

Good for the Economy.  
Good for the Environment.

# How Investing in **Michigan's Water Infrastructure** Protects Our Economy, Creates Jobs and Drives Growth



MICHIGAN  
BUSINESSES FOR  
**CLEAN WATER**



# Introduction

Grabbing our toothbrush in the morning, we turn the faucet handle and water flows. At work, water-cooled data centers enable us to send e-mails. On the rainy drive home, we speed past culverts draining water from the interstate. During the weekend, we swim in the lake with our families before gathering for dinner with friends.

Every day, Michigan residents and businesses depend on a vast, complex system to manage wastewater and stormwater and reliably deliver clean, affordable drinking water to our taps. Keeping Michigan's water infrastructure functioning properly — and keeping contaminants out of our water supplies — is essential to the state's economy, public health and our quality of life.

However, relative to the rest of the nation, Michigan has for decades grossly underinvested in this crucial network. As this report shows, investing in Michigan's water infrastructure is crucial to protecting industries ranging from manufacturing to brewing that pump billions of dollars into the state's economy each year. It's essential to protecting the reputation of "Pure Michigan" as a water-based paradise for tourists (search Google images for "Michigan" and "water" and the results aren't pretty).

Investing in water infrastructure can also create tens of thousands of jobs in construction and related industries. E2's research shows that investing \$12 billion on top of existing water infrastructure expenditures in Michigan over the next two decades directly creates nearly 90,000 full-time job-years and generates \$8.8 billion in total labor income across direct, indirect and induced effects<sup>1</sup> — income that workers and their families can then reinject into their local economies.

**But first, we must fix the system.**

## The System

When you zoom in on a map of Detroit's water and sewer system, the fine blue and red lines representing 6,400 miles of water mains and sewer lines resemble veins and capillaries displayed on a high school biology classroom's human circulatory system wall chart.<sup>2</sup> Without even showing the streets themselves, the water mains and sewer lines are so dense they clearly demarcate hundreds of individual city blocks.

As intricate as Detroit's water main and sewer system is, it's a drop in the bucket compared to Michigan's overall water infrastructure network. The statewide numbers are staggering: 150,000 miles of sewer, 38,000 miles of storm sewer pipe, 1.6 million inlets and catch basins, 725,000 manholes, 1.3 million septic systems, 500,000 lead service lines<sup>3</sup> and 35,000 regulated county storm water drains, to name a few.<sup>4</sup>

This sprawling system delivers 481 million gallons of drinking water — the lifeblood for all of us — to faucets in Michigan homes every day.<sup>5</sup>

This infrastructure also removes wastewater from our schools and businesses, suppresses fires, waters crops, manages stormwater run-off — and underpins the financial success of tens of thousands of companies representing every major sector and industry in a Michigan economy worth half a trillion dollars a year.<sup>6</sup>

## The Funding Gap

Compared to the rest of the nation, Michigan has chronically underinvested in this essential water infrastructure. According to Business Leaders for Michigan, a roundtable group of CEOs representing dozens of the state's largest employers, Michigan spends \$90 less per capita annually than the U.S. average on infrastructure for drinking and stormwater, sewers and dams.<sup>7</sup> The same group also said Michigan's highest-value infrastructure investments are in water infrastructure, particularly in drinking water and sewers.

The American Society of Civil Engineers, meanwhile, gives low grades for various Michigan water system components: drinking water (D), stormwater (D-) and wastewater (C).<sup>8</sup>

One reason why the grades are so low is the system's age: In Detroit, approximately 80 percent of the city's combined water system's transmission and distribution infrastructure was installed prior to 1940.<sup>9</sup> Other Michigan water systems date back a century — when Model-Ts were rolling off Ford's Highland Park plant production line and Ty Cobb was lacing up his spikes for the Tigers.<sup>10</sup>



