

May 27, 2008

The Ministry of Transportation of Ontario  
Pavements and Foundations Section  
Building 'C' – Room 223  
Downsview, Ontario

Attention: Ms. Anna Piascik, P. Eng., Foundation Engineer  
Cc: Mr. Jason Wright, P.Eng., Northeastern Region – North Bay

Subject: Draft Foundation Investigation and Design Report  
**Proposed Culvert Replacement, Assignment #6**  
Highway 101, Approximately 4.36 Km East Of Highway 67  
German Twp - Northeastern Region Contract # 5006-E-0070  
GWP# 5056-03-00 Geocres #42A-72

This cover letter is further to the MTO 2 Memorandums dated May 9<sup>th</sup> and 14<sup>th</sup> 2008 regarding the questions and comments of the Draft Report for the above noted project.

| AMEC Response to MTO memo dated May 9 <sup>th</sup> |  |
|---|--|
| 1.  | GWP number added to Title Page.  |
| 2.  | MTO GEOCRES Number 42A-72 added to Final Report and Foundation Drawings.   |
| 3.  | Groundwater Table Elevations added to Table in Section 5.5.  |
| 4a.   | The terms of Reference specify roadway protection as one of the alternatives being considered. Clarification has been made by replacing "roadway protection" with "roadway protection (cut and cover using temporary shoring)".  |
| 4b.   | Clarification has been made by replacing "specialist contractor" with "specialist contractor (Contractor specializing in tunneling)".  |
| 4c.   | Clarification has been made by replacing "could result in deep excavation to prevent slough" with "Could result in wider excavation (flattened side slopes) to prevent slough".  |
| 5.  | The terms of Reference specify roadway protection as one of the alternatives being considered. Clarification has been made by replacing "roadway protection" with "roadway protection (cut and cover using temporary shoring)".  |
| 6.  | Bearing capacities have been referred to founding levels / inverts. Founding soils are indicated.  |
| 7.  | NSSP's are included in Appendix D.<br>Reference to SP 421S01 included in Section 6.3   |
| 8.  | The terms or reference specify that "Critical issues that may involve complex subsurface conditions or design requirements that would require specialized construction procedures should be 'red-flagged' ". The 'Red-flagging' has been indicated by bolding and yellow highlights. |
| 9.  | Cross Section along culver profile included as Dwg. 2. Scales, legend and symbols now shown.   |
| 10.   | Ground surface elevation shown on BH Logs.   |

| AMEC Response to MTO memo dated May 14 <sup>th</sup> |  |
|--|--|
| 1.   | GEOCRES Number 42A-72 shown on cover page.   |
| 2.   | Plasticity chart amended as required.  |
| 3.   | Replacement csp is cut lengthwise before insertion into existing csp. Results in slightly smaller diameter csp. Clarification has been made in Section 6.1.  |
| 4.   | Discussion and Recommendations section starts on new page.   |
| 5.   | <u>Borehole Logs</u><br>-moisture content not carried out on Split Spoon Sample #15.<br>-Elevations have been included on BH Logs.   |
| 6.   | <u>Borehole Location and Stratigraphy Plan</u><br>-Appropriate symbols have been used on stratigraphy profile.<br>-Soil Stratigraphy along culvert profile is included in Dwg. 2. Groundwater levels are also shown. |

We trust that our response addressed all your questions and comments. Should have any questions or concern, please do not hesitate to contact me at your convenience.

