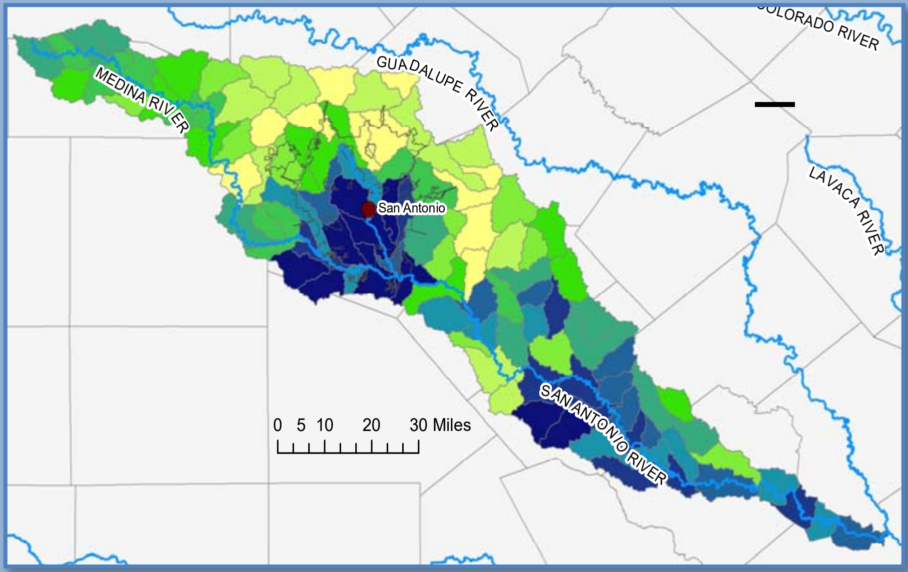
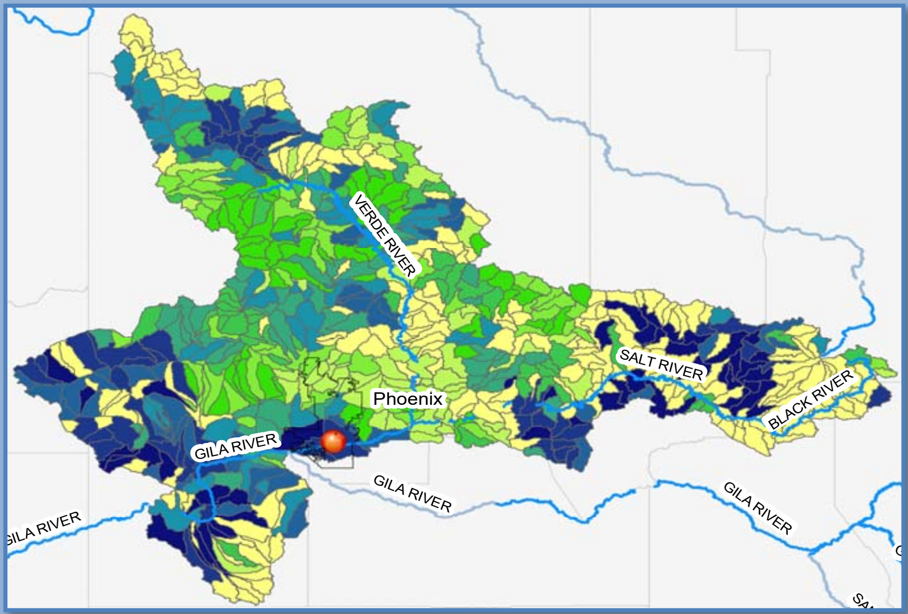
Appendix II

EPA Recovery Potential Screening (RPS) Tool: Potential Applications for Watershed Analysis and Water Equity Mapping





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Water Equity Mapping Approach

Introduction

A primary goal of the Water Reuse Action Plan is to identify more effective methods of water reuse and to identify barriers to this goal.[1] We sought to develop a methodology and identify tools that would help the EPA consider the broad range of local factors that impact water reuse in a particular area. This project sought to apply the Environmental Protection Agency (EPA) Recovery Potential Screening Tool (RPS), which is a tool designed to compare the condition and restoration potential of watersheds within a given region. By comparing social, environmental, and stressor data available through RPS at the subwatershed level, we developed visualizations to help local and national stakeholders understand and identify vulnerability hotspots in the San Antonio River and Verde River Watersheds. The maps presented in this report are meant to offer the reader a broad and integrated understanding of water equity, which refers to a populations' access to adequate and safe water for sustaining livelihoods, human well-being, and socioeconomic development.[2] National and local datasets that profile anthropogenic and environmental threats to water security and sustainability can help to inform water equity priorities within these watersheds. The indicators selected from the 284 indicators stored in the RPS Tool were designed to capture elements of water equity and to create a foundation on which the EPA and other stakeholders can make informed decisions about water management.

Primary Elements of Water Equity

Water Access: A populations' access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socioeconomic development.

Watershed Health: Quality of the water in a watershed to ensure an adequate, reliable, and continual supply of clean water for human uses and ecosystems.

Water Resilience: the capacity of a water supply to adapt to or recover from the effects of rapid hydrologic change or a natural disaster.

The Recovery Potential Screening (RPS) Tool

The RPS Tool was originally developed to help states, territories and tribes identify priority areas for watershed restoration and support.[3] The RPS Tool is an Excel spreadsheet that calculates index scores at the watershed and subwatershed level using data for a series of social, environmental, and stressor indicators. As of 2021, the tool contains 284 unique indicators from many national database sources, including the National Hydrography Dataset, the US Census Bureau, and National Land Cover Database. Data are stored by 12-digit Hydrologic Unit Codes (HUC12 regions), which are watershed boundaries

[1] For more information, see the Water Reuse Action Plan.

[2] For more information, see the U.S. Water Alliance National Briefing Paper

[3] Overview of Recovery Potential Screening (RPS), EPA.

that divide a region at the local, subwatershed level.[4] It is possible to combine multiple indicators to produce a single comparative index score for each of the HUC12 regions in a particular state or sub-state area. See Attachment 1 for more information about the calculations in the RPS Tool. The EPA completed RPS updates for the lower 48 states in November 2021.

HYDROLOGIC UNIT CODE DIVISIONS

Hydrologic Unit Codes (HUCs): The Watershed Boundary Dataset maps the entire U.S. surface level drainage using a series of hydrologic units that nest within one another. This enables users to better visualize the broader watershed or smaller units that comprise the given area. Each hydrologic unit in the Watershed Boundary Dataset is assigned a Hydrologic Unit Code (HUC) and the hydrologic units are therefore referred to as HUCs. Watershed levels include:

HUC4: Divides areas at the subregion level and delineates large river basins.

HUC6: Divides a watershed at the basin level.

HUC8: Divides the watershed at the subbasin level and delineates medium-sized river basins.

HUC12: The finest level of watershed granularity, HUC12 regions are divided at the local, subwatershed level and delineate tributary systems. The continental U.S. is comprised of about 90,000 HUC12 regions.

Modifications include updating older indicators with more recent data where possible and adding over 30 new indicators into the tool, which include a series of indicators that could be relevant to Environmental Justice (EJ) initiatives. This report includes data and results from Texas and Arizona RPS Tools that include the 2021 updates. Most indicators in the updated tools are comprised of data collected between 2016 and 2020.

Data Selection: RPS Indicators

To better understand the environmental, social, and economic demands on water supplies, we selected a subset of indicators designed to identify areas across the whole watershed that would benefit the most from development of water reuse plans. The final selection of indicators was informed by Consensus Building Institute's stakeholder engagement process for the WRAP pilot where partners decided on water equity considerations to be factored into the RPS mapping. We selected a total of 21 indicators from the RPS Tool to illustrate social equity, watershed health, and climate vulnerabilities across three elements – water access, watershed health and water resilience. See Attachment 2 for more detailed descriptions of each indicator.

Water Access

Water access includes societal factors that impact a population's sustainable access to water for socioeconomic development and human wellbeing. The indicators chosen to demonstrate water access across the watershed display factors that impact whether people have access to clean, safe water. They also capture a number of stressors that influence which groups of the population may be most

[4] Hydrologic Unit Maps, USGS.

underserved across the watershed. Although additional factors beyond those indicators listed below can influence water security, these indicators offer insights to help stakeholders identify hotspots within the region that may be worth investigating further. In order to characterize vulnerability associated with water access, we selected eight indicators from the 284 available in the RPS Tool to depict the most vulnerable areas in the watershed with respect to water access. We split these eight indicators into two sub-categories: social vulnerability, which identifies socially vulnerable communities, and human land and water use, which illustrates the current regional demand on water.

Social Vulnerability

1. % Low-Income Population in Watershed
2. % Minority Population in Watershed
3. % Linguistically Isolated Population in Watershed
4. % < High School Educated Population in Watershed
5. % Vulnerable Age Group Population in Watershed

Human Land and Water Use

1. Population Density in Watershed
2. Domestic, Agricultural and Industrial Water Demand in Watershed
3. Groundwater Source Protection Areas in Watershed

Watershed Health

Watershed health reflects the health of the watershed and the ability to supply sufficient clean water to the population. Water quality, ground, and surface water supply, and natural landcover are important indicators for watershed health. Indicators selected to visualize watershed health include:

Watershed Health

1. % Natural Land Cover (N-Index1) in Watershed[5]
2. Soil Stability, Mean in Watershed
3. Preliminary Healthy Watershed Analysis (PHWA) Watershed Health Index, State[6]

[5] The % Natural Land Cover is included in this analysis as a standalone indicator. It also factored into the PHWA, and therefore, may have a somewhat greater influence on the Watershed Health index scores.

[6] The Preliminary Healthy Watershed Analysis (PHWA) Watershed Health Index is an index based on the EPA's Healthy Watersheds Assessment Framework. It integrates data from the following sub-indices: landscape condition, habitat, hydrology, geomorphology, water quality and biological condition data. For more information about the PHWA Watershed Health Index, see the EPA PHWA overview report.

4. Change in % N-Index1 in Watershed (2001-16).[7]

Toxics Load

1. Toxic Release and Exposure Potential in WS
2. Hazardous Waste Management Sites, Count in WS
3. Risk Management Plan Sites, Count in WS

Water Resilience

Water Resilience captures the capacity of a watershed to withstand or adapt to or recover from rapid or significant changes in the water system, including natural disasters. We selected the following six indicators to illustrate the climate vulnerabilities within the watershed and inform considerations for water resilience:

Present Vulnerability

1. % 100-Year Flood Zone in Watershed
2. PHWA Watershed Vulnerability Index, State
3. Wildfire Hazard Potential, Mean in WS (2018)

Projected Vulnerability

1. Projected Change in Annual Temperature
2. % Projected Change in Annual Precipitation, Inverse
3. % Projected Change in Annual Evaporative Deficit

All indicators were standardized on a percentile scale according to the range of values within the mapping area to generate the maps in this report. The projected change in annual temperature and % projected change in annual precipitation have relatively small ranges across both the San Antonio Watershed and the Verde, Salt and Gila River Basins. The projected change in annual temperature, for example, varies by just less than one degree Fahrenheit across the San Antonio region. While the maps in the following section indicate "hotspots," these are all based on relative values across the watershed and general projected trends. To view the full dataset for each indicator, see the RPS Tool the [EPA RPS Website](#).

[7] The N-Index1 indicates land classified as natural land cover, according to the CDL-NLCD Hybrid Land Cover dataset. This indicator was compared alongside the other indicators included in the Watershed Health index and was not incorporated into the index itself.

Water Equity Mapping

The San Antonio Watershed

While many of the stakeholders involved in this project are based in the central San Antonio area, both federal and local stakeholders expressed interest in expanding the water equity data visualization beyond the immediate watershed to the larger surrounding basin, including regions upstream and downstream of the City of San Antonio. We selected the San Antonio Basin (HUC6: 121003), shown in Exhibit 1, to broaden the scope of the water equity mapping around the San Antonio urban center. This basin extends from Kerr and Bandera counties, downstream to Victoria and Refugio counties, with the San Antonio River at its center. It is comprised of 107 HUC12 regions, including 31 that fall within the San Antonio city boundary.

