UNITED STATES OF AMERICA
BEFORE THE
DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Millennium Pipeline Company, L.P.,	)	
	)	
Appellant,	)	
	)	**AFFIDAVIT OF**
v.		**TIMOTHY C. MCGUIRE**
	)	
State of New York, Department of State,	)	
Respondent.	)	

STATE OF WISCONSON)
) ss:
COUNTY OF DODGE)

Timothy C. McGuire, being duly sworn, deposes and says as follows:

1. I am employed by Michels Directional Crossings, a division of the Michels Corporation. I make this Affidavit to demonstrate the very low probability of successfully using Horizontal Directional Drilling ("HDD") technology to support a crossing of the Hudson River in the vicinity of the existing Tennessee Gas Pipeline crossing from Rockland County on the west shore of the Hudson River to Westchester County on the east shore of the Hudson River. More specifically, we evaluated the feasibility of an HDD on the west shore in Tallman State Park at the southern end of the Piermont Marsh and a separate HDD on the east shore of the Hudson River on the northern end of the property holdings of Mercy College.

2. Our evaluation was made at the request of Michael Baker, Jr., Inc. ("Baker") and the Millennium Pipeline Company, L.P. (" Millennium"). At the request of Baker and

Millennium, we were asked to evaluate whether HDD construction is feasible at these locations and if there are any problems that might affect feasibility to identify those problems.

3. In performing our evaluation, we received certain materials from Baker and Millennium pertinent to the proposed directional drill sites, including topographic information, geologic information, and information pertinent to the sediments in the Hudson River.

4. A copy of my resume is annexed to this Affidavit as Attachment "A." I have a Bachelors of Science degree in Geological Engineering from Colorado School of Mines (1986), and over 16 years of combined professional experience between consulting engineering and underground construction contracting. Approximately 4 out of the 16 professional years, I was a geotechnical engineer for a major engineering consultant company and performed geological and environmental site investigations, underground soils/bedrock and hydro-geologic analysis, construction feasibility evaluations, and preparation of summary reports and recommendations. The balance of my professional experience has been as a contractor in the underground mining and utility construction industry with over 11 years specializing in construction of utilities placed underground via HDD, primarily throughout the U.S. and Canada.

5. While working for Michels Directional Crossings, I have been involved with thousands of land to land HDD crossings ranging up to approximately 6,040 feet in length and over 48 inches in diameter, drilling through virtually every class of soil and bedrock type (see also Attachment "B" for Michels Statement Of Qualifications). Approximately 15 of these crossings have been the much less common land to water and water to water crossings, similar to the approach suggested for the Hudson River Millennium Pipeline crossing. I have also reviewed and discussed the information regarding these crossings with Mr. Robert Westphal, Senior Vice President with Michels Corporation, who has over 30 years of experience in the

underground utility construction industry, 15 of which have included HDD construction. A copy of his resume is attached to this Affidavit as Attachment "C."

6. An HDD crossing typically consists of two active construction locations, one at the entry point of the crossing and one at the exit point. A small diameter pilot hole is drilled from the entry location at the ground surface and is guided underground along a pre-determined pathway under the water body or obstruction being crossed and back to the ground surface at a pre-designated exit location on the opposite side of the crossing. Steering and guidance of the pilot hole drilling assembly is achieved with highly sophisticated tools developed in the petroleum drilling industry. The pilot bit is advanced by adding 30-foot sections of drill stem behind the pilot drilling assembly, resulting in a continuous 'string' in the bore-hole that connects the down-hole tooling with the drill rig at the entry location at all times during drilling and reaming operations. Depending on the size of utility being installed and the existing ground conditions in the crossing, the pilot hole is subsequently enlarged with increasingly greater diameter reaming tools to a size large enough to facilitate installation of the utility. During this reaming process, access must be made available for heavy equipment at both the entry and exit locations, primarily to facilitate handling of the drilling tools and the continuous processing of the drilling fluid slurry generated by the HDD process.

