Using Business Objects and Web Intelligence to Inform Water Quality Assessment Decisions

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Missouri Department of Natural Resources

Data Management Tools Session

The National Water Quality Data Management Training Workshop

May 31, 2017

Problem

- How can we speed up and our assessment process while allowing for flexible automation.

- Solution: SAP Business Objects – Web Intelligence
  - Web Based Reporting tool that our IT implemented and maintains.
    - Customizable reporting that includes conditional formatting and formula writing, and input controls
  - Based on our data management system
  - This cut our assessment time by at least 50% if not more. It also decreases training time for new staff. Went from average of 120 days to 44 days.

Context

- 4300+ Assessment Units
- 2,000,000+ Data Points
- 3 Staff
- Assess Streams and Reservoirs

Process

- How has the tool / process improved workflow?
  - Semi-Automated
    - Only internal data. We use external data but import it into our system.
    - Human element
      - Manual selection of AU to be assessed
      - Can pick and choose the following to use in assessment via input controls
        - Sites, sample numbers, dates, parameters, organization, QC, etc. pretty well anything tied to the sample data.
      - Once selections are made formatting and organizing of data is automatic
        - Conditional formatting to highlight exceedances, new data, etc.
        - Includes mathematical and logical formulas, can pass formulas to excel
          - Eg. Counts, means, geomeans,
      - Output to Excel or PDF
    - Most QC of data should be done before assessments, but small amount of QC for duplicate samples, Upstream/Downstream comparisons, the "exceptions", etc.

Process

- Is the tool available for use?
  - Not open source, but should be implementable through most IT programs by their database management staff.
  - Used for auto generating 303(d) list and delist.
    - Summarizing pollutants and sources
  - Used for calculating 305(b) stats
  - Can be utilized for other programs as well
    - Eg. Permits and Compliance/Enforcement use it as well.
- Saves Time
  - Tool does 95% of the time consuming tedious, repetitive tasks
  - Allows us to more effectively organize data to analyze it in different ways
    - Can group, create sections, and create breaks in the data and summarize for each
    - Eg. Can choose which sites to group together for an U/D comparison then create sections of the data and have summary statistics calculated for each automatically.
  - The tool reports all media types at one time for each AU and also generates a summary of the available data and AU status from last assessment cycle

