

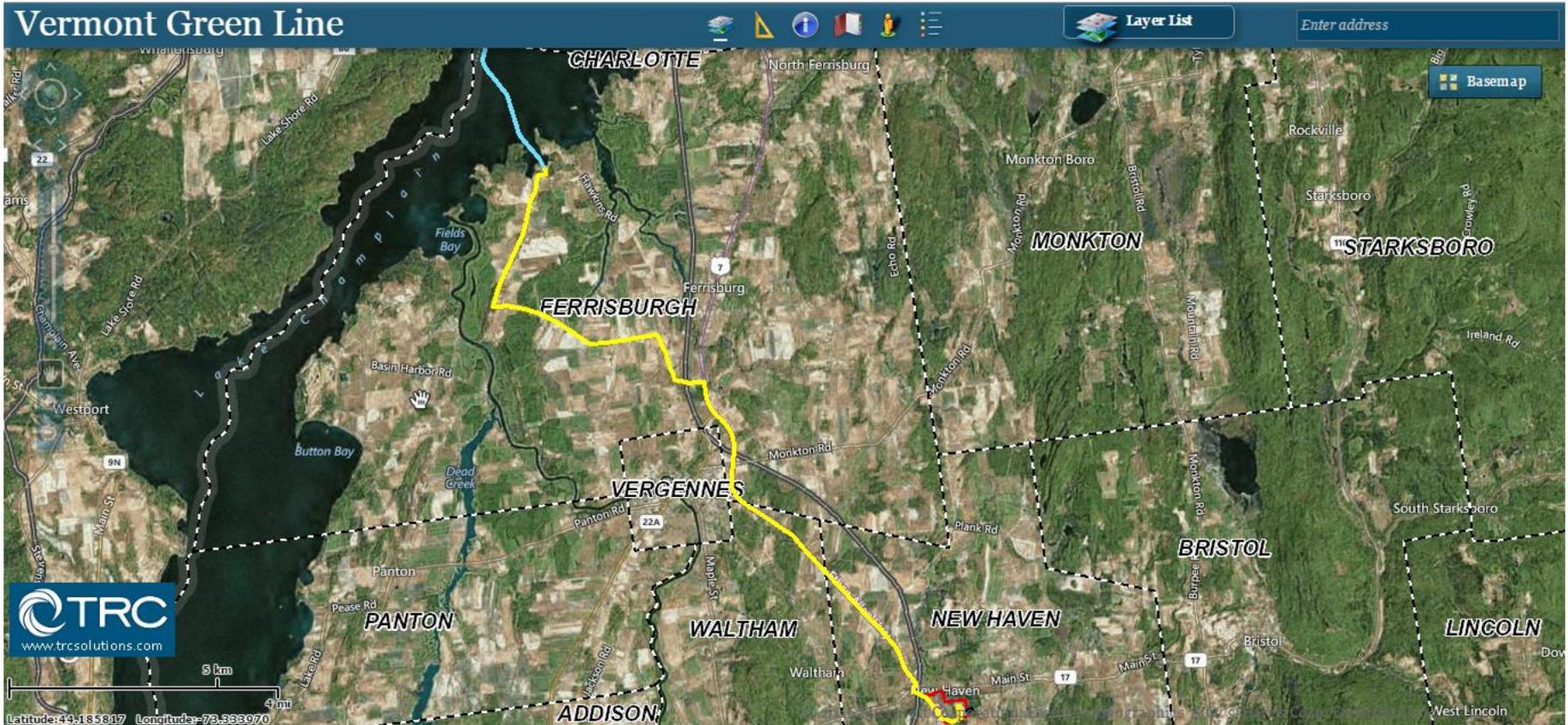
VERMONT GREEN LINE

*Delivering Renewable Energy and
Economic Benefits*



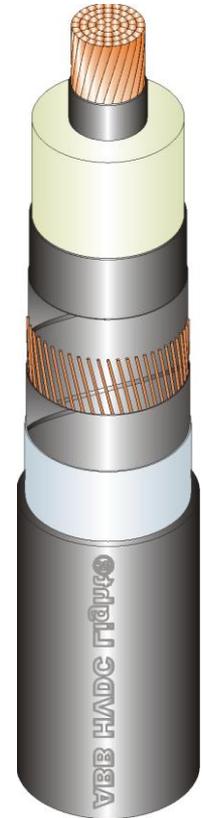
Presentation for Ferrisburgh, April 28, 2016

