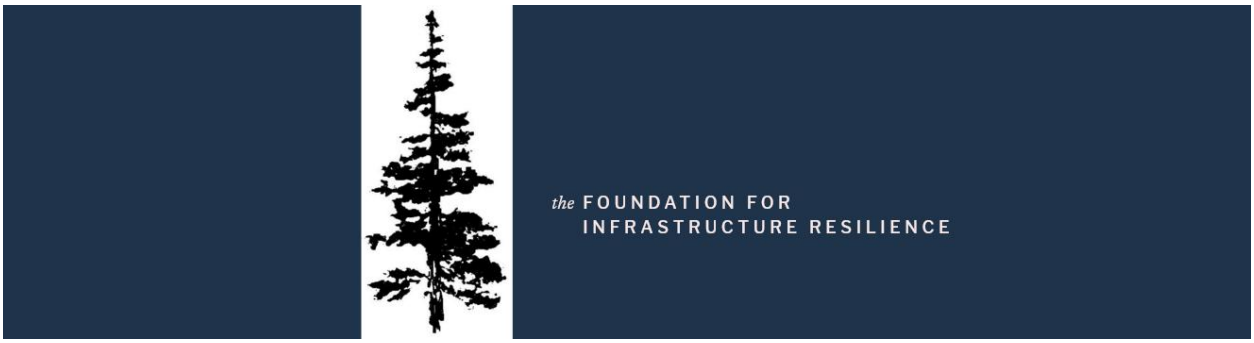

Assessment of Critical Infrastructure with No Grid Power

Water and Wastewater Sector

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Introduction

> ***"There is a lack of understanding of the cascading, cross-sector interdependencies between infrastructure and what that means for prioritizing backup generation and other limited resources to maintain services and functions during a long-term, widespread outage."*- The President's National Infrastructure Council**

The purpose of this paper is to assess the Critical Infrastructure (CI) Sectors' "timeframe to failure" in a Black Sky Event (BSE-nationwide or near nationwide grid power outage lasting 30 days) to assist in the understanding of cascading and cross-sector interdependencies in a BSE. This paper demonstrates the fundamental need for a resilient electric grid as none of the fifteen other critical infrastructures can continue to fully function without electricity from the grid. Most fail completely. A small number of CI elements (not the majority of any CI) may continue to function at an insufficient level using on-site natural gas generation, solar, wind, or other sources. This paper demonstrates that all CI rely on the grid.

This paper benefits leaders and planners involved with resilience and continuity of operations for each CI sector or CI element. The Energy Sector is not analyzed as this paper focuses on the impact to the other fifteen sectors by the loss of the grid. Elements of the Energy Sector not contained in the grid are addressed in specific CI (e.g. gas for automobiles is in the Transportation CI).

"Critical infrastructures are those infrastructure systems and assets that are so vital that their incapacitation or destruction would have a debilitating effect on security, the economy, public health, public safety, or any combination thereof." (DHS, CISA).

"CI in a BSE" has been poorly analyzed which contributes to current plans and organizations being "overmatched" by a BSE.[1] There are occasionally "bright spots" of planning and preparation in each CI; however, most plans are dated or insufficient.[2] [3]

The analysis of CI "time to failure" in a BSE has largely been ignored despite the key role time plays in a disaster. Every CI fails without power, the question addressed is "When?". For example, most of the IT Sector likely fails immediately without electricity but the Dams Sector will likely continue to function.

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[1] The Presidents National Infrastructure Advisory Council, Surviving a Catastrophic Power Outage; How to Strengthen the capabilities of the Nation, Dec 2018

[2] Ibid

[3] DHS/CISA, Critical Infrastructure Sectors (plans are located in each sector), https://www.cisa.gov/topics/critical-infrastructure-security-and-resilience/critical-infrastructure-sectors

The need for each CI is also based on time. For example, a healthy human can live for weeks without food, but only for days without water[4] thereby making the Water/Wastewater Sector more BSE time-critical than the Food/Agriculture Sector. Every CI is needed, but an analysis focused on time is required to conduct resilience planning.