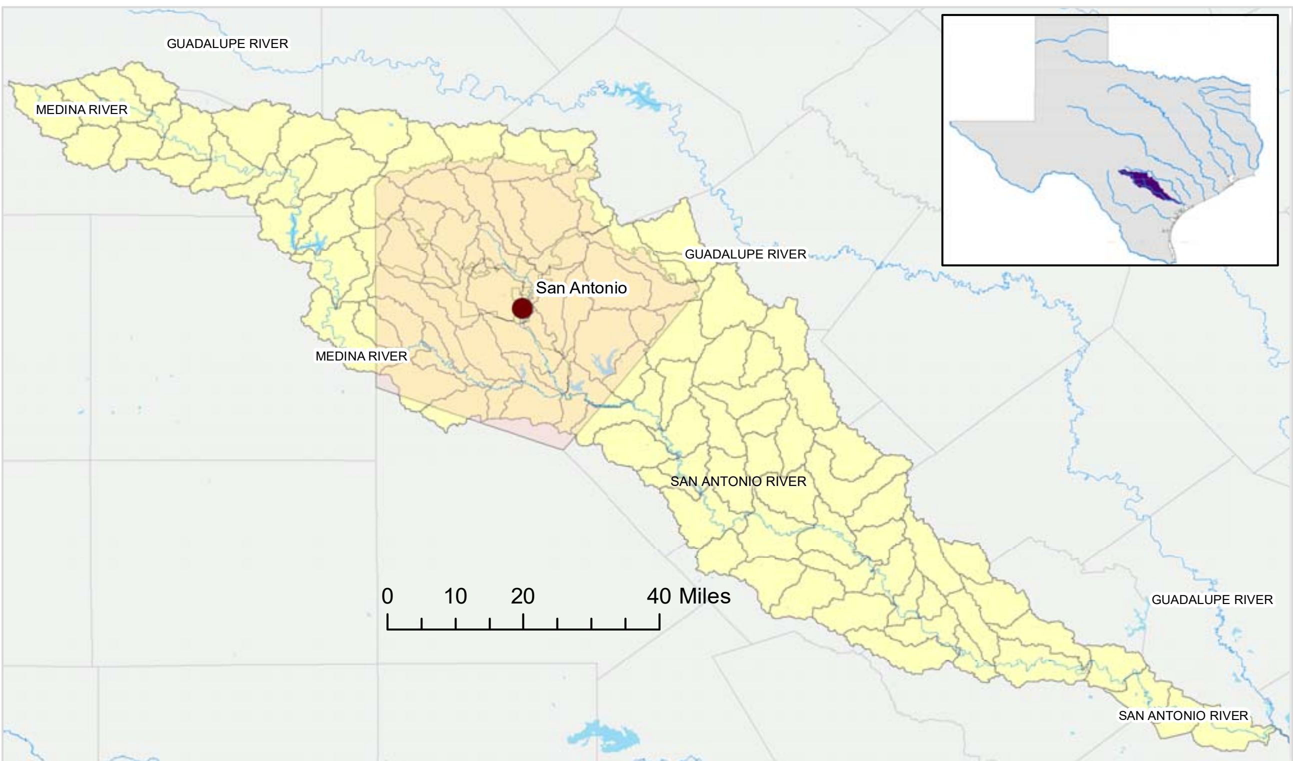

Exhibit 1. The San Antonio River Basin HUC12 Regions.

Water Access

Social equity and human access to natural and manmade resources are essential to Integrated Watershed Resource Management (IWRM). In order to identify the most socially vulnerable areas in the San Antonio River Basin, we selected five indicators that equally contribute to a broad social vulnerability index: the percent of the population identified as low-income, the percent minority (non-white), percent linguistically isolated, percent with less than a high-school education, and the percent vulnerable age group (below 5 and above 64). See Attachment 2 for more information about the source data and other details for each of these indicators.

A particular consideration, both within the city and throughout the surrounding watershed, are socially vulnerable populations who may be disproportionately affected by water mismanagement. Exhibits 2 and 3 present heatmaps that divide the index scores by decile for the full basin and Bexar County, respectively. The lowest scores (first decile, depicted in light red) indicate the least socially vulnerable HUC12 regions, while the highest scores (tenth decile, depicted in dark red) show the HUC12 regions with the highest social vulnerability index scores across the watershed.

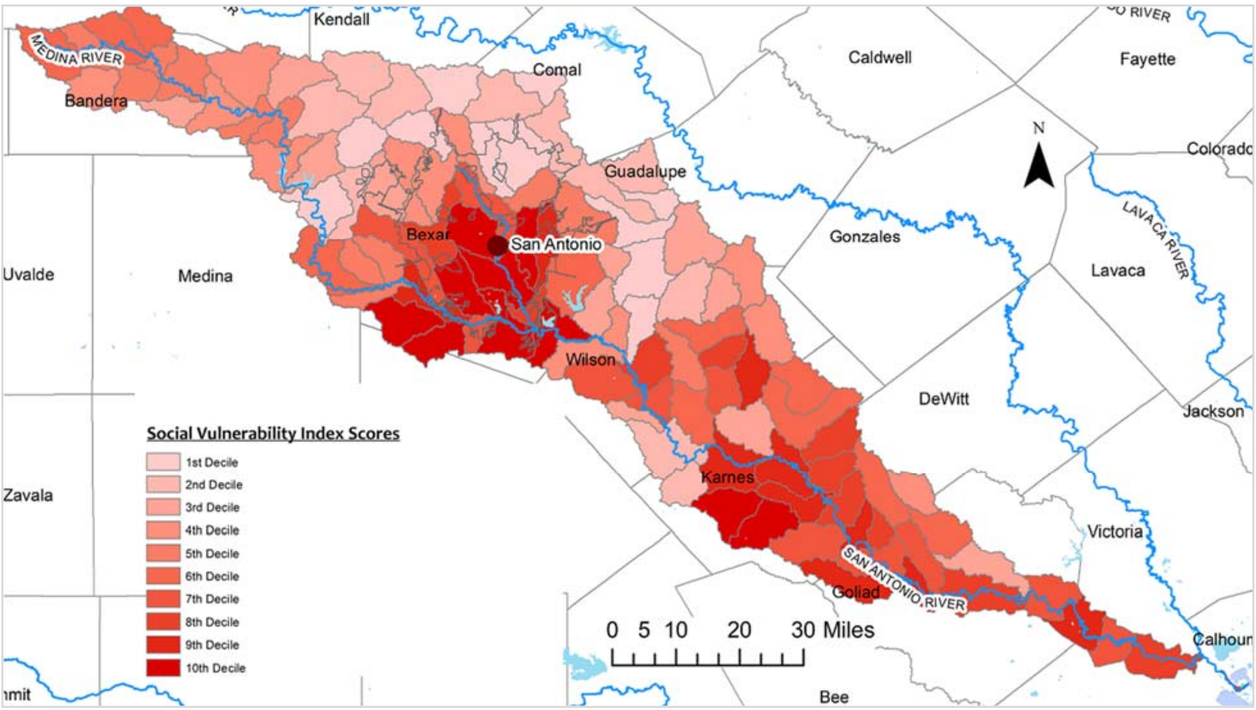

Exhibit 2. The top [10th] decile of vulnerable HUC12 regions in the watershed include the central and southern portion of the city of San Antonio and the HUC12 regions south of the city along the Medina River and directly south of the intersection between the San Antonio and Medina Rivers. Other socially vulnerable regions include the Hondo Creek region of Karnes County and central Goliad County along the San Antonio River, both downstream of the City of San Antonio.

The RPS Tool is a valuable resource for regions with little local data concerning water equity and reuse. In the case of San Antonio, the City has invested in the collection of local data and the development of a visualization tool called the Equity Atlas. The RPS Tool can be used to supplement or broaden this type of local tool, or to compare national datasets with local data. Exhibit 3 compares the Equity Atlas map for low income and minority populations (divided by census tract) and the RPS map that captures broad social vulnerability by HUC12 region. The map trends overlap, and both local and national mapping tools indicate that central and Southern Bexar County are home to some of the most vulnerable populations.

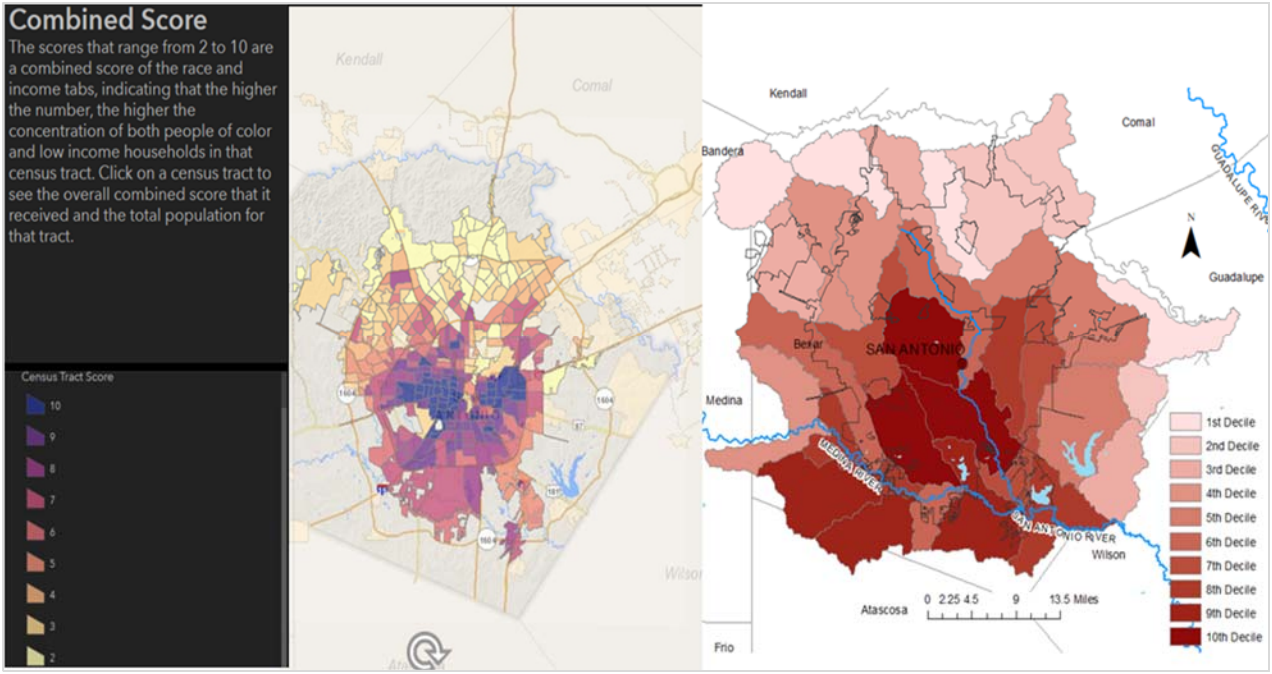

Exhibit 3. The map on the right shows Bexar County social vulnerability based on RPS data: dark maroon regions have the greatest socially vulnerable populations of the 107 HUC12 regions in the basin. Scores are based on the five indicators included in the index (percent low-income, minority, linguistically isolated, less than high school education and vulnerable age). The San Antonio Equity Atlas map on the left displays a combined low income and minority population score. Higher values indicate a larger socially vulnerable population. The granularity of the Equity Atlas map is finer and more clearly illustrates the population divisions within the city boundaries. The RPS map includes more indicators to generate the final score (percent linguistically isolated and percent vulnerable age group in addition to percent low income and percent minority). The RPS map also includes all HUC12 regions with a majority area in Bexar County, rather than only regions within the San Antonio city boundary. The map trends overlap, and both indicate that central and Southern Bexar County are home to some of the most vulnerable populations. See Attachment 2 for more details about individual indicators.

All HUC12 regions with the highest social vulnerability scores fall along or just south of the San Antonio and Medina Rivers. Areas with high social vulnerability (Shown in Exhibit 3) face the greatest potential impacts of inadequate access to green space, water management issues and old infrastructure, and polluted or unhealthy local waterways. Identification of these social vulnerability hotspots can inform future water management plans and strategies to improve underserved community access to clean, safe, and affordable water services.

In addition to social vulnerabilities, water access must take into account water use patterns and water protection areas. San Antonio, the second most populated city in Texas, is home to just over 1.5 million people.[8] The San Antonio water Systems, or SAWS, began a water conservation program in 1982 to

[8] https://www.census.gov/quickfacts/sanantoniocitytexas

incentivize sustainable water management practices. Water use over the past three decades has increased by about 20% compared to the 80% growth in population over the same period.[9]

The San Antonio River and Medina River upstream of the city are directly affected by the higher water demand in the city. The central city region of San Antonio has the highest water demand after combining agricultural, industrial, and domestic water use data (Exhibit 4). In central San Antonio in Bexar County, water demand is primarily domestic and industrial, while regions in central eastern Medina County use water primarily for agricultural purposes.

