KARLENG Karl Engineering Consultants Ltd.

File: 2008-1020 (Site Summary) (SH#27) Date: April 2009

BRIEF SITE SUMMARY AND RISK ASSESSMENT

1) Site (SH 27): Hwy 32:12 Judy Creek

2) Reference Location: i) Hwy 32:12 @ 20.4 km South of Town of Swan Hills
ii) 0.13 km north of Judy Creek Culvert (BF 75478)
iii) Judy Creek Culvert (BF 75478) @ Hwy 32:12 @ km 48.27

3) Legal Description Along Highway: LSD 11 - Sec 15 - Twp 64 - Rge 10 - W5M

4) UTM Coordinates: N 6044579.8, E 601656.6, Zone 11

5) AT File: Hwy 32:12, BF 75478 (Judy Creek Culvert)

6) AT Plan and Profile: See Figures 1, 2, and 2a

7) General Description of Instability.

The site distress entails the scour erosion of creek bank which encroachment onto highway right-of-way can potentially cause future destabilization of the highway embankment.

Judy Creek is flowing along a stretch of meandering channel along the east side of Highway 32:12 and has eroded into the creek bank beside the highway. The eroded creek bank is located approximately 100 to 130 m north of the Judy Creek culvert (multi-plate) (BF 75478), which carries the flow (from west to east) beneath Highway 32. At this location, the creek meanders to the west and is eroding into the east side of the highway. At top of the scoured bank, a setback space (from the east edge of pavement to top the creek bank) can be estimated at approximately 11 to 15 m distance.

Exposed soil was observed along the over-steepened bank, and the exposed soil comprises a mixture of glacial till soils (sand, silt, and clay), shale and sandstone pieces, and intermittent organic beds.

Judy Creek flows relatively steadily at this location. Information from AT Bridge File (BF 75478) indicates that the Judy Creek Culvert was installed in 1981, and that the average creek flows was estimated in the range between 2 m^3/s (70 ft^3/s) and 6 m^3/s (200 ft^3/s). At the time of a July 2008 inspection (2008 Slide Tour), a 0.3 to 0.5 m depth of water flow was observed at low water flow conditions. For the erosion scour to undermine and destabilize this creek bank, it is apparent the severe scouring of creek will occur under high flow condition when higher flows are to occur in

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spring and after periods of intense precipitation. The creek has a width varying between 3 and 6 m. It is very likely that, at times of highwater flow, the erosion of the bank has been undermining the toe to result in slumping and steepening of the bank reducing the setback clearance from the top of bank to edge of pavement.

Further erosion may result in slumping, localized instability of the embankment, distress to the pavement, and/or closure of one or both of the travel lanes.

8. Date of Initial Observation

   June 2007 (callout)

9. Date of Recent Observation

   July 2008 (2008 annual Geohazard Assessment Site Inspection)

10. Instrumentation Installed

    N/A

11. Instrumentation Operational

    None

12. Risk Assessment

    PF (8) * CF (3) = 24

    PF = 8

    - Presently, with a 3m height steep bank and a 11m (can be as narrow as 7m) setback space to pavement edge, a perceptible slope line of about 2H:1V can be established for slope safety assessment. It is cautious to rank the hazard failure level for bank failure as uncertain because it will be dependent on future level scouring and toe instability created from future severe flood events.
    - The destabilizing trigger (channel erosion of bank) for potential failure of creek bank will remain active during times of severe floods for this creek channel of substantial flows. There is a major bridge culvert immediately upstream.

    CF = 3

    - Blocking of channel flow will occur when severe bank slumping failures occur.
    - Partial closure of road will be a possibility if severe failure of bank occurs.

    Note: This Risk Assessment rating is based on Scheme proposed by AI in the Request for Proposal. (2000)
    Probability Factor (PF) : 1 to 20 scale
    Consequence Factor (CF) : 1 to 10 scale

13. Geotechnical Conditions

    From published information, the generalized geologic structure at the site consists of overburden soils of 0 to 15 m of quaternary deposits underlain by bedrock of the Paskapoo Formation (Cretaceous) and Wapiti Formation (Cretaceous).

