SPILL RESPONSE, CLEANUP AND ENVIRONMENTAL ISSUES ASSOCIATED WITH A METHANOL SPILL IN ALASKA

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LEGAL NOTICE

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SECTION 1

INTRODUCTION

1.1 BACKGROUND

The State of California has taken the lead in developing and implementing alternative fuel strategies to reduce pollution levels in urban areas, and to decrease dependency on foreign oil production. As the use of alternative fuels increases, concerns regarding effective methods of fuel transportation and storage will be brought into focus. In response to these concerns, adequate measures must be developed to ensure that public health and safety is maintained in the event of an accidental spill or release.

One alternative fuel identified by the State of California as a viable substitute for gasoline is methanol (methyl alcohol). As methanol has not historically been used in large quantities, there is very little information available concerning the impact that a large scale methanol spill may have on public health and the environment. There is also negligible information available regarding appropriate spill control and cleanup measures that should be implemented to minimize these impacts. One moderately sized methanol spill which occurred in Alaska in 1989 provides some insight into these problems and issues. This report focusses on this spill, and the resulting control and cleanup measures that were implemented.

1.2 METHANOL SPILL DESCRIPTION

In December 1989, an act of vandalism resulted in the spillage of 9,300 gallons of methanol near Fairbanks, Alaska. The methanol was stored in railroad cars, and was intended for use by ARCO Alaska, Inc. (hereafter referred to as ARCO) as an anti-freeze agent in drilling activities at Prudhoe Bay. Some of the methanol sank into the frozen railbed and the surrounding soil, and a small quantity spilled over into a pit containing partially frozen water. Methanol that accumulated in pools and did not seep into the ground was recovered using vacuum trucks. Contaminated soil was excavated, and the U.S. Environmental Protection Agency (EPA) and the Alaska Department of Environmental Conservation (ADEC) declared the contaminated soil a hazardous waste, and mandated that ARCO dispose of it appropriately.

1.3 PROJECT OBJECTIVE

The objective of the project reported herein was to document the events associated with the spill, and ascertain the following:

- The responsiveness of the EPA, ADEC, and ARCO upon discovery of the spill
- Effectiveness of remediation measures and mitigation efforts
- Significance of the methanol contaminated soil being declared a hazardous waste

Of interest also were recommendations made by EPA, ADEC, and ARCO to improve response and facilitate cleanup of future methanol spills.

1.4 PROJECT APPROACH

This project was completed through a series of data gathering and evaluation phases. The first phase consisted of contacting knowledgeable representatives of the parties involved, and establishing the chronology of the spill and cleanup events. The second phase involved detailed conversations with the EPA, ADEC, and ARCO to document their interactions, and establish how effective these interactions were, and how they might have been improved. The third and final phase of this project consisted of collating and reporting the data collected. Some effort was also spent in extrapolating the project results to identify spill prevention and management measures that may be appropriate to the California alternate fuel program.

SECTION 2

SITE DESCRIPTION AND SPILL CLEANUP

ARCO maintains a general spill cleanup plan that was implemented in response to the methanol spill that occurred in December, 1989. However, the nature and location of the spill, and the ambient conditions existing during and after the spill, determined to a large extent the specific cleanup procedures that were adopted. This section discusses the general ARCO clean-up plan, and the site-specific issues which dictated the soil excavation and groundwater monitoring strategy. The methanol reclamation activities are also discussed here briefly as an introduction to Section 4.

2.1 GENERAL ARCO SPILL CLEANUP PLAN

The general spill cleanup plan developed by ARCO and implemented in response to the methanol spill reported herein is comprised of the following elements:

- Contact the Fairbanks Fire Department
- Contact the Facility Manager
- Contact the ARCO Environmental Group in Anchorage, Alaska
- Contact the National Response Center if amount spilled exceeds the legal reportable quantity
- Contact ADEC to identify appropriate cleanup and treatment options

Control of the spill is handed over to the Fairbanks Fire Department, who operates a Hazardous Materials Response Vehicle. The Fire Department has an overall emergency response plan, which covers a broad range of emergency situations. After the Fire Department determines whether or not evacuation is necessary, and certifies that

the area contains no fire or explosion hazards, site control passes to ARCO and ADEC for cleanup and management.

This procedure proved successful initially; the area was secured by the fire department within 2 hours, and ARCO and ADEC quickly adopted a spill cleanup plan. Complications arose in identifying appropriate treatment/disposal options after the contaminated soil was excavated. The concerns and issues that were raised by EPA and ARCO as a result of these complications are presented in detail in Section 4.

Under federal law, each state is required to have a general spill response plan (also known as a contingency plan) that identifies appropriate spill response procedures, and defines the roles that EPA, State and Local agencies play in selecting an appropriate spill cleanup strategy. The State Oil and Hazardous Chemicals Response Plan (SOHCRP) is the guideline document adopted by the State of Alaska. Unfortunately, this document focusses primarily on oil spill response issues; little can be found pertaining to the situation created by the ARCO methanol spill. For this reason, SOHCRP procedures were not considered applicable, and were therefore not implemented. As a result of the limited scope of this guideline document, it is currently undergoing extensive revision. The State of California spill response document is more general, and will be a critical element in identifying and selecting appropriate cleanup strategies in the event of a methanol spill in California. This document is discussed more fully in Section 5.

2.2 SITE DESCRIPTION AND ENVIRONMENTAL CONDITIONS

The spill occurred at a material storage and transfer facility in Fairbanks, Alaska. Approximately 9,300 gallons of methanol were released; most of the methanol spilled off

the railbed onto the gravel pad covering the facility grounds. A small portion of the methanol flowed into a gravel pit lake. The valley in which the transfer facility is located contains a large groundwater reservoir. Wells used to supply residents and businesses are located approximately 0.06 miles from the spill area. The water table is normally 10 to 15 ft below the surface.

Snow cover at the time of the spill was approximately 1.5 ft, and the ground was frozen to a depth of approximately 3.5 ft. The snow melted and the frozen ground thawed in the area surrounding the spill. The methanol migrated in the soil until it was sufficiently diluted by moisture in the soil to allow refreezing to occur. Migration of methanol in the ground is related to the quantity of soil thawed, which is limited by the ambient temperature, the quantity of moisture in the soil, etc. For the 1-week period following the spill, air temperatures ranged from -10 F to 10 F. It is believed that the low temperature played a key role in minimizing methanol migration in the soil.

2.3 SOIL EXCAVATION AND GROUNDWATER MONITORING PROCEDURES

Initial cleanup activity consisted of removing the standing liquid (a methanol/water mixture) with a vacuum truck, collecting contaminated snow that did not melt, and excavating contaminated soil using heavy equipment. The standing liquid was shipped directly to the North Slope for use in oil drilling operations. The snow was collected in a lined, bermed containment area, and later melted and shipped as anti-freeze. The excavates soil was also stored in a lined, bermed area until spring. In addition, groundwater monitoring was performed to determine if drinking well or reservoir contamination occurred.

2.3.1 Soil Excavation

Three general areas required excavation: the facility gravel fill, the area adjacent to the railroad track (comprised of silt, peat, and some clay), and the railroad bed. Soil excavation in all areas continued until the cleanup standard of 1,000 ppm was met. An HNu portable photo-ionization detector (PID) was used to assess the level of contamination. Methanol was not found at depths exceeding 6 ft, and most of the methanol was confined to a depth of 2 ft. The 1,000 ppm cleanup standard was established by ADEC and EPA based on data indicating that biodegradation occurs below 1,000 ppm. It was therefore assumed that natural processes would remove the methanol remaining in the soil. The contaminated soil was covered with plastic sheets until spring, when reclamation began.

Soil borings were obtained from the railbed to determine the methanol contamination depth at the spill site. Boring was halted at a depth of 6 ft to prevent inadvertent groundwater contamination during soil boring. Methanol concentrations in the bore samples ranged from 27,300 ppm on the surface to below the detection limit (30 ppm) at the bottom.

2.3.2 Groundwater Monitoring

Four monitoring wells were installed around the spill site to ascertain whether methanol seeped into the reservoir or drinking wells. As a precautionary measure, water samples were also collected from residential wells to determine ingestion levels, if any. A sample of water under the ice layer in the gravel pit was also collected and analyzed. No methanol was measured in excess of the 15 ppm detection limit in December, and monitoring continued through the summer of 1990.

2.4 METHANOL RECLAMATION

Methanol contained in the contaminated soil was ultimately reclaimed and used as anti-freeze in North Slope drilling operations. Controversy between ARCO and EPA Region X still exists regarding the classification of this technique as reclamation. This controversy is discussed in more detail in Section 4; only the reclamation procedure adopted is described here.

By taking advantage of the solubility of methanol in water, reclamation through soil washing was achieved. The soil was washed with water, and methanol was collected in the rinsate. The rinsate was reconstituted with concentrated methanol, and used as anti-freeze in North Slope drilling operations. Following methanol recovery, the soil, gravel, and railbed material was reused and placed on the facility grounds. During reclamation, air monitoring was conducted to measure methanol vapor concentrations.

SECTION 3

WASTE CHARACTERIZATION

One of the major problems associated with a methanol spill is the fact that methanol is a specifically listed as a hazardous waste under Subpart D - Lists of Hazardous Wastes in the RCRA regulations (40 CFR 261.33 (d)), rather than a hazardous waste due to characteristic, as in Subpart C - Characteristics of Hazardous Waste (40 CFR 261.20 - 260.24). Therefore, any material which is contaminated with methanol is classified a hazardous waste.

3.1 METHANOL CHARACTERISTICS

Methanol, CAS No. 67-56-1, is completely water soluble, which creates a potential for groundwater contamination if spilled. It freezes at -114 °F, and is therefore useful as an antifreeze agent. Methanol is 100 percent volatile, the vapor is heavier than air and can travel to an ignition source and flashback, and it burns with little or no visible flame. Otherwise it is easy to deal with. It is biodegradable at concentrations below 1,000 ppm (above which it is toxic to aquatic life and microorganisms) and it is easily air stripped or adsorbed with activated charcoal. As stated in the Hoechst Celanese Material Safety Data Sheet (MSDS), "Waste disposal method: This product when spilled or disposed is a hazardous solid waste as defined in Resource Conservation Recovery Act regulations (40 CFR 261). Preferred method is incineration or biological treatment in federal/state approved facility." (Appendix A).

3.2 THE ALASKA SPILL AND RCRA RAMIFICATIONS

The focal point of the difficulty in the Alaska spill situation is the way in which methanol is listed under RCRA. Materials are listed as hazardous wastes in one of two ways:

- Characteristic, i.e. ignitability, corrosivity, etc. (RCRA Subpart C),
- Specific listing, i.e. the lists in RCRA Subpart D.

Methanol is specifically listed under Subpart D. It is easily ignited (flash point 53 °F), burns with a nearly invisible flame, and is toxic by inhalation or ingestion to humans. Any of these factors, if actively present, would cause methanol contaminated material to be listed by Subpart C characteristic as well as specifically listed under Subpart D.

In the Alaska situation, the methanol in the soil was too dilute and cold to ignite (it was attempted in a test by the fire department at the spill site), and not likely pose a threat to human or biological life (it did not penetrate to the groundwater aquifer). However, once the methanol contaminated soil had been excavated, it had to be treated as a hazardous waste under RCRA Subpart D; EPA did not consider the mixture of methanol and gravel to be a non-hazardous waste under 40 CFR 261.3.

The fact that the methanol contaminated soil became a hazardous waste under RCRA effectively eliminated any "treatment" options, such as air stripping, bioremediation or soil washing, since those activities would require an EPA permit. EPA is capable of issuing such a permit in an emergency situation, but would not do so. ARCO wanted to use a water wash process on the soil to reclaim the methanol. The EPA said that the washing was treatment, not reclamation. A long and intricate argument ensued.

In Alaska, methanol is used as an anti-freeze and as a deicer, and it is usually mixed with water. The reclamation performed by ARCO was possible due to the miscibility of the methanol and water, and the fact that the original use involved a methanol/water solution.

In California, methanol is primarily used for other purposes. One significant use is as a major component of fuel for alternate fueled vehicles. Methanol fuel contaminated material, could be considered hazardous waste under RCRA, as seen by the example of the Alaska spill. There is some question as to whether it would be automatically classified as such in a California spill.

SECTION 4

AGENCY INTERACTIONS

The major organizations involved in the Alaska methanol spill were contacted and the spill events and interactions were discussed with them. Also solicited were their comments and recommendations regarding future methanol spills. All of the people interviewed provided consistent accounts of the events, and made coherent recommendations for future methanol spill related activities.

4.1 FAIRBANKS FIRE DEPARTMENT

4.1.1 Fire Department Activities

The Fairbanks fire department was the first agency brought onto the scene of the incident. The incident commander was Bill Shechter, who is trained as a 40 CFR 1910 On-Scene Commander. The fire department's primary role was to assure the safety of the site personnel and local residents, prevent or contain any fire or explosion, and assess the immediate risks.

Upon arrival, the fire department initially evacuated residents and workers from the site and adjacent areas to avoid their exposure to possible airborne contaminants. When organic vapor analysis indicated that the surrounding area was safe to re-enter, local residents and workers were permitted to return to their usual routines. After the fire department determined that site conditions was no longer posed an immediate risk, control was turned over to ARCO and the state (ADEC).

The fire department worked closely with the transfer yard personnel in securing the facility, evacuating workers, and initially containing the spilled material. The Fire Department had a good rapport with ARCO, and ARCO was very helpful in controlling the situation.

The primary role of the fire department was initial hazard assessment and protection of public safety. After this was accomplished, the fire department had no more involvement (other than writing up an incident report). For this particular incident, the fire department costs were negligible. It was not necessary for the fire department crews to "suit up" and go in to rescue personnel or contain the spill. The crews were also still available to take other emergency calls.

4.1.2 Fire Department Comments and Recommendations

In a hazardous materials spill involving ignitable or flammable material, the local fire department must be notified first, and should be equipped to respond. The fire department should:

- Know who is the responsible party at a facility in which hazardous materials are used.
- Already have an established contact at the facility.
- Know what and where materials are transported through or stored in the community.
- Require all companies using hazardous materials to have a complete spill response plan, even small companies.

4.2 ARCO ALASKA, INC.

4.2.1 ARCO Activities

After the fire department turned control of the incident over to ARCO, ADEC, and the EPA, ARCO began spill cleanup procedures, as discussed in Section 2.

The soil excavation and groundwater monitoring strategy was acceptable to all parties involved. However, when ARCO developed plans for dealing with the contaminated material, the situation became complicated and problematic. Initially, ARCO, with the consent of ADEC, developed several strategies to use the material in simple processes. For example, ARCO solicited bids from asphalt companies to use the methanol contaminated gravel in asphalt manufacturing, a process that would destroy the methanol (Appendix F). However, the EPA stepped in and said that the methanol contaminated gravel and soil was a hazardous waste under RCRA. This eliminated what ARCO and ADEC perceived to be several environmentally and economically sound treatment options (including using the material in asphalt manufacture, air stripping, bioremediation, etc.) The options remaining were: a) obtain an EPA RCRA treatment permit, which would allow ARCO to treat the waste, b) ship the material to a treatment or disposal site in the Continental U.S. or c) find a way to reclaim the material for its originally intended use (in which case, the material would no longer be classified as a RCRA waste, instead it would be considered a usable material.)

Because the methanol was originally intended for use as an antifreeze agent , the third option was selected by ARCO as the most viable. ARCO contracted for the contaminated material to be rinsed with warm water, and the rinsate (methanol and water) was reconstituted and shipped to the North Slope drilling site.

4.2.2 ARCO Comments and Recommendations

Partially as a result of this incident, ARCO Alaska, Inc. is no longer in the business of chemical shipping and storage. ARCO now subcontracts these activities and does not take possession of a chemical until it reaches the drilling site.

ARCO enjoyed excellent relations with ADEC, which was involved in evaluating and approving ARCO's cleanup activities. Communications between ARCO and ADEC were smooth, culminating in a Compliance Order by Consent (Appendix E) under which ARCO cleaned up the spill site and reclaimed the methanol from the contaminated media.

ARCO was continually frustrated in attempts to implement what it perceived as reasonable soil cleanup strategies. As methanol is listed as a RCRA waste under Subpart D, soil contaminated with methanol is also classified as hazardous waste. Therefore, the EPA would not allow ARCO to explore these options because ARCO does not have a RCRA permit for treating hazardous waste. EPA could have granted a temporary permit, but would not do so.

The EPA involvement complicated matters because of the application of RCRA rules to the cleanup process. The cleanup options were limited by the strict interpretation of the RCRA regulations applied by EPA Region X to the situation, in spite of the fact that the intent of the environmental, health and safety concerns, codified in RCRA, could have been met by the original treatment strategies explored by ARCO with the consent of ADEC.

The contractors involved in the cleanup and reclamation were effective; there were some problems getting them mobilized, however, they completed the job. The least satisfactory performance was from the reclaiming group. The process selected was viable, however the reclaiming group was not completely aware of the regulatory problems involved. Some of the gravel, which contained peat, had high levels after cleaning and had to be recleaned.

An ARCO representative commented that any facility handling methanol must have a spill response plan, and must have the means to implement the plan, as necessary. All agencies involved in a spill situation must be aware of the cleanup plans and, if necessary, approve them. Additionally, the relevant parties must be included in all communications.

ARCO also maintains that the regulatory status of spilled methanol should be re-evaluated, especially because the use of methanol as a motor fuel may increase. Treating a material as a hazardous waste when it does not manifest hazardous characteristics (i.e. ignitability, corrosivity, etc.) can involve expensive and unnecessary handling requirements under RCRA.

4.3 ADEC

4.3.1 ADEC Activities

ADEC was involved in the first hours after the spill was discovered. By state law, spills are reported to ADEC immediately. Initially the fire department managed the site, and when the situation was downgraded from a fire hazard, ADEC oversaw the cleanup activities. The EPA was involved at an early stage, and they initially determined that the material would have to be treated as a hazardous waste under RCRA.

The long and protracted discussions between ADEC, ARCO and the EPA focussed on several issues such as waste classification, treatment options, and regulation interpretations. It took one month to resolve the hazardous waste issue, and in that time, extensive research, reading of regulations and negotiation occurred. Ultimately, ADEC was responsible for interpreting the applicable regulations and advising the responsible party (ARCO) on compliance actions. Eventually ADEC and ARCO

negotiated the compliance order by consent, but only after the hazardous waste issue was resolved.

ADEC supervised the cleanup, reclamation and follow-up monitoring of the spill. The cleanup matter will be closed when the methanol concentrations in any of the wells are below detection limit (<5 ppm). This monitoring program is nearly complete (as of March, 1991). The compliance order by consent is specified a completion date of April 30, 1991.

4.3.2 ADEC Comments and Recommendations

This was the first methanol spill that has faced ADEC. Difficulties that were encountered resulted from a lack of experience, and severely limited resources; ADEC has a very small staff. Ten days after this methanol spill, another major spill occurred at a different location. Clean-up activities for both spill events went on for months.

The public reaction was mainly curiosity and concern. No public picketing or protest activities occurred.

ADEC maintains that this particular methanol spill caused negligible long term environmental effects, because it was in an industrial area, and on a gravel pad. However, under different circumstances, a large scale methanol spill could be disastrous. Methanol is potentially toxic to organics, and can cause stunted trees, kill plants, animals and fish, and damage sensitive tundra requires years to recover.

ADEC, along with ARCO, was frustrated that the EPA would not issue an emergency permit for treatment of the contaminated soil under RCRA. EPA insisted that ARCO ship the contaminated material to the continental U.S. for disposal or treatment at a RCRA permitted facility (there are no RCRA permitted treatment or

disposal facilities in Alaska.) This despite the fact that ADEC evaluated and approved a number of alternate treatment strategies.

4.4 EPA, ALASKA

4.4.1 EPA Activities

EPA was notified through the National Response Center, which was contacted by the ARCO Supervisor. ADEC coordinated the cleanup activities, and EPA maintained an oversight and guidance role. Had ADEC not been capable of coordinating the cleanup the EPA's Alaska Operations Office would have taken over.

EPA classified the contaminated soil as a RCRA waste, because methanol (which is a listed waste) was applied to the land in a manner constituting disposal. The soil was therefore a U listed waste under 40 CFR 261.34. If no means of reclaiming the methanol were available, EPA ruled that the soil should be manifested and shipped to a RCRA permitted facility that could treat or incinerate it. There are no such treatment facilities in Alaska, ARCO would have had to ship the soil to the Continental U.S.

ADEC and EPA suggested to ARCO that "the methanol may be reclaimed from the soils and used for the original intended purpose if the reclamation can be demonstrated as legitimate reclamation and therefore not require permitting by EPA under RCRA for treatment or disposal and permitting by ADEC under the State Hazardous Waste Siting regulations." (Appendix C)

ARCO elected to reclaim the material.

4.4.2 EPA Comments and Recommendations

Communications between the EPA, ADEC, and ARCO were not always peaceful. RCRA is cumbersome, and it caused some awkwardness in the reclamation effort. The

EPA felt that, at the time, the state agency was not capable of dealing with the technical aspects of RCRA.

EPA commented that the approach taken by ADEC and ARCO in dealing with the regulatory considerations involved in the spill cleanup was indirect, but the methanol reclamation project generally met the spirit of the law. The reclamation strategy was unique, however, a lot of methanol was lost, probably due to volatization. The amount recovered was acceptable, but delays due to inexperience probably caused the losses. EPA contributed to the delay because of their lack of assurance that the recycling activity was legitimate.

EPA would not recommend the soil washing reclamation activity again, unless it could be performed sooner after the spill and initial excavation, which would reduce the volatization losses and losses due to natural degradation). Some people in the Alaska EPA are not now completely convinced that the soil washing activity was legitimate reclamation.

Methanol is listed as a RCRA waste primarily because it is ignitable and burns with a nearly invisible flame. One option suggested by EPA Alaska for avoiding confusion in future methanol spill events is to change the way in which methanol is listed. Delisting (i.e. removing it as a specifically U listed waste) is possible for non-ignitable wastes, but may require several years.

