ENVIRONMENTAL CONCERNS AND RECOMMENDATIONS: ALASKA HIGHWAY RECONSTRUCTION AND MAINTENANCE KILOMETRE 1008-1635

by

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EPS 8-PR-80-1

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ABSTRACT

Environmental concerns associated with Alaska Highway reconstruction and maintenance practices in the Yukon and practices which might be useful in resolving concerns are identified in this report.

Although this information is applicable to Yukon highways in general, the focus of this report is on:

(i) Alaska Highway widening and paving between Watson Lake and Haines Junction,

(ii) Relocation of certain sections of Alaska Highway between Watson Lake and Haines Junction,

(iii) Alaska Highway maintenance practices between Watson Lake and Haines Junction.

Recommendations for specific sites on this stretch of highway were made during the study and may be obtained from the Environmental Protection Service, Whitehorse, along with brief site descriptions which complement the more general information contained in this report.

RÉSUMÉ

Le rapport fait état des préoccupations que soulèvent, sur le plan de l'environnement, la réfection et l'entretien de la route de l'Alaska au Yukon, ainsi que des initiatives pouvant contribuer à aplanir ces difficultés.

Bien que les données présentées concernent les routes du Yukon en général, elles portent plus principalement sur:

(i) l'élargissement et l'asphaltage de la route de l'Alaska, entre Watson Lake et Haines Junction;

(ii) le déplacement de certains tronçons entre ces deux localités;

(iii) les travaux d'entretien entre ces deux localités.

Au cours de l'étude, on a fait des recommandations concernant le choix de certains endroits sur ce tronçon d'autoroute, dont on peut prendre connaissance en s'adressant au Service de la protection de l'environnement, à Whitehorse; s'y ajoute une brève description des lieux, qui vient compléter les renseignements plus généraux consignés dans le rapport.

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ACKNOWLEDGMENTS

This report was prepared at the request of the Environmental Protection Service in Whitehorse. Funding was provided by the Department of Public Works.

I am indebted to Mr. C.A. Lewis, Environmental Protection Service (EPS), Ottawa, and to Mr. Colin Wykes and Mr. Ken Weagle, EPS, Whitehorse, for laying the groundwork for this report and for giving me the opportunity to produce it.

A survey of Yukon highways was conducted in early June 1978. All results were discussed with government personnel in Whitehorse and their helpfulness is gratefully acknowledged. In particular, I wish to thank:

- Mr. Jim Coxford, Department of Public Works, Whitehorse.
- Mr. Ches Campion, Yukon Department of Highways, Whitehorse.
- Mr. Mel O'Recklin, Water Resources Branch, Department of Indian and Northern Affairs, Whitehorse.
- Mr. Obert Switzer, Fisheries and Marine Service, Department of Fisheries and Oceans, Whitehorse.
- Mr. Colin Wykes and Mr. Ken Weagle, Environmental Protection Service, Department of the Environment, Whitehorse.
- Mr. Malcolm Dennington, Canadian Wildlife Service, Department of the Environment, Whitehorse.

The assistance of Professor Stan Thompson, Department of Civil Engineering, University of Alberta, Edmonton, is also acknowledged.

1 INTRODUCTION

Certain highway reconstruction and maintenance practices in the Yukon are the source of some environmental concern. These concerns were identified during a three-week, 5,000-kilometre highway survey conducted in early June 1978. Practices which might be useful in resolving concerns were also identified. Special emphasis was given to sections of the Alaska Highway which have already been reconstructed. Short stretches of highway in the State of Alaska were also included in the survey.

The highways were driven slowly and scanned for evidence of unusual environmental disturbance. Numerous stops were made. At each one, the location was recorded (relative to highway kilometre or mile posts) and photographs and notes were taken. Later, these observations were synthesized into general statements of environmental concern.

The general statements of environmental concern are listed, illustrated and briefly discussed in the body of the report. General recommendations to resolve these concerns are also given. Although the material is applicable to Yukon highways in general, the focus in this report is on:

(i) Alaska Highway widening and paving between Watson Lake and Haines Junction,

(ii) relocation of certain sections of the Alaska Highway between Watson Lake and Haines Junction,

(iii) Alaska Highway maintenance practices between Watson Lake and Haines Junction.

Recommendations for specific sites on this stretch of highway are available from the Environmental Protection Service together with brief site descriptions which complement the more general information contained in this report.

The report is to be used by the Department of Public Works (DPW) in Whitehorse as input to an Initial Environmental Evaluation (IEE). The IEE is to contain an evaluation of the environmental effects or problems likely to be associated with the Alaska Highway reconstruction work. Procedural details are as follows:

- The IEE is the second stage in the three-stage Federal Environmental Assessment and Review Process (EARP). It is more rigorous than the first stage, environmental screening, but less rigorous than the third stage, the environmental impact statement.

- It is to be prepared or procured by DPW since DPW is the proponent department for the reconstruction work and since federal funds are involved.

- Both existing and new reports are to be used as inputs to the IEE.
  The new reports were prepared by:
  - Department of Indian and Northern Affairs, Water Resources Branch,
  - Department of Fisheries and Oceans, Fisheries and Marine Service,
  - Department of Environment, Environmental Protection Service, Canadian Wildlife Service, Atmospheric Environment Service, Canadian Forestry Service.

- DPW is to provide funding for the preparation of reports.

- An identification of environmental effects/problems likely to be associated with the reconstruction work will be included in the IEE.

- The significance of each environmental problem will be judged in the IEE.

- Mitigating measures to resolve environmental problems will be given.

- An environmental impact statement will be prepared if the environmental problems identified in the IEE cannot be resolved and if, in the judgment of DPW, these problems are significant.

- The completed IEE should be made public. Recent EARP amendments make this possible and a precedent is available - an IEE of environmental problems likely to be associated with an expansion of Hamilton Airport was made public in order to gauge public opinion; it led to better judgments regarding the significance of the environmental problems identified in the IEE.

- The above points are aspects of EARP which should apply to Alaska Highway reconstruction work. The points which follow are not part of EARP in a formal sense but are felt to be important nonetheless.

- The IEE should contain DPW's reasons for accepting, rejecting or modifying any environmental recommendations or suggestions which may be brought forward by other government departments, by consultants or by the public-at-large. This procedure is advocated (although not formally, as yet) by the Environmental Assessment and Review Office, Department of the Environment.

- A Highway Maintenance Manual should be prepared by DPW to help ensure that the environmental protection efforts made during highway reconstruction are sustained once the reconstruction work has been completed. The manual should be presented to the Yukon Department of Highways.

- The manual should contain the environmental recommendations pertaining to highway maintenance contained in this report.

- The manual should not contain information which conflicts with anything contained in the Maintenance Manual to be prepared for the Shakwak Project.

- The environmental concerns and recommendations contained in this report should be reflected in the conditions attached to the water and land use permits which DPW must obtain before reconstruction work can commence on the Alaska Highway.

- Serious consideration should be given to having an environmental coordinator for the Project; some one who can serve as a single point of contact on environmental protection matters, provide briefings to the resident engineer as required, be present when reconstruction is underway in critical areas, add site-specific detail to environmental stipulations and ensure that they are adhered to etc.

2 REMOVAL OF TOPSOIL AND VEGETATION DURING HIGHWAY RECONSTRUCTION AND MAINTENANCE OPERATIONS

Environmental concerns in this section are focussed on (a) the removal of topsoil and vegetation to obtain fill in the vicinity of streams, rivers, lakes and wetlands and (b) right-of-way maintenance clearing practices (removal of roadside vegetation by highway maintenance staff).

2.1 Environmental Concerns

i) Topsoil and vegetation may be removed in the vicinity of streams, rivers, lakes and wetlands to obtain fill for highway reconstruction purposes.

ii) The areas cleared of topsoil and vegetation during reconstruction operations may not be allowed to revegetate. Yukon Department of Highways maintenance staff regularly plow up all such areas, using road graders.

iii) It may take ten years or more to phase road graders out of maintenance clearing operations and to replace them with vegetation cutters, because of the high cost reportedly involved.

iv) Road graders may be used to remove slash in erosion-prone areas and in the vicinity of streams, rivers, lakes or wetlands.

v) Trees at the edge of cleared right-of-way may be damaged during reconstruction operations and may not be removed.

2.2 Discussion

A strip of land must be cleared of topsoil and vegetation on each side of the highway in order to obtain fill for reconstruction purposes. The outer margins of these cleared areas are located approximately 30 m from the highway centreline. Environmental problems arise when streams, rivers, lakes or wetlands are located in or near these cleared areas. Difficulties also develop when erosion-prone soils are not allowed to revegetate once reconstruction operations have been completed.

Yukon Department of Highways maintenance staff regularly use road graders to plow up areas cleared during reconstruction operations. They do this in order to prevent these areas from revegetating (Plates 1-6). Road graders are also used to clear slash (Plate 7).

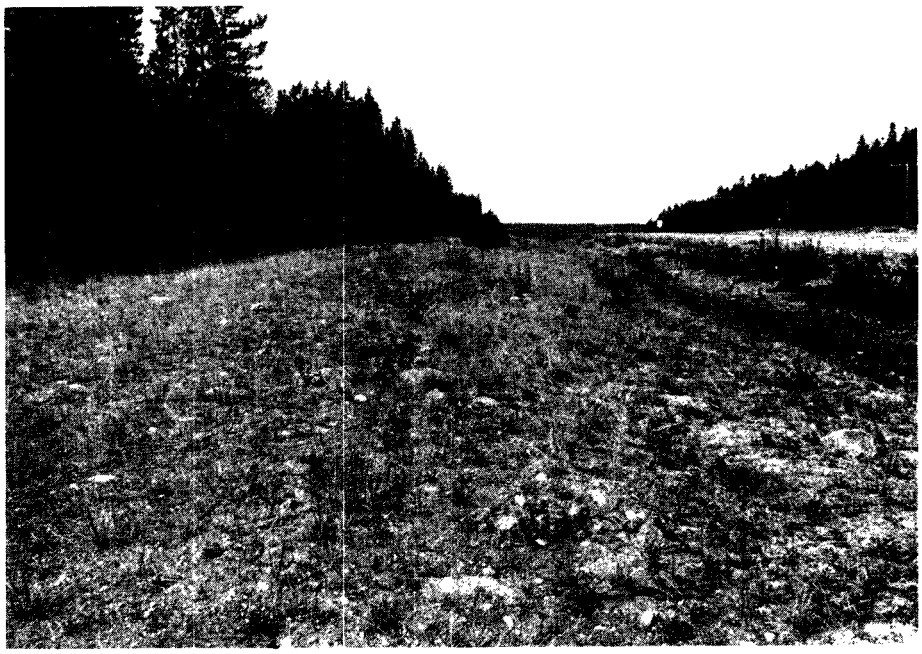


PLATE 1 Cleared right-of-way, reconstructed section of Alaska Highway, km 1022, sparsely vegetated.

PLATE 2 Location as for Plate 1, sparsely vegetated cleared right-of-way.

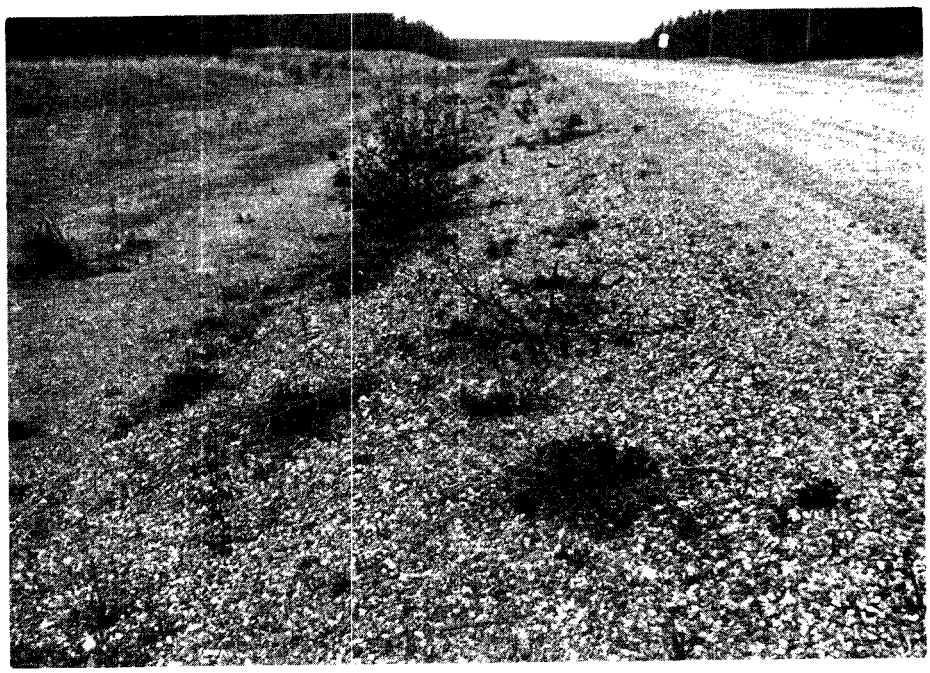


PLATE 3 Location as for Plate 1, highway shoulders beginning to vegetate.

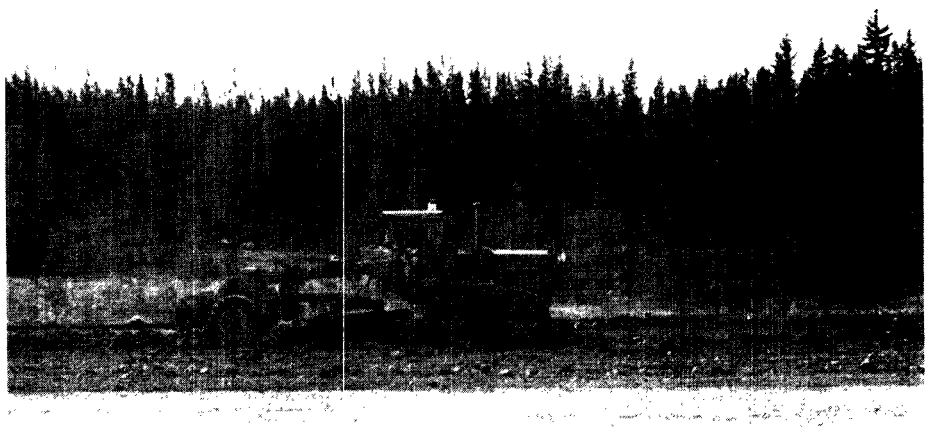


PLATE 4 Location as for Plate 1, maintenance staff use of road graders to clear vegetation from road-sides in the Yukon.

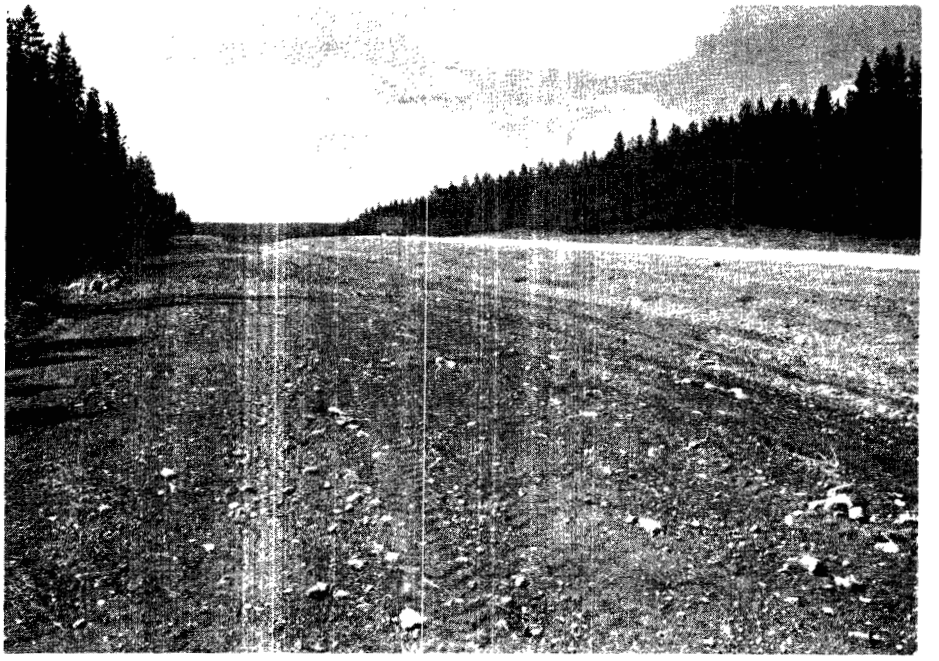


PLATE 5 Location as for Plate 1, clearing with road grader has been completed, all vegetation has been removed.

PLATE 6 Road grader clears a 4 m swath of vegetation. Cleared area in this picture is approximately 8 m wide, but it approaches 12 m wide in other sections of this highway. Robert Campbell Highway, km 56.

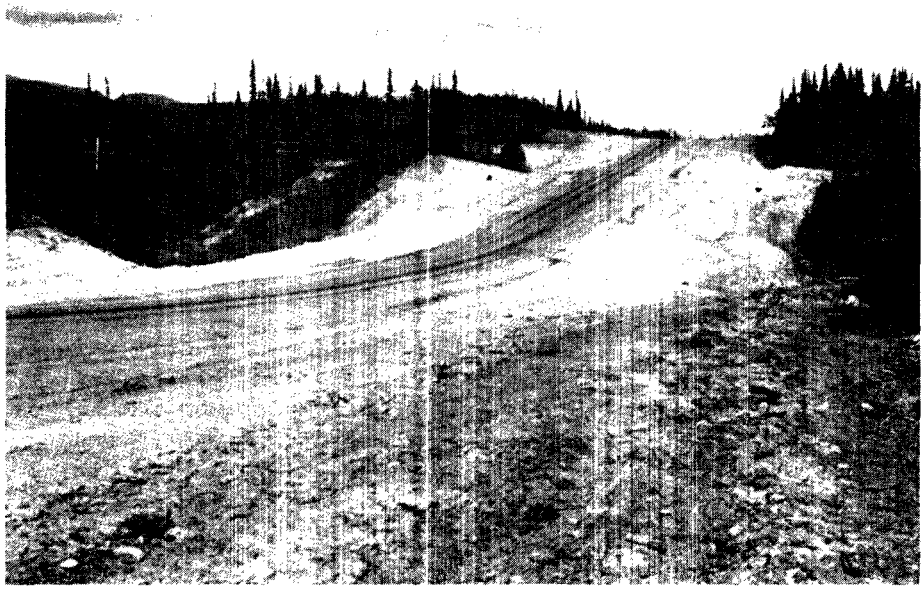


PLATE 7 Road graders are used here to keep the rights-of-way cleared of vegetation and to remove slash. The slash was left at the edges of the cleared rights-of-way when the highway was first built in the early 1940s. Rain-fall in this area is low and soils are high in silt and sand, hence erosion problems are likely. Alaska Highway, km 1628, to be reconstructed.

Environmental problems arise when streams, rivers, lakes or wetlands are located in or near the areas plowed up by road graders. They can also occur when road graders are used on erosion-prone soils (Plates 8-10).

Wind erosion can become a problem when silty or sandy soils are cleared of vegetation. This problem is perhaps greatest on sections of the Alaska Highway lying in the rain shadow of the St. Elias Mountains (Plate 11).

Erosion and aesthetic problems inevitably result when topsoil and vegetation are removed at stream crossings (Plate 12).

Trees at the edge of a cleared right-of-way can be damaged and may not be removed during reconstruction operations (Plate 13).

Enormous areas are cleared of topsoil and vegetation during reconstruction operations. The reasons for continuing to clear to the margins of these areas (as opposed to some intermediate distance) after reconstruction operations have been completed are not clear. There are, in fact, a number of precedents to support the view that a much

PLATE 8 Gully erosion can result when silty soils are not allowed to revegetate. The most vulnerable areas are at the bottoms of ditches. Alaska Highway, km 1628, reconstructed section.

PLATE 9 Silty soils kept clear of vegetation in approach to to Teslin River, gullys 0.3 -0.6 m deep. Alaska Highway, km 1345, section reconstructed in 1977.

PLATE 10 Gully erosion silty, soil. Robert Campbell Highway, km 100.

PLATE 11

Sparsely vegetated sand dune is in low rainfall area. Alaska Highway, km 1568, highway to be reconstructed.

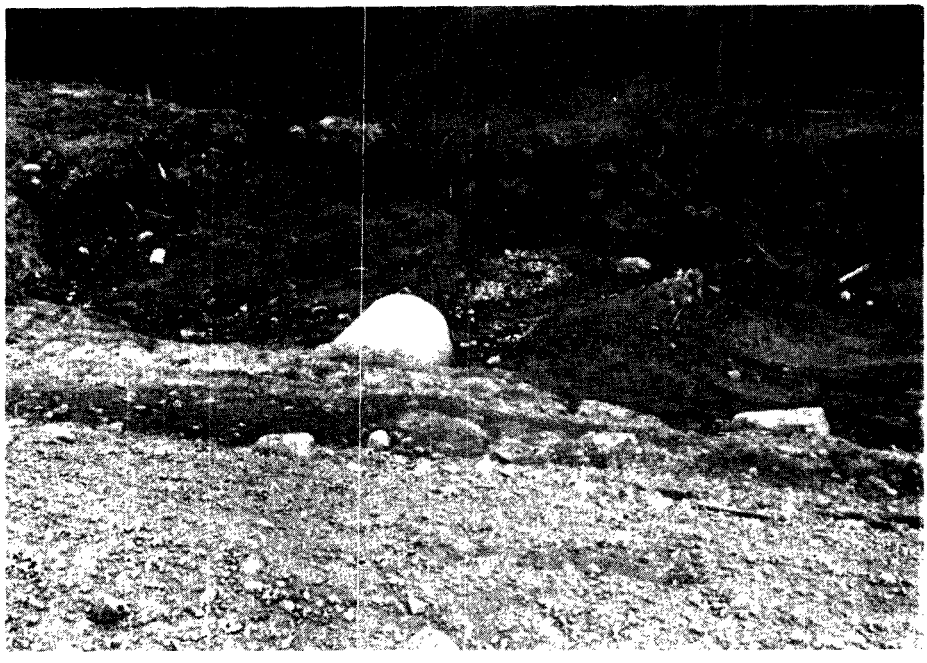


PLATE 12 Shorelands at minor stream crossing cleared of soil and vegetation. Erosion and aesthetic problems have resulted. Alaska Highway, km 1415, reconstructed section.

PLATE 13

Cowley Creek, trees pushed over by having equipment adjacent to creek, some will die and many will eventually block creek. Alaska Highway, km 1457, reconstructed section.

narrower, cleared right-of-way would be entirely satisfactory. The Superintendent of Highways in Tok, Alaska, reports that a vegetation cutter is used to clear about 640 km of Alaska Highway right-of-way annually. The cutter clears a swath approximately 4 m wide on both sides of the highway (Plates 14-16). This size of cleared right-of-way is found to be quite satisfactory. In addition, equipment and manpower requirements are low (at least, relative to the Yukon).

In Haines, Alaska, the Highways Superintendent reported that maintenance clearing procedures in his area of jurisdiction are somewhat similar to those used near Tok, although wider areas are cleared on curves (Plates 17-19). He also reported that the principal cause of big game collisions on his highways was excessive speed; he did not feel that the width of the cleared right-of-way played a part in these accidents. This counters the argument that a wide right-of-way is needed so that drivers will have sufficient time to see and react to big game/horses darting across the highway. Yukon's Department of Renewable Resources (Wildlife) staff supported the views of the Haines Highway Superintendent. It has also been argued that if cleared rights-of-ways are narrow, then trees are much more likely to fall on highways and significant traffic accident/blockage problems could result. According to the Highways Superintendent, however, problems with fallen trees were not significant on highways near Haines even though the forest edge is relatively close to the highway.

Federal Department of Forestry staff in Whitehorse supported the views of the Haines Highway Superintendent. In addition, they noted that: (i) trees at the margins of cleared rights-of-way are no more likely to fall than other trees (it has been argued that trees at the margins of cleared rights-of-way are weaker than other trees and, hence, more likely to fall); and (ii) forest fires in the Yukon will spread across highways regardless of the width of cleared rights-of-way (it has been argued that wide, cleared rights-of-way are needed to help prevent the spread of forest fires).

The conclusion to the above discussion seems clear enough: relatively narrow, cleared rights-of-way work well in Alaska; evidence that they would work well in the Yukon is available.

Sections of the Haines Road and Klondike Highway have cleared rights-of-way almost identical in size to those used in Alaska and no serious problems have been reported (Plates 20-24).

2.3 Recommendations

The following recommendations apply to reconstruction and maintenance operations on the Alaska Highway between Watson Lake and Haines Junction.

