Guidance for Site Investigation Remedial Investigation, and Remedial Action Verification Sampling for Soil

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- David Whelihan, URS Corporation

Site Investigation Remedial Investigation Remedial Action Verification Sampling SOIL

Purpose

Provide guidance on conducting:

- Site Investigations for soil
- Remedial Investigations for soil
- Verification Sampling for Soil Remedial Actions

SI/RI/RA Verification - Soil OVERVIEW

- Up to May 7th N.J.A.C. 7:26E (Tech Regs) is the "What" and the "How"
- After May 7th – Tech Regs are still the "What" do to, but the guidance is the "How" to do it
- SI – RI – RA Verification Sampling Guidance for SOIL

SI/RI/RA Verification – SOIL Presentation Outline:

- Site Investigation – Kathi Stetser
- Natural Background Sampling – Ted Toskos
- Questions & Break
- Remedial Investigation – John Doyon
- Remedial Action Verification Sampling – Ted Toskos
- Questions

SITE INVESTIGATION

Kathi Stetser
Roux Associates, Inc.

Site Investigation

- Conducted in potential or known AOCs to identify the highest contaminant concentrations.
- Determine if there are exceedances of applicable soil remediation standards.
- Sufficiently evaluate the AOC to determine if further action is required.

SI Required

- Potentially contaminated AOCs are identified during PA required because:
  - ISRA Site triggered assessment
  - Desired site-wide final remediation document
  - Remediating site/portion of site for use as child care center or school
  - Conducting child care center eval pursuant to Madden Bill
- A regulated UST is removed or closed in place
- Ordered by a court or the NJDEP.

AOC Specific Guidance

- Guidance is based on common/typical scenarios.
- Investigator should use Professional Judgment.
- Alternate Strategies may be more appropriate.
- The Goal is to detect contamination.

Types of AOCs

- ASTs/USTs
- Piping
- Pads and Storage Pads
- Loading/Unloading Areas
- Rail Lines
- Transformers
- Floor Drains and Sumps
- Roof Leaders
- Swales and Culverts
- Storm Sewers
- Septic System/Seepage Pits
- Landfills/Dumps
- Pits
- Dry Wells
- Surface Impoundments

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Areas Subject to SI Sampling

- Current and historical operations
- Areas away from operations
- Building Interiors

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Building Interiors

A site investigation of building interiors is conducted when:

- Contaminants inside the building have the potential to migrate to the environment outside the building.
- Contaminants outside the building have the potential to migrate into the building.

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Field Sampling Planning

- Preliminary Conceptual Site Model
  - Source
  - Pathway
  - Receptors
- AOC History
  - Past Discharges
  - Remedial Actions

SI Sampling Plan

- Size, location and nature of the AOC
- Potential COCs and their migration characteristics
- Physical characteristics of the Site/AOC
- Hydrogeologic conditions
- Potential receptors

Sampling Access

- It may not be practical or possible to sample at an AOC
- Alternative assessment methods may be necessary
- The alternative must provide reliable data to confirm the presence or absence of contaminants
- Ability to access the AOC must be considered when planning investigation program

Field Documentation

- Boring and test pit logs
  - Soil type
  - Visual observations
  - Field meter readings
  - Depth to water
- Sample location map
  - Field Reference or Survey Points
- Depth of sample collection
- Analytical parameters

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Notify NJDEP

- An unreported site related or upgradient source discharge is identified (*Hotline*)
- Immediate Environmental Concern (IEC) conditions are identified (*Hotline*)
- Munitions are identified (*911 and Hotline*)
- Material Presenting a Potential Explosive Hazard (MPPEH) is identified (*911 and Hotline*)
- Anthropogenic (man-made) Radioactive Material is identified (*identify on PA/SI Form – check box*)

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Site Investigation Report

- Description of the AOCs
- Presentation of field sampling activities
- Summary of analytical results
- Recommendations for either
  - Additional sampling/remediation; or
  - No further evaluation.

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Forms for Submission with SI Report

- SI Report Form (currently PA/SI Form)
- Case Inventory Document
- Annual Fee Form (if first major document submitted)
- RAO and RAO Form (if no further remediation is required)

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NATURAL BACKGROUND INVESTIGATION SOIL

Ted Toskos

AMEC

Natural Background Investigation – Soil

- During the course of an investigation, there may be contaminants found in the soil at a site or AOC which exceed an applicable soil remediation standard but which may be naturally occurring.