If a methanol spill occurs, EPA recommended the following procedure:

- Contact the U.S. Coast Guard National Response Center (1-800-424-8802)
- Deal with the immediate threats to health and safety
- Contact the EPA and the RCRA authorized state agency

SECTION 5

CONSIDERATIONS IN PREPARING FOR POTENTIAL METHANOL SPILLS IN CALIFORNIA

There are a number of issues that must be considered in developing appropriate methanol spill response and cleanup strategies in California. Of primary importance is that candidate strategies comply with applicable state and federal regulations. Of great importance also is effective communication between the various regulatory agencies involved, as demonstrated by the problems encountered in the ARCO methanol spill cleanup activities. This section discusses the general California regulatory framework in which a candidate methanol spill cleanup strategy must fit, and identifies critical elements of a comprehensive spill cleanup. At the end of this section, key results and issues that were distilled from the ARCO methanol spill experience which are applicable to California spill planning efforts are summarized.

5.1 GENERAL CALIFORNIA SPILL RESPONSE AND CLEANUP GUIDELINES

In the event of a methanol spill (or any toxic chemical spill), the fire department should be notified immediately. Chemical spill specialists on the fire department staff are capable of identifying hazards, such as fire, explosion, and personal exposure, at the spill site. If the spill occurs at a facility where chemicals are routinely handled and/or stored, the Fire Department will probably have a Hazardous Materials Management Plan (HMMP) on file for that particular facility. The HMMP is used to identify potentially hazardous areas. If a spill occurs during transport, the shipping manifests and

drivers log data are used to identify hazards. After the fire department secures the site, other regulatory agencies coordinate the cleanup activities.

When a reportable quantity (RQ) spill occurs in the State of California, spill response guidelines set forth in the State Contingency Plan must be implemented. Upon identification of a RQ spill event, the U.S. Coast Guard National Response Center must be notified. The National Response Center then notifies the appropriate EPA Regional Office to coordinate response activities. The EPA designates the Federal On-scene Coordinator, who evaluates the spill situation to determine overall responsibility, and supervises spill cleanup activities. The Coordinator also determines the role and level of action the EPA will assume.

Initial inquiries to EPA Region IX suggest that, while every spill event is handled on an individual basis, reclamation of methanol contaminated soil and water would be allowable. If reclamation is not desired, then methanol contaminated soil and water is regulated as a hazardous waste as per 40 CFR 261.33(d). As a hazardous waste, any contaminated soil or water may not be treated except at a RCRA permitted Hazardous Waste Treatment Facility. Provided that the end use of the reclaimed methanol is not as a fuel or recycled for heat content, the methanol may be reclaimed as it was done in the Alaska spill example. The reclaimed methanol must be used in some non-combustion process, such as antifreeze in the Alaskan spill case. If the methanol is reclaimed and subsequently classified as a hazardous waste, then the soil the methanol was reclaimed from might revert to a hazardous waste classification. This is due to vagaries in 40 CFR that might view the reclamation of methanol as treating of the soil rather than the soil being cleansed as a consequence of the reclamation.

Further information on the classification of materials as waste can be obtained from the EPA Region IX RCRA Hotline [(415) 744-2074], or the general EPA Information Hotline [(800)424-9346]. Regulations concerning contaminated water, and allowable uses of water/methanol mixtures may be obtained from the EPA Water Usage Hotline [(800) 368-5888]. Every spill event will be different and coordination with the EPA can be facilitated by appropriate use of these information sources.

5.2 CRITICAL ELEMENTS OF A GENERAL METHANOL SPILL CLEANUP PLAN

When a methanol spill occurs, the methanol will accumulate in 4 different forms:

- Vapor phase methanol which is released to the air (generally it is not possible to recover methanol in the vapor state)
- Liquid phase methanol pooled in terrain features
- Liquid phase methanol accumulated in soil (or other solid)
- Liquid phase methanol accumulated in water

Pooled methanol should be immediately recovered to minimize losses via volatilization and intrusion into the soil and groundwater. The highest concentration of methanol found at the spill scene will be in the pooled form, thus special personal protective equipment may be required.

The soil underneath and surrounding any pooled methanol must be tested to determine possible contamination and identify appropriate excavation measures. Excavation should continue until soil no longer exhibits hazardous or toxic characteristics. The excavated soil should be transported to a contained area until further treatment or reclamation. As demonstrated by the ARCO spill cleanup, the methanol can be reclaimed by washing the soil with water. The washed soil can be

exempted as a hazardous waste under 40 CFR 261.4.a(iii), provided that the soil does not meet other hazardous material criteria, and that the recovered methanol recovered is not subsequently designated a hazardous waste.

Should the methanol spill reach confined or unconfined aquifers, or local overland runoff, then the water must be monitored to determine the level of contamination. If the level is sufficiently high, the contaminated water may require collection. In some cases, continuous monitoring and collection may be necessary over a period of time. The collected water is classified as a hazardous waste under 40 CFR 261.33(d), unless the methanol/water mixture is useable in a non-combustion process. The Alaskan spill experience indicated that EPA Region X allowed ARCO to reuse a methanol/water mixture as anti-freeze in drilling operations. Of course, this option may not be viable if significant contamination of the methanol/water mixture exists which might alter the useability of the methanol/water mixture.

Volatilization of the methanol during spill cleanup can be problematic, and ambient atmospheric contamination concentrations should be monitored to insure adequate protection for spill response and cleanup personnel. The Occupational Safety and Heath Act (OSHA) regulates allowable working conditions for on-site personnel. The Permissible Exposure Limit (PEL) for unprotected personnel exposed to methanol 200 ppm. This is based on a time weighted average for an 8 hour work shift of a maximum 40 hr week. A short term exposure (15 min) limit for methanol is 250 ppm.

5.3 LESSONS LEARNED FROM THE ARCO METHANOL SPILL EXPERIENCE

As a result of the situation created by the ARCO methanol spill, several issues were raised that may be of interest to California agencies involved with the alternate

fuels program. These issues, such as effective inter-agency communication, appropriate waste classification and treatment strategies, and the extrapolation of "cold weather" spill results to "warm weather" situations, are discussed in this section.

5.3.1 Inter-Agency Communication Barriers

Perhaps the primary contributor to the problems encountered by EPA, ADEC, and ARCO in cleaning up the Alaska methanol spill was the lack of consensus between the parties regarding interpretations of applicable regulations. The differences resulted in extensive delays to reclamation activities. These delays may have contributed to the rather disappointing methanol recovery results achieved by ARCO using the soil washing technique. California is now in a good position to initiate dialogue among the various regulatory agencies regarding contaminated material classification, and appropriate disposal/treatment/reclamation strategies.

By initiating these discussions now, before methanol is more commonly distributed, many of the problems encountered in Alaska may be ameliorated to a large extent. As indicated several times in this report, every methanol spill that occurs is and will be handled separately, therefore no blanket inter-agency agreement can be reached ahead of time that will satisfy every situation. However, such basic problems as waste classification, and identification of appropriate cleanup strategies can be considered, and perhaps resolved.

It is recognized that a fuel mixture comprised of methanol and gasoline may find widespread use in California. Thus, parallel discussions exploring the circumstances arising from a gasoline/methanol mixture spill can also be initiated.

5.3.2 Extrapolation of Cold Weather Results to Warm Weather Situations

There is some concern over the applicability of the ARCO spill results to situations that may arise in California. Certainly there is agreement that the methanol did not migrate further into the ground due to the below freezing ambient conditions, and the depth of the permafrost layer. Had a similar spill occurred in California, the results may have been quite different. Under warmer ambient conditions, the methanol probably would have migrated to the ground water, and more extensive monitoring would have been necessary. Also, the methanol would have probably migrated through the soil more quickly, and penetrated further before dilution to below the 1,000 ppm limit.

As indicated previously, each spill event is different, and attempting to extrapolate the results from one spill event can results in erroneous or misleading conclusions. Strategies for monitoring aqueous contaminant concentrations and excavating contaminated soil are well documented, and will doubtlessly be implemented in the event of a methanol spill in California. These cleanup procedures may involve detailed hydrogeologic studies to predict contaminant plume migration patterns, and to identify aquifers that may be at risk of contamination.

5.3.3 Summary of Lessons Learned

Even though extrapolation of the ARCO spill results may not be possible, there are several lessons that may be learned from the ARCO spill incident. These lessons can be summarized as:

- Initiate communications between regulatory agencies regarding key issues such as waste classification and viable treatment options before a major spill occurs.
- Develop a general framework in which the agencies involved can work to develop a spill cleanup plan. As discussed previously, this has been accomplished in a general sense under the California State Contingency Plan. However, a more detailed framework focussing on methanol spill issues may help smooth over potential problems.
- It may be beneficial to require companies that transport and/or store large quantities of methanol to develop a specific methanol spill response plan. The plan (which requires approval) may outline waste treatment options in which the company is interested, and may contain cleanup criteria established by the appropriate regulatory agency. Of course, in the event of a spill, the treatment strategy would have to be approved in advance by the governing agency. Still, had such a document existed at the time of the ARCO spill, the delays and frustrations experienced by the parties involved may have been greatly reduced.

APPENDIX A

Material Safety Data Sheet for Methanol
March 20, 1989

Material Safety Data Sheet

Hoechst Celanese

Chemical Group
Hoechst Celanese Corporation
PO Box 569320 / Dallas, Texas 75356-9320
Information phone: 214 689 4000
Emergency phone: 800 835 5235

METHANOL

Issued March 20, 1989 #56

Identification

Product name: Methanol

Chemical name: Methanol

Chemical family: Alcohol

Formula: CH_3OH

Molecular weight: 32

CAS number: 67-56-1

CAS name: Methanol

Synonyms: Methyl alcohol; carbinol; monohydroxymethane; methyl hydroxide.

Department of Transportation information
Hazard classification: Flammable Liquid
Shipping name: Methanol
United Nations number: UN1230
DOT Emergency Response Guide no.: 28

Physical data

Boiling point (760 mm Hg): 64.6°C (148°F)

Freezing point: −97.8°C (−144°F)

Specific gravity (H_20 = 1 @ 20/20°C): 0.7925

Vapor pressure (20°C): 96.0 mm Hg

Vapor density (Air = 1 @ 20°C): 1.11

Solubility in water (% by WT @ 20°C): Complete

Percent volatiles by volume: 100

Evaporation rate (BuAc = 1): 2.0

Appearance and odor: Clear, colorless, mobile liquid with mild alcohol odor.

Fire and explosion hazard data

Flammable limits in air, % by volume
Upper: 36.5
Lower: 5.5

Flash point (test method):
Tag open cup (ASTM D1310): 60°F (15°C)
Tag closed cup (ASTM D56): 54°F (12°C)

Extinguishing media:
Use CO_2 or dry chemical for small fires, alcohol-type aqueous film-forming foam or water spray for large fires. Water may be ineffective but should be used to cool fire-exposed structures and vessels.

Special fire-fighting procedures:
Wear self-contained breathing apparatus (SCBA) and complete personal protective equipment when potential for exposure to vapors or products of combustion exists. Water spray can be used to reduce intensity of flames and to dilute spills to nonflammable mixture.

Unusual fire and explosion hazards:
Vapor is heavier than air and can travel considerable distance to a source of ignition and flashback. Material can burn with little or no visible flame.

Hazardous ingredients information

Component, wt. %	Exposure levels: OSHA PEL	Exposure levels: ACGIH TLV®	Exposure levels: IDLH[1]	Subject to SARA §313 reporting?
• Methanol, 99.85% CAS No. 67-56-1	200 ppm[2], 8-hr TWA, 250 ppm, 15-min STEL	200 ppm[2], 8-hr TWA, 250 ppm, STEL	25,000 ppm	Yes

(1) Immediately Dangerous to Life or Health
(2) Potential contribution to overall exposure possible via skin absorption

Special hazard designations

	HMIS	NFPA
Health:	3	1
Flammability:	3	3
Reactivity:	0	0
Personal protective equipment:	G	—

Key: 0 - Minimal; 1 - Slight; 2 - Moderate; 3 - Serious; 4 - Severe

SARA §311 hazard categories

Acute health:	Yes
Chronic health:	Yes
Fire:	Yes
Sudden release of pressure:	No
Reactive:	No

Reactivity data

Stability:
Stable

Hazardous polymerization:
Will not occur.

Conditions to avoid:
Heat, sparks, flame.

Materials to avoid:
Sulfuric acid; oxidizing agents such as hydrogen peroxide, nitric acid, perchloric acid and chromium trioxide.

Hazardous combustion or decomposition products:
Carbon monoxide.

Health data

Effects of exposure/toxicity data

Acute:

Ingestion (swallowing): Poisonous if swallowed. Can affect the optic nerve resulting in blindness. Can cause mental sluggishness, nausea and vomiting leading to severe illness, possibly death (in humans). Practically non-toxic to animals (oral LD50, rats: 7.5 g/kg).

Inhalation (breathing): Extremely high levels cause stupor, headache, nausea, dizziness and unconsciousness. Practically non-toxic to animals (inhalation LC50, rats, 4 hrs: 64,000 ppm).

Skin contact: Essentially non-irritating. Repeated or prolonged contact causes drying, brittleness, cracking and irritation. Slightly toxic to animals by absorption (dermal LD50, rabbits: 20 g/kg).

Eye contact: May cause eye injury which may persist for several days. Liquid, and vapor in high concentrations, causes irritation, tearing and burning sensation.

Chronic:

Mutagenicity: *In vitro*, limited evidence of mutagenicity (mouse lymphoma forward mutation assay) *In vivo*, no information.

Carcinogenicity: No evidence of carcinogenic potential in limited animal studies in which methanol was given orally or applied to the skin.

Reproduction: Methanol – reported to cause birth defects in rats exposed to very high levels of vapors (20,000 ppm).

(continued)

Emergency and first aid procedures

Ingestion (swallowing): Induce vomiting of conscious patient immediately by giving two glasses of water and pressing finger down throat. Contact a physician immediately.

Inhalation (breathing): Remove patient from contaminated area. If breathing has stopped, give artificial respiration, then oxygen if needed. Contact a physician immediately.

Skin contact: Remove contaminated clothing and wash contaminated skin with large amounts of water. If irritation persists, contact a physician.

Eye contact: Flush eyes with water for at least 15 minutes. Contact a physician immediately.

Note to physician: When plasma methanol concentrations are higher than 20 milligrams per deciliter, when ingested doses are greater than 30 milliliters, and when there is evidence of acidosis or visual abnormalities, a 10% solution of ethanol in 5% aqueous dextrose, administered intravenously, is a safe, effective antidote *(Western Journal of Medicine*, March 1985, p. 337).

Spill or leak procedures

Steps to be taken if material is released or spilled:
Eliminate ignition sources. Avoid eye or skin contact. Place leaking containers in well-ventilated area. If fire potential exists, blanket spill with foam or use water spray to disperse vapors. Contain spill to minimize contaminated area and facilitate salvage or disposal. To clean up spill, flush area sparingly with water or use an absorbent. Avoid runoff into storm sewers and ditches which lead to natural waterways. Call the National Response Center (800-424-8802) if spill is equal to or greater than reportable quantity (5000 lb/day) under "Superfund". All clean-up and disposal should be carried out in accordance with federal, state and local regulations. If required, state and local authorities should be notified.

Waste disposal method:
This product when spilled or disposed is a hazardous solid waste as defined in Resource Conservation Recovery Act regulations (40CFR261). Preferred method is incineration or biological treatment in federal/state approved facility.

Special protection information

Respiratory protection:
Use full-face NIOSH-approved self-contained breathing apparatus (SCBA) or other air-supplying full-face respirator.

Ventilation

Local exhaust: Recommended when appropriate to control employee exposure.

Mechanical (general): Not recommended as the sole means of controlling employee exposure.

Protective gloves:
Neoprene or rubber.

Eye protection:
Chemical safety goggles.

Other protective equipment:
For operations where spills or splashing can occur, use impervious body covering and boots. A safety shower and eye bath should be available.

Special precautions

Precautions to be taken in handling and storing:
Store in a cool, well-ventilated area. Do not expose to temperatures above 49°C (120°F). Keep away from heat, sparks and flame. Keep containers closed. Use only DOT-approved containers. Use spark-resistant tools. Do not load into compartments adjacent to heated cargo. When transferring follow proper grounding procedures. Use with adequate ventilation. Provide emergency exhaust. Avoid breathing vapor. Avoid contact with eyes, skin and clothing. Wash thoroughly with soap and water after handling. Wash contaminated clothing thoroughly before re-use. Discard contaminated leather clothing.

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APPENDIX B

ADEC Memorandum, Methanol Spill Cleanup
January 18, 1990

MEMORANDUM State of Alaska

TO: Pete McGee
Regional Supervisor
Northern Regional Office

DATE: January 18, 1990

FILE NO:

TELEPHONE NO: 465-2671

FROM: Jeff Mach, Chief
Solid & Haz. Waste Management

SUBJECT: Re: Methanol Spill Cleanup

This memo is to explain the regulatory status, under RCRA, of contaminated environmental media (soil, snow, standing water) resulting from the methanol spill which occurred in the Fairbanks railroad yard on December 4, 1989.

It is the Department's opinion, after discussions with the U.S. Environmental Protection Agency (EPA) and other state officials, that the methanol contaminated soil is a hazardous waste (U154), regulated under 40 CFR 261.33(d).

Regulation 40 CFR 261.33(d) regulates as hazardous waste any residue or contaminated soil, water or other debris resulting from the cleanup of a spill into or on any land or water of any commercial chemical product or manufacturing chemical intermediate having the generic name listed in the P or U wastes under 40 CFR 261.33. Because the methanol was applied to the land in lieu of its original intended use, and it is a use constituting disposal, the spilled methanol, contaminated soil, and water and cleanup debris are regulated as hazardous waste.

After the spill, methanol on the ground and in the snow was collected. This methanol has been reclaimed and is now awaiting use in an antifreeze mixture, an intended purpose of methanol. Likewise, if methanol contained in the soil can be reclaimed through soilwashing or some other reclamation method and then used for an intended purpose, it will not be regulated as a hazardous waste after processing. The goal of the State and EPA is to be able to separate out the hazardous waste (methanol) contained in the soil and thereby recover a usable product as part of this cleanup.

Reclamation of the methanol, as described above, does not require a RCRA Subtitle C Hazardous Waste permit, if the process is a legitimate reclamation process and not a treatment process. Proposals for reclamation by soil washing or other process however, must provide a method to demonstrate that the process is reclamation and not treatment. This demonstration could be accomplished by estimating the levels of methanol that will be reclaimed from the contaminated soils based on the degree of contamination. Further this demonstration should include the

maximum levels of contamination in the soil after the reclamation process is complete.

If a proposal is accepted by the Regional Office Supervisor as a legitimate reclamation activity and not a treatment of hazardous waste, then the following steps are required:

a.) The waste generator is required to obtain an EPA identification number from EPA Region 10. This can be done by filing an EPA form 8700-12 Notification of Hazardous Waste Activity;

b.) All on-site reclamation activity must occur 90 days after the generation of the waste unless a 30 day extension is requested as per 40 CFR 262.34(b);

c.) Any hazardous waste associated with this spill that are shipped off-site would require manifesting as a hazardous waste and must be shipped to a RCRA permitted treatment, storage or disposal facility. If, in this case, ARCO were to decide to ship any of the hazardous waste to their interim status facility at Prudhoe Bay, they could request a change if necessary in their Part A application to include hazardous waste U154 and if necessary increase their design capacity for storage under 40 CFR 270.72(b);

d.) Any debris (absorbants, contaminated materials, etc.) generated as a result of the spill or reclamation activities are regulated as hazardous waste and would be required to be managed as such;

e.) Any liquid residuals from the reclamation activity that can not be used for their original intended purpose must also be managed as a hazardous waste;

f.) Soil residuals left after reclamation must be analyzed and meet specifications established by the Regional Office Supervisor. The level will be established by the Regional Office as part of the reclamation demonstration review. After the soil has been processed and the methanol level in the soils have been demonstrated through sampling and analyses, the soil will be considered no longer to contain a hazardous waste and would be considered a clean material for reuse; and

g.) Any of the soil residuals not meeting the specification levels established by the Regional Supervisor must also be managed as a hazardous waste.

Incineration, bio-remediation or land spreading are considered treatment and require RCRA hazardous waste permits. Any management method that does not show the reclamation and use for the original intended purpose would require RCRA Subtitle C permitting prior to treatment.

Treatment or disposal of the contaminated soil without reclamation of the methanol is regulated under the RCRA hazardous waste requirements. A final option would be the delisting of the waste through the Assistant Administrator of EPA.

ARCO should submit waste management proposal that they are interested in pursuing to the Northern Regional Office for review. A copy of these proposals should also be sent to Carl Lautenberger at EPA-AOO in Anchorage. Review of these proposals will be done in a timely manner, to assist in the determination of legitimate reclamation processes.

cc:
David DiTraglia - ADEC
Steve Torok - EPA/AOO-JUNO
Carl Lautenberger - EPA/AOO-ANCH
Marcia Bailey - EPA/Region 10

APPENDIX C

US EPA, Region 10, Memorandum, ARCO Methanol Spill - Fairbanks, Alaska
February 12, 1990

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
SEATTLE, WASHINGTON 98101
February 12, 1990

REPLY TO ATTN OF: AOO/A

MEMORANDUM

SUBJECT: ARCO Methanol Spill - Fairbanks, Alaska

FROM: Alvin L. Ewing
Assistant Regional Administrator

TO: Thomas P. Dunne
Acting Regional Administrator

On December 4, 1989, approximately 9,000 gallons of methanol were released from 3 railroad tank cars in Fairbanks, Alaska. The Alaska Department of Environmental Conservation (ADEC) responded to the incident and continues to manage the cleanup as the primary monitoring agency with oversight and guidance from the EPA AOO/A. Some of the methanol has been recovered from the site. ARCO plans to use the liquid material for its original purpose as a deicer for down hole injection in the Prudhoe Bay oilfields.

Spill residues of methanol are regulated as a hazardous waste (methanol is listed as a hazardous waste due to flamability) and therefore treatment, storage, and disposal activities must comply with all RCRA requirements. To date, 3500 cu. yds. of contaminated soil have been excavated with additional volumes remaining under the railroad bed. ADEC has requested that ARCO develop a proposal for the disposal of the contaminated soils. ADEC and EPA have suggested to ARCO that the methanol may be reclaimed from the soils and used for the original intended purpose if the reclamation can be demonstrated as legitimate reclamation and therefore not require permitting by EPA under RCRA for treatment or disposal and permitting by ADEC under the State Hazardous Waste Siting regulations. ARCO is currently investigating the feasibility of recovering the methanol by various water flushing procedures. The 90-day temporary storage for RCRA waste will likely expire before recovery procedure is completed so ARCO is expected to request a 30-day extension.

