

A landscape photograph of a calm pond surrounded by trees. The water is still, reflecting the sky and the surrounding greenery. The trees are mostly evergreens, with some bare branches visible in the foreground. The overall scene is peaceful and natural.

PHASES II and III

PROJECT UPDATE

**WILLAND POND WELL
INVESTIGATION
HYDROGEOLOGIC
ASSESSMENT**

Phase II and III Work Efforts

Phase II

Develop a Numerical Groundwater Flow Model to assess the relationship between pumping the Willand Pond 12-Inch Production Well on Willand Pond and the Willand Pond Aquifer.

Phase III - Part I

- Evaluate the construction status of the Existing Willand Pond 12-Inch Well.

Evaluate the Willand Pond Aquifer through Geophysical Methods.

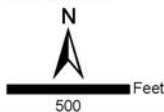
Stormwater Structures and Wetlands Map

Legend

	City Boundary		Sewer Line
	Watershed Boundary		Storm Drain
	Parcels		Water Line
	Wetlands		Former Pump Stations
	Estimated Location of Esker	Land Use	
	Water		Commercial
			Residential
			Forest
			Scrub land

Stormwater Structures

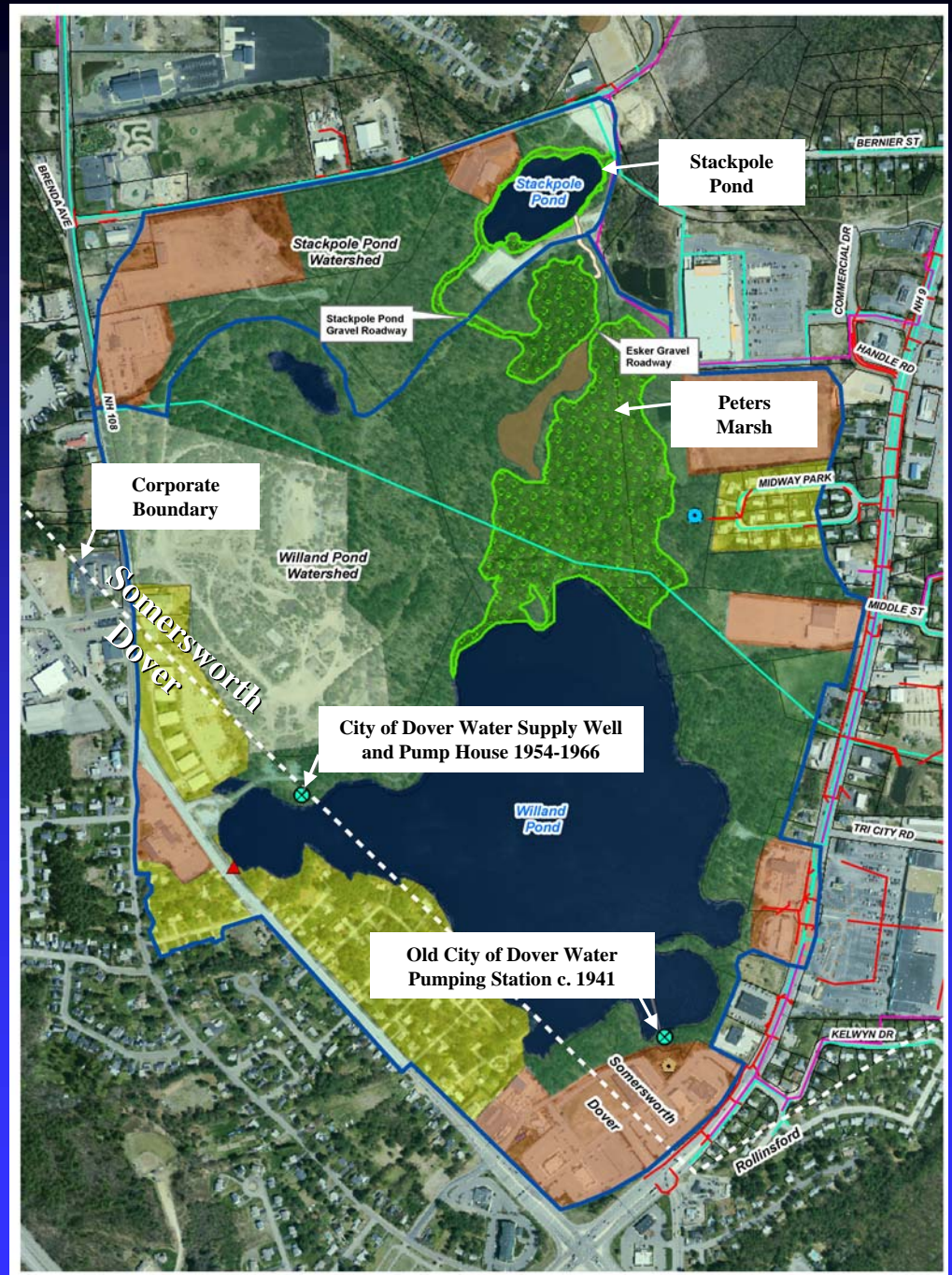
- Constructed Wetland
- Infiltration Basin
- Extended Detention Basin and Underground Storage
- Water Quality Unit



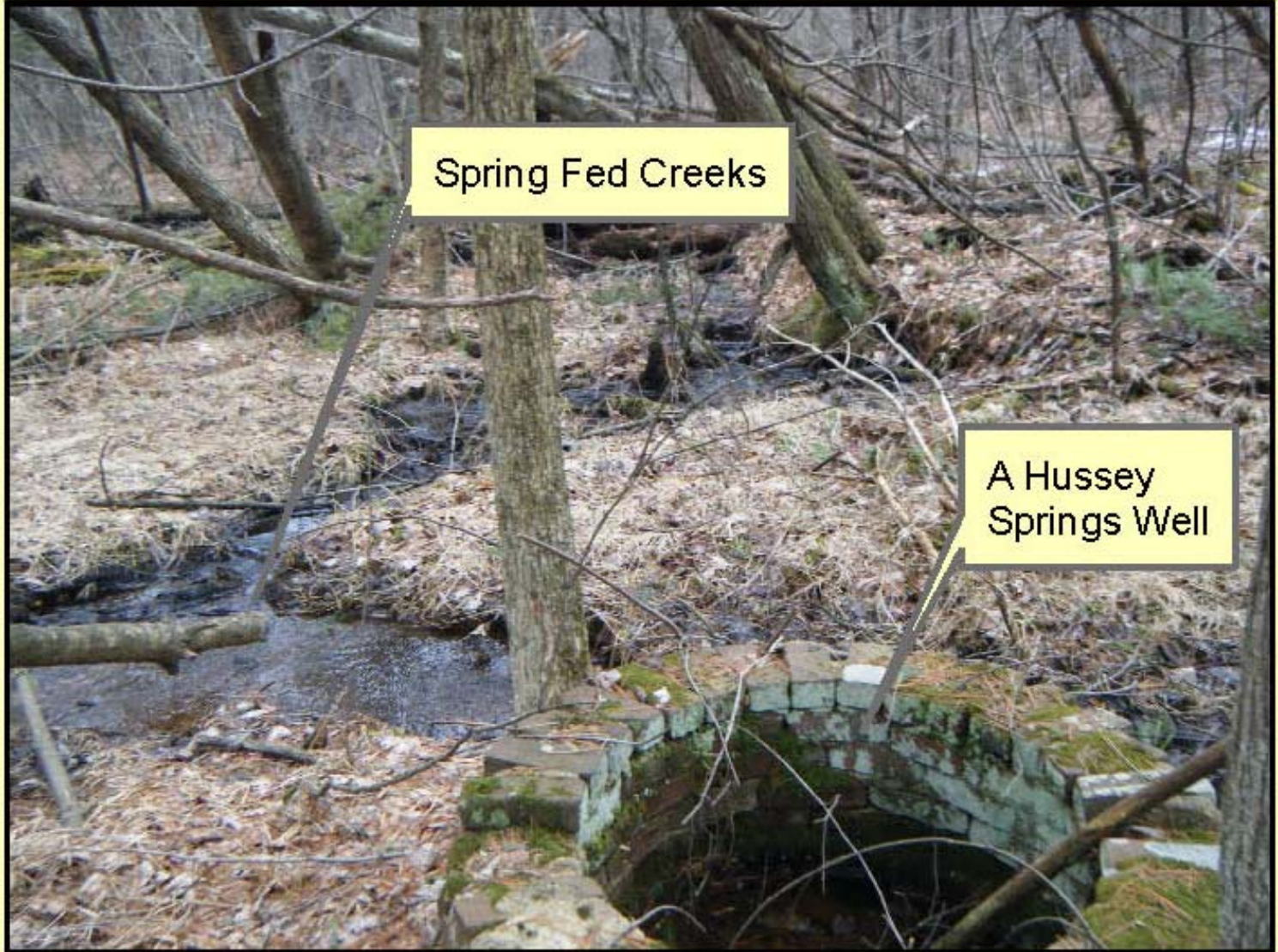
Horsley Witten Group
 phone: 508-833-8800
 www.horsleywitten.com

