



**TITLE: BUILDING BRIDGES-  
FASTER, BETTER, SAFER  
UNDER EMERGENCY CONDITIONS**  
**CATEGORY: EMERGENCY RESPONSE**  
AT RIVER CROSSINGS  
HIGHWAY #10 YUKON

PAPER PREPARED FOR PRESENTATION AT THE STRUCTURES-BRIDGES SESSIONS  
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## **Abstract:**

Nahanni Range Road in Yukon starts at km108 of the Robert Campbell Highway and leads towards Northwest Territory.

Heavy rains, snow melt and the spring freshet in June 2012 wiped out culverts at three locations on Nahanni Range Road. More than 100 miners, mill workers and exploration companies were out of work due to the wash outs and a major mining company shut down operations as this was the only road link to that part of the country.

The rehabilitation of the road including the river crossings became a priority. The tender package was prepared and advertised within 48 hours in response to the emergency situation. There were some unknown conditions since the road was not accessible and as a result extra work was also anticipated during construction. Many design decisions had to be made on site during construction.

Contractors were informed about the upcoming tender with short closing date and as a result six companies participated in the tender. Contract was awarded to the lowest bidder. Three modular 140', 120', 40' oil field type bridges were purchased from Northern Mat & Bridge Ltd to replace three washed out culvert locations. To meet the emergency need, three bridges were installed on temporary structures in about a week, and the road was opened to the public. All bridges were reinstalled on permanent structures during the next two months and have 50 years expected service life.

Many challenges were faced during the construction.

This paper describes the project objectives, award process and details that revealed to be a cost-effective solution for Yukon Territory.

## **Background:**

### **100 miners out of work due to Yukon road closure (CBC News)**

**Nahanni Range Road to North American Tungsten mine washed out in 3 spots**

[CBC News](#) Posted: Jun 19, 2012 11:42 AM CT Last Updated: Jun 19, 2012 2:06 PM CT



Figure 1: The Nahanni Range Road, which leads to the mine, was washed out in three locations. (Yukon Department of Highways and Public Works)

[North American Tungsten has shut down operations while a government contractor repairs three washouts leading to its mine on the Yukon and N.W.T. border.

A skeleton staff will keep machinery idling until more than a hundred workers are called back.

Heavy rains and snow melt wiped out culverts in three spots on the Nahanni Range Road. Company CEO Steve Leahy said without large supplies of fuel and food, they had to let most of their workers go until the road re-opens.

"The balance [of workers] is waiting to hear and certainly we appreciate their patience but on the other hand it's certainly out of our hands," said Leahy. The government estimates it could take up to two weeks to reopen the road.

Leahy thinks it will be sooner, and he said he is encouraged by the government's quick response. "Also that the contractor, I understand, is already mobilized and equipment is moving towards the particular washouts that need to be repaired. So we are hoping that this will be a little shy of the two-week timeframe that everyone is talking about."

Leahy said it will take a bit of planning and time to get operations going again once the road reopens]

### **History of the Road:**

The Nahanni Range Road was constructed in the early 1960s. The washout culverts were constructed during that time period

with some modifications done on later dates.



Figure 2: Aerial View of Highway#10 (Nahanni Range Road)

### **Emergency Response from Government of Yukon:**

In response to the emergency washout situation, the specification and tender package was prepared and advertised within 48 hrs. There were some unknown conditions since the road was not accessible and as a result, many of the design decisions had to be made at the site during construction. Due to time constraints, proper site survey, geotechnical investigation, hydraulic analysis and proper design work could not be done.



Figure 3: Aerial View of Highway#10 after washout Km74

## **Project Development:**

The Yukon Government held an emergency meeting on June 15, 2012 and put in place a project team to assess available options to meet its objectives. Six companies participated in the tender process and the contract was awarded to the lowest bidder for a value of \$845,000.00. Rip rap to be paid from provisional cost. The challenge was to open the road in the shortest possible time for the public and mining companies. Three modular type bridges were supplied and were installed on temporary road structure in about a week to open the road.

## **Specifications of Bridges:**

- 1) Width 4450mm, with a running surface of 4268mm
- 2) Minimum 305mm splash guard
- 3) Maximum 915mm high guiderail
- 4) Design CAN/CSA S6-06
- 5) Loading CL625 (Ont.)
- 6) Deck structure to be Douglas Fir or approved equivalent, incl. wearing strip, Modular type and prefabricated structure was expected.
- 7) Support structure: single span, lock block abutments, with rip rap and acceptable environmental protection. All bridges to be raised by extra 1m to allow extra freeboard.

## **Challenges:**

There was substantial public pressure to reopen the road. Many people were laid off; miners were running out of fuel and food supply.

## **Engineering decisions:**

To reopen the road quickly, we agreed to stage construction. Stage 1: Install the bridges on a temporary structure at the edge of the existing road/abutment and open the road with limited restriction. Stage 2: Once the road is open, construct proper abutment, approaches, side slopes etc. and move the bridge to the proper location.

Due to the time restraint, it was decided to procure predesigned, modular type bridges which will be readily available.

