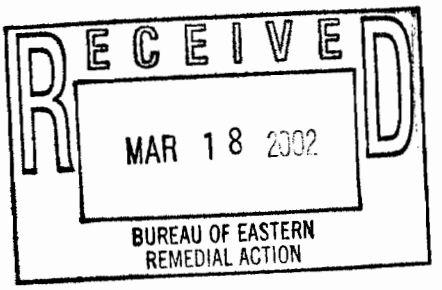
Environmental Resources Management

475 Park Avenue South
29th Floor
New York, NY 10016
(212) 447-1900
(212) 447-1904 (Fax)

14 March 2002

Robert C. Knizek, P.E.
Chief, Eastern Field Services Section
Bureau of Construction Services
Division of Environmental Remediation
New York State Department of Environmental Conservation
625 Broadway
Albany, New York 12233

ERM



Re: ***Harmon Railroad Yard Site, Operable Unit II***
NYSDEC Site No. 3-60-010
Response to NYSDEC Comment Letter on O&M Manual

Dear Mr. Knizek:

This letter is in response to your 6 March 2002 comment letter on the Operable Unit II Operations and Maintenance (O&M) Manual. The O&M Manual will be revised to address your comments. The revised plan will be transmitted to your office upon completion.

Sincerely,

Carla Weinpahl
Senior Project Manager

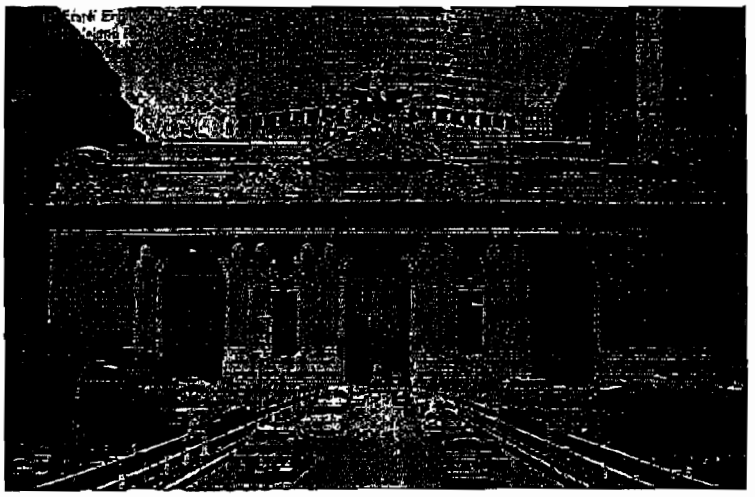
cc: Karen Timko (Metro-North)
Mukesh Mehta (Metro-North)
Gerard Burke (NYSDEC)
Brian Morrissey (ERM)

F:\OU-II\CONSTRUCTION\response to DEC's comments on O&M Plan.doc

Metro-North Railroad

CAPITAL PROGRAMS DEPARTMENT

11th floor
420 Lexington Avenue
New York, NY 10017
Fax: 212-499-4420



Fax

To: Gerard Burke **From:** Mukesh Mehta.

Fax: 518 402-9819 **Date:** 5/7/02

Phone: **Pages:** 1+1

Re: **Cc:**

☐ Urgent ☐ For Review ☐ Please Comment ☐ Please Reply ☐ Please Recycle

As requested.

Comments:

Gerard,

Attached is the FA estimate for the additional work at OV-II. This is for your review.

Thanks.

Mukesh.

4/29/02
FA Cost Estimate for
Additional Work Items

HARMON LAGOON REMEDIATION
OU-2 2002

Description	Quantity	Units	Unit Price	Dur.	Man Days	Labor $	Material	Equipment	Contracts	Total
1. Install signs and door closers on buildings				2	10	$ 5,425	$ 1,052			$ 6,477
2. Fabricate and install grating pad for drums				1	5	2,710	276	$ 744		3,730
3. Blacktop area from drain to building				2	14	7,588	3,700	1,949		13,237
SUB TOTAL					29	$15,723	$ 5,028	$ 2,693		
GRAND TOTAL										$23,444

Fax
518 402 9819

SECTION 11374
SOIL GAS EXTRACTION EQUIPMENT

PART 1 - GENERAL

1.01 WORK INCLUDED:

A. The Contractor shall provide all labor, equipment and materials necessary to procure, install, adjust, test and place in satisfactory operation the Soil Gas Extraction System for Area L1/L2, Area L3 and Area L4, as shown on the Contract Drawings and specified herein.