Vermont Land Cable Route



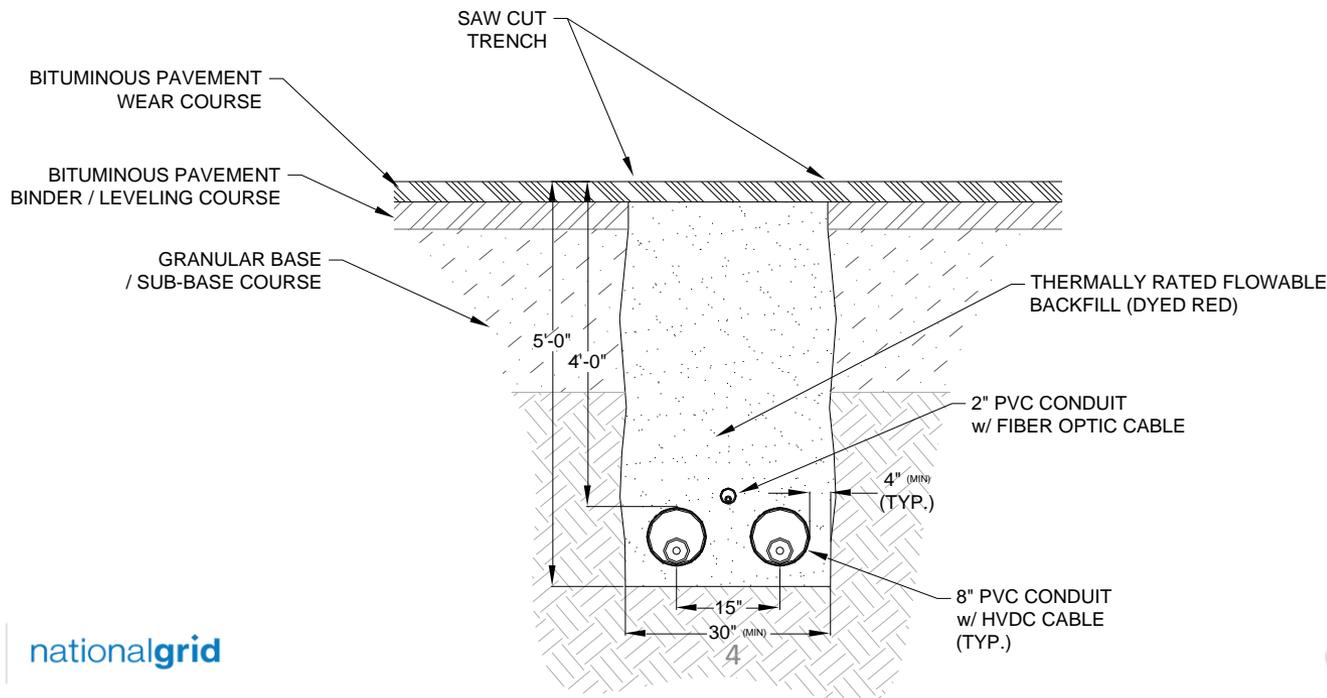
Terrestrial Construction Methodology

- Conventional cut-and-cover of concrete and/or flowable fill encased conduits (duct bank)
- Horizontal Directional Drill (HDD)
 - Landfall Location
 - Environmentally Sensitive Areas (streams, wetlands, etc.)
 - Railroad Crossings



Duct Bank w/Flowable Fill

- Limits the length and time that trenches will be open for public safety
- Provides mechanical protection for the cable from vehicle loading.
- Provides Thermal Stability to Cable System
- Allows for easier access and less environmental disturbance in the event that a cable repair is necessary post installation



