Development Of Contaminated Properties

Procedures of Herriman City

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(This letter, to be signed by a Professional Engineer, certifies that the remediation plan approved by the City was completed.)

HERRIMAN AREA
LAND DEVELOPMENT

Considerations Prior to Obtaining a Building Permit

How Do I Determine If I Have To Conduct An Environmental Assessment?

Environmental studies conducted by the U. S. Bureau of Reclamation and the Utah Department of Environmental Quality in 1998 and 1999 have indicated a potential for lead and arsenic contamination in soils on some agricultural properties generally north of Main Street in and around Herriman, Utah.

Therefore, prior to application for a building permit, new homes and subdivisions to be built in the suspected area require a review of the environmental status of the property.

Applicants must file a request for a review at the Herriman Planning and Zoning Office. The request should include the address and a map of the property to be permitted.

The Planning and Zoning Office will then review the soil data provided by the agencies for the site to determine if the property will require an in-depth Environmental Site Assessment (ESA). An ESA is a study of the physical and chemical parameters in a potentially contaminated environmental media, such as soil and water. The studies are designed to determine what contaminants, if any, are found on the property and the specific location and depth of those contaminants.

If the Planning Office determines than an ESA is required for your property, the steps to completing an ESA are described next. All plans and reports require the stamp of a Professional Engineer (PE). Environmental and geotechnical engineers commonly produce such reports.

Steps To Completing An Environmental Assessment

Step 1: Submit a Sampling and Analysis Plan

A Sampling and Analysis Plan (SAP) must be submitted to the Planning and Zoning Office prior to any sampling events. The plan should include what work you intend to do and details of how to do it. Soil samples analysis for lead and arsenic will be required by a certified laboratory. When the Plan is reviewed, the Planning Office will be looking for sampling design, sampling methods, sample handling, and data quality objectives. Once approved, sampling can begin.

Step 2: Submit Sampling Results and Remedial Plan

Upon completion of the SAP, a detailed report presenting the results of the sampling must be submitted to the Herriman Planning and Zoning Office. A Remedial Plan must also be submitted at this time. The Plan should explain in detail how areas of contamination are to be remediated.

Will the contaminated soils be removed? Deep tilled? Capped? Consolidated and Capped? Or will the use of the property be altered to comply with local ordinances?

Step 3: Submit Final Report

Upon completion of the remediation, a final report must be submitted to the Planning and Zoning Office. The report must present results from samples collected during the remediation and show that any contamination on the property has been mitigated as specified in the Remedial Plan. This report must be certified by a registered professional engineer indicating that the Remedial Plan was effectively implemented.

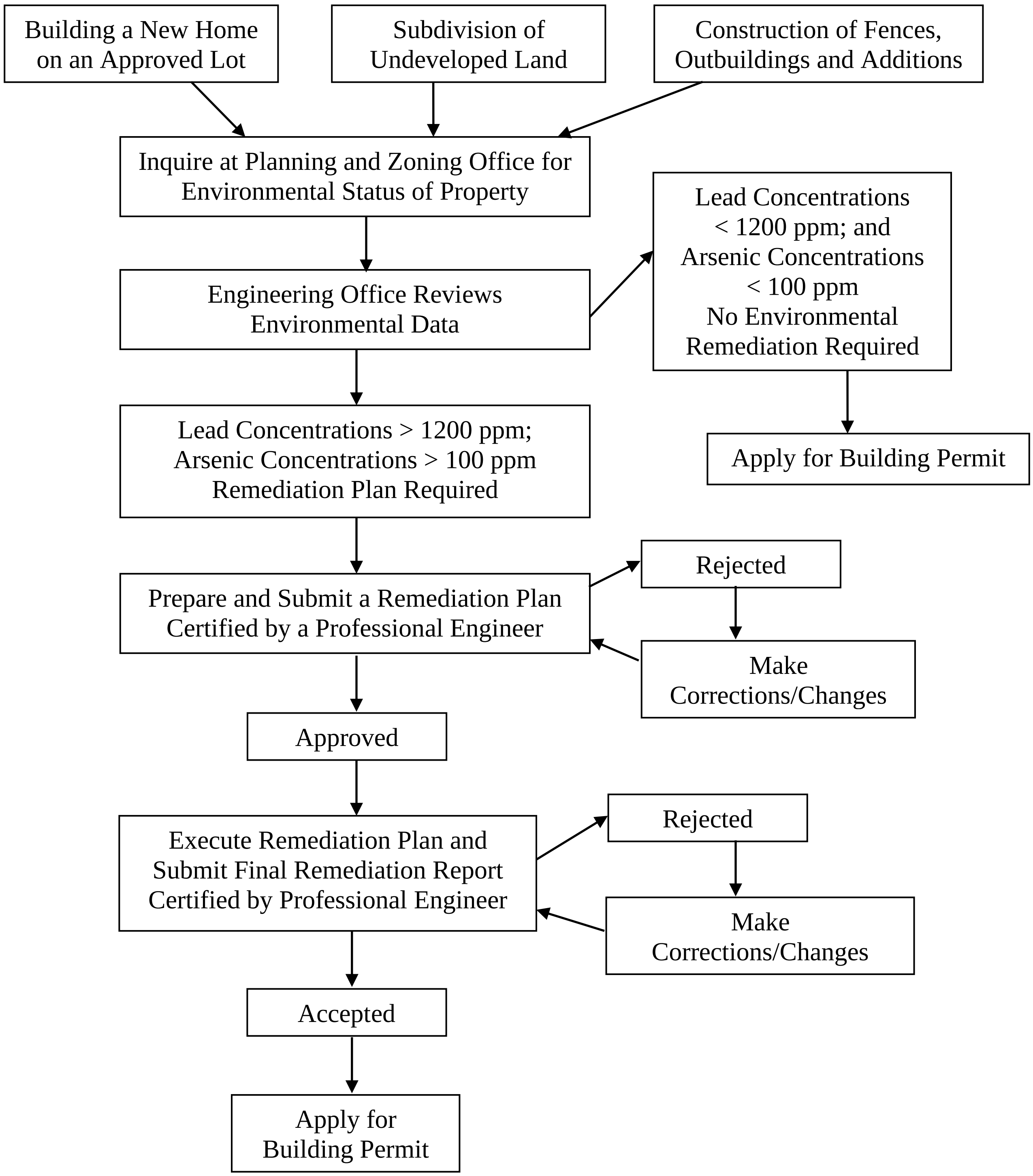
Step 4: File for Building Permit

Once the Planning and Zoning Office approves the final report, the steps to obtain a building permit can be initiated.

Time to complete an ESA and Remediation: 2 to 6 months

Cost: Dependent on acreage, extent of contamination, and remediation technique, the costs may range from approximately $500 to $52500 for the ESA. Remediation costs, again dependent upon type and extent, may range from $1,000s to $10,000s or more.

Environmental Guidelines Prior to Obtaining a Building Permit



HERRIMAN DEVELOPMENT CHECKLIST

for agricultural lands contaminated with mining waste

1. Pre-Development General Information

   A. Brief Introduction to the Proposed Development Project and why remediation may be needed as a part of the development.

   B. Site Description

      Tentative Address of Site and Tax Code Number(s)
      Legal Description
         Metes and Bounds
         Size (acreage involved)
      Owner
         Name
         Address
         Telephone Number
         Fax
         E-mail
         The best method of contact

   C. Site Characteristics

      Past use of property
         Crops grown
         Location of underground storage tanks, current or historic
         Location of irrigation reservoirs, current and historic Fertilizers or pesticides used and rate, if known
         Mining activities (including top soil, sand and gravel) Importation of fill
         Known excavations

      Current Zoning

      Layout of property
         Location of current structures on site
            Storage sheds, barns, outbuildings
            Roads and trails
            Irrigation pipes and ditches, historic ditches Places with pavement (pads, driveways, roads)
      Extent of Contamination
         Was the property sampled by EPA or LTDEQ (1997-8)?
         Has deep tilling been used after 1998?
         Have soils been removed from the property after 1998?

General description of the location of contamination on the property. *(Submit maps and analytical results from EPA/UDEQ sampling.)*

D. New Sampling Program *(If the property owner did not participate in the EPA/UDEQ sampling program in 1997-1998, or if the soils have been disturbed by deep tilling or soils excavation, a sampling program is necessary to determine the extent and depth of contamination, or to confirm that the levels of contamination are now low. Discuss the sampling plan with the city/county in advance to ensure that it adequately determines the extent of contamination.)*

Include the Sampling Plan which describes where the samples were collected, how the samples were collected, what chemicals were analyzed, how deep in the soil, where the samples are located in relation to the proposed buildings, who collected the samples, and which laboratory analyzed them.

Include a map which shows the lead concentrations, the location of the proposed building(s), the location of the driveway(s), the location of the road(s), the location of buried utilities, the location of future easements, wells, proposed on-site repository(s).

Provide copies of the Certificates of Analysis.

2. Proposed Development

A. Plans

Introduce the nature of the development project and remediation approach.

Type of land uses within the development. Will a zoning change be needed? Has an application for a change been made? Has it been granted?

Development drawings and specifications, including location of building(s), driveways, roads, buried utilities, and any waste repositories.

Who will perform the work? (Contractor, owner, consultant and experience with contaminated soils/wastes)

B. Soils

How does the development location relate to the contamination location. Note that there are different contamination amounts allowed for different land uses. Check with the City for the current requirements.

At which locations will soils be disturbed during site preparation and construction?

What special Personal Protective Equipment will be provided to construction workers and when will it be used?

C. Removal or remediation of contaminated soils

Remediation plan - describe how the contamination will be prevented from exposing people in the development (e.g. capping with clean cover, paving it over, removal of contaminated soils to an off-site location, removal of contaminated soils from residential yard areas to other areas not in public use, etc.) Check with the Bureau of Reclamation booklet for examples of options.

Where will the contaminated soils go? Stay on-site, removed off-site, consolidated to an on-site location?

3. During Development

A. Provide methods to be used for runoff control and dust control. Indicate the safety measures to be instituted for workers (e.g. routine health and safety briefings, personal protective equipment, trench safety, etc.)

B. Provide method of transport of soils to landfills or repositories, etc., methods to prevent or control dust and mud on the streets, routes of truck travel, how many loads, and maximum loads per day. How will trucks and equipment be decontaminated following use?

C. If contamination will remain on site (perhaps buried), are any special precautions necessary to prevent further digging and re-exposure of the waste? Who will be responsible for this?

4. Following Development

A. Provide a map showing where the soils were disturbed and provide chemical analysis data demonstrating final surface conditions. Provide Certificates of Analysis.

B. Provide map showing locations where contaminated materials have been capped in place or locations where excavated contaminated soils have been placed.

C. Indicate the thickness and nature of any caps, e.g., 12" of topsoil, 4" asphalt, etc. What is the chemical composition of the cap?

D. What are potential long-term contamination management problems? What steps have been taken to prevent problems in the future? Who will be responsible? Who will maintain any waste repositories or caps? *If substantial long term* *problems are anticipated, the city may require a site management plan containing the details.*

SUGGESTED LEAD & ARSENIC GUIDELINES FOR DIFFERENT LAND USES
As of January, 2003 - Check with City to determine if still valid

LAND USE	Maximum Lead Concentration Maximum Arsenic Concentration in Soils	Source of Information
Residential	1200 mg/Kg (parts per million) 100 mg/Kg (parts per million)	City of Herriman Council Resolution
Commercial	4000 mg/Kg (parts per million) 300 mg/Kg (parts per million)	EPA site specific Baseline Health Risk Assessment
Industrial	4000 mg/Kg (parts per million) 300 mg/Kg (parts per million)	EPA site specific Baseline Health Risk Assessment

NOTICE: Property owners/operators could be liable under state and federal law for cleanup costs if a release of hazardous substances occurs. They could also be subject to private lawsuits from the future owners if the property is presented as clean when it is not. Issuance of a building permit does NOT absolve the landowner from compliance with applicable state and federal regulations. Examples of this include streambed modifications, wetland disturbances, and groundwater protection. Issuance of a building permit does not release the property owner from any liabilities. Nor does the city accept any liability for any releases of hazardous substances by virtue of issuance of the permit. Submittal of fraudulent information to a governmental body is a criminal offense.

Questions? Call the City of Herriman Building Permit Office at (801) 446-5327 for current building permit requirements. Call the U. S. Bureau of Reclamation (Provo) at (801) 379-1265 for technical assistance.

Date:______________________________

City Planning Department
City of Herriman
5355 West Herriman Main Street
Herriman, Utah 84096

Re: Contaminated Soil Remediation Plan Certification

To Whom It May Concern:

This letter is provided to certify that the Contaminated Soil Remediation Plan for the subject property listed below was executed as described in the plan and that the average lead concentration in soil on the property is less than 1600 mg/kg lead and average concentration less than 100 mg/kg arsenic.

Property Description	**Certification**
________________________ Physical Address	________________________ Printed Name of Registered Professional Engineer
________________________ Street	
________________________ City, State and Zip Code	________________________ Signature of Registered Professional Engineer
________________________ Owner of Property	________________________ Registration No. State of Utah

Remediation Plan:

Date Submitted:_________________

Date Approved:_________________

Stamp

Excerpt from Herriman City's development standards regarding Environmental Site Assessment:

4.04 Environmental Site Assessment

In 2001 the Environmental Protection Agency issued a record of decision regarding the environmental mitigation that occurred in Herriman under an Emergency Response Action. Certain properties were tested and found high levels of lead and arsenic. As properties develop, some properties that have been tested shall follow a procedure for clean up prior to development of the property. The City has information on areas that have or are suspected to have lead and arsenic contamination. The clean up levels can be seen in the list below for each specific type of use:

Area Types	Lead (ppm)	Arsenic (ppm)
Residential	1,200	100
Commercial (Except Day Care)	4,000	300
Industrial	4,000	300
Recreation / Open Space	4,000	300

In 2001 the Environmental Protection Agency tested numerous properties and the levels found were documented and are on file at the City. Some properties were not tested and may be required to conduct tests to determine the property's individual lead and arsenic levels. In some areas, additional testing may be required to determine depths of lead and arsenic levels. If it is determined that lead and arsenic levels are present or suspected, the developer shall submit a remediation plan. See *Section 4.04.01* for plan requirements. After the remediation plan is reviewed and approved by the City a preconstruction meeting shall be held and then the site may be remediated. The developer shall be responsible for all quality control and assurance that the site is cleaned to appropriate levels. After cleanup is complete, a final report shall be submitted to the City stating how cleanup was initiated and any additional information found during the remediation process. See *Section 4.04.02* for Final Report requirements.

4.04.01 **Remediation Plan.** The remediation plan shall be reviewed by the Engineering Department. All plans shall discuss what levels are present on property and how the site will be remediated and what precautions and sampling will be conducted to ensure property is cleaned to the appropriate levels. The remediation plan shall show at a minimum:

1. Site Location
2. Site History and Previous Investigations
3. Proposed Use
4. Cleanup Goals
5. Site Health and Safety
6. Site Security
7. Work Plan / Removal Procedures
8. Air Monitoring and Dust Control

9. Storm Water Pollution and Prevention Plan
10. Confirmation Sampling
11. Post Remedial Management
12. Quality Assurance Plan

4.04.02 **Final Remediation Report**. After remediation efforts have been completed the developer shall submit a report outlining the remediation process. This report shall show the following at a minimum:

1. Results
2. Methods
3. Deviation from plan

Section B
Information

Fact Sheets for Control of Erosion and Sediment Control
(Suggestions on how to prevent erosion during construction)

Deep Tilling: An Alternative Remedial Solution
Is Deep Tilling an Option for My Property?

FACT SHEETS FOR CONTROL OF EROSION AND SEDIMENT:

Stabilized Roadway Entrance

1. DESCRIPTION: A temporary stabilized pad of gravel for controlling equipment and construction vehicle access to the site.

2. APPLICATION: At any site where vehicles and equipment enter the public right of way.

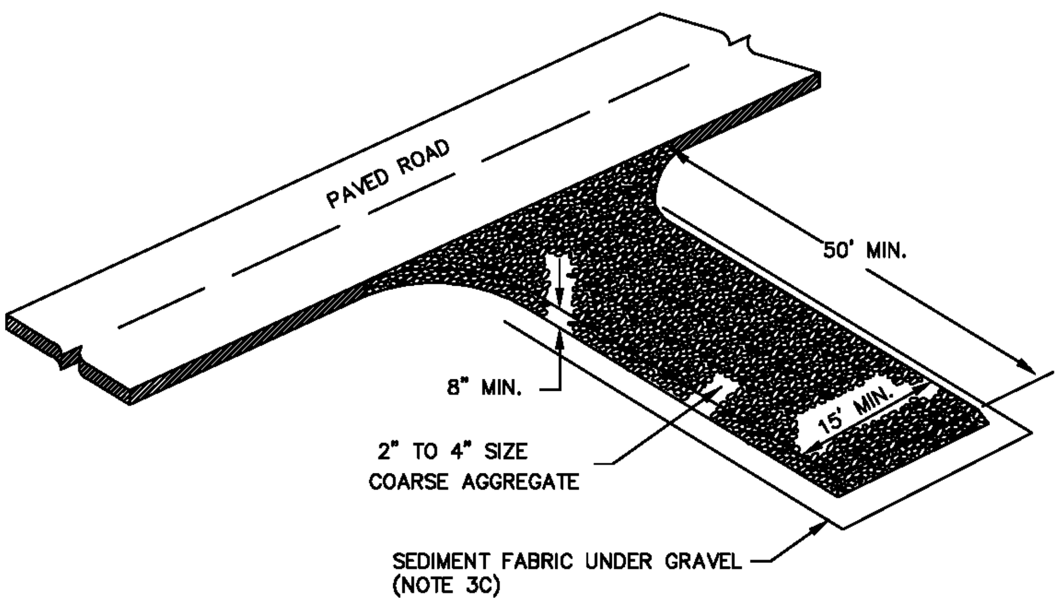
3. INSTALLATION/APPLICATION CRITERIA: Refer to APWA Section 01 57 00.