## The Economic Costs

Chronically underfunded, maintenance-deferred water infrastructure costs Michigan money. In Flint in 2014, for example, the drinking water supply was switched from Lake Huron to the Flint River to save a few bucks. Soon afterward, lead leached into the improperly treated water supply, children were exposed to the lead and a vast public health crisis costing at least \$600 million and counting ensued.<sup>11 12 13</sup> As recently as 2018, the state was spending \$22,000 a day on bottled water for the city.<sup>14</sup>

Other costs lurk below the surface. In Detroit, about 10 to 50 percent of treated drinking water is lost through leakage.<sup>15</sup> Septic systems across the state leak, too, resulting in untreated wastewater seeping into soil and potentially contaminating groundwater sources. According to the Michigan Dept. of Environmental Quality, in 2015 alone more than 4,100 septic failures were reported to local Michigan health departments, putting burdens on homeowners or others for upgrades.<sup>16</sup>[RC2]

### PFAS a growing risk to Michigan's economy

Over the past few decades, more than 60 cars have been pulled from the Rouge River near Detroit.<sup>20</sup> Unfortunately, not all water pollution in Michigan is as easy to identify or remove from local water supplies.

One of the most pressing — and potentially costly — pollutants in Michigan's water system are tiny, odorless, tasteless chemical compounds called perfluoroalkyl and polyfluoroalkyl substances, or PFAS, which accumulate over time and don't break down either in the environment or in the human body.<sup>21</sup>

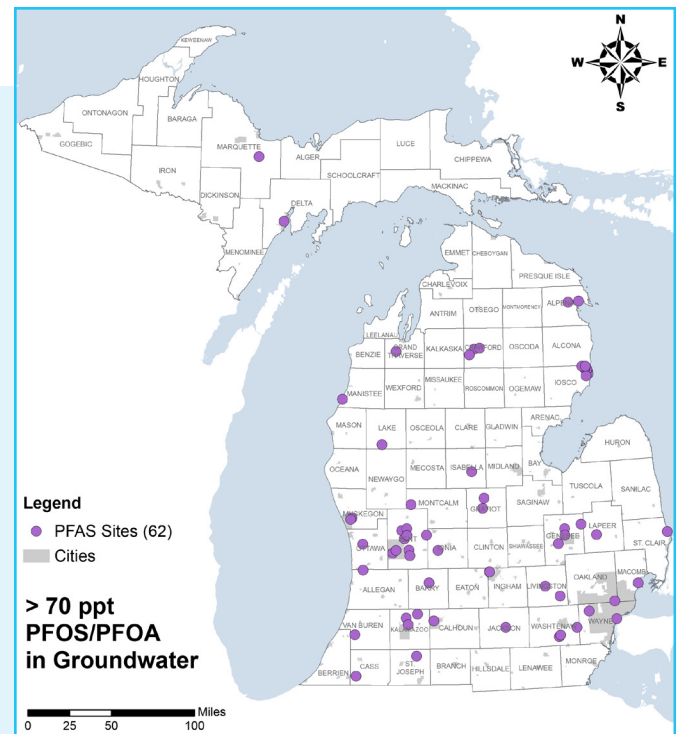
PFAS were used in manufacturing processes across the country. In Michigan, for example, the large, publicly traded shoe manufacturer Wolverine World Wide increased the water resistance of Hush Puppies produced in its Rockford tannery with PFAS-based ScotchGuard. For years, Wolverine dumped the tannery's waste sludge in the area, contaminating drinking water supplies. Now, many locals are learning about the health impacts of having elevated PFAS in their bodies. As with lead, pregnant women and kids in particular are more vulnerable to adverse health consequences from PFAS exposure.

In April 2019, the Detroit Free Press called PFAS the most widespread, serious environmental crisis in Michigan in more than 40 years.<sup>22</sup> The newspaper said PFAS could negatively impact Michigan's hunting and fishing industry, property values, local business development and employment at facilities like airports.

PFAS could also potentially expose major Michigan employers like Wolverine to costly legal claims from the state and individuals, with several lawsuits already being filed.<sup>23</sup> The military is also potentially liable to PFAS contamination claims.

