

ArcIMS in Conjunction with Oracle Expedites Decisions in Environmental Investigations

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Abstract

During an environmental investigation, a number of samples were to be collected using direct push equipment and analyzed immediately at an on-site laboratory. Using ArcIMS in conjunction with an Oracle database, the resulting data were displayed in "near real-time", symbolizing sample locations based on analytes detected within a particular analyte group. This presentation of data allowed the entire project team to view the sampling results spatially, via the internet, and to plan the next round of sampling locations within hours of the receipt of laboratory data. Prior to the development of this procedure, an effort such as this would have been prolonged by days or even weeks. Using this method, decisions could be made and implemented daily, demonstrating a cost savings of thousands of dollars.

Task Overview

- Phase I Sampling Event
- Groundwater sample locations:
 - 6/day on first sweep (analytical data < 24 hr turn)
 - Minimum 2 samples per location (1-Duplin aquifer, 1-Upper Black Creek aquifer)
 - Second sweep – 1 sample/boring on 24 hr turn
- Groundwater samples are analyzed for full suite of VOCs (volatile organic compounds)
- Primary contaminants of concern:
 - Chlorinated Solvents
 - TRICHLOROETHENE
 - 1,1-DICHLOROETHANE

Needs Assessment

- Spatial display of analytical results immediately upon receipt of laboratory data.
- Tabular reports of analytical data (all, or hits only, to include basic data fields, including analytical result)
- Users will consist of internal Shaw project team as well as external users (client, contracting partners, etc.)

Needs Assessment

Spatial Display of Analytical Data

- Data loaded into Shaw's Oracle system upon receipt.
- Functionality developed to group by the 4 chlorinated solvent compounds of concern.
- Data access limited to this particular area of concern.
- SQL scripts developed to incorporate appropriate symbolization, grouping by compound and by aquifer (sampling zone).

SQL Script

```
CREATE OR REPLACE PROCEDURE IMS_SUMMARY (output_set_in NUMBER,  
output_category_in VARCHAR2, option_id_in NUMBER,  
uid_in VARCHAR2, session_id VARCHAR2) AS  
BEGIN  
UPDATE IMS_DETAIL_DATA TP  
SET LIMIT_MCL = (SELECT DISTINCT UPPER_LIMIT  
FROM PROJ_LIMIT PL  
WHERE PL.CASNO = TP.CASNO  
AND LIMIT_NAME = 'MCLs');  
UPDATE IMS_DETAIL_DATA TP  
SET LIMIT_PRG = (SELECT DISTINCT UPPER_LIMIT  
FROM PROJ_LIMIT PL  
WHERE PL.CASNO = TP.CASNO  
AND LIMIT_NAME = '2002 SOIL RES PRG');  
commit;  
UPDATE IMS_DETAIL_DATA TP  
SET MEDIA = decode(sample_type,'GW', 'WATER', 'SS', 'SOIL', 'DS', 'SOIL', 'SO',  
'SOIL', 'UNK');
```

SQL Script

```
UPDATE IMS_DETAIL_DATA TP
SET ZONE = sample_type
where sample_type in ('SS','DS','SO');
UPDATE IMS_DETAIL_DATA TP
SET ZONE = 'UNK'
where sample_type NOT in ('SS','DS','SO','GW')
AND ZONE IS NULL;
UPDATE IMS_DETAIL_DATA TP
SET ZONE = FIELD_BATCH_NO
WHERE SAMPLE_TYPE = 'GW'
AND ZONE IS NULL
AND FIELD_BATCH_NO IS NOT NULL;
UPDATE IMS_DETAIL_DATA TP
SET ZONE = 'WT2/U'
WHERE ZONE IS NULL
AND SAMPLE_TYPE = 'GW'
AND TO_NUMBER(END_DEPTH) < '41';
UPDATE IMS_DETAIL_DATA TP
SET ZONE = 'WT2/L'
WHERE ZONE IS NULL
AND SAMPLE_TYPE = 'GW'
AND TO_NUMBER(END_DEPTH) BETWEEN '41' AND '66';
UPDATE IMS_DETAIL_DATA TP
SET ZONE = 'SDL'
WHERE ZONE IS NULL
```

Needs Assessment

Spatial Display of Analytical Data (continued)

- Layer 1: All planned locations and locations sampled to date
- Layer 2 and 3: (Groundwater sampling results for each aquifer)
 - Any of 4 chlorinated solvents are detected above MCLs to be symbolized in red
 - Any of 4 chlorinated solvents are detected to be symbolized in orange
 - Any VOCs detected to be symbolized in yellow

Needs Assessment

Spatial Display of Analytical Data (continued)

