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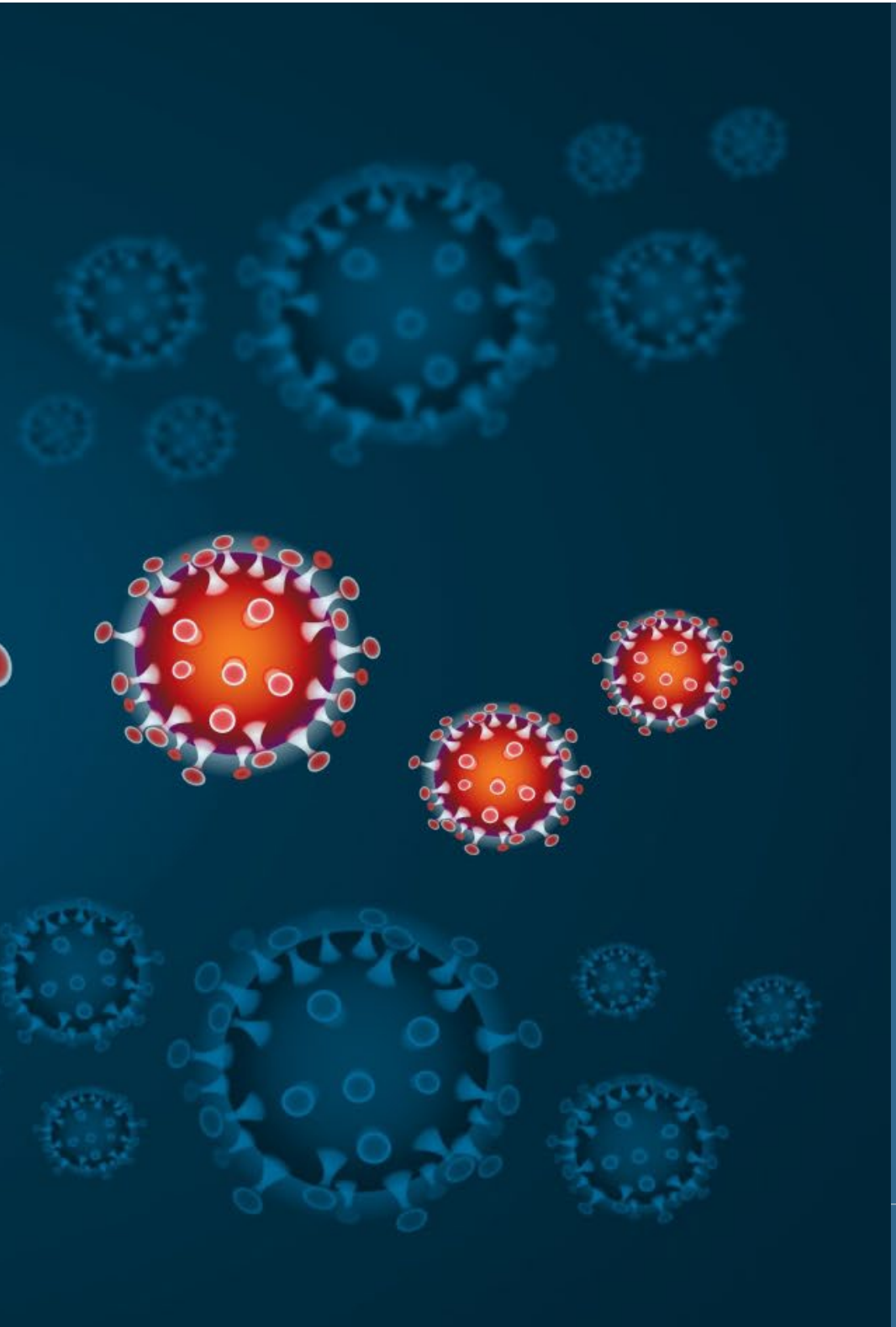
WHITE PAPER

April 2020

Covid-19 Water Industry Impact: Navigating toward Resiliency

Key Implications for the Future of U.S. Municipal Water



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Executive Summary

Water & wastewater system owners and operators have been thrust into uncharted territory as Covid-19 wreaks havoc on national healthcare systems and economies, globally. Irrespective of this disruption, utilities must provide essential services to sustain populations while they hunker down for weeks, if not months of quarantine. Benchmark epidemiology curves from Asia and Europe suggest that the U.S. will be forced to grapple with the contagion through August, at a minimum.

The foreseen devastation is global and largely uninhibited by geographic, economic, and demographic boundaries that have isolated many in more localized catastrophes (e.g. Hurricane Harvey, California's Camp Fire). With the world on notice, simultaneously, all signposts indicate that strategies to address existing and new water & wastewater operations and services will be necessary.