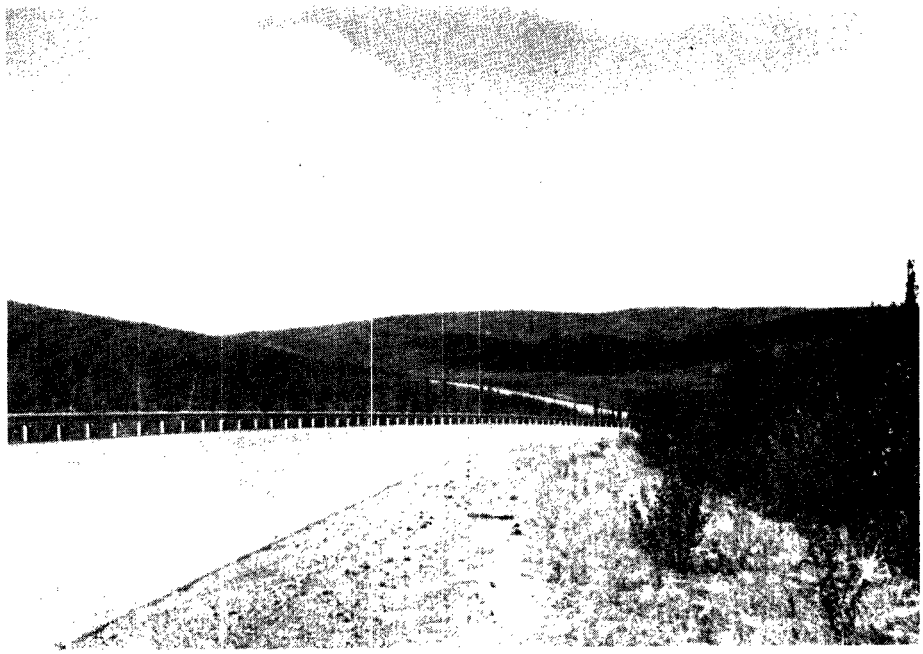


PLATE 14 Right-of-way cleared with a vegetation cutter. The cutter clears a 4 m swath on each side of the highway. One cutter clears approximately 640 km of highway per year. Soils are sandy and hence erosion-prone. Alaska Highway in State of Alaska, vicinity of Tok.

PLATE 15 Right-of-way cleared with a vegetation cutter. Care has to be taken to keep the rights-of-way cleared of rocks and other obstacles. The cutter used on this highway has to be repaired a great deal. If the "down-time" could be reduced a single cutter could clear much more than 640 km of highway per year. Alaska Highway, vicinity of Tok, Alaska.

PLATE 16 Narrow cleared right-of-way, soils are sandy and hence erosion-prone. Highway 5, Alaska.

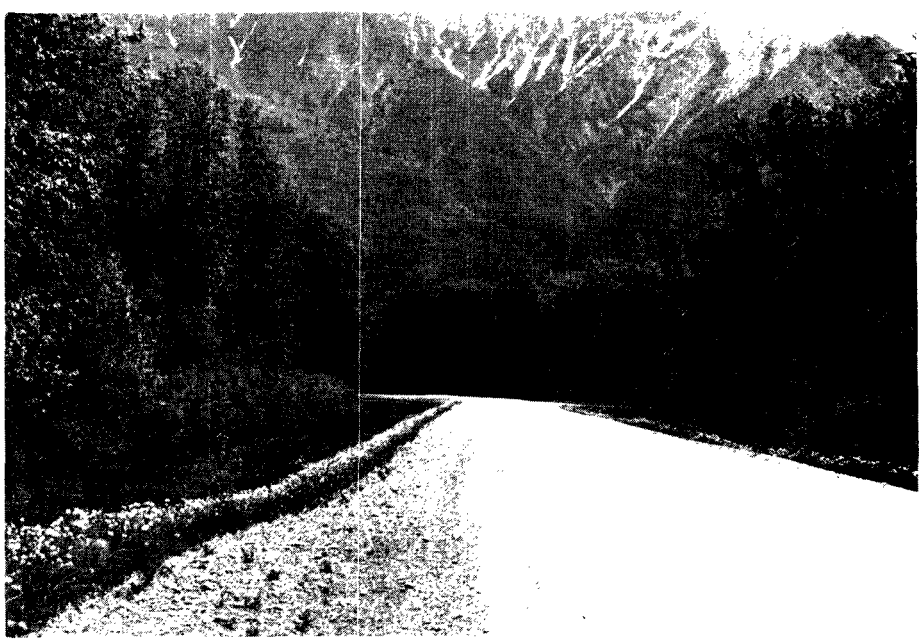


PLATE 17 Narrow, naturally vegetated cleared right-of-way. A vegetation cutter is used to clear a swath on either side of the highway. Haines Road, Alaska.

PLATE 18 Description as for Plate 17. Haines Road, Alaska.

PLATE 19 Wide, naturally vegetated rights-of-way on curves. Haines Road, Alaska.

PLATE 20 Narrow cleared right-of-way. A road grader was used to cut a 4 m swath on either side of the road. Additional widening is prevented by slash left from original road construction operations. The slash is hidden by bush at left and right in picture. Haines Road, km 242, Yukon.

PLATE 21

Narrow cleared right-of-way, well vegetated foreslope, clearing in foreground done by hand. Klondike Highway, km 102.

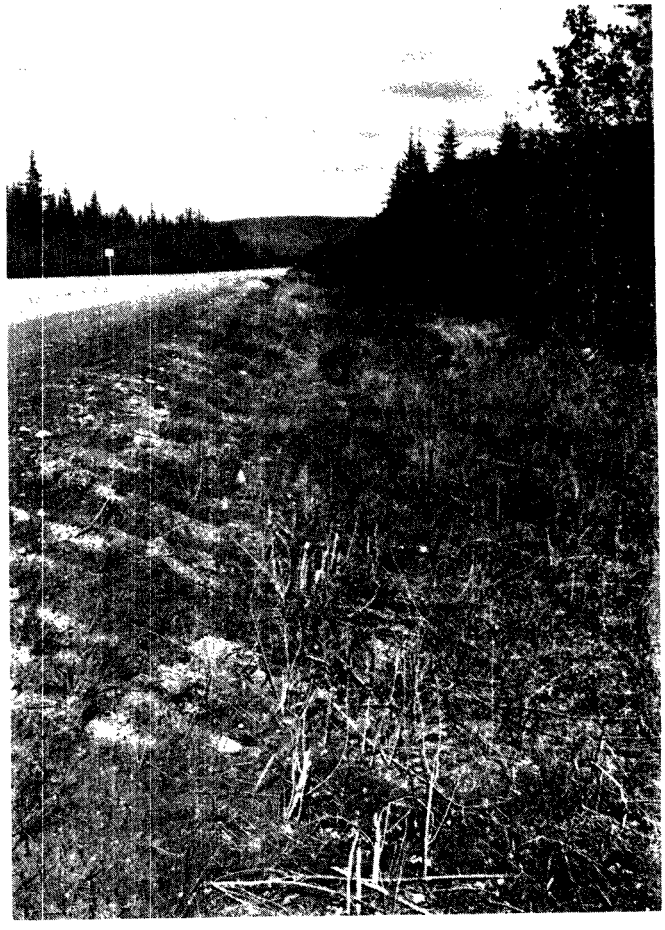


PLATE 22 Description as for Plate 21. Klondike Highway, km 21.

PLATE 23 Narrow right-of-way cleared with road grader, sandy soil. Klondike Highway, km 45.

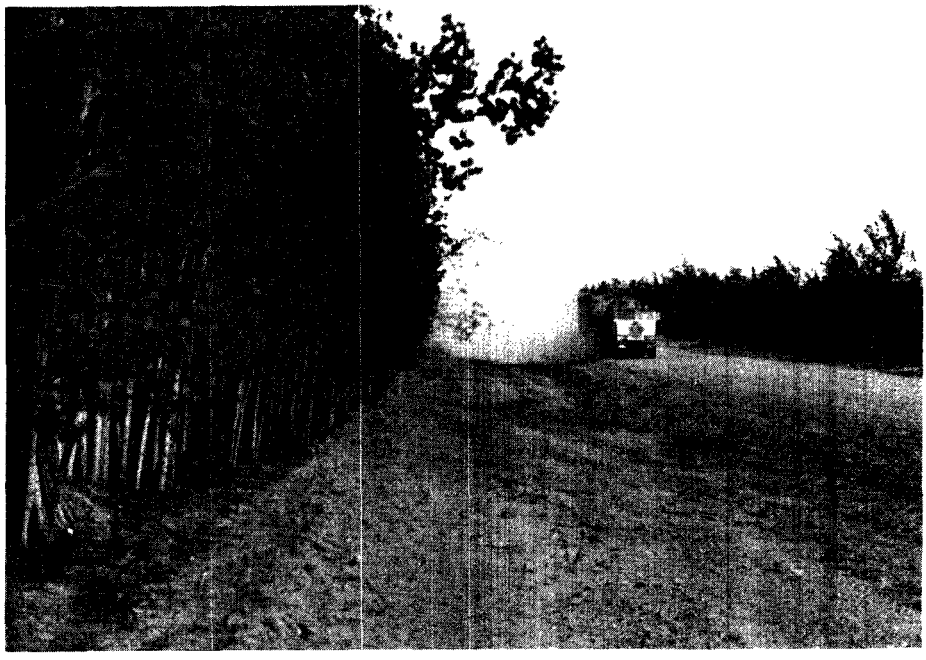


PLATE 24 Narrow right-of-way cleared with road grader, 4 m on either side of highway, sandy soil. Disadvantages of a narrow cleared right-of-way on gravel roads is shown - dust dissipates less slowly creating visibility problems. The problem would not be encountered on the Alaska Highway since it is to be paved. Advantage of vegetated buffers at stream crossings and around road-side lakes and wetlands is also known. They help shield these areas from dust. Klondike Highway, km 57.

i) Vegetation and topsoil should not be removed within 30 m of major streams (defined in Chapter 4), rivers, lakes or wetlands to obtain fill for reconstruction purposes.

ii) Vegetation and topsoil should not be removed within 8 m of minor streams (defined in Chapter 4) to obtain fill for reconstruction purposes.

iii) Highway maintenance staff should not use road graders to remove vegetation within 30 m of major streams (defined in Chapter 4), rivers, lakes or wetlands.

iv) Highway maintenance staff should not use road graders to remove vegetation within 8 m of minor streams (defined in Chapter 4).

v) The areas defined in recommendations i-iv should be clearly marked to assist heavy equipment operators.

vi) When vegetation must be removed in the vicinity of rivers, lakes and wetlands it should be hand-cleared initially. This hand-cleared vegetated buffer should be left in

place until culvert installation etc. actually takes place. All areas designated for hand-clearing should be flagged to assist heavy equipment operators.

vi) An environmental briefing program should be developed for the resident engineer. Its objective should be to communicate the concerns and recommendations contained in this report, so that he may in turn brief heavy equipment operators etc.

vii) Maintenance clearing operations should be limited to a strip of land 4 m wide on either side of the highway. Wider areas should be cleared on curves (up to 9 m on either side of the highway). Wide areas should also be provided in areas prone to icing. Supposedly, icy sections of the highway melt faster in the spring when cleared rights-of-way are wide - this hypothesis should be tested.

viii) A plan to phase road graders out of vegetation maintenance clearing operations over the next three years should be developed and given top priority for implementation. The road graders should be replaced with vegetation cutters. The Yukon Department of Highways recently purchased its first cutter.

ix) Since a single vegetation cutter can clear 640 km of highway right-of-way per year (according to the Highway Superintendent in Tok, Alaska), the single cutter of the Yukon Department of Highways could be put to work exclusively on the Watson Lake-Haines Junction section of the Alaska Highway - a distance of almost 640 km.

x) Vegetation on erosion-prone silty and sandy soils should always be cleared with a vegetation cutter.

xi) Vegetation cutters should not be used within 8 m of major streams (defined in Chapter 4), rivers, lakes or wetlands. They should not be used within 3 m of minor streams (defined in Chapter 4). These areas should be well marked to assist vegetation cutter operators. If vegetation must be removed within the boundaries defined above, then it should be removed by hand.

xii) Road graders should not be used to remove old slash within 30 m of major streams (defined in Chapter 4), rivers, lakes or wetlands or within 8 m of minor streams (defined in Chapter 4).

xiii) As well, road graders should not be used to remove old slash in erosion-prone areas. An environmentally appropriate way to resolve the aesthetic problem of old roadside slash would be to leave the slash where it is and follow recommendation vii. Within five or ten years, an aesthetically acceptable screen would develop to hide the slash from view (Plate 20).

3 BACKSLOPES

The concerns listed below have been synthesized from observations made on Yukon highways. Special attention has been given to reconstructed sections of the Alaska Highway between Watson Lake and Haines Junction. Site-specific detail is available from the Environmental Protection Service.

3.1 Environmental Concerns:

i) Slopes may exceed 1.5:1 (approximately 30 degrees). Such slopes do not vegetate well and are erosion-prone.

ii) Large backslopes in silty or sandy soils may continue to erode and may be slow to revegetate, even when cut at angles of approximately 30 degrees. Additional steps to ensure that these slopes stabilize and revegetate as quickly as possible may not be taken.

3.2 Discussion

Slopes in silty or sandy soils are unstable when cut at angles much in excess of 30 degrees. Such slopes cause erosion, revegetation and maintenance problems. Yet most backslopes in silty or sandy soils in the Yukon are cut at angles well in excess of 30 degrees (Plates 25-28). Slopes in dead-ice morraine areas can cause problems when cut at angles much in excess of 30 degrees (revegetation difficulties, falling rock problems, extra maintenance work), yet most backslopes in dead-ice morraine areas in the Yukon have been cut at angles well in excess of 30 degrees.

Although some large backslopes have been cut at angles of approximately 30 degrees, additional steps are rarely taken to ensure that they stabilize and revegetate quickly.

3.3 Recommendations

i) Backslopes should not be cut at angles greater than 30 degrees (approximate). Geotechnical tables would have to be consulted for precise information on natural angles of repose for specific soil types. For example, see Hardy Assoc. 1979. Shakwak Highway Project Reclamation Program Formulation. Project No. 010417. Vol. I and II.

ii) A horizontal hydro-seeded space 4 m wide should be provided between the edge of the highway and the base of the backslope. Such an area provides a place for slope revegetation to start (Plate 29).

iii) When backslopes are higher than 8 m, a bench should be provided part-way up the slope; this would provide a place for slope revegetation to begin (analogous to the flat,

PLATE 25

Backslope nearly vertical, silty soil, extensive slumping. Robert Campbell Highway, km 85.

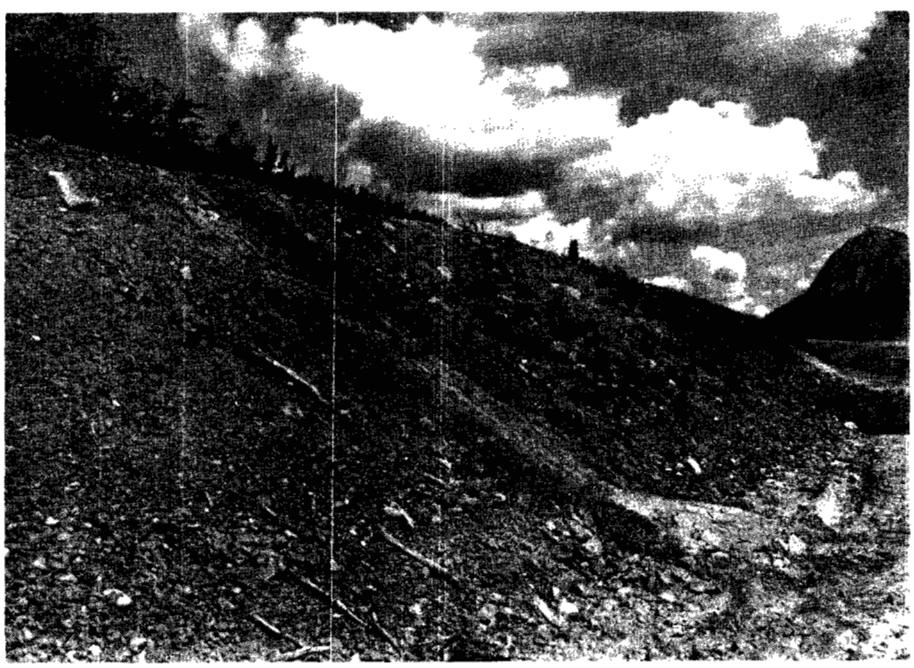


PLATE 26 Backslope at 45°, silty soil, top of slope has slumped (upper left to lower right in picture). Alaska Highway, km 1390, reconstructed section. Other backslopes on this section are also cut at angles well in excess of 30 degrees as are backslopes at km 1100 (reconstructed section), km 1180 (reconstructed section), km 1345 (to be reconstructed).

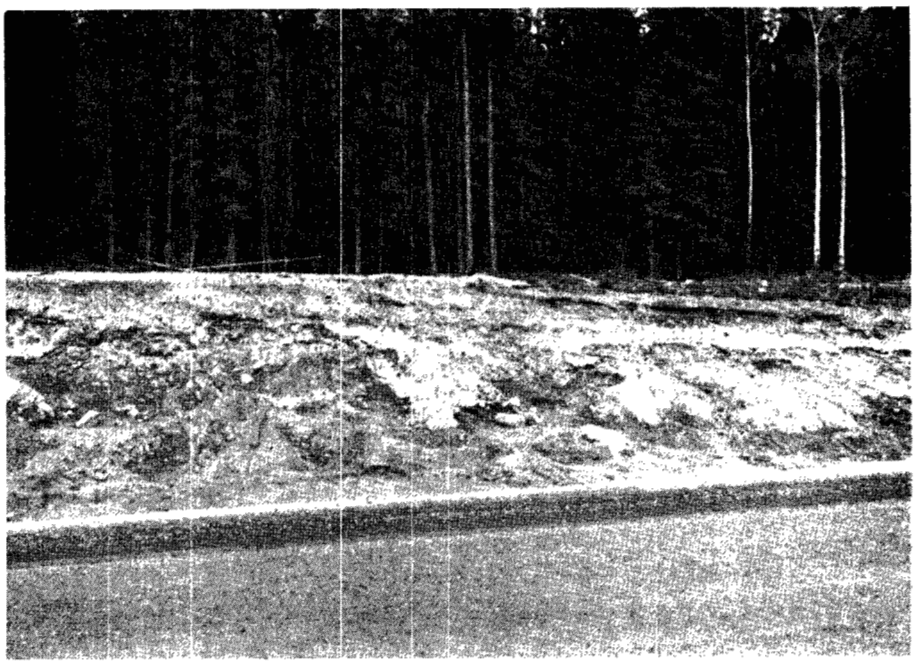


PLATE 27 Small steep cut in sandy, silty soil. Contrast the revegetation and soil stability problems here with successful revegetation efforts nearby (see next plate). Alaska Highway, km 1398.

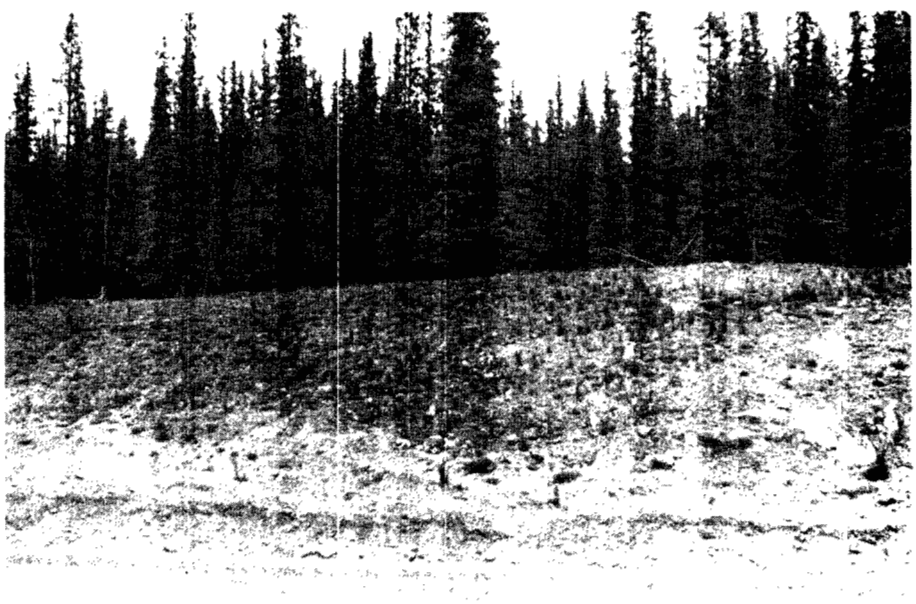


PLATE 28 Location as for Plate 27, well vegetated 30° backslope.

PLATE 29 Horizontal vegetated space provided at base of backslope speeds up slope revegetation. A bench cut part way up the slope would speed up revegetation by trapping fine materials, providing a place for revegetation to start and acting as a seed source. Note that slope revegetation is facilitated when the top of the slope is rounded off (slightly left of centre in picutre). Alaska Highway, Alaska.

revegetated area at the base of the slope in Plate 29, which traps rocks, stones and fine material). (Plates 30 and 31).

iv) If backslopes are cut in silty or sandy soils and do not revegetate despite repeated efforts, then the slopes should be covered with a layer of gravel 0.3 m thick (Plates 32 and 33).

v) The tops of backslopes should be rounded-off to facilitate revegetation and prevent slumping (Plates 29 and 34).

vi) The surface of all backslopes should be roughened.

vii) All backslopes should be hydroseeded. If this is not economically feasible, then consideration should be given to hydroseeding large, erosion-prone backslopes, particularly in the vicinity of lakes, rivers, streams and wetlands. Remaining areas could be seeded much less expensively by dry broadcasting from a truck or light aircraft. For details on the economic costs and benefits of alternative methods of seeding, see the reference cited in recommendation (i).

PLATE 30 Bench cut in 30° backslope prevents stones and gravel from collecting at base. Revegetation starts on bench and eventually provides a seed source for the revegetation of adjacent areas. Klondike Highway.

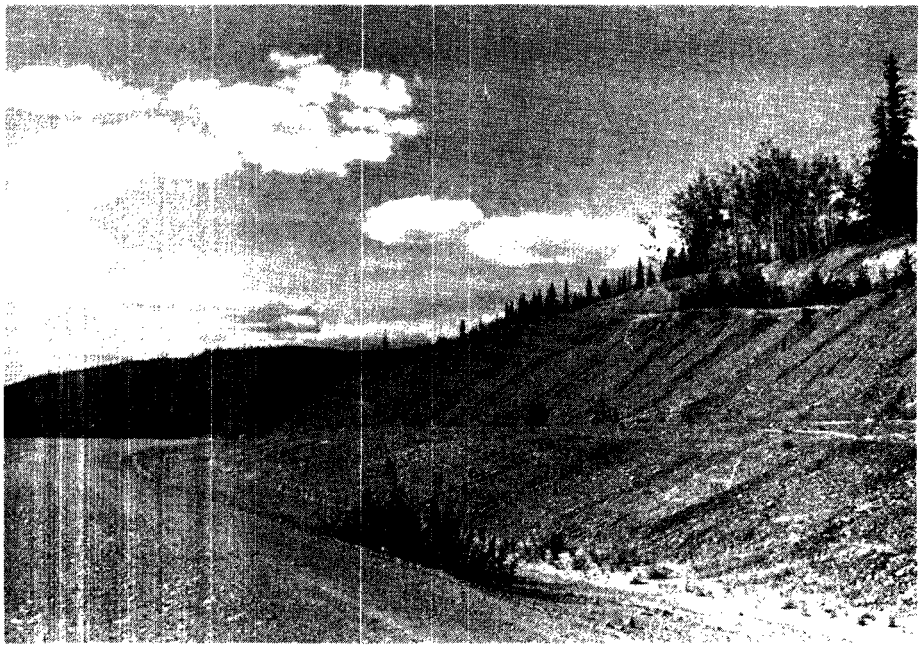


PLATE 31 Benches cut in 30° backslope, sandy soils. Benches beginning to vegetate. They were likely cut to meet additional fill requirements during reconstruction operations. Klondike Highway.

