WiseH2O App Database and QA/QC Report

1 Introduction

MobileH2O, LLC has developed a fast, inexpensive, and easy-to-use water quality screening tool called the WiseH2O Mobile Application (WiseH2O App) using patented mobile phone technology and chemical test strips. Outdoor enthusiasts can use the app to check water quality and ensure the health of the waterways they enjoy. The app also provides natural resources managers and scientists with water quality screening results to identify "hot spots" with impaired water quality conditions.

The app's observation information has been organized into an MS EXCEL file (DB File) containing a database and supporting analyses, allowing users and resource managers to understand and investigate water quality and stream conditions within the area of interest. To ensure accuracy, a quality assurance/quality control (QA/QC) assessment of the colorimetric algorithm performance and the data was conducted, providing all users with confidence in the screening results. The database components and the QA/QC assessment methods (Chapter 3) are detailed in this document. Chapter 4 covers the calibration and verification of the colorimetric algorithm in the WiseH2O app. If the Scorecard is included in the TU-DB, the scorecard computations and use are presented in Chapter 5.

2 MS Excel TU-DB Overview

The distributed DB file has twelve sheets that include the database; use, water quality chemistry, water temperature, and water temperature analyses; metadata; and scorecard computations (optional) (Figure 1). Table 1 describes the analysis and functions within each sheet. General overview and rules for navigating the DB file include:

1. *TU_DB Sheet:* This is the database (TU-DB) that includes the overall data set upon which the use, analyses, and scorecard sheets are based. The TU-DB includes data submitted through the WiseH2O App to the online database and subsequent GIS analyses. The app data includes the sampling sources, water quality results, stream disturbances, climatic conditions, relevant monitoring sites, geographic coordinates, date/time, and comments. From the observations' geographic locations, the GIS analysis determines which TU Chapter areas and HUCs-12 they fall within, and the stream names and trout and brook trout stream designations they are on. The TU-DB is in an MS EXCEL Table format, allowing subsequent data to automatically update the tables and graphs in the analyses and scorecard sheets.
2. *Use Sheet:* This sheet presents tables and charts of the app's adoption in the study area. The analyses include the number of samples per year, types of data submitted, number of users and their frequency of use, organizations' and chapters' use and participation, and monitoring site observations. Monitoring station lists in the analysis sheets are dynamically linked to the "TU Monitoring Stations" table in the Use Sheet.

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3. *Analysis Sheets.* These sheets organize and evaluate the water quality and water temperature information submitted by the app. The analyses include the overall distribution of water quality concentration per year; concentration distributions per weather conditions, water level, and water clarity reported when submitting an observation; and monitoring stations. A drop-down menu in the yellow cell (N62) allows users to choose the monitoring station to graph in the bar graph below.
4. *Metadata Sheet*: Provides a description and source for each column in the TU-DB.
5. *Light Yellow Cells* on any sheet can be edited, changing displays or computations. Many have drop-down menus guiding entries that can be activated by clicking on the cell to reveal a drop-down arrow on the right side of the cell.
6. *Subset Reporting:* The distribution of a subset of data to a select audience (e.g., an individual TU Chapter) can simply be performed by removing the non-pertinent data in the TU-DB. The Monitoring Station List in the Use Sheet will also need to be refined. Filtering the TU-DB does not change the analyses.
7. *Scorecard Sheet (optional)*: This describes the computations for the Driftless Scorecard. The scorecard processes observation results and GIS information to summarize the overall fisheries conditions, disturbances, and nutrient conditions within each TU Chapter Area based on observations. Database users can change the weighting of parameters including the overall conditions (uses nutrients, water temp, and disturbances data), habitat risks (uses nutrients, water temp, and disturbances data), and nutrient risk. *Chapter 5. Driftless Area Scorecard* outlines methods for deriving the scores.

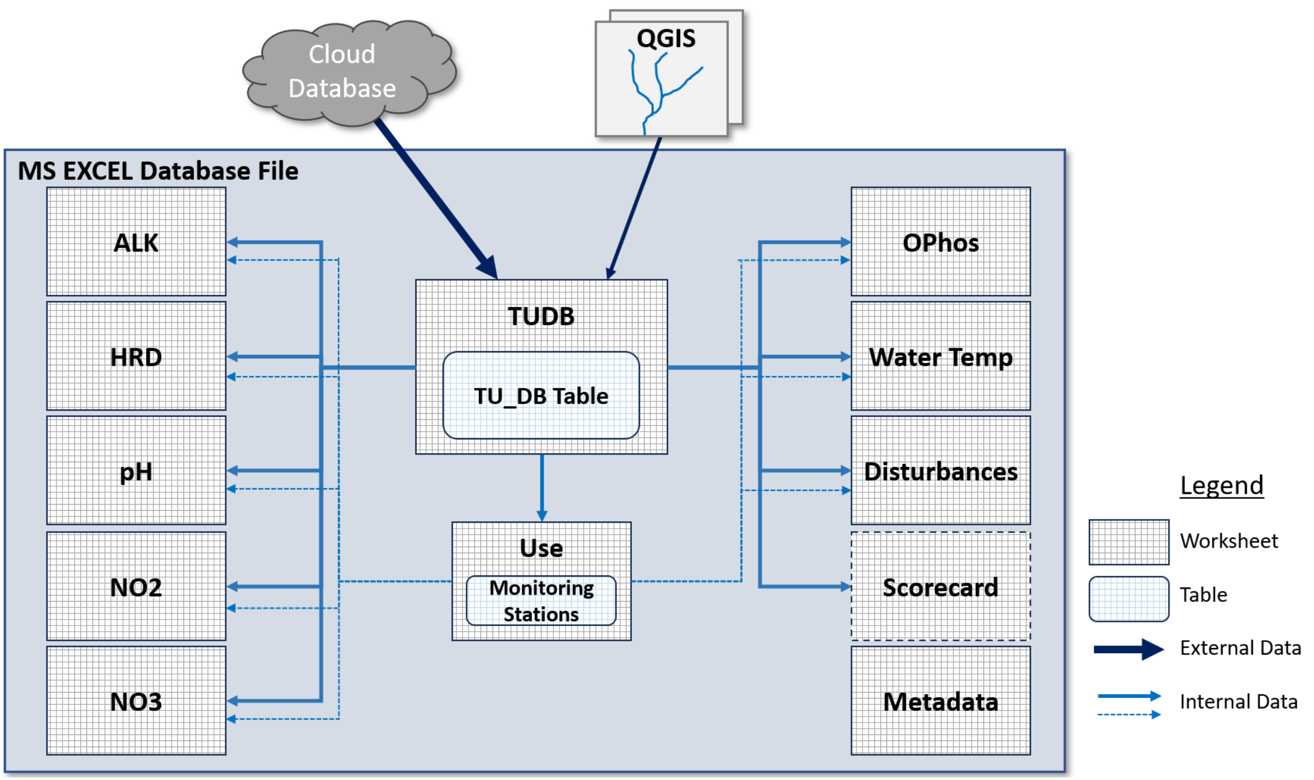


Figure 1. Components and data flow in the WiseH2O DB. Note, that the Scorecard sheet is optional.

Table 1. Description of the WiseH2O database sheets in the project database file.

MS Excel Sheets	Sheet Type: Descriptions
TUDB	**Database:** Table of data submitted through the WiseH2O App to the online database and GIS analysis. The app data includes the sampling sources, water quality results, stream disturbances, climatic conditions, relevant monitoring sites, geographic coordinates, date/time, and comments. From the observations' geographic locations, the GIS analysis determines which TU Chapter areas and HUCs-12[1] areas they fall within, and the stream names and trout and brook trout stream designations they are located upon. The data supporting the tables and graphs in the analysis sheets is dynamically linked to the "TU_DB" table on the TUDB Sheet. The "TU_DB" table is an Excel Table format, which allows for the automatic updating of all the analyses upon future database updates.
Use	**Analysis**: Includes tables and charts on the app's use within the study area including the number of samples per year, types of data submitted, number of users and their frequency of use, organizations and chapters use and participation, and monitoring site observations. The monitoring station lists in the analysis sheets are dynamically linked to the list in the "TU Monitoring Stations" table.
ALK, HRD, pH (5n1 Test Strip Results)	**Analysis**: Alkalinity, hardness, and pH results from the 5n1 test strip colorimetric analysis. The analyses include the overall distribution of water quality concentration per year; weather conditions, water level, and water clarity reported when submitting an observation; and monitoring stations. A drop-down menu in the yellow cell (N62) allows users to choose the monitoring station to graph in the bar graph below.
NO2, NO3 (2n1 Test Strip Results)	**Analysis**: Nitrite and Nitrate results from the 2n1 test strip colorimetric analysis. The analyses include the overall distribution of water quality concentration per year; weather conditions, water level, and water clarity reported when submitting an observation; and monitoring stations. A drop-down menu in the yellow cell (N62) allows users to choose the monitoring station to graph in the bar graph below.
OPhos	**Analysis**: Orthophosphate results from the orthophosphate test strip readings. The analyses include the overall distribution of water quality concentration per year; weather conditions, water level, and water clarity reported when submitting an observation; and monitoring stations. A drop-down menu in the yellow cell (N62) allows users to choose the monitoring station to graph in the bar graph below.
Water Temp	**Analysis**: A summary of monthly and maximum water temperatures, per water year, submitted with the app observations. A drop-down menu in the yellow cell (D45) allows users to choose the monitoring station to display in the line graph below. Background temperature thresholds in the graphs can be changed in the yellow cells Y10-AB10.
Disturbances	**Analysis**: Stream disturbance types reported by users include fish barriers, bank erosion, trash, pipe/drain outflow, livestock in water, algal blooms, fish kill, and none (no disturbance present). The analysis includes the overall occurrences for each disturbance type as well as the number occurring per year.
Metadata	**Description**: Provides a description and source for each column in the database.
Scorecard	**Reporting**: Supporting analysis for the Driftless Scorecard. Process observation results and GIS information to summarize the overall fisheries conditions, disturbances, and nutrient conditions within each TU Chapter Area based on observations. Appendix B. Driftless Area Scorecard outlines methods for deriving the scores.

