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LEASE OPERATIONS ENVIRONMENTAL GUIDANCE DOCUMENT

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Lease Operations
Environmental Guidance Document

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1. OVERVIEW

This publication, entitled Lease Operations Environmental Guidance Document (herein after referred to as "Document"), has been prepared for the Bureau of Land Management (BLM) as part of a United States Department of Energy (DOE) grant (Grant Number DE-FG26-99BC15036). The intent of this Document is to describe general guidelines, practices and essential components of oil and gas lease operations as they pertain to the protection and restoration of the environment. It is not a regulation or regulatory document and should not be considered such. The basis of the guidance provided in this Document has been obtained mostly from standard industry practices, although some sections outline requirements set forth in 43 CFR Part 3100 Series (Proposed Rules for Onshore Oil and Gas Leasing Operations, Bureau of Land Management, Department of the Interior). The Document contains discussions in nine different areas as follows:

- Good Lease Operating Practices;
- Site Assessment and Sampling;
- Spills/Accidents;
- Containment and Disposal of Produced Waters;
- Restoration of Hydrocarbon Impacted Soils;
- Restoration of Salt Impacted Soils;
- Pit Closures;
- Identification, Removal and Disposal of Naturally Occurring Radioactive Materials (NORM); and
- Site Closure and Construction Methods for Abandoned Wells/Locations.

This Document is primarily directed towards the operation of oil and gas producing wells. It is not the intent of this Document to cover operations of other oil and gas activities such as disposal facilities, bulk storage facilities or gas processing plants. However, some of the practices contained in this Document could be utilized for such

facilities. In addition, this Document is confined to surface equipment and impact and does not cover impact to groundwater beyond removal of possible surface point sources.

The guidelines assume that the reader has knowledge of industry practices and standards as well as local, state, and federal rules and regulations, sampling protocols and sample analysis interpretation. Restoration alternatives for various scenarios are discussed, but due to the many different site conditions that exist and their unique complexity, the appropriate alternative may have to be determined by factors not addressed in this Document. Additionally, there are other requirements such as National Pollution Discharge Elimination System (NPDES) permits that may be applicable but are not covered in this Document. It is difficult to provide absolute guidance as to the proper action, but this Document should provide the reader with a general understanding of common practices associated with oil and gas operations.

2. GOOD LEASE OPERATING PRACTICES

By recognizing and conducting good lease operating practices, leaks and waste from produced fluids can be minimized. Leaks, drips and drops that have the potential to impact soil, surface water and ground water over time due to cumulative effects can be properly managed. Catastrophic events can even be minimized or prevented by attention to equipment conditions. Proper care will have a positive effect on lease operation costs. Good lease operating practices can increase operating income and reduce potentially costly remediation and restoration expenses at some later date.

In any property or facility inspection, regardless of the nature of the review, attention must be given to identify potential point sources of hydrocarbons or produced water coming from active or inactive equipment. Pro-active inspections and preventative maintenance will prevent many minor leaks from becoming major leaks and contributing to a cumulative effect on such media as soil and possibly surface water. Continued minor leaks and spillage also have the possibility of impacting shallow ground water and therefore must be mitigated at the earliest possible point in time.

Areas where an operator or inspector can identify issues that need improvement will be reviewed. Issues involving hydrocarbon or produced salt water leaks should be addressed and repaired as soon as they are noticed. The cost to perform this type of maintenance in a timely manner will benefit the prudent operator. While costs may impact income in the short term, it is far cheaper to make repairs now versus paying for a clean-up that may well cost ten to twenty times more in the future. It is time and money well invested.

Initial inspections may be initiated at any point from the wellhead itself to the production or tank battery. Many leases will have multiple wells producing into a central tank battery; there may be different leases producing into a common pad area with multiple batteries located at that one location. Regardless of where the inspection or review starts, some type of organized plan should be followed and a protocol for consistency and repeatability should be established. A Lease Inspection Summary Form is provided in Appendix B. The form can be modified to suit the operator/inspector/technician conducting the audit.

2.1. Basic Information

A certain level of basic information is required to properly identify the lease. At a minimum, the following basic information should be included in any lease inspection.

- Company name and lease name;
- Location by footage or spot location for well or in the case of a multiple well lease, the central battery;
- County and state;
- Lease operator and telephone number or other means of contact;
- Number of wells on lease;
- Lease production rates in barrels of oil per day (BOPD), thousand cubic feet of gas per day (MCFD), and barrels of water per day (BWD);
- Presence of signs at the entrance, battery, and well(s);
- Fencing location, condition, gate(s), and lock(s);
- Terrain (flat, moderate, steep);
- Adjacent property use (i.e.: wheat field); and
- Soil type and slope.

2.2. Wellhead(s) and Prime Moving Equipment (pumping units)

The condition of the wellhead and prime moving equipment (pumping unit) is the first point that the environment could be exposed to the impact of hydrocarbon and salt water spillage and leaks. It is imperative that necessary attention be given to this area to minimize the potential for impact. In addition to review for the presence of hydrocarbon and salt water impact, safety issues such as security fencing, belt guards, proper electric safeguards, and automatic shut-offs should also be noted. Pumping unit lube oil storage (bulk and small container storage) and waste oil disposal are also

issues to be considered. At a minimum, the following information regarding wellheads and primary moving equipment should be documented during a lease inspection:

- Wellhead size and condition;
- Prime moving equipment size, condition and presence of appropriate security devices; and
- General comments regarding the condition of piping, valves, vents, seals, and flowlines should be noted. Presence of leaks and spillage. If there is any surficial impact from produced hydrocarbons or salt water, the source and extent should be noted and dimensions documented.

2.3. Oil/Condensate Tank(s)

Generally, oil stock tanks are located in a manner that will allow easy access and maintenance. Conditions may be deemed to be good if the tanks are painted and the paint is in good condition, there is little or no rust present, and all screw connections, valves, plates, and the end of the sales load line show no or little evidence of hydrocarbon leaks or spillage. Conditions may be deemed to be fair if the tanks are painted but the paint is weathered, there is minimal rust present, or some of the screw connections, valves, plates, or the end of the sales load line show some evidence of hydrocarbon leaks or spillage. Conditions may be deemed to be poor if the tanks are painted but the paint is in poor condition, the tanks are unpainted, there is rust present, or many of the screw connections, valves, plates, or the end of the sales load line show evidence of hydrocarbon leaks or spillage. It is important to note as much information as is necessary to properly document conditions as this equipment may be the single largest potential source of hydrocarbon impact from the battery. At a minimum, the following information regarding oil/condensate tanks should be documented during a lease inspection:

- Number of tanks and size;
- Condition; and

- General comments regarding the condition of piping, valves, vents, seals, and hatches should be noted. If there is any surficial impact from hydrocarbons, the extent should be noted and dimensions documented.

2.4. Salt Water Tank(s)

Generally, salt water stock tanks are also located in a manner that will allow easy access and maintenance. Conditions may be deemed to be good if the tanks are painted and the paint is in good condition, there is little or no rust present, and all screw connections, valves, plates, and the end of the water load line show no or little evidence of salt water leaks or spillage. Conditions may be deemed to be fair if the tanks are painted but the paint is weathered, there is minimal rust present, or some of the screw connections, valves, plates, or the end of the salt water load line show some evidence of salt water leaks or spillage. Conditions may be deemed to be poor if the tanks are painted but the paint is in poor condition, the tanks are unpainted, there is significant rust and/or corrosion present, or many of the screw connections, valves, plates, or end of the sales load line show evidence of salt water leaks or spillage. It is important to note as much information as is necessary to properly document conditions as this equipment may be the single largest potential source of salt water impact from the battery.

Produced salt water tanks historically have been constructed of steel. Tank design varies somewhat to meet production and disposal needs. As a result, steel salt water tanks come in two primary configurations. They may be closed top or open top. With advances in construction methods and increased awareness of the potential impact of salt water, tanks are now often made of fiberglass. Fiberglass tanks are also available in the two configurations, closed or open top. In those batteries or facilities where open top salt water tanks are utilized, netting is necessary to protect migratory fowl and other protected bird species. It is important to keep netting in good condition and intact whenever it is required. At a minimum, the following information regarding wellheads and primary moving equipment should be documented during a lease inspection:

- Number of tanks and size;
- Condition;

- Type of top;
- Netting condition, if required. Netting conditions may be evaluated based on the following. Good condition: securely in place, no rips or tears; Poor condition: not completely secure, sagging, ripped or torn. If there is an open top tank present and the netting is absent, steps should be taken to correct it immediately; and
- General comments regarding the condition of piping, valves, vents, seals, and hatches should be noted. If there is any surficial impact from produced salt water, the extent should be noted and dimensions documented.

2.5. Production vessels

Due to the nature of oil and gas production facilities, the proper placement of production vessels in relationship to the well and stock tanks can and does vary. The list below includes the most common types of surface process equipment but is in no way intended to be a complete list. The general idea is to document the number of each type of equipment present at the battery, the size and general condition. At a minimum, the following information regarding production vessels should be documented during a lease inspection:

- Separator(s), number of units, size and condition;
- Heater treater(s), number of units, size and condition;
- Production unit(s), number of units, size and condition;
- Compressor(s), number of units, size and condition;
- Circulation pump(s), number of units, size and condition;
- Gunbarrel(s), number of units, size and condition;
- Free water knock-out(s), number of units, size and condition;
- Other production equipment that may be present should be included and listed, with attention to number of units, size and condition; and

- General comments regarding the condition of piping, valves, vents, seals, and hatches should be noted. If there is any surficial impact from hydrocarbons or salt water, the extent should be noted and dimensions documented.

2.6. Containment

Secondary containment (also known as berms, firewalls, or dikes), when properly constructed and maintained, should prevent migration to surface waters of produced hydrocarbons and salt water. Surface impact to soil will be contained and minimized to the area within the containment. Minimal data should be collected to document containment type, condition and wear, erosion, and breaches. There may containment of some type located around the stock tank(s) and process equipment or it may be localized around each equipment grouping. Some operators even build a berm around the wellhead(s) and/or the prime pumping unit(s). At a minimum, the following information regarding containment should be documented during a lease inspection:

- Type of containment. Containment construction can include native dirt, gravel, concrete, corrugated tin with rubber gaskets, etc. There may be a combination of materials and cover;
- Size or dimensions. This includes the length, width and height at the lowest point of the containment. These values can also be used in calculating the volume the containment can hold in the event of an accident or catastrophic event and is required to meet the Spill Prevention, Control and Countermeasure (SPCC) Plan; and
- Condition, including the presence and amount of wear, erosion, breaches, and vegetation.

2.7. Tier III Chemicals

Many leases require the use of chemicals to effectively enhance and maximize production rates. There are certain reporting requirements that have to be met when certain types of chemicals, known as Tier III chemicals, are present on a lease, regardless where they are located (at the battery or at one or more wells). It is prudent

to know what chemicals are located on the lease. At a minimum, the following information regarding Tier III Chemicals should be documented during a lease inspection:

- Chemical present. A Material Safety Data Sheet (MSDS) on all chemicals present at the battery/well(s) should be readily available to any lease operating personnel and should be on file in the closest field office;
- Type of storage. Containers may include five (5) gallon closed top buckets or pails, steel or plastic barrels/drums, and steel or fiberglass tanks;
- Size and condition of containers including rust, corrosion, breaches or leaks, presence or absence of locks on valves of larger containers; and
- Unlabelled chemicals.

2.8. Environmental Concerns

Environmental concerns that should be included in a lease inspection are distance to any surface water and water body type. Water bodies can include but are not limited to any shallow depression, bar ditch, or watercourse likely to hold water or allow water to flow during a storm event, intermittent or permanent streams, farm ponds, flood control ponds and lakes, rivers, and any larger body of water.

Other environmental concerns that should be noted include free standing fluids, presence of earthen pits, denuded areas, stressed or dying vegetation, heavy accumulations of hydrocarbons, presence of asphalt or paraffin constituents, and salt crystals present on the ground. The presence of any moist areas immediately downslope from the facility or battery could be a cause for concern and should be documented as necessary.

3. SITE ASSESSMENT AND SAMPLING

This section contains basic information in assessing a site for impact from oil and gas operations. The information gathered during a site assessment can be used to determine if restoration is needed and to select specific remediation alternatives. An example of a site assessment and sampling is provided in Appendix A. Sample forms

are provided in Appendix B and flowcharts for site assessment and sampling are provided in Appendix C.

3.1. Review published information and regulatory information

The first step in performing a site assessment should include obtaining and reviewing soil, geology, hydrology, climatological data and regulatory information. Much of this information is easily obtained. A Site Data Evaluation Form is presented in Appendix B. This form lists such basic information and should be modified to site specific situations.

3.1.1. Soil Surveys

Soil surveys can provide an abundance of useful information concerning soil properties at the site. This information may include, but is not limited to, texture, permeability, depth to bedrock, erosion factors, slope, drainage, background contaminant concentrations, land uses, favorable vegetation, flooding potential, and depth to water.

3.1.2. Geologic and Hydrologic Atlases

Geologic and hydrologic atlases can provide useful information concerning the geology and hydrology of the area. This information may include, but is not limited to, bedrock type, bedrock properties, depth to bedrock, major aquifers, recharge areas for aquifers, depth to groundwater, groundwater use and quantity, chemical makeup of groundwater, and location of water wells.

3.1.3. Water Well Searches

Many states have agencies that can perform water well searches for specific areas. These searches can provide the location of nearby water wells, depth to groundwater, and subsurface conditions.

3.1.4. Climatological Data

Climatological data may not be site specific, but regional data is usually available. This data can include annual precipitation rates, monthly precipitation rates, and evaporation rates.

3.1.5. Regulatory Constraints

Remediation requirements differ from state to state and may be handled on a case by case basis. Requirements are typically contingent on protecting the environment and

leaving the land in a condition conducive to the intended use. Local, state, and federal rules and regulations should be reviewed carefully to determine acceptable remedial practices and requirements.

3.2. Eliminate Remediation Alternatives

Many times, remediation alternatives can be eliminated based on the information obtained during the review of published and regulatory information. Eliminating unsuitable alternatives early can conserve both time and money.

3.3. On-Site Assessment

A visit to the site is necessary in order to obtain site specific information. The on-site assessment should include verification of the general conditions revealed during the review of published information. During the site visit a site sketch should be drafted to show surface features and proximity to surface waters, roads, residences, water wells, etc. Other information to obtain during an on-site assessment could include surrounding property use, availability of surrounding property for reclamation activities, or active utilities. A basic Site Assessment Form is provided in Appendix B.

3.4. Sampling

The purpose of sampling is to identify if any impact associated with the oil and gas operations is present at the site. If the site has been impacted, the sampling should characterize the impact for restoration design. The objective of sampling is to collect and analyze an appropriate number of samples that will provide the information needed to achieve the purpose of the sampling. More samples do not necessarily mean that better information will be obtained. Often, fewer samples from numerous sampling points (ie. composite samples) provide more useful information concerning the "average" concentration of contaminants in an area.

Basically, there are two types of samples - soil samples and water samples. These samples can either be obtained as grab or composite samples. Composite samples are obtained from multiple intervals/locations and mixed to form one sample. Grab samples are typically obtained from a discrete sampling location. There are many different types of sampling devices available. Some of the most common sampling devices for soil are trowels, augers, and drilling rigs. In the absence of specific sampling tools, shovels,

spades and post-hole diggers can be utilized. Water samples are typically collected with bailers or other specialty devices. Alternative devices may be used for soil and water sampling, but care should be taken to avoid compromising the quality of the collected samples.

Samples can be analyzed at analytical laboratories as well as with field instruments. It should be noted that, field instrument readings may or may not be sufficient to fulfill sampling requirements; however, they can prove beneficial for field screening and can aid in determining the appropriate samples for submission to an analytical laboratory.

Analytical testing parameters vary for different situations. For hydrocarbon impact, the requested analysis could include Total Petroleum Hydrocarbons (TPH), Benzene, Toluene, Ethylbenzene and Total Xylenes (BTEX), Chlorides, and Electrical Conductance (EC). Additional parameters may include Metals or Polyaromatic Hydrocarbons (PAH's). For salt water impact, the analysis could include Chlorides, Total Soluble Salts (TSS), Cation Exchange Capacity (CEC), Sodium Absorption Ratio (SAR), pH, EC, and Exchangeable Sodium Percentage (ESP).

3.4.1. Sampling Procedures

The following are general guidelines for collecting samples and submitting the samples to a laboratory for analysis:

- Determine the number and type of samples to obtain.
- Collect samples with the appropriate sampling device.
- Record pertinent information concerning the samples. This information could include such properties as color, texture, soil type, moisture content, olfactory observations, sample depth, etc. A soil boring log is typically completed when subsurface samples are collected. An example Soil Boring Form is provided in Appendix B.
- Mark the location of the samples on the site sketch.
- Place the sample in appropriate containers with preservatives, if required. Analytical laboratories will usually provide proper containers and preservatives.

- Label the containers with the site name, unique sample number, sample depth, date, sampler's initials/name, and any requested test to be performed.
- Place and pack the samples in appropriate shipping/delivery container and preserve with ice as necessary to comply with proper temperature requirements.
- Complete a chain-of-custody to track samples from collection to the laboratory.
- Decontaminate sampling tools with appropriate detergent/chemicals between individual sampling events and at the conclusion of sampling.
- Deliver the samples to the laboratory with proper chain-of-custody.

4. SPILLS AND ACCIDENTS

Spills and accidents can at times be avoided on leases by following good operating procedures. However, when these events occur, it is imperative to minimize their effects. One of the most critical elements to minimize the effects of spills and accidents is identifying the incident in its early stages. Typically, the more time that passes before incidents are identified, especially spills, then the greater the associated costs are for correcting the problem. Therefore, field personnel associated with the operations of the facility should be aware of any incident that may occur and should always check all aspects of the operations when on site.

At a minimum, the following steps or actions should be followed when an accident or spill has occurred. Reporting requirements for 43 CFR Part 3100 Series are also covered. Additional reporting may be required by local, state and federal rules and regulations. An example incident, sampling forms, and a flowchart are provided in Appendix A, Appendix B and Appendix C, respectively. The course of action for each step will, of course, depend on the specific site situation. Examples are provided to aid the reader for each step.

- Take immediate actions to eliminate the source. This action could include shutting down the well to prevent fluid or gas loss in flowlines, closing the valve on a stock tank to prevent fluid loss, or de-energizing the facility for safety. If for any reason, there is eminent danger associated with the site (fire, H_2S gas, presence of benzene, etc.), then trained emergency response personnel should be contacted to manage the situation.

- Initiate efforts to mitigate and control the effects of the spill or accident. Mitigation could include digging an earthen pit/trench or constructing a dike(s) to catch free liquids.

- Document the spill or accident (See Accident/Spill Report Form, Appendix B). At a minimum, the supplied form should be completed to document pertinent information concerning the incident. Completing the form will also allow the operator to determine if contacting or reporting to the BLM is required. Operators may want to modify the form or create their own form if supplemental information is desired. In

addition to contacting the BLM, other local, state and federal agencies may require notification.

- If required, notify the BLM and other appropriate agencies. The BLM must be notified within 24 hours of identifying an incident if certain conditions exist. These conditions include the following:
    - Release or Fire Consumption of ≥ 500 barrels of fluid or 500 McF of gas;
    - Spill, Venting, or Fire in or near sensitive area (park, recreation site, threatened and endangered species habitat, riparian area, water body, urban or suburban area, etc.);
    - Major, Life-threatening, or Fatal injury; or
    - Loss of Well Control Release of Hazardous Substance reportable under EPA 40 CFR part 302.
- Complete measures to restore damage to the environment and/or equipment and ensure spill or accident does not occur again. These actions are dependent on site-specific factors.
- If required, provide a written report to the BLM within 10 days or other agencies as required. A written report to the BLM is required if any of the conditions outlined above for verbal reporting exist. Additionally, if the spill/accident involved the release of 10 to 100 barrels of liquid, 50 to 500 McF of gas, or a fire that consumed these volumes, a written report must be filed. At a minimum, the report should contain the following information:
    - Description of the facility;
    - Lease name or number;
    - Official contact;
    - When and where the spill/accident occurred;
    - Whether sensitive areas were affected;
    - Direct and indirect causes of the event;
    - Estimated volume of materials discharged or lost;
    - Description of any injuries, damage, or contamination;
    - Response actions to control and clean up spill or accident;
    - Remediation plans;
    - Prevention plans to ensure incident will not occur again; and

    - If required, a Spill Prevention Control and Countermeasure Plan (SPCC) or Contingency Plan.
- Continue to monitor, control, investigate or remediate the effects of the spill or accident until all impacted media has been restored. Provide the BLM and other agencies with reports as requested to document these activities.

5. CONTAINMENT AND DISPOSAL OF PRODUCED WATERS

Containment and disposal of produced water on leases is an important operation. Proper disposal of produced water is required to ensure the protection of the environment and to monitor compliance of disposal facilities with the terms of their permits. The BLM, in conjunction with 43 CFR Part 3100 Series, requires approval of produced water disposal unless one of the following conditions exist:

- It is injected into the same formation from which it is produced as part of an enhanced recovery project approved by the BLM or Bureau of Indian Affairs;
- It is injected into an approved disposal well on the same Federal or Indian lease; or
- It is injected or disposed of in the same well bore and formation from which it is produced.

The BLM will approve the disposal of produced water by several methods. These methods include, but are not limited to, the following:

- Injection into the subsurface;
- Discharge into pits;
- Surface discharge under a National Pollution Discharge Elimination System (NPDES) Permit; or
- Discharge/disposal to a commercial pit or disposal facility.

When choosing a disposal option, the operator must consider several factors. Economics play an important role in the disposal of produced water; however, liability is also a factor that should be considered.

In the event that the selected disposal option is a pit or an NPDES Permit, the liability associated with impact to the environment could be quite costly. Although one of these options may be appropriate, the operator should continue to closely monitor the chemical content of the produced water. A change in the chemical content of the water could substantially impact the environment and ultimately could result in high cleanup

costs. Other factors in determining the disposal option include the amount of fluid produced, the chemical quality of the fluid, the location of existing disposal facilities and/or wells, and the means of transporting the fluid to the facility. Additionally, the practicability of converting an existing well or drilling a new well for subsurface disposal should be evaluated.

The following steps outline 43 CFR Part 3100 Series requirements for the disposal of produced water under BLM. Additional requirements from other local, state and federal agencies may also apply. It is not the intent of this Document to address disposal facilities or disposal wells. Therefore, the following information pertains to BLM requirements for approval of disposal options and does not cover in detail the BLM requirements and processes for constructing disposal wells or pits, converting existing wells for disposal, obtaining NPDES permits, constructing roads or pipelines, or operating disposal facilities. Required forms are in Appendix B and flowcharts for each of the disposal options are presented in Appendix C.

5.1. Disposal facility on non-BLM managed property

- Prepare and submit a Sundry Notice and Report on Wells (SN), Form 3160-5 (see Appendix B), or other filing instruments acceptable to the BLM. The forms should describe the disposal method and location of the disposal facility.
- Provide the BLM with the surface use permits and the disposal facility name/number and permit.
- If a pipeline or a road is constructed to transport the fluid off of the lease but on BLM managed property, then obtain a right-of-way (R/W) authorization in accordance with 43 CFR Part 2800. Include with the SN the construction plans of the pipeline/road following the requirements of 43 CFR Subpart 3145.
- Provide additional information as requested by the BLM as necessary to obtain disposal permit.

5.2. Disposal well on lease or BLM managed property

- Prepare and submit a SN, Form 3160-5 (see Appendix B), or other filing instruments acceptable to the BLM. These forms should describe the disposal method and

location of the disposal facility. Include the location, name/number, and Underground Injection Control (UIC) Permit.

- If a new disposal well is being drilled or an existing well is being converted, then submit an Application for Permit to Drill or Renter (APD), Form 3160-3 (See Appendix B) following the requirements of 43 CFR Part 3145 (Drilling and Additional Well Operations).

- If the new or converted well is off the lease or if a road or pipeline is constructed off the lease but on BLM managed property, then obtain a right-of-way (R/W) authorization in accordance with 43 CFR Part 2800. Include with the SN the construction plans of the pipeline/road following the requirements of 43 CFR Subpart 3145.

- Provide additional information as requested by the BLM as necessary to obtain disposal permit.

5.3. NPDES facility on lease or BLM managed property

- Prepare and submit a SN, Form 3160-5 (see Appendix B), or other filing instruments acceptable to the BLM. The forms should describe the disposal method and location of the disposal facility. Include the location, name/number, NPDES Permit, and supply a current water quality analysis and plans for the surface use from the origin of the produced water to the point of discharge.

- If a new NPDES facility is being constructed, then include the construction plans following the additional well requirements of 43 CFR Subpart 3145 with the SN.

- In the event that a pipeline or a road is constructed to transport the fluid to a facility that is off of the lease but on BLM managed property, then obtain a right-of-way (R/W) authorization according to 43 CFR Part 2800. Include with the SN the construction plans of the pipeline/road following the requirements of 43 CFR Subpart 3145.

- Provide additional information as requested by the BLM as necessary to obtain disposal permit.

- Continue to monitor the chemical quality and quantity of the produced water. If the makeup of the produced water changes to the extent that it no longer satisfies the standards used to obtain the original permit, submit an amended proposal for the BLM's approval.

5.4. Disposal pit on lease or BLM managed property

- Prepare and submit a SN, Form 3160-5 (see Appendix B), or other filing instruments acceptable to the BLM. The forms should describe the disposal method and location of the disposal facility. Additional requirements include submitting the following information:

    - Daily quantity of produced water;
    - Quality of produced water if the average volume is greater than 5 barrels per day;
    - Source of produced water;
    - Emergency contingency plan;
    - Demonstrate adequate storage capacity and stability of the pit and its levees;
    - Provide information to document the ability of the pit to safely contain produced water and associated liquids and solids, and prevent leakage that could impact soil, surface water, ground water and intermittent drainage;
    - Measures to prevent liquid hydrocarbons from entering the pit; and
    - Measures to prevent access by livestock and wildlife including birds (if pit liquids could injure birds).

5.4.1. Additional BLM submittal requirements for lined pits

- Schedule and disposal option for precipitated solids;
- Liner specifications to document impermeability, compatibility with contained liquids/solids, and durability for weather and other conditions of the site; and
- Proposed leak detection system and monitoring plans to adequately detect leaks.

5.4.2. Additional BLM submittal requirements for unlined pits

- Documentation that the produced water is of equal or better quality than existing surface and subsurface water sources and State or Federal water quality standards;

- Beneficial purpose of the pit (irrigation, livestock, wildlife, etc.) and documentation to support the water quality will meet minimum standards for such uses;
- Documentation that the pit will not receive greater than 5 barrels per day of produced water; and
- Documentation that the pit will not degrade the quality of surface water, groundwater, and soils in the area.

- If a new pit is being constructed, include with SN the construction plans following the additional well requirements of 43 CFR Subpart 3145.
- Provide additional information as requested by the BLM as necessary to obtain disposal permit.
- Continue to monitor the chemical quality and quantity of the produced water. If the makeup of the produced water changes to the degree that it no longer satisfies the standards used to obtain the original permit, submit an amended proposal for the BLM's approval.

6. RESTORATION OF SALT-IMPACTED SOILS

Salt impact to soils can result from many situations including, but not limited to, pipeline breaks, pits, tank/vessel failure and spills. Often, salt impact to soil can be limited to the upper horizon if quick response actions are taken to minimize the effects. However, with time the impact can penetrate to depth due to soil properties, volume of source, and other factors. The purpose of this section is to aid in 1) assessing the impact and site conditions, 2) evaluating remediation alternatives, and 3) conducting remediation activities, if necessary.

There are several alternatives for remediating salt-impacted soil. These include, but are not limited to, natural remediation, pond construction, land application, chemical amendment application, burial, road spreading, soil washing, solidification and off-site disposal.

Information gathered during site assessment should be used to determine which alternative or alternatives could be used. Other factors to consider are time constraints, liability, economics, intended land uses, regulatory requirements, community considerations, corporate policies and landowner considerations. Different types of salt impacted soil remediation alternatives are summarized below. An example of a salt impacted soil restoration is included in Appendix A.

6.1. Natural Remediation

Natural remediation is the process of allowing nature to reclaim the area. Natural remediation is typically used in situations where the effects of salt water impact are minimal or where taking action is technically/economically unfeasible or would create more harm than good. Natural remediation could also include the introduction of salt tolerant plants to enhance the environment and/or prevent further erosion. Terracing and other agronomy practices can also be used to prevent erosion in areas too extensively damaged for remediation.

6.2. Pond Construction

Constructing a pond over salt damaged areas can be utilized under certain conditions. This remediation alternative is generally reserved for historical areas where there is natural drainage and the soil profile has been eroded away. Ponds can be a cost-

effective method for restoring impacted areas to beneficial use. Caution should be exercised when constructing a pond to ensure that underlying groundwater will not be adversely impacted and that the water in the pond will meet quality standards for the intended use.

6.3. Land Application

Land application involves spreading salt-impacted soil over an area and incorporating it into the soil so that the final salt concentration is acceptable. Land spreading rates can be calculated by using loading formulas. Care should be taken when determining these values to ensure that the land spreading does not adversely impact the application area.

6.4. Chemical Amendment Application

Chemical amendment application is probably the most utilized remediation alternative for salt-impacted soil. It involves flushing salts from the root zone through the incorporation of amendments. Typical amendments include gypsum or some other form of calcium and organic matter.

The gypsum or calcium is used primarily to displace sodium, and the organic matter improves drainage and permeability of the soil. The quantity or rate of gypsum/calcium to apply can be calculated from the sodium adsorption ratio (SAR) and the exchangeable sodium percentage (ESP). However, most agronomy laboratories can provide this information from the sample analysis. Additional steps may need to be implemented to improve drainage when there is dispersed soil, tight clays, shallow bedrock, confining layers, or a high groundwater table. These steps could include mechanically ripping, chiseling, plowing, or introducing chemicals.

Flushing the salts requires the percolation of water through the impacted area; therefore, moisture is a key factor in this remediation option. The time and success of this option are dependent on the amount of moisture. Therefore, the addition of water or irrigation to the impacted area may have to be performed to achieve satisfactory results.

Additional requirements may include erosion control measures such as terracing or berming. These measures cannot only prevent erosion but can also aid in containing

moisture on the site. Site conditions should be evaluated carefully when considering this option to ensure that conditions are favorable for the success of the amendments.

6.5. Burial

Burial involves burying salt impacted soil at a depth below the root zone. Burial should not be performed if there is any possibility that the action could impact groundwater or surrounding land uses.

6.6. Road Spreading

Road spreading involves spreading salt-impacted soil on lease/county roads and incorporating the soil into the road. Road spreading is not a wide-spread disposal option for salt-impacted soil and should only be used if the material can improve the road and the action will not adversely affect surrounding media.

6.7. Soil Washing

Soil washing usually includes chemical and mechanical washing/flushing of the soil. Soil washing can be performed in situ or by removal and replacement. If performed in situ, a drainage system is usually installed to collect fluid generated during the washing/flushing process. Salts in the soil are removed through fluids during flushing and the fluid is contained and properly disposed off-site.

6.8. Solidification

Solidification is a waste-fixation process intended to immobilize or encapsulate waste constituents in a solidified matrix that prevents soil and groundwater contamination. This process is generally accomplished by adding and mixing a cementing agent such as fly ash to the impacted material. This process usually requires that the operator demonstrate the solidified materials integrity through leachate or other analytical test. Complying with the testing can be difficult. Typically, the solidified matrix is buried on-site in trenches.

6.9. Off-site Disposal

Off-site disposal involves removing, transporting and disposing of the salt-impacted material to an approved off-site disposal facility. Off-site disposal facilities could include landfills, commercial pits, or commercial soil farming facilities. This process is typically

the most expensive of the available disposal options due to transportation and disposal costs and is typically reserved for situations when time is critical and/or possible litigation is likely.

6.10. Steps for Restoration of Salt Impacted Soils

- Gather information concerning the physical characteristics of the site. This information could include such items as soil types, proximity to surface water, slopes, vegetative cover, depth to bedrock, annual precipitation, depth to groundwater, and intended land use.
- Design a sampling plan to determine the physical extent and degree of chemical impact and subsurface conditions. The sampling plan should be sufficient to collect enough information to be able to make an informed decision on the restoration protocol.
- Collect samples in accordance with the sampling plan. The initial plan may have to be modified in the field based on additional information obtained during sampling.
- Evaluate sample analysis and physical characteristics of the site to determine which restoration protocol to use.
- Review local, state and federal rules and regulations to determine if the selected restoration option is allowed. If required, submit a restoration plan with sample analysis to the appropriate regulatory agency for approval.
- If the restoration option requires additional land use, obtain approval from the surface owner.
- Proceed with restoration (See Section 10, Reclamation and Construction Methods for Oil and Gas Operations).

7. RESTORATION OF HYDROCARBON IMPACTED SOILS

Hydrocarbon impact to soils can result from many situations including, but not limited to, pipeline breaks, pits, tank/vessel failure and spills to name a few. Many times hydrocarbon impact to soil is limited to the upper horizon, but can penetrate to depth due to soil properties, source volume, time, and other factors. The purpose of this section is to aid in 1) assessing the impact and site conditions, 2) evaluating remediation alternatives, and 3) conducting remediation activities.

There are several alternatives for remediating hydrocarbon-impacted soil. They include, but are not limited to, land application, natural attenuation, bioremediation, dilution burial, road spreading, solidification and off-site disposal.

Information obtained during a site assessment should be used to determine which alternative or alternatives could be utilized. Other factors to consider are time constraints, liability, economics, intended land uses, regulatory requirements, community considerations, corporate policies and landowner considerations. The different types of hydrocarbon impacted soil remediation alternatives are summarized below. An example of a hydrocarbon restoration is provided in Appendix A.

7.1. Natural Attenuation

Natural attenuation involves remediation of the impacted soil by allowing nature to recover on its own with negligible to minimal input from humans. Natural attenuation is accomplished through decomposition of the hydrocarbons by soil microbes (biodegradation). Factors that affect the rate of decomposition include, but are not limited to, soil moisture, aeration, and available nutrients. Natural attenuation can be augmented by various activities including disking the soil to increase the aeration and moisture content. Natural attenuation is typically used when the hydrocarbon impact is minimal and is confined to the surface or near surface soil.

7.2. Land Application

Land application involves rendering the impacted soil harmless or reducing the chemical constituents to acceptable concentrations through dilution, chemical alteration and biodegradation mechanisms. This is accomplished by dispersing and incorporating the impacted soil over an area. The size of the area to apply the impacted soil is dictated

by the chemical composition of the area and the impacted material. Loading formulas can be used to determine the volume per acre to disperse the impacted material. The impacted material is typically spread at depths usually no greater than one (1) inch and incorporated in the top six (6) inches of soil. Caution should be exercised when land applying hydrocarbon impacted material. Additional analysis may be required on the impacted soil to ensure that no other chemicals are present which could result in damage to the surface soil on which the impacted soil is being applied. Many times highly saline conditions are present in hydrocarbon impacted areas. Introducing saline conditions could render the area where the material is being applied unfit for its intended use. Land application is typically used when there is a sufficient area available to accommodate the volume of impacted material. The area should be relatively flat, not in close proximity to surface waters, and the operation should not affect the current or future use of the land. Landowner approval should be obtained prior to performing any land application activities.

7.3. Bioremediation

Bioremediation utilizes biodegradation as stated above and involves the decomposition of hydrocarbons by soil microbes. The difference between natural attenuation and bioremediation is that bioremediation typically involves human enhancement. This enhancement can include disking the material, adding fertilizer or organic matter, applying moisture, or even introducing additional microbes. The human enhancement will generally reduce the time required to achieve the desired results. Treatment cells are often constructed when bioremediation is used. These cells are normally bermed to prohibit any contaminants mitigating from the cell and in extreme cases, it may be required to line the cells with an impermeable liner. The cell berms are typically constructed with topsoil from within the cell and used to top dress the cell when final closure is achieved. In-situ bioremediation can also be performed. When hydrocarbon impact extends into the subsurface, in-situ bioremediation will typically be enhanced by creating an environment in the subsurface conducive for microbial action. This enhancement can include the introduction of microbes, oxygen, moisture, or a combination of these factors. Bioremediation normally requires less space than land application because the depth of hydrocarbon impacted material in the cells can be

much greater, or the impact can be left in place if the in-situ method is chosen. Bioremediation usually requires maintenance which may include disking, incorporating organic material or fertilizer, and monitoring cells, or maintenance and monitoring of the in-situ system. Bioremediation can be used when the available land for land spreading is not available or the chemical composition of the impacted material is too high for land application.

7.4. Dilution Burial

Dilution burial involves mixing the hydrocarbon impacted soil with adjacent soil to reduce the constituents to acceptable levels. The resultant waste/soil mix is then buried in trenches below the root zone. Once the mix is buried in the trench, the biodegradation mechanisms are restricted due to the anoxic environment. Therefore, dilution burial should not be considered unless the resulting mixture contains very low levels of hydrocarbons. Dilution burial may be used in situations where the hydrocarbon impact is minimal and surrounding land use is limited.

7.5. Road Spreading

Road spreading involves blending hydrocarbon impacted soil with road oil or road mixes and spreading the mixture as road material or directly incorporating the material into the road surface. The primary limitations for using hydrocarbon impacted material for road spreading are the salt content and the stability of the hydrocarbons within the matrix to ensure that there is no adverse impact to the environment during stormwater runoff events. Weathered crude oil with large asphaltic fractions are ideally suited for road spreading. Local, state and federal regulations should be reviewed to determine if road spreading is allowed.

7.6. Solidification

Solidification is a waste-fixation process intended to immobilize or encapsulate waste constituents in a solidified matrix that prevents soil and groundwater contamination. This process is generally accomplished by adding and mixing a cementing agent such as fly ash to the impacted material. This process usually requires that the operator demonstrate the solidified materials integrity through a leachate or other analytical test.

