



River & Reservoir Compliance Monitoring Program

Dennis Baxter

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River Monitoring – A Core TVA Practice



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What We Do at TVA

Serve the people of the Tennessee Valley
to make life better



Energy



Environment



Economic Development

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Reservoir Ecological Health Monitoring Program

Monitoring Objective:

Provide long-term aquatic data to
support TVA's operations and
stewardship of the Tennessee Valley



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Program Benefits

- Public demonstration of commitment to water and ecological resources in the Valley
- Supports TVA's Natural Resources Plan (NRP EIS) objectives
- Trending water quality and biological monitoring data provide essential information on TVA's Integrated River System and potential operational impacts
- TVA Reservoir and River Compliance Monitoring data support Valley States [303(d) and 305(b) reporting], USFWS programs, and compliance support for TVA's operating facilities
- Supports the timely or expedited permitting/licensing of new or existing transmission lines
- Ensures mitigation of ROS/ROD Operation Compliance Commitments is maintained

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FY2019 Funding Sources



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FY2019 Funding Sources

Environmental Compliance & Operations

- **Reservoir Ecological Health (f.k.a., “Vital Signs”)**
 - 69 sites on 31 reservoirs monitored
 - Includes fish, benthos & sediments: 2-year rotation
 - WQ, DO, & chlorophyll: 2-year rotation
 - Supports TVA operational decisions, compliance activities, economic development, and stewardship responsibilities
- **River Water Quality & Ecological Health (a.k.a., “Fixed Stations”)**
 - 18 major tributary sites monitored on 2-year cycle
 - Includes WQ, fish, benthos & habitat assessment
 - Measures quality of inflows to reservoir system
- **Fish Contaminants**
 - 70 reservoir & 18 river sites monitored on 4-year rotation
 - Coordinated with state agencies
 - Supports decisions about fish consumption advisories

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FY2019 Funding Sources

Natural Resources

- **Stream Ecological Health**
 - Hundreds of stream sites monitored on 5-year rotation
 - Fish, benthos, and habitat assessment (~110 sites annually)
 - Supports NRP, Presidential EO Climate Change, watershed management objectives, and state water quality assessments

River Management

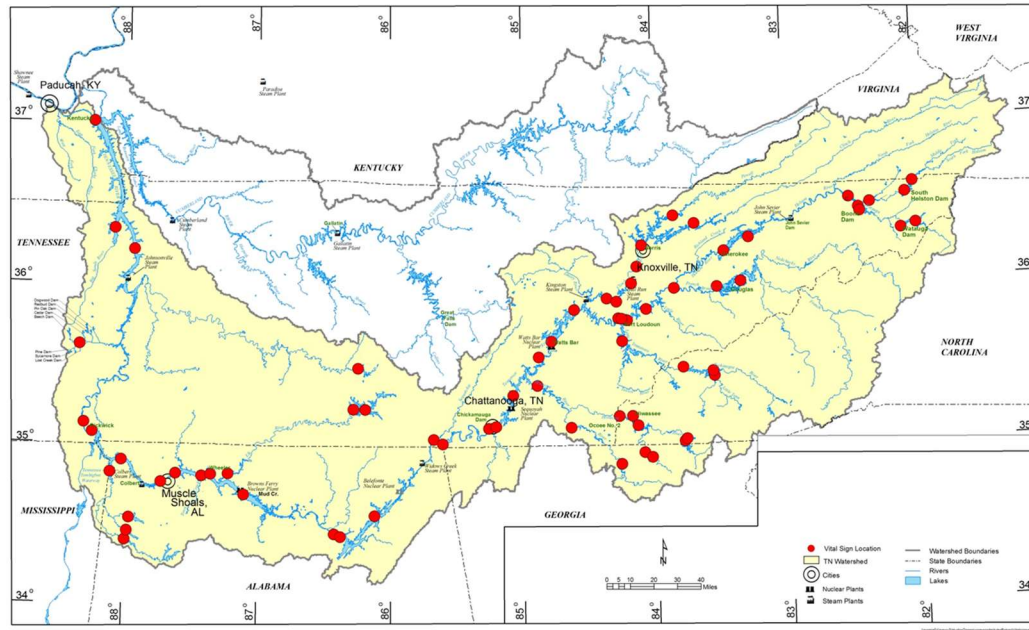
- **Tailwater Assessments**
 - 37 sites on 14 tailwaters monitored on 5-year rotation
 - Fish, benthos, and habitat assessment
 - Documents conditions/improvements in TVA tailwaters
 - Supports Reservoir Release Improvement Program

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Reservoir Ecological Health Locations

