ENSR | AECOM

Prepared for:
National Fuel Gas Distribution Corporation
6363 Main Street
Williamsville, New York 14221

Asphalt Cap Work Plan – Building 8

Mineral Springs Road Site
West Seneca, New York

The RETEC Group, Inc.
October 2007
Project No.: 04870-025-400

Merged with ENSR in 2007
RETEC

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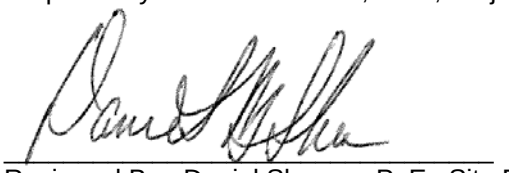
Mineral Springs Road Site
West Seneca, New York

Prepared By - Mark Hofferbert, P. E., Project Manager



Reviewed By - Daniel Shearer, P. E., Site Engineer

The RETEC Group, Inc.
October 2007
Project No.: 04870-025-400

Merged with ENSR in 2007
RETEC

Contents

List of Appendices

Statement of Limitations

Work for this project was performed, and this remedial design prepared, in accordance with generally accepted professional practices for the nature and condition of the work completed in the same or similar localities, at the time the work was performed. It is intended for the exclusive use of National Fuel Gas Distribution Corporation for specific application to the Mineral Springs Road former manufactured gas plant site in Buffalo (and West Seneca), New York. No other warranty, express or implied, is made.

1.0 Introduction

This Work Plan presents the design and details for construction of an asphalt cap at the Mineral Springs Road former manufactured gas plant (MGP) site in Buffalo and West Seneca, New York. It has been prepared by ENSR Corporation (ENSR) on behalf of National Fuel Gas Distribution Corporation (NFG) in accordance with the provisions of the Voluntary Cleanup Agreement (VCA) [NFG, 1998] between the New York State Department of Environmental Conservation (NYSDEC) and NFG.

The Mineral Springs Road former MGP site lies in a mixed industrial and residential area of Buffalo and West Seneca, New York. The stratigraphy of the site consists of several feet of soil and fill, a nearly continuous upper confining clay layer (UCL), a groundwater bearing strata of silt, sand, and gravel, and a lower confining clay layer (LCL). Subsurface MGP purifier residuals and subsurface NAPL-impacted soils were delineated in several areas above the UCL. Subsurface NAPL-impacted soils were also delineated in several areas between the UCL and LCL. These materials were removed or capped during the successful implementation of a site-wide remediation, as detailed in the NYSDEC-approved *Remedial Design / Work Plan, Mineral Springs Site, Buffalo, NY* [RETEC, 1999]. Analytical results indicate that the remaining on-site soils are non-hazardous. Except for on-site personnel performing excavations in impacted soil, the environmental risk to on- and off-site receptors associated with this site is negligible.

In April 2007 NFG noted that portions of the gravel parking area to the south and west of Building 8 exhibited a bluish tint. NFG and their subcontractor Nature's Way, investigated the area with a Geoprobe. A representative of the NYSDEC was present during the investigation. Blue stained soil, presumed to be impacted by purifier residuals, was identified in several of the borings. NFG has determined that the area should be capped with asphalt, as was done previously for similarly impacted soils during site-wide remediation.

The scope of work for this Work Plan is based on relevant sections of the 1999 Remedial Design / Work Plan. A design figure and site photos are included in Appendix A. Nature's Way's investigation report and bore logs are included in Appendix B. Petromat product literature and an installation guide are provided in Appendix C.

2.0 Storm Water Systems

2.1 Design Basis

Installation of additional storm drain catch basins are required to enhance drainage away from the proposed asphalt cap.

2.2 Technical Specifications

The Excavation Contractor shall install storm water catch basins and subsurface piping as shown in Figure 1 and described herein.

Approximate delineation of underground utilities will be provided by NFG. Protection of existing facilities and utilities shall be the responsibility of the Contractor. Contractor shall also obtain any permits related to the work, if necessary.

Any imported materials must be approved by the Engineer prior to delivery to the site. NFG will provide temporary materials staging areas following consultation with the Contractor.

Contractor shall perform all necessary construction surveying for the work. The Contractor shall employ a licensed New York State land surveyor to conduct the final as-built survey and to provide field verification of excavation depths as necessary and as requested by the Engineer. Surveyed points shall be on a 25-foot (maximum) grid.

The contractor shall grade and compact the existing ground surface within the footprint of the proposed asphalt cap. Final grades shall slope towards the proposed catch basin locations and shall allow construction of the 4" thick asphalt cap without the edges of the cap rising above adjacent paved areas. Grading that creates ponding or other drainage problems will not be accepted.

The Contractor shall provide and install two 2' x 2' pre-cast concrete storm water catch basins. The top elevation of the basins shall be determined by the Contractor, in consultation with NFG and the Engineer. Note that existing adjacent catch basins and monitoring well MW-10 have surface elevations of approximately 587.5' (see Figure1).

The Contractor shall provide and install approximately 200 feet of 6'' PVC storm sewer pipe to connect the proposed catch basins with the existing storm water systems. Pipe slopes shall be determined by the Contractor, in consultation with NFG and the Engineer.

During grading and excavation for the storm water system, the Contractor shall place excavated soils on 6 mil polyethylene sheeting for characterization by the Engineer. Soils deemed by the Engineer to be unimpacted based on visual and PID headspace readings shall be reused as backfill or otherwise onsite.

Soils deemed by the Engineer to be impacted shall be covered by the Contractor at the end of the day. The Contractor shall then sample, characterize, and dispose of the material off site at a disposal facility approved by NFG.

Only soils deemed by the Engineer to be unimpacted shall remain at the surface following final grading.

The Contractor shall survey as-built locations of new storm sewers, including pipe inverts and catch basin rim elevations.

3.0 Asphalt Cap Construction

3.1 Design Basis

Capping contains and isolates contaminated soil through placement of clean materials over the existing substrate. Reduction of infiltration will reduce mobilization of contaminants to the groundwater. An asphalt cap will be placed over areas known to contain subsurface deposits of soil impacted by purifier box waste, effectively preventing direct contact by humans and environmental receptors.

3.2 Technical Specifications

The Asphalt Contractor shall construct the asphalt cap as shown in Figure 1 and described herein.

The asphalt cap shall consist of:

- 2½ inch thick Type 3 asphalt dense binder course, then
- Petromat 4598 placed to manufacturer's specifications, then
- 1½ inch thick (minimum) Type 7 asphalt wearing course, then
- Two coats of asphalt sealant.

Approximate delineation of underground utilities will be provided by NFG. Protection of existing facilities and utilities shall be the responsibility of the Contractor.

The Contractor shall re-grade and compact the existing gravel surface, if necessary. The Contractor shall compact all subgrades (and imported gravel, if required) by three passes with a vibratory steel-wheeled roller or by three passes with a walk-behind tamper. The asphalt cap shall be placed directly on the graded and compacted native material. Final surface elevations of the asphalt cap shall promote runoff to the catch basins.

Contractor shall perform all necessary construction surveying for the work. The Contractor shall employ a licensed New York State land surveyor to conduct the final as-built survey and to provide field verification of excavation depths as necessary and as requested by the Engineer. Surveyed points shall be on a 25-foot (maximum) grid.

Asphalt materials shall conform to Section 401-2 of the NYSDOT Standard Specifications (NYSDOT, 1990) for Type 3 (binder) and Type 7 (wearing) bituminous plant mixtures. Asphalt shall be placed with a paving machine, then steel-wheel compacted (three passes). Perimeter edges of asphalt caps shall be sloped and buried to prevent damage from snowplows and to match edges with adjacent asphalt and structures, where applicable.

Two coats of asphalt sealant shall be applied to the finished asphalt surface. No striping is required in this scope of work.

Petromat product literature and an installation guide are provided in Appendix C.

4.0 General Requirements

This section describes the general requirements for conducting the work, including health and safety requirements, environmental monitoring and control, and project reporting.

4.1 Health and Safety

A site-specific health and safety plan (HASP) shall be prepared by the Excavation Contractor prior to the start of work. It shall satisfy the requirements of industry standards for work at hazardous waste sites (29 CFR 1910.120), standards for the construction industry (29 CFR 1926), general industry standards (29 CFR 1910), and standards for specific hazardous materials (29 CFR 1900.1000). The Contractor shall submit the HASP to NFG for review prior to conducting any work. As a minimum subjects covered in the HASP shall include:

- Health & Safety Risk Analysis
- Personal Protective Equipment
- Air Monitoring & Action Levels
- Site Control
- Decontamination
- Emergency Response Plan
- Lockout/Tagout
- Heavy Equipment Operations
- Excavation and Trenching
- Material Safety Data Sheets
- Health and Safety Records and Reports

Prior to the work, the Excavation Contractor shall provide to NFG evidence of the following items for each person who will be entering the work zone:

- Respirator fit test
- OSHA 40 hour training or 8 hour refresher training
- Annual physical

Persons without these items both on-file and up-to-date with NFG will not be allowed to enter the work zone.

Hours of operation shall be daylight hours between 8 AM and 5 PM, Monday through Friday, unless otherwise allowed in writing by NFG.

4.2 Environmental Monitoring and Control

Environmental monitoring and mitigation procedures will be followed to manage impacts during construction and to control fugitive emissions.

4.2.1 Erosion Control

The Excavation Contractor shall comply with the following erosion and sedimentation control measures:

- All disturbed areas shall be graded to promote sheet flow of runoff water and to prevent erosion
- Any stockpiled soil shall be covered
- Erosion caused by site work shall be repaired immediately

4.2.2 Dust, Vapor, and Odor Monitoring

In accordance with 29 CFR 1910.120(h), an on-site air monitoring program will be implemented by the Engineer to identify and quantify airborne levels of hazardous substances to determine the appropriate level of employee protection required for personnel working on-site.

During excavation or handling of potentially impacted soils, the work area air quality monitoring will consist of:

- MIE Miniram dust meter to monitor dust levels, in mg/M^3
- PID (Photo Ionization Detector) to monitor for VOCs, in ppm

In addition to the work area monitoring program, the Engineer will monitor community air quality upwind and downwind of the work area to provide real-time estimates of total hydrocarbons, odor, and particulate releases to the community as a result of remedial activities.

The results of the monitoring will be used by the Engineer to ensure that all action levels outlined in the HASP are followed. As the work proceeds, it may be necessary for the Excavation Contractor, at the Engineer's request, to control compounds or odors which are released due to the Contractor's activities. Either the rate of excavation shall be reduced or engineering controls such as water mist or foam shall be applied.

4.2.3 Mobilization, Demobilization, Decontamination

NFG will provide designated equipment lay down areas to the Excavation and Asphalt Contractors. The Contractors shall confine their operations to the areas designated by NFG.

During the work activities, the work areas shall be secured and barricaded (temporary fencing, cones and caution tape) to ensure the safety of the NFG facility workers, visitors and Contractor's personnel.

During the course of this work, the Contractors shall:

- Avoid (or repair) damage to existing structures
- Avoid adverse effects to human health and the environment
- Contractors shall not disrupt or hinder the work of others
- All work shall be conducted in accordance with all OSHA and local regulations

Trucking of all materials both on- and off-site shall be done in accordance with applicable DOT standards. Trucks hauling materials to and from the site shall use only designated haul roads and shall ensure that the work activity does not conflict with other NFG site operations.

Equipment and personnel which come in contact with impacted materials shall be cleaned prior to demobilization from the site. Equipment decontamination procedures shall consist of mechanical measures such as brushing that leave majority of soils and debris in the excavation area. Any residual impacts will be cleaned using a high pressure hot water wash to the Engineer's satisfaction.

