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# CD-2 Gravel Road Erosion

Submitted to



Submitted by



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## CD-2 GRAVEL ROAD EROSION

Following spring breakup events in the Colville River Delta, inspection of the CD-2 gravel road has been conducted annually since 1999. The inspection has been performed in order to determine if erosion of the road occurred as a result of contact with spring breakup floodwaters.

Since 1999, requirements of USACE 2-96087 were met annually and additional reporting and remedial action plans were not required. There has not been any erosion exceeding 20 cubic yards of gravel per one hundred linear feet of road (level of permit Notice of Violation). High water marks have been noted on the gravel road with photography. In general, it was noted annually that areas protected by jute mat, grass and sparse vegetation were significantly less likely to erode than areas with no jute mat or vegetation. The following sections provide a brief summary of erosion monitoring along the CD-2 between the periods of 1999 and 2004.

### 1.0 1999 Spring Breakup

The tundra immediately adjacent to the facility was not inundated by water from the Nigliq or Sakoonang Channels during the 1999 spring breakup. Thus, no water from the river channels passed through the culverts located in the CD-2 road. Additionally, no or very little water flowed from Nanuk Lake through the swale to the North side of the road. However, water did back up into the swale from the tap lake. Photographs along the CD-2 road were not taken during the 1999 spring breakup event.

### 2.0 2000 Spring Breakup

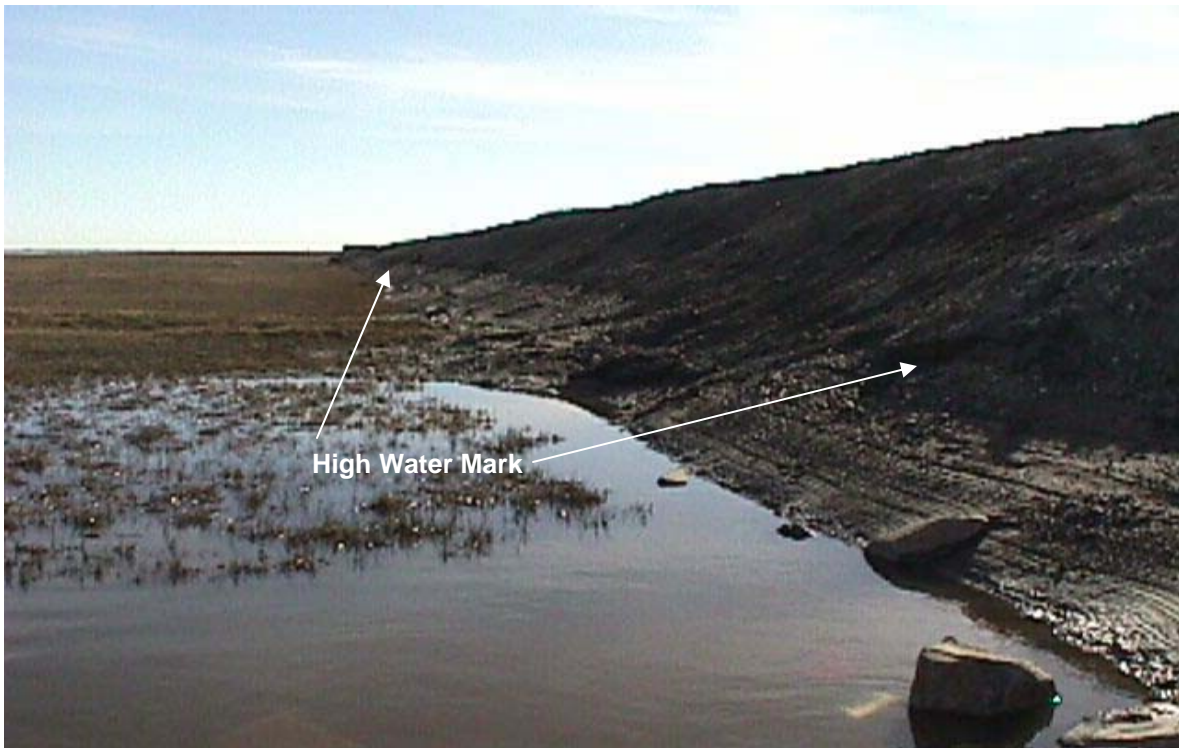
Visual inspection of the CD-2 road during the 2000 spring breakup revealed the presence of a high water mark. The high water mark appeared to have been caused by either the settlement of the gravel embankment below the flood peak water surface or the removal of fines from the gravel embankment. However, no material was observed deposited in significant quantities along the toe of the embankment. High water marks along the CD-2 access road are presented in the following photos 1 through 4.