Yours truly,

**AMEC Earth and Environmental**  
**A Division of AMEC Americas Limited**



Hoda Seddik, M.A.Sc., P.Eng.  
 Consulting Engineer  
 Associate Asphalt & Pavement Engineer



Jane Doucette, P.Eng.  
 Associate Geotechnical Engineer

May 9, 2008

TO: Jason Wright  
Northeastern Region – North Bay

FROM: Anna Piascik, P. Eng.  
Foundation Engineer  
Pavements and Foundations Section  
Building ‘C’ – Room 223  
Downsview, Ontario

RE: DRAFT FOUNDATION INVESTIGATION AND DESIGN REPORT  
**PROPOSED CULVERT REPLACEMENT**  
HIGHWAY 101, APPROXIMATELY 4.36 KM EAST OF HIGHWAY 67  
GERMAN TWP

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We have evaluated the Draft Foundation Investigation and Design Report for the above project, prepared by AMEC (Project No. TB7206006-II) dated 10 April, 2008 to determine the Consultant’s performance in providing the deliverables as would be required by MTO for similar consultant assignments.

The accuracy of the subsurface information and the adequacy and technical aspects of the recommendations remain the responsibility and liability of the Consultant. The Ministry assumes no responsibility or liability for these aspects of the Report. These aspects will be reviewed in order to assess the Consultant’s performance in this assignment upon implementation of the recommendations in the design and upon review of the performance of the foundations of the completed project. The following comments are provided:

1. Cover Page – GWP number should be indicated in the title.
2. MTO GEOCRETS No. **42A-72** has been assigned to the Final Report and Foundation Drawings (BH Locations and Soil Strata).
3. Section 5.5 – In addition to the depths, groundwater table elevations should be provided.
4. Section 6.1 – Table require revisions and clarifications (for example: roadway protection as a construction technique (?), “*specialist contractor (?)*”, “*...could result in deep excavation to prevent slough*”(?) etc.). Two approaches for culvert replacement should be discussed: (1) cut and cover construction; and (2) tunneling.

5. Section 6.1 – Please clarify: “*Based on comparison of the two alternatives presented in the RFP, it is recommended that culvert replacement be carried out at the existing culvert location using roadside protection*”. Does it mean that the cut and cover technique is recommended?
6. Section 6.1 – The report should provide recommendations on the geotechnical capacities referring to the founding levels/inverts, instead of speculations on “may be used” or “nearby location”. Founding soils should be indicated.
7. Section 6.4 - Appropriate NSSPs should be included in the Contract Documents to address possible dewatering requirements and presence of cobbles and boulders. Reference should also be made to SP 421S01 for installation of pipe culverts.
8. General – What is the purpose of highlighting the text and using bold fonts in the report?
9. Drawing – Cross section along the culvert centerline is missing. The drawing is incomplete, including missing data on locations and elevations. Scales, legend and symbols were not shown. Please refer to MTO Standard Drawing for guidance.
10. Borehole Logs – Ground surface elevations at the borehole locations are missing.

The Final Foundation Report should be accompanied by a cover letter from AMEC explaining changes made in the Final Report in response to these comments on the Draft Report. Where changes are not made, explanation is required. If you have any questions or need any clarification then please contact us.

Anna Piascik, P. Eng.  
Foundation Engineer

for

Tae C. Kim, P. Eng.  
Senior Foundation Engineer

# memorandum



Telephone: (416) 235-5327  
Fax: (416) 235-3919

To: Jason Wright, P. Eng. 2008 05 14  
Project Soil Engineer  
Geotechnical Section  
Northeastern Region

From: Pavements and Foundations Section  
Room 232, Central Building  
Downsview, Ontario

Re: Comments on the Draft Foundation Investigation and Design Report  
Culvert Replacement on Hwy 101, East of Hwy 67, German Township  
Northeastern Region Contract # 5006-E-0070

We have evaluated the Draft Foundation Investigation and Design Report for the above noted project produced by AMEC Earth and Environmental dated April 10, 2008 for MTO Northeastern Region to determine the consultant's performance in providing the deliverables as would be required by MTO for similar consultant assignments. The accuracy of the subsurface information and the adequacy and technical aspects of the recommendations remain the responsibility and liability of the consultant. The Ministry assumes no responsibility or liability for these aspects of the report. These aspects will be reviewed in order to assess the Consultant's performance in this assignment upon implementation of the recommendations in the design and upon review of the performance of the foundations of the completed project. Following are our comments:

- The Geocres Number for this project is 42A-72. This number should be shown on the cover page of the final Foundation report.
- We feel that the plasticity chart provided on Enclosure B11 does not belong to this project. Please note the project number, location and the date shown on the chart. We expect the MTO designated contact to thoroughly review the Foundation report prior to submission.
- As noted in Section 6.1 on Page 9, we are not sure how the re-lining of a CSP culvert could be done with the same diameter CSP.
- The "Discussion and Recommendations" section should start on a new page.