[1] HUCs are unique Hydrological Unit Codes assigned to the United States by the USGS. HUC12 is the smallest areal unit. To learn more: https://water.usgs.gov/GIS/huc.html

3 Quality Assurance/Quality Control Assessment Summary

To ensure accuracy and reporting to the database, the colorimetric algorithm calibration is verified and the water quality, weather conditions, stream conditions, and associated GIS information are reviewed. The QA/QC review process includes two stages:

i. Comparison of paired field water sampling/test strip observations used to verify the colorimetric algorithms for assessing alkalinity, hardness, pH, nitrate, and nitrite. A full review of the calibration results is in Appendix A.
ii. Review of the database to determine the validity of outliers based on spatial comparison with local measurements, individual observer results, and review of the image capture used in the colorimetric analysis.

This chapter summarizes the calibration and verification results and outlines the methods for database review. Chapter 4 details the calibration and verification process and outcomes.

3.1 Calibration and Verification Results

A summary of the colorimetric algorithm calibration and verification performance for each constituent is provided below and in Table 2.

A. Alkalinity: Of the 421 readings taken for colorimetric and laboratory calibration, the colorimetric algorithm correctly binned 88%. Paired field water samples resulted in 93% correctly binned after the algorithm was extended to read values over 240 mg/l $CaCO_3$ as the field samples concentrations averaged 228 mg/L $CaCO_3$ with a maximum of 279 mg/L $CaCO_3$.
B. Hardness: Of the 402 readings taken for colorimetric and laboratory calibration, the colorimetric algorithm correctly binned 96%. Paired field water samples resulted in 100% correctly binned as all laboratory readings were over 180 mg/l $CaCO_3$, the greatest concentration bin on the test strip.
C. pH: Of the 421 readings taken for colorimetric and laboratory calibration, the colorimetric algorithm correctly binned 96%. The greater accuracy is due to the more pronounced color contrast between pH bin intervals making it simpler to identify the correct reading.
D. Nitrate (NO_3): For colorimetric and laboratory calibration, the algorithm correctly binned 92% of the 98 observations. Compared to total nitrate/nitrite taken from paired field samples, the app correctly binned 79% of the 136 paired field samples. The paired field samples ranged from 1.1 and 4.8 mg/L with many sampled values falling close to the boundary between intervals. No sample was greater than one bin off the target and laboratory reading bin.
E. Nitrite (NO_2): Of the 98 readings taken for colorimetric and laboratory calibration, the colorimetric algorithm correctly binned 94%. Note, the color change between the 0.15 and 0.30 mg/L bins is very slight, thus during lower light conditions difficult to determine (Figure 7).
F. Orthophosphate (O-Phos): O-Phos is detected by the user comparing colors in a tube to a reference scale, thus it does not make use of the colorimetric algorithm and is reliant on the user to correctly identify the concentration. Paired field water samples were compared to the bin concentration logged by users to determine accuracy. In the Kiap-TU-WISH Chapter with multiple users, the concentration reported in 34 out of 39 observations was correctly binned (87%). In the North Alkali Wetlands Project with a few users, the concentration reported in 49 out of 76 observations was correctly binned (64%). In all cases, the orthophosphate concentrations were low and the erroneously reported bins were one bin away from the laboratory concentrations. Thus, the accuracy is dependent on the user's ability to match the color in the tube with the scale on the test strip vial.

Table 2. Summary results from the WiseH2O app colorimetric algorithm calibration and verification process.

		Colorimetric/Laboratory Calibration		Paired Field Water Sampling verification			
Constituent	**Test Strip**	**Sample Count**	**% Correct Bins**	**Sample Count**	**% Correct Bins**	**Range [mg/L]**	**Mean [mg/L]**
Alkalinity	5n1	421	88%	28	93%	106-279	228
Hardness	5n1	402	96%	22	100%	182-331	284
pH	5n1	421	96%	-	-	-	-
Nitrate (NO_3)	2n1	98	92%	136	79%	1.1-4.8	2.8
Nitrite (NO_2)	2n1	98	94%	39	73%	<0.06	<0.06
O-Phos	O-Phos	-	-	39	87%	0.010-0.237	0.036
		-	-	76	64%	0.067-0.300	0. 157

3.2 Database Review

QA/QC of the database included the review of the water quality and temperature results, GIS data, and internal functionality between sheets. The steps for QA/QC of the water quality and temperature results include:

i. *Observation readings:* Comparison of colorimetric analysis and paired field water sampling/test strip observations to determine if the alkalinity, hardness, pH, nitrate, and nitrate were correctly calculated.

ii. *Spatial Examination*: For violations or anomalies in the data that remained following the examination of the colorimetric algorithm, data was mapped to identify a consistent pattern or a one-off. If the anomalous measurements were from multiple individuals in the same region or stream network, then the observations were deemed acceptable. If a single measurement was taken from a user that consistently provides acceptable values, then the environmental conditions (e.g., water level, water clarity, recent events) were evaluated to determine if these could be the cause.

iii. *Image Capture Evaluation*: If neither the user nor environmental conditions provided insight into the anomalous result, then the device user would be checked to determine if the image was properly being captured. Though the image capture algorithms in the app have safeguards against common errors, specific uses may exist that would create errors that are not accounted for in the app. If consistently poor results were observed from a user, then the image captures were retrieved to determine why the image capture algorithm had incorrectly captured the test strip and calibration card.

GIS data review includes determining if all the observations have data associated with each GIS layer and spot-checking for chapter affiliation, HUC12, trout and brook trout stream designation, and stream name. Once the TU-DB information was determined to be complete, the DB File was checked to make sure all the data was correctly referenced and displayed.

4 Colorimetric Algorithm Calibration

The WiseH2O app uses colorimetric algorithms to screen alkalinity, hardness, pH, nitrate, and nitrate concentrations in water. To ensure the accuracy of these algorithms, a comparison was made between colorimetric/laboratory analysis for calibration and paired field water sampling/test strip observations for verification. The calibration process involved setting target concentrations and then capturing images with the app and training the algorithm to select bin range. Target concentrations included not only the test strip bin values but also interim values between the two bins. For instance, if a test strip's bins are 40 and 80 mg/L with a dividing concentration of 60 mg/L, the accuracy near the dividing line was determined by setting test values for 55 mg/l and 65 mg/L. The colorimetric/laboratory analysis used images captured by the app under a variety of lighting conditions (e.g., sunny, cloudy, mid-day, evening), multiple brands/models of mobile phones (e.g., iPhone, Android, Motorola), and spanning the concentration range in the test strips.

Paired field water sampling/test strip observations compared laboratory results from stream field samples against the WiseH2O app concentrations collected simultaneously. Two field studies were used in the verification: i) angler water quality sampling QA/QC plan for the Trout Unlimited Kiap-TU-WITH Chapter in Wisconsin, as part of the 2020-2021 Ancle Science Program in the Driftless Area (https://www.mobileh2o.com/driftlessprogram) and ii) the 2021-2023 water quality sampling campaign monitoring the North Alkali Ditch Wetlands Project in Idaho. The following are the results from the calibration and verification of the colorimetric algorithm.

5n1 Test Strip: Four hundred twenty-one colorimetric/laboratory measurements were used to calibrate the colorimetric algorithm of alkalinity, hardness, and pH (Figure 2, Figure 3). From the sample set, 400 were used for calibration and 21 for verification. From the Kiap-TU-Wish monitoring, up to 29 observations were used to verify the colorimetric algorithm.

Figure 2. Color range of test strips pads for alkalinity and total hardness (5n1 test strips).