4.3 Project Reporting

Upon completion of the remedial activities, the Engineer will prepare a Final Engineering Report, approved by a professional engineer licensed in the state of New York. The following items will be included in the report:

- A description of all field work
- As-built drawings
- All pertinent analytical results,
- Copies of the bills of lading and manifests from the disposal of materials
- Status of the site upon completion

During the course of the work, the Contractor(s) shall regularly provide to the Engineer:

- Equipment and material testing records, including analytical results,
- As-built drawings
- Daily field reports
- Weigh tickets
- Surveyor's records

5.0 References

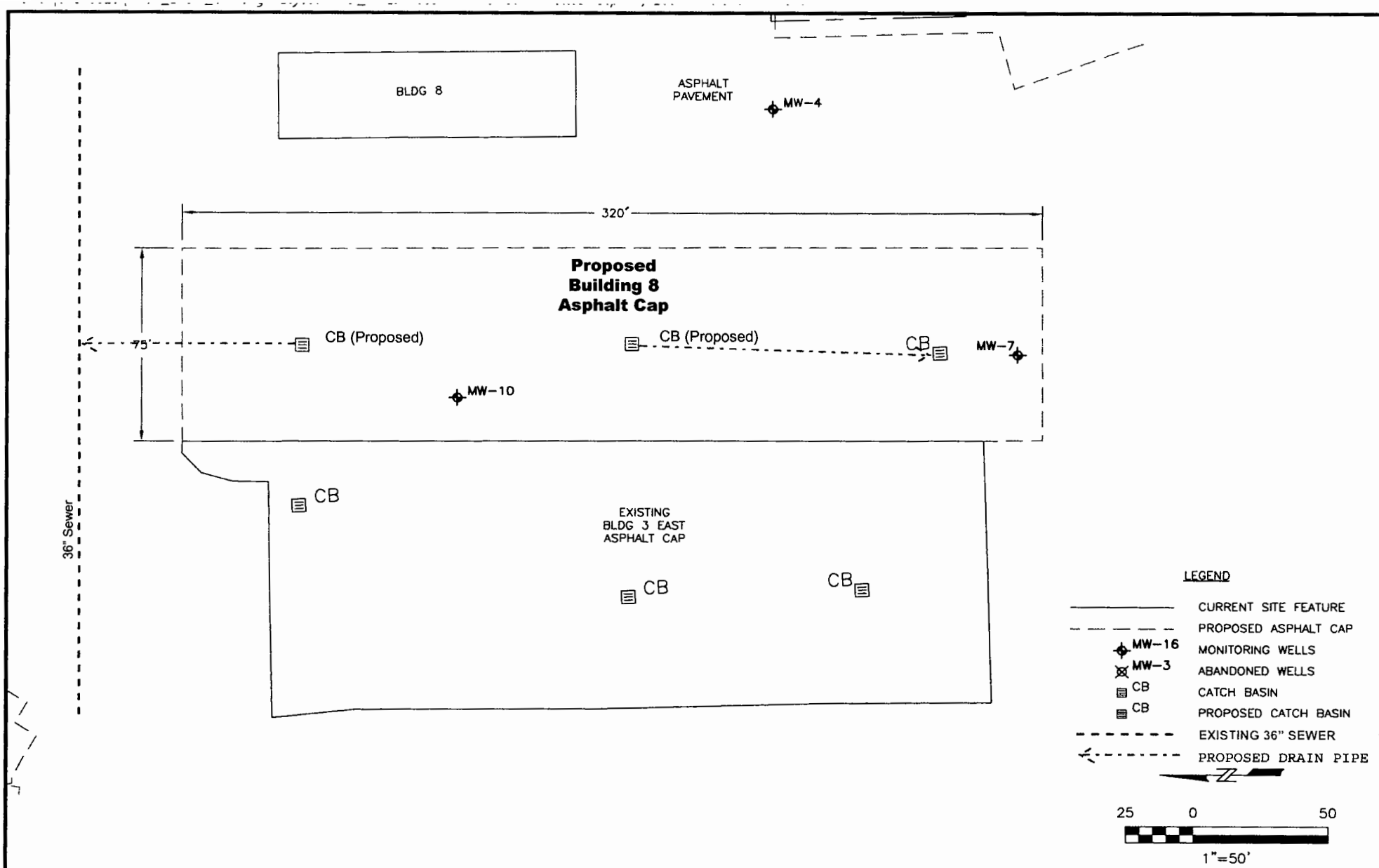
National Fuel Gas, 1998. Application for Voluntary Cleanup Agreement, Mineral Springs Road Site, Buffalo, New York. August 4, 1998.

NYSDOT, 1990. Standard Specifications, Construction and Materials. Office of Engineering. January 2, 1990 with Addendum No. 1, November 18, 1993.

RETEC, 1999. Remedial Design / Work Plan, Mineral Springs Site, Buffalo, New York. February 10, 1999.

Appendix A –

Figure 1 and Site Photos



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NATIONAL FUEL GAS MINERAL SPRINGS ROAD MGP SITE 04870025			**PROPOSED ASPHALT CAP AND CATCH BASINS**
DATE: 9/14/07	DRWN: MAW/BIL		**FIGURE 1**

Site photos of blue stain in gravel area southwest of Building 8.

Appendix B –

Nature's Way Report

NATURE'S WAY
ENVIRONMENTAL CONSULTANTS & CONTRACTORS, INC.

CRITTENDEN
(716) 937-6527
SYRACUSE
(315) 635-9818

August 8, 2007

Mr. Charlie Burke
National Fuel Gas
365 Mineral Springs Road
Buffalo, New York 14210

Re: Summary of Site Work
National Fuel Gas Facility
365 Mineral Springs Road
Buffalo, New York 14210
Page 1 of 2

Dear Mr. Burke:

Please find the following summary report of activities and data collected pursuant to the scope of work outlined in our June 25, 2007 proposal.

A subsurface investigation was conducted on July 19, 2007 in the vicinity of Former Building #7, located south and west of Site Building #8, at the National Fuel Gas Mineral Springs Road Facility. This investigation consisted of the advancement of twenty earthprobe borings with a direct push Simco Earthprobe 200, securing continuous soil samples at 2.0 foot intervals to a maximum depth of 4.0 feet. Boring locations are depicted on the site map included as Attachment #1 to this report. A calibrated OVM/PID was utilized to scan sample jar head-space with readings recorded for each 2.0 foot interval. Detailed descriptions of the soil horizons encountered and OVM/PID readings recorded at each boring location are provided on individual soil boring logs included as Attachment #2 to this report.

Blue/ green staining was noted present in nine of the twenty borings, encountered at depths of 1.2' below ground surface (bgs) to 3.0' bgs, extending in depth from 1.4' to 3.5' bgs. The thickness of this blue staining ranged from approximately 0.2' to 1.0' thick. OVM readings slightly above background of 0.0 parts per million (ppm), were recorded for the 2.0' to 4.0' interval of EP 1(1.8 ppm) and the 0.0'-2.0' interval for EP 15 (19.6 ppm). Significantly elevated OVM readings were recorded for each of the 0.0' to 2.0' and 2.0' to 4.0' intervals at both the EP 4 (58.0ppm, 570.0 ppm) and EP 8 (108 ppm, 564 ppm) boring locations.

Well decommissioning was performed on MW 8 and MW 3 according to the methods outlined in our September 7, 2006 work plan. The broken surface casings at both MW 8 (2" diameter well) and MW 3, (4" diameter well) were removed, and these wells were subsequently over-drilled with a 4 1/4 HSA or 6 1/4 HSA to a completion depth of 16.0' below ground surface (bgs). The PVC well screen and riser was removed from the boring and the open hole was then tremmie grouted with a cement bentonite slurry introduced at bottom to displace groundwater and assure a proper seal. Well abandonment logs are included as Attachment #3 to this report.

NATURE'S WAY
ENVIRONMENTAL CONSULTANTS & CONTRACTORS, INC.

CRITTENDEN
(716) 937-6527
SYRACUSE
(315) 635-9818

Mr. Charlie Burke
National Fuel Gas

Summary of Site Work

Monitoring well repair was conducted at MW 21, located on Calais Avenue. A square was sawed within the asphalt, and the damaged road box and concrete seal were removed and replaced. After this restoration, top of casing measurements at the MW 21 location, as well as measurements at the MW 14 and MW 20 locations were surveyed with a transit. These recorded readings (not converted into elevations due to unknown benchmark location) are as follow:

MW 14	2.75
MW 20	4.98
MW 21	4.44

On August 1, 2007, a mini-excavator was mobilized to the site to perform a test pit in the vicinity of the stained soils along the stream bank adjacent to and down-gradient from the existing slurry wall. Visibly impacted soils were removed and stockpiled on plastic. The excavation was backfilled with clay and compacted, overlain by filter fabric and 3" surge stone.

Respectfully submitted,

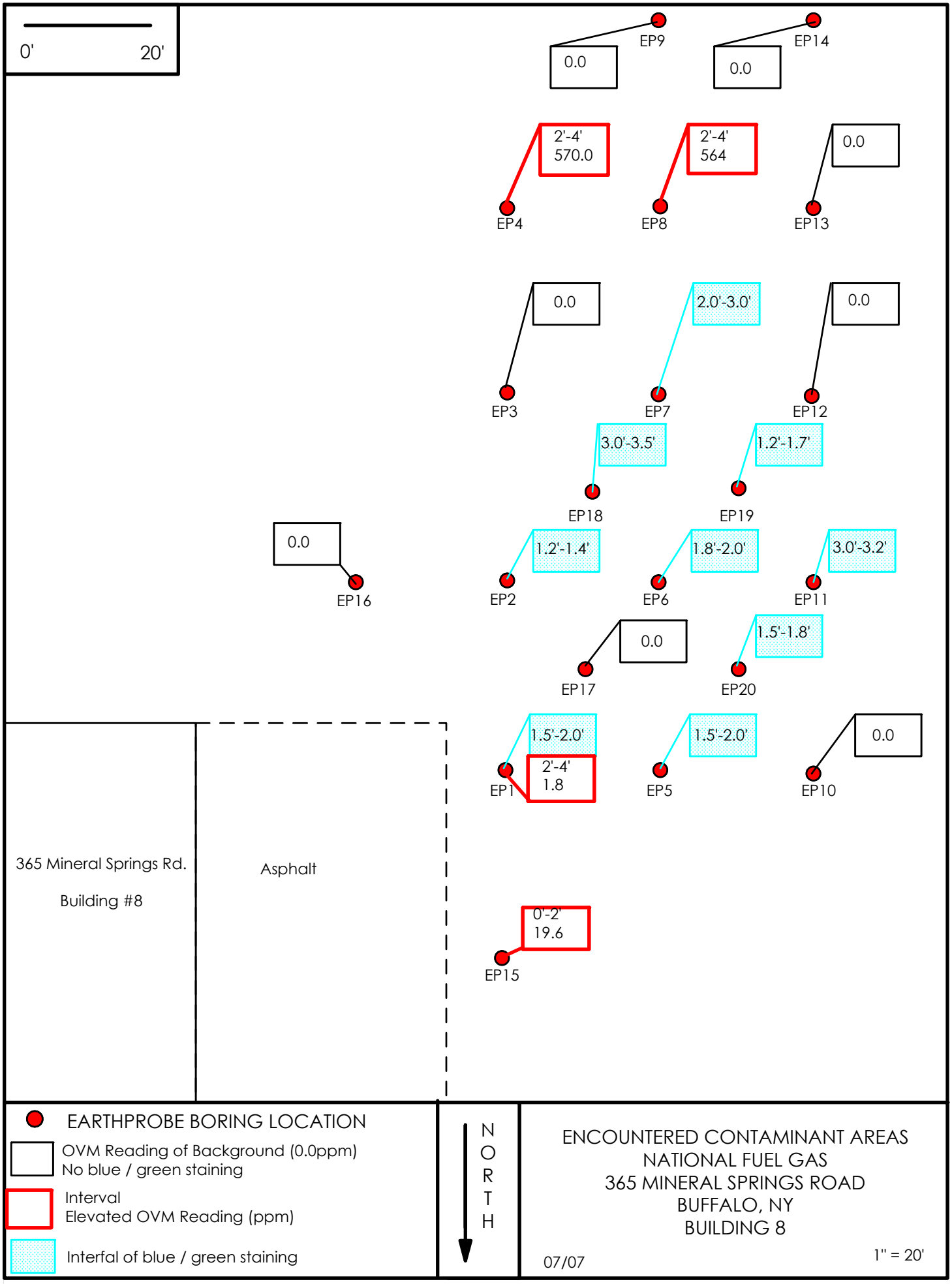
Dale M. Gramza
Manager of Geologic Services

NATURE'S WAY
ENVIRONMENTAL CONSULTANTS & CONTRACTORS, INC.

CRITTENDEN
(716) 937-6527
SYRACUSE
(315) 635-9818

Attachment #1

3553 CRITTENDEN ROAD • CRITTENDEN, NEW YORK 14038 • FAX (716) 937-9360
7 ZUK PIERCE DRIVE • CENTRAL SQUARE, NEW YORK 13036 • FAX (315) 635-9577


0'
20'
EP9
0.0
EP14
0.0
2'-4'
570.0
EP4
2'-4'
564
EP8
0.0
EP13
0.0
EP3
2.0'-3.0'
EP7
0.0
EP12
3.0'-3.5'
EP18
1.2'-1.7'
EP19
0.0
EP16
1.2'-1.4'
EP2
1.8'-2.0'
EP6
3.0'-3.2'
EP11
0.0
EP17
1.5'-1.8'
EP20
1.5'-2.0'
2'-4'
1.8
EP1
1.5'-2.0'
EP5
0.0
EP10
365 Mineral Springs Rd.
Building #8
Asphalt
0'-2'
19.6
EP15
EARTHPROBE BORING LOCATION
OVM Reading of Background (0.0ppm)
No blue / green staining
Interval
Elevated OVM Reading (ppm)
Interfal of blue / green staining
NORTH
ENCOUNTERED CONTAMINANT AREAS
NATIONAL FUEL GAS
365 MINERAL SPRINGS ROAD
BUFFALO, NY
BUILDING 8
07/07
1" = 20'

NATURE'S WAY
ENVIRONMENTAL CONSULTANTS & CONTRACTORS, INC.

