Methodology for Iowa's 2004 water quality assessment, listing, and reporting pursuant to Sections 305(b) and 303(d) of the federal Clean Water Act.

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Introduction

This methodology attempts to incorporate recommendations in U.S. EPA's July 2003 guidance for the 2004 assessment, listing, and reporting requirements pursuant to Sections 303(d) and 305(b) of the federal Clean Water Act (Sutfin 2003, U.S. EPA 2003). This EPA guidance establishes the formats for an "integrated report" that satisfies the listing requirements of Section 303(d) and the reporting requirements of Sections 305(b) and 314 of the Clean Water Act (CWA). This EPA guidance replaces all previous guidance pertaining to Sections 305(b) and 303(d) except EPA's Consolidated Assessment and Listing Methodology (CALM) (U.S. EPA 2002). This methodology meets the requirements of CWA, Section 303(d)(1)(a) and 40 CFR Section 130.24 and incorporates requirements of Iowa's "credible data" law (Attachment 1). The changes in methodology between the 2002 and 2004 listing cycles are summarized in Table 1 and are explained throughout this document.

Overview of the assessment and listing process:

The process of assessing water quality and adding waterbodies to the state list of "impaired" waters involves three interrelated program areas of the federal Clean Water Act (CWA): (1) establishment of state water quality standards that identify beneficial uses for the state's waterbodies and that identify criteria to determine whether the use is being achieved, (2) development of water quality assessments by comparing water quality information to water quality standards to determine whether or not beneficial uses are being achieved, and (3) addition of the appropriate waters assessed as not fully attaining beneficial uses ("impaired") to the State's Section 303(d) list. The 303(d) list is thus a public accounting of all assessed waterbodies determined to be impaired where a TMDL needs to be developed. A waterbody placed on the 303(d) list does not meet water quality standards including designated uses, numeric criteria, narrative criteria, and/or anti-degradation requirements as defined in U.S. EPA's regulations regarding water quality standards (40 CFR 131). The violations of water quality standards might be due to an individual pollutant, multiple pollutants, or an unknown cause of impairment. Other waterbodies may be assessed as impaired, but not included on the 303(d) list. These waters will be included in Category 4 of the Integrated Report (water is impaired, but a TMDL is not needed) (see Table 3). This includes waterbodies where: a TMDL has been completed but water quality standards have not yet been attained; other required control measures are expected to result in attainment of water quality standards in a reasonable period of time; or, the impairment or threat is not caused by a "pollutant."

The Total Maximum Daily Load (TMDL):

The Geological Survey and Land Quality Bureau of the Iowa Department of Natural Resources (IDNR) identifies waterbodies in the state of Iowa that may require a total maximum daily load (TMDL) allocation

to address the causes and sources of pollutants contributing to impairment of a designated use or other applicable beneficial use. In general terms, a TMDL defines the level of water quality needed to support a water quality standard, including the designated uses, water quality criteria, and the anti-degradation policy that comprise the standard. Conceptually, a TMDL is the maximum pollutant load from point sources and nonpoint sources, plus a load allocated to a margin of safety, that a waterbody can receive and continue to meet water quality standards. The "margin of safety" accounts for the lack of understanding of the relationship between pollutant loads and water quality. The methodology used to identify impaired waterbodies during the 2004 reporting/listing cycle in Iowa is described in this document.

Deadlines:

According to current EPA regulations, the Section 303(d) list of impaired waterbodies must be submitted to EPA by April 1 of every even numbered year. Thus, this methodology was designed to meet the deadline for submission of the list to be submitted to U.S. EPA in April 2004. This list is composed of waters included on Category 5 of the Integrated Report, and only includes those waters for which a TMDL needs to be developed. This includes waterbodies impaired by "pollutants" such as nitrate and fecal coliform bacteria. The source of impairment might be from point sources, nonpoint sources, groundwater or atmospheric deposition. Some sources of impairment exist across state lines. Historically, Iowa has listed impaired waterbodies regardless of whether the source of pollutant is known and regardless of whether the pollutant source(s) can be legally controlled or acted upon by the state of Iowa. This methodology is consistent with that history.

The "integrated" report/list:

Based on previous guidance from U.S. EPA (1997), Iowa DNR has historically produced separate Section 305(b) reports and Section 303(d) lists. Section 305(b) reports have attempted to characterize water quality statewide and thus identified not only designated use impairments but also water quality concerns that are worthy of note and further investigation but do not constitute use impairments. The 303(d) lists, on the other hand, have represented the subset of waterbodies assessed for the Section 305(b) report with known and reasonably verifiable impairments of a designated use or general use, as defined in the *Iowa Water Quality Standards* (IAC 2002), that are appropriate for Section 303(d) listing. Based on development of new guidance by U.S. EPA (2003), however, an "integrated report" was prepared for the 2004 cycle that incorporates elements of both the Section 305(b) report and Section 303(d) list.

The five general categories in the integrated assessment report, as defined by U.S. EPA (2003) are as follows:

1. All designated uses are met;
2. Some of the uses are met, but there are insufficient data to determine if remaining uses are met;
3. insufficient data to determine whether any uses are met;
4. water is impaired, but a TMDL is not needed
5. water is impaired, and a TMDL is needed (i.e., the Section 303(d) list).

As specified in Iowa's credible data law, waterbodies where the assessment indicates a potential impairment, but where sufficient and credible data are lacking, will not be included on the 2004 303(d) list but will be included in Category 2 or 3 and placed on the state list of "waters in need of further investigation" as provided for by Iowa's "credible data" legislation. Explanations of these categories and their subcategories, and details regarding their used for Iowa's 2004 integrated report, are included in this document.

The Assessment and Listing Process

Preparation of Iowa's integrated 305(b)/303(d) report and list includes the following basic steps:

- Assemble all existing and readily available water quality-related data and information;
- Identify water quality-related data and information of sufficient quality and quantity for purposes of water quality assessment;
- Compare these water quality-related data and information to state water quality standards to determine the degree to which assessed waters meet these standards;
- Identify impairments that are based on water quality-related data and information that meet data quantity and quality requirements;
- Place waters into one of the five categories specified in U.S. EPA's (2003) guidance for water quality assessment and listing;
- Prepare the state list of waters in need of further investigation;
- Prioritize the waterbodies on the draft Section 303(d) list (Category 5) for TMDL development (high, medium, and low);
- Provide the draft integrated report, including the draft Section 303(d) list (Category 5), to the public for review and comment;
- Revise and finalize the integrated report based on new information and public input; and
- Develop a schedule for development of TMDLs for Section 303(d)-listed waterbodies.

Sources of existing and readily available water quality-related data and information:

As specified in U.S. EPA's current (1992) TMDL rule (40 CFR 130.7), sources of existing and readily available water quality-related data and information to be considered as part of Section 303(d) listing includes but is not limited to the following:

- the state's most recent (2002) CWA Section 305(b) report;
- CWA Section 319 nonpoint source assessments;
- dilution calculations, trend analyses, or predictive models for determining the physical, chemical, or biological integrity of streams, rivers, lakes, and estuaries;
- water quality-related data and water-related information from local, State, Territorial, or Federal agencies (especially the U.S. Geological Survey's National Water Quality Assessment Program (NAWQA) and National Stream Quality Accounting Network (NASQAN)), Tribal governments, members of the public, and academic institutions.

Historically, the majority of information used by IDNR to develop the Section 303(d) list of impaired waters has been taken from Iowa's Section 305(b) report. Data sources used to assess water quality conditions in Iowa for purposes of Section 305(b) reporting include, but are not limited to, the following:

- Physical, chemical, and biological data from ambient fixed station water quality monitoring networks conducted by IDNR and other agencies (e.g., U.S Geological Survey, U.S. Army Corps of Engineers);
- Data from water quality monitoring conducted by adjacent states on border rivers and waters flowing into the state;
- Data from biological monitoring being conducted by IDNR in cooperation with the University of Iowa Hygienic Laboratory (UHL) as part of a current effort to establish biological criteria for Iowa's ecoregions and subecoregions and as part of the on-going regional Environmental Monitoring and Assessment Program (EMAP) project;
- Data from the IDNR-sponsored lake monitoring project conducted by Iowa State University;
- Data from monitoring of bacterial indicators in rivers and at beaches of publicly-owned lakes;
- Data from programs to monitor fish tissue for toxic contaminants;
- Reports of pollutant-caused fish kills;
- Where available, data from public water supplies on the quality of raw and finished water;
- Drinking water source water assessments under Section 1453 of the Safe Drinking Water Act;
- Data from special studies of water quality and aquatic communities;

- Best professional judgement of IDNR staff;
- Results of volunteer monitoring (e.g., by IOWATER-trained volunteers);
- Water-related information received from the public.

The cutoff date for the data collection period for Iowa's 2004 Integrated Report is the end of the calendar year 2002. For purposes of developing water quality assessments for the 2004 integrated report, three years of water quality data are used for both conventional pollutant parameters (e.g., indicator bacteria) and the less frequently monitored toxic parameters (e.g., toxic metals). Historically, only two years of data were used for Iowa's previous Section 305(b) reports. The use of three years of data will increase, for most assessments, the number of samples upon which the decision on use support is based. Older data, up to five years old, are used to supplement data from the current assessment period for water quality parameters with low collection frequency (e.g., toxic metals). As specified in Iowa's credible data law, and based on the uncertainty inherent in using old data to characterize current water quality conditions, data older than five years are not used for purposes of adding waters to Category Five of the Integrated Report (i.e., the Section 303(d) list). Data older than five years are generally believed to be less reflective of current ambient water quality than are more recent data. The sources of water quality data used for water quality assessments and impaired waters listings in Iowa are discussed in more detail below.

- **Physical, chemical, and biological data from ambient fixed station water quality monitoring networks conducted by IDNR and other agencies**

  The IDNR, in cooperation with UHL, has conducted routine ambient monitoring of river water quality since the early 1980s. Due to resource constraints, the majority of this monitoring prior to 1999 was limited to relatively few (16) locations. Due to an appropriation from the Iowa Legislature, this monitoring program was significantly expanded beginning in October 1999. Iowa rivers are now monitored monthly at 82 sites for 94 physical, chemical, and bacterial parameters through a contract with the UHL which provides both data collection and laboratory services. Sixty-two of these sites are classified as ambient (background) sites. These sites are distributed throughout every major river basin in an effort to provide good geographic coverage of the state. Twenty-three of the sites are associated with 10 major cities, with monitoring stations located both upstream and downstream from these cities. In addition to the standard parameters, the upstream/downstream urban sites are being tested for a variety of pharmaceuticals, industrial chemicals, and insecticides. For more information on the IDNR's ambient and city monitoring programs see the following web site: *http://wqm.igsb.uiowa.edu/*.

Long-term ambient water-quality monitoring has also been conducted in Iowa by the following agencies: U.S. Army Corps of Engineers, U.S. Geological Survey (USGS), and utilities such as the Des Moines Water Works, the Cedar Rapids Water Department, and the Rathbun Rural Water Association. The monitoring networks in Iowa conducted by agencies other than IDNR are typically designed to answer questions specific to the effects of in-stream structures or large facilities on water quality (e.g., flood control reservoirs or power generating facilities). For example, networks have been established by the U.S. Army Corps of Engineers on the Des Moines, Raccoon, and Iowa rivers to evaluate changes in water quality caused by Saylorville, Red Rock, and Coralville reservoirs. In general, stations in these networks have remained fixed for about the last three decades, and they have been monitored more frequently than stations in the IDNR/UHL network. Thus, these networks provide a relatively long-term database that can be used to characterize water quality conditions. For information on the monitoring networks on the Des Moines and Raccoon rivers, see the following web site: *http://www.cce.iastate.edu/research/lutz/dmrwqn/dmrwqn.html*.

Currently, USGS conducts routine water quality monitoring at two fixed stations in Iowa: the Mississippi River at Clinton and the Missouri River at Omaha (Council Bluffs). Both of these sites are remnants of the USGS National Stream Quality Accounting Network (NASQAN). In late 1994, the USGS began routine monitoring at selected locations in the Skunk, Iowa, Cedar, and Wapsipinicon river basins as part of the National Water Quality Assessment Program (NAWQA) in the Eastern Iowa Basins study unit. This monitoring was conducted through September 1998. The NAWQA program is designed to generate comprehensive and nationally-consistent water quality information that can be used to describe the status and trends of the nation's water resources. NAWQA monitoring in the Eastern Iowa Basins study unit is currently in the low-intensity phase with resumption of routine monitoring scheduled for 2005 (Stephen Kalkhoff, U.S. Geological Survey, Iowa City, personal communication). During the 2000-2002 period, four stations in the Eastern Iowa Basins NAWQA unit were monitored: Wapsipinicon River near Tripoli (Bremer Co.), Iowa River near Rowan (Wright Co.), South Fork Iowa River near New Providence (Hardin Co.), and Iowa River near Wapello (Louisa Co.) Data from USGS monitoring in Iowa are available at the following web site: *http://waterdata.usgs.gov/nwis/sw*.

- **Data for Iowa tributaries of the Upper Mississippi River generated by the Long Term Resource Monitoring Program**

  Intensive water quality monitoring of Pool 13 of the Upper Mississippi River and several Iowa tributaries is conducted by Iowa DNR staff at Bellevue, Iowa, as part of the Long-Term Resource Monitoring Program (LTRMP). The LTRMP was authorized under the Water Resources Development Act of 1986 as an element of the U.S. Army Corps of Engineers Environmental Management Program (EMP) and is currently being implemented by the U.S. Geological Survey in cooperation with the five Upper Mississippi River basin states (Illinois, Iowa, Minnesota, Missouri, and Wisconsin). State staff at six field stations in the Upper Mississippi River system conduct monitoring of fisheries, macroinvertebrates, vegetation, as well as water quality on specified reaches of the river. Water quality monitoring by the LTRMP began in 1988 and continues. LTRMP stations with chemical data used for water quality assessments in Iowa are summarized in Table 2.

- **Data from water quality monitoring conducted by adjacent states on border rivers and waters flowing into the state**

  States adjacent to Iowa (South Dakota, Minnesota, Wisconsin, Illinois, Missouri, and Nebraska) also have fixed station ambient water quality monitoring programs that generate data useful for purposes of water quality assessments in Iowa. Data from these monitoring networks are available either through the U.S. EPA's national water quality database "STORET" or through personal contacts with water quality monitoring staff of environmental agencies in these states. These data are used with the guidelines described in this document to assess the degree to which Iowa water quality standards are being met.

- **Data from biological monitoring being conducted by IDNR in cooperation with UHL as part of a current effort to establish biological criteria for Iowa's ecoregions and subecoregions and as part of the ongoing Regional EMAP project**

  Biological criteria or "biocriteria" are narrative or numeric expressions that describe the best attainable biological integrity (reference condition) of aquatic communities inhabiting waters of a given designated aquatic life use. In order to develop biocriteria, knowledge of the variation in the ecological and biological conditions within a state is necessary. Ecoregions, generally defined as regions of relative homogeneity in ecological systems and relationships between organisms and their environments, have been used by several

states when developing biocriteria for their water quality standards. Reference sites are located on the least impacted streams within an ecoregion. Reference sites can thus serve as benchmarks to which water quality-impaired streams can be compared.

In Iowa, a list of candidate stream reference sites was generated for the state's ten ecoregions and subecoregions. Sampling of reference sites began in 1994 and continues; the current rate of sampling is 20 sites per year. Stream biological sampling is conducted from July 15 to October 15. In addition to reference site sampling, sampling at "test" sites is conducted to determine how much a stream's biological health is impacted by disturbances such as channelization, livestock grazing, manure spills, wastewater discharges and urban runoff. Currently, approximately 40 test sites are sampled per year. At both reference sites and test sites, standard sampling procedures are used so that data from all sites are comparable. The samples measure how many types of benthic macroinvertebrates and fish are present and the abundance of each type in relation to the whole sample. Benthic macroinvertebrates are collected from several types of habitat including aquatic vegetation, boulders, leaf packs, overhanging vegetation, rocks, root mats and woody debris. Fish are sampled in one pass through the sampling area using electrofishing gear.

These bioassessment sampling protocols have also been used to examine the location and amount of biological impairment in TMDL-targeted watersheds. That is, this "watershed" sampling has been used to identify problem areas that need to be addressed. So far, a total of 48 sites in three Iowa watersheds have been sampled (IDNR/WRS 2001). More watershed sampling is planned to support development of stream restoration plans, including TMDLs. The data from the sampling of reference sites, test sites, and watershed sites are being used to develop indicators of stream biological integrity that will form the basis for establishment of numeric biocriteria and that will be used for Section 305(b) assessments of aquatic life use support.

In 2002, Iowa DNR, in cooperation with the University of Iowa Hygienic Laboratory, began sampling for a Regional Environmental Monitoring and Assessment Program (REMAP) project designed to randomly select Iowa stream sites over four years to objectively measure biological integrity in flowing streams. This project is based on a random sampling design that will be used to obtain an unbiased sample population from which accurate statements about the status of Iowa's perennial streams can be extrapolated.

The survey will sample approximately 60 sites a year and measure several indicators of stream ecosystem health including: fish tissue, sediment, and water contaminant levels; physical habitat quality; and fish and benthic macroinvertebrate populations. This study will determine the current biological health of Iowa streams and help provide a uniform assessment of stream conditions in the Central Plains of the United States. Methods of data collection and analysis used in the Iowa stream survey will be similar to those used in the 1994-1995 REMAP survey of perennial streams in Kansas, Missouri, and Nebraska.

- **Data from the IDNR-sponsored lake monitoring conducted by Iowa State University**

  Data from statewide lake surveys completed in the early 1980s (110 lakes) and early 1990s (115 lakes) by Iowa State University have served as a basis for past assessments of lake water quality. Beginning in 2000, 132 lakes throughout Iowa were monitored annually as part of a IDNR-sponsored five-year project to assess their condition and measure the temporal variability in water quality; this monitoring is being conducted by Iowa State University. All lakes assessed in the earlier studies are being sampled as well as 17 additional lakes. Each lake is sampled three times during the summer season to assess seasonal variability. Samples are taken at the deepest point in each lake basin. Vertical probes are lowered through the water column to determine vertical profiles for temperature, dissolved oxygen, specific conductivity, pH, turbidity, and chlorophyll. An integrated column sampler is used to collect water from the upper mixed zone in thermally stratified lakes and from the entire water column in lakes that lack stratification. The data from these samples are used to develop water quality assessments for the lakes monitored. In addition, concentrations of pesticides and metals in both water and bottom sediments, as well as plankton populations, will be analyzed from each lake.

- **Data from monitoring of bacterial indicators in rivers and at beaches of publicly-owned lakes**

  Indicator bacteria, such as fecal coliform bacteria and *E. coli*, are commonly monitored by state environmental agencies to indicate the degree to which surface waters support their designated uses for primary contact recreation. High levels of these indicator bacteria suggest that using a river or lake for primary contact recreation (e.g., swimming or water skiing) presents a health risk due to the potential for waterborne diseases. As part of fixed station monitoring networks in Iowa, several river reaches designated for primary contact recreation uses are monitored for bacterial indicators on a monthly basis.

Historically, this type of monitoring had not been conducted at Iowa's lakes. In 1999, however, the IDNR Division of Parks, Recreation and Preserves monitored ten of Iowa's public beaches for bacterial contamination. Iowa State University monitored two additional beaches as part of an intensive study of Clear Lake. In 2000, beach monitoring was expanded to thirty-one Iowa beaches. From May through September, these beaches were monitored weekly. In addition to weekly monitoring, four beaches were sampled twice daily from late May through early July to determine the daily variability in bacteria levels at these beaches. All beaches were monitored for three U.S. EPA-recommended bacterial indicators: fecal coliform, enterococci, and *E. coli*. Since 2001, thirty-five beaches at state-owned lakes have been monitored on a weekly basis during the summer recreational season.

- **Data from programs to monitor fish tissue for toxic contaminants**

  Annual, routine monitoring for bioaccumulative toxics in Iowa fish tissue is conducted as part of three long-term programs: (1) U.S. EPA Region VII's *Regional Ambient Fish Tissue Monitoring Program*, (2) water quality studies of the Des Moines River near Saylorville and Red Rock reservoirs conducted by Iowa State University under contract with the U.S. Army Corps of Engineers, and (3) water quality studies of the Iowa River near Coralville Reservoir conducted by the University of Iowa also under contract with the U.S. Army Corps of Engineers.

  Since 1980, annual fish collection and analysis activities in Iowa have been conducted by IDNR as part of the U.S. EPA Region VII's *Regional Ambient Fish Tissue (RAFT) Monitoring Program*. Each year in late summer, IDNR fisheries biologists collect fillet samples of both bottom-feeding fish (common carp or channel catfish) and predator fish (usually largemouth bass, crappie, or walleye) from approximately 20 RAFT screening locations on rivers and lakes in Iowa. Selection of sample sites is based on the level of fishing use and date of most recent fish tissue sampling. Currently, samples are analyzed for 19 pesticides, 4 organic compounds, and 4 metals. The RAFT program also involves (1) monitoring for trends in levels of toxics in bottom feeding fish (common carp) at ten fixed sites on Iowa's larger rivers as well as (2) follow-up monitoring designed to verify the existence of high contaminant levels and to determine whether the issuance of consumption advisories is justified.

