APPENDIX E

BRIDGE HYDRAULICS RECONNAISSANCE REPORT

STATE OF ALASKA
Department of Transportation and Public Facilities
Northern Region

RECONNAISSANCE REPORT
Bridge Hydraulics

Introduction

On September 24, 2009, I accompanied Northern Region Design staff on a reconnaissance field trip to evaluate bridge site options over Sadie Creek. The reconnaissance team spent several hours inspecting creek crossing locations via helicopter. This report presents photographs of the bridge sites being considered for the project, my anticipated bridge length requirements, and rough cost estimates for planning purposes.

Data Gaps

Little hydrologic and hydraulic information is available for Sadie Creek. I have offered conservative bridge lengths to address the current uncertainties at the site. Cost savings may be realized if shorter bridge spans can be used. The following lists key variables are needed to make that determination.

- Peakflow data or estimates;
- High ice elevation, thickness, and aufeis accumulations (if any);
- General spring snowmelt and breakup patterns;
- High water elevation, including floods over ice
- Velocities during floods;
- Spring snowpack data, and historical trends;
- Meteorologic data for Kotzebue Sound and the Baldwin Peninsula; and
- Arctic hydrologic and geomorphic processes

We will need a thorough understanding the role of permafrost within the Sadie Creek basin. The Baldwin Peninsula features numerous thermokarst lakes, many of which are presently dry lake beds. These landscape features suggest a dynamic subsurface flow regime and a gradually changing surface topography as underlying ice layers thaw.

Bridge Considerations

Figure 1 (attached) provides an aerial view of the creek crossing locations being considered at the time of the site visit. Photographs were taken of the stream crossing locations from both the upstream and downstream directions (Figures 2-11). Note the persistent snow (or ice) along the banks of the Sadie Creek in Figure 1. These snow patches may serve as indicators of winter ice surface widths and the lateral limits of spring floods.

We have yet to determine the lateral extent of the Sadie Creek floodplain and the potential impact(s) of a bridge-related encroachment. At this stage, it is reasonable to assume that the active channel and a portion of the overbank areas should be spanned. Preliminary bridge span requirements for planning purposes can be inferred from channel and overbank features, along with distance measuring tools in Google Earth. Table 1 below lists conservative bridge length estimates for stream crossing options. Note that the easterly option (Crossing #2) would likely require two bridges. Additional analysis will allow us to evaluate the feasibility of shorter span lengths or the use of culverts. For this reconnaissance report, I assume that beam type bridges (precast concrete or steel) with relatively short spans and pier heights are appropriate for the Sadie Creek crossing alternatives. The maximum span length available for standard decked bulb-tee girders is 150 ft. I also assume that the shipment and transport of this girder type would be feasible to the creek crossing sites, as Kotzebue is on the water port location.

Based upon recent bridge project bid tab data, the following cost estimating factors may be used for planning purposes. These cost factors area based upon bridge deck area in square feet (SF), and include all bridge-related construction and labor items (primarily the Section 500 pay items) and temporary work structures needed to access in-water work areas.

1. Short spans (<140-ft) and pier heights (<40-ft) use $500/SF
2. Moderate spans (130-ft to 150-ft) and pier heights (40-ft to 80-ft) use $750/SF
3. Long spans (>150-ft) and tall piers (>80-ft) use $1000/SF

The structures that best represents these classifications or "types" are described below, with photographed examples provided as attachments to this report. I anticipate that the Sadie Creek crossings could be accommodated with a "Type 1" structure, using relatively short spans and pier heights. Descriptions of the larger structure types are provided below for comparative purposes.

- "Type 1". Standard decked bulb-tee girder superstructure on *driven pile* foundations, similar to the Bridge No. 649 Chistochina River on the Tok Cutoff highway. This structure would acceptable for low to moderate ice loads only.

- "Type 2". Standard decked bulb-tee girder superstructure on *drilled shaft* foundations, similar to the Bridge No. 1386 South Channel replacement bridge in Unalaska. This structure would be acceptable for low to moderate ice loads only.

