DEQ Reuse Toolbox

2013 Idaho Water Reuse Conference

May 15-16, 2013

DEQ Reuse Toolbox

State of Idaho
Department of Environmental Quality

Revised November 2012

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DEQ Toolbox

Purpose

- A directory of available "tools" for DEQ staff when conducting water reuse activities
- Promote the use of standardized tools and methods to promote Statewide consistency in reuse permitting activities
- Increase efficiency and streamline the permitting process

Types of Tools

- Modeling programs
- Technical resources (library, web)
- DEQ guidance

DEQ Guidance

- DEQ Guidance for Reclamation and Reuse of Municipal and Industrial Wastewater
  - Comprehensive guidance
  - Primary reference document used in developing reuse permits
  - Under development or being updated:
    - Reuse at forest sites
    - Rapid infiltration
    - Irrigation guidance
  - Guidance was developed by a technical work group consisting of consultants, the regulated community, and DEQ

Modeling Tools

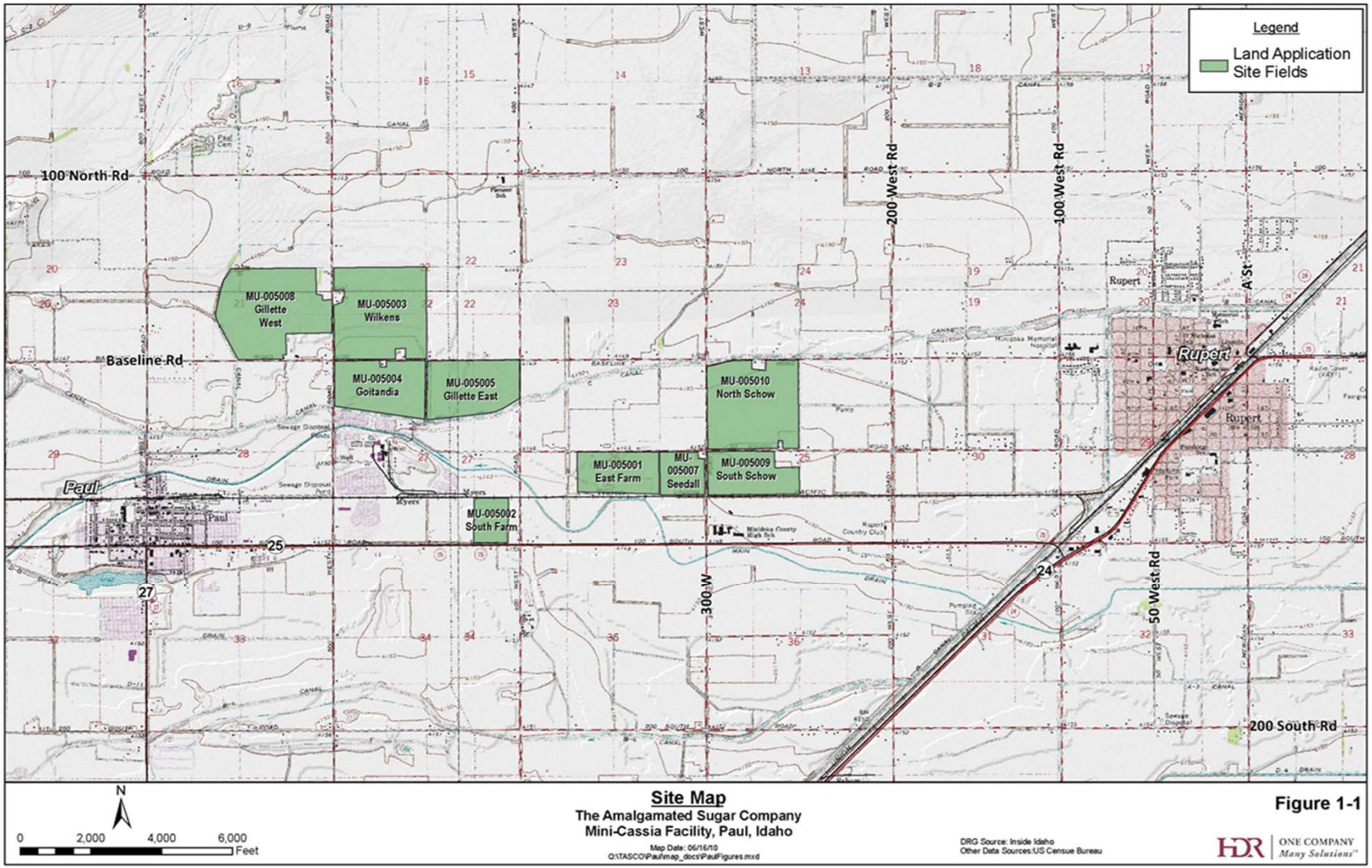
- Reuse System Modeling
  - Spreadsheet models and graphics that estimate ground water impacts from reuse activities
  - Two modules:
    - The nutrient and hydraulic balance module calculates the loss of constituents to ground water (percolate concentration and volume)
    - The ground water contaminant transport module calculates the down gradient ground water concentrations using input from the first module

