The Development of a GIS Based Interface to an ORACLE Water Quality Database at the WVDEP, Division of Mining and Reclamation

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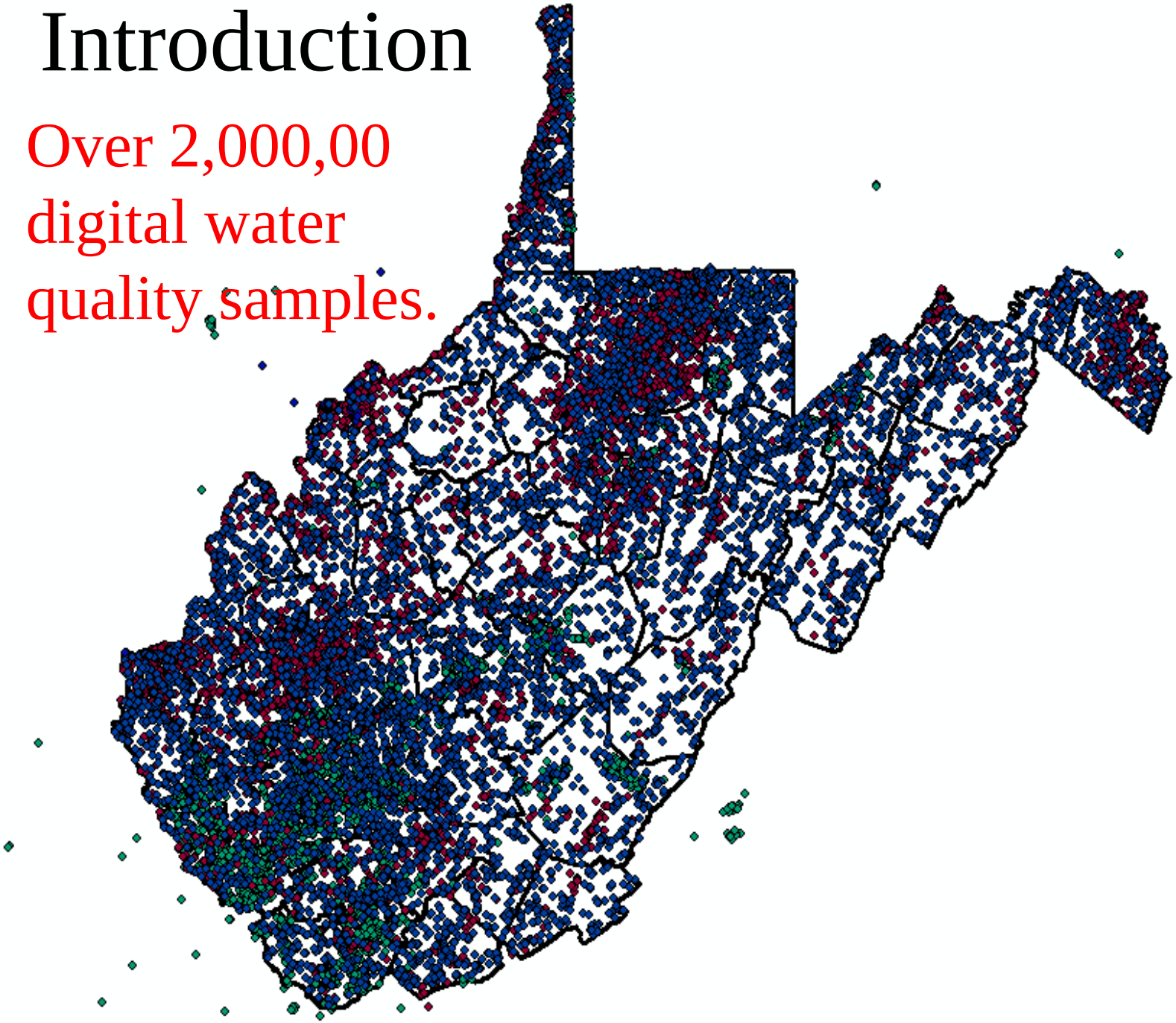
Introduction

- Over 2,000,00 digital water quality samples.



Introduction

- Summary of WVDEP Water Quality Databases.
- GIS access of the states water quality data.
- Issues with mixing data for different sources.
- The use of water quality data in surface and groundwater modeling.

WVDEP/DMR Water Quality Databases

- The DMR has several types of water quality data.
  - NPDES Point source and instream
  - SMCRA Permit Data
  - Watershed Data
  - AML Program
  - Other NPDES sampling (ie TMDL, Anti-Deg)

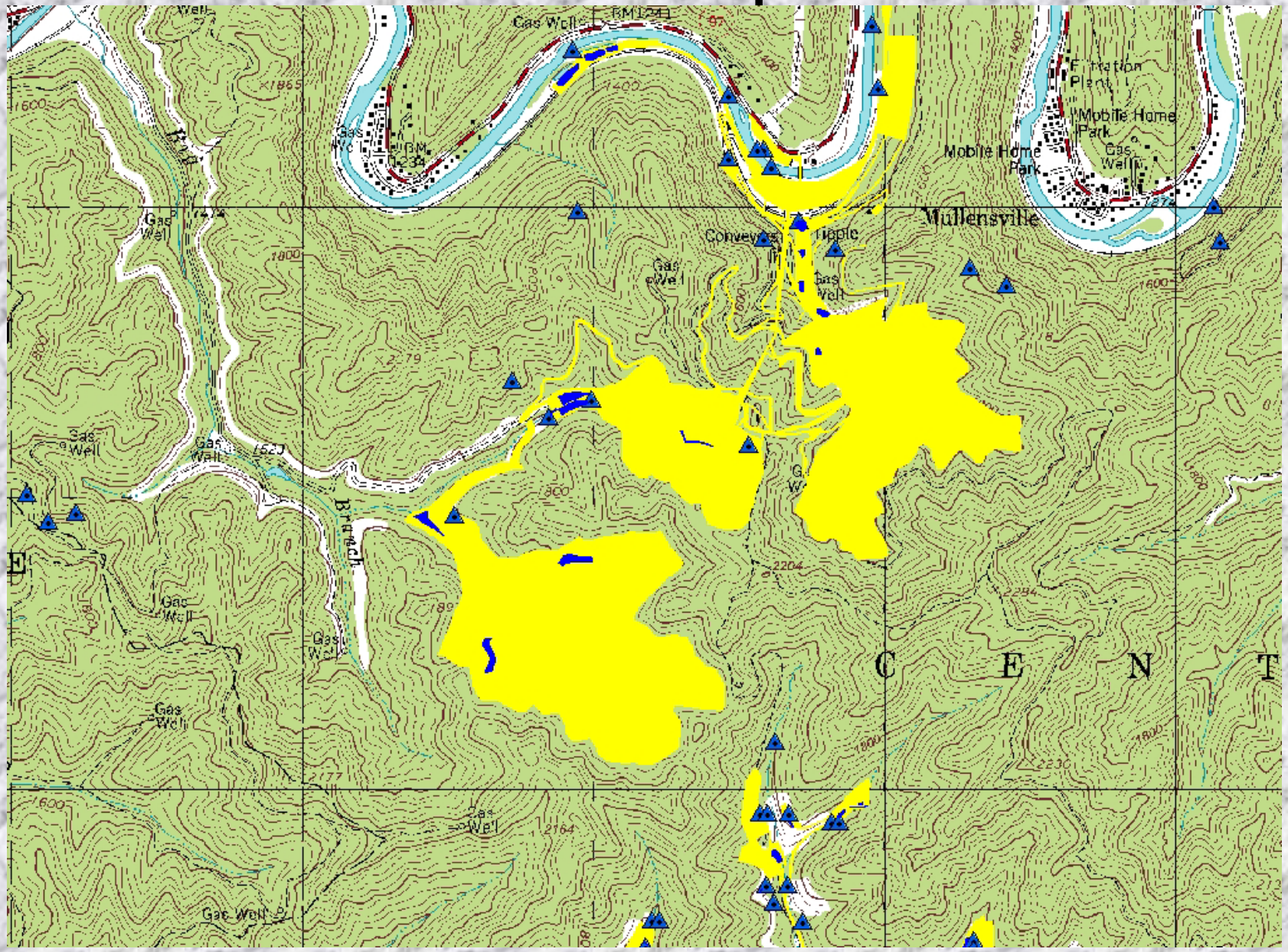
NPDES Data

- **Primary Compliance Points**
- **Company Supplied**
- **Averaged Data**
- **Only when flow occurs**
- **Entered in ORACLE**
  - **Through ERIS not EQUIS**
  - **75% Electronic**
  - **QNCR checks for non-compliance**

