Metropolitan Council

Industrial Water Conservation Motivations Report

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June 2018

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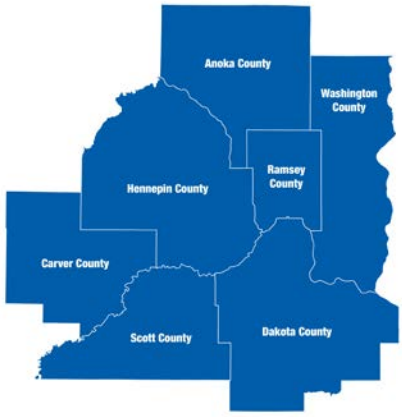

The Metropolitan Council is the regional planning organization for the seven-county Twin Cities area. The Council operates the regional bus and rail system, collects and treats wastewater, coordinates regional water resources, plans and helps fund regional parks, and administers federal funds that provide housing opportunities for low- and moderate-income individuals and families. The 17-member Council board is appointed by and serves at the pleasure of the governor.

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A summary report outlining industry reasons for success of, or barriers to, water conservation recommendations and findings developed by the Minnesota Technical Assistance Program for assistance clients and intern host companies in the eleven-county metropolitan area from 2012-2017.

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Executive summary

The Minnesota Technical Assistance Program (MnTAP) at the University of Minnesota continues a successful, collaborative relationship with Metropolitan Council Environmental Services (MCES), working together to address the metro-area need for industrial sector water use efficiency awareness and water use reductions. Since the launch of the industry-focused technical assistance partnership in 2012, MnTAP has worked with numerous operations in the metro providing a range of practical suggestions to improve industrial water efficiency. Since 2012 MnTAP, with MCES support, has made 194 water efficiency recommendations representing potential annual water savings of over 279,000,000 gallons per year. Approximately 82% or 159 of the water efficiency recommendations resulted from 20 MnTAP intern projects. The remaining 18% or 35 water efficiency recommendations resulted from 10 MnTAP staff site assessments. Implemented recommendations as of this report total over 95,700,000 gallons per year or approximately 34% of the recommended opportunity.

	Number of recommendations	Water saving potential (gal/year)	Recommendations implemented (gal/year)	Realized cost savings ($/year)
2012-2017 MnTAP intern projects	159	209,090,000	87,032,000	488,000
MCES sponsored projects/grants and site assessments	35	70,410,000	8,751,000	Not Available
TOTAL	**194**	**279,500,000**	**95,783,000**	**488,000**

MCES seeks to maximize the water efficiency achieved in order to maintain sustainable water supplies across the metro area for continued regional public health, quality of life and economic development. To inform future outreach efforts and identify leverage points that encourage implementation of industrial water efficiency activities, MCES seeks a better understanding of the motivations and barriers to acting on water efficiency recommendations. Specifically, MnTAP was asked to review data collected from activities to date and follow-up with facilities to identify key factors that support implementation of industrial water efficiency.

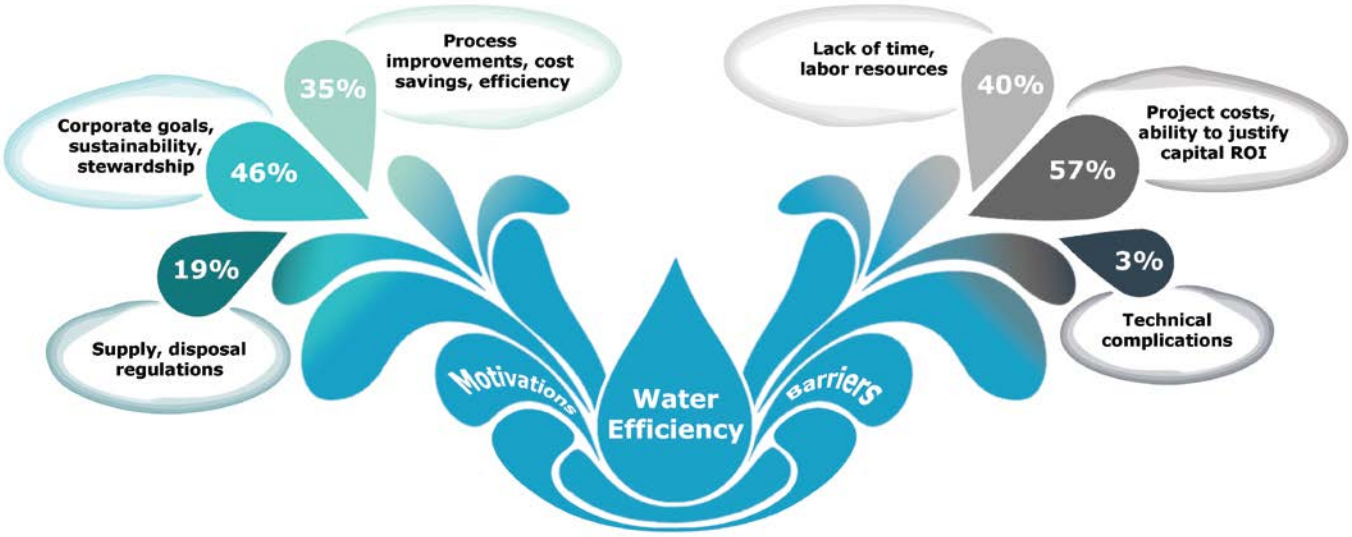
MnTAP has interviewed facility staff on reasons why water conservation technical assistance recommendations made by MnTAP during staff site assessments or summer intern projects, were or were not pursued. The answers are complex and varied as to what prompts metro-area industries to spend time and effort on recognizing, understanding and improving their water use.

MnTAP water-assistance records resulting from MCES sponsored projects between 2012 and 2017 have been used to assemble this report. Facility contacts interviewed include industries using their own groundwater wells, industrial operations within the Department of Natural Resources (DNR) North and East Metro Groundwater Management Area, and operations that were facing practical limitations or cost increases for water or water-related energy use. A total of 26 unique projects have been part of the MCES sponsored MnTAP technical assistance activities, and 20 interviewees who participated in or have assumed responsibility for these projects discussed water efficiency motivations with MnTAP staff members.

The interview questions were structured to better understand the motivations and barriers to water efficiency identification and implementation as well as to gain insight on the assistance process.

Themes around motivations for industrial water efficiency implementation shown on the left half of the water splash graphic include corporate goals such as sustainability and stewardship, process improvement for cost savings and efficiency, supply management and disposal regulations.

Themes around barriers for industrial water efficiency implementation shown on the right side include project cost and ability to justify capital return on investment, lack of time or labor resources to focus on improvements and technical complications to the project.



Numerous factors motivate facilities to work with MnTAP on their water efficiency issues including regulatory constraints, energy costs (e.g. water heating and steam processes), metro-area wastewater discharge strength and sewer availability charges (SAC), water supply and quality issues, and corporate sustainability and site continuous improvement goals.

Regardless of the motivations, some of the facilities receiving MnTAP water efficiency assistance provided comments about the experience. Eighteen of the twenty commenters found the internship or staff site assessment assistance either helpful or very helpful to project success. Thirteen would be interested in renewing work with MnTAP on water conservation. MnTAP continues to follow-up with facilities to provide additional assistance as needed.

Overall, successful water efficiency projects tend to be with companies that have longer term, engaged interactions with MnTAP. This relationship may have been developed through staff site assessments, MnTAP staff knowledge of the businesses through past activities or by introduction through a trusted third party. Because time is most often a limit with facilities, an effective strategy to engage companies has been through a short site assessment and follow-up opportunity discussion to identify site water efficiency potential. Additional resource support through the MnTAP intern program can help drive implementation of these and additional water efficiency recommendations. The identified opportunity potential, the dedicated engineering resources offered through the intern program and the formal arrangement of student, advisor, and facility commitment of time and financial support makes a strong, productive relationship with a documented impact on water conservation

Introduction

The Minnesota Technical Assistance Program (MnTAP) is an outreach and assistance program at the University of Minnesota Minneapolis campus that helps Minnesota businesses develop and implement industry-tailored solutions that prevent pollution at the source, maximize efficient use of resources, and reduce energy use and costs to improve public health and the environment. MnTAP has been providing technical assistance services at industrial facilities across the state for over 30 years. MnTAP's technical assistance staff members hold degrees in engineering and science and provide staff site visits, support student intern projects and generate resources as direct technical assistance for Minnesota businesses.

The Metropolitan Council is the regional policy-making body, planning agency, and provider of essential regional services for the Twin Cities metropolitan region. The Council's mission is to foster efficient and economic growth for a prosperous region. Metropolitan Council Environmental Services (MCES) is nationally renowned for its superior work treating wastewater, monitoring air and water quality, and planning for a long-range water supply to meet future demand. Effective and resilient water supplies for the region's municipalities are the focus of the Water Supply Planning Group of MCES.

