



August 1, 2006

File: 15-85-48

Alberta Infrastructure and Transportation
Room 223, Provincial Building
4709 – 44 Avenue
Stony Plain, Alberta
T7Z 1N4

Attention: Mr. Randy Shaul

**NORTH CENTRAL REGION – STONY PLAIN AREA
GEOHAZARD ASSESSMENT CALL-OUT (CE 142-06)
NC 55: NORTHEAST RAMP EROSION
AT HWY 779 AND HWY 16 INTERCHANGE**

Dear Sir:

This report presents the results of a call-out for the above noted site located at the Hwy 779/Hwy 16 interchange, approximately 2 km north of the Town of Stony Plain. The site is located in Sec. 9, Twp. 9, Rge. 25, W4M. Mr. Don Proudfoot, P. Eng. and Mr. Gustavo Padros, M.Sc. of Thurber Engineering Ltd. conducted the inspection on July 18, 2006. Mr. Randy Shaul of Alberta Infrastructure and Transportation (AIT) made the request for the call-out, and was present during the site reconnaissance along with Mr. David Tough, AIT's area Maintenance Contract Inspector (MCI).

1. BACKGROUND

Soil erosion and gullies were first noted three years ago on the north slope of the northeast ramp embankment of the Hwy 779/Hwy 16 interchange. Remedial measures back then consisted of backfilling the gullies and the eroded surface. In Spring 2006 the erosion features reappeared and worsened through the year prompting a callout request.

2. OBSERVATIONS

The north slope of the northeast embankment of the Hwy 779/Hwy 16 interchange was inspected during the site reconnaissance. Silty sand appeared to be the main constituent of the embankment. Most of the slope was covered with grass and appeared to be performing well. However erosion features were noted in a zone

about 40 m long where a gravel layer about 3 m wide was present beside the highway, in a zone where bare soil extends from the edge of the gravel layer to the toe of the slope (designated Zone A), and in an area where the vegetation was scarce (designated Zone B) as illustrated on Figure No. NC55-1.

Further descriptions of the affected areas are as follows:

2.1 Erosion Features in Zone A

Three erosion holes associated with piping were noticed, as described below and shown on Figure No. NC55-1.

A hole 2.5 m long x 1.7 m wide x 0.6 m deep was noted beside the highway shoulder, penetrating about 0.4 m into the pavement. About 6 m downslope there was another hole 1.6 m long x 0.6 m wide and 0.8 m deep. These holes were connected underneath the surface through a piping tunnel, the former being the entrance hole and the latter being the exit hole. Erosion gullies were noticed outside the exit hole, running downslope.

A second hole 1.7 m long x 1.2 m wide x 0.6 m deep located 17 m south of the first hole was also noticed beside the highway, penetrating about 0.3 m into the pavement. The exit hole was located about 4 m downslope and was about 0.6 m x 0.6 m wide and 0.3 m deep. Erosion gullies were noticed outside the exit hole.

A third hole 0.3 m long x 0.3 m wide x 0.3 m deep was also noticed, located 2 m beside the highway, 24 m south of the second hole. The exit hole was located about 5 m downslope and was about 0.6 m long x 0.2 m wide and 0.3 m deep.

Several erosion gullies were noted downslope of the gravel layer. One of the gullies had created a hole 1.4 m long x 0.6 m wide x 0.6 m deep.

Accumulation of silt was observed at the toe of the embankment.

2.2 Erosion Features in Zone B

Several shallow erosion holes caused by running water were noticed along the highway north shoulder, where large amount of gravel and scarce vegetation cover were present. The holes were about 0.6 m x 0.3 m wide and 0.20 m deep. They are shown on Figure No. NC55-1.

2.3 Other Observations

The surface of the pavement on the access ramp appears to drain towards the northeast due to a built in super-elevation, which would cause runoff from the roadway to drain down the affected slope area. The height of the ramp fill varied from about 2.3 to 4.5 m and was inclined at 12.5° (4.5H:1V) over the main area affected by erosion. A number of overhead lighting posts were present spaced out along the slope parallel to the ramp. A service road was present parallel to the toe of the embankment slope. A pair of 600 mm diameter CSP culverts drained ditch water under the ramp fill and service road to the north at the east end of the slope erosion limits. Another 600 mm diameter CSP culvert drained water from the depressed area between the ramp and Hwy 779 onto a riprap lined channel that ran down the ramp fill side slope. This channel had no signs of erosion.