## **Borehole Logs**

- Atterberg test results without knowing the natural moisture content are not useful (Ref. BH 2, Sample 15).
- The borehole elevations are missing on the logs. The elevations shown on the drawing suggest that borehole elevations were recorded.

### **Borehole Location and Stratigraphy Plan**

- The symbols for describing soil type are not according to the Unified Soil Classification System. Also, they are different from those shown on the borehole logs.
- The drawing should show soil stratigraphy along the culvert profile. It should also show the culvert invert in relation to the Groundwater elevation.

The final Foundation Report should accompany a covering letter explaining, in sequence, how the changes were made in the Foundation report in response to our comments on the draft report. Where the changes are not made, explanation would be required.

K. Ahmad, P. Eng.  
Foundation Engineer  
For  
T.C. Kim, P. Eng.  
Senior Foundation Engineer

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## **CONSTRUCTION SPECIFICATION FOR PIPE CULVERT INSTALLATION IN OPEN CUT**

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#### **421.01 SCOPE**

This specification covers the requirements for installing pipe culverts, pipe culvert end sections and concrete appurtenances in open cut.

#### **421.02 REFERENCES**

This specification refers to the following standards, specifications or publications:

##### **Ontario Provincial Standard Specifications, General**

OPSS 180      Management and Disposal of Excess Material

### **Ontario Provincial Standards Specifications, Construction:**

|          |   |
|----------|---|
| OPSS 206 | Grading   |
| OPSS 409 | Closed Circuit Television Inspection of Pipelines   |
| OPSS 503 | Site Preparation for Pipelines, Utilities and Associated Structures in Open Cut                       |
| OPSS 504 | Preservation, Protection and Reconstruction of Existing Facilities                                    |
| OPSS 507 | Site Restoration Following Installation of Pipelines, Utilities and Associated Structures in Open Cut |
| OPSS 514 | Trenching, Backfilling and Compacting   |
| OPSS 517 | Dewatering of Pipeline, Utility and Associated Structure Excavation                                   |
| OPSS 538 | Support Systems   |
| OPSS 539 | Protection Schemes  |
| OPSS 904 | Concrete Structures   |
| OPSS 905 | Steel Reinforcement for Concrete  |

### **Ontario Provincial Standard Specifications, Materials:**

|           |   |
|-----------|---|
| OPSS 1004 | Aggregates - Miscellaneous                      |
| OPSS 1205 | Clay Seal                                       |
| OPSS 1301 | Hydraulic Cementing Materials                   |
| OPSS 1302 | Water   |
| OPSS 1350 | Concrete - Materials and Production             |
| OPSS 1440 | Steel Reinforcement for Concrete                |
| OPSS 1801 | Corrugated Steel Pipe Products                  |
| OPSS 1820 | Circular Concrete Pipe                          |
| OPSS 1840 | Non-Pressure Polyethylene Plastic Pipe Products |
| OPSS 1841 | Polyvinyl Chloride Pipe Products                |
| OPSS 1860 | Geotextiles                                     |

### **American Society for Testing and Materials:**

C171 - 97a - Sheet Materials for Curing Concrete

C507 - 95a - Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe

## **421.03 DEFINITIONS**

For this specification the following definitions apply:

**Backfilling:** means the operation of filling the trench with bedding, cover and backfill material, or embedment and backfill material.