In an effort to carry out the mission of providing resilient water supplies for the Metro region, MCES has funded MnTAP technical assistance and **MnTAP Intern Program** efforts to assist businesses with identification and implementation of water efficiency projects. MCES seeks to maximize the water efficiency achieved in order to maintain sustainable water supplies across the metro area. To inform future outreach efforts and identify leverage points that encourage implementation of industrial water efficiency activities, MCES seeks a better understanding of the motivations and barriers to acting on water efficiency recommendations. Specifically, MnTAP was asked to review data collected from activities to date and follow-up with facilities to identify key factors that support implementation of industrial water efficiency. This work has been funded by MCES through a grant from the Clean Water, Land and Legacy Amendment.

MnTAP is well-qualified to lead these kinds of projects due to a strong history of applying pollution prevention and conservation solutions to businesses across Minnesota, including industrial water conservation. MnTAP staff members have many years of experience applying source reduction practices in industrial settings and have an understanding of business operations needed to offer customized solutions. Additionally, MnTAP is well known as a leading pollution prevention provider in the State of Minnesota. This reputation, as well as MnTAP's broad network of vendors, county and city government personnel, professional associations, and other contacts is routinely leveraged to provide effective technical assistance.

Approach

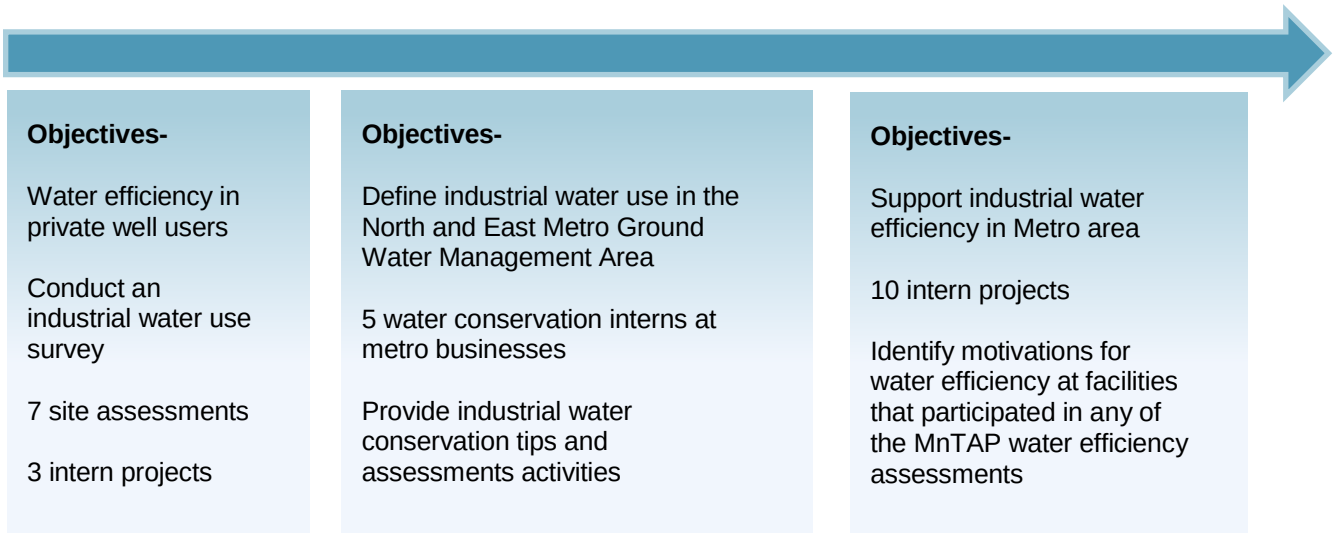
This report compiles assistance information from MCES-sponsored client interactions aimed at improving water efficiency at industrial facilities located within the eleven-county metropolitan area (Anoka, Carver, Chisago, Dakota, Hennepin, Isanti, Ramsey, Scott, Sherburne, Washington, and Wright). Results and implementation data were analyzed to document what conditions tend to promote or constrain industrial investment in water efficiency. Improvement recommendations are categorized in the MnTAP data as implemented, planned, proposed or not planned when the information was gathered during routine follow-up activities.

Along with data analysis, an interview survey was developed to confirm recorded implementation data and probe reasons why various recommendations either were or were not implemented. Questions were designed to gain insights on motivations for water efficiency with appropriate facility contacts. The interviews documented impromptu comments and remarks that often helped to explore attitudes, perceptions, and constraints surrounding industrial water use issues and identify the opportunities and barriers for water conservation at these facilities.

Background

An active partnership between the MCES Water Supply Planning and MnTAP was launched in 2012 to study aspects of industrial groundwater use in the eleven-county Twin Cities metropolitan region. The history of MCES and MnTAP collaborations includes the following:

Figure 1. Partnership timeline



This long-standing relationship has shown substantial documented success in identifying opportunities for industrial water efficiency. Specifically, 194 water efficiency recommendations representing potential annual water savings of nearly 280,000,000 gallons. Implemented water efficiency recommendations as of this report total over 95,000,000 gallons per year or approximately 34% of the recommended opportunities. This work continues to provide opportunities to revisit organizations that have received technical assistance for water efficiency. MnTAP has used these follow up activities to inquire about facility motivations and barriers to implementing water efficiency recommendations. This information will be used to craft future approaches to water efficiency technical assistance and encourage implementation.

MCES-Sponsored Projects

MCES-sponsored projects have successfully combined MnTAP staff site assessment activities with intern projects aimed at fulfilling specific water efficiency goals. Table 1 identifies project work accomplished through surveying, water conservation site assessments, and in-depth water opportunity identification and implementation utilizing the MnTAP summer intern program. Reports and case studies from these MCES-sponsored activities are available on-line.

Table 1. Projects and outcomes

Year	Project	Outcomes
2012	"Assessing the Opportunity and Barriers for Water Conservation by Private Industrial Water Users"	- Industrial well user survey (excerpted in Appendix F) - Seven technical site assessments - Three intern projects
2013	MnTAP SOLUTIONS	- Three intern project summaries
2014	MnTAP SOLUTIONS	- One intern project summary
2014 - 2015	"Industrial Water Conservation in the North and East Metro Groundwater Management Area"	- Water use analysis - Ten technical topic outreach e-newsletters - Three technical site assessments - Three intern projects
2015	MnTAP SOLUTIONS	- Four intern project summaries
2016 - 2017	"Metro Water Conservation Utilizing MnTAP Interns"	- Ten intern projects - Report on motivations and barriers to water efficiency - Impactful promotional information on water efficiency - Report on 2016-2017 grant objectives
2016	MnTAP SOLUTIONS	- Seven intern project summaries
2017	MnTAP SOLUTIONS	- Five intern project summaries

SOURCE: MnTAP data, completed grant reports, and applicable *SOLUTIONS* publications.

Technical site assessments are a primary way MnTAP staff members work with businesses throughout the year. This type of interaction has a short duration, utilizes experienced engineering staff, and results in focused recommendations that are left for the facility to implement. While staff site assessments offer limited time and resources for implementation activities, periodic follow-up is conducted to answer site staff questions and encourage implementation. Since 2012, 35 water efficiency recommendations resulted from 10 MnTAP staff site assessments.

Site assessments often uncover substantial improvement opportunities that the company may not have time to implement. Implementation can often be achieved with follow-on intern support. Intern projects commit both MnTAP and the facility to invest time and money on the goals of an agreed upon project executed by an engineering student applied full time over 12 weeks. This degree of project investment often supports implementation of recommendations due to the presence of extra engineering help and the longer timeframe of the assistance activity. Successful intern projects are generally identified through staff site assessments and staff knowledge of the businesses. The formal arrangement of student, advisor, and facility, along with the facility commitment of time, resources, and financial support makes a strong, productive relationship with a documented impact on water conservation.

Recommendation Analysis

MCES-Sponsored Intern Projects

Since 2012, MCES has provided full or partial support for 20 MnTAP facilitated intern projects in the greater metro area with an emphasis on water efficiency and conservation. Availability of consistent funding has strengthened MnTAP's ability to recruit sites and increase engagement to address water efficiency. The 20 intern projects resulted in 159 water efficiency recommendations as summarized in Table 2 below.

Table 2. MCES-Sponsored intern projects (2012-2017)

Year	Sector	Number of recommendations	Water saving potential (gal/year)*	Number of implemented recommendations	Recommendations implemented (gal/year)	Realized cost savings ($/year)
2013	Metal products	9	10,941,000	6	9,935,000	91,000
	Food processing	6	5,903,000	1	1,111,000	1,000
	Food processing	8	30,593,000	7	22,343,000	97,000
2014	Filtration products	8	7,070,000	3	2,620,000	6,000
2015	Food processing	2	2,203,000	2	2,203,000	15,000
	Commercial properties	12	7,161,000	2	360,000	1000
	Power generation	5	6,910,000	5	6,726,000	11,000
	Organics processing	6	7,742,000	5	9,330,000	33,000
2016	Education	3	3,536,000	-	-	-
	Building materials	36	14,858,000	8	3,676,000	6,000
	Residential properties	2	3,000,000	2	3,000,000	3,000
	Healthcare	16	13,024,000	8	8,955,000	83,000
	Power generation	12	7,399,000	10	6,155,000	22,000
	Electronics	2	11,900,000	1	7,600,000	90,000
	Bio tech	8	6,072,000	5	2,868,000	27,000
	SUB-TOTAL	**135**	**138,312,000**	**65**	**86,882,000**	**486,000**
2017	Metal forming	10	5,586,000	-	-	-
	Horticulture	2	48,000,000	-	-	-
	Building materials	4	14,909,000	-	-	-
	Power equipment	3	1,780,000	-	-	-
	Beverages	5	503,000	1	150,000	2,000
	TOTAL	**159**	**209,090,000**	**66**	**87,032,000**	**488,000**

* Rounded up to the nearest 1,000.