    A. Clear and grub area and grade to provide maximum slope of 1 percent away from paved roadway.
    B. Compact subgrade.
    C. Place filter fabric under stone if desired (recommended for entrance area that remains more than 3 months).

4. INSTALLATION/APPLICATION CRITERIA: Refer to APWA Section 01 57 00.

5. MAINTENANCE:

    A. Requires periodic top dressing with additional stones.
    B. Prevent tracking or flow of mud into the public right-of-way.
    C. Periodic top dressing with 2 inches stone may be required, as conditions demand, and repair any structures used to trap sediments.
    D. Inspect daily for loss of gravel or sediment buildup.
    E. Inspect adjacent areas for sediment deposit and install additional controls as necessary.
    F. Expand stabilized area as required to accommodate activities.



Stabilized Roadway Entrance

Silt Fence

1 DESCRIPTION: A temporary sediment barrier consisting of a filter fabric stretched across and attached to supporting posts and entrenched.

2. APPLICATION: To intercept sediment from disturbed areas of limited extent.

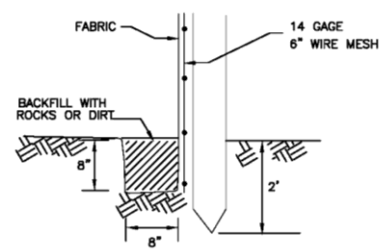
   A. Perimeter Control: Place barrier at down gradient limits of disturbance.
   B. Sediment Barrier: Place barrier at toe of slope or soil stockpile.
   C. Protection of Existing Waterways: Place barrier at top of stream bank.
   D. Inlet Protection.

3. INSTALLATION/APPLICATION CRITERIA: Refer to APWA Section 01 57 00.

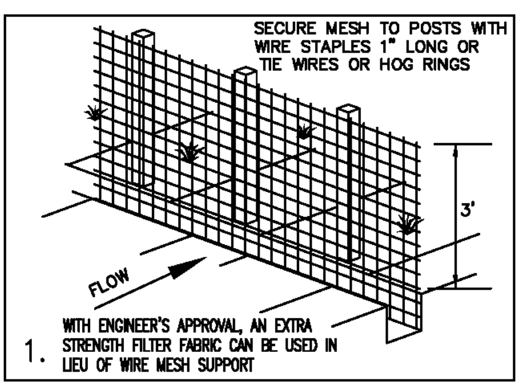
   A. Synthetic filter fabric shall be a pervious sheet of propylene, nylon, polyester, or polyethylene yarn. Synthetic filter fabric shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of 6 months of expected usable construction life at a temperature range of 0° F to 120° F.
   B. Burlap shall be 10 ounces per square yard of fabric.
   C. Posts for silt fences shall be either 2" x 4" diameter wood, or 1.33 pounds per linear foot steel with a minimum length of 5 feet. Steel posts shall have projections for fastening wire to them.
   D. The fabric is cut on site to desired width, unrolled, and draped over the barrier. The fabric toe is secured with rocks or dirt. The fabric is secured to the mesh with twin, staples or similar devices.
   E. When attaching two silt fences together, place the end post of the second fence inside the end post of the first fence. Rotate both posts at least 180 degrees on a clockwise direction to create a tight seal with the filter fabric. Drive both posts into the ground and bury the flap.
   F. When used to control sediments from a steep slope, silt fences should be placed away from the toe of the slope for increased holding capacity.

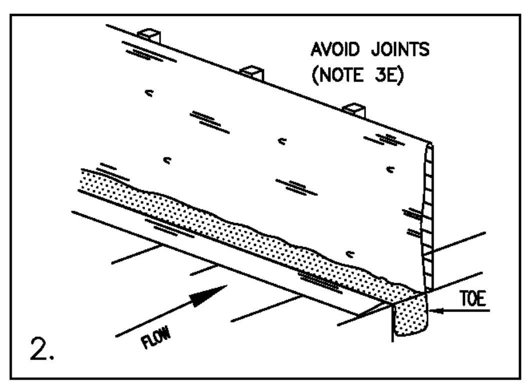
4. MAINTENANCE:

   A. Inspected immediately after each rainfall and at least daily during prolonged rainfall.
   B. Should the fabric on a silt fence or filter barrier decompose or become ineffective before the end of the expected usable life and the barrier still be necessary, the fabric shall be replaced promptly.
   C. Sediment deposits should be removed after each storm event. They must be removed when deposits reach approximately one-half the height of the barrier.
   D. Re-anchor fence as necessary to prevent shortcutting.
   E. Inspect for runoff bypassing ends of barriers or undercutting barriers.



TOE DETAIL





Dikes, Berms and Drainage Swales

1. DESCRIPTION AND PURPOSE: An earth dike is a temporary berm or ridge of compacted soil used to divert runoff or channel water to a desired location. A drainage swale is a shaped and sloped depression in the soil surface used to convey runoff to a desired location. Earth dikes and drainage swales are used to divert off site runoff around the construction site, divert runoff from stabilized areas and disturbed areas, and direct runoff into sediment basins or traps.

2. SUITABLE APPLICATIONS: Earth dikes and drainage swales are suitable for use, individually or together, where runoff needs to be diverted from one area and conveyed to another.

   A. Earth dikes and drainage swales may be used:
      1. To convey surface runoff down sloping land
      2. To intercept and divert runoff to avoid sheet flow over sloped surfaces
      3. To divert and direct runoff towards a stabilized watercourse, drainage pipe or channel
      4. To intercept runoff from paved surfaces
      5. Below steep grades where runoff begins to concentrate
      6. Along roadways and facility improvements subject to flood drainage
      7. At the top of slopes to divert run on from adjacent or undisturbed slopes
      8. At bottom and mid slope locations to intercept sheet flow and convey concentrated flows.
      9. Divert sediment laden runoff into sediment basins or traps

3. LIMITATIONS: Dikes should not be used for drainage areas greater than 10 acres or along slopes greater than 10 percent. For larger areas more permanent drainage structures should be built. All drainage structures should be built in compliance with local municipal requirements.

   A. Earth dikes may create more disturbed area on site and become barriers to construction equipment.
      1. Earth dikes must be stabilized immediately, which adds cost and maintenance concerns.
      2. Diverted stormwater may cause downstream flood damage.
      3. Dikes should not be constructed of soils that may be easily eroded.
      4. Regrading the site to remove the dike may add additional cost.
      5. Temporary drains and swales or any other diversion of runoff should not adversely impact upstream or downstream properties.
      6. Temporary drains and swales must conform to local floodplain management requirements.
      7. Earth dikes/drainage swales are not suitable as sediment trapping devices.
      8. It may be necessary to use other soil stabilization and sediment controls such as check dams, plastics, and blankets, to prevent scour and erosion in newly graded dikes, swales, and ditches.

4. IMPLEMENTATION: The temporary earth dike is a berm or ridge of compacted soil, located in such a manner as to divert stormwater to a sediment trapping device or a stabilized outlet, thereby reducing the potential for erosion and offsite sedimentation. Earth dikes can also be used to divert runoff from off site and from undisturbed areas away from disturbed areas and to divert sheet flows away from unprotected slopes.

   A. An earth dike does not itself control erosion or remove sediment from runoff. A dike prevents erosion by directing runoff to an erosion control device such as a sediment trap or directing runoff away from an erodible area. Temporary diversion dikes should not adversely impact adjacent properties and must conform to local floodplain management regulations, and should not be used in areas with slopes steeper than 10%.Slopes that are formed during cut and fill operations should be protected from erosion by runoff. A combination of a temporary drainage swale and an earth dike at the top of a slope can divert runoff to a location where it can be brought to the bottom of the slope (see EC-u, Slope Drains) A combination dike and swale is easily constructed by a single pass of a bulldozer or grader and compacted by a second pass of the tracks or wheels over the ridge. Diversion structures should be installed when the site is initially graded and remain in place until post construction BMPs are installed and the slopes are stabilized.

B. Diversion practices concentrate surface runoff, increasing its velocity and erosive force. Thus, the flow out of the drain or swale must be directed onto a stabilized area or into a grade stabilization structure. If significant erosion will occur, a swale should be stabilized using vegetation, chemical treatment, rock rip-rap, matting, or other physical means of stabilization. Any drain or swale that conveys sediment laden runoff must be diverted into a sediment basin or trap before it is discharged from the site.

5. GENERAL: Care must be applied to correctly size and locate earth dikes, drainage swales. Excessively steep, unlined dikes, and swales are subject to erosion and gully formation.

A. Conveyances should be stabilized.
B. Use a lined ditch for high flow velocities.
C. Select flow velocity based on careful evaluation of the risks due to erosion of the measure, soil types, overtopping, flow backups, washout, and drainage flow patterns for each project site.
D. Compact any fills to prevent unequal settlement.
E. Do not divert runoff onto other property without securing written authorization from the property owner.
F. When possible, install and utilize permanent dikes, swales, and ditches early in the construction process.
G. Provide stabilized outlets.

6. EARTH DIKES: Temporary earth dikes are a practical, inexpensive BMP used to divert stormwater runoff. Temporary diversion dikes should be installed in the following manner:

A. All dikes should be compacted by earth moving equipment.
B. All dikes should have positive drainage to an outlet.
C. All dikes should have 2:1 or flatter side slopes, 18 in. minimum height, and a minimum top width of 24 in. Wide top widths and flat slopes are usually needed at crossings for construction traffic.
D. The outlet from the earth dike must function with a minimum of erosion. Runoff should be conveyed to a sediment trapping device such as a Sediment Trap (SE-3) or Sediment Basin (SE-2) when either the dike channel or the drainage area above the dike are not adequately stabilized.
E. Temporary stabilization may be achieved using seed and mulching for slopes less than 5% and either rip-rap or sod for slopes in excess of 5%. In either case, stabilization of the earth dike should be completed immediately after construction or prior to the first rain.
F. If riprap is used to stabilize the channel formed along the toe of the dike, the following typical specifications apply:

Channel Grade	Riprap Stabilization
0.5-1.0%	4 in. Rock
1.1-2.0%	6 in. Rock
2.1-4.0%	8 in. Rock
4.1-5.0%	8 in. - 12 in. Riprap

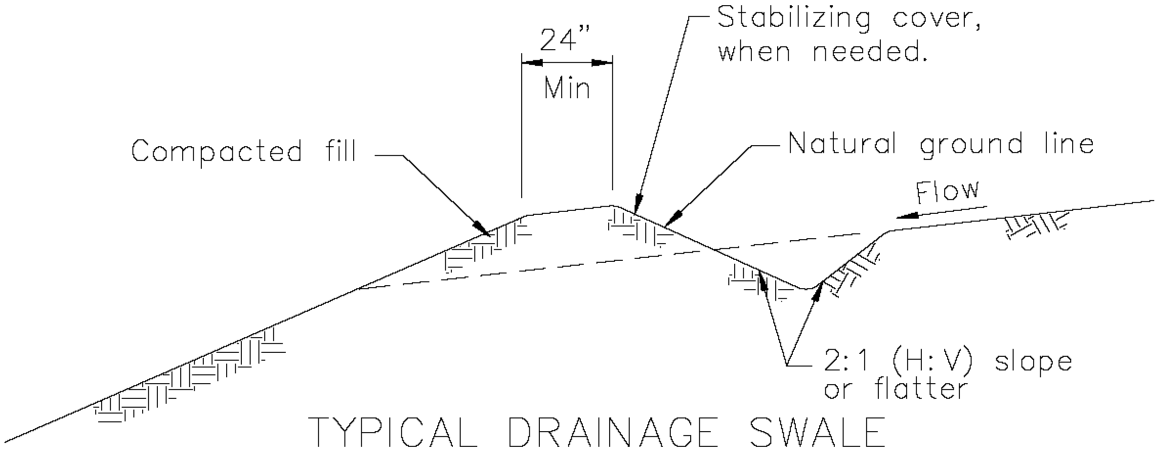
G. The stone riprap, recycled concrete, etc. used for stabilization should be pressed into the soil with construction equipment.
H. Filter cloth may be used to cover dikes in use for long periods.
I. Construction activity on the earth dike should be kept to a minimum.

7. DRAINAGE SWALES: Drainage swales are only effective if they are properly installed. Swales are more effective than dikes because they tend to be more stable. The combination of a swale with a dike on the downhill side is the most cost effective diversion.

A. Standard engineering design criteria for small open channel and closed conveyance systems should be used (see the local drainage design manual). Unless local drainage design criteria state otherwise, drainage swales should be designed as follows:
1. No more than 5 acres may drain to a temporary drainage swale.
2. Place drainage swales above or below, not on, a cut or fill slope.
3. Swale bottom width should be at least 2 ft
4. Depth of the swale should be at least 18 in.
5. Side slopes should be 2:1 or flatter.
6. Drainage or swales should be laid at a grade of at least 1 percent, but not more than 15 percent.
7. The swale must not be overtopped by the peak discharge from a 10-year storm, irrespective of the design criteria stated above.
8. Remove all trees, stumps, obstructions, and other objectionable material from the swale when it is built.
9. Compact any fill material along the path of the swale.
10. Stabilize all swales immediately. Seed and mulch swales at a slope of less than 5 percent, and use rip-rap or sod for swales with a slope between 5 and 15 percent. For temporary swales, geotextiles and mats (EC-7) may provide immediate stabilization.
11. Irrigation may be required to establish sufficient vegetation to prevent erosion.
12. Do not operate construction vehicles across a swale unless a stabilized crossing is provided.
13. Permanent drainage facilities must be designed by a professional engineer (see the local drainage design criteria for proper design).
14. At a minimum, the drainage swale should conform to predevelopment drainage patterns and capacities.
15. Construct the drainage swale with a positive grade to a stabilized outlet.
16. Provide erosion protection or energy dissipation measures if the flow out of the drainage swale can reach an erosive velocity.

8. COSTS: Cost ranges from $15 to $55 per ft for both earthwork and stabilization and depends on availability of material, site location, and access.
A. Small dikes: $2.50 - $6.50/linear ft; Large dikes: $2.50/yd^3.
B. The cost of a drainage swale increases with drainage area and slope. Typical swales for controlling internal erosion are inexpensive, as they are quickly formed during routine earthwork.

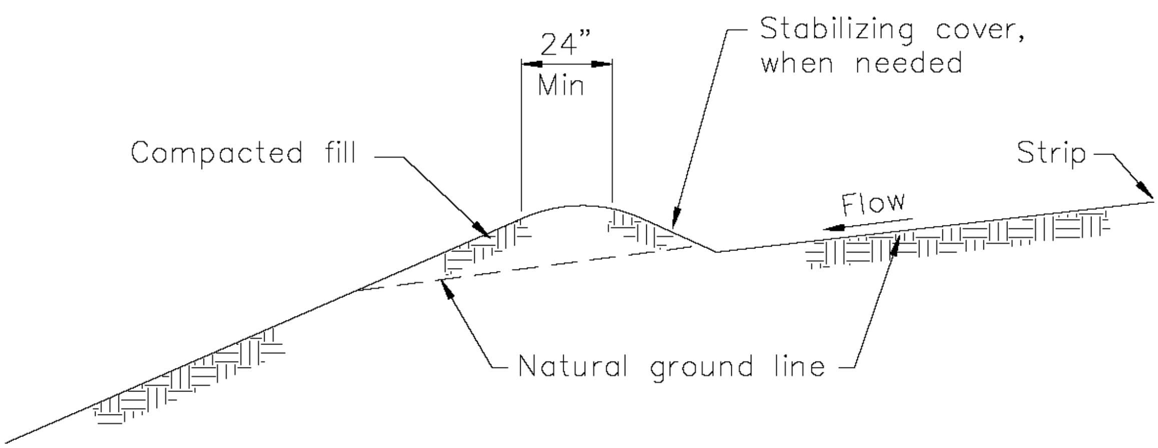
9. INSPECTION AND MAINTENANCE: Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
A. Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
B. Inspect ditches and berms for washouts. Replace lost riprap, damaged linings or soil stabilizers as needed.
C. Inspect channel linings, embankments, and beds of ditches and berms for erosion and accumulation of debris and sediment. Remove debris and sediment and repair linings and embankments as needed.
D. Temporary conveyances should be completely removed as soon as the surrounding drainage area has been stabilized or at the completion of construction.



TYPICAL DRAINAGE SWALE
NOT TO SCALE

NOTES:

1. Stabilize inlet, outlets and slopes.
2. Properly compact the subgrade.



TYPICAL EARTH DIKE
NOT TO SCALE

Dikes, Berms and Drainage Swales

Sediment Traps/Basins

1. DESCRIPTION AND PURPOSE: A sediment basin is a temporary basin formed by excavation or by constructing an embankment so that sediment-laden runoff is temporarily detained under quiescent conditions, allowing sediment to settle out before the runoff is discharged.

2. SUITABLE APPLICATIONS: Sediment basins may be suitable for use on larger projects with sufficient space for constructing the basin. Sediment basins should be considered for use:

   A. Where sediment-laden water may enter the drainage system or watercourses.
   B. On construction projects with disturbed areas during the rainy season.
   C. At the outlet of disturbed watersheds between 5 acres and 75 acres.
   D. At the outlet of large disturbed watersheds, as necessary.
   E. Where post construction detention basins are required.
   F. In association with dikes, temporary channels, and pipes used to convey runoff from disturbed areas.