NPDES Data

- ***Flow***
- ***Iron***
- ***Manganese***
- ***TSS***
- ***pH***
- ***Aluminum***
- ***Selenium***

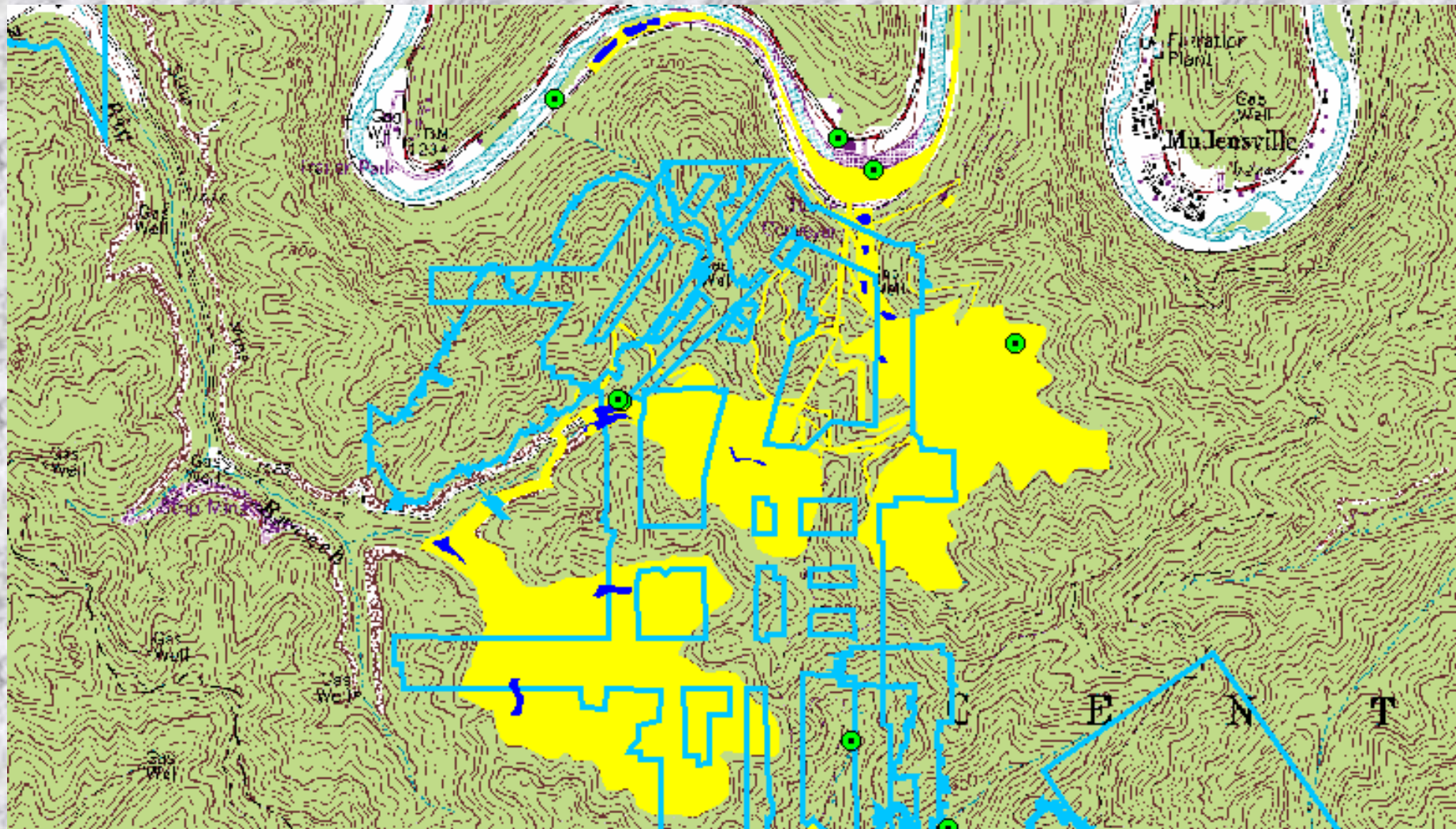
NPDES Sample Sites



SMCRA Permit Data

- Company supplied Data
- Instream and groundwater
- No electronic entry at this time
- Very large legacy

Water Sample Sites



Permit Based Data

- 1. Article III
  - Baseline Surface and Ground Water
    - 6 Months prior to mining.
    - 1 Time Heavy Metals
  - During Mining
    - Quarterly Sampling
  - Baseline Benthic Sampling
    - Single time at base of Valley Fills
    - Rapid Bio-assessment protocol/ WVSC

Watershed Data for CHIAs

- Trend Stations. (Not Company Data)
  - Heavy Metals
  - Baseline
  - Benthic
- BWQ. (Company Data)
  - Site Specific NPDES used for Anti-Deg

Trend Station Quarterly Sampling

- **ANTIMONY**
- **ARSENIC**
- **BERYLLIUM**
- **CADMIUM**
- **CHROMIUM**
- **COPPER**
- **LEAD**
- **MERCURY**
- **NICKEL**
- **SELENIUM**
- **SILVER**
- **THALLIUM**
- **ZINC**
- **CYANIDE**
- **PHENOLS**
- **NITRATE**

Trend Station Monthly Baseline Sampling

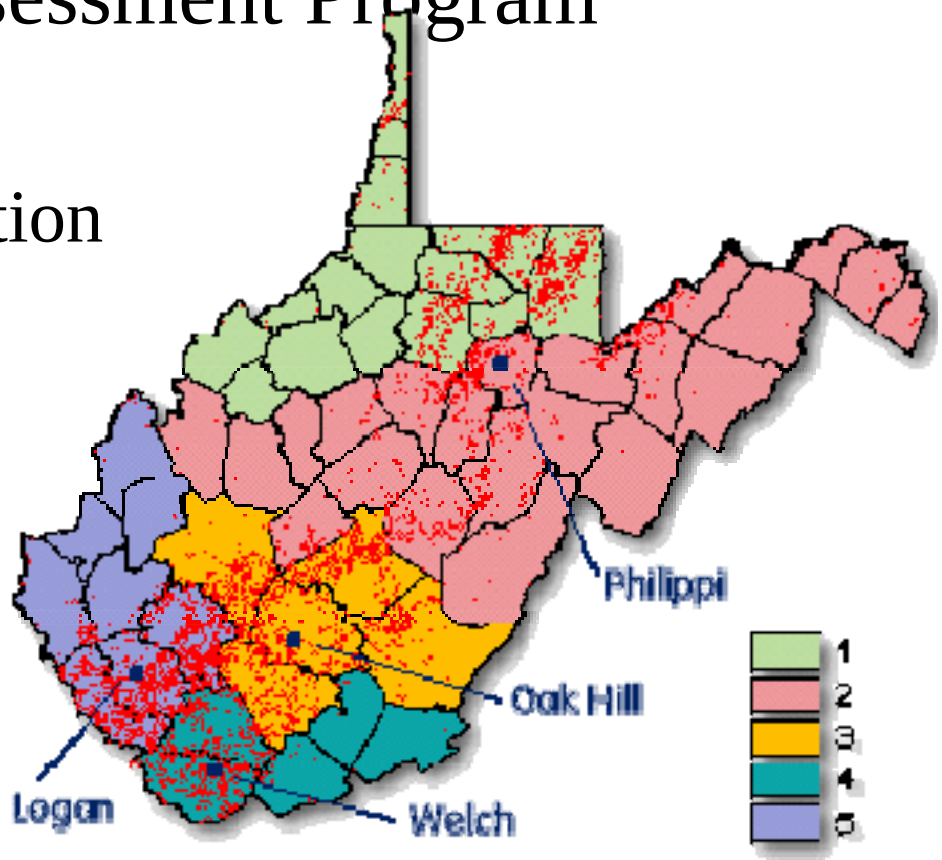
- **FIELD pH:**
- **FIELD COND:**
- **FIELD TEMP:**
- **FIELD DISS. OXY:**
- **FLOW**
- **CONDUCTIVITY**
- **SULFATE**
- **DS**
- **TSS**
- **pH**
- **ALKALINITY**
- **ACIDITY**
- **MIN. ACIDITY**
- **DISS. IRON**
- **DISS. MN**
- **DISS. AL**
- **IRON**
- **MANGANESE**
- **ALUMINUM**

AML Data

- All hand entered
- Almost all on site point source
- A separate Access database.