Missouri Department of Natural Resources
Barn Hollow - WBID 2693.00

National Park Service
HUC 8: 11010008

Org	Site Code	Site Name	Media Type	Sample Type	Yr	Mo	Dy	Time	H	Sample ID	C (C)	DO (mg/l)	Flow (cfs)	pH (pH units)	SC (uS/cm)
NPS/NPS-ONSR	2693/0.1	Barn Hollow Ck, upstream of entrance to Jacks Fork R	Water - Raw - Grab	Grab	2010	7	1			245709	20.00	2.76	0.14	7.20	320.60
NPS/NPS-ONSR	2693/0.1	Barn Hollow Ck, upstream of entrance to Jacks Fork R	Water - Raw - Grab	Grab	2011	6	8			245710	18.20	8.44	1.60	7.89	251.40
NPS/NPS-ONSR	2693/0.1	Barn Hollow Ck, upstream of entrance to Jacks Fork R	Water - Raw - Grab	Grab	2011	8	3			245711	25.30	4.94	0.04	7.62	270.00
NPS/NPS-ONSR	2693/0.1	Barn Hollow Ck, upstream of entrance to Jacks Fork R	Water - Raw - Grab	Grab	2011	9	8			245712	15.50	6.18	0.02	7.91	271.80
NPS/NPS-ONSR	2693/0.1	Barn Hollow Ck, upstream of entrance to Jacks Fork R	Water - Raw - Grab	Grab	2012	6	12			245713	17.90	6.09	0.21	7.80	247.40
NPS/NPS-ONSR	2693/0.1	Barn Hollow Ck, upstream of entrance to Jacks Fork R	Water - Raw - Grab	Grab	2012	8	7			245714	21.20	4.52	0.10	7.72	319.90
NPS/NPS-ONSR	2693/0.1	Barn Hollow Ck, upstream of entrance to Jacks Fork R	Water - Raw - Grab	Grab	2012	9	17			245715	18.40	6.28	0.11	8.01	302.80
NPS/NPS-ONSR	2693/0.1	Barn Hollow Ck, upstream of entrance to Jacks Fork R	Water - Raw - Grab	Grab	2013	5	23			245716	16.10	5.52	0.33	7.64	259.10
NPS/NPS-ONSR	2693/0.1	Barn Hollow Ck, upstream of entrance to Jacks Fork R	Water - Raw - Grab	Grab	2013	6	11			245717	17.50	8.25	0.91	7.80	256.30
NPS/NPS-ONSR	2693/0.1	Barn Hollow Ck, upstream of entrance to Jacks Fork R	Water - Raw - Grab	Grab	2013	7	2			245718	19.00	3.06	0.07	7.72	301.80
NPS/NPS-ONSR	2693/0.1	Barn Hollow Ck, upstream of entrance to Jacks Fork R	Water - Raw - Grab	Grab	2013	7	29			245719	19.10	4.07	0.02	7.76	272.40
NPS/NPS-ONSR	2693/0.1	Barn Hollow Ck, upstream of entrance to Jacks Fork R	Water - Raw - Grab	Grab	2014	5	19			266329	13.90	9.78	0.69	7.95	251.20
NPS/NPS-ONSR	2693/0.1	Barn Hollow Ck, upstream of entrance to Jacks Fork R	Water - Raw - Grab	Grab	2014	6	18			266333	21.30	3.96	0.19	7.79	315.00
NPS/NPS-ONSR	2693/0.1	Barn Hollow Ck, upstream of entrance to Jacks Fork R	Water - Raw - Grab	Grab	2014	7	15			266337	20.20	4.99	0.09	7.99	290.70
NPS/NPS-ONSR	2693/0.1	Barn Hollow Ck, upstream of entrance to Jacks Fork R	Water - Raw - Grab	Grab	2014	8	11			266341	21.40	4.32	0.12	7.93	239.10
NPS/NPS-ONSR	2693/0.1	Barn Hollow Ck, upstream of entrance to Jacks Fork R	Water - Raw - Grab	Grab	2015	7	21			266345	19.40	6.00		7.61	261.60

	C (C)	DO (mg/l)	Flow (cfs)	pH (pH units)	SC (uS/cm)
Average:	19.03	5.57		7.77	276.9
Exceedances:	0	8	--	0	--
Total Number of Samples:	16	16	15	16	16
Binomial Probability Type One Error Rate:	=BINOM.DIST (16,16,0.90, TRUE)	=BINOM.DIST (8,16,0.90,TRUE)	--	=BINOM.DIST (16,16,0.90, TRUE)	--

*Sample is the average of two or more duplicate samples.

Dissolved Oxygen

The water quality standard for Dissolved Oxygen (for the protection of warm water habitat and cool water habitat) is 5.0 mg/L as a minimum. The water quality standard for Dissolved Oxygen (for the protection of cold water habitat) is 6.0 mg/L as a minimum. The water quality standard allows no more than ten percent of the samples to fall below either 5.0 mg/L or 6.0mg/L depending on the applicable use. To account for Type One and Type Two Errors we use the Binomial Probability formula to give us a Type One Error rate. The minimum allowable error rate is 0.1; a stream would be judged as impaired if the Type One error rate is less than 0.1.