Watershed and Wetlands Map
 Willand Pond
 Somersworth/Dover, NH

4/09 mw R:\8094 SW Cole Willand Pond\GIS\Maps App B-1

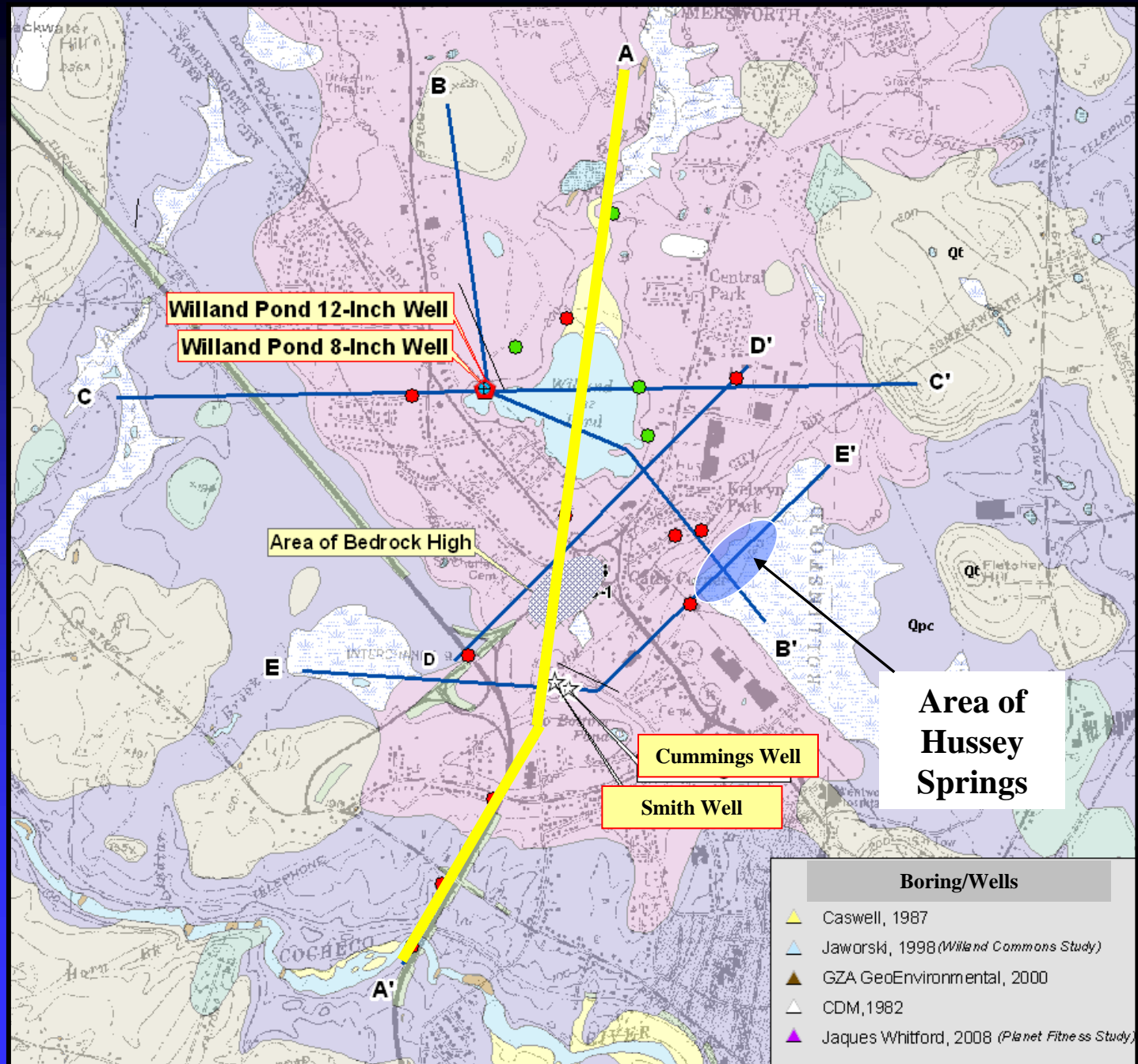


Hussey Springs

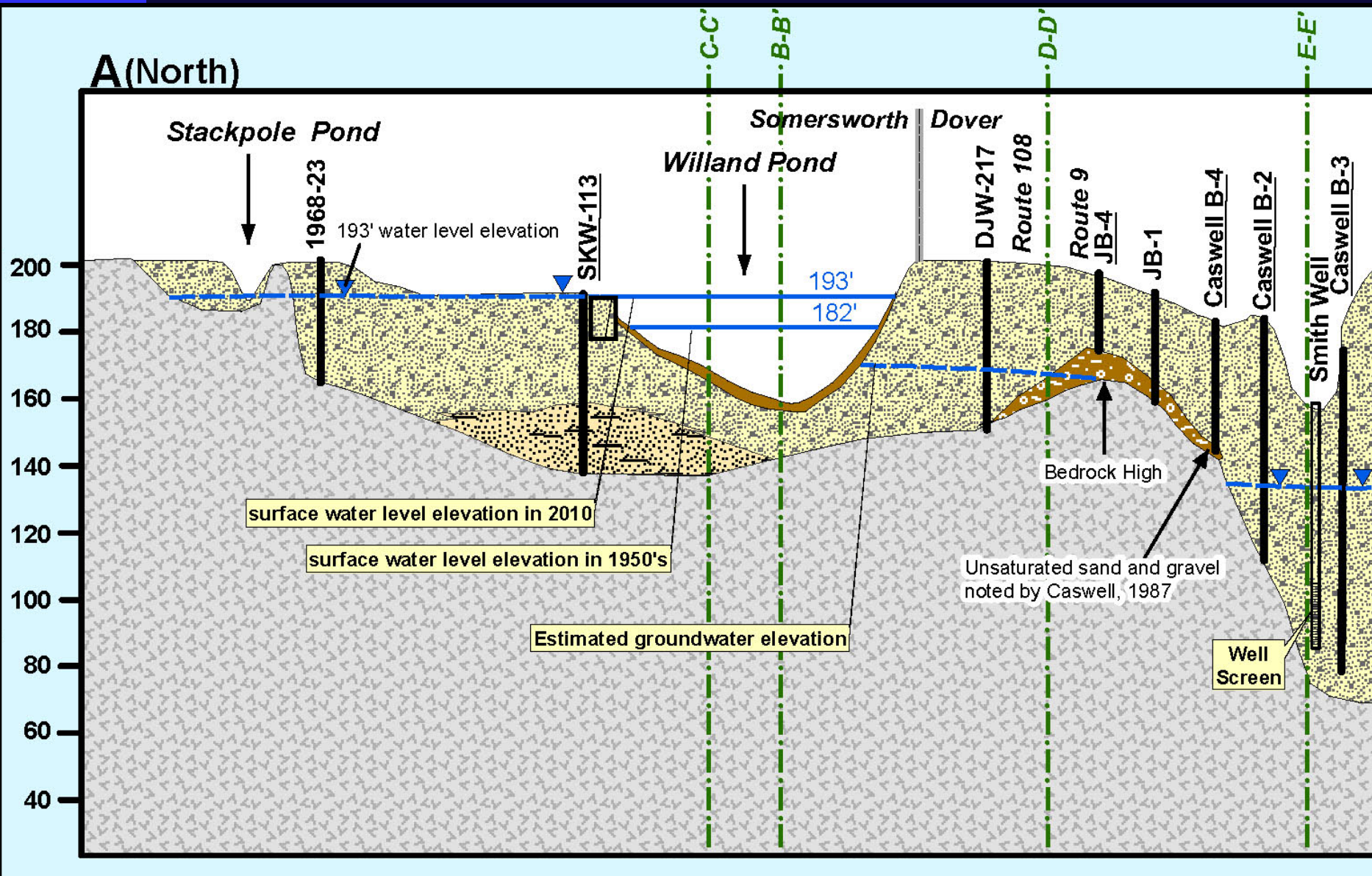


Geologic Cross-Sections
of the
Willand Pond Aquifer

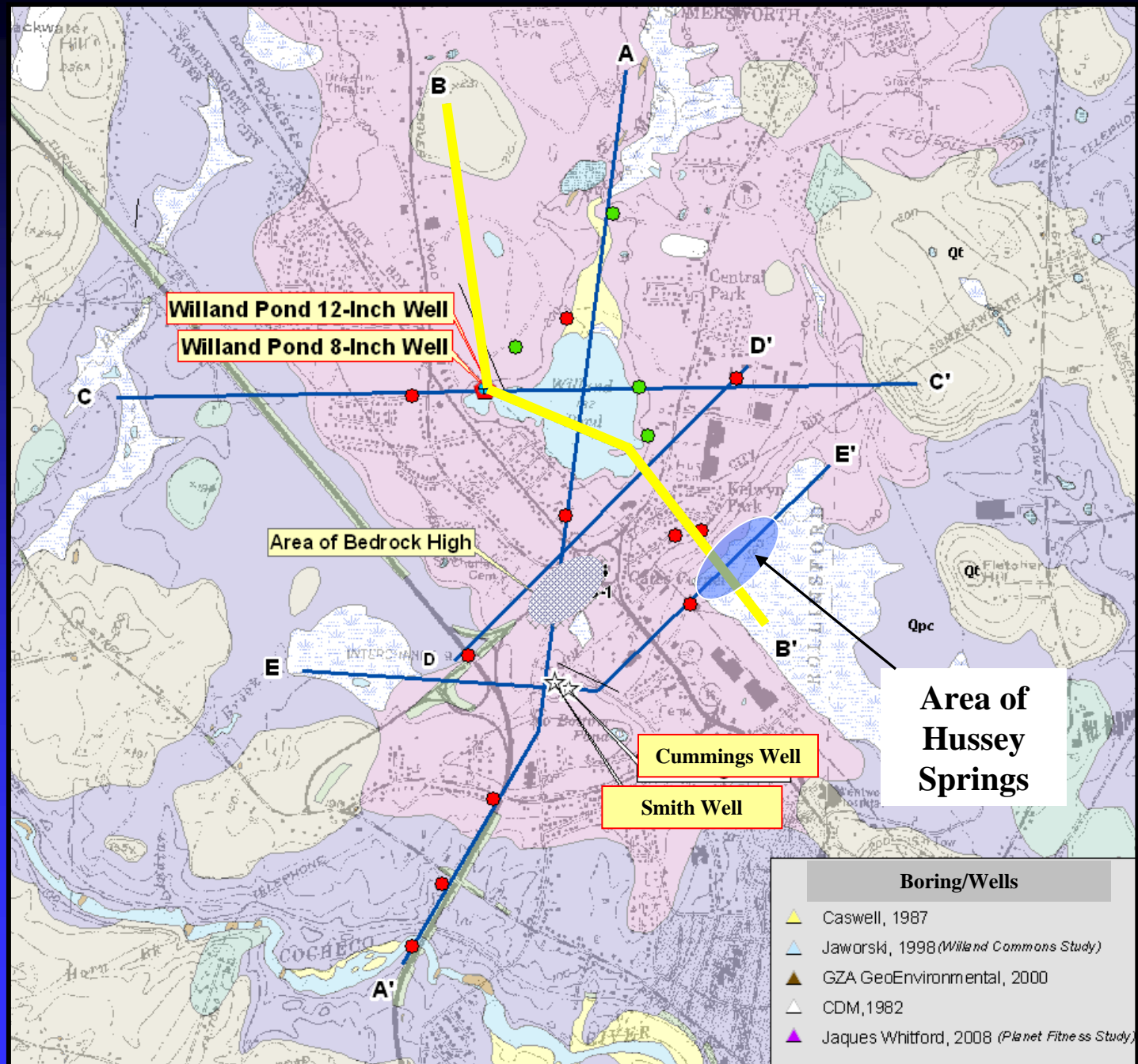
Geologic Cross-Sections



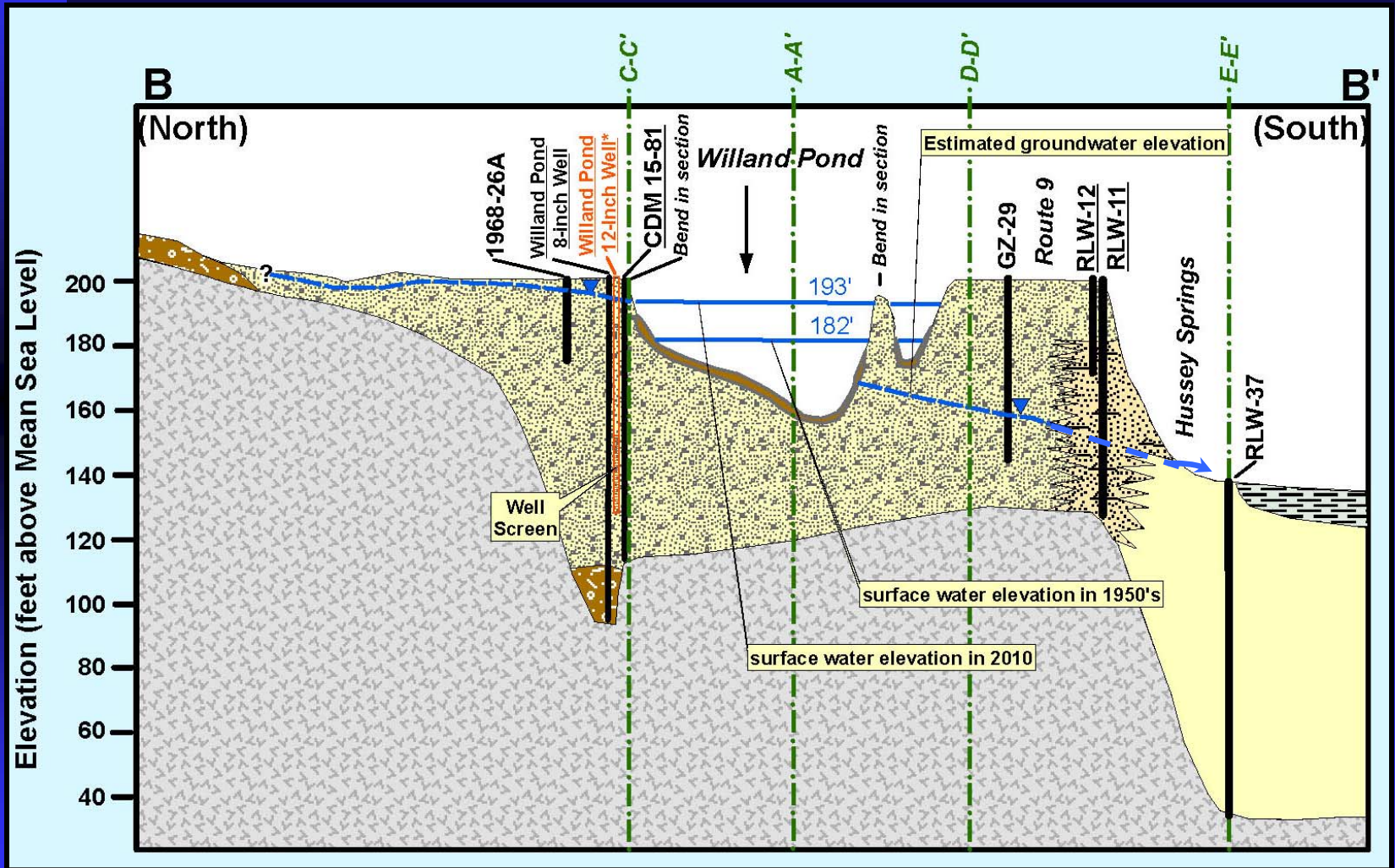
Cross-Section A - A'



Geologic Cross-Sections



Cross-Section B - B'



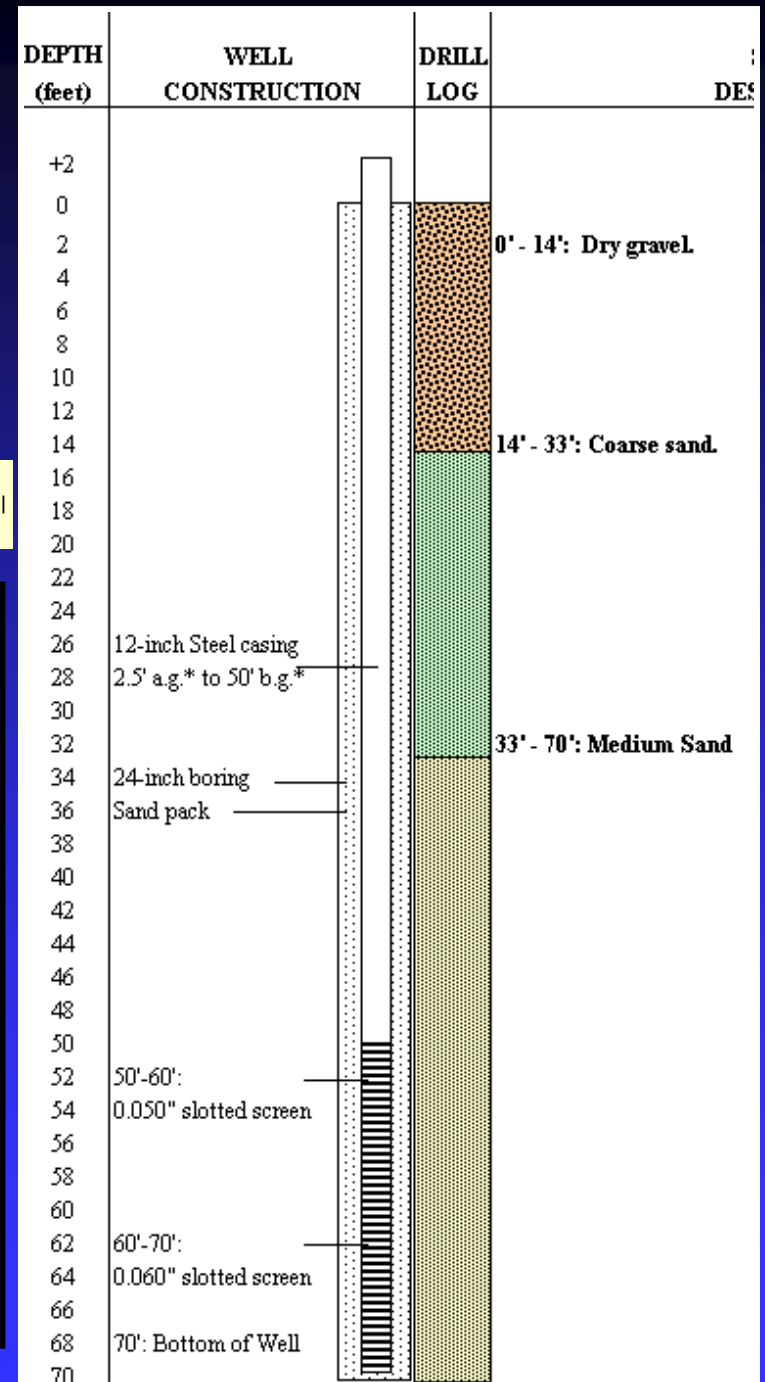
Vertical Exaggeration = 27

Evaluation of Willand Pond 12-Inch Production Well

- Rehabilitation
 - Video Log
- Eight-Hour Step Test
- Ambient Monitoring

Willand Pond 12-Inch Well

Hydrogeologic log created from information on R.E. Chapman 1961 well completion form.