3. LIMITATIONS: Sediment basins must be installed only within the property limits and where failure of the structure will not result in loss of life, damage to homes or buildings, or interruption of use or service of public roads or utilities. In addition, sediment basins are attractive to children and can be very dangerous. Local ordinances regarding health and safety must be adhered to. If fencing of the basin is required, the type of fence and its location should be shown in the SWPPP and in the construction specifications.

   A. Generally, sediment basins are limited to drainage areas of 5 acres or more, but not appropriate for drainage areas greater than 75 acres.
   B. Sediment basins may become an "attractive nuisance" and care must be taken to adhere to all safety practices. If safety is a concern, basin may require protective fencing.
   C. Sediment basins designed according to this handbook are only practically effective in removing sediment down to about the medium silt size fraction. Sediment-laden runoff with smaller size fractions (fine silt and clay) may not be adequately treated unless chemical treatment is used in addition to the sediment basin.
   D. Sites with very fine sediments (fine silt and clay) may require longer detention times for effective sediment removal.
   E. Basins with a height of 25 ft or more or an impounding capacity of 5o ac-ft or more must obtain approval from Division of Safety of Dams.
   F. Standing water may cause mosquitoes or other pests to breed.
   G. Basins require large surface areas to permit settling of sediment. Size may be limited by the available area.

4. IMPLEMENTATION

   General. A sediment basin is a controlled stormwater release structure formed by excavation or by construction of an embankment of compacted soil across a drainage way, or other suitable location. It is intended to trap sediment before it leaves the construction site. The basin is a temporary measure with a design life of 12 to 28 months in most cases and is to be maintained until the site area is permanently protected against erosion or a permanent detention basin is constructed.

   A. Sediment basins are suitable for nearly all types of construction projects. Whenever possible, construct the sediment basins before clearing and grading work begins. Basins should be located at the stormwater outlet from the site but not in any natural or undisturbed stream. A typical application would include temporary dikes, pipes, and/or channels to divert runoff to the basin inlet.
   B. Many development projects in California will be required by local ordinances to provide a stormwater detention basin for post-construction flood control, desilting, or stormwater pollution

control. A temporary sediment basin may be constructed by rough grading the post- construction control basins early in the project.

C. Sediment basins trap 70-80 % of the sediment that flows into them if designed according to this handbook. Therefore, they should be used in conjunction with erosion control practices such as temporary seeding, mulching, diversion dikes, etc., to reduce the amount of sediment flowing into the basin.

Planning. To improve the effectiveness of the basin, it should be located to intercept runoff from the largest possible amount of disturbed area. The best locations are generally low areas. Drainage into the basin can be improved by the use of earth dikes and drainage swales (see BMP EC-9). The basin must not be located in a stream but it should be located to trap sediment-laden runoff before it enters the stream. The basin should not be located where its failure would result in the loss of life or interruption of the use or service of public utilities or roads.

A. Construct before clearing and grading work begins when feasible.
B. Do not locate in a stream.
C. Basin sites should be located where failure of the structure will not cause loss of life, damage to homes or buildings, or interruption of use or service of public roads or utilities.
D. Large basins are subject to state and local dam safety requirements.
E. Limit the contributing area to the sediment basin to only the runoff from the disturbed soil areas. Use temporary concentrated flow conveyance controls to divert runoff from undisturbed areas away from the sediment basin.
F. The basin should be located: (1) by excavating a suitable area or where a low embankment can be constructed across a swale, (2) where post-construction (permanent) detention basins will be constructed, and (3) where the basins can be maintained on a year-round basis to provide access for maintenance, including sediment removal and sediment stockpiling in a protected area, and to maintain the basin to provide the required capacity.

Design. Sediment basins must be designed in accordance with Section A of the State of California NPDES General Permit for Stormwater Discharges Associated with Construction Activities (General Permit) where sediment basins are the only control measure proposed for the site. If there is insufficient area to construct a sediment basin in accordance with the General Permit requirements, then the alternate design standards specified herein may be used. Sediment basins designed per the General Permit shall be designed as follows:

Option 1: Pursuant to local ordinance for sediment basin design and maintenance, provided that the design efficiency is as protective or more protective of water quality than Option 3.

OR

Option 2: Sediment basin(s), as measured from the bottom of the basin to the principal outlet, shall have at least a capacity equivalent to 3,600 cubic feet (133 yd^3) of storage per acre draining into the sediment basin. The length of the basin shall be more than twice the width of the basin. The length is determined by measuring the distance between the inlet and the outlet; and the depth must not be less than 3 ft nor greater than 5 ft for safety reasons and for maximum efficiency.

OR

Option 3: Sediment basin(s) shall be designed using the standard equation:

$$As = 1.2Q/Vs \qquad \text{(Eq. 1)}$$

Where:

As = Minimum surface area for trapping soil particles of a certain size
Vs = Settling velocity of the design particle size chosen

Q = C I A

Where:

Q = Discharge rate measured in cubic feet per second
C = Runoff coefficient
I = Precipitation intensity for the 10-year, 6-hour rain event
A = Area draining into the sediment basin in acres

The design particle size shall be the smallest soil grain size determined by wet sieve analysis, or the fine silt sized (0.01 mm [or 0.0004 in.]) particle, and the *Vs* used shall be 100 percent of the calculated settling velocity.

The length is determined by measuring the distance between the inlet and the outlet; the length shall be more than twice the dimension as the width; the depth shall not be less than 3 ft nor greater than 5 ft for safety reasons and for maximum efficiency (2 ft of sediment storage, 2 ft of capacity). The basin(s) shall be located on the site where it can be maintained on a year-round basis and shall be maintained on a schedule to retain the 2 ft of capacity.

OR

Option 4: The use of an equivalent surface area design or equation, provided that the design efficiency is as protective or more protective of water quality than Option 3.

A. Other design considerations are:

The volume of the settling zone should be sized to capture runoff from a 2-year storm or other appropriate design storms specified by the local agency. A detention time of 24 to 40 hours should allow 70 to 80 % of sediment to settle.

The basin volume consists of two zones:

1. A sediment storage zone at least 1 ft deep.
2. A settling zone at least 2 ft deep.

The length to settling depth ratio (L/SD) should be less than 200.

Sediment basins are best used in conjunction with erosion controls. Sediment basins that will be used as the only means of treatment, without upstream erosion and sediment controls, must be designed according to the four options required by the General Permit (see Options 1-4 above). Sediment basins that are used in conjunction with upstream erosion and sediment controls should be designed to have a capacity equivalent to 67 yd^3 of sediment storage per acre of contributory area.

The length of the basin should be more than twice the width of the basin; the length should be determined by measuring the distance between the inlet and the outlet.

The depth must be no less than 3 ft.

Basins with an impounding levee greater than 4.5 ft tall, measured from the lowest point to the impounding area to the highest point of the levee, and basins capable of impounding more than 35,000 ft^3, should be designed by a Registered Civil Engineer. The design should include maintenance requirements, including sediment and vegetation removal, to ensure continuous function of the basin outlet and bypass structures.

Basins should be designed to drain within 72 hours following storm events. If a basin fails to drain within 72 hours, it must be pumped dry.

Sediment basins, regardless of size and storage volume, should include features to accommodate overflow or bypass flows that exceed the design storm event.

Include an emergency spillway to accommodate flows not carried by the principal spillway. The spillway should consist of an open channel (earthen or vegetated) over undisturbed material (not fill) or constructed of a non-erodible riprap.

The spillway control section, which is a level portion of the spillway channel at the highest elevation in the channel, should be a minimum of 20 ft in length.

Rock or vegetation should be used to protect the basin inlet and slopes against erosion.

A forebay, constructed upstream of the basin may be provided to remove debris and larger particles.

The outflow from the sediment basin should be provided with velocity dissipation devices (see BMP EC-10) to prevent erosion and scouring of the embankment and channel.

Basin inlets should be located to maximize travel distance to the basin outlet.

The principal outlet should consist of a corrugated metal, high density polyethylene (HDPE), or reinforced concrete riser pipe with dewatering holes and an anti-vortex device and trash rack attached to the top of the riser, to prevent floating debris from flowing out of the basin or obstructing the system. This principal structure should be designed to accommodate the inflow design storm.

A rock pile or rock-filled gabions can serve as alternatives to the debris screen; although the designer should be aware of the potential for extra maintenance involved should the pore spaces in the rock pile clog.

The outlet structure should be placed on a firm, smooth foundation with the base securely anchored with concrete or other means to prevent floatation.

Attach riser pipe (watertight connection) to a horizontal pipe (barrel). Provide anti-seep collars on the barrel.

Cleanout level should be clearly marked on the riser pipe.

Proper hydraulic design of the outlet is critical to achieving the desired performance of the basin. The outlet should be designed to drain the basin within 24 to 72 hours (also referred to as "drawdown time"). The 24-hour limit is specified to provide adequate settling time; the 72-hour limit is specified to mitigate vector control concerns.

The two most common outlet problems that occur are: (1) the capacity of the outlet is too great resulting in only partial filling of the basin and drawdown time less than designed for; and (2) the outlet clogs because it is not adequately protected against trash and debris. To avoid these problems, the following outlet types are recommended for use: (1) a single orifice outlet with or without the protection of a riser pipe, and (2) perforated riser. Design guidance for single orifice and perforated riser outlets follow:

Flow Control Using a Single Orifice At The Bottom Of The Basin (Figure 1): The outlet control orifice should be sized using the following equation:

$$a = \frac{2\,A(H - Ho)^{0.5}}{3600\,CT(2g)^{0.5}} = \frac{(7x10^{-5})\,A(H - Ho)^{0.5}}{CT} \qquad \text{(Eq.2)}$$

where:

a = area of orifice (ft^2)
A = surface area of the basin at mid elevation (ft^2)
C = orifice coefficient
T = drawdown time of full basin (hrs)
g = gravity (32.2 ft/s^2)
H = elevation when the basin is full (ft)
Ho = final elevation when basin is empty (ft)
With a drawdown time of 40 hours, the equation becomes:

$$a = \frac{(1.75x10^{-6})A(H- Ho)^{0.5}}{C} \qquad \text{(Eq. 3)}$$

Flow Control Using Multiple Orifices (see Figure2):

$$a_t = \frac{2\,A(h_{max})}{3600\,CT(2g[h_{max} - h_{\text{centroid of orifices}}])} \qquad \text{(Eq.4)}$$

With terms as described above except:

a_t = total area of orifices
h_{max} = maximum height from lowest orifice to the maximum water surface (ft)
$h_{\text{centroid of orifices}}$ = height from the lowest orifice to the centroid of the orifice configuration (ft)

Allocate the orifices evenly on two rows; separate the holes by 3x hole diameter vertically, and by 120 degrees horizontally (refer to Figure 2).

Because basins are not maintained for infiltration, water loss by infiltration should be disregarded when designing the hydraulic capacity of the outlet structure.

Care must be taken in the selection of "C"; 0.60 is most often recommended and used. However, based on actual tests, GKY (1989), "Outlet Hydraulics of Extended Detention Facilities for Northern Virginia Planning District Commission", recommends the following:

C = 0.66 for thin materials; where the thickness is equal to or less than the orifice diameter, or
C = 0.80 when the material is thicker than the orifice diameter

Installation. Securely anchor and install an anti-seep collar on the outlet pipe/riser and provide an emergency spillway for passing major floods (see local flood control agency).

A. Areas under embankments must be cleared and stripped of vegetation.
B. Chain link fencing should be provided around each sediment basin to prevent unauthorized entry to the basin or if safety is a concern.

5. COSTS: Average annual costs for installation and maintenance (2 year useful life) are:

A. Basin less than 50,000 ft^3: Range, $0.24 - $1.58/ ft^3. Average, $0.73 per ft^3. $400 - $2,400, $1,200 average per drainage acre.
B. Basin size greater than 50,000 ft^3: Range, $0.12 - $0.48/ ft^3. Average, $0.36 per ft3. $200 - $800, $600 average per drainage acre.

6. INSPECTION AND MAINTENANCE: Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.

A. Examine basin banks for seepage and structural soundness.
B. Check inlet and outlet structures and spillway for any damage or obstructions. Repair damage and remove obstructions as needed.
C. Check inlet and outlet area for erosion and stabilize if required.
D. Check fencing for damage and repair as needed.
E. Sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when sediment accumulation reaches one- half the designated sediment storage volume. Sediment removed during maintenance may be incorporated into earthwork on the site or disposed of at appropriate locations.
F. Remove standing water from basin within 72 hours after accumulation.
G. BMPs that require dewatering shall be continuously attended while dewatering takes place. Dewatering BMPs shall be implemented at all times during dewatering activities.
H. To minimize vector production:
    1. Remove accumulation of live and dead floating vegetation in basins during every inspection.
    2. Remove excessive emergent and perimeter vegetation as needed or as advised by local or state vector control agencies.