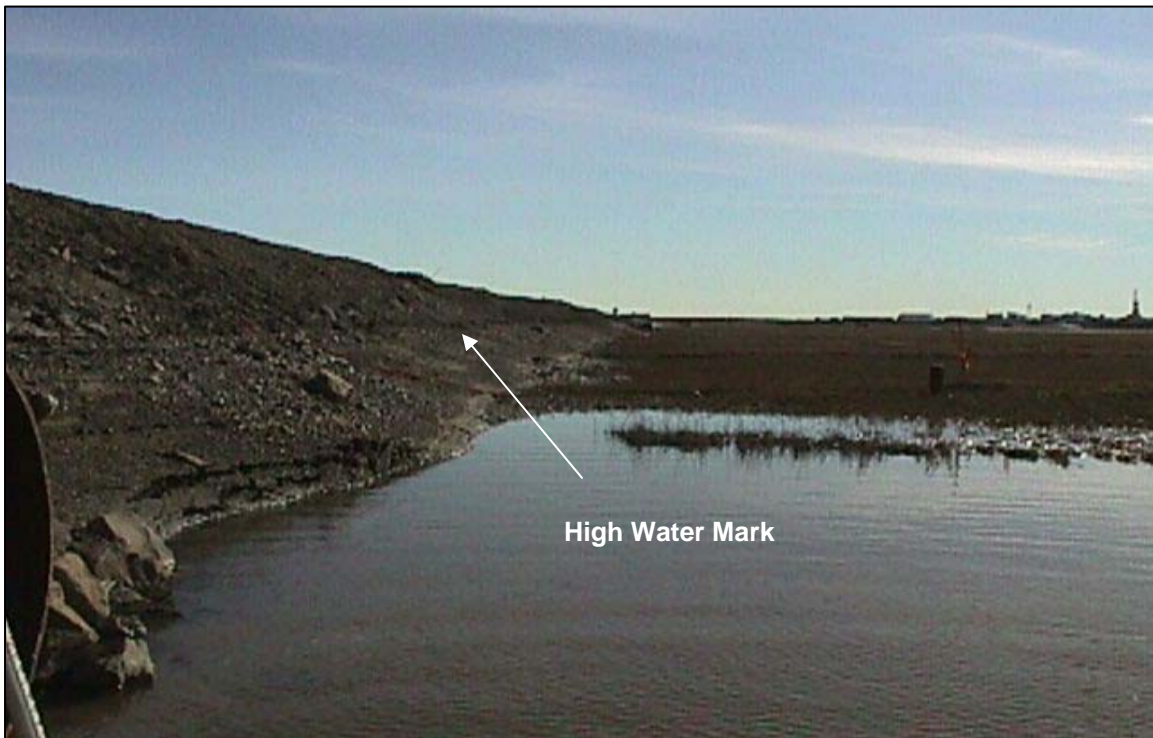
**Photo 1** Looking east along the north side of the embankment on the road to CD-2 near culvert #24. (6/15/00)



**Photo 2** Looking east along the south side of the embankment on the CD-2 access road near culvert #24. (6/15/00)



**Photo 3** Looking east along the north side of the embankment on the CD-2 access road near culvert #5. (6/18/00)



**Photo 4** Looking east along the south of the embankment on the road to CD-2 near culvert #5. (6/18/00)

### 3.0 2001 Spring Breakup

The CD-2 access road was inspected for erosion 5 days after the peak water surface elevation had passed during the 2001 spring breakup event. Visual inspection of the road revealed high water marks where the gravel structures were inundated by breakup flows.

