

Visualizing Environmental Data using GIS

A Presentation by:
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GeoEngineers, Inc.



Presentation Outline

- **ArcGIS Server Example**
- **ArcMap Desktop Example**
- **3D Example**
- **Other Examples**

Project Background

- A pulp mill operated from 1930 until 1997
- Contaminants
 - Petroleum hydrocarbons (hydraulic or fuel oil)
 - Polychlorinated biphenyls (PCBs) from electrical equipment
 - Lead from a lead-based mortar between bricks inside part of the mill
 - Dioxins and furans from ash.
 - Arsenic

Project Background

- **Problem: Needed a centralized way to view, query and assess existing environmental data.**
 - Site is under an Agreed Order with Ecology.
 - Our task Complete an Upland Remedial Investigation (RI) work plan

- **Solution: Web-based viewer via MS SharePoint**
 - Communicate and coordinate efficiently with all involved parties
 - Client, Internal (Project Managers, Staff) and Ecology

Data Challenges

- **Historic data collected from multiple consulting companies over 10 years.**
- **Good News – Consulting firm provided an EQUIS backup file**
- **Bad News – Data was in pretty bad shape**

ArcGIS - Map Viewer Demo

The screenshot shows a Windows Internet Explorer browser window displaying the GeoEngineers website. The address bar shows the URL: <https://clients.geoextranet.com/sites/0013701503/default.aspx?RootFolder=%2fsites%2f0013701503%2fdrafts%2fdue%20Diligence&FolderC>. The page title is "Home - Port Angeles Mill RI/FS Support".

The main content area displays "GeoEngineers Project Information" for Project ID: 00137-015-03. It lists two project managers:

- Rob Leet**, Project Manager | GeoEngineers, Inc.
Telephone: (206) 239-3230
Fax: (206) 728-2732
Mobile: (206) 850-2351
Email: rleet@geoengineers.com
- Kurt S. Anderson**, Principal | GeoEngineers, Inc.
Telephone: (425) 861-6077
Fax: (425) 861-6050
Mobile: (206) 406-9773
Email: kanderson@geoengineers.com

Below the contact information, there are two tables under the heading "PROJECT DELIVERABLES":

Finals

Type	Name	Modified By
Folder	Weekly Status Reports	Gianna Malo
Document	Signed AO Support FE	Gianna Malo

Drafts

Type	Name	Modified By
Folder	May 5 2010 Figures	Rob Leet
Folder	May 4 2010 Figures	Kurt S. Anderson
Folder	WWTP Area	Rob Leet
Document	Quantities and Major Assumptions - Anderson Comments	Rob Leet

On the right side of the page, there is a "Links" section with a dropdown arrow. Below it, there is a "Click Here for Help" button with a question mark icon. Further down, there is a "Requirements" section listing:

- Internet Explorer 7.0 or Higher -
- Adobe Flash Player -

A red arrow points to the "Interactive Map Viewer" button, which is highlighted with a yellow border.

Map Viewer Demo

http://gis.geoengineers.com/rayonier_silverlight/index.aspx

Rayonier File Tools Help

PORT ANGELES HARBOR

Map Layers

- PCB exceedances in Groundwater
- PCB exceedances in Groundwater
- Ammonia exceedances in Groundwater
- Ammonia exceedances in Groundwater
- Interim Action Areas
- Finishing_Room
- Fuel_Tank_No2
- Hog_Fuel_Pile
- Machine_Shop
- SSL_Lagoon
- ExcavationLimits(2006 Interim Action
- Known Above Ground Piping

Map Navigation: + - Hand Left Arrow Right Arrow Globe

Map Labels: Main Process Area, Log Yard, BLUFF, Chlorine Dioxide Generator, Primary Clarifier, Fire-Fab Area, Secondary Treatment, Drainage Ditch, Bank Yard, BLUFF

Query Tool

MATRIX	ANALYTE GROUP	SCREENING LEVEL	DEPTH	RESULTS
CLEAR DATA		EXPORT DATA		Results: 29 Items
METALS	Lead	DB02SS	DB02	0 FEET 0.25 FEET
METALS	Antimony	DB02SS	DB02	0 FEET 0.25 FEET
METALS	Arsenic	DB02SS	DB02	0 FEET 0.25 FEET

Record: << < 0 > >> Records (0 out of 29 Selected) Options...

554 Feet

How Do You Do That?

Views created in SQL Management Studio Express

The screenshot displays the Microsoft SQL Server Management Studio interface. The Object Explorer on the left shows a database structure with various tables and views. The main window shows the definition of the view `vw_GEI_CONVERTED_ACTIONLEVELS...` and its relationship to the table `vw_GEI_GIS_ALL_DATA`. The view definition includes columns such as `action_level_code`, `action_level`, `warning_level`, `unit`, `ebatch`, `remark`, `max_yn`, `matrix`, `facility_id`, `cas_rn`, and `subfacility_code`.

The view definition is shown in the following table:

Column	Alias	Table	Output	Sort Type	Sort Order	Filter
sys_sample_co...		vw_GEI_GIS_ALL_DATA (dbo)	<input checked="" type="checkbox"/>			
sample_name	SAMPLE	vw_GEI_GIS_ALL_DATA (dbo)	<input checked="" type="checkbox"/>	Ascending	1	
sys_loc_code	LOCATION	vw_GEI_GIS_ALL_DATA (dbo)	<input checked="" type="checkbox"/>	Ascending	2	

The view definition is also shown in the following SQL query:

```
SELECT TOP (100) PERCENT dbo.vw_GEI_GIS_ALL_DATA.sys_sample_code, dbo.vw_GEI_GIS_ALL_DATA.sample_name AS SAMPLE,
dbo.vw_GEI_GIS_ALL_DATA.sys_loc_code AS LOCATION, dbo.vw_GEI_GIS_ALL_DATA.method_analyte_group_code AS ANALYTE_GROUP,
dbo.vw_GEI_GIS_ALL_DATA.chemical_name AS ANALYTE, dbo.vw_GEI_GIS_ALL_DATA.CONVERTED AS RESULT,
dbo.vw_GEI_GIS_ALL_DATA.target_unit AS UNIT, dbo.vw_GEI_GIS_ALL_DATA.lab_qualifiers AS QUALIFIER,
dbo.vw_GEI_GIS_ALL_DATA.start_depth, dbo.vw_GEI_GIS_ALL_DATA.end_depth, dbo.vw_GEI_GIS_ALL_DATA.depth_unit,
```

The results of the view are shown in the following table:

sys sample code	SAMPLE	LOCATION	ANALYTE GROUP	ANALYTE	RESULT	UNIT	QUALIFIER
01-14633-DN28A	01-14633-DN...	PZ-11	BTEX	Toluene	0.000200000009	mg/l	U
01-14633-DN28A	01-14633-DN...	PZ-11	BTEX	Xylenes	0.0006	mg/l	U
01-14633-DN28A	01-14633-DN...	PZ-11	BTEX	Benzene	0.000200000009	mg/l	U
01-14633-DN28A	01-14633-DN...	PZ-11	BTEX	Ethylbenzene	0.000200000009	mg/l	U
01-14633-DN28A	01-14633-DN...	PZ-11	CPAH	Benzo(a)pyrene	0.1	ug/l	U
01-14633-DN28A	01-14633-DN...	PZ-11	METALS	Lead	0.002	MG/L	NULL
01-14633-DN28A	01-14633-DN...	PZ-11	METALS	Nickel	0.0115	MG/L	###

The status bar at the bottom indicates "Ready" and "1 of 4415" records.

How Do You Do That?