Other Considerations:

EPA is currently advocating methanol as an alternative fuel under the Proposed Amendments to the Clean Air Act. Oil industry is opposing alternative fuels provision of Administration Bill in part on the grounds that it is a threat to the environment. EPA

treatment of methanol contaminated soil (no longer flamable) as a hazardous waste will lend credance to the industry position. ARCO has expressed its intention to use the Fairbanks incident in arguments against alternative fuels legislation.

APPENDIX D

Compliance Order by Consent, ADEC and ARCO
(Signed) May 26, 1990

STEVE COWPER, GOVERNOR

REPLY TO:

☐ 1031 W 4th AVENUE SUITE 200
ANCHORAGE, ALASKA 99501-1994
PHONE: (907) 276-3550
FAX: (907) 276-3697

☒ 1st NATIONAL CENTER
100 CUSHMAN ST. SUITE 400
FAIRBANKS, ALASKA 99701-4679
PHONE: (907) 452-1568
FAX: (907) 456-1317

☐ P.O. BOX K—STATE CAPITOL
JUNEAU, ALASKA 99811-0300
PHONE: (907) 465-3600
FAX: (907) 463-5295

DEPARTMENT OF LAW

OFFICE OF THE ATTORNEY GENERAL

April 19, 1990

William T. Christian
Senior Attorney
ARCO Alaska, Inc.
P.O. Box 100360
Anchorage, AK 99510-0360

Re: Fairbanks Methanol Spill

Dear Bill,

Enclosed is the final Compliance Order by Consent that formalizes our agreement concerning the recovery of methanol spilled in the Fairbanks rail yard last winter. As we discussed earlier, I am sending it first to you for ARCO's endorsement. When you return it to me, Pete will sign it and we will provide you with a copy.

ADEC commends ARCO's responsiveness and willingness to address this methanol spill in an innovative and environmentally responsible manner. I am confident that the reclamation will proceed as to the ultimate recovery of the product and remediation of the site.

Sincerely,

DOUGLAS B. BAILY
ATTORNEY GENERAL

By: Leone
Leone Hatch
Assistant Attorney General

LH/lc

cc: William (Pete) McGee, ADEC
Barbara Lither, EPA

DEPARTMENT OF ENVIRONMENTAL CONSERVATION

NORTHERN REGIONAL OFFICE

ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION Complainant, vs. ARCO ALASKA, INC. Respondent.	)

C.O. No. 90310910901

COMPLIANCE ORDER BY CONSENT

WHEREAS, the State of Alaska, Department of Environmental Conservation, (ADEC) and ARCO, Alaska, Inc. (ARCO) desire to provide for the cleanup of a methanol spill, it is hereby covenanted and agreed as follows:

I. Findings and Conclusions

A. ARCO is the lessee and operator of a facility known as the North Star Pipeyard located off Van Horn Road in Fairbanks, Alaska, located at SE 1/4, of NW 1/4, Section 22, Township 1 South, Range 1 West, Fairbanks Meridian. ARCO leased the premises from the North Star Terminal, Inc. Among other functions, ARCO uses the facility to transfer chemicals, including methanol, from rail tank cars to trucks for shipment to the North Slope to use in the company's oil production activities.

B. On or about December 4, 1989, one or more saboteurs opened valves on three rail tank cars on a rail spur at the North Star Terminal. This resulted in a spill of approximately 9300 gallons of methanol onto the railbed and adjacent soils.

C. Upon discovering the spill on December 4, ARCO began cleanup and reclamation activities.

D. Standing methanol was removed by vacuum truck from the surface at the site, and most of the contaminated snow and gravel was excavated and placed in lined, bermed, covered cells to forestall the migration of the methanol.

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E. ARCO intends to continue to reclaim the remainder of the methanol contained in contaminated gravel and soil at the site.

F. Remedial Action Plan

The remedial action plan pursuant to which ARCO will conduct excavation, reclamation, and associated activities in accordance with this Order, called "Plan of Operations ARCO Methanol Reclamation Project, Contract No. AK89-0658" and prepared by Environmental Services, Limited, is adopted and appended as Attachment 1. At the conclusion of the plan, ARCO shall have reclaimed the spilled methanol for its intended use as an antifreeze, and shall have dedicated it to that purpose.

II. Testing

A. ARCO will conduct sampling, testing, and monitoring during the execution of activities under this Order as set forth in the Plan, appended hereto as Attachment 1.

III. Management of Hazardous Substances and Contaminated Materials

ARCO shall manage all hazardous substances and contaminated materials in such a manner as to minimize or eliminate spillage, leakage, evaporation, and other means of migration, as described in the Plan of Operations (Attachment 1). Liquids shall be kept in closed containers. Contaminated gravel or soils shall be covered and placed in lined enclosures. Liner materials shall be resilient, resistant to penetration by contaminated materials, and capable of withstanding local temperature fluctuations. Leaking drums and other containers shall be secured. All containers shall be clearly labeled with origin, contents, and date of containment.

IV. Schedule

A. ARCO's reclamation contractor shall be mobilized at the site on or before April 15, 1990.

B. ARCO shall complete excavation of the contaminated materials from the railroad spur area on or before April 30, 1990.

C. All excavation and reclamation must be completed by September 30, 1990.

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D. All conditions of this Compliance Order must be met by April 30, 1991.

V. Deadlines

A. ARCO shall comply with the deadlines set forth in this Compliance Order.

B. Subject to the provisions of paragraph 8, a violation of the deadlines may, at ADEC's option, constitute a breach of this Compliance Order.

VI. Existing or Future Obligations

A. Nothing in this Compliance Order shall be construed as altering ARCO's existing or future obligations to monitor, record, or report information required under applicable environmental laws, statutes, regulations, or permits, or to allow ADEC access to such information. Nothing in this Compliance Order shall alter ADEC's authority to request and receive any relevant information under applicable environmental laws or in administrative or judicial proceedings.

VII. Force Majeure

If any event occurs which causes delay and effectively precludes compliance with the terms of this Compliance Order, ARCO shall promptly notify ADEC orally and shall, within 5 days of oral notification to ADEC, notify ADEC in writing of the anticipated length and cause of the delay, the measures taken and to be taken by ARCO to prevent or minimize the delay, and the timetable by which ARCO intends to implement these measures.

If ARCO demonstrates to ADEC's satisfaction that the delay or anticipated delay has been or will be caused by circumstances beyond the reasonable control and despite the due diligence of ARCO, the time for performance hereunder shall be excused or extended for a period equal to the delay resulting from such circumstances.

Delays in implementation of this Order caused by acts of ADEC or other state or federal agencies shall be considered force majeure events.

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However, "Force Majeure" shall not include increased costs of performance of the terms and conditions of the Compliance Order, a change in ARCO's economic circumstances, or normal weather conditions.

VIII. Jurisdiction and Venue

The parties agree that any judicial action brought by either party to enforce or to adjudicate any provision of this Compliance Order shall be brought in the superior court for the State of Alaska, Fourth Judicial District, at Fairbanks, Alaska.

IX. Access and Records

For the purposes of implementation of this Order and to the extent such access is in ARCO's control, ARCO shall allow ADEC unrestricted access to the real property described in paragraph 1 and to other real property which may be involved in activities associated with performance of this Compliance Order. ARCO shall obtain such right of access for ADEC from its contractors, lessees and lessors. ADEC shall have the right to take samples, conduct tests, take photographs, make sound recordings, and conduct other activities to monitor compliance with this Compliance Order.

Whenever reasonably feasible, ADEC will inform ARCO at the time of obtaining access, of ADEC's presence on the real property. ARCO may have a representative accompany ADEC. Upon request, ARCO shall make available to ADEC for inspection and copying, all documents, records, photographs, data, and other writings related to any activities taken pursuant to this Compliance Order.

X. Duplicate Samples

At the request of ADEC, ARCO shall allow ADEC to obtain split or duplicate samples of any materials collected by ARCO pursuant to this Compliance Order. If ADEC finds, in its discretion, that the analytical results it obtains from its split or duplicate samples differ significantly from those obtained from ARCO's analytical results, then the On-Scene-Coordinator (OSC) shall have the option of halting all or a part of the remedial actions

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dependant upon testing by the affected laboratory until the source of unacceptable variation is determined.

XI. Records Preservation

ARCO shall preserve during the pendency of this Compliance Order and for a minimum of three years after the completion of the activities required by this Compliance Order all records and documents in ARCO's possession which relate in any way to this Compliance Order or to activities conducted pursuant to this Compliance Order.

XII. Confidential Information

ARCO may assert that documents or information provided pursuant to this order are confidential, if appropriate, pursuant to AS 46.03.311 or under other applicable state law. Such an assertion shall be substantiated when the confidentiality claim is made. All information submitted by or on behalf of ARCO to ADEC with a claim of confidentiality shall be treated as confidential until ADEC has made a determination regarding the claim of confidentiality and has notified ARCO in writing of such determination, and until ARCO has had the opportunity to judicially challenge any such determination.

XIII. Costs and Reimbursement

All costs incurred by ARCO in carrying out the provisions of this Compliance Order shall be borne by ARCO. Nothing in this paragraph precludes ARCO from seeking reimbursement for costs from entities other than the State of Alaska. ARCO shall not be required to reimburse the State of Alaska for state expenditures of funds where such expenditures are related to activities conducted at the site pursuant to this Compliance Order, except that ARCO shall reimburse the state for state expenditures from the state Oil and Hazardous Substance Response Fund (Fund).

Whenever practical, ADEC agrees to consult with ARCO before expending Fund monies on activities at the site. ARCO shall reimburse the state within 60 days from the date the state submits proof of expenditures to ARCO. However, in the event ARCO

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breaches this Compliance Order, nothing herein shall be construed to limit the state's right to seek reimbursement of monies expended or costs incurred by the state.

XIV. On-Scene Coordinator

ARCO shall allow the On-Scene Coordinator (OSC) to observe and review all activities performed pursuant to this Compliance Order. The OSC shall have authority to authorize minor modifications in the activities performed pursuant to this Compliance Order. The OSC shall also have authority to determine compliance with sampling and remedial action plans. Requests for minor modifications shall, when feasible, be submitted in writing to the OSC. The ADEC Northern Regional Supervisor shall have sole discretion to determine what constitutes minor modifications. Authority for plan approvals and other major modifications shall remain in the ADEC Northern Regional Supervisor.

XV. Breach

Time is of the essence in this Compliance Order. ARCO understands that any deviation from the terms or deadlines set forth herein, other than violations caused by Force Majeure, may at ADEC's option be deemed a breach of this Compliance Order and may result in prompt legal action to enforce the terms and deadlines of this Compliance Order or other provisions of state law.

XVI. Waiver

A failure to enforce any provision of this order does not imply a waiver of ADEC's right to insist upon strict performance of the same or other provisions of this order in the future.

XVII. Modifications

ADEC may, with ARCO's consent, modify the requirements contained in this Compliance Order and all documents incorporated into it. If ADEC finds that a modification is necessary to achieve the goals of this Order, but ARCO is not willing to agree to that modification, ADEC will request the modification in writing, stating the reasons therefore. If the parties are unable

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to reach an agreement, the modification will take effect and the provisions of paragraph will 35 apply.

XVIII. Indemnification and Hold Harmless

ARCO agrees to defend, at its sole expense, and to hold the State of Alaska and its representatives, agents, and employees harmless and to indemnify the State of Alaska against all liability, losses, and damages, including any awards of costs and attorneys' fees, by reason of claims for injury to or death of persons and loss or damage to property arising out of or any manner connected with the incidents which give rise to this Compliance Order, or any corrective actions taken pursuant to this Compliance Order or otherwise, whether such claims are rightfully or wrongfully brought or filed; provided, however, that ARCO shall not defend or indemnify or hold harmless the State of Alaska, its representatives, agents, or employees from any claims arising out of or in any manner connected with the incidents which give rise to this Compliance Order or any corrective actions taken pursuant to this Compliance Order or otherwise for that portion of the damages or injury for which the state is comparatively at fault if the state's "independent negligence" is negligence other than in (i) the state's negotiation, determination, or specification of ARCO's responsibilities under this Compliance Order, or (ii) the state's assessment, approval, acceptance, denial, or rejecting of ARCO's performance under this Compliance Order. It is specifically understood and agreed that this paragraph includes, but is not limited to, any damages to present or future owners of the property described in paragraph 1 of this Compliance Order or to other members of the public resulting from the incidents which give rise to this Compliance Order, or from any corrective actions taken pursuant to this Compliance Order or otherwise.

XIX. State not a Party

The State of Alaska shall not be held as a party to any contract entered into by ARCO related to activities conducted

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pursuant to this Compliance Order.

XX. Other Legal Obligations

The requirements, duties, and obligations set forth in this Compliance Order are in addition to any requirements, duties, or obligations contained in any permit which ADEC has issued or may issue to ARCO. This Compliance order does not relieve ARCO from the duty to comply with requirements contained in any such permit or with other applicable state and federal laws.

XXI. Reservation of Rights

A. The execution of this Compliance Order is not an admission of liability of ARCO on any issue dealt with in this Compliance Order. In signing this Order, ARCO and ADEC do not admit, and reserve the right to controvert in any subsequent proceedings, the validity of or responsibility for any of the factual or legal determinations made herein; provided, however, that ARCO shall not controvert or challenge, in any subsequent proceedings initiated by the State of Alaska, the validity of this Order or the authority of ADEC to issue and enforce this Order.

B. ARCO expressly reserves the right to claim that no harm has been or will be caused by the presence of any of the chemical substances described in this order.

C. ADEC expressly reserves the right to initiate administrative or legal proceedings related to any violation not described in this Compliance Order. In addition, ADEC and the Department of Law expressly reserve the right to initiate administrative or legal proceedings related to violations described in this Compliance Order if ARCO breaches this Compliance Order or if, in ADEC's opinion, subsequently discovered events or conditions constitute an immediate threat to public health, public safety, or the environment whether or not ADEC may have been able to discover the event or condition prior to entering into the Compliance Order. The state expressly reserves the right to initiate administrative or legal proceedings if ARCO

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does not comply with the provisions set forth herein to the satisfaction of ADEC.

XXII. Covenant Not to Sue

Subject to the provisions of Sections 17 and 23, provided ARCO complies with the terms of this Compliance Order to the satisfaction of ADEC, ADEC shall not institute any action against ARCO, whether civil, criminal, administrative, penalty, or cost recovery, for the potential violations described in paragraph 1.

XXIII. Property Transfer

If ARCO transfers, sells, or subleases the property described in paragraph 1 to another party prior to ARCO's fulfillment of the provisions of this Compliance Order, ARCO shall incorporate a copy of this Compliance Order into the documents of transfer or lease, and shall provide in those documents that the new owners or lessees shall take or lease subject to the provisions of this Compliance Order.

XXIV. ADEC Order

ARCO acknowledges and agrees that this Compliance Order constitutes an order of ADEC for the purposes of AS 46.03.50, AS 46.03.65, AS 46.03.850 and for all other purposes.

XXV. Authorizations

ARCO is responsible for applying for, in good faith and with due diligence, all necessary permits, approvals, clearances, and other authorizations, including but not limited to property access authorizations, for activities conducted pursuant to this Compliance Order. ARCO shall use its best efforts to obtain such authorizations in a timely fashion. Except as provided in paragraph 8, failure by ARCO to timely obtain such authorizations shall not excuse any failure to comply with the deadlines or provisions of this Compliance Order.

XXVI. Periodic Briefings

At the request of ADEC, ARCO shall schedule and conduct periodic briefings at reasonable intervals in Fairbanks concerning

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the status of activities conducted pursuant to this Compliance Order.

XXVII. Monthly Progress Reports

A. ARCO shall prepare and submit to ADEC not less than once per month written progress reports concerning the status of activities conducted pursuant to this Compliance Order. The content of these reports will be sufficient to develop a chronological record of all site activities and should include the following elements:

1. Estimates of the percentage of project completed;

2. A summary for the reporting period of actions taken toward satisfaction of this Compliance Order, including a description of work performed on the site;

3. A summary for the reporting period of community relations activities, if any, including community contacts, citizens concerns, and efforts to resolve any concerns;

4. A summary for the reporting period of problems or potential problems encountered;

5. A summary for the reporting period of projected work for the next reporting period; and,

6. Copies of contractor daily reports, RCRA manifests (if applicable), and laboratory/monitoring data.

B. Monthly progress reports shall be submitted on the fifteenth day of each month.

XXVIII. Records

ARCO shall maintain or cause to be maintained written records of all remedial activities performed pursuant to this Compliance Order. ARCO shall make the records available to ADEC for inspection and copying upon ADEC's request.

XXIX. Completion

A. Application - When ARCO believes that the specific requirements of this Order have been met, ARCO shall submit to ADEC a notice of completion. The notice shall include or reference any supporting documentation.

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Fairbanks, Alaska 99701
100 Cushman, Suite 400
Phone: (907) 452-1568

B. Certification - Upon receipt of the notice of completion, ADEC shall review the final report and any other supporting documentation. ADEC shall issue a certification of completion upon a determination that ARCO has demonstrated compliance with the requirements of this Compliance Order. The issuance of a certification of completion pursuant this Order discharges this Compliance Order.

C. ADEC shall issue either the certification of compliance or the rejection of the notice within thirty days of receipt of the notice of completion. If ADEC fails to act within 30 days, the notice will be deemed rejected.

D. If ADEC fails to issue a certificate of completion upon receipt of ARCO's notice of completion and the parties are unable to resolve disputes in accordance with paragraph 36, ADEC shall issue a written rejection of the notice of completion which shall constitute final agency action for purposes of judicial review pursuant to ARAP 602 (a) (2).

E. Notwithstanding any provision to the contrary, this Order is not discharged until all provisions are carried out to the satisfaction of ADEC, and all methanol contamination at the site is reduced below 1000 ppm by weight.

XXX. Incorporation

Any reports, plans, specifications, schedules, and attachments required by this Compliance Order are, upon approval or approval with modifications by ADEC, incorporated into this Compliance Order. Any non-compliance with such reports, plans, specifications, schedules, and attachments may be considered non-compliance with the requirements of this Compliance Order.

XXXI. Parties Bound

This Compliance Order shall apply and be binding upon ADEC and ARCO, their agents, successors, and assigns and upon all persons, contractors, and consultants acting on behalf of ADEC or ARCO.

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XXXII. Copies

Upon retention, ARCO shall provide a copy of this Compliance Order to all contractors, sub-contractors, laboratories, and consultants retained to conduct any portion of the work performed pursuant to this Compliance Order.

XXXIII. ARCO Representative

ARCO shall designate a representative who shall be empowered on behalf of ARCO to communicate with, and to receive and comply with, all communications and orders of ADEC. ARCO shall also designate field representatives who shall be authorized to and at all times be available to communicate and cooperate with field representatives of ADEC. ARCO shall keep ADEC informed of any changes of ARCO representatives during the term of the Compliance Order.

XXXIV. Dispute Resolution

A. If ARCO objects to an ADEC action taken or decision made pursuant to this Compliance Order, ARCO shall notify ADEC in writing within 7 calendar days of notice of the action or decision. ADEC and ARCO shall then have an additional 14 calendar days from the date of receipt by ADEC of the notification of objection to reach agreement.

B. If ADEC and ARCO cannot reach agreement on the disputed matter within 14 days after receipt by ADEC of the Notice of Objection, ADEC shall provide a written statement of its decision to ARCO. ADEC's written decision shall constitute a final agency action for purposes of judicial review pursuant to ARAP 602(a)(2). The parties agree that the ADEC decision shall remain in effect pending resolution of the appeal unless a stay is granted by the court on appeal. The parties agree that the appeal process shall be expedited wherever possible.

C. ADEC and ARCO agree that the dispute resolution process shall only be invoked for those disputes which ARCO can demonstrate involve acts or omissions which, if performed, involve direct monetary expenditures by ARCO of $50,000 or more. The

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dispute resolution process shall not be invoked by ARCO for purposes of delay.

XXXV. Effective Date

Upon execution by both ARCO and ADEC, this Compliance Order shall be effective retroactively to the date the remedial action plan was initiated in the field.

XXXVI. Prior Drafts

This Order represents the entire integrated agreement of the parties. Prior drafts of this Compliance Order and other material or statements related to the development of the final Order shall not be used in any litigation involving the interpretation of this document.

XXXVII. Severability

It is the intent of the parties hereto that the clauses of this Compliance Order are severable and should any part of it be declared by a court of law to be invalid and unenforceable, the other clauses shall remain in full force and effect.

XXXVIII. Definitions

The following definitions shall apply in this Compliance Order.

A. "Contaminated material" means any material, including, but not limited to, absorbent pads, used containers and gravel, which has been in sufficient contact with a hazardous material to contain no less than 1000 ppm by weight of methanol.

B. "Hazardous substance" means (a) an element or compound which, when it enters into the atmosphere or in or upon the water or surface or subsurface land of the state, presents an imminent and substantial danger to the public health or welfare, including but not limited to fish, animals, vegetation, or any part of the natural habitat in which they are found; (b) oil; or (c) a substance defined as a hazardous substance under 42 U.S.C. 9601(14).

C. "On-Scene Coordinator" or "OSC" means the ADEC official designated by ADEC to coordinate and direct response actions under

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this Compliance Order. For purposes of this Compliance Order, the OSC shall be the ADEC Northern Regional Supervisor or his designee.

D. "Submit to ADEC" means to expeditiously provide the documents or other information required to the ADEC Northern Regional Supervisor. A document or other information shall be deemed submitted to ADEC at such time as the document is physically received by the ADEC Northern Regional Office or is sent by telephonically confirmed telecopy at the ADEC Northern Regional Office. Telecopies are to be followed by hard copy. Required or requested documents shall be submitted in accordance with schedules contained herein, or, if not scheduled, as they become available.

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STATE OF ALASKA
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Fairbanks, Alaska 99701 Phone: (907) 452-1568

Department of Environmental Conservation

By: William D. McGee
Northern Regional Supervisor

Date: 4/26/90

ASSENT OF COUNSEL

Approved as to legality and form.
Dated: 4-26-90

DOUGLAS B. BAILY
ATTORNEY GENERAL

By: _____
Leone Hatch
Assistant Attorney General

ARCO, Alaska, Inc.

