

PUGET SOUND BASIN

SOLID WASTE MANAGEMENT BRANCH

**REPORT TO THE TULALIP INDIAN TRIBE -
EVALUATION OF THE EBEEY SLOUGH
LANDFILL OPERATION**

**ENVIRONMENTAL
PROTECTION
AGENCY
REGION X**

WORKING PAPER NO. 87

U.S. ENVIRONMENTAL PROTECTION AGENCY

REGION X

1200 SIXTH AVENUE

SEATTLE, WASHINGTON 98101



January 12, 1973 . 3

REPLY TO
ATTN OF: 10CSW - M/S 533

Mr. Wayne Williams
Tribal Manager
Tulalip Indian Tribe
3901 Totem Beach Road
Marysville, Washington 98270

Dear Mr. Williams:

We are glad to submit for your review three copies of the technical assistance report prepared for the Tulalip Indian Tribe by this office. Your guidance and overall assistance in the development of the report has been appreciated.

The general purpose of the report is to disseminate information and knowledge to the Tribe on the environmental aspects of solid waste management as well as provide some technical assistance in the operation of sanitary landfills. To complement the information contained in the report, we have also enclosed copies of each publication referenced in it.

Special attention is directed to the conclusions and recommendations discussed in the cover memorandum and the Recommendations section of the report. Several significant deficiencies were apparent to EPA in the operation of the Ebey Slough landfill at the time of our inspections. The report correctly concludes that these conditions should be the subject of immediate abatement action. In addition, it should be noted that the report based its recommendations upon proposed federal Sanitary Landfill Guidelines.

Careful consideration should be given to the report and steps initiated to implement its recommendations. The Solid Waste Management Branch will be glad to give additional technical assistance to you in meeting these recommendations once the Tribe has had the opportunity to consider the report.

To provide for a full discussion of the report contents, please call either Mr. Rod Hansen or myself (telephone 442-1260) by January 26, 1973.

Sincerely,

Lester E. Blaschke
Chief, Solid Waste Management Branch

Enclosures

ENVIRONMENTAL PROTECTION AGENCY

10CSW - M/S 533

DATE: January 11, 1973

SUBJECT: Report to the Tulalip Indian Tribe
Evaluation of the Ebey Slough Landfill Operation

Lester E. Blaschke, Chief
Solid Waste Management Branch

Enclosed is the technical assistance report prepared for the Tulalip Indian Tribe.

The findings of the report are that serious water pollution problems exist at the landfill site, and that decomposition gases present a potentially serious fire and explosion hazard. In addition, the Federal Water Pollution Control Act Amendments of 1972 may have an impact upon this operation.

The report presents several important recommendations to the Tribe. The most significant of these is that the disposal of decomposable solid wastes at the site be terminated. In addition, the report contains specific recommendations that include:

1. The elimination of solid waste-surface water contact that occurs along a portion of the existing fill.
2. The containment, collection, and treatment of leachate from the existing fill.
3. An assessment of decomposition gas control needs, as they relate to the intended final site use.
4. The construction of gas vents through the final cover.
5. The monitoring of methane concentrations in the existing maintenance building, if it is to be retained, and the removal of welding and cutting operations from the building.

Conditions at the site merit immediate abatement action. A meeting with the Tulalip Tribe should be requested to provide for a full discussion of the report. In addition, copies of the report should be circulated to the other Divisions of EPA Region X for review with respect to their activities.

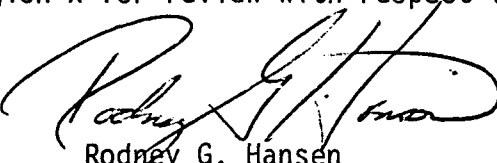

Rodney G. Hansen
Mission 5000 Project Officer
Solid Waste Management Branch

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USEPA Sanitary Landfill Guidelines,
September 8, 1972 Draft

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SUMMARY AND RECOMMENDATIONS

By letter dated April 21, 1972, the Solid Waste Management Branch, U.S. Environmental Protection Agency, Region X, requested from the Bureau of Indian Affairs information concerning the operation of a solid waste landfill on the Tulalip Indian Reservation. Correspondence resulting from this inquiry led to two inspections of the operation, and to meetings with the Tulalip Tribal Manager and officials of the landfill operator, Seattle Disposal Company.

The Tulalip operation is a general-use landfill that receives primarily non-residential solid wastes generated within the City of Seattle. The Tulalip Tribe assumes responsibility for the operation of the landfill through a lease arrangement with Seattle Disposal Company. Inspections conducted by Solid Waste Management Branch personnel indicated a number of operating deficiencies that were brought to the attention of the Tribe. This report was prepared to provide more detailed assistance and recommendations directed towards eliminating the operating deficiencies. The most serious deficiencies are water pollution resulting from the operation, and decomposition gas control at the site.

Water pollution is occurring from the deposition of decomposable solid waste into ponded ground and surface waters, from direct solid waste-surface water contact along the working face and in the barge channel, and from leachate produced by water percolating through the landfill. At a minimum, to be in compliance with federal standards, this operation requires:

1. The elimination of solid waste-surface water contact in the barge channel;
2. The containment, collection, and treatment of leachate along the working face; and
3. An assessment of ground water movements and leachate collection needs under and around the perimeter of the landfill. Additional collection facilities may be required to meet the federal guidelines.

These procedures will reduce, but may not eliminate, unnecessary water pollution resulting from operations at the site. It may not be possible to eliminate adverse impacts associated with past operations without removing the completed fill. The natural topography and hydrology of the site makes proper environmental controls extremely difficult and potentially expensive. Proper control measures would include the termination of general-use disposal activities at the Tulalip site. That is, decomposable materials should not be accepted at the Tulalip site.

Decomposition gas problems may result from the lack of adequate assessment and control measures both prior to and during the landfill operation. Significant quantities of carbon dioxide and methane may be expected, as may detectable quantities of the sulfides of hydrogen.

Carbon dioxide will dissolve calcium, magnesium, iron, and other substances that are undesirable at high concentrations. Solutions of these substances will also inhibit potential leachate treatment processes. Methane presents a fire and explosion hazard both during and after

disposal operations at the landfill. Hydrogen sulfide and associated mercaptans present odor problems that may impact intended post-operative uses.

