ORANGE WATER AND SEWER AUTHORITY

A public, non-profit agency providing water, sewer and reclaimed water services to the Carrboro-Chapel Hill community.

Agenda
Work Session of the OWASA Board of Directors
Thursday, April 13, 2017, 6:00 P.M.
OWASA Community Room

The Board of Directors appreciates and invites the public to attend and observe its meetings. For the Board's Work Session, public comments are invited on only items appearing on this agenda. Speakers are invited to submit more detailed comments via written materials, ideally submitted at least three days in advance of the meeting to the Clerk to the Board via email or US Postal Service (aorbich@owasa.org/400 Jones Ferry Road, Carrboro, NC 27510).

Public speakers are encouraged to organize their remarks for delivery within a four-minute time frame allowed each speaker, unless otherwise determined by the Board of Directors.

The Board may take action on any item on the agenda.

Announcements

a. Announcements by the Chair
   - Any Board Member who knows of a conflict of interest or potential conflict of interest with respect to any item on the agenda tonight is asked to disclose the same at this time.
   - Announcement of the Nominating Committee

b. Announcements by Board Members

c. Announcements by Staff

Consent Agenda

Information and Reports

1. Quarterly Report on Attendance at Board and Committee Meetings (Andrea Orbich)

Action

2. Minutes of the March 9, 2017 Work Session of the Board of Directors (Andrea Orbich)
3. Minutes of the March 23, 2017 Meeting of the Board of Directors (Andrea Orbich)
4. Resolution Awarding a Construction Contract for the Eastowne, Eubanks and Meadowmont 1 Pump Station Rehabilitation Project (Simon Lobdell)

Regular Agenda

Discussion

5. Review Employee Health and Dental Insurance (Stephanie Glasgow/Ellen Tucker, Hill, Chesson and Woody)

Discussion and Action

6. Action Plan to Improve the Fluoride Feed System (Kenneth Loflin)

Discussion

7. Discuss Draft Energy Management Plan (Mary Tiger)
8. Review Board Work Schedule (John Young/Ed Kerwin)
   a. Request(s) by Board Committees, Board Members and Staff
   b. April 27, 2017 Board Meeting
   c. May 11, 2017 Work Session

d. 12 Month Board Meeting Schedule
e. Pending Key Staff Action Items

Summary of Work Session Items

9. Executive Director will summarize the key staff action items from the Work Session

Closed Session

10. The Board of Directors will convene in a Closed Session for the Purpose of Discussing a Personnel Matter (Robert Morgan)

ORANGE WATER AND SEWER AUTHORITY - QUARTERLY REPORT

ATTENDANCE AT BOARD AND COMMITTEE MEETINGS

BOARD OF DIRECTORS	JANUARY 2017	FEBRUARY 2017	MARCH 2017
JOHN A. YOUNG CHAIR	January 12 WS (Meeting) January 26 Board (Meeting)	February 9 WS (Meeting) February 17 SMB (Meeting) February 23 Board (Meeting)	March 9 WS (Meeting) March 23 Board (Absent)
JEFF DANNER, VICE CHAIR	January 12 WS (Meeting) January 26 Board (Meeting)	February 9 WS (Meeting) February 17 SMB (Meeting) February 23 Board (Meeting)	March 9 WS (Absent) March 23 Board (Meeting)
BARBARA M. FOUSHEE, SECRETARY	January 12 WS (Meeting) January 26 Board (Meeting)	February 9 WS (Meeting) February 17 SMB (Meeting) February 23 Board (Absent)	March 9 WS (Meeting) March 23 Board (Meeting)
YINKA AYANKOYA	January 12 WS (Meeting) January 26 Board (Meeting)	February 9 WS (Meeting) February 17 SMB (Meeting) February 23 Board (Meeting)	March 9 WS (Meeting) March 23 Board (Meeting)
TERRI BUCKNER	January 12 WS (Meeting) January 26 Board (Meeting)	February 9 WS (Meeting) February 17 SMB (Meeting) February 23 Board (Meeting)	March 9 WS (Meeting) March 23 Board (Absent)
DAVE MOREAU	January 12 WS (Meeting) January 26 Board (Meeting)	February 9 WS (Meeting) February 17 SMB (Meeting) February 23 Board (Meeting)	March 9 WS (Meeting) March 23 Board (Meeting)
ROBERT MORGAN	January 12 WS (Meeting) January 26 Board (Meeting)	February 9 WS (Meeting) February 17 SMB (Meeting) February 23 Board (Meeting)	March 9 WS (Meeting) March 23 Board (Meeting)
HEATHER PAYNE	January 12 WS (Meeting) January 26 Board (Meeting)	February 9 WS (Meeting) February 17 SMB (Meeting) February 23 Board (Absent)	March 9 WS (Meeting) March 23 Board (Absent)

APRIL 13, 2017

Board of Directors	January 2017	February 2017	March 2017
Ruchir Vora	January 12 WS (Meeting) January 26 Board (Absent)	February 9 WS (Meeting) February 17 SMB (Absent) February 23 Board (Meeting)	March 9 WS (Meeting) March 23 Board (Meeting)
Total Meetings Held:	**2**	**3**	**2**

Board – Board of Directors
SMB – Special Meeting of the Board
WS – Work Session

April 13, 2017

ORANGE WATER AND SEWER AUTHORITY

WORK SESSION OF THE BOARD OF DIRECTORS

MARCH 9, 2017

The Board of Directors of the Orange Water and Sewer Authority (OWASA) held a work session on Thursday, March 9, 2017 at 6:00 P.M. in the Community Room in OWASA's Administration Building, 400 Jones Ferry Road, Carrboro.

Board Members present: John A. Young, Chair; Barbara Foushee, Secretary; Yinka Ayankoya; Terri Buckner; David Moreau; Bob Morgan; Heather Payne; and Ruchir Vora. Board Member absent: Jeff Danner, Vice Chair.

OWASA staff present: Ed Kerwin; Mary Darr; Monica Dodson; Greg Feller; Alicia Grey; Stephanie Glasgow; Katie Harrold; Randy Horton; Ken Loflin; Andrea Orbich; Ruth Rouse; Todd Taylor; Mary Tiger; Stephen Winters; and Robert Epting, Esq., Epting and Hackney.

Others present: Elijah Ayankoya; Daria Barazandeh; Jennie Baumann; Jackson Boone; Joal H. Broun; Lauren Brown; Dr. Rodney Coleman, First Baptist Church; Rachel Conerly; Theodore Cukkinos; Zachary Davidson; Don DeMichels; Eleanor Dillon; Parker Emmerson; Braxton Foushee; Fredrick Harris; Quinton Harper; Thomas Hartwell; Dr. Rebecca King; Debbye Krueger; Lew Lampiris; Roy Piscitello; Sharon Reese; Ali Saeed, NC Oral Health; Lisa Stauffer; Wendy Schwade; Rhonda Stephens; Charlee Sturmer; Corey Sturmer; Claire Viadro; Wynona Thompson; Jane Weintraub; Alex White; Lamont Wilkins; Tim Wright; Sam Yanuck; Kurt Yokum; Valerie Yow; Brad Ives, Associate Vice Chancellor of Campus Services and Margaret Holton, Water, Sewer and Reclaimed Water Coordinator, University of North Carolina at Chapel Hill; and Annie Chen, Ann Danells, Winston George, Brittany Klein, and Duane Laucheryes, UNC School of Dentistry.

There being a quorum present, Chair John Young called the meeting to order.

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<u>MOTIONS</u>

1. Terri Buckner made a motion that: 1) OWASA will continue to follow its current policy and practice of fluoridating the public drinking water supply; 2) OWASA staff is directed to stay abreast of developments in scientific research and accepted public health policy and practice related to public water supply fluoridation; and 3) staff will continue to monitor and improve OWASA's fluoride feed system, and inform the Board when the improved system is ready for operation; second by Dave Moreau and the motion passed with a vote of seven to one with Yinka Ayankoya opposed because she does not want fluoride in the drinking water.

2. Robert Morgan made a motion that the Board approve the Draft Initial Implementation Plan for OWASA's Diversity and Inclusion Program, hire a consultant within the next quarter, and

receive quarterly reports in June and September 2017; second by Terri Buckner and unanimously approved.

3. Yinka Ayankoya made a motion that as a practice for the next election of Officers of the Board, the full Board of Directors would serve on the Nominating Committee, and that each Board member will be considered available for nomination for each office, except those who specifically indicate (for each office) before the election that he or she is unwilling or unable to serve; second by Robert Morgan and unanimously approved.

4. Robert Morgan made a motion to set one-year term limits for each of the offices of Chair, Vice Chair and Secretary, the Board agreed not to amend the Bylaws to provide for these changes, but rather, agreed that these procedures would be followed as current practice; second by Terri Buckner and the motion passed with a vote of five to three with Dave Moreau, Heather Payne and Ruchir Vora opposed.

ANNOUNCEMENTS

John Young said that any Board Member who knows of a conflict of interest or potential conflict of interest with respect to any item on the agenda tonight is asked to disclose the same at this time; none were disclosed.

Ruth Rouse, Planning and Development Manager, said the N.C. Environmental Management Commission approved continuation of OWASA's allocation of 5% of the Jordan Lake supply, or about 5 million gallons per day. Jordan Lake is an important back up supply in the event of an extended drought or operational emergency such as the one in early February. OWASA has mutual aid agreements with the City of Durham and the Town of Cary to use their existing infrastructure to access our Jordan Lake allocation when needed.

ITEM ONE: WHETHER TO REVIEW OWASA'S CURRENT PRACTICE OF FLUORIDATING DRINKING WATER

The Board received public comments from more than 40 people via e-mail and letters, etc., prior to the meeting tonight. The Board also received public comment at the meeting from 20 individuals (5 concurred with the practice of water fluoridation and 13 opposed water fluoridation).

Terri Buckner arrived at 6:52 P.M.

Following discussion, Board members noted the concerns on both sides and stated that the public's input is respected and helpful.

Terri Buckner made a motion that: 1) OWASA will continue to follow its current policy and practice of fluoridating the public drinking water supply; 2) OWASA staff is directed to stay abreast of developments in scientific research and accepted public health policy and practice related to public water supply fluoridation; and 3) staff will continue to monitor and improve OWASA's fluoride feed system, and inform the Board when the improved system is ready for operation; second by Dave Moreau and the motion passed with a vote of seven to one with Yinka Ayankoya opposed because she does not want fluoride in the drinking water. Please see Motion 1 above.

The Board expressed appreciation to the public for attending the meeting and providing comments.

ITEM TWO: DISCUSS INITIAL IMPLEMENTATION PLAN FOR OWASA'S EMPLOYEE DIVERSITY AND INCLUSION PROGRAM

Dr. Rodney Coleman, Pastor at Chapel Hill Baptist Church, expressed support of the plan and inquired on how frequent the plan would be evaluated for success.

After discussion, there was Board agreement to accept the Initial Implementation Plan for the Employee Diversity and Inclusion Program. The Board requested that staff hire a consultant in the next quarter to review and assist in further developing the plan, and that staff provide status reports in June and September 2017.

Robert Morgan made a motion that the Board approve the Initial Implementation Plan for OWASA's Diversity and Inclusion Program, hire a consultant within the next quarter, and receive quarterly reports in June and September 2017; second by Terri Buckner and unanimously approved. Please see Motion 2 above.

ITEM THREE: DISCUSS FISCAL YEAR (FY) 2018 DRAFT BUDGET AND RATES

Braxton Foushee said that he would like the Board to evaluate options for live viewing and videoing all OWASA Board meetings as part of the FY 2018 budget review process.

Terri Buckner proposed that the Board consider reducing the water commodity rate for area businesses for one year in response to the February water emergency. After discussion, the proposal was not supported by the Board.

ITEM FOUR: DISCUSSION OF BOARD OFFICER NOMINATION AND ELECTION PROCESS

Yinka Ayankoya made a motion that as a practice for the next election of Officers of the Board, the full Board of Directors would serve on the Nominating Committee, and that that each Board member will be considered available for nomination for each office, except those who specifically indicate (for each office) before the election that he or she is unwilling or unable to serve; second by Robert Morgan and unanimously approved. Please see Motion 3 above.

Robert Morgan made a motion to set one-year term limits for each of the offices of Chair, Vice Chair and Secretary, the Board agreed not to amend the Bylaws to provide for these changes, but rather, agreed that these procedures would be followed as current practice; second by Terri Buckner and the motion passed with a vote of five to three with Dave Moreau, Heather Payne and Ruchir Vora opposed. Please see Motion 4 above.

The Board discussed selection of committee members and appointment of officers of committees, but took no action.

ITEM FIVE: REVIEW BOARD WORK SCHEDULE

The Board received a status report from Todd Taylor on evaluation of proposals for installing the Advanced Metering Infrastructure (AMI) system and the start of contract negotiations with the selected firm, Mueller Systems. The AMI project will begin later this year.

The Board agreed to discuss the AMI manual meter reading option on April 27, 2017.

The Board agreed that the Minutes of the Board of Directors Meeting on February 9, 2017 will include the Resolution of Appreciation to the Staff of OWASA as unanimously approved by the Board on February 9th.

ITEM SIX: RESOLUTION SETTING THE DATE OF MAY 25, 2017 FOR A PUBLIC HEARING ON OWASA'S FISCAL YEAR 2018 BUDGET

Without objection, the Board approved the Resolution Setting the Date of May 25, 2017 for a Public Hearing on OWASA's Fiscal Year 2018 Budget.

ITEM SEVEN: RESOLUTION SETTING THE DATE OF MAY 25, 2017 FOR A PUBLIC HEARING ON PROPOSED REVISIONS TO OWASA'S RATES, FEES AND CHARGES

Without objection, the Board approved the Resolution Setting May 25, 2017 as the Date for a Public Hearing on the Proposed Revisions to OWASA's Schedule of Rates, Fees and Charges.

ITEM EIGHT: MINUTES

Without objection, the Board approved the Minutes of the January 26, 2017 Meeting of the Board of Directors.

ITEM NINE: MINUTES

Without objection, the Board approved the Minutes of the February 23, 2017 Closed Session of the Board of Directors.

ITEM TEN: EXECUTIVE DIRECTOR'S SUMMARY OF THE KEY STAFF ACTION ITEMS FROM THIS WORK SESSION

Mr. Kerwin said the key items for staff action are:

- Evaluate options for live viewing and video of all OWASA Board meetings as part of the FY 2018 budget review process.

- Proceed with Initial Implementation Plan for Diversity and Inclusion Program; hire consultant within the next quarter; provide progress reports in June and September 2017.

ITEM ELEVEN: CLOSED SESSION

Without objection, the Board convened in a Closed Session for the purpose of discussing a personnel matter.

The meeting was adjourned at 9:55 P.M.

Respectfully submitted by:

Andrea Orbich
Executive Assistant/Clerk to the Board

Attachments

ORANGE WATER AND SEWER AUTHORITY

MEETING OF THE BOARD OF DIRECTORS

MARCH 23, 2017

The Board of Directors of the Orange Water and Sewer Authority (OWASA) held a regular meeting on Thursday, March 23, 2017, at 7:00 P.M. in the Council Chamber at the Chapel Hill Town Hall, 405 Martin Luther King Jr. Boulevard, Chapel Hill.

Board Members present: Jeff Danner (Vice Chair), Barbara Foushee (Secretary), Yinka Ayankoya, David (Dave) Moreau, Robert Morgan and Ruchir Vora. Board Members absent: John A. Young (Chair), Terri Buckner and Heather Payne.

OWASA staff present: Ed Kerwin, Mary Darr, Monica Dodson, Greg Feller, Vishnu Gangadharan, Stephanie Glasgow, Alicia Grey, Simon Lobdell, Andrea Orbich, Kevin Ray, Todd Taylor, Stephen Winters, Robin Jacobs (Epting and Hackney) and Robert Epting (Epting and Hackney).

Others present: Jeremy Adkins, WTVD; Daria Barazandeh; Alice Boyle; Lauren Brown; Isabel Calingaert; Bill Camp; Rachel Conerly; Zachary Davidson; Eleanor Dillon; David Halley, True North Forest Management Services; Meg Holton, Water, Wastewater and Stormwater Manager at the University of North Carolina at Chapel Hill (UNC); Micah Intrator; Benjamin Kaplan; Debbye Krueger; D. G. Martin; Lillian Mundich; Reade Oakley; Gabriel Pelli; Lauren Piontka; Lorelai Rao; Sharon Reese; JohnAnn Shearer, U.S. Fish and Wildlife Service; Marcela Slade; Charlee Sturmer; Corey Sturmer; Aimee Tomcho, Audubon North Carolina; Claire Viadro; Amy Weiss; Lamont Wilkins; Gwen Willock; Mike Willock, DDS; William Young; Valerie Yow.

There being a quorum present, Vice Chair Jeff Danner called the meeting to order.

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MOTIONS ACTED UPON

1. Dave Moreau made a Motion that staff provide the Board information via e-mail about OWASA's business relationship with Wells Fargo; second by Ruchir Vora and the Motion passed with a vote of five to one with Jeff Danner opposed.

2. Ruchir Vora requested that staff provide the Board information about OWASA's business relationship with Wells Fargo as an agenda item at a future meeting; second by Robert Morgan and the Motion failed with a vote of four to two with Jeff Danner and Yinka Ayankoya opposed.

3. The Board approved amending OWASA's Schedule of Rates, Fees and Charges to determine the water commodity surcharges applicable under water shortage declaration stages will apply to multi-family master-metered accounts. This item was approved by adoption of the Consent

Agenda. (Motion by Dave Moreau, second by Barbara Foushee, and the Motion passed with a vote of five to one with Ruchir Vora opposed.)

4. BE IT RESOLVED THAT the Board of Directors of Orange Water and Sewer Authority adopts the Resolution Awarding a Construction Contract for the Rogerson Drive Force Main Rehabilitation Project. (Motion by Dave Moreau, second by Barbara Foushee and the resolution passed with a vote of five to one with Ruchir Vora opposed.)

5. Dave Moreau made a Motion to approve the Minutes of the February 9, 2017 Work Session of the Board of Directors; second by Barbara Foushee and the Motion passed with a vote of five to one with Ruchir Vora opposed.

6. Dave Moreau made a Motion to approve the Minutes of the February 23, 2017 Meeting of the Board of Directors; second by Barbara Foushee and Motion passed with a vote of five to one with Ruchir Vora opposed.

7. Dave Moreau made a Motion to approve the Minutes of the March 9, 2017 Closed Session of the Board of Directors; second by Barbara Foushee and Motion passed with a vote of five to one with Ruchir Vora opposed.

8. Robert Morgan made a Motion to approve and to authorize staff to implement the Action Plan resulting from the Foxcroft Drive Water Main Break, and directing that the Board and public be kept advised as to staff's progress in completing the Action Plan; second by Ruchir Vora and unanimously approved.

9. BE IT RESOLVED THAT the Board of Directors of Orange Water and Sewer Authority adopts the Resolution of the Orange Water and Sewer Authority Authorization of a New Utilities Engineer Position in the Engineering and Planning Department to Support the Capital Improvements Program. (Motion by Dave Moreau, second by Barbara Foushee and unanimously approved.)

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ANNOUNCEMENTS

Conflict of Interest

Jeff Danner said any Board Member who knows of a conflict of interest or potential conflict of interest with respect to any item on the agenda tonight is asked to disclose at this time; none were disclosed.

Lake Recreation

Todd Taylor, General Manager of Operations, announced that the reservoirs will reopen for recreation on Saturday, March 25, 2017. University Lake will be open Fridays through Sundays from 6:30 A.M. until 6:00 P.M. and the Cane Creek Reservoir will be open on Fridays and Saturdays from 6:30 A.M. until 6:00 P.M.

Audubon Society Recognition

Ruth Rouse, Planning and Development Manager, said that OWASA received an award from Audubon North Carolina for OWASA's forestry work at OWASA's Cane Creek Reservoir Mitigation Tract. Aimee Tomcho, Conservation Biologist with Audubon North Carolina, presented the award to Ms. Rouse. Ms. Tomcho recognized the importance of partnerships such as the one between OWASA, Dave Halley of True North Forest Management Services, OWASA's consultant, US Fish and Wildlife Service, and Audubon North Carolina to preserve song bird habitat.

PETITIONS AND REQUESTS

Jeff Danner reminded the public that on March 9, 2017, the OWASA Board of Directors decided to continue the current policy of fluoridating drinking water.

Mike Willock, Chapel Hill dentist, said that he believes fluoride is a toxic and does not recommend the use of fluoride of any kind.

Eleanor Dillon petitioned the Board to stop fluoridating drinking water.

Daria Barazandeh requested that the Board hold a fair and legitimate debate on water fluoridation and suggested that Dr. Paul Connett be invited to speak as the expert on fluoride.

Lamont Wilkins opposed fluoridation of drinking water.

Sharon Reese opposed fluoridation of drinking water.

Micah Intrator petitioned the Board to stop fluoridating the drinking water.

Gabriel Pelli opposed fluoridation of drinking water.

Alice Boyle asked the Board to discontinue fluoridating the drinking water.

Corey Sturmer opposed fluoridation of drinking water.

Lillian Mundich opposed fluoridation of drinking water.

William Young opposed fluoridation of drinking water.

Lorelai Rao opposed fluoridation of drinking water.

Amy Weiss opposed fluoridation of drinking water.

Zachary Davidson proposed that the Board remove fluoride from the drinking water.

Isabel Calingaert opposed fluoridation of drinking water.

Lauren Brown opposed fluoridation of drinking water.

Claire Viadro opposed fluoridation of drinking water.

Marcela Slade opposed fluoridation of drinking water.

Yinka Ayankoya stated that she opposes fluoridation of drinking water.

The Board heard the petitions and took no action.

Ruchir Vora requested that staff investigate OWASA's financial involvement with Wells Fargo.

Dave Moreau made a Motion that staff provide the Board information via e-mail about OWASA's business relationship with Wells Fargo; second by Ruchir Vora and the Motion passed with a vote of five to one with Jeff Danner opposed. Please see Motion 1 above.

Ruchir Vora requested that staff provide the Board the information about OWASA's business relationship with Wells Fargo as an agenda item at a future meeting; second by Robert Morgan and the Motion failed with a vote of four to two with Jeff Danner and Yinka Ayankoya opposed. Please see Motion 2 above.

Jeff Danner asked for petitions and requests from the staff; none were received.

ITEM ONE: 12 MONTH BOARD MEETING SCHEDULE

The Board received this as an information item.

ITEM TWO: DETERMINE CONSERVATION WATER COMMODITY CHARGES UNDER MANDATORY WATER USE RESTRICTIONS FOR MULTI-FAMILY MASTER-METERED CUSTOMERS

The Board approved amending OWASA's Schedule of Rates, Fees and Charges to determine the water commodity surcharges applicable under water shortage declaration stages will apply to multi-family master-metered accounts. This item was approved by adoption of the Consent Agenda. (Motion by Dave Moreau, second by Barbara Foushee, and the Motion passed with a vote of five to one with Ruchir Vora opposed. Please see Motion 3 above.)

ITEM THREE: RESOLUTION AWARDING A CONSTRUCTION CONTRACT FOR THE ROGERSON DRIVE FORCE MAIN REHABILITATION PROJECT

Dave Moreau made a Motion to approve the resolution; second by Barbara Foushee and the resolution passed with a vote of five to one with Ruchir Vora opposed. Please see Motion 4 above.

ITEM FOUR: MINUTES

Dave Moreau made a Motion to approve the Minutes of the February 9, 2017 Work Session of the Board of Directors; second by Barbara Foushee and the Motion passed with a vote of five to one with Ruchir Vora opposed. Please see Motion 5 above.

ITEM FIVE: MINUTES

Dave Moreau made a Motion to approve the Minutes of the February 23, 2017 Meeting of the Board of Directors; second by Barbara Foushee and Motion passed with a vote of five to one with Ruchir Vora opposed. Please see Motion 6 above.

ITEM SIX: MINUTES

Dave Moreau made a Motion to approve the Minutes of the March 9, 2017 Closed Session of the Board of Directors; second by Barbara Foushee and Motion passed with a vote of five to one with Ruchir Vora opposed. Please see Motion 7 above.

ITEM SEVEN: ACTION PLAN TO IMPROVE THE FLUORIDE FEED SYSTEM

The Board received a presentation from Kenneth Loflin, Water Supply and Treatment Manager, on the Action Plan to improve the fluoride feed system at the Jones Ferry Road Water Treatment Plant.

Bill Camp said that staff has done a good job to provide a solution that will work and mitigate risk.

William Young said that the upgrades and improvements cost too much and OWASA should let customers decide if they even want fluoride in the drinking water.

Dr. Claire Viadro said that cost is too high and the Board should allow customers to have a say in where money is spent. Dr. Viadro also petitioned the Board to pay for the water filters that customers purchase and applauded the Board Member who opposed fluoridation of drinking water.

Micah Intrator said he opposes fluoridating the drinking water and the money should go towards purchasing toothpaste for those who want fluoride.

Corey Sturmer said that a new cost/benefits analysis should be done now that new costs have been provided.

Gabriel Pelli said that it is a waste of money to improve the fluoride feed system and that the Board should discontinue the use of fluoridating drinking water.

Rachel Conerly said it was ludicrous to spend customers' money to poison the community.

Zachary Davidson said the Board should not spend money to poison the community.

Barbara Foushee inquired about staffing and training needs for the Water Supply and Treatment department as a result of the fluoride overfeed.

Dave Moreau suggested that the State, in coordination with others, provide guidance and support on water supply matters during various water emergencies instead of only focusing on enforcement of the quality of drinking water. The Board and staff agreed with Dr. Moreau's suggestion, and he will prepare a draft request to the State in this regard.

Robert Morgan said that he would like to delay action until he can further review new information on this agenda item.

Ms. Foushee stated that she was uncomfortable voting on this matter until she understood staffing needs.

The Board agreed to defer action on the proposed Action Plan of the fluoride feed system until the April 13, 2017 meeting. Board members were encouraged to request any additional information they may need from staff in advance of the meeting.

The Board requested that staff distribute to the Board by e-mail the information provided by the public tonight on this item.

ITEM EIGHT: ACTION PLAN RESULTING FROM FOXCROFT DRIVE WATER MAIN BREAK

Robert Morgan made a Motion to approve and to authorize staff to implement the Action Plan resulting from the Foxcroft Drive Water Main Break, and directing that the Board and public be kept advised as to staff's progress in completing the Action Plan; second by Ruchir Vora and unanimously approved. Please see Motion 8 above.

ITEM NINE: FISCAL YEAR 2018 DRAFT BUDGET REVIEW AND STAFF RATE ADJUSTMENT RECOMMENDATION

The Board discussed the draft budget and rate adjustment recommendation for July 2017 through June 2018 (FY 2018). Stephen Winters, Director of Finance and Customer Service, said that staff's preliminary work on the draft 2018 budget indicates that staff will not be requesting an increase in the rates for monthly water and sewer service in the FY 2018 budget.

ITEM TEN: PROPOSED RESOLUTION OF THE ORANGE WATER AND SEWER AUTHORITY AUTHORIZATION OF A NEW UTILITIES ENGINEER POSITION IN THE ENGINEERING AND PLANNING DEPARTMENT TO SUPPORT THE CAPITAL IMPROVEMENTS PROGRAM

Ruchir Vora made a motion to approve the resolution; second by Dave Moreau and unanimously approved. Please see Motion 9 above.

ITEM ELEVEN: EXECUTIVE DIRECTOR WILL SUMMARIZE THE KEY ACTION ITEMS FROM THE BOARD MEETING AND NOTE SIGNIFICANT ITEMS FOR DISCUSSION AND/OR ACTION EXPECTED AT THE NEXT MEETING

Ed Kerwin summarized the meeting as follows:

- April 13, 2017 Work Session will include the following items:
  - Discuss Draft Energy Management Plan;
  - Discuss Fiscal Year 2018 draft budget, rates, and reserves;
  - Authorize staff to publish proposed rates;
  - Review employee health and dental insurance update;
  - Award a construction contract for pump station improvements;
  - Action Plan to improve the fluoride feed system;
- Staff will e-mail information about OWASA's financial involvement with Wells Fargo;
- Dave Moreau will prepare a draft document for review by the Board and staff regarding Dr. Moreau's suggestion that the State, in coordination with others, provide guidance and support on water supply matters during various water emergencies instead of only focusing on enforcement of the quality of drinking water;
- Staff will provide the Board via e-mail information presented in this meeting by the public about fluoridation of drinking water; and
- Staff will implement the Foxcroft Drive water main break Action Plan.

ITEM TWELVE: CLOSED SESSION

Without objection, the Board agreed to delay the Closed Session until April 13, 2017.

The meeting was adjourned at 9:45 P.M.

Respectfully submitted,

Andrea Orbich
Executive Assistant/Clerk to the Board

Attachments

<u>Agenda Item 4</u>:

Resolution Awarding a Construction Contract for the Eastowne, Eubanks and Meadowmont 1 Pump Station Rehabilitation Project

<u>Purpose</u>:

This memorandum recommends that OWASA Board award a construction contract to Water and Waste Systems Construction, Inc. ("Water and Waste Systems") for the construction of the Eastowne, Eubanks, and Meadowmont 1 Pump Station Rehabilitation Project ("Project").

<u>Background</u>:

This project provides renovations to three of OWASA's 21 wastewater pump stations to ensure reliable operation. An engineering study completed in Fiscal Year 2016 refined the scope and costs of improvements as follows:

1) Eastowne Pump Station: replacement of the existing "can" style pump station with a submersible station and improvements to the electrical and control systems.
2) Eubanks Pump Station: equipment rehabilitation, electrical system improvements, installation of a new flow meter.
3) Meadowmont 1 Pump Station: replacement of the electrical distribution system and installation of a variable frequency drive (VFD).

<u>Advertising and Bidding</u>

OWASA staff and its consultant Kimley Horn and Associates ("Engineer") developed a Preliminary Engineering Report, design and specifications for the improvements. Prospective bidders were screened through our standard prequalification process, which involved having interested contractors submit a package outlining their qualifications, including past performance on similar projects, credentials of their management team, safety record, etc. Only those firms that clearly demonstrated the capability to adequately perform the project work were invited to submit bids.

The Request for Qualifications (RFQ) was posted in December 2016. After review, eleven contractors were prequalified to bid on the project. The invitation for bids was issued to the prequalified contractors on February 21, 2017. A total of six bids were received on March 23, 2017 and opened publicly. Water and Waste Systems was the low, responsive and responsible bidder for the project with a bid of $820,000.00. A copy of the certified bid tabulation is attached with the Engineer's recommendation to award (Attachment 2), and the results are summarized below:

Water and Waste Systems Construction, Inc.	**$820,000.00**
Carolina Civilworks, Inc.	$909,759.46
Laughlin Sutton	$920,800.00
Turner Murphy	$1,056,584.48
Haren Construction	$1,072,000.00
Gilbert Engineering	$1,075,554.46
Engineer's Final Estimate	*$770,000.00*

Minority and Women Business Enterprise (MWBE) Participation

OWASA's Minority Business Participation Outreach Plan and Guidelines include all of the statutory requirements from the State of North Carolina, and specifies a 10% goal for participation by minority businesses. In keeping with standard practice, OWASA staff took several actions to solicit minority participation in this contract, including advertising the RFQ in the Greater Diversity News, North Carolina Institute of Minority Economic Development, North Carolina Department of Administration Historically Underutilized Businesses, OWASA's website, and plan rooms, and requiring bidders to follow "good faith" efforts to solicit participation by minority subcontractors. In addition, OWASA staff publicly advertised the formal bid itself as an additional effort to solicit participation by subcontractors where it was feasible

The apparent low bidder (Water and Waste Systems) provided documentation of good faith efforts and identified MWBE participation of $90,000.00 (11% of the total bid amount). The selected subcontractor is a minority owned business.

Bid Analysis and Recommendation

The six bids received were spread over a relatively tight range (the high bid was 31% higher than the low bid). The low bid was about 6.5% higher than the Engineer's estimate and reflects a reasonable and competitive cost for the work. The primary cost that exceeded the engineer's estimate are primarily driven by increased electrical contractor costs.

Water and Waste Systems' ability to complete this project was evaluated thoroughly during the prequalification process, and they demonstrated sufficient qualifications in past project performance, personnel qualifications/experience, reference checks, and all other rated categories. OWASA staff also determined that Water and Waste Systems' safety performance, relevant project experience, bonding capacity, and other non-rated categories met our requirements.

Kimley Horn's recommendation that the construction contract for this project be awarded to Water and Waste Systems is attached along with the certified bid tabulation (Attachment

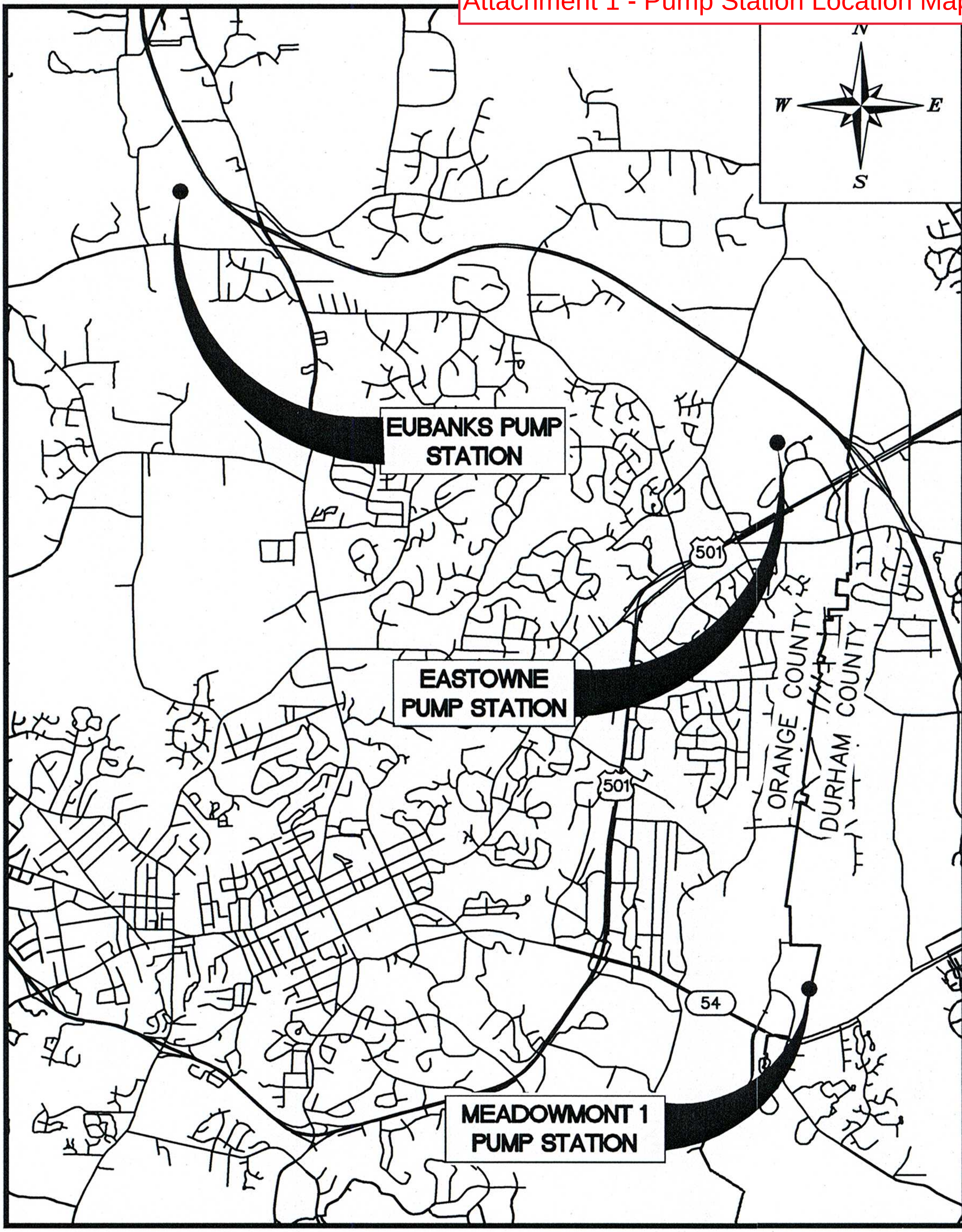
2). OWASA staff strongly concurs with this recommendation because of the importance of the project. In order to proceed, we request the Board's adoption of the attached resolution (Attachment 3) awarding the construction contract to Water and Waste Systems.

Information

Attachments

1. Pump Station Location Map
2. Engineer's Recommendation for Award and Certified Bid Tabulation
3. Resolution

Attachment 1 - Pump Station Location Map



1" = 3000'

PROJECT SITE

Attachment 2 - Engineer's Recommendation of Award and Certified Bid Tabulation

Kimley»Horn

March 28, 2017

300 W. Morgan St.
Suite 1500
Durham, NC 27701

Mr. Simon Lobdell, P.E.
Orange Water and Sewer Authority
400 Jones Ferry Rd
Carrboro, NC 27510-0366

Re: **Evaluation for Low Responsive and Responsible Bid Proposal Eastowne, Eubanks, and Meadowmont 1 Pump Stations Improvements Project**

Dear Simon:

In accordance with the Orange Water and Sewer Authority's request, we have reviewed the proposal from Water and Waste System Construction, Inc. for completeness and have determined it to be responsive with no apparent shortcomings nor omissions. Based on the information in the proposal and the Certified Bid Tabulation, it appears that Water and Waste System Construction, Inc. is currently the low responsive and responsible bidder for this project with a Base Bid Amount of $820,000.00.

This letter is based solely on the information provided in the proposal and is not a recommendation or a guarantee of their performance on this project.

Please advise if you have any questions. I can be reached at 919-653-2963.

Best regards,

KIMLEY-HORN AND ASSOCIATES, INC.

Zachary G. Purvis, P.E.
Project Manager

Attachments:

1. Certified Bid Tabulation
2. Bid Package Checklist

TEL 919-677-2000

PAY ITEM NO.	ITEM DESCRIPTION	UNIT	EST. QTY.	Water & Waste Systems Construction, Inc.		Carolina Civil Works, Inc.		Laughlin-Sutton Construction Company		Turner Murphy Company, Inc.		Haren Construction Company, Inc.		Gilbert Engineering Company	
				UNIT PRICE BID	EXTENDED TOTAL	UNIT PRICE BID	EXTENDED TOTAL	UNIT PRICE BID	EXTENDED TOTAL	UNIT PRICE BID	EXTENDED TOTAL	UNIT PRICE BID	EXTENDED TOTAL	UNIT PRICE BID	EXTENDED TOTAL
1	Mobilization (maximum 3% of Base Bid)	LS	1	$ 24,000.00	$ 24,000.00	$ 23,960.00	$ 23,960.00	$ 27,624.00	$ 27,624.00	$ 32,000.00	$ 32,000.00	$ 30,000.00	$ 30,000.00	$ 30,000.00	$ 30,000.00
2	Eastowne Pump Station Upgrades	LS	1	$ 411,380.00	$ 411,380.00	$ 490,025.00	$ 490,025.00	$ 479,807.54	$ 479,807.54	$ 413,610.02	$ 413,610.02	$ 591,025.54	$ 591,025.54	$ 590,220.00	$ 590,220.00
3	Eubanks Pump Station Upgrades	LS	1	$ 69,045.00	$ 69,045.00	$ 44,425.00	$ 44,425.00	$ 78,218.00	$ 78,218.00	$ 200,000.00	$ 200,000.00	$ 40,000.00	$ 40,000.00	$ 73,100.00	$ 73,100.00
4	Meadowmont 1 Pump Station Upgrades	LS	1	$ 204,600.54	$ 204,600.54	$ 240,375.00	$ 240,375.00	$ 224,176.00	$ 224,176.00	$ 300,000.00	$ 300,000.00	$ 300,000.00	$ 300,000.00	$ 271,260.00	$ 271,260.00
5	CITI Allowance	LS	1	$ 90,974.46	$ 90,974.46	$ 90,974.46	$ 90,974.46	$ 90,974.46	$ 90,974.46	$ 90,974.46	$ 90,974.46	$ 90,974.46	$ 90,974.46	$ 90,974.46	$ 90,974.46
6	Contingency Allowance	LS	1	$ 20,000.00	$ 20,000.00	$ 20,000.00	$ 20,000.00	$ 20,000.00	$ 20,000.00	$ 20,000.00	$ 20,000.00	$ 20,000.00	$ 20,000.00	$ 20,000.00	$ 20,000.00
				TOTAL	**$ 820,000.00**	**TOTAL**	**$ 909,759.46**	**TOTAL**	**$ 920,800.00**	**TOTAL**	**$ 1,056,584.48**	**TOTAL**	**$ 1,072,000.00**	**TOTAL**	**$ 1,075,554.46**

Certification:
The bids tabulated herin were opened and read aloud at 2:00 P.M., local time on March 23, 2017 at 400 Jones Ferry Rd, Carborro, NC. The bid tabulation is correct in that it contains the prices as represented on the original bid proposal of each bidder. Math errors have been corrected and are denoted in italic text.

KIMLEY-HORN AND ASSOCIATES, INC.

