MEMORANDUM

TO John Stecyk, Regional Engineer (Small Craft Harbours - Central & Arctic Region)

DATE October 27, 2009

CC Alan Kathan

FROM Gordon Chrystal

PROJECT No. 09-1345-1001

PANGNIRTUNG SMALL CRAFT HARBOUR – ANCILLARY PROJECT REQUIREMENT
PERMIT APPLICATION FOR THE DUVAL RIVER CROSSING (TEMPORARY – FOR DURATION OF PROJECT ONLY)

This memorandum is in support of the provisional submission on the proposed Duval River crossing identified as being required by the Hamlet of Pangnirtung for the dredging contract for the small craft harbour. The original submission drawings (Dwg. No. 0913451001A004; signed and sealed) are attached as reference.

Preliminary hydrology has been carried out on the Duval River. The catchment area has been mapped at 95.5 km^2. In addition to applying a simplified run-off methodology to the catchment (assuming a nominal run-off factor, average slopes and a generic storm distribution), the catchment has been compared to the existing data available for the Sylvia Grinnell River catchment, for which measured stream flow data is available along with the corresponding rainfall events.

The two catchments can be considered hydrologically comparable (with respect to run-off factors and climatic conditions) and the relative return period flows for the Duval River are considered acceptable. The results are as follows for the Duval River:

Return Period (Years)	River flow (m^3/second)
1 : 10	17.7
1 : 100	23.8
1 : 1000	30.1

The 1:100 year flow is selected as the design flow.

At an installed slope of 2%, and a culvert length of 26 m (calculated on a revised side slope of 1.5:1 and a berm height of 6 m from channel bottom to top of berm on the upstream face), the configuration of 3 culverts (each at 1.8 m diameter) accommodates the design flow as follows:

Q_{peak} (m^3/s), Tailwater Depth (m) & Velocity (m/s)	24	1.5	4.02
Pipe discharge Q_p (m^3/s) – per pipe	8.000		
Calculated inlet head H(m)	2.877	(a 1m surcharge at the headwall)	
Control type	Inlet		
Critical flow depth H_c (m)	1.406		
Normal depth H_n (m)	1.299		
Culvert flow depth at entrance (m)	1.406		
Culvert exit velocity (m/s)	4.063	(velocity will scour river channel)	

There was a gauging station in the Duval River that was discontinued in 1983. Limited and sporadic data is available but the reliability of the data is questionable.

This gauging station recorded maximum daily discharges at 22.3 m^3/second and lower (less than the 1:100 year return flows) and a single maximum instantaneous discharge measured at 39.7 m^3/second (in 1982). This is not considered a reasonable flow condition as it was a single reading taken from a total of 4 years of flow data. This higher flow of 39.7 m^3/sec has been checked against the proposed design and the culvert configuration will accommodate this flow with a 2.6 m head at the inlet (total water depth = 4.4 m at this flow on the headwall).

The minimum height of the berm crossing is required to be 6 m (from channel floor to berm top) to ensure no overtopping under these circumstances.

Two additional circumstances have been considered in this design review:

- The maximum capacity of the culvert is estimated at 50 m^3/sec, at which point the culvert berm structure will be over-topped. This represents a capacity of approximately 100% in excess of the 1:100 year design flow and is greater than any previously measured flow in the Duval River.
- The Duval River flood event of 2007 that caused significant damage resulted from a break in an ice dam in the upper reaches of the Duval River catchment; it was not entirely caused by the run-off from the high rainfall event that occurred at that time. This would be considered a catastrophic event for which culverts are not normally designed. Under normal operating conditions a dam break would be expected to cause the failure of smaller infrastructure.

As a supplement to the technical review, it is requested that during construction the Contractor be required to have a Spill Plan in place that complies with the following specification: EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices. At a minimum the Contractor is required to have a Spill Kit on site and available for use that would contain and deal with a spill from the envisaged construction equipment.

Trust this information is sufficient to support the application for the Duval River (Temporary) River crossing.

Please contact me at (403) 509-1873 should you have any questions regarding this assessment.

Regards

Technical memorandum written by:

Gordon Chrystal, P.Eng (AB)

Senior Project Manager.

Technical memorandum reviewed by:

Bill Y. Liu, P.Eng, Ph. D.

Associate; Senior Geotechnical Engineer

REGISTERED PROFESSIONAL ENGINEER
Y. LIU
LICENSEE
NWT/NU