**Concrete Appurtenances:** mean concrete head walls, cut-off walls, stiffeners, aprons, collars and any other concrete fixtures associated with the pipe culvert excluding concrete bedding or concrete structures covered elsewhere in the Contract and specified as such.

**Excavation, Earth and Rock:** means the excavation classified as earth and rock according to OPSS 206.

**Flexible Pipe:** means pipe that can deflect 2% or more without cracking, such as polyvinyl chloride or polyethylene or steel pipe.



**Pipe Culvert:** means an installation designed to provide for the conveyance of surface water, pedestrians or livestock using preformed or precast pipe sections, circular or non-circular in cross-section, laid end to end using suitable joint materials.

**421.05 MATERIALS**

**421.05.01 Pipe Materials**

**421.05.01.01 General**

Pipe type and class shall be selected according to the terms of the Contract. The pipe size shall be according to the size specified; however, if the size specified is not available then the next larger size pipe shall be used.

Fittings shall be suitable for and compatible with the class and type of pipe for which they will be used.

Couplers that do not follow the contour of the flexible pipe require a polyethylene gasket which shall consist of a 2 m wide strip of 150 µm polyethylene film and shall be folded so as to produce a 1 m wide strip. The polyethylene shall be according to ASTM C 171.

**421.05.01.02 Concrete Pipe**

Circular concrete pipe and joints shall be according to OPSS 1820.

Elliptical concrete pipe and joints shall be according to ASTM C 507.

**421.05.01.03 Corrugated Steel Pipe Products**

Corrugated steel pipe products shall be according to OPSS 1801.

**421.05.01.04 Polyethylene Plastic Pipe Products**

Polyethylene plastic pipe products shall be according to OPSS 1840.

**421.05.01.05 Polyvinyl Chloride Plastic Pipe Products**

Polyvinyl chloride plastic pipe products shall be according to OPSS 1841.

**421.05.02 Mortar**

Mortar for joints shall be composed of one part normal Portland cement and two parts mortar sand, wetted with only sufficient water to make the mixture plastic. The mortar sand shall be according to OPSS 1004, the normal Portland cement shall be according to OPSS 1301, and the water shall be according to OPSS 1302.

**421.05.03 Clay Seal**

Clay seal material shall be according to OPSS 1205.

**421.05.04 Concrete**

Concrete for concrete appurtenances shall be according to OPSS 1350 with a nominal minimum 28 day compressive strength of 30 MPa.

**421.05.05 Reinforcing Steel**

Reinforcing steel shall be of the size and grade specified and shall be according to OPSS 1440.

**421.05.06 Geotextile**

Geotextile shall be according to OPSS 1860.

**421.07 CONSTRUCTION**

**421.07.01 Site Preparation**

Site preparation shall be according to OPSS 503.

**421.07.02 Preservation and Protection of Existing Facilities**

Preservation and protection of existing facilities shall be according to OPSS 504.

**421.07.03 Protection Against Floatation**

Damage to the pipeline due to floatation shall be prevented during construction and until completion of the work.

**421.07.04 Cold Weather Work**

All work shall be protected from freezing. Pipes and bedding material shall not be installed on frozen ground.

**421.07.05 Transporting, Unloading, Storing and Handling Pipe**

All pipes, fittings and gaskets that are unsound or damaged shall be rejected.

Manufacturer's handling and storage recommendations shall be followed.

**421.07.06 Excavation**

Excavation for placing pipe culverts shall be according to OPSS 514.

**421.07.07 Support Systems**

Support systems shall be according to OPSS 538.

**421.07.08 Dewatering**

Dewatering shall be according to OPSS 517.

#### **421.07.09 Protection Schemes**

The construction of all protection schemes shall be according to OPSS 539. Where the stability, safety or function of an existing roadway, railway, other works, or proposed works may be impaired due to the method of operation, such protection as may be required shall be provided. Protection may include sheathing, shoring and the driving of piles where necessary to prevent damage to such works or proposed works.

#### **421.07.10 Backfilling and Compacting**

Backfilling and compacting shall be according to OPSS 514.