Iowa State University conducts annual fish contaminant monitoring for bottom-feeding fish (common carp) at Saylorville and Red Rock reservoirs as part of a U.S. Army Corps of Engineers water quality monitoring program. The University of Iowa conducts fish contaminant monitoring as part of a similar program at Coralville Reservoir.

Fish contaminant monitoring is also conducted as part of special studies of water quality. For example, the Kansas City District of the U.S. Army Corps of Engineers periodically conducts fish contaminant monitoring at Rathbun Reservoir in southern Iowa. Also, fish contaminant monitoring was conducted over a 13-year period (1988-2000) in Pool 15 of the Upper Mississippi River near Davenport, Iowa, in response to a PCB contamination problem.

- **Reports of pollutant-caused fish kills**

  IDNR routinely receives reports of fish kills that are investigated by IDNR staff from either the Fisheries Bureau or Compliance & Enforcement Bureau. Information from the reports of these kills, including location, the cause and source of the kill, the size of waterbody affected, and the number of fish killed, is entered into the IDNR Fish Kill Database (MS-Access).

- **Data from public water supplies on the quality of surface water sources and finished water**

  The IDNR Environmental Services Division administers the public drinking water program in Iowa under delegation of authority from the U.S. Environmental Protection Agency. As required by the Safe Drinking Water Act of 1996, IDNR prepares an annual report of violations of national primary (finished) drinking water standards by public water supplies in the state (reports are available at *http://www.state.ia.us/epd/wtrsuply/report/report.htm*). In addition, several public water supplies using surface water sources in Iowa have generated long-term databases for the quality of raw water used at their facilities. For example, the municipal water supplies at Cedar Rapids and Des Moines routinely collect data on levels of toxic contaminants in the Cedar and the Raccoon/Des Moines rivers, respectively, which can influence their water treatment processes.

  Since 1994, Syngenta, Inc. has sponsored a voluntary program to monitor levels of atrazine in Iowa impoundments used as a source of potable water for a municipal water supply. During the period 2000-2002, this program included surface water supplies for ten

Iowa municipalities: Centerville, Chariton, Fairfield, Lamoni, Leon, Montezuma, Mt. Ayr, Osceola, Corydon, and Winterset.

- **Data from special studies of water quality and aquatic communities**

  Special/intensive studies of water quality are typically conducted over a finite time period and are targeted toward understanding or characterizing specific water quality issues. This type of study differs from "routine", monitoring that is conducted over a long time frame and that typically generates information necessary to describe general water quality conditions. The sampling protocol for intensive studies is site-specific and is based on the contaminant(s) of concern. These studies typically require multiple samples per site over a relatively short time frame. If the contaminants of concern have significant seasonal or daily variation, season of the year and time of day variation are accounted for in sampling design. The number of sampling sites, sampling frequency and parameters vary depending on the study.

  Each year, a number of special water quality studies are conducted in the state. These studies include monitoring conducted in support of TMDL development. Results of special studies may be summarized in the form of a published document or an unpublished report. For example, IDNR has recently published reports on the water quality of Sny Magill Creek in Clayton County and Walnut Creek in Jasper County. Surveys of aquatic communities are occasionally conducted by IDNR staff as part of special studies. In addition, a number of water quality reports have been generated during the period 1997-2002 from the U.S. Geological Survey's National Water Quality Assessment (NAWQA) Program. Special water quality studies conducted by colleges and universities as part of undergraduate and graduate projects are also sources of water quality data and other water-related information.

- **Best professional judgement of IDNR staff**

  IDNR utilizes observations of professional staff of the IDNR bureaus of Fisheries and Wildlife, as well as professional staff in other agencies, to assess support of aquatic life uses in certain types of Iowa waterbodies that have historically lacked chemical, physical, and/or biological water quality data. For example, due to the lack of water quality monitoring at Iowa wetlands, water quality assessments for these waterbodies have been based entirely on observations of biologists in the IDNR Wildlife Bureau.

- **Results of volunteer monitoring**

  The Iowa volunteer monitoring program (IOWATER) was established in 1999 by the IDNR. This program provides training, equipment and supplies to volunteers for monitoring streams throughout Iowa.

- **Water quality-related data and information received from the public**

  Additional water quality-related data and information are received from the public. While potentially useful for developing Section 305(b) water quality assessments, these data and information are most often used to initiate investigations by IDNR field staff. Results of these investigations may influence or direct future water quality monitoring activities. In all cases, the value, accuracy and potential utility of these data for purposes of CWA reporting are evaluated by the IDNR on a case-by-case basis.

Identifying impairments:

As specified in U.S. EPA's July 1992 TMDL rule, sources of existing and readily available water quality-related data and information to be considered as part of Section 303(d) listing include but are not limited to the following:

- the state's most recent CWA Section 305(b) report;
- CWA Section 319 nonpoint source assessments;
- dilution calculations, trend analyses, or predictive models for determining the physical, chemical or biological integrity of streams, rivers, lakes, and estuaries; and
- water quality-related data and information from local, State, Territorial, or Federal agencies (especially the U.S. Geological Survey's National Water Quality Assessment Program (NAWQA) and National Stream Quality Accounting Network (NASQAN)), tribal governments, members of the public, and academic institutions).

The majority of information used by IDNR to develop the Section 303(d) list of impaired waters (Category 5 of the integrated report) is taken from Iowa's Section 305(b) assessments. Due to the importance of data quality and quantity in developing accurate assessments, and due to requirements of Iowa's credible data law, only a subset of this information is used for purposes of placing waters into Category 5. The process of determining whether or not data from the above data sources are appropriate for placing waterbodies in Category 5 is described below.

Types of Assessments: *Evaluated* and *Monitored*:

For purposes of developing Section 305(b) assessments, the existing and readily available water quality data described above are used to make two types of water quality assessments: "evaluated" and "monitored." As described in guidelines for Section 305(b) reporting (U.S. EPA 1997, pages 1-5 and 1-9),

Evaluated waters are

> those for which the use support decision is based on water quality information other than current site-specific data such as data on land use, location of sources, predictive modeling using estimated input values, and some questionnaire surveys of fish and game biologists. As a general rule, if an assessment is based on older ambient data (e.g., older than five years), the State should also consider it "evaluated."
>
> For example, water quality assessments based on results from only a few grab samples or on professional judgment of local biologists would be considered "evaluated" assessments.

Monitored waters are

> those waterbodies for which the use support decision is principally based on current, [five years old or less] site-specific ambient monitoring data believed to accurately portray water quality conditions. Waters with data from biosurveys should be included in this category along with waters monitored by fixed-station chemical/physical monitoring or toxicity testing. To be considered "monitored" based on fixed station chemical/physical monitoring, waters generally should be sampled quarterly or more frequently.

Although EPA's guidelines for the 2004 integrated report (U.S. EPA 2003) do not distinguish between "monitored" and "evaluated" assessments, Iowa DNR feels that the distinction remains important for determining the relative scientific strength and confidence of the water quality assessments developed. Thus the Iowa Assessment Database (ADB+) is designed to track "monitored" versus "evaluated" assessments while still complying with the integrated reporting format recommended by EPA (2003).

In terms of the ability of Section 305(b) assessments to characterize current water quality conditions, IDNR considers "evaluated" assessments as having relatively lower confidence while "monitored" assessments are of relatively higher confidence. IDNR considers "monitored" assessments as sufficiently accurate to be appropriate for both Section 305(b) assessments and Section 303(d) listing (i.e., for placing waters into Category 5 of the integrated report). The lower confidence "evaluated" assessments, however, are viewed as appropriate only for Section 305(b) reporting. Thus, any waters assessed (evaluated) as "impaired" are identified as having "insufficient data" to determine whether beneficial uses are met and will be placed in Categories 2 or 3 (i.e., categories for waterbodies with insufficient information) of the integrated report/list.

Data *quantity* considerations ("data completeness" guidelines):

For purposes of Section 303(d) listing in Iowa (i.e., placing waters in Category 5), data quantity issues are addressed through IDNR guidelines for water quality assessments. Beginning with Iowa's Section 305(b) report for 1990, IDNR staff developed "data completeness" guidelines to avoid basing water quality assessments on inadequate amounts of water quality data and to reduce errors in assessments (for example, incorrectly concluding that an impairment exists). For the various parameters used to develop water quality assessments, these guidelines establish the minimum number of data points needed over a given assessment period to adequately determine whether the applicable water quality standards are being met. Assessments that meet these data completeness guidelines are of relatively high confidence and are considered "monitored." Assessments based on an insufficient amount of data to meet these guidelines are of relatively low confidence and are thus considered "evaluated." The current version of Iowa's Section 305(b) data completeness guidelines is presented in Table 8. The significance of data completeness guidelines and the credible data law to Iowa's Section 305(b) water quality assessments and Section 303(d) listings is summarized in Figure 1.

Data *quality* considerations ("credible data" requirements):

As defined by U.S. EPA, data quality objectives are qualitative and quantitative statements that clarify objectives, define appropriate types of data, and specify levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support decisions. Iowa's credible data law (Attachment 1) defines data quality objectives for the state's Section 303(d) listings. These objectives are as follows:

- "*Credible data*" means scientifically valid chemical, physical, or biological monitoring data collected under a scientifically accepted sampling and analysis plan, including quality control and quality assurance procedures.

- Data dated more than five years before the department's date of listing or other determination under section 455B.194, subsection 1, shall be presumed not to be credible data unless the department identifies compelling reasons as to why the data is credible.

As stated in the 2001 Iowa Code, Section 455B.194, subsection 1, (Iowa's credible data law) the department shall use "credible data" when doing any of the following:

- Developing and reviewing any water quality standard.
- Developing any statewide water quality inventory or other water assessment report. (Note that Iowa's Section 305(b) assessments are not subject to requirements for "credible data".)

- Determining whether any water of the state is to be placed on or removed from any Section 303(d) list.
- Determining whether any water of the state is supporting its designated use or other classification. (Note that the credible data law does not require the use of credible data for establishment of a designated use or other classification of a water of the state.)
- Determining any degradation of a water of the state under 40 CFR 131.12.
- Establishing a total maximum daily load (TMDL) for any water of the state.

Rationale for any decision not to use existing and readily available data:

IDNR reviews all existing and readily available water quality-related data and information for purposes of water quality reporting and impaired waters listing as required by Sections 305(b) and 303(d) of the Clean Water Act. Certain categories of water quality information, however, do not meet requirements of either Iowa's credible data law or IDNR's data completeness guidelines for water quality assessments and impaired waters listings. The ultimate reasons for not using certain "existing and readily available data" are (1) the need for reasonably accurate assessments of water quality and (2) the desire to add only waterbodies to the state's Section 303(d) list (Category 5) that are actually "impaired." Placing waters on the state's Section 303(d) list on the basis of inaccurate and/or incomplete data increases the risk that the department's limited resources, including staff time and monitoring dollars, will be used unwisely. Examples of water quality information that typically would not be considered appropriate as the basis for Section 303(d) listing include the following:

- **Best professional judgement of IDNR staff:** IDNR utilizes observations of professional staff of the IDNR bureaus of Fisheries and Wildlife, as well as professional staff in other agencies for purposes of water quality (Section 305(b)) reporting. Best professional judgement is used to assess support of aquatic life uses in certain types of Iowa waterbodies that have historically lacked chemical, physical, and/or biological water quality data (primarily, lakes and wetlands). To be added to Iowa's list of impaired waters (Category 5), all assessments of impairment based solely on best professional judgement will be further investigated to better document any failure to meet water quality standards. Past experience with assessments based primarily on best professional judgment has demonstrated that such follow-up investigations are necessary to (1) better determine whether a water quality impairment actually exists and (2) more accurately identify the causes and sources of any existing impairment.

- **Data or information older than five years from the end of most recent Section 305(b) reporting cycle:** Data dated more than five years before the end of the most recent Section 305(b) period (the end of calendar year 2002) are presumed under state law to be "not credible" unless IDNR identifies compelling reasons as to why the older data are credible. For any water of the state for which credible data exist, data older than five years may be used for identifying water quality trends. This provision of Iowa's credible data law was based on, and is consistent with, U.S. EPA's (1997) recommendation that data older than five years should not be used to make the type of water quality (Section 305(b)) assessment ("monitored" assessment) that is believed to accurately portray site-specific water quality conditions. Historically, data older than five years have been used for Section 305(b) reporting in Iowa but have not been used for Section 303(d) listing. All such assessments, however, are considered "evaluated" and are thus of relatively lower confidence than "monitored" assessments which are based primarily on recent, site-specific ambient monitoring. As the data upon which assessments are based age beyond five years, the assessment type is changed from "monitored" to "evaluated". Once placed in Category 5, however, a waterbody will not be moved to a non-TMDL category without "good cause" as defined by U.S. EPA regulations (e.g., a TMDL for the waterbody is approved by EPA or new monitoring data suggest that the impairment no longer exists).

- **Data that do not meet "completeness guidelines" developed for Section 305(b) reporting:** In order to improve the accuracy of water quality assessments, IDNR has identified "data completeness guidelines" for using results of routine water quality monitoring for Section 305(b) reporting (Table 8). These guidelines identify the numbers of samples needed for water quality assessments that can support Section 303(d) listings (i.e., *monitored* assessments). These guidelines also identify assessments appropriate only for Section 305(b) reporting (i.e., *evaluated* assessments). These criteria were first developed for Iowa's 1990 Section 305(b) report and are designed to improve, within the constraints of resources available for monitoring and the designs of existing monitoring networks, the accuracy of Section 305(b) water quality assessments. This improvement in assessment accuracy increases the confidence with which waterbodies are added to Iowa's Section 303(d) list. Although IDNR ambient water quality monitoring networks, and networks of other agencies, are designed to produce sufficient data to meet Iowa's "completeness guidelines," not all monitoring activities are so designed. Thus, the use of these criteria will eliminate certain data from consideration for Section 303(d) listing.

- **Results of volunteer monitoring that do not meet requirements specified in Iowa's credible data legislation and/or Section 305(b) data completeness guidelines:** Results from volunteer monitoring can only be used for Section 303(d) listing if requirements of Iowa's credible data law are met. These requirements include that the monitoring must be supported by an IDNR-approved sampling and analysis plan that includes quality control and quality assurance procedures.

- **Results of habitat assessment:** Although detailed information on the quality of aquatic habitats is collected as part of the IDNR/UHL stream biocriteria and REMAP projects, IDNR has not yet developed methodologies for using results of habitat assessments to identify water quality impairments. IDNR does, however, incorporate observations on the quality of aquatic habitat into Section 305(b) water quality assessments. This information is also used in the identification of causes and sources of impairments of aquatic life uses identified through biological monitoring.

- **Assessments of "general use" waters based on criteria methods applicable to "designated use" waters.** Occasionally, chemical or biological monitoring is conducted on Iowa's general use-only waters. Typically this situation occurs in intermittent headwater reaches upstream from stream reaches designated for Class B(LR) aquatic life uses. General use waters are protected only against acutely toxic conditions and aesthetically objectionable/nuisance conditions attributable to pollution sources as described in the narrative criteria of the *Iowa Water Quality Standards*, Section 61.3(2) (IAC 2002). In contrast, Class B(LR) waters are also protected by numeric criteria designed to guard against chronically toxic as well as acutely toxic conditions.

  Due to the lack of numeric water quality criteria and assessment methodologies for general use waters, IDNR sometimes uses Class B(LR) water quality criteria and assessment methodologies developed for Class B(LR) streams to make use of the available data and to assess aquatic life conditions in general uses waters. Although not entirely appropriate, the use of Class B(LR) criteria and methods to assess general use-only streams can indicate the existence of pollution-caused water quality problems in general use streams. Unfortunately, however, results of monitoring from general use streams do not often indicate whether a failure to meet Class B(LR) water quality standards or ecoregional expectations for fish and macroinvertebrates is due to man-made pollution sources or is simply due to the naturally-reoccurring extreme conditions inherent in general uses streams.

The aquatic environment of most general use streams is one of extremes ranging from flood flow to no flow, from completely frozen in winter to extremely warm water temperatures in summer. Due to their position in relation to sources of groundwater, many general use stream reaches experience no-flow conditions at least once per year. These extremes are sometimes reflected in results of water quality monitoring and biological assessments. For example, as streams move toward their typical no-flow conditions in summer, chemical water quality can degrade drastically, especially regarding levels of dissolved oxygen and pH. As stream flow ceases and the only remaining water exists as isolated pools, violations of Class B(LR) criteria for dissolved oxygen and/or pH—not unexpectedly—become more common, often with sufficient frequency to suggest impairment of aquatic life uses. Also, due to seasonally reoccurring intermittent flow, the types of aquatic life that inhabit general use streams are often only those able to withstand extremes environmental conditions (the so-called "pioneer species"). Consequently, general use streams tend to have biological diversity that is low relative to more stable environments of Class B(LR) and Class B(WW) streams. Thus, the use of biological assessment methods developed for the ecologically more stable and diverse Class B(LR) streams to assess general use reaches will likely overstate the existence of impairment.

For these reasons, general use-only stream reaches that show impairment based on a comparison of monitoring data to Class B(LR) water quality criteria, or that show failure to meet regional expectations for aquatic biota (fish or aquatic macroinvertebrates) of Class B(LR) streams, will not be added to Iowa's Section 303(d) list of impaired waters. The assessment type for these waters will be considered "evaluated" (indicating an assessment with relatively lower confidence) as opposed to "monitored" (indicating an assessment with relatively high confidence). Such waters will be placed in either Category 2 or 3 and will be added to the state's list of "waters in need of further investigation" as provided in Iowa's credible data law. Once on this list, the assessments can be reviewed to better determine the nature of the water quality problems suggested by chemical or biological monitoring and to determine whether follow-up monitoring is justified.

List of waters in need of further investigation:

Although not used for identifying Category 5 waters (=Section 303(d) listing), the above types of water-related information are used for Section 305(b) water quality assessments and thus can be used to place waterbodies on a separate list of Iowa waterbodies in need of further investigation. As provided for in Iowa's credible data law, this list is not part of the Section 303(d) process in Iowa and includes waterbodies where limited information suggests, but does not conclusively (credibly) demonstrate, a water quality impairment. If the results of further investigative monitoring demonstrate, with credible data, that a water quality impairment exists, the affected waterbody can be added to Iowa's Section 303(d) list.

The 2004 list of waters in need of further investigation (WINOFI) is comprised of those waterbodies assessed (evaluated) as "impaired" in subcategories 2b and 3b of the Integrated Report. The assessments of any impairments in waterbodies in these subcategories are based on less than complete information; thus, the assessment is of relatively low confidence and is not appropriate for addition to the list of waterbodies in need of TMDLs in Category 5.

Overwhelming evidence of impairment:

Situations exist where reliable and credible information can accurately indicate an impairment of beneficial uses even though this information does not meet data quantity requirements for Section 305(b) reporting and/or Section 303(d) listing (Table 8). The following are examples of instances where overwhelming evidence of an impairment justifies determination of impairment, and addition of an Iowa waterbody to Category 4 (water is impaired, but a TMDL is not needed) or Category 5 (=Section 303(d) list) of Iowa's integrated assessment/listing report.

- Presence of reoccurring, man-made circumstances that result in acutely toxic conditions for aquatic life.

- Man-made alterations of hydrology, flow, or habitat that degrade the quality of aquatic habitats as reflected in significant, adverse deviations in biotic integrity from the reference condition or from the pre-modification aquatic communities.

- Chronic de-watering of a considerable section of a waterbody related to man-made alterations of local hydrology.

- Presence of exotic species (e.g., common carp or purple loosestrife) at levels that are believed to impair one or more designated uses.

- Trophic state index (Carlson 1977, 1991) values for chlorophyll-a or secchi depth that are based on less than three years of data but are more than five TSI points greater than values used to identify impairment with a complete dataset (three or more years of data resulting from three to five samplings per year). For more information on IDNR's use of Carlson's trophic state index, see Attachment 3.

