

19

Facilities Complexes and Equipment Operations

Many witnesses at the formal and community hearings described the impact that construction and operation of compressor stations and associated pipeline facilities and equipment is likely to have on the physical, biological and human environment. I have dealt elsewhere with transportation, the physical environment and the location of the pipeline in relation to wildlife, all issues that have direct bearing on the complexes of facilities and the operation of equipment during pipeline construction and operation. Aircraft control is integral to both this chapter and the chapter on Transportation; the subject is dealt with separately because of its complexity and its central importance to effective environmental control in the region.

In this chapter, I shall focus on compressor stations and associated facilities in their relation to the environment. I recognize the artificiality of this categorization in view of the complex interrelationship of all aspects of the environment, of which a fuller appreciation is given in the chapters of Part Two of this volume. In this chapter, I shall simply present some concerns and recommendations related to specific aspects of the project.

The impact of the construction and operation of the facilities that are associated with the pipeline will depend on two factors, with which I shall deal in turn. The first is the location and design of facilities — particularly of compressor stations — in relation to terrain sensitivities, fish and wildlife habitats, migration routes and aesthetic factors. The second relates to the operation of the equipment that is associated with those facilities.

Facilities Complexes: Location and Design

Compressor stations will be located along the pipeline at intervals of approximately 50 miles at hydraulically optimum points chosen on the basis of pipe and station size and on gas volumes; the position of the stations may then be adjusted slightly to accommodate site-specific geotechnical considerations. The degree of flexibility in choosing and

adjusting station sites is said to be limited if hydraulic balance and throughput efficiency are to be maintained.

Compressor station sites will be the focal points of activity during the construction and operation of the pipeline because frequently they are also the location of airstrips, heliports, temporary and permanent roads, wharves, stockpile sites, borrow pits, camps and permanent staff quarters. They are, therefore, called facilities complexes.

From a broad, regional perspective, the pipeline is a linear development across the northern landscape with nodes of activity at 50-mile intervals. From a local perspective, however, these nodes are the focal points of many environmental concerns. For example, a facilities complex could sprawl from a wharf site on the Mackenzie River to stockpile sites on the right-of-way and include heliports, airfields and borrow pits. It may include several miles of connecting roads and encompass tens of square miles of land. Such complexes were characterized at the Inquiry as mini-industrial developments and from an environmental perspective, they must be viewed in this way.

Activities at these facilities will be at a high level during the construction phase, and they will persist at a lower level, punctuated periodically by special maintenance and emergency operations, throughout the life of the pipeline. There may also be sustained bursts of activity at compressor sites if the gas pipeline is looped or if an oil pipeline is built. Should these events occur, the whole construction scenario would be repeated — perhaps with greater environmental consequences.

Construction of the pipeline cannot be considered as a single event. Even after construction is completed, there will be some disrupting and disturbing activity, and that activity will be particularly pronounced at the facilities complexes.

Biologists and other people at both the formal and community hearings voiced concern over the levels of logistical and construction activity at these facilities complexes and over their potential effects on the environment and on society. These witnesses expressed concern about the effect of disturbance by transport activities, noise and increased

human access during critical life stages of birds, fish and mammals; the impact on fish, aquatic biota and habitat, of run-off, sedimentation and increased siltation caused by the disruption of drainage and the construction of facilities on gravel pads; the threat to bird and fish populations posed by spills of fuel and hazardous substances; and the aesthetic results of the location and design of these facilities. In particular, native people were concerned about the possible impacts on their resources and their way of life.

Overall Plan

The various engineering and environmental aspects of facilities complexes have not yet been brought together in a clear and comprehensive way. An overall plan is, therefore, essential if the extent of the activities, their interrelationship and their impact are to be properly understood by everyone associated with their design, approach and regulation.

1. Before the final design phase, the Company shall prepare for approval by the Agency a comprehensive, but concise, overall plan for the project's transportation facilities, including airstrips, heliports, temporary and permanent roads, wharves, stockpile sites, borrow pits, camps and permanent staff quarters. This plan shall take into account the other overall plans requested elsewhere in this report. The Agency may request the Company to resubmit parts of this overall plan if, for any reason, they do not meet with its approval. The Company shall undertake to keep this overall plan up to date to reflect the latest policies and actions of the Company, the Agency and government.