CRITTENDEN
(716) 937-6527
SYRACUSE
(315) 635-9818

Attachment #2

3553 CRITTENDEN ROAD • CRITTENDEN, NEW YORK 14038 • FAX (716) 937-9360
7 ZUK PIERCE DRIVE • CENTRAL SQUARE, NEW YORK 13036 • FAX (315) 635-9577

Hole Number: EP 1

DATE: 07/19/07 ELEVATION:

PROJECT: Subsurface Earthprobe Investigation Located at 365 Mineral Springs Road Building #8, Buffalo, NY 14210

PREPARED FOR: National Fuel Gas

BORING LOCATION: See Map

SN	0/6	6/12	12/18	18/24	N	OVM	LITH	DESCRIPTION AND CLASSIFICATION	REC	COMMENTS
1						0.0		Gravel fill (0.5)	1.8'	Gravel fill to 0.5 foot over coarse silty fill with little gravel to 1.5 feet over sandy fill with some gravel to 2.0 over clayey lake sediment to end of boring
								Moist, brown and dark gray, gravelly (SANDY-SILT) fill with 15 to 25% gravel (1.5)		
								Moist, light brown, and GREEN, gravelly (SILTY-SAND) fill with 20 to 40% gravel, fibrous wood (2.0)		
2						1.8		Moist, gray (CLAYEY-SILT) with some clay, weakly thinly laminated (4.0)	1.8'	
								Boring Completed at 4.0 feet BGS		

0 5 10 15 20

LOGGED BY: Dale M. Gramza / Senior Geologist

Hole Number: EP 2

DATE: 07/19/07 ELEVATION:

PROJECT: Subsurface Earthprobe Investigation Located at 365 Mineral Springs Road
Building #8, Buffalo, NY 14210

PREPARED FOR: National Fuel Gas

BORING LOCATION: See Map

SN	0/6	6/12	12/18	18/24	N	OVM	LITH	DESCRIPTION AND CLASSIFICATION	REC	COMMENTS
1						0.0		Gravel fill (0.5)	1.8'	Gravel fill to 0.5 foot over clayey soil fill to 1.2 feet over coarse silty fill to 1.4 feet over sandy fill with little gravel to 3.0 feet over clayey lake sediment to end of boring
								Moist, brown (CLAYEY-SILT) fill with some clay (1.2)		
2						0.0		Extremely moist, BLUISH GREEN (SANDY-SILT) fill with little very fine size sand (1.4)	1.8'	
								Moist, distinctly mottled, rusty brown, gravelly (SILTY-SAND) fill with 15 to 25% gravel, very fine to fine size sand (3.0)		
								Moist, gray (CLAYEY-SILT) with some clay, thinly laminated (4.0)		
								Boring Completed at 4.0 feet BGS		

0 5 10 15 20

LOGGED BY: Dale M. Gramza / Senior Geologist

Hole Number: EP 3

DATE: 07/19/07 ELEVATION:

PROJECT: Subsurface Earthprobe Investigation Located at 365 Mineral Springs Road
Building #8, Buffalo, NY 14210

PREPARED FOR: National Fuel Gas

BORING LOCATION: See Map

SN	0/6	6/12	12/18	18/24	N	OVM	LITH	DESCRIPTION AND CLASSIFICATION	REC	COMMENTS
1						0.0		Gravel fill (0.5)	1.8'	Gravel fill to 0.5 foot over clayey soil fill to 0.8 foot over sandy fill to 3.2 feet over clayey lake sediment to end of boring
								Moist, brown (CLAYEY-SILT) fill with some clay (0.8)		
2						0.0		Moist, light gray to rusty brown, (SAND) fill with very fine to coarse size sand (3.2)	1.8'	
								Moist, gray (CLAYEY-SILT) with some clay, thinly laminated (4.0)		
								Boring Completed at 4.0 feet BGS		

0
5
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15
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LOGGED BY: Dale M. Gramza / Senior Geologist

Hole Number: EP 4

DATE: 07/19/07 ELEVATION:

PROJECT: Subsurface Earthprobe Investigation Located at 365 Mineral Springs Road
Building #8, Buffalo, NY 14210

PREPARED FOR: National Fuel Gas

BORING LOCATION: See Map

SN	0/6	6/12	12/18	18/24	N	OVM	LITH	DESCRIPTION AND CLASSIFICATION	REC	COMMENTS
1						58.0		Gravel fill (0.5)	1.5'	Gravel fill to 0.5 foot over mixed sandy fill with little gravel to 3.5 feet over silty lake sediment to end of boring
								Extremely moist, mixed brown and dark gray, gravelly (SILTY-SAND) fill with 15 to 25% gravel, very fine to coarse size sand		
2						570.0			1.6'	
								(3.5) Moist, gray (CLAYEY-SILT) with little clay, weakly thinly laminated (4.0)		
								Boring Completed at 4.0 feet BGS		

0 5 10 15 20

LOGGED BY: Dale M. Gramza / Senior Geologist PAGE 1 of 1

Hole Number: EP 5

DATE: 07/19/07 ELEVATION:

PROJECT: Subsurface Earthprobe Investigation Located at 365 Mineral Springs Road
Building #8, Buffalo, NY 14210

PREPARED FOR: National Fuel Gas

BORING LOCATION: See Map

SN	0/6	6/12	12/18	18/24	N	OVM	LITH	DESCRIPTION AND CLASSIFICATION	REC	COMMENTS
1						0.0		Gravel fill (0.5)	1.8'	Gravel fill to 0.5 foot over sandy fill to 0.9 foot over coarse silty fill to 1.5 feet over coarse silty fill to 2.0 feet over sandy fill with little gravel to 3.4 feet over silty lake sediment to end of boring
								Moist, white (SAND) fill with medium to coarse size sand (0.9)		
								Moist, brown (SANDY-SILT) fill with little very fine size sand (1.5)		
2						0.0		Moist BLUISH GREEN (SANDY-SILT) fill with little very fine size sand (2.0)	1.8'	
								Moist, distinctly mottled, rusty brown, gravelly (SILTY-SAND) fill with 15 to 25% gravel, very fine to medium size sand (3.4)		
								Moist, gray (CLAYEY-SILT) with little clay, weakly thinly laminated (4.0)		
								Boring Completed at 4.0 feet BGS		

0
5
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15
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LOGGED BY: Dale M. Gramza / Senior Geologist

Hole Number: EP 6

DATE: 07/19/07 ELEVATION:

PROJECT: Subsurface Earthprobe Investigation Located at 365 Mineral Springs Road
Building #8, Buffalo, NY 14210

PREPARED FOR: National Fuel Gas

BORING LOCATION: See Map

SN	0/6	6/12	12/18	18/24	N	OVM	LITH	DESCRIPTION AND CLASSIFICATION	REC	COMMENTS
1						0.0		Gravel fill (0.5) Moist, mixed brown and yellowish brown, (SANDY-SILT) fill with 5 to 15% gravel (1.8)	1.8'	Gravel fill to 0.5 foot over coarse silty fill with trace gravel to 1.8 feet over coarse silty fill to 2.0 feet over sany fill with little gravel to 3.7 feet over silty lake sediment to end of boring
2						0.0		Moist, BLUISH GREEN (SANDY-SILT) fill mixed with very fine size sand (2.0) Moist, rusty brown, gravelly (SILTY-SAND) fill with 15 to 25% gravel, very fine to medium size sand (3.7) Moist, gray (CLAYEY-SILT) with little clay, weakly thinly laminated (4.0) Boring Completed at 4.0 feet BGS	1.8'	

LOGGED BY: Dale M. Gramza / Senior Geologist

Hole Number: EP 7

DATE: 07/19/07 ELEVATION:

PROJECT: Subsurface Earthprobe Investigation Located at 365 Mineral Springs Road
Building #8, Buffalo, NY 14210

PREPARED FOR: National Fuel Gas

BORING LOCATION: See Map

SN	0/6	6/12	12/18	18/24	N	OVM	LITH	DESCRIPTION AND CLASSIFICATION	REC	COMMENTS
1						0.0		Gravel fill (0.5)	1.8'	Gravel fill to 0.5 foot over sandy fill with little gravel to 2.0 feet over coarse silty fill mixed with clayey soil fill to 3.0 feet over silty lake sediment to end of boring
								Moist, brown, gravelly (SILTY-SAND) fill with 15 to 25% gravel, very fine to fine size sand (2.0)		
2						0.0		Moist BLUISH GREEN (SANDY-SILT) fill mixed with light brown (CLAYEY-SILT) fill (3.0)	1.8'	
								Moist, grayish brown (CLAYEY-SILT) with little clay, weakly thinly laminated (4.0)		
								Boring Completed at 4.0 feet BGS		

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15
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LOGGED BY: Dale M. Gramza / Senior Geologist

Hole Number: EP 8

DATE: 07/19/07 ELEVATION:

PROJECT: Subsurface Earthprobe Investigation Located at 365 Mineral Springs Road
Building #8, Buffalo, NY 14210

PREPARED FOR: National Fuel Gas

BORING LOCATION: See Map

SN	0/6	6/12	12/18	18/24	N	OVM	LITH	DESCRIPTION AND CLASSIFICATION	REC	COMMENTS
1						108.0		Gravel fill (0.5)	1.8'	Gravel fill to 0.5 foot over sandy fill with little gravel to 3.5 feet over clayey lake sediment to end of boring
								Moist, mixed dark gray and rusty brown, gravelly (SILTY-SAND) fill with 15 to 25% gravel, very fine to fine size sand		
2						564.0			1.8'	
								(3.5) Moist, gray (CLAYEY-SILT) with some clay, weakly thinly laminated (4.0)		
								Boring Completed at 4.0 feet BGS		

0
5
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15
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LOGGED BY: Dale M. Gramza / Senior Geologist

Hole Number: EP 9

DATE: 07/19/07 ELEVATION:

PROJECT: Subsurface Earthprobe Investigation Located at 365 Mineral Springs Road
Building #8, Buffalo, NY 14210

PREPARED FOR: National Fuel Gas

BORING LOCATION: See Map

SN	0/6	6/12	12/18	18/24	N	OVM	LITH	DESCRIPTION AND CLASSIFICATION	REC	COMMENTS
1						0.0		Gravel fill (0.6)	1.8'	Gravel fill to 0.6 foot over sandy fill with little gravel to 2.0 feet over clayey soil fill 3.5 feet over sandy fill to 3.7 feet over clayey lake sediment to end of boring
								Moist, dark gray, gravelly (SILTY-SAND) fill with 15 to 25% gravel, very fine to fine size sand (2.0)		
2						0.0		Moist, brown (CLAYEY-SILT) fill with some clay (3.5)	1.9'	
								Extremely moist, dark gray (SILTY-SAND) fill with very fine to coarse size sand (3.7)		
								Moist, gray (CLAYEY-SILT) with little clay, weakly thinly laminated (4.0)		
								Boring Completed at 4.0 feet BGS		

0 5 10 15 20

LOGGED BY: Dale M. Gramza / Senior Geologist PAGE 1 of 1

Hole Number: EP 10 ABC

DATE: 07/19/07 ELEVATION:

PROJECT: Subsurface Earthprobe Investigation Located at 365 Mineral Springs Road
Building #8, Buffalo, NY 14210

PREPARED FOR: National Fuel Gas

BORING LOCATION: See Map

SN	0/6	6/12	12/18	18/24	N	OVM	LITH	DESCRIPTION AND CLASSIFICATION	REC	COMMENTS
1						0.0		Gravel fill 0.5	1.8'	Gravel fill to 0.5 foot over sandy fill with little gravel to refusal
								Moist, mixed dark gray and rusty brown, gravelly (SILTY-SAND) fill with 15 to 25% gravel, very fine to medium size sand		
2						0.0		2.6	1.8'	Three attempts to advance earthprobe boring within a 6.0' radius; refusal 2.6' bgs
								Earthprobe Refusal at 2.6' BGS		

0
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LOGGED BY: Dale M. Gramza / Senior Geologist

Hole Number: EP 11

DATE: 07/19/07 ELEVATION:

PROJECT: Subsurface Earthprobe Investigation Located at 365 Mineral Springs Road
Building #8, Buffalo, NY 14210

PREPARED FOR: National Fuel Gas

BORING LOCATION: See Map

SN	0/6	6/12	12/18	18/24	N	OVM	LITH	DESCRIPTION AND CLASSIFICATION	REC	COMMENTS
1						0.0		Gravel fill (0.6)	1.8'	Gravel fill to 0.6 foot over mixed sandy and clayey soil fill to 3.0 feet over gravel fill to 3.2 feet over silty lake sediment to end of boring
								Moist, mixed dark gray, gravelly (SILTY-SAND) fill and brown (CLAYEY-SILT) fill		
2						0.0		(3.0)	1.8'	
								Moist, BLUISH GRAY, very gravelly (SAND) fill with 40 to 60% gravel, very fine to fine size sand (3.2)		
								Moist, gray (CLAYEY-SILT) with little clay, weakly thinly laminated (4.0)		
								Boring Completed at 4.0 feet BGS		

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LOGGED BY: Dale M. Gramza / Senior Geologist

Hole Number: EP 12 AB

DATE: 07/19/07 ELEVATION:

PROJECT: Subsurface Earthprobe Investigation Located at 365 Mineral Springs Road
Building #8, Buffalo, NY 14210

PREPARED FOR: National Fuel Gas

BORING LOCATION: See Map

SN	0/6	6/12	12/18	18/24	N	OVM	LITH	DESCRIPTION AND CLASSIFICATION	REC	COMMENTS
1						0.0		Gravel fill (0.5)	2.0'	Gravel fill to 0.5 foot over sandy fill with little gravel to 1.5 feet over clayey soil fill to 3.0 feet over sandy fill with little gravel to 3.5 feet over clayey lake sediment to end of boring
								Moist, mixed gray and rusty brown, gravelly (SILTY-SAND) fill with 15 to 25% gravel (1.5)		
2						0.0		Moist, olive brown (CLAYEY-SILT) fill with some clay (3.0)	2.0'	
								Extremely moist, dark gray, gravelly (SILTY-SAND) fill with 15 to 25% gravel, very fine to fine size sand (3.5)		
								Moist, gray (CLAYEY-SILT) with little clay, weakly thinly laminated (4.0)		12A Refusal at 2.2' BGS, moved 5.0' into grid
								Boring Completed at 4.0 feet BGS		