Even if general-use disposal operations are terminated, the following recommendations should be adopted:

1. An assessment of gas control needs, as they relate to the intended final use of the site, should be performed.
2. Steps should be taken to assure proper cover ventilation at the site.
3. Buildings should be constructed on the site only with extreme caution. If the existing maintenance building is to be retained, its ventilation must be assured and monitored. Welding and cutting operations should not be conducted within the building.

INTRODUCTION

Background

Since the establishment of the EPA Regional office in July of 1971, the Solid Waste Management Branch has been engaged in an effort to identify and resolve the most significant solid waste problems within Region X. Emphasis has been placed upon identifying problems and a course of action that will compliment and benefit the activities of the affected state and local jurisdictions. In the process of this research, interest became directed towards a landfill operation on the Tulalip Indian Reservation near Everett, Washington.

By letter dated April 21, 1972, the Solid Waste Management Branch requested from the Bureau of Indian Affairs information concerning the operation of this landfill. Correspondence resulting from this inquiry led to two inspections of the operation, and to meetings with the Tulalip Tribal Manager and officials of Seattle Disposal Company.

Purpose of Report

The Tulalip Indian Tribe is responsible for the operation of this landfill through a lease with Seattle Disposal Company. The inspections conducted by personnel from the Solid Waste Management Branch indicated a number of operating deficiencies that were brought to the attention of the Tribal Manager. The Tribal Manager expressed an interest in upgrading the operation where practical, and in receiving recommendations from EPA directed towards this end.

The purpose of this report is to relay these recommendations to the Tulalip Tribe. Its conclusions are based upon a water based inspection that was conducted on June 9, 1972, and a site inspection that was

conducted, in the presence of the Tribal Manager and officials of Seattle Disposal Company, on July 13, 1972. The recommendations are based upon the proposed Federal Sanitary Landfill Guidelines, dated September 8, 1972. They are intended to indicate where deficiencies occur, and what types of abatement actions are required to upgrade operations at the site.

I OPERATION DESCRIPTION

Site Description

The landfill operation is being conducted on a portion of an island in the Snohomish River estuary, as indicated in Figures 1 and 2. The natural topography of the site is flat, characteristic of a brackish water marsh. Salt grasses dominate the natural flora, and the ground water table was observed to be at the land surface. Fine grained soils predominate.

Approximately one-quarter of the site has been covered with solid waste. The portion of the site nearest to Interstate Highway 5 has been completed, and the landfill operation is proceeding westward. Currently, there is no vehicle land access to the site, but a road is to be constructed in the near future.

Operating Practices

Seattle Disposal Company operates a barge transfer station at Pier 35, Seattle, that receives primarily non-residential solid wastes from private collectors in the City of Seattle. Four or five barges per week, carrying up to 1500 tons of solid wastes each, are delivered to the Tulalip disposal site.

For barge unloading purposes, a channel has been dredged from Ebey Slough into the interior of the island. The sides of the barge channel have been constructed of a soil-solid waste mixture; the soils available at the site are not suitable for this purpose, and suitable soils have not been imported. As a result, there is direct contact between solid wastes and the waters flowing into and out of the barge channel. In addition, leachate discharges into the channel have been observed. These conditions are shown in Figures 3 and 4.