> ***"Current planning frameworks focus on sector-by-sector preparedness and response, but in a catastrophic power outage, U.S. infrastructure and services will fail as a system. We need to take a systems approach—from the federal level down to the local level—to plan, design, and respond to these never-before-experienced events. This approach must move beyond existing planning and response frameworks and provide the guidance needed for an integrated cross-sector, cross-government strategy."*** **- The President's National Infrastructure Council**

Sector Analysis

In order to analyze CI timeframes, one must define the CI, deconstruct each CI into its elements (subsectors), and determine supporting infrastructures. This paper therefore defines/describes each CI with their sub and supporting elements. "Time to failure" is then portrayed and assessed. Understanding the timelines of CI failure in a BSE will assist in BSE (and other disaster) planning.

Failure means the majority of that sector or subsector is unable to perform the majority of its function. Consideration is given to the capability of sector specific backup power.

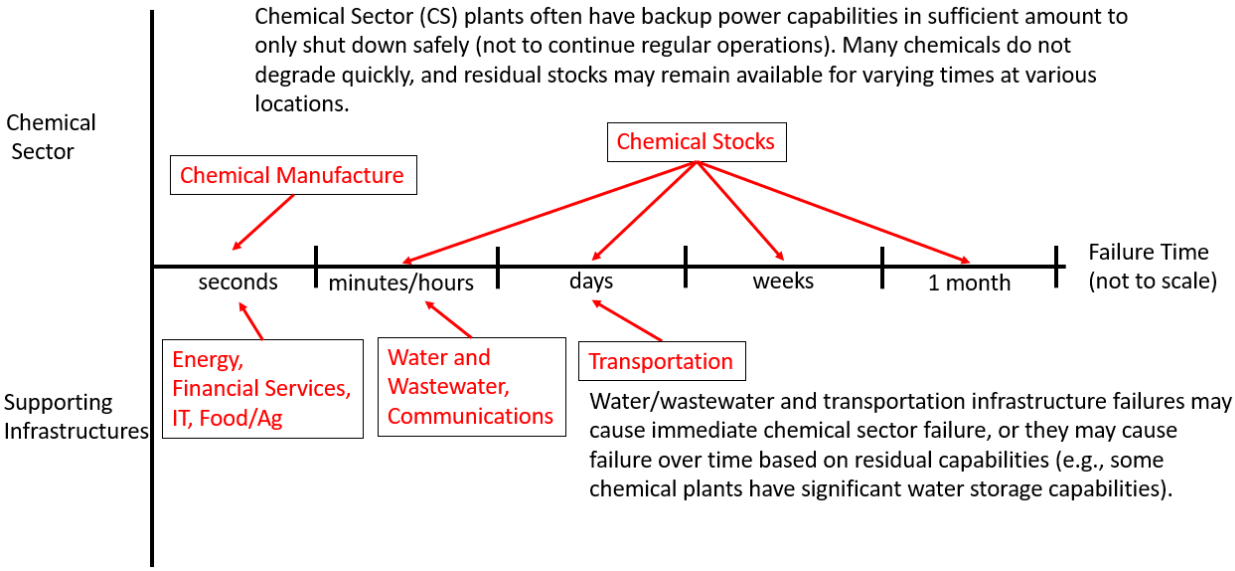
Subsectors are the main elements of the CI that, if failing, would cause the CI to fail. Assessed subsector timelines to failure are at the top of each timeline diagram (see below). Subsector elements assessed failure timelines may be used to plan sector resilience/continuity. If there is no plan to address CI subsectors, the sector will likely fail in a BSE.

Supporting CI (the bottom half of each diagram) shows the assessed failure times of supporting CI. Supporting CI are required for a given CI to function. The impact of the loss of supporting CI is not necessarily felt right away. For example, most water treatment systems have stocks of chemicals on-hand, so the immediate failure of the Chemical Sector will impact water treatment only when stored stocks are depleted and no more chemicals are coming from factories. If unaddressed, supporting CI will cause the given CI to fail anywhere from seconds to weeks (not depicted).

Diagram Example: The Chemical Sector Diagram is depicted below. The Chemical Sector subsectors are chemical plants and chemical stocks (located on the top with arrows depicting assessed BSE failure timelines). The Chemical Sector supporting CI are located on the bottom

[4] FEMA, FEMA NATIONAL US&R RESPONSE SYSTEM STRUCTURAL COLLAPSE TECHNICIAN , https://www.fema.gov/pdf/emergency/usr/appen_b.pdf

with their own assessed failure timelines (note that supporting CI will not necessarily cause the Chemical CI to fail in the same "failure time").