7. In addition, an area must be made available at one end of the crossing to facilitate delivery, stringing, fabrication, testing, and pullback support for the product line being installed into the crossing. The area and configuration must be adequate enough such that the product line is not subjected to undue strain during installation into the crossing. Ideally, the product line is pre-staged in one continuous length for the pullback to avoid additional risk to the installation caused as a result of excessive lag periods when the product line sits idle in the bore-hole during

installation. This lag time occurs when the installation must be halted long enough to allow a welded connection of additional segments of product lines until the full HDD length is achieved (approximately 4 hours to weld, test, and coat each occurrence). Once the pilot hole has been enlarged to the desired diameter, the product line is attached to the drill string and pulled back through the crossing by the HDD rig to the entry location until one continuous section of product line extends from the exit to the entry location.

8. The width of the Hudson River at this crossing location prohibits conventional HDD technology from being implemented to span the entire length from ground surface to ground surface. The longest HDD crossing of relevant proportional diameter ever installed in the world is approximately 6,500 Feet in length. The longest 24 Inch HDD crossing ever installed by Michels with our state-of-the art equipment is approximately 6,040 Feet. An HDD crossing of the entire span of the Hudson River at this location is simply not considered feasible with the technology and equipment presently available in the HDD industry.

9. Since a continuous length crossing spanning the entire river is not considered feasible at this location, Michels was asked to consider an alternative crossing scenario where two shorter HDD crossings would be drilled from either side into the river bottom with the balance of the span to be conventionally trenched and laid in the river bottom between the two ends of these crossings in the river. This alternative would consist of beginning each HDD at the ground surface on either side of the river and drilling down underneath each bank of the river and up to an exit location within the river bottom. An HDD crossing of this type, where one end exits in a marine environment, can be feasible under the right conditions, but is considered to be much less common in the industry and has typically accounted for approximately less than 2% of all HDD crossings in the past. It is anticipated that each of these crossings would be

approximately 4,000 to 5,000 feet in length and would require significant marine resources (jack-up barges and support vessels) to facilitate exit side HDD operations in the river. While these lengths are considered feasible with presently available HDD technology and equipment, and land to water crossings have been successfully completed in the past, several site-specific factors present uniquely difficult challenges which are adverse to successful HDD crossings at this location.

10. First, the bedrock conditions in the vicinity of the crossings are considered to be some of the hardest found anywhere in North America. Based on the available geologic information, it appears that much of the eastern side of the Hudson River is underlain by the Yonkers-Fordham gneisses and Inwood marble. Each of these bedrock units would present unique challenges to HDD technology.

11 Directional steering of the pilot hole in gneiss is difficult due to the 'banded' nature of this rock and the extreme variability in hardness between these bands that can cause the pilot bit to inadvertently deflect resulting in misalignments of the bore-hole that can prevent successful product line installation. In addition, the general hardness and high compressive strengths of gneiss results in excessive down-hole tool wear and extremely slow penetration rates with both the pilot bits and reaming tools. If the marble is encountered at the crossing location, the varying grades of hardness within the marble can lead to similar problems as experienced within the gneiss.

12 Similar challenges could be expected on the western side of the river where it appears that a bedrock unit identified as the 'Palisades sill' will likely be encountered. These types of intrusive units are notoriously difficult to drill given the extremely high unconfined compressive strengths and extreme hardness typically encountered in such units. High degrees

of bedrock fracturing are also common along the edges of sills, which can cause lost drilling fluid circulation and pilot bit steering difficulties.

13. Based on past experience, Michels estimates that a 24 inch diameter by 4,500 Foot long HDD crossing drilled in these types of bedrock under normal operating conditions would take up to approximately 80-90 days, working 24-hours/day to complete. This estimate does not take into account the inefficiencies of working one end of the crossing under marine conditions in the river, which could result in up to a 50% increase in construction time required to complete these particular crossings.

14. The soft river bottom sediment where these HDDs would exit can present another set of problems even though these sediments are considered extremely easy to drill through. Unfortunately, the drilling tools that are used to drill the pilot hole in rock cannot be used to successfully guide the pilot bit from the end of the rock, through the sediment and up to the river bottom. Therefore several changes of down-hole tooling will be required to complete the pilot hole and subsequent reaming operations, dramatically increasing the risk of down-hole failure. In addition, the differential wear of the bore-hole between the rock/sediment interface as drilling and reaming operations progress will result in bore-hole misalignment that may lead to drill string failure or potentially prevent product line installation.

