

Management and Analysis of Groundwater Data

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Presentation Overview

- Technology Overview
 - Field Instrumentation
 - Software
- Field Applications
- Demonstration
- The Future

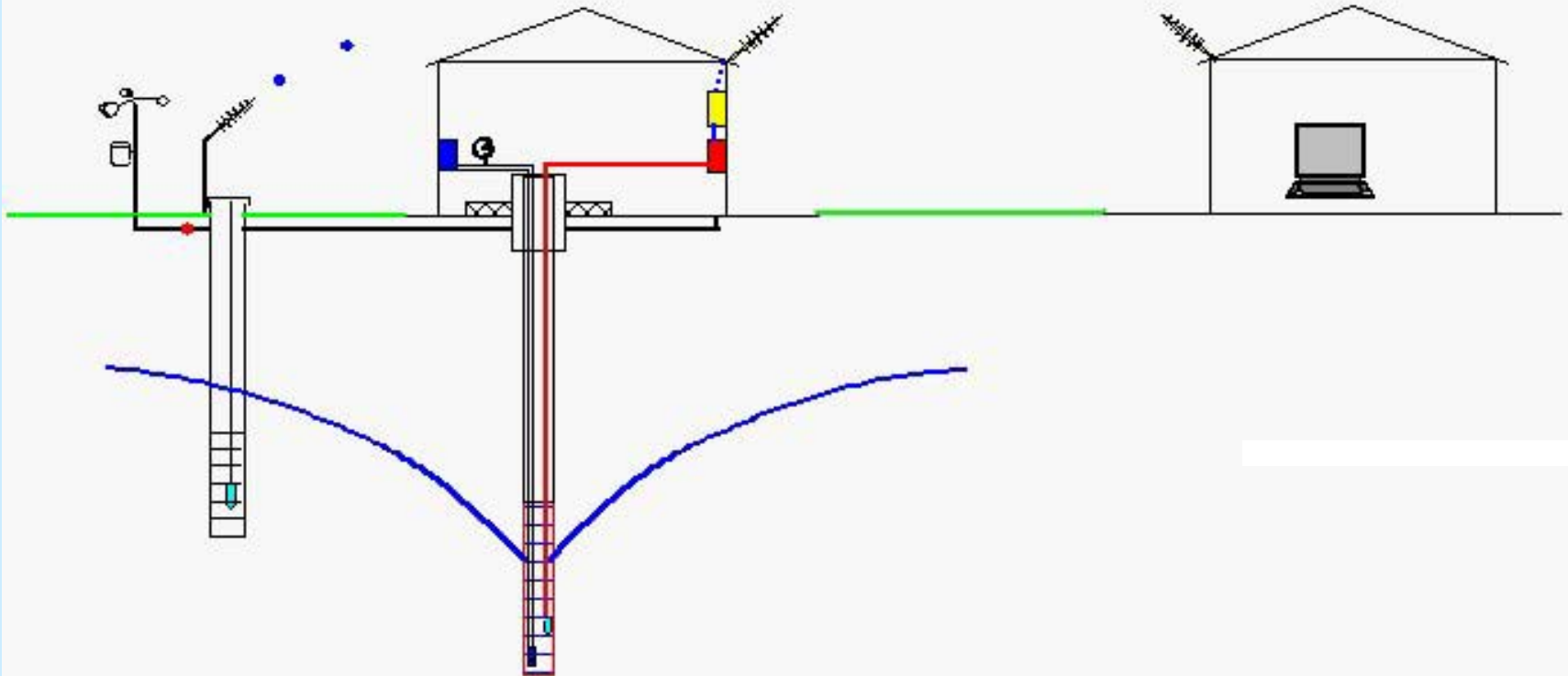
Technologies and Definitions

- Computer processing speeds
- Global Positioning Systems (GPS)
- Aerial and satellite imagery
- Chemical and physical parameter sensors
- Solar power
- Wireless telecommunications
- Programmable Logic Controller (PLC)
- Supervisory Control and Data Acquisition (SCADA)
- Geographic Information Systems (GIS) software
- Artificial Neural Networks (ANN)
- Groundwater modeling software
- Database and internet programming
- Data visualization and rendering (VAR) software