ODBC connection through ArcCatalog (ArcGIS)

The screenshot shows the ArcCatalog interface with the following details:

- Title Bar:** ArcCatalog - ArcInfo - Database Connections\PA_MILL.odc
- Location:** Database Connections\PA_MILL.odc
- Menu Bar:** File Edit View Go Tools Window Help
- Stylesheet:** FGDC ESRI
- Conversion Tools:** CACHED
- Left Pane (Database Connections):**
 - Add OLE DB Connection
 - Add Spatial Database Connection
 - arcims_project_loc.sde
 - BNSF Smelter.odc
 - BNSF_AuburnRailYard.odc
 - CityofOlympia.odc
 - Crystal Mountain.odc
 - dahp.sde
 - DAHP_ADMIN.sde
 - DAHP_GLO.odc
 - DAHP_MASTER_SA1.odc
 - DAHP_MASTER_SA2.odc
 - DAHP_MASTER_SA3.odc
 - DAHP_MASTER_SA4.odc
 - DAHP_MASTER_SA5.odc
 - DAHP_MASTER_SA6.odc
 - DAHP_MASTER_SA7.odc
 - DAHP_MASTER_SA8.odc
 - DAHP_MASTER_SA9.odc
 - East Bay Olympia.odc
 - EQUIS5_ACCESS.odc
 - EQUIS_CARTMAN.odc
 - EQUIS_MASTER.odc
 - EQUIS_MASTER_BCK.odc
 - EQUIS_REDMOND.odc
 - GEIBase Admin.sde
 - GISTESTING_ADMIN.sde
 - OLE DB Connection.odc
 - PA_MILL.odc
 - pamill_spatial_admin.sde
 - Portland Harbor.odc
- Main Pane (Contents):**

Name	Type
dbo.st_notice_template	Microsoft SQL Server Table
dbo.st_report	Microsoft SQL Server Table
dbo.st_report_event	Microsoft SQL Server Table
dbo.st_report_event_job	Microsoft SQL Server Table
dbo.st_report_parameter	Microsoft SQL Server Table
dbo.st_report_task	Microsoft SQL Server Table
dbo.st_report_type	Microsoft SQL Server Table
dbo.st_report_use	Microsoft SQL Server Table
dbo.st_role	Microsoft SQL Server Table
dbo.st_service_reservation	Microsoft SQL Server Table
dbo.st_task	Microsoft SQL Server Table
dbo.st_user	Microsoft SQL Server Table
dbo.st_user_facility	Microsoft SQL Server Table
dbo.st_user_notice	Microsoft SQL Server Table
dbo.st_user_report	Microsoft SQL Server Table
dbo.st_user_report_parameter	Microsoft SQL Server Table
dbo.st_user_role	Microsoft SQL Server Table
dbo.st_version	Microsoft SQL Server Table
dbo.vw_ANALYTE_GROUP_DESCRIPTIONS	Microsoft SQL Server Table
dbo.vw_Analytes	Microsoft SQL Server Table
dbo.vw_coord_non_numeric	Microsoft SQL Server Table
dbo.vw_downhole_data	Microsoft SQL Server Table
dbo.vw_GEI_CONVERTED_ACTIONLEVELS	Microsoft SQL Server Table
dbo.vw_GEI_GIS_ALL_DATA	Microsoft SQL Server Table
dbo.vw_GEI_GIS_EXCEED_CUL	Microsoft SQL Server Table
dbo.vw_GEI_GIS_SAMPLES	Microsoft SQL Server Table
dbo.vw_GEI_LOCATION	Microsoft SQL Server Table
dbo.vw_lithology	Microsoft SQL Server Table
dbo.vw_location	Microsoft SQL Server Table
dbo.vw_MATRIX_DESCRIPTIONS	Microsoft SQL Server Table
dbo.vw_SCREENING_LEVEL_LIST	Microsoft SQL Server Table
dbo.vw_table_row_count	Microsoft SQL Server Table
dbo.vw_tkauhi_test	Microsoft SQL Server Table
dbo.vw_well	Microsoft SQL Server Table
dbo.vw_well_segment	Microsoft SQL Server Table

Directly connecting to EQUIS db

Microsoft SQL Server Table selected

How Do You Do That?

Created an Event Theme within ArcMap

The image shows two overlapping 'Add Data' dialog boxes in ArcMap. The top dialog is open to 'Database Connections' and lists various .odc files. A red box highlights 'PA_MILL.odc'. A red arrow points from this box to the bottom dialog. The bottom dialog is open to 'PA_MILL.odc' and lists various database views. A red box highlights 'dbo.vw_GEI_GIS_EXCEED_CUL'. The 'Name' field at the bottom of the second dialog contains 'dbo.vw_GEI_GIS_EXCEED_CUL'.

Top Dialog: Add Data

Look in: Database Connections

- DAHP_MASTER_SA2.odc
- DAHP_MASTER_SA3.odc
- DAHP_MASTER_SA4.odc
- DAHP_MASTER_SA5.odc
- DAHP_MASTER_SA6.odc
- DAHP_MASTER_SA7.odc
- DAHP_MASTER_SA8.odc
- DAHP_MASTER_SA9.odc
- East Bay Olympia.odc
- EQUIS5_ACCESS.odc
- EQUIS_CARTMAN.odc
- EQUIS_MASTER.odc
- EQUIS_MASTER_BCK.odc
- EQUIS_REDMOND.odc
- GEIBase Admin.sde
- GISTESTING_ADMIN.sde
- OLE DB Connection.odc
- PA_MILL.odc
- pamill_spatial_admin.sde
- Portland Harbor
- Project Location
- PSE_Projects.sde
- PSE_Spills.odc
- Ridgeline.sde
- Spokane_NPS.o
- sustone_window
- TacomaRailYard
- Williams_Confide
- Williams_PCGP.s

Name: PA_MILL.odc

Show of type: Datasets and Layers (*.lyr)

Bottom Dialog: Add Data

Look in: PA_MILL.odc

- dbo.st_user
- dbo.st_user_facility
- dbo.st_user_notice
- dbo.st_user_report
- dbo.st_user_report_parameter
- dbo.st_user_role
- dbo.st_version
- dbo.vw_ANALYTE_GROUP_DESCRIPTIONS
- dbo.vw_Analytes
- dbo.vw_coord_non_numeric
- dbo.vw_downhole_data
- dbo.vw_GEI_CONVERTED_ACTIONLEVELS
- dbo.vw_GEI_GIS_ALL_DATA
- dbo.vw_GEI_GIS_EXCEED_CUL
- dbo.vw_GEI_GIS_SAMPLES
- dbo.vw_GEI_LOCATION
- dbo.vw_lithology
- dbo.vw_location
- dbo.vw_MATRIX_DESCRIPTIONS
- dbo.vw_SCREENING_LEVEL_LIST
- dbo.vw_table_row_count
- dbo.vw_tkauhi_test

Name: dbo.vw_GEI_GIS_EXCEED_CUL

Show of type: Datasets and Layers (*.lyr)

Buttons: Add, Cancel

How Do You Do That?

Created an Event Theme within ArcMap

Untitled - ArcMap - ArcView

File Edit View Bookmarks Insert Selection Tools Window Help

Editor Task: Create New Feature Target: 500 Georeferencing Layer: Spatial Analyst Layer:

Layers

- ARCSD01
- dbo.vw_GEI_GIS_EXCEED_CUL

Open

Joins and Relates

Remove

Data

Geocode Addresses...

Display Route Events...

Display XY Data ...

Properties...

EventTheme.mxd - ArcMap - ArcView

File Edit View Bookmarks Insert Selection Tools Window Help

Editor Task: Create New Feature Target: 500 Georeferencing Layer: Spatial Analyst Layer:

Layers

- ARCSD01
- dbo.vw_GEI_GIS_EXCEED_CUL

Display XY Data

A table containing X and Y coordinate data can be added to the map as a layer

Choose a table from the map or browse for another table:

dbo.vw_GEI_GIS_EXCEED_CUL

Specify the fields for the X and Y coordinates:

X Field: EASTING

Y Field: RESULT

Coordinate System: EASTING NORTHING

Description: Unknown Coordinate System

Warn me if the resulting layer will have restricted functionality

OK Cancel

start

Start

Microsoft Power...