Removal of Abandonment Sediment



Video Log – Selected Photographs

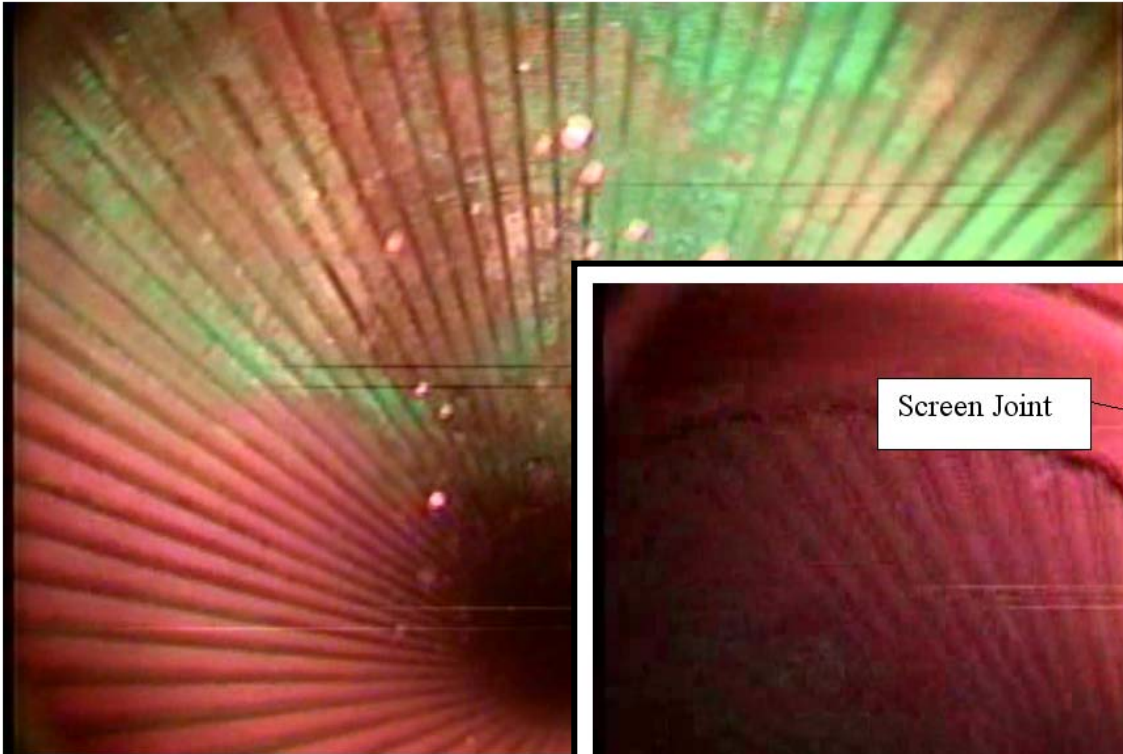


Photo 5 – Green color is copper incrustation

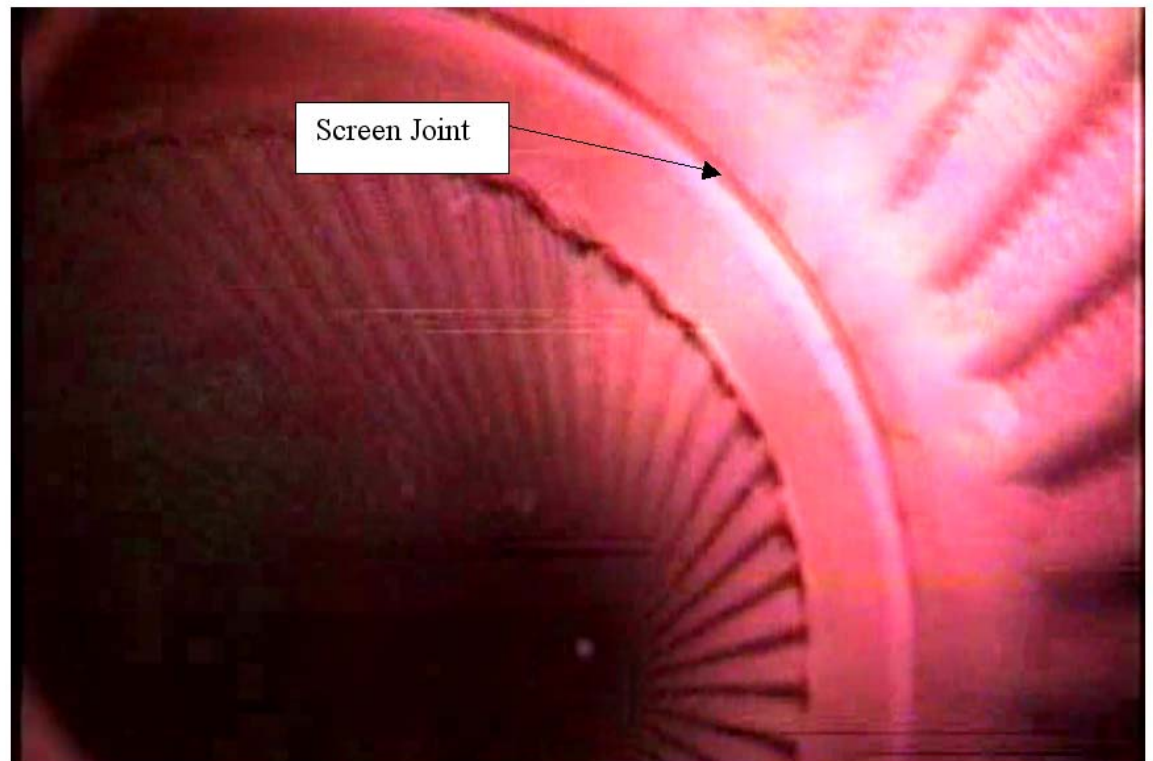


Photo 7 – Joint in screen at 62 feet is in good condition.

Video Log – Selected Photographs

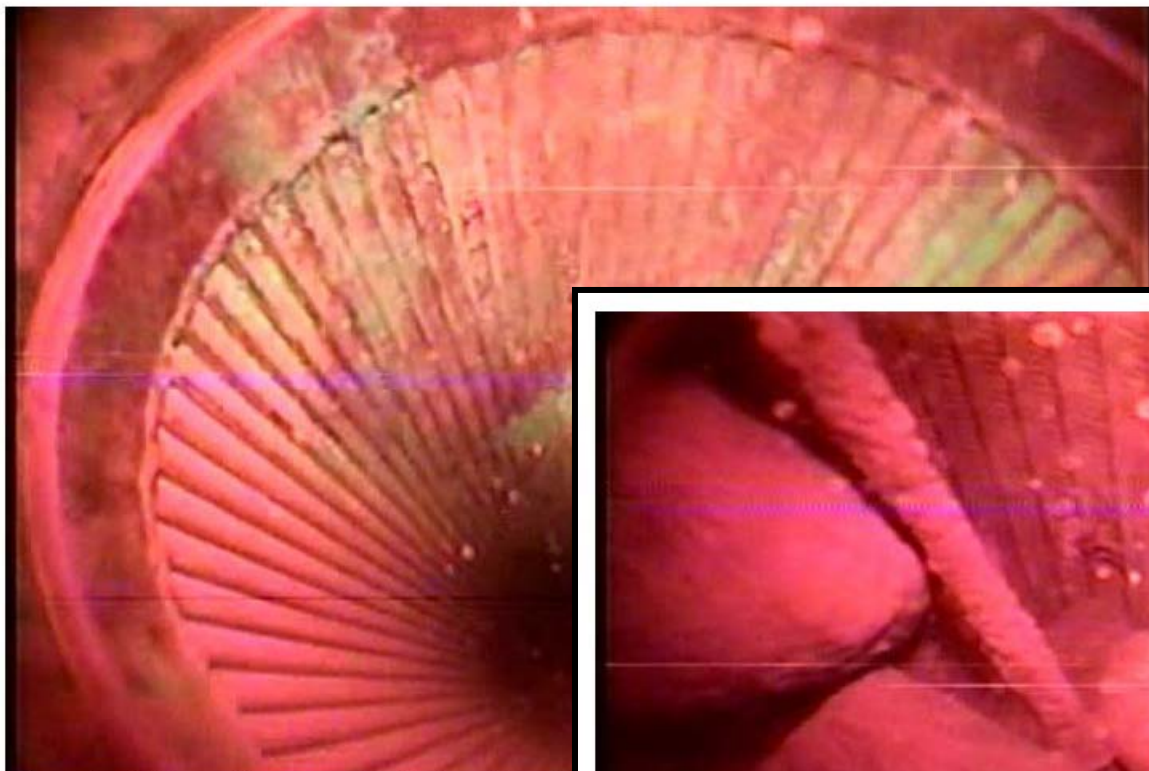


Photo 8 – Mineral incrustation below first joint

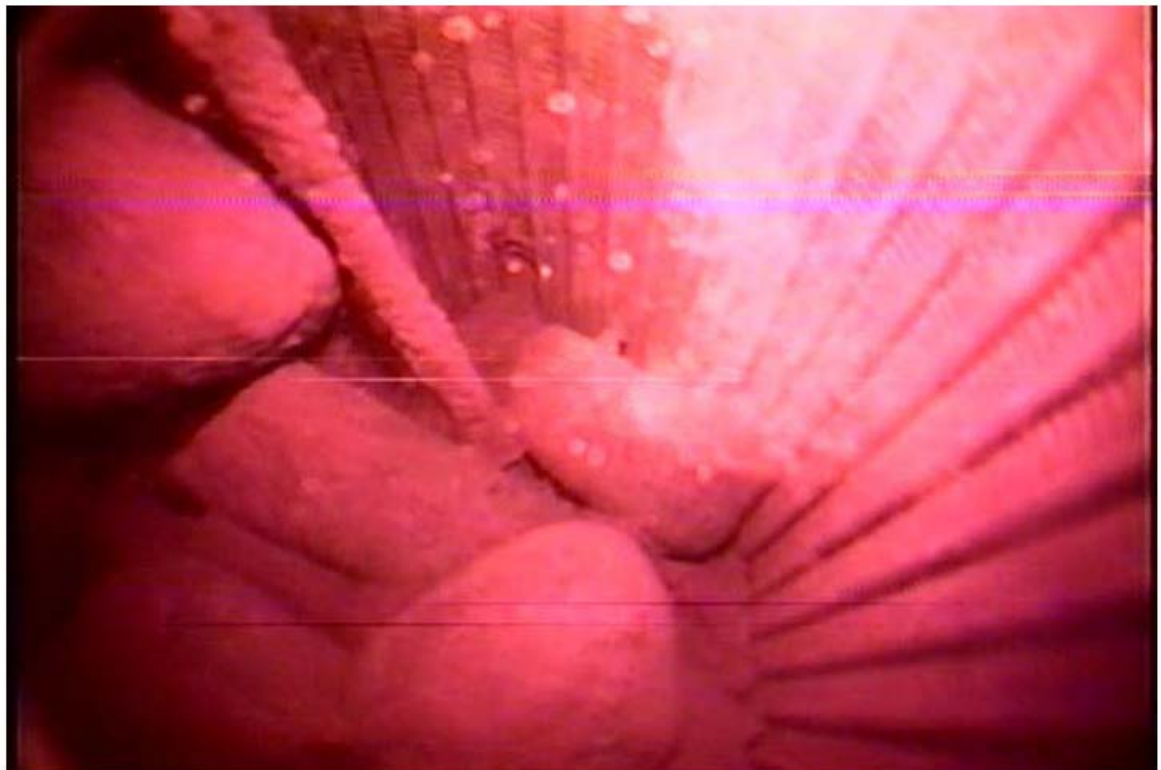


Photo 12 - Cobbles and rod like item on bottom of well. Sand and fine sediment surround cobbles. It may be possible to remove the steel rod from the well, but the cobbles would remain in place during the future use of the well.