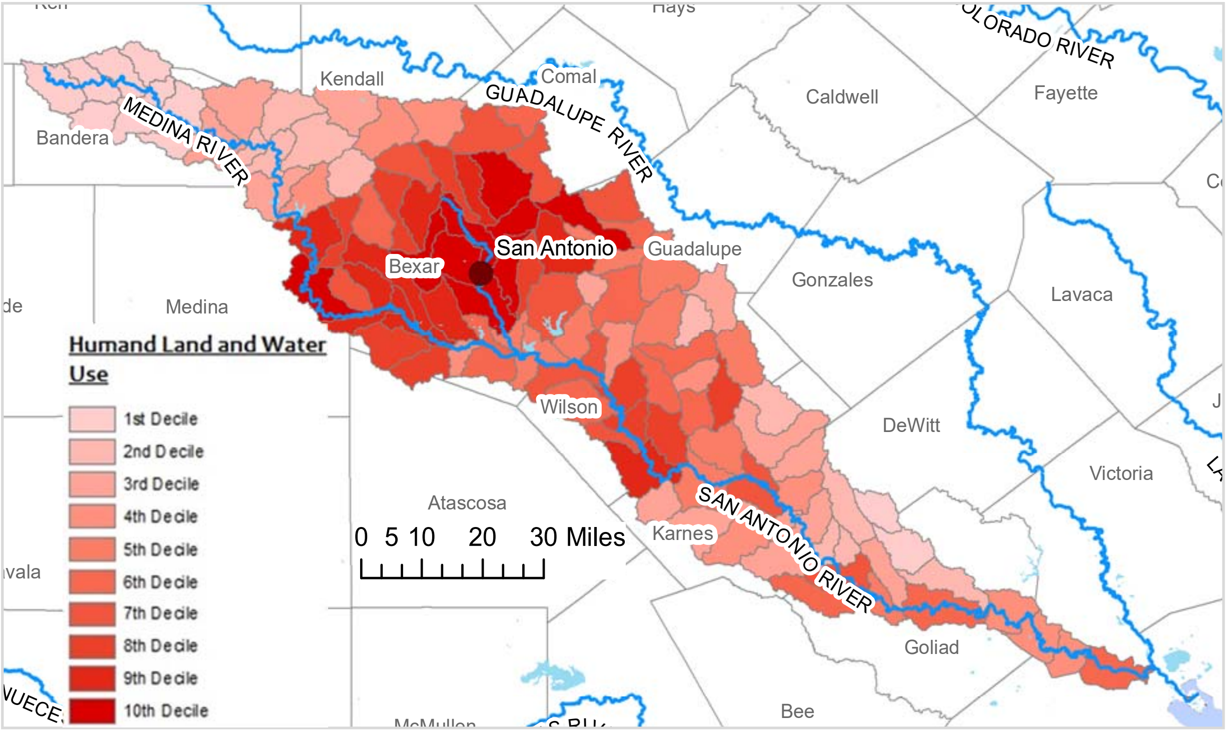

Exhibit 4. Dark red regions indicate the greatest water and land use [10th decile]. Regions of greatest water use were calculated by combining domestic, agricultural, and industrial water demand, and groundwater source protection areas in the watershed. Hotspots include areas of the city of San Antonio and areas of Bexar County along the Medina River. The index includes agricultural, industrial, and domestic water demand.

Exhibit 5 illustrates the top decile crossover between the greatest water demand in the watershed and areas with the lowest groundwater source protection areas. Commercial activity and industrial production grew over the last decade. The city is home to three Air Force bases and one army post. Biomedical and medical industries account for a significant portion of the city's economy.[10] These industries, along with the high population density in the area, accounts for a significant portion of the industrial and domestic water demand in the watershed. Regions south and west of Bexar County have greater agricultural water demand than the rest of the watershed, particularly in the eastern portion of

[9] https://texaslivingwaters.org/water-conservation/how-san-antonio-reduced-its-daily-water-use-by-85-gallons-per-person/

[10] https://www.city-data.com/us-cities/The-South/San-Antonio-Economy.html

Medina County. Exhibit 5 shows the crossover between regions with the highest water demand and those with the fewest source protection areas.

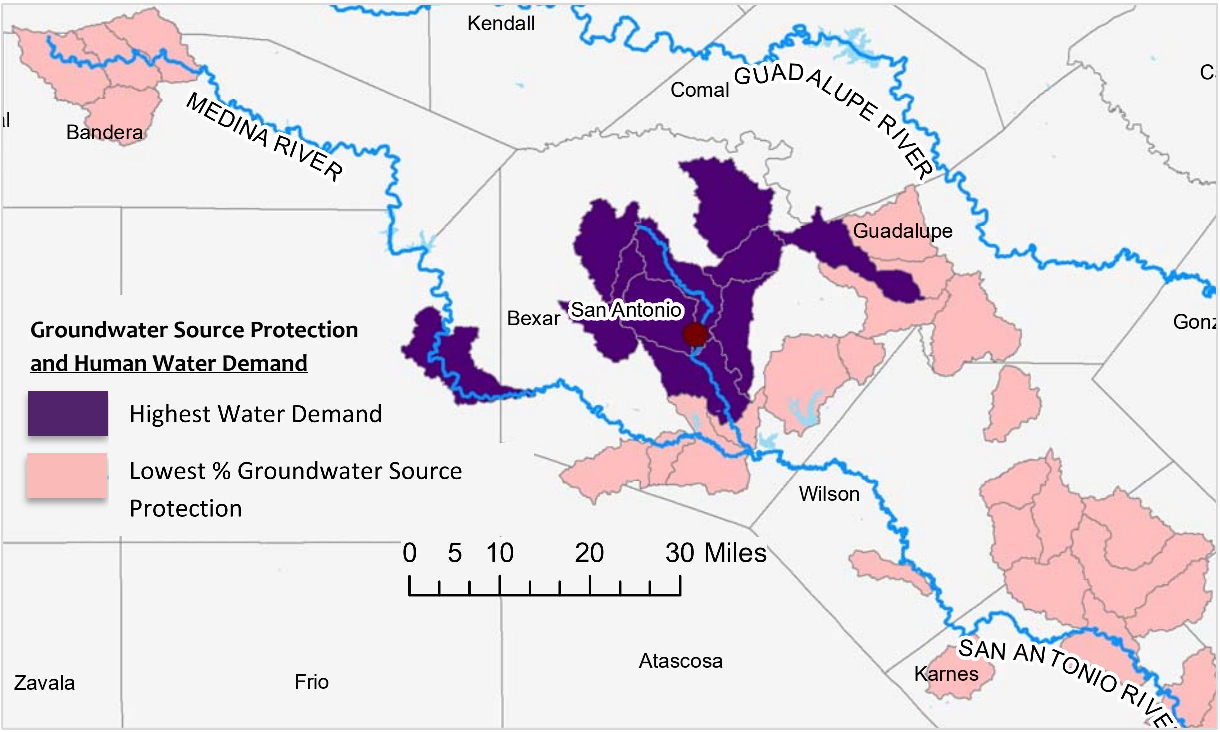

Exhibit 5. The pink HUC12 regions indicate those with the lowest proportion of groundwater source protection areas in the watershed (lowest decile). Purple regions indicate those with the highest domestic, industrial, and agricultural water demand within the watershed.

The red areas illustrate the lowest decile of percent drinking water source protection areas – specifically groundwater. These regions have the smallest percent of source protection areas in the basin. Groundwater is the primary water supply source in the San Antonio River Basin and the main source is the Edwards Aquifer which the City of San Antonio sits on. While it is important to protect regions that have the highest water usage – especially as the majority of the population sits on the region's primary aquifer and demand is projected to grow as population increases – the headwater regions of the Medina River may also be important to protect in the future.

Unprotected regions will also be severely impacted by a reduction in or the mismanagement of water distribution and access. There is no current overlap between HUC12 regions with the lowest source protection areas and highest water demand. However, source protection areas are scarcest southeast of the city of San Antonio along the river, with the exception of the cluster of HUC12 regions at the head of the Medina River. Increases in population density or water demand in these regions will likely impact groundwater distribution needs and water access and increase the need for source protection areas near these communities.[11]

[11] https://www.mysoutex.com/karnes_countywide/news/water-is-there-enough-for-everyone/article_869edb3e-7e22-11e7-8fb5-2ba6cce62ba4.html

Watershed Health

Watershed health captures the watershed's ability to supply sufficient clean water to its population to maintain socioeconomic and general wellbeing. This category includes the overall ecological health of the watershed. Exhibit 6 presents the watershed health vulnerability index scores for each HUC12 region were generated using the RPS Tool by combining three indicators: the % Natural Land Cover (N-Index1) in Watershed (2016); the mean Soil Stability in the Watershed (by HUC12); and the Preliminary Healthy Watershed Analysis (PHWA) Watershed Health Index, State (2016).[12]

The darkest areas in the watershed indicate the lowest overall watershed health indices, or the areas of highest watershed health vulnerability. Areas in central and northern San Antonio and central Wilson County suffer from the lowest watershed health in the San Antonio Basin. Additional areas of low watershed health include the HUC12 regions in the southern region of Karnes County.

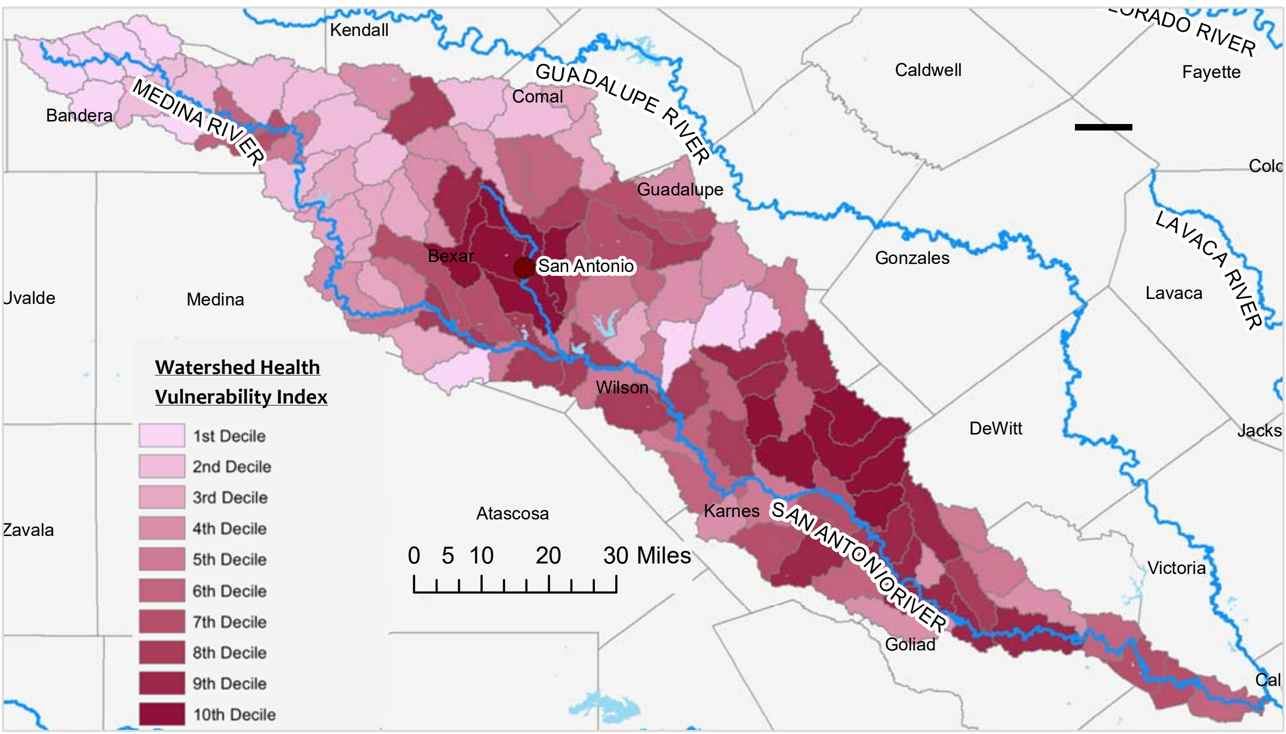

Exhibit 6. The darkest colors in the watershed health vulnerability heatmap indicate the HUC12 regions with the lowest index scores by decile. Watershed vulnerability trends loosely follow the broad social vulnerability hotspots.

Exhibit 7 overlays these poor watershed health areas with the previous analysis of socially vulnerable populations (Exhibit 2), showing that many of the HUC12 regions with the most socially vulnerable populations lie in close proximity to those with the greatest watershed health vulnerability.

[12] The PHWA Health Index is comprised of water quality, landscape condition, habitat, hydrology, geomorphology, and biological condition sub-indices. For more information see the EPA page here.