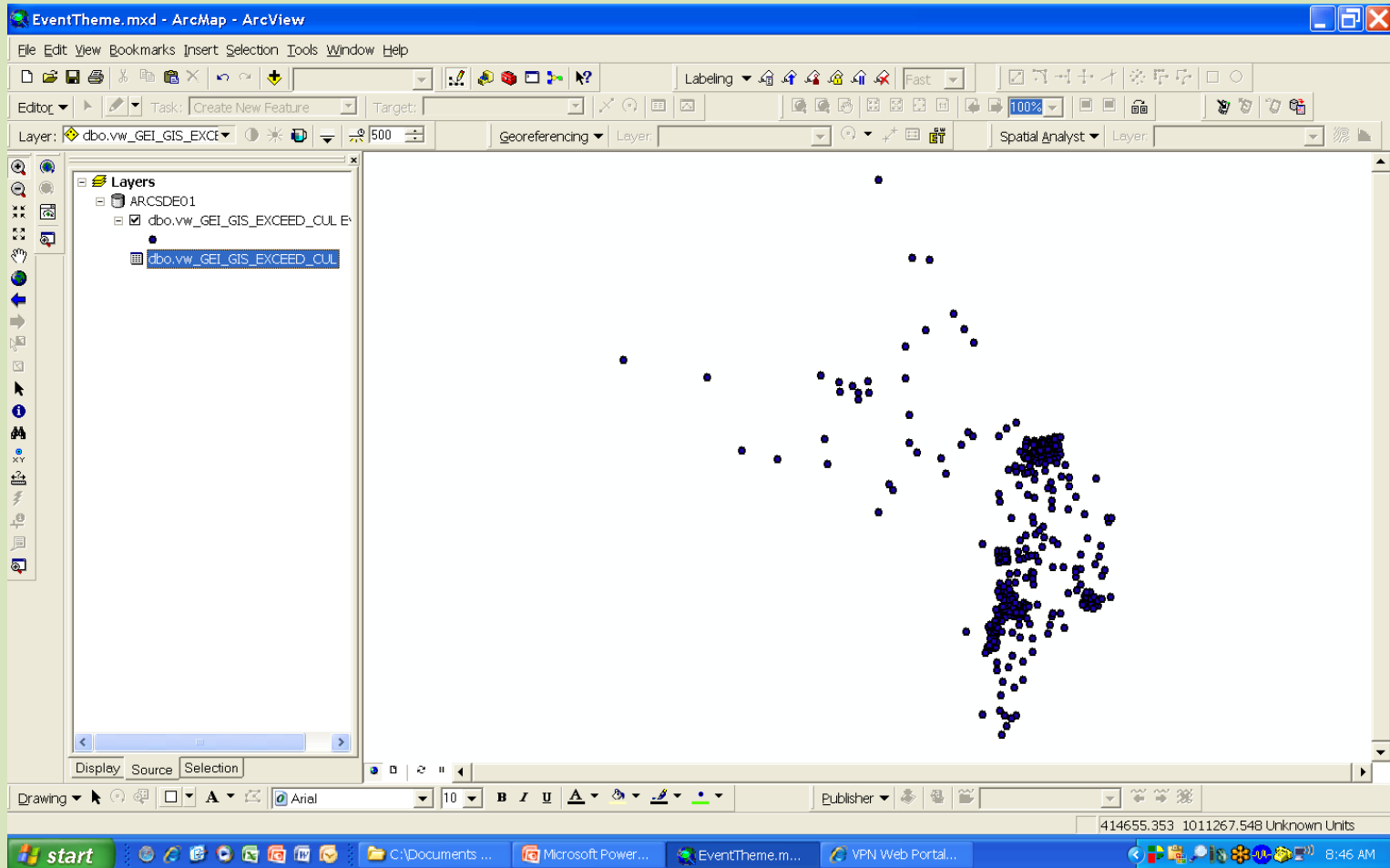
EventTheme.m...

VPN Web Portal...

8:39 AM

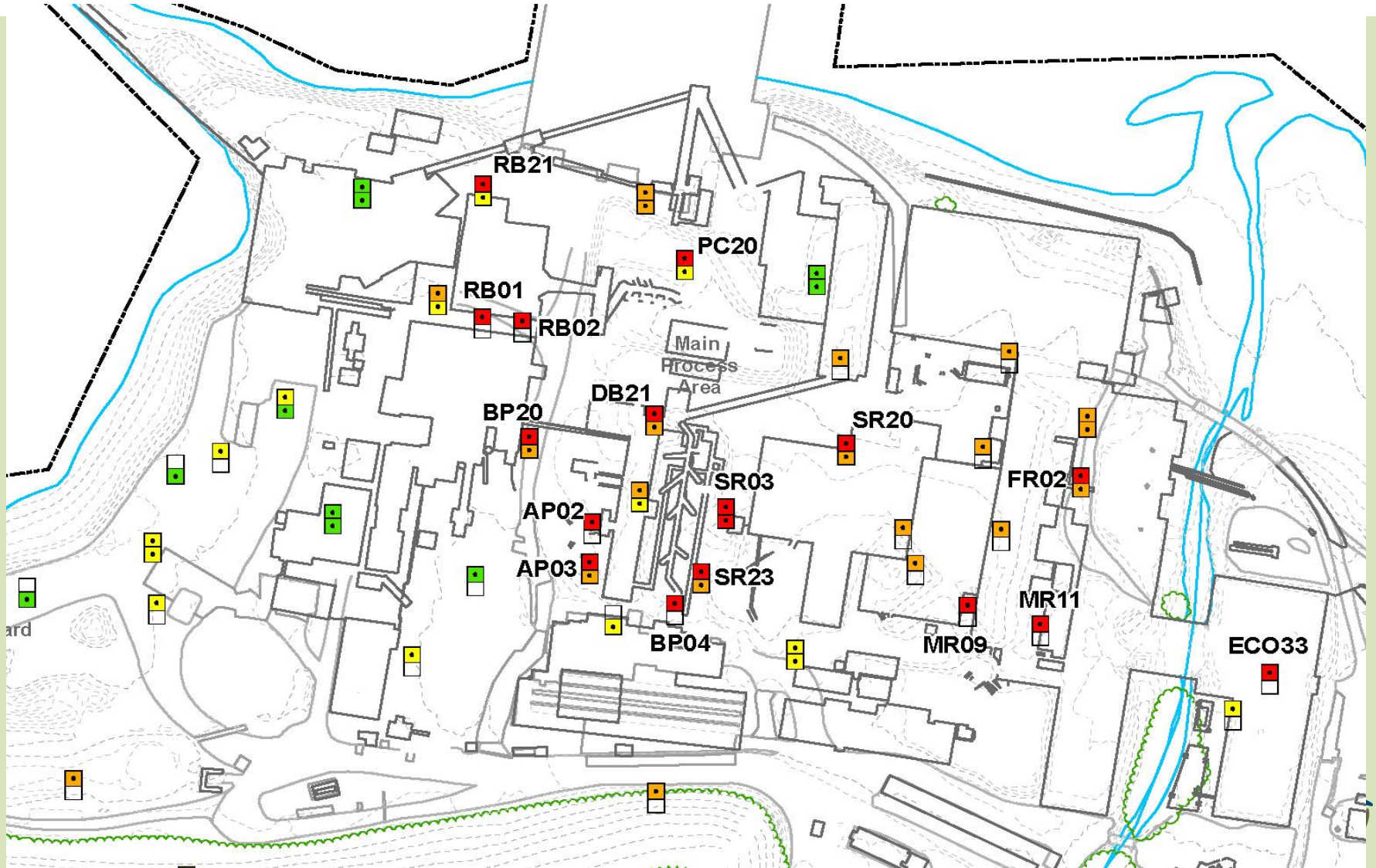
How Do You Do That?