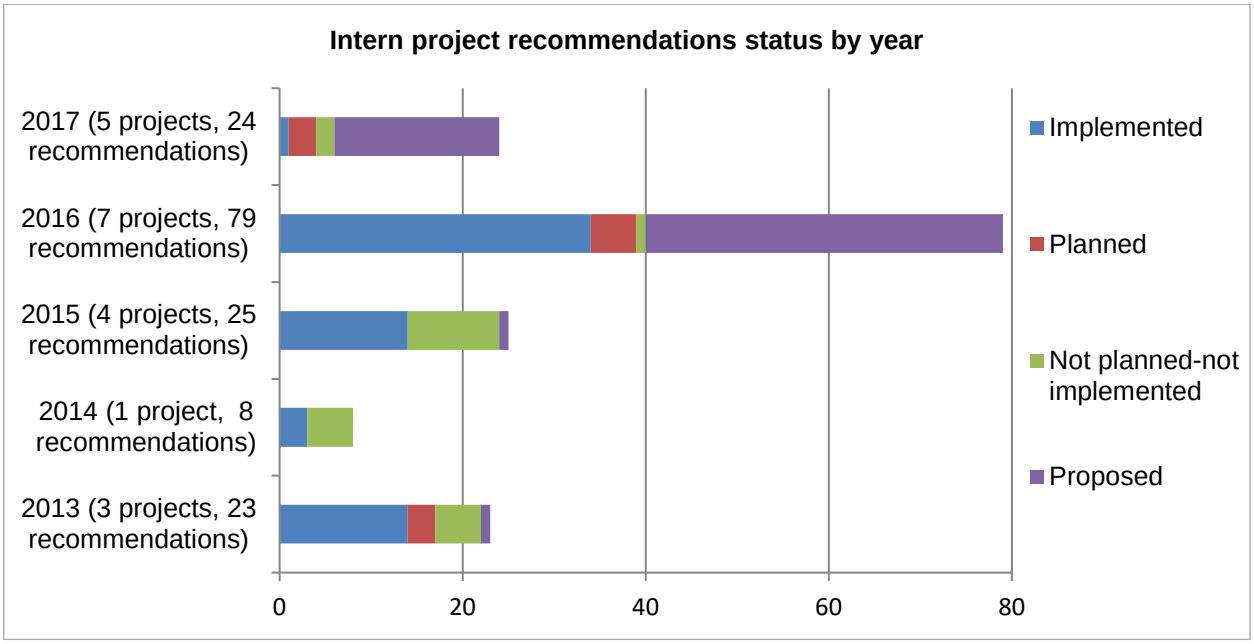
SOURCE: MnTAP data, MCES project reports, and applicable *SOLUTIONS* publications.

Recommendations from the intern projects conducted in 2017 are excluded from a number of calculations because these sites have not had sufficient time to implement recommendations.

- Total intern-based water recommendations – 209 million gallons/year.
- The recommendations for water saving from 2012 through 2016 from 15 facility projects total 138,312,000 gallons/year or 66% of the total potential.
- Five facilities without implementation yet recorded from 2017 have a 70,275,000 gallon/year potential, or 34% of the total.
- Total intern recommendations implemented to date – 87 million gallons/year, 63% of recommendations made through 2016 across 15 sites.
- Average implemented dollar value $31,800 per site through 2016 across 15 sites.

The progress status of the intern project recommendations is documented internally by MnTAP. This information combined with the interview process defined the current status of the project recommendations. A total of 159 intern recommendations were made between 2013 and the end of 2017 (there were no MCES-sponsored intern projects in 2012). Sixty-six of these recommendations have been implemented, 11 recommendations are planned to be implemented while 23 are not planned for implementation at this time. Fifty-nine of the recommendations are still under consideration and listed as proposed. The status of all 159 recommendations is shown graphically in Figure 2.

Figure 2. Intern project recommendations status by year



MCES-sponsored site assessments

Several project grants had technical site assessment assistance objectives in addition to intern project objectives. Seven technical site assessments were completed during efforts to assess water efficiency opportunities in facilities using private well water. An additional three site assessments were done in the North and East Metro Groundwater Management Area. The 10 site assessments resulted in 35 water efficiency recommendations identified in Table 3 below.

Table 3. Project site assessment results

Year	Sector	Number of site assessment recommendations	Water saving potential (gal/year)*	Site assessment recommendations implemented (gal/year)	Number of intern recommendations	Intern recommendations implemented (gal/year)
2012	Food processing	2	870,000	-	-	-
	Food processing	1	1,000,000	-	-	-
	Beverages	4	4,500,000	-	-	-
	Food processing	4	52,080,000	-	8	22,343,000
2013	Metal products	1	1,577,000	-	9	9,935,000
	Food processing	3	-	5,718,000	6	1,111,000
	Food processing	3	-	-	-	-
2015	Power equipment	3	1,010,000	-	-	-
	Food processing	4	3,234,000	3,033,000	-	-
	Horticulture	10	6,140,000	-	2	-
	TOTAL for both projects	**35**	**70,410,000**	**8,751,000**	**25**	**33,389,000**

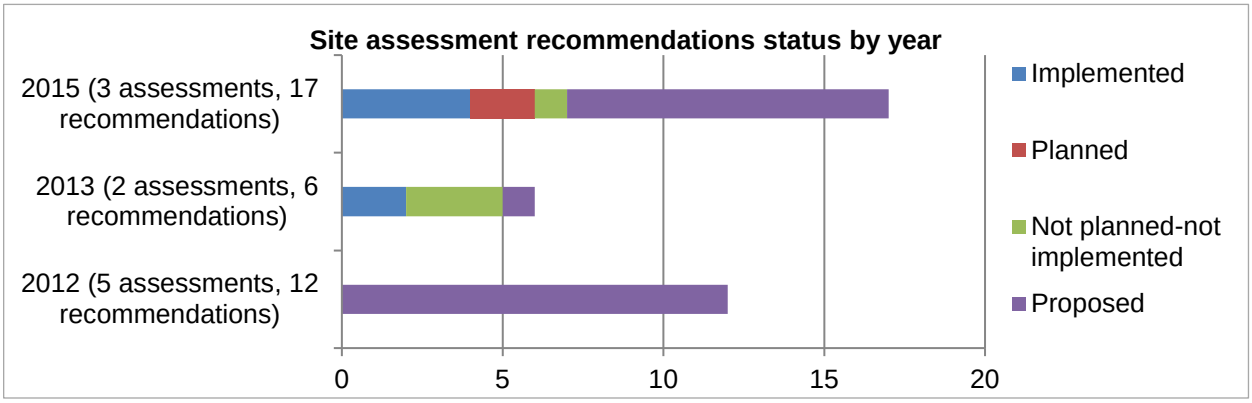
* Rounded up to the nearest 1,000.

SOURCE: MnTAP data, MCES project reports, and applicable ***SOLUTIONS*** publications.

Site assessments offer industrial facilities a minimal time commitment option to screen for water efficiency opportunities. When substantial water efficiency potential is identified, a follow-on intern project can be used to provide additional engineering resources at the site to launch implementation.