15. When the pilot bit encounters the softer river sediment and exits the river bottom, the drilling fluid in the bore-hole will drain from the higher elevations and flow into the river resulting in a temporary increase in turbidity in the water. Time consuming and costly marine containment measures would have to be implemented to prevent further loss of drilling fluid into the river to complete each HDD crossing. These containment measures could further complicate drilling operations by interfering with the HDD alignment and/or vessel navigation in the river in

the vicinity of the exit location. If containment measures cannot be implemented, the drilling fluid will continuously flow from the bore-hole into the river for the duration of the reaming and installation operations.

16. Drilling fluid is typically pumped at a rate of 350 gallons per minute ("gpm") for the smaller reaming passes and up to 800 gpm for the larger passes. Therefore, if containment measures are not implemented, it could be reasonably anticipated that an average of 10,000 to 11,000 barrels of drilling fluid would flow into the Hudson River during each day of 24-hour drilling operations. While the drilling fluid additives are environmentally safe, the resultant continuous increase in turbidity in the river over the duration of HDD construction is not likely to be acceptable by the governing agencies. Even if containment measures can be implemented, it is unlikely that 100% containment can be achieved due to the high pressure gradient of the drilling fluid in the bore-hole as it flows from the top of the hillside to the bottom of the river. The softer river sediment will tend to collapse into the bore-hole and cannot provide the overburden pressure that would be required to contain the drilling fluid given the shallow depths that these HDD alignments would be drilled at to facilitate exiting in the river bottom. In addition, these drilling fluid containment measures must be removed prior to pulling the product line into its final position. Drilling fluids must still be added during product line installation to lubricate the hole. While the product line is being pulled into operation, approximately 30,000 barrels of drilling fluids would be released to the Hudson River. At this point in time, there is no available technology to contain this type of release.

7. The second factor that Michels considers adverse to HDD operations at this crossing location is the relatively extreme elevation change from the entry location at the top of the hillsides above the river banks to the bottom of the river where the bore-hole exits would be

located. While not insurmountable, this elevation change presents unique hydraulic conditions in the bore-hole which the driller must continuously contend with and control. The difference in head pressure of the drilling fluid at the top of the hill and the bottom of the river will cause the bore-hole to drain, potentially uncontrollably, to an elevation approximately equal to that of the river surface. This can cause additional excessive drilling tool wear, excess friction on the product line during installation and, as noted above, the release of drilling fluids to the Hudson River. In addition, if aquifers are present in the bedrock of either hillside, the water from these aquifers may drain into the bore-hole and cause drilling fluid slurry problems and/or present environmental concerns.

18. The third factor adverse to HDD construction at this location is the requirement for continuous marine support at each of the exit locations in the river, especially considering the relatively swift currents in the river. This marine support would be required to facilitate handling of the drilling tools, containment of the drilling fluid slurry, and processing of the slurry material as required to remove the formation solids from the slurry such that the drilling fluid can be re-used in the HDD operations. While marine equipment is available that could support these HDD operations, it is not readily obtainable in the northeast and would likely have to be mobilized from the Gulf of Mexico. In addition, this support equipment may present unacceptable obstructions to other marine vessels that regularly traverse the navigable waterways of the Hudson River. Also, careful consideration would have to be given to day to day logistical support issues, such as the safety and reliability of crew, equipment, fuel, and materials transport/transfer to and from each marine location on a continuous basis.

19. The fourth factor to consider at these crossing locations is the general constructability of the HDD crossings given the unique characteristics of the product line

materials that would be specified in the design to meet the operational requirements of the given conditions. The rigid steel pipe requires careful handling prior to and during installation to prevent undue strain or buckling. This would mean that the product line would likely have to be pulled from the land-side of each crossing to the river bottom at a very low angle and turn radius resulting in significant minimum design lengths of each crossing. However, limited space on the land-side prevents stringing the product line in continuous sections and thus increases the risk of failure during the installation as a result of excessive idle periods incurred while welding the shorter sections together during installation. Also, the section of the product line that will eventually end up protruding from the river-end of the HDD bore-hole and into the river bottom would require up to 3 inches of concrete coating for buoyancy control which would have to be pulled through the bore-hole. Michels does not consider installation of thick concrete-coated steel pipe in an HDD bore-hole drilled through hard bedrock to be feasible given the risk of this material breaking off of the steel product line during installation and resulting in failure of the HDD crossing. The product lines could potentially be pulled from the river-side up to the land-side of each crossing to avoid the concrete coating problems; however, the limitations of staging areas for the product line sections in the river and the general feasibility of handling the long sections of steel pipe in the river current limit the likelihood of success for this option.