Five key areas most impacted…

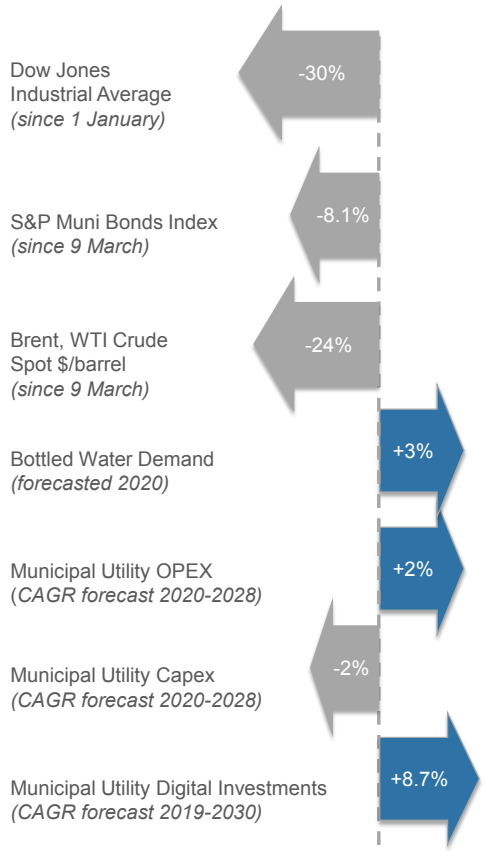
At this stage of the outbreak, Bluefield Research anticipates five key areas most impacted by the upheaval that will reshape the municipal water sector long beyond the current health crisis:

1. Capital and Operating Expenditures
2. Workforce Management
3. Affordability
4. Customer Communications
5. Resilience Planning

The short-term impacts created by the pandemic are so significant in scale that they will catalyze a new approach to urban resilience going forward.

This approach will be characterized by an acceleration of digitalization and re-prioritization of capital needs, from reactive underinvestment to longer term planning for infrastructure sustainability.

Exhibit 1: Key Change Indicators, Covid-19 Impact



Source: Dow Jones, S&P, Energy Information Administration, Utilities, Bluefield Research

Accelerating Recession Puts Utilities to the Test

The cascading effects of geopolitical and economic events, some of which could have been anticipated and prepared for, have left none untouched by the severity of the public health crisis and associated financial upheaval.

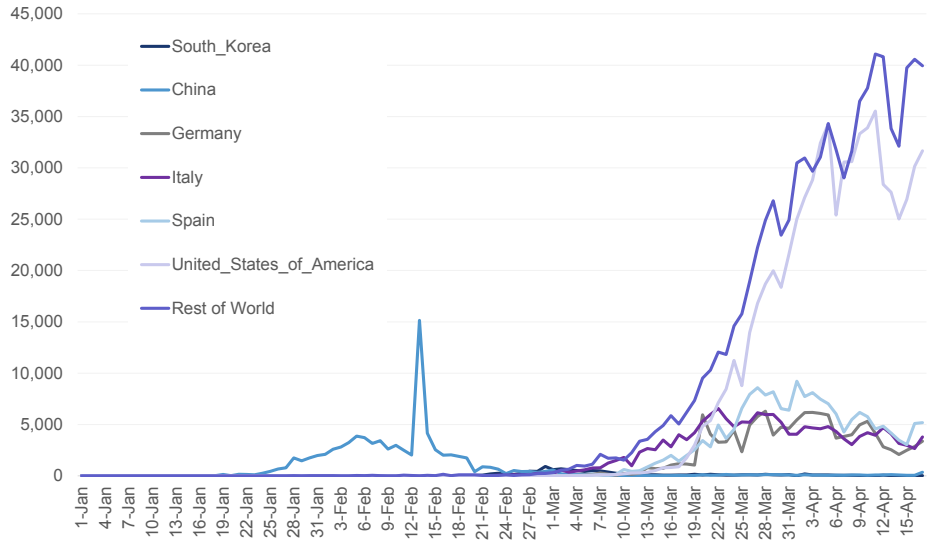
Confluence of Events Upends U.S., Global Economy

On 23 January 2020, or two and one-half months ago, the central government of China imposed a lockdown in Wuhan and other cities in Hubei Province. As of 15 April 2020 and the publication of this paper, **confirmed Covid-19 cases, globally, neared 2 million,** and the U.S. became the global epicenter of the pandemic, led by New York City. This has come on the heels of China, South Korea, Italy, Spain, and other countries' moves to restrict movement through varied strategies—social distancing, quarantining, and sheltering in place.

The U.S., in contrast, is unique in that its population is large, exceeding 300 million people and is highly fragmented in its governance (i.e. city, county, state, federal). Further, its healthcare services are similarly disjointed with more than 25 million people without health insurance coverage. The spread of the virus is anticipated to peak by late April, requiring over 260,000 hospital beds.

The economic impacts, which clearly have yet to play out, are projected to be longer lasting and more severe than other developed countries.

Exhibit 2: New Confirmed Covid-19 Cases through 15 April 2020

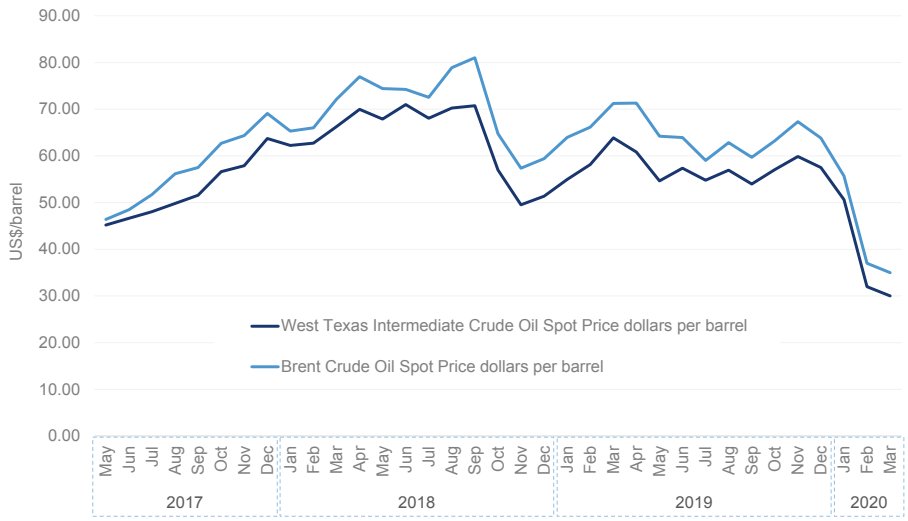


Source: World Health Organization

The global economic free fall actually began weeks prior, after Saudi Arabia and Russia, at the Organization of Petroleum Exporting Countries (OPEC) meetings, failed to reach an agreement to slow oil production as a means to bolster oil prices to levels closer to US$55 per barrel.

- On March 9, Brent crude oil front-month futures prices fell below US$35 per barrel, a 24% daily decline which represented the second largest price drop on record. Since then, on 30 March 2020, West Texas Intermediate prices have plummeted further to sub-US$20 per barrel and an 18-year low.
- Strides in upstream oil and gas exploration and production via hydraulic fracturing techniques propelled the U.S. towards energy independence, but not without financial risk that became apparent over the last year. Looking forward, oil prices sustained at current levels (even below US$40 per barrel) will devastate the highly levered sector through layoffs, bankruptcies, and investor pull-backs.

Exhibit 3: Spot Oil Prices, West Texas Intermediate and Brent Crude



Source: Energy Information Administration

By afternoon, 12 March 2020, public sentiment collapsed on the heels of notable Covid-19 cases, corporate and organizational shutdowns (e.g. National Basketball Association, National Hockey League), and an abrupt (and unclear) White House declaration to reduce travel between Europe and the U.S.

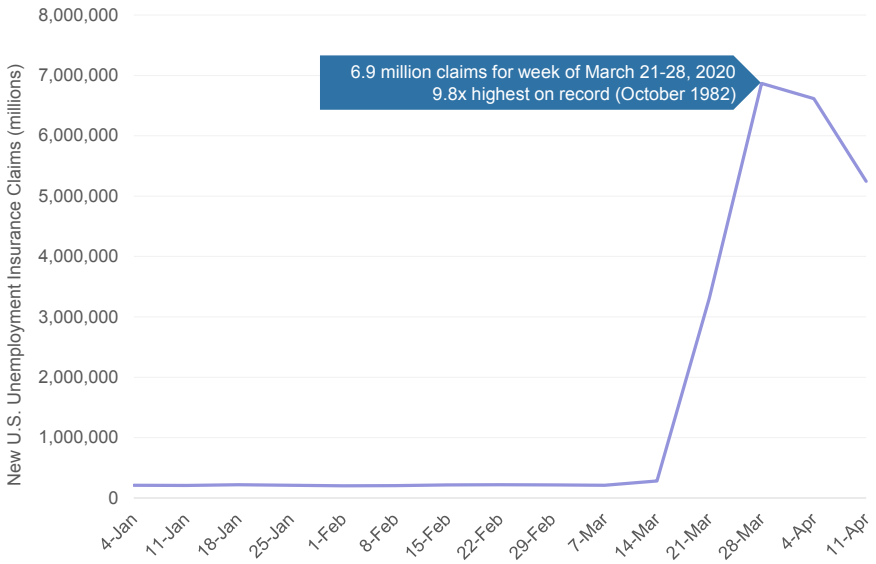
- The Dow Jones Industrial Average fell by nearly a third since its high in January 2020, to levels below 20,000. Markets have recovered slightly since with a US$2 trillion injection of capital into the economy by Congress.
- Municipal bond prices, a key source for public infrastructure funding, have declined 8.1% since 9 March 2020.

This precipitous decline, which continued for the better part of a week, was partly a result of pre-existing economic uncertainty. Recessionary concerns, globally, have heightened over the last year because of tariffs on Chinese products, an inverted bond-yield curve, soft industrial production, Brexit, and expectations that a 10-year bull run would run out of steam.

Almost overnight, the global economy, let alone the U.S. economy, has snowballed into an all-out freeze on non-essential economic activity.

- In Q2 2020, U.S. gross domestic product (GDP) is expected to decline 20%, the greatest quarterly decline on record.
- More troubling of all, new unemployment insurance claims in the U.S. surpassed 6..8 million for the week of 21 to 28 of March. Not only is this a lagging indicator, it is only one week in what appears to be the leading edge of anticipated layoffs and furloughs across all corners of the economy.

Exhibit 4: U.S. Unemployment Spike Portends Tougher Times Ahead



Source: U.S. Bureau Labor Statistics

"...Not only is this a lagging indicator, it is only one week in what appears to be the leading edge of anticipated layoffs and furloughs across all corners of the economy.

The economic impacts sparked by Covid-19 are already wide-sweeping, leaving none of the 49,000 public water and 18,000 public wastewater systems in the U.S. untouched.

Economic Ripple Effect to Impact Municipal Operating Budgets

Into the foreseeable future, state and municipal governments will be squeezed further as their key revenue sources disintegrate seemingly overnight, thereby increasing pressure on community water system financing.

Key revenue reductions…

Key revenue reductions, among others, will stem from:

- Sales tax return declines as many services and businesses will be closed because of quarantine-like measures.
- Significant cuts to income tax returns on the heels of scaling unemployment and reduced wages going forward.
- Lower capital gains tax revenues from equity transactions after significant stock market declines.
- Property taxes are likely to decline following an economic reset, thereby undercutting municipal revenues over time.

These revenue reductions will also be accompanied by increasing expenses, including unprecedented unemployment insurance claims and Medicaid costs.

To no avail, public wastewater utilities requested US$12.5 billion in the third phase of coronavirus economic relief to offset revenue lost to service reductions for industrial and commercial users.

Historical Evidence Signals Possible Lag in Municipal Pullback

The historical impact of prior economic downturns on utility expenditures for water & wastewater infrastructure is well documented and enables scenario analysis of the potential impacts going forward on players across the water industry value chain—hardware and technology vendors, engineering firms, utilities, and investors.

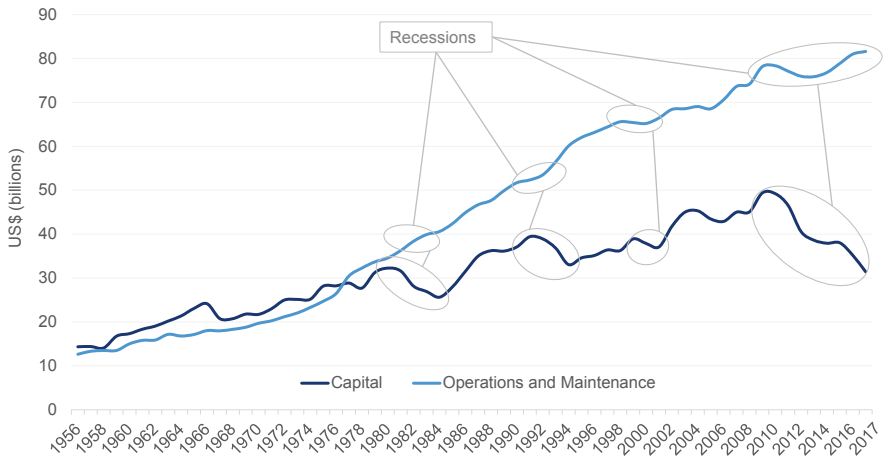
In contrast to utility capital expenditures (CAPEX), recessionary impacts on operating expenditures (OPEX) are far more limited. To put things in perspective, loss of existing water services and water quality presents a far more significant threat than unemployment and an economic downturn. Millions of miles of pipe and tens of thousands of plants do not operate themselves.

- Since 1956, the compound annual growth rate for public utility OPEX has been 3.05%.
- In all but one historical recession analyzed by Bluefield, OPEX outpaces Bluefield's *Maintaining Status Quo scenario*. Even in the most dramatic example (2007-2009), 10-year OPEX growth is 12%, versus Bluefield's anticipated 16% over 10 years.

In any case, operating budget revisions are likely to include short term freezes on spending for external service providers that will cascade across the value chain.