No indications of significant erosion due to breakup flows were observed anywhere along the road. Areas where inundation did occur had some minor settlement of fine-grained material from the surface course, however, no slumping or side slope deterioration was observed. High water marks along the CD-2 access road are presented on the following photos 5 through 13.



Photo 5 Facing east from Culvert #24 along the north side of the CD-2 access road. (6/16/01)



Photo 6 Facing east from Culvert #24 along the south side of the CD-2 access road. (6/16/01)

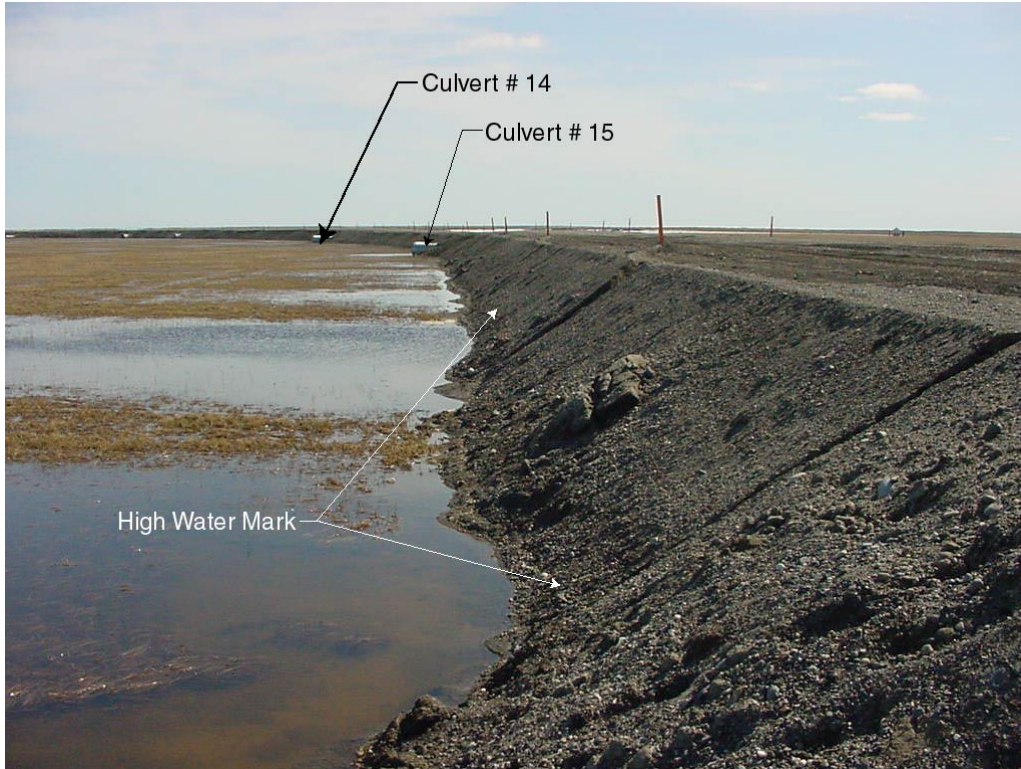


Photo 7 Facing east from Culvert #16 along the north side of the CD-2 access road. (6/16/01)