Total Number of Exceedances: [   ]   Total Number of Samples: [16]

The Binomial Probability Type One Error Rate is: [   ]   Thus Barn Hollow is judged as impaired for Dissolved Oxygen

Ammonia Toxicity

Input Controls
New Map Reset

Document Input controls (3)
Unclassified Flag In list All ...
Sample Type In list All values
Qa Rated In list Y

Report Input Controls (3)
Recreational Season Flag = Y

Site Code
- [ ] (Select All)
- [ ] 3240/0.2
- [x] 3240/1.7
- [ ] 3240/2.6
OK

Organization Name
- [ ] (Select All)
- [ ] Black and Veatch Inc.
- [x] Newton County Health Dept.
OK

Org	Site	Location	Type	Year	Mo	Day	QA	Sample ID	Value
NCHD	3240/1.7	Baynham Br. @ Lime Kiln Dr	Grab	2010	9	7	Y	184753	800.40
NCHD	3240/1.7	Baynham Br. @ Lime Kiln Dr	Grab	2010	9	21	Y	184754	435.20
NCHD	3240/1.7	Baynham Br. @ Lime Kiln Dr	Grab	2010	10	6	Y	190840	155.30
NCHD	3240/1.7	Baynham Br. @ Lime Kiln Dr	Grab	2010	10	19	Y	190841	461.10

2010 Recreational Season Geometric Mean - No Data Qualifier Adjustment:	438.52	Sample Count = 15
2010 Recreational Season Geometric Mean:		438.52

*Sample is the average of two or more duplicate samples.

Org	Site	Location	Type	Year	Mo	Day	QA	Sample ID	Value
NCHD	3240/1.7	Baynham Br. @ Lime Kiln Dr	Grab	2011	4	5	Y	209654	126.60
NCHD	3240/1.7	Baynham Br. @ Lime Kiln Dr	Grab	2011	4	12	Y	209655	275.50
NCHD	3240/1.7	Baynham Br. @ Lime Kiln Dr	Grab	2011	4	19	Y	209656	816.40
NCHD	3240/1.7	Baynham Br. @ Lime Kiln Dr	Grab	2011	4	26	Y	209657	974.00
NCHD	3240/1.7	Baynham Br. @ Lime Kiln Dr	Grab	2011	5	3	Y	209658	171.00
NCHD	3240/1.7	Baynham Br. @ Lime Kiln Dr	Grab	2011	5	10	Y	209659	410.60
NCHD	3240/1.7	Baynham Br. @ Lime Kiln Dr	Grab	2011	5	17	Y	209660	410.60
NCHD	3240/1.7	Baynham Br. @ Lime Kiln Dr	Grab	2011	5	31	Y	209661	290.90
NCHD	3240/1.7	Baynham Br. @ Lime Kiln Dr	Grab	2011	6	7	Y	209662	146.70
NCHD	3240/1.7	Baynham Br. @ Lime Kiln Dr	Grab	2011	6	14	Y	209663	365.40
NCHD	3240/1.7	Baynham Br. @ Lime Kiln Dr	Grab	2011	6	21	Y	209664	210.10
NCHD	3240/1.7	Baynham Br. @ Lime Kiln Dr	Grab	2011	6	28	Y	209665	248.90
NCHD	3240/1.7	Baynham Br. @ Lime Kiln Dr	Grab	2011	7	5	Y	209666	365.40
NCHD	3240/1.7	Baynham Br. @ Lime Kiln Dr	Grab	2011	7	12	Y	209667	727.00
NCHD	3240/1.7	Baynham Br. @ Lime Kiln Dr	Grab	2011	7	20	Y	209668	387.30
NCHD	3240/1.7	Baynham Br. @ Lime Kiln Dr	Grab	2011	7	26	Y	209669	275.50
NCHD	3240/1.7	Baynham Br. @ Lime Kiln Dr	Grab	2011	8	2	Y	209670	135.40
NCHD	3240/1.7	Baynham Br. @ Lime Kiln Dr	Grab	2011	8	9	Y	209671	1986.30
NCHD	3240/1.7	Baynham Br. @ Lime Kiln Dr	Grab	2011	8	16	Y	209672	101.40
NCHD	3240/1.7	Baynham Br. @ Lime Kiln Dr	Grab	2011	8	23	Y	209673	55.60
NCHD	3240/1.7	Baynham Br. @ Lime Kiln Dr	Grab	2011	8	30	Y	209674	65.00
NCHD	3240/1.7	Baynham Br. @ Lime Kiln Dr	Grab	2011	9	6	Y	209675	36.80
NCHD	3240/1.7	Baynham Br. @ Lime Kiln Dr	Grab	2011	9	13	Y	209676	118.70
NCHD	3240/1.7	Baynham Br. @ Lime Kiln Dr	Grab	2011	9	20	Y	209677	200.00
NCHD	3240/1.7	Baynham Br. @ Lime Kiln Dr	Grab	2011	9	27	Y	209678	28.50
NCHD	3240/1.7	Baynham Br. @ Lime Kiln Dr	Grab	2011	10	4	Y	209679	47.30
NCHD	3240/1.7	Baynham Br. @ Lime Kiln Dr	Grab	2011	10	11	Y	209680	256.90
NCHD	3240/1.7	Baynham Br. @ Lime Kiln Dr	Grab	2011	10	18	Y	209681	1046.20
NCHD	3240/1.7	Baynham Br. @ Lime Kiln Dr	Grab	2011	10	26	Y	209682	228.20