Other NPDES sampling

- Watershed Assessment Program
  - TMDL
  - Anti-Degradation



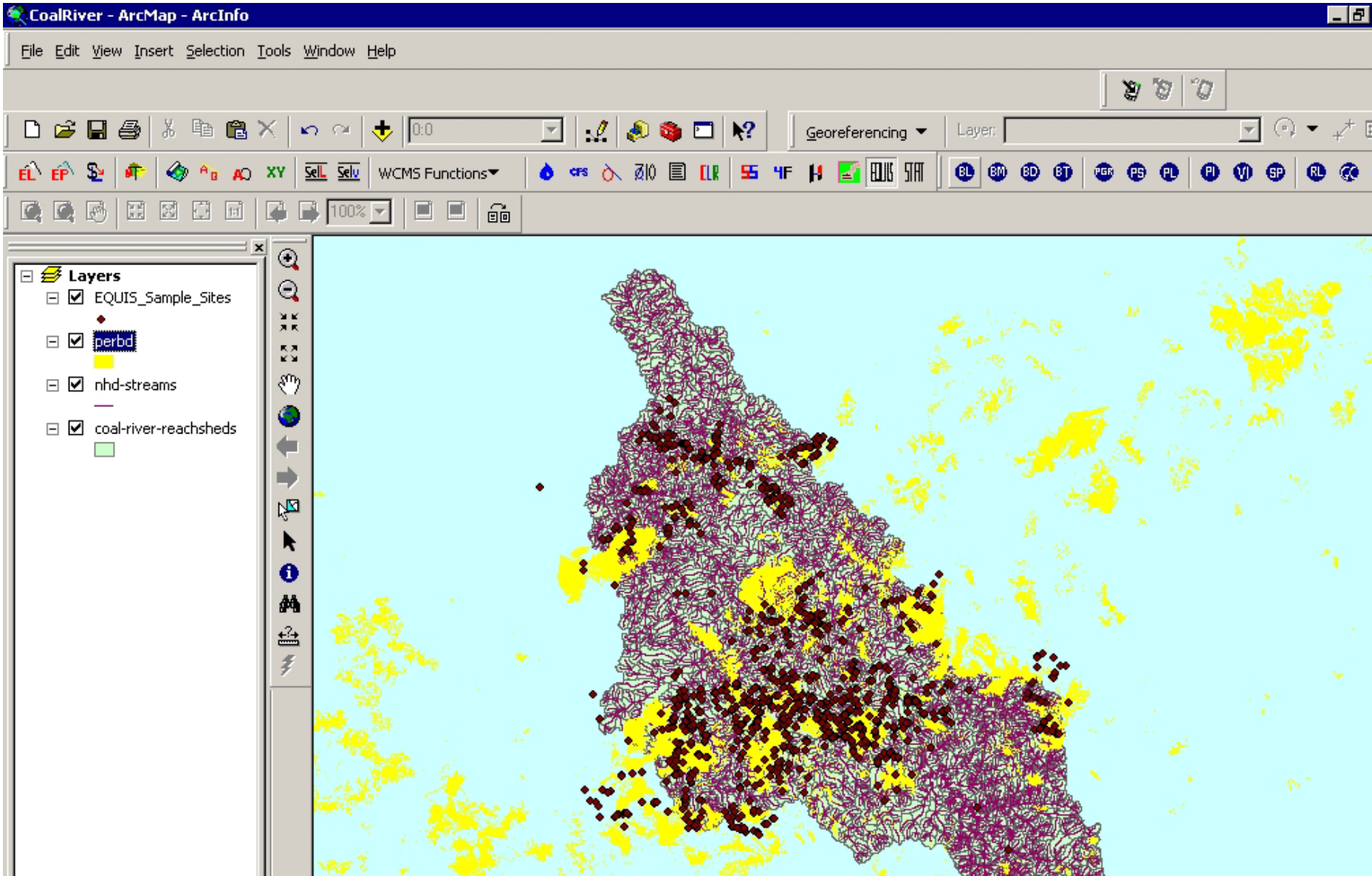
Accessing Water Quality Data Using ArcGIS

- Viewing Points
- Attaching Data
- Manipulating Data
- Demo

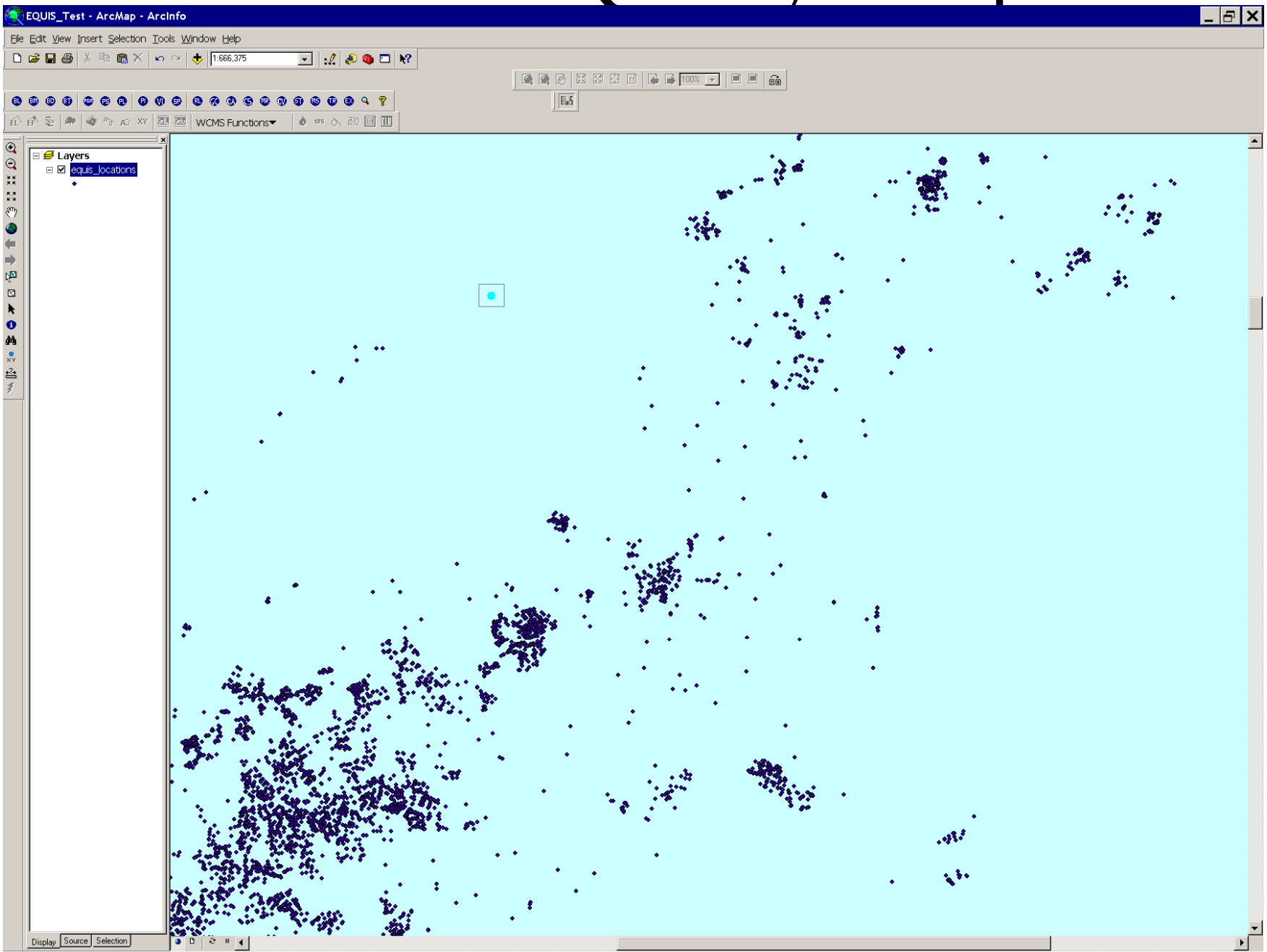
Water Quality Database

SMCRA Data, Watershed Data, and soon other NPDES

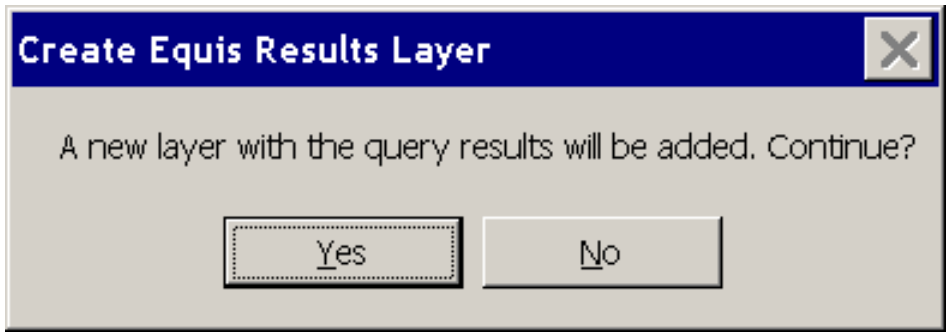
NOT NPDES or AML



Choose Water Quality Samples



Crystal Reports in opened



Display Sample Parameters

WCMS - EQuIS Water Quality Interface

Report by Point

Select a Point:

[Select a Point]

490043.4139 , 4329563.5616

Get Samples for the point

Report by Date Range

Select a Parameter:

[Select a Parameter]

Select Date Range:

Start [Select Start date]

End [Select End date]

Get Samples on the range

Exit Report Form

Select a point

Display Sample Parameters

WCMS - EQuIS Water Quality Interface

Report by Point

Select a Point:

490043.4139 , 4329563.561

Get Samples for the point

Report by Date Range

Select a Parameter:

[Select a Parameter]

Select Date Range:

Start [Select Start date]

End [Select End date]

Get Samples on the range

Exit Report Form

- 9/18/2002
- 11/16/2002
- 3/10/2003
- 3/24/2003
- 6/17/2003
- 6/23/2003
- 8/8/2003
- 8/28/2003
- 11/30/2003
- 8/10/2004
- 11/8/2004
- 3/14/2005
- 5/9/2005
- 8/9/2005

Main Report

Report Generated on: Monday, November 19, 2007

Following Report is generated for the:

Sample Date:	Sample Coordinate	
9/18/2002	X: 490043.4139	Y: 4329563.5616

Download report data

Current Page No.: 1 | Total Page No.: 1+ | Zoom Factor: 100%

Select date range

Display Sample Parameters

WCMS - EQuIS Water Quality Interface

Report by Point

Select a Point:

490043.4139 , 4329563.561

Get Samples for the point

Report by Date Range

Select a Parameter:

Aluminum

Select Date Range:

Start 2002-09-18 01:00:00

End [Select End date]

2002-09-18 01:00:00
2002-09-18 01:15:00
2002-09-18 01:25:00
2002-09-18 01:35:00
2002-09-18 08:50:00
2002-09-18 09:10:00
2002-09-18 09:30:00
2002-09-18 10:55:00

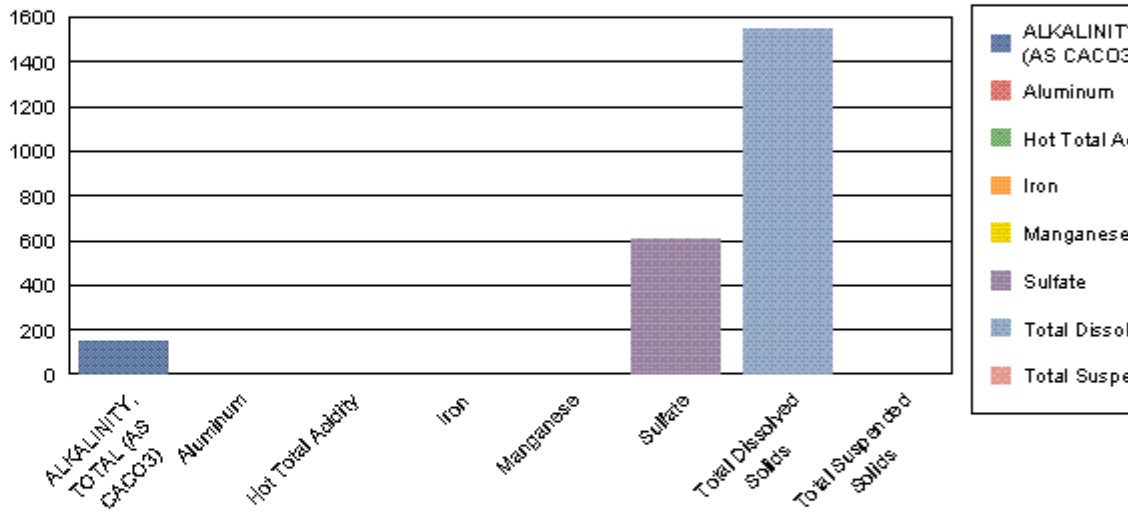
Get

- 9/18/2002
  - CHIA#1
  - CHIA#2
  - GW-1
  - GW-2
  - SEEP #2
  - SEEP #3
  - WT-1
- 11/16/2002
- 3/10/2003
- 3/24/2003
- 6/17/2003
- 6/23/2003
- 8/8/2003
- 8/28/2003
- 11/30/2003
- 8/10/2004
- 11/8/2004
- 3/14/2005
- 5/9/2005
- 8/9/2005

Main Report

Sample Report

For 9/18/2002



System Location Code: ***CHIA#1***

Chemical Name	Result Value	Fraction	Facility ID	Task
ALKALINITY, TOTAL (AS CACO3)	148.00 mg/l	T	481	OMR
Aluminum	0.00 mg/l	T	481	OMR
Hot Total Acidity	0.00 mg/l	T	481	OMR
Iron	0.23 mg/l	T	481	OMR
Manganese	0.15 mg/l	T	481	OMR
Sulfate	610.00 mg/l	T	481	OMR

Display Sample Parameters

WCMS - EQuIS Water Quality Interface

Report Data

Report by Point

Select a Point:

490043.4139 , 4329563.561

Get Samples for the point

Report by Date Range

Select a Parameter:

Sulfate

Select Date Range:

Start 2002-09-18 01:00:00

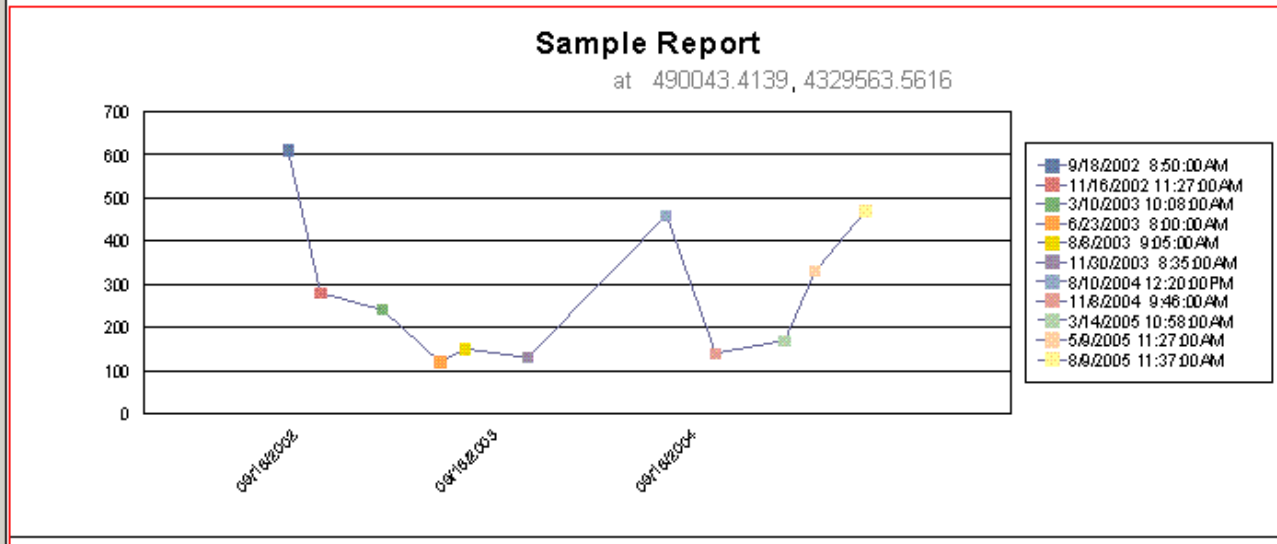
End 2005-08-09 12:20:00

Get Samples on the range

Exit Report Form

- CHIA#1
- CHIA#2
- GW-1
- GW-2
- SEEP #2
- SEEP #3
- SEEP #7
- WT-1
- WT-2
- WT-3
- WT-4
- WT-5
- WT-6
- WT-7
- WT-8
- WT-9