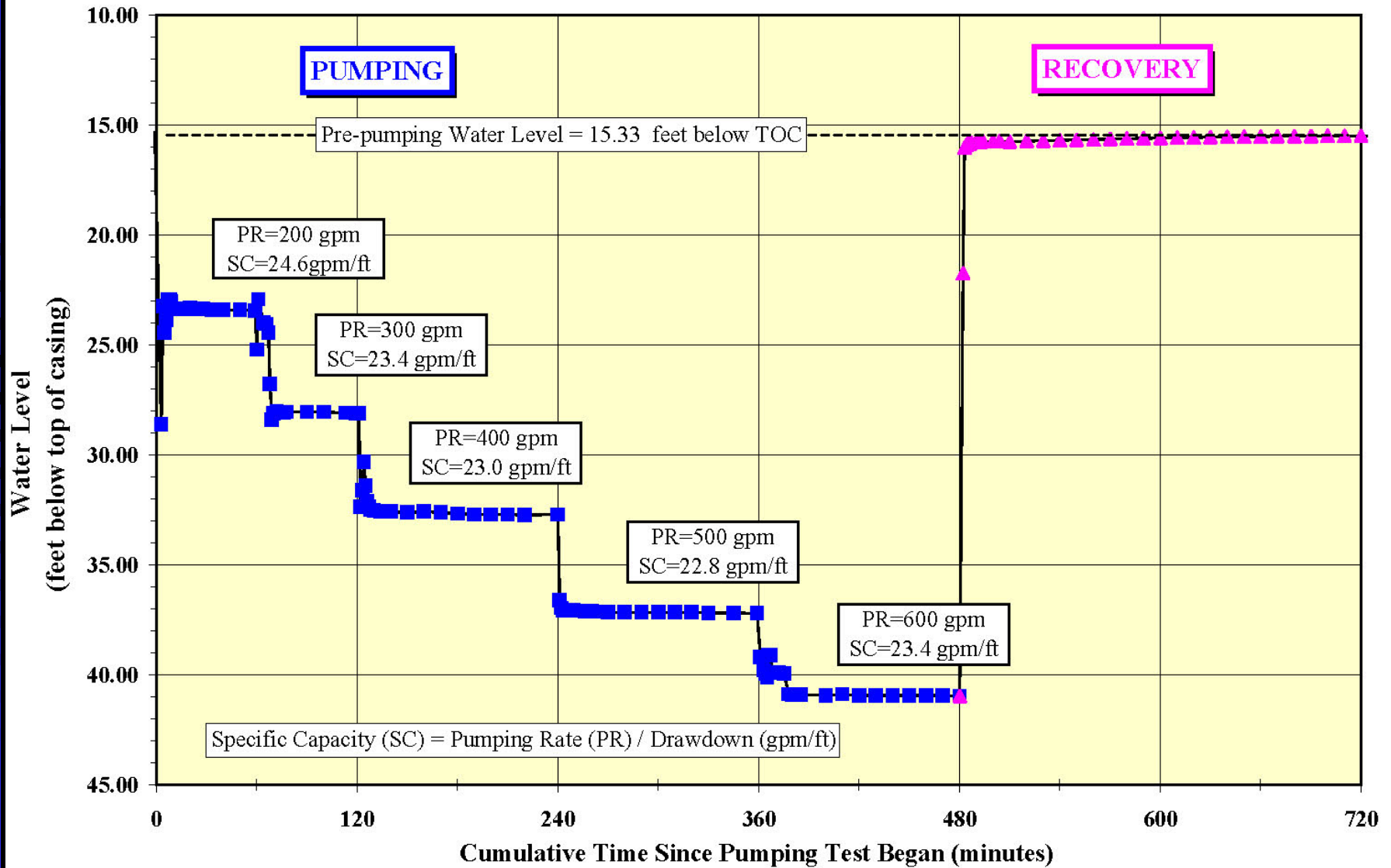
Eight-Hour Step Test



Pumping-Induced Water Level Variations within Willand Pond 12-Inch Well

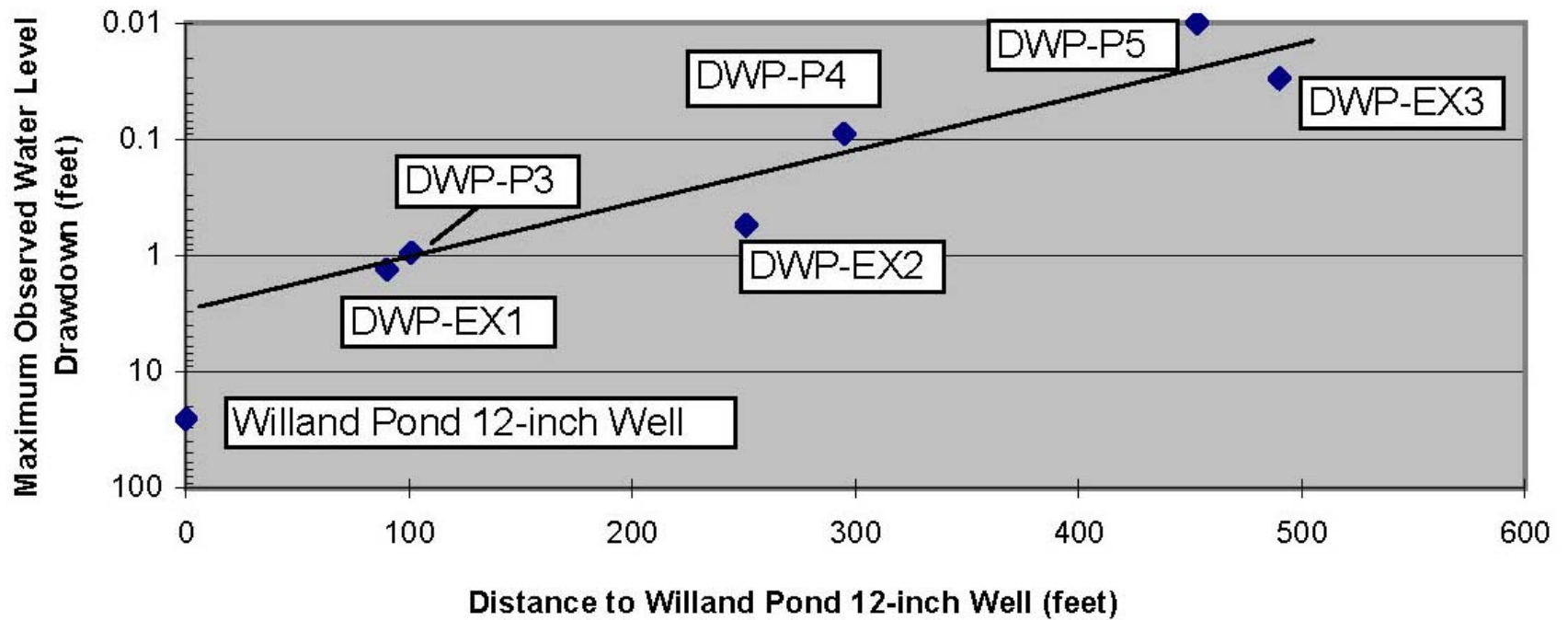
Step Drawdown Test of Willand Pond 12-Inch Well

Maximum Drawdown Observed During Pumping Test = 25.63 feet

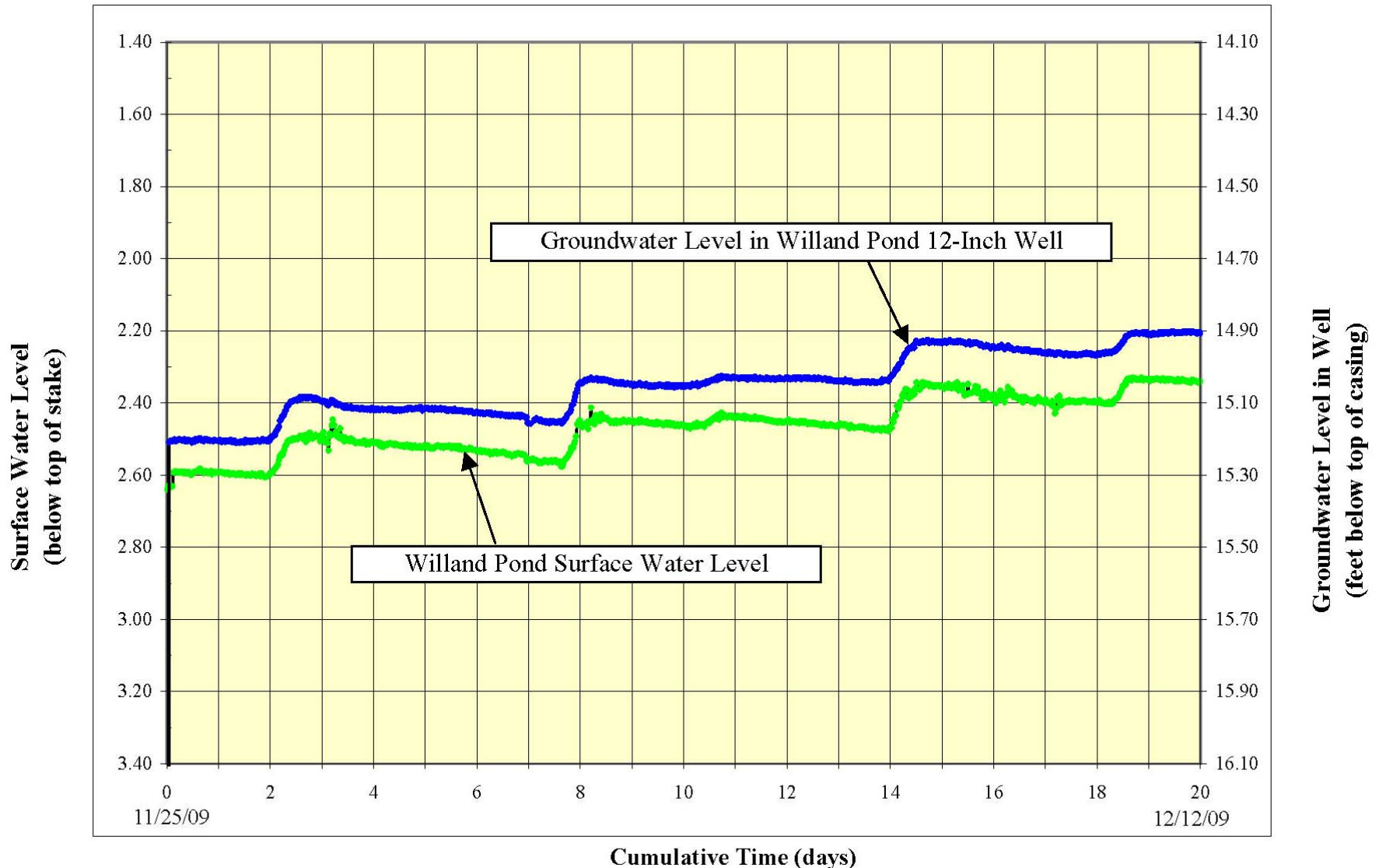


Plot of Water Level versus Time for February 17 to February 18, 2010

Willand Pond 12-inch Well Step Drawdown Test



Ambient Water Level Monitoring



Water Levels Versus Time - November 25, 2009 to December 12, 2009

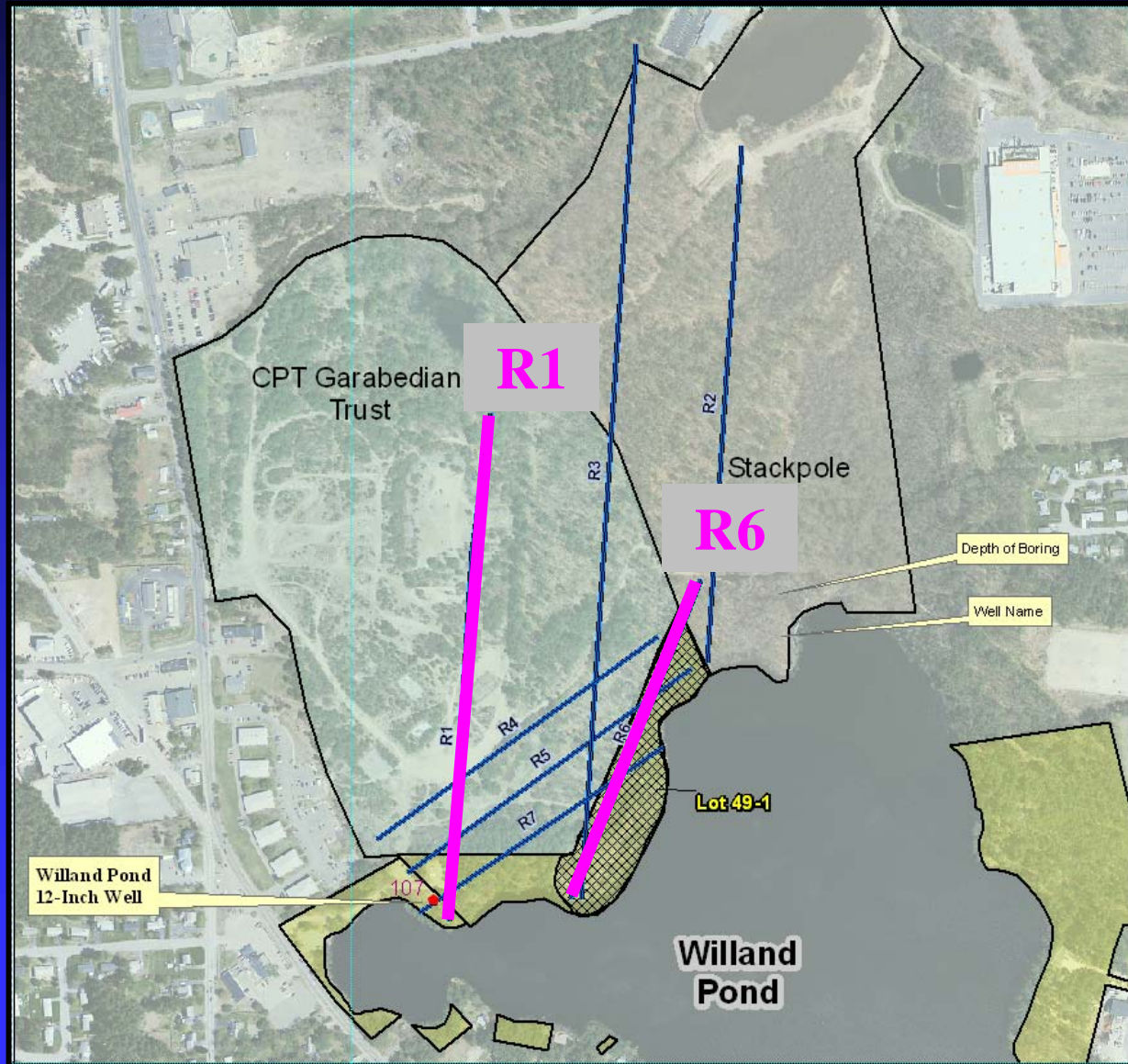
Results of Evaluation of Willand Pond 12-Inch Production Well

The Willand Pond 12-Inch Well
can:

- Still function as a Production Well for the near future.
- Produce approximately 600 gpm.
- Is hydraulically connected to Willand Pond.

