

Mississippi River Watershed Report Card Technical Paper: Preliminary Data and Analysis Methods

Introduction

This technical summary documents the indicators chosen through the report card development process with experts polled within each region. Indicators were chosen based on results of these workshops, subsequent data inquiries and analysis, and additional follow-up with participants and invitees. The analysis presented in the report card is based on the data collected and analyzed according to these discussions. However, reviewing the analysis suggests that results may not accurately reflect actual conditions. We have received additional ideas on indicators, ways to analyze data and additional questions. In particular, we feel that the transportation, water supply, and flood control and risk reduction goals require additional attention. We will continue to pursue new analyses for these indicators, with additional feedback from participants at the summit and from workshop invitees.

Remaining tasks also include analysis of additional indicators that are important at the scale of, or beyond the scale of, the entire Mississippi Watershed. These include Climate Change, Nutrient Loading and Hypoxia in the Gulf of Mexico, and Sediment Delivery to the coastal wetlands of Louisiana. These issues are of national importance, and are directly related to the services provided by the Mississippi River. These indicators need to be evaluated further and included in the report card analysis and reporting framework.

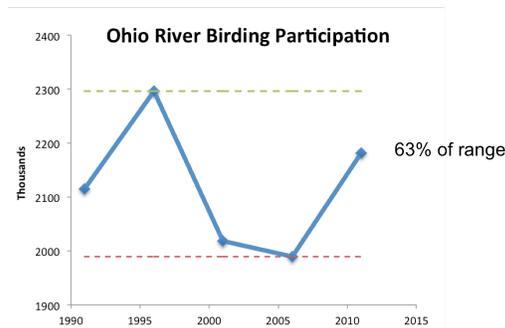
The methods and the results shown are the product of much effort and deliberation by partners in the 5 basins and at the University of Maryland Center for Environmental Science (UMCES). Regional experts in each goal area suggested these indicators, and the UMCES team developed them further. Not all indicators were selected from the basin workshops. UMCES selected indicators for the Version 1 draft report card based on data availability, relevance to measuring the goal, consistency with other basin indicators, and the ability to develop a relevant scoring method.

For the indicators selected, there were three basic scoring methods that were applied:

1. Native scoring. For some indicators, the data provider had already provided a rating of observations or results. These may have been measured against a regionally specific desired condition, or some other method. Generally, we use this method when the assessment methods were from an accepted source, using generally accepted practices. For example, the EPA National Rivers and Streams Assessment provided ratings for

indicators in the ecosystems goal based on ecologically relevant thresholds for the ecoregion in which the measurements were taken.

2. Comparison to historical range of data. For several indicators, (in recreation, for instance), most recent data were compared to the historical range of data available. The most desirable (e.g., highest participation rate in birding) was the top score, and the least desirable value became the lowest possible score.



Source: National Survey of Fishing, Hunting, & Wildlife-Associated Recreation (FHWAR), US Census

3. Comparison to national average. Where adequate time series of data did not exist or where this method was most relevant, data were compared to the national average. Unemployment for instance was aggregated for the states in the basin, and this value was compared to the national average. Scoring was accomplished by creating ranges bounded by the standard deviation of the data from the 50 states. If the basin average was within one standard deviation of the US average, the resulting score was a “C” for example.

Description	Standard Deviation	Grade
substantially above national average	1.5 - 2.5	A
above national average	0.5 - 1.5	B
near national average	-0.5 - 0.5	C
below national average	-1.5 - -0.5	D
substantially below national average	-2.5 - -1.5	F

All measurements were converted to a 0-100 range, to enable aggregation of individual indicator results to the goal score. Final scores were given a grade based on the simple grading scheme as below:

Score	Grade
80-100	A
60-80	B
40-60	C
20-40	D
0-20	F

To calculate basin scores from state level results, state results were area weighted based on the percent of the basin represented by that state. Basin score = sum of state scores x % of basin represented by that state.

RECREATION: Hunting, fishing, wildlife-watching participation

Data source:

National Survey of Fishing, Hunting and Wildlife Associated Recreation (FHWAR)
US Fish and Wildlife Service and the US Census.

<http://www.census.gov/prod/www/fishing.html>

Data description:

Participation in activities as described in survey.

How scored:

2011 data compared to % of 20-year data range

Detailed scoring:

State-level data scored based on latest year of available data. Basin scored as weighted average of state scores based on area in basin.