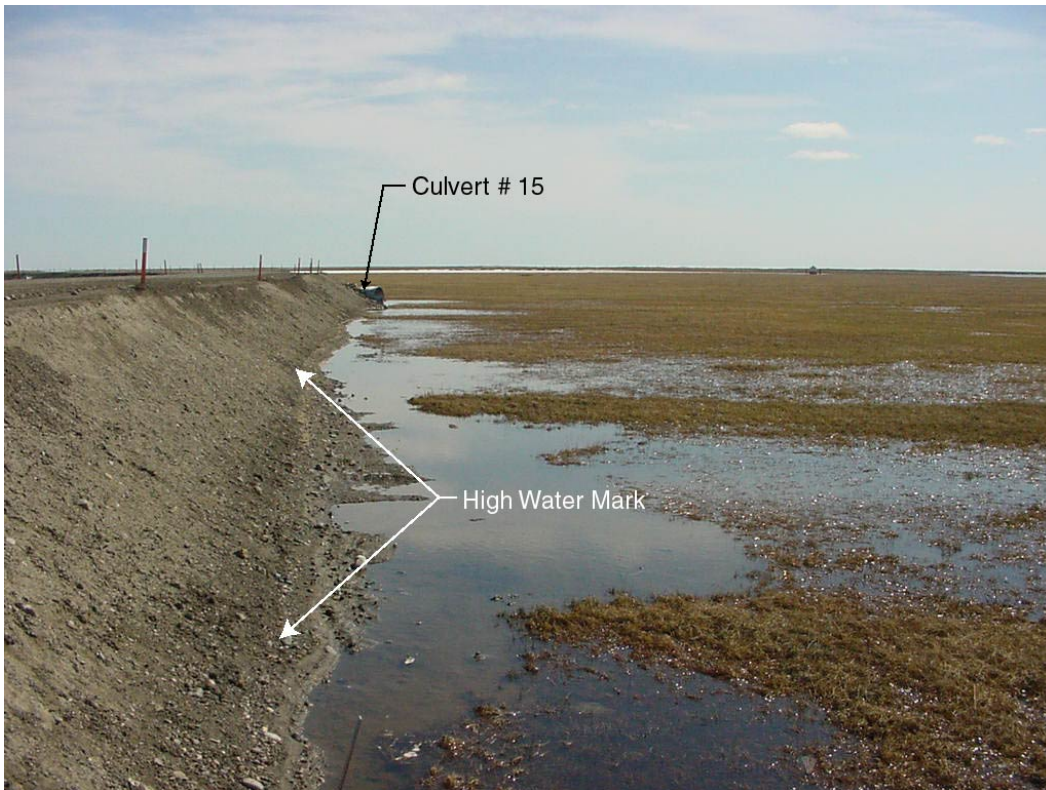


Photo 8 Facing east from Culvert #16 along the south side of the CD-2 access road. (6/15/01)