Another growing economic concern is poorly managed stormwater. In a single day in August 2014, a record six inches of rain fell in the Detroit area. In Oakland, Wayne and Macomb counties, combined flood damages topped \$1 billion. For at least one Michigan company, it could have been worse.<sup>17</sup> The search-engine optimization business Search Optics, which employs more than 100 people, limited damage when five quick-thinking employees in its Ferndale office unplugged first-floor computers and, as the water rushed in, lugged them to higher ground, saving valuable hardware and data.<sup>18</sup>

With every deluge, instances like the scramble at Search Optics likely occur across Michigan. And due to the climate crisis, those deluges could be more frequent and more severe. According to the 2018 National Climate Assessment, projections suggest a heightened risk of inland flooding in the Midwest with average annual damages topping \$500 million (in 2015 dollars) by 2050.<sup>19</sup>



Michigan Dept. of Environment, Great Lakes, and Energy  
Map. Current as of July 2, 2019



## The Economic Opportunity

Based on averaging the findings of five studies on Michigan's water infrastructure, E2 estimates the amount of spending required over the next two decades to overhaul the state's water infrastructure — including residential waterlines, wastewater and stormwater infrastructure — is an additional \$12.2 billion on top of existing expenditures.<sup>24</sup> This works out to about \$610 million in additional, essential expenditures every year.

(Note: Given that E2's analysis was based in part on studies conducted when PFAS was not a widely known issue, additional expenditures for more expensive and/or extensive filtration could be required.)

Significant economic benefits are expected to result from this spending. Nearly 4,500 direct jobs, more than 300 indirect jobs and more than 2,900 induced jobs would be sustained each year over the 20-year period of additional expenditures. That works out to nearly 90,000 direct, full-time job-years over the next two decades.

Of the \$610 million in additional expenditures over the 20-year period, \$441 million each year would go into the pockets of workers who are directly and indirectly involved with the overhaul of water systems.

Importantly, there would also be broader economic benefits like decreasing healthcare costs and more efficient operations of myriad businesses and industries reliant on clean water. (See Table 1.)

**Table 1. Annual economic impacts of 20-year period of additional water infrastructure spending**

Impact Type	Employment	Labor Income
Direct Effect	4,494	\$291 million
Indirect Effect	313	\$16.3 million
Induced Effect	2,910	\$134 million
<b>Total Effect</b>	<b>7,717</b>	<b>\$441.3 million</b>

## Clean Water Company Profile: Weller Water, Grand Rapids



**Matt Weller founded a residential water purification business in Grand Rapids in 2018.**

Weller Water is a family-owned company in Grand Rapids that specializes in distributing and installing advanced water purification systems for residential customers.

Matthew Weller is the company's founder and CEO. He started the business in 2018 after working in the water industry for more than a decade. The company now employs more than 30 people and is rapidly growing.

Throughout his career, Weller felt traditional methods of removing toxic chemicals from drinking water were inadequate. When the extent of the PFAS contamination in Michigan became public, he knew there had to be better and more effective way of removing these toxic chemicals from the water.

"The thing that hit me the hardest is my family lives in Rockford," Weller said. "It is

directly affecting people I know. When the whole thing hit, I was already witnessing people I have known for years dying of cancer and I knew we had to do better. It's just everywhere. It's about more than money for me, it's about helping people."

In 2019, Weller Water is opening a second location in downtown Williamston. The facility will serve as a storefront and educational center. Residents can walk in and get their home drinking water tested for chlorine, PH, fluoride, nitrites, lead, arsenic, PFAS, PFOA, PFOS and more. Customers can also attend workshops and learn about their own water's quality as well as solutions for water contamination challenges.

Some of the water testing can be done on-site; other samples that need more advanced water testing are sent to Alpha Analytical, a nationally accredited lab, with results available after about six to 10 days.

Weller is optimistic about the new Williamston location: "It's centrally located," he said. "We cover the entire state and we want to be accessible to as many people as possible."

