

Appendix C

Water Quality Assessment

Introduction

The Floridan aquifer system (FAS) is the primary source of potable water in North Florida. Lowered water levels in the FAS create a potential for saltwater intrusion and subsequent reductions in groundwater quality. Saltwater intrusion can occur from saltwater moving inland from the ocean (i.e., lateral intrusion) or from relic seawater migrating vertically (i.e., upconing). Saltwater intrusion can affect the productivity of existing groundwater withdrawal infrastructure and the availability of potable groundwater.

To monitor changes in groundwater quality, the Suwannee River Water Management District (District) has maintained a district-wide water quality monitoring network, including groundwater monitoring wells, since the 1970's. Monitoring intervals vary for each well over time, ranging from monthly to annually, or less. Water samples collected from the monitoring wells are analyzed to measure several analytes, including nutrients, metals, common ions, and chemical properties such as color, turbidity and alkalinity. Three of the analytes measured; total chloride, total dissolved solids (TDS), and specific conductivity, are useful indicators of the presence of saltwater in freshwater sources. These three analytes were analyzed as part of this assessment.

The Environmental Protection Agency (EPA) has established National Primary and Secondary Drinking Water Regulations which contain water quality standards for several contaminants. Primary water quality standards are mandatory and enforceable, to protect public health, while secondary water quality standards are non-mandatory guidelines aimed at managing aesthetic attributes such as color, odor, and taste. Of the three analytes considered for this assessment, chloride and TDS are subject to secondary drinking water quality standards. The secondary maximum contaminant level (SMCL) for chloride is 250 milligrams per liter (mg/L) to ensure palatability, and the SMCL for TDS is 500 mg/L, to ensure desirable appearance and taste (United States Environmental Protection Agency, 2023). While no EPA water quality standards are established for specific conductivity, 1,500 $\mu\text{mhos/cm}$ is the upper bound of typical potable water suggested by Shaw and Trost (1984).

Methods

The District groundwater monitoring network currently consists of 78 stations, with 39 stations in the WWSP region (Figure D1). Sixteen stations (wells) are currently sampled twice per year, 21 are sampled quarterly, and two are sampled monthly. Water quality samples are collected from each well following the most current Florida Department of Environmental Protection (DEP) Standard Operating Procedures for groundwater sample collection (Chapter 62-160, F.A.C.).

Total chloride, TDS, and specific conductivity sample data were statistically analyzed by SJRWMD data analysts using SAS and R software, omitting suspect data points, sample duplicates, and blanks. The current status of each analyte for individual wells was determined for an assessment period of five years, from January 1, 2017, to

December 31, 2021. At least three years of data during the five-year status assessment period were required to complete the assessment, with the last year being 2021. The status is calculated as the median of annual median values for the five-year period. Some well locations lack sufficient data to determine the status for one or more analytes and are listed as “insufficient data” (Table C1).

The current trend of each analyte for each well was determined for an assessment period of 15 years, from January 1, 2007, to December 31, 2021. At least 10 years of data were required from the 15-year period of record to calculate a trend, with the last year being 2021. Trends were evaluated using a non-seasonal version of the nonparametric Mann-Kendall test (Meals et al., 2011). Some stations lacked sufficient data to determine trends for one or more analytes.

Results

Chloride

The chloride status assessment determined that only one monitoring well had a chloride concentration that exceeded the SMCL of 250 mg/L (Table C1; Figure C2). This monitoring well is located in southern Levy County (S141429001) and had a concentration of 641 mg/L. This well is approximately 440 feet deep and in close proximity to the coast, therefore the high chloride concentration combined with high TDS levels and specific conductivity, indicates the presence of saltwater.

The chloride trend analysis determined there were 18 monitoring wells with sufficient data to analyze a trend. Of these, there were seven wells with a stable trend, nine wells with an increasing trend, and two wells with a decreasing trend. Some of the wells with increasing trends are not in close proximity to the coast, however they are in locations that are commonly associated with land application of fertilizers or other land use activities. Monitoring well S141429001, which had a high chloride concentration status, does not have enough data to determine a trend.

TDS

The TDS status assessment determined there were 18 wells with a TDS concentration below 250 mg/L and 15 wells with a concentration between 250 mg/L and 500mg/L. There were four monitoring wells in Levy County that had a TDS concentration above the SMCL of 500 mg/L (Table C1; Figure C3). The four wells with high TDS were S121332003 (706 mg/L), S111324036 (860 mg/L), S141620007 (2,082 mg/L), and S141429001 (4,746 mg/L).