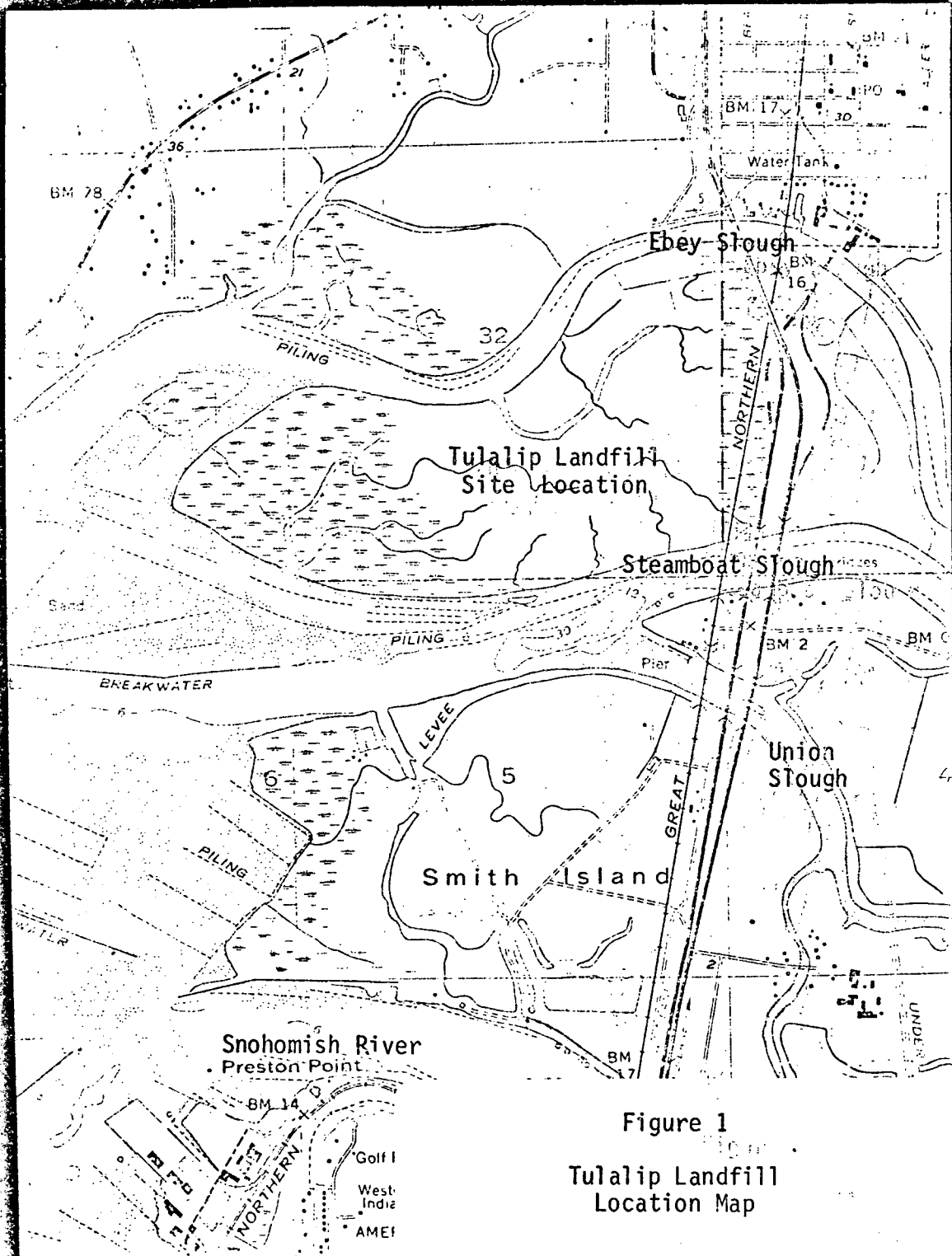




Figure 2
Aerial Photo of Landfill Site



Figure 3
Barge Channel Side Wall



Figure 4
Leachate Discharge From Barge
Channel Side Wall

Solid waste is lifted from the barge to the landfill surface by a crane equipped with a modified clamshell bucket. From there, a crawler tractor equipped with a large landfill blade pushes the waste to the active disposal area. During unloading operations, a significant quantity of waste falls into the barge channel, as shown in Figure 5. Nets are used to inhibit the passage of this solid waste into Ebey Slough, and the barge channel is periodically skimmed with a large screen that is attached to a crane. During the July 13 investigation, the unloading area was equipped with a tarp to catch spillage below the clamshell bucket. This tarp was not observed during the June 9 investigation.

The completed perimeter of the landfill is surrounded by a dike constructed of soils dredged at the site. Cover and dike material is excavated from the site, and solid waste is deposited into water that collects in the fill areas. A long, active working face is exposed to ground and surface waters. Cells are not constructed to provide for the collection and treatment of the resulting leachate. Figures 6 and 7 illustrate these conditions.

The soils dredged from the site are not workable under all conditions, so no daily cover is applied. Rather, soil is mixed with solid waste for daily application, and a final cover is applied at a later date. The soil-solid waste mixture is deposited and compacted in horizontal lifts. Prior to the application of the final cover, solid waste is visible throughout the fill area, as illustrated in Figure 8.

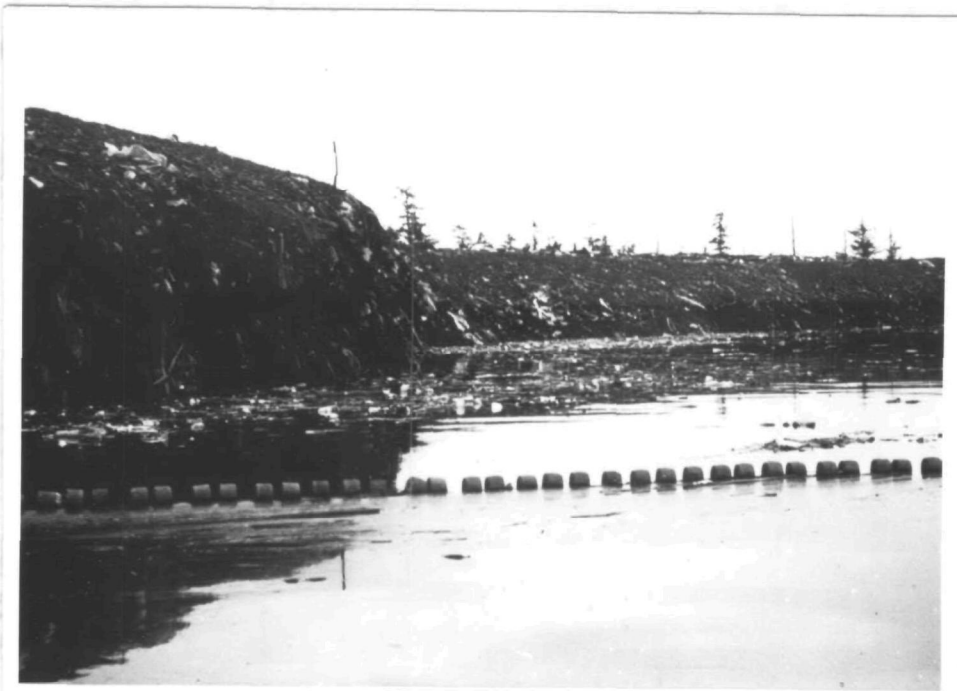


Figure 5
Solid Waste Spillage in Barge Channel



Figure 6
Crane Constructing Perimeter Dike
Along Northern Active Working Face
Looking West



Figure 7
Western Active Working Face
Looking South



Figure 8
Completed Fill Prior to Application
of Final Cover

II SANITARY LANDFILL GUIDELINES

As charged by Section 209 of the Solid Waste Disposal Act, as amended, the Office of Solid Waste Management Programs, U.S. Environmental Protection Agency, is preparing guidelines for the operation of solid waste disposal systems. A draft of the Sanitary Landfill Guidelines has been completed and is in the review process. Although the latest draft available to the Solid Waste Management Branch, U.S. EPA, Region X is not final and will be changed, it is completed to a sufficient degree to justify its application in an evaluation of the Tulalip Landfill operation. The Tribe is also referred to References 1 through 3 for Sanitary Landfill information.

The purpose of the Guidelines is to provide for sanitary landfill operations that will have minimum impact upon the environment and the public health. The Guidelines do not establish new standards, but set forth requirements and recommended operating procedures to insure that the design, construction, and operation of sanitary landfills meet acceptable health and environmental standards.

The Requirements sections of the Guidelines delineate minimum levels of performance required at general-use sanitary landfills. The mix and composition of the wastes accepted at the Tulalip site place it within the general-use category, so the Requirements sections should be applied to its operation.

Each Requirement is supported with recommended operating procedures that are intended to emphasize specific items of concern. Owners and operators of sanitary landfills should employ the most efficient engineering methods available to satisfy the Requirements. The Operating Procedures

represent such methods and techniques, based on current knowledge, for meeting the Requirements. If techniques other than those specified are used, the operator should demonstrate to the Tribe that such techniques will meet the Requirements.

