A Comprehensive Assessment of Changes to Flows and Levels Resulting from Reclaimed Water Aquifer Recharge using an Integrated Model

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Outline

• Model background
• Case study: the Tampa Bay Integrated Water Resource Partnership
• Scenario description
• Discussion of results
• Conclusion
Integrated Hydrologic Model (IHM) and Integrated Northern Tampa Bay (INTB) Model
IHM Application: Tampa Bay Regional Integrated Water Resource Partnership

• Study partners: Hillsborough County, City of Tampa, City of Plant City and City of Temple Terrace

• The second phase of a regional reclaimed water feasibility study/master plan to evaluate the water resource benefits to the region by recharging the groundwater system in the District’s Water Use Caution Areas (WUCAs) in the Tampa Bay region.

• INTB Modeling Objective: to evaluate the technical feasibility of using excess reclaimed water to significantly increase direct and indirect recharge opportunities (recharge wells, RIBs) in eastern Hillsborough County including portions of the Dover WUCA and Northern Tampa Bay Area WUCA.
Alternative Locations

1320’ by 1320’ grid cell discretization in MODFLOW component model in this area

Legend:
- MFL Stations of Interest
- Two Rivers Cells
- Lake Thonotosassa Cells
- Cone Ranch Cells

Lake Thonotosassa
Two Rivers
Cone Ranch
Typical INTB Output

- Daily time series at each gauge of interest
  - Average flows over simulation period
- Average SAS and UFA heads over simulation period
- Comparisons are made to a baseline simulation
## Simulation Locations

<table>
<thead>
<tr>
<th>Location</th>
<th># of INTB Cells</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake Thonotosassa</td>
<td>10</td>
</tr>
<tr>
<td>Two Rivers</td>
<td>14</td>
</tr>
<tr>
<td>Cone Ranch</td>
<td>13</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location</th>
<th>Alternative</th>
<th>Amount per cell, mgd</th>
<th>Total Amount, mgd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cone Ranch</td>
<td>RIB (surficial)</td>
<td>0.10</td>
<td>1.3</td>
</tr>
<tr>
<td>Two Rivers</td>
<td>RIB (surficial)</td>
<td>0.10</td>
<td>1.4</td>
</tr>
<tr>
<td>Lake Thonotosassa</td>
<td>RIB (surficial)</td>
<td>0.10</td>
<td>1.0</td>
</tr>
<tr>
<td>Cone Ranch</td>
<td>Injection (Floridan)</td>
<td>1.00</td>
<td>13.0</td>
</tr>
<tr>
<td>Two Rivers</td>
<td>Injection (Floridan)</td>
<td>1.00</td>
<td>14.0</td>
</tr>
</tbody>
</table>

Simulation Locations Relative to Flow Stations
RIBs: UFA Recovery

1.3 mgd Total

1.4 mgd Total

1.0 mgd Total
Injection: UFA Recovery

13 mgd Total

14 mgd Total
Flow Hydrographs

Hillsborough River
Morris Bridge
Average Flow Comparison

**Floridan injection results in the highest average and 95th percentile flow increases, due to quantity and location.**
### Normalized Average Flow Increases, cfs/mgd of Applied Flux

<table>
<thead>
<tr>
<th>Station</th>
<th>Cone Ranch, 1.3 mgd Surficial</th>
<th>Two Rivers, 1.4 mgd Surficial</th>
<th>Lake Thonotosassa, 1.0 mgd Surficial</th>
<th>Cone Ranch, 13 mgd Floridan</th>
<th>Two Rivers, 14 mgd Floridan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hillsborough River At Morris Bridge</td>
<td>0.62</td>
<td>0.64</td>
<td>0.20</td>
<td>0.62</td>
<td>0.82</td>
</tr>
<tr>
<td>Blackwater Creek Near Knights</td>
<td>0.62</td>
<td>0.00</td>
<td>-0.01</td>
<td>0.55</td>
<td>0.03</td>
</tr>
<tr>
<td>Hillsborough River Near Zephyrhills</td>
<td>0.61</td>
<td>0.60</td>
<td>0.02</td>
<td>0.60</td>
<td>0.72</td>
</tr>
<tr>
<td>Crystal Springs</td>
<td>0.00</td>
<td>0.10</td>
<td>0.02</td>
<td>0.00</td>
<td>0.31</td>
</tr>
</tbody>
</table>
## Flow Component Changes - Average Flows

### Hillsborough River at Morris Bridge (units CFS)

<table>
<thead>
<tr>
<th>Simulation Detail</th>
<th>Cone Ranch</th>
<th>Two Rivers</th>
<th>Lake Thonotosassa</th>
<th>Cone Ranch</th>
<th>Two Rivers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>90 mgd Baseline</td>
<td>1.3 mgd RIBs</td>
<td>Difference from Baseline</td>
<td>1.4 mgd RIBs</td>
<td>Difference from Baseline</td>
</tr>
<tr>
<td>Total Flow</td>
<td>353.3</td>
<td>356.1</td>
<td>0.8</td>
<td>356.2</td>
<td>0.9</td>
</tr>
<tr>
<td>Baseflow</td>
<td>102.0</td>
<td>102.2</td>
<td>0.2</td>
<td>102.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Runoff</td>
<td>253.3</td>
<td>253.9</td>
<td>0.6</td>
<td>253.9</td>
<td>0.6</td>
</tr>
</tbody>
</table>

Percent of Flow Change Attributed to Baseflow:
- 25% for Cone Ranch
- 32% for Two Rivers
- 54% for Lake Thonotosassa
- 24% for Cone Ranch
- 52% for Two Rivers

Percent of Flow Change Attributed to Runoff:
- 75% for Cone Ranch
- 68% for Two Rivers
- 46% for Lake Thonotosassa
- 76% for Cone Ranch
- 48% for Two Rivers
• INTB Model provides improved accuracy, flexibility, and capability compared to standalone groundwater or surface water application

• Changes induced by RIBs and injection wells cause dynamic responses to runoff, baseflow, recharge, water-body stage, uplands ET, and water-body ET

• Integrated models capture all dynamic responses, including:
  • Total streamflow: directly simulate change to surface runoff and baseflow
  • Fraction of streamflow that is runoff and baseflow
  • Springflow and groundwater levels, including simulated water above land

• One model to assess flow and level changes provides efficiency and flexibility
Questions?