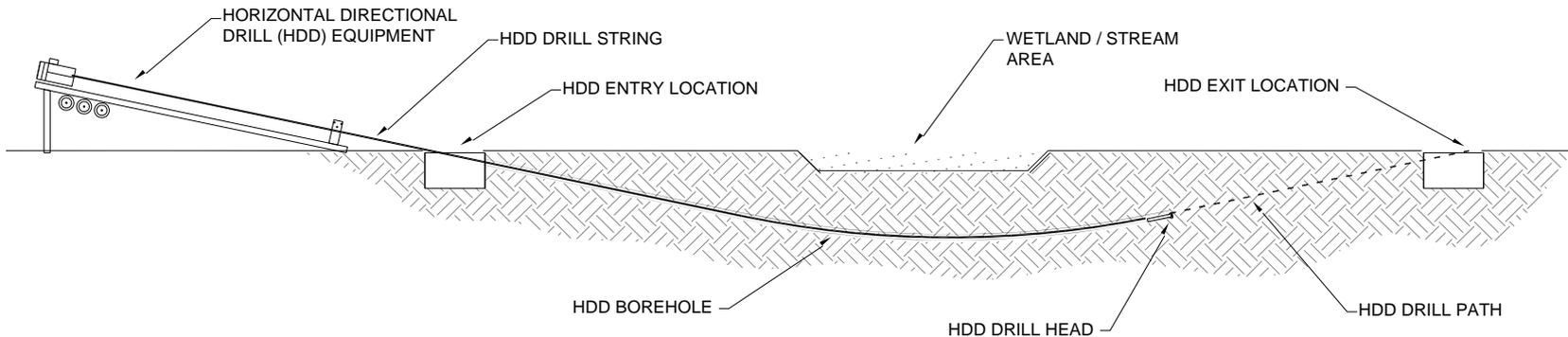
Splice Joint Bays

- Cable splices will occur approximately every ½ mile
- Splice joint bays will be utilized at each splice location. Following splicing, bays will be backfilled with thermal fill, a protective cap will be installed, and surface conditions will be restored (no above-ground manhole/structure)



Horizontal Directional Drilling

- Little Chicago Road (South Sling Creek)
- Tappers Crossing (Railroad)
- Rt 7 (Railroad)



NOTE: ALL DIMENSIONS ARE APPROXIMATE

Construction Process

- Approximately 150-500 feet of duct bank construction per day
- Temporary cover (e.g., patch)
- Once duct bank and joint bay installation is complete, final pavement restoration will occur (where proposed in-road)
- HVDC cables will be pulled into conduits and prepared for splicing
- Splicing will take approximately 1 week
- When the splice is complete, splice joint bay will be backfilled and restored.