Zachary G. Purvis, P.E.
Project Manager

NORTH CAROLINA PROFESSIONAL SEAL 33186 ENGINEER ZACHARY G. PURVIS

Digitally signed by Zachary G. Purvis
DN: C=US, E=zak.purvis@kimley-horn.com, O="Kimley-Horn and Associates, Inc.", OU=Kimley-Horn, CN=Zachary G. Purvis
Reason: I am approving this document
Date: 2017.03.27 11:20:26-04'00'

Attachment 3

RESOLUTION AWARDING A CONSTRUCTION CONTRACT FOR THE EASTOWNE, EUBANKS, AND MEADOWMONT 1 PUMP STATIONS REHABILITATION PROJECT

WHEREAS, there is a need to renovate the Eastowne, Eubanks, and Meadowmont 1 Pump Stations; and

WHEREAS, plans and specifications for the construction of this project have been prepared by Kimley Horn and Associates; and

WHEREAS, advertisement for contractor qualifications was published on the websites of the North Carolina Institute of Minority Economic Development, North Carolina Department of Administration, and OWASA on December 8, 2016, and 11 contractors were qualified to bid; and

WHEREAS, on February 21, 2017, the prequalified contractors were formally invited to submit construction bids for the project, and six bids were received; and

WHEREAS, Water and Waste Systems Construction, Inc. of Garner, North Carolina has been determined to be the low responsive, responsible bidder for the project; and

WHEREAS, on June 9, 2016 the Board approved a resolution authorizing funds for Capital Improvement Projects, including funds for this project;

NOW, THEREFORE, BE IT RESOLVED:

1. That the Orange Water and Sewer Authority Board of Directors awards the construction contract to Water and Waste Systems Construction, Inc., the low responsive, responsible bidder for the Eastowne, Eubanks, and Meadowmont 1 Pump Stations, in accordance with the approved plans and specifications, in the amount of $820,000.00, subject to such change orders as may apply.

2. That the Executive Director be, and hereby is, authorized to execute said contract, subject to prior approval of legal counsel, and to approve and execute change orders and such documents as may be required in connection with the construction contract.

Adopted this 13th day of April, 2017.

____
John A. Young, Chair

ATTEST:

____
Barbara M. Foushee, Secretary

Agenda Item 5:

Review Employee Health and Dental Insurance

Purpose:

Information and update from staff and Hill, Chesson and Woody to generate Board discussion and guidance regarding employee insurances beginning July 1, 2017.

Background:

The Orange Water and Sewer Authority began using the firm of Hill, Chesson and Woody in April 2014 to manage benefit plans and negotiate premiums for Employee Health, Dental, Life, Dependent Life, Accidental Death and Dismemberment (AD&D) and Long Term Disability (LTD) Insurance.

The current Employee Health and Dental contracts expire on June 30, 2017.

The Life, Dependent Life, AD&D and LTD contracts are set to expire on June 30, 2018.

The Board received a presentation from Hill, Chesson and Woody in January 2017 that included:

- Post-election Healthcare Predictions
- Overview of Utilization and Cost
- Financial Performance
- Benefit Benchmarking

Information:

A representative from Hill, Chesson and Woody will be presenting renewal data at the April 13, 2017 Board Work Session.

Agenda Item 6:

Action Plan to Improve the Fluoride Feed System

Purpose:

Provide Action Plan to ensure safe and reliable operation of the fluoride feed system at the Jones Ferry Road Water Treatment Plant to include a projected date to resume drinking water fluoridation.

Note About Fluoridation

At their March 9, 2017 meeting, the OWASA Board of Directors decided to continue the current policy of fluoridating drinking water. The Board's discussion and decision followed a public process including comments by more than 40 people in Board meetings, by e-mail, etc. OWASA will continue to monitor scientific developments, best practices and recommendations regarding fluoridation.

Background:

On February 2, 2017, OWASA temporarily discontinued fluoridation following an accidental overfeed of fluoride. No drinking water with elevated levels of fluoride entered the public water supply system.

An independent consultant (CH2M) determined in a February 10, 2017 report that the primary cause of the overfeed was:

- Unintentional operator keystroke increased pump feed rate to higher than desired level.
- Subsequent adjustment made 12 seconds later, but the pump did not respond as expected.

The secondary cause was that during the subsequent routine inspection, the operator failed to take timely corrective action.

At its March 23, 2017 meeting, the OWASA Board reviewed staff's Action Plan to improve the safety and reliability of the fluoride feed system and provided feedback that has been incorporated into this plan.

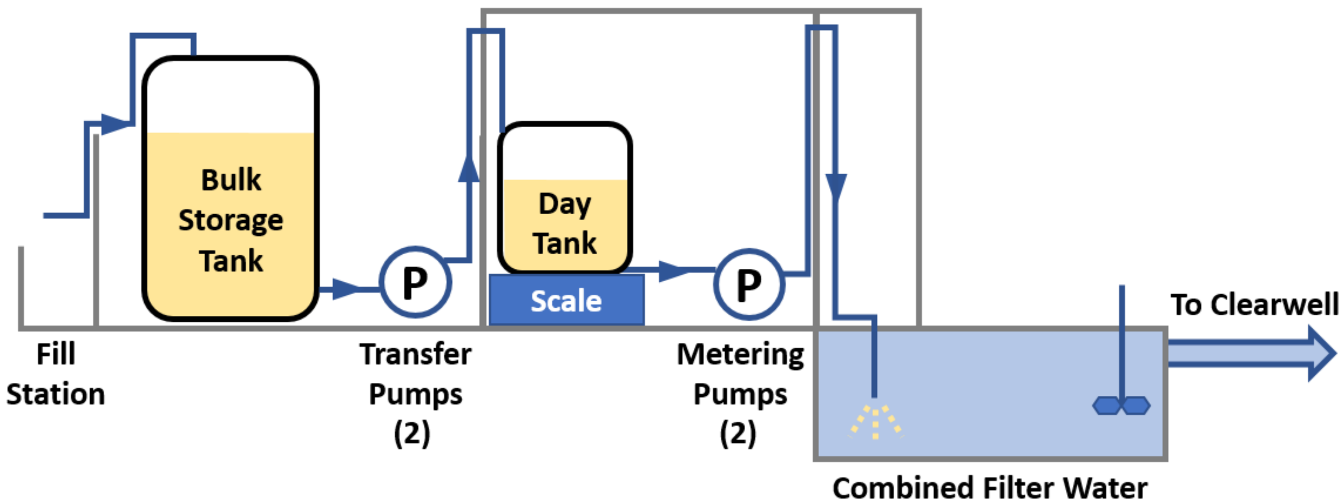
Staff developed the following information (and recommendations) using details provided in a Technical Memorandum on the fluoride feed system evaluation by the professional engineering firm, Hazen.

Existing System

OWASA stores and feeds fluoride in the form of liquid hydrofluorosilicic acid. This chemical is the most common liquid form of fluoride used for drinking water fluoridation in the US, and it is certified by National Sanitation Foundation (NSF) International as suitable for use in drinking water.

OWASA provides drinking water to its public water supply system with an average fluoride concentration of 0.7 parts per million (ppm) as recommended by the US Public Health Service to promote strong teeth. The maximum concentration of fluoride allowed in drinking water is 4.0 ppm and is called the Maximum Contaminant Level (MCL). The secondary standard for fluoride concentration in drinking water is 2.0 ppm. The fluoride concentration in OWASA's treated water is consistently 0.7 ppm, well below the maximum allowable concentration and the secondary standard. **Figure 1-1** summarizes the existing design of the fluoride feed system.

Figure 1-1: Existing Fluoride Feed System Design



Fluoride solution is stored in a 6,000 gallon bulk storage tank located outside in a concrete containment structure. The containment structure can hold the full contents of the bulk storage tank in the event it leaks. The bulk tank level sensor allows the plant to monitor the tank liquid level from the plant control room and is used to provide an alarm in the control room for bulk tank high and low level. The bulk storage area is also equipped with an emergency shower and eyewash station.

The fluoride 68 gallon day tank, weigh scale, and metering pumps are located indoors, in the Fluoride Room. The Fluoride Room includes an emergency shower and eyewash station.

Fluoride solution is transferred to the day tank in the Fluoride Room using one of two manually operated transfer pumps (one serves as a backup) located in the bulk tank containment area. The transfer pump discharge piping includes a valve vent for siphon protection to prevent the bulk tank from overfilling the day tank while the transfer pumps are off. Each fluoride transfer pump is started with a pushbutton that must be held in place while the pump operates, to avoid the risk of accidental overflow at the day tank. An overflow or leak from the day tank would drain to a containment area within the Fluoride Room.

The day tank sits on a weigh scale which allows staff to maintain accurate records of the amount of fluoride. The weight of the day tank is displayed in the Fluoride Room as well as in the plant control room.

The fluoride solution is pumped from the day tank with one of two pumps (one pump serves as a backup) to the application point shown in **Figure 1-1**.

Existing control strategies for monitoring and alarms for the existing fluoride system are summarized in **Table 1-1**.

Table 1-1: Existing Fluoride System Control Strategies

Item	Control Strategy
Bulk Tank Liquid Level	Monitor tank level continuously with ultrasonic level sensor Display tank level and stored volume in control room Alarm in control room for high level or low level in tank
Transfer Pumps	Manual operation only, no remote start capacity Must press and hold pushbutton to operate pump to fill day tank
Day Tank Weigh Scale	Monitor weight of solution in day tank continuously Display weight of solution outside of fluoride room and in control room Alarms high and low day tank weight in plant control room
Metering Pumps	Start and stop pumps manually at the pump Pumps are not connected to plant control room for remote start or remote stop Pump accepts speed control signal from program, sending no speed feedback signal to control room Plant staff can select one of three available control modes for metering pump speed: 1. Automatic flow-paced mode, in which the program sends pump speed signal based on total filtered water flow rate and on the fluoride concentration set point entered by plant staff in control room. 2. Remote manual speed control mode, in which program sends pump speed signal based on plant staff entering desired pump speed in percent in plant control room. This was the normal operating mode. 3. Local manual control of pump speed at pump.

Action Plan to Improve Fluoride Feed System

Staff prepared the Action Plan in careful consideration of the following information:

1. CH2M (consulting engineers) Technical Memorandum dated February 10, 2017 on the primary and contributing causes of the fluoride overfeed.

2. CH2M (consulting engineers) letter dated February 15, 2017 on the continuous improvement process and additional steps for consideration in response to the fluoride overfeed.

3. After Action Review Report on the fluoride overfeed prepared by staff dated March 10, 2017.

4. Hazen (consulting engineers) Technical Memorandum on the fluoride feed system evaluation.

Improvements prior to restarting the fluoride system are intended to ensure a safe and reliable operation of the system through prevention, detection, and/or mitigation of irregular operating conditions. This Action Plan identifies improvements, summarized in **Figure 1-2** and **Table 1-2**. These improvements include new fluoride feed pumps, control valves, online instrumentation, programming for monitoring and controls, and administrative controls, procedures and support for our staff.

Figure 1-2: Improvements to Fluoride Feed System Design
(Improvements in red)

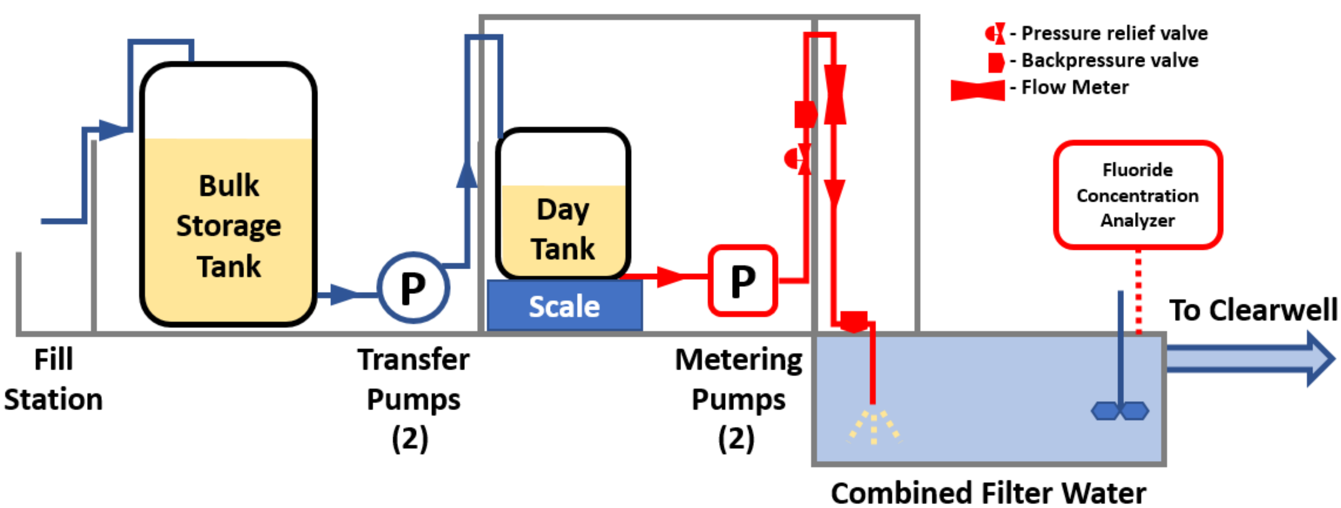


Table 1-2: Action Plan of Improvements to Fluoride Feed System

Recommended Improvement	Benefit
Pumps, Pipe, and Valves	
1. Replace current pumps with smaller pumps closer to the annual peak flow capacity.	Less fluoride can be transferred in the event of a pump or control system malfunction.
2. Install a pressure relief valve and backpressure valves.	Provide overpressure relief and reduces the risk of siphoning from day tank to application point.
3. Pressure test existing fluoride piping and valves to check for leaks. Replace if leaks are detected.	Identify and reduce risk of pipe leaks.
Instrumentation	
1. Install a magnetic flow meter.	Plant control room receives continuous confirmation of the chemical flow rate.
2. Install a continuous fluoride concentration analyzer on sample stream prior to the clearwell.	Plant control room receives continuous confirmation of actual fluoride concentration before water enters clearwell.
Programming & Control System	
1. Modify plant control input screens to allow readings only between pre-identified ranges.	Program will not accept entries outside of acceptable ranges. Minimize likelihood of unintentional key stokes leading to overfeed situations.
2. Add alarms and failsafe modes to program for pumps. Continuously compare target values for chemical flow and concentration to actual values from chemical flow meter and fluoride concentration analyzer.	Program will issue alarm messages to the plant control room and stop pump when the actual chemical flow or concentration varies from the target by more than the allowable variance.
3. Add alarm for drop in weight of chemical solution in day tank.	Program will issue alarm message to the plant control room and stop pump if weight of stored solution decreases faster than it should.
4. Provide mechanism for positive feedback from pumps to plant control room.	Program will indicate actual pump speed, operational status, input loss of signal, monitor run/fail, tube failure, etc.
Administrative	
1. Develop standard operating procedure (SOPs) for contractors working onsite and approvals for unplanned work.	Ensures that contractors performing work do not become a distraction to staff or otherwise interfere with the normal operation of the plant.
2. Develop a cross-training program for operation, maintenance and laboratory staff.	

Recommended Improvement	Benefit
	Ensures we have adequate internal resources to address operational needs and provide additional organizational flexibility.
3. Update the Water Treatment Plant Operation and Maintenance (O&M) Manual and review it as needed (at a minimum annually); provide and document training on the O&M Manual. Note: This manual is essentially the "owner's manual" for the plant and specifies how it is designed and should be operated.	Ensures the O&M Manual is reviewed and updated frequently. Ensures that staff receives training on this document at regular intervals.
4. Update applicable SOPs and review them as needed (at a minimum annually); provide and document training on the SOPs. SOPs to be updated include, among others are: • Standard Operating Procedure on Discontinuing Pumping of Finished Water to the Distribution System • Standard Operating Procedure on Plant Optimization – Upset • Standard Operating Procedure on Manual Operation of Water Treatment Plant	Ensures SOPs are reviewed and updated frequently. Ensures that staff receives training on these documents at regular intervals.

No additional staffing needs have been identified at this time. Therefore, the focus will be on improving systems, SOPs, training and support for existing staff.

Implementation Approach

Staff will hire a consulting engineer (Hazen) to further design the improvements in the Action Plan. We anticipate these costs will not exceed the formal bidding threshold and therefore will not require Board authorization. There are funds in the Capital Improvements Program for these improvements. In order to expedite the implementation of the recommended improvements, OWASA may pre-purchase certain pieces of equipment such as new pumps and flow meters because they have long lead times. We anticipate that most of the construction work will be completed by outside contractors. The consulting engineer will oversee the work of these contractors.

Many of the near term administrative improvements (such as communications, SOP and O&M Manual updates, cross-training, etc.) are currently underway. Funding has been earmarked in the Fiscal Year 2018 budget for performing the plant risk assessment. Future budgets may include other infrastructure, instrumentation, administrative, procedural, and staffing improvements resulting from that assessment.

Estimated Cost and Time to Complete

The preliminary estimated cost of equipment and labor is $123,500 - $175,500. This cost estimate will be updated once the consulting engineer completes the design criteria.

Item	Preliminary Cost[1]	Schedule
Purchase and installation of metering pumps	$25,000 - $30,000	3 – 6 months
Testing, purchase and installation of piping and backpressure valves and pressure relief valves	$10,000 - $15,000	3 – 6 months
Purchase and installation of flow meter	$10,000 - $20,000	1 – 2 months
Purchase and installation of fluoride analyzer	$10,000 - $20,000	1 – 2 months
Electrical evaluation and installation	$20,000 - $25,000	Contractor Availability
Programming, field testing, start up, and training	$20,000 - $25,000	Contractor Availability
SUBTOTAL:	$95,000 - $135,000	
CONTINGENCY 30%:	$28,500 - $40,500	
TOTAL PRELIM COST & SCHEDULE:	**$123,500 - $175,500**	**4 - 8 months**

[1]Range in cost by manufacturer

The improvements are projected to be completed in the Fall 2017. Staff will explore opportunities to expedite the work. However, the instrumentation, pumping and safety related equipment is custom built for fluoride systems and will likely have long lead times.

Preliminary Schedule	
March 2017	Engineer design begin
April 2017	Equipment selection complete and ordered
June 2017	Equipment arrives and design completed
August 2017	Modifications complete
September 2017	System is commissioned and tested
End of September 2017	Fluoride feed resumes

Staff will also strive to complete all of the recommended administrative improvements prior to resuming fluoridation.

Staff Recommendation

Staff believes that successful implementation of the Action Plan will ensure a safe and reliable fluoride feed system for our community. Staff recommends that the Board approve the following motion:

> *The Board directs the Executive Director to implement staff's Action Plan to improve the safety and reliability of the fluoride feed system at the Jones Ferry Road Water Treatment Plant; to keep the Board and public advised as to staff's progress towards completion of the improvements; and to announce in advance the date fluoridation of OWASA drinking water will resume.*

Agenda Item 7:

Discuss Draft Energy Management Plan

Purpose:

Review Draft Energy Management Plan and provide feedback

Background:

The OWASA Board of Directors established the "Implementation of an Energy Management Program" as Strategic Initiative #4 of OWASA's Strategic Plan (adopted on June 9, 2016). Two key actions were established for this initiative: (1) develop an Energy Management Program for OWASA, and (2) prepare and adopt an Energy Management Plan and implement the program.

On June 25, 2015, the Board supported goals and objectives to guide the development of the Energy Management Plan.

On May 26, 2016, the Board of Directors approved a revised Project Charter describing the proposed process and timetable for development of the plan.

On September 8, 2016, the Board approved the Energy Management Program, including a Stakeholder Engagement Plan.

Action/Recommendation:

Staff requests questions and feedback for incorporation into the Energy Management Plan

Information:

The Draft Energy Management Plan is written to serve as a working implementation plan for meeting OWASA's Energy Management Goals and Objectives. The Executive Summary is long, written to give Board and community members a complete snapshot of the Plan's components. The level of detail provided in the appendices is meant to serve as much as a resource for staff in the coming year as for the Board and community. The plan itself is organized into the following sections:

- **Draft Energy Management Plan**
    - Executive Summary
    - Introduction and Purpose
    - Background
    - Energy Management Program
    - Update and Strategies to Meet Objective 1 (Electrical Energy Use)
    - Update and Strategies to Meet Objective 2 (Natural Gas Use)
    - Update and Strategies to Meet Objectives 3 and 4 (Biogas-to-Energy)
    - Update and Strategies to Meet Objective 5 (Renewable Energy)
    - Moving Forward
- **Appendix A:** Strategy Evaluation Summary
- **Appendix B:** Energy Strategy Summaries
- **Appendix C:** CIP Projects Unlikely to Reduce Energy Use
- **Appendix D:** Relative Comparison of Biogas-to-Energy Options

OWASA'S DRAFT ENERGY MANAGEMENT PLAN

This plan describes Orange Water and Sewer Authority's (OWASA) use of energy in our facilities and what we've done and plan to do to use energy more efficiently, use renewable energy sources, and reduce our greenhouse gas (GHG) emissions. By reducing our use of energy and increasing our use of renewable energy sources, we can help reduce the demand for water resources, improve environmental impact of our operations, reduce costs, and improve reliability.

April 2017

ORANGE WATER AND SEWER AUTHORITY

A public, non-profit agency providing water, sewer and reclaimed water services to the Carrboro-Chapel Hill community.

Contents

Energy Management Plan for the Orange Water and Sewer Authority

DRAFT

April 2017

Executive Summary

This plan describes Orange Water and Sewer Authority's (OWASA) use of energy in our facilities and what we've done and plan to do to use energy more efficiently, use renewable energy sources, and reduce our greenhouse gas (GHG) emissions. We use a lot of energy to operate our water, wastewater and reclaimed water facilities, protect the environment, and provide service to about 83,000 residents through about 21,500 customer accounts in the Carrboro-Chapel Hill community. On the other end of the wire, it takes a lot of water to produce the electricity we use. By reducing our use of energy and increasing our use of renewable energy sources, we can help reduce the demand for water resources, improve environmental impact of our operations, reduce costs, and improve reliability.

This plan is a key milestone in those efforts, as it represents our first formal, comprehensive, organization-wide evaluation of ways we can better manage energy across all our facilities. This plan will also help us be better prepared for an increasingly uncertain energy future.

In 2014, the OWASA Board of Directors identified the "Implementation of an Energy Management Program" to be a top strategic priority for the organization. Since that time, with the assistance of OWASA staff, the OWASA Board of Directors has reviewed an assessment of OWASA's energy use, established Calendar Year (CY) 2010 as the baseline year, identified concrete goals and objectives against that baseline, and worked with staff to define a program that achieves those goals and objectives.

OWASA's Energy Management Program is structured to not just identify energy conservation measures, but to more directly integrate energy management and clean energy strategies into our every-day decision-making. OWASA's Energy Management Program involves staff from across the organization, including a committed group of individuals serving on the organization's Energy Team, numerous partners and stakeholders, and a comprehensive, systematic methodology for identifying, evaluating, and prioritizing clean energy strategies that will increase the sustainability of our organization and community for years to come. This Plan is a result of the contribution of many throughout this Program.

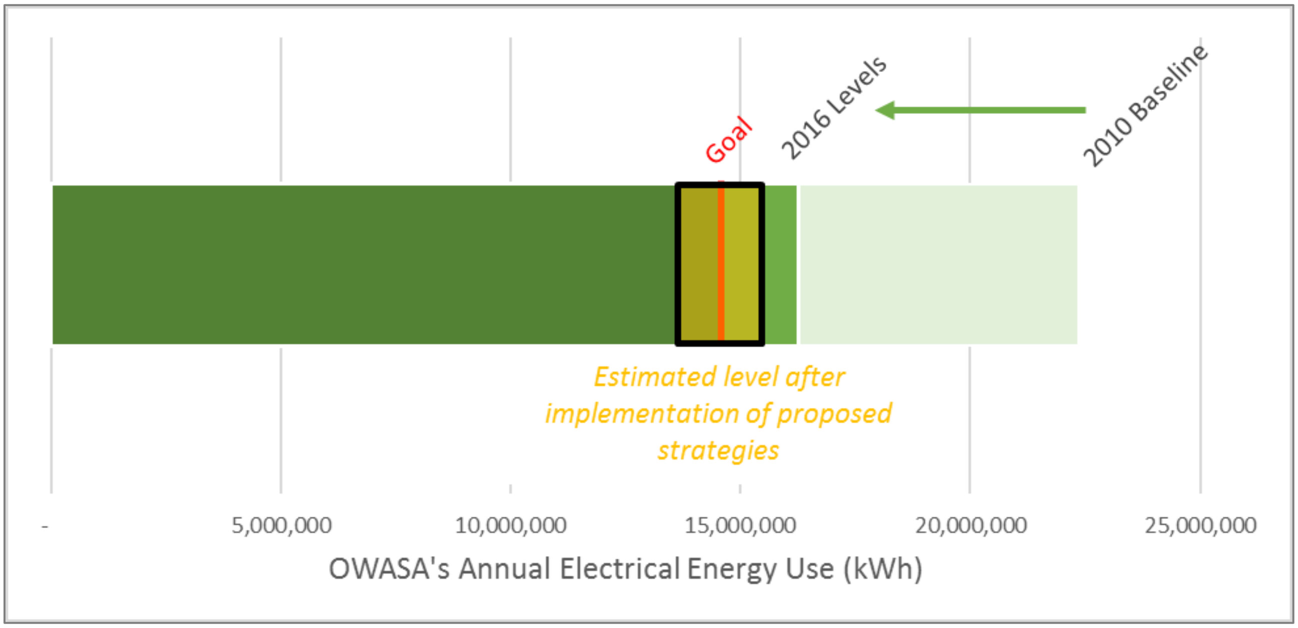
Our annually-updated Energy Management Plan will serve as an essential guide for OWASA's investments in energy efficiency and renewable energy strategies. It provides our employees, customers and community better understanding of the energy imbedded in their water and wastewater services. In turn, this will lead to greater conservation of our essential water and energy resources, and greater support and awareness for OWASA's clean energy strategies.

The proposed action items and associated resource requests are organized and quantified against each goal and objective set by the Board of Directors as summarized below.

Objective 1: Reduce use of purchased electricity by 35% by the end of Calendar Year 2020 compared to the Calendar Year 2010 baseline

Since 2010, we have reduced our annual electrical energy usage by about 6 million kilowatt-hours (kWh), a 27% reduction. To meet our goal by 2020, we need to reduce our annual electrical energy use by an additional 1.8 million kWh, another 8 percentage points of baseline. Figure 1 shows our current progress towards this goal and the estimated range of electrical use levels anticipated as a result of the proposed strategies (illustrated by the black outline).

Figure 1: Summary of Progress Towards Objective 1



These strategies are listed in Table 1. Some of the strategies are projects that have already been identified as part of OWASA's Capital Improvement Program (CIP) for purposes other than energy management, but that have the potential to reduce the amount of energy required for that facility or function (projects in blue). The remaining strategies are recommended to either be (a) implemented within the upcoming fiscal year (FY18) (in green) or (b) further evaluated to determine their potential savings and associated costs (in yellow). For those in which we can provide an estimated range of energy savings, we estimate they will reduce our annual electricity use by an additional 963,000 - 2.3 million kWh, or an additional 4.3 - 10.4% of the 2010 baseline. (These projects are bolded within the table.)

Table 1: Recommendations and Estimated Annual Savings in Electrical Energy Use

Currently in CIP: 367,000 – 534,000 annual kWh savings	
	Cane Creek Raw Water Transmission Main Capacity
	Cane Creek Pump Station Improvements
	University Lake Pump Station Improvements
	Finished Water Pump Rehabilitation and Replacement
	Knolls Pump Station Abandonment
	Reduction of Inflow and Infiltration in Wastewater System
	Eastowne, Eubanks, and Meadowmont 1 Pump Station Improvements
	WWTP Solids Thickening Improvements
	Building Envelope Rehabilitation
	Administration Building Heating, Ventilation, and Air Conditioning (HVAC) System Upgrade
Implement: 212,000 – 383,000 annual kWh savings	
	LED Lighting Retrofit
	Energy Optimization for IT Server Room: low to no cost strategies
	Backwash Filters in Off-Peak Times
	Pump and Motor Asset Management Program
	HVAC: Operational Changes and Minor Controls
	Finished Water Pump Use Optimization
Evaluate: 384,000 to 1.4 million annual kWh savings	
	HVAC: Equipment Replacement
	Optimize WWTP Filter Backwash
	System-Wide Energy Model
	Power Supply Optimization
	Real-Time Nitrification Control System
	Solar PV: Small scale, OWASA ownership
	Raw Water Pumping Optimization Operating Procedure and Associated Schedule
	Optimization Wastewater Pump Station Design, Operations, and Maintenance

Fiscal Year 2018 Budget:
In addition to what is budgeted in the FY17-FY21 CIP budget, the following resources are requested to pursue the strategies above and meet Objective 1:

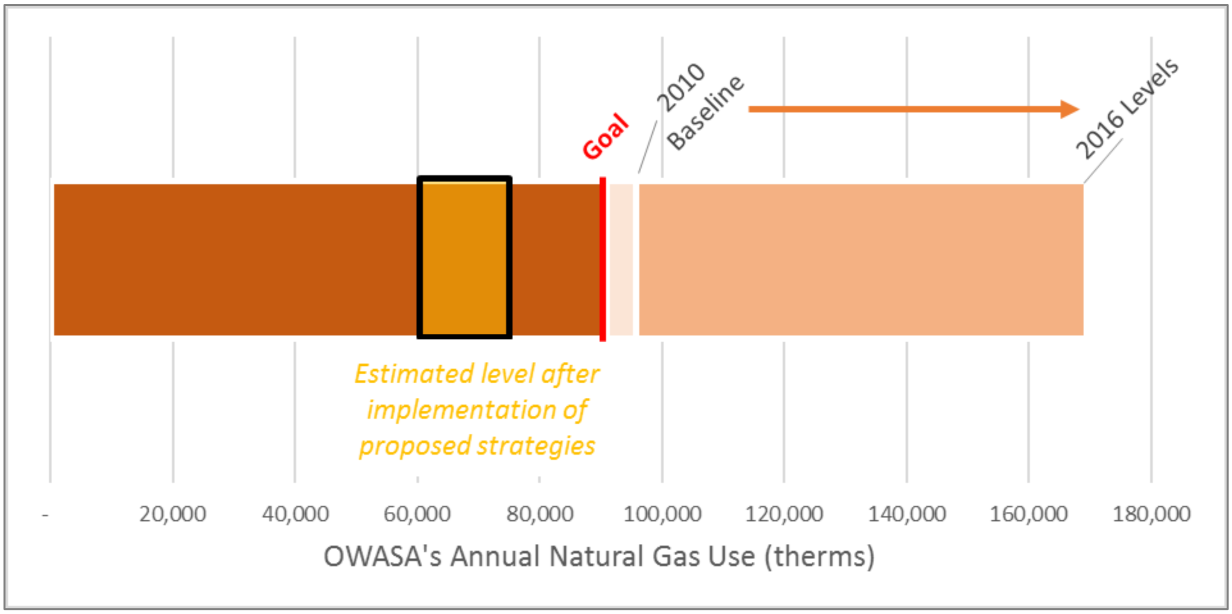
- Capital Improvements Budget: $95,000
- Technical Assistance and Consultants: $17,000
- Operating Budget: $17,000
- Capital Equipment: $35,000

Objective 2: Reduce use of purchased natural gas by 5% by the end of Calendar Year 2020 compared to the Calendar Year 2010 baseline

Compared to 2010, our CY 2016 natural gas use was about 75,000 therms (about 79%) higher. This is primarily due to the exclusive reliance on natural gas (instead of biogas) to heat the digesters at the Mason Farm Wastewater Treatment Plant (WWTP) while two digesters and our gas storage unit were undergoing major rehabilitation in late 2015 and 2016. We anticipate that in bringing this system back on-line in the coming months, we will restore our natural gas use to 2010 levels. Figure

2 illustrates the progress that we need to make to meet Objective 2 (difference between 2016 Levels and Goal) and the estimated levels of annual natural gas use after brining the biogas system online and implementing the proposed strategies.

Figure 2: Summary of Progress Towards Objective 2



We anticipate that the strategies shown in Table 2 will significantly advance us towards our natural gas use reduction goal. In addition to reducing current levels of natural gas use back to 2010 levels by bringing the biogas-to-boiler system online, we estimate that the following strategies will reduce annual natural gas use by an additional 21,000 to 35,000 therms (23-38% of the 2010 baseline).

Table 2: Recommendations and Estimated Annual Savings in Natural Gas Use

Currently in CIP: 7,000 to 12,000 annual therm savings	
	Administration Building HVAC System Upgrade
	Building Envelope Rehabilitation
Implement: 7,000 to 12,000 annual therm savings	
	HVAC: Operational Changes and Minor Controls
Evaluate: 7,000 to 11,000 annual therm savings	
	HVAC: Equipment Replacement
	Water heating efficiency in Administration Building

Fiscal Year 2018 Budget:
Beyond what is budgeted in the CIP, there are no additional funds requested to pursue natural gas management strategies. The costs of the HVAC improvements are recognized in the previous section of the report

Objective 3: Beneficially use all WWTP biogas by 2022, provided the preferred strategy is projected to have a positive payback within the expected useful life of the required equipment

Objective 4: Formally engage local governments and partners in discussion about potential development of biogas-to-energy project at the Mason Farm WWTP

(The following provides a combined update on Objectives 3 and 4, given their complementary nature.)

The Mason Farm WWTP produces about 110,000 cubic feet of biogas each day as a by-product of the anaerobic digestion process. The biogas is comprised of methane, carbon dioxide (CO_2), water vapor, and other trace gases, and is a renewable energy source with an estimated energy content of about 560 BTUs per cubic foot.

By maximizing the beneficial use of biogas, wastewater utilities can reduce their carbon footprint, lessen the impact of future increases in the cost of grid-supplied electricity and natural gas, and meet some or all of their on-site power requirements with a locally-produced and controlled supply of renewable energy, thereby increasing reliability and redundancy, and resiliency.

Over the past year and a half, OWASA staff have researched a range of options for biogas utilization and their application at the Mason Farm WWTP. Key resources in that research were a 2011 Biogas Utilization Study conducted for OWASA, the Department of Energy's Combined Heat and Power Technical Assistance Program, discussions with regional agencies on the potential to partner in the provision of supplemental feed stock and/or in purchasing biogas-generated energy, and numerous discussions with technology vendors, consultants, and other wastewater utilities that have implemented biogas to energy projects.

The primary options evaluated and compared for a biogas-to-energy project at the WWTP were:

1. Baseline biogas to boilers with excess flared off (Existing Program)
2. Biogas Combined Heat and Power (CHP) system operating continuously (330 kW)
3. Biogas CHP system operating during on-peak times (1,350 kW)
4. Biogas CHP with high-strength organic waste receiving (700 kW)
5. Biogas used as a Renewable Compressed Natural Gas (rCNG) for vehicle fuel
6. Biogas delivered to other parties or aggregator via "Mobile Pipeline" strategy
7. Biogas injected to PSNC Natural Gas Pipeline

While the screening level analysis is an important step in surveying and summarizing our options, it is difficult to draw conclusions as to the best path forward for a biogas-to-energy project on this analysis alone. The evaluation of each individual option is complex in its assumptions regarding scale, cost of technology, market acceptance, and partnership arrangements. Furthermore, the addition of any biogas-to-energy project increases the complexity of operations and management at the Mason Farm WWTP, and it must be done in consideration of the need for future upgrade and expansion of the plant, including the development of future resource recovery facilities at the plant.

The screening-level analysis of options does not identify an obvious and clear path forward on a discrete biogas-to-energy project. However, it does help define the opportunities, complexities, and risks associated with various options and will serve as a good springboard for further analysis. Using this overview as a starting point, our recommendations for the upcoming year are to:

1. **Conduct additional analyses of gas production rates and gas quality to better inform biogas treatment and conditioning requirements and related capital and operating costs for the various biogas-to-energy options,** now that the digester rehabilitation project has been completed and improvements will soon be made to the gas piping and use system (see Objective 2).

2. **Engage a consultant to conduct a technical review of our screening study based on their experience in the industry**, including:
   - The suite of options being considered, and recommendations for other options not currently considered;
   - The capital and operating and maintenance (O&M) cost assumptions made for each option;
   - Identification of potential "game-changers" that may be on the horizon and have major implications for the timing, scale, feasibility, and approach to a future biogas-to-energy strategy;
   - The evaluation of each strategy against our set of criteria shown in Appendix D;
   - Facilitation of a peer review of the study with other utilities and key stakeholders;
   - Facilitation of a workshop with potential partners in the most advantageous options; and
   - Determination as to whether one or more options could meet OWASA's biogas-to-energy objective, and if so, development of a proposed approach, cost estimate, and preliminary implementation schedule for each identified option.

3. **Identify a preferred option in the context of a long-term resource recovery plan for the Mason Farm WWTP.** Where cost-effective, provide flexibility in project design to accommodate cost-effective expansion and/or incorporation of additional biogas-to-energy strategies.

Fiscal Year 2018 Budget: We estimate the technical review to be conducted by a consulting firm with relevant experience will cost about $50,000.

Objective 5: Seek proposals for third-party development of renewable energy projects on OWASA property

The OWASA Energy Team reviewed and discussed the potential for various renewable energy projects on OWASA-owned land. Solar photovoltaic (PV) installations present a unique and mutually beneficial opportunity for public-private partnerships in renewable energy installations in the Piedmont of North Carolina. To determine the potential applicability of this strategy to OWASA, we engaged the National Renewable Energy Laboratory (NREL) Solar Technical Assistance Team (STAT) to help evaluate the technologic and economic viability of potential development of one or more solar PV installations on OWASA-owned land.

Their analysis indicates that it may be feasible for third-party development of a large-scale solar PV project on OWASA-owned land, such as property near to the Cane Creek Reservoir or the Biosolids Management site.

Development of one or more solar PV projects may be feasible for OWASA. However, before moving forward with a Request for Proposals (RFP) from qualified solar energy developers for such a project, we recommend that during the coming year we:

1. **Consider renewable energy generation in the development of a plan and policy framework for long-term management and disposition of OWASA lands, as part of the Board of Director's Strategic Initiative on land management.** Currently, the Board is scheduled to receive and discuss an overview of land management at their August 10, 2017 work session.

2. **In support of the Board's consideration of renewable energy generation on OWASA-owned land, further evaluate the feasibility and implications of converting one or more OWASA sites for solar PV development, taking into consideration feedback from our neighbors and other stakeholders**. For screening purposes, the potential solar PV locations were selected for conceptual evaluation simply because they represented large tracts of cleared, OWASA-owned land. Before further considering solar PV deployment at one or more sites, we need to investigate alignment with long-term organizational needs and local land use plans, and seek and consider the input from other stakeholders, including our neighbors, U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency, and other stakeholders.

3. **Evaluate interconnection requirements, agreement provisions, and associated costs in partnership with Duke Energy.**

4. **Evaluate and compare public-private partnership arrangements for large-scale, solar-PV developments**.

Staff proposes to move forward with these next steps over the coming year and incorporate the findings in next year's Energy Management Plan. Based on the conclusions, we will make a recommendation on if and how to move forward with obtaining and considering proposals for development of a large-scale solar PV project on OWASA-owned land.

Fiscal Year 2018 Budget: We do not anticipate that the steps proposed will require anything more than staff and Board time.

In addition to the above strategies and recommendations, staff will continue to pursue cost-effective opportunities to further increase energy efficiency and incorporate renewable energy in our future capital improvements planning, design and investments, as well as our operating and maintenance strategies and decisions.

We will update this plan annually to document our progress towards our objectives, potential strategies for meeting those objectives, and anticipated resources and timetable needed to meet our objectives.

Introduction and Purpose

This plan describes Orange Water and Sewer Authority's (OWASA) use of energy in our facilities and what we've done and plan to do to use energy more efficiently, use renewable energy sources, and reduce our greenhouse gas (GHG) emissions. We use a lot of energy to operate our water, wastewater and reclaimed water facilities, protect the environment, and provide service to about 83,000 residents through about 21,500 customer accounts in the Carrboro-Chapel Hill community.

In Calendar Year 2016, our facilities used about 65 billion BTUs of energy – enough to power about 1,800 homes for a year. That energy cost about $1.1 million, about 4% of our annual operating expenses in Fiscal Year 2016.

Historically, energy supplies have been reliable and relatively inexpensive. When many of our water and wastewater facilities were originally built, the amount and cost of energy they needed was of less concern than the initial cost to build or expand our facilities. Energy conservation and energy management planning was not always a high priority, but that is no longer the case at OWASA.

Fortunately, our energy costs are relatively low in comparison to other areas of the country; however, those costs are rising and will likely continue to rise in the years ahead. The price we pay for electricity will be affected by the costs Duke Energy incurs to modernize its existing power generation facilities, construct new generating capacity, upgrade the electrical transmission system, meet North Carolina's Renewable Energy Portfolio Standards, comply with more stringent environmental standards, remediate coal ash waste disposal problems, and reduce its GHG emissions.

The price we pay for energy will also be affected by global energy markets and supplies, and our national efforts to become more energy independent through use of domestic energy supplies and renewable energy. Rising global demand for non-renewable fossil fuels such as coal will inevitably lead to rapid increases in energy costs.