How water quality data and other water-related information are summarized to determine whether waters are Section 303(d) "impaired":

- **Physical, chemical, and bacterial data from fixed station water quality monitoring networks**

  These types of data are used with methods for Section 305(b) water quality assessments developed by U.S. EPA and modified by the IDNR (see Tables 4 through 8). In general, the U.S. EPA (1997, 2002) guidelines specify that aquatic life uses of surface waters with more than 10% of samples in violation of state water quality criteria for conventional parameters (for example, dissolved oxygen, pH, temperature) are assessed as "impaired." An exception is when high levels primary productivity result in levels of pH that exceed Iowa water quality criteria for protection of Class A and Class B uses. Such violations result from other water quality problems (e.g., nutrient enrichment) that often indicate impairment independently from data for pH. For toxic parameters (e.g., ammonia, toxic metals, pesticides), more than one violation of an acute or chronic water quality criterion over a three-year period suggests impairment of aquatic life uses. U.S. EPA (1997, 2002) has also developed separate assessment methodologies for using results of fixed station and other ambient monitoring to determine support of fish consumption, primary contact recreation, and drinking water uses. IDNR has modified U.S. EPA's (1997, 2002) Section 305(b) water quality assessment guidelines for assessing drinking water uses with data for nitrate in surface water sources (see Table 7). Also, IDNR has developed assessment methods for data types and assessment categories for which U.S. EPA does not provide specific assessment methods (e.g., using fish kill information and results of biological monitoring to assess support of aquatic life uses (see below and Attachment 2)).

- **Data from biological monitoring being conducted by IDNR in cooperation with UHL as part of a current effort to establish biological criteria for Iowa's ecoregions and subecoregions**

  Benthic macroinvertebrate and fish sampling data from the IDNR/UHL stream biocriteria and REMAP sampling sites are used to identify impairments of warmwater stream aquatic life uses. IDNR uses a Benthic Macroinvertebrate Index of Biotic Integrity (BM-IBI) and a Fish Index of Biotic Integrity (F-IBI) to summarize biological sampling data. The BM-IBI and F-IBI combine several quantitative measurements or "metrics" that provide a broad assessment of stream biological conditions. A metric is a characteristic of the biological community that can be measured reliably and responds predictably to changes in stream quality. The BM-IBI and F-IBI each contain twelve metrics that relate to species diversity, relative abundance of sensitive and tolerant organisms, and the proportion of individuals belonging to specific feeding and habitat groups. The metrics are numerically ranked and their scores are totaled to obtain an index rating from 0 (poor) – 100 (optimum). Qualitative scoring ranges of poor, fair, good, and excellent have been established that reflect the biological community characteristics found at each level. The categories of "fair" and "poor" indicate an impairment of the aquatic life use. A framework for using these data to assess support of aquatic life uses was first developed for the 2000 Section 305(b) reporting cycle. The same framework used for the 2002 reporting/listing cycle will be used for the 2004 cycle; a description of this framework is included as Attachment 2.

- **Data from the IDNR-sponsored lake monitoring conducted by Iowa State University**

  The IDNR–sponsored lake water quality monitoring program began in 2000 and is to continue through 2004. Each lake is sampled three times during the summer season to assess seasonal variability of chemical, physical, and biological parameters (e.g., plankton populations). Samples are taken at the deepest point in each lake basin. In order to account for the year-to-year variability in lake water quality, state limnologists recommend that the combined data from at least three years of monitoring results from this type of lake survey should be used to identify water quality impairments. Thus, median water quality values from a three to five-year period will be used to calculate a trophic state index (TSI) (see Attachment 3). TSI values will be compared to existing state water quality standards to determine the existence of an impairment. Similar to the time frame used for other sources of water quality data, lake data from the years 2000, 2001, and 2002 will be used to identify water quality impairments for the 2004 Section 303(d) list.

- **Data from monitoring of bacterial indicators in rivers, lakes, and beach areas**

  [Note: In July 2003, Iowa DNR adopted criteria for *E. coli* in place of the previous criterion for fecal coliform bacteria into the *Iowa Water Quality Standards*. In addition, a proposed change in the Water Quality Standards was made to change the current Class A (primary contact) use designation to three designations: Class A1 (primary contact recreation), Class A2 (secondary contact recreational use), and Class A3 (children's recreational use) Because both the previous criterion for fecal coliform bacteria and the previous Class A designation framework were in effect during nearly all of the 2000-2002 reporting period, data for fecal coliform bacteria from Class A waterbodies will be used to assess support of primary contact recreation in Iowa surface waters designated for this use. This approach is the same used for previous Section 305(b) reports in Iowa. Methods for using E. coli and the new Class A designation framework will be developed for Iowa's 2006 integrated report and Section 303(d) list.]

  The state of Iowa considers waters with levels of fecal coliform bacteria greater than 200 organisms per 100 ml during non-runoff conditions to present an unacceptable risk of waterborne disease to swimmers, water skiers, and other persons using surface waters for recreational activities where ingestion of water is likely to occur (Section 61.3, *Iowa Water Quality Standards*). In the context of Section 305(b) reporting, U.S. EPA (1997, 2002) recommends that support of primary contact recreation uses be based on (1) a comparison of the geometric mean of at least five samples collected over a 30-day period to state water quality criteria for indicator bacteria (fecal coliforms, *E. coli*, and/or enterococci) and (2) the percentage of samples that exceed a single-sample maximum value. In cases where the geometric mean exceeds the state water quality criterion, or more than 10% of the samples exceed the single-sample maximum value, primary contact uses should be assessed as "impaired."

  While U.S. EPA's recommended approach is preferred, differences in monitoring frequencies of Iowa waterbodies require that different approaches be used when developing assessments of support of primary contact recreation uses. Iowa river reaches and some lakes designated for primary contact recreation are typically sampled once per month as part of ambient water quality monitoring activities; none of these river or lake stations are monitored more than twice per month. Thus, a maximum of two samples of indicator bacteria are collected from these stations during any 30-day period.

This amount of data is not sufficient for use with U.S. EPA's recommended approach for assessing support of primary contact uses. Swimming beaches at selected Iowa lakes, however, are monitored more frequently than rivers. Beginning in 1999, IDNR began a weekly sampling program during summer months (May through September) at swimming beaches of selected state-owned lakes. This program generates the minimum amount of data needed for use with U.S. EPA's recommended assessment methods (i.e., 5 samples collected over a 30-day period). Thus, IDNR uses different procedures to determine the level of use support of the Class A (primary contact recreation) uses at lake beaches versus river reaches and non-beach areas of lakes.

Rivers and non-beach areas of lakes: To be assessed as "fully supported" the designated primary contact uses, the following conditions should be met: (1) the geometric mean of at least ten samples collected preferably during the recreational seasons (April 1 to October 31) of the current reporting period (calendar years 2000 through 2002) at flows not materially affected by surface runoff should not exceed the respective water quality criterion of 200 organisms per 100 ml of fecal coliform bacteria and (2) no more than 10 percent of these samples should exceed a single sample maximum allowable density of 400 organisms per 100 ml of fecal coliform bacteria. In addition, no swimming area closures can have been issued during the two-year assessment period. While not entirely consistent with the assessment approach recommended by U.S. EPA (1986, 1997, 2002), the IDNR approach appropriately uses the available monitoring data while incorporating the basic elements of U.S. EPA's approach. The IDNR requirement for at least 10 samples is based on the resultant improvement in the ability of U.S. EPA's recommended assessment approach to accurately identify an impairment based on a critical value of 10% violation. At sample sizes less than 10, the probability of incorrectly concluding that impairment exists (Type 1 error) with U.S. EPA's approach is approximately 60%; with 10 samples, the probability of this type of error decreases to approximately 30% (Smith et al. 2001). IDNR views this approach as a reasonable balance between the probability of Type I decision error (listing an attaining waterbody as "impaired") and Type II decision error (assessing an impaired waterbody as fully supporting).

Lake beaches:

Two types of bacteria-related water quality information are used to assess support of the Class A (primary contact recreation) use at Iowa's lake beaches: (1) data for indicator bacteria from weekly beach monitoring and (2) information on the closure of beach areas for swimming.

In general, the same approach used for the 2002 Section 305(b) report and list will be used for the 2004 report/list: If either of the following exist, the Class A uses of that beach and lake would be assessed as "not supporting" and would be a candidate for Section 303(d) listing:

1. The geometric mean of at least five samples collected over a 30-day period exceeds the Iowa water quality criterion.

2. If levels of indicator bacteria in either year resulted in IDNR issuing a warning that "swimming is not recommended". In the event that a beach was closed to swimming during either year, the Class A uses would be assessed as "not supporting."

This assessment approach is consistent with that recommended by U.S. EPA (1986, 1997, 2002). Due to sampling frequency, however, the use of single-sample maximum values to assess beaches, as is done for Iowa rivers, is problematic and is thus not used to assess Iowa beaches. That is, with less than 10 (usually 5) samples collected during any 30-day period at Iowa beaches, the occurrence of a single level of bacteria above the single-sample maximum value will result in more than 10% violation of the single-sample maximum value and thus suggest impairment of the primary contact recreation uses. As noted by Smith et al. (2001), the use of less than 10 samples in an assessment based on a critical value of 10% results in large probabilities (approximately 60%) of incorrectly concluding that an impairment exists. For this reason, the single-sample maximum value is not used to assess support of primary contact recreation uses with data from the IDNR beach monitoring program.

For additional information on how IDNR determines support of primary contact recreation uses, see Tables 7 and 8.

- **Data from programs to monitor fish tissue for toxic contaminants**

  The Iowa DNR uses "action levels" published by the U.S. Food and Drug Administration to determine whether issuance of a fish consumption advisory is justified. The existence of a fish consumption advisory indicates an impairment of the fish consumption use (see Table 7). Due to the variability in fish contaminant levels (primarily, between-fish variability), IDNR requires that two consecutive samplings from a waterbody show that contaminant levels in fish exceed an FDA action level before an advisory is issued. In general, these "consecutive" samples are collected in consecutive years as part of the annual U.S. EPA Region VII/IDNR Regional Ambient Fish Tissue (RAFT) monitoring program or as part of special follow-up studies conducted by IDNR. The need to schedule follow-up samplings one year after the first sampling is related to the length of time required for sample analysis and data reporting. Samples of Iowa fish tissue for RAFT monitoring are typically collected by IDNR biologists in late summer; samples are sent to the U.S. EPA Region VII laboratory in Kansas City for analysis in early fall. Results from this analysis are supplied to IDNR in late spring or summer of the following year. Decisions to conduct follow-up sampling at a given site is thus based on results of the previous year's sampling. Similarly, before an advisory is rescinded, two consecutive samplings must show that levels of all contaminants are below their respective FDA action levels. And, similar to the sampling schedule for establishing advisories, these consecutive samplings typically occur in consecutive years. Waterbodies covered by consumption advisories are monitored on an every-other-year basis as part of RAFT monitoring to identify any changes in contaminant levels and to justify the continuance of the advisory.

- **Reports of pollutant-caused fish kills**

  Occurrence of a single pollutant-caused fish kill, or a fish kill of unknown origin, on a waterbody or waterbody reach during the most recent three-year period (2000-2002) indicates an impairment of the aquatic life uses. The "once in three-year" frequency of criteria violation [i.e., an acutely toxic condition] is designed to provide protection for ecological recovery from a severe stress and is consistent with U.S. EPA recommendations (U.S. EPA 1994: page 3-3).

  Each report of a fish kill will be reviewed to determine whether development of a TMDL is appropriate. If a cause of the kill was not identified during the IDNR investigation, or if the kill was attributed to non-pollutant causes (e.g., winterkill), the assessment type will be

considered "evaluated." Such assessments, although suitable for Section 305(b) reporting, lack the degree of confidence to support addition to the state Section 303(d) list of impaired waters. Waterbodies affected by such fish kills will be placed in IR subcategories 2b or 3b.

If, however, a cause of the kill is identified, and the cause is either known, or suspected, to be a "pollutant,", the assessment type is considered "monitored" and the affected waterbody is a candidate for Section 303(d) listing. Waterbodies affected by this type of kill will be handled as follows:

- TMDLs will not be developed for kills caused by a one-time illegal or unauthorized release of manure or other toxic substance where enforcement actions were taken. Such waterbodies will be placed into Integrated Report subcategory 4d.

- Fish kills attributed to a pollutant, but where a source of the pollutant was not identified, will be placed into Integrated Report subcategory 5b. The intent of placing these waterbodies into Category 5 is not to necessarily require a TMDL but to keep the impairment highlighted due to the potential for similar future kills from the unaddressed causes and/or sources.

- Fish kills attributed to authorized discharges (i.e., a wastewater discharge meeting permit limits) are considered for Section 303(d) listing (subcategory 5a) as the existing, required pollution control measures are not adequate to address this impairment.

- **Data from the statewide survey of freshwater mussels from 1998-1999**

  Information from *Statewide Assessment of Freshwater Mussels (Bivalva: Unionidae) in Iowa Streams: Final Report* (Arbuckle et al. 2000) was used to assess support of aquatic life uses of Iowa streams and rivers. The survey conducted by Arbuckle et al. (2000) involved re-sampling of sites visited in the mid-1980s by Frest (1987). For purposes of identifying candidates for Section 303(d) listing, the number of mussel species reported for a given waterbody by Frest was compared to the number of species reported for the same waterbody by Arbuckle et al. (2000). The degree to which the aquatic life use was supported was based on the percent change in the number of mussel species from the 1984-85 period to the 1998-99 period. If the mean waterbody species richness (SR) was

greater than three in the 1984-1985 survey period, then the following assessment approach using percent change from the 1984-85 to 1998-99 survey periods will be used to identify candidates for Section 303(d) listing:

If species richness (SR) in 1984-85 is > 3, and the percent decline in SR from 1984-85 to 1998-99 is:	**Then use support category is:**	**Integrated Report Category**
< 10%	Fully Supporting	1
10-25%	Fully Supporting / Threatened with minor impacts	1
26-50%	Fully Supporting / Threatened with a declining trend (potentially "impaired")	1 or 5b
51%-75%	Partially Supporting ("impaired")	5b
> 75%	Not Supporting ("impaired")	5b

The decision to consider only those sites having four or more species reported in the 1984-85 survey is based on (1) a review of the historical distributions of freshwater mussels in Iowa and (2) the framework (i.e., percent decline) described in table above. For the Iowa ecoregions that show historical presence of a stream/river community of freshwater mussels (all ecoregions except 47e, 47f in Missouri River drainage, and 40 in Missouri River drainage), a species richness of approximately 4 appears to characterize average species richness from the 1984-85 survey by Frest. The decision to identify a waterbody as impaired due to a decline in species richness between the 1984-85 and 1998-99 survey periods is based on quartiles (i.e., more than 25% decline: "fully supported/threatened with a declining trend"; more than 50% decline, "partially supported"; more than 75% decline, "not supported." Any decision to add a waterbody to the state list of impaired waters based on a percent decline of between 26 and 50 percent will be made on a case-by-case basis, with listing more likely as the percent decline approaches 50 percent. Using four species as a minimum for this assessment approach allows for some decline between the survey periods (which may be due to problems with sampling efficiency as opposed to the actual elimination of species) without identifying waterbody as "impaired."

As presented by Arbuckle et al. (2000), the potential causes of declines in species richness of Iowa's freshwater mussels include siltation, destabilization of stream substrate, stream flow instability, and high in-stream levels of nutrients (phosphorus and

nitrogen). Their study also suggested the importance of stream shading provided by riparian vegetation to mussel species richness. For purposes of Section 305(b) reporting and Section 303(d) listing, the following causes and sources will be identified for all waters assessed as "impaired" due to declines in the mussel community: siltation from agricultural and natural sources; flow modification due to hydromodification of the watershed; and nutrients from agricultural and natural sources. Because site-specific causes and sources of these impairments were not identified, any waters assessed as impaired due to declines in the freshwater mussel community will be placed into subcategory 5b. As is typical for Section 305(b) water quality assessments, the sources of impairment identified for Iowa's freshwater mussel community are only *potential* sources. The timing and magnitude of a statewide water quality assessment process does not often allow precise determinations of pollutant "sources." More accurate information on sources would typically be gathered during TMDL development.

- **Data from public water supplies on the quality of raw and finished water**

  Data for the quality of raw (untreated) water from a surface water source will be used with the methodology for identifying impairments in Class C (drinking water use) waters described in Table 7. Impairments related to the quality of finished (treated) water will be determined through review of annual IDNR public drinking water program compliance reports (available at *http://www.state.ia.us/epd/wtrsuply/report/report.htm*). Information from these reports on violations of Class C water quality criteria and issuance of drinking water advisories will be used with methods described in Table 7 to determine the existence of impairment of drinking water uses.

- **Data from special studies of water quality and aquatic communities**

  Results of special water quality studies that meet all requirements of Iowa's "credible data" law, including the availability of a quality assurance project plan (or equivalent plan or methodology for sampling and analysis), will be considered on a case-by-case basis. IDNR will review all relevant quality assurance/project plans for special studies prior to the decision to use study results for purposes of Section 303(d) listing. Results from special studies that meet "credible data" requirements will be compared to water quality criteria as specified in the *Iowa Water Quality Standards* with the methods described in this document.

- **Results of volunteer monitoring that meet "credible data" requirements**

  Results of volunteer monitoring that meet all requirements of Iowa's "credible data" law, including the availability of a quality assurance project plan (or equivalent plan or methodology for sampling and analysis), will be considered on a case-by-case basis. IDNR will review all relevant quality assurance/project plans for volunteer monitoring studies prior to the decision to use study results for purposes of Section 303(d) listing. Results from volunteer monitoring studies that meet "credible data" requirements will be compared to water quality criteria as specified in the *Iowa Water Quality Standards* with the methods described in this document.

Exclusion of waters from the 2004 Section 303(d) list:

According to U.S. EPA regulations (40 CFR 130.7), a state must demonstrate "good cause" for exclusion of previously "impaired" waterbodies. According to these regulations, "good cause" includes, but is not limited to, more recent or accurate data; more sophisticated water quality modeling; flaws in the original analysis that led to the water being listed; or changes in conditions; e.g., new control equipment or the elimination of discharges." Thus, the following can be used to demonstrate good cause for not listing a waterbody on the Section 303(d) list or to decrease the scope of impairment to a listed waterbody:

- **More recent or accurate data**. Additional monitoring data from a waterbody demonstrates that it meets and maintains applicable water quality standards. Data must be generated from monitoring studies and programs consistent with Iowa's "credible data" law and must be in sufficient quantity to be used with Section 305(b) water quality assessment procedures (see Table 8).
- **Flaws in original analysis or errors in listing**. Errors in the data or flaws in assessment procedures used to list the waterbody invalidate the basis for listing.
- **New conditions.** Examples of new conditions include revised water quality standards, the elimination of discharges, and new control equipment such that a listed waterbody no longer meets the criteria for Section 303(d) listing.

For any waterbody listed on a previous Section 303(d) list and not included on the 2004 list, a waterbody-specific rationale will be incorporated into Iowa's Section 305(b) Assessment Database (ADB+).

Waterbodies added to an Iowa 303(d) list will be placed on subsequent lists unless (1) there are sufficient credible data to reassess the waterbody and demonstrate that 303(d) listing is not appropriate or (2) some other "good cause" is demonstrated for not including the water on the 303(d) list. Age of

data alone is not an adequate justification for not including a previously-listed water on a new list of impaired waters. This provision is especially relevant to waterbodies included on lists based on results of one-time surveys (e.g., results of biological assessments conducted as part of biocriteria development). For example, if a waterbody was added to Iowa's 2002 303(d) list based on a biological assessment, this waterbody should remain on Iowa's subsequent 303(d) lists until (1) a TMDL is completed, (2) additional monitoring is conducted that shows "full support" of aquatic life uses, or (3) a flaw in the original data analysis or assessment is discovered. This issue is less critical for waterbodies assessed with results of ongoing annual monitoring programs such as that generated through IDNR's routine ambient water quality monitoring network. In addition, lack of sufficient data to develop a "monitored" assessment for a previously-listed waterbody is not adequate justification for excluding a waterbody from Section 303(d) listing. For example, if a routinely-monitored waterbody was added to Iowa's 2002 303(d) list based on a "monitored" assessment showing violations of the Iowa water quality criterion for indicator bacteria, this waterbody should remain on Iowa's 2004 list even though routine monitoring failed to generate a sufficient number of samples to develop a "monitored" assessment for the 2004 reporting/listing cycle.

Placement of waters within the integrated report/list categories:

In their July 2003 guidance for the 2004 integrated assessment, reporting, and listing cycle, U.S. EPA (2003) recommends that reporting requirements of Sections 305(b) and 303(d) be "integrated" into a report that contains five assessment categories:

- Category 1: All designated uses are met.
- Category 2: Some of the designated uses are met but there is insufficient data to determine if remaining designated uses are met.
- Category 3: Insufficient data to determine whether any designated uses are met.
- Category 4: Water is impaired or threatened but a TMDL is not needed because:

  4a. A TMDL has been completed;
  4b: Other required control measures are expected to result in attainment of water quality standards in a reasonable period of time;
  4c: The impairment or threat is not caused by a "pollutant."

- Category 5: Water is impaired or threatened and a TMDL is needed [the state's Section 303(d) list].

As described in Table 3, this framework differs from the five-part listing format used by Iowa DNR for the 2002 Section 303(d) list (IDNR 2002). The five categories for the 2004 integrated report/list are further explained below. The text in italics is taken directly from U.S. EPA's (2003) guidance. Notes that follow these excerpts contain IDNR's interpretations and modifications of U.S. EPA's guidance.