Environmental Assessment and Risk Analysis Element

Research Project Summary

Ambient Levels of Metals in New Jersey Soils

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Natural Background Investigation – Soil

- Not required to remediate natural background

Natural Background Investigation – Soil

Sampling for Natural Background in Soil

- Select a background reference area that has as similar as possible physical, chemical, geological, and biological soil characteristics as the AOC being investigated, but that is not affected by activities on the site

Natural Background Investigation – Soil

Sampling for Natural Background in Soil (cont.)

- Collect a minimum of 10 background soil samples from the selected background reference area.
- Collect the samples from a depth that coincides with the interval of interest or comparable soil horizon to the AOC soil sample

Natural Background Investigation – Soil
Sampling for Natural Background in Soil (cont.)

- Collect background samples at locations unaffected by current and historic site operations as documented by the PA, including aerial photographs
- Wherever possible, collect background samples from locations which are topographically upgradient and upwind of contaminant sources

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Natural Background Investigation – Soil
Statistical Outlier Review

- Check that data is normal or log-normal
- Can use ProUCL(*) or other statistical program

Arsenic Data (mg/kg)	
24	31
25	33
27	35
29	36
30	34

(*) http://www.epa.gov/esd/tsc/software.htm

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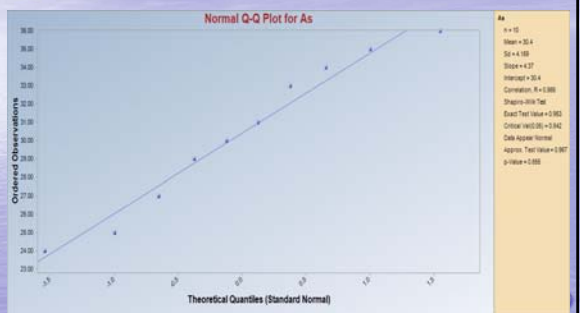
Natural Background Investigation – Soil
Statistical Outlier Review (cont.)



Statistical test for normal distribution (using proUCL)

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Natural Background Investigation – Soil
Statistical Outlier Review (cont.)

Checking for outliers (using proUCL)

Natural Background Investigation – Soil
Statistical Outlier Review (cont.)

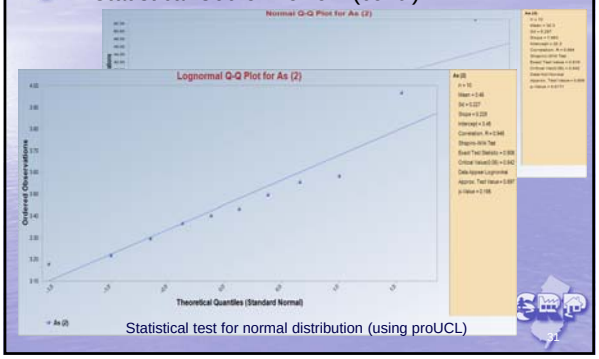
- Apply the highest contaminant concentration found in the background samples as an upper limit for the contaminant concentrations found on the site.
- If contaminant concentrations in any AOC samples exceed background, conduct additional investigation to resolve

Natural Background Investigation – Soil
Statistical Outlier Review (cont.)

- Check that data is normal or log-normal
- Can use ProUCL or other statistical program

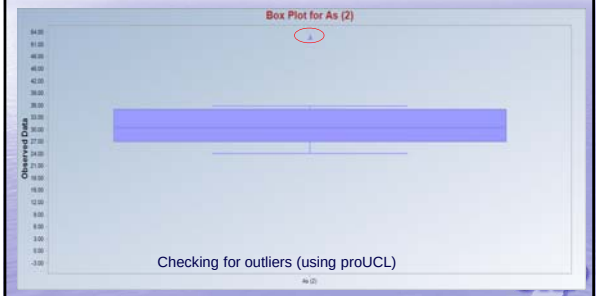
Arsenic Data (mg/kg)	
24	31
25	33
27	35
29	36
30	53

Natural Background Investigation – Soil
Statistical Outlier Review (cont.)



Statistical test for normal distribution (using proUCL)

Natural Background Investigation – Soil
Statistical Outlier Review (cont.)



Checking for outliers (using proUCL)

Natural Background Investigation – Soil
Statistical Outlier Review (cont.)

- Cannot use outlier as background, unless the location is re-sampled and the results are within 20% of the first result.
- In this case use average of the two as the upper limit.
- If contaminant concentrations in any AOC samples exceed background, conduct additional investigation to resolve.