#### **421.07.11 Pipe Installation**

##### **421.07.11.01 General**

If a universal dimple coupler or any other coupler which does not follow the contour of the flexible pipe sections to be joined, then polyethylene gaskets shall be installed at all joints where such couplers are used. Polyethylene gaskets shall be installed symmetrically about the pipe joint, between the coupler and the pipe, and should be of sufficient length to equal the circumference of the pipe plus a minimum overlap of 300 mm.

Pipe shall be laid within the specified alignment and grade tolerances. When bell and spigot pipe is laid, the bell end of the pipe shall be laid upgrade.

Pipe shall be kept clean as work progresses. Water shall not be allowed to flow through the pipe during construction. The trench shall be kept dry. A removable watertight bulkhead shall be installed at the open end of the last pipe laid whenever work is suspended.

Pipe shall not be laid until the preceding pipe joint has been completed and the pipe is carefully embedded and secured in place.

When the Owner raises or lowers the invert of a pipe culvert by up to 150 mm, it will not constitute a Change in the Work and no adjustment will be made to the payment. Where the invert of a pipe culvert is raised or lowered by more than 150 mm, then this shall constitute a Change in the Work for the full extent of the change from the original grade.

The pipe culvert cut-end finish and end sections shall be as specified.

When installing gaskets all pipe ends shall be thoroughly cleaned and lubricated with a lubricant recommended by the pipe manufacturer.

When gaskets have been affixed, the pipe shall be handled so the gasket is not damaged, displaced, or contaminated with foreign matter. Any gasket displaced or contaminated shall be removed, cleaned and lubricated if required, and reinstalled before closure of the joint is attempted.

If necessary, the pipe shall be properly positioned by means of a puller mechanism. The mechanism anchor shall be at least three pipe lengths from the joint being made. Sufficient pressure shall be applied in making the joint to ensure that the joint is in position. Sufficient restraint shall be applied to the line to ensure that joints are held in this position.

Once the pipe has been jointed, a test shall be made with a feeler gauge at intervals around the joint to make sure the gasket has not been displaced from the spigot groove. If the gasket is found out of position, the joint shall be opened and the gasket placed in its proper position. If necessary, a new gasket shall be installed.

#### **421.07.11.02                      Circular Concrete Pipe**

All circular concrete pipe joints shall have elastomeric gaskets.

#### **421.07.11.03                      Non-Circular Concrete Pipe**

Pipe with lift holes shall be laid so that the lift holes are at the 12 o'clock position of the pipe. The lift holes shall be filled with non-shrink mortar before the trench is backfilled.

All non-circular concrete pipe joints shall be wrapped with geotextile unless mortar joints are specified.

A 600 mm wide strip of geotextile shall be placed to form a continuous barrier centred around the exterior of the buried joints. Geotextile shall be of the type, class and filtration opening size specified. Geotextiles shall be free of folds, tears and wrinkles. The geotextiles shall be joined so that the material laps a minimum of 500 mm and shall be pinned together. Alternatively, the geotextile shall be joined to conform with the seam requirements of OPSS 1860.

Joints to be mortared shall be thoroughly cleaned and wetted before placing mortar. Mortar shall be trowelled evenly inside the lower half of the bell of the receiving pipe and over the upper half of the spigot of the pipe being laid. The spigot then shall be placed into the bell of the pipe already laid and the pipe pushed into position. Mortar then shall be carefully spread over the joint around the outer circumference of the pipe. After the mortar joint is complete the joint inside the pipe shall be wiped clean and smooth.

#### **421.07.11.04                      Corrugated Steel Pipe**

Riveted corrugated steel pipe shall be laid with the inside circumferential laps pointing in the direction of the flow. The longitudinal laps shall be located in the upper half of the pipe.

