Developing a Water Availability Study

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Presentation Overview

• Project Purpose and Background
• Study Methodology
• Model Inputs
• Analysis / Scenarios
• Results
• Conclusions
Purpose

Determine the availability of water from the Reading Area Water Authority water supply reservoir to meet the demand of the proposed Birdsboro Power electric generating facility for DRBC consumptive use permitting
Background

• Proposed Birdsboro Power electric generating plant
• 485-Megawatt (MW) natural gas-fired combined cycle (NGCC) combustion turbine electric plant
Power Plant Location Map

- Former Armorcast site, Birdsboro, PA
Birdsboro Power Water Use

Average

- Consumption: 2.35 MGD
- Demand: 0.35 MGD
- Total: 2.70 MGD

Peak

- Consumption: 2.62 MGD
- Demand: 0.45 MGD
- Total: 3.07 MGD
RAWA Water Supply Reservoir

- Lake Ontelaunee
  - Berks County
  - Maiden Creek Watershed > Schuylkill River > Delaware River Basin
- Birdsboro Power located directly on the Schuylkill River (different subwatershed)
Watershed and Reservoir Map
Methodology

- Reservoir simulation study assuming historic flows will occur in the future
- Sequential analysis of reservoir stage, inflow, outflow, withdrawals, operating conditions, and evaporation
- Stream gauge information or surrogate watershed/stream gauge data
- Period of record 1938 – 2016
Major Events

- 1925: Lake
- 1953: Ontelaunee Constructed
- 1960: Drought
- 1980: Drought
- 2002: Ontelaunee Energy Online
- 2017: Proposed Birdsboro Power
Previous Studies (by Other Consultants)

- Dam Break Study: Ontelaunee Dam, Ontelaunee Hydroelectric Project (FERC, 1995)
- Water Availability Study: Ontelaunee Energy Center (Earth Tech, 2000)
- Water Availability Study: Ontelaunee Energy II LLC (Earth Tech, 2008)
- Water Availability Study: Proposed Berks Hollow Energy Station (Tata and Howard, 2012)
Water Balance Formula

$$\frac{\Delta S}{\Delta T} = \frac{S - S_0}{\Delta T} = I \pm GW - L - O - E - MI - CW$$

- Change in storage over time
- Input
- Output
Model Input: Surface Water Inflow

- USGS Gauges on Maiden Creek at Virginville
  - January 1973 to September 1995
  - March 2012 to present
- Fill in data gaps using surrogate watershed
  - USGS Gauge on Fishing Creek near Bloomsburg (1938 to present)
- Calibration procedure – correction factor of 9 CFS added to Fishing Creek data
Model Input: Groundwater Exchange

• Losses due to seepage through dam considered small / offset by direct groundwater input
• Assume majority of groundwater baseflow is to tributaries entering the lake
• Conservative input of 15 CFS (50-yr drought flow) for tributaries
Model Inflow: Quarry Discharge to Lake

Quarry discharges
Average of 1.5 MGD daily
Model Outflow: Spillway Discharge

Stage to volume polynomial equation

\[ Y = 0.0187x^3 - 15.486x^2 + 4263.1x - 391144 \]
Model Outflow: Existing Withdrawals

Average = 13.4 MGD

Ontelaunee Energy I in Service
Model Outflow: Birdsboro Power

Average:
- Consumption: 2.35 MGD
- Demand: 0.35 MGD
- Total: 2.70 MGD

Peak:
- Consumption: 2.62 MGD
- Demand: 0.45 MGD
- Total: 3.07 MGD
# Model Outflow: Evaporation