2011 Recreational Season Geometric Mean - No Data Qualifier Adjustment:	223.32	Sample Count = 29
2011 Recreational Season Geometric Mean:		223.32

*Sample is the average of two or more duplicate samples.

Bacteria

Baynham Br. is a Class B Whole Body Contact recreational water with an E. coli standard of 206 colonies/100 ml. This standard is interpreted as the geometric mean of at least five samples taken during the recreational season, April 1 to October 31, of any given year. A water body is judged to be impaired if the standard is exceeded in any of the last three years for which there is adequate data. Baynham Br. is also a Secondary Contact recreational water with an E. coli standard of 1134 colonies/100 ml. This standard is interpreted as the geometric mean of at least five samples taken during the recreational season, April 1 to October 31, of any given year. A water body is judged to be impaired if the standard is exceeded in any of the last three years for which there is adequate data.
Baynham Br. has exceeded one or both criterion at least once in the last three years of available data.
Thus Baynham Br. is judged as impaired for Escherichia coli.

Missouri Department of Natural Resources, Water Protection Program, (573)751-1300, www.dnr.mo.gov

http://www.dnr.mo.gov/mocwis_public/wqa/waterbodySearch.do

Missouri Department of Natural Resources
Blackberry Cr. - WBID 3184.00

Assessment Summary
HUC 8: 11070207

Media Type Sampled	Year Range	Sampling Organization	Samples Collected
Community Data - Invertebrates	2010 - 2011	Missouri Dept. of Natural Resources	4
		Subtotal:	4
Sediment - Solid Phase	2013 - 2013	Missouri Dept. of Natural Resources	1
		Subtotal:	1
Water - Raw - Grab	2010 - 2012	Jasper County Health Dept.	48
	2006 - 2006	Missouri Dept. of Natural Resources	4
	2010 - 2011	Missouri Dept. of Natural Resources / FEBIO	4
	2006 - 2016	Missouri Dept. of Natural Resources / FELWF	44
	2014 - 2014	Missouri Dept. of Natural Resources / FESAC	1
	2013 - 2013	Missouri Dept. of Natural Resources / FEWLA	1
		Subtotal:	102
		Total Number of Samples:	**107**

Blackberry Cr.'s (3184.00) Uses and their 2016 Listing Cycle Status

Category 5

Human Health Protection (HHP) -- Use Not Assessed, Inadequate Data

Irrigation (IRR) -- Use Not Assessed, Inadequate Data

Livestock and Wildlife Watering (LWW) -- Use Not Assessed, Inadequate Data

Protection of Aesthetics and Acute Toxicity (GEN) -- Use Not Assessed, Inadequate Data

Protection of Aquatic Life (AQL) -- Use Not Supported

Secondary Contact Recreation (SCR) -- Use is Fully Supported

Whole Body Contact (WBC B) -- Use is Fully Supported

Assessment Comments: impaired by chloride, sulfate plus chloride (total dissolved solids), and low DO
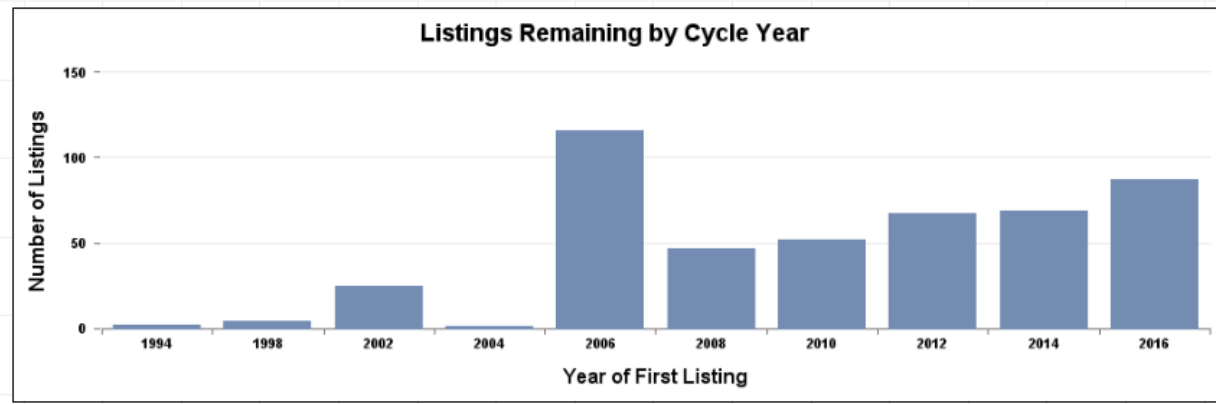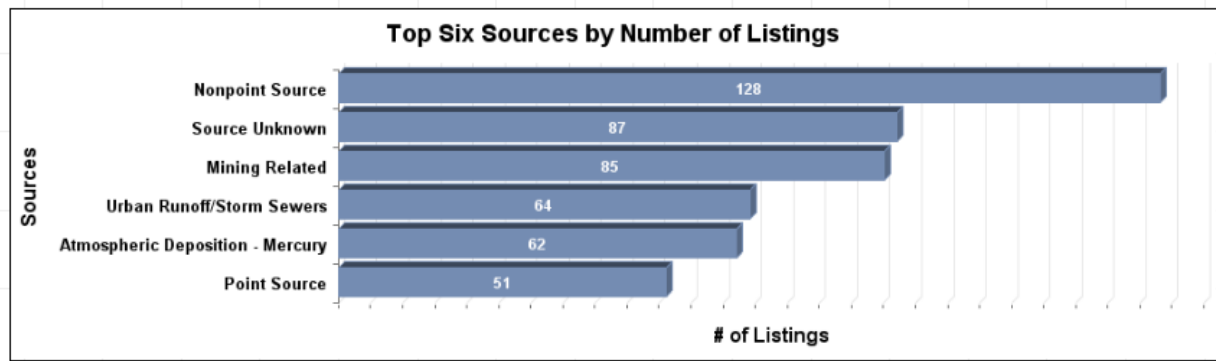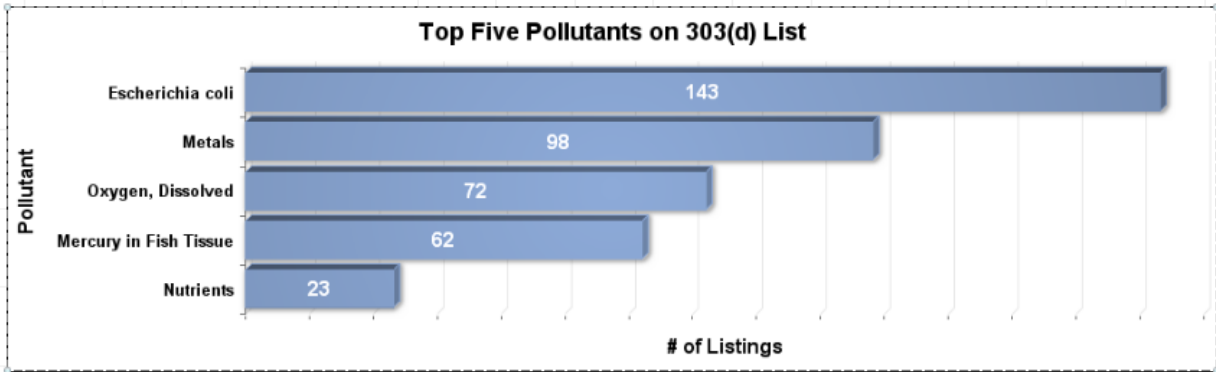
Blackberry Cr.'s 2016 Impairments

Protection of Aquatic Life (AQL) -- Chloride (W)

Protection of Aquatic Life (AQL) -- Oxygen, Dissolved (W)

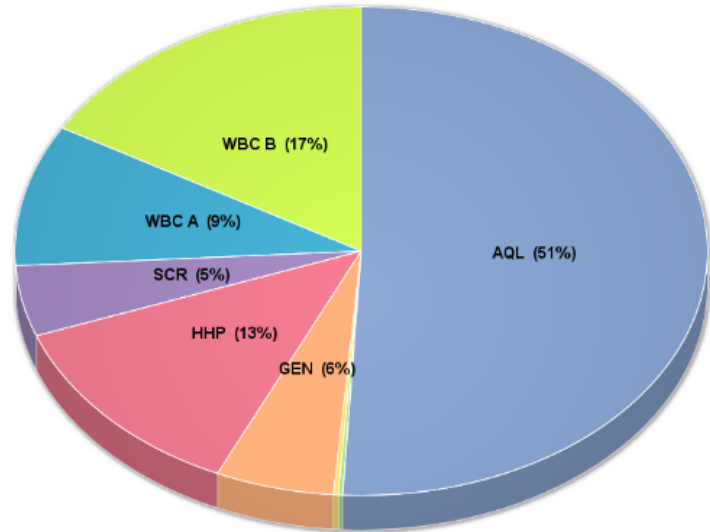Protection of Aquatic Life (AQL) -- Total Dissolved Solids (W)