The Guidelines also encompass considerations that relate to the safety of the on-site personnel, and to the intended final use of the site. In all cases, the final site use should guide the landfill operating plans. Important provisions include final grade, compaction, and decomposition gas control.

When adopted, the Guidelines will apply to both existing and new Federal Agency installations. Thus, the Requirements sections are written to be applied as performance standards upon federal installations. The Guidelines are also recommended to other agencies that are responsible for solid waste disposal operations for use in their activities. The Tulalip Tribe, which falls within this latter category, should evaluate and consider the Guidelines for adoption and application to disposal operations that are conducted on Reservation lands.

III OPERATION EVALUATION

The various impacts addressed by the Guidelines include impacts upon air and water quality, aesthetics, the public health and safety. The purpose of this section is to assess the operation of the Tulalip Landfill as compared to the Guidelines. A copy of the September 8, 1972 draft is appended to this report for reference.

Since the Requirements are written as performance standards for federal installations, all are not specifically applicable to the Tulalip operation. Those specifying environmental and operating performance levels are applicable for assessment purposes, however. These Requirements and their recommended Operating Procedures will form the basis of this evaluation.

Water Quality

The Water Quality Requirement states that,

The location, design, and operation of the sanitary landfill shall minimize environmental hazards and shall conform to applicable ground and surface water quality standards. Applicable standards are existing Federal, State, or local standards which are legally enforceable.

The intent of this section is to eliminate discharges into ground and surface waters from sanitary landfills. The recommended Operating Procedures are written to eliminate direct contact with potential receiving waters, and to minimize the percolation of water through the landfill. The alternative to these measures is the construction of potentially expensive leachate collection and treatment systems.

The first Operating Procedure outlines nine tasks that should be performed in evaluations of proposed landfill sites. Proper performance of these tasks will provide for the elimination of poor sites, and will generate information that will permit effective water quality control practices at sites that are chosen for use.

The nine tasks include an evaluation of the geology and hydrology of the landfill area, an assessment of potential leachate-water quality interrelationships, the specification of a proposed water quality sampling program, and a delineation of potential leachate control systems. The information generated from the performance of these tasks would not only be useful in a water quality impact assessment, but would also contribute information valuable for post-utilization purposes. If operations at the Tulalip site are to continue, the operator should prepare such an assessment for the Tribe.

The most common water quality hazard that results from solid waste landfills is the production of leachates that arise from contact between the solid waste and external waters passing through or adjacent to the site. The second and fifth Operating Procedures recommend practices to minimize this contact. In addition, the fourth Operating Procedure gives implicit recognition to this leachate generation mechanism. Although it is not necessary to elevate the bottom of a landfill to provide for flood protection, it is often times necessary to elevate the landfill to provide for ground water protection. Since flood plains are usually associated with high ground water tables, landfills located in flood plains present greater environmental hazards than those located in non-flood plain areas.

Leaching is a visible problem at the Tulalip site. Solid wastes are deposited directly into the ground water, there is direct solid waste-surface water contact along the working face and in the barge channel, and the wide, flat landfill surface provides for the percolation of incident precipitation into the landfill.

The second Operating Procedure recommends the diversion of surface waters around and over the landfill. At the Tulalip site, diversion trenches are not necessary because the surface of the landfill is above that of the surrounding land area. However, the landfill should be graded to permit the runoff of incident precipitation. Even though the final cover is constructed out of a tight soil, cracks will develop that permit percolation into the landfill. Such cracks were observed during the July 13 inspection. The final cover should be constructed with an adequate slope and drainage facilities provided to permit the rapid runoff of incident precipitation.

The intent of the fifth Operating Procedure is to eliminate leachate generation resulting from direct contact between solid waste and ponded ground waters. This provision should be expanded to include direct contact between solid waste and adjacent surface waters. These two mechanisms present the most severe environmental hazards at the Tulalip site.

In the barge channel, spillage, as well as direct contact, creates water quality degradation. During both inspections, the barge channel waters were visibly polluted, being more colored, and containing more floating scum and debris than the waters of Ebey Slough. Because of

tidal action, the barge channel waters pass into Ebey Slough in a diluted state.

These conditions merit immediate abatement. A water tight barrier should be constructed between the landfill and Ebey Slough, and unloading practices should be upgraded to eliminate spillage.

Along the active working face, direct contact between ponded ground and surface waters and solid waste was observed. Although the tight soils at the site will inhibit the movement of the resulting leachate through the ground, surface runoff of the leachate is not inhibited. It can be seen, from Figure 2, that such surface runoff is a potentially severe hazard.

The third Operating Procedure recommends the construction of leachate collection and treatment systems where necessary to protect ground and surface waters. Such abatement measures are definitely required for surface waters at the Tulalip site, and may be required for ground water. Conditions at the site make the construction and operation of proper control measures very difficult, however. At a minimum, cells should be constructed around the active working face, and treatment should be provided for water that accumulates in a cell during deposition.

If the assessment recommended as the first Operating Procedure had been performed prior to the initiation of operations at the Tulalip site, the difficulties associated with operating the site as a general-use landfill would have been more apparent. Given the water quality considerations presented above, the Tulalip Tribe should seriously consider the termination of general-use disposal activities at this site. If implemented,

the recommended abatement measures would reduce, but would not eliminate, adverse water quality impacts resulting from the landfill operation. More effective water pollution abatement would result from moving the disposal of decomposable solid wastes to an alternative site. Even if operations are terminated, there will be a long term environmental impact because of past operating procedures.

Aesthetics

The Guidelines require a sanitary landfill to be operated in an aesthetically acceptable manner. The purpose of this provision, and the supporting Operating Procedures, is to minimize adverse visual impacts upon adjacent land and water resource uses. Since recreation is an important use of the navigable waters adjacent to the Tulalip Landfill, aesthetic considerations should be incorporated into its operation.

Although aesthetic conditions at the Tulalip site are poor, the fact that there is no public access to the site reduces aesthetic impacts. In addition, the surface operations are not readily visible from the adjacent waterways.

The first two Operating Procedures are directed at the containment of blowing litter to the immediate vicinity of the working face. No blowing litter controls are practiced at the Tulalip site. The operator did indicate that blowing litter was a problem on windy days. Tarps and portable litter fences should be used to control litter around the barge unloading operation, and in the area of active deposition.