Communications, Energy, Financial Services, and IT are required for the administration of most CI. This includes (and is not limited to) financial transactions for supplies/raw materials, pay for employees, supply chain efforts, and the ability to effectively coordinate and execute operations. These CI are important for CI survival while other CI (e.g., Water) are more important for human survival. As humans are a required element of each CI, food and water become Supporting CI for all other CI.

Sectors are identified as local, regional, or national to assist in assigning planning responsibility. For example, if a CI is national, national planning should occur as well as regional and local planning. If it is local, then local planning is required. For example, wastewater treatment plants require local planning as there is no national wastewater system while the Finance CI requires a national plan.

A brief impact statement for the failure of each CI is included as is a brief recommendation for each CI based on the failure timeline.

Additional Considerations

In addition, the following entities are important in analyzing the impact timelines of BSE in the US (these are not official Critical Infrastructures):

- People: People are an element of all CI, and their survival needs to be considered within each CI. For example, a water treatment plant may want to have its personnel and families live at the treatment plant in a BSE (some have planned for this). Much of

"power out" planning focuses on human survival vs CI survival. Humans can generally survive for 3 days without water or 3 weeks without food.[5] As people are an element of each CI, there is a first order need for food and water in each CI. Family concerns and widespread societal panic that could lead to desperate behavior, to include looting, rioting and violence, may keep people away from their CI posts (exacerbating CI failure). CI personnel may have old, sick (to include medicated), and very young dependents that have more pressing needs earlier in a BSE. Shelter may be a necessity. Many books and recommendations for family preparedness have been published (to include by FEMA[6]) but it is improbable that preparedness of CI individuals and families can be accurately determined (until an actual emergency occurs). In addition, it is unclear how many CI workers will show up to work without some form of compensation (finance).

- Fuel: Fuel is not a CI, but elements of the fuel system are included in several CI. Transportation includes rail, barge/ship, and truck transportation for fuels. Many CI and individuals have backup generation, but the lack of fuel will restrict their usage. If gas stations and bulk fuel distributors are not functioning, then all CI that depends on backup generation will not have (or run out of) the fuel required to function (Commercial facilities, communications (for credit cards) and finance generally are required for the normal function of gas stations.[7]). Previous power outages have shown that gas for automobiles/trucks and generators is generally unavailable.[8] This problem remains.[9] Superstorm Sandy demonstrated the need for backup power, especially for the fuel industry.
- Backup generation: Many CI have elements that have backup generation. If CI have backup generation, then their "time to failure" is extended. If CI have fuel storage for their backup generation, then their "time to failure" is further extended. There are no CI that have full backup generation for all elements. Some CI have sufficient backup power to last hours and days, but no CI has sufficient backup power to last weeks (due to lack of on hand fuel). A CI plan that relies on continuous fuel resupply for backup generation is assessed as unlikely (due to the failure of CI that are required for continuous

[5] FEMA, FEMA NATIONAL US&R RESPONSE SYSTEM STRUCTURAL COLLAPSE TECHNICIAN , https://www.fema.gov/pdf/emergency/usr/appen_b.pdf

[6] FEMA, Build a Kit, https://www.ready.gov/kit

[7] FEMA, Power Outage, Keep Vehicles Fueled, https://community.fema.gov/ProtectiveActions/s/article/Power-Outage-Keep-Vehicles-Fueled#:~:text=%E2%80%9CKeep%20your%20car%20fuel%20tank,Several%20Minutes%20or%20Several%20Days

[8] FEMA, Power Outage, https://community.fema.gov/ProtectiveActions/s/article/Power-Outage-Keep-Vehicles-Fueled

[9] The Presidents National Infrastructure Advisory Council, Surviving a Catastrophic Power Outage; How to Strengthen the capabilities of the Nation, Dec 2018, page 30 https://www.cisa.gov/sites/default/files/publications/NIAC%2520Catastrophic%2520Power%2520Outage%2520Study_FINAL.pdf

resupply). In addition, Superstorm Sandy showed that backup generators require significant maintenance when in constant use.[10]

