Risk Allocation Seminar
Groundwater Risk

CSVA Symposium

Toronto

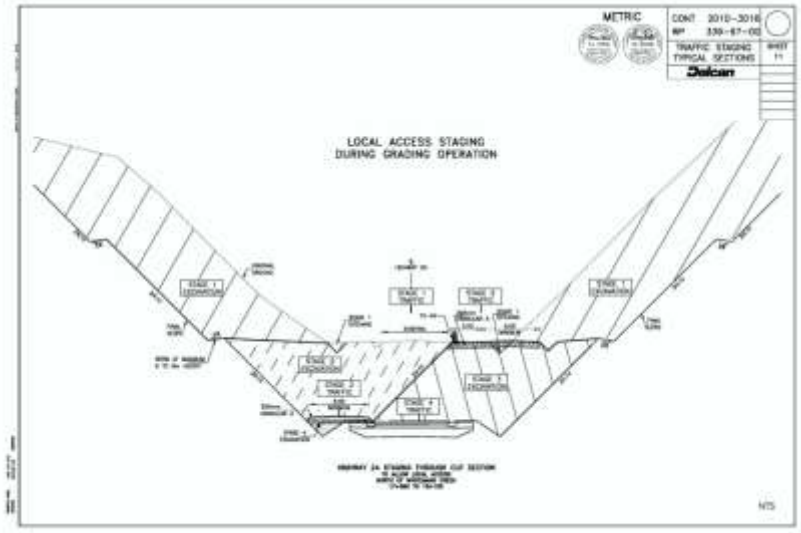
November 17, 2014

Frank Hochstenbach

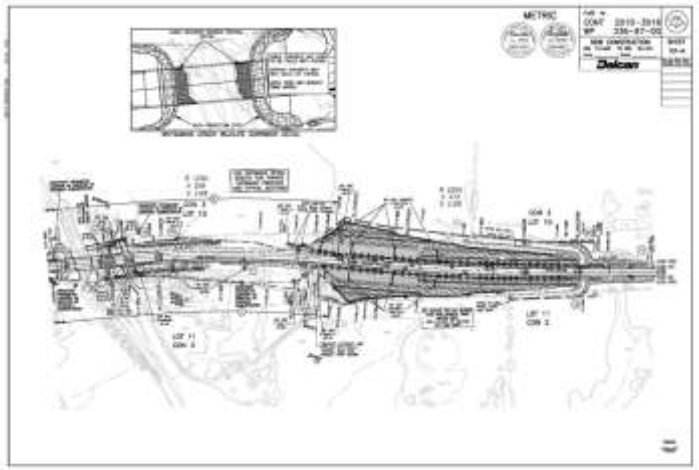
Risk Allocation Seminar
Groundwater Risk

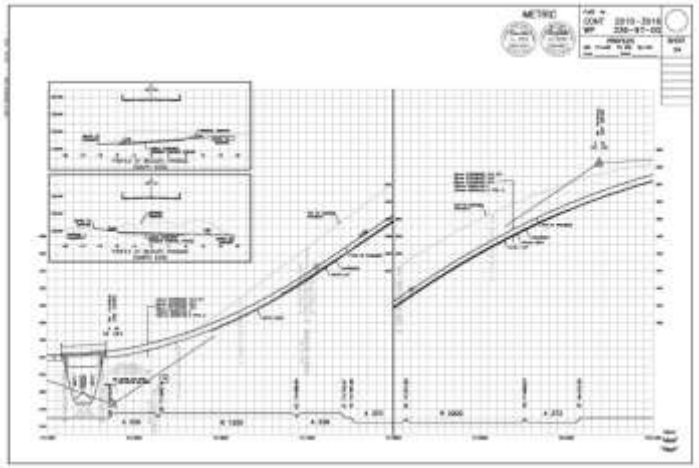
The Project:

- Whitemans Creek Bridge Replacement
  - Included lowering the vertical alignment of the highway through the valley
  - Large excavations



Risk Allocation Seminar
Groundwater Risk





Risk Allocation Seminar
Groundwater Risk

The Risk: Groundwater

- Boreholes showed high water table in the area of excavation
- Ditch inlet structures showed large volumes of flowing water
- Sensitive, pristine watercourse (Whitemans Creek)
- Highway had been uploaded from Municipality; no historic information