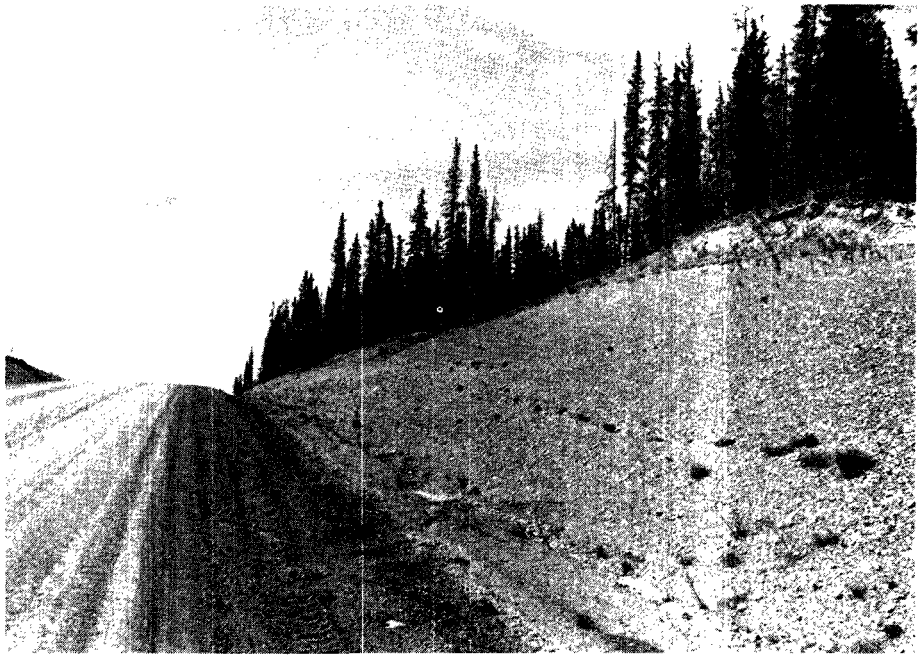


PLATE 32 Backslope at 35°, sandy soil, covered with a layer of gravel. It is likely that sandy gravel originally covered the slope surface. Eventually the sand eroded away leaving pure gravel. Robert Campbell Highway, km 345.

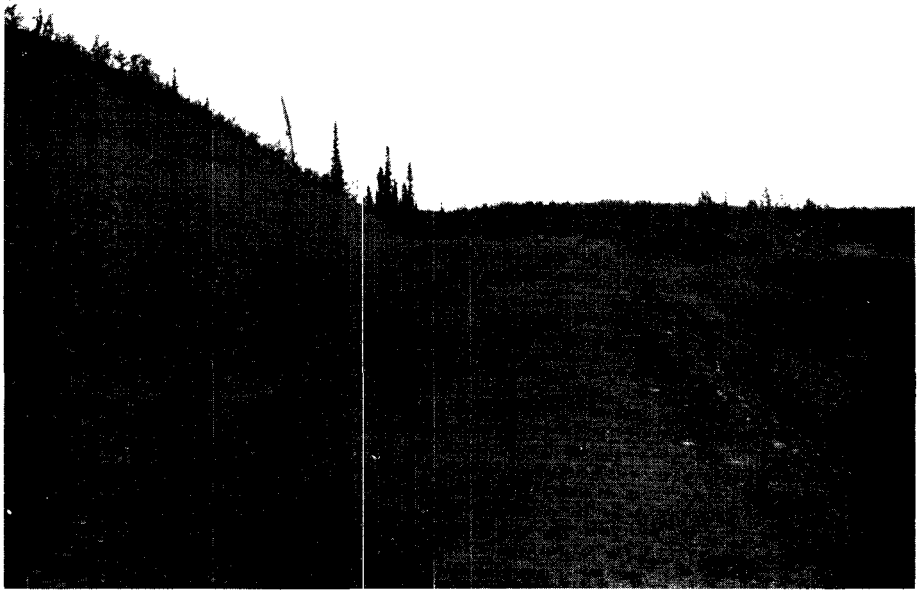


PLATE 33 Backslope at 30° partially covered with gravel. It is likely that sandy gravel originally covered the slope, as for Plate 32. Klondike Highway, km 287.

PLATE 34 Rounded off backslope in silty soil increases stability in the most slump-prone part of the slope and facilitates the spread of vegetation from areas at left of picture downslope. An abrupt change in slope gradient would have been less effective.

4 RIVER AND STREAM CROSSINGS

The concerns listed in this section have been synthesized from site-specific observations made on Yukon highways. The purpose was to identify environmental problems at existing crossings, with special emphasis on sections of the Alaska Highway which have been reconstructed, and to apply them to sections of the Alaska Highway which will be reconstructed. Site-specific detail is available from the Environmental Protection Service.

4.1 Environmental Concerns:

i) Vegetation and topsoil may be removed in the vicinity of river and stream crossings during reconstruction operations.

ii) The areas which have been cleared of vegetation and topsoil during reconstruction operations may be maintained in that condition by highway maintenance staff. Road graders may be used for this purpose.

iii) Foreslopes may be constructed too steeply and may not vegetate, particularly in the vicinity of culvert entrances and exits. Rip-rap may not be used at culvert entrances and exits when fills have a high silt or sand content.

iv) Fill may be deposited in shoreland areas on either side of crossing structures during reconstruction operations.

v) Backslopes may be constructed too steeply and may fail to vegetate. The concern is greatest in areas having soils with a high silt or sand content.

vi) Roadside ditches and rip-rap may not be provided for slopes leading to stream and river crossings. This is a particular concern in areas having soils with a high silt or sand content.

vii) Minor streams may sustain enormous impacts despite their importance in maintaining good local drainage, especially when wetlands, lakes or rivers are located nearby. Chutes and rip-rap may not be provided in areas where culverts must be raised. Shoreland areas at minor stream crossings may be cleared of topsoil and vegetation during reconstruction operations and maintained in that condition by highway maintenance staff.

viii) Natural stream flow may be greatly disturbed by culverts; if stream cross-sections inside culverts are noticeably smaller than natural stream cross-sections, particularly in early June when stream flows are high; if culverts are not installed on the natural stream gradient; or if culvert inverts are located on or above the stream bed rather than below it.

ix) Old and poorly installed culverts may not be replaced on reconstructed sections of the Alaska Highway. Culverts on abandoned sections of highway may not be removed nor maintained.

x) Excessively large, permanent weirs may be built by highway maintenance crews near culvert exits to make it easier to obtain water for highway dust control purposes. Juvenile fish may be attracted to the backwaters created at the weirs and may be removed in significant quantities during dust control operations.

xi) Water trucks, tourist vehicles and boat launching operations may not be restricted to a limited but reasonable number of access points at river/stream crossings. Extensive destruction of shoreland vegetation could result.

xii) Appropriate environmental standards may be applied to reconstruction operations but may not be maintained once the work has been completed. Environmental problems may go unnoticed at crossing structures. Once they are discovered, they may not be dealt with promptly.

4.2 Discussion

If the concerns listed in the preceding section are to be resolved, then a minimum environmental disturbance objective must be sought at all Yukon river and stream crossings. This section identifies reconstruction and maintenance practices which are likely to be a hindrance in such an effort. The next section identifies reconstruction and maintenance practices which are likely to be useful in such an effort.

There can be no doubt that a minimum environmental objective is worth pursuing at all river and stream crossings. Unfortunately, there is little hard evidence to suggest that such an objective is being actively sought in the Yukon at this time. Topsoil and vegetation are removed in the immediate vicinity of most river and stream crossings in order to obtain fill for reconstruction purposes. Normally, a 60 m wide swath is cleared (30 m on either side of the highway centreline). Stream bank vegetation on either side of crossing structures is also often destroyed (Plates 12 and 35-39).

Once reconstruction operations have been completed, the areas which have been cleared of vegetation and topsoil are maintained in that condition by highway maintenance staff. Road graders are used for this purpose (Plates 12 and 35-39).

By removing vegetation and topsoil at stream crossings and in the approaches to stream crossings, all control over surface run-off is lost. Problems with erosion, drainage, aesthetics and fish habitat degradation are the result. These problems are most acute in areas having soils with a high silt or sand content.

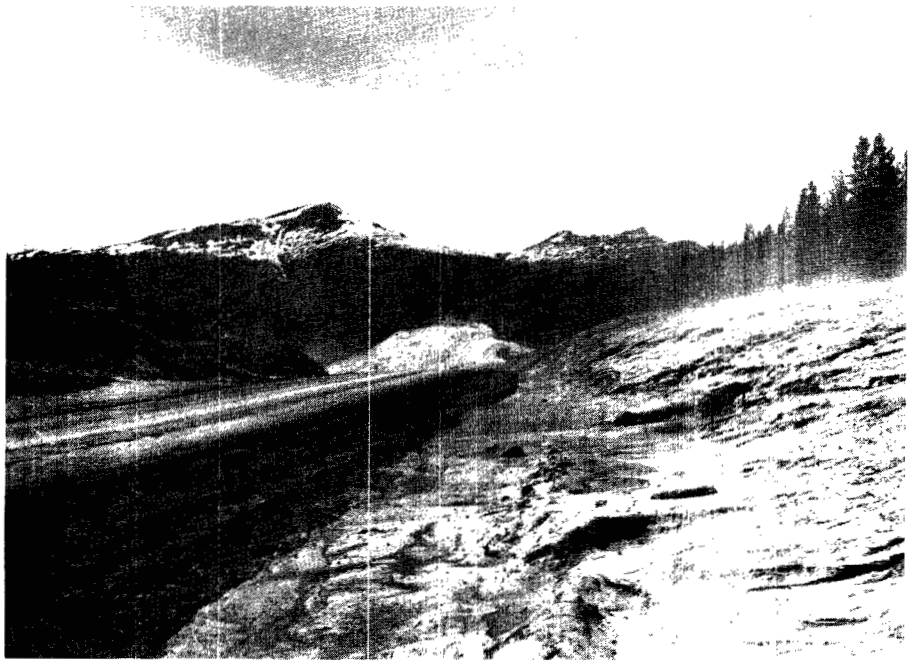


PLATE 35 Right-of-way approaching Seagull Creek, 60 m wide. Wind and water erosion problems are evident. No ditches or checks have been provided. No rip-rap or other means have been used to stabilize the area. Alaska Highway, km 1180. Reconstructed section.

PLATE 36 Wide right-of-way cleared for reconstruction purposes at stream crossing. The area cannot revegetate because highway maintenance staff periodically plow it up with road graders. Robert Campbell Highway, km 397.

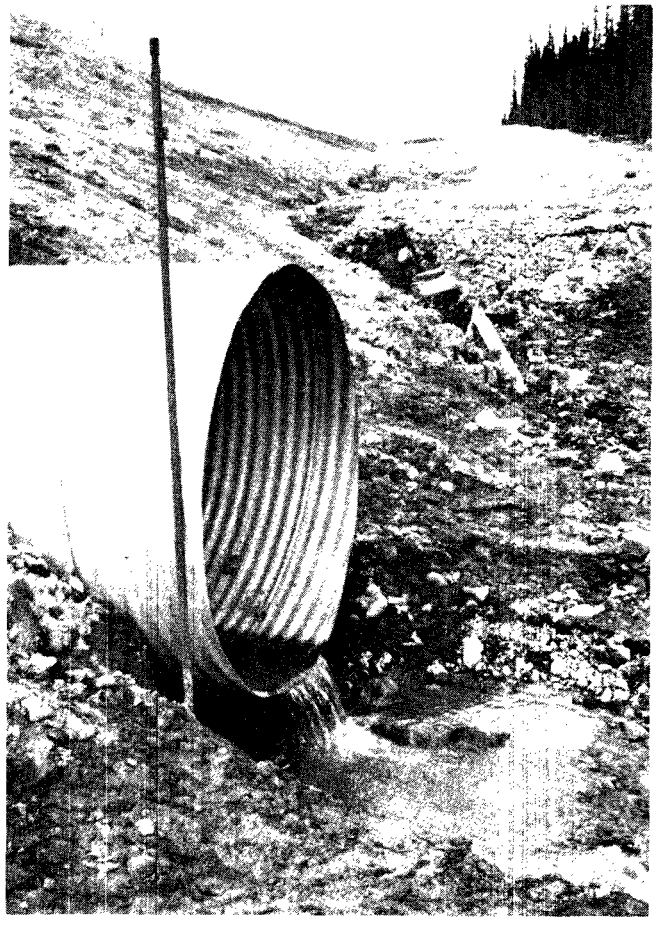
PLATE 37

Wide right-of-way clearing at minor stream crossing. Road graders are used to ensure that the area is kept clear of vegetation. Alaska Highway, km 1392. Reconstructed section.

PLATE 38 Topsoil and vegetation removed at minor stream crossing during reconstruction. Highway maintenance staff use road graders to keep these areas cleared of vegetation. Alaska Highway, km 1407. Reconstructed section.

PLATE 39

Top soil and vegetation removed at stream crossing during reconstruction. Erosion evident. Alaska Highway, km 1418.3 Reconstructed section.



Foreslopes at culvert entrances and exits are usually constructed too steeply. They are unstable, will not vegetate and are easily eroded by run-off from highways. Eventually the eroded material finds its way into streams and may partially block stream channels and degrade fish habitat. Rip-rap is used only occasionally around culvert entrances and exits as a means of stabilizing foreslopes (Plates 40-43).

When substantial fill is required at streams and in the approaches to streams, some of the fill ends up in shoreland areas on either side of crossing structures (Plates 10 and 44-47).

Roadside ditches and/or ditch checks are usually not provided for slopes leading to stream or river crossings (Plates 43 and 47-54). The problem is greatest in areas having soils with a high silt or sand content.

Backslopes are usually constructed at angles well in excess of 30 degrees. Such slopes are unstable and will not vegetate. The problem is greatest in areas having soils with a high silt or sand content (Plate 55). Other techniques are available for stabilizing backslopes (benches, rip-rap) but are never used in the Yukon.

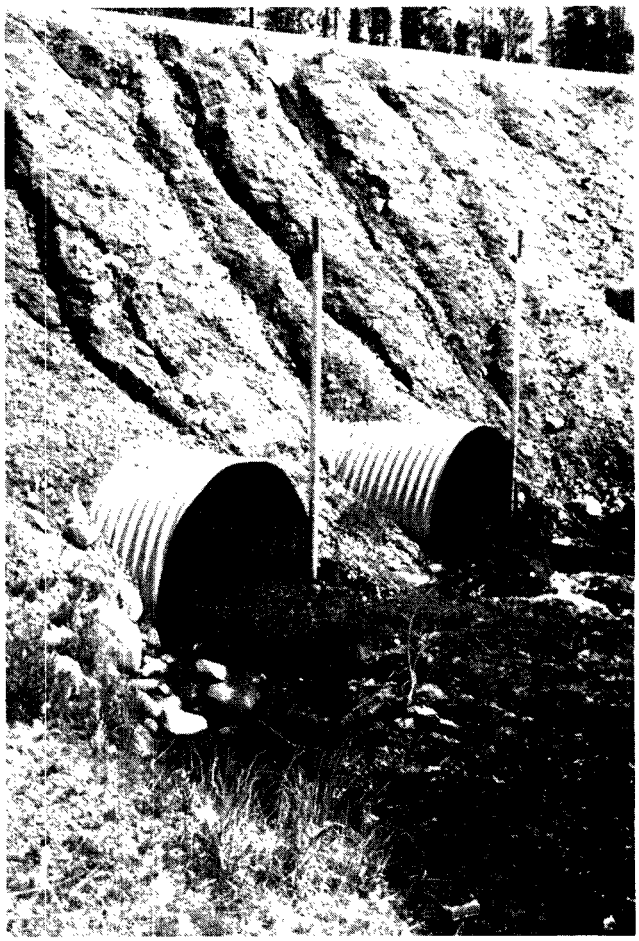


PLATE 40

Foreslope too steep. Eroded material ends up in stream. This problem can arise if the highway is widened and if the culverts used in the old highway are not replaced with longer ones or if sections are not added to the ends of the culverts already in place. Alaska Highway, km 1071. Reconstructed section.

PLATE 41

Sand used for fill aggravates problem (see plate 40). Gravel should always be used to stabilize foreslopes at culvert entrances and exits. Serious erosion problems evident after reconstruction should be resolved by highway maintenance staff through addition of rip-rap. Cowley Creek, Alaska Highway, km 1459. Reconstructed section.

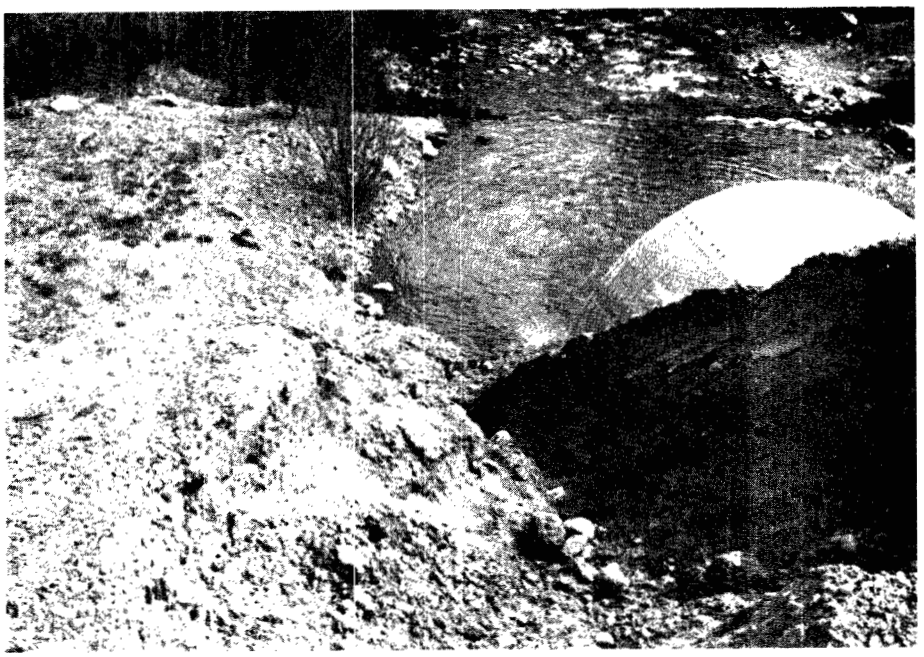


PLATE 42 For problem description, see Plate 41. Fill has high sand content. Wolf Creek, Alaska Highway, km 1459. Reconstructed section.

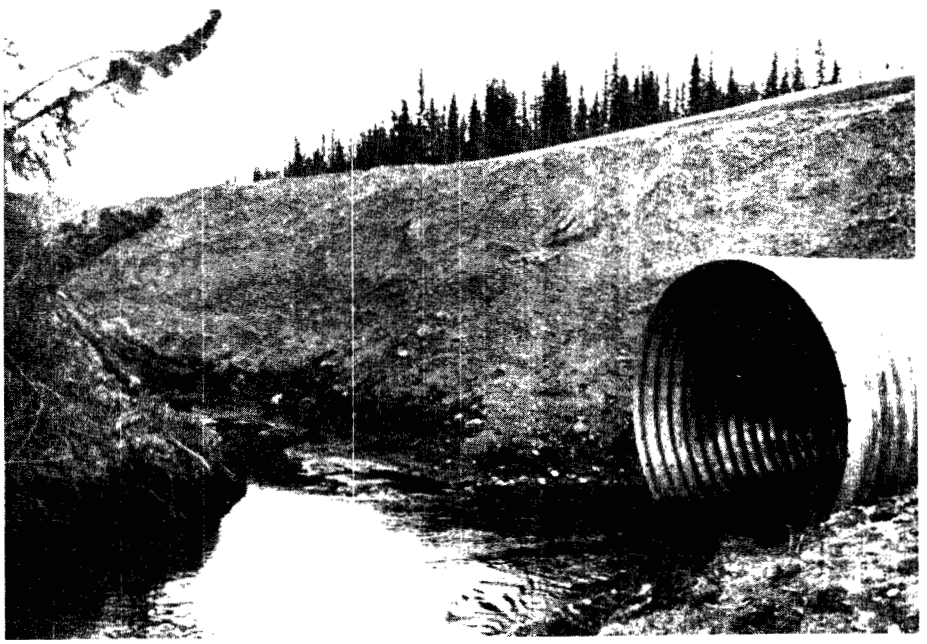


PLATE 43 Fill with high silt content and foreslope well in excess of 30°. Much of this material will end up in the stream and in the ditch; it will not stabilize or vegetate and is highly sensitive to erosion from highway run-off. Alaska Highway, km 1411. Reconstructed section.

PLATE 44 When substantial fills are required at streams and in the approaches to streams, some of the fill ends up in shoreland areas on either side of crossing structures. Cowley Creek, Alaska Highway, km 1457. Reconstructed section.

PLATE 45

For problem description, see Plate 44. Alaska Highway, km 1418.3. Reconstructed section.

PLATE 46 For problem description, see Plate 44. Alaska Highway, km 1421.5. Reconstructed section.

PLATE 47

For problem description, see Plate 44. The lack of rip-rap in the ditch and the fact that this area is cleared periodically with road graders adds to the environmental impact at this crossing. Alaska Highway, km 1418.3. Reconstructed section.

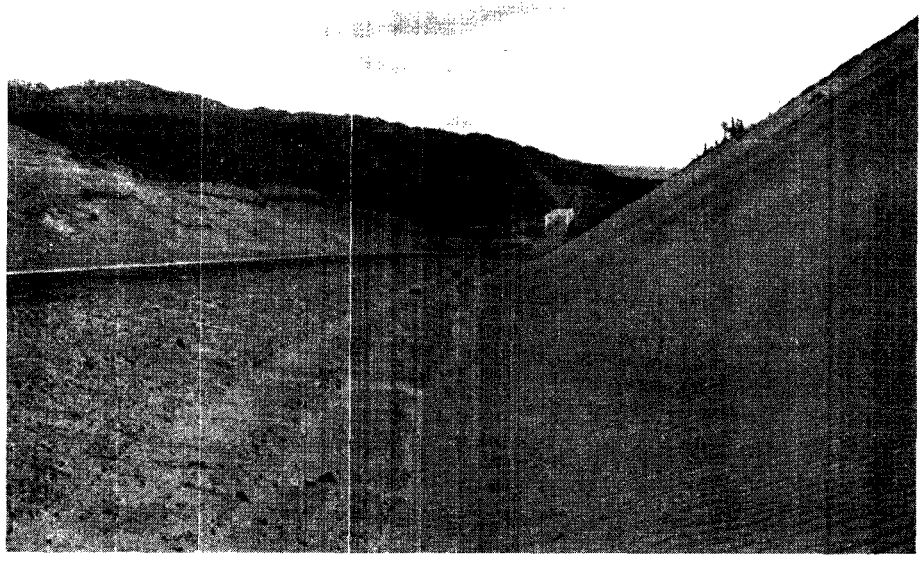


PLATE 48 Lack of rip-rap in ditch, approach to Yukon River, large silty sand backslopes. Alaska Highway, km 1444. Reconstructed section.

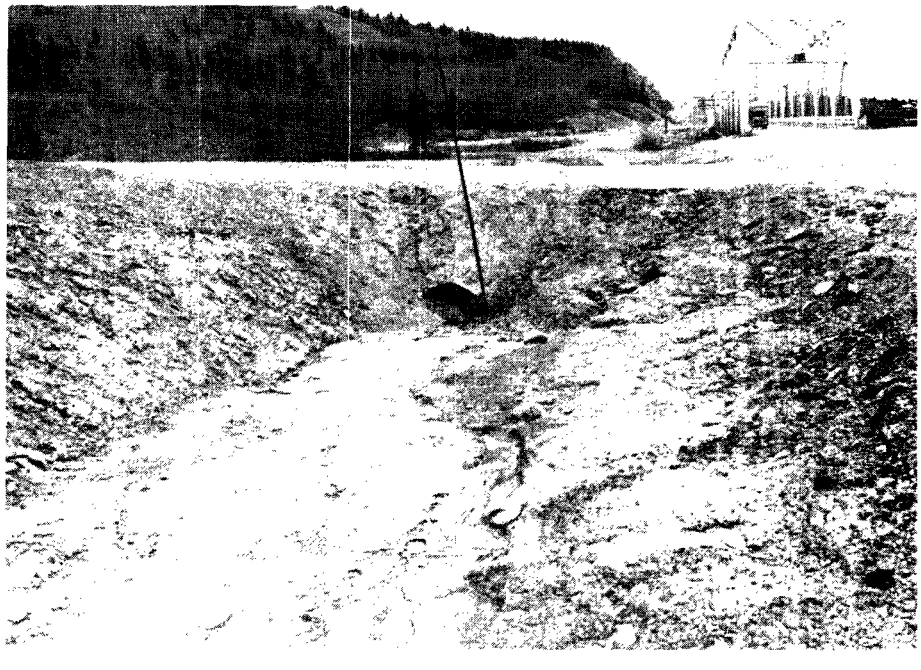


PLATE 49 Lack of rip-rap and under-sized, poorly maintained culvert in approach to Yukon River, Alaska Highway, km 1444. Reconstructed section.