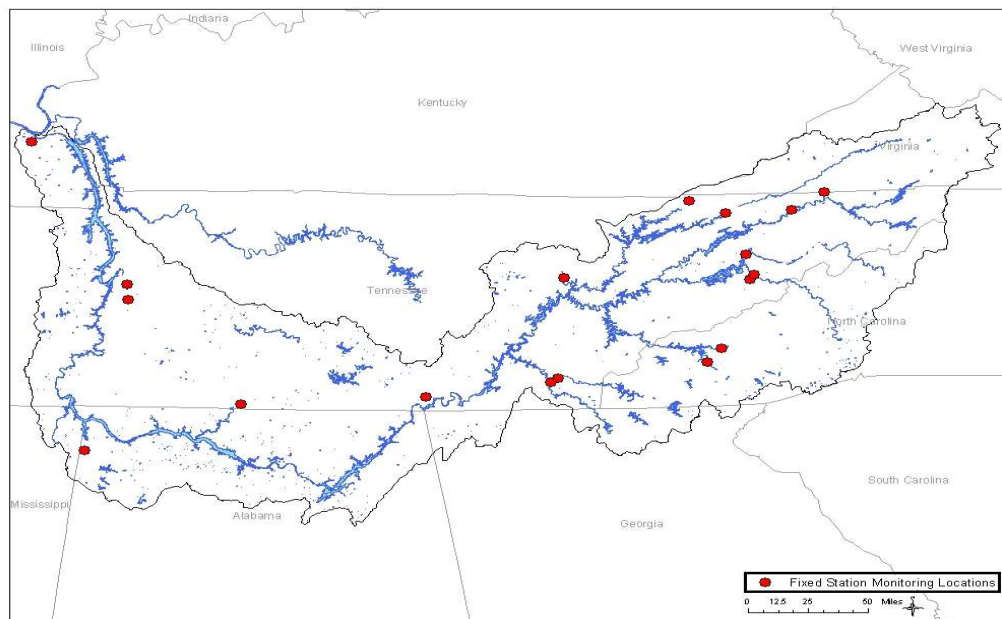


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Fixed Station Locations

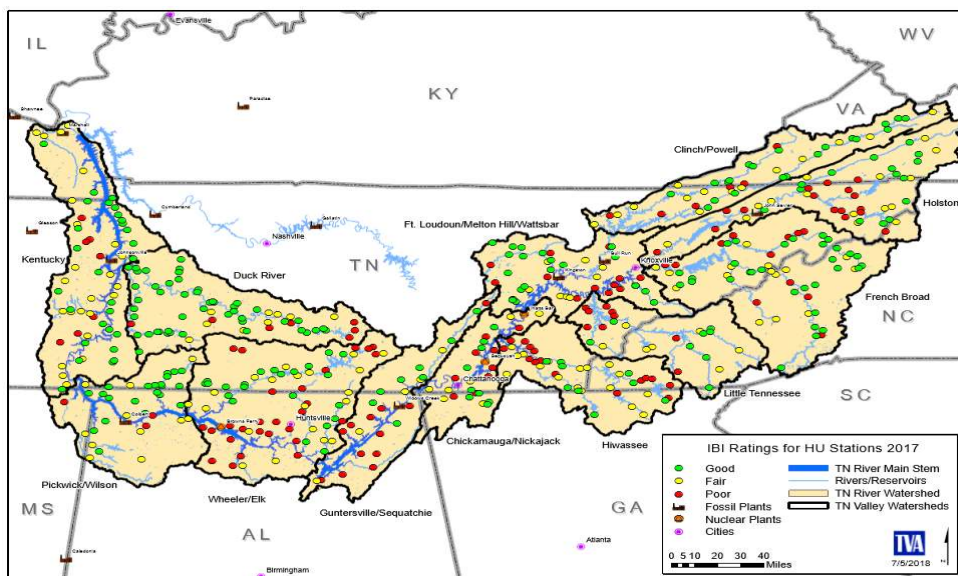


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Hydrologic Unit Stream Locations



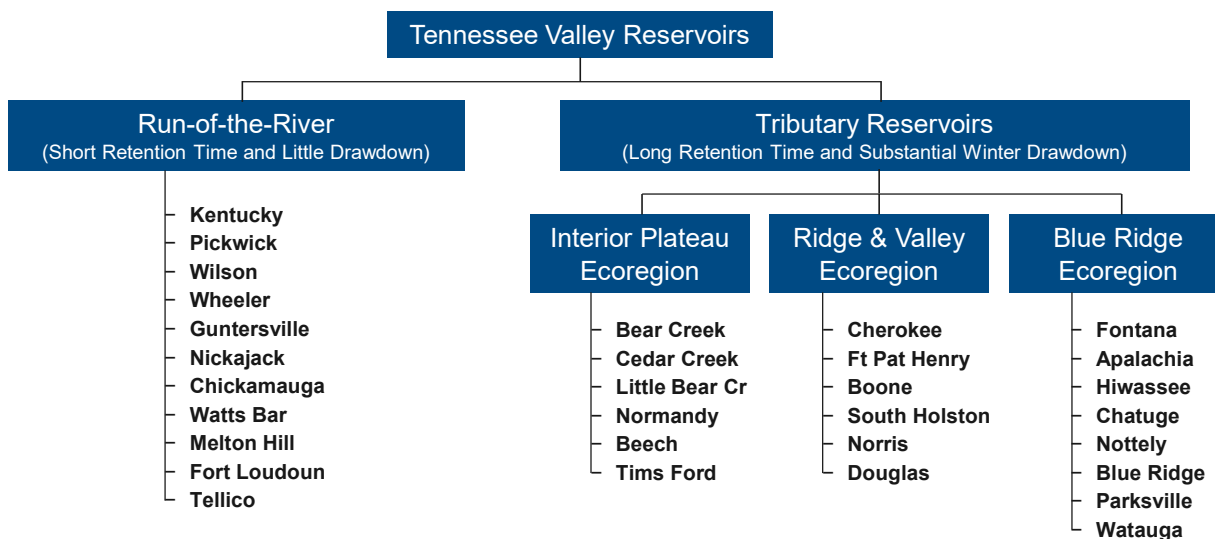
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Data Evaluation – Reservoir Classification