0 5 10 15 20

LOGGED BY: Dale M. Gramza / Senior Geologist PAGE 1 of 1

Hole Number: EP 13

DATE: 07/19/07 ELEVATION:

PROJECT: Subsurface Earthprobe Investigation Located at 365 Mineral Springs Road
Building #8, Buffalo, NY 14210

PREPARED FOR: National Fuel Gas

BORING LOCATION: See Map

SN	0/6	6/12	12/18	18/24	N	OVM	LITH	DESCRIPTION AND CLASSIFICATION	REC	COMMENTS
1						0.0		Gravel fill 0.5	1.8'	Gravel fill to 0.5 foot over sandy fill with little gravel to 3.5 feet over silty lake sediment to end of boring
								Moist, dark gray, gravelly (SILTY-SAND) fill with 15 to 25% gravel, very fine to fine size sand		
2						0.0		3.5	1.8'	
								Moist, gray (CLAYEY-SILT) with little clay, weakly thinly laminated 4.0		
								Boring Completed at 4.0 feet BGS		

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LOGGED BY: Dale M. Gramza / Senior Geologist

Hole Number: EP 14

DATE: 07/19/07 ELEVATION:

PROJECT: Subsurface Earthprobe Investigation Located at 365 Mineral Springs Road
Building #8, Buffalo, NY 14210

PREPARED FOR: National Fuel Gas

BORING LOCATION: See Map

SN	0/6	6/12	12/18	18/24	N	OVM	LITH	DESCRIPTION AND CLASSIFICATION	REC	COMMENTS
1						0.0		Gravel fill (0.6)	1.9'	Gravel fill to 0.6 foot over mixed sandy fill with little gravel to 3.5 feet over silty lake sediment to end of boring
								Moist, mixed dark gray and dark brown, gravelly (SILTY-SAND) fill with 15 to 25% gravel, very fine to medium size sand		
2						0.0			1.9'	
								(3.5) Moist, gray (CLAYEY-SILT) with little clay, weakly thinly laminated with occasional fine size roots (4.0)		
								Boring Completed at 4.0 feet BGS		

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LOGGED BY: Dale M. Gramza / Senior Geologist PAGE 1 of 1

Hole Number: EP 15

DATE: 07/19/07 ELEVATION:

PROJECT: Subsurface Earthprobe Investigation Located at 365 Mineral Springs Road
Building #8, Buffalo, NY 14210

PREPARED FOR: National Fuel Gas

BORING LOCATION: See Map

SN	0/6	6/12	12/18	18/24	N	OVM	LITH	DESCRIPTION AND CLASSIFICATION	REC	COMMENTS
1						19.6		Gravel fill (0.8)	1.9'	Gravel fill to 0.8 foot over sandy fill with little gravel to 3.0 feet over apparent silty slack water sediment to end of boring
								Moist, rusty brown, gravelly (SILTY-SAND) fill with 15 to 25% gravel, very fine to fine size sand (3.0)		
2						0.0			1.8'	
								Extremely moist, brown (CLAYEY-SILT) with little clay, blocky soil structure (4.0)		
								Boring Completed at 4.0 feet BGS		

0 5 10 15 20

LOGGED BY: Dale M. Gramza / Senior Geologist

Hole Number: EP 16

DATE: 07/19/07 ELEVATION:

PROJECT: Subsurface Earthprobe Investigation Located at 365 Mineral Springs Road
Building #8, Buffalo, NY 14210

PREPARED FOR: National Fuel Gas

BORING LOCATION: See Map

SN	0/6	6/12	12/18	18/24	N	OVM	LITH	DESCRIPTION AND CLASSIFICATION	REC	COMMENTS
1						0.0		Gravel fill 0.5	1.9'	Gravel fill to 0.5 foot over sandy fill with little gravel to 2.0 feet over mixed sandy and clayey soil fill to 3.8 feet over silty slack water sediment to end of boring
								Moist, brown and gray, gravelly (SILTY-SAND) fill with 15 to 25% gravel, very fine to medium size sand 2.0		
2						0.0		Extremely moist, mixed dark gray (SILTY-SAND) fill with 5 to 15% gravel and occasional red brick fragments and gray (CLAYEY-SILT) fill with some clay 3.8	1.9'	
								Moist, gray (CLAYEY-SILT) with little clay, blocky soil structure 4.0		
								Boring Completed at 4.0 feet BGS		

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LOGGED BY: Dale M. Gramza / Senior Geologist

Hole Number: EP 17

DATE: 07/19/07 ELEVATION:

PROJECT: Subsurface Earthprobe Investigation Located at 365 Mineral Springs Road Building #8, Buffalo, NY 14210

PREPARED FOR: National Fuel Gas

BORING LOCATION: See Map

SN	0/6	6/12	12/18	18/24	N	OVM	LITH	DESCRIPTION AND CLASSIFICATION	REC	COMMENTS
1						0.0		Gravel fill (0.5)	1.8'	Gravel fill to 0.5 foot over sandy fill with little gravel to 1.0 foot over sandy fill with trace gravel to 3.8 feet over apparent silty slack water sediment to end of boring
								Moist, gray and dark gray, gravelly (SILTY-SAND) fill with 15 to 25% gravel, very fine to fine size sand (1.0)		
2						0.0		Moist, distinctly mottled, rusty brown (SILTY-SAND) fill with 5 to 15% gravel, very fine to medium size sand	1.9'	
								(3.8)		
								Moist, gray (CLAYEY-SILT) with little clay, blocky soil structure (4.0)		
								Boring Completed at 4.0 feet BGS		

0 5 10 15 20

LOGGED BY: Dale M. Gramza / Senior Geologist

Hole Number: EP 18

DATE: 07/19/07 ELEVATION:

PROJECT: Subsurface Earthprobe Investigation Located at 365 Mineral Springs Road
Building #8, Buffalo, NY 14210

PREPARED FOR: National Fuel Gas

BORING LOCATION: See Map

SN	0/6	6/12	12/18	18/24	N	OVM	LITH	DESCRIPTION AND CLASSIFICATION	REC	COMMENTS
1						0.0		Gravel fill (0.6)	1.8'	Gravel fill to 0.6 foot over coarse silty fill with little gravel, concrete and brick to 3.0 feet over coarse silty fill with wet gravel to 3.5 feet over silty lake sediment to end of boring
								Moist, dark gray and olive gray, gravelly (SANDY-SILT) fill with 15 to 25% gravel, concrete and red brick fragments		
2						0.0			1.8'	
								(3.0) Extremely moist BLUEISH GREEN and rusty brown, gravelly (SANDY-SILT) fill with 15 to 25% gravel and red bricks, little very fine size sand (3.5)		
								Moist, gray (CLAYEY-SILT) with little clay, thinly laminated with very thin coarse silt lenses (4.0)		
								Boring Completed at 4.0 feet BGS		

0 5 10 15 20

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Hole Number: EP 19

DATE: 07/19/07 ELEVATION:

PROJECT: Subsurface Earthprobe Investigation Located at 365 Mineral Springs Road
Building #8, Buffalo, NY 14210

PREPARED FOR: National Fuel Gas

BORING LOCATION: See Map

SN	0/6	6/12	12/18	18/24	N	OVM	LITH	DESCRIPTION AND CLASSIFICATION	REC	COMMENTS
1						0.0		Gravel fill (0.5)	1.9'	Gravel fill to 0.5 foot over mixed sandy and clayey soil fill to 1.2 feet over coarse silty fill mixed with clay to 1.7 feet over sandy fill with trace gravel to 3.5 feet over silty lake sediment to end of boring
								Moist, mixed dark gray, gravelly (SILTY-SAND) fill and brown (CLAYEY-SILT) fill (1.2)		
2						0.0		Moist, BLUEISH GRAY (SANDY-SILT) fill mixed with brown (CLAYEY-SILT) fill (1.7)	1.9'	
								Moist, rusty brown (SILTY-SAND) fill with 5 to 15% fine size gravel, very fine to coarse size sand (3.5)		
								Moist, gray (CLAYEY-SILT) with little clay, weakly thinly laminated (4.0)		
								Boring Completed at 4.0 feet BGS		

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LOGGED BY: Dale M. Gramza / Senior Geologist

Hole Number: EP 20

DATE: 07/19/07 ELEVATION:

PROJECT: Subsurface Earthprobe Investigation Located at 365 Mineral Springs Road
Building #8, Buffalo, NY 14210

PREPARED FOR: National Fuel Gas

BORING LOCATION: See Map

SN	0/6	6/12	12/18	18/24	N	OVM	LITH	DESCRIPTION AND CLASSIFICATION	REC	COMMENTS
1								Gravel fill (0.5)	1.8'	Gravel fill to 0.5 foot over mixed coarse silty fill with little gravel to 1.5 feet over coarse silty fill to 1.8 feet over partially cemented coarse silty fill to 3.4 feet over silty lake sediment to end of boring
								Moist, mixed gray and brown, gravelly (SANDY-SILT) fill with 15 to 25% gravel and occasional red brick fragments (1.5)		
2								Extremely moist BLUEISH GRAY (SANDY-SILT) fill with little very fine size sand (1.8)	1.8'	
								Moist, dark gray, partially cemented (SANDY-SILT) fill with little very fine to fine size sand (3.4)		
								Moist, gray (CLAYEY-SILT) with little clay, thinly laminated with very thin coarse silt lenses (4.0)		
								Boring Completed at 4.0 feet BGS		

0 5 10 15 20

LOGGED BY: Dale M. Gramza / Senior Geologist

NATURE'S WAY
ENVIRONMENTAL CONSULTANTS & CONTRACTORS, INC.

CRITTENDEN
(716) 937-6527
SYRACUSE
(315) 635-9818

Attachment #3

3553 CRITTENDEN ROAD • CRITTENDEN, NEW YORK 14038 • FAX (716) 937-9360
7 ZUK PIERCE DRIVE • CENTRAL SQUARE, NEW YORK 13036 • FAX (315) 635-9577

HOLE NUMBER: MW 3

DATE: 7/19/07

ELEVATION:

PROJECT: Subsurface Earthprobe Investigation Located at 365 Mineral Springs Road
Building #8, Buffalo, NY 14210

PREPARED FOR: National Fuel Gas

BORING LOCATION: See Map

SN	0/6	6/12	12/18	18/24	OVM	LITH	DESCRIPTION AND CLASSIFICATION	REC	MONITORING WELL	REMARKS	COMMENTS
							Overdrill 4" PVC well with 6 1/4" HSA to 16.0 feet Remove 10.0' screen and 5.0' of riser pipe, tremmie grout open hole			Cement / Bentonite Grout	Remove surface casing Note: Well casing cover missing, solid debris in well from from 7.3 to 16.0 feet Water Level at 5.5' BGS
							16.0		16.0		

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15
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LOGGED BY: Dale M. Gramza / Senior Geologist

HOLE NUMBER: MW 8

DATE: 7/19/07 ELEVATION:

PROJECT: Subsurface Earthprobe Investigation Located at 365 Mineral Springs Road
Building #8, Buffalo, NY 14210

PREPARED FOR: National Fuel Gas

BORING LOCATION: See Map

SN	0/6	6/12	12/18	18/24	OVM	LITH	DESCRIPTION AND CLASSIFICATION	REC	MONITORING WELL	REMARKS	COMMENTS
							Overdrill 2" PVC well with 4 1/4" HSA to 16.0 feet				Remove surface casing
							Remove 10.0' screen and 5.0' of riser pipe, tremmie grout open hole				Note: Well casing cover missing, solid debris in well from from 5.5 to 16.0 feet
											Water Level at Ground Surface
										Cement / Bentonite Grout	
							16.0 Over drilling completed at 16.0' feet		16.0		

LOGGED BY: Dale M. Gramza / Senior Geologist

Appendix C –

Petromat Product Literature

Technical Data Sheet

PROPEX FABRICS

Style 4598

Petromat®

nonwoven paving fabric

Style 4598 is a nonwoven polypropylene paving fabric. We wish to advise that Petromat® 4598 meets the following minimum average roll values (MARV) listed below:

Property	Test Method	Minimum Average Roll Value (English)	Minimum Average Roll Value (Metric)
Unit Weight	ASTM-D-5261	4.1 oz/yd^2	140 g/m^2
Tensile Strength	ASTM-D-4632	101 lbs	0.450 kN
Elongation	ASTM-D-4632	50 %	50 %
Mullen Burst	ASTM-D-3786	200 psi	1370 kPa
Asphalt Retention	ASTM-D-6140	0.20 gal/yd^2	0.90 l/m^2
UV Stability	ASTM-D-4355	70 % at 150 hrs	70 % at 150 hrs

Propex Fabrics Inc. manufactures Petromat® 4598 in the USA. The values listed are a result of testing conducted in on-site laboratories in accordance with our quality control procedures (QEP). This information will be supplied to Propex Fabrics Inc.'s original customer of record at the time of fabric shipment.