B. The equipment shall be installed complete with vacuum blower explosion proof motor and motor controls, flanged inlet and outlet, inlet filter, vacuum release valve, temperature gauge, pressure gauge, vacuum gauge, sample ports and manual dilution air valve. The unit shall be skid mounted and shall also be provided with a control panel, all accessories, valves, special tools, base attachments, mountings, anchor bolts and other appurtenances as specified or as may be required for satisfactory installation. A separately skid mounted vapor/liquid separator tank, level controls, transfer pump and appurtenances shall also be installed complete with all appurtenances.

1.02 IDENTIFICATION:

A. The equipment shall be identified with the Equipment Identification Numbers: B201, B202, B301 and B401 as shown on the Contract Drawings. A corrosion resistant nameplate, securely affixed in a conspicuous place on the Equipment shall show the Equipment Identification Number, Manufacturer's name or trademark and other such information as Manufacturer may consider necessary.

1.03 CODES AND STANDARDS:

A. Underwriters Laboratories (UL) or Factory Mutual Ownering Division

B. National Electrical Code (NEC).

C. American Society of Mechanical Owners (ASME), Code Section 8, Division 1.

D. National Fire Code, National Fire Protection Association (NFPA).

E. FM, Factory Mutual.

F. AWS: Welding Code, Current Edition.

G. The Hydraulic Institute.

1.04 MANUFACTURER'S SPECIAL SERVICES

A. Manufacturer shall be responsible to ensure that the Equipment is operational in accordance with the Manufacturer's Operations and Maintenance Manual and check-out procedure.

B. It is the intent of this Specification that all components of the Equipment be provided by one Manufacturer who shall have the sole responsibility of matching all components and providing equipment which functions together as a system.

C. The Manufacturer shall provide the services of a qualified technical representative who shall:

1. Inspect the installation of the Equipment furnished under this Specification.

2. Supervise the start-up and Manufacturer's standard check-out testing of the Equipment.

3. Instruct the Owner's operating personnel in the maintenance and operation of the Equipment.

4. Certify proper installation, start-up, and calibration of the Equipment.

5. Sign in and out of the office of the Owner each day the representative is at the Project Site.

D. The services of the Manufacturer's representative shall be provided for a period of not less than one (1) working day at the Project Site during installation of the Equipment, one (1) day at the Project Site to observe performance testing, and one (1) day training. This total of three (3) days may not necessarily be consecutive.

E. The time specified above is exclusive of travel time to and from Project Site and does not relieve Manufacturer from providing sufficient service to place Equipment in satisfactory operation. Any additional time required to achieve successful installation and operation of the Equipment shall be at the expense of the Contractor.

1.05 TESTING:

A. All tests shall be conducted in accordance with Section 01400 – "Quality Requirements" and the requirements specified herein.

B. Shop Tests:

1. Manufacturer's standard shop tests shall be conducted.

2. Defects or defective Equipment shall be corrected or replaced by the Contractor at no additional cost to Metro-North.

3. The Equipment shall not be shipped to the Project Site until all defective Equipment has been corrected or replaced.

C. Field Mechanical Tests:

1. After the Equipment has been installed, calibrated and serviced, the Contractor shall perform a mechanical and electrical test of the Equipment through a full range of operating conditions and control cycles. The Engineer must be present for these tests.

2. The equipment shall be capable of operating in a satisfactory manner without defects or operational difficulties.

3. All defective Equipment or workmanship revealed by or noted during the tests shall be corrected or replaced immediately by the Contractor at no additional cost to Metro-North.

4. If necessary, tests shall be repeated until satisfactory results are obtained. The cost of additional testing will be backcharged to the Contractor.