2. The overall plan shall show in map form the location of all project facilities related to the pipeline right-of-way, the Mackenzie River, existing communities and existing or proposed facilities not related to the project, such as the Mackenzie Highway, land lines, winter roads, borrow pits and wharves. The overall plan shall also specify the design standards to be applied, the general work schedule for each facility and, if requested by the Agency, the total estimated capital cost and the annual operation and maintenance cost of each facility.

In addition, the overall plan shall outline the rationale that was used to determine the design standard and location for each particular facility and the reasons why the Company has chosen to build new wharves and stockpile sites or to use existing facilities; to use temporary or permanent wharves and stockpile sites; to use gravel roads or snow roads; to build new airports or heliports or to use existing facilities; to use airstrips or heliports; and to use new or existing rights-of-way for roads or other linear facilities.

The overall plan shall list all of the assumptions that the Company has made regarding the availability of existing facilities and the approximate volume of project-related traffic that such facilities will sustain during the construction

period (broken down into monthly or seasonal periods, as appropriate) and during pipeline operation (broken down on a quarterly basis); all of the assumptions that the Company has made regarding facilities that parties not associated with the pipeline company may build, for example, extensions to the Mackenzie Highway and facilities built by the gas producers in the Delta.

3. The overall plan shall be approved by the Agency before the Company submits site-specific applications for construction and operation of facilities.

Site-specific Applications

4. The Company shall file with the Agency site-specific applications for the construction and operation of each compressor station and for other facilities. Each of these applications shall be integrated into the overall plan. Because the operations of all facilities at compressor stations are generally interrelated, site-specific applications shall be submitted on the basis of a complex of facilities centred on a compressor station, unless otherwise approved by the Agency. That is to say, applications for activities at each compressor station site and for all associated facilities that serve that site and the adjacent right-of-way shall be filed as a group.

5. Each application shall include a concise summary of all engineering, socio-economic and environmental information that was used in site selection; construction drawings and specifications that comply with the relevant design and environmental standards of the government and the Agency; the schedule of construction and the duration of use of all facilities; the maximum anticipated volumes of traffic and camp populations for various periods during construction and operation; and the exact location of the sources of borrow material and of haul routes, together with the quantities and quality of this material. Each application shall state whether or not the facilities will be required during the operations and maintenance phase of the pipeline. Each application shall include plans for the abandonment of facilities that are not required after construction and for the eventual abandonment of all facilities when the useful life of the project has ended.

Location and Design Considerations

The cumulative level of activities at the facilities complexes and the period over which these activities will take place have the potential for the creation of unacceptable environmental disturbance. The location and design of these complexes is fundamental to a successful resolution of the environmental concerns that they raise. For example, in the chapter, The Physical Environment, I describe the importance of valleys in the northern ecosystem. Valleys are as important to the local ecosystems that the pipeline will cross as the facilities complexes are to the pipeline itself, for they are also nodes of activities – geological, hydrological, biological, cultural and socio-economic – within an ecosystem. This is

why I recommend in the chapter on The Physical Environment that, wherever possible, facilities (particularly groups of facilities) should be kept out of valleys.

6. The location and design of facilities complexes shall conform to the recommendations I have made in Parts One and Two of this report to protect local people's activities and the terrain, waterbodies, wildlife and fish. In general, location and design shall take into account the specific characteristics of the local and regional environment, including geotechnical characteristics, wildlife and fish habitat and migrations, local land and water use, archaeological resources, and the aesthetic values of landscapes and waterbodies. In view of the central importance of valleys to the regional landscapes, ecosystems and land use patterns of local people, particular care should be taken to avoid adverse environmental effects on valleys.

7. Upon abandonment of a facility, it shall be removed and the area shall be restored, as directed by the Agency.

Many particular concerns and recommendations related to facilities complexes are dealt with elsewhere in this report, but a few issues arose during the course of the Inquiry that warrant particular mention here.

ROADS, AIRSTRIPS AND HELIPORTS

Biological experts testified that their greatest concern with respect to roads, airstrips and heliports is that they will increase access to formerly isolated areas and will pose a serious threat to the viability of populations of caribou, moose and Dall's sheep that have survived mainly because large parts of their habitats are inaccessible.

8. During construction, the Company shall limit the use of all roads, airstrips and heliports under its jurisdiction to vehicles and aircraft that are associated with the pipeline project. Access to facilities built by the Company for its own use shall be limited to authorized personnel of the Company, Agency or government. The Company shall take all reasonable steps to discourage access by any other persons.