Created an Event Theme within ArcMap



All GIS data stored on ArcSDE

ArcGIS Desktop Example “Lego” diagrams

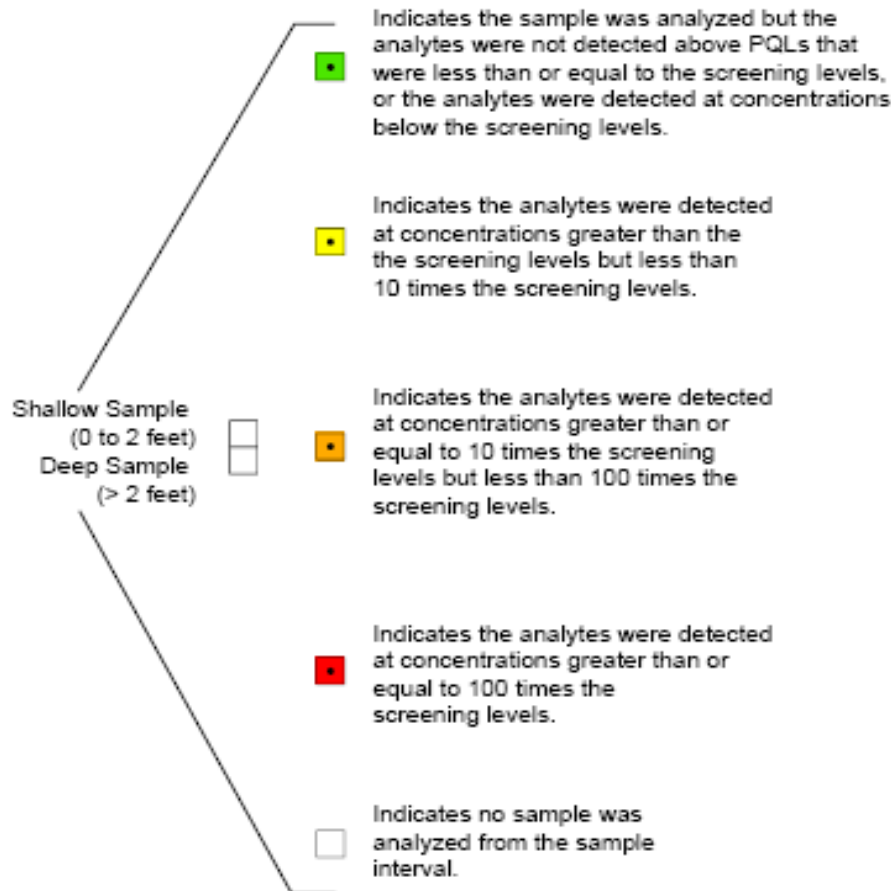


ArcGIS Desktop Example “Lego” diagrams

Explanation

Total Petroleum Hydrocarbon Concentrations in Soil

(Highest ratio of detected concentrations to screening levels at each sample location determines symbol color)



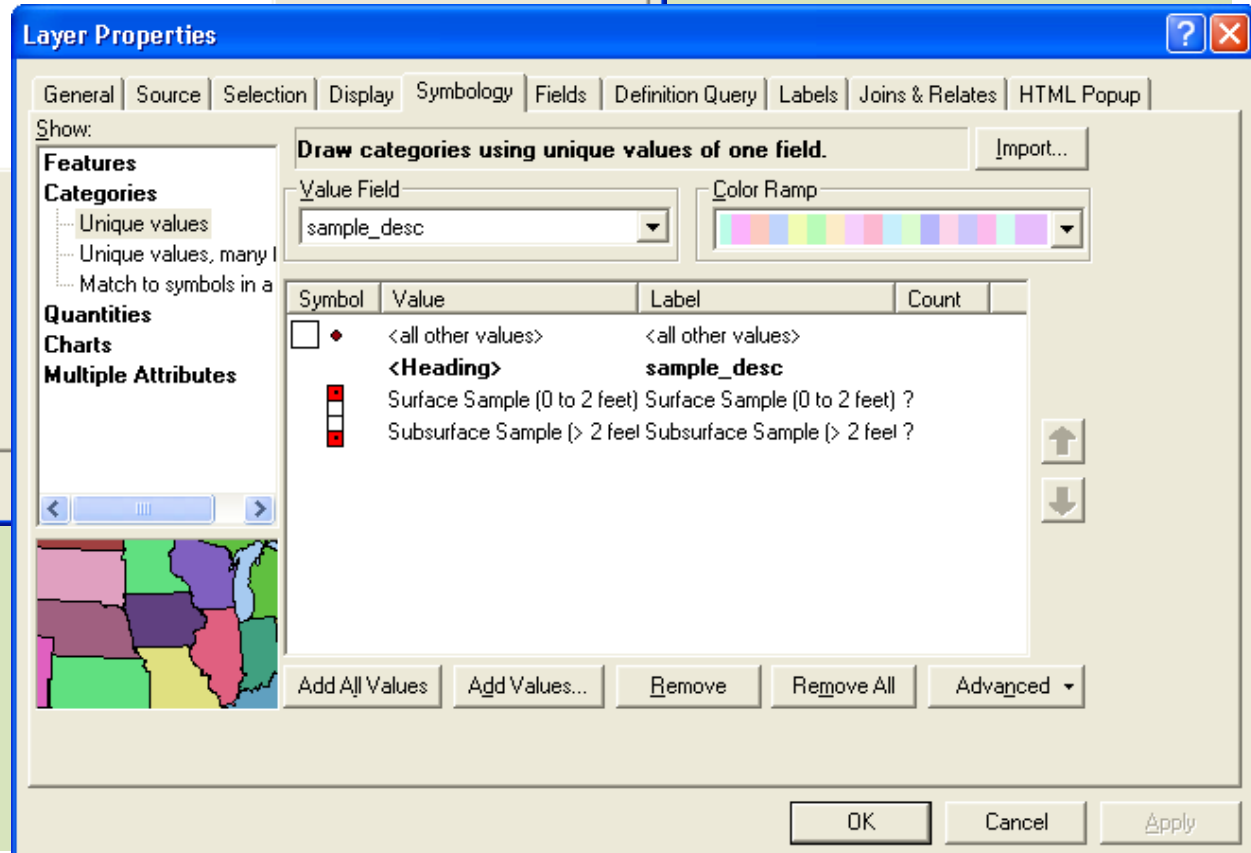
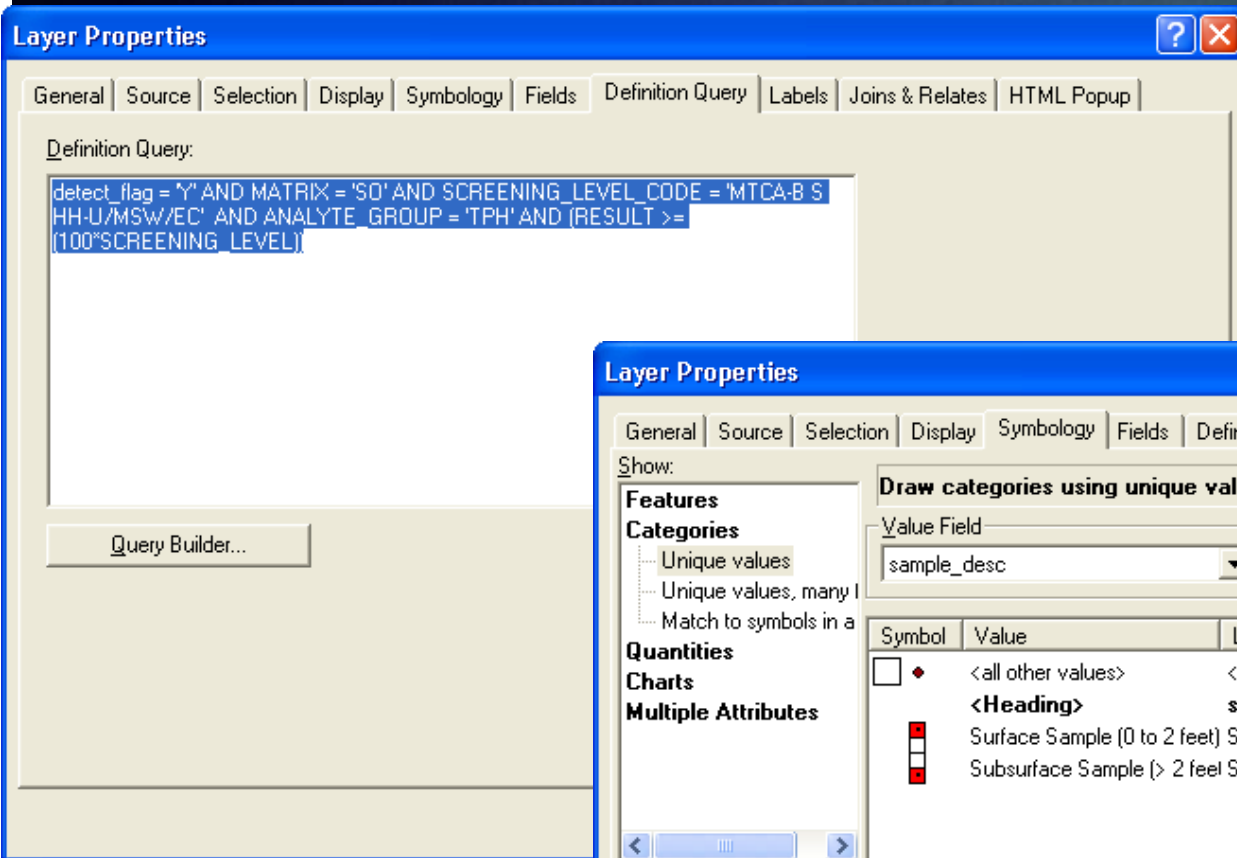
In one graphic
we are showing
7 pieces of
information