Complying with the test can be difficult. The solidified matrix is typically buried on-site in trenches.

7.7. Off-site Disposal

Off-site disposal involves removing, transporting and disposing of the hydrocarbon impacted material to an approved off-site disposal facility. Off-site disposal facilities could include landfills, commercial pits, or commercial soil farming facilities. This process is typically the most expensive of the available disposal options due to transportation and disposal costs and is typically reserved for situations when time is critical and/or possible litigation is likely.

7.8. Steps for Restoration of Hydrocarbon Impacted Soils

- Gather information concerning the physical characteristics of the site. This information could include such things as soil types, proximity to surface water, slopes, vegetative cover, depth to bedrock, depth to groundwater, and intended land use.
- Design a sampling plan to determine the physical extent and degree of chemical impact. The sampling plan should be sufficient to collect enough information to be able to make an informed decision on the restoration protocol.
- Collect samples in accordance with the sampling plan. The initial plan may have to be modified in the field based on additional information obtained during sampling.
- Evaluate the sample analysis and physical characteristics of the site and determine which restoration protocol to perform.
- Review local, state and federal rules and regulations to determine if the selected restoration option is permitted. If required, submit the restoration plan with sample analysis to the appropriate regulatory agency for approval.
- If the restoration option requires additional land use, obtain approval from surface owner.
- Proceed with restoration (See Section 10, Reclamation and Construction Methods for Oil and Gas Operations).

8. PIT CLOSURE

Although research indicates that reserve pit wastes produced during oil and gas drilling operations is usually non-hazardous in terms of toxicity, management and closure of pits should be performed in a manner that prohibits impact to intended land uses, land resources and water resources. Constituents of concern that are typically associated with pits include but are not limited to chlorides, hydrocarbons, and metals. The physical structure of pits, or lack thereof, can be the principal limitation in closure.

When using pits, the introduction of chemicals, waste oils and other hazardous waste should be eliminated. Even small quantities of these chemicals can effect the chemical makeup of the entire contents of the pit and substantially increase disposal costs. Even introducing highly saline produced water to a fresh water mud system could result in the off-site disposal of the entire pit contents.

Pit closure typically involves three phases. The first phase includes dewatering and/or removal or pit liquids. The second phase involves addressing the pit solids and the third phase involves closure of the pit. Alternatives for these three phases are discussed below. A pit closure example is provided in Appendix A and a flowchart is provided in Appendix C.

8.1. Fluid Disposal

The first step in pit closure should be the disposal of any free liquids. Proper disposal of the liquids should begin with obtaining representative samples to accurately characterize the fluid. Results of the sampling and local, state and federal regulations should be reviewed to determine an appropriate fluid disposal option. Actions to eliminate fluids such as aeration should be performed prior to disposal. If timing is not an issue, fluid disposal should be performed during hot, dry periods when the fluid levels are low. A few of the most common fluid disposal options are discharge, land application, and off-site disposal. These options are discussed below.

8.1.1. Discharge

Discharge of pit liquids is allowed under certain circumstances in some states. Permits from appropriate regulatory agencies are normally required for discharge. The liquids

will typically have to meet water quality criteria before discharging is allowed. In some instances, the water can be treated on-site to meet these water quality criteria.

8.1.2. Land Application

Land application involves dispersing the fluid over an area. The size of the area to apply the fluid is dictated by its chemical composition and the chemical composition of the fluid. Appropriate loading formulas should be used to determine the volume per acre to disperse the fluid. Caution should be exercised when land applying pit fluids. Additional analysis may be required on the fluid to ensure that no other chemicals are present which could cause serious damage to the area that the fluid is being applied. Introducing saline conditions could render the application area unfit for its intended use. Land application is typically performed when there is a sufficient area available to accommodate the volume of fluid. The area should be relatively flat, not in close proximity to surface waters, and the operation should not affect the current or future use of the land. Landowner approval should also be received prior to the performance of land application.

8.1.3. Off-Site Disposal

Off-site disposal involves removing and disposing the fluid to an approved off-site disposal facility. Off-site disposal facilities could include commercial pits, commercial disposal facilities, or injection wells. This option is typically the most expensive of the available disposal options due to transportation and disposal costs.

8.2. Solids Disposal

After liquid disposal or dewatering, the next step is to address pit solids. The majority of pit solids are normally drill cuttings, bentonite clay and barite. As with the pit liquids, the pit solids should be sampled to characterize their makeup. Local, state and federal rules and regulations should be reviewed to determine whether solids removal and disposal and/or restoration is required and the options that are permitted. Salt and/or hydrocarbon concentrations can dictate the need or requirement for addressing pit solids. Remediation options for pit solids are similar to those outlined for salt and hydrocarbon impact and include, but are not limited to, land application, burial, road

spreading, solidification and off-site disposal. These options are discussed in more detail below:

8.2.1. Land Application

Land application involves dispersing and incorporating the pit solids over an area. The size of the area to apply the material is dictated by the chemical composition of the area and the material. Loading formulas can be used to determine the volume per acre to disperse the material. The material is typically spread at depths usually no greater than one (1) inch and incorporated in the top six (6) inches of soil. Caution should be exercised when land applying pit solids. Additional analysis may be required on the material to ensure that no other chemicals are present which could result in damage to the surface soil on which the material is being applied. Highly saline conditions can be present in pit solids. Introducing saline conditions could render the area where the material is being applied unfit for its intended use. Land application is typically used when there is a sufficient area available to accommodate the volume of material. The area should be relatively flat, not in close proximity to surface waters, and the operation should not affect the current or future use of the land. Landowner approval should be obtained prior to performing any land application activities.

8.2.2. Dilution Burial

Dilution burial involves mixing the pit solids soil with adjacent soil to reduce the constituents to acceptable levels. The resultant mix is then buried in trenches below the root zone.

8.2.3. Road Spreading

Road spreading involves blending the pit solids with road oil or road mixes and spreading the mixture as road material or directly incorporating the material into the road surface. Limitations for using pit solids for road spreading are the salt content and the stability of any hydrocarbons within the matrix to ensure that there is no adverse impact to the environment during stormwater runoff events. Additionally, the clay content of the solids needs to be such that the material is suitable for road material. Local, state and federal regulations should be reviewed to determine if road spreading is allowed.

8.2.4. Solidification

Solidification is a waste-fixation process intended to immobilize or encapsulate waste constituents in a solidified matrix that prevents soil and groundwater contamination. This process is generally accomplished by adding and mixing a cementing agent such as fly ash to the pit solids. This process usually requires that the operator demonstrate the solidified materials integrity through a leachate or other analytical test. Complying with the test can be difficult. The solidified matrix is typically buried on-site in trenches.

8.2.5. Off-Site Disposal

Off-site disposal involves removing, transporting and disposing of the pit solids to an approved off-site disposal facility. Off-site disposal facilities could include landfills, commercial pits, or commercial soil farming facilities. This process is typically the most expensive of the available disposal options due to transportation and disposal costs and is typically reserved for situations when time is critical and/or possible litigation is likely.

8.3. Final Pit Closure

If pit solids are at acceptable regulatory levels, the most common closure techniques are in-place closure and trenching. If pit solids are removed due to regulatory constraints or other factors, then typically in-place closure is performed. These options are discussed in more detail below.

8.3.1. In-Place Closure

In some areas, closing a pit in place after dewatering is an acceptable practice. This action typically involves pushing the berms of the pit over the pit contents, compacting the surface, and revegetating the area.

8.3.2. Dilution Burial/Trenching

Dilution burial/trenching involves burying and/or mixing the pit solids with soil and burying the mixture. The material is typically buried in trenches below the root zone. This option is typically performed when there is not a chemical issue with the pit solids, but there is a structural issue due to the clay content and the volume of pit solids does not allow for in place closure.

8.4. Steps for Pit Closure

- Gather information concerning the physical characteristics of the site. This information could include such items as soil types, proximity to surface water, slopes, vegetative cover, depth to bedrock, depth to groundwater, and intended land use.
- Collect representative samples of any pit liquids.
- Evaluate the analytical results and review local, state and federal rules and regulations to determine the proper liquid disposal option.
- Dispose of liquids (See Section 10, Reclamation and Construction Methods for Oil and Gas Operations).
- Collect representative samples of pit solids.
- Evaluate the analytical results and review local, state and federal rules and regulations to determine the proper disposal option for pit solids.
- Remove, dispose and/or treat pit solids as required (See Section 10, Reclamation and Construction Methods for Oil and Gas Operations).
- Proceed with pit closure (See Section 10, Reclamation and Construction Methods for Oil and Gas Operations).

9. IDENTIFICATION, REMOVAL AND DISPOSAL OF NORM

Some underground formations in which oil and natural gas are originally located contain small concentrations of radium and other radioactive materials. These radioactive materials are slightly soluble in the presence of chlorides. The material can be transported to the surface by produced fluids and the radionuclides may be deposited in scale or sludge on the internal surfaces of tubing, surface piping, vessels, and other equipment. This material is referred to as Naturally Occurring Radioactive Material (NORM). A typical definition of NORM by regulatory agencies is "a naturally occurring material not regulated under the Atomic Energy Act whose radionuclide concentrations have been increased as a result of human practices."

NORM generated in oil and gas operations emits two types of radiation which are of concern as follows:

- Alpha particles travel a short distance and can be blocked by a piece of paper or the upper layers of skin. This property makes alpha radiation essentially non-hazardous when NORM is contained within equipment. However, if NORM in loose scale dust is inhaled or ingested, alpha radiation can pose a threat to internal organs.

- Gamma rays are a form of energy similar to X-rays used by physicians and dentists. They are capable of penetrating the walls of oil field equipment. Fortunately, most NORM in oil field equipment has a low level of radioactivity and the resulting gamma ray emissions are not harmful to workers that are near the equipment. It is gamma radiation that is usually surveyed to detect the presence of NORM within equipment.

9.1. Identification and Sampling

NORM-contaminated equipment may be present on some oil and gas properties. The external surfaces of all equipment should be surveyed to detect the presence of NORM. Surveys may be conducted with hand held instruments, capable of measuring up to 2000 microroentgens per hour. The most common instruments include sodium iodide scintillation, gamma scintillation, alpha scintillation, geiger muller or energy compensated GM devices. The instruments should be calibrated at least annually with a Cesium 137 or Radium 226 standard. Surveyors should be properly trained in the use of the survey instrument. Equipment surveys should be conducted with the detector or

hand held probe at a distance of no greater than one centimeter from the external surface of the equipment.

When working with equipment or where scale dust is likely to be present or generated, minimum worker safety precautions should be observed. Appropriate clothing and at least an air purifying respirator should be worn in these conditions.

9.2. Removal and Disposal

The level that requires special requirements for removal and disposal of NORM-contaminated equipment and scale/sludge varies. Local, state and federal rules and regulations should be reviewed to determine these levels.

9.2.1. Equipment

In order to restore these properties, NORM-contaminated equipment should be removed or disposed. Some cost-effective options currently available are as follows (subject to local, state and federal rules and regulations):

- Sell as scrap for recycling. The purchaser should be informed of the presence of NORM in the equipment.
- Transfer to persons who intend to use the equipment for the original purpose for which it was designed. The transferee should be informed of the presence of NORM in the equipment.
- Bury on the property where it was located at a minimum depth to allow for a minimum of three feet of compacted cover, subject to written approval of the landowner.

Under no circumstances should NORM-contaminated equipment be donated for unrestricted use to any organization (including but not limited to a community, school, church or other public organization) or individual.

9.2.2. Scale or Sludge

NORM-contaminated scale or sludge should be handled, moved or stored so that loose radioactive material cannot escape into the environment. Such material may be

disposed by the following methods, subject to local, state, and federal rules and regulations.

- Burial or land application, subject to approval of the landowner. The NORM-contaminated material should be blended with uncontaminated soil or material so that post-burial or post-landfarming measurements at the surface do not exceed specified levels.
- Placement in the wellbore of a well being plugged.
- Disposal to a commercial disposal site that is approved for disposal of NORM.

10. RECLAMATION AND CONSTRUCTION METHODS FOR OIL AND GAS OPERATIONS

This section contains guidelines and steps to reclaim, restore and remediate the impact from oil and gas operations. Prior to performing any of these tasks, local, state and federal rules and regulations should be reviewed to determine if the methods are permitted for the individual situations. All required forms should be completed and permits/approvals should be obtained. All activities should be documented and copies of all the required documentation should be retained in the project file of record. Some of the methods are very specialized and require specialty companies/personnel to perform the operations. Therefore, the Scope of Work to perform these activities is not detailed. Flowcharts for selected activities are provided in Appendix C.

10.1. Health and Safety

- All restoration activities should comply with all applicable health & safety regulations, including but not limited to those covered under the Occupational Safety and Health Administration (OSHA).

10.2. Active Utilities

10.2.1. Identification and Notification For Active Utilities

- Locate and identify all utilities prior to initiating any reclamation work.
- Notify the appropriate line locator service to identify all active subsurface utilities and/or pipelines.
- Take actions to identify and notify all other utility or pipeline/flowline owners/operators in the site vicinity that are not subscribers to the line locator services.
- Identify all above-ground utilities and/or pipelines within the work area(s). Assume that any above-ground electrical lines and/or other utilities in the work area(s) are energized.
- Take appropriate precautions to ensure worker safety and avoid damaging any utilities.

10.2.2. Damage To Active Utilities

- Take appropriate precautions and measures to contain any spills and minimize impact to surrounding media.
- Contact the owner/operator of the utility.
- Contact qualified personnel to de-energize or shut-off the utility.
- Restore any impact caused by damaging active utilities or pipelines in compliance with applicable laws, rules and regulations.

10.3. Removal of Abandoned Flowlines

- Remove and contain any residual product.
- Purge or clean lines as necessary to remove any additional product.
- Dispose or recycle any fluid/product in accordance with applicable rules and regulations.
- Remove all exposed abandoned flowlines.
- At a minimum, remove all abandoned buried flowlines to the point that the burial depth is sufficient to not interfere with the intended land use. Leaving buried flowlines can carry liability and accordingly removal of all buried flowlines should be considered.
- Cap all flowlines that are cut and left in place with either a welded or threaded cap or plug.
- Dispose or recycle all removed flowline material in accordance with applicable rules and regulations. Obtain waste manifests for all disposed material.
- Grade all disturbed areas with soil from the immediate surrounding area to blend with the existing terrain.
- Plant the disturbed area in cover that is consistent with the intended land use.

10.4. Concrete and Gravel Restoration

10.4.1. Concrete and Gravel Removal and Burial

- Excavate a grave sufficient to allow a burial depth a minimum of 3 feet below final grade or as dictated by regulatory agencies.
- Place concrete or gravel in the grave.
- Backfill any voids created during removal and cover the buried material. Backfilling and covering should be performed in 6 to 12 inch lifts, compacting between lifts.
- Grade the disturbed areas with soil from the immediate surrounding area to blend with the existing terrain.
- Plant the disturbed area in cover that is consistent with the intended land use.

10.4.2. Concrete and Gravel Removal and Off-Site Disposal

- Excavate the concrete or gravel.
- Remove and transport the excavated material to an appropriate disposal facility/location or reclaimer/recycler.
- Backfill the void created during removal with suitable material in 6 to 12 inch lifts, compacting between lifts.
- Grade the areas disturbed during removal and backfilling with soil from the immediate surrounding area to blend with the existing terrain.
- Plant the disturbed area in cover that is consistent with the intended land use.

10.4.3. Concrete Removal for On-Site Erosion Control

On-site disposal of concrete structures for erosion control should only be considered under special circumstances. Although many surface owners believe that placing concrete in eroded areas will prevent further erosion, many times this action can actually create additional problems. If on-site disposal for erosion control is chosen, local Natural Resources and Conservation Service (NRCS) personnel or other qualified personnel should be contacted to determine if this option is appropriate. At a minimum, the following steps should be taken:

- Remove and break the concrete into appropriate pieces. Contact local NRCS or qualified personnel to determine the appropriate size in which to break the concrete.
- Place concrete as appropriate in eroded areas.
- Backfill the void from concrete removal with suitable material in 6 to 12 inch lifts, compacting between lifts.
- Grade the areas disturbed during concrete removal with soil from the immediate surrounding area to blend with the existing terrain.
- Plant the disturbed area in cover that is consistent with the intended land use.

10.5. Debris Restoration

10.5.1. Debris Removal and Disposal

- Remove all miscellaneous debris and/or abandoned materials.
- Remove trees, stumps, and brush only as necessary to restore the location to its original condition. Trees and stumps should be removed to a minimum depth of 12 inches below the final grade.
- Dispose debris in an approved/permitted disposal facility or at a reclaimer/recycler in accordance with applicable rules and regulations. Obtain waste manifests for all disposed material.
- Grade all disturbed areas with soil from the immediate surrounding area to blend with the existing terrain.
- Plant the disturbed area in cover that is consistent with the intended land use.

10.5.2. Debris Removal and Burning

- Burning should be performed in accordance with all applicable laws and ordinances.
- Obtain any required permits.
- Prepare a contingency plan to address emergency procedures in the event burning gets out of control.
- Provide constant oversight by qualified personnel.

- Burn at times and in a manner that the surrounding vegetation and other adjacent property is not be jeopardized.
- Bury or land spread residue/ash remaining after burning. Bury at a depth adequate to provide a minimum of 3 feet of compacted cover over all sections of the buried material or disperse and disk/till the material into the soil in a manner that incorporates the material in the top six inches.
- Grade all disturbed areas with soil from the immediate surrounding area to blend with the existing terrain.
- Plant the disturbed area in cover that is consistent with the intended land use.

10.5.3. Anchor Removal and Disposal

- Remove all dead-man, expanding, helical or any other type of guy-wire anchors.
- Dispose the anchor material in an approved/permitted disposal facility or at a reclaimer/recycler in accordance with applicable rules and regulations. Obtain waste manifests for all disposed material.
- Grade the disturbed areas with soil from the immediate surrounding area to blend with the existing terrain.
- Plant the disturbed area in cover that is consistent with the intended land use.

10.6. Lease Road And Pad Restoration

- Remove and dispose the surface material.
- Rip and cross rip the area to sufficiently break up the soil to a minimum depth of 12 inches below the existing grade. The distance between rippers should not exceed 30 inches. Precautions should be taken to rip only the defined areas not disturb the surrounding areas.
- Grade all disturbed areas with soil from the immediate surrounding area to blend with the existing terrain.
- Plant the disturbed area in cover that is consistent with the intended land use.

10.7. Tank, Equipment and Vessel Removal And Disposal

- Remove all contents from the equipment.
- Purge, flush and clean all equipment to remove any residual product.
- Reclaim, recycle or dispose the equipment, contents and any material generated during the cleaning process in accordance with applicable local, state, and federal laws, rules and regulations.
- Obtain waste manifest for all disposed material.
- Obtain/follow appropriate permits, notifications, and rules or regulations including but not limited to Department of Transportation (DOT) requirement when transporting equipment or contents off-site.
- Grade all disturbed areas with soil from the immediate surrounding area to blend with the existing terrain.
- Plant the disturbed area in cover that is consistent with the intended land use.

10.8. Salt Impacted Soil Restoration

10.8.1. Chemical Amendment Application to Salt Impacted Soils

Chemical application can involve the use of common amendments such as gypsum and organic matter, or it can involve the use of specialty chemicals. If specialty chemicals are chosen then an appropriate firm should be contracted to perform the application. These firms will usually provide all of the sampling, design, agency approvals, construction, monitoring, and final closure. If common amendments are chosen, the following steps should be taken.

- Grade the area along contour lines to mitigate overland flow during the restoration process. Grade banks of the area to a maximum slope of 4:1 and blend with the existing terrain.
- Install berms, terraces or siltation barriers as necessary to prevent erosion and allow moisture to be retained on the impacted area.

- Apply gypsum or other calcium sources. Determine the appropriate volume based on analytical results.
- Apply organic matter at the rate of 20 to 30 tons per acre. Organic matter could include, but is not limited to manure, straw, hay, tree and/or leaf mulch, or peanut hulls. Do not apply any organic material that may introduce vegetation that is inconsistent with the intended land use.
- Disk or till the soil in such a manner as to distribute the amendments evenly through the top six (6) inches of soil.
- Install a fence as necessary around the perimeter of the impacted area to deter entry by livestock or wildlife.
- Apply water as necessary to the area (Moisture is a key factor in treating salt-impacted soil with amendments. Berming of the cell will aid in keeping the area moist, but during dry spells, adding water will enhance the process).
- Collect samples periodically to monitor the progress.
- Add additional gypsum (calcium) and organic material as dictated by analytical results.
- Continue sampling and maintaining the impacted area until the analytical results are at acceptable levels.
- When sampling indicates that the area is at acceptable levels, plant the disturbed area in cover that is consistent with the intended land use.

10.8.2. Burial of Salt Impacted Soils

- Excavate the salt impacted soil and stockpile the material.
- Collect samples from the base of the excavated area(s) to document the removal of the impacted material.
- Continue excavating until analytical results are at acceptable levels or the desired depth is reached.

- Excavate trenches. The volume of material to be buried will dictate the size and depth of the trenches (The bottom of the trenches should be a safe distance above groundwater and allow for a minimum of 5 feet of compacted cover over the buried material, or as regulatory constraints dictate.).
- Place the excavated material into the trenches.
- Backfill any voids created from removal and cover the mixture in the trenches. Excess material from the trenches can be used to backfill the voids created during excavation. The voids should be filled in approximately 6 to 12 inch lifts and compacted before applying the next lift.
- Grade the areas disturbed during removal and burial with soil from the immediate surrounding area to blend with the existing terrain.
- Plant the disturbed area in cover that is consistent with the intended land use.

10.8.3. Road Spreading of Salt Impacted Soils

- Excavate the salt impacted soil and stockpile the material.
- Collect samples from the base of the excavated area(s) to document the removal of the impacted material.
- Continue excavating until analytical results are at acceptable levels or desired depth.
- Backfill any voids created from soil removal with suitable material. The voids should be filled in approximately 6 to 12 inch lifts and compacted before applying the next lift.
- Grade the areas disturbed during removal with soil from the immediate surrounding area to blend with the existing terrain.
- Plant disturbed area in cover consistent with the intended land use.
- Apply the excavated material to the lease roads or county roads in accordance with local, state or federal rules and regulations. The material should be applied in a manner that pollution of surface or subsurface waters will not occur and surrounding

property will be protected. The material should not be applied where water collects and stands. Care should be taken to prevent runoff to borrow ditches or adjacent areas.

10.8.4. Soil Washing of Salt Impacted Soils

Soil washing can be performed in situ or by removal and replacement. If one of these options is chosen, a specialty company should be contracted to perform the restoration. These firms will usually provide all of the sampling, design, agency approvals, construction, monitoring, and final closure.

10.8.5. Solidification and Burial of Salt Impacted Soils

- Excavate the salt impacted soil and stockpile the material.
- Collect samples from the base of the excavated area(s) to document the removal of the impacted material.
- Continue excavation until sample results are at acceptable levels or the desired depth is reached.
- Excavate trenches. The size and depth of the trenches will be dictated by the volume of salt impacted soil to be solidified. (The bottom of the trenches should be a safe distance above groundwater and allow for a minimum of 5 feet of compacted cover over the buried material, or as regulatory constraints dictate.).
- Solidify impacted soil by mixing with fly ash or other cementing material.
- Sample the solidified material to document physical and chemical properties.
- Place the solidified mixture into the trenches.
- Backfill any voids created from removal and cover the mixture in the trenches. Excess material from the trenches can be used to backfill the voids created during excavation. The voids should be filled in approximately 6 to 12 inch lifts and compacted before applying the next lift.
- Grade the areas disturbed during removal and burial with soil from the immediate surrounding area to blend with the existing terrain.

- Plant the disturbed area in cover that is consistent with the intended land use.

10.8.6. Off-Site disposal of Salt Impacted Soils

- Excavate the salt impacted soil and stockpile the material.
- Collect samples from the base of the excavated area(s) to document the removal of the impacted material.
- Continue excavation until sample results are at acceptable levels or desired depth is reached.
- Collect sample from excavated material and provide to disposal facility for approval.
- Transport and dispose material at appropriate facility. Obtain manifests for disposed material.
- Backfill any voids created from removal with suitable material. The voids should be filled in approximately 6 to 12 inch lifts and compacted before applying the next lift.
- Grade the areas disturbed during removal with soil from the immediate surrounding area to blend with the existing terrain.
- Plant the disturbed area in cover that is consistent with the intended land use.

10.9. Hydrocarbon Impacted Soil Restoration

10.9.1. Natural Attenuation of Hydrocarbons

Although natural attenuation will occur in the absence of human intervention, the following steps will aid in reducing the restoration time.

- Disk or till the area of impact to a depth of six inches.
- Apply 160 lbs/acre nitrogen and 40 lbs/acre potassium and phosphorus.

10.9.2. Surficial Asphaltic Weathered Hydrocarbon Dispersal

- Remove surficial asphaltic weathered hydrocarbons.
- Break up and disperse the hydrocarbons evenly over the location being restored.

- Disk or till the area to mix the hydrocarbons evenly through the top six (6) inches of soil.

10.9.3. Land Application of Hydrocarbons

- Collect and evaluate samples of the hydrocarbons and the background areas being utilized for land application.
- Determine the size of the area to apply hydrocarbons. Use loading formulas to calculate the size of the area.
- Excavate the hydrocarbons and hydrocarbon impacted soil and stockpile the material.
- Collect samples from the base of the excavated area(s) to document the removal of the impacted material.
- Continue excavating until analytical results are at acceptable levels.
- Backfill any voids created from hydrocarbon removal with suitable material. The voids should be filled in approximately 6 to 12 inch lifts and compacted before applying the next lift.
- Grade the areas disturbed during hydrocarbon removal with soil from the immediate surrounding area to blend with the existing terrain.
- Plant the disturbed area in cover that is consistent with the intended land use.
- Spread the excavated material and fertilizer over the land application area. Fertilizer should be composed of nitrogen, potassium, and phosphorus.
- Disk or till the area in such a manner as to distribute the material evenly throughout the area.
- Plant the disturbed area in cover that is consistent with the intended land use.

10.9.4. Bioremediation of Hydrocarbons with a Treatment Cell

Local, state and federal rules and regulations should be reviewed to determine any limiting site factors for bioremediation. Generally, the bioremediation cell should be

constructed in an area that is relatively flat (less than 5% slope). The base of the cell should be 20 to 30 feet above the water table unless there is a confining layer between the bottom of the cell and the water table. The confining layer could be either shale or a minimum of 12 inches of either loam, silt loam, silt, sandy clay loam, silty clay loam, clay loam, sandy clay silty clay, or clay. If a confining layer is present, the base of the cell should be a minimum of 10 feet above the water table. The base of the cell should be a minimum of 2 feet above bedrock and the cell should be a minimum of 100 feet from surface water. Impermeable liners should be utilized in situations where site conditions warrant.

- Determine the size of the cell. The size of the cell is dictated by the volume of impacted material to be bioremediated. Generally, the thicker the material applied to the cell, the longer the remediation time and more maintenance that is required. If the material is to be applied at depth of 4 inches, then for every cubic yard of material, the cell should have a surface area of 81 square feet (ie. 1000 yards of material would require a cell of 81,000 square feet or approximately 2 acres).

- Excavate the topsoil within the cell and use the topsoil to construct an earthen berm around the perimeter of the cell. The berm should be a minimum of 3 feet in height and 3 feet in width. The side slopes of the berm should be a maximum of 3:1. Topsoil not used for constructing the berm should be stockpiled outside of the cell.

- Construct a fence around the perimeter as necessary to deter entry from humans, livestock or wildlife.

- Excavate the hydrocarbons and hydrocarbon impacted soil and stockpile the material.

- Collect samples from the base of the excavated area(s) to document the removal of the impacted material.

- Continue excavating until analytical results are at acceptable concentrations.

- Backfill any voids created from hydrocarbon removal with suitable material. Subsoil from the base of the cell can be stripped and used to fill the voids. The voids should

be filled in approximately 6 to 12 inch lifts and compacted before applying the next lift.

- Grade the areas disturbed during hydrocarbon removal with soil from the immediate surrounding area to blend with the existing terrain.
- Plant the disturbed area in cover that is consistent with the intended land use.
- Spread the excavated material, organic material, and fertilizer over the land farm cell. Organic matter will aid in aeration of the cell and the decomposition will increase the soil temperature (biodegradation is limited when soil temperatures are below 5° C). Organic matter could include but is not limited to straw, hay, tree and/or leaf mulch, peanut hulls or manure. Fertilizer should be composed of nitrogen, potassium, and phosphorus. Optimum degradation of petroleum hydrocarbons occurs when the carbon to nitrogen ratio is 150:1 and the nitrogen to phosphorus to potassium ratio is 4:1:1. In the absence of calculating the optimal ratios, an application of 160 lbs/acre nitrogen and 40 lbs/acre potassium and phosphorus will normally be sufficient. Split applications of the fertilizer will increase the fertilizer-use efficiency and lessen the potential of oxygen deficiency by nutrient enrichment.
- Disk or till the organic matter, fertilizer and excavated material in such a manner as to distribute the material evenly throughout the top 6 to 10 inches of the cell.
- Collect samples from the cell to determine the initial concentrations.
- Apply water as necessary to the cell (Moisture is a key factor in bioremediation. Berming of the cell will aid in keeping the area moist, but during dry spells, adding water will enhance the process).
- Collect samples periodically to monitor the progress.
- Add fertilizer, organic material or disk the cell as dictated by analytical results.
- Continue sampling and maintaining the cell until the analytical results are at acceptable levels.

- Collect samples in the subsurface below the cell (These samples will document that no vertical migration of the hydrocarbons has occurred or impact from vertical migration is minimal.).
- If subsurface samples show impact above acceptable levels, take appropriate steps to address the impact.
- When samples indicate that the material within the cell and subsurface samples are within acceptable levels, close the cell. Spread the berms and stockpiled topsoil evenly over the cell and grade the area to blend with the existing terrain.
- Plant the disturbed area in cover that is consistent with the intended land use.

10.9.5. In-Situ Bioremediation of Hydrocarbons

In-situ bioremediation of hydrocarbon impacted soil at depth is typically performed by specialty companies. These companies may add microbes, surfactants, or enhance subsurface conditions. If this option is selected, then an appropriate firm should be contracted to perform the work. These firms will usually provide all of the sampling, design, agency approvals, construction, monitoring, and final closure.

10.9.6. Road Spreading of Hydrocarbons

- Excavate the hydrocarbons and hydrocarbon impacted soil and stockpile the material.
- Collect samples from the base of the excavated area(s) to document the removal of the impacted material.
- Continue excavating until the analytical results are at acceptable levels.
- Backfill any voids created from hydrocarbon removal with suitable material. The voids should be filled in approximately 6 to 12 inch lifts and compacted before applying the next lift.
- Grade the areas disturbed during hydrocarbon removal with soil from the immediate surrounding area to blend with the existing terrain.
- Plant disturbed area in cover consistent with the intended land use.

- Apply the excavated material to the lease roads or county roads in accordance with local, state and federal rules and regulations. The material should be applied in a manner that pollution of surface or subsurface waters will not occur and surrounding property will be protected. There should be no free liquids when the material is applied and the material should not be applied where water collects. The ambient air temperature should be above 45° F and care should be taken to prevent runoff to borrow ditches or adjacent areas. Conditions conducive to rapid absorption of hydrocarbons such as soil moisture or soil types should be avoided. At completion of the application, there should be a uniform base with no visible free-standing oil.

10.9.7. Dilution Burial/Trenching of Hydrocarbons

- Excavate the hydrocarbons and hydrocarbon impacted soil and stockpile the material.
- Collect samples from the base of the excavated area(s) to document the removal of the impacted material.
- Continue excavation until sample results are at acceptable levels.
- Excavate trenches. The size and depth of the trenches will be dictated by the volume of hydrocarbons to be diluted (The bottom of the trenches should be a safe distance above groundwater and allow for a minimum of 5 feet of compacted cover over the buried material, or as regulatory constraints dictate.).
- Dilute hydrocarbons by mixing with soil excavated from the trenches. The volume of soil to mix with the hydrocarbons will be determined by the sample results of the impacted material and the target concentration of the mixture. If the concentration of hydrocarbons in the impacted material is 4% by volume and the target concentration is 1% by volume, then the impacted material should make up 25% of the final mixture and the volume of non-impacted material should make up 75% of the mixture. In other words, a 3:1 mix should be utilized.
- Place the mixture into the trenches.

- Backfill any voids created from hydrocarbon removal and cover the mixture in the trenches. Excess material from the trenches can be used to backfill the voids created during excavation. The voids should be filled in approximately 6 to 12 inch lifts and compacted before applying the next lift.
- Grade the areas disturbed during hydrocarbon removal and burial with soil from the immediate surrounding area to blend with the existing terrain.
- Plant the disturbed area in cover that is consistent with the intended land use.

10.9.8. Solidification and Burial of Hydrocarbons

- Excavate the hydrocarbons and hydrocarbon impacted soil and stockpile the material.
- Collect samples from the base of the excavated area(s) to document the removal of the impacted material.
- Continue excavation until sample results are at acceptable levels.
- Excavate trenches. The size and depth of the trenches will be dictated by the volume of hydrocarbons to be solidified. (The bottom of the trenches should be a safe distance above groundwater and allow for a minimum of 3 to 5 feet of compacted cover over the buried material, or as regulatory constraints dictate).
- Solidify hydrocarbons by mixing with fly ash or other cementing material.
- Sample the solidified material to document physical and chemical properties.
- Place the solidified mixture into the trenches.
- Backfill any voids created from hydrocarbon removal and cover the mixture in the trenches. Excess material from the trenches can be used to backfill the voids created during excavation. The voids should be filled in approximately 6 to 12 inch lifts and compacted before applying the next lift.
- Grade the areas disturbed during hydrocarbon removal and burial with soil from the immediate surrounding area to blend with the existing terrain.

- Plant the disturbed area in cover that is consistent with the intended land use.

10.9.9. Off-Site Disposal of Hydrocarbons

- Excavate the hydrocarbons and hydrocarbon impacted soil and stockpile the material.
- Collect samples from the base of the excavated area(s) to document the removal of the impacted material.
- Continue excavating until analytical results are at acceptable levels.
- Collect samples from the excavated material and provide the results to the disposal facility for approval.
- Transport and dispose the material to a permitted disposal facility. Obtain manifests for all disposed material.
- Backfill any voids created from hydrocarbon removal with suitable material. The voids should be filled in approximately 6 to 12 inch lifts and compacted before applying the next lift.
- Grade the areas disturbed during hydrocarbon removal with soil from the immediate surrounding area to blend with the existing terrain.
- Plant the disturbed area in cover that is consistent with the intended land use.

10.10. Pit Closure

10.10.1. Off-Site Disposal of Pit Fluid

- Collect and analyze representative samples of the pit fluid.
- Provide the analytical results to the disposal facility for approval as necessary.
- Remove, transport and dispose the fluid to a permitted disposal facility. Obtain manifests for all disposed material.

10.10.2. Land Application of Pit Fluid

- Collect, analyze and evaluate representative samples of the pit fluid and the areas being utilized for land application.

- Determine the size of the area to apply the fluid. Use loading formulas to calculate the size of the area.
- Remove and apply the fluid uniformly over the land application area. If hydrocarbons are present in the fluid, apply fertilizer composed of nitrogen, potassium, and phosphorus.

10.10.3. Surface Discharge of Pit Fluid

- Collect and analyze representative samples of the pit fluid.
- Provide the results to the appropriate regulatory agency along with other requested information to obtain approval/permit.
- Remove and discharge fluids in accordance with permit.

10.10.4. Land Application of Pit Solids

- Collect and evaluate samples of the pit solids and the background areas being utilized for land application.
- Determine the size of the area to apply the material. Use loading formulas to calculate the size of the area.
- Excavate the pit solids and stockpile the material.
- Collect samples from the base of the excavated area(s) to document the removal of the impacted material.
- Continue excavating until analytical results are at acceptable levels.
- Spread the excavated material and fertilizer as necessary uniformly over the land application area. Fertilizer should be composed of nitrogen, potassium, and phosphorus.
- Disk or till the area in such a manner as to distribute the material evenly throughout the area.

10.10.5. Road Spreading of Pit Solids

- Collect and evaluate samples of the pit solids.
- Excavate the pit solids and stockpile the material.
- Collect samples from the base of the excavated area(s) to document the removal of the impacted material.
- Continue excavating until the analytical results are at acceptable levels.
- Apply the excavated material to the lease roads or county roads in accordance with local, state and federal rules and regulations. The material should be applied in a manner that pollution of surface or subsurface waters will not occur and surrounding property will be protected. There should be no free liquids when the material is applied and the material should not be applied where water collects. The ambient air temperature should be above 45° F and care should be taken to prevent runoff to borrow ditches or adjacent areas. Conditions conducive to rapid absorption of hydrocarbons such as soil moisture or soil types should be avoided. At completion of the application, there should be a uniform base with no visible free-standing oil.

10.10.6. Dilution Burial/Trenching of Pit Solids

- Collect and analyze representative samples of the pit solids.
- Excavate the pit solids and stockpile the material.
- Collect samples from the base of the excavated area(s) to document the removal of the impacted material.
- Continue excavation until sample results are at acceptable levels.
- Excavate trenches. The size and depth of the trenches will be dictated by the volume of pit solids to be diluted (The bottom of the trenches should be a safe distance above groundwater and allow for a minimum of 5 feet of compacted cover over the buried material, or as regulatory constraints dictate.).