9. After construction and during the operation of the pipeline, the Company shall limit access to the roads, airstrips and heliports that will be required for its operation and, using methods approved by the Agency, shall remove or otherwise obstruct access to facilities that are not required. Where local people and government authorities agree that project access roads to previously inaccessible areas are beneficial, such roads shall be left intact after pipeline construction is completed.

Well-travelled roads, steep embankments, and, to a lesser extent, airstrips act as barriers to migrating caribou. Not only will such barriers increase exposure of caribou to hunters and predators, they may cause minor diversions in line of travel,

long-term changes in migration patterns, and even abandonment of part or all of a traditional range. Roads can also be barriers to fish if stream crossings are not properly designed.

10. The Company shall design and maintain roads so that easy passage of fish and mammals is assured. Culverts shall be designed so that the passage of fish is not impeded. (See Fish.) The Company shall not use snow clearing techniques that leave long, unbroken stretches of snowfence or deep drifts and snowbanks that could impede the movements of caribou. Snowfencing shall be removed in spring before the migrating caribou arrive.

When surface and subsurface drainage is affected, as it may be by the construction of gravel pads, the result may be erosion and sedimentation. These, in conjunction with run-off water that may contain fuels or other toxic substances, could disturb waterbodies and could pose a hazard to aquatic ecosystems.

11. To protect waterbodies from impacts associated with the construction and operation of roads, airstrips and heliports, an undisturbed buffer strip 300 feet wide, or as specified by the Agency, shall be left between each facility and adjacent waterbody.

12. The construction and operation of roads, airstrips and heliports shall not adversely affect local drainage patterns. (See Terrain Considerations: Drainage and Erosion.)

WHARF AND STOCKPILE SITES

The environmental problems associated with wharves and stockpile sites focus on two items: the disturbance to fish harvesting, and the disturbance of aquatic resources by siltation or by spills of fuels.

13. Because stream and river mouths are frequently areas used by local people for fishing and are often areas of high aesthetic, archaeological and recreational value, wharves shall be located at least 1,500 feet away from the estuaries of streams and rivers, unless otherwise approved by the Agency.

14. To minimize the problems related to drainage and erosion and their adverse effects on waterbodies and fish, stockpile sites shall be located 300 feet from the shoreline, unless otherwise approved by the Agency.

15. In selecting sites for wharves and stockpile sites, the Company shall consider the requirements for effective control of accidental fuel spills. For example, areas of fast water and limited access, and areas that have important biological or sociological features susceptible to spills shall be avoided. (See Management of Fuels and Hazardous Substances.)

16. Unless otherwise approved by the Agency, all storage areas for bulk fuel and chemicals shall be located at least 1,000 feet from any waterbody. To reduce the risk of a spill entering a waterbody, storage facilities for fuels and chemicals shall be located on the part of the site farthest from the water. (See Management of Fuels and Hazardous Substances.)

17. To reduce the risk of leaks not being detected and to facilitate maintenance and repair, all fuel piping systems at wharves, stockpile sites and camps shall be located above ground, except at places, such as road crossings, where short sections of the pipe shall be installed in culverts.

CONSTRUCTION CAMPS

In the socio-economic chapters of this report, I make some recommendations that pertain to the operation of camps. The control of alcohol and of access to communities by camp personnel are examples. On the environmental side, I am most concerned about locating and operating camps so that their adverse effects on terrain, waterbodies, mammals and fish are kept to a minimum.

18. To minimize the area disturbed, camps shall, where possible, be located at stockpile sites, wharves or compressor station sites. Applications to locate camps elsewhere shall be supported by documentation explaining why the camp cannot be located at a preferred site.

19. The camps built or used by the Company shall provide their own support facilities, such as power and water supply, their own sewage treatment and disposal, first aid stations, and recreational facilities.

Compressor and Related Noise

In the chapter on The Physical Environment, I discussed the adverse effects of noise in general. I now wish to address the specific problems of high intensity noise produced in the operation of compressor stations, and to make recommendations on how these problems can be avoided or reduced.

Not all compressor stations will be the same: all stations will have compressors, but the horsepower will vary; some stations will have heat exchangers to chill the gas, but others will not. The noise will, therefore, vary in pitch, intensity and duration from station to station. Gas turbine engines produce high frequency, directional noise at the air intake and low frequency, non-directional noise at the exhaust. Heat exchanger fans direct noise upward and pipes emit high-frequency, pure-tone noises. Vent valves when "blown down" produce intense noise levels — at and beyond the threshold of pain — although the duration is short and the occurrence is infrequent. Control valves and various auxiliary pieces of equipment contribute lower intensity noise.