Looking forward, it is likely that we will be required to incorporate more advanced water and wastewater treatment technologies to meet future environmental and public health standards. Some of those technologies are likely to be more energy intensive than our existing processes, which will compound the effect of future energy price increases. In 2002, the Electric Power Research Institute (EPRI) projected that more stringent standards could increase unit electricity consumption for water and wastewater treatment by 5 to 10% within the next 20 years.

But it's not just about how much we pay to purchase energy.

Through our participation in professional associations, collaborative research efforts, and industry conferences and workshops, we continue to gain an understanding and awareness of the inter-relationships between energy consumption, water consumption, and climate change. Much of the energy we use is derived from fossil fuels, which contributes to GHG emissions. We want to do our part to reduce the GHG emissions associated with our operations.

It takes a lot of water to produce the electricity we use. Coal-fired power plants and nuclear power plants with wet recirculating cooling systems with cooling towers consume almost one-half gallon of water and 0.75 gallons of water, respectively, to produce 1 kilowatt-hour of electricity. By reducing our energy use, we can help reduce the strain that energy production places on our regional and national water resources.

We are committed to be more energy independent and to use renewable energy sources where technically and economically feasible. With proper planning and design, those strategies can help reduce our risks from power outages caused by extreme weather (such as Hurricane Fran in 1996 and the severe ice storm in 2001), high demand conditions, and other events.

Achieving reductions in energy use and increasing our use of renewable energy sources are important ways OWASA demonstrates its commitment to sustainability. This plan is a key milestone in those efforts, as it represents our first formal, comprehensive, organization-wide evaluation of ways we can better manage energy across all our operations. This plan will also help us be better prepared for an increasingly uncertain energy future.

An essential underpinning for all the energy efficiency strategies proposed in this plan is OWASA's and the Carrboro – Chapel Hill community's commitment to the efficient and sustainable use of water. Water use efficiency, conservation, and the use of reclaimed water are not just essential to our long-term sustainable water resource management program – they are also key strategies in our energy savings and GHG reduction efforts. When our customers use less water, less fuel must be used to produce the power required to pump, treat and deliver that water, heat or process that water for certain end uses by our customers, and then collect and treat the resulting wastewater. Also, somewhere a lot of water is being withdrawn and used at the power generating plants that provide the electricity needed for our water and wastewater operations.

This plan will serve as an essential guide for OWASA's investments in energy efficiency and renewable energy strategies. It provides our employees, customers and community better understand the energy imbedded in their water and wastewater services. In turn, this will lead to greater conservation of our essential water and energy resources, and greater support and awareness for OWASA's clean energy strategies.

Background

The OWASA Board of Directors established the "Implementation of an Energy Management Program" as Strategic Initiative #4 of OWASA's Strategic Plan (adopted on June 9, 2016). The goal of this initiative, which was first established as part of OWASA's Strategic Plan for Fiscal Years 2014 – 2017 (adopted on March 13, 2014), is to develop and implement *"Cost-effective measures to reduce our use of energy, related energy costs, and associated greenhouse gas (GHG) emissions."*

Two key actions were established for this initiative: (1) develop an Energy Management Program for OWASA, and (2) prepare and adopt an Energy Management Plan and implement the program.

As the first step in this initiative, OWASA staff prepared a technical memorandum that provided (a) a baseline assessment of OWASA's energy use; (b) an overview of energy management strategies to date; and (c) potential goals and objectives for Energy Management. On June 25, 2015, the Board supported the following objectives to guide the development of the Energy Management Plan.

Objective 1: Reduce use of purchased electricity by 35% by the end of Calendar Year 2020 compared to the Calendar Year 2010 baseline.

Objective 2: Reduce use of purchased natural gas by 5% by the end of Calendar Year 2020 compared to the Calendar Year 2010 baseline.

Objective 3: Beneficially use all WWTP biogas by 2022, provided the preferred strategy is projected to have a positive payback within the expected useful life of the required equipment.

Objective 4: Formally engage local governments and partners in discussion about potential development of biogas-to-energy project at the Mason Farm WWTP.

Objective 5: Seek proposals for third-party development of renewable energy projects on OWASA property.

On May 26, 2016, the Board of Directors approved a revised Project Charter describing the proposed process and timetable for development of the plan. On September 8, 2016, the Board approved the Energy Management Program, including a Stakeholder Engagement Plan.

Incorporated into the Program is the requirement for business case evaluations of the clean energy strategies that we purse. However, OWASA recognizes that the price we pay for energy and other goods and services does not reflect the value that carbon emission reductions have on society. On September 8, 2016, the Board also agreed to incorporate the social cost of carbon (SCC) in our business case evaluations of clean energy projects, and to base the economic value of carbon emission reductions on the Federal Interagency Social Cost of Carbon Working Group's central value for the SCC (2017 value of $39 per metric ton of carbon dioxide emissions, at a 3% discount rate). The Board agreed that inclusion of the SCC in business case evaluations would influence, but not on its own propel the pursuit of a clean energy project. This provides a method for quantifying and engaging the community in a discussion about the willingness to pay for carbon emission reductions.

Energy Management Program

OWASA's Energy Management Program can be summarized in the following seven basic steps:

1. Establish organizational commitment, including goals and objectives for energy management set by the Board (see Background section);
2. Develop a baseline of energy use (see 2015 technical memorandum);
3. Evaluate the system;
4. Identify clean energy opportunities;
5. Evaluate and prioritize opportunities for implementation against Board-defined criteria;
6. Create an implementation plan that sets forth the proposed actions, timetable, resource requirements, and expected outcomes for the upcoming year; and
7. Provide for monitoring and reporting level of progress in achieving performance objectives.

As agreed upon in the Project Charter, Steps 3 through 7 will be repeated on an annual basis and summarized in an updated Energy Management Plan. An overarching resource in each of these steps are our partners and stakeholders.

Partners in Energy Management: Stakeholders in the Energy Management Program are as much internal, as external. In fact, instrumental in the implementation of OWASA's Energy Management Program is its Energy Team. In 2016, OWASA convened its first Energy Team, comprised of staff from across the organization, representing a diversity of perspectives and functions. Members of the Energy

Team graciously volunteered to serve as energy management champions and liaisons in the organization. In preparing this Plan, the Energy Team met to review OWASA energy use data, brainstorm energy management strategies, and evaluated and prioritized those strategies for inclusion in this Plan. The Energy Team will continue to meet on a quarterly basis through December 2019 (at which time the charge of the team will be reevaluated and adapted). Members of the Energy Team (and their primary role at OWASA) are identified in Table 3.

Table 3: OWASA's Energy Team

Energy Team Member	**Title**
Ryan Byars	Database Administrator
Sandra Bradshaw	Laboratory Supervisor, Wastewater Treatment
Terry Burkhart	Plant Operator, Water Treatment
Dirk Cartner	Plant Operator, Wastewater Treatment
Pat Davis	Utility Advisor
Rod Dail	Maintenance Mechanic, Wastewater Treatment
Monica Dodson	Operations Supervisor, Water Treatment
Adam Haggerty	Asset Management and Facilities Engineer
Simon Lobdell	Utilities Engineer
Bradley McBane	Plant Operator, Water Treatment
Todd Norman	Plant Operator, Wastewater Treatment
Eric Oldham	Maintenance Supervisor, Water Treatment
Kelly Satterfield	Finance and Procurement Manager
Ted Shaffer	Crew Leader, Distribution and Collection
Mary Tiger	Sustainability Manager (Team Leader)

OWASA's Energy Team and Energy Management Program is supported by the active engagement of stakeholders and industry experts. In early 2016, OWASA committed to participate in the Department of Energy's Better Buildings, Better Plants Challenge. Through this national program, we have access to national experts, peers (from within and outside of the water/wastewater industry) also working to manage their energy use, a Technical Assistance Manager assigned to OWASA, and best practice guidance documents. Through the Better Buildings Program and with resources from other federal and state programs, we have received, at no cost to our customers, technical assistance from: North Carolina State University's Industrial Assessment Center (NCSU IAC) to conduct an energy audit of our water system; the Department of Energy's Combined Heat and Power Technical Assistance Program (DOE CHP TAP) to conduct a high-level analysis of a potential biogas-fueled combined heat and power project at our wastewater treatment plant; and the National Renewable Energy Laboratory's Solar Technical Assistance Team (NREL STAT) to conduct a screening-level analysis of the technologic and economic potential for solar PV development on one or more tracts of OWASA-owned land.

Additionally, we've engaged North Carolina's Advanced Energy to conduct an audit of our Heating, Ventilation, and Air Conditioning (HVAC) systems and spoken with peers undertaking similar efforts and technology vendors with lead-edge innovations. We've met with staff from our member local governments, the University of North Carolina at Chapel Hill, Chapel Hill – Carrboro City School System, and City of Durham to discuss opportunities to coordinate and collaborate on clean energy efforts.

This Plan is a result of contributions from these stakeholders. We will continue to engage internally and externally to advance and expand our energy management efforts.

For example, over the coming year, through our participation in the Betters Plants Program, Cascade Energy and the Department of Energy will conduct in-plant energy management training at OWASA in May 2017. In-Plant Trainings are system specific workshops led by energy experts that train participants on how to identify, implement, and replicate energy saving projects. These trainings are provided free-of-charge, but they do require a significant time commitment. The four-day training program will be very hands-on. Instead of focusing on a specific equipment type, the trainers will work with OWASA staff to identify process-related energy saving opportunities through a systems approach. We are looking forward to the information that the instructors will share with our team, as well as the on-site evaluation of our system and identification of clean energy opportunities. (We will open this training to other interested partners and utilities, provided space is available.)

Additionally, in June 2017, the NCSU IAC will sponsor a national expert in pumping systems to conduct a pump and motor systems course for NCSU engineering students and staff at OWASA, using our finished water pump system as a working case study.

Through these types of partnerships, OWASA welcomes the opportunity to leverage our efforts in energy management for educational purposes and cost savings for our rate payers.

Evaluating the system (Program Step 3): Ongoing monitoring of our energy use helps to inform our day-to-day energy management efforts, as well as long-term strategic plans. Some studies have found that the practice of monitoring energy use can result in 5-20% of energy savings where energy efficiency is viewed as a daily performance goal. At OWASA, energy use monitoring takes place at varying levels of specificity and frequency. We have 42 electricity meters and 9 natural gas meters. Behind our meters are hundreds of pumps, motors, and equipment.

At a high level, we review our energy bills each month and report those to the Board and the community in our Key Performance Indicator (KPI) Report. We are currently working to make our energy billing data available to all in the organization via an energy dashboard which will be updated monthly when energy bills are received.

Through advanced metering and power monitoring technology, we are gaining increasing access to more frequent energy use data. A growing number of our electricity meters are ‘smart meters’ and can provide data at 30 minute intervals at a facility level, one day after the use occurs. We are working to incorporate this data into our maintenance, operations, asset management, and capital improvement plans.

We are also increasing access to more discrete energy-use data. Within each of our treatment plants, we are installing real-time energy monitors and incorporating that data into our real-time Supervisory Control and Data Acquisition (SCADA) system on specific processes within the plants. This support tool will help us better understand and control energy use in key processes, to establish more specific energy use reduction goals and monitor/verify demand consumption, and to monitor and verify the impact of the strategies we implement.

We have worked with the NCSU IAC to install temporary data loggers on large pumps and motors associated with raw water supply, drinking water treatment, and water distribution. As a Department of Energy Better Buildings Partner, we have short-term access to various equipment to better measure energy consumption.

With a strong understanding of where we use energy and how much we use, we are better equipped to focus analysis of where and how we can conserve energy, increase efficiency, and potentially generate renewable energy.

Identifying clean energy strategies (Program Step 4): Many, if not all, of our decisions have an impact on our energy use. It is important that our goal of resource stewardship echo through those decisions, and that we engage a wide range of internal and external stakeholders in identifying and pursuing clean energy opportunities.

In 2016, OWASA's Energy Management Program was presented and discussed at staff meetings across the organization, where employees were invited to identify opportunities to reduce our overall energy use and to volunteer to serve on OWASA's Energy Team. We require our consultants assisting with preliminary engineering reviews and project design to prioritize and evaluate the energy savings impacts of the alternatives they present to us. And we've engaged consultants on targeted audits of certain systems. We have and continue to review best practices and work with industry leaders to explore and evaluate leading edge technology.

Appendix A and Appendix B provide details on the 26 strategies that were identified for consideration in this Energy Management Plan. Appendix A summarizes the evaluation and prioritization of each strategy. Appendix B provides detailed summaries of the strategies considered for this year's Plan.

The strategies we considered were not limited to capital projects or equipment replacement. We've challenged ourselves to review our processes and operations and to consider if changes can be made to reduce our use of energy while still ensuring system performance. We've considered automation and controls, maintenance improvements, and how business measures can complement our energy management efforts.

Evaluating energy strategies (Program Step 5): On September 8, 2016, the OWASA Board of Directors approved the Energy Management Program which included six criteria against which clean energy strategies would be qualitatively evaluated. The Energy Team used this framework to discuss and evaluate each of the 26 strategies considered for inclusion in this Plan. In considering each strategy, we asked:

1. Is the strategy financially responsible (at a high level)?
   - Likely a good use of public funds
   - Financial viability of similar projects in similar organizations and circumstances
   - Opportunities for outside funding/financing

2. Is the strategy realistic and implementable?
   - Degree to which the strategy has been proven at a scale relevant to our operation
   - Organizational capacity to undertake and manage the project
   - Reasonable amount of staff time to implement

3. What are the operational impacts (positive and negative) of the strategy?
   - Consistent with how OWASA wants to operate
   - Degree to which strategy helps to resolve an existing or expected problem
   - Impact on safety, comfort, and productivity

4. What is the energy and greenhouse gas reduction potential?
    - Potential to reduce OWASA's energy use and/or carbon emissions

5. How does the strategy coordinate with other projects?
    - Interdependence with other project(s)
    - Potential to take advantage of economies of scale to save money and/or staff time

6. What are the community impacts of the strategy?
    - Stakeholder enthusiasm
    - Coordination with community initiatives

Energy Team members reviewed the strategy summaries in Appendix B prior to meeting as a group to discuss and prioritize each strategy. After discussing each strategy against the six evaluation criteria summarized above, each Team member provided a recommendation as to whether to (a) implement, (b) study, (c) delay until upgrade, or (d) delay action on the strategy indefinitely. The Team's final ranking of the strategies discussed in this Plan was based on the overall average of the Team's recommendations.

For those clean energy strategies that were recommended to be implemented (independent of those that were already prioritized in the Capital Improvement Program), we conducted a business case evaluation of the strategy to ensure that they would have a positive net present value within the life of the investment. As directed by the Board of Directors, this business case evaluation separately addresses the impact of the social cost of carbon. The results of this business case evaluation are included in the strategy summary.

The remainder of this plan is organized around the five goals and objectives for OWASA's Energy Management Program. Each section provides a status update on our progress toward meeting the objective and identifies an implementation plan for the coming year.

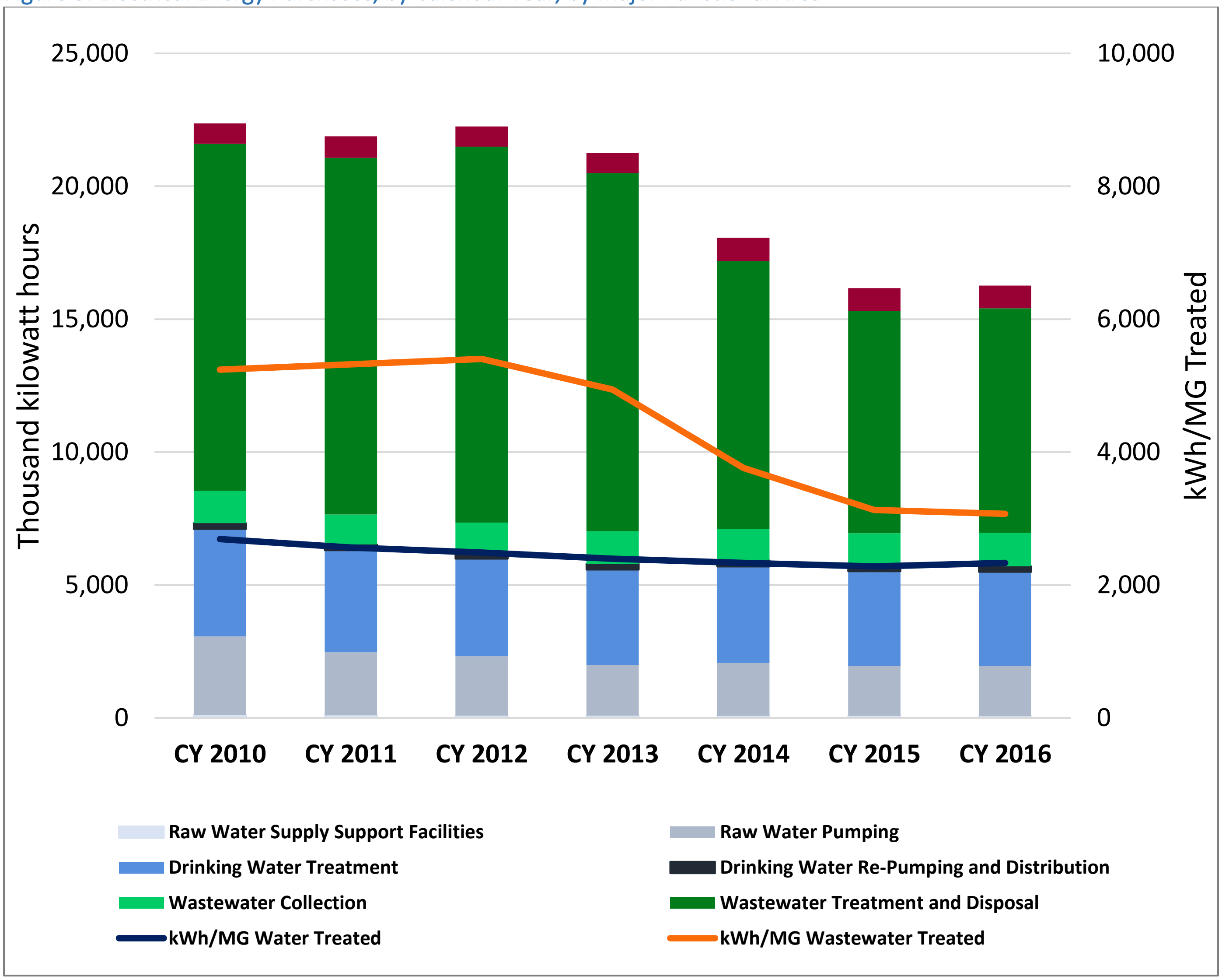
Objective 1

Reduce use of purchased electricity by 35% by the end of Calendar Year 2020 compared to the Calendar Year 2010 baseline.

Trends in Electrical Energy Use

Figure 3 shows seven years of historical electrical energy use across all OWASA facilities, by major functional area. This graph compiles monthly billing data for all OWASA's electrical service accounts (served primary by Duke Energy, as well as Piedmont Electric Membership Corporation). Since 2010, we have reduced our use of purchased electricity by more than 27%.

Figure 3: Electrical Energy Purchases, by Calendar Year, by Major Functional Area



We recognize and appreciate that the energy management objective is set against our overall use of electrical energy, regardless of customer demand, so that water conservation be considered an energy management strategy. Nonetheless, we are mindful of the change in our energy use intensity (EUI) to provide our services. Overlaid on Figure 3 are our trends in EUI for our water supply and treatment operations, and our wastewater collection, treatment and recycling operations (including the reclaimed water system over the baseline period. This EUI analysis only reflects electricity use at our facilities directly associated with water and wastewater pumping, piping, and treatment. It does not take into account the electricity use for the Administration Building, Operations Center, or lake offices and recreation facilities, since energy use at those support facilities is not directly affected by changes in water and wastewater demand.

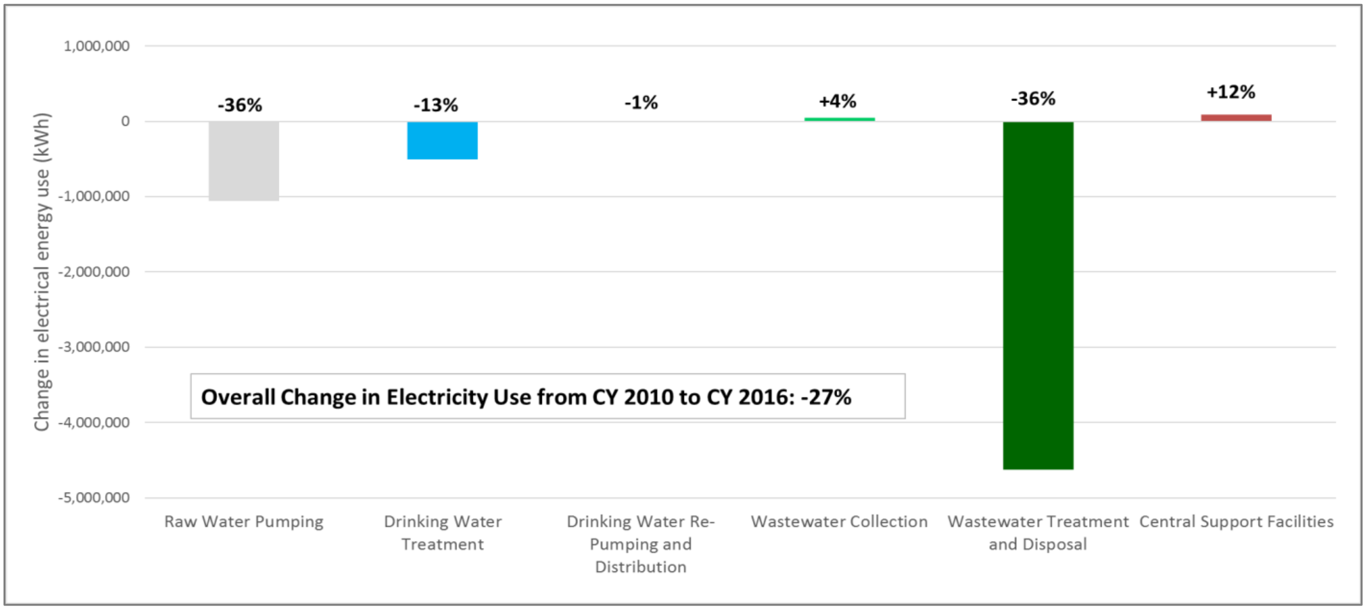
Figure 3 shows that we have achieved substantial sustained reductions in our use of electricity, as well as our energy use intensity, compared to our CY 2010 baseline.

Our electrical use is charged site-specific rates. Larger facilities, like the Mason Farm WWTP, are charged using Time of Use rates and contract demand (Duke Energy's OPT-V rate schedule). Our smaller facilities, such as many of our wastewater pump stations, are simply charged for their energy use (kWh), much like residential customers. In Fiscal Year 2010, OWASA was billed $1.26 million for electricity at an average of $0.0555 per kwh. In Fiscal Year 2016, we were billed $1.1 million at an average of $0.0649 per kwh. In absolute dollars, we spent nearly $200,000 less on electricity in 2016 than in 2010. However, if we had used the same amount of electrical energy in 2016, as we did in 2010, but were charged at 2016 levels, we would have paid about $430,000 more. Through our energy management efforts, we avoided over $400,000 in annual operating and maintenance expenses in FY16.

Benchmarking the energy use of our facilities with peer organizations is difficult. There are many factors that significantly impact the energy use (e.g. topography, length of mains, internal standards for quality and redundancy, age and layout of the plant, local regulations, etc.) of one facility that make this comparison difficult. The American Water Works Association publishes survey results of energy use intensity (kBTU/yr/MG), but there is no consideration of the aforementioned factors in these numbers. A 2007 Water Research Foundation report proposes an index in an attempt to control for certain comparable variables between systems. However, even this index, misses key differences between system design and service area characteristics and has been found to be an ineffective method of comparison. While staff will continue to stay abreast of best practices in the industry regarding energy management, we propose that the year-to-year internal comparison is the most effective method for measuring and ensuring our progress towards our energy management objectives.

As noted above, since 2010, we have reduced our use of purchased electrical energy by over 27%**.** Figure 4 provides a breakdown of the change in electrical energy use by functional area. The size of the bar represents the amount of absolute change in electrical energy use, while the text within the figure shows the percent change.

Figure 4: Change in Electrical Energy Use Since Calendar Year 2010, by functional area



The most significant reduction in electrical energy use over the past seven years has been in wastewater treatment and disposal, primarily due to a $8.4 million investment in energy efficient blowers, mixers, and fine bubble diffused aeration system (funded with a 20-year, 0% interest loan from the NC State Revolving Fund). This capital project has resulted in a reduction of about 3.1 million kWh/year and represents, about a 14% reduction against our 2010 baseline.

We've also seen a significant decrease in the amount of energy used for raw water pumping. This is in-part due to the installation of a new, low-flow pump and variable frequency drive (VFD) at University Lake which has enabled us to better optimize system-wide raw water pumping across a wide range of demand conditions. The University Lake Pump Station Improvement project cost about $300,000, most of which was funded with an American Reinvestment and Recovery Act grant. We estimate that this project is responsible for a reduction of about 650,000 kWh per year, representing a 3% reduction against our 2010 baseline.

Our customers' water use stewardship has helped to reduce our use of energy across the board, from pumping raw water, treating and delivering drinking water, collecting wastewater, and treating and disposing of wastewater. In 2016, we treated about 250 million less gallons of water than in 2010, despite an 5.6% increase of customer accounts. About half of this demand reduction can be attributed to a concurrent increase in reclaimed water demands. Since 2010, we have increased our annual production and delivery of reclaimed water from about 145 million to 268 million gallons which we estimate uses about three-quarters of the energy required to pump and treat raw water from our reservoirs. Given current energy use intensity estimates for finished drinking water, wastewater treatment, and reclaimed water treatment and delivery, we estimate that our customers' increased water use stewardship corresponds to an estimated annual energy savings of about 1.2 million kWh per year (about 5% of the 2010 baseline).

We estimate that the remaining 5% of the baseline reduction is the result of a suite of energy efficiency projects, such as LED lighting retrofits, cool roof installations on buildings, HVAC improvements, replacement of pumps, motors, and motor controls with more efficient equipment and VFDs, and an ongoing commitment to continuous improvement in our operations with energy management in-mind.

Proposed Electrical Energy Management Strategies (described in detail in Appendix A and B)

To meet the goal of reducing purchased electrical energy by 35% by 2020, we need to reduce annual our electrical energy use by an additional 1.8 million kWh (8 percentage points of the CY 2010 baseline). The OWASA Energy Team has spent the last year exploring, refining, and prioritizing strategies to meet this goal. The following section proposes a suite of energy management strategies and provides estimates for their impact on our progress towards this goal. Where we are able to calculate a general estimate for the energy savings of a certain project, we have provided an approximate range to better gauge our expected progress towards our goal.

The proposed projects for the Fiscal Year 2018 are grouped into three major categories: projects currently in the CIP, energy management strategies to implement, and energy management strategies worthy of further evaluation. Table 4 lists each of these strategies, their estimated electrical energy reduction potential (if enough information is available to develop an estimate), a three-year timeline, FY18 cost estimates, and assignment of the responsible party for moving forward with each strategy.

Projects currently in CIP: Of the projects in our CIP, the Energy Team identified 10 projects with the potential to the energy efficiency of our operations. For these projects, the reduction in energy savings is a secondary rather than primary objective. From the preliminary information that we have on some of these projects, **we estimate that this suite of strategies has the potential to reduce purchased electricity by 367,000 to 534,000 kWh per year (1.6-2.4% of the 2010 baseline)**. Other projects are too early in the engineering and design phase to estimate energy savings. The costs for these projects are already budgeted for in the CIP. (Appendix C identifies specific projects in the CIP that are unlikely to reduce our use of energy as currently designed.)

Strategies to Implement: Based on a favorable evaluation against the six criteria and guiding framework, the Energy Team recommends the implementation of six energy strategies in FY18. **This suite of strategies is estimated to reduce our use of purchased electricity by an additional 212,000 to 383,000 kWh per year (about 0.9-1.7% of the 2010 baseline).**

Strategies to Evaluate: Based on their potential, but given the uncertainty about their specific cost and benefits, the Energy Team recommends further evaluation of 8 additional strategies. **Based on preliminary estimates, this suite of strategies could potentially reduce our use of purchased electricity by another 384,000 to 1.4 million kWh per year (about 1.7-6.3% of the 2010 baseline).**

Table 4: Project Plan for Proposed Electricity Management Strategies and Estimated Energy Savings and Costs

Energy Management Strategy	**Estimated Potential Energy Savings (kWh)**	**Timeline and Cost (in $1,000s) Light shading: Study Dark shading: Implement**			**Project Management**
		FY18	FY19	FY20	
Currently In CIP					
Cane Creek Raw Water Transmission Main Capacity (CIP No. 271-05)	TBD				Engineering
Cane Creek Pump Station Improvements (CIP No 270-16)	138,000–227,000				Engineering
University Pump Station Improvements (CIP No 270-11)	TBD				Engineering
Finished Water Pump Rehabilitation and Replacement (CIP No 272-42)	TBD				Engineering
Knolls Pump Station Abandonment (CIP No 277-37)	25,000				Engineering
Reduction of Inflow and Infiltration in Wastewater System (CIP No. 276-17 & 18)	TBD				Engineering
Eastowne, Eubanks, and Meadowmont 1 PS Improvements (CIP No. 277-24)	5,000-14,000				Engineering
WWTP Solids Thickening Improvements (CIP No. 278-51)	24,000-72,000				Engineering
Building Envelope Rehabilitation (CIP No. 278-68)	TBD				Engineering
Administration Building Heating, Ventilation, and Air Conditioning (HVAC) System Upgrade (CIP No. 280-06)	173,000-194,000				Engineering
Implement					
LED Lighting Retrofit (Admin Building and WTP) (Other priority locations - TBD)	117,000-196,000	95			Maintenance
Energy Optimization for IT Server Room: low to no cost strategies	5,000-8,000	0			IT
Backwash Filters in Off-Peak Times	Demand savings	0			WTP Operations
Pump and Motor Asset Management Program	TBD	12			Asset Mgmt/Sust/ Maintenance
HVAC: Operational Changes and Minor Controls	77,000-128,000	12			Maintenance
Finished Water Pump Use Optimization	12,000-50,000	Free-of-charge			WTP Operations
Evaluate					
HVAC: Equipment Replacement	*97,000-162,000*	TBD			Maintenance
Optimize WWTP Filter Backwash	*20,000-40,000*	5			WWTP Operations
System-Wide Energy Model	-				Sustainability

Power Supply Optimization	*TBD*				Engineering
Real-Time Nitrification Control System	*103,000-207,000*	35			WWTP Ops & Eng.
Solar PV: Small scale, OWASA ownership	*162,000 – 1,000,000*	5			Sustainability
Raw Water Pumping Optimization Operating Procedure and Associated Schedule	*TBD*				WTP Ops & Eng.
Reconsider Wastewater Pump Station Design, Operations, and Maintenance	*TBD*				Maint. & Eng.

Fiscal Year 2018 Budget:
In addition to what is budgeted in the CIP for FY 2017-2021, the following is requested to pursue the strategies above:

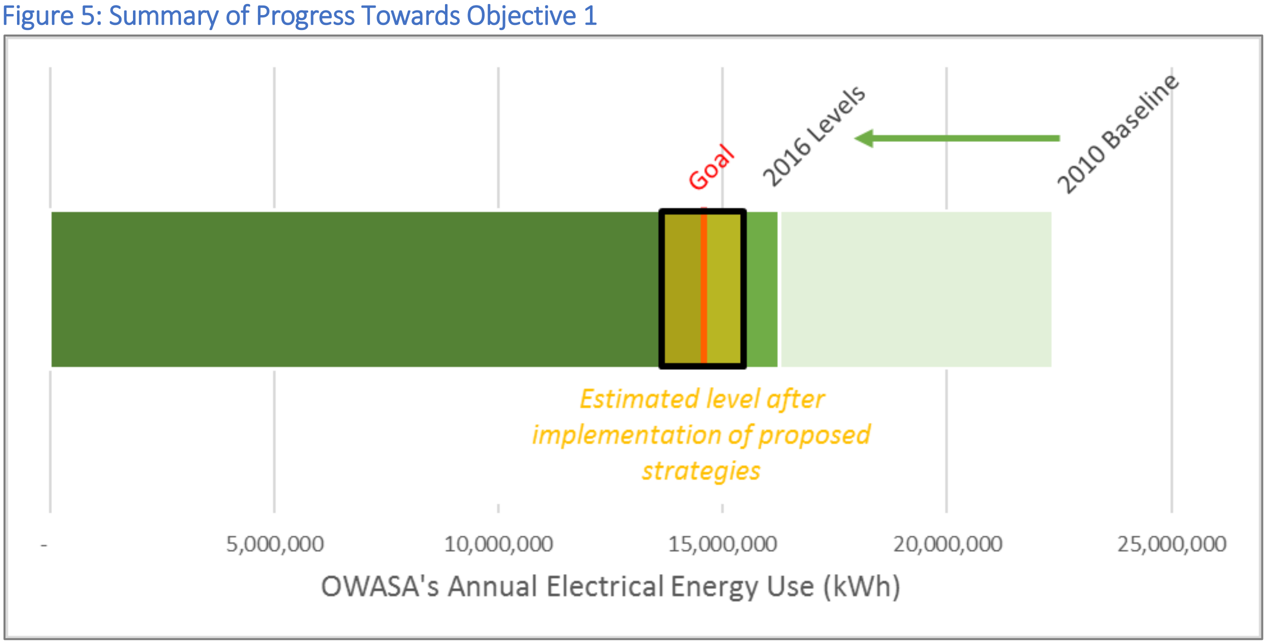
- Capital Improvements Budget: $95,000 (LED Lighting)
- Technical Assistance and Consultants: $17,000 (Pump and Motor Asset Management Program and Solar PV modeling)
- Operating Budget: $17,000 (WWTP backwash monitor and HVAC controls)
- Capital Equipment: $35,000 (ammonia monitor; cost also includes alkalinity analyzers for RCW)

As previously discussed, the NCSU IAC will bring in a pump optimization expert to develop our finished water pump use optimization analysis free-of-charge as a case study for their graduate students.

Where applicable, we will pursue Duke Energy Smart Saver Incentives (energy efficiency rebates) for these projects, as we have done recently with the HVAC equipment replacement at Cane Creek Reservoir, LED lighting replacements at the WWTP, and the aeration and mixing energy efficiency improvements project at the WWTP.

Figure 5 shows our current progress towards Objective 1 and the estimated range of electrical use levels anticipated as a result of the proposed strategies (illustrated by the black outline).

Figure 5: Summary of Progress Towards Objective 1



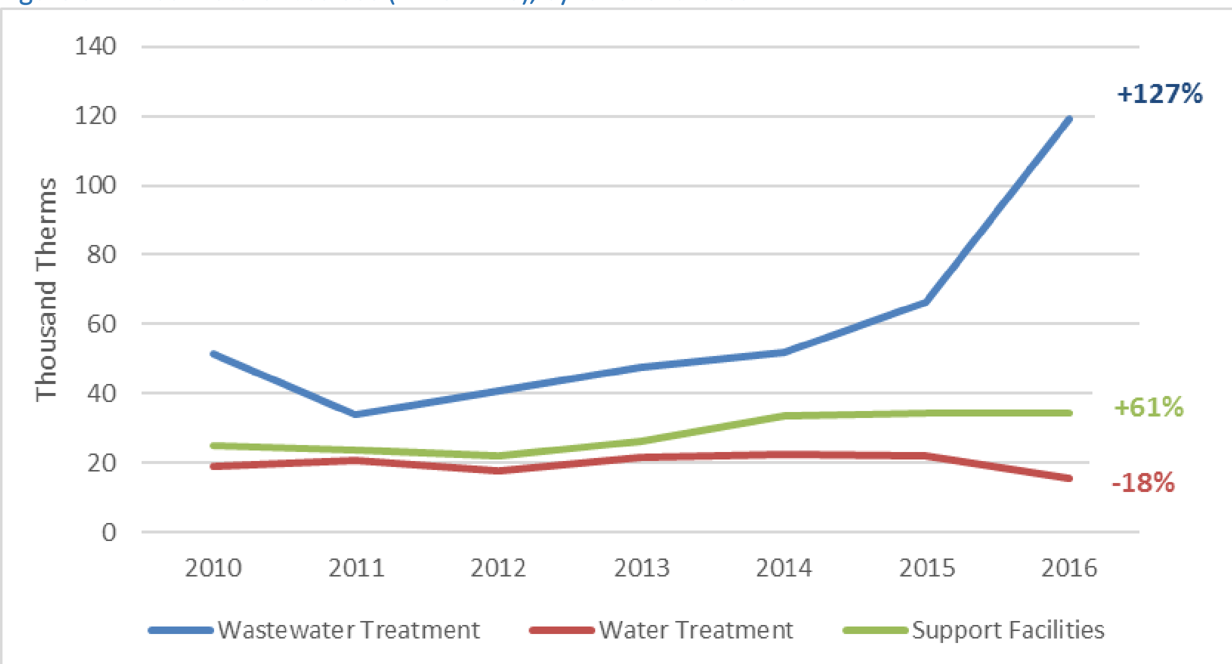
Objective 2

Reduce use of purchased natural gas by 5% by the end of Calendar Year 2020 compared to the Calendar Year 2010 baseline.

Trends in Natural Gas Use

Figure 6 shows historical natural gas use across the major functional areas, based on monthly billing data for our nine different natural gas accounts over a seven-year period from Calendar Year 2010 to 2016.

Figure 6: Annual Natural Gas Use (CY10-CY16), by functional area



Our largest use of natural gas occurs at the WWTP, where it is used mostly as a supplemental fuel for running the two boilers that provide heat for the anaerobic digestion (solids treatment) process. Methane – or biogas – is produced as a by-product of the digestion process, and under normal operations, is used as the primary fuel in our boilers at the plant. However, starting in late 2015 and proceeding to present, we have had to rely almost exclusively on natural gas to heat the boilers while two digesters and our gas storage unit were undergoing major rehabilitation. This project resulted in a significant increase in natural gas use at the WWTP. As we bring the biogas feed to boiler system on-line in the coming months, we expect to return natural gas use to 2014 levels.

It is important to note that decisions made in pursuit of Objective 3 and 4 (beneficial use of biogas) have the potential to impact our use of natural gas for digester heating. Under some scenarios, it may be more advantageous to treat and condition all of the biogas for another use (i.e. vehicle fuel) and use natural gas to heat boilers. As we move forward with evaluating options for beneficial biogas use, we will consider the implications on our overall energy balance and associated costs.

We also use natural gas in our main office buildings and at the WTP for domestic water heating and for running boilers that provide hot water for space heating. In these facilities where natural gas is used for space heating, our use varies with changes in temperature. Adjustments to thermostats, improvements to building insulation, and investment with high efficiency HVAC equipment can help reduce our use of natural gas.

Overall, we used about 73,000 therms more in 2016 than in 2010, an increase of about 79%. In addition to the digester rehabilitation project, we have experienced decreased efficiency in natural gas use in the Administration Building, while at the same time achieving some modest savings at the WTP and Operations Center. (For example, we have stopped using natural gas to regularly heat the generator building, resulting in annual reduction of 1,250 therms.)

Proposed Natural Gas Management Strategies

Although our natural gas use in 2016 was 79% higher than in 2010, we anticipate that in bringing the biogas-to-boiler system back on-line in the coming months, we will restore our natural gas use to 2010 levels. Therefore, each of the strategies below are placed in context against our 2010 baseline.

As with the strategies proposed for Objective 1, the following strategies are grouped into three major categories: projects currently in the CIP, energy management strategies to implement, and energy management strategies worthy of further evaluation. Table 5 lists each of these strategies, their estimated natural gas reduction potential (if enough information is available to develop an estimate), a three-year timeline, FY18 cost estimates, and assignment of the responsible party for moving forward with each strategy.

> **Projects Currently in CIP**: There are two project currently in the Capital Improvement Program that have the potential to reduce our use of natural gas. From the preliminary information that we have on these projects, **we estimate that they will reduce our current use of natural gas by 7,000 to 12,000 therms (about 8-13% of 2010 baseline).**
>
> **Strategies to Implement:** The proposed HVAC improvements, operational changes, and minor control adjustments also have the potential to reduce our use of natural gas for heating purposes by an **additional 7,000 – 12,000 annual therms (about 8-13% of 2010 baseline).**
>
> **Strategies to evaluate:** Beyond operational changes and minor control adjustment, Advanced Energy recommended several longer-term HVAC equipment replacements. For those replacements that would be optimal over the next few years, **the estimated natural gas savings from those projects is an additional 7,000 to 11,000 annual therms (about 8-12% of the 2010 baseline).** Additionally, while we expect that the new HVAC system in the Administration Building will significantly decrease the natural gas used to heat the building, we will also investigate the efficiency of the water heating system in the Administration Building.