- Dilute the pit solids by mixing with soil excavated from the trenches. The volume of soil to mix with the solids will be determined by the sample results of the impacted material and the target concentration of the mixture.
- Place the mixture into the trenches.
- Cover the mixture in the trenches in approximately 6 to 12 inch lifts, compacting before applying the next lift.
- Grade the areas disturbed during with trenching with soil from the immediate surrounding area to blend with the existing terrain.
- Plant the disturbed area in cover that is consistent with the intended land use.

10.10.7. Solidification and Burial of Pit Solids

- Collect and analyze representative samples of the pit solids.
- Excavate the pit solids and stockpile the material.
- Collect samples from the base of the excavated area(s) to document the removal of the impacted material.
- Continue excavation until sample results are at acceptable levels.
- Excavate trenches. The size and depth of the trenches will be dictated by the volume of pit solids to be solidified. (The bottom of the trenches should be a safe distance above groundwater and allow for a minimum of 5 feet of compacted cover over the buried material, or as regulatory constraints dictate).
- Solidify pit solids by mixing with fly ash or other cementing material.
- Sample the solidified material to document physical and chemical properties.
- Place the solidified mixture into the trenches.
- Backfill and cover the mixture in the trenches in approximately 6 to 12 inch lifts compacting before applying the next lift.
- Grade the areas disturbed during trenching with soil from the immediate surrounding

area to blend with the existing terrain.

- Plant the disturbed area in cover that is consistent with the intended land use.

10.10.8. Off-Site Disposal of Pit Solids

- Collect and analyze representative samples of the pit solids.
- Excavate the pit solids.
- Collect samples from the base of the excavated area(s) to document the removal of the impacted material.
- Continue excavating until analytical results are at acceptable levels.
- Provide the analytical results to the disposal facility for approval.
- Transport and dispose the material to a permitted disposal facility. Obtain manifests for all disposed material.

10.10.9. In-Place Pit Closure

- Remove and dispose pit liquids.
- Remove and dispose pit solids as necessary
- Level and grade pit berms to cover the pit.
- Add suitable fill material as necessary to bring the final grade of the pit area to the level of the surrounding terrain.
- Grade the pit area to blend with the existing terrain.
- Plant the disturbed area in cover that is consistent with the intended land use.

10.10.10. Pit Closure by Burial/Trenching

- Remove and dispose pit liquids.
- Remove and dispose the pit solids as necessary.
- Excavate trenches within or extending from the pit.
- Segregate and stockpile the topsoil.

- Push the pit berms and squeeze the remaining pit solids/drilling mud into trenches.
- Add and mix subsoil excavated from the trenches with the pit contents squeezed into the trenches as necessary for solidification. Fill trenches to a level that will allow for a minimum of 3 to 5 feet of cover over the pit contents or as dictated by regulatory agencies.
- Continue squeezing until the pit can be covered.
- Cover and compact the pit area and trenches.
- Grade all disturbed areas, apply stockpiled topsoil evenly over areas and blend with the existing terrain.
- Plant the disturbed area in cover that is consistent with the intended land use.

10.11. Water Well Plugging

Water wells should be plugged by a licensed well driller in accordance with applicable local, state and federal rules and regulations.

10.12. Sediment Control Barriers

10.12.1. Bale Sediment Control Barriers

- Use bales consisting of straw or hay securely bound with wire or twine. The bales should be standard sized rectangular bales approximately 18 x 20 x 36 inches in size.
- Place the bales end to end.
- Stake the bales with lumber or metal approximately 36 inches long, and of sufficient strength to be driven firmly in the ground.
- At approximately 100 linear feet intervals, replace a bale with pile of loose rock or other acceptable filtering material to approximately 2/3 of the height of the bale to act as a spillway.

10.12.2. Siltation Screen Sediment Control Barriers

- Use framework of any type of material capable of supporting the filtering material and withstanding the force of water flowing through the screen. Filtering material

should be burlap or plastic. The maximum size opening for either type of screen should not exceed 1/8 inch.

- Install screen with framework supports having a maximum spacing of 10 feet center to center.
- Secure filter materials to the ground between supports to prevent the material from curling or rolling up.

10.13. Pond and Terrace Construction

For pond and terrace construction, local NRCS, civil engineering firms, or other qualified personnel should be contacted. These entities can provide specifications for the construction.

10.14. Planting

10.14.1. Seeding

- Fill and shape areas and refinish slopes to the established typical grade.
- Till, disk or harrow the soil on the contour to a depth of four inches and roll the area.
- Determine proper seed composition and rates based on land use and surface owner preferences.
- Plant seed with mechanical equipment designed and capable of planting the material uniformly and at the specified rate. Hand plant in areas that are too small or inaccessible to accommodate the specified equipment.
- Apply fertilizer as needed. Fertilizer containing nitrogen, phosphate, and potassium is normally sufficient.
- Water as necessary through germination and root establishment.

10.14.2. Row Bermuda Sprigging

- Fill and shape areas and finish slopes to the established typical grade.
- Till, disk or harrow the soil on the contour to a depth of 4 inches and roll the area.
- Plant 20 to 40 bushels per acre of sprigs with an automatic sprig planter, except that

hand planting may be used in areas where the sprig planter cannot operate. The sprig planter should automatically open the furrows, place the sprigs in the furrow, then cover the sprigs and furrow with soil in one continuous operation.

- Plant the sprigs in furrows parallel to the approximate contour lines of the slopes. The distance between furrows should not exceed 20 inches on centers. The sprigs should be placed approximately 3 inches deep with the ends of the sprigs meeting or overlapping.
- Compact the soil by rolling immediately after planting. Roll slopes along approximate contour lines.
- Apply fertilizer as needed. Fertilizer containing nitrogen, phosphate, and potassium will generally be sufficient.
- Water as necessary until root establishment.

10.14.3. Broadcast Bermuda Sprigging

- Fill and shape areas and finish slopes to the established typical grade.
- Till, disk or harrow the soil on the contour to a depth of 4 inches and roll the area.
- Plant 20 to 40 bushels per acre of sprigs with an automatic sprig planter, except that hand planting may be used in areas where the sprig planter cannot operate. The sprig planter should be equipped with an adjustable mechanism for accurately distributing sprigs. It should be equipped with straight disks spaced on two inch centers on tandem axles. The rear disk wheels should be placed so they trail between the front disks. The machine should have an accurate and adjustable mechanism for adjusting the depth of sprig placement. The broadcasting and pressing operation should be performed simultaneously.
- Broadcast the sprigs evenly and uniformly on the soil surface and immediately press into the soil. The planting depth mechanism should be adjusted to cause the disk wheels to penetrate 4 inches deep.
- Within two hours after the sprigs have been planted, disk the areas to a depth of

approximately 4 inches with either a tandem or offset disk plow.

- Compact the soil by rolling immediately after planting. Roll slopes along approximate contour lines.
- Apply fertilizer as needed. Fertilizer containing nitrogen, phosphate, and potassium will generally be sufficient.
- Water as necessary until root establishment.

11. REFERENCES

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APPENDIX A

EXAMPLES

Site Assessment and Sampling Example

Scenario: Several areas of hydrocarbons were discovered at the surface in a field between the pumping unit and the tank battery. The areas appeared to be in close proximity to the subsurface flowline from the well to the tank battery.

- A backhoe was used to excavate around the flowline to determine if a leak had occurred. A leak was discovered in the line (See Site Sketch, On-Site Assessment Form). The line was repaired and the excavated material was stockpiled on plastic sheeting.
- A physical assessment and sampling of the site was performed to document the release and physical characteristics of the site (see Site Data Evaluation Form and On-Site Assessment Form).
- To determine the extent of impact, seven (7) boreholes were advanced with hand augers in the vicinity of the leak and surface hydrocarbons. Locations of the borings are depicted on the Site Sketch in the On-Site Assessment Form and visual observations from the borings are included in the Soil Boring Logs.
- Samples were collected from each of the borings and from the stock-piled material. Sample results are summarized in Table 1 - Analytical results, and the samples are summarized below:
    - HA-1 was composited from a depth of 1 to 3.5 feet below ground surface (bgs) from boring #1 (HA-1). The sample had elevated benzene, toluene, ethylbenzene, and total xylenes (BTEX) concentrations and elevated total petroleum hydrocarbon (TPH) concentrations.
    - HA-2 was composited from a depth of 1 to 3.5 feet bgs from boring #2 (HA-2). The sample had elevated BTEX and TPH concentrations.
    - HA-4 was composited from a depth of 1 to 3.5 feet bgs from boring #4 (HA-4). The sample had elevated BTEX and TPH concentrations.
    - HA-3,4,6,7 was composited from ground surface to a depth of to 3.5 feet bgs from borings 3, 5, 6 and 7 (HA-3, HA-5, HA-6 and HA-7). BTEX concentrations were not detected and the TPH concentration was minimal.
    - SS-1 was composited from the stock-piled soil excavated while repairing the line leak. The sample has elevated BTEX and TPH concentrations.
- Based on the analytical results and sample locations, it was estimated that the volume of soil that had been impacted by the line leak was approximately 50 cubic yards (15 feet by 30 feet by 3 feet).

SITE DATA EVALUATION

Operator: ABC Operating Lease Name: ABC Unit #1

Spot: NW/4 NW/4 NW/4 Sec. 15 T 8N R 5E County Seminole State OK

Soil Characteristics

Soil Horizon (Name) Asher Texture Clay loam

Permeability 0.6 to 2 inches/hour Slope 1 to 5%

Depth to Water 50 feet Depth to Bedrock Less than 5 feet

Erosion Factor Not Available Shrink-Swell Potential Moderate

Flood Potential Moderate Land Uses Range/Pastureland

Crop/Vegetation Suitability Little Bluestem, Big Bluestem, Switchgrass, Indiangrass

SAR Not Available CEC Not Available Salinity Not Available pH 6.8 to 7.9

Geology

Uppermost Bedrock (Name) Vanoss (Pennsylvanian) Bedrock Thickness 250 feet

Bedrock Type Shale w/crossbedded sandstone Depth to Bedrock 5 to 50 feet

Hydrology

Site Underlain by Aquifer ☒Yes ☐No ☒Major ☐Minor Aquifer Recharge Area ☐Yes ☒No

Aquifer Name Vamoosa Depth to Water 50 feet

Water Quality Fair (500 to 1,000 ppm TDS) Water Quantity 50 gpm

Distance and type of nearest wells Greater than 1 mile

Hydrologically Sensitive Area ☐ Yes ☒ No

Climate

Annual Precipitation 39 inches Annual Evaporation 25 inches

Regulatory

List Regulatory Agencies	Contact	Number
Oklahoma Corporation Commission	Jack Doe	(555) 555-1234
BLM	Bob Doe	(555) 555-2345

Remediation Alternatives (List and determine if applicable based on site data and regulatory constraints)

In situ Bioremediation	☒Yes ☐NO
Land Application	☒Yes ☐NO
Bioremediation	☒Yes ☐NO
Road Spreading	☒Yes ☐NO
Off-site Disposal	☒Yes ☐NO

ON-SITE ASSESSMENT FORM

Operator: ABC Operating Lease Name: ABC Unit #1

Spot: NW/4 NW/4 NW/4 Sec. 15 T 8N R 5E County Seminole State OK

Form Prepared By: John Doe Date: 1/1/2000

Land Use Range/Pasture Vegetation Bermuda/Native Grasses

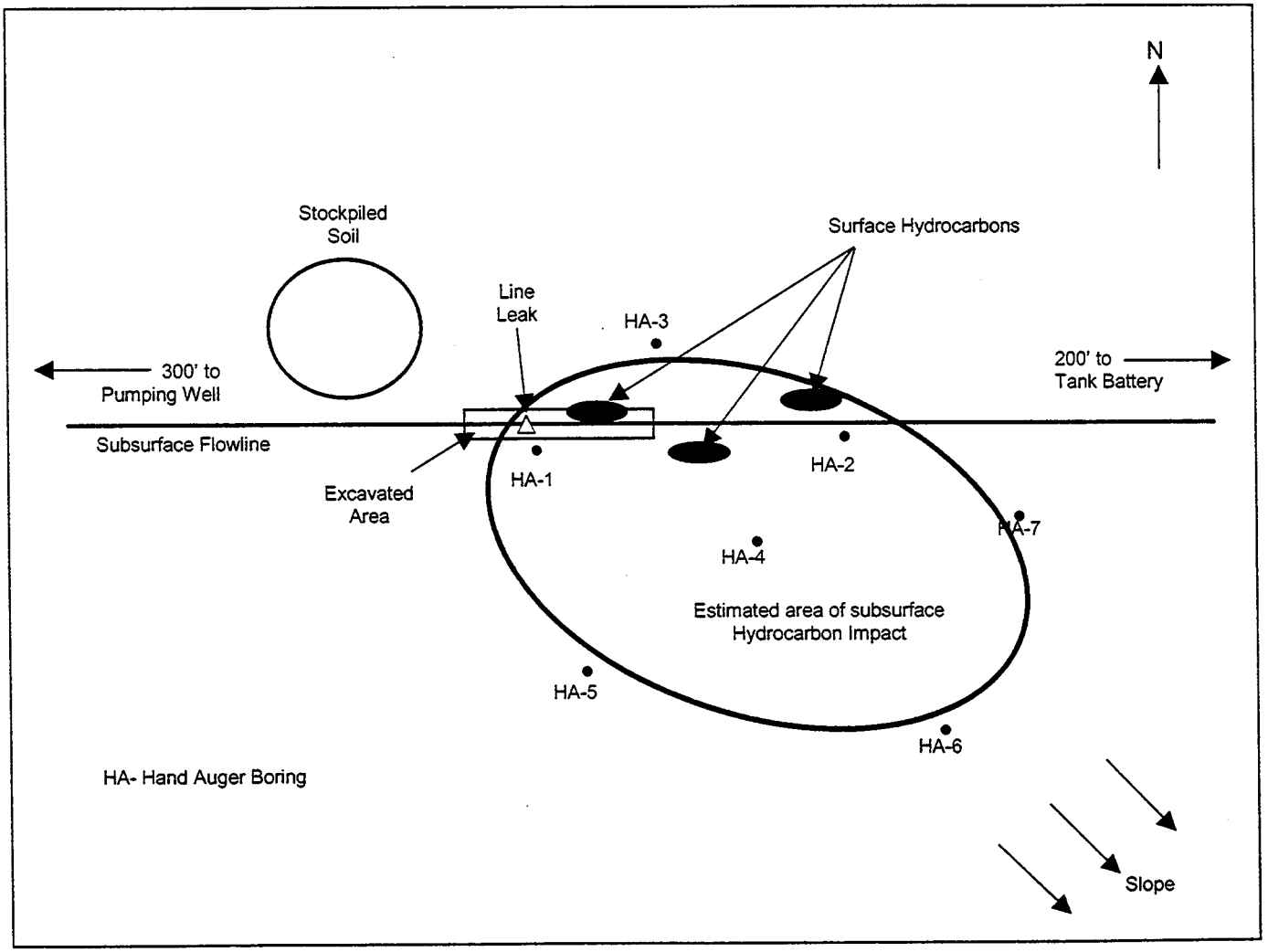
Slope 1 to 5% Distance to Surface Water 500 Feet

Aerial Extent of Impact 450 square feet Depth of Impact 3.5 feet

Physical Hazards Overhead electric lines, pumping unit

Other Issues

SITE SKETCH



Scale 1 Inch ≅ 10 feet

Soil Boring Log

Lease Name:	ABC Unit #1		
Operator:	ABC Operating		
County:	Seminole	Soil Boring ID	HA-1
State:	OK	Soil Boring Location	5 feet south of line leak
Spot Location:	NW/4 NW/4 NW/4 Sec. 15-T8N-R5E	Drilling Date:	1/1/00
Logged by:	John Doe	Drilling Company:	
		Driller:	
Surface Cover:	Hydrocarbon/soil	Driller's Assistant:	
Plugging Material:	Not Applicable	Drilling Method:	Hand Auger
Total boring depth:	3.5 feet	Sampling Method:	Hand Auger

Depth	Sample Description
0-1'	Loam, dark brown, moist
1 - 3.5 feet	Clay, dark brown, moist, medium plasticity, hydrocarbon staining, odor
3.5 feet	Sandstone
TD - 3.5 feet	

Soil Boring Log

Lease Name:	ABC Unit #1		
Operator:	ABC Operating		
County:	Seminole	Soil Boring ID	HA-2
State:	OK	Soil Boring Location	20 feet east of line leak
Spot Location:	NW/4 NW/4 NW/4 Sec. 15-T8N-R5E	Drilling Date:	1/1/00
Logged by:	John Doe	Drilling Company:	
		Driller:	
Surface Cover:	Hydrocarbon/soil	Driller's Assistant:	
Plugging Material:	Not Applicable	Drilling Method:	Hand Auger
Total boring depth:	3.5 feet	Sampling Method:	Hand Auger

Depth	Sample Description
0-1'	Loam, dark brown, moist
1 - 3.5 feet	Clay, dark brown, moist, medium plasticity, hydrocarbon staining, odor
3.5 feet	Sandstone
TD - 3.5 feet	

Soil Boring Log

Lease Name:	ABC Unit #1		
Operator:	ABC Operating		
County:	Seminole	Soil Boring ID	HA-3
State:	OK	Soil Boring Location	15 feet W/NW of line leak
Spot Location:	NW/4 NW/4 NW/4 Sec. 15-T8N-R5E	Drilling Date:	1/1/00
Logged by:	John Doe	Drilling Company:	
		Driller:	
Surface Cover:	Hydrocarbon/soil	Driller's Assistant:	
Plugging Material:	Not Applicable	Drilling Method:	Hand Auger
Total boring depth:	3.5 feet	Sampling Method:	Hand Auger

Depth	Sample Description
0-1'	Loam, dark brown, moist
1 - 3.5 feet	Clay, dark brown, moist, medium plasticity
3.5 feet	Sandstone
TD - 3.5 feet	

Soil Boring Log

Lease Name:	ABC Unit #1		
Operator:	ABC Operating		
County:	Seminole	Soil Boring ID	HA-4
State:	OK	Soil Boring Location	15 feet E/SE of line leak
Spot Location:	NW/4 NW/4 NW/4 Sec. 15-T8N-R5E	Drilling Date:	1/1/00
Logged by:	John Doe	Drilling Company:	
		Driller:	
Surface Cover:	Hydrocarbon/soil	Driller's Assistant:	
Plugging Material:	Not Applicable	Drilling Method:	Hand Auger
Total boring depth:	3.5 feet	Sampling Method:	Hand Auger

Depth	Sample Description
0-1'	Loam, dark brown, moist
1 - 3.5 feet	Clay, dark brown, moist, medium plasticity, hydrocarbon staining, odor
3.5 feet	Sandstone
TD - 3.5 feet	

Soil Boring Log

Lease Name:	ABC Unit #1		Page 1 of 1
Operator:	ABC Operating		
County:	Seminole	Soil Boring ID	HA-5
State:	OK	Soil Boring Location	15 feet south of line leak
Spot Location:	NW/4 NW/4 NW/4	Drilling Date:	1/1/00
	Sec. 15-T8N-R5E		
Logged by:	John Doe	Drilling Company:	
		Driller:	
Surface Cover:	Hydrocarbon/soil	Driller's Assistant:	
Plugging Material:	Not Applicable	Drilling Method:	Hand Auger
Total boring depth:	3.5 feet	Sampling Method:	Hand Auger

Depth	Sample Description
0-1'	Loam, dark brown, moist
1 - 3.5 feet	Clay, dark brown, moist, medium plasticity
3.5 feet	Sandstone
TD - 3.5 feet	

Soil Boring Log

Lease Name:	ABC Unit #1		
Operator:	ABC Operating		
County:	Seminole	Soil Boring ID	HA-6
State:	OK	Soil Boring Location	30 feet SE of line leak
Spot Location:	NW/4 NW/4 NW/4 Sec. 15-T8N-R5E	Drilling Date:	1/1/00
Logged by:	John Doe	Drilling Company:	
		Driller:	
Surface Cover:	Hydrocarbon/soil	Driller's Assistant:	
Plugging Material:	Not Applicable	Drilling Method:	Hand Auger
Total boring depth:	3.5 feet	Sampling Method:	Hand Auger

Depth	Sample Description
0-1'	Loam, dark brown, moist
1 - 3.5 feet	Clay, dark brown, moist, medium plasticity
3.5 feet	Sandstone
TD - 3.5 feet	

Soil Boring Log

Lease Name:	ABC Unit #1		
Operator:	ABC Operating		
County:	Seminole	Soil Boring ID	HA-7
State:	OK	Soil Boring Location	35 feet E/SE of line leak
Spot Location:	NW/4 NW/4 NW/4	Drilling Date:	1/1/00
	Sec. 15-T8N-R5E		
Logged by:	John Doe	Drilling Company:	
		Driller:	
Surface Cover:	Hydrocarbon/soil	Driller's Assistant:	
Plugging Material:	Not Applicable	Drilling Method:	Hand Auger
Total boring depth:	3.5 feet	Sampling Method:	Hand Auger

Depth	Sample Description
0-1'	Loam, dark brown, moist
1 - 3.5 feet	Clay, dark brown, moist, medium plasticity
3.5 feet	Sandstone
TD - 3.5 feet	

Table 1
ABC Unit #1 Flowline Leak
Soil Analytical Results

SAMPLE ID	HA-1	HA-2	HA-4	HA-3,5,6,7	SS-1
SAMPLE DEPTH	1-3.5'	1-3.5'	1-3.5'	0-3.5'	
SAMPLE DATE	1/1/00	1/1/00	1/1/00	1/1/00	1/1/00

SOIL ANALYSIS	METHOD	UNITS	PQL					
Chloride	325.3	mg/Kg	10	176.1	186.3	168.3	154.6	168.9
Conductivity	120.1	umho/cm	NA	224.5	236.9	220.5	205.8	248.3
Benzene	8020	mg/Kg	0.1	0.005	0.004	0.004	BPQL	0.003
Toluene	8020	mg/Kg	0.1	0.015	0.011	0.0052	BPQL	0.0086
Ethylbenzene	8020	mg/Kg	0.1	0.022	0.009	0.015	BPQL	0.058
Xylenes	8020	mg/Kg	0.1	0.085	0.052	0.158	BPQL	0.189
TPH - diesel	8015M	mg/Kg	10	20,458	12,562	8,253	42	18,586

KEY
TPH - Total Petroleum Hydrocarbons
mg/Kg - milligrams per Kilogram
umho/cm - micromhos per centimeter
BPQL - Below Practical Quantitation Limit

Spill/Accident Example

Scenario: An above ground flowline from a pumping well to the tank battery ruptured. The pumper discovered the rupture while gauging the tanks. The exact amount of fluid released was not known, but it appeared by the tank gauging that somewhere between 100 and 200 barrels of crude oil may have been lost. The oil had migrated from the rupture across the surface to a natural drainage path and was approximately 500 feet from reaching an intermittent stream.

- The pumper immediately shut down the pumping unit.
- A backhoe and operator were requested for emergency response from a local-oilfield service company. The backhoe was used to dig a collection pit within the drainage path at the furthest downgradient point of surface impact from the release. The purpose of the pit was to catch free liquids and to prohibit the oil from migrating to the intermittent stream. Additionally, the backhoe was used to back drag the impacted surface area from where the leak originated to the collection pit. This process removed free liquids from the impacted area and helped prevent vertical migration of the oil. A vaccum truck was used to evacuate free liquids from the collection pit. The removed liquids were properly disposed at a commercial disposal facility. Approximately 75 barrels of fluid were recovered from the trench.
- An Accident/Spill Report was completed for the spill (see Exhibit A).
- Since the release was estimated to be between 100 and 200 barrels of oil, the BLM was contacted to report the spill.
- The entire flowline was visually checked for wear and possible weak areas. Approximately 100 feet of the flowline was replaced.
- A physical assessment and sampling of the site was performed to document the release and physical characteristics of the site (see Site Data Evaluation Form and On-Site Assessment Form).
- Samples were collected from the surface of the impacted area. Visual observations indicated that the vertical migration of impact did not extend beyond 6 inches below ground surface, so samples were also collected at a depth of six inches (see Table 1, Analytical Results).

- Based on the analytical results and site conditions, in-situ bioremediation of the impacted area was the chosen remediation option.
- A written report was prepared and forwarded to the BLM including the selected remediation option.
- Upon approval of the remediation plan by the BLM, approximately 1 foot of impacted soil was removed from the base and sides of the collection pit and stock piled. The collection pit was backfilled and the stock-piled material was dispersed over the immediate surrounding area. Fertilizer and hay were added to the surface of the impacted area and the area was disked.
- Approximately 6 months after the incorporation of the hay and fertilizer, a confirmatory sample was collected from the impacted area (see Table 1). Since the confirmatory sample showed acceptable levels, the area was planted with cover consistent with the surrounding area.
- Results of the confirmatory samples were forwarded to the BLM to document final closure.

ACCIDENT/SPILL REPORT

Operator: ABC Operating Date of Occurrence: 1/1/2000

Lease Name: ABC Unit #1 Date of Inspection: 1/1/2000

Spot: NW/4 NW/4 NW/4 Sec. 15 T 8N R 5E County Seminole State OK

Type Facility: Pumping Well/Flowline Leak Contact: John Doe

Accident/Spill (Describe in detail including cause, injuries/damage to environment, volume of material lost.)

An above ground flowline from a pumping well to the tank battery ruptured. The pumper discovered the rupture while gauging the tanks. The exact amount of fluid released was not known, but it appeared by the tank gauging that somewhere between 100 and 200 barrels of crude oil may have been lost. The oil had migrated from the rupture across the surface to a natural drainage path and was approximately 500 feet from reaching an intermittent stream.

Section A* (Check all that apply)

- ☒ Release or Fire Consumption of ≥ 100 barrels of fluid or 500 McF of gas
- ☐ Spill, Venting, or Fire in or near sensitive area (park, recreation site, threatened and endangered species habitat, riparian area, water body, urban or suburban area, etc.).
- ☐ Major, Life-threatening, or Fatal injury.
- ☐ Loss of Well Control.
- ☐ Release of Hazardous Substance reportable under EPA 40 CFR part 302.

* Notify BLM within 24 hours if any box in Section A is checked.

Section B (Check all that apply)**

- ☐ Release or Fire Consumption of 10 to 100 barrels of fluid or 50 to 500 McF of gas

** Notify BLM in writing within 10 days if any box in Section A or Section B is checked.

When and where did the incident occur (Attach a site sketch, if necessary)

The incident occurred sometime between 12:00 pm on December 31, 1999 and 12:00 pm on January 1, 2000. The incident originated from an above ground flowline rupture approximately 100 feet from the pumping well (See Site Sketch on On-Site Assessment Form).

ACCIDENT/SPILL REPORT

Were Sensitive areas affected? ☐ **Yes** ☒ **No** **(If Yes, describe)**

List Emergency Response Actions

The pumper immediately shut down the pumping unit. A backhoe and operator were requested for emergency response from a local oilfield service company. The backhoe was used to dig a collection pit within the drainage path at the furthest downgradient point of surface impact from the release. The purpose of the pit was to catch free liquids and to prohibit the oil from migrating to the intermittent stream. Additionally, the backhoe was used to back drag the impacted surface area from where the leak originated to the collection pit. This process removed free liquids from the impacted area and helped prevent vertical migration of the oil. A vaccum truck was used to evacuate free liquids from the collection pit. The removed liquids were properly disposed at a commercial disposal facility. Approximately 75 barrels of fluid were recovered from the trench.

List Preventive Actions to ensure incident will not happen again

The entire flowline was visually checked for wear and possible weak areas. Approximately 100 feet of the flowline was replaced.

Detail Remediation Plan

Based on the analytical results and site conditions (See Site Data Evaluation Form, On-Site Assessment Form and Table1, Analytical Results), in-situ bioremediation of the impacted area should be performed. Fertilizer and hay should be added to the surface of the impacted area and the area should be disked.

SITE DATA EVALUATION

Operator: ABC Operating Lease Name: ABC Unit #1

Spot: NW/4 NW/4 NW/4 Sec. 15 T 8N R 5E County Seminole State OK

Soil Characteristics

Soil Horizon (Name) Asher Texture Clay loam

Permeability 0.6 to 2 inches/hour Slope 1 to 5%

Depth to Water 50 feet Depth to Bedrock 100 feet

Erosion Factor Not Available Shrink-Swell Potential Moderate

Flood Potential Moderate Land Uses Range/Pastureland

Crop/Vegetation Suitability Little Bluestem, Big Bluestem, Switchgrass, Indiangrass

SAR Not Available CEC Not Available Salinity Not Available pH 6.8 to 7.9

Geology

Uppermost Bedrock (Name) Vanoss (Pennsylvanian) Bedrock Thickness 250 feet

Bedrock Type Shale w/crossbedded sandstone Depth to Bedrock 100 feet

Hydrology

Site Underlain by Aquifer ☒Yes ☐No ☒Major ☐Minor Aquifer Recharge Area ☐Yes ☒No

Aquifer Name Vamoosa Depth to Water 50 feet

Water Quality Fair (500 to 1,000 ppm TDS) Water Quantity 50 gpm

Distance and type of nearest wells Greater than 1 mile

Hydrologically Sensitive Area ☐ Yes ☒ No

Climate

Annual Precipitation 39 inches Annual Evaporation 25 inches

Regulatory

List Regulatory Agencies	Contact	Number
Oklahoma Corporation Commission	Jack Doe	(555) 555-1234
BLM	Bob Doe	(555) 555-2345

Remediation Alternatives (List and determine if applicable based on site data and regulatory constraints)

In situ Bioremediation	☒Yes ☐NO
Land Application	☒Yes ☐NO
Bioremediation	☒Yes ☐NO
Road Spreading	☒Yes ☐NO
Off-site Disposal	☒Yes ☐NO

ON-SITE ASSESSMENT FORM

Operator: ABC Operating Lease Name: ABC Unit #1

Spot: NW/4 NW/4 NW/4 Sec. 15 T 8N R 5E County Seminole State OK

Form Prepared By: John Doe Date: 1/1/2000

Land Use Range/Pasture Vegetation Bermuda/Native Grasses

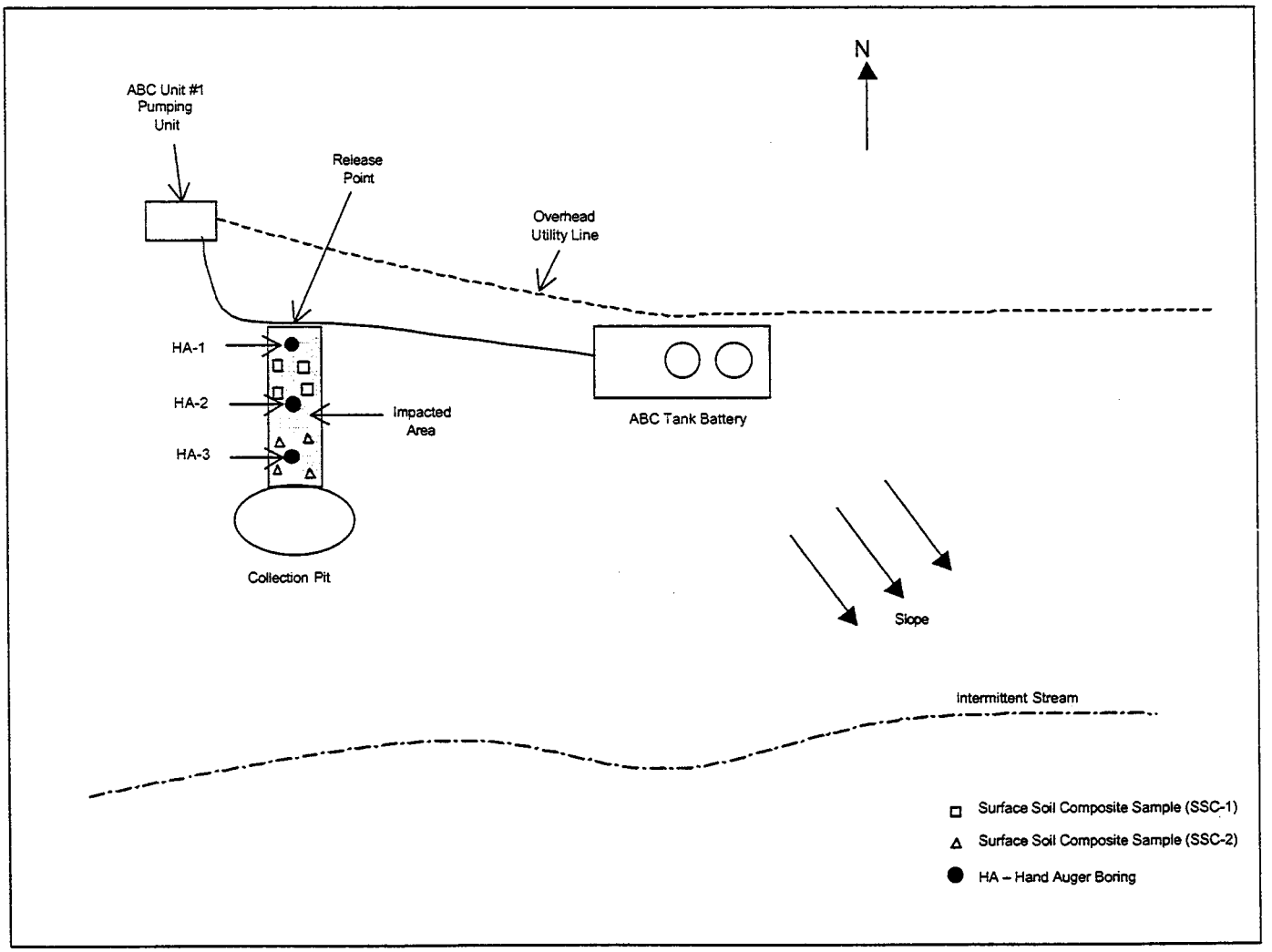
Slope 1 to 5% Distance to Surface Water 500 Feet

Aerial Extent of Impact 2,000 square feet Depth of Impact 6 inches

Physical Hazards Overhead electric lines, pumping unit

Other Issues

SITE SKETCH



Scale 1 inch ≅ 200 feet

Soil Boring Log

Lease Name:	ABC Unit #1		
Operator:	ABC Operating		
County:	Seminole	Soil Boring ID	HA-1
State:	OK	Soil Boring Location	25 feet south of spill
Spot Location:	NW/4 NW/4 NW/4 Sec. 15-T8N-R5E	Drilling Date:	1/1/00
Logged by:	John Doe	Drilling Company:	
		Driller:	
Surface Cover:	Hydrocarbon/soil	Driller's Assistant:	
Plugging Material:	Not Applicable	Drilling Method:	Hand Auger
Total boring depth:	1 foot	Sampling Method:	Hand Auger

Depth	Sample Description
0-6"	Loam, hydrocarbon impacted, slight odor
6"-12"	Clay, dark brown, moist, medium plasticity
Total Depth 1 foot	

Soil Boring Log

Lease Name:	ABC Unit #1		
Operator:	ABC Operating		
County:	Seminole	Soil Boring ID	HA-2
State:	OK	Soil Boring Location	50 feet south of spill
Spot Location:	NW/4 NW/4 NW/4 Sec. 15-T8N-R5E	Drilling Date:	1/1/00
Logged by:	John Doe	Drilling Company:	
		Driller:	
Surface Cover:	Hydrocarbon/soil	Driller's Assistant:	
Plugging Material:	Not Applicable	Drilling Method:	Hand Auger
Total boring depth:	1 foot	Sampling Method:	Hand Auger

Depth	Sample Description
0-6"	Loam, hydrocarbon impacted, slight odor
6"-12"	Clay, dark brown, moist, medium plasticity
Total Depth 1 foot	

Soil Boring Log

Lease Name:	ABC Unit #1		
Operator:	ABC Operating		
County:	Seminole	Soil Boring ID	HA-3
State:	OK	Soil Boring Location	75 feet south of spill
Spot Location:	NW/4 NW/4 NW/4 Sec. 15-T8N-R5E	Drilling Date:	1/1/00
Logged by:	John Doe	Drilling Company:	
		Driller:	
Surface Cover:	Hydrocarbon/soil	Driller's Assistant:	
Plugging Material:	Not Applicable	Drilling Method:	Hand Auger
Total boring depth:	1 foot	Sampling Method:	Hand Auger

Depth	Sample Description
0-6"	Loam, hydrocarbon impacted, slight odor
6"-12"	Clay, dark brown, moist, medium plasticity
Total Depth 1 foot	

Table 1
ABC Unit #1 Flowline Leak
Soil Analytical Results

SAMPLE ID	SSC-1	SSC-2	HAC	Conf.-1
SAMPLE DEPTH	Surface	Surface	6-12"	Surface
SAMPLE DATE	1/1/00	1/1/00	1/1/00	6/28/00

SOIL ANALYSIS	METHOD	UNITS	PQL				
Chloride	325.3	mg/Kg	10	176.1	186.3	154.6	168.9
Conductivity	120.1	umho/cm	NA	224.5	236.9	205.8	230.8
Benzene	8020	mg/Kg	0.1	0.002	BPQL	BPQL	BPQL
Toluene	8020	mg/Kg	0.1	0.015	0.011	BPQL	BPQL
Ethylbenzene	8020	mg/Kg	0.1	0.022	0.009	BPQL	BPQL
Xylenes	8020	mg/Kg	0.1	0.085	0.052	BPQL	BPQL
TPH - diesel	8015M	mg/Kg	10	7546	8254	42	115

KEY
TPH - Total Petroleum Hydrocarbons
mg/Kg - milligrams per Kilogram
umho/cm - micromhos per centimeter
BPQL - Below Practical Quantitation Limit

Salt Impacted Soil Restoration Example

Scenario: Salt-water impact to soil was evident within and around a tank battery that was being closed. The tank battery had been in use for many years and the exact cause of the impact was unknown. It was assumed that the impact was the result of minor spills and leakage over a long time period.