Category 1 waterbodies: *Waters belong in Category 1 if they are attaining all designated uses and no use is threatened. Segments should be listed in this category if there are data and information that are consistent with the State's methodology and this guidance, and support a determination that all WQSs are attained and no designated use is threatened.*

Iowa DNR has made the following modifications to Category 1 waters: Iowa waters assessed as "fully supported / threatened" with only minor impacts and no declining water quality trend would also be placed in Category 1. Iowa DNR has long-considered waterbodies assessed as "fully supported / threatened" and <u>not</u> showing a worsening water quality trend as meeting the assessed beneficial use even though results of monitoring may suggest minor impacts.

Category 2 waterbodies: *Waters should be placed in Category 2 if there are data and information that meet the requirements of the State's assessment and listing methodology that support a determination that some, but not all, designated uses are attained and none are threatened. Attainment status of the remaining designated uses is unknown because data are insufficient to categorize a water consistent with the State's listing methodology.*

Iowa DNR has made the following modification to IR Category 2: the addition of subcategory 2b.

<u>Category 2a: Some uses supported; insufficient information to determine whether other uses are supported.</u> Although this wording is identical to U.S. EPA's definition of IR category 2, IDNR considers Iowa waters with at least one beneficial use assessed as "fully supported / threatened" with no declining water quality trend as appropriate for Category 2.

Category 2b: At least one use assessed as supported with at least one other use "evaluated" as "impaired." An "evaluated" assessment of impairment lacks sufficient confidence to take forward to either Category 5 (Section 303(d) list) or Category 4 (impaired but TMDL not required). This subcategory allows tracking of the "impaired / evaluated" waterbodies (e.g., a biological assessment of impairment based on either (but not both) fish and macroinvertebrate IBI values). Waters placed into subcategory 2b will be added to Iowa's list of "waters in need of further investigation."

Category 3 waterbodies: *Waters belong in Category 3 if there are insufficient or no data and information to determine, consistent with the State's listing methodology, if any designated use is attained. To assess the attainment status of these waters, States should schedule monitoring on a priority basis to obtain data and should also make efforts obtain information necessary to move these waters into Categories 1, 2, 4, and 5.*

Iowa DNR has made the following modifications to IR Category 3: the addition of subcategory 3b.

Category 3a. Insufficient data exist to determine whether any uses are met; no uses are assessed [either "evaluated" or "monitored"]. This wording is consistent with U.S. EPA's definition of IR category 3.

Category 3b: Insufficient data exist to determine whether any designated uses are met, but at least one use is potentially impaired based on an "evaluated" assessment. This category is similar to IDNR's Category 2b, but no other uses are assessed as "fully supported" or "fully supported / threatened" (i.e., the only use assessed is the one assessed as "impaired/evaluated." Similar to IDNR subcategory 2b, this subcategory allows tracking of the "impaired / evaluated" waterbodies. Waters placed into subcategory 3b will be added to Iowa's list of "waters in need of further investigation."

Category 4 waterbodies: *Waters belong in Category 4 if one or more designated uses are impaired or threatened but establishment of a TMDL is not required. States may*

place an impaired or threatened water that does not require a TMDL in one of the following three subcategories:

- *Category 4a: a TMDL has been completed for the water-pollutant combination. Waters should only be placed in Category 4a when all TMDLs needed to result in attainment of all applicable WQ Standards have been approved or established by EPA. Current regulations do not require TMDLs for all waters.;*

- *Category 4b: other required control measures are expected to result in the attainment of WQSs in a reasonable period of time. Some waters may be excluded from Category 5, and placed into Category 4b. In order to meet the requirements to place these waters into Category 4b, the State must demonstrate that "other pollution control requirements (e.g., best management practices) required by local, State or Federal authority" (see 40 CFR 130.7(b)(1)(iii)) are expected to address all water-pollutant combinations and attain all WQ Standards in a reasonable period of time. EPA expects that States will provide adequate documentation that the required control mechanisms will address all major pollutant sources and establish a clear link between the control mechanisms and WQ Standards.*

- *Category 4c: the impairment or threat is not caused by a pollutant. Waters should be listed in Category 4c when an impairment is not caused by a pollutant. "Pollution," as defined by the Clean Water Act, is the "man-made or man-induced alteration of the chemical, physical, biological and radiological integrity of water." In some cases, the pollution is caused by the presence of a pollutant and a TMDL is required. In other cases, pollution does not result from a pollutant and a TMDL is not required. An example of a pollutant stressor would be copper; an example of a non-pollutant stressor ("pollution") would be low flow.*

Iowa DNR has made the following modifications to IR Category 4: the addition of subcategory 4d.

> Category 4d. Water is impaired due to a pollutant-caused fish kill and enforcement actions were taken against the party responsible for the kill: a TMDL is not needed. For purposes of Section 305(b) assessments in Iowa, all waters affected by a fish kill, whether caused by a known pollutant or a suspected pollutant, are assessed as "impaired." Those kills where a

cause was identified are placed into either Category 4d (responsible party identified and enforcement action taken: TMDL not required) or Category 5 (no responsible party identified; enforcement action not taken: a pollutant problem may remain and a TMDL is potentially needed).

Category 5 waterbodies: *This category constitutes the Section 303(d) list that EPA will approve or disapprove under the CWA. Waters should be placed in Category 5 when it is determined, in accordance with the State's assessment and listing methodology, that a pollutant has caused, is suspected of causing, or is projected to cause an impairment or threat. If that impairment or threat is due to a pollutant, the water should be placed in Category 5 and the pollutant causing the impairment identified.*

Iowa DNR has made the following modifications to IR Category 5: the addition of subcategory 5b.

Category 5a: Water is impaired or threatened by a pollutant stressor and a TMDL is needed. This wording is consistent with U.S. EPA's definition of IR Category 5.

Category 5b: Impairment is based on results of biological monitoring or a fish kill investigation where specific causes and/or sources of the impairment have not yet been identified. The assessment adequately demonstrates that an impairment exists but either the cause or the source of the impairment is unknown. The primary use of this subcategory is for biologically-based (biomonitoring) impairments with the cause listed as "unknown" and for fish kill-based impairments where a cause was identified but no source was found. Additional monitoring / investigation is needed to determine causes or sources before the TMDL can be developed.

A summary of the integrated report categories and subcategories used by IDNR for the 2004 reporting listing cycle is presented in Table 1 of Attachment 3.

Prioritization and scheduling of waters for TMDL development:

CWA Section 303(d) requires that each *"state shall establish a priority ranking for such waters, taking into account the severity of the pollution and the uses to be made of such waters."* A system of prioritization for waterbodies included in Category 5 of the Integrated Report has been developed by the IDNR based on several factors. Included in these factors are the required elements of *"the severity of the pollution and the uses to be made of such waters."* The methods developed are described below; these methods are the same as used to prioritize waterbodies on Iowa's 2002 list. These criteria are a guide. Other factors, such as best professional judgement of IDNR staff, results of volunteer monitoring, and public comments, may also be considered when prioritizing waters. If a waterbody meets any one criteria in a priority category, that does not necessarily mean the water will be prioritized as such, since many waters fit some criteria from all categories.

Priorities **Applicable Criteria**

High

- Waters where sufficient water quality information exists to understand and analyze causes and effects of the problems and opportunities are available to correct or substantially improve water quality;
- Waters with imminent human health or aquatic health problems;
- Waters with documented widespread local support for water quality improvement; or
- Waters where state or federally threatened or endangered species are impacted.

Medium

- Waters where sufficient water quality information exists to understand and analyze causes and effects of the problems; however, opportunities are not immediately available to correct or substantially improve water quality; or
- Waters where local support for TMDL development is expected but not known.

Low

- Waters where insufficient water quality information exists to understand and analyze causes and effects of the problems and limited opportunities are available, at this time, to correct or substantially improve water quality;
- Waters with no evident local support for water quality improvements.

Addressing interstate inconsistencies in Section 303(d) lists:

Inconsistency in the Section 303(d) listings of border rivers and other interstate waters is a national problem (see GAO 2002). Thus, IDNR will request and review the draft 303(d) lists of states with which

Iowa shares border waters: South Dakota (Big Sioux River), Nebraska (Missouri River), Missouri (Des Moines River), and Illinois and Wisconsin (Mississippi River). IDNR will also provide its draft 303(d) list to TMDL coordinators of these states and to the Upper Mississippi River Basin Association. Where the listing in another state is different than in Iowa, the IDNR will review the assessment data, supporting information, and assessment methodology that support the listing in the other state. These data will be reviewed and applied to Iowa's Section 303(d) listing methodology outlined in this document. The Iowa 303(d) list will or will not be changed pending the review of this additional information.

The IDNR Geological Survey and Land Quality Bureau will also review the Section 303(d) listings from adjacent states for waters that either enter Iowa from Minnesota or leave Iowa into Minnesota or Missouri, or that are shared with Iowa by either state (e.g., Tuttle Lake, Emmet County). Where Section 303(d) listing decisions differ across a state line, the supporting assessment data and methodology will be requested from the appropriate state. The IDNR Geological Survey and Land Quality Bureau will review these data using Iowa's Section 303(d) listing methodology outlined in this document to determine whether modifications to Iowa's Section 303(d) list are justified.

This process of reviewing Section 303(d) listings for waters that border or are shared with adjacent states is designed to reduce between-state inconsistencies in Section 303(d) listings and to provide a basis for cooperation on future development of TMDLs for these interstate waters.

Public participation:

A draft of this methodology will be provided to the public for review and comment. The draft methodology will be available in hard copy by contacting the IDNR. The draft is also available at the IDNR Total Maximum Daily Load Program website at *http://www.iowadnr.com/water/tmdlwqa/tmdl/publicnotice.html*. Comments on the draft methodology will be received for a period of thirty days.

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Table 1. Summary of changes in Iowa DNR's Section 303(d) listing methodology between the 2002 and 2004 listing cycles.

Change in Methodology:	**2002 Listing Cycle**	**2004 Listing Cycle**
Number of years of data for conventional parameters (e.g., DO, pH, bacterial indicators)	two (from October 1, 1999 to September 30, 2001)	three (from January 1, 2000 to December 31, 2002)
Data monitoring cutoff period	September 30, 2001	December 31, 2002
Trophic State Index impairment threshold for chlorophyll-a and secchi depth	70	65
Format of list	five part list 303(d) list based on U.S. EPA's July 2000 TMDL rule with modifications by IDNR	five-part list integrated (305(b)/303(d)) report and list based on U.S. EPA's proposed "Watershed Rule" and on U.S. EPA's July 2003 guidance (U.S. EPA 2003) with modifications by IDNR
Database	used U.S. EPA's *Assessment Database* (ADB)	used IDNR's assessment database (ADB+)

Table 2. Iowa tributaries to the Upper Mississippi River monitored from 2000-2002 as part of the Long-Term Resource Monitoring Program by staff from the Bellevue Field Station.

No.	**Waterbody, Location**	**Designated Uses****	**County**	**Station No.**
1.	Catfish Cr., near mouth,	B(WW)	Dubuque	CF00.3M
2.	Elk R., near mouth	B(WW)	Clinton	ER02.4M
3.	Maquoketa R., near mouth	A,B(WW)	Jackson	MQ02.1M
4.	Mill Cr. near mouth	B(WW)	Jackson	MC01.0M
5.	Rock Cr., upstream PCS Nitrogen	B(LR)	Clinton	RK03.7M
6.	Rock Cr., near mouth	B(LR)	Clinton	RK00.1M
7.	Tete de Mortes Cr.	B(WW)	Jackson	TM4.2M
8.	Turkey R., near mouth	B(WW)	Clayton	TK04.8M
9.	Upper Iowa R. near mouth	A,B(WW)	Allamakee	UI02.9M
10.	Yellow R, near mouth	A,B(WW)	Allamakee	YL01.5M
11.	Wapsipinicon R., near mouth,	A,B(WW)	Clinton	WP02.M

**Designated Uses (from *Iowa Water Quality Standards* (IAC 2000)):
Class A = primary human contact/recreation;
Class B(WW) = significant resource warmwater aquatic life;
Class B(LR) = limited resource warmwater aquatic life;

Table 3. A comparison of U.S. EPA's assessment/listing protocol for the 2004 integrated 305(b)/303(d) report/list and the protocol used for Iowa's 2002 Section 303(d) list.

U.S. EPA's 2004 Integrated Reporting / Listing Protocol	***Corresponding Parts of Iowa's 2002 Listing Protocol***
Category 1: all uses met	**Not applicable:** The five-part listing protocol for Iowa' 2002 Section 303(d) list did not specifically address waters assessed as "fully supporting" designated uses.
Category 2: some uses met; insufficient information to determine if other uses are met	**Not applicable:** The five-part listing protocol for Iowa' 2002 Section 303(d) list did not specifically address waters assessed as "fully supporting" designated uses or that were "not assessed."
Category 3: insufficient information to determine whether any uses are met	**Not applicable:** The five-part listing protocol for Iowa' 2002 Section 303(d) list did not specifically address waters that were "not assessed."
Category 4: Water is impaired or threatened but a TMDL is not needed	**Part Two:** waterbodies impaired by pollution that is not caused by a pollutant; **Part Three:** waterbodies for which TMDLs had been established but water quality standards not yet attained. **Part Four:** waterbodies for which technology-based controls or other enforceable controls would attain water quality standards by the next listing cycle.
Category 5: Water is impaired or threatened and a TMDL is needed	**Part One:** waterbodies for which TMDLs would be required to be established within 10-15 years. **Part Five:** of the list includes waterbodies that are biologically impaired, but no source or cause of impairment has been identified.

Table 4. Summary of Iowa water quality criteria used to make assessments of support of beneficial designated uses of Iowa surface waters for purposes of Section 305(b) reporting and 303(d) listing. The criteria listed are only for those parameters monitored in Iowa surface waters as part of the IDNR ambient monitoring network. For a complete list and description of Iowa water quality criteria, see the *Iowa Water Quality Standards* (available at the following IDNR web site: http://www.iowadnr.com/water/standards/index.html).

	DESIGNATED USE					
PARAMETER	**Class A: swimmable**	**Class B(WW): significant resource aquatic life**	**Class B(LR): limited resource aquatic life**	**Class B(CW): coldwater aquatic life**	**Class B(LW): aquatic life of lakes and wetland**	**Class C: source of a water supply**
dissolved oxygen (mg/l) (24-hour minimum / 16-hour minimum)	none	5.0	5.0	7.0	5.0	none
temperature (added heat)	none	no increase > 3 C; increase < 1 C / hr; no increase above 32 C	no increase > 3 C; increase < 1 C / hr; no increase above 32 C	no increase > 2 C; increase < 1 C / hr; no increase above 20 C	no increase > 2 C; increase < 1 C / hr; no increase above 20 C	none
pH	not < 6.5; not > 9; .max. change = 0.5 units	not < 6.5; not > 9. max. change = 0.5 units	not < 6.5; not > 9. max. change = 0.5 units	not < 6.5; not > 9. max. change = 0.5 units	not < 6.5; not > 9. max. change = 0.5 units	none
ammonia-nitrogen (mg/l)	none	criteria are dependent on the pH and temperature of the lake, stream or river; see Tables 3a through 3c of the *Iowa Water Quality Standards* (IAC 2002) for criteria for Class B(CW), B(WW), B(LW) and B(LR) waters.				none
nitrate-nitrogen (mg/l)	none	none	none	none	none	MCL: 10

Table 4 (continued)

	DESIGNATED USE					
PARAMETER	**Class A: swimmable**	**Class B(WW): significant resource aquatic life**	**Class B(LR): limited resource aquatic life**	**Class B(CW): coldwater aquatic life**	**Class B(LW): aquatic life of lakes and wetland**	**Class C: source of a water supply**
chloride (mg/l)	none	none	none	none	none	MCL: 250
fluoride (ug/l)	none	none	none	none	none	MCL: 4,000
fecal coliform bacteria	Apr. -Oct.: ≤ 200 organisms / 100 ml when not materially affected by surface runoff	none	none	none	none	none
TOXIC METALS (all values in ug/l; chronic / acute / human health criteria (HHC) are given; NA = value not applicable)						
arsenic	none	200 / 360 / NA	1000 / 1800 / NA	200 / 360 / NA	200 / 3360 / NA	HHC: 0.18
cadmium	none	15 / 75/ 168	25 / 100 / NA	1 / 4/ 168	1 / 4/ 168	MCL: 5
chromium	none	40 / 60/ 3365	200 / 300 / NA	40 / 60/ 3365	10 / 15/ 3365	MCL: 100
copper	none	35 / 60/ 1000	55 / 90 / NA	20 / 30/ 1000	10 / 20/ 1000	HHC: 1300
cyanide	none	10 / 45 / NA	10 / 45 / NA	5 / 20 / NA	10 / 45 / NA	HHC: 700
lead	none	30 / 200 / NA	80 / 750 / NA	3 / 80 / NA	3 / 80 / NA	MCL: 50
mercury	none	2.1 / 4.0 / 0.15	3.7 / 6.9	3.5 / 6.5 / 0.15	0.91 / 1.7 / 0.15	HHC: 0.05
zinc	none	450 / 500 / 5000	2000 / 2200 / NA	200 / 220 / 5000	100 / 110 / 5000	HHC: 9100
PESTICIDES (all values in ug/l; chronic / acute / human health criteria (HHC) are given; NA = value not applicable)						
2,4-D	none	none	none	none	none	HHC: 100
2,4,5-TP (Silvex)	none	none	none	none	none	HHC: 10
alachlor	none	none	none	none	none	MCL: 2
atrazine	none	none	none	none	none	MCL: 3

Table 4 (continued)

	DESIGNATED USE					
PARAMETER	**Class A: swimmable**	**Class B(WW): significant resource aquatic life**	**Class B(LR): limited resource aquatic life**	**Class B(CW): coldwater aquatic life**	**Class B(LW): aquatic life of lakes and wetland**	**Class C: source of a water supply**
carbofuran	none	none	none	none	none	MCL: 40
chlorpyrifos	none	0.041 / 0.083 /NA	0.041 / 0.083 / NA	0.041 / 0.083 / NA	0.041 / 0.083 / NA	none
DDT+DDD+DDE	none	0.001 / 0.8 / 0.0059	0.029 / 0.95 / NA	0.001 / 0.9 / 0.0059	0.001 / 0.55 / 0.0059	HHC: 0.0059
dieldrin	none	0.056 / 0.24 / 0.0014	0.056 / 0.24 / NA	0.056 / 0.24 / 0.0014	0.056 / 0.24 / 0.0014	HHC: 0.0014
dinoseb	none	none	none	none	none	MCL: 7
lindane	none	NA / 0.95 / 0.63	NA / 0.95 / NA	NA / 0.95 / 0.63	NA / 0.95 / 0.63	HHC: 0.19
parathion	none	0.13 / 0.65 / NA	0.13 / 0.65 /NA	0.13 / 0.65 /NA	0.13 / 0.65 /NA	none
picloram	none	none	none	none	none	MCL: 500
simazine	none	none	none	none	none	MCL: 4

Table 5. General water quality criteria to protect beneficial general uses for all Iowa surface waters (from the *Iowa Water Quality Standards*, IAC, Section 61.3(2)).
The following criteria are applicable to all surface waters including general use and designated use waters, at all places and at all times, to protect livestock and wildlife watering, aquatic life, noncontact recreation, crop irrigation, and industrial, domestic, agricultural, and other incidental water withdrawal uses not protected by specific numerical criteria in the subrule 61.3(3) of the *Iowa Water Quality Standards*:
1. All waters of the state shall be "free from" the following:
▪ substances attributable to point source wastewater dischargers that will settle to form sludge deposits;
▪ floating debris, oil, grease, scum and other materials from wastewater discharges or agricultural practices in amounts sufficient to create a nuisance;
▪ materials attributable to wastewater discharges or agricultural practices producing objectionable color, odor, or other aesthetically objectionable conditions;
▪ substances attributable to wastewater discharges or agricultural practices in concentrations or combinations which are acutely toxic to human, animal, or plant life;
▪ substances attributable to wastewater discharges or agricultural practices in quantities which would produce undesirable or nuisance aquatic life;
2. The turbidity of a receiving water shall not be increased by more than 25 nephelometric turbidity units by any point source discharge;
3. Total dissolved solids shall not exceed 750 mg/l in any lake or impoundment or in any stream with a flow rate equal to or greater than three times the flow rate of upstream point source dischargers;
4. Water which enters a sinkhole or losing stream segment shall not exceed a fecal coliform bacteria content of 200 organisms per 100 ml, except when the waters are materially affected by surface runoff; but in no case shall fecal coliform levels downstream from an existing discharge which may contain pathogens to humans be more than 200 organisms per 100 ml higher than the background level upstream from the discharge. No new wastewater discharges will be allowed on watercourses which directly or indirectly enter sinkholes or losing stream segments.

Table 6. Methods for determining support of **AQUATIC LIFE USES** for general use and designated use surface waters in Iowa for Section 305(b) reporting and 303(d) listing.