Modeling Tools

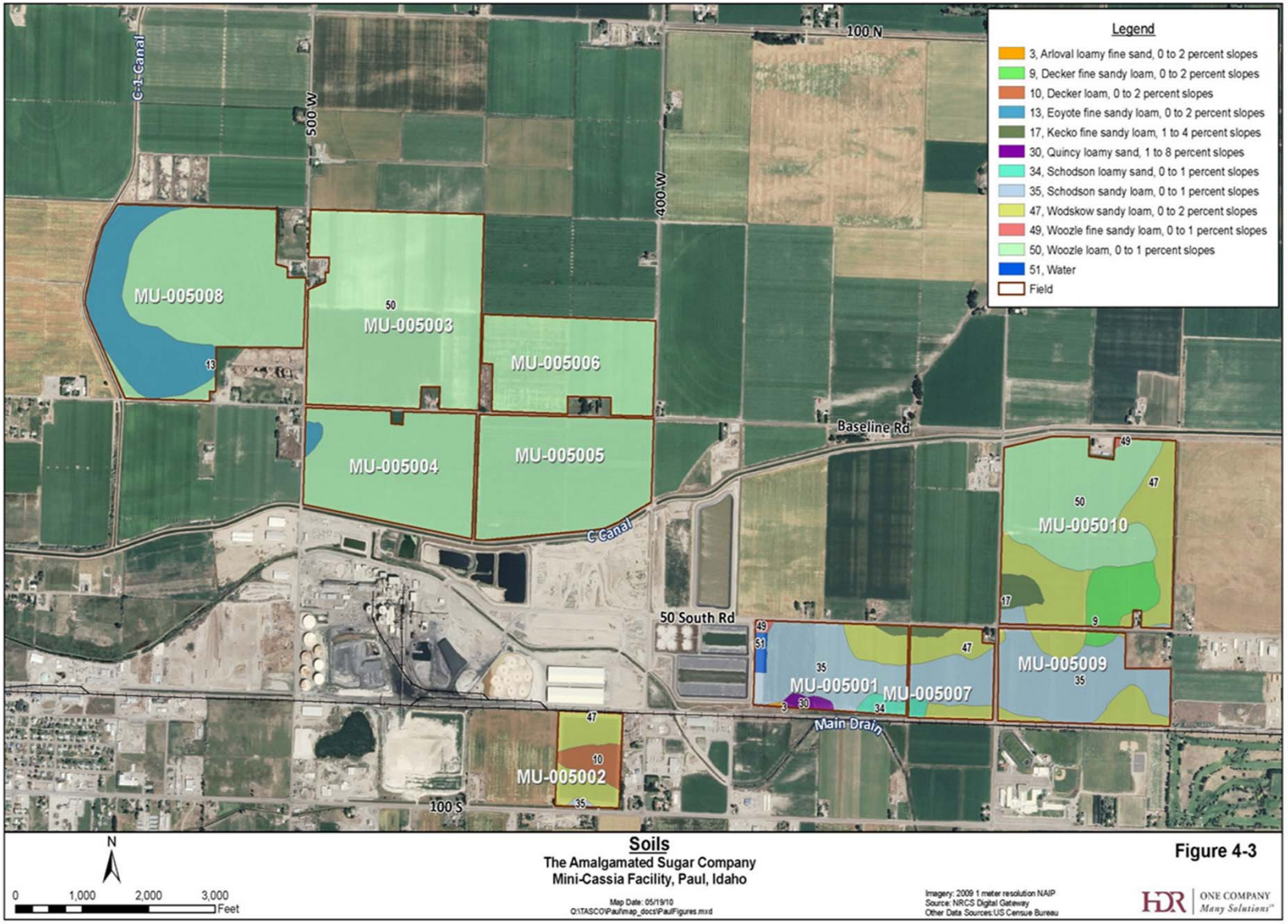
- Reuse System Modeling (continued)
  - Ground water modeling is based on an adaptation of the Domenico (1987) solution… one of the most popular analytical solutions used for modeling ground water contaminant transport
  - Used primarily for nitrogen and salt (NVDS) analysis
  - Developed in conjunction with the consulting and regulated community