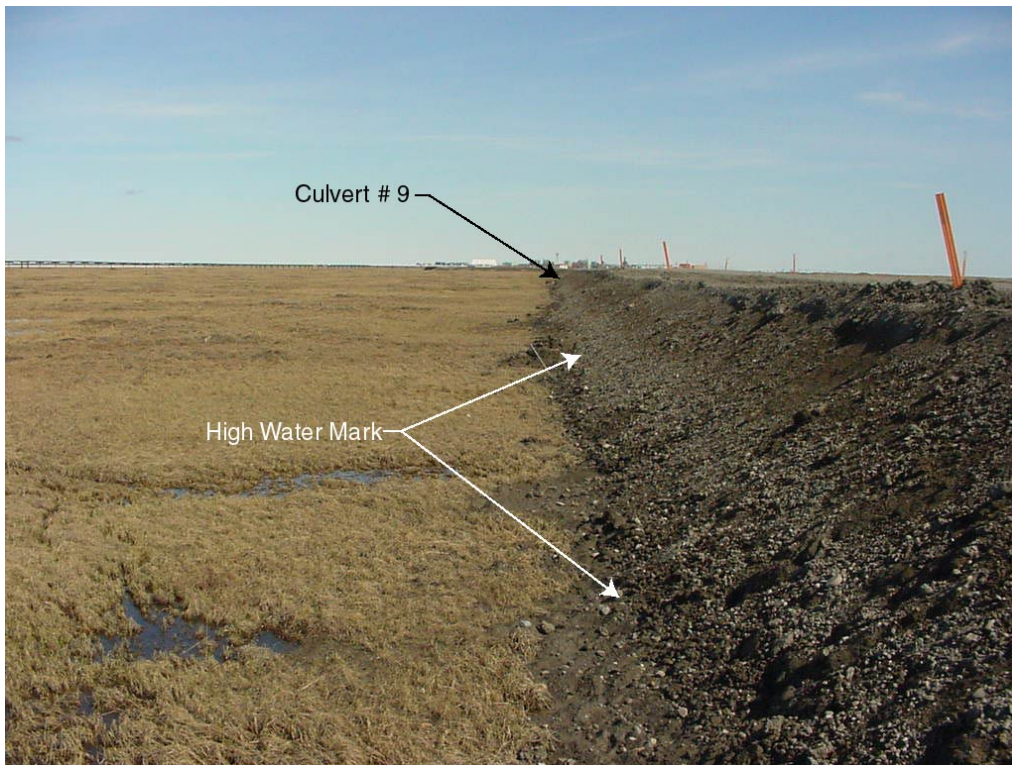


Photo 9 Facing east from Culvert #10 along the north side of the CD-2 access road. (6/15/01)

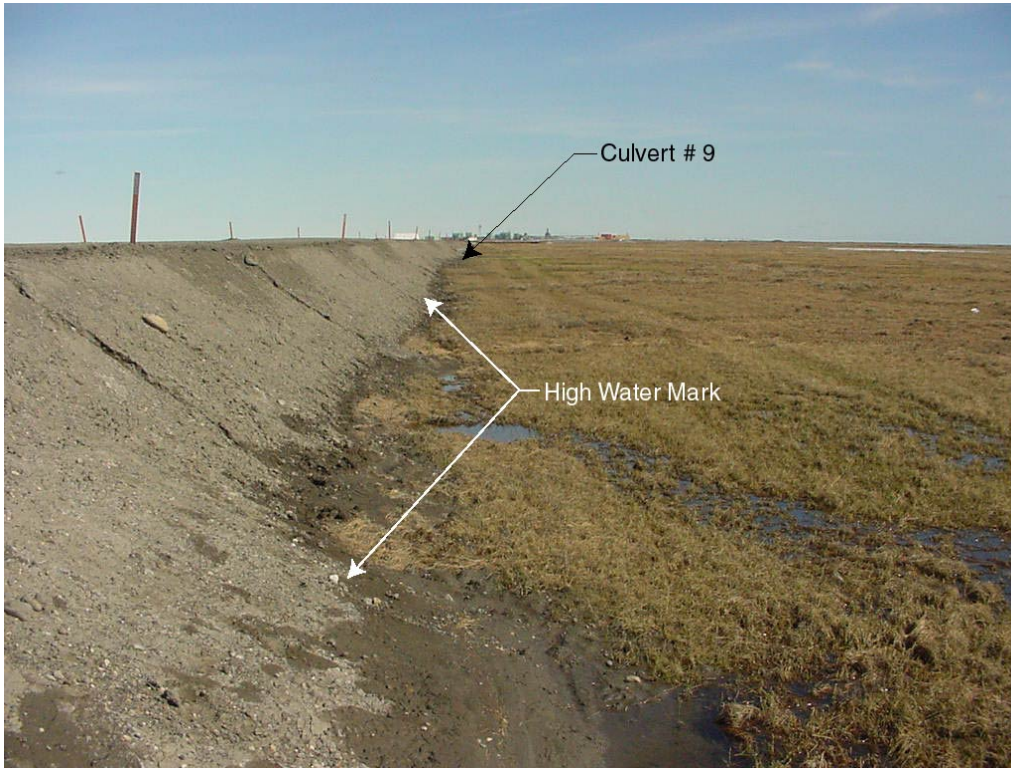


Photo 10 Facing east from Culvert #10 along the north side of the CD-2 access road. (6/15/01)