Layer 2: (Soil sampling results)

- Any of 4 chlorinated solvents are detected above PRGs to be symbolized in red
- Any of 4 chlorinated solvents are detected to be symbolized in orange
- Any VOCs detected to be symbolized in yellow

Needs Assessment

Spatial Display of Analytical Data (continued)

Additional layers:

- Site aerial photography (10 rasters to reflect change over time and assist in identification of contaminant source(s))
- Potentiometric surface contours
- Vector basemap layers
 - Roads
 - Streams
 - Base boundary
 - Restoration program site boundaries

Needs Assessment Tabular Reports

- Identify tool on IMS site provides report generation.
- Ability to open in Excel
- Records are highlighted in same color conventions as map symbols.

Needs Assessment

User Access

- IMS site is hosted on server in the DMZ to allow for external user access.
- Appropriate security measures are incorporated.

IMS/Oracle connection

- Current strategy based on SDE and SQL Server
- Legacy Oracle-based ShawView Environmental Database using Stored Procedures and COM+ components to process data



- Oracle + Shapefiles = No direct connection.
Query results extracted to dBase files

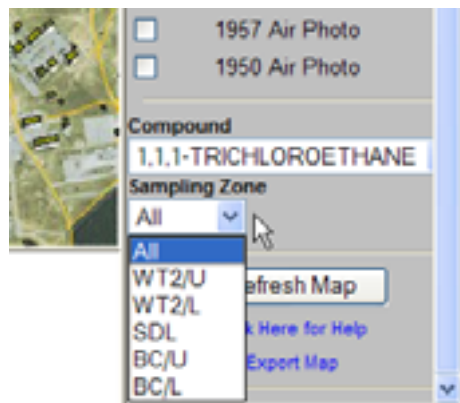
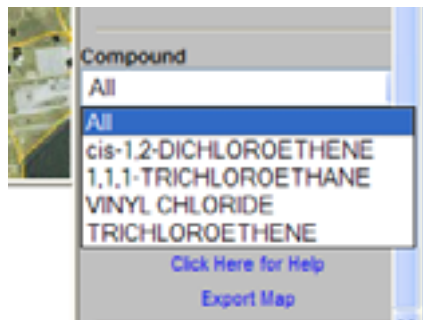
```
Function ExportToDBase(RS)
```

```
Dim DBFCN  
Dim fso  
Dim lDBFTableName  
Dim DBFFFileName  
Dim lDBFPath  
Dim RecordCount
```

```
do while not RS.EOF  
strSQL = "INSERT INTO " & lDBFTableName & " ( " & _  
"LOCATION_C, " & _  
"SAMPLEZONE, " & _  
"MEDIA, " & _  
"CASNO, " & _  
"PARAMETER, " & _  
"SYMBOL, " & _  
"CREATEDATE " & _  
) VALUES ("
```

HTML and Java Script Code

- HTML Viewer TOC.HTM was modified to present Compound and Sampling Zone dropdowns:



AXL Code

- aimsCustom.js was modified to inject SpatialQuery AXL during render event for performing on-the-fly symbology and joins to previously extracted Oracle data:

```
function addSpecialRenderToMap(i)
{
    var customString = "";
    var whereString = "";
    var outlineColor = "0,0,0";
    var width = "10";
    var mciprg = "MCL";
    var symboltype = "circle";

    customString += '<SPATIALQUERY subfields="ALL" where="" + whereString + "" ';
    customString += 'joistables="DETECT" ';
    customString += 'joineexpression="To={Sample_Locs_2007Mar13.LOCATION_C},From={DETECT.LOCATION_C},Type={scan}" ';
    customString += '/>\n';
    customString += '<GROUPRENDERER\n';
    customString += '  <VALUEMAPRENDERER lookupfield="DETECT.SYMBOL">\n';
    customString += '    <EXACT value="4" label="1 or more Chlorinated Solvents Exceed" + mciprg + "">\n';
    customString += '      <SIMPLEMARKERSYMBOL color="255,0,0" type="" + symboltype + "" outline="" + outlineColor + "" width="" + width + "" />\n';
    customString += '    </EXACT>\n';
    customString += '    <EXACT value="3" label="1 or more Chlorinated Solvents Detected">\n';
    customString += '      <SIMPLEMARKERSYMBOL color="255,153,0" type="" + symboltype + "" outline="" + outlineColor + "" width="" + width + "" />\n';
    customString += '    </EXACT>\n';
    customString += '    <EXACT value="2" label="1 or more VOCs Detected">\n';
    customString += '      <SIMPLEMARKERSYMBOL color="255,255,51" type="" + symboltype + "" outline="" + outlineColor + "" width="" + width + "" />\n';
    customString += '    </EXACT>\n';
    customString += '    <EXACT value="1" label="No VOCs Detected">\n';
    customString += '      <SIMPLEMARKERSYMBOL color="51,255,51" type="" + symboltype + "" outline="" + outlineColor + "" width="" + width + "" />\n';
    customString += '    </EXACT>\n';
    customString += '  </VALUEMAPRENDERER>\n';
    customString += '  <SIMPLELABELRENDERER field="LOCATION_C" labelweight="high_weight" labelpriorities="0,0,0,0,1,0,0,0">\n';
    customString += '    <TEXTSYMBOL transparency="0.8" antialiasing="true" font="Courier New" fontstyle="bold" fontsize="12" fontcolor="0,0,255" glowing="224,224">\n';
    customString += '  </SIMPLELABELRENDERER>\n';
    customString += '</GROUPRENDERER>\n';
}
```