Underground Cable Installation Process



Excavate trench



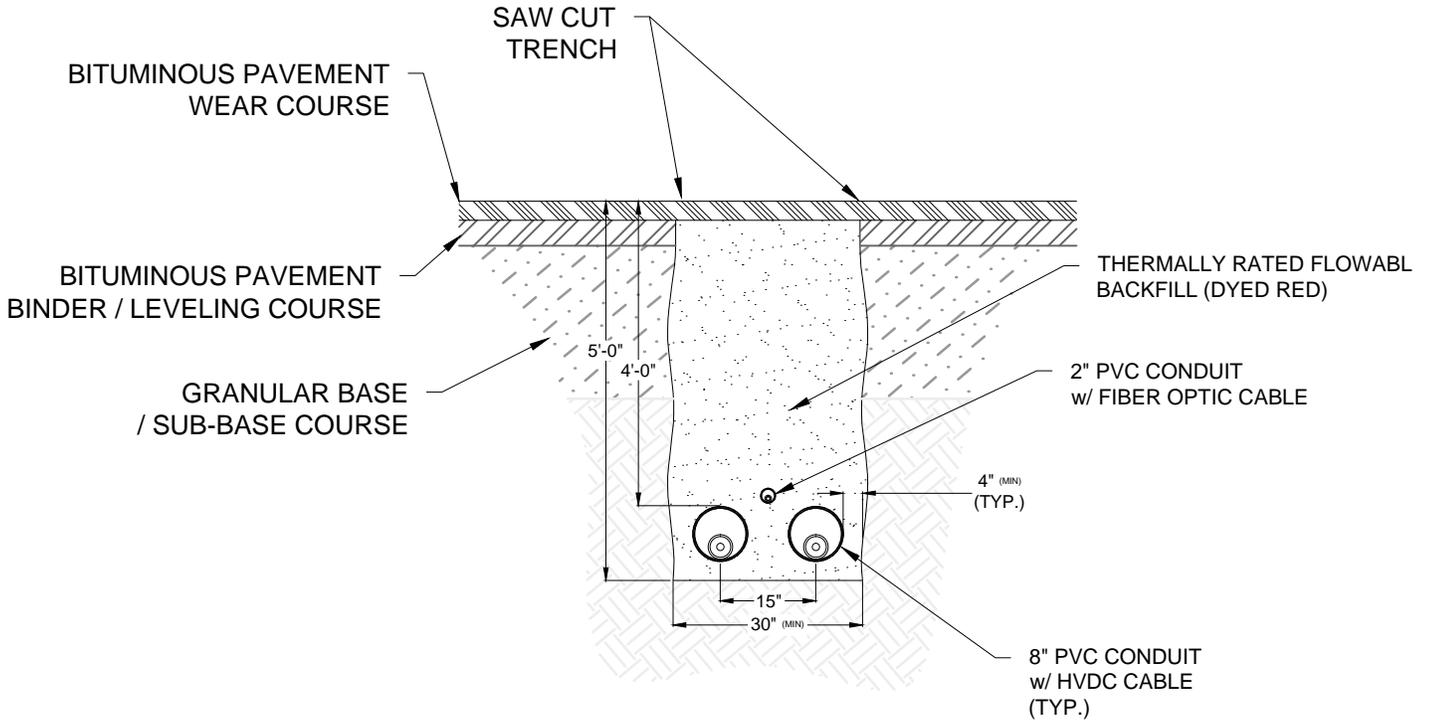
Lay conduit and encase in concrete/flowable fill