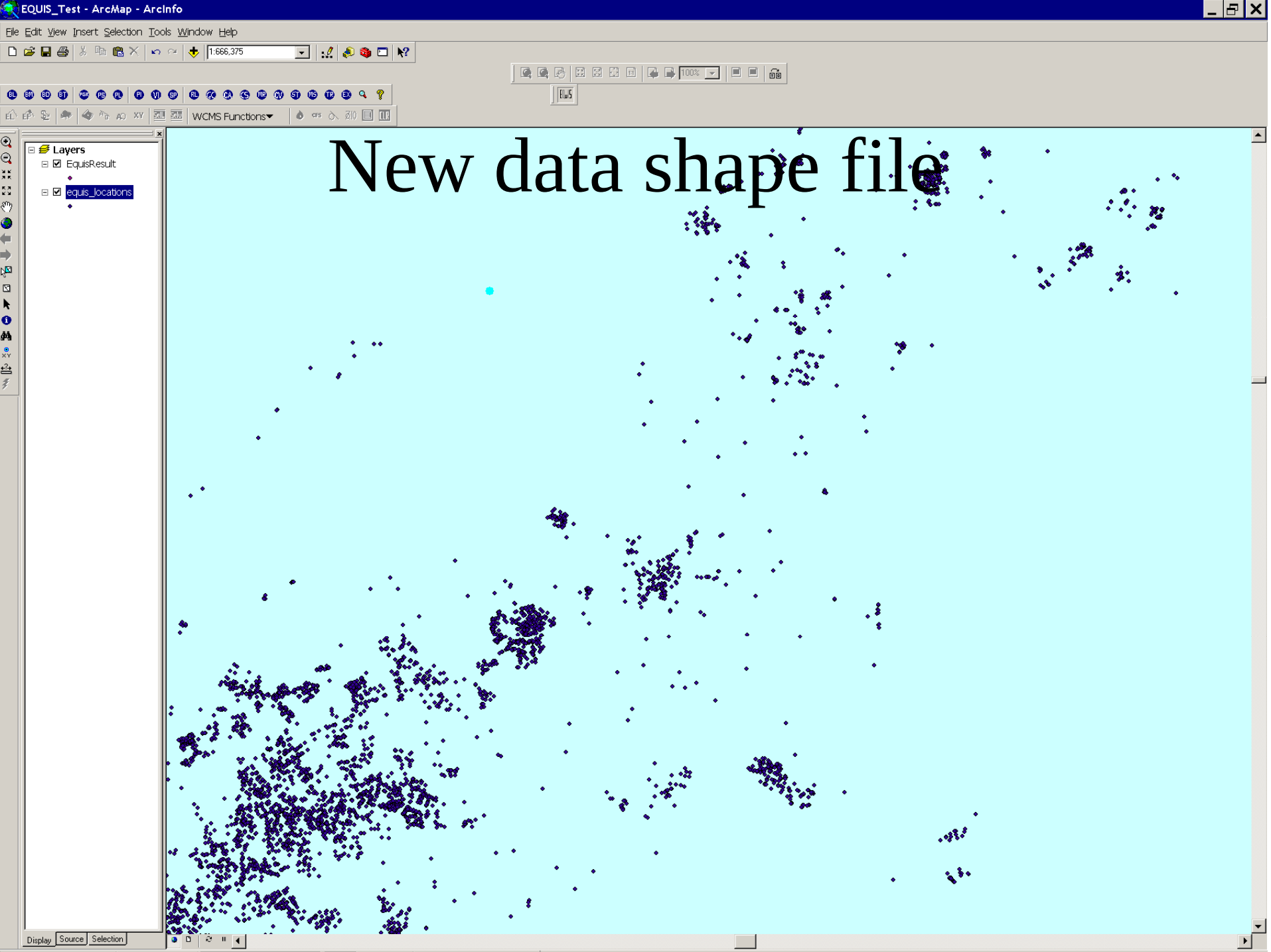
Main Report



System Location Code: CHIA#1

Sulfate

SampleDate	CAS_RN	Fraction	Result	Facility ID	Task Code
9/18/2002 8:50:0	14808-79-8	T	610.00 mg/l	481	OMR
11/16/2002 11:27	14808-79-8	T	280.00 mg/l	481	OMR
3/10/2003 10:08:(	14808-79-8	T	240.00 mg/l	481	OMR
6/23/2003 8:00:0	14808-79-8	T	120.00 mg/l	481	OMR
8/8/2003 9:05:00	14808-79-8	T	150.00 mg/l	481	OMR
11/30/2003 8:35:	14808-79-8	T	130.00 mg/l	481	OMR
8/10/2004 12:20:(	14808-79-8	T	460.00 mg/l	481	OMR
11/8/2004 9:46:0	14808-79-8	T	140.00 mg/l	481	OMR


EQUIS_Test - ArcMap - ArcInfo
File Edit View Insert Selection Tools Window Help
1:666,375
WCMS Functions
Layers
EquisResult
equis_locations
Display
Source
Selection
New data shape file

EQUIS_Test - ArcMap - ArcInfo

File Edit View Insert Selection Tools Window Help

1:666,375

WCMS Functions

Layers

EquisResult

equis_locations

New data now a .dbf

Attributes of EquisResult

FID	Shape	X_Coord	Y_Coord	Res_Num	Chem_Name	SampleID	Fraction	Res_Unit	CAS_RN	SampleDate	TestID	Task_Code	FacilityID	SysLocCode
0	Point	490043.4139	4329563.5616	73	Specific Conductance	1	N	umho/cm	139	2003-03-10	47	OMR	481	CHIA#1
1	Point	490043.4139	4329563.5616	11	Flow	1	N	gpmin	239	2003-03-10	47	OMR	481	CHIA#1
2	Point	490043.4139	4329563.5616	3	TEMPERATURE	1	N	deg C	TEMP	2003-03-10	47	OMR	481	CHIA#1
3	Point	490043.4139	4329563.5616	24	Sulfate	1	T	mg/l	14808-79-8	2003-03-10	48	OMR	481	CHIA#1
4	Point	490043.4139	4329563.5616	1	Aluminum	1	T	mg/l	7429-90-5	2003-03-10	48	OMR	481	CHIA#1
5	Point	490043.4139	4329563.5616	0	Iron	1	T	mg/l	7439-89-6	2003-03-10	48	OMR	481	CHIA#1
6	Point	490043.4139	4329563.5616	0	Manganese	1	T	mg/l	7439-96-5	2003-03-10	48	OMR	481	CHIA#1
7	Point	490043.4139	4329563.5616	13	ALKALINITY, TOTAL (AS CACO3)	1	T	mg/l	ALK	2003-03-10	48	OMR	481	CHIA#1
8	Point	490043.4139	4329563.5616	1	Hot Total Acidity	1	T	mg/l	HTA	2003-03-10	48	OMR	481	CHIA#1
9	Point	490043.4139	4329563.5616	44	Total Dissolved Solids	1	T	mg/l	TDS	2003-03-10	48	OMR	481	CHIA#1
10	Point	490043.4139	4329563.5616	5	Total Suspended Solids	1	T	mg/l	TSS	2003-03-10	48	OMR	481	CHIA#1
11	Point	490043.4139	4329563.5616	11	Flow	2	N	gpmin	239	2003-06-09	53	OMR	481	CHIA#1
12	Point	490043.4139	4329563.5616	17	TEMPERATURE	2	N	deg C	TEMP	2003-06-09	53	OMR	481	CHIA#1
13	Point	490043.4139	4329563.5616	8	pH	3	N	pH	1	2003-06-23	54	OMR	481	CHIA#1
14	Point	490043.4139	4329563.5616	44	Specific Conductance	3	N	umho/cm	139	2003-06-23	54	OMR	481	CHIA#1
15	Point	490043.4139	4329563.5616	12	Sulfate	3	T	mg/l	14808-79-8	2003-06-23	55	OMR	481	CHIA#1
16	Point	490043.4139	4329563.5616	0	Aluminum	3	T	mg/l	7429-90-5	2003-06-23	55	OMR	481	CHIA#1
17	Point	490043.4139	4329563.5616	0	Iron	3	T	mg/l	7439-89-6	2003-06-23	55	OMR	481	CHIA#1
18	Point	490043.4139	4329563.5616	0	Manganese	3	T	mg/l	7439-96-5	2003-06-23	55	OMR	481	CHIA#1
19	Point	490043.4139	4329563.5616	11	ALKALINITY, TOTAL (AS CACO3)	3	T	mg/l	ALK	2003-06-23	55	OMR	481	CHIA#1
20	Point	490043.4139	4329563.5616	1	Hot Total Acidity	3	T	mg/l	HTA	2003-06-23	55	OMR	481	CHIA#1
21	Point	490043.4139	4329563.5616	30	Total Dissolved Solids	3	T	mg/l	TDS	2003-06-23	55	OMR	481	CHIA#1
22	Point	490043.4139	4329563.5616	1	Total Suspended Solids	3	T	mg/l	TSS	2003-06-23	55	OMR	481	CHIA#1
23	Point	490043.4139	4329563.5616	8	pH	4	N	pH	1	2003-08-08	129	OMR	481	CHIA#1
24	Point	490043.4139	4329563.5616	91	Specific Conductance	4	N	umho/cm	139	2003-08-08	129	OMR	481	CHIA#1
25	Point	490043.4139	4329563.5616	35	Flow	4	N	gpmin	239	2003-08-08	129	OMR	481	CHIA#1
26	Point	490043.4139	4329563.5616	20	TEMPERATURE	4	N	deg C	TEMP	2003-08-08	129	OMR	481	CHIA#1
27	Point	490043.4139	4329563.5616	15	Sulfate	4	T	mg/l	14808-79-8	2003-08-08	130	OMR	481	CHIA#1
28	Point	490043.4139	4329563.5616	0	Aluminum	4	T	mg/l	7429-90-5	2003-08-08	130	OMR	481	CHIA#1
29	Point	490043.4139	4329563.5616	0	Iron	4	T	mg/l	7439-89-6	2003-08-08	130	OMR	481	CHIA#1
30	Point	490043.4139	4329563.5616	0	Manganese	4	T	mg/l	7439-96-5	2003-08-08	130	OMR	481	CHIA#1
31	Point	490043.4139	4329563.5616	12	ALKALINITY, TOTAL (AS CACO3)	4	T	mg/l	ALK	2003-08-08	130	OMR	481	CHIA#1
32	Point	490043.4139	4329563.5616	1	Hot Total Acidity	4	T	mg/l	HTA	2003-08-08	130	OMR	481	CHIA#1
33	Point	490043.4139	4329563.5616	65	Total Dissolved Solids	4	T	mg/l	TDS	2003-08-08	130	OMR	481	CHIA#1
34	Point	490043.4139	4329563.5616	10	Total Suspended Solids	4	T	mg/l	TSS	2003-08-08	130	OMR	481	CHIA#1
35	Point	490043.4139	4329563.5616	8	pH	5	N	pH	1	2002-09-18	51	OMR	481	CHIA#1
36	Point	490043.4139	4329563.5616	17	Specific Conductance	5	N	umho/cm	139	2002-09-18	51	OMR	481	CHIA#1
37	Point	490043.4139	4329563.5616	22	Flow	5	N	gpmin	239	2002-09-18	51	OMR	481	CHIA#1
38	Point	490043.4139	4329563.5616	17	TEMPERATURE	5	N	deg C	TEMP	2002-09-18	51	OMR	481	CHIA#1
39	Point	490043.4139	4329563.5616	61	Sulfate	5	T	mg/l	14808-79-8	2002-09-18	52	OMR	481	CHIA#1
40	Point	490043.4139	4329563.5616	0	Iron	5	T	mg/l	7439-89-6	2002-09-18	52	OMR	481	CHIA#1
41	Point	490043.4139	4329563.5616	0	Manganese	5	T	mg/l	7439-96-5	2002-09-18	52	OMR	481	CHIA#1
42	Point	490043.4139	4329563.5616	14	ALKALINITY, TOTAL (AS CACO3)	5	T	mg/l	ALK	2002-09-18	52	OMR	481	CHIA#1
43	Point	490043.4139	4329563.5616	15	Total Dissolved Solids	5	T	mg/l	TDS	2002-09-18	52	OMR	481	CHIA#1
44	Point	490043.4139	4329563.5616	7	pH	6	N	pH	1	2002-11-16	49	OMR	481	CHIA#1