DATE ISSUED: 03/10/05

Propex Fabrics Inc.
260 The Bluffs
Austell, GA 30168
PH: 770-944-4569
PH: 800.445.7732
FX: 770.944.4584 (Quotes)
FX: 770.944.4678 (Technical)
www.geotextile.com

PROPEX FABRICS

Civil Engineering Fabrics

Petromat®
Installation Guide

Contents

Part I – What Petromat Is And What It Does

Petromat is a nonwoven polypropylene fabric. When used in combination with an asphalt tack coat, the Petromat System forms an asphalt membrane interlayer within the pavement section. This layer acts as a barrier to surface water infiltration and limits softening of the subgrade and freeze-thaw damage, which could otherwise occur. The Petromat membrane interlayer also absorbs stresses, improving resistance to pavement fatigue and reflective cracking. These combined Petromat functions have been widely shown to extend the life of asphalt cement concrete overlays and chip seal surface treatments. Petromat also promotes longer pavement life in new asphalt cement concrete pavements.

The Petromat System was first introduced in 1966. Since that time, hundreds of millions of square yards of Petromat have been installed around the world. Over 100 million square yards of paving fabric are installed annually on thousands of jobs in the United States.

The key to the performance of the Petromat System is proper installation. This installation guide provides important information to help you install the Petromat System properly and safely. Because no guide can cover every installation challenge, an experienced representative is available through your Propex distributor to help with your special conditions.

Call 1-800-445-SPEC for the Propex distributor nearest you.

Installation Checklist For Hot Mix Asphalt Concrete Overlays

SURFACE PREPARATION

- Clean surface free of dirt, water and debris (page 8).
- Fill cracks greater than 1/8" (page 9).
- Correct areas of subgrade failure (pages 8, 9, 11).
- Portland cement concrete pavements require special care (page 10).

TACK COAT APPLICATION

- Uncut paving grade asphalt is preferred (page 5).
- Verify application rate between 0.20 gallons/square yard and 0.30 gallons/square yard (page 11).
- Check function of distributor truck (pages 6, 7, 12).
- Apply tack coat 2" to 3" beyond area of Petromat placement (page 11).
- Do not allow traffic on tack coat (page 12).
- Special care is needed for emulsified asphalt tack coat (pages 5, 20).

PETROMAT PLACEMENT

- Protect paving fabric from elements until ready to use (page 4).
- Install smooth side up, fuzzy side down (pages 13, 14).
- Verify even roll brake tension (page 14).
- Avoid sharp turns (pages 14, 17).
- Overlap joints 1" to 3" (page 14).
- Verify tack coat or emulsion is placed between all overlaps (page 14).
- Do not place more than can be paved in the same day (page 15).
- Allow only construction traffic on paving fabric (page 5).

OVERLAY PLACEMENT

- Apply a minimum of 1.5" of compacted asphalt concrete (page 15).
- Maximum asphalt temperature 325°F (page 15).

Installation Checklist For Chip Seal/Paving Fabric Systems

SURFACE PREPARATION

- o Clean surface free of dirt, water and debris (pages 8, 16).
- o Fill cracks greater than 1/8" (pages 9, 16).
- o Correct areas of subgrade failure (pages 8, 16).

TACK COAT APPLICATION

- o Check function of distributor truck (pages 6, 7, 12).
- o Verify residual asphalt tack coat application rate between 0.20 gallons/square yard and 0.30 gallons/square yard (page 16).
- o Apply tack coat 2" to 3" wider than Petromat (page 11).

PETROMAT PLACEMENT

- o Protect paving fabric from elements until ready to use (page 4).
- o Install smooth side up, fuzzy side down (page 17).
- o Verify even roll brake tension (page 17).
- o Avoid sharp turns (pages 14, 15, 17).
- o Overlap joints 1" to 3" (page 17).
- o Verify tack coat or emulsion is placed between all overlaps (page 17).
- o Do not place more than can be paved in the same day (page 15).
- o Allow only construction traffic on paving fabric (page 5).

SANDING AND ROLLING

- o Broadcast dry sand, 4 to 6 pounds per square yard (page 17).
- o Roll with rubber-tire roller until the fabric is saturated with tack coat (page 17).

PLACEMENT OF CHIP SEAL

- o Remove excess sand (page 17).
- o Visually inspect fabric bond at all overlaps (page 17).
- o Apply chip seal overspray. Increase application rate where paving fabric is dry (page 17).
- o Place chips and roll according to local specifications (page 17).

Part II – Materials And Equipment For Installation

A. PETROMAT

Material The principal component of the Petromat System is the nonwoven paving fabric designed specifically for use in pavement rehabilitation projects. One side of the Petromat fabric is heat-set, or fused, to create a smooth surface. This heat-set side reduces bleed-through of the asphalt tack coat and also helps prevent fabric pick-up by trucks during hot weather installation. Both of these conditions cause problems with paving fabrics that are "fuzzy" on both sides. Petromat has a tight, needle-punched, nonwoven structure that absorbs and holds the asphalt tack coat to provide a durable, stable waterproofing membrane. Fabrics with looser structures may not sufficiently stabilize the asphalt tack coat and may compress during overlay placement, resulting in asphalt bleed-through.

Petromat rolls come in widths to match most roadway requirements. A sample specification for paving fabric is included in the Appendix to this installation guide.

Storage and Handling Use care in handling and storing Petromat rolls to limit potential damage to the fabric. Petromat comes from the factory in a black plastic wrapper to protect the fabric from moisture and exposure to sunlight.

The wrapper should be left intact around the roll for continued protection until the material is to be placed. Avoid getting moisture in the fabric as this can reduce bonding of the fabric to the pavement. Do not store Petromat rolls on the ground where rain or other runoff can get into the fabric.

Prolonged exposure to sunlight can cause degradation of paving fabric. We recommend protecting the fabric from sunlight and limiting exposure to less than two weeks.

Petromat comes wound on a cardboard tube or core. Take care to avoid breaking this core. To protect the core during unloading, a pipe slightly smaller in diameter and length than the core can be inserted inside the roll. Do not drag or push the material off the truck onto the end of the roll. A pipe can also be inserted during installation of the paving fabric to prevent breaking the core of the roll. If the core breaks accidentally, the pipe will stiffen the core enough to place the fabric.

Temporary Traffic Construction vehicle traffic will not damage the Petromat. However, truck and equipment drivers should maintain slow speeds while driving on the fabric. Care should be taken not to make any sudden starts, stops or turns.

Freshly installed paving fabric may have less skid resistance than dry pavement, and moisture can further reduce the skid resistance. Traffic should not be permitted on the paving fabric due to safety considerations. If it is necessary to allow traffic on the fabric before the overlay is placed, the surface should be sanded. The paving fabric surface is slippery when wet. All safety precautions, including but not limited to warning signs and speed reductions, should be taken to limit the possibility of a skidding hazard.

B. TACK COAT MATERIALS

The Petromat System consists of Petromat paving fabric combined with an asphalt cement tack coat. Each element depends on the other for optimum performance. The Petromat fabric provides durability to the tack coat, such that it performs its waterproofing function even when deformed.

The tack coat is a hot liquid asphalt seal applied to the pavement surface to saturate the paving fabric and bond it to the pavement. The quality of the asphalt cement tack coat is one of the most important factors in successful installation of the Petromat System. Poor placement technique or use of an inappropriate asphalt can lead to slipping of the pavement overlay or unsatisfactory waterproofing performance. Uncut paving grade asphalt cements (AC, AR or penetration grades) are preferred for use as the tack coat material. The most commonly used are AC-20 and AR-4000. The actual grade of asphalt cement will depend on the geographic area and the season.

Asphalt emulsions (RS or CRS grades) are not recommended, but can be used if necessary. If an emulsion must be used, it is important that a sufficient amount be applied such that the residual asphalt will provide the necessary coverage. Also allow sufficient time for the emulsion to cure before laying the Petromat. More information regarding use of emulsified asphalts is provided in Part V of this installation guide.

Cutback asphalts (RC, MC and SC grades) or emulsions containing oil distillates should not be used for the tack coat. These materials contain solvents that can lead to instability of the overlay and are therefore unsuitable for use with Petromat.

C. DISTRIBUTOR TRUCK

Uniform application of the tack coat is vital to ensure that the Petromat is saturated with asphalt and can provide its full waterproofing benefit. A distributor truck is preferred to obtain the most uniform tack coat application rate possible. The condition of the distributor truck should not be overlooked. Prior to beginning the job, check the spray nozzles on the truck to verify that a uniform spray is delivered.

The tack coat should not be applied with heavy spots, streaks or gaps. The height of the spray bar and spray nozzles can be adjusted to attain the correct spray width and overlap. (See Figure 1)

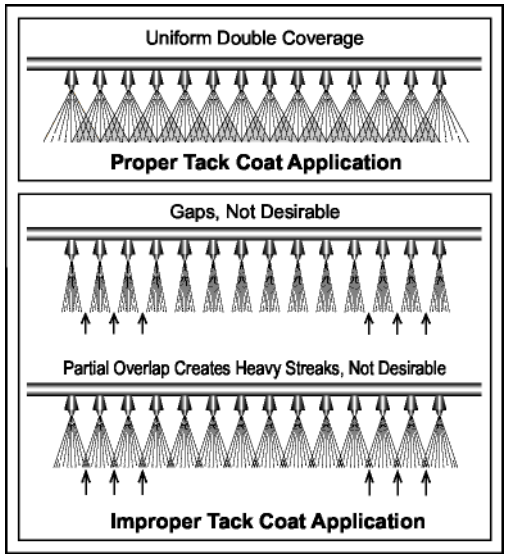


Figure 1 **DISTRIBUTOR TRUCK SPRAYS**

If there is not room on the site to move a distributor truck, hand spray or use a squeegee to place the tack coat. If hand spraying or squeegee placement is used, pay careful attention to maintaining the proper amount and uniform tack coat application.

It is very important that the tack coat application rate be verified. The actual amount of tack coat on the pavement surface should be measured. This can be calculated based on the change in weight of the distributor truck, change in level gauge, on-board computer or other reliable metering system. Before relying on on-board metering systems, their sensitivity to the truck speed should be checked.

D. INSTALLATION EQUIPMENT

Experienced Petromat installers have a specially equipped tractor or distributor truck designed to place the paving fabric. This equipment has attachments to lay down and broom in the paving fabric and apply uniform tension as the laydown operation proceeds.

Like any piece of construction equipment, the laydown equipment should be in good condition. The equipment should have a roll brake at each end of the fabric boom to prevent uncontrolled unrolling of the paving fabric. The brake tension should be adjusted evenly to limit wrinkling of the fabric. The laydown equipment will often have brooms attached to smooth out the fabric as it is laid. The brooms should be in good condition. The laydown equipment may also have a tension bar to apply the paving fabric smoothly and keep wind from rolling up the edges of the fabric as it is laid. The tension bar can often be adjusted as needed to smooth out the paving fabric. Best results may be obtained if this bar is bowed out. (See Figure 2)

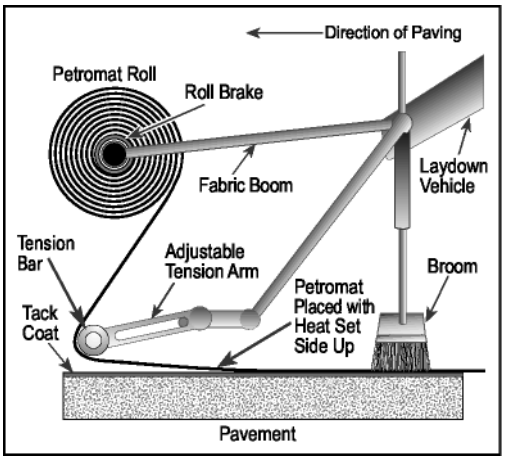


Figure 2 **COMPONENTS OF LAYDOWN EQUIPMENT**

If necessary, Petromat can be installed by hand. In this case, insert a pipe through the core of the roll and use hand brakes at each end to apply tension to the fabric during the placement procedure.

E. MISCELLANEOUS EQUIPMENT

The following miscellaneous equipment may be useful during the Petromat installation:

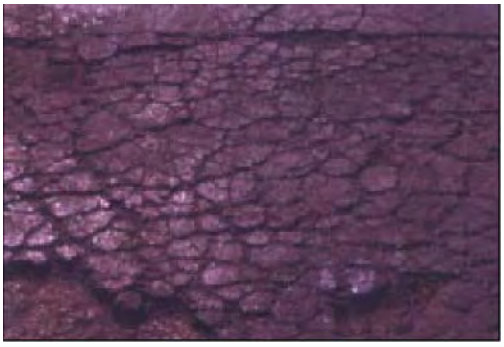
- Scissors, utility knife or other fabric-cutting device.
- Stiff bristle push brooms.
- Length of standard pipe, slightly shorter and smaller in diameter than the roll core, to insert inside the core when handling the fabric.
- Bucket and squeegee or small hand wand to apply asphalt on fabric joints and in areas not reached with the distributor truck.
- Rubber-tire roller to smooth fabric into the tack coat for chip seals, or to correct blisters or other loss of bond between the fabric and underlying pavement.
- Washed concrete sand (as prescribed).