- "Type 3". Steel girder superstructure with a precast or cast-in-place deck, similar to Bridge No. 671 Kenai River at Soldotna or Bridge No. 539 Knik River along the Old Glenn Highway. A substantial pier may be required to resist moderate to severe ice loads, possibly with ice-breaking provisions. Examples include Bridge No. 271 Yukon River and Bridge No. 205 Copper River at Chitina. Above the "high ice" elevation, the pier segments may be of reduced size.

TABLE 1. Preliminary bridge cost estimates for planning purposes only. These cost estimates are based upon a bridge deck width of 27 ft*.

River	Bridge "type" and unit cost per sq. ft.	Prelim. Length (ft)	Estimated Cost ($)
Sadie Creek #1	Type 1, $500/SF	420	6 mil
Sadie Creek #2a	Type 1, $500/SF	220	3 mil
Sadie Creek #2b	Type 1, $500/SF	100	1.5 mil

*DOT&PF Northern Region is planning for a 24 ft wide typical section per AASHTO low volume road standards. The proposed bridge would accommodate this roadway section with 1.5 ft wide bridge rails on each side.

ATTACHMENT 1

Sadie Creek Crossing Alternatives #1 & #2, Cape Blossom Access

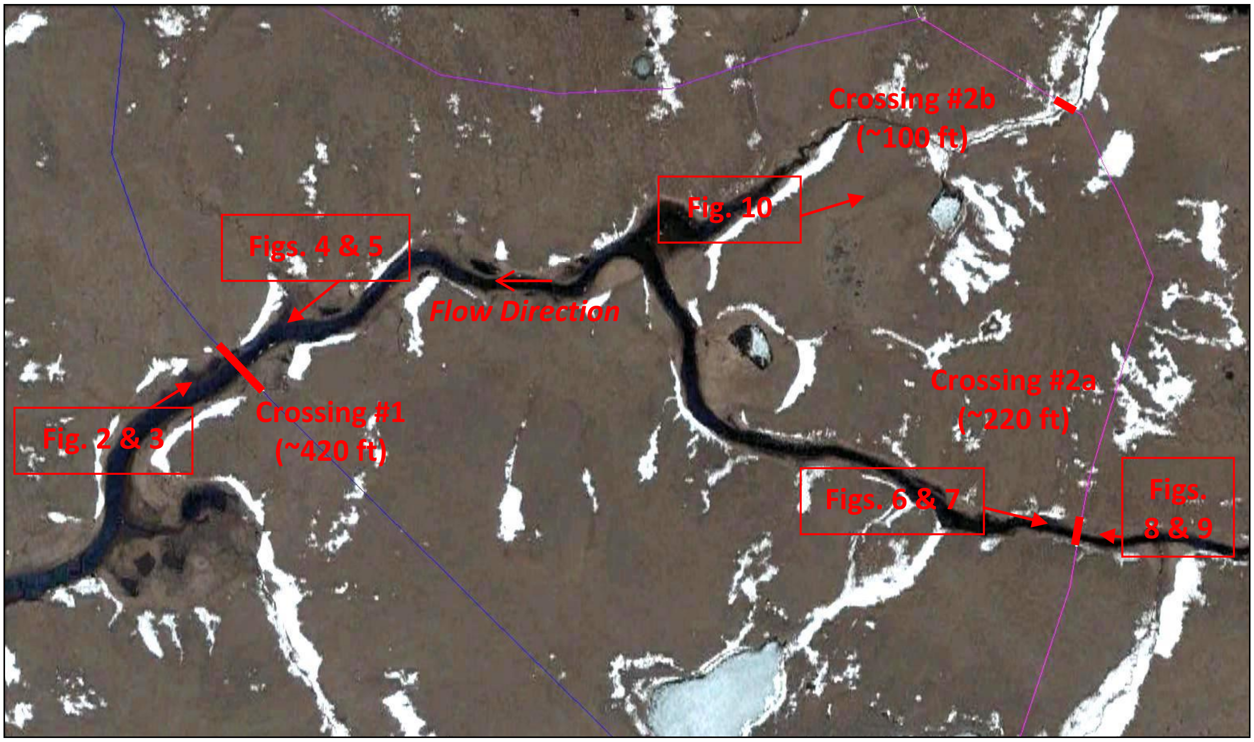


FIGURE 1. An aerial view of Sadie Creek and the stream crossing locations being considered. The straight line distance between Crossings #1 & #2a is about 1.21 miles. (Photo from Google Earth)

Sadie Creek Crossing #1

The red line on the figures illustrates the approximate spatial scale of the proposed bridge. Note that the bridge would be elevated and that our bridge concept would include sloping spill-through abutments.