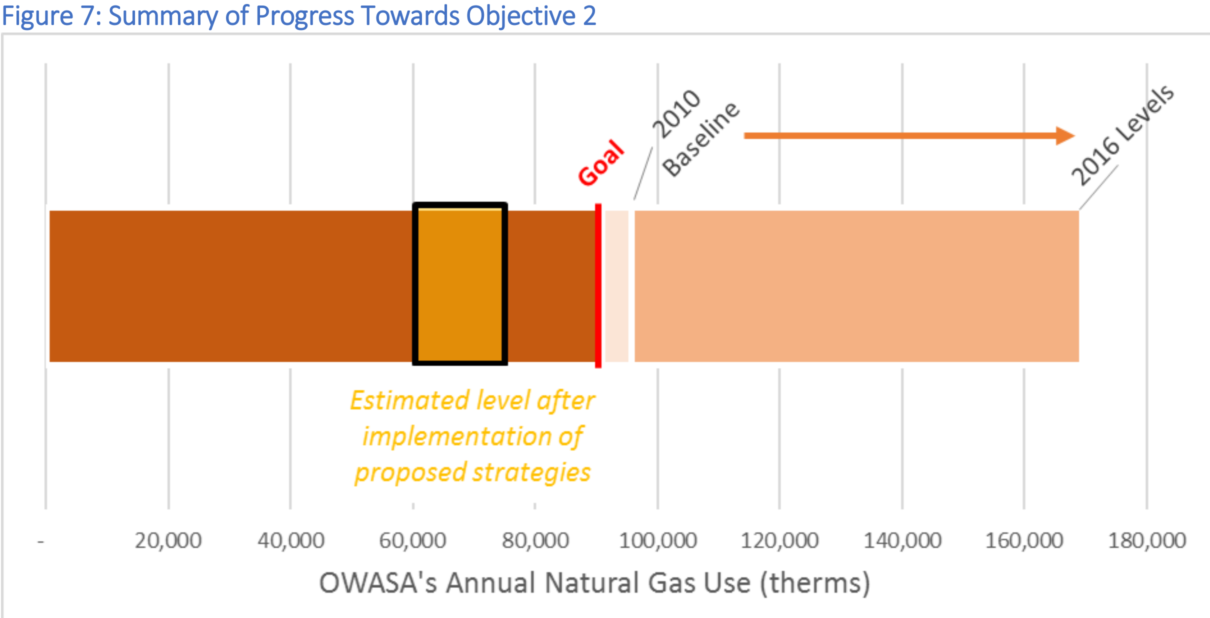
Table 5: Project Plan for Proposed Natural Gas Management Strategies and Estimated Energy Savings and Costs

Proposed Natural Gas Management Strategies	Estimated Natural Gas Savings (therms)	Timeline and Cost (in $1,000s)			Project Management
		FY18	FY19	FY20	
Currently in CIP					
Admin Building HVAC System Upgrade	7,000-12,000				Engineering
Building Envelope Rehabilitation	TBD				Engineering
Implement					
HVAC: Operational Changes and Minor Controls	7,000-12,000	10			Maintenance
Evaluate					
HVAC: Equipment Replacement	7,000-11,000	TBD			Maintenance
Water heating efficiency in Administration Building	TBD	TBD			Maintenance

Fiscal Year 2018 Budget:
Beyond what is budgeted in the CIP, there are no additional funds requested to pursue natural gas management strategies. The costs of the HVAC improvements are recognized in the previous section of the report as many of our natural gas management strategies have a concurrent benefit of reducing electricity use.

Figure 7 illustrates the progress that we need to make to meet Objective 2 (difference between 2016 Levels and Goal) and the estimated levels of annual natural gas use after brining the biogas system online and implementing the proposed strategies.

Figure 7: Summary of Progress Towards Objective 2



Objectives 3 and 4

Beneficially use all WWTP biogas by 2022, provided the preferred strategy is projected to have a positive payback within the expected useful life of the required equipment.

Formally engage local governments and partners in discussion about potential development of biogas-to-energy project at the Mason Farm WWTP.

(The following provides a combined update on Objectives 3 and 4, given their complementary nature.)

The Mason Farm WWTP produces about 110,000 cubic feet of biogas each day as a by-product of the anaerobic digestion process. The biogas is comprised of methane, carbon dioxide (CO_2), water vapor, and other trace gases, and is a renewable energy source with an estimated energy content of about 560 BTUs per cubic foot.

OWASA uses a portion of the biogas as fuel for two boilers that provide heat for the WWTP digestion process. Throughout the year, the WWTP produces more biogas than needed for the boilers. According to the U.S. Environmental Protection Agency, the global warming potential of methane is 28 to 36 times greater than CO_2. Therefore, the unused biogas at the WWTP is flared off by a waste gas burner to oxidize the methane to CO_2 and water, thereby minimizing fugitive methane emissions. It is estimated that in CY 2016, we used an average of about 33.3 million BTUs/day to meet our digester heating requirements. That is about 54% of the estimated BTU value of the biogas produced each day at the WWTP.

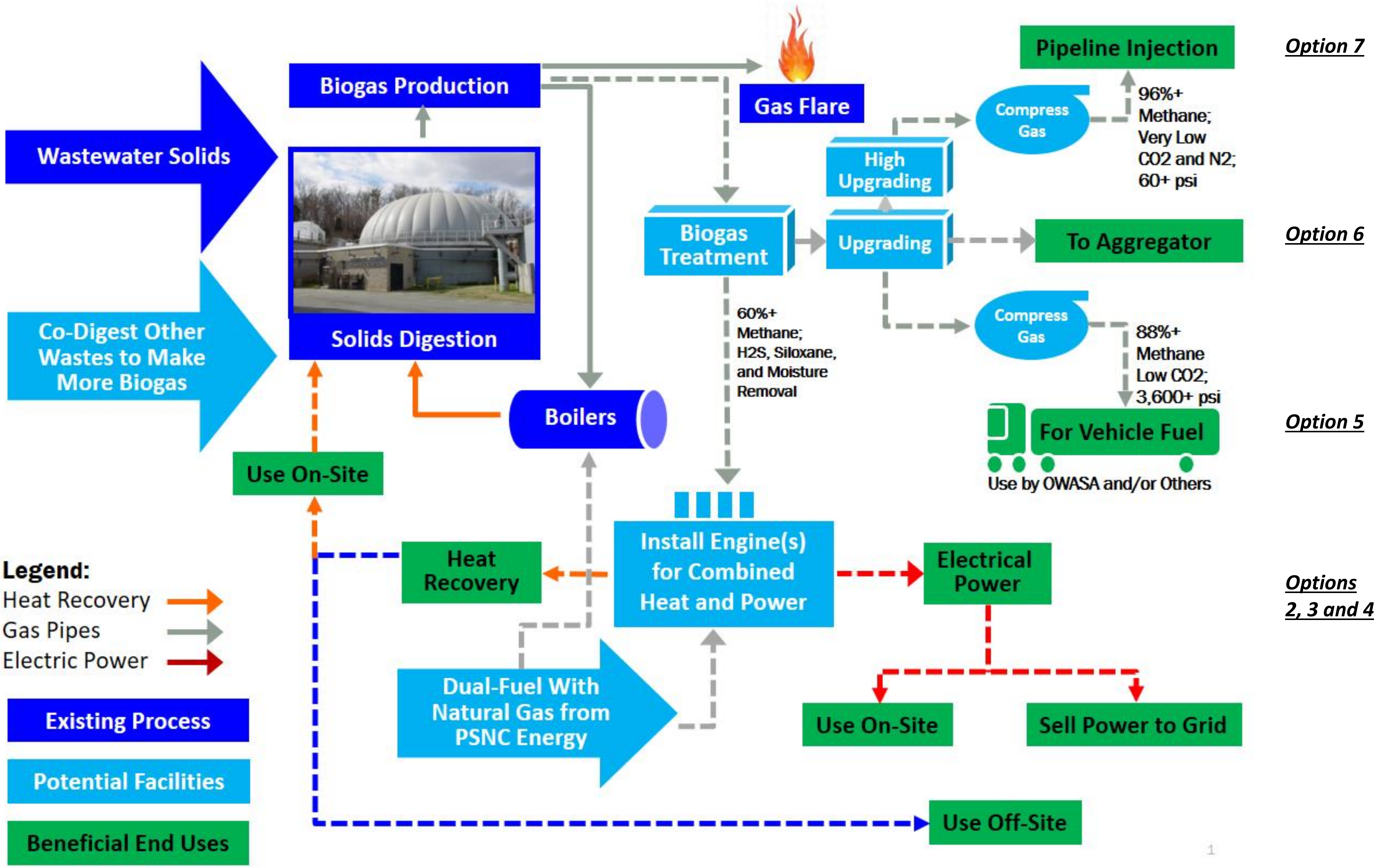
Many wastewater utilities have implemented other technologies to maximize the beneficial use of their biogas. The primary strategies include treating and conditioning the biogas for use as: (a) fuel for running a combined heat and power (CHP) system that includes an engine that produces electrical or mechanical energy, and a system for recovering and using the waste heat from the engine; (b) a renewable compressed natural gas (*r*CNG) that can be used as vehicle fuel; and (c) a renewable fuel supply that is injected into the natural gas pipeline grid for subsequent use by other parties.

Several utilities have also successfully implemented strategies for increasing the amount of biogas produced at their WWTPs, such as accepting fats, oils, and grease, food waste, and other high-strength organic waste (HSOW) for co-digestion with wastewater solids and using advanced digestion processes to achieve greater volatile solids destruction.

By maximizing the beneficial use of biogas through the above strategies, wastewater utilities can reduce their carbon footprint, lessen the impact of future increases in the cost of grid-supplied electricity and natural gas, and meet some or all their on-site power requirements with a locally-produced and controlled supply of renewable energy, thereby increasing reliability and redundancy, and resiliency. Unlike renewable wind and solar energy production (excluding systems that have integrated energy storage capacity), digester biogas can provide a reliable baseload power and heat supply, and/or vehicle fuel supply, as it is produced 24 hours a day, 7 days a week, regardless of weather or daytime factors.

Figure 8 illustrates the potential for application of these strategies at the WWTP and introduces the options discussed later in this Plan.

Figure 8: Schematic of Biogas-to-Energy Options at the Mason Farm Wastewater Treatment Plant



In recognition of these potential benefits, the OWASA Board of Directors established an objective of maximizing the beneficial use of the biogas produced at the WWTP by the end of Calendar Year 2022, provided the preferred strategy is projected to have a positive payback within the expected useful life of the required equipment. To inform decisions, actions, and future investments regarding the achievement of this objective, staff conducted a screening-level analysis for several options for maximizing the beneficial use of OWASA's biogas.

Over the past year and a half, staff has researched a range of options for biogas utilization and their application at the WWTP. Key resources in that research were a 2011 Biogas Utilization Study conducted for OWASA[1], the Department of Energy's Combined Heat and Power Technical Assistance Program, discussions with regional agencies on the potential to partner in the provision of supplemental feed stock and/or in purchasing biogas-generated energy, and numerous conversations with technology vendors, consultants, and other wastewater utilities that have implemented biogas-to-energy projects.

The following is an overview of the primary options considered for this screening analysis. All options except Option 1 (Existing Strategy) would require installation of new equipment to treat biogas to remove different impurities that can damage equipment that runs on the biogas. Key parameters of concern are hydrogen sulfide (H_2S, CO_2, siloxanes, and moisture). Biogas treatment, conditioning, and compression systems are costly from both a capital and operating and maintenance standpoint, and the costs will vary depending on quality of the raw biogas and the ultimate use of the biogas. If biogas is to be used as vehicle fuel or delivered to the natural gas pipeline grid, additional treatment and high level compression will be required. The energy required for gas treatment, conditioning, and compression equipment will offset some of the energy production and carbon reduction benefits from the biogas to energy system.

All biogas-to-energy systems are subject to occasional interruptions in the supply of biogas for extended periods due to digester rehabilitation and replacement work, problems with gas storage, treatment, and delivery, and/or other factors. In those situations, another fuel source such as natural gas must be purchased and used to meet digester heating requirements and/or vehicle fueling needs, and/or more electricity must be purchased from the grid.

Summary of Biogas to Energy Options

Option 1 – Continue to use the biogas as fuel for the boilers, and flare off any unused gas (Existing Program): This option involves the continuation of OWASA's current practice of using a substantial portion of the biogas as fuel for the two boilers at the WWTP, and flaring off the biogas that is not needed for digester heating. This is the simplest, lowest cost, and most commonly used approach for beneficially using WWTP biogas. Minimal treatment of the biogas is provided for use in boilers; therefore, this option has the highest operating and maintenance costs for maintenance, repair and periodic retubing of the boilers.

Use of the biogas for digester heating enables OWASA to offset the need use of fossil fuel-based natural gas. However, as noted above, natural gas must be purchased and used to meet digester heating

[1] The 2011 Biogas Utilization Study determined that the only economically viable project of the suite considered was a combined heat and power system supplemented with enhanced gas production by co-digesting fats, oils, and greases (FOGs) from the region. In 2011, there were many concerns about the long-term certainty of the FOG market and supply and the operational concerns of a FOG receiving station at the Mason Farm WWTP.

requirements during periods when the supply of biogas is interrupted. And other times, we generate more biogas than we can use, and the biogas must be flared.

Option 2 – Install a biogas-fueled 330 kW CHP system to offset electrical power use and meet much of the digester heating requirements: This option includes the installation of a reciprocating internal combustion engine and waste heat recovery system that is designed to operate continuously, and closely matched to the existing biogas production. The electricity produced by the engine would either be sold to Duke Energy under a power purchase agreement (PPA), or used to offset electrical use and billing charges through a net metering arrangement.

To ensure proper operation and extend the useful life of the engine, the biogas must be treated to remove H_2S, moisture, siloxanes, and particulates which can damage the engine. The minimum required methane content of the biogas is 60%.

The engine would be enclosed to provide for sound attenuation. Given the special expertise required to ensure proper operation and maintenance of the CHP and gas treatment systems, it is assumed that OWASA would enter extended maintenance contracts with the engine and gas treatment system manufacturers.

Several wastewater utilities have successfully implemented biogas CHP systems at this scale, primarily in higher energy cost markets and/or with funding assistance from others. This option does not require supplemental High Strength Organic Waste (HSOW) receiving and co-digestion, nor a third-party recipient of the output (aside from negotiations with Duke Energy). Unfortunately, given the current relatively low cost of electrical energy, the economics of this project are not favorable.

Option 3 – Install a biogas-fueled 1,350 kW CHP system, and optimize the operation of the system around peak time of day rate periods for electricity: This option includes the installation of a reciprocating internal combustion engine and waste heat recovery system that is designed and operated to primarily offset electricity demands at the WWTP during Duke Energy's peak time of day rate period. Under this approach, the engine would typically operate about 8 hours a day for five days a week, and the waste heat would be recovered and used for digester heating during that period. The engine would be designed to run primarily off biogas, but have the capability to also be fueled by natural gas. Natural gas use would be required to meet digester heating needs during the time of the day when the engine was not being run.

Gas treatment and conditioning requirements and operation and maintenance service arrangements would be the same as for Option 2.

The DOE CHP TAP team completed a screening-level analysis of this option at no cost to OWASA. DOE CHP TAP concluded that if an additional 135,000 cubic feet of gas storage capacity was installed at the WWTP to store biogas during the off-peak hours for use during the on-peak hours, the current gas production rate would enable a 1,350-kW engine to offset the WWTP's monthly peak power requirements, assuming Calendar Year 2016 demand conditions.

The analysis also showed that due to the much larger engine operating only about 8 hours a day, this option would result in substantial over-production of waste heat compared to the thermal requirements of the digesters. DOE CHP TAP projected that only 27% of engine's waste heat engine would be used over the course of the year. The waste heat that is not used is about 4,950 million BTUs. That is well-below what is needed for digester heating; however, that heating demand is spread over all the off-peak hours, while the CHP system would only operate during on-peak hours.

Like Option 2, the engine would be enclosed to provide for sound attenuation, and it is assumed that OWASA would enter extended maintenance contracts with the engine and gas treatment system manufacturers.

The economics of this option are more favorable than Option 2. There are some embedded assumptions in this option that would need to be explored, primarily Duke Energy's willingness to reduce the WWTP's contract demand to 15 kW. This option is intriguing because of the back-up power potential offered by a dual-fueled (biogas and natural gas) reciprocating engine, and its capacity to adapt to supplemental high strength organic waste in the future.

Option 4 – Install a biogas-fueled 700 kW CHP system and HSOW receiving and processing facilities to enhance biogas production and renewable energy generation[2]: This option includes installation of a 700 kW CHP system, and facilities for receiving and processing HSOW for co-digestion to enhance gas production and support greater power production levels. Like Option 2, the engine would be operated on a continuous basis, and closely matched to the much higher projected biogas production rate associated with co-digestion of HSOW.

Electricity produced could either be sold to Duke Energy under a PPA, or used to offset electrical use and billing charges through a net metering arrangement. Gas treatment and conditioning requirements and operation and maintenance service arrangements would be the same as for Options 2 and 3.

This option offers potentially significant additional revenue streams from the receipt of tip fees for accepting HSOW, and the sale of greater amounts of electricity made possible by enhanced gas production. However, when compared to Options 2 and 3, this option would have much higher capital and operating and maintenance costs, be more challenging to operate and maintain, and present greater operating and financial risks due to the inclusion of facilities for HSOW receiving, processing and co-digestion. The operation of HSOW receiving and processing facilities will result in more truck traffic and greater risk of objectionable off-site odors.

If the anticipated supply of HSOW and/or the tip fees for accepting and processing those wastes are lower than projected, revenues would be less favorable. Lower volumes of HSOW will mean less biogas production, less power generation, and lower revenues from the sale of electricity than projected for this option. Implementation of HSOW receiving and co-digestion will require careful management to ensure proper performance of the digesters and quality of the biosolids. For this analysis, it is assumed that processing of HSOW will not increase biosolids production volumes.

Option 5 – Install a system that enables biogas to be used as *r*CNG in vehicles and certain equipment: This option includes installation of a gas treatment and conditioning system, gas compression and storage facilities, and an *r*CNG fueling station to fill OWASA vehicles at the WWTP. To be used as vehicle

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[2] Option 4 below includes the installation of HSOW receiving facilities and co-digestion of supplemental waste streams to increase gas production. It would also be possible to include HSOW processing for each of the other options; however, that was not done for the purpose of this screening analysis, given the risks and uncertainty of ensuring an adequate supply of such wastes and the attendant operating and management challenges.

fuel, the *r*CNG must have a higher methane content (>88%) and lower CO_2 content than is needed to fuel a CHP as proposed for Option 2 - 4. The biogas must also be compressed to a much higher pressure – about 3,600 pounds per square inch (psi). Thus, this option involves higher costs for gas treatment, conditioning and compression than the CHP options.

At current biogas production rates, an rCNG system could generate around 130,000 diesel gallon equivalents (or about 164,000 gasoline gallon equivalents) of vehicle fuel each year, which substantially exceeds OWASA's total annual vehicle fuel requirements. For this option, it is assumed that the excess *r*CNG vehicle fuel produced would be sold for use by others. Since it is very unlikely that OWASA could provide an rCNG fill station at the WWTP for use by others, it is assumed that an *r*CNG tube truck will be used to transport the fuel for off-site use.

This option assumes that a slow-fill rCNG fueling station is installed at the WWTP to enable refueling of the biosolids tanker trucks, roll-off container truck, and other trucks parked overnight at the facility.

To fully use the fuel produced under this option, OWASA and other fleet owners would need to convert a number of existing vehicles to run on *r*CNG, and/or replace existing vehicles with new *r*CNG-ready vehicles. Vehicle conversion costs or incremental costs for new rCNG-ready vehicles can cost from around $10,000 to more than $30,000.

The environmental attributes of this option are substantial, as use of *r*CNG instead of diesel fuel or gasoline substantially reduces emissions of nitrous oxide, carbon monoxide, particulate matter, and volatile organic compounds and ozone-forming emissions.

In addition to the revenue received from the sale of *r*CNG fuel (or the vehicle fuel purchase costs offset by this option), additional revenues are projected for the sale of renewable energy credits associated with the sale and use of the *r*CNG. A Renewable Identification Number (RIN) is assigned to biofuel for tracking its production, use, and trading under the U.S. Environmental Protection Agency's Renewable Fuel Standard (RFS) established in accord with the Energy Policy Act of 2005 and the Energy Independence and Security Act of 2007. Gross revenues for sale of the RINs are assumed to be $2.50 per Ethanol Gallon Equivalent; costs for RIN certification and marketing is assumed to be 25% of the gross revenues.

This option has the potential to be a strong investment for OWASA, if certain assumptions prove favorable, such as RIN market value and longevity and end-market acceptance for excess *r*CNG.

Option 6 – Install a system that enables biogas to be converted to *r*CNG for off-site transport to an end user or a biomethane aggregator that upgrades the biogas for wholesale delivery to a natural gas pipeline and/or other end users ("Mobile Pipeline" option): This option includes a gas treatment and conditioning system and compression facilities for uploading biogas into tube trucks for transport to an off-site location for use by another party, such as an industry, *r*CNG fueling operation, or aggregator that upgrades the biogas and injects it into a natural gas pipeline and/or delivers it to other end users.

*r*CNG production levels would be the same as for Option 5. The level of gas treatment that OWASA would need to provide will depend on the recipient's needs; however, for this screening analysis, it is assumed that biogas would be treated and compressed to the same level as for Option 5, but the required tube transport truck would be owned and operated by another party.

It is assumed that any additional equipment needed for upgrade of the biogas would be paid for and operated and maintained by the end user or aggregator.

There are no existing biomethane aggregator systems in North Carolina; therefore, there is great uncertainty in the terms and conditions, and associated costs and benefits that would apply to OWASA under this option.

Option 7 – Install a system for upgrading the biogas for direct injection into the natural gas pipeline system, where it can be used by natural gas customers: This option includes the treatment and compression of the biogas to gas pipeline standards, and the establishment of an interconnection to inject *r*CNG into the natural gas pipeline system. The *r*CNG would be blended in the pipeline and be available for heating, industrial process, CNG fueling, and other purposes.

This option assumes that we can take advantage of the existing natural gas pipeline infrastructure and enables 100% of the biogas to be used. This option would have substantial capital costs for gas treatment and conditioning, as the biogas would be required to meet very strict gas quality standards. Extensive gas testing and monitoring would be required on an ongoing basis.

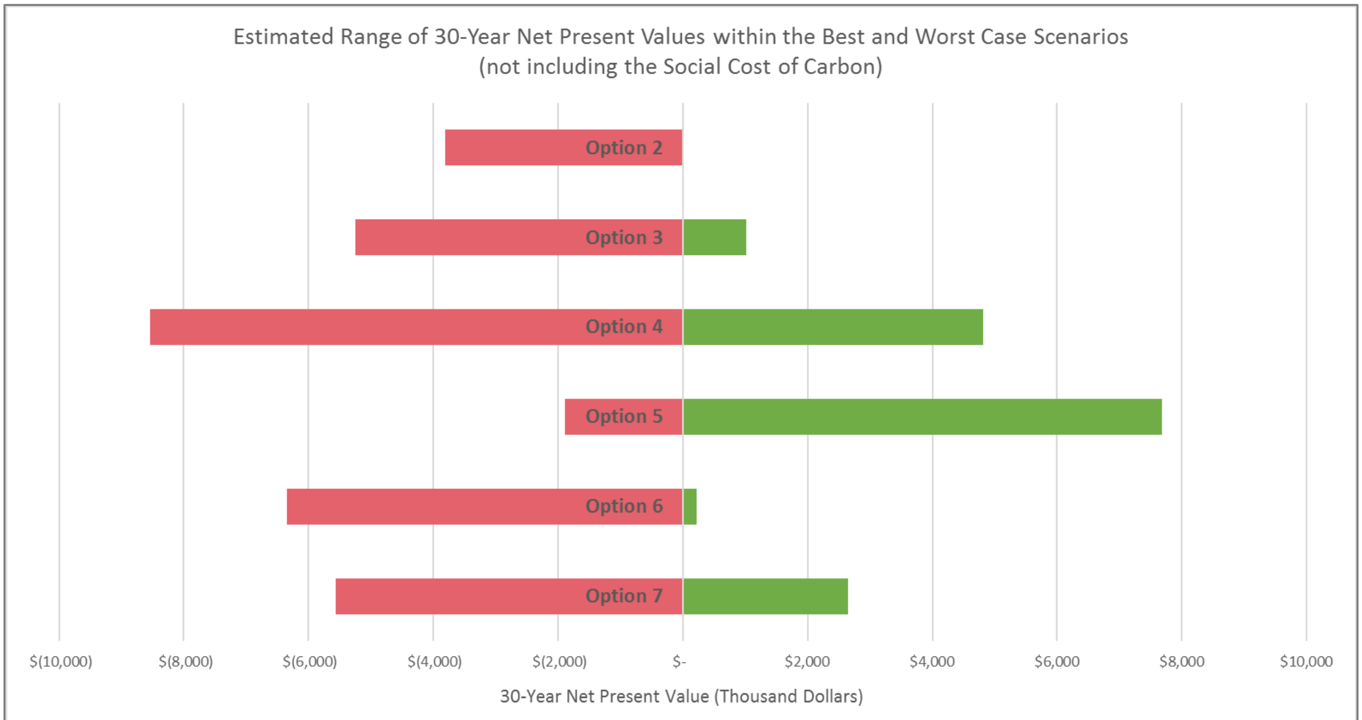
North Carolina does not have statewide standards for injection of biogas into the natural gas pipeline; therefore, there is uncertainty about the technical and economic feasibility of this option. However, based on the experience in other states, biogas injection to the natural gas pipeline has been feasible only for biogas generators that are much larger than OWASA.

Comparison of Options

Appendix D provides a relative comparison of each of the options against clean energy project criteria. While Options 2 through 7 would increase our renewable energy generation and reduce greenhouse gas emissions, each come with varying levels of financial, implementation, and operational risk.

Although the screening level analysis is an important step in surveying and summarizing our options, it is difficult to draw conclusions as to the best path forward for a biogas-to-energy project on this analysis alone. The evaluation of each individual option is complex in assumptions regarding scale, cost of technology, market acceptance, and partnership arrangements. Figure 7 illustrates the range of financial uncertainty for each option, showing the range of 30-Year Net Present Values between the best and worst case scenario for each option. Those options that involve more marketplace engagement (e.g. Option 4) tend to have broader ranges, with potential for great opportunity but also great risk. The less complex options (e.g. Option 2) have more certainty, but less financial viability.

Figure 9: Range of Financial Viability of Biogas-to-Energy Options



Option 2: *Biogas Combined Heat and Power (CHP) system operating continuously (330 kW)*
Option 3: *Biogas CHP system operating during on-peak times (1,350 kW)*
Option 4: *Biogas CHP with high-strength organic waste receiving (700 kW)*
Option 5: *Biogas used as a Renewable Compressed Natural Gas (rCNG) for vehicle fuel*
Option 6: *Biogas delivered to other parties or aggregator via "Mobile Pipeline" strategy*
Option 7: *Biogas injected to PSNC Natural Gas Pipeline*

The identification of a successful biogas-to-energy option does not lie in the economics alone. It is critical to evaluate how the project would impact our WWTP operations and our community. Appendix D captures OWASA staff's review of these considerations and provides comparison for each of the options. Each option would increase staff maintenance responsibility and the complexity of operations, even if operations and maintenance of the system itself is contracted out (the costs of which we have incorporated into each of the options). Furthermore, without the context of a long-term resource recovery plan for the Plant, it is difficult to forecast how such a project will integrate with future plans at the WWTP.

Key Takeaways and Recommended Next Steps to Inform Biogas to Energy Decisions

Staff's high-level screening does not identify an obvious and clear path forward on a discrete biogas-to-energy project. However, it does help capture an overview of the opportunity and risks associated with various options and will serve as a good springboard for further analysis. Using this overview as a starting point, our recommendations for the upcoming year are to:

1. **Conduct additional analyses of gas production rates and gas quality to better inform biogas treatment and conditioning requirements and related capital and operating costs for the various biogas-to-energy options**, now that the digester rehabilitation project has been completed and improvements will soon be made to the gas piping and use system (see Objective 2).

2. **Engage a consultant to conduct a technical review of our screening study**, including:
   - The suite of options being considered, and recommendations for other options not currently considered;
   - The capital and operating and maintenance (O&M) cost assumptions we have made for each option
   - Identification of potential "game-changers" that may be on the horizon and have major implications for the timing, scale, feasibility, and approach to a future biogas-to-energy strategy;
   - The evaluation of each strategy against our set of criteria;
   - Facilitation of a peer review of the study with other utilities and key stakeholders;
   - Facilitation of a workshop with potential partners in the most advantageous options; and
   - Determination as to whether one or more options could meet OWASA's biogas-to-energy objective, and if so, development of a proposed approach, cost estimate, and preliminary implementation schedule for each identified option.

3. **Identify a preferred option in the context of a long-term resource recovery plan for the Mason Farm Wastewater Treatment Plant.** Where practical, provide flexibility in project design to accommodate cost-effective expansion and/or incorporation of additional biogas to energy strategies.

Fiscal Year 2018 Budget: We estimate the cost of the technical review to be conducted by a consulting firm with relevant experience will cost about $50,000.

Objective 5

Seek proposals for third-party development of renewable energy projects on OWASA property

The OWASA Energy Team reviewed and discussed the potential for various renewable energy projects on OWASA-owned land. Solar photovoltaic (PV) installations present a unique and mutually beneficial opportunity for public-private partnerships in renewable energy installations in the Piedmont of North Carolina. Due to the OWASA's status as a tax-exempt, government entity, we are not able to take advantage of any financial incentives, such as the Federal 30% Investment Tax Credit (ITC) or Modified Accelerated Cost Recovery System (MACRS) depreciation (five year), but private developers with tax liability are. There are many examples of public-private partnerships where a government agency has partnered with a private developer to develop a solar project, some with contractual agreements that enable the government agency to take full ownership of the system once the tax credits have been monetized by the private developer(s).

To determine the potential applicability of this strategy to OWASA, we engaged the National Renewable Energy Laboratory (NREL) Solar Technical Assistance Team (STAT) in a screening-level techno-economic evaluation of potential opportunities for development of solar photovoltaic (PV) systems at various

OWASA-owned facilities and tracts of land. The NREL team provided this analysis to OWASA free-of-charge. OWASA staff identified relatively large tracts of land with open space that could potentially be used for a solar development. We requested that they model two scenarios: one with no financial incentives (e.g. ITC, MACRS) and another with the full 30% ITC. We also asked that they incorporate the Social Cost of Carbon (SCC) into these analyses.

The table below provides a summary of their preliminary estimates on the economics of large-scale solar PV installations on OWASA-owned land. For context, solar PV systems typically come with a 25-year warranty, meaning that any system with a payback period greater than 25 years may not be economically feasible. The levelized cost of energy (LCOE) is calculated by dividing all lifetime costs associated with the installation and operations of a PV system by the total amount of energy produced over the assumed lifetime (warranty period) of the system. The LCOE is a useful metric in comparing the lifetime average electrical energy costs of alternative projects.

Table 6: Summary of Site Requirements, Energy Output, and Costs for Potential Large-Scale PV Systems on OWASA-owned land

Potential Location	Property Near to Cane Creek Reservoir	Utility-scale with fixed axis (e.g. Biosolids Management Site)	Utility-scale with one-axis tracking (e.g. Biosolids Management Site)
PV System Size (kW)	756	5,000	5,000
Required Land Area (acres)	1.21	13.2	21.8
Ground Coverage Ratios	0.9	0.5	0.3
Electricity Output in kWh (for context: % of OWASA 2010 electrical energy use baseline)	1,097,000 (4.9%)	7,490,000 (33.5%)	9,310,000 (57.2%)
Installed Cost without FED ITC – OWASA Owned	$1,607,000	$9,100,000	$9,600,000
Installed Cost minus FED ITC ($) – Private Development	$1,125,000	$6,510,000	$6,870,000
Simple Payback (yrs.) without ITC and without Social Cost of Carbon (SCC)	25.1	25.3	21.5
Simple Payback (yrs.) without ITC and with SCC	20.4	20.0	17.0
Simple Payback (yrs.) with ITC/without SCC	17.5	18.1	15.4
Levelized Cost of Energy ($/kWh) without ITC/without SCC (OWASA-ownership scenario)	$0.1284	$0.1251	$0.1059
Levelized Cost of Energy ($/kWh) without ITC/with SCC	$0.1051	$0.1024	$0.0849
Levelized Cost of Energy ($/kwh) with ITC/without SCC	$0.0967	$0.1001	$0.0848

NREL's geospatial analysis and modeling indicate that a large-scale (0.756 – 5 megawatt) development of a solar PV system would be marginal in terms of financial viability within the 25-year warrantied life of a solar PV system if developed by OWASA, particularly when adding in the cost of interconnecting with Duke Energy and discounting future energy sales. Incorporating the social cost of carbon (SCC) significantly improves the economics, but does not negate the significant upfront capital costs (even if financed with low-to-no interest financing, such as Clean Renewable Energy Bonds or State Revolving

Funds). Partnering with a third-party solar developer would have the combined benefit of effectively reducing the installation cost by taking advantage of the Federal ITC, as well as deflecting the initial capital costs to a later date (at which point OWASA could have the option of purchasing the system at a significantly depreciated value). There are several financing structures that allow for this type of relationship.[3] A system of this size may require environmental analyses to be conducted on the land (e.g. National Environmental Policy Act (NEPA) studies).

Recommendation

NREL's screening study indicates that one or more tracts of OWASA land could potentially be attractive for third-party development of a large-scale solar PV project. However, before moving forward with a Request for Proposals (RFP) from qualified solar energy developers, we recommend that during the coming year we:

1. **Consider renewable energy generation in the development of a plan and policy framework for long-term management and disposition of OWASA lands, as part of the Board of Director's Strategic Initiative on land management.** Currently, the Board is scheduled to receive and discuss an overview of land management at their August 10, 2017 work session.

2. **In support of the Board's consideration of renewable energy generation on OWASA-owned land, further evaluate the feasibility and implications of converting one or more OWASA sites for solar PV development, taking into consideration feedback from our neighbors and other stakeholders**. For screening purposes, the potential solar PV locations were selected for conceptual evaluation simply because they represented large tracts of cleared, OWASA-owned land. Before further considering solar PV deployment at one or more sites, we need to investigate alignment with long-term organizational needs and local land use plans, and seek and consider the input from other stakeholders, including our neighbors, U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency, and other stakeholders.

3. **Evaluate interconnection requirements, agreement provisions, and associated costs in partnership with Duke Energy.**

4. **Evaluate and compare public-private partnership arrangements for large-scale, solar-PV developments.**

Following Board concurrence, staff would move forward with these next steps over the coming year and incorporate the findings in the FY18 update of the Energy Management Plan. Based on this analysis, we will make a recommendation on if and how to move forward with the preparation and issuance of an RFP for potential development of a large-scale solar PV project on OWASA-owned land.

Fiscal Year 2018 Budget: We do not anticipate that the steps proposed will require anything more than staff and Board time.

[3] See: http://www.nrel.gov/docs/fy16osti/65638.pdf

Moving Forward

This Energy Management Plan documents our proposed strategies and approach for reducing our use of fossil fuel derived electricity and natural gas, and our efforts to incorporate the use of renewable energy sources in our operations. In Fiscal Year 2018, we will implement several projects to further reduce our use of energy and to move closer to our Year 2020 energy use reduction targets. We will also incorporate energy efficiency measures into the planning and design of new capital projects, and pursue cost-effective strategies for the use of renewable energy in our operations.

In future annual updates of this Plan, we will document our progress towards our energy management goals and objectives, and present updated recommendations and proposed strategies for further improving our use of energy and reducing our carbon footprint.

As we move forward, we welcome the questions, comments, and suggestions from our customers, our member governments, and others. We will also continue and expand on our efforts to partner with other agencies on these important efforts, so that we can achieve our energy management goals and objectives in a more cost-effective manner than would otherwise be possible.

Appendix A: Strategy Evaluation Summary

The following strategies were identified by OWASA staff and advisors as opportunities to reduce our use of purchased electricity and natural gas. Each strategy is summarized in a 1-3-page summary in Appendix B. Each strategy is linked to an energy strategy summary that provides background on the potential of the strategy.

After reviewing energy strategy summaries, the OWASA Energy Team met over the course of two meetings (February 24, 2017 and March 1, 2017) to review, discuss, and prioritize each of the energy strategies. Each Team member provided a recommendation as to how to best move forward with the strategy: **implement (1-6), study (7-15)**, **defer until upgrade (16-22)**, or **defer indefinitely (23-26)**.
The final recommendation is the average recommendation from the group's vote.

As reviewed, discussed, and accepted by the OWASA Board of Directors, the OWASA Energy Team evaluated each strategy qualitatively against the following six criteria (and guiding considerations). Each cell of the table below is color-coded to indicate whether a strategy is favorable, neutral, or unfavorable against each criterion.