PLATE 50

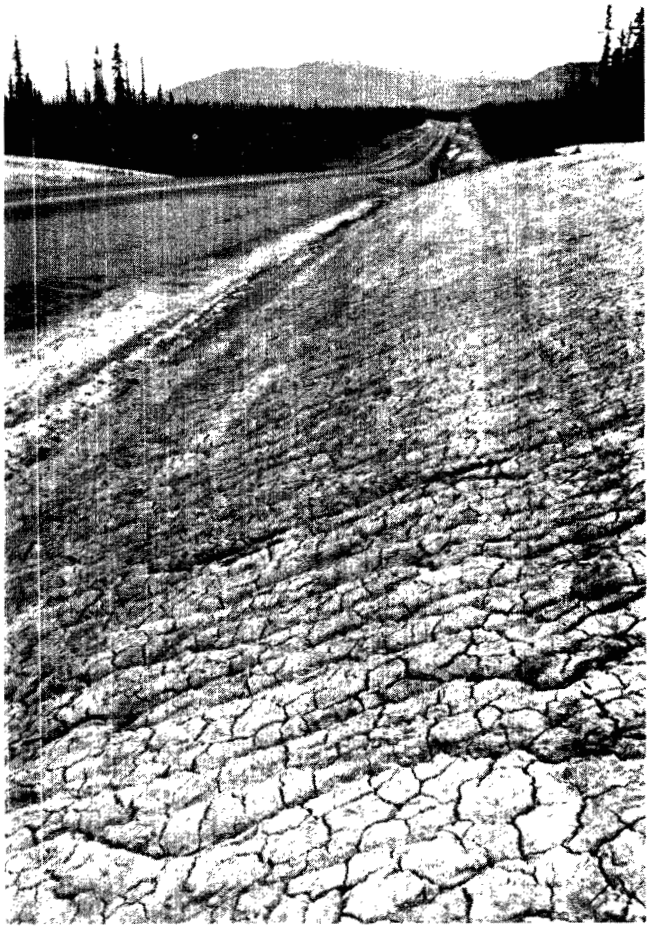
Location as for Plate 49.

PLATE 51 Ditch in silty soil lacks rip-rap. Approach to bridge at Nisutlin Bay inlet, Alaska Highway, km 1291. Reconstructed section.

PLATE 52 Ditch in silty soil leading to Marsh Lake lacks rip-rap. Alaska Highway, km 1418. Reconstructed section.

PLATE 53

Ditch lacks rip-rap. Sediment in run-off may clog minor drainage culverts (one is located at bottom of hill), erosion-prone silty soils. Alaska Highway, km 1415. Reconstructed section.



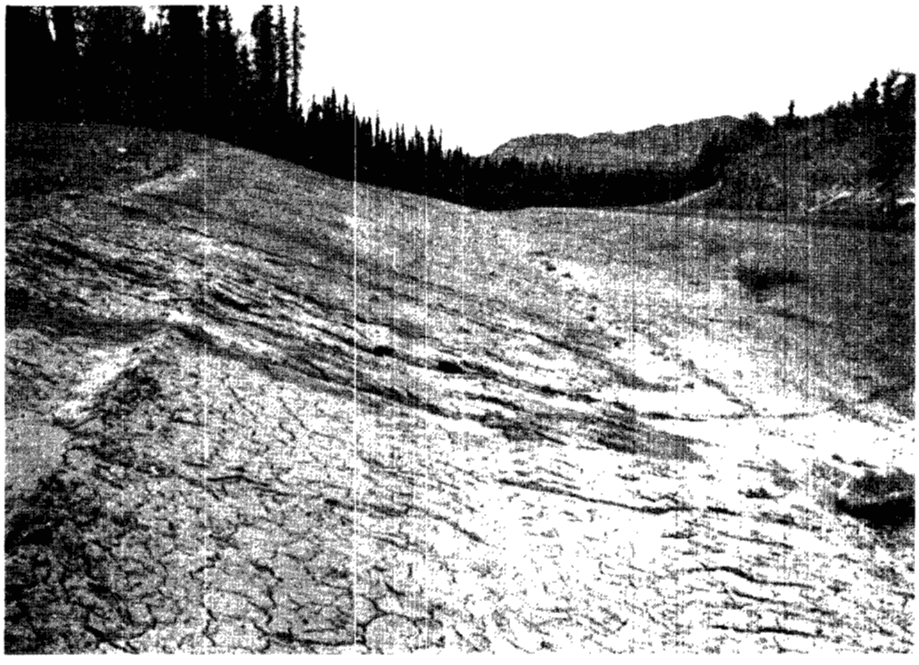


PLATE 54 For problem description, see Plate 53. Alaska Highway, km 1416. Reconstructed section.

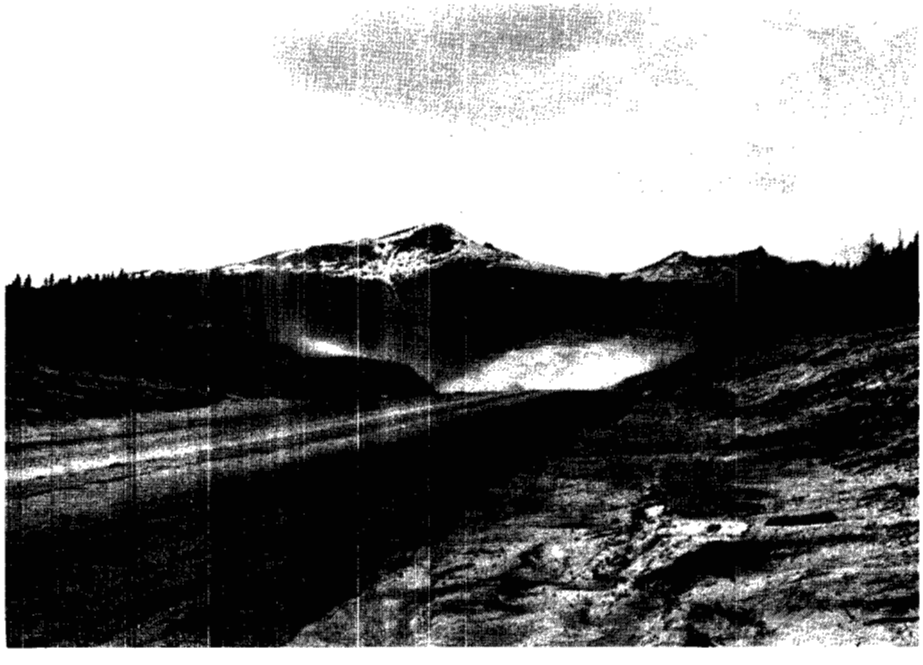


PLATE 55 Steep, sandy-silt backslopes in approach to Seagull Creek. Alaska Highway, km 1180. Reconstructed section.

Minor streams sustain enormous impacts at many highway crossings in the Yukon despite their importance in maintaining good local drainage, especially when wetlands, lakes or rivers are located nearby (Plates 56-60).

Stream cross-sections inside most culverts were found to be noticeably smaller than natural stream cross-sections. Observations were made in early June when stream flows are high (Plates 61 and 62).

Virtually all culverts in the Yukon are installed in a nearly-horizontal position. Included in this generalization are all culverts on reconstructed sections of the Alaska Highway. When culverts are installed in this way, they affect stream flow. The effect is quite marked, particularly at culvert entrances and exits. The gradient changes from natural stream gradient to near-horizontal culvert gradient at entrances, and from near-horizontal culvert gradient to natural stream gradient at exits. Streams with a steep gradient are affected most by such culverts. Streams in nearly-flat, low-lying areas are affected least (Plates 63-73).

Culverts installed in the above manner are technically inferior to those installed on the stream gradient. In addition, they often represent a physical or velocity barrier to fish.

Virtually all culvert inverts in the Yukon are located on or above the stream bed, rather than below it. This increases the likelihood that stream cross-sections inside culverts will be noticeably smaller than natural stream cross-sections. It also increases the likelihood that culverts will have smooth rather than natural gravel bottoms - stream-bottom materials are much less likely to remain inside culverts when inverts are located on or above the stream bottom (Plates 61 and 63-73). In addition to these environment-related drawbacks, there are good technical reasons (which will not be discussed here) for preferring culverts with inverts located below the stream bed. Reasons for the environmental preference are clear enough: a semi-natural stream of water moving through a culvert with a rough bottom, and natural velocity checks to facilitate fish passage, is certain to be preferred over a highly modified stream of water moving through a culvert with no natural bottom.

Old and improperly installed culverts are sometimes not replaced on reconstructed sections of the Alaska Highway (Plate 74).

Culverts on abandoned sections of Yukon highways are not removed and are not maintained even though they may not be properly installed and may be important in

PLATE 56 Minor stream crossing, stream flows into river, soils are high in silt. Robert Campbell Highway, km 335.

PLATE 57 Minor stream crossing, note extensive destruction of shorelands. Alaska Highway, km 1501. Section being reconstructed.

PLATE 58 Location as for Plate 57.

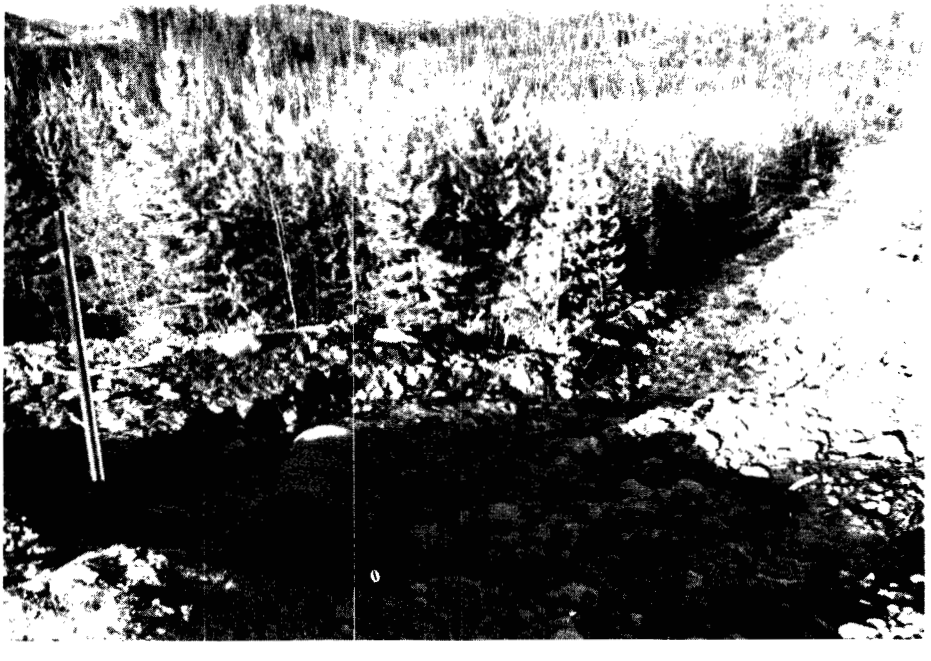


PLATE 59 Minor stream crossing, stream leads to Rancheria River located nearby. Alaska Highway, km 1110-1111. Section to be relocated.

PLATE 60

Minor stream crossing, raised outfall with no chute, sandy soil. Alaska Highway, km 1409. Reconstructed section.

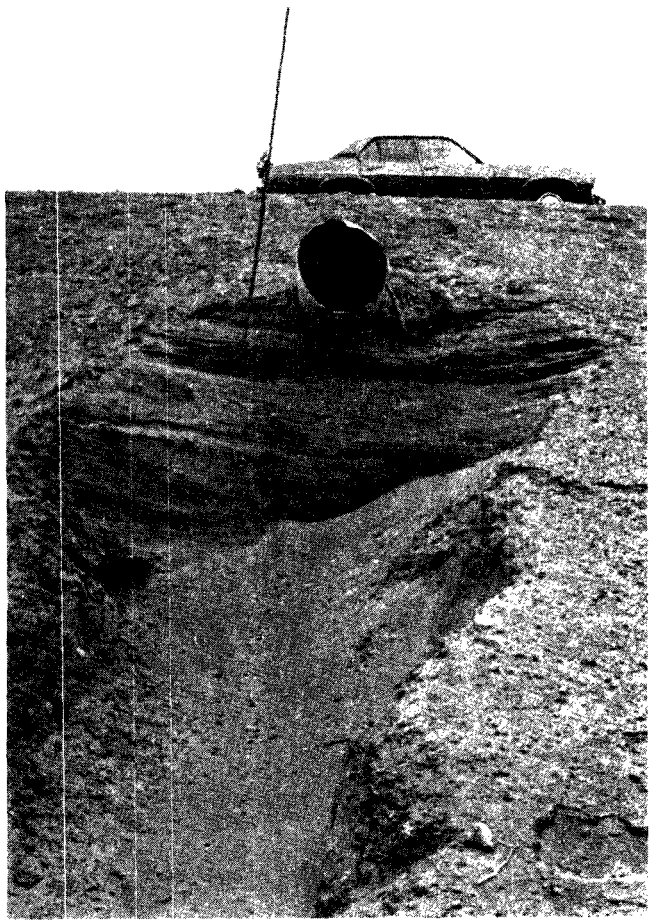


PLATE 61 Stream profile in culvert much smaller than natural stream profile. Klondike Highway, km 32.

PLATE 62

Description as for Plate 61. Carcross Highway.

PLATE 63 Culvert installed in a nearly horizontal position. Stream drops steeply as it leaves the culvert. Haines Road, km 81.

PLATE 64 Description as for Plate 63. Alaska Highway, reconstructed section near Tok, Alaska.

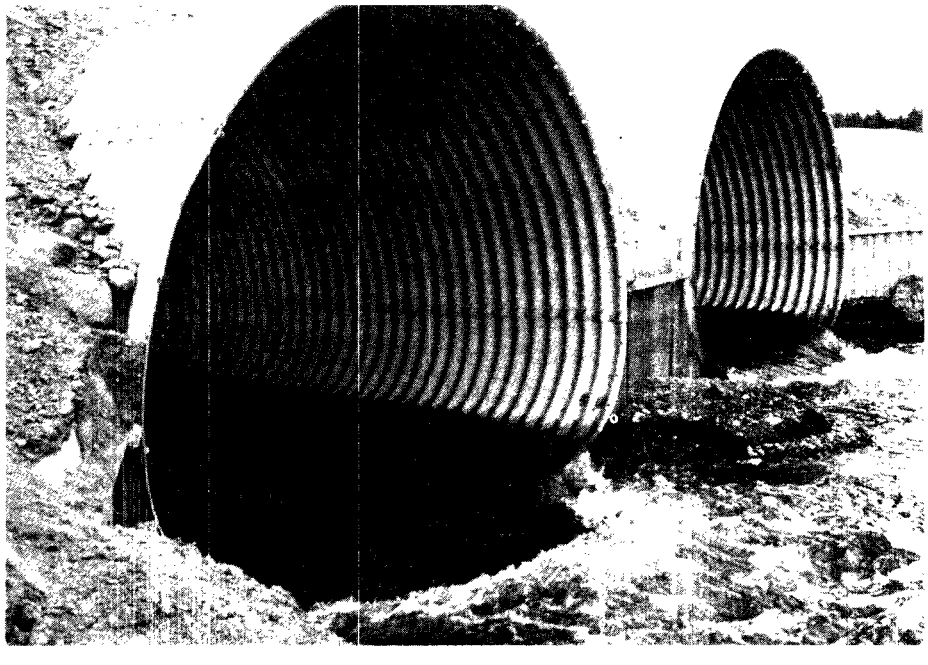
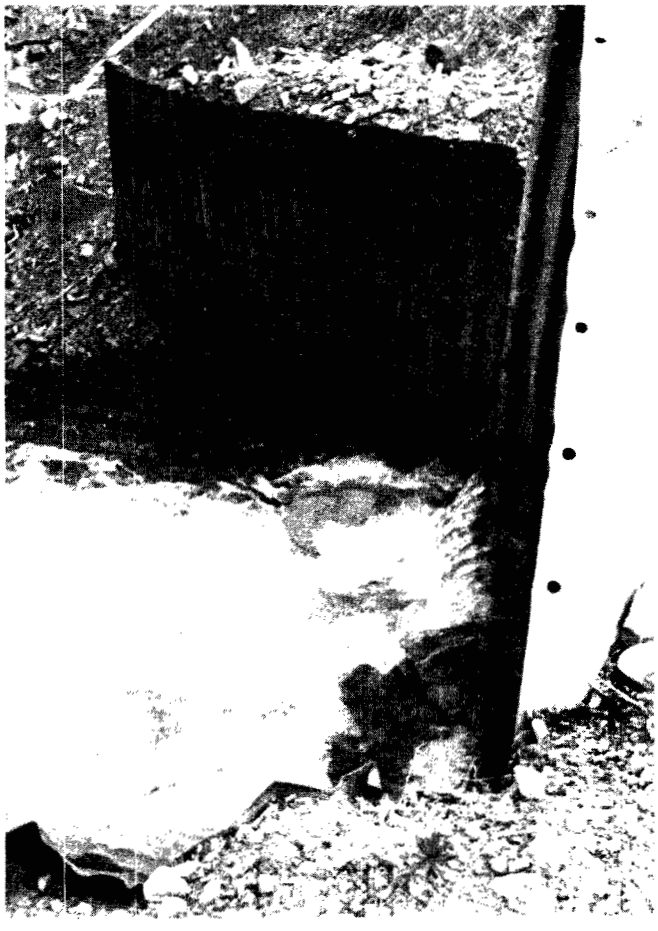


PLATE 65 Description as for Plate 63. Judas Creek, Alaska Highway, km 1402.5. Reconstructed section.

PLATE 66

Description as for Plate 63. Haines Road, mile post 120.



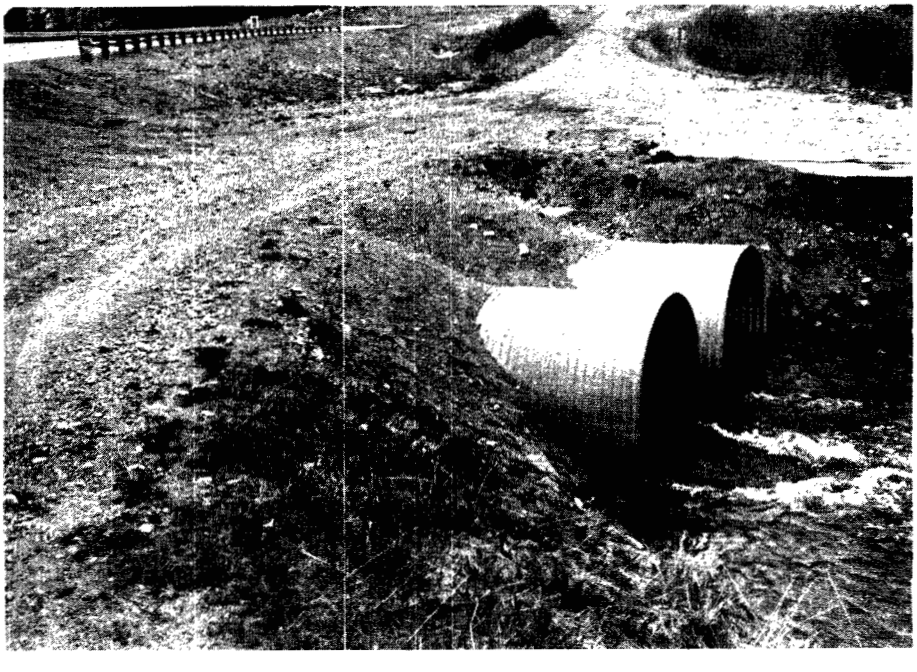


PLATE 67 Description as for Plate 63. McIntyre Creek, Alaska Highway, km 1479. Reconstructed section.

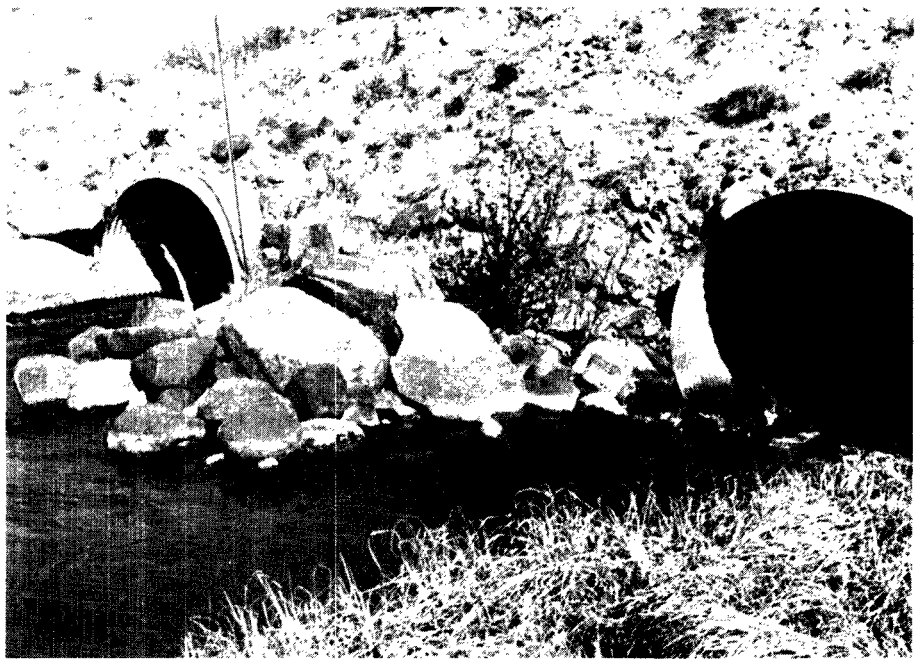


PLATE 68 Culvert installed in a nearly horizontal position, view of culvert entrance. Cowley Creek, Alaska Highway, km 1457. Reconstructed section.

PLATE 69 Stream must drop down sharply as it leaves culvert. Cowley Creek, Alaska Highway, km 1457. Reconstructed section.

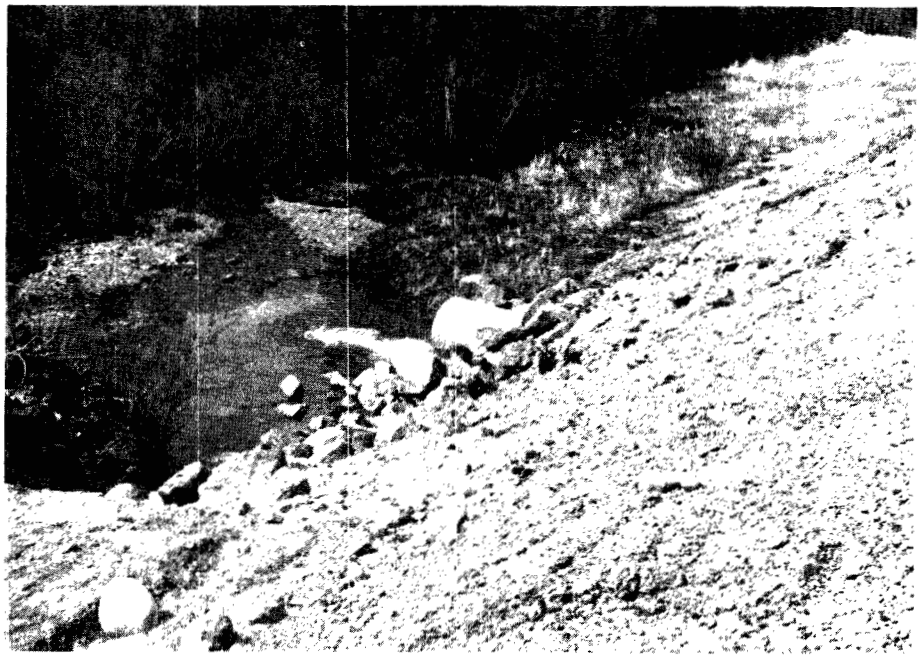


PLATE 70 Grayling stream, water must drop down sharply as it leaves culvert. Alaska Highway, km 1421.5. Reconstructed section.

PLATE 71 Culvert installed in a nearly horizontal position, stream flow affected at culvert entrance. Alaska Highway, km 1185. Highway to be reconstructed.

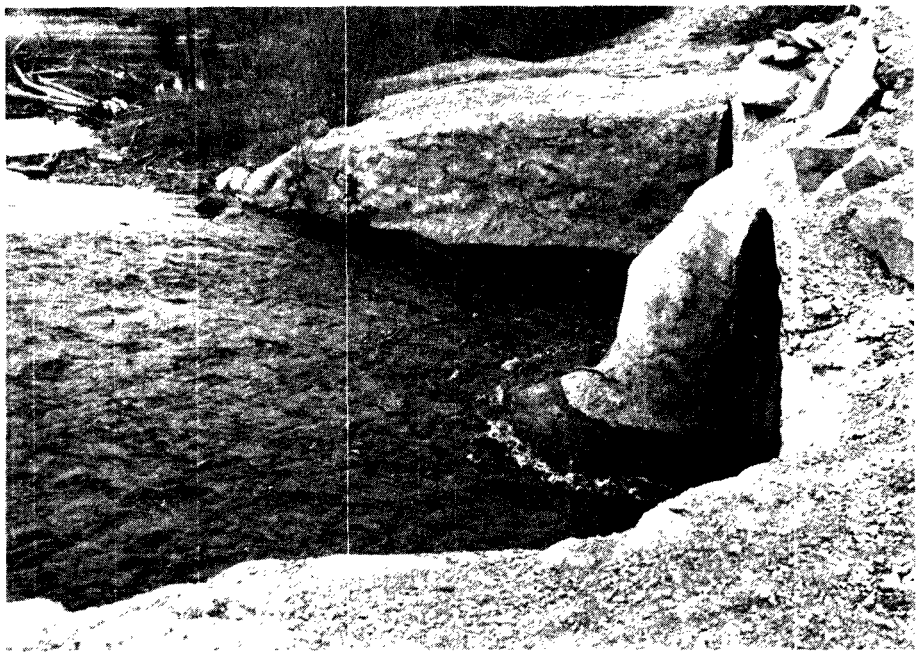


PLATE 72 Culverts installed in a nearly horizontal position, stream flow affected at culvert entrances. Marshall Creek, Alaska Highway, km 1619. Highway to be reconstructed.