FIGURE 2. An upstream view of the Crossing #1 location over Sadie Creek.

FIGURE 3. Another upstream view of Sadie Creek from the Crossing #1 site. This low-angle perspective shows the shallow topography of the area.

FIGURE 4. A downstream view of the Crossing #1 site over Sadie Creek.

FIGURE 5. Another downstream view of the Crossing #1 site over Sadie Creek, this one from a lower angle.

Sadie Creek Crossing #2a

The red line on the figures illustrates the approximate spatial scale of the proposed bridge. Note that the bridge would be elevated and that our bridge concept would include sloping spill-through abutments.

FIGURE 6. An upstream view of the Crossing #2a site over Sadie Creek. For planning and preliminary cost estimating purposes, we anticipate this bridge would be 220 ft long.

FIGURE 7. Another upstream view of the Crossing #2a site over Sadie Creek.

FIGURE 8. A downstream view of the Crossing #2a location over Sadie Creek.

FIGURE 9. Another downstream view of the Crossing #2a location over Sadie Creek, this one from a lower angle.

Sadie Creek Crossing #2b

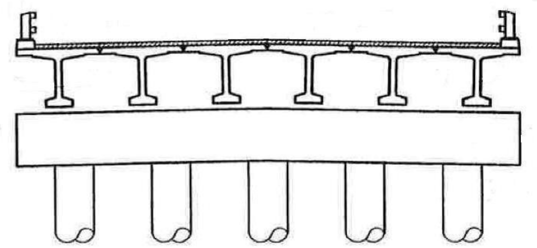
The red line on the figure illustrates the approximate spatial scale of the proposed bridge.

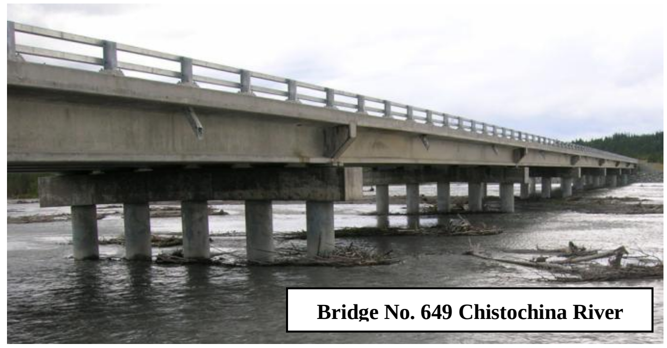
FIGURE 10. An upstream view of the Crossing #2b site over Sadie Creek. The flow direction is to the bottom left of the photograph.

ATTACHMENT 2

Pier Type Examples

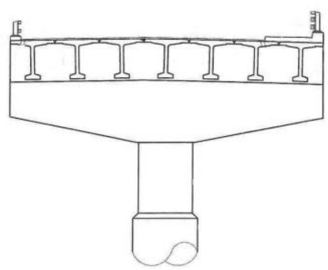
<u>"Type 1" Example</u>. Standard decked bulb-tee girder superstructure on *driven pile* foundations, acceptable for low to moderate ice loads only.