> "We've been letting water infrastructure go to the dogs for too long. For all the wrong reasons, this is the opportunity to address the problems we have known about for decades.
>
> Reese Tisdale, President, Bluefield Research

Exhibit 5: U.S. Municipal Water/Wastewater Utility OPEX vs. CAPEX 1956-2017



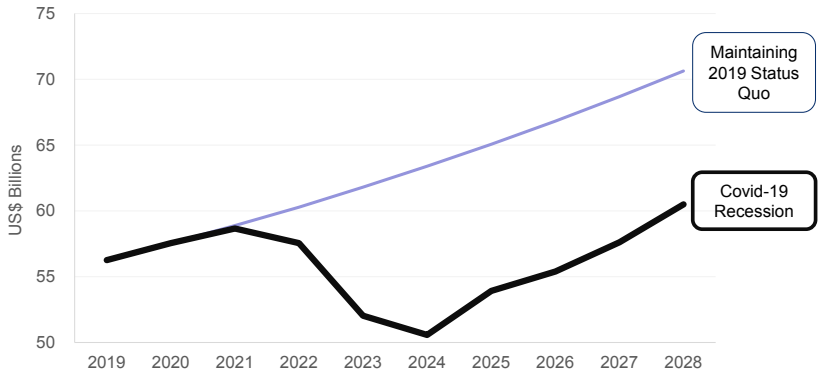
Source: Congressional Budget Office, Bluefield Research

The knock-on effect of an economic downturn reshapes Bluefield's CAPEX outlook, albeit with a delayed impact. Capital Improvement Plans have shown to be somewhat shielded from short-term market shifts, as the project lifecycle—engineering, financing, and construction—require years of planning. Although, the rapidity at which workforce disruption has happened, raises concerns about the traditional lag.

To analyze the potential range of CAPEX impacts, Bluefield's team of water experts applied the last four recessions to its baseline forecast scenario, *Maintaining Status Quo*.

- In the best-case scenario (2001), the 10-year growth rate is 16%, whereas the worst-case scenario (1990) would result in a 0% growth rate during the same period. Bluefield's *Maintaining Status Quo*, or the historical trend, is 26% growth over a 10-year period.
- The Covid-19 pandemic has intensified recessionary impacts with estimates of up to a 3.8% contraction of GDP for 2020. The correlation between GDP reductions and water infrastructure spend, considering these inputs, suggests investment is likely to fall well under US$52 billion (-10% in 2023), as new and large capital projects are postponed.
- For original equipment manufacturers (OEMs), distributors, engineering consultancies, and other service providers, these impacts include major hits to corporate earnings, downsizings, and bankruptcies for smaller, venture-dependent organizations on discretionary budgets.
- With upwards of US$6 billion worth of water lost annually to leakage in the U.S., emerging contaminants (e.g. PFAS, lead, algae blooms) threatening water supplies, and rising population demands, water & wastewater infrastructure has long been recognized for a needed upgrade. If unemployment rises to depression-levels (24%), water infrastructure projects present an opportunity to invest in the future.

Exhibit 6: U.S. Municipal Water/Wastewater Utility CAPEX 2019-2028



Source: Bluefield Research

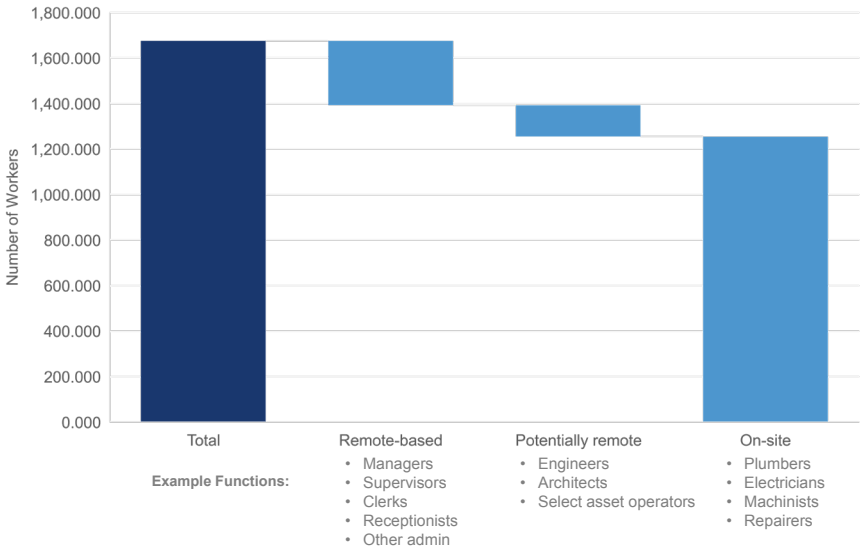
Remote Workforce to Accelerate Digital Buildout

Containment measures to slow the spread of Covid-19 are taking their toll on utility operations. Telecom, power, and water utility customer consumption patterns have morphed overnight. Entire sectors, including water, have shifted to telecommuting models, thereby putting pressure on essential services. For the utility workforce, network operators and their emergency protocols, asset redundancy, remote management, and levels of automation are being tested.

- The U.S. water sector employs roughly 1.7 million people, spread across 212 different standard occupation classifications (SOCs) from plumbers to managing directors.
- While many administrative and management functions can be moved to remote locations, at least 1.25 million workers perform functions on site.
- Employees working on site account for more than 70% of industry personnel at greater risk of coronavirus exposure. To address this risk, increased cleaning, rotating teams, and social distancing have been implemented.
- Some water suppliers are already taking more drastic precautionary measures, such as the Carlsbad desalination plant in California where the facility's 10-person team is sheltering in place for three weeks with no-contact supply deliveries.