Comments:

Data are collected only every 5 years.

RECREATION: Hunting and fishing license sales

Data source:

US Fish And Wildlife Service

National Hunting License Report 2004-2013

Data description:

License Sales.

How scored:

3-year average 2011 – 2013 as % of Range

Detailed scoring:

State-level data scored based on latest 3 years of available data.

Comments:

RECREATION: Access (not scored)

Data source:

Data description:

How scored:

Detailed scoring:

Comments:

This indicator has been repeatedly suggested as a potential measure of recreation, and we are researching ways to access and interpret these data. Issues include the consistency of local, state, and federal sources of data and the relatively slow change in this indicator over time.

ECOSYSTEMS: Benthic Multimetric Index

Data source:

EPA National Rivers and Streams Assessment 2008-2009.

<http://water.epa.gov/type/rsl/monitoring/riverssurvey/>

Data description:

An assessment of invertebrate animal community health, based on multiple metrics.

How scored:

Native scoring

Detailed scoring:

EPA score of good (=1.0), fair (=0.5), bad (=0) were averaged over the sub-basin.

Comments:

Source: EPA's National River and Streams Assessment

Indicator: variety and abundance of macroinvertebrates, taxa loss

Target: observed vs expected conditions, thresholds dependent on the location (climatic region) and size class of river/stream, assessments completed by EPA

Macroinvertebrate Multimetric Index- ..."to determine the Macroinvertebrate MMI, ecologists selected six metrics indicative of different aspects of macroinvertebrate community structure: taxonomic richness, taxonomic composition, taxonomic diversity, feeding groups, habits/habitats, pollution tolerance. The specific metrics chosen for each of these characteristics varied among the nine ecoregions used in the analysis. Each metric was scored and then combined to create an overall Macroinvertebrate MMI for each ecoregion. Analysts calculated a Macroinvertebrate MMI for each site, factored in the river or stream length represented by the site, and then generated an estimate of the river and stream length in a region, and nationally, with a given Macroinvertebrate MMI score.

ECOSYSTEMS: Fish Multimetric Index

Data source:

EPA National Rivers and Streams Assessment 2008-2009.

<http://water.epa.gov/type/rsl/monitoring/riverssurvey/>

Data description:

An assessment of fish community health.

How scored:

Native scoring

Detailed scoring:

EPA score of good (=1.0), fair (=0.5), bad (=0) were averaged over the sub-basin.

Comments:

Source: EPA's National River and Streams Assessment

Indicator: variety and abundance of fish

Target: observed vs expected conditions, thresholds dependent on the location (climatic region) and size class of river/stream, assessments completed by EPA

Fish Multimetric Index- For the NRSA, scientists developed a Fish MMI using an approach that estimates expected condition at individual sites. Separate indices were developed for each of the three major climatic regions. These indices were based on a variety of metrics including taxa richness, taxonomic composition, pollution tolerance, habitat and feeding groups, spawning habits (specifically, the percent of individuals that deposit eggs on or within the substrate in shallow waters), the number and percent of taxa that are migratory, and the percent of taxa that are native.

ECOSYSTEMS: Riparian Index

Data source:

EPA National Rivers and Streams Assessment 2008-2009.

<http://water.epa.gov/type/rsl/monitoring/riverssurvey/>

Data description:

Indicator: riparian vegetative cover + riparian disturbance

How scored:

Native scoring

Detailed scoring:

Target: least-disturbed reference condition- dependent on ecoregion

EPA score of good (=1.0), fair (=0.5), bad (=0) were averaged over the sub-basin.

Comments:

Source: EPA's National River and Streams Assessment

Indicator: riparian vegetative cover + riparian disturbance

Target: least-disturbed reference condition- dependent on ecoregion

Riparian Vegetative Cover(NRSA)- "A river or stream can be buffered from the effects of human disturbance in the watershed by varied, multi-layered vegetation in the land corridor that surrounds it. Healthy, intact vegetative cover in these riparian areas can help reduce nutrient and sediment runoff from the surrounding landscape, prevent streambank erosion, provide shade to reduce water temperature, and provide leaf litter and large wood (such as branches and logs) to serve as food, shelter, and habitat for aquatic organisms. The NRSA uses a measure of riparian vegetative cover that sums the amount of cover provided by three layers of riparian vegetation: the ground layer, woody shrubs, and canopy trees. Because the amount and complexity of riparian vegetation differs naturally within and among ecoregions, lower-than-expected riparian vegetative cover was assessed by comparison with expected values at least-disturbed sites estimated within ecoregions."

