Alternative and Clean Fill Guidance for Site Remediation Program Sites

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Alternative and Clean Fill Technical Guidance Committee

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- David Barskey, DEP
- Kathleen Kunze, DEP
- Carrie McGowan, ISP Corporation
- Kathleen Murray, TERMS Environmental Services, Inc.
- Neil Rivers, Langan Engineering & Environmental Services

Presentation Outline

- History, Transition, Goals, and Main Principles
- Alternative Fill
- Clean Fill
- Compliance and Case Examples
- Questions

Fill Guidance: History

- Problematic uses of contaminated fill
- June 2008 Guidance
- Stakeholder process initiated June 2010
- New guidance finalized August 2011

Fill Guidance: Transition

From now until May 2012

- Use this guidance to comply with the requirements of the current Technical Rules and SRRA

After May 2012

- This guidance will be changed to support the new rule requirements

Fill Guidance: Goals

- For SRP sites only
- Avoid "de facto landfilling"
- Provide alternatives to clean fill
- Clean fill

Fill Guidance: Overarching Principles

Don't make it worse

- **Like-on-like** – Limit types of contamination
- **75th percentile** – Limit the concentration of contamination to be used as fill
- **Volume limit** – Quantities of fill are limited to the amount needed to complete the remediation

Fill Guidance: Main Principles

- Guidance provides information on how to "do it right"
- Allows flexibility through the use of professional judgment
- With the use of professional judgment comes responsibilities

Alternative Fill

Kathleen Kunze

Alternative Fill

Definition - material to be used in a remedial action that

- Contains contaminants in excess of the most stringent soil remediation standards
- Contains contaminants in excess of criteria or action levels for contaminants without standards, such as asbestos, radiation, hexavalent chromium and dioxins
- Does not contain free liquid or product
- Can be "soil" or "non-soil"

Alternative Fill

Purpose

- To provide guidance on the use of alternative fill at SRP site Areas of Concern

- To provide details on sampling frequencies and compliance with the proposed rule requirements (like-on-like/75th percentile)

Alternative Fill Requirements for

Off-site donors

On-site donors

Alternative Fill

Receiving Site AOC Data

- Evaluate RI data for each receiving AOC to determine contaminants of concern and their concentrations
- Organize list of contaminants for like-on-like evaluation and compliance calculation
  - –May group PAHs with same health-based criteria
  - –May not include non-carcinogenic PAHs since they have different health endpoints
- Determine the 75th percentile value for each contaminant
  - –Other compliance options acceptable with variance

Alternative fill

Characterize the donor site

- Must have a thorough understanding of the donor site as to uniformity as well as contaminant types and concentrations
- Conduct a site review to determine sampling needs and data gaps for fill material
- Use existing data and/or collect new discrete data as per Table 1 sampling frequencies

Alternative Fill

Existing data may be used when

- A NJ certified lab performed the analyses
- The data meet data quality requirements (QA/QC)
- Acceptable sample collection methods were used
- Alternative fill was not moved to another property after sampling was conducted

Alternative Fill

Existing Composite Data

- May be used if reliable and representative
- May not be used for VOC characterization
- May be used to reduce discrete sampling required in Table 1

Note: Use of composite data is a variance requiring justification

Alternative Fill

Obtaining New Data for Donor Site

- Design sampling strategy and frequency based on site review and Table 1. Can modify frequencies based on level of knowledge of the donor source
- Analyses - TCL/TAL
  - Analytes may be added or deleted based on site review or existing data

Alternative Fill

Donor Site Data Evaluation

- Organize all usable data on spreadsheet

  -Compare COCs to comply with like-on-like requirement (with PAH exception)

  -Compare maximum values of each COC to 75th percentile value at receiving site AOC

Alternative Fill

Impact to Ground Water (IGW) Evaluation

- If donor material ≤IGW default soil screening levels or site specific IGW soil screening levels, can use as alternative fill
- If >IGW default soil screening levels, run SPLP test as per IGW guidance
  - Pass SPLP, can use as alternative fill
  - Fail SPLP, cannot use as alternative fill unless fill won't impact groundwater remedy or adjacent surface water

NOTE: Default IGW screening levels for metals with secondary GWQS do not apply

Requirements for Other Alternative Fill Materials:

- **Sediments**
  - Includes dredge material (DM) and processed dredge material (PDM)
  - Additives are a concern for PDM
  - Can use Office of Dredging and Sediment Technology data but need an Acceptable Use Determination (AUD)
- **Historic fill**
  - Non-soil material requires Certificate of Authority to Operate/Beneficial Use Determination (CAO/BUD) from Solid Waste.
  - Evaluate data per section 4.5 of this guidance
  - Follow IGW guidance

Additional Materials to be Considered for Off-site Alternative Fill Material:

- **Recycled concrete**
  - Use this guidance and the Department's Recycled Concrete Guidance
  - Need CAO/BUD from NJDEP Division of Solid Waste
  - If IGW concerns, follow section 4.6 of this guidance

Restrictions / Exclusions

- PCB restriction
- Asbestos exclusion
- RCRA waste exclusion
- Dioxin exclusion
- Radiological material exclusion

Alternative Fill from On-site Donors

- AOC data evaluation
  - Consolidation encouraged if not increasing gw contamination or mixing incompatible contaminants
- Exceptions to 75th and like-on-like (variance)
  - Only if increasing clean AOCs
- IGW considerations
- Historic fill at Brownfield sites across property lines
  - If no increase in gw contamination
  - If protective
- All other restrictions/exclusions apply

Clean Fill

David Barskey

Clean Fill

Current Technical Rule and Guidance

- Tech Rule N.J.A.C. 7:26E-6.4(b)2 and 3
- Fill must be uncontaminated
  - No contamination over any applicable remediation standard
  - Must be free of extraneous debris or solid waste
- Quality of fill must be documented with a certification and a description of the steps taken to confirm fill is clean
- Previously no guidance on clean fill

Clean Fill

New Guidance

- Provides the details on how to determine fill is clean leading to appropriate and consistent decisions
- Provides a formal definition of Clean Fill consistent with current Tech Rule
- Provides the details on how to comply with current and proposed rule requirements

Clean Fill

Applicability of guidance

- For fill from on-site and off-site sources
- Off-site sources can be from in-state and out-of-state
- Guidance applies to SRP sites only
- Can use professional judgment to deviate from guidance, include justification in RAW and/or RAR

Clean Fill

Definition in guidance

- Meets all soil standards, including impact to ground water
- Meets all soil criteria or action levels
- Has no debris, solid waste, or free liquids
- Can be soil or nonsoil - also defined in guidance

Clean Fill

Donor Site Review and Data Assessment

- Must have a thorough understanding of donor site
  - Historical and current use
  - The types and concentrations of natural or man-made hazardous substances at the site
- Conduct a site review
  - Similar to a Preliminary Assessment
- Assess analytical data
  - Existing data from the site review and/or
  - New data from this technical guidance

Clean Fill

Existing data may be used when

- NJ certified lab performed the analyses
- Data meets data quality requirements (QA/QC)
- Acceptable sample collection methods were used
- Clean fill was not moved to another property after sampling was conducted

Clean Fill

Existing composite sample data

- Existing composite sample data may be used when the data are reliable and representative
- Use of composite sample data is a deviation from the guidance requiring justification
- If composite sample data are used, support with additional discrete sample data

Clean Fill

New data using this technical guidance

- Develop a sampling strategy and frequency
  - Base it on the site review and existing reliable data
  - Use Table 2 to establish sampling frequency, to be discussed in more detail later in the training

Clean Fill

New data using this technical guidance (continued)

- Select the analyses needed
  - Target Compound List (TCL) organics and Target Analyte List (TAL) inorganics
  - Can modify analyses needed based on site review and existing data
  - Other analyses may be needed to ensure geophysical compatibility or to assess other potential contaminants, such as dioxins or hexavalent chromium

Clean Fill

Testing of Fines and Sand from Quarries

- Data is needed to show that the material is clean
- One sample per year from a commercial quarry/source is acceptable
- May use existing data from the source operator
- Analyze additional samples from other sources, based on the donor site review and initial data results

Clean Fill

Natural background

- Do not use material with natural concentrations that exceed standards or criteria
- Screen for radiation above natural background levels when natural sources of radioactivity may exist at the donor site
- Exception - When receiving AOC and donor material are the same natural geologic material and have the same background levels (Most likely when donor material is from an on-site source)