Final paving with new asphalt



Pull and splice cable and complete final restoration



NOTE: ALL DIMENSIONS ARE APPROXIMATE

MUNICIPAL ROAD CABLE IN PAVEMENT

SCALE: 1:30



Patrick M. Convery
4/4/2016



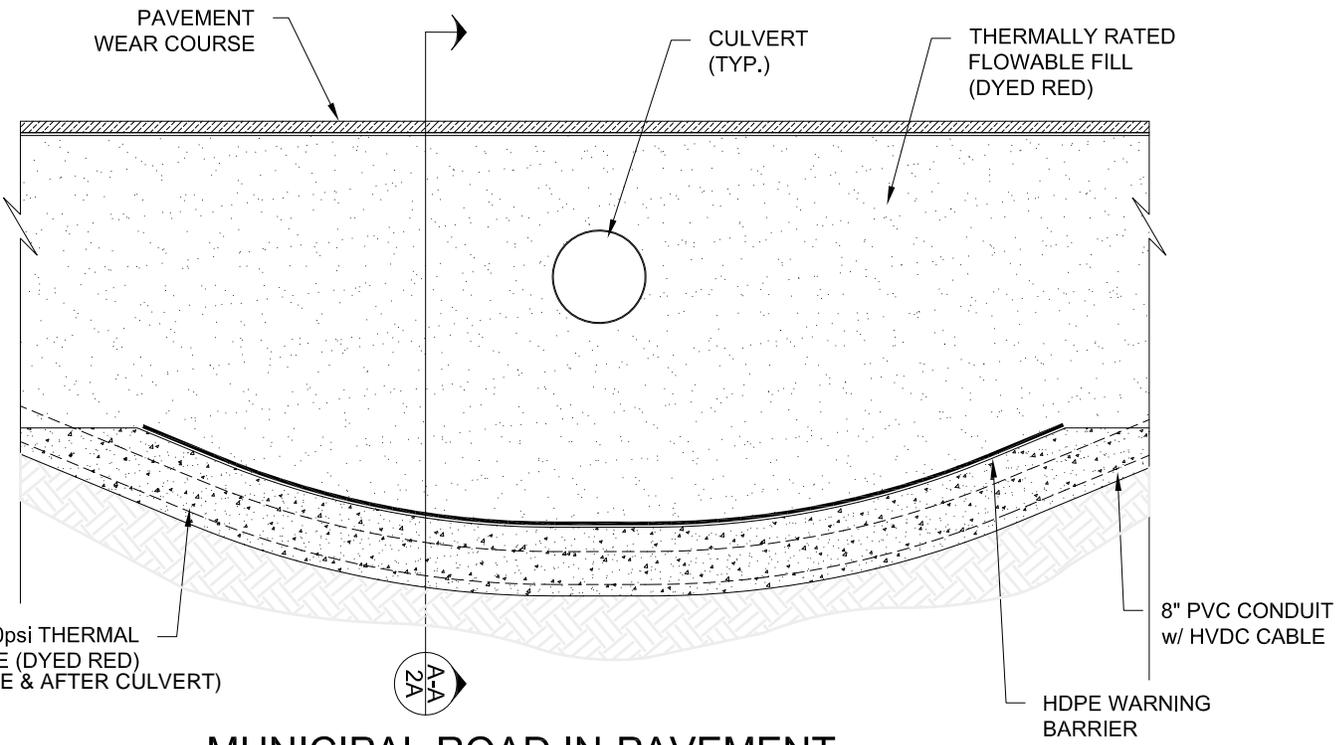
Cornerstone
Energy Services

PROFESSIONAL SERVICES IN NEW YORK
PROVIDED BY: ENERGY INFRASTRUCTURE ENGINEERING, DPC.

REVISION No.	DATE
DRAWN BEC	DATE 3/30/2016
CHECKED REH	DATE 3/30/2016
APPROVED	DATE
SCALE: 1" = 30'	

VERMONT GREEN LINE
MUNICIPAL ROAD CABLE IN PAVEMENT SECTION

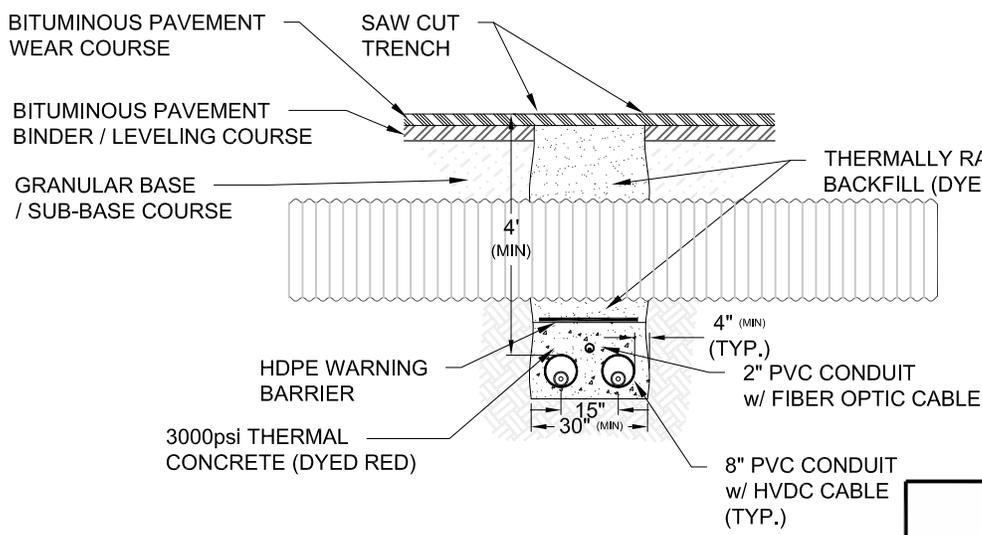
Dwg No.:



**MUNICIPAL ROAD IN-PAVEMENT
TYPICAL TRENCH (CULVERT CROSSING)**
SCALE: 1:50

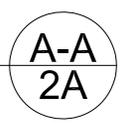


Pat Convery
4/4/2016



NOTE: ALL DIMENSIONS ARE APPROXIMATE

**MUNICIPAL ROAD IN-PAVEMENT
SECTION (CULVERT CROSSING)**
SCALE: 1:50



REVISION No.	DATE
DRAWN BEC	DATE 4/04/2016
CHECKED REH	DATE 4/04/2016
APPROVED	DATE
SCALE: AS NOTED	

VERMONT GREEN LINE
MUNICIPAL ROAD IN-PAVEMENT SECTION

Dwg No.: _____



FTB™ & Flowable Fill for Trench Backfill

Vermont Green Line Project

National Grid

April 5, 2016

WHAT IS FLUIDIZED THERMAL BACKFILL?