Three portable, oil field type bridges were supplied by Northern Mat & Bridge. The bridges were designed by Associated Engineering.

Yukon Government reviewed the design to satisfy their need and made them field fit for particular washout locations. The Contract documents were prepared according to our need and the field conditions. Abutments, side slopes, back walls, end supports were designed in our office following the TAC and CSA guidelines. The design was kept very simple using the local, easily available material to expedite the installations keeping in mind that the Contractor had very little experience building bridges. Side slopes were designed with 2:1 slope. Existing road was cut down to accommodate the girder depths during the temporary installation. Load distribution during launching was calculated and balanced to avoid tipping the truck during launch. To raise the bridge and for side slopes, granular material was used from the adjacent pits and compacted to 98% SPDD. Geofabric and rip rap was used to mitigate future erosion.

**a) Bridge launching without adequate & proper equipment:**

**Bridge span 120 ft. river width 155 ft. at km 38:**

To assemble the substructure and assist with launching, no crane was locally available.

Two sets of girders were spliced together using two hi boy trucks driving back to back. Splice plates were bolted on one set of girders on the first truck. The other set of girders were on the second truck and were backed to fit-in. The challenge was to align the holes to run bolts through the predrilled holes. Once the splices were properly bolted, the truck at the back pulled out slowly for the preparation of launching. It was obvious that the centre of gravity would be outside the truck bed. To counter the load and to prevent the truck from tipping, concrete lock blocks size 750x750x1500mm were placed on top and front end of the loaded truck. Abutments were cut down to accommodate the girder depths at the edge (side) of the existing road, as this was the temporary location. Truck was backed slowly to the temporary location, overhanging the substructure over the river. On the other abutment, two excavators (EX400) were ready to support the cantilever ends of the substructure, once the girders were within their reach.

The winch on the truck was released slowly while another

excavator pushed the substructure slowly with strict monitoring in place. Once the cantilever end came within the reach of the excavators at the other end, girders were anchored and supported to complete the launch.

It was a very tense time as there was a potential of substructure falling into the river. It should be noted; the contractor was not experienced and had never built a bridge of this size.

Back walls for the abutments were constructed from raw cut trees available locally and backfilled with previously excavated material. Deck modules were installed and the bridge was ready to open in a controlled manner.

**Bridge span 40 ft. river width 30 ft. at km 65**

It was a simple installation since the span was short and road was cut to accommodate the depth of the girders. Bridge was installed at the edge of the road to allow abutments be built at the appropriate alignment in stage 2.

**Bridge span 140 ft. river width 130 ft. at km 74**

Launching of this bridge was equally challenging as the bridge at km 38. However, since the crew gained some experience from the previous launch, they showed better confidence and launching went reasonably well as planned.

Road was opened to traffic in the specified time frame.

Crew started to build the approaches, abutments, erosion control and later moved the bridges at the appropriate alignment and at the higher design elevation. Approach roads, side slopes were built to the appropriate standard.



Figure 4: Two sets of girders to be spliced together on top of two trucks



Figure 5: A view of girder launching



Figure 6: Bridge launching



Figure 7: Temporary back wall made of trees

**b) Reinstallation of bridges on permanent structures:**

At km 38 (Dolly Varden), major erosion caused construction of north and south abutments very challenging. Abutments were to be built in fast moving water while maintaining environmental control. A temporary earth dam was built across the inlet of the open channel without altering stream bed or banks to guide the flow of water. The earth dam was about 1 meter above the water elevation. We dug a test hole up stream of the multiplates and found that the top 300mm consisted of stone 80mm with sand and small gravels. Below 300mm was hard due to natural cementation. We also dug a test hole near the edge of the proposed abutment location (under the old multiplate location), it was an easy digging to a depth of 800mm. It was hard to dewater this site sufficiently to place and compact material. Geotextile was placed and then rocks were used in the foundation above the water level. The voids were filled with the locally available fine sand with water jetting. Once backfilled above water level, granular material was placed in equal layers and geotextile was used to avoid any potential erosion in the future. Lifts and backfill were placed and compacted with the smooth drum roller to achieve the required compaction



Figure 8: Building foundation in progress



Figure 9: Building foundation and placing of geotextile

### **Construction of Lock Block abutments:**

Lock blocks (750x750x1500mm and 750x750x750mm) were installed using Geogrid, Geofabric, Weeping tiles etc. A steel bearing plate was installed on top of the lock blocks to transfer the load.



Figure 10: Lowering and placing of lock blocks



Figure 11: Placing of Geogrid



Figure 12: Half of permanent abutment

### **Recycling & Salvage Existing Culverts:**

All existing culverts were removed and damaged culverts were disposed of to an approved recycling facility at Watson Lake. Undamaged culverts were salvaged for future use.

### **Conclusions:**

The challenge was met by opening the road for traffic in about one week, resulting in miners, mill workers and exploration companies back on the jobs with minimum delay. If similar wash out conditions happen in the future, we will be ready and able to deal with the situation in a safe and professional way.



Figure 13: Bridge after placing on lock blocks



Figure 14: Underside view of girder and deck after permanent placement