The third Operating Procedure recommends immediate cover for certain wastes, and cover at the end of each operating day. Wastes that require

immediate cover include dead animal carcasses, dewatered sludges, and dry incinerator and air pollution control residues. None of these wastes are delivered to the Tulalip site. Aesthetic problems do result from the absence of daily cover operations, however. The soil-solid waste mixture contains large amounts of visible solid waste prior to the application of final cover.

In addition to presenting a major water quality problem, operations in the barge unloading channel also present a major aesthetics problem. Floating refuse and the walls constructed of refuse are visible to the public from Ebey Slough. The installation of litter control fences, and the construction of a water tight barrier, as discussed above, would alleviate these adverse aesthetic conditions.

Gases

The Guidelines require that,

Decomposition gases generated within the sanitary landfill shall be controlled on-site.

The monitoring and control of decomposition gases is important in part because of the water quality problems that can result from the generation of soluble gases, and because methane production can present serious fire and explosion hazards. Since post-operative uses are intended for the Tulalip Landfill, the latter item is of extreme importance. Methane accumulations should also be of concern in buildings constructed for operation and maintenance purposes during the life of the landfill.

Data that have been developed with respect to gas production in sanitary landfills have not been related to solid waste composition.

Since the composition of the solid waste at the Tulalip Landfill varies somewhat from that found in most general-use landfills, available data are not necessarily applicable to the Tulalip operation. However, the paper and restaurant wastes accepted are subject to anaerobic decomposition, so gas production may be expected.

Based upon the limited amount of data available in the literature, and upon the fact that brackish water infiltration does occur at the Tulalip site, the ultimate gas composition is expected to be characterized by the presence of carbon dioxide (CO_2), methane (CH_4), and hydrogen sulfide (H_2S) and associated mercaptans (organic sulfide compounds).

The carbon dioxide produced passes into solution, and can create water quality problems by dissolving calcium, magnesium, iron, and other substances which are undesirable at high concentrations. Iron oxide is visible along the walls of the barge channel. Leachate containing these materials will also migrate through the fill to the working face. High concentrations of these materials will also have an adverse impact upon potential leachate treatment mechanisms.

Even though the sulfide compounds will comprise a very small portion of the decomposition gas volume (less than one percent), they may present continuing odor problems. Hydrogen sulfide exhibits a "rotten-egg" smell that is detectable at concentrations of less than one percent. The mercaptans present odor problems at concentrations of less than one part per billion (10,000,000 parts per billion equal one percent). Usually, problem concentrations of the sulfide gases are not expected at solid waste landfills. In this case, however,

brackish water infiltration will supply sulfates that will be utilized in the production of sulfide gases.

The methane gas may present explosion and fire hazards both during and after the operation of the landfill. The landfill surface is broad, and the final cover and perimeter dikes are impermeable except for cracks that may develop as the final cover dries. Thus, gas pockets may form within the fill, resulting in explosion and fire hazards. In a similar situation, fire problems have been experienced at the University of Washington's Montlake Landfill. Small gas bubbles were observed in puddles on the completed portions of the Tulalip Landfill during the July 13 inspection.

If buildings are constructed for post-operative uses, or for operation and maintenance purposes during the landfill operation, gas collection and venting become very important. In the past, methane gas explosions have caused injury and death at completed landfills. Enclosed structures also present explosion hazards at operating landfills. If proper gas control is not practiced during the operation of the landfill, possible post-operative uses may be restricted.

The Operating Procedures recommend an assessment of decomposition gas control needs, and the prevention of lateral gas migration. The assessment is needed to relate required control measures to operating safety needs, and to intended post-operative uses. Since an assessment has not been performed for the Tulalip Landfill, gas generation rates, composition, and potential migration paths have not been defined. The operator should be required to perform such an assessment for the Tulalip Tribe.

Other Guidelines Requirements

The site inspections performed by the Solid Waste Management Branch were directed at the adverse, environmental impacts resulting from the Tulalip Landfill operation. EPA's immediate concern in this matter relates to the elimination of these impacts. Several other Guidelines Requirements should also be of interest to the Tribe. Since the purpose of this report is to inform the Tribe of the environmental aspects of solid waste management as well as to provide some technical assistance to the Tribe in the operation of sanitary landfills, these requirements will be noted below.

The intent of the Safety Requirement is self explanatory. The Tribe should examine the Operating Procedures to insure that the operating personnel are protected. Special attention should be directed towards Procedure 2.6.1.G. The potential explosion and fire hazards have been discussed above. Ventilation of the maintenance shed must be assured, and ventilation trenches should be provided in the final cover.

Proper cover application is important for a number of reasons. The Cover Application Requirement is supported by recommended Operating Procedures that will satisfy most cover needs. The type of soil used for cover, grading practices, and the soil's ability to support vegetative cover will all impact post-operative uses of the site.

The marshy nature of the Tulalip site makes the exclusion of hazardous and special wastes vitally important. In addition to those wastes listed in the Hazardous and Special Wastes Requirement, all dead animals, sludges, ashes, animal wastes, and pesticide containers should be excluded.

The Inspections Requirement is written for agencies that are subject to the legal authority of the Environmental Protection Agency. The Tribe should examine the Operating Procedures, and provide for a formal inspection program to ensure that proper operating practices are followed. This is necessary for environmental, public health, and safety reasons, as well as to ensure that the intended final site use can be attained.

REFERENCES

1. Brunner, Dirk R. and D. J. Keller, Sanitary Landfill Design and Operation, U.S. Government Printing Office, Washington, D.C., 1972.
2. Sorg, T. J. and H. L. Hickman, Jr., Sanitary Landfill Facts, Public Health Service Publication No. 1792, U. S. Government Printing Office, Washington, D.C., 2nd. ed., 1970.
3. Recommended Standards for Sanitary Landfill Design, Construction and Evaluation and Model Sanitary Landfill Operation Agreement, prepared by National Solid Waste Management Association and the Federal Solid Waste Management Program, U. S. Government Printing Office, Washington, D.C., 1971.