Modeling Tools

- These models were recently used in developing permit limits for one of The Amalgamated Sugar Company facilities located near Paul, Idaho
- This facility was a good candidate for modeling… abundance of historical wastewater & ground water data and aquifer characteristics were defined
- Models were calibrated using this data
- Calibrated models were used to establish constituent (NVDS) loading rates for the reuse permit



The Amalgamated Sugar Company, Mini-Cassia Facility



Soils Mapping

Modeling Tools

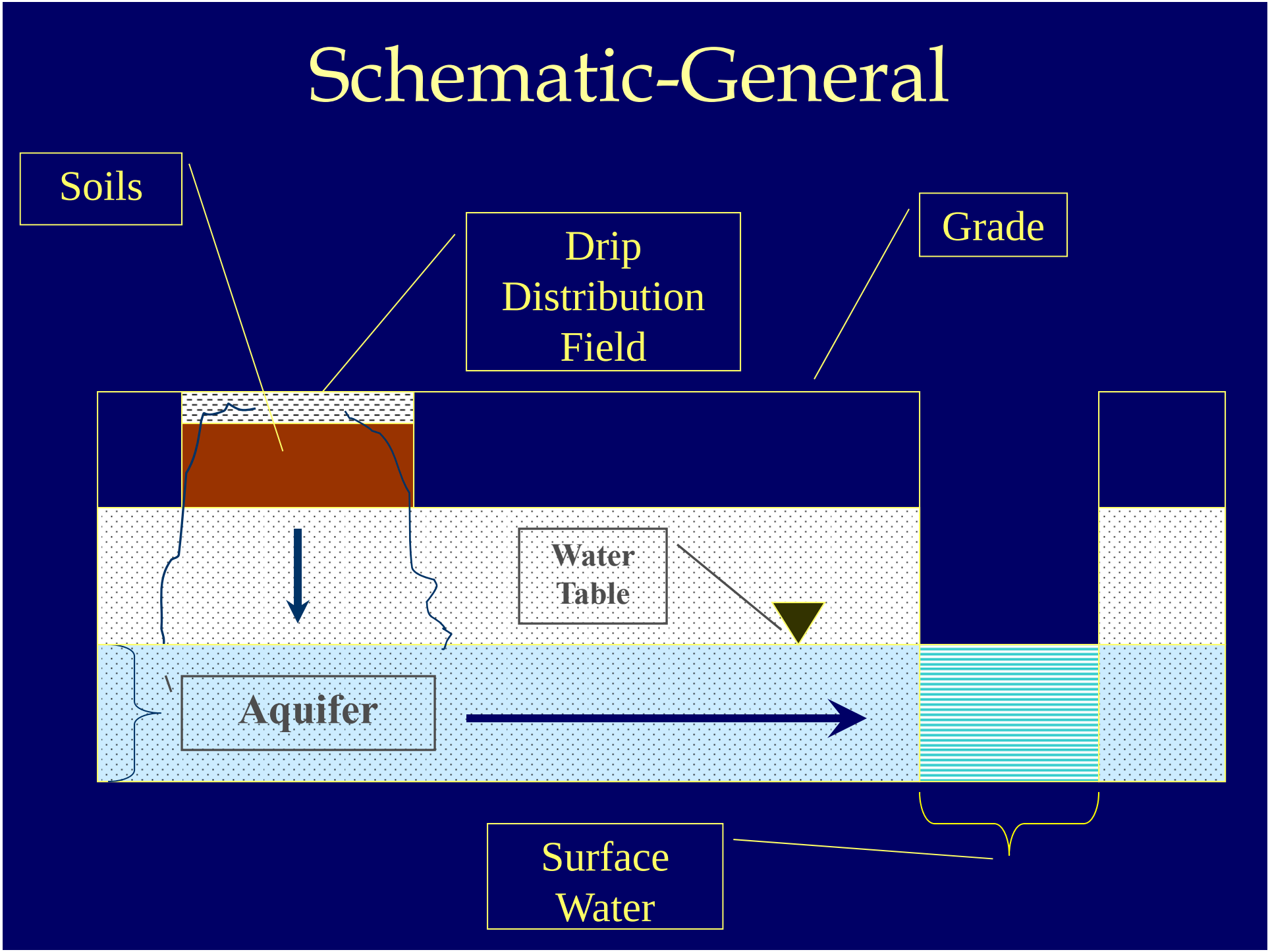
- The reuse system modeling tool is currently being expanded to address phosphorus
- Mike Cook from our State Technical Services Division