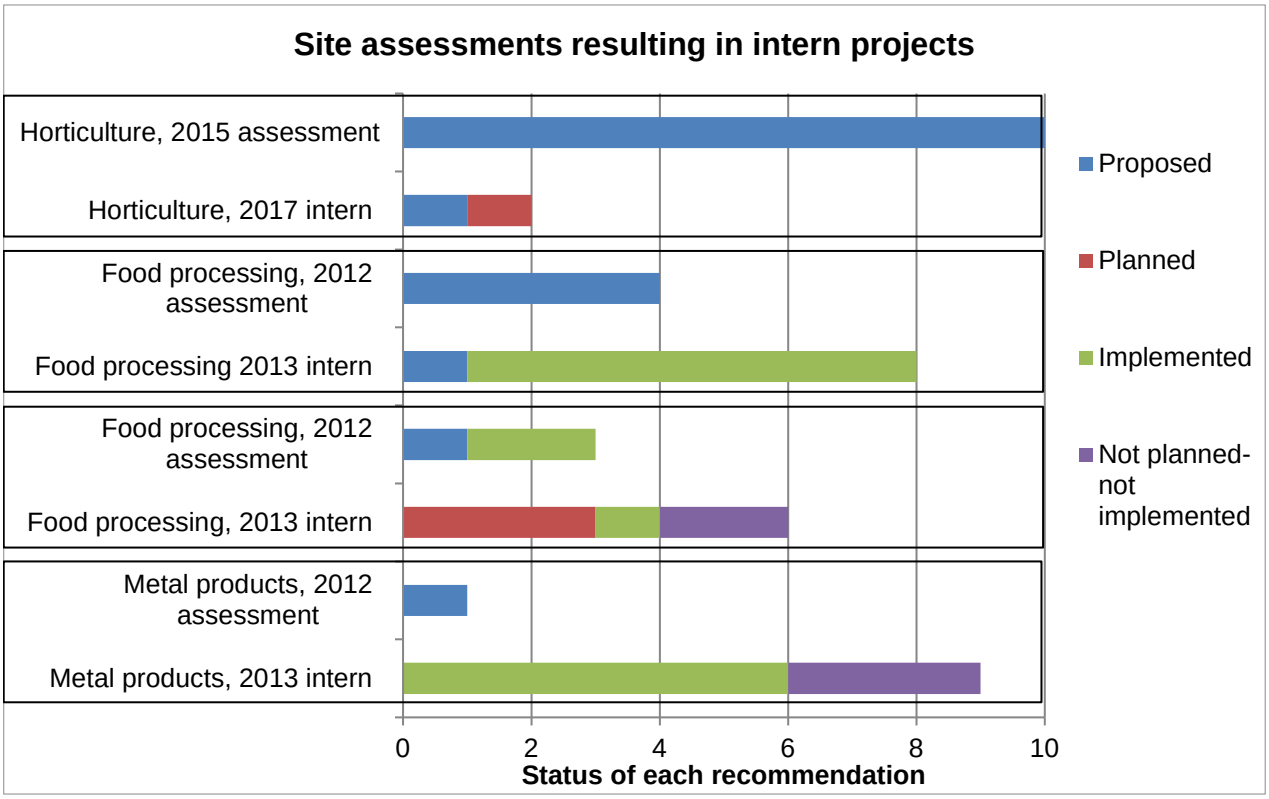
Six of these recommendations have been implemented, two recommendations are planned to be implemented while four are not planned at this time based on follow-up with the facilities. Twenty-three of the recommendations are still under consideration and listed as proposed. The status of all 35 recommendations is shown graphically in Figure 3.

Figure 3. Site assessment recommendations status by year



Four of the 10 site assessments resulted in intern projects as illustrated below in Figure 4.

Figure 4. Site assessments resulting in intern projects



Both the MnTAP staff site assessments and the intern projects focused on water efficiency, but from different perspectives and with different amounts of time available to spend on assistance work. There were 18 recommendations made by MnTAP staff regarding water conservation opportunities across the four site assessments, and there were 25 recommendations made during the subsequent intern projects. Only four of the documented site assessment recommendations were translated directly to intern project objectives. So while site assessment recommendations often become the foundation of subsequent intern project proposals and/or work plan objectives, the interns generally found additional opportunities. For example, the metal products company had one site assessment recommendation, and the subsequent intern project developed nine highly detailed recommendations, six of which have been implemented.

No implementation of water conservation recommendations was reported subsequent to three of the four site assessments. Implementation is typically more difficult during site assessments because of the inherent short-term nature of MnTAP staff time and resources in the site assessment process. Continued follow-up by MnTAP staff is key in converting the recommendations to actions. Implementation is a goal for the student interns in their summer work. Three of the four intern projects initiated by site assessments have achieved substantial levels of implementation, and the fourth, newest intern project has the same expectation due to commitment from the company as soon as funding is available.

Interview Process

The 2017 objective to interview companies receiving water conservation recommendations launched in late 2016. The effort started by assembling the data cited above from intern projects and site assessments to use as input to the process.

A student worker was hired for Summer 2017 to make contact with the interview candidates, introduce the project, set up interview appointment times, and conduct interviews if needed. Outreach continued throughout the summer to contacts or organizations that were difficult to reach. The approach used included the following.

- Initiate contact with the target company
- Introduce the project through phone, voice mail and email were used when necessary
- Confirm the appropriate contact was made
- Provide background information and reminder of the previous work and results
- Schedule a time for an interview with MnTAP staff
- Send interview reminders
- Conduct the interview and record responses
- Send an acknowledgement to the facility participant and invite them to the Intern Symposium

If the primary contact was unavailable or no longer with the company, phone calls were made to either a staff member who interacted with MnTAP in the past, or to the organization general number to request another potential contact with knowledge of water conservation at the organization. Most of the interviewed contacts had roles as plant managers, maintenance managers, environmental specialists, environmental engineers, or sustainability leaders. Facility follow-up and interviewing were conducted using a script template (**Appendix A**) to ensure the same questions were used at each interview. Categorized project impacts as well as factors that motivate or deter projects from being implemented were documented.

The conversations were congenial and often ran 20 to 40 minutes. The length of the interviews was designed to balance the contact's time commitment with the amount of information sought. The main information targeted from the interviews included:

- Motivations for water conservation
- Barriers to water conservation
- Rank of water efficiency relative to other business priorities
- Estimated timeline for water project implementation
- Helpfulness of technical assistance
- Sharing other implemented actions or projects

MnTAP interviews were conducted with site staff from MCES-sponsored intern project facilities. Sixteen phone interviews and four in-person interviews were conducted for a total of 20 interviews

representing 66% of the potential 30 projects participating in MCES sponsored activities. One project had four separate sites that were each interviewed while one interview represented two different projects. MnTAP was not able to reach anyone at six of the project sites and staff at two sites declined to be interviewed.

The opportunity to connect with busy facility contacts provided a chance to learn about additional initiatives in water conservation that the facilities were thinking about or undertaking. For example:

- Approved a large project to eliminate noncontact cooling water: goal is to turn off water to the trim cooler (which takes away excess heat); all cooling for air compressors will be either chiller or combo of more trim coolers, etc.
- Fully commissioned project, a closed-loop cooling system reusing water for running equipment (all very large test cells set up, looking to do same with other test cells)
- Working with vendor to ensure reverse osmosis system working at top performance

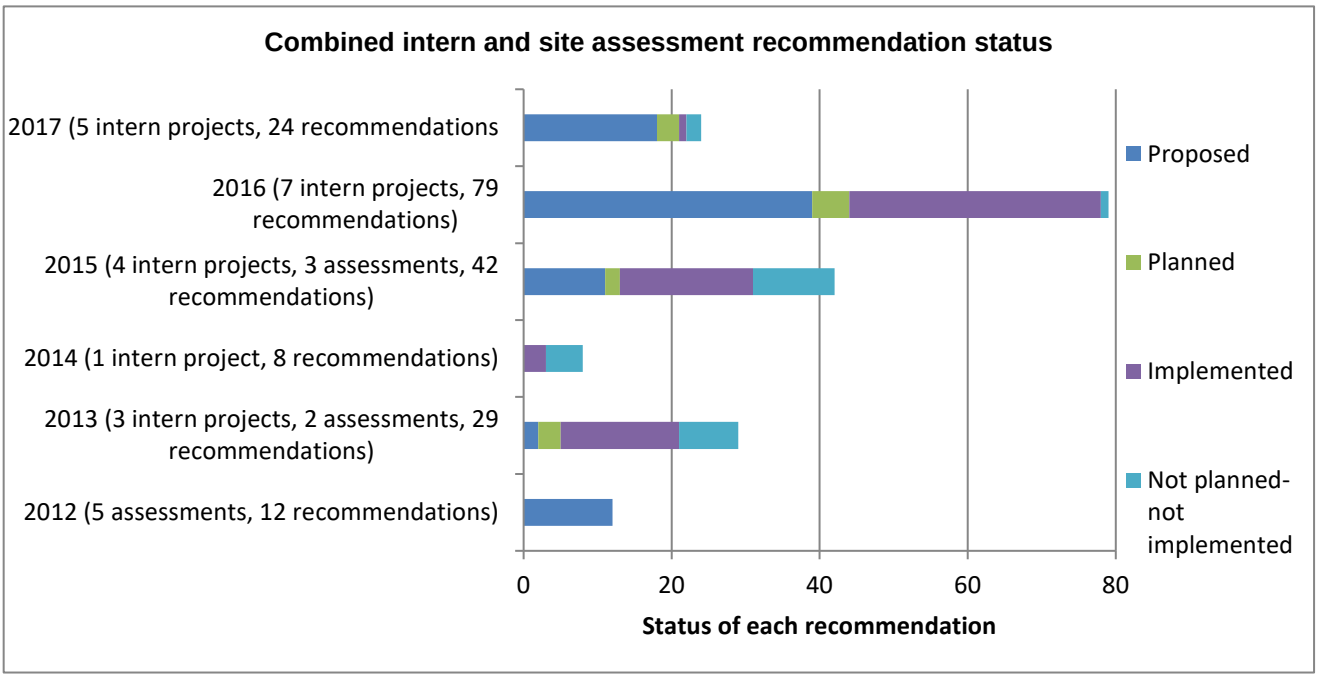
Additional miscellaneous comments were transcribed from the interview notes and were edited as necessary to ensure confidentiality (**Appendix B*).***

Interview Survey Analysis

The 20 interviews provided an opportunity to follow up with facility staff on the projects. Records on implementation and staff contact information were updated to facilitate future communications. Of the 194 recommendations listed in Table 2 and Table 3 above, MnTAP was able to confirm the status of recommendations through the interviews and the remaining recommendations were reviewed using previously recorded data. Figure 5 indicates the status for 194 water efficiency recommendations made during all MCES sponsored projects and interactions.

