Partners of Scott County Watersheds

Scott County Water Quality Snapshots

What does the data show?

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PSCW Vice Chair

Background

- PSCW – diverse group with mission to develop and implement ways we can be better stewards of watersheds in Scott County. (reps from County, Bett, Dav, Eld, Corn Gwrs, citizens, EICC)
- Since 2000 water quality data has been collected annually in fall and spring around the county.
- PSCW coordinates snapshots, hosted by Bettendorf or Davenport.
- Utilizes volunteers/city staff to collect and analyze water samples.
- Utilized Iowa DNR IOWATER program for equipment and resources until 2017.

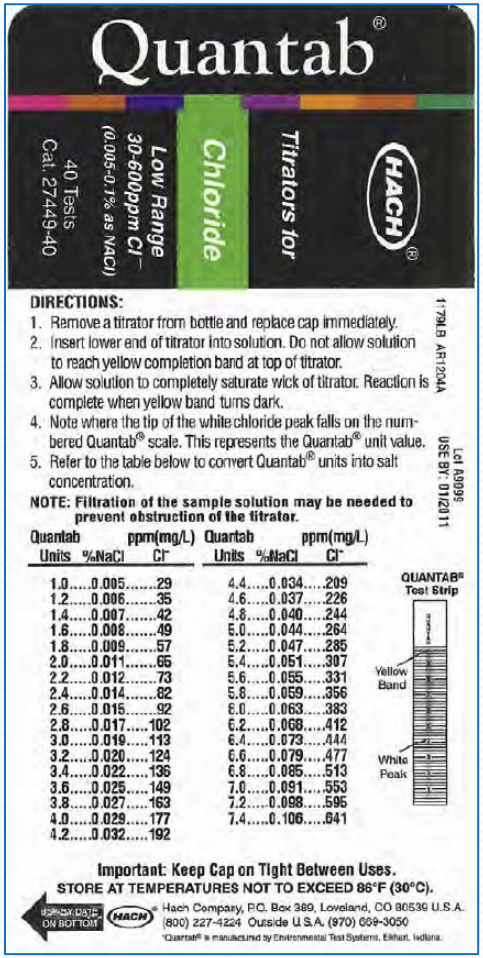
Background

- 239 sample sites throughout Scott County through the years. (not all by PSCW, mostly streams & some lakes)
- Analyzed for nitrate, nitrite, phosphorus, chloride, pH, dissolved oxygen, air/water temperature, transparency, water color. Identified issues in local environment.
- Chemicals analyzed with field kits or test strips (some lab analyses though)
- Indicator fecal bacteria lab analyses also conducted until 2014 (*e coli*).
- Other testing in County done by state, federal or municipalities. I only included relevant data (no metals, pesticides, etc)

Background

- Fall 2017 collected all data from Iowa DNR and local resources to generate a Scott County Database (Oct 2000 to Oct 2017):
  - 1999 *e coli* analyses
  - 2655 water temperature results
  - 774 air temperature
  - 2268 transparency
  - 3021 phosphorus
  - 2605 dissolved oxygen
  - 2354 nitrite
  - 2354 nitrate
  - 2457 pH
  - 2561 chloride

IOWATER Sampling Equipment



Quantab®

HACH®

Titrators for

Chloride

Low Range
30-600ppm Cl⁻
(0.005-0.1% as NaCl)

40 Tests
Cat. 27449-40

DIRECTIONS:

1. Remove a titrator from bottle and replace cap immediately.
2. Insert lower end of titrator into solution. Do not allow solution to reach yellow completion band at top of titrator.
3. Allow solution to completely saturate wick of titrator. Reaction is complete when yellow band turns dark.
4. Note where the tip of the white chloride peak falls on the numbered Quantab® scale. This represents the Quantab® unit value.
5. Refer to the table below to convert Quantab® units into salt concentration.

NOTE: Filtration of the sample solution may be needed to prevent obstruction of the titrator.