The company represents several water treatment industry equipment manufacturers, including HANS premium water appliances, which are manufactured in Farmington Hills. HANS premium water appliances meet NSF/ANSI standard 58 certification to reduce lead, hexavalent chromium, chloroform, arsenic, PFOA, PFO and other contaminants.

Weller owns one himself, and with good reason: PFAS has recently been discovered in soil about three miles from his home.

## The Jobs

The additional expenditures are expected to directly result in 89,880 full-time job-years. Put another way, these critical investments in Michigan's water infrastructure would create nearly 9,000 new jobs in the state with enough work to sustain them for 10 years.

The occupational clusters expected to experience the greatest growth across all job types — direct, indirect and induced — as a result of additional water infrastructure spending are:

- Construction and extraction
- Office and administrative support
- Sales and related occupations
- Management
- Transportation and material moving

A sampling of other jobs that could be created by scaling up clean water investments include: plumbers, pipefitters and steamfitters; industrial machinery mechanics; plant and water system operators; boiler operators; drafters, engineering and mapping technicians; landscaping and grounds-keeping workers; septic tank servicers and sewer pipe cleaners; dispatchers; chemists and materials scientists.<sup>26</sup>

According to the American Water Works Association, a trade group, one segment of society is particularly well-suited for water industry jobs: veterans. The group encourages companies to actively recruit veterans, saying they are a good fit for the water sector because of their technical expertise and experience working nontraditional hours in highly regulated environments.<sup>27</sup>

A 2014 Anderson Economic Group (AEG) report for Michigan State University (MSU), the University of Michigan (UM) and Wayne State University (WSU), tallied about 138,000 “core” water services jobs in Michigan already. These are jobs involved in seven industries designated by the North American Industry Classification System (NAICS). They include everything from jobs in architecture to jobs in waste treatment and “are closely connected to challenges in the availability and management of high-quality water, and to opportunities in offering solutions to these challenges,” AEG wrote.<sup>28</sup>

For example, in May 2019 a Farmington Hills-based company called HANS Premium Water secured approval to construct a 500,000-square-foot plant in Lyon Township off Interstate 96. When it opens in 2020, the plant is expected to employ 200 people to help build the company's reverse-osmosis purifier, which is designed to help remove harmful man-made contaminants like per- and polyfluoroalkyl substances, or PFAS (see Sidebar), from water systems in homes and businesses.<sup>29</sup> This investment impacts other Michigan companies as well, including Weller Water (see Case Study).

## The Fiscal Impacts

Because of the job creation, earned income growth and increased business activity in the water infrastructure sector modeled in our analysis, the additional \$12.2 billion in expenditures impacts tax revenue as well.

Each year, about \$34.7 million in additional tax revenue will be collected, for \$694 million in total tax revenue over the full two decades.

Of this, the vast majority — \$28 million annually, or \$560 million over 20 years — will be collected by the state or local municipalities.

**Table 2. Annual tax revenues over 20-year period of additional water infrastructure spending**

Local	State	Federal
\$15.4 million	\$12.6 million	\$6.7 million

## The Broader Water Economy

A glance at two industries — commercial fishing and beer brewing — illustrates how Michigan's economy outside the water services sector depends on clean water.

The gross dockside value of commercial fishing in Michigan is about \$5.4 million annually.<sup>30</sup> As fish landings are processed and delivered to consumers, the industry's value swells to \$50 million annually.<sup>31</sup> Want to wash down your whitefish tacos with a Michigan craft beer? According to the Michigan Brewers Guild, the direct economic impacts of craft brewing in Michigan include more than 5,000 jobs and nearly \$150 million in wages.<sup>32</sup>

Without clean water at every step in the value chain, these industries' economic benefits — not to mention a tasty Made-in-Michigan meal — evaporates.

