RBDMS Environmental
for Analytical and Field Data Management

Paul Jehn
About RBDMS

• Originally designed to help agencies manage oil and gas injection well data and evaluate the risk injection wells pose to underground sources of drinking water (USDWs).

• Now also used to monitor the environmental effects of oil and gas exploration and production activities as well as coal, industrial, and aggregate minerals mining operations.

• Allows integration of oil and gas resource data and state source water protection planning, a requirement of the Safe Drinking Water Act Revisions

In March 2001, DOE honored the RBDMS project with an Energy 100 Award.

RBDMS is now a mission-critical tool for 22 state agencies.
All the RBDMS Suite of Tools are:

- Compatible with SQL and Oracle
- Used as a group or individually
- Regulatory agencies or industry
Developed for the oil and gas regulatory program

Modules are compatible with all water programs

Modules include:
- Field inspection
- Data mining
- Wellbore schematics
- Electronic permitting and reporting
- Water quality/quantity, environmental data
Manages data collected for environmental matrices: surface water, ground water, sediment, soil, air.

- Qualitative and measured field observations
- Analytical water quality and chemical data reporting from industry operators and their third-party laboratories.
Data entry
- Electronic transfer
- Web interface

Data management
- Custom querying capability
- Automated alerts

Data Reporting
- GIS
- Database interface
- Public Web interface
- Export routine
RBDMS Environmental architecture:

- Web client
- RBDMS web service and data access middle tiers for handling data exchange, validation, alert notifications
- Proven RBDMS Env SQL Server data structure.
- Electronic data delivery in two formats:
  - XML based on a subset of the EPA WQX schema
  - Excel spreadsheet
Secure logon and roles-based security that integrates with the eForm architecture.

A filterable dashboard.

Online form completion for facility creation, sample data, and field and laboratory results.

Client- and server-side data validation for immediate user feedback.

A server-neutral GIS.

Chain-of-custody and statistical reporting.

Electronic data deliverable formats based on the EPA WQX schema ([http://www.epa.gov/storet/wqx/index.html](http://www.epa.gov/storet/wqx/index.html)).
Each record displayed in the dashboard is hyperlinked to related pages.
Dashboard filtering options include specifying search criteria to filter for desired datasets.

Targeted searches by facility:

Searches for specific strings:

Complex AND and OR queries:
Dashboard filtering options also include grouping facilities by project.

Set the active project.

Filter the dashboard to show only those facilities that are associated with the project.

Clear the filtered view of the dashboard.
Automated alerts and data validation checks included in RBDMS Env:

**Facility:**
- Name
- Location
- Location Extent

**Sample:**
- Sample Date
- Sample Location
- Sampler Name
- Orphaned Data

**Results:**
- Cation:Anion Ratio
- Exceedance
- Holding Time
- Missing Analysis
- Dissolved vs. Total
- % Difference from Baseline
- Sodium Absorption Ratio
## Automated alerts for Results in RBDMS Env:

<table>
<thead>
<tr>
<th>Alert</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cation Anion Ratio</strong></td>
<td>Generates alerts where the Cation/Anion ratio is not within limits. The milliequivalents are calculated by dividing the Result.ResultValue by the Parameter.MEQFactor column.</td>
</tr>
<tr>
<td><strong>Exceedance</strong></td>
<td>For a given analysis, an acceptable range of <em>Upper</em> and <em>Lower Criteria</em> is specified (e.g., the pH must be 5-10), and this range is applied to all facility locations.</td>
</tr>
<tr>
<td><strong>Holding Time</strong></td>
<td>Generates alerts for analyses that have not been reported and with the current date greater than the sample date + holding time or with the analysis date &gt; sample date + holding time.</td>
</tr>
<tr>
<td><strong>Missing Analysis</strong></td>
<td>Samples are compared to the earliest sample collected for the location (Loc). If the earliest sample has ParameterIDs that are not in the current sample, then an eNotify record is added.</td>
</tr>
<tr>
<td><strong>Dissolved vs. Total</strong></td>
<td>Creates an alert record if a dissolved analysis is greater than a total analysis.</td>
</tr>
<tr>
<td><strong>% Difference From Baseline</strong></td>
<td>Compares current results to previous results against a specified deviation allowed for a confidence interval (if adequate data present). Location-specific warnings are then generated.</td>
</tr>
<tr>
<td><strong>Sodium Absorption Ratio</strong></td>
<td>The ratio of sodium milliequivalents to calcium plus magnesium milliequivalents is calculated, and the result is compared to an upper and lower limit.</td>
</tr>
</tbody>
</table>
The data submitted will be checked for pre-defined validation errors. Users receive a confirmation of the status of the upload (Pass or Fail with reason).