Department of Environmental Quality

Determining Setback Distances Between Drainfields and Surface Water

M. Cook, Soil Scientist
(Michael.Cook@deq.idaho.gov)

Schematic-General



Soil Sorption Sheet

Project Description ---->	General Model Development Copy

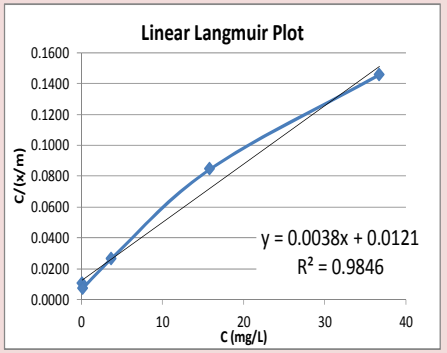
P Sorption Isotherm Data Entry — Date: 1/23/2012 15:01

Yellow Cells Only for Data Entry. All other Cells are Calculated.

Instructions: Enter Batch Analyses Data on the Left.
Then enter Intercept and Slope from Linear Trend Line to the right.

Horizon No. Horizon 1
Sample ID W.BAY_#1_18-2

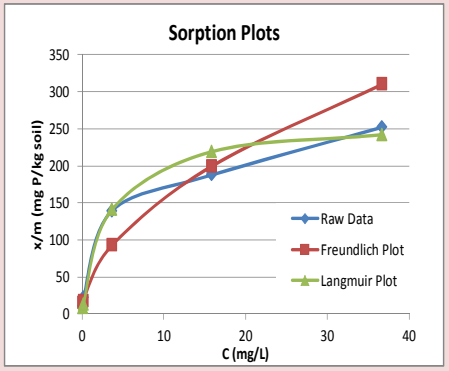
Batch	C(i)	C(eq)	x/m	log(x/m)	log(C)	C/(x/m)	KCb/(1+KC)	kC^b
1		0.079	-1.9	#NUM!	-1.10	-0.0416	6.37	12.34
2		0.11	10.37	1.015779	-0.95861	0.0106	8.7873	14.68
3		0.16	22	1.342423	-0.79588	0.0073	12.5905	17.87
4		3.66	139.2	2.143639	0.563481	0.0263	140.7259	92.43
5		15.84	187.46	2.272909	1.199755	0.0845	219.1114	199.47
6		36.75	252.2	2.401745	1.565257	0.1457	242.1746	310.28
7				#NUM!	#NUM!	0	0	0.00
8				#NUM!	#NUM!	0	0	0.00
9				#NUM!	#NUM!	0	0	0.00
10				#NUM!	#NUM!	0	0	0.00
11				#NUM!	#NUM!	0	0	0.00
12				#NUM!	#NUM!	0	0	0.00
13				#NUM!	#NUM!	0	0	0.00
14				#NUM!	#NUM!	0	0	0.00