Flowable fill is an engineered backfill consisting of natural aggregates, a fluidizing agent, cementitious material and water that flows easily into the trench instead of attempting to compact.

Flowable fill is commonly referred to as controlled low strength material (CLSM), controlled density fill (CDF) and slurry.

WHY INTERRA BACKFILLS ?

Hand Excavate-able

Low strength (50-150 psi) like a stiff soil allowing for future access to the subsurface conduits if necessary.

Flow-ability

Flows fluently enough to fill all voids and crevices especially between the conduits, and to bond with the trench sidewalls, eliminating the possibility of settlement.

Maximum Density

Once hardened, flowable fill will be able to support load from the traffic above eliminating the possibility of future settlement. Designed to achieve maximum density at initial set.

Same Day Restoration

Install permanent base asphalt restoration in the same shift.



BENEFITS OF INTERRA BACKFILLS

Eliminate Trench Settlement

inTerra Flowable Fill will fill all voids within the trench and will achieve maximum density in its initial set, eliminating the potential for trench settlement.

Water Permeable

inTerra Flowable Fill's & FTB are water permeable and do not create water dams.

Eliminate Shrinkage and Heaving

inTera Flowable Fill will not shrink or heave once installed eliminating settlement and cracking of the asphalt surface above.

Same Day Restoration

Install permanent base asphalt restoration in the same shift.



PARAMETER	FTB / Flowable Fill	DOT Spec Gravel
Compaction Required?	No	Yes
Maximum Density Achieved	Always	Rarely (Trench too narrow and can't get between conduits)
Settlement	Never	Too Often
Resistance to Freeze-Thaw and Wet-Dry Cycles	Yes	Yes
Create Water Dams?	No	No
Durable over the Long-Term?	Yes	No (Gravel = Settlement)
Labor Resources	Conserved; More Economical	Wasted; Higher Cost
Public Relations:	Better ---	Worse ---
<i>Road Plates Required?</i>	<i>No</i>	<i>Yes</i>
<i>Speed of Trench Restoration</i>	<i>Fast</i>	<i>Slow</i>
<i>Roadway Disruption</i>	<i>Short</i>	<i>Long</i>
Liability	Low	High
Established Method?	Yes	Yes
Proven Method?	Yes	No
COMPARISON SUMMARY	FTB / Flowable Fill is superior to Gravel for Sub-base and Trench Backfill	

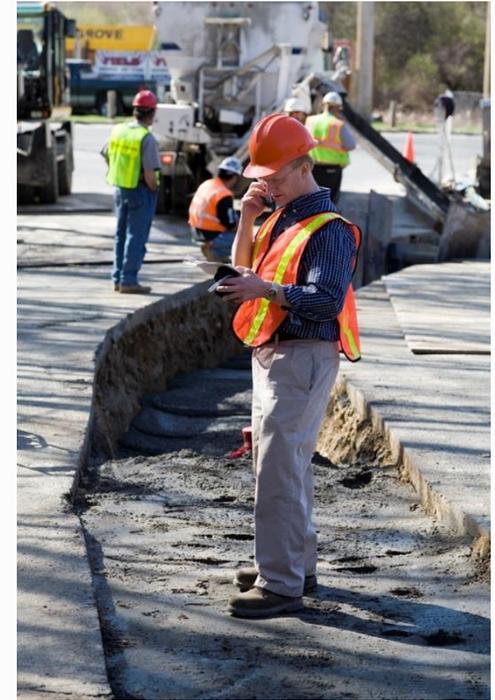
Background

- Permeability: 10^{-5} to 10^{-8} cm/s Native Soils: Glacial Till; Silty Sand; Clay
 10^{-4} cm/s Flowable Fill ('CLSM') vs.
 10^{-3} cm/s Fluidized Thermal Backfill ('FTB')
 10^{-1} to 10^{-3} cm/s DOT Gravel Borrow

Reference

- Matt Campano, VP Utility Division, Daniel O'Connell & Sons
Mobile: 617 – 212 – 2496

