

ENVIRONMENTAL REVIEW OF GULF CANADA
OPERATIONS IN THE MACKENZIE DELTA

SEPTEMBER 1975



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REPORT PREPARED

BY

DR. L. C. BLISS

DEPARTMENT OF BOTANY

UNIVERSITY OF ALBERTA

ENVIRONMENTAL REVIEW

OF THE

GULF CANADA OPERATIONS IN THE MACKENZIE DELTA

SEPTEMBER, 1975

GULF OIL CANADA LIMITED

CALGARY, ALBERTA

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I. ACKNOWLEDGEMENTS	1
II. INTRODUCTION	2
III. OLD WELLSITES	3
A. Gulf-Mobil Titalik K-26	3
B. Gulf-Mobil Kikoralok N-46	4
C. Gulf-Mobil Toapolok O-54	5
D. Gulf-Mobil Toapolok H-24	6
E. Gulf-Mobil Ya Ya A-28	9
F. Gulf-Mobil Ya Ya P-53	10
G. Gulf-Mobil Ya Ya M-33	11
H. Gulf-Mobil Ya Ya I-17	13
I. Gulf-Imperial-Shell Reindeer F-36	15
J. Gulf-Mobil Kilagmiotak F-48	18
K. Gulf-Mobil Kilagmiotak M-16	20
L. Gulf-Mobil Atigi O-48	22
M. Gulf-Mobil Ikhil I-37	23
N. Gulf-Mobil East Reindeer A-01	25
O. Gulf-Mobil East Reindeer P-60	28
P. Gulf-Mobil East Reindeer C-38	29
Q. Gulf-Mobil East Reindeer G-04	30
R. Gulf-Mobil Siku C-55	33
S. Gulf-Mobil Parsons N-10	35
T. Gulf-Mobil Parsons O-27	38
U. Gulf-Mobil Parsons P-53	40
V. Gulf-Mobil Kamik L-60	42
W. Gulf-Mobil Kamik D-58	45
X. Gulf-Mobil Ogeoqeoq J-06	46
Y. Gulf-Mobil Parsons A-44	47
Z. Gulf-Mobil Caribou N-25	49
IV. New Well Site	54
A. Gulf Mobil	54
V. Winter Road and Airstrip	55
A. Winter Road	55
B. Rat Airstrip	57
VI. Staging Site	59
A. Toapolak Staging Area	59
VII. Base Camp	60
VIII. Conclusions and Recommendations	64

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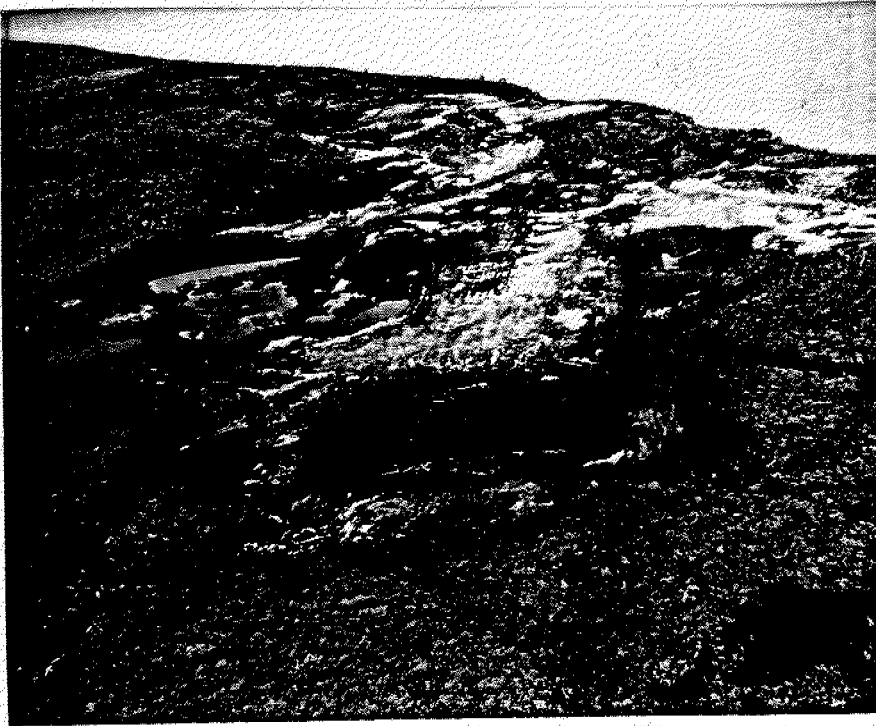
II. INTRODUCTION

This, the fourth environmental review of the Gulf Oil Canada operations in the Mackenzie Delta region was conducted in early September. The objective was to review nearly all of the old well sites, and to concentrate on those leases that have presented some problems. An important part was to review aspects of the operations that have resulted in a steady improvement in maintaining terrain stability.

III. OLD WELL SITES

A. Gulf-Imperial-Shell Titalik K-26

This lease continues to be wet because of annual flooding and an inadequate volume of material to refill the sumps and pits that settled (1036-32-8). Little can be done to improve the site unless gravel was hauled to the site. This is not recommended. Grasses seeded one year ago have largely been eliminated by silt deposits and standing water. The best practice is to let the site stabilize on its own, which means several small ponds and a slow establishment of native sedges and willows.

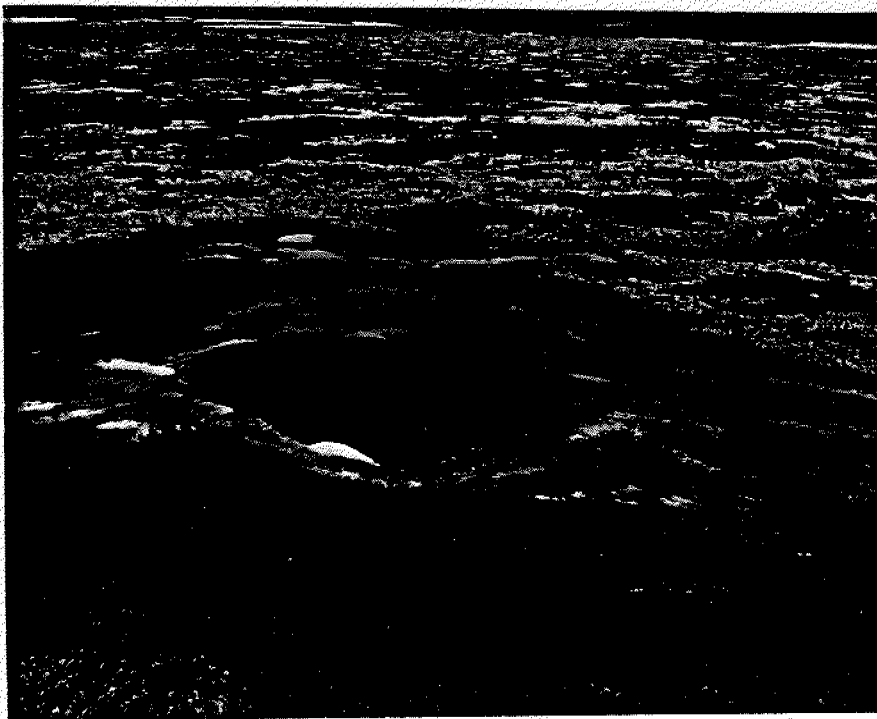


1037-32-8

Aerial view of K-26.
Note the general
lack of grass growth
compared with the
previous year.

B. Gulf-Mobil Kikoralok N-46

The N-46 well was drilled in poorly drained shrubland (1974), backfilled in winter, and seeded in June, 1975. The lease is wet (1037-2-10), but this is to be expected in these poorly drained soils next to the river. No further leveling should be done for surface damage would only increase. Annual flooding will deposit silt in the wet sites and in time the native willows and sedges will reestablish. Seeding these very wet soils will not be successful in contrast with the growth of grass on the mounded sump.



1037-2-10

Establishment of grass on the mounded sump in contrast with the wet soils on the adjacent flat.

C. Gulf-Mobil Toapolak O-54

This well, also drilled in flat land subject to annual flooding is about as wet as in the previous year (972-6-12). Grass was easily established on the moist soils in 1974, but the annual flooding of 1975 has significantly reduced the cover (1037-3-12). Reseeding this and other lowland sites will not be successful because of the silt addition each year and the presence of water for several weeks. Plant succession by native sedges and willows appears to be the best solution and therefore these sites will appear bare and wet for more years than is true in the uplands.

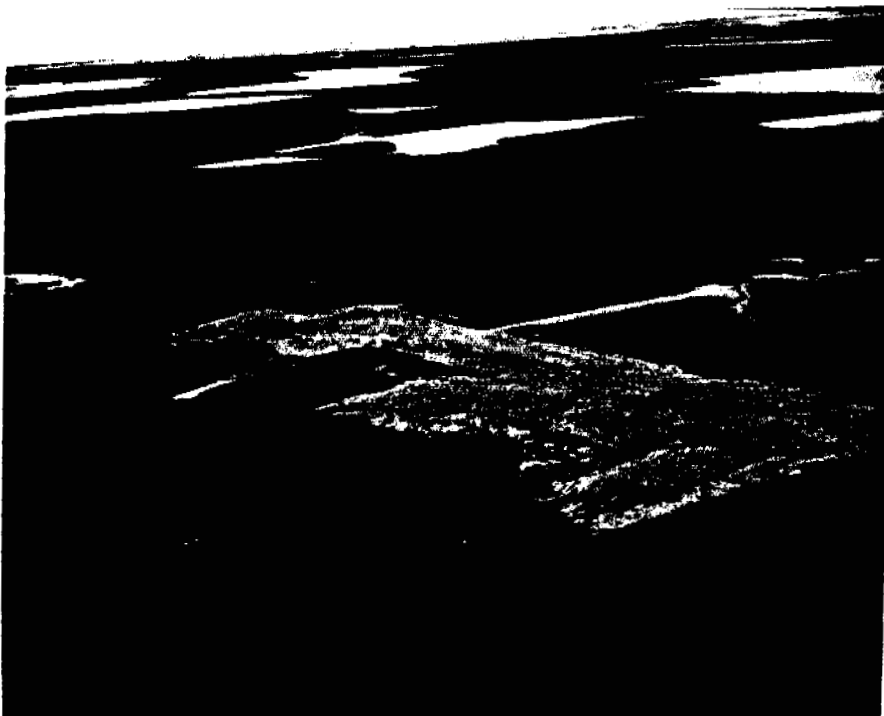


1037-3-12

General view of the
clean and relatively
dry O-54 lease.

D. Gulf-Mobil Toapolak H-24

This is a very clean lease, one with no serious environmental problems (1037-4-10). The camp was placed over raised center polygons and this wet land now shows in the foreground (1037-6-5). The surface was disturbed a bit in filling the kitchen sump but this wet spot should be left alone and not be filled over for the peat mat is intact. The edge of the camp sump (1037-6-1) and the flare pit should be filled in with existing gravel, but care must be taken not to thin the insulative cover over the sump. The gravel pad has settled around the piling, but this process should be allowed to continue for 1-3 years before the piles are cut off (1037-5-6). The lease was seeded in June 1975 and it is very evident that grasses will grow only on the moist mineral soil or in pockets in the gravel pad where silt and water accumulate.