Natural Background Investigation – Soil
Statistical Outlier Review (cont.)

- Alternatively, ProUCL can be used to statistically compare AOC sampling results to background sampling results and determine whether AOC results can be considered background.

QUESTIONS
&
BREAK

Remedial Investigation
SOIL

John Doyon
NJDEP

Remedial Investigation - Soil Purpose

PRIMARY PURPOSE:

- Fully delineate vertical & horizontal extent of contaminated soil to applicable soil remediation standards
- Each AOC where contaminants exceed standards

Remedial Investigation - Soil Purpose (continued)

Additional Objectives:

- Immediate Environmental Concern Conditions/ areas of highly contaminated soil
- Containment/stabilization remedies (IRMs) prevent contaminant exposure/offsite migration
- Migration paths & receptor exposure

Remedial Investigation - Soil Purpose (continued)

Additional Objectives (continued):

- Ecological issues
- Surface & subsurface site characteristics
- Permits for remediation activities

Remedial Investigation - Soil
GOALS

- Complete/Update Conceptual Site Model (dynamic)
- Complete Information = Good Remedial Action Decision
- Ultimate Goal = Protect Human Health & Environment

Remedial Investigation - Soil
Delineation Using Collected Data

Conceptual Site Model:

- Describes expected source of contaminant
- Defines the extent of the area of concern
- Identifies relevant environmental media
- Identifies relevant fate & transport pathways
- Defines potential exposure pathways

Remedial Investigation - Soil
Delineation Using Collected Data

Judgmental Sampling Approach

- Collect samples at step-out locations surrounding previous sample exceeding standard
- Three dimensional approach

Remedial Investigation - Soil Delineation Using Collected Data

Judgmental Sampling Approach (continued)

Sample location/frequency-professional judgment

- Soil properties affect contaminant migration
- Physical & chemical nature of contaminant
- Manner contaminant released
- Timing & duration of release
- Volume of release

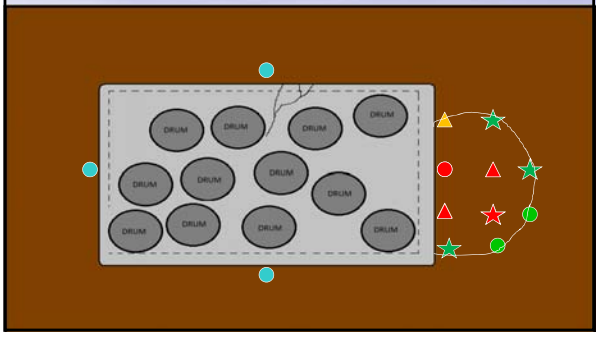
Remedial Investigation - Soil Delineation Using Collected Data

Judgmental Sampling Approach (continued)

- Above factors used to determine the three D's:
  - Distance
  - Direction
  - Depth
- Subsequent step-outs – Same logic
- Establish decreasing trend & furthest sample concentrations below standard(s)

Remedial Investigation - Soil Delineation Using Collected Data

Judgmental Sampling Approach



Remedial Investigation - Soil Delineation Using Collected Data
Probabilistic Sampling Techniques

- No clear understanding of contaminant sources
- Contaminant characteristics don't allow for biasing
- Characterize historic fill, statistical analysis, fall-out from stack emissions.
- Types:
  - Adaptive Cluster Sampling
  - Ranked Set Sampling
  - Stratified Sampling
  - Incremental Sampling (ITRC)

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Remedial Investigation - Soil Delineation Using Collected Data
Incremental Sampling*

- Structured composite sampling and processing protocol
- Designed to reduce data variability and increase sample representativeness
- Specifically defined boundaries of sample area (Decision Unit)
- Use systematic planning approach

*See ITRC Incremental Sampling Document http://www.itrcweb.org/ism-1/

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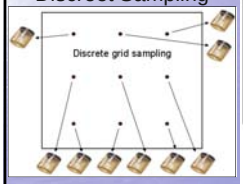
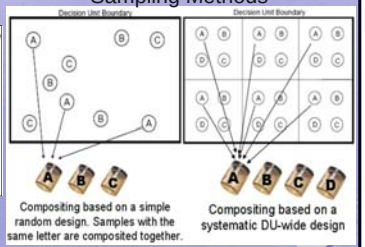
Remedial Investigation - Soil Delineation Using Collected Data
Incremental Sampling (continued)