Evaluation of the
Willand Pond Aquifer
through
Geophysical Methods

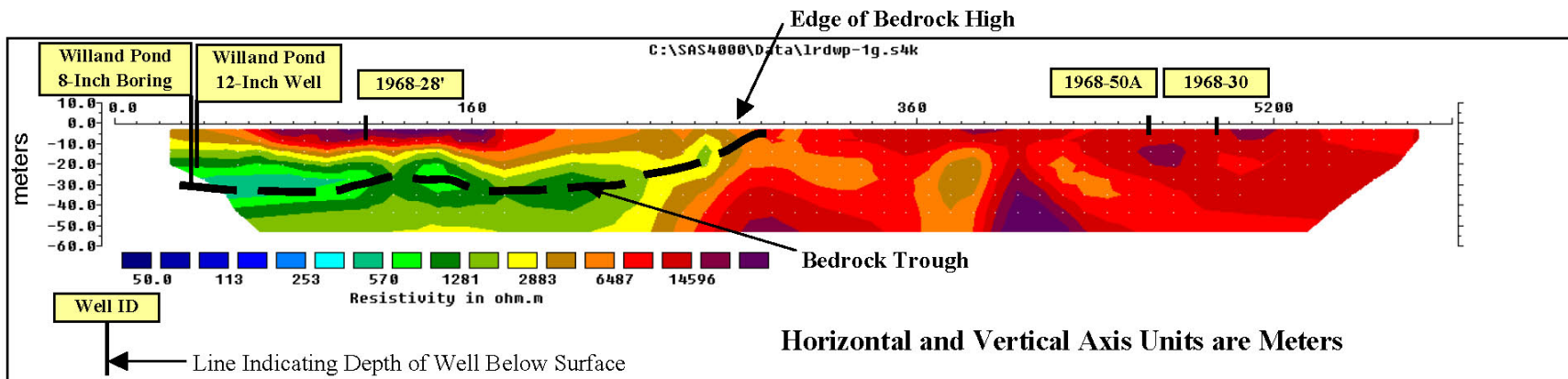
Geophysical Surveys



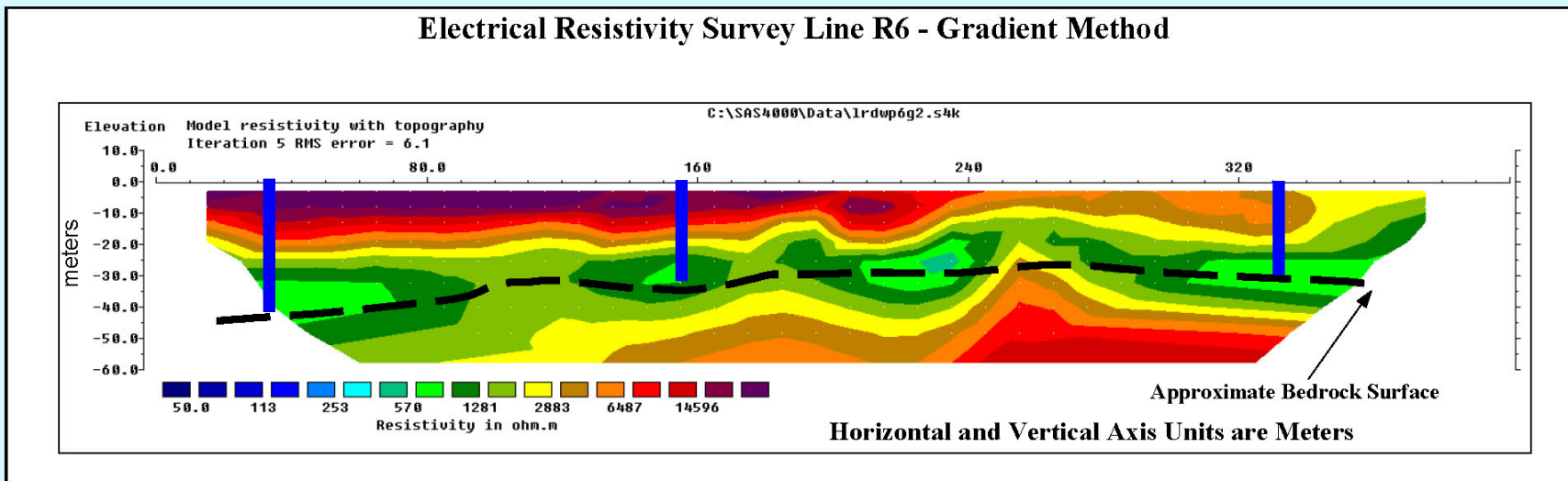
South

North

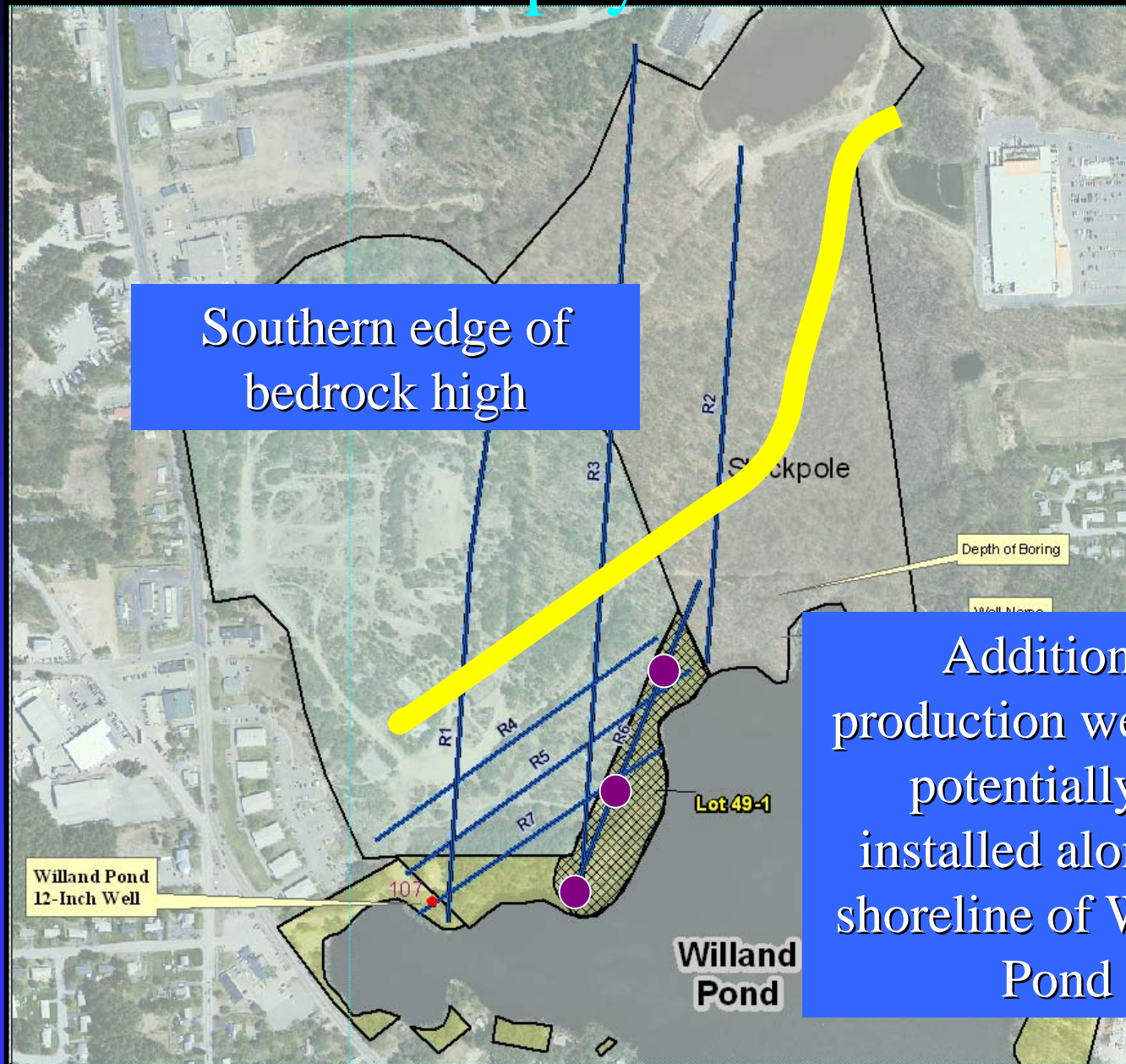
Electrical Resistivity Survey Line R1 - Gradient Method



Electrical Resistivity Survey Line R6 - Gradient Method



Results of Geophysical Assessment



Southern edge of
bedrock high

Additional
production wells can
potentially be
installed along the
shoreline of Willand
Pond

Willand Pond
12-Inch Well

Depth of Boring

Well Name

Lot 49-1

Willand
Pond

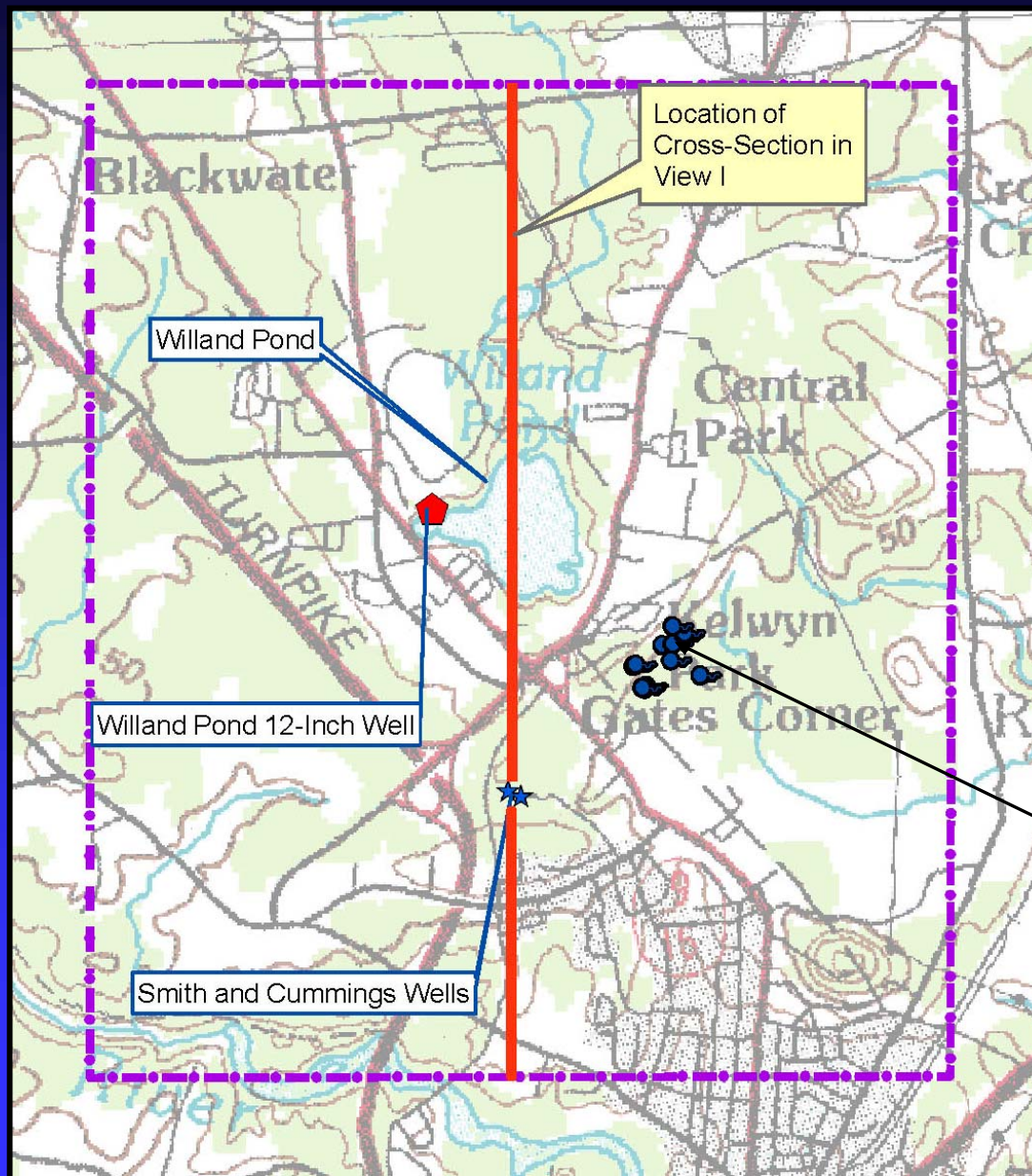
**Modeling of
Willand Pond 12-Inch
Production Well
and
Willand Pond Water Levels**