Quantab Units	ppm(mg/L) %NaCl	ppm(mg/L) Cl⁻	Quantab Units	ppm(mg/L) %NaCl	ppm(mg/L) Cl⁻
1.0	0.005	29	4.4	0.034	209
1.2	0.006	35	4.6	0.037	226
1.4	0.007	42	4.8	0.040	244
1.6	0.008	49	5.0	0.044	264
1.8	0.009	57	5.2	0.047	285
2.0	0.011	65	5.4	0.051	307
2.2	0.012	73	5.6	0.055	331
2.4	0.014	82	5.8	0.059	356
2.6	0.015	92	6.0	0.063	383
2.8	0.017	102	6.2	0.068	412
3.0	0.019	113	6.4	0.073	444
3.2	0.020	124	6.6	0.079	477
3.4	0.022	136	6.8	0.085	513
3.6	0.025	149	7.0	0.091	553
3.8	0.027	163	7.2	0.098	595
4.0	0.029	177	7.4	0.106	641
4.2	0.032	192			

QUANTAB® Test Strip

Yellow Band

White Peak

Lot A0096
USE BY: 01/2011

1179LB AR1204A

Important: Keep Cap on Tight Between Uses.
STORE AT TEMPERATURES NOT TO EXCEED 86°F (30°C).

USE-BY DATE ON BOTTOM

HACH

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*Quantab® is manufactured by Environmental Test Systems, Elkhart, Indiana.

OK, we have a lot of data……now what?

"Think this is bad? You should see the inside of my head."

Large database offers opportunities:

- Not many counties have this much data over a long period.
- Determine trends, changes since inception.
- Identify areas of concern.
- Dispel conventional wisdom.
- Identify education and stewardship opportunities.
- Let's get started…..

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Methods

- Of the 239 locations, 55 had a dataset over 10 years (minimum threshold).
- Calculated average concentrations of nitrate, nitrite, phosphorus, chloride, transparency, dissolved oxygen and pH for each sample location over sample period.
- Generated charts of concentrations vs. time for each parameter, as to determine a line slope and trend.
- This data analysis enabled generation of a Matrix…

Why a matrix?

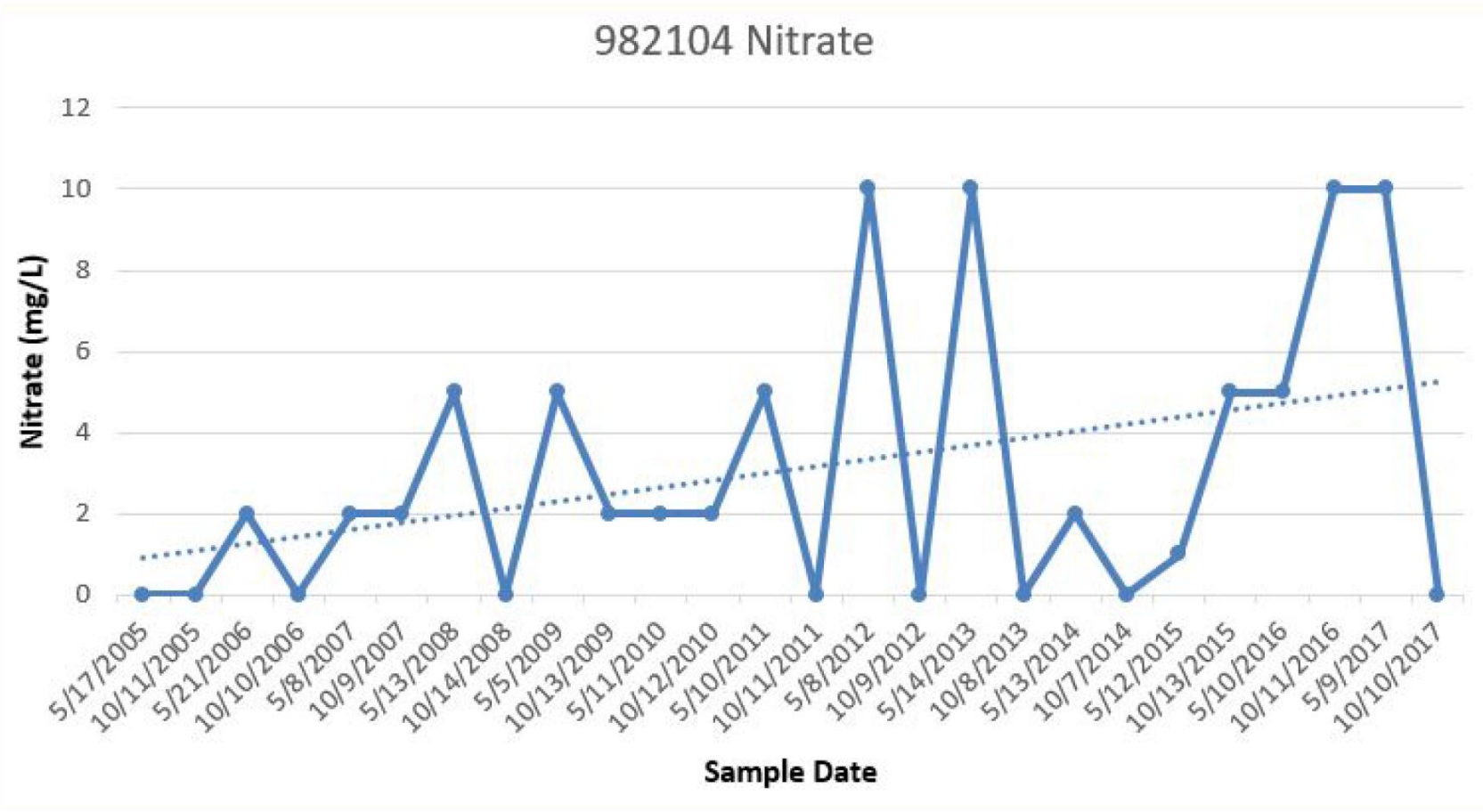
- The key is determining trends.
- Most parameters don't have water quality standards.
- Assumes that optimum condition for a water body is a desirable trend.
- Allows for comparison of a trend (Up, Down or Stable) for each sample location, parameter and water body.
- Also allows for comparison of average value to a reference value for a parameter.
- Enables a focus on areas of concern.