Same Day Paving = Reduced Road Plates & Headaches





Controlled Low-Strength Material Waterville to Skowhegan, Maine

Prepared for:

ABB Inc. – Power Systems North America

Cianbro Corporation

Vermont Green Line Project

Background

- Trench:

4-8 feet Deep; ~2-3 feet Wide

~ 90% on Shoulder w/in 1-3 feet of Travel Lane; ~10% in Travel Lane

- Permeability: 10^{-5} to 10^{-8} cm/s Native Soils: Glacial Till; Silty Sand; Clay
 10^{-4} cm/s Flowable Fill ('CLSM') vs.
 10^{-3} cm/s Fluidized Thermal Backfill ('FTB')
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Historical Proof

MassPike – Boston

Completed 2000
Photos taken 2006



- West-bound starting just after Copley Sq. Entrance



- No water dams
- No damage from freeze-thaw / wet-dry cycles
- Smooth
- No settlement
- Excellent performance 6-years running

MassPike, Boston

Completed 2000
Photos taken 2006



- No water dams
- No damage from freeze-thaw / wet-dry cycles
- Smooth
- No settlement
- Excellent performance 6-years running

- Same-day paving (3-inch overlay on CDF)
- **Traffic applied within 3-hours of paving**

Connecticut Route 34 (District III)



- Same-day paving (3-inch overlay on CDF)
- **Traffic applied within 3-hours of paving**

Completed 1999 Photos taken 2006



- No water dams
- No damage from freeze-thaw / wet-dry cycles
- Smooth
- No settlement
- Excellent performance 7-years running

Monroe, Connecticut (District III)



- Same-day paving (3-inch overlay on CDF)
- **Traffic applied within 3-hours of paving**

Completed 1999 Photos taken 2006



- No water dams
- No damage from freeze-thaw / wet-dry cycles
- Smooth
- No settlement
- Excellent performance 7-years running

Harvard Avenue, Brookline, MA

Completed 2000
Photos taken 2006



- No water dams
- No damage from freeze-thaw / wet-dry cycles
- Smooth
- No settlement
- Excellent performance 6-years running

- Same-day paving (3-inch overlay on CDF)
- **Traffic applied within 3-hours of paving**

Contact	Title	DPW/Company	Phone - Cell	Projects	Location	Owner	Product Supplied	Length	Date
Matt Campano	Vice President - Utility Division	Daniel O'Connell & Sons (Formerly)	617-212-2496	Summit Natural Gas Pipeline	Skowhegan, Maine	Maine DOT	Flowable Fill	8 miles	Summer 2012
				Electric Line	Cambridge, MA	NSTAR/ Eversource	Flowable Fill	1 mile	Fall 2013
Brian Zaniboni	Director of Highway Operations	City of Newton, MA	(617) 594-2922	NSTAR Oil Cooling Line	Dedham Street, Newton, MA	NSTAR/ Eversource	Flowable Fill	3 miles	Summer 2013
Mario Madrid	Construction Inspector	City of Lowell - Engineering Department	978-674-4070	Various Utility Installations	Lowell, MA	City of Lowell	Flowable Fill	---	2013 - Present
BG Chabot	Sr. Civil Supervisor	National Grid	508-631-1744	S-145 T-146 Cable Replacement Project	Salem, MA	National Grid	Flowable Fill & Fluidized Thermal Backfill	1.5 miles	Summer 2015
Tom Murphy	CM/Electrical Inspector	National Grid	339-221-3616	Carusso & McGovern (master contract)	Eastern MA	National Grid	Flowable Fill	---	November 2012 - Current
				Riley Brothers (master contract)	Eastern MA	National Grid	Flowable Fill	---	August 2011 - December 2012
				Feeney Brothers (master contract)	Eastern MA	National Grid	Flowable Fill	---	January 2013 - Current
					Shattuck Road, Andover, MA	National Grid	Ductbank Concrete	---	2015
Bill Dwyer	Superintendent of Streets	City of Cambridge, MA DPW	617-224-2859	Electric Line	Cambridge, MA	NSTAR/ Eversource (Daniel O'Connell)	Flowable Fill	1 mile	Fall 2013