Construction of Two-Layer

MODFLOW-SURFACT

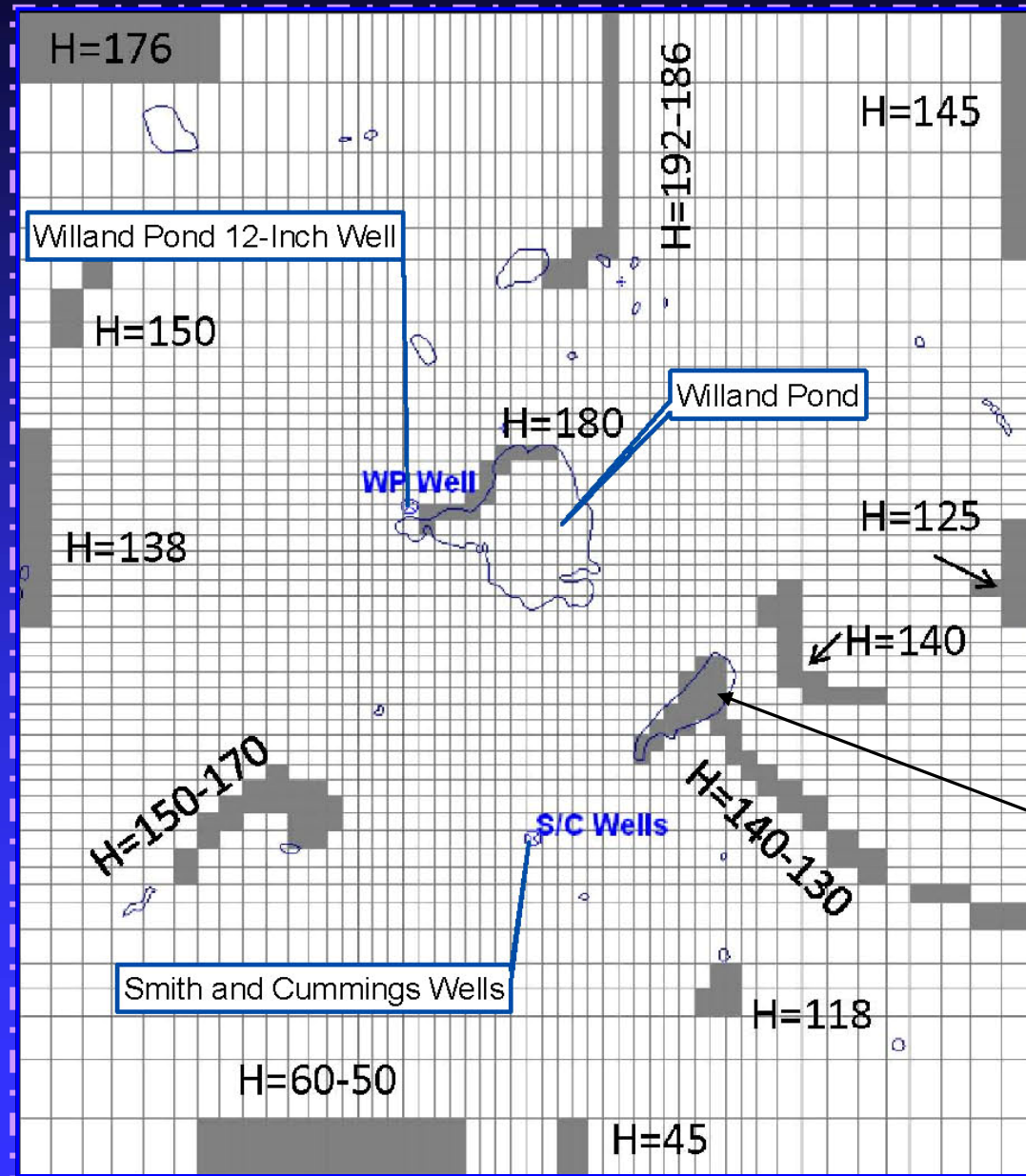
Numerical Model

- Model Domain



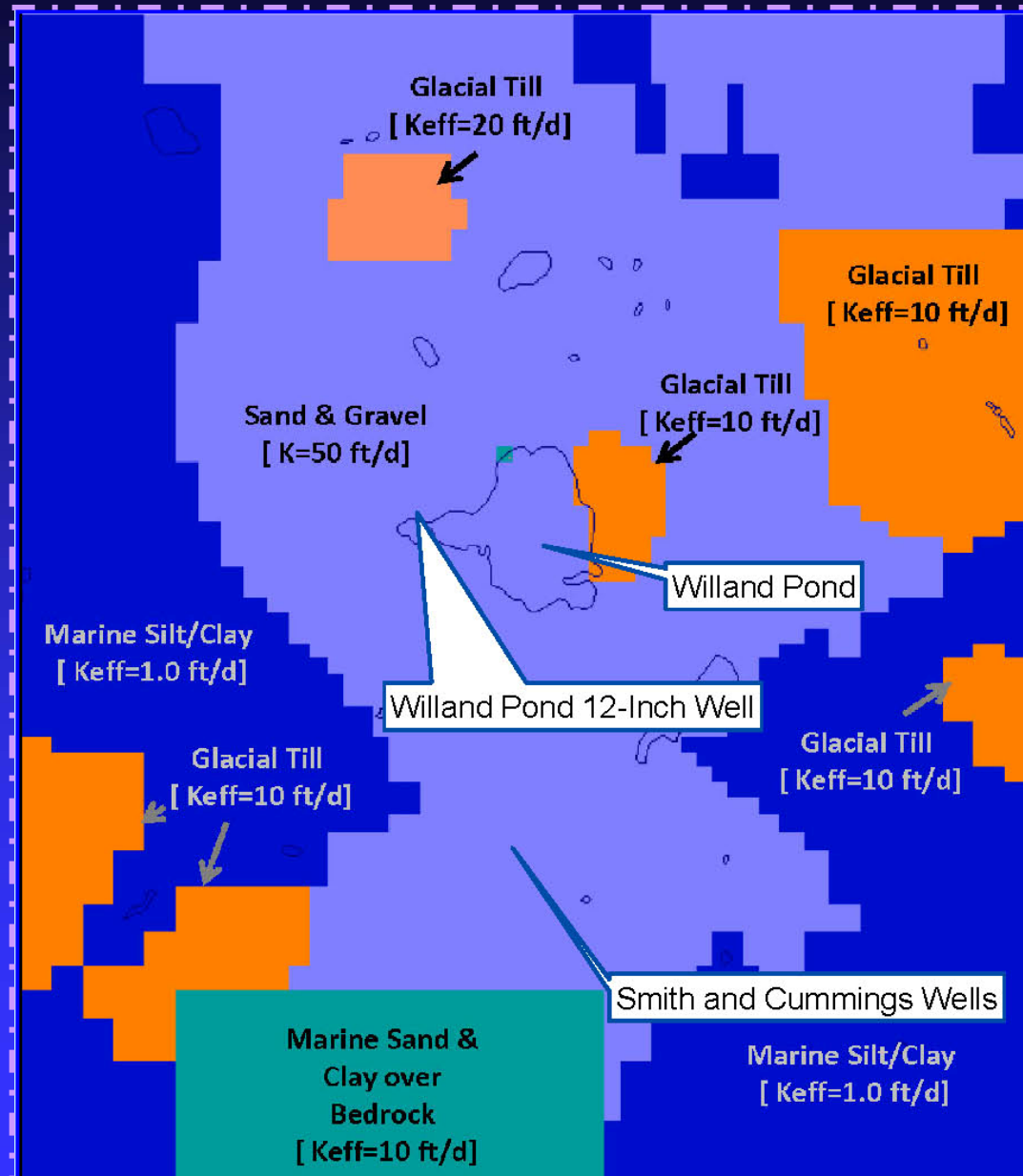
**Area of
Hussey
Springs**

• Model Cells and Drains



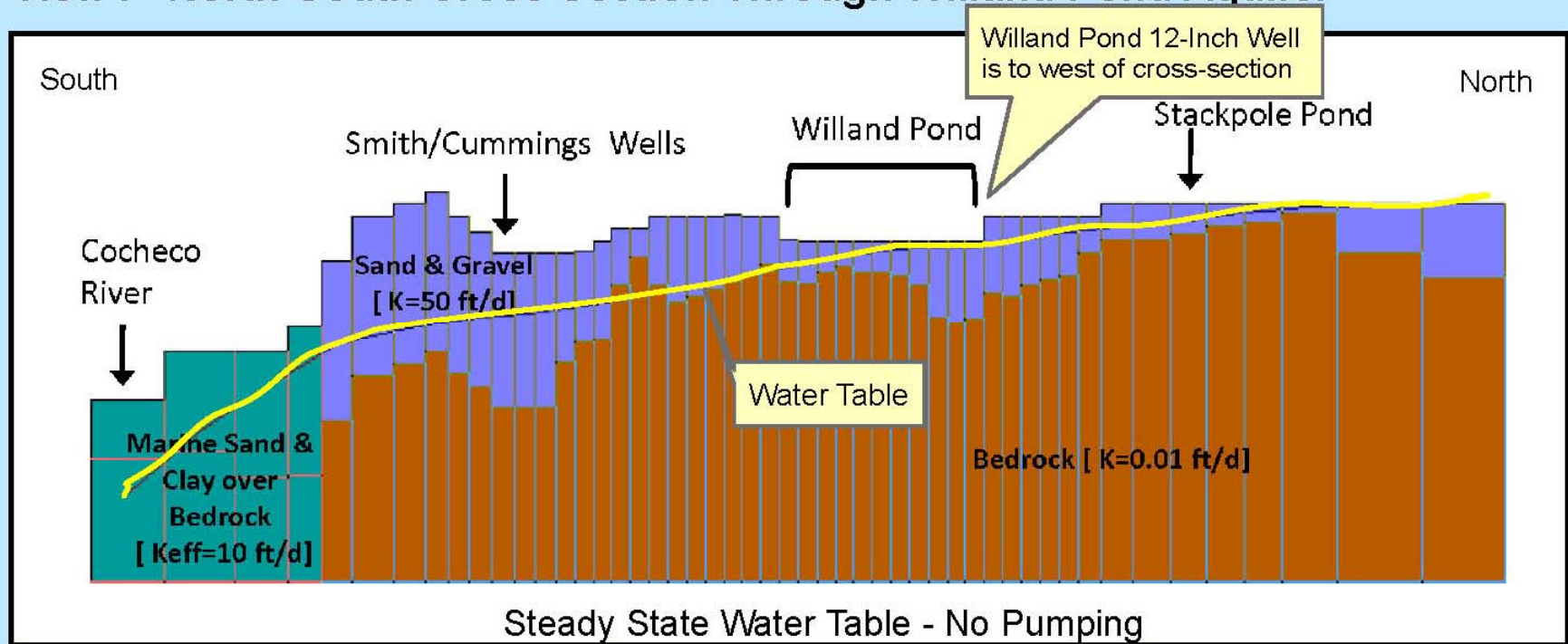
Area of Hussey Springs

• Model Parameters – Conductivity



• Model Cross-Section

View I - North-South Cross Section Through Willand Pond Aquifer

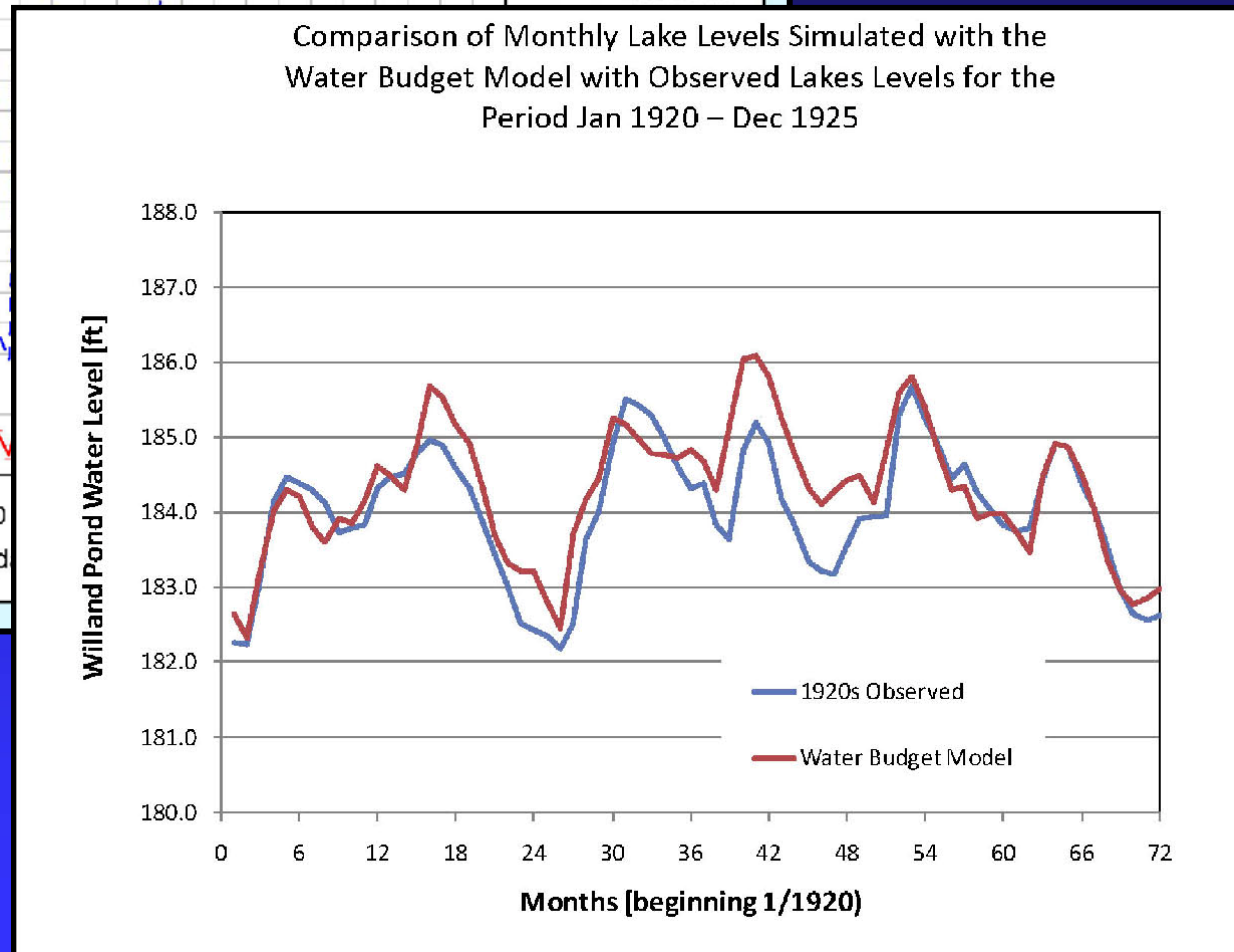
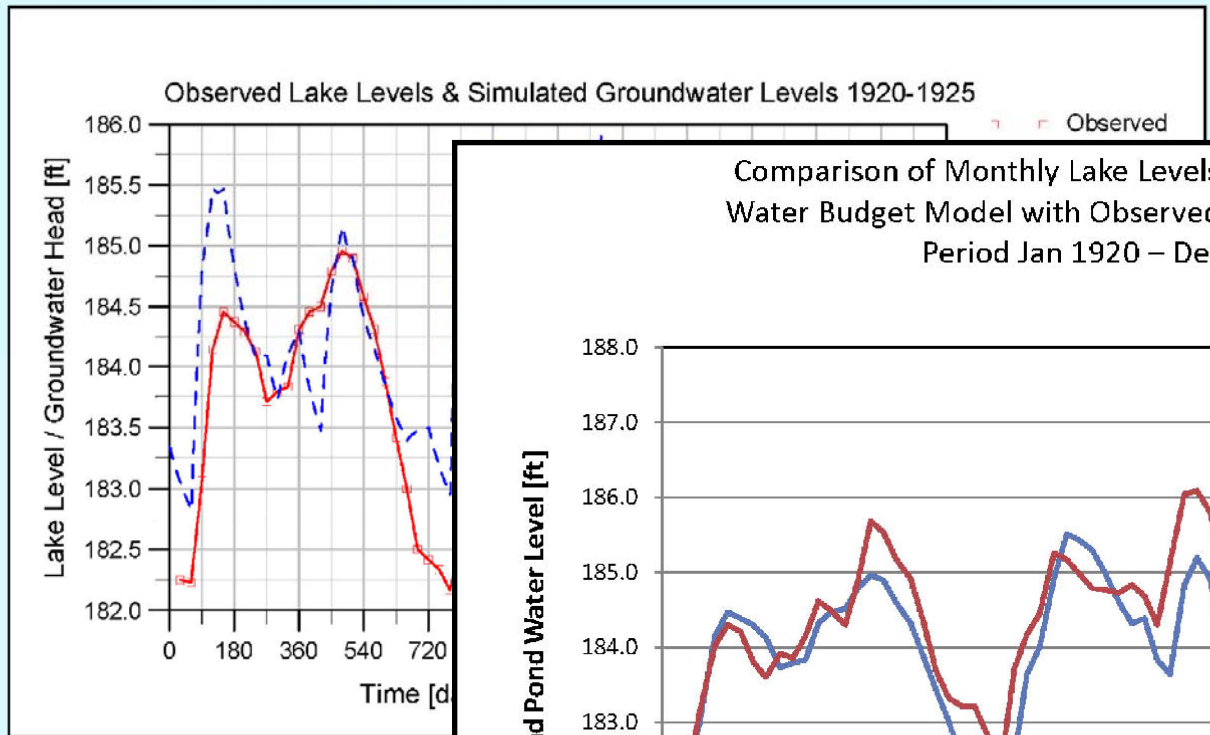


