WORLD RESOURCES INSTITUTE

Working Paper

CASE STUDY

AQUEDUCT INFORMS AU OPTRONICS CORPORATE WATER STRATEGY

TIEN SHIAO, PAUL REIG, KEITH LIAO, AND FRANCIS GASSERT

EXECUTIVE SUMMARY

The World Resources Institute (WRI) Markets and Enterprise Program conducted a global geographic water risk assessment with multinational electronics manufacturer AU Optronics (AUO). WRI plotted AUO's fabrication plants worldwide on global maps of water risk using Aqueduct's Water Risk Atlas. This assessment aims to identify which AUO fabrication plants are located in areas and draw from sources that face potential water risks. From this assessment, WRI concluded that: (a) the majority of AUO's fabrication plants are located in areas facing relatively low current water risks, including water stress; (b) by 2025, the majority of AUO's fabrication plants will face medium to high increases in water stress; and (c) the source reservoirs for AUO's fabrication plants face similar levels of water risk.

This case study allows AUO to better prioritize resources and develop risk mitigation solutions. It is important to note that the scope of this case study is limited to the identification of geographic water risks; it does not aim to develop specific facility-level risk reduction strategies and solutions. In this document, WRI provides some high-level recommendations to AUO on how to move forward in developing corporate water strategy. This case study is intended to help other companies understand how they can use Aqueduct's Water Risk Atlas to inform corporate water strategy.

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ABOUT AQUEDUCT

Aqueduct's Water Risk Atlas is an open source global database and interactive mapping tool that helps companies quantify and map water risks worldwide. The Atlas includes detailed global maps of Baseline Water Stress, Water Reuse, Socio-economic Drought, and Projected Change in Water Stress (see Table 1 for definitions of these terms). The global maps and underlying data were originally developed by ISciences for the Coca-Cola Company and donated to WRI's Aqueduct project in 2011.[1] The Atlas highlights geographic exposure of water risk to help companies, investors, and other audiences make better-informed risk management decisions. By January 2013, WRI will provide a total of 17 global maps for physical, regulatory, and reputational risk based on WRI's peer-reviewed water risk framework. Additional global maps include droughts, upstream storage, groundwater stress, flow from upstream protected lands, threatened amphibians that indicate more fragile freshwater ecosystems, and access to improved sources of water indicate areas with low access to safe drinking water supplies.

Table 1 | **Definitions in Aqueduct's Water Risk Atlas**

GLOBAL MAP	DEFINITION	INTERPRETATION
Baseline Water Stress	The ratio of total freshwater withdrawal for the year 2000 relative to expected renewable surface freshwater supply based on 1950–1990 climatic norms. The ratio provides an assessment of the demand for freshwater from households, industry, and irrigated agriculture relative to freshwater availability in a typical year.	High levels of baseline water stress (above 40%) indicate that demand for freshwater approaches (or exceeds) the renewable surface freshwater supply, which leads to greater socio-economic competition for freshwater and a higher risk of supply disruptions.
Water Reuse	The ratio of total non-consumptive withdrawal for the year 2000 relative to expected renewable surface freshwater supply based on 1950-1990 climatic norms. The ratio provides an assessment of renewable surface freshwater that has been previously withdrawn and discharged as upstream wastewater.	High levels of water reuse (above 40%) indicate that a large fraction of the renewable surface freshwater supply at a given location is an upstream user's wastewater. It measures the degree to which water quality is an ongoing concern, and it captures a proxy for dependence on water treatment.
Socio-economic Drought	The ratio of current water stress to baseline water stress. Socio-economic drought occurs when demand for freshwater exceeds supply. It more accurately characterizes drought for large point source users than other common drought measures do, such as meteorological, agricultural, and hydrological indices. Two versions of the indicator are computed. The one-year indicator is more sensitive to annual fluctuations in weather. The three-year indicator describes long-term droughts that may persist even though the most recent year of water is more typical.	Socio-economic drought indices substantially above 1 indicate that there is significantly more competition for freshwater resources among major point source users (irrigated agriculture, industry, and domestic) than would be present in a typical year with normal weather. The three-year socio-economic drought indicator was chosen for this study.
Projected Change in Water Stress	The ratio of projected water stress during three 11-year time frames (centered on the years 2025, 2050, and 2095) to baseline water stress. The analysis incorporates three benchmark scenarios of economic and environmental change used by the Intergovernmental Panel on Climate Change (IPCC scenarios B1, A1B, and A2) in the Fourth Assessment Report.	This measures long-term change in water stress due to changes in economic growth, population growth, and climate change. Severely more stressed (conditions 2.0–2.8 times more stressed than baseline) means that without sufficient investment, communities may face new restrictions on water use and/or occasional supply disruptions.

Source: ISciences, L.L.C. (2011), "Freshwater Sustainability Analyses: Interpretative Guidelines." For more information on these definitions as well as data sources and methodologies used to prepare each map, see http://insights.wri.org/aqueduct/welcome.

As water scarcity increases, as water quality decreases, and as competition for use increases, businesses are facing growing risks associated with water. These risks can threaten a company with financial losses from disruption of the production process; higher costs related to supply chain disruption; changes in the production process; capital expenditures to secure, save, recycle, or treat water; regulatory compliance; the increased price of water; delayed and suppressed growth due to increased competition for water; and even social and political pressure to reduce its use of shared public water resources.[2] Although a company's exposure to water risk varies between different industry sectors and geographies, water risks for businesses and investors can be grouped into three broad categories of physical (quantity and quality), regulatory, and reputational risks (see Table 2).[3,4]

CORPORATE WATER MANAGEMENT

Water can create financial risks for businesses. In order to respond to these risks, a company needs a comprehensive understanding of their water use, their risks, and impacts on their surrounding watersheds.

Although each company's water management approach differs, the World Business Council for Sustainable Development's Water for Business Report[5] defines corporate water management as a complex, iterative process that requires companies to assess and reassess the situation, evaluate and reevaluate their impacts and determine the best course of action on a continual basis. As defined by WBCSD, corporate water management plans should include five stages:

Table 2 | **Types of Water Risks for Businesses**

WATER RISKS	DESCRIPTION	BUSINESS RISK	AQUEDUCT'S WATER RISK ATLAS
Physical Risks	Current or predicted changes in water quantity (e.g., droughts, floods, overdrawn surface water) or quality that may impact a company's direct operations, supply chains, and/or logistics.	■ Disruption of operations due to loss of access to adequate water (quantity and quality), delays in obtaining water use permits, and loss of license to operate due to conflicts between water users. ■ Increasing costs associated with alternative sources of water and increasing water treatment costs.	■ Baseline Water Stress ■ Water Reuse ■ Socio-economic Drought ■ Projected Change in Water Stress ■ Maps under development and available by January 2013
Regulatory Risks	Impacts of current and/or anticipated water-related regulations on a company.	■ Disruption of operations due to loss of license to operate. ■ Increasing costs due to more stringent regulations and higher water price.	■ Maps under development and available by January 2013
Reputational Risks	Current or potential conflicts with the public regarding water issues that can damage a company's brand image and potentially result in a loss of the company's license to operate in a certain community.	■ Disruption of operations due to loss of social license to operate due to water conflicts with other water users. ■ Loss of customers due to perceptions of a company's impact on water resources.	■ Maps under development and available by January 2013

Source: Ceres (2012), "Clearing the Waters: A Review of Corporate Water Risk Disclosure in SEC Filings" and "The Ceres Aqua Gauge: A Framework for 21st Century Water Risk Management"

1. **Assessing global and local water situations.** Companies with global operations can think through how their overall water footprint relates to the global water situation and then focus on the critical points in their value chain that deserve priority.

2. **Accounting for water use** and understanding its impacts on the local watershed.

3. **Identifying specific water risks and opportunities** by interpreting findings from stages one and two.

4. **Determining action and setting targets.**

5. **Monitoring and communicating** performance with internal and external stakeholders.

Aqueduct's Water Risk Atlas is designed to help companies assess global water conditions and identify water risks so they can understand their water challenges and develop strategies to address them. Corporate water strategy then guides specific corporate water management decisions. Elements of a water strategy include setting quantifiable performance targets to drive performance improvements (e.g., reduction targets for water conservation and efficiency), defining the scope of water management (e.g., supplier performance and improved water management practices across supply chains), and developing program-level strategies to respond to risks and impacts, such as decreasing water quality and degrading ecosystems (e.g., basin restoration projects and working with local and regional governments to strengthen water management capacity).[6]

COMPANY BACKGROUND

AU Optronics was formed in September 2001 by the merger of Acer Display Technology, Inc. and Unipac Optoelectronics Corporation. Headquartered in Hsinchu, Taiwan, AUO is a leading manufacturer of flat-panel displays and accounts for 17% of the world's market share in thin film transistor-liquid crystal display (TFT-LCD).[7] AUO generated $12.5 billion in sales revenue in 2011 and has more than 45,000 employees in offices and operations in Taiwan, China, Japan, Singapore, South Korea, the United States, and Europe. AUO expanded its market into renewable energy in late 2008. The Display and Solar businesses were established respectively as the company's two core businesses in 2010.

AUO has pursued a number of sustainability initiatives with targets to reduce greenhouse gas emissions, water use, and waste. Its social, economic, and environmental performance has been repeatedly recognized. In 2011, the company was named the global sector leader by Sustainable Asset Management and appeared on the Dow Jones Sustainability World Index. In addition, AUO tracks water use across its direct operations and has a performance goal to bring product water intensity (cubic meter of water per square meter of product produced) 30% below 2010 levels by 2015. In order to do this, AUO will implement technologies such as water recycling, rainwater collection, and advanced wastewater treatment. AUO wants to continue to develop a comprehensive water strategy with the goal of reducing water risks and improving sustainability in the watersheds in which it operates. As a result, AUO selected Aqueduct's Water Risk Atlas to complete a company-wide geographic water risk assessment.

WHY ASSESS WATER RISKS?

Water is an essential and expensive component of the liquid crystal display manufacturing process. Large quantities of ultrapure water are required for rinsing and cooling during the construction of LCD panels.[8] In addition, numerous chemicals are used and discharged, leading fabrication plants to face stringent wastewater discharge regulations when treating their water on-site. In order to meet influent water and wastewater discharge requirements while remaining cost-effective, almost all of AUO's fabrication plants recycle water.

AUO has already suffered water-related financial impacts. Due to low rainfall and subsequently low reservoir levels in 2002, AUO's fabrication plants in Longtan, Taiwan, were forced to truck in water. The process significantly increased the operating cost at those plants. For the fabrication plants in Hsinchu, Taiwan, getting access to an adequate municipal water supply is a continuous problem because other water-intensive companies compete for the same limited water source. Additionally, as a multinational company, AUO faces close scrutiny from local nongovernmental organizations and communities, driving the company to treat its wastewater to meet higher quality standards than those set by government regulations for pre-treatment on-site.

These experiences and exposure to various water risks motivated AUO to use Aqueduct's Water Risk Atlas to assess the geographic water risks facing AUO's 24 fabrication plants worldwide and 16 municipal source reservoirs for AUO's fabrication plants, as described in this case study.

ROAD MAP TO A COMPREHENSIVE WATER STRATEGY

Analysis

WRI plotted AUO's 24 fabrication plants and 16 municipal water sources on Aqueduct's global maps of Baseline Water Stress, Water Reuse, Socio-economic Drought, and Projected Change in Water Stress (see Figures 1, 2, 3, and 4).

Each global map displays different threshold levels of stress, reuse, and competition between water users. For easier interpretation, WRI grouped the threshold levels for each map into water risk levels of low, medium, and high (see Table 3). Thereafter, the overall level of water risk for each fabrication plant and reservoir was determined by the highest level of water risk for stress, reuse, or competition.

Results

AUO's fabrication plants are located in China (6 plants), Czech Republic (1 plant), Taiwan (15 plants), Singapore (1 plant), and Slovakia (1 plant). The company reported source water information for 16 of the 24 fabrication plants. The majority (94%) of AUO's total source water withdrawal is from municipal water systems, 6% from groundwater, and less than 1% from rainwater. Ten out of 16 fabrication plants receive their water supply from a combination of sources, but all 16 receive at least part of their water supply from local municipal water systems that in turn receive some or all their water from surface water reservoirs.

Each global map provides information on specific water risks a company might face (see Table 2). For example, baseline water stress indicates the potential risks associated with disruptions in water supply driven by increases in demand and diminishing supplies; water reuse highlights areas with a high dependency on wastewater treatment due to large quantities of upstream discharge; socio-economic drought indicates recent increases in competition for water; and projected change in water stress flags regions likely to see future changes in the current state of water stress.

Table 3 | **Definition of Risk Levels**

GLOBAL MAP	LEVEL OF RISK
Baseline Water Stress (ratio of total withdrawal to freshwater availability)	**Low:** Low (<10%) **Medium:** Moderate (10–<20%), Medium-High (20–40%) **High:** High, Extremely High (40–>80%)
Water Reuse (ratio of upstream non-consumptive use to freshwater availability)	**Low:** Low (<10%) **Medium:** Moderate (10–<20%), Medium-High (20–40%) **High:** High, Extremely High (40–>80%)
Three-Year Socio-economic Drought (ratio of current water stress to baseline water stress)	**Low:** Relatively Wet (<1), Near Normal Conditions, (1–1.7x), Low Impact Drought (1.7x) **Medium:** Moderate Drought (1.7–<2.0x) **High:** Severe Drought (2.0–2.8x), Extreme Drought (2.8–8.0x), Exceptional Drought (8.0x)
Projected Change in Water Stress for 2025 and Scenario A1B (ratio of projected change in water stress to baseline water stress)	**Low:** Exceptionally Less Stressed (<0.125x), Extremely Less Stressed (0.125–0.357x), Significantly Less Stressed (0.357–0.500x), Moderately Less Stressed (0.500–0.588x), Wetter but Still Extremely High Stress (<0.588x), Near Normal Conditions (0.588–1.7x) **Medium:** Near Normal Conditions (0.588–1.7x) with uncertainty in direction or magnitude, Drier but Still Low Stress (>1.7x), Moderately More Stressed (1.7–2x) **High:** Severely More Stressed (2–2.8x), Extremely More Stressed (2.8–8x), Exceptionally More Stressed (>8x)

Source: ISciences, L.L.C. (2011), "Freshwater Sustainability Analyses: Interpretative Guidelines." For more information on these definitions as well as data sources and methodologies used to prepare each map, see http://insights.wri.org/aqueduct/welcome.

Table 4 | **Number of AUO's Fabrication Plants Located in Areas of Current Water Risk**

GLOBAL MAPS*	NUMBER OF FABRICATION PLANTS (% OF TOTAL)		
	LOW	MEDIUM	HIGH
Overall Water Risk**	11 (46%)	12 (50%)	1 (4%)
Baseline Water Stress	14 (58%)	10 (42%)	0
Water Reuse	21 (88%)	3 (12%)	0
Socio-economic Drought	21 (88%)	2 (8%)	1 (4%)

* Global maps available at: www.wri.org/aqueduct.
** Includes Baseline Water Stress, Water Reuse and Socio-economic Drought.

Based on the Aqueduct geographic water risk assessment for AUO's fabrication plants, the majority of AUO's fabrication plants are located in areas of low and medium water risk (see Table 4). However, the Aqueduct analysis of future water stress shows that by 2025, the majority of AUO's fabrication plants are located in areas that will face medium and high increases in water stress (see Table 5).

The majority of municipal reservoirs supplying water to AUO's fabrication plants are located in areas currently facing low and medium water risk (see Table 6), and all of them are located in areas that by 2025, based on IPCC Scenario A1B, will face low to medium increases in water stress (see Table 7). In general, AUO's fabrication plants and the reservoirs supplying their water face similar levels of risk due to their close proximity. The tabulated statistics are slightly different because not all of the fabrication plants reported information about their source water supply.

Discussion and Recommendations

The results of the analysis show that the majority of AUO's fabrication plants are located in areas facing relatively low current water risks, including water stress. More important for future risk management planning, however, is the finding that by 2025 the majority of AUO's fabrication plants will face medium to high increases in water stress. The municipal source reservoirs are located in areas with similar levels of water risk due to their close proximity to the fabrication plants.

AUO has largely responded to physical water supply risks in their direct operations by implementing water recycling in its fabrication plants. However, there are other water risks to consider, including water quality, ecosystem vulnerability, uncertainty in regulation from poor water governance, and competition with other water users in the watershed.

The results of this study suggest the following priority actions to inform AUO's water strategy:

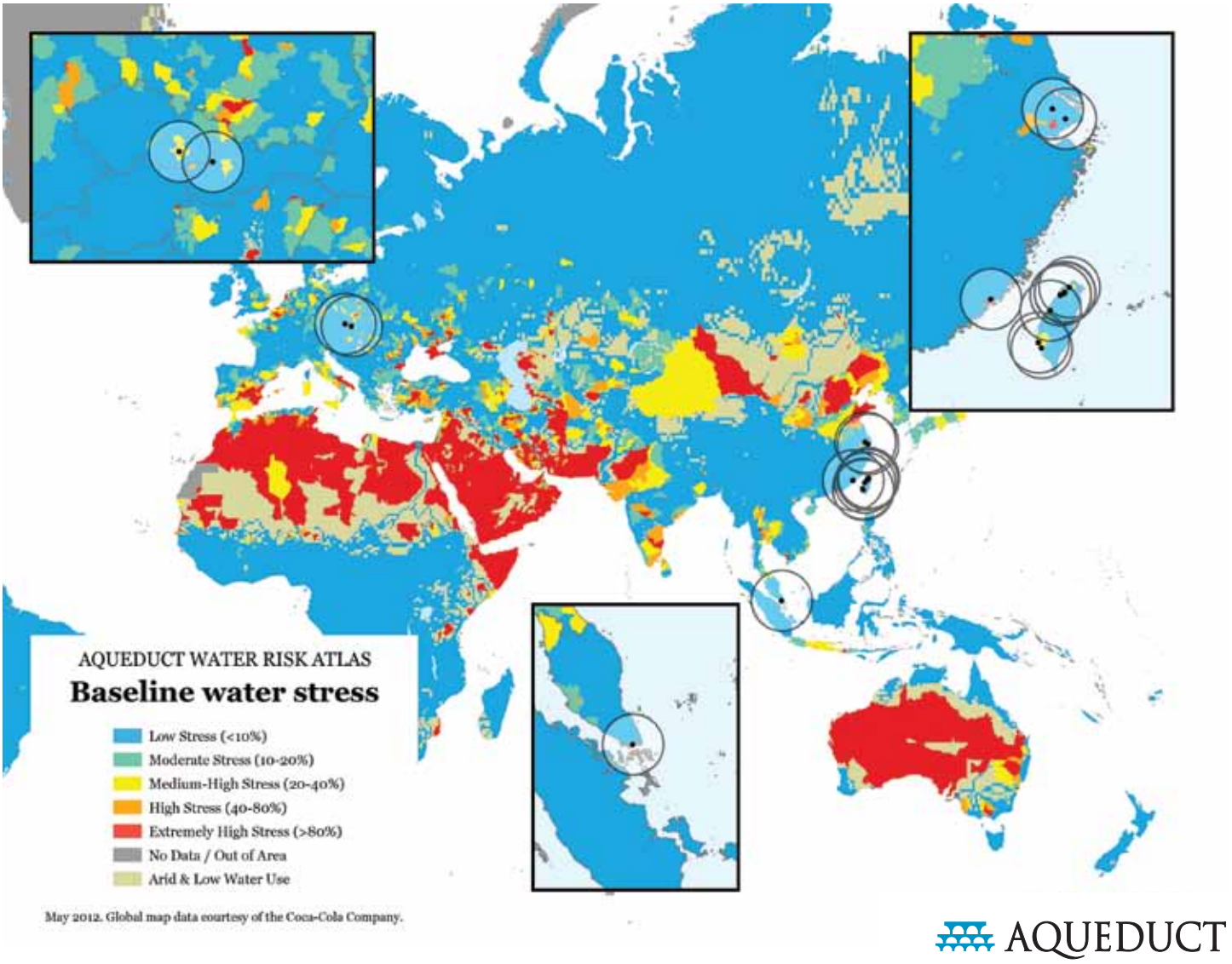
- **Plot AUO's fabrication plants on additional maps for regulatory and reputational risk, which will be available for Aqueduct's Water Risk Atlas by January 2013.** This will help AUO form a more comprehensive water strategy and set performance targets focused on improving conditions for communities and ecosystems within the watersheds in which it operates.

Table 5 | **Number of AUO's Fabrication Plants Located in Areas of Projected Change in Water Stress in 2025**

GLOBAL MAPS*	NUMBER OF FABRICATION PLANTS (% OF TOTAL)		
	LOW	MEDIUM	HIGH
Projected Change in Water Stress	6 (25%)	11 (46%)	7 (29%)

* Global maps available at: www.wri.org/aqueduct.

Figure 1 | **AUO's Manufacturing Plants on Aqueduct's Baseline Water Stress Map**



Source: World Resources Institute (2012), using ISciences, L.L.C., "Freshwater Sustainability Analyses: Interpretative Guidelines."
Note: Circles highlight locations of the manufacturing locations. Each manufacturing location may have more than one fabrication plant. There are 12 manufacturing plants and 24 fabrication plants.

Table 6 | **Number of Water Supply Reservoirs in Areas of Current Water Risk**

GLOBAL MAPS*	NUMBER OF MUNICIPAL SOURCE WATER LOCATIONS (% OF TOTAL)		
	LOW	MEDIUM	HIGH
Overall Water Risk**	4 (25%)	12 (75%)	0
Baseline Water Stress	4 (25%)	12 (75%)	0
Water Reuse	14 (88%)	2 (12%)	0
Socio-economic Drought	16 (100%)	0	0

* Global maps available at: www.wri.org/aqueduct.
** For fabrication plants with more than one municipal water source, the municipal water source with the highest level of stress, reuse, and socio-economic drought is shown.

- **Prioritize AUO's fabrication plants for facility-level water risk assessment, based on the level of their exposure to baseline water stress and projected change in water stress.** Since Aqueduct's Water Risk Atlas does not provide results for local watershed conditions, AUO should also conduct an in-depth water risk assessment of its local operations and other water users in the watershed, including communities, other industries, farmers, and governments. These strategies also might include engaging outside the company's direct operations to improve watershed conditions, such as working to reduce system leaks, investing in more water-efficient equipment for municipal customers, investing in efficient irrigation technologies for agricultural customers, or working with local and regional governments to strengthen their water management capacity.

- **Plot AUO's supplier locations across Aqueduct's Water Risk Atlas and encourage suppliers to adopt improved water practices.** Often the biggest water risks stem from a company's value chain or "indirect use" rather than its direct operations. Such engagement efforts with suppliers or a corporate policy that mandates suppliers to improve water conservation can have far-reaching impacts on improving watershed conditions and reducing risk exposure.

- **Continue to monitor and disclose water risks and mitigative actions.** Reporting a company's risks and mitigative actions helps improve internal understanding of water challenges and demonstrates AUO's progress and good practice to external stakeholders. Demonstrating such progress can help build AUO's credibility with local communities, civil society, and governments. Examples of disclosure initiatives include the Water Disclosure Project of the Carbon Disclosure Project (CDP) and the Global Reporting Initiative.

As a result of this geographic water risk assessment, AUO plans to assess water risks using Aqueduct's Water Risk Atlas for 20 of its largest suppliers who manufacture electronic components. AUO intends to share its water management system and conservation technologies with suppliers in order to conserve water resources across the company's value chain. In addition, in June 2012 AUO used Aqueduct's Water Risk Atlas to disclose the number of its fabrication plants in geographies exposed to water risks in the 2012 CDP Water Project's questionnaire. The CDP Water Project is supported by 655 institutional investors representing $78 trillion assets.[9]

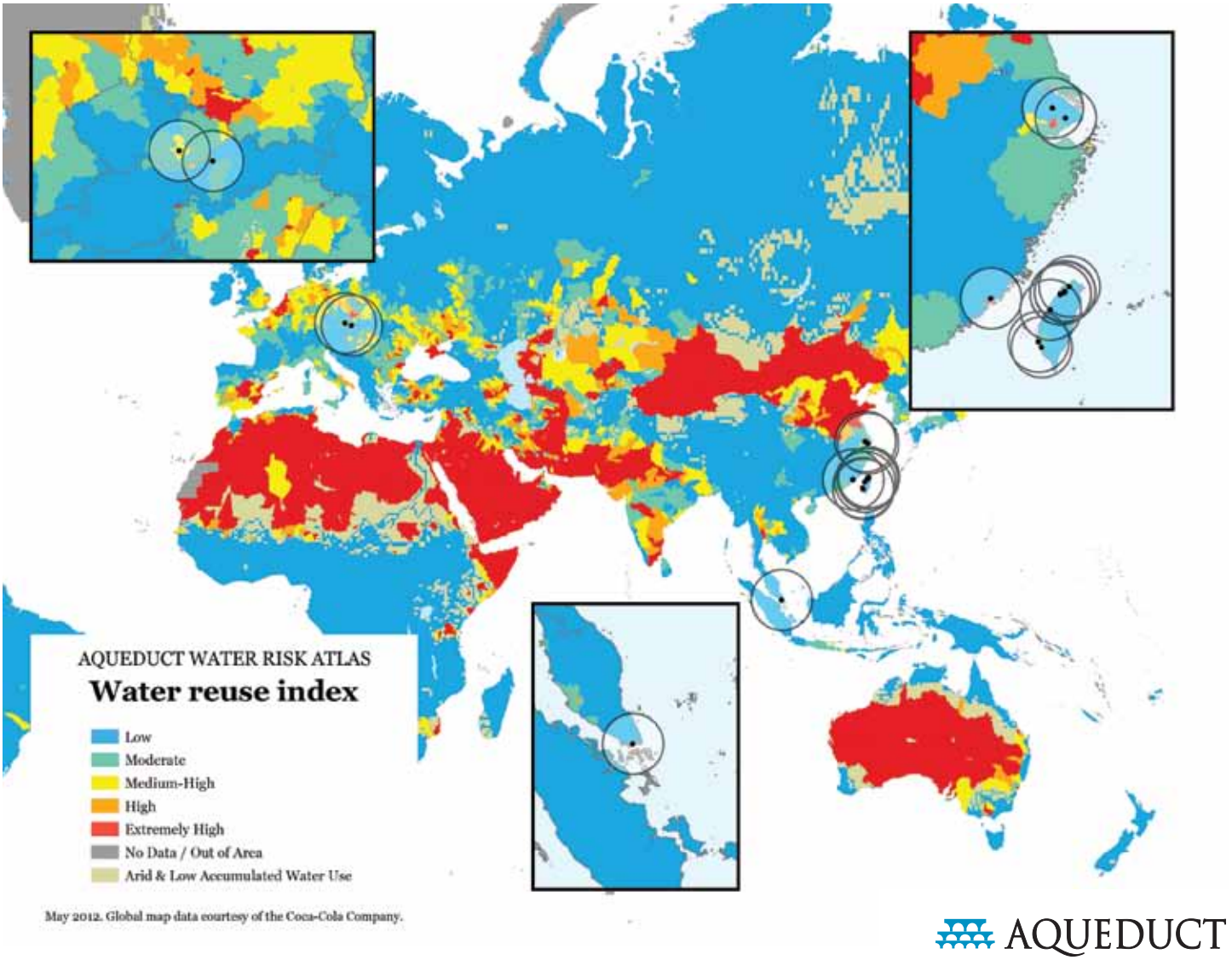
Table 7 | **Number of Water Supply Reservoirs in Areas of Projected Change in Water Stress in 2025**

GLOBAL MAPS*	NUMBER OF MUNICIPAL SOURCE WATER LOCATIONS (% OF TOTAL)		
	LOW	MEDIUM	HIGH
Projected Change in Water Stress	6 (37%)	10 (63%)	0

* Global maps available at www.wri.org/aqueduct.

ANNEX 1: MAPS

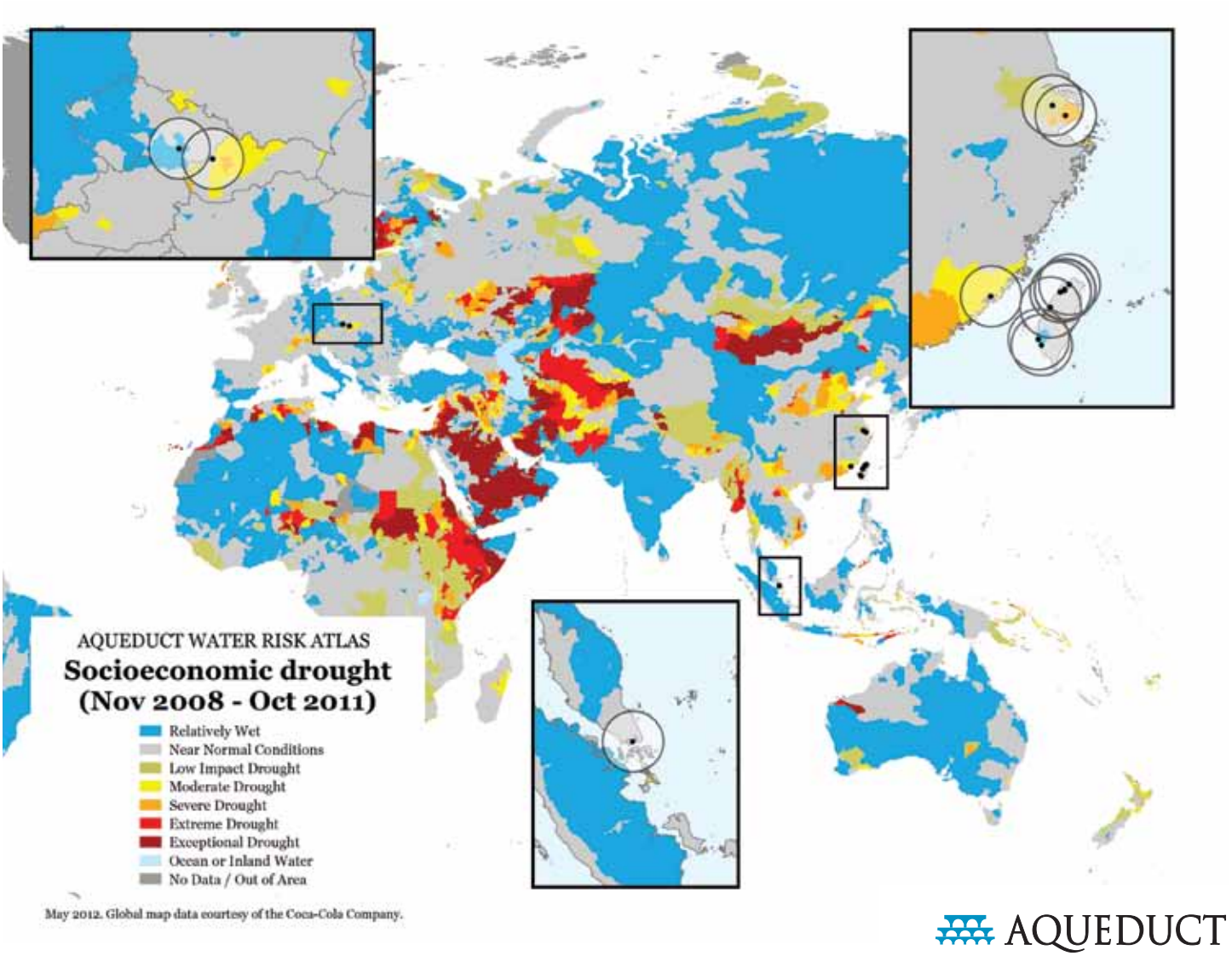
Figure 2 | **AUO's Fabrication Plants on Aqueduct's Water Reuse Index Map**



Source: World Resources Institute (2012), using ISciences, L.L.C., "Freshwater Sustainability Analyses: Interpretative Guidelines."
Note: Circles highlight locations of the manufacturing locations. Each manufacturing location may have more than one fabrication plant. There are 12 manufacturing plants and 24 fabrication plants.