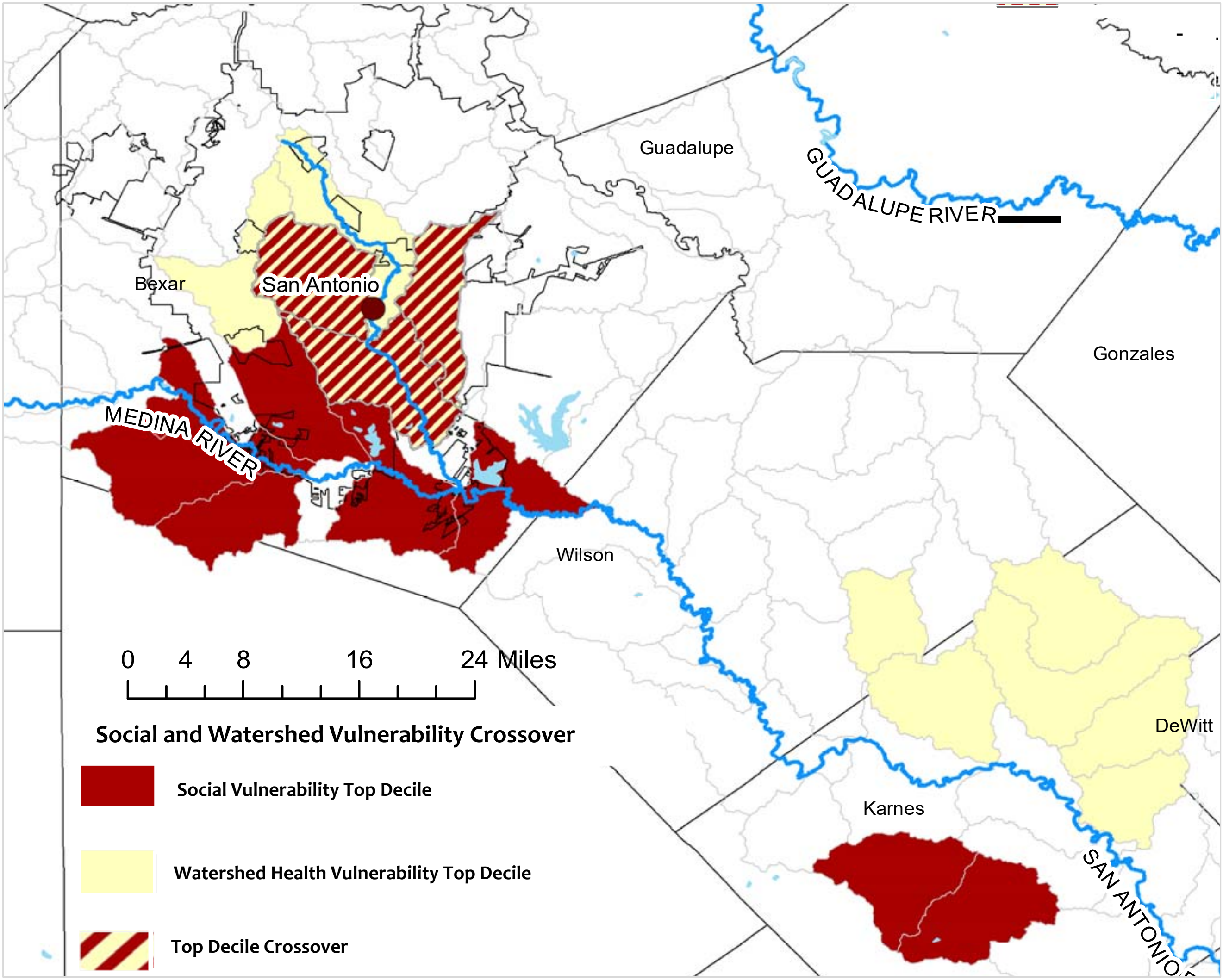

Exhibit 7. High social vulnerability index and watershed health vulnerability index crossover: A cluster of three HUC12 regions in the central San Antonio area fall within the highest decile of social vulnerability and the highest decile of watershed health vulnerability based on the indicators within each index score (see Exhibits 2 and 6).

Water Resilience

Water resilience includes present and projected climate-related vulnerabilities and stabilizing qualities that protect the watershed from extreme conditions and natural disasters. Flood risk is of particular concern to stakeholders in the city of San Antonio, as are other stresses related to changing climate and natural resource management. Exhibit 8 visualizes present water resilience as illustrated by three indicators: % 100-Year Flood Zone in Watershed; PHWA Watershed Vulnerability Index, State; and Wildfire Hazard Potential, Mean in WS (2018).[13] Regions that have the lowest environmental stability in

[13] The PHWA Vulnerability Index is comprised of land use change, water use, and wildfire risk sub-indices. For more information see the Overview Report of the Preliminary Healthy Watersheds Assessment: https://www.epa.gov/sites/default/files/2017-02/documents/170215phwa_overview_report_final_508v2.pdf

the basin (10th decile) include portions of upper San Antonio and southern HUC12 regions along the border of Bexar County and Atascosa County. Additional regions that experience current environmental stress include the HUC12 regions south of the Guadalupe River in western Guadalupe county, and central Bandera County along the Medina River.

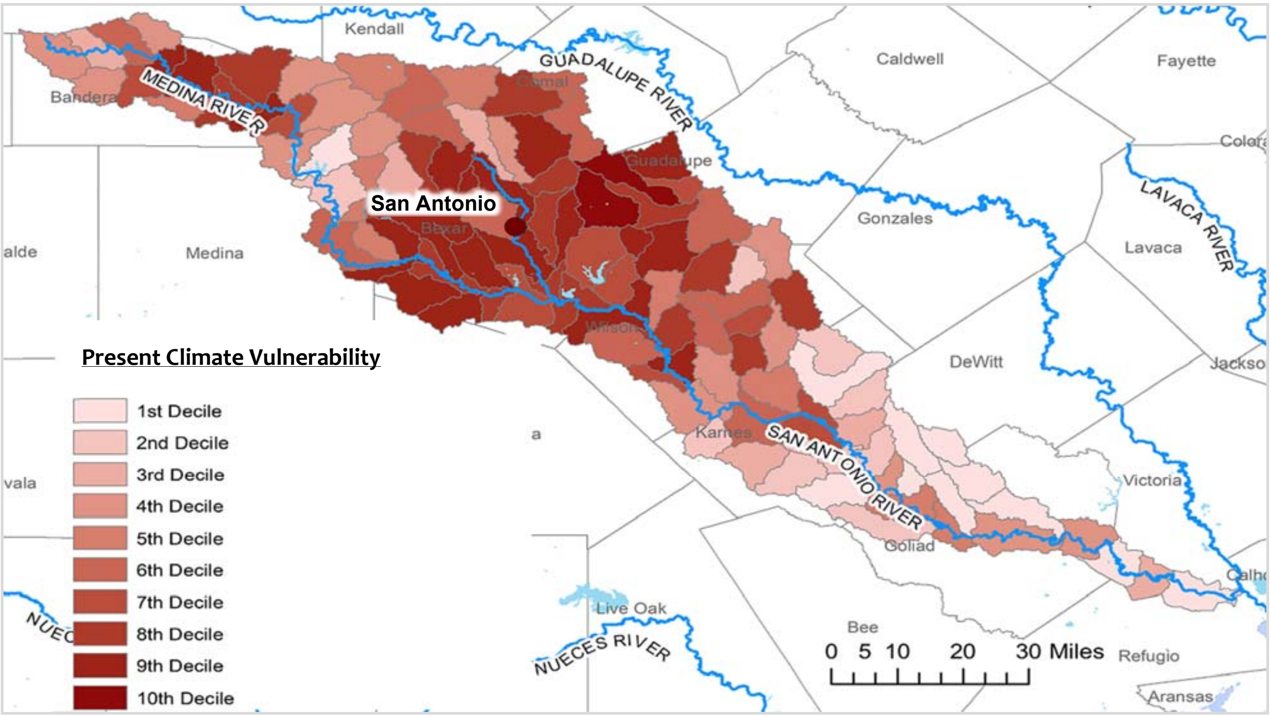

Exhibit 8. Present climate vulnerability index scores include three indicators: %100-year flood zone in watershed, PHWA watershed vulnerability index, and mean wildfire hazard potential in watershed. HUC12 Regions with greatest vulnerability fall in the lowest deciles (dark red).

Projected climate vulnerability will be impacted by many changing factors, including the projected change in annual rainfall, increase in temperature and increase in annual runoff. Exhibit 9 captures the projected increase in these values between 2061 and 2090 based on relative and historical conditions. Areas with the greatest vulnerability are found toward the northern border of the San Antonio River Basin, particularly north of the city of San Antonio. Regions in Bandera county along the Medina river fall within the highest deciles for present climate vulnerability and projected climate vulnerability. Southern Kendall, Comal and Guadalupe counties are also projected to have the greatest climate vulnerability within the region in the second half of the century. For more information about climate vulnerability indicators, see Attachment 2.

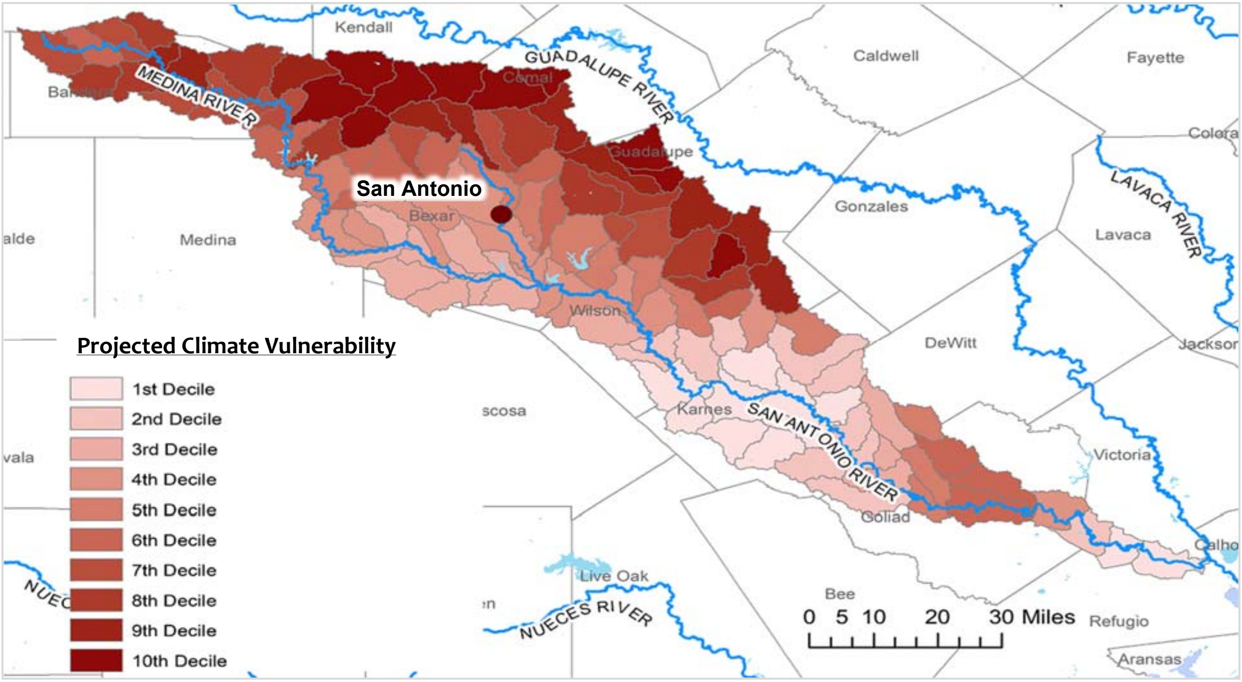

Exhibit 9. Projected Climate Vulnerability. Northern regions of the greater San Antonio watershed face greatest environmental threats when considering projected temperature change, evaporative deficit, and projected annual precipitation change (inverse). Annual precipitation change is projected to be negative (reflecting a decrease in annual precipitation totals) in the 2061-2100 period.

A comparison of water resilience to water access and watershed health reveals that the areas of present climate vulnerability show significant overlap with areas of watershed health and social vulnerability throughout the central portions of the San Antonio Watershed. Projections suggest that the degree of overlap in these vulnerabilities may decrease as the areas of highest climate vulnerability shift to the north in the second half of the 21st century.

The Verde, Salt and Gila River Basins

Although stakeholder conversations for the WRAP project primarily focused on the Upper Verde River Basin, the water equity mapping was designed to visualize the broader basin area comprised of the Verde, Salt and Gila Rivers (see Exhibit 10).

Exhibit 10. Verde River and Surrounding Watersheds. The Verde, Salt and Gila Rivers converge just north of Phoenix, and each is a part of one or more watersheds that comprise the central and southern regions of Arizona. This area includes the Verde River Basin to the North (HUC6 150602) the Salt Basin to the West (HUC6 150601) and the Lower Gila-Agua Fria Basin to the Southeast (HUC6 150701). This entire area includes 634 distinct HUC12 regions.

Water Access

The heatmap in Exhibit 11 includes the three major watershed regions. The darkest colors indicate areas with the highest social vulnerability index scores based on five social indicators: the percent low-income, the percent minority (non-white), percent linguistically isolated, percent with less than a high-school education, and the percent vulnerable age group (below 5 and above 64). Particularly high values for social vulnerability occur north of the Salt River around the Fort Apache-White Mountain Reservation (Exhibit 11). Additional vulnerability hotspots fall within the central and southern boundaries of the city of Phoenix, as well as the western half of Maricopa County along the Gila River. Some additional areas of vulnerability include northwestern Maricopa County and in the upper reaches of the Verde River watershed. Water access is important to consider in remote regions of the state that have higher proportions of native and minority populations and low-income communities, many of whom rely on the land through farming.