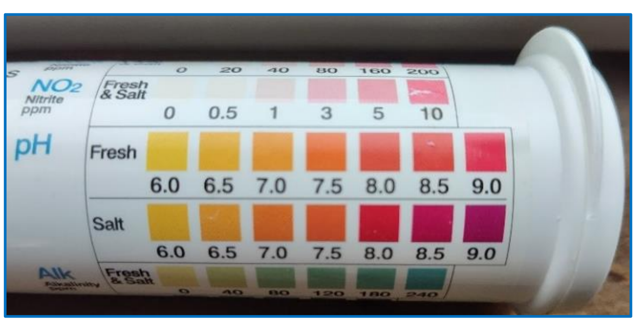


Figure 3. Color range of test strips pads for pH (5n1 test strips).

Alkalinity: Of the calibration data set, 371 correctly binned the alkalinity concentration with an 88% success rate (Table 3). The 40 mg/L $CACO_3$ was the least accurate at 73%. For incorrectly assessed bins, the results were off by one bin category and often by samples with concentrations near the concentration dividing two bins (Figure 4). For example, a 40 mg/L $CaCO_3$ target could erroneously return a value of 0 or 80 mg/L $CaCO_3$, but would not 120, 180, and 240 mg/L $CaCO_3$. Most errors occurred during lower light conditions.

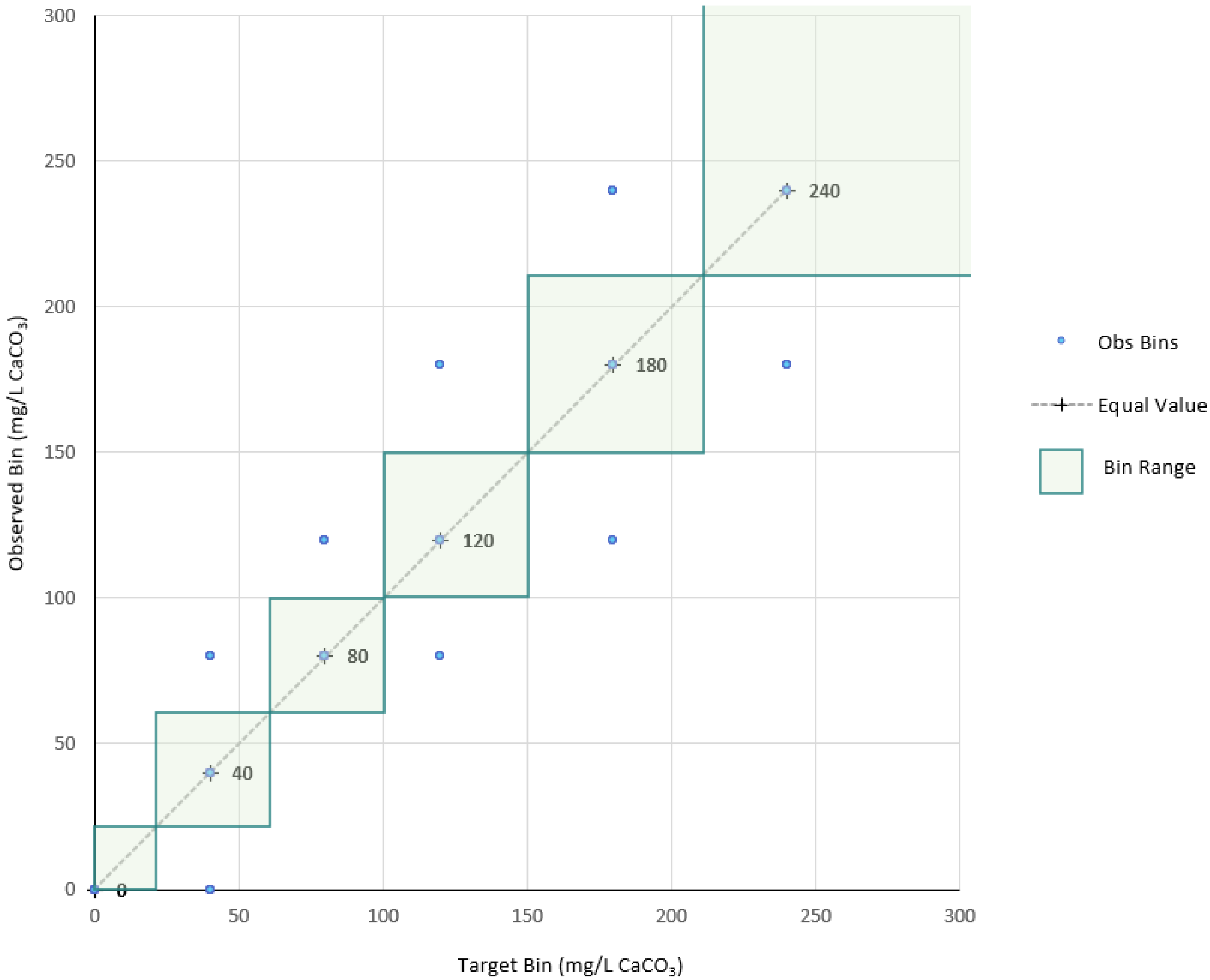


Figure 4. Colorimetric/laboratory calibration bin results for alkalinity. Each observed bin result represents multiple data points.

Of the paired field samples, 26 samples ranged from 195 to 279 mg/L $CaCO_3$ with the other two reading 108 and 122 mg/L $CaCO_3$ (Table 2). The app correctly "binned" 26 of the samples in the high range but switched the binned values of lower bins.

Table 3. Alkalinity target and correct bin results from the calibration/verification of the WiseH2O app colorimetric algorithm

Bin Concentrations	Target Bins [count]	Correct App Bin [count]	% Correct
0	62	62	*100%*
40	94	69	*73%*
80	90	86	*96%*
120	52	46	*88%*
180	74	66	*89%*
240	49	42	*86%*
Total	**421**	**371**	***88%***

Hardness: Of the training data set, 386 of the 402 correctly binned the concentration with a 96% success rate (Table 4). The 30 mg/L $CACO_3$ was the least accurate at 87%. Like alkalinity, for incorrectly assessed bins the results were off by one bin category and often by samples with concentrations near the concentration dividing two bins (Figure 5). The 22 paired field samples ranged from 182 to 331 mg/L $CaCO_3$ (Table 2). The app correctly "binned" all the samples in the high range.

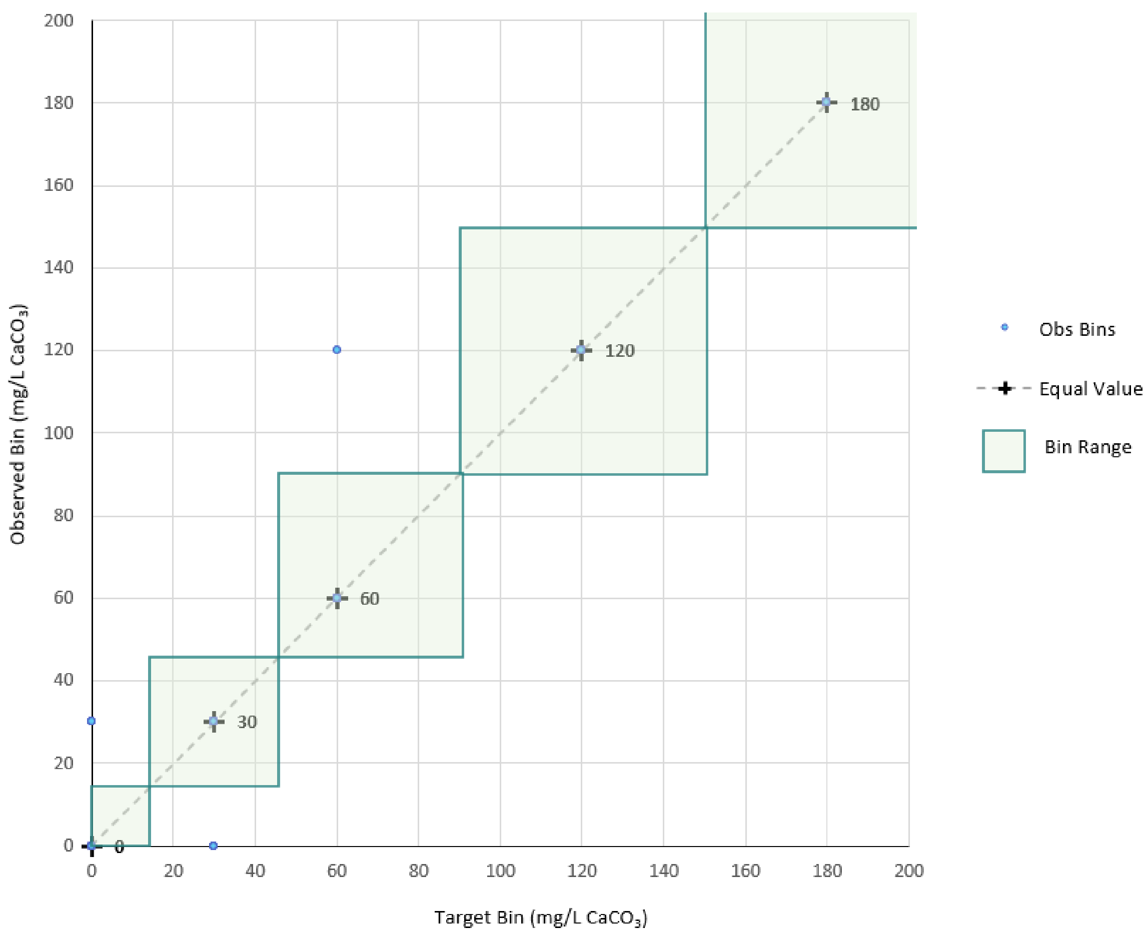


Figure 5. Colorimetric/laboratory calibration bin results for total hardness. Each observed bin result represents multiple data points.

