Hydrogeology and Water-Supply Availability in the Pinelands

Pinelands Science-Policy Forum
Eco-Complex Bordentown, NJ

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NEW JERSEY COASTAL PLAIN AQUIFERS
PINELANDS AND KIRKWOOD-COHANSEY AQUIFER SYSTEM

EXPLANATION

- PINELANDS AREA
- K-C AQUIFER SYSTEM
KIRKWOOD-COHANSEY AQUIFER SYSTEM WITHDRAWALS, 2003

EXPLANATION

- 0 - 10
- 10 - 50
- 50 - 100
- 100 - 300
- 300 - 700

PINELANDS AREA
K-C AQUIFER SYSTEM
RESPONSES TO GROUND-WATER WITHDRAWALS

- Water-level decline
- Stream depletion
- Ecological change
Problem

- Demand for water from the aquifer system is increasing as planned growth occurs within & around the Pinelands area.

- The effects of changes in ground-water use on the ecology of the Pinelands are poorly understood.
Kirkwood-Cohansey Project
A hydroecological investigation in the New Jersey Pinelands

- New Jersey Pinelands Commission
- U.S. Geological Survey
- Rutgers University
- U.S. Fish and Wildlife Service
- NJ Department of Environmental Protection
Kirkwood-Cohansey Project Components

- **Hydrology (USGS)**
- Wetland-forest Communities (PC)
- Swamp Pink (USFWS)
- Intermittent Pond Vegetation (PC and NJ DEP)
- Anuran-larval Development (PC)
- Stream Fish and Macro-invertebrates (USGS)
- Nitrogen (Rutgers)
- Physiological Stress (RU)
- Landscape Models (RU & USGS)
- Build-out and Water-demand (PC)
- Data Management and Data Analysis (USGS)
- Public Information (PC)
Objectives

Determine:

- Key controls on flow regimes and water budget
- Relations between aquifer system, wetlands, and streams
- How wetland water levels and stream flows are affected by hydrologic stress
Objectives (continued)

Determine:

- How wetland and steam species respond to changes in hydrologic regime across habitat variations
- Ecosystem response to potential hydrologic stresses

Pine Barrens Tree frog

Swamp Pink
Approach

- Characterize hydrology and stream & wetland assemblage composition in selected study areas
- Establish linkages between hydrology and key assemblages
- Develop and link hydrologic and ecological models
- Apply the linked models to evaluate hydrologic alteration scenarios at the landscape level
Hydrologic Analysis

- Define hydrogeologic framework
- Hydrologic monitoring and mapping
- Wetland/aquifer interactions
- Water budgets
- Modeling
Fish & Invertebrate Assessments
Ecological Response Models

Example Logistic Regression Vegetation Models
Landscape Modeling

Hydrologic model outputs → Landscape models → Ecological models → Ecological effects of hydrologic change
Selected Study Areas

Hydrologic Data Networks

- Continuous water levels
- Wetland well transects
- Stream gaging
- Staff gages
- Synoptic water-levels
- Seepage runs
- Aquifer test
- ET Monitoring (1 site)
Hydrogeologic Framework

- Borehole database
- Cross sections

**Explanation**

<table>
<thead>
<tr>
<th>Layer</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AB A-1</td>
<td>Upper aquifer - upper layer</td>
</tr>
<tr>
<td>AB A-1C1</td>
<td>Upper - leaky confining layer</td>
</tr>
<tr>
<td>AB A-1B</td>
<td>Upper aquifer - lower layer</td>
</tr>
<tr>
<td>AB C-1</td>
<td>Middle leaky - confining layer</td>
</tr>
<tr>
<td>AB A-2</td>
<td>Middle aquifer</td>
</tr>
<tr>
<td>AB C-2</td>
<td>Lower leaky - confining layer</td>
</tr>
<tr>
<td>AB A-3</td>
<td>Lower aquifer</td>
</tr>
<tr>
<td>AB C-3</td>
<td>Lower Kirkwood confining layer</td>
</tr>
</tbody>
</table>
Hydrogeologic Framework

Geospatial datasets

- Unit tops
- Thicknesses
- Relative permeability
Mapping Depth to Water

DEPTH TO WATER TABLE, CM

- 0
- >0.0 - 0.2
- >0.2 - 0.4
- >0.4 - 0.6
- >0.6 - 0.8
- >0.8 - 1
- >1.0 - 1.5
- >1.5 - 2
- >2.0 - 3
- >3.0 - 5
- >5.0 - 10
- >10.0 - 21
- Monitor ET directly using an energy budget variant of the eddy correlation method
- Explore relations between ET and depth to water, soil moisture
Weekly Net Radiation and Latent Heat Flux
McDonalds Branch Tower Site
11/04 - 2/07

Total WY 2005 ET: 80.6 cm
Total WY 2006 ET: 78.6 cm
Monthly land-surface water budget
McDonalds Branch basin
Water years 2005-2006
Aquifer Test Setup

McDonalds Branch Test
MCDONALDS BRANCH
AQUIFER TEST
INDUCED DRAWDOWN IN WETLANDS
McDonalds Branch Test, November 2007
INDUCED DRAWDOWN IN WETLANDS

McDonalds Branch Test, November 2007

Drawdown = 5 cm
Albertsons Brook Test
8/30/07 – 9/19/07

Pumping Period

Stream Stage

Water levels in observation wells
Simulated water levels – water table
Model calibration: stream baseflow

Baseflow at 01466500 McDonalds Branch in Byrne State Forest

Diagram showing discharge in cubic meters per day from 01-Sep-04 to 01-Dec-06. The graph compares observed and simulated data.
Model Calibration—water levels

McDonalds Branch midbasin/wetlands 051559 (OW-2S):
screen from 34.96 to 31.92m Aquifer unit=A1B
Water-Demand Scenarios

- Sensitivity Analyses
  - setback distance from streams and wetlands
  - pumping well depth
  - basin position
  - withdrawal rate

- Case Studies
  - effects of incremental withdrawals
Water-Management Strategies

- Setbacks from wetlands and streams
- Specify production zone depths
- Conjunctive use of SW & GW
- Conjunctive use of confined/unconfined aquifers
- Aquifer storage and recovery
- Carrying capacity threshold