(Important Considerations: size, gradient/depth, ecoregion, reservoir management objective, etc.)



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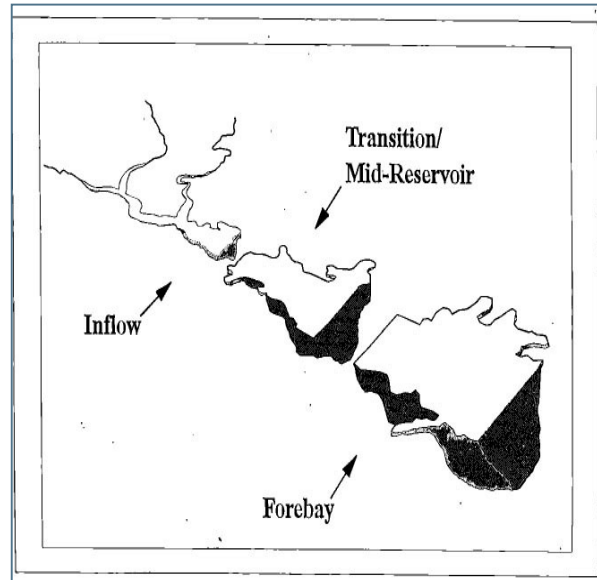


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Monitoring Design – Sampling Location

Depending on size,
up to 4 stations per
reservoir

- Inflow
- Transition zone
- Forebay
- Embayment



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Reservoir Water Quality



- Physical/Chemical Water Quality Parameters
- Dissolved Oxygen Measurements
- Chlorophyll Concentrations
- Sediment Quality (metals, pesticides, and PCBs)

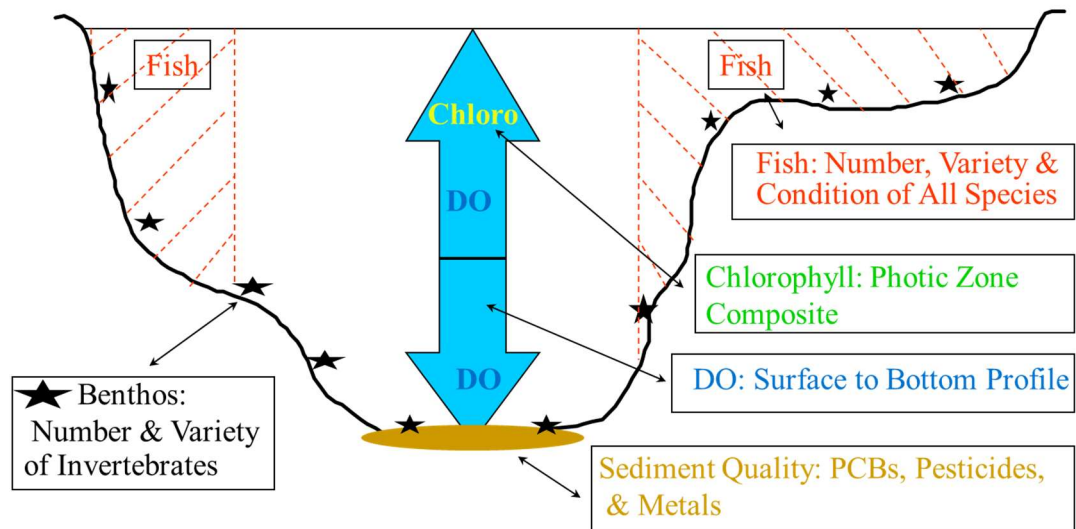
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Monitoring Design & Sampling Methods

“Compartments” in Reservoir Cross-section



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Monitoring Design – Selection of Indicators