Helical corrugated steel pipe without rerolled ends shall be installed so that the helix angle is constant for the total length of the installation. Each pipe section shall be installed next to the previous section such that the lockseam forms a continuous helix. For rerolled ends, the correct fit of the coupling system does not depend on the location of the helical lockseam and corrugation.

Where paved invert pipe is to be installed, the paved portion of the pipe shall be carefully centred on the bottom throughout the length of the installation.

When joint seals are specified, they shall be installed immediately before the installation of steel couplers.

Corrugated steel pipe sections shall be joined by means of steel couplers. The couplers shall be installed to lap approximately equal portions of the pipe being connected and such that the corrugations or projections of the coupler properly engage the pipe corrugations. As the coupler is being tightened it shall be tapped with a mallet to take up the slack. On bituminous coated pipe, the contacting surfaces of the coupler and pipe shall be lubricated with vegetable oil, or a similar lubricant before tightening the coupler.

Structural plate culverts may be assembled in the trench or beside the excavation. If the assembled structure has to be moved to its final position it shall be moved so that no damage or distortion is caused to the structure.

When the structural plate culvert has been placed to the specified alignment and grade, all assembly bolts shall be retightened with a torque wrench to a minimum of:

- a) 200 N·m for 3.5 and 3.0 mm gauge of pipe;
- b) 340 N·m for heavier than 3.5 mm gauge of pipe.

#### **421.07.11.05 Polyethylene Plastic Pipe**

Polyethylene plastic pipe shall be jointed by one of the following methods:

- a) Bell and Spigot

Bell and spigot joints shall have elastomeric gaskets.

At the end of a day's work, the last pipe shall be blocked as may be required to prevent movement.

- b) Welded Joint

Extrusion fillet welding shall be completed using equipment designed to secure the two pipe ends.

Once the bell and spigot are joined in the normal manner, the fillet area between the tip of the bell and the neck of the spigot is preheated. The hot extrude shall be pressed into the fillet area to fuse the joint together. This procedure can be applied to the outside surface of small diameter pipes or can be accomplished by welding on the inside surface of the larger diameter pipes.

- c) Thermal Fusion Joint

Procedures recommended by the pipe manufacturer shall be followed.

- d) Screw-on Coupler

Polyethylene plastic pipe sections may be joined by means of a screw-on coupler supplied by the manufacturer. The coupler shall be installed to lap approximately equal portions of the pipes being connected such that the corrugations or projections of the coupler properly engage the pipe corrugations.

- e) Split Coupler

Polyethylene plastic pipe sections may be joined by means of a split coupler supplied by the manufacturer. The coupler shall be installed to lap approximately equal portions of the pipe being connected and such that the corrugations or projections of the coupler properly engage the pipe corrugations. The coupler shall be secured to the pipe with nylon ties supplied by the manufacturer.

#### **421.07.11.06 Polyvinyl Chloride Plastic Pipe**

Polyvinyl chloride plastic pipe shall be jointed using a bell and spigot joints with elastomeric gaskets.

At the end of a day's work, the last pipe shall be blocked as may be required to prevent movement.

#### **421.07.12 Closed Circuit Television (CCTV) Inspection**

When specified, CCTV inspection of pipe culverts shall be according to OPSS 409.

#### **421.07.13 Cleaning and Flushing Pipe Culverts**

When specified, pipe culverts shall be cleaned and flushed just prior to inspection and acceptance.

**421.07.14 Clay Seals**

Clay seals shall be placed as specified and compacted to 95% of the maximum dry density.

**421.07.15 Concrete Appurtenances**

Concrete appurtenances shall be constructed as specified. Concrete in concrete appurtenances shall be placed according to OPSS 904. Reinforcing steel shall be placed according to OPSS 905. Steel grating shall be installed when specified.

**421.07.16 Protection from Traffic**

Before allowing the movement of construction equipment or any vehicular traffic over the completed structure the depth of backfill over the pipe culvert shall be at least equal to the minimum specified for protection.

**421.07.17 Site Restoration**

Site restoration shall be according to OPSS 507.