1. Financially Responsible (High level)
   a. Likely a good use of public funds
   b. Financial viability of similar projects in similar organizations and circumstances
   c. Opportunities for outside funding/financing
2. Realistic/Implementable
   d. Degree to which the strategy has been proven at a scale relevant to our operation
   e. Organizational capacity to undertake and manage the project
   f. Reasonable amount of staff time to implement
3. Operational Impacts
   g. Consistent with how OWASA wants to operate
   h. Degree to which strategy helps to resolve an existing or expected problem
   i. Impact on safety, comfort, and productivity
4. Energy/Carbon Reduction Potential
   j. Potential to reduce OWASA's energy use and/or carbon emissions
5. Coordination with Other Projects
   k. Interdependence with other project(s)
   l. Potential to take advantage of economies of scale to save money and/or staff time
6. Community Impacts
   m. Stakeholder enthusiasm
   n. Coordination with community initiatives

Energy Strategy		Financially Responsible (High level)	Realistic/ Implementable	Operational Impacts	Energy/Carbon Reduction Potential	Coordinates with Other Projects	Community Impacts
1	LED Lighting Retrofit	Duke Energy incentives currently available Payback well within life of asset	Yes – at a pace that maintenance staff can keep up with	Improved Safety and visibility; reduced maintenance requirements	>30% more efficient than most lighting technology Lighting accounts for small amount of overall energy use	Retrofits can be easily coordinated with other building maintenance and upgrade projects	Limited: Better evening visibility; reduced "light pollution"
2	Energy Optimization for IT Server Room: Low to No Cost Strategies	Operational changes require no investment	Yes	Must ensure proper humidity levels in IT server room; will require an incremental approach	Very modest energy savings	No	None
3	Backwash WTP Filters in Off-Peak Times	No capital investment required; could save money	Yes	Not expected: In winter and summer, there are times during	Demand savings, but no energy savings	No	None

Energy Strategy		Financially Responsible (High level)	Realistic/ Implementable	Operational Impacts	Energy/Carbon Reduction Potential	Coordinates with Other Projects	Community Impacts
				the working day that are considered "off-peak"			
4	Pump and Motor Asset Management Program	Early payback expected based on experience of others	Yes, but is technically involved and includes multifaceted effort	Could help identify pumps and motors that need to be replaced before they fail Will help inform performance-based maintenance program	Significant potential: pumps and motors account for the largest energy use at OWASA	Yes – Asset Management Program	None
5	Heating, Ventilation, and Air Conditioning Assessment: Operational Changes and Minor Controls	Minor up-front costs Quick payback expected	Yes	Improved occupant comfort and health	Energy and natural gas savings potential: modest	No	Limited – improved visitor comfort
6	Finished Water Pump Use Optimization	Modest cost for a study expected to be offset by cost savings from improved optimization	Yes	Use of right pump for right flow condition can reduce pump wear and tear Better control of pump start/stop operations Will be important to avoid large flow changes in the plant	Potential to reduce a modest portion of the energy used for finished water pumping	Finished Water Pump Rehabilitation and Replacement (CIP No 272-42) – anticipated to be completed in FY22 (not worth waiting)	None
7	Heating, Ventilation, and Air Conditioning Assessment: Equipment Replacement	In instances of aging equipment or quick payback	Yes	Improved occupant comfort and health	Energy and natural gas savings potential	No	Limited – improved visitor comfort
8	Optimize WWTP Filter Backwash	Modest cost for monitoring and control system	Potentially	Increased effort for monitoring	Could provide 50% reduction in energy use for backwashing denitrification filters Modest energy savings	Strategy will be irrelevant when we must run the filters in denitrification mode (anticipated to begin around 2024)	None
9	System-Wide Energy Model	Likely a high-cost study	Potentially	Would provide a theoretical baseline for future decision-making	No direct energy savings, but helpful for setting realistic goals	Yes – would provide a benchmark for all our processes	None
10	Power Supply Optimization	Modest cost of study could identify cost of upgrade	Involved study; strategy may have limited benefits to OWASA	Reduction in power quality could negatively impact VFDs and other equipment	Anticipated limited savings opportunity at plants	Could be coordinated with ongoing electrical system configuration study at WWTP	None
11	Real-Time Nitrification Control System	Modest up-front investment: We already have about 75% of the monitoring equipment Controls will require back-up	Potentially	Would enable changes to operational strategies Potential to improve plant performance Automation requires calibration and over-sight	Potential to reduce energy use at WWTP by about 5-10%; chemical use reductions may also occur	Coordinates with planned upgrade to a high-performance SCADA system	None

	Energy Strategy	Financially Responsible (High level)	Realistic/ Implementable	Operational Impacts	Energy/Carbon Reduction Potential	Coordinates with Other Projects	Community Impacts
12	Small-Scale Solar PV System: OWASA ownership	Screening study shows the simple payback just within the useful life of equipment Technology evolving; costs declining	Yes	Solar PV integrated with parking canopy could provide protection for mobile assets	Potential to reduce energy use by 160,000 to-1 million kWh/year	No	Potential to collaboratively purchase solar PV solutions with regional partners Public commitment to renewable energy
13	Raw Water Pumping Optimization Operating Procedure and Associated Schedule	Modest cost for study; no cost for use of schedule	On a given day, objective of saving energy may be outweighed by drinking water quality and quantity considerations	Using the schedule as guidance, instead of a requirement, would provide operators flexibility in decision-making	Modest savings provided pump optimization protocols are clear and utilized	Optimization protocols should be developed as pump station upgrades are deigned and completed	None
14	Large-scale (5 MW) Solar PV System: private ownership	Requires no up-front capital outlay Most economically viable solar PV option	Likely, provided interested 3rd party wants to partner	Could conflict with other existing and/or planned uses of OWASA lands Makes beneficial use of OWASA land-holdings	Significant, but energy benefits delayed for OWASA until we take ownership of PV system	Conversion of biosolids management program to 100% composting or non-land application program could enable some OWASA land to be repurposed for solar PV	Significant commitment to renewable energy and offsetting carbon emissions Potential educational site
15	Reconsider Wastewater Pump Station Design, Operations, and Maintenance	Upgrades at point of rehab could be cost-effective Low-cost Operational and maintenance changes	Individual consideration of each of the 22 pump stations would be labor intensive	Pumping rates must be sufficient to minimize potential for grit accumulation Wet well turnover important to prevent well becoming septic Pumping capacity must be sufficient for high flow events	If energy use of all wastewater pump stations could be reduced 10% through this strategy, savings would be about 0.8% of OWASA's total annual electricity use	Operational and design improvements can be incorporated into design of future wastewater pump station rehabilitation and replacement projects	None
16	Equalization Basin for Wastewater Inflow at WWTP	Expensive	Requires space in a very space-constrained site	Would greatly benefit operations at the plant through better management of flow and nutrients; however, EQ basin would require mixing, odor control, effective maintenance, etc.	Peak demand savings and opportunity to utilize pumps at most efficient flows Wouldn't change total pollutant loads or flow Might require more energy to pump and aerate/mix	Necessary to coordinate with numerous in plant projects Could defer treatment plant capacity expansion	None
17	Reduce Peak Demand for Reclaimed Water Service	On-campus storage would be very expensive to construct	Uncertain; limited space on UNC campus for siting RCW storage tank	Requires significant coordination and planning between WWTP staff and UNC Extended residence time could degrade RCW quality and adversely affect end uses RCW storage could provide increased reliability/redundancy	Minimal net energy savings expected due to need to pump RCW to higher tank; storage could enable more optimum RCW pump operations	No	Would require investment from UNC to be cost-of-service

	Energy Strategy	Financially Responsible (High level)	Realistic/ Implementable	Operational Impacts	Energy/Carbon Reduction Potential	Coordinates with Other Projects	Community Impacts
18	Battery-Based Energy Storage for Peak Demand Reduction	Not likely to have direct positive financial payback unless costs decline substantially; however, strategy may provide redundancy/resiliency benefits	No known applications of this technology at scale and applications comparable to OWASA	None	Technology would require increased electricity use due to inherent inefficiencies Could enable reduced electricity demands during peak time of day rate periods	When looking at generator and redundancy applications, and potential deployment of renewable energy strategies, it should be considered	None
19	Wastewater Pump Station Abandonment	Elimination of wastewater pump stations can be very costly	Topography and other factors may prevent station abandonment; removal can be complicated (i.e. land crossing, interconnection with other systems)	Operating and maintenance savings Pump station elimination can reduce safety and wastewater overflow risks	Relatively small impact versus effort In some cases, reductions in OWASA energy use may be offset by the requirement for private wastewater pumps to be installed to serve some low-lying service locations	As pump stations are identified for potential rehabilitation or replacement, the technical feasibility and benefits and costs of abandoning those stations should be considered prior to a final investment decision being made	Might require customer pumping
20	Geothermal Systems for Heating and Cooling	Can be feasible on a case-by-case basis	Can work on a case-by-case basis (e.g. Admin HVAC system)	Can require a great deal of space Are generally quieter, last longer, and have lower maintenance requirements than conventional HVAC systems They aren't dependent on the temperature of the outside air, and provide more stable humidity control	Case-by-case basis; Technical guidance indicates potential electricity savings in range of 25 to 50% compared to conventional HVAC systems	Evaluate potential application of geothermal HVAC technology on case-by-case basis as building renovations and new buildings are being planned and designed	Potential for positive perception from some
21	Reduce Throttling/Generate Energy at Head of Water Treatment Plant	New throttle valve: modest investment with modest energy savings at best	Reduction of throttling may not be possible due to the configuration of the Cane Creek raw water transmission main and raw water pump station	If operation gets closer to breakpoint and air is entrained, the water treatment process may be disrupted and that could be costly	Marginal – running pumps at lower levels (not burning as much head as we used to)	Conduct energy modeling (including "burned" energy) as part of the Cane Creek Pump Station Upgrade project Evaluate and consider options when existing flow throttling valve needs major maintenance or needs to be replaced	None
22	In-Pipeline Turbines for Hydropower Generation	Previous studies found no economically feasible opportunities	Technology may be feasible in the future Low and intermittent raw and finished water flows limit feasibility	If matched with end us of electricity, would provide back-up energy supply	Low to modest energy generation and use potential due to limited flows and pressures and lack of nearby end uses for electricity produced by turbines	When existing throttling/sleeve valves are getting replaced and/or when new pressure zone is being considered for low part of service area	None

Energy Strategy		Financially Responsible (High level)	Realistic/ Implementable	Operational Impacts	Energy/Carbon Reduction Potential	Coordinates with Other Projects	Community Impacts
			Energy recovery from distribution system difficult to match with end uses for electricity produced			When expanded Quarry Reservoir is being planned	
23	Reduce Distribution System Head Loss/Velocity	No economically viable solution	Distribution system model does not indicate need for this strategy	No	None	No	None
24	Four-Day Work Weeks	Unlikely based on other studies	Applicable to office settings (not 24/365); may not be responsive to needs of certain customers	Internal equity issues Would complicate scheduling of meetings and interactions with internal staff, project consultants, and others	Energy and cost saving benefits only realized if building is completely shut-down for one weekday	No	Extended office hours (beyond 8:00 – 5:00) could benefit some customers but adversely affect others
25	Wind Power	High cost in our geography and at our scale; likely to be negative payback	No, especially given limited wind potential for Piedmont region	Would require contract operation and maintenance	Minimal	NA	Likely neighborhood concerns
26	Solar Drying for Wastewater Solids	Not for OWASA-owned facility, since solar dryer would have to be located at remote site	Highly unlikely unless solar drying services are offered by another nearby utility at very low cost to OWASA	Solar dryer would have to be located off-site due to space constraints at WWTP Solids loading and unloading process is labor intensive	Reduced energy use and carbon emissions compared to thermal drying	Conflicts with OWASA's existing targets for liquid versus dewatered biosolids management	Odor control

Appendix B: Energy Strategy Summaries

1- LED Lighting Retrofits

BEST PRACTICE / TECHNOLOGY OVERVIEW
Description of Process: The California Energy Commission has reported that lighting accounts for 35 to 45 percent of electrical energy use in office buildings. Advanced lighting technologies, such as light emitting diodes (LEDs), offer substantial energy savings compared to older technologies – such as fluorescent, high-pressure sodium, and metal halide lights – that are still used throughout many of OWASA's facilities. LED lights can use about 75% less energy and last about 25 times longer than incandescent lighting. LED lights are about 30% more efficient and last about 65% longer than T-8 fluorescent lights.
Operational/Implementation Considerations: In addition to reducing electricity use and costs, LEDs can improve lighting quality, reduce maintenance requirements and costs, and reduce heat output from lights. In hard-to-reach applications such as the warehouse and treatment plant basins, use of LEDs can reduce employee safety risks associated with more replacement of older lights that have much shorter useful lives. LED lights are also safer for the environment and employee health, as they do not have the handling and disposal risks associated with fluorescent lights and other bulbs that contain mercury.
POTENTIAL APPLICATION TO OWASA
OWASA has already implemented LED retrofits at several facilities, including the Administration Building (outdoor lighting), Water Treatment Plant, Wastewater Treatment Plant, and University Lake; however, there are many remaining opportunities for LED retrofits and installation of lighting controls at these and other OWASA facilities. A 2016 study by McKim and Creed identified opportunities to improve lighting quality while reducing electricity use in OWASA's Administration Building.
ECONOMIC CONSIDERATIONS
Capital Costs: LED lights are considerably more expensive than other lights. We have received cost estimates for the materials for the OWASA Administration Building (McKim and Creed) and the Water Treatment Plant (NCSU Industrial Assessment Center).

	Admin Building	**WTP**
Equipment	$32,000 (5% above estimated costs)	$31,500 (5% above estimated costs)
Installation (estimated at 50% of material cost)	$16,000	$15,750

Operating Costs: Anticipated savings in maintenance from a decreased need to change light bulbs.

Potential Cost Savings: McKim and Creed estimated that a LED lighting retrofit of the Administration Building would save about 69,500 kWh per year. NCSU estimated that a LED lighting retrofit of the Jones Ferry Water Treatment Plant would save about 126,500 kWh per year. We estimate the total estimated annual electrical energy savings for these two retrofits to be between 117,000 (60% of projected range) and 196,000 kWh.

Financial Analysis: If the life of an LED light bulb is 13 years and a discount rate of 2.11%, the Net Present Value of a LED lighting retrofit that achieved 60% of the projected savings would be **$8,400**. If you incorporate the Social Cost of Carbon at the levels projected by the Federal Interagency Working Group, the Net Present Value of a LED lighting retrofit that achieved 80% of the projected savings would increase to **$28,433**. This does not assume an incentive from Duke Energy, which would increase the value of the project.

CASE STUDIES

Locations: 1. United States Army Reserve 99th Regional Support Command
2. Macon Water Authority (Georgia) http://www.maconwater.org/news/MWA-saving-money-through-lighting-retrofit

Scale: 1. 1,250 lighting troffers and occupancy sensors were installed in three buildings.
2. 750 troffers and sensors were installed in two buildings

Drivers/Funding: 1. Energy conservation goals mandated in President's Executive Order 13693; reduced maintenance requirements for LEDs, which reportedly will need replaced only once every 10 to 14 years.

Results: 1. 51% energy use reduction; $20,200 annual energy cost savings
2. Annual savings ~$35,000 ($24,000 in electricity; $7,250 maintenance; $4,000 HVAC)

RELATED STUDIES / FINDINGS

- McKim and Creed. *Lighting and Lighting Control Assessment – Administration Building*. 2016.
- NCSU Industrial Assessment Center. Energy Conservation Report. 2016.

SUMMARY OF STRATEGY EVALUATION

Each cell of the table below is color-coded to indicate whether a strategy is favorable, neutral, or unfavorable against each criterion.

Financially Responsible (High level)	Realistic/ Implementable	Operational Impacts
Duke Energy incentives currently available Payback well within life of asset	Yes – at a pace that maintenance staff can keep up with	Improved safety and visibility; reduced maintenance requirements
Energy/Carbon Reduction Potential	**Coordinates with Other Projects**	**Community Impacts**
>30% more efficient than most lighting technology Lighting accounts for small amount of overall energy use	Retrofits can be easily coordinated with other building maintenance and upgrade projects	Limited: Better evening visibility; reduced "light pollution"

RECOMMENDED NEXT STEPS / NEEDS

Pursue LED lighting retrofit in Administration Building and WTP, continue lighting retrofits at WWTP, and identify additional opportunities for lighting retrofits

2- Energy Optimization in IT Server Room

BEST PRACTICE / TECHNOLOGY OVERVIEW
Description of Process: The IT server room is an interior room in the lower level of the OWASA Administrative Building that houses 3 virtual servers, 2 phone servers, 3 storage arrays, and 4 test machines. Servers, data storage arrays, networking equipment, and the cooling and power conditioning that support them tend to draw large amounts of energy 24 hours per day, 7 days per week. The server room is cooled by dedicated air conditioning units that are separate from the rest of the building. Primarily, a 5-ton Data Aire (2012) unit cools and dehumidifies the space. The thermostat on the Data Aire is set at 68 degrees Fahrenheit. A 2-ton wall-mounted Fujitsu unit (2003), as well as a 3-ton wall-mounted Fujitsu unit (2010), provide back-up cooling. Their thermostats are set at 74 degrees Fahrenheit. The Lawrence Berkeley National Lab summarized the following fourteen measures to save energy in a server room or closet. A. Simplest, No-Cost or Very-Low-Cost Measures 1. Determine computational functions/Turn off any unused servers 2. Increase temperature set-points to the high end of ASHRAE's recommended limit 3. Examine power backup requirements 4. Airflow management: Install blanking panels and block holes between servers in racks B. A Little More Work but Still Fairly Simple 5. Replace the oldest equipment with high-efficiency models 6. Move to a more energy-efficient internal or external data center space, or to cloud solutions 7. Energy-efficiency awareness training for IT custodial and facility staff C. Higher Investment, But Very Cost-Effective 8. Implement server power management 9. Consolidate and virtualize applications 10. Implement rack/infrastructure power monitoring 11. Install variable frequency drives on cooling units 12. Install rack- and row-level cooling 13. Use air-side economizers 14. Install dedicated cooling for the room, rather than depending on building cooling
Operational/Implementation Considerations: 1. The Data Aire cooling system also regulates humidity. Any changes to thermostat settings may require additional adjustments to the fan speed to ensure the proper humidity range is maintained. 2. The general trends of hardware consolidation and cloud computing are reducing our thermal footprint. Thus, our cooling needs will likely decrease over time which may require the cooling system to be downsized. An oversized cooling system can cause as many environmental problems as an undersized one.

POTENTIAL APPLICATION TO OWASA

OWASA already employs some of the recommended best management practices, including:
#3. The generators at the Jones Ferry Road Water Treatment Plant provide power back-up.
#6. IT Staff strive to move to cloud solutions when they make sense. Recently, IT staff have moved the email and Sharepoint servers to the cloud.
#9. We have maximized our use of servers (i.e. consolidated and virtualized)
#14. We have dedicated cooling for the room, rather than depending on building cooling.

Low-to-No Cost Opportunities
There are opportunities to optimize energy use at low-to-no cost.
#2. The thermostats are cautiously set to provide a time buffer if the Data Aire unit goes down. IT Staff believes that there is opportunity to reduce this buffer to reduce energy use without compromising the servers.
#4. There is also an opportunity to improve airflow within the server room. This could include ensuring optimal hardware spacing and placement of blanking panels in racks.

ECONOMIC CONSIDERATIONS

Capital Costs: Not Applicable

Operating Costs: To be determined

Potential Cost Savings: Increasing the cooling set point from 68 degrees to 74 degrees would save over 8,000 kWh per year (about $622/year). We estimate the annual electrical energy use savings to be between 5,000 (60% of projected savings) and 8,000 kWh.

RELATED STUDIES / FINDINGS

- Energy Efficiency in Small Server Rooms
- Fact Sheet: Improving Energy Efficiency for Server Rooms and Closets
- Advanced Energy HVAC Assessment. 2017.

SUMMARY OF STRATEGY EVALUATION

Each cell of the table below is color-coded to indicate whether a strategy is favorable, neutral, or unfavorable against each criterion.

Financially Responsible (High level)	Realistic/ Implementable	Operational Impacts
Operational changes require no investment	Yes	Must ensure proper humidity levels in IT server room; will require an incremental approach
Energy/Carbon Reduction Potential	**Coordinates with Other Projects**	**Community Impacts**
Very modest energy savings	No	None

RECOMMENDED NEXT STEPS

1. Turn off physical test servers when not in-use
2. Incrementally increase temperature on thermostat and monitor impact on room humidity

3- Shift Water Plant Filter Backwash Pumping to Off-Peak Periods

BEST PRACTICE / TECHNOLOGY OVERVIEW
Description of Process: When operational flexibility allows, water and wastewater utilities should schedule certain plant and equipment operations for the time of day when electric usage rates and demand charges are lowest. Although such strategies would not reduce the total amount of electricity required for the process or equipment, they may provide energy cost savings for the water utility, thereby freeing up funds to meet other operating, maintenance, and capital needs. The drinking water treatment process involves passing water through a multi-media filter to remove very small particles. Over time, filters clog up and they must be cleaned periodically to restore treatment performance and hydraulic capacity. Filters are cleaned by using pumps to "backwash" drinking water in reverse through the filter. Compressed air is used in the process. The backwash process "wastewater" is removed and usually either treated and recycled at the water plant, or discharged to the wastewater collection system. The backwash cycle is usually triggered after a set time interval, when the filter effluent turbidity is greater than a treatment guideline, or when the differential pressure (head loss) across the filter exceeds a set value. Depending on treatment plant flow rates, water quality and filter conditions, and applicable electric utility rates, it may be possible for some water utilities to save money by conducting their water treatment plant filter backwashing process during the off-peak rate period.
Operational/Implementation Considerations: Filter backwashing is essential to the provision of safe and aesthetically pleasing drinking water to our customers. Reduced filter performance can cause taste and odor problems, reduce the hydraulic treatment capacity of the filters, and result in failure to meet drinking water regulations and/or internal organizational standards, such as those established under the Partnership for Safe Water. Water plant operators may not have the ability to consistently operate the filter backwash process during off-peak rate periods. In such situations, the energy cost savings may be very minimal. Under the current rate structure charged by Duke Energy, on-peak times are: • Summer Months (June 1 – September 30): 1pm-9pm (Monday-Friday) • Winter Months (October 1 – May 31): 6am-1pm (Monday – Friday)
POTENTIAL APPLICATION TO OWASA
Filter backwashing at OWASA's Jones Ferry Road Water Treatment Plant (WTP) is accomplished via a 250-horsepower (hp), constant speed pump originally installed in the late-1940s. The soft-start motor was most recently renovated around 2007. There are two constant speed 60-horsepower air scour blowers that can each provide 1,600 cubic feet per minute (cfm) of air for filter backwashing. A blower is turned on for about five minutes to air scour the filter just before the backwash is turned on. The pump draws water from a basin beneath the pump on the first floor, then pumps it up and through the dual-media filter. Water plant operators control the valves to designate which filter is washed.

The backwash pump typically runs once or twice a day, as needed, and operates for several minutes each time. It is estimated that the pump runs only about 1.4% of the time, which equates to about 120 hours a year at current flow conditions.

A recent pump evaluation by the North Carolina State University Industrial Assessment Center showed that the pump operates with maximum power initially, then the power draw gradually drops through the backwash cycle. Flow is high initially, then drops to an intermediate level for the rest of the cycle.

For a typical backwash cycle, the pump uses about 15 to 30 kWh.

Pump test results indicate the majority of the backwash pump power measurements are in the 110 to 120 kW range (about 150 to 160 hp) and the pump's operating efficiency is low – typically between 50% and 60%.

A new backwash pump could be installed to improve the pumping efficiency to between 80% and 90%; however, the energy and cost savings would likely be very small due to the limited hours of operation. Assuming a 30% net increase in efficiency, the energy savings would total only about 4,200 kWh a year and the cost savings would be about $325 a year (assuming the average cost of electricity including kWh and kW charges).

Another opportunity to achieve energy cost savings would be to conduct the filter backwash process during off-peak demand periods when electricity and demand charges are much lower than during the peak period.

The estimated total annual energy use for the backwash pump is about 14,000 kWh. Excluding consideration of the energy used by the air scour blowers, and not factoring in power demand charges, if it is assumed that all of the backwash pump energy use occurred during the on-peak period, but is shifted to the off-peak period, the savings per kWh shifted would be slightly less than $0.03, and the annual savings would only be about $400. Factoring in the concurrent use of the air scour blower, the savings would be even greater.

If it is assumed that the backwash pump process only requires about 110 kW and that demand coincides with the monthly peak demand of the WTP, shifting the process to the off-peak demand period would not provide any noticeable savings in peak demand charges, since OWASA would continue to be charged for 500 kW of on-peak demand, which is 50% of the existing 1,000 kW monthly Contract Demand for the WTP.

If implementation of the backwash process run-time change enabled OWASA to reduce the Contract Demand level at the WTP, the annual cost savings could be substantial. For example, a shift to a Contract demand of 700 kW would lower the minimum monthly billing demand to 350 kW. If this was accompanied by a monthly peak demand reduction of 110 kW, annual energy costs could drop by about $14,000. However, if operating constraints prevent the backwash process from being consistently run during the off-peak period, the annual savings would drop to about $2,000.

In 2016, on-peak demand ranged between 432 and 512 kW.

One disadvantage of reducing the contract demand would be that OWASA would potentially be giving up 300 kW of power allocation assurance from Duke Energy. If we chose to retain the 1,000-kW assurance, we would be required to pay a monthly extra facilities fee to Duke Energy. If OWASA chose to accept the reduced assurance, but then needed larger power capacity in the future, we would be required to pay for the increased capacity at the rates then in effect. Another disadvantage is that if peak demand exceeded the new 700 kW contract demand level (due to high water demands or other factors), Duke Energy could ratchet up the contract demand to a higher amount, thereby increasing the monthly minimum demand charge.

ECONOMIC CONSIDERATIONS

Capital Costs: There are no direct capital costs to implement this strategy.

Operating Costs: To be determined

Potential Cost Savings: It does have the potential to reduce peak demands by about 100 kW (up to $824/month), as well as on-peak energy use (which costs twice as much as off-peak) (about $13-$26/month). (This does not include the concurrent savings in blower operations.)

Potential Energy Savings: Changing filter backwash pumping to the off-peak period does not reduce the total amount of electricity used for the backwash process.

RELATED STUDIES / FINDINGS

- *Energy Conservation/Management Assessment Assistance Report*. North Carolina State Industrial Assessment Center (NCSU IAC). 2016.
- *Duke Energy OPT-V rate schedule* (Effective January 1, 2016)

SUMMARY OF STRATEGY EVALUATION

Each cell of the table below is color-coded to indicate whether a strategy is favorable, neutral, or unfavorable against each criterion.

Financially Responsible (High level)	Realistic/ Implementable	Operational Impacts
No capital investment required; could save money	Yes	Not expected: In winter and summer, there are times during the working day that are considered “off-peak”
Energy/Carbon Reduction Potential	**Coordinates with Other Projects**	**Community Impacts**
Demand savings, but no energy savings	No	None

RECOMMENDED NEXT STEPS

Develop a strategy to backwash filters in off-peak times, track demands, and negotiate lower contract demand with Duke Energy to realize cost savings.

4- Pump and Motor Asset Management Program

BEST PRACTICE / TECHNOLOGY OVERVIEW

Description of Process: Pumping systems – which include the pump, motor, pipes, valves and fittings, and end use components) are essential to water, wastewater, and reclaimed water treatment and service delivery, and account for most electrical energy used by the water sector. By optimizing the design, installation, operation, maintenance, repair, and replacement of pump systems, organizations will not only save energy – they will better ensure worker safety while meeting customer needs in a more reliable and cost-effective manner.

Pump system optimization is defined as:

> *The process of identifying, understanding and cost effectively eliminating unnecessary losses while reducing energy consumption and improving reliability in a pumping system, which while meeting process requirements, minimizes the cost of ownership over the economic life of the pumping system.*

Pump system optimization looks at how the whole system functions together, and how changing one or more parts can improve the performance of the entire system. An optimization program includes best practices for:

1. pump system design and equipment selection;
2. installation and commissioning;
3. flow control;
4. operation;
5. maintenance;
6. stocking the right parts;
7. ensuring motor efficiency;
8. tracking lifecycle history;
9. establishing a pump management program; and
10. procedures for maintaining required information, monitoring and documenting changes, and providing staff with the training needed to ensure safe and efficient operation of the pumping systems.

Operational/Implementation Considerations: As a general guide, pumps should not operate at flow more than 10 to 15 percent outside of their Best Efficiency Point (BEP). If a pump system is not well-designed or not properly operated or maintained, it will operate below its BEP. When that occurs, it can lead to surge and vibration, potential bearing and shaft seal problems, heat, noise, and cavitation. These problems can damage pump system components, increase maintenance and energy costs, and ultimately lead to pump failure.

A common design practice has been to oversize pumps to ensure that there is more than enough pumping power for the application rather than not enough, and to control excessive flows coming out of the pump by throttling it back on the discharge side or recirculating it. This approach is an inefficient and costly way to design a system, as It increases energy costs for operating the pumping system, reduces the operating life of the equipment, and likely increases the frequency of failure.

POTENTIAL APPLICATION TO OWASA

Much of the electricity OWASA uses is for running pumps and motors; therefore, optimization of pump and motor operations, maintenance, and repair and replacement decisions has a significant potential to reduce energy use at OWASA. OWASA's asset management program includes more than 350 motors and 350 pumps, with the largest being the 700 horsepower pumps at the Cane Creek Reservoir raw water pump station.

General tasks for implementing an optimization program include:

1. screen and prioritize pumping systems to identify best performance improvement opportunities;
2. gather and analyze additional data (using in-house team and/or pump system specialist);
3. identify economically viable performance improvement opportunities;
4. implement improvements;
5. document and report on results;
6. celebrate successes; and
7. repeat the process.

ECONOMIC CONSIDERATIONS

Oftentimes, pump system selection decisions are made based on the initial purchase price rather than the total lifecycle cost (LCC) of the system. The table below shows the typical breakout of the lifecycle costs of a pump.

Purchase price	9%
Installation and commissioning cost	8%
Maintenance cost	28%
Operating cost	55%

Capital Costs: To be determined

Operating Costs: Estimated $12,000 for a consultant to assist with pump and motor evaluation

Potential Cost Savings: To be determined

Potential Energy Savings: To be determined

Following are some general rules-of-thumb regarding potential energy savings from some pump optimization strategies:

- variable frequency drives (VFDs) can reduce energy use by 10 to 50% and may have a payback of 1-8 years;
- by eliminating pump discharge throttling, energy use may be reduced by as much as 50%;
- savings from implementing a motor maintenance plan can range from 2 to 30 percent of total motor system energy use (EPRI 1996 and FOE 2006).

CASE STUDIES

Locations: Fairfax Water implemented a water treatment and distribution system energy management program which includes the use of power logic systems to optimize energy use, document large pump operations, and identify disturbances and causes of failures.

Results: Energy use at the Corbalis and Griffith drinking water plants was reduced by 13.3% and 9.4%, respectively from 2012 to 2014.

RELATED STUDIES / FINDINGS

Technical References

- Consortium for Energy Efficiency, Inc. and Pacific Gas and Electric Company. *Motor Efficiency, Selection and Management – A Guidebook for Industrial Efficiency Programs*. 2011
- De Almeida, Anibal T. and Fong, Joao. Institute for Industrial Productivity. Washington, DC. August 2011. www.iipnetwork.org

- US Department of Energy - Motor Decisions Matter http://www.motorsmatter.org/index.asp
- US Department of Energy – Pumping System Assessment Tool http://www.energy.gov/eere/amo/articles/pumping-system-assessment-tool
- Water Research Foundation and Global Water Research Coalition. *Energy Efficiency in the Water Industry: A Compendium of Best Practices and Case Studies – Global Report*. 2010.
- Water Research Foundation and New York State Energy Research and Development Authority. *Energy Efficiency Best Practices for North American Drinking Water Utilities*. 2011.

OWASA Studies

- Hazen and Sawyer. *Draft Technical Memorandum: Cane Creek Raw Water Transmission Facility Improvements*. February 1, 2002.
- Hazen and Sawyer. *Technical Memorandum: Cane Creek Field Tests and Booster Pump Alternatives*. August 30, 2002.
- HDR. Cane Creek and University Lake Raw Water Pump Stations Energy Audits. April 2002.

SUMMARY OF STRATEGY EVALUATION

Each cell of the table below is color-coded to indicate whether a strategy is favorable, neutral, or unfavorable against each criterion.

Financially Responsible (High level)	Realistic/ Implementable	Operational Impacts
Early payback expected based on experience of others	Yes, but is technically involved and includes multifaceted effort	Could help identify pumps and motors that need to be replaced before they fail Will help inform performance-based maintenance program
Energy/Carbon Reduction Potential	**Coordinates with Other Projects**	**Community Impacts**
Significant potential: pumps and motors account for the largest energy use at OWASA	Yes – Asset Management Program	None

RECOMMENDED NEXT STEPS / NEEDS

Focus on pumps and motors during In Plant Training

Audit the efficiency of the current fleet of motors at OWASA

Develop specifications for all motor replacements to include Premium, high -efficiency motors

5 and 7- Organization-wide HVAC Systems Assessment

BEST PRACTICE / TECHNOLOGY OVERVIEW

Description of Process: Heating, ventilation, and air conditioning (HVAC) is required for user comfort and equipment operations and protection. In many cases, HVAC improvements can be completed relatively easily without impacting operations. Retrofitting with new HVAC technologies and implementing effective system controls (such as occupancy sensors and schedules) have the potential to:

- Notably reduce electricity and natural gas use;
- Increase performance of HVAC systems;
- Maximize and protect the health, satisfaction, and productivity of building occupants, and
- Incorporate the use of renewable energy technology in meeting HVAC requirements.

Air conditioning systems include roof top units, heat pumps, and chilled water systems. Energy efficiency of HVAC systems can be achieved by incorporating improved compressors, high-efficiency motors, better insulation, and improved system controls. New high-efficiency HVAC systems can reduce energy use by 20 to 40 percent as compared to conventional systems from 10 to 20 years ago, adding operational controls, such as timers and electronic time clocks that can stop equipment operation or change temperature at scheduled times, can reduce energy consumption by up to 20 percent (California Energy Commission). Many of the operational controls can be automated with computerized systems that adjust operation by considering the weather and building-use patterns. Additionally, proper duct work installation and sealing can provide up to 11 percent reduction in energy use and optimizing performance of existing systems can provide up to 20 percent reduction.

The ventilation system is vital to ensure overall HVAC system efficiency. Ventilation systems either supply or remove air from a space by natural or mechanical means. Facilities consume large amounts of energy by heating, cooling, and blowing outside air for ventilation and temperature control. Potential energy saving measures can include installing outside air economizers that automatically control air flow; for manual dampers, reducing energy use by setting air flow to match ventilation needs; and installing variable-speed drives on exhaust fans and hoods.

Operational/Implementation Considerations: When evaluating an existing HVAC system for proper size and optimization, a water utility must understand the current and future potential load demand. It is recommended that an outside HVAC expert be hired to assist in understanding the load demand and selection of equipment for the various water facility buildings. As with any equipment, establishing a routine maintenance program will assist in preventing energy loss, help control maintenance costs, and extend the life of the equipment.

POTENTIAL APPLICATION TO OWASA

OWASA requested assistance from Advanced Energy in identifying opportunities to:

a) reduce energy use;
b) increase performance of heating, ventilation, and air conditioning (HVAC) systems;
c) verify and refine asset inventory and provide condition assessment;
d) maximize and protect the health, satisfaction, and productivity of building occupants; and

e) incorporate the use of renewable energy technology in meeting HVAC requirements.

Advanced Energy audited the HVAC systems at the WTP, the WWTP, and the Operations Center. Their audit did not include the HVAC system of the Admin building because that system is planned to be replaced soon.

Advanced Energy's recommendation for areas where we can reduce our use energy for heating, ventilation, and air conditioning are summarized in the following table

Energy Conservation Measure	Estimated Annual Electrical Energy Use Reduction (kwh)	Estimated Annual Natural Gas Use Reduction (therms)	Estimated net installed costs	Simple payback without incorporating social cost of carbon (SCC)	Simple payback with incorporating SCC
1. Adjust operational set point temperatures	82,100	3,910	$0	Immediate	Immediate
2. Adjust unoccupied set point temperatures	29,500	4,900	$8,320	1.9	1.3
3. Install EC Motors	5,700	0	$1,910	5.9	4.7
4. Install DCV Controls	19,100	3,590	$1,960	0.6	0.4
ECM 1- 4: Operational Changes and Minor Controls	**77,000 (60% of projected savings) - 128,000**	**7,000 (60% of projected savings) - 12,400**	**$12,000**		
5. Adjust Exhaust Fan Controls	3,907	5,118	$7,500	2.3	1.8
6. Replace HVAC Equipment*	157,670	5,315	$25,525	<2.0	<2.0
ECM 5-6: Equipment Replacement	**97,000 (60% of projected savings) – 162,000**	**6,950 (60% of projected savings) – 11,584**	**$33,625**		

*Only incorporated replacement of HAC equipment that is within 3 years of end of life or which had an individual payback period of less than 2 years.

ECONOMIC CONSIDERATIONS

Initial up-front costs:

Operational Changes and Minor Controls: Operating Budget: $12,000
Capital Replacement and Investment: TBD, Advanced Energy estimates $33,625

Operating Costs: Should represent similar operating costs in maintaining equipment

Potential Cost Savings: Reduced energy costs

Operational Changes and Minor Controls: Operating Budget: >$15,000/year
Capital Replacement and Investment: TBD

RELATED STUDIES / FINDINGS

- NC DEQ Fact Sheet on Energy Efficiency in Industrial HVAC Systems

SUMMARY OF STRATEGY EVALUATION: OPERATIONAL CHANGES AND MINOR CONTROLS

Each cell of the table below is color-coded to indicate whether a strategy is favorable, neutral, or unfavorable against each criterion.

Financially Responsible (High level)	Realistic/ Implementable	Operational Impacts
Minor upfront costs Quick payback expected	Yes	Improved occupant comfort and health
Energy/Carbon Reduction Potential	**Coordinates with Other Projects**	**Community Impacts**
Energy and natural gas savings potential: modest	No	Limited – improved visitor comfort

SUMMARY OF STRATEGY EVALUATION: CAPITAL INVESTMENT

Each cell of the table below is color-coded to indicate whether a strategy is favorable, neutral, or unfavorable against each criterion.

Financially Responsible (High level)	Realistic/ Implementable	Operational Impacts
Higher capital expense; early payback expected	Yes	Improved occupant comfort and health
Energy/Carbon Reduction Potential	**Coordinates with Other Projects**	**Community Impacts**
Energy and natural gas savings potential	No	Limited – improved visitor comfort

RECOMMENDED NEXT STEPS / NEEDS

Proceed with operational changes and minor controls recommended by Advanced Energy

Further evaluate the capital replacements and investment recommended by Advanced Energy

6- Finished Water Pumping Optimization

BEST PRACTICE / TECHNOLOGY OVERVIEW
Description of Process: Improving energy efficiency of pumping systems does not necessarily involve replacing pumps or installing VFDs. In many cases, pump modifications or operational adjustments can shift pump operation to a more efficient range and time of day when the cost of electricity is lower. Pump scheduling can help optimize energy used to distribute drinking water, as well as to reduce the cost to pump finished water. Furthermore, keeping tanks at lower levels can reduce the amount of energy required to pump finished water because there is less head to overcome. Keeping water levels in the clearwell as high as is practical could reduce energy use.
Operational/Implementation Considerations: Running tanks at lower levels has water quality benefits, as it can help increase the turnover in tanks. At minimum, we want to completely replace (i.e. turnover) all the water in a tank every five days: a goal that we have met with some degree of regularity. We have set an internal goal of every four days. We currently have a study underway to determine the lowest levels possible in which these tanks can operate while still ensuring adequate service to customers and fire protection. We must balance water quality and energy efficiency with water quantity requirements. Per North Carolina's Rules Governing Public Water Systems 15A: 18C. 0805 "(b) The elevated storage for a municipality shall be sufficient to minimize the effect of fluctuating demand plus provide a reserve for fire protection, but not be less than 75,000 gallons in capacity. (c) The combined elevated and ground storage of the finished water for the community and non-transient, non-community water systems shall be a minimum of one-half day's supply of the average annual daily demand." We must also consider having enough water supply in storage to maintain flow and pressure in the event of a major line break or water treatment plant outage. Additionally, it is important to leave some room for storage in the clearwell, so that the water treatment process can run efficiently without overflow.

POTENTIAL APPLICATION TO OWASA

OWASA utilizes four elevated storage tanks (Nunn Mountain, Carrboro, Manning, and Hilltop) and one ground storage tank (Nunn Mountain). These tanks provide a combined storage capacity of 6.5 million gallons, and the clearwell stores an additional 1.5 million gallons (located at the WTP). Unless there is an extenuating circumstance, our standard operating procedure is to fill these tanks in off-peak hours to avoid on-peak demand charges and energy use rates.

There are four finished water pumps:

	Pump #4	Pump #5	Pump #6	Pump #7
Manufacturer	Ingersoll-Dresser	Layne & Bowler	Fairbanks Morse	Fairbanks Morse
Type	Vertical Turbine	Vertical Turbine	Vertical Turbine	Horizontal Split Case
Pump Speed	Variable	Constant	Variable	Variable
Capacity	6,400 gpm	5,600 gpm	12,000 gpm	4,166 gpm
TDH, feet	250	240	255	220
Motor				
Manufacturer	US Electric Motors	US Electric Motors	US Electric Motors	US Electric Motors
Horsepower	500	450	600	300
Speed	1,185 rpm	1,180 rpm	1,200 rpm	1,750 rpm
Power Supply (V-Hz-Phase)	460-60-3	2,300-60-3	460-60-3	460-60-3

Typically, water plant operators choose a pump and use it consistently to meet demands. Pump #5 is rarely, if ever used. There is an opportunity to develop a schedule to better match pump selection and output to demands. Pump curves overlap one another.

We estimate that finished water pumping at OWASA uses about 2.5 million kilowatt-hours each year (about 70% of the energy used at the Jones Ferry Road Water Treatment Plant).

ECONOMIC CONSIDERATIONS

Capital Costs: NA

Operating Costs: To be determined, but likely nominal

Potential Cost Savings: A 0.5-2% reduction in energy used by finished water pumps would save about 12,500-50,000 kwh annually.

RELATED STUDIES / FINDINGS

- OWASA Hydraulic Model conducted by AECOM (2010)

SUMMARY OF STRATEGY EVALUATION

Each cell of the table below is color-coded to indicate whether a strategy is favorable, neutral, or unfavorable against each criterion.

Financially Responsible (High level)	Realistic/ Implementable	Operational Impacts
No cost for study expected	Yes	Use of the right pump for the right flow condition can reduce pump wear and tear Better control of pump start/stop operations Will be important to avoid large flow changes in the plant
Energy/Carbon Reduction Potential	**Coordinates with Other Projects**	**Community Impacts**
Potential to reduce a modest portion of the energy used for finished water pumping	Finished Water Pump Rehabilitation and Replacement (CIP No 272-42) – anticipated to be completed in FY22 (not worth waiting)	None

RECOMMENDED NEXT STEPS/NEEDS

Develop a schedule to match pump curves for each of the finished water pump against system demand to ensure that we are utilizing the most efficient pump for the system demand (This schedule will be developed as an educational case study for NCSU Industrial Assessment Center (IAC) engineering students. The NCSU IAC will fund the development of this schedule.)

Incorporate energy monitor into evaluation of finished water pumping (Energy monitors will be installed soon)

Pursue recommendations to keep tanks at lower level for water quality and energy benefits, if this can be done without adversely affecting service to our customers (We have begun this already.)

8- Optimize WWTP Filter Backwash

BEST PRACTICE / TECHNOLOGY OVERVIEW
Description of Process: We have six denitrification filters at the Mason Farm Wastewater Treatment Plant that require backwashing to remove solids loading. We use two 50-horsepower pumps (installed in 2005) to backwash the filters, but only one runs at a time. We also use two air blowers (at 100 and 150 hp each).
Operational/Implementation Considerations: Currently, we operate all 6 filter beds and backwash each filter twice per week. Reducing the number of filters that we use would not be practical. We need six filters during high-flow events, and they take time to bring up to operation. There could be energy savings in reducing the number of backwashes. We currently run the backwash pumps in off-peak times, so there would be minimal demand savings, but there could be energy savings. This strategy will not be applicable when we must start running the filters in denitrification mode, which will be required when Jordan Lake Rules go into effect (currently scheduled to go into effect in 2024).
POTENTIAL APPLICATION TO OWASA
The primary reason for running backwashes is to remove suspended solids. Backwashes are run based on time, not on solid concentration. With data from head loss meters, we could identify a strategy to reduce backwashes by up to half (i.e. one filter per day instead of two). If the backwash filter pumps use about 1% of the energy consumed at the Mason Farm Wastewater Treatment Plant, a 25-50% reduction in energy use would equate to about 20,000 - 40,000 kWh of savings per year.
ECONOMIC CONSIDERATIONS
Up-front costs: Cost of head loss meters (about $5,000)
Operating Costs: To be determined
Potential Cost Savings: To be determined

SUMMARY OF STRATEGY EVALUATION

Each cell of the table below is color-coded to indicate whether a strategy is favorable, neutral, or unfavorable against each criterion.