		Beneficial Use "Fully Supported"		**Beneficial Use "Impaired"**	
Type of waterbody	**Source of Information**	**Fully Supported**	**Fully Supported/Threatened**	**Partially Supporting**	**Not Supporting**
Rivers, streams, lakes & flood control reservoirs	Data from ambient water quality monitoring during current reporting period.	No violations of acute or chronic toxicity criteria in grab samples; criteria for conventional pollutants exceeded in ≤ 10% of samples.	Up to one violation of acute or chronic toxicity criteria if grab samples are collected quarterly or more frequently. Category not used for "conventional" pollutants.	Category not used for toxic pollutants. Criteria for conventional pollutants exceeded in 11-25% of samples. May not apply to pH**.	> one violation of acute / chronic criteria if samples collected quarterly or more often; criteria for conventionals exceeded in > 25% of samples. May not apply to pH**.
Warmwater Streams and Rivers	Stream biocriteria sampling data (see Attachment 2)	Scores for both fish and macroinvertebrate indexes of biotic integrity significantly greater than the ecoregion / subecoregion biological impairment criterion	Scores for both fish and macroinvertebrate indexes of biotic integrity approximately equal to the ecoregion / subecoregion biological impairment criterion	Scores for one of the indexes of biotic integrity (fish or macroinvertebrate) significantly less than the ecoregion / subecoregion biological impairment criterion	Scores for both indexes of biotic integrity (fish and macroinvertebrate) significantly less than the ecoregion / subecoregion biological impairment criterion
Coldwater Streams	Stream biocriteria sampling data (See Attachment 2)	Two or less of the eight biological indicators less than the 25th percentile of the respective indicator value for Iowa coldwater streams.	From two to four of the eight biological indicators less than the 25th percentile of the respective indicator value for Iowa coldwater streams.	From five to six of the eight biological indicators less than the 25th percentile of the respective indicator value for Iowa coldwater streams.	From seven to eight of the eight biological indicators less than the 25th percentile of the respective indicator value for Iowa coldwater streams.
Rivers, streams, lakes & flood control reservoirs	Fish kill reports*	No pollutant-caused fish kills during the most recent 3-year period.	[Category not used for Section 305(b) reporting in Iowa.]	One pollutant-caused fish kill during the most recent 3-year period	More than one pollutant-caused fish kill during the most recent 3-year period

* Sources of fish kills will be reviewed to determine whether the affected waterbody is a candidate for 303(d) listing.

**Violations of Class A or B criteria for pH that result solely from high levels of primary productivity are not considered as indicating impairment.

Table 7. Methods for determining support of classified, beneficial uses for **FISH CONSUMPTION, PRIMARY CONTACT RECREATION, and DRINKING WATER** for surface waters in Iowa for Section 305(b) reporting and 303(d) listing.

		Beneficial Use Fully Supported		**Beneficial Use Impaired**	
Type of Waterbody	**Source of Information**	**Fully Supported**	**Fully Supported/Threatened**	**Partially Supporting**	**Not Supporting**
FISH CONSUMPTION USES					
Streams, rivers, lakes, & flood control reservoirs	monitoring of levels of toxic contaminants in fish tissue	Levels of all toxics less than one-half the respective FDA action levels; waterbody is not covered by a fish consumption advisory	Level of at least one toxic is greater than one-half the respective FDA action level; waterbody is not covered by a fish consumption advisory	[Category not part of IDNR's consumption advisory protocol and is thus not used for Iowa Section 305(b) reporting or 303(d) listing]	Levels of one or more toxics have exceeded respective FDA action levels in two consecutive samplings and a "no fish consumption" advisory is in effect for the general population
PRIMARY CONTACT RECREATION (SWIMMABLE) USES					
Streams, rivers, lakes, & flood control reservoirs	monthly monitoring data for fecal coliform bacteria	Geometric mean of fecal coliform samples $\leq$ 200 orgs / 100 ml and $\leq$ 10% of samples > 400 orgs/100 ml.	[Category not used for Section 305(b) reporting]	Geometric mean of fecal coliform samples $\leq$ 200 orgs/100 ml but > 10% of samples > 400 orgs/100 ml.	Geometric mean of fecal coliform samples > 200 orgs/100 ml.
lake beaches	weekly monitoring data for fecal coliform bacteria	Geometric mean of at least 5 fecal coliform samples over a 30-day period $\leq$ 200 orgs / 100 ml.	[Category not used for Section 305(b) reporting]	[Category not used for Section 305(b) reporting]	Geometric mean of at least 5 fecal coliform samples over a 30-day period $\geq$ 200 orgs / 100 ml.
Streams, rivers, lakes, & flood control reservoirs	closure of beaches and other swimming areas	No swimming area closures in effect during the biennial reporting period	[Category not used for Section 305(b) reporting]	One swimming area closure of less than one week duration during the biennial reporting period	More than one swimming area closure, or one swimming area closure of more than one week duration during the biennial period

Table 7. (continued).

		Beneficial Use Fully Supported		Beneficial Use Impaired	
Type of Waterbody	**Source of Information**	**Fully Supported**	**Fully Supported/Threatened**	**Partially Supporting**	**Not Supporting**
DRINKING WATER USES					
Waterbodies designated for use as a source of potable water (=raw water source)	ambient monitoring data for toxics	All levels of toxic metals or pesticides are less than human health criteria (HHC) or maximum contaminant levels (MCLs).	Average levels of toxic metals or pesticides ≤ HHC or MCL, but one or more samples > MCL.	[category not used for Section 305(b) reporting]	Average level of toxic metals or pesticides greater than the MCL.
Waterbodies designated for use as a source of potable water (=raw water source)	ambient monitoring data for nitrate	All levels of nitrate are less than U.S. EPA's maximum contaminant level (MCLs).	No more than 10% of samples violate the MCL for nitrate. Or, trend analysis shows a significant increase in contaminant levels.	From 11-25% of samples violate the MCL for nitrate and/or from 15-25% of samples violated the MCL for nitrate in the previous biennial reporting period.	More than 25% of samples exceed the MCL for nitrate and/or more than 25% of samples violated the MCL for nitrate in the previous biennial reporting period..
Municipal drinking water (=finished water)	public water supplies using surface waters	No drinking water supply closures or advisories in effect; water not treated beyond reasonable levels	Some drinking water use restrictions have occurred and/or the potential for adverse impacts to source water quality exist.	One drinking water advisory lasting 30 days or less per year, or other problems not requiring closure but affecting treatment costs	One or more drinking water supply advisory lasting more than 30 days per year, or one or more drinking water supply closures per year

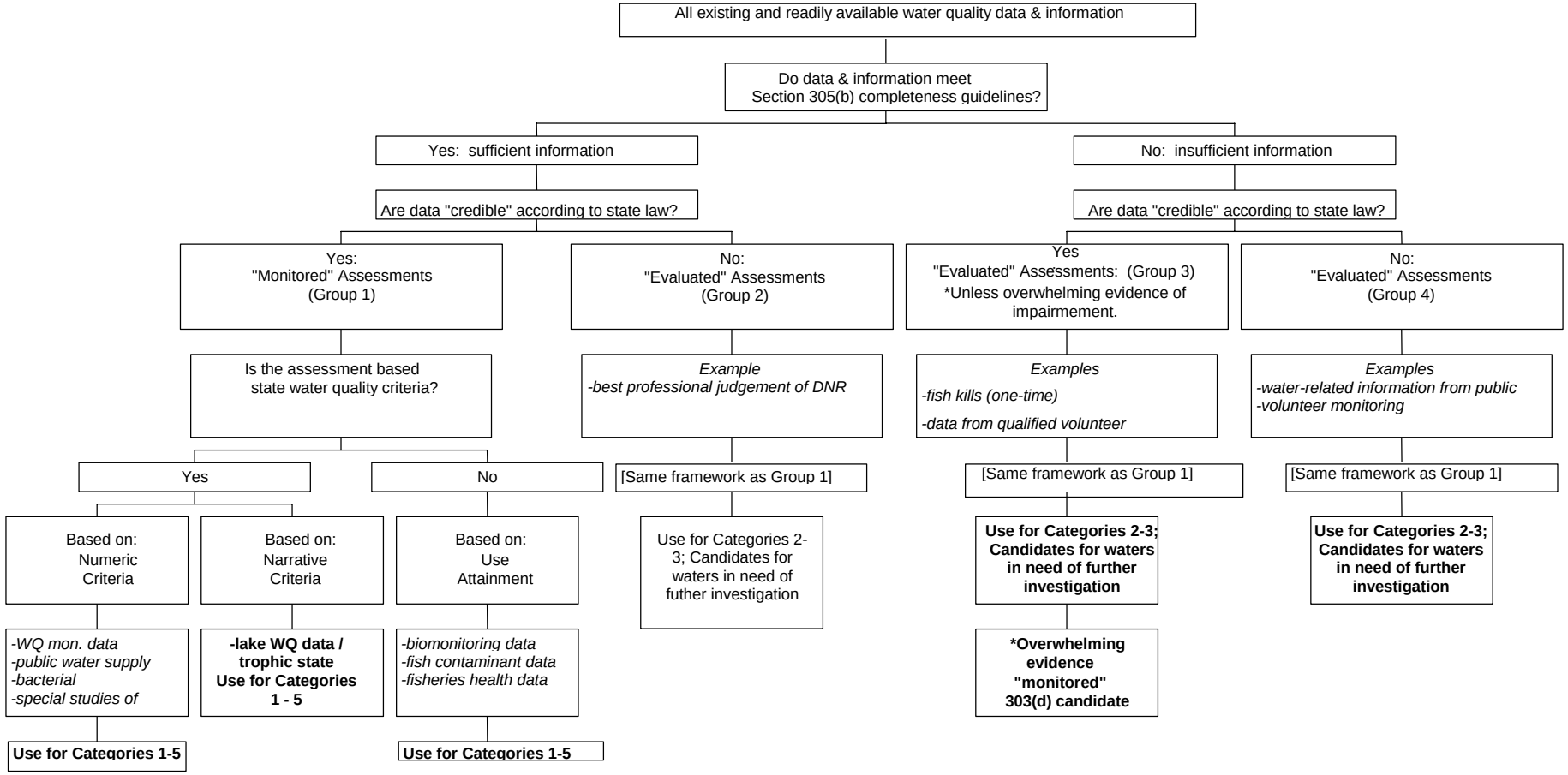
Table 8. Data completeness guidelines for using results of routine ambient water quality monitoring to make "monitored" assessments of designated beneficial uses for water quality assessments. "Monitored" assessments are used to place waters in Categories 4 and 5 (i.e., Section 303(d) list) of Iowa's 2004 Integrated List/Report.*

DESIGNATED USE	TYPE OF INFORMATION	DATA REQUIRED
Aquatic Life	Data for levels of toxics in waterbodies designated for "fishable" (Class B) uses or classified for general uses.	Data collected quarterly or more frequently during calendar years 2000-2002 (minimum of 10 samples).
	Data for levels of conventional pollutants (DO, pH, temp.) in waterbodies designated for "fishable" (Class B) uses or classified for general uses.	Data collected monthly or more frequently during calendar years 2000-2002 (minimum of 10 samples).
	Data from DNR biocriteria sampling at reference, test, and watershed sites.	Assessments conducted during the most recent 5 complete calendar years; includes results for both fish and aquatic macroinvertebrates.
	Data from the ISU/Iowa DNR statewide lake survey	Data collected at least 3 times per summer for at least 3 years.
	Results of fish kill investigations	Reports of pollutant-caused fish kills from the most recent 5 complete calendar years.
Fish Consumption	Data for levels of toxic contaminants in fish tissue in waterbodies designated for fishable (Class B) or classified for general uses	All data on levels of toxic contaminants in fish tissue collected over the most recent 5 complete calendar years (1998-2002)
Primary Contact Recreation	Data for levels of fecal coliform bacteria from river waterbodies or non-beach areas of publicly-owned lakes and flood control reservoirs designated for swimmable (Class A) uses	Data collected monthly or more frequently during April-October periods of the calendar years 2000-2002; at least 10 samples need to be collected at flows not materially affected by surface runoff**
	Data for levels of fecal coliform bacteria from beach areas of publicly-owned lakes and flood control reservoirs	At least five samples approximately equally spaced over a 30-day period during April-October periods of calendar years 2000-2002.
	Data from the ISU/Iowa DNR statewide lake survey	Data collected at least 3 times per summer for at least 3 years.
Drinking Water	Data for levels of toxics from waterbodies designated for drinking water (Class C) uses.	Data collected quarterly or more frequently during calendar years 2000-2002 (minimum of 10 samples).
	Data for levels of nitrate from waterbodies designated for drinking water (Class C) uses.	Data collected monthly or more frequently during calendar years 2000-2002 (minimum of 10 samples).

*Data that do not meet IDNR's completeness guidelines can be used to develop "evaluated" (versus "monitored") assessments for purposes of water quality reporting. These "evaluated" assessments, however, are of generally lower confidence and are not appropriate for adding waters to Categories 4 or 5 of the Integrated Report. Evaluated assessments are, however, appropriate for adding waters to Categories 1, 2 and 3.

**For purposes of Section 305(b) reporting in Iowa, "materially affected" by surface runoff is defined by flows greater than the long-term monthly average flow plus one standard deviation of the long-term monthly average flow. Flow statistics are taken from the report *Statistical Summaries of Selected Iowa Streamflow Data through September 30, 1988* (U.S. Geological Survey Open-File Report 90-170).

Figure 1. Use of water quality data and information for Iowa's 2004 integrated Section 305(b)/303(d) report/list.



Attachment 1.
Excerpt from Senate File 2371: Iowa's credible data legislation

PAG LIN

1 1 SENATE FILE 2371
1 2
1 3 AN ACT
1 4 RELATING TO THE ESTABLISHMENT OF A WATER QUALITY INITIATIVE
1 5 PROGRAM BY THE DEPARTMENT OF AGRICULTURE AND LAND STEWARD-
1 6 SHIP AND THE DEPARTMENT OF NATURAL RESOURCES, DEFINING
1 7 AND PROVIDING FOR THE USE OF **CREDIBLE DATA** FOR QUALITY CONTROL
1 8 AND ASSURANCE PROCEDURES, AND PROVIDING FOR OTHER PROPERLY
1 9 RELATED MATTERS, AND PROVIDING AN APPLICABILITY DATE.
1 10
1 11 BE IT ENACTED BY THE GENERAL ASSEMBLY OF THE STATE OF IOWA:
1 12

7 21 Sec. 9. Section 455B.171, Code 1999, is amended by adding
7 22 the following new subsections:

7 23 NEW SUBSECTION. 10A. **"Credible data"** means scientifically
7 24 valid chemical, physical, or biological monitoring data
7 25 collected under a scientifically accepted sampling and
7 26 analysis plan, including quality control and quality assurance
7 27 procedures. Data dated more than five years before the
7 28 department's date of listing or other determination under
7 29 section 455B.194, subsection 1, shall be presumed not to be
7 30 credible data unless the department identifies compelling
7 31 reasons as to why the data is credible.

7 32 NEW SUBSECTION. 14A. "Historical data" means data
7 33 collected more than five years before the department's date of
7 34 listing or other determination under section 455B.194,
7 35 subsection 1.

8 1 NEW SUBSECTION. 19A. "Naturally occurring condition"
8 2 means any condition affecting water quality which is not
8 3 caused by human influence on the environment including, but
8 4 not limited to, soils, geology, hydrology, climate, wildlife
8 5 influence on the environment, and water flow with specific
8 6 consideration given to seasonal and other natural variations.

8 7 NEW SUBSECTION. 31A. "Section 303(d) list" means any list
8 8 required under 33 U.S.C. } 1313(d).

8 9 NEW SUBSECTION. 31B. "Section 305(b) list" means any
8 10 report or list required under 33 U.S.C. } 1315(b).

8 11 NEW SUBSECTION. 39A. "Total maximum daily load" means the
8 12 same as in the federal Water Pollution Control Act.

Sec. 10. NEW SECTION. 455B.193 QUALIFICATIONS FOR COLLECTION OF CREDIBLE DATA.

For purposes of this part, all of the following shall apply:

1. Data is not credible data unless the data originates from studies and samples collected by the department, a professional designee of the department, or a qualified volunteer. For purposes of this subsection, "professional designee" includes governmental agencies other than the department, and a person hired by, or under contract for compensation with, the department to collect or study data.

2. All information submitted by a qualified volunteer shall be reviewed and approved or disapproved by the department. The qualified volunteer shall submit a site specific plan with data which includes information used to obtain the data, the sampling and analysis plan, and quality control and quality assurance procedures used in the monitoring process. The qualified volunteer must provide proof to the department that the water monitoring plan was followed. The department shall review all data collected by a qualified volunteer, verify the accuracy of the data collected by a qualified volunteer, and determine that all components of the water monitoring plan were followed.

3. The department shall retain all information submitted by a qualified volunteer submitting the information for a period of not less than ten years from the date of receipt by the department. All information submitted shall be a public record.

4. The department shall adopt rules establishing requirements for a person to become a qualified volunteer. The department of natural resources shall develop a methodology for water quality assessments as used in the section 303(d) listings and assess the validity of the data.

Sec. 11. NEW SECTION. 455B.194 CREDIBLE DATA REQUIRED.

1. The department shall use credible data when doing any of the following:

a. Developing and reviewing any water quality standard.

b. Developing any statewide water quality inventory or other water assessment report.

c. Determining whether any water of the state is to be placed on or removed from any section 303(d) list.

d. Determining whether any water of the state is supporting its designated use or other classification.

e. Determining any degradation of a water of the state under 40 C.F.R. } 131.12.

f. Establishing a total maximum daily load for any water of the state.

2. Notwithstanding subsection 1, credible data shall not be required for any section 305(b) report and credible data shall not be required for the establishment of a designated use or other classification of a water of the state.

3. This section shall not be construed to require credible data as defined in section 455B.171, subsection 10A, in order for the department to bring an enforcement action for an illegal discharge.

Sec. 12. NEW SECTION. 455B.195 USE OR ANALYSIS OF CREDIBLE DATA.

1. For any use or analysis of credible data described in section 455B.194, subsection 1, all of the following shall apply:

a. The use of credible data shall be consistent with the requirements of the federal Water Pollution Control Act, 33 U.S.C. } 1251 et seq.

b. The data quality for removal of water of the state from any list of impaired waters including any section 303(d) list shall be the same as the data quality for adding a water to that list.

c. A water of the state shall not be placed on any section 303(d) list if the impairment is caused solely by violations of national pollutant discharge elimination system program permits or stormwater permits issued pursuant to section 455B.103A and the enforcement of the pollution control measures is required.

d. A water of the state shall not be placed on any section 303(d) list if the data shows an impairment, but existing technology-based effluent limits or other required pollution control measures are adequate to achieve applicable water quality standards.

e. If a pollutant causing an impairment is unknown, the water of the state may be placed on a section 303(d) list. However, the department shall continue to monitor the water of the state to determine the cause of impairment before a total maximum daily load is established for the water of the state

and a water of the state listed with an unknown status shall retain a low priority for a total maximum daily load development until the cause of the impairment is determined unless the department, after taking into consideration the use of the water of the state and the severity of the pollutant, identifies compelling reasons as to why the water of the state should not have a low priority.

f. When evaluating the waters of the state, the department shall develop and maintain three separate listings including a section 303(d) list, a section 305(b) report, and a listing for which further investigative monitoring is necessary. The section 305(b) report shall be a summary of all potential impairments for which credible data is not required. If credible data is not required for a section 305(b) report, the placement of a water of the state on any section 305(b) report alone is not sufficient evidence for the water of the state's placement on any section 303(d) list. When developing a section 303(d) list, the department is not required to use all data, but the department shall assemble and evaluate all existing and readily available water quality-related data and information. The department shall provide documentation to the regional administrator of the federal environmental protection agency to support the state's determination to list or not to list its waters.

g. The department shall take into consideration any naturally occurring condition when placing or removing any water of the state on any section 303(d) list, and establishing or allocating responsibility for a total maximum daily load.

h. Numerical standards shall have a preference over narrative standards. A narrative standard shall not constitute the basis for determining an impairment unless the department identifies specific factors as to why a numeric standard is not sufficient to assure adequate water quality.

i. If the department has obtained credible data for a water of the state, the department may also use historical data for that particular water of the state for the purpose of determining whether any trends exist for that water of the state.

2. This section shall not be construed to require or authorize the department to perform any act listed in section 455B.194, subsection 1, not otherwise required or authorized by applicable law.

Sec. 13. LEGISLATIVE STUDY. The legislative council is requested to establish an interim study relating to the use of plant nutrients on Iowa soil. The committee is directed to submit its findings, with any recommendations, in a report to

3 the general assembly not later than January 15, 2001.