3. ASSESSMENT

The super-elevation of the pavement on the access ramp to Hwy 779, caused runoff to drain down the affected ramp sideslope. No visible damage occurred where dense grass cover was present and the water drained in a sheet flow manner. However, the embankment is composed of silty sand, which is highly susceptible to erosion, and problems have arisen in zones where bare soil was exposed, topsoil was thin or absent, and the flow had become concentrated possibly due to slight irregularities in the road and sideslope surfaces.

Some of the concentrated runoff created erosion gullies, starting from the edge of the gravel layer and extending downhill, as rainwater removed the silty sand grains. As the velocity of water increased so did its erosive capacity and gullies widened and deepened towards the bottom of the slope.

There were also some locations where water infiltrated the embankment body and then seeped towards its sides. When the flowing water reached the surface of the embankment and exits, it removed the easily eroded silty sand grains, creating a tunnel-type hole that started at the surface and progressed towards the inside of the embankment as more water continued to flow. This erosion process, known as piping, continued until the tunnel reached the surface of the embankment where the infiltration of water was originated.

4. RISK LEVEL

Based on the AIT's Risk level rating system, the risk level for this site has been assessed as follows:

$$\text{Risk (22)} = \text{PF (11)} \times \text{CF (2)} \quad [\text{Eq. 1}]$$

This risk level was based on a Probability Factor (PF) of 11 (active erosion with moderate but increasing rate of intensity) and a Consequence Factor (CF) of 2 (erosion affecting use of the highway ramp but not requiring closure of the roadway).

5. RECOMMENDATIONS

The recommended remedial measures consist of the following:

- The piping tunnels should be excavated;
- The affected sideslope areas should be re-graded scraping the surface of the sand fill and using it to carefully backfill the excavated piping holes and erosion gullies in thin track-packed lifts to a smooth consistent finished surface;
- The re-graded area should be covered with a minimum of 100 mm of imported clayey topsoil which should be track-packed in place in a direction up-and-down (not parallel to) the slope;
- In order to provide erosion protection in the north slope, the eroded Zones A and B should be double seeded and covered with straw matting (low flow soil covering) to ensure sufficient grass coverage.

In the short term, water draining from the highway should be prevented from entering the sideslope until the grass has had a chance to properly catch (about two years). An asphalt curb or filter sock tube (for example by Erscon) placed/pinned to the north shoulder of the highway could be considered for this purpose. The length of the curb/filter sock would need to be about 270 m to drain water from the high point of the ramp down towards the east to the point where the pair of 600 mm diameter CSP culverts are located. A ½ CSP pipe should be installed to convey the flow from the curb down the side slope to the CSP draining under the service road.

The ball park cost of the proposed repairs is about \$ 30,000 to \$50,000.



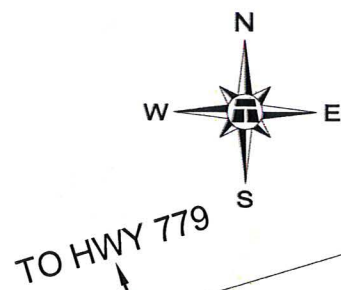
6. CLOSURE

We trust that the above information is sufficient for your present requirements. However, if you have any questions or require any additional input please do not hesitate to call us.

Yours truly,
Thurber Engineering Ltd.
Don Proudfoot, P. Eng.
Review Principal

Gustavo Padros, M.Sc.,
Assistant Project Engineer
/dw

Attachments



PIPING TUNNEL	SIZE OF HOLES (LENGTH X WIDTH X DEPTH) (mXmXm)	
	ENTRANCE	EXIT
#1	0.3 X 0.3 X 0.3	0.6 X 0.2 X 0.3
#2	1.7 X 1.2 X 0.6	0.6 X 0.6 X 0.3
#3	2.5 X 1.7 X 0.6	1.6 X 0.6 X 0.8

LEGEND:

- ✦ LIGHT POLE
- ▨ ZONE B (SCARCE VEGETATION COVER)
- ▩ GRAVEL LINER
- ① → PHOTO AND DIRECTION

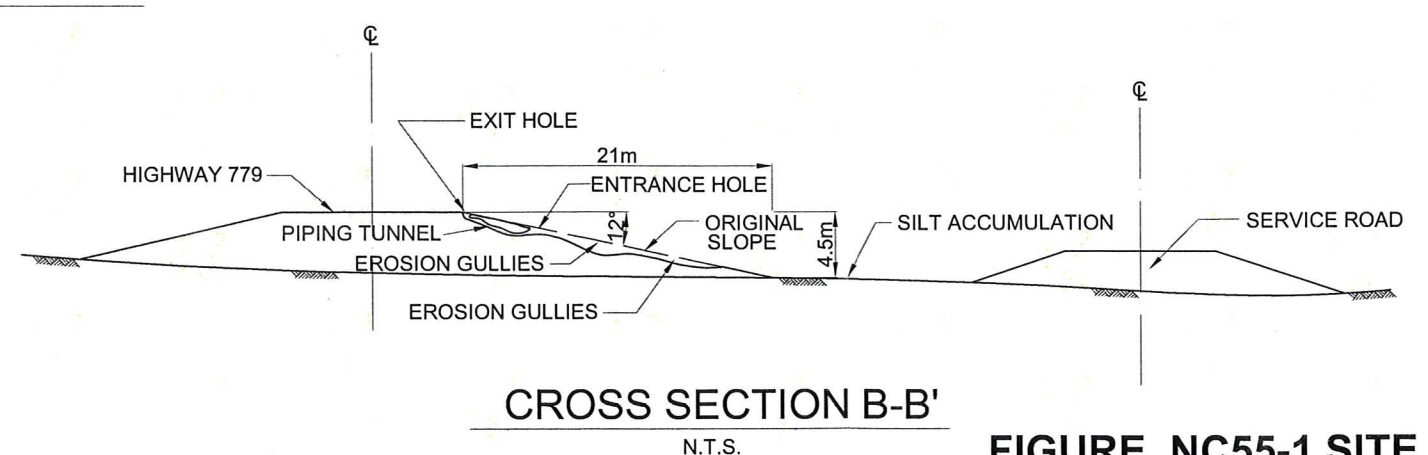
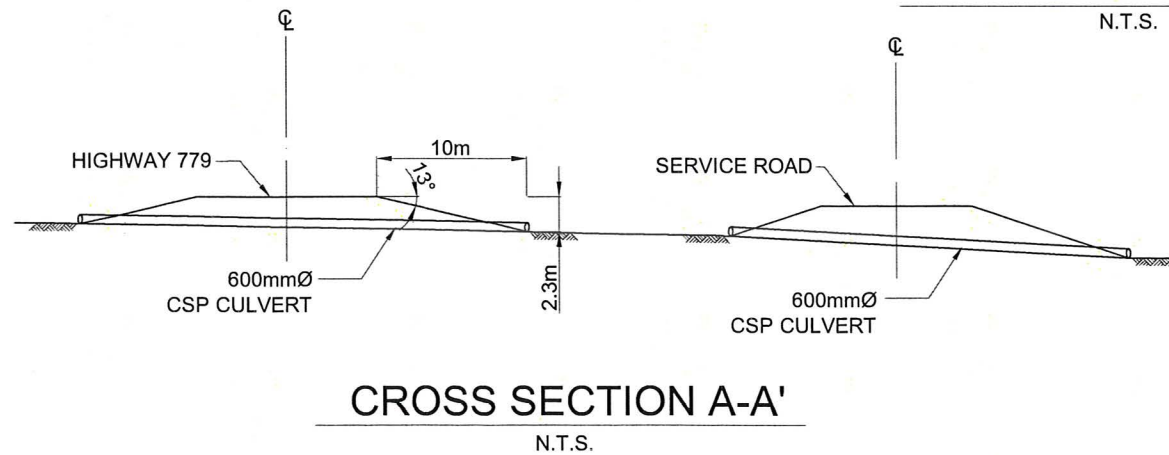
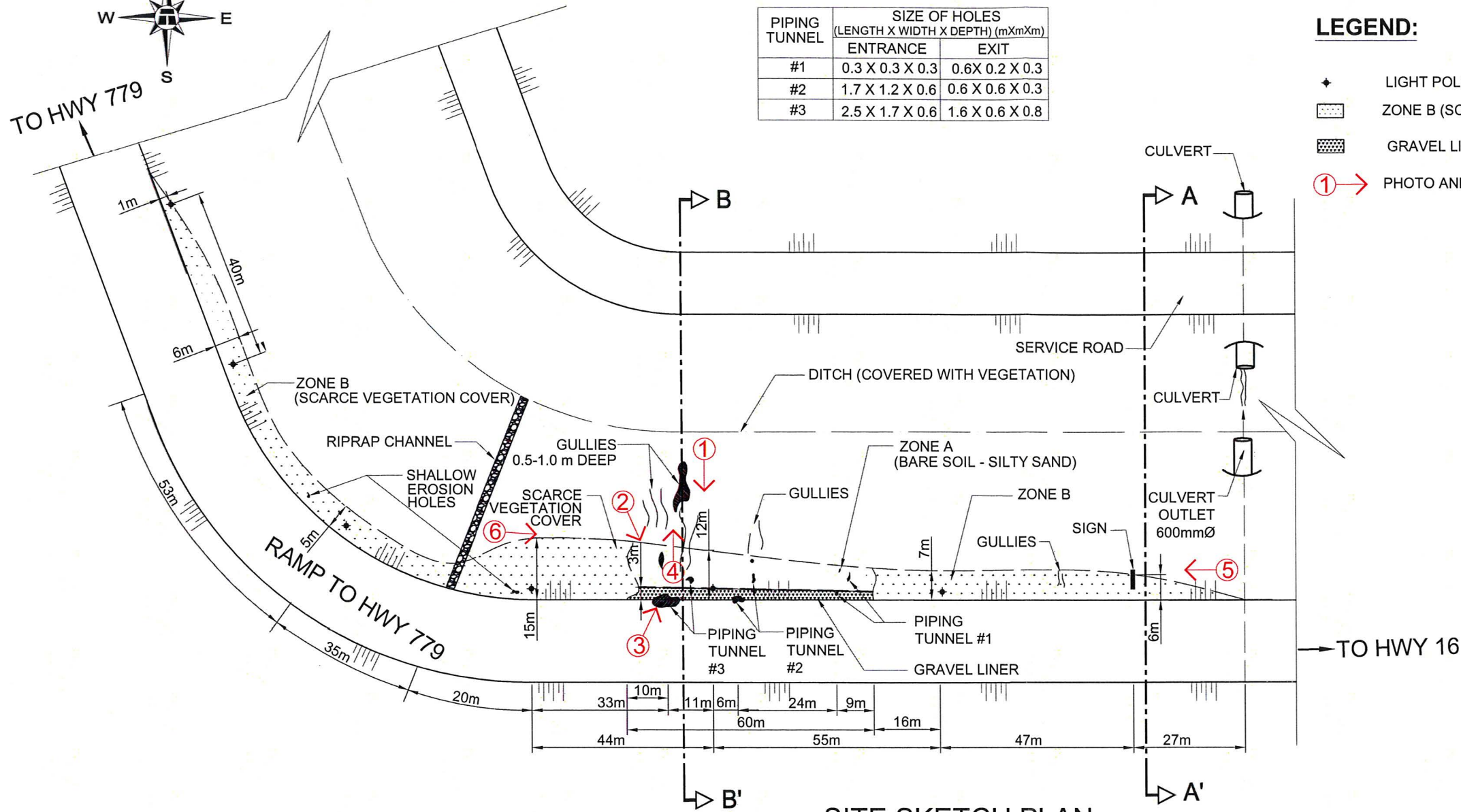


FIGURE NC55-1 SITE PLAN
NC55: HWY 779 & HWY 16 INTERSECTION
NORTH CENTRAL REGION-STONY PLAIN AREA GEOHAZARD ASSESSMENT

DATE : JULY 2006
THURBER PROJECT #15-85-48



PHOTO 1: View of the north slope of the northeast ramp.



PHOTO 2: Entrance hole of piping tunnel No. 3.



PHOTO 3: Exit hole of piping tunnel No. 3, penetrating into the pavement.



PHOTO 4: View facing downslope of the entrance hole of piping tunnel No. 3, erosion gullies and lack of vegetation.



PHOTO 5: West view of the northeast ramp and adjacent service road.



PHOTO 6: East view of northeast ramp and service road.