Clean Fill

Evaluate potential impacts to ground water (IGW)

- If donor material ≤default IGW soil screening levels no further evaluation is needed - can use as clean fill
- If >default IGW soil screening levels, run the Synthetic Precipitation Leaching Procedure (SPLP) test
  - Select samples per IGW guidance – highest contaminant levels, etc.
  - If samples "Pass SPLP" - can use as clean fill
  - If samples "Fail SPLP" - cannot use as clean fill
- Default IGW SSLs do not apply to metals with secondary ground water quality criteria, such as aluminum or manganese, unless they are from a discharge

Clean Fill

Exclusions - Can not use donor material that

- Contains asbestos
  - Either naturally occurring, or Asbestos containing material (ACM). Note: ACM with <1% asbestos is not a reliable indicator of clean material
- Is RCRA hazardous
  - Conduct RCRA tests if there is any question that the donor material not nonhazardous
- Has dioxins/furans > the standards or criteria

Clean Fill

Recycled Concrete

- Use this Guidance and the Recycled Concrete Guidance
- May use data generated from Recycled Concrete Guidance, if equivalent to data from this Guidance
- Evaluate impacts to ground water using Section 6.5 of this guidance
- Requires a Certificate of Authority to Operate/Beneficial Use Determination (CAO/BUD) for beneficial reuse from the Department's Solid and Hazardous Waste Management Program

Clean Fill

Sediment

- Includes Dredged Material and Processed Dredged Material (PDM)
- Base sampling and analyses on site review and Table 2
- May be able to use data generated for the NJDEP Office of Dredging and Sediment Technology (ODST), if the data are reliable
- Evaluate PDM bench-scale data from ODST, additives may be a concern requiring further evaluation
- ODST requires the supplier to have an Acceptable Use Determination (AUD) and the receiving SRP site an approved Remedial Action Workplan

Practical Considerations and Professional Judgment

Application of the Fill Guidance for SRP Sites and the LSRP's Role as Gatekeeper

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Topics

- Distributions and Statistics
- Sample Frequencies
- Compliance Options
  - 75th Percentile
  - 95th Upper Confidence Limit
- Fill Use Plan
- Tracking of Material
- Professional Judgment
- Wrap up and Example
- Questions and Answers

Statistics and Distributions

- Statistics computed from the sample population are only inferences or estimates about characteristics of the population, such as location, spread, and skewness
- What is the variability of the data?
  - Distribution around the mean
  - For normal (Gaussian) distributions, +/- 2 Standard Deviations = 95% of the Population
  - There are other many distributions types, but not all data has a distribution

Statistics and Distributions

- Outliers (Black Swans) Exist – how do we account for and avoid them?
- *Please, don't drive a school bus blindfolded*