“My business relies on fresh clean water as the main ingredient in our product,” said Mark Sellers, Founder of HopCat and Grand Rapids Brewing Company. “Without clean water, we can't serve beer, and without beer — we have no business.”<sup>33</sup>

It's not just commercial fishermen and brewers who depend on clean, affordable water. According to Michigan Sea Grant — a collaboration between UM and MSU, funded in part by the National Oceanic and Atmospheric Administration — in 2010 an estimated 660,000 jobs and \$49 billion in annual wages were linked to four water-dependent Michigan economic sectors: farming, manufacturing, mining and energy production.<sup>34</sup>

In the auto industry, it takes up to 40,000 gallons of water — enough to fill a large backyard swimming pool — to manufacture a single car.<sup>35</sup>

In the IT industry, water is used to power and cool dozens of Michigan-based servers that are part of the internet's backbone.<sup>36</sup> Nationwide in 2020, about 138 billion gallons of water will be consumed by data centers.<sup>37</sup>

In Michigan's tourism and recreation industry, clean water is critical for businesses involved in popular outdoor activities like boating, fishing and hunting. The overall Michigan tourism industry is worth about \$17 billion a year. However, when billions of gallons of untreated sewage flows into Michigan's waterways on an annual basis, some of the industry's 200,000 jobs are put at risk.<sup>38</sup>

## Water, Water Everywhere

### A sampling of Michigan industries that depend on clean water



#### Commercial Fishing

Generates **\$50 million** in annual revenues.



#### Craft Brewing

Employs more than 5,000 Michiganders who take home **\$150 million** in annual wages.



#### Auto Manufacturing

It takes up to **40,000 gallons** of water to manufacture a single car.



#### Information Technology

Nationally, data centers — including dozens in Michigan — use **138 billion gallons** of water a year for cooling.

## Clean Water Worker Profile: Steve Rochow, Environmental Compliance Specialist, City of Kalamazoo Water Reclamation Plant

**The Kalamazoo Water Reclamation Plant processes 26 million gallons of wastewater every day.**

Steve Rochow has worked in the water industry for 31 years. He began his career as a sampling technician at the City of Kalamazoo's Water Reclamation Plant. For the last seven years, his position at the plant has been environmental compliance specialist. Rochow investigates sources of pollution and helps ensure that companies comply with local, state and federal environmental laws and regulations in order to protect the local community's drinking water.

The Kalamazoo Water Reclamation Plant was established in 1955. Originally, it was designed to process 5 million gallons of residential wastewater per day. From the late 1960s until the early 1970s, the plant expanded to meet the growing needs of Kalamazoo and the surrounding area. These efforts included connecting several large industrial facilities to the plant to decrease direct discharge into waterways and help clean up the Kalamazoo River. The plant received another massive upgrade in the mid-1980s, thanks

to a \$100 million grant from the U.S. Environmental Protection Agency (EPA). The grant enhanced the city's ability to remove pollutants and toxins from the water.

Currently, the plant processes an average of 26 million gallons of wastewater every day, with a design capacity of 53 million gallons per day. The wastewater flows through several stages of treatment before it is released back to the Kalamazoo River, including solids handling, primary, secondary and tertiary treatment.

Rochow's experience in the water industry has taught him that communities and businesses need to work together to create a healthy environment which includes clean water. In part, this can be achieved by reducing water pollutants at their source and by investing in clean water infrastructure.

Rochow is a member of the Kalamazoo River Watershed Council where he encourages

individuals to become involved with community actions to help prevent pollutants from entering local creeks and rivers. "Small daily activities add up to a cleaner environment," Rochow said.

Rochow believes supporting clean water endeavors is a way to "pay it forward" so future generations have an environment free of toxins and rich in fish and wildlife. "Few things in life are as beautiful as a flowing stream or river with abundant waterfowl and a healthy aquatic environment," Rochow said.