- A physical assessment and sampling of the site was performed to document the degree of impact and physical characteristics of the site (see Site Data Evaluation Form and On-Site Assessment Form).
- To determine the extent of impact, seven (7) boreholes were advanced with hand augers in the vicinity of the tank battery and impacted area. Locations of the borings are depicted on the site sketch in the On-Site Assessment Form and visual observations from the borings are included in the Soil Boring Logs.
- Samples were collected from each of the borings, from the surface of the impacted area, and from surface background locations. Sample results are summarized in Table 1 – Agronomy Analytical results and surface sampling locations are depicted on the site sketch in the On-Site Assessment Form.
- Based on visual observations, the analytical results and sample locations, it was estimated that the aerial extent of soil that had been impacted by salt water was approximately 4500 square feet. The depth of impact was estimated to be approximately three (3) feet.
- It was determined, by a review of the analytical results, soil properties, available restoration protocols and economics, that the preferred restoration option would be amendment application.
- The area was graded and terraced to mitigate overland flow during the restoration process and to retain moisture for flushing during the restoration
- Gypsum was applied at the rate of 5 tons per acre and organic matter was applied at the rate of 20 to 30 tons per acre.
- The area was tilled to incorporate the amendments evenly through the top six (6) inches of soil.

- A progress sample (PS-1) was collected approximately six (6) months after the initial application of amendments (see Table 1).
- Analytical results from the sample indicated that the Total Soluble Salts (TSS) and the Exchangeable Sodium Percentage (ESP) had decreased, but the values were still above the range typical of productive soil.
- A second progress sample (PS-2) was collected approximately six (6) months after the second application (see Table 2).
- Analytical results from the second sample indicated that the soil was within the range typical of productive soil.
- The impacted area was graded and planted in cover consistent with the intended land use.

SITE DATA EVALUATION

Operator: ABC Operating Lease Name: ABC Unit #1

Spot: NW/4 NW/4 NW/4 Sec. 15 T 8N R 5E County Seminole State OK

Soil Characteristics

Soil Horizon (Name) Chickasaw Texture Sandy loam

Permeability 2 to 4 inches/hour Slope 1 to 5%

Depth to Water > 50 feet Depth to Bedrock 50 feet

Erosion Factor Not Available Shrink-Swell Potential Low

Flood Potential Low Land Uses Range/Pastureland

Crop/Vegetation Suitability Bermuda Grass, Little Bluestem, Big Bluestem, Switchgrass, Indiangrass

SAR Not Available CEC Not Available Salinity Not Available pH 6.8 to 7.9

Geology

Uppermost Bedrock (Name) Vanoss (Pennsylvanian) Bedrock Thickness 250 feet

Bedrock Type Shale w/crossbedded sandstone Depth to Bedrock 50 feet

Hydrology

Site Underlain by Aquifer ☐Yes ☒No ☐Major ☐Minor Aquifer Recharge Area ☐Yes ☒No

Aquifer Name Vanoss Depth to Water > 50 feet

Water Quality Poor (> 1,000 ppm TDS) Water Quantity < 10 gpm

Distance and type of nearest wells Greater than 1 mile

Hydrologically Sensitive Area ☐ Yes ☒ No

Climate

Annual Precipitation 39 inches Annual Evaporation 25 inches

Regulatory

List Regulatory Agencies	Contact	Number
Oklahoma Corporation Commission	Jack Doe	(555) 555-1234
BLM	Bob Doe	(555) 555-2345

Remediation Alternatives (List and determine if applicable based on site data and regulatory constraints)

Amendment Application	☒Yes ☐NO
Land Application	☒Yes ☐NO
Soil Washing	☒Yes ☐NO
Road Spreading	☒Yes ☐NO
Off-site Disposal	☒Yes ☐NO

ON-SITE ASSESSMENT FORM

Operator: ABC Operating Lease Name: ABC Unit #1

Spot: NW/4 NW/4 NW/4 Sec. 15 T 8N R 5E County Seminole State OK

Form Prepared By: John Doe Date: 1/1/2000

Land Use Range/Pasture Vegetation Bermuda/Native Grasses

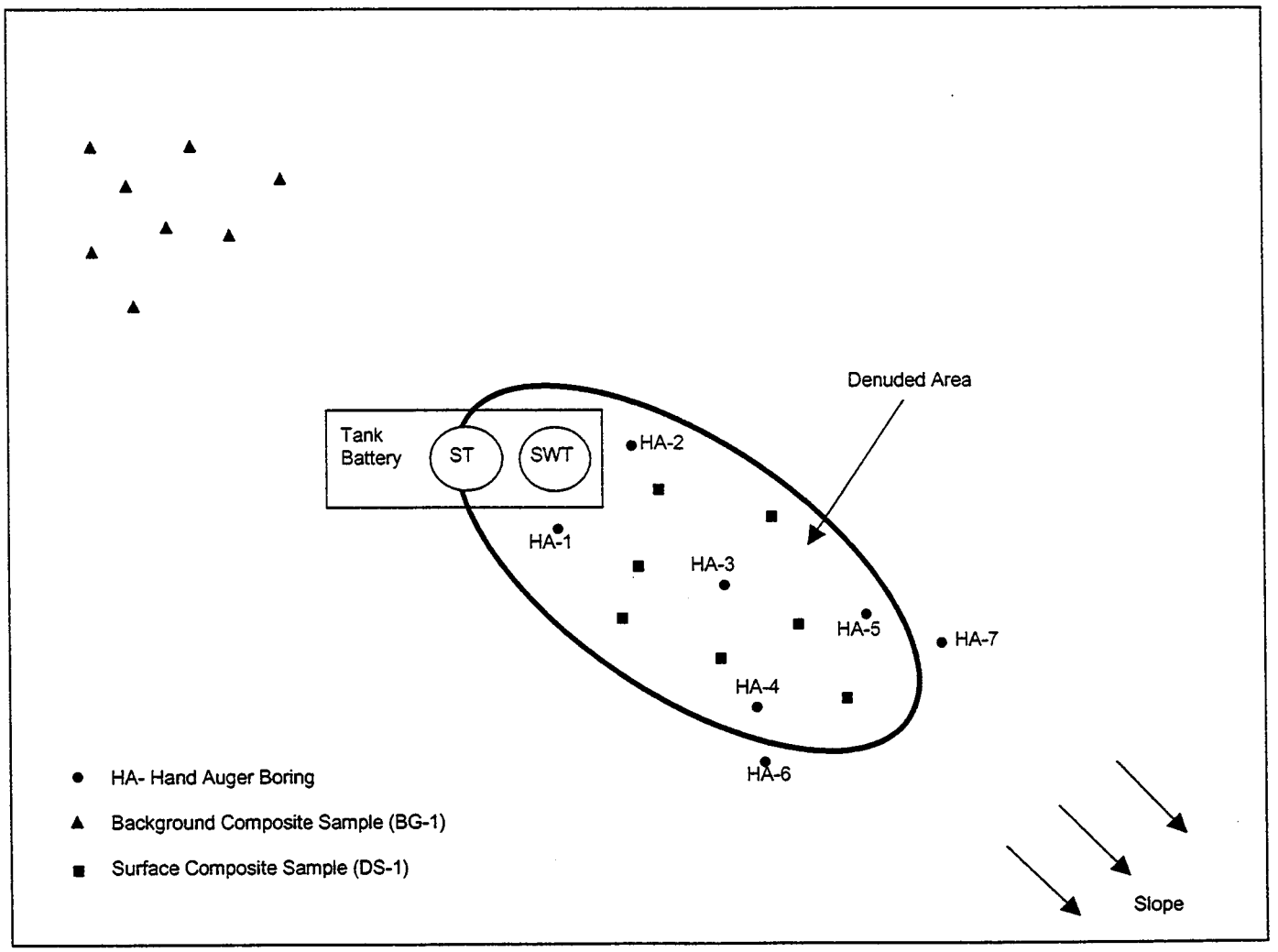
Slope 1 to 5% Distance to Surface Water 500 Feet

Aerial Extent of Impact 450 square feet Depth of Impact 3 feet

Physical Hazards Overhead electric lines, pumping unit

Other Issues

SITE SKETCH



Scale 1 inch ≅ 40 Feet

Soil Boring Log

Lease Name:	ABC Unit #1		
Operator:	ABC Operating		
County:	Seminole	Soil Boring ID	HA-1
State:	OK	Soil Boring Location	NW portion of impact
Spot Location:	NW/4 NW/4 NW/4 Sec. 15-T8N-R5E	Drilling Date:	1/1/00
Logged by:	John Doe	Drilling Company:	
		Driller:	
Surface Cover:	Soil/denuded	Driller's Assistant:	
Plugging Material:	Not Applicable	Drilling Method:	Hand Auger
Total boring depth:	4 feet	Sampling Method:	Hand Auger

Depth	Sample Description
0-4'	Sandy Loam, brown, moist
TD - 4 feet	

Soil Boring Log

Lease Name:	ABC Unit #1		
Operator:	ABC Operating		
County:	Seminole	Soil Boring ID	HA-2
State:	OK	Soil Boring Location	NE portion of impact
Spot Location:	NW/4 NW/4 NW/4 Sec. 15-T8N-R5E	Drilling Date:	1/1/00
Logged by:	John Doe	Drilling Company:	
		Driller:	
Surface Cover:	Soil/denuded	Driller's Assistant:	
Plugging Material:	Not Applicable	Drilling Method:	Hand Auger
Total boring depth:	3.5 feet	Sampling Method:	Hand Auger

Depth	Sample Description
0-4'	Sandy Loam, brown, moist
TD - 4 feet	

Soil Boring Log

Lease Name:	ABC Unit #1		
Operator:	ABC Operating		
County:	Seminole	Soil Boring ID	HA-3
State:	OK	Soil Boring Location	Ceter of impact
Spot Location:	NW/4 NW/4 NW/4 Sec. 15-T8N-R5E	Drilling Date:	1/1/00
Logged by:	John Doe	Drilling Company:	
		Driller:	
Surface Cover:	Soil/denuded	Driller's Assistant:	
Plugging Material:	Not Applicable	Drilling Method:	Hand Auger
Total boring depth:	3.5 feet	Sampling Method:	Hand Auger

Depth	Sample Description
0-4'	Sandy Loam, brown, moist
TD - 4 feet	

Soil Boring Log

Lease Name:	ABC Unit #1		
Operator:	ABC Operating		
County:	Seminole	Soil Boring ID	HA-4
State:	OK	Soil Boring Location	SW portion of impact
Spot Location:	NW/4 NW/4 NW/4	Drilling Date:	1/1/00
	Sec. 15-T8N-R5E		
Logged by:	John Doe	Drilling Company:	
		Driller:	
Surface Cover:	Soil/denuded	Driller's Assistant:	
Plugging Material:	Not Applicable	Drilling Method:	Hand Auger
Total boring depth:	3.5 feet	Sampling Method:	Hand Auger

Depth	Sample Description
0-4'	Sandy Loam, brown, moist
TD - 4 feet	

Soil Boring Log

Lease Name:	ABC Unit #1		
Operator:	ABC Operating		
County:	Seminole	Soil Boring ID	HA-5
State:	OK	Soil Boring Location	SE portion of impact
Spot Location:	NW/4 NW/4 NW/4	Drilling Date:	1/1/00
	Sec. 15-T8N-R5E		
Logged by:	John Doe	Drilling Company:	
		Driller:	
Surface Cover:	Soil/denuded	Driller's Assistant:	
Plugging Material:	Not Applicable	Drilling Method:	Hand Auger
Total boring depth:	3.5 feet	Sampling Method:	Hand Auger

Depth	Sample Description
0-4'	Sandy Loam, brown, moist
TD - 4 feet	

Soil Boring Log

Lease Name:	ABC Unit #1		
Operator:	ABC Operating		
County:	Seminole	Soil Boring ID	HA-6
State:	OK	Soil Boring Location	SW of impact
Spot Location:	NW/4 NW/4 NW/4	Drilling Date:	1/1/00
	Sec. 15-T8N-R5E		
Logged by:	John Doe	Drilling Company:	
		Driller:	
Surface Cover:	Grass	Driller's Assistant:	
Plugging Material:	Not Applicable	Drilling Method:	Hand Auger
Total boring depth:	3.5 feet	Sampling Method:	Hand Auger

Depth	Sample Description
0-4'	Sandy Loam, brown, moist, rootlets
TD - 4 feet	

Soil Boring Log

Lease Name:	ABC Unit #1		
Operator:	ABC Operating		
County:	Seminole	Soil Boring ID	HA-7
State:	OK	Soil Boring Location	SE of impact
Spot Location:	NW/4 NW/4 NW/4 Sec. 15-T8N-R5E	Drilling Date:	1/1/00
Logged by:	John Doe	Drilling Company:	
		Driller:	
Surface Cover:	Grass	Driller's Assistant:	
Plugging Material:	Not Applicable	Drilling Method:	Hand Auger
Total boring depth:	3.5 feet	Sampling Method:	Hand Auger

Depth	Sample Description
0-4'	Sandy Loam, brown, moist, rootlets
TD - 4 feet	

Table 1
ABC Unit #1 - Tank Battery Impact
Agronomy Analytical Results

SAMPLE ID	BG-1	DS-1	HA-1	HA-1	HA-2	HA-2	HA-3
SAMPLE TYPE	Grab	Grab	Grab	Grab	Grab	Grab	Grab
SAMPLE DATE	Jan-00	Jan-00	Jan-00	Jan-00	Jan-00	Jan-00	Jan-00
SAMPLE DEPTH	0-6"	0-6"	1-2'	3-4'	1-2'	3-4'	1-2'

AGRONOMY ANALYSIS	METHOD	UNITS	TARGET LEVEL						
Electrical Conductivity, EC	SMT	umhos / cm	4000	2988	23564	17560	4320	18652	3256	15654
pH	SMT	su	–	7.3	6.5	6.6	6.3	6.9	7.1	7.3
Boron, B	SMT	ppm	–	0.1	0.23	0.56	0.23	0.26	0.18	0.21
Sodium, Na	SMT	ppm	–	85	4562	5045	242	1456	102	1543
Calcium, Ca	SMT	ppm	–	372	501	780	282	351	194	474
Magnesium, Mg	SMT	ppm	–	58	94	177	62	55	53	89
Potassium, K	SMT	ppm	–	53	92	33	106	50	44	78
Total Soluble Salts, TSS	SMT	ppm	2600	1972	15552	11590	2851	12310	2149	10332
Sodium Adsorption Ratio, SAR	SMT	su	12	5	15.1	55.3	3.4	1.6	0.6	17.1
Exchangable Sodium Percent, ESP	SMT	%	15	3.4	25.3	28.1	3.6	23.5	8.3	28.6
Potassium Adsorption Ratio, PAR	SMT	su	–	0.4	0.6	0.2	0.9	0.4	0.4	0.5
Exchangable Potassium Percent, EPP	SMT	%	–	7.4	8.8	5.1	11.3	7.1	7.5	8.2

KEY
SMT - Salinity Management Test
conducted at the Soil, Water and Forage Laboratory
umhos / cm - micromhos per centimeter
su - standard units
ppm - parts per million

Table 1
ABC Unit #1 - Tank Battery Impact
Agronomy Analytical Results

SAMPLE ID	HA-3	HA-4	HA-4	HA-5	HA-5	HA-6	HA-7
SAMPLE TYPE	Grab	Grab	Grab	Grab	Grab	Grab	Grab
SAMPLE DATE	Jan-00	Jan-00	Jan-00	Jan-00	Jan-00	Jan-00	Jan-00
SAMPLE DEPTH	3-4'	1-2'	3-4'	1-2'	3-4'	0-4'	0-4'

AGRONOMY ANALYSIS	METHOD	UNITS	TARGET LEVEL							
Electrical Conductivity, EC	SMT	umhos / cm	4000	3477	20085	3028	17560	2988	2589	3054
pH	SMT	su	–	6.8	7.7	6.5	7.3	7	6.9	6.4
Boron, B	SMT	ppm	–	0.26	0.43	0.15	0.15	0.25	0.17	0.18
Sodium, Na	SMT	ppm	–	120	1256	186	987	147	105	98
Calcium, Ca	SMT	ppm	–	351	930	291	229	286	305	198
Magnesium, Mg	SMT	ppm	–	55	209	197	62	53	64	52
Potassium, K	SMT	ppm	–	50	200	19	36	65	82	59
Total Soluble Salts, TSS	SMT	ppm	2600	2295	13256	1998	11590	1972	1709	2016
Sodium Adsorption Ratio, SAR	SMT	su	12	1.6	32	21.4	5.8	5	5	5
Exchangable Sodium Percent, ESP	SMT	%	15	5.6	31.3	6.8	19.3	5.3	4.8	5.3
Potassium Adsorption Ratio, PAR	SMT	su	–	0.4	0.9	0.1	0.3	0.4	0.4	0.4
Exchangable Potassium Percent, EPP	SMT	%	–	7.1	11.6	4.7	6.5	7.4	7.4	7.4

KEY
SMT - Salinity Management Test
conducted at the Soil, Water and Forage Laboratory
umhos / cm - micromhos per centimeter
su - standard units
ppm - parts per million

Table 1
ABC Unit #1 - Tank Battery Impact
Agronomy Analytical Results

SAMPLE ID	PS-1	PS-2
SAMPLE TYPE	Grab	Grab
SAMPLE DATE	Jul-00	Jan-01
SAMPLE DEPTH	0-6"	0-6"

AGRONOMY ANALYSIS	METHOD	UNITS	TARGET LEVEL		
Electrical Conductivity, EC	SMT	umhos / cm	4000	9652	3258
pH	SMT	su	–	6.9	6.8
Boron, B	SMT	ppm	–	0.31	0.28
Sodium, Na	SMT	ppm	–	1986	205
Calcium, Ca	SMT	ppm	–	204	203
Magnesium, Mg	SMT	ppm	–	48	56
Potassium, K	SMT	ppm	–	62	53
Total Soluble Salts, TSS	SMT	ppm	2600	6370	2150
Sodium Adsorption Ratio, SAR	SMT	su	12	5	5
Exchangable Sodium Percent, ESP	SMT	%	15	19.6	13.4
Potassium Adsorption Ratio, PAR	SMT	su	–	0.4	0.4
Exchangable Potassium Percent, EPP	SMT	%	–	7.4	7.4

KEY
SMT - Salinity Management Test
conducted at the Soil, Water and Forage Laboratory
umhos / cm - micromhos per centimeter
su - standard units
ppm - parts per million

Hydrocarbon Restoration Example

Scenario: Several areas of hydrocarbons were discovered at the surface in a field between the pumping unit and the tank battery. The areas appeared to be in close proximity to the subsurface flowline from the well to the tank battery.

- A backhoe was used to excavate around the flowline to determine if a leak had occurred. A leak was discovered in the line (See Site Sketch, On-Site Assessment Form). The line was repaired and the excavated material was stockpiled on plastic sheeting.
- A physical assessment and sampling of the site was performed to document the release and physical characteristics of the site (see Site Data Evaluation Form and On-Site Assessment Form).
- To determine the extent of impact, seven (7) boreholes were advanced with hand augers in the vicinity of the leak and surface hydrocarbons. Locations of the borings are depicted on the Site Sketch in the On-Site Assessment Form and visual observations from the borings are included in the Soil Boring Logs.
- Samples were collected from each of the borings and from the stock-piled material. Sample results are summarized in Table 1 - Analytical results.
- Based on the analytical results and sample locations, it was estimated that the volume of soil that had been impacted by the line leak was approximately 50 cubic yards (15 feet by 30 feet by 3 feet).
- It was determined, by a review of the available restoration protocols and economics, that the preferred disposal option would be road spreading.
- An application for applying the hydrocarbon impacted soil to a local county road was prepared and forwarded to the state regulatory agency (See Application For Oil or Drill Cuttings Use by County Commissioners).
- Upon approval of the permit, the hydrocarbon impacted soil was removed and transported to the county road. County personnel applied the material to the road.
- Hydrocarbon impacted soil was removed to the point that there was no visual indications of impact. At this point, a confirmatory soil sample was collected from the base and sides of the

excavated area. Concentrations in the sample were below regulatory levels; therefore, no further soil was excavated.

- The excavation was filled with fill material compacted and graded to blend with the existing terrain. The disturbed area was planted in cover consistent with the surrounding area.

SITE DATA EVALUATION

Operator: ABC Operating Lease Name: ABC Unit #1

Spot: NW/4 NW/4 NW/4 Sec. 15 T 8N R 5E County Seminole State OK

Soil Characteristics

Soil Horizon (Name) Asher Texture Clay loam

Permeability 0.6 to 2 inches/hour Slope 1 to 5%

Depth to Water 50 feet Depth to Bedrock Less than 5 feet

Erosion Factor Not Available Shrink-Swell Potential Moderate

Flood Potential Moderate Land Uses Range/Pastureland

Crop/Vegetation Suitability Little Bluestem, Big Bluestem, Switchgrass, Indiangrass

SAR Not Available CEC Not Available Salinity Not Available pH 6.8 to 7.9

Geology

Uppermost Bedrock (Name) Vanoss (Pennsylvanian) Bedrock Thickness 250 feet

Bedrock Type Shale w/crossbedded sandstone Depth to Bedrock 5 to 50 feet

Hydrology

Site Underlain by Aquifer ☒Yes ☐No ☐Major ☒Minor Aquifer Recharge Area ☐Yes ☒No

Aquifer Name Vamoosa Depth to Water 50 feet

Water Quality Fair (500 to 1,000 ppm TDS) Water Quantity 50 gpm

Distance and type of nearest wells Greater than 1 mile

Hydrologically Sensitive Area ☐ Yes ☒ No

Climate

Annual Precipitation 39 inches Annual Evaporation 25 inches

Regulatory

List Regulatory Agencies	Contact	Number
Oklahoma Corporation Commission	Jack Doe	(555) 555-1234
BLM	Bob Doe	(555) 555-2345

Remediation Alternatives (List and determine if applicable based on site data and regulatory constraints)

In situ Bioremediation	☒**Yes** ☐**NO**
Land Application	☒**Yes** ☐**NO**
Bioremediation	☒**Yes** ☐**NO**
Road Spreading	☒**Yes** ☐**NO**
Off-site Disposal	☒**Yes** ☐**NO**

ON-SITE ASSESSMENT FORM

Operator: ABC Operating Lease Name: ABC Unit #1

Spot: NW/4 NW/4 NW/4 Sec. 15 T 8N R 5E County Seminole State OK

Form Prepared By: John Doe Date: 1/1/2000

Land Use Range/Pasture Vegetation Bermuda/Native Grasses

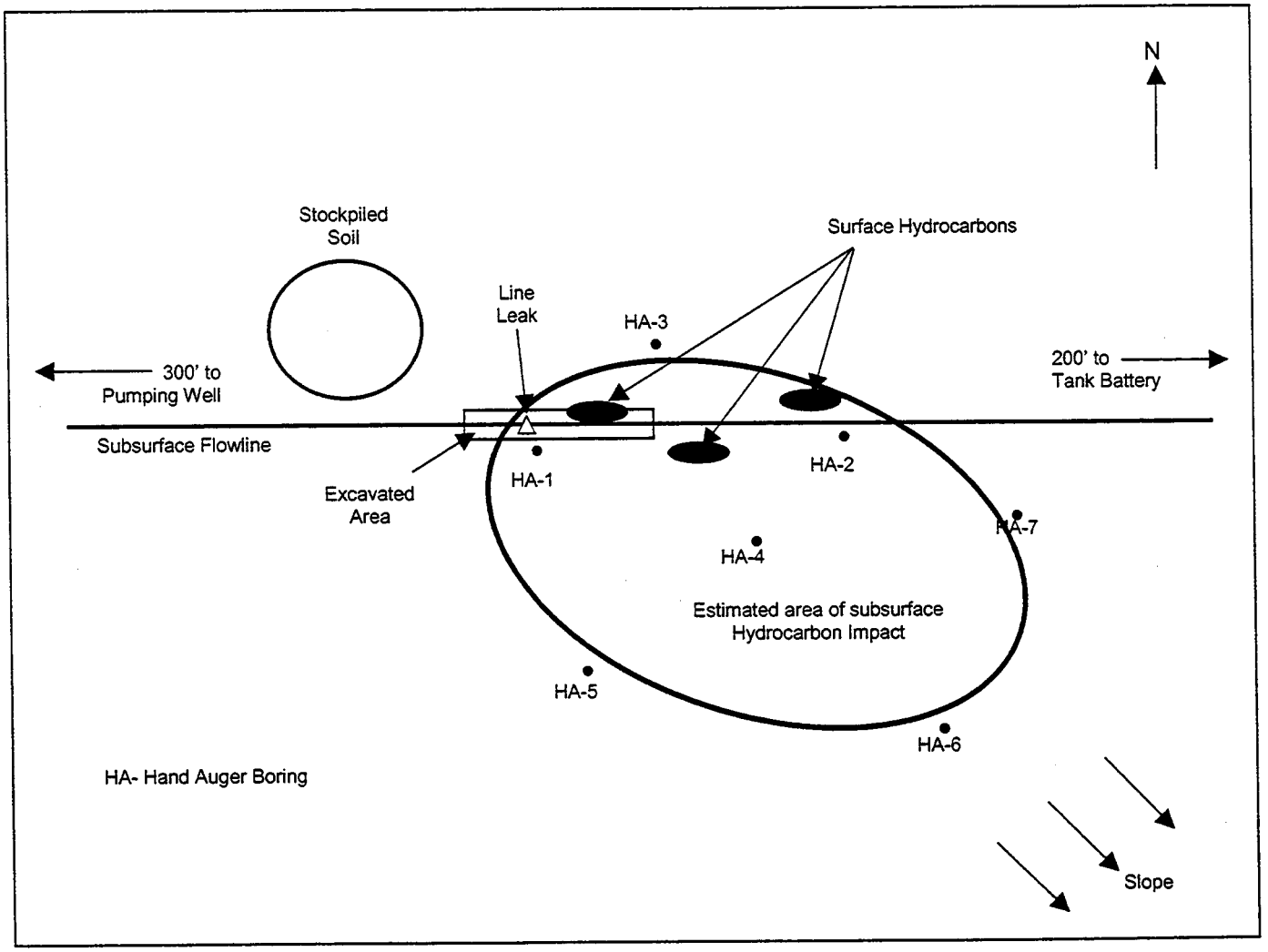
Slope 1 to 5% Distance to Surface Water 500 Feet

Aerial Extent of Impact 450 square feet Depth of Impact 3.5 feet

Physical Hazards Overhead electric lines, pumping unit

Other Issues

SITE SKETCH



Scale 1 Inch ≅ 10 feet

Soil Boring Log

Lease Name:	ABC Unit #1		
Operator:	ABC Operating		
County:	Seminole	Soil Boring ID	HA-1
State:	OK	Soil Boring Location	5 feet south of line leak
Spot Location:	NW/4 NW/4 NW/4	Drilling Date:	1/1/00
	Sec. 15-T8N-R5E		
Logged by:	John Doe	Drilling Company:	
		Driller:	
Surface Cover:	Hydrocarbon/soil	Driller's Assistant:	
Plugging Material:	Not Applicable	Drilling Method:	Hand Auger
Total boring depth:	3.5 feet	Sampling Method:	Hand Auger

Depth	Sample Description
0-1'	Loam, dark brown, moist
1 - 3.5 feet	Clay, dark brown, moist, medium plasticity, hydrocarbon staining, odor
3.5 feet	Sandstone
TD - 3.5 feet	

Soil Boring Log

Lease Name:	ABC Unit #1		
Operator:	ABC Operating		
County:	Seminole	Soil Boring ID	HA-2
State:	OK	Soil Boring Location	20 feet east of line leak
Spot Location:	NW/4 NW/4 NW/4	Drilling Date:	1/1/00
	Sec. 15-T8N-R5E		
Logged by:	John Doe	Drilling Company:	
		Driller:	
Surface Cover:	Hydrocarbon/soil	Driller's Assistant:	
Plugging Material:	Not Applicable	Drilling Method:	Hand Auger
Total boring depth:	3.5 feet	Sampling Method:	Hand Auger

Depth	Sample Description
0-1'	Loam, dark brown, moist
1 - 3.5 feet	Clay, dark brown, moist, medium plasticity, hydrocarbon staining, odor
3.5 feet	Sandstone
TD - 3.5 feet	

Soil Boring Log

Lease Name:	ABC Unit #1		
Operator:	ABC Operating		
County:	Seminole	Soil Boring ID	HA-3
State:	OK	Soil Boring Location	15 feet W/NW of line leak
Spot Location:	NW/4 NW/4 NW/4	Drilling Date:	1/1/00
	Sec. 15-T8N-R5E		
Logged by:	John Doe	Drilling Company:	
		Driller:	
Surface Cover:	Hydrocarbon/soil	Driller's Assistant:	
Plugging Material:	Not Applicable	Drilling Method:	Hand Auger
Total boring depth:	3.5 feet	Sampling Method:	Hand Auger

Depth	Sample Description
0-1'	Loam, dark brown, moist
1 - 3.5 feet	Clay, dark brown, moist, medium plasticity
3.5 feet	Sandstone
TD - 3.5 feet	

Soil Boring Log

Lease Name:	ABC Unit #1		
Operator:	ABC Operating		
County:	Seminole	Soil Boring ID	HA-4
State:	OK	Soil Boring Location	15 feet E/SE of line leak
Spot Location:	NW/4 NW/4 NW/4	Drilling Date:	1/1/00
	Sec. 15-T8N-R5E		
Logged by:	John Doe	Drilling Company:	
		Driller:	
Surface Cover:	Hydrocarbon/soil	Driller's Assistant:	
Plugging Material:	Not Applicable	Drilling Method:	Hand Auger
Total boring depth:	3.5 feet	Sampling Method:	Hand Auger

Depth	Sample Description
0-1'	Loam, dark brown, moist
1 - 3.5 feet	Clay, dark brown, moist, medium plasticity, hydrocarbon staining, odor
3.5 feet	Sandstone
TD - 3.5 feet	

Soil Boring Log

Lease Name:	ABC Unit #1		
Operator:	ABC Operating		
County:	Seminole	Soil Boring ID	HA-5
State:	OK	Soil Boring Location	15 feet south of line leak
Spot Location:	NW/4 NW/4 NW/4	Drilling Date:	1/1/00
	Sec. 15-T8N-R5E		
Logged by:	John Doe	Drilling Company:	
		Driller:	
Surface Cover:	Hydrocarbon/soil	Driller's Assistant:	
Plugging Material:	Not Applicable	Drilling Method:	Hand Auger
Total boring depth:	3.5 feet	Sampling Method:	Hand Auger

Depth	Sample Description
0-1'	Loam, dark brown, moist
1 - 3.5 feet	Clay, dark brown, moist, medium plasticity
3.5 feet	Sandstone
TD - 3.5 feet	

Soil Boring Log

Lease Name:	ABC Unit #1		
Operator:	ABC Operating		
County:	Seminole	Soil Boring ID	HA-6
State:	OK	Soil Boring Location	30 feet SE of line leak
Spot Location:	NW/4 NW/4 NW/4	Drilling Date:	1/1/00
	Sec. 15-T8N-R5E		
Logged by:	John Doe	Drilling Company:	
		Driller:	
Surface Cover:	Hydrocarbon/soil	Driller's Assistant:	
Plugging Material:	Not Applicable	Drilling Method:	Hand Auger
Total boring depth:	3.5 feet	Sampling Method:	Hand Auger

Depth	Sample Description
0-1'	Loam, dark brown, moist
1 - 3.5 feet	Clay, dark brown, moist, medium plasticity
3.5 feet	Sandstone
TD - 3.5 feet	

Soil Boring Log

Lease Name:	ABC Unit #1		
Operator:	ABC Operating		
County:	Seminole	Soil Boring ID	HA-7
State:	OK	Soil Boring Location	35 feet E/SE of line leak
Spot Location:	NW/4 NW/4 NW/4	Drilling Date:	1/1/00
	Sec. 15-T8N-R5E		
Logged by:	John Doe	Drilling Company:	
		Driller:	
Surface Cover:	Hydrocarbon/soil	Driller's Assistant:	
Plugging Material:	Not Applicable	Drilling Method:	Hand Auger
Total boring depth:	3.5 feet	Sampling Method:	Hand Auger

Depth	Sample Description
0-1'	Loam, dark brown, moist
1 - 3.5 feet	Clay, dark brown, moist, medium plasticity
3.5 feet	Sandstone
TD - 3.5 feet	

Table 1
ABC Unit #1 Flowline Leak
Soil Analytical Results

SAMPLE ID	HA-1	HA-2	HA-4	HA-3,5,6,7	SS-1	Conf-1
SAMPLE DEPTH	1-3.5'	1-3.5'	1-3.5'	0-3.5'		
SAMPLE DATE	1/1/00	1/1/00	1/1/00	1/1/00	1/1/00	4/12/00

SOIL ANALYSIS	METHOD	UNITS	PQL					
Chloride	325.3	mg/Kg	10	176.1	186.3	168.3	154.6	168.9	126.3
Conductivity	120.1	umho/cm	NA	224.5	236.9	220.5	205.8	248.3	205.6
Benzene	8020	mg/Kg	0.1	0.005	0.004	0.004	BPQL	0.003	BPQL
Toluene	8020	mg/Kg	0.1	0.015	0.011	0.0052	BPQL	0.0086	BPQL
Ethylbenzene	8020	mg/Kg	0.1	0.022	0.009	0.015	BPQL	0.058	BPQL
Xylenes	8020	mg/Kg	0.1	0.085	0.052	0.158	BPQL	0.189	BPQL
TPH - diesel	8015M	mg/Kg	10	20,458	12,562	8,253	42	18,586	23

KEY
TPH - Total Petroleum Hydrocarbons
mg/Kg - milligrams per Kilogram
umho/cm - micromhos per centimeter
BPQL - Below Practical Quantitation Limit

OKLAHOMA CORPORATION COMMISSION
Oil & Gas Conservation Division
Post Office Box 52000-2000
Oklahoma City, Oklahoma 73152-2000

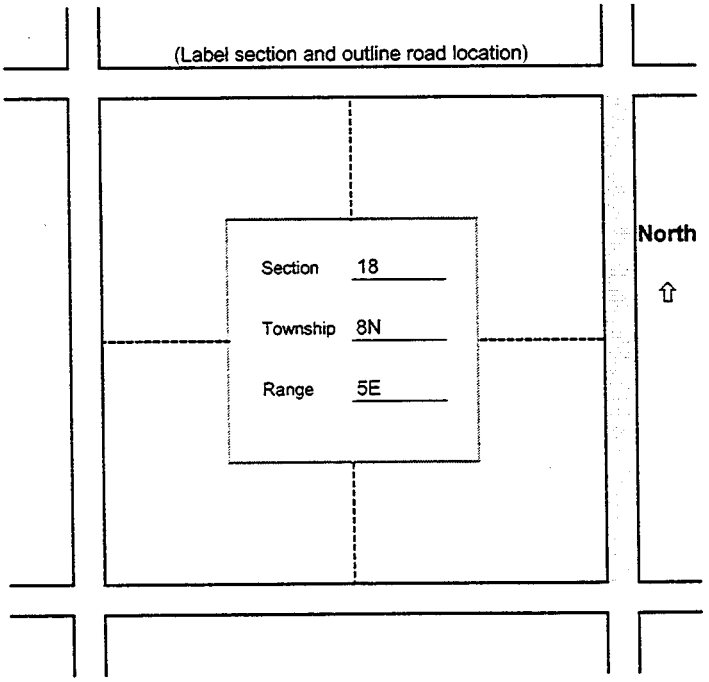
Form 1014W
Rev. 1996

Application For Oil or Drill Cuttings Use By County Commissioners

OAC 165:10-7-22 and 165:10-7-28

PLEASE TYPE OR PRINT WITH BLACK INK

Operator ABC Operating			OCC No. 458976
Address 555 North Commerce Street			Phone No. (555) 555-3456
City Seminole	State OK	Zip 74884	FAX No. (555) 555-8642
Road Location East Section Line Road Section 18-T8N-R5E			County Oklahoma
Source of Material Hydrocarbon spill from line leak			Volume bbls. 50 cu.yd.
Proposed Hauler AAA Trucking			Phone No. (555) 555-6897
Proposed Beginning Date 4/1/00		Proposed Completion Date 5/1/00	



MATERIAL TO BE APPLIED

- [ ] Waste Oil or Waste Oil Residue
- [x] Crude Oil Contaminated Soil
- [ ] Oil-Based Drill Cuttings
- [ ] Freshwater Drill Cuttings

I hereby certify that I am authorized to submit this application which was prepared by me or under my supervision. The facts and proposals made herein are true, correct and complete to the best of my knowledge and belief. If approved, all work will be performed in accordance with applicable OCC rules.

Signature

15-Mar-00
Date

(OVER)

FOR OCC USE ONLY

[X] **APPROVED** [ ] **DISAPPROVED**

District Manager	3/25/00 Date	856932 Permit No.