5. Contractor shall provide a copy of its standard start-up and check-out report for the Equipment to the Engineer.

D. Field Performance Tests:

1. The Manufacturer shall observe all testing required to ensure that the Equipment provided meets the mechanical and performance criteria specified in Section 3.03. This performance testing shall be conducted by the Contractor only after the Manufacturer has submitted the Equipment Manufacturer's Certification Form, and within ninety (90) days after the Manufacturer's Certification has been received by the Engineer.

2. The Contractor shall provide sampling and analytical methods to the Engineer for approval prior to testing, and shall give the Engineer reasonable notice prior to testing.

4. Effluent from the Equipment shall meet the criteria specified in Paragraph 3.03. Sampling for the performance test shall be conducted at the minimum and maximum flows specified.

5. Equipment shall be capable of operating in a satisfactory manner and of meeting effluent performance criteria without defects or operational difficulties.

6. All defective Equipment or workmanship revealed or noted as a result of the tests shall be corrected or replaced immediately by the Contractor under the warranty, at no additional cost to the Metro-North.

7. Tests shall be repeated at the Contractor's expense until satisfactory results are obtained.

1.06 SUBMITTALS:

A. In accordance with the procedures and requirements set forth in this Section and in Section 01330 – "Environmental Submittals", the equipment the Contractor shall submit the following:

1. Shop Drawings for all equipment and accessory items provided.

2. Preliminary Operation and Maintenance Manuals.

3. Final Operation and Maintenance Manuals.

4. List of Spare Parts, Special Tools and Lubricants to be provided at no additional cost to Owner.

5. Reports of all Shop and Field Tests.

6. Lubrication Schedule.

7. Written reports of all field acceptance test results and work performed by Manufacturer's representative during site visits.

8. Certified Letter of Compliance.

9. All other information necessary to enable the Engineer to determine whether proposed equipment meets the specified requirements.

B. Each submittal shall be identified by the applicable Equipment Identification Number and Specification Section.

C. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Job Specification.

D. Partial, incomplete or illegible submissions will be returned to the Contractor without review for resubmittal.

E. Shop drawings shall include but not be limited to:

1. Manufacturer's literature consisting of equipment specifications and product (including pressure gauges, valves, drain valves, vent valves, etc.) data sheets identifying all materials used and methods of fabrication, illustrations and complete installation instructions for the Soil Gas Extraction Equipment and all appurtenances. Literature shall include information on surface preparation and paints used for shop coating, including color chips or samples.

2. Complete assembly, layout, installation and foundation drawings, including piping and wiring drawings with clearly marked dimensions. A schedule of all parts shall be included in the drawings. (Location of pipe supports and hangers shall be the responsibility of the Contractor).

3. Weights of all component parts, assembled weight of units (empty and full) and approximate total shipping weight.

4. Sample equipment nameplate data sheet.

5. Templates for anchor bolts.

F. Certified Letter of Compliance:

The Contractor shall submit to the Engineer a letter of compliance which certifies that the Soil Gas Extraction Equipment covered by this Section is installed in accordance with the Manufacturer's installation instructions and approved Shop Drawings and conform to the requirements of this Specification. The letter of compliance shall be submitted in accordance with Section 01330 – "Environmental Submittals" and with the Equipment Manufacturer Certification Form shown at the end of this Section.

1.07 OPERATION AND MAINTENANCE MANUALS:

A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in Section 01330 – "Environmental Submittals".

B. A preliminary Operations and Maintenance Manual shall be included in the Shop Drawing submittal. Without inclusion of these manuals the submittal will be considered incomplete and will be returned without review.

1.08 TOOLS, SUPPLIES AND SPARE PARTS:

A. The Contractor shall furnish all special tools necessary to disassemble, service, repair and adjust the equipment.

B. The Contractor shall supply any spare parts recommended by the Manufacturer but not specified herein.

C. Spare parts and special tools lists to be included with the shop drawing submittal shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "one (1) lot of packing material" are not acceptable.

D. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one (1) size or equipment model shall have the same part number.

1.09 DELIVERY, STORAGE AND HANDLING:

A. Equipment and materials shall be delivered and handled in original, undamaged shipping containers, with tags and labels intact and legible except where partial disassembly is required by transportation regulations or for protection of component.