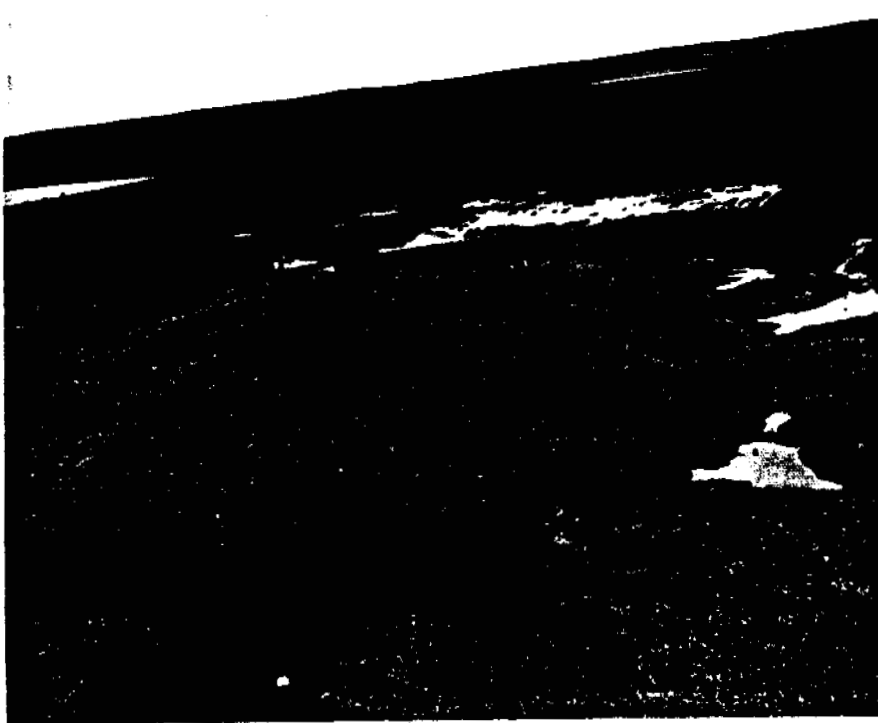
1037-4-10

Aerial view of H-24,
note that grass grew
only on the mineral
soil.



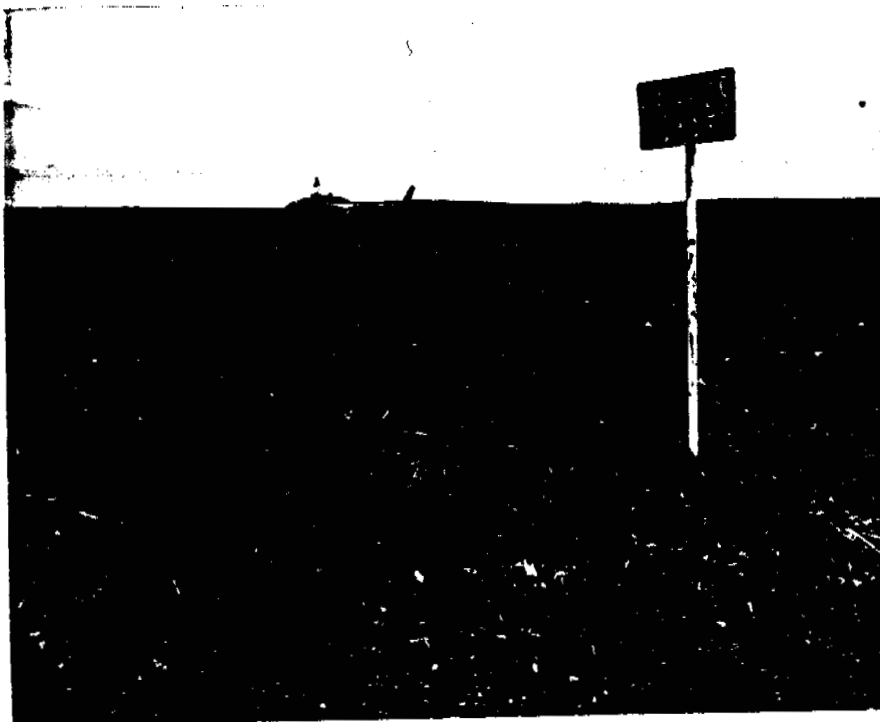
1037-6-5

Close-up of the wet
polygonal ground ad-
jacent to the kitchen
sump.



1037-6-1

Portion of the kitchen
sump that has settled
and should be filled.

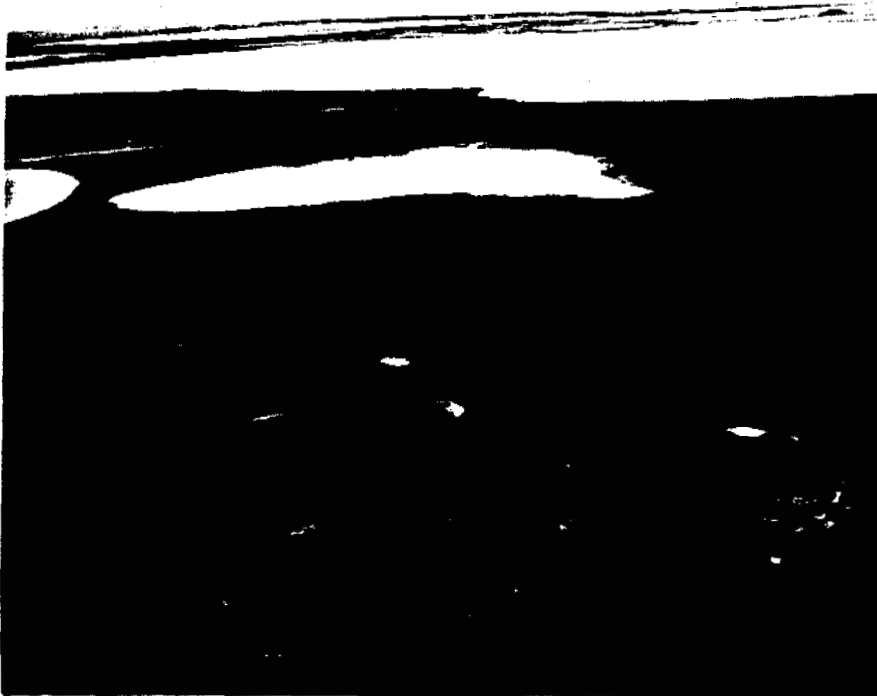


1037-5-6

Rig piling that will
continue to be exposed
for 2-3 years until the
gravel cover stabilizes.

E. Gulf-Mobil Ya Ya A-28

This well drilled February-June 1974 and restored and seeded the winter and summer of 1974-75 is a very clean lease (1037-9-5). Two pits, the garbage (right) and flare (centre) have settled a bit and may need to be refilled. Here as elsewhere, there is a good catch of grass on mineral soil. Native grasses adjacent to the lease have begun to seed in, although establishment will be slow on the gravel.



1037-9-5

Aerial view of A-28
showing the massiveness
of the gravel pad neces-
sitated by a spring drill.

F. Gulf-Mobil Ya Ya P-53

This well drilled in early 1973 is a stable, but rather wet site because of the abundance of ice-rich raised center polygons (1037-7-3). As recommended in 1974, the lease should be reseeded because there is not a good stand of native grass in the immediate area that can or have invaded. This is the only restoration advised for this site. If gravel were hauled in to cover the polygons, they would reform leaving wet trenches as are present now. The snow road shows in the background.

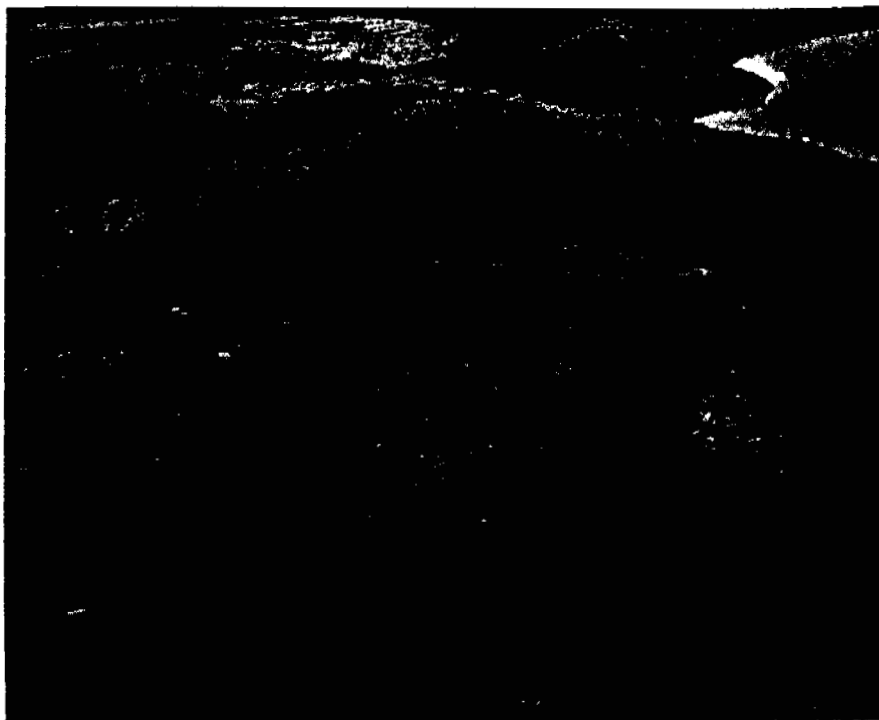


1037-7-3

The P-53 lease showing water at the tops of the ice wedges, but no more water than in previous year.

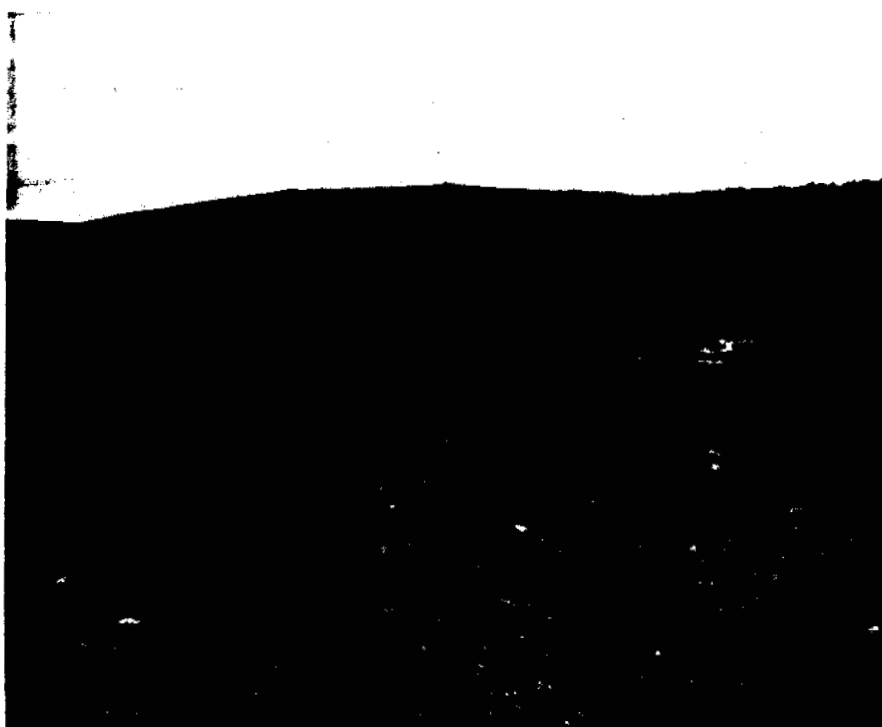
G. Gulf-Mobil Ya Ya M-33

This well was drilled from November to February and reseeded in June 1975 (1037-7-9). The location has little polygonal ground and relatively little massive ice. Although there are one or two wet spots, far more surface damage would be done by returning to this area for minor leveling than would be accomplished. The lease was well seeded and there is a good catch of timothy, fescue and nugget bluegrass (1037-8-3). Of all of the leases inspected over four years, this is one of the best, thanks to its upland location, no need for a gravel pad, and therefore, ease of reseeding, and adequate spoil for a large sump cap.



1037-7-9

View of M-33 showing the
clean appearance of this
upland site.