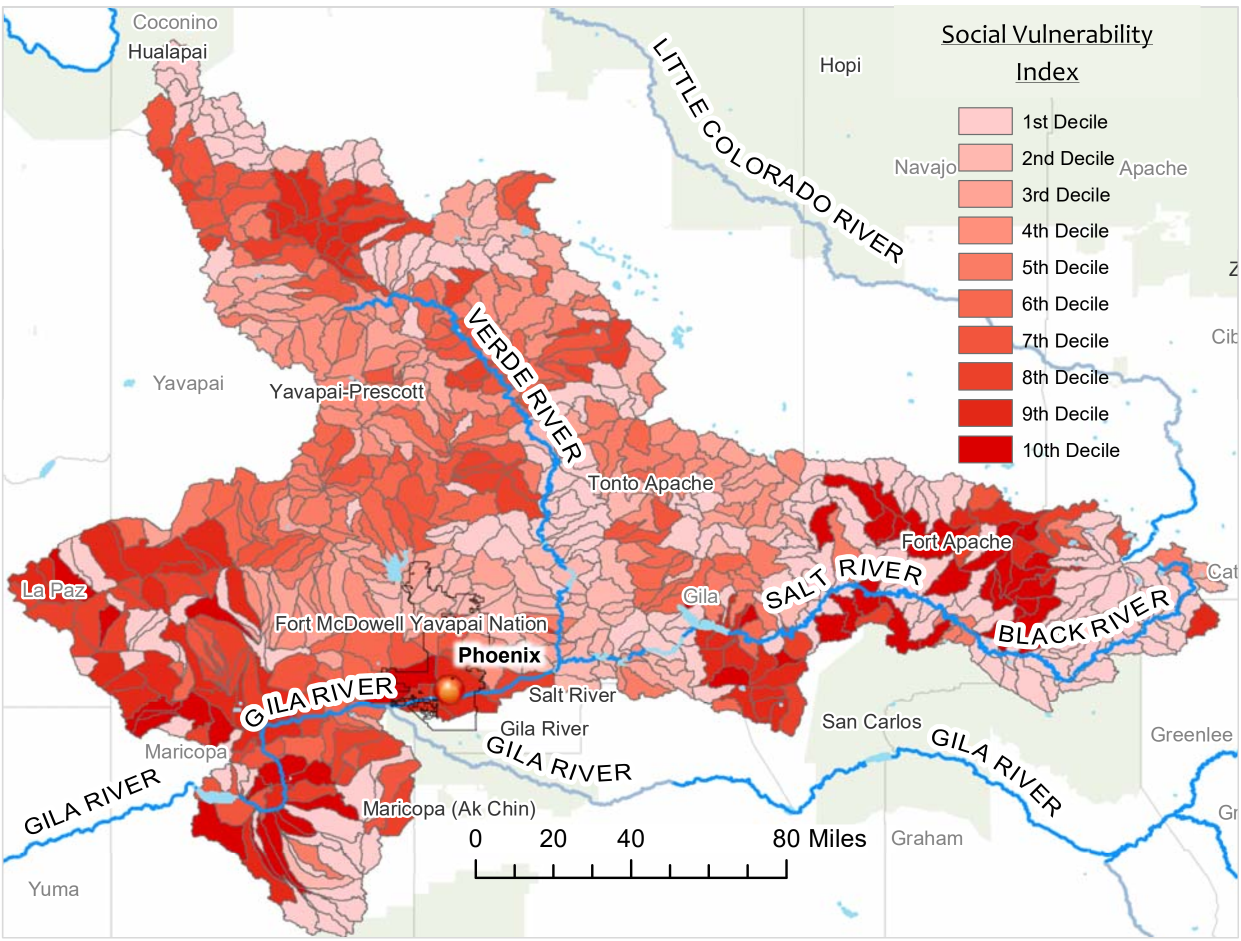

Exhibit 11. This heatmap displays the broad social vulnerability index across the Verde, Salt and Lower Gila watersheds, by decile. These scores integrate data from five indicators: the population identified as low-income, the percent minority (non-white), percent linguistically isolated, percent with less than a high-school education, and the percent vulnerable age group (below 5 and above 64).

Exhibit 12 illustrates human land and water use. The areas with the greatest population and domestic, industrial, and agricultural water use include the central Phoenix area and Peoria just west of the city border. Additional regions along the Gila River feeding into the city, as well as those extending beyond the city to the Southwest have among the highest use of land and water resources. The southwest portion of the Gila River in Maricopa County has particularly high levels of agricultural water demand compared to other HUC12 regions, while areas of highest industrial water demand include central Phoenix and Glendale/Peoria to the west of the city. Because water demand and population are highest in the Phoenix area, regions downstream along the southern Gila River may be affected if the city experiences water shortages. Arizona already has a management plan that controls water access in and around Phoenix, but by broadening understanding of water demand across multiple connected watersheds and subwatersheds, stakeholders and policymakers may better understand the relationships between central city water use and demand in more remote regions of the state.

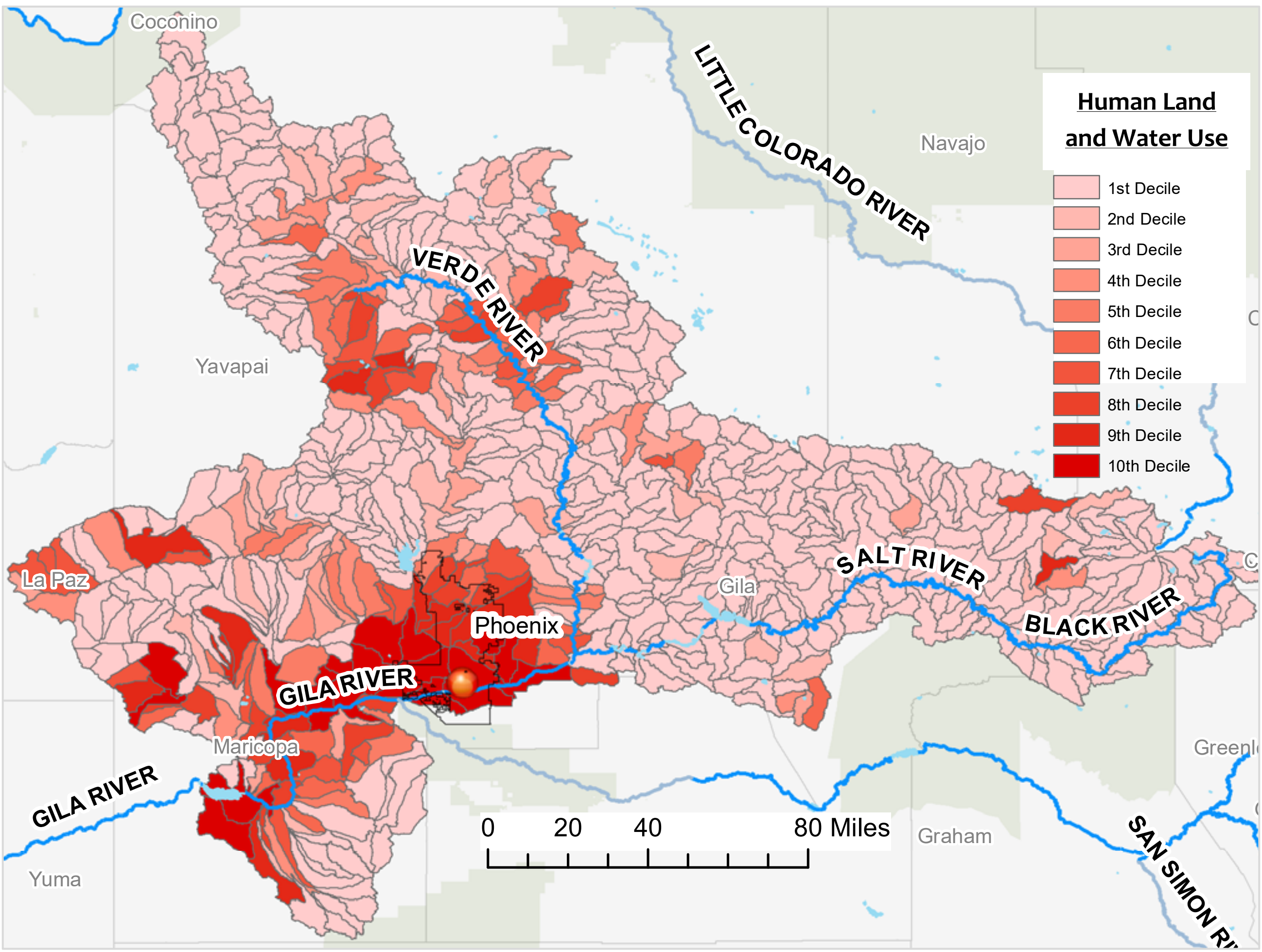

Exhibit 12. Dark red regions indicate the greatest water and land use [10th decile] within the Verde, Salt and Gila River Basins. Regions of greatest water use were calculated by combining domestic, agricultural, and industrial water demand, and groundwater source protection areas in the watershed. Hotspots include areas of central and western Phoenix above and along the Gila River as well as those just south of the Gila River to the east of the city border, and regions surrounding Flagstaff, Prescott, and Sedona near the Upper Verde River.

Watershed Health

Regions with the greatest watershed health vulnerability in the Salt, Gila and Verde River watersheds include the series of HUC12 regions along and north of the Gila River, ranging from Phoenix through central Maricopa County, the Middle Verde subwatershed and parts of the Salt River (see Exhibit 13).

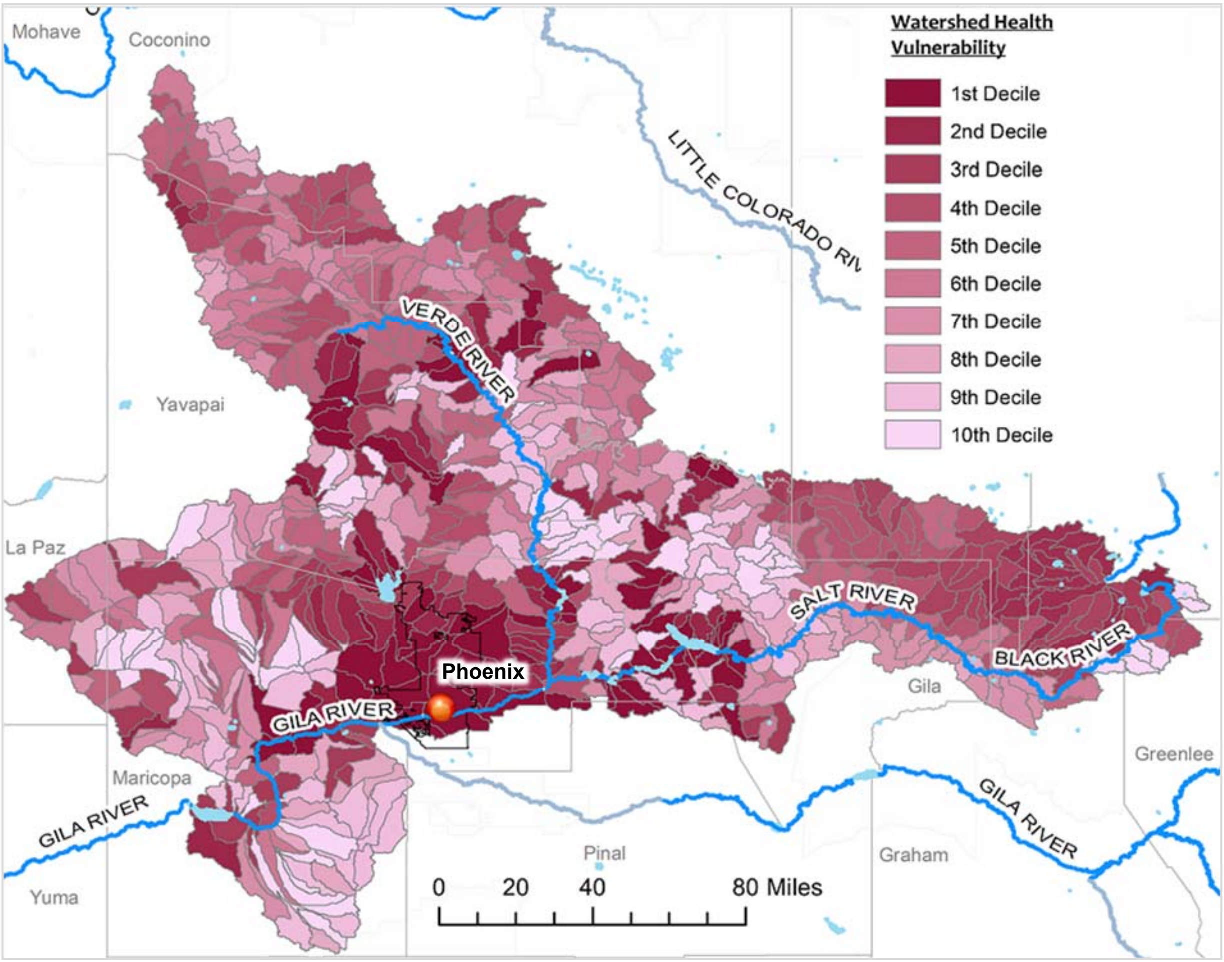

Exhibit 13. This map displays the watershed health vulnerability index, which was generated by combining three environmental indicators: the % natural land cover (N-Index1) in watershed, Soil stability mean in watershed, and Preliminary Healthy Watershed Analysis (PHWA) Watershed Health Index, State. The top decile (darker colors) indicates areas with the highest vulnerability, or the lowest scores for these combined indicators.