One challenge with effective follow-up with specific project recommendations was facility staff turnover. There were eight instances where the interview contacts were not familiar with the original projects. Staff turnover can have some tendency to divert or reduce any progress being made to implement project recommendations. New contacts were able to speak to water conservation motivations and barriers but tended to be limited in their knowledge about specific project recommendations. This observation points to advantages of supporting quick implementation of project recommendations where possible as well as the importance of renewing contacts with facilities to remind them of past analysis efforts and to renew the potential for future collaboration.

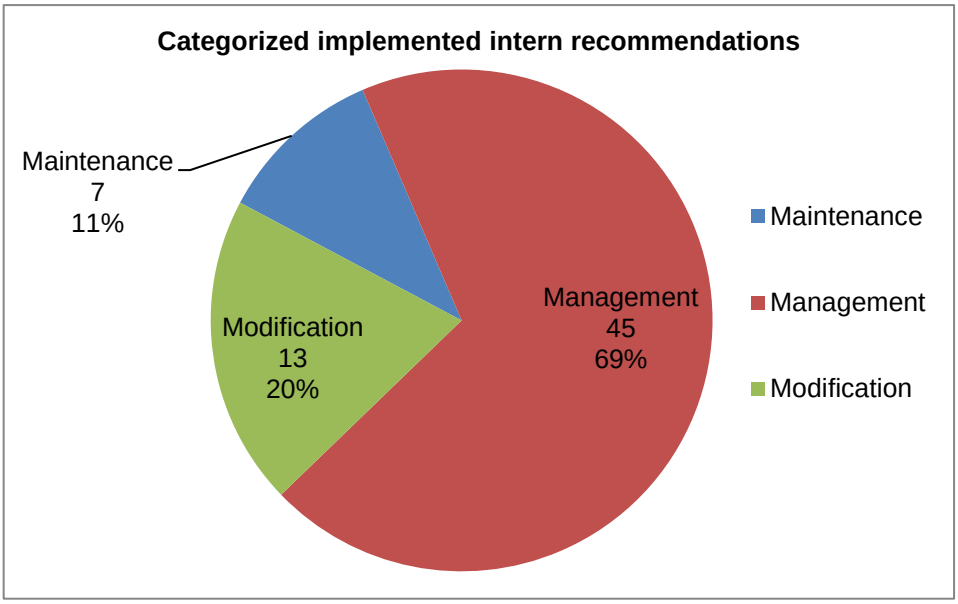
Figure 5. Combined intern and site assessment assistance recommendation status



Recommendation Types

Recommendations are specific to projects and do not easily translate directly from one facility to another. Sixty-five implemented intern project recommendations have been grouped into the categories of maintenance, management and modification as shown in Figure 6.

Figure 6. Categorized implemented intern recommendations



Maintenance involves repairing items in the existing process so that it operates as it was designed. This might include fixing leaks or repairing valves. Maintenance may be considered one of the easiest categories to address and maintenance processes are often embedded within facility operations. However, maintenance staff are often stretched to keep the primary process operating. Non-critical maintenance activities may be relegated to a longer timeline even if they offer a measure of water savings due to prioritization of production activities.

Management of the existing system was identified as the most implemented and promising intern recommendation category. This includes optimizing operations within system limitations, controlling system parameters, and doing what is possible with what is available using little to no capital investment. Management recommendations include changes to an operational protocol, like reducing water flow or optimizing use of existing equipment. This type of optimization process is ideal for engineering interns who have the training to collect required information to develop a process modification proposal, gain management approval and implement the change in a controlled manner.

Modifications to a process imply a larger change including equipment changes or redesigning the process. These recommendations often include the potential for risk to production, quality, or equipment. Process modifications may also require additional engineering resources or capital to make the change which can introduce delay in the implementation of the recommendation. Many modification recommendations are implemented but may require more time than the 12 weeks the intern is on site. Learning about implementation of process modifications requires effective follow-up with facility staff familiar with the project.

Motivations for Implementation

Common responses and interpretations about motivations were noted. Three categories of motivations emerged from collating all the recurring comments for implementation of water efficiency recommendations: corporate goals, efficiency improvements/benefits, and regulatory constraints, as shown in Figure 7. The actual comments and number of occurrences of each comment are included in Figure 8 with color coding to indicate the classification they were placed under.

Figure 7. Themes around motivations

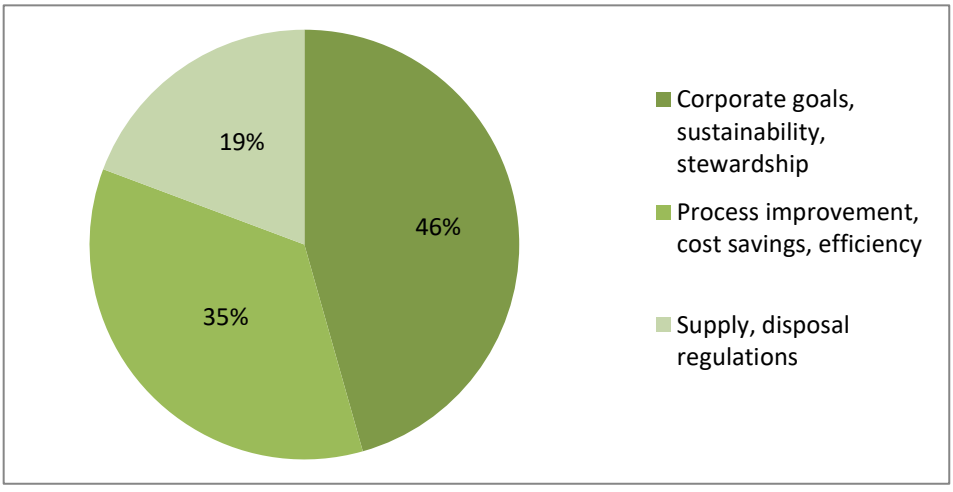
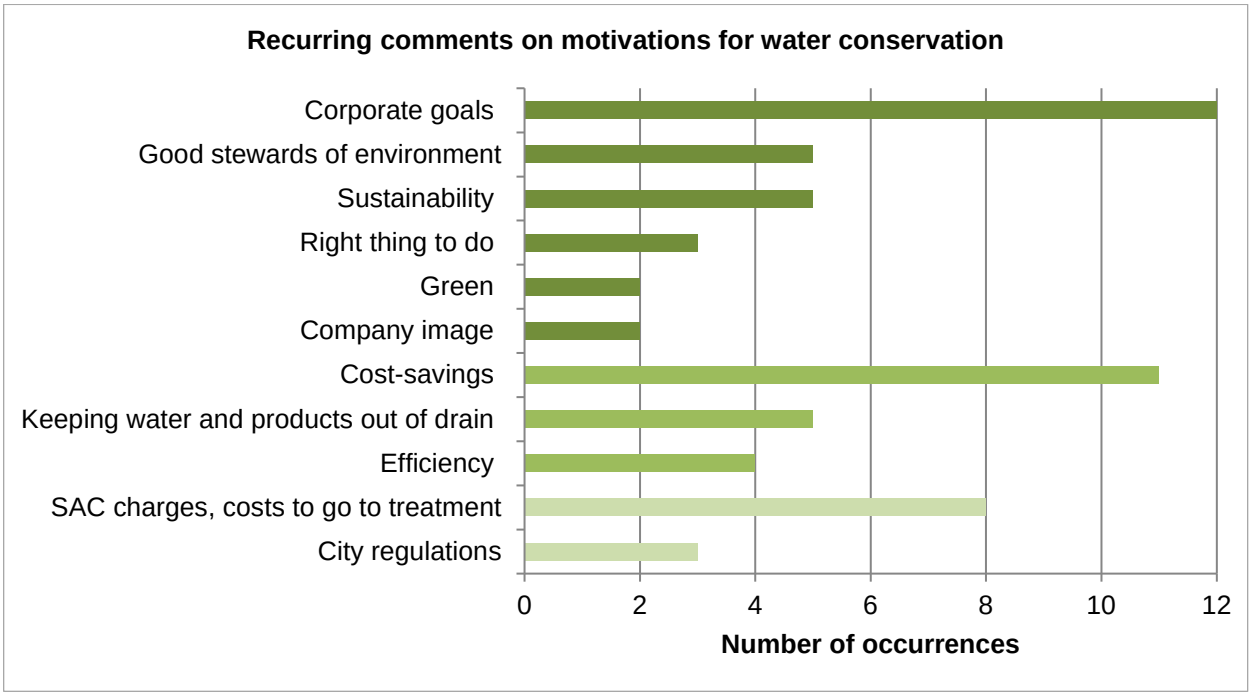


Figure 8. Recurring comments on motivations for water conservation



Many of the findings collected and interpreted in this report reflect the same answers and attitudes found in the MnTAP water conservation surveying conducted on-line in Assessing the Opportunity and Barriers for Water Conservation by Private Industrial Water Users in 2012-2013. One series of questions from the previous survey scored topics in order of concern from high importance to low importance. Topics of concern include:

- Regulations
- Cost of access or disposal
- Adequate water supply and quality
- Fluctuating aquifer levels

The graphed response ranges excerpted from the earlier report is reproduced in **Appendix F.** Barriers to water efficiency were not explored in the previous survey.