4 Sec. 14. **APPLICABILITY OF SECTION 303(d) LISTS**. This Act
5 takes effect July 1, 2000. However, any requirements under
6 this Act which apply to a section 303(d) list shall not apply
7 for the section 303(d) list for the year 2000, but any
8 requirements shall take effect for all section 303(d) lists
9 created after the year 2000 list.
10
11
12
13 MARY E. KRAMER
14 President of the Senate
15
16
17
18 BRENT SIEGRIST
19 Speaker of the House
20
21 I hereby certify that this bill originated in the Senate and
22 is known as Senate File 2371, Seventy-eighth General Assembly.
23
24
25
26 MICHAEL E. MARSHALL
27 Secretary of the Senate
28 Approved , 2000
29
30
31
32 THOMAS J. VILSACK
33 Governor

Attachment 2

Guidelines for Determining Section 305(b) Aquatic Life Use Support (ALUS)
Using 1997 – 2002 Stream Biocriteria Sampling Data

Introduction:

Since the late 1980s, U.S. EPA has encouraged states to develop and adopt narrative and biological criteria (biocriteria) for surface waters. Biocriteria are narrative or numeric expressions that describe the best attainable biological integrity (reference condition) of aquatic communities inhabiting waters of a given designated aquatic life use (U.S. EPA 1990a). Supported by a water quality planning grant from the U.S. EPA Region VII, geographers of the U.S. EPA Corvallis Environmental Research Laboratory collaborated with DNR staff to revise and subdivide the ecoregions in Iowa (see Omernik et al. 1993; Griffith et al. 1994). As part of this effort, a list of candidate stream reference sites was generated. Reference sites are located on the least impacted streams within an ecoregion or subecoregion. Reference sites can thus serve as benchmarks to which water quality-impaired streams can be compared. A pilot reference site sampling study was conducted in 1994 to develop standardized data collection procedures for assessing the quality of aquatic habitat and for sampling benthic macroinvertebrate and fish communities (Wilton 1996). Approximately 100 reference sites were sampled during the initial reference site sampling period 1994-1998; an additional 75 sites were sampled with the biocriteria sampling protocol as part of test site sampling and sampling for watershed projects. These data, as well as recent reference site sampling data from 1999-2001, were used to develop indicators of stream biological integrity and biological assessment criteria used in assessments of aquatic life use support for the 2002 Section 305(b) report.

The following guidelines for using these data to assess support of aquatic life uses were developed by DNR staff for the 2000 and 2002 Section 305(b) reporting cycles. Guidelines were developed for assessing support of Class B(LR) and Class B(WW) warmwater aquatic life uses of wadeable streams. Guidelines were also developed for determining the level of support for the Class B(CW) coldwater aquatic life uses designated for trout streams of northeastern Iowa. . Uses designated for individual stream and river reaches in Iowa are summarized in the "Water Use Designations" portion of the *Iowa Water Quality Standards* (IAC 2002); definitions of

designated uses [e.g., Class B(WW), Class B(LR), and Class B(CW)] are presented in the *Iowa Water Quality Standards* (IAC 2002).

Determining Support of Class B(LR) and B(WW) Aquatic Life Uses

Benthic macroinvertebrate and fish sampling data from 1997 – 2002 DNR/UHL stream biocriteria sampling sites were used to assess support of warmwater stream aquatic life uses. The Iowa DNR uses a Benthic Macroinvertebrate Index of Biotic Integrity (BM-IBI) and a Fish Index of Biotic Integrity (F-IBI) to summarize biological sampling data. The BM-IBI and F-IBI combine several quantitative measurements or "metrics" that provide a broad assessment of stream biological conditions. A metric is a characteristic of the biological community that can be measured reliably and responds predictably to changes in stream quality. The BM-IBI and F-IBI each contain twelve metrics that relate to species diversity, relative abundance of sensitive and tolerant organisms, and the proportion of individuals belonging to specific feeding and habitat groups. The metrics are numerically ranked and their scores are totaled to obtain an index rating from 0 (poor) – 100 (optimum). Qualitative scoring ranges of poor, fair, good, and excellent have been established that reflect the biological community characteristics found at each level.

Biotic index (qualitative) scoring guidelines:

- Benthic Macroinvertebrate Index of Biotic Integrity (BM-IBI):
  Poor (0-30);
  Fair (31-55);
  Good (55-75);
  Excellent (76-100).

- Fish Index of Biotic Integrity (F-IBI):
  Poor (0-25);
  Fair (26-50);
  Good (51-70);
  Excellent (76-100).

I. Determining the level of aquatic life use support for individual stream sampling sites

To determine the level of aquatic life use support for a stream sampling site, the BM-IBI and the F-IBI scores from that stream are compared against index levels measured at reference stream sites located in the same ecological region. Reference sites are also stratified by habitat class in three ecoregions (riffle streams and non-riffle streams) for comparison of F-IBI scores. A set of biological assessment criteria were specifically developed for the 2002 305(b) report using stream reference site data from 1994-2001. The 25th percentile values of the reference site BM-IBI and F-IBI index scores were used as the biological impairment criteria (BIC) for 305(b) assessment purposes (Table 1).

Generally, a stream is considered biologically impaired if one or both of its index scores are significantly lower than the BIC.

Procedure for determining aquatic life use support status using 1997 – 2001 biological sampling data.

1) Determine the level of assessment (Level 3 or 4).

   If the site has a valid BM-IBI score and valid F-IBI score, the biological assessment level is 4 (go to step 2). If either the BM-IBI or the F-IBI score is missing or incomplete, the biological assessment level is 3 (go to step 4).

Level 4 Biological Assessment:

2) Identify the applicable biological impairment criteria (BIC).
   a) Determine the ecoregion where the site is located.
   b) Determine the habitat class (only applies to F-IBI results for streams located in ecoregions 47b, 47c, and 47f).
      i) Riffle habitat streams have ≥ 10% sampling area as riffles **and** ≥ 10% stream bottom as cobble-size or larger rock substrates **and** total ≥ 30% stream bottom as rock substrate.
      ii) Non-riffle habitat streams have ≤ 10% sampling area as riffles **or** ≤ 10% stream bottom as cobble-size or larger rock substrates **or** total ≤ 30% stream bottom as rock substrate.
   c) Select the applicable BIC from Table 1.

   Go to Step 3.

3) Compare the F-IBI score and the BM-IBI score to the applicable BIC (Table 1) to determine the level of aquatic life use support (ALUS). The sequence of steps listed below is followed.
   a) If BM-IBI - 7 points > BIC and F-IBI - 7 points > BIC, ALUS is fully supporting, otherwise go to b);
   b) If BM-IBI + 7 points ≥ BIC and F-IBI + 7 points is ≥ BIC, ALUS is fully supporting/threatened, otherwise go to c);
   c) If either BM-IBI + 7 points < BIC or F-IBI + 7 points < BIC (but not both), ALUS is partially supporting, otherwise go to d);
   d) If BM-IBI + 7 points < BIC and F-IBI + 7 points is < BIC, ALUS is not supporting.

Level 3 Biological Assessment (either BM-IBI or F-IBI is missing or partial result):

4) From Table 1, identify the applicable biological impairment criteria (BIC) to compare against the F-IBI or BM-IBI score from the sampling site that is being assessed**.**
   a) Determine the ecoregion where the sampling site is located.
   b) Determine the habitat class for stream sites located in ecoregions 47b, 47c, or 47f (applies to streams that have fish sampling results only).

i) Riffle habitat streams have ≥ 10% sampling area as riffles and ≥ 10% stream bottom as cobble or larger rock substrates and total ≥ 30% of stream bottom as rock substrate.
ii) Non-riffle habitat streams have ≤ 10% sampling area as riffles or ≤ 10% stream bottom as cobble or larger rock substrates or ≤ 30% of stream bottom as rock substrate.

c) Select the applicable BIC from Table 1.

5) Compare the index score against the applicable BIC to determine ALUS. When available, qualitative (partial) benthic macroinvertebrate sampling results can be considered as supplemental information to adjust the assessment result upward or downward using best professional judgement.
a) If the index score - 7 points > BIC, ALUS is fully supporting, otherwise go to b);
b) If the index score + 7 points ≥ than BIC, ALUS is fully supporting/threatened, otherwise go to c);
c) go to i) if site has F-IBI score; go to ii) if site has BM-IBI score.
i) If F-IBI + 7 points < BIC and qualitative benthic macroinvertebrate sampling results are considered fair or good, ALUS is partially supporting.
ii) If BM-IBI + 7 points is < BIC and BM-IBI qualitative rating is fair, ALUS is partially supporting.
d) go to i) if site has F-IBI score; go to ii) if site has BM-IBI score.
i) If F-IBI + 7 points < BIC and qualitative benthic macroinvertebrate sampling results are considered poor, ALUS is not supporting.
ii) If BM-IBI + 7 points is < BIC and BM-IBI qualitative rating is poor, ALUS is not supporting.

Table 1. Biological Impairment Criteria(BIC) used to assess support of B(LR) and B(WW) aquatic life uses of Iowa's wadeable warmwater streams for the 2002 Section 305b assessment.

Ecoregion:	**F-IBI**	**BM-IBI**
40 – Central Irregular Plains	33	46
47 – Western Corn Belt Plains (WCBP) **Subregions**:		
47(a) – WCBP /Northwest Iowa Loess Prairies	40	53
47(b) – WCBP / Des Moines Lobe		
(Stable Riffle Habitat*)	55	63
(No Stable Riffle Habitat)	32	63
47(c) – WCBP / Iowan Surface		
(Stable Riffle Habitat)	71	59
(No Stable Riffle Habitat)	43	59
47(d) – WCBP / Missouri Alluvial Plain	-	-
47(e) – WCBP / Loess Hills and Rolling Loess Prairies	31	56
47(f) – WCBP / Southern Iowa Rolling Loess Prairies		
(Missouri Drainage System)	31	56
(Mississippi Drainage System)		
(Stable Riffle Habitat)	41	53
(No Stable Riffle Habitat)	34	53
52 – Paleozoic Plateau (Driftless Area)	59	61
72 – Central Interior Lowland	34	53

Determining Support of B(CW) [coldwater] Aquatic Life Uses

Nine coldwater streams where biocriteria sampling was done from 1994-1998 were used to establish criteria used to determine the status of Class B(CW) aquatic life use. Eight biological indicators that reflect coldwater stream water quality and habitat suitability were calculated, and a ranking system was used to determine the level of B(CW) use support.

Coldwater stream biological indicators used to determine B(CW) aquatic life use status.

1. Number of sensitive benthic macroinvertebrate taxa.
2. Benthic macroinvertebrate biotic index of organic enrichment.
3. Percent dominance of three most abundant benthic macroinvertebrates.
4. Number of coldwater fish species.
5. Percent abundance of coldwater fish species
6. Coldwater stream fish index of biotic integrity (IBI) (Mundahl and Simon 1999).
7. Presence/absence of trout.
8. Trout reproduction rating for stream.

The degree of B(CW) use support for a given stream site was assessed by determining the number of biological indicator values that ranked below the 25th percentile of indicator values from all nine coldwater stream sampling sites. Sites with $\leq$ 2 indicators ranking below the 25th percentile level are assessed as fully supporting or fully supporting/threatened (=FS or FS/T); sites with 2-4 indicators ranking below the 25th percentile level are assessed as fully supporting/threatened (=FS/T); sites with 5 or 6 indicators below the 25th percentile level are assessed as partially supporting (=PS); sites with 7 or 8 indicators below the 25th percentile level are assessed as not supporting (=NS).

II. Applying the site assessment results to a Section 305(b) stream segment.

a) Stream segment assessments derived from a single sampling event. When data from one sampling event at one sampling site are the only data available, the assessment result for that site (e.g., fully supporting/threatened) is applied to the entire stream segment length. Most of the stream segments assessed for Section 305(b) reporting with results of 1997-2002 biocriteria sampling belong to this category.

b) Stream segments with multiple sampling sites. Relatively few stream segments have data from multiple biological sampling sites, and these are examined on a case-by-case basis. In general, when data from multiple sites are available, the lowest assessment result is assigned to the entire stream segment length. For example, if one site assessment result indicates aquatic life use is partially supporting and a second site assessment result is fully supporting/threatened uses, the partially supporting assessment is applied to the entire stream segment. One exception of this is when one or more sites are judged to be unrepresentative of the stream segment as a whole (e.g., mixing zone of wastewater discharge). In this case, only the assessment results from the site or sites that are considered representative are used to make the assessment for the entire stream segment.

III. Identifying causes and sources of impairment.

As defined in guidelines for Section 305(b) reporting (U.S. EPA 1997), *causes* of water quality impairment are those pollutants and environmental stressors that contribute to the impairment of designated uses in a waterbody. *Sources* are the activities, facilities or conditions that contribute the pollutants and environmental stressors which result in the impairment of designated beneficial uses. For example, high levels of pesticides (the *cause*) from agricultural activities (the *source*) can impair a waterbody's designated beneficial uses as a source of drinking water.

Causes and sources of impairment are specified for stream segments assessed as either "partially supporting" or "not supporting" aquatic life uses. DNR TMDL & Water Quality Assessment Section staff follow U.S. EPA guidelines and use best professional judgement to identify and assign a magnitude to each cause and source of impairment. DNR staff consider available information about pollution sources and recent events affecting water quality. Summary information from stream physical habitat evaluations are also used to assess causes and sources that are related to habitat alterations. The information reviewed includes floodplain land uses, buffer strip width and vegetation, channel sinuosity and morphometry, bank conditions, sediment composition, stream flow, and instream habitat.

References for Attachment 2:

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IAC. 2002. Chapter 567-61: water quality standards. Iowa Administrative Code [effective date 08/14/2002].

Mundahl, N.D. and T.P. Simon. 1999. Chapter 15:383-416. Development and application of an index of biotic integrity for coldwater streams of the upper Midwestern United States. In Assessing the Sustainability and Biological Integrity of Water Resources Using Fish Communities. CRC Press LLC.

Omernik, J.M., G.E. Griffith, and S.M. Pierson. 1993. Ecoregions and western cornbelt plains subregions of Iowa. U.S. Environmental Protection Agency, Environmental Research Laboratory, Corvallis, Oregon. 29 p.

U.S. EPA. 1990. Biological criteria – national program guidance for surface waters. EPA-440/5/5-90-004. U.S. Environmental Protection Agency, Office of Water Regulations and Standards. Washington D.C.

U.S. EPA. 1997. Guidelines for the preparation of the comprehensive state water quality assessments (305(b) reports) and electronic updates. Assessment and Watershed Protection Division, Office of Wetlands, Oceans, and Watersheds, Office of Water, U.S. Environmental Protection Agency, Washington, D.C.

Wilton, T.F. 1996. Pilot study of biocriteria data collection procedures for wadeable streams in Iowa: final report. Iowa Department of Natural Resources, Environmental Protection Division, Water Resources Section. 18p.

Attachment 3

THE USE OF THE TROPHIC STATE INDEX TO IDENTIFY WATER QUALITY IMPAIRMENTS IN IOWA LAKES FOR THE 2004 SECTION 305(b) REPORTING AND SECTION 303(d) LISTING CYCLES

Iowa DNR

TMDL & Water Quality Assessment Section

Geological Survey & Land Quality Bureau

October 2003

Revised: December 2004

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INTRODUCTION

Historically, relatively little water quality monitoring has been conducted on Iowa lakes. Prior to the five-year survey of Iowa lakes conducted by Iowa State University that began in 2000 (Downing and Ramstack 2001, 2002, Downing, et al. 2003), lake surveys in Iowa have typically involved sampling in only summer seasons of one year at roughly ten-year intervals (see Bachmann 1965, Bachmann et al. 1980, and Bachmann et al. 1994). This amount of data, although providing a snapshot of lake water quality given the climatic conditions of the specific year of sampling, has not been particularly useful for developing a more accurate characterization of lake-specific water quality over the long-term. In addition, due to the general lack of historical data, accurate identification of trends in water quality parameters at most Iowa lakes is not possible. Diagnostic/feasibility studies at Iowa lakes (e.g., Bachmman et al. 1982), have included more intensive water quality monitoring, but such studies have been conducted on relatively few lakes and are of a relatively short duration (from one to two years). Due to this general lack of data, historical assessments of lake water quality in Iowa, such as those used for Section 305(b) reporting and Section 303(d) listing, have been based primarily on the best professional judgement of Iowa DNR fisheries biologists. The nearly total reliance on best professional judgement, while a valid assessment technique, resulted from this lack of routine ambient monitoring at Iowa lakes and the lack of state water quality criteria for parameters that are most likely to indicate lake water quality impairments (e.g., nutrients (nitrogen and phosphorus), chlorophyll, turbidity, and impacts due to the accumulation of sediment in lake basins). Previous Section 305(b) assessments that were based on best professional judgement were supplemented with lake monitoring data as this information was available (e.g., Bachmann et al. 1982, Bachmann et al. 1994). The current and on-going lake survey conducted by Iowa State University (Downing and Ramstack 2000, 2001) is designed as a five-year study and thus is capable of providing data that can be used to better characterize lake water quality than was possible with data from previous surveys.

This lake assessment methodology for Iowa's integrated (305(b)/303(d)) report involves the use of data from the Iowa State University survey with Carlson's (1977) trophic state index (TSI) to identify lakes that do not fully meet the *Iowa Water Quality Standards* (IAC 2002). The existence of any lake impairments suggested by a TSI value will be verified by IDNR field (Fisheries Bureau) staff. This approach is consistent with Iowa's credible data law and allows assessment of water quality impacts due to parameters that currently lack numeric criteria in the *Iowa Water Quality Standards*. The use of TSI values for chlorophyll and Secchi depth serves as an interim method of assessing lake water quality in Iowa until numeric criteria for nutrient parameters and their response variables (chlorophyll-a and turbidity) are adopted into the *Iowa Water Quality Standards*. To achieve that goal, Iowa DNR is participating in the EPA Region 7 regional technical assistance group (RTAG) that was established to assist states in the adoption of numeric criteria for nutrients and nutrient-related parameters.

ASSESSMENT RATIONALE

"Trophic state" has long been used by limnologists to classify lakes and is based on the chemistry and biology of lakes. Although a number of approaches exist for classifying lakes according to trophic state, and although a number of controversies exist regarding how "trophic state" is defined, the use of this framework has the advantages of historical usage, general acceptance of the trophic state concept (e.g., "eutrophic" indicates nutrient enrichment), and an improved ability to describe lake condition versus a description using a single variable or number (e.g., total phosphorus concentration of 100 parts per billion). Table 2 describes the general framework of the lake trophic state concept. For a discussion on the development and variety of trophic state indices, see Chapter 2 (The Basis for Lake and Reservoir Nutrient Criteria) in U.S. EPA (2000).

Carlson's (1977) trophic state index is a numeric indicator of the continuum of the biomass of suspended algae in lakes and thus reflects a lake's nutrient condition and water transparency. The level of plant biomass is estimated by calculating the TSI value for chlorophyll-a. TSI values for total phosphorus and Secchi depth serve as surrogate measures of the TSI value for chlorophyll. The focus on turbidity in general, and chlorophyll in particular, seems appropriate for assessing the degree to which Iowa lakes support their designated Class A (primary contact recreation) and Class B (aquatic life) uses. Carlson's trophic state index provides a convenient and well-established method for identifying turbidity-related impacts to Iowa lakes. As described by Carlson (1991), turbidity, and especially turbidity related to large populations of suspended algae, is a key indicator of the degree to which a lake supports primary contact uses:

> [plant] biomass is a proximate measure of the problems that plague lakes. Probably few citizens complain about the productivity of their lake and fewer yet lodge complaints about phosphorus concentrations. A biomass-related trophic state definition places the emphasis of the classification on the problem rather than on any potential cause.

Because of this direct linkage between the perceived level of water quality and turbidity, TSI values for chlorophyll-a and Secchi depth will be used as guidelines to identify Iowa lakes that do not meet Iowa's narrative water quality standard protecting against "aesthetically objectionable conditions." Both chlorophyll-a and Secchi depth are applicable to Iowa's narrative water quality criterion protecting against "aesthetically objectionable conditions" in Iowa surface waters (IAC 2002, 61.3(2)). IDNR field (Fisheries Bureau) staff will be contacted to verify that the "aesthetically objectionable condition" suggested by the TSI values does, in fact, exist. For two reasons, TSI values for total phosphorus were not used as the primary basis for assessing support of either primary contact recreation uses or aquatic life uses:

1. TSI's for total phosphorus are poor predictors of impairment due to either Secchi depth or chlorophyll-*a*: The typical use of the TSI for total phosphorus to measure trophic state (and the level of "water quality") presumes that the relationship between total phosphorus and chlorophyll-a will, more or less, hold for the lake being assessed. The production of chlorophyll in Iowa's natural lakes and impoundments, however, is sometimes limited by nutrients other than phosphorus (i.e., nitrogen) and/or high levels of non-algal turbidity in the water column. The result is that lakes with very high levels of total phosphorus that suggest strong hyper-eutrophy sometimes have levels of chlorophyll-*a* and Secchi depth that suggest relatively good water quality (i.e., in the middle to lower eutrophic range). The Iowa lakes in Table 3 are those that have TSI values for total phosphorus in the hypereutrophic range (i.e., greater than 70) but that have TSI values for chlorophyll-a and Secchi depth less than 65. Examples of lakes in Iowa with relatively high TSI values for total phosphorus but low values for chlorophyll-a and Secchi depth include West Lake Osceola (Clarke County), Lake Keomah (Mahaska County), and Center Lake (Dickinson County). Thus, while these lakes have very high levels of total phosphorus that might suggest impairment of designated uses, the levels of chlorophyll-a and Secchi depth are relatively low and do not suggest impairment (Figures 1 and 2). Because of this lack of correlation between TSI values for total phosphorus and TSI values for the response variables that define the "aesthetically objectionable conditions," TSI values for total phosphorus were not used as the primary basis for determining the level of use support or for identifying water quality impairments at Iowa lakes.