By: _____

Title: Vice President in charge of Finance, Planning and Control

Date: 4/27/90

I, Joseph P. McCoy, hereby certify that I am the Vice President in charge of Finance, Planning and Control of ARCO, Alaska, Inc. and that I have the authority to enter into this agreement on behalf of ARCO and thereby legally bind ARCO to the terms set forth herein. I further acknowledge that I am endorsing this Order voluntarily after obtaining advice of counsel.

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APPENDIX E

SPILL MITIGATION PLAN FOR THE DECEMBER 4TH METHANOL SPILL, NORTHSTAR PIPEYARD, FAIRBANKS, ALASKA

(As prepared for ARCO Alaska, Inc. by America North, Inc.)
March 22, 1990

SPILL MITIGATION PLAN
FOR THE DECEMBER 4TH METHANOL SPILL
NORTH STAR PIPEYARD

FAIRBANKS, ALASKA

Prepared for:

ARCO Alaska Inc.
P. O. Box 100360
Anchorage, Alaska 99512-0360

Prepared by:

America North Inc.
201 E. 56th, Suite 200
Anchorage, Alaska 99518

March 22, 1990

ARCO ALASKA, INC.
NORTH STAR PIPEYARD METHANOL SPILL
SPILL MITIGATION PLAN

EXECUTIVE SUMMARY

This Spill Mitigation Plan describes environmental and health aspects of the December 4th, 1989 methanol spill at the North Star Pipeyard in Fairbanks, Alaska. The discharge valves on three railroad tanker cars were opened by an unknown person or persons, and sabotage is suspected. Extensive emergency and immediate response actions were conducted. This Plan documents these past activities and identifies future monitoring and remedial action at the site. This Plan will also serve to identify agreements and guidelines which have been established between ARCO and the Alaska Department of Environmental Conservation (DEC) regarding the spill cleanup.

To summarize the response effort and remediation/monitoring activities:

- Analytical results indicate that ground water at the site has not been impacted.
- Results of sampling and analysis of area ground-water supply wells and surface water indicate that no contamination of the water supplies in the vicinity of the site has occurred as a result of the spill.
- Most of the soils in the area of the spill which were contaminated by the methanol were excavated during the first few weeks of the cleanup response action. Largely due to the difficulty of access, isolated areas of contamination remained after this initial response. ARCO excavated these soils to remove contamination. A cleanup level of 1,000 parts per million (ppm) methanol in soil was determined to be appropriate by the DEC.
- Approximately 3,500 cubic yards of contaminated soil is stockpiled on site in containment areas. ARCO intends to reclaim the methanol contained in the stockpiled soil.
- Recovered methanol product has been or will be utilized as originally intended (as an antifreeze agent) in the North Slope oil fields.
- Ground-water monitoring wells will be sampled monthly, or until the railroad bed is determined to be "clean" (i.e., methanol concentrations are reduced to below 1,000 ppm).
- Surface water sources and private water wells will be sampled again only if on-site monitoring well sampling indicates that methanol contamination is migrating from the site.

- Site remediation will be considered complete when the identified areas where contamination levels exceed a cleanup level are excavated, methanol in contaminated soil is reclaimed, and methanol which is in soils (at concentrations above 1,000 ppm) in the ballast-area of the railroad tracks has been reclaimed.

ARCO ALASKA, INC.
DECEMBER 4TH, 1989
NORTH STAR PIPEYARD METHANOL SPILL
SPILL MITIGATION PLAN

1.0 INTRODUCTION

America North Inc. (ANI) was hired by ARCO Alaska, Inc. (ARCO) to prepare a Spill Mitigation Plan (Plan) for the methanol spill which occurred at the North Star Pipeyard (pipeyard) in Fairbanks, Alaska on or about December 4, 1989. The Plan documents actions taken at the site to mitigate effects of the methanol spill. Furthermore, it will outline proposed measures to remediate any remaining contamination (above the 1,000 ppm cleanup level) and to monitor soil and ground water at the site.

2.0 BACKGROUND

2.1 Physical Setting

A methanol spill occurred during the night of December 3, 1989 or during the early morning hours of December 4, 1989 at the pipeyard in Fairbanks, Alaska. Figure 1 is a site location map, and Photograph 1 in Appendix A is an aerial view of the spill site. Air temperature at the time of the spill was approximately 0 to 10° F. The snow cover was about 1.5 feet thick at the time of the incident, and the ground in the yard (gravel pad) was generally frozen to 3.5 feet below the ground surface.

2.2 Conditions and Initial Events Associated With the Spill

Sometime prior to 2:00 AM Monday, December 4th, unknown saboteurs opened the discharge valves on three 30,000-gallon tanker cars containing methanol. This act was manifested by various graffiti written on the tanks; furthermore, specialized tools and knowledge were required to open the valves.

At the time of the spill, the tanker cars were located on an isolated railroad siding in the western portion of the pipeyard. The discharge valves are at the base of the tank midway between the ends of each tanker car. Vertical drain spouts on the northern and middle tanker cars directed the methanol discharge directly downward onto the railroad tracks, and the methanol flowed by gravity along the path of least resistance. A 90-degree elbow on the southern tanker car drain spout directed the discharge horizontally to the east, and methanol from this car preferentially flowed in that direction.

A switching crew, unaware of the spill, began moving the three tanker cars at approximately 2:00 AM on December 4th. The rail cars had been moved only a relatively short distance (approximately one-quarter mile) before the crew realized the discharge valves had been opened, and a spill had occurred. The crew immediately closed the valves, and began

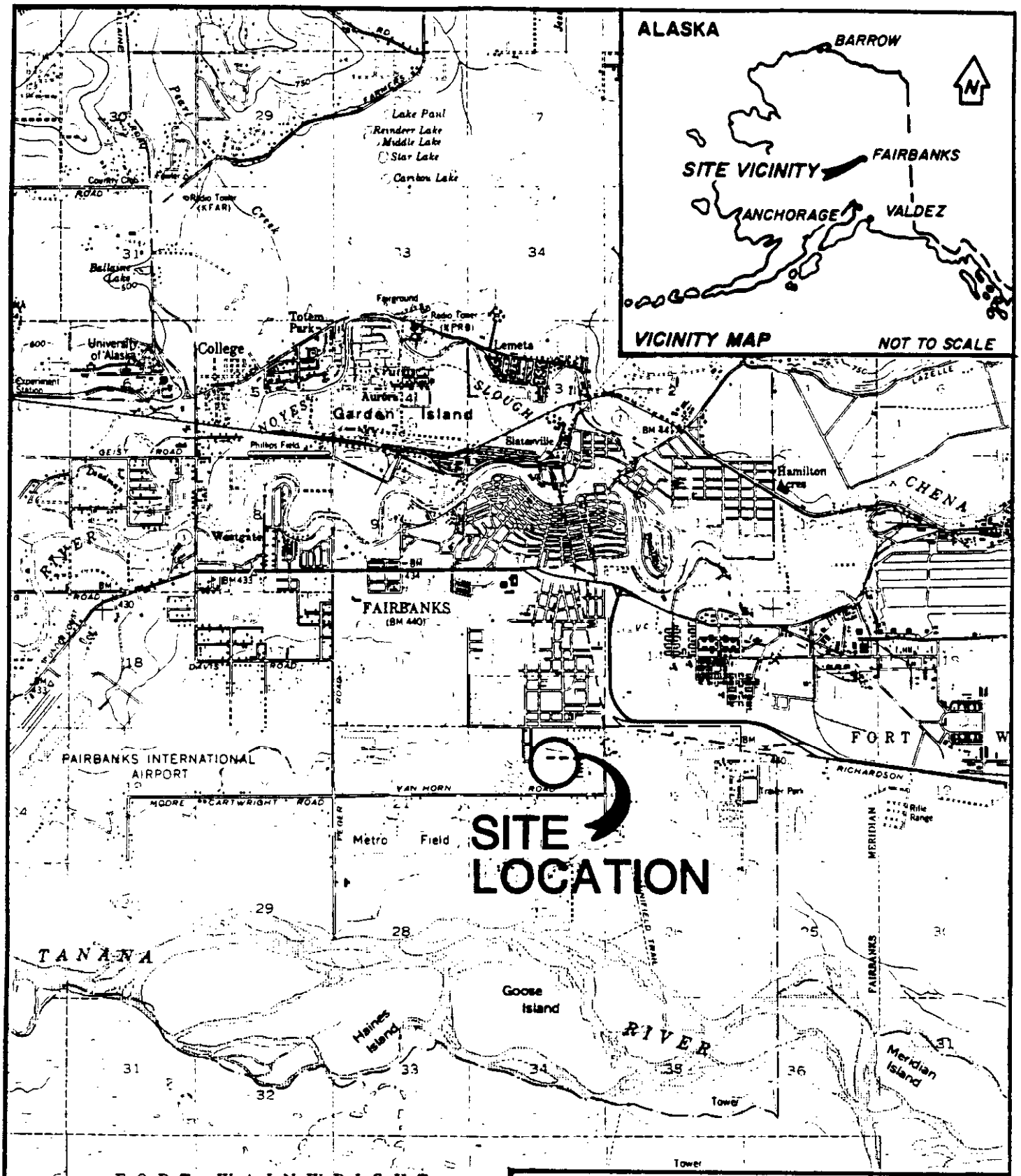


FIGURE 1

SITE LOCATION MAP

ARCO ALASKA Inc. Fairbanks Methanol Spill	America North Inc. Environmental Consulting / Natural Resources Management
ANI. PROJ. # 253	Chk BA Drwn C.D.S JAN., 1990

notifying authorities. The emergency response action will be discussed in the following section.

3.0 EMERGENCY RESPONSE

The current Spill Contingency Plan (SCP) for the pipeyard identifies the principal actions to be taken in the event of a spill. As outlined in the SCP, the initial objective after detection of a spill is the protection of the health and safety of the personnel and general population in the area. Then, the spill source should be stopped if it can be accomplished safely. After detection of the spill (during the car move) SCP procedures were followed.

ARCO hired Martech Construction, Inc. (Martech) on December 4th, 1989 as the response contractor for the spill. As one of its first tasks, Martech outlined a spill response plan to ARCO on the 4th ((D. Maiero, 1989). This plan outlined actions which were to be taken to contain the spill and begin cleanup. The remainder of this section provides a chronology of the emergency response events associated with the spill, and outlines health and safety considerations of the emergency response action.

3.1 Chronology of Emergency Response Events

After closing the discharge valves on the railroad tanker cars, Alaska Railroad personnel notified the Fire Department and Police, and Mr. Tom Edmunds, the ARCO Supervisor of the Fairbanks facility. The initial volume estimate of spilled methanol was approximately 50,000 gallons. This estimate was based on the known initial volumes of the three tanker cars (two of the three cars were only partially full), while making some allowance for methanol which remained in the cars. Since a spill of this magnitude might pose a threat to local residents and response personnel, the local Emergency Services, Police, and Fire Department who were summoned, secured the area. Approximately ten residences and businesses were evacuated in the early morning hours.

ARCO's Supervisor, Tom Edmunds, arrived at the pipeyard at approximately 3:00 AM. Various emergency responders were present on site. Bud Sands, the Fairbanks Fire Chief, was the coordinator of emergency operations at this time.

Mr. Edmunds surveyed the situation and estimated the potential quantity of methanol that may have spilled from the three tanker cars (approximately 50,000 gallons). He notified additional authorities, including Mr. John Janssen with DEC, and the National Response Center. He also notified other ARCO contacts, those local response team members listed in the Contingency Plan. Shortly after these team members came on location, Martech was mobilized.

The late morning of the spill revealed that the vents on top of the cars had not been opened, and a partial vacuum had resulted. This negative pressure had greatly slowed the flow of methanol from the cars. In addition, data on actual fluid levels in the tanker cars was obtained which reduced the potential spill size. The initial spill estimate was accordingly revised downward to 12,000 gallons. This estimate was revised further during the days following the spill. Ultimately, the volume of methanol which spilled was

accurately determined by pumping the remaining contents of the three tanker cars to tanker trucks and calculating this quantity. Then, by subtracting this quantity from the known original volume of the three tanker cars (incorporating appropriate temperature corrections), it was determined that approximately 9,300 gallons of methanol were released during the spill.

By early morning on December 4th, a joint decision by the Fire Department, ARCO, and the Alaska Railroad was made to move the rail cars out of the immediate area of the spill to avoid risk of fire. During early afternoon, Dr. Gary Lawley, the industrial hygienist (IH) for Martech, determined by organic vapor analysis that there was no measurable atmospheric contamination . On-site testing determined there was no potential for explosion. Evacuated residents were therefore allowed to return to their homes and businesses.

Incineration of the methanol was initially considered as a response option. On-site tests were conducted to determine the material's flammability given site conditions. Contaminated material was placed in a container and an ignition source was introduced. This test indicated low potential for burning (the methanol was too cold or too dilute). Furthermore, the local Fire Department advised against burning. This alternative was accordingly abandoned.

Martech personnel began arriving at the site late in the morning on December 4th. Martech's initial focus was evaluation of the hazardous nature of the situation, while also scheduling immediate acquisition of equipment to recover the spilled methanol. Starting in the late afternoon of December 4th, Martech obtained and had deployed high capacity vacuum trucks to remove ponded surface accumulations of snow melt and methanol. As the methanol was recovered, it was diluted with water to reduce any risk of ignition. This recovered liquid was temporarily stored on site. Plans were made to mobilize equipment to address the next priority, removal of contaminated material (primarily soil and snow).

3.2 Health and Safety Considerations

Given ARCO's early estimates of the spill size, and the use of reference materials which described the properties of methanol under more temperate conditions, local emergency responders took precautions such as evacuation of local residences and businesses. Until risks were more clearly known, local authorities were reluctant to permit commencement of cleanup activities until time and effort were initially committed to evaluation of the health and safety aspects of the emergency spill situation.

Cold temperatures and snow cover helped measurably in keeping health and safety risks low. Initial monitoring of the air at the spill site with detector tubes indicated the absence of hazardous concentrations (with respect to inhalation) of methanol vapors. The permissible exposure level (PEL) for methanol in the breathing zone is 200 ppm as regulated by the Occupational Safety and Health Administration (OSHA). According to Dr. Lawley, methanol concentrations in air rarely exceeded 5 to 10 ppm in the breathing zone. Near the contaminated soil pile, where increased volatilization was occurring during soil moving activities, occasional readings near the PEL were obtained if instrument

readings were recorded within close proximity (one to two feet) of the soil surface. Since these concentrations were not observed in an area routinely inhabited by workers, and since the high concentrations were not observed in a normal breathing zone, special mitigation measures were not necessary. (pers. comm., 1990).

Five commercial and residential water wells in the area adjacent to the spill site were sampled to determine if methanol concentrations were present in the water (see Figure 2). ARCO provided drinking water to these people while water samples from their wells were being analyzed. Surface water in the area was also sampled (gravel pit lake located to the west of the site, Figure 2). The water sampling assured local residents that potentially downgradient (with respect to ground-water flow) drinking water sources were not affected.

Martech assured ARCO that all contractor employees working at the site had received Hazwoper instruction as per 29 CFR 1910.120, Section Q. This training is required to conduct cleanup operations at a spill site such as this one.

4.0 SITE INVESTIGATION ACTIVITIES

4.1 Free Product

Recovery operations initially focused on retrieving methanol product which had pooled in numerous depressions at the site (see Photographs 1 and 2, Appendix A). Phases of the operation are discussed below.

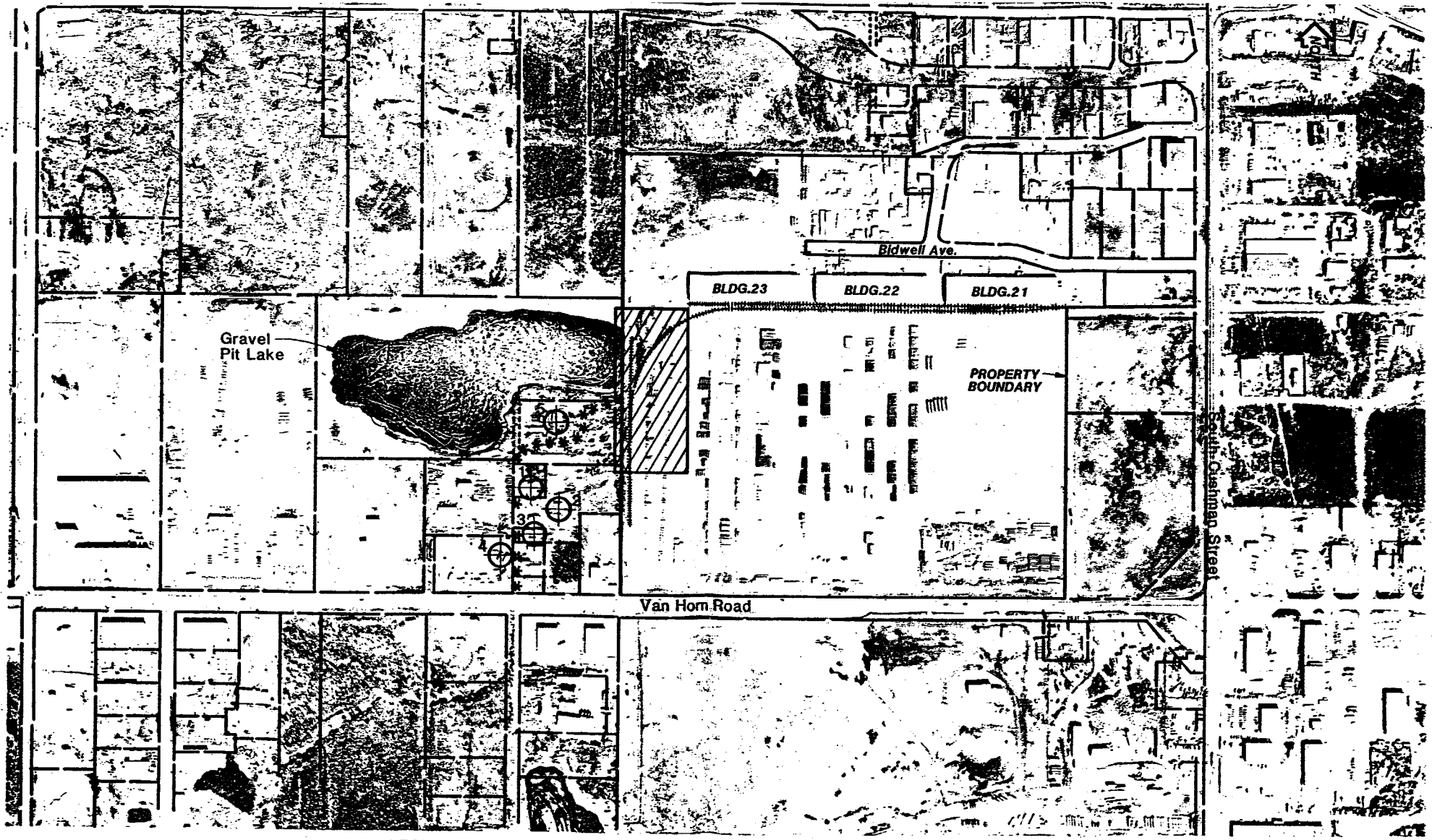
4.1.1 Removal and Storage

High capacity vacuum trucks were provided to Martech by subcontractor VRCA Environmental Services (VRCA), to recover the pooled free product. Most of the free product was recovered within 24 hours of discovery of the spill. Generally, the methanol had been somewhat diluted by snow melt. Workers also mixed water with the free methanol product (at a ratio of approximately 1:1) as it was vacuumed up to reduce fire hazard potential, thus increasing the total volume of contaminated fluid recovered. This mixture was stored in an on-site tank.

Arco estimates that as of January 4, 1990 approximately 4,600 gallons of 22% methanol had been recovered (Falcone, 1990). This equates to approximately 1,000 gallons of the ±99% methanol product (see Appendix B).

4.1.2 Disposition

The free methanol recovered at the spill site has been used as an antifreeze on the North Slope. The diluted methanol (22%) and water mixture was combined with concentrated methanol to keep it from freezing while enroute to the North Slope (resulting in a mixture that is 40% to 60% methanol). The concentration will then be readjusted on the North Slope for use as an antifreeze.



America North Inc.

Environmental Consulting /
Natural Resources Management

LEGEND

**** WEST SIDE ACCESS ROUTE

⊕2 WATER WELL SAMPLE LOCATION AND NUMBER (See table 1, Page1)

SEE FIGURES 3 AND 4 FOR DETAIL,THIS AREA.

APPROXIMATE SCALE: 1"=400'

ARCO ALASKA Inc.
NORTH STAR TERMINALS
Fairbanks Methanol Spill

ANI #253 Ckd. BA Drwn.CDS

Figure 2
AREA MAP

January, 199

4.2 Contaminated Snow

Snow cover at the time of the incident was one to two feet deep. The spilled methanol was diluted as it mixed with the snow, since a portion of the contaminated snow melted (liquid recovery was accomplished as described above). Contaminated snow removal, storage, and disposition is described in the following sections.

4.2.1 Removal and Storage

Contaminated snow was visually discernible. Heavily contaminated snow was discolored (yellowish), and very "mushy". Moderately to lightly contaminated snow was evidenced by varying degrees of discoloration and a slightly melted condition (slightly mushy to granular). This contaminated snow was collected primarily using two methods: the high capacity vacuum trucks, and excavation equipment. Because it was not possible to separate clean snow from contaminated snow with any real precision in an area where some degree of contamination was discernible, these collection methods retrieved a substantial volume of clean snow with the contaminated snow.

Suspect snow was scooped or gathered by using front-end loaders, backhoes, and hand tools. Most of the snow in the track ballast area (Photograph 6, Appendix A, & Figure 3) was removed to a lined containment area since it was contaminated to varying degrees (see Photograph 3, Appendix A).

Samples of contaminated snow were collected to assess the methanol concentration in the accumulated snow pile. These samples were collected in covered buckets, and taken to the Shannon and Wilson, Inc. (Shannon and Wilson) laboratory to thaw. After the samples melted, they were analyzed for methanol.

Methanol concentrations in the melted snow were 1,360 and 5,500 ppm in the two samples which were analyzed. ARCO used these values (average value equals 3,430 ppm) in calculations to estimate the volume of methanol recovered in the contaminated snow (see Appendix B). Approximately 1,000 cubic yards of snow were accumulated in the containment area. This calculates to approximately 260 gallons of methanol.