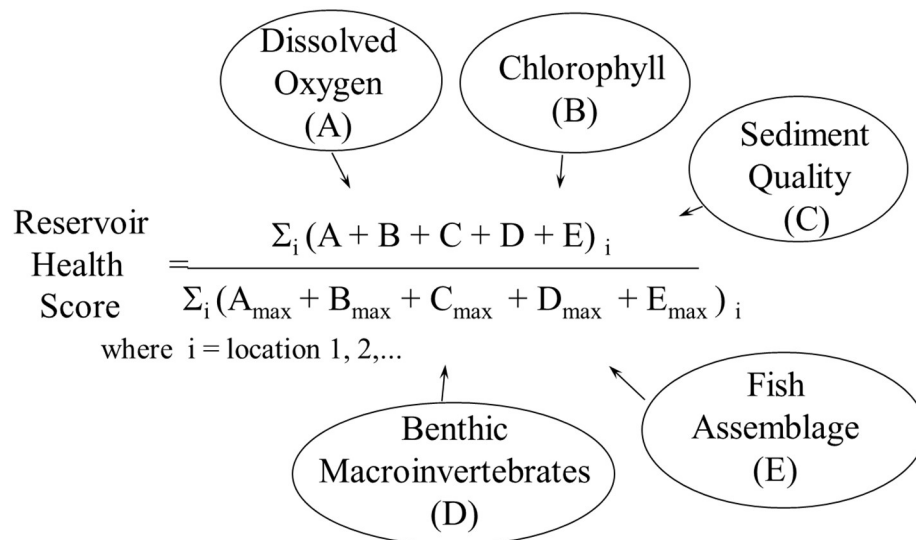
■ Five Key Indicators

- Chlorophyll
- Dissolved Oxygen
- Fish Community
- Benthic Macroinvertebrate Community
- Sediment Quality

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Ecological Health Score Calculation Utilizing Five Key Indicators



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Reservoir Ecological Health Scores 1994-2017

Reservoir	Area (Acres)	Res. Eco. Health on 2002 Criteria																												1994-2017			
		1991*	1992*	1993*	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Average	
Kentucky	180,300	69	87	82	75	71	77	75	75	73	75	75	75	75	75	75	75	75	70	69	67	67	70	75					X			73	
Pickwick	43,100	77	78	70	80		70	75	71	72	82	77	66	63	64	76	80	80	80	80	80	80	80	80	80	80	80	80	X			73	
Wilson	15,500	67	62	69	68		68	78	55	54	63	63	64	63	52	68	68	68	68	68	68	68	68	68	68	68	68	68	X			67	
Wheeler	67,100	71	74	72	73	66			61	64	72	73	66	64	55	68	64	55	68	64	55	68	64	55	68	64	55	68	71	X		73	
Guntersville	67,500	85	87	85	81	87		84	81	77	79	74	68	79	67	70	86	80	80	80	80	80	80	80	80	80	80	80	X			67	
Nickajack	10,400	87	81	94	90	88		87	85	94	91	93	75	85	78	71	94	70	94	70	94	70	94	70	94	70	94	X				55	
Chickamauga	35,400	85	88	85	84	81		84	81	78	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	X				81	
Watts Bar	39,000	70	77	74	71		67	60	59	54	69	57	59	65	54	61	67	75										X				63	
Fort Loudoun	14,800	63	63	62	58	47	52	57	61	47	49	45	65	59	61	59	50	55	58	62	62	62	62	62	62	62	62	62	X			63	
Melton Hill	5,700	67	66	65	65		67	63	67	61	66	73	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	X				67	
Tellus	15,900	61	57	61	69	51		61	65	61	63	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	X				67	
Beech	900			69	58	55	56	53	42	47	47	47	47	51	47	44		54										X				52	
Normandy	3,200		58		64	59	64	59	50	54	47	47	51	52	47		45		80									X				56	
Bear Creek	700			64	60	56	42	52	51	42	45	64	60	47		57		54											X			52	
Little Bear Creek	1,600			68	64	64	60	69	60	62	66	60	71	67		64		69											X			64	
Cedar Creek	4,200			69	72	60	64	64	69	63	64	64	63	69	64	64	60	69												X			55
Time Ford	10,000	60	63	58	58	56	49	44	49	48	51	55	52	51		51		80										X				54	
Hixessee	6,100	72	71	71	62		60	67	69	60	64	70	65	67	66		71											X				66	
Chattahoochee	7,100	69	79	83	72		76	55	49	58	57	53	48	53	46	61	59	67	58									X				59	
Netley	4,200	60	61	65	56	49	46	48	48	68	54	59	57	46	53	46	53	46		47									X			52	
Blue Ridge	3,300	87	83	91	80	84		82	84	87	80	81	83	86	82		91		84									X				84	
Ocee No. 1	1,900	74	74	67	67	67		62	58	67	66	62	76	71	76	73	76	76											X			68	
Apalachia	1,100							73	66	64	72	77	78	78	80	74	76		77									X				74	
Norms	34,200	71	72	71	63	64		67	67	67	66	64	60	67	64		69		66										X			65	
Fontana	10,000			73	78	74	66	66	66	73	63	69	69	67	69	69	69	71		73								X				70	
Douglas	30,400	60	64	62	62	47		54	56	59	55	55	60	55	59	56	59	56		60									X			59	
Cherokee	30,300	57	57	67	53	59	49	50	50	50	52	51	53	51	53	51	50		56									X				53	
Fort Pat. Henry	900			82	60	56	55	56	68	78	84	60	64	64	56	67		69											X			62	
Boone	4300	63	63	68	56	49		55	40	48	54	50	50	50	50	48	52		64	64	58								X			53	
South Holston	7600	63	69	64	64		55	52	50	53	61	57	60	64	59		67											X				58	
Watauga	6,400	75	72	66	68		74	60	68	73	60	60	79	75	69	71		77										X				73	