Vertical Exaggeration = 20x

Model Calibration

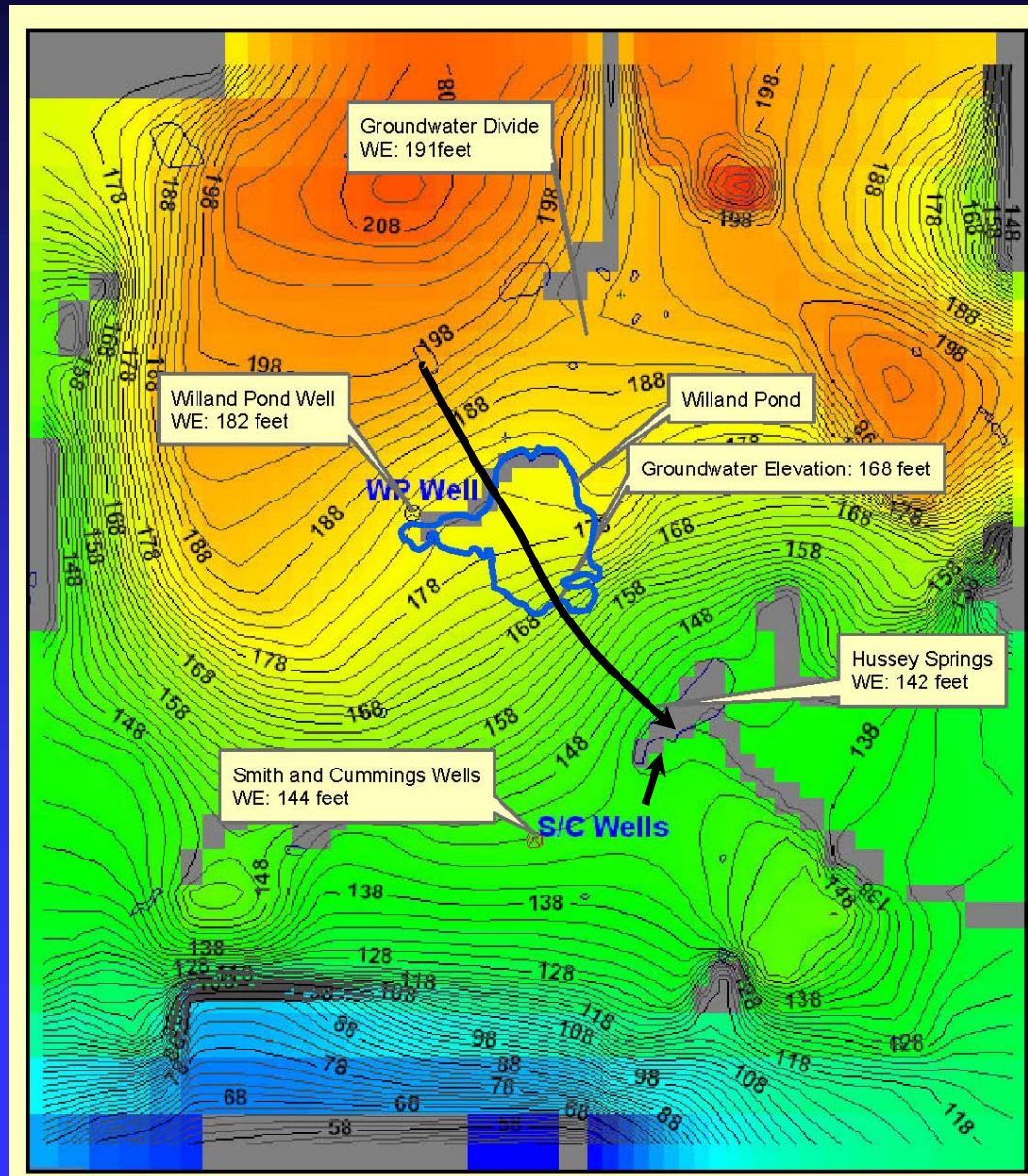
• Model Calibration

View K - Calibration to Aquifer Water Level - North Shore of Willand Pond

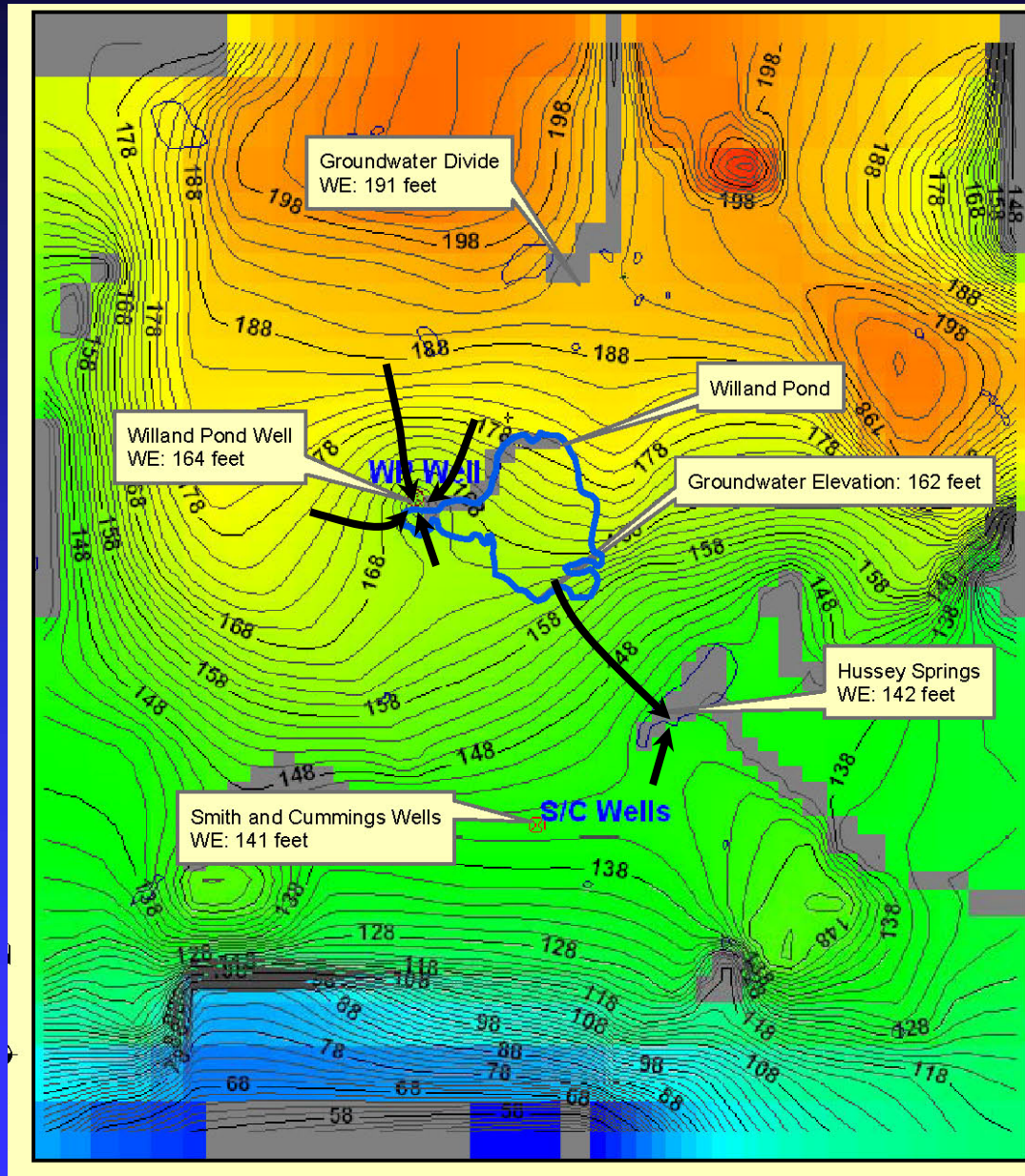


Model Simulations

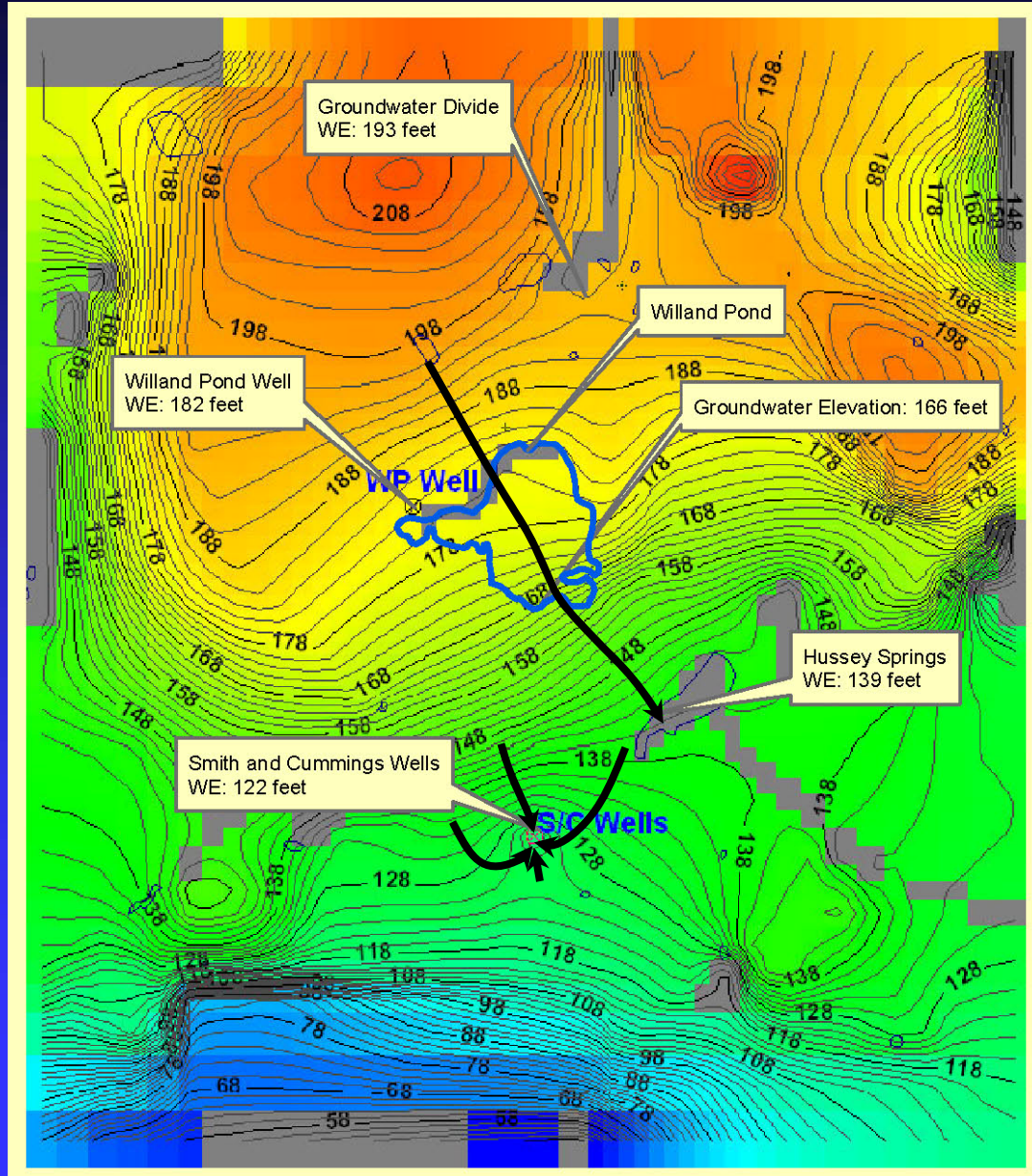
Water Table – Static Conditions



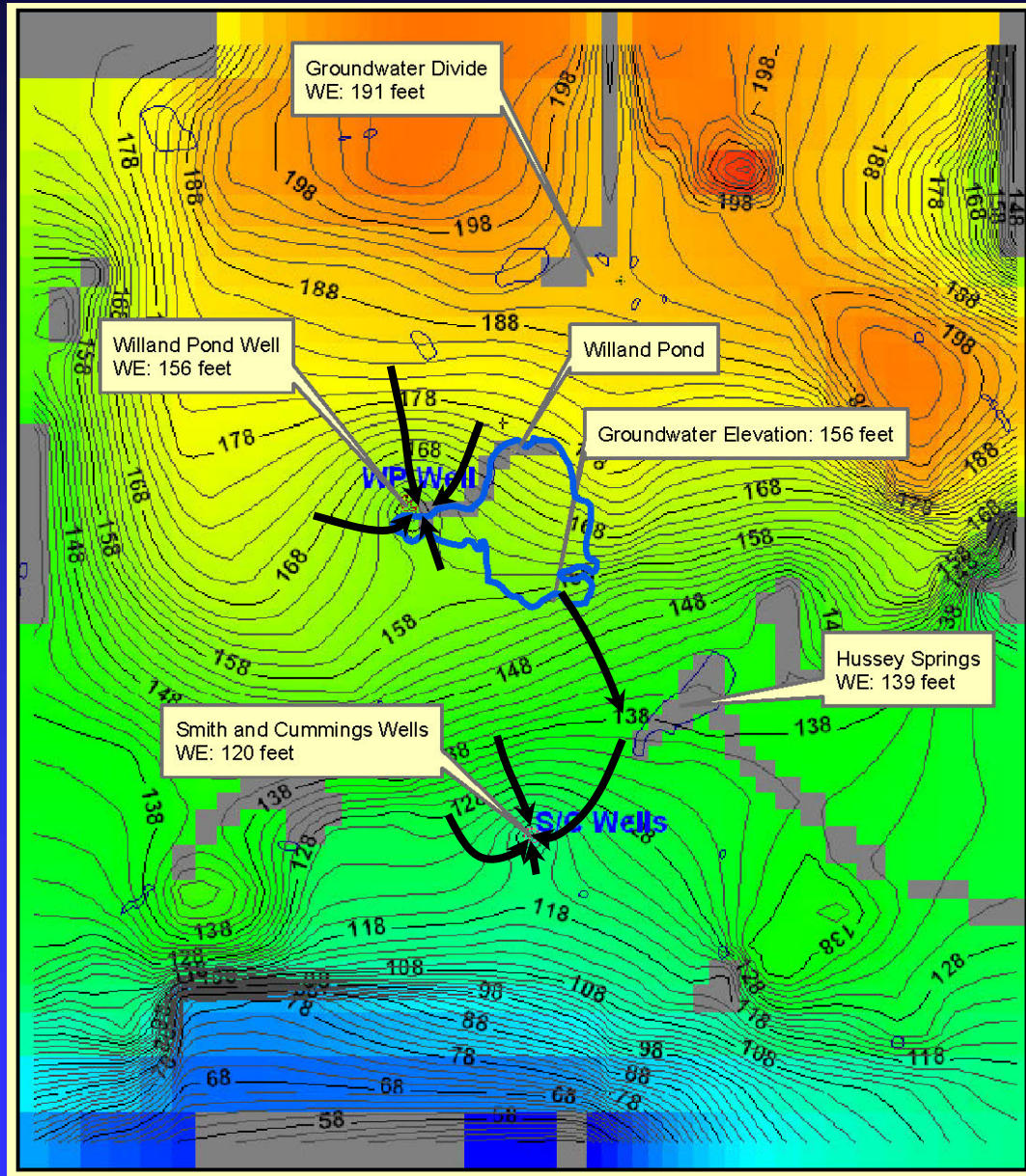
WP 12-inch Well at 500 gpm



Smith/Cummings – 500 gpm



Three Wells – 1000 gpm

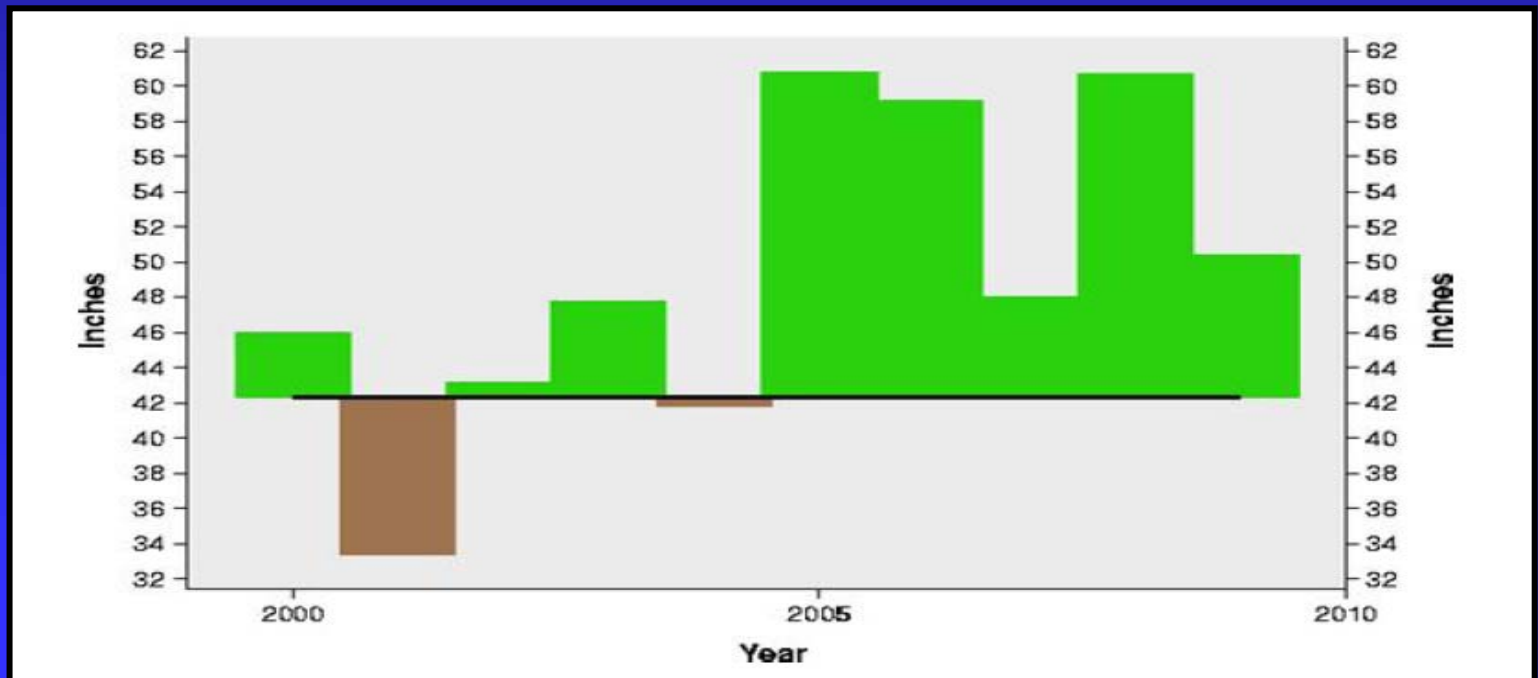


Results of Numerical Modeling

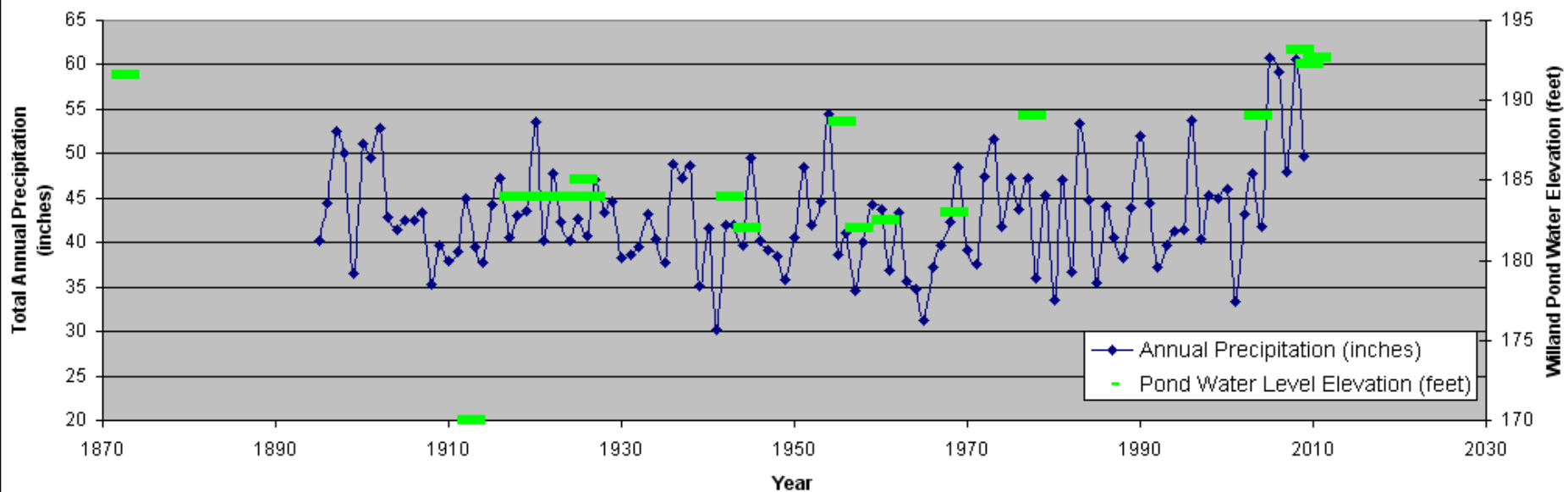
- The water table in the Willand Pond Aquifer slopes southward from the area of Stackpole Pond towards the Smiths and Cummings Wells and various springs.
- Groundwater flows into Willand Pond along the north shore of the Pond.
- Willand Pond surface water is “perched” above the groundwater table along the south shore of the Pond.

Results of Numerical Modeling

- Above average precipitation between 2002 and 2010 has resulted in higher groundwater levels in the Willand Pond Aquifer, and higher surface water levels in Willand Pond.



Willand Pond Water Elevation Compared to Annual Precipitation



Results of Numerical Modeling

- The pumping of the Willand Pond 12-Inch Well will induce the flow of water from the Pond into the Aquifer.
- This could potentially result in the lowering of the water level in the Willand Pond by 5 to 10 feet.

“Next Steps”

**Phase III – Part 2
Work Tasks**

Next Steps

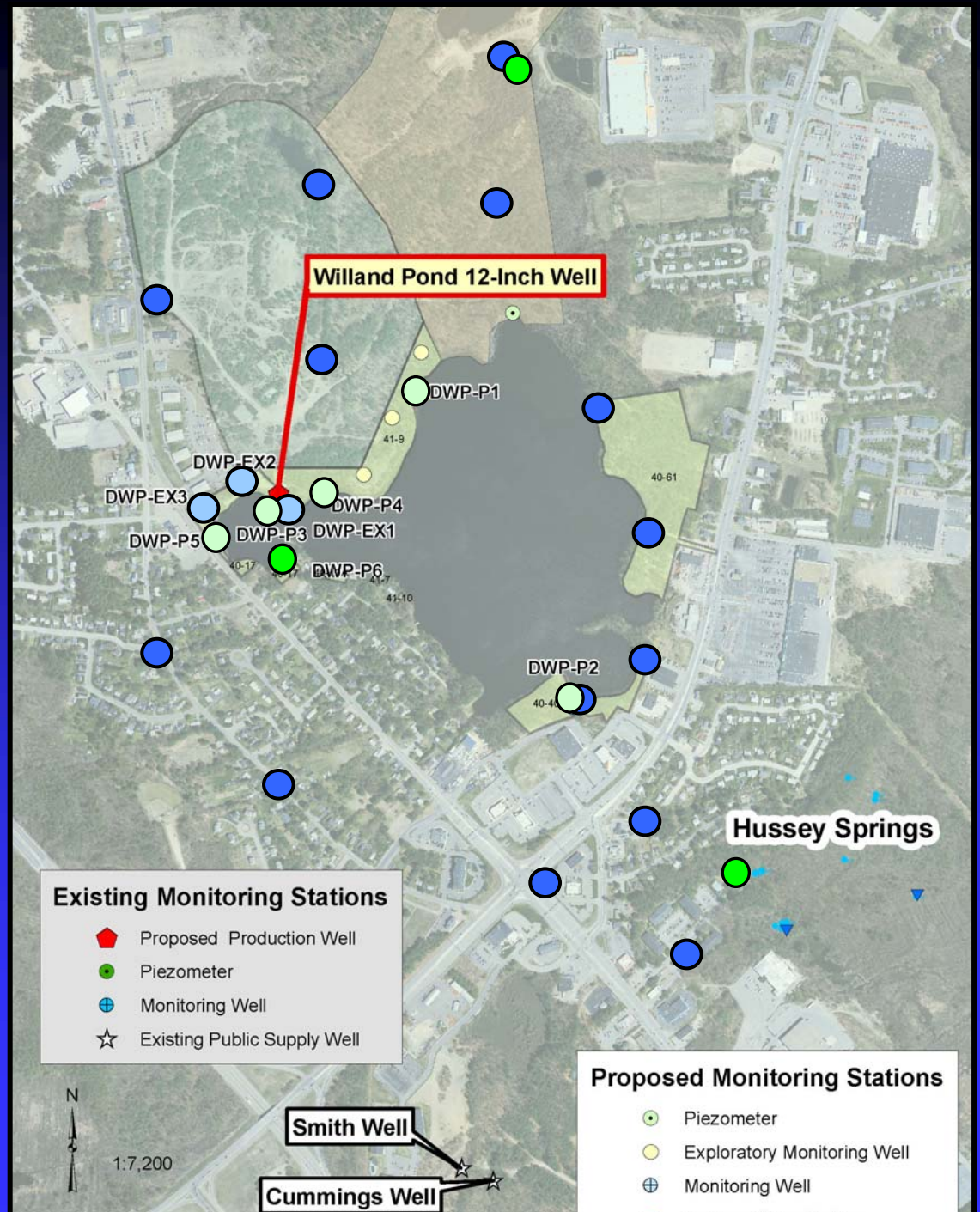
- **Meet with NHDES to:**
 - **Review project findings to date;**
 - **Review proposed 90-Day pumping test and monitoring plan; and**
 - **Discuss opportunities for developing additional groundwater supply wells.**

Next Steps - Continued