Because there are so many sources of noise at compressor stations and because the ultimate noise level is so dependent on final design, I do not propose to specify details of noise control. Rather, I will highlight noise problems from an environmental (as opposed to worker safety) perspective and discuss the objectives of ameliorative measures.

20. To minimize disturbance to wildlife and people and to maintain the environmental attributes of the region, the best practicable technology shall be employed for compressor station noise abatement.

The pipeline companies have undertaken to restrict ambient noise levels at the compressor station fence line of compressor stations to 60 dBA. The National Energy Board, while accepting this, foresees that further noise abatement measures might be necessary to prevent adverse environmental effects. Industry's commitment to restrict sound to a maximum of 60 dBA can be interpreted as evidence that such attenuation can be achieved. Evidence brought before me clearly indicates that it is technically possible to attain even lower levels. Carl Koskimaki, testifying for Arctic Gas, said that "maximum silencing" techniques could reduce fence line noise levels from the 59-67 dBA range to around 50 to 53 dBA (F3937).

It is difficult to judge how much noise abatement will be necessary to protect birds and wildlife from unacceptable disturbance. The problem is site-specific and depends both on the nature of the installation and on the local environmental sensitivities. The evidence I heard emphasized the sensitivity of birds, in particular snow geese, to compressor station noise. Dr. William Gunn, an ornithological consultant to Arctic Gas, suggested that, at compressor stations adjacent to habitat frequented by significant numbers of birds, noise levels should not exceed 50 dBA at a distance of 1,000 feet. Various figures have been quoted by other specialists. Clearly, there are circumstances that warrant reducing noise below conventional abatement standards.

21. Compressor stations located in environmentally sensitive areas and areas used extensively by local people shall incorporate special noise abatement designs and operating measures to reduce the disturbance effects to levels that permit normal use of the regional environment. The determination of these site-specific levels shall rest initially with the Company, and prior to completion of design, all the supporting information leading to the design levels shall be submitted to the Agency for approval.

CUMULATIVE EFFECTS

As with all other environmental impacts, each source of noise must be considered in the present and future context of cumulative impact. Although compressor stations will be major sources of noise pollution, they will be only one factor in a much broader setting. Noise will emanate from each part of a facilities complex. In the future, looping, additional compressor units, an oil pipeline, a highway, roads and more people may augment the problem. In the Mackenzie Delta, ongoing petroleum exploration and development will be a major factor, especially in view of the environmental sensitivity of the area during certain times of the year.

Station layout and design, equipment specification, and operating procedures are nearly as important as noise suppression devices. It is costly and perhaps technically impossible to make changes after a problem arises; therefore, careful planning and design are essential. Furthermore, the

cumulative impact is handled more effectively and economically by proper initial design of all contributing sources rather than by overly strict constraints on subsequent additions.

22. *Noise abatement plans for pipeline facilities shall incorporate cumulative considerations of all sources of noise. This consideration shall encompass all company and private activities that can be expected to occur in the region of impact throughout the life of the pipeline project. Particular attention shall be given to facilities in the Mackenzie Delta as they relate to ongoing petroleum developments and to the cumulative effect on migratory birds using the area during nesting, moulting and staging.*

MONITORING

Installation of noise attenuation devices and implementation of abatement procedures will not necessarily ensure compliance with site-specific environmental constraints. Much of the design is theoretical and, as I have explained, noise emissions are complex and difficult to predict. There is a need both to test the noise levels at each site shortly after start-up and to monitor the levels on a long-term basis to ensure that acceptable cumulative levels are not exceeded.

23. *The Company shall monitor the noise level of each compressor station as prescribed by the Agency and shall report the results to the Agency within six months of start-up of each station. The Company shall monitor the noise level periodically throughout the life of the project as required by the Agency and in any case within six months of any modification that is likely to alter noise emissions.*

BLOWDOWN NOISE

From time to time, the pipeline at compressor stations and meter stations will be blown down to atmospheric pressure, and meter stations. These blowdowns occur rather infrequently during normal maintenance operations, and also under emergency conditions. The pressure of the gas in the pipeline causes vented gas to escape at very high – even supersonic – velocity. Noise levels of 140 dBA (beyond the threshold of pain) are reached and exceeded. For obvious reasons, unattenuated blowdown noise is totally unacceptable in sensitive wildlife areas, where native people are hunting, fishing or trapping, or near settlements and recreation areas.

