Potomac Aquifer Recharge Monitoring Laboratory (PARML): Report to Oversight Committee

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Modeled Potomac Aquifer water levels with and without SWIFT
Problem Statement: Groundwater models needed for local-scale analysis of SWIFT projects

- Modeling Objectives (SWIFT sites):
  - What are the expected water level changes in the vicinity of James River?
  - Where to monitor water levels to document impacts?
- One limitation of the Regional Model: *Computational grid was not designed to address modeling objectives*
- Greater resolution in proximity to each SWIFT site requires finer-scale numerical grids
Objectives and Approach

Go/No Go

VALIDATE REGIONAL MODEL

DEVELOP LOCAL MODEL

MODEL SCENARIOS

Groundwater Modeling of Managed Aquifer Recharge at the Regional and Local Scale
Andrew Frazier, MS Thesis (2022)
Objective 1

Regional Model Validation

- Data: USGS water level data from PAS wells located within 50 mi of the James River SWIFT site
2020 Simulated Head

- Last output from observed data
- Statistical Analysis
  - Pearson’s Coefficient of Determination
  - Nash-Sutcliffe Efficiency
  - Percent Bias
  - Visual Comparison
Validation Summary

- 94% of comparisons acceptable
- Limited to 50 mi from JR SWIFT site

<table>
<thead>
<tr>
<th>Data Issue</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>None (1)</td>
<td>27</td>
<td>40%</td>
</tr>
<tr>
<td>Trend Fit (2)</td>
<td>21</td>
<td>31%</td>
</tr>
<tr>
<td>Cyclic Data (3)</td>
<td>3</td>
<td>4%</td>
</tr>
<tr>
<td>Fluctuating Data (4)</td>
<td>13</td>
<td>19%</td>
</tr>
<tr>
<td>Poor Fit (5)</td>
<td>4</td>
<td>6%</td>
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</table>
James River SWIFT Site

- 10 recharge wells
- 2 MGD capacity each
- Operational in 2025
Local Model Grid

- 60 Layers
- 106 Rows
- 101 Columns
Scenario 1: 0%

- Regional model to local model comparison
- Comparison to observed data
- Baseline for other scenarios
- Results greater differences towards model center
- Cells diverge from regional model after reaching modeled crater
Model Scenarios

- Four scenarios
- Conservative capacity
- Flow divided evenly between 10 wells
- Run at regional and local scale

### Objective 3

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Total Flow Rate Q (MGD)</th>
<th>Flow Rate per Well (cfd)</th>
<th>% of Capacity</th>
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</thead>
<tbody>
<tr>
<td>Scenario 1</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Scenario 2</td>
<td>8</td>
<td>106,944</td>
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<td>Scenario 3</td>
<td>12</td>
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<td>Scenario 4</td>
<td>16</td>
<td>213,889</td>
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</tbody>
</table>
Anticipated Impact to Regional Groundwater Levels

Control Scenario: No Managed Aquifer Recharge

MAR Scenario (16 MGD)
Anticipated Change in Water Levels

LM Simulated Head at Cell 1

LM Simulated Head at Cell 2
Anticipated Change in Water Levels

LM Simulated Head at Cell 3

LM Simulated Head at Cell 4
Outcomes

Modeling Objectives:
- What are the expected water level changes in the vicinity of James River?
- Where to monitor water levels to document impacts?
GW Monitoring: James River

- Local data monitoring by PARML in collaboration with HRSD
  - Instrumentation and data acquisition systems
  - Data monitoring and management