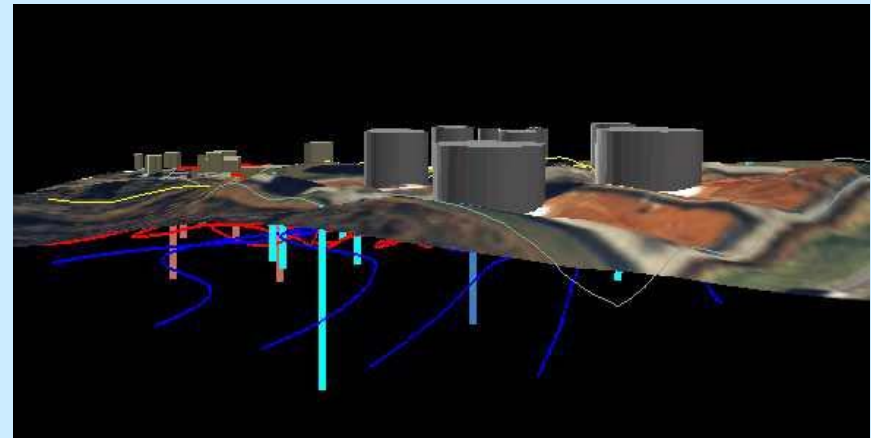
Technology Principle

- Conventional modeling techniques rely on historic, usually “snapshot in time” data and are time consuming to build and calibrate. Predictive results are rarely tested on an ongoing basis to see if the prediction was accurate under myriad environmental conditions.
- Building “learning” models of environmental data can be accomplished by integrating stand-alone technologies.
- In the process, data can be managed, analyzed and visualized in a rapid and efficient manner.