Maricopa county is the most populous county in Arizona, with over four million inhabitants, most of whom reside within and surrounding the city borders of Phoenix. In August 2021, 86% of Maricopa County was classified as a severe drought region by the National Oceanic and Atmospheric Administration.[14] Water management practices in the Upper Verde River and along the Salt River ultimately impact the water flowing downstream towards Maricopa County via the Gila River. This water is needed to support the substantial agricultural land use in Maricopa and in Pinal County to the west.

The Central Arizona Project (CAP) supplies water to nearly 80% of the state's population and significantly benefits Pinal County and to a lesser extent the population of Phoenix.[15] This said, regions within and just outside of the northern Phoenix city boundary (through which the CAP canal system runs) fall into the top decile of most vulnerable areas for watershed health based on natural land cover, soil stability and the PHWA Watershed Health Index. Although these regions have access to water via the canal system, the health of these subwatersheds is worthy of consideration in future water management planning. Subwatersheds outside of the Phoenix area with greater watershed vulnerability include those around Cottonwood near the border between Yavapai and Coconino counties extending to the west and East from the upper Verde River. Additional watersheds with high vulnerability include the HUC12 regions surrounding Roosevelt Lake, the largest visible lake along the Salt River in the watershed health.

Exhibit 14 shows the top deciles for both watershed health vulnerability and social vulnerability. The two indices are closely correlated across the map – areas of high social vulnerability along the Gila River south of Phoenix and the Salt River east of the city also have high watershed health vulnerability index scores. The highest areas of social vulnerability fall along and above the Salt River in Navajo, Gila, and Graham counties. Additional regions of high watershed health vulnerability occur in Maricopa County and Western Regions of Navajo county. Areas with the highest watershed health vulnerability scores include the regions along the Upper Verde River subwatershed and areas upstream along the Salt River (e.g., the northern section of Graham County and the southern regions of Navajo County). These areas fall within the San Carlos and White Mountain Apache Tribal lands. It will be of particular importance when developing water reuse action plans to consider tribal communities, especially those that are not served by the CAP system. Policy and management changes in hotspot areas that focus on human equity are likely to support surrounding ecosystem health and vice versa. Additionally, the environmental stresses that occur in portions of the Verde River watershed are likely to adversely impact areas downstream of vulnerable subwatersheds.

[14] Historical Conditions for Maricopa County, Drought.gov

[15] https://www.cap-az.com/water/cap-system/water-operations/system-map/

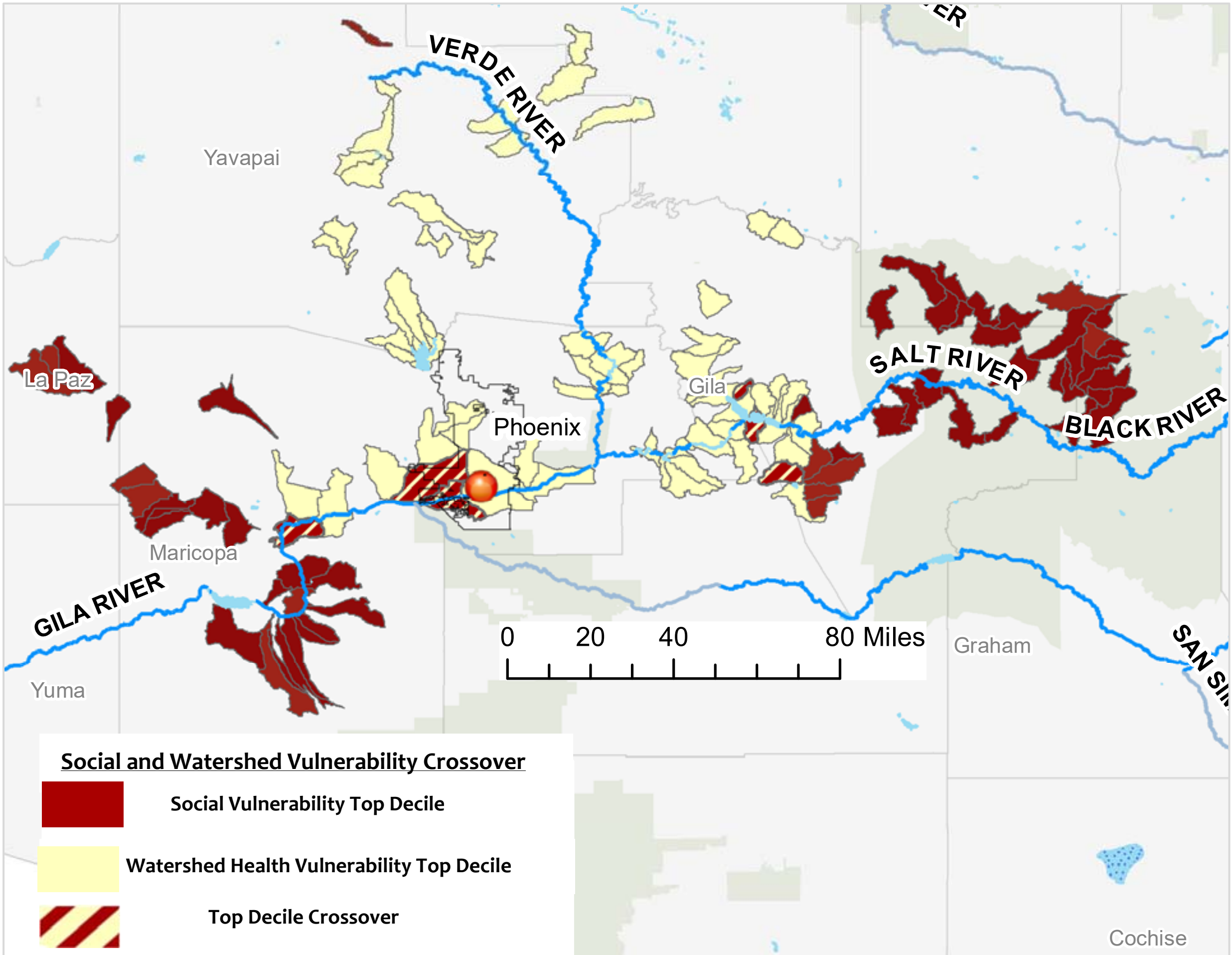

Exhibit 14. Top decile crossover between socially vulnerable HUC12 regions and those with the lowest watershed health illustrated in Exhibit 12. Striped HUC12 regions indicate areas of crossover between the HUC12 regions within the top decile for both indices.

Water Resilience

The RPS contains datasets that, when combined to form a single index, indicate regions facing high environmental stress levels – Present Climate Vulnerability Index. Stressor indicators included in this index are the % 100-year flood zone (high-risk flood zone areas), the wildfire hazard potential, and the PHWA watershed vulnerability index score (which has implications for future degradation of watershed processes and aquatic system health).[16] As shown in Exhibit 15, the eastern border of these watersheds generally experiences the greatest present climate vulnerability, specifically the band of HUC12 regions reaching from the border between Yavapai and Coconino counties down into northern Pinal county and northern Graham county. The high vulnerability HUC12 regions roughly follow the expanse of the

[16] For more information, see the EPA site on the Healthy Watersheds Analysis: https://www.epa.gov/hwp/download-preliminary-healthy-watersheds-assessments

Coconino National Forest, which includes 1.8 million acres of wilderness and recreation areas.[17] Wildfire risk is a significant contributor to the present vulnerability scores of these regions.

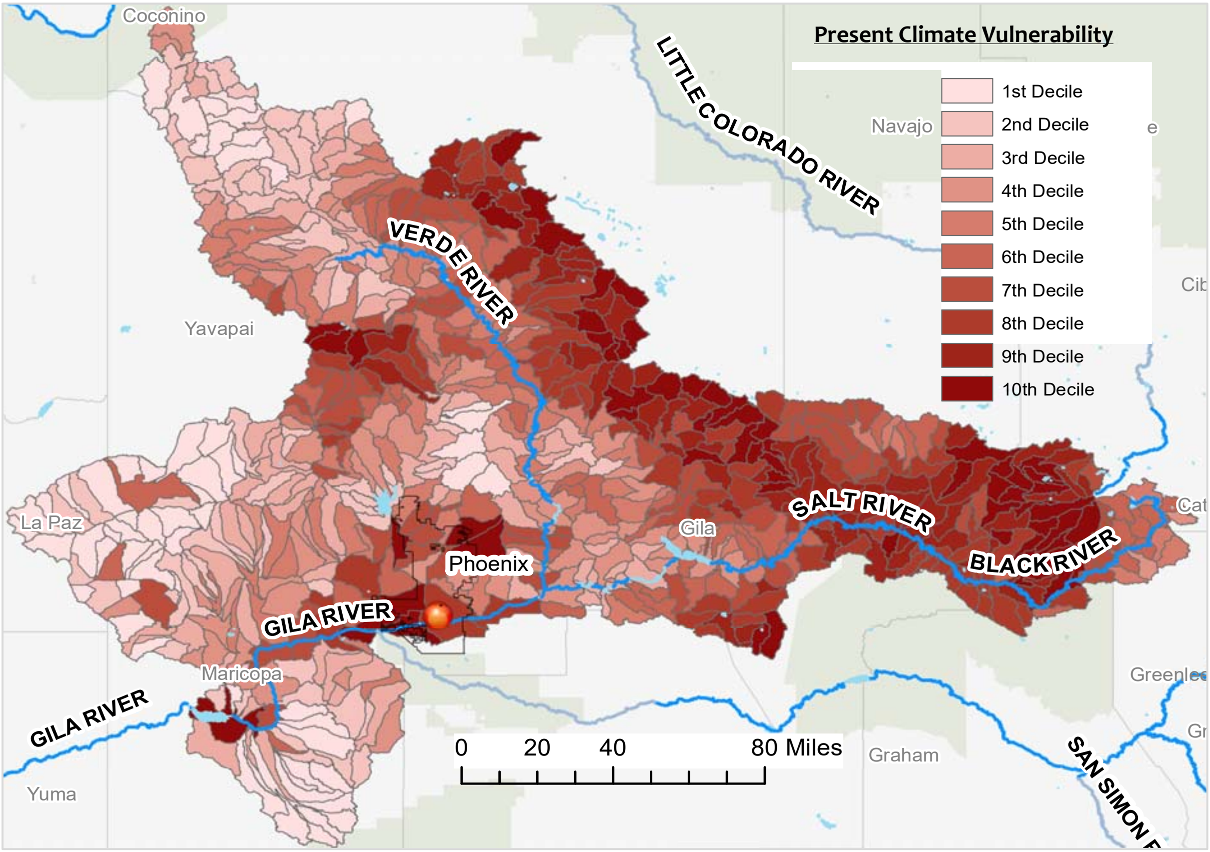

Exhibit 15. Present climate vulnerability based on the combination of three indicators: % 100-year flood zone, PHWA watershed vulnerability index, and wildfire hazard potential, Mean in watershed. Dark colors indicate areas of greatest vulnerability.

Exhibit 16 presents projected vulnerability index scores that were generated by integrating the following stressor indicators into a single index score: the projected change in annual temperature, the % projected change in annual precipitation (inverse), and the % projected change in annual evaporative deficit. The change in annual precipitation reflects average model projections from 2061-2090 relative to historical 1971-2000 conditions.[18] These indicators can be used to identify regions that are particularly sensitive to climate change and will likely be impacted the most in the coming century. The western border of the watersheds included in this analysis demonstrate the greatest vulnerability or lowest projected resilience. Given that the western portion of the watershed is presently vulnerable (as shown in Exhibit 15), immediate action to develop or strengthen long-term water reuse action plans will be of particular importance. Additionally, because vulnerable populations such as tribes own a significant portion of the land along the western Salt and Black Rivers, it will be important for the federal

[17] https://www.fs.usda.gov/coconino

[18] See the EPA RPS Mapping tool for indicator explanations and sources.

government to prioritize action in these regions to increase land and watershed resiliency in the face of climate change.