Table 4. Hardness target and correct app bin results from the calibration/verification of the WiseH2O app colorimetric algorithm

Bin Concentrations	Target Bins [count]	Correct App Bin [count]	% Correct
0	61	58	*95%*
30	92	80	*87%*
60	90	89	*99%*
120	63	63	*100%*
180	96	96	*100%*
Total	**402**	**386**	***96%***

pH: Of the training data set, 421 correctly binned the concentration with a 96% success rate (Table 5). The color changes along the pH are strong, thus the correct identification of pH is easier for the colorimetric algorithm across the range of pH values on the test strip (Figure 3).

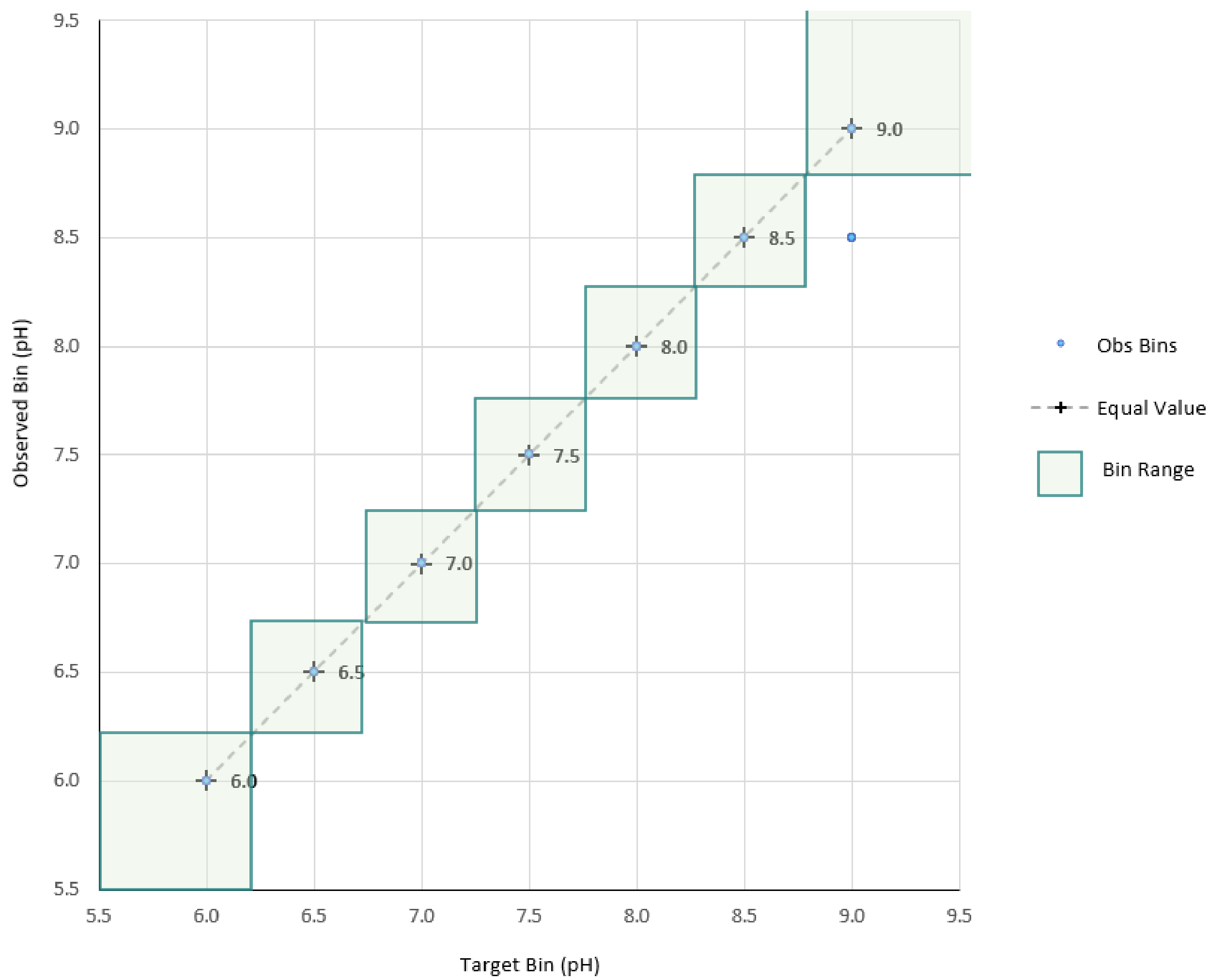


Figure 6. Colorimetric/laboratory calibration bin results for total hardness. Each observed bin result represents multiple data points.

Table 5. pH target and correct app bin results from the calibration/verification of the WiseH2O app colorimetric algorithm

Bin Concentrations	Target Bins [count]	Correct App Bin [count]	% Correct
6.0	62	62	*100%*
6.5	42	36	*86%*
7.0	90	90	*100%*
7.5	78	78	*100%*
8.0	74	74	*100%*
8.5	26	26	*100%*
9.0	49	40	*82%*
Grand Total	**421**	**406**	***96%***

2n1 Test Strip: Both colorimetric/laboratory analysis was used to calibrate and verify the colorimetric analysis of NO_3 and NO_2 (Figure 7). The algorithm calibration used 98 images captured by the app under a variety of lighting conditions, with several phone brands/models, and over concentrations in the algorithm calibration. Paired laboratory field samples/app test strip readings from the Kiap-TU-Wish and North Alkali studies were used to refine and verify the calibration.

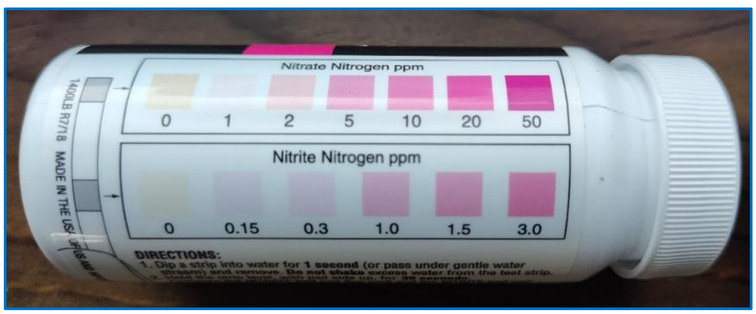


Figure 7. Color range of test strips pads for nitrate and nitrite (2n1 test strips).

NO_3: Of the training data set, 98 correctly binned the concentration with a 92% success rate (Table 6, Figure 8, Figure 9). Due to the slight color change between the 0 and 1 mg/L pads and 2 and 5 mg/L pads, the 0, 1, and 2 mg/L were the least accurate. Greater concentration bins were very accurate, suggesting this tool would be effective at identifying "hot spots" when sampling in the field.

Table 6. NO_3 target and correct app bin results from the calibration/verification of the WiseH2O app colorimetric algorithm.

Bin Concentrations	Target Bins [count]	Correct App Bin [count]	% Correct
0	6	4	*67%*
1	16	12	*75%*
2	18	16	*89%*
5	12	12	*100%*
10	12	12	*100%*
20	18	18	*100%*
50	16	16	*100%*
Grand Total	**98**	**90**	***92%***