Sample Distributions

Lognormal

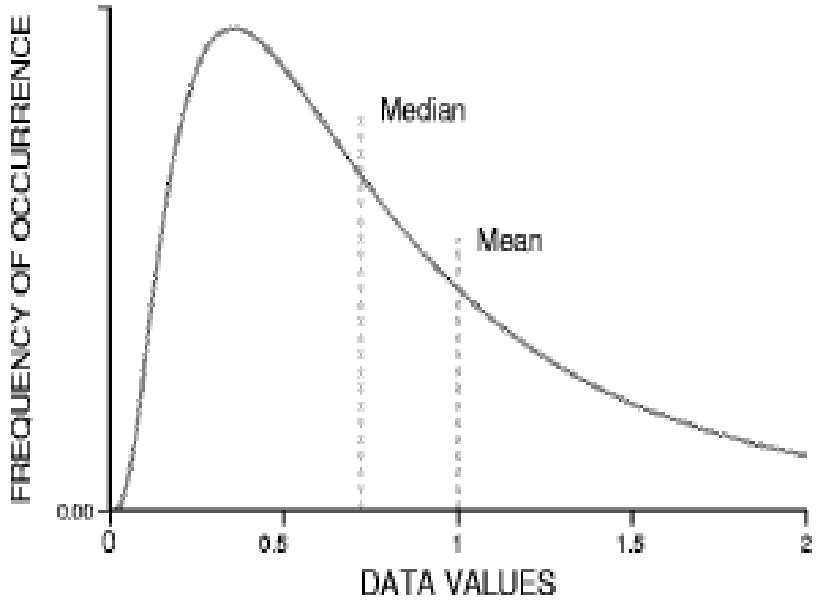


Figure 1.1 Density Function for a Lognormal Distribution

Normal

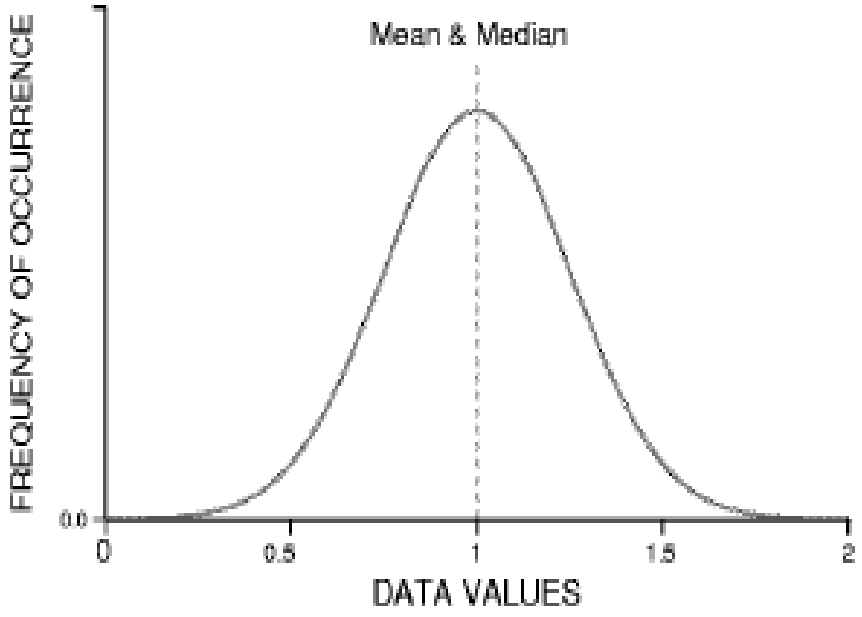
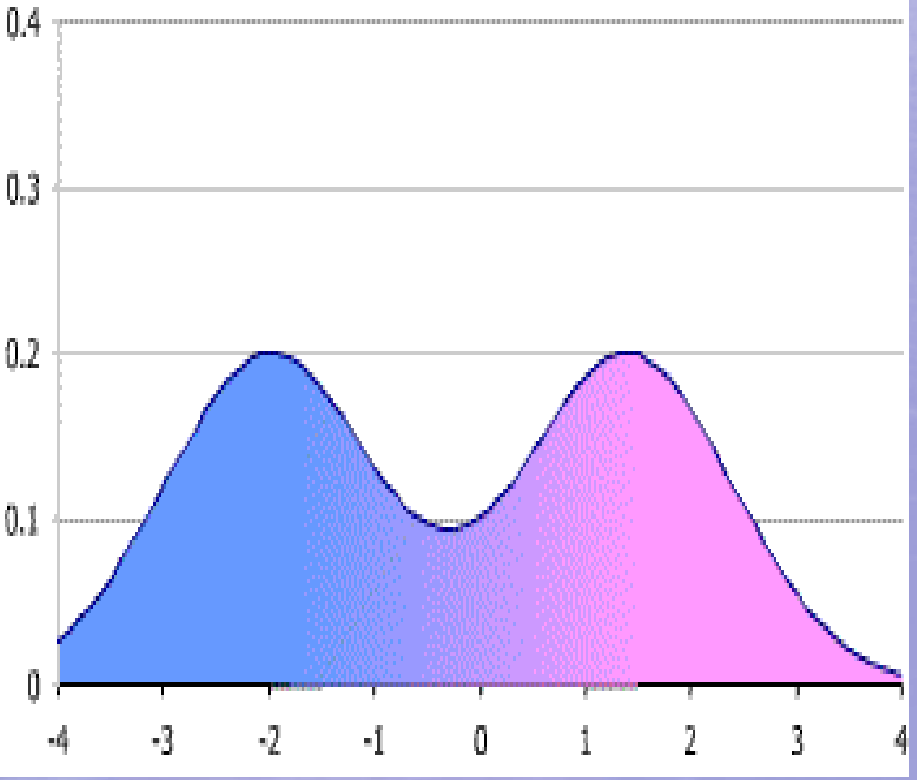