Duration of Permit: From 4/1/00 To 5/1/00
(Maximum 60 days) Mo/Day/Year Mo/Day/Year

PERMIT REQUIREMENTS

1. **APPLICANT SHALL NOTIFY THE APPROPRIATE DISTRICT OFFICE TWO (2) DAYS PRIOR TO BEGINNING WASTE APPLICATION.**
2. The applicant shall comply with OAC 165:10-7-22 or 165:10-7-28 as appropriate.
3. Waste oil, waste oil residue, and crude oil contaminated soil applied under this Rule shall contain crude oil and materials produced with crude oil only and shall not contain any refined oils such as motor oils, lubricants, compressor oils or hydraulic fluids.
4. If required by the District Manager, a hydrocarbon analysis shall be submitted with this form. The analysis shall be performed by a state-certified laboratory in accordance with OCC-approved methods.
5. Waste oil, waste oil residue, and crude oil contaminated soil shall be applied in such a manner that pollution of surface or subsurface waters will not likely occur and public and private property adjoining the application site will be protected.
6. All free liquids shall be removed before cuttings are applied.
7. During application, all necessary signs, lights, and other safety and warning devices shall be used as traffic requires to alert users to conditions. A sign shall be posted with the contractor's or authority's name and telephone number to contact in case of an emergency.
8. Materials shall not be applied when the temperature is less than 45°F; in any area where water collects and stands; or where conditions such as grade, soil moisture content, soil type, or tight or packed soil conditions cause runoff or prevent rapid absorption of the oil
9. Proper care shall be taken to avoid runoff of oil into borrow ditches or adjacent areas.
10. Following completion of the project, there shall be a uniform soil/oil (or cuttings) base with no visible free-standing oil
11. **FAILURE TO COMPLY WITH EITHER THE TERMS OF THIS PERMIT OR APPLICABLE RULES SHALL RESULT IN REVOCATION OF THIS PERMIT.**

Pit Closure Example

Scenario: A reserve pit resulting from the drilling of a shallow exploratory dry hole needed to be closed. The pit contained drill cuttings and drilling mud/fluid.

- A physical assessment and sampling of the site was performed to document the chemical characteristics of the pit contents and the physical characteristics of the site (see Site Data Evaluation Form and On-Site Assessment Form).
- To determine if any impact and the extent, a borehole was advanced within the pit. The location of the boring is depicted on the Site Sketch in the On-Site Assessment Form and visual observations from the boring are included in the Soil Boring Log.
- Samples were collected from different depth interval in the boring, from the surface of the pit solids and from the pit fluid.. Sample results are summarized in Table 1 - Analytical results.
- Based on the analytical results, the pit fluid was removed and disposed to a Class II salt water injection well. This decision was based on the slightly elevated chloride levels in the fluid.
- Since there was no indication that the pit solids contained any contaminant concentrations above regulatory limits, the pit solids were minimal, and there was sufficient depth to allow for a minimum of 3 foot of cover over the solids, the pit was closed in place after dewatering.
- The berms of the pit were placed over the pit solids and compacted. The stockpiled topsoil was spread uniformly over the disturbed area and blended with the existing terrain.
- The disturbed area was planted in cover consistent with the surrounding area.

SITE DATA EVALUATION

Operator: ABC Operating Lease Name: ABC Unit #1

Spot: NW/4 NW/4 NW/4 Sec. 15 T 8N R 5E County Seminole State OK

Soil Characteristics

Soil Horizon (Name) Asher Texture Clay loam

Permeability 0.6 to 2 inches/hour Slope 1 to 5%

Depth to Water 50 feet Depth to Bedrock Less than 5 feet

Erosion Factor Not Available Shrink-Swell Potential Moderate

Flood Potential Moderate Land Uses Range/Pastureland

Crop/Vegetation Suitability Little Bluestem, Big Bluestem, Switchgrass, Indiangrass

SAR Not Available CEC Not Available Salinity Not Available pH 6.8 to 7.9

Geology

Uppermost Bedrock (Name) Vanoss (Pennsylvanian) Bedrock Thickness 250 feet

Bedrock Type Shale w/crossbedded sandstone Depth to Bedrock 5 to 50 feet

Hydrology

Site Underlain by Aquifer ☒Yes ☐No ☐Major ☒Minor Aquifer Recharge Area ☐Yes ☒No

Aquifer Name Vamoosa Depth to Water 50 feet

Water Quality Fair (500 to 1,000 ppm TDS) Water Quantity 50 gpm

Distance and type of nearest wells Greater than 1 mile

Hydrologically Sensitive Area ☐ Yes ☒ No

Climate

Annual Precipitation 39 inches Annual Evaporation 25 inches

Regulatory

List Regulatory Agencies	Contact	Number
Oklahoma Corporation Commission	Jack Doe	(555) 555-1234
BLM	Bob Doe	(555) 555-2345

Remediation Alternatives (List and determine if applicable based on site data and regulatory constraints)

Off-site Disposal ☒Yes ☐NO

Land Application ☒Yes ☐NO

Burial/Trenching ☒Yes ☐NO

Road Spreading ☒Yes ☐NO

In-place Closure ☒Yes ☐NO

ON-SITE ASSESSMENT FORM

Operator: ABC Operating Lease Name: ABC Unit #1

Spot: NW/4 NW/4 NW/4 Sec. 15 T 8N R 5E County Seminole State OK

Form Prepared By: John Doe Date: 1/1/2000

Land Use Range/Pasture Vegetation Bermuda/Native Grasses

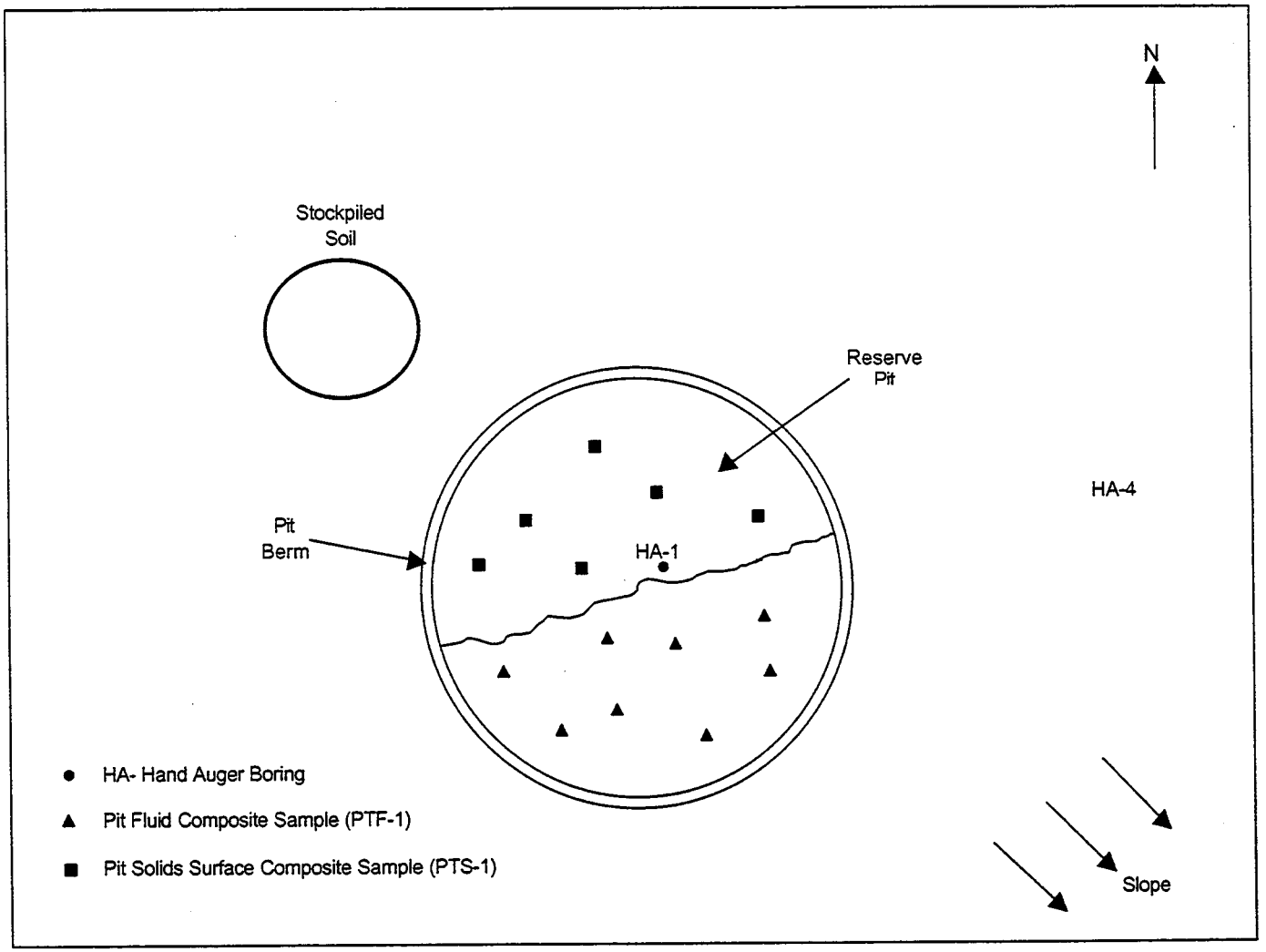
Slope 1 to 5% Distance to Surface Water 500 Feet

Aerial Extent of Impact 3600 square feet Depth of Impact 3 feet

Physical Hazards

Other Issues

SITE SKETCH



Scale 1 Inch ≅ 20 feet

Soil Boring Log

Lease Name:	ABC Unit #1		
Operator:	ABC Operating		
County:	Seminole	Soil Boring ID	HA-1
State:	OK	Soil Boring Location	Center of Reserve Pit
Spot Location:	NW/4 NW/4 NW/4	Drilling Date:	1/1/00
	Sec. 15-T8N-R5E		
Logged by:	John Doe	Drilling Company:	
		Driller:	
Surface Cover:	Pit Solids	Driller's Assistant:	
Plugging Material:	Not Applicable	Drilling Method:	Hand Auger
Total boring depth:	4 feet	Sampling Method:	Hand Auger

Depth	Sample Description
0 - 1.5 feet	Drilling Mud, grey, moist to wet
1.5 - 3 feet	Drilling mud/cuttings, grey, moist
3 - 4 feet	Clay to Clay Loam, dark brown, moist, low plasiticity
TD - 4 feet	

Table 1
ABC Unit #1
Reserve Pit Closure
Analytical Results

SAMPLE ID	PTS-1	HA-1	HA-1	HA-1
SAMPLE DEPTH IN FEET	surface	0-1.5'	1.5-3'	3-4'
SAMPLE DATE	1/1/00	1/1/00	1/1/00	1/1/00

SOIL ANALYSIS	METHOD	UNITS	PQL				
Chloride	325.3	mg/Kg	10	85	36	52	43
Specific Conductance	9050	umho/cm	-	658	436	505	258
Benzene	8020	mg/Kg	0.005	ND	ND	ND	ND
Toluene	8020	mg/Kg	0.005	ND	ND	ND	ND
Ethylbenzene	8020	mg/Kg	0.005	ND	ND	ND	ND
Xylenes	8020	mg/Kg	0.005	ND	ND	ND	ND
TPH - crude oil	8015M	mg/Kg	1	1.2	ND	ND	ND
Arsenic	7060	mg/Kg	3	ND	ND	ND	ND
Barium	6010	mg/Kg	1	1.8	1.2	ND	ND
Cadmium	6010	mg/Kg	1	ND	ND	ND	ND
Chromium	6010	mg/Kg	1	ND	ND	ND	ND
Lead	6010	mg/Kg	1	ND	0.12	ND	ND
Mercury	7471	mg/Kg	0.02	ND	ND	ND	ND
Selenium	7740	mg/Kg	4	ND	ND	ND	ND
Silver	6010	mg/Kg	1	ND	ND	ND	ND
Zinc	6010	mg/Kg	3	ND	ND	ND	ND

KEY
TPH - Total Petroleum Hydrocarbons
mg / Kg - milligrams per Kilogram
umho / cm - micromhos per centimeter
Mg / L - micrograms per Liter
PQL - Practical Quantitation Limit
ND - None Detected greater than Lab PQL

Table 1
ABC Unit #1
Reserve Pit Closure
Analytical Results

SAMPLE ID				PTF - 1
SAMPLE DATE				1/1/00
WATER ANALYSIS	METHOD	UNITS	PQL	
Chloride	300.0	mg/L	0.016	2256
Specific Conductance	120.1	umho/cm		3256
Benzene	8020	mg/L	0.0002	ND
Toluene	8020	mg/L	0.0002	ND
Ethylbenzene	8020	mg/L	0.0002	ND
Xylenes	8020	mg/L	0.0002	ND
TPH - crude oil	8015M	mg/L	1	ND
Arsenic	7060	mg/L	0.03	ND
Barium	6010	mg/L	0.02	0.85
Cadmium	6010	mg/L	0.01	ND
Chromium	6010	mg/L	0.01	ND
Lead	6010	mg/L	0.03	ND
Mercury	7470	mg/L	0.0005	ND
Selenium	7740	mg/L	0.04	ND
Silver	6010	mg/L	0.01	ND
Zinc	6010	mg/L	0.04	ND

KEY
TPH - Total Petroleum Hydrocarbons
mg / Kg - milligrams per Kilogram
umho / cm - micromhos per centimeter
Mg / L - micrograms per Liter
PQL - Practical Quantitation Limit
ND - None Detected greater than Lab PQL

APPENDIX B

FORMS

LEASE INSPECTION SUMMARY

INSPECTION BY:_____ **DATE:**_____

Company _____ Lease _____

Spot Loc. _____ Sec. _____ T _____ R _____

County _____ State _____

Lease Operator _____ Phone _____

# of wells on lease _____ Lease Production Rates _____ BOPD _____ MCFD _____ BWD

Signs (Yes/No) @ Entrance _____ @ Battery _____ @ Well(s) _____

Fencing (Yes/No & Cond.) _____ Gate (Yes/No) _____ Locked (Yes/No) _____

Terrain (Flat, Moderate, Steep) _____ Adjacent Property (ie: wheat field) _____

Soil Type _____ Slope _____

WELLHEAD

Size	Condition

PUMPING UNIT

Size	Condition	Security

OIL TANKS

#	Size	Condition

CONDENSATE TANKS

#	Size	Condition

SALTWATER TANKS

#	Size	Type	Condition	Net Condition

PRODUCTION VESSELS

#	Type	Size	Condition
___	Separator		
___	Heater Treater		
___	Production Unit		
___	Compressor		
___	Circulation Pump		
___	Wellhead/Ppmg Unit		
___	Gunbarrel		
___	FWKO		
___	Other (list)		

CONTAINMENT

Type	Size	Condition/Comments

TIER III CHEMICALS

Storage	Size	Contents/Comments

Piping, Valves, Vents, Hatches, Seals, Etc. (Condition, comments, surficial extent of hydrocarbon impact, etc.)

@ Tanks _____

@ Production Vessels _____

@ Wellhead/Ppmg Unit _____

@ Loading Points _____

ENVIRONMENTAL CONCERNS (Distance to surface water, denuded areas, etc.) _____

_____

_____

SITE DATA EVALUATION

Operator:_____ Lease Name:_____

Spot:_____ Sec._____ T_____ R_____ County_____ State_____

Soil Characteristics

Soil Horizon (Name)_____ Texture_____

Permeability_____ Slope_____

Depth to Water_____ Depth to Bedrock_____

Erosion Factor_____ Shrink-Swell Potential_____

Flood Potential_____ Land Uses_____

Crop/Vegetation Suitability_____

SAR_____ CEC_____ Salinity_____ pH_____

Geology

Uppermost Bedrock (Name)_____ Bedrock Type_____

Bedrock Thickness_____ Depth to Bedrock_____

Hydrology

Site Underlain by Aquifer ☐Yes ☐No ☐Major ☐Minor Aquifer Recharge Area ☐Yes ☐No

Aquifer Name_____ Depth to Water_____

Water Quality_____ Water Quantity_____

Distance and type of nearest wells_____

Hydrologically Sensitive Area ☐ Yes ☐ No

Climate

Annual Precipitation_____ Annual Evaporation_____

Regulatory

List Regulatory Agencies	Contact	Number

Remediation Alternatives (List and determine if applicable based on site data and regulatory constraints)

_____ ☐Yes ☐NO

_____ ☐Yes ☐NO

_____ ☐Yes ☐NO

_____ ☐Yes ☐NO

_____ ☐Yes ☐NO

ON-SITE ASSESSMENT FORM

Operator:_____ Lease Name:_____

Spot:_____ Sec._____ T_____ R_____ County_____ State_____

Form Prepared By:_____ Date:_____

Land Use_____ Vegetation_____

Slope_____ Distance to Surface Water_____

Aerial Extent of Impact_____ Depth of Impact_____

Physical Hazards_____

Other Issues_____

_____

_____

SITE SKETCH

Scale _____

Soil Boring Log

Lease Name: _____
Operator: _____
County: _____
State: _____
Spot Location: _____

Logged by: _____

Surface Cover: _____
Plugging Material: _____
Total boring depth: _____

Soil Boring ID _____
Soil Boring Location _____
Drilling Date: _____

Drilling Company: _____
Driller: _____
Driller's Assistant: _____
Drilling Method: _____
Sampling Method: _____

Depth	Sample Description
0	
5	
10	
15	
20	
25	
30	
35	
40	

ACCIDENT/SPILL REPORT

Operator:_____ Date of Occurrence:_____

Lease Name:_____ Date of Inspection:_____

Spot:_____ Sec.____ T____ R____ County_____ State_____

Type Facility_____ Contact_____

Accident/Spill (Describe in detail including cause, injuries/damage to environment, volume of material lost.)

_____

_____

_____

_____

_____

_____

_____

_____

Section A* (Check all that apply)

- ☐ Release or Fire Consumption of ≥ 100 barrels of fluid or 500 McF of gas
- ☐ Spill, Venting, or Fire in or near sensitive area (park, recreation site, threatened and endangered species habitat, riparian area, water body, urban or suburban area, etc.).
- ☐ Major, Life-threatening, or Fatal injury.
- ☐ Loss of Well Control.
- ☐ Release of Hazardous Substance reportable under EPA 40 CFR part 302.

* Notify BLM within 24 hours if any box in Section A is checked.

Section B** (Check all that apply)

- ☐ Release or Fire Consumption of 10 to 100 barrels of fluid or 50 to 500 McF of gas

** Notify BLM in writing within 10 days if any box in Section A or Section B is checked.

When and where did the incident occur (Attach a site sketch, if necessary)

_____

_____

_____

_____

ACCIDENT/SPILL REPORT

Were Sensitive areas affected? ☐ Yes ☐ No (If Yes, describe)

List Emergency Response Actions

List Preventive Actions to ensure incident will not happen again

Detail Remediation Plan

Form 3160-3
(August 1999)

FORM APPROVED
OMB No. 1004-0136
Expires November 30, 2000

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

APPLICATION FOR PERMIT TO DRILL OR REENTER

	5. Lease Serial No.
	6. If Indian, Allottee or Tribe Name
1a. Type of Work: ❑ DRILL ❑ REENTER	7. If Unit or CA Agreement, Name and No.
1b. Type of Well: ❑ Oil Well ❑ Gas Well ❑ Other ❑ Single Zone ❑ Multiple Zone	8. Lease Name and Well No.
2. Name of Operator	9. API Well No.
3a. Address / 3b. Phone No. *(include area code)*	10. Field and Pool, or Exploratory
4. Location of Well *(Report location clearly and in accordance with any State requirements.*)* At surface At proposed prod. zone	11. Sec., T., R., M., or Blk. and Survey or Area
14. Distance in miles and direction from nearest town or post office*	12. County or Parish / 13. State

15. Distance from proposed* location to nearest property or lease line, ft. (Also to nearest drig. unit line, if any)	16. No. of Acres in lease	17. Spacing Unit dedicated to this well
18. Distance from proposed location* to nearest well, drilling, completed, applied for, on this lease, ft.	19. Proposed Depth	20. BLM/BIA Bond No. on file
21. Elevations (Show whether DF, KDB, RT, GL, etc.)	22. Approximate date work will start*	23. Estimated duration

24. Attachments

The following, completed in accordance with the requirements of Onshore Oil and Gas Order No.1, shall be attached to this form:

1. Well plat certified by a registered surveyor.
2. A Drilling Plan.
3. A Surface Use Plan (if the location is on National Forest System Lands, the SUPO shall be filed with the appropriate Forest Service Office).
4. Bond to cover the operations unless covered by an existing bond on file (see Item 20 above).
5. Operator certification.
6. Such other site specific information and/or plans as may be required by the authorized officer.

25. Signature	Name *(Printed/Typed)*	Date
Title		
Approved by *(Signature)*	Name *(Printed/Typed)*	Date
Title	Office	

Application approval does not warrant or certify the the applicant holds legal or equitable title to those rights in the subject lease which would entitle the applicant to conduct operations thereon.
Conditions of approval, if any, are attached.

Title 18 U.S.C. Section 1001 and Title 43 U.S.C. Section 1212, make it a crime for any person knowingly and willfully to make to any department or agency of the United States any false, fictitious or fraudulent statements or representations as to any matter within its jurisdiction.

**(Instructions on reverse*

INSTRUCTIONS

GENERAL: This form is designed for submitting proposals to perform certain well operations, as indicated on Federal and Indian lands and leases for action by appropriate Federal agencies, pursuant to applicable Federal laws and regulations. Any necessary special instructions concerning the use of this form and the number of copies to be submitted, particularly with regard to local, area, or regional procedures and practices, either are shown below or will be issued by, or may be obtained from local Federal offices.

ITEM 1: If the proposal is to redrill to the same reservoir at a different subsurface location or to a new reservoir, use this form with appropriate notations. Consult applicable Federal regulations concerning subsequent work proposals or reports on the well.

ITEM 4: Locations on Federal or Indian land should be described in accordance with Federal requirements. Consult local Federal offices for specific instructions.

ITEM 14: Needed only when location of well cannot readily be found by road from the land or lease description. A plat, or plats, separate or on this reverse side, showing the roads to, and the surveyed location of, the well, and any other required information, should be furnished when required by Federal agency offices.

ITEMS 15 AND 18: If well is to be, or has been directionally drilled, give distances for subsurface location of hole in any present or objective production zone.

ITEM 22: Consult applicable Federal regulations, or appropriate officials, concerning approval of the proposal before operations are started.

BLM would like you to know that you do not have to respond to this or any other Federal agency-sponsored information collection unless it displays a currently valid OMB control number.

NOTICE

The Privacy Act of 1974 and regulation in 43 CFR 2.48(d) provide that you be furnished the following information in connection with information required by this application.

AUTHORITY: 30 U.S.C. 181 et seq., 25 U.S.C. 396; 43 CFR 3160

PRINCIPAL PURPOSES: The information will be used to: (1) process and evaluate your application for a permit to drill a new oil, gas, or service well or to reenter a plugged and abandoned well; and (2) document, for administrative use, information for the management, disposal and use of National Resource Lands and resources including (a) analyzing your proposal to discover and extract the Federal or Indian resources encountered; (b) reviewing procedures and equipment and the projected impact on the land involved; and (c) evaluating the effects of the proposed operation on the surface and subsurface water and other environmental impacts.

ROUTINE USE: Information from the record and/or the record will be transferred to appropriate Federal, State, and local or foreign agencies, when relevant to civil, criminal or regulatory investigations or prosecution, in connection with congressional inquiries and for regulatory responsibilities.

EFFECT OF NOT PROVIDING INFORMATION: Filing of this application and disclosure of the information is mandatory only if you elect to initiate a drilling or reentry operation on an oil and gas lease.

BURDEN HOURS STATEMENT

Public reporting burden for this form is estimated to average 30 minutes per response, including the time for reviewing instructions, gathering and maintaining data, and completing and reviewing the form. Direct comments regarding the burden estimate or any other aspect of this form to U.S. Department of the Interior, Bureau of Land Management, Bureau Clearance Officer, (WO-630) MS 401 LS, 1849 C Street, N.W., Washington, D.C. 20240, and the Office of Management and Budget, Interior Desk Officer (1004-0136), Washington, D.C. 20503.

The Paperwork Reduction Act of 1980 (44 U.S.C. 3501 et seq.) requires us to inform you that:

This information is being collected to allow evaluation of the technical, safety, and environmental factors involved with drilling for oil and/or gas on Federal and Indian oil and gas leases.

This information will be used to analyze and approve applications.

Response to this request is mandatory only if the operator elects to initiate drilling or reentry operations on an oil and gas lease.

Form 3160-5
(August 1999)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

FORM APPROVED
OMB No. 1004-0135
Expires November 30, 2000

SUNDRY NOTICES AND REPORTS ON WELLS

Do not use this form for proposals to drill or to re-enter abandoned well. Use Form 3160-3 (APD) for such proposals.

SUBMIT IN TRIPLICATE - Other instructions on reverse si

5. Lease Serial No.

6. If Indian, Allottee or Tribe Name

7. If Unit or CA/Agreement, Name and/or No.

1. Type of Well
   ☐ Oil Well ☐ Gas Well ☐ Other

8. Well Name and No.

2. Name of Operator

9. API Well No.

3a. Address

3b. Phone No. *(include area code)*

10. Field and Pool, or Exploratory Area

4. Location of Well *(Footage, Sec., T., R., M., or Survey Description)*

11. County or Parish, State

12. CHECK APPROPRIATE BOX(ES) TO INDICATE NATURE OF NOTICE, REPORT, OR OTHER DATA

TYPE OF SUBMISSION	TYPE OF ACTION			
☐ Notice of Intent	☐ Acidize	☐ Deepen	☐ Production (Start/Resume)	☐ Water Shut-Off
☐ Subsequent Report	☐ Alter Casing	☐ Fracture Treat	☐ Reclamation	☐ Well Integrity
☐ Final Abandonment Notice	☐ Casing Repair	☐ New Construction	☐ Recomplete	☐ Other _____
	☐ Change Plans	☐ Plug and Abandon	☐ Temporarily Abandon	
	☐ Convert to Injection	☐ Plug Back	☐ Water Disposal	

13. Describe Proposed or Completed Operation (clearly state all pertinent details, including estimated starting date of any proposed work and approximate duration thereof. If the proposal is to deepen directionally or recomplete horizontally, give subsurface locations and measured and true vertical depths of all pertinent markers and zones. Attach the Bond under which the work will be performed or provide the Bond No. on file with BLM/BIA. Required subsequent reports shall be filed within 30 days following completion of the involved operations. If the operation results in a multiple completion or recompletion in a new interval, a Form 3160-4 shall be filed once testing has been completed. Final Abandonment Notices shall be filed only after all requirements, including reclamation, have been completed, and the operator has determined that the site is ready for final inspection.)

14. I hereby certify that the foregoing is true and correct
Name *(Printed/Typed)*

Title

Signature

Date

THIS SPACE FOR FEDERAL OR STATE OFFICE USE

Approved by	Title	Date
Conditions of approval, if any, are attached. Approval of this notice does not warrant or certify that the applicant holds legal or equitable title to those rights in the subject lease which would entitle the applicant to conduct operations thereon.	Office	

Title 18 U.S.C. Section 1001 and Title 43 U.S.C. Section 1212, make it a crime for any person knowingly and willfully to make to any department or agency of the United States any false, fictitious or fraudulent statements or representations as to any matter within its jurisdiction.

GENERAL INSTRUCTIONS

This form is designed for submitting proposals to perform certain well operations, and reports of such operations when completed, as indicated on Federal and Indian lands pursuant to applicable Federal law and regulations. Any necessary special instructions concerning the use of this form and the number of copies to be submitted, particularly with regard to local area, or regional procedures and practices, either are shown below or will be issued by, or may be obtained from the local Federal office.

SPECIFIC INSTRUCTIONS

Item 4 - Locations on Federal or Indian land should be described in accordance with Federal requirements. Consult the local Federal office for specific instructions.

Item 13 - Proposals to abandon a well and subsequent reports of abandonment should include such special information as is required by the local Federal office. In addition, such proposals and reports should include reasons for the abandonment; data on any former or present productive zones, or other zones with present significant fluid contents not sealed off by cement or otherwise; depths (top and bottom) and method of placement of cement plugs; mud or other material placed below, between and above plugs; amount, size, method of parting of any casing, liner or tubing pulled and the depth to top of any left in the hole; method of closing top of well and date well site conditioned for final inspection looking to approval of the abandonment.

NOTICE

The Privacy Act of 1974 and the regulation in 43 CFR 2.48(d) provide that you be furnished the following information in connection with information required by this application.

AUTHORITY: 30 U.S.C. 181 et seq., 351 et seq., 25 U.S.C. 396; 43 CFR 3160.

PRINCIPAL PURPOSE: The information is used to: (1) Evaluate, when appropriate, approve applications, and report completion of subsequent well operations, on a Federal or Indian lease; and (2) document for administrative use, information for the management, disposal and use of National Resource lands and resources, such as: (a) evaluating the equipment and procedures to be used during a proposed subsequent well operation and reviewing the completed well operations for compliance with the approved plan; (b) requesting and granting approval to perform those actions covered by 43 CFR 3162.3-2, 3162.3-3, and 3162.3-4; (c) reporting the beginning or resumption of production, as required by 43 CFR 3162.4-1(c); and (d) analyzing future applications to drill or modify operations in light of data obtained and methods used.

ROUTINE USES: Information from the record and/or the record will be transferred to appropriate Federal, State, local or foreign agencies, when relevant to civil, criminal or regulatory investigations or prosecutions in connection with congressional inquiries or to consumer reporting agencies to facilitate collection of debts owed the Government.

EFFECT OF NOT PROVIDING THE INFORMATION: Filing of this notice and report and disclosure of the information is mandatory for those subsequent well operations specified in 43 CFR 3162.3-2, 3162.3-3, 3162.3-4.

The Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.) requires us to inform you that:

This information is being collected to evaluate proposed and/or completed subsequent well operations on Federal or Indian oil and gas leases.

Response to this request is mandatory.

BLM would like you to know that you do not have to respond to this or any other Federal agency-sponsored information collection unless it displays a currently valid OMB control number.

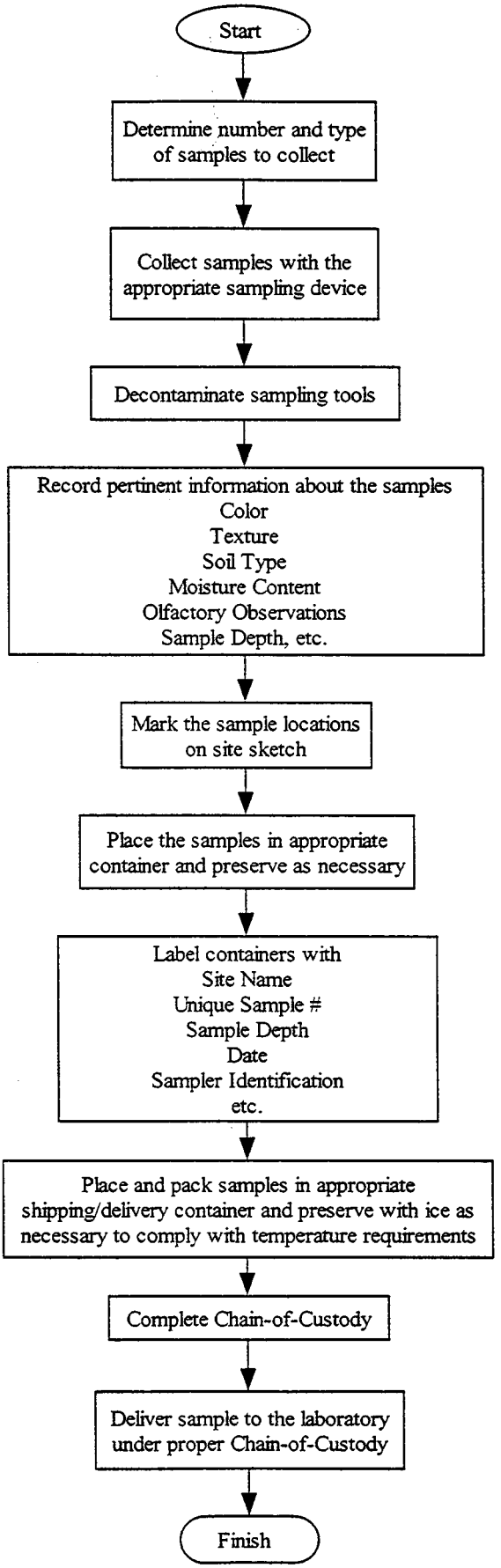
BURDEN HOURS STATEMENT

Public reporting burden for this form is estimated to average 25 minutes per response, including the time for reviewing instructions, gathering and maintaining data, and completing and reviewing the form. Direct comments regarding the burden estimate or any other aspect of this form to U.S. Department of the Interior, Bureau of Land Management, Bureau Clearance Officer, (WO-630), Mail Stop 401 LS, 1849 C St., N.W., Washington D.C. 20240 and the Office of Management and Budget, Interior Desk Officer, (1004-0135), Office of Information and Regulatory Affairs, Washington, D.C. 20503.