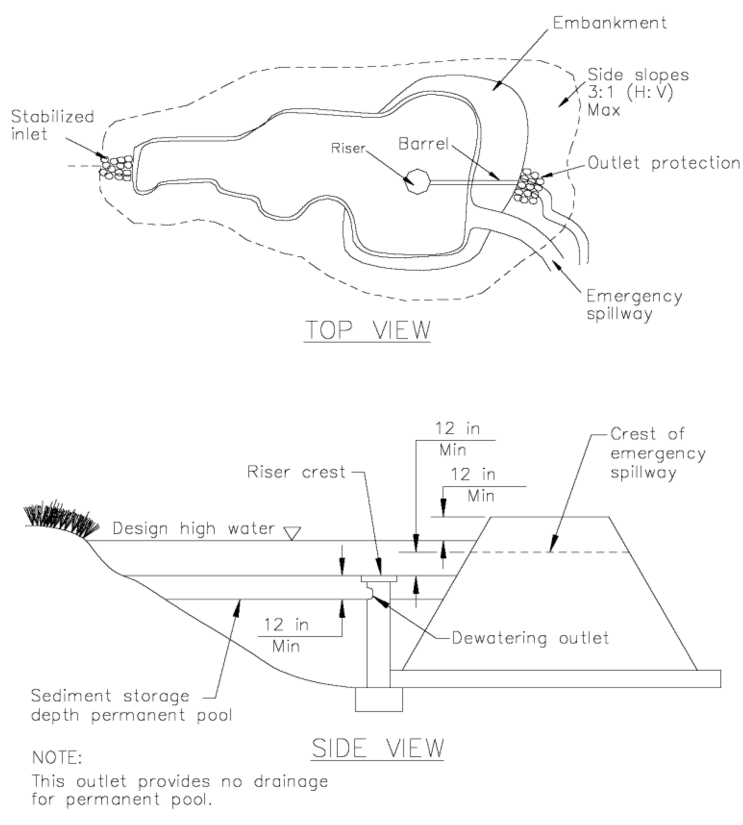


FIGURE 1: TYPICAL TEMPORARY SEDIMENT BASIN
SINGLE ORIFICE DESIGN
NOT TO SCALE

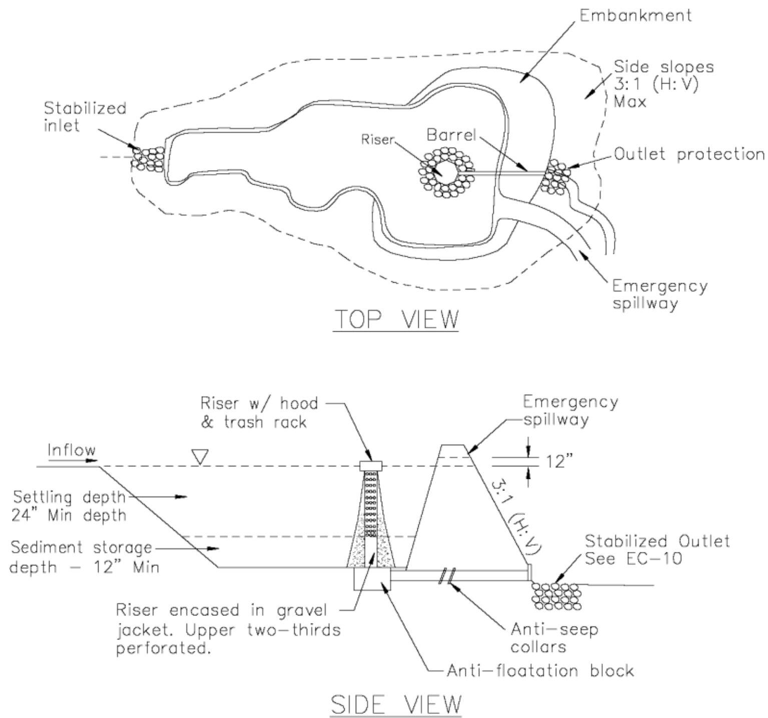


FIGURE 2: TYPICAL TEMPORARY SEDIMENT BASIN

MULTIPLE ORIFICE DESIGN

NOT TO SCALE

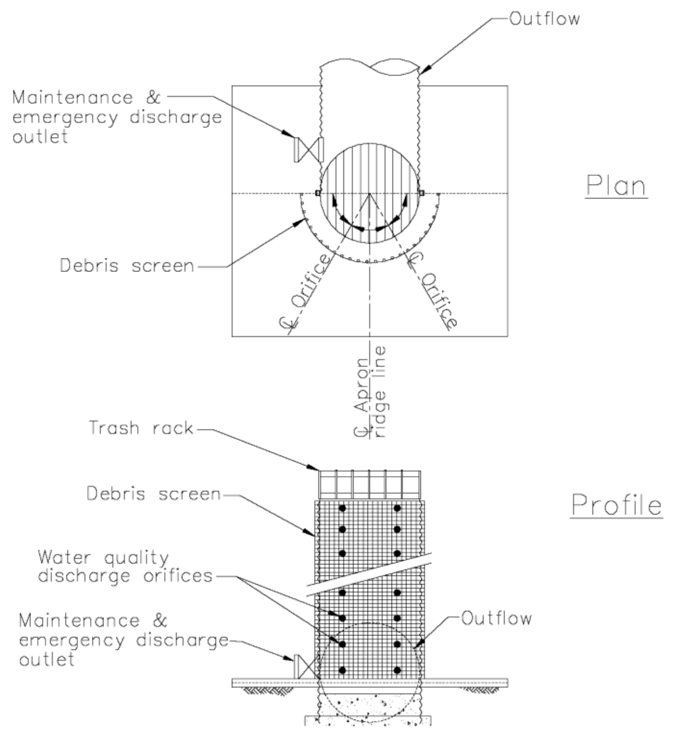


FIGURE 3: MULTIPLE ORIFICE OUTLET RISER

NOT TO SCALE

DEEP TILLING: AN ALTERNATIVE REMEDIAL SOLUTION

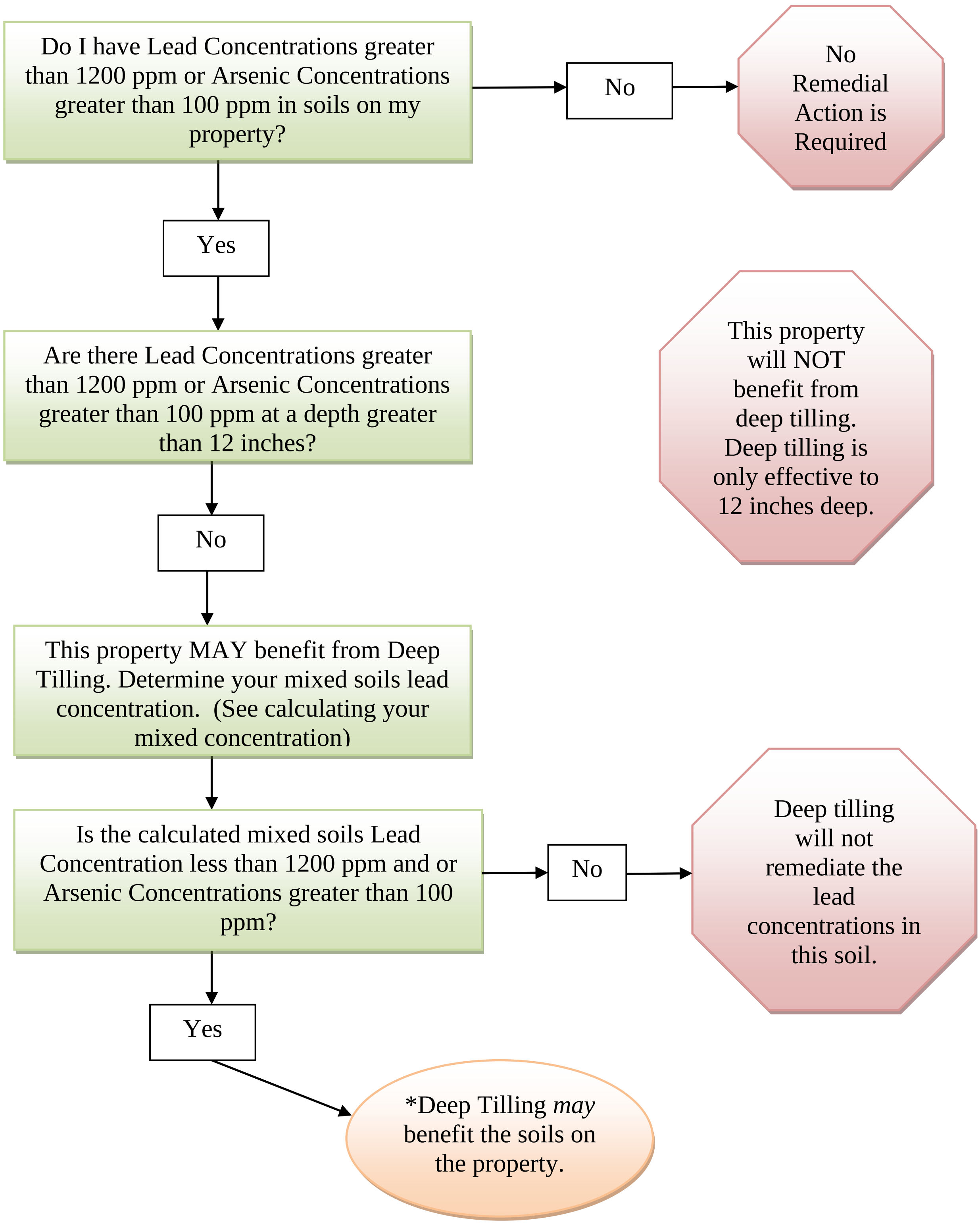
Is Deep Tilling an Option for My Property?

Herriman Land Use Planning
Public Works Department

What is Deep Tilling?
Deep tilling consists of the mixing of soil layers mechanically. Tilling would include blending the soil from 0-12 inches. Lead concentrations would be, more or less, evenly distributed after tilling through the 0-12 inch horizon to eliminate areas of higher concentrations of lead. Farming practices over the century have used tilling the plow under crop stubble following harvest. This practice has in effect mixed the top 10 inches of soil for a good portion of the properties in Herriman, Utah.

What is the concentration limit?
A residential limit of 1200 parts per million (ppm) lead and 100 ppm arsenic has been established for soils in the Herriman area. Recent soil removals of lead contaminated soils have found that once the high lead concentrated soils were removed arsenic concentrations also decreased.

How Do I Know If I Am a Candidate for Deep Tilling?



Calculating Your Mixed Soil Lead Concentration

The mixed soil lead concentrationof your soil can be calculated by using the following formula:

Mixed Soil Lead Conc. = (X+Y) / 2

X = Lead concentration from the 0-6 inch interval
Y = Lead concentration from the 6-12 inch interval

Use the quick reference table to determine if soil layers may be mixed. The lead concentrations in the table show the maximum concentrations that when mixed should theorectically meet the 1200 ppm lead limit. The maximum lead concentration mixable in any layer is 3200 ppm and that is only if the other layer contains 0 ppm lead.

To use the table, look up the lead concentration for the 0-6 inch interval in Column X. Then look at the adjacent value in Column Y. This value is the maximum lead concentration in the 6-12 inch interval allowed if the soils were mixed in order to meet the 1200 ppm lead concentration limit.

For example:
The lead concentration in the 0-6 inch layer is 724 ppm. Using the quick reference chart, find the nearest greater value in Column X. In this case, the value is <1000. For this X value the Y value is <1676. Therefore if the 0-6 inch interval has a concentration of 824 ppm, then the 6-12 inch interval must have a concentration less than 1676 ppm lead in order for the mixed soil lead concentration to be below the 1200 ppm lead limit. This is only an approximation. Using the formula instead of the table, a 0-6 inch soil layer with a concentration of 724 ppm can have a concentration up to 1676 ppm in the 6-12 inch layer.

Discussion

Mathmatically the mixing of soils is easy. However, in reality soils cannot be totally homogenized using mechanical means. If **both** the 0-6 inch and 6-12 inch soil layers to be mixed contain lead concentrations close to maximum mixing concentrations in the table, “hotspots” may be left behind after the mixing is completed. Deep tilling would probably not be effective in these cases and another remedial alternative should be investigated.

Alternatively, tilling may be effective on portions of the property and not others. Under this scenario, divide the property into discreet sections and determine the calculated mixed concentration per section.

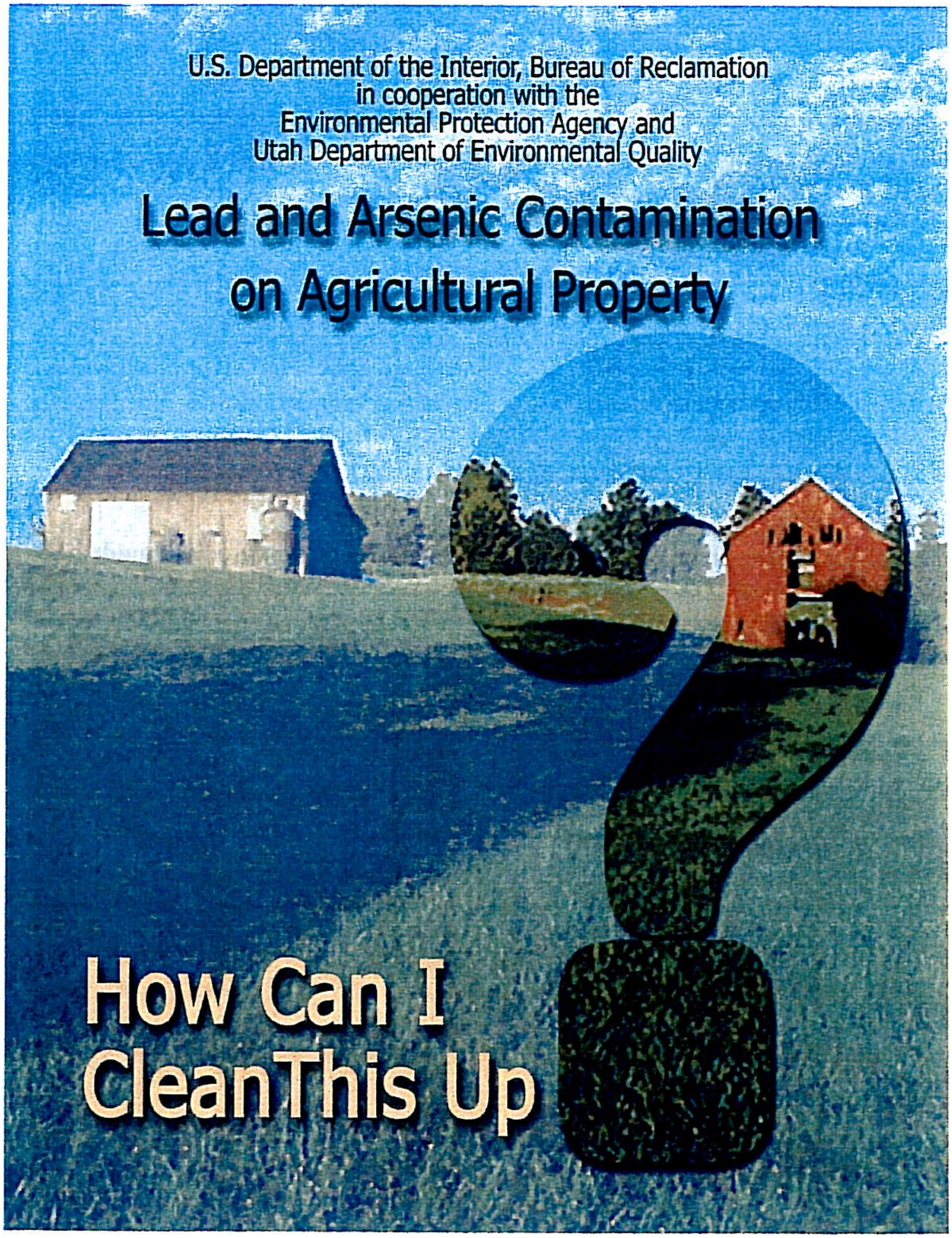
Mixed Soil Concentration (ppm) Quick Reference

X	Y	Lead Conc.
0-6 inch interval	**6-12 inch interval**	**Maximum Limit (ppm)**
0	<2400	1200
<200	<2200	1200
<400	<2000	1200
<600	<1800	1200
<800	<1600	1200
<1000	<1400	1200
<1200	<1200	1200
<1400	<1000	1200
<1600	<800	1200
<1800	<600	1200
<2000	<400	1200
<2200	<200	1200
<2400	<0	1200

SECTION C
TECHNICAL GUIDANCE

How Do I Develop Contaminated Properties
(Experience and Lessons from the U.S Bureau of Reclamation)

LEAD AND ARSENIC CONTAMINATION ON AGRICULTURAL PROPERTY:
How Can I Clean This Up?


U.S. Department of the Interior, Bureau of Reclamation
in cooperation with the
Environmental Protection Agency and
Utah Department of Environmental Quality
Lead and Arsenic Contamination
on Agricultural Property
How Can I
CleanThis Up

This book has been prepared by the Bureau of Reclamation to be used as a **guide only**. For specific information about possible contaminants located on your property and possible cleanup techniques, please contact the Environmental Protection Agency or Utah Department of Environmental Quality.

Lead and Arsenic Contamination on Agricultural Property

How Can I Clean This Up?

CONTENTS

APPENDICES

FIGURES

INTRODUCTION

This manual is written for agricultural property owners who suspect that their lands may have been contaminated by historic mining activities.

It is intended as a guide only, since many different methods of sampling and addressing contaminated soils have been successfully completed.

This manual is designed to assist you with:

- ❑ Performing initial investigations
- ❑ Selecting a sampling method appropriate for your property's conditions
- ❑ Analyzing the soil samples
- ❑ Evaluating the results of the sample analysis

Included are examples of cleanup techniques and associated costs along with long-term management considerations, where needed.

It is important to note that if you suspect that your property may be contaminated, you should contact your local government prior to beginning any action.

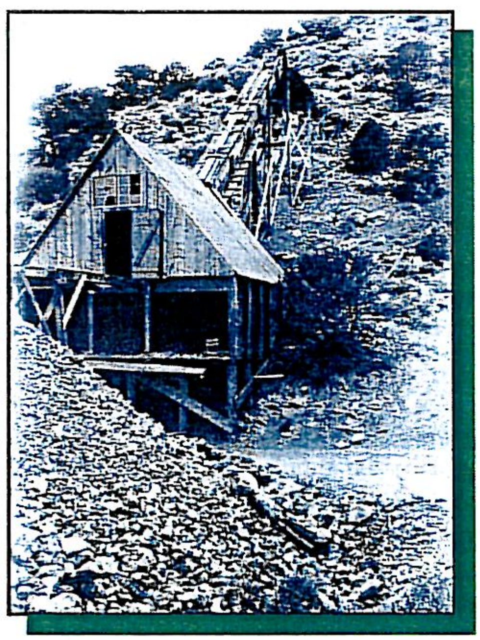


Figure i-1: Waste rock in foreground of smelter building, Caresa Mining Company, Utah. Used by permission, Utah State Historical Society, All Rights Reserved Photo No. 28188.

Where does mining waste come from?

Shortly after the westward migration began in the United States, mineral resources were discovered in the new territories.

In Utah, mining began on a small scale during the 1860's. The 1872 Mining Law allowed miners to make a claim on Federal land for only $5. Mining became profitable with the completion of the Intercontinental Railroad in 1879, and railroad spurs were built to most of the mining districts in Utah.

Early miners were not aware of environmental issues. Often, miners disposed of mining waste by dumping it near the mine entrance or into the nearest stream or river. Even as mining technologies improved, many of the mining methods remained unchanged.

In Utah, there are four major types of mining wastes: ***waste rock***, ***tailings***, ***slag***, and ***stack contaminants***.

Waste Rock: During mining operations, miners simply set aside the rock which did not contain enough precious metals to process. This ***waste rock*** was usually piled near the mine portal or open pit mine. However, because historic processing techniques were quite crude, some of that waste rock contains high levels of precious metals.

Tailings: Historically, the precious metals were removed from the metal-bearing rock, known as ore, by grinding and milling. When ground, the ore resembled fine sand. The metal-bearing sand, called concentrate, was separated from the nonmetallic sand, or ***tailings***, by gravity. The concentrate was shipped by rail to smelters for further processing. Since it had no further mining use, the waste tailings were simply set aside, often in large open piles.

Slag: At the smelter, the concentrate was processed using high temperatures to "drive off" the sulfur and separate the metals from the concentrate. The waste from this smelting operation was called ***slag***. The slag was disposed of in a convenient location near the smelter.

Stack contaminants: Early smelters had little air emissions controls. Smelter stacks belched out sulfur gases and fine particles, or ***stack contaminants***, which settled onto surrounding properties.

All of these waste products contained various concentrations of lead and arsenic. Lead poisoning of miners and smeltermen was common–and was considered a public health threat by health officials of the early 1900's. "Smelterman's itch," a prominent condition of the day, was likely caused by the arsenic in the smelter fumes.

In those early days, no environmental laws existed to protect the nearby farmers and townspeople, so the farmers took matters into their own hands by suing the mining and smelting companies for damages to farm lands and produce.

In 1875, the farmers of Herriman, Utah, filed a suit against the owner of the lead mill on Butterfield Creek. The farmers won their case, and the court ordered the miners to cease polluting the creek. However, the pollution continued. In 1905, West Jordan farmers filed a suit against several of the mining companies in Bingham Canyon. This time, when the farmers won their case, some permanent improvements resulted.

Perhaps the most famous case of all was the "Smelter Smoke" case of 1903. Local farmers sued several smelter owners claiming that the air pollution was killing their crops. The farmers won this case, and the court required the smelters to use low sulfur ores or install smoke abatement equipment.

The two cases prompted permanent improvements. As a result, many small smelters went out of business, and new smelters were built away from population centers. To prevent further complaints, smelter owners bought thousands of acres of land surrounding these new smelters.

Many properties affected by the mining and smelting operations have been passed down to heirs or sold; and today, many landowners are discovering that their lands may be contaminated from past practices.

CHAPTER 1

HOW DID MINING WASTE GET ONTO MY LAND?

Wastes from mining and smelting operations were usually left close to the mines or smelters where the wastes were generated. Obvious signs of these operations may remain, such as structures or ruins, waste rock, tailings, or slag heaps.

Historic mines are easy to locate because they are normally found in mountainous areas and are easily identified from landmarks.