Overburden soils:

- Quaternary Deposits – typically glacial and glacio-lacustrine soils comprising primarily of sands, gravels, silts, and clay beds.

Bedrock

- Paskapoo Formation (Cretaceous) – grey to greenish grey calcareous sandstone, siltstone, mudstone, minor conglomerate, limestone, coal, and tuff beds
- Wapiti Formation (Cretaceous) – grey, feldspathic clayey sandstone, bentonitic mudstone and bentonite, scattered coal beds, non-marine
- The soil on the exposed backslope comprises a mixture of glacial till soils (sand, silt, and clay), shale and sandstone pieces, and intermittent organic beds (may be attributed to colluvial deposition) The sand and silt on the exposed river bank face are susceptible to erosion.

From published topographical and hydrogeological maps, it appears that surface drainage and groundwater regime is generally directed to the north – northeast, towards the Freeman River Valley.

14. Chronology

2007 Callout Inspection by Thurber Engineering Ltd.

- 2007 Callout Inspection Report included possible remedial measures to slowing down further retrogression of the river bank, including: (1) forming a new spillway channel along floodplain along east side of meander to capture the high flow volume at times of severe eroding flows, (but not to realign the creek, and existing creek alignment will be untouched), (2) install rock vanes within creek at toe of river bank to redirect flow away from toe of slope, (3) armor the exposed river bank with rip-rap to reduce erosion potential at this location. In-stream works may require proper approvals (DFO or Alberta Environment) prior to proceeding with its construction.

2008 April Swan Hills Area (Peace Region) awarded to Karl Engineering Consultants Ltd. (transfer of site responsibility to Karl Engineering Consultants Ltd.) (KarlEng)