Risk Allocation Seminar
Groundwater Risk

Risk Mitigation during Detailed Design:

- Hydrogeological Investigation:
- Bridge Foundations were main area of concern
  - Well investigated
  - Provided recommendations for de-watering
- Water Well survey conducted
  - Identified wells at risk for reduced volume due to excavation
  - Identified wells for monitoring during construction

Risk Allocation Seminar
Groundwater Risk

Risk Mitigation during Detailed Design:

- Hydrogeological Investigation (continued)
- Large Excavation North of Bridge was of lesser concern
  - Subsurface water identified
  - Recognized that water would daylight during excavation, but it wasn't as great of a concern
  - Predicted that post-construction flows would be similar to pre-construction
  - Recommended subdrains under pavement structure

Risk Allocation Seminar
Groundwater Risk

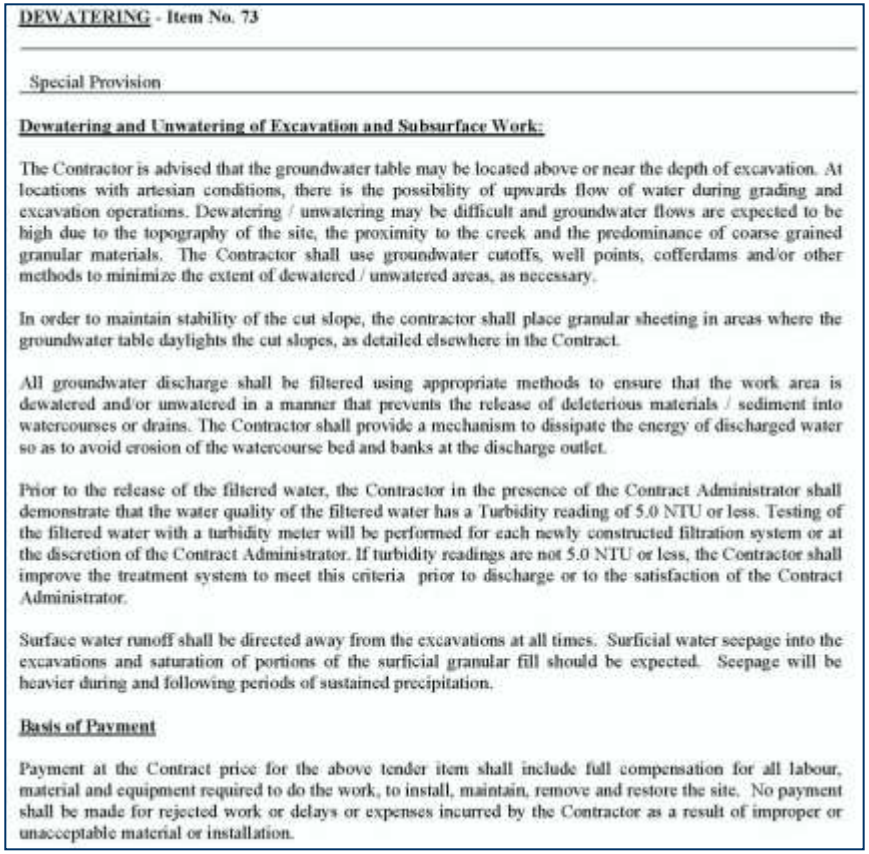
Risk Mitigation during Detailed Design (con't):

- We recognized that, during construction, water would daylight in the area of the large excavation
- Potential Impacts were identified:
  - Risk of erosion on cut slopes
  - Risk of sediment contaminating creek
- Quantities and source unknown

Risk Allocation Seminar
Groundwater Risk

Risk was managed by transferring the risk to the Contractor

- TPM Consultant's recommendation: *"The contractor will know ways to manage this issue; we'll leave it up to them."*
- Special Provision written
- Item was paid "Lump Sum"



DEWATERING - Item No. 73

Special Provision

Dewatering and Unwatering of Excavation and Subsurface Work:

The Contractor is advised that the groundwater table may be located above or near the depth of excavation. At locations with artesian conditions, there is the possibility of upwards flow of water during grading and excavation operations. Dewatering / unwatering may be difficult and groundwater flows are expected to be high due to the topography of the site, the proximity to the creek and the predominance of coarse grained granular materials. The Contractor shall use groundwater cutoffs, well points, cofferdams and/or other methods to minimize the extent of dewatered / unwatered areas, as necessary.