How Do You Do That?

- Chemical Data
 - TPH Exceedance in Soil (Result $\geq 100 \times SL$)
 - sample_desc
 - Surface Sample (0 to 2 feet)
 - Subsurface Sample (> 2 feet)
 - TPH Exceedance in Soil ($100 \times SL > RES \geq 10 \times SL$)
 - sample_desc
 - Surface Sample (0 to 2 feet)
 - Subsurface Sample (> 2 feet)
 - TPH Exceedance in Soil ($10 \times SL > RES > SL$)
 - sample_desc
 - Surface Sample (0 to 2 feet)
 - Subsurface Sample (> 2 feet)
 - No TPH Exceedance in Soil
 - sample_desc
 - Surface Sample (0 to 2 feet)
 - Subsurface Sample (> 2 feet)

From one SQL View complete definition queries within ArcMap to show different information

How Do You Do That?



ArcGIS Desktop Example “Lego” diagrams

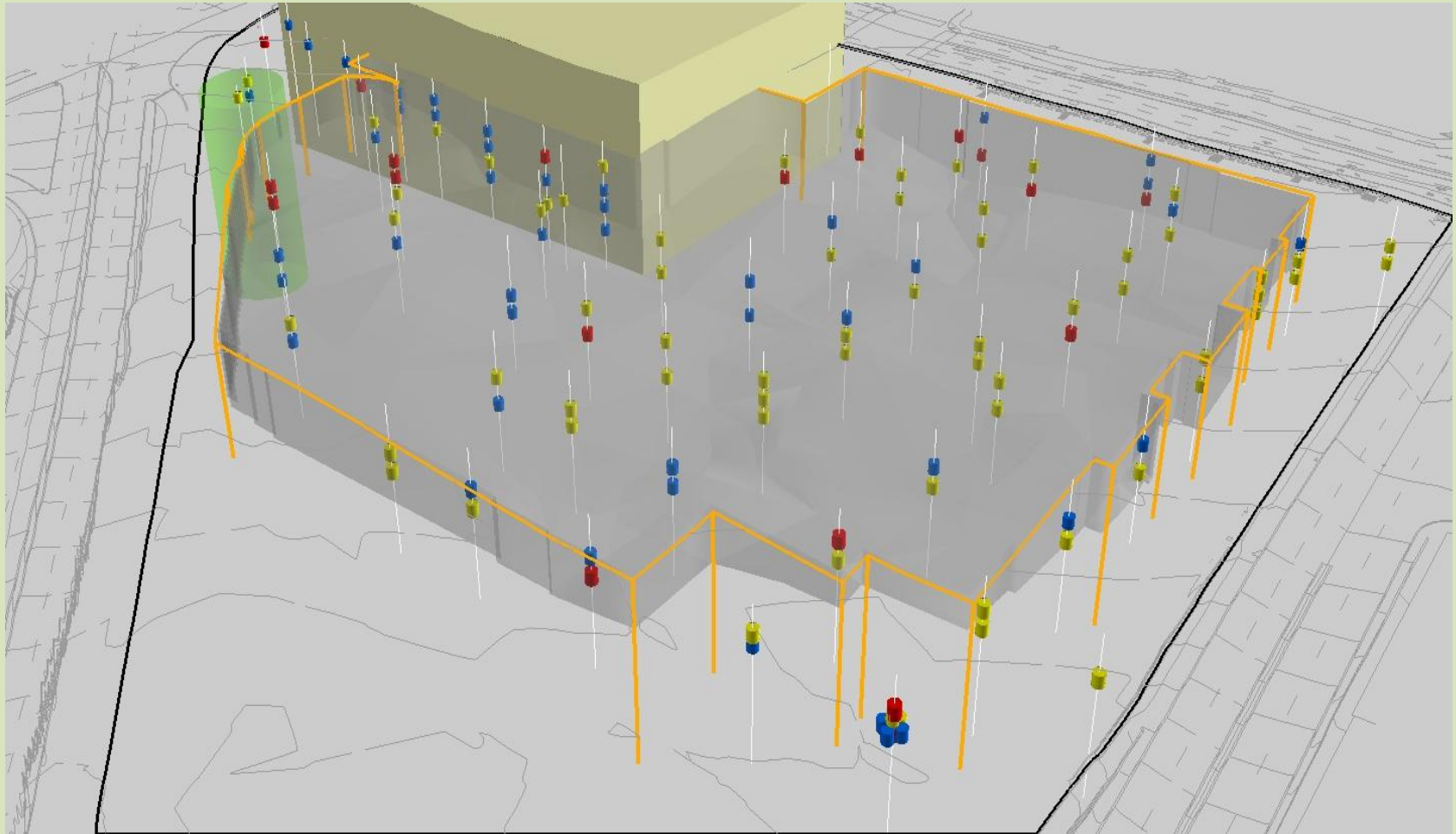


ODBC Connection – MS Access

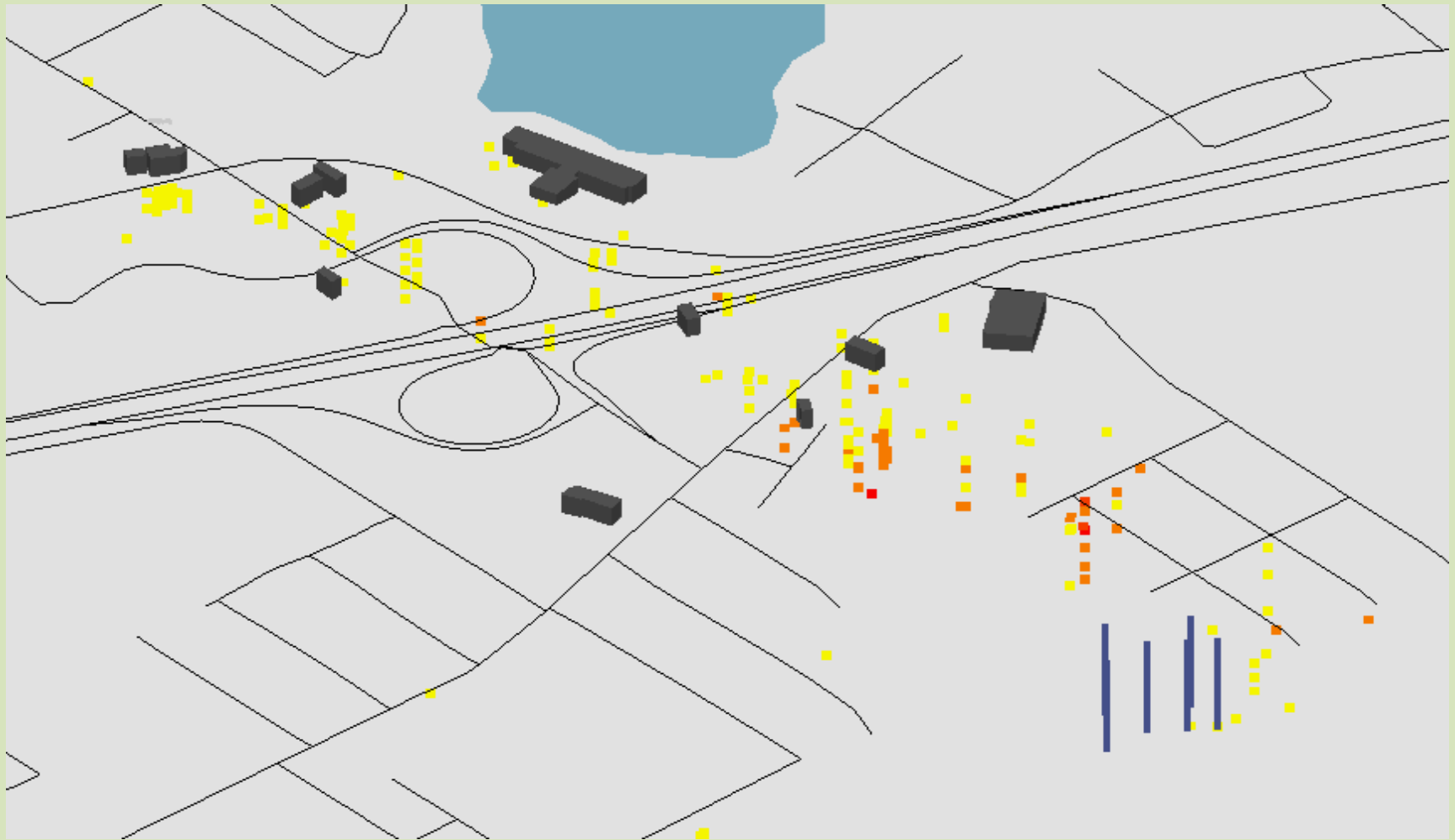
The screenshot displays the Microsoft Access interface with the 'dbo_dt_coordinate' table open in Datasheet View. The table contains the following data:

facility_id	sys_loc_code	coord_type	observation	identifier	x_coord	y_coord	elev	elev_unit	horz_cc
1	AP01	WSPN		PRIMARY	1011547.63725	417839.15165			13
1	AP02	WSPN		PRIMARY	1011582.23626	417826.997803			13
1	AP03	WSPN		PRIMARY	1011579.38489	417779.10059			13