Matrix

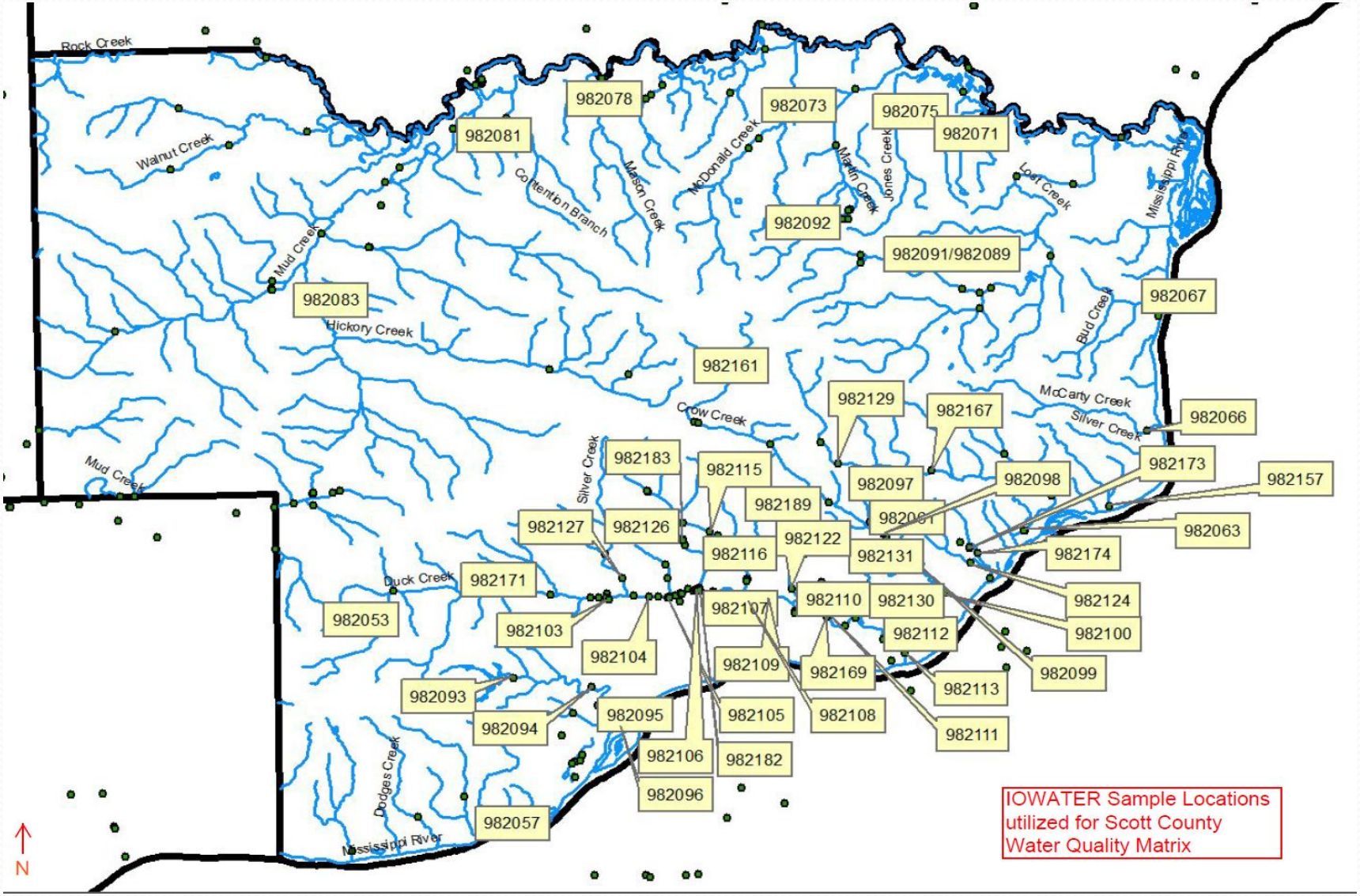
- Trends determined by calculating slope of concentration charts for each parameter in Excel©.
- Up trend means a positive slope, Down is a negative slope, Stable means very small or undeterminable slope.
- Generally we don't want an Up trend, we like Down trends, and depending on the average concentration, Stable can be desirable or not desirable.
- Transparency and Dissolved Oxygen special cases, they are the opposite, Down is not optimum.
- pH is a range (6-9), so Stable is optimum if avg is OK.