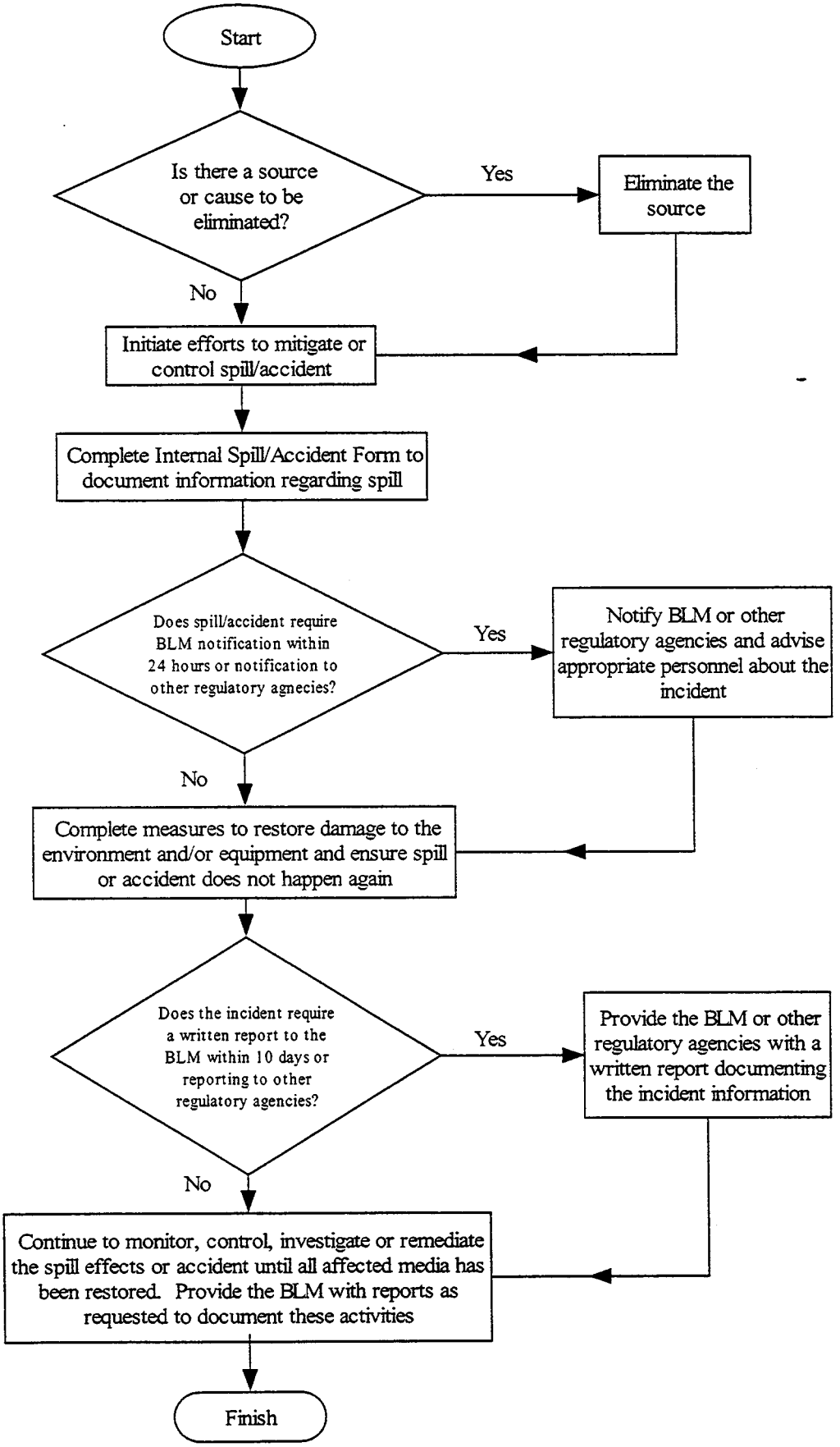
APPENDIX C

FLOWCHARTS

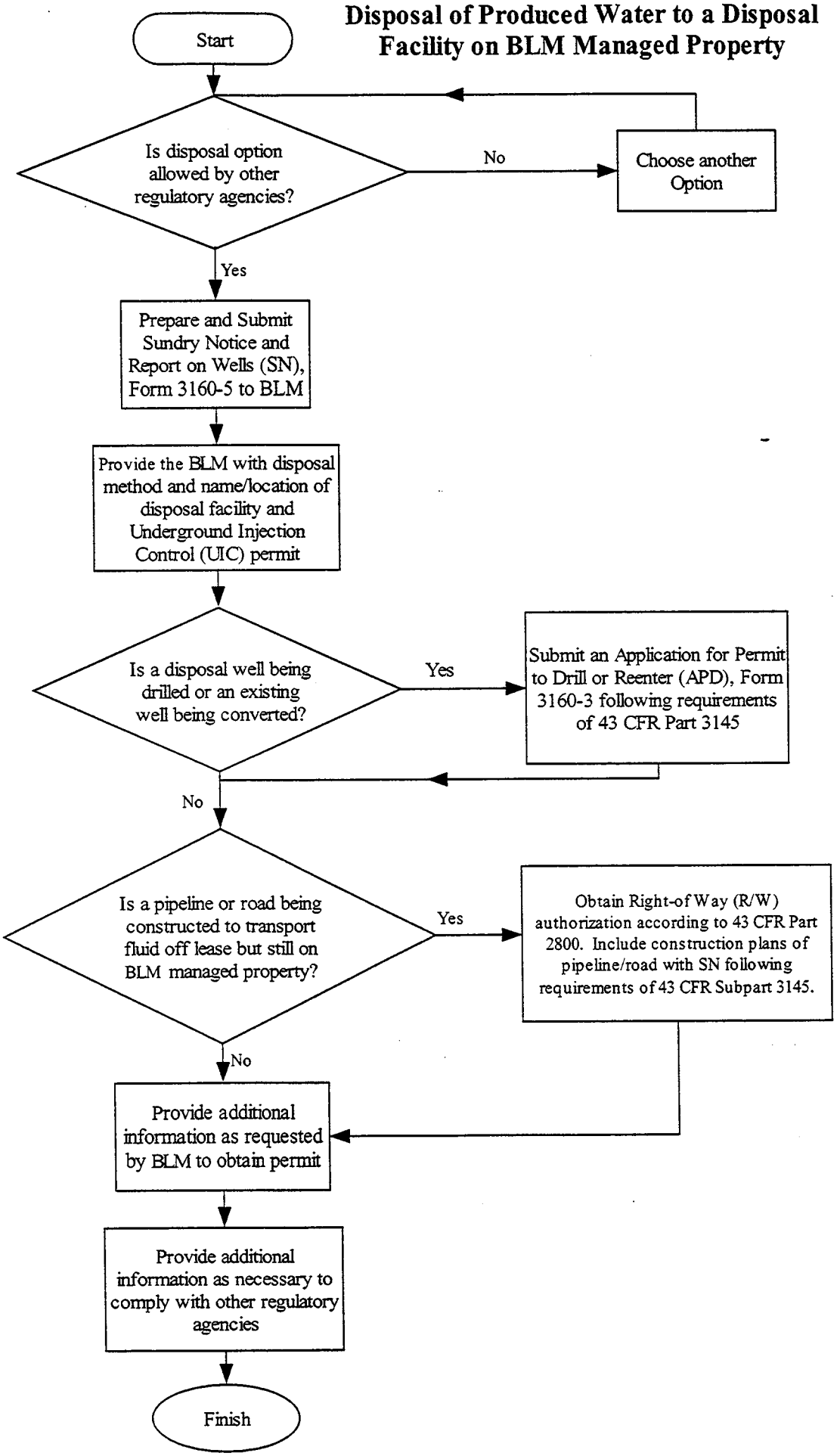
Sampling


Start
Determine number and type of samples to collect
Collect samples with the appropriate sampling device
Decontaminate sampling tools
Record pertinent information about the samples
Color
Texture
Soil Type
Moisture Content
Olfactory Observations
Sample Depth, etc.
Mark the sample locations on site sketch
Place the samples in appropriate container and preserve as necessary
Label containers with
Site Name
Unique Sample #
Sample Depth
Date
Sampler Identification
etc.
Place and pack samples in appropriate shipping/delivery container and preserve with ice as necessary to comply with temperature requirements
Complete Chain-of-Custody
Deliver sample to the laboratory under proper Chain-of-Custody
Finish

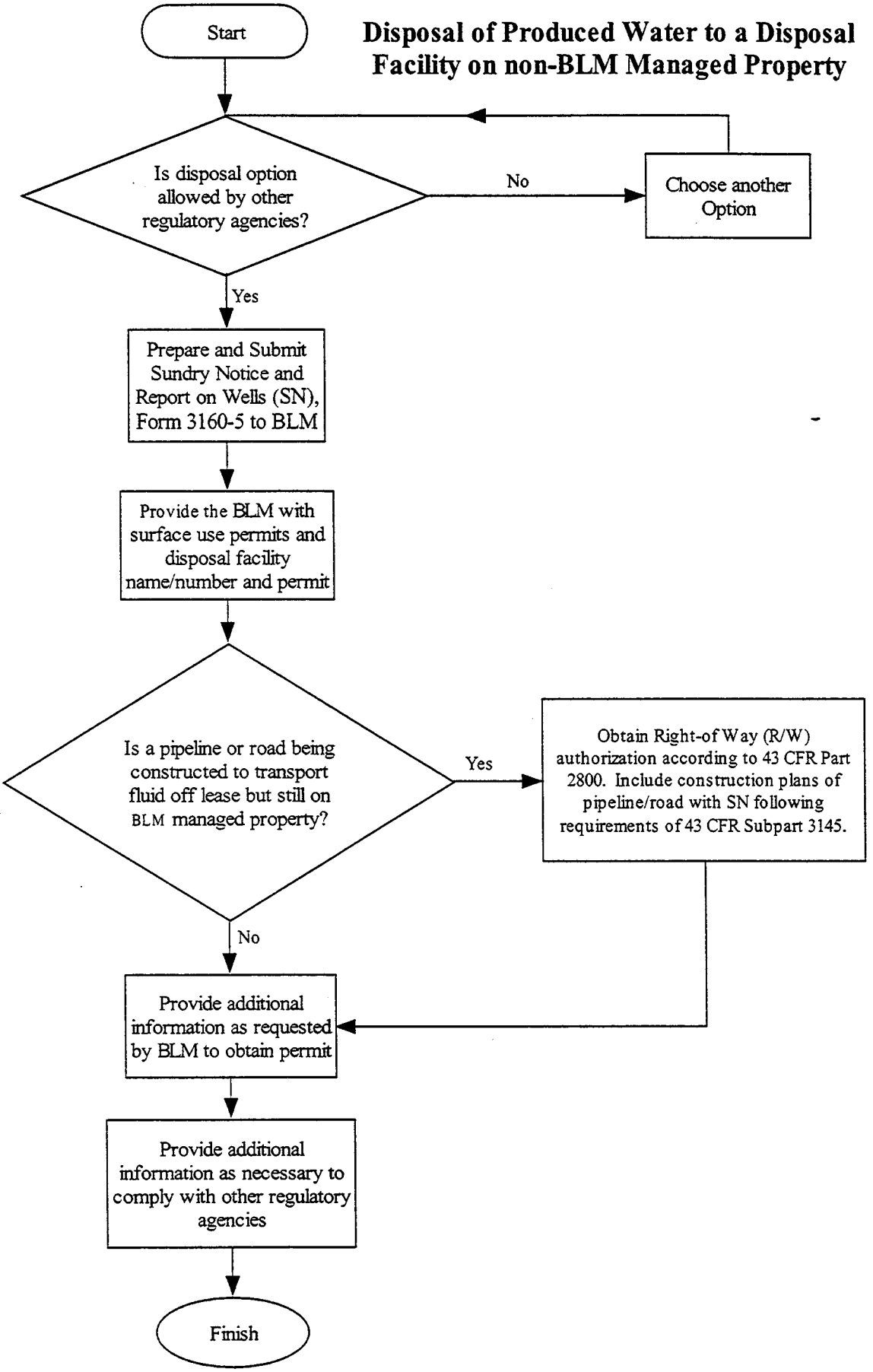
Spill/Accident



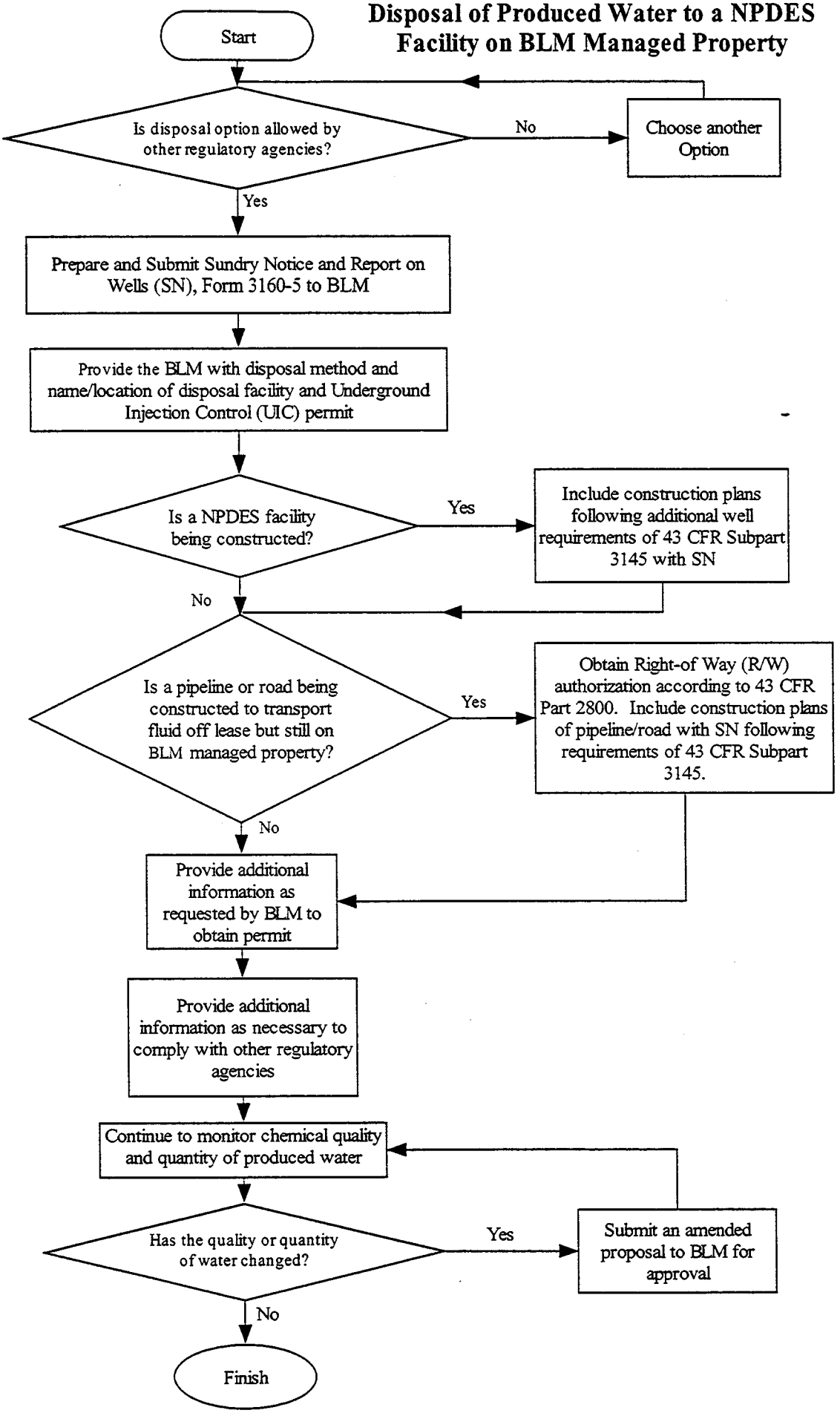
Disposal of Produced Water to a Disposal Facility on BLM Managed Property



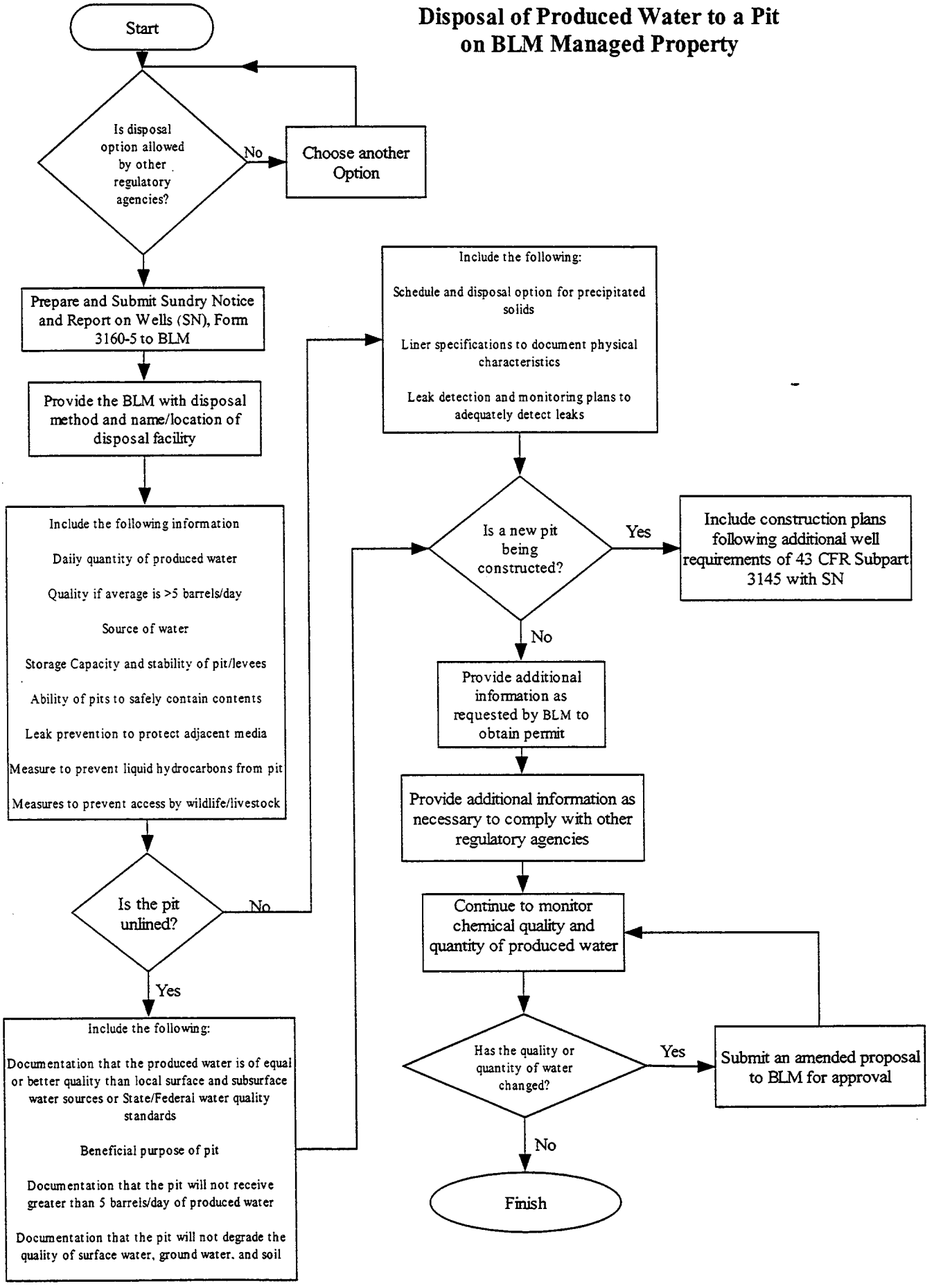
Disposal of Produced Water to a Disposal Facility on non-BLM Managed Property



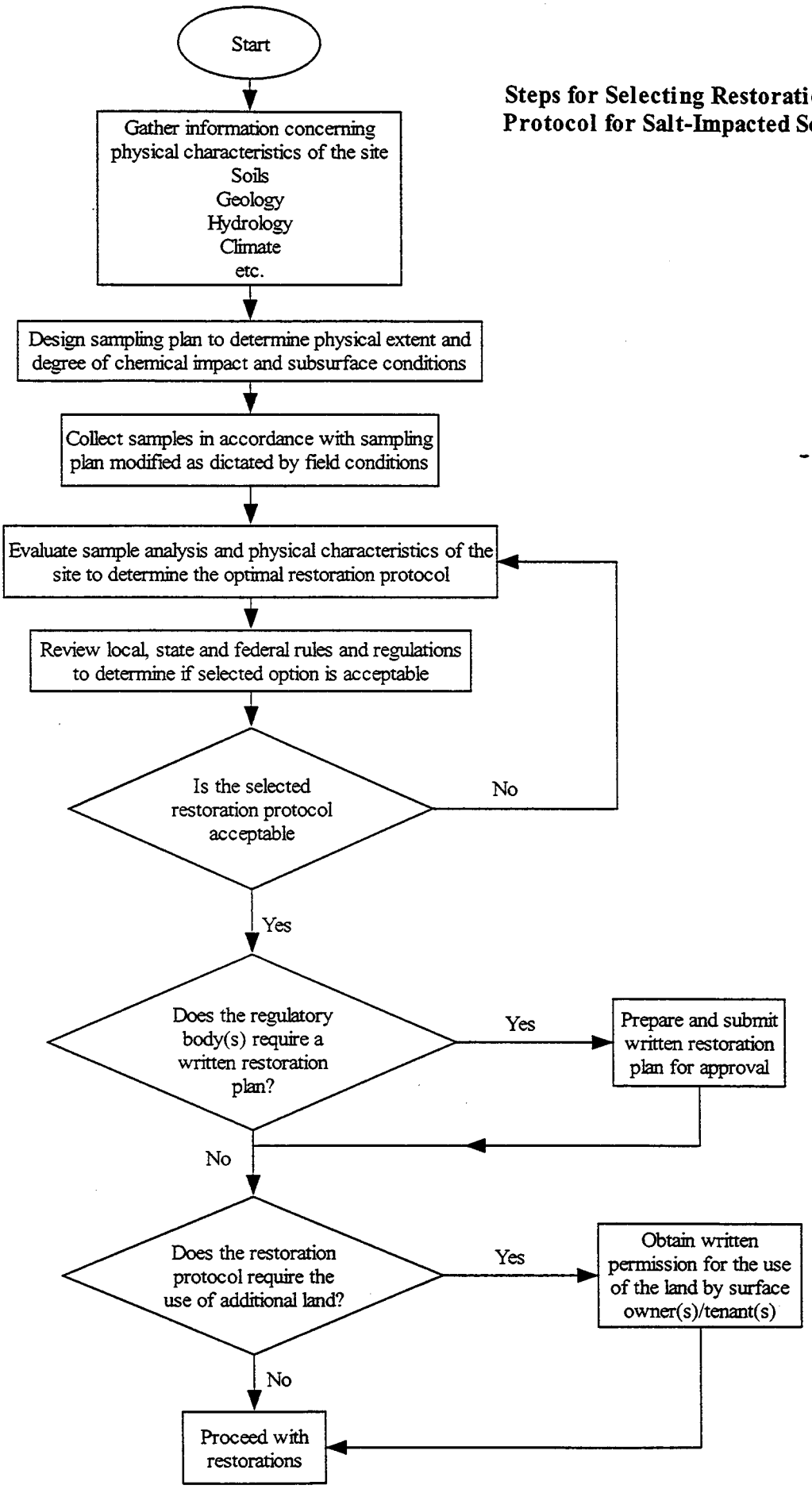
Disposal of Produced Water to a NPDES Facility on BLM Managed Property



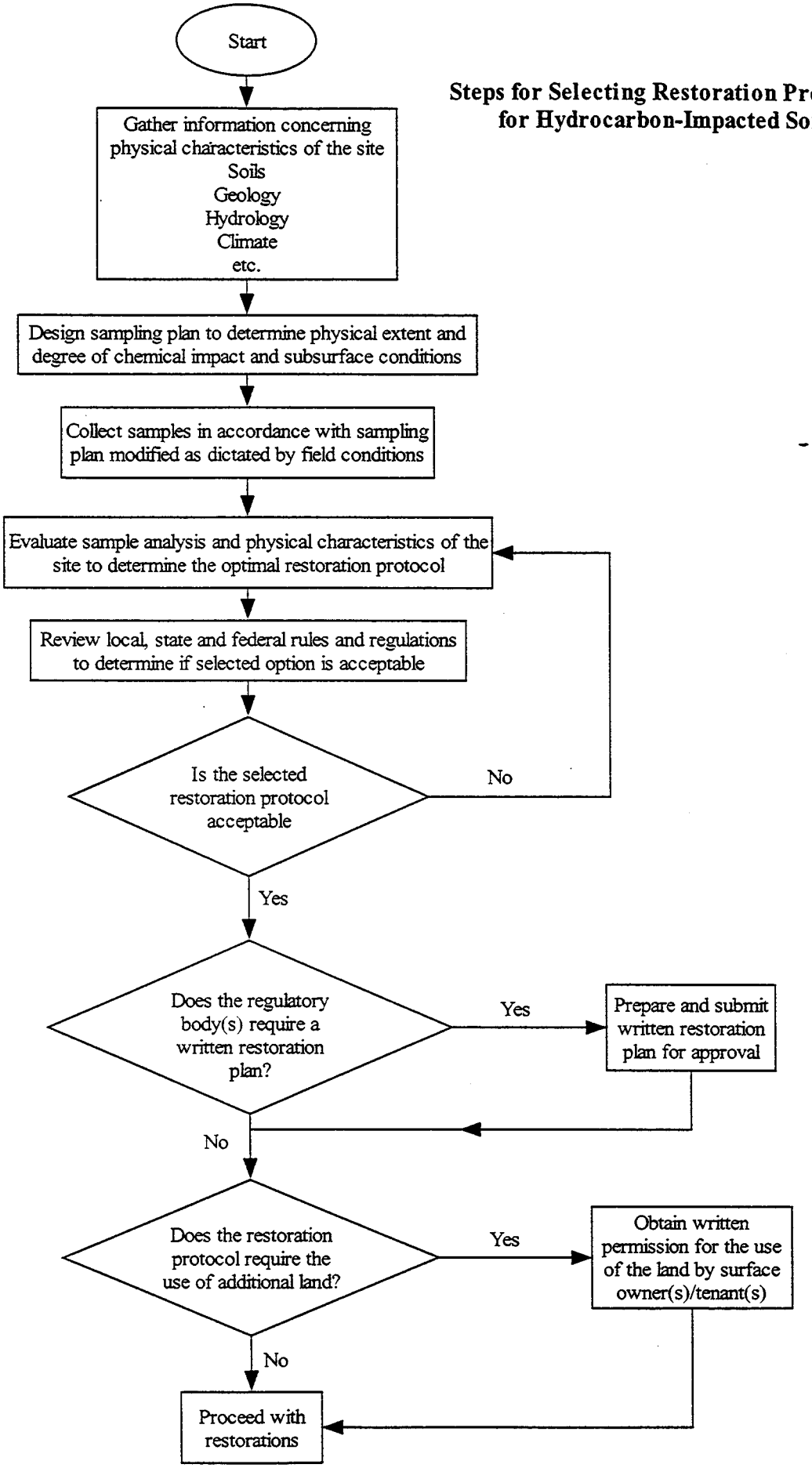
Disposal of Produced Water to a Pit on BLM Managed Property



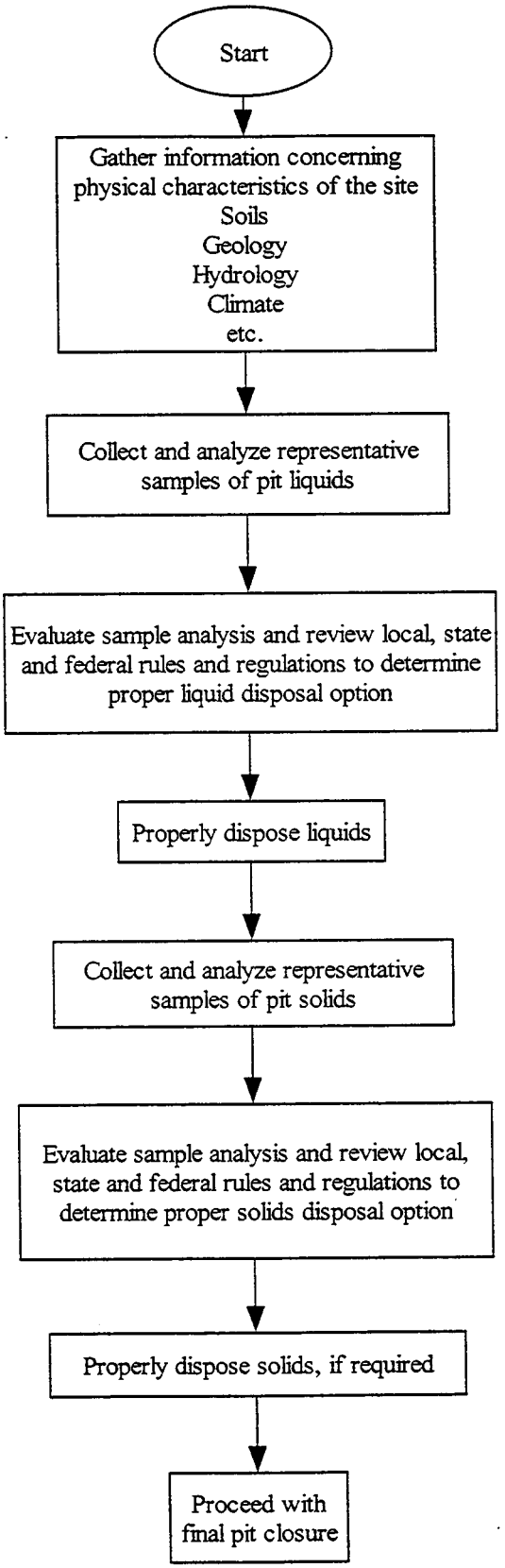
Steps for Selecting Restoration Protocol for Salt-Impacted Soil



Steps for Selecting Restoration Protocol for Hydrocarbon-Impacted Soil

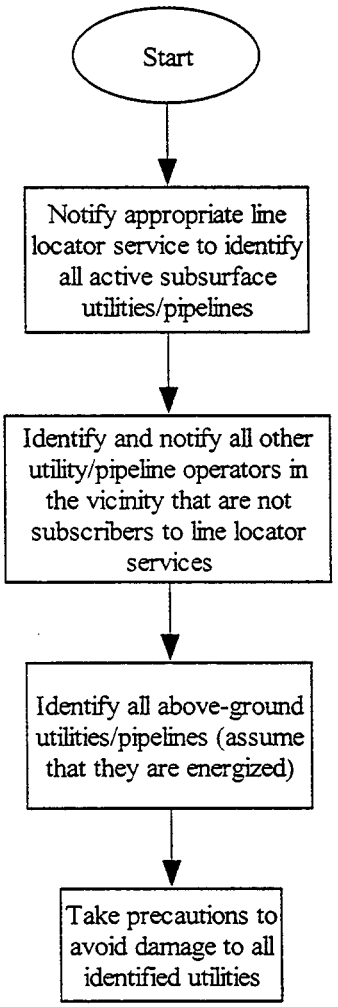


Steps for Pit Closure

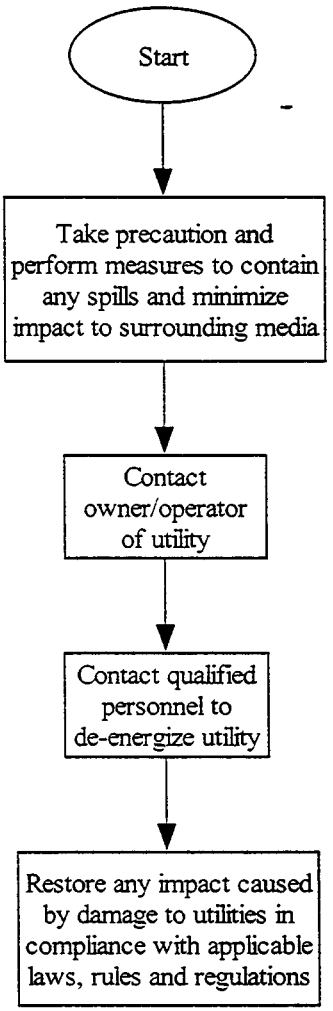


Active Utilities

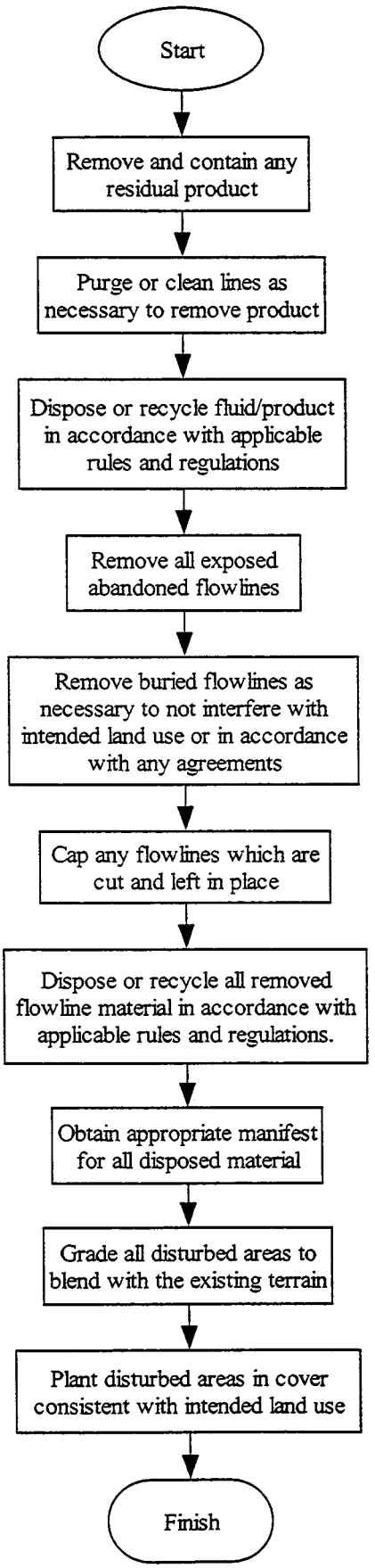
Identification and Notification for Active Utilities



Damage to Active Utilities

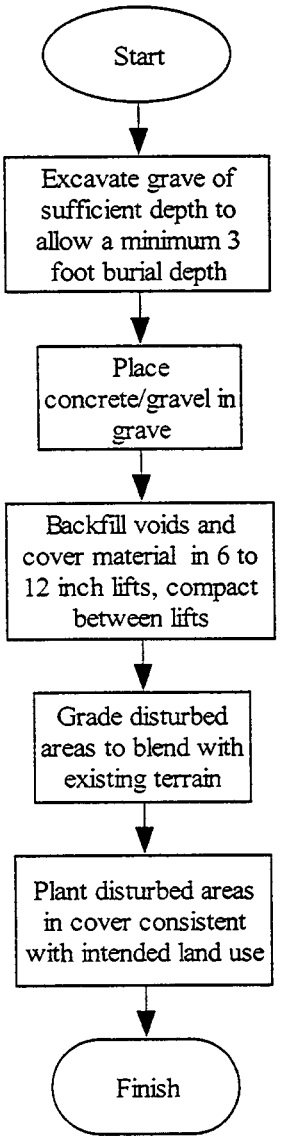


Removal of Abandoned Flowlines

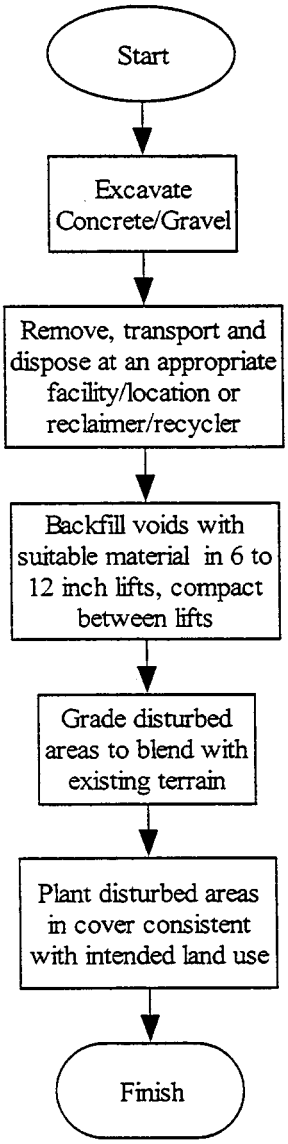


Concrete and Gravel Restoration

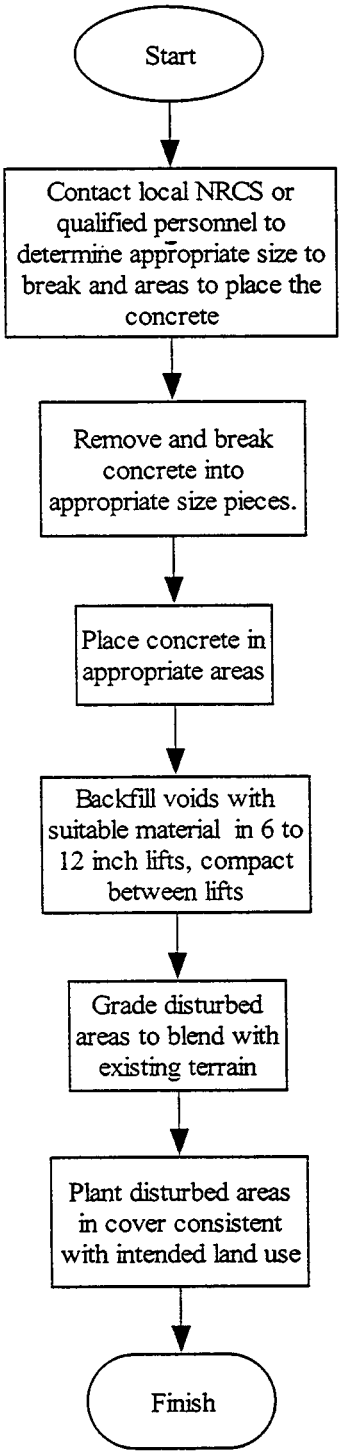
Concrete and Gravel Removal and Burial



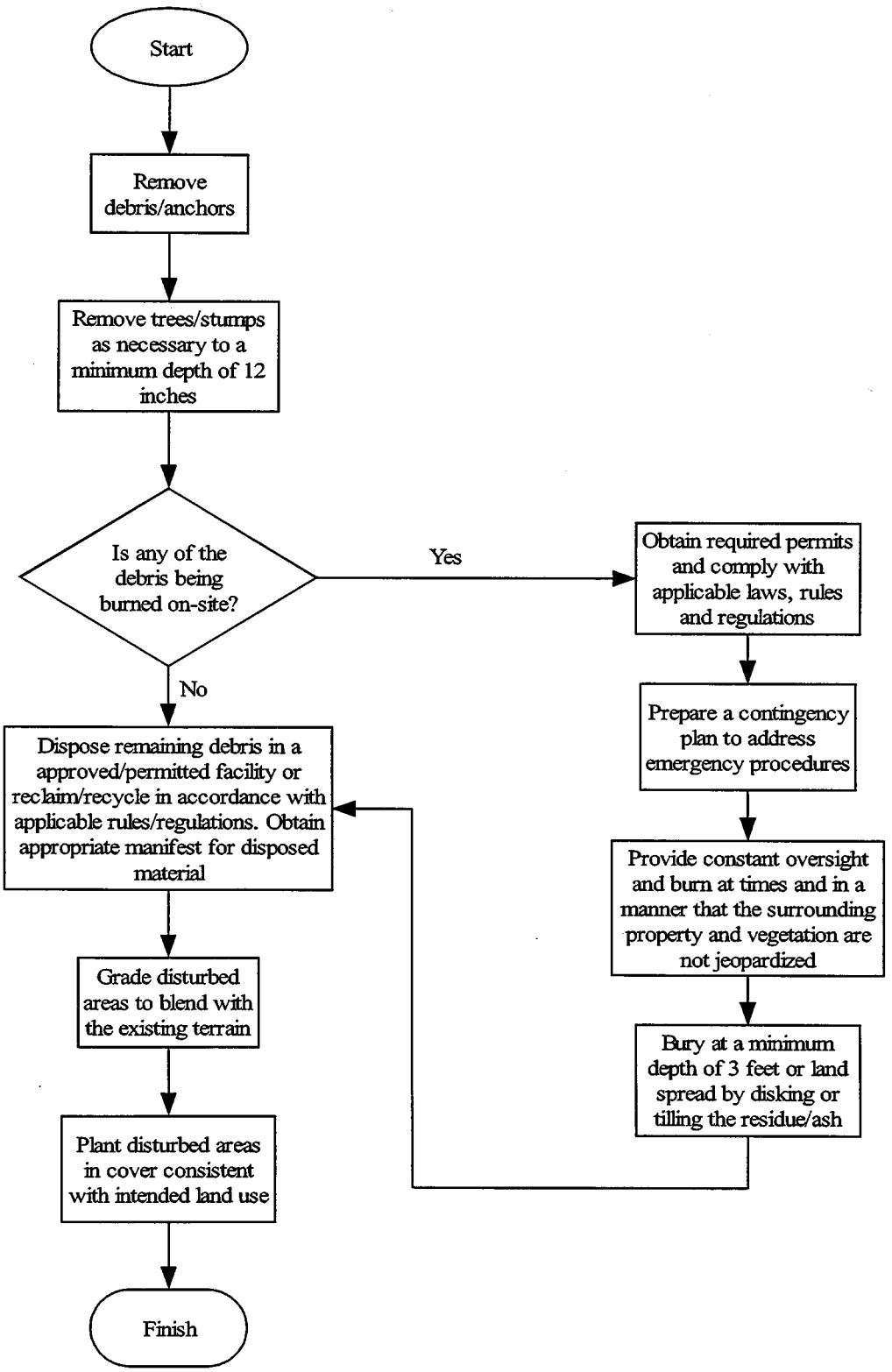
Concrete and Gravel Removal and Off-Site Disposal



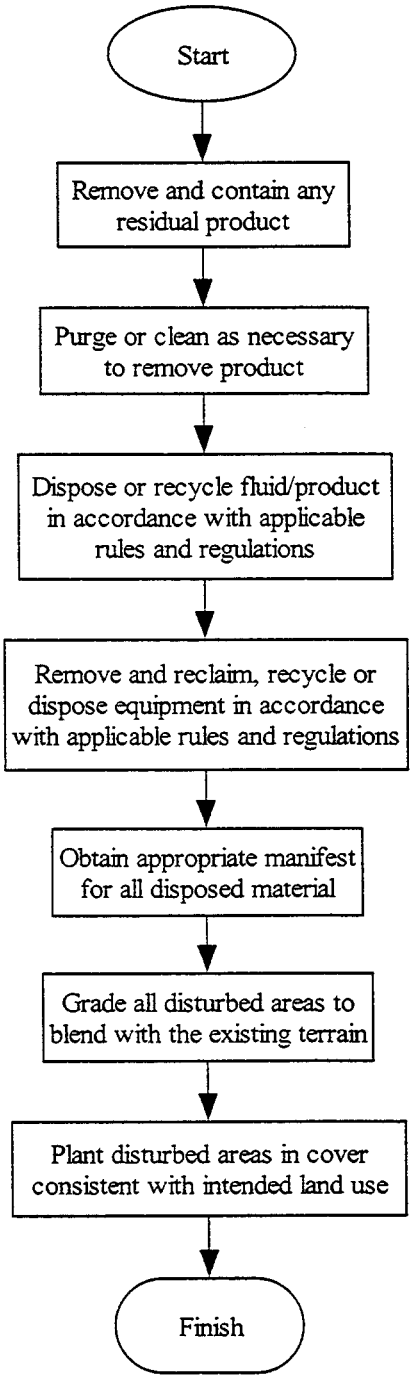
Concrete Removal for On-Site Erosion Control