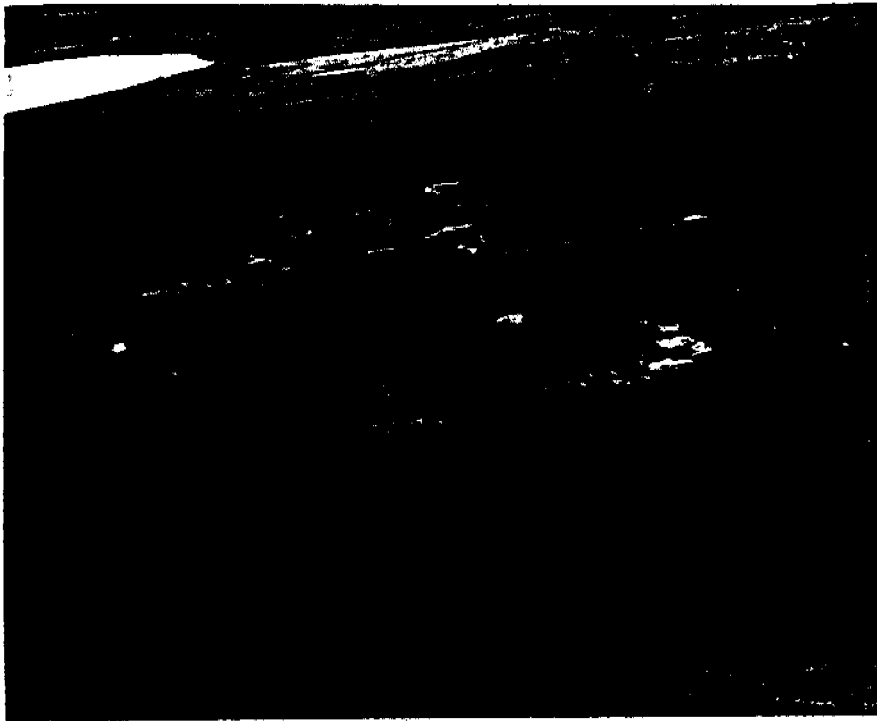


1037-8-3

Reseeding has been very
successful on the
mineral soil.

H. Gulf-Mobil Ya Ya I-17

Again this well was drilled in an upland site in winter (1974-75) without a gravel pad and in an area of relatively low ice content (1037-11-6). The only pond is at the flare pit (1037-11-10) where a pool 1-2 feet deep occurs. Because there is no excess soil and the entire site is stabilizing with a good grass cover, it is not recommended that equipment be brought in to fill this small wet site. More new total terrain damage would be done than can be corrected by this operation.



1037-11-6

Aerial view I-17 illustrating the relative ease of reseeding and site restoration in upland sites drilled in mid-winter.



1037-11-10

Flare pit pond

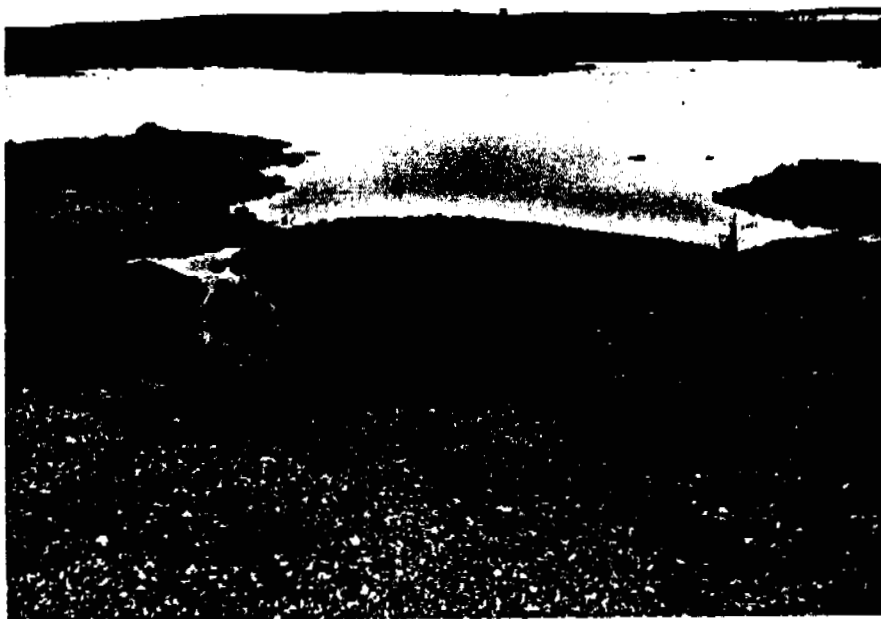
I. Gulf Imperial Shell Reindeer F-36

This well, drilled in 1973, and filled in the 1973-74 winter, has been a wet site from the start. It was releveled in 1974-75 winter, resulting in eliminating some wet areas (1037-1-2). The third sump, required by the land-use people, here and elsewhere has added significantly to the problems of sump meltout. This sump with a water pool of 3 to 5 feet should be refilled this winter (1037-2-6). The site is drier and more stable than in August 1974 (972-1-6). There is a considerable amount of native grass at the edge of the lease and this grass is becoming established on mineral soil (1037-2-5). Establishment on gravel will be much slower and since this material covers large areas of the disturbed lease, reseeding can be questioned.



1037-1-2

Aerial view of F-36 showing the reworked gravel (immediate foreground) from the winter restoration work. Note the ponded area of the third sump (centre),



1037-2-6

Pond at the third sump



1037-2-5

Polar grass at edge of
the lease. This acts
as a seed source for
grass establishment in
the foreground.

J. Gulf-Mobil Kilagmiotak F-48

This lease has greatly improved over the past two summers, for there is much less surface water than in the past. Pumping out and channel draining the water off the site has reduced melt-out at the well sump (1036-13-12). Should any further restoration be done, it should be aimed at keeping the channel open (lower centre) to drain off water from spring snowmelt. The site is definitely stabilizing and native plants are establishing (1036-14-8). Seeding in 1973 was not as successful as at some locations.



1037-13-12

Aerial view of F-48
showing the significant
drying that has occurred
in three years.

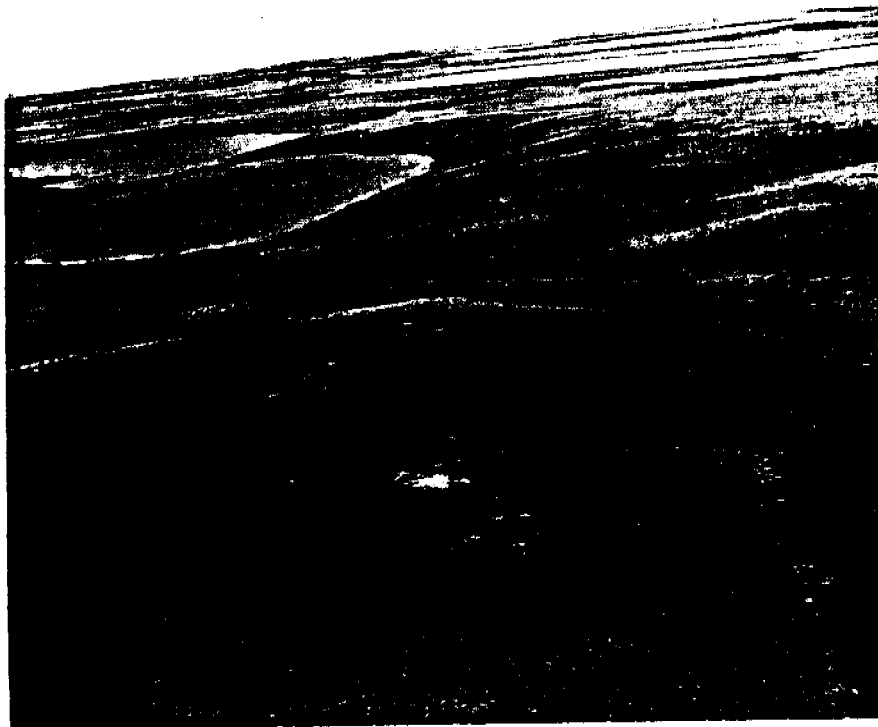


1037-14-8

Establishment of native
grasses and sedges
at F-48.

K. Gulf Mobil Kilagmiotak M-16

This lease drilled in winter (1974 to 1975) without a gravel pad again illustrates the significant reduction in terrain damage that results (1037-12-5) on an upland location. Approximately 30% of the lease was lightly bladed in the cleanup and the native plants are coming up (1036-13-2). Reseeding appears less successful at this site, possibly the result of the drier soils on the more wind exposed site.



1037-12-5

Aerial view M-16, note the lightly bladed surface that has enhanced regrowth of native plants

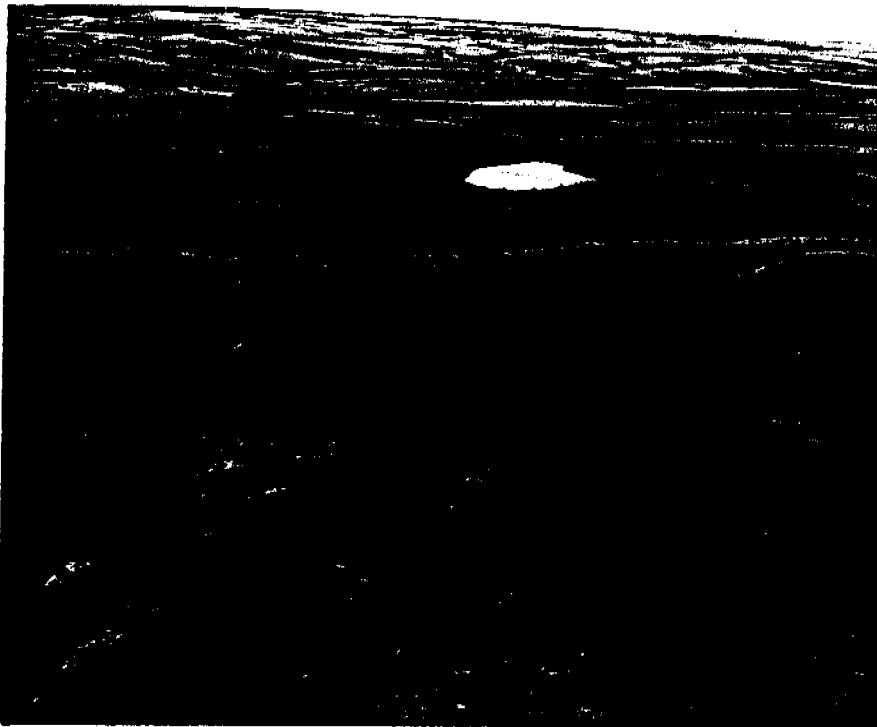


1037-13-2

Regrowth of native plants in lightly bladed surface, note reseeded area on right on the mounded soil

L. Gulf-Mobil Atigi O-48

This well, drilled in early 1974, is situated on a rolling dry slope near the northeast side of the Caribou Hills. There is a significant increase in plant cover (1037-25-3) in relation to the previous year (1072-22-2). Due to a small drainage through the lease, some water remains on the site, but no more than in the previous year, nor is the one small pond deepening.