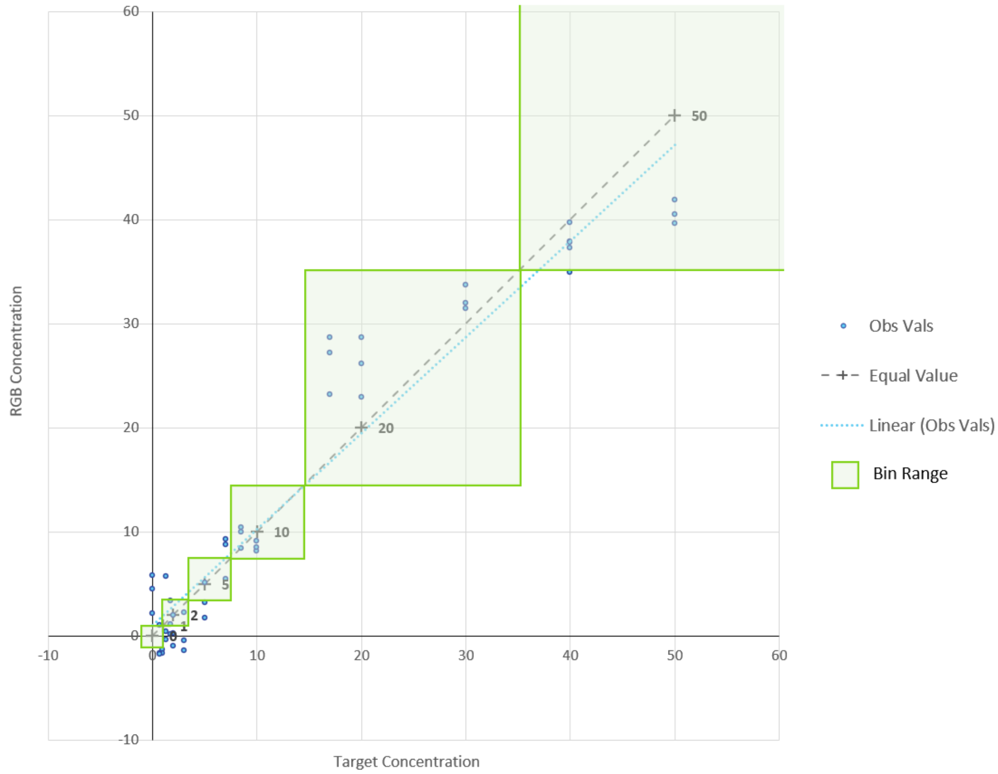


Figure 8. Colorimetric/laboratory calibration RGB results for NO_3. These raw concentration results are before the binning step in the colorimetric algorithm in Figure 9.

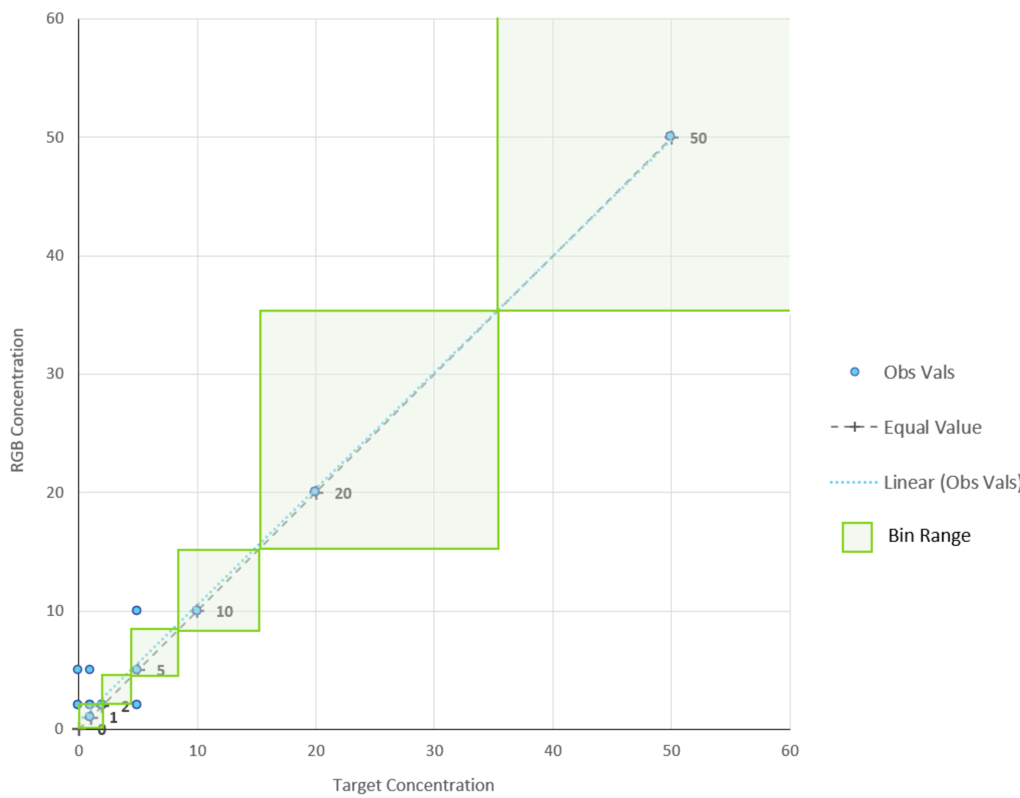


Figure 9. Colorimetric/laboratory calibration bin results for NO_3. Each observed bin result represents multiple data points.

For field testing in Idaho, paired laboratory sampling and test strip results were compared for 102 samples collected to monitor a designed wetlands efficacy in Idaho during the 2021-2023 irrigation season. Water samples were collected at four locations on the project and taken to the Idaho Analytical Laboratory for analyzing water chemistry including total nitrogen concentrations. Of these, the nitrate and nitrite test strips were compared to the NO_2/NO_3 results. Of the 102 samples collected, the app correctly binned the value on 84% of the observations (Figure 10, Figure 11). Of the remaining 16%, most had concentrations near the boundaries between bins. For example, the boundary between the 2 mg/L bin and 5 mg/L NO_3 bin is 3.5 mg/L NO_3. Several observations with lab values of 3.6 mg/L NO_3 (thus categorized into the 5 mg/L NO_3 bin), the test strip reported 3.2-3.4 mg/L NO_3 which is categorized in the 2 mg/L NO_3 bin.

The Kiap-TU-WISH Chapter study collected 34 paired nitrate and nitrite samples from 3 locations along both Pine Creek and Trimbelle River. The result correctly binned 74% of the samples, which ranged from 1.1 to 4.8 mg/L (Figure 10, Figure 11).

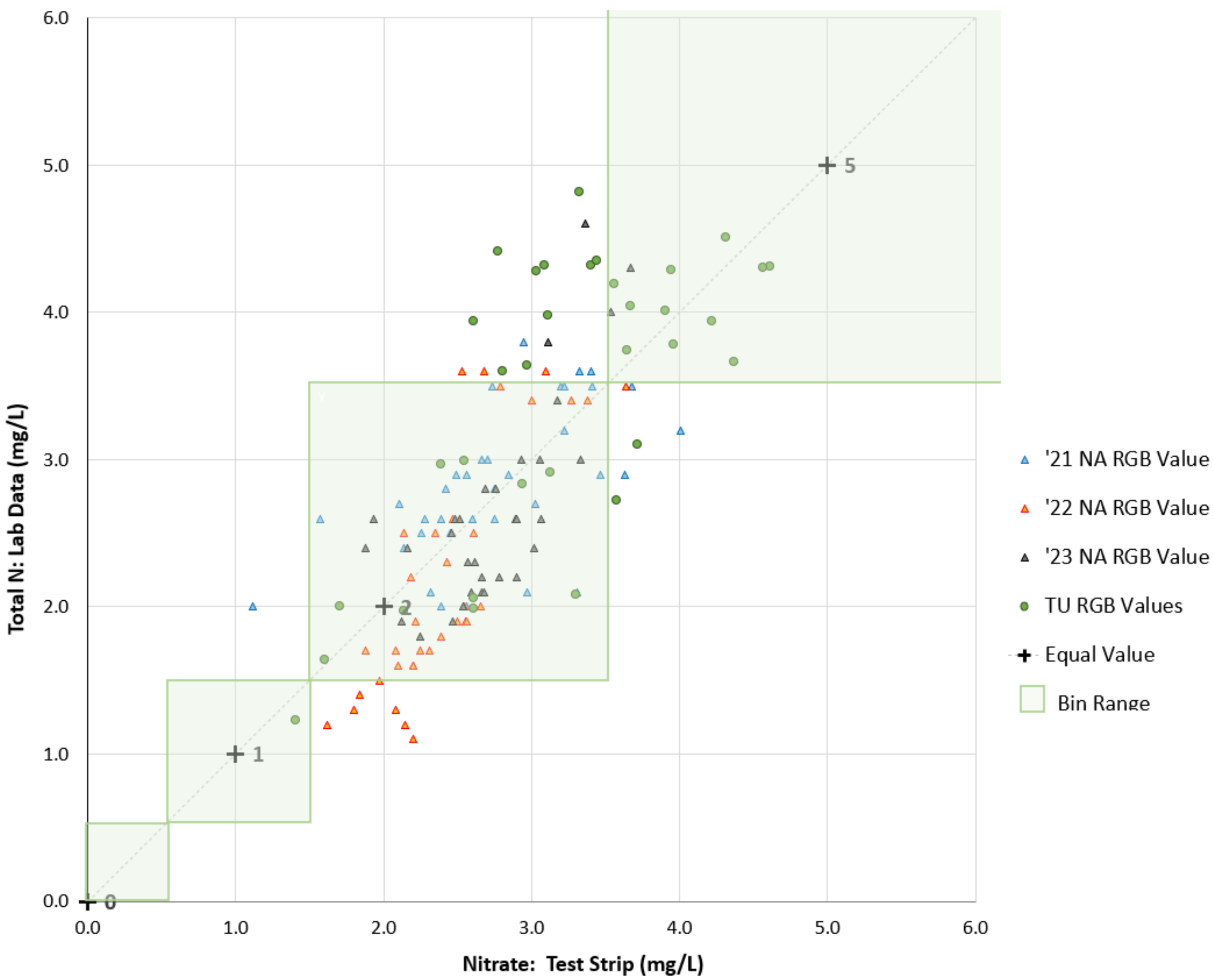


Figure 10. Paired test strip RGB-derived concentrations and laboratory results from the Kiap-TU-Wish Chapter Sampling Program and North Alkali Drain Wetlands Project. These raw concentration results are before the binning step in the colorimetric algorithm in Figure 11.