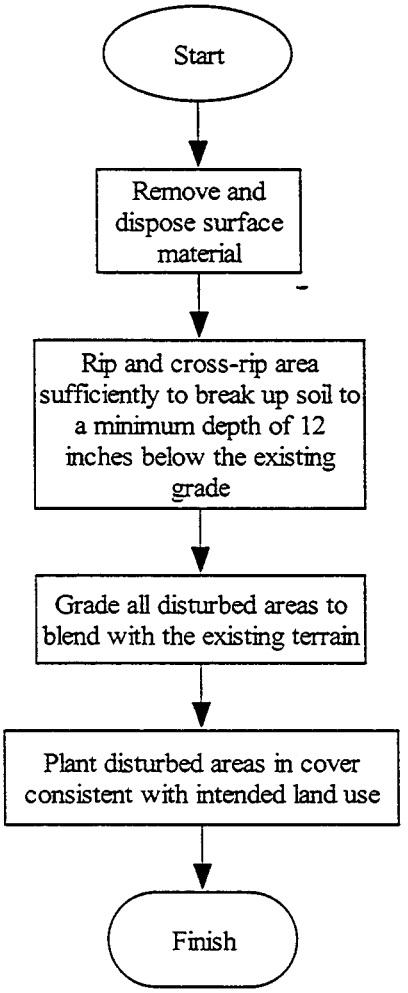
Debris/Anchor Removal and Disposal



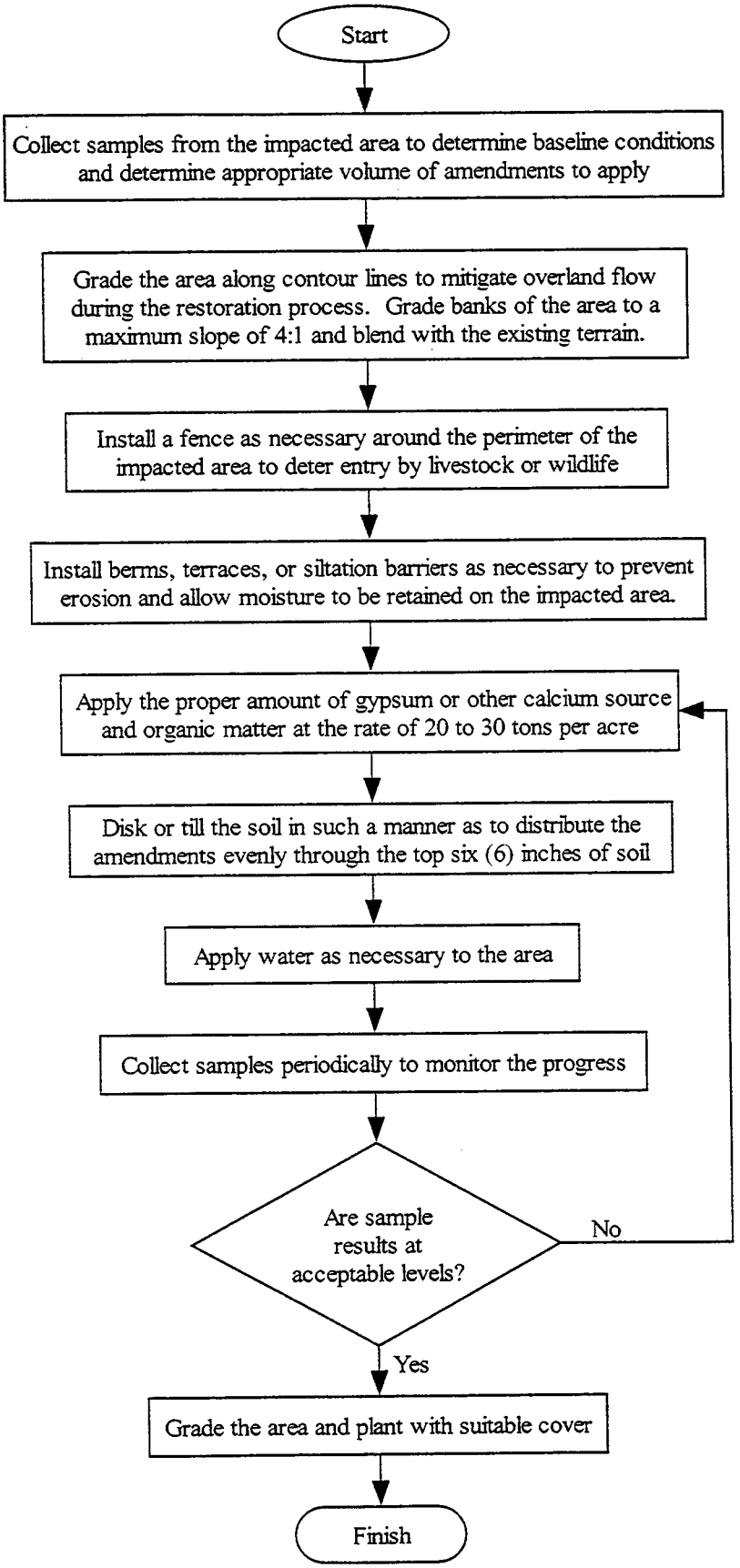
Tanks, Equipment and Vessel Removal and Disposal



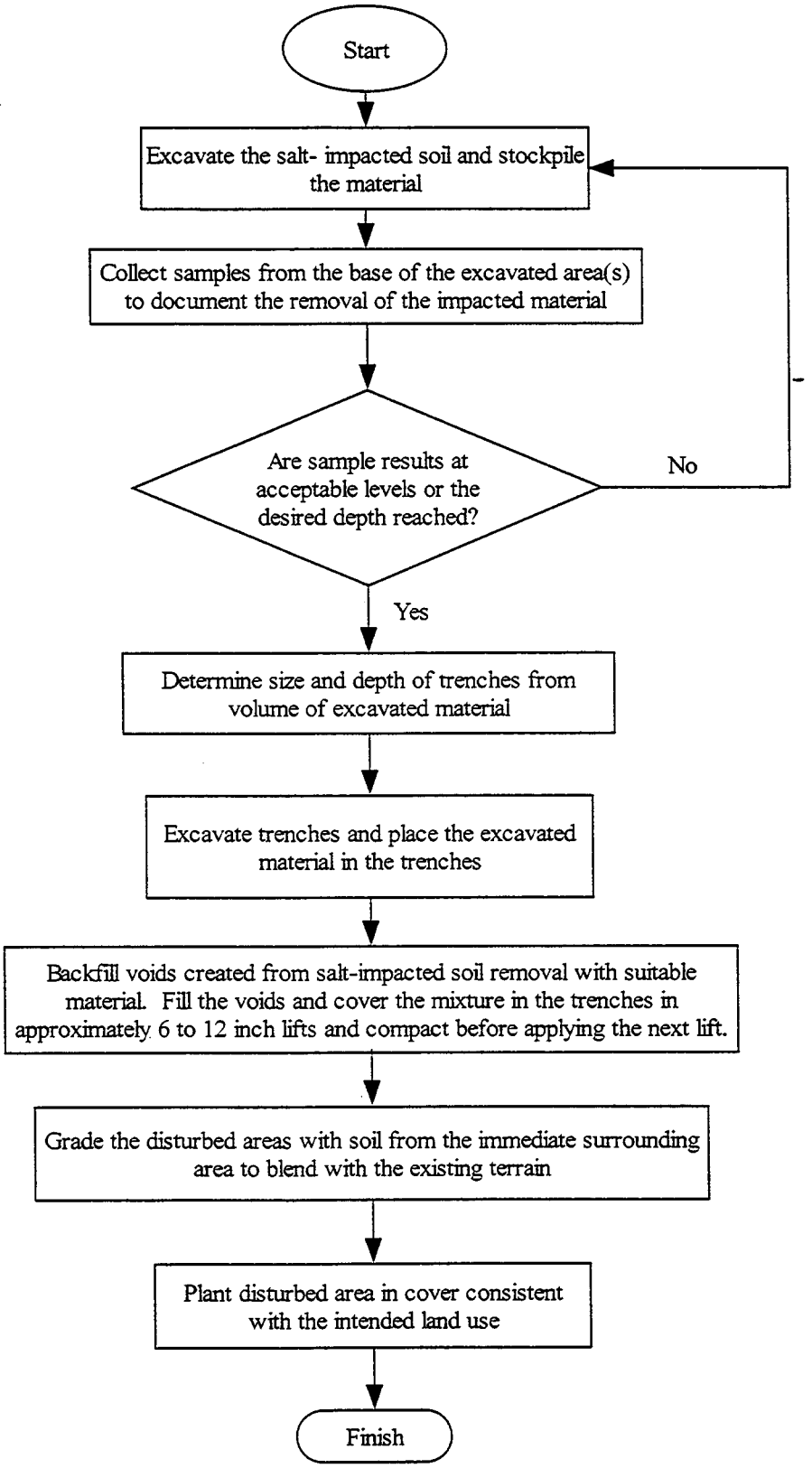
Lease Road and Pad Restoration



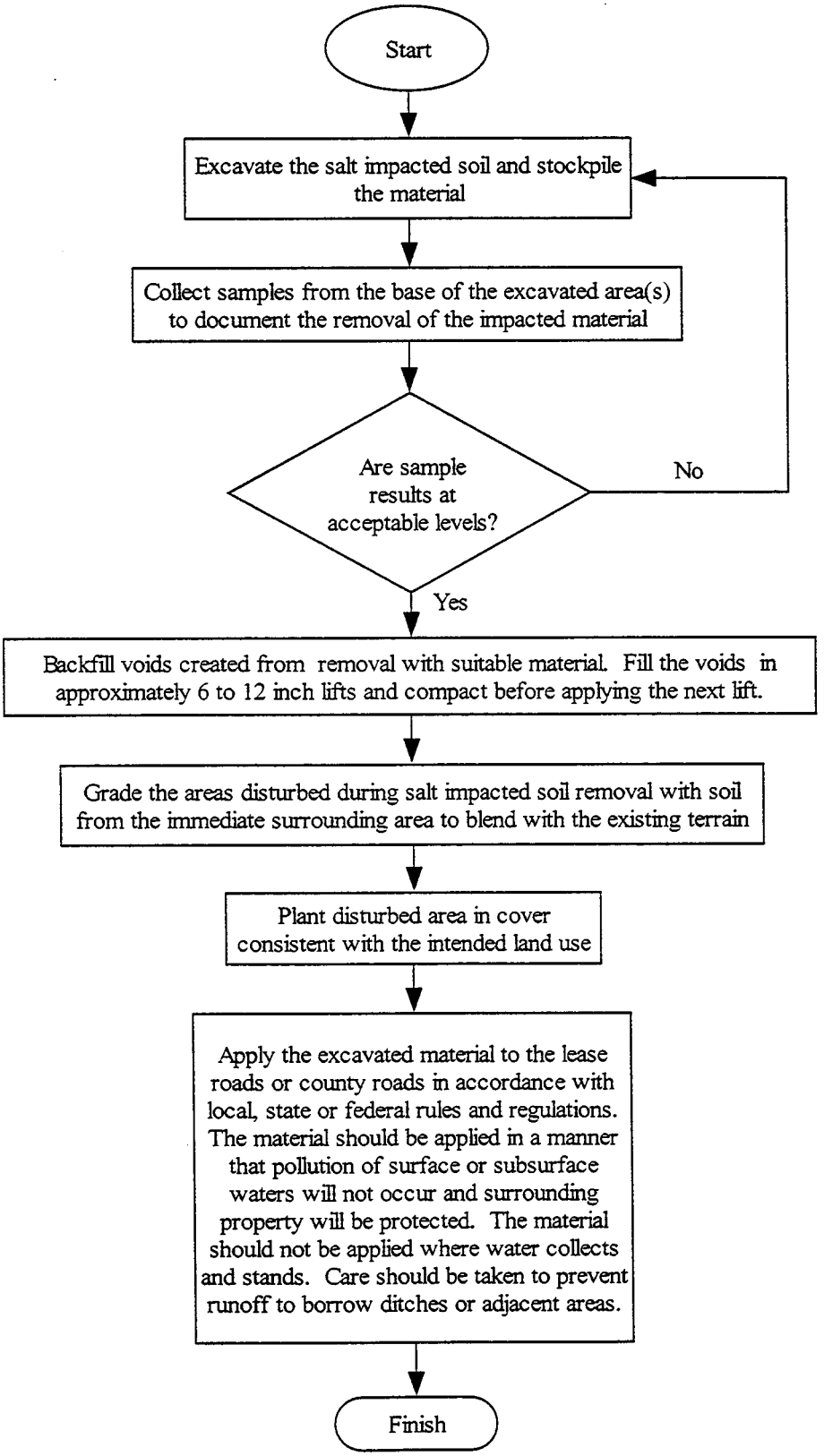
Chemical Amendment Application to Salt-Impacted Soils



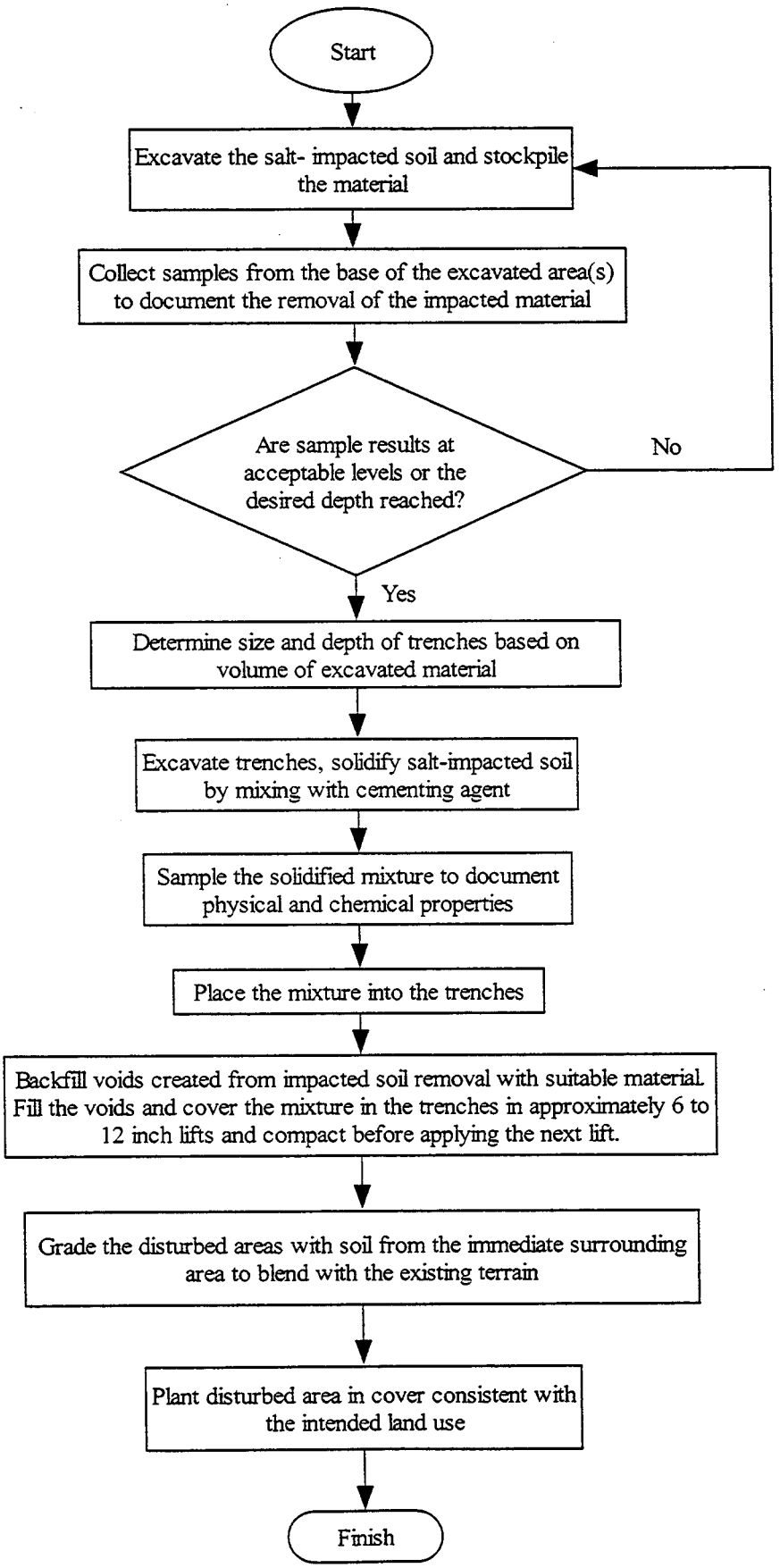
Dilution Burial of Salt-Impacted Soil



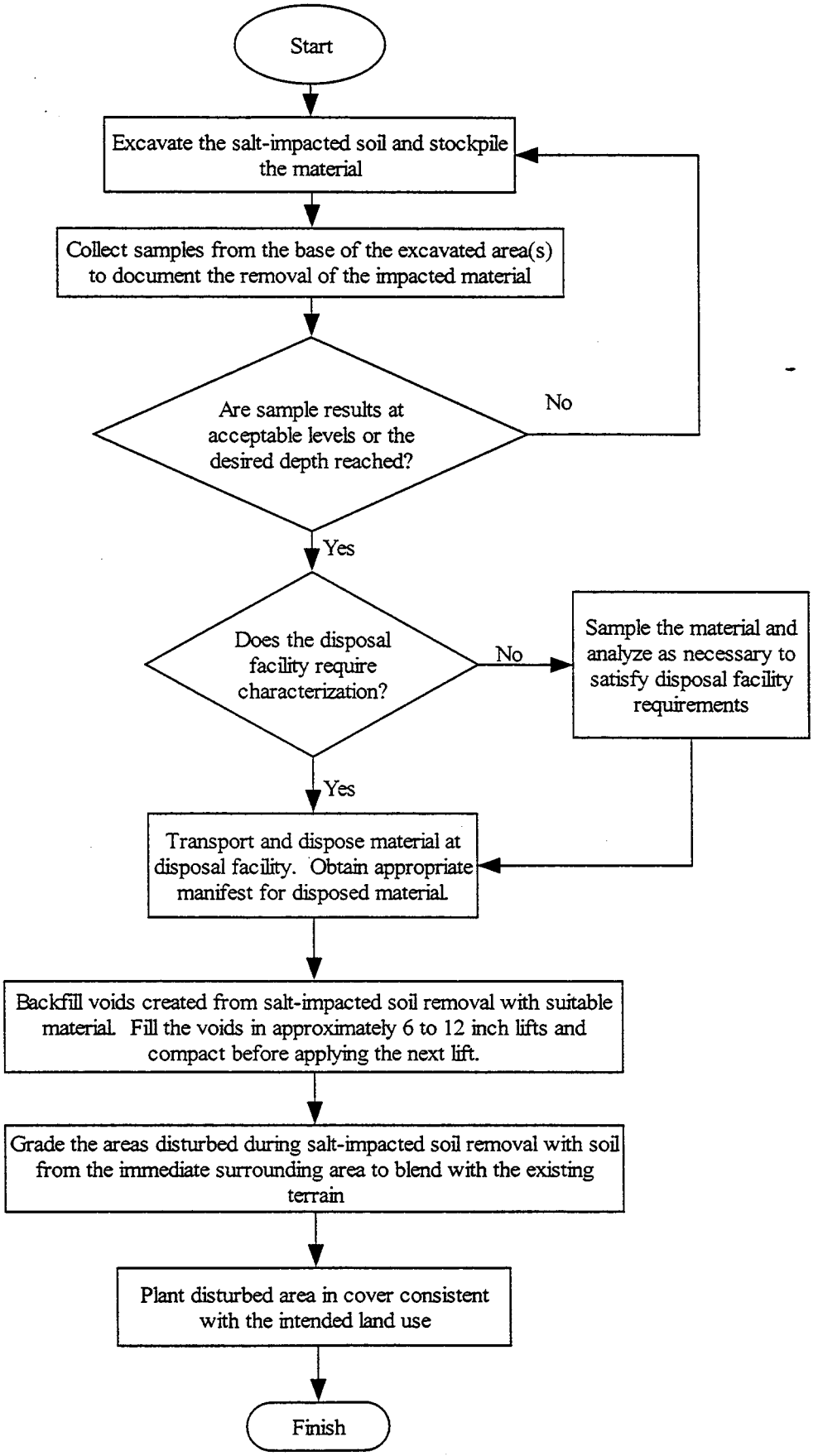
Road Spreading of Salt Impacted Soils



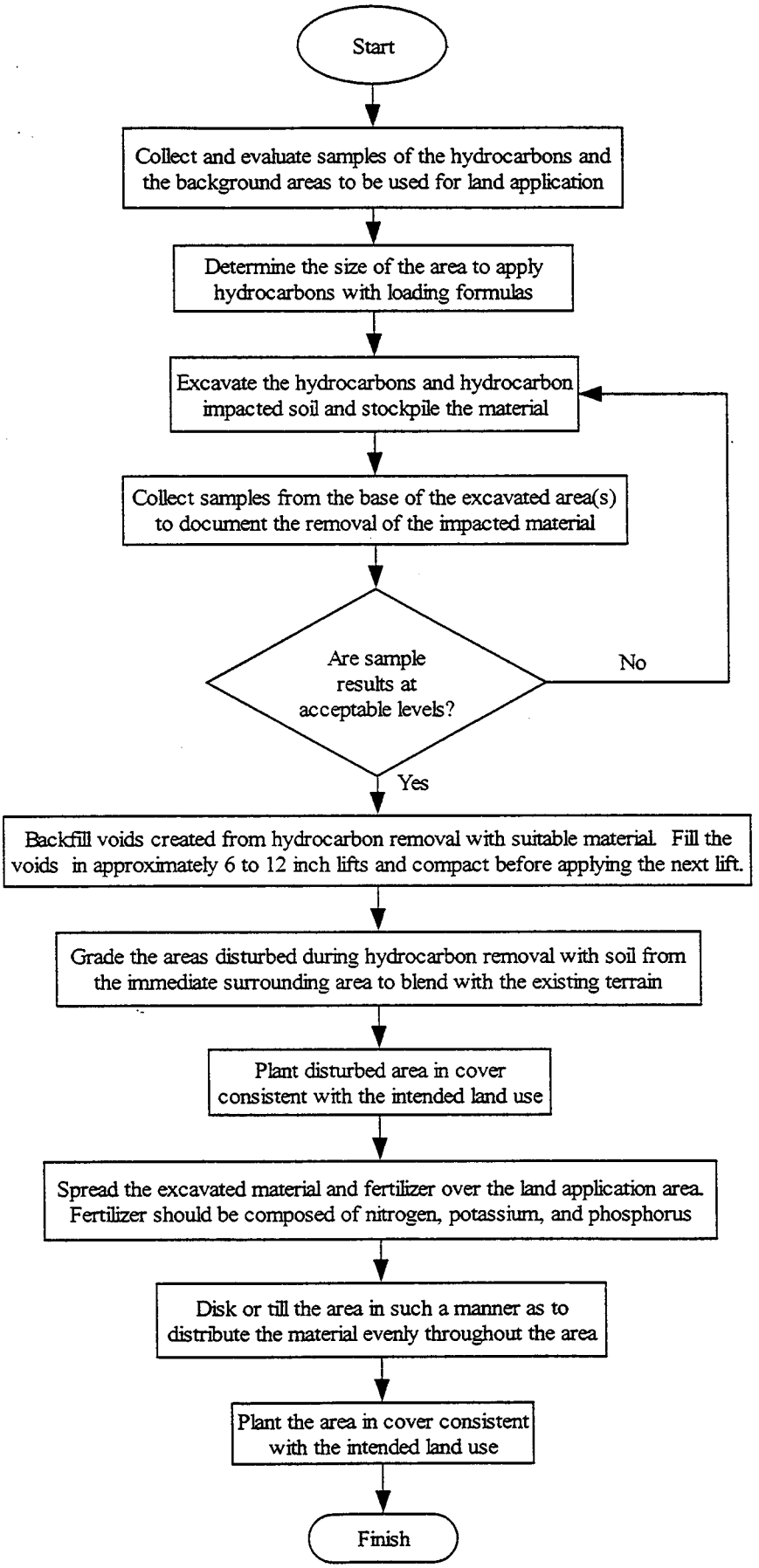
Solidification and Burial of Salt-Impacted Soil



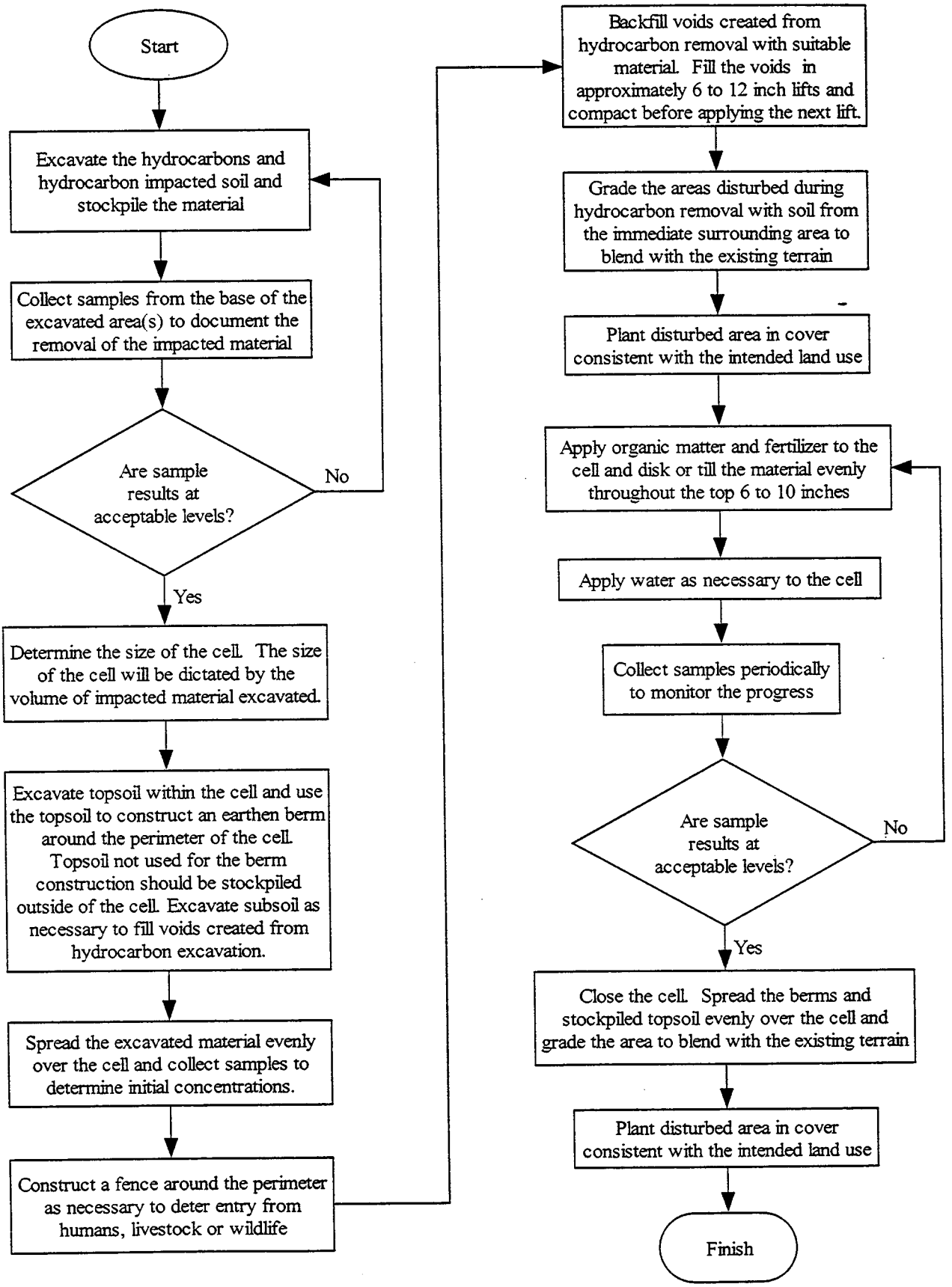
Off-Site Disposal of Salt-Impacted Soil



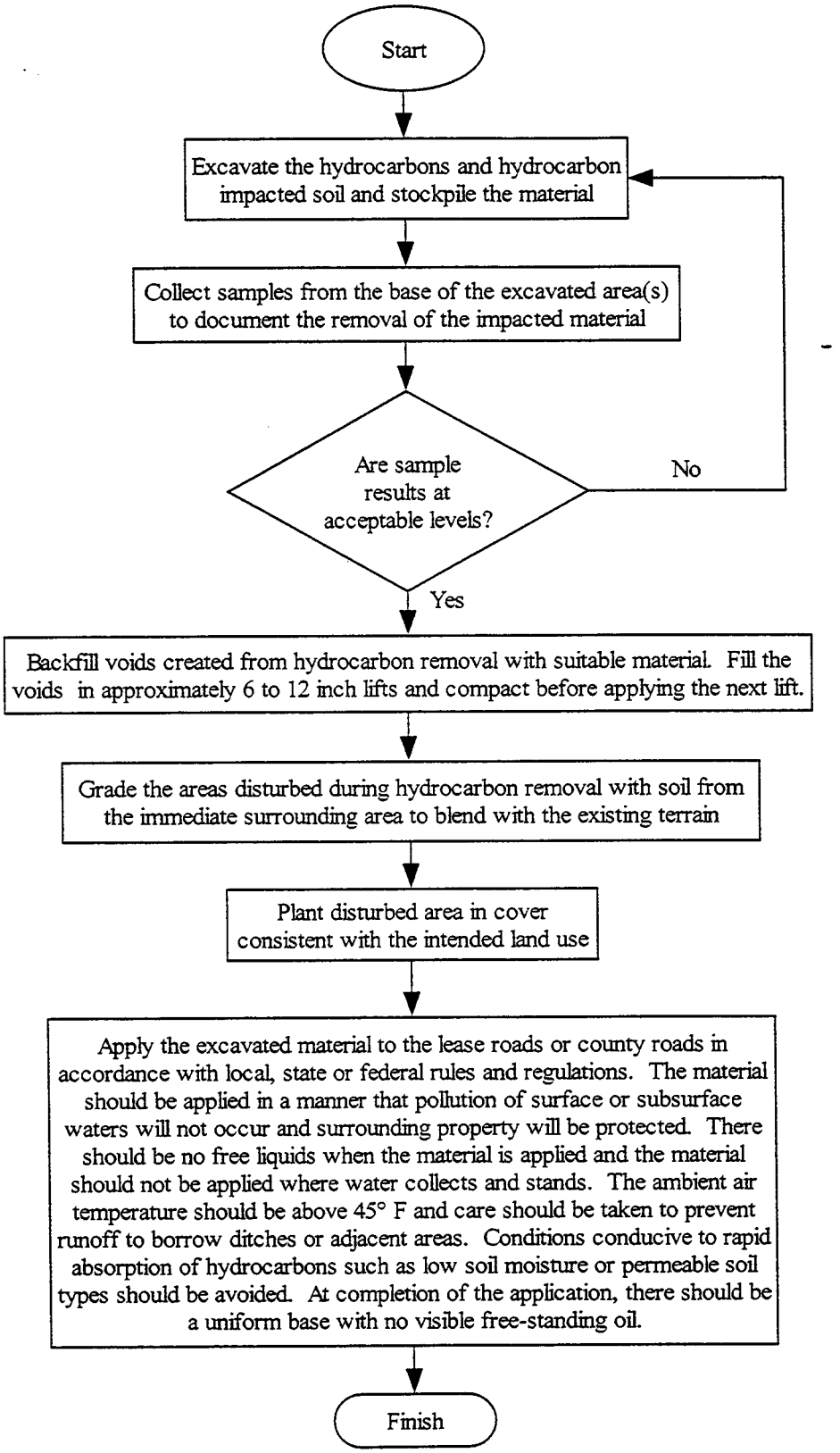
Land Application of Hydrocarbons



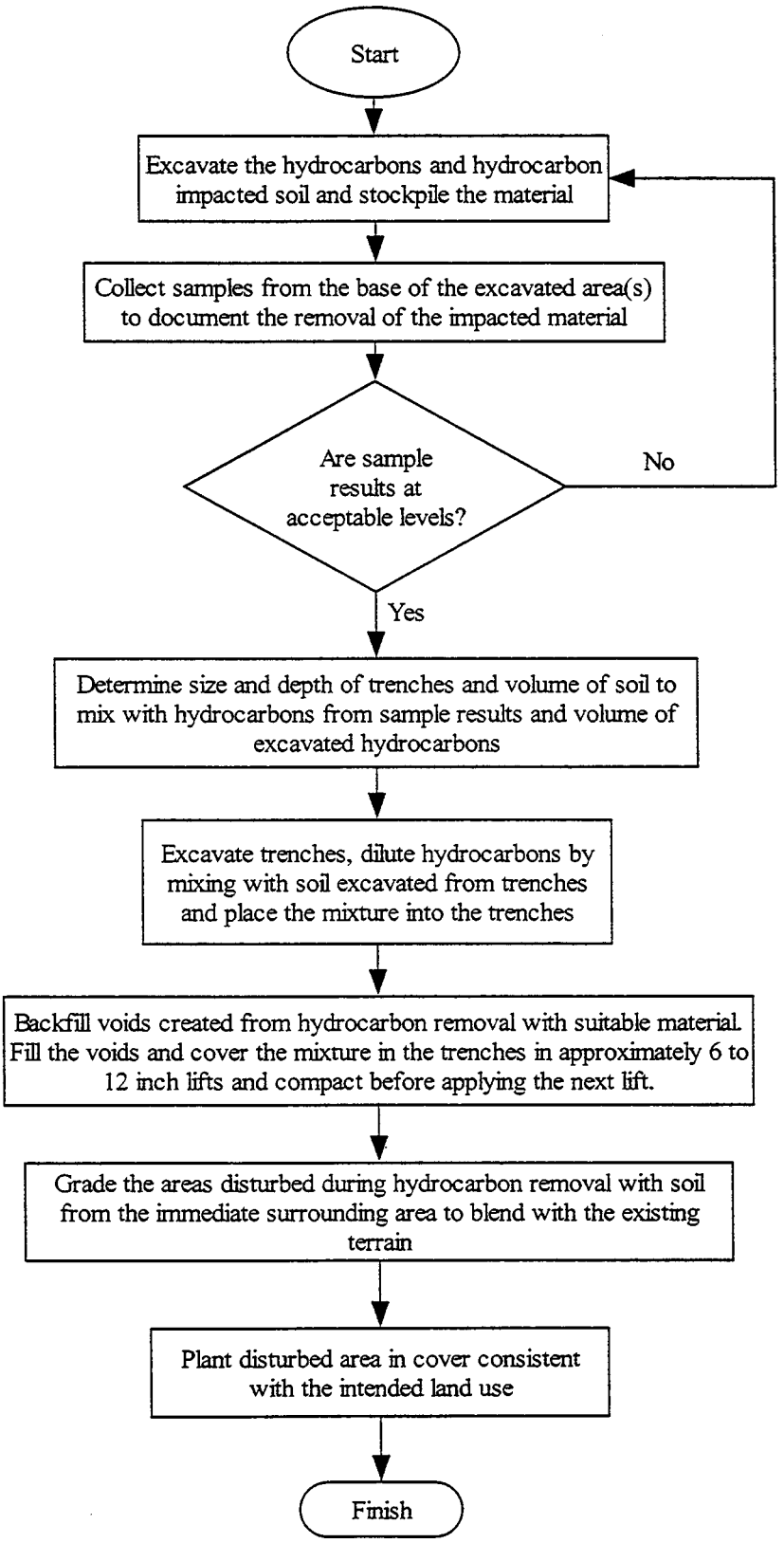
Bioremediation of Hydrocarbons with a Treatment Cell