Financially Responsible (High level)	Realistic/ Implementable	Operational Impacts
Modest cost for monitoring and control system	Potentially	Increased effort for monitoring
Energy/Carbon Reduction Potential	**Coordinates with Other Projects**	**Community Impacts**
Could provide 50% reduction in energy use for backwashing denitrification filters Modest energy savings	Strategy will be irrelevant when we must run the filters in denitrification mode (anticipated to begin around 2024)	None

RECOMMENDED NEXT STEPS / NEEDS

Test and evaluate marginal reduction in filter backwash frequency

Track the energy use impact of the marginal changes, as well as the impact on water quality

Potentially install an ultrasonic or secondary float system to optimize filter backwash frequency

9- Development of a System-wide Energy Model

BEST PRACTICE / TECHNOLOGY OVERVIEW

Description of Process: Water and wastewater utilities use a lot of energy to pump and treat raw water, deliver clean drinking water, and collect and treat wastewater. Managing that energy use requires a good understanding of how the different parts of the system are inter-related, and how the performance of one component may affect the overall performance of the system. However, as a utility system grows larger and more complex, it becomes more difficult for managers and operators to understand and optimize the performance of the system against multiple objectives, such as maintaining high quality drinking water and adequate flow and pressure while reducing energy use and costs.

To address this challenge, utilities are relying more and more on computer system modeling to guide system operations, evaluate the need for future improvements to meet projected demands, and inform energy management efforts. Models can simulate very large networks, incorporate vast amounts of operating data, and quickly simulate a wide range of scenarios, including alternative strategies for reducing energy use and costs while maintaining desired levels of service. Integrated dynamic monitoring and modeling systems are now being used by some utilities for real-time optimization of flow and pressure, water quality, energy use, etc. in water systems.

By developing a model that estimates baseline "unavoidable" minimum energy use that reflects customer demands, local topography, system layout, and other factors, and comparing that estimate to its actual performance, a utility can begin to assess the degree of system energy losses, and more fully realize opportunities for improved energy management.

Such an effort does not directly save energy, but it is essential for improving utility operations and future energy efficiency investment decisions.

Operational/Implementation Considerations: Water distribution system hydraulic models can be adapted to develop estimates of the baseline minimum energy use level for water utilities; however, due to the complex nature of wastewater treatment and disposal, it is more difficult to develop energy models for the wastewater system.

Implementation of a decision support system could provide operators with real-time visualization of system operations and efficiency, and guidance about how best to operate the system to meet level-of-service objectives at the lowest cost. Such systems require installation and maintenance of a large number of real-time monitors.

Energy management must be balanced against other essential operating objectives, such as maintaining distribution system water quality, flow and pressure.

POTENTIAL APPLICATION TO OWASA

OWASA does not have models of system-wide energy use. Development of a baseline minimum energy level for the water supply and drinking water distribution system would enable OWASA to quantify the gap between actual energy use and the minimum baseline, and to identify and pursue the most cost-effective opportunities for reducing energy use across this functional area.

It may be possible to incorporate energy use and management into the water system hydraulic model developed for OWASA by AECOM. However, the usefulness of such an energy model may be limited due to the lack of detailed monitoring data available for development, calibration, and verification of the model.

This model will help inform the potential for OWASA to pursue additional energy savings beyond the achievement of currently set goals and objectives.

ECONOMIC CONSIDERATIONS

Capital Costs: To be determined

Operating Costs: To be determined

Potential Cost Savings: To be determined

Potential Energy Savings: To be determined

CASE STUDIES

Location: A water system energy model and associated decision support system were developed for **Severn Trent Water's Melbourne Area Network** in Australia.

Scale: The Melbourne Area Network includes 2 water supply reservoirs and a river withdrawal; one water plant; and 7 water pumping stations.

Results: The modeling system enabled Severn Trent to achieve a 9% of energy savings with no capital investment required, and an additional 4.5% reduction in energy costs with a 1.5-year payback. The study concluded that energy cost savings of 19% could be achieved If the system was upgraded to best practices. The study and modeling system have changed the way the network is operated.

RELATED STUDIES / FINDINGS

- *Severn Trent Water Melbourne real time pump and turbine network optimization*. Tom Clifford. April 2016.
- Energy Efficiency Optimization in Water Distribution Systems. A. Bolognesi et. al. Science Direct. 2013. http://www.sciencedirect.com/science/article/pii/S187770581400023X

SUMMARY OF STRATEGY EVALUATION

Each cell of the table below is color-coded to indicate whether a strategy is favorable, neutral, or unfavorable against each criterion.

Financially Responsible (High level)	Realistic/ Implementable	Operational Impacts
Likely a high-cost study	Potentially	Would provide a theoretical baseline for future decision-making
Energy/Carbon Reduction Potential	**Coordinates with Other Projects**	**Community Impacts**
No direct energy savings, but helpful for setting realistic goals	Yes – would provide a benchmark for all our processes	None

RECOMMENDED NEXT STEPS/NEEDS

Identify and work with an energy expert to calculate a theoretical energy model for OWASA's operations

10- Power System Optimization

BEST PRACTICE / TECHNOLOGY OVERVIEW

Description of Process: Water and wastewater utilities that operate at voltages higher than required for optimum operation of electronic equipment may be able to save energy through voltage optimization, which is the systematic controlled reduction of voltage to reduce energy use, power demand and reactive power demand.

When voltage is supplied at a level greater than that at which equipment is designed to operate most effectively, it causes excess power demand and energy use, and can significantly increase wear on, and shorten the useful life of, equipment.

Voltage optimization (VO) systems include devices that provide a fixed voltage adjustment, or ones that automatically regulate the voltage. The devices are usually installed in series with the main electrical supply to a building. The device is essentially a transformer that delivers power at a reduced voltage from the electric utility grid. It can improve power quality by balancing phase voltages, filtering harmonics, and reducing voltage spikes from the supply.

According to the U.S. Department of Energy, each percent reduction in voltage reduces energy use (kWh) by 0.8% and power demand (kW) by 0.6%. Each one volt increase raises the operating temperature of most appliances by 0.5°C, and each 1% of voltage imbalance increases three-phase motor winding temperature by 10°C. A 10°C increase in operating temperature can reduce the useful life of electrical equipment by roughly 50%.

According to Legrand Power, the use of VO in recent years has resulted in average energy savings of around 13%, and has made this one of the fastest-growing energy saving strategies. Hilton Hotels, Ikea, and many other companies and agencies have implemented voltage optimization to achieve energy savings.

Operational/Implementation Considerations: Proper selection of VO systems is important for ensuring that the energy savings from using the correct voltage are not offset by the energy required by the device. Also, the VO system must ensure that the voltages supplied do not fall below the levels required to maintain essential equipment and functions.

VO systems may not offer as much energy savings for new facilities that have little or no incandescent lighting, partly high-frequency fluorescent lighting (no saving), some variable speed drives (no saving), and higher motor efficiencies (less waste to save).

The design of the facility's electrical system, size of the electrical load, and the facility's peak load will be important factors that determine the feasibility, cost-effectiveness and energy savings of a VO system.

POTENTIAL APPLICATION TO OWASA

OWASA could benefit from a study of the feasibility and benefits and costs of implementing voltage optimization systems at its major facilities, such as the water and wastewater treatment plants, raw water pump station stations, large wastewater pump stations, and the Administration Building and Operations Center.

An expert consultant could provide recommendations regarding the potential application of VO systems to our various facilities, the correct sizing of the systems, and recommended priorities.

ECONOMIC CONSIDERATIONS

Capital Costs: To be determined

Operating Costs: To be determined

Potential Cost Savings: To be determined

Potential Energy Savings: To be determined.

CASE STUDIES

Location: **Plum Creek Timber Company's Fiberboard facility** in Columbia Falls, Montana and **Accor Novotel/Ibis Hotels** in Sydney, Australia

Scale: The Plum Creek plant has very large (10,000+ hp) synchronous motors, which are each directly connected to one of three 13.8 kV feeders from the electric distribution substation and many other motors for rolling, pressing, etc. The company installed a real-time voltage control system, which provides plant engineers and local electric utility operators full visibility and control of the system.

The Accor Novotel/Ibis Hotels project included installation of voltage optimization systems at two hotels at a cost of $185,000 ($65,000 was for fire-proofing).

Drivers/Funding: Plum Creek received a $337,000 incentive from the electric utility cooperative.

Results: Plum Creek achieved a demand savings of 3.72%. Accor Novotel/Ibis Hotels achieved a 6% - 7% energy use reduction across the two hotels.

RELATED STUDIES / FINDINGS

- *Saving Megawatts With Voltage Optimization*. Utilidata. 2015.
- *Accor Novotel/Ibis Hotels: voltage optimisation pioneers*. New South Wales Government - Office of Environment & Heritage. January 2017.
- *Voltage and Power Optimization Saves Energy and Reduces Peak Power.* US Department of Energy.
- *Voltage Optimization*. ExplainThatStuff. http://www.explainthatstuff.com/voltage-optimisation.html

Legrand Power. http://legendpower.com/product-info/terms-and-faq/faq-voltage-optimization/

SUMMARY OF STRATEGY EVALUATION

Each cell of the table below is color-coded to indicate whether a strategy is favorable, neutral, or unfavorable against each criterion.

Financially Responsible (High level)	Realistic/ Implementable	Operational Impacts
Modest cost of study could identify cost of upgrade	Involved study; strategy may have limited benefits to OWASA	Reduction in power quality could negatively impact VFDs and other equipment
Energy/Carbon Reduction Potential	**Coordinates with Other Projects**	**Community Impacts**
Anticipated limited savings opportunities at plants	Could be coordinated with ongoing electrical system configuration study at WWTP	None

RECOMMENDED NEXT STEPS/NEEDS

Implement study of the feasibility and benefits and costs of implementing voltage optimization systems at its major facilities, such as the water and wastewater treatment plants, raw water pump stations, large wastewater pump stations, and the Administration Building and Operations Center.

11- Real-Time Nitrification Control System

BEST PRACTICE / TECHNOLOGY OVERVIEW
Description of Process: Aeration and mixing in the biological treatment process typically accounts for more than half of the energy used in most wastewater treatment plants. By optimizing the biological treatment process and aeration system, wastewater treatment utilities can save energy and chemicals while improving treatment performance. Most plants with real-time control systems use dissolved oxygen (DO) measurements and fixed DO set-points to control the biological treatment process, reduce aeration requirements and energy use, and reduce chemical use. Another strategy receiving increasing consideration is the implementation of real-time ammonia-nitrogen monitoring and control of the nitrification process. Under this approach, a control module continuously adapts the DO set-point to reach the required ammonia effluent concentration. Influent flow and ammonia concentration data is gathered in real-time and incorporated in to a model that predicts the aeration rate required to achieve the optimum nitrification level, and then to control that rate. This combination of feed-forward and feed-back control enables: more timely reaction to peak loads than is possible with DO monitoring only; better ensures compliance with effluent requirements; and additional energy savings. Based on the reported experience of other wastewater treatment plants, real-time nitrification control systems may achieve as much as a 13% to 28% reduction in energy use for the biological treatment process.
Operational/Implementation Considerations: The approach to implementing a real-time control strategy for a particular treatment facility depends on specific factors, including system configuration, performance requirements (discharge limitations), and wastewater characteristics. The nitrification rate increases proportionally with DO concentration up to about 1.5 to 2.0 mg DO/L, but only a marginal increase in the nitrification rate is achieved once DO levels exceed 2.0 mg/L. High DO levels are also detrimental to denitrification. DO levels must be optimized to maintain both nitrification and denitrification capacity, and to minimize energy use. Feed forward control can enable the system to react faster to widely varying conditions, thereby helping to reduce short-term effluent peaks. However, the control system is based on a system model, which will have certain limitations. To improve system performance, monitoring data from effluent ammonium sensors is needed to inform refinements to the model.
POTENTIAL APPLICATION TO OWASA
The Mason Farm WWTP has a real-time process control system that is based on DO levels. This system, which includes a fine bubble diffused aeration system and high-efficiency mixers, has enabled more optimum performance at the plant, and helped us achieve more than a 30% reduction in total electricity use at the WWTP. Implementation of real-time nitrification control could enable additional improvements in process control, effluent quality, and chemical and energy management.

Some of the required effluent analyzers are already in place to support implementation of a real-time nitrification control system; however, additional flow and ammonia monitors and associated controls would need to be installed.

ECONOMIC CONSIDERATIONS

Capital Costs: To be determined

Operating Costs: To be determined

Potential Cost Savings: To be determined

Potential Energy Savings: Assuming that plant aeration and mixing system costs account for about 25% of the energy use at the WWTP, and that implementation of real-time nitrification control could enable a 5-10% reduction in that use, electricity use at the plant could be reduced by about 103,000 to 207,000 kWh a year, assuming CY 2016 conditions and use. That would be a 2.5% reduction from CY 2016 use. This estimate is conservative compared to the levels of energy savings achieved at the WWTPs shown in the case study information below.

CASE STUDIES

Location and Scale: **Grand Rapids Water Resource Recovery Facility** in Michigan. 61.1 mgd plant with an average-day flow of 38 mgd.
J.D. Phillips Water Reclamation Facility in Colorado Springs, Colorado. 23.6 mgd plant with average-day flow of about 8 mgd.
Hutchinson, Kansas, Wastewater Treatment Plant. 8.3 mgd capacity with average day flows of about 4.5 mgd.

Drivers/Funding: Reduce energy and chemical use and costs

Results: Grand Rapids estimates energy use reduction of about 15%. J. D. Phillips WRF reduced energy use by about 20%. Hutchinson WWTP reduced energy use by 10% to 15%.

RELATED STUDIES / FINDINGS

- *Real-Time Nitrification Control Nets Energy Savings*. AWWA Opflow. July 2016.
- *Ammonia-Based Aeration – Real-Time On-Line Probes Save Energy Costs*. Kaitlyn Bilodeau and Viraj DeSilva. Water Environment & Technology. January 2016.

SUMMARY OF STRATEGY EVALUATION

Each cell of the table below is color-coded to indicate whether a strategy is favorable, neutral, or unfavorable against each criterion.

Financially Responsible (High level)	Realistic/ Implementable	Operational Impacts
Modest up-front investment: We already have about 75% of the monitoring equipment Controls will require back-up	Potentially	Would enable changes to operational strategies Potential to improve plant performance Automation requires calibration and over-sight
Energy/Carbon Reduction Potential	**Coordinates with Other Projects**	**Community Impacts**
Potential to reduce energy use at WWTP by about 5-10%; chemical use reductions may also occur	Coordinates with planned upgrade to a high-performance SCADA system	None

RECOMMENDED NEXT STEPS / NEEDS

Install additional flow and ammonia monitors and associated controls on aeration basins

Develop system for real-time nitrification control

12 and 15- Solar Photovoltaic Development

BEST PRACTICE / TECHNOLOGY OVERVIEW

Description of Process: Solar Photovoltaic (PV) systems convert sunlight directly into electricity using solar panels. Recent developments in technology and economies of scale from increased solar panel production have brought the cost of solar PV technology down. Currently, the State of North Carolina ranks third in the nation for solar energy production, with over 2,000 MW of solar energy capacity.

Solar PV panels have improved in quality and efficiency, and are oftentimes warranted for up to 25 years. However, PV panels reportedly will continue to produce electricity beyond 25 years, but at a declining efficiency as the system ages.

There are, generally, three types of solar systems: ground mount, rooftop, and parking canopy. The latter two types lend themselves to smaller scale developments that can offset the need for purchased electricity at adjacent facilities. Net metering allows a location to export excess solar electricity onto the utility grid when the facility is not using all that is produced. When energy consumption exceeds solar production, power is drawn from the grid.

Ground mounted PV systems are anchored to the ground and are comprised of solar panels that are either mounted at a fixed tilt angle or on a tracking system. They are typically lower in cost than rooftop or canopy systems. Ground mount systems can be developed at a small or large scale, and are the technology typically used in solar “farms”. Power generated by these large “qualified facilities” can be sold to Duke Energy under a Power Purchase Agreement.

Over recent years, many public agencies have pursued solar PV projects on public facilities through third-party design-build-finance-own-operate models. Third-party ownership has sparked significant growth in the solar marketplace because it allows public agencies to “host” solar PV projects with little to no capital outlay. Under this approach, governmental agencies like OWASA that are unable to directly receive federal and/or state tax incentives for renewable energy projects can partner with third parties that can benefit from such tax incentives. There are many examples of water and wastewater utilities that have hosted third-party solar PV systems at public facilities, under the condition that the public agency has the right to purchase the system at fair market value by a specified date after the tax incentives have been monetized by the project developer.

The federal government offers a 30 percent investment tax credit, allowing owners to deduct 30% of the cost of a solar system from their federal taxes owed. Between 2010 and 2015, private developers (including homeowners) of solar PV systems in North Carolina benefited from a 35 percent state tax credit for solar projects. The sunset of the state tax credit has slowed development of third-party owned solar PV in North Carolina.

An additional factor that has somewhat constrained third-party development of solar PV systems at public facilities is that North Carolina utility law prohibits any party other than a regulated electric utility to sell electricity to a party other than the regulated utility. This means that electricity produced by a system owned and operated by a third-party cannot be sold to a public agency, even if it is proposed to be used at a public facility at which the private solar PV system is located.

Operational/Implementation Considerations: In addition to how a system would be financed, owned, and operated, there are additional considerations for OWASA in pursuing solar PV.

Ground mount systems require available land that is not planned for use in the next 30-40 years. A large-scale (5 MW) project requires about 575,000 square feet of suitable land (about 13.2 acres). A challenge of large-scale solar PV developments on remote land is the cost of interconnecting to the grid, and the requirement for the project developer to pay for any required station upgrades.

Rooftop systems are well-suited for sites that have no shading obstructions, a relatively new roof with few obstructions from rooftop equipment (i.e. HVAC equipment, ventilation fans, skylights), and structural integrity of the roof system that can support the weight of PV panels and mounting structures.

Parking canopies are elevated panels that still allow for parking. They have the accompanying benefit of providing shading and cover for vehicles parked underneath.

POTENTIAL APPLICATION TO OWASA

The National Renewable Energy Laboratory's (NREL) Solar Technical Assistance Team conducted a technical and economic feasibility screening evaluation of potential opportunities for development of solar PV systems at various facilities and tracts of land owned by OWASA. NREL provided this analysis free-of-charge.

Potential sites screened for a ground-mounted PV on OWASA land include:

- Open space at Cane Creek Reservoir (smaller scale)
- Biosolids Application Site (5 MW)
- Cane Creek Mitigation Tract (5 MW)

The Administration Building at 400 Jones Ferry Road was evaluated as a potential site for a solar rooftop system, once roof improvements are made. Additionally, the equipment parking lot at 400 Jones Ferry Road was identified as a good spot for a solar PV parking lot canopy system that would provide protection for many of OWASA's mobile assets.

Based on results from the NREL Screening Study, a small-scale roof-mounted or parking canopy solar PV System would generate between 162,000 and 182,000 kWh per year and cost about $350,000. (See details below). A large-scale system (about 750 KW) would generate about 1 million kWh per year and would cost more than $1.6 million.

The significant capital costs, as well as the potential for a private company to take advantage of federal tax credits, make public private partnership a viable option for a large scale, solar PV system.

ECONOMIC CONSIDERATIONS - Examples from NREL Study

Installation Type	Roof Mount	Parking Canopy	Small-Scale Ground Mount	Large-Scale Ground Mount	Large-Scale Ground w/ Tracking
PV System Size (kW)	127	112	756	5,000	5,000
Electricity Output (kWh)	182,483	162,452	1,097,320	7,490,000	9,310,000
Installed Costs ($)	$334,012	$354,665	$1,607,060	$9,100,000	$9,600,000
Annual O&M Costs	$2,514	$2,239	$15,119	$74,976	$84,973
Electricity Value	$10,923	$9,740	$64,121	$359,856	$446,677
Simple Payback (yrs.)	30.6	36.4	25.1	25.3	21.5
Simply Payback with Social Cost of Carbon (yrs.)	25.0	29.7	20.4	20.0	17.0

RELATED STUDIES / FINDINGS

- The City of Raleigh has partnered/developed a suite of Solar PV projects across its assets: https://www.raleighnc.gov/home/content/AdminServSustain/Articles/SolarPhotovoltaic.html
- http://www.newsobserver.com/news/business/article84421832.html
- NREL STATE technical memorandum on solar techno-economic analysis on OWASA sites. 2016.

SUMMARY OF STRATEGY EVALUATION: OWASA OWNERSHIP

Each cell of the table below is color-coded to indicate whether a strategy is favorable, neutral, or unfavorable against each criterion.

Financially Responsible (High level)	Realistic/ Implementable	Operational Impacts
Screening study shows the simple payback just within the useful life of equipment Technology evolving; costs declining	Yes	Solar PV integrated with parking canopy could provide protection for mobile assets
Energy/Carbon Reduction Potential	**Coordinates with Other Projects**	**Community Impacts**
Potential to reduce energy use by 160,000 to 1 million kWh/year	No	Potential to collaboratively purchase solar PV solutions with regional partners Public commitment to renewable energy

SUMMARY OF STRATEGY EVALUATION: PRIVATE DEVELOPMENT

Each cell of the table below is color-coded to indicate whether a strategy is favorable, neutral, or unfavorable against each criterion.

Financially Responsible (High level)	Realistic/ Implementable	Operational Impacts
Requires limited up-front capital outlay Most economically viable solar PV option	Likely, provided interested 3rd party wants to partner	Could conflict with other existing and/or planned uses of OWASA lands Makes beneficial use of OWASA land-holdings
Energy/Carbon Reduction Potential	**Coordinates with Other Projects**	**Community Impacts**
Significant, but energy benefits delayed for OWASA until we take ownership of PV system	Conversion of biosolids management program to 100% composting or non-land application program could enable	Significant commitment to renewable energy and offsetting carbon emissions Potential educational site

	some OWASA land to be repurposed for solar PV	

RECOMMENDED NEXT STEPS/NEEDS

Pursue further evaluation of investment of OWASA-owned, small-scale solar PV system (about 100-750 kW system). The next steps to pursuing a OWASA-owned PV installation include:

1. Model with additional site details, such as a full year of hourly electricity data and detailed rate or tariff structure,
2. Confirm land/roof/space availability and condition and,
3. Confirm interconnection agreement ability.
4. Fully model the economics

We estimate the cost of this modeling to be about $5,000.

Given the up-front capital costs and the potential for a private entity to benefit from the current federal tax credit, evaluate the potential of OWASA land for third-party, private development of a large, utility-scale 5MW system.

Current upgrades to the Administration Building roof should be done in a manner that does not preclude future installation of a rooftop solar PV system on the building

13- Raw Water Pumping Optimization Operating Procedure and Associated Schedule

BEST PRACTICE / TECHNOLOGY OVERVIEW

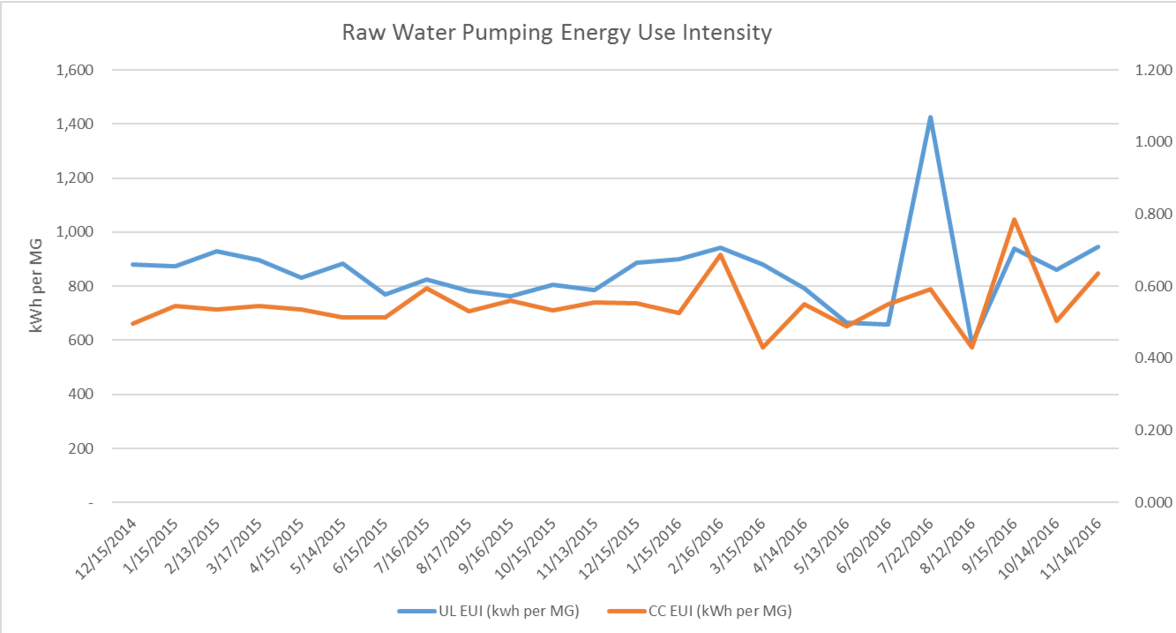
Description of Process: Raw water pumping represents our third largest use of electricity. Under normal circumstances, we pump raw water from both the Cane Creek Reservoir and University Lake, pumping more from Cane Creek daily. **Water quality and quantity must be taken into consideration when sourcing raw water, but in the cases when there is no water quality or quantity reason to use one raw water source over another, there could be an opportunity to save energy by choosing the water source with the lowest energy use intensity**. A raw water pumping optimization operating procedure and associated schedule could help inform water plant operators when energy savings could be realized by pumping water from one reservoir over the other, and how much.

Operational/Implementation Considerations: To keep the lines charged, we must draw at least 1 MGD from University Lake during the summer (less in the winter) and 3 MGD from Cane Creek (year-round). Over the past two years, we have tended to draw the minimum amount from University Lake and the rest from Cane Creek when there were no other issues.

POTENTIAL APPLICATION TO OWASA

Raw water must be pumped from University Lake (normal pool elevation is 349 feet MSL) and Cane Creek Reservoir (normal pool elevation is 500 feet MSL), through transmission mains that are about 1.33 miles and 10.95 miles long, respectively, to the Jones Ferry Road WTP. The University Lake Pump Station is at an elevation of about 340 feet MSL, while the Cane Creek Raw Water Pump Station is at about 461 feet MSL. The highest elevation along the Cane Creek raw water transmission main is 580 feet MSL. The Jones Ferry Road WTP is at 479 feet.

Despite the greater pumping distance, the Energy Use Intensity (kwh required to pump 1,000 gallons of water) has been lower for the Cane Creek Pump Station over the past two years. This could be function of elevation changes, resistance within the raw water pipe, current pump efficiency, and economies/efficiencies of scale. The spike in University Lake's Energy Use Intensity in the graph below corresponds with a great reliance on UL raw water, suggesting that given the existing old pumps (that run at a constant speed) and transmission lines, we would not likely achieve energy savings by relying more on University Lake unless more efficient pumps and controls are installed at University Lake.



In general, Water Treatment Plant operators pump more raw water from the Cane Creek Reservoir than from University Lake. The following table provides the average daily values for water pumped from each reservoir since 2010.

	University Lake Reservoir	*Cane Creek Reservoir*
2010	*2.80 MGD*	*4.91 MGD*
2011	*2.92*	*4.06*
2012	*3.33*	*3.43*
2013	*2.06*	*4.53*
2014	*1.95*	*5.00*
2015	*1.53*	*5.21*
2016	*1.68*	*4.95*

Assuming that a million gallons pumped from Cane Creek requires about 100 kWh less than University Lake, decreasing the average daily pumped from 1.68 to 1.5 MGD could save about 24,800 kWh annually.

ECONOMIC CONSIDERATIONS

Capital Costs: None

Operating Costs: To be determined, likely nominal

Potential Cost Savings: To be determined

RELATED STUDIES / FINDINGS

- HDR Engineering Energy Audit of Cane Creek and University Lake Raw Water Pumping Stations (2002)

SUMMARY OF STRATEGY EVALUATION

Each cell of the table below is color-coded to indicate whether a strategy is favorable, neutral, or unfavorable against each criterion.

Financially Responsible (High level)	Realistic/ Implementable	Operational Impacts
Modest cost for study; no cost for use of schedule	On a given day, objective of saving energy may be outweighed by drinking water quality and quantity considerations	Using the schedule as guidance, instead of a requirement, would provide operators flexibility in decision-making
Energy/Carbon Reduction Potential	**Coordinates with Other Projects**	**Community Impacts**
Modest savings provided pump optimization protocols are clear and utilized	Optimization protocols should be developed as pump station upgrades are deigned and completed	None

Recommended Next Steps/Needs

Further investigation into the optimal amount to pump from each reservoir to decrease the energy use intensity of entire raw water pumping operation. A study would include an evaluation of pump curves of each pump at University Lake and Cane Creek, daily energy use and pump rates, and anticipated impacts on treatment costs.

Currently, it does not appear that any energy savings would be gained by developing a schedule that prioritizes University Lake raw water. In fact, assuming that there is not a need from a water quality or quantity perspective, we should minimize the amount of water pumped from University Lake Reservoir until upgrades are completed to the University Lake Pump Station, at which point a raw water pumping schedule should be re-evaluated.

Additionally, it is recommended that once the energy optimization schedule is updated with each raw water pump station upgrade.

15- Reconsider WW Pump Station Design, Operations, and Maintenance

BEST PRACTICE / TECHNOLOGY OVERVIEW

Description of Process: Wastewater pump stations are essential for moving wastewater out of areas where conveyance by gravity flow is not possible. Pump stations are also used to discharge wastewater to force mains, which are pressurized pipes that convey wastewater to a gravity collection main or to the wastewater treatment plant (WWTP).

In some cases, wastewater pump stations are oversized relative to the most common incoming flow (to handle large storm events and/or future growth). If not designed with a pump (or series of pumps) that can manage maximum flow and head but also match the best efficiency point with the most frequent flow conditions, total energy use and wear-and-tear on pumps will be higher. In some cases, an easy way to deal with fluctuating inflow rates is to either use multiple pumps or pumps of different sizes in the station. The vast majority of our pump stations are equipped with two pumps of the same size.

POTENTIAL APPLICATION TO OWASA

In 2016, energy use by OWASA's pump stations accounted for 7% of our overall energy use. A systematic review of the design, operations, and maintenance of OWASA's 21 wastewater pump stations (starting with the largest pump stations first) could help reduce that energy use. OWASA's Capital Improvements Program provides funding for the renovation/replacement of several pump stations and force mains.

ECONOMIC CONSIDERATIONS

Capital Costs: Not yet determined

Operating Costs: Not yet determined

Potential Cost Savings: Not yet determined

Potential Energy Savings: Potential to reduce energy use at Wastewater Pump Stations

RELATED STUDIES / FINDINGS

- *Draft Legion Road Pump Station Abandonment Evaluation. Adam Haggerty. February 28, 2013.*
- *Forest Creek II Pump Station Abandonment Evaluation. Adam Haggerty.*
- *Pump Station Abandonment Potential – Summary Table. Adam Haggerty.*

SUMMARY OF STRATEGY EVALUATION

Each cell of the table below is color-coded to indicate whether a strategy is favorable, neutral, or unfavorable against each criterion.

Financially Responsible (High level)	Realistic/ Implementable	Operational Impacts
Upgrades at point of rehab could be cost-effective Low-cost Operational and maintenance changes	Individual consideration of each of the 22 pump stations would be labor intensive	Pumping rates must be sufficient to minimize potential for grit accumulation Wet well turnover is important to prevent well from becoming septic

		Pumping capacity must be sufficient for high flow events
Energy/Carbon Reduction Potential	Coordinates with Other Projects	Community Impacts
If energy use of all wastewater pump stations could be reduced 10% through this strategy, savings would be about 0.8% of OWASA's total annual electricity use	Operational and design improvements can be incorporated into design of future wastewater pump station rehabilitation and replacement projects	None

RECOMMENDED NEXT STEPS / NEEDS

Engage third-party to assist OWASA in evaluating the design, operations, and maintenance of wastewater pumps stations considering best practices in the industry

Incorporate energy savings sub-objectives into the scope of pump station rehabilitation projects

16- Equalization Basin for Wastewater Inflow

BEST PRACTICE / TECHNOLOGY OVERVIEW

Description of Process: In wastewater treatment systems, improved efficiency and process control are possible when facilities are operating under uniform flow and loading conditions. Some wastewater treatment plants (WWTPs) have installed flow equalization (EQ) basins to provide temporary storage of peak diurnal or wet-weather flows, and subsequent release for treatment during low-flow conditions. This results in more uniform primary effluent quality.

From an energy management perspective, EQ basins do not reduce the volume of wastewater that must be pumped and treated. Rather, by storing flow during on-peak electrical energy billing periods and enabling treatment during off-peak periods, EQ basins can help reduce *peak* energy use, thereby offering energy cost savings. Additionally, through the use of an EQ basin, flow can be better optimized to allow the operation of pumps and other equipment at optimal energy efficient points.

EQ basins offer other important benefits. By mitigating peak flows, they can reduce hydraulic, pumping, and treatment process capacity requirements, thereby potentially providing substantial long-term capital cost savings for wastewater utilities. EQ basins can also be used to temporarily hold incoming sewage during plant maintenance, or to enable dilution and distribution of high-strength waste batch discharges which might otherwise upset the biological treatment process.

Operational/Implementation Considerations: To minimize maintenance requirements, it is preferable to locate EQ basins near the head of the WWTP, but downstream of pretreatment facilities such as bar screens and grit removal processes. Adequate mixing and aeration must be provided to keep EQ basins aerobic and prevent solids deposition. It is desirable to construct multiple or compartmentalized basins so that maintenance and repair can be done while still providing some level of flow equalization.

In any business case evaluation of EQ basins, it is important to consider that potential peak-energy cost savings may be offset by additional energy use associated with aeration, mixing and re-pumping during off-peak periods.

POTENTIAL APPLICATION TO OWASA

EQ basins were a strategy evaluated as part of the *Mason Farm Wastewater Treatment Hydraulic and Treatment Capacity Study* (Hazen and Sawyer, 2010).

Section 6.13.1 of the report indicates that to equalize peak flows assuming the 18.5 MGD plant expansion and a peaking factor of 2.75, an EQ basin of 5.5 MG would be needed. The report states:

> *Construction of flow equalization facilities at this time is unnecessary to meet the current effluent limits but should be considered during the next expansion to the Mason Farm WWTP. The need for flow equalization will be dependent on future collection system conditions and technologies installed to meet future flows and/or effluent limits.*

ECONOMIC CONSIDERATIONS

Capital Costs: Not yet determined

Operating Costs: Not yet determined

Potential Cost Savings: Not yet determined

CASE STUDIES

Locations: Raleigh Neuse River WWTP; Chattanooga Moccasin Bend WWTP; Sacramento Regional WWTP; Post Falls WWTP (Idaho)

Scale: EQ basins at Post Falls WWTP were sized to accommodate 25% of plant influent volume (15% for diurnal flow variation and 10% for recycle flow streams)

RELATED STUDIES / FINDINGS

- Hazen and Sawyer. *Mason Farm Wastewater Treatment Hydraulic and Treatment Capacity Study.* 2010.

SUMMARY OF STRATEGY EVALUATION

Each cell of the table below is color-coded to indicate whether a strategy is favorable, neutral, or unfavorable against each criterion.

Financially Responsible (High level)	Realistic/ Implementable	Operational Impacts
Expensive	Requires space in a very space-constrained site	Would greatly benefit operations at the plant through better management of flow and nutrients; however, EQ basin would require mixing, odor control, effective maintenance, etc.
Energy/Carbon Reduction Potential	**Coordinates with Other Projects**	**Community Impacts**
Peak demand savings and opportunity to utilize pumps at most efficient flows Wouldn't change total pollutant loads or flow Might require more energy to pump and aerate/mix	Necessary to coordinate with numerous in plant projects Could defer treatment plant capacity expansion	None

RECOMMENDED NEXT STEPS

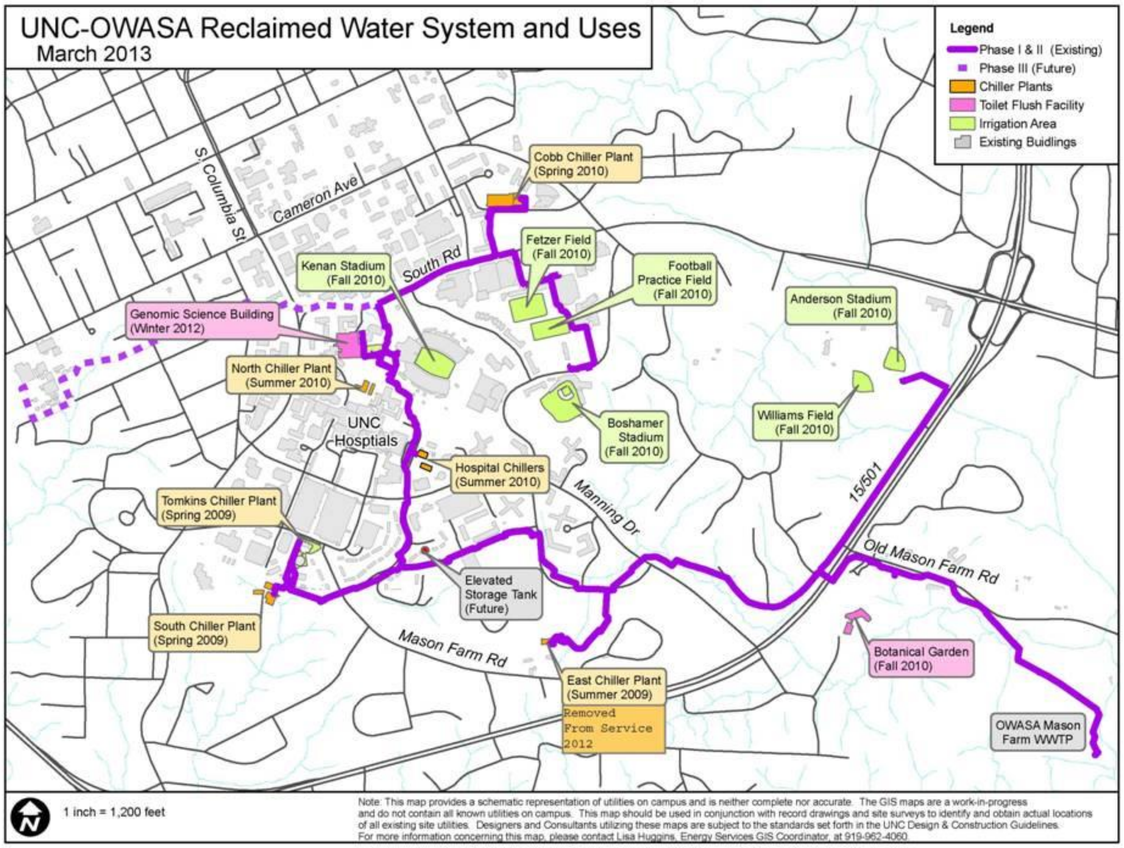
Defer feasibility study until capacity upgrade at wastewater treatment plant

18- Reduce Peak Demand for Reclaimed Water Service

BEST PRACTICE / TECHNOLOGY OVERVIEW

Description of Process:

The reclaimed water distribution facility at the Mason Farm Wastewater Treatment Plant pumps reclaimed water to the University of North Carolina via more than 25,000 feet of reclaimed water line. The University uses the reclaimed water for make-up water in the central campus and UNC Hospitals chiller plant cooling towers, irrigation for a few athletic fields, and a limited amount of toilet flushing (see map below). According to the Chilled Water Systems Manager Doug Mullen, about 90% of the reclaimed water provided to the University is used in cooling towers.



Reclaimed water for cooling tower purposes is provided on-demand for the University (i.e. there is no reclaimed water storage facility on OWASA's reclaimed water distribution system). The University does have some on-site storage for irrigation water. Irrigation systems pull from underground cisterns which are refilled by rainwater and reclaimed water.

In FY16, the reclaimed water system accounted for approximately 4.5% of the electricity used at the Mason Farm Wastewater Treatment Plant. The peak demands of the reclaimed water system are coincident with on-peak energy use at the plant.

Under the current Duke Energy rate schedule, OWASA is billed higher rates for on-peak energy use and demand. In the summer months (June 1 – September 30), on-peak hours are 1pm-9pm Monday- Friday. In 2016, the peak hour of reclaimed water demand occurred between 1pm-9pm about 70% of the time.

Nonetheless, reclaimed water requires less energy to provide than drinking water. Energy use intensity of the RCW system was about 65% of the 2015 energy use intensity for our water supply, treatment, and distribution system.

OWASA could reduce energy costs if peak reclaimed water demands and associated pumping can be reduced or shifted to off-peak rate periods.