Example parameter chart

indicates why a long term dataset is important



Locations used for Matrix



Scott County Water Quality Matrix, 2000-2017 Database

STORET ID	Stream Name	Sample Collection Setting	Nitrate Trend	Nitrate Mean (mg/L)	Nitrite Trend	Nitrite Mean (mg/L)	Phosphorus Trend	Phosphorus Mean (mg/L)	Transparency Trend	Transparency Mean (cm)	Dissolved Oxygen Trend	Dissolved Oxygen Mean (mg/L)	Chloride Trend	Chloride Mean (mg/L)	pH Trend	pH Mean	*e coli* Geometric Mean (org/100 ml)
982093	Blackhawk Creek	Rural	Up	0.3	Down	0.12	Down	2	Down	36	Up	6	Down	33	Stable	8	400
982094	Blackhawk Creek	Suburban	Down	0.3	Down	0.03	Stable	0.5	Down	39	Stable	8	Stable	42	Up	8	545
982095	Blackhawk Creek	Suburban	Stable	0.3	Down	0.01	Stable	0.2	Down	44	Up	8	Down	63	Stable	8	514
982096	Blackhawk Creek	Suburban	Stable	0.8	Down	0.01	Stable	0.2	Down	42	Down	8	Down	55	Stable	8	282
982067	Bud Creek	Rural	Up	3	Down	0.03	Down	0.1	Up	26	Down	8	Stable	34	Up	8	117
982182	Candlelight Creek	Urban	Stable	0.3	Down	0.02	Down	0.3	Up	52	Down	8	Stable	183	Down	8	686
982183	Candlelight Creek	Urban	Stable	0.1	Stable	0	Down	0.7	Down	51	Down	5	Down	123	Down	8	546
982097	Crow Creek	Suburban	Up	3	Down	0.03	Stable	0.7	Stable	39	Up	8	Stable	50	Down	8	644
982098	Crow Creek	Suburban	Up	3	Down	0.04	Up	0.4	Stable	42	Down	7	Up	68	Up	8	567
982099	Crow Creek	Suburban	Up	3	Down	0.03	Stable	0.4	Stable	45	Up	8	Up	59	Down	8	422
982100	Crow Creek	Suburban	Stable	3	Down	0.05	Up	0.4	Stable	51	Down	8	Up	80	Stable	8	374
982161	Crow Creek	Suburban	Up	3	Down	0.02	Stable	0.4	Stable	47	Up	7	Up	51	Stable	8	545
982057	Donaldson Creek	Rural	Up	5	Down	0.24	Stable	0.3	Stable	30	Stable	8	Up	65	Stable	8	429
982053	Duck Creek	Rural	Up	5	Up	0.08	Up	0.2	Stable	25	Down	8	Down	37	Up	8	562
982103	Duck Creek	Suburban	Up	4	Stable	0.13	Up	0.3	Stable	27	Down	8	Stable	36	Down	8	248
982104	Duck Creek	Urban	Up	3	Down	0.08	Up	0.2	Up	31	Stable	8	Stable	42	Stable	8	933
982105	Duck Creek	Urban	Up	4	Down	0.04	Up	0.4	Stable	33	Stable	8	Down	52	Stable	8	489
982106	Duck Creek	Urban	Up	3	Down	0.03	Up	0.4	Stable	36	Stable	9	Down	97	Down	8	824
982107	Duck Creek	Urban	Stable	3	Down	0.04	Down	0.2	Stable	40	Stable	8	Down	91	Stable	8	798
982108	Duck Creek	Urban	Down	3	Down	0.03	Up	0.2	Up	40	Up	8	Up	58	Down	8	445
982109	Duck Creek	Urban	Up	3	Down	0.08	Up	0.2	Up	43	Down	9	Up	56	Down	8	660
982110	Duck Creek	Urban	Up	2	Down	0.09	Down	0.2	Stable	48	Up	9	Up	60	Down	8	595
982111	Duck Creek	Urban	Up	3	Stable	0.06	Stable	0.2	Stable	45	Stable	8	Stable	93	Stable	8	341
982112	Duck Creek	Urban	Up	3	Up	0.07	Up	0.2	Stable	50	Down	9	Up	83	Stable	8	346
982113	Duck Creek	Urban	Stable	3	Down	0.08	Up	0.3	Stable	44	Stable	8	Stable	55	Down	8	332