Record: 1 Show: All Selected Records (0 out of 1815 Selected) Options

Display Source Selection

Drawing Arial 10

444622.123 4168688.421 Meters

start SA Programmin... Microsoft Excel -... WQI MetaFrame Pres... EQUIS_Test - Ar... 2:19 PM

Apple and Oranges – mixing data from different sources

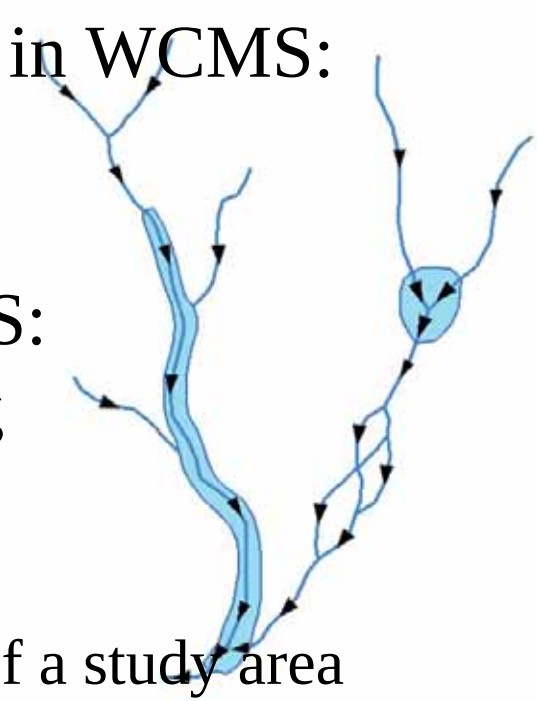
- Migrating data in Oracle using EQUIS
  - Putting legacy data into EQUIS is very tough
  - AML and WAP data is in Access
  - NDPES data is averaged
- Company's often re-use and name sample data.
- Legacy data depends on supplied location points.
- Compliance vs monitoring data.
- Locations problems with 3rd party data.

Database use in Surface and Ground Water Modeling

- Surface Water
  - HSPF
  - Sorting point source and instream
  - Art III vs Clean Water act goals
- Ground Water
  - ModFlow
  - Laminar vs karst flow
  - Mine pools

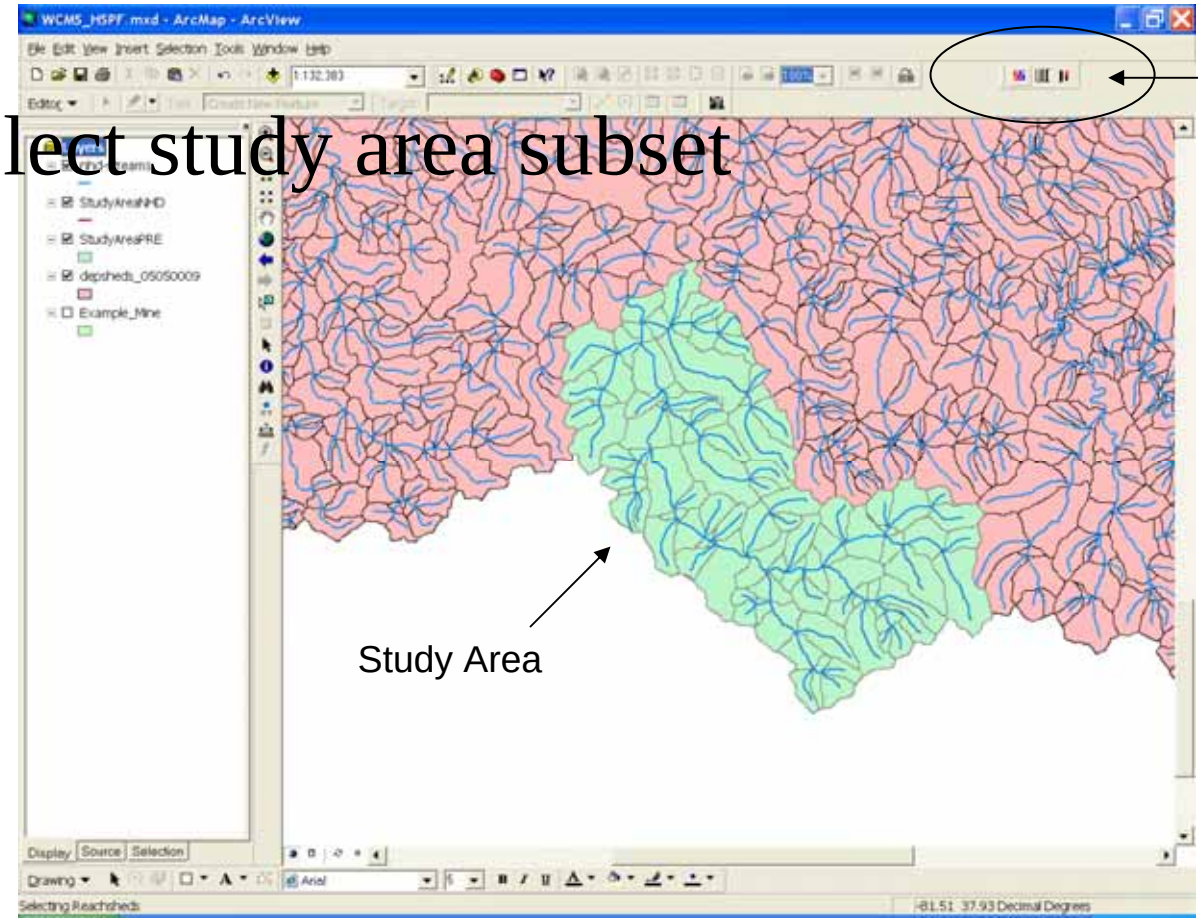
Capabilities related to HSPF

- Hydrologic Simulation Program-Fortran
- Functions related to HSPF already in WCMS:
  - Watershed delineation
  - Change/edit land cover
- New functions for HSPF in WCMS:
  - Create input files for HSPF modeling
  - Stream and watershed calculations
  - Model land cover changes
  - Compare pre/post mining attributes of a study area
- Under development