Tailings and slag, however, are not as easily recognized. With changes in land uses, these wastes now may be located in agricultural or populated areas. Characteristically, tailings are sandy piles and the slag is black and rocklike; and vegetation rarely grows on these wastes.

Although some lands may contain the original wastes, in many cases, the wastes have been moved from the original mining and smelting sites by water, air, or people.

Waste Transported by Water

Mining waste as well as the wastes from milling, grinding, and smelting operations were frequently dumped directly into streams, mixing with the stream sediments. These contaminated sediments were then carried downstream. As the water slowed, the sediments "dropped out," contaminating channels, streambanks, ditches or canals, and fields irrigated with the contaminated water. During floods, sediment was also deposited in the flood plains.

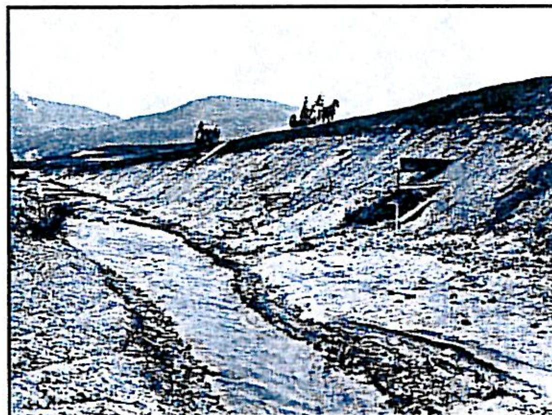


Figure 1-1: Channel downstream of the Utah Copper Company Mines. Used by permission, Utah State Historical Society, all rights reserved. Photo No. 25203.

In areas where the mining wastes have not been cleaned up, this process still continues. For example, Bingham Creek flows from the Kennecott Mining operation to the cities of South Jordan and West Jordan. Evidence of mining waste has been found not only in the downstream creek channel itself but also throughout the entire flood plain of the creek. Downstream farmers frequently used the creek to irrigate their fields. Consequently, contamination from mining waste is found in and adjacent to historic irrigation ditches. Today, most of those farmlands have been developed into suburban neighborhoods.

Figure 1-2: Irrigated field downstream of the Utah Copper Company Mining District. Visible contaminants are present in the photo foreground. Used by permission, Utah State Historical Society, all rights reserved. Photo No. 25196.

Waste Transported by Air

Contamination transported by winds has been found in some areas of Salt Lake Valley.

Early smelter smoke emissions contained high concentrations of lead, arsenic, and other heavy metal, resulting in the contamination of large areas downwind of the smoke stacks.

The waste piles surrounding smelters are also a source of windborne contamination. For example, a huge tailings pile from the smelting operations at the Sharon Steel site (formerly USSRM) in the city of Midvale, Utah, was the source of windborne contamination which affected properties in the western parts of Midvale.

Waste Transported by Humans

Contaminated wastes were also relocated by people for a variety of uses.

Before the dangers of this practice were known, property owners hauled waste rock or tailings from mining districts and smelting operations for use in home or farm construction projects. Tailings containing lead and arsenic unknowingly have been used for fill in yards and sandboxes. Waste rock from mines was used for foundations, driveways, and roadbase. In addition, some contractors used mining waste as a primary source of fill material, spreading the wastes on properties of unsuspecting homeowners. No one knew that this readily available material was a potential health risk.

Railroad companies still routinely use slag as rail ballast. Some slags, such as those from old lead smelters, contain dangerous amounts of lead. Other slags, such as those generated from copper smelting, may not have significant quantities of lead. Historic railroad rights-of-way, therefore, require special attention to determine if the slags used in the construction are contaminated.

What are the Health Concerns?

Mining wastes containing high concentrations of lead, arsenic, and other heavy metals are dangerous to human health.

Typically, the amount of lead and arsenic contained in mining wastes are proportionate to the amounts of these natural elements contained in the ore itself.

In the natural environment, lead and arsenic occur in low concentrations in rocks and do not generally pose a health risk. This changes once mining begins. Since milling and smelting operations concentrate the lead, arsenic, and other heavy metals, the concentrations in the waste materials are higher than those found in the natural environment.

In high concentrations, lead and arsenic are poisons.

Young children are particularly at risk. Young children play in dirt and then stick their fingers and toys into their mouths, inadvertently swallowing the lead and arsenic contained in the dirt.

Young children readily digest lead because their bodies are rapidly growing. They require large amounts of calcium to develop their growing central nervous systems. Because of the similar chemical structure between lead and calcium, an enzyme in the stomach that helps calcium pass into the blood stream mistakes the lead for calcium, thus the lead is readily absorbed into the bloodstream. Once in the bloodstream, lead inhibits brain development. Although the effects of lead on the brain are subtle, scientific research shows that lead can reduce a person's IQ and cause behavioral problems.

Adults are not as sensitive to lead for several reasons: their central nervous systems are fully developed; they spend less time outside "in the dirt;" and if exposed to contaminated soils, they limit their ingestion of lead because they wash their hands before eating. In addition, industrial hygiene advances in the smelting industry have made lead poisoning far less common than in the past.

It should be pointed out that the mining industry is not the only source of lead contamination.

Lead was commonly used in *paint* until 1978. Lead paint flakes off as it degrades, contaminating the dust in homes or the soil surrounding the house.

Tetraethyl lead, an octane-enhancing additive, was used in gasoline until the early 1980's. Lands adjacent to major highways are likely contaminated with lead from automotive exhaust.

Some hobbyists who work with *lead solder* and artists using *lead in stained glass windows* can find themselves exposed to unhealthy amounts of lead.

Lead arsenate was a popular pesticide in the 1930's. Soils on properties once used for orchards may be contaminated with both lead and arsenic from spraying with this pesticide.

All of these sources of lead contribute to the total cumulative health concern.

Land Use Makes a Difference

The primary use of a contaminated area and the frequency that people are exposed to its soils determine acceptable lead and arsenic concentration limits.

The U.S. Environmental Protection Agency (EPA) has established recommended acceptable lead concentration limits depending on land use and the composition of the lead.

If land use is commercial, industrial, or agricultural and small children are not likely to be regularly exposed to its soils, the standards are somewhat more flexible. However, if the contamination is in a residential area, standards are more stringent.

For example, the recommended concentration limits in ***commercial and industrial areas*** are less stringent. Since children do not normally use these areas and the soils are covered by buildings and parking lots, with the remaining property landscaped, these soils receive little direct human contact. In some cases, commercial and industrial areas are not cleaned up unless lead concentration levels exceed 7,000 milligrams of lead per kilogram of soil (mg/kg).

It has also been determined that mining wastes on ***vacant lands*** do not usually pose a human health problem (even in residential areas) because children, who are the most sensitive to lead, are not frequently exposed to the soils.

In ***agricultural areas***, concentration limits are even less stringent because there is little human activity.

These areas are normally covered with crops which reduces the likelihood of dust migration or inhalation. However, when agricultural areas are proposed for development, it is important to determine the *future* land use so that the appropriate cleanup technique is used.

Residential areas have the most stringent concentration limits. In Utah, the range has been from between 500 and 1,800 mg/kg lead.

Thus, land use is an extremely important factor in determining *"how clean is safe."* Therefore, the EPA has directed that cleanup decisions be based on a property-by-property basis when the future use of the property has ben determined.

What Levels of Lead are Dangerous?

Lead composition also determines *how clean is safe*.

Some forms of lead, such as lead sulfide or galena, are not digestible. Other lead compounds are much more digestible, such as lead carbonate, lead oxide, lead chloride, and the lead in paint. Thus, cleanup standards vary widely depending on the form of lead present in the contaminated soils. The specific standard for any particular locality and for any land use is determined by the EPA.

Lead in Soils: Safe Levels in Various Communities in the State of Utah

A brief summary of clean up levels for several communities in the State of Utah is contained in Figure 1-3:

Community	*Residential Land Use (mg/kg)*	*Non-Residential Land Use (mg/kg)*
Midvale	500	2000 (Slag)
West Jordan (Phase III)	1100	2000 (In drainage areas)
Murray	800	N/A
Herriman	1200-1600	Under development
Stockton	500	N/A

Figure 1-3: Action levels in various communities in Utah.

Breaking the Exposure Path

The goal of any cleanup project for lead and arsenic is to *break the exposure pathway*. There are several ways to accomplish this.

Sometimes, the most effective procedure to *break the exposure pathway* is simply to remove the contamination from the people or remove the people from the contamination. Other times, it is more effective to place a layer of clean material, or a "cap," between the contaminated soils and the people. Another method, which may be used when only the top several inches are contaminated, is to dilute the concentrations by "deep tilling."

All of these methods, plus others, are described in detail in Chapters 4 and 5.

However, the first step is to determine if you have contaminated soils on your property, the concentrations, and if these concentrations pose a health risk.

CHAPTER 2

POTENTIAL AREAS OF CONTAMINATION
HOW DO I LEARN MORE?

If you suspect that your property has been impacted or is located in an area downstream or downwind of an historic mining district or smelter, you are probably ready to find out more.

- ☐ Do I have contaminated soils on my property?
- ☐ If so, what are the concentrations of these contaminants?
- ☐ Are the concentrations in my soil at levels that are dangerous?

To answer these questions, the first step is to research the past and present land uses of your property.

A written or oral history of the past uses of your property and the surrounding area may be available through family members, neighbors, local libraries, irrigation companies, water user associations, or county/state/Federal Governments. These histories may contain information about the past uses of your property and provide clues about possible locations of contamination.

Family History Family members and written/oral family histories are valuable resources.

Land use records are frequently kept by family members in ledgers, diaries, journals, personal correspondence, etc.

Diaries and family records may describe the extent of flooding during the time when mining was active. These records may contain information on past irrigation practices, and may even chronicle discussions with the mining companies and describe any damages. Family diaries are usually held privately by the family, but copies can sometimes be found in the Utah State Historical Society Library, local historical societies, and genealogical archives.

Figure 2-1 is an example of a record of historical water uses in Herriman, Utah.

> The History of Water in Herriman was
> written
> in
> 1951
>
> My father, Albert J. Crane, has always been interested and associated with the different water companies in the town. The information contained wherein was taken directly from the Minute Books of the Herriman Irrigation and Herriman Pipeline Companies. He is serving as secretary for both companies at this time.

Figure 2-1: Journal entry from a personal history.

Irrigation Company Records

Irrigation company records are also an excellent source of information.

Irrigation ledgers may provide a written record of when the irrigation ditches, canals, and pipelines were constructed; the location of diversions; sources of water; locations of irrigated lands; families using the water; and general historical irrigation information.

Information written during the timeframe of active mining activities is the most useful in determining which lands might be most affected.

If the irrigation company is still in operation, such as the Herriman Irrigation Company, in Herriman, Utah, the records are kept by the officers of the company.

If the irrigation company is no longer in operation, the records may be found in the Utah State Historical Society Library

Historic Photographs

Historic photographs may provide a useful historical background of your property.

In addition to personal sources, historical photographs are available through local libraries, the Utah State Historical Society, and government agencies. You may also obtain aerial photographs (see Figure 2-2) from these same sources, local vendors, or the Internet.

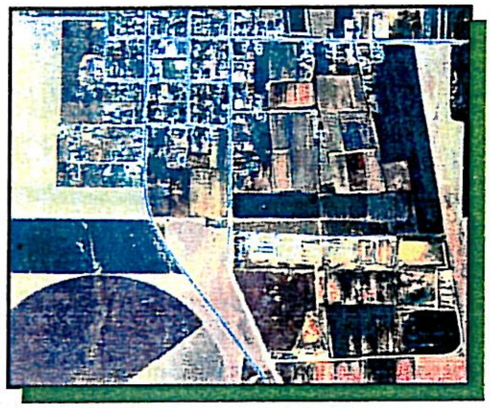


Figure 2-2: Aerial photograph of Herriman, Utah.

Maps

Federal, state, county, and city agencies keep historical land use maps and records.

Figure 2-3 illustrates irrigated lands and location of irrigation ditches in Herriman. City/county governments have maps of existing land use and zoning. Although property boundary maps are available from city/county governments, please be aware that boundaries may be in dispute.

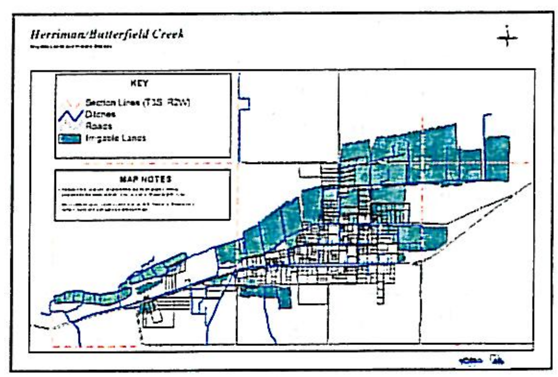


Figure 2-3: Map of Herriman, Utah, depicting the location of historic ditches and corresponding irrigated lands. Source: USBR,1998.

Land Surveys

Since some historic waterways in operation during mining activities may have been relocated or abandoned, it is important to determine their locations.

When lands are surveyed, the surveyor makes notes in a log book that "call out," or record, irrigation ditches and streams. Surveying records are an excellent resource for the location of historic or existing waterways. One source for obtaining this information is the U.S. Bureau of Land Management.

Court Transcripts

Transcripts from court cases related to water issues are available from your local courthouse.

Figure 2-4 is a court transcript detailing the suit between Herriman Irrigation Company and Keel Mining.

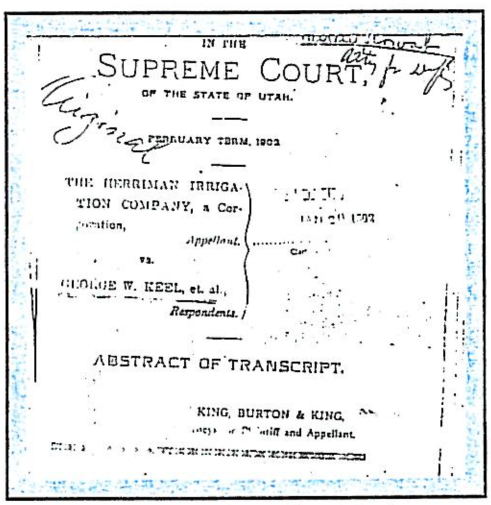

IN THE
SUPREME COURT,
OF THE STATE OF UTAH.
FEBRUARY TERM, 1903
THE HERRIMAN IRRIGATION COMPANY, a Corporation, Appellant,
vs.
GEORGE W. KEEL, et. al., Respondents.
ABSTRACT OF TRANSCRIPT.
KING, BURTON & KING,
and Appellant.

Figure 2-4: Supreme Court Case. Herriman Irrigation Company vs. George W. Keel Mining.

George Keel diverted water from Butterfield Creek for use in his mining operations. When the water was diverted back into Butterfield Creek, it was full of mine waste. The contaminated water was then used for irrigation of fields downstream, and these fields became contaminated.

This type of information is very valuable when determining the historical background of your property. In addition, water rights disputes were quite common in the early 1900's. Information about the various cases is available through Supreme Court and District Court databases and is sometimes accessible over the Internet.

Property Zoning

It is very important for land owners to find out the zoning regulations and local master plans for their properties. This information is available from local, city, or county governments.

If land is proposed for a use that is inconsistent with the zoning and the master plans for that community, then additional requirements for negotiating changes may be necessary.

Some local governments also may have open space requirements for development of large parcels. It is essential to contact local planning and building permit authorities early in the process.

Helpful Resources

The following resource list was used to determine the historical background of Herriman, Utah. This resource list may be helpful to you, but these resources may vary depending on where your property is located.

- Environmental Protection Agency, Region 8
  999 18th Street, Suite 500
  Denver, Colorado 80202
  1-800-227-8917
  http://www.epa.gov

- Statistics and Technology of Precious Metals, Census Office

- Local newspapers

- The Engineering and Mining Journal
  29 N. Wacker Dr.
  Chicago, Illinois 60606

- Map Sales
  Department of Natural Resources
  Utah Geological Survey
  1594 West North Temple, Suite 3110
  Salt Lake City, Utah 84116
  801-537-3320
  http://www.ugs.state.ut.us/

- Salt Lake County Health Department
  2001 South State Street
  Salt Lake City, Utah 84190
  801-468-2750

- Salt Lake County Zoning Department
  2001 South State Street
  Salt Lake City, Utah 84190
  801-468-2000

- Utah State Board of Water Resources
  Department of Natural Resources
  801-537-3100 (leave a message; the Board meets once every 6 weeks)
  http://www.nr.state.ut.us/WTRRESC/WTRRESC.HTM

- State and Local Irrigation Records
  Department of Natural Resources
  Water Rights Division
  1594 West North Temple, Suite 220
  Salt Lake City, Utah 84116
  801-538-7240 (ask for Distribution Section)
  http://nrwrt1.nr.state.ut.us/wrinfo/index.html

- Utah Department of Environmental Quality (UDEQ)
  168 North 1950 West
  Salt Lake City, Utah 84116
  801-536-4100
  http://www.deq.state.ut.us

- Bureau of Land Management
  2370 South 2300 West
  West Valley City, Utah 84119
  801-977-4300 (ask for cadastral surveyor field notes)
  http://www.cadastral.com

- Bureau of Reclamation
  302 East 1860 South
  Provo, Utah 84606
  801-379-1000
  http://provo.uc.usbr.gov

- Utah State Historical Society
  300 Rio Grande
  Salt Lake City, Utah 84101-1182
  801-533-3535

CHAPTER 3

SAMPLING THE SUSPECTED AREA OF CONTAMINATION

If you suspect that your property is contaminated, you may want to collect samples of your soil and have them analyzed.