APPENDIX

DRAFT

SANITARY LANDFILL GUIDELINES

Prepared By

Office of Solid Waste Management Programs

U. S. ENVIRONMENTAL PROTECTION AGENCY

Cincinnati, Ohio

September 8, 1972

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1. INTRODUCTION

1.1.0. GENERAL

Sanitary landfilling is the most widely applied and only environmentally acceptable land solid waste disposal method available today. A sanitary landfill is an engineered land disposal facility at which solid waste is spread in thin layers, compacted to the smallest practical volume, and covered with soil each operating day in a manner which minimizes environmental hazards.

The prescribed guidelines are intended to provide for operations that will have minimum impact on the environment, and they apply to both existing and new Federal agency installations (Sec. 209 and Sec. 211, PL 91-512). The guidelines do not establish new standards, but set forth requirements to insure that the design, construction, and operation of sanitary landfills meet the health and environmental standards for the area in which they are located.

The Requirements section of the guidelines delineate minimum levels of performance required of general-use sanitary landfills. It is possible to construct a sanitary landfill on nearly all topographies, although some land formations present unique problems. While it is impossible to delineate all the techniques required at every potential site, the Operating Procedures are intended to emphasize specific items of concern. Owners and operators of sanitary landfills are expected to employ the best technology available to satisfy the Requirements. The Operating Procedures represent techniques based on current knowledge for meeting the Requirements. If techniques other than those specified

are used, it is the obligation of the proposed facility's owner and operator to demonstrate to the responsible agency in advance that such techniques will ensure meeting the Requirements.

These guidelines are also recommended to State, interstate, regional, and local government agencies for use in their activities.

1.2.0. DEFINITIONS (as used in these guidelines)

Cell: Compacted solid wastes that are enclosed by undisturbed soil and/or cover material.

Cover Material: Soil that is used to cover compacted solid waste in a sanitary landfill.

Daily Cover: Cover material that is spread and compacted on the top and side slopes of compacted solid waste at least at the end of each operating day in order to control vectors, aesthetics, fire and moisture.

Final Cover: Cover material which serves the same functions as daily cover, but in addition is permanently exposed on the surface, must support vegetation, and must resist weathering for a longer period of time.

Free Moisture: Liquid which will drain freely from solid waste.

Groundwater: That water below ground whose pressure is equal to or greater than atmospheric pressure.

Hazardous Wastes: Materials or combinations of materials which require special management techniques because of their

acute and/or chronic effects on the health and welfare of the public (or those individuals who handle them).

Health Care Facilities: Institutions and offices including hospitals, nursing homes, clinics, etc., where medical services are regularly rendered.

Infectious Waste: Laboratory wastes including pathological specimens (i.e., all tissues, specimens of blood elements, excreta, and secretions obtained from patients or laboratory animals) and disposable fomites (any substance which may harbor or transmit pathogenic organisms) attendant thereto. Also, surgical operating room pathologic specimens and disposable fomites attendant thereto and similar disposable materials from out-patient areas and emergency rooms. Also, equipment, instruments, utensils, and fomites of a disposable nature from the rooms of patients who are suspected to have or have been diagnosed as having a communicable disease and must, therefore, be isolated, as required by public health agencies.

Leachate: Liquid that has percolated through solid waste or other medium and contains dissolved or suspended materials from it.

Open Burning: Uncontrolled burning of wastes in the open or in an open dump.

Open Dump: A land site at which solid waste is disposed of in a manner which does not protect the environment and is exposed to the elements, vectors, and scavengers.

Plans: Reports and drawings prepared to describe the sanitary landfill site and proposed operation which must be submitted to regulatory authorities for their consideration. Preliminary and final plans may be prepared; the final plans expanding on items contained within the preliminary plans.

Runoff: The portion of precipitation which drains from an area as surface flow.

Sanitary Landfill: A disposal facility employing an engineered method of disposing of solid wastes on land in a manner which minimizes environmental hazards by spreading the solid wastes in thin layers, compacting the solid wastes to the smallest practical volume, and applying cover material at the end of each working day.

Scavenging: Uncontrolled removal of solid waste materials.

Sludge: A semiliquid sediment resulting from industrial, institutional, or commercial processes.

Solid Waste: Garbage, refuse, and other discarded solid materials, resulting from industrial, commercial, and agricultural operations, and from community activities, excluding solids or dissolved material in domestic sewage or other significant pollutants in water resources, such as silt, dissolved or suspended solids in industrial waste water

effluents, dissolved materials in irrigation return flows or other common water pollutants.

Vector: A living insect or other arthropod or animal (not human) which can carry infectious diseases from one person or animal to another.

Water Table: The upper water level of a body of groundwater.

Working Face: That portion of the sanitary landfill where waste is discharged and is spread and compacted prior to the placement of cover material.

2. REQUIREMENTS

2.0.0. GENERAL

2.0.1. Federal executive agencies shall conform to applicable Federal, State, interstate, regional, and local standards where they are more stringent than these Requirements.

2.0.2. Federal agencies shall comply with the applicable sections of the National Environmental Policy Act of 1969.

2.0.3. Solid waste generated at Federal facilities and solid waste disposed of at Federal facilities shall not be disposed of by open burning or open dumping.

2.0.4. A plan for the design and operation of the sanitary landfill shall be developed by a professional engineer who has demonstrated his qualifications in previous similar design. The plan shall be submitted to the responsible agency for review and approval.

2.1.0. WATER QUALITY: The location, design, and operation of the sanitary landfill shall minimize environmental hazards and shall conform to applicable ground and surface water quality standards.

Applicable standards are existing Federal, State, or local standards which are legally enforceable.

2.1.1. Operating Procedures:

A. The plans shall include:

1. Current and projected use of water resources in the potential zone of influence of the sanitary landfill;
2. Groundwater elevation and movement;

3. Potential interrelationship of the sanitary landfill, local aquifers, and surface waters based on historical records or other sources of information;
 4. Initial quality of water resources in the potential zone of influence of the sanitary landfill;
 5. Proposed location of observation wells, sampling stations, and testing program planned, when appropriate;
 6. Description of soil and geologic material to a depth of at least 50 feet below the bottom of the proposed fill;
 7. Provision for surface water runoff control;
 8. Proposed separation between the lowest portion of the sanitary landfill and the historical high water table elevation;
 9. Potential of leachate generation and proposed control systems for the protection of ground and surface waters.
- B. Surface water courses and runoff shall be diverted from the sanitary landfill by trenches and proper grading. The sanitary landfill shall be constructed and cover material graded so as to promote rapid surface water runoff without excessive erosion. Regrading shall be done as required during construction and after completion to avoid ponding of precipitation and to maintain cover integrity.
- C. Leachate collection and treatment systems shall be used where necessary to protect ground and surface waters.