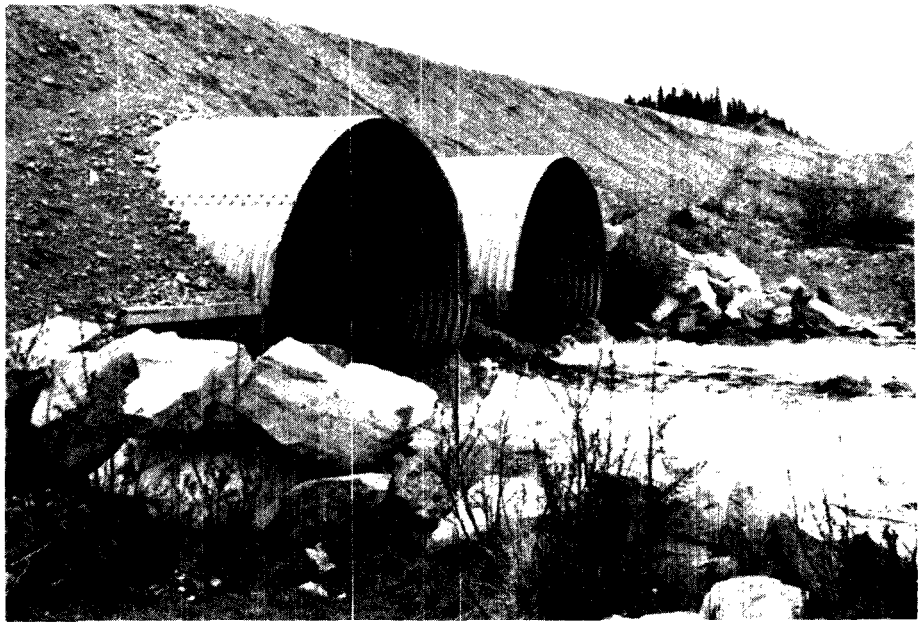
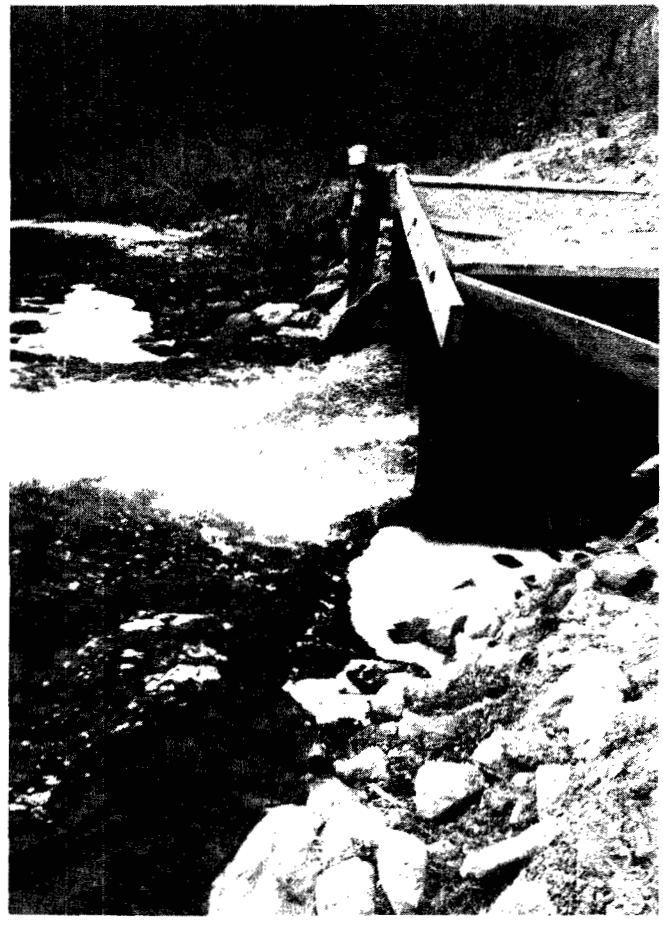


PLATE 73 Streams must drop down sharply as they leave culverts at Marshall Creek, Alaska Highway.

PLATE 74

Wooden box culvert installed in early 1940s. Culverts should have been replaced when this section of highway was reconstructed. In some instances old and poorly installed culverts may not be removed in abandoned sections of highway. Hays Creek, Alaska Highway, km 1274. Reconstructed section.



maintaining good local drainage, especially when wetlands, lakes and rivers are nearby (Plate 75).

Permanent weirs are often built by highway maintenance crews near culvert exits. Water is pumped from the backwaters which have been created and used for highway dust control purposes (Plate 76). Unfortunately, fish can be attracted to these backwaters. In one instance at least, a large number of juvenile fish were removed by a water truck operator.

Water trucks, tourist vehicles and boat launching operations are not restricted in any way at most stream and river crossings. Extensive shoreline vegetation destruction has resulted (Plates 77-78).

4.3 Recommendations

The recommendations listed below have been developed to resolve one or more of the problems outlined in the previous section. The focus is on all river and stream crossings which are likely to be affected by highway reconstruction and maintenance activities on the Alaska Highway between Watson Lake and Haines Junction.

PLATE 75

Deteriorating wooden culvert installed in early 1940s. Alaska Highway, km 1387. Section to be reconstructed.

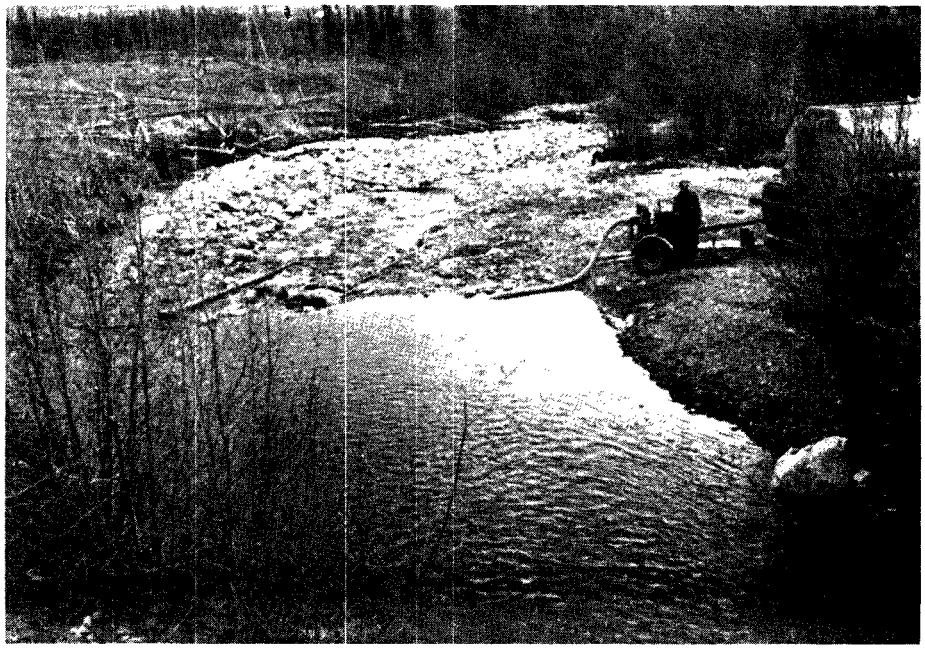


PLATE 76 Large permanent weir created by highway maintenance staff, water is being pumped from backwater into truck, fish attracted to the backwater. Stoney Creek, Alaska Highway, km 1538. Reconstructed section.

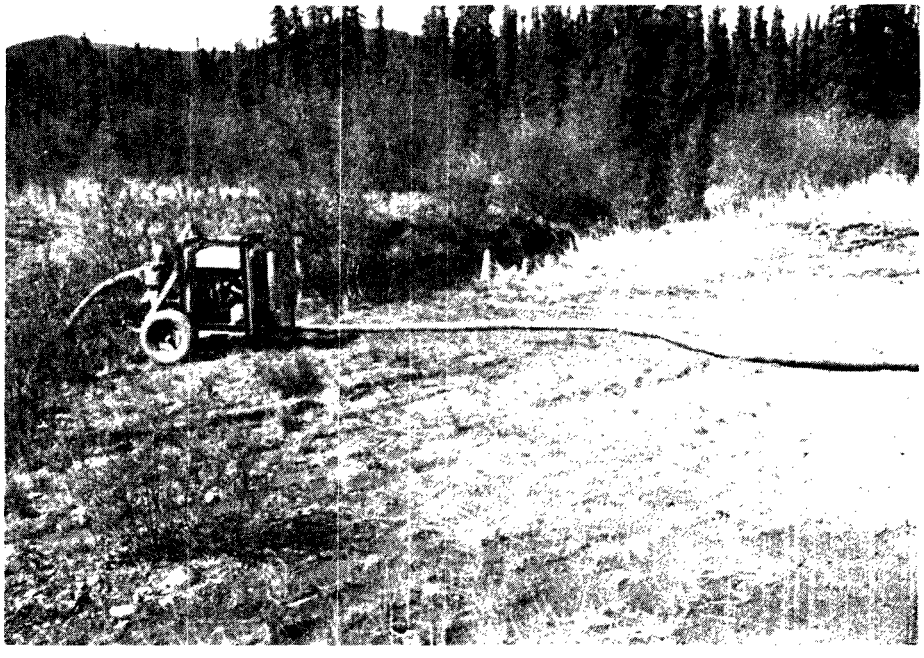


PLATE 77 No access restriction to the banks of this creek. Alaska Highway, north of Haines Junction.

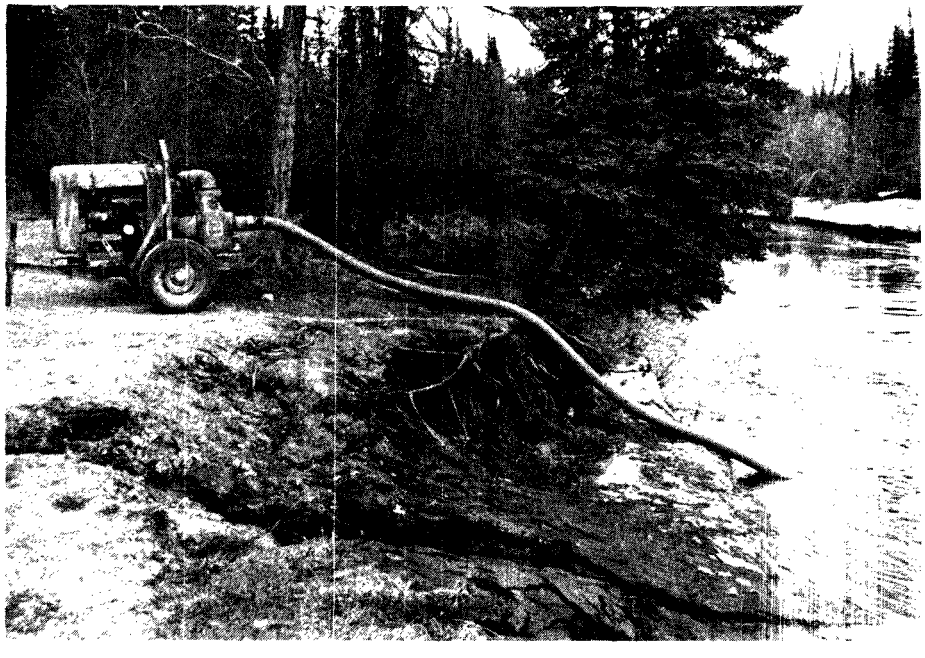


PLATE 78 Description as for Plate 77, Judas Creek. Alaska Highway, km 1402.5. Reconstructed section.

Requirements additional to the ones proposed here are likely to be provided by the Fisheries and Marine Service, Department of Fisheries and Oceans, and the Water Resources Branch, Department of Indian and Northern Affairs, Whitehorse.

i) Topsoil and vegetation should not be removed to obtain fill within 30 m of any major stream or river or within 8 m of any minor stream crossing (Plates 79-82).

ii) Highway maintenance staff should not use road graders to remove vegetation in the areas defined above in i) (Plates 79-82).

iii) Highway maintenance staff should not use vegetation mowers or cutters within 16 m of any major stream or river crossing or within 3 m of any minor stream crossing (Plates 81 and 82).

iv) The areas defined above in i and ii should be clearly marked to assist reconstruction and maintenance equipment operators.

v) If vegetation must be cleared within the boundaries defined in recommendation iii then the clearing should be done by hand and only when and where necessary (e.g. to maintain sighting distance on curves).

vi) Foreslopes should not exceed 30 degrees and whenever fills having a high silt or sand content are used at stream crossings, then the entire foreslope at culvert entrances and exits should be covered with 0.3 m thick layer of rip-rap (Plates 83-86).

vii) Backslopes should not exceed 30 degrees. When large cuts (in excess of 8 m) and soils high in silt or sand are involved, then additional steps should be taken to be absolutely sure that the slopes will stablilize and vegetate (see Chapter 3 for further detail).

viii) Heavy equipment should be kept clear of shoreland areas on either side of crossing structures except when and where absolutely required. Sections of shoreline which are not to be disturbed should be clearly marked to assist heavy equipment operators. Since a bulldozer can completely destroy such areas within minutes, it is recommended that an environmental briefing program be developed for equipment operators.

ix) Ditches should be provided to control drainage in the approaches to river and stream crossings. Rip-rap should be used and the ditches should be allowed to revegetate. The revegetation process could be accelerated if a hydro-seeder were used. Small settling basins should be provided when extensive slopes and silty or sandy soils are involved. The ditches should be monitored to see that they are functioning properly. If not, then additional steps (e.g. settling basins, rip-rap, etc.) would have to be taken.

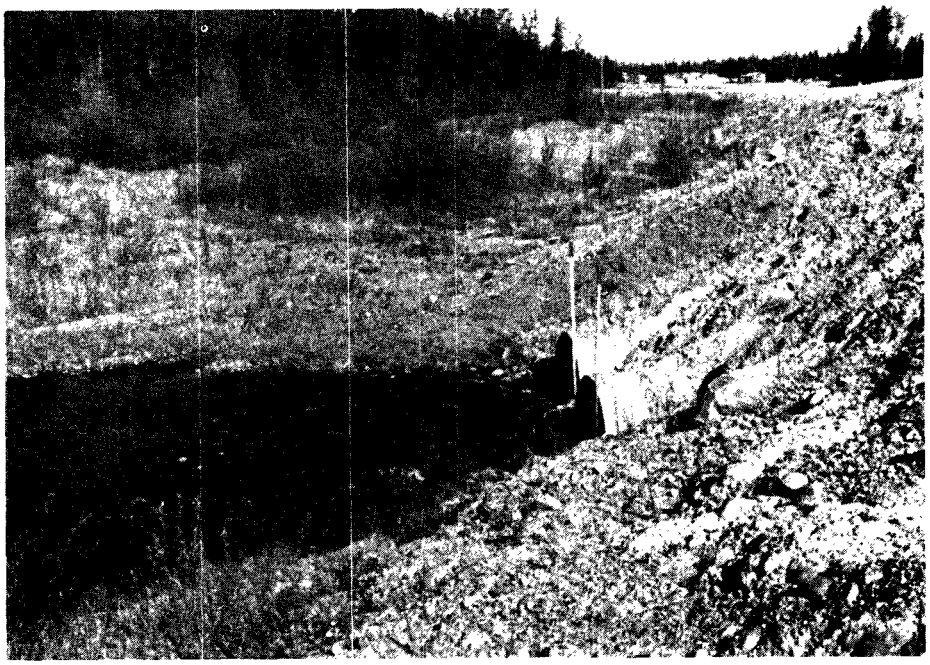


PLATE 79 Stream crossing, well vegetated shorelands. Alaska Highway, km 1014. Reconstructed section.

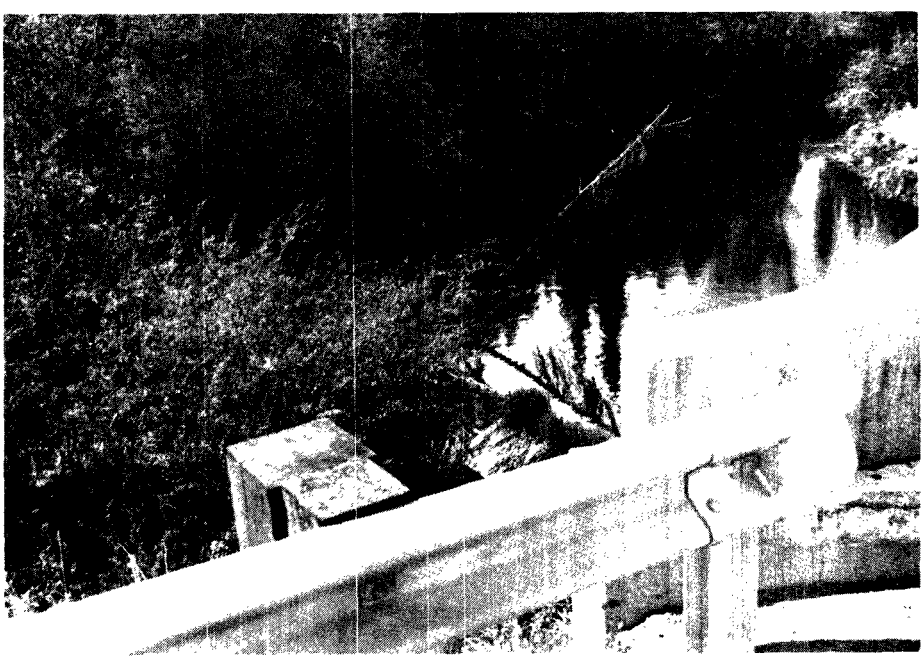


PLATE 80 River crossing, well vegetated shorelands. Alaska Highway, Alaska. Reconstructed section.

PLATE 81

Minor stream crossing. Banks well vegetated at culvert entrance, culvert exit described in Plate 82. Alaska Highway, km 1379. Section to be reconstructed.

PLATE 82 Minor stream crossing, vegetation cleared at culvert exit. Location as for Plate 81.

PLATE 83 Stable, well-vegetated foreslope. Alaska Highway, north of Haines Junction.

PLATE 84 Foreslope at low angle. Location as for Plate 83.

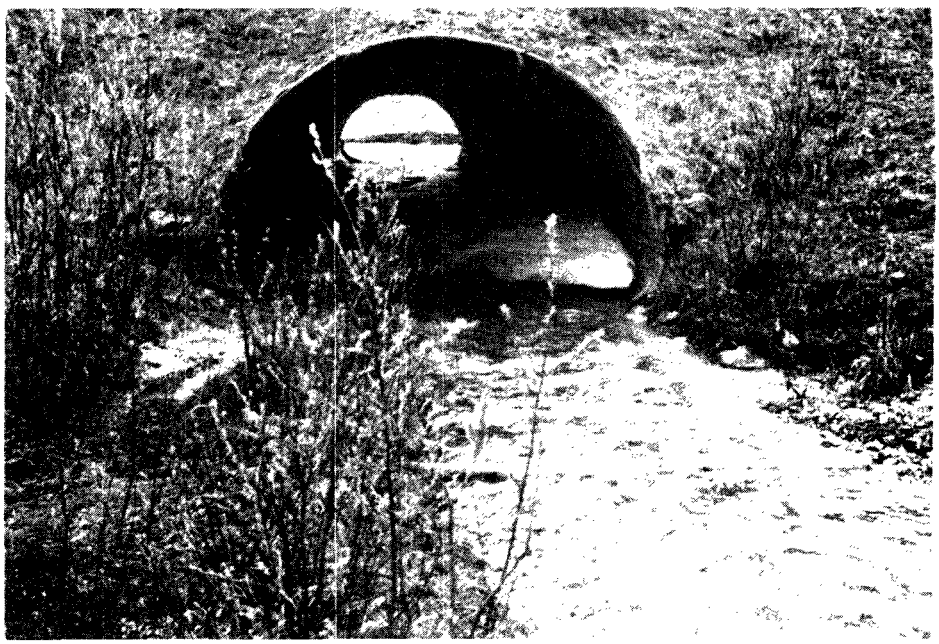


PLATE 85 Stable, well-vegetated foreslope, culvert inverts below natural bottom, stream width in culvert approximately equal to natural stream width. Alaska Highway, north of Haines Junction.

PLATE 86

Rip-rap at culvert exit acts to keep foreslope material out of grayling stream. Alaska Highway, km 1421.5. Reconstructed section.

x) If culvert exits are raised at minor stream crossings, then chutes and rip-rap should be provided. Particular care should be taken to ensure that heavy equipment operators do not disturb shoreland soils and vegetation.

xi) Culverts should be sized and installed so that the stream is constricted as little as possible (Plates 85, 87 and 88).

xii) Since a culvert arch is much better at reproducing a natural stream cross-section than a circular culvert, particularly when large streams are involved, it is recommended that culvert arches be used on all large streams (3 m or more in width in early June when water levels are high) (Plates 85, 87 and 88).

xiii) All culverts should be installed on the stream gradient.

xiv) Culvert inverts should be installed below the natural stream bottom. More sophisticated criteria are clearly required here; ones which relate culvert diameter to the optimum depth for installation of inverts (Plates 85, 87 and 89).

xv) Highway maintenance staff periodically install culverts. The recommendations listed above should also apply to such installations.

xvi) Certain sections of highway are to be widened. Existing culverts on these sections should be replaced, particularly when they are old and/or not installed according to the above recommendations x to xiv. New culverts should be installed immediately after the old culverts have been removed.

xvii) Certain sections of the Alaska Highway are to be abandoned during reconstruction operations. Culverts on these sections should be removed, particularly when the culverts are old and/or improperly installed. Stream channels should be restored to near-natural conditions immediately after culverts are removed.

xviii) Excessively large weirs should not be permitted in Yukon streams. No more than one third of any stream channel should be obstructed. Greater emphasis should be given to excavating small holes on stream bottoms in order to obtain the water depth needed for efficient water removal.

xix) Vehicular access to shorelands at stream and river crossings should be controlled. This recommendation can be met if reconstruction and maintenance practices are chosen which allow large amounts of vegetation to remain on either side of crossing structures (Plates 90-92).

xx) Bare areas should be scarified, hydro-seeded and protected with berms. Particular attention should be given to bare shorelines.

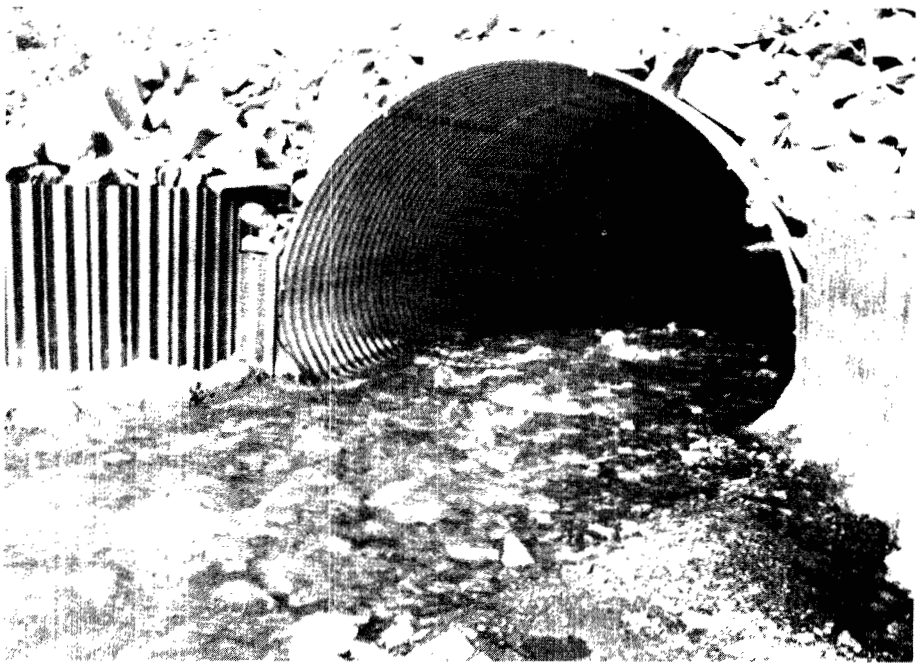


PLATE 87 Stream width inside culvert approximately equal to stream width outside culvert, invert below natural stream bottom. Haines Road, mile post 120.