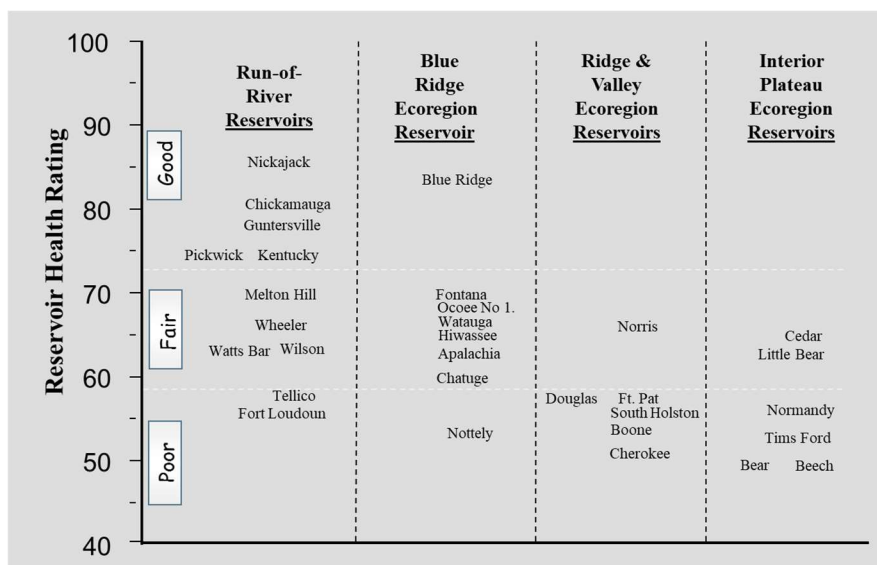
* 1991, 1992, and 1993 are scored on 2000 criteria for 4 of the 5 indicators. A change in processing of benthic macroinvertebrate samples beginning in 1994 prevents appropriate scoring of the earlier results on the latter criteria.

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Long-Term Average Reservoir Ecological Health Scores 1994-2018



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Metrics Used to Evaluate Fish Assemblage Results

- **Species Richness and Composition Metrics**
 1. Total number of species
 2. Number of centrarchid species
 3. Number of benthic invertivore species
 4. Number of intolerant species
 5. Number of top carnivore species
 6. Percent tolerant individuals (excluding Young-of-Year)
 7. Percent non-native species
 8. Percent dominance by one species
- **Trophic Composition Metrics**
 9. Percent individuals as omnivores
 10. Percent individuals as top carnivores
- **Abundance Metrics**
 11. Average number per run
- **Fish Health Metrics**
 12. Percent individuals with anomalies



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Ecological Health Rating Methods – Reservoir Benthic Macroinvertebrates

Based on Seven Equally Weighted Components (Metrics)

Metric	Run-of-River Res.	Tributary Res.
Taxa Richness	X	X
EPT Taxa	X	
Long-lived Taxa	X	
Non- Chironomid / Oligochaete Density	X	X
Percent Oligochaetes	X	X
Dominance	X	X
Zero Samples	X	X
Non- Chironomid / Oligochaete Taxa		X
Chironomid Density		X

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Ecological Health Rating Methods – Sediment Quality Rating