4.2.2 Disposition

ARCO transported a "snow melter" from the North Slope to Fairbanks to melt the snow. Contaminated snow was loaded into a hopper on the snow melter unit, and fed into a chamber of heater water. The unit burned diesel fuel to heat the water, which in turn provided energy to melt the snow. After melting, the methanol and water mixture was filtered to remove rocks, gravel, and debris. The dilute mixture was then combined with concentrated methanol to prevent the mixture from freezing (resulting in a mixture that was 40% to 60% methanol), and also transported to the North Slope for use as an antifreeze agent. The materials filtered out of the snow melt were placed in the contaminated soil area described in section 4.3 below.

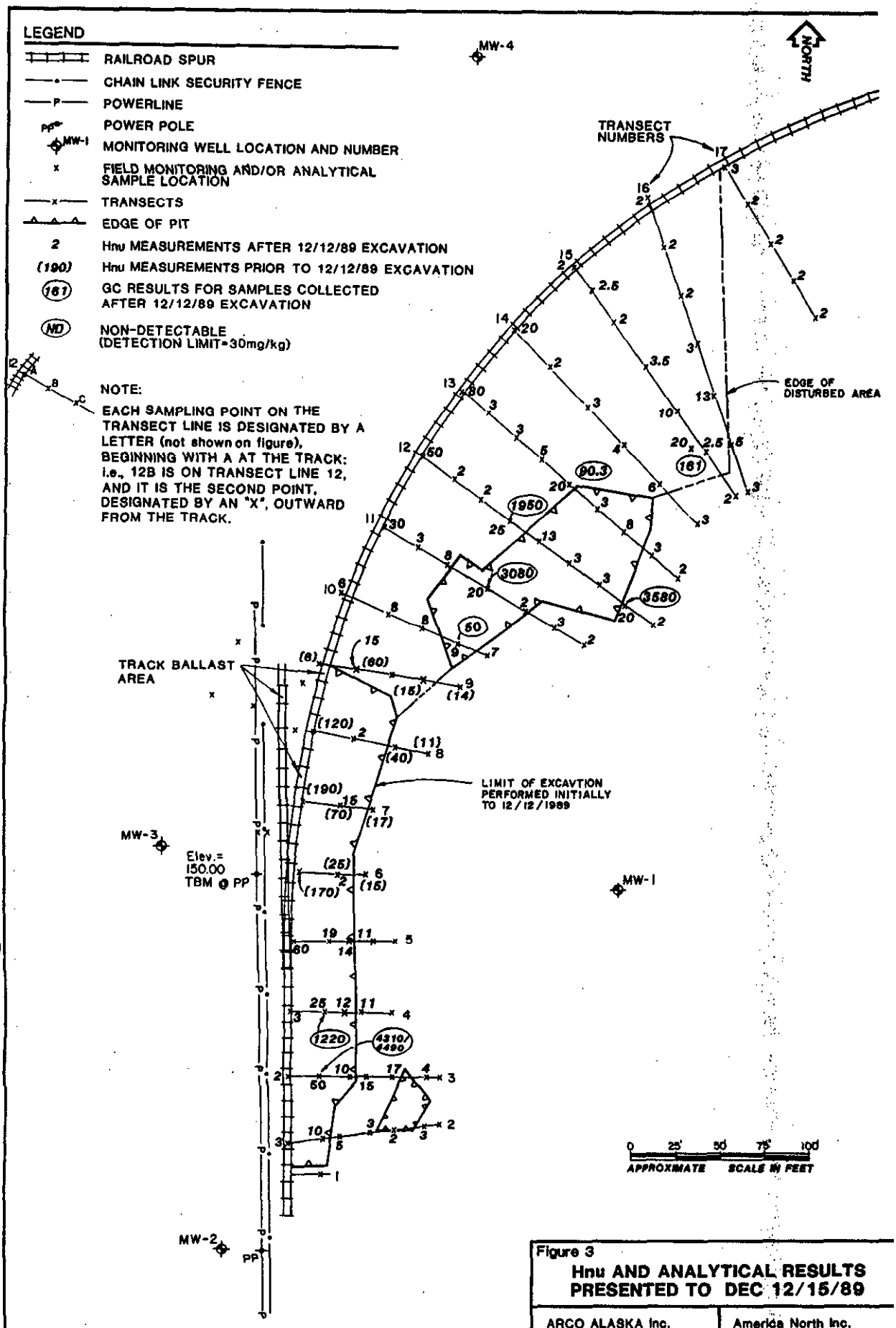


Figure 3

Hnu AND ANALYTICAL RESULTS PRESENTED TO DEC 12/15/89

ARCO ALASKA Inc. Fairbanks Methanol Spill	America North Inc. Environmental Consulting / Natural Resources Management
ANI # 253	Ckd.B.A. Drwn.CDS January, 1990

4.3 Contaminated Soil

The spill contaminated both surface snow and near-surface soils at the site. At the time of the spill, soils in the yard area were frozen from 1.5 to 3.5 feet below the ground surface. The spilled methanol was diluted by mixing with snow as it spread out onto the ground surface. Also, the methanol penetrated the frozen soil profile vertically to varying depths, resulting also in additional dilution and diffusion of the spilled product. In the following subsections, cleanup guidelines established by the DEC will be outlined, then contaminated soil removal and storage activities will be discussed. Subsequent subsections will describe remaining soil contamination which has been or will be excavated.

4.3.1 Definition of Cleanup Action Levels

DEC established a 1,000 ppm guideline for cleanup of soils at the site. Available information indicated methanol had a toxicity to aquatic life and microorganisms at a concentration above about 1,000 ppm (Enviro TIPS, 1985).

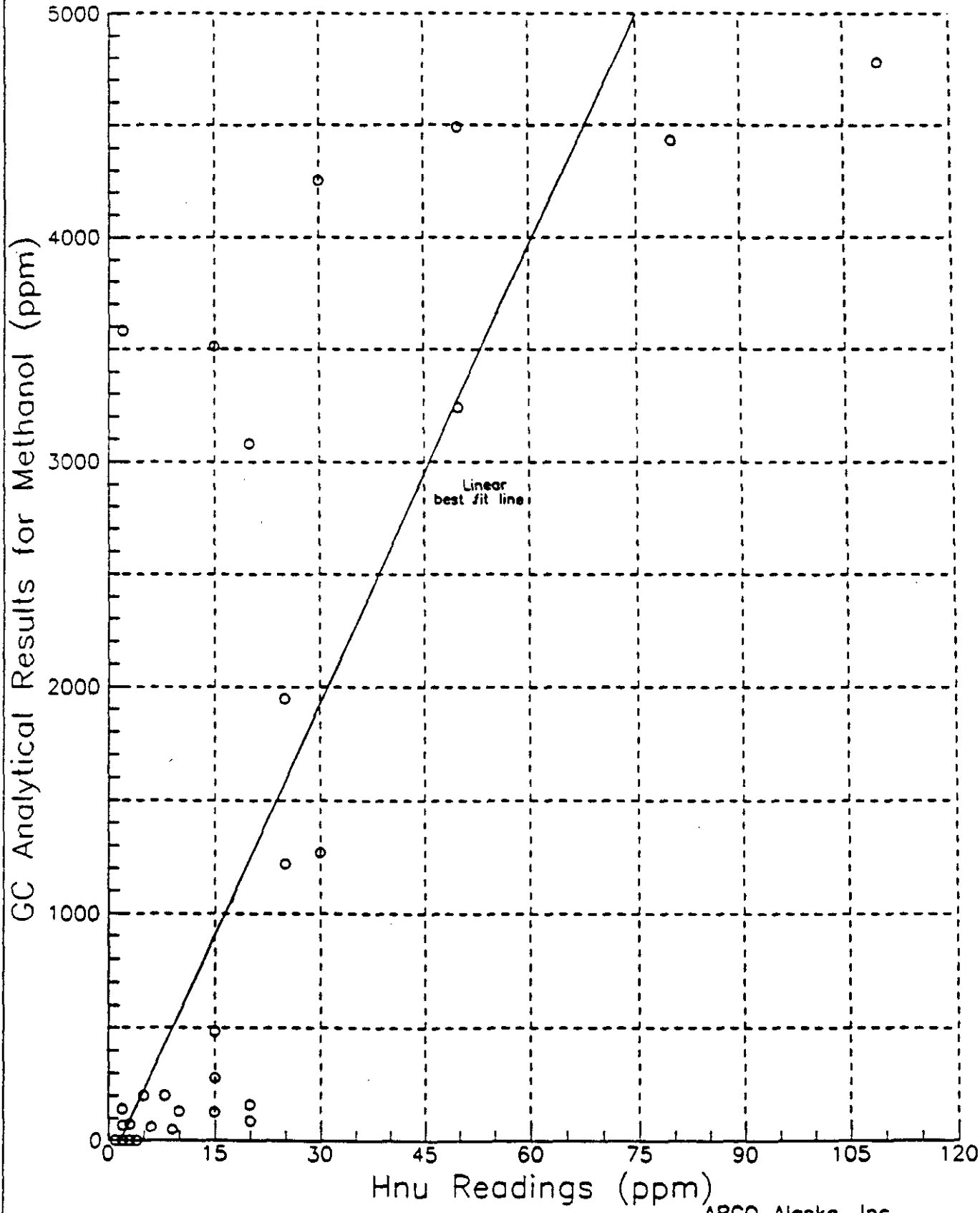
4.3.2 Detection

The tendency of the methanol to thaw the frozen soils was a key to determining the extent of contamination at a particular locale. For instance, in an area of apparent impact where the methanol had thawed soils at the ground surface, contaminated soil was excavated to the depth where the ground was again frozen. Moderately to heavily contaminated soil could also be detected visually since the methanol would tend to discolor impacted soils at the site (see Photograph 4, Appendix A).

A photoionization detector (PID) instrument, manufactured by HNU Systems, Inc. (Hnu), was used to refine the detection of contaminated soil in the field. Initially, soil samples were collected for laboratory analysis to verify the progress of cleanup operations. A gas chromatography method (U.S. EPA Method 8015) was used to analyze soil samples (the detection limit was 30 ppm). These samples were also field-detected with the Hnu to determine organic vapor concentrations. The objective of this exercise was to establish a correlation between field readings with the PID, and the gas chromatograph (GC) analytical results determined by the laboratory.

Based on early results, it was determined that a field PID reading of approximately 15 to 20 ppm roughly correlated to a methanol concentration in soil of less than 1000 ppm. Additional efforts to correlate field readings to laboratory analytical results reinforced this correlation. Figure 4 is a plot illustrating this correlation (Shannon and Wilson, 1990).

To facilitate monitoring efforts, a transect coordinate system was established on-site from which to reference all soil sampling and field monitoring locations and results. This coordinate system was based on a survey, and soil sampling and field monitoring were performed at points along the transects to provide a systematic sampling of the area.



NOTE: GC analytical results higher than 5000 ppm were obtained and are not shown on this figure.

ARCO Alaska, Inc.
Methanol Release
Fairbanks, Alaska
CALIBRATION CURVE (Hnu vs GC Results)

SHANNON & WILSON, INC.
Geotechnical Consultants

FIG. 4

Once an area was considered clean by the cleanup contractor, Shannon and Wilson personnel monitored the area with the Hnu PID based on the transect coordinate system. During the first screening of the area, locations which exceeded a predetermined level of contamination according to Hnu tests were sampled and analytically tested (using U.S. EPA Method 8015) to determine whether methanol concentrations in excess of the DEC's 1,000 ppm guideline were present. After additional excavation in the areas where contamination was analytically detected at concentrations greater than 1,000 ppm, the site was again monitored and samples were collected and analytically tested. This process continued until the areas were field monitored and analytically tested to be below the 1,000 ppm guideline.

Figures 3 and 5 graphically illustrate data which was presented to the DEC on December 15th and December 20th. These diagrams show the spill area in plan view; sampling locations (PID and GC) are indicated, and measured methanol concentration data which were available at the respective times are plotted.

4.3.3 Removal and Storage

Contaminated soil was excavated using primarily heavy equipment. Heavy equipment included trackhoes, four-wheel drive front-end loaders, and backhoes. High capacity vacuum trucks were also used to remove contaminated soil and snow, particularly from the ballast area of the railroad tracks (see Photograph 5, Appendix A). Hand tools, such as spades and shovels, were also used to gather isolated pockets of contaminated soil which were difficult to access by the heavy equipment.

Frozen soil and cold weather conditions made it difficult to excavate the soil. Such conditions required the use of bulky gear by site workers, which hampered the efficiency of removal operations. Operation of mechanical equipment (engines, hydraulics, etc.) was also hampered by cold weather. Facets of the cleanup operation involving water, such as decontamination, were complicated by the fact that air temperatures were well below freezing. The frozen state of the soil retarded vertical migration of the methanol product.

Soil which was heavily contaminated was generally thawed and noticeably discolored (it appeared dark, as if moistened). As with snow, it was difficult to differentiate between lightly contaminated soil and clean soil when excavating in some areas. A substantial portion of the soil which was excavated was therefore only lightly contaminated or not contaminated at all. This is particularly true since one of the phenomena which was occasionally observed at the site involved the spreading of the methanol below the ground surface (see Figure 6). That is, as contaminated soil was "followed out" (by excavating), the contaminated or thawed zone would occasionally be found beneath soils which were frozen at the surface. The zones of subsurface contamination beneath the frozen (non-contaminated) surface layer were relatively restricted, and detection and removal did not present significant difficulty. Again, it was generally not practical to separate the non-contaminated surface soils, thus increasing the volume of material which was excavated.

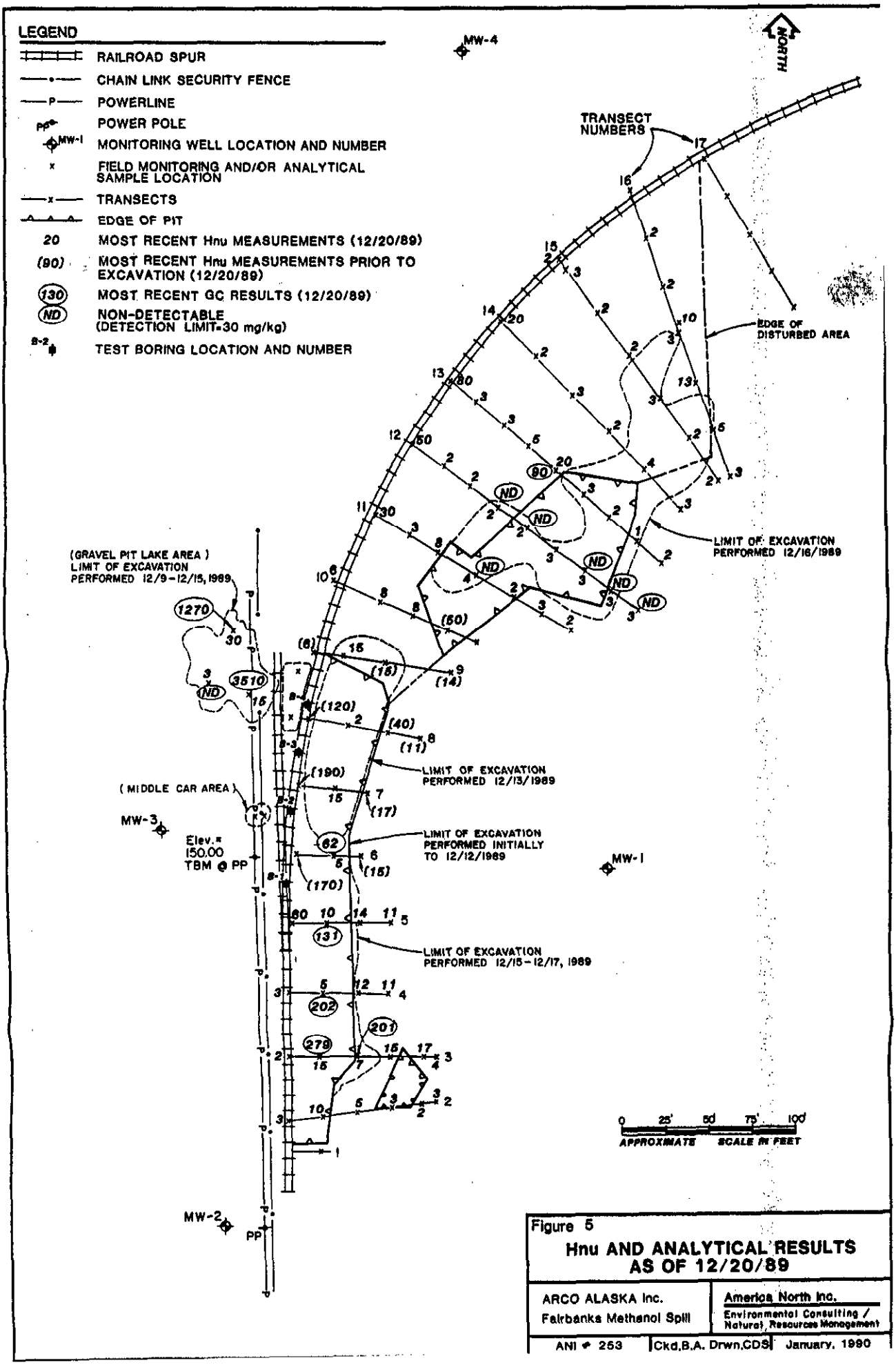


Figure 5

Hnu AND ANALYTICAL RESULTS AS OF 12/20/89

ARCO ALASKA Inc. Fairbanks Methanol Spill	America North Inc. Environmental Consulting / Natural Resources Management
ANI # 253	Ckd.B.A. Drwn.CDS January, 1990

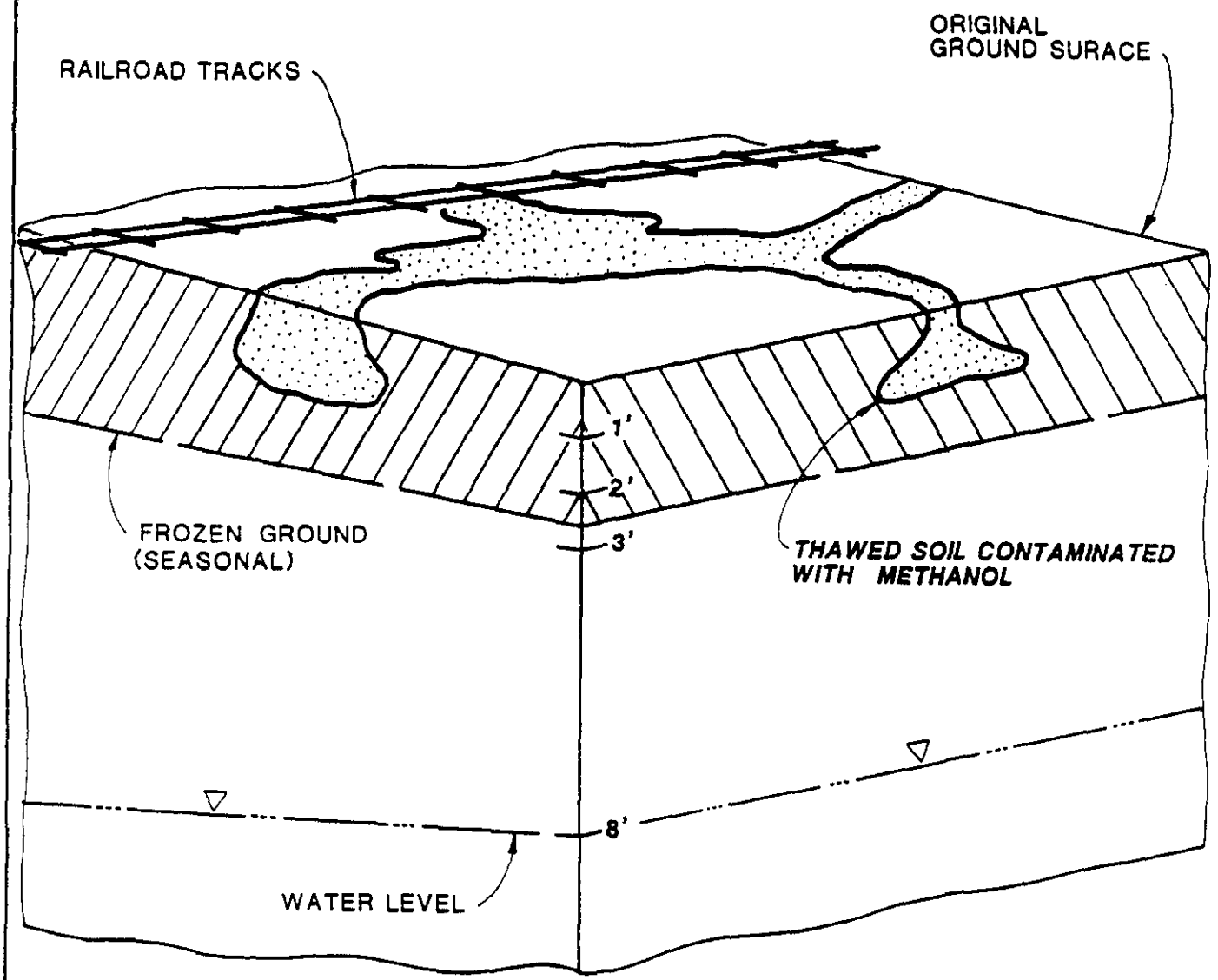


Figure 6

METHANOL - SPREADING PHENOMENOM

ARCO ALASKA Inc. Fairbanks Methanol Spill	America North Inc. Environmental Consulting / Natural Resources Management
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Contaminated soil was stored on-site in two lined and bermed containment areas built adjacent to each other (see Photograph 3, Appendix A). After the majority of the excavation operations were complete, soil piles were covered to keep snow (moisture) and wind from affecting the piles.

4.3.4. Contaminated Soil Disposition

ARCO proposes to reclaim methanol from the contaminated soil which is stockpiled at the site. Reclamation, most likely using a water-wash process, will be used to remove methanol from the materials. This reclaimed methanol will be used as an antifreeze agent on the North Slope.