- Military: The Military role in a BSE is governed by the same processes and procedures that apply to hurricanes and other natural disasters.[11] In sum, the US Military relies on other local/state/federal organizations for the welfare of its personnel and families that live off-installation (approximately 70 percent[12] of its force). In modern times, the military has not responded to community needs until a DSCA (Defense Support of Civilian Authorities) request is approved.[13] Certain commanders do have the ability to respond to emergencies without DSCA approvals.[14] There is currently no published military plan that addresses a BSE despite the severe impact it would have on military personnel and the infrastructure required to support military bases.
- Governance: As with the Military, continuity plans that address governance are inadequate for a BSE. Some agencies will have a skeletal capability to function, but the ability to support the population with required governance in a BSE is deficient.[15] [16]

Recommendations

Plan for a BSE. Subsector elements and supporting CI may be used to organize planning for sector resilience (see Food/Ag Sector for example). If there is no plan to address subsector elements or supporting CI, the sector will fail in a BSE.

There is a lack of redundancy throughout CI (e.g., each household taps into one water system and if that system fails to produce, there is no alternate system). Increasing sector redundancy while eliminating single points of failure will increase CI resilience.

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[10]P CISA, Resilient Power Best Practices for Critical Facilities and Sites with Guidelines, Analysis, Background Material, and References 61, ttps://www.cisa.gov/sites/default/files/2023-03/CISA_Resilient_Power_Best_Practices_for_Critical_Facilities_and_Sites_508c.pdf

[11] Congressional Research Service, Defense Primer: Defense Support of Civil Authorities, https://crsreports.congress.gov/product/pdf/IF/IF11324#:~:text=Courts%20have%20generally%20construed%20this,and%20criteria%20for%20handling%20requests.

[12] US Dept of Housing and Urban Development, Community Housing Impacts of the Military Housing Privatization Initiative, p 1, https://www.huduser.gov/portal/sites/default/files/pdf/insight_3.pdf

[13] DODD 3025.18, Defense Support to Civil Authorities, https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodd/302518p.pdf

[14] Congressional Research Service, Defense Primer: Defense Support of Civil Authorities, https://crsreports.congress.gov/product/pdf/IF/IF11324#:~:text=Courts%20have%20generally%20construed%20this,and%20criteria%20for%20handling%20requests.

[15] The Presidents National Infrastructure Advisory Council, Surviving a Catastrophic Power Outage; How to Strengthen the capabilities of the Nation, Dec 2018, page 10 https://www.cisa.gov/sites/default/files/publications/NIAC%2520Catastrophic%2520Power%2520Outage%2520Study_FINAL.pdf

[16] DHS/CISA, Critical Infrastructure Sectors (plans are located in each sector), https://www.cisa.gov/topics/critical-infrastructure-security-and-resilience/critical-infrastructure-sectors

CI are most often considered individually instead of as "strands" of mutually supporting CI. National, state, and local planning should prepare using a "mutually supporting CI" approach.

Explore increasing natural gas generation and solar generation that does not rely on the grid or grid power (based on CI requirements).

Summary Table

The following table summarizes the assessed general failure times for each CI without power. The United States Government published an Energy Sector Specific Plan (SSP) that includes wording stating that each sector is reliant on energy/electricity.[17] While the reliance on electricity was clearly stated, the timeline to failure was not. This table summarizes the assessed "times to failure" based on the more detailed CI analysis contained herein. These failure summaries are assessed for the majority of the CI (every sector will have some well-prepared entities).

Critical Infrastructure (CI)	Failure Within Seconds	Failure Within Minutes/hours	Failure Within Days	Limited Failure
Chemical				
Commercial Facilities				
Communications				
Critical Manufacturing				
Dams				
Defense Industrial Base				
Emergency Services				
Energy				
Financial Services				
Food and Agriculture				
Government Facilities				
Healthcare				
Information Technology				
Nuclear				
Transportation				
Water and Wastewater				

[17] FEMA, DHS, Energy Sector Specific Plan, p 19, https://www.cisa.gov/sites/default/files/publications/nipp-ssp-energy-2015-508.pdf

Notes:

"The NIPP [National Infrastructure Protection Plan] 2013 identifies lifeline functions— water, transportation systems, communications, and energy—as services and resources that are essential to the operations of most critical infrastructure partners and communities."[18]

Most Sector Strategic Plans contain a section describing sector dependencies. These provide the bulk of the sector interdependencies discussed in this paper.

The Financial Services Sector is normally ignored in most Sectors. This paper includes Financial Services in each CI as a "Supporting CI" (except Emergency Services). All CI include personnel who require paychecks (Assumption: Most ES personnel will report for duty without pay…for a period of time). All CI require the ability to pay bills, invoices and conduct other purchase/sell transactions. Required payments don't become free in a power outage.