982169	Duck Creek	Urban	Up	3	Down	0.07	Stable	0.2	Up	46	Down	8	Up	102	Stable	8	567
982171	Duck Creek	Rural	Up	4	Down	0.08	Down	0.2	Stable	29	Stable	9	Up	98	Stable	8	508
982061	Field Sike Creek	Suburban	Up	2	Down	0.11	Down	0.4	Up	38	Stable	8	Up	57	Stable	8	329
982092	Glynns Branch	Rural	Up	7	Down	0.07	Stable	0.3	Stable	33	Down	7	Down	32	Up	8	283
982115	Goose Creek	Urban	Up	2	Stable	0.11	Up	0.2	Down	34	Down	8	Stable	77	Down	8	855
982116	Goose Creek	Urban	Up	2	Down	0.03	Up	0.2	Down	35	Up	7	Up	82	Stable	8	742
982118	Greenway Creek	Urban	Down	1	Down	0.03	Up	0.5	Up	51	Down	7	Up	174	Down	8	1074
982189	Hanlin Creek	Suburban	Down	0.2	Down	0.01	Up	0.3	Down	53	Down	5	Up	133	Up	7	141
982083	Hickory Creek	Rural	Up	6	Down	0.06	Stable	0.4	Up	40	Down	8	Up	30	Stable	8	319
982075	Jones Creek	Rural	Up	3	Down	0.04	Stable	0.2	Up	34	Down	9	Stable	27	Up	8	1159
982091	Lost Creek	Rural	Up	6	Down	0.07	Stable	0.3	Down	36	Down	8	Up	27	Up	8	294
982132	Manhole Gilbert/13th	Urban	Down	1	Down	0.02	Up	0.4	Down	55	Stable	9	Up	300	Down	8	61
982078	Mason Creek	Rural	Stable	4	Down	0.12	Stable	0.4	Stable	46	Down	8	Stable	40	Down	8	614
982066	McCarty Creek	Rural	Up	6	Down	0.03	Down	0.1	Down	46	Down	8	Down	27	Up	8	302
982071	McDonald Creek	Rural	Up	4	Down	0.13	Down	0.3	Down	46	Up	6	Stable	27	Up	8	467
982073	McDonald Creek	Rural	Up	5	Down	0.07	Down	0.5	Stable	46	Down	9	Stable	35	Up	8	328
982081	Mud Creek	Rural	Up	5	Down	0.16	Up	0.4	Up	38	Down	8	Up	26	Stable	8	557
982122	Pheasant Ck	Urban	Down	1	Down	0.01	Up	0.2	Stable	47	Up	8	Up	123	Down	8	456
982174	Pigeon Creek, East	Suburban	Stable	2	Down	0.03	Stable	0.3	Down	50	Down	7	Up	86	Up	8	876
982124	Pigeon Creek, West	Suburban	Down	2	Down	0.03	Up	0.2	Down	54	Down	8	Up	100	Down	8	848
982173	Pigeon Creek, West	Suburban	Down	2	Down	0.03	Up	0.6	Down	41	Stable	9	Up	72	Up	8	516
982126	Robin Creek	Urban	Down	0.1	Down	0.01	Up	0.3	Up	49	Down	6	Down	133	Down	8	910
982089	S Trib Lost Grove Lake	Rural	Up	7	Down	0.11	Down	0.3	Up	29	Down	7	Up	27	Up	8	311
982127	Silver Creek	Suburban	Up	4	Down	0.07	Up	0.3	Stable	41	Up	7	Down	66	Down	8	478
982063	Spencer Creek	Suburban	Up	6	Down	0.05	Down	0.3	Up	40	Stable	9	Up	37	Up	8	729
982129	Spencer Creek	Rural	Up	8	Up	0.04	Stable	0.3	Down	35	Up	8	Up	27	Stable	8	308
982167	Spencer Creek	Rural	Up	7	Down	0.03	Stable	0.3	Down	29	Stable	8	Stable	34	Stable	8	220
982130	Stafford Ck	Urban	Stable	1	Stable	0.06	Up	0.3	Down	44	Up	7	Up	184	Stable	8	1055
982131	Stafford Ck	Urban	Stable	1	Down	0.02	Stable	0.2	Down	50	Stable	7	Up	132	Stable	8	847
982157	Unnamed Creek near I-80	Rural	Up	13	Down	0.09	Up	3.1	Down	44	Up	8	Down	116	Up	8	2570