Examples of Traditional Composite Sampling Methods

Discreet Sampling





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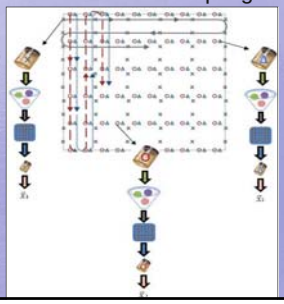
Remedial Investigation - Soil Delineation Using Collected Data

Incremental Sampling (continued)

Incremental Sampling

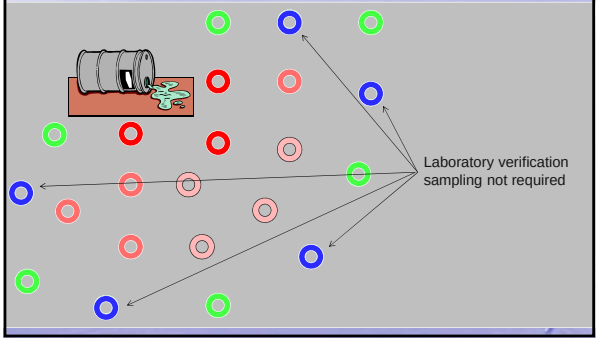


Remedial Investigation - Soil

Delineation using Field Screening

- Field screening methods can't be used to verify contaminant identity or clean zones
- 10+ samples taken at AOC, may use up to 50% field screening methods to document clean
- More than 50% requires variance

Remedial Investigation - Soil Delineation using Field Screening

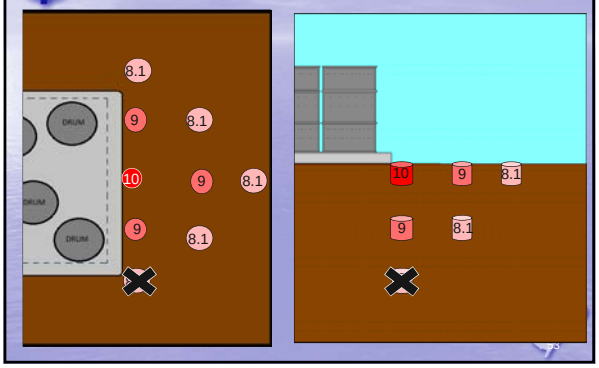


Remedial Investigation - Soil Delineation Through Extrapolation

Establish contaminant gradient by showing levels decrease as follows:

- 10% or more between initial sample & each of two sequential delineation samples
- 5X Reduction between initial sample & single delineation sample
- Reasonable combination of laboratory samples & field instrument readings
- Once gradient established, extrapolate contaminant limits
- When gradient used to estimate limits, need laboratory confirmation prior to completing Remedial Action

Extrapolation Example 10% Reduction



Remedial Investigation - Soil Delineation below the water table

If a vertical soil contaminant gradient has not been established to the water table:

- Delineate all contaminants below the water table to direct contact soil cleanup standards
- Contaminants having water solubility >100 mg/L, delineate saturated zone soil for residual product
- Samples reported on dry weight basis - results will be biased high.

Remedial Investigation - Soil Delineation/Restricted Use

Future use restricted/property owner agrees to deed notice:

- Can delineate contamination to non-residential direct contact soil remediation standard (NRDCSRS)
- Still need to delineate to IGW standard (unsaturated zone) when below res/non-res direct contact standard
- Characterize magnitude/extent of remaining contaminants
- Determine if contaminants migrated off property above RDCSRS

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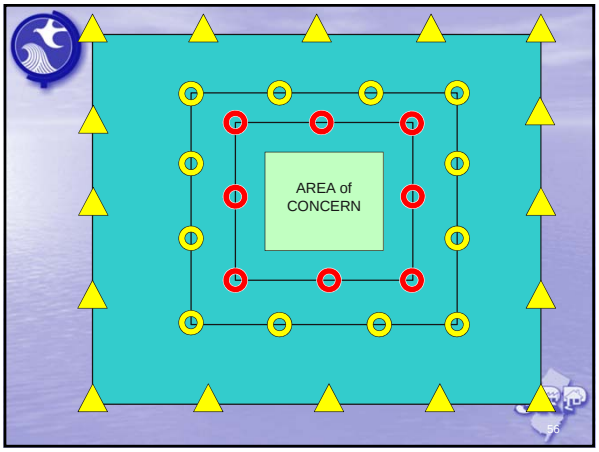