IMS Viewer



IMS Viewer

Legend Groundwater Sample Locations

-  1 or more Chlorinated Solvents Exceed MCL
-  1 or more Chlorinated Solvents Detected
-  1 or more VOCs Detected
-  No VOCs Detected
-  Restoration Program Sites
-  Roads Off Base
-  Roads On Base
-  Streams
-  Buildings
-  Shaw AFB Boundary
-  2005 Air Photo

Tabular Report

Detail Table for Location AOCNDPT-9

[Open in Excel](#)

Location	Sample Type	Sampling Zone	Object Type	Sample Date	Sample Purpose	Start Depth	End Depth	Ground Elevation	Parameter	Result	Qualifier	Units	Detect	Limit MCL	Limit Prg	North	East
AOCNDPT-9	GW	BC/U	HYPN	2/9/2007	REG	103	105.5	235.5265	1,1,1,2-TETRACHLOROETHANE	1	U	ug/L	N	No Limit	3.18717193	782583.731	2162258.7676
AOCNDPT-9	GW	BC/U	HYPN	2/9/2007	REG	75	77.5	235.5265	1,1,1,2-TETRACHLOROETHANE	1	U	ug/L	N	No Limit	3.18717193	782583.731	2162258.7676
AOCNDPT-9	GW	BC/U	HYPN	2/9/2007	REG	103	105.5	235.5265	1,1,1-TRICHLOROETHANE	1	U	ug/L	N	200	198.238557	782583.731	2162258.7676
AOCNDPT-9	GW	BC/U	HYPN	2/9/2007	REG	75	77.5	235.5265	1,1,1-TRICHLOROETHANE	1	U	ug/L	N	200	198.238557	782583.731	2162258.7676
AOCNDPT-9	GW	BC/U	HYPN	2/9/2007	REG	103	105.5	235.5265	1,1,2,2-TETRACHLOROETHANE	1	U	ug/L	N	No Limit	0.40761860	782583.731	2162258.7676
AOCNDPT-9	GW	BC/U	HYPN	2/9/2007	REG	75	77.5	235.5265	1,1,2,2-TETRACHLOROETHANE	1	U	ug/L	N	No Limit	0.40761860	782583.731	2162258.7676
AOCNDPT-9	GW	BC/U	HYPN	2/9/2007	REG	103	105.5	235.5265	1,1,2-TRICHLOROETHANE	1	U	ug/L	N	5	0.72862538	782583.731	2162258.7676
AOCNDPT-9	GW	BC/U	HYPN	2/9/2007	REG	75	77.5	235.5265	1,1,2-TRICHLOROETHANE	1	U	ug/L	N	5	0.72862538	782583.731	2162258.7676
AOCNDPT-9	GW	BC/U	HYPN	2/9/2007	REG	103	105.5	235.5265	1,1-DICHLOROETHANE	1.17		ug/L	Y	No Limit	50.6396833	782583.731	2162258.7676
AOCNDPT-9	GW	BC/U	HYPN	2/9/2007	REG	75	77.5	235.5265	1,1-DICHLOROETHANE	1	U	ug/L	N	No Limit	50.6396833	782583.731	2162258.7676
AOCNDPT-9	GW	BC/U	HYPN	2/9/2007	REG	103	105.5	235.5265	1,1-DICHLOROETHENE	6.1		ug/L	Y	7	12.3530677	782583.731	2162258.7676
AOCNDPT-9	GW	BC/U	HYPN	2/9/2007	REG	75	77.5	235.5265	1,1-DICHLOROETHENE	1	U	ug/L	N	7	12.3530677	782583.731	2162258.7676
AOCNDPT-9	GW	BC/U	HYPN	2/9/2007	REG	103	105.5	235.5265	1,1-DICHLOROPROPENE	1	U	ug/L	N	No Limit	No Limit	782583.731	2162258.7676
AOCNDPT-9	GW	BC/U	HYPN	2/9/2007	REG	75	77.5	235.5265	1,1-DICHLOROPROPENE	1	U	ug/L	N	No Limit	No Limit	782583.731	2162258.7676
AOCNDPT-9	GW	BC/U	HYPN	2/9/2007	REG	103	105.5	235.5265	1,2,3-TRICHLOROBENZENE	1	U	ug/L	N	No Limit	No Limit	782583.731	2162258.7676