B. Spare parts and special tools shall be packed in containers bearing labels clearly designating contents and pieces of equipment for which they are intended.

C. Spare parts and special tools shall be delivered at the same time as equipment for which they are intended and shall be stored where directed by the Engineer. All spare parts shall be turned over to Owner after completion of Work.

D. All materials and equipment shall be stored in original shipping containers with tags and labels intact and legible, up off ground, under cover, protected from weather and construction activities.

E. Damage to equipment shall be avoided through proper handling and storage.

PART 2 - PRODUCTS

2.01 SUPPLIER / MANUFACTURER:

A. The Equipment shall be the following Gasho Soil Gas Extraction (SGE) System with separately mounted GX Vapor-Liquid Separator, manufactured by Gasho Associates of West Chester, PA:

1. Area L1/L2
   EN909 Blower Package with GX200 liquid/vapor separator.

2. Area L3

EN404 Blower package with GX-30 liquid/vapor separator.

3. Area L4
   ~~EN707~~ EN858 Blower package with GX-60 liquid/vapor separator.

B. The facility has been designed around the Gasho SGE ~~and Model GX200 VSM~~. If a "substitute" system is proposed by the Contractor, the Contractor shall be responsible for all changes in the electrical and piping systems, and any changes to the building structure resulting from the use of the substitute system, including redesign. Contractor shall comply with Section 01631 - "Approvals and Substitutions", in its entirely, with regard to submittals and costs associated with the use of the substitute equipment.

2.02 DESIGN CRITERIA:

A. Area L1/L2
The Equipment shall be capable of treating an influent air stream and shall meet the following performance criteria listed below:

1.	Total System Air Flow, scfm	720
2.	Soil Gas Flow, scfm	720
3.	Vacuum Blower inlet, inches w.c.	35
4.	Process Inlet Temperature, °F	40-180
5.	Soil Gas LEL, percent	0-90

B. Area L3
The Equipment shall be capable of treating an influent air stream and shall meet the following performance criteria listed below:

1.	Total System Air Flow, scfm	42
2.	Soil Gas Flow, scfm	42
3.	Vacuum Blower inlet, inches w.c.	30
4.	Process Inlet Temperature, °F	40-180
5.	Soil Gas LEL, percent	0-90

C. Area L4
The Equipment shall be capable of treating an influent air stream and shall meet the following performance criteria listed below:

1.	Total System Air Flow, scfm	~~130~~ 220
2.	Soil Gas Flow, scfm	~~130~~ 220
3.	Vacuum Blower inlet, inches w.c.	~~65~~ 70
4.	Process Inlet Temperature, °F	40-180
5.	Soil Gas LEL, percent	0-90

2.03 SYSTEM COMPONENTS – SOIL GAS EXTRACTION EQUIPMENT:

The Soil Gas Extraction System including the vapor-liquid separator shall be fully factory assembled and pre-wired with all instrumentation.

A. Blower:

1. Blowers shall be of the rugged, industrial-duty, regenerative type, designed to equate the performance of other-technology multistage and positive displacement type

blowers via maintenance-free, single stage dynamics, free of contacting moving parts other than motor ball bearings.

2. Blowers shall be designed for continuous industrial (service, delivering clean air, free of oils or any other "contaminants").

3. Blower impeller, housing, cover and acoustical integral manifold cavity shall be of rugged, superior castability and ductility, aluminum alloy, inherently resistant to corrosion and sparking.

4. The regenerative slower impeller shall be of one piece, solid, dynamically balanced, radial-blade type, shimmed to a solid machined shoulder on the motor shaft. A circlip seat is not acceptable.

5. The blower will be equipped with a teflon shaft seal, vacuum impregnated castings to eliminate material porosity, and sealed with a high temperature anaerobic type sealant. The final assembly is to be leak tested to less than 1cc/sec @ 3 psi.

6. The blower shall be equipped with integral inlet and outlet muffling. The muffling material shall be held in place with a screen. Spring or wire arrangements are not acceptable.

7. The blower inlet and outlet flanges shall be of cast iron construction to resist stripping of threads. Soft metals such as aluminum are not acceptable.