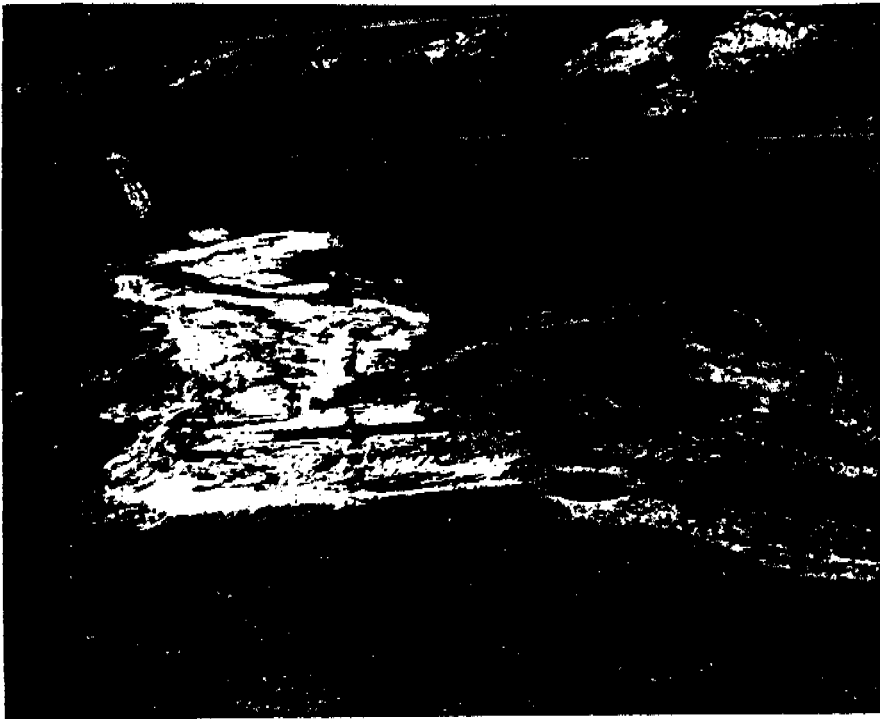
1037-25-3

General view O-48; a stable site with considerable growth of grasses.

M. Gulf-Mobil Ikhil I-37

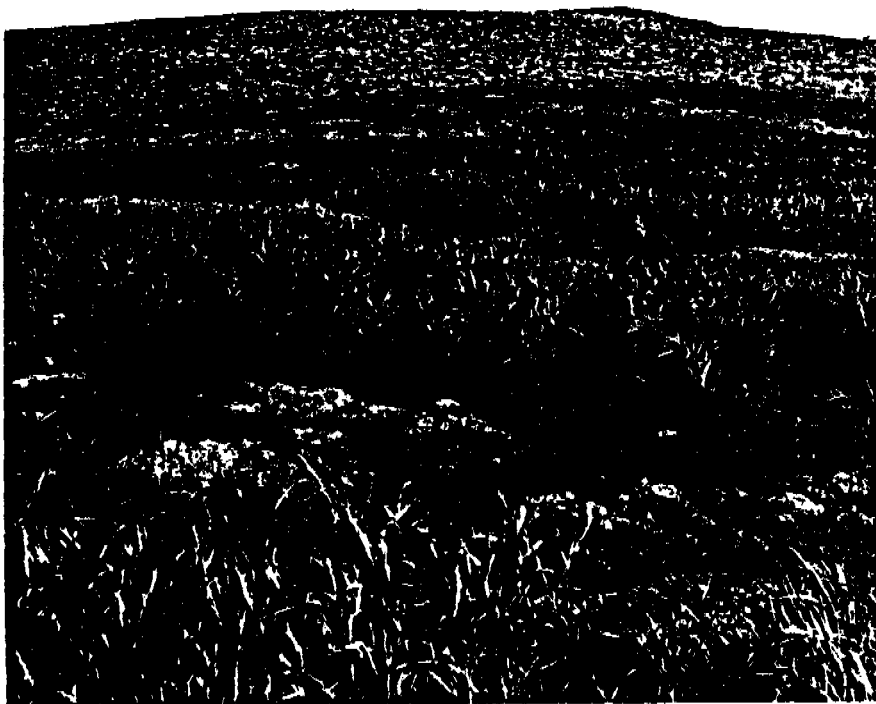
The Ikhil site has had further restoration this year. The piles have been recut and drainage channels opened to permit water to drain from the edge of the well sump. Water will continue to accumulate on the lease because it is along a natural drainage flow. Some grass is establishing on the gravel pad (1037-30-3). This results in part from the retention of water on the lease. Climax timothy established more rapidly than nugget Kentucky bluegrass, but the latter species is now forming considerable ground cover (1037-32-6).

The lease is clean and needs only to have the drainage channels kept open so that spring and summer runoff will drain through the lease. Excess gravel from the pad might be bladed into the shallow pool, provided bringing the equipment into the site would not do more terrain damage than its successful use would accomplish. This is questioned on an environmental basis.



1037-30-3

General view of I-37
showing about the same
amount of water as the
previous year but with
a greater growth of
grasses.



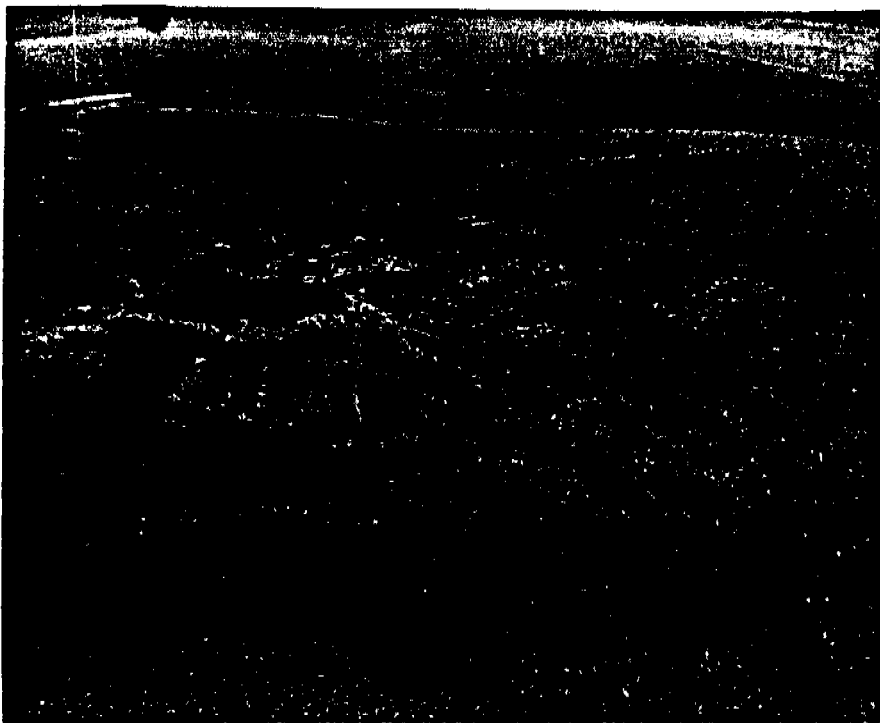
1037-32-6

Seeded plots of June
1974 (climax timothy-
tall, nugget Kentucky
bluegrass short)

N. Gulf-Mobil East Reindeer A-01

The A-01 lease again illustrates how a site stabilizes over time (1037-28-11). Contrast this with (791-1-3) in 1972 which showed two ponds and much bare surface. The seeded plots established in 1973 show that arctared fescue (left 3) and nugget Kentucky bluegrass (centre 3) (1037-29-6) have done much better than the seed mix (2) and climax timothy (right 4).

The remaining pond is well stabilized and is ringed by marsh fleabane and sedge (1037-29-3). The small stream running through the site is well surrounded by vegetation, a channel that did not erode a deep channel over the past five years.



1037-28-11

General view A-01 showing
the seeded plots of 1973
and the natural esta-
blishment of vegetation
over the lease



1037-29-6

Close up of nugget
Kentucky bluegrass with
the mixed seeded plot
to the right.

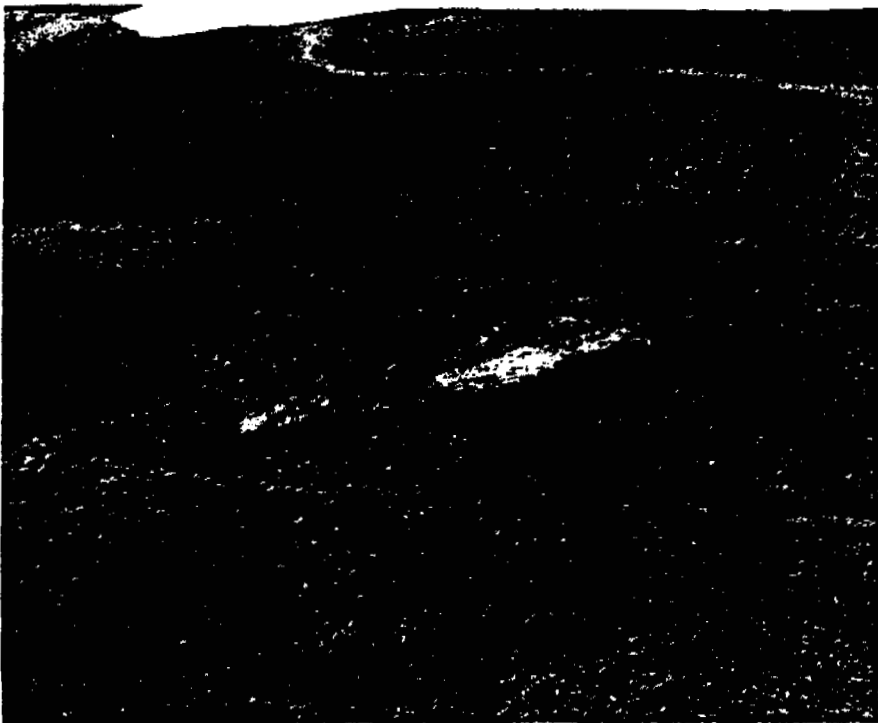


1037-29-3

Pond with its ring
of native sedges
and marsh fleabane

O. Gulf-Mobil East Reindeer P-60

This is another well drilled in 1970, one at which native species have become well established and where there was little settlement (1037-28-2). Remains of drilling mud and wood chips have delayed plant establishment in some places.



1037-28-2

General view of P-60
showing natural establishment of vegetation over six summers

P. Gulf-Mobil East Reindeer C-38

This well site continues to improve in appearance, five summers after site restoration (1037-27-2). Contrast this view with that of 1972 (971-5-7) and the appearance of plant cover on the drilling mud three months after the mud spread (B-8). The ponded mud shows in the lower right corner of the 1975 photo. Marsh fleabane grasses and sedges now cover 35 to 55% of the mud surface and these species cover 60 to 80% of the well site..

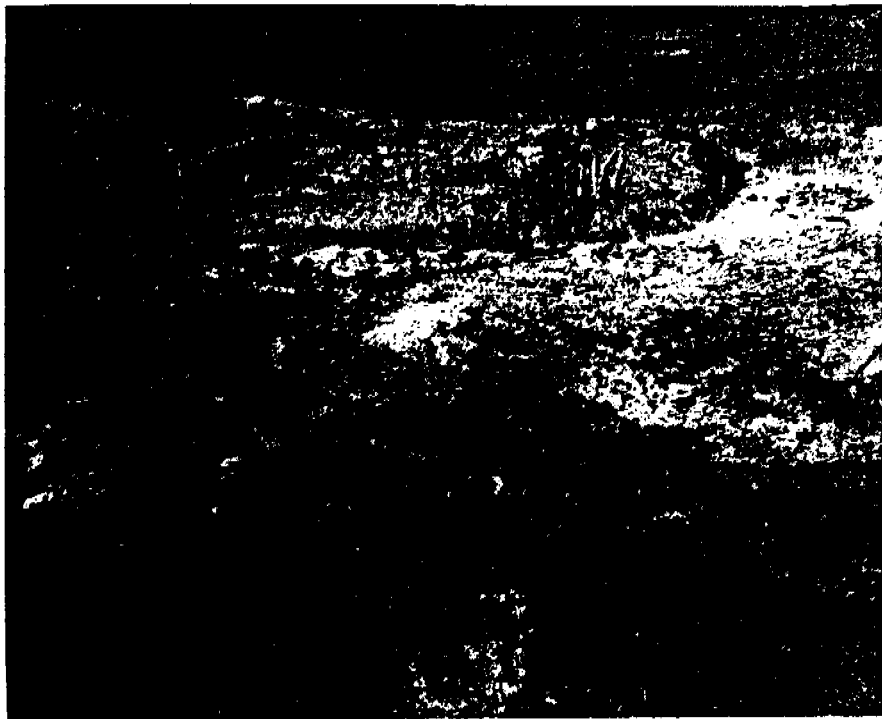


1037-27-2

Aerial view of C-38 showing the nearly complete cover of native grasses at the lease and the significant plant cover on the drilling mud in the right foreground.