Desalination plant

Exhibit 7: Water Sector Labor Composition and Remote Worker Estimate



Source: Bureau of Labor Statistics, Brookings Institution, Bluefield Research

Containment measures are taking their toll on utility operations.

The future implications for water workforce management could be more significant going forward. While broad in its impact, the need for remote monitoring and system redundancy is not unique. As recently as the wildfires in California and Australia and Hurricanes Harvey, Sandy, and Katrina, limited physical access to water systems required operators to gather real-time insights into water supplies, asset conditions, and operations.

It is too late for most utilities to rapidly transition to significant remote operational control of their assets in the next three months. The industry as a whole has been forced into a defensive crouch, only able to reactively carry out crucial repairs. This implies that utilities that have already invested heavily in remote monitoring and digital asset management will likely see more immediate benefits from a resiliency perspective. Those that have not will be more challenged into the foreseeable future.

- 79% of US community water systems have supervisory control and data acquisition (SCADA) systems fully implemented, while just 21% have network optimization solutions in place that facilitate remote management.

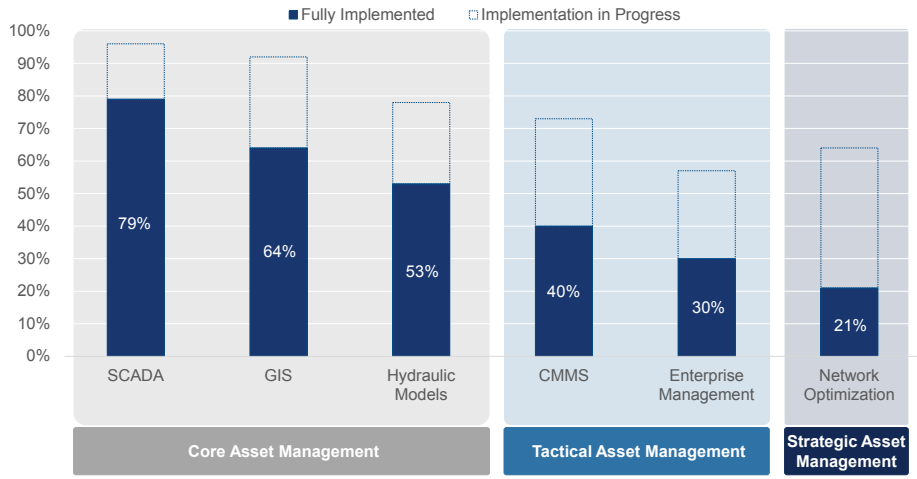
The current challenges will compel utilities to assess their operational vulnerabilities and to accelerate their digital journey, from Core to Strategic Asset management. Establishing one's current situational awareness marks an important first step to advanced asset management.

Key steps to advanced asset management…

Along this path, key steps include:

- **Increased remote monitoring of key assets** including treatment plants, pumping stations, pressure reducing valves, core water and sewer mains. Some providers are already offering free remote-monitoring and control licenses during the pandemic.
- **Adopt solutions that enable remote work**, such as cloud-based data access, secure remote communications channels.
- Resiliency planning that makes use of improved data collection capabilities, such as event management simulations using a digital twin.

Exhibit 8: Digital Asset Management Technology Implementation Rates



Source: American Water Works Association State of the Water Industry 2018, Bluefield Research

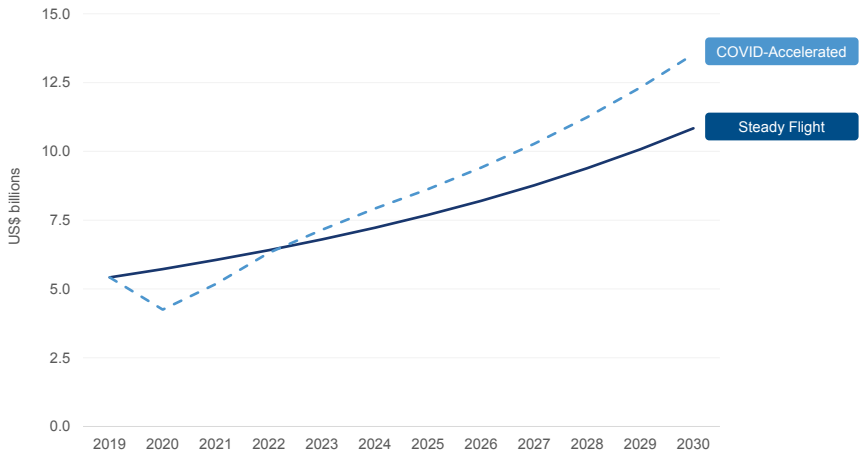
Once the crisis passes, Bluefield anticipates a material increase in demand for solutions which enable greater resilience against future shocks, such as remote monitoring of critical treatment and conveyance assets, process automation and optimization platforms, and mobility and cybersecurity solutions for a more distributed workforce.