B. Motors:

1. Integrally mounted, direct-drive motors shall be NEMA frame explosion-proof as required to meet the requirements of a division 1 & 2, class 1, group d hazardous atmosphere. Motors shall be UL & CSA approved.

2. Motors shall be capable of carrying full rated load continuously with a temperature rise not exceeding 80°C above an ambient temperature of 40°Cas limited by NEMA Class B thermal protection. The motor windings, however, shall be equipped with Class F insulation.

3. The motor ball bearings shall be permanently sealed and B10 life rated for greater than 15,000 hours of continual maintenance-free operation at 120°C motor temperature. The impeller and bearing shall be double sealed polyacrylic with rheotemp 500 high temperature grease. The bearing shall be heat stabilized at 325°F.

C. Motor Starter and Electrical Wiring:

The motor starter shall be factory pre-wired and shall be housed within an explosion proof enclosure. Wiring, conduit, fittings and connectors shall be installed as per Class 1, Division 2, explosion proof specifications.

D. Gauges:

A temperature gauge shall be mounted on the discharge side of the blower. A pressure gauge shall be mounted at the blower inlet to measure the vacuum (inches of H.G. and inches of W.C.). A second pressure gauge shall be mounted on the blower outlet to monitor the discharge pressure (psi).

E. Process Valves:

A manual fresh air dilution valve and an automatic vacuum relief valve shall be installed at the blower inlet. A sample port with a plug cap shall be located at the blower outlet.

F. Skid:

All components of the Soil Gas Extraction System shall be mounted on a common skid. Components of the vapor-liquid separator shall be mounted on its own skid.

G. Silencer:

An outlet silencer shall be mounted on the exhaust of the blower. The overall noise level shall not exceed 85 dBA.

H. Unit Enclosure

The unit shall be mounted in an insulated cabinet to reduce the maximum noise level from the system to not more than 75 dBA at three feet.

I. Inlet Filter:

A dense media particulate filter shall be mounted prior to the blower inlet to protect the impeller and housing from dirt and abrasives.

2.04 SYSTEM COMPONENTS - VAPOR-LIQUID SEPARATOR:

The vapor-liquid separator for NAPL Area L4 shall be rated for up to 500 CFM and shall have a liquid capacity of ~~75~~ 22 gallons {Gasho Model GX-60 or approved equal}. The vapor-liquid separator for NAPL Area L3 shall be rated for up to 250 CFM and shall have a liquid capacity of 8 gallons {Gasho Model GX-30 or approved equal}. }. The vapor-liquid separator for NAPL Area L1/L2 shall be rated for up to 2000 CFM and shall have a liquid capacity of 95 gallons {Gasho Model GX-200 or approved equal}.

A. Vessel:

The vessel shall be designed to protect the downstream Soil Gas Extraction System components from entrained water. The pressure vessel shall consist of an epoxy painted cylindrical steel tank with flanged tangential, side inlet and flanged top outlet. Baffle plates shall be provided within the vessel as a vortex breaker.

B. Demister:

A packaged stainless steel demister shall be placed within the vessel for small water droplet removal.

C. Controls:

An explosion proof level switch shall be provided to initiate operation of the condensate transfer pump.

D. Condensate Transfer Pump:

Condensate transfer pump shall be provided on the vapor-liquid separator skid with all appurtenances. The condensate transfer pump shall automatically begin to operate on high liquid level and shall inject the condensate into the air stripper ground water recovery

influent line at a manually set rate. The transfer pump shall be as described on the Contract Drawings.

E. Sight Glass:

A liquid level indicator shall be provided for easy viewing of the water level within the vessel.

F. Ports:

A drain port, automatic pump control ports, and a bayonet heater port shall be provided with caps. (Heater not to be supplied.)

G. Skid Mounting:

The vapor-separator module and condensate liquid transfer pump shall be skid mounted with fork lift channels and lifting lugs to provide ease of placement and mobility.