Missouri Department of Natural Resources
2016 Section 303(d) Listed Waters

U.S. Environmental Protection Agency Approved

Row #	Year	WBID	Waterbody	Class	Imp. Size	WB Size	Units	IU	Pollutant	Source	County Up/Down	WBD 8	Comment
1	2012	2188	Antire Cr.	P	1.90	1.90	Miles	WBC B	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	07140102	1
2	2012	2188	Antire Cr.	P	1.90	1.90	Miles	AQL	pH (W)	Source Unknown	St. Louis	07140102	1
3	2010	7627	August A Busch Lake No. 37	UL	30.00	30.00	Acres	GEN	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	St. Charles	07110009	1, 7
4	2016	4083	Barker Creek tributary	C	1.20	1.20	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Henry	10290108	1
5	2012	752	Bass Cr.	C	4.40	4.40	Miles	WBC A	Escherichia coli (W)	Rural NPS	Boone	10300102	1
6	2012	3240	Baynham Br.	P	4.00	4.00	Miles	WBC B	Escherichia coli (W)	Rural NPS	Newton	11070207	1
7	2014	3224	Beef Br.	P	2.50	2.50	Miles	AQL	Cadmium (S)	Mill Tailings	Newton	11070207	1
8	2014	3224	Beef Br.	P	2.50	2.50	Miles	AQL	Cadmium (W)	Mill Tailings	Newton	11070207	1
9	2014	3224	Beef Br.	P	2.50	2.50	Miles	AQL	Lead (S)	Mill Tailings	Newton	11070207	1
10	2014	3224	Beef Br.	P	2.50	2.50	Miles	AQL	Zinc (S)	Mill Tailings	Newton	11070207	1
11	2014	3224	Beef Br.	P	2.50	2.50	Miles	AQL	Zinc (W)	Mill Tailings	Newton	11070207	1
12	2006	2760	Bee Fk.	C	8.70	8.70	Miles	AQL	Lead (W)	Fletcher Lead Mine/ Mill	Reynolds	11010007	1
13	2014	7309	Bee Tree Lake	L3	10.00	10.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	St. Louis	07140102	1
14	2006	7365	Belcher Branch Lake	L3	42.00	42.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Buchanan	10240012	1
15	2014	3980	Bens Branch	C	5.80	5.80	Miles	AQL	Cadmium (S)	Oronogo/Duenweg Mining Belt	Jasper	11070207	1
16	2014	3980	Bens Branch	C	5.80	5.80	Miles	AQL	Lead (S)	Oronogo/Duenweg Mining Belt	Jasper	11070207	1
17	2014	3980	Bens Branch	C	5.80	5.80	Miles	AQL	Zinc (S)	Oronogo/Duenweg Mining Belt	Jasper	11070207	1
18	2016	3980	Bens Branch	C	5.80	5.80	Miles	AQL	Zinc (W)	Oronogo/Duenweg Mining Belt	Jasper	11070207	1
19	1998	2916	Big Cr.	P	34.10	34.10	Miles	AQL	Cadmium (S)	Glover smelter	Iron	08020202	1
20	1998	2916	Big Cr.	P	34.10	34.10	Miles	AQL	Lead (S)	Glover smelter	Iron	08020202	1
21	2010	1578	Big Piney R.	P	7.80	7.80	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Texas	10290202	1, 5
22	2006	2080	Big R.	P	81.30	81.30	Miles	AQL	Cadmium (S)	Old Lead Belt tailings	St. Francois/Jefferson	07140104	1
23	2010	2080	Big R.	P	81.30	81.30	Miles	AQL	Lead (S)	Mill Tailings	St. Francois/Jefferson	07140104	1
24	2016	2080	Big R.	P	81.30	81.30	Miles	HHP	Lead (T)	Mine Tailings	Washington/Jefferson	07140104	1
25	2012	2080	Big R.	P	81.30	81.30	Miles	AQL	Zinc (S)	Old Lead Belt tailings	St. Francois/Jefferson	07140104	1
26	2006	3184	Blackberry Cr.	C	6.50	6.50	Miles	AQL	Chloride (W)	Asbury Power Plant	Jasper	11070207	1
27	2016	3184	Blackberry Cr.	C	6.50	6.50	Miles	AQL	Oxygen, Dissolved (W)	Ind. Point Source Discharge and NPS	Jasper	11070207	1
28	2008	3184	Blackberry Cr.	C	6.50	6.50	Miles	AQL	Sulfate + Chloride (W)	Asbury Power Plant	Jasper	11070207	1
29	2012	111	Black Cr.	P	19.40	19.40	Miles	WBC B	Escherichia coli (W)	Shelbyville WWTF	Shelby	07110005	1
30	2006	3825	Black Cr.	P	1.60	1.60	Miles	AQL	Chloride (W)	Urban Runoff/Storm Sewers	St. Louis	07140101	1
31	2012	3825	Black Cr.	P	1.60	1.60	Miles	SCR	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	07140101	1
32	2012	3825	Black Cr.	P	1.60	1.60	Miles	WBC B	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	07140101	1
33	2002	2769	Black R.	P	47.10	47.10	Miles	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Butler	11010007	1, 5

Top Five Pollutants on 303(d) List

Pollutant	# of Listings
Escherichia coli	143
Metals	98
Oxygen, Dissolved	72
Mercury in Fish Tissue	62
Nutrients	23

Listings Remaining as of the 2016 303(d) List

Year of First Listing	Total Listings
1994	2
1998	4
2002	25
2004/2006	117
2008	47
2010	52
2012	67
2014	69
2016	*87*
Total :	470

Top Six Sources by Number of Listings

Sources	# of Listings
Nonpoint Source	128
Source Unknown	87
Mining Related	85
Urban Runoff/Storm Sewers	64
Atmospheric Deposition - Mercury	62
Point Source	51

Listings Remaining by Cycle Year

Number of Listings vs Year of First Listing (1994, 1998, 2002, 2004, 2006, 2008, 2010, 2012, 2014, 2016)

MO 303(d) Listed Waters | MO 303(d) Delisted Waters | Charts--Total Listings-Top 5 Pollutants-Top 6 Sources | Charts--Use Impairment Distribution and Top 10 HUCs

Charts--Total Listings-Top 5 Pollutants-Top 6 Sources ▾ | Track Changes: Off | Page 1 of 1 | 130% ▾ | 209 days ago.