Part III - Installation For Hot Mix Asphalt Concrete Overlays

A. APPLICATIONS

The most common use of the Petromat System is as an interlayer for asphalt concrete hot mix overlays on existing asphalt pavements and on Portland cement concrete pavements. Petromat can be installed with new asphalt concrete pavements following similar procedures. This section presents detailed guidance for installation of the Petromat System in these applications.

Surface Preparation The first step in the installation of the Petromat System on existing asphalt concrete pavements is the preparation of the pavement to receive the tack coat. Before beginning the project, determine what pavement surface preparation will be required. Give careful attention to areas that show signs of structural or subgrade distress, such as alligator cracking or pavement deformation. In these areas, the engineer should specify procedures for removing or stabilizing the questionable pavement area.



Photograph of unstable pavement requiring removal and replacement prior to overlay.

It is important that the surface on which the Petromat System is placed is dry and free of dirt. Sweep off accumulations of dust, debris, water, oil and other foreign matter. Power brooms may be helpful where large areas are to be resurfaced.

Sharp changes in the pavement surface should either be ground down or smoothed out with an asphalt concrete leveling course. The guiding principle is that the tack coat should be able to completely cover the pavement surface and the Petromat conform to the surface.

Where grooves in milled pavements result in vertical surfaces, a leveling course will be required (Figure 3). When paving over a shoulder or other sharp edge, the surface should be ground down or a leveling course of asphalt mix used to smooth it out. Use a fine mix for the leveling course so that the tack coat can not sink into the pores.

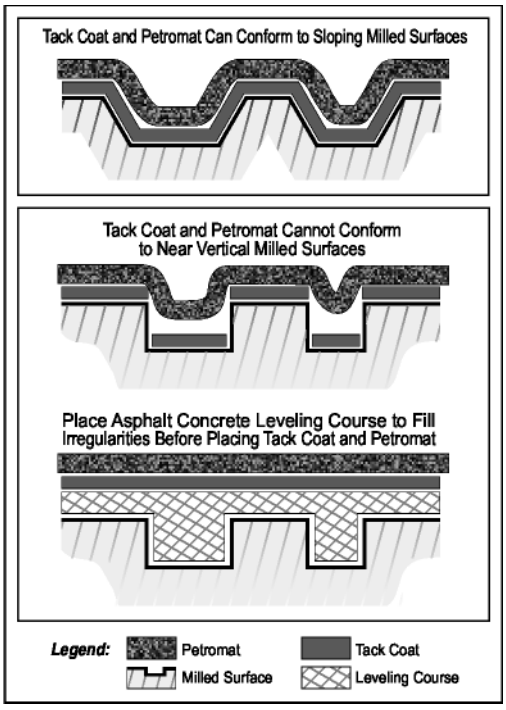


Figure 3 **PREPARATION OF MILLED OR VERTICAL SURFACES**

Crack Treatment Cracks less than 1/8" wide do not require any special attention before application of the tack coat. Cracks from 1/8" to 3/8" should be filled with a liquid crack sealant so that the tack coat cannot seep down into the crack. Fill cracks larger than 3/8" with a more stable crack filler, such as hot or cold asphalt mix, emulsion slurry, or commercially available crack filler.

If the crack filler contains an emulsified asphalt or cutback asphalt, allow it to cure completely before placing the tack coat and Petromat. Otherwise, the paving fabric will form a membrane that can trap volatiles or moisture, leading to separation of the paving fabric from the pavement surface.

Fill cracks flush with or slightly below the existing pavement surface. If cracks are overfilled, such that the filler mounds up above the surface of the pavement, a noticeable bump in the pavement can result. This can lead to shoving of the overlay or bleeding of excess asphalt. (See Figure 4)

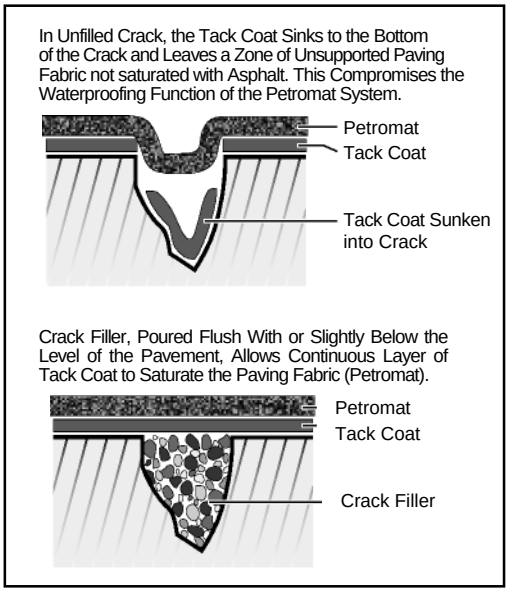


Figure 4 **CRACK FILLING**

C. PREPARATION OF PORTLAND CEMENT CONCRETE PAVEMENT SURFACES

Inadequate pavement stability is one of the leading causes of early cracking of overlays with and without paving fabric. For the best performance of the overlay, there should be no differential movement at joints in the existing concrete pavement. Differential movement will result in early reflective cracking. It may not be possible to stabilize the joints sufficiently to obtain the full benefit from the Petromat System. In these cases, we recommend either Propex's Petrotac® or Pro-Guard® pavement repair composite membranes, which tolerate slightly more movement.

There are three approaches that may be used in applying the Petromat System over existing Portland cement concrete pavements. The approach depends on the condition of the existing pavement and the anticipated traffic volume. For best results, an asphalt concrete leveling course can be used over the Portland cement concrete pavement.

Light Traffic, Stable Pavement In low-traffic volume areas, it may be possible to place the Petromat System directly over the existing Portland cement concrete pavement. For this approach, the traffic volume should be less than about 5,000 vehicles per day with a low percentage of buses and other heavy vehicles. For good performance of the overlay, there should be no differential movement at cracks and joints. Clean the surface and fill cracks as described for asphalt cement concrete pavements.

Sharp changes in the pavement surface should be given special attention, as they may indicate an unstable concrete slab. Unstable areas must be stabilized before proceeding. Stable areas with sharp changes in grade should either be ground down or smoothed out with a leveling course of asphalt mix.

Heavy Traffic, Stable Pavement Where traffic levels are relatively heavy but the concrete pavement is stable, a leveling course of asphalt concrete should be placed before the Petromat System is installed. In this approach, there should be no differential movement at joints and cracks in the Portland cement concrete.

This leveling course should be 1" to 2" thick. The asphalt concrete mix should leave a relatively smooth surface after compaction. Do not use an open, coarse mix, because this will allow the tack coat to seep down into the pores, leaving inadequate tack coat to saturate the paving fabric. (See Figure 5)

Unstable Pavement Crack and seat or grout rehabilitation techniques should be used where the existing Portland cement concrete pavement experiences differential movement. In the crack and seat approach, the existing pavement is typically broken into sections about 3' to 6' square. The broken surface is then rolled in place with a heavy roller to provide a stable surface.

After stabilizing the concrete, an asphalt hot mix leveling course is placed. The leveling course should be 1" to 2" thick. The leveling course asphalt mix should not be so coarse and open as to allow the tack coat to seep into the pore spaces. The Petromat System and overlay may then be installed.

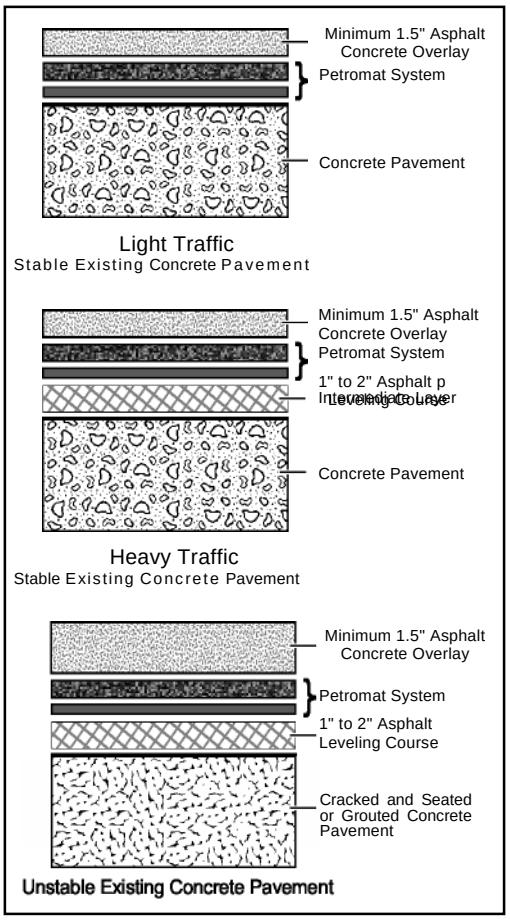


Figure 5 **PORTLAND CEMENT CONCRETE PAVEMENT TREATMENTS**

D. NEW PAVEMENTS

Petromat can be used with new asphalt concrete pavement construction to limit water infiltration and prolong pavement life. The paving fabric should be placed in the pavement section about one-third to one-half of the way up from the bottom. There should be at least 1.5" of compacted asphalt over the Petromat. The asphalt concrete on which the Petromat is placed should be relatively densely graded to limit loss of tack coat.

E. TACK COAT PLACEMENT

Tack Coat Amount It is critical that the tack coat be applied correctly. Excessive or insufficient tack coat can lead to shoving or delamination of the overlay. The leading cause of poor performance of overlays with paving fabric is placement of an insufficient amount of tack coat.

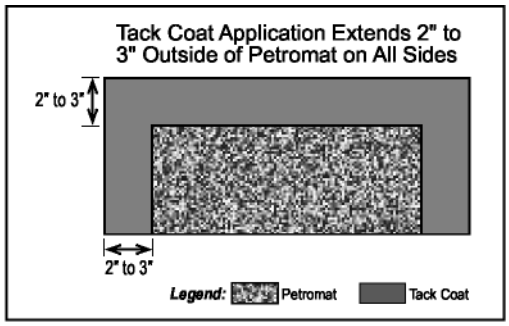


Figure 6 **TACK COAT APPLICATION**

The tack coat should extend beyond the paving fabric by 2" to 3" on all sides. Tack coat should also be applied between all fabric overlaps. A tack coat application rate of 0.25 gallons per square yard is required with Petromat under most conditions when using an uncut paving grade asphalt tack coat. A minimum application rate of 0.22 gallons per square yard is required to saturate Petromat and bond it to the pavement surfaces. It is critical not to apply excess tack coat in locations where vehicles do a lot of hard starting, stopping and turning or on steep grades (greater than 8%). These areas include intersections, bus stops and sharp turns. In these locations, the maximum tack coat application rate should be limited to 0.20 to 0.25 gallons per square yard. Applying less tack coat than the above recommended amounts can result in construction problems or long-term pavement performance problems.

TABLE 1: GALLONS OF UNCUT PAVING GRADE ASPHALT TACK COAT PER MILE OF ROAD

Width of Application (Feet)	Tack Coat Application Rate		
	0.20 gallons/ Square Yard	0.25 gallons/ Square Yard	0.30 gallons/ Square Yard
8	940	1170	1410
10	1170	1470	1760
12	1410	1770	2110
14	1640	2050	2460
16	1880	2350	2820
20	2350	2930	3520
24	2820	3520	4220
30	3520	4400	5280

Close-up of streaks of asphalt tack coat. Streaks are unacceptable for the installation of the Petromat system (refer to Part II C of this

Also, the application rate should not exceed 0.30 gallons per square yard, as this may lead to overlay rutting and shoving. The optimum application rate depends on a number of factors including: pavement roughness, pavement porosity, and whether or not a leveling course is used. In general, more tack coat is needed for rough and porous pavements. Less tack coat is typically needed when placing Petromat over a fine mix asphalt leveling course. Experienced Petromat installers are able to adjust the tack coat application rate within the range of 0.20 to 0.30 gallons per square yard to achieve optimum pavement performance and ease of construction. Table 1 gives the tack coat volume for one mile of road of varying widths, assuming the use of uncut paving grade asphalt tack coat.

The tack coat volume can be monitored using the mechanical or visual gauging system on the distributor equipment. The truck weight tickets can be used to verify the application rate.

Before applying the tack coat, it is important to verify proper operation of the distributor truck. The distributor truck should apply an even and uniform spray of tack. An accumulation of tack may build up where the distributor truck starts and stops. Accumulations of excessive tack coat can lead to overlay rutting and shoving. Consequently, starting and stopping should be kept to a minimum and squeegees should be used to spread any accumulated tack.

Photograph of uniform tack coat installation.

Construction traffic should be kept off the tack coat before the Petromat is placed. Traffic can pick up the tack coat, leaving insufficient tack coat to saturate the paving fabric and bond it to the pavement and the new overlay.

Tack Coat Temperature The temperature of the asphalt tack coat should be high enough to allow uniform tack coat application. The allowable temperature range for uncut paving grade asphalt cement tack coat material is 290°F to 325°F. These temperatures correlate with widely accepted temperatures for asphalt placement.

Air Temperature Most state and local agencies have specifications for the minimum temperature for placement of asphalt tack coats and hot mixes, and the applicable specifications should be followed. In the absence of such specifications, the following guidelines are offered. For uncut paving grade asphalt cement tack coat materials, the air temperature should be sufficient to allow adequate "tack" or stickiness to hold the fabric in place. This temperature will vary for different asphalt types. As a rule-of-thumb, the temperature should be 50°F and rising.