Q. Gulf-Mobil East Reindeer G-04

This well drilled in the spring of 1971 has gone through five summers of plant growth and yet the sump cap is relatively unvegetated with native grasses and sedges (1037-26-6). This results from having no large population of native grasses nearby. Contrast this with C-38 and the rapid establishment of native grasses. The one ponded area has changed very little from the 1972 survey (791-10-2). Stability has probably been achieved at both the rig site (1037-26-9) and camp sump. The sump cap is now covered with a weedy mustard species into which a native upland sedge is establishing, but there is a distinct lack of grasses (1037-26-11). This site should be reseeded.



1037-26-6

General view of G-04
drilled in 1971, note
the general lack of
natural revegetation



1037-26-9

Rig piles showing the
amount of settlement
over the past three years



1037-26-11

Close-up of sump cap
showing establishment
of a weedy mustard plant
and a native sedge with
little or no grass

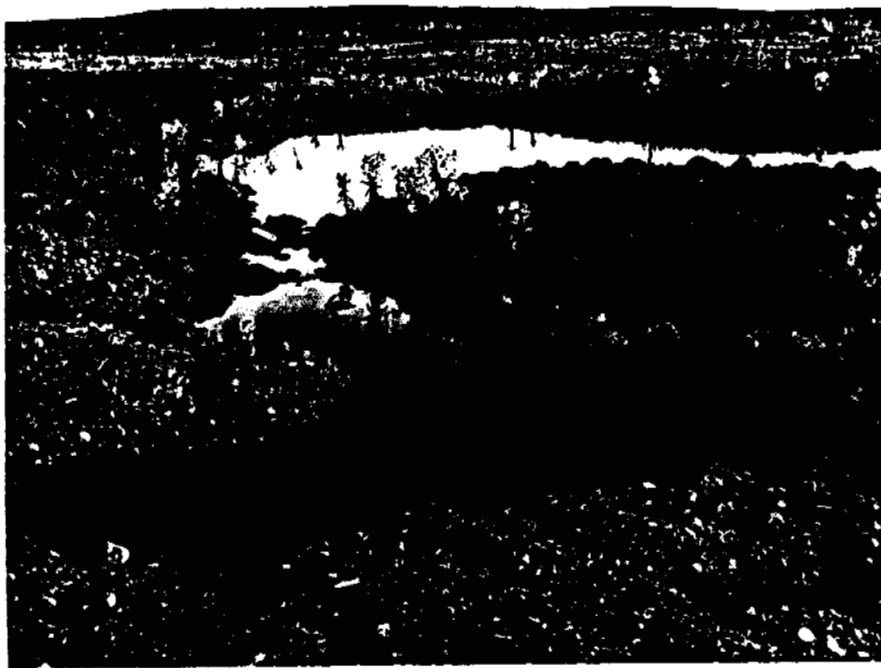
R. Gulf-Mobil Siku C-55

This lease, because of its location on ice-rich polygons and loss of spoil over a summer, continues to be wet (1037-15-8). The lease has been reworked for three years and is drier than in 1973 (see 879-16-9). Although gravel could be hauled from Parsons Lake the total terrain impact of building the road and use of a scarce resource seems unjustified. It is recommended that this site be left to further stabilize on its own, including the establishment of native plants (1037-16-12) and the exposure of piles which can be cut off in 1-2 years.



1037-15-8

General view C-55
showing ponded areas
at the well sump



1037-16-12

Growth of marsh flea-
done and sedges in
moist soils

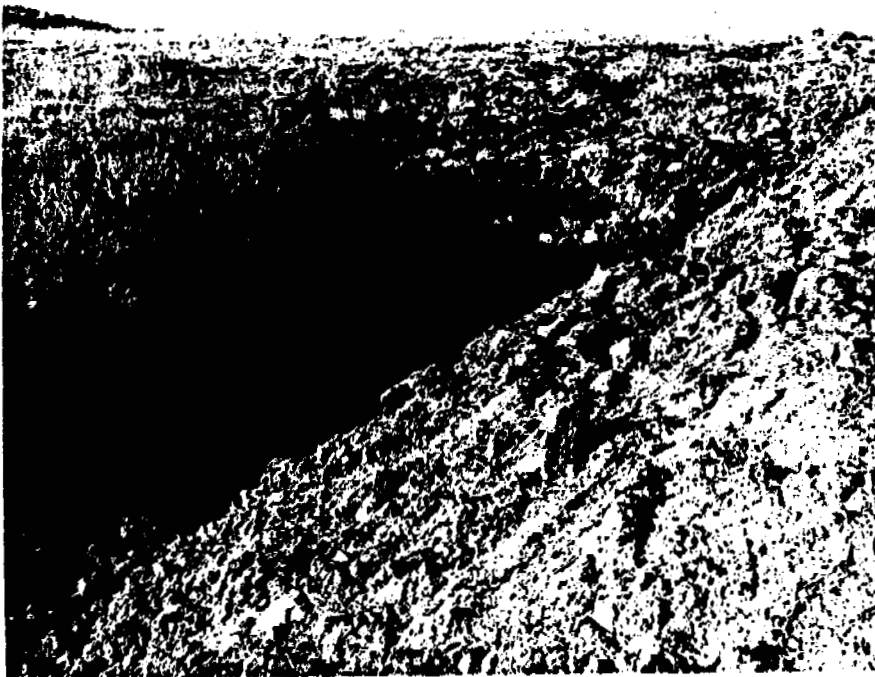
S. Gulf-Mobil Parsons N-10

This well, drilled in an area of massive ice-wedge high centre polygons has stabilized very well (1037-17-3). Initially ice-wedges 5-8 feet deep were exposed and covered with peat from the spoil pile. There appears to have been very little settlement in two summers (1037-17-12). Thus a site that had the potential for serious thermokarst problems has been stabilized. There are several small wet spots but they are smaller than in 1974 (972-20-1) and they should not be filled in, for more surface damage would be done in the process. Native species are invading the lease as well as a considerable cover of seeded grasses (1037-18-5).



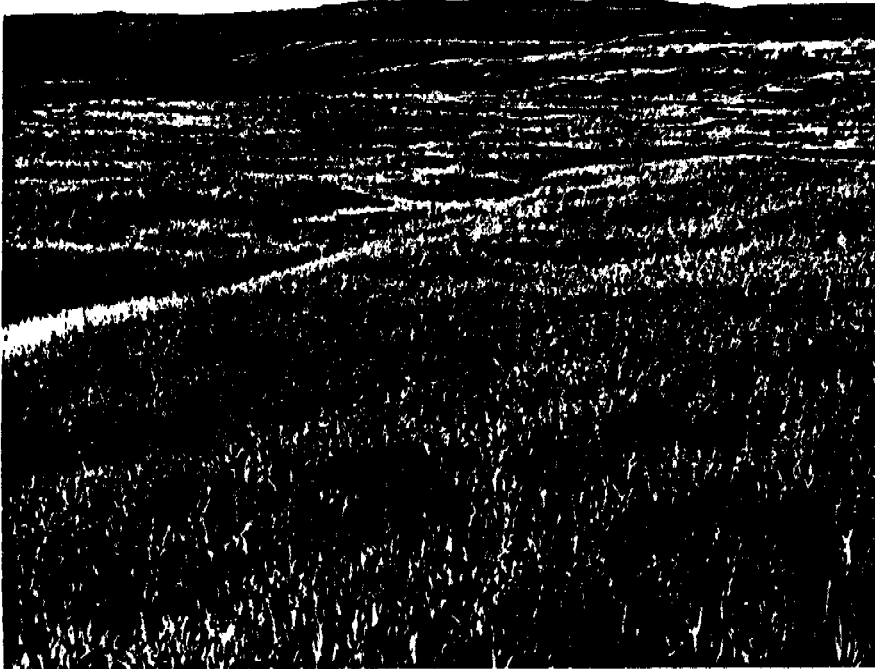
1037-17-3

Aerial view of N-10
which shows a reduction
of surface water and
a stabilized surface



1037-17-12

Huge ice wedges were
filled with rip-rap
and peat and are now
quite stable



1037-18-5

Solid stand of grass,
two years after seeding

T. Gulf-Mobil Parsons O-27

This well drilled March to September was situated on a height of land. With an adequate gravel pad and its better drained soil, the site was more readily restored (1036-22-3). A second well (directional) is planned for the 1975-76 winter from this site. The lease was used for summer seismic surveys under the lake and by DPW in planning the gravel road from Inuvik to Tuktoyotuk. The summer camp sump has been plastic lined and melt-out appears to not have been a problem (1037-21-9).



1037-22-3

Aerial view of O-27.
Note the clean site
with well stacked
supplies

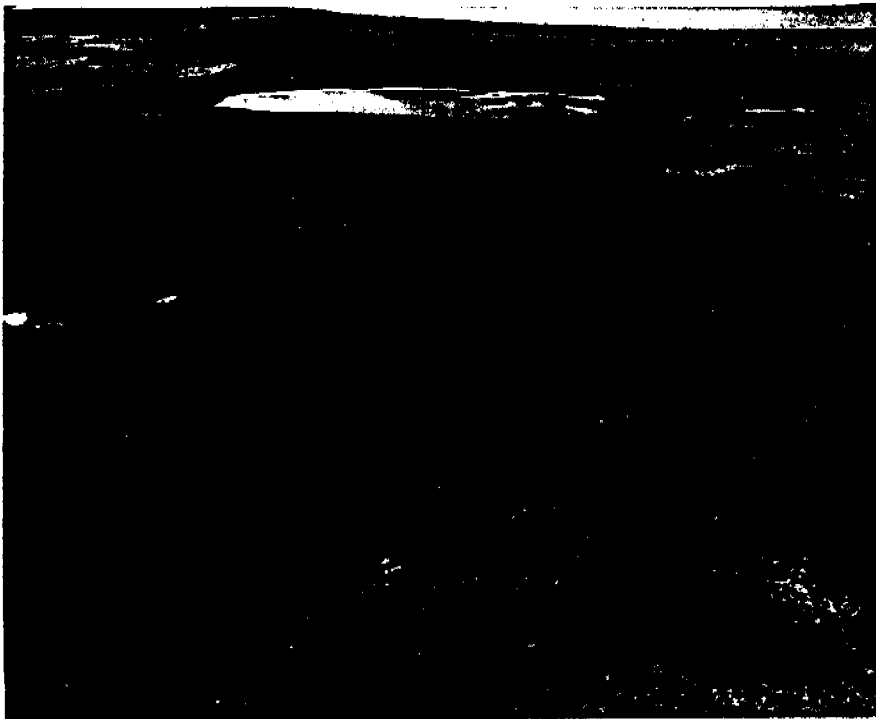


1037-21-9

Plastic-lined summer
sump used by the sum-
mer seismic crew.