Photo courtesy of Steve Rochow



## The Market — and Made-in-Michigan Innovation

According to Brookings, demand for fresh water technology is worth \$100 billion annually in the U.S., and \$400 billion a year globally.<sup>39</sup> In a March 2018 report, the U.S. EPA said the nation's drinking water utilities need about \$470 billion in infrastructure investments over the next 20 years to ensure the economic well-being, health and security of Americans.<sup>40</sup> And as noted by AEG, demand for water-related infrastructure and sanitation projects in the developing world is estimated to be in the trillions of dollars over the next few decades.<sup>41</sup>

Michigan is surrounded by 84 percent of North America's surface fresh water, and 18 percent of the entire world's surface fresh water. As companies and regions battle for market share in the water services sector, Michigan's location is a unique competitive advantage.<sup>42</sup>

Another local advantage: Michigan's university system.

According to AEG, more than 3,400 degrees were awarded in water-related fields at just three local universities — UM, MSU and WSU — in 2012 alone.<sup>43</sup> All three of these universities have departments, programs or initiatives focused on water, like WSU's Urban Watershed Environmental Research Group, which in part focuses on monitoring and evaluating the impact that pollution in the St. Clair watershed has on the region's economy.<sup>44</sup> From 2009 to 2013, UM, MSU and WSU received about \$300 million in total research awards focused on water innovation, an amount similar to the funding for advanced automotive research at the universities.

## Conclusion

Michigan has for decades underinvested in its water infrastructure at the expense of the economy and the health of families in the state. To ensure Michigan's economy continues to grow — and that all Michiganders enjoy a high quality of life — this gap should be closed.

Fortunately, investing an additional \$12.2 billion in Michigan's own water infrastructure needs on top of existing expenditures would over the next two decades help create **nearly 90,000 direct job-years in multiple industries — including good jobs for veterans — while generating about \$441.3 million in additional earned income for state residents annually.**

This essential spending would also help businesses in the state's water services industry become national leaders in developing and commercializing new water technologies, just as early-mover states like California have become national leaders in clean tech. And it would ensure that all Michigan industries, whether they are directly or indirectly reliant on clean, affordable water, are in the best position possible for decades of ongoing growth.

### Methodology

For the jobs, income and tax revenue data, E2 contracted BW Research which used the Emsi Input-Output model that traces spending and infrastructural developments through the economy to determine the economic impact of the change in water infrastructure spending in the state of Michigan.<sup>45</sup>

The cumulative effects of the initial job change are quantified and the results are categorized into direct, indirect and induced effects.

- Direct effects show the change in the economy associated with the initial job creation (or loss), or how the industry experiences the change (i.e., workers digging ditches to replace pipe).
- Indirect effects include all the backward linkages, or the supply chain responses as

a result of the initial job change (i.e., water pipe manufacturers).

- Induced effects refer to household spending and are the result of workers who are responsible for the direct and indirect effects spending their wages (i.e., direct and indirect workers spend income on clothes, food, healthcare, etc.).

### About E2

E2 (Environmental Entrepreneurs) is a national, nonpartisan group of business leaders, investors, and professionals from every sector of the economy who advocate for smart policies that are good for the economy and good for the environment.

### About BW Research Partnership

BW Research is a full-service applied research firm that is focused on supporting our clients with economic and workforce research, customer and community research, as well as strategic planning and evaluation services.

### About Michigan Businesses for Clean Water

Businesses for Clean Water is a campaign to raise awareness of the economic importance of clean water to the State of Michigan. We are building a statewide movement of business leaders and Michiganders who believe that clean water is key — to their communities, their health, their economic well-being and their future.