24. *At all compressor stations, the Company shall install the best practicable noise attenuation equipment to reduce blowdown noise to levels that will minimize the disturbance to humans and to wildlife.*

25. *As part of the final design, the Company shall submit plans, designs and operating procedures (including expected frequency of maintenance and emergency false-alarm blowdowns) for compressor stations, meter stations or other project facilities where blowdown can be expected during the life of the pipeline.*

Emissions from Facilities

Changes in air quality that are associated with major construction projects are generally temporary or localized in nature, and they are not, therefore, considered to be one of the more serious environmental issues. But, because the ambient air quality of the Mackenzie Valley and Western Arctic is still virtually unimpaired, the next major source of industrial air pollution takes on greater significance than the magnitude of the emissions alone would otherwise merit.

COMPRESSOR STATIONS

The Arctic Gas pipeline project would require a 30,000-horsepower compressor station every 50 miles, usually accompanied by a 17,000-horsepower chilling unit. We can assume that a future gas pipeline project in the Mackenzie Valley will be of comparable magnitude. Natural gas, which is among the cleanest of fuels, would be used to power the pipeline. But each station would emit nearly 1,000 tons of exhaust gases per hour for a total of about 400 thousand tons per operating day for the whole pipeline North of 60. Of this 400 thousand tons, about two million Imperial gallons is water vapour or steam. The volumes are impressive. Furthermore, these emissions will continue and even increase for at least two decades.

Concern about compressor station emissions focuses on the potential problems of ice fog and concentrations of nitrogen dioxide.

26. *In final design preparations, the Company should include site-specific analyses to ensure that all its compressor stations comply with the Clean Air Act: Ambient Air Quality Objectives (The Canada Gazette, Part II, Vol. 108, No. 11, and Vol. 109, No. 3). (See The Physical Environment.)*

The National Energy Board concurs with this recommendation, but in its report does not state explicitly whether it is the "maximum desirable level" or the less stringent "maximum acceptable level" of nitrogen dioxide that it fears may be exceeded. For reasons stated in the chapter on The Physical Environment, I believe the "maximum desirable level" is appropriate in the Mackenzie Valley from a purely environmental standpoint. I cannot comment on the practicability of achieving this level because the detailed technical design considerations are the responsibility of others. But I must note that, if it is not practicable here, it is probably not applicable anywhere, and in that case, it should be reassessed.

27. *Air quality over the long term should be monitored and, in particular, the problems associated with ice fog near communities and at transportation facilities should be assessed. Relocation of pipeline facilities or other preventive measures that can be implemented only during the initial design and construction phases may be the only way to ameliorate unacceptable conditions.*

OTHER EMISSIONS

The construction phase of the project may also cause air quality problems, although combustion emissions produced during this phase will be of smaller volume and of much shorter duration than during pipeline operation. Incinerators, space heaters, vehicles, construction equipment and open fires will burn mainly gasoline, diesel fuel and similar substances. Their use will produce relatively low velocity and low temperature emissions of various kinds, which will stay near ground level. Dispersion above even a shallow inversion layer is unlikely. Such emissions contribute both the nuclei and the water vapour that are essential to ice fog formation, and they contribute pollutants that accumulate as inversion conditions persist, eventually exceeding established ambient air quality objectives, even though emission standards for individual pieces of equipment may have been met.

I understand that emission guidelines or standards are being drafted by the Environmental Protection Service, Department of the Environment.

28. The Agency should consult with the Company and the Department of the Environment with respect to requirements for emission control devices and to the maximum permissible levels of emission for construction equipment and vehicles.

Emission control devices are adjusted at the factory by the manufacturers of vehicles and equipment to meet government requirements. Of course, these devices may be rendered less effective or useless if tampered with later. In recognition of this problem, Ontario has enacted legislation to prevent removal or alteration of the devices so that they fail to comply with regulations (Ontario, Statutes of Ontario, *The Environment Protection Act, 1971, c.86 as amended by c.94, 1973*). This law could be used by the Agency as a model to develop measures to prevent tampering with approved and specified settings of emission control devices on construction equipment and vehicles used on the project.