Process Schematic



Field Instrumentation



Software

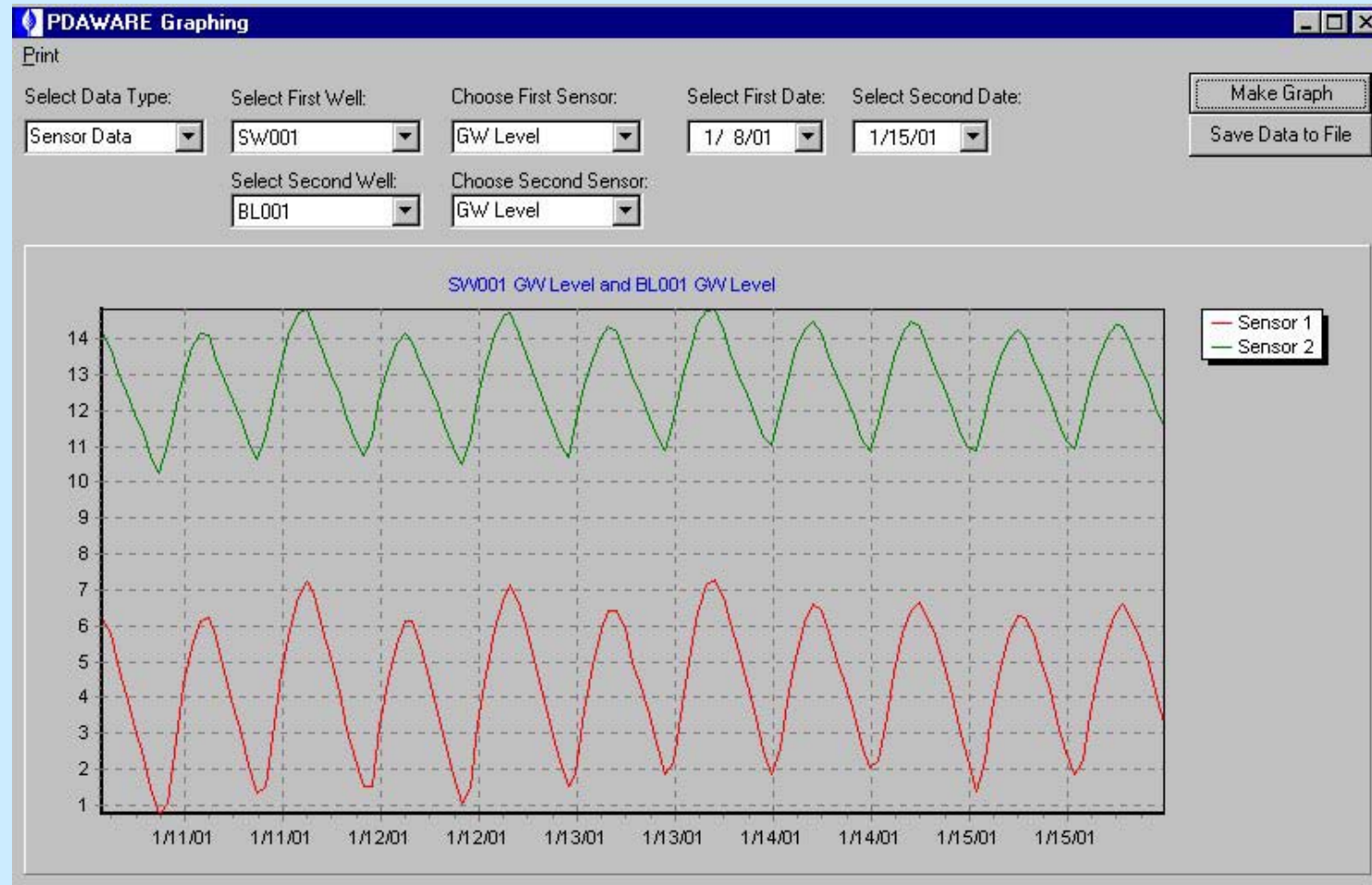
- **Telemetry** - ProAcq PDAWARE or Campbell Scientific
- **GIS** - ESRI ArcView and ArcGIS or MapObjects
- **Database** - Microsoft Access /SQL, Oracle, etc.
- **GEMS** – Geographic Environmental Management System (Summit Envirosolutions)
- **Data Visualization** - SESCO EWB (VisualGroundwater) and Summit Envirosolutions (RealFlow)
- **Modeling** - MODFLOW Graphical User Interface (GUI)
- **Artificial Neural Network** - NOAH, LLC