The 2012-2013 survey report identified a variety of factors that motivate operational changes to capture water conservation savings in industries using their own wells. Process needs, the perceived value of the water resource, and the operational constraints of keeping water use costs under control all contributed to the answers given. Comments provided about motivations for water efficiency explored in this report indicate similar concerns with a possible additional level of corporate focus on water use.

Barriers to Implementation

Common responses and interpretations about barriers to implementation were also noted. Three barrier themes emerged: costs, lack of resources, and technical complications as shown in Figure 9. The actual comments and number of occurrences of each comment are included in Figure 10 with color coding to indicate the classification they were placed under.

Figure 9. Themes around barriers

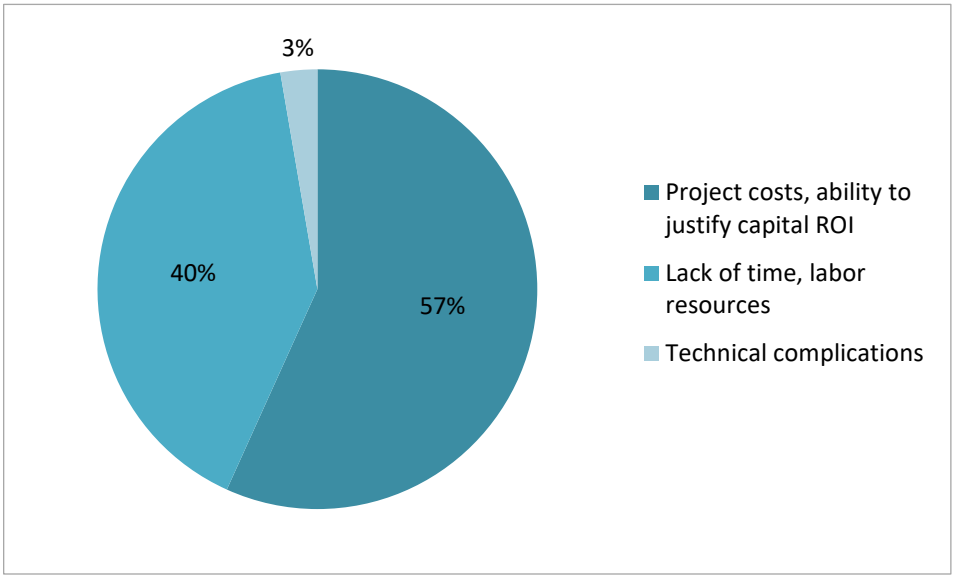
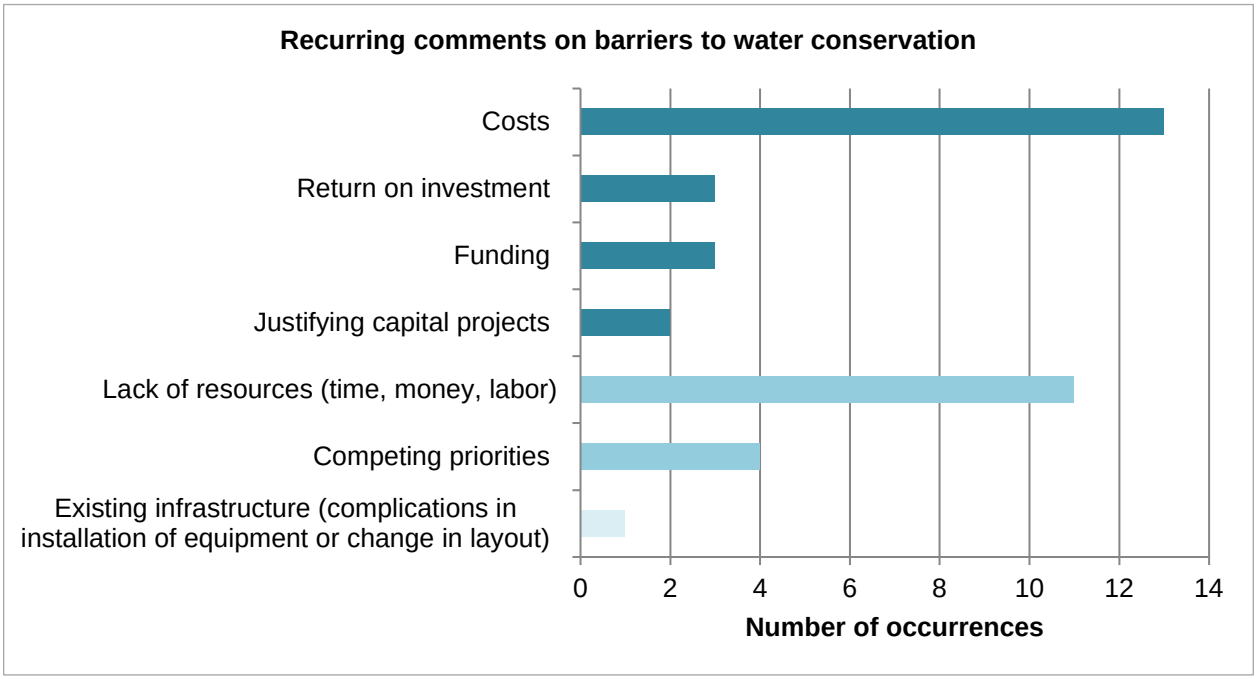


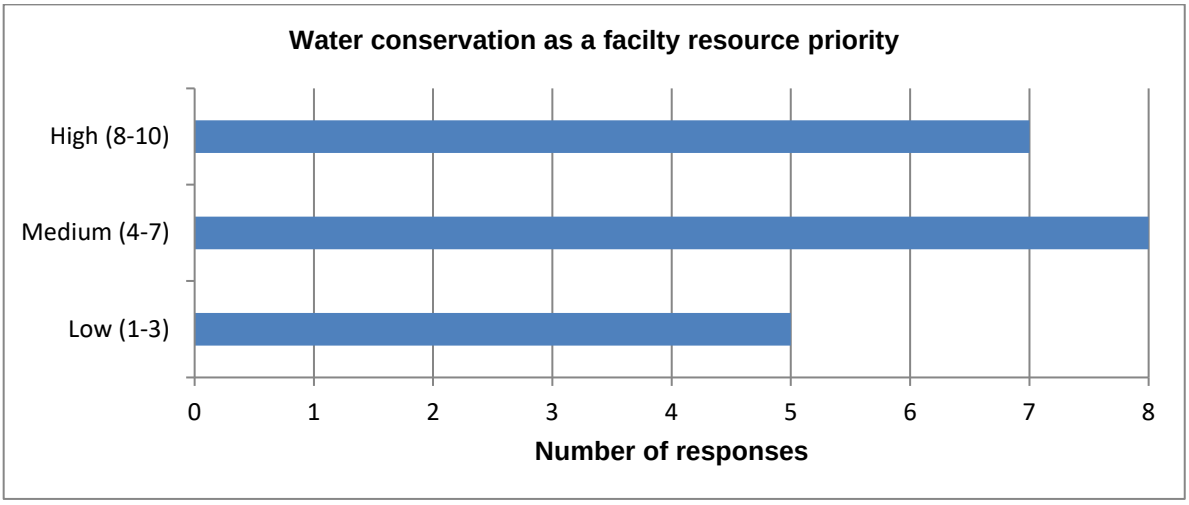
Figure 10. Recurring comments about barriers to water conservation



Priority and Investment

Understanding facility resource priorities was investigated by posing the question, "How do water conservation objectives rank with facility resource priorities?" A range of rankings on a scale from 1-10 were applied. Low priority was equal to 1-3, medium priority 4-7, and high priority was 8-10. The results are shown in Figure 11 and collected answers and related comments based on this interview question are found in **Appendix C**.