2. The *Iowa Water Quality Standards* lack water quality criteria—narrative or numeric—that are relevant to impacts of total phosphorus in surface waters. When developing this assessment procedure, careful consideration of Iowa's numeric and narrative criteria in the *Iowa Water Quality Standards* showed that none of these criteria are directly relevant to levels of phosphorus in the water column of a lake. That is, phosphorus is not a toxic substance at

ambient levels seen in Iowa waters. In addition, high levels of phosphorus in Iowa lakes do not necessarily lead to either "nuisance aquatic life" or "aesthetically objectionable conditions." For example, lakes with growths of aquatic macrophytes in littoral zone areas can have high levels of phosphorus but have low levels of chlorophyll-*a* and have good water transparency.

For lakes where assessment information from the IDNR Fisheries Bureau is available, TSI values were used to support assessments of the designated Class B aquatic life uses based on best professional judgement of IDNR fisheries biologists. According to biologists in the IDNR Fisheries Bureau, algal blooms can also cause impairments to aquatic life uses of Iowa lakes through interference with some spawning activities of nest building species, e.g., bluegill, bullhead, crappie and largemouth) and lowered levels (sags) of dissolved oxygen that, in extreme cases, can cause fish mortality. For purposes of Section 305(b) assessments for the 2002 reporting cycle, TSI values were used primarily to support previous assessments of support of aquatic life uses supplied by the IDNR Fisheries Bureau.

IDENTIFYING WATER QUALITY IMPAIRMENTS AT IOWA LAKES BASED ON TSI:

For purposes of developing water quality assessments for the 2004 Section 305(b) reporting cycle, Carlson's (1977, 1984, 1991) "trophic state index" (TSI) was used with data generated for 132 Iowa lakes as part of the Iowa State University surveys in 2000, 2001, and 2002 (Downing and Ramstack 2001, 2002, Downing et al. 2003). Overall (three-year) median values calculated from this dataset were used to calculate TSI values for total phosphorus, chlorophyll-a, and Secchi depth for each lake; the ranges of these values are summarized in Table 4. The identification of a potential impairment of either the primary contact or aquatic life uses, however, was based on TSI values for chlorophyll-a and/or secchi depth. The TSI values for the indicator variable of total phosphorus is used primarily to interpret discrepancies between TSI values for chlorophyll-a and secchi depth.

Relevant state water quality criteria:

The *Iowa Water Quality Standards* do not contain numeric criteria for either nutrients (e.g., nitrogen or phosphorus), chlorophyll, or turbidity that apply to ambient water quality. Thus, the assessments of the degree to which the these parameters might impair the Class A (primary contact recreation) uses and/or the Class B (aquatic life) uses are based on a comparison of lake-specific TSI values to the following narrative criteria for general use waters as defined in Section 61.3(2) of the *Iowa Water Quality Standards*:

> *Such waters shall be free from materials attributable to wastewater discharges or agricultural practices producing objectionable color, odor, or other aesthetically objectionable conditions.*
>
> *Such waters shall be free from substances, attributable to wastewater discharges or agricultural practices, in quantities which would produce undesirable or nuisance aquatic* life;

Examples of *aesthetically objectionable conditions* include blooms of algae or high levels of non-algal turbidity that make the lake unsuitable (aesthetically unpleasing) for primary contact recreation. Blooms of bluegreen algae also constitute *aesthetically objectionable conditions* due to their ability to create unpleasant floating scums on the water surface or unpleasant odors, both of which can limit the primary contact recreation uses at a lake. For purposes of water quality assessment, bluegreen algae can be considered a form of *nuisance aquatic life* due to their ability to produce toxins that can adversely affect aquatic life and the uses of the lake for watering by livestock and wildlife. In severe cases, levels of these toxins in lake water can affect human health.

IDNR is aware that some of the *aesthetically objectionable conditions* and/or *undesirable or nuisance aquatic life* at the lakes assessed as "impaired" may not be attributable to either wastewater discharges or agricultural practices. For example, a number of lakes assessed as "impaired" based on TSI values are very shallow (mean depth less than 2 meters) natural lakes of glacial origin with very low watershed:surface area ratios. The turbidity-related water quality problems at these lakes, whether caused by algae or suspended inorganic sediments, are due primarily to lack of sufficient water depth to prevent internal nutrient recycling and sediment re-suspension due to either bottom-feeding fish (e.g., common carp) and/or wind/wave action. Regardless, the levels of nutrients and turbidity (whether of algal or non-algal origin) at these lakes constitute limitations to the use of these lakes for their designated beneficial uses. Thus, these lakes are appropriate for addition to the state list of impaired waters.

Data sources:

The primary data source for assessing the degree to which Iowa lakes support their designated primary contact and/or aquatic life uses is the water quality dataset for chlorophyll-a and Secchi depth generated for 132 Iowa lakes sampled as part of the Iowa State University surveys in 2000, 2001, and 2002 (Downing and Ramstack 2001, 2002, Downing et al. 2003). Data for inorganic suspended solids and total phosphorus from this survey were also used to interpret TSI values and to provide a more complete assessment of lake water quality. Information from the IDNR Fisheries Bureau on recent water quality conditions/problems, the status of fish populations, and on lake history was used to supplement assessments based on TSI values for chlorophyll-a and/or Secchi depth and to verify the existence of any "aesthetically objectionable condition" suggested by TSI values. In addition, information on lake plankton communities in Downing et al. (2002) was used to interpret discrepancies observed between TSI values for chlorophyll-a and Secchi depth and to determine the proportion of the phytoplankton community composed of bluegreen algae.

Data requirements for listing:

Data quantity:

In 1990, in order to improve the accuracy and confidence level of water quality assessments, IDNR developed "data completeness guidelines" for using results of routine water quality monitoring for Section 305(b) reporting. These guidelines identify the numbers of samples needed for water quality assessments that can support Section 303(d) listings (i.e., a *monitored* assessment). Assessments based on less than the recommended number of samples are considered "evaluated"; these assessments are of relatively lower confidence than "monitored" assessments and are thus not appropriate for impaired waters listing but are appropriate for Section 305(b) water quality reporting. In order to account for the year-to-year variability in lake water quality, state limnologists participating in the U.S. EPA Region 7 nutrient criteria regional technical assistance group (RTAG) (IA, KS, MO, NE) recommend in 2001 that the combined data from at least three years of monitoring conducted from three to five times per year should be used to characterize lake water quality and to identify water quality impairments. This recommendation has been incorporated into IDNR's data completeness guidelines. Thus, for purposes of Iowa's 2004 Integrated Report, overall median water quality values from the three-year period from 2000 through 2002 (N=9) will be used to calculate TSI values to determine the existence of an impairment. As is typical in all monitoring networks, special circumstances occasionally prevent either sample collection (e.g., adverse weather conditions) or the reporting of data (e.g., laboratory accidents). During the period

2000-2002, one or more samples are missing for 17 lakes sampled as part of the ISU survey of 132 Iowa lakes (Table 5). For purposes of identifying candidate lakes for Iowa's 2004 impaired waters list, only those lakes with at least 8 samples for chlorophyll-a and Secchi depth over the 2000-2002 period will be considered to meet IDNR's data completeness guidelines. Assessments for lakes with seven or fewer samples for this period will be considered "evaluated" and thus will not be used to identify candidate lakes for impaired waters listing. Other lake water quality datasets appropriate for calculating TSI values will be reviewed to determine compliance with Iowa DNR's data completeness guidelines.

Data quality:

As specified in the 2001 Iowa Code, Section 455B.194, subsection 1, (Iowa's credible data law) the department shall use "credible data" when determining whether any water of the state is to be placed on or removed from any Section 303(d) list (Category 5 of the 2004 Integrated Report). In addition, Iowa's credible data law specifies that data more than five years before the end of the most recent Section 305(b) period (the end of calendar year 2002) are presumed under state law to be "not credible" unless IDNR identifies compelling reasons as to why the older data are credible. Data generated by the ISU lake survey (e.g., Downing and Ramstack 2001, 2002, Downing et al. 2003) meet all requirements of Iowa's credible data law and can thus be used to add waters to Iowa's 2004 impaired waters list. Other datasets appropriate for calculating TSI values will be reviewed to determine compliance with Iowa's credible data law.

Threshold TSI values:

A TSI value of greater than 65 for either chlorophyll-a or Secchi depth will be used to identify candidate lakes for Category 5 of Iowa's 2004 Integrated (305(b) / 303(d)) Report (see Table 1 for a description of the "Integrated Report" categories). This methodology is similar to that used by the Minnesota Pollution Control Agency for lakes in the Western Corn Belt Plains ecoregion of southern Minnesota (MPCA 2002). Nearly the entire state of Iowa lies in this same ecoregion, the exceptions being the portion of south-central and southeastern Iowa in the Central Irregular Plains ecoregion and the portion of northeastern Iowa in the Driftless Area ecoregion. Lakes with TSI values greater than 65 are likely to have nutrient or sediment-related water quality problems that contribute to excessive turbidity that impair either the Class A or Class B uses and are thus potential candidates for Section 303(d) listing. These threshold values are less than the value (70) used for the 2002 Section 305(b)/303(d) reporting/listing cycle. This lowering is based on the availability of sufficient data (three years) to more accurately characterize lake water quality.

Assessment categories ("monitored" and "evaluated"):

Prior to revisions to guidance for state compliance with Sections 305(b) and 303(d) of the Clean Water Act (U.S. EPA 2003), U.S. EPA (1997) recommended that states place water quality assessments into one of two categories: evaluated or monitored. "Evaluated" assessments were those based on data older than five years or other than site-specific ambient monitoring data (e.g., questionnaire surveys of fish and game biologists [=best professional judgement] or predictive modeling using estimated input values) and thus were of relatively low confidence. IDNR has historically not considered waterbodies identified as "impaired" based on "evaluated" assessments as candidates for the state's Section 303(d) list. In contrast, "monitored assessments" were based primarily on recent, site-specific ambient monitoring data and thus were of relatively high confidence. IDNR has, however, historically considered waterbodies identified as "impaired" based on "monitored" assessments as candidates for the state's Section 303(d) list. In order to maintain continuity with past assessment procedures, and due to the

usefulness of the approach, IDNR will continue to identify each assessment of lake water quality as either "evaluated" or "monitored."

For purposes of preparing Iowa's 2004 list of impaired waters, the use support categories of "not supported / monitored" and "partially supported / monitored" were the categories containing candidate lakes for Section 303(d) listing. The use support category of "partially supported / evaluated", however, contains lakes with marginally good water quality whose current TSI values and support status, although suggesting "impairment," could be significantly affected by results of subsequent lake monitoring. The use support categories of "fully supported / threatened (no declining trend)" and "fully supported" contain lakes with good to very good water quality that, even considering the variability present in lake monitoring data, will likely not have TSI values that justify addition to future Section 303(d) lists.

Lakes with insufficient data to support impaired waters listing:

Due to the availability of sufficient data (three years of monitoring three times per year) for nearly all of the 132 lakes in the ISU survey (Downing and Ramstack 2001, 2002; Downing et al. 2003), most 2004 assessments based on TSI values are considered "monitored," are of relatively high confidence, and are thus appropriate for adding lakes to Iowa's 2004 Section 303(d) list. Two lakes sampled as part of the ISU survey, however, lack sufficient data upon which to develop a "monitored" assessment: Lacey-Keosauqua Lake in Van Buren County and Williamson Pond in Lucas County (Table 5). Lacey-Keosauqua Lake was not sampled in 2002 due to dam failure; Williamson Pond was not sampled in 2001. The assessment category for these lakes will be "evaluated." These two lakes will thus not be candidates for Category 5 of Iowa's 2004 integrated Section 305(b) report/Section 303(d) list. All the remaining 130 lakes were sampled at least once in each of the years from 2000 to 2002, although 15 of these lakes lack two or more samples of having a compete dataset (27 samples) for the three-year period (Table 5). Sufficient data, however, are available for these 15 lakes upon which to base a "monitored" assessment and thus identify candidate lakes for addition to Category 5.

Use support categories:

The following are detailed descriptions of the use support categories used for Section 305(b) lake assessments for the 2004 reporting cycle. The TSI values associated with each of these use support categories are summarized in Table 6. Any impairments (i.e., "aesthetically objectionable conditions") suggested by TSI values for chlorophyll-a and/or Secchi depth are verified by contact with IDNR field (Fisheries) staff.

Not Supporting and "monitored": candidates for Section 303(d) listing:

To be assessed as "not supporting" designated uses, and to be considered as a candidate for Section 303(d) listing, the lake-specific TSI values for chlorophyll-a or Secchi depth must be greater than 70. These lakes are likely to have severe turbidity-related impacts, of either algal or non-algal origin, that (1) interfere with designated uses for primary contact recreation and/or aquatic life, (2) constitute an aesthetically objectionable condition that violates narrative criteria for general use waters as defined in Section 61.3(2) of the *Iowa Water Quality Standards*. In addition, the nutrient conditions of these lakes suggest the possibility that the phytoplankton community of the lake is dominated by bluegreen algae, a potential nuisance aquatic species that also can be considered a violation of narrative criteria in Section 61.3(2) of the *Iowa Water Quality Standards*. The TSI threshold value for chlorophyll-a and/or Secchi depth is the lower limit that identifies "hyper-eutrophic" lakes. Thus, this threshold value provides strong evidence of a water quality impairment.

Partially Supporting and "monitored": candidates for Section 303(d) listing:

To be assessed as "partially supporting" designated uses and to be considered as a candidate for Section 303(d) listing, the lake-specific TSI values for chlorophyll-a and Secchi depth must be between 65 and 70. These lakes are likely to have moderate turbidity-related impacts, of either algal or non-algal origin, that interfere with designated uses for primary contact recreation and/or aquatic life. The TSI threshold value for chlorophyll-a and Secchi depth is in the middle range between eutrophic and hypereutrophic lakes. The threshold value for this use support category is that used by the Minnesota Pollution Control Agency to identify Section 303(d)-impaired lakes in southern Minnesota (MPCA 2002). As such, this threshold is appropriate for identifying impairments in Iowa lakes.

Partially Supporting and "evaluated": not candidates for Section 303(d) listing:

Lakes with TSI values for chlorophyll-a or Secchi depth between 65 and 70 that are based on less than sufficient data (i.e., samples from at least three years of monitoring from three to five times per year) are assessed as "partially supporting" designated uses for primary contact recreation and/or aquatic life. These lakes may have turbidity-related impacts, of either algal or non-algal origin, that may interfere with designated uses for primary contact recreation and/or aquatic life. These TSI threshold values are in the middle to upper range between eutrophic and hyper-eutrophic lakes. The lower TSI value for these parameters (65) is used by the state of Minnesota as the threshold for identifying impaired lakes in southern Minnesota that are candidates for Section 303(d) listing (MPCA 2002). Thus, while the TSI values for Iowa lakes in this category *may* be impaired for Class A or Class B uses, insufficient data are available for developing Section 305(b) assessments having the high degree of confidence needed to justify Section 303(d) listing. These lakes will be placed into Integrated Report categories 2b or 3b and will thus be added to Iowa's list of waters in need of further investigation (see Table 1).

Fully Supporting / Threatened and "evaluated" or "monitored": not candidates for Section 303(d) listing:

Lakes with TSI values for chlorophyll-a or Secchi depth of between 55 and 65 are assessed as "fully supporting but threatened" for their designated uses for primary contact recreation and/or aquatic life. These lakes may have minor turbidity-related impacts, of either algal or non-algal origin, that interfere with, but do not limit, the designated uses for primary contact recreation and/or aquatic life. The TSI threshold values for both chlorophyll-a and Secchi depth in this category are in the middle range of eutrophic lakes to the middle range between eutrophic and hypereutrophic lakes. The lower TSI value for defining this use support category (55) is in the middle range of eutrophic lakes. Iowa lakes with TSI values in this range appear to have relatively good water quality but may experience episodes of poorer water quality due to algal blooms or to occasional high levels of non-algal turbidity.

Identifying trends in lake water quality: For the majority of Iowa lakes, sufficient data do not exist to determine the existence of water quality trends over time. This lack of data stems from the design of previous statewide surveys of Iowa lakes which involved sampling during only one summer season at approximately 10 year intervals (e.g., see Bachmann et al. 1980, Bachmann et al. 1994). The year-to-year variability in lake data—due largely to climatic factors—makes the exiting data of little use for trend determination.

If, however, a lake in this category shows evidence of a declining level of water quality over time (adverse water quality trend), and this trend can be demonstrated with sufficient credible data, then the lake will be identified as "fully supporting / threatened with a declining trend" and will be a candidate for Section 303(d) listing.

Fully Supporting and "evaluated" or "monitored": <u>not</u> candidates for Section 303(d) listing:

Lakes with TSI values for chlorophyll-a and secchi depth of less than 55 have good to excellent water transparency and do not typically have turbidities due to either algal or non-algal sources that limit designated uses for either primary contact recreation or aquatic life. In terms of water transparency, lakes in this category have the best water quality in the state

<u>MANAGEMENT AND ACCESSIBILITY OF ASSESSMENTS:</u>

Assessments of the degree of support of the Class A and Class B uses for the 130 lakes sampled as part of the ISU survey have been entered into Iowa DNR's Section 305(b) assessment database (ADB+). The narrative descriptions of these assessments use qualitative characterizations of TSI values; Table 7 summarizes these characterizations.

Table 1. Summary of U.S. EPA's "integrated reporting" format as used for Iowa's 2004 Section 305(b) and Section 303(d) cycles.

Integrated Report Category	Source of Category	Description of Category
1	U.S. EPA	All designated uses are met.
2a	U.S. EPA	Some of the designated uses are met but there is insufficient data to determine if remaining designated uses are met.
2b	IDNR	At least one use assessed as supported with at least one other use potentially impaired based on an "evaluated" assessment. This subcategory, along with subcategory 3b, forms the state list of waters in need of further investigation.
3a	U.S. EPA	Insufficient data to determine whether any designated uses are met.
3b	IDNR	Insufficient data exist to determine whether any designated uses are met, but at least one use is potentially impaired based on an "evaluated" assessment. This subcategory, along with subcategory 2b, forms the state list of waters in need of further investigation.
4a	U.S. EPA	Water is assessed as impaired or threatened but a TMDL is not needed because a TMDL has been completed.
4b	U.S. EPA	Water is assessed as impaired but a TMDL is not needed because other required control measures are expected to result in attainment of water quality standards in a reasonable period of time.
4c	U.S. EPA	Water is assessed as impaired but a TMDL is not needed because the impairment or threat is not caused by a "pollutant."
4d	IDNR	Water is assessed as impaired due to a pollutant-caused fish kill but a TMDL is not needed because enforcement actions were taken against the party responsible for the kill.
5a	U.S. EPA	Water is assessed as impaired or threatened by a pollutant stressor and a TMDL is needed [along with Category 5b, the state's Section 303(d) list].
5b	IDNR	Water is assessed as impaired or threatened based on results of biological monitoring or a fish kill investigation where specific causes and/or sources of the impairment have not yet been identified [along with Category 5a, the state's Section 303(d) list].

Table 2. Changes in temperate lake attributes according to trophic state (modified from U.S. EPA 2000, Carlson and Simpson 1995, and Oglesby et al. 1987).

TSI Value	Attributes	Primary Contact Recreation	Aquatic Life (Fisheries)
50-60	eutrophy: anoxic hypolimnia; macrophyte problems possible	[none]	warmwater fisheries only; percid fishery; bass may be dominant
60-70	bluegreen algae dominate; algal scums and macrophyte problems occur	weeds, algal scums, and low transparency discourage swimming and boating	Centrarchid fishery
70-80	hyper-eutrophy (light limited). Dense algae and macrophytes	weeds, algal scums, and low transparency discourage swimming and boating	Cyprinid fishery (e.g., common carp and other rough fish)
>80	algal scums; few macrophytes	algal scums, and low transparency discourage swimming and boating	rough fish dominate; summer fish kills possible

Table 3. Iowa lakes with TSI values for total phosphorus greater than 70 (=hyper-eutrophic) that have TSI values for chlorophyll-a and Secchi depth that do not suggest impairment of primary contact recreation and/or aquatic life uses (i.e., TSI values of 65 or less). TSI values are based on data from the Iowa State University statewide survey of 130 Iowa lakes in 2000, 2001, and 2002 (N approximately equal to 9); lakes are ranked by the TSI value for total phosphorus.