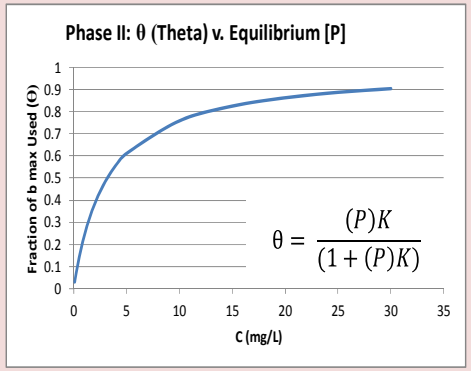


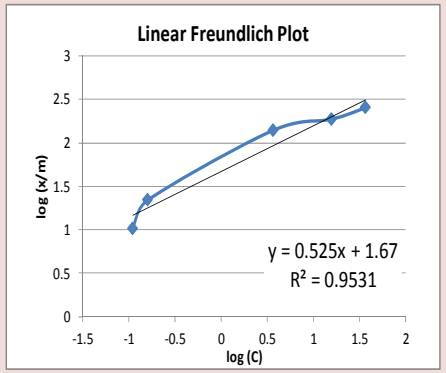
Langmuir	
Intercept =	0.0121
Slope =	0.0038
b =	263 mg/kg
K =	0.31405

$\frac{C}{x/m} = \frac{1}{Kb} + \frac{C}{b}$

slope = 1/b
intercept = 1/Kb







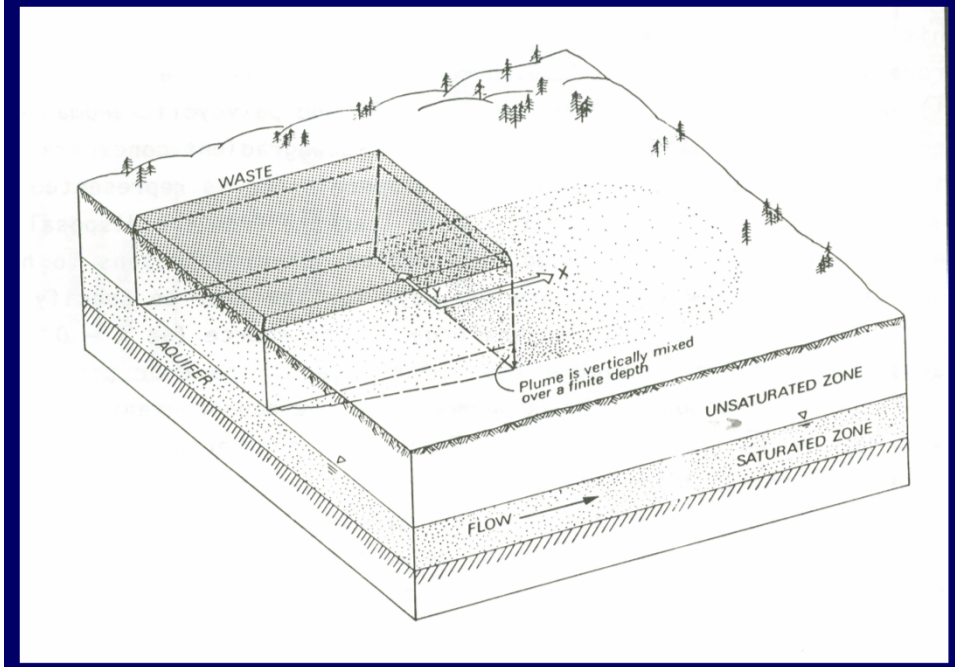
Freundlich	
Intercept =	1.67
Slope =	0.525
n =	1.90
k =	46.77

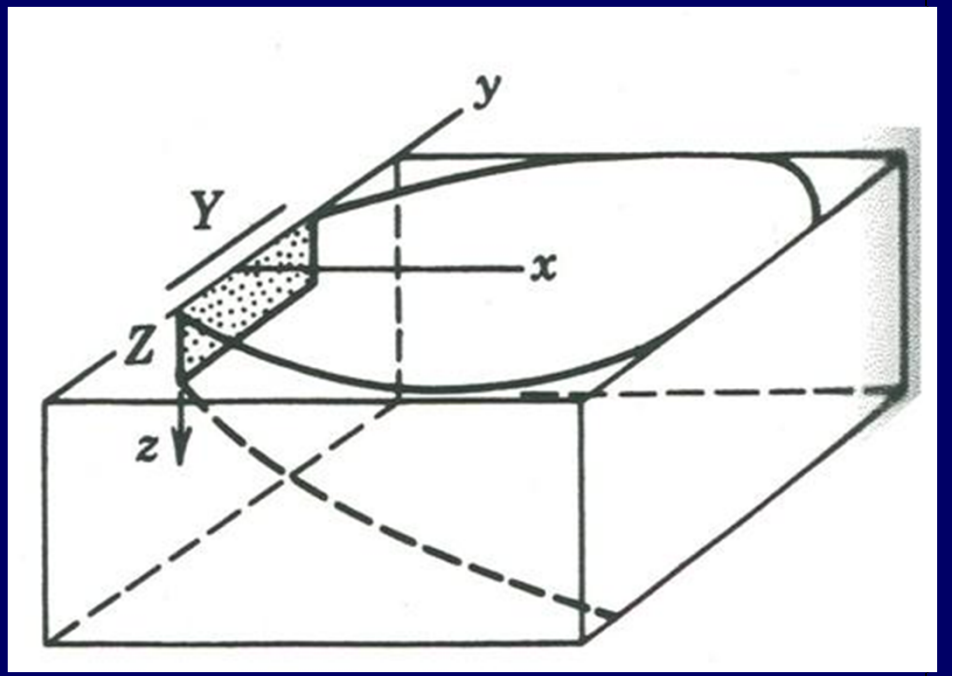
$x/m = kC^b = kC^{(1/n)}$

$\log(x/m) = \log(k) + (b)\log(C)$
$= \log(k) + (1/n)\log(C)$
slope = b = 1/n
intercept = log(k)