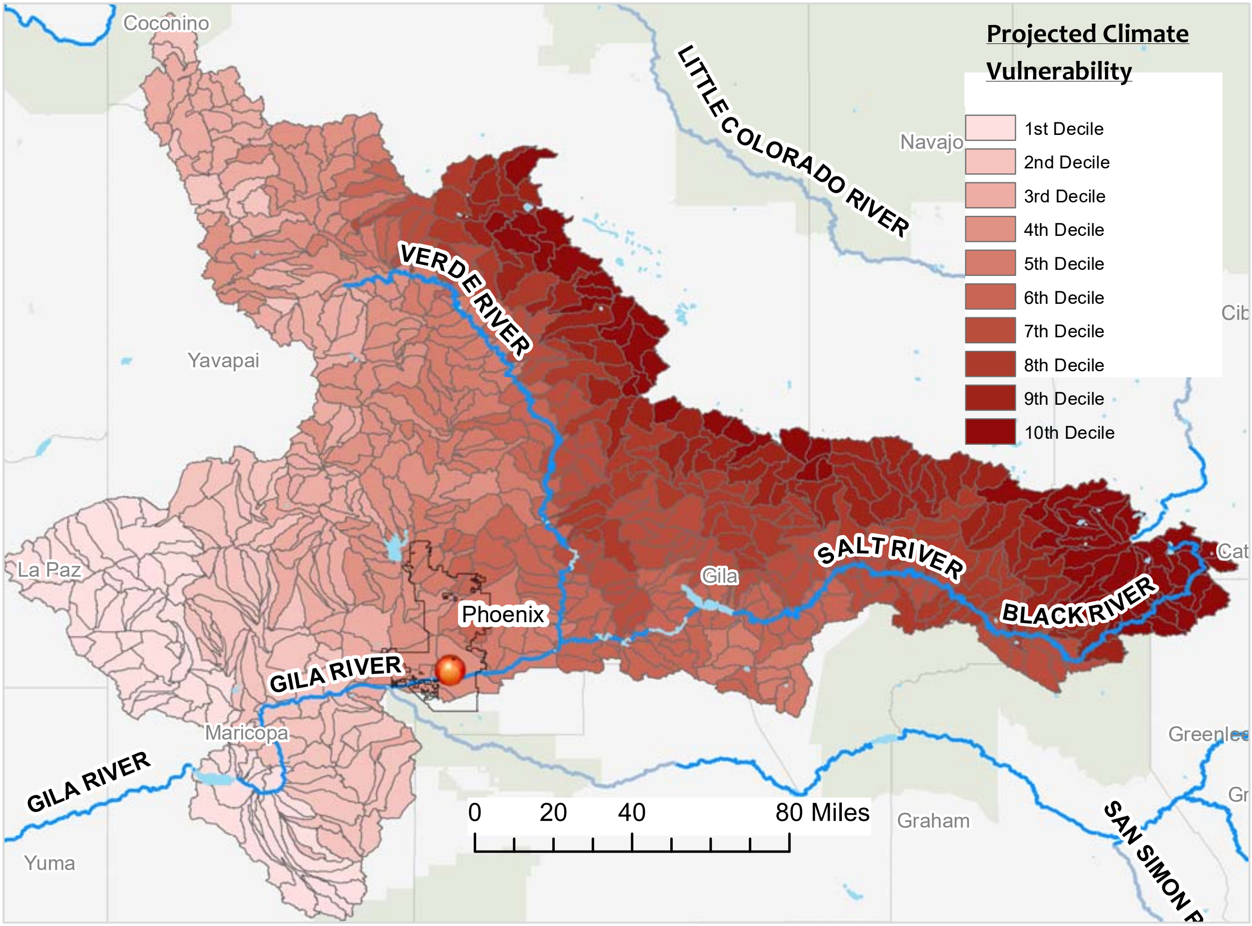

Exhibit 16. Projected climate vulnerability (2061 -2100). Darker maroon regions indicate greater vulnerability based on three indicators: projected change in annual temperature, the % projected change in annual precipitation (Inverse), and the % projected change in annual evaporative deficit.

Water Equity Mapping using the RPS Tool: Lessons Learned

The RPS Tool is extremely valuable as a public repository of data for over 200 social, environmental and stressor indicators. Given this, it has great potential to supplement IWRM and efforts such as this project, as it can help to jumpstart the visualization process to improve the understanding of social and environmental dynamics that impact water equity within and across watersheds. The tool is also accessible to the public and downloadable directly from the EPA RPS website.[19] Lessons learned through this project about using the RPS Tool to visualize water equity at the watershed level are outlined below.

- **RPS is a comparative tool, meaning that index scores are based on the raw data for the specific watershed region chosen by the user**. The index scores provide valuable insights into water equity within the selected region.
- **The tool's visualization display capabilities are limited in producing clear visualizations of a given watershed.** The tool has a user-friendly map function that is useful for quickly visualizing indicators. These maps are low resolution and cannot be used for water equity visualization. Fortunately, RPS data and results can be readily integrated into ArcGIS to produce higher-resolution maps that can be used effectively to convey water equity at the watershed and subwatershed levels.
- **Combining too many indicators to generate an index can lead to a significant amount of "noise."** The RPS Tool allows users to incorporate as many social, stressor and environmental indicators as they choose. However, selecting too many indicators may obscure the relative contribution of any indicator(s) to each HUC12 index score.
- **Data stored in RPS may not be as recent or as granular as the most recent data collected locally.** Much of the data in RPS is from 2016 to 2019, while some indicators use even older data. Local agencies or communities may have more recent data that will better represent their communities and watershed as a whole.[20]
- **Using the techniques developed through the course of this project, the RPS Tool could be applied at any of the other UWFP locations.** The data in RPS is easily exportable and can be used with other software tools such as GIS to create visuals that could range in geographic scale from the full state to a handful of HUC12 regions. The modular nature of the RPS Tool allows the user to easily select the region of interest and to identify data-driven hotspots within it. The tool, updated in August of 2021 to include a number of EJ social indicators, provides data from national data sources. For regions with little local data, RPS may serve as a first step toward identifying disadvantaged areas and areas that would benefit most from IWRM.

[19] Find state specific RPS Tools at: https://www.epa.gov/rps/downloadable-rps-tools-comparing-watersheds

[20] The RPS Tool is regularly updated, with another update and release anticipated for 2022.

Attachment 1. Visualizations Generated Using the EPA RPS Tool

The RPS Tool is extremely valuable as a repository of data for over 200 indicators in three major categories – social, environmental and stressor. The RPS Tool also includes 31 base indicators. These include reference metrics such as the HUC 6, HUC 8 and HUC 12 regional watershed boundaries, watershed size, and other geographical information. For more information about the three major categories of indicators and associated sub-categories, see the EPA RPS Indicator Overview website.[21]

The RPS Tool can be customized to evaluate an area as large as an entire state or as small as a handful of HUCs at the 12-digit level, or HUC 12. Once HUC 12 regions of interest are selected, the tool uses the data for each of these HUC12 regions to calculate index and RPI scores, both of which are generated using comparative formulas that identify the most highly influenced HUC12 regions based on the social, environmental and stressor indicators of interest. The tool is unique because it applies a watershed-based approached to evaluating multiple data elements at the level of HUCs, which allows the user to better understand the relationships among these data in these hydrologic regions. The tool allows users to apply custom weighting for indicators when generating the index, which is valuable if the user wishes to emphasize the impacts of certain indicators in a particular RPS data visualization.

Calculations

Index Scores: The RPS Tool categorizes all data as either base, ecological, stressor, or social indicators. To effectively combine and compare indicators from multiple datasets that may be in different units of measurement, the RPS Tool normalizes the data within a range of 0 to 1, then transforms the data into an index with values ranging from 0 to 100. If combining multiple indicators into the index value (e.g., % Wetlands Remaining in the watershed and % Forest Remaining in the watershed), the user is able to assign weights to each indicator, if desired. The tool generates index scores by calculating the relative value of each score within the subset of HUC12 regions selected for the analysis. The Index score calculations are generated using the formula below:

$$IndNorm = \frac{\dfrac{Weight * (Ind_1 - Ind_1Min)}{(Ind_1Max - Ind_1Min)} + \dfrac{Weight * (Ind_2 - Ind_2Min)}{(Ind_2Max - Ind_2Min)}}{Ind_x}$$

Where *IndNorm* is the normalized index score for one of the categories (either ecological, stressor, or environmental, depending on the indicators used), Ind_1Max is the maximum value within the HUC 12 regions selected for indicator 1's dataset, Ind_1Min is the minimum value in the set for indicator 1. Ind_x represents the total number of indicators (e.g., two in the example above). The social, stressor, and environmental indices are calculated in the same way.

[21] https://www.epa.gov/rps/overview-selecting-and-using-recovery-potential-indicators

Recovery Potential Index Score: The Recovery Potential Index (RPI) score is calculated from the ecological, stressor and social index scores. In this way, the tool is able to generate a value for each HUC12 region based on indicators from multiple categories. The rank ordered RPS score is designed to support the user in identifying areas with the greatest "recovery potential," or areas that have the lowest stressor index scores and highest social and ecological index scores. Each RPS score is calculated from the following formula:

$$RPI\ \text{Score} = \frac{[Ecological\ Index + Social\ Index + (100 - Stressor\ Index)]}{3}$$

Recovery Potential Index scores are relative in that the watersheds' scoring range and distribution is *based only on the gradient of scores for the watersheds screened*. The tool does not account for or incorporate any cutoff values (e.g., healthy or unhealthy, impaired or unimpaired), as such thresholds are highly case-specific.[22]

For each of the categories identified in this report, we generated a normalized index that groups the selected indicators into relevant categories (see the list on page 3 of this report). These values, which range from 1 – 100, were then extracted, analyzed, and mapped using ArcGIS. Due to recent RPS Tool updates and the goals of this project, we did not generate maps displaying the RPI scores of our two major watershed regions. This choice was made to avoid directionality issues with the selected indicators. For certain environmental and social indicators, high scores represent positive watershed qualities, while for others high scores represent negative watershed qualities. We chose to illustrate the watershed using indexes to avoid conflating index scores or combining contrasting data into one score.

[22] For more information about calculations, see the RPS User Guide: https://www.epa.gov/sites/default/files/2020-08/documents/181001_rpstool_userguide508.pdf

Attachment 2. Indicator Summary and Source Information

The following table summarizes the data included in each of the indicators referenced in this report and their sources. Indicators that comprise the population vulnerability and toxics load index categories are social indicators, indicators in the watershed health category are ecological indicators, and indicators within present and projected climate vulnerability and land and water use are categorized as stressor indicators.

POPULATION VULNERABILITY	
% Low-Income Population in WS	Percent of total population in the HUC12 living in a household with low-income. Low-income is defined as a household income that is less than or equal to twice the federal poverty level. Source data was a map layer of low-income population count by census block group from the US Census Bureau American Community Survey 2013-2017 Five-Year Summary, prepared by EPA for the EJSCREEN mapping tool (2018 update; https://www.epa.gov/ejscreen). Low-income populations were assumed to follow the same pattern of distribution as the total population within a census block group. Calculated for each HUC12 as: Population in Low-Income Households in HUC12 / Total Population in HUC12 * 100.
% Minority Population in WS	Percent of total population in the HUC12 that is in a minority group. Minority groups include individuals who define their race as other than white alone and/or list their ethnicity as Hispanic or Latino. That is, all people other than non-Hispanic white-alone individuals. Source data was a map layer of minority population count by census block group from the US Census Bureau American Community Survey 2013-2017 Five-Year Summary, prepared by EPA for the EJSCREEN mapping tool (2018 update; https://www.epa.gov/ejscreen). Census block groups are the smallest geographic units used by the US Census Bureau to report demographic data. Minority populations were assumed to follow the same pattern of distribution as the total population within a census block group. Calculated for each HUC12 as: Minority Population in HUC12 / Total Population in HUC12 * 100.
% < High School Educated Population in WS	Percent of the age 25 and over population in the HUC12 with less than a high school degree. Source data was a map layer of population counts with less than high school education by census block group from the US Census Bureau American Community Survey 2013-2017 Five-Year Summary, prepared by EPA for the EJSCREEN mapping tool (2018 update; https://www.epa.gov/ejscreen). Populations with less than high school education were assumed to follow the same pattern of distribution as the total population within a census block group. Calculated for each HUC12 as: Population with Less Than High School Education in HUC12 / Age 25 and Over Population in HUC12 * 100.
% Linguistically Isolated Population in WS	Percent of households in the HUC12 that are linguistically isolated. Households in which all members age 14 years and over speak a non-English language and also speak English less than 'very well' are considered linguistically isolated. Source data was a map layer of linguistically isolated household counts by census block group from the US Census Bureau American Community Survey 2013-2017 Five-Year Summary, prepared by EPA for the EJSCREEN mapping tool (2018 update; https://www.epa.gov/ejscreen). Populations living in linguistically isolated households were assumed to follow the same pattern of distribution as the total population within a census block group. Calculated for each HUC12 as: Linguistically Isolated Household Count in HUC12 / Total Household Count in HUC12 * 100.