1) E coli TMDL (126 org/ 100 mL) exceedances not highlighted due to majority of locations exceeding the TMDL.

TRENDS: Green-desirable trend, Yellow-stable trend, Red-undesirable trend
MEANS: Green-no concern, Yellow-concern, Red- high concern

Matrix

- DNR reviewed methodology, agreed and made suggestions, but will not comment on report.
- Key is the trends. The reference values and averages add accuracy.
- Had to research reference values to compare averages to, so to determine if a trend warranted concern.
  - Two sets of reference values.
    - First based on IOWATER concern levels (if average exceeds these site is a high concern and coded Red in Matrix)
    - Second based on literature (if exceeded coded Yellow in Matrix).
    - Green means average below both reference levels!
    - Neither one enforceable by state or feds. Neither one based on drinking water standards.
- For instance, pH has a desirable range of 6-9, dissolved oxygen desirable at 5 mg/L and above, phosphorus negative impacts above 0.1 mg/L.
- No standards from state or feds anytime soon, at least for nutrients. Variable, hard to obtain, controversial.
- Trends
  - Red = not desirable
  - Yellow = stable
  - Green = desirable
  - Remember, desirable can mean Up or Down trend, depending on the parameter

Matrix

- Color coding based on trend and average values (as compared to reference values)
- For instance for a given parameter:
  - Red trend and a red average = sample location a high concern
  - Red trend and a yellow average = sample location a concern
  - Yellow trend and green average = not a concern
  - Green trend and green average = not a concern
  - 9 determination categories total.

Matrix

- Utilized Matrix to review each sample location and associated stream for each parameter.
- 26 Streams in Matrix and one storm sewer
- Rural: 12
- Urban: 7
- Remaining 7 Suburban/Rural or Suburban/Rural

Results

- Nitrates:
  - No areas of high concern, one location with average above drinking water standard (not a DW source).
  - Trends mostly Up or Stable in rural settings.
  - Mix of Up, Stable, Down in suburban.
  - Mostly Up in urban.
  - Most sample locations had average values between 1 and 6 mg/L. Rural settings tended to have higher averages.
  - Nitrates are present and a concern for Rural, Suburban and Urban settings.

Results

- Nitrites:
  - No areas of high concern.
  - Short lived chemical in nitrogen cycle.
  - Minor concern in rural and suburban settings.
  - Trends are predominantly Down or Stable.
  - Only one location with average above reference value.

Results

- Transparency:
  - One area of high concern, rural location Spencer Creek.
  - Trends a mix in all 3 settings.
  - Lower values (less transparent) tended to be in rural settings.
  - A concern in suburban and rural settings.