2.045 SYSTEM COMPONENTS – GRANULAR ACTIVATED CARBON:

The granular activated carbon canisters shall be rated for each of the three NAPL areas and shall meet the following requirements:

A. Area L1/L2
The Equipment shall be capable of treating an influent air stream with the characteristics listed below.

1. Design Air Flow,-Max.,scfm	1500
2. Inlet/Outlet Connections, inches	8/8
3. Carbon Weight, lbs	500
4. Canister, Dia/Height, inches	36/48
5. Canister, Internal Components	CPVC

B. Area L3
The Equipment shall be capable of treating an influent air stream with the characteristics listed below.

1. Design Air Flow,-Max.,scfm	100
2. Inlet/Outlet Connections, inches	2/2
3. Carbon Weight, lbs	200
4. Canister, Dia/Height, inches	24/36
5. Canister, Internal Components	PVC

C. Area L4
The Equipment shall be capable of treating an influent air stream with the characteristics listed below.

1. Design Air Flow,-Max.,scfm	~~300~~ 500
2. Inlet/Outlet Connections, inches	4/4
3. Carbon Weight, lbs	~~170~~ 140
4. Canister, Dia/Height, inches	~~24/36~~ 24/34
5. Canister, Internal Components	PVC

PART 3 - EXECUTION

3.01 INSPECTION

A. The Contractor shall carefully inspect installed work of other trades to verify that all preparatory work is properly completed prior to installation of equipment.

B. The Contractor shall commence with installation when conditions are satisfactory.

3.02 EQUIPMENT INSTALLATION:

A. Installation of the Soil Gas Extraction Equipment shall be performed in accordance with the written instructions supplied by the Manufacturer, the approved Shop Drawings and in conformity with the applicable sections of Division 1.

B. All Work shall be installed plumb, level, straight and accurately fitted and adequately reinforced and anchored in place.

3.03 ACCEPTANCE TESTING:

A. After soil gas extraction equipment has been installed, calibrated and serviced, the Equipment Subcontractor shall, in conjunction with other "crafts" where necessary, give all Equipment a running test of not less than one (1) day of continuous operation.

1. Equipment supplied under this Specification shall operate satisfactorily without defects or operational difficulties.

2. All defects or defective equipment revealed by or noted during the tests shall be corrected and/or replaced immediately by the Contractor at no additional cost to the Metro-North.

3. If necessary, running tests will be repeated until satisfactory results are obtained.

B. Contractor shall make adjustments as necessary to place his equipment in satisfactory working order at time of test.

C. Contractor shall furnish all materials and test equipment necessary so that tests may be conducted over full range of possible operating conditions.

* * *

END OF SECTION

EQUIPMENT MANUFACTURER CERTIFICATION FORM

DATE:

COMPANY NAME:

ADDRESS:

PROJECT:

Gentlemen:

This is to certify that the following Equipment furnished to the above Project was made in accordance with the approved Contract Drawings and Specifications.

We have inspected our Equipment after its installation at the Project Site and found it to be in good operating condition in accordance with Manufacturer's standard check-out tests. Our warranties have been validated and will be good until _____.

	Equipment Description	Equipment ID No.	Model No.
1.			

Signed by an officer of the company (or authorized representative)

NAME: SIGNATURE:

TITLE: DATE:

CATION OF SHEETING WALL (BID OPTION NO.1)
(16'D)
DWG. C-7)

NAPL AREA L1

NAPL AREA L2

NAPL AREA L3
(HAND EXCAVATION REQUIRED)

PROPOSED LOCATION OF EQUIPMENT BUILDING
FOR AREA L1 AND L2 (SEE DWG. EA-1)

PROPOSED LOCATION OF EQUIPMENT PADS
FOR AREA L3 W/ SOUND PROOF ENCLOSURE
(SEE DWG. EA-2)

DRAINAGE SWALE

PROPOSED LOCATION OF PODUCT RECOVERY PULL BOX

CONCRETE WATER
METER PIT

TREATMENT
PLANT BUILDING

VALVE
BOX

SLUDGE DIGESTER

PUMP
STATION

REMAINS OF FOUNDATIONS

LIMITS OF PAVEMENT

ANCHOR TRENCH OF LINER

TOP OF SHEET PILE
AS LOCATED 6/2/95

8" C.I.P.