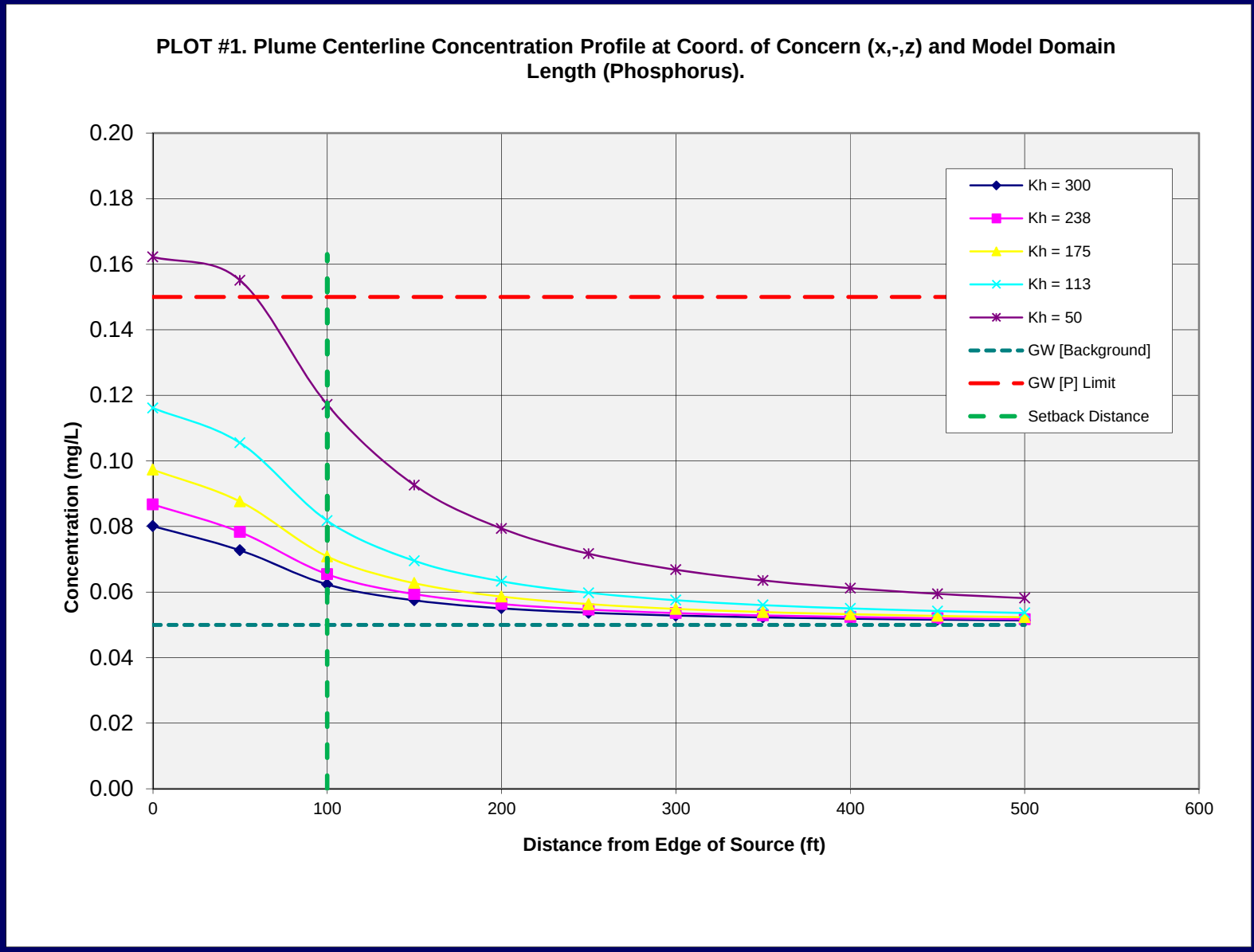
Determining P Dispersion/Diffusion

- Mixing Modeling: percolate and GW
- Domenico Equations as in NP Tool

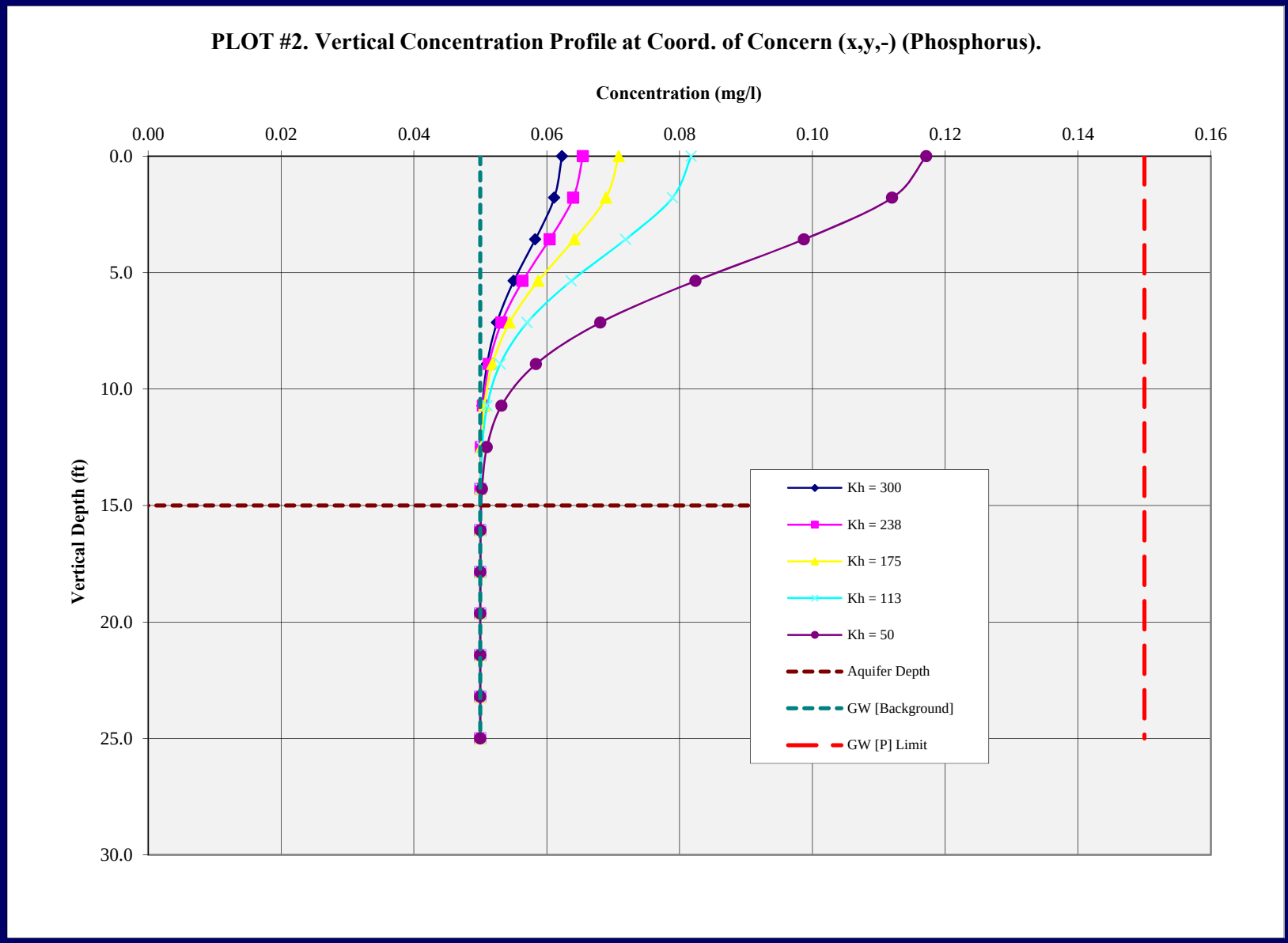




Ground Water Plume Centerline Concentration Plot



Ground Water Vertical Concentration Plot



Questions?

Other Modeling Tools

- Rapid infiltration excel spreadsheet
  - May be used for evaluating rapid infiltration systems
  - Calculates the ground water mounding beneath a rapid infiltration basin given various basin geometries, size, and loading rates
  - Incorporates the calculation methodology and associated 'nomographs' found in *EPA Process Design Manual for Land Treatment of Municipal Wastewater, 1981*

Other Modeling Tools

- WhAEM Software (Well Capture Zone Delineation) is a public domain program written by the USGS and used by EPA for source water assessments. May be used in the reuse program for delineating the capture zone of wells that may be impacted by reuse activities
- DEQ Microbial Risk Assessment Model – this model determines the transport of microbial constituents and the risk to potential receptors. May be used to establish buffer distances http://www.deq.idaho.gov/media/529643-microbial_risk_assessment.pdf

Other Modeling Tools

Microbial Risk Assessment Model Abstract

- "provides technical and scientific background necessary for making quantitative assessments of risk to human health from microbial constituents"
- "the fate and transport approach is largely based on EPA work (1982) with improvements made in aerosolization and dispersion & deposition modeling and in using the results to address human health impacts"

Other Modeling Tools

- Agricultural Research Service Irrigation Drift Model (Drift2) estimates the downwind drift and evaporation loss from a sprinkler system. May be used to establish buffer distances