# Footnotes

- <sup>1</sup> Unless otherwise states, all economic data in this report is based on research performed for E2 by BW Research Partnership. For methodology, see page 6 of this report.
- <sup>2</sup> <https://detroitmi.gov/document/download-water-and-sewer-maps>
- <sup>3</sup> <https://apnews.com/206e17375e164f0d947331682a58b7f4>
- <sup>4</sup> [https://www.infrastructurereportcard.org/wp-content/uploads/2016/10/FullReport-MI\\_2018-FINAL-1.pdf](https://www.infrastructurereportcard.org/wp-content/uploads/2016/10/FullReport-MI_2018-FINAL-1.pdf)
- <sup>5</sup> <https://pubs.usgs.gov/circ/1441/circ1441.pdf>
- <sup>6</sup> <https://fred.stlouisfed.org/series/MINGSP>
- <sup>7</sup> <https://businessleadersformichigan.com/investing-mich-infrastructure-report/>
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- <sup>10</sup> <http://fixmistate.org/>
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- <sup>14</sup> [https://www.mlive.com/news/flint/2018/03/states\\_average\\_monthly\\_bottled.html](https://www.mlive.com/news/flint/2018/03/states_average_monthly_bottled.html)
- <sup>15</sup> [https://www.infrastructurereportcard.org/wp-content/uploads/2016/10/FullReport-MI\\_2018-FINAL-1.pdf](https://www.infrastructurereportcard.org/wp-content/uploads/2016/10/FullReport-MI_2018-FINAL-1.pdf)
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- <sup>17</sup> <https://www.crainsdetroit.com/article/20141222/NEWS/141229993/aftermath-of-august-flooding-10-billion-gallons-of-sewer-overflows>
- <sup>18</sup> <https://www.crainsdetroit.com/article/20140824/NEWS/308249965/quick-thinking-workers-save-company-data>
- <sup>19</sup> <https://nca2018.globalchange.gov/chapter/21/>
- <sup>20</sup> <https://www.crainsdetroit.com/article/20160610/BLOG012/160619966/rouge-river-displays-mankinds-industrial-might-mistakes-and-new>
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[https://www.michigan.gov/documents/snyder/21st\\_Century\\_Infrastructure\\_Commission\\_Final\\_Report\\_1\\_544276\\_7.pdf](https://www.michigan.gov/documents/snyder/21st_Century_Infrastructure_Commission_Final_Report_1_544276_7.pdf)
- <sup>25</sup> Construction and extraction alone is responsible for roughly half the expected job growth.
- <sup>26</sup> [https://www.bls.gov/oes/2017/may/naics4\\_221300.htm](https://www.bls.gov/oes/2017/may/naics4_221300.htm)
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- <sup>31</sup> <http://michiganblueeconomy.org/wp-content/uploads/2015/03/Michigan-Blue-Economy-Report.pdf>
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- <sup>35</sup> <https://www.waterworld.com/industrial/process-water/article/16210874/driving-process-water-efficiency-in-the-automotive-industry>
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- <sup>40</sup> [https://www.epa.gov/sites/production/files/2018-10/documents/corrected\\_sixth\\_drinking\\_water\\_infrastructure\\_needs\\_survey\\_and\\_assessment.pdf](https://www.epa.gov/sites/production/files/2018-10/documents/corrected_sixth_drinking_water_infrastructure_needs_survey_and_assessment.pdf)
- <sup>41</sup> [https://urcmich.org/wp-content/uploads/2015/03/URC\\_Water-Industry-Sector.pdf](https://urcmich.org/wp-content/uploads/2015/03/URC_Water-Industry-Sector.pdf)
- <sup>42</sup> [https://urcmich.org/wp-content/uploads/2015/03/URC\\_Water-Industry-Sector.pdf](https://urcmich.org/wp-content/uploads/2015/03/URC_Water-Industry-Sector.pdf)
- <sup>43</sup> [https://urcmich.org/wp-content/uploads/2015/03/URC\\_Water-Industry-Sector.pdf](https://urcmich.org/wp-content/uploads/2015/03/URC_Water-Industry-Sector.pdf)
- <sup>44</sup> <https://livinggreen.wayne.edu/uwerg>
- <sup>45</sup> Economic models were developed in both Emsi Input-Output and Impact Analysis for Planning (IMPLAN). The models and their outcomes were compared.

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For more information on this report or on E2's work on clean water in Michigan, please contact [mpreskill@e2.org](mailto:mpreskill@e2.org).