There are four purposes for sampling at this point.

- ❑ It may be necessary to provide information on the location of the contamination to the planning/building permit sections of the local government in any application for zoning changes or for a building permit.

- ❑ Purchasers of land in suspected zones of contamination will most likely request sampling information. Real estate agents will seek to protect the property purchaser from unknowingly buying contaminated property. Also, banks are not likely to lend money for the purchase of properties in these areas without proof of the actual conditions.

- ❑ A knowledge of exactly where the contamination exists on large parcels of property will allow any potential developer or buyer to design the development around the contamination. It will also provide the developer with information for preparing a cost estimate if some clean up is needed.

- ❑ Once you have cleaned up contamination on your property, local authorities will require sampling to document that cleanup activities have taken place.

In some cases, the Federal or state government may have already performed studies and sampled your property, and the results may have been provided to the city and/or county governments. If this is the case, then resampling likely is not necessary unless conditions have changed between the time of sampling and the inquiry or if more detailed information is required.

Before launching into any sampling program, determine what data may already exist on the property. At the very least, this may aid in targeting the sampling areas of most concerns.

In order for your results to be universally accepted and recognized, a standard method for collecting and analyzing your samples must be followed.

The following five steps must be completed in order to successfully sample your property:

1. Determine the area to be sampled.

2. Determine the level of accuracy desired.

3. Determine the location of each sample collection point.

4. Collect samples using proper protocols.

5. Submit the samples for analysis.

The first portion of this chapter covers the process of determining sample collection points on your property, and the second portion provides instructions for obtaining soil samples from those collection points.

Step 1: Determining the area to be sampled

Determining the area to be sampled involves using your knowledge of past uses of your property (see Chapter 2 for assistance).

Knowing the past uses of property and resultant potential areas of contamination will assist you with determining the areas that should be sampled.

For example, if your property was flood irrigated with potentially contaminated water (water that flowed through mining wastes) or if lead arsenate was used as a pesticide on your property, it is recommended that you systematically collect soil samples from your entire property.

If you have determined that only a portion of your property may be contaminated, then only that portion needs sampling. However, if you are unable to determine past uses of your property, then your entire property should be sampled.

If your entire property is being considered for development, it is recommended that the entire area be sampled. For increased accuracy, more samples should be collected in areas with suspected contamination.

It is important to note that if you suspect that your property may be contaminated, you should first contact your local government.

Some areas require special attention, particularly yard areas where small children play.

In general, EPA considers that the "yard" area is the *exposure unit* for studying the risks associated with lead exposure. Therefore, the average concentration of lead in a yard area is used to evaluate whether or not the property is safe. However, special emphasis should be placed on areas where small children play, such as swing sets and sandboxes.

Although the average concentration at the ground's surface (0 - 6 inches) is used to determine if a health threat exists, finer detail is required to determine what cleanup techniques are appropriate and to estimate costs.

For that reason, it is often convenient to subdivide potential yards into "zones;" i.e., front yard, back yard, play areas, garden areas, back pastures for livestock, etc. Consider possible future land uses when subdividing the property into zones. It may not be necessary to clean the whole property if the average concentrations are too high. Instead, a cleanup of the one or two elevated zones may do the job. If the land has not been subdivided, creative development design may yield several clean parcels, and only one area may require cleanup.

Step 2: Determining the level of accuracy desired from your sample results

The more soil samples collected, the more confident you will be with the results.

For example, ten soil samples collected on a 1-acre lot will be more representative of the contamination than one sample collected on that 1-acre lot.

However, ten samples would cost ten times more, and the information from the additional nine samples may not be beneficial. Therefore, prior to collecting soil samples, you should make a list of questions to be answered.

Sometimes it is more cost effective to collect samples in stages. The first stage establishes rough areas of contamination. The second set of sampling further defines the boundaries of contamination.

If you have questions or concerns about the number of samples appropriate for your property, contact the EPA (see Chapter 2, page 2-4).

Step 3: Determining the location of each sample collection point

Equipment and Supplies Needed:

- ➜ Property drawing
- ➜ Engineer's scale or ruler
- ➜ Colored pencils (2-3 colors)
- ➜ 100-foot tape measure

Step 1: ***Obtain a copy of your property drawing.*** Property plats are available from the County Recorder's Office, or you can draw a map of your property to scale (an accurate measurement of the property dimension is essential).

If there is no existing survey for your property or if you are not certain where the boundaries are located, you may need to have a surveyor verify the property boundaries (see Figure 3-1).

Step 2: ***Draw all obstructions, such as buildings, historic irrigation ditches or canals, fences, trees, and underground utilities, on your property drawing.*** One possible source of contamination is from water that flowed through mining or smelting wastes.

Frequently, historic ditches and canals have been filled in and are no longer obvious. Even if they have been filled in, the contamination would still be in the soil. Therefore, it is important to know everything you can about the history of your property (see Figure 3-1).

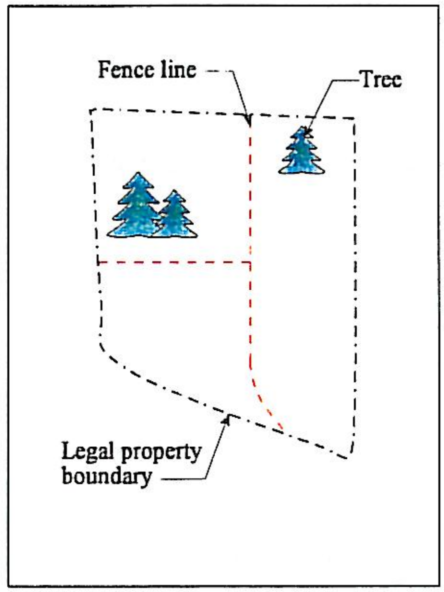


Figure 3-1: Example of a property plat, with obstacles noted.

Check historical records, talk to family members, ask neighbors, research historical photographs, and check the local irrigation company records (see Chapter 2).

Be sure to contact your local ***Blue Stakes*** office. They will come to your property and mark any underground utilities. *Blue Stakes* is located under "Utilities" in the telephone directory yellow pages (in Utah, the number is: 1-800-662-4111).

Step 3: ***Divide your property into zones.*** Dividing your property into zones will provide a way to change your sample density. Sample density is the number of samples per area (i.e., one sample per acre or ten samples per acre).

If you do not plan to develop your property or do not have special consideration areas, it is not necessary to divide your property into zones.

Some areas where dividing your property into zones is beneficial include:

Area	Sample Density
Children's play areas	Increased
Parks or ball fields/open space	Decreased
Subdivided residential lots	Increased
Subdivided commercial lots	Decreased

Also, if you suspect that a specific area is more contaminated than the rest of your property, you may decide to collect twice as many samples in that area. In this case, divide your property into two zones to allow you to easily sample Zone 2 with greater accuracy.

If you plan to develop agricultural farmland into other land uses, however, it is prudent to divide your property into zones to obtain an accurate representation of your property.

For example, if a large property is going to be developed and divided into a residential subdivision, a park, and a light commercial area, each area would require a different sampling approach, with a varying number of samples.

Figure 3-2 depicts a property with a small area of suspected contamination. In this example, the property has been divided into two zones: Zone 1 encompasses the entire property except Zone 2; Zone 2 encompasses the suspected contaminated area.

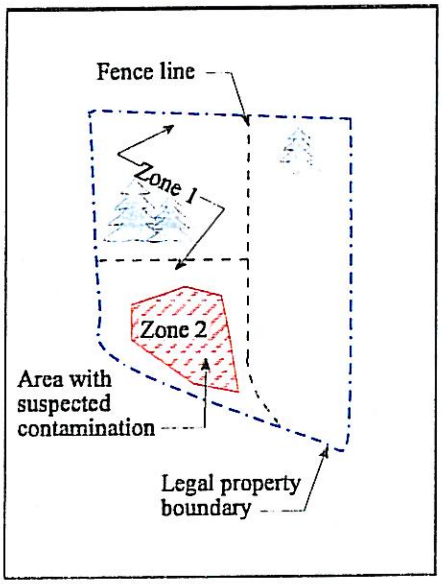


Figure 3-2: Dividing your property into zones.

Step 4: ***Divide your property into a grid.*** The grid sampling method is simply an intersecting pattern of horizontal and vertical crossing lines at regularly spaced intervals, forming a grid. To select sampling points using this method, the following procedures should be followed:

1) **Draw a "grid" in each zone.** Using a colored pencil, draw a series of equally spaced horizontal and vertical lines, resulting in each zone being divided into squares of relatively equal size. It is up to you to determine how close together the horizontal and vertical lines should be drawn. Remember, this will determine the accuracy of your sample results. The upper right-hand corner of each zone will serve as the measurement point for documenting the exact location of each sample collection point. Either corner would suffice, but a beginning measuring point *must be established* and be consistent throughout (see Figure 3-3).

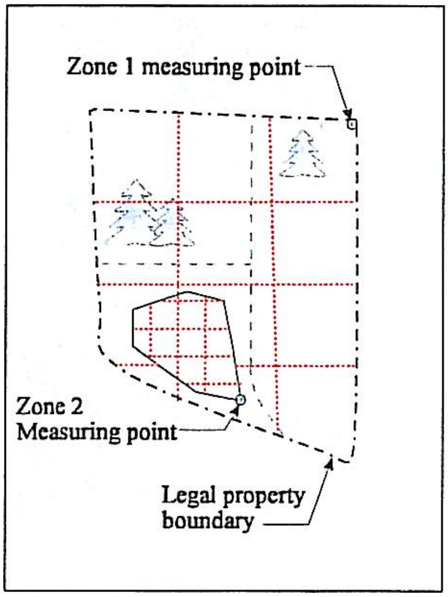


Figure 3-3: Drawing a grid in the zones on your property.

2) Mark each intersecting point with an "X." This intersecting point becomes the sample collection point (see Figure 3-4).

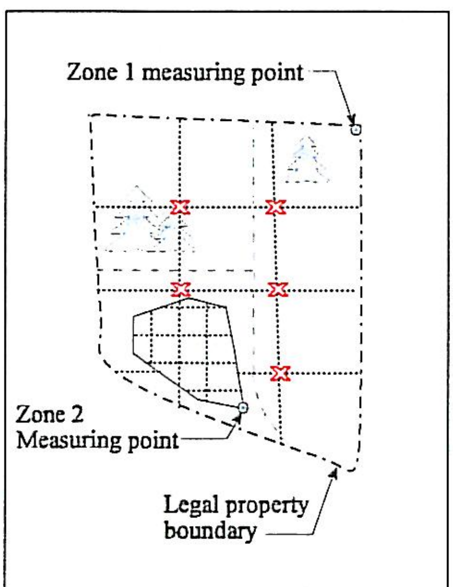


Figure 3-4: Mark each intersecting point on your grid with an "X".

3) Number each intersecting point. It is important that each "intersection" be given its own unique number or letter identification in order to track the sample through the sampling process. These will serve as the sample collection location points for your property (see Figure 3-5).

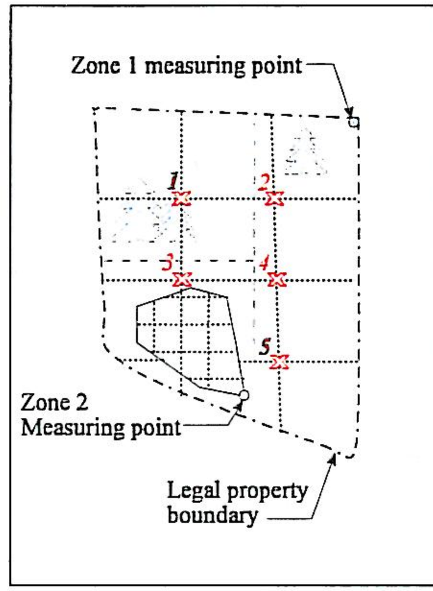


Figure 3-5: Number each intersecting point on your grid.

4) Repeat the process for each zone.

Step 4: Collecting soil samples

Equipment and Supplies Needed:

- ➔ Resealable plastic bags (pint size)
- ➔ Permanent marker
- ➔ Stainless steel or plastic spoon
- ➔ Distilled or deionized water
- ➔ Closed-tube auger, post hole digger, or shovel
- ➔ Rubber mallet or hammer

Step 1: ***Mark the plastic bags.*** Each plastic bag should have the following information printed on it using a permanent marker:

- Property owner's name
- Zone number
- Sample collection point numbers
- Date and time sample was taken
- Depth of the sample taken
- Initials of the person who took the sample

Step 2: ***Obtaining a surface (<u>0 to 2 inches</u>) sample.*** At each of the surface sample collection points, obtain a minimum of ½ cup of soil from a depth of 0 to 2 inches and place the soil in the plastic bag labeled with the corresponding sample collection point number.

Step 3: ***Decontamination of metal collection tools.*** If the sampling spoon is used to collect samples from more than one location, it must be washed thoroughly with detergent and rinsed with deionized or distilled water. (Deionized water is available at a water softener supply store. Distilled water is available at grocery or hardware stores.) This procedure is necessary to prevent cross-contamination from one sample collection point to another.

Step 4: ***Obtaining a deep hole sample.*** Two different tools may be used to dig deep holes to obtain soil samples: a closed tube auger or a shovel (see Figure 3-6).

Either of these tools can be used to collect three separate soil samples from each deep hole. The samples are collected from the following depths: one from between 0 and 6 inches, one from between 6 and 12 inches, and one from between 12 and 18 inches.

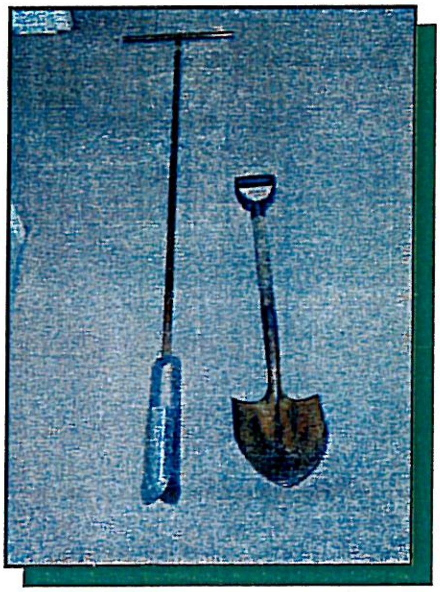


Figure 3-6: Tools used to take a deep hole soil sample. Left - closed tube auger. Right - shovel.

Step 4A: ***For collecting deep hole samples using a closed-tube auger:***

- Rotate the auger until it is 6 inches deep.
- Remove the auger from the hole.
- Tap the sides of the tube with a rubber mallet or hammer to loosen the soil. (Wet or muddy may not come out of the tube easily, and you may have to use a spoon to remove the soil.)
- Remove the soil from the tube and mound it on a plastic sheet away from the open hole to prevent contaminating the deep hole.
- Place ½ cup of soil into the plastic bag labeled *0-6 inches*.

If dirt or mud sticks to the inside of the auger tube, you must decontaminate it thoroughly by washing with detergent and rinsing with deionized or distilled water before digging the next deep hole.

After collecting soil samples from each of the three depths for that sample collection point (0-6 inches, 6-12 inches, 12-18 inches), move to the next deep hole location and repeat the procedure.

- **Step 4B:** ***For collecting deep hole samples using a shovel:***

• Dig the hole to its full depth of 18 inches.

• Using a tape measure, mark one side of the hole in 6-inch increments.

• Collect soil samples at 6-inch increments. Beginning at the bottom of the hole to prevent cross-contamination of soils, remove soil from the sides of the hole and place ½ cup of soil into the plastic bag that corresponds with that depth (0-6 inches, 6-12 inches, or 12-18 inches).

• When soil samples have been collected from each of the three depths, move to the second deep hole and repeat the procedure.

Step 5: Submitting samples for analysis

Once the soil samples have been collected and placed into the sampling bags, they are ready for shipment to a laboratory for analysis.

At this point, it is important to fill out a *Chain-of-Custody* form (see Appendix B), documenting what types of samples were collected (surface or deep hole), the location where they were collected, and the time they were collected. This form will help you keep a record of your samples.

Samples can be analyzed at any state-certified laboratory approved to analyze soil samples for lead and arsenic. For lead and arsenic in soil, all samples should be analyzed by EPA Method 6010: Inductively Coupled Plasma (ICP). The samples can also be analyzed using a graphite furnace, although the increased sensitivity that this method provides is usually not necessary.

In addition to ICP tests, you may need to analyze a representative soil sample for leaching potential (the ability for contamination to move within soil layers) using EPA Method 1311: Toxicity Characteristic Leaching Procedure (TCLP). The benefits of analyzing for leaching potential are discussed in Chapter 4. ICP sample analysis costs ranges from \$20 to \$30 per sample. The cost for TCLP analysis ranges from \$60 to \$70 per sample.

SPECIAL SAMPLING TECHNIQUES

Old filled in irrigation ditches can pose a problem for some cleanup techniques. The concentrations in these old buried channels may be quite high, and small amounts of these materials may contaminate large amounts of surface area–especially using cleanup techniques such as deep tilling. *Therefore, once located by map or sampling, disturbance of old irrigation or ditch channels should be avoided.*

If your property contains an historic canal or ditch, grid sampling alone will not be sufficient to determine how far the water has distributed the contamination nor how deeply the contaminates have seeped into the channel. There are two types of sampling techniques that answer these questions:

Trench sampling is used to determine how deeply the contaminants have seeped into the soil.

Line sampling is used to determine how far the contamination has spread perpendicular from the canal or ditch. The purpose and methodology of these techniques are further discussed below.

Trench Sampling

Trench sampling determines how deeply contamination has seeped through the soil underlying and surrounding the ditch or canal bed.

Using a backhoe, dig a small trench perpendicular to the channel centerline. Collect samples from the side walls and floors of the trench at 2-foot intervals (and at characteristics or strata soil changes) using a stainless steel spoon (see Figure 3-7). For each sample collected, carefully document the distances from the ditch and surface of the soil.

Figure 3-7: Using a backhoe, small trenches are dug perpendicular to the centerline of the historic ditch/canal. Samples are collected from the side walls and floor of the trench at 2-foot intervals (or on a 2-foot grid) or where the characteristics or strata of the soil change.

The number of trenches dug and sampled will depend on your knowledge of the contamination and your sampling program goals. If sample results are above levels of concern, line sampling of adjacent areas should be performed to identify the boundary of contamination.

Line Sampling

Line sampling enables the user to identify the lateral boundary of contamination along a canal or ditch.

Samples are collected in 25- to 100-foot intervals perpendicular to the ditch or canal (see Figure 3-8).

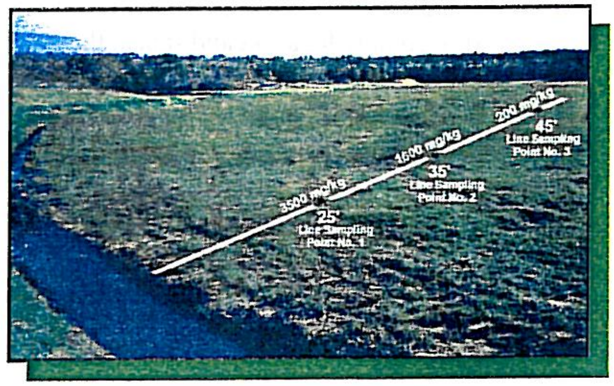


Figure 3-8: Line sampling technique. Sample No. 1 was collected 25 feet from the ditch bank. Sample results showed contaminant concentrations at 3,500 mg/kg. To determine how far the contamination spread from the ditch, another sample was collected 10 feet from sampling point No. 1. Results at sampling point No. 2 showed contamination levels still above local levels of concern at 1,600 mg/kg, so another sample was collected 10 feet from sampling point No 3. Results at sampling point No. 3 were 200 mg/kg, and the boundary of contamination can now be accurately calculated.

The distance from the ditch/canal depends on land contour obstacles; but in general, begin about 25 feet perpendicular from the canal or ditch. The sample must then be submitted for analysis, with additional sampling as follows:

If the sample results are *below* the *levels of concern*, then another sample should be collected 5 to 10 feet *closer* to the canal or ditch, along the same line. If the sample results are *above* the *levels of concern*, then another sample should be collected 5 to 10 feet *farther* away from the canal or ditch, along the same line.

These steps should be repeated until the boundary of contamination is determined (see Figure 3-8).

CHAPTER 4

CLEANING UP CONTAMINATED PROPERTIES

Laboratory sample results likely will be in the report format shown in Figure 4-1. This report will include the name of the person who analyzed the samples, sample ID number(s), date the laboratory received the sample, analytical

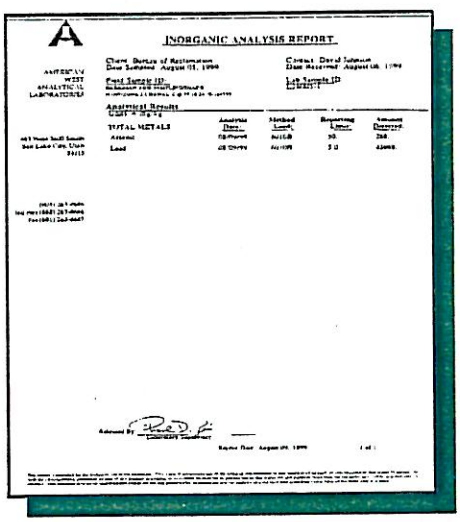


Figure 4-1: Sample analysis report.

method used by the laboratory to analyze the sample, and sample analysis results.

If any of the results are above the levels of concern (see Chapter 1), you will now need to evaluate the results and determine what the results mean.

To obtain a visual representation of the extent of contamination on your property, record the sample results on your property map (see Figure 4-2). Begin by writing the concentration levels on each corresponding sampling location, then plot the area (see lower portion of Figure 4-2).

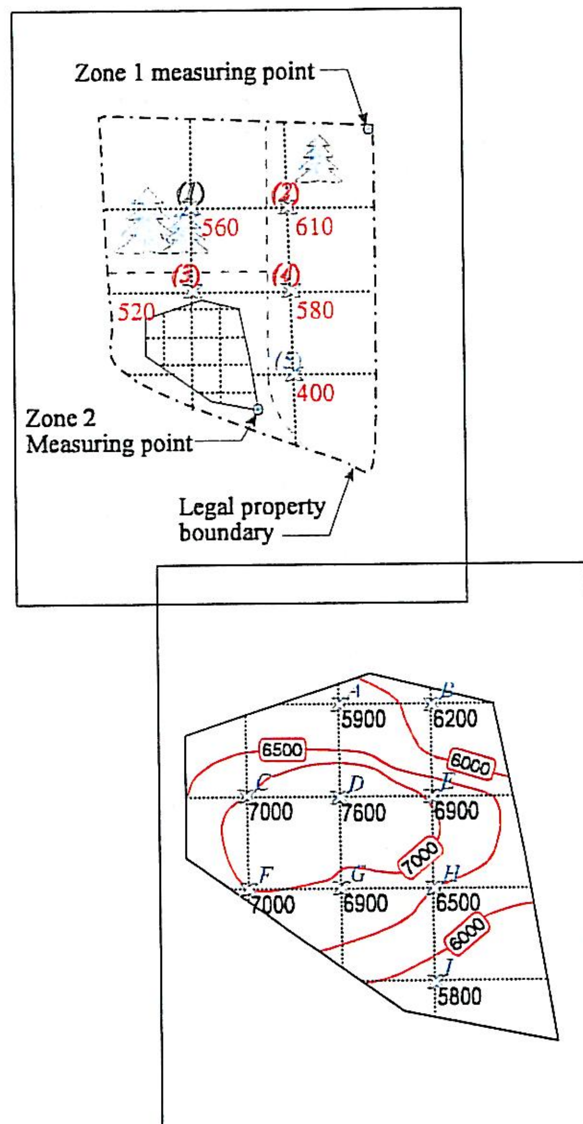


Figure 4-2: Sample analysis results for Zones 1 and 2. The lower portion of the figure shows Zone 2 plotted.

Cleaning Up Contaminated Property

If you have determined the contaminated areas on your property, you will now have to decide how to clean these areas.

As discussed below, "cleaning up" your property does not necessarily mean removing all of the contamination. The goal of cleaning up your property is simply to minimize the potential of human exposure to the contaminants.

Cleaning up your property is a process which may involve obtaining permits and approvals from your city, county, and state agencies. Assistance may be obtained from a private environmental firm or, in Utah, from the State Department of Environmental Quality (see Chapter 2, page 2-4).

Many methods exist to effectively clean up a contaminated property. The method most appropriate for your property will depend on many factors, including levels of contaminants, existing property conditions, future property development, amount of contaminated soil, budget limitations, and many other factors impossible to predict in this report. However, in an effort to assist you during the cleanup process, a few techniques and examples are discussed below.

Cleanup Techniques

There are two general categories of cleanup techniques:

1. Removing the contaminated soil from your property.

2. Using the soil on your property in a way that minimizes the potential of human exposure.

Following are eight cleanup techniques. The first technique falls into the first general category of removing the contaminated soil from your property. The remaining seven cleanup techniques fall into the second category of using the soil on your property in a way that minimizes the potential of human exposure.

Technique 1: Removing the Contaminated Soil

- ***General Technique Overview.*** Using this technique, all contaminated soil is excavated from the property and transported to a landfill or other area for permanent storage.

Soils contaminated with lead and arsenic from mining wastes can generally be placed in a *Subtitle D* landfill. Most local dumps or municipal landfills are classified as Subtitle D landfills, meaning they do not accept leachable hazardous waste. Fortunately, soils containing high concentrations of heavy metals such as lead from mining waste are not usually leachable.

To determine if your soil is a leachable hazardous waste, a TCLP test must be performed (See Chapter 3 - Step 5: Submitting samples for analysis). If the results from the TCLP test are less than 5 milligrams per liter (mg/L) for both lead and arsenic, then the soil is acceptable for nonregulated disposal at a Subtitle D landfill.

- ***Technique Advantages.*** Removing all contaminated soil from your property (or otherwise reducing the concentrations of lead and arsenic below the EPA site specified levels) is the only way that EPA will declare your property legally clean, thereby freeing you from any current or future building restrictions.

- ***Cost Considerations.*** Removing contamiated soil from a property usually requires the most upfront costs of any other cleanup method. It is important to note that nearly every other method of cleanup will require long-term operation and maintenance as well as strict land use restrictions, known as institutional controls.

For example, soil that is capped with a protective layer of soil and/or geosynthetics will require frequent sampling of predetermined monitoring locations and strict restrictions on the types of vegetation and buildings that may be constructed on the cap. Therefore, depending on your property conditions or future development plans, removing the contaminated soil may be the most economical method of cleaning up your property.

● ***Property Use Restrictions and Institutional Controls***. None.

> An example case study illustrating removing contaminated soil from a property is provided in Chapter 5 - Case Study 1.

Technique 2: Developing Contaminated Areas into Greenbelts

● ***General Technique Overview***. Contaminated soils are removed from various portions of a large property and placed in one contained area of the property. The contained area is then developed into a greenbelt (areas of undeveloped lands such as parkways/trails, parks, or farmlands that encircle a community). The property owner and all subsequent owners are responsible for maintaining the greenbelt in perpetuity to prevent human exposure and/or contaminant migration.

● ***Technique Advantages***. Greenbelts provide a variety of amenities, such as attractive views, open space preservation, and convenient recreation opportunities. People value these amenities which are reflected in increased real property values and marketability.

Natural open space and trails are prime attractions for potential home buyers. According to research conducted by American Lives, Inc., in 1995 for the real estate industry, 77 percent of all home buyers and shoppers rated natural open space as either "essential" or "very important" in planned communities.

Because the EPA allows greenbelts to contain higher levels of lead and arsenic, contaminated soil can be permanently left in these areas without an environmental impact; however, minimum grass or other coverage of the contaminated soils as well as institutional controls will be required. The requirements will be available from the EPA or your state or local government.

Figure 4-3 shows a greenbelt area where contaminated soil was covered with sod and a jogging pathway.

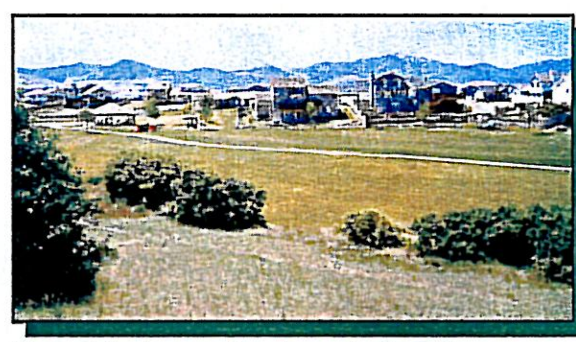


Figure 4-3: A contaminated area developed into a greenbelt recreational property.

● ***Cost Considerations***. The cost of developing a greenbelt depends on the type and complexity of the design, as well as the cost of the land it will cover. However, when this method can be used in a residential property development, it is usually relatively economical because of the increased value it adds to the adjacent properties.

● ***Property Use Restrictions and Institutional Controls.*** Land use restrictions and institutional controls will be required.

Technique 3: Using Contaminated Soil as Backfill

● *General Technique Overview.* Some contaminated soils may be used as backfill in sewer trenches, around basements as fill material, under asphalt roads as roadbase, to build needed infrastructure of a community, or general fill as seen in Figures 4-4, 4-5, and 4-6.

Figure 4-4: Contaminated soil used as backfill material under a road and a tennis court.

Figure 4-5: Contaminated soil could be used as fill for an overpass.

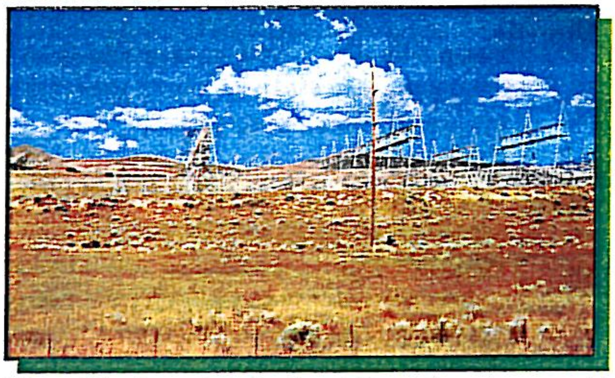


Figure 4-6: Contaminated soil could be used as a base material for a substation.

The contaminated soil is covered with clean soil, concrete or asphalt, or other surfacing to minimize the risk of human exposure to the contaminated material. The property owner and all subsequent owners are responsible for maintaining the protective surfacing in perpetuity.

As a farm or other agricultural ground becomes a subdivision or an outlying development to an existing town, more infrastructure is needed. Rural roads and highways are improved and electrical power needs increase. Two-lane dirt roads become four-lane highways, requiring overpasses; new overpasses require fill material. The need for additional power requires new substations. All of these developments could be constructed using contaminated soils as long as the development design prevents human exposure and institutional controls are developed and maintained.

● *Technique Advantages.* When covered with a protective surfacing, this method provides effective protection from contaminant exposure while minimizing cleanup costs.

● *Cost Considerations.* Using the contaminated soil as backfill material eliminates hauling and disposal costs, as well as costs to purchase and haul clean backfill. When applicable, this method is usually very economical.

● ***Property Use Restrictions and Institutional Controls.*** Use of this method requires the approval of your state department of environmental quality. and land use restrictions and institutional controls will be required.

Technique 4: Capping the Contaminated Soil

● *General Technique Overview.* Contaminated soil is consolidated in one area and capped with clean soil, geosynthetic materials, or other protective surfacing.

● *Technique Advantages.* As described in Technique 3, contaminated soil may be consolidated into one area and capped with a protective surfacing. Many different surfacing techniques exist, and each will provide a different level of protection and subsequent environmental restrictions on your property.

For example, areas covered with concrete will require stringent property use restrictions, while areas covered with a clay liner or geosynthetics may allow for numerous future developments.

This cleanup technique is particularly advantageous as a temporary cleanup in areas that will not be developed for several years. However, in some unique cases, an engineered cap can realistically be considered a permanent solution, along with institutional controls.

In one location in Utah, contaminated soil in a rural area was covered with clean fill. The area was then zoned for a convenience store or strip mall site to reduce the risk of future exposure (see Figures 4-7 and 4-8).

Figure 4-7: Contaminated soil capped with clean soil (top of cap is shown).

Figure 4-8: Contaminated soil capped with clean soil (profile view is shown).

In another case, contaminated soils could be consolidated into one area and then used to build a berm around the perimeter of a soccer field. The elevated mounds could then be covered with clean material and a lawn could be planted. In this case, the contaminated soil would create great seats for parents and friends to watch sporting activities (see Figure 4-9).

Figure 4-9: A landscaping berm constructed in Riverton, Utah, is an example of where contaminated soil could be used.

● *Cost Considerations*. In areas where land costs are low and/or the protective surfacing provides a practical use in addition to exposure prevention, capping, with institutional controls, is an economical solution.

● *Property Use Restrictions and Institutional Controls*. It will be necessary to establish the groundwater level, and groundwater monitoring will be required to ensure that no contamination leaches into the groundwater. In addition, land use restrictions and institutional controls will be required.

An example case study describing the capping of a 1.5-acre area is provided in Chapter 5 - Case Study 2.

Technique 5: Deep Tilling

● *General Technique Overview*. Deep tilling, or discing, can be effective in large, flat areas where contamination concentrations above acceptable levels are present in and on the surface, with very low concentrations of contamination below.

A tractor with a till or disc attachment is used to drive over the area, mixing the surface soils with the clean soils below, creating a homogenous layer of soil with an acceptable level of contamination (see Figure 4-10).

Figure 4-10 : A Cat SS-250 is utilized to deep till to an 18-inch depth.

● *Technique and Advantages/Disadvantages*. If tilling is successful, it achieves an average level of contamination below harmful levels for a very low cost. However, this method requires a shallow, relatively low concentration level of contamination so that when the surface soils are mixed with the underlying soils, the overall soil contamination is diluted.

Theoretically, this method should work–but in practice, it actually has a relatively low success rate. The low success rate is mainly due to three reasons:

1. Because unknown contaminated "hot spots" may elevate the overall concentration averages, the exact location of contaminated soils can be difficult to determine without collecting a large number of samples per acre.

2. In some areas, historic irrigation ditches may be unrecognizable or filled with clean soil. Accidental tilling into an old ditch bed could uncover soil with extremely high contaminant concentrations which could significantly raise the overall average contaminant concentrations.

3. Tilling may not work because the soil is too hard to effectively mix the surface soil with the clean underlying soil.

> **SUGGESTION:**
>
> If you are considering tilling but are unsure if it will be effective, section off a 0.25-acre parcel and try it! Till this section, then take a composite soil sample for analysis. If the contaminant concentrations of the mixed soil are not below the level of concern, explore another cleanup technique. Sampling before continuing is much more economical than tilling the entire area, only to find out afterwards that tilling was not effective.

● *Cost Considerations*. Tilling to dilute the surface soil contamination concentration is usually the least expensive method to clean up agricultural property. However, this technique does require collecting a large number of soil samples once the soil has been tilled to ensure that the average lead and arsenic soil concentration is below levels of concern. Therefore, the added analytical costs should be considered when deciding if this cleanup method is appropriate for your property.

● *Property Use Restrictions and Institutional Controls*. None.

> An example case study illustrating tilling an agricultural property is provided in Chapter 5 - Case Study 3.

Technique 6: Relocating a Water Source

● *General Technique Overview.* Ditches or canals with contaminated beds are capped with clean soil, and a new ditch/canal is constructed.

● *Technique Advantages*. Contaminated soil is covered to minimize future human exposure and further contaminant migration.

In one area, a canal harboring contaminated soil along its banks abutted a residential area. The only way to *remove* the contaminated soil and rebuild the ditch required removing all of the trees along the canal (see Figure 4-11).

Figure 4-11: Photo of the contaminated ditch adjacent to a residential neighborhood, prior to cleanup.

Instead, the old ditch was "capped" with clean soil and the canal was relocated (see Figure 4-12).

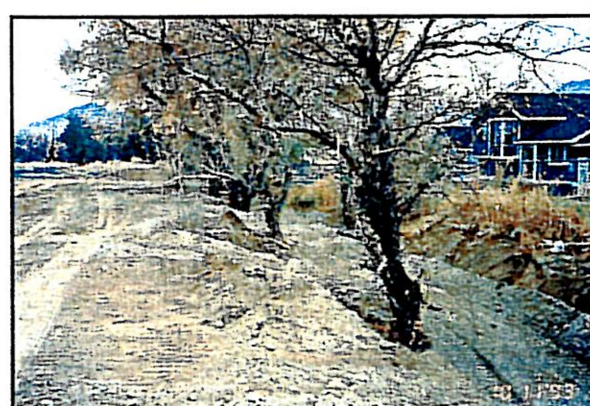


Figure 4-12: Photo of the capped contaminated ditch after cleanup (prior to revegetation).

Capping the ditch was more cost effective because it eliminated the cost associated with hauling and disposing of the contaminated soil. It also made the adjoining homeowners very happy because the trees were saved.

● *Cost Considerations.* Covering, or capping, the existing ditch or canal with clean soil and relocating the ditch or canal is a very economical way to inhibit future contaminant migration and human exposure. However, because the contaminated soil will still remain on your property, you will be required to ensure that contaminant migration and/or human exposure to the soil does not occur. This will most likely involve monitoring the soil cap to ensure that it is continuously intact and is not disturbed by humans, animals, or natural forces.

In addition, if development is ever planned for the property, the increased probability of environmental or human contact may require you to implement another cleanup of the area.

● *Property Use Restrictions and Institutional Controls.* Monitoring of the cap will be required. In addition, land use restrictions and institutional controls will be required.

Technique 7: Engineering Controls in Ditches and Canals

● *General Technique Overview.* "Engineering controls," or engineered fabricated materials, are placed into a ditch/canal to prevent further spreading of contamination.

● *Technique Advantages.* Contamination in canal/ditch beds is of particular concern because of the rapid contaminant transport vehicle provided by moving water. If the source of the contamination is still active, downstream areas are rapidly covered with a layer of contaminated sediment. As the water moves through the ditch/canal, contaminants leach through the bed soils and are transported deeper into the underlying soil.

Although this technique does not remove the contamination from the canal/ditch bed, it prevents contaminants from spreading and creating an even larger problem.

Figure 4-13 shows a photograph of a canal that was excavated and lined to prevent soil contamination from moving downstream. This canal was excavated to a depth of approximately 3 feet. A geotextile liner was placed in the bottom and sides of the canal. Eighteen inches of compacted clay soil was placed on the liner, and an 18-inch layer of rock or gravel was added to prevent erosion.

Figure 4-13: A geosynthetic liner being placed in a ditch to prevent further contaminant migration.

● *Cost Considerations.* The cost of placing engineering controls in a ditch are dependent on the width of the canal and the type of control placed into the ditch. In almost every case, the prevention measure this technique adds makes this a very cost-effective cleanup method. Costs for operation and maintenance of the contaminated area should be considered when deciding if this technique is appropriate for your property (see Technique 6, Cost Considerations).

● *Property Use Restrictions and Institutional Controls*. Monitoring of the cap will be required. In addition, land use restrictions and institutional controls will be required.

Technique 8: Construct a Pipeline

● *General Technique Overview*. The contaminated soils within an irrigation ditch are excavated and removed, and the ditch is replaced with an irrigation pipeline and backfilled with clean material. Figure 4-14 illustrates this remediation process.

Figure 4-14: Pipeline replacing contaminated ditch.

● *Technique Advantages*. There are many benefits to replacing a ditch with a pipeline. The benefits include reducing the volume of material excavated, stopping erosion, making the system more efficient and less costly to operate, minimizing weed control, and eliminating ditch cleaning.

● *Cost Considerations*. If all of the contaminated soil is removed from the existing ditch prism before the pipeline is laid, you will be able to apply to the EPA to declare your property as legally clean, thereby releasing you from any future cost for maintenance or additional cleanup during a future redevelopment.

The only additional cost to consider under this scenario is the cost for collecting and analyzing a large number of samples from the excavated ditch to ensure that all contaminated soil has been removed.

If you choose not to excavate all the contaminated soil from the ditch before laying the pipeline and clean fill, you will be required to monitor the area to ensure that the soil is not disturbed. Furthermore, future development of your property may require you to implement another cleanup effort to prevent future exposure.

● *Property Use Restrictions and Institutional Controls*. If all contaminated soils are removed, there will be no restrictions or institutional controls. If the contaminated soils are not removed, you will be required to monitor the area to ensure that the soil is not disturbed and land use restrictions and institutional controls will be required.

CHAPTER 5

CASE STUDIES

The following three case studies were developed to provide examples of cleanup techniques for agricultural areas. The 1999 approximate costs for cleanup are reflected. Every project is different and costs estimated are hypothetical.

CASE STUDY 1: REMOVING THE CONTAMINATED SOIL FROM THE PROPERTY

BACKGROUND: The owner of an agricultural property applies for a permit to subdivide his 16-acre parcel into thirty-two ½-acre lots. His property is within 10 miles of a closed mine, and he knows that the irrigation water he used when the property was farmed came from the general direction of the mine. Although the irrigation ditch is now dry, he samples his property to determine if it contains any contamination.

Sample results indicate that the earth underlying and bordering the irrigation canal on his property is contaminated with lead concentrations ranging between 9,000 and 22,000 mg/kg and arsenic concentrations ranging between 100 and 650 mg/kg.

Trench sampling reveals that the depth of the contamination averages 18 inches, but varies from 6 to almost 48 inches. Toxicity Characteristic Leaching Procedure (TCLP) test results are below 5 mg/L for both lead and arsenic. The estimated amount of contaminated material is 28,000 cubic yards.

CLEANUP TECHNIQUE: In order to sell the properties with a clean title and no environmental restrictions, the property owner decides to remove all the contaminated soil from his property. He obtains approval from city, county, and state officials to hire a construction company trained in hazardous waste operations to complete the excavation.

The construction company excavates the soil using the heavy construction equipment listed below. The soil is loaded into dump trucks and hauled to a county landfill 3 miles away. The landfill normally accepts soil without large rocks or roots for no charge; but because of the high levels of lead and arsenic, the property owner's material is classified as "impacted clean soil," and the owner is charged a rate of $19 per ton for disposal.

Samples are frequently collected and analyzed at a local laboratory during the excavation to ensure that all contaminated soil is removed. The excavated area is then re-graded without bringing in any additional outside soil.

CASE STUDY I (CONT.)

COSTS: When the project has been successfully completed, 28,667 cubic yards of material have been removed. The total project cost is $523,450.53.

Equipment Used: 1 - Pickup truck
1 - 14G blade
1 - CAT 980 front-end loader
1 - CAT 330 trackhoe and/or 1 D6 dozer
1 - Water truck
6 - Belly dump trucks
4 - End-dump trucks

Final equipment hours: 3,021 hours

Crew size: 9 people

Final man hours: 3,066.5 hours

Total cubic yards removed: 28,667 cubic yards

Unit price for site work: $5.60 per cubic yards

Subtotal project cost: $160,535.20

Repository dumping unit cost: $19 per ton (1.5 tons per cubic yards)
Subtotal dumping cost: $363,115.33

Total project cost: $523,450.53

Case Study 2: Capping Contaminated Soil

Background: An agricultural property owner discovers that the soil surrounding his neighbor's house has dangerous levels of lead and arsenic. Afraid of the potentially devastating effects of lead on his children, he samples the soil on the 1.5-acre parcel surrounding his house that his family considers as their yard.

He collects samples from the surface and a sample from the 0- to 6-inch depth, 6- to 12-inch depth, and 12- to 18-inch depth on a 25-foot grid. Sample results reveal that in one 40- by 20-foot area, near the back of his house, the soil contamination is as follows:

★ Average surface lead concentration in the soil is 4,900 mg/kg

★ Average concentration at 0-6 inches below the surface is 2,600 mg/kg

★ Average concentration at 6-12 inches below the surface is 1,100 mg/kg

★ Average concentration at 12-18 inches below the surface is 600 mg/kg.

The property owner notes that this area is at a lower elevation than the rest of his yard and theorizes that the contamination may be a result of frequent puddling irrigation water. All other areas sampled on his property were below 1,100 mg/kg, and these areas were not considered a risk to humans.

Cleanup Technique: To avoid paying disposal costs, the property owner decides to level the area with clean fill and cap it by placing a concrete pad. The new concrete pad will be used as a basketball court. The court will be placed on top of the 40- by 20-foot contaminated area. When the court is finished, it will be approximately half court size, or 47 feet by 25 feet.

A construction company is hired to do the work. First, a bobcat is used to spread 6 inches of roadbase on top of the contaminated material. Care is taken to avoid spreading the contaminated material into clean areas. Then, a compaction roller is used to compact the roadbase. Next, the construction company places forms for the new concrete pad that will be 4 inches thick. Concrete is then placed into the forms.

CASE STUDY 2 (CONT.)

COSTS: When the construction company has successfully capped the 40- by 20-foot contaminated area, the total project cost is $4,095.00.

Equipment used: 1 - Bobcat
1 - Compaction roller

Final equipment hours: 2 hours

Crew size: 2 Employees

Final man hours: 8 hours

Total area capped: 47 feet by 25 feet

Total cubic yards of roadbase installed: 23 cubic yards

Total cost for roadbase: $15.00/cy (labor and materials)

Total cubic yards of concrete placed: 15 cubic yards

Total cost for concrete: $250.00 per cubic yards (Includes labor and materials)

Total project cost: $4,095.00

Case Study 3: Tilling

Background: An agricultural property owner is aware from family records that his property was irrigated with contaminated water for several years. Since he has used sprinklers to carry the irrigation water to his crops, he believes that there is a good chance that only the top few inches of soil is contaminated.

He conducts a sampling program on his 30-acre parcel and discovers that the average surface (0 to 6 inches) lead concentration is 2,000 mg/kg; the average lead concentration at 6 to 12 inches is 200 mg/kg; and the average lead concentration at 12 to 18 inches is 150 mg/kg.

Cleanup Technique: Since the EPA has determined that the acceptable level of lead on a residential property is an average of 1,000 mg/kg, the property owner receives a permit to deep till his property to 18 inches. He hires a landscaping company to till the property using a CAT SS 250, an oversized rototiller.

A CAT SS 250 can till 1 acre every 2 hours on flat, cultivated, large rock free land. Approximate cost for the CAT SS 250 is $60 per hour based on a monthly rate of $12,000. A heavy equipment operator for the CAT SS 250 will cost approximately $30 per hour.

Costs: When the landscaping company has successfully tilled all 30 acres, the total project cost is $5,400.00.

The average lead concentration for the property is 783 mg/kg {(2,000 mg/kg + 200 mg/kg + 150 mg/kg)/3 = 783 mg/kg} when all 18 inches are tilled. On residential property, contamination levels of 783 mg/kg is below the acceptable level of lead.

Equipment Used: 1 CAT SS 250 rototiller

Final equipment hours: 60 hours

Crew size: 1 employee

Final man hours: 60 hours

Total area tilled: 30 acres

Unit price for site work: $90 per hour

Total project cost: $5,400.00

CHAPTER 6

DISCUSSION OF LONG-TERM MANAGEMENT OF CONTAMINATED SOIL

By law, removing the contaminated soil from your property is the only way to claim that your property is legally clean. When this is not technically or economically feasible, several options exist for permanently storing the contaminated soils on your property (see Chapter 4).

It is important to understand that if contaminated soil remains on your property, you are responsible for the long-term management of it, including ensuring that the method you choose to store it protects human health and the environment.

If you clean up your property under the Utah Voluntary Cleanup Program and elect to keep contaminated soils on your property, you will have to develop and submit for approval a long-term management plan for the contaminated soils.

A long-term management plan should include a detailed description of where the contaminated soil will be permanently stored and how you will ensure that exposure does not occur, including proposed institutional controls. When developing your plan, consider that it will continue in perpetuity. As conditions on your property change, the plan will need to be updated and reapproved by the state.

Elements to consider when designing your plan include:

- ❑ The concentration of lead and arsenic in your soil.
- ❑ The proximity of the storage area to residences or children's play areas.
- ❑ The estimated life expectancy of the storage system.
- ❑ The potential for future acute exposure (brief exposure to extremely high levels of lead or arsenic).
- ❑ The potential for future long-term exposure.
- ❑ Practical measures to prevent exposure.

■ ***Future Land Use***. As has been discussed in Chapters 1 and 4, changes in the land use of your property will require you to evaluate whether your property cleanup method will remain effective. For example, if the use changes from agricultural to residential, then the acceptable level of lead and arsenic concentration in the soil will become more stringent, as will the acceptable location and circumstances of the stored contaminated soil. A new cleanup effort may be required to prevent future exposure to humans and/or the environment.

A form has been included in this document to assist you in preparing a long-term management plan (see Appendix C). An example of a completed form is shown on the next page. To develop an appropriate and acceptable long-term management plan for your property, please contact the Utah Department of Environmental Quality.

Long-Term Management Plan

Detailed description of where the contaminated soil will be stored:
Contaminated soil will be covered with a new concrete pad. Six inches of roadbase and 4 inches of concrete will be placed over the contaminated soil. The dimensions of the concrete pad will be 30 feet by 50 feet. Test holes have shown that contaminated soil is at least 50 feet above the water table and groundwater contamination is therefore unlikely.
How far away is the contaminated soil from a residence or play area? (A plan drawing of the proposed site is required).
100 feet (a drawing of my property with the proposed location of the concrete pad is attached).
What is the life expectancy of the storage system?
With the concrete mix and base course I am using, the life expectancy of the concrete pad is 20 years.
How could exposure occur?
■ Concrete could erode, exposing contaminated soil. ■ I may remove the concrete in several years, exposing contaminated soil. ■ New owners of my property may remove the concrete, unknowingly exposing contaminated soil.

Appendix A

GLOSSARY

Engineering Controls Engineering controls include the engineering methods to improve unsafe or unusable areas, including the use of natural or manufactured materials.

Institutional Controls Limitations or land use restrictions placed on a property that contains contaminated soils.

Geosynthetics Geosynthetics are specially designed impermeable fabricated materials.

Homogeneous A homogeneous soil is a soil that is uniform in composition throughout the soil layers; i.e., the contamination throughout the soil layers is the same.

Leaching Potential Remediation costs can also be affected by the type of soil contamination; therefore, soils should also be analyzed in an analytical soils laboratory to determine the type of contamination within the soil and whether the contaminant is migratory. Migratory contaminants can leach out or move within the soil profile. Nonmigratory contaminants will not leach out or move within the soil profile. Nonleachable or nonmigratory soils are easier and less expensive to remediate.

Volume Volume in this manual is a measurement in cubic yards. Volume is used when calculating the amount of material required to be excavated and the amount of material needed to fill the excavated space. The calculated volume will also tell you the number of truckloads needed to haul your material. However, when natural soil is disturbed, its volume expands due to the exposure to air and the loss of the soil's compactness or density. This expansion is referred to as swell or fluff and must be accounted for whenever transporting soils. When transportation volumes are calculated, a 10 to 20 percent additional volume should be added to the total volume of excavated materials.

Weight Weight is a unit of measurement in tons. Generally, weight is referred to when transporting materials. Often, it is necessary to convert from cubic yards to tons or from tons to cubic yards. All types of soils have various densities; therefore, their weights vary. Soils weights can range between 2,000 pounds and 3,500 pounds per cubic yard depending on the types of soils and the amount of moisture within the soils. An average number for the weight of most soils would be 2,800 pounds or 1.4 tons per cubic yard. Soils can be analyzed in soil engineering laboratories to gain a better understanding of the type and weight of soils that you may have on your property.

Appendix B

CHAIN-OF-CUSTODY FORM

U.S. ENVIRONMENTAL PROTECTION AGENCY
Environmental Services Division

CHAIN OF CUSTODY RECORD

REGION VIII, ONE DENVER PLACE
999 18TH. STREET
DENVER, CO. 80202-2413

PROJ. NO.	PROJECT NAME

SAMPLERS: *(Signature)*

STAT. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CON-TAINERS							REMARKS

Relinquished by: *(Signature)*	Date/Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date/Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date/Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date/Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date/Time	Received for Laboratory by: *(Signature)*	Date/Time	Remarks	

Distribution: Original Accompanies Shipment: First Copy to Coordinator Field Files: Second Copy to Representative of Inspected Facility

Split Samples: ☐ Accepted ☐ Declined _______ Signature

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Appendix C

LONG-TERM MANAGEMENT FORM

Detailed description of where the contaminated soil will be stored:
How far away is the contaminated soil from a residence or play area? (A plan drawing of the proposed site is required).
What is the life expectancy of the storage system?
How could exposure occur?