Figure 1.2 Density Function for a Normal Distribution

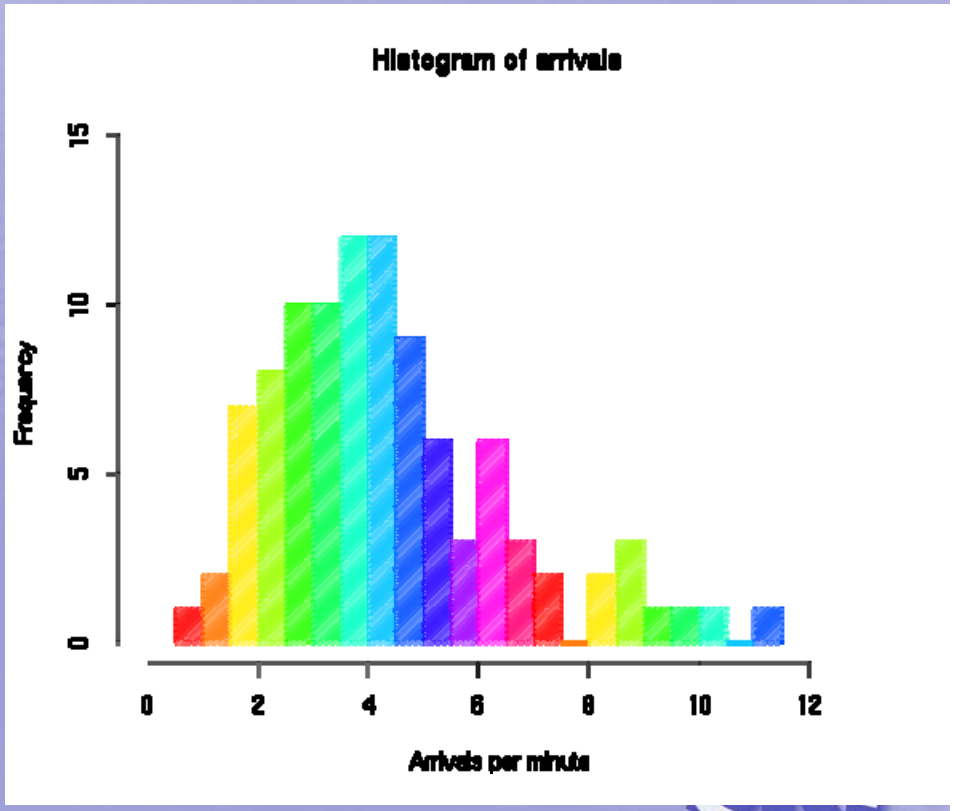
D.R. Helsel & R.M. Hirsch, *Statistical Measures in Water Resources*, USGS, September 2002.

Sample Distributions

Bimodal



Nonparametric



General References

- Richard O. Gilbert, *Statistical Methods for Monitoring Environmental Pollution*, John Wiley & Sons, 1987.
- D.R. Helsel and R.M. Hirsch, *Statistical Methods in Water Resources*, USGS, Techniques of Water-Resources Investigations of the United States Geological Survey, Book 4: Hydrologic Analysis and Interpretation.
- *Data Quality Assessment: Statistical Methods for Practitioners*, USEPA, EPA QA/G-9S, EPA/240/B-06/003, February 2006.
- Nassim Nicholas Taleb, *The Black Swan*, 2nd Edition, Random House, 2007.

Sample Frequency

- Guidance Tables 1 and 2
  - Default – Current TRSR Soil Reuse
    - 2 per first 100 CY, 1 per 100 CY thereafter
    - Reduction for > 10,000 CY
  - Reduced sampling frequency when there is site review and field screening
  - Both are based on biased grab samples
  - Other reductions in sampling frequency are possible – **Deviation** from Guidance

Tables 1 and 2 - Excerpt

Proposed Volume	Default Sampling Scheme without justification	Reduced Sampling Scheme with justification
(Cubic Yards)	(Samples)	(Samples)
0 to 20	1	1
20.1 to 40	2	2
40.1 to 60	3	2
60.1 to 80	4	2
80.1 to 100	5	2
100.1 to 200	6	3
200.1 to 300	7	3
300.1 to 400	8	4
400.1 to 500	9	4
500.1 to 600	10	5
600.1 to 700	11	5
700.1 to 800	12	6
800.1 to 900	13	6
900.1 to 1,000	14	7