20. In addition, regardless of direction of installation, once the crossings are installed in the river bottom, the ends of the product lines must still be connected to the conventionally trenched section between the two HDD ends in the river. Michels has experienced first hand the complications of performing 'wet' tie-ins of high pressure gas lines, especially in swift current conditions, and would only consider such methods as a last resort and only after detailed consultation with marine pipeline experts.

21. Several other site-specific factors represent challenges to a lesser degree than those previously identified, such as the magnetic interference incurred with the pilot hole survey operations as a result of crossing the electric railroad lines along the river bank on the east shore, the practical timing of marine support operations to coincide with the many variables of HDD operations, and the limited access to the hillsides in the event of inadvertent drilling fluid loss from the bore-hole due to steep grades on both sides of the river, the railroad tracks on the east side of the river, and the Piermont Marsh on the west side of the river. While each of these or the other previously identified factors taken individually does not present a challenge that cannot be overcome with prudent HDD practices, the combination of these s factors uniquely associated with the suggested Millennium Pipeline crossings at this location on the Hudson River presents a complex array of variables that would result in an extremely time consuming and costly alternative with a very low probability of success.

Dated: April 16, 2003

TIMOTHY C. MCGUIRE

Sworn to before me this
16 day of April, 2003

Notary Public

JESSICA FOCHS
NOTARY PUBLIC
STATE OF WISCONSIN

Attachment A

Tim C. McGuire

VICE PRESIDENT – DIRECTIONAL CROSSINGS DIVISION
MICHELS CORPORATION
817 W. Main Street, Brownsville, WI 53006
Phone: (920) 583-3132 / Fax: (920) 583-3429
E-mail: tmcguire@michels-usa.com

PROFESSIONAL EXPERIENCE:

2002 – Present

Vice President, Michels Directional Crossings, Brownsville, WI
Responsible for horizontal directional drilling division construction operations. Duties include profit and loss responsibility for multiple and simultaneous directional drilling gas, product, water, sewer, civil, electric, telephone cable, and environmental projects. Day to day involvement with bid estimating, construction feasibility evaluation, specification and design criteria review, proposal preparation, contract and subcontract negotiations, project planning and oversight, cost scheduling, allocation of divisional resources, and interface with utility construction managers, engineers and owners. Report directly to the Senior Vice President and President of the company.

1998 – 2002

General Manager, Michels Directional Crossings, Brownsville, WI
Responsible for estimating, planning and managing horizontal directional drilling projects for various size utilities up to 48" in diameter and 6,000' in length in a wide range of unconsolidated soil and bedrock conditions.

1994 – 1998

Project Engineer/Project Manager, Michels Corporation, Brownsville, WI
Responsible for assessing feasibility of design specifications, recommendation and implementation of construction methods, and day-to-day on-site management and coordination of horizontal directional drilling projects for various utilities.

1992 – 1994

Division Manager, Michels Environmental Services, Michels Corporation, Brownsville, WI
Responsible for estimating, designing, planning and coordinating underground environmental remediation projects utilizing horizontal directional drilling technology.

1992

Drilling Division Manager, Harrison Western Mining Corporation, Denver, CO
Responsible for estimating, planning and managing various vertical, angle and horizontal drilling projects for geotechnical investigations, civil construction, mining operations and environmental evaluation and remediation. Evaluated, designed and implemented various drilling methods, equipment, materials and tools while managing day-to-day drilling operations on geotechnical, civil, mining and environmental drilling projects.

1987 – 1991

Project Manager/Geotechnical & Environmental Engineer, Ebasco Corporation, Denver, CO
Responsible for coordinating and managing remedial investigations, feasibility studies, risk assessments, and remedial construction projects at various hazardous waste contaminated sites in the United States. Designed, specified, coordinated and implemented geologic, hydrogeologic, geophysical and environmental field investigation programs to evaluate specific site conditions utilizing various drilling technologies throughout the United States. Interpreted geotechnical and geochemical data and compiled with all other available site information to produce comprehensive summary reports. Installed monitoring wells and conducted hydrogeological field investigations at numerous locations. Conducted field logging and laboratory testing to determine quantitative properties of soil and rock materials.