GATE

CHAIN LINK FENCE

AE1-6

Unknown 2"

Unknown 2" well

WBL1
2" well

3" = pipe
possible well

Four
Unknown
3" Diam.
Wells

VE1-1
VE1-2
VE1-3
VE1-4
VE1-5
VE1-6
VE1-7
VE1-8
VE1-9
VE1-10
VE1-1/RW2

VE2-1

VE3-1
VE3-2
VE3-3

AI1-1/OW8
AI1-2
AI1-3
AI1-4
AI1-5
AI1-6
AI1-7
AI1-8
AI1-9
AI1-10
AI1-11
AI1-12
AI1-13
AI1-14
AI1-15
AI1-16

AI2-1
AI2-2
AI2-3

AI3
AI3-2
AI3-4
AI3-5
AI3-6

OW9
OW10
OW11
OW12

PGW-1

LEGEND

	PERIMETER GROUND WATER MONITORING WELL
OW	EXISTING OBSERVATION WELL
AI	AIR INLET WELL
AI/OW	EXISTING OBSERVATION WELL TO BE MODIFIED TO AIR INLET WELL
VE	SOIL GAS EXTRACTION WELL
VE/RW	EXISTING VENR PILOT WELL TO BE MODIFIED TO SOIL GAS EXTRACTION WELL
	ESTIMATED NAPL CONTOUR
	VAPOR EXTRACTION LINE
	PRODUCT LINE CONDUIT FOR FUTURE ACTIVE PRODUCT RECOVERY SYSTEM

LEGEND FOR EXISTING UTILITIES

SOURCE: "AS BUILT" RECORD DRAWING BY OGDEN REMEDIATION SERVICE CO.
DATED : MAY 3,1996

E	ELECTRICAL LINE
S	SANITARY SEWER
SS	STORMWATER SEWER
W	WATER MAIN
	OVERHEAD WIRES
X	FENCE
	UTILITY POLE
C.I.P.	CAST IRON PIPE

NOTES:

1. PROPER PRECAUTIONS INCLUDING THE REQUIREMENT OF HAND EXCAVATION SHALL BE IMPLEMENTED NEAR ALL SUBSURFACE UTILITIES. ALL EXCAVATIONS IN AREA L3 SHALL BE PERFORMED WITH HAND TOOLS.
2. ALL UNDERGROUND PIPING IN NAPL AREA L3 SHALL BE SCH 80 PVC.
3. SEE NOTES ON DRAWING C-2

0 15' 30'
GRAPHIC SCALE

CHOR TRENCH OF LINER

TOP OF EXISTING SHEET PILE

PROPOSED LOCATION OF EQUIPMENT BUILDING FOR AREA L4 (SEE DWG. EA-3)

POSED EXTERIOR DIKED TANK ON CONCRETE PAD (500 GAL.)

PROPOSED PRODUCT RECOVERY PULL-BOX

SAFETY BOLLARD (TYPICAL)

TOP OF SHEET PILE AS LOCATED 5/2/95

EXISTING ASPHALT BERM

A13-5

FA4-24

FA4-19

FA4-21

FA4-23

VE4-13

VE4-12

VE4-11

VE4-10

FA4-25

FA4-20

FA4-22

FA4-16

FA4-18

FA4-14

VE4-9

FA4-17

FA4-12

VE4-8

FA4-15

VE4-7

FA4-4

FA4-6

FA4-8

FA4-10

VE4-2

FA4-5

VE4-3

CHAIN LINK FENCE

FA4-7/OW1

OW2

VE4-4

FA4-9/OW3

VE4-5/RW1

OW4

FA4-11/OW5

VE4-6

FA4-13/OW6

PROPOSED PRODUCT RECOVERY PULL-BOX

EXISTING OVERHEAD WIRES

GATE

GATE

TANK

Unknown well

Unknown well

Unknown well

WB3

NAPL AREA L4

ING OBSERVATION WELL

NLET WELL

ING OBSERVATION WELL TO BE MODIFIED TO AIR INLET WELL

ED AIR INJECTION WELL

ING OBSERVATION WELL TO BE MODIFIED TO FORCED AIR INJECTION WELL

GAS EXTRACTION WELL

0 15' 30'

GRAPHIC SCALE