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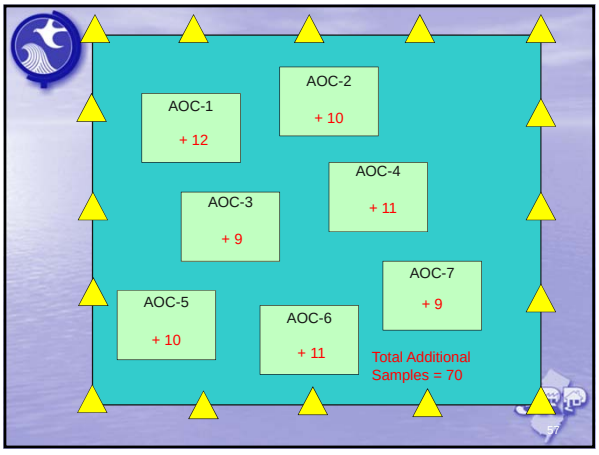

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Remedial Investigation Regulatory/Mandatory Timeframes

If the discharge at the site was discovered prior to **May 7, 1999**,

The Remedial Investigation shall be completed and Remedial Investigation Report submitted by **May 7, 2014**.

Remedial Action Verification Sampling - Soil

Ted Toskos
AMEC

VERIFICATION SAMPLING OF SOIL FOR REMEDIAL ACTIONS

Purpose:

- Provide assistance in developing sampling designs for soil to confirm remedial action has met its objectives

Verification Sampling - Soil RAs
Single Phase Remediations

- The requirements are same as for any other remedial action

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Verification Sampling - Soil RAs
Confirmation Sampling

- Soil Excavation
  - RI samples may be used if they were collected in appropriate locations and adequate frequency
  - Side-wall samples
    - Every 30 ft or other defensible interval
    - Collect samples at the top and bottom of the wall
  - Bottom samples
    - One sample per 900 sf of bottom area

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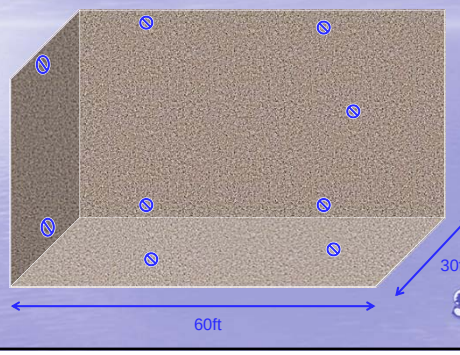
Verification Sampling - Soil RAs
Confirmation Sampling (cont.)



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Verification Sampling - Soil RAs
Confirmation Sampling (cont.)

- Bias sample locations based on RI data, field screening data and observations and contaminant properties

Verification Sampling - Soil RAs
Confirmation Sampling (cont.)

- In-Situ Soil Remediation
  - One sample per 900 sf
  - In 2-ft thick layers
  - May be modified based on technology requirements
  - For large treatment areas alternate sampling frequencies may be appropriate

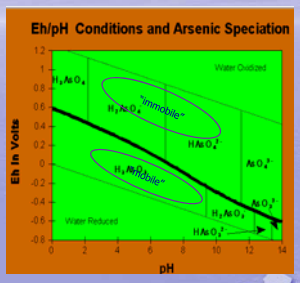
Verification Sampling - Soil RAs
Confirmation Sampling (cont.)

- In-Situ remediation methods often produce changes in site redox conditions, create intermediate reaction products or alter contaminant mobility
- Consider these factors when selecting sampling locations and analytical parameters
- Consider the time necessary for reactions to complete and soils to re-equilibrate when scheduling the sampling event

Verification Sampling - Soil RAs
Confirmation Sampling (cont.)

For example, arsenic can occur at a site either as a contaminant or naturally.

- Arsenic valence state and solubility change with redox.
- An RA utilizing reductive processes may mobilize arsenic.
- Mobility is further controlled by other ions present in the ground.



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Verification Sampling - Soil RAs
Confirmation Sampling (cont.)

- Ex-Situ Treatment
  - For on-site or off-site reuse, follow the Department's Alternative and Clean Fill Guidance for SRP Sites document
  - For off-site disposal, follow Department requirements and receiving specifications for the facility

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Verification Sampling - Soil RAs
Confirmation Sampling (cont.)

- General Considerations
  - Confirmation sampling should be biased to highest contaminant concentration
  - If delineation was determined based on concentration gradients, the RA verification sampling must confirm the delineation
  - Consult the Alternative and Clean Fill Guidance document when alternative or clean fill will be used as part of a remedial action.

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QUESTIONS