EDUCATION:

BS Geological Engineering, Minor in Hydrogeology from the Colorado School of Mines

PRESENTATIONS:

MCI Engineer Training Seminar "Horizontal Directional Drilling Design, Specification and Construction for Trenchless Placement of Underground Utilities"

1996 Midwest Gas Association "Horizontal Directional Drilling Large Diameter Pipeline Installations"

1995 National Groundwater Association Outdoor Action Conference "Horizontal Directional Drilling Demonstration for Installation of Horizontal Wells"

Robert H. Westphal
SENIOR VICE PRESIDENT
MICHELS CORPORATION
817 W. Main Street, Brownsville, WI 53006
Phone: (920) 583-3132 / Fax: (920) 583-3429
E-mail: westphal@michels-usa.com

PROFESSIONAL EXPERIENCE:

2000 – Present
Senior Vice President, Michels Corporation, Brownsville, WI
Michels Pipeline Construction, Brownsville, WI
Michels Directional Crossings, Brownsville WI & Airdrie, Alberta, Canada
Responsibilities include executive oversight of all operations within Pipeline Construction and Directional Drilling divisions. Complete profit and loss responsibility for all projects related to Pipeline and Drilling divisions. Oversee business development, finalizing estimates of all major projects, negotiation of contract agreements, subcontractor management, utility owner interface from project start to finish, human and equipment resource allocation, and general management of all Pipeline and Drilling division operations. Report directly to the President of the company.

1989 – 2000
Vice President, Michels Pipeline Construction, Inc.
Michels Corporation, Brownsville, WI
Responsible for general and regional construction operations of this telecommunications OSP construction division. Duties include complete profit and loss responsibility for multiple and simultaneous telephone cable, gas and directional drilling construction projects including, but not limited to, bid estimating, bid preparation, project management, and interface with utility construction managers, engineers and consulting engineers. Report directly to the President of the company.

1981 – 1988
General Superintendent, Mid-America Line & Cable Division
Michels Pipeline Construction, Inc., Brownsville, WI
Complete profit and loss responsibility for hundreds of fiber optic and OSP telecommunication construction projects varying in size up to $10-million. Duties include bid estimating and preparation and complete control of all phases of utility OSP construction projects.

1979 – 1980
Project Manager, Mid-America Line & Cable Division
Michels Pipeline Construction, Inc., Brownsville, WI
Responsible for project management, including the coordination of labor, equipment, materials, construction scheduling and production. Projects included various OSP telephone cable and rural water construction projects.

1973 – 1978
Project Superintendent, Mid-America Line & Cable Division
Michels Pipeline Construction, Inc., Brownsville, WI
Responsible for overall supervision of construction crews on various cable construction projects.

1969 – 1972
Crew Foreman, Mid-America Line & Cable Division
Michels Pipeline Construction, Inc., Brownsville, WI
Managed a utility construction crew as well as operated heavy equipment for cable construction as a working foreman.

1966 – 1969
Equipment Operator, Michels Pipeline Construction, Inc., Brownsville, WI
Operated all types of utility construction equipment and specialized in backhoe operations.

Laborer, Michels Pipeline Construction, Inc., Brownsville, WI
Laborer on various utility construction projects.

Laborer, Cooks Masonry, Brownsville, WI

1962 – 1963
Parts and Sales Department, Humphrey Chevrolet/Krause Oldsmobile

EDUCATION:

1962 Graduate of Mayville High School, Mayville, WI

STATEMENT OF QUALIFICATIONS
MICHELS DIRECTIONAL CROSSINGS

Michels Directional Crossings, a division of Michels Corporation, has been utilizing Horizontal Directional Drilling (HDD) technology for trenchless installation of underground utilities since 1986. Michels Corporation has been in business and performing underground utility construction since 1960 and has since diversified and expanded into . HDD is a trenchless method of underground utility construction where a conduit is installed from one surface location to another below the ground surface utilizing a guided directional drilling system. Michels has successfully completed thousands of HDD crossings throughout the United States, including Hawaii and Alaska, and several others around the world. Since starting directional drilling operations, our HDD capacity has expanded in virtually every aspect of the technology, setting new industry records year after year. As an industry leader, Michels continually tests and expands the HDD construction limits with our largest capacity equipment, while at the same time providing extremely reliable services for HDD projects of a less challenging nature, greatly succeeding at both ends of the spectrum. No HDD project is considered to be too large, too small, too difficult, or too distant for Michels.

