

WATER AND WASTEWATER UTILITIES AND DATA CENTERS

FREQUENTLY ASKED QUESTIONS (FAQs)

Many questions have been raised by utility personnel regarding data centers and what water and wastewater utilities should know. This document sets out to provide answers to some of those questions. Utilities should track data center development because these facilities, along with other industrial sources, can be large, variable water users whose water quality requirements and wastewater characteristics differ from typical domestic flows, particularly during construction and cooling system operation. Early engagement enables forecasting, securing supply, infrastructure or treatment updates, negotiated service terms (rates, allocations, onsite reuse), and regulatory compliance to avoid operational surprises and protect system resilience.

DATA CENTER BASICS AND SITING

Q. What are the main types of data centers?

A. Data centers generally fall into three categories: hyperscale (large cloud providers), colocation (shared facilities), and enterprise (dedicated facilities for a single organization), each with different scales and infrastructure needs. The use of these facilities (Cloud, AI, hybrid) will determine the density (MW/sq ft) of the buildings and overall campus (MW/acre).

Q. What factors influence where data centers are located?

A. Key considerations for site selection encompass access to power, land availability, time to market and cost-effectiveness, plus access to fiber, water supply (and discharge)

and watershed conditions, access to workforce. The presence of existing data centers, and proximity to users or essential infrastructure can also play a role based on the type of facility. In addition, geology and climate play a role in site selection. The stability of the ground, susceptibility to natural disasters (i.e., earthquakes or flooding), and soil composition are factors that can influence both the structural integrity of a data center and its operational efficiency. An increasingly important factor is community acceptance, which can result in schedule delays.

Q. Why is power availability so critical to data center design?

A. Power demand determines data center size and capacity (both measured in MW). Cooling methodologies are often selected based on the balance between power supply capacity and water demand vs capacity.

Q. What are the primary operating concerns for data center operators?

A. The data center industry prioritizes ultra-low latency and near-perfect reliability. Latency measures the round-trip time for data to travel between an end-user device and a data center. Reliability, or “uptime,” is typically set at 99.999% annually, allowing just 5.25 minutes of downtime per server per year, including maintenance. With such limited tolerance for outages, cooling system failures are unacceptable, driving exceptionally high standards for water quality, availability, and reliability.

COOLING TECHNOLOGIES, POWER–WATER TRADEOFFS AND SOURCES

Q. Why is water used in many data centers?

A. Due to water’s unique physical properties, including high specific heat, thermal conductivity, and high heat of vaporization, water is a more efficient cooling medium than air. This allows facilities to reduce power consumption compared to fully air-cooled systems, especially at large scales and during peak energy-use periods.

Q. Do all data centers rely on water for cooling?

A. No. Some data centers use air-based or closed-loop cooling systems and may use little

to no water for cooling during normal operations. Regardless of the type of cooling, data centers will need water for domestic use, plus firewater.

Q. What cooling technologies are commonly used in data centers?

A. Common approaches include air cooling, evaporative cooling, cooling towers, adiabatic systems, and increasingly, liquid-based cooling at the server level.

Q. What tradeoffs exist between power and water use in data center cooling?

A. Cooling systems that minimize water use often require more power, while water-based systems typically reduce power demand but increase on-site direct water consumption. Technologies like adiabatic systems use water for only a small percentage of the year to minimize power demand, particularly during peak energy cycles. The indirect water use based on the power generation source is an additional consideration.

Q. How are emerging technologies changing data center cooling?

A. Liquid cooling technologies such as direct-to-chip and immersion cooling are being adopted to manage higher heat loads, shifting how heat is removed from the facility, potentially reducing the need for air-cooling or water-based cooling systems. Rejecting the heat from liquid-to-chip closed loops may still require evaporative cooling. Additionally, implementing liquid cooling does not eliminate the need to cool the building.

Q. What water sources do data centers use?

A. Data centers may use potable water, reclaimed water, recycled water, groundwater, surface water, or blended sources, depending on availability and local regulations. Rainwater harvesting is also being evaluated at new sites to help augment the demand on other sources. Facilities may also use an initial source for start-up then change after a few years and may use different sources for different uses on-site.

Q. Why are data centers increasingly interested in reclaimed water?

A. Reclaimed water can reduce demand on freshwater drinking water supplies and support corporate sustainability and water resilience goals, while also enabling more power efficient cooling strategies.

Q. Is there a difference between recycled and reclaimed water?

A. Yes. Recycled water broadly refers to treated water reused for various purposes from sources such as process wastewater, stormwater, or repurposed potable water, while reclaimed water more specifically denotes rigorously treated municipal wastewater that meets safety standards for designated non-potable applications.

Q. What sustainability goals are influencing data center water use?

A. Many data center operators have commitments related to carbon neutrality,

water efficiency, and water stewardship, which affect cooling design and water sourcing decisions.

WASTEWATER STREAMS AND SYSTEM OPERATIONS

Q. What wastewater streams are associated with data centers?

A. Typical streams include domestic wastewater, cooling system blowdown, and discharges associated with construction, commissioning, or maintenance. If there is on-site treatment, there may be additional waste streams from these systems.

Q. What is cooling systems blowdown?

A. Blowdown is water discharged from a cooling system to control the buildup of dissolved solids (also called salts) as water evaporates during cooling operations. Blowdown from data centers is regulated and must comply with Federal, State and local discharge requirements.

Q. Why is data center blowdown more concentrated than source water?

A. As water evaporates, dissolved constituents remain behind and become more concentrated, increasing total dissolved solids (TDS) and other parameters in the blowdown. In addition, data center operators may add water conditioning chemicals, such as biocides, corrosion inhibitors, scale inhibitors, dispersants, and pH adjustment chemicals depending on the cooling design.

Q. Can data center water use and effluent discharge change after startup?

A. Yes. Facilities may modify cooling strategies, chemical programs, operating setpoints, or reuse practices over time, affecting both water demand, water quality requirements and wastewater discharge flows/quality. Utilities should consider engaging with data center operators on a periodic basis to document current practices.

UTILITY COORDINATION AND PLANNING

Q. Why is early coordination between utilities and data centers important?

A. Early communication allows utilities to understand cooling design, water use patterns, potential wastewater impacts, potential funding of utility improvements, service terms, and sampling, containment, and pretreatment requirements before systems are built and operating.

Q. How does water move through a data center facility?

A. Water enters the site for domestic use, cooling, and fire protection. It is then consumed or evaporated during cooling and leaves the site as wastewater, cooling system blowdown, or evaporative losses.

Q. Why is not all water supplied to a data center returned as wastewater?

A. A portion of cooling water may be lost through evaporation, meaning less supplied water returns to the wastewater system.

PERFORMANCE METRICS AND DEMAND VARIABILITY

Q. What metrics are used to evaluate data center water performance?

A. The most common metric for evaluating water performance at a data center is Water Usage Effectiveness (WUE), which is a standard industry metric representing water intensity per megawatt, and total annual or peak-day water demand. WUE measures the total volume of water (in L) used divided by the total energy consumed (in kWh) of all IT technologies (servers and networking equipment) within the data center.

Q. What is Power Usage Effectiveness (PUE)?

A. PUE measures the ratio of total facility power consumption (in kWh) divided by IT equipment power consumption (in kWh), indicating how efficiently a data center uses energy.

Q. How are PUE and water use related?

A. Cooling systems that improve PUE often rely on water, meaning gains in energy efficiency may increase water consumption. PUE and WUE are inversely related with higher WUE

correlating to a reduction in PUE. PUE is a measure of sustainability, efficiency, and cost per kWh of IT, and as such, data center companies are incentivized to reduce PUE from multiple perspectives and actively work to decrease their PUE. One of the most effective ways to reduce PUE is to implement water-based cooling systems that take advantage of water's unique physical characteristics to efficiently remove heat.

Q. What are “cycles of concentration” and why do they matter?

A. Cycles of concentration (CoC) describe how many times dissolved constituents are concentrated through evaporation before blowdown occurs, directly affecting water efficiency and effluent quality.

Q. Is operational data center water use consistent throughout the year?

A. No. Water use varies with weather, cooling design and demand, IT load, and operational changes, with higher use typically occurring during warmer periods. Also, fluctuations in water quality, both influent water quality and effluent discharge limitations, may influence the CoC the data center provider can perform, ultimately impacting the overall water demand for the facility. Water demand for the power plants required to power the data centers tends to be more uniform throughout the year because the steam and cooling demands are related to power consumption, rather than the ambient temperature.

Q. Why should utilities be concerned about peak water demand rather than average demand?

A. Cooling systems must function during the hottest conditions, so utility infrastructure design is sized for worst-case temperature and load scenarios. Some on-site storage is encouraged to help reduce peak loads for utilities.

Q. How does seasonal weather affect data center water use?

A. Water demand increases during hot and humid periods and may drop significantly during cooler months, especially for air-assisted cooling systems.

Q. Can daily or weekly water use fluctuate significantly?

A. Yes. Operational changes, climate conditions, maintenance, storage capacity, and cooling optimization can cause short-term spikes or reductions in water use and discharge. This is particularly true in hybrid cooling systems, where water consumption only happens on the hottest days of the summer, frequently when temperatures exceed 85 degrees F.

Q. How can the fluctuations in water demand be managed?

A. Fluctuations in water demand, whether daily variations (daily peaking during the hottest times of the day), or seasonal fluctuations (weekly or monthly peaks of extended cooling demand) can be managed by developing or

amending water-wastewater infrastructure to accommodate peak demands. However, this is often not feasible as the level-of-effort to build out the infrastructure is cost and/or schedule prohibitive, or not feasible from the perspective of utility operations with regard to water quality/age and flushing requirements. Large scale storage is increasingly common at larger data center sites to reduce peak demands, particularly for centers using adiabatic systems that are only episodically used. Alternatively, incorporating storage to accommodate demand fluctuations is often a solution that meets the demand and reliability considerations of the data center provider without putting undue burden on the utility.

WATER CHEMISTRY, TREATMENT CHEMICALS, AND EFFLUENT CHARACTERISTICS

Q. How is water chemistry managed within cooling systems?

A. Chemicals are often applied to control scaling, corrosion, biological growth, and fouling, ensuring system reliability and efficiency.

Q. What common types of chemicals are used in data center cooling systems?

A. Typical categories include corrosion inhibitors, scale inhibitors, biocides, dispersants, and pH adjustment chemicals. The specific chemicals will be selected based on the water source, cooling technology, and metallurgy.

Q. How does source water quality affect cooling system operation?

A. Higher dissolved solids or specific constituents may limit achievable cycles of concentration and influence chemical selection and blowdown rates. Additionally, variations in pH can impact these processes. Changes in pH levels can alter the solubility and stability of certain chemicals.

Q. Does cooling system blowdown add new contaminants to wastewater?

A. Blowdown generally reflects concentrated source water constituents and added treatment chemicals. Data center operators work with one or more water treatment chemical providers to develop the chemical regime right for the specific makeup water. They recognize the importance of using additives that do not cause problems for the wastewater treatment plant in which the blowdown is discharged, and the chemical providers offer a range of products that have low toxicity. The specific blend of chemicals can vary significantly, and the specifics can be requested by the community in which they will discharge the blowdown.

Q. What operational events can temporarily change effluent quality?

A. Maintenance activities, tank draining, chemical program changes, and system cleaning can produce short-term changes in wastewater characteristics. Construction of the building or system on an existing site can also impact effluent quality.

Q. How does data center ramp-up affect water and wastewater systems?

A. If operating parameters are held constant, then as servers are added and IT loads increase, cooling demand and associated water use and discharge typically increase over time.

Q. Do data centers operate the same way throughout their lifespan?

A. No. Cooling strategies, operating setpoints, and water management practices often evolve in response to performance goals and external pressures.

INFORMATION GAPS, AND SHARED UNDERSTANDING

Q. What information gaps exist for utilities evaluating data centers?

A. Water and wastewater utilities may lack detailed knowledge of cooling design, chemical programs, future expansion plans, and operational flexibility. Additionally, data center developers may have uncertainty around their ultimate water and wastewater projections due to a handful of parameters over which they have varying degrees of control. Project parameters that are unknown, or are in flux, such as power availability and timeline or site conditions that impact the ultimate facility capacity can impact the ultimate water-wastewater demand projection. These unknowns can be compounded as they may influence the chosen cooling technology,

further impacting the water and wastewater demand.

Q. Why is shared technical understanding critical between utilities and data centers?

A. Collaboration and transparency improve planning, reduces risk of system upset, and supports sustainable growth for both data center development and utility operations. This collaboration should continue after the data center enters operation, particularly if the data center is performing maintenance on the cooling system or has a change in loadings.

PRETREATMENT REGULATION CONTEXT AND OVERSIGHT CHALLENGES

Q. How are data centers addressed under existing pretreatment regulations?

A. Data centers are considered industrial users, but there is not a categorical standard with effluent limitations for data centers. Data centers are accountable to meet the General Pretreatment Regulations for Existing and New Sources of Pollution in 40 CFR Part 403.

Q. Are data centers typically classified as Significant Industrial Users (SIUs)?

A. Often they are not, because cooling system blowdown is excluded from flow-based SIU thresholds, even though it may still affect treatment processes. One of the challenges of modern pretreatment program administration

is that data centers are one of several new types of facilities that were not envisioned in the period when most of the effluent guidelines and standards were developed.

Q. Why do current pretreatment regulations struggle to address data centers?

A. Regulations were not designed for facilities with large, intermittent construction discharges and relatively low-strength routine operations discharges, creating gaps in oversight.