Results

- Phosphorus:
  - All locations had averages above reference level.
  - Portions of Blackhawk Creek (rural reach), Candlelight Creek, Pigeon Creek West, I-80 Unnamed Creek, Crow Creek are areas of high concern.
  - Higher averages tended to be in rural locations ($\geq$0.3 mg/L), but urban and suburban not much lower (0.2 mg/L).
  - Generally Up in urban and suburban, mixed in rural.
  - Present and a concern in all 3 settings.

Results

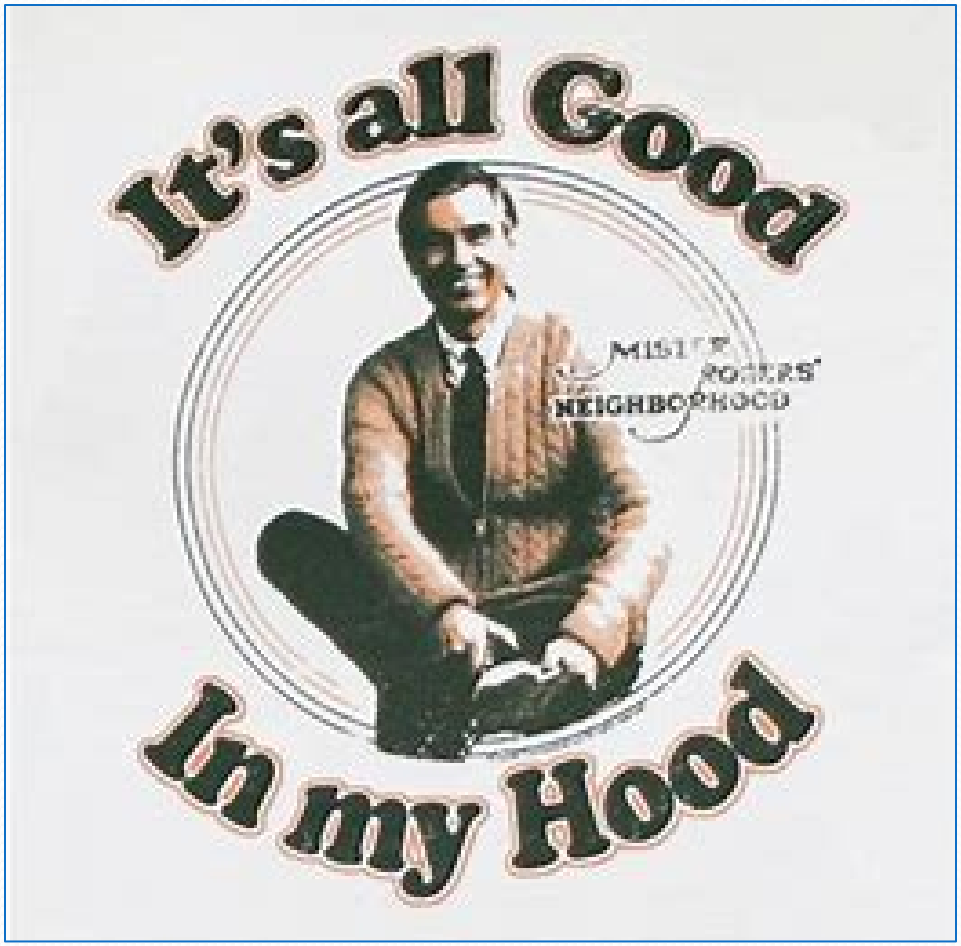
- Dissolved Oxygen:
  - Two areas of high concern. Candlelight Creek, Hanlin Creek.
  - Trends generally down (not desirable) in rural settings (but high average concentrations though). Mix for suburban and urban.
  - Minor concern for urban and suburban settings.

Results

- Chloride:
  - Areas of high concern: Candlelight Creek, portion of Duck Creek, Greenway Creek, Hanlin Creek, Pheasant Creek, Pigeon Creek West, Robin Creek, Stafford Creek, Unnamed I-80 Creek. One storm sewer had highest average at 300 mg/L.
  - Trends generally up in urban and rural settings. Mix for rural.
  - Present and a concern for urban and suburban settings.
  - State WQ standards exist, calculated for individual water body.

Results

- pH:
  - No concerns!