Composite Sample Protocols

- **Deviation** from guidance based on professional judgment
- Not appropriate for volatile organics
- Especially appropriate for stockpiles
- Examples of other available guidance:
  - ITRC Incremental Sampling Methodology Draft
  - NJDEP ODST Dredging Technical Manual
  - ASTM D6051-96(2006) and C702 / C702M–11
  - USEPA SW-846, Chapter 9

Compliance Options

- 75th Percentile
- 95th Upper Confidence Level of the Mean

75th Percentile

- Objective for the 75th Percentile
  - Rather than increase the characterization effort, SRP opted to employ a more conservative limit
  - Allows importation of the largest volume of contaminated fill, while minimizing the inclusion of extreme concentrations
  - Provides a margin of safety to prevent bringing on-site concentrations above those already present

75th Percentile

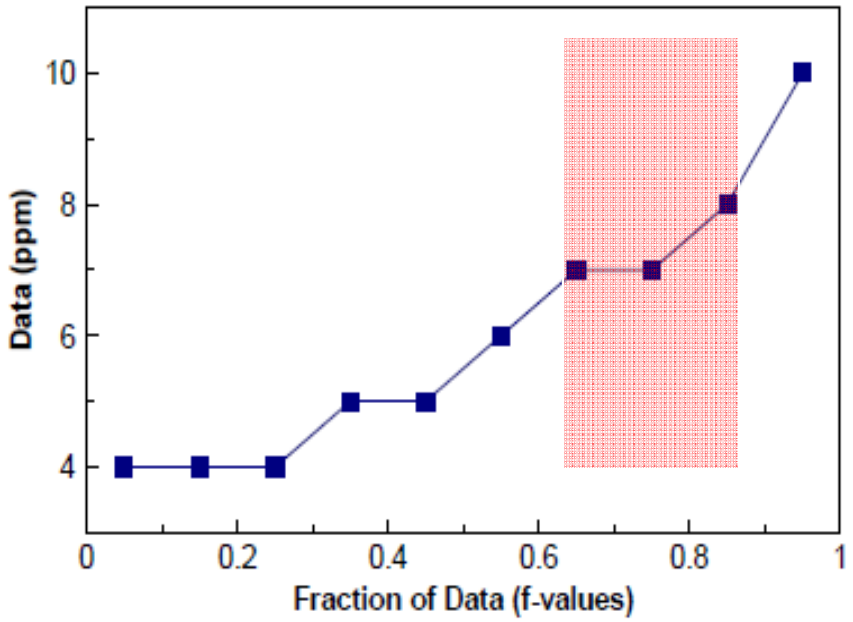
- The use of the 75th percentile offers certain advantages
  - For many distribution types, observations in the distribution exhibit a central tendency
  - Potential outliers for a given population are generally above the 75th percentile or below the 25th percentile.

Quantile Plots

Example Data

i	$X_{(i)}$	F_i
1	4	0.05
2	4	0.15
3	4	0.25
4	5	0.35
5	5	0.45
6	6	0.55
7	7	0.65
8	7	0.75
9	8	0.85
10	10	0.95

Quantile Plot - Skewed



USEPA, 2006, Box 2-16.

Calculation of the 75th Percentile

Sample ID	Conc.
	mg/kg
1	2.0
2	5.0
3	10
4	19
5	21
6	25
7	51
8	612
Mean	93
75th Percentile	32

- Consider the following
  - MS Excel: "Percentile" function calculates 75th Percentile:

    "=Percentile(B6:B13,0.75)"
  - Mean = 93 mg/kg
  - 75th Percentile = 32 mg/kg
  - This data is nonparametric (no distribution)

Alternative to the 75th Percentile

- 95th Upper Confidence Limit of the Mean (95th UCL)
- Variance from Proposed Rule

95th Upper Confidence Limit of the Mean (95th UCL)

- 95% Upper Confidence Limit is the region about the *sample mean* that is likely to contain the underlying actual *population mean.*
- OR - 5% probability that the population mean will fall outside the 95% Upper and Lower Limits
- Upper Confidence Limit < 2.5% Chance.
- Commonly used in Risk Assessments.