No backup effort is considered effective unless it has been planned for and at least partially rehearsed. For example, a food warehouse that relies on IT to receive invoices is not considered functional by simply stating that warehouses can use paper invoices and manual accounting; they have to plan and rehearse this option for it to be viable.

[18] DHS, Chemical Sector Specific Plan, 2015, p 5, https://www.cisa.gov/sites/default/files/publications/nipp-ssp-chemical-2015-508.pdf

Water and Wastewater

Define/Describe CI: "Safe drinking water is a prerequisite for protecting public health and all human activity, and properly treated wastewater is vital for preventing disease and protecting the environment. Ensuring continuity of drinking water and wastewater treatment and service is essential to modern life and the Nation's economy."[19] "The Water and Wastewater Sector is a complex sector composed of drinking water and wastewater infrastructure of varying sizes and ownership types. Multiple governing authorities pertaining to the Water and Wastewater Sector provide for public health, environmental protection, and security measures, among others."[20] "There are over 148,000 public water systems in the United States. EPA classifies these water systems according to the number of people they serve, the source of their water, and whether they serve the same customers year-round or on an occasional basis."[21]

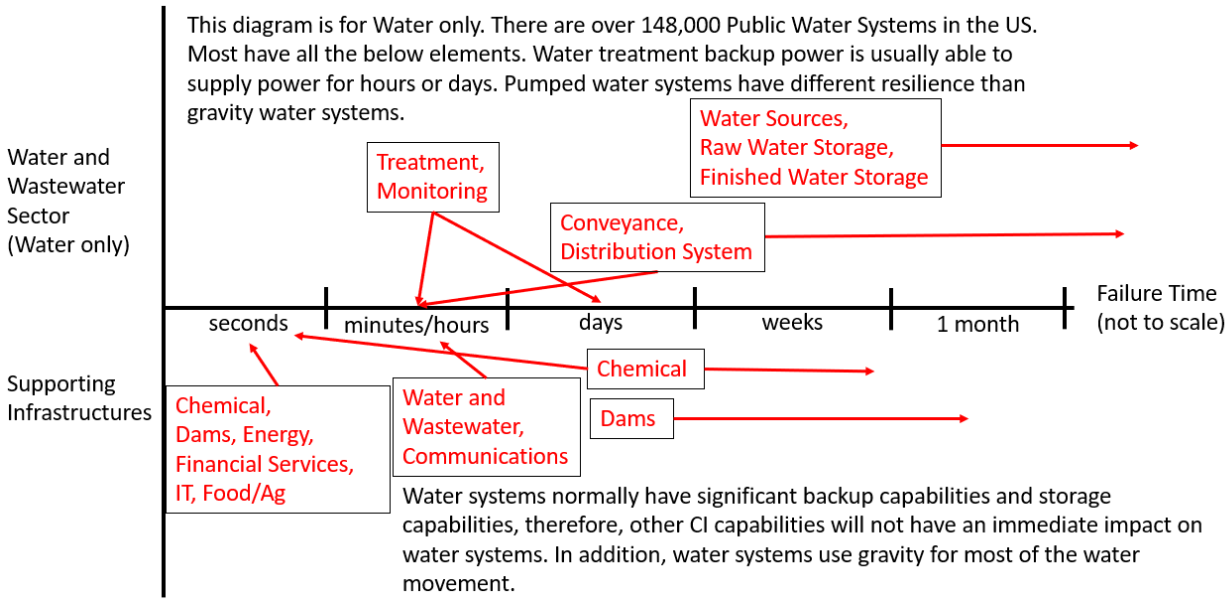
- "Physical Elements (of a water system)
  - Water source. This may be ground water, surface water, or a combination of the two. The vast majority of CWSs serving fewer than 10,000 people use ground water as their source. Large CWSs obtain most of their water from surface sources.
  - Conveyance. To bring water from a remote source to the treatment plant, CWSs may use pipes or open canals; the water may be pumped or gravity-fed.
  - Raw water storage. Reservoirs or lakes hold water from the source before it is treated; these reservoirs may be in remote or urban areas.
  - Treatment. A variety of physical and chemical treatments are applied, depending on the contaminants detected in the raw water.
  - Finished water storage. Treated water is stored before being distributed to customers. In a limited number of cases, treated water is stored in large, uncovered reservoirs that may be vulnerable to attack and contamination.
  - Distribution system. This network of pipes, tanks, pumps, and valves conveys water to customers. The flow is adjusted so that the proper volume and pressure is delivered when and where needed.
  - Monitoring system. Most monitoring is conducted for conventional regulated and unregulated contaminants. Some utilities have sensors installed at critical points to monitor a range of physical properties, such as water pressure and water quality."[22]

[19] DHS, CISA, Water and Wastewater SSP, p 1, https://www.cisa.gov/sites/default/files/publications/nipp-ssp-water-2015-508.pdf

[20] Ibid, p 2

[21] EPA, Information About Public Water Systems, https://www.epa.gov/dwreginfo/information-about-public-water-systems#:~:text=There%20are%20over%20148%2C000%20public,or%20on%20an%20occasional%20basis.

[22] DHS, CISA, Water and Wastewater SSP, p 4, https://www.cisa.gov/sites/default/files/publications/nipp-ssp-water-2015-508.pdf



Failure timeline: (subsectors sourced from Water/Wastewater SSP) Water systems are built relying on the natural resource of water (other CI require mostly manmade resources). Those resources do not cease in a BSE and make many water systems very resilient. Water sources, raw water storage and finished water storage are often controlled by gravity and can easily last for over 30 days. Many conveyance and distribution systems are also gravity powered. Pumped water systems, however, require power and backup fuel.[23] Pumped systems will rapidly fail without backup power. Treatment requires power and will last as long as the backup generation continues (if chemicals remain available). Monitoring using electronics will also depend on backup generation.[24] Water treatment systems are high energy users.[25] Systems that require pumps also require energy. Many water sources will rapidly become too contaminated (in a BSE) for the remaining inoperable water treatment plants to process, due to untreated sewage discharge from municipal and industrial sources, as well as catastrophic releases from rapidly de-energized chemical and manufacturing plants.

Describe CI Interdependencies (first order interdependencies that, if failing, will cause (at varied times) the Water and Wastewater (water only) Sector to fail)

- Communications, Energy, Financial Services, and IT are required for the administration of all CI. This includes (and is not limited to) financial transactions for supplies/raw materials, pay for employees, supply chain efforts, and the

[23] DHS, CISA, Water and Wastewater SSP, p 40-41, https://www.cisa.gov/sites/default/files/publications/nipp-ssp-water-2015-508.pdf

[24] DHS, CISA, Water and Wastewater SSP, p 4, https://www.cisa.gov/sites/default/files/publications/nipp-ssp-water-2015-508.pdf

[25] Daw, Hallet, Dewolfe and Venner, NREL, Energy Efficiency Strategies for Municipal Wastewater Treatment Facilities, p vi, https://www.nrel.gov/docs/fy12osti/53341.pdf

ability to effectively coordinate and execute operations. Food/Ag and Water are required to maintain the human element of each CI.
    - Chemical: Water treatment for most systems requires chemicals. Some use natural filtrations.
    - Dams: Dams, in several locations, create/control required water sources.

Sort into local or regional or National entities Water is a local CI with State and National regulation.

Impact of this CI with no power (to CI and to society) Generally, humans may live up to 3 days without water.[26] Humans forced to consume untreated contaminated water may rapidly develop life-threatening diseases. Most CI require water.

(Wastewater) Define/Describe CI: "Wastewater is predominantly treated by publicly owned treatment works (POTWs), although there is a small number of private facilities such as industrial plants. The POTWs and privately owned wastewater treatment works that discharge treated effluent into the waters of the United States are subject to regulation under the Clean Water Act (CWA) National Pollutant Discharge Elimination System (NPDES) program…. There are more than 16,500 POTWs in the United States that collectively provide wastewater service and treatment to more than 227 million people and are generally designed to treat domestic sewage. However, POTWs also receive wastewater from industrial (non-domestic) users; these industrial users discharge effluent into a collection system for subsequent treatment at a POTW and are subject to the national pretreatment program."[27]

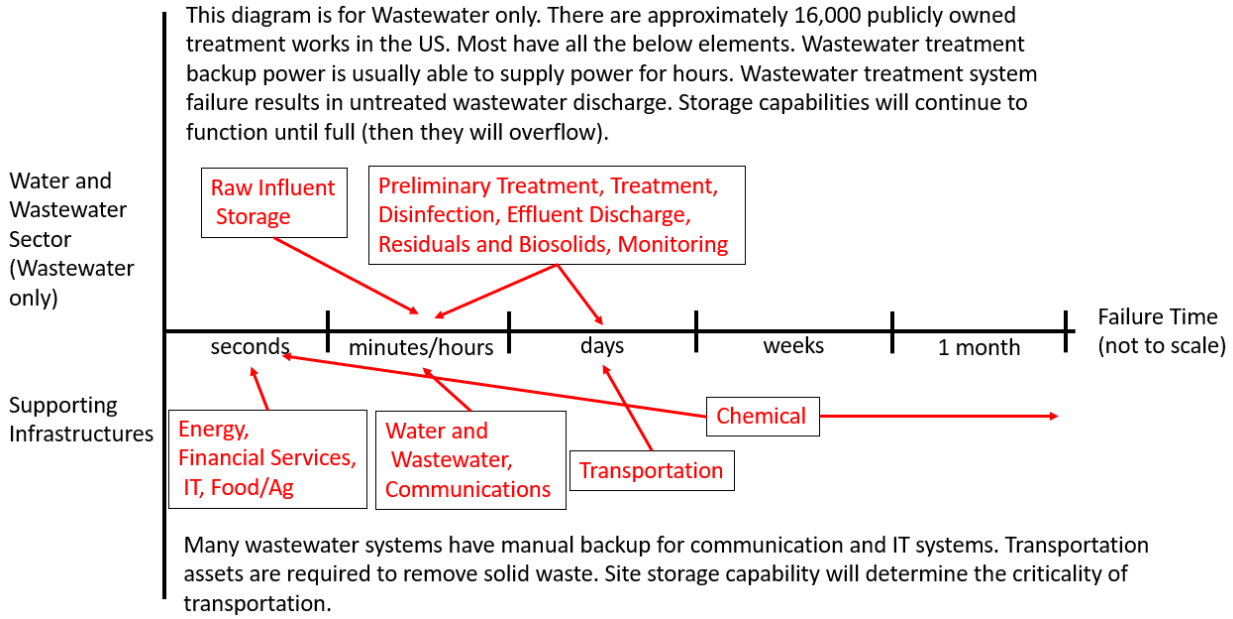
- "Physical Elements (of a wastewater system)
    - Collection. A network of pipes, conduits, tunnels, lift stations, equipment, and appurtenances convey and pump wastewater from the source to the treatment plant. There are three principal types of municipal sewers: sanitary sewers, storm sewers, and combined sewers. Treatment plant operations can profoundly differ based on the type of collection.
    - Raw influent storage. Raw sewage and industrial effluent can be stored in tanks or impoundments, generally for the purposes of flow equalization prior to treatment.
    - Preliminary treatment. This includes removal of materials (rags, wood, plastic, grit, etc.) that could damage a plant's headworks or impair operations. Means for removal can include chemical addition, pre-aeration, bar racks, screens, shredding equipment, and/or grit chambers. Pretreatment can include coagulation, flocculation, and flotation for particle and solids removal.
    - Treatment. Primary treatment involves suspended and floating material removal. Secondary treatment provides for the reduction of dissolved and colloidal organic substances and suspended matter. Many secondary treatment processes involve biological treatment. The use of settling

[26] Johnson, J., MedicalNewsToday, https://www.medicalnewstoday.com/articles/325174

[27] DHS, CISA, Water and Wastewater SSP, p 5, https://www.cisa.gov/sites/default/files/publications/nipp-ssp-water-2015-508.pdf

tanks to separate the solids from the liquid is common; however, flotation and other methods might be used. Physical and chemical treatment processes are used for oil, grease, heavy metals, solids, and nutrient removal. Advanced wastewater treatment processes (that can include physical, chemical, biological or a combination) are utilized for nutrient and soluble organics reduction and resource recovery.