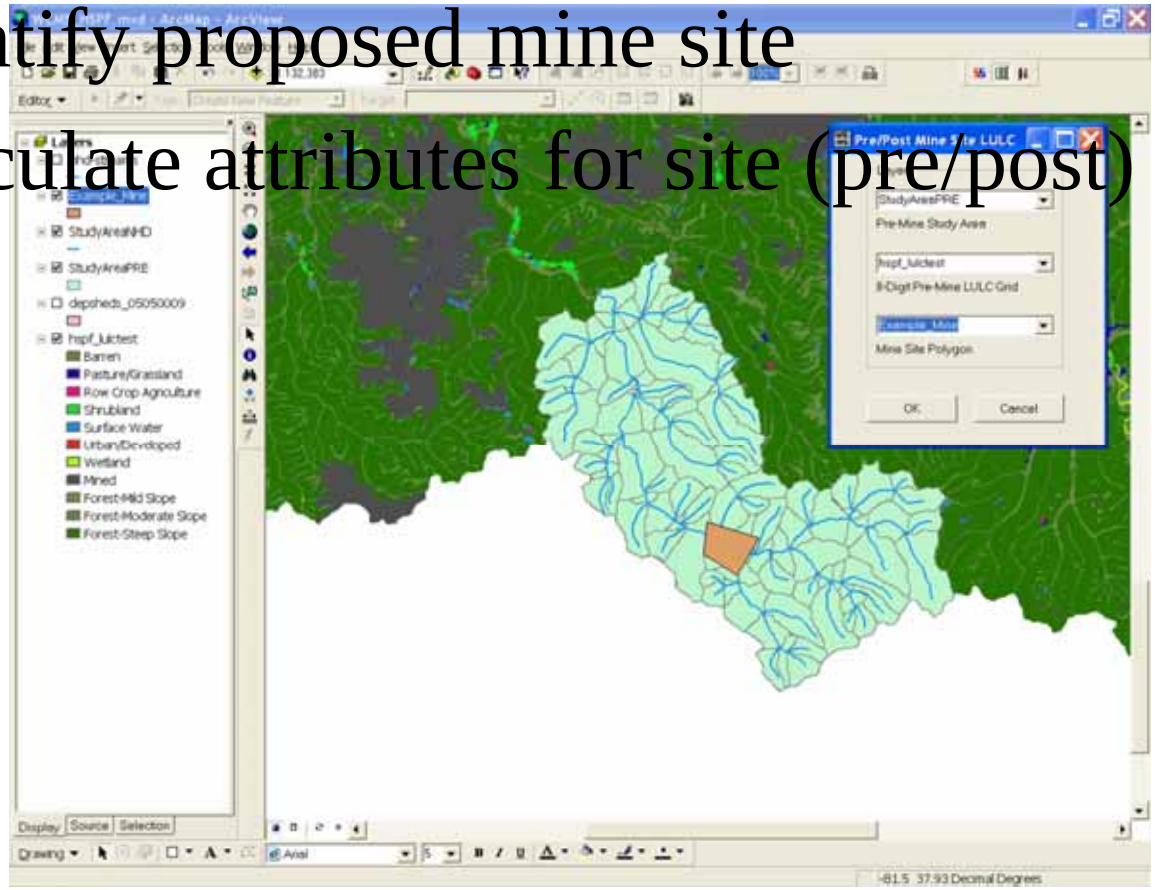
HSPF-WCMS Step 1

- Select study area subset



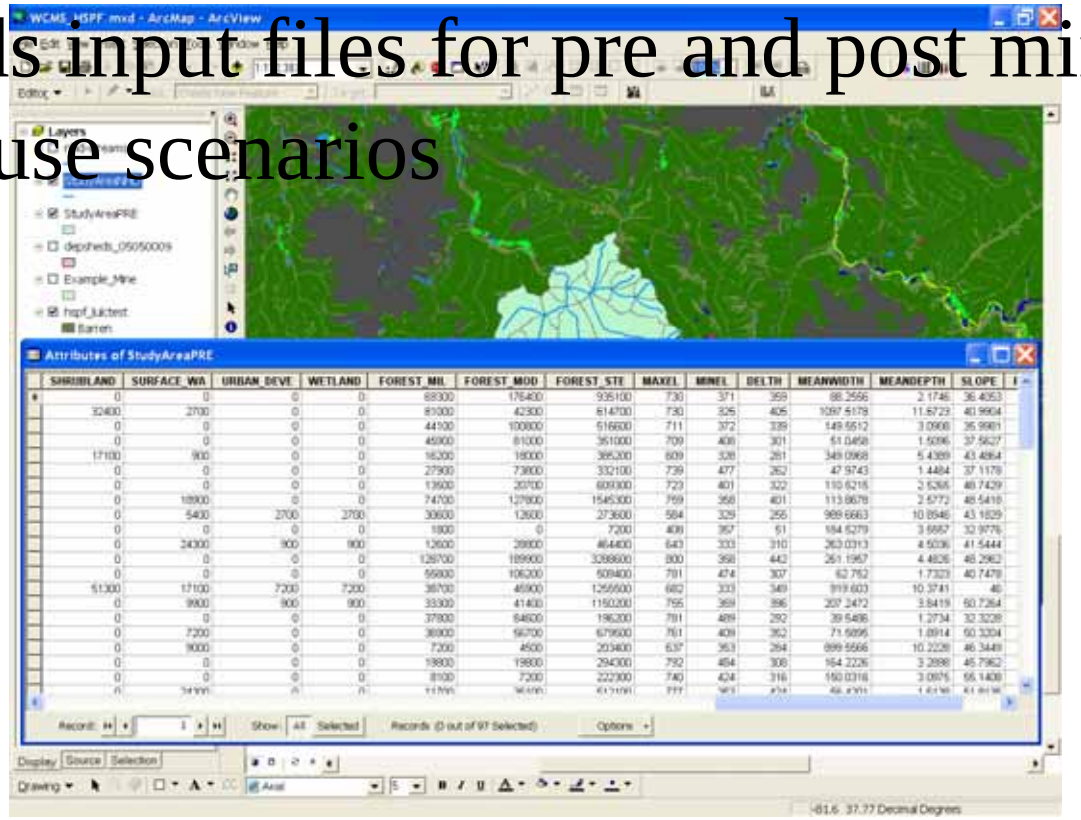
HSPF-WCMS Step 2

- Identify proposed mine site
- Calculate attributes for site (pre/post)