95th Upper Confidence Limit of the Mean (95th UCL)

- Sample size is especially important when there is large variability in the underlying distribution of concentrations
- If UCL appears to exceed the range of concentrations detected
  - Default to the maximum value
  - Additional samples suggested

USEPA ProUCL

- 95th UCLs are calculated by USEPA's ***Free*** ProUCL software
  - Version 4.10 latest
  - http://www.epa.gov/esd/tsc/software.htm
- Guidance recommends a minimum of 20 samples
  - Do not exclude "outliers" with statistical tests
  - ProUCL now handles non-detect data

USEPA ProUCL

- ProUCL calculates Goodness-of-Fit tests, the distribution, and ***recommends*** the appropriate UCL
- The ***user*** is responsible for selecting an appropriate UCL for the data distribution
- Save and print output(s) for report

Actual Site Characterization Data

		Excel Statistics			ProUCL Statistics	
Parameter	**No. Samples**	**Max**	**Mean**	**75th Perc.**	**95th UCL**	**Dist.**
		mg/kg	mg/kg	mg/kg	mg/kg	
PAHs						
Benzo(a)Anthracene	119	12	0.56	0.52	0.73	LogNorm
Benzo(b)Fluoranthene	119	9.2	0.64	0.75	0.94	LogNorm
Benzo(k)Fluoranthene	119	13.0	0.40	0.37	1.14	None
BbF and BkF Subtotal				***1.12***	***2.08***	
Benzo(a)Pyrene	119	11.0	0.54	0.57	0.72	LogNorm
Indeno(1,2,3-cd)Pyrene	119	3.1	0.35	0.41	0.64	None
Pesticides & PCBs						
Total PCBs	117	5.15	0.21	0.11	0.55	None
Metals						
Arsenic	113	669	15	11	41	None
Lead	117	19,000	624	304	1,797	None

Fill Use Plan

- Appendix B of the Guidance
- Report in the RAW and/or RAR
- Required per TRSR 7:26E-6.4(d), but not defined in regulation
  - TRSR references the 1998 *Guidance Document for the Remediation of Contaminated Soils*
  - Outdated but some key concepts remain:
    - Determination of waste classification
    - Rationale used for characterization of the soil

Fill Use Plan

- Figures and plans
  - Areas of concern
  - Fill depth cross sections
  - Engineering controls
- Other considerations
  - Pinelands restrictions
  - Objectionable odors or appearance
  - Regulatory compliance
  - Allowable storage time – 6 months

Tracking and Flow of Material

- Suggested Best Management Practices
  - Weight tickets for all materials on and off site
  - Document Gatekeeper approvals and permits
  - Establish a grid system for fill areas
  - Soil Erosion Controls
  - Dust Control
  - Field inspection procedure for incoming loads
- Document in the RAW and/or RAR

Professional Judgment

- LSRP is the Gatekeeper for the Site
  - Responsible for the protectiveness of the remedy
  - Responsible for the quality of the material imported onto the site
- The "Person Responsible for Conducting the Remediation" remains responsible for the property

Wrap Up

- Hypothetical Project Site
- Questions and Answers

Hypothetical Project Site

- Low lying Brownfield redevelopment
- Fill required to meet remedial objectives based on the Conceptual Site Model (CSM) for the site
  - Backfill area of concern excavations
  - Engineering controls for site wide historic fill material
  - Raise the grade out of the flood plain
- The use of alternate fill material reduces the reliance on clean fill and the remedy cost

Hypothetical Project Site

- Review RI Data from Site
- Develop protective acceptance criteria for donor materials based on
  - Like-on-Like
  - Develop 75th Percentile (or the 95th UCL)
  - Use Soil Remediation Standards Guidance, including Impact to Groundwater
  - Geotechnical considerations

Hypothetical Project Site

- Review Donor Site Data: Alternative or Clean Fill
  - Site Review – was it reliable?
  - Sampling protocol – was it adequate?
  - Data Review – was it usable?
  - Where can the material be used?
    - Sub Grade
    - Final Cover
    - No Use – Rejected
  - Document for the RAW and RAR

Questions?