ECOSYSTEMS: Total nitrogen

Data source:

EPA National Rivers and Streams Assessment 2008-2009.

<http://water.epa.gov/type/rs1/monitoring/riverssurvey/>

Data description:

Indicator: amount of nitrogen (ug/L)

How scored:

Native scoring

Detailed scoring:

Target: background levels, based on least-disturbed reference sites (different for each ecoregion)

EPA score of good (=1.0), fair (=0.5), bad (=0) were averaged over the sub-basin.

Comments:

Are my edits factually correct?

Nutrients were assessed at EPA sampling locations in the basins, and data reflect results in streams and rivers in each basin. This data set does not reflect nutrient levels/fluxes in the mainstem or major tributaries, which are cumulative in nature. Those results will be measured and evaluated in the “nutrient yield” indicator and the extent of hypoxia indicator for the watershed.

Total Nitrogen- "Four chemical stressors were assessed as indicators in the NRSA: total phosphorus, total nitrogen, salinity, and acidification. These stressors were selected because of national or regional concerns about the extent to which they might be affecting the quality of the biological communities in rivers and streams, and to allow comparison of findings with the 2004 WSA." High levels of nutrients such as nitrogen and phosphorus can lead to excessive growth of algae. Subsequent decay of algae causes low dissolved oxygen conditions and reduced water clarity. "Natural variability in phosphorus concentrations is reflected in the regional thresholds for high, medium, and low levels, which are based on least-disturbed reference sites for each of the nine NRSA ecoregions...Low dissolved oxygen levels, algae blooms, and degraded habitat conditions for benthic macroinvertebrates and other aquatic life can result from high nitrogen concentrations."

ECOSYSTEMS: Total phosphorus

Data source:

EPA National Rivers and Streams Assessment 2008-2009.

<http://water.epa.gov/type/rsl/monitoring/riverssurvey/>

Data description:

Indicator: amount of phosphorus (ug/L)

How scored:

Native scoring

Detailed scoring:

Target: background levels, based on least-disturbed reference sites (different for each ecoregion)

EPA score of good (=1.0), fair (=0.5), bad (=0) were averaged over the sub-basin.

Comments:

Nutrients were assessed at EPA sampling locations in the basins, and data reflect results in streams and rivers in each basin. This data set does not reflect nutrient levels/fluxes in the mainstem or major tributaries which are cumulative in nature. Those results will be measured

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ECOSYSTEMS: Woody wetland loss

Data source:

Multi-Resolution Land Characteristics.

<http://www.mrlc.gov>

Data description:

Woody wetland loss between 2001 and 2006,

How scored:

Calculated as the % loss of woody wetlands.

Detailed scoring:

Comments:

Initial suggestions included change in bottomland hardwood forest. The closest category from land use data sets available was the “woody wetlands” classification. Subsequent discussions suggested that an indicator of *total* wetland loss would be more relevant to all basins in the watershed, and that the bottomland hardwood issues were mostly relevant to the Lower Mississippi and Arkansas/Red River basins. We plan to replace woody wetland loss with wetland loss. Additionally, we are exploring the separate question of coastal wetlands in Louisiana as they relate to the change in the Mississippi River delta from sediment delivery and channel issues.

ECONOMY: Employment by sector (agriculture, manufacturing, trade & transportation)

Data source:

Bureau of Labor Statistics 2013

Data description:

state employment for those three sectors

How scored:

2013 data scored relative to national average standard deviation.

Detailed scoring:

State standardized values calculated as difference from national average divided by the national std dev. Basin-level values are calculated as area-weighted average of states in basin.

Comments:

These results are thought to be correlated with overall economy performance in each basin and not necessarily reflective of conditions directly related to river or water resource management. We plan to explore other economic analyses that can be included to better reflect the effect of river and water resources management on economy in each basin.

ECONOMY: Income per capita

Data source:

Bureau of Economic Analysis 2013

Data description:

State income per capita

How scored:

2013 data scored relative to national average standard deviation

Detailed scoring:

State standardized values calculated as difference from national average divided by the national std dev. Basin-level values are calculated as area-weighted average of states in basin.

Comments:

These results are thought to be correlated with overall economy performance in each basin and not necessarily reflective of conditions directly related to river or water resource management. We plan to explore other economic analyses that can be included to better reflect the effect of river and water resources management on economy in each basin.

ECONOMY: GDP by sector (agriculture, manufacturing, trade & transportation)

Data source:

Bureau of Labor Statistics 2013

Data description:

State GDP for those three sectors

How scored:

2013 data scored relative to national average standard deviation

Detailed scoring:

State standardized values calculated as difference from national average divided by the national std dev. Basin-level values are calculated as area-weighted average of states in basin

Comments:

These results are thought to be correlated with overall economy performance in each basin and not necessarily reflective of conditions directly related to river or water resource management. We plan to explore other economic analyses that can be included to better reflect the effect of river and water resources management on economy in each basin.

TRANSPORTATION: Condition rating of locks and dams

Data source:

These data were provided personally from a request to the US Army Corps of Engineers (USACE) 2010 Inland Navigation Operational Condition Assessments

Data description:

Operational Condition Assessment (OCA) Grade – A, B, C, D, F assigned by the Corps (A = adequate; B = probably adequate; C = probably inadequate; D = inadequate; F = failed)

Percentages of Total Mississippi Valley Division Lock and Dam Components in A, B, C, D, F, CF conditions as established by the USACE 2010

How scored:

Native scoring: average grade for all system components in each basin

Detailed scoring:

Data are percent of components receiving each letter grade. We converted the letter grades to numerical grades and calculated a weighted average based on the percent assigned each grade.

Comments:

Vast majority of grades assigned are B (~85%); although C, D, F, CF percentages are low, the components in these ranges carry significant Consequence and Risk resulting from continued deterioration or failure

It has been suggested that the average infrastructure condition may not be an adequate measure of infrastructure health, because failure of individual key elements could result in major losses. We are exploring the ability to measure this as an indicator. Additionally, we seek additional guidance on indicators that can reflect issues like budget shortfalls for needed maintenance, backlogs of repairs necessary, and additional critical infrastructure condition measurements.

TRANSPORTATION: Tonnage

Data source:

US Army Corps of Engineers

Data description:

Waterborne Tonnage by State (tons locked)

How scored:

3-yr average 2011-2013 tonnage scored relative to 10-year historical range of data.

Detailed scoring:

Totals calculated as simple sum of tonnages reported for each state in a basin. Score is calculated by comparing the average of the last 3 years of data to the range of annual data compiled for the last 10 years.

Comments:

This indicator has limited relevance in the Missouri basin and the Lower Mississippi because there are no locks on the mainstem of the river.

News article on the recent rise in water-borne transport in the Mississippi River watershed:

http://www.reuters.com/article/2014/09/26/us-usa-grains-barges-idUSKCN0HL1L120140926?utm_source=Circle+of+Blue+WaterNews+%26+Alerts&utm_campaign=98b2bc7af1-RSS_EMAIL_CAMPAIGN&utm_medium=email&utm_term=0_c1265b6ed7-98b2bc7af1-250663297

TRANSPORTATION: Stoppages

Data source:

These data were provided personally from a request to the US Army Corps of Engineers

Data description:

Scheduled/unscheduled stoppages due to infrastructure, environmental or tow-related reasons based on detailed reporting stoppage time with cause.

How scored:

3-year average number of stoppages compared to 20-year historical range of values

Detailed scoring:

Comments:

TRANSPORTATION: Maintenance compared with need (not scored)

Data source:

Data description:

How scored:

Detailed scoring:

Comments:

This indicator is identified for further research and development

FLOOD CONTROL & RISK REDUCTION: Number of people at risk

Data source:

FEMA Hazus database.

<http://www.fema.gov/hazus>

And US Census

Data description:

Number of people residing in 100-year flood plain. Population change in Census Blocks that intersect Special Flood Hazard Area, compared to population change in sub-basin as a whole.

How scored:

Scored as the change over the 10-year census period in the number of people living within the boundary of the flood hazard area as defined by FEMA.

Detailed scoring:

Comments:

Population protected by levees are not considered to be in the flood plain for this analysis.