4.3.5 Area East of Railroad Tracks

Initial contaminated soil removal efforts focused on the area east of the railroad tracks where the majority of the spilled product drained (see Figures 3 and 5, and Photograph 6 in Appendix A). By systematically monitoring and excavating soil in this area of the spill, it was determined that all soil which was contaminated above the DEC-established guideline (1,000 ppm) had been removed. Data was presented to the DEC, and the area was refilled with clean gravel and leveled to grade after DEC approval was granted. A summary of samples and detected concentrations is contained in Table 1.

4.3.6 Gravel Pit Lake Area

An area west of the tracks which slopes toward the gravel pit lake and the recycling facility was contaminated by the methanol spill. Contaminated soil excavation in this area was complicated by various considerations. For instance, during yard construction activities, surficial peat soils which are native to the area had not been removed, and soils at this locale are high in organics. Also, access for excavation was difficult in this area (see Figures 2 and 5, and Photograph 6 in Appendix A) since an overhead powerline is present and the ground surface slopes to the adjacent gravel pit lake. Access was further complicated by the presence of materials associated with the recycling facility.

Results for samples collected December 14, 1989 indicated that methanol concentrations exceeded the cleanup level at two of three locations sampled. ARCO subsequently excavated these remaining contaminated soils, and stockpiled these soils in the containment area on site. Analysis of samples collected at this location verified that methanol concentrations in the soil are below the cleanup level. This area will be refilled with soil from which methanol has been reclaimed.

4.3.7 Middle Car Area

The middle car area (see Figure 5) is on the west side of the railroad tracks near the point where the middle railroad car discharged methanol. The original

evaluation indicated a small area of contamination was present. ARCO excavated soil remaining at this locale which was contaminated above the cleanup level, and stockpiled this soil in the on-site containment area.

4.3.8 Railroad Bed

Contaminated snow and ballast material in the railroad bed was removed using high capacity vacuum trucks and other equipment (primarily hand tools such as shovels). On December 9, 1989 four borings were drilled in the center of the railroad tracks to depths of six feet below the ground surface. These borings were positioned near the points where the down-spouts from the leaking railroad cars were located during the spill incident (see Figure 5 for boring locations). Based on laboratory analyses of soil samples collected from these borings, contamination still exists in the railroad bed near the points where the down spouts (vertical) for the two northern cars were positioned (the down-spout for the southern car was directed horizontally eastward). Contamination was detected in Boring B-2 to a depth of approximately three feet below the ground surface, and in Boring B-4 to a depth of approximately five feet below the ground surface.

Further excavation of the railroad bed would have compromised the integrity of the track system. Removal of contaminated soil in the railroad bed was therefore halted in December after excavation to the extent practical, to explore options for reclamation of the methanol. Furthermore, ARCO did not perform complete excavation of the railroad bed because of the unfavorable working conditions (arctic). Complete excavation of contaminated soil in the railroad bed is currently proposed, and this will be discussed in Section 5.

4.4 Ground Water

Ground water was investigated by sampling the unconfined aquifer via monitoring wells on-site, and local water-supply wells off-site.

4.4.1 Ground-Water Monitoring Wells

An ARCO contractor, Shannon and Wilson, constructed four ground-water monitoring wells to define the ground-water flow direction and gradient at the site and to monitor ground water for the presence of methanol (see Figure 5). In accordance with standard site investigation protocol, wells were placed upgradient (with respect to the ground-water flow direction) and downgradient from the source or area of release. The upgradient well is intended to provide data on the background concentrations of the contaminant, while the monitoring wells which are at the source or downgradient from the source are intended to monitor ground water for impacts as a result of the spill. The placement of these wells was based on site-specific considerations such as location and size of the impacted area, one well was constructed upgradient, and three wells were constructed downgradient from the source. The wells were also positioned in a triangular or rectangular (as opposed to linear) arrangement so they would adequately define a planar (water-table)

surface.

ARCO obtained water samples from the four ground-water monitoring wells which were constructed at the site, and submitted these samples for laboratory analysis. The wells were screened in the shallow, unconfined aquifer; screen positioning was intended to span the anticipated range of water-table fluctuations. The water-table depth was approximately eight feet below the ground surface at the time the monitoring wells were constructed (December 6th and 9th).

Water-level elevations were measured in the ground-water monitoring wells by Shannon and Wilson. Based on contouring of this data, the water-table gradient in the unconfined (alluvial) aquifer is approximately 0.001 feet/foot. The direction of ground-water flow is generally to the west-northwest. However, the ground-water flow direction exhibits a north-northwesterly component in the area west of the yard (railroad tracks) and south of the gravel pit lake. The gravel pit lake to the west of the yard may be responsible for the apparent variation in the ground-water flow direction.

U.S. EPA Method 8015 was used for analysis of methanol in water. Methanol was nondetectable in all four samples collected from the ground-water monitoring wells (detection limit was 15 ppm). This indicates that methanol has not affected ground-water in the unconfined aquifer at the pipeyard.

Ground-water monitoring wells MW-2 and MW-3 are located on property owned by the adjacent recycling facility. These wells will be abandoned per DEC regulations when monitoring is discontinued (see Figure 5). The two wells on the ARCO-leased property may be sealed and maintained for future monitoring needs after the monitoring schedule which is currently proposed is completed.

4.4.2 Water-Supply Wells

Water samples were collected from domestic water-supply wells located in close proximity to the yard or spill site. The wells in the vicinity of the spill are to the west of the pipeyard (see Figure 2). The wells which were sampled supply drinking water to the local residents and businesses. Analytical results indicate that methanol is nondetectable in these wells.

If methanol impacts ground water in the unconfined aquifer in this area, the contamination plume will be detected initially in the on-site monitoring wells. Therefore, monitoring emphasis has been placed on on-site monitoring wells, and off-site water supply wells should not require additional monitoring unless a contamination plume is detected in ground water at the site.

5.0 FURTHER RECLAMATION AND MONITORING

Previous sections describe steps which were taken to excavate contaminated soil and snow at the site. Limited contamination remains in soils at the site at levels above the 1,000

ppm cleanup level. This section will outline methods which ARCO proposes to use to reclaim methanol from contaminated soils at the site; it will also identify the frequency of monitoring events.

5.1 Railroad Bed

Contaminated gravel/soil ballast was removed from the track area with equipment during excavation activities, and stockpiled in the containment area. After DEC approval was granted, this track area was reballasted. ARCO proposes to excavate contaminated soil remaining in the railroad bed in an intensive operation to be conducted this spring. It is currently anticipated that railroad bed excavation and rebuilding will occur over a weekend to minimize the length of time that the railroad siding is unavailable for use. Other reclamation alternatives were investigated (passive and active ventilation), although they have been abandoned due to regulatory and practical considerations. Complete railroad bed excavation and reconstruction was not performed in December because of the arctic working conditions. Also, increased demand for methanol on the North Slope during the winter months is responsible for heavier usage demands on the railroad siding. Therefore, excavation of the railroad bed is more feasible in the spring due to lower demand for methanol and more moderate climatic conditions.

A PID will be used in the field to guide excavation. Soil samples will be obtained after the railroad bed is excavated, and these samples will be submitted for GC analysis. Analytical results will verify all soils which are contaminated above 1,000 ppm have been excavated. Methanol will be reclaimed from the contaminated soil, and used in reconstruction of the railroad bed where appropriate.

5.2 Ground Water and Surface Water

Monthly sampling of the ground-water monitoring wells will be performed by Shannon and Wilson into summer, or until the railroad bed is considered clean. Water-level measurements will also be recorded monthly to determine seasonal variations in ground-water flow direction and gradient. Water samples will be submitted for methanol analysis by U.S. EPA Method 8015.

6.0 SUMMARY

A substantial percentage of the methanol which was spilled during the December 4th incident in Fairbanks has been accounted for. Free product was recovered, contaminated snow was accumulated, and most of the contaminated soil has been excavated and stockpiled on-site. The free product, as well as methanol which was in the snow, has been reclaimed and used as an antifreeze agent on the North Slope. Reclamation of methanol from the contaminated soil will most likely be accomplished using a water-wash system.

Contaminated soil remaining in the railroad bed will be excavated, the methanol will be reclaimed, and the soil will be used (where appropriate) to reconstruct the railroad bed.

Ground-water flow direction and gradient have been defined by installation of ground-water monitoring wells at the site. Sampling of these wells, in addition to local water-supply wells, indicates that ground water in the area has not been impacted as a result of the methanol spill. Monthly sampling of the on-site ground-water monitoring wells will be performed to monitor for the potential development of a contaminant plume.

LIST OF REFERENCES

ARCO, 1990. Personal communication with Joe Falcone by Brad Authier, ANI.

Enviro TIPS, January, 1985. Environment Canada, Environmental Protection Service; Technical Information for Problem Spills (Manual for Methanol).

Martech, December 6, 1989. Memo from Dave Maiero to Tom Edmunds, ARCO; Spill Response Plan, December 6, 1989.

Martech, January, 1990. Personal communication with Dr. Lawley of Martech by Brad Authier, ANI.

Shannon and Wilson, 1990. "Cleanup Monitoring & Soil and Groundwater Studies, Methanol Release Site, Fairbanks, Alaska."

TABLES

ARCO ALASKA, INC. FAIRBANKS METHANOL SPILL

TABLE 1: SUMMARY OF SAMPLES COLLECTED IN ASSOCIATION WITH SPILL (WITH HNU AND ANALYTICAL RESULTS)

Sample Identification	Date Sampled	Type of Sample	Sampled By	Parameter Tested	HNU* Reading	Methanol Analysis (ppm)**	Comments
252-1206-301	12/6/89	soil	GM	Methanol		13,100	From surface of excavated area
252-1206-302	12/6/89	soil	GM	Methanol		104	From surface of excavated area
252-1206-303	12/6/89	soil	GM	Methanol		14,200	From surface of excavated area
252-1206-304	12/6/89	soil	GM	Methanol		3,310	From surface of excavated area
252-1206-305	12/6/89	soil	GM	Methanol		3,180	From surface of excavated area
252-1206-306	12/6/89	soil	GM	Methanol		5,090	From surface of excavated area
252-1206-307	12/6/89	soil	GM	Methanol		9,150	From surface of excavated area
252-1206-308	12/6/89	soil	GM	Methanol		4,940/3,960	From surface of excavated area
252-1206-1	12/6/89	water	JWL	Methanol		<DL	From Ken DePue residence
252-1206-2	12/6/89	water	JWL	Methanol		<DL	Municipal water sample
252-1206-101	12/6/89	snow	JC & GM	Methanol		1,360	Melted snow sample
252-1206-102	12/6/89	snow	JC & GM	Methanol		5,500	Melted snow sample
252-1206-103	12/6/89	water	JC & GM	Methanol		<DL	Water from gravel pit
252-1206-201	12/6/89	water	JWL	Methanol		<DL	Sample from MW-1
252-1206-202	12/6/89	water	JWL	Methanol		<DL	Sample from MW-2
252-1206-203	12/6/89	water	JWL	Methanol		<DL	Sample from MW-3
252-1207-1	12/7/89	water	JWL & DP	Methanol		<DL	From Johnny Miller residence
252-1208-1	12/8/89	water	JWL & RF	Methanol		<DL	From Barney Kopf residence
252-1208-2	12/8/89	water	JWL & RF	Methanol			Duplicate of 252-1208-1, not tested
252-1208-3	12/8/89	water	JWL & RF	Methanol		<DL	From well at City Electric

* The Hnu was calibrated to a benzene standard using 100 ppm isobutylene calibration gas.

** <DL = less than the detection limit, which is 30 parts per million (ppm) for soil samples and 15 ppm for water samples: Analysis by U.S. EPA Method 8015 Modified.

1. Sample 252-1212-15F was collected two feet to the west and two feet deeper than actual transect location 15F. Localized contamination had been observed at this location, and this sample was collected to confirm that soil was "clean."

ARCO ALASKA, INC. FAIRBANKS METHANOL SPILL

TABLE 1: SUMMARY OF SAMPLES COLLECTED IN ASSOCIATION WITH SPILL (WITH HNU AND ANALYTICAL RESULTS)

Sample Identification	Date Sampled	Type of Sample	Sampled By	Parameter Tested	HNU* Reading	Methanol Analysis (ppm)**	Comments
252-1208-4	12/8/89	water	JWL & RF	Methanol		<DL	From Scotty Haskins shop
252-1209-411	12/9/89	soil	SA & DB	Methanol		<DL	From test hole B-1
252-1209-412	12/9/89	soil	SA & DB	Methanol		<DL	From test hole B-1
252-1209-413	12/9/89	soil	SA & DB	Methanol		<DL	From test hole B-1
252-1209-411	12/9/89	soil	SA & DB	Methanol		<DL	From test hole B-1
252-1209-421	12/9/89	soil	SA & DB	Methanol		14,900	From test hole B-2
252-1209-422	12/9/89	soil	SA & DB	Methanol		8,100	From test hole B-2
252-1209-423	12/9/89	soil	SA & DB	Methanol		2,100	From test hole B-2
252-1209-424	12/9/89	soil	SA & DB	Methanol		<DL	From test hole B-2
252-1209-425	12/9/89	soil	SA & DB	Methanol		<DL	From test hole B-2
252-1209-426	12/9/89	soil	SA & DB	Methanol		<DL/<DL	From test hole B-2
252-1209-431	12/9/89	soil	SA & DB	Methanol		<DL	From test hole B-3
252-1209-432	12/9/89	soil	SA & DB	Methanol		<DL	From test hole B-3
252-1209-433	12/9/89	soil	SA & DB	Methanol		<DL	From test hole B-3
252-1209-441	12/9/89	soil	SA & DB	Methanol		23,400	From test hole B-4
252-1209-442	12/9/89	soil	SA & DB	Methanol		27,300	From test hole B-4
252-1209-443	12/9/89	soil	SA & DB	Methanol		5,400	From test hole B-4
252-1209-444	12/9/89	soil	SA & DB	Methanol		<DL	From test hole B-4
252-1209-445	12/9/89	soil	SA & DB	Methanol		6,800	From test hole B-4
252-1209-446	12/9/89	soil	SA & DB	Methanol		<DL	From test hole B-4
252-1209-451	12/9/89	soil	GM & DB	Methanol		5,700/5,500	From spoil stockpile
252-1209-452	12/9/89	soil	GM & DB	Methanol		67	From spoil stockpile
252-1209-453	12/9/89	soil	GM & DB	Methanol		170	From spoil stockpile

* The Hnu was calibrated to a benzene standard using 100 ppm isobutylene calibration gas.

** <DL = less than the detection limit, which is 30 parts per million (ppm) for soil samples and 15 ppm for water samples: Analysis by U.S. EPA Method 8015 Modified.

ARCO ALASKA, INC. FAIRBANKS METHANOL SPILL

TABLE 1: SUMMARY OF SAMPLES COLLECTED IN ASSOCIATION WITH SPILL (WITH HNU AND ANALYTICAL RESULTS)

Sample Identification	Date Sampled	Type of Sample	Sampled By	Parameter Tested	HNU* Reading	Methanol Analysis (ppm)**	Comments
252-1210-461	12/10/89	soil	GM & DB	Gradation			From spoil stockpile
252-1210-462	12/10/89	soil	GM & DB	Gradation			From spoil stockpile
252-1210-463	12/10/89	soil	GM & DB	Gradation			From spoil stockpile
252-1210-464	12/10/89	soil	GM & DB	Gradation			From spoil stockpile
252-1211-204	12/11/89	water	SA	Methanol		<DL	Sample from MW-4
252-1212-3B	12/12/89	soil	DB & SR	Methanol	50	4,310/4,490	Surface sample from transect lines
252-1212-4B	12/12/89	soil	DB & SR	Methanol	25	1,220	Surface sample from transect lines
252-1212-8A	12/12/89	soil	DB & SR	Methanol	120	8,650	Surface sample from transect lines
252-1212-10D	12/12/89	soil	DB & SR	Methanol	9	49.5	Surface sample from transect lines
252-1212-11A	12/12/89	soil	---	Methanol	30	4,250	Surface sample from transect lines
252-1212-11D	12/12/89	soil	SA & GM	Methanol	20	3,080	Surface sample from transect lines
252-1212-12A	12/12/89	soil	SA & GM	Methanol	50	3,240	Surface sample from transect lines
252-1212-12D	12/12/89	soil	SA & GM	Methanol	25	1,950	Surface sample from transect lines
252-1212-12H	12/12/89	soil	SA & GM	Methanol	2	3,580	Surface sample from transect lines
252-1212-13A	12/12/89	soil	SA & GM	Methanol	80	4,430	Surface sample from transect lines
252-1212-13E	12/12/89	soil	SA & GM	Methanol	20	90.3	Surface sample from transect lines
252-1212-15F[1]	12/12/89	soil	SA & GM	Methanol	20	161	Surface sample from transect lines
252-1212-465	12/12/89	soil	SA & GM	Methanol	120	6,360	From spoil stockpile
252-1212-466	12/12/89	soil	SA & GM	Methanol	160	6,810	From spoil stockpile
252-1212-467	12/12/89	soil	SA & GM	Methanol	180	12,200	From spoil stockpile

* The Hnu was calibrated to a benzene standard using 100 ppm isobutylene calibration gas.

** <DL = less than the detection limit, which is 30 parts per million (ppm) for soil samples and 15 ppm for water samples: Analysis by U.S. EPA Method 8015 Modified.

1. Sample 252-1212-15F was collected two feet to the west and two feet deeper than actual transect location 15F. Localized contamination had been observed at this location, and this sample was collected to confirm that soil was "clean."

ARCO ALASKA, INC. FAIRBANKS METHANOL SPILL

TABLE 1: SUMMARY OF SAMPLES COLLECTED IN ASSOCIATION WITH SPILL (WITH HNU AND ANALYTICAL RESULTS)

Sample Identification	Date Sampled	Type of Sample	Sampled By	Parameter Tested	HNU* Reading	Methanol Analysis (ppm)**	Comments
252-1213-7B	12/13/89	soil	SA & JB	Methanol	15	484	Surface samples from transect lines
252-1213-9B	12/13/89	soil	SA & JB	Methanol	15	128	Surface sample from transect lines
252-1213-8Y	12/13/89	soil	SA & JB	Methanol	150	12,300	Surface sample from location 8Y
252-1213-8Z	12/13/89	soil	SA & JB	Methanol	110	4,780	Surface sample from location 8Z
252-1214-7Z	12/14/89	soil	SA & JB	Methanol	300	23,900	Surface sample from location 7Z
252-1214-8W	12/14/89	soil	SA & JB	Methanol	15	3,510	Surface sample from location 8W
252-1214-8X	12/14/89	soil	SA & JB	Methanol	3	<DL	Surface sample from location 8X
252-1214-9Z	12/14/89	soil	SA & JB	Methanol	30	1,270	Surface sample from location 9Z
252-1218-3B	12/18/89	soil	SA	Methanol	15	279	Surface samples from transect lines
252-1218-3C	12/18/89	soil	SA	Methanol	8	201	Surface samples from transect lines
252-1218-4B	12/18/89	soil	SA	Methanol	5	202	Surface samples from transect lines
252-1218-5B	12/18/89	soil	SA	Methanol	10	131	Surface samples from transect lines
252-1218-6B	12/18/89	soil	SA	Methanol	6	61.6	Surface samples from transect lines
252-1218-6Y	12/18/89	soil	SA	Methanol	150	8,320	Surface sample from location 6Y
252-1218-11D	12/18/89	soil	SA	Methanol	4	<DL	Surface samples from transect lines
252-1218-12D	12/18/89	soil	SA	Methanol	2	<DL/<DL	Surface samples from transect lines
252-1218-12E	12/18/89	soil	SA	Methanol	2	<DL	Surface samples from transect lines
252-1218-12G	12/18/89	soil	SA	Methanol	2	<DL	Surface samples from transect lines
252-1218-12H	12/18/89	soil	SA	Methanol	3	<DL	Surface samples from transect lines
252-1218-13H	12/18/89	soil	SA	Methanol	1	<DL	Surface samples from transect lines
252-1218-13G	12/18/89	soil	SA	Methanol	2	<DL	Surface samples from transect lines

* The Hnu was calibrated to a benzene standard using 100 ppm isobutylene calibration gas.

** <DL = less than the detection limit, which is 30 parts per million (ppm) for soil samples and 15 ppm for water samples: Analysis by U.S. EPA Method 8015 Modified.

ARCO ALASKA, INC. FAIRBANKS METHANOL SPILL

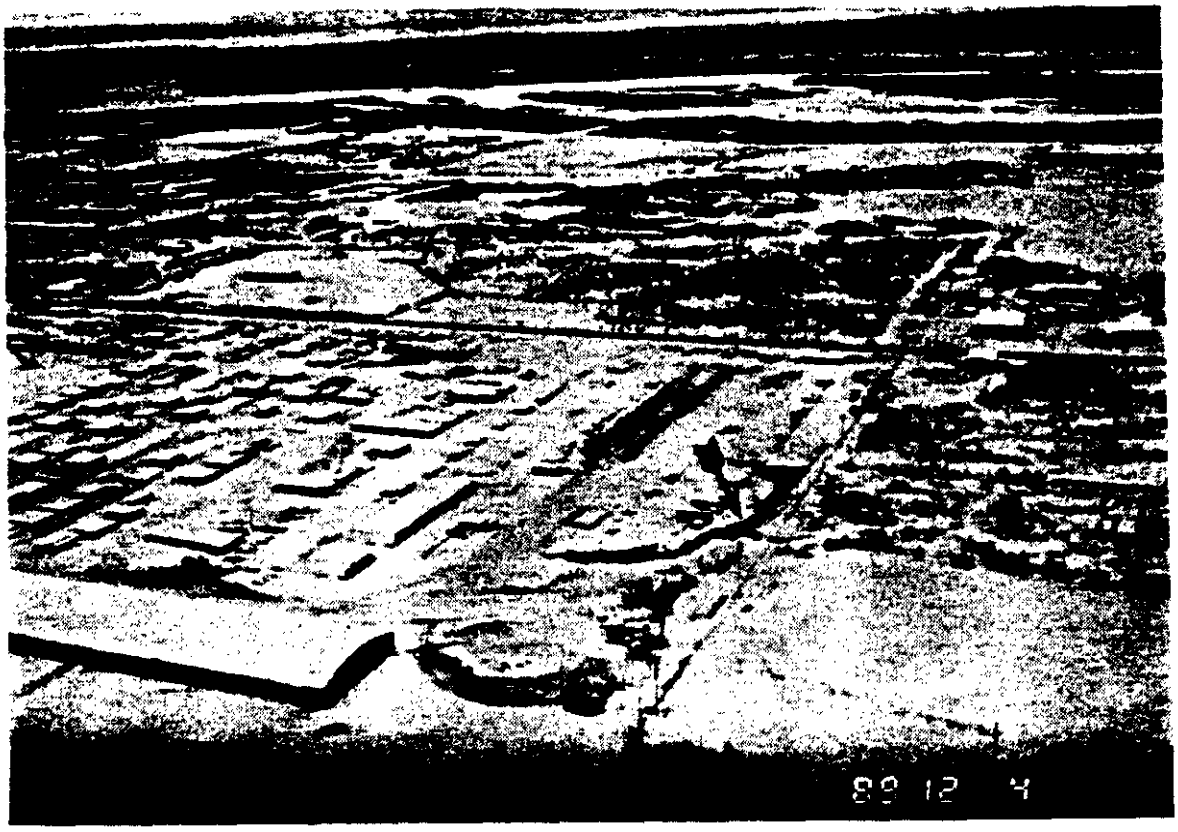
TABLE 1: SUMMARY OF SAMPLES COLLECTED IN ASSOCIATION WITH SPILL (WITH HNU AND ANALYTICAL RESULTS)

Sample Identification	Date Sampled	Type of Sample	Sampled By	Parameter Tested	HNU* Reading	Methanol Analysis (ppm)**	Comments
252-1218-13F	12/18/89	soil	SA	Methanol	3	74.4	Surface samples from transect lines
252-1218-14D	12/18/89	soil	SA	Methanol	2	141	Surface samples from transect lines
252-1218-14E	12/18/89	soil	SA	Methanol	4	<DL	Surface samples from transect lines
252-1218-15D	12/18/89	soil	SA	Methanol	2	70.1	Surface samples from transect lines
252-1218-15E	12/18/89	soil	SA	Methanol	3	<DL/<DL	Surface samples from transect lines
252-1218-15F	12/18/89	soil	SA	Methanol	2	<DL	Surface samples from transect lines
252-1227-02	12/27/89	water	DP & RF	Methanol			Sample from MW-2, bottle froze
252-1227-10	12/27/89	water	DP & RF	Methanol		<DL	Sample from MW-3
252-1228-08	12/28/89	water	DP & RF	Methanol		<DL	Sample from MW-2, replaces 252-1227-08
252-1228-10	12/28/89	water	DP & RF	Methanol		<DL	Sample from MW-1
252-1228-18	12/28/89	water	DP & RF	Methanol		<DL	Sample from MW-4

* The Hnu was calibrated to a benzene standard using 100 ppm isobutylene calibration gas.
** <DL = less than the detection limit, which is 30 parts per million (ppm) for soil samples and 15 ppm for water samples: Analysis by U.S. EPA Method 8015 Modified.

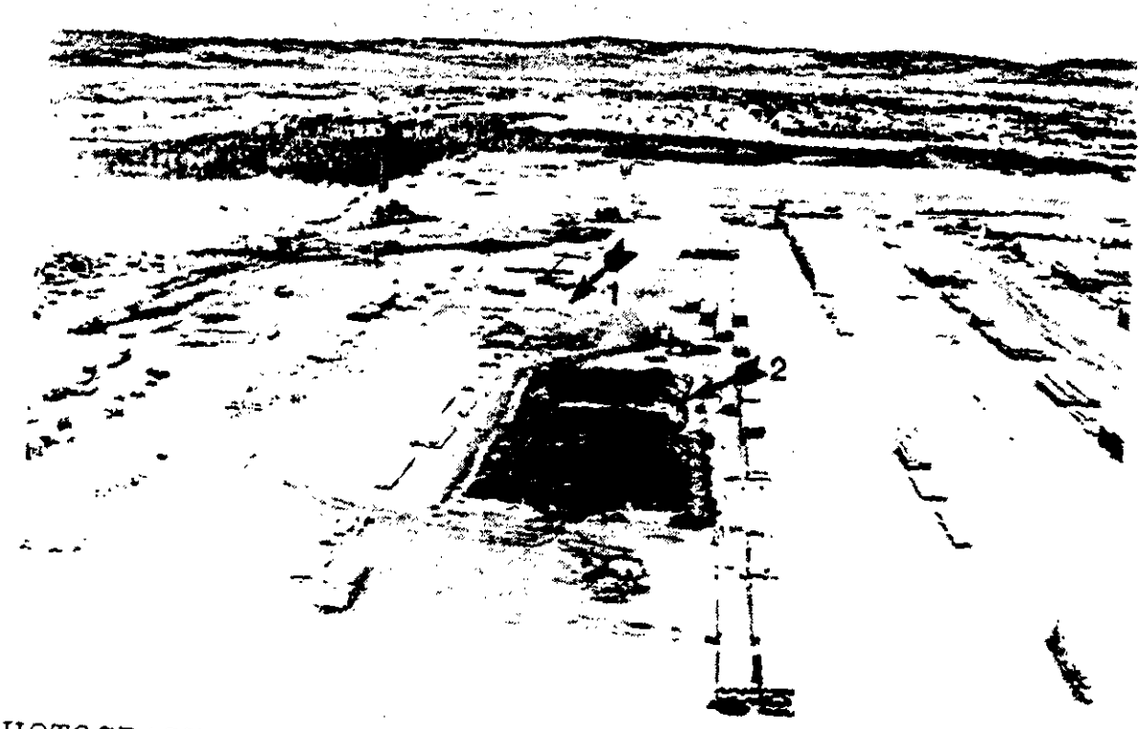
APPENDIX A

PHOTOGRAPHIC LOG



PHOTOGRAPH 1. Arrow designates spilled methanol as it appeared on the morning of December 4, 1989. View is looking south-southeast.

PHOTOGRAPH 2. Appearance of spill area on the morning of December 4, 1989.



PHOTOGRAPH 3. Aerial view of the spill site (looking north): No. 1 arrow denotes location of the contaminated snow pile; No. 2 arrow denotes location of the contaminated soil.

PHOTOGRAPH 4. Darker area of gravel is contamination remaining after initial excavation. View is looking north in the excavation to the east of the railroad tracks.

PHOTOGRAPH 5. Close-up view of the railroad bed after some of the contaminated gravel was removed.

PHOTOGRAPH 6. Excavated area of the spill. Arrow denotes the spill area near the lake.

APPENDIX B

CALCULATION OF RECOVERED METHANOL

ARCO ALASKA, INC.

Fairbanks Methanol Spill

Calculation of Methanol Recovery

(Best Estimate Based on Information Available 12/11/89)

VOLUME SPILLED:	**9,300 gallons**
VOLUME RECOVERED:	
Vacuum Truck Liquid Recovery:	4,600 gallons (total)
4600 gallons x 0.20 =	920 gallons (methanol)
Snow Recovered:	1,000 cubic yards
1,000 x 27 ft^3/yd^3 =	27,000 ft^3
27,000 ft^3 ÷ (3.4 ft^3 snow/1 ft^3 water) =	7,941 ft^3
7,941 x 62.5 lbs/ft^3 =	496,323 lbs water
496,323 lbs x 0.00343 (3,430 ppm) =	1,702 lbs
1,702 lbs ÷ 6.6 lbs/gal =	258 gallons (methanol)
Soil Recovered:	
3,020 yd^3 x 1.3 tons/yd =	3,926 tons
3,926 tons x 2000 lb/ton =	7,852,000 lbs
7,852,000 lbs x 0.006230 (6230 mg/kg)	48,918 lbs
48,918 lbs ÷ 6.6 lb/gal =	7,412 gallons (methanol)
Volatilization (C.H.A.R.M. Model):	350 gallons (methanol)
(350-500 gallons from pooled surface)	
TOTAL VOLUME RECOVERED:	**8,940 gallons**
DIFFERENCE BETWEEN VOLUME SPILLED AND VOLUME RECOVERED:	**360 gallons**
(12/11/89)	(96% recovered)

Prepared by: E. R. Mancini

Date: 12/11/89

APPENDIX F

Groundwater Issues Relating to an Alaskan Methanol Spill

S.B. Robertson, ARCO Alaska, Inc.

As prepared for the Society of Petroleum Engineers
69th Annual Technical Conference and Exhibition
SPE 20694, September, 1990

SPE
Society of Petroleum Engineers

SPE 20694

Groundwater Issues Relating to an Alaskan Methanol Spill

by S.B. Robertson, ARCO Alaska, Inc.

II

This paper was prepared for presentation at the 65th Annual Technical Conference and Exhibition of the Society of Petroleum Engineers held in New Orleans, LA, September 23-26, 1990.

ABSTRACT

In December, 1989, at a materials storage yard in Fairbanks, Alaska, a saboteur opened the bottom valves on three railroad tankcars of methanol. One of the concerns was that methanol could contaminate the shallow, local groundwater. Samples taken from nearby drinking water wells, groundwater monitoring wells around the spill site, and from an adjacent gravel-pit lake were found to be below the analytical detection limit of 15 ppm. Comparative elevations at four monitoring wells demonstrated that groundwater flow was to the west-northwest. The local residential wells were southwest of the spill, away from any potential groundwater plume. The methanol leached down to as close as 2 ft (0.6 m) above the water table, which was 8 ft (2.4 m) below the surface of the yard. Dilution by snow and subsequent freezing in the soil helped to limit the downward spread of the methanol. Contaminated soil (>1000 ppm) was removed. Natural processes, volatilization and biodegradation, are expected to remove the remaining methanol in the unexcavated soil. Cleanup options were limited by the possible hazardous waste classification of the spill contaminated soil. The winter methanol spill in a severe northern climate provided some advantages over what might be expected under milder, more temperate conditions. The regulatory status of spilled methanol waste should be reevaluated, especially if use of methanol as a motor fuel increases.

References and illustrations at end of paper.

INTRODUCTION

Methanol is used in the oilfields of the North Slope of Alaska for freeze protection. Air temperature, ground temperature (wells are drilled through 2000 ft (610 m) of permafrost) and gas expansion are sources of cooling that may result in its use, for example, to protect pipelines and shut-in water injection wells, for lowering the freezing point of water vapor and hydrates in natural gas handling, and as a component in water-based hydraulic fracturing for well stimulation. The material is transported by railroad tank car to ARCO's North Star Pipeyard, a material storage and transfer facility in Fairbanks, Alaska. There it is transferred to tank trucks and driven up the Dalton Highway (the TransAlaska Pipeline Haul Road) to Prudhoe Bay.

On December 4, 1989, at approximately 2:30 a.m., while moving tank cars on a siding in the pipeyard the railroad switching crew noticed methanol leaking from three of the 30,000 gal (114 m^3) capacity cars. The crew closed the valves on the bottom of the tank cars, which had been opened by saboteurs. Special tools are required to open the valves and seals had to be broken. Graffiti was written on each of the three cars which also indicated that sabotage was involved The Fire Department and other emergency responders were quickly called to the scene. Because of the potential fire and health risks, nearby residents, with homes southwest of the pipeyard, were evacuated. After organic vapor analysis demonstrated little or no atmospheric contamination

and no danger of explosion, the residents were allowed to return home. Because vents on top of the cars had not been opened, a partial vacuum developed upon drainage. This prevented release of the entire contents of the cars. Subsequent measurement of the remaining contents revealed that only approximately 9300 gal (35 m^3) of methanol had spilled, rather than the 67,000 gal (254 m^3) originally feared.

METHANOL AND SITE CHARACTERISTICS

Methanol is a clear, colorless, flammable liquid with an alcohol-like odor. The vapors are heavier than air. Methanol is completely soluble in water. It has a flash point of 53 °F (12 °C) and burns with a bluish, almost invisible, flame. Methanol has low toxicity on contact and moderate toxicity by inhalation to humans. Toxic effects of methanol can be manifested from absorption through oral, inhalation, or dermal routes. Effects can range from irritation at low exposures to blindness and death at high exposures. The probable oral lethal dose for a 155 lb (70 kg) man is as low as 1 oz (28 g) . It is toxic to aquatic life and microorganisms at concentrations above about 1000 ppm. Methanol biodegrades rapidly.[1]

In cold temperatures methanol vapors are minimal due to the decreased vaporization rate. Snow and frozen ground will be thawed upon contact with methanol until the methanol is diluted to the point where refreezing takes place. The amount of soil thawing depends upon many factors, such as the ambient temperature and the amount of moisture in the snow and ground. For example, the freezing point of 20% methanol is approximately 10 °F (-12°C).[1]

Air temperature during the week following discovery of the spill was approximately -10 to 10 °F (-23 to -12 °C) . Snow cover at the time was about 1.5 ft (0.5 m) and the ground was frozen to approximately 3.5 ft (1.1 m). There was no precipitation at the time of the spill and cleanup. Afterward, portions of the area were covered with a reinforced plastic material to avoid complications of snow accumulation.

The North Star Pipeyard is approximately 1.5 miles (2.4 km) south of downtown Fairbanks, on a floodplain between the Chena and Tanana Rivers (Figure 1). The alluvial fill of the valley is a large groundwater reservoir. The deposits are made up of layers of silt, sand, and gravel. The distribution of these sediments and of the discontinuous permafrost can affect water quality and flow rates of water wells. The water-table is normally 10 to 15 ft (3 to 4.6 m) below the surface.[2] The gradient of the water-table yields a flow direction to the west or west-northwest (i.e., parallel to the rivers) or to the northwest (when the aquifer recharge is from the Tanana River and discharge is to the Chena River.[3]

Most of the spill ran off the railroad bed and onto the gravel pad of the yard. West of the yard is a gravel pit lake, which received a small portion of methanol runoff, and south of the lake are residences and businesses that use wells for their water source (Figure 2). The wells were located approximately 0.06 mile (0.09 kilometer) from the spill area. After the residents returned to their homes, ARCO furnished them with bottled water until the quality of the groundwater could be assured.

GROUNDWATER MONITORING PROGRAM

To determine if methanol had reached the groundwater and to provide an early warning system for potential downstream users of the water, four monitoring wells were installed around the spill site. In addition, although it was highly unlikely that contamination would be found (because of presumed groundwater direction and low flow-rate), water samples were taken from the wells of the local residents. A water sample was also taken from under the ice on the gravel pit lake near where it appeared that some of the methanol might have made contact.

Methods[4]

The locations of the groundwater monitoring wells (MW-1 through MW-4) were designed to allow determination of the local gradient (and thus flow direction), provide monitoring in the presumed direction of flow, establish monitoring between the spill site and the residences, and give us an upstream control sample (Figure 2). Drilling was done using a truck mounted drill rig and an 8-inch (20-cm) O.D. hollow stem auger. All wells were drilled to a depth in excess of 15 ft (4.6 m). The 2-inch (5-cm) I.D., Schedule 40 PVC well casing, which included a 10-ft (3-m) section of well screen with 0.020-inch (0.5-mm) openings at the bottom, was installed through the auger string. The annulus was backfilled with native materials topped with a

bentonite pellet seal and sealed at the top with a cement mixture. Wells MW-2 and MW-3 were finished with a locking steel casing over the stick-up, while wells MW-1 and MW-4, where working vehicles could be reasonably be expected, used flush-mount sealed monuments at the ground surface to protect the well casing.

Soil borings were also obtained from the railroad bed to determine depth of contamination at the site of the discharges from the tankcars. Two borings (B-2 and B-4) were taken directly under where vertical discharges occurred; while the other two (B-1 and B-3) were taken "between cars." To avoid accidental contamination of groundwater, the borings stopped at 6 ft (1.8 m). Soil for analysis was obtained with a split spoon sampler from both the borings (continuous) and the water monitoring wells (2.5-ft [O.76-m] intervals).

Prior to purging and sampling the monitoring wells, static water levels were obtained using steel tape or electric sounder. Well locations and elevations had been surveyed after installation. After extracting three borehole volumes to flush the well, 1.1-qt (1.0-liter) samples initially were taken with a teflon bailer. Subsequently, 1.35-fl oz (40-ml) samples were deemed adequate. The 6-inch (15-cm) power auger used to drill through the ice of the gravel pit lake was also used to flush the hole and bring in new water. The sample was then taken from the surface. The wells from the area residences and businesses were purged and then sampled with a teflon bailer where possible; otherwise, sampling was from a faucet nearest the well.

U.S. EPA Method 8015 Modified, which uses gas chromatography with a flame ionization detector, was used to determine the methanol concentration in water (detection limit 15 ppm) and soil (detection limit 30 ppm).

Results

Groundwater elevations determined on December 11 and 28, 1989 (Table 1) confirmed that the local gradient would yield flow to the west-northwest, as predicted from previous regional descriptions. Depth to the water table varied according to surface topography and ranged from 6.6 to 8.3 ft (2.0 to 2.5 m) below the surface. Station MW-1 is within the pipeyard and was approximately the same surface elevation as the spill area. Water table depth at MW-1 was 8.0 ft (2.4 m).

No methanol was detected in any of these December water samples (Table 2). Groundwater sampling from the monitoring wells will continue through the summer, 1990. A low level of methanol (40 ppm) was detected at the northern monitoring well (MW-4) in late April. Based on our current understanding of local groundwater flow, this station was not considered to be downstream from the spill. Further work is planned to determine the source of this contamination.

Methanol in the railroad bed ranged from a high of 27,300 ppm near the top of a "discharge" boring to below detection limits at the bottom of all borings and all samples from the "between-car" sites (Table 2).

SPILL CLEANUP

The initial cleanup activity consisted of removal of the standing liquids, comprised of methanol diluted by melted snow, with a high capacity vacuum truck. This material was ultimately shipped up to the North Slope for use as a freeze protection agent in the oilfields. Contaminated snow was removed with light excavation equipment and hand tools and stored in a bermed and lined containment area. This snow was eventually melted, reconstituted with concentrated methanol, and also shipped north for use as antifreeze.

Cleanup of the contaminated gravel soil was accomplished by excavating the material with heavy equipment and placing it in a lined bermed containment area. Hand tools were used in areas of difficult access, e.g. between railroad ties. Most of the material excavated consisted of the gravel fill in the pipeyard. In addition, some cleanup was necessary west of the railroad track. This area was mostly silt and peat with some zones of clay. Excavation of obviously softened, methanol-thawed soil was conducted first. Then the frozen soil was examined to determine if it met the cleanup standard of 1000 ppm established by the Alaska Department of Environmental Conservation (ADEC), to avoid toxicity to aquatic life and microorganisms.[1] Additional excavation was continued until all areas met the cleanup standard. Natural processes, volatilization and biodegradation, are expected to remove the

methanol remaining in the ground. Approximately 2500 yd^3 (1920 m^3) were excavated and stored in the containment area.

One area in which cleanup was initially deferred was the railroad bed. Various techniques for cleaning the bed in place, such as bioremediation and vaporization, were considered, but ultimately it was decided to excavate and clean the material during the spring using the same procedures employed on the rest of the contaminated materials.

Testing of the soil was conducted in two ways. The initial screening utilized a HNu (brand) photoionization detector (PID) to determine methanol vapor concentrations immediately above the soil. Although the empirically derived relationship between PID readings and GC determination of methanol in the soil varied, nominal PID concentrations less than or equal to 15 ppm corresponded to less than 1000 ppm in the gravel. Final confirmation of methanol concentrations in the excavated area was conducted by testing soil samples with a GC.

Despite the fact that the fill material of the yard was essentially uniform material, there was sufficient heterogeneity in permeability that some areas displayed deeper penetration of methanol than others. Also, occasionally methanol apparently would travel down a zone of higher permeability (possibly contraction cracks in the frozen soil) then spread out in lower strata. These lower areas could have higher methanol concentrations than the soil immediately above (Figure 3). In some areas methanol penetrated below the frozen ground but none reached groundwater. The deepest penetration encountered was 6 ft (1.8 m), which was 2 ft (0.6 m) above the water table (Figure 4).

The contaminated soil was covered with reinforced plastic sheeting and held until spring, when reclamation activities with thawed material could commence. Taking advantage of the solubility of methanol in water, reclamation was conducted by low volume rinses of batches of soil. The rinsate was collected, reconstituted with concentrated methanol, and shipped to the North Slope. At this time, final cleanup of the railroad bed was also conducted. The track was removed, ballast gravels were excavated, and these materials were run through the methanol reclamation process. The railroad bed was then reballasted and the track replaced. The railroad spur was out of service for three days. All cleaned yard and railbed material was reused and placed on the yard pad. During reclamation, air monitoring was conducted with a PID to ensure that incidental volatilization of methanol did not result in an unsafe or unhealthy condition. Measured concentrations at this time did not exceed detection limits, with the exception of one reading of 10 ppm that was suspected of being erroneously influenced by high water vapor at the site of measurement. Mass balance calculations were performed to provide estimates of distribution fate of the spilled methanol (Table 3). The largest amount of methanol recovered was in the standing liquid at the time of the spill.

REGULATORY CONSIDERATIONS

The way in which the regulatory agencies handled this spill provides an interesting example of the confusing and unsettled application of the Resource Conservation and Recovery Act (RCRA) to spill contaminated soil. A number of the features of RCRA are difficult to apply in spill clean-up situations in part because RCRA was designed to govern the fate of intentionally created hazardous waste. Two examples of this misfit are the mixture rule and application of the 90 day storage period limitation. A similar unsettled situation apparently exists with regard to the application of RCRA rules to CERCLA (Comprehensive Environmental Response, Compensation and Liability Act) response actions.

The initial agency position was that the spill was governed by Alaska's spill clean-up laws, which would have allowed flexibility in both the timing and nature of the clean-up. However, a few weeks after the spill, EPA Region 10 made a determination that RCRA rules applied. Consequently, several potentially attractive, environmentally sound handling options were excluded. For example, with the assent of ADEC, ARCO had solicited bids from asphalt contractors to use the gravel in an asphalt batch plant. That option, which would have effectively destroyed any remaining methanol, was eliminated by the EPA's action.

RCRA coverage of methanol spill clean-up material by RCRA is especially problematic. Methanol is a RCRA "U" listed waste (U 154). Under 40 CFR 261.3(a)(2)(iii), mixtures of listed hazardous wastes and other solid wastes become hazardous under the so called "mixture rule." However, if the listed hazardous waste is listed

only because it exhibits a RCRA characteristic (ignitability in the case of methanol), mixtures of the listed waste and other solid wastes are no longer hazardous if the mixture fails to exhibit that characteristic. The contaminated gravels in the Fairbanks spill were not ignitable, and the agency could have followed this rule, making the gravels non-hazardous solid waste. EPA chose not to take this position, relying on internal policy and a court case which held that environmental media (natural materials such as soils and gravel) could not constitute solid waste. Therefore, the mixture of gravel and methanol could not be judged non-hazardous under the characteristic-retention text.