When limitations to equipment capacity are exceeded, Michels custom fabricates larger rigs, several of which are the largest rigs currently available anywhere in the world. When multiple rigs are required to complete a project on schedule, Michels provides virtually unlimited support with our 35 owned and operated HDD rigs, each with highly experienced support crews. When unforeseen conditions are encountered on a project, Michels provides complete 24-hour machine shop fabrication support for manufacturing or repairing specialized equipment and down-hole drilling tools capable of overcoming the most difficult drilling conditions. The resources available to Michels Directional Crossings as a division of a much larger utility contractor provide our drilling division with unprecedented capabilities in the HDD industry.

Michels resources are matched only by our experience in HDD crossing technology. Michels has directionally drilled and installed virtually every type of utility under most conceivable crossing conditions, and many under inconceivable conditions. Michels drilling superintendents each have a minimum of 5 years experience and some have as much as 25 years experience. An HDD utility crossing typically crosses underneath locations where surface obstructions prevent traditional construction via conventional trenching methods or where disturbance to the surface is simply not feasible. From some of the hardest solid bedrock conditions, to massive boulders and cobbles, to soft silts, sands, and clays, Michels has successfully completed crossings up to 50-Inches in diameter and over 6,000 feet in length.

<u>Michels HDD Crossing Length Summary</u>
-Longest: 6,041 Feet (24 Inch)
-Over 12 Greater Than 5,000 Feet
-Over 35 Greater Than 4,000 Feet
-Over 100 Greater Than 3,000 Feet
-Over 500 Greater Than 2,000 Feet
-Thousands Less Than 2,000 Feet

<u>Michels HDD Crossing Diameter Summary</u>
-Largest: 49.75 Inch (2,350 Feet)
-Over 20 Greater Than 40 Inches
-Over 50 Greater Than 30 Inches
-Over 200 Greater Than 16 Inches
-Over 700 Greater Than 12 Inches
-Thousands Less Than 12 Inches

<u>Types of Crossings Performed By Michels</u>
- River, stream, and canal crossings
- Water body crossings (lakes, ponds, tidal bays etc.)
- Environmentally sensitive areas including wetlands
- Heavily congested surface areas (roadways, railroad tracks, airport facilities, industrialized areas)
- Aesthetically sensitive locations (historical or archeological significant grounds and structures or pristine residential areas)
- Hazardous waste contaminated areas
- Geologically unstable areas (landslides)
- Heavily laced utility corridors
- Land to marine conduit transition locations (beach approaches)

Michels has diversified and adapted HDD technology to successfully complete crossings for most of the major utilities in the United States with 100% satisfaction. Pipeline (Natural Gas & Fuel Products), Civil (Water & Sewer Force Mains), Telecommunications (Fiber Optics & Telephone Duct Banks), and Electrical (Cable Duct Banks) are the most common types of utilities installed by Michels. Michels is recognized by each of these utility industries as a leader in HDD technology, especially when it comes to completing the most difficult projects on schedule and within budget as exemplified by successful completion of numerous milestone projects in each of these industries.