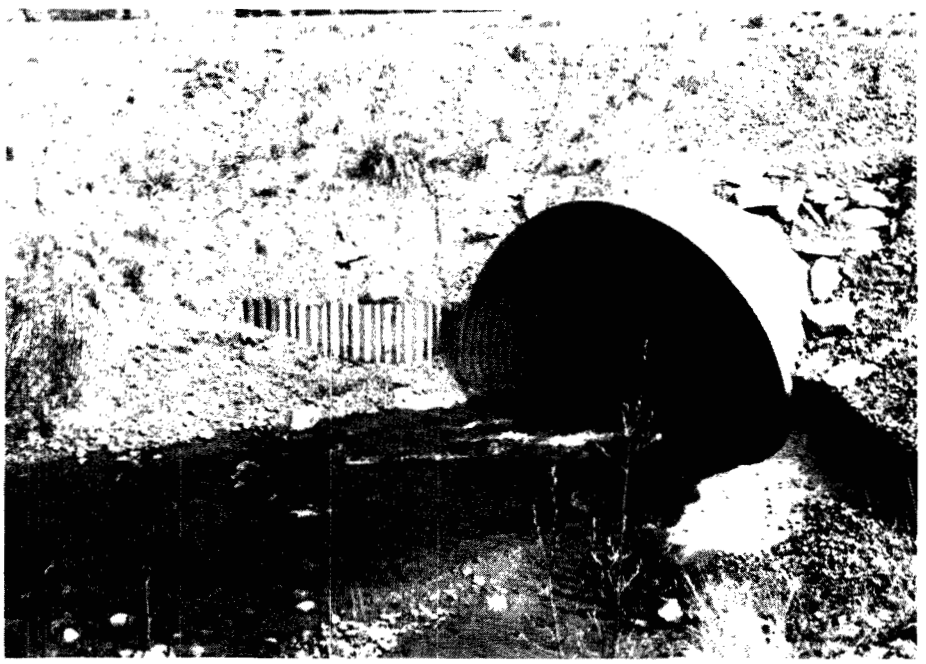


PLATE 88 Description as for Plate 87. Wolf Creek, Alaska Highway, km 1459. Reconstructed section.

PLATE 89

Invert below natural stream bottom, foreslope at low angle with some gravel to increase stability. Robert Campbell Highway.

PLATE 90 Vehicular access control at a U.S. bridge. Brush has been left between the highway foreslope and the parking area and between the parking area and the stream. The vehicles in the parking area belong to fishermen. Alaska Highway, Alaska.

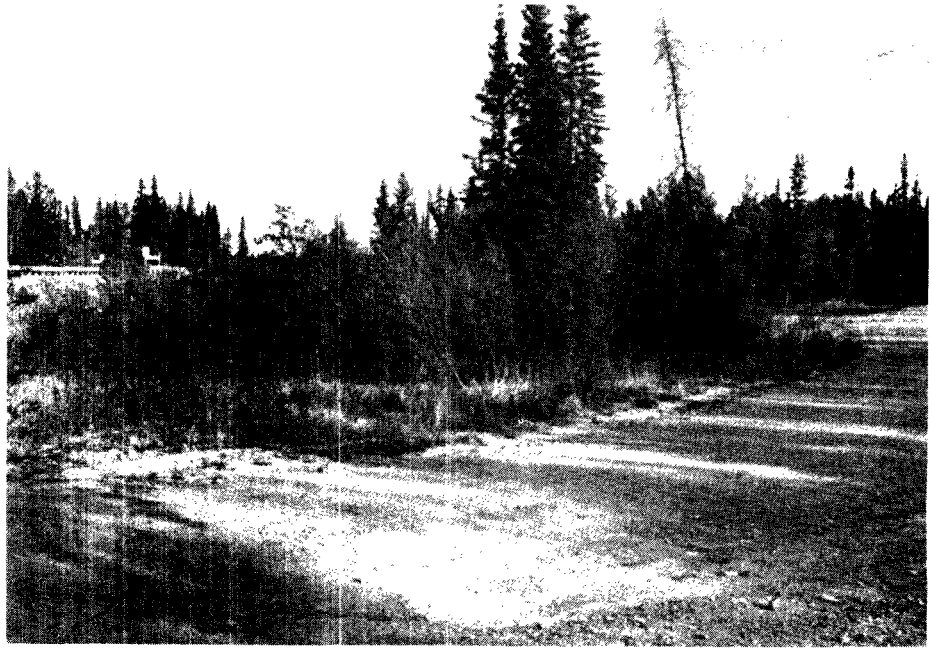
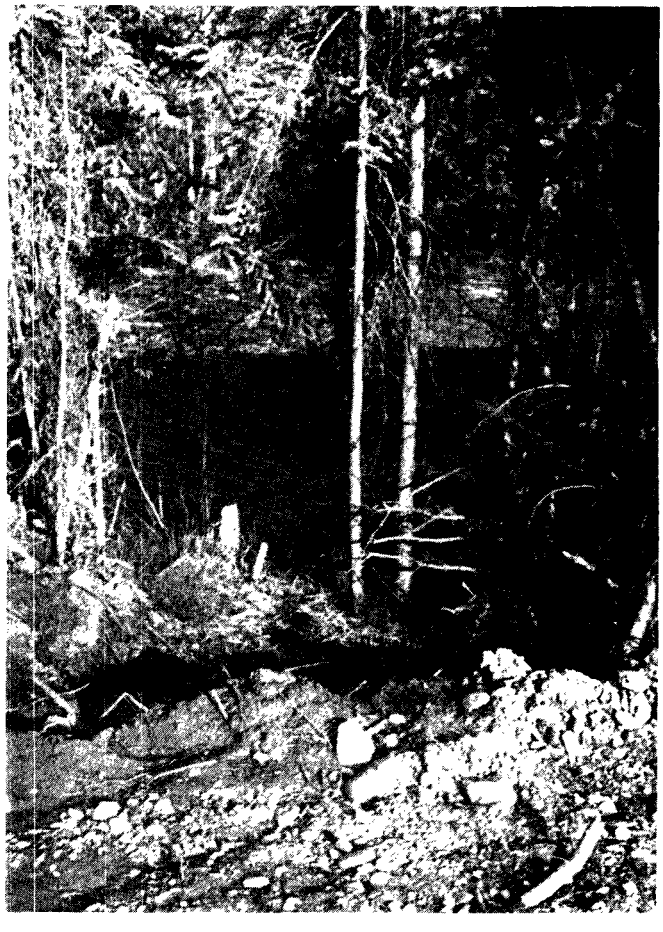


PLATE 91 Vehicular access control at Clear Creek bridge. Vegetation has been left between the highway foreslope and the parking area. The bridge is centre left and the stream runs from centre right. Vegetation has also been left between the parking area and the stream (see next plate). Klondike Highway, km 38.

PLATE 92

Vehicular access control at Clear Creek bridge. A strip of vegetation has been left between edge of the parking area and the stream bank. Klondike Highway, km 38.



xxi) Care should be taken to ensure that highway maintenance practices at stream and river crossings complement any environmental protection efforts made during reconstruction operations. The recommendations listed in this section have been devised with that purpose in mind.

5 WETLANDS, LAKES AND RIVERS ADJACENT TO THE ALASKA HIGHWAY

5.1 Environmental Concerns:

i) New alignments may be chosen which eliminate or greatly reduce the size of wetland buffer zones.

ii) New alignments may parallel the shores of rivers and lakes such that existing naturally vegetated buffer zones are either eliminated or greatly reduced in size.

iii) Sections of highway adjacent to wetlands may be widened such that wetland buffer zones are either eliminated or greatly reduced in size and such that existing buffer zone vegetation is destroyed.

iv) Sections of highway which parallel river and lake shorelines may be widened such that buffer zones are either eliminated or greatly reduced in size and such that existing buffer zone vegetation is destroyed.

v) The realignment and widening operations described above may result in the partial filling-in of biologically vital lake and river shoreline areas. They may also result in the partial or complete filling-in of wetlands.

vi) Culverts may interfere with the natural drainage systems associated with adjacent wetlands, lakes and rivers.

vii) Ditches and ditch checks may not be provided to control run-off in the vicinity of wetlands, lakes and rivers.

viii) The vegetated banks of natural drainage systems associated with nearby wetlands, lakes and rivers may be destroyed.

ix) Highway maintenance staff may use road graders near wetlands, lakes and rivers.

x) Vegetation and topsoil may be removed near wetlands, lakes and rivers to obtain fill for highway reconstruction purposes.

xi) When fills are required near wetlands, lakes and rivers, some of the fill may end up in these water bodies or in the protective buffers of vegetation which surround them.

xii) Highway maintenance staff may not be especially careful in the handling of spoil obtained at the base of steep, unstable backslopes. The spoil may be dumped into wetlands, lakes or rivers.

xiii) Highway maintenance staff may use road graders to clear old slash in the vicinity of wetlands, lakes and rivers.

5.2 Discussion

5.2.1 Wetlands. Wetlands and the protective vegetation which surrounds them should be maintained for a number of reasons. They help to ensure good natural drainage and flood control in low-lying areas. The rim of protective vegetation which surrounds them filters out the sediment in run-off from highway shoulders, ditches and rights-of-way. This allows the natural wetland drainage system to function properly, helps to maintain water quality and reduces the need for highway drainage maintenance operations. Wetlands also represent an important aesthetic resource for tourists and residents travelling the Alaska Highway and they provide wildlife viewing and hunting opportunities (during this survey, waterfowl were seen or heard at virtually all wetlands having at least some water). Finally, wetlands on the Alaska Highway are important simply because there are so few of them and because most of them are very small.

Although roadside wetlands should be protected wherever they occur in the Yukon, some of them are being destroyed or degraded. They have been partially filled-in and the protective vegetation which surrounds them has been destroyed (Plates 93-95). Wetland drainage and associated stream bank vegetation has been adversely affected (Plates 96 and 97). Occasionally, construction equipment is used in wetlands; problems with drainage and permafrost can result (Plates 96-99).

In most instances, fills have slopes well in excess of 30 degrees. They will not revegetate and when wetlands are located nearby they become the receiving body for sediment and calcium chloride in highway run-off (Plate 100).

When fills are required near wetlands or streams, some of the fill inevitably ends up on those areas (Plates 101-103). The wetlands along the Rancheria River are in an area of particular concern (Plates 104 and 105); some backslopes are unstable and the spoil accumulating at their bases could be dumped into the Rancheria River or into wetlands (Plates 106 and 107).

In certain instances, as along the Rancheria River, it is possible that present plans for highway straightening and widening will result in the destruction of a number of wetlands (Plates 104 and 105).

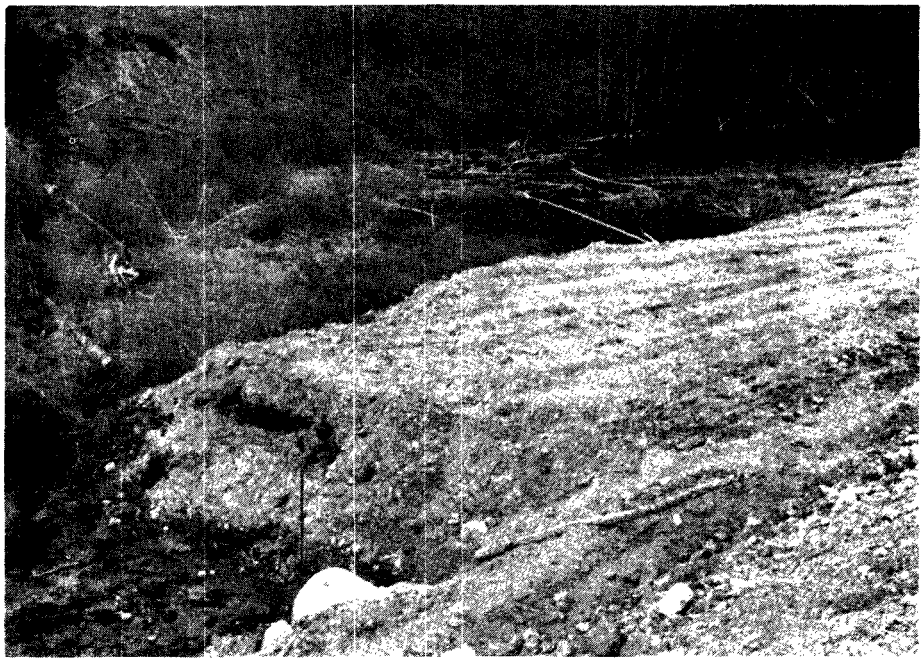


PLATE 93 Excessive use of fill adjacent to wetland, poor drainage control, Alaska Highway, km 1393.

PLATE 94 Excessive use of fill, right-of-way vegetation cleared with road grader adjacent to wetland. In 1976, a 5 - 7 m aspen buffer zone separated this wetland from the highway. The wetland supports buffle heads in the spring. Alaska Highway, km 1393. Reconstructed section.

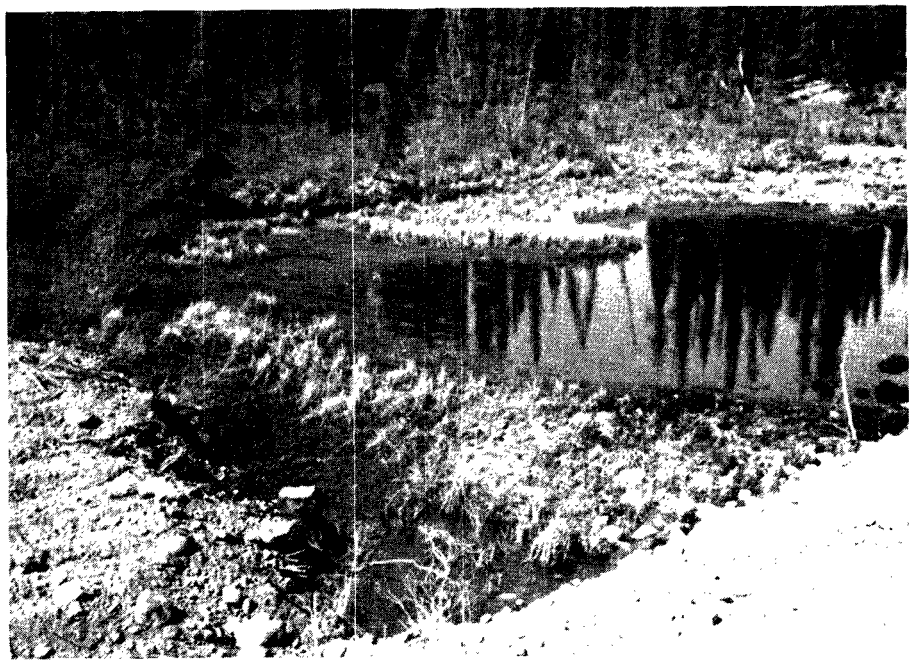


PLATE 95 Wetland partially filled in. Klondike Highway, km 74.

PLATE 96

Wetland drainage and associated stream bank vegetation adversely affected by highway reconstruction practices. Alaska Highway, km 1393. Reconstructed section.

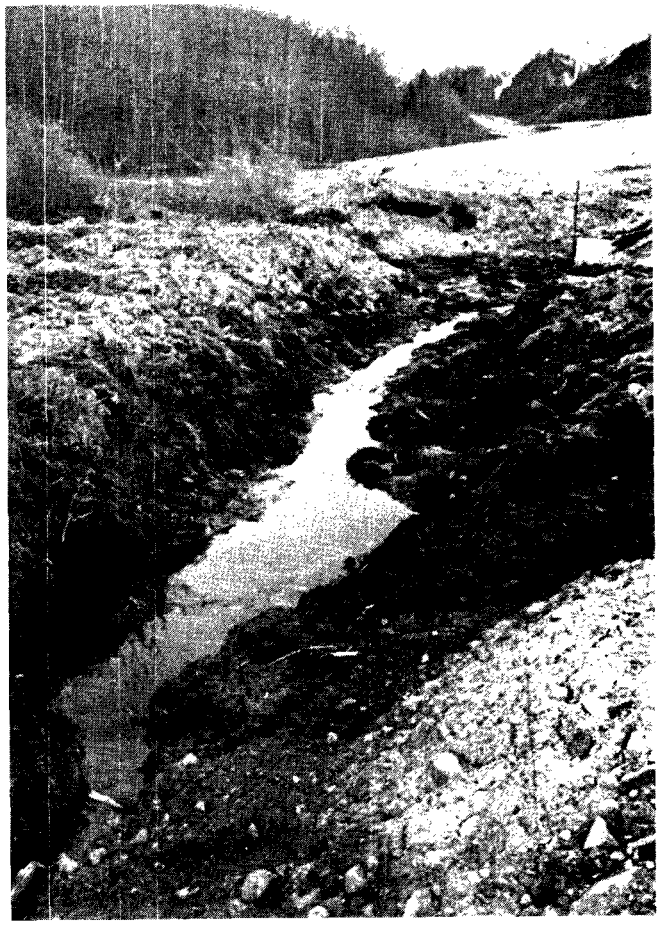


PLATE 97

Stream bank vegetation associated with wetland drainage destroyed during highway recent reconstruction operations. There are also ditch drainage problems. Alaska Highway, km 1397. Reconstructed section.

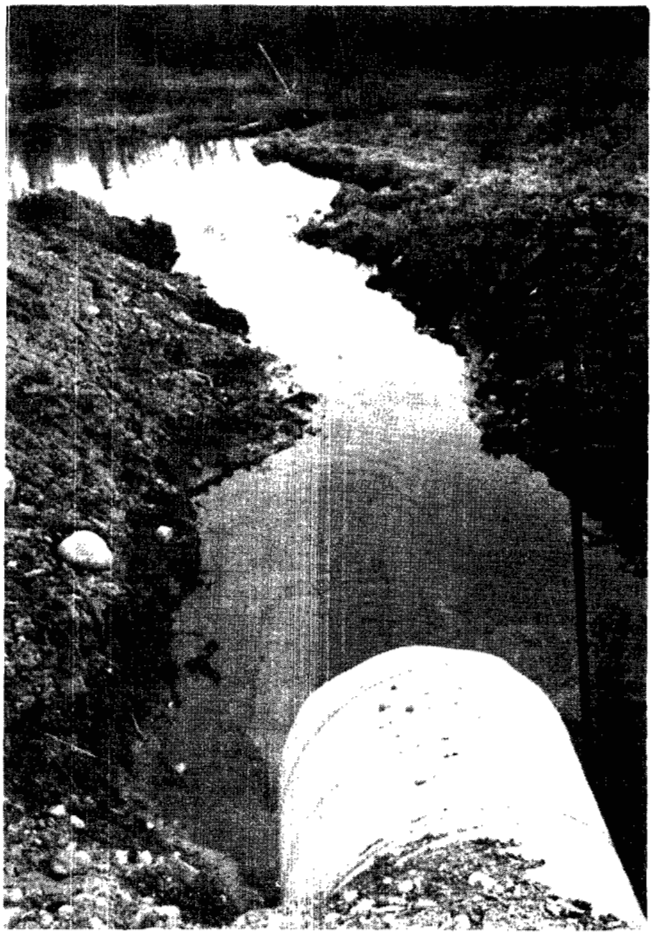


PLATE 98 Disturbed organic material and a drainage problem caused by construction equipment. Robert Campbell Highway, km 333.5.

PLATE 99 Drainage problem caused by construction equipment. The problem continues although the disturbed organic material (ridge on right hand side of picture) has since revegetated. Alaska Highway, km 1097.5.

PLATE 100 Foreslope at 45°, bench not provided at top of slope. No rip-rap at base, silt from highway run-off spreads out from base of slope. Robert Campbell Highway.

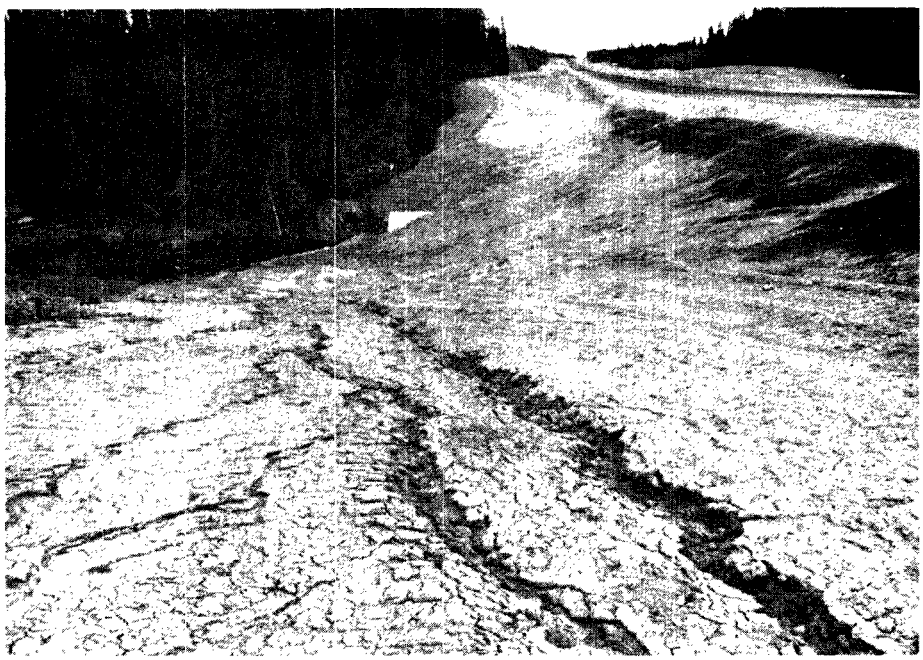


PLATE 101 When fills are required near wetlands and streams, some inevitably ends up in these areas rather than on the highway. Alaska Highway, km 1411. Reconstructed section.

PLATE 102 Description as for Plate 101. Highway maintenance staff use road graders in shoreland areas to clear vegetation.

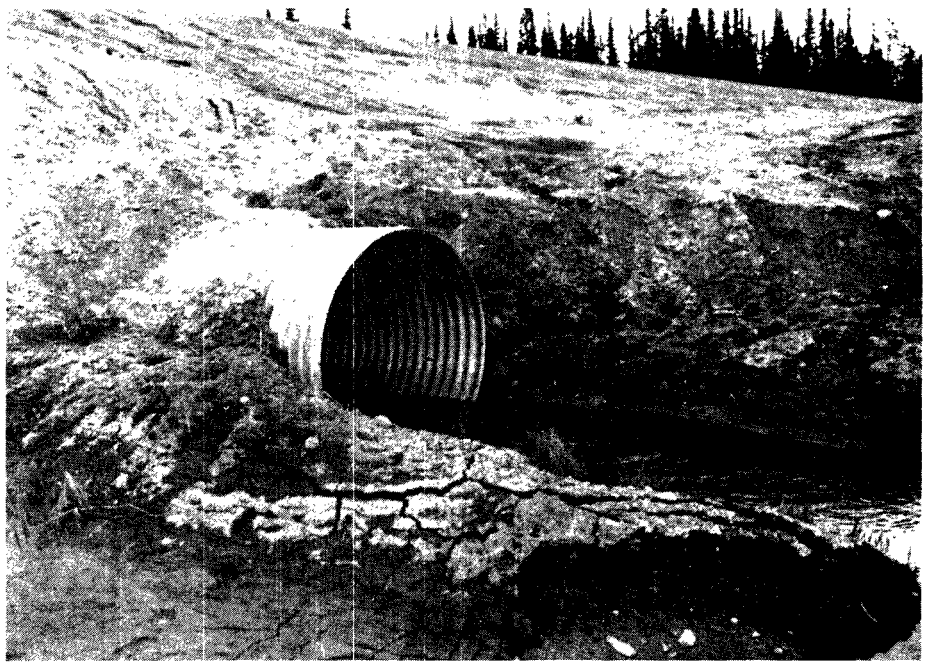


PLATE 103 Description as for Plates 101, 102.