**421.07.18 Management and Disposal of Excess Material**

Management and disposal of excess material shall be according to OPSS 180.

**421.09 MEASUREMENT FOR PAYMENT****421.09.01 Actual Measurement****421.09.01.01 Pipe Culverts**

Measurement of pipe culverts is in metres along the horizontal length of the pipe, from one end of the pipe or pipe end section to the other end of the pipe or the other pipe end section. Where the grade of the pipe culvert is 10% or greater, then the above measurement is of the slope length.

**421.09.01.02 Concrete Appurtenances**

Measurement for concrete appurtenances will be made in cubic metres of the volume of concrete placed or lump sum.

**421.09.02 Plan Quantity Measurement**

When measurement is by Plan Quantity, such measurement will be based on the units shown in the clauses under Actual Measurement.

**421.10****BASIS OF PAYMENT****421.10.01**

***"size, type, class"* Pipe Culvert - Item**  
**Clay Seal - Item**  
**Concrete Appurtenance - Item**

Payment at the Contract price for the above item shall be full compensation for all labour, equipment and material to do the work.

**421.10.02****Swamp Excavation**

Where the Contract requires swamp excavation to place a pipe culvert, payment for the swamp excavation shall be under the tender item covering the swamp excavation for earth embankment construction. No alterations shall be made to the tender item for the pipe culvert so affected.

**421.10.03****Closed Circuit Television Inspection**

When a CCTV inspection of pipe culverts is specified, payment for the CCTV inspection shall be according to OPSS 409.

(size) PIPE CULVERT – Item No.  
(size) NON-CIRCULAR PIPE CULVERT – Item No.  
(size) PIPE CULVERT EXTENSION – Item No.  
(size) NON-CIRCULAR PIPE CULVERT EXTENSION – Item No.

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Special Provision No. 421S04

August 2007

OPSS 421, April 1999, Construction Specification for Pipe Culvert Installation in Open Cut is amended as follows:

#### **421.02 REFERENCES**

Section 421.02 of OPSS 421 is amended by deleting the following:

OPSS 538      Support Systems

and replacing it with:

OPSS 538      Shoring and Bracing

#### **421.03 DEFINITIONS**

Section 421.03 of OPSS 421 is amended by the addition of the following definitions:

**Pipe Type** means a pipe's inner wall design, which can be smooth or corrugated.

**Pipe Class** means a pipe's physical material specifications such as load and pressure ratings, wall thickness, protective coatings, corrugation profiles, ring stiffness constants, and reinforcement.

#### **421.05.01 Pipe Materials**

##### **421.05.01.01 General**

Clause 421.05.01.01 of OPSS 421 is amended by deleting the first paragraph and replacing it with the following:

Pipe culvert size, type, and class shall be as specified in the Contract Documents. Pipe culvert type shall be consistent throughout the length of the pipe culvert as specified in the Contract Documents.

#### **421.09.01 Actual Measurement**

Subsection 421.09.01 of OPSS 421 is amended as follows:

Clause 421.09.01.01 is amended by the addition of **Non-Circular Pipe Culvert** to the title.

Subsection 421.09.01 is further amended by the addition of the following clause:



**421.09.01.03                      Pipe Culvert Extension**  
**Non-Circular Pipe Culvert Extension**

Measurement for payment for pipe culvert extension is in metres along the horizontal length of the pipe extension.

**421.10                              BASIS OF PAYMENT**

Subsection 421.10.01 of OPSS 421 is deleted and replaced with the following:

**421.10.01                      “size” Pipe Culvert – Item**  
**“size” Non-Circular Pipe Culvert – Item**  
**“size” Pipe Culvert Extension – Item**  
**“size” Non-Circular Pipe Culvert Extension – Item**  
**Clay Seal – Item**  
**Concrete Appurtenance - Item**

Payment at the Contract price for the above item shall be full compensation for all labour, equipment and material to do the work.

WARRANT:    Always with these items.