Interestingly, the chemical reactant in the test strip pads slightly changed per "batch" impacting the colorimetric responses to sampled water concentrations. The RGB analysis can detect these changes as is evident in the 2021 and 2022 observations. The beginning of the 2022 sampling season used test strips left over from the 2021 season, which are observed by the cluster of orange triangles near the 3.4-3.6 mg/L NO_3 laboratory value (Figure 10). The 2022 batch of test strips consistently plots lower versus the same value for the balance of the year.

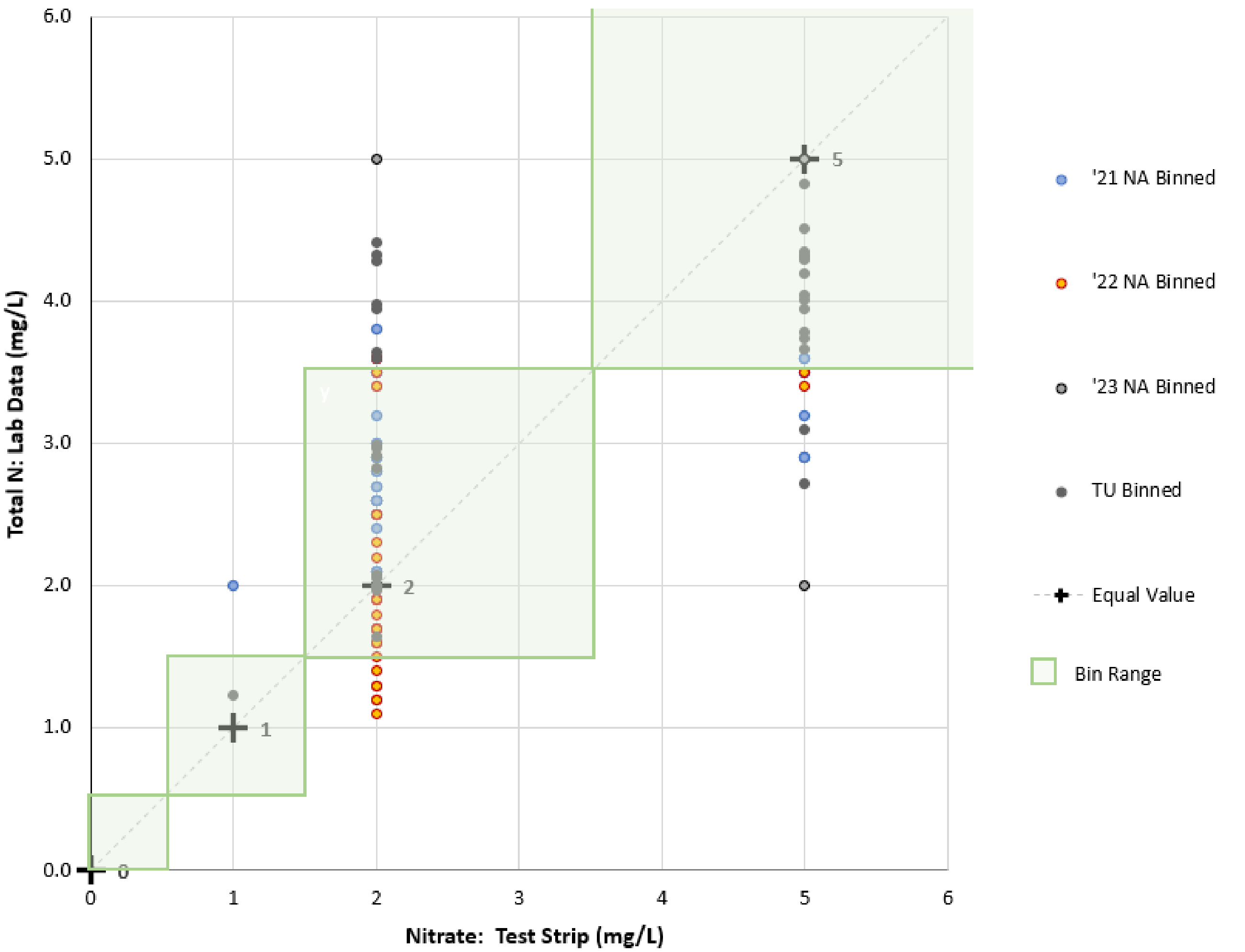


Figure 11. Paired test strip binned (reported) concentrations and laboratory results from the Kiap-TU-Wish Chapter Sampling Program and North Alkali Drain Wetlands Project.

Nitrite (NO_2): Of the 98 readings taken for colorimetric and laboratory calibration, the colorimetric algorithm correctly binned 93% with no erroneous bin reporting more than one bin away (Table 7, Figure 12). Given the slight color change between the 0.15 and 0.30 mg/L bins, there is greater difficulty distinguishing between the two bins under variable light conditions (Figure 7). The laboratory results from the paired field samples were <0.06 mg/L. Of the 39 samples, the algorithm incorrectly binned 5 (Table 2) with values of 0.15 and 0.3 mg/L.

Table 7. NO_2 target and correct app bin results during the calibration/verification of the colorimetric algorithm in the WiseH2O app.

Bin Concentrations	Target Bins [count]	Correct App Bin [count]	% Correct
0.00	12	11	*92%*
0.15	16	14	*88%*
0.30	18	16	*89%*
1.00	18	18	*100%*
1.50	18	16	*89%*
3.00	16	16	*100%*
Total	**98**	**91**	***93%***

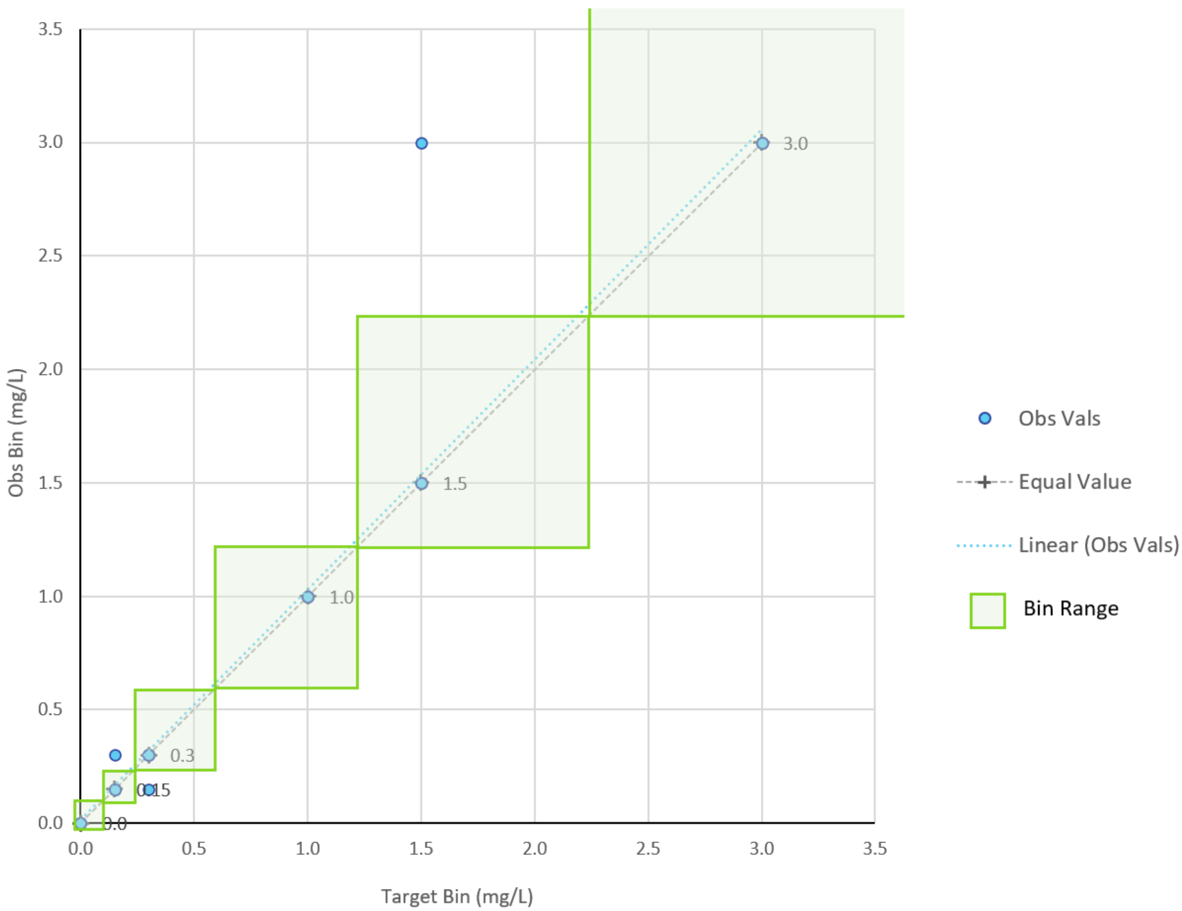


Figure 12. Colorimetric/laboratory bin results for NO_2. Each observed bin result represents multiple data points.