Photo 11 Facing east from Culvert #04 along the north side of the CD-2 access road. (6/15/01)



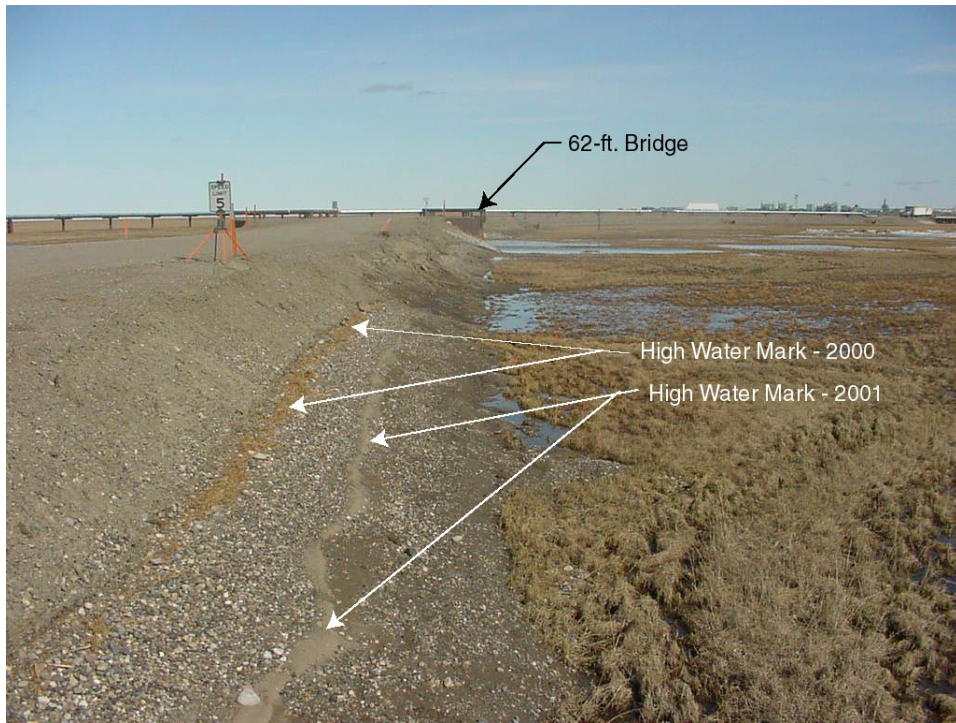


Photo 12 Facing east from Culvert #04 along the south side of the CD-2 access road. (6/15/01)