1	AP04	WSPN		PRIMARY	1011563.14214	417753.41757			13
1	AP20	WSPN		PRIMARY	1011581.28942	417799.098253			13
1	B-11	WSPN		PRIMARY	1011270.80774	417627.39201			11
1	B-12	WSPN		PRIMARY	1011116.04444	417682.790237			11
1	B-13	WSPN		PRIMARY	1011160.45095	417725.877747			11
1	B-14	WSPN		PRIMARY	1011142.42455	417598.373891			11
1	B-15	WSPN		PRIMARY	1011123.5188	417619.038309			11
1	B-17	WSPN		PRIMARY	1011256.29868	417584.744168			11
1	B-21	WSPN		PRIMARY	1011200.90045	417773.801611			11
1	B-23	WSPN		PRIMARY	1011277.40277	417780.836306			11
1	B-9	WSPN		PRIMARY	1011229.03924	417704.333992			11
1	BL01	WSPN		PRIMARY	1011980.43133	417929.723648			13
1	BL02	WSPN		PRIMARY	1011994.52874	417899.506845			13
1	BL03	WSPN		PRIMARY	1012026.13367	417916.875576			13
1	BL20	WSPN		PRIMARY	1011949.81854	417777.196066			13
1	BP01	WSPN		PRIMARY	1011675.14782	417926.571423			13
1	BP02	WSPN		PRIMARY	1011691.52509	417876.585959			13
1	BP03	WSPN		PRIMARY	1011711.74913	417822.25864			13
1	BP04	WSPN		PRIMARY	1011676.13240	417729.676804			13
1	BP20	WSPN		PRIMARY	1011510.82138	417928.607181			13
1	BS01	WSPN		PRIMARY	1011789.78998	418269.645868			13

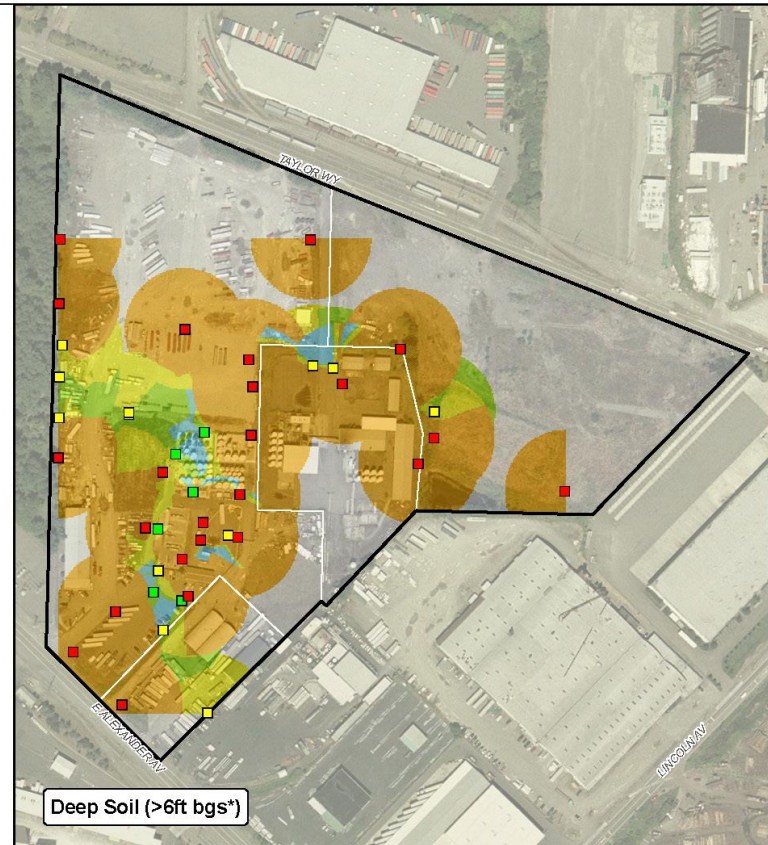
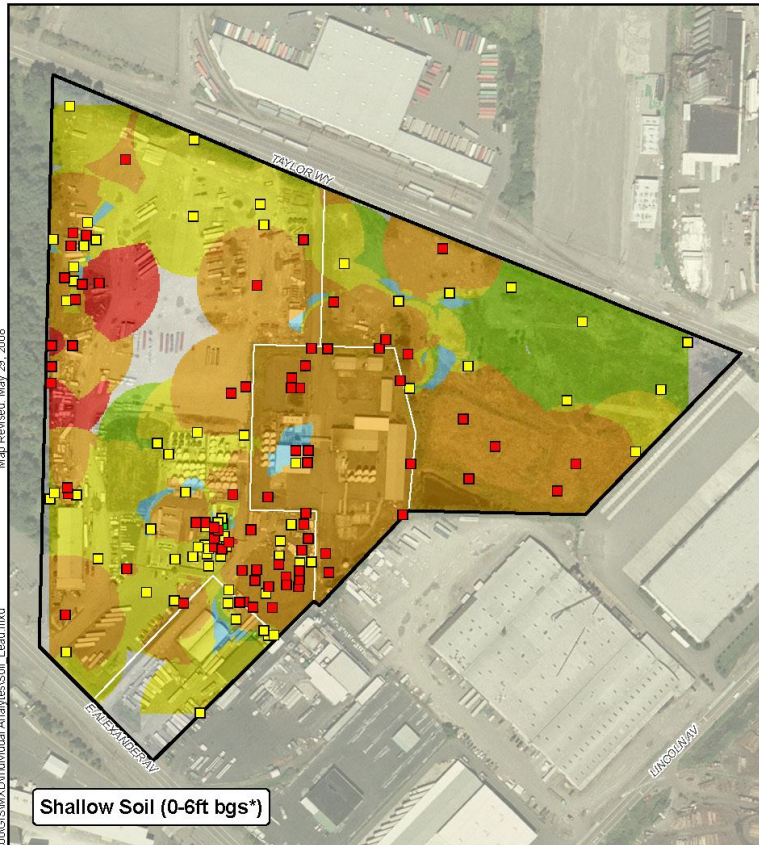
3D Example