U. Gulf-Mobil Parsons P-53

The P-53 lease is a clean, neat site with a small pond at the flare pit (1037-25-10). The site was seeded in June 1974. In August 1974 a fire burned several acres (1037-25-12) and the regrowth in one year shows clearly in contrast with (972-17-11) last year. On the ground, there was some regrowth of dwarf shrubs and the stimulated growth of polar grass (1037-26-2). Grass cover from reseeding has increased from the previous year.



1037-25-10

Aerial view of the
reseeded P-53 site



1037-25-12

Edge of the 1974 tundra
fire on right

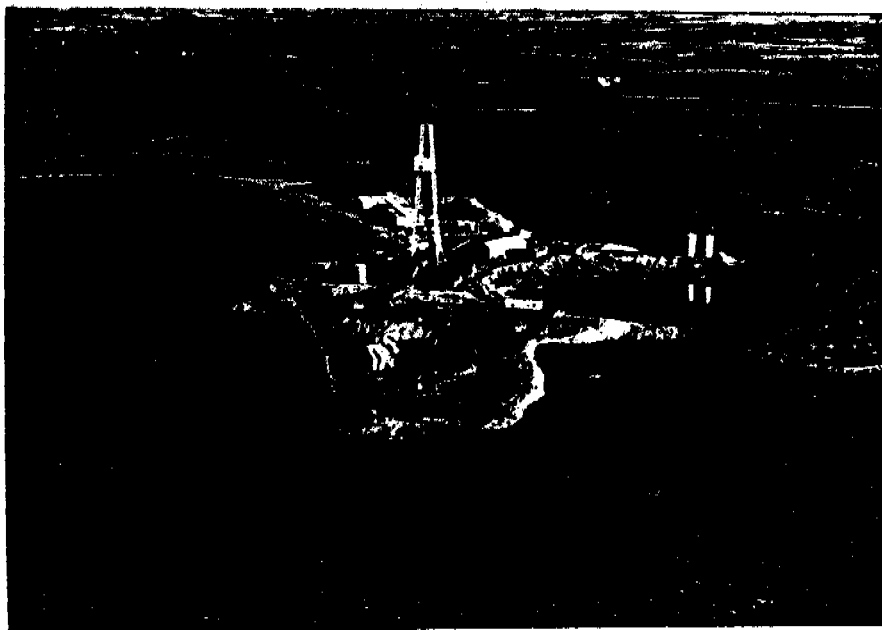


1037-26-2

Close-up of polar grass
and dwarf shrubs one
year after the tundra
fire.

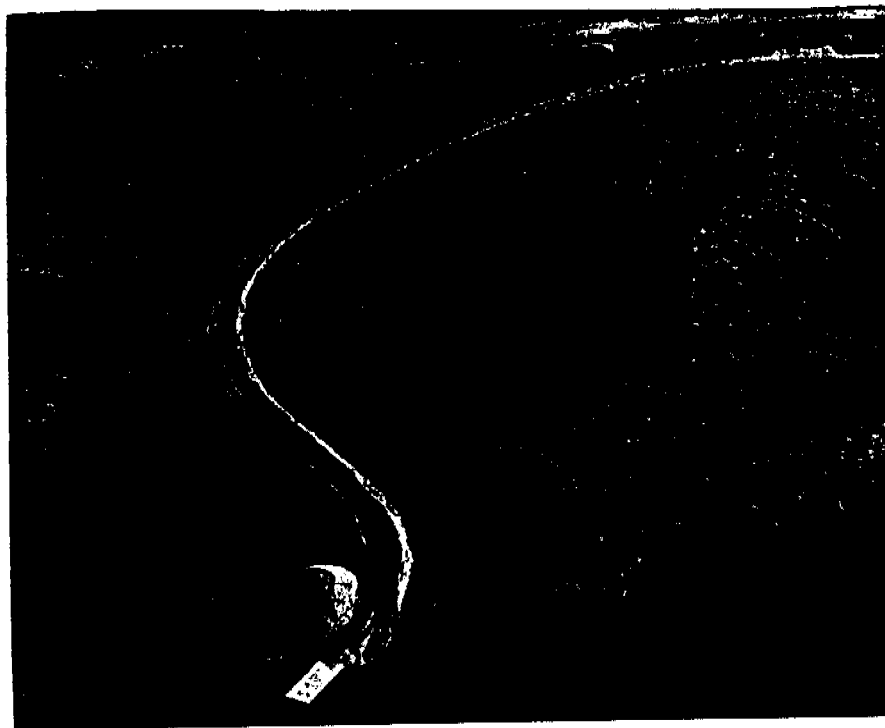
V. Gulf-Mobil Kamik L-60

This lease on top of a hill was drilled from March to June. All equipment is neatly arranged on the gravel pad and will be cleaned up in January 1976 (1037-19-3). The gravel road to the nearby lake was well built and maintained (1037-19-5). Although massive ice was not evident in the sumps, melt-back over the summer amounted to 10-15 feet laterally. The rig and storage tanks were placed far enough back from the sump that their security was not endangered (1037-20-9). The site is clean and should present few problems in restoration for the gravel supply and sump spoil have an adequate volume.



1037-19-3

Aerial view of L-60
showing the clean site
with neatly arranged
equipment.



1037-19-7

Gravel road, note the
absence of off-road
tracks and the surface
patterning on the road
of ice-wedge polygons
(centre of road)



1037-20-9

Well sump showing lateral melt out from near the box to the present wall face. Note plastic and wood cover to protect the sump face below the fuel tanks.

W. Gulf-Mobil Kamik D-58

This well drilled from November to March was cleaned up in early 1975 and reseeded in June. The site is very clean and there is no problem with surface water (1037-21-1). Note that the lease is slightly higher than that in the foreground and therefore had less potential for meltout problems following cleanup.

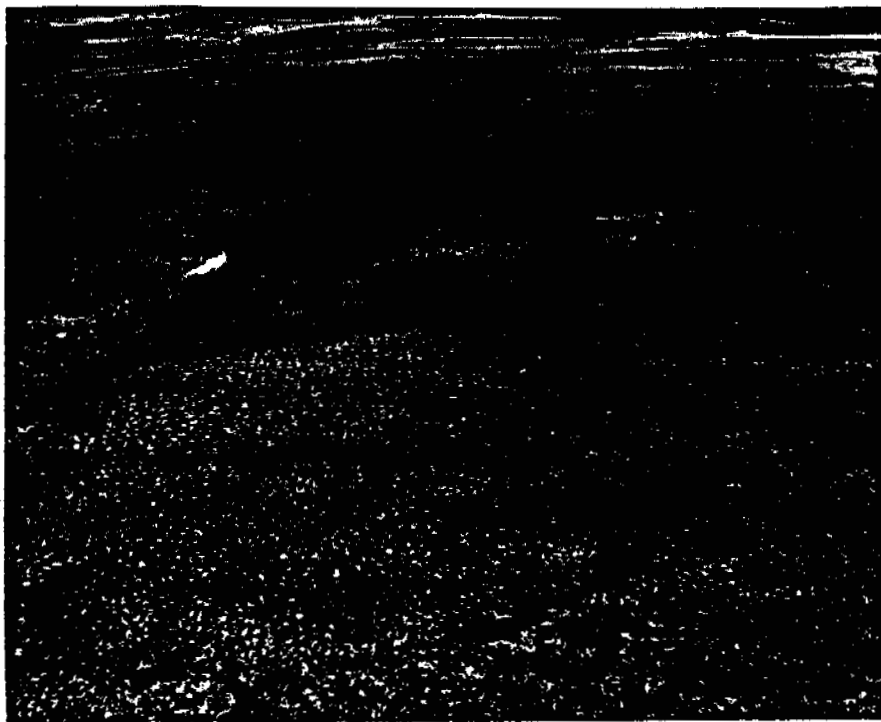


1037-21-1

Aerial view of D-58.
Note the considerable
cover of grass after
only one summer

X. Gulf-Mobil Ogeogeoq J-06

This well was drilled from February to March and cleaned up and seeded in June 1975. There is a good catch of grass over much of the lease. As with M-16, much of the site was lightly bladed with the result that the soil polygons (hummocks) are reforming and native plants that survived the operations as well as the reseeded should provide considerable plant cover in 2-4 years. The lease is very clean and dry, one of the best looking leases the first year (1036-26-11).

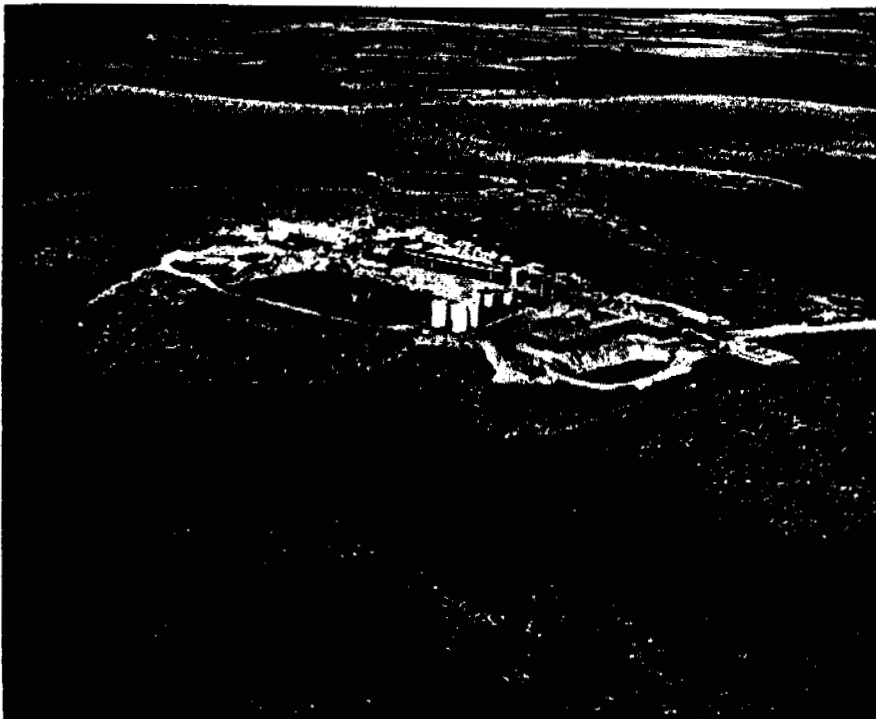


1037-27-11

General view J-06 showing
the clean and dry lease.

Y. Gulf-Mobil Parsons A-44

This well on a hill top was drilled from April to July (1037-22-10). The topographic location and vegetation would indicate that ice content should have been rather low, yet massive ice was found in the sumps. However, the faces stabilized in July through the provision of extra gravel and plastic on the banks, which slumped off and "sealed" the sump faces (1037-23-7). An estimated 60-65% loss of volume has occurred with the sump spoil, but the volume of gravel on the pad should result in an adequate volume for back fill.



1037-22-10

Aerial view of A-44,
note the neat place-
ment of equipment and
supplies

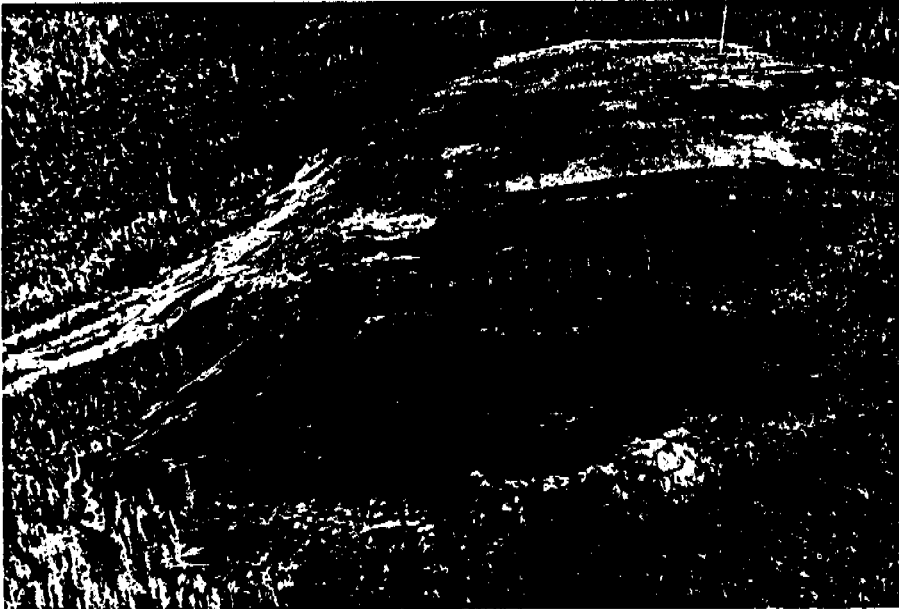


1037-23-7

Sump face showing the
remains of plastic used
to help seal the ice-
rich walls.

