Water as Production Infrastructure

UPW Demand and Risk in High-Tech Sectors

Mapping Freshwater Constraints and UPW Capital Expenditures on Global Industrial Corridors, 2026–2030

Research Brief · Preview of the First Edition

Sumanth N.S. · Sunward Research

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Executive Summary

Water as Production Infrastructure: UPW Demand and Risk in High-Tech Sectors

Mapping Freshwater Constraints and UPW Capital Expenditures on Global Industrial Corridors, 2026–2030

Information in this report is current to 30 September 2026. Several facts are time-sensitive and are flagged for re-checking in the chapters.

The global semiconductor industry is in the middle of a historic construction surge. SEMI forecast in early 2025 that 18 new fab construction projects would start that year.[1] In July 2026, TSMC raised its planned Arizona investment to $265 billion; Arizona state authorities describe the expanded plan as ten fabs, two advanced-packaging facilities, and an R&D centre.[2,3] Samsung, Intel, Micron, and Texas Instruments have each made multi-billion-dollar semiconductor investment commitments.[4]

Every front-end wafer fab in this buildout needs ultrapure water — commonly targeted at a resistivity of about 18.2 MΩ·cm and total organic carbon below one part per billion — in volumes measured in millions of gallons a day.[5] A 2024 peer-reviewed study found that about 40% of existing semiconductor facilities, and 40–49% of those announced since 2021, sit in basins projected to face high or extremely high water stress in 2030 and 2040, depending on the climate scenario.[6] That is the central problem this report examines: the largest coordinated industrial buildout in a generation is concentrating in corridors where reliable, high-quality freshwater supply is already under structural pressure.

What this report provides

This is not a report about climate risk in the abstract. It analyses how water scarcity turns into financial exposure for an advanced manufacturing facility — in capital expenditure, operating cost, regulatory compliance, and the legal and contractual questions that diligence can miss. Claims are sourced to primary documents where available. Where the public data runs out, the report says so rather than papering over the gap.

The report covers four regions, each assessed on its own mechanism rather than forced into a single index:

- **North America.** Arizona's exposure runs through the Colorado River's operating rules — including the federal 2027–2028 guidelines issued in August 2026 — and a facility's position within the allocation system.[7] Texas's runs through groundwater balance in the Carrizo-Wilcox Aquifer and incomplete state visibility of large industrial water use.[8]
- **Europe.** Rhine and Danube risk depends on each facility's dependency pathway — intake, cooling, logistics, or site access. The Silicon Saxony cluster's direct water supply is Elbe-linked; its Rhine or Danube exposure is indirect.[9] As this report was finalised in September 2026, provisional official ELWIS data showed the Rhine's Kaub gauge falling to 0 cm on 25 September — below the lowest known level of 25 cm (October 2018) that ELWIS still lists for the gauge.[10] This indicates a new observed record low, although ELWIS's historical-minimum field had not been updated at the publication cut-off. It shows that the low-water logistics risk in Chapter 4.2 is current, not only historical.
- **Asia-Pacific.** Taiwan faces repeated drought, though its chip production was protected during the 2021 shortage.[11] Korea's challenge is delivering dedicated water infrastructure for new clusters, with flooding a separate site-resilience issue.[12]
- **India.** Four states are assessed individually; the evidence available on industrial water sourcing varies sharply from state to state.[13]

The report also covers the cost layers that turn location risk into financial exposure — UPW treatment infrastructure, PFAS compliance, and zero-liquid-discharge architecture (Chapter 2) — and the energy-water dynamic, in which heat, water stress, and grid stress are distinct risks that can overlap (Chapter 3). Chapter 5 turns the findings into six water-risk review questions, a view of the supplier landscape, and a legal and contractual risk review.

What makes this report different

Much published analysis of semiconductor water risk stops at headline statistics or overstates how comparable cross-regional figures are. This report tries to do neither. Where comparable primary-source data exists, it is cited and used. Where it does not, the report offers a diligence framework instead: specific questions, with sourcing guidance, that a site-selection or project team can run against primary data it obtains directly.

Tracing figures back to their origins produced several findings worth knowing before using common reference numbers:

- **The most-quoted fab water figure does not add up as usually presented.** About 4.8 million gallons a day for a large fab is widely repeated alongside 2,200 gallons per wafer and 40,000 wafers a month.[14] Those inputs give about 2.9 million gallons, not 4.8. The figures come from two sources nine years apart, joined in a 2013 article. The 4.8 million figure survives only as a rough reference for one large fab, supported by modern facility data rather than by its derivation (Chapter 1.1).
- **UPW market-share figures are not comparable.** Publishers put semiconductors at around half or more of UPW demand, but those shares sit on market totals that differ several-fold (Chapter 5.2).[15]
- **The Rhine has no single shutdown point.** At the Kaub gauge, the official equivalent low-water level has been 77 cm since 2023.[16] The Kiel Institute used the earlier 78 cm benchmark to identify low-water periods linked to measurable drops in German industrial production. Below that level, barges carry progressively lighter loads; how low they can go depends on the vessel, its cargo, and the channel, not on one universal gauge reading (Chapter 4.2).
- **Samsung's two CHIPS Act figures are both correct.** The $6.4 billion preliminary terms and the $4.745 billion final award are two stages of the same negotiation, not contradictory numbers (Chapter 4.1).[17]

Who this report is for

Corporate strategy and site-selection teams evaluating semiconductor manufacturing locations in water-stressed corridors. Analysts and investors seeking background research on water risk in the semiconductor supply chain. Legal and risk management teams reviewing utility agreements and compliance provisions. Trade press editors and analysts tracking the intersection of industrial policy and physical resource constraints.

In every case, the report is background research to inform the reader's own judgement. It is not advice on any specific site, company, transaction, or investment, and it does not perform diligence on the reader's behalf.

Scope note

This report covers semiconductor manufacturing, consistently identified as one of the largest UPW end markets. Pharmaceutical and power-generation UPW are reserved for future work. Vietnam was considered for the emerging-hub analysis but excluded because the available primary sources did not meet this report's evidential standards; the exclusion is documented rather than silent.