- **Establish monitoring sites for Pumping Test**
 - Install piezometers and monitoring wells:
 - Along Willand Pond shoreline;
 - Adjacent properties to City Lots;
 - Within City Right of Ways; and
 - Near Hussey Springs.

Proposed Monitoring Locations

- Piezometers
- Monitoring Wells

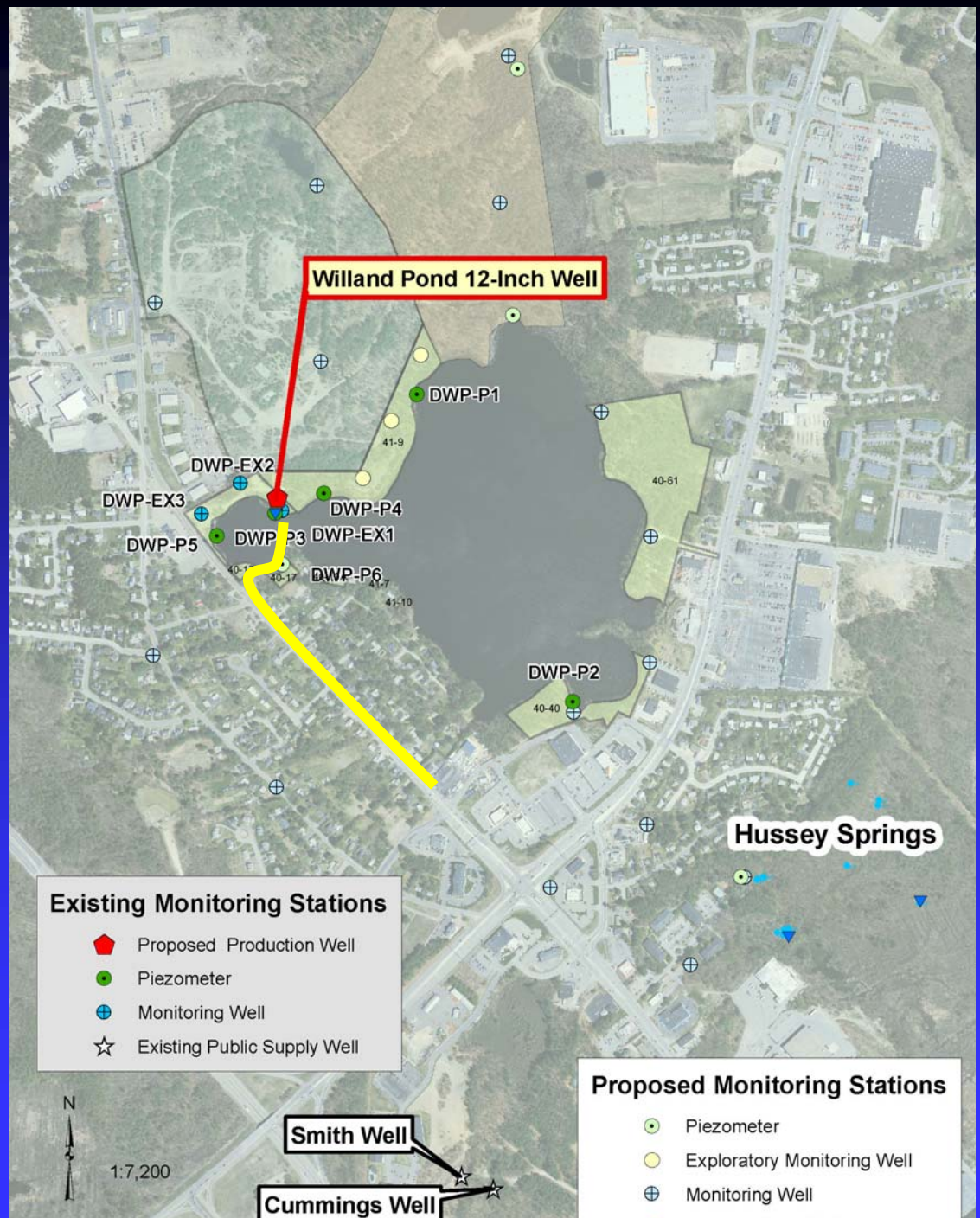


Next Steps - Continued

- **Conduct an Extended (90 day) Pumping Test of the Willand Pond 12-Inch Well**
 - Pumping Rate: 600 gpm.
 - Discharge of Water into City storm drains.



Proposed Discharge Line Location



Next Steps - Continued

- **Conduct a Water Quality Assessment Program for the Willand Pond 12-Inch Well and Willand Pond.**
 - Analyze for All EPA drinking water standards.
 - Perform MPA analyses and bacteriological analysis to evaluate surface water influence.

Next Steps - Continued

- Assess the Potential for Developing an Additional Production Well on the north shore of Willand Pond.



Next Steps - Continued

- **Continue long term (180-day) monitoring of water levels in:**
 - **Willand Pond 12-Inch Well;**
 - **Willand Pond;**
 - **Selected monitoring wells and piezometers;**
 - **Hussey Springs;**
 - **Smith and Cummings Wells; and**
 - **The flow (discharge in two creeks) from Hussey Springs.**

Next Steps - Continued

- **Assess the sustainable yield of Willand Pond 12-Inch Production Well.**
- **Evaluate the efficiency of lowering water levels in Willand Pond using the Willand Pond 12-Inch Well.**

Next Steps - Continued

- Obtain an approval from the NHDES for withdrawing groundwater from the existing Willand Pond 12-Inch Production; or**
- Obtain a Groundwater Withdrawal Permit from the NHDES for a new groundwater supply well on the north shore of Willand Pond.**

The End



- Bedrock Topography