The TDS trend analysis determined that there were eight wells with a stable trend, six wells with an increasing trend, and four wells with a decreasing trend. The six wells that were found to have an increasing TDS trend are located in Madison, Taylor, Lafayette, and Levy counties. However, all six wells with increasing trends have TDS concentrations well below the SMCL of 500 mg/L. Of the four wells with high TDS

concentrations, three of them had insufficient data for the trend analysis, and the one well that had enough data for a trend analysis (S111324036) showed to be stable.

Specific Conductivity

The specific conductivity status analysis determined that there are 34 wells with concentrations less than 1,000 $\mu\text{mhos/cm}$ and one well with a concentration between 1,000 and 1,500 $\mu\text{mhos/cm}$. Two wells had a concentration above 1,500 $\mu\text{mhos/cm}$. The two wells with high specific conductivity were S141620007 (2,198 $\mu\text{mhos/cm}$) and S141429001 (4,961 $\mu\text{mhos/cm}$). Both wells are located in southern Levy County (Table C1; Figure C4). As stated above, well S141429001 shows high concentrations of chlorides, TDS, and specific conductivity, which indicates presence of saltwater.

The specific conductivity trend analysis determined eleven wells with a stable trend, four wells with an increasing trend, and three wells with a decreasing trend. There were 19 wells with insufficient data to conduct a trend analysis. Furthermore, the four monitoring wells that were found to have an increasing specific conductivity trend are located in Madison, Taylor, and Levy counties. The three wells with a decreasing trend are in Madison, Lafayette, and Levy counties.

Table C1. Chloride, TDS, and specific conductivity status and trends for monitoring wells in the WWSP

Station	Chloride (mg/L)	Chloride Trend	TDS (mg/L)	TDS Trend	Specific Conductivity (µmhos/cm)	Specific Conductivity Trend
N010632002	5.5	Insufficient Data	192.1	Insufficient Data	332.9	Insufficient Data
N020611002	4.8	Stable	195.6	Stable	326.5	Stable
N020822002	4.6	Increasing	179.7	Increasing	302.5	Increasing
N021013001	3.1	Stable	224.5	Decreasing	318.0	Decreasing
S010602003	4.8	Insufficient Data	152.3	Insufficient Data	254.4	Insufficient Data
S010920002	5.9	Increasing	213.9	Increasing	352.5	Stable
S020301006	6.6	Insufficient Data	189.7	Insufficient Data	354.1	Insufficient Data
S030424003	6.0	Insufficient Data	261.9	Insufficient Data	476.4	Insufficient Data
S031035001	6.2	Stable	219.0	Decreasing	401.1	Decreasing
S040723011	7.1	Increasing	212.8	Increasing	392.0	Increasing
S050615002	4.3	Decreasing	207.0	Decreasing	361.0	Stable
S051209001	10.6	Stable	308.1	Stable	477.0	Stable
S051214008	5.1	Increasing	190.0	Stable	355.3	Stable
S051331002	3.2	Stable	155.0	Increasing	268.0	Stable
S061025003	11.4	Insufficient Data	211.3	Insufficient Data	382.1	Insufficient Data
S080907003	6.2	Stable	117.5	Stable	209.0	Stable
S081132001	11.1	Insufficient Data	374.8	Insufficient Data	583.8	Insufficient Data
S081313005	6.5	Insufficient Data	263.1	Insufficient Data	447.8	Insufficient Data
S090914003	4.4	Insufficient Data	158.3	Insufficient Data	283.0	Insufficient Data
S090925006	23.5	Insufficient Data	348.5	Insufficient Data	580.0	Insufficient Data
S091011004	7.6	Insufficient Data	365.8	Insufficient Data	548.0	Insufficient Data
S101210001	4.5	Insufficient Data	185.3	Insufficient Data	330.8	Insufficient Data
S101429021	14.9	Increasing	355.5	Increasing	575.0	Increasing
S101429023	12.1	Stable	318.9	Stable	551.5	Stable
S111117007	14.5	Insufficient Data	276.5	Insufficient Data	472.5	Insufficient Data
S111324036	31.3	Increasing	859.7	Stable	1,162.8	Stable
S111325017	10.7	Decreasing	346.6	Decreasing	579.3	Decreasing