Notes

1. SEMI press release, Jan 2025. https://www.semi.org/en/semi-press-release/eighteen-new-semiconductor-fabs-to-start-construction-in-2025-semi-reports
2. TSMC Arizona page. https://www.tsmc.com/static/abouttsmcaz/index.htm
3. Arizona Commerce Authority, Jul 2026. https://azcommerce-prod.azurewebsites.net/news-events/news/2026/7/tsmc-announcement/
4. Commerce, Dec 2024. https://www.commerce.gov/news/press-releases/2024/12/biden-harris-administration-announces-chips-incentives-award-samsung; Micron, Jan 2026. https://investors.micron.com/news/press-release/2026/Micron-Celebrates-Official-Groundbreaking-at-New-York-Megafab-Site-01-16-2026/default.aspx; DCD, 2026. https://www.datacenterdynamics.com/en/news/samsung-texas-instruments-and-amkor-finalize-chips-act-funding-agreements/
5. SEMI F63 guide page. https://store-us.semi.org/products/f06300-semi-f63-guide-for-ultrapure-water-used-in-semiconductor-processing
6. doi:10.1016/j.isci.2024.108791. https://doi.org/10.1016/j.isci.2024.108791
7. US Bureau of Reclamation, decision documents. https://www.usbr.gov/ColoradoRiverBasin/post2026/decision-doc/
8. Texas Tribune, Aug 2021. https://www.texastribune.org/2021/08/02/san-antonio-water-supply-rural-wells/; East Wilco Insider, Feb 2024. https://www.eastwilcoinsider.com/article/215,looking-for-enough-water; Texas Tribune, 23 Jun 2026. https://www.texastribune.org/2026/06/23/texas-data-centers-puc-water-survey/; Community Impact, Aug 2026. https://communityimpact.com/central-austin/texas-legislature/live-updates-ercot-will-complete-data-center-audit-in-late-2026-officials-say/; National Law Review, Sep 2026. https://natlawreview.com/article/texas-escalates-data-center-oversight-attorney-general-water-use-investigation
9. HOCHTIEF. https://www.hochtief.com/news-media/press-releases/press-release/hochtief-erhaelt-flusswasserwerk-auftrag-fuer-die-deutsche-halbleiterindustrie; Saxony Trade & Invest, Jun 2026. https://business-saxony.com/en/news-events/news/news-detail/n2048-starting-in-2030-the-elbe-river-will-supply-industrial-water-to-dresdens-chip-factories; CCNR Resolution 2022-II-19. https://ccr-zkr.org/files/infovoiedeau/Resolution2022-II-19_de.pdf; ELWIS Kaub. https://www.elwis.de/DE/dynamisch/Wasserstaende/Pegeleinzeln%3AKAUB
10. ELWIS Kaub gauge page. https://www.elwis.de/DE/dynamisch/Wasserstaende/Pegeleinzeln%3AKAUB
11. MSCI blog. https://www.msci.com/research-and-insights/blog-post/how-climate-change-affected-thirsty-chipmakers; UNU-EHS. https://ehs.unu.edu/news/news/how-the-lack-of-a-typhoon-affected-lives-5-facts-on-the-taiwan-drought.html
12. Reuters, 21 Jul 2026. https://www.reuters.com/business/energy/power-water-needs-test-south-koreas-push-build-ai-chip-hub-beyond-seoul-2026-07-21/
13. New Indian Express, 21 May 2026. https://www.newindianexpress.com/states/karnataka/2026/May/21/cauvery-water-in-kollegal-lakes-to-aid-bengaluru-units; TN Semiconductor Policy 2024. https://storage.investingintamilnadu.com/Guidance/Uploads/Others/scp_2024.pdf; SIPCOT. https://sipcotweb.tn.gov.in/Projects; Invest UP. https://invest.up.gov.in/semiconductor-sector/; Gujarat Semiconductor Policy 2022–27. https://gsem.gujarat.gov.in/ViewFile?fileName=6xgb5BzRwLcpgBXp6CFgCVBiRk8xOF4krJYWdNycigq3G4SVWAvvRSJ3io6lB0yqPe5NhqsdUOHgHr35FHASH__HASHPIJyM0EOPcQjTra4Zznf3vfGwN5jDVdBZw5XjfcJ65VrlZTA4u8KD9OHASH_HASHHhZromHASH__HASHc3bEw%3D%3D
14. China Water Risk, 2013. https://cwrrr.org/resources/analysis-reviews/8-things-you-should-know-about-water-and-semiconductors/
15. Mordor Intelligence. https://www.mordorintelligence.com/industry-reports/ultra-pure-water-market
16. CCNR Resolution 2022-II-19. https://ccr-zkr.org/files/infovoiedeau/Resolution2022-II-19_de.pdf; Kiel Institute working paper. https://www.kielinstitut.de/fileadmin/Dateiverwaltung/IfW-Publications/fis-import/859784e9-2447-4878-87b9-4014cb0d356a-KWP_2155_low_water_econ_activity.pdf; CCNR market observation. https://inland-navigation-market.org/chapitre/4-niveaux-deau-et-taux-de-fret/?lang=de
17. US Dept of Commerce, 20 Dec 2024. https://www.commerce.gov/news/press-releases/2024/12/biden-harris-administration-announces-chips-incentives-award-samsung; NIST CHIPS page. https://www.nist.gov/chips/samsung-electronics-texas-austin

Chapter 1.0 — Introduction

What this report is about

The global semiconductor industry is in an active and well-documented construction surge. SEMI forecast in early 2025 that 18 new fab construction projects would start that year, 15 of them 300mm facilities, with most expected to begin operating in 2026–2027.[1]

The largest single commitments show the scale. In March 2025, TSMC announced a total planned US investment of $165 billion in Arizona, covering six fabs, two advanced-packaging facilities, and an R&D centre.[2] In July 2026, TSMC announced another $100 billion, bringing its planned Arizona investment to $265 billion.[3] TSMC described the addition as several more fabs; Arizona state authorities describe the expanded plan as ten fabs, two advanced-packaging facilities, and an R&D centre.[4] No construction timeline was given for the newest fabs. Once the announced fabs are complete, about 30% of TSMC's 2nm-and-below capacity is expected to sit in Arizona.[5] In January 2026, Micron broke ground in Clay, New York, on a memory complex of up to four fabs, planned at up to $100 billion over more than 20 years; the company says its first fab there will provide supply in 2030 and beyond.[6,7] Across the US, EU, South Korea, Japan, Taiwan, and India, government incentive programmes are funding fabs at a scale not seen in decades.

Every front-end wafer fab among them needs water. Not ordinary water — ultrapure water, processed through multi-stage treatment to the standards examined in Chapter 1.2. A 2024 peer-reviewed study found that about 40% of existing semiconductor facilities, and 40–49% of those announced since 2021, sit in basins projected to face high or extremely high water stress in 2030 and 2040, depending on the climate scenario (Chapter 1.3).[8] That is the central tension this report examines: the largest coordinated industrial buildout in a generation is concentrating in corridors where water supply is already under structural pressure.

This is not a general argument about climate and industry. It is a specific, bounded, financially consequential problem. Water treatment is a capital cost, not only an environmental line item: vendor and historical estimates suggest a large fab's water systems can cost tens of millions of dollars, though site-specific costs vary widely (Chapter 2). Source-water quality is not a sustainability metric either — it shapes the design, maintenance cycle, and energy cost of the UPW system (Chapter 1.2). And the rules governing industrial water access differ sharply by country, by state, and sometimes by county. Understanding those differences is not background reading. It is site-selection diligence.

What this report covers — and what it does not

This report covers the water-intensity and water-security dimensions of semiconductor manufacturing specifically. It examines the technical requirements that make water a constrained and costly input rather than a commodity utility. It maps the policy and physical conditions shaping water access across four regions — North America, Europe, Asia-Pacific, and India. And it provides a diligence framework for teams evaluating sites in water-stressed corridors.

Ultrapure water is also used in pharmaceutical and biologics manufacturing, power generation, flat-panel displays, and other industries. Market-research publishers consistently identify semiconductor and electronics manufacturing as one of the largest UPW end markets, often at around half or more of demand, but the reported share depends on each publisher's definition of the market (Chapter 5.2). Pharmaceutical and power-generation UPW are reserved for future work. They are not covered here, and this report's silence on them should not be read as a finding that those sectors face lower risk.

This report does not provide engineering specifications for UPW system design. It is not regulatory compliance guidance, legal advice, or investment advice, and it does not assess or recommend any

company, security, transaction, or investment. And it does not rate regions against each other on a single composite index. One consistent finding across the regional chapters is that the variables shaping water risk are not comparable on one scale. The mechanism generating risk in Arizona — Colorado River operating rules and a facility's position within the allocation system — differs categorically from Texas's aquifer-visibility problem, from Korea's challenge of delivering dedicated water infrastructure for new clusters, and from India's state-by-state variation in sourcing evidence.[9] A single index would manufacture comparability where none exists.

How the claims in this report were produced

The report's claims were produced through a two-pass process. A first pass extracts and tags claims from source material without drafting prose, separating what a source actually says from how it might be interpreted. A second pass converts the checked fact-set into chapter prose. Drafting does not happen directly from raw sources in a single step.

Within that process, each claim carries one of four confidence levels:

- **Verified** — traced directly to a primary source and confirmed in its own text.
- **Reported** — appearing in credible secondary reporting but not yet traced to its primary source.
- **Modelled** — derived by applying stated assumptions to verified inputs.
- **Interpretive** — an analytical judgment where evidence points consistently in one direction without establishing a causal rule.

These levels are not printed as bracket labels in the prose; that would read as internal scaffolding. Instead, they are carried by sentence construction. A verified claim is stated directly, with its source named. A reported claim is introduced with language such as "according to reporting." A modelled claim states its assumption in the same sentence. An interpretive claim is framed as analysis — "this suggests" — not as established fact. Where a figure still awaits primary-source confirmation, the text says so.

This system exists for a specific reason. An early draft of this report's Arizona chapter stated that ADEQ's Advanced Water Purification rules "mandate that heavy industrial setups integrate direct potable reuse and reclaimed wastewater into their intake streams." The actual rules do no such thing. The error came not from a fabricated source, but from treating a secondary source's interpretive framing as established fact and building financial claims on top of it. The two-pass protocol and the confidence-level system were built in response. A later multi-layer review of the full draft found and corrected further errors of the same kind. That review is part of the method: the protocol reduces errors, and review catches the ones that get through.

How to read this report

Each chapter supports two reading modes. A reader who needs orientation — the central risk in a corridor, its current status, the key diligence questions — can read the prose straight through. A reader doing active diligence on a specific site can use the confidence signals in each sentence to separate primary-source-confirmed findings from those needing further verification, and to see where this research deliberately stopped short of a conclusion the evidence did not support.

Chapter 1 builds the technical and scoping foundation: water volume, purity requirements, and the geographic mismatch between where fabs are being built and where stable water supply exists. Chapters 2 and 3 examine infrastructure costs and the energy-water tension. Chapter 4 covers four regions in separate, mechanism-specific assessments: North America, Europe, Asia-Pacific, and India. Chapter 5 turns the findings into a set of water-risk review questions, a view of the supplier landscape, and a legal and contractual risk review.

This report does not claim to be complete. It flags claims that still need primary-source confirmation, regions where research came up short, and gaps that were identified but not yet

closed. Vietnam was excluded from Chapter 4.4 because the available public information did not meet this report's evidential standards — not because Vietnam's semiconductor water risk is absent. A report that states its limitations this way is, in this project's assessment, more useful than one that papers over them.

Chapter 1.1 — The Math of High-Tech Factories

Before this report can make any claim about water as a financial or siting risk, it needs a sense of scale: how much water does a large modern fab use in a day? This sounds like the simplest question in the report. It is not. The most widely repeated answer turns out to rest on a shakier foundation than its wide circulation suggests, while real facility data tells a more useful story.

Where semiconductors sit within industrial UPW demand — and why this report concentrates there

Ultrapure water is not a semiconductor-only category. It is also essential to pharmaceutical and biologics manufacturing, power generation (boiler feedwater for high-pressure turbines), flat-panel display production, and a tail of laboratory and specialty uses.

Market-research publishers consistently identify semiconductor and electronics manufacturing as one of the largest UPW end markets, with pharmaceuticals and biotechnology usually a distant second.[10] But the reported shares depend heavily on how each publisher defines the market, and the totals those shares apply to differ several-fold (Chapter 5.2). This report therefore does not quote a consensus share.

This report still concentrates on semiconductor manufacturing, for three reasons. Semiconductor fabs carry very large single-facility capital budgets. They are the subject of the most active, geographically dispersed government investment programmes — the CHIPS Act, the EU Chips Act, and India's and South Korea's national strategies, all examined elsewhere in this report. And the public disclosure around fabs — company ESG reporting, government environmental assessments, regulatory dockets — appears denser and more traceable than what this research found for the other major UPW-using sectors. That availability is what makes primary-source verification achievable at real depth.

This is a deliberate scope choice, not an oversight. Pharmaceutical and power-generation UPW demand are reserved for future work. Both sectors face real water-purity and water-scarcity exposure of their own, driven by different factors: pharma by sterility and regulatory compliance, power generation by turbine feedwater chemistry.

A related scope choice deserves the same directness. This report's regional chapters focus on the largest, most capital-intensive facilities, sometimes called gigafabs — TSMC uses its GIGAFAB™ label for fabs with capacity of more than 100,000 12-inch wafers per month.[11] Most of the world's fabs fall below that size and run older, trailing-edge process nodes.

That focus is reasonable on water-intensity grounds, though the evidence is directional rather than precise. Multiple sources report that water use per wafer rises as process technology advances: advanced process flows can involve more layers and more complex patterning, cleaning, and rinse sequences. An S&P Global Ratings case study found that TSMC's water use per unit rose by more than 35% after it moved to 16nm processes in 2015.[12] One industry analysis puts water use at roughly 15 litres per wafer for each lithography-etch loop, and notes that some advanced patterning approaches need more of those loops.[13] That is a single reported estimate, not a confirmed benchmark, and the relationship varies by node, tool mix, and process integration. It should not be read as a universal rule — for example, EUV lithography can reduce multi-patterning compared with older approaches. This research did not find a corroborated per-layer water figure

for legacy versus leading-edge nodes.

The practical conclusion is narrow but useful. Large leading-edge fabs are a reasonable focus for water-risk analysis, because of their scale and because per-wafer water intensity is reported to rise with process complexity. This report does not claim to know precisely how much more water-intensive they are.

A reported reference figure: about 4.8 million gallons per day

The most widely repeated figure for a large fab's water use is about 4.8 million gallons per day — roughly 18.2 million litres. It appears in near-identical wording across many publications, including a 2025 peer-reviewed paper.[14] Tracing it back shows why it should be treated with care.

The widely copied wording comes from a 2013 China Water Risk article. That article cites two separate sources. The 4.8 million gallon figure comes from a 2000 industry report on energy and water efficiency in semiconductor manufacturing.[15] A separate figure — about 2,200 gallons of water per 300mm wafer, including about 1,500 gallons of UPW — comes from a 2009 Global Water Intelligence article.[16] The article then links them with a hypothetical fab processing "say, 40,000 wafers a month."[17]

The two figures do not reproduce each other. At 2,200 gallons per wafer, 40,000 wafers a month works out to about 2.9 million gallons per day, not 4.8 million. Reaching 4.8 million would take about 65,000 wafers a month. The 4.8 million figure and the per-wafer figure are separate claims from sources nine years apart, not one calculation. This report therefore does not tie 4.8 million gallons per day to a specific wafer count.

The same source is also the origin of a common comparison with a city of about 60,000 people. The comparison holds as long as the time periods match. At 4.8 million gallons a day, a fab would use about 1.75 billion gallons a year. At roughly 80 gallons per person per day, that is comparable to the total water use of about 60,000 people over the same period. The original wording mixed the two, setting the fab's daily use against the city's annual use.

What real facility figures show

Industry sources also commonly cite a wider range of about 5 to 10 million gallons a day (roughly 20 to 38 million litres) for a single fab.[18] Facility-level figures, which carry more weight than a repeated rule of thumb, sit toward the lower end of that range for a single large fab.

Intel's environmental assessment for its Ocotillo campus in Arizona — a government-filed document published by NIST — projects total water demand of about 14 million gallons per day for three fabs at full build-out.[19] The assessment gives a campus total, not per-fab figures. Divided evenly, that is about 4.7 million gallons per day per fab; that is a modelled average, not a disclosed fab-level number.

TSMC's first Arizona fab has been reported to use about 4.75 million gallons per day.[20] Press reports put the projected demand of TSMC's original three-fab Arizona build-out at roughly 16–17 million gallons per day once complete; the underlying city filing was not located.[21] A separate report citing the American Bar Association puts a single TSMC Arizona fab at 8.9 million gallons per day — almost double the other single-fab figure — so it should be read alongside, not in place of, the lower estimate.[22] These figures measure different things: single fabs, multi-fab campuses, whole sites, planned versus operating capacity, and different points in a production ramp. They should not be averaged together or used to claim that advanced fabs "typically" use some multiple of a baseline.

What this means for the figure this report uses

This report uses about 4.8 million gallons per day (about 18.2 million litres) as a reported order-of-magnitude reference for a single large fab. It is supported less by its original derivation,

which does not reconcile, than by its rough agreement with modern single-fab figures such as TSMC Arizona's first fab and the per-fab average implied by Intel's Ocotillo assessment. It is not tied to a specific wafer count, and it is not a substitute for site data.

Multi-fab campuses can draw several times that amount, as the Arizona figures show. Any chapter in this report citing a specific facility's water use should cite that facility's own disclosed or government-filed figure directly.

A second, separate number: UPW conversion efficiency

A related but distinct figure is the ratio of municipal water needed to produce UPW. A widely repeated reference range is that about 1,400 to 1,600 gallons of municipal water go into every 1,000 gallons of UPW.[23] This range traces back to the same 2000 industry report. It is useful as a reported reference, not a universal purification efficiency: actual ratios depend on feedwater quality, recovery design, and how much reject water is recycled.

This figure describes efficiency inside the UPW process, not facility-level consumption, and the two should not be merged. A fab's total draw depends on its scale and scope. Its UPW conversion efficiency, separately, determines how much of that draw is lost in purification — a process Chapter 1.2 addresses directly.

Chapter 1.2 — The Purity Problem

The previous chapter looked at how much water a large fab draws in a day. This chapter explains why that water cannot come straight from a tap, or even from a well-run municipal treatment plant, without extensive further processing. The gap between "clean" and "ultrapure" is not a matter of degree. It is a different category of water, described by an industry guide, produced by a multi-stage process, and sensitive to feedwater quality in ways that translate directly into capital and operating cost.

The specification and the industry guide behind it

The semiconductor industry's reference document for ultrapure water is SEMI F63, the *Guide for Ultrapure Water Used in Semiconductor Processing*. The current revision is SEMI F63-1224.[24] As its title says, F63 is a guide: it sets out quality expectations and process-control parameters rather than a legally binding standard. Its scope covers facilities making devices with line widths of 32nm and smaller, making it directly relevant to the advanced logic manufacturing discussed throughout this report.

Advanced-fab UPW specifications commonly target the following.[25] The exact current limits should be confirmed against the F63-1224 text itself before being attributed to it specifically.

- **Resistivity of about 18.2 MΩ·cm at 25°C.**[26] This is effectively the theoretical upper limit for pure water — the point where almost no ions remain to conduct electricity. Tap water, and even reverse osmosis water, falls far below this level.
- **Total organic carbon (TOC) below about 1 part per billion.** One part per billion is one microgram per litre. Ordinary municipal water carries organic carbon in the parts-per-million range — roughly a thousand times higher.
- **Very low particle counts** — commonly fewer than one particle per millilitre larger than 0.05 micrometres. A human hair is about 50–70 micrometres wide, so this threshold is about a thousand times smaller.
- **Silica and bacteria at trace levels** — commonly targets around 0.3 parts per billion silica and below 0.1 colony-forming units of bacteria per millilitre.

Why the specification matters for yield

Wafers in advanced fabrication pass through hundreds of individual steps, and many of them end with a UPW rinse to remove chemical residues from lithography, etching, and deposition. Contamination reaching a wafer surface during those rinses can create defects. At leading-edge nodes, where features measure a few nanometres, particles far too small to see can matter.

That is why UPW quality is monitored continuously in operating fabs. TOC analysers, particle counters, and resistivity sensors sit at multiple points in the distribution system, and a deviation at any point triggers a response. In practice, the UPW system is not a background utility. It is an actively instrumented, continuously managed production input.

The treatment process: from tap to tool

Producing UPW from municipal or raw water takes several stages, each removing a different kind of contaminant. No single technology reaches the target alone. Exact configurations vary with feedwater quality, plant size, and design choices, but a typical advanced UPW train looks like this.[27]

Pretreatment removes suspended solids, chlorine, and biological load. It usually combines media filtration, granular activated carbon, and temperature control. This stage prepares the water for membranes; it does not purify it to any usable specification on its own.

Reverse osmosis (RO) follows. Many semiconductor fabs use double-pass RO — two RO stages in series — for extra removal of dissolved solids, silica, and organics. RO membranes remove the large majority of dissolved solids and need periodic replacement; how often depends on feedwater and operating conditions.

Electrodeionisation (EDI or CEDI) comes next. It uses an electric field together with ion-exchange resin to drive out remaining ions without chemical regenerants. It raises resistivity substantially, but not to the final target.

UV oxidation, typically at 185nm, breaks remaining organic compounds into smaller fragments that later stages can remove. It is a key step in driving TOC down toward the sub-1-ppb target.

Final polishing combines submicron filtration, membrane degasification to remove dissolved CO_2 and O_2, non-regenerable ion exchange, and ultrafiltration. This stage delivers water that meets the resistivity and TOC targets at the point of use.

What feedwater quality does to this process

The train above is designed for feedwater within a manageable quality range. When feedwater degrades — when dissolved solids rise, biological load increases, or silica spikes — the effects spread through the whole train.

Higher dissolved solids increase scaling and fouling pressure on RO membranes, which can shorten their service life. Membrane replacement is a direct, recurring operating cost, and in a large fab treating millions of gallons a day, faster replacement cycles add up.

Higher organic load raises demand on pretreatment, UV oxidation, and final polishing. The plant can respond in several ways — more consumables, heavier UV duty, added polishing capacity, more maintenance, and potentially more energy use. If it cannot keep up, the TOC target is breached and production is at risk.

This is the mechanism that makes source-water quality a capital and operating planning variable, not only an environmental consideration. A site drawing stable, low-TDS groundwater runs its UPW system in a different regime from a site drawing reclaimed municipal effluent of variable composition. Both can reach the target. The equipment, the maintenance cycle, and the cost of getting there differ — sometimes substantially.

Chapter 1.3 takes this mechanism into geography: where fabs are being built, and what the water situation looks like there.

Chapter 1.3 — The Location Problem

Chapters 1.1 and 1.2 established two points. A large fab draws water on the order of millions of gallons a day — about 4.8 million gallons is a reported reference for a single large fab. And that water must meet a purity target that ordinary municipal or groundwater supply cannot reach without multi-stage treatment. This chapter adds the third dimension: where fabs are being built, and what the water situation looks like there.

In short, a significant share of global semiconductor manufacturing is being built in places where reliable freshwater supply is already under structural pressure. The fab locations are current or announced siting decisions. The water-stress classification applied to them is a forward-looking projection of basin conditions in 2030 and 2040.

The dataset behind the numbers

Most public statements about semiconductor water stress trace back to one dataset: the World Resources Institute's Aqueduct tool, which rates water stress at the level of individual watersheds. This is worth saying plainly. Institutional sources such as Robeco, Water Tech Online, and SEMI all cite semiconductor water-stress figures that derive from Aqueduct.[28] A reader seeing these figures across different reports might assume independent confirmation. In most cases, they draw on the same data.

That is not a weakness of the dataset; it reflects Aqueduct's status as a common reference for this kind of analysis, and Intel and TSMC have both been reported to use it in their own risk assessments.[29] The most methodologically transparent version of the analysis is a 2024 peer-reviewed study by Josh Lepawsky, published in *iScience*. It combines facility location data and customer–supplier network data with Aqueduct water-stress projections under three climate scenarios for 2030 and 2040. Its findings are the basis for the headline figures in this chapter.

What the numbers say — and what they don't

The 2024 study found that about 40% of existing semiconductor facilities, 24–40% of facilities under construction, and 40–49% of facilities announced since March 2021 are in basins projected to face high or extremely high water stress in 2030 and 2040, depending on the climate scenario. A separate US-focused analysis, reported by Water Tech Online from WRI data, found that 38% of 108 existing and announced US fab sites in 2023 were in regions of high or extremely high water stress.[30]

These figures need careful handling. They describe projected watershed-level stress, not facility-level disruption. A fab in a high-stress basin has not necessarily had any supply problem. A 2025 analysis by SEMI and Waterplan found that only 16% of the sites it analysed were currently affected by water scarcity — while warning that this lower figure could give a false sense of security.[31] Watershed stress ratings describe a structural condition: the ratio of water demand to availability in a basin. A site can sit in a high-stress basin and operate without incident for years, until a drought, an allocation change, or a regulatory shift turns latent risk into an operational one.

The 40% projection and the 16% current-impact figure are both useful, and they are compatible. They measure different things. The point is not that one corrects the other, but that both are relevant to a diligence team.

The geographic pattern

The 2024 study identifies two regions of particular concern: Taiwan and the US desert southwest.[32] That matches the regional pattern documented in Chapter 4.

In the United States, existing and announced fab sites — concentrated in Arizona and Texas, and increasingly in Ohio and New York — span a range of water-stress conditions. Arizona's Phoenix corridor falls within WRI's high and extremely high stress categories. The Colorado River, which supplies a meaningful share of Arizona's water, has been in what the Bureau of Reclamation describes as a multidecadal drought over the past 26 years.[33] In August 2026, the federal government issued operating guidelines for 2027–2028 within a longer 2027–2036 decision framework, while longer-horizon allocation remains open (Chapter 4.1). Texas's Carrizo-Wilcox Aquifer, the groundwater source for Samsung's Taylor fab, raises a different question: whether modeled available groundwater, permitted withdrawals, actual extraction, and committed demand are in balance — and whether the state can see the full picture (Chapter 4.1).

Taiwan concentrates the sharpest version of this exposure. TSMC held about 72–73% of the global pure-play foundry market in the second quarter of 2026, according to TrendForce and Counterpoint Research.[34] Taiwan's reservoirs depend substantially on typhoon rainfall. In 2020, no typhoon made landfall for the first time in 56 years, and the drought that followed into 2021 was widely described as Taiwan's worst in more than half a century.[35,36] The twelve reservoirs that supply its chip fabs fell to about 5.4% of combined capacity at the worst point, according to MSCI, and water was trucked in as an emergency measure (Chapter 4.3).[37,38]

Yet the 2021 drought is also documented evidence that production was protected: chipmakers reported no water-related production suspension that year.[39] Because customers of Taiwan's leading-edge fabs cannot easily switch suppliers, this geographic concentration creates systemic supply-chain exposure — if a future shortage exceeds the effectiveness of the mitigation and allocation measures that shielded production in 2021.

South Korea faces a different form of water pressure, covered in Chapter 4.3. Other major Asian semiconductor hubs, including mainland China and Singapore, are outside the regional chapters of this edition, although Singapore's water-recycling requirements are discussed in Chapters 2.3 and 5.2. In South Korea, semiconductor water risk currently shows up mainly through rapidly growing demand, reuse targets, and the challenge of delivering dedicated water infrastructure for new clusters, with severe flooding as a separate site-resilience issue (Chapter 4.3). Samsung's own disclosures treat water stress as a material risk and set a goal of holding 2030 withdrawal at its 2021 baseline of about 0.3 million tonnes per day.[40]

Why siting decisions don't simply follow water availability

A natural question follows: why are fabs being built in water-stressed places at all? The answer has several layers, each of which limits how much the pattern is likely to change even as water risk becomes better understood.

Industrial clustering creates strong inertia. Semiconductor ecosystems — suppliers, equipment vendors, trained workers, infrastructure — are concentrated in specific corridors. A fab outside them faces higher costs and longer ramp times, even if its water situation is better. Taiwan's lead in advanced manufacturing was built on decades of ecosystem development, not on water policy.

Government incentives have reinforced rather than redirected this pattern. The CHIPS Act provides $39 billion in manufacturing incentives, and several of the largest awards support projects in Arizona and Texas — both high-stress states by WRI measures.[41,42] The EU Chips Act has supported investment in Germany's Silicon Saxony cluster.[43] That cluster's direct water infrastructure is Elbe-linked; its Rhine or Danube exposure is indirect, arising only where suppliers or freight routes depend on those rivers (Chapter 4.2). Industrial policy aimed at strategic manufacturing goals is not primarily designed around water security.

The gap between siting decisions and water conditions is therefore not simply a planning failure that better information would fix. It reflects real competing priorities — supply-chain resilience, ecosystem density, national strategy — that water risk must be weighed against. The evidence in this report suggests that one important response will be greater investment in treatment, reuse, and contingency infrastructure at sites that remain attractive for strategic and ecosystem reasons.

That is the bridge to Chapter 2. The location problem is real and documented. The response to it — filtration infrastructure, reclamation systems, zero-liquid-discharge architecture — is where the financial consequences of location become measurable.

Notes

1. SEMI press release, Jan 2025. https://www.semi.org/en/semi-press-release/eighteen-new-semiconductor-fabs-to-start-construction-in-2025-semi-reports
2. TSMC news release. https://prpoc.cld.tsmc.com/english/news/3210
3. TSMC Arizona page. https://www.tsmc.com/static/abouttsmcaz/index.htm
4. Arizona Commerce Authority, Jul 2026. https://azcommerce-prod.azurewebsites.net/news-events/news/2026/7/tsmc-announcement/
5. TSMC letter to US BIS, May 2025. https://downloads.regulations.gov/BIS-2025-0021-0045/attachment_1.pdf
6. Micron release. https://investors.micron.com/news/press-release/2026/Micron-Celebrates-Official-Groundbreaking-at-New-York-Megafab-Site-01-16-2026/default.aspx
7. Micron 10-Q, May 2026. https://www.sec.gov/Archives/edgar/data/0000723125/000072312526000015/mu-20260528.htm
8. doi:10.1016/j.isci.2024.108791. https://doi.org/10.1016/j.isci.2024.108791
9. Reuters, 21 Jul 2026. https://www.reuters.com/business/energy/power-water-needs-test-south-koreas-push-build-ai-chip-hub-beyond-seoul-2026-07-21/
10. Mordor Intelligence. https://www.mordorintelligence.com/industry-reports/ultra-pure-water-market; Future Market Insights. https://www.futuremarketinsights.com/reports/ultrapure-water-market; Research and Markets. https://www.researchandmarkets.com/reports/5741606/ultra-pure-water-market-report; Grand View. https://www.grandviewresearch.com/industry-analysis/ultrapure-water-treatment-systems-market-report; Research Nester. https://www.researchnester.com/reports/ultrapure-water-market/6952; Verified Market Reports. https://www.verifiedmarketreports.com/product/ultrapure-water-market-size-and-forecast/; Mordor. https://www.mordorintelligence.com/industry-reports/ultra-pure-water-market; FMI. https://www.futuremarketinsights.com/reports/ultrapure-water-market
11. TSMC Form 20-F, FY2010. https://www.sec.gov/Archives/edgar/data/0001046179/000095012311035858/h05002e20vf.htm; TSMC GIGAFAB page. https://www.tsmc.com/english/dedicatedFoundry/manufacturing/gigafab
12. S&P Global Ratings, Feb 2024. https://spglobal.com/ratings/en/research/articles/240226-sustainability-insights-tsmc-and-water-a-case-study-of-how-climate-is-becoming-a-credit-risk-factor-12992283
13. SemiAnalysis, Oct 2025. https://newsletter.semianalysis.com/p/euv-requirements-halved-applied-materials
14. PMC12510042. https://pmc.ncbi.nlm.nih.gov/articles/PMC12510042/
15. China Water Risk, 2013. https://cwrrr.org/resources/analysis-reviews/8-things-you-should-know-about-water-and-semiconductors/
16. China Water Risk, 2013. https://cwrrr.org/resources/analysis-reviews/8-things-you-should-know-about-water-and-semiconductors/
17. China Water Risk, 2013. https://cwrrr.org/resources/analysis-reviews/8-things-you-should-know-about-water-and-semiconductors/
18. Water Tech Online. https://www.watertechonline.com/wastewater/article/55245741/carollo-engineers-managing-water-infrastructure-for-semiconductor-fabs-challenges-and-opportunities-in-the-chips-act-era; Robeco, Mar 2026. https://www.robeco.com/en-int/insights/2026/03/why-the-future-of-chips-depends-on-water
19. NIST draft environmental assessment, Jul 2024. https://www.nist.gov/system/files/documents/2024/07/08/Intel%20Ocotillo%20EA_DRAFT%20FINAL_VOLUME%201%208July2024.pdf
20. Axios, Aug 2025. https://www.axios.com/local/phoenix/2025/08/27/tsmc-industrial-water-reclamation-plant-phoenix; azfamily, Aug 2026. https://www.azfamily.com/2026/08/24/arizonas-chip-footprint-grows-tsmcs-water-demand-sparks-questions/
21. Axios, Aug 2025. https://www.axios.com/local/phoenix/2025/08/27/tsmc-industrial-water-reclamation-plant-phoenix
22. American Bar Association, "A Tale of Two Shortages". https://www.americanbar.org/groups/environment_energy_resources/resources/newsletters/water/reconciling-demand-water-microchips-arizona/
23. China Water Risk, 2013. https://cwrrr.org/resources/analysis-reviews/8-things-you-should-know-about-water-and-semiconductors/
24. SEMI F63 product page. https://store-us.semi.org/products/f06300-semi-f63-guide-for-ultrapure-water-used-in-semiconductor-processing

25. AXEON explainer. https://www.axeonwater.com/blog/ultrapure-water-systems-in-semiconductor-manufacturing-explained/
26. SEMI standards document. https://downloads.semi.org/web/wstdsbal.nsf/de4d7939711aeedf8825753e0078317f/0fa88758bd19728a882580c7001d8fea/%24FILE/6086.pdf
27. AXEON explainer. https://www.axeonwater.com/blog/ultrapure-water-systems-in-semiconductor-manufacturing-explained/
28. Robeco, Mar 2026. https://www.robeco.com/en-int/insights/2026/03/why-the-future-of-chips-depends-on-water
29. PMC version. https://pmc.ncbi.nlm.nih.gov/articles/PMC10826299/
30. Water Tech Online (Carollo Engineers). https://www.watertechonline.com/wastewater/article/55245741/carollo-engineers-managing-water-infrastructure-for-semiconductor-fabs-challenges-and-opportunities-in-the-chips-act-era
31. SEMI blog, 16 Dec 2025. https://www.semi.org/en/blogs/ripple-effects-why-water-risk-is-the-next-major-business-challenge-for-the-semiconductor-industry
32. doi:10.1016/j.isci.2024.108791. https://doi.org/10.1016/j.isci.2024.108791
33. USBR decision documents. https://www.usbr.gov/ColoradoRiverBasin/post2026/decision-doc/
34. Counterpoint Research. https://counterpointresearch.com/en/insights/global-semiconductor-foundry-market-share
35. UNU-EHS. https://ehs.unu.edu/news/news/how-the-lack-of-a-typhoon-affected-lives-5-facts-on-the-taiwan-drought.html
36. Taiwan Central Weather Administration presentation. https://www.weather.gov/media/climateservices/CPASW/2024/Thursday/1-Thur-Session12-Lo.pdf
37. MSCI blog. https://www.msci.com/research-and-insights/blog-post/how-climate-change-affected-thirsty-chipmakers
38. OPB/NPR, Apr 2023. https://www.opb.org/article/2023/04/19/epic-drought-in-taiwan-pits-farmers-against-high-tech-factories-for-water/
39. MSCI blog. https://www.msci.com/research-and-insights/blog-post/how-climate-change-affected-thirsty-chipmakers
40. Samsung Semiconductor sustainability page. https://semiconductor.samsung.com/sustainability/environment/
41. Austin American-Statesman, Dec 2024. https://www.statesman.com/story/business/technology/2024/12/23/samsung-chips-act-science-funding-texas-instruments-taylor-austin/77178995007/
42. DCD. https://www.datacenterdynamics.com/en/news/samsung-texas-instruments-and-amkor-finalize-chips-act-funding-agreements/
43. HOCHTIEF. https://www.hochtief.com/news-media/press-releases/press-release/hochtief-erhaelt-flusswasserwerk-auftrag-fuer-die-deutsche-halbleiterindustrie; Saxony Trade & Invest, Jun 2026. https://business-saxony.com/en/news-events/news/news-detail/n2048-starting-in-2030-the-elbe-river-will-supply-industrial-water-to-dresdens-chip-factories

About the Full Report

This research brief contains the Executive Summary and Chapter 1. The full report continues with the cost, energy, regional, and decision-framework chapters listed below, together with their notes and the complete reference list.

• Chapter 2 — The Rising Costs of Industrial Water Infrastructure

• Chapter 3.1 — The Electricity Cost of Clean Water

• Chapter 3.2 — Thermal Bottlenecks

• Chapter 3.3 — Real-World Cost Studies: A Diligence Framework for Industrial Water Exposure

• Chapter 4.1 — North America: Water Allocation Risk in the Colorado River Basin and Texas Aquifer Corridor

• Chapter 4.2 — Europe: Reading River-Dependent Water Risk on the Rhine and Danube

• Chapter 4.3 — Asia-Pacific: Taiwan and South Korea Under Different Water Pressures

• Chapter 4.4 — Emerging Hubs: India's Semiconductor Corridors

• Chapter 5 — Strategic Takeaways

Full report: https://sunwardresearch.gumroad.com/l/water-production-infrastructure

References

Web sources accessed up to 30 September 2026. Live ELWIS gauge data accessed 26 September 2026 (provisional).

American Bar Association, "A Tale of Two Shortages". https://www.americanbar.org/groups/environment_energy_resources/resources/newsletters/water/reconciling-demand-water-microchips-arizona/

Arizona Commerce Authority, Jul 2026. https://azcommerce-prod.azurewebsites.net/news-events/news/2026/7/tsmc-announcement/

Austin American-Statesman, Dec 2024. https://www.statesman.com/story/business/technology/2024/12/23/samsung-chips-act-science-funding-texas-instruments-taylor-austin/77178995007/

AXEON explainer. https://www.axeonwater.com/blog/ultrapure-water-systems-in-semiconductor-manufacturing-explained/

Axios, Aug 2025. https://www.axios.com/local/phoenix/2025/08/27/tsmc-industrial-water-reclamation-plant-phoenix

azfamily, Aug 2026. https://www.azfamily.com/2026/08/24/arizonas-chip-footprint-grows-tsmcs-water-demand-sparks-questions/

CCNR market observation. https://inland-navigation-market.org/chapitre/4-niveaux-deau-et-taux-de-fret/?lang=de

CCNR Resolution 2022-II-19. https://ccr-zkr.org/files/infovoiedeau/Resolution2022-II-19_de.pdf

China Water Risk, 2013. https://cwrrr.org/resources/analysis-reviews/8-things-you-should-know-about-water-and-semiconductors/

Commerce, Dec 2024. https://www.commerce.gov/news/press-releases/2024/12/biden-harris-administration-announces-chips-incentives-award-samsung

Community Impact, Aug 2026. https://communityimpact.com/central-austin/texas-legislature/live-updates-ercot-will-complete-data-center-audit-in-late-2026-officials-say/

Counterpoint Research. https://counterpointresearch.com/en/insights/global-semiconductor-foundry-market-share

DCD, 2026. https://www.datacenterdynamics.com/en/news/samsung-texas-instruments-and-amkor-finalize-chips-act-funding-agreements/

doi:10.1016/j.isci.2024.108791. https://doi.org/10.1016/j.isci.2024.108791

East Wilco Insider, Feb 2024. https://www.eastwilcoinsider.com/article/215,looking-for-enough-water