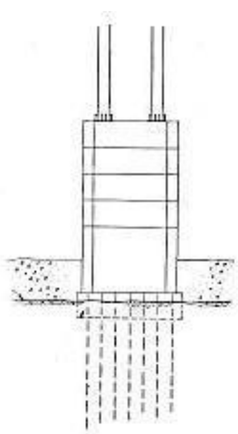
Bridge No. 649 Chistochina River

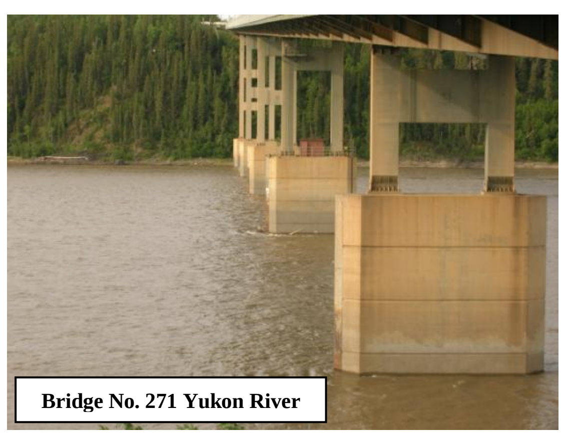
<u>"Type 2" Example</u>. Standard decked bulb-tee girder superstructure on *drilled shaft* foundations, acceptable for low to moderate ice loads only.



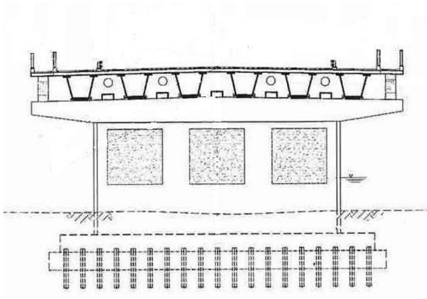
Bridge No. 1386 South Channel

<u>"Type 3" Examples</u>. Steel girder superstructure with a precast or cast-in-place deck. A substantial pier may be required to resist moderate to severe ice loads, possibly with ice-breaking provisions. Above the "high ice" elevation, the pier segments may be of reduced size.

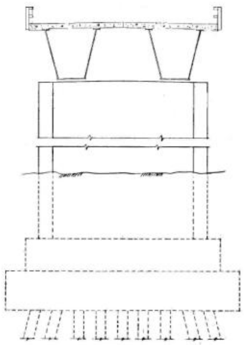


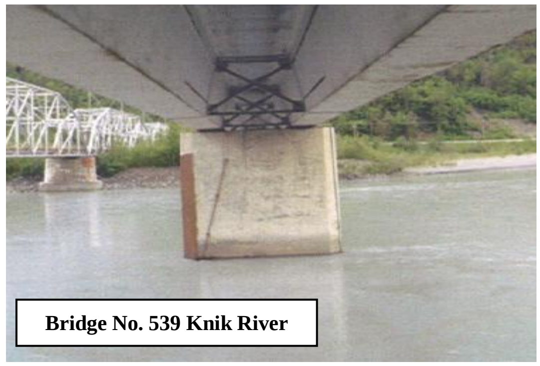


Bridge No. 271 Yukon River

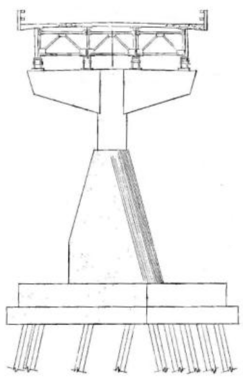


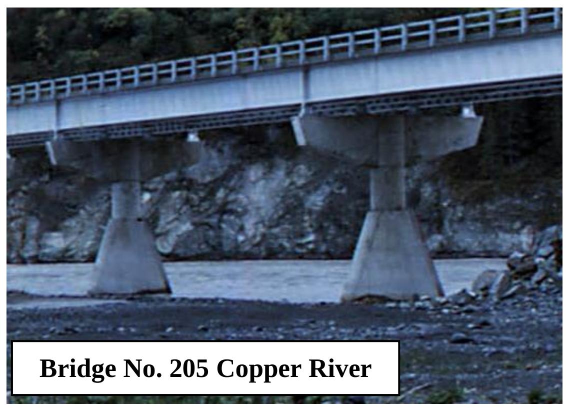
Bridge No. 671 Kenai River (Soldotna)





Bridge No. 539 Knik River





Bridge No. 205 Copper River