Using this method avoids key-entry errors and saves time.
Steps in EDD processing:

- Upload a schema-compliant XML or approved-format Excel data file.
- Parse the data file and store in the DMZ tables.
  - For XML files, this action will validate the data against the schema. The schema location is [http://www.rbdmsonline.org/xml/COEnvEDD.xsd](http://www.rbdmsonline.org/xml/COEnvEDD.xsd).
  - For Excel files, the action will read the file, checking for format conformance then populate the DMZ tables with the data.
- Perform second-round QC checks on the data to validate FacilityIDs, LabIDs, among many other checks.
Users also can download files they previously uploaded.

- Retrieve the original file uploaded (Excel or XML).
- Export the data in schema-compliant XML from the Home page dashboard.
Industry operator or laboratory representatives can log in to RBDMS Env and upload data in online forms.

- Create new facilities and report sample data and results on single forms.
- Client-side data validation checks flag entries that are out of range or incorrectly formatted for immediate corrections.
RBDMS Environmental GIS Query to find available monitoring data
Select station and expand to see sampling events
Expand event to see results

<table>
<thead>
<tr>
<th>ParamID</th>
<th>Result Value</th>
<th>Qual</th>
<th>Units</th>
<th>ListSeq</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature, water</td>
<td>9</td>
<td></td>
<td>Celsius</td>
<td></td>
</tr>
<tr>
<td>Temperature, air</td>
<td>6</td>
<td></td>
<td>Celsius</td>
<td></td>
</tr>
<tr>
<td>Discharge, cubic feet per second</td>
<td>7140</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discharge, instantaneous, cubic feet per</td>
<td>7140</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specific conductance, water, unfiltered</td>
<td>200</td>
<td></td>
<td>user:</td>
<td></td>
</tr>
<tr>
<td>Dissolved oxygen, water, unfiltered</td>
<td>10.4</td>
<td></td>
<td>mg/L</td>
<td></td>
</tr>
<tr>
<td>Dissolved oxygen, water, unfiltered, po</td>
<td>90</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemical oxygen demand, low level, w</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH, water, unfiltered, field</td>
<td>7.4</td>
<td></td>
<td>pH, SU</td>
<td></td>
</tr>
<tr>
<td>Residue on evaporation, dried at 105 d</td>
<td>300</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residue, total nonfilterable, milligrams</td>
<td>160</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ammonia, water, unfiltered,</td>
<td>0.02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrite plus nitrate, water, unfiltered,</td>
<td>0.33</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orthophosphate, water, filtered, milligram</td>
<td>0.08</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phosphorus, water, unfiltered</td>
<td>0.11</td>
<td></td>
<td>mg/L</td>
<td></td>
</tr>
<tr>
<td>Orthophosphate, water, filtered, milligram</td>
<td>0.02</td>
<td></td>
<td>mg/L</td>
<td></td>
</tr>
<tr>
<td>Organic carbon, water, unfiltered, milligram</td>
<td>9.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chloride, water, filtered, milligrams per</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silica, water, filtered, milligrams per liter</td>
<td>5.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arsenic, water, unfiltered, micrograms</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chromium, water, unfiltered, micrograms</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Trend Reports by Analyte or Location
A server-neutral GIS interacts with both statistical reports and the project builder.
Implementation in Colorado

- This Program applies to all newly developed or new expansions of wells or pads, not existing wells or pads.
- 2) This Program is contingent upon landowner-approved access.
- 3) Samples will be collected in accordance with a Sampling and Analysis Plan developed for COGA’s voluntary program and approved by the COGCC.
Sampling will be conducted at two downgradient groundwater features within a ½ mile radius of the surface location of the proposed oil and gas well pad.

Post-drilling sampling will be conducted within 1 to 3 year period.

In the event of a complaint from a water well owner located within ½ mile of the well pad, the operator will, upon proper notification and expeditious access to the well granted by the landowner, make its best efforts to collect a sample within 48 hours, after being notified of a complaint alleging a distinct, identifiable change in water quality (such as odor, color, taste, or turbidity).

Samples will be collected by qualified individuals and sent to a certified laboratory for analysis.
Within three months of collecting the sample(s), the landowner will be provided with a letter explaining the testing and analyses completed and a copy of the laboratory analytical report. Landowners must also consent to allowing the laboratory analytical results to be submitted to the operator, COGCC, or any other regulatory agencies.
Landowners will also be provided with educational materials developed specifically for COGA’s Program that address topics such as water well integrity, groundwater quality, and oil and gas operations and regulations.

The groundwater sampling data will be made available to the public, including operators, by the COGCC through their database link via their website. The data will be posted within two weeks of electronic submittal to the COGCC.
The COGCC database will be used to assist operators in conducting the baseline groundwater sampling program and to characterize and evaluate trends in groundwater quality within different basins in Colorado.
90% of operators have agreed to participate in the program

COGCC estimates that there will be 3,100 new wells in 2012

At 4 samples/wells=12,000 samples for 2012

Sample results can be exported