F. PETROMAT PLACEMENT

Temperature The surface temperature of the tack coat at the time that Petromat is placed should not exceed 325°F. The temperature of the tack coat drops very quickly after it contacts the pavement surface, so this is generally not a consideration. When uncut paving grade asphalt cement tack coat is used, Petromat can usually be placed closely behind the distributor truck. Place the paving fabric while the tack coat is still sticky enough to hold the fabric in place. Paving fabric can be placed after the tack coat has lost its stickiness, but pneumatic rolling may be necessary to keep the material in place. The heat of the overlay will then soften and draw the asphalt tack up into the paving fabric. In very hot weather, (in excess of 100°F, 38°C) it helps to let the asphalt tack coat firm up before placing the fabric, while in cool weather, the fabric should be placed into the tack coat immediately.

Paving Fabric Placement – Mechanical Petromat has a fuzzy side and a relatively smooth, heat-set side. Install the fabric with the fuzzy side down into the tack coat. With the smooth side up, fabric pick-up by construction equipment and bleed-through of the tack coat will be minimized. For ease of installation, Petromat is rolled at the factory with the fuzzy side "in" so that it can easily be installed correctly when using lay- down equipment.

A pipe slightly smaller in diameter and length than the roll core can be inserted into the roll. This adds strength and helps the core resist buckling, especially if the core was accidentally broken during handling.

Initially, hold the fabric in place at the beginning point and unroll about 20' to 50' of fabric into the tack coat. The material should be lined up with the tack coat and installed as smoothly as possible.

During placement, turns of the laydown equipment should be made gradually to limit wrinkling of the fabric. Avoid moving equipment on the paving fabric before the overlay is placed. This can cause wrinkles in the paving fabric and in extreme instances can rip the fabric. The fabric roll brakes should be adjusted evenly. Poorly adjusted brakes result in uneven tension in the paving fabric, which can cause wrinkles during placement.

Petromat can be placed on slopes of up to about 8%. On steeper slopes, it may be difficult to compact the asphalt overlay without slippage. Take extra precaution when maneuvering installation equipment on slopes.

Photograph of hand brake for manual placement.

Paving Fabric Placement – Manual When installing Petromat by hand, use hand brakes to maintain tension on the fabric and minimize wrinkling. Do not rest the Petromat roll on the pavement and roll it out. This will not provide adequate tension on the fabric and will also incorrectly place the smooth, heat-set side down into the tack coat.

The fabric should be broomed in, working from the center out, to smooth the fabric into the tack coat. When placing Petromat by hand, the tack coat may have cooled such that the fabric does not adhere well. Under these circumstances, it may be helpful to roll the installed paving fabric using a rubber-tire roller to promote adhesion to the pavement.

Joints and Overlaps Tack coat should be applied between all overlaps. At joints, overlap the fabric by 1" to 3". End joints should be made to overlap or "shingle" in the direction that the pavement overlay will be placed. Adjacent rolls should also overlap 1" to 3". Overlaps of adjacent rolls may be greater than 3" in some cases, depending on the width of the road. However, adjacent rolls should not have overlaps wider than 6". Do not overlay on joints or overlaps that do not have tack coat between the overlapping fabrics. Care should be taken to limit excessive tack or emulsion beyond the overlap.

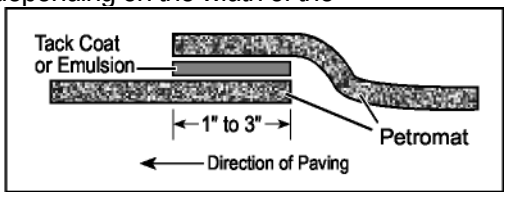


Figure 7 **JOINTS AND OVERLAPS**

Drains, Expansion Joints and Other Penetrations At drains, expansion joints or other penetrations, Petromat can be placed over the opening. After the fabric is in place, cut out the excess fabric around the inside of the opening.

Curves Sharp curves may be encountered that will not allow mechanical paving fabric placement without wrinkles. In this condition, it may be desirable to cut and piece the paving fabric around the curve. The joints in this procedure should be treated as with other overlaps mentioned previously.

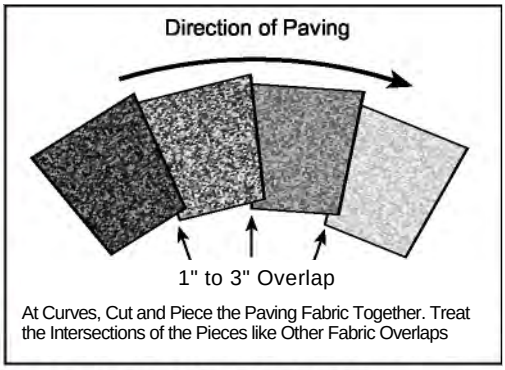


Figure 8 **PETROMAT PLACEMENT AROUND CURVES**

G. OVERLAY PLACEMENT

The asphalt concrete overlay can be placed immediately after the Petromat has been installed. No cure time is necessary when using an uncut paving grade asphalt tack coat, and there is no need for additional tack coat application before paving. Installation of the Petromat System by an experienced crew will easily stay well ahead of paving operations. However, no more paving fabric should be placed than will be covered in the same day by the paving crew.

A maximum temperature for the hot mix will usually be dictated by the governing state or local agency. In the absence of such specification, the maximum temperature allowed should not exceed 325°F at the time of placement.

The overlay should be designed based on the condition of the pavement and the anticipated traffic. A minimum compacted thickness of 1.5” is required. Thinner overlays will not generate enough heat to draw the asphalt tack coat up into the paving fabric and produce a waterproof membrane. If the overlay thickness is tapered toward the edges, Petromat should not be placed where the thickness tapers to less than 1.5”, or the edge should be milled to allow a minimum 1.5” overlay thickness to the edge.

Part IV – Installation of Chip Seal/Paving Fabric Systems

A. APPLICATIONS

Petromat can be used with chip seals as a cost-effective maintenance solution for low volume pavements. A chip seal/paving fabric system consists of aggregate chips embedded in an asphalt binder and placed over an asphalt-saturated paving fabric. The Petromat paving fabric provides an excellent seat for the chips and forms a continuous, long-lasting, waterproofing membrane. The primary difference between this application and use with hot mix asphalt concrete overlays is that the chip seal procedure does not generate enough heat to draw the tack coat up into the paving fabric. Additional measures, such as rolling the fabric and placing a second tack coat, are used to fully saturate the paving fabric.

B. SURFACE PREPARATION

Surface preparation for chip seal overlays follows the procedures given in Part II B for hot mix overlays.

The surface on which the Petromat will be placed should be free of dirt, debris, water, oil and loose stone. A power broom may be helpful in preparing the roadway surface. areas showing signs of subgrade distress should be repaired.

Cracks greater than 1/8" should be sealed with a liquid crack sealant. Where cracks greater than 3/8" are present, a more stable crack filler should be used such as hot or cold asphalt mix or commercial crack filler.

C. TACK COAT PLACEMENT

The tack coat for this application can be either an uncut paving grade asphalt cement or an emulsified asphalt. Again, a pure uncut asphalt cement is recommended instead of the emulsion. The tack coat should provide enough asphalt to saturate the paving fabric and bind the Petromat to both the existing pavement surface and new surface treatment.

Use of an uncut paving grade asphalt tack coat will follow the same guidelines given in Part II E. Under normal conditions the tack coat application rate for Petromat should be 0.25 gallons per square yard of uncut paving grade asphalt cement. A greater amount of tack coat is needed for rough and porous surfaces. Less tack coat is typically needed when placing Petromat over a smooth surface. An experienced Petromat installer can evaluate project requirements and adjust the application rate as necessary. The tack coat application rate should be within the range of 0.20 to 0.30 gallons per square yard of residual asphalt.

When an emulsion is used, the application rate must be increased to allow for complete evaporation of water and additives in the emulsified asphalt. The residual asphalt coverage, after curing, should be 0.25 gallons per square yard. Emulsified asphalt curing time can become critical. The length of time required for all the water and additives to evaporate is highly dependent on the type of emulsion and weather conditions.

Additional details for use of emulsified asphalts are given in Part V.

Uncut paving grade asphalt tack coats should be placed at temperatures of 290°F to 325°F. Emulsified asphalt tack coats should be applied at temperatures below 160°F.

D. PETROMAT PLACEMENT

The paving fabric should be placed into the tack coat smoothly and without wrinkles. Place the fuzzy side of the Petromat fabric down. With the smooth side up, fabric pick-up by construction equipment is limited. Fabric roll brakes should be adjusted to provide even tension. Poorly adjusted brakes can cause wrinkles in the fabric. Turns of the installation equipment should be made gradually to avoid wrinkling.

Overlaps of the Petromat should be kept to a minimum when used with chip seal pavements. Tack coat should be applied between all overlaps. At joints, overlap the fabric by 1" to 3". Adjacent rolls should also overlap 1" to 3". Overlaps of adjacent rolls may be greater than 3" in some cases, depending on the width of the road. However, adjacent rolls should never have overlaps wider than 6". Do not apply chip seal treatment on joints or overlaps that do not have tack coat between the overlapping fabrics. Care should be taken not to spray excessive tack or emulsion beyond the overlap.

E. SANDING AND ROLLING

Chip seal pavements require sanding and rolling once the Petromat fabric has been placed. A uniform layer of sand is applied to the fabric at the rate of 4 to 6 pounds per square yard. The sanded fabric is thoroughly rolled using a rubber-tire roller. This step is important to ensure a strong bond between the paving fabric and the pavement and at overlap joints. During the rolling operation, the tack coat should be observed to come up from beneath and saturate the paving fabric, changing the fabric color from gray to a dark brown or black.

F. CHIP SEAL PLACEMENT

The next step is to sweep off any accumulations of sand or debris. Prior to chip seal application, inspect the fabric to verify that it is adhered to the pavement and that overlaps are tightly bonded. Apply additional tack to any loose overlaps and reroll as necessary to saturate overlap and achieve a good bond. The chip seal is then placed following procedures dictated by state or local agencies. This usually involves a tack of emulsified asphalt into which chip stone is immediately set and secured by rolling. In areas where the paving fabric appears to be dry or not fully saturated, the chip seal tack coat application should be increased by about 0.1 gallons per square yard. Do not use cutback asphalts for the overspray. Finally, roll the surface to stabilize the chips and embed them in the tack coat. A rubber-tire roller is often used to minimize breaking of the chips.

Part V – Special Considerations

A. EMULSIFIED ASPHALT TACK COATS

Emulsified Asphalts Uncut paving grade asphalt cement is the preferred tack coat for use in the Petromat System. Emulsified asphalt tack coats can be used with the Petromat System; however, there are several construction-related concerns that make emulsions difficult to use. These include the relatively long curing time required for emulsions and the higher volume of tack coat that must be applied.

Emulsified asphalts are a blend of asphalt and water. The asphalt content may be only 50% to 70% of the total emulsion. Emulsions must be applied at a high rate to ensure the required residual asphalt coverage after the water has evaporated. For example:

1. Emulsion has 60% by volume asphalt content.
2. A tack coat with a residual asphalt coverage of 0.25 gallons per square yard is required.
3. The required emulsion application rate = 0.25 ÷ 0.6 = 0.42 gallons per square yard.

Emulsions are relatively free-flowing at these high application rates. They will tend to run off comparatively gentle slopes or uneven pavements, leaving no asphalt on the high points and an excess of asphalt in low spots.

The curing time for emulsified asphalt tack coats can become critical. Sufficient time must be allowed for all water and any additives to evaporate. The length of time necessary is dependent on the type of emulsion, whether rapid setting (RS, CRS), medium setting (MS, CMS) or slow setting (SS, CSS). Weather conditions also affect the curing time significantly. The medium-and slow-setting emulsions (MS, CMS, SS and CSS) require much longer curing times, which makes them impractical for use with paving fabrics. Table 2 provides cure time guidelines for rapid-setting emulsions.

TABLE 2: CURING TIME FOR RAPID-SETTING EMULSIFIED ASPHALTS (RS & CRS)

Air Temperature	Humidity		
	Dry	Moderate	Humid
60°F	2 hrs.	3 hrs.	4 hrs.
75°F	1 hrs.	2 hrs.	3 hrs.
90°F	0.5 hr.	1 hr.	2 hrs.

When cured, the surface will be tacky, and the color will have changed from an initial brown hue to glossy black. In windy weather, the surface of an emulsified asphalt tack coat may cure without the full thickness curing. Before installing the fabric, check carefully that the emulsion has cured thoroughly and not just skinned over.

Temperature When emulsified asphalt tack coats are used, the air temperature should be 60°F and rising. Cool temperatures lengthen the time that it takes for the tack coat to cure. The temperature of the asphalt emulsion itself should not exceed 160°F.

C. WET CONDITIONS

There is always a risk of poor bonding within the pavement system if moisture is present during construction. This is also true when paving fabrics are used. Therefore, Propex recommends the existing pavement surface, tack coat, and the Petromat be completely dry during construction.

Photograph of a site that is too wet for overlay placement.

If the pavement surface is wet when the tack coat is placed, the tack coat may not properly bond to the existing pavement, leading to an unsatisfactory installation. We do not recommend placing the asphalt tack coat on a wet pavement surface.