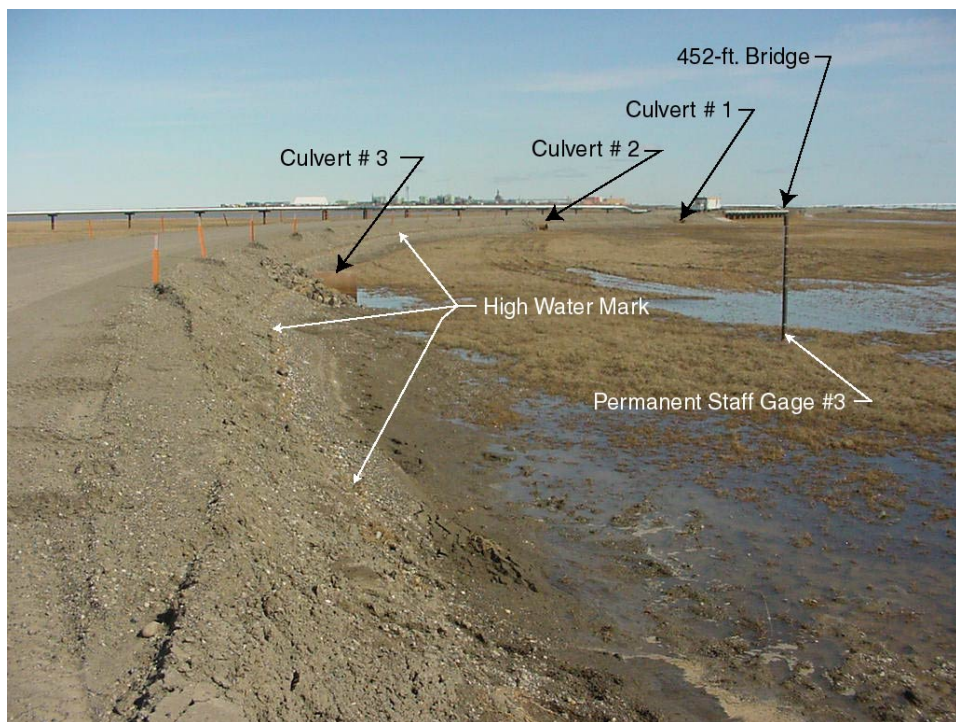


Photo 13 Facing east along the south side of the CD-2 access road from the 62-foot bridge. (6/16/01)

## 4.0 2002 Spring Breakup

Alpine's CD-2 road was inspected for erosion on May 31 approximately six days after the peak water surface elevation had occurred during the 2002 spring breakup event. No significant erosion due to breakup flows was observed anywhere along the gravel structures.

In areas where inundation did occur, some minor settlement of fine-grained material was noted, however, no slumping or side slope deterioration was noted. High water marks were noted along the road and are presented on the following photographs 14 through 20.

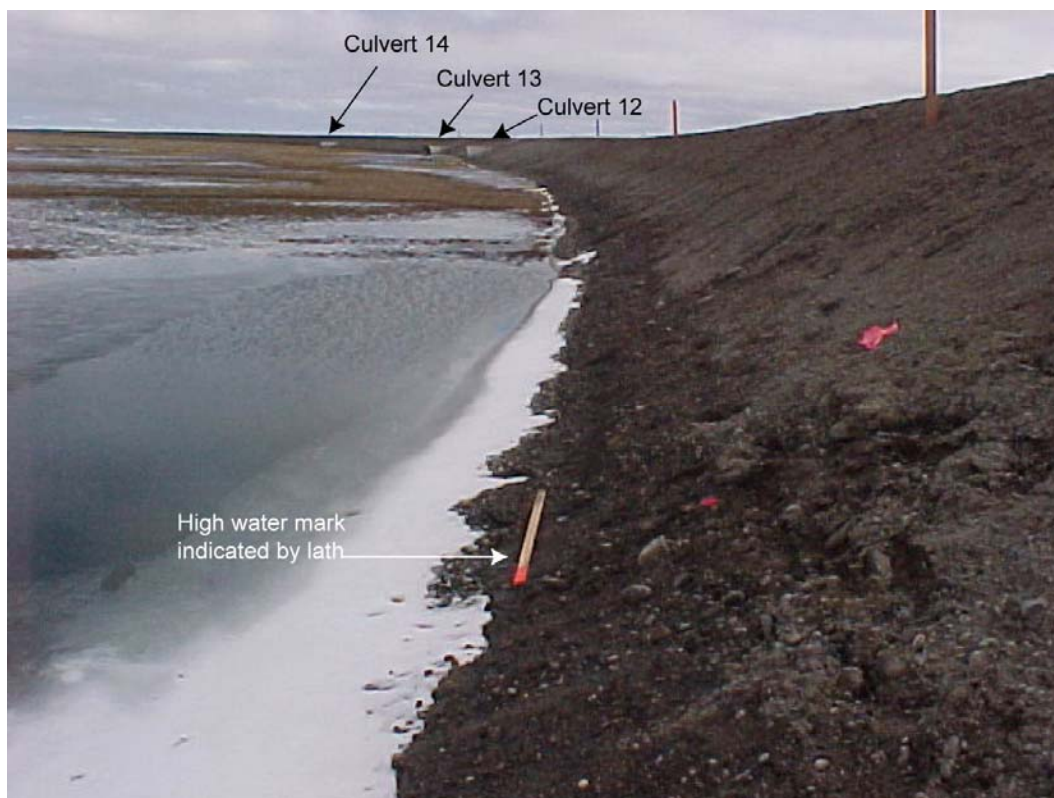


Photo 14 Facing east from Culvert #11 along the north side of the CD-2 access road. (5/31/02)