Results

- Bacteria impairment:
  - No recent data since 2014.
  - *E coli* is an indicator species of fecal contamination. Some concern of validity as a indicator, but USEPA in 2012 recommended to continue using it.
  - Virtually all locations have values that exceed the Duck Creek TMDL of 126 org/100 ml. (probably same standard would be used for other watersheds)
  - Current DNR 303 (d) bacteria impairments in Scott County: Duck Creek, Crow Creek, Stafford Creek, Candlelight Creek, Robin Creek, Goose Creek, Silver Creek, Pheasant Creek, Lake of the Hills.
  - Trends can't be determined, too sporadic and ubiquitous.
  - Present and a concern for rural, urban and suburban settings.
  - More later….

Results

- Accuracy:
  - IOWATER kits never as accurate as a laboratory, but cheaper and easier.
  - Mid 2000's split samples collected by Iowa DNR (328 total). Allows for comparison of nitrate/nitrite IOWATER results to lab results. P could not be compared.
  - 83% of field test results were less than the corresponding lab result.
  - Average difference was 4 mg/L.
  - Margin of error can be estimated at 4 mg/L for nitrate/nitrite IOWATER field results, emphasizing likely <u>underestimating</u> actual value.
  - More later….

Results

- Comparison to other Iowa Counties:
  - Not all have large dataset like Scott County
  - Compared nitrate and phosphorus IOWATER data average concentration for entire County. Difficult to compare, different geomorphic (landform) regions.
  - Nitrate
    - 61 of 99 counties had data to compare to
    - Scott County average 3.2 mg/L, we are 48th of 62. Missing 1/3 of Iowa to compare to though.
  - Phosphorus
    - 90 of 99 counties had data to compare to
    - Scott County average 0.4 mg/L, we are 17th of 90. Eight other counties same average.

Results

- May 2018 Snapshot:
  - Revised sample locations to ensure greater coverage, efficiency, and avoid duplication.
  - 48 sample locations. Two ponds with floating treatment wetlands.
  - 9 locations split sample, lab analysis for NO3 and P.
  - No surprises in results, continued trends.
  - Lab results
    - 7 of 9 P field samples 0.1 to 0.2 mg/L less than lab, but lab measured TP. Highest lab result: 2.9 mg/L at 982157 (unnamed I-80 Creek).
    - 6 of 9 NO3 field samples less or equal to lab (within 3 mg/L). Highest lab result 15.1 mg/L at 982157.

Snapshots -future

- Fall 2017 IOWATER no more, DNR to provide some equipment and tech support. Data storage changed.
- Same time Scott County, Waste Commission, Dav, Bett, Nahant, PSCW, others, formed committee (XWST) to keep snapshots going.
  - We will create a public online database for all past and current data. Also more features…sign up for events, create graphs. Through Xstream Cleanup.
  - Revised sample locations.
  - Split samples for lab analysis of select sites. Adds accuracy and validity. Nutrients and hopefully DNA fecal tracking.
  - Working on better sampling equipment and training.
  - Snapshots still coordinated by PSCW.
  - Spring, Summer, Fall. Summer event will have invertebrate surveys.

Conclusions

- Nutrients a concern in urban, suburban and rural areas
  - Not just coming in from rural to urban
  - General trends not desirable.
- Chloride not just a urban concern. Somewhat Up, some areas of concern.
- DO generally not desirable trend but current averages OK.
- Transparency somewhat not desirable trends, few areas of concern.
- pH is OK.
- Database and Matrix allow for focus on specific parameters on specific water bodies.
- Majority of streams originate within County borders, so WQ issues are our problem.
- There are WQ issues:
  - Not the end of the world, but not great either.
  - Too many undesirable trends.
  - Scott County is probably average in Iowa for our type of landforms (more research to verify)
  - Biggest concerns are likely nutrients and bacteria impairments.
    - No recent or significant data on other chemicals of concern

Recommendations

- Continue snapshots – focus on validity, coverage, training, replicability, equipment, micro-invertebrates. Lab analysis with field analysis, add MST.
  - MST will allow for identification of probable fecal sources, needed to address bacteria impairments. Accurate and valuable, but expensive.
  - Look into more extensive analysis on a 5 year period?
- Use Matrix to focus on problem areas.
  - Most likely as part of larger effort, countywide water quality plan.
  - Some may be quick fixes, others a combined effort.

Questions?