ProAcq PDAWARE



ProAcq, Inc.

Synchronized
Real Time Logging
& Control Systems



Need for Database Tool: Geographic Environmental Management System (GEMS)

■ Including:

- Expedient data entry
- Relational database
- Ability to trend, graph, and export report-ready data
- Easily import data into GIS and industry standard software



GEMS Data Query

Search Criteria

* Required Search Criteria

Select Location(s)
B-11 *

Select Parameter(s)
Ground Water Elevation *
Media
water

Select a Sort Order

ASC	Sort Order	DESC	
1	Location		R E S E T
	Sample DateTime		
	Parameter		
	Numeric Result		
	Log Date/Time		

Select Date Period

Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

Month: Aug
Year: 2001
Select Current Month
Select Current Quarter
Select Current Year
Select All

Start Date: 1/1/50 *
End Date: 8/23/2002 *

☐ Parameter Search On/Off

☒ Advanced Search Options

Optional Search Criteria

Exclusions
BAE
Analytic Result Codes
SAR
Source
Sample Number
Laboratory

Setting Limits on Results

☐ Numeric Limits On/Off
☐ Graphic Limits On/Off

Numeric Result Values

Minimum	Maximum

Graphic Result Values

Minimum	Maximum

☒ 3-D Visualization

3-D Visualization

Report Date:
Assign Date to Queried Data
Go to 3-D Worksheet

Regulatory Limit Exceedance

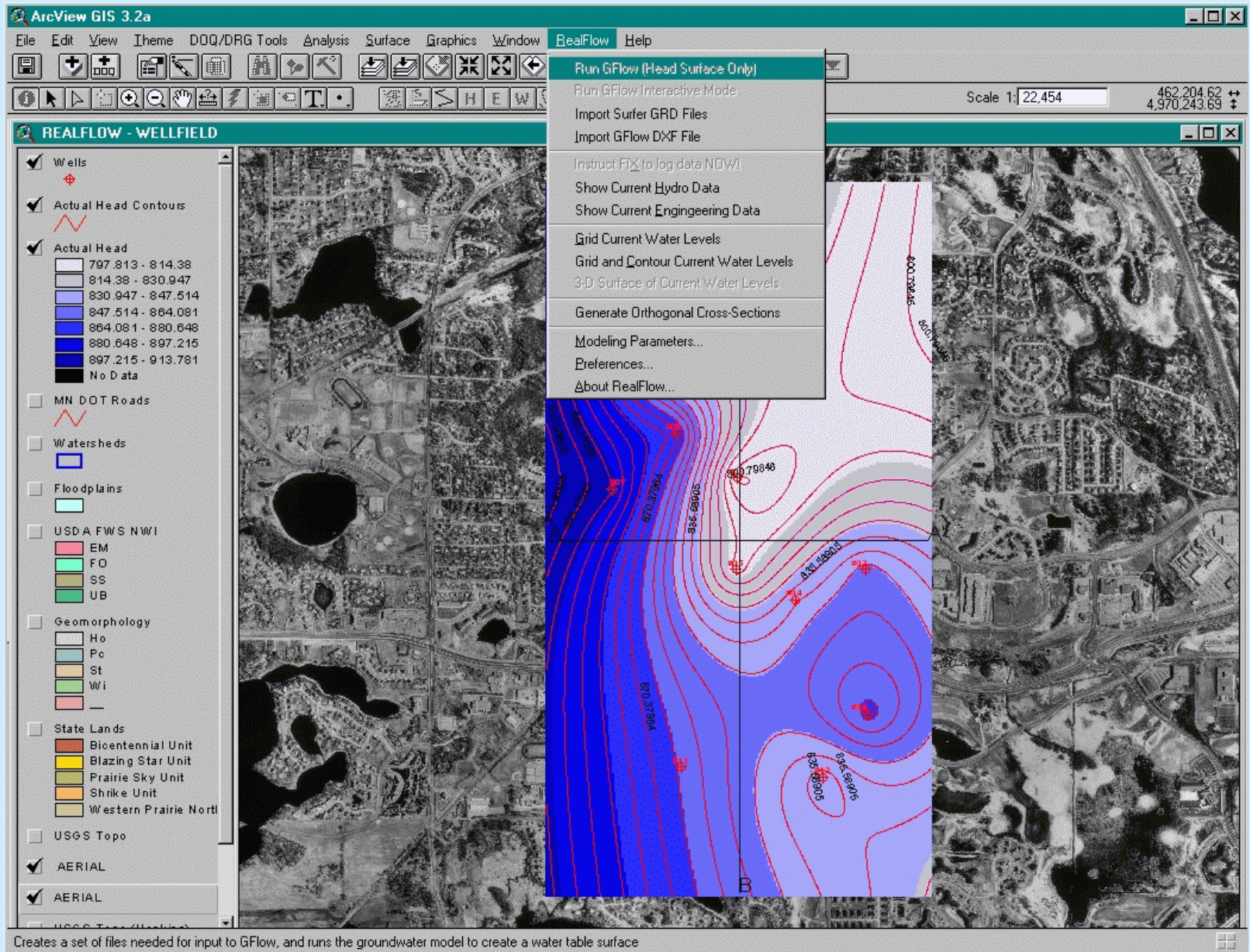
☒ Actual ☐ Potential
Limit
Medium

HELPFUL HINTS

Select a Location using the pull down box. Location groups will show up at the top of the list and will always start with an underline. Selecting a location group will instruct the query to include all locations in the location group. To create a new location group or to edit an existing location group, click the location groups button on the right side of the form.

NOTE:
Once you have filled in the Required Search Criteria (Location, Parameter, and Date Period), click on "Search Results" for a table of your results.