Lake Name	County	TSI for total phosphorus	TSI for chlorophyll-a	TSI for Secchi depth	Use Support for 2004 305(b) report
Red Rock Reservoir	Marion	78.4	**41.1**	57.4	FST
Meadow Lake	Adair	77.1	**64.5**	60.7	FST
Saylorville Reservoir	Polk	76.0	**49.7**	64.1	FST
Hannen Lake	Benton	75.9	**54.8**	50.4	FS
Lake Keomah	Mahaska	75.0	**57.6**	64.1	FST
Arrowhead Lake	Pottawattamie	73.4	**57.6**	62.3	FST
Center Lake	Dickinson	72.9	**61.2**	61.5	FST
Badger Lake	Webster	72.8	**50.0**	60.7	FST
Beeds Lake	Franklin	72.7	**54.7**	57.4	FST
West Osceola	Clarke	70.9	**55.4**	59.3	FST
Rodgers Park Lake	Benton	70.8	**49.9**	58.0	FST

Table 4. Ranges of TSI values for Iowa lakes based on overall median values from the 2000, 2001, and 2002 statewide surveys of 132 Iowa lakes by Iowa State University (Downing and Ramstack 2001, 2002; Downing et al. 2003). Lakes were sampled approximately three times per summer.

	TSI Values:		
	total phosphorus	**chlorophyll-a**	**Secchi depth**
minimum	49	38	34
10th percentile	57	49	50
25th percentile	64	54	57
median	***69***	***59***	***62***
75th percentile	76	65	70
90th percentile	84	71	75
maximum	92	81	87
mean	70	59	63
standard deviation	9.6	8.9	9.9

Table 5. Lakes lacking two or more samples of the complete data set (total of 27 samples (3 per parameter per year)) for chlorophyll-a, Secchi depth, and/or total phosphorus for the years 2000, 2001, or 2002.

	Lake Name	County	No. of samples, (chlorophyll -a)	Number of samples, Secchi depth	No. of samples, total phosphorus	Total number of samples, 2000-02	Years Sampled	Assessment Category for 2004
1.	Lacey Keosauqua Park Lake	Van Buren	**3**	**6**	**6**	**15**	**2**	**E**
2.	Williamson Pond	Lucas	**6**	**6**	**6**	**18**	**2**	**E**
3.	West Okoboji Lake	Dickinson	**7**	**7**	9	23	3	M
4.	Three Mile Lake	Union	**6**	9	9	24	3	M
5.	Willow Lake	Harrison	**8**	9	**7**	24	3	M
6.	Black Hawk Lake	Sac	**7**	9	9	25	3	M
7.	Blue Lake	Monona	**7**	9	9	25	3	M
8.	Dale Maffitt Lake	Madison	**7**	9	9	25	3	M
9.	Hawthorn Lake (aka Barnes City Lake)	Mahaska	**7**	9	9	25	3	M
10.	Hickory Grove Lake	Story	**7**	9	9	25	3	M
11.	Lake Geode	Henry	**7**	9	9	25	3	M
12.	Lake Wapello	Davis	**7**	9	9	25	3	M
13.	Lower Gar Lake	Dickinson	**7**	9	9	25	3	M
14.	Rock Creek Lake	Jasper	**7**	9	9	25	3	M
15.	Rodgers Park Lake	Benton	**7**	9	9	25	3	M
16.	Storm Lake	Buena Vista	**7**	9	9	25	3	M
17.	Thayer Lake	Union	**7**	9	9	25	3	M

Table 6. Summary of ranges of TSI values and measurements for chlorophyll-a and Secchi depth used to define Section 305(b) use support categories for the 2004 reporting cycle.

Level of Support	TSI value	Chlorophyll-a (ug/l)	Secchi Depth (m)
fully supported	<=55	*<=12*	*>1.4*
fully supported / threatened	55 → 65	*12 → 33*	*1.4 → 0.7*
partially supported (evaluated: in need of further investigation)	65 → 70	*33 → 55*	*0.7 → 0.5*
partially supported (monitored: candidates for Section 303(d) listing)	65-70	*33 → 55*	*0.7 → 0. 5*
not supported (monitored or evaluated: candidates for Section 303(d) listing)	>70	*>55*	*<0.5*

Table 7. Descriptions of TSI ranges for Secchi depth, phosphorus, and chlorophyll-a for Iowa lakes. These characterizations were used in developing lakes-specific assessments that are included in the Iowa's Section 305(b) assessment database (ADB+).

TSI value	Secchi description	Secchi depth (m)	Phosphorus & Chlorophyll-a description	Phosphorus levels (ug/l)	Chlorophyll-a levels (ug/l)
> 75	extremely poor	< 0.35	extremely high	> 136	> 92
70-75	very poor	0.5 – 0.35	very high	96 - 136	55 – 92
65-70	poor	0.71 – 0.5	high	68 – 96	33 – 55
60-65	moderately poor	1.0 – 0.71	moderately high	48 – 68	20 – 33
55-60	relatively good	1.41 – 1.0	relatively low	34 – 48	12 – 20
50-55	very good	2.0 – 1.41	low	24 – 34	7 – 12
< 50	exceptional	> 2.0	extremely low	< 24	< 7

Figure 1. TSI values for 132 Iowa lakes sampled from 2000-2002: total phosphorus versus secchi depth.

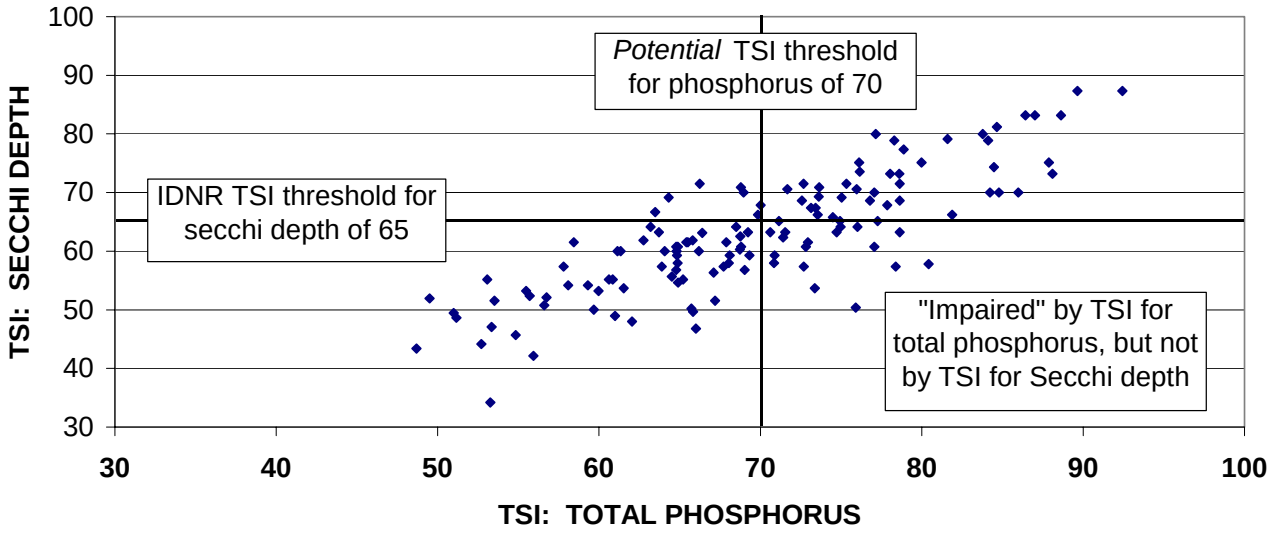
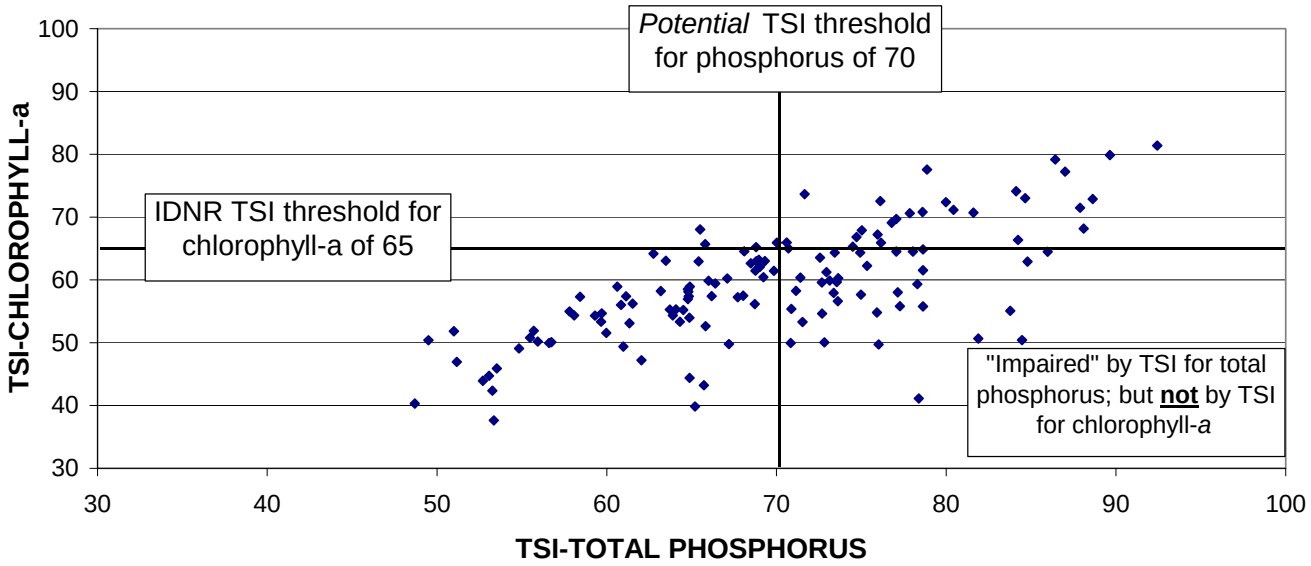


Figure 2. TSI values for 132 Iowa lakes sampled from 2000-2002: total phosphorus versus chlorophyll-a.



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Attachment 4

Iowa DNR interpretations of Section 305(b) causes of impairment as identified by U.S. EPA (1997).

Information is also included on the historical use of the individual cause categories for water quality assessments in Iowa and on the existence of numeric criteria in the Iowa Water Quality Standards.

Cause Code	Cause Category	Historically Used?	Numeric Criteria?	Description
0000	cause unknown	yes	no	Causes of impairment are identified as "unknown" where results of water quality monitoring suggest an impact, but no cause of the impact is apparent. Most often, this cause category is used when results of biological monitoring suggest a impact to biotic integrity but do not suggest a specific cause of the impact. In such cases, follow-up monitoring is often needed to determine the specific cause or causes of the impairment.
0100	unknown toxicity	yes	no	"Unknown toxicity" is identified as a cause of impairment when results of monitoring results suggest some type of toxic impact but the identities of the substances causing toxicity are unknown. For example, results of a biological assessment that shows a complete lack of aquatic life in a stream strongly suggest the presence of toxic substances; the cause of impairment in such a case would be identified as "unknown toxicity."
0200	pesticides	yes	yes	"Pesticides" refers to any substance, either currently or historically, used to kill plants, insects, algae, fungi, and other organisms; includes herbicides, insecticides, algalcides, fungicides, and other substances. For purposes of 305(b)/303(d) reporting in Iowa, this category includes priority pesticides* (as defined in Section 307a of the Clean Water Act) as well as non-priority pesticides (e.g., cyanazine, and metolachlor).
0250	atrazine	yes	yes	a subcategory of the "pesticides" cause category (0200).
0300	priority organics	yes	yes	"Priority organics" are toxic organic pollutants listed in Section 307a of the federal Clean Water Act: "Priority organics" includes the following pollutant groups: chlorinated benzenes, chlorinated ethanes, chlorinated phenols, other chlorinated organics, haloethers, halomethanes, nitrosamines, non-chlorinated phenols, phthalate esters, polynuclear aromatic hydrocarbons (PAHs), pesticides and metabolites*, DDT and metabolites, polychlorinated biphenyls (PCBs), and other organics. . For purposes of 305(b)/303(d) reporting in Iowa, this cause category does not include the following groups of priority organics: pesticides and metabolites (cause code 0200), DDT and metabolites (cause code 0200), or polychlorinated biphenyls (PCBs) (cause code 0410).
0400	nonpriority organics	no	no	"Nonpriority organics" include toxic organic pollutants not listed in Section 307a of the federal Clean Water Act
0410	PCBs	yes	yes	"Polychlorinated biphenyls" or PCBs; a subcategory of the "priority organics" cause category (0300).
0420	dioxins	no	yes	
0500	metals	yes	yes	Includes the following toxic metals: aluminum, antimony, arsenic, asbestos, beryllium, cadmium, chromium, copper, cyanide, lead, mercury, nickel, selenium, silver, thallium, zinc. All but aluminum are identified as "priority pollutants" under Section 307a of the Clean Water Act.
0600	ammonia (un-ionized)	yes	yes	The identification of ammonia as a cause of fish kills is typically based on the presumed presence of high levels of ammonia in most types of untreated wastewater, especially in the high-strength waste

Cause Code	Cause Category	Historically Used?	Numeric Criteria?	Description
				generated by animal feeding operations.
0700	chlorine	yes	yes	"Chlorine" and chloramines are widely used in treatment of potable water supplies and wastewater treatment plant effluents and are used in a variety of industrial applications, including power generating facilities and paper mills. Although the *Iowa Water Quality Standards* contain numeric criteria to protect aquatic life uses from adverse impacts of total residual chlorine, analytical difficulties have precluded analysis for total residual chlorine as part of ambient surface water monitoring since 1999. Currently, the only scenario that would lead to identification of chlorine as the cause of an impairment is the accidental release of chlorine to surface waters such that a fish kill occurs (e.g., as would potentially occur following a water main break).
0720	cyanide	no	yes	a subcategory of the "metals" cause category (0500).
0750	sulfates	no	no	"Sulfate" is a naturally-occurring dissolved constituent of water. At high levels (e.g., greater than 600 mg/l), sulfate in drinking water can have laxative effects on consumers. Levels of sulfate in Iowa surface waters are relatively low; the *Iowa Water Quality Standards* do not contain numeric criteria for sulfate.
0800	other inorganics	no	yes	
0900	nutrients	yes	no	High levels of plant nutrients (primarily, nitrogen and phosphorus) indicate the potential for water quality problems in surface waters that result from excessive production of plant biomass. In lakes, high levels of nutrients can lead to excessive growth of aquatic plants, especially algae (cause 2210), which can interfere with recreational uses of a lake (e.g., boating, swimming, and fishing). Excessive plant growth can also lead to oxygen depletion (cause 1200) of lake water through respiration related to bacterial decomposition of plant material and other organic matter that accumulates on the lake bottom. Severe cases of oxygen depletion can lead to fish kills. High levels of plant nutrients are generally attributed to agricultural nonpoint source pollution and to naturally-occurring conditions, especially the internal nutrient recycling that occurs in the shallow glacial lakes of northern Iowa. Urban point sources and urban runoff, however, also contribute excessive amounts of nutrients to Iowa lakes. Both the origin of high levels of plant nutrients and the nutrient concentrations that can impair aquatic life uses of Iowa's surface waters are poorly understood. Due to the natural fertility of Iowa's soils, levels of plant nutrients were likely relatively high prior to settlement in the mid-19th century (Menzel 1983). Application of fertilizers, however, especially for row crop agriculture, has increased nutrient levels in the state's surface waters over that during presettlement times. The threshold levels at which plant nutrients cause problems in Iowa's surface waters have not been identified. The *Iowa Water Quality Standards* does not contain water quality criteria for either levels of phosphorus or nitrogen related to protection for primary contact recreation (Class A) or for aquatic life (Class B) beneficial uses. DNR, however, has recently been involved with a U.S. EPA effort to develop regionally-based water quality criteria for nutrients for inclusion into state water quality standards.
0910	phosphorus	yes	no	a subcategory of the "nutrients" cause category (0900).
0920	nitrogen	yes	no	a subcategory of the "nutrients" cause category (0900).

Cause Code	Cause Category	Historically Used?	Numeric Criteria?	Description
0930	nitrate	yes	yes	High levels of nitrate in drinking water can lead to infant methemoglobinemia (blue baby syndrome) in infants. To protect against this condition, the U.S. EPA recommends that nitrate levels in water delivered by a public water supply to consumers should not exceed a maximum contaminant level (MCL) of 10 mg/l as nitrogen. The *Iowa Water Quality Standards* identify this 10 mg/l MCL as the water quality criterion to protect surface waters used as a source of a municipal water supply.
1000	pH	yes	yes	"pH" is a measure of the hydrogen ion activity in a water sample. The pH of natural waters is a measure of acid-base equilibrium achieved by the various dissolved compounds, salts, and gases.
1100	siltation	yes	no	Silt delivered to streams and rivers through nonpoint source runoff and/or through streambank erosion can degrade aquatic habitat through covering of coarse substrates and through deposition in pools. Siltation impacts in lakes refer to the erosion of soil particles by precipitation and movement of soil particles in runoff to lake basins where accumulation of silt occurs. The amount of silt delivered to Iowa's lakes, especially man-made lakes, is an important factor in determining the quality of a lake for fishing, swimming and for use as a source of drinking water. Water quality impacts related to high rates of siltation/sedimentation include the delivery of excessive levels of plant nutrients (primarily phosphorus) to lakes, loss of lake volume, loss of surface area, a shortened useful life of the lake, interference with reproduction and growth of certain fish species, and impairments to recreational uses such as boating and fishing. While the delivery and accumulation of sediment is often the most serious problem in man-made lakes, it is generally less of a problem in the natural lakes of north-central and northwest Iowa. Natural lakes generally have smaller watersheds relative to lake surface area, and their watersheds have less topographic relief and lower erosion rates than do lake watersheds in other regions of the state. Man-made lakes with low sedimentation rates tend to have clearer water and more productive fisheries than do lakes receiving large amounts of sediment. The man-made lakes in Iowa with the best water quality have relatively steep sides, small watersheds, and have well-controlled watersheds with a high percentage either in approved soil conservation practices or in non-crop land uses (e.g., pasture or forest) (see Hill 1981). Ideally, a man-made lake in Iowa would have a watershed-to-surface area ratio of approximately 20:1.
1200	organic enrichment / low dissolved oxygen	yes	yes	Impairments due to organic enrichment occur when the amount of organic material delivered to the waterbody exceeds the capacity of the stream to mineralize and assimilate this organic material. In the absence of excessive inputs of oxygen-demanding organic material—as commonly measured through biochemical oxygen demand or "BOD"—streams, rivers, and lakes can process organic material without serious consequences to either chemical water quality or aquatic life. When inputs of organic materials exceed the stream or river's assimilative capacity, however, degradation of water quality will occur. The high rates of bacterial respiration resulting from the excessive amounts of organic material can lower the level of dissolved oxygen below that needed to support aquatic life. Organic enrichment is a common problem in the shallow natural lakes of glacial origin in northcentral Iowa and in shallow man-made impoundments throughout the state. Most of the lakes with impacts due to organic enrichment are the relatively shallow natural lakes in northcentral and northwest Iowa (Figure 3-18). Wind action at shallow lakes in summer tends to circulate lake water at all depths, thus resuspending sediments and nutrients that have settled to the bottom of the lake back into the

Cause Code	Cause Category	Historically Used?	Numeric Criteria?	Description
				water column. The increased levels of nutrients in the water column can increase plant production, usually in the form of algae. Continued resuspension of sediment and nutrients can lead to poor water transparency due to high levels of planktonic algae or due to high concentrations of suspended sediment. The high levels of biological productivity in these lakes can lead to depletion of dissolved oxygen, and fish kills can occur. In temperate climates such as Iowa's, deeper lakes tend to thermally stratify during summer: a relatively cold and stagnant bottom layer of the lake (hypolimnion) becomes isolated from the relatively warm and wind-circulated surface layer (epilimnion) by a middle layer with a temperature gradient (metalimnion or thermocline). As summer progresses, bottom layers of stratified eutrophic lakes tend to become increasingly nutrient-rich and oxygen-poor. The isolation of this bottom layer, however, prevents movement of the poor-quality water to the surface layer of the lake. This isolation tends to improve the water quality of the surface layer of a lake that is used by aquatic life and is used for water-based recreation (e.g., swimming and water skiing). Water quality studies on Iowa lakes have shown that lakes with average depths greater than 13 feet tend to establish and maintain thermal stratification in summer and thus have better water quality than do shallower lakes (Bachmann et al. 1994).
1300	total dissolