Reasonable Potential

Implementing Local Limits In Industrial User Permits

Bruce Kent USEPA Region 8 Wastewater
Kent.bruce@epa.gov
(303) 312-6819

NPDES Program

- The NPDES regulations require permit writers to assess effluent to evaluate impact of direct discharges on downstream water quality
- An assessment is used to base a decision to place limits in NPDES Permits that protect water quality standards
  - Water Quality Based Effluent Limits (WQBELs)
- Local Limits can derived from either WQBELs, any applicable water quality standards and biosolids standards
  - Toxic criteria for aquatic life
    - Numeric or Whole Effluent Toxicity (WET)
  - Human health criteria
  - Biosolids Part 503 Regulations

NPDES Regulations:

- 40 CFR 122.4(d)(1)(i):

  Limitations must control all pollutants or pollutant parameters (either conventional, non-conventional or toxic pollutants) which the Director determines are or may be discharged at a level which will cause, have the *reasonable potential* to cause, or contribute to an excursion above any State water quality standard, including State narrative criteria for water quality.

NPDES Regulations:

- 40 CFR 122.4(d)(1)(ii):

  When determining whether a discharge causes, has the *reasonable potential* to cause, or contributes to an excursion above a narrative or numeric criterion within a State water quality standard, the permitting authority shall use procedures which account for existing controls on point and non-point sources of pollution, *the variability of the pollutant or pollutant parameter in the effluent*, the sensitivity of the species to toxicity testing (when evaluating whole effluent toxicity), and where appropriate, the dilution of the effluent in the receiving water.

NPDES Regulations:

- 40 CFR 122.44(d)(1)(iii):

  When the permitting authority determines, using procedures in paragraph (d)(1)(ii) of this section, that a discharge causes has the *reasonable potential* to cause, or contributes to an in-stream excursion above the allowable ambient concentration of a State numeric criteria within a State water quality standard for an individual pollutant, ***the permit must contain effluent limits for that pollutant.***

What Does This Have To Do With Local Limits?

- A similar approach could be used to establish a basis for including (or excluding) Local Limits in IU permits
  - Allows Control Authority to justify why a facility needs a Local Limit as a permit limit using a scientific approach
  - May be used to justify not including a Local Limit in a permit

What is Required

- Local Limit Permitting
  - Don't forget to include categorical pretreatment standards when applicable (PSES, PSNS)
    - Technology standards are required!
  - If Local Limit is more stringent than the categorical standard, apply Local Limit for same parameter
    - Need to protect effluent and biosolids quality
    - No exceedance of Maximum Available Headworks Loading (MAHL) and Maximum Available Industrial Loading (MAIL)

What about other pollutants?

– Decision to include other permit limits
  - Include **All** Local Limits in every IU permit
    – EPA requires monitoring for all permitted parameters regardless if they are consistently below detection
    – Seems like a lot of $ for monitoring that isn't used by the control authority
  - Don't require any permit limits based on Local Limits
  - Arbitrary decision of which Local Limits are applied to permitted facilities
    – Limit for every pollutant detected?
    – Limit only pollutants which are close to the local limit?

Evaluate Pollutants of Concern

- Pollutants of Concern
  - At a minimum, permit applications should require monitoring of local limit parameters
  - Identify pollutants of concern from permit application
    - Categorical standard parameter, any local limit parameter
- Evaluate
  - Analyze effluent data for pollutants of concern to see if a Local Limit based permit limit is needed
    - Evaluate variability of data to see if the effluent has REASONABLE POTENTIAL to exceed a Local Limit

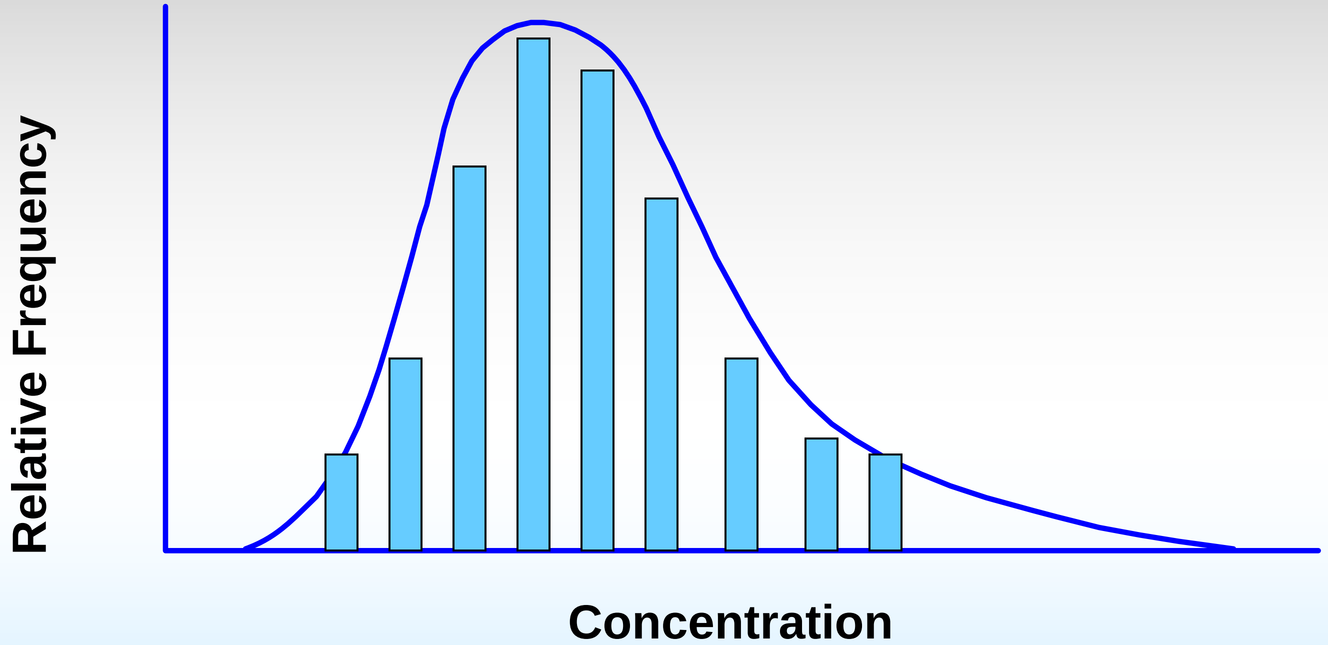
Data Needs

- How much data do I need?
  - – 1 pt? Statistical methods fail but can use “default” conditions to estimate variability
  - – 1-10 pts? Statistical methods may not always be reliable but can use “defaults”
  - – >10 pts. Statistical methods can be applied (but use caution!)
    - Large percentages of non-detected values (less than values)
    - Data must fit a known distribution pattern to apply parametric statistics
    - Be aware! EXCEL statistics package have a financial basis NOT scientific basis.

Effluent Data Distribution

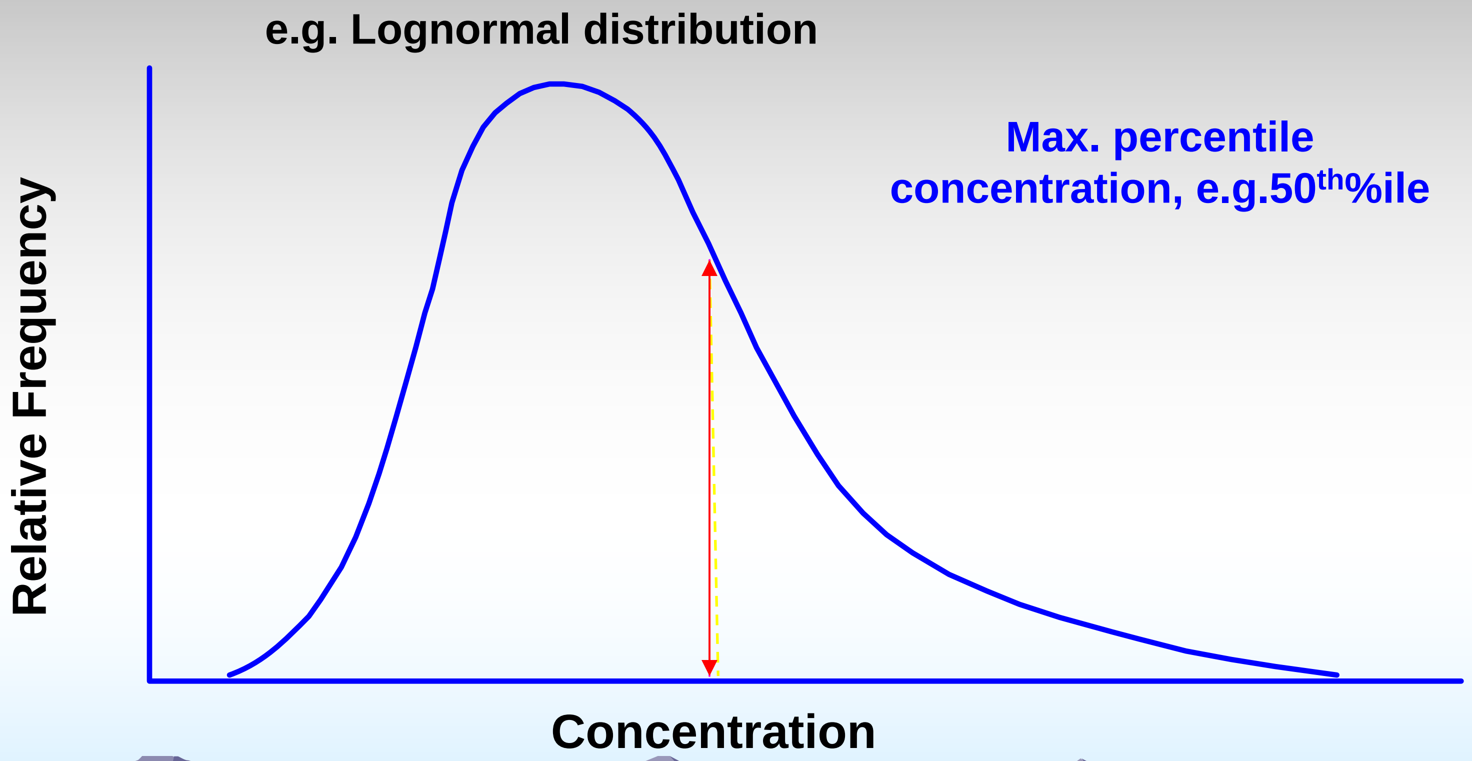
Lognormal Distribution: **the probability distribution of any random variable whose logarithm is normally distributed**

Relative Frequency: **the fraction or ratio of the number of observations in a category or class to the total number of observations**



What is the Maximum Reported Value?

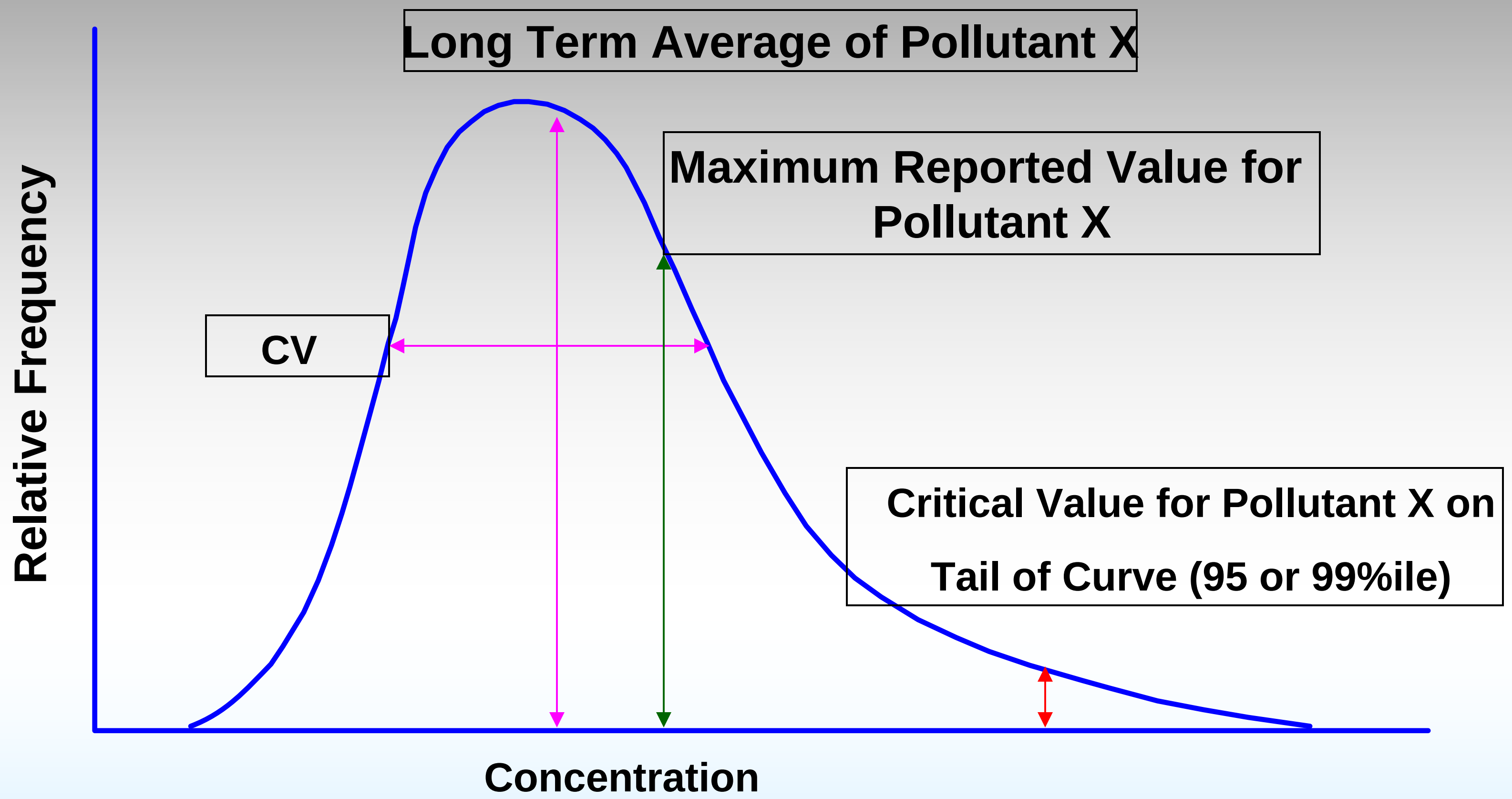
– **Statistics tell us that we can be 99% sure that the largest value of our measurements of the concentration of a pollutant will be at or greater than *some percentile* of the distribution of all effluent pollutant concentrations.**



Effluent Data Variability

- Maximum reported effluent values **do not** represent the highest possible effluent value
- The highest possible effluent values can be predicted using statistics to establish:
  - the actual distribution characteristics of the effluent data
  - variability of the effluent data set using standard statistical procedures

Key Terms for Data Distribution



Summary: Why Do Statistics?

- Can predict maximum possible effluent value (e.g. 99%ile) for a pollutant using statistical tools to determine:
  - Type of data distribution (Normal, lognormal, other)
  - Variability of the distribution (e.g. Coefficient of Variation (CV) or the Standard Deviation divided by the Mean)

EPA Guidance on Assessing Data Variability

- *Technical Support Document for Water Quality-based Toxics Control, EPA/505/2-90-001, March 1991*
  - *Chapter 3: Effluent Characterization*
  - *Appendix E: Lognormal Distribution and Permit Limit Derivations*
- *Recent EPA Effluent Guidelines:*
  - *Aquaculture (40 CFR 451)*
  - *Centralized Waste Treatment (40 CFR Part 437)*
  - *Meat Products (40 CFR Part 432)*

Other State Guidance/Information

- EPA Region 6 RP Guidance
- State of Colorado (Only Region 8 State)
- Other State WQS/Guidance

  Virginia, Oklahoma, Washington, Oregon, etc.
- *No Existing Policies or Guidance for the Pretreatment Program*

Determining Effluent Variability

- Statistical Analysis to define data distribution
- Determine data variability using statistical parameters
- Determine effluent values at upper end of distribution
- Compare upper distribution value with Local Limit

Effluent Data Evaluation

- Determine valid data points
  - Qualitative check for data “anomalies”
    - Use of correct reporting units
    - Laboratory errors
    - Sampling errors
    - Upset conditions in treatment unit
    - Elevated detection limits/reporting levels
  - Quantitative checks for “Outliers”
    - Remove outliers after statistical procedure run
    - e.g. ProUCL
      - Dixon Test (for small data sets)
      - Rosner Test (for large data sets)

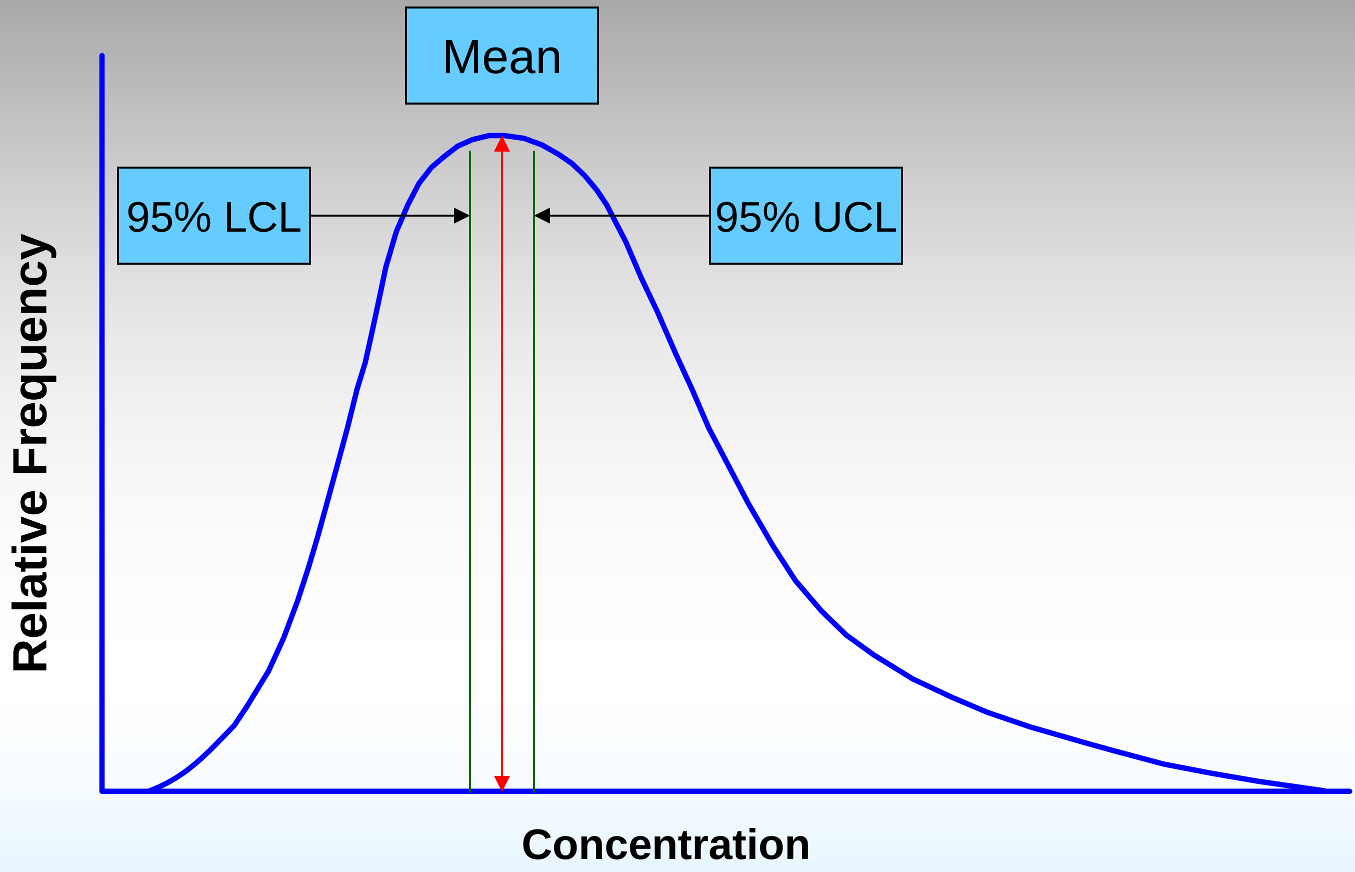
Statistical Software

- EPA's Pro UCL Software (free download)
- Provides data analysis:
  - Goodness of fit tests for Normal, Lognormal, and Gamma distribution
  - Calculates Regression Order Statistics (ROS) estimates for non-detected data points in different distributions
  - Incorporates multiple non-detect values
  - Data OutlierTests (quantitative procedures)
  - Histograms, box plots, q-q plots of data distribution
  - Relatively easy use

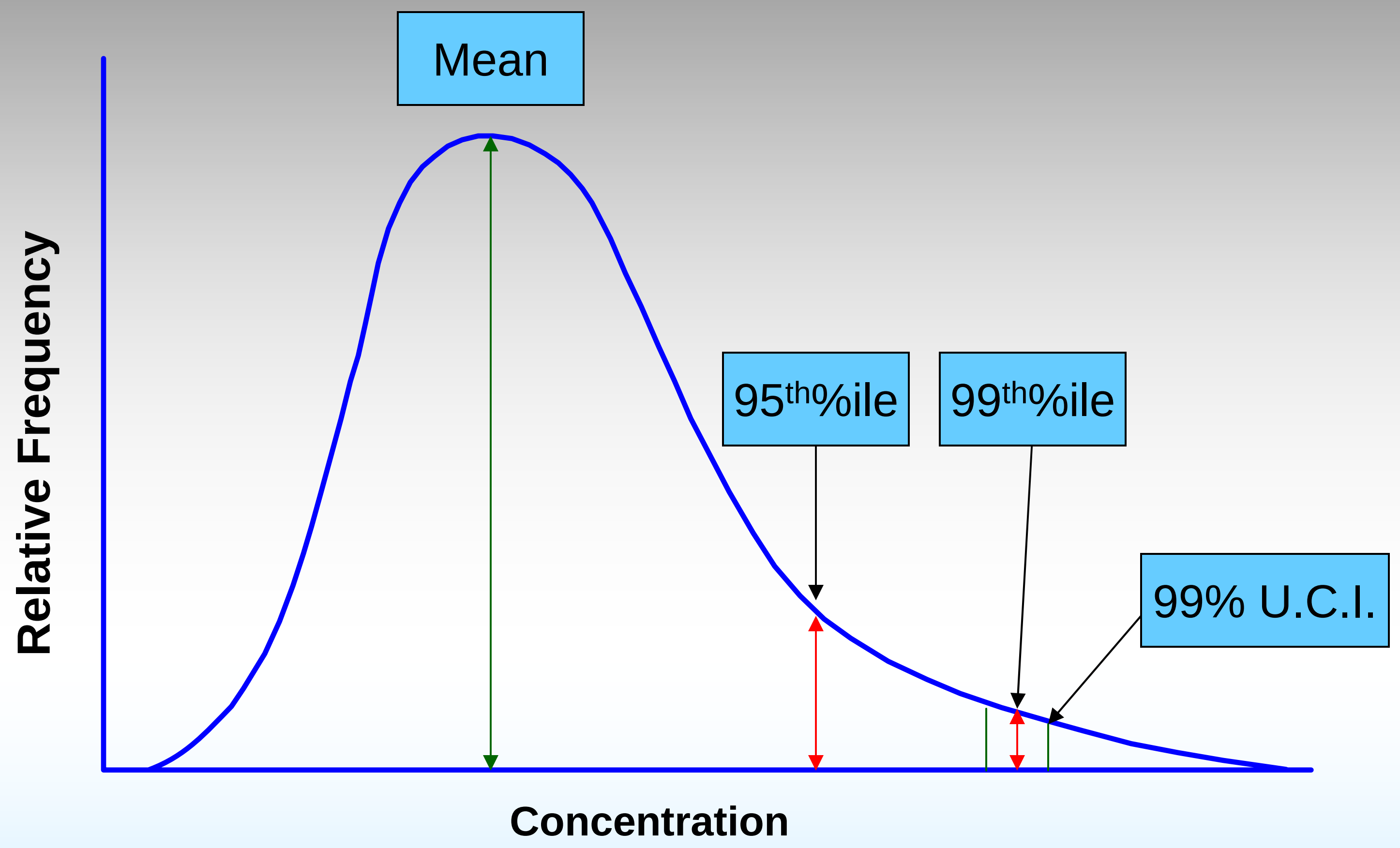
Statistical Software (Con't)

- EPA's ProUCL (con't)
  - Generates some statistical data including:
    - Mean, standard deviation, variance, etc.
  - Calculates 95% confidence interval for the <u>mean</u> of the data set
    - Not same as EPA TSD (95 or 99% probability at 95 or 99% confidence interval of the <u>max</u> of the data set)
  - Used to make risk management decisions for site cleanup activities

What is the 95 UCL of the Mean?



What is the 99% Probability Basis and 99% Confidence Interval

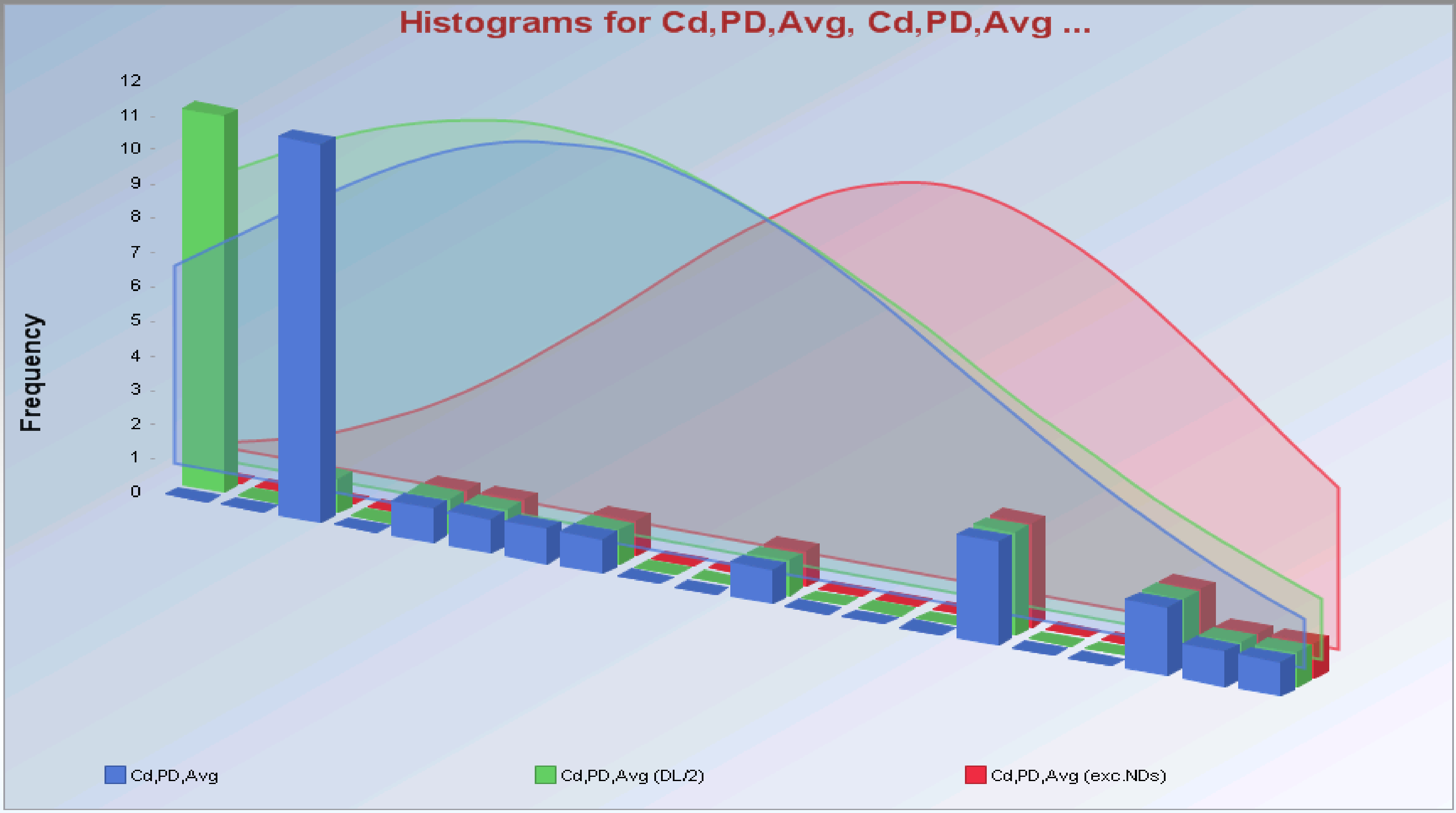


ProUCL 4.0.02

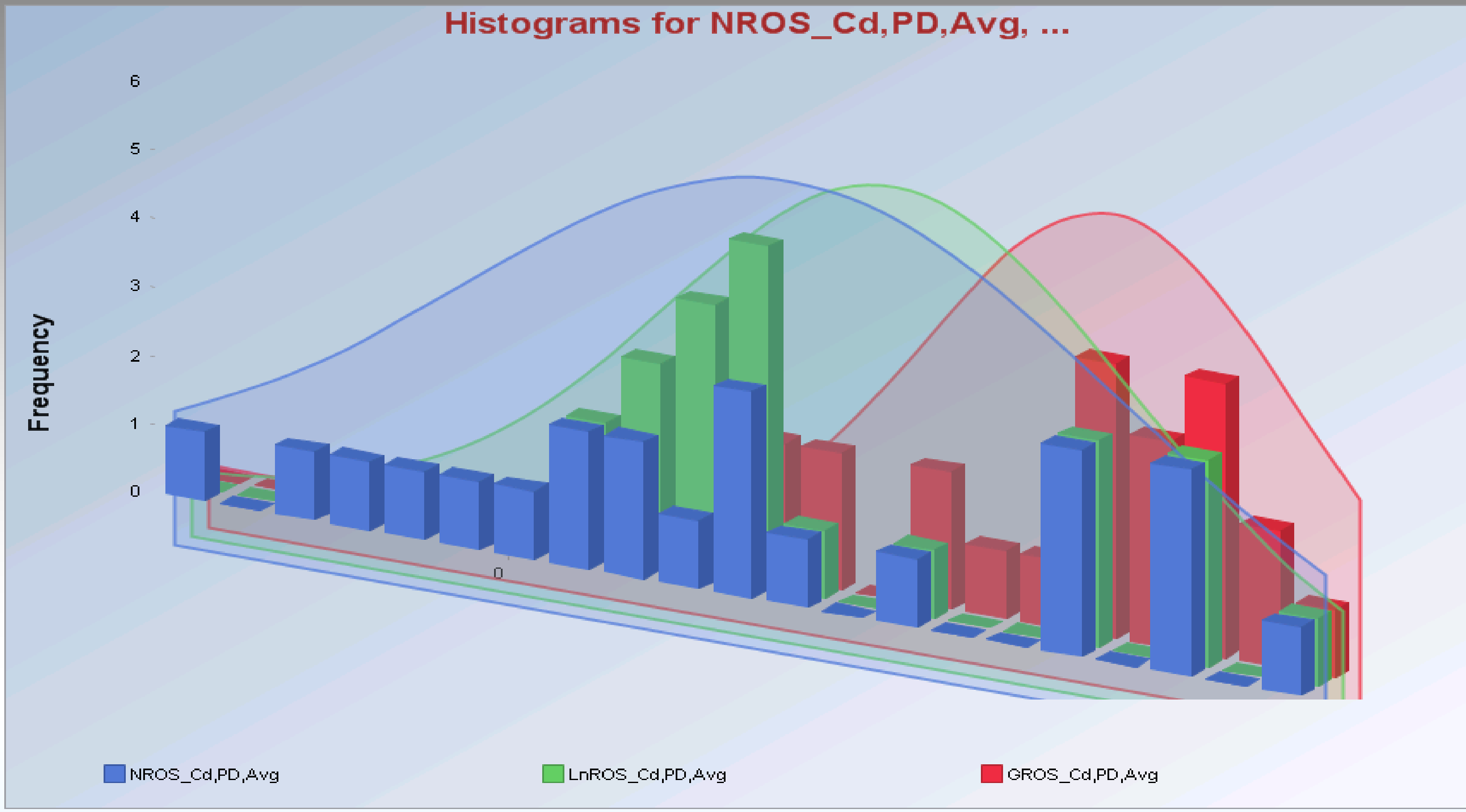
Leadville Mine Drainage Tunnel
High Flow

Cadmium, Potentially Dissolved, ug/L	w/out Non-Detected Values	ND/2
<0.15	0.24	0.075
<0.15	0.71	0.075
<0.15	0.34	0.075
<0.15	0.63	0.075
<0.15	0.61	0.075
<0.15	0.45	0.075
<0.15	0.28	0.075
0.24	0.82	0.24
0.71	0.76	0.71
<0.15	0.61	0.075
<0.15	0.72	0.075
0.34		0.34
0.63		0.63
<0.15		0.075
<0.15		0.075
<0.3		0.15
0.61		0.61
0.45		0.45
0.28		0.28
0.82		0.82
0.76		0.76
0.61		0.61
0.72		0.72

ProUCL 4.0.02
Histograms



ProUCL 4.0.02
Histograms



ProUCL 4.0.02
Outlier Tests

Outlier Tests for Selected Variables

User Selected Options

From File E:\RP\LMDT.highflow.Cd.wst

Full PrecisionOFF

Test for Suspected Outliers with Dixon test 1

Test for Suspected Outliers for Rosner test 1

Dixon's Outlier Test for Cd,PD,Avg

Number of data = 11

10% critical value: 0.517

5% critical value: 0.576

1% critical value: 0.679

1. Data Value 0.82 is a Potential Outlier (Upper Tail)?

Test Statistic: 0.185

For 10% significance level, 0.82 is not an outlier.

For 5% significance level, 0.82 is not an outlier.

For 1% significance level, 0.82 is not an outlier.

2. Data Value 0.24 is a Potential Outlier (Lower Tail)?

Test Statistic: 0.192

For 10% significance level, 0.24 is not an outlier.

For 5% significance level, 0.24 is not an outlier.

For 1% significance level, 0.24 is not an outlier.

ProUCL Goodness of Fit Tests

- For Effluent Data Sets With and Without Non-Detected Data
- Not always reliable for data sets with a high percentage of non-detected values
- Can be used to verify data distribution assumption
- Uses several statistical tests to determine how well data fit a known distribution (normal, lognormal, gamma)
- Provides summary output of goodness of fit results for data distributions including ROS estimates for NDs

ProUCL GOF Summary Statistics

	Num Obs	Num Miss	Num Valid	Detects	NDs	% NDs
Raw Statistics	23	0	23	11	12	52.17%

	Number	Minimum	Maximum	Mean	Median	SD
Statistics (Non-Detects Only)	12	0.15	0.3	0.163	0.15	0.0433
Statistics (Detects Only)	11	0.24	0.82	0.561	0.61	0.202
Statistics (All: NDs treated as DL value)	23	0.15	0.82	0.353	0.24	0.247
Statistics (All: NDs treated as DL/2 value)	23	0.075	0.82	0.311	0.15	0.281
Statistics (Normal ROS Estimated Data)	23	-0.359	0.82	0.273	0.24	0.339
Statistics (Gamma ROS Estimated Data)	23	0.178	0.82	0.565	0.61	0.191
Statistics (Lognormal ROS Estimated Data)	23	0.0818	0.82	0.363	0.254	0.241

ProUCL GOF Summary Statistics

Normal Distribution Test Results

	No NDs	NDs = DL	NDs = DL/2	Normal ROS
Correlation Coefficient R	0.963	0.892	0.894	0.985

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Shapiro-Wilks (Detects Only)	0.91	0.85	Data Appear Normal
Lilliefors (Detects Only)	0.233	0.267	Data Appear Normal
Shapiro-Wilks (NDs = DL)	0.779	0.914	Data Not Normal
Lilliefors (NDs = DL)	0.273	0.185	Data Not Normal
Shapiro-Wilks (NDs = DL/2)	0.781	0.914	Data Not Normal
Lilliefors (NDs = DL/2)	0.278	0.185	Data Not Normal
Shapiro-Wilks (Normal ROS Estimates)	0.959	0.914	Data Appear Normal
Lilliefors (Normal ROS Estimates)	0.145	0.185	Data Appear Normal

ProUCL GOF Summary Statistics

Gamma Distribution Test Results

	No NDs	NDs = DL	NDs = DL/2	Gamma ROS
Correlation Coefficient R	0.926	0.934	0.921	0.924

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Anderson-Darling (Detects Only)	0.636	0.731	
Kolmogorov-Smirnov (Detects Only)	0.273	0.256	Data appear Approximate Gamma Distribution
Anderson-Darling (NDs = DL)	2.1	0.753	
Kolmogorov-Smirnov (NDs = DL)	0.297	0.183	Data Not Gamma Distributed
Anderson-Darling (NDs = DL/2)	2.152	0.765	
Kolmogorov-Smirnov (NDs = DL/2)	0.305	0.186	Data Not Gamma Distributed
Anderson-Darling (Gamma ROS Estimates)	1.02	0.746	
Kolmogorov-Smirnov (Gamma ROS Est.)	0.22	0.182	Data Not Gamma Distributed

ProUCL GOF Summary Statistics

Lognormal Distribution Test Results

	No NDs	NDs = DL	NDs = DL/2	Log ROS
Correlation Coefficient R	0.937	0.899	0.892	0.977

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Shapiro-Wilks (Detects Only)	0.865	0.85	Data Appear Lognormal
Lilliefors (Detects Only)	0.28	0.267	Data Not Lognormal
Shapiro-Wilks (NDs = DL)	0.786	0.914	Data Not Lognormal
Lilliefors (NDs = DL)	0.297	0.185	Data Not Lognormal
Shapiro-Wilks (NDs = DL/2)	0.772	0.914	Data Not Lognormal
Lilliefors (NDs = DL/2)	0.306	0.185	Data Not Lognormal
Shapiro-Wilks (Lognormal ROS Estimates)	0.941	0.914	Data Appear Lognormal
Lilliefors (Lognormal ROS Estimates)	0.163	0.185	Data Appear Lognormal

Note: Substitution methods such as DL or DL/2 are not recommended.

Other Statistical Methods

- EPA Technical Support Document
  - Provides formulas for normal, lognormal, and delta-lognormal distribution
  - Provides lognormal statistical functions for one non-detect level (EPA delta-lognormal)
  - No accompanying software provided
- EPA's recent Effluent Guidelines (see previous slide (Guidance)
  - Provide lognormal statistical functions for multiple non-detect levels (EPA modified delta-lognormal)
  - No software provided

EPA Technical Support Document

- **<u>Chapter 3 Effluent Characterization</u>**

Page 53 Box 3-2: Determining Reasonable Potential for Excursions above Ambient Criteria Using Effluent Data Only

Step 1: Determine total number of valid data points and the highest value from the data set

Step 2: Determine Coefficient of Variation (CV) of data set or for less than 10 valid data points use default CV of 0.6

Step 3: Determine probability and confidence interval desired (99/99 or 95/95)

Step 4: Multiply <u>highest</u> effluent value by multiplier from Table 3-1 or 3-2. Use this new value and appropriate dilution to project a maximum receiving water concentration.

Step 5: Compare maximum receiving water with applicable WQS. EPA recommends permitting authorities find reasonable potential when the projected receiving water concentration exceeds the applicable WQS.

EPA Technical Support Document

- Provides lookup tables with "Reasonable Potential Multiplying Factors" for the 99% Confidence Level and 99% Probability Basis and the 95% Confidence Level and 95% Probability Basis

  (Page 54: Tables 3-1 and 3-2)

Table 3-1 TSD Page 54

Table 3-1. Reasonable Potential Multiplying Factors: 99% Confidence Level and 99% Probability Basis

Number of Samples	Coefficient of Variation																			
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
1	1.6	2.5	3.9	6.0	9.0	13.2	18.9	26.5	36.2	48.3	63.3	81.4	102.8	128.0	157.1	190.3	227.8	269.9	316.7	368.3
2	1.4	2.0	2.9	4.0	5.5	7.4	9.8	12.7	16.1	20.2	24.9	30.3	36.3	43.0	50.4	58.4	67.2	76.6	86.7	97.5
3	1.4	1.9	2.5	3.3	4.4	5.6	7.2	8.9	11.0	13.4	16.0	19.0	22.2	25.7	29.4	33.5	37.7	42.3	47.0	52.0
4	1.3	1.7	2.3	2.9	3.8	4.7	5.9	7.2	8.7	10.3	12.2	14.2	16.3	18.6	21.0	23.6	26.3	29.1	32.1	35.1
5	1.3	1.7	2.1	2.7	3.4	4.2	5.1	6.2	7.3	8.6	10.0	11.5	13.1	14.8	16.6	18.4	20.4	22.4	24.5	26.6
6	1.3	1.6	2.0	2.5	3.1	3.8	4.6	5.5	6.4	7.5	8.6	9.8	11.1	12.4	13.8	15.3	16.8	18.3	19.9	21.5
7	1.3	1.6	2.0	2.4	2.9	3.6	4.2	5.0	5.8	6.7	7.7	8.7	9.7	10.8	12.0	13.1	14.4	15.6	16.9	18.2
8	1.2	1.5	1.9	2.3	2.8	3.3	3.9	4.6	5.3	6.1	6.9	7.8	8.7	9.6	10.6	11.6	12.6	13.6	14.7	15.8
9	1.2	1.5	1.8	2.2	2.7	3.2	3.7	4.3	5.0	5.7	6.4	7.1	7.9	8.7	9.6	10.4	11.3	12.2	13.1	14.0
10	1.2	1.5	1.8	2.2	2.6	3.0	3.5	4.1	4.7	5.3	5.9	6.6	7.3	8.0	8.8	9.5	10.3	11.0	11.8	12.6
11	1.2	1.5	1.8	2.1	2.5	2.9	3.4	3.9	4.4	5.0	5.6	6.2	6.8	7.4	8.1	8.8	9.4	10.1	10.8	11.5
12	1.2	1.4	1.7	2.0	2.4	2.8	3.2	3.7	4.2	4.7	5.2	5.8	6.4	7.0	7.5	8.1	8.8	9.4	10.0	10.6
13	1.2	1.4	1.7	2.0	2.3	2.7	3.1	3.6	4.0	4.5	5.0	5.5	6.0	6.5	7.1	7.6	8.2	8.7	9.3	9.9
14	1.2	1.4	1.7	2.0	2.3	2.6	3.0	3.4	3.9	4.3	4.8	5.2	5.7	6.2	6.7	7.2	7.7	8.2	8.7	9.2
15	1.2	1.4	1.6	1.9	2.2	2.6	2.9	3.3	3.7	4.1	4.6	5.0	5.4	5.9	6.4	6.8	7.3	7.7	8.2	8.7
16	1.2	1.4	1.6	1.9	2.2	2.5	2.9	3.2	3.6	4.0	4.4	4.8	5.2	5.6	6.1	6.5	6.9	7.3	7.8	8.2
17	1.2	1.4	1.6	1.9	2.1	2.5	2.8	3.1	3.5	3.8	4.2	4.6	5.0	5.4	5.8	6.2	6.6	7.0	7.4	7.8
18	1.2	1.4	1.6	1.8	2.1	2.4	2.7	3.0	3.4	3.7	4.1	4.4	4.8	5.2	5.6	5.9	6.3	6.7	7.0	7.4
19	1.2	1.4	1.6	1.8	2.1	2.4	2.7	3.0	3.3	3.6	4.0	4.3	4.6	5.0	5.3	5.7	6.0	6.4	6.7	7.1
20	1.2	1.3	1.6	1.8	2.0	2.3	2.6	2.9	3.2	3.5	3.8	4.2	4.5	4.8	5.2	5.5	5.8	6.1	6.5	6.8

Table 3-2 TSD Page 54

Table 3-2. Reasonable Potential Multiplying Factors: 95% Confidence Level and 95% Probability Basis

Number of Samples	Coefficient of Variation																			
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
1	1.4	1.9	2.6	3.6	4.7	6.2	8.0	10.1	12.6	15.5	18.7	22.3	26.4	30.8	35.6	40.7	46.2	52.1	58.4	64.9
2	1.3	1.6	2.0	2.5	3.1	3.8	4.6	5.4	6.4	7.4	8.5	9.7	10.9	12.2	13.6	15.0	16.4	17.9	19.5	21.1
3	1.2	1.5	1.8	2.1	2.5	3.0	3.5	4.0	4.6	5.2	5.8	6.5	7.2	7.9	8.6	9.3	10.0	10.8	11.5	12.3
4	1.2	1.4	1.7	1.9	2.2	2.6	2.9	3.3	3.7	4.2	4.6	5.0	5.5	6.0	6.4	6.9	7.4	7.8	8.3	8.8
5	1.2	1.4	1.6	1.8	2.1	2.3	2.6	2.9	3.2	3.6	3.9	4.2	4.5	4.9	5.2	5.6	5.9	6.2	6.6	6.9
6	1.1	1.3	1.5	1.7	1.9	2.1	2.4	2.6	2.9	3.1	3.4	3.7	3.9	4.2	4.5	4.7	5.0	5.2	5.5	5.7
7	1.1	1.3	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.1	3.3	3.5	3.7	3.9	4.1	4.3	4.5	4.7	4.9
8	1.1	1.3	1.4	1.6	1.7	1.9	2.1	2.3	2.4	2.6	2.8	3.0	3.2	3.3	3.5	3.7	3.9	4.0	4.2	4.3
9	1.1	1.2	1.4	1.5	1.7	1.8	2.0	2.1	2.3	2.4	2.6	2.8	2.9	3.1	3.2	3.4	3.5	3.6	3.8	3.9
10	1.1	1.2	1.3	1.5	1.6	1.7	1.9	2.0	2.2	2.3	2.4	2.6	2.7	2.8	3.0	3.1	3.2	3.3	3.4	3.6
11	1.1	1.2	1.3	1.4	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	2.7	2.8	2.9	3.0	3.1	3.2	3.3
12	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.0
13	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.5	2.6	2.7	2.8	2.9
14	1.1	1.2	1.3	1.4	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.3	2.4	2.5	2.6	2.6	2.7
15	1.1	1.2	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.8	1.9	2.0	2.1	2.2	2.2	2.3	2.4	2.4	2.5	2.5
16	1.1	1.1	1.2	1.3	1.4	1.5	1.6	1.6	1.7	1.8	1.9	1.9	2.0	2.1	2.1	2.2	2.3	2.3	2.4	2.4
17	1.1	1.1	1.2	1.3	1.4	1.4	1.5	1.6	1.7	1.7	1.8	1.9	1.9	2.0	2.0	2.1	2.2	2.2	2.3	2.3
18	1.1	1.1	1.2	1.3	1.3	1.4	1.5	1.6	1.6	1.7	1.7	1.8	1.9	1.9	2.0	2.0	2.1	2.1	2.2	2.2
19	1.1	1.1	1.2	1.3	1.3	1.4	1.5	1.5	1.6	1.6	1.7	1.8	1.8	1.9	1.9	2.0	2.0	2.0	2.1	2.1
20	1.1	1.1	1.2	1.2	1.3	1.4	1.4	1.5	1.5	1.6	1.7	1.7	1.8	1.8	1.8	1.9	1.9	2.0	2.0	2.0

EPA Technical Support Document

- TSD Drawbacks
  - Assumes effluent data is lognormally distributed. This may not always be true especially for large data sets.
  - Chapter 3 tables show *only* 99% Probability and 99% Confidence Level and 95% Probability and 95% Confidence Level multiplication factors
  - Tables 3-1 and 3-2 limit number of samples to 20
  - Chapter 3 procedure does not account for Non-detected data in a data set. TSD Appendix E contains statistical formulas for delta-lognormal distribution which provides for one non-detect level.

Recent EPA Effluent Guidelines

- OCPSF (1987) Introduced Delta-lognormal distribution to calculate variability factors for Maximum Daily and Monthly Average ELG limits. Provides statistical distribution functions for detected data and for non-detected data at one detection level. (Used same distribution function as Appendix E of the TSD)

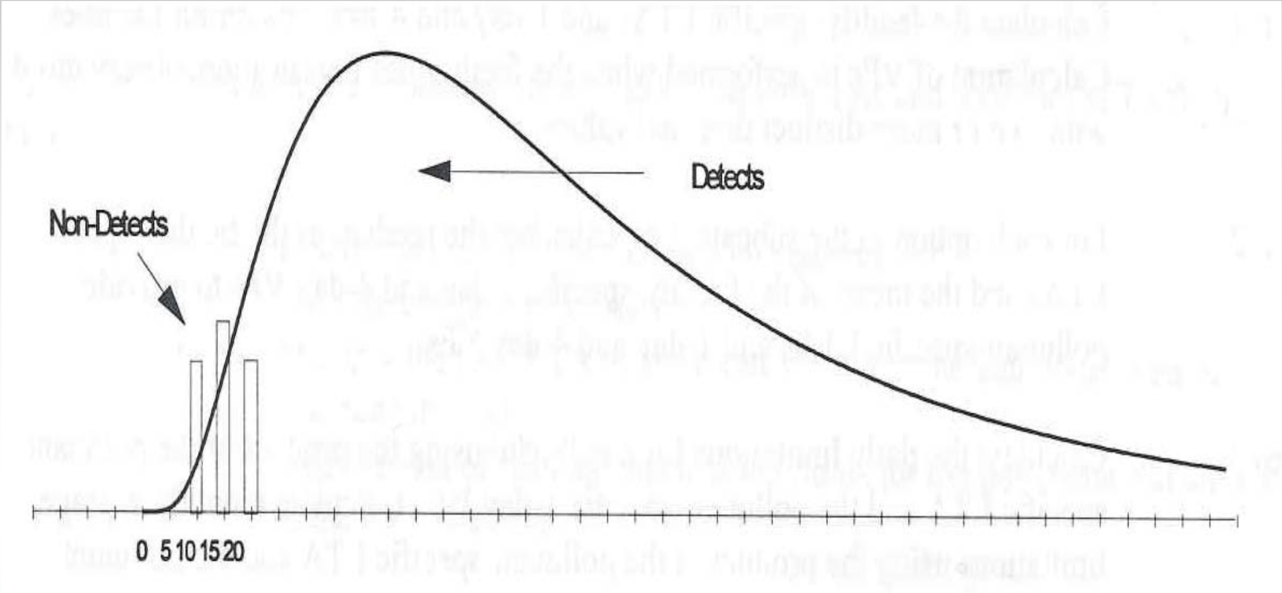
- 1990's and 2000"s: Centralized Waste Treatment (40 CFR 437), Aquaculture (40 CFR 451), Metal Products & Machinery (40 CFR 438), Meat and Poultry Products (40 CFR 432), etc. Introduced EPA's Modified Delta-lognormal distribution to calculate variability factors for Daily Maximum and Monthly Average ELG limits. Provides statistical distribution functions for detected data and multiple non-detection levels.