3D Example



Mapping Concentrations in Surfer



Map Revised: May 29, 2008

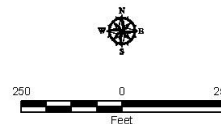
Part: P:\040441\11000\GIS\SMA\Individual Analyses\Soil_Lead.mxd
Office: TAC

Notes:
 1. The locations of all features shown are approximate.
 2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
 3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources:
 Sample data obtained from CC, Prologis and PSC. Aerial photo (dated September 2009) from Aerials Express (obtained from <http://services.arcgisonline.com/wc/>, April 2009). Street labels from Pierce County.
 PSC Screening Levels obtained from Table 8.7 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- | | | | |
|---|-----------------------------|---|--------------|
| ■ | Results exceeding PSC value | ■ | Lead (mg/kg) |
| ■ | Detect Results | ■ | <0.1 |
| ■ | Non-detect Results | ■ | 0.1 - 5 |
| | | ■ | 5 - 24 |
| | | ■ | 24** - 5,000 |
| | | ■ | >5,000 |
- *Below Ground Surface (BGS)
 ** Indicates PSC Screening Level

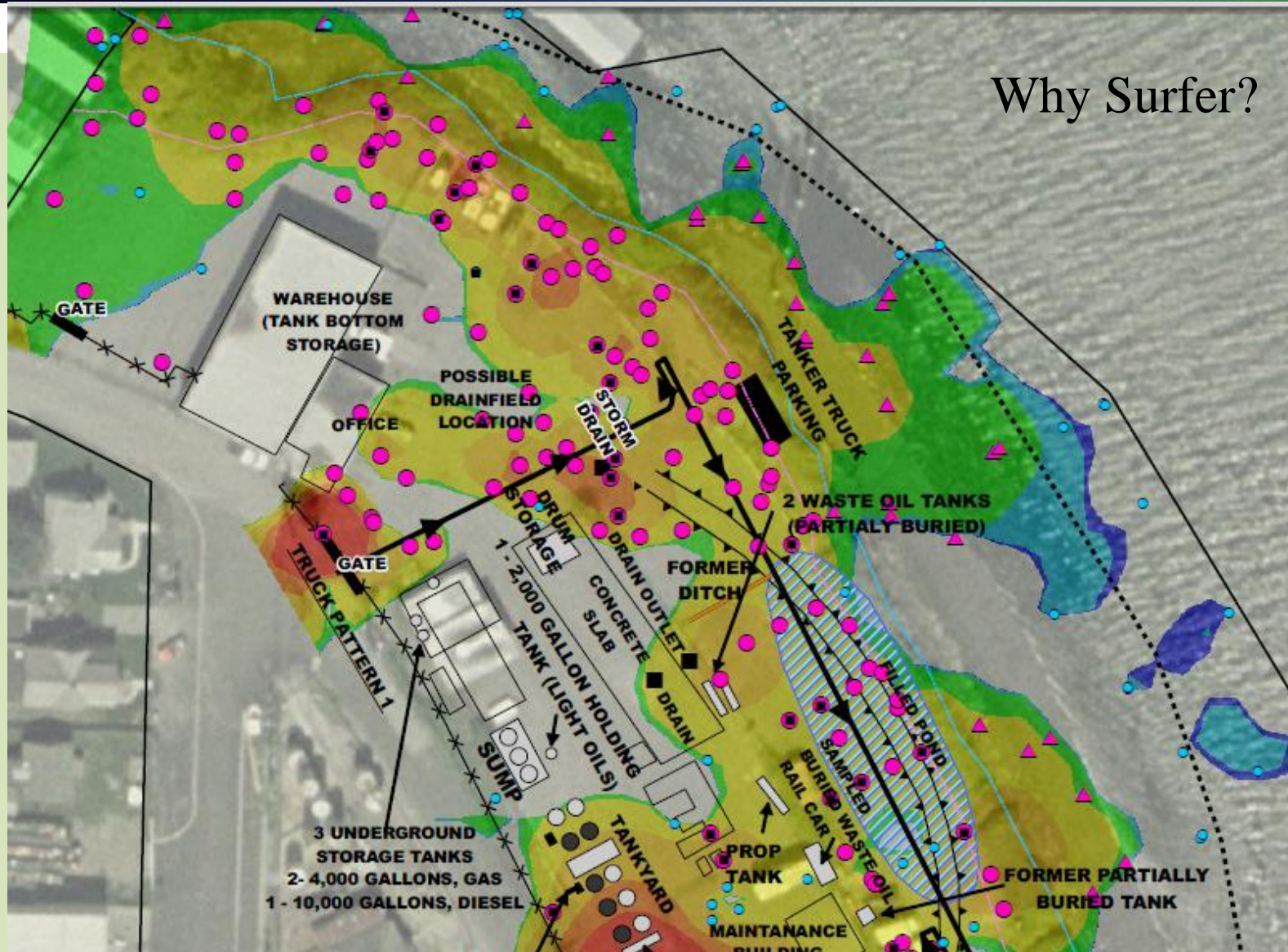


Lead in Soil	
Taylor Way and Alexander Avenue Fill Site Tacoma, Washington	
GEOENGINEERS	Figure X



Chemical Concentrations - Surfer

Why Surfer?