5 Driftless Area Scorecard

The Driftless Area Scorecard summarizes the WiseH2O app findings for anglers and water managers to be aware of the water quality conditions, issues, and potential mitigating and restoration opportunities to address issues. This document outlines the computations and rankings supporting the TU DARE Scorecard (Scorecard). The examples provided herein are illustrative and do not reflect the final numbers used in the scorecards.

5.1 Calculations

Calculations proceed by first calculating the nutrient, water temperature, and stream disturbance health categories on page 2 (Figure 14), then aggregating those to generate the overall fish and habitat health (Figure 13). Category calculation per zone (e.g., chapter areas), as presented in Figure 15, proceeds as follows:

1) Zone Count is the number of observations values in the database (a.k.a., *TU_DB* table) binned by the metric/concentration into *good, average, poor,* and *lethal* for NO_2, NO_3, OP, and water temperature *(show-stopper) (Lethal)* for stream temperature. The yellow cells in the value column can be edited to adjust the value metric Col. C. Stream Disturbances counts the number of "Present" values.

2) Zone Scores: NO_2, NO_3, OP, and Stream Temperature, the following equations are used:

$$Quality\ Score\ (QS) = \sum_{i}^{n} QWt_i * Obs_i / Obs_{Total} \qquad \text{Eq. 1}$$

Where: QWt_i is the quality weight.
Obs_i is the number of observations in a concentration bin or range.
Obs_{Total} is the total number of observations in a zone.
i is a quality interval.
n is the number of quality intervals.

For the **Nutrient** score, the NO2, NO3, OP zonal scores are computed by:

$$Zone\ Score = \sum QS_{NO2} * Wt_{NO2} + QS_{NO3} * Wt_{NO3} + QS_{oP} * Wt_{oP} \qquad \text{Eq. 2}$$

Where: $\sum Wt_{NO2} + Wt_{NO3} + Wt_{oP} = 1$

For stream temperature, the quality score and zonal score are equivalent.

For stream disturbances, zonal scores are classified as either below or above the percentage occurrence threshold, which is defined as how many stream disturbances occurred in the total stream disturbances reported, including the "none" category. Full credit for the weight is given if below the threshold. Stream disturbances also apply a "showstopper" term for Fish Kill if a threshold is reached. If exceeded, a negative term is introduced producing a lethal flag. The value categories and weights (Figure 15, Figure 16 yellow cells) are editable for refining the scoring.

3) Rating scores. The scores are rated as good, average, poor, and lethal according to the thresholds at the bottom. The values can be edited to refine the scoring.

4) Fish and Habitat scores are a weighted aggregated of the nutrient, stream temperature, and select stream disturbances using Eq. 2 with modified terms (Figure 16) Weighting and rating thresholds are editable in the sheet.

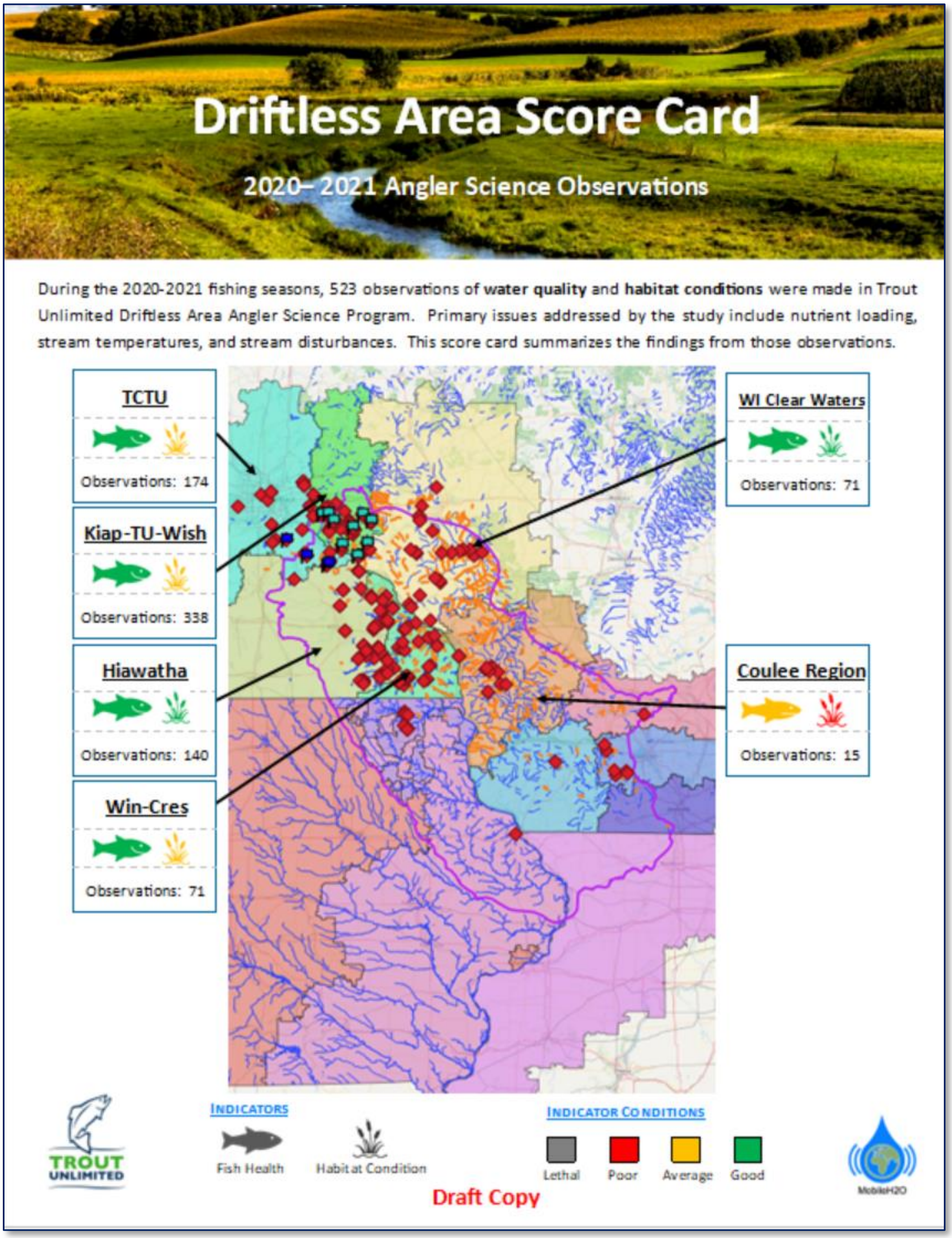
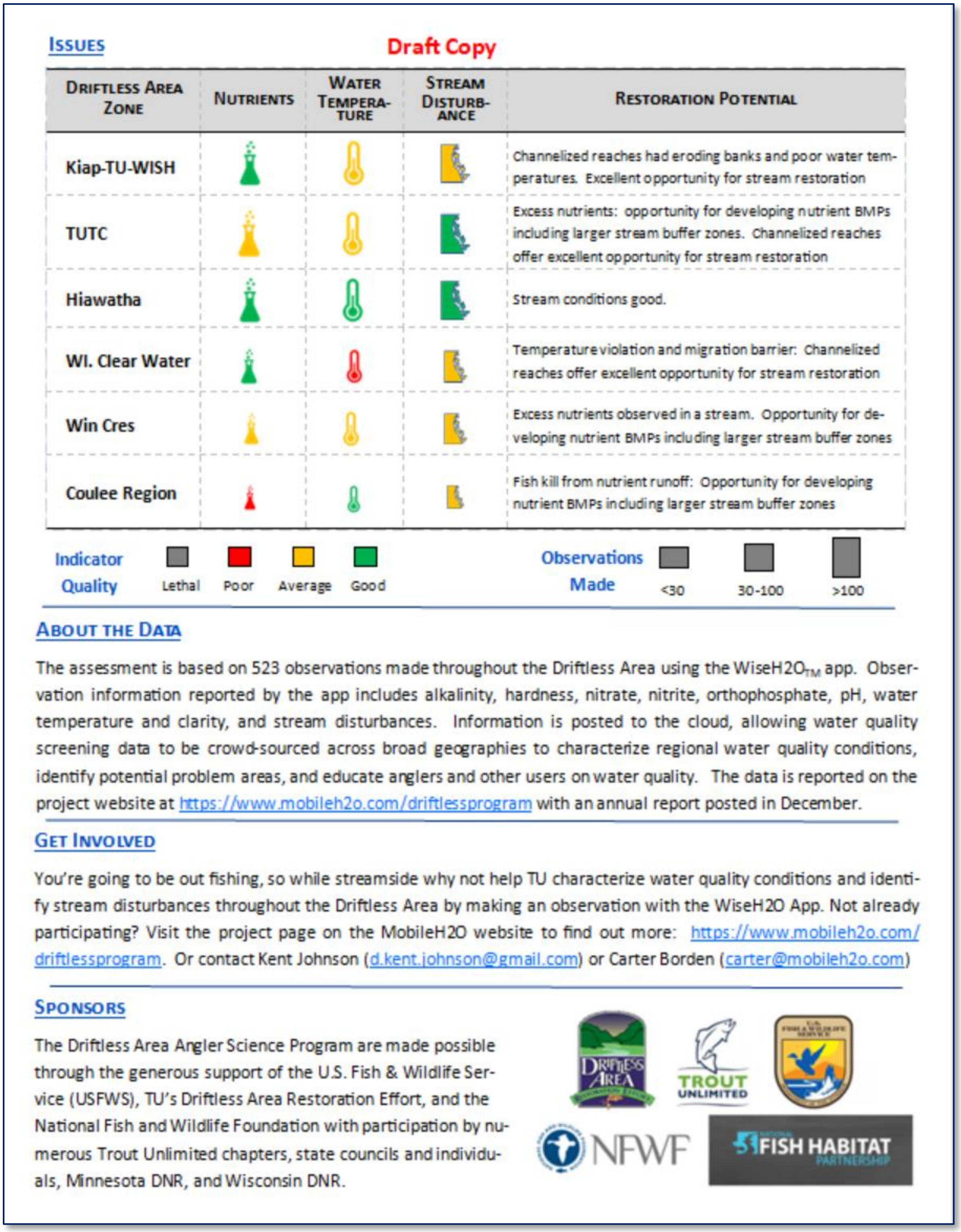