RealFlow



Existing Field Applications

- Municipal (Water Supply)
- Petroleum Refining/Distribution (Monitoring/Remediation)
- Mining (Monitoring/Remediation)

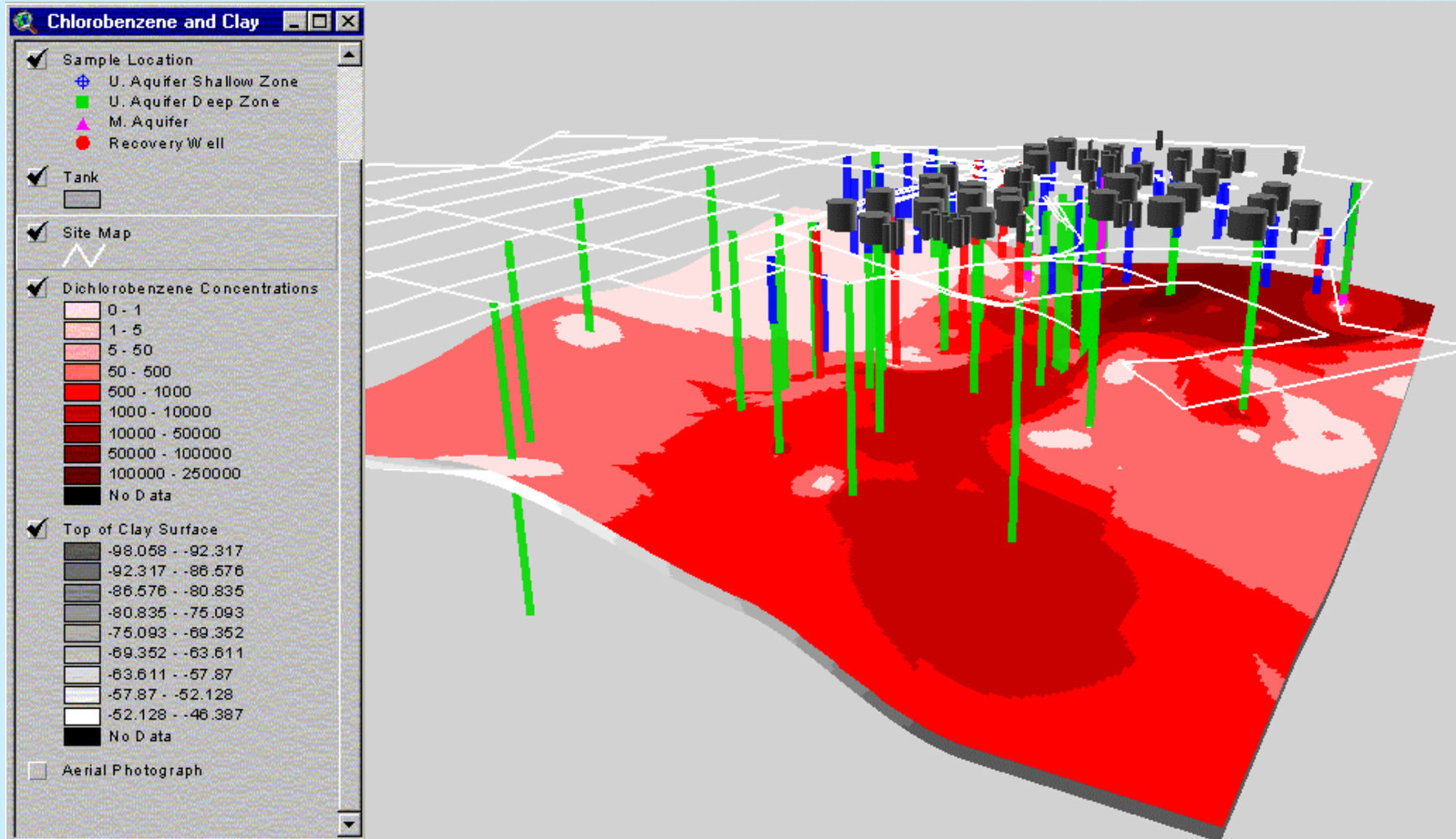
DEMONSTRATION

Municipal Well Field

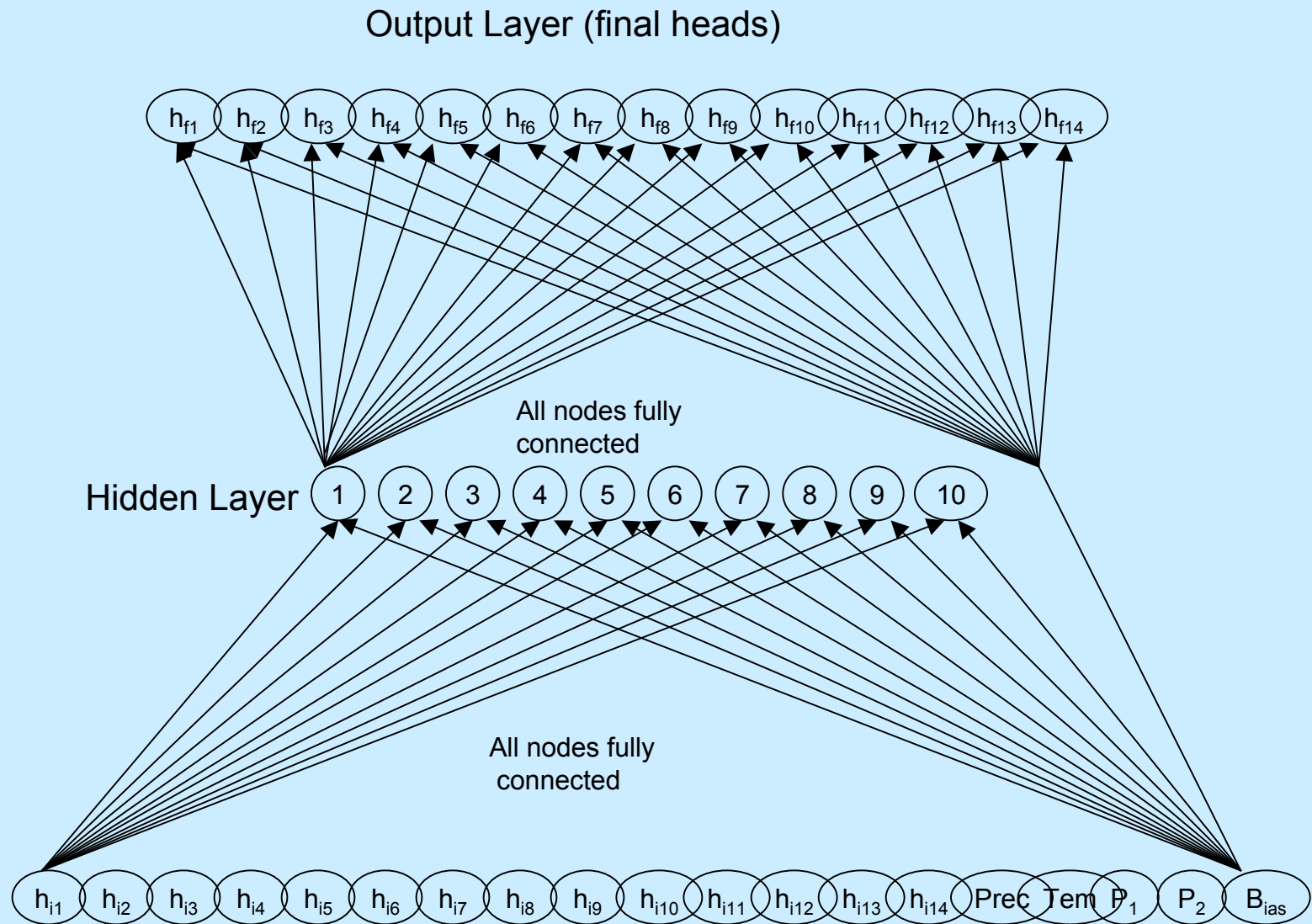
Setting: 4 production wells instrumented with sensors

- ProAcq is continually performing aquifer testing
- RealFlow (ArcView extension) hooks up to PLC, mines current data, spatially analyzes head values and water quality (conductivity) in near-real time
- GEMS enables historic data analysis and ongoing aquifer parameter calculation
- EWB allows 3-D animations of physical and chemical data
- Export to GroundwaterVistas enables ongoing calibration