Percentage of Uses Impaired on 303(d) List

AQL (51%)
WBC B (17%)
HHP (13%)
WBC A (9%)
GEN (6%)
SCR (5%)

Use
■ AQL ■ CLF ■ DWS ■ GEN ■ HHP ■ SCR ■ WBC A ■ WBC B

Top Ten HUCs by Number of Listings

HUC 8	# of Impairments
11070207	79
07140102	39
07140101	28
10300101	27
07140104	27
11010007	24
10300102	20
11010002	16
10300200	13
10290106	12

MO 303(d) Listed Waters   MO 303(d) Delisted Waters   Charts--Total Listings-Top 5 Pollutants-Top 6 Sources   Charts--Use Impairment Distribution and Top 10 HUCs

Charts--Use Impairment Distribution and Top 10 HUCs ▾   Track Changes: Off   Page 1 of 1   120%   209 days ago.
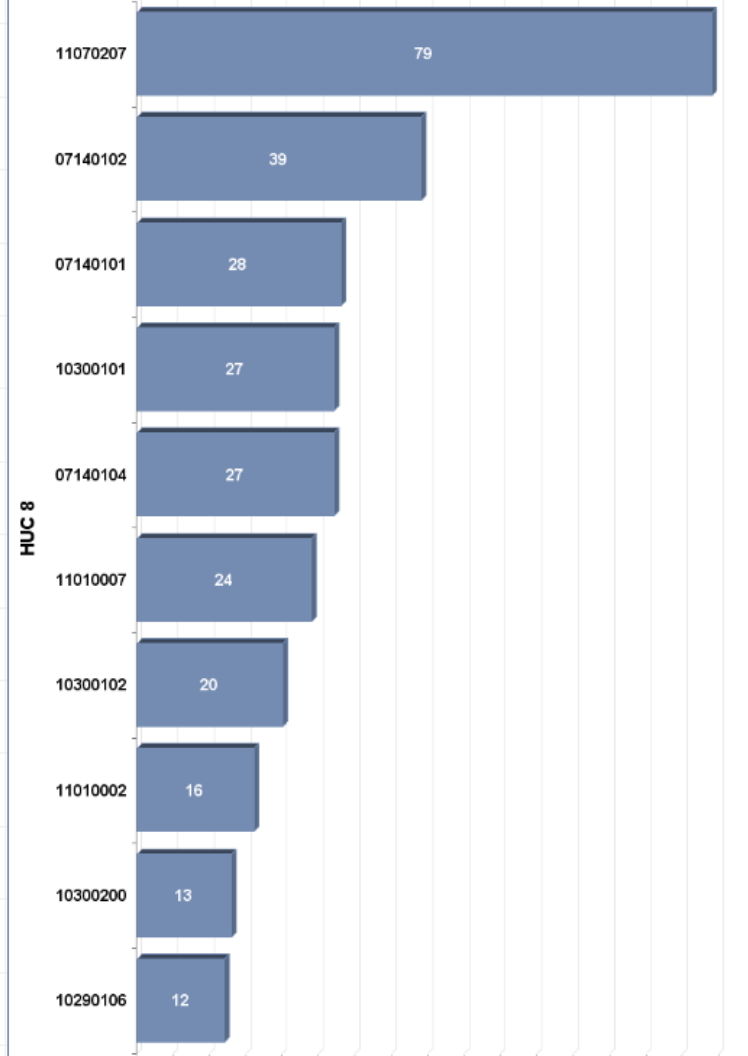
Lesson Learned

- We thought automation was not manageable, but with the right tools, a certain level of automation is possible and that automation can be flexible and customizable.

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