Figure 13. The front page of the TU DARE scorecard is based on WiseH2O data.



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Driftless Area Zone	Nutrients	Water Temperature	Stream Disturbance	Restoration Potential
Kiap-TU-WISH				Channelized reaches had eroding banks and poor water temperatures. Excellent opportunity for stream restoration
TUTC				Excess nutrients: opportunity for developing nutrient BMPs including larger stream buffer zones. Channelized reaches offer excellent opportunity for stream restoration
Hiawatha				Stream conditions good.
WI. Clear Water				Temperature violation and migration barrier: Channelized reaches offer excellent opportunity for stream restoration
Win Cres				Excess nutrients observed in a stream. Opportunity for developing nutrient BMPs including larger stream buffer zones
Coulee Region				Fish kill from nutrient runoff: Opportunity for developing nutrient BMPs including larger stream buffer zones

Indicator Quality: Lethal, Poor, Average, Good

Observations Made: <30, 30-100, >100

ABOUT THE DATA

The assessment is based on 523 observations made throughout the Driftless Area using the WiseH2O$_{TM}$ app. Observation information reported by the app includes alkalinity, hardness, nitrate, nitrite, orthophosphate, pH, water temperature and clarity, and stream disturbances. Information is posted to the cloud, allowing water quality screening data to be crowd-sourced across broad geographies to characterize regional water quality conditions, identify potential problem areas, and educate anglers and other users on water quality. The data is reported on the project website at https://www.mobileh2o.com/driftlessprogram with an annual report posted in December.

GET INVOLVED

You're going to be out fishing, so while streamside why not help TU characterize water quality conditions and identify stream disturbances throughout the Driftless Area by making an observation with the WiseH2O App. Not already participating? Visit the project page on the MobileH2O website to find out more: https://www.mobileh2o.com/driftlessprogram. Or contact Kent Johnson (d.kent.johnson@gmail.com) or Carter Borden (carter@mobileh2o.com)

SPONSORS

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Figure 14. The back page of the TU DARE scorecard is based on WiseH2O data.

	Zone		Zone Count: Kiap TU Wish	Zone Count: Twin Cities	Zone Count: Hiawatha		Zone Scores: Kiap TU Wish	Zone Scores: Twin Cities	Zone Scores: Hiawatha	
Metric	**Value**	**Quality**	1	2	3	**Weight**	1	2	3	
Nutrients						**1.0**	**0.85**	**0.77**	**0.70**	**Notes**
NO2						0.0	0.00	0.00	0.00	
NO3						0.5	0.40	0.38	0.28	
Phos						0.5	0.44	0.39	0.41	
NO2	0	*Good*	170	127	80	1	0.75	0.79	0.63	
	0.15	*Ave*	40	11	32	0.6	0.11	0.04	0.15	
	0.3	*Poor*	7	15	15	0.4	0.01	0.04	0.05	
	1	*Lethal*	5	8	1	0	0.00	0.00	0.00	
		Observations	*226*	*161*	*128*		0.9	0.9	0.8	
NO3	2	*Good*	125	76	23	1	0.55	0.47	0.18	
	5	*Ave*	88	68	49	0.6	0.23	0.25	0.23	
	20	*Poor*	12	17	50	0.4	0.02	0.04	0.16	
	50	*Lethal*	1	0	6	0	0.00	0.00	0.00	
		Observations	*226*	*161*	*128*		0.8	0.8	0.6	
Phos	0	*Good*	224	88	87	1	0.74	0.53	0.62	
	100	*Ave*	67	51	39	0.6	0.13	0.18	0.17	
	500	*Poor*	13	25	14	0.4	0.02	0.06	0.04	
	1000	*Lethal*	0	2	0	0	0.00	0.00	0.00	
		Observations	*304*	*166*	*140*		0.9	0.8	0.8	
Stream Temp							**0.98**	**0.92**	**0.97**	
Temperature	67	*Ave*	315	156	100	1	0.98	0.90	0.96	
	76	*Poor*	8	18	4	0.2	0.00	0.02	0.01	
	77	*SS*	0	0	0	0	0.00	0.00	0.00	
		Observations	*323*	*174*	*104*		1.0	0.9	1.0	
Stream Disturbances						**1.0**	**0.50**	**0.60**	**0.90**	**Notes**
Fish Barrier	5%	*Poor*	5	0	0	0.1	0.10	0.10	0.10	
Bank Erosion	5%	*Poor*	76	10	16	0.1	0.00	0.00	0.00	
Trash	5%	*Poor*	44	8	2	0.1	0.00	0.00	0.10	
Pipe Drain	5%	*Poor*	12	3	5	0.1	0.10	0.10	0.10	
Livestock in Water	5%	*Poor*	0	2	3	0.1	0.10	0.10	0.10	
Algal Bloom	5%	*Poor*	3	1	1	0.1	0.10	0.10	0.10	
None	80%	*Poor*	197	126	93	0.2	0.20	0.00	0.20	
Fish Kill	2	*Poor*	1	0	0	0.2	-0.10	0.20	0.20	>=2 show stopper
		Observations	*338*	*150*	*120*					
				Thresholds		*Good*	*Ave*	*Poor*	*Lethal*	
						0.80	0.65	0.50	0.20	

Figure 15. Sheet computing Nutrient, Stream Temperature, and Stream Disturbance categories on Page 2 of the Scorecard. For space, only the Kiap-TU-WISH, TCTU, and Hiawatha chapters are shown. Value categories, weights (yellow cells), and quality thresholds are editable for refining the scoring.

			Zone Count			Zone Scores				
Zone			Kiap TU Wish	Twin Cities	Hiawatha		Kiap TU Wish	Twin Cities	Hiawatha	
		Observations	338	174	140					
Metric	**Value**	**Quality**	1	2	3	**Weight**	1	2	3	
Overall - Fish						**1.0**	**0.89**	**0.86**	**0.88**	**Notes**
Nutrients						0.4	0.30	0.29	0.29	
Stream Temp						0.4	0.39	0.37	0.39	
Stream Disturbances (algal bloom)						0.2	0.20	0.20	0.20	
Fish Kill >=2	Show Stopper					-1.0	0.00	0.00	0.00	
Habitat						**1.0**	**0.73**	**0.72**	**0.82**	**Notes**
Nutrients						0.3	0.23	0.22	0.22	
Fish Barrier						0.1	0.10	0.10	0.10	
Bank Erosion						0.1	0.00	0.00	0.00	
Trash						0.1	0.00	0.00	0.10	
Pipe Drain						0.1	0.10	0.10	0.10	
Livestock in Water						0.1	0.10	0.10	0.10	
Algal Bloom						0.2	0.20	0.20	0.20	
					Thresholds	*Good*	*Ave*	*Poor*	*Lethal*	
						0.80	0.65	0.50	0.20	

Figure 16. Sheet computing Fish and Habitat Scores on Page 1 of the Scorecard. For space, only the Kiap-TU-WISH, TCTU, and Hiawatha chapters are shown. Weights (yellow cells) and quality thresholds are editable for refining the scoring

Curious about the reported data? See the observation results and download the data below in the *Observations Section*. The section also includes a document outlining the data processing methodology and the computations and ranking methods supporting the Driftless Area Scorecard.