This was the result of a simple GIS analysis measuring population growth in census tracts that are within flood zone compared to growth in the basin. States that had greater population growth in the 100-year floodplain relative to the state population received lower scores than states that had negative growth in the floodplain compared to state population changes.

FLOOD CONTROL & RISK REDUCTION: Levee miles inspected and certified

Data source:

US Army Corps of Engineers 2013 National Levee Database.

<http://nld.usace.army.mil/egis/f?p=471:1:>

Data description:

Condition of levees inspected by the US Army Corps of Engineers.

How scored:

Levee condition “Unacceptable” = 0 pts; “Minimally Acceptable” = 50 pts; “Acceptable” = 100 pts. Weighted by number of miles.

Detailed scoring:

Scores of "acceptable", "minimally acceptable", and "unacceptable" were converted to 100, 50, and 0 and averaged over the sub-basin

Comments:

FLOOD CONTROL & RISK REDUCTION: Community rating system

Data source:

FEMA National Flood Insurance Program Community Rating System

<http://www.fema.gov/national-flood-insurance-program-community-rating-system>

Data description:

May 2012, % of top 50 communities in the state participating in the Community Rating System.

Area-weighted by state

How scored:

Percent of top 50 communities (measured by number of National Flood Insurance Program Policies) that participate in the Community Rating System voluntary incentive program.

Detailed scoring:

Comments:

WATER SUPPLY: Designated use attainment

Data source:

USEPA, Designated use/303(d) list

<http://water.epa.gov/scitech/datait/tools/waters/data/downloads.cfm>

How scored:

Native scoring

Detailed scoring:

% of river miles assessed attaining designated use

Target: 100% attainment

Comments:

Percentage of assessed stream miles meeting their designated uses (a function of water quality). This is a measure of overall water quality. States are somewhat inconsistent in the way they designate uses.

WATER SUPPLY: Health-based violations

Data source:

2013 Government Performance and Results Act (GPRA) of Total Water Systems

SDWIS/FED drinking water data

<http://water.epa.gov/scitech/datait/databases/drink/sdwisfed/pivottables.cfm#details>

Data description:

USEPA Drinking Water Act reporting for municipal supplies,

How scored:

Native scoring. Percent of systems not reporting any health-based violations. GPRA contains data on systems reporting health-based violations (Maximum Contaminant Level, Maximum Residual Disinfectant Level, Treatment Technique). Applies to Community Water Systems only. Area-weighted by state

Detailed scoring:

Percent of municipal supplies passing reported by state. Basin percent passing is computed as weighted average by area of state scores.

Comments:

Feedback suggests that health based violations should be scored with a different standard than the quintile-based scoring used for other indicators. Currently, a score of 80% means that 20% of the time water treatment facilities were not meeting their requirements, but still scored an A.

WATER SUPPLY: Water supply stress index (not YET scored)

Data source:

2010 WaSSI model results for HUC8 watersheds. Area-weighted by how much area each HUC8 occupies within each sub-basin

<http://www.fs.usda.gov/ccrc/tools/wassi>

Data description:

Stress index is computed for each 8-digit Hydrologic Unit Code (HUC) watershed as the ratio of water demand to water supply. Potential threshold identified: watersheds are considered stressed when water demand (from power plants, agriculture, and municipalities) exceeds 40% (water supply stress index of 0.4) of available supply.

How scored:

The stress index is calculated as the ratio demand/supply and we score this pass (=100) for values less than 0.4 and fail (=0) for values above 0.4 based on output from the model calculations.

Detailed scoring:

Comments:

Initial calculations were performed using this online water stress modeling tool:

<http://www.fs.usda.gov/ccrc/tools/wassi>

User guide for the online water stress tool:

<http://www.wassimap.sgcp.ncsu.edu/help/wassiuserguide.pdf>

The underlying calculations are monthly for all 8-digit Hydrologic Unit Code (HUC) watersheds in the US.

Application paper:

<http://iopscience.iop.org/1748-9326/8/3/035046>

This indicator may not reflect the whole story of water stress in the basins. It does not account for aquifer depletion, nor the temporal nature of some water stress problems. We are looking for alternative indicators/indices for water stress. Alternatives could include:

<http://www.waterfootprint.org/Reports/Hoekstra-et-al-2012-GlobalMonthlyWaterScarcity.pdf>

This appears to capture temporal changes in water stress.