- In the near term, Bluefield forecasts a 22% decline in 2020 digital water spend for the U.S. and Canada markets relative to 2019. A return to growth is expected by 2021, albeit supported by a host of new and different drivers.

- In the new, COVID-accelerated growth scenario, the U.S. and Canada digital water market expands at a compound annual growth rate of 8.7% between 2019 and 2030, compared to 6.5% in Bluefield's pre-crisis *Steady Flight* forecast.

First-hand experience with workforce and operational disruption will spark greater interest in digital solutions. This is expected to build on the pent-up demand created by the outbreak. Further, increased focus on building resiliency to future shocks (e.g. pandemics, wildfires, hurricanes, tornados, drought), coupled with a greater comfort with digital technologies will result in greater long-term uptake of digital water solutions.

Exhibit 9: U.S. and Canada Digital Water Growth Scenarios, 2019-2030



Source: Bluefield Research

Managing Affordability: Rapid Changes from Chronic to Acute

Utilities have largely been considered recession-proof, as evidenced by their stable demand and employment numbers over time. Prior to the current crisis, water bill affordability was already an issue that has been further exacerbated.

- If rate trends of the past several years continue, 36% of households won't be able to afford water within the next five years, let alone at the end of this downturn.
- At the same time, only 21% of utilities feel they are currently able to fully cover costs and services, according to the American Water Works Association.
- Water & wastewater rates rose more than 30% from 2012 to 2019, more than double the growth rate for real median household income since 2012.
- This is evident in financially constrained city water departments, such as Detroit, Michigan where over 20% of customers do not pay their bills and the moratorium on shut offs will further reduce payments.

In the short term, utilities have rightfully taken measures to limit financial impacts on customers. A number of states and utilities have placed shut-off moratoriums to protect end users, but the question remains for how long.

The combination of increasing capital needs from utilities, slowing per capita demand, and increased industrial focus on water management has been undermining the traditional utility model for years. This downturn does not represent the shot across the bow, but rather, it presents a significant risk to utilities and its stakeholders.

The key will be leveraging innovation to do more with less. This includes insight-driven solutions to optimize billing rates and structure, moderate rate changes, and equitably address the infrastructure investment gap.

Exhibit 10: Example Covid-19 Shut-off Moratoriums

Service Area	Water Utility	Date Effective	Deadline	Note
California	California Public Utilities Commission	17 March	TBD	Retroactively applied since 4 March 2020 to 12 major utilities
Connecticut	PURA–Connecticut Public Utilities Authority	13 March		Major utilities affected: Aquarion, Connecticut Water Co., Avon Water Co., Torrington Water co.
Detroit, MI	Detroit Water and Sewer Department	9 March	9 April	Water Restart plan, after 30 days, $25/month
Hartford, CT	Metropolitan District, Hartford	13 March	TBD	
Jacksonville, FL	Jacksonville Energy Authority	15 March	TBD	
Pittsburgh, PA	PWSA Pittsburgh	1 March	1 May	
Seattle, WA	Seattle Public Utilities	10 March	TBD	Hotline set up to request deferred payment
Toledo, OH	City of Toledo Water Service	11 March	TBD	
Tulsa, OK	Tulsa Metropolitan Utility Authority	16 March	TBD	Also restore service to citizens without water

Note Food and Water Watch reports 113 municipal systems with shutoff moratoriums in place
Source: Utilities, Food and Water Watch, Bluefield Research

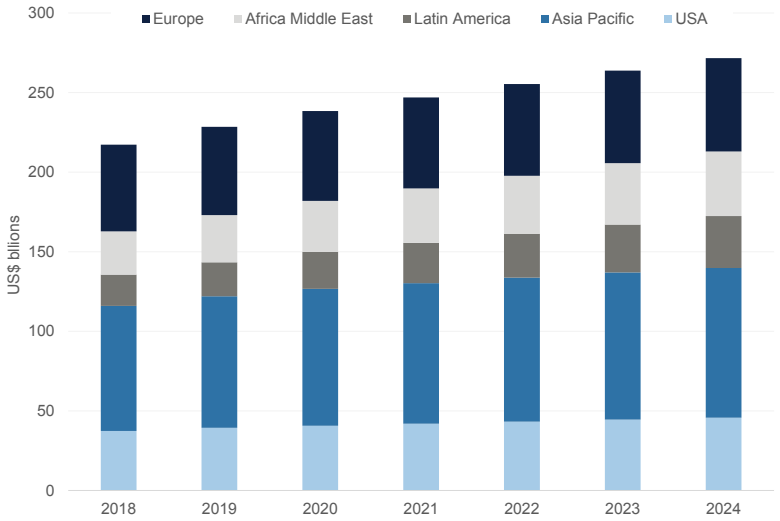
Customer Communications

Recent events have called into question the public's understanding of water supply and wastewater treatment services. The water industry's inability to educate its customers on the quality and value-added services provided has sown distrust and actions that undermine the system as a whole.