The remaining options were either reclaiming and recycling the contained methanol or full compliance with RCRA storage, transportation, and disposal rules. Because no RCRA treatment or disposal facilities exist in Alaska, the latter would have meant an expensive and environmentally inappropriate rail car shipment of the gravels to a disposal area or incinerator in the lower '48.

ARCO chose to reclaim and recycle the methanol in the gravel. EPA and ADEC assisted in our pursuit of this alternative. Remaining issues were promptly and harmoniously settled with ARCO's agreement to a State consent order stipulating the reclamation project previously discussed.

Given the increasing importance of methanol as a transportation fuel component, the outcome of this matter indicates that EPA's rules on the handling of methanol contaminated soils should be reexamined and rationalized.

CONCLUSIONS

The physical conditions prevailing in a winter methanol spill in severe northern climates provided some advantages over what might be expected under milder, more temperate conditions. Dilution by snow melt and subsequent freezing in the ground limited the vertical transport of the methanol. Although the groundwater was shallow (~8 ft [2.4 m]) there was no initial evidence that it was reached by the methanol. A finding four months later, of a low level of methanol at the northward monitoring well is being investigated. Data indicate that groundwater flow was not in the direction of the local resident or business wells. Cleanup options were limited by hazardous waste considerations. This, in part, led to the decision to reclaim the methanol from the soil rather than other options. The regulatory status of spilled methanol should be reevaluated, especially since the use of methanol as a motor fuel may increase. In spills where contaminated material has to be declared a waste, treating it as a hazardous waste when it no longer manifests hazardous characteristics, often can involve expensive and environmentally unnecessary handling requirements under RCRA.

ACKNOWLEDGEMENTS

The assistance of J. Brendel, W. Christian, and K. Heiden in preparation of this paper is greatly appreciated.

REFERENCES

1. Environmental Protection Service. "Methanol," *Environmental and Technical Information for Problem Spills,* Environment Canada, Ottawa (Jan. 1985), 100 p.

2. Péwé, T.L. " Groundwater," *Geologic Hazards of the Fairbanks Area, Alaska,* Alaska Geological & Geophysical Surveys Special Report 15 (1982), p. 67-85.

3. U.S. Geological Survey. *Hydrologic Information for Land-Use Planning, Fairbanks Vicinity, Alaska,* Open-File Report 78-959 (1978), p. 19-21.

4. Shannon & Wilson, Inc. "Cleanup Monitoring & Soil and Groundwater Studies, Methanol Release Site, Fairbanks, Alaska. Draft report prepared for ARCO Alaska, Inc. (Jan. 1990), 11 p. + appen.

Table 1. Groundwater elevations (ft) at methanol spill site (December 11 and 28, 1989).

Well ID	Water Elevation 12-11	12-28	Water Table Depth 12-11	12-28
MW-1	138.63	138.55	7.99	8.07
MW-2	138.69	138.56	6.61	6.74
MW-3	138.46	138.39	8.30	8.37
MW-4	138.50	138.39	6.84	6.95

Table 2. Methanol concentrations in groundwater monitoring wells and soil borings (Dec. 1989) (<DL = below detection limit).

ID	Soil Boring Interval (ft)	Date	Methanol (ppm)
MW-1		12-6-89	<DL
MW-2		12-6-89	<DL
MW-3		12-6-89	<DL
MW-4		12-11-89	<DL
MW-1		12-28-89	<DL
MW-2		12-28-89	<DL
MW-3		12-27-89	<DL
MW-4		12-28-89	<DL
B-1	0.0-1.5	12-9-89	<DL
B-1	1.5-3.0	12-9-89	<DL
B-1	3.0-4.5	12-9-89	<DL
B-1	4.5-6.0	12-9-89	<DL
B-2	0.0-1.5	12-9-89	14,900
B-2	1.5-2.0	12-9-89	8,100
B-2	2.5-3.0	12-9-89	2,100
B-2	3.0-3.5	12-9-89	<DL
B-2	3.8-4.2	12-9-89	<DL
B-2	4.5-6.0	12-9-89	<DL
B-3	0.0-1.5	12-9-89	<DL
B-3	1.5-3.0	12-9-89	<DL
B-3	3.0-4.5	12-9-89	<DL
B-4	0.0-1.5	12-9-89	23,400
B-4	1.5-3.0	12-9-89	27,300
B-4	3.0-3.5	12-9-89	5,400
B-4	3.5-4.5	12-9-89	<DL
B-4	4.5-4.8	12-9-89	6,800
B-4	4.8-6.0	12-9-89	<DL

Table 3. Distribution of methanol resulting from December 4, 1989 spill.

Material	Volume (gal)	Percent of spill
Initial volatilization *	350	4
Free liquid †	1012	11
Snow †	321	3
Soil †	7,225	78
(Reclaimed †)	(70)	(<1)
(Volatilized #)	(7342)	(79)

* CHARM model

† Volume of material x ave. sample concentration

by subtraction

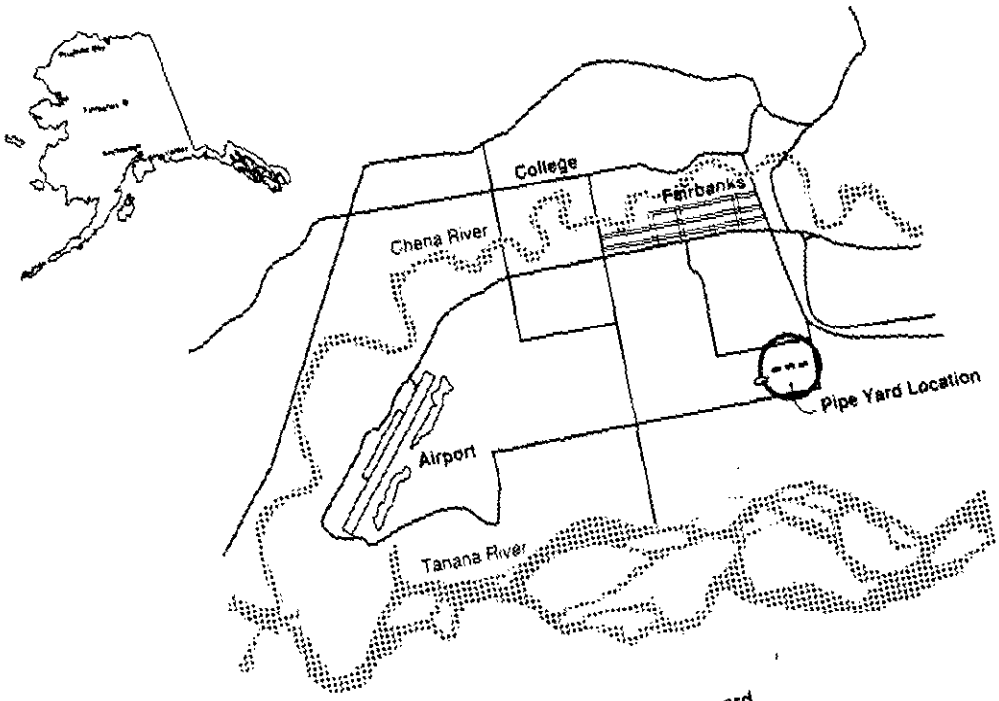


Figure 1. Location map of pipeyard.

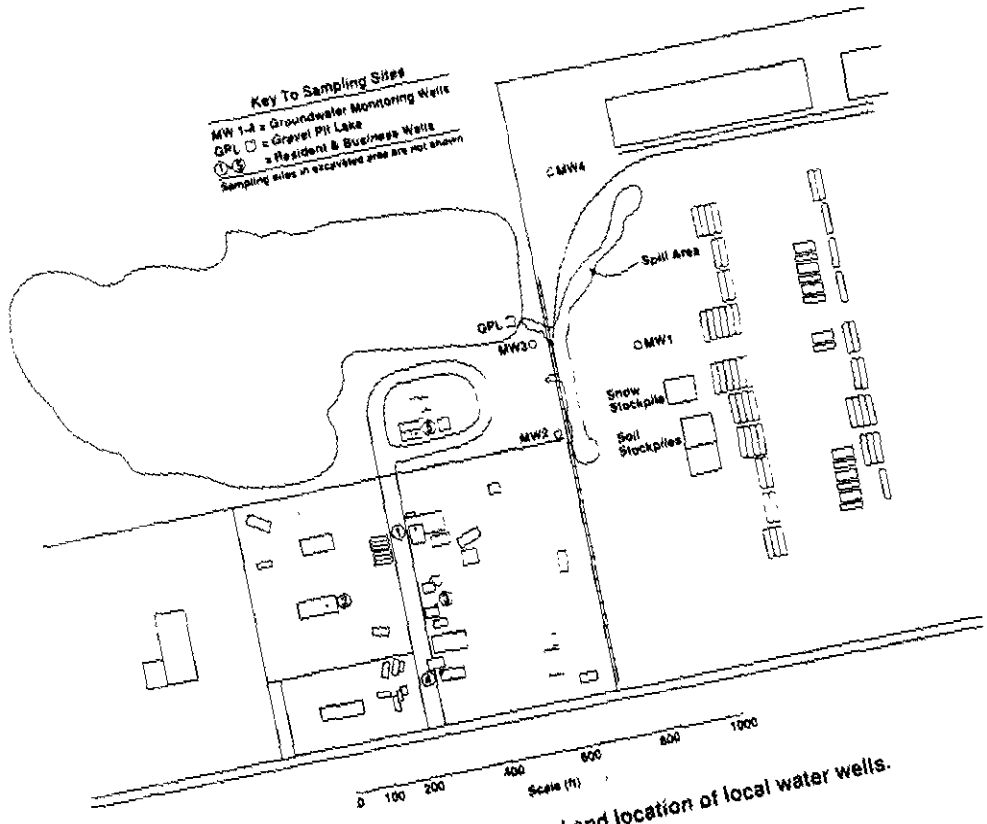


Figure 2. Map of spill in yard and location of local water wells.

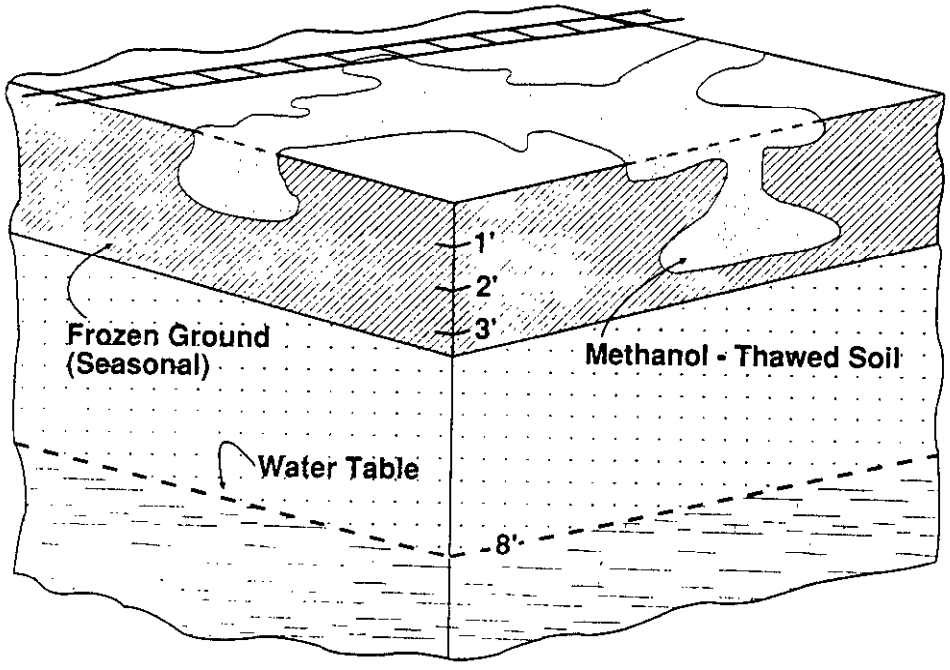


Figure 3. Possible subsurface methanol spreading characteristics.

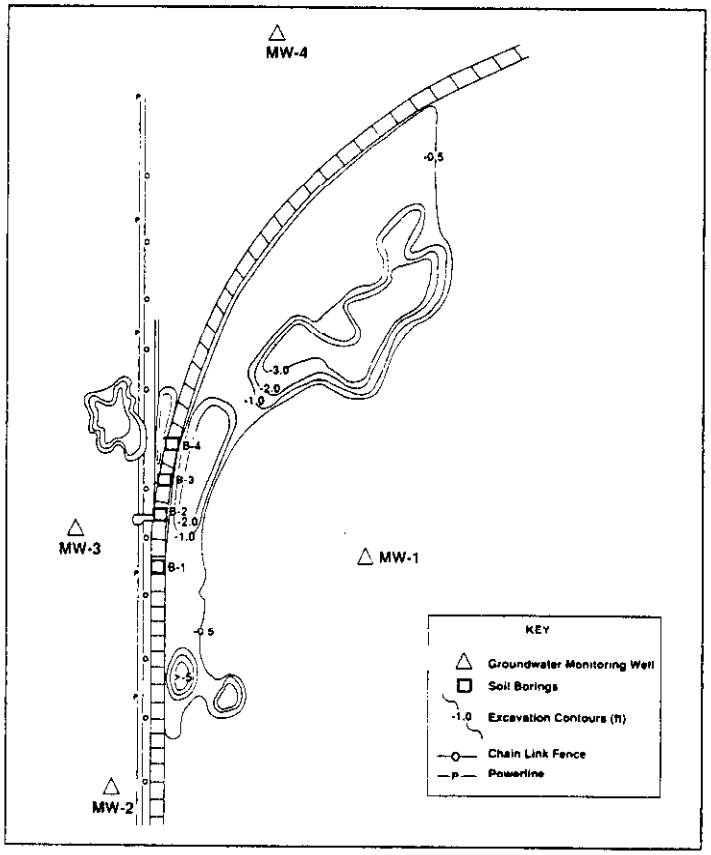


Figure 4. Locations of monitoring wells and borings, and general areas of excavation.

APPENDIX G

ANFIRS INCIDENT REPORT
Fairbanks Fire Department, Alaska

STATE OF ALASKA
ANFIRS INCIDENT REPORT

ANFIRS 1

FILL IN THIS REPORT IN YOUR OWN WORDS

Fairbanks FIRE DEPARTMENT

1 ☐ DELETE
2 ☐ CHANGE

A
FDID: 3 1 0 0 0 6 1 3 3 4 | INCIDENT NO. EXP. NO.: 0 0 | MO.: 1 2 | DAY: 0 4 | YEAR: 8 9 | DAY OF WEEK: Monday | ALARM TIME: 0 2 2 4 | ARRIVAL TIME: 0 2 3 5 | TIME IN SERVICE: 0 4 2 0

B
TYPE OF SITUATION FOUND: Large Methanol Spill 14.7 | TYPE OF ACTION TAKEN: iNvestigated 3 | MUTUAL AID 1 ☐ REC'D 2 ☐ GIVEN

B1
MUTUAL AID GIVEN TO: FDID: 0 | FD NAME: N/A

C
FIXED PROPERTY USE: Pipe Yard 953 | IGNITION FACTOR: None — | PROPERTY CODE

D
CORRECT ADDRESS: STREET: 1100 VAN Horn Rd. | CITY: FBKS | ZIP CODE: 99701 | CENSUS TRACT

E
OCCUPANT NAME (Last, First, Middle, Suff.): Alyeska Pipeline Co's | TELEPHONE: 456-4153 | ROOM OR APT.

E1
SSN | DOB | SEX 1 ☐ MALE 2 ☐ FEMALE | RACE W-WHITE B-BLACK I-AM. IND or AK NATIVE A-ASIAN or PACIFIC ISLANDER U-UNKNOWN | LIC NUM/ST

F
OWNER NAME (Last, First, Middle, Suff.): Rees, Chuck | ADDRESS (Street, City, State, Zip): 1968 Hilton FBKS AK 99701 | TELEPHONE: 456-6403

F1
SSN: 563 38 2145 | DOB: 6/2/1929 | SEX 1 ☑ MALE 2 ☐ FEMALE | RACE W-WHITE (circled) B-BLACK I-AM. IND or AK NATIVE A-ASIAN or PACIFIC ISLANDER U-UNKNOWN | LIC NUM/ST

G
METHOD OF ALARM FROM PUBLIC: 911 | DISTRICT: 11 | CO: 01 | SHIFT: C | NO. ALARMS: 1

H
NUMBER OF FIRE SERVICE PERSONNEL RESPONDED: 009 | NUMBER ENGINES RESPONDED: 001 | NUMBER AERIAL APPARATUS RESPONDED: 0 | NUMBER OTHER VEHICLES RESPONDED: 004

H1
WIND DIREC: VAR | SPEED MPH: LT | TEMP + or - (FARENH): 011 | CONDITIONS: Cloudy 2

I
NUMBER OF INJURIES: FIRE SERVICE 0 | OTHER 0 | NUMBER OF FATALITIES: FIRE SERVICE 0 | OTHER 0

COMPLETE FOR ALL INCIDENTS

COMPLETE IF CASUALTY

J
COMPLEX | MOBILE PROPERTY TYPE

S
IF MOBILE PROPERTY | YEAR | MAKE | MODEL | SERIAL NO. | LICENSE NO.

K
AREA OF FIRE ORIGIN | EQUIPMENT INVOLVED IN IGNITION

T
IF EQUIPMENT INVOLVED IN IGNITION | YEAR | MAKE | MODEL | SERIAL NO.

L
FORM OF HEAT OF IGNITION | TYPE OF MATERIAL IGNITED | FORM OF MATERIAL IGNITED

M
METHOD OF EXTINGUISHMENT | LEVEL OF FIRE ORIGIN | ESTIMATED LOSS (DOLLARS ONLY)

M1
INSURANCE AGENT | COMPANY | ESTIMATED PROPERTY VALUE

COMPLETE FOR ALL FIRES

N
NUMBER OF STORIES | CONSTRUCTION TYPE

O
EXTENT OF FLAME DAMAGE | EXTENT OF SMOKE DAMAGE

P
DETECTOR PERFORMANCE | SPRINKLER PERFORMANCE

Q
IF SMOKE SPREAD BEYOND ROOM OF ORIGIN | TYPE OF MATERIAL GENERATING MOST SMOKE | AVENUE OF SMOKE TRAVEL

R
FORM OF MATERIAL GENERATING MOST SMOKE

COMPLETE IF STRUCTURE FIRE

☐ CHECK IF COMMENTS ON REVERSE SIDE

U
OFFICER IN CHARGE (Name, Position, Assignment): Bob Cerny B.C. A shift | DATE: 12-4-89
MEMBER MAKING REPORT (IF DIFFERENT FROM ABOVE) | DATE: 12-5-89

12-729 Rev. 10/86

FAIRBANKS FIRE DEPARTMENT

Individual Run Report

Date: 12-4-89 | Station No.: Hq | Weather Wind: ZVV Temp: 11 | Run Report No. F8 -: 01334

Location of Incident:
1100 Van Horn Rd
Pipe Yard.

Person Reporting Incident: Yard Master
Address:
Phone No.: 456-4153

Time Alarm Received: 0224

	Time Out	Time On Location	Time In
HQ. COMMAND	0228	0235	0420
ENGINE E 8	0228	0235	0420
ENGINE			
ENGINE			
C4	0227	0231	
TRUCK			
AMBULANCE A3	0228	0235	0420
STA. 4 ENGINE			
ENGINE			
ER	0228	0241	
501-1504	0251	0255	

Alarm Received Via:
911 Phone ✓ | Police Dept. ____
Bus. Phone ____ | Verbal ____
Auto. Alarm ____ | Other ____

CLASSIFICATION OF ALARM (Calls Other Than Fires)

____ In Buildings
____ Brush or Grass
____ Rubbish
____ Controlled Burning
____ Vehicles in Street
____ Misc. Fires Outdoors
____ Rescue or Emergency
____ Steam & Smoke Scare
____ Accidental Alarm/Malfunction
____ False Alarms
✓ Hazardous Spill

Investigator Notified

PERSONNEL RESPONDING

	Engine	Engine	Engine	Engine	Truck	Ambulance #3	ADDITIONAL UNITS RESPONDING
On Duty	Rockney					Muir	
	Stern					Mercer	V-17
	Helmers						Craig
	Dick						
							C-4
							Sands
							UAF
							Olden
Off Duty							

Submitted By: Bl Craig
Title: B C.

COMPLETE REVERSE SIDE FOR ANY FIRE INCIDENT

NARRATION OF INCIDENT

Responded To Reported Large quantity of Methanol spilled. Turned out to be about 30 To 70,000 Gals. Crew stood by as Sands Notified DEC & AKR & ARCO & FNSB Safety Co-ordinator & UAF Safety Co-ordinator.

COMMENTS:

Graffitee on tank cars indicated Sabotage of the cars making spill deliberate.

EQUIPMENT USED OR CONSUMED

_____ Out before arrival of apparatus
_____ By occupants (with extinguishers, hose lines, etc.)
_____ Automatic sprinkler controlled fire
_____ Portable extinguishers
_____ Light units used
_____ Salvage covers spread
_____ Mops, brooms, etc. used
_____ Breathing apparatus
_____ Small tools (axes, etc.)
_____ Feet of ladders

NONE

_____ Feet booster hose used
_____ Feet 1½" hose used
_____ Feet 1¾" hose used
_____ Feet 2½" hose used
_____ Feet 3" hose used
_____ Feet 5" hose used
_____ Gals. water
_____ Hydrants
_____ # _____ # _____
Glycol _____ _____ _____

Mechanical Performance of Vehicles

OK

Equipment Damaged or Destroyed

Accidents: 0
Injuries: _____
Etc.: _____

Equipment Lost or Found

0

Probable Cause: Methanol HAZ MAT SPill

Est. Bldg. Loss 0
Est. Content Loss _____
Est. Other Loss _____
Est. Total Loss 0

Owner: _____ Address: _____
Occupant: _____ Address: _____
Vehicle Lic: _____
Insurance: Company and/or Agent:

Estimated Value of:
Bldg. _____ Contents _____
Other _____