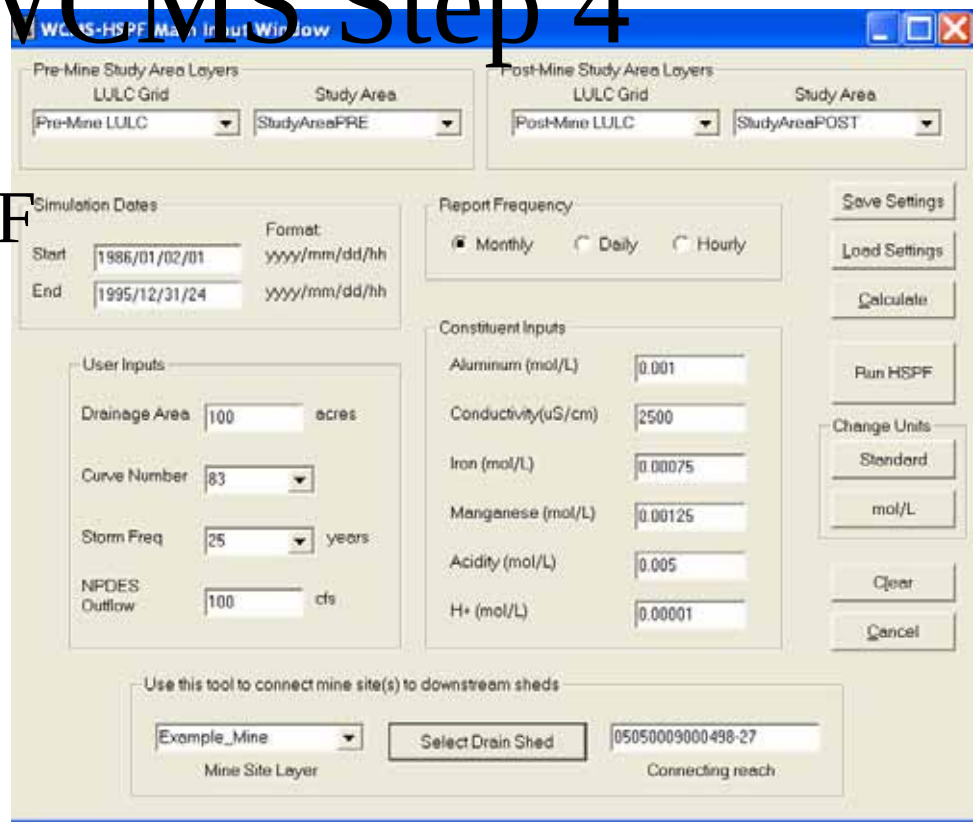


HSPF-WCMS Step 3

- Builds input files for pre and post mining land use scenarios



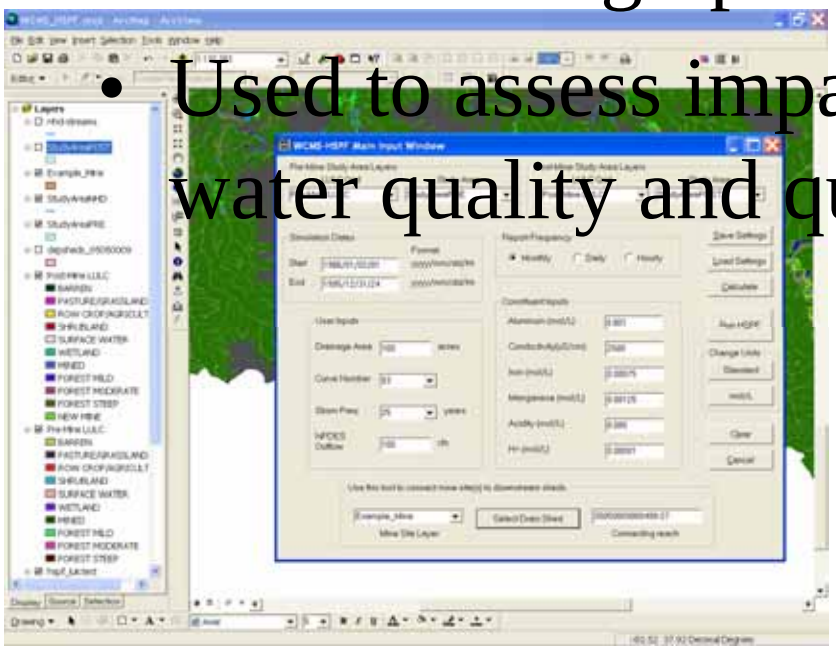
HSPF-WCMS Step 4

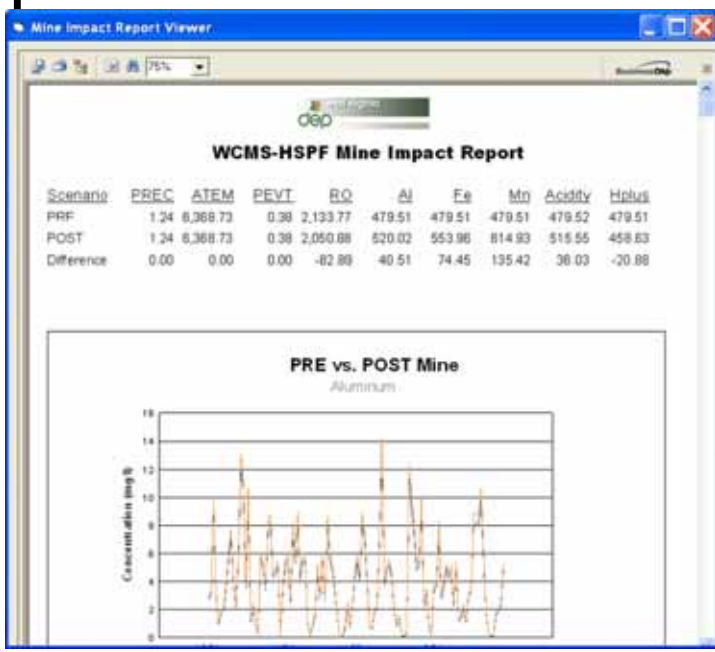


- Main inputs to HSPF
- Pre mining layer
- Post mining layer
- Specify:
  - Simulation dates
  - Time interval
- For proposed mine:
  - Storage pond info
  - Outflow
  - Outflow constituent parameters (Al, Fe, Mn, Acidity, etc.)

HSPF-WCMS Results and output

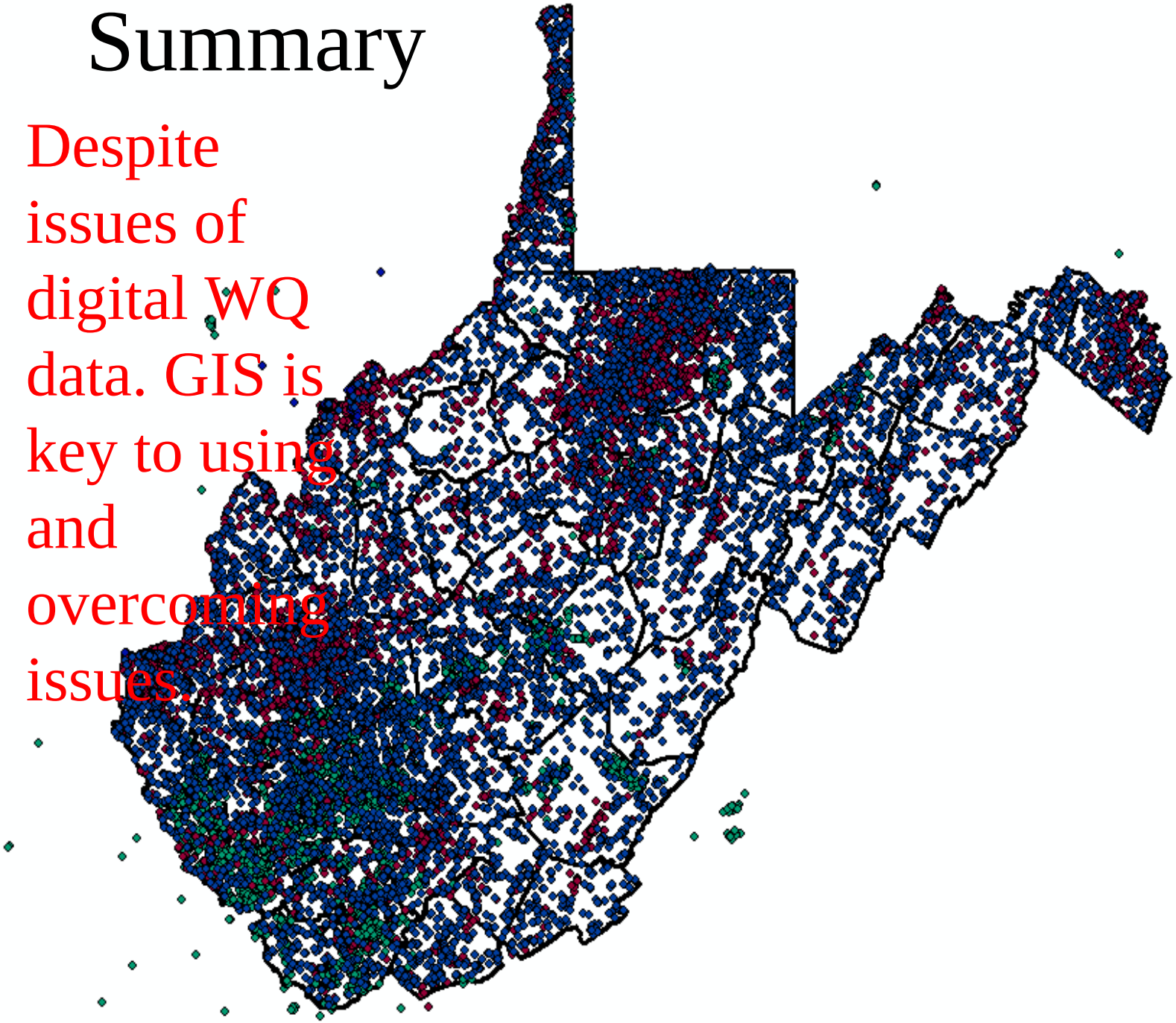
- Report on pre and post mine site
- Tabular and graphic format
- Used to assess impact of proposed site on water quality and quantity





Summary

- Despite issues of digital WQ data. GIS is key to using and overcoming issues.



Any Questions