- COD assimilative capacity – Carlisle and Phillips methodology for quantifying soil assimilative capacity for organic waste applied to land
  - Calculation methodology is in DEQ guidance section 4.4.18
  - Spreadsheet tool under development

Technical Resources (web)

- Soil Mapping - National Resource Conservation Service
  http://websoilsurvey.nrcs.usda.gov/app/
  - soil surveys are used to determine if the site may have limitations based on soil properties and topography
  - used to characterize the soil water holding capacity
- Ground Water Data – Idaho Department of Water Resources
  http://www.idwr.idaho.gov/water/well/ search.htm
  - May provide ground water quality data for wells in proximity of the reuse site

Technical Resources (web)

- Crop evapotranspiraton – ET Idaho and Agrimet http://data.kimberly.uidaho.edu/ETIdaho/ and http://www.usbr.gov/pn/agrimet/
  - Used to determine the amount of irrigation water required for the crops being grown
  - Agrimet includes weekly ET forecasts for various locations and crops
- Crop nutrient uptake http://plants.usda.gov/npk/main
  - Used to determine the amount of nutrient uptake for different crop types

Technical Resources (web)

- Idaho Climate Summaries http://www.wrcc.dri.edu/
  - Meteorological data for weather stations all over Idaho, website includes precipitation return frequency maps
- Flood Maps (Google FEMA flood maps)
  - Used to determine if reuse site is located in a flood plain
- University of Idaho Extension, College of Agriculture
  http://www.cals.uidaho.edu/edComm/catalog.asp
  - Catalog of fertilizer & irrigation guides and crop management techniques

Reuse Permitting

- Kaizen Process – Tom Rackow from our DEQ Idaho Falls Office