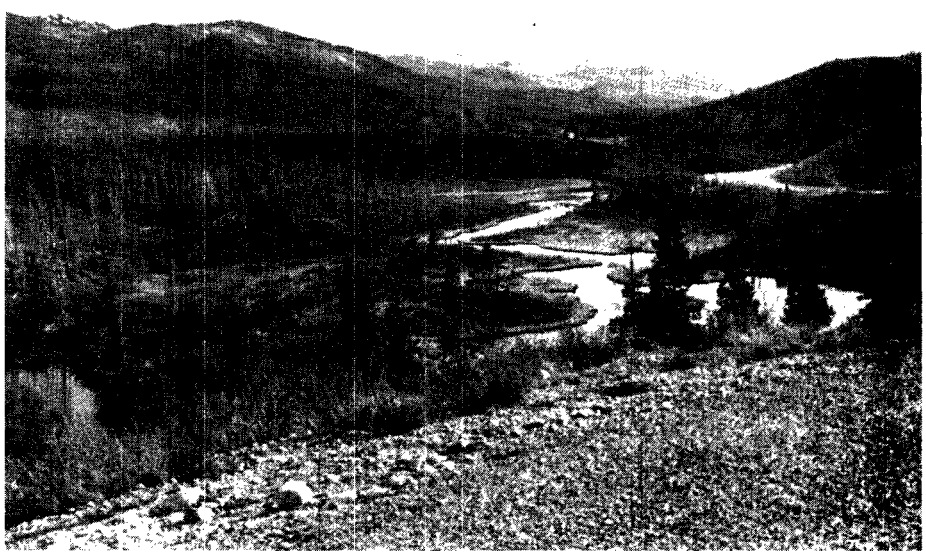


PLATE 104 When extensive cuts are needed for highway widening and straightening adjacent to wetlands some of the cut material may end up in the wetland instead of on the highway (ordinarily cut material is used as fill on other sections of highway). Alaska Highway, km 1128.

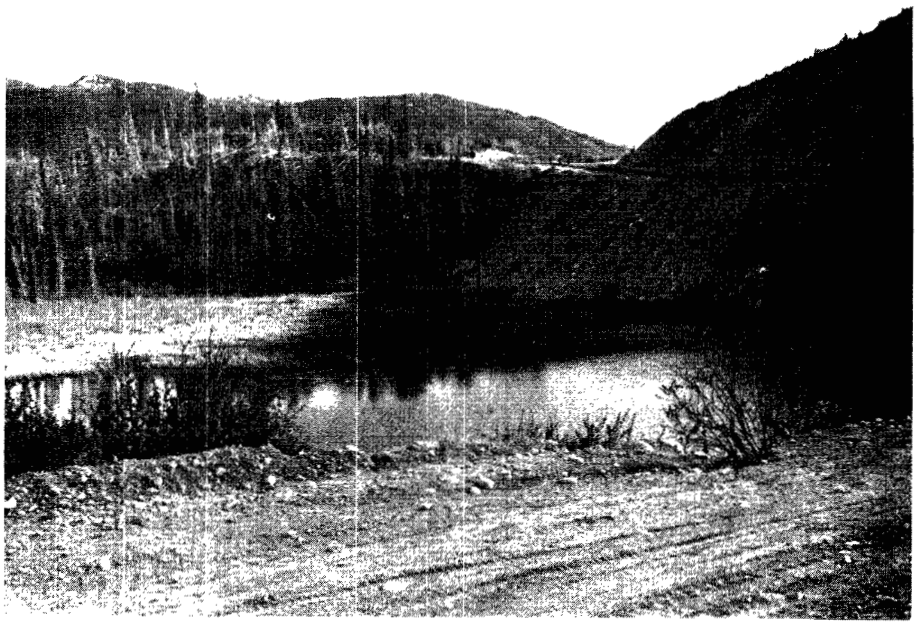


PLATE 105 Description as for Plate 104.

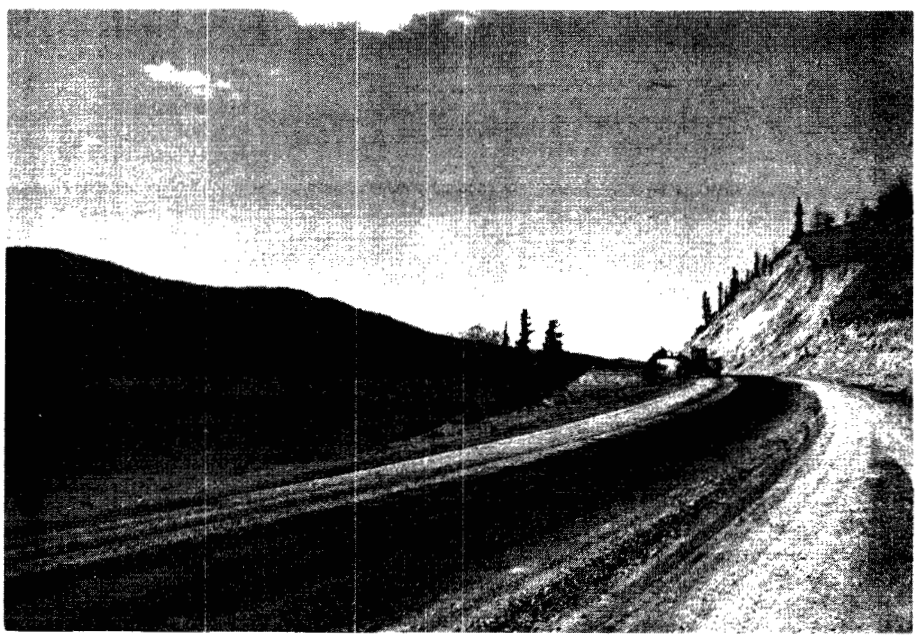


PLATE 106 Front-end loader dumping spoil from base of steep, unstable backslope into Fox Lake. Klondike Highway, km 70.

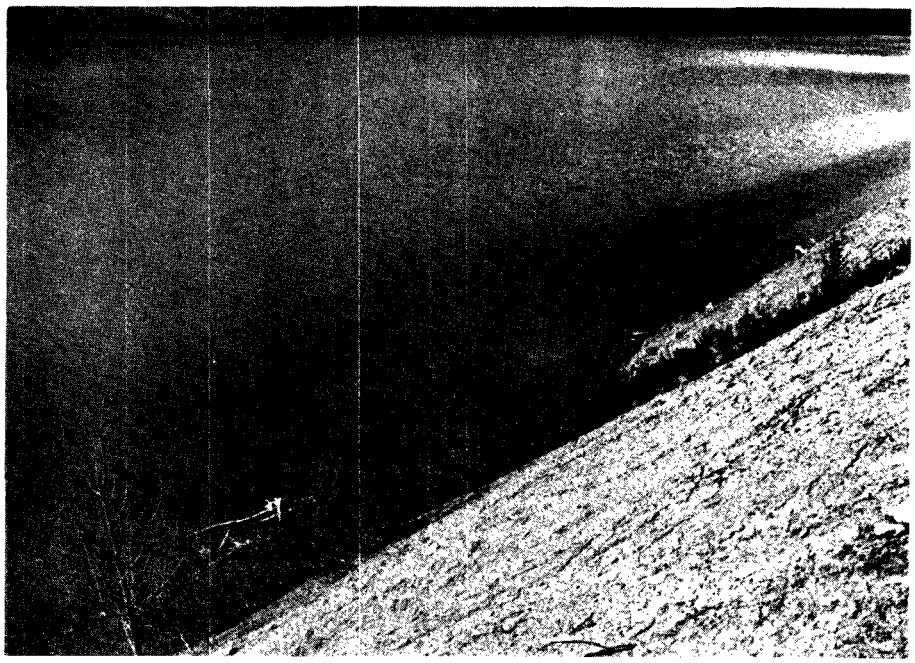


PLATE 107 Slope to Fox Lake showing effects of spoil disposal practice.

5.2.2 Small Lakes and Ponds. Waterfowl were seen or heard at virtually all small lakes and ponds on the Alaska Highway between Watson Lake and Haines Junction. These water bodies should be maintained for all of the reasons given in section 5.2.1. They are relatively scarce, have enormous scenic value, provide fishing and hunting opportunities and have high potential as rest stops for vehicles.

The highway comes extremely close to many of these water bodies. If it is widened any further, the narrow buffer zones which protect biologically vital near-shore areas will be destroyed (Plates 108-110).

Certain sections of the highway are to be relocated and some small ponds may be partially or completely filled in (Plate 111).

Vehicular access is not well controlled at many small lakes and ponds. The problem may worsen when reconstruction operations begin (Plate 112).

Road graders are used on the Alaska Highway to clear old slash. Buffer zone vegetation is removed along with the slash (Plate 113). See section 5.2.3 below for more information.

PLATE 108 Small lake showing narrow buffer zone to highway (at right) and to rest stop (foreground). Highway widening towards the lake would destroy the buffer zone. Uncontrolled movement of heavy equipment at the rest stop would destroy that buffer zone. If trees had been left standing in the buffer zone the latter problem would not likely occur. (see Plate 110). Alaska Highway, km 1155. Highway to be widened.

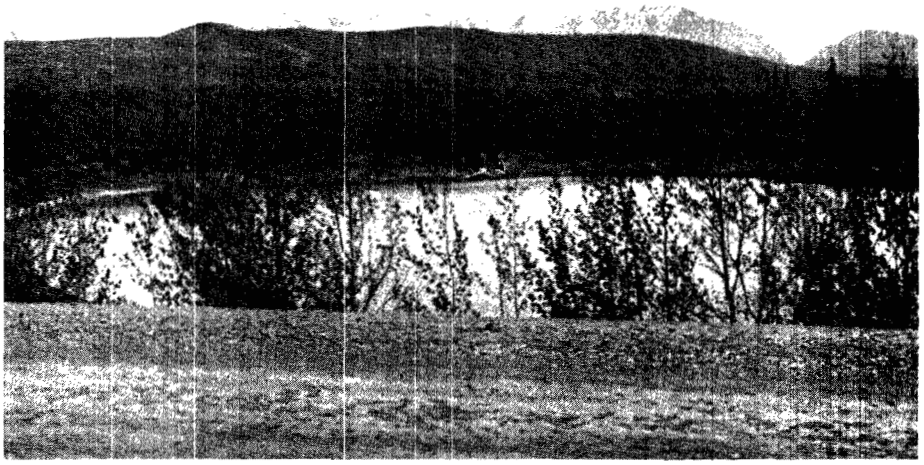


PLATE 109 Pond showing narrow buffer zone to highway. If the highway is widened toward the lake the vegetated foreslope/buffer zone will be destroyed. This is one of the few ponds between Whitehorse and Haines Junction, hence it has a high scarcity value. Alaska Highway, km 1523 - 24. Highway to be widened.

PLATE 110 Controlled vehicular access at small lake. The highway is to be widened here and heavy equipment could destroy the treed buffer zone. Alaska Highway, km 1359.

PLATE 111 One of the few ponds between Whitehorse and Haines Junction; it has a high scarcity value. The highway is to be relocated here and the new alignment may result in the partial filling in of the pond. Alaska Highway, km 1590.

PLATE 112 Uncontrolled vehicular access to small lake results in buffer zone destruction. Haines Road, km 151.

PLATE 113 Slash beside small lake. This excellent buffer zone (about 30 m wide) would be damaged if road graders were used to remove the slash or if the highway were widened toward the lake. Alaska Highway, km 1238.3. Highway to be widened.

5.2.3 Rivers and Large Lakes. The Alaska Highway is adjacent to the shores of some large lakes (Plate 114); it also parallels some rivers (Plate 115 and 116). Existing vegetated buffer zones may be damaged or destroyed when the highway is widened (Plate 117). Buffer zones of appropriate size (30 m of vegetation between highway and water body) may not be provided when sections of highway are relocated.

Service roads may be established for reconstruction purposes between the highway and lakes or rivers. Maintenance staff may later use road graders to prevent service roads from revegetating (Plates 118 and 119). Fills may be inadvertently dumped into lakes and rivers and associated buffer zones. Biologically vital nearshore areas may be affected (Plate 120). Trees may be pushed into water bodies during reconstruction operations (Plate 121).

5.3 Recommendations

i) A naturally vegetated buffer zone 30 m wide (minimum) should be left between relocated sections of highway and wetlands, lakes and rivers (Plates 122 and 123).

ii) Highway widening should not partially fill in water bodies or the protective buffers of vegetation which surround them. Widening should take place on the side of the highway opposite water bodies (Plate 124-127).

iii) Buffer zones should be clearly marked to assist equipment operators.

iv) An environmental briefing program should be developed for equipment operators to communicate the concerns and recommendations listed in this report.

v) Buffer zones which are inadvertently cleared of vegetation should be landscaped and hydro-seeded. Slopes should not exceed 1.5:1.

vi) Topsoil and vegetation should not be removed within 30 m of any lake, wetland or river to obtain fill for highway reconstruction purposes.

vii) Construction equipment should not be operated in wetlands. Wetland vegetation should be hand-cleared in winter (Plate 128).

viii) Shoreland vegetation along streams leading to nearby lakes, wetlands or rivers should be maintained during reconstruction and maintenance operations. Additional recommendations are given in Chapter 4.

ix) Foreslopes leading to water bodies should not exceed 1.5:1 (about 30 degrees). Hydro-seeded benches should be provided at the tops and bottoms of these slopes to provide a place for revegetation to start and to provide a seed source for adjacent parts

PLATE 114 Highway near shores of Teslin Lake. Foreslope at 30° is becoming well vegetated and should be maintained during reconstruction operations.

PLATE 115 Alaska Highway near banks of Swift River at Swift River Bridge.

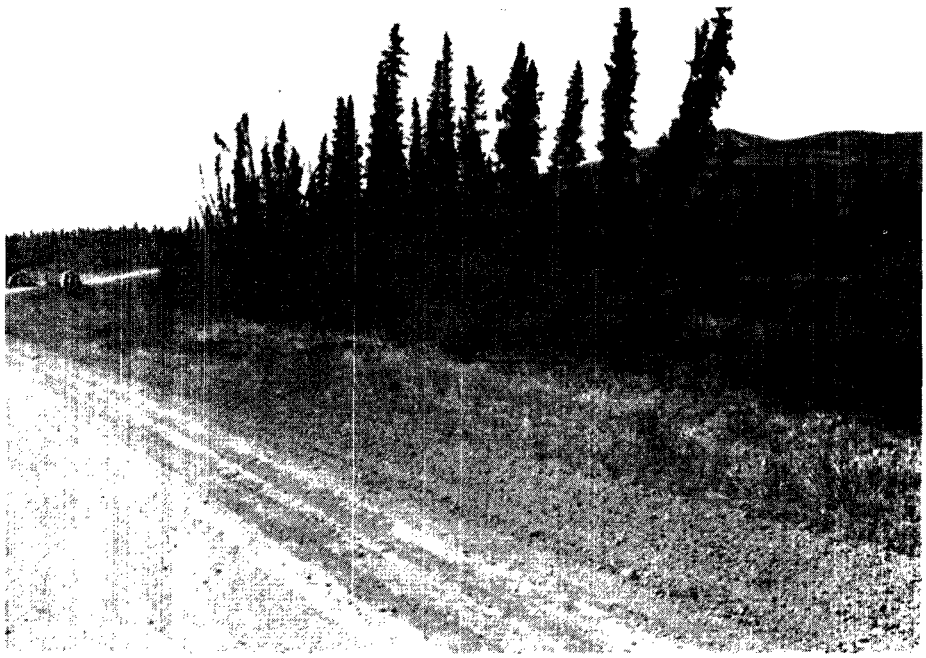


PLATE 116 Alaska Highway near banks of Smart River at Smart River Bridge.

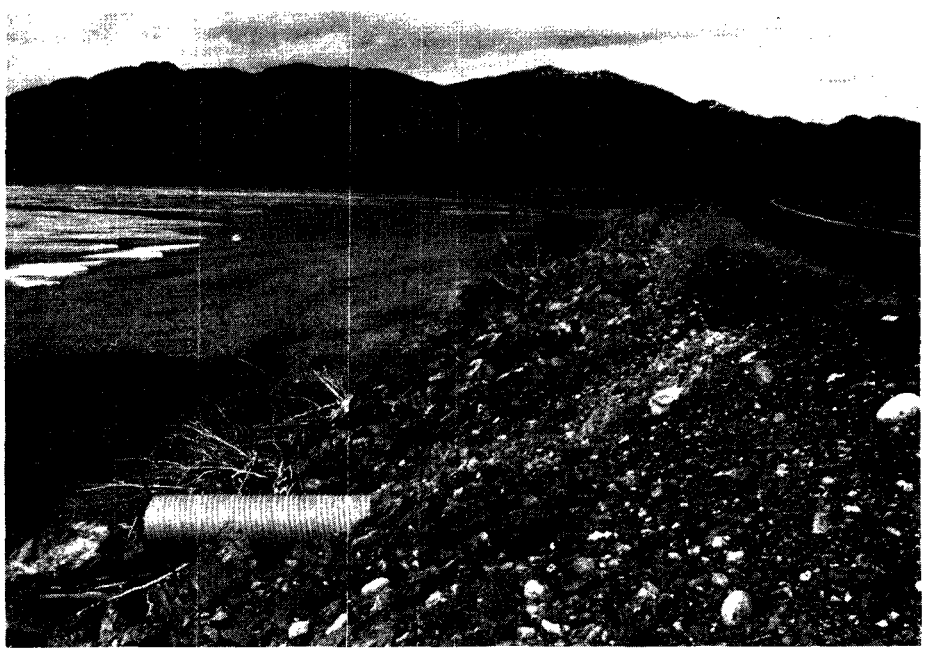


PLATE 117 Alaska Highway at Marsh Lake Shoreline. No vegetated buffer zone.

PLATE 118 Service road/right-of-way maintenance clearing between Alaska Highway and Morley River. No vegetated buffer zone.

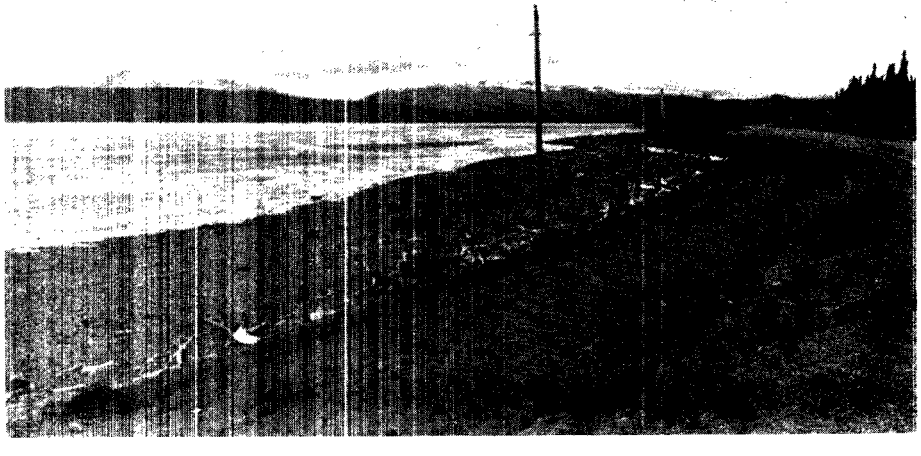
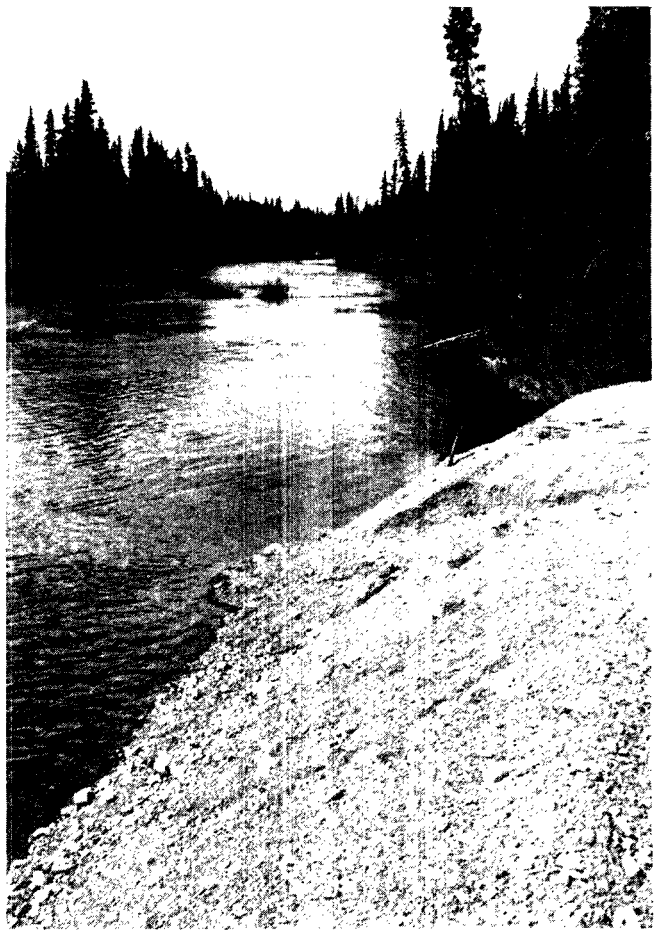


PLATE 119 Service road/right-of-way maintenance clearing between Alaska Highway and Teslin Lake.

PLATE 120

Fill inadvertently dumped into Morley River. Reconstructed section of Alaska Highway.



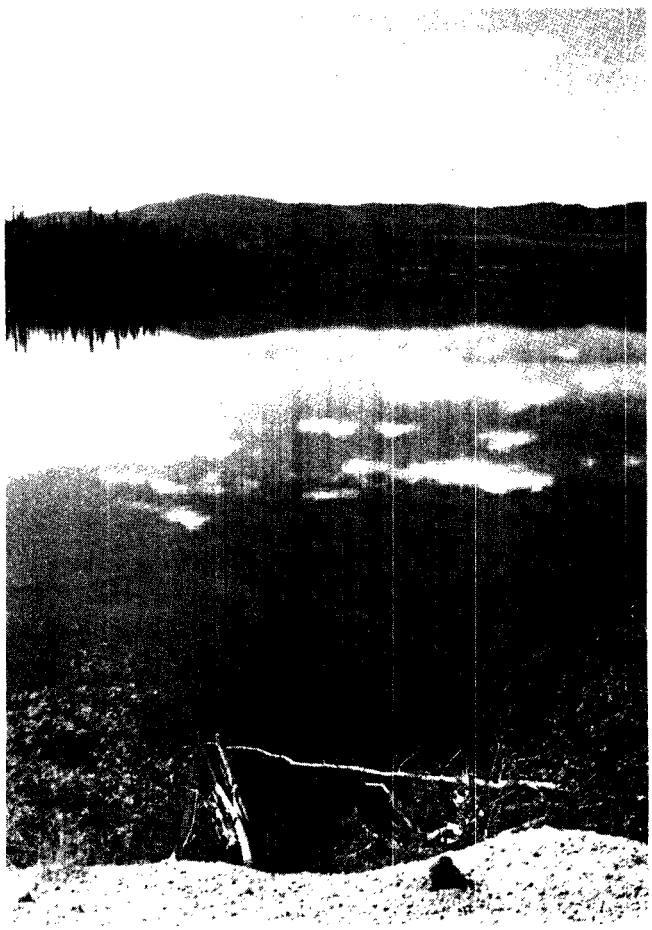


PLATE 121

Trees which once grew on Twin Lakes shoreline are now in lake. Klondike Highway, km 287.

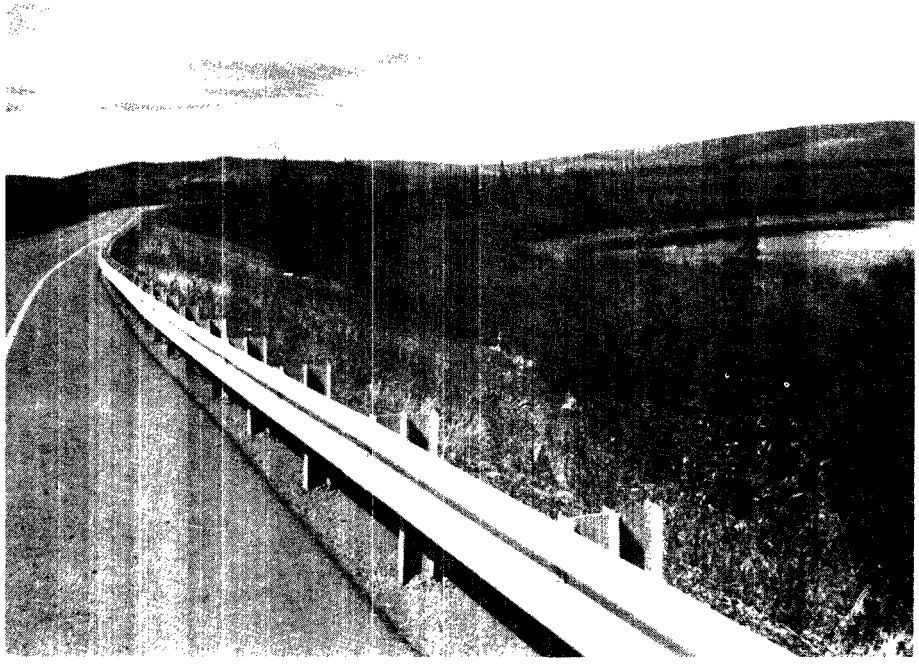


PLATE 122 Good buffer zone to wetland, foreslope at 30° and well vegetated. Alaska Highway, Alaska.

PLATE 123

Foreslope well vegetated, shoreland vegetation undisturbed. Location as for Plate 122.