As consumers flock to supermarkets to hoard bottled water and toilet paper, municipal water utilities' communication strategies regarding the safety of tap water come to the fore.

- A 2019 Consumer Reports survey of bottled water use found that 34% of U.S. consumers regularly avoid tap water because of water quality concerns.
- Another 17% don't drink tap water at all, despite the fact that between half and two-thirds of bottled water comes from municipal sources.
- In March 2020, despite tap water safety assurances from hundreds of municipalities, and the International Bottled Water Association's confirmation that 'no authority has directed consumers to stock up on bottled water in connection with the COVID-19 outbreak', several states reported consumers stockpiling bottled water.

Exhibit 11: Bottled Water Market Value Outlook 2018-2024



Source: International Bottled Water Association, Bluefield Research

At the same time, consumers are shifting to "disposable" wipes, which are not disposable in sewer systems. These wipes, alongside a myriad of other greases, liquids, and items are taxing sewer system assets and creating blockages. Under normal circumstances, dealing with blockages is an expensive repair, which is even more challenging with limited workforce.

- The City of Charleston, South Carolina spent over US$140,000 in 2018 to remove a wipe-based sewer blockage, which has returned. Several other cities including Lexington, Kentucky; Austin, Texas; and Spokane, Washington are warning residents against flushing wipes as part of their Covid-19 communications program.
- New York City spent over US$18 million between 2010 and 2015 on wipe-related equipment repairs.
- In dealing with these maintenance issues, utilities face the prospect of lost revenue due to shutoff moratoriums and falling commercial and industrial consumption.

What was already a challenging task for municipal water utilities—effectively communicating the quality and value of their services—has become even more pressing. In general, utilities' communication focuses on three key aspects of drinking water demand:

Utilities' communication focuses on three key aspects of drinking water demand…

- Increase transparency concerning the status of operations through increased communication. Multiple channels have emerged in recent years enabling utilities to stay more connected to customers.
- Underscore the efficacy of treatment plant disinfection.
- Guarantee continuity of supply, despite labor challenges and unpaid bills during times of crisis.

Wake up Call for Industry Improvement

The remainder of 2020 promises to be one of the most difficult years for the global economy since the Great Depression. The water industry, however, faces an enormous opportunity to rise to the occasion by realizing step changes in terms of investment levels and operational improvements that will prepare cities for ongoing operations in the face of future disruptive events.

In terms of investment levels, traditional models of raising rates on financially burdened customers and waiting for federal government handouts will not suffice in repairing today's water networks. The current infrastructure investment model needs to change, starting from the bottom-up. Following the 2008 Great Recession, it wasn't until 2018 that state and local construction put in place values for water and sewer returned to 2006 levels at US$38 billion. Up until now, Infrastructure Week in Washington D.C. seemed be a weekly event with nothing to show for it.

For operational improvements toward greater resiliency, advanced asset management allows for real-time condition assessments, predictive maintenance, and enhanced prioritization of capital investments. The forced shift to remote work, optimization of resources, and need for redundancy in response to the coronavirus are likely to instigate demonstrable movement toward resiliency—more so than previous crises based on the widespread impacts of this pandemic. Not since World War II has disruption occurred at such scale. As millions file jobless claims, water infrastructure is one sector that will be core to a more resilient future.

Why Bluefield?

Market insights are more than just the gathering of information, news, and data from a myriad of disconnected sources. Bluefield has dedicated years in shaping its perspective on the global water industry, stakeholders, and the outlook under a range of scenarios.

Not all market research is created equal. Training-up general consultants is frustrating, so working with industry experts enables intellectual honesty from the outset. An experienced and vetted market research firm should be able to transparently share data sources, forecast assumptions, and the math.

It's important you find the right firm to fit your needs and not brand alone. Don't be fooled by the big brand and high price, because some of the largest and most recognized consultancies also rely on Bluefield Research for water market insights. Our in-house capabilities enable you and your colleagues to test our methodology and assumptions in person.

At Bluefield Research, our team of water experts understands many of the challenges facing companies across the water value chain, from municipal water & wastewater agencies and investor-owned utilities (IOUs) to digital water software developers, hardware and device manufacturers, and engineering and technology consultants. We also believe in the opportunity. This enables us to support companies with market forecasts, competitive analysis, venture capital investment trends, and project deployment data.

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Companies and organizations across the value chain are developing strategies to capitalize on greenfield opportunities in water – new build, new business models, and private investment. Bluefield Research supports a growing roster of companies across key technology segments and industry verticals addressing risks and opportunities in the new water landscape.

Companies are turning to Bluefield for in-depth, actionable intelligence into the water sector and the sector's impacts on key industries. The insights draw on primary research from the water, energy, power, mining, agriculture, financial sectors and their respective supply chains.

Bluefield works with key decision-makers at utilities, project development companies, independent water and power providers, EPC companies, technology suppliers, manufacturers, and investment firms, giving them tools to define and execute strategies.