If the surface of the tack coat becomes wet before the paving fabric is placed, squeegee standing water off the surface and allow the surface to dry before placing the Petromat. Rolling the fabric with a rubber-tire roller may be required to improve adhesion. Petromat fabric should not be placed on wet tack coat.

Propex also recommends that the Petromat be completely dry prior to placement of the overlay. However, if Petromat is slightly damp to the touch, an overlay can be placed. If free water can be forced from the paving fabric or is beaded on the surface, allow the fabric to dry before placing the overlay. A squeegee or broom can be used to force the water out of the paving fabric to help accelerate the drying process. Rain will sometimes cause a blistered appearance in the Petromat surface. If this occurs, the fabric should be rolled down with a rubber-tire compactor before the overlay is placed.

B. RECYCLING OF PAVEMENTS CONTAINING PETROMAT

If pavements containing Petromat are to be recycled, we recommend that the milling machine does not cut deep enough to penetrate the Petromat System, so that the waterproof, stress-relieving interlayer remains intact. If a pavement containing Petromat must be recycled, field studies have shown that standard cold milling techniques can be used in the recycling operation. Satisfactory performance has been obtained at proportions of up to 70% recycled pavement (containing Petromat) to 30% virgin hot mix.

Part VI – Troubleshooting Guide

A. WRINKLES

Wrinkles may be formed during placement of the paving fabric. Causes include out-of adjustment roll brakes on the laydown equipment, sharp turns of the laydown equipment and maneuvering of equipment on the paving fabric. Wrinkles that result in three layers of fabric should be repaired.

Generally, these wrinkles will be more than 1" high. They should be slit and laid flat in the direction of paving. Extra tack coat should be placed at the location of the overlap. Wrinkles less than 1" high are usually not a problem and can be left in place.

Photograph of wrinkle that requires repair.

Photograph of wrinkle that can be left in place.

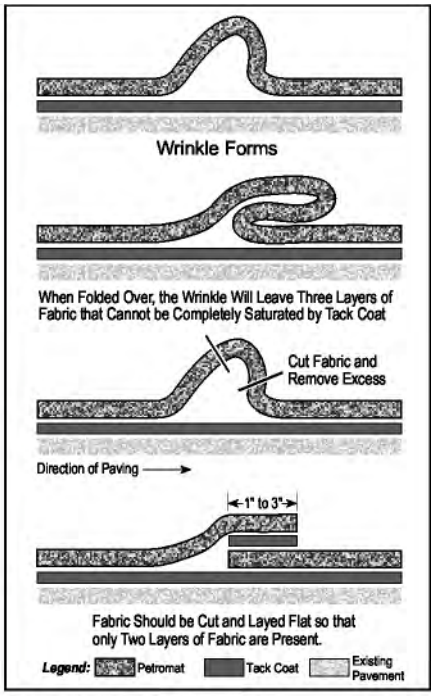


Figure 9 **WRINKLE REPAIR**

B. TRUCKS PICK UP FABRIC

In hot weather, construction traffic may pick up the paving fabric. Petromat is designed with a fuzzy (beard) side and a smooth (heat-set) side. Install the fabric with the smooth (heat-set) side up to limit the potential for trucks to pick up the fabric. If this problem does occur, broadcast sand or hot mix over the fabric. Be sure to sweep off any excess sand before placing the asphalt concrete overlay. The amount of tack coat should not be reduced to remedy this condition, unless it exceeds the previously prescribed rate of application.

It is also possible to go to a stiffer grade of asphalt tack coat material, such as from an AR-4000 to an AR-8000, to reduce this problem. This minimizes asphalt seeping through the paving fabric and sticking to the tires of the equipment.

C. BLISTERS

Blisters may form under the paving fabric before overlay construction if the pavement is saturated with water. This must be corrected before the overlay is placed, or they can cause delamination of the overlay. Blisters can be treated by rolling the paving fabric with a rubber-tire roller until the fabric adheres to the pavement surface. If it is suspected that the subgrade is thoroughly saturated, it may be necessary to install drainage.

D. EXCESS TACK COAT AND BLEED-THROUGH

Bleed-through occurs when excess tack coat material seeps through the asphalt concrete overlay to the surface. This can happen even when relatively thick overlays are used. Bleed-through can soften the overlay mix and cause rutting and shoving of the overlay.

Bleeding can occur where the distributor truck stops and starts, leaving a thick spot in the tack coat. Improper adjustment of the spray bar can leave heavy streaks of tack coat, also leading to bleed-through. During tack coat application, check adjustment of the equipment and keep the distributor truck moving, limiting starting and stopping. Use a squeegee to spread any excess tack coat before it cools. Alternatively, blot up any heavy spots in the tack coat using dry sand. Broadcast the sand over the heavy spots and then sweep away excess.

Photograph of broadcasting asphalt on Petromat.

E. OVERLAY DELAMINATION OR SHOVING

Historically, overlay delamination or shoving is the leading cause of complaints on the service of pavements containing paving fabric. The main cause of overlay delamination or shoving is insufficient tack coat. If the tack coat is too light to saturate the paving fabric and adhere it to the pavement, there will be a dry layer at the fabric/pavement interface. In extreme cases, the overlay may literally peel off the old pavement. It is critical to check and verify the uniformity and quantity of the tack coat spray from the distributor at the beginning of the job and at intervals throughout the operation. Also be sure the pavement and paving fabric are dry during construction and prior to overlay placement.

F. DIFFICULTY BONDING FABRIC TO PAVEMENT

Rolling with a rubber-tire roller can improve adhesion of the paving fabric to the tack coat in a number of situations. Rolling can be particularly helpful when the tack coat has cooled and in locations where the tack coat has been reduced, such as at intersections. In these and other situations, a rubber-tire roller applies a uniform pressure across the fabric to set it into the tack coat. However, rolling should not be used as a substitute for placing the amount of tack coat prescribed in this document.

Appendix

Paving Fabric Guide Specification*

DESCRIPTION

This work shall consist of furnishing and placing an asphalt overlay geotextile (paving fabric) beneath a pavement overlay or between pavement layers to provide a water-resistant membrane and crack-retarding layer.

MATERIAL REQUIREMENTS

Paving Fabric: The paving fabric will be a staple fiber, needle-punched, nonwoven material consisting of at least 85 percent by weight polyolefins, polyesters or polyamides. The paving fabric shall be resistant to chemical attack, rot and mildew and shall have no tears or defects that will adversely alter its physical properties. The fabric shall be specifically designed for pavement applications and be heat-set on one side to reduce bleed-through of tack coat and to minimize fabric pick-up by construction equipment during installation. The fabric shall meet the physical requirements specified in Table 1.

Tack Coat: The tack coat used to impregnate the fabric and bond the fabric to the pavement shall be the same grade asphalt cement as used in the hot mix asphalt. A cationic or anionic emulsion may be used as approved by the Engineer. The Contractor shall follow the recommendations of the paving fabric manufacturer when an asphalt emulsion is used. The use of cutbacks or emulsions that contain solvents shall not be permitted.

CONSTRUCTION AND INSTALLATION REQUIREMENTS

Shipping and Storage: The paving fabric shall be kept dry and wrapped such that it is protected from the elements during shipping and storage. If stored outdoors, the fabric shall be elevated and protected with a waterproof cover. The paving fabric shall be labeled in accordance with ASTM D 4873-88, “Standard Guide for Identification, Storage, and Handling of Geotextiles.”

Weather Limitations: The air and pavement temperatures shall be at least 50°F and rising for placement of asphalt cement and shall be at least 60°F and rising for placement of asphalt emulsion. Neither asphalt tack coat nor paving fabric shall be placed when weather conditions are not suitable, in the opinion of the Engineer.

Surface Preparation: The pavement surface shall be dry and be thoroughly cleaned of all dirt and oil to the satisfaction of the Engineer. Cracks 1/8” wide or greater shall be cleaned and filled with suitable bituminous material or by a method approved by the Engineer. Crack-filling material shall be allowed to cure prior to placement of paving fabric. Potholes and other pavement distress shall be repaired. Repairs shall be performed as directed by the Engineer.

Tack Coat Application: The tack coat shall be applied using a calibrated distributor spray bar. Hand spraying, squeegee and brush application may be used in locations where the distributor truck cannot reach. Every effort shall be made to keep hand spraying to a minimum.

* Note: This specification is for an overlay application, not for a chip seal treatment. For a chip seal specification, please contact Proper Fabrics Inc.

The tack coat shall be applied uniformly to the prepared, dry pavement surface. The tack coat application rate must be sufficient to saturate the fabric and to bond the fabric to the existing pavement surface. The tack coat application rate shall be 0.22 to 0.30 gallons per square yard as required by the roadway surface and environmental conditions. When using emulsions, the application rate must be increased as directed by the Engineer to offset the water content of the emulsion. Within street intersections, on steep grades or in other zones where vehicle speed changes are common, the normal application rate shall be reduced by about 20 percent as directed by the Engineer, but to not less than 0.20 gallons per square yard.

The temperature of the tack coat shall be sufficiently high to permit a uniform spray pattern. For asphalt cements, the minimum temperature shall be 290°F. To avoid damage to the fabric, distributor tank temperatures shall not exceed 325°F. For asphalt emulsions, the distributor tank temperatures shall be maintained between 130°F and 160°F.

The target width of the tack coat application shall be equal to the paving fabric width plus 6". Tack coat application shall be wide enough to cover the entire width of fabric overlaps. The tack coat shall be applied only as far in advance of paving fabric installation as is appropriate to ensure a tacky surface at the time of paving fabric placement. Traffic shall not be allowed on the tack coat. Excess tack coat shall be cleaned from the pavement.

Paving Fabric Placement: The paving fabric shall be placed onto the tack coat using mechanical or manual laydown equipment capable of providing a smooth installation with a minimum amount of wrinkling or folding. The paving fabric shall be placed before the asphalt cement tack coat cools and loses its tackiness. Paving fabric shall not be installed in areas where the overlay asphalt tapers to a minimum compacted thickness of less than 1.5".

When asphalt emulsions are used, the emulsion shall be allowed to cure properly such that essentially no water moisture remains prior to placing the paving fabric. Fabric wrinkles severe enough to cause folds shall be slit and laid flat. Brooming and/or rubber-tire rolling will be required to maximize paving fabric contact with the pavement surface. Additional hand-placed tack coat may be required at overlaps and repairs as required by the Engineer.

Turning of the paver and other vehicles shall be done gradually and kept to a minimum to avoid movement and damage to the paving fabric. Abrupt starts and stops shall also be avoided. Damaged fabric shall be removed and replaced with the same type of fabric and a tack coat.

Joints and Overlaps: At joints, fabric rolls shall overlap by 1"to 3". End joints and joints from repair of wrinkles should be made to overlap or "shingle" in the direction that the pavement overlay will be placed. Overlaps of adjacent rolls may be as great as 6" to accommodate variations between the width of the roadway and the paving fabric. Excess fabric shall be cut and removed to ensure that overlaps of adjacent rolls do not exceed 6". A uniform application of tack coat shall be applied between all fabric overlaps. Any locations that do not have tack between the overlaps shall be corrected by manual placement of tack coat prior to overlay construction.

All areas with paving fabric placed will be paved the same day. No traffic except necessary construction traffic will be allowed to drive on the paving fabric.

Overlay Placement: Asphalt overlay construction shall closely follow fabric placement. All areas in which paving fabric has been placed will be paved during the same day. Excess tack coat that bleeds through the paving fabric shall be removed. Excess tack coat can be removed by broadcasting hot mix or sand on the paving fabric. Excess sand or hot mix should be removed before beginning the paving operation. In the event of rainfall on the paving fabric prior to the placement of the asphalt overlay, the paving fabric must be allowed to dry completely before asphalt is placed. Overlay asphalt thickness shall meet the requirements of the contract drawings and documents. The minimum compacted thickness of overlay asphalt shall not be less than 1.5" in areas of paving fabric installation.

METHOD OF MEASUREMENT

Paving Fabric: The paving fabric will be measured by the square yard.

Tack Coat: Tack coat will be measured by the gallon.

BASIS OF PAYMENT

Paving Fabric: The accepted quantities of paving fabric will be paid for at the contract unit price per square yard in place.

Tack Coat: The accepted quantities of tack coat for the paving fabric will be paid for at the contract unit price per gallon complete in place.

TABLE 1: PHYSICAL REQUIREMENTS OF PAVING FABRICS[1, 2, 3]

Property	Test Method	Units	Required Values
Tensile Strength	ASTM D 4632-91	Pounds	90
Tensile Elongation	ASTM D 4632-90	%	50
Asphalt Retention	TX DOT 3099	Gallons/Square Yard	0.20
Melting Point	ASTM D 276-87	°F	300
Surface Texture	Visual Inspection	——	Heat-Set On One Side

NOTES

1 Certification of conformance from paving fabric manufacturer may be required.

2 All numerical values represent minimum average roll values (average of test results from any sampled roll in a lot shall meet or exceed the minimum values) in weaker principal direction. Lot shall be sampled according to ASTM D 4354-89, "Practice for Sampling of Geosynthetics for Testing."

3 Conformance of paving fabrics to specification property requirements shall be determined in accordance with ASTM D 4759-88, "Practice for Determining the Specification Conformance of Geosynthetics."