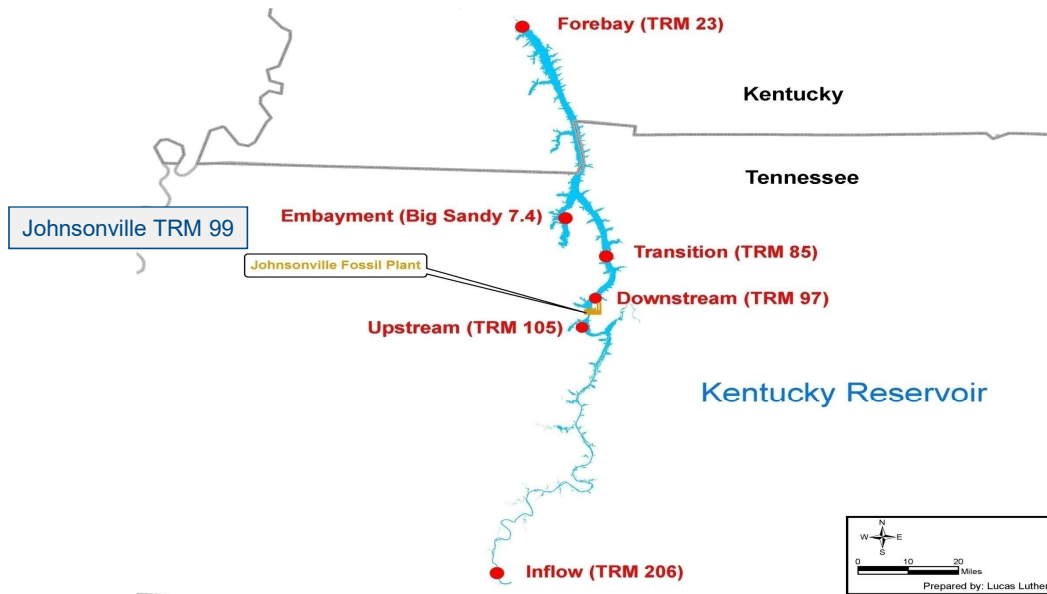
- Sediment analyses for metals, pesticides, and PCBs
- Sediment quality rating compares results to EPA Region 5 sediment guidelines and laboratory detection limits
- Site receives highest score if no metals exceed guidelines and no PCBs or pesticides are detected

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Upstream vs. Downstream RFAI Locations



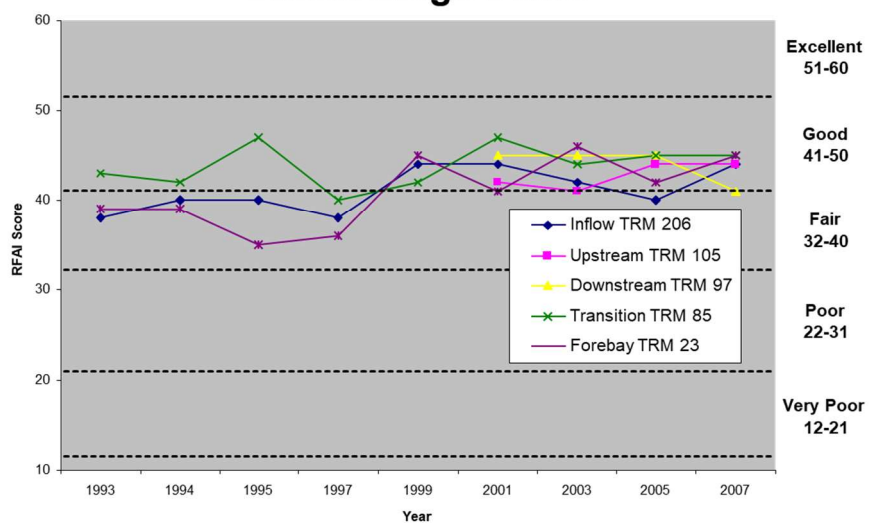
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Monitoring Results for Kentucky Reservoir

Reservoir Fish Assemblage Index



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“if you build it, they will come”



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Sampling Stations

Tailwater	Station (River Mile)		
Apalachia	Big Bend (51.2)	Reliance (48.0)	Hwy 411 (42.4)
Cherokee	Below Dam (51.1)	Nance F. (33.3)	McKinney (25.0)
Norris	Miller Island (77.0)	Fish Trap (70.5)	Hwy 61 (66.7)
South Holston	Below Weir (49.2)	Hick. Tree (44.4)	Webb Br. (39.4)
Wilbur	Near Dam (31.0)	Elizabeth. (21.8)	Saylor Is. (16.4)
Blue Ridge	Upper Station (50.5)	Middle Station (45.9)	Lower Station (38.5)

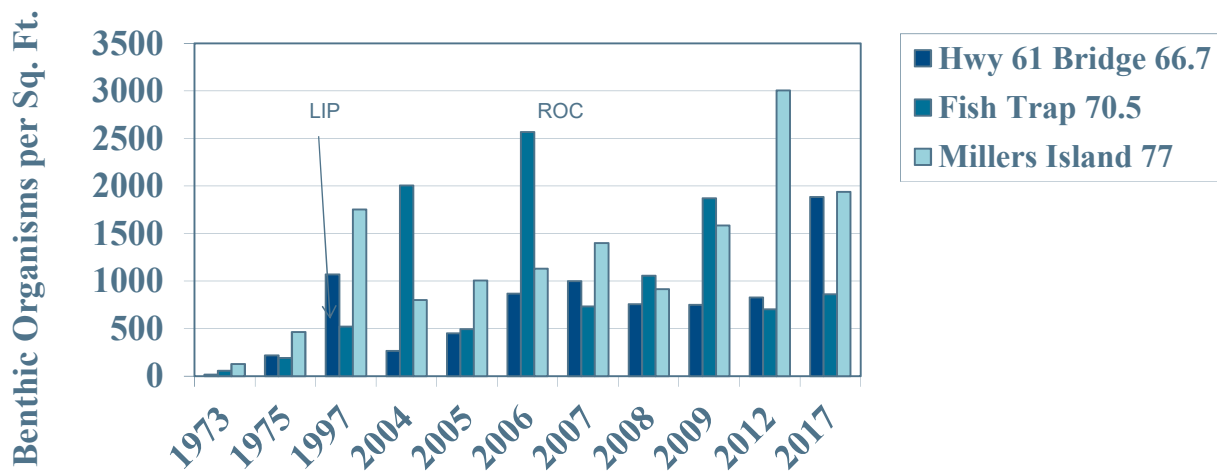
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Norris