2008 July Annual Geohazard Assessment Site (Slide Tour) Inspection by KarlEng.

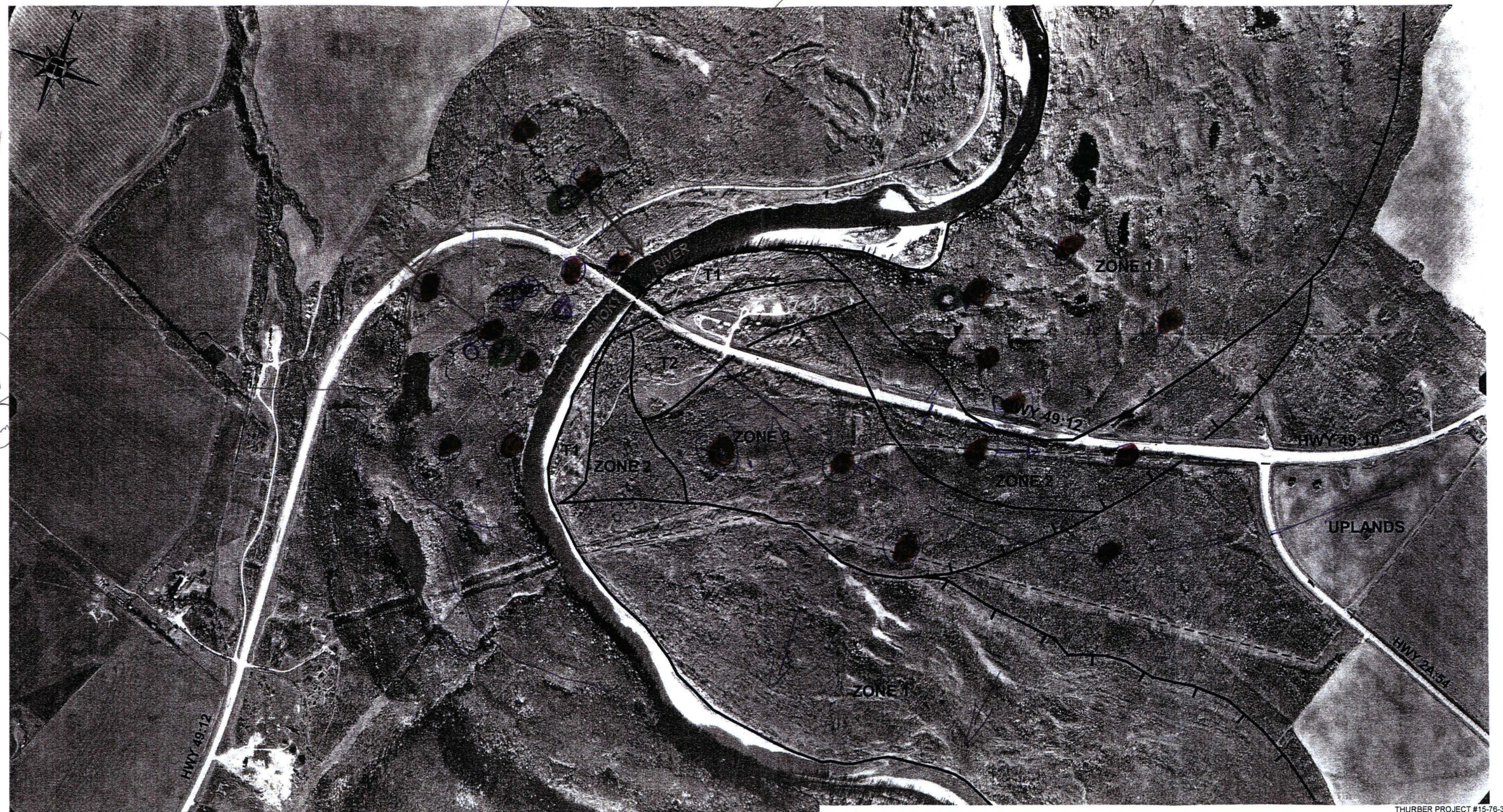
- Observed that the site had experienced additional erosion and lateral degradation of river bank, resulting in an increase of retrogression (and encroachment) of the river bank into the east ditch, reducing setback clearance distance from approximately 7m to the ditch (about 11m to pavement edge)
- Suggested possible remedial options to slow down further flow erosion impact and further retrogression. 1) form new spillway channel 2) armor the exposed river bank with rip-rap to reduce erosion potential at this location. In stream work option may require approval/consent from other agency.
- AT regional maintenance staff will attempt to seek consent and to implement remedial option.

END

BETWEEN SI-02 + SI-09 140-180m (40-45m) 70m

42 way between #9 & #2

45m



THURBER PROJECT #15-76-30

LEGEND

- CREST OF VALLEY SLOPE
- ZONE 1 VALLEY SLOPE SECTION SUBJECT TO CONTINUOUS HIGH RATE OF LANDSLIDE MOVEMENT
- ZONE 2 VALLEY SLOPE SECTION SUBJECT TO INTERMITTENT MODERATE LANDSLIDE ACTIVITY
- ZONE 3 DORMANT TO LOW LANDSLIDE ACTIVITY ZONE
- T1 LOWER RIVER TERRACE
- T2 UPPER RIVER TERRACE
- POWER LINE

0 100 200 400 600m
SCALE

SI

REFLECTO InSAR Reflectors

SI in each hole
3 RR in each hole

ENGINEER	DWP
DRAWN	ZD
DATE	MARCH, 2002
APPROVED	
SCALE	1:10,000

ALBERTA TRANSPORTATION

1994 AERIAL PHOTO SHOWING TERRAIN UNITS ON EAST SIDE OF LITTLE SMOKY RIVER

PEACE REGION (SWAN HILLS)
SH3-HWY 49:12

LITTLE SMOKY RIVER, AB
(NORTH OF BRIDGE)

THURBER

DRAWING No.
15-76-30-5