D. If a sanitary landfill is located in a flood plain, the bottom of the sanitary landfill shall not be lower than the high water mark of the 50-year design flood.

E. In no case shall solid waste be allowed to contact ground water.

2.2.0. AIR QUALITY: The design and operation of the sanitary landfill shall minimize environmental hazards and shall conform to applicable ambient air quality standards and source control regulations.

2.2.1. Operating Procedures:

A. Open burning of solid wastes shall be prohibited.

B. Plans shall include an effective dust control program.

2.3.0. AESTHETICS: The sanitary landfill shall at all times be operated in an aesthetically acceptable manner.

2.3.1. Operating Procedures:

A. Plans shall include an effective litter control program.

B. Portable litter fences or other devices shall be used in the immediate vicinity of the working face and other locations, as appropriate, to control blowing litter.

C. Certain wastes shall be covered immediately and the remainder by the end of each operating day. Refer to Requirements 2.8.0., 2.8.1., and 2.10.1. E, G, and H.

D. Vegetation shall be cleared only as necessary. Natural windbreaks, such as green belts, shall be maintained where they will improve the appearance and operation of the sanitary landfill.

2.4.0. GASES: Decomposition gases generated within the sanitary landfill shall be controlled on-site.

2.4.1. Operating Procedures:

A. Plans shall assess the need for gas control and indicate the location and design of any vents, barriers, or other control measures to be provided.

B. Decomposition gases shall not be allowed to migrate laterally from the sanitary landfill. They shall be vented into the atmosphere directly through the cover material, cut-off trenches, or forced ventilation systems in such a way that they do not become concentrated in explosive quantities. Information on the limits of inflammability of gases is available in such references as the Handbook of Chemistry and Physics (44th ed. Cleveland, Chemical Rubber Publishing Co., 1962, 3604 p.).

2.5.0. VECTORS: Conditions shall be maintained that are unfavorable for the harboring, feeding, and breeding of insects, birds, and rodents.

2.5.1. Operating Procedures:

A. Plans shall include contingency programs for vector control, and the operating authority shall remain prepared at all times to implement these procedures.

B. All solid waste shall be covered by the end of each operating day. Refer to Requirements 2.8.0. and 2.8.1.

2.6.0. SAFETY: The sanitary landfill shall be designed, operated, and maintained in such a manner as to protect the health and safety of personnel associated with the operation. The Occupational Safety and Health Act of 1970 (PL 91-596) shall apply, and the design and operation shall comply with applicable provisions of the Act.

2.6.1. Operating Procedures:

A. An operating manual describing the various tasks that must be performed during a typical shift, as well as safety precautions and procedures, shall be available to employees for reference. Employees shall be instructed as to these tasks and safety precautions and procedures.

B. Safety devices, including but not limited to, roll bars and automatic fire extinguishers shall be provided on all rolling equipment to protect the health and safety of operators.

C. Provision shall be made to extinguish any fires in wastes being delivered to the site or which occur at the working face or within equipment or personnel facilities. Communications equipment shall be available for emergency situations.

D. Scavenging shall be prohibited to avoid injury and to prevent interference with operations.

E. Access to the site shall be controlled and shall be by established roadways only. The sanitary landfill shall be

accessible only when operating personnel are on duty. Large containers may be placed outside the site entrance so that users can deposit waste after hours; they and areas around them shall be maintained in a sanitary and litter-free condition.

F. Traffic signs shall be provided to promote an orderly traffic pattern to and from the discharge area, and if necessary, to restrict access to hazardous areas or to maintain efficient operating conditions. Drivers of manually discharged vehicles shall not hinder operation of mechanically discharged vehicles. No vehicle shall be left unattended at the working face or along traffic routes.

G. Decomposition gases shall not be allowed to concentrate in a manner that will present an explosion hazard.

2.7.0. SITE SELECTION: Site selection and utilization shall comply with local land-use planning and zoning regulations, as well as with Requirement 2.0.1.

2.7.1. Operating Procedures:

A. Site development plans shall be prepared by a professional engineer and shall include:

1. Initial and final topographies at contour intervals of two feet or less;
2. Land use and zoning within 1/4 mile of the site, including location of all residences, buildings, wells, water courses, arroyos, rock outcroppings, roads, and soil or rock borings. All airports within five miles of

the site shall be identified to aid in assessment of the potential hazard of birds to aircraft.

B. Plans shall describe the projected use of the completed sanitary landfill site. In addition to maintenance programs and provisions for monitoring and controlling decomposition gas and leachate, the project plans shall include the following specific ultimate use criteria;

1. Cultivated Area. The major concern if the completed site is to be cultivated is that the integrity of the final cover not be disturbed by agricultural cultivation activities. In this regard, a sufficient depth of cover material to allow cultivation and to support vegetation shall be applied in addition to the minimum specified in Requirement 2.8.1.

2. Structures: If major structures are to be built on or near a completed sanitary landfill, a professional engineer shall design and construct them. The use of battered pilings or preplanned islands of well-compacted or undisturbed soil is strongly recommended. Any materials to be imbedded in the landfill shall be corrosion resistant. Pavements and utility lines shall be able to withstand differential settlement conditions. Decomposition gas controls shall be included in the project plans and specifications.

C. The site shall comply with appropriate Federal, State, or local health, environmental, planning, and solid waste management Agency requirements.

D. Site development shall conform to any existing State, regional, or local solid waste management plans.

E. The hydrogeology of the site shall be evaluated in order to design the site in a manner to protect ground water resources. Unacceptable hydrogeologic conditions may be altered to render the site acceptable, but all alterations must be detailed in the plans.

Precipitation, evapotranspiration, and other climatological conditions shall be considered in the site selection.