Equipment Operations

The aspects of the pipeline project that I have described – that is, the aspects relating to physical plant – are only one part of the environmental impact associated with facilities complexes. Construction and maintenance of the pipeline right-of-way and operation of the facilities will depend on the use of a variety of equipment with attendant environmental consequences. Construction involves local and long-distance hauling by truck, barge, aircraft and helicopter. Stations and bases will be supplied by barge and truck, access to the right-of-way will usually be by truck or helicopter, travel along the right-of-way will involve off-road vehicles, and most line patrols will be carried out by light aircraft. The effects of all these operations will occur during all seasons, they will be

widespread, and each will raise particular environmental concerns.

The potential risks to waterbodies, terrain, fish, birds and mammals will be great if the construction and operation activities associated with these operations are not carefully planned and controlled. Although the environmental impacts and mitigative measures related to the operation of equipment tend to be activity-specific and site-specific, we can gain an overall perspective by discussing the issue according to the three types of vehicles involved: road vehicles, off-road vehicles and barges. Aircraft pose a special problem that I deal with in a separate chapter, Aircraft Control.

There are two general recommendations that are important in meeting the environmental concerns that I set out in the chapters on The Physical Environment, Wildlife, and Fish.

29. The Company shall assess the environmental effects and limitations of all equipment used for construction and operation of the pipeline and shall select equipment that is least disruptive.

30. The Company shall establish clear environmental and scheduling guidelines for equipment deployment and operation during all aspects of construction and operation.

Road Vehicles

A great many vehicles are required on any pipeline project. Arctic Gas planned to use 350 tractor-trucks, a corresponding number of trailer units, and 1,500 trucks during the construction phase. Local transportation and maintenance activities at each compressor station site and at the regional headquarters sites will require road vehicles, such as cars and light trucks, and work equipment, such as graders and loaders. The operation of these road vehicles poses various environmental problems. For instance, in the chapter on Wildlife, I describe how road traffic can disturb wildlife and act as barriers to migrations of mammals. There are also indirect problems: vehicles using snow roads and temporary winter stream crossings can damage terrain and water resources; and fuels and other hazardous substances could pose local environmental problems if they were spilled during transportation. I have dealt with these types of problems and the mitigative measures throughout this report. The recommendations that follow are meant to supplement those specific aspects by providing a general approach to the operation of road vehicles.

31. Unless otherwise approved by the Agency, road vehicles shall be operated only on public roads or other suitably prepared surfaces within designated rights-of-way or on lands covered by permit.

32. Operation of road vehicles shall be scheduled to avoid adverse impacts on terrain and wildlife. (See Terrain Considerations: Snow Roads, and Wildlife.)

Off-road Vehicles

Off-road or low ground pressure vehicles comprise various wheeled or tracked vehicles designed for use in muskeg, and over rock, rough ground and snow-covered terrain. They will be used to transport equipment and supplies along the pipeline right-of-way, and for normal and emergency inspection, maintenance and repair work. Hundreds of pieces of equipment, such as backhoes, bulldozers, side-booms, graders, earth movers, loaders and specialized trucks, will be required during construction and, to a lesser extent, will be used in operation and maintenance of the pipeline.

The main environmental concern is that the ground surface vegetation mat may be damaged. This could lead to erosion, disruption of surface and shallow subsurface drainage, disruption of thermal regimes in soil and to the deposition of sediment on land or its discharge into waterbodies. The manner in which the vehicles cross watercourses, particularly in summer, also raises concern for fish. In general, these vehicles have a very high potential for disturbance or harassment of wildlife. All these concerns relate to the type of vehicles and, perhaps more importantly, to the way in which they are operated. There will be a great need to ensure that vehicle operators are well-advised of the environmental hazards and do, in fact, operate all off-road vehicles in an environmentally conscientious manner.

33. Use of off-road vehicles shall comply with plans developed in conjunction with, and supervised by, the relevant territorial or federal wildlife, fish and land use agencies, or the Agency, as appropriate. Such plans shall specify types of vehicles, frequency of passage, and times and areas of avoidance. A particular aspect to be addressed is contingency planning for summer travel along the right-of-way. Such planning shall consider travel that may be required due to a pipeline rupture or other technical or environmental situation that requires prompt corrective action.

34. All off-road vehicles shall be operated with particular care to avoid damage to the vegetation mat and drainage courses in both permafrost and non-permafrost areas. Travel along the pipeline right-of-way shall be confined, as far as practicable, to the winter months when there is sufficient frost penetration and snow cover to provide adequate protection of the ground surface.