Operational/Implementation Considerations:

Development of an elevated reclaimed water storage tank on-campus could mitigate the on-peak demands of the reclaimed water system, and help maintain adequate system pressure on-campus. However, there are a couple of concerns regarding this strategy:

- Increase in overall energy use to pump water: Pumping water to an elevated storage tank would require the use of more energy, even if in off-peak times. The cooling tower at the Tomkins Chiller Plant is currently the highest point in the reclaimed water distribution system. Our pumps must maintain enough pressure in the line to pump water to the Tomkins Chiller Plant. An elevated storage tank would need to be higher than the Tomkins Plant to maintain adequate pressure.
- Potential decline in reclaimed water quality: UNC's Chiller plant operators have experienced issues with reclaimed water chemistry if the water is held for over a week; therefore, UNC's practice is to flush water in the towers after about seven days of use. There is concern by the chiller plant operators that water chemistry could be further compromised if an on-campus reclaimed water storage tank was in place and resulted in greater reclaimed water distribution system residence times.
- Site constraints: The PER for the reclaimed water system prepared by Hazen and Sawyer in 2003 stated that "elevated storage for this purpose may be precluded due to site constraints within the main campus area." However, UNC has identified and reserved a potential site for an elevated reclaimed water storage tank, should that be determined economically feasible in the future.

POTENTIAL APPLICATION TO OWASA

Given that chillers demand the majority of reclaimed water and the chillers require make-up water in the heat of the day (corresponding to Duke Energy's peak rate periods), it would be difficult for UNC to adjust its draw on the reclaimed water system to reduce electricity demand. There may be an opportunity to pursue a memorandum of understanding with the University's Athletics Department to reduce the-peak draw of irrigation water, but the energy and cost savings of this strategy would be relatively small.

ECONOMIC CONSIDERATIONS

Capital Costs: An on-campus reclaimed water storage facility would likely cost well over $1 million to design and build.

Operating Costs: Potentially increase in energy use costs for pumping up to higher elevation

Potential Cost Savings: Some or all of the cost savings on on-peak energy demand and energy use may be offset by increase in off-peak energy use to pump water to a much higher elevation

RELATED STUDIES / FINDINGS

- Hazen and Sawyer Preliminary Engineering Report on Reclaimed Water System Project, 2003

SUMMARY OF STRATEGY EVALUATION

Each cell of the table below is color-coded to indicate whether a strategy is favorable, neutral, or unfavorable against each criterion.

Financially Responsible (High level)	Realistic/ Implementable	Operational Impacts
On-campus storage would be very expensive to construct	Uncertain; limited space on UNC campus for siting RCW storage tank	Requires significant coordination and planning between WWTP staff and UNC Extended residence time could degrade RCW quality and adversely affect end uses RCW storage could provide increased reliability/redundancy
Energy/Carbon Reduction Potential	**Coordinates with Other Projects**	**Community Impacts**
Minimal net energy savings expected due to need to pump RCW to higher tank; storage could enable more optimum RCW pump operations	No	Would require investment from UNC to be cost-of-service

RECOMMENDED NEXT STEPS / NEEDS

Continue to monitor energy use of reclaimed water system and explore strategy later

18- Battery-Based Energy Storage Systems for Peak Demand Reduction

BEST PRACTICE / TECHNOLOGY OVERVIEW

Description of Process: Battery-based energy storage (BBES) is a technology through which electricity is converted into another form of stored energy, which is then converted back to electrical energy for use later. BBES systems are being increasingly used in homes, commercial and industrial settings, and the electric utility industry to quickly release stored electricity for peak shaving and load shifting, power outages, frequency regulation and voltage control, integration of renewable power, and supplying power for off-the-grid applications.

BBES systems do not reduce the amount of electricity used, but they can reduce peak demands for grid-supplied electricity and enable more electricity demand to be met by clean renewable energy sources. BBES technology will be essential to the expanded deployment of intermittent renewable energy sources, especially solar PV and wind power, since energy storage will help smooth out the widely varying power output of those systems by supplementing power production when sunlight and wind power are unavailable or limited.

Several companies, including LG, Mercedes-Benz, Redflow, Samsung, Sonnen, Sunverge, and Tesla, are producing BBES systems, and the technology and system economics are undergoing rapid transformation. GTM Research, which tracks the energy storage sector for the Energy Storage Association, has projected that there will be an eight-fold increase in installed energy storage capacity by 2020. BBES prices have dropped considerably in the last two years, and the levelized cost per kWh produced over the life of the battery are expected to continue to drop rapidly over the next several years.

Operational/Implementation Considerations: A battery storage system consists of the battery, monitoring and control system, and power conversion system.

Battery types are lead-acid, advanced lead-acid, molten salt, lithium ion, and flow batteries. The monitoring and control system (battery management system) helps ensure safe and optimum performance, prevents battery cells overcharging, and controls the battery charge and discharge process. The power conversion system converts the battery power to electricity.

Some key considerations for battery selection include: performance requirements relating to the specific application; ambient conditions; safety; performance guarantee and warranty provisions; depth and length of power discharge; calendar and cycle life; efficiency; maintenance requirements and costs; capital costs; utility/grid requirements; and track record of the company and technology.

The specific application of the BBES will affect the capacity requirements, system performance, cost and life time. Generally, the amount of a battery's capacity that is repeatedly used (depth of discharge) will substantially affect its operational life, which is measured in charge cycles. A battery's capacity is often referred to in energy terms as power over a specified time (e.g., Megawatt hours [MWh] or kilowatt hours [kWh]). Another important metric is the amount of power an installation can provide (Megawatts [MW] or kilowatts [kW]).

POTENTIAL APPLICATION TO OWASA

BBES technology may eventually become feasible for OWASA if peak power costs increased considerably and/or OWASA decides to implement renewable energy generation systems to meet power needs at one or more of its facilities.

BBES technology and costs are changing rapidly and there is limited experience in operating and maintaining these systems. Considering these factors, OWASA should continue to stay informed of advancements in and experience with this technology.

ECONOMIC CONSIDERATIONS

Capital Costs: A December 2016 report by Lazard estimated that the installed cost for a 100 kW BBES system ranges from $1,200 to $2,600/kW.

Operating Costs: Operating costs will be dependent on the technology selected and the scale of the application. For example, many lithium-ion battery systems require air conditioning to maintain proper operating temperatures. This requires additional electricity consumption. Another key operating cost factor will be the efficiency of the system, which will affect the amount and cost of electricity required to charge the system.

Lazard's December 2016 report indicates that the levelized cost of energy (average cost per kWh produced by the system over the entire life of the system, including all capital and operating costs) for a 100-kW lithium-ion battery storage system for a commercial application would range from about $0.60 to $1.20/kWh, assuming a charging cost of $0.105/kWh.

Potential Cost Savings: Potential cost savings will be dependent on the technology selected, scale of application, utility rates in effect, and other factors.

Potential Energy Savings: BBES systems do not reduce electrical energy use – in fact, due to the inefficiencies in converting and storing electricity for later use, and additional power requirements for air conditioning, controls, etc., they can be expected to increase the total amount of electricity use. BBES systems will, however, reduce peak demands for grid-supplied electricity.

CASE STUDIES

Location: In September 2014, the **University of California at San Diego** (UC-San Diego) installed a BBES system that is integrated with the university's microgrid, which generates 92% of the electricity used on campus annually.

In 2012, **Gills Onions**, a fresh-cut onions processing plant in Oxnard, California, partnered with Prudent Energy Services Corporation (PESC), to install a BBES system to reduce peak demand charges.

Scale: The UC-San Diego BBES has capacity of 2.5 megawatts (MW) and 5 megawatt-hour (MWh)—enough to power 2,500 homes.

The Gills Onions BBES system consists of three 200 kW modules that provides six hours of storage – enough to offset the expensive peak utility rate period. The system also provides the ability to offset spikes in usage to reduce demand charges, with the full 600 kW available throughout the entire day. The system is integrated with Gills Onions' advanced 600 kW anaerobic digestion advanced energy recovery system.

Drivers/Funding: UC-San Diego received $3.25 million in financial incentives from California's Self-Generation Incentive Program.

Gills Onions received an undisclosed incentive from California's Self-Generation Incentive Program. The company wanted to reduce peak power costs, and offset future increases in peak power rates.

PESC owns, operates, monitors and maintains the Gills Onions system to ensure its safe and reliable performance. In return, it receives an undisclosed share of the energy cost savings resulting from the project (calculated as avoided charges, costs, and fees that Gills would have had to pay to the electric utility).

Results: The reductions in on-peak energy costs and demand charges are estimated to save Gills Onions hundreds of thousands of dollars per year in lower electricity bills.

RELATED STUDIES / FINDINGS

- Energy Storage Association website – http://energystorage.org/
- Gills Onions Battery Storage System – http://energystorage.org/energy-storage/case-studies/peak-shaving-and-demand-charge-avoidance-prudent-energy-vanadium-redox
- *Lazard's Levelized Cost of Storage – Version 2.0*. December 2016.
- *Vanadium Flow Battery Juices Onion Plant*. Power Magazine. December 1, 2012. http://www.powermag.com/vanadium-flow-battery-juices-onion-plant/

SUMMARY OF STRATEGY EVALUATION

Each cell of the table below is color-coded to indicate whether a strategy is favorable, neutral, or unfavorable against each criterion.

Financially Responsible (High level)	Realistic/ Implementable	Operational Impacts
Not likely to have direct positive financial payback unless costs decline substantially; however, strategy may provide redundancy/resiliency benefits	No known applications of this technology at scale and applications comparable to OWASA	None
Energy/Carbon Reduction Potential	**Coordinates with Other Projects**	**Community Impacts**
Technology would require increased electricity use due to inherent inefficiencies Could enable reduced electricity demands during peak time of day rate periods	When looking at generator and redundancy applications, and potential deployment of renewable energy strategies, it should be considered	None

RECOMMENDED NEXT STEPS / NEEDS

Stay informed of BBES cost trends, and actual operating experience of others that install the technology.

Evaluate the feasibility of incorporating BBES technology as part of future renewable energy projects.

19- Elimination of Wastewater Pumping Stations

BEST PRACTICE / TECHNOLOGY OVERVIEW

Description of Process: Wastewater pump stations are essential for moving wastewater out of areas where conveyance by gravity flow is not possible. Pump stations are also used to discharge wastewater to force mains, which are pressurized pipes that convey wastewater to a gravity collection main or to the wastewater treatment plant (WWTP).

Where practical, wastewater pumping stations should be eliminated by extending gravity sewer lines to the stations, thereby eliminating the need for electricity to pump the wastewater to a downstream point in the wastewater collection system.

Operational/Implementation Considerations: Where feasible, wastewater collection lines are constructed with a downhill slope to allow wastewater to flow by gravity to the WWTP. Where collection mains encounter a hill, or become excessively deep, a pump station is used to raise the wastewater to a level where it can flow again by gravity to the WWTP.

While they are essential in many areas, wastewater pumping stations not only require the use of purchased energy to convey sewage, they also have higher operating and maintenance requirements and costs than gravity sewers, have greater adverse noise, odor and aesthetic impacts, and pose higher operating risks, such as during power outages.

Elimination of pump stations may be possible through the extension of gravity sewers; however, such extensions may be very costly. A decision to eliminate a pump station must consider several factors, including but not limited to: the cost, complexity, and community/environmental impacts of the required gravity sewer extension; the operating and maintenance requirements and costs, the remaining useful life of the station (and associated force main), and future plans and costs for renovating or replacing the station and force main; and operating risks.

POTENTIAL APPLICATION TO OWASA

OWASA has 21 wastewater pumping stations located throughout its service area. In Calendar Year 2016, these stations account for about 1.26 million kWh of OWASA's electricity use – about 7.7% of OWASA's total use of purchased electricity that year.

Based on prior analyses, it may be technically possible to eliminate several wastewater pump stations by extending gravity sewer service to those locations. Those stations, including their firm pumping capacity in gallons per minute (gpm), and average annual electricity use in CY 2014-16, are summarized below.

Clayton Road – 200 gpm; 1,100 kWh
Eastowne – 850 gpm; 53,600 kWh (would require gravity connection to Durham)
Forest Creek II – 150 gpm; 5,100 kWh
Legion Road – 85 gpm; 7,900 kWh
Manning Drive -100 gpm; 7,400 kWh
Meadowmont #1 - 372 gpm; 19,900 kWh (would require gravity connection to Durham)
Meadowmont #2 – 70 gpm; 7,700 kWh (would require gravity connection to Durham)
Oaks III – 350 gpm; 18,600 kWh (would require gravity connection to Durham)
Patterson Place – 45 gpm; 800 kWh
Tinkerbell – 250 gpm; 10,900 kWh

Together, these stations use about 133,000 kWh of electricity annually. That is about 11% of the total amount of electricity used at all 21 stations, and 0.8% of OWASA's total electricity use in CY 2016.

While OWASA would save energy by eliminating some stations by connecting to the Durham sewer system, some of those savings may be offset if Durham must pump those additional flows to get to the South Durham water Reclamation facility.

(Note: The above list includes several stations for which OWASA recently decided to renovate rather than eliminate. Those are the Tinkerbell and Forest Creek stations. It does not list some small pumping stations located on the north side of Chapel Hill that could be eliminated by constructing one larger consolidated pump station in their place.)

OWASA's Capital Improvements Program provides funding for the renovation/replacement of several pump stations and force mains; however, it does not specifically identify funding for the elimination of any of the above stations.

ECONOMIC CONSIDERATIONS

Capital Costs: Elimination of wastewater pump stations can be very costly. For example, the elimination of the Legion Road pump station has an estimated cost of nearly $900,000 and the lifecycle cost analysis indicates it would have a negative payback.

Operating Costs: Not yet determined – will depend on stations eliminated

Potential Cost Savings: Not yet determined – will depend on stations eliminated

Potential Energy Savings: Not yet determined – will depend on stations eliminated

CASE STUDIES

Location: OWASA's Lloyd Street, Starlite Drive, North Forest Hills, and Cleland Drive wastewater pump stations were removed from service in the last decade or so.

Drivers/Funding: These pump stations were nearing the end of their useful life and renovation and replacement were projected to be costly. Concerns about long-term maintenance needs and risks, energy use, and other factors were important factors in the decision to eliminate these stations.

Results: Removal of these stations resulted in total annual energy savings of about 17,000 kWh, and reduced OWASA's operating costs and risks. Extension of gravity sewer lines also made sewer service accessible to previously unserved properties downstream of the Lloyd Street and Starlite Drive stations.

RELATED STUDIES / FINDINGS

- *Draft Legion Road Pump Station Abandonment Evaluation. Adam Haggerty. February 28, 2013.*
- *Forest Creek II Pump Station Abandonment Evaluation. Adam Haggerty.*
- *Pump Station Abandonment Potential – Summary Table. Adam Haggerty.*

SUMMARY OF STRATEGY EVALUATION

Each cell of the table below is color-coded to indicate whether a strategy is favorable, neutral, or unfavorable against each criterion.

Financially Responsible (High level)	Realistic/ Implementable	Operational Impacts
Elimination of wastewater pump stations can be very costly	Topography and other factors may prevent station abandonment; removal can be complicated (i.e. land crossing, interconnection with other systems)	Operating and maintenance savings Pump station elimination can reduce safety and sewer overflow risks

Energy/Carbon Reduction Potential	Coordinates with Other Projects	Community Impacts
Relatively small impact versus effort In some cases, reductions in OWASA energy use may be offset by the requirement for private sewer pumps to be installed to serve some low-lying service locations	As pump stations are identified for potential rehabilitation or replacement, the technical feasibility and benefits and costs of abandoning those stations should be considered prior to a final investment decision being made	Might require customer pumping

RECOMMENED NEXT STEPS / NEEDS

Moving forward, the technical and economic feasibility of eliminating pump stations should be considered as gravity sewers are extended as new development occurs, and whenever OWASA undertakes engineering evaluations when it is determined that an existing pump station needs to be renovated or replaced.

20- Geothermal Systems for Heating and Cooling

BEST PRACTICE / TECHNOLOGY OVERVIEW

Description of Process: Geothermal heating and cooling systems (also referred to as ground-source heat pumps or geo-exchange systems) use the ground, groundwater, or surface water as a heat source or sink. Since subsurface ground and groundwater temperatures are relatively stable throughout the year than outside air temperatures, ground-source heat pumps are much more efficient than air-source heat pumps.

A geo-exchange system is made up of one or more ground loops, heat pumps, and air delivery systems. Most system designs use a closed loop system of pipes buried in the ground or placed in a water source near the building. A heat-absorbing carrier fluid (typically one with anti-freeze properties) is pumped through the pipe loop to either absorb or dissipate heat within the ground or the water source. In the winter, the heat pump extracts heat from the fluid in the pipe loop, compresses it, and delivers it to the building. The process is reversed in the summer, as the heat pump extracts heat from the building, which is then dissipated to the ground or water source.

There are three primary types of closed loop systems. **Vertical** systems involve installation of deep boreholes which are typically between 100 and 500 feet deep. Subsurface temperatures are more stable at these depths, and vertical systems provide a higher energy output per unit of land area required. **Horizontal** systems involve the installation of “slinky” ground loops at a much shallower depth, but require much more land area. **Water source** systems (lake, pond, or other source) eliminate the need for well drilling and major excavation.

Operational/Implementation Considerations: Geothermal heating and cooling systems have several advantages compared to conventional electric, air-source heating, and cooling systems. They generally use 25% to 50% less electricity, are quieter, last longer, have lower maintenance requirements, and don't depend on the temperature of the outside air. They also improve humidity control by maintaining about 50% relative indoor humidity

Some key disadvantages of this technology are that it is costlier to install, and not typically a good solution for retrofitting existing buildings. For sites where land availability is very limited, installation of ground-source heating and cooling systems may be technically or economically infeasible.

POTENTIAL APPLICATION TO OWASA

Geo-exchange heating and cooling is a proven technology at the scale and type of operations like those at OWASA. Therefore, it is an option to be considered as OWASA constructs new and expanded facilities, and replaces heating and cooling systems at existing facilities.

There are two recent examples where we have considered geo-exchange systems. We evaluated the feasibility of replacing the existing, old air-source heat pump at the Cane Creek Reservoir office building with a geo-exchange system. Due to low electricity costs and the very low energy use at the building, the payback period would have exceeded the useful life of the system. Based on that analysis, the decision was made to install a conventional heat pump system.

The study of alternative heating and cooling system technologies for the Administration Building did not consider a subsurface geo-exchange heating and cooling system due to major site constraints; however, the study did evaluate the feasibility of installing a water-source geo-exchange system, with the water source being the raw or finished water line on the site. That alternative (using the finished water line) was ranked highest of the options considered, and it is now under final design.

ECONOMIC CONSIDERATIONS

Capital Costs: The cost to design and install the water-sourced heating and cooling system for the Administration Building is estimated to be about $2 million. Others have reported that geo-exchange systems cost about 10 percent more to build than conventional systems.

Operating Costs: The operating cost of the planned system at the Administration Building is projected to be about $27,500 a year in electricity and natural gas and $18,000 a year in maintenance.

Potential Cost Savings: Potential cost savings in maintenance costs with Brady, as well as reduced energy costs

Potential Energy Savings: McKim and Creed estimate that the new Admin HVAC system will use about 200,000 kWh less and 12,500 less therms than the existing system, representing about 33% of the electricity and 60% of the natural gas used by the building in 2016 – for a savings of about $20,000 annually.

CASE STUDIES

Location: The **North Carolina Botanical Garden Visitor Education Center**, which was completed in 2009, has a geothermal heat exchange system.

Scale: The closed-loop system consists of 30 wells about 500 feet deep, and provides heating and cooling for about 29,000 square feet of building space.

Drivers/Funding: NC Botanical Garden staff wanted the building to be a model of sustainable building, and it was designed to achieve the U.S. Green Building Council Leadership in Energy and Environmental Design (LEED) program's Platinum certification, the highest standard granted for sustainable buildings. UNC students provided $210,000 of funding for the geo-thermal system through the students' clean energy fund.

Location: **Garrett Building #2, a new office building built in Oklahoma City, Oklahoma** in the late-1990s, is served by a closed-loop ground-source heat pump system.

Scale: The system includes 40 boreholes approximately 250 feet deep, on 20 foot centers. The office building is about 20,000 square feet.

Drivers/Funding: Owner's heating and cooling system contractor recommended ground-source heat pump system to reduce energy use, energy costs, and maintenance expenses.

Results: The system is estimated to be 47% more energy efficient, and has reduced energy costs per square foot by about 57% per square foot when compared to an adjacent 15,000 square foot office building that has an air-cooled condenser, gas-fired boiler, and economizer. Monthly peak energy demands are also lower by an average of about 33%.

The Town of Carrboro plans to evaluate geo-thermal heating and cooling for a new library building at 203 South Greensboro Street.

RELATED STUDIES / FINDINGS

- McKim and Creed HVAC Systems Upgrade Study for OWASA Administration Building (2016)

SUMMARY OF STRATEGY EVALUATION

Each cell of the table below is color-coded to indicate whether a strategy is favorable, neutral, or unfavorable against each criterion.

Financially Responsible (High level)	Realistic/ Implementable	Operational Impacts
Can be feasible on a case-by-case basis	Can work on a case-by-case basis (e.g. Admin HVAC system)	Can require a great deal of space Are generally quieter, last longer, and have lower maintenance requirements than conventional HVAC systems They aren't dependent on the temperature of the outside air, and provide more stable humidity control
Energy/Carbon Reduction Potential	**Coordinates with Other Projects**	**Community Impacts**
Case-by-case basis; Technical guidance indicates potential electricity savings in range of 25 to 50% compared to conventional HVAC systems	Evaluate potential application of geothermal HVAC technology on case-by-case basis as building renovations and new buildings are being planned and designed	Potential for positive perception from some

RECOMMENDED NEXT STEPS / NEEDS

Evaluate potential application of geothermal HVAC technology on case-by-case basis as building renovations and new buildings are being planned and designed

21- Reduce Throttling/Generate Energy at Head of Water Treatment Plant

BEST PRACTICE / TECHNOLOGY OVERVIEW
Description of Process: One energy management best practice for water utilities is to minimize the use of throttling valves to control the flow of water, such as in a raw water transmission main, or to install in-pipe hydropower generation systems to recover energy from pipes where in-line flow and pressure control is required.
Operational/Implementation Considerations: Flow throttling is a simple, relatively inexpensive, and effective way to control flow; however, throttle valves convert hydraulic energy of the pump into frictional heat, thereby wasting some of the pump's energy. Flow throttling can lead to pump and pump system maintenance issues, such as wear and failure of seals, bearings, wear rings, impellers, and shafts. Thus, it can lead to unplanned downtime and expensive maintenance work. The need for flow throttling can be eliminated by measures such as installing variable speed drives to control pumping flows and pressures. However, in some situations, flow throttling is required to maintain pressure and eliminate air entrainment in a pipeline, such as a section of gravity pipe that is directly tied to a pressurized water main. For in-pipe energy recovery systems, the end use of the electricity will be an important factor that drives the design and feasibility of the system. The capital and operating costs will depend on whether the electricity is delivered to the grid or used on-site at a nearby facility. Where the power is to be used on-site, provisions must be made to ensure sufficient power is available to the site during periods when the in-pipe energy recovery system is off-line or generating power at a substantially reduced rate.
POTENTIAL APPLICATION TO OWASA
Water from the Cane Creek Reservoir is pumped to the Jones Ferry Road WTP via a raw water main that includes a long stretch of pipe through which water would flow by gravity at a high pressure if it was not properly controlled. To control flow and pressure and ensure that air is not entrained in that section of pipe, OWASA has installed a sleeve (flow throttling) valve on the 30-inch raw water main at the WTP. The sleeve valve helps prevent cavitation in the pipe. If flow is not throttled, sections between the high point in the line and the WTP would flow by gravity, and hydraulic fluctuations would form at points where the flow transitions from gravity to pressure flow. This could entrain air and cause treatment problems at the WTP. By throttling flow with the sleeve valve, we maintain pressure in the line and prevent air entrainment. The sleeve valve will continue to be required even if one (or both) of the Cane Creek raw water pumps is retrofitted with a variable speed drive. In 2002 Hazen and Sawyer recommended installation of a new automated flow throttling valve that could sense pressure at critical points in the transmission main, and minimize gravity flow and restrict air entrainment. The valve would be controlled through the WTP SCADA system. This

recommendation has not been implemented; however, it would be an important capability to have if and when variable speed drives are installed on the Cane Creek pumps.

Currently, plant operators receive pressure alarms that indicate a need to change the position of the existing sleeve valve, and they can adjust the position from the operators' control room. This procedure is relatively straightforward, as there are only three fixed pumping rates from Cane Creek.

There is also a throttle valve on the raw water main from University Lake; however, that valve is only used when we are using the large fixed speed pumps at the lake. Most of the time, we do need to operate that throttle valve since we are almost exclusively using the small variable speed pump to convey water from University Lake.

A screening analysis was done on the potential to recover energy from the Cane Creek raw water main using in-pipe energy recovery technology. It was concluded that such a system might generate around 30 to 40 kW of power, but the payback would be beyond 50 years.

ECONOMIC CONSIDERATIONS

Capital Costs: In 2002, Hazen and Sawyer estimated that it would cost about $150,000 to purchase and install a new throttle valve on the Cane Creek raw water main. Installation of an in-pipe energy recovery system on the Cane Creek raw water main would be considerably higher, and it is likely that the throttle valve would still be required. Based on information provided by one manufacturer, a 40 kW in-pipe turbine would cost around $175,000 and a 100-kW system would cost around $250,000 **excluding** consideration of construction and interconnection costs.

Operating Costs: To be determined

Potential Cost Savings: To be determined

Potential Energy Savings: Assuming a 30-kW system and an efficiency of 90%, the annual generation would be almost half of the total annual electricity use at the Administration Building, and about 7% of the total annual use at the WTP.

RELATED STUDIES / FINDINGS

- *Energy Conservation Report for OWASA – Report #NC-0567*. NC State University Industrial Assessment Center. May 19, 2016.
- *Energy Efficiency Best Practice Guide – Pumping Systems*. Sustainability Victoria. 2009.

SUMMARY OF STRATEGY EVALUATION

Each cell of the table below is color-coded to indicate whether a strategy is favorable, neutral, or unfavorable against each criterion.

Financially Responsible (High level)	Realistic/ Implementable	Operational Impacts
New throttle valve: modest investment with modest energy savings at best	Reduction of throttling may not be possible due to the configuration of the Cane Creek raw water transmission main and raw water pump station	If operation gets closer to breakpoint and air is entrained, the water treatment process may be disrupted and that could be costly
Energy/Carbon Reduction Potential	**Coordinates with Other Projects**	**Community Impacts**
Marginal – running pumps at lower levels (not burning as much head as we used to)	Conduct energy modeling (including "burned" energy) as part of the Cane Creek Pump Station Upgrade project Evaluate and consider options when existing flow throttling valve needs major maintenance or needs to be replaced	None

RECOMMENDED NEXT STEPS

Delay consideration until throttle valve is replaced at the Water Treatment Plant.

22- In-Pipeline Turbines for Hydropower Generation

BEST PRACTICE / TECHNOLOGY OVERVIEW

Description of Process: In-pipe hydroelectric power generation involves the installation of one or more turbines either in-line or in conjunction with a pressure relief valve or throttle valve. The excess pressure in the water is used to spin a turbine that is connected to a generator that produces electricity. Recovered power is either used in a nearby facility or delivered to the electricity grid in accordance with agreements with the electric utility.

Operational/Implementation Considerations: In-pipe turbine devices have been certified as safe for use in drinking water systems. When properly designed and installed, they do not impede or disrupt water delivery. Minor environmental disturbance occurs during turbine and generator installation; however, unlike fossil-fuel energy generation operations, in-pipe turbines do not cause any ongoing adverse environmental effects once they are in service.

In-pipe turbine systems can include customized monitors and controls for modulating flow and pressure in the pipe. Surge relief valves are provided to prevent overpressure from water hammer in the event of a sudden shutdown of the turbine(s).

Lucid Energy has stated that its technology is suitable for installation in steel pipes ranging from 24 to 96 inches in diameter, and that to be cost-effective, flows should usually be at least 20 mgd, velocities be at least 3 feet per second but no more than 9 feet per second, and at least five to seven pounds per square inch of pressure be available for power extraction. It advises that smaller pipes typically have only enough potential energy to power a small device or instrument.

Rentricity manufactures in-pipe turbine systems for pipes ranging from 4 inches to 36 inches in diameter.

There are several potential barriers to implementing this technology. First, flow and pressure conditions may be insufficient to generate a meaningful amount of power. Second, installation locations may be in remote areas where it is costly to connect and deliver the power to the grid or a nearby facility. Electric utility standby and interconnection charges for such arrangements may make in-pipe turbines economically infeasible.

POTENTIAL APPLICATION TO OWASA

OWASA has completed some preliminary assessments of in-pipe hydroelectric generation technology. The key take-away from these analyses is that currently, there are no economically feasible opportunities to incorporate this technology into the OWASA system.

The most recent evaluation was done by AECOM, an engineering consulting firm that developed and maintains OWASA’s water distribution system hydraulic model. AECOM used the model to evaluate potential sites where OWASA could generate electricity with in-pipe turbines and use that electricity at nearby OWASA facilities.

The AECOM study concluded that there were no existing locations in the 640-foot or 740-foot pressure zones that meet the following four main criteria they identified for hydroelectric generation:

- Excess pressure head which can be used for power generation;
- Consistent or regular flow in one direction;
- Adequate pipe diameter;
- Close proximity to an OWASA facility at which the power could be used.

OWASA also did a cursory evaluation of the feasibility of recovering energy from water flows in the raw water mains entering the Water Treatment Plant. Currently, raw water flows and pressure are controlled via throttling valves. Flows can range from 5 to more than 10 mgd, and the normal operating pressure of the throttle on the Cane Creek line is around 45 to 50 pounds per square inch. Hazen and Sawyer concluded that (a) the corresponding head ranges from about 70 down to 40 feet; (b) the power output may be in the range of 30 to 40 kW; and (c) it would not be possible to find a single turbine that would operate over this wide range of flow and head. Thus, the choice would be to (a) install multiple turbines to cover all operating conditions, or (b) select a single turbine to cover a limited range and continue to use the throttling valve for flows outside that range.

Lucid Energy advised that in-pipe turbine technology would not be cost-effective at the site due to the limited and widely varying flow and pressure in the raw water mains and the low cost OWASA pays for electricity from Duke Energy.

In a much older analysis, Hazen and Sawyer did a cursory evaluation of the feasibility of producing electricity from the water spillovers and downstream releases at Cane Creek Reservoir. This work drew extensively from Hazen and Sawyer's design work on Durham's Little River Reservoir project, which was undertaken around the same time as Cane Creek Reservoir. It was concluded that hydropower generation at Little River Reservoir was not economically feasible. Projected spill volumes and frequencies, and downstream release provisions were projected to be much lower at Cane Creek Reservoir than Little River Reservoir. Also, the Cane Creek Dam is only about 75% high as the Little River Dam – this alone translates to a 25% lower energy potential. Based on these factors, Hazen and Sawyer concluded, and OWASA concurred, that hydropower generation at Cane Creek Reservoir was economically infeasible, and would provide very limited and highly variable renewable energy generation benefits.

ECONOMIC CONSIDERATIONS

Capital Costs: Capital costs vary with pipeline size, flow and pressure conditions, end use of recovered energy, and other factors.

Operating Costs: In-pipe turbine systems are inexpensive to operate and maintain.

Potential Cost Savings: Potential cost savings will vary depending on the design and operating conditions of the in-pipe energy recovery system, and the end uses of the electricity.

Potential Energy Savings: Energy savings will vary depending on the design and operating conditions of the system, and the end uses of the electricity.

CASE STUDIES

Location: In-pipe turbines have been installed at several water utilities in the country, including: Portland Water Bureau (PWB); San Antonio Water System (SAWS); Keene, New Hampshire Water Plant; and Halifax Water in Canada.

Scale: The PWB system consists of four 42-inch Lucid Energy turbines in a 50-inch drinking water main that has an average daily flow of about 72 mgd and 12 feet of head. The system has a capacity of about 200 kW.

The SAWS project has a generation capacity of 60 kW and includes three Lucid Energy turbines in a 24-inch raw water main with average-day flows of more than 15 mgd. SAWS is leasing the system for $7,000 a year for seven years. The power generated is used at a nearby SAWS water pump station.

The Keene Water Plant system has two in-pipe turbines on a raw water main with flows averaging about 3 mgd and pressures of about 84 pounds per square inch. The system has a combined capacity of 62 kW. Power is delivered to the grid.

The Halifax Water system has a 32-kW system at a drinking water distribution control chamber.

Drivers/Funding: The PWB and SAWS projects are hosted by the water systems, but were developed and financed by private parties at no initial cost to either water system. Lucid Energy, based in Portland, Oregon, wanted a local project that it could showcase near its corporate headquarters. The PWB project cost about $1.6 million, PWB decided not to provide funding for the project as it had a long payback of between 18 and 25 years. The project developer has a 20-

year power purchase agreement with the electric utility, and PWB shares in the revenues from the project. PWB has the right to purchase the turbine system after 20 years.

Keene received an American Reinvestment and Recovery Act grant of $200,000 for its project.

The Halifax Water system cost $443,000.

Results: The PWB in-pipe turbines produce an average of about 900 mWh of electricity each year, enough to power about 100 homes.

The Halifax Water turbine project generates enough electricity to power about 30 homes.

RELATED STUDIES / FINDINGS

- *Technical Memorandum: Hydro-Generation Site Identification*. AECOM. 2016.
- Lucid Energy website: http://lucidenergy.com/
- Rentricity website: http://rentricity.com/
- E-mail communication from Jim McCarthy to Pat Davis summarizing key findings from Hazen and Sawyer's prior evaluations of hydropower generation opportunities at OWASA. August 29, 2013.

SUMMARY OF STRATEGY EVALUATION

Each cell of the table below is color-coded to indicate whether a strategy is favorable, neutral, or unfavorable against each criterion.

Financially Responsible (High level)	Realistic/ Implementable	Operational Impacts
Previous studies found no economically feasible opportunities	Technology may be feasible in the future Low and intermittent raw and finished water flows limit feasibility Energy recovery from distribution system is difficult to match with end uses for the electricity produced	If matched with end us of electricity, would provide back-up energy supply
Energy/Carbon Reduction Potential	**Coordinates with Other Projects**	**Community Impacts**
Low to modest energy generation and use potential due to limited flows and pressures and lack of nearby end uses for electricity produced by turbines	When existing throttling/sleeve valves are getting replaced and/or when new pressure zone is being considered for low part of service area When expanded Quarry Reservoir is being planned	None

RECOMMENDED NEXT STEPS
Although the results of the evaluations summarized above have not been promising, the Energy Team recommends that we evaluate the potential application of this technology on a case-by-case basis as pipeline replacement and other system improvement needs are identified and evaluated. In their 2016 Technical Memorandum, AECOM concluded that if OWASA created a new, lower pressure zone at a hydraulic grade of 520 feet from the eastern portion of the existing 640 zone, that the feed locations for that pressure zone could potentially provide a viable site for inline hydroelectric generation if located near the Rogerson Drive Pump Station or Legion Road Pump Station.

23- Reduce Distribution System Head Loss/Velocity

BEST PRACTICE / TECHNOLOGY OVERVIEW
Description of Process: Overcoming head loss and friction loss in pipes are two of the primary causes for high pumping costs and energy use within a distribution system. Much of the head loss and friction loss is a function of pipe diameter and roughness of the interior of the pipe. Higher flow velocity requires more energy. Pipes from the water pump station to elevated storage tanks result in the most significant impact on energy use as pumps must overcome the head pressure between pressure zones.
Operational/Implementation Considerations: A 2010 Hydraulic Model conducted by AECOM generally indicated that there are not many locations in the OWASA water distribution system where friction losses and flow velocities are excessive. The model did identify 900 feet of undersized water main from the Nunn Mountain Tank to the intersection of Stateside Drive and Highland Drive.
POTENTIAL APPLICATION TO OWASA
Increasing the pipe diameter in this portion of the distribution system would not likely reduce the amount of energy required to pump finished water in the 740-Zone, unless the water was coming from the Calvander Pump Station. The Nunn Mountain pumps transfer water from the ground storage reservoir into the elevated tank. The volume of the water pumped (and the associated energy use and cost) is determined by the water demand in the 740-Foot Pressure Zone. The head working against the pumps is determined by the tank and piping geometry and the pumping flow rates. From the tank the water drains by gravity into the 740-Foot Pressure Zone, not from pumping.
RELATED STUDIES/FINDINGS
• OWASA Hydraulic Model conducted by AECOM (2010)

SUMMARY OF STRATEGY EVALUATION

Each cell of the table below is color-coded to indicate whether a strategy is favorable, neutral, or unfavorable against each criterion.

Financially Responsible (High level)	Realistic/ Implementable	Operational Impacts
No economically viable solution	Distribution system model does not indicate need for this strategy	No
Energy/Carbon Reduction Potential	**Coordinates with Other Projects**	**Community Impacts**
None	No	None

RECOMMENDED NEXT STEPS

None recommended at this time

24- Four-Day/Extended Day Work Week

BEST PRACTICE / TECHNOLOGY OVERVIEW

Description of Process: A four-day, extended day (nine or ten hours) work week is one strategy that many public and private entities have implemented in certain areas to reduce operating expenses, save energy, increase employee productivity and job satisfaction, and enhance employee recruitment and retention efforts. A reduced week also enables employees to reduce their commuting costs, time, and related energy use.

Energy savings are achieved by the organization if the reduction in energy use for heating, cooling, lighting, etc. for the one additional day offices are closed is greater than the energy used to operate the affected buildings for the extended hours the offices are open.

Operational/Implementation Considerations: This strategy is primarily applicable to office-type buildings and/or operations that can be temporarily shut down for extended periods of time. The potential energy savings will not be fully realized if heating, cooling, and lighting systems are not cut back during the additional day the building is closed.

The extended workday can make the organization more accessible to customers and clients who work a traditional eight-hour workday. Potential drawbacks associated with a four-day/extended day work week are that customers and clients may find it more difficult to schedule meetings with employees and some employees may find it difficult to obtain extended child/elderly care services.

POTENTIAL APPLICATION TO OWASA

This strategy could potentially apply to OWASA's office operations; however, it would not be feasible for facilities and services that must operate on a continuous basis, such as water supply and treatment and wastewater collection and treatment.

Since currently less than 4 percent of OWASA's electrical energy use and about 12 percent of its natural gas are for operation of office-type buildings, this strategy would likely have very limited energy savings. Furthermore, the replacement of the Admin HVAC system will further reduce electrical and natural gas use in the building. While some customers working a traditional eight-hour workday may benefit from having extended in-person access to OWASA offices, others may be adversely affected if OWASA offices are open only four days a week.

ECONOMIC CONSIDERATIONS

Capital Costs: None

Operating Costs: Could vary considerably, depending on how strategy effects overtime costs

Potential Cost Savings: Likely to be small

Potential Energy Savings: Likely to be small, as this strategy would primarily be limited to office building.

CASE STUDIES

Locations: In 2008, to reduce costs and energy use, the **State of Utah** became the first state to implement a four-day, 10 hours a day work week for most state employees.

To reduce personnel and other costs, **Victorville, California** implemented a four-day/nine hours a day work week.

Scale: Utah implemented its program in most all its office buildings

Drivers/Funding: Cost-cutting measure following economic downturn and rising energy prices

Results: Utah discontinued its four-day work week after energy prices declines, the public complained about not having access to state services on Fridays, and a follow-up study showed that normalized energy use in 125 state office buildings dropped only 10.5 percent compared to the expected 20 percent.

SUMMARY OF STRATEGY EVALUATION

Each cell of the table below is color-coded to indicate whether a strategy is favorable, neutral, or unfavorable against each criterion.

Financially Responsible (High level)	Realistic/ Implementable	Operational Impacts
Unlikely based on other studies	Applicable to office settings (not 24/365); may not be responsive to needs of certain customers	Internal equity issues Would complicate scheduling of meetings and interactions with internal staff, project consultants, and others
Energy/Carbon Reduction Potential	**Coordinates with Other Projects**	**Community Impacts**
Energy and cost saving benefits only realized if building is completely shut-down for one weekday	No	Extended office hours (beyond 8:00 – 5:00) could benefit some customers but adversely affect others

RECOMMENDED NEXT STEPS / NEEDS

None at this time

25- Wind Power

BEST PRACTICE / TECHNOLOGY OVERVIEW

Description of Process: Wind power is being increasingly harnessed to produce clean, renewable electricity, and wind-based power generating capacity has increased substantially in the United States over the last several decades. However, it supplies only about five percent of our country's electricity generation mix.

Wind turbines use blades to collect the wind's kinetic energy. Wind flows over the blades creating lift (similar to the effect on airplane wings), which causes the blades to rotate and turn a drive shaft. The drive shaft turns an electric generator, which produces electricity.

Unlike conventional fossil-fueled power generators, no fuel or other variable costs are associated with wind power generation. The wind turbine's power generating capacity is very closely related to the available wind resource – that is, the average wind speed. The power generated is a function of the cube of the average wind speed.

Wind power can be developed at either a commercial or residential scale; however, as discussed below, there are significant economies of scale in wind power generation.