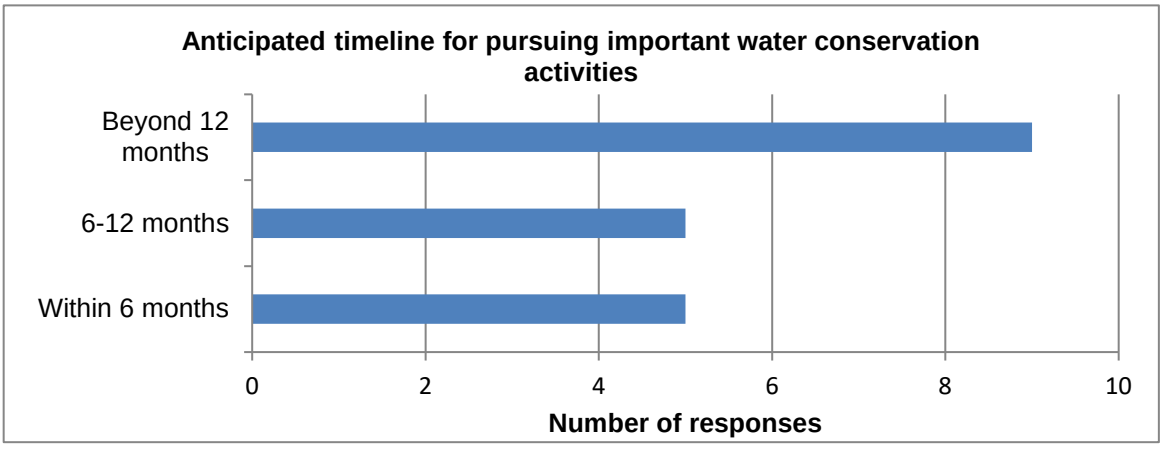
Figure 11. Water conservation as a facility resource priority



Water efficiency was ranked as a high or medium facility priority by 75% of the respondents. Over half the respondents indicated that the timeline for pursuing important water efficiency activities was over one year as shown in Figure 12 below. Full recorded responses are summarized in **Appendix D**. Based on the responses collected, the long implementation timeline is related to:

- How water efficiency projects fit into budget cycles, especially when considering a major capital improvement or piece of equipment
- Other operational priorities that currently compete with already limited facility resources
- Whether the project is related to the core production of the site or a secondary activity

Figure 12. Timeline for pursuing important water conservation activities



Technical Assistance Process

MnTAP benefits from understanding how assistance work can be improved. We took the opportunity while connected with facility contacts to ask about their opinion of the assistance work provided, either as an intern project or a site assessment. Twelve responded that the intern project assistance and internship was critical to the project success. Six offered that MnTAP site assessment assistance was helpful. Thirteen stated they would be open to working with MnTAP again, while two stated that renewed work with MnTAP was not appropriate at this time.

There were no negative responses about the assistance received. Collected comments based on this interview question are found in **Appendix E**. Company benefits from the projects included the following.

- Developing a new understanding of how facility water is used by correcting assumptions like water volume used and distribution pathways
- Increasing focus on and helping staff notice more about water use
- Having an intern focus on water use and develop well supported efficiency options to consider

Conclusions

Between 2012 and 2017, MnTAP made 194 water efficiency recommendations identifying potential annual water savings of over 279,000,000 gallons per year. Approximately 82% of the recommendations resulted from 20 MnTAP intern projects while 18% resulted from 10 MnTAP staff site assessments. To date, implemented water efficiency recommendations total over 95,700,000 gallons per year, 34% of the recommended opportunity.

MnTAP interviewed industrial facility staff on reasons why water conservation technical assistance recommendations made during MnTAP staff site assessments or summer intern projects were or were not pursued. Interview results revealed factors that influence implementation of water efficiency recommendations.

Industrial facility water use and efficiency improvement ideas and actions can be motivated by corporate goals or site continuous improvement. Additional factors motivating facility water efficiency include regulatory constraints, energy costs, metro area wastewater strength and sewer availability charges (SAC), water supply and quality issues. Motivations can be constrained by competing limited internal resources such as time and capital. Projects that were difficult to justify based on return on investment, and/or technologically or logistically challenging were less likely to be implemented. Competing priorities was a common reason recommendations had not been implemented. Whether explicitly stated or interpreted in the responses, limited time, human resources and capital were always part of the conversations.

Follow-up is conducted after any technical assistance activity to determine how the facility is progressing toward implementation of recommendations and to identify if additional resources may be needed. These interactions positively reinforce company actions and help maintain the MnTAP-client relationship. Due to the often protracted implementation timeline for industrial projects, follow-up is critical for measuring and verifying the impact of applied technical assistance services.

MnTAP will continue to successfully combine experienced MnTAP program staff, in-depth internships for appropriate projects, and long-term follow-up to successfully support industrial water efficiency initiatives and achieve meaningful results.

Appendix A

Motivation report interview template

Companies which have been given prior water conservation suggestions will be interviewed. A summary report will outline reasons for success or barriers to implementation of the suggestions. Company identities will remain confidential in the report.

"What are the major kinds of goals and opportunities that can motivate …… to conserve water? [*Opportunities to implement*]

Examples:

Cost too high- need new well

Lag in production demand

Water supply at capacity

Expensive to treat water (softening, filtration, purification technologies, reverse osmosis, deionization)

1'
2'
3'

"What kind of resources would be necessary to move MnTAP recommendations or other new water conservation opportunities toward implementation?" In other words, what are the main obstacles/barriers to water conservation at *……..*? [*Barriers to implementation*]

Examples:

Inexpensive water cost

No time

Production demands

Cost to implement change

1'
2'
3'

"How do water conservation objectives rank with ***……..*** resource priorities?"

Rank	1-3 low	4-7 medium	8-10 high	Explanation

"What timeline could you anticipate to budget for ……..to pursue important water conservation activities?"

Within 6 months	6-12 months	Beyond 12 months

"Was follow-up after receiving the Site Visit report helpful / Was the internship critical to project success?"

Follow-up helpful?	Yes	No	Reason
Internship helpful?	Yes	No	Reason

"Would you like to renew working with MnTAP on water conservation?"

Yes	No	Maybe / unknown	Not at this time

"Have there been other efforts at water conservation at **……..** that you can share?"

Additional water conservation initiatives	Implemented	Partially implemented	Not implemented	Planned	Reason

Appendix B

"Any other water conservation efforts you are willing to share?"

	Drip irrigation has been implemented - major water savings Working on other aspects with engineering firm
	Other areas where leakage is problem (mainly piping - flume systems, etc.) Replace several old machinery (both brush washers, etc.)
	Approved a large project to eliminate noncontact cooling water: goal is to turn off water to the trim cooler (which takes away excess heat); all cooling for air compressors will be either chiller or combo of more trim coolers, etc. 5 ultrasonic meters measuring water distribution Talking about wastewater treatment (load); studying where load coming from in building, what processes/areas to look at; possibility of recycling process (if treat or concentrate wastewater)
	Typically water lawns every other day Adhere to water restriction if there are any
	Ventilation in clean rooms Reclaim water temps. (heat exchanger to preheat and precool air) Smart controllers for lawn watering; sensors look at weather forecast Wanted to implement lawn sensors (but too far away/property too large to do wireless) - would show how much water in soil
	Non-contact cooling water is biggest opportunity for freshwater cost savings Other wastewater opportunities (large COD/TSS): receiving raw material water, condensate, product water Plan to take individual water samples to analyze to see where TSS/COD coming from in all processes: general overview of what's going down sewers, where it's coming from, what strength (volume)? Trying to automate water meters to track water consumption per individual stream (also cooling water, wastewater to track condensate) Automatic valves on 2 out of 7 wet air scrubbers (use much water & chemicals) controlling level and blowdown (how much water that's contaminated removed from system); more stability over how much water used instead of manually; levels of pumps go too low --> suck air --> damage pumps --> pay for another one; gives operator less to worry about One tank feeds to all scrubber systems - cuts down on chemical usage & costs Starting "renew" (2nd) phase; more money for upgrades & improving efficiency
	Privatizing controls; less watering on "shoulder" season

	Changing nozzles Working with vendor to ensure RO working at top performance Taking membranes off of secondary RO on site (so no need for extra flushes) Boilers - potential to cause damage to personnel Switching over to LED lighting (re-lamping), in the final stages of capital approval
	Planning RO system to capture wastewater and reuse/recycle it (but not for sanitation) - to eliminate sewage bill & better the environment, capacity: about 8,000 gal. per day and up to 20,000 gal. per day when expanded; advantage: holding tank "sucked dry" every day, going to make life a lot easier Updates: not planning to send water down to greenhouse anymore; converted to smaller system; rooms still get washed down; replacement machine smaller & moved to another room (no longer in operation); small tank of water used for processing --> big change in water consumption; sanitation used in small amounts all over the place; product line now less volume; separated floor drains from processing rooms so no worry about processed water mixing with sanitary sewer Greenhouse: concept in development Recycling, composting, food-to-animals (feed)
	Adjusting rate structure - additional revenue for irrigation program Commercial program - cost-share (50%) efficiency improvements starting this year 10-year plans In the future: washer and dryer efficiency Internal team to review applications Reached out to departments and volunteer board (broader decision-making)
	New building: installed different drainage systems to reuse groundwater for irrigation, applied for silver LEED certification
	Past intern was with existing water recycling, but the machines were moved (some past work was not as flexible to accommodate rearranging the equipment on the manufacturing floor; machines moved --> water recycling system no longer worked)
	Fully commissioned project: closed-loop cooling system: reusing water for running equipment (all very large test cells set up, looking to do same with other test cells) Energy is next main focus
	Reverse osmosis --> CIP Separation of waste streams Reasons: keep wastewater out of treatment plant, reduce strength charge, don't want to send product down the drain

	Smart controllers at other properties Exterior and interior LED lighting (for past 7 years - use rebates) Reason: financial justification ("no brainer")
	Ideas for improvement: electrical load, lighting retrofit (LED) Ideas for MCES improvement: charge fees monthly?, log SACs per property Janitorial cleaning agents - paid a little more to go green, best thing for society to do (no validation required), rational decision, little things add up, impacts janitorial service costs Paper towels automatic dispensers (8-12 inch pieces) - reduction in paper Reduced refuse in tons Solar gardens? Difficult to install because of additional structure as a barrier Subsidies and incentives help

Appendix C

"How do water conservation objectives rank with facility resource priorities?"