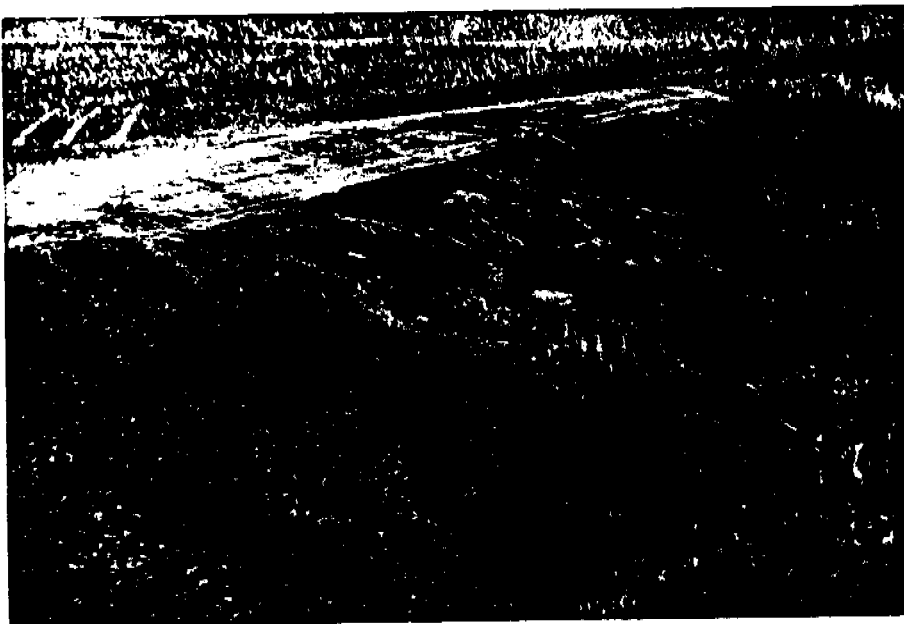
Z. Gulf-Mobil Caribou N-25

This well was drilled from April to September and the lease restored in early 1975 and seeded in June. The site is on a bench which drops off steeply to the Caribou Creek (1037-36-25). Water saturated soil slumped during spring and summer (1037-38-5A) and some additional slumping may occur in subsequent years. However, slump material is not removed from the base by water (1037-38-1A) and thus a new angle of repose will form with time. The rapid growth of grasses at this site (1037-37-5) within a forest climate indicate that with reseeded on the slope, stability should be enhanced (1037-37-6). The flare pit was planted to grass and shrubs (1037-37-22). Unless excessive runoff occurs with snowmelt this depression should rapidly stabilize.



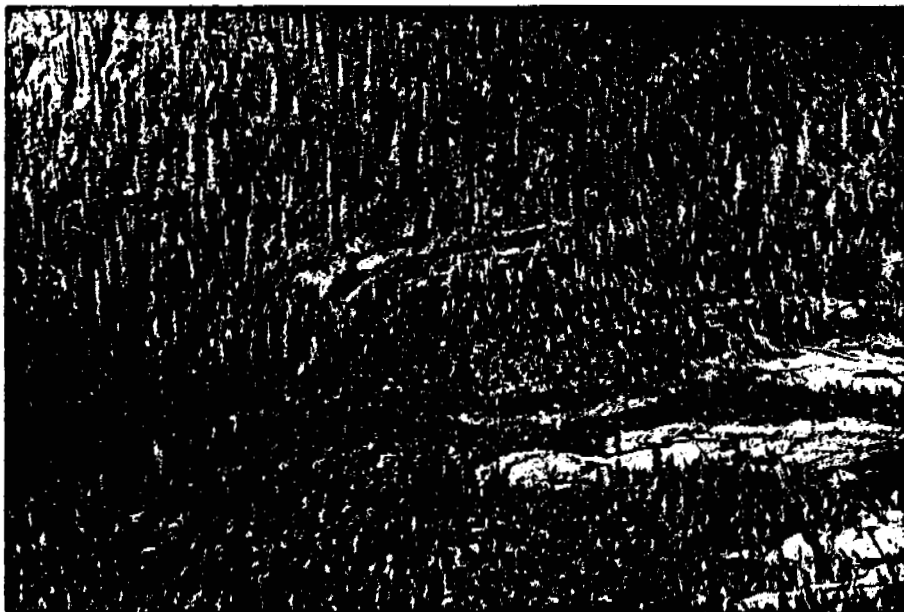
1037-36-25

General view of N-25
showing one small pond
and the sump slope



1037-38-5A

Slope showing slumpage
along about 50% of
the face



1037-38-1A

Lower slope showing
that little of the
flow reached the
stream.



1037-37-5

Lush growth of grasses
seeded June 1975



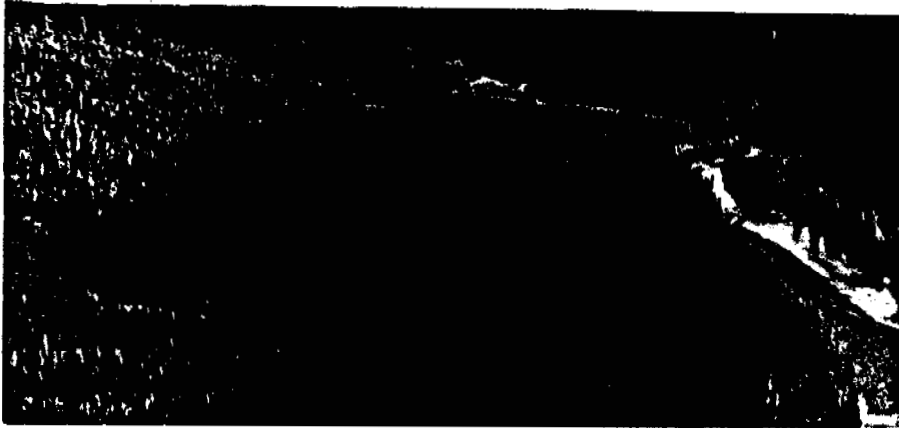
1037-37-6

Close-up of slope
showing some clumps of
grass and favorable
microsites for grass
establishment



1037-37-22

Flare pit with trans-
planted shrubs and grasses



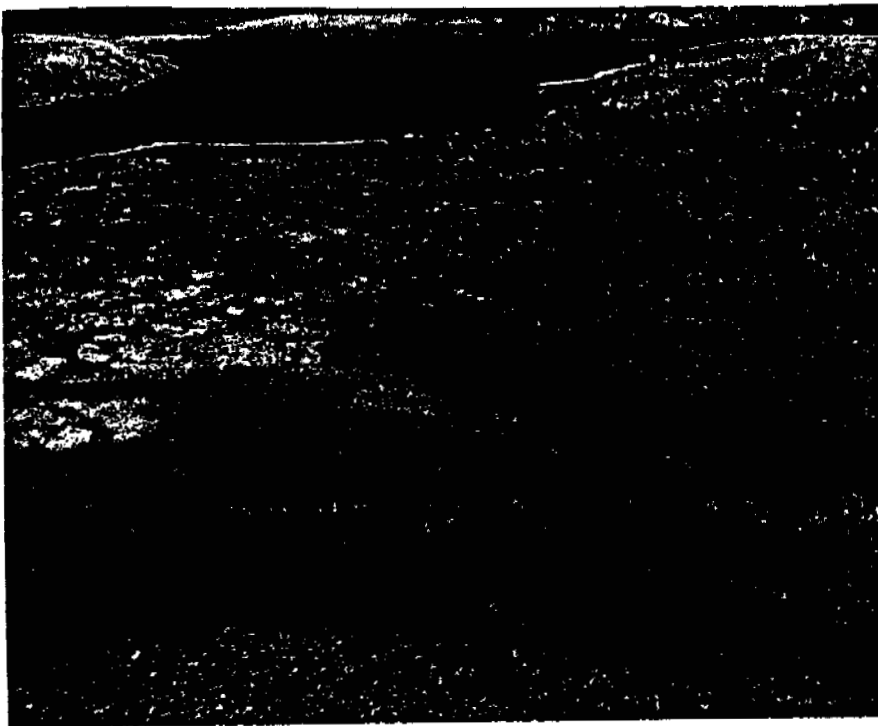
1037-39-9A

Air strip on which many plants remain. There is no indication of water or thermokarst erosion (1037-38-9A).

IV. NEW WELL SITE

A. Gulf-Mobil Parsons

This is an aerial view prior to site preparation for 1975-76 winter drill (1037-18-9),



1037-18-9

General view for a
winter 1976 drill
near Parsons Lake

V. WINTER ROAD AND AIRSTRIP

A. Lucus Point - Parsons Lake Winter Snow-Ice Road

This road has been used for three winters in the movement of many loads of equipment and supplies. Although some surface disturbance has occurred, there is little if any evidence of meltout and slumping (1037-23-9). The bridge across Holmes Creek has had the approached rebuilt (1037-23-12).



1037-23-9

Parsons Lake-Lucas Point
winter road. Note there
is no evidence of melt-
out and that disturbance
impact is reduced through
the wet land (natural
ponds) in the centre right



1037-23-12

Rebuilt bridge over
Holmes Creek

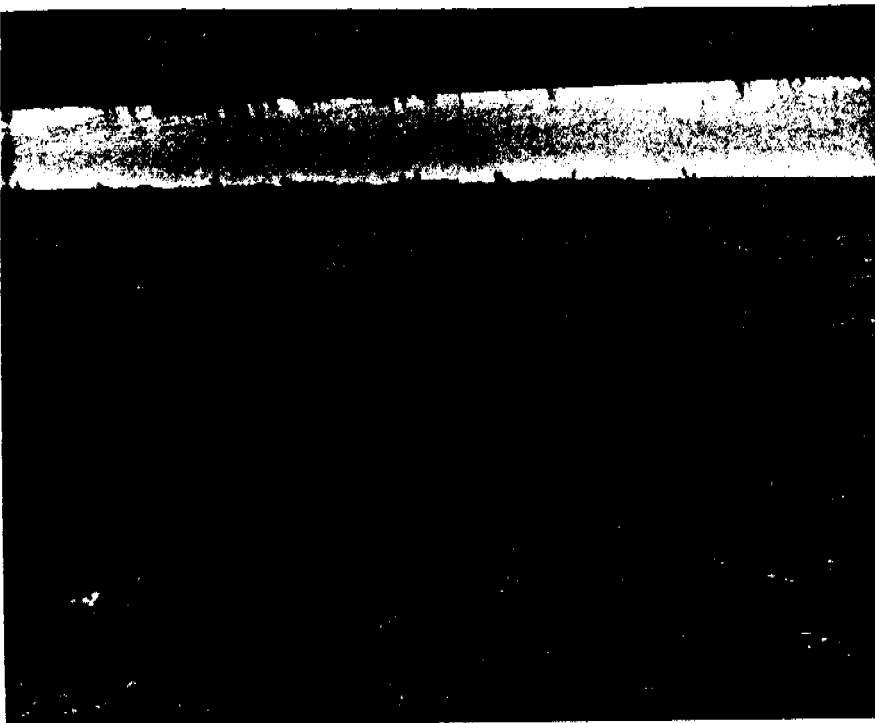
B. Rat Air Strip

The airstrip has been used a third winter and while plant cover is less than in previous years (1037-33-10, 1037-33-12), there is still considerable regrowth. The land remains in good condition with no evidence of melt-out.