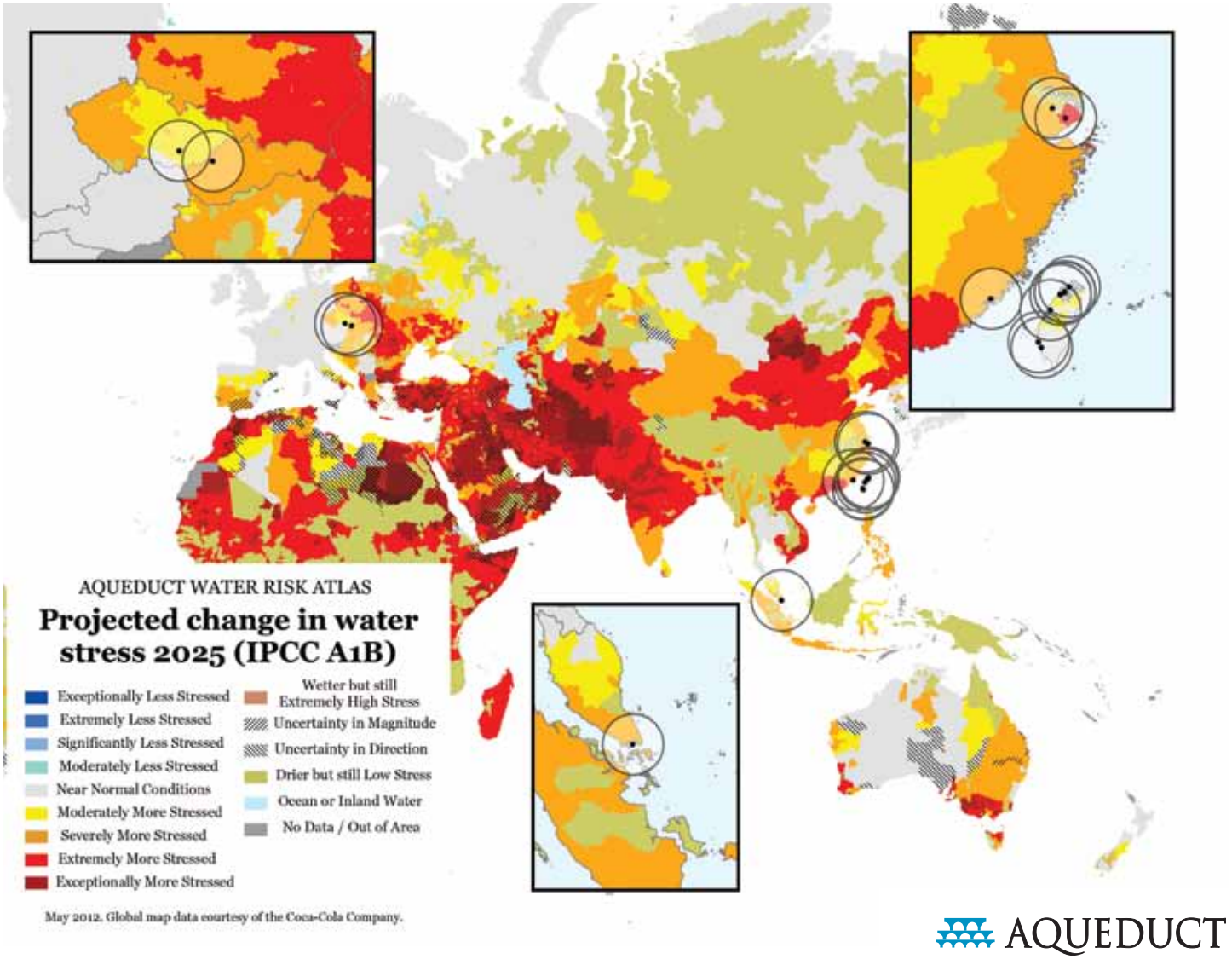
ANNEX 1: MAPS

Figure 3 | **AUO's Fabrication Plants on Aqueduct's Socio-economic Drought Map**



Source: World Resources Institute (2012), using ISciences, L.L.C., "Freshwater Sustainability Analyses: Interpretative Guidelines."
Note: Circles highlight locations of the manufacturing locations. Each manufacturing location may have more than one fabrication plant. There are 12 manufacturing plants and 24 fabrication plants.

Figure 4 | **AUO's Fabrication Plants on Aqueduct's Projected Change in Water Stress Map**



Source: World Resources Institute (2012), using ISciences, L.L.C., "Freshwater Sustainability Analyses: Interpretative Guidelines."
Note: Circles highlight locations of the manufacturing locations. Each manufacturing location may have more than one fabrication plant. There are 12 manufacturing plants and 24 fabrication plants.

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ABOUT WRI

The World Resources Institute (WRI) is a global environmental and development think tank that goes beyond research to create practical ways to protect the Earth and improve people’s lives. We work with governments, companies, and civil society to build practical solutions to urgent environmental challenges. WRI’s transformative ideas protect the Earth and promote development because sustainability is essential to meeting human needs and fulfilling human aspirations for the future.

ABOUT THE AUTHORS

Tien Shiao is a Senior Associate with the Markets and Enterprise Program at WRI, where she leads the design and development of the Aqueduct Project.
Contact: tshiao@wri.org

Paul Reig is an Associate with the Markets and Enterprise Program at WRI, where he manages the design and development of the Aqueduct project.
Contact: preig@wri.org

Keith Liao is a Senior Engineer within AUO Optronics Corporate Sustainability and Environment Department.
Contact: keith.liao@auo.com

Francis Gassert is a Research Assistant with the Markets and Enterprise Program at WRI, where he manages the geospatial analysis and data analytics for the Aqueduct project.
Contact: fgassert@wri.org

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