Pipeline

- Williams Transco – 1 Crossing x 24 Inch to 6,041 Feet; North Carolina; Granite and Sandstone
- Vector Pipeline – 6 Crossings x 42 Inch to 2,230 Feet; Michigan; Sandstone, Sands, & Gravels
- Alliance Pipeline - 6 Crossings x 36 Inch to 3,633 Feet; Illinois to Minnesota; Limestone, Sands, & Gravels
- Maritimes & Northeast Pipeline – 5 Crossings x 24 or 30 Inch to 2,989 Feet; Maine; Granite, Gneiss, & Schist
- Pacific Pipeline – 6 Crossings x 20 Inch to 5,107 Feet; California; Granodiorite, Sands, & Gravels
- PNGTS Pipeline - 12 Crossings x 24 or 30 Inch to 2,868 Feet; New Hampshire to Maine; Gneiss, Schist, & Phyllite
- Northern Border Pipeline -6 Crossings x 36 Inch to 3,727 Feet; Illinois to Iowa; Limestone, Sands, & Gravels
- Florida Gas Transmission – 32 Crossings x 22 thru 36 Inch to 4,044 Feet; Mississippi to Florida; Limestone, Sands, & Gravels
- Empire State Pipeline – 4 Crossings x 24 Inch to 4,590 Feet; New York to Ontario, Canada; Limestone, Sands, Gravels
- Express Pipeline – 2 Crossings x 24 Inch to 3,166 Feet; Montana; Shale & Sandstone
- Michigan Consolidated Gas – 10 Crossings x 36 Inch to 2,600 Feet; Michigan; Sands, Gravels, & Cobbles
- Colonial Pipeline – 1 Crossing x 10.75 Inch to 5,851 Feet; Virginia; Silts & Sands

Civil

- City of Honolulu – 2 Steel w/HDPE Force Main Crossings x 46 Inch to 3,100 Feet; Hawaii; Coral, Sands, & Gravels
- St. Charles County – 1 Steel Water Main Crossing x 42 Inch to 3,500 Feet; Missouri; Limestone, Sands, & Gravels
- Nueces River Authority – 2 Steel Water Main Crossings x 50 Inch to 2,360 Feet; Texas; Silts & Sands
- Massachusetts Water Resources – 1 HDPE Force Main Crossing x 42 Inch to 2,025 Feet; Massachusetts; Silts, Sands, & Gravels
- Superior Water & Power – 1 Steel Water Main Crossing x 24 Inch to 4,500 Feet; Wisconsin; Sands & Gravels
- St. Peter Sanitary District – 1 HDPE Force Main Crossing x 14 Inch to 3,333 Feet; Minnesota; Sands & Gravels
- Missouri American Water Works – 1 Steel Water Main Crossing x 36 Inch to 4,605 Feet; Missouri; Silts, Sands & Gravels
- Public Utility Agency Of Guam – 1 HDPE Offshore Sewer Outfall x 28 Inch to 1,760 Feet; Guam; Coral Reef
- City Of Norfolk – 1 Steel Water Main Crossing x 48 Inch to 2,100 Feet; Virginia; Silts & Sands

Telecommunications

- AT&T – Over 800 Crossings Including Beach Approaches Throughout United States to 4,500 Feet
- U.S. Sprint – Over 200 Crossings Including Beach Approaches Throughout United States to 3,500 Feet
- MCI – Over 100 Crossings Throughout United States to 4,000 Feet
- Level 3 Communications – Over 50 Crossings Throughout United States to 3,800 Feet With up to 42x1.25 Inch Ducts
- MFN – Over 10 Crossings Throughout U.S., including 5,111 Foot Hudson R. to Manhatten, NY With 21x1.25 Inch Ducts

Electrical

- United Illuminating – 8 x 5 Inch HDPE bundle to 600 Feet; Interstate-95; Connecticut; Schist bedrock
- Northern States Power – 20 Inch Steel With 4 x 6 Inch HDPE bundle to 1,200 Feet; Mississippi R.; Minnesota; Sands
- Com Electric – 18 Inch Steel With 3 x 6 Inch HDPE bundle to 1,500 Feet; Maryland; Sands & Gravel

Michels' broad range of HDD experience and capacity allows us to accurately estimate the resources required to complete a crossing and provide the utility owner with a reliable expectation of project costs and schedule. The accuracy of an estimate depends directly on the amount and quality of information provided regarding a given crossing. The more accurate and complete the information is, the more accurate the required resources can be estimated. The following is the type of information that helps Michels evaluate any given HDD crossing:

- Design Entry Angle, Minimum Depth, Exit Angle, & Geometry of Alignment (Plan & Profile)
- Length of Crossing, Diameter of Utility, Tolerance Of Placement, Carrier Pipe Specification
  Ground Conditions (Soil-USCS Classification & Blow Count Density; Rock-Type, Unconfined Compressive Strength, Rock Quality, Rock Characteristics)
  Special Restrictions to Working Conditions (Time Constraints, Available Work Areas, Proposed Access)

Michels crews and equipment can be mobilized anywhere in the world to complete a wide range of HDD crossings.