In order to maintain stability of the cut slope, the contractor shall place granular sheeting in areas where the groundwater table daylights the cut slopes, as detailed elsewhere in the Contract.

All groundwater discharge shall be filtered using appropriate methods to ensure that the work area is dewatered and/or unwatered in a manner that prevents the release of deleterious materials / sediment into watercourses or drains. The Contractor shall provide a mechanism to dissipate the energy of discharged water so as to avoid erosion of the watercourse bed and banks at the discharge outlet.

Prior to the release of the filtered water, the Contractor in the presence of the Contract Administrator shall demonstrate that the water quality of the filtered water has a Turbidity reading of 5.0 NTU or less. Testing of the filtered water with a turbidity meter will be performed for each newly constructed filtration system or at the discretion of the Contract Administrator. If turbidity readings are not 5.0 NTU or less, the Contractor shall improve the treatment system to meet this criteria prior to discharge or to the satisfaction of the Contract Administrator.

Surface water runoff shall be directed away from the excavations at all times. Surficial water seepage into the excavations and saturation of portions of the surficial granular fill should be expected. Seepage will be heavier during and following periods of sustained precipitation.

Basis of Payment

Payment at the Contract price for the above tender item shall include full compensation for all labour, material and equipment required to do the work, to install, maintain, remove and restore the site. No payment shall be made for rejected work or delays or expenses incurred by the Contractor as a result of improper or unacceptable material or installation.

Risk Allocation Seminar
Groundwater Risk

During Construction…

- Water daylighted in the cut slope
- High volume was a surprise
- Water had to be captured and filtered before being discharged into creek
- The wells for three properties went dry

Risk Allocation Seminar
Groundwater Risk

The Contractor managed the water using:

- Straw bales
- Silt bags
- Collection ponds
- Settling tanks
- Collecting the water in tanker trucks

Risk Allocation Seminar
Groundwater Risk

As a result…

- The Contractor said that there was no way they could have anticipated this much water when they bid it
- Since they had collected the water in tanker trucks, they could quantify the volume
- They claimed for extra fees for the work required to properly manage the volumes encountered
- A Change Order was paid

Risk Allocation Seminar
Groundwater Risk

In retrospect, what else could have been done?

- More field investigation?
- Drawdown Tests?
- Monitor for a couple of years before construction?
- Test Pits for bidders?
- Accept risk and:
  - Use Working Day Contract, or
  - Pay Time & Material
- Would these strategies have been successful?

Risk Allocation Seminar
Groundwater Risk

In Conclusion: End Results of the Risk Transfer Strategy

- Transferring the Risk was the right strategy:
  - The water was managed by the Contractor
  - The claim covered the extra costs for managing the water
- Would have preferable to have more advance work defining quantity of water. Since we couldn't adequately quantify the Risk, we couldn't completely transfer the Risk:
  - We couldn't counter the claim by telling the Contractor "He ought to have known the volume" because WE didn't know
  - If we had arbitrarily picked a very large volume, we would have paid for it whether the high volume occurred or not
  - We paid for the actual quantities realized
- We were fortunate that the Contractor was willing to work with us to resolve this problem

Risk Allocation Seminar
Groundwater Risk

Would the results have been different with another contract model (e.g. Design-Build, CMGC)?

- Regardless of the model, there was still the risk
- The Hydrogeological Investigation would likely have been part of the DB-Ready Package
- The contractor may have had additional hydrogeological work conducted. They still likely would have claimed for the extra costs, but they may have been able to better manage their schedule based on more advanced information
- However, regardless of the model, we still would have had some risk of a claim for the severe situations uncovered during construction
- With CMGC, contractor involvement during design may have been beneficial

Risk Allocation Seminar
Groundwater Risk

Thank You

Any Questions?