Rapid Visualization and Rendering

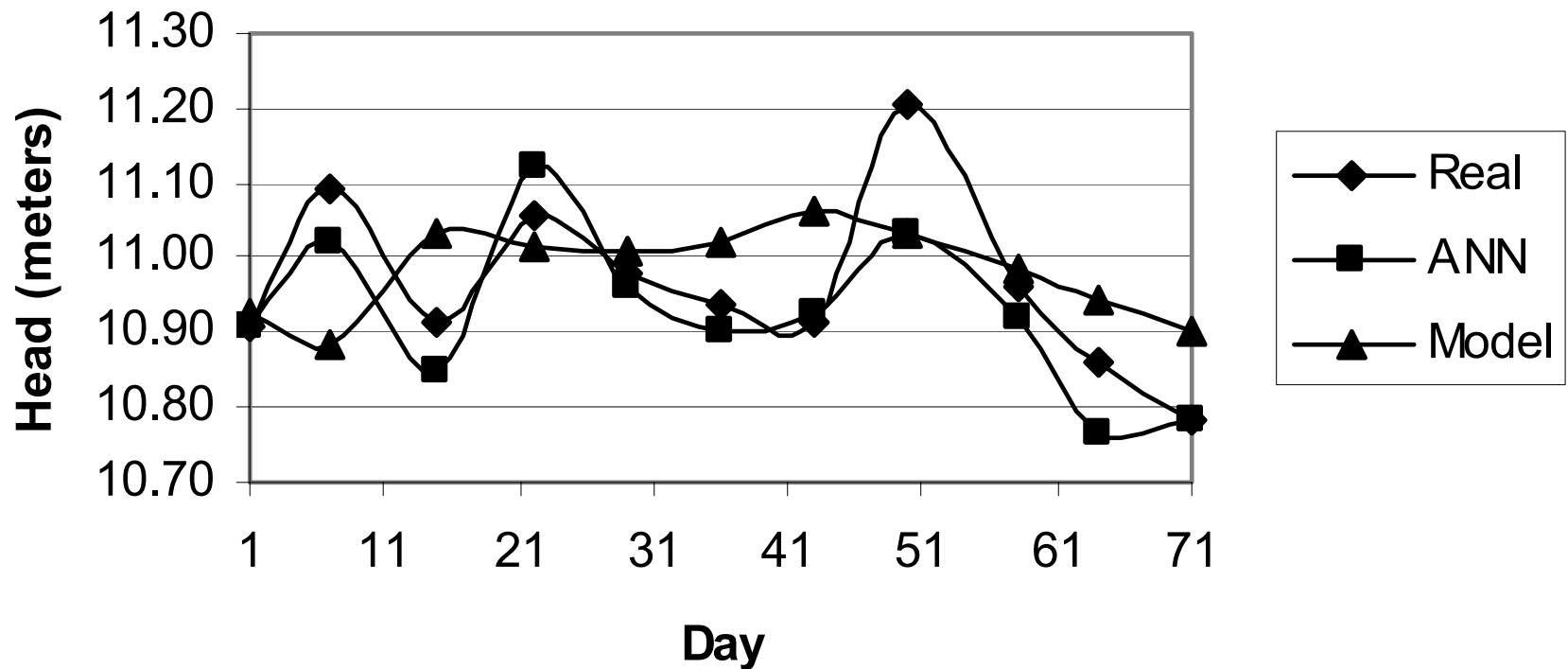


The Future - Artificial Neural Network



Input Layer (initial heads, precipitation, temperature, pumping rates, and bias)

Artificial Neural Network – Case Study



Summary

- Sensors are and will increasingly become available for a wide range of parameters
- Wireless communications are becoming commonplace
- By combining relational databases and GIS (GEMS), spatial analysis of continuous data streams is fast and efficient
- Computing power and internet speeds will enable real-time modeling for both physical and chemical parameters (RealFlow®)
- Neural Networks will significantly augment conventional modeling techniques

Conclusions

- The ability to control and continuously monitor environmental conditions leads to “smart” models that learn over time
- The technology is as applicable to surface water, air quality, and noise as it is to groundwater

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