Culvert and Bridge Design Basis
Point Thomson Gas Cycling Project
Information to EIS Team
4/11/03

Design Basis for Culverts and Bridges - Draft Project Description Rev. B

Purpose:

- Establish locations where access roads cross streams.
- Estimate stream flows at each crossing.
- Select bridge or culvert to make crossing.
- Calculate culvert hydraulics and determine number of pipes.
- Determine scour mat dimensions.

References:

1. 1998 Spring Breakup and Hydrologic Assessment, Sourdough Area Development Project , North Slope Alaska, prepared for BP Exploration by Michael Baker Jr., Inc
2. Point Thomson Planning Maps, sheet 1 and 2, prepared by BPXA Cartography, dated April 24, 2002.
3. Stream Crossing Design Procedure for Fish Streams on the North Slope Coastal Plain of Alaska, prepared by G.N.McDonald & Associates for BP Exploration and ADEC.
4. 2001 URS Regression Equations prepared for ConocoPhillips.

Design Basis:

Location of Stream Crossings:

- Reference 1 was used for identifying the streams crossing the access road alignment. The 1998 spring breakup survey provided the maximum water depth, flow velocity, stream width and slope for streams within the project area.

Watershed Areas:

- Reference 2 was used for estimating the watershed (drainage area) for culverts and bridges.

Design Flood Discharges:

- Culverts and bridges designed for a 50-year design flood, with a headwater to depth ratio no greater than 1.5 to limit vortex erosion.
- Reference 3 was used as the basis for the design of culvert stream crossings. This manual was developed for the North Slope operators and ADEC to provide a consistent set of design and installation standards for culverts, bridges, and pipeline crossings of fish streams.
- Figure 5-3 in Reference 3, was used to estimate the flood peak flow for a 50-year return year as a function of drainage area.

- An adjustment factor to account for the percentage of lakes and ponds (30%) in the drainage area was applied to the design peak flows. The adjustment factor was arrived at by using Figure 5-4 in Reference 3.
- Unadjusted regional 2001 URS Regression Equations prepared for ConocoPhillips were used to verify the peak flows for a 50-year return period.

Fish Passage Criteria:

- Culverts were designed in accordance with Reference 3 in order to ensure safe fish passage. The hydraulic design of the culverts are based on achieving type 3 tranquil flow as described in the document.

Consideration for selecting bridges:

- Initial assessment of the streams crossing gravel roads identified three potential locations where bridges might be required. From the 1998 observations regarding flow, width and depth of streams the three largest streams were identified as candidates for bridges. The estimated maximum flows for the three largest streams ranged from 849 to 2,358 cubic feet per second (cfs). The estimated maximum flows for all other streams ranged from 68 to 700 cfs.
- After further information is collected during the spring 2003 hydrology and analyzed an assessment will be conducted to finalize whether these streams will require bridges or culverts. The assessment would include developing a preliminary design meeting the criteria established in Reference 3 (fish passage, surface water elevations, water flow velocities, etc.) for both culverts and bridges.

Work conducted by URS in early 2003

The work conducted by URS was initiated in an effort to confirm the peak flows used to the size the culverts as described above.

Comparison of the unadjusted region regression equation developed in 2001 were used to estimate the flood peak discharges on 12 streams within the Point Thomson project area.

Estimates of the 1998 flood peak discharges were then compared to the predicted flood peak frequency relationships. The comparison suggests that the return period associated with the 1998 flood peak discharges varied from 1.01 to 667 years. There was one steam (located near the proposed new mine site) within the project area that exhibited the exceptionally high return period. The 2001 regional regression equation would have to be adjusted by a factor of 2.82 if the estimated 667-year event was scaled as a 25-year event within the Point Thomson Unit.

It is unlikely that the Point Thomson streams experienced a flood as large as a 667-year event. The adjustment factor for the 2001 regional regression equation would be approximately 1.6 if similar assumptions were used to scale the observed data from stream with the next largest estimated return period stream (105 year event).

The wide range of return periods calculated for the 1998 flood peak discharges suggests that another year of data could better establish the appropriate adjustment factor for the 2001 regional regression equation. The current plan is to collect hydrology data during the spring of 2003 at the following streams within or near the project area:

- Stream at proposed Mine Site (Flood-volume data & Flood-peak-discharge)
- West Badami Creek (Flood-peak-discharge)
- Middle Badami Creek (Flood-peak-discharge)
- East Badami Creek (Flood-peak-discharge)

It is expected this data will allow a more refined adjustment factor to be selected and applied to the 2001 regional regression equations.

Final Design of Culverts and Bridges

Final design of the culverts and bridges will be completed after the spring 2003 hydrology data is collected and analyzed. The updated regional regression equations can be used for design of the culverts and bridges within the Point Thomson project area. The updated regional equation should allow refinement of the divisions between streams which should be crossed by bridges and streams which should be crossed by culverts.

JOE
4/11/03

Culverts and Bridges Design Basis 4_11_03.doc