CONSTRUCTION/ COMMISSIONING DISCHARGES AND SAMPLING

Q. Why are construction-related discharges more concerning than routine blowdown?

A. Construction activities such as flushing and passivation can produce short-term, high-strength discharges that pose greater risk to biological treatment processes at a wastewater utility.

Q. What activities generate wastewater during data center commissioning?

A. Commissioning may involve system flushing, chemical cleaning, passivation of piping, and testing of cooling loops, each producing distinct wastewater streams.

Q. Why is sampling prior to discharge critical during construction?

A. Chemical inventories and SDS (safety data sheet) reviews alone may not reveal all constituents present; sampling provides direct confirmation of wastewater quality before release.

Q. Why can chemical review based on SDSs be insufficient?

A. SDSs may list broad chemical categories or omit trace constituents, making it difficult to identify compounds that could inhibit treatment processes.

TREATMENT PROCESS SENSITIVITY, LONG-TERM CONSTITUENTS, AND RESPONSE

Q. Which wastewater treatment processes are most sensitive to data center discharges?

A. Nitrification and biological phosphorus removal are particularly sensitive to inhibitory compounds and shock loading events.

Q. How do short-term discharges affect biological treatment differently than steady flows?

A. Shock loads can temporarily inhibit microbial activity before acclimation occurs, leading to effluent quality excursions even when average conditions are acceptable.

Q. Why is TDS (total dissolved solids) a long-term concern for utilities serving data centers?

A. TDS accumulates due to evaporation and concentration and is not removed by conventional treatment, posing potential risks to effluent quality and receiving waters. This concern can be exacerbated in circumstances where the wastewater facility treating the cooling tower blowdown is also providing reclaim to the data center. This scenario presents the potential for increasing TDS concentrations at a macro level because there is no effective pathway for TDS removal.

Q. How can elevated salinity affect wastewater treatment performance?

A. Across the US, the average TDS at wastewater utilities is in the range of 600 to 700 mg/L. There is a perception that the influent wastewater must be under 1,000 mg/L, but activated sludge systems can operate well above that with appropriate acclimation and attention paid to corrosion protection. However, there are concerns about higher TDS values, including:

- Increased salinity can disrupt bioflocculation, settling, and nutrient removal processes, particularly in advanced treatment systems.
- In some cases, salinity is a concern because an imbalance between monovalent and divalent cations allows monovalent cations to displace divalent ones, reducing flocculation efficiency.
- In circumstances where TDS concentrations do not adversely impact biological treatment performance, there

may be challenges in meeting surface water discharge compliance or effluent management requirements. Specifically, TDS may be directly limited in a discharge permit or indirectly limited by way of toxicity thresholds.

- Higher TDS values can be problematic in communities producing reclaim water, because it can be harmful in irrigation uses and may limit reclaim water suitability for some industrial applications.

Q. Why are metals such as molybdenum important to monitor?

A. Certain metals can accumulate in biosolids and affect land application compliance even when present at low concentrations in wastewater.

Q. Why might metals be present in so-called clean water flushes?

A. Metals can leach from piping materials during extended stagnation or initial system startup, even when no chemicals are intentionally added.

Q. What indicators help utilities detect treatment stress early?

A. Changes in oxygen demand, UV transmittance, chlorine demand, and nutrient removal efficiency can signal emerging process inhibition.

Q. How can utilities respond to unexpected data center discharge impacts?

A. Strategies include reducing discharge rates, requiring off-site disposal, modifying chemical programs, and increasing coordination with facility operators.

Q. What key lessons have utilities learned from data center discharges?

A. Proactive oversight, advance communication, and flexibility in response are more effective than relying solely on traditional permitting approaches.

Q. What steps can utilities take to better manage future data center growth?

A. Developing guidance, improving monitoring, engaging early with developers, and sharing lessons learned across the industry can reduce risk while supporting growth.

ACKNOWLEDGEMENTS

Many thanks to the following authors and reviewers, as well as the WEF Advancing Understanding of Data Center Effluent Planning Group and the WEF HOD AI Working Group for their expertise in reviewing this resource:

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WEF Advancing Understanding of Data Center Effluent Planning Group

WEF HOD AI Working Group

ADDITIONAL RESOURCES

Advancing Understanding of Data Center Effluent (2026) Water-AI Nexus Center of Excellence, webcast 18-Feb-2026, water-ai-nexus.org.

Principles for Sustainable Water Use by Data Centers: Building More Effective Public-Private Collaboration (2025) Water-AI Nexus Center of Excellence, Web., water-ai-nexus.org