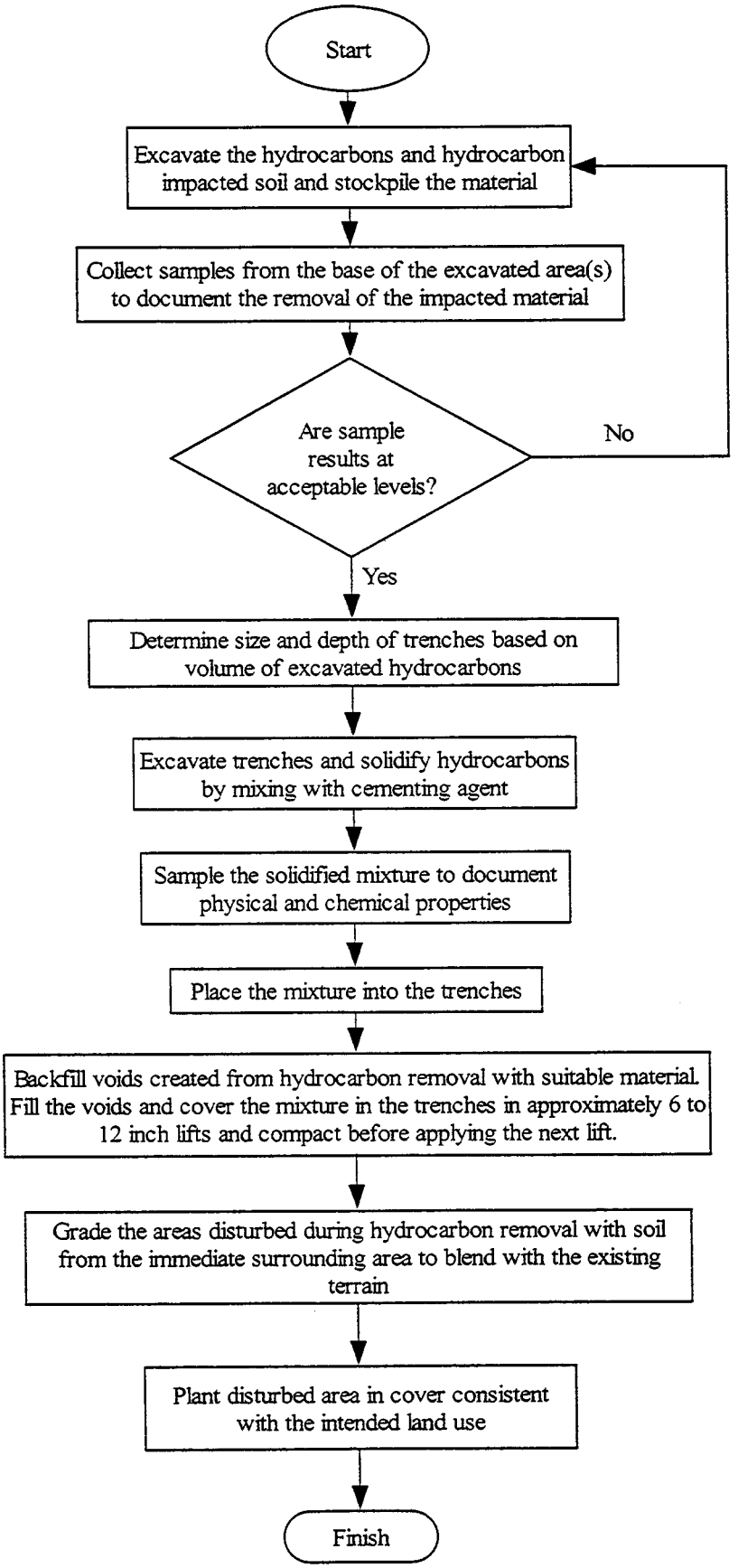
Road Spreading of Hydrocarbons



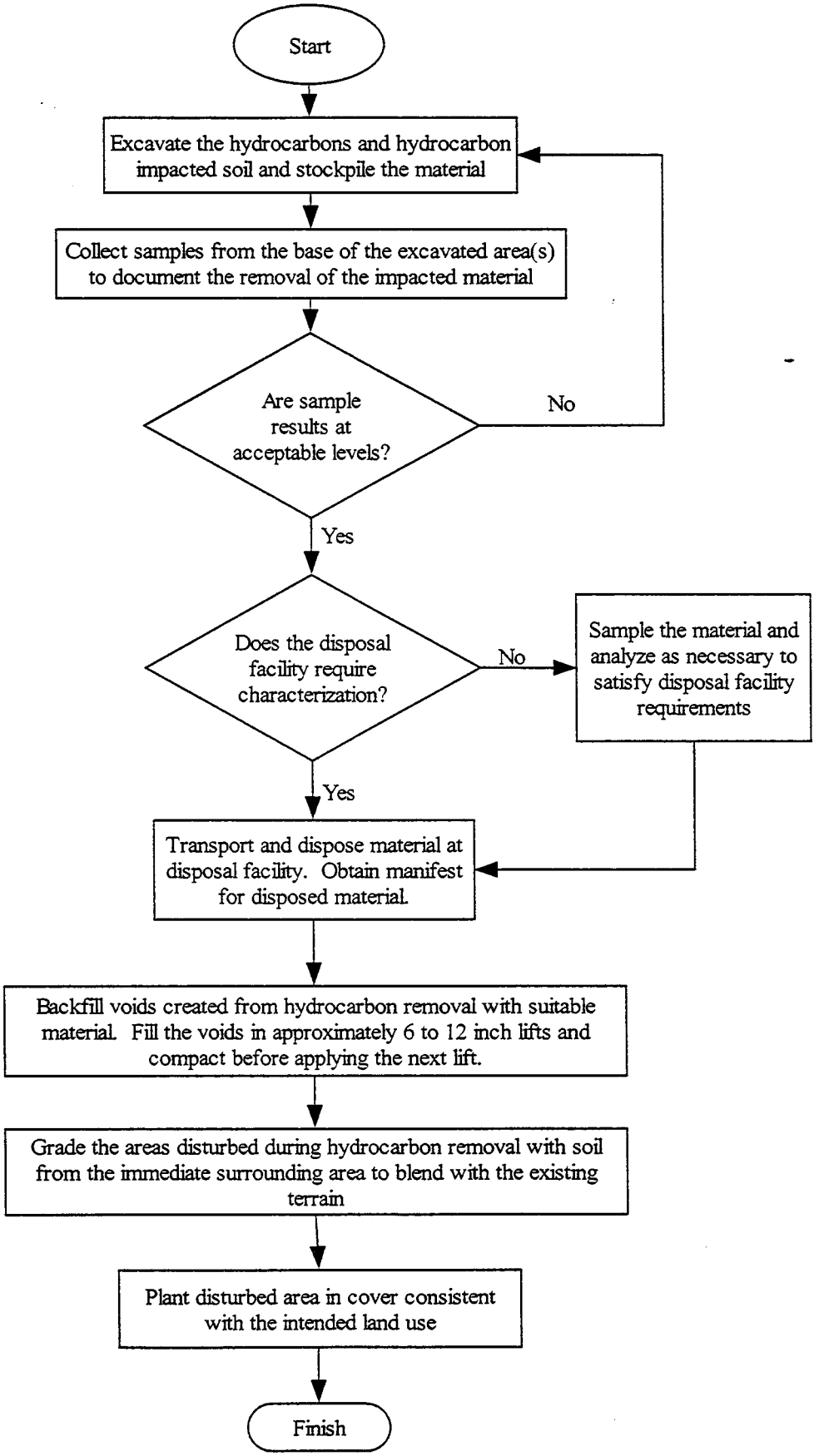
Dilution Burial of Hydrocarbons



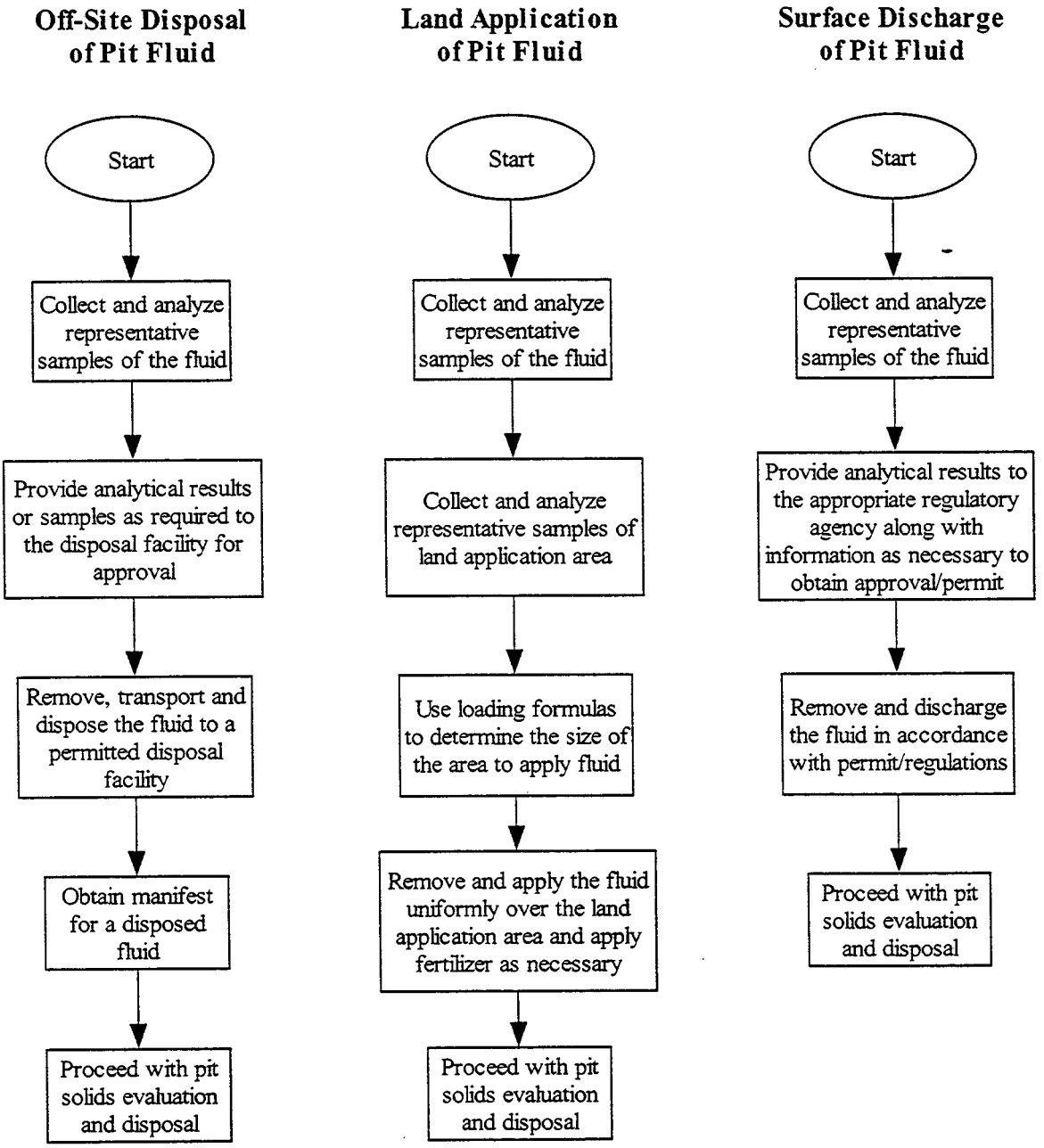
Solidification and Burial of Hydrocarbons



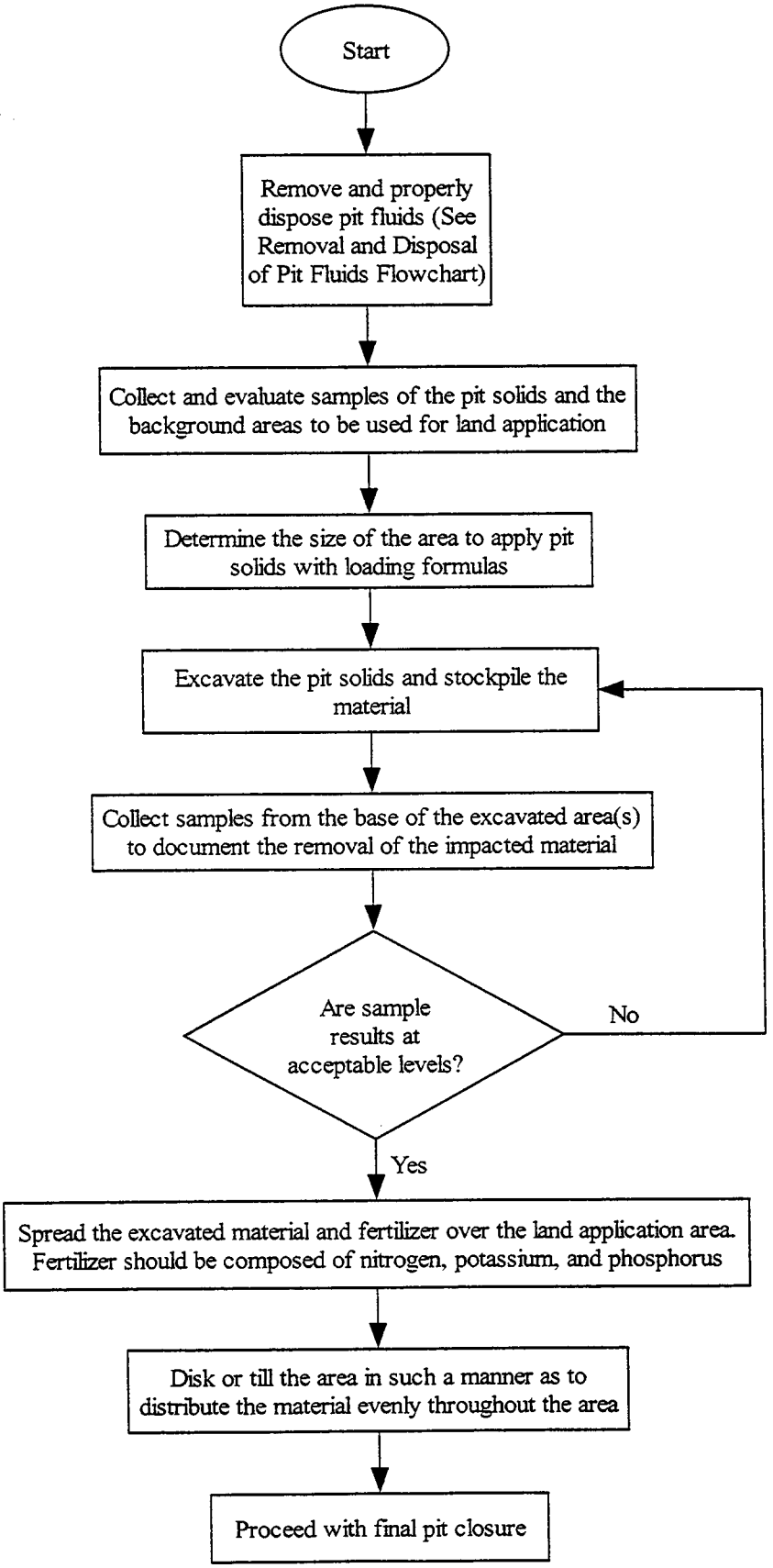
Off-Site Disposal of Hydrocarbons



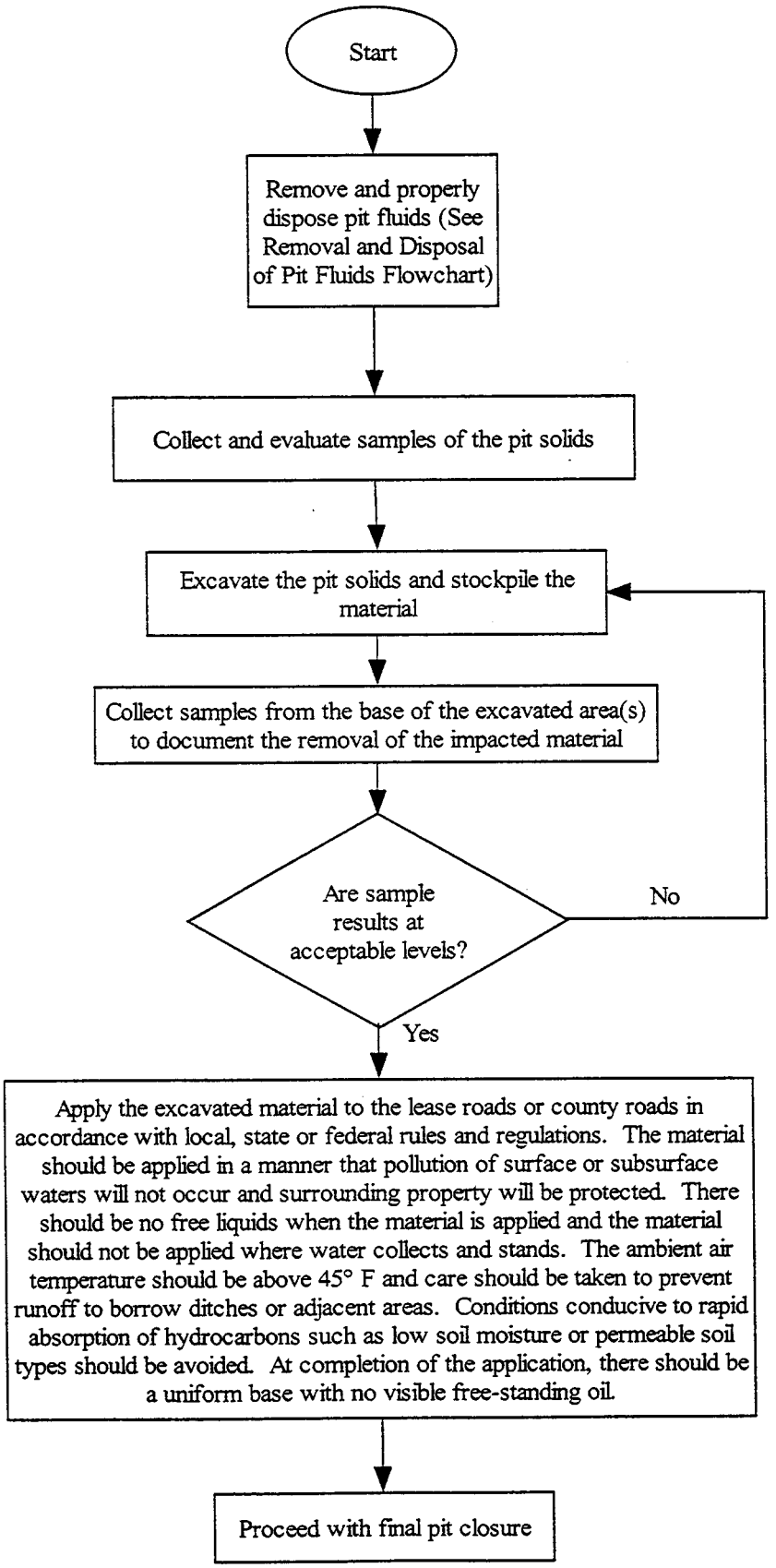
Removal and Disposal of Pit Fluids



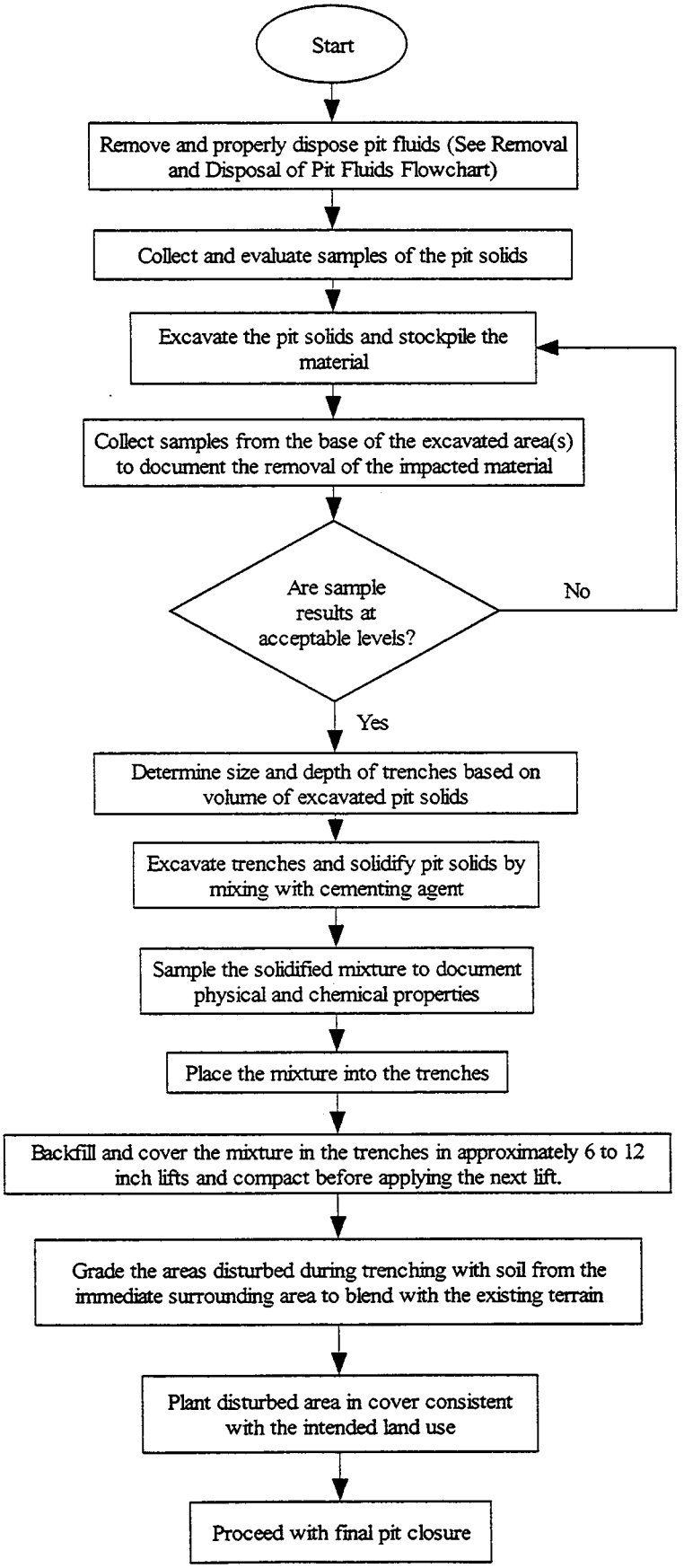
Land Application of Pit Solids



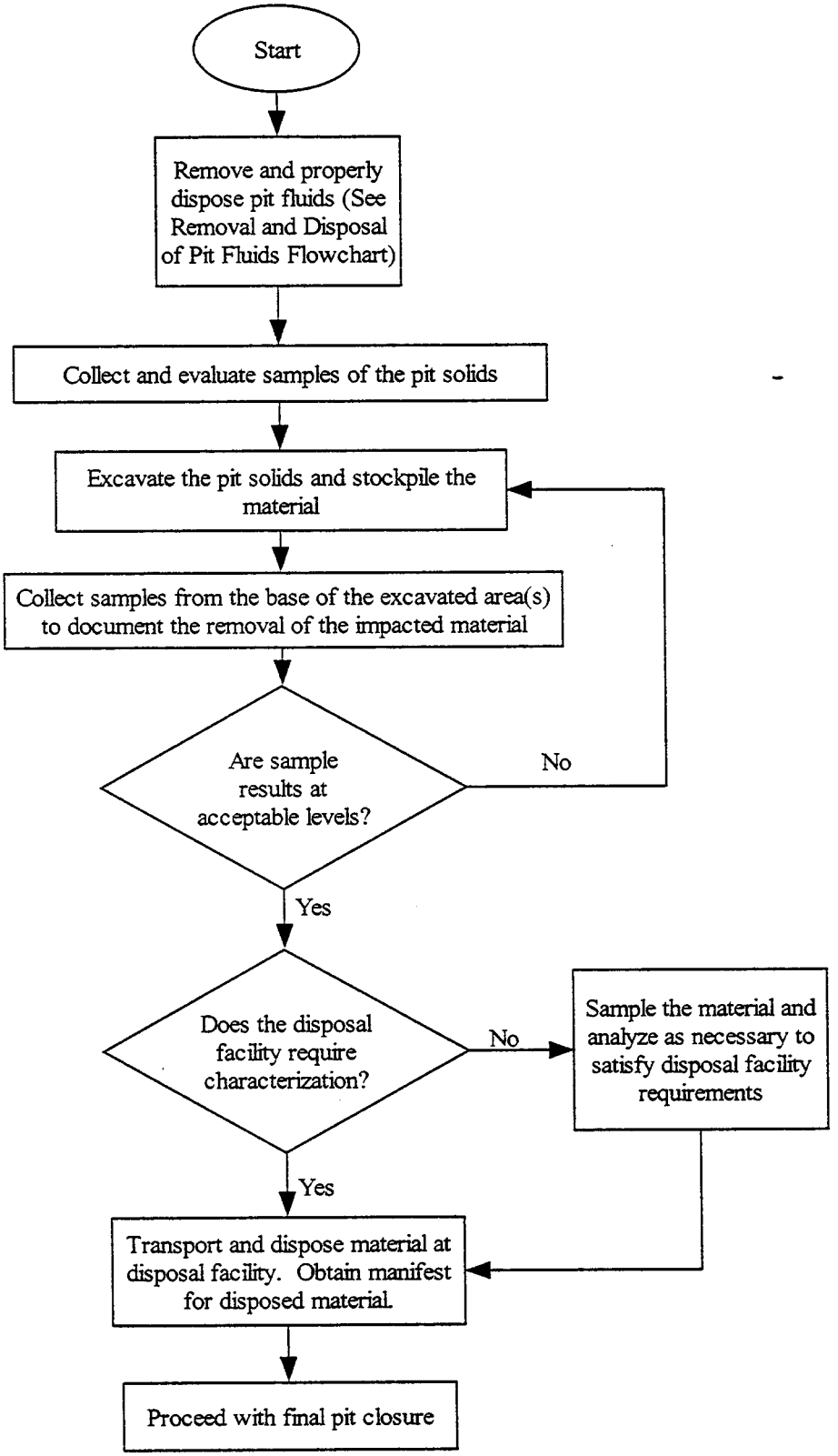
Road Spreading of Pit Solids



Solidification and Burial of Pit Solids

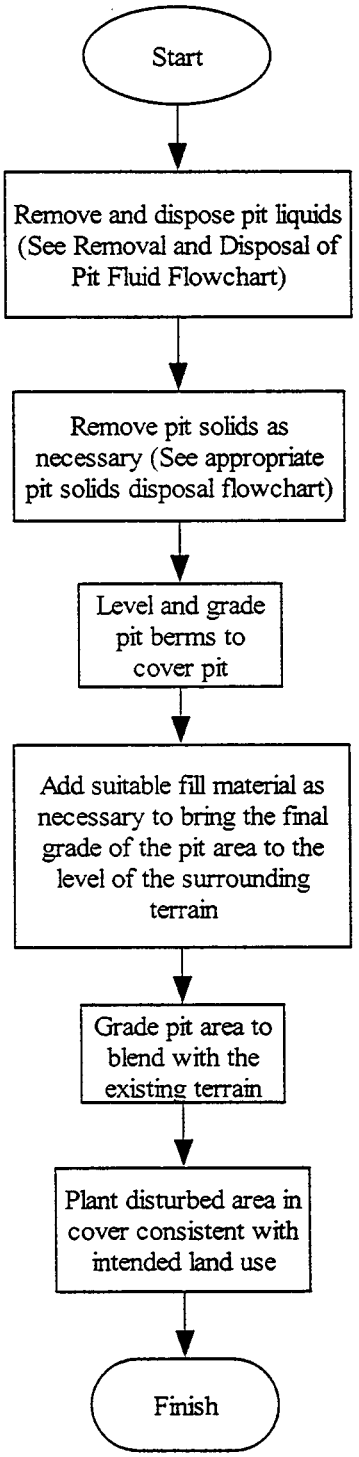


Off-Site Disposal of Pit Solids

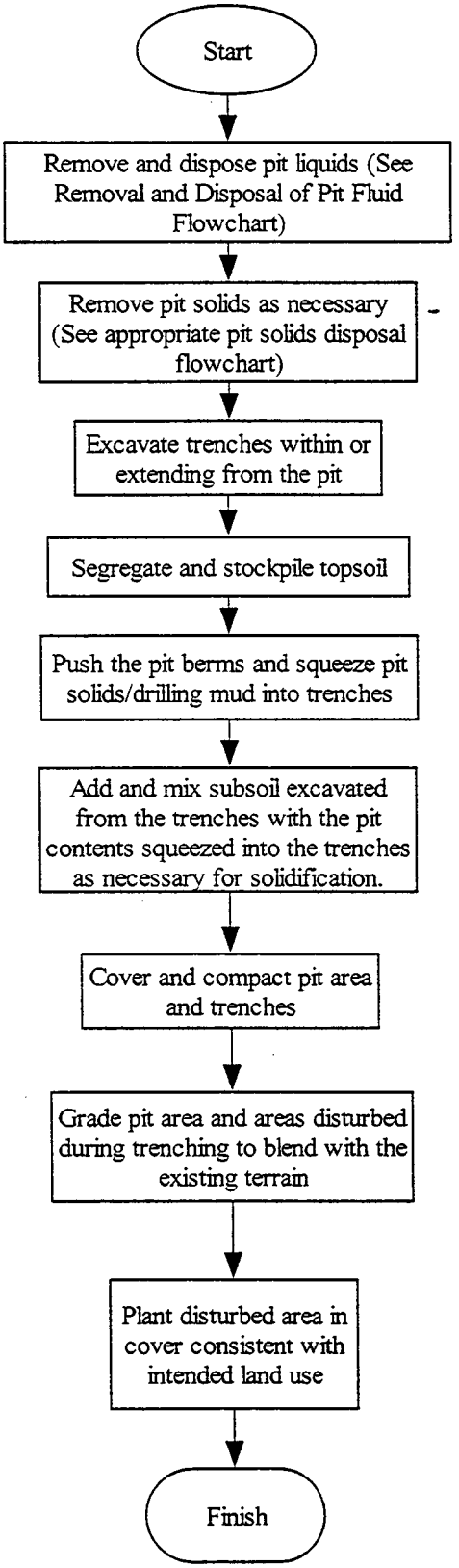


Final Pit Closure

In-Place Pit Closure

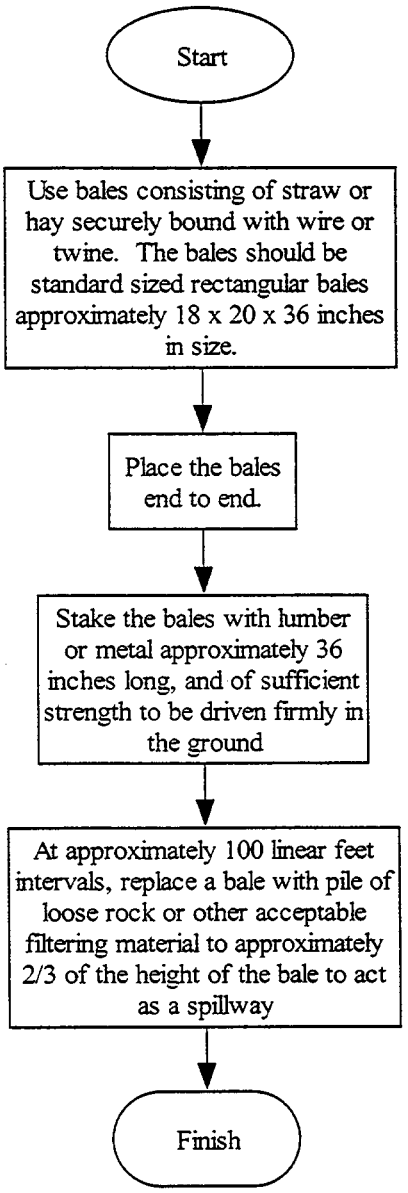


Pit Closure by Burial/Trenching

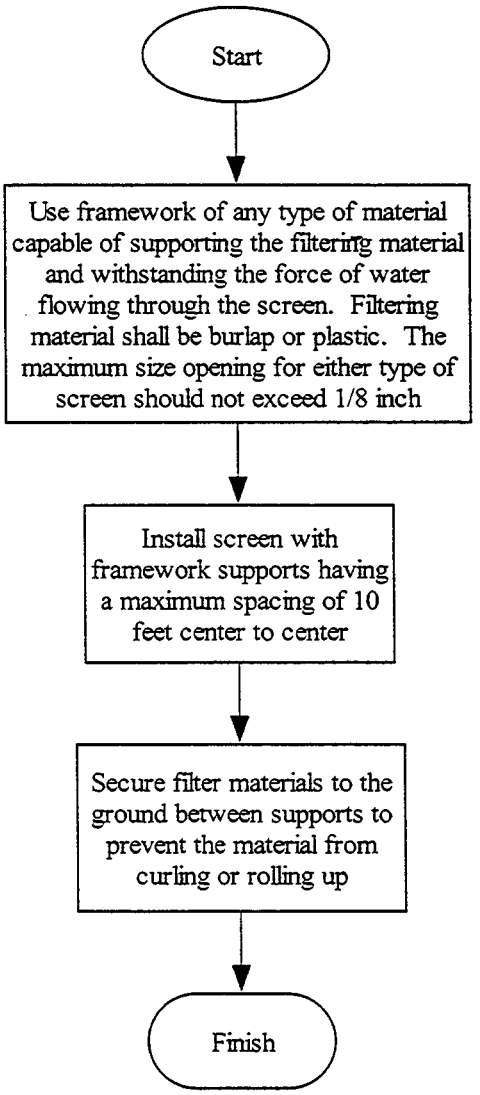


Sediment Control Barriers

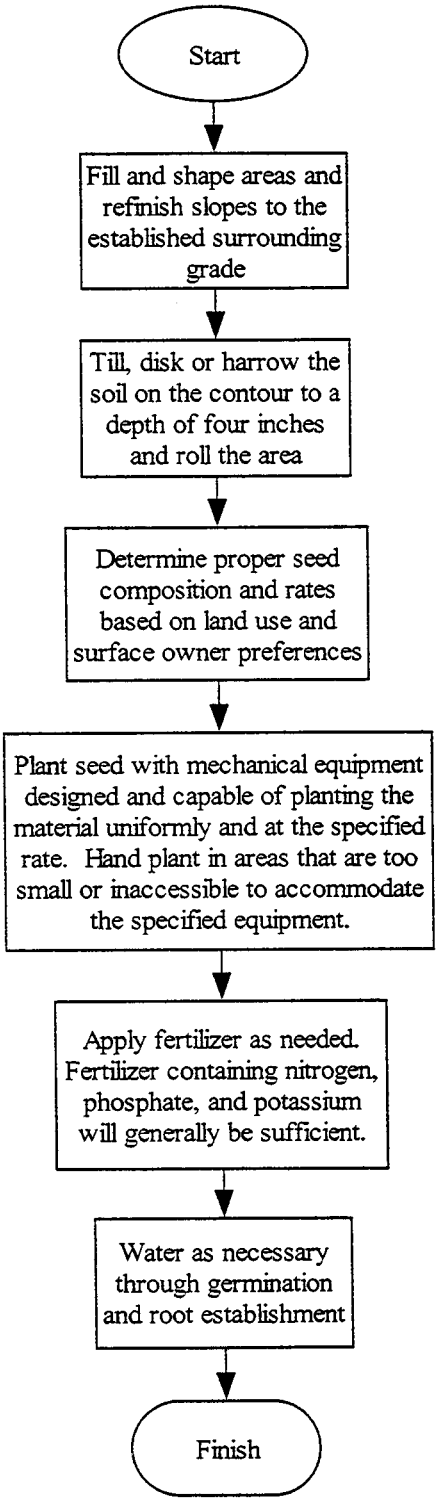
Bale Barriers



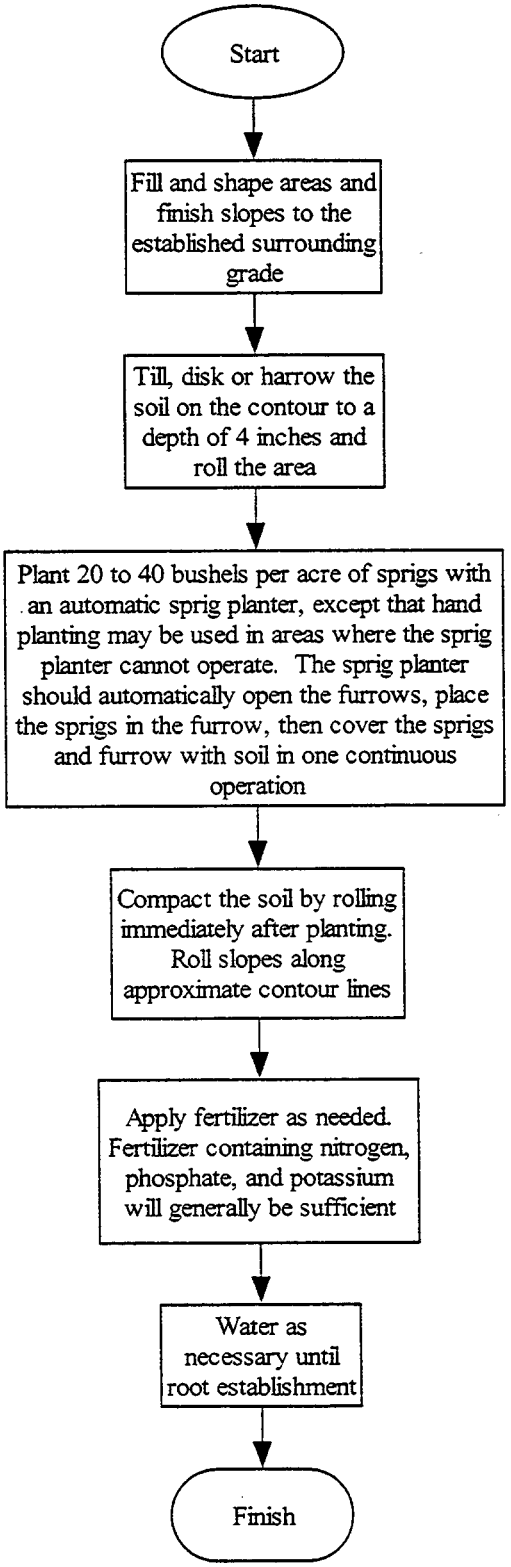
Siltation Screen Barriers



Seeding


Start
Fill and shape areas and refinish slopes to the established surrounding grade
Till, disk or harrow the soil on the contour to a depth of four inches and roll the area
Determine proper seed composition and rates based on land use and surface owner preferences
Plant seed with mechanical equipment designed and capable of planting the material uniformly and at the specified rate. Hand plant in areas that are too small or inaccessible to accommodate the specified equipment.
Apply fertilizer as needed. Fertilizer containing nitrogen, phosphate, and potassium will generally be sufficient.
Water as necessary through germination and root establishment
Finish

Row Sprigging



Broadcast Sprigging