Relative Abundance of All Benthic Organisms



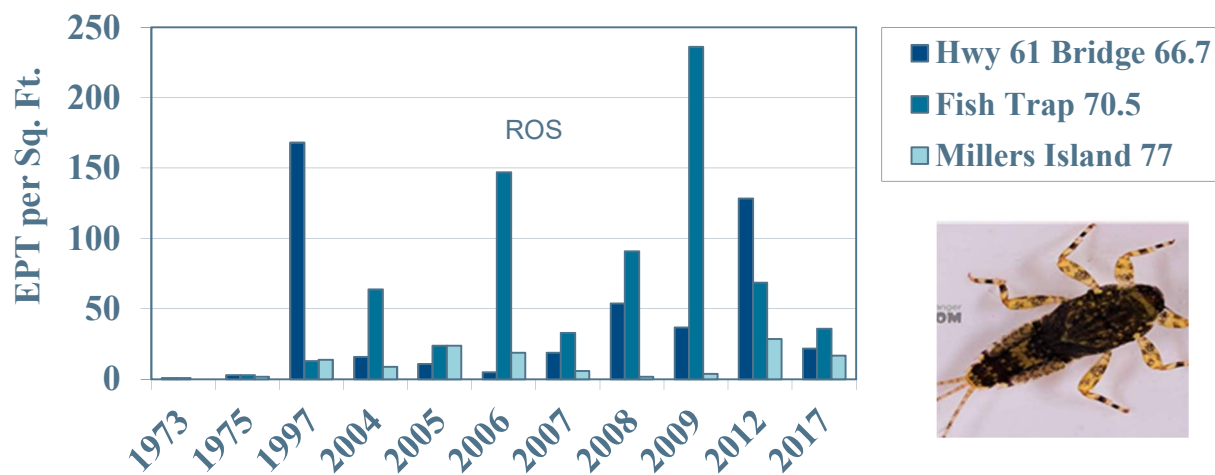
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Norris

EPT



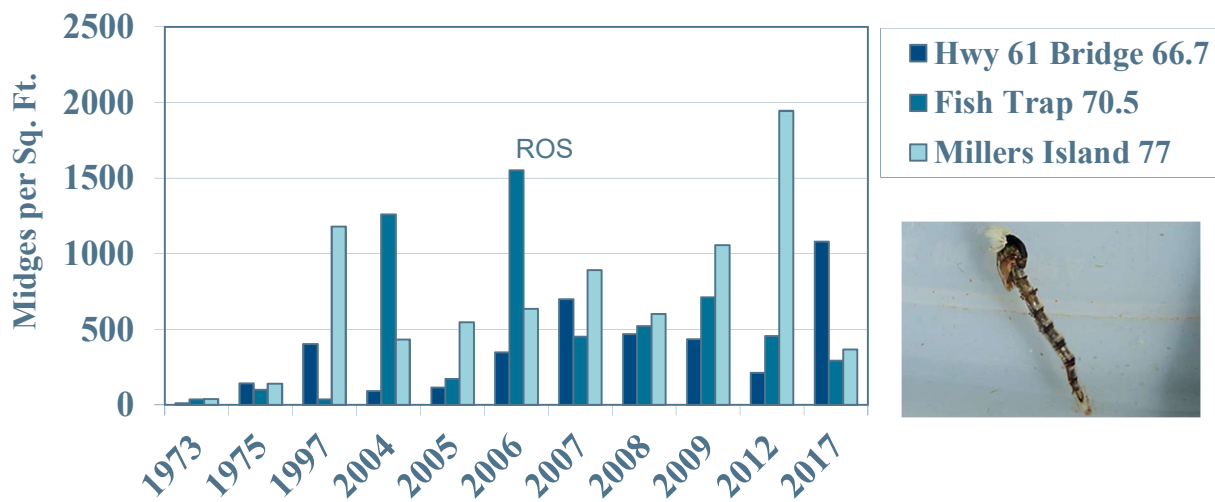
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Norris