EPA Delta-lognormal Statistics

- Assumes lognormal distribution of all positive values (non-censored data)
- Assumes a discrete distribution of censored (non-detected) values that occur with a given probability (uses frequency of non-detected data within the entire data set)
- Was modified to accommodate multiple non-detect values. (modified delta-lognormal)
  - Assumes discreet distributions of multiple non-detected value(s) that occur with a given probability

EPA Delta-lognormal Statistics

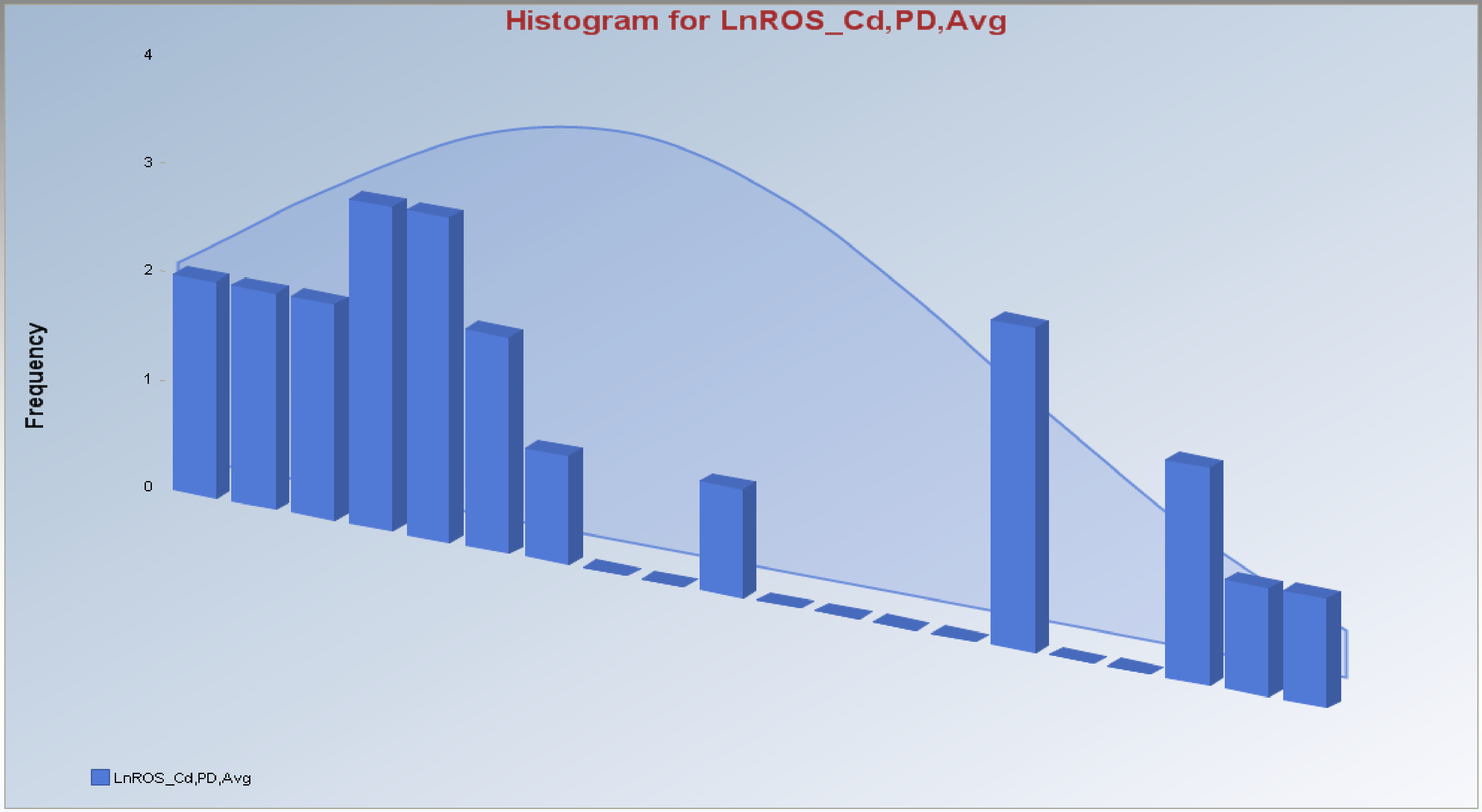
- Produces a similar distribution to the Lognormal ROS in ProUCL using simple substitution??



ProUCL LnROS ND data fill

Raw Data	LnROS Data
Leadville Mine Drainage Tunnel	Leadville Mine Drainage Tunnel
High Flow	High Flow
Cadmium, Potentially Dissolved, ug/L	Cadmium, Potentially Dissolved, ug/L
<0.15	0.08175
<0.15	0.10590
<0.15	0.12589
<0.15	0.14426
<0.15	0.16196
<0.15	0.17952
<0.15	0.19727
0.24	0.24
0.71	0.71
<0.15	0.21549
<0.15	0.23443
0.34	0.34
0.63	0.63
<0.15	0.25436
<0.15	0.27554
<0.3	0.19890
0.61	0.61
0.45	0.45
0.28	0.28
0.82	0.82
0.76	0.76
0.61	0.61
0.72	0.72

ProUCL LnROS Histogram



Summary of Statistical Tools

- ProUCL
  - Histograms
  - Regression Order Statistics (ROS) estimates for non-detected values
  - Outlier Tests
  - Goodness of Fit Tests w/Summary Statistics

- EPA TSD and ELGs
  - Formulas for Normal, Lognormal, and Delta-lognormal statistical distributions
  - Modified Delta-lognormal statistical distributions for data sets with multiple non-detected values
- Other States Guidance and Policies (Colorado, EPA Region 6, Oklahoma, Virginia, etc.

Reasonable Potential Procedure

- Excel based spreadsheeet (RP Procedure)
- Developed for RP for NPDES Permitting
- For data sets without non-detected data
  - Assumes data is lognormally distributed when number of valid detected data points is between 10 and 30
  - Assumes data is normally distributed when number of valid detected data points is 30 or greater
  - Uses default CV of 0.6 when less than 10 valid data points

Reasonable Potential Procedure

- For data sets with non-detected data
  - Assumes data is delta-lognormally distributed (calculates censored (non-detect) distribution and non-censored (detected) distribution and combines results.
  - Optional multiple reporting levels using modified delta-lognormal distribution functions

Reasonable Potential Procedure

- Corrects Excel calculations to reflect Significant Figures
  - Must enter significant figures in spreadsheet (based on limiting number of sig figs in data set)
  - Intermediate calculations are carried with one additional sig fig and final result is rounded to original sig fig value.

Calculates Maximum Projected Effluent Concentration (MEC) = 95% c.i., 95% probability of maximum reported effluent concentration or = 99%c.i./99%prob.

Reasonable Potential Procedure

- Calculates maximum projected effluent value at the 95/95 or 99/99 level of distribution
- Compare upper end projected effluent value with Local Limit
- If projected effluent value exceeds Local Limit, recommend that RP is found.
- If less than Local Limit, use discretion to require limit, monitoring, or possibly remove limit

References and Web Links

- The "TSD" EPA Technical Support Document for Water Quality Based Toxics Control EPA/505/2-90-001 March 1991, 2nd Printing
  - http://www.epa.gov/npdes/pubs/owm0264.pdf
- ProUCL (Free EPA Software)
  - http://www.epa.gov/esd/tsc/software.htm
- ELGs (Since 1987- delta-log procedures)
  - http://www.epa.gov/waterscience/guide/
- Reasonable Potential Procedure EXCEL Spreadsheet for Local Limits. Region 8 Pretreatment Webpage
  - http://epa.gov/region8/water/pretreatment/
- Data Quality Assessment: Statistical Methods for Practitioners EPA QA/G-9S, EPA/240/B-06/003 February 2006
  - http://www.epa.gov/quality/qa_docs.html
- R (or is it S in disguise?)