Tabular Report

AOCNWP-15	GW	BC/U	HYPN	11/19/2006	REG	142.5	142.5	251.8037	TOLUENE	1	U	ug/L	N	1000	65.6015044	782252.908	2160232.963
AOCNWP-15	GW	WT2/L	HYPN	11/13/2006	REG	53.1	53.1	251.8037	TRICHLOROETHENE	1	U	ug/L	N	5	0.05298333	782252.908	2160232.963
AOCNWP-15	GW	WT2/L	HYPN	11/13/2006	REG	42.9	42.9	251.8037	TRICHLOROETHENE	1	U	ug/L	N	5	0.05298333	782252.908	2160232.963
AOCNWP-15	GW	WT2/L	HYPN	11/13/2006	FD	53.1	53.1	251.8037	TRICHLOROETHENE	1	U	ug/L	N	5	0.05298333	782252.908	2160232.963
AOCNWP-15	GW	WT2/L	HYPN	11/14/2006	REG	62.4	62.4	251.8037	TRICHLOROETHENE	1	U	ug/L	N	5	0.05298333	782252.908	2160232.963
AOCNWP-15	GW	BC/U	HYPN	11/16/2006	REG	112.12	112.12	251.8037	TRICHLOROETHENE	49		ug/L	Y	5	0.05298333	782252.908	2160232.963
AOCNWP-15	GW	BC/U	HYPN	11/16/2006	REG	89.61	89.61	251.8037	TRICHLOROETHENE	2		ug/L	Y	5	0.05298333	782252.908	2160232.963
AOCNWP-15	GW	BC/U	HYPN	11/16/2006	REG	94.66	94.66	251.8037	TRICHLOROETHENE	2		ug/L	Y	5	0.05298333	782252.908	2160232.963
AOCNWP-15	GW	BC/U	HYPN	11/16/2006	REG	100.93	100.93	251.8037	TRICHLOROETHENE	34		ug/L	Y	5	0.05298333	782252.908	2160232.963
AOCNWP-15	GW	BC/U	HYPN	11/16/2006	REG	105.6	105.6	251.8037	TRICHLOROETHENE	34		ug/L	Y	5	0.05298333	782252.908	2160232.963
AOCNWP-15	GW	BC/U	HYPN	11/17/2006	REG	122.5	122.5	251.8037	TRICHLOROETHENE	93		ug/L	Y	5	0.05298333	782252.908	2160232.963
AOCNWP-15	GW	BC/U	HYPN	11/18/2006	REG	132.5	132.5	251.8037	TRICHLOROETHENE	46		ug/L	Y	5	0.05298333	782252.908	2160232.963
AOCNWP-15	GW	BC/U	HYPN	11/19/2006	REG	142.5	142.5	251.8037	TRICHLOROETHENE	45		ug/L	Y	5	0.05298333	782252.908	2160232.963
AOCNWP-15	GW	WT2/L	HYPN	11/13/2006	REG	53.1	53.1	251.8037	VINYL CHLORIDE	2	U	ug/L	N	2	0.07906778	782252.908	2160232.963
AOCNWP-15	GW	WT2/L	HYPN	11/13/2006	REG	42.9	42.9	251.8037	VINYL CHLORIDE	2	U	ug/L	N	2	0.07906778	782252.908	2160232.963
AOCNWP-15	GW	WT2/L	HYPN	11/13/2006	FD	53.1	53.1	251.8037	VINYL CHLORIDE	2	U	ug/L	N	2	0.07906778	782252.908	2160232.963
AOCNWP-15	GW	WT2/L	HYPN	11/14/2006	REG	62.4	62.4	251.8037	VINYL CHLORIDE	2	U	ug/L	N	2	0.07906778	782252.908	2160232.963
AOCNWP-15	GW	BC/U	HYPN	11/16/2006	REG	112.12	112.12	251.8037	VINYL CHLORIDE	2	U	ug/L	N	2	0.07906778	782252.908	2160232.963

Updates

- New layers added and updated as “step-outs” are planned.
 - Allows for team review and final decisions to be made.

Step-Outs (Proposed Sampling Locations)



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