ELWIS Kaub. https://www.elwis.de/DE/dynamisch/Wasserstaende/Pegeleinzeln%3AKAUB

Future Market Insights. https://www.futuremarketinsights.com/reports/ultrapure-water-market

Grand View. https://www.grandviewresearch.com/industry-analysis/ultrapure-water-treatment-systems-market-report

Gujarat Semiconductor Policy 2022–27. https://gsem.gujarat.gov.in/ViewFile?fileName=6xgb5BzRwLcpgBXp6CFgCVBiRk8xOF4krJYWdNycigq3G4SVWAvvRSJ3io6lB0yqPe5NhqsdUOHgHr35FHASH__HASHPIJyM0EOPcQjTra4Zznf3vfGwN5jDVdBZw5XjfcJ65VrIZTA4u8KD9OHASH_HASHHhZromHASH__HASHc3bEw%3D%3D

HOCHTIEF. https://www.hochtief.com/news-media/press-releases/press-release/hochtief-erhaelt-flusswasserwerk-auftrag-fuer-die-deutsche-halbleiterindustrie

Invest UP. https://invest.up.gov.in/semiconductor-sector/

Kiel Institute working paper. https://www.kielinstitut.de/fileadmin/Dateiverwaltung/IfW-Publications/fis-import/859784e9-2447-4878-87b9-4014cb0d356a-KWP_2155_low_water_econ_activity.pdf

Micron 10-Q, May 2026. https://www.sec.gov/Archives/edgar/data/0000723125/000072312526000015/mu-20260528.htm

Micron, Jan 2026. https://investors.micron.com/news/press-release/2026/Micron-Celebrates-Official-Groundbreaking-at-New-York-Megafab-Site-01-16-2026/default.aspx

Mordor Intelligence. https://www.mordorintelligence.com/industry-reports/ultra-pure-water-market

MSCI blog. https://www.msci.com/research-and-insights/blog-post/how-climate-change-affected-thirsty-chipmakers

National Law Review, Sep 2026. https://natlawreview.com/article/texas-escalates-data-center-oversight-attorney-general-water-use-investigation

New Indian Express, 21 May 2026. https://www.newindianexpress.com/states/karnataka/2026/May/21/cauvery-water-in-kollegal-lakes-to-aid-bengaluru-units

NIST CHIPS page. https://www.nist.gov/chips/samsung-electronics-texas-austin

NIST draft environmental assessment, Jul 2024. https://www.nist.gov/system/files/documents/2024/07/08/Intel%20Ocotillo%20EA_DRAFT%20FINAL_VOLUME%201%208July2024.pdf

OPB/NPR, Apr 2023. https://www.opb.org/article/2023/04/19/epic-drought-in-taiwan-pits-farmers-against-high-tech-factories-for-water/

PMC version. https://pmc.ncbi.nlm.nih.gov/articles/PMC10826299/

PMC12510042. https://pmc.ncbi.nlm.nih.gov/articles/PMC12510042/

Research and Markets. https://www.researchandmarkets.com/reports/5741606/ultra-pure-water-market-report

Research Nester. https://www.researchnester.com/reports/ultrapure-water-market/6952

Reuters, 21 Jul 2026. https://www.reuters.com/business/energy/power-water-needs-test-south-koreas-push-build-ai-chip-hub-beyond-seoul-2026-07-21/

Robeco, Mar 2026. https://www.robeco.com/en-int/insights/2026/03/why-the-future-of-chips-depends-on-water

S&P Global Ratings, Feb 2024. https://spglobal.com/ratings/en/research/articles/240226-sustainability-insights-tsmc-and-water-a-case-study-of-how-climate-is-becoming-a-credit-risk-factor-12992283

Samsung Semiconductor sustainability page. https://semiconductor.samsung.com/sustainability/environment/

Saxony Trade & Invest, Jun 2026. https://business-saxony.com/en/news-events/news/news-detail/n2048-starting-in-2030-the-elbe-river-will-supply-industrial-water-to-dresdens-chip-factories

SEMI blog, 16 Dec 2025. https://www.semi.org/en/blogs/ripple-effects-why-water-risk-is-the-next-major-business-challenge-for-the-semiconductor-industry

SEMI F63 guide page. https://store-us.semi.org/products/f06300-semi-f63-guide-for-ultrapure-water-used-in-semiconductor-processing

SEMI press release, Jan 2025. https://www.semi.org/en/semi-press-release/eighteen-new-semiconductor-fabs-to-start-construction-in-2025-semi-reports

SEMI standards document. https://downloads.semi.org/web/wstdsbal.nsf/de4d7939711aeedf8825753e0078317f/0fa88758bd19728a882580c7001d8fea/%24FILE/6086.pdf

SemiAnalysis, Oct 2025. https://newsletter.semianalysis.com/p/euv-requirements-halved-applied-materials

SIPCOT. https://sipcotweb.tn.gov.in/Projects

Taiwan Central Weather Administration presentation. https://www.weather.gov/media/climateservices/CPASW/2024/Thursday/1-Thur-Session12-Lo.pdf

Texas Tribune, 23 Jun 2026. https://www.texastribune.org/2026/06/23/texas-data-centers-puc-water-survey/

Texas Tribune, Aug 2021. https://www.texastribune.org/2021/08/02/san-antonio-water-supply-rural-wells/

TN Semiconductor Policy 2024. https://storage.investingintamilnadu.com/Guidance/Uploads/Others/scp_2024.pdf

TSMC Arizona page. https://www.tsmc.com/static/abouttsmcaz/index.htm

TSMC Form 20-F, FY2010. https://www.sec.gov/Archives/edgar/data/0001046179/000095012311035858/h05002e20vf.htm

TSMC GIGAFAB page. https://www.tsmc.com/english/dedicatedFoundry/manufacturing/gigafab

TSMC letter to US BIS, May 2025. https://downloads.regulations.gov/BIS-2025-0021-0045/attachment_1.pdf

TSMC news release. https://prpoc.cld.tsmc.com/english/news/3210

UNU-EHS. https://ehs.unu.edu/news/news/how-the-lack-of-a-typhoon-affected-lives-5-facts-on-the-taiwan-drought.html

US Bureau of Reclamation, decision documents. https://www.usbr.gov/ColoradoRiverBasin/post2026/decision-doc/

Verified Market Reports. https://www.verifiedmarketreports.com/product/ultrapure-water-market-size-and-forecast/

Water Tech Online. https://www.watertechonline.com/wastewater/article/55245741/carollo-engineers-managing-water-infrastructure-for-semiconductor-fabs-challenges-and-opportunities-in-the-chips-act-era