POPULATION VULNERABILITY	
% Vulnerable Age Group Population in WS	Percent of total population in the HUC12 that is under age 5 or over 64 years old. Source data were map layers of under age 5 and over age 64 population counts by census block group from the US Census Bureau American Community Survey 2013-2017 Five-Year Summary, prepared by EPA for the EJSCREEN mapping tool (2018 update; https://www.epa.gov/ejscreen). Vulnerable age group populations were assumed to follow the same pattern of distribution as the total population within a census block group. Calculated for each HUC12 as: (Population Under Age 5 in HUC12 + Population Over Age 64 in HUC12) / Total Population in HUC12 * 100.
TOXICS LOAD	
Risk Management Plan Sites, Count in WS	Number of sites in the HUC12 that are in the EPA Toxics Release Inventory (TRI) database. The TRI stores information on certain facilities that handle toxic chemicals in amounts above established levels, including on-site or off-site land, air, or water disposal, recycling, energy recovery, or treatment. There are 770 individually listed chemicals and 33 chemical categories covered by the TRI Program. Source data was a map layer of TRI facilities in the EPA Facility Registry Service (FRS): Facility Interests Dataset (December 2020 version; https://www.epa.gov/frs/geospatial-data-download-service).
Hazardous Waste Management Sites, Count in WS	Count of Hazardous Waste Treatment, Storage, or Disposal (TSD) facilities in the HUC12. TSD facilities are regulated under the Resource Conservation and Recovery Act (RCRA) and either hold hazardous waste (storage) or change the physical, chemical, or biological characteristics of waste to minimize its environmental threat (treatment and disposal). Source data was the US EPA Facility Registry Service (FRS; December 2020 version: https://www.epa.gov/frs/geospatial-data-download-service. Calculated using latitude and longitude coordinates in the FRS as the count of TSD facilities located in the HUC12. Facilities with missing coordinates in the FRS are not included in HUC12 counts.
Toxic Release and Exposure Potential in WS	The relative potential for toxic chemical release and human exposure in the HUC12. Higher values correspond to greater potential relative to other HUC12s for toxic release and exposure due to a combination of: the magnitude of chemical releases, the size of exposed populations, and the estimated dose of chemicals at points of human exposure. Quantified from 2015 to 2019 Risk-Screening Environmental Indicators (RSEI) Scores calculated by EPA for facilities that release toxic chemicals through air emissions or wastewater discharge. RSEI scores for all facilities nationwide were downloaded from the EasyRSEI database dashboard in December 2020; https://edap.epa.gov/public/extensions/EasyRSEI/EasyRSEI.html). RSEI scores were assigned to HUC12s using mapped locations of Toxics Release Inventory (TRI) facilities in the EPA Facility Registry Service (FRS): Facility Interests Dataset (December 2020 version; https://www.epa.gov/frs/geospatial-data-download-service). Calculated as the sum of 2015-2019 RSEI Scores for TRI facilities in each HUC12.
WATERSHED HEALTH	
% N-Index1 in WS (2016)	Percent of the HUC12 classified as natural land cover (including barren land) by the 2016 CDL-NLCD Hybrid Land Cover dataset. Natural land cover classes in the N-Index1 include barren, forest, wetlands, shrubland, and grassland; codes 131, 141 through 143, 152, 171, 190, and 195 in the 2016 CDL-NLCD Hybrid Land Cover dataset. Equation used: N-Index1 Area / HUC12 Area * 100. See also 2016 CDL-NLCD Hybrid Land Cover glossary definition.
Soil Stability, Mean in WS	Mean soil stability in the HUC12. Soil stability is the inverse of soil erodibility. Source data was a 100-meter resolution grid of soil map units and attributes in the Natural Resources Conservation Service (NRCS) Soil Survey Geographic (STATSGO2) database, acquired from the US Geological Survey in July 2013. Mean soil erodibility was calculated as the average of erodibility grid values per HUC12. Mean soil stability was calculated as 1 - Mean soil erodibility.
PHWA Watershed Health Index, State	The statewide Watershed Health Index score for the HUC12 from the 2021 EPA Preliminary Healthy Watersheds Assessment (PHWA). The Watershed Health Index is an integrated measure of watershed condition that combines Landscape Condition, Hydrologic, Geomorphology, Habitat, Water Quality, and Biological Condition Sub-Index scores. Higher scores correspond to greater potential for a watershed to have the structure and function in

POPULATION VULNERABILITY	
	place to support healthy aquatic ecosystems. Source data were statewide Watershed Health Index scores for HUC12s developed as part of the 2021 EPA Preliminary Healthy Watersheds Assessment (August 8, 2021 version). NOTE: PHWA scores/percentiles are not suitable for comparing HUC12s that occur in different states to one another. Scoring of a given HUC12 reflects its condition relative to all other HUC12s within the same state only. See also PHWA glossary definition.
% N-Index1 Change in WS (2001-16)	The change in the percentage of the HUC12 with natural cover (including barren land) from 2001 to 2016. Calculated from the National Land Cover Database 2016 (NLCD 2016) 2001 and 2016 Land Cover Datasets (January 2019 version). Natural cover classes included in the N-Index1 are 'Barren Land (Rock/Sand/Clay)', 'Deciduous Forest', 'Evergreen Forest', 'Mixed Forest', 'Shrub/Scrub', 'Grassland/Herbaceous', 'Woody Wetlands', and 'Herbaceous Wetlands' cover classes; codes 31, 41, 42, 43, 52, 71, 90, and 95 in the 2001 and 2016 Land Cover datasets. Positive values denote an increase in N-Index1; negative values denote a decrease in N-Index1. Equation used: (Area Changing to N-Index1 – Area Changing From N-Index1)/(HUC12 Area) * 100.
PRESENT CLIMATE VULNERABILITY	
Wildfire Hazard Potential, Mean in WS (2018)	The mean wildfire hazard potential in the HUC12. Wildfire hazard potential ranges from 1 (very low risk of wildfire) to 5 (very high risk of wildfire) and depict the relative potential for the occurrence of wildfire that would be difficult for suppression resources to contain. Calculated from the 2018 USDA Forest Service Wildfire Hazard Potential geospatial grid dataset. Calculated as the average of wildfire hazard potential for grid pixels in the HUC12. Areas not assigned a Wildfire Hazard Potential value (non-burnable lands and water) were excluded from the mean calculation.
% 100-Year Flood Zone in WS	Percent of the HUC12 that is in the 100-year flood zone. The term 100-year flood is used to describe a flood magnitude that has a 1% chance of occurring in a given year. The 100-year flood zone is the area that is at-risk for flooding during a 100-year flood and is used for flood risk mapping under the National Flood Insurance Program. Source data were 100-year flood zone map layers maintained in the FEMA Flood Insurance Rate Maps National Flood Hazard Layer (acquired February 2021; https://www.fema.gov/flood-maps/national-flood-hazard-layer). For HUC12 analysis, portions of the 100-year flood zone were removed if they overlapped surface waters such as rivers and lakes or wetlands.
PHWA Watershed Vulnerability Index, State	The statewide Watershed Vulnerability Index score for the HUC12 from the 2021 EPA Preliminary Healthy Watersheds Assessment (PHWA). The Watershed Vulnerability Index characterizes the vulnerability of aquatic ecosystems in a watershed to future alteration based on Land Use Change, Water Use Change, and Wildfire Vulnerability Sub-Index scores. Higher scores correspond to greater potential vulnerability of aquatic ecosystems to future degradation. Source data were statewide Watershed Vulnerability Index scores for HUC12s developed as part of the 2021 EPA Preliminary Healthy Watersheds Assessment (August 8, 2021 version). NOTE: PHWA scores/percentiles are not suitable for comparing HUC12s that occur in different states to one another. Scoring of a given HUC12 reflects its condition relative to all other HUC12s within the same state only. See also PHWA glossary definition.
PROJECTED CLIMATE VULNERABILITY	
% Projected Change in Annual Precipitation, inverse	Projected percent change in annual precipitation in the HUC12. Positive values indicate a projected increase in average annual precipitation during 2061-2090 relative to historical 1971-2000 conditions; negative values indicate a projected decrease. Annual precipitation during the future and historical periods is calculated from results of 30 climate models summarized by the USGS National Climate Change Viewer program (https://www2.usgs.gov/landresources/lcs/nccv.asp). Projected future conditions reflect a high greenhouse gas emission scenario, with continued increases in emissions through 2100 (the Representative Concentration Pathway 8.5 emission scenario). Calculated for each HUC12 as: (Projected Future Annual Precipitation - Historical Annual Precipitation) / Historical Annual Precipitation x 100. See also the Climate Projection Data glossary definition.

POPULATION VULNERABILITY	
Projected Change in Annual Temperature	Projected change in annual temperature in the HUC12 (degrees Celsius). Annual temperature is the average of daily highs across a calendar year. Positive values indicate a projected increase in average annual temperature during 2061-2090 relative to historical 1971-2000 conditions; negative values indicate a projected decrease. Average annual temperature during the future and historical periods is calculated from results of 30 climate models summarized by the USGS National Climate Change Viewer program (https://www2.usgs.gov/landresources/lcs/nccv.asp). Projected future conditions reflect a high greenhouse gas emission scenario, with continued increases in emissions through 2100 (the Representative Concentration Pathway 8.5 emission scenario). Calculated for each HUC12 as: (Projected Future Annual Temperature - Historical Annual Temperature. See also the Climate Projection Data glossary definition.
% Projected Change in Annual Evaporative Deficit	Projected percent change in annual evaporative deficit in the HUC12. Evaporative deficit is a measure of atmospheric water shortage and is defined as the difference between potential evapotranspiration and actual evapotranspiration. Positive values indicate a projected increase in average annual evaporative deficit during 2061-2090 (i.e., drier conditions) relative to historical 1971-2000 conditions. Annual evaporative deficit during the future and historical periods is calculated from water balance models that simulate the hydrologic response to 30 climate models. The water balance model simulates the combined effects of precipitation and temperature changes independent of land use and vegetation cover. Analysis of climate model results and water balance modeling was completed by the USGS National Climate Change Viewer program (https://www2.usgs.gov/landresources/lcs/nccv.asp). Projected future conditions reflect a high greenhouse gas emission scenario, with continued increases in emissions through 2100.[23]
HUMAN LAND AND WATER USE	
Population Density in WS	Human population density in the land area of the HUC12 (persons per square kilometer). Source data used was the EPA EnviroAtlas 'Dasymetric Population for the Conterminous United States' raster (February 2015 version: https://enviroatlas.epa.gov/enviroatlas/DataFactSheets/pdf/Supplemental/DasymetricAllocationofPopulation.pdf). The dasymetric population raster is derived from 2010 US Census Bureau census block populations using a geospatial technique called dasymetric mapping. Dasymetric mapping uses information on land cover and slope to distribute populations to grid pixels within each census block.
Domestic Water Demand in WS	Daily domestic water use in the HUC12 (million gallons per day). Domestic water use includes indoor and outdoor household uses, such as drinking, bathing, cleaning, landscaping, and pools. Domestic water can include surface or groundwater that is self-supplied by households or publicly supplied. Water used in a HUC12 may originate from within or outside the HUC12. Calculated by downscaling county water use estimates for 2005 reported by US Geological Survey ('Estimated Use of Water in the United States County-Level Data for 2005') using the 2006 National Land Cover Database (2006 NLCD) Land Cover dataset and 2010 US Census population estimates from the US Census Bureau. This indicator was calculated for EPA EnviroAtlas.

[23] These indicators were recalculated after the completion of this report and offer different projections of climate and hydrology. The most recent version of the EPA EJSCREEN tools are available on the EPA website: https://www.epa.gov/rps/downloadable-rps-tools-comparing-watersheds.

POPULATION VULNERABILITY	
Agricultural Water Demand in WS	Daily agricultural water use in the HUC12 (million gallons per day). Agricultural water use includes surface and groundwater that is self-supplied by agricultural producers or supplied by water providers (governments, private companies, or other organizations). Water used in a HUC12 may originate from within or outside the HUC12. Calculated by downscaling county water use estimates for 2005 reported by US Geological Survey ('Estimated Use of Water in the United States County-Level Data for 2005') using the 2006 National Land Cover Database (2006 NLCD) Land Cover dataset, the 2010 Cropland Data Layer, and a custom geospatial dataset of irrigated area locations. Counties with zero reported water use were assigned a state-level average value to address issues with water use reporting. This indicator was calculated for EPA EnviroAtlas.
Industrial Water Demand in WS	Daily industrial water use in the HUC12 (million gallons per day). Industrial water use includes water used for chemical, food, paper, wood, and metal production. Only includes self-supplied surface water or groundwater by private wells or reservoirs. Industrial water supplied by public water utilities is not counted. Water used in a HUC12 may originate from within or outside the HUC12. Calculated by downscaling county water use estimates for 2005 reported by US Geological Survey ('Estimated Use of Water in the United States County-Level Data for 2005') using a geospatial dataset on the location of industrial facilities as of 2009/10. Water use by industrial facilities in counties that were reported to have zero industrial water use in the USGS dataset was estimated from values for nearby facilities. This indicator was calculated for EPA EnviroAtlas.