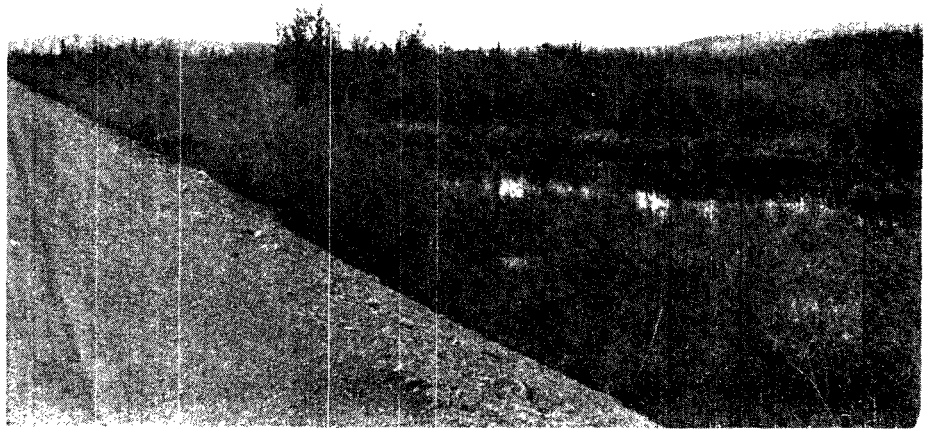


PLATE 124 Existing strips of natural revegetation between highway and wetlands, no matter how small, should be maintained. Any highway widening should occur on the side opposite the wetland. Klondike Highway.

PLATE 125 Description as for Plate 124. Alaska Highway, Alaska.

PLATE 126

Narrow vegetated buffer zone at Marsh Lake. Typical of the buffer zone width at many water bodies along sections of the Alaska Highway which are to be widened. It is critical that they be left undisturbed. Alaska Highway, km 1427. Reconstructed section.

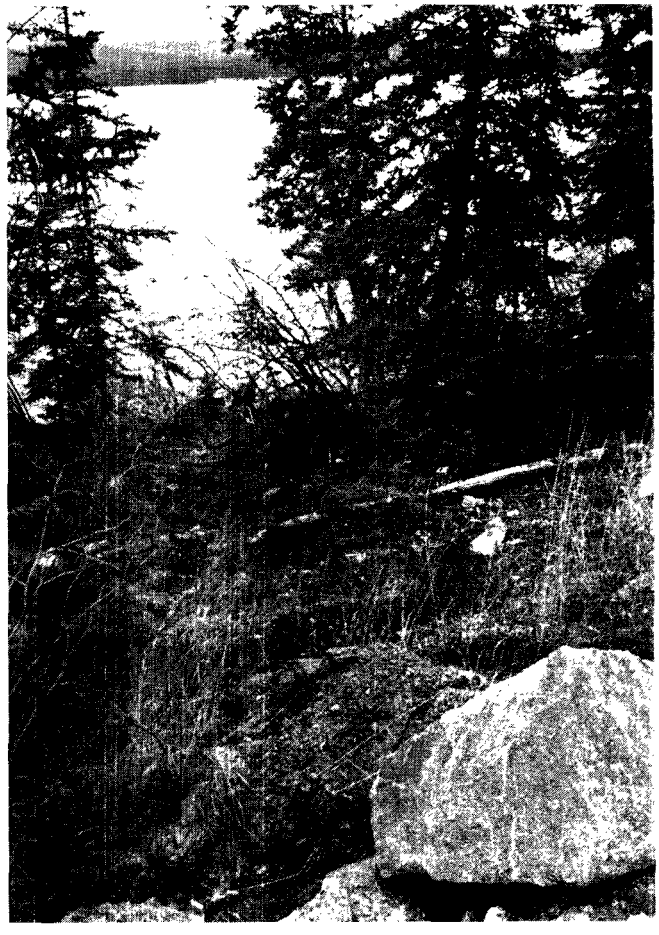


PLATE 127 A somewhat wider vegetated buffer zone, approximately 7 m wide, has been provided. Location as for Plate 40.

PLATE 128 Wetland vegetation should be hand-cleared in winter. Construction equipment should not be used in the right-of-way on either side of the highway. Alaska Highway, km 1097.5.

of the slope. Rip-rap should be used on the bench at the base of the slope to prevent wave erosion and slope undercutting (Plates 122, 123 and 129-131).

x) Extra precautions should be taken to keep fill out of water bodies and buffer zones during cut and fill operations.

xi) Highway maintenance staff should not use road graders to clear vegetation within 30 m of any lake, wetland or river.

xii) Spoil removed from the base of unstable backslopes during maintenance clearing operations should not be dumped into the Rancheria River or into wetlands associated with the Rancheria River (Plate 132).

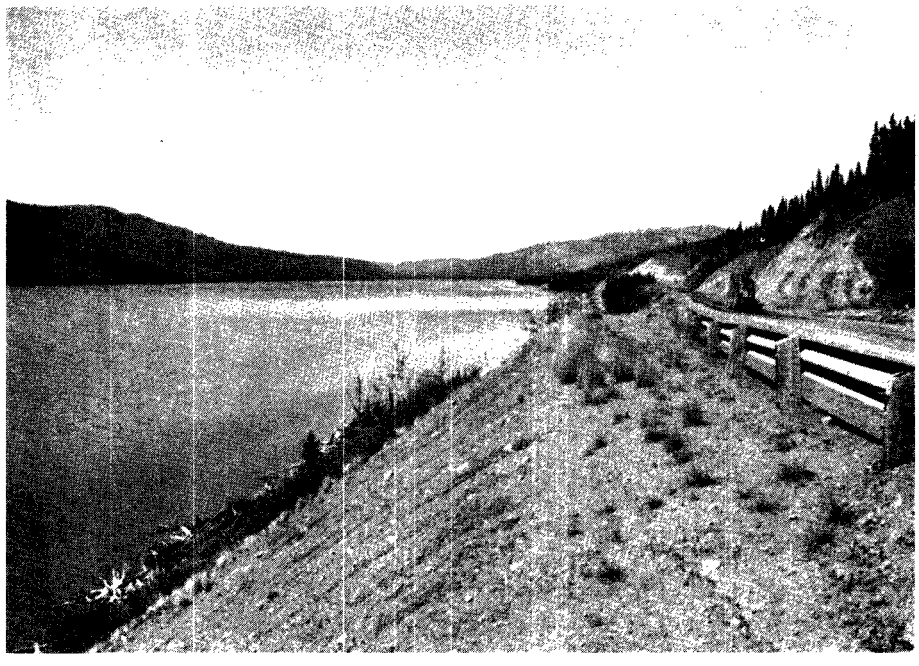


PLATE 129 Bench provided at top and bottom of slope to Fox Lake. Vegetation can start here and spread to the remainder of the slope. Klondike Highway km 70.

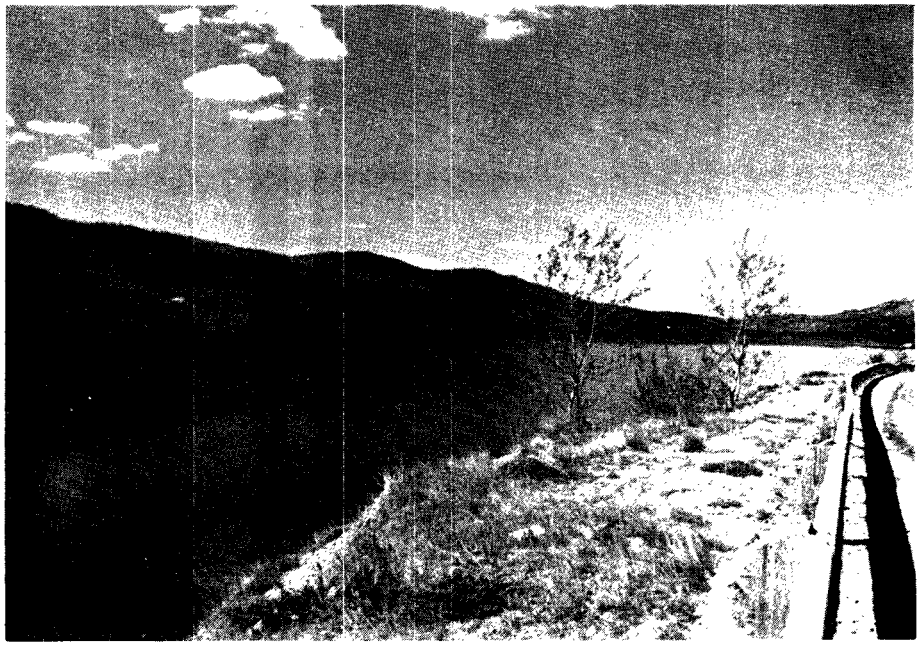


PLATE 130 Bench provided at top of slope leading to Fox Lake. Klondike Highway, km 70.

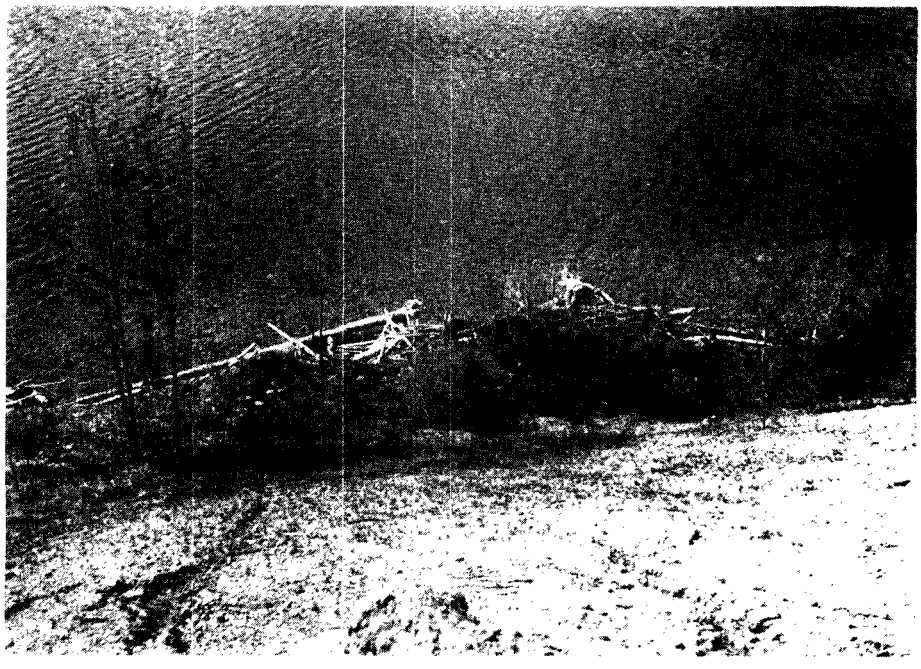


PLATE 131 Bench provided at base of slope leading to Fox Lake. Vegetation is spreading from here to the remainder of the slope. If rip-rapped, the bench would also protect the slope from erosion and undercutting by wave action. Klondike Highway, km 70.

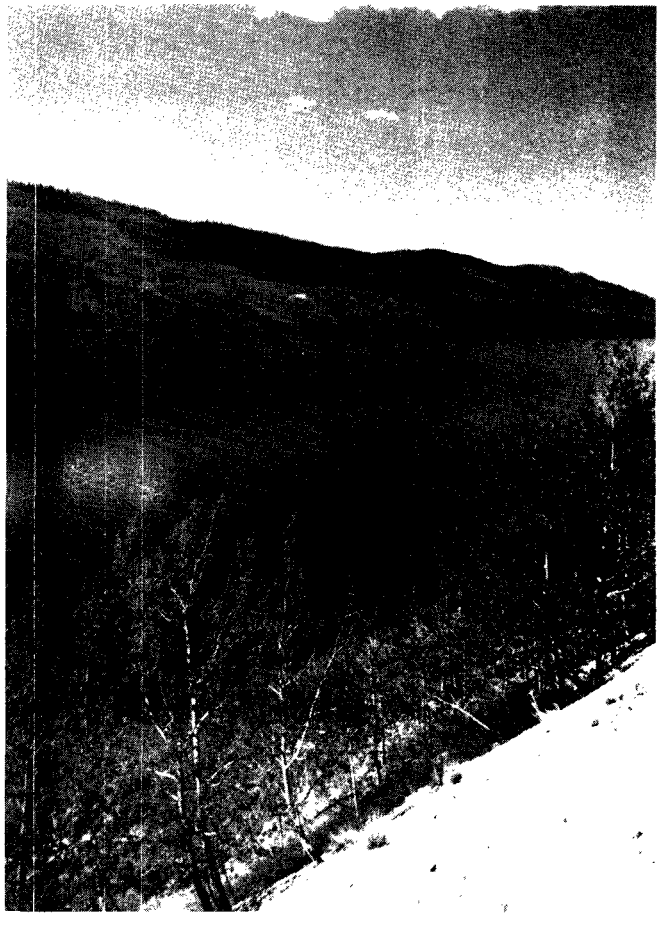


PLATE 132

Spoil disposal site at Fox Lake (bottom right in the picutre). Vegetation remains in background. If spoil from highway maintenance clearing must be dumped into water bodies then disposal sites at least 60 m apart should be used. The effect would be as shown here. The alternative would be to dump spoil along the entire shoreline and destroy all vegetation. Klondike Highway, km 70.

6 BORROW PITS

6.1 Environmental Concerns:

i) Borrow pits may be sited either near the Alaska Highway where they can cause aesthetic problems, or near wetlands, lakes and rivers where environmental problems could arise.

ii) Buffer zone vegetation between borrow pits and the highway may be destroyed because (i) gravel truck access may not be restricted to a single entrance/exit or (ii) road graders may be used to keep areas of highway right-of-way cleared of vegetation in the vicinity of borrow pits.

iii) Slash may not be cleared at borrow pits.

iv) Abandoned borrow pits may not be landscaped to improve their appearance and to facilitate revegetation efforts (slopes in excess of 30 degrees will not revegetate properly; slopes of 15-20 degrees will revegetate).

v) Efforts to restore abandoned borrow pits to semi-natural conditions may fail if vehicular access is not restricted (it is not proposed that vehicular access be entirely prohibited - only that it be restricted to areas of limited but reasonable size).

vi) Borrow pit policy initiatives may not be taken. A policy may be needed, for example, to actively encourage vehicular access to abandoned borrow pits along the Alaska Highway, with emphasis being given to areas having high scenic or recreational value; borrow pit rehabilitation efforts may not be in accord with such a policy.

6.2 Discussion

Borrow pits are often situated near water bodies because gravel deposits are frequently substantial in such areas. Borrow pits located near the highway cause aesthetic problems (Plate 133). Abandoned borrow pits are rarely landscaped or seeded (Plate 133). Buffer zone space may be provided between the highway and borrow pits; however, trees and shrubs in these areas are often removed (Plate 134). Buffer zone vegetation is often prevented from developing because vehicular access at borrow pits is not restricted. Single entrances/exits at both existing and abandoned borrow pits are needed to resolve this problem, but are usually not provided (Plate 135). Road graders are used to keep wide areas of highway right-of-way cleared of vegetation in the vicinity of borrow pits. Buffer zone vegetation is removed in the process (Plates 136 and 137). Slash is sometimes not removed at borrow pits (Plate 138).

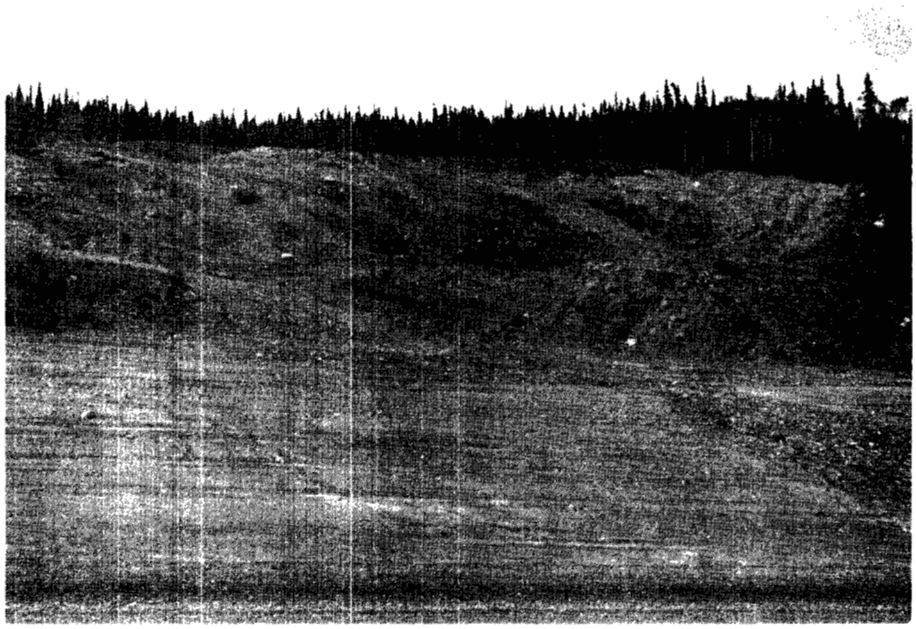


PLATE 133 Abandoned borrow pit lacks a single entrance/exit to provide opportunity for buffer zone vegetation to develop, is not landscaped and revegetation efforts have not been taken. It is aesthetically unpleasing to tourists and others who travel the Alaska Highway, km 1392. Reconstructed section.

PLATE 134 Active borrow pit, screen of trees of variable width - here quite narrow, in other parts of pit, screen is 5 m wide. In still other areas all trees have been removed. Alaska Highway, km 1470. Reconstructed section.

PLATE 135 Unrestricted access to borrow pit prevents buffer zone vegetation from developing, pit is abandoned and has been well landscaped. Alaska Highway, km 1026. Reconstructed section.

PLATE 136 Restricted access to borrow pit. Road graders periodically clear the buffer zone area to prevent trees and shrubs from growing. The next plate shows how vegetation can develop in such areas if given a chance. Alaska Highway, km 1470. Reconstructed section.

PLATE 137 Brush in buffer zone in area not recently cleared by road graders. Location as for Plate 136.

PLATE 138 Slash around perimeter of borrow pit not removed. Alaska Highway, km 1470. Reconstructed section.

6.3 Recommendations

i) New borrow pits should not be sited within 30 m of the Alaska Highway or any wetland, lake or river. All trees and shrubs in these areas should be left standing.

ii) Berms should be used to separate existing borrow pits from wetlands, lakes and rivers. Such a recommendation would apply when the distance separating a borrow pit from a wetland or water body is very short (8 m or less). Berm slopes should not exceed 1.5:1.

iii) Berms should be used at existing and abandoned borrow pits to control access when pits are located near the Alaska Highway and whenever access is unrestricted. Berm slopes should not exceed 1.5:1 and should be hydro-seeded (Plate 139).

iv) Trees and shrubs should not be removed from borrow pit buffer zones. Highway maintenance staff should not remove vegetation within 30 m of any borrow pit located on the Alaska Highway. These 30 m no-clearing zones should be clearly marked to assist equipment operators. If right-of-way clearing is essential for sighting or other purposes, then a vegetation cutter should be used to clear a swath no wider than 4 m.

v) Slash and partially felled trees should be removed at borrow pits.

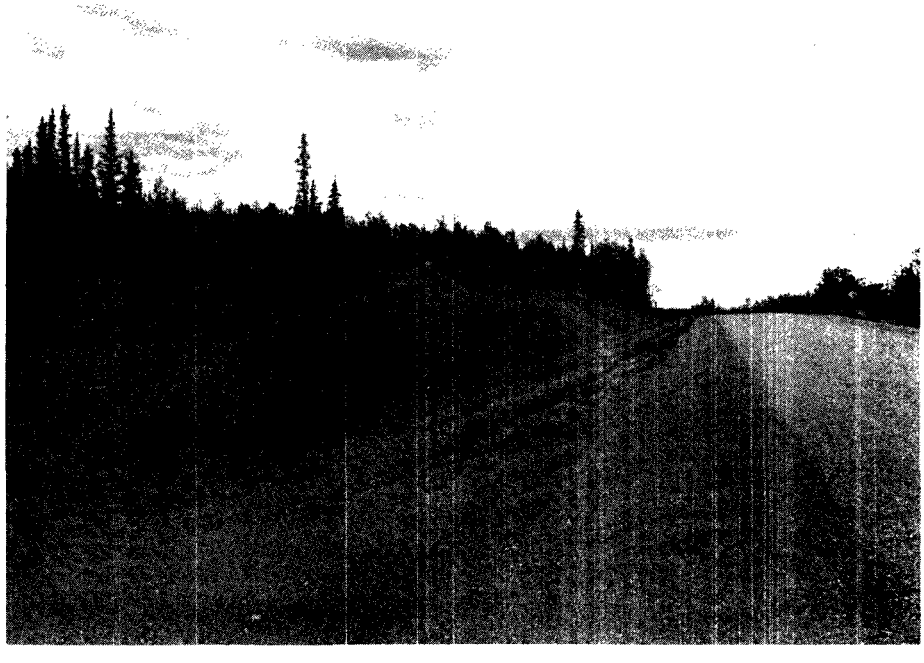


PLATE 139 Berm used to control access at abandoned borrow pit. The berm provides a physical screen which could be vegetated if slopes were reduced to 1.5:1 and hydroseeded (berm slope in background is at 1.5:1 and is beginning to vegetate naturally).

7 WORK AND ENGINEERING CAMPS

The construction of any major road project requires the establishment of fairly large temporary camps. The environmental concerns related to work camps include:

i) the storage and handling of petroleum products;

ii) the disposal of waste lubes and oils;

iii) the implementation of a contingency plan to deal with petroleum product and hazardous chemical spills;

iv) the disposal of solid wastes;

v) the disposal of sewage and camp liquid wastes;

vi) the location of camps;

vii) the taking of water for camp use.

These concerns are addressed below, under four headings: Petroleum Product Handling, Solid Waste, Sewage, and General Considerations.

7.1 Petroleum Product Handling

The major problems that have been encountered with the storage of petroleum products in the Yukon in the past are spillage of materials and improper storage practices. The storage of these products is addressed in Land Use Permits, and conditions pertain to three items of concern:

i) storage of products no closer than 12 metres from a water course;

ii) impermeable dykes surrounding storage areas containing more than 4,000 litres (880 gallons);

iii) the reporting of spills over 1700 litres (400 gallons) within 8 hours of the mishap.

In addition, it is suggested that valves and piping for petroleum storage areas comply with the regulations under the Territorial Gas Handling Ordinance.

The Environmental Protection Service, in co-ordination with industry, has been developing guidelines for the dyking of petroleum storage areas in the north. The service also offers assistance in the field of impermeable dykes.

The proponent should also be aware of the "Contingency Plan to Deal with Oil and Hazardous Chemical Spills in Yukon" which is in place under the auspices of the Yukon Disaster Committee. It is recommended that the proponent also draw up a concise contingency plan to deal with spills from the operation.

7.2 Solid Waste Disposal

Much consideration has been given to the solid waste disposal problem in Yukon. In the past, there have been problems with many uncontrolled disposal sites which used unapproved techniques for disposal. The use of these techniques usually results in blowing debris and wildlife problems. A sub-committee of the Land Use Advisory Committee has prepared a set of guidelines for solid waste disposal in small Yukon communities which will hopefully alleviate these problems. The Land Use Advisory Committee has also adopted the policy that solid waste (excluding bulky metal waste and building materials) be incinerated in a fuel-fired incinerator and the debris buried under one metre of compacted soil. This policy has greatly reduced the above-mentioned problems. In relation to bulky metal scrap and building materials, it is recommended that they be removed to the nearest approved solid waste disposal area.

7.3 Sewage Disposal

Sewage from large work-camp complexes in the Yukon has not presented a significant problem to date. The methods for sewage disposal are: septic systems for small camps (less than 10 men) and lagoons for larger camps. The lagoons are usually designed for 100% retention of the effluent for the duration of the camp if the camp is to be of short term (less than 6 months) or seasonal. If an effluent is to flow from the lagoon, then the proponent will not only need a Land Use Permit but also a Water Use Authorization.

For camps in many areas of the Yukon, the above philosophy plus back-filling of the lagoon after abandonment of the camp has resulted in adequate sewage treatment.

7.4 Camp Locations

Frequently, the location of work-camps is dictated by its proximity to the project. Several considerations have been used in the past to reduce the environmental concerns associated with such camps. For aesthetic purposes, the camps, wherever possible, have been a minimum of 100 metres from roads and a tree screen has been left between the camp and the road. If possible, previously disturbed areas (i.e. old borrow pits) have been used for camp sites. As well, camps have not been located within 30 metres of water bodies. Finally, consideration has been given to camp locations in relation to potable water supplies of suitable size to supply the camp.

All the above considerations are addressed in the Land Use Permits and Water Use Authorizations necessary before a camp can be established. This section of the report merely skims the surface of the requirements and outlines the items of major concern to the Environmental Protection Service.