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Station	Chloride (mg/L)	Chloride Trend	TDS (mg/L)	TDS Trend	Specific Conductivity (µmhos/cm)	Specific Conductivity Trend
S111336004	13.8	Insufficient Data	384.5	Insufficient Data	607.5	Insufficient Data
S111336005	9.4	Insufficient Data	NA	NA	NA	NA
S111436007	8.0	Increasing	269.0	Increasing	469.0	Increasing
S121330002	11.0	Insufficient Data	373.6	Insufficient Data	572.0	Insufficient Data
S121332003	42.1	Insufficient Data	706.1	Insufficient Data	970.3	Insufficient Data
S121429005	7.2	Increasing	NA	NA	NA	NA
S131734004	7.1	Insufficient Data	156.5	Insufficient Data	268.3	Insufficient Data
S141305001	2.4	Insufficient Data	201.5	Insufficient Data	330.0	Insufficient Data
S141429001	640.9	Insufficient Data	4,745.5	Insufficient Data	4,960.8	Insufficient Data
S141429005	11.5	Stable	288.3	Stable	471.0	Stable
S141620007	44.8	Insufficient Data	2,081.8	Insufficient Data	2,198.0	Insufficient Data
S151719004	7.8	Increasing	310.9	Stable	528.0	Stable

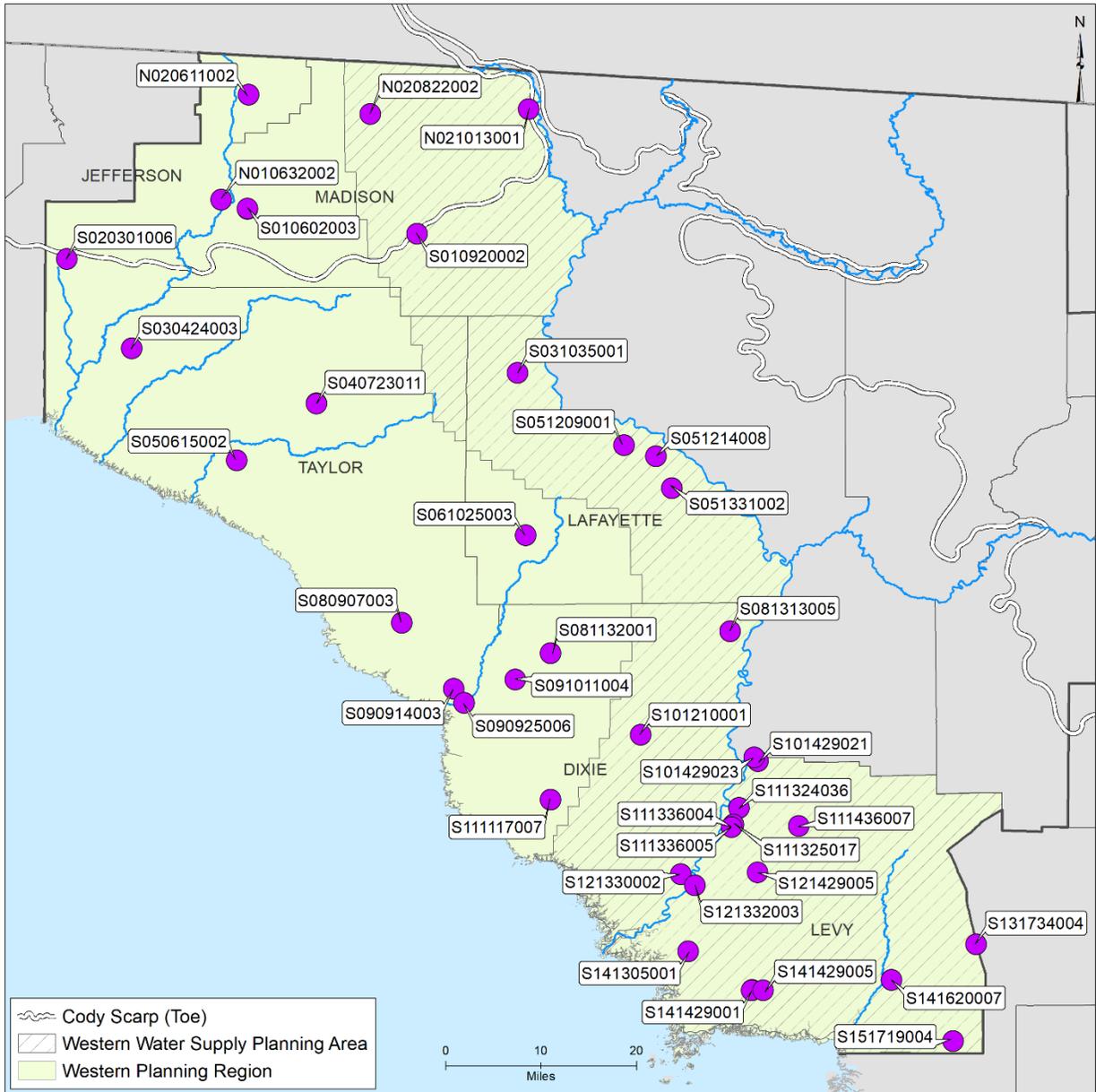