<table>
<thead>
<tr>
<th>Month</th>
<th>Evaporation Rate (inch/month)</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>0.85</td>
<td>New London, CT, Study</td>
</tr>
<tr>
<td>February</td>
<td>0.93</td>
<td>New London, CT, Study</td>
</tr>
<tr>
<td>March</td>
<td>1.51</td>
<td>New London, CT, Study</td>
</tr>
<tr>
<td>April</td>
<td>2.16</td>
<td>NWS / SRBC</td>
</tr>
<tr>
<td>May</td>
<td>4.84</td>
<td>NWS / SRBC</td>
</tr>
<tr>
<td>June</td>
<td>5.40</td>
<td>NWS / SRBC</td>
</tr>
<tr>
<td><strong>July</strong></td>
<td><strong>5.95</strong></td>
<td><strong>NWS / SRBC</strong></td>
</tr>
<tr>
<td>August</td>
<td>4.84</td>
<td>NWS / SRBC</td>
</tr>
<tr>
<td>September</td>
<td>3.60</td>
<td>NWS / SRBC</td>
</tr>
<tr>
<td>October</td>
<td>2.23</td>
<td>NWS / SRBC</td>
</tr>
<tr>
<td>November</td>
<td>1.66</td>
<td>New London, CT, Study</td>
</tr>
<tr>
<td>December</td>
<td>1.34</td>
<td>New London, CT, Study</td>
</tr>
</tbody>
</table>

5.6 MGD
Common Weir Equation

\[ Q = CLH^{3/2} \]

*Where:*

- \( Q \) = Flow over spillway
- \( C \) = 3.66 (calibrated dimensionless coefficient)
- \( L \) = Effective length of spillway
- \( H \) = Height of water surface above spillway
Model Analysis: Conservation Release

Required for downstream fishery

<table>
<thead>
<tr>
<th>Reservoir Stage (Ft AMSL, NGVD 29)</th>
<th>Reservoir Inflow (CFS)</th>
<th>Conservation Release (CFS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 302 Ft</td>
<td>Not Applicable</td>
<td>51 CFS</td>
</tr>
<tr>
<td>300 to 302 Ft</td>
<td>Not Applicable</td>
<td>36 CFS</td>
</tr>
<tr>
<td>&lt; 300 Ft</td>
<td>≤ 28.8 CFS</td>
<td>28.8 CFS</td>
</tr>
<tr>
<td>&lt; 300 Ft</td>
<td>&lt; 28.8 CFS</td>
<td>Reservoir Inflow Rate</td>
</tr>
</tbody>
</table>
Model Analysis: Excel Macro

- Daily analysis for >28,500 days!
- Analytical Excel sheet: Goal seek and macro (i.e. auto routine / loop)
  - Solve the ratings curve polynomial regression
  - Check if conservation release was needed and apply
  - Pass previous days storage to next day
Model Scenarios

<table>
<thead>
<tr>
<th>Scenario 1</th>
<th>Scenario 2</th>
<th>Scenario 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>16.47 MGD</strong></td>
<td><strong>25.27 MGD</strong></td>
<td><strong>18.67 MGD</strong></td>
</tr>
</tbody>
</table>

- RAWA Average
- RAWA Projected
- Birdsboro Power Peak
- Berks Hollow
Predicted Stage 1938 - 2016

- Spillway Elevation (304.29 Ft)
- Lowest Elevation of Usable Storage (282 Ft)

Scenario 1 - RAWA Avg Use & Birdsboro Power at 100%
Predicted Stage 1953 - 1955

- Historical Synthetic Hydrologic Record (Year)

- Spillway Elevation (304.29 Ft)

- Lowest Elevation of Usable Storage (282 Ft)

- Scenario 1 - RAWA Avg Use & Birdboro Power at 100%
- Scenario 2 - RAWA Avg Use & Birdboro Power at 100% & Berks Hollow at 100%
- Scenario 3 - RAWA projected Use & Birdboro Power at 100%
Predicted Stage 1960’s
Predicted Stage 1980-1981

Spillway Elevation (304.29 Ft)

Lowest Elevation of Usable Storage (282 Ft)

Scenario 1 - RAWA Avg Use & Birdsboro Power at 100%
Scenario 2 - RAWA Avg Use & Birdsboro Power at 100% & Berks Hollow at 100%
Scenario 3 - RAWA projected Use & Birdsboro Power at 100%

Historical Synthetic Hydrologic Record (Year)
Model Conclusions

• Lake Ontelaunee has sufficient capacity to support Birdsboro Power’s water use in addition to RAWA’s current and projected needs
• *Note: Berks Hollow’s docket was rescinded removing their water use from consideration*
• The current conservation release and proposed Birdsboro Power withdrawals do not have an adverse impact on the storage of the lake