35. All operators of off-road vehicles shall be familiar with and follow techniques to minimize disturbance to terrain, watercourses, wildlife and fish. Anyone harassing wildlife shall be subject to immediate dismissal.

36. To allow passage of off-road vehicles during routine and emergency operations, and to keep disturbance from such vehicles to a minimum, the Company shall construct drainage and erosion control devices, shoo-fly roads and other devices.

AIR CUSHION VEHICLES

Air cushion vehicles (hovercraft) may be used for access to the right-of-way for normal and emergency repairs, particularly in the Mackenzie Delta. The advantages of using such vehicles in summer, during floods and during freeze-up and break-up are obvious, but there could be adverse environmental effects, principally related to terrain damage and noise.

Terrain damage can be caused by the air cushion itself or by the vehicle or tractor towing the air cushion vehicle. Several passes by a machine, the air cushion skirt of which is in contact with the ground, can damage vegetation and, in permafrost areas, can cause a slight increase in the depth of thaw of the soil. The ability of large, heavily laden air cushion vehicles to navigate on steep slopes is limited and can also lead to terrain damage.

The noise problem is particularly troublesome because periods when use of air cushion vehicles offers the greatest advantages frequently coincide with periods of high sensitivity for birds. These vehicles are extremely noisy to operate. One pass of a towed air cushion vehicle produces a noise greater than 56 dBA over a swath 3,200 feet wide, with lesser disturbance, (between 50 and 56 dBA) for a further 1,600 feet on either side, for a total width of 6,400 feet (Commission Counsel 1976, "Project Operation: Transportation Requirements," p.11).

Clearly, air cushion vehicles have distinct environmental disadvantages that offset their logistic advantages.

37. The use of air cushion vehicles during pipeline construction and operation shall be subject to special approval by the Agency. The Company shall submit to the Agency detailed information on the use and control of such vehicles, including the type and size of equipment, travel corridors, frequency of passage and times and areas of avoidance for wildlife reasons.

38. Air cushion vehicles shall avoid critical wildlife and bird habitat areas when they are occupied. (See Wildlife.) Of particular concern are the areas in the Mackenzie Delta that are important for nesting and staging birds, and offshore areas used by white whales for calving and nursing.

Barges

As I describe in the chapter on Transportation, the barging requirements of the pipeline and gas plants give rise to concerns about strains on normal community resupply services. But there are environmental concerns as well.

In the lower Mackenzie Delta, there are several marine areas that are critical to wildlife. The western portions of the Mackenzie River estuary, particularly Mackenzie, Shallow and Shoalwater bays, are important nursing and rearing areas for white whales and during summer more than 4,000 occupy these areas. The warm shallow waters and plentiful food provide ideal habitat for cows with calves. Similarly, from July through September, many thousands of waterfowl

require the shelter of river islands, coastal lagoons, spits and offshore islands for moulting and staging.

The protection that needs to be accorded wildlife in the area is, in most instances, site-specific. In Volume One, I discussed the need for a whale sanctuary in west Mackenzie Bay and in the chapter on Wildlife in this volume I discuss the site-specific measures necessary to protect critical bird areas. In spite of these prohibitions, however, it would appear that wildlife can coexist with marine transport in most areas if the situation is controlled.

39. *Marine traffic shall be limited to specific shipping corridors through Mackenzie Bay, Shallow Bay, Shoalwater Bay and the lower Mackenzie Delta. Buoyed channels currently maintained by Transport Canada through Mackenzie, Shallow and Shoalwater bays should be reviewed to ascertain whether they can accommodate the substantially greater volumes of traffic that would result from a pipeline and related transportation needs in the Delta area without unduly damaging the natural environment. If, for wildlife*

reasons, the channels cannot be enlarged or extended, they should be relocated as soon as possible to ensure that the channels are well-known before major developments get underway.

A second problem related to marine transport in the context of pipeline construction is spills of petroleum and other toxic materials. Large spills of fuel into the Mackenzie River, the Mackenzie Delta, or the Beaufort Sea could mean the widespread destruction of waterfowl and fish and their habitats. The performance of river operators to date has been good, but a surge of traffic will increase risks because greater volumes of fuels will be handled and experienced labour may be in short supply. A continuing high standard of transport and unloading operation will be necessary if environmental damage is to be avoided.

40. *During the construction and operation phases of the pipeline, Company personnel involved with operating, loading or unloading barges shall follow procedures recommended in Management of Fuels and Hazardous Substances.*