Midges

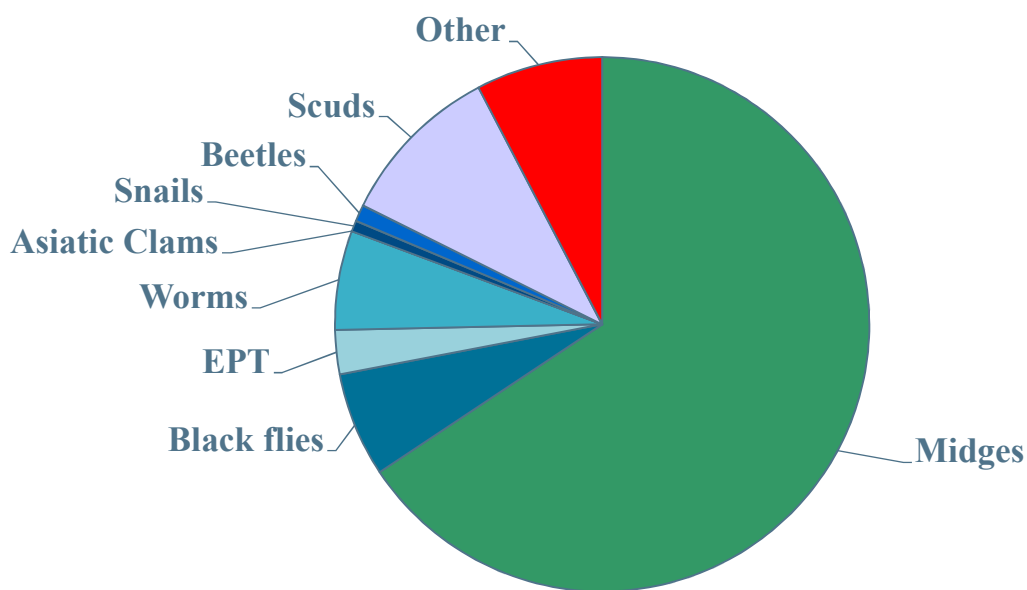


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Norris: Species Composition

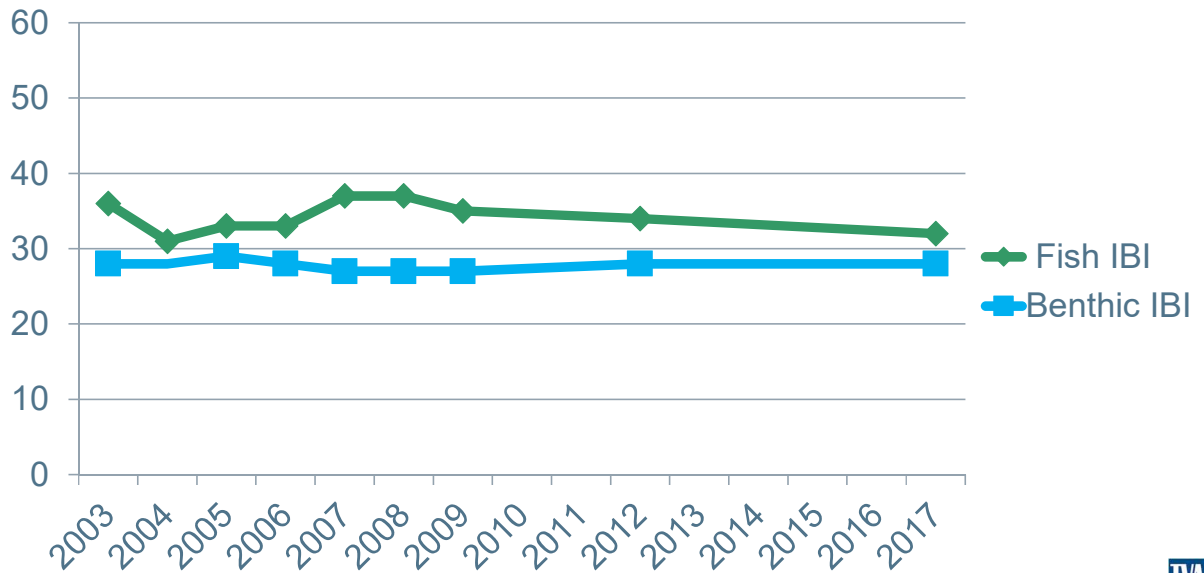


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Norris: Fish and Benthic Index Scores



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Baetis Tricaudatus (Blue-Winged Olive)



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Summary

- TVA's Monitoring Program approved by EPA and TDEC in 2001 & 2008 for CWA Section 316 Compliance
- Ongoing Reservoir Ecological Health Monitoring Program has demonstrated no appreciable harm from TVA operations, including power plant and land management activities of the Valley's resources
- Benthic macroinvertebrate communities have responded favorably to Reservoir Release Improvements
- Fish and Benthic index scores have remained stable post Reservoir Release Improvement
- TVA believes current monitoring and evaluation program is sufficient to assess Valley-wide conditions

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