F. The site shall be accessible by permanent roads leading from the public road system; temporary roads may be provided as needed to deliver wastes to the working face. All roads to the working face shall be passable regardless of weather.

G. The site shall be so located and operated that it does not attract birds, which could be a hazard to low-flying aircraft.

2.8.0. COVER APPLICATION: A cover of soil shall be applied and compacted over all exposed solid waste by the end of each operating day. A final cover of soil shall be applied and compacted as each area is completed.

2.8.1. Operating Procedures:

A. Plans shall specify:

1. Cover material sources and soil classifications

(Unified Soil Classification System or U. S. Department of Agriculture classification system);

2. Surface grades and side slopes needed to promote maximum runoff, without excessive erosion, to minimize infiltration;

3. Procedures to promote vegetative growth to combat erosion and improve appearance of areas as they are completed or are to remain unused for over nine months;

4. Procedures to maintain cover integrity; e.g., regrading and recovering.

B. Daily cover shall be applied regardless to weather; therefore, sources of cover material shall be accessible regardless of weather.

C. The thickness of the compacted daily cover shall not be less than six inches.

D. The thickness of the compacted final cover shall not be less than two feet.

2.9.0. SOLID WASTES ACCEPTED: Except for the materials mentioned in Requirement 2.10.0., all other solid wastes are acceptable without special handling.

2.9.1. Operating Procedures: Routine sanitary landfill techniques of spreading, compacting, and covering with appropriate material by the end of each working day shall be utilized to dispose of such wastes.

2.10.0. HAZARDOUS AND SPECIAL WASTES: Under no circumstances shall any of the following be accepted for disposal: infectious institutional wastes, bulk liquids, semiliquids, sludges containing free moisture, highly flammable or volatile substances, unexpended

pesticide containers, pesticides, raw animal manure, septic tank pumpings, raw sewage sludge, radioactive materials, and explosives. Certain industrial process wastes may also be prohibited. Some of the wastes that are acceptable may require special handling.

2.10.1. Operating Procedures:

- A. In consultation with appropriate environmental protection agencies, the designer and operator shall determine what specific wastes fall under the unacceptable categories listed above and shall name them in the operating plan. They shall also decide what, if any, industrial process wastes must be prohibited.
- B. Regular users of the facility shall be given a list of the prohibited materials, and it shall also be displayed prominently at the site entrance. If a regular user persists in making unacceptable deliveries, he shall be barred from the installation.
- C. The operating plan shall specify the procedures and precautions to be taken if unacceptable wastes are delivered to the facility or are improperly left there.
- D. Certain bulky wastes, such as automobile bodies, furniture, and appliances shall be crushed on solid ground and then pushed onto the working face near the bottom of the cell or into a separate disposal area. Other bulky items, such as demolition and construction debris, tree stumps, and large timbers, shall be pushed onto the working face near the bottom of the cell or into a separate disposal area; they need not be

compacted. The special areas used only for bulky wastes shall be identified on the final plan of the completed site.

E. Procedures for disposing of dead animals have been established by law in most States, and the operating plan shall comply accordingly. In most cases, small carcasses shall be placed with residential and commercial wastes and covered immediately. Very large carcasses are usually dismembered for easier transport. In the absence of applicable State laws, they shall be placed in a pit and covered with two feet of compacted soil. The soil shall be regraded periodically to keep water from ponding as a result of settlement, which could be appreciable.

F. The criteria used for determining whether an industrial process waste is acceptable include the hydrogeology of the site, the chemical and biological stability of the waste, and the safety of personnel.

D. Dewatered sludges from water treatment plants and digested and dewatered sludges from waste water treatment facilities shall be placed on the working face with other wastes and shall be covered immediately with soil or other solid wastes. The quantities accepted shall be determined by operational problems encountered at the working face.

H. Incinerator and air pollution control residues shall be incorporated into the working face and shall be covered immediately if they are very dry.

I. Expended pesticide containers shall be crushed and disposed of with other solid wastes.

2.11.0. EQUIPMENT: At a minimum, the equipment available shall be capable of spreading and compacting the solid waste and the cover material required for the most severe combination of waste delivery and weather conditions expected during any one operating day.

2.11.1. Operating Procedures:

A. Equipment shall spread the solid waste accepted in layers no more than two feet thick, compact the waste, and place, spread, and compact the cover material. These operations shall be on a working face slope maintained at 3:1 or steeper.

B. Equipment manuals, catalogs, and spare parts lists shall be available at the equipment maintenance facility.

C. Arrangements shall be made and indicated in the plans whereby substitute equipment will be available to provide uninterrupted service during routine maintenance periods or equipment breakdowns.

2.12.0. INSPECTIONS: Responsible environmental protection agencies shall establish and maintain inspection and correction programs for sanitary landfills for which they are responsible.

2.12.1. Operating Procedures:

A. During the first year of operation inspections shall be conducted at least every 30 days; after a year, they shall generally be conducted semiannually.

B. The inspecting agency shall define sample collection and analysis requirements appropriate to the site.

C. The agency's internal inspection reports shall contain at least the following information:

1. Date of inspection, site identification and location, name of inspector and title, types of industries and an estimate of population served.
2. An identification and brief discussion of any operational problems, complaints, or difficulties.
3. Adequacy of operation and performance with regard to applicable requirements and recommendations for corrective actions.
4. Qualitative and/or quantitative evaluation of the aesthetic and environmental impact of the sanitary landfill with regard to the effectiveness of:
 - (a) waste disposal in the areas served;
 - (b) gas and leachate control including;
 - results of leachate sampling conducted on the site perimeter,
 - results of gas sampling and analyses,
 - results of ground and surface water quality analyses upstream and downstream of the site;
 - (c) efforts to control vectors, birds, or other pests;

- (d) air quality control and elimination of open burning practices;
- (e) noise control;
- (f) cover placement;
- (g) dust and litter control.

D. Following each inspection an evaluation of the operation's suitability with respect to these Requirements and applicable standards shall be prepared by the agency's inspecting authority.

E. The completed sanitary landfill shall be inspected by the governmental agency responsible for regulating its proper operation. Following final acceptance, a detailed description, including a plat, shall be recorded with the county's land recording authority. The description shall include general types and location of wastes, depth of fill, and other information of interest to potential land owners.

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