Operational/Implementation Considerations: A good site for a wind turbine needs exposure to wind. The more wind, the greater the amount of energy and cost savings generated by the turbine.

Wind speed and turbulence vary at different heights in the atmosphere. The following table summarizes average wind speeds in the piedmont region of North Carolina, as indicated by the National Renewable Energy Laboratory's annual average wind speed maps.

Height (Meters)	Average Wind Speed, meters per second (m/s)
30	Less than 4
50	0 to 5.6
80	4 to 4.5
110	Near 0

An average wind speed of 4 meters per second (around 9 miles per hour) is considered the minimum wind resource needed for small wind projects. At a height of 110 meters, the National Renewable Energy Laboratory suggests that the wind resource potential is near zero in the piedmont region of the state.

Commercial scale wind turbines require a 30 to 50 feet wide support foundation. Turbine blades can extend more than 60 meters; since the turbine must be able to spin in any direction, this clearance must be provided in every direction. In a 2009 study of 172 wind projects, the National Renewable Energy Laboratory found that an average of about 85 acres of land was needed for every 1 megawatt (mW) of installed capacity.

General Electric produces commercial scale wind turbines ranging from 1.7 to 3 mW, with tower heights ranging from 65 to 164.5 meters (213 to 540 feet).

Wind power projects can provide many benefits, but they also have several potential drawbacks, as they can

- generate noise that may be considered undesirable to nearby neighbours;
- adversely impact aesthetics, as the height and scale may be unacceptable to some people;
- adversely affect wildlife, including birds and bats;
- potentially affect local air traffic; and
- generate concern about structural stability and potential damage from structural failure.

Assessment of the wind resource at a prospective wind turbine site is a complex process involving several stages of data collection, modeling, and statistical analysis. To inform such assessments, it is generally recommended that a high quality meteorological monitoring campaign at the turbine location and at hub height be conducted for a period of at least 12 months.

POTENTIAL APPLICATION TO OWASA

Based on the limited available wind resource and other factors, it is unlikely to be economically feasible for OWASA to develop a wind power project, or to host a wind power project developed by another party. A detailed site assessment and feasibility study would be needed to fully assess the potential for OWASA to produce electricity from wind.

North Carolina utility laws prevent OWASA from purchasing electricity produced by any party other than Duke Energy. These laws preclude an alternative strategy to seek and consider proposals for offsetting a portion of OWASA's use of fossil fuel derived electricity by entering into agreements that enable OWASA to take credit for wind power generated by third parties.

ECONOMIC CONSIDERATIONS

Capital Costs: According to Windustry (a non-profit organization that promotes renewable energy) commercial scale wind turbine projects reportedly cost between $1.3 million and $2.2 million per mW of installed capacity. Small scale wind turbines range from 2 kW to around 100 kW and cost between $3,000 and $8,000 per kW of installed capacity.

In a wind turbine feasibility study report for the Riverhead Sewer District, Neutral Power reported that the cost of buying and installing a 750-kW wind turbine would be about $2,100 to $2,300 per kW of capacity. The cost of a 250-kW turbine was reported to be around $3,300 per kW.

The American Wind Energy Association reports that the cost of buying and installing a small wind energy system typically ranges from about $3,000 to $5,000 per kW for a grid-connected system.

Operating Costs: In the Riverhead wind turbine study, Neutral Power reported that the National Renewable Energy Laboratory's *Wind Turbine Design Cost and Scaling Model* indicated an annual operating and maintenance cost of $40,000 for a 750-kW wind turbine.

Potential Cost Savings: Will vary based on local conditions, power costs, etc.

Potential Energy Savings: Will vary based on wind conditions and other factors.

CASE STUDIES

Location: The Atlantic County Utilities Authority (ACUA) in New Jersey allowed a private developer to construct the Jersey-Atlantic Wind Farm at the utility's Wastewater Treatment Facility (WWTF), with the provision that ACUA would have the right to purchase wind power for a twenty year period from 2005 to 2025 (WERF).

Scale: The private wind farm at the WWTF consists of five, 380-foot high turbines that have a combined power generation capacity of 7.5 mW.

Drivers/Funding: The ACUA pursued this project to offset rising electricity rates charged by its electric utility. It did not contribute any funding for construction of the project.

Results: This arrangement offsets about two-thirds of the WWTF's annual electricity requirements. The ACUA can purchase wind power at a lower rate than it is charged by its electric utility, and is now assured of more stable electricity prices through 2025.

RELATED STUDIES / FINDINGS

- *Riverhead Sewer District Wind Turbine Feasibility Study*. Neutral Power. April 2010.
- *Wind Turbine Design Cost and Scaling Model*. National Renewable Energy Laboratory. 2006.
- *North Carolina – Annual Average Wind Speed Map at 80 meters*. AWS Truepower and National Renewable Energy Laboratory. 2010.
- *US Department of Energy, Energy Efficiency and Renewable Energy Program*. WindExchange website.
- *Energy Efficiency in Wastewater Treatment in North America: A Compendium of Best Practices and Case Studies of Novel Approaches*. Water Environment Research Foundation and International Water Agency. 2010.

SUMMARY OF STRATEGY EVALUATION

Each cell of the table below is color-coded to indicate whether a strategy is favorable, neutral, or unfavorable against each criterion.

Financially Responsible (High level)	Realistic/ Implementable	Operational Impacts
High cost in our geography and at our scale; likely to be negative payback	No, especially given limited wind potential for Piedmont region	Would require contract operation and maintenance
Energy/Carbon Reduction Potential	**Coordinates with Other Projects**	**Community Impacts**
Minimal	NA	Likely neighborhood concerns

RECOMMENDED NEXT STEPS / NEEDS

None at this time

26- Greenhouse Solar Drying of Water and/or Wastewater Solids

BEST PRACTICE / TECHNOLOGY OVERVIEW

Description of Process: Solar drying technology is an energy-efficient strategy for reducing the moisture content and volume of water and wastewater solids.

For many decades, solar drying of solids was accomplished via paved drying beds upon which liquid or dewatered solids were applied and allowed to dry (via evaporation and drainage) over time.

Drying beds are simple, relatively cheap to construct, and require minimal operation attention. However, they have disadvantages due to large area requirements, dependence on local climatic conditions, less predictable and effective solids removal, low pathogen removal levels, and odor issues.

More recently, greenhouse solar drying technology has been developed to overcome many of the disadvantages of solids drying bed technology. Greenhouse solar dryers concentrate solar radiation inside a climate-controlled building that has a transparent roof. Typically, dewatered solids are loaded into the front end of the dryer either manually (with a front-end loader) or automatically through a conveyor system. To facilitate evaporation of moisture, the dewatered solids are spread in a layer on the dryer floor, and automated equipment periodically turns, mixes, breaks up, and aerates the solids, and moves them from one end of the dryer to the other.

Climate sensors and ventilation systems are installed to provide optimum ventilation, air flow, and moisture conditions in the solar dryer. Ventilators and louvers are used to remove humid, warm air from the greenhouse and to replace it with cooler, drier ambient air.

Greenhouse solar dryers are usually designed for batch operations. Dewatered solids are transported and loaded into the greenhouse dryer, and the building is closed when it has been loaded to its maximum operating depth. The greenhouse dryer remains closed until the solids dry to at least 75%, at which time the solids are removed, and the process is repeated. Multiple greenhouse dryers are required to process multiple batches of solids.

By drying solids to a content of 75% or more solids, greenhouse solar dryers substantially reduce the volume of solids that must be transported to a final destination, thereby saving time and reducing costs and energy use for final transport. By using renewable solar energy as the primary energy input, solar drying has very little carbon emissions compared to traditional thermal dryers.

Operational/Implementation Considerations: Solar drying systems can be automated and controlled by a programmable logic controller. They are very safe and relatively simple to operate, as they require little operator attention. Operators need to know how to operate a front-end loader.

In addition to the solar greenhouse structures, a control building is required to house electrical equipment, instrumentation, and controls. Provisions must also be made for storing and curing the dried solids until they can be beneficially reused off-site. Additionally, provisions must be made to temporarily store liquid or dewatered solids prior to solar drying, or to dispose of those solids via another option, during periods of extended cold and cloudy weather when solar drying operations are much less efficient.

Solar drying has three key additional disadvantages when compared to traditional thermal drying.

First, it is not specifically designated as a process for removing pathogens in US EPA 40 CFR 503 (EPA's Biosolids Rule); however, it may be designated as a Class A process based on a site-specific performance evaluation and associated permit. Second, system performance is much less predictable as it varies with climate, and supplemental heating systems may be needed in winter. Third, solar drying requires considerable land area.

Durham County's study of biosolids management alternatives estimates that about 11,000 square feet of solar greenhouse space is required for each 1 mgd of wastewater flow, assuming an input solids concentration of 17%.
POTENTIAL APPLICATION TO OWASA
Greenhouse solar drying technology could potentially be applicable to OWASA operations; however, land constraints would likely make this strategy infeasible at the Mason Farm WWTP. Potential options could include installing solar drying facilities at OWASA's biosolids land application site, or hauling dewatered solids to a solar drying facility owned and operated by another entity. Transporting liquid biosolids to off-site drying facilities would mitigate some, if not all, of the energy benefits associated with this strategy. Based on biosolids management cost analyses completed by Raleigh and Durham County, it is unlikely that solar drying technology will be financially cost-effective for OWASA in the foreseeable future.
ECONOMIC CONSIDERATIONS
Capital Costs: The Raleigh biosolids management plan reports that a solar drying system with a capacity of 14,637 dry tons a year (about 1.7 dry tons/hour) would cost about $23.7 million to build ($ dry ton/day). The system would consist of 16 modules, each about 42 feet wide by 450 feet long (total system of 168,000 square feet).
Operating Costs: The Raleigh study indicated that solar drying operating costs are less than half of that for traditional thermal dryers, and that the 16-module system would have an operating cost of about $25.45 dry ton.
Potential Cost Savings: Depends on site conditions and other available options for solids management and disposal.
Potential Energy Savings: Greenhouse solar dryers with ventilation and mixing systems reportedly use between 15 and 40 kWh of electricity per ton of evaporated water. That is about two to three times less than the energy used for traditional thermal dryers. Less fossil-fuel derived energy use result in lower CO_2 emissions. One study of different drying systems in Germany concluded that CO_2 emissions from solar dryers are only 15% of that from thermal dryers. (The Raleigh study estimated that energy use for greenhouse solar drying would be about 110 kWh per dry ton of solids.)
CASE STUDIES
Parkson reports that it has at least 15 solar dryers in operation in nine different states in the U.S. The dryers serve WWTPs ranging in size from about 0.3 mgd to 8 mgd, and were built between 2002 and 2011.
Locations: The **Tooele, Utah Wastewater Treatment Plant** reportedly installed the first solar thermal dryer in the U.S.
Scale: The solar dryer is about 49,000 square feet and serves a 2.5 mgd WWTP.
Drivers/Funding: The solar dryer and dewatering system cost about $4.9 million.
Results: The dryer reduces solids volume by about 75%.

RELATED STUDIES / FINDINGS

- "Technical Memorandum: Biosolids Management Alternatives Evaluation – Durham County." HDR. September 2, 2016
- "Preliminary Engineering Report: Neuse River Resource Recovery Facility Bioenergy Recovery Program –Volume 1." Black & Veatch, Brown and Caldwell, and Hazen. May 2016.
- "Solar Dryers for Biosolids – Features and Design Information." Huber Technology, Inc.

SUMMARY OF STRATEGY EVALUATION

Each cell of the table below is color-coded to indicate whether a strategy is favorable, neutral, or unfavorable against each criterion.

Financially Responsible (High level)	Realistic/ Implementable	Operational Impacts
Not for OWASA-owned facility, since solar dryer would have to be located at remote site	Highly unlikely unless solar drying services are offered by another nearby utility at very low cost to OWASA	Solar dryer would have to be located off-site due to space constraints at WWTP Solids loading and unloading process is labor intensive
Energy/Carbon Reduction Potential	**Coordinates with Other Projects**	**Community Impacts**
Reduced energy use and carbon emissions compared to thermal drying	Conflicts with OWASA's existing targets for liquid versus dewatered biosolids management	Odor control

RECOMMENDED NEXT STEPS / NEEDS

Given that the Board of Directors has directed OWASA toward recycling about 75% of its biosolids in liquid form on approved farmland and recycling about 25% in dewatered form at a private composting facility in Chatham County and the space constraints at the Mason Farm WWTP, moving forward with a study on the potential of greenhouse solar drying is not recommended.

Appendix C: CIP Projects Unlikely to Reduce Energy Use

The following projects were previously identified as having a potential impact on electricity use. However, as each project design was developed, their potential to reduce energy use was determined to be nominal.

1. **Rogerson Drive Pump Station Rehabilitation (CIP No. 277-31)**
   Preliminary engineering was completed in FY16 which refined the project scope to include installation of grinders and installation of four (two new and two replacement) variable frequency drives (VFDs); electrical distribution system replacement; ventilation and air conditioning improvements; and various other safety, efficiency, and functional enhancements. While installing four VFDs will allow for operational flexibility, it will be unlikely to have a significant impact on energy use, as we currently only use the non-VFDs as back-up.

2. **Nunn Mountain Pump Station Evaluation**
   Although VFDs are necessary to keep adequate pressure in the 740 zone when the Nunn Mountain Elevated Tank is offline for service, these VFDs will provide no measurable energy savings on an ongoing basis. This is since we do not keep constant water levels in the elevated tank and do not require variable rates of pumping. (i.e. the pumps are either on or off). Installing soft-starts on the motor could reduce demand costs.

3. **Wastewater Treatment Plant Intermediate Pump Stations (IPS) Rehabilitation (CIP No. 278-54)**
   A FY 2016 study determined that, given uncertainty on when we would need additional capacity, rehabilitation of certain components of both Intermediate Pump Stations at the Wastewater Treatment Plant was preferable to replacing or relocating stations. The current project will proceed with making electrical system improvements, ventilation and air conditioning improvements, and replacement of variable frequency drives (VFDs) as recommended. With this project, there will be very minor energy efficiency improvements made in lighting and space conditioning.

4. **WTP Filter Media and Backwash Pump Replacement (CIP No 272-40)**
   We originally planned to replace the filter backwash pump in advance of replacing media in the ten dual-media filters at the Water Treatment Plant. As part of the project, our consultant tested the performance of the 250-hp, constant speed pump originally installed in the late-1940s and found it to be a high-performing pump and did not recommend replacing the pump.

   Although the pump is not operating at maximum efficiency, the energy and cost savings of a new, more efficient pump would likely be very small due to the hours of operation. The backwash pump typically runs once or twice a day, as needed, and operates for several minutes each time. It is estimated that the pump runs only about 1.4% of the time, which equates to about 120 hours a year at current flow conditions. Assuming a 30% net increase in efficiency, the energy savings would total only about 4,200 kWh a year and the cost savings would be about $325 a year (assuming the average cost of electricity including kWh and kW charges).

We should continue to evaluate the efficiency of backwash pump and be prepared to replace the pump with a high-efficiency model when the current pump fails. As currently scoped, this project will include some electrical system upgrades, which will likely result in modest energy savings.

7. **Water Treatment Generator Building Louver Replacement (CIP 272-34)**
   Over the last year, we have realized that we do not need to constantly heat the Water Treatment Plant generator building. Each of the generators have block heaters that allow them to start when needed, and operators and maintenance staff have not needed the heat when using and working on the generators. So, while this project is important to have a properly operating system, the need for natural gas to heat this building has been significantly reduced without this project.

Relative comparison of performance to each other (only applicable to the objective for that row)

Key to Cell Shading:	UNACCEPTABLE	SIGNIFICANT CONCERN	ACCEPTABLE	BETTER	BEST

		OPTION 1 BASELINE (EXISTING PROGRAM) BIOGAS TO BOILERS WITH EXCESS FLARED OFF	OPTION 2 BIOGAS CHP SYSTEM OPERATING CONTINUOUSLY - 330 kW NET METERING OR SALE TO DUKE ENERGY	OPTION 3 BIOGAS CHP SYSTEM DUAL-FUELED WITH NATURAL GAS FOR FULL PEAK POWER GENERATION - 1,350 kW	OPTION 4 BIOGAS CHP SYSTEM WITH HIGH-STRENGTH ORGANIC WASTE (HSOW) RECEIVING - 700 kW	OPTION 5 BIOGAS USED AS RENEWABLE COMPRESSED NATURAL GAS (rCNG) FOR VEHICLE FUEL	OPTION 6 BIOGAS DELIVERED TO OTHER PARTIES OR AGGREGATOR VIA "MOBILE PIPELINE" STRATEGY	OPTION 7 BIOGAS WHOLESALED TO PSNC NATURAL GAS PIPELINE
FINANCIALLY RESPONSIBLE	30-YEAR NET PRESENT VALUE w/out SCC (Best Case/Worst Case)		($133,000) / ($3,816,000)	+$1,014,000 / ($5,255,000)	+ $4,812,000 / ($8,539,000)	+ $7,680,000 / ($1,895,000)	+$220,000 / ($6,348,000)	+ $2,653,000 / ($5,562,000)
	30-YEAR NET PRESENT VALUE with SCC (BEST/WORST)		($51,000) / ($2,533,000)	+$1,754,000 / ($4,516,000)	+ $6,733,000 / ($6,578,000)	+ $8,824,000 / ($751,000)	+$1,364,000 / ($1,520,000)	+ $3,722,000 / ($4,443,000)
	INITIAL CAPITAL COSTS (BEST/WORST)	$0 No new equipment needed	$2.2 million / $2.8 million Small engine and heat recovery system; gas treatment and conditioning; electrical systems integration 60% methane concentration	$3.2 million / $4.5 million Large engine and heat recovery system; additional biogas storage tank; gas treatment and conditioning; electrical systems integration ~60% methane concentration	$4.6 million / $6.5 million Moderate-sized engine and heat recovery system; HSOW receiving and processing facilities; larger gas treatment and conditioning system; electrical systems integration ~60% methane concentration	$3.0 million / $4.2 million Gas treatment, conditioning and upgrade system; gas compression; gas storage and vehicle fueling station; vehicle conversions; tube truck for off-site transport of gas ~88% - 90% methane concentration	$1.3 million / $2.3 million Dependent on capital costs borne by aggregator; would require baseline investment in preliminary gas treatment, conditioning and upgrade system and gas compression and storage; could require tube truck for off-site transport of gas Could range from ~60% - 90% methane concentration	$2.9 million / $4.3 million Gas treatment, conditioning, and upgrade system; gas compression; pipeline interconnection ~98% methane concentration
	OPERATING AND MAINTENANCE (O&M) COSTS	Boiler maintenance (higher because there is no gas treatment and conditioning); supplemental purchase of natural gas	Moderate O&M costs for engine and gas treatment systems	Moderate O&M costs for engine and gas treatment systems	High O&M costs for engine, gas treatment, and HSOW receiving and processing systems	Potentially high O&M costs for gas treatment and compression system and vehicle fueling arrangements as well as mobile gas transport operations	Moderate to high O&M costs for gas treatment and compression system	Potentially high O&M costs for gas treatment and compression system and ongoing monitoring
	ANNUAL NET SAVINGS (COSTS) POTENTIAL - EXCLUDING SCC	Use of biogas in boilers instead of natural gas offsets cost of natural gas	Reduction in electricity purchases and of natural gas needed for heating digesters	Reduction in electricity purchases and of natural gas needed for heating digesters	Revenue from tipping fees and reduction in electricity purchases and of natural gas needed for heating digesters	Revenue from sale of rCNG and any associated RINs; offset purchase of vehicle fuel	Revenue from sale of biogas and any associated RINs	Revenue from sale of biogas and any associated RINs

		OPTION 1 BASELINE (EXISTING PROGRAM) BIOGAS TO BOILERS WITH EXCESS FLARED OFF	OPTION 2 BIOGAS CHP SYSTEM OPERATING CONTINUOUSLY - 330 kW NET METERING OR SALE TO DUKE ENERGY	OPTION 3 BIOGAS CHP SYSTEM DUAL-FUELED WITH NATURAL GAS FOR FULL PEAK POWER GENERATION - 1,350 kW	OPTION 4 BIOGAS CHP SYSTEM WITH HIGH-STRENGTH ORGANIC WASTE (HSOW) RECEIVING - 700 kW	OPTION 5 BIOGAS USED AS RENEWABLE COMPRESSED NATURAL GAS (rCNG) FOR VEHICLE FUEL	OPTION 6 BIOGAS DELIVERED TO OTHER PARTIES OR AGGREGATOR VIA "MOBILE PIPELINE" STRATEGY	OPTION 7 BIOGAS WHOLESALED TO PSNC NATURAL GAS PIPELINE
	FINANCIAL RISK FACTORS	Minimal risks Vulnerable to large increases in Duke Energy rates	Biogas storage rehabilitation can impact biogas availability; air permitting requirements Decreases in future price Duke Energy pays for purchase of power would adversely affect project payback; biogas storage rehabilitation can impact biogas availability; air permitting requirements	Start-stop operation of engine on daily basis could potentially adversely affect useful life of engine; changes in Duke Energy rates could reduce financial benefit; biogas storage rehabilitation can impact biogas availability; air permitting requirements	High risk Potential for stranded capital if supply of HSOW fails to materialize; decline in tip fees charged would reduce financial viability; variability in composition and quality of HSOW could affect digestion process stability; processing of HSOW could increase biosolids production and associated costs, nutrient loads, etc. and reduce available digester capacity	Moderate risk RIN market price subject to volatility, and federal RFS requirements could be rescinded; rCNG system outage could affect availability of essential vehicles and equipment unless adequate alternative supply of CNG fuel was available	Moderate risk RIN market price subject to volatility, and federal RFS requirements could be rescinded; rCNG system outage could affect availability of essential vehicles and equipment unless adequate alternative supply of CNG fuel was available	Moderate risk RIN market price subject to volatility, and federal RFS requirements could be rescinded; rCNG system outage could affect availability of essential vehicles and equipment unless adequate alternative supply of CNG fuel was available
REALISTIC/ IMPLEMENTABLE	DEMONSTRATED SUCCESS	Successfully used at many WWTPs in U.S.; has been used successfully by OWASA since 1977	Successfully used at several WWTPs in U.S., including at scale of OWASA	Successfully used at some private facilities and a few larger WWTPs	Successfully used at several WWTPs; however, most are at scale larger than OWASA and received grant funding to improve financial feasibility	Extensively used in Europe; a few WWTPs in U.S. are using biogas rCNG as vehicle fuel; limited experience at OWASA's scale	No known aggregator projects in NC, and very limited experience in U.S.; no identified WWTPs; some experience in Europe	Several large WWTPs in U.S. have pipeline injection systems, and others (including Raleigh) are planned; very little experience at scale of OWASA WWTP
	IMPLEMENTATION RISK FACTORS	None	Electrical configuration at WWTP presents challenges for integration	Duke Energy's willingness to reduce Contract Demand minimum to 15 kW; Duke Energy's willingness to allow system to run in parallel; electrical configuration at WWTP presents challenges for integration	Electrical configuration at WWTP presents challenges for integration	Complexity associated with partnership coordination	No biomethane pipeline injection standards established in NC; no biomethane aggregators in NC; complexity associated with partnership coordination	No biomethane pipeline injection standards established in NC

OPERATIONAL IMPACTS	EMPLOYEE HEALTH AND SAFETY	Minimal risk	Slightly greater risk for operation and maintenance of on-site power generation (similar to standby power generation)	Slightly greater risk for operation and maintenance of on-site power generation (similar to standby power generation); gas storage (especially if pressured) presents safety concerns	Greater risk for operation and maintenance of on-site power generation (similar to standby power generation); greater risk for operation and maintenance of HSOW receiving and processing	Greater risk for operation and maintenance of gas treatment, conditioning and compression system and vehicle fueling system	Greater risk for operation and maintenance of gas treatment, conditioning and compression system and vehicle fueling system	Greater risk for operation and maintenance of gas treatment, conditioning and compression system
	WORK EFFECT ON EMPLOYEES (PROGRAM STAFF AND MANAGEMENT)	Minimal effect	CHP and biogas treatment and conditioning systems will increase staff maintenance responsibilities and complexity of operations	CHP and biogas treatment and conditioning systems will increase staff maintenance responsibilities and complexity of operations	CHP, biogas treatment and conditioning, and HSOW receiving systems will substantially increase staff maintenance responsibilities and complexity of operations	Much greater level of maintenance and complexity of operations for biogas treatment and conditioning system and rCNG storage and fueling system. Vehicle conversions to rCNG will increase complexity for vehicle maintenance staff	Greater level of maintenance and complexity of operations for biogas treatment and conditioning system and rCNG storage and fueling system.	Biogas treatment and conditioning system, as well as monitoring equipment, will increase staff maintenance responsibilities and complexity of operations
	OPERATIONAL RESILIENCY AND RELIABLITY	Provides basic level of operational resiliency and reliability	Greater level of operation resiliency and reliability; could be directly tied to a 24/7 baseload at WWTP	A 1,350kW CHP system that can be powered with biogas and natural gas provides energy supply back-up roughly equivalent to current peak demands	Greater level of operation resiliency and reliability	Greater level of operation resiliency and reliability	Greater level of operation resiliency and reliability	On-site use of natural gas if pipeline goes down
	OTHER OPERATIONAL RISK FACTORS	None	Space requirements of gas treatment and storage facilities and CHP system eliminates availability for future needs of WWTP	Space requirements of gas treatment and storage facilities and CHP system eliminates availability for future needs of WWTP	Space requirements of gas treatment and storage facilities, CHP system, and HSOW receiving and processing station eliminates availability for future needs of WWTP	Space requirements of gas treatment, compression, and storage facilities, *r*CNG vehicle fueling equipment, and vehicle access eliminates availability for future needs of WWTP	Space requirements of gas treatment, compression, and storage facilities, rCNG fuel uploading equipment, and vehicle access eliminates availability for future needs of WWTP	Space requirements of gas treatment and compression facilities eliminates availability for future needs of WWTP
ENERGY/CARBON REDUCTION POTENTIAL	RENEWABLE ENERGY GENERATION (NET) AND REDUCTION IN GREENHOUSE GAS EMISSIONS	Use of biogas in boilers instead of natural gas provides moderate reduction in GHGs	~ 1.9 million kWh/year Greater reduction in GHGs ~750 Metric Tons/Year from kWh	~ 1.335 Million kWh/year Greater reduction in GHGs	~ 4 million kWh/year High Reduction in GHGs	High reduction in GHGs if off-setting diesel fuel	High reduction in GHGs	High reduction in GHGs

COORDINATION WITH OTHER PROJECTS	INTERDEPENDENCE WITH OTHER (OWASA) PROJECTS / POTENTIAL TO TAKE ADVANTAGE OF ECONOMIES OF SCALE	None	Unknown without long-term WWTP site development plan	Unknown without long-term WWTP site development plan	Unknown without long-term WWTP site development plan	Unknown without long-term WWTP site development plan	Unknown without long-term WWTP site development plan	Unknown without long-term WWTP site development plan
COMMUNITY IMPACTS	NOISE, ODOR, AND TRAFFIC CONCERNS	Minimal concerns	Increased noise risk due to CHP system operation; increased odor risk if gas treatment system malfunctions	Increased noise risk due to CHP system operation with large engine; increased odor risk if gas treatment system malfunctions	Increased noise from CHP system operation; increased odor risk from transport, receipt, and processing of HSOW; increased truck traffic for hauling HSOW and more biosolids	Increased noise risk due to system operation; tube truck transport; increased odor risk if gas treatment system malfunctions	Increased noise risk due to system operation; tube truck transport; increased odor risk if gas treatment system malfunctions	Increased noise risk due to system operation; increased odor risk of gas treatment system malfunctions
	SERVICE TO COMMUNITY	Provides limited direct benefit to the community	Provides limited direct benefit to the community	Provides limited direct benefit to the community	Provides convenient local option for disposal of HSOW from the community	Provides locally-derived renewable vehicle fuel for potential use locally	Provides locally-derived renewable vehicle fuel for potential use locally	Provides limited direct benefit to the community

Agenda Item 8:

Review Board Work Schedule

Purpose:

a) Request(s) by Board Committees, Board Members and Staff
b) Review the draft agendas and discuss expectations for the April 27, 2017 and May 11, 2017 meetings
c) Review and update the 12 Month Board Meeting Schedule
d) Review Pending Key Staff Action Items

Information:

- Draft agenda for the April 27, 2017 meeting
- Draft agenda for the May 11, 2017 work session
- Draft 12 Month Board Meeting Schedule
- Pending Key Staff Action Items from Board Meetings

April 13, 2017

Agenda
Meeting of the OWASA Board of Directors
Thursday, April 27, 2017, 7:00 P.M.
Chapel Hill Town Hall

In compliance with the "Americans with Disabilities Act," interpreter services are available with five days prior notice. If you need this assistance, please contact the Clerk to the Board at 919-537-4217 or aorbich@owasa.org.

The Board of Directors appreciates and invites the public to attend and observe its meetings. Public comment is invited either by petition upon topics not on the Board's agenda, or by comments upon items appearing on the Board's agenda. Speakers are invited to submit more detailed comments via written materials, ideally submitted at least three days in advance of the meeting to the Clerk to the Board via email or US Postal Service (aorbich@owasa.org/400 Jones Ferry Road, Carrboro, NC 27510).

Public speakers are encouraged to organize their remarks for delivery within a four-minute time frame allowed each speaker.

Announcements

1. Announcements by the Chair
   A. Any Board Member who knows of a conflict of interest or potential conflict of interest with respect to any item on the agenda tonight is asked to disclose the same at this time.
2. Announcements by Board Members
3. Announcements by Staff

Petitions and Requests

1. Public
2. Board
3. Staff

CONSENT AGENDA
Action

1. Resolution Awarding Audit Contract to Martin Starnes & Associates, CPAS, P.A. and Authorizing Chair of the Board of Directors and the Finance Officer to Execute Said Contract (Stephen Winters)
2. Minutes of the February 17, 2017 Special Work Session of the Board of Directors (Andrea Orbich)
3. Minutes of the April 13, 2017 Closed Session of the Board of Directors for the Purpose of Discussing a Personnel Matter (Robert Morgan)

REGULAR AGENDA
Discussion and Action

4. Review Draft Fiscal Year 2018 Budget, Rates, and Reserves and Authorize Staff to Publish Draft Fiscal 2018 Budget and Rates Information (Stephen Winters)
5. Approval of Energy Management Plan (Mary Tiger)

Discussion

6. ***Tentative*** - Discuss Advanced Metering Infrastructure Manual Read Charge (Stephen Winters)
7. Discuss Options to Advance Employee Pay Based on Performance (Stephanie Glasgow)
8. Discuss Near-Term Action Plan to Improve Strategic Communications during OWASA related Emergencies (Ed Kerwin)

Information and Reports

9. Financial Report for the Nine Month Period Ended March 31, 2017 (Stephen Winters)

Summary of Board Meeting Action Items

10. Executive Director will summarize the key action items from the Board meeting and note significant items for discussion and/or action expected at the next meeting

Closed Session

11. The Board of Directors will convene in a Closed Session for the Purpose of Discussing a Personnel Matter (Robert Morgan)

Agenda
Work Session of the OWASA Board of Directors
Thursday, May 11, 2017, 6:00 P.M.
OWASA Community Room

The Board of Directors appreciates and invites the public to attend and observe its meetings. For the Board's Work Session, public comments are invited on only items appearing on this agenda. Speakers are invited to submit more detailed comments via written materials, ideally submitted at least three days in advance of the meeting to the Clerk to the Board via email or US Postal Service (aorbich@owasa.org/400 Jones Ferry Road, Carrboro, NC 27510).

Public speakers are encouraged to organize their remarks for delivery within a four-minute time frame allowed each speaker.

The Board may take action on any item on the agenda.

Announcements

a. Announcements by the Chair
   - Any Board Member who knows of a conflict of interest or potential conflict of interest with respect to any item on the agenda tonight is asked to disclose the same at this time.

b. Announcements by Board Members

c. Announcements by Staff

Consent Agenda
Action

1. Award the Rogerson Drive Pump Station Rehabilitation Contract (Simon Lobdell)
2. ***If Needed*** - Approve Advanced Metering Infrastructure Manual Read Charge (Stephen Winters)

Regular Agenda
Discussion

3. Review Advanced Metering Infrastructure Procurement Contract (Todd Taylor)
4. ***If Needed*** - Review Employee Health and Dental Insurance Renewal (Stephanie Glasgow/Ellen Tucker, Hill, Chesson and Woody)
5. Review Information and Options for Employee Merit Pay for Fiscal Year 2018 (Stephanie Glasgow)
6. Review Board Work Schedule (John Young/Ed Kerwin)
   a. Request(s) by Board Committees, Board Members and Staff
   b. May 25, 2017 Board Meeting
   c. June 8, 2017 Work Session
   d. 12 Month Board Meeting Schedule
   e. Pending Key Staff Action Items

Summary of Work Session Items

7. Executive Director will summarize the key staff action items from the Work Session

OWASA Board of Directors – 12 Month Board Meeting Schedule (April 7, 2017)

Month	Board Meetings		Committee & Other Meetings and Reports
	Work Session	**Business Meeting**	
April 2017	***Discuss Draft Energy Management Plan*** Discuss Employee Health and Dental Insurance Renewal - Update () Award the Eastowne, Eubanks and Meadowmont 1 Pump Station Improvements Contract Approve Action Plan to resume fluoride CS – ED Interim Review () *4/13/2017*	***Approve Energy Management Plan*** ***Discuss AMI Manual Read Charge (tentative)*** FY 18 Draft Budget, Rates and Reserves and authorize staff to publish proposed rates () Discuss Options to Advance Employee Pay Based on Performance Q3 Financial Report () Appoint Audit Firm () Discuss near-term action plan to improve strategic communications during OWASA related emergencies CS – ED Interim Review () *4/27/2017*	
May 2017	***Review AMI System Procurement Contract*** ***Approve AMI Manual Read Charge (if needed)*** Discuss Employee Health and Dental Insurance Renewal (if needed) () Discuss Employee Merit Pay for FY 18 () Award the Rogerson Drive Pump Station Rehabilitation Contract *5/11/2017*	***Approve AMI System Procurement Contract*** Public Hearings – FY 18 Budget and Rates () Approve Employee Health and Dental Insurance Renewal () Award the Water Treatment Plant Filter Media and Backwash Improvements Contract *5/25/2017*	
June 2017	***Discuss LRWSP – Demands & Yield*** Approve FY 18 Budget and Rates () Approve Employee Merit/Cost of Labor Pay Increases for FY 18 () Award the Hillsborough Street Water Main Replacement Contract Discuss KPI Trends Election of Officers () *6/8/2017*	TBD *6/22/2017*	*Progress Report on Diversity and Inclusion*
July 2017	TBD *7/13/2017*	TBD *7/27/2017*	
August 2017	***Overview of Land Management*** Award the Brandywine Drive Water Main Replacement Contract CS – General Counsel Review () 8/10/2017	Preliminary 12 Month Financial Report () CIP Semiannual Report () EEO/Affirmative Action Report () Award the Administration Building HVAC Replacement Contract CS – General Counsel Review () *8/24/2017*	
September 2017	Diversity and Inclusion Progress Report Award the Dobbins Drive Water and Sewer Main Replacement Contract CS – ED Review () *9/14/2017*	Annual Report and Financial Audit () Approve General Counsel Engagement () CS – ED Review () *9/28/2016*	*Progress Report on Diversity and Inclusion*
October 2017	Discussion of impact on MFMM rate change CS – ED Review () 10/12/2017	Q1 Financial Report () Strategic Trends Report () CS – ED Review () 10/26/2017	
November 2017	TBD 11/9/2017	*Holiday - no meeting*	
December 2017	Discuss KPI Trends 12/14/2017	*Holiday - no meeting*	

Current and Pending Key Projects and Stages – in ***bold italics***

January 2018	FY 19 Budget Calendar and Assumptions () Employee Health and Dental Insurance Update () CY 17 Biosolids Report 1/11/2018	Annual Lakes Recreation Report (regular agenda) () Q2 Financial Report () CIP Semiannual Report () 1/25/2018	
February 2018	CS - General Counsel Interim Review () *2/8/2018*	CS - General Counsel Interim Review () *2/22/2018*	
March 2018	FY 19 Draft Budget & Rates () Set date for Public Hearings – FY 19 Budget & Rates () CS - ED Interim Review () *3/8/2018*	FY 19 Draft Budget & Rates () CS – ED Interim Review () *3/22/2018*	

The 12 Month Board Meeting Schedule shows Strategic Plan initiatives and other priority efforts that the Board and staff plan to give greatest consideration to during the next twelve months. The schedule also shows major recurring agenda items that require Board action, or items that have been scheduled in response to the Board's prior standing request. This schedule does not show all the items the Board may consider in a work session or business meeting. It also does not reflect meetings at which the Board will discuss and act on the update of the Strategic Plan.

The 12 Month Board Meeting Schedule will be reviewed and updated at each monthly work session and may also be discussed and updated at the Board's business meetings.

In addition to the initiatives shown in this schedule, staff will be working on other Strategic Plan and organizational priorities that are not expected to require major additional discussion with the Board except as part of budget deliberations.

The schedule implies that the following Strategic Plan initiatives would be addressed beyond the 12-month period. The Board may conclude that one or more of the following initiatives are higher priority. The schedule will be revised as needed to reflect the Board's priorities, and any additional initiatives that the Board may decide to address.

- Development of a plan and policy framework for OWASA lands is considered a longer-term priority.
- Improve effectiveness as a learning organization is considered a longer-term priority.
- Water Conservation Plan will be prepared concurrent with update of the Long-Range Water Supply Plan.

The OWASA Board determines which topics it wants to explore as a full Board (potentially in a work session format) and which topics it wants to assign to Board committees or committee chairs for further analysis and development of recommendations. Board also determines priorities and desired timeframes for addressing topics. Committee meetings will be updated on the schedule routinely.

OWASA Board of Directors – 12 Month Board Meeting Schedule (April 7, 2017)

<u>Abbreviations Used in Draft Schedule:</u>

↻	Recurring agenda item (generally these are "required" items)	JLP	Jordan Lake Partnership
AMI	Advanced Metering Infrastructure	LRWSP	Long-Range Water Supply Plan
CE	Community Engagement	MST	Mountains-to-Sea Trail
CEP	Community Engagement Plan	MFMM	Multi-Family Master Meter
CIP	Capital Improvements Program	NRTS	Natural Resources/Technical Services
COLA	Cost of Labor Adjustment	Q	Quarter
CS	Closed Session of the Board	SOW	Scope of Work
CY	Calendar Year	TBD	To Be Determined
ED	Executive Director	WTP	Water Treatment Plant
FY	Fiscal Year	WWTP	Wastewater Treatment Plant

Current and Pending Key Projects and Stages

Project	Strategic Initiative	Project Lead	Apr-17	May-17	Jun-16	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18
AMI	6	Taylor	Manual Read	Contract										
Total Compensation Study		Glasgow	*Schedule To Be Determined*											
MFMM Rate Structure Study	4	Winters												
LRWSP	1	Rouse			Demand & Yield									
Energy Plan	5	Tiger												

Stages	Committee Discussion	Feasibility Study	Board Review	Community Engagement	Action	Procurement	Implementation

Current and Pending Key Projects and Stages – in ***bold italics***

Pending Key Staff Action Items from Board Meetings

Date	Action Item	Target Board Meeting Date	Person(s) Responsible	Status
3-23-2017	Staff to evaluate a document Dave Moreau will prepare regarding a potential request of the State (possibly in coordination with others) seeking guidance/criteria/support from the State on drinking water supply matters during various water emergencies (currently, the State's focus is enforcement of drinking water quality).	TBD	Kerwin Taylor Loflin	
3-23-2017	Proceed to implement Foxcroft Drive water main break Action Plan.	NA	Gangadharan Others	Keep Board updated.
3-9-2017	Proceed with Initial Implementation Plan for Diversity and Inclusion Program; hire consultant within next quarter; provide progress reports in June and September 2017.	9-14-2017	Kerwin Dept. Dirs.	
3-9-2017	Evaluate options for live viewing and video of all OWASA Board meetings as part of the FY 2018 budget review process.	TBD	Orbich Grey	3-24-2017: Updated website to clarify options for viewing televised/live steamed Board meetings.
1-26-2017	For the next CIP report, consider adding multi-year budget information. Provide an explanation of significant budget impacts or delays for key projects in the report narrative.	8-24-2017	Gangadharan	
12-8-2016	Implement improvements to the Key Performance Indicators as discussed with the Board on 12-8-2016.	NA	Tiger All Dept. Directors	Many improvements made to the November KPI Report; others are in-development

Pending Key Staff Action Items from Board Meetings

Date	Action Item	Target Board Meeting Date	Person(s) Responsible	Status
4-28-2016	Consider educational and public access opportunities at the Cane Creek mitigation tract.	8/10/2017	Rouse Feller	Low priority. Staff will contact our Partners to obtain feedback on alternative educational opportunities on the Cane Creek Mitigation Tract. Staff will work with our Partners to develop a plan regarding public access and educational opportunities for late calendar year 2017 and beyond. Staff will provide an update to the Board of Directors at a work session in CY 2017 (to coincide with overview of forest management work session item).