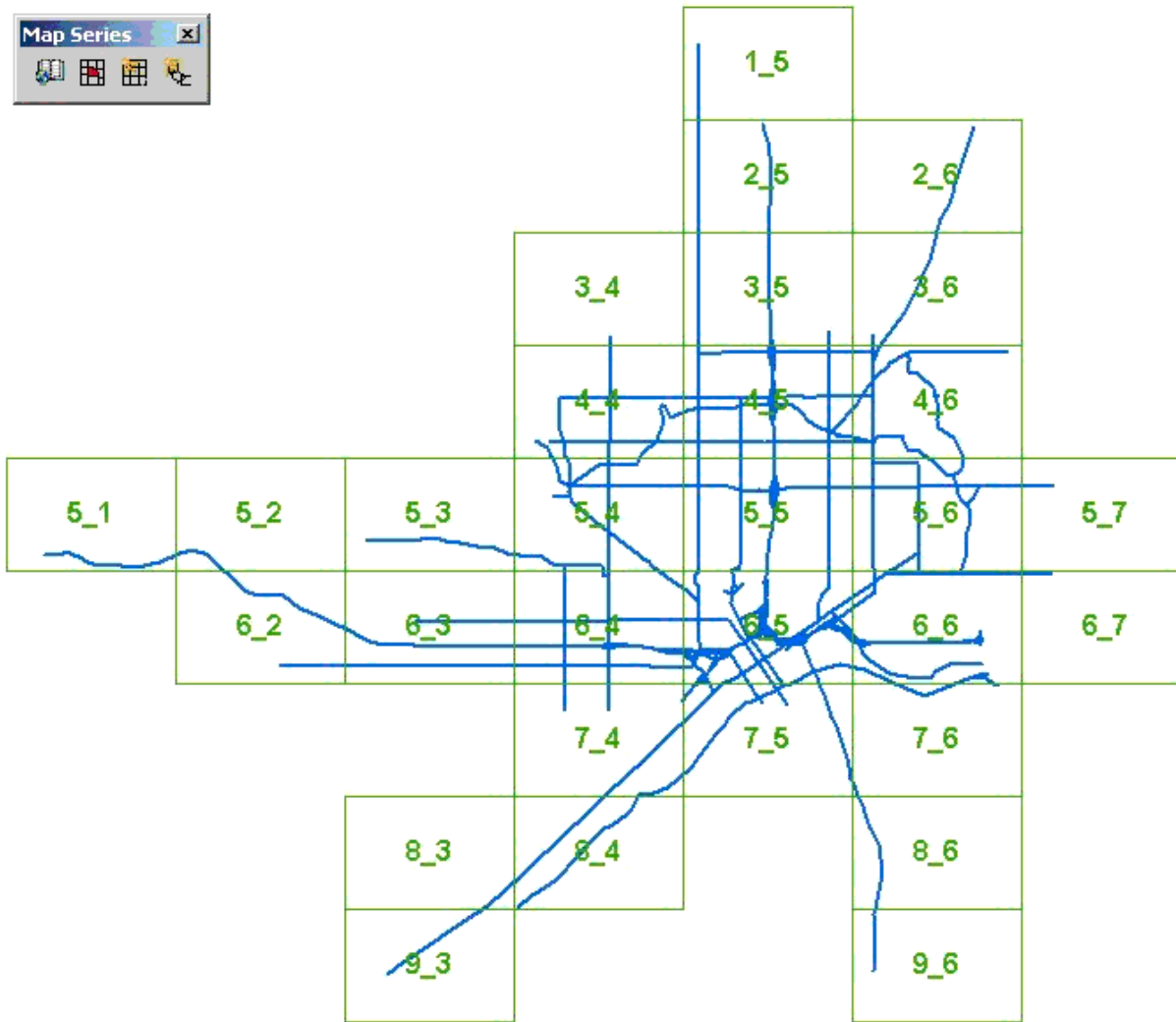
Aroclor Ratios

1																				
2			RATIO OF DETECTED AROCLOR 1260 TO PCB TOTALS																	
3																				
4																				
5																				
6																				
7																				
8																				
9			Sample Depths Below Ground Surface (ft)																	
10	Area	Location	1	2	3	4	5	6	7	8	9	10	11	12	13	14	16	17	19	20
65	Terminal	SB-36		100		100			100		100									
66	Terminal	CS-B2-S5			100															
67	Terminal	IS-B3-B3		100																
68	Terminal	T-117 B5		100		100														
69	Terminal	CS-B2-B2			100															
70	Terminal	T117-PS-6		100		100			100		100									
71	Terminal	T-117 D10		100		100			100											
72	Terminal	IS-BA-S3		100																
73	Terminal	SB-40		100					100		100									
74	Terminal	SB-24		100		100														
75	Terminal	SB-50		100		100														
76	Terminal	SB-25				100														
77	Terminal	T-117 B3		100		100			100											
78	Terminal	T-117 B2		100		100			100		81			71		58		100		
79	Terminal	IS-B2-S6			100															
80	Terminal	IS-BA-B1		100																
81	Terminal	T117-RW-05	100																	
82	Terminal	IS-B3-S4		100																
83	Terminal	T-117 B4		100		100			100		100									
84	Terminal	IS-B2-S2B							100											
85	Terminal	T117-PS-7		100		100					100									

Custom Symbols

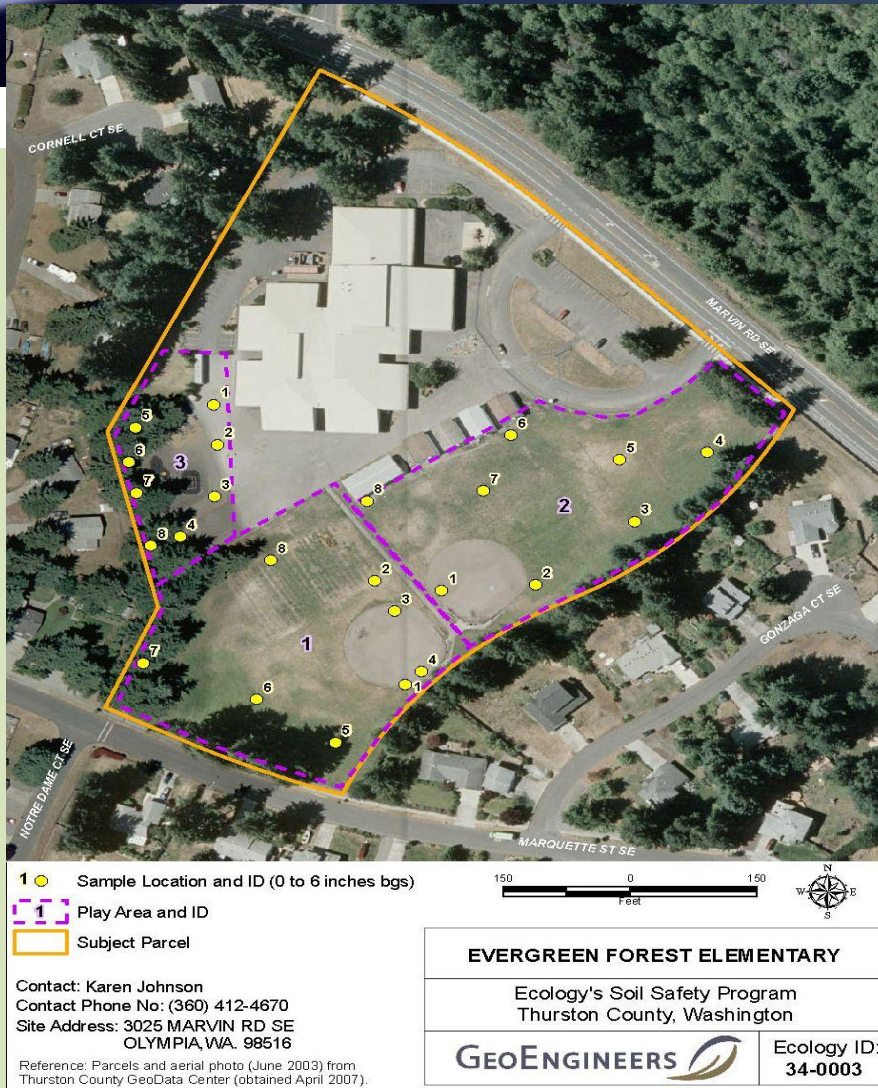


MapBook Example



Multipage document based on a dataset and an index grid representing the pages

MapBook Example



EVERGREEN FOREST ELEMENTARY
 Ecology's Soil Safety Program - Thurston County, WA.
 Ecology ID: 34-0003
 X, Y: 1077009, 622524

ARSENIC (mg/kg)	Play Area 1	Play Area 2	Play Area 3
Sample Location	5/7/2007	5/7/2007	5/8/2007
1	4.9	5.4	3.4
2	3.7	4.2	5.9
3	4.8	4.4	4.5
4	4.2	5.7	4.7
5	3.4	3.5	4.6
6	11	5.5	2.6
7	12	4.5	3.5
8	4.7	5.4	3.3
.....			
Average	6.1	4.8	4.1
Max	12	5.7	5.9

LEAD (mg/kg)	Play Area 1	Play Area 2	Play Area 3
Sample Location	5/7/2007	5/7/2007	5/8/2007
1	5.4	6.9	4.2
2	5.9	6.9	9.3
3	8.6	7.0	6.0
4	5.2	8.5	5.3
5	5.4	4.6	5.5
6	21	9.9	2.9
7	18	7.4	3.9
8	7.1	8.3	3.7
.....			
Average	9.6	7.4	5.1
Max	21	9.9	9.3

Displayed data collected (over 1,000 samples)
 from 44 facilities using MapBook and EQuIS

Discussion

Thank you, for more information contact Tonya Kauhi 253-383-4940 or tkauhi@geoengineers.com