Rank	Number of responses recorded	Example reasons for ranking
Low (1-3)	4	Low cost of water, long ROI timeframe, no compliance reason for conserving water Barriers and other, more pressing priorities (i.e. opening a new building, financial challenges) Water conservation rising in priority level, not a lack of interest, just competing priorities; depends what other priorities are : health & safety, quality assurance, environmental compliance; don't want legal trouble; keeping in mind that customers in future may look favorably upon environmental friendliness Cost of product; save gas & electricity; cost of water so low; TSS not really an incentive
Medium (4-7)	8	Water conservation is a management priority Tie in with wastewater treatment issues as well, but not as high as researching markets/products Corporate mentality on cutting water & water costs visible and applauded, but not much assistance with capital relief; think cost savings vs. costs Need to be good stewards but have an obligation to provide safe, playable spaces for public use, and can't do that without water; challenge: monitor spaces to ensure only doing what's necessary and no more Will never run out of water, tanks replenished with city water For entity responding Mostly cost-savings, "because we're in business," "we want to conserve resources, but there are certain standards we have to have in place, so those standards have to take precedence" Keep at forefront but not the focus on regular basis

Rank	Number of responses recorded	Example reasons for ranking
High (8-10)	7	Water & recycling a high priority; one of targeted goal areas Only priority above water conservation is raw material Big push on conservation on utilities Work with 10 million gal. of water; pay front and back (to buy water then to put in sewer) Hard drive to look at and reduce water usage; all environmental projects have high priority - engineers respond to all of them; holistic scale: multiple projects to obtain corporate objectives Water close second to energy - lighting; cost of water tripled over past few years, got people's attention Environment & safety important, just finding time is key
Other comments		Annual internal & external audit (will have conversations about water & recycling) First goal is to keep product running, then to be as efficient as possible, but use lots of water in the process Will never run out of water, tanks replenished with city water Subset of targets Environmental goals not as urgent Numerous environmental initiatives, very conscious company, want to remain competitive

Appendix D

Anticipated timeline for pursuing important water conservation activities

	Timeline	Responses recorded	Example reasons for rank
	Within 6 months	4	Budgeting happens middle of year (18-month cycles) Now-next 5 years 2 or 3 water projects a year Overhaul
	6-12 months	5	Depends on location and needs- location and situation dependent 6-9 months for small projects (i.e. capturing rinsewater) if time & materials; In full force early next year; funds for 10-year program Within a year to 18 months If pilot recycling system works on line #2, then it will take 6-12 months to add to other areas in facility Depends on scale; cooling water project may take a year, but not food-related projects (i.e. collecting rainwater from roof) would take multiple years
	Beyond 12 months	9	Depends on performance of co. & owners' mood i.e. RO water (taking out of pond and putting back on lawn, but too much elevation and currently not cost-effective) By next summer; air-treatment currently priority with complaints of odor and pressure from city End of growing year - reflect on successes, challenges, improvements Next year for large projects (i.e. ionized rinse) if capital Hope next 5 years 1-2 years
	Additional comments		Would call landscaping guy and ask when have time to do this Replace as needed, when things fail On track to meet 2020 corporate targets Finding days to shut down a barrier; constantly move bottom line

Appendix E

"MnTAP assistance helpful?"

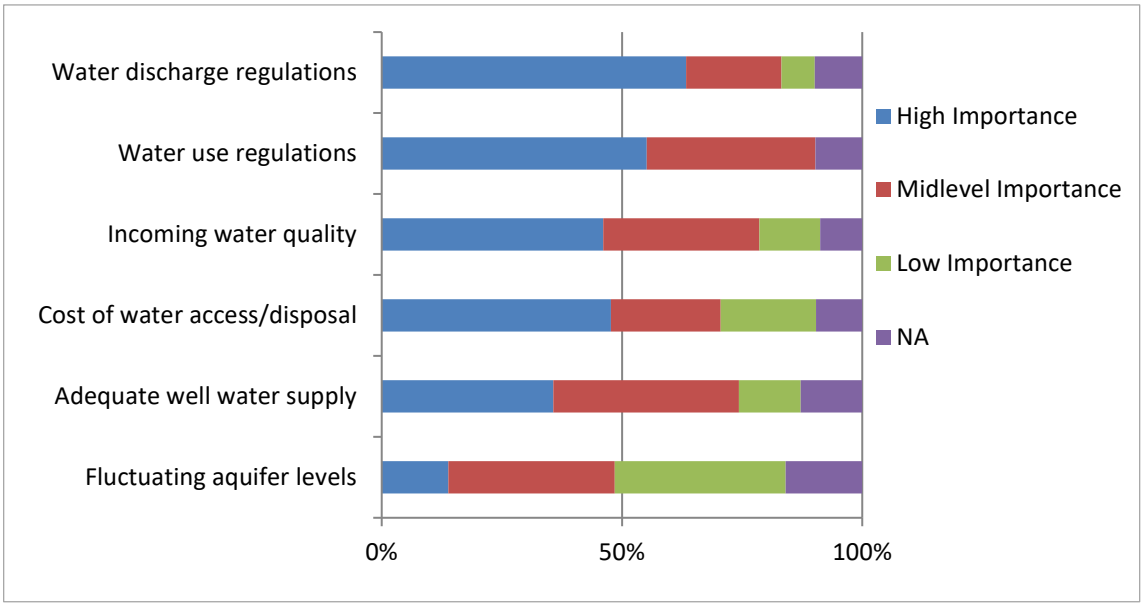
Assistance description	Helpful yes	Helpful no	Comments
Intern project assistance Was internship critical to project success?	12	-	Kept it in mind & focused on it, although didn't change investment levels, still focused on repairs & team approach (i.e. "softer" projects) Intern's report first time looking at water after it passes, data on how it's moving in the plants; learned a lot, corrected misconceptions, needed data to write actions; seeing variations between equipment, too (Intern an employee now) Information, added resource, additional focus on specific areas Intern able to assemble some of data that others don't have time to pull together and provide useful perspective Intern helped wind up and inspect if program would be viable or not Wouldn't be anywhere where at now without MnTAP Set foreground for program (eye-opening: difficult to reach folks, not much traction, $ speaks) Project led to refocusing; lots of impact - critical to success; reports referenced all the time; less time spent proving it works and more time to get funding All really positive experiences; extra set of hands and thoughts (from intern); staff always "running from fire to fire" Very helpful as an intern; staff focuses on product & production, manufacturing engineer focuses on equipment "Made us think about it more," look at features (suggestions) when replacing (equipment) Interns priceless Engineers so busy, intern able to work independently, jump in and collect data, justify process changes, fresh perspective, don't have competing priorities (can focus on one project) Impressed with intern's knowledge and ability to identify opportunities in savings DI water system
Site visit technical assistance	6	-	Better/longer relationship cemented understanding of capabilities and trust Made a difference in water conversations; MnTAP looking for specifics, brings attention to detail (whereas staff see everything everyday); know costs involved with leaks

Appendix F

MnTAP water conservation surveying was first conducted on-line in "Assessing the Opportunity and Barriers for Water Conservation by Private Industrial Water Users" in 2012-2013.

The questions emphasized ranking the impact of water supply, quality, regulations, and costs against business concerns and decision making capacity, and whether any efforts toward a water focus was part of the facility culture. A basic question about industrial water use scored topics in order of concern to the surveyed facility as related to industrial water use processes.

Figure 13. Industrial well users ranking of topics of concern (2012-2013)



The report identified factors that motivate implementation of operational changes to capture water conservation savings vary across industries. Process needs, the perceived value of the water resource, and the operational constraints of keeping water-use costs under control all contribute to the priority given to water conservation projects.

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