Figure C1. Water quality monitoring stations in the WWSP region

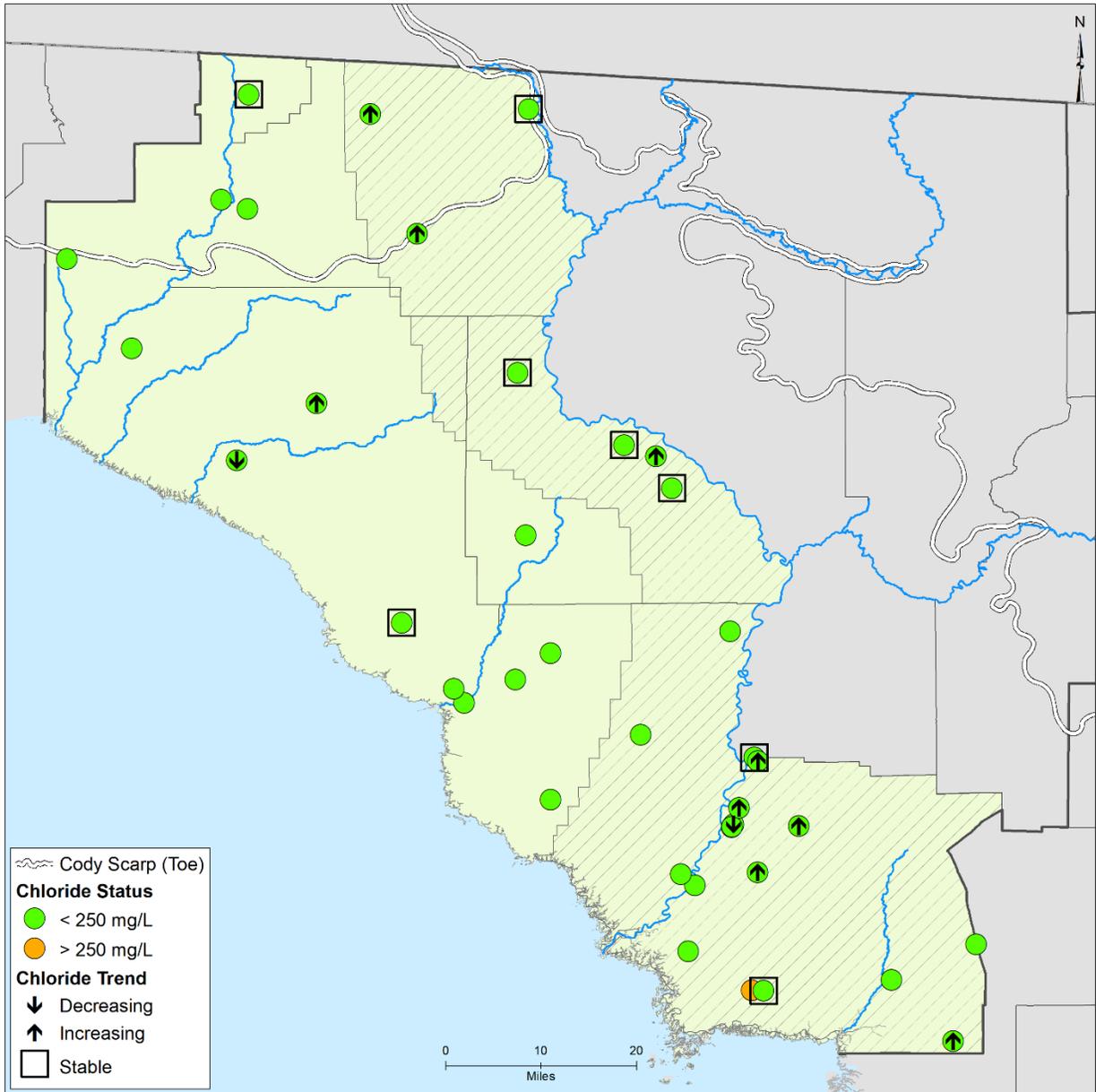


Figure C2. Chloride status and trends in the WWSP region

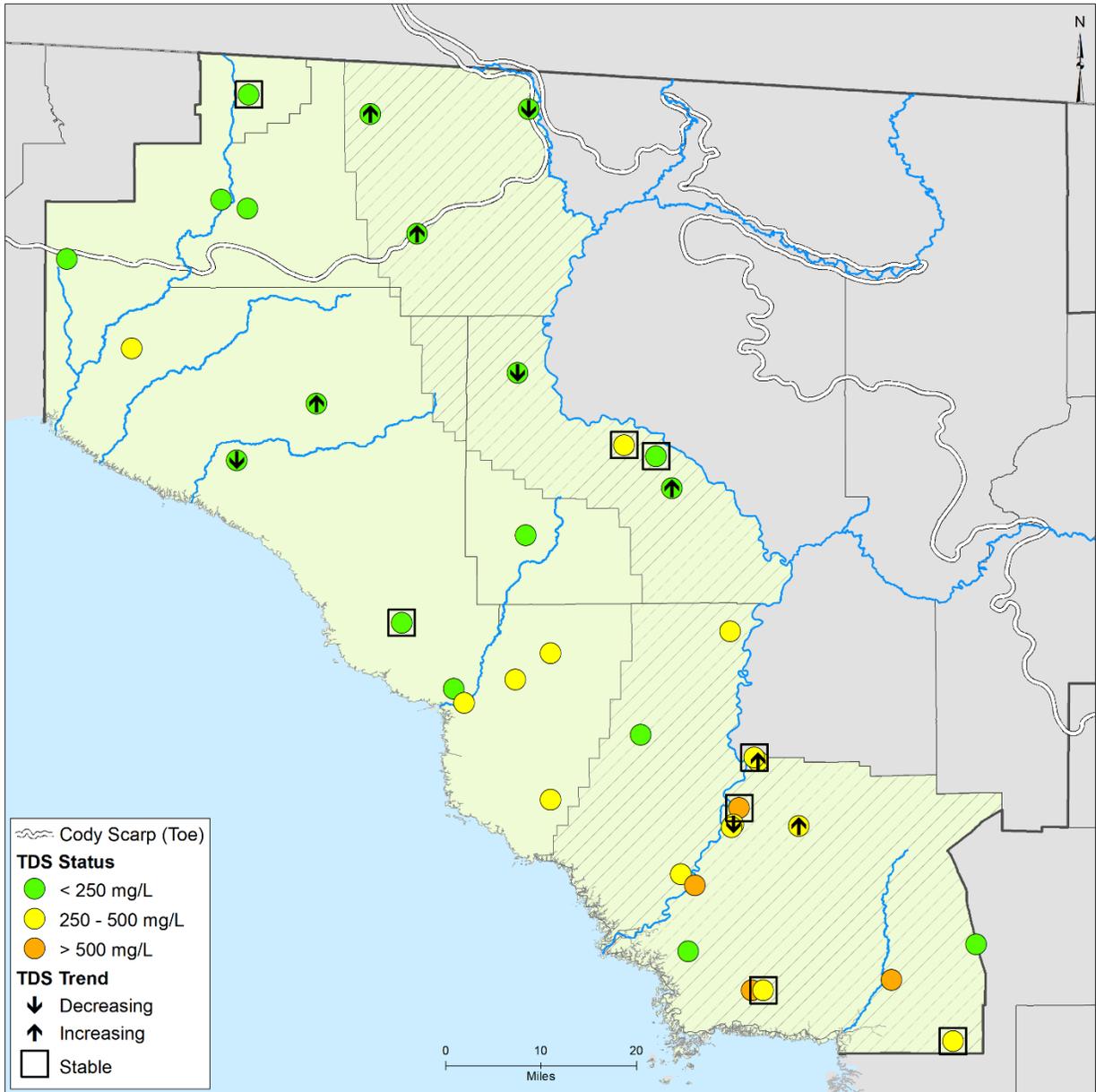


Figure C3. Total dissolved solids (TDS) status and trends in the WWSP region

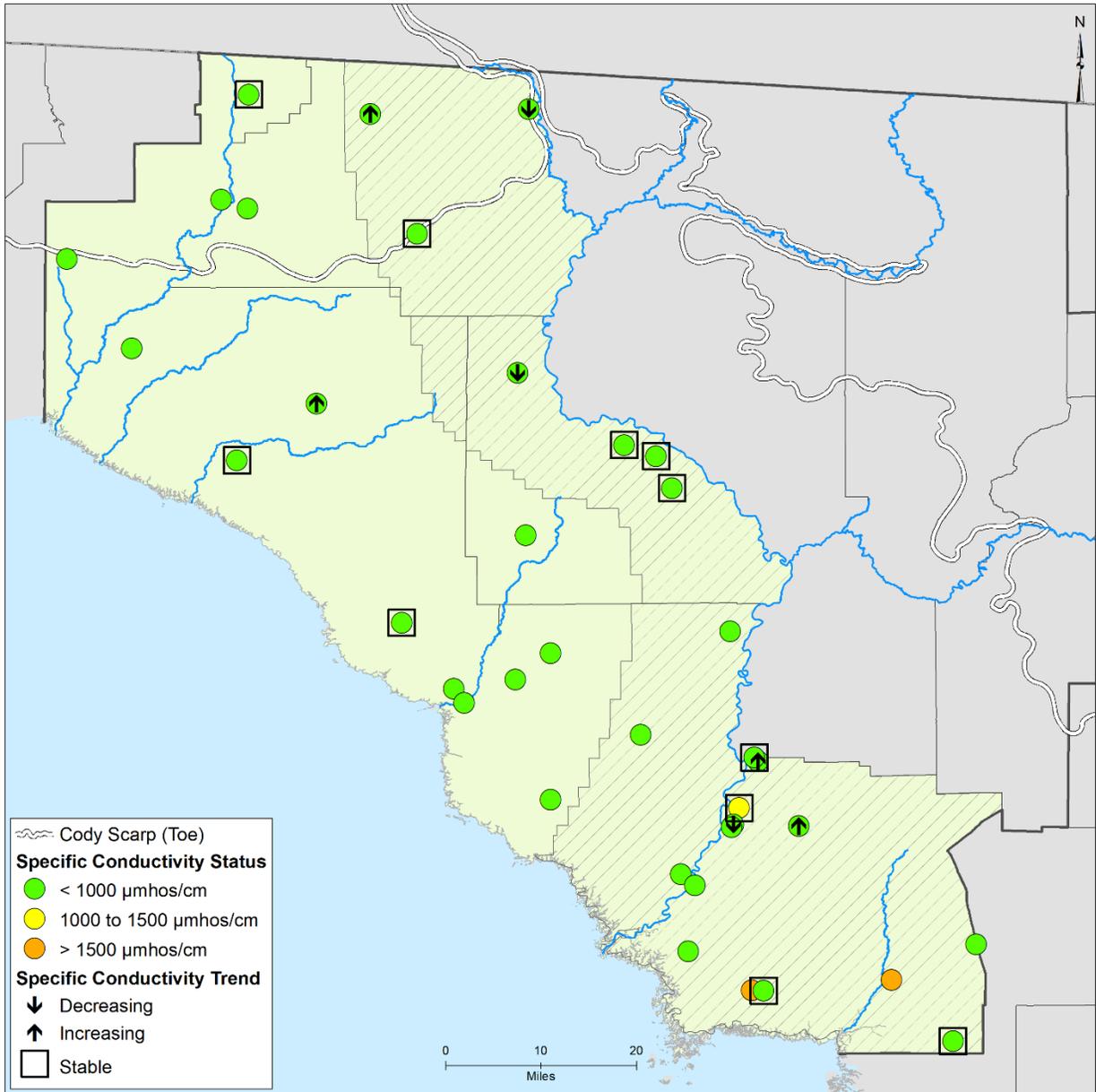


Figure C4. Specific conductivity status and trends in the WWSP region

References

- Meals, D.W., Spooner, J., Dressing, S.A., and Harcum, J.B. 2011. *Statistical Analysis for Monotonic Trends*. Tech Notes 6, November 2011. Developed for U.S. Environmental Protection Agency by Tetra Tech, Inc., Fairfax, VA, 23 p. Available online at <https://www.epa.gov/polluted-runoff-nonpoint-source-pollution/nonpoint-source-monitoring-technical-notes>. Accessed February 22, 2023.
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- United States Environmental Protection Agency. 2023. *Secondary Drinking Water Standards: Guidance for Nuisance Chemicals*. <https://www.epa.gov/sdwa/secondary-drinking-water-standards-guidance-nuisance-chemicals>. Accessed February 22, 2023.