Photo 15 Facing east from culvert #11 along the south side of the CD-2 access road. (5/31/02)



Photo 16 Facing west from culvert #14 along the north side of the CD-2 access road. (5/31/02)



Photo 17 Facing west from culvert #14 along the south side of the CD-2 access road. (5/31/02)



Photo 18 Facing east from culvert #20 along the north side of the CD-2 access road. (5/31/02)



Photo 19 Facing east from culvert #20 along the south side of the CD-2 access road. (5/31/02)



Photo 20 Facing east along the south side of the CD-2 access road from the 62-foot bridge. (5/31/02)

## 5.0 2003 Spring Breakup

The CD-2 access road was inspected for erosion on June 13, approximately six days after the peak water surface elevation had occurred during the 2003 spring breakup event. No significant erosion due to breakup flows was observed anywhere along the gravel structures.

In areas where inundation did occur, some minor settlement of fine-grained material was noted, however, no slumping or side slope deterioration was noted. High water marks along the CD-2 access road are presented on the following photographs 21 through 23.



Photo 21 Looking east on the north side of the CD-2 access road from culvert #24. (6/13/03).



Photo 22 Looking west on the north side of the CD-2 access road from Culvert # 24. (6/13/03)



Photo 23 Looking west on the south side of the CD-2 access road from Culvert # 24. (6/13/03)

## 6.0 2004 Spring Breakup

The CD-2 road at Alpine was inspected on June 1<sup>st</sup> and 2<sup>nd</sup>, approximately five days after peak water surface elevation during the spring 2004 breakup event. The inspection was performed to determine if erosion of the road had occurred as a result of contact with spring breakup floodwaters. Photography of high water marks and erosion documented during the erosion investigation are shown in Photos 24 through 30.

While much of the CD-2 road was protected by drifted snow and ice at the waters edge, some erosion resulted in areas that were exposed to wave action. Minor settlement of fine-grained material below the high water line was noted on a widespread basis on both sides of the road. Limited erosive damage on the north side of the road was primarily a result of wind-driven wave action caused by strong winds blowing out of the north during peak stage. However, the road performed as designed and erosion effects were minor. Alpine personnel have already addressed routine maintenance activities along the road.

Essentially the entire 10,600-foot segment of road between the CD-1 runway and the CD-2 pad was in contact with the floodwater during the 2004 breakup event. On the north side of the road, 770-feet of the road (7% of the total road length) experienced minor side slope erosion damage, while 93% of the road did not experience side slope erosion. On the south side of the road, 1720-feet of the road (16% of the total road length) experienced minor side slope erosion damage, while 84% of the road did not experience side slope erosion. All of the documented erosion along the road is classified as minor. The eroded material was generally redistributed from near the high water line to the toe of the road.





**Photo 24** Sideslope erosion of surficial gravel due to wind-driven wave impact on north side of CD-2 road between the 452-foot bridge and Culvert #25. (6/1/04)



**Photo 25** High water mark on north side of CD-2 road between the 62-foot and 452-foot bridges. (6/1/04)



Photo 26 High water mark on north side of CD-2 road between the 62-foot bridge and Culvert #22. (6/1/04)



Photo 27 High water mark on north side of CD-2 road between the 62-foot bridge and Culvert #22 near Permanent Staff Gage #4. (6/1/04)



Photo 28 Looking east from culvert # 17 at the north side of the CD2 road. (6/1/04)



Photo 29 Looking west from culvert # 10 on south side of the CD2 road. (6/1/04)



Photo 30 Looking west on south side of CD-2 road at culvert # 16 (6/1/04)