1037-33-10

Rat strip after
three winters of use



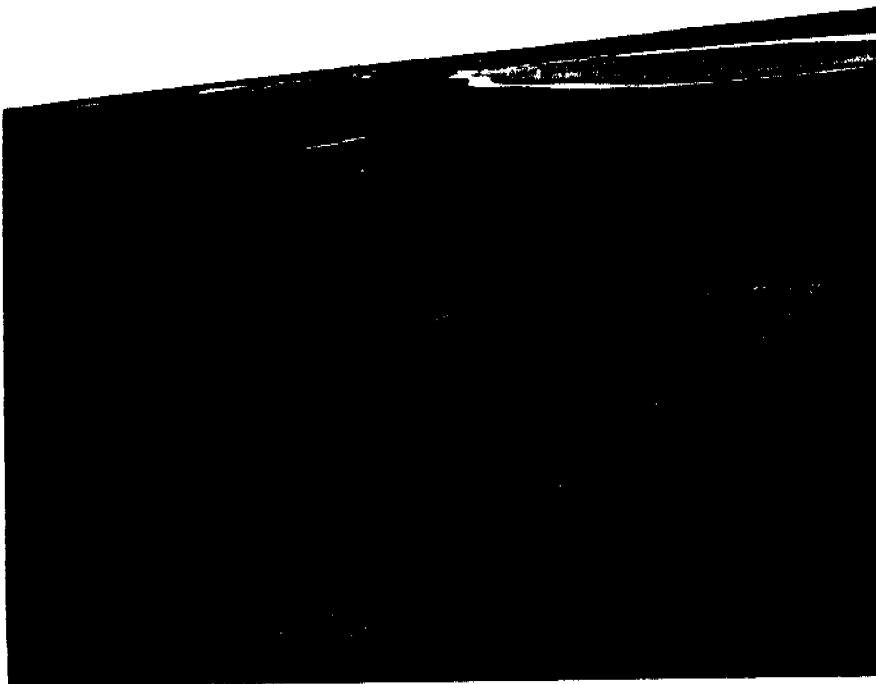
1037-33-12

Regrowth of grasses
and forbs but with
less willow than in
the past.

VI. STAGING SITE

A. Toapolak Staging Area

This site has been used three years and as evidence from the air, it has been maintained very well with very little indication that vehicles or equipment have gotten off the pad other than via the snow road (1037-3-1).



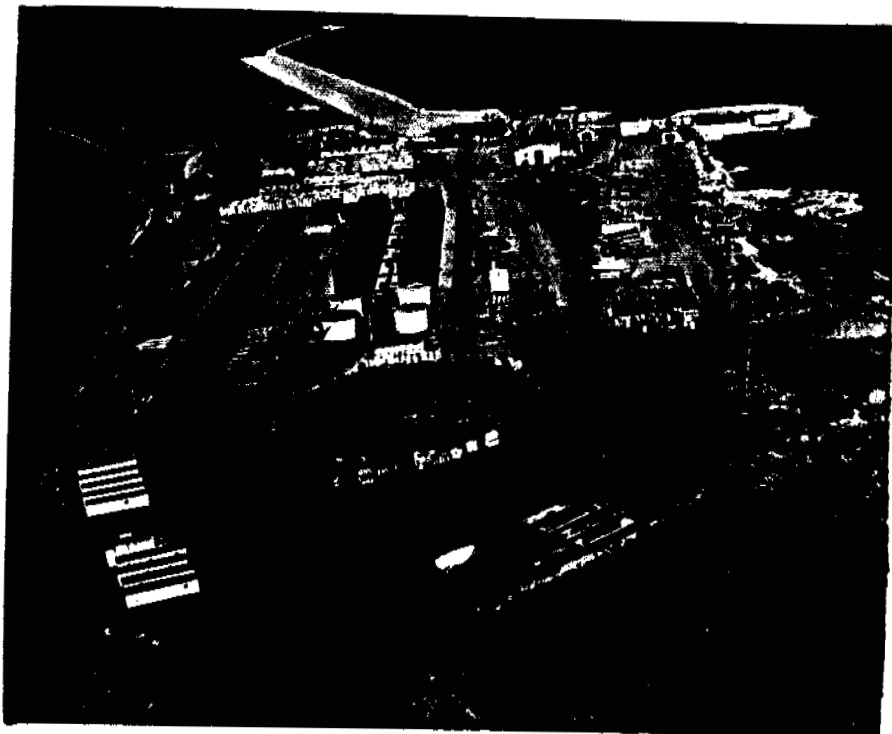
1037-3-1

Toapolak staging site
after three years of use

VII. BASE CAMP

Swimming Point Base Camp continues to be maintained in an environmentally sound manner over its four years of operation. The gravel pad had been expanded to the east to better accommodate the garbage - refuse pit and the storage of equipment (compare 1037-24-9 in 1975 and 791-30-11 in 1972). The tanks were being painted at the time of this survey. Bank stability has been somewhat of a problem, although the amount of shrub cover has changed little since 1972.

The botanic Garden was initiated in August 1973 to include the old corral and the adjacent pen area (1037-24-6). It contains native plants typical of dry slopes and ridges (1037-34-1), rolling upland with shrubs (1037-34-3), common grasses and sedges (1037-34-6) and wet sites with sedges and flowering herbs. There are approximately 90 labeled species in the Garden.



1037-24-9

General view of
the base camp



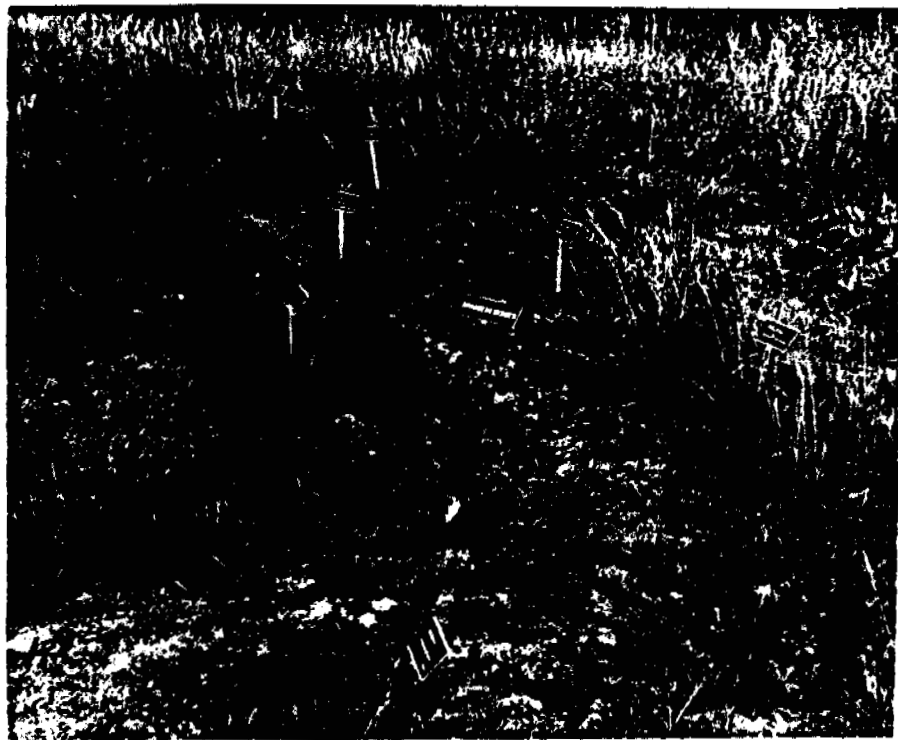
1037-24-6

Swimming Point Botanic
Garden showing shrub tundra
in the corral and beyond.
Wet tundra plants are
within the boardwalk
with the grasses and
sedges to the right and
dry slope plants to the
left of the walk



1037-34-1

Dry slope plants



1037-34-3

Native grasses and
sedges



1037-34-6

Dwarf heath shrubs in
the shrub tundra section

VIII. CONCLUSIONS AND RECOMMENDATIONS

The fourth annual environmental survey shows that nearly all leases have significantly improved in terms of terrain stability, drying of pools, and regrowth of vegetation (natural and reseeded).

Initial site restoration is more successful for the first winter drilling, because there is no loss of soil volume, and therefore, there is adequate material for adequate caps on all sumps. Gravel pads are not needed in this first round of wells which conserves material needed for other uses and its absence provides a much better seed bed.

Medium-term and long-term restoration procedures should be based upon terrain stability. If a site is drying out or if there is little surface subsidence and expansion of small ponded areas, further site restoration is not recommended. Additional site leveling should be limited to those leases, where surface stability is deteriorating. Small ponded areas are aesthetically less pleasing, but the terrain cost of thinning the cap of a sump for spoil or winter road construction to bring in gravel may result in more environmental damage than the restoration procedure will correct.

If small drainage channels run through a lease, it becomes difficult to prevent one or more "ponds" from forming (A-01, I-37), and at the former lease a stable pond surrounded by vegetation has developed in three years. Leases away from drainage channels can be effectively dried by maintaining drainage channels or by pumping out ponds as at F-48.

Lowland leases on ice-rich high centre polygons often result in wet sites that regardless of restoration procedures will remain wet for a number of years (P-53, C-55). Reseeding should be done at Ya Ya P-53, but no other restoration is recommended for either site.

Reseeding of all upland leases is recommended to speed site stability. As the pictures show, this is successful on mineral soil, but of very minor success on gravel. The earlier leases in areas with considerable populations of native grasses reseeded naturally in 2-4 years (C-38, P-60, A-01) as opposed to G-04 where native plant establishment has been very slow. This site should be seeded this spring.

Floodplain sites in the modern delta (K-26, O-54, N-46) will remain wet for several years because of annual flooding. Reseeding these leases is not very successful beyond the first year because of silt deposition and standing flood waters. Let natural succession take place with reestablishment of willows and sedges. Should ponds occur as at K-26, they will slowly fill with silt from flooding.

In spring and summer drilling, angle the well sump from the rig, leaving as much land as possible between rig and sump wall. The use of extra gravel along the edges and plastic over the sump wall enable a slope of gravel to build up and protect any massive ice as the wall melts back.

Unless absolutely necessary, do not blast a second well sump. The several wells where these have been used including Ya Ya A-28, result in problems of inadequate volume for backfilling, especially spring and summer wells. Flare pits have been a problem in 1974. It is

recommended that rip-rap be added and covered where possible with a cap of peaty soil.

Rip-rap and peat were successfully used to prevent melt of massive ice wedges that were exposed at N-10. This procedure is recommended in future situations of this kind.

Where possible fill sumps with gravel and use the mineral soil-peat surface materials to spread over the surface. This will provide a much better seed bed.

The procedure used at M-16 and J-06 early winter drills should be repeated where possible. The surface was lightly bladed which removed soil from much of the lease, material that could be used to cap sumps. This left surfaces (at least 30% of the lease) on which native plants with intact root systems will regrow. Light fertilizer application would stimulate plant growth.

Encourage the addition of polar grass (Arctagrostis latifolia) to the seed mixes to speed the establishment of a permanent sod.

When sump analysis show that toxic materials are not present and there is no danger of fluids getting into lakes, partially pump out sumps prior to back-filling. This will reduce some of the problems of wet sites.