- Disinfection. Disinfection inactivates or destroys pathogenic bacteria, viruses, and protozoan cysts. Chemical disinfection (such as chlorine), ozonation, and ultraviolet irradiation are among the types of processes used.
- Effluent/discharge. Treatment plant effluent can be discharged to a body of water or wetlands, to ground water aquifers via percolation (via deep-well injection), land-applied, or re-used for other purposes….
- Residuals and biosolids. These treatment processes can encompass the costliest part of wastewater treatment. Some of the solids treatment processes include thickening, stabilization, digestion, chemical, composting, dewatering, incineration, and heat drying equipment….
- Monitoring system. Sensors can be installed at critical points to monitor a range of physical properties, such as flow rates and water quality indicators, and to detect levels of contaminants before, during, and after treatment."[28]



Failure timeline: Wastewater systems rely on gravity as sewage flows downhill. Pumps elevate sewage so that it may have a downhill flow for the next leg of its journey. If not pumped,

[28] DHS, CISA, Water and Wastewater SSP, p 7, https://www.cisa.gov/sites/default/files/publications/nipp-ssp-water-2015-508.pdf

sewage will simply backup and may overflow. "If it is not contained within a short amount of time, this sewage will flow over land and may eventually enter a drainage system or a local stream or lake."[29] Wastewater pumping stations left idle for several days may not be able to restart due to settling and solidification of the fibrous matter in the sewage. Wastewater treatment requires a lot of power.[30] Generators may function for hours, but once they fail, most wastewater functions will fail causing backup and sewage spills.

Describe CI Interdependencies (first order interdependencies that, if failing, will cause (at varying times) the Water and Wastewater (wastewater only) Sector to fail).

- Communications, Energy, Financial Services, and IT are required for the administration of all CI. This includes (and is not limited to) financial transactions for supplies/raw materials, pay for employees, supply chain efforts, and the ability to effectively coordinate and execute operations. Food/Ag and Water are required to maintain the human element of each CI.
- Chemical: Most wastewater treatment is dependent on chemicals. Most treatment plants have stored chemicals.
- Financial Services: Plants require constant replenishment/purchase of chemicals and constant removal (paid haulers) of solid wastes.

Sort into local or regional or National entities Wastewater is a local CI with State and National regulation.

Impact of this CI with no power (to CI and to society) Wastewater systems use gravity in several stages of the treatment process and may use pumping stations along collection paths.[31] If the flow of wastewater is interrupted pipes will continue to back up and eventually overflow.[32] Wastewater treatment facilities also use pumps without which sewage will also backup/overflow and the pumps may become permanently damaged. Wastewater discharge is clean water that most often flows to natural waters (e.g., rivers). Without treatment, wastewater overflow will contaminate freshwater sources. The health impacts would be significant and widespread. Solid waste is usually binned at wastewater treatment plants, but those storage facilities are limited, and solid waste may cause contamination if there is too much.

Conclusion

- **Summary**: Assessment: "The Water and Wastewater Sector is dependent on sectors such as Chemical or Energy for continuity of its operations."[33], therefore, the Water and Wastewater Sector will fail in a BSE (failure time depending on backup generator

[29] City of Durham, Sanitary Sewage Spill Prevention and Best Management Practices, https://www.durhamnc.gov/DocumentCenter/View/2904/Sanitary-Sewer-Spill-Prevention-PDF?bidId=#:~:text=A%20sewage%20spill%20occurs%20when,lids%2C%20cleanouts%2C%20or%20outside%20drains

[30] Daw, Hallet, Dewolfe and Venner, NREL, Energy Efficiency Strategies for Municipal Wastewater Treatment Facilities, p vi, https://www.nrel.gov/docs/fy12osti/53341.pdf

[31] Enviroline Co, The ins and outs of a lift station, https://enviro-line.com/2021/08/the-ins-and-outs-of-a-lift-station/

[32] Ibid

[33] DHS, CISA, Water and Wastewater SSP, p 18, https://www.cisa.gov/sites/default/files/publications/nipp-ssp-water-2015-508.pdf

capability). Water and Wastewater are mutually supporting. Water treatment is based on the cleanliness of water sources that often can be contaminated by wastewater. Wastewater conveyance and treatment requires water. Both are dependent on gravity, but they also require power. Water/wastewater systems are local.

- **Point towards broad solutions:** Prioritization of water usage in a BSE is required. People require drinking water. Many other uses of water can be reduced/eliminated in an emergency (eliminating the need for a lot of wastewater treatment). Rainwater collection is a viable option in many localities. Wastewater volume may be controlled by water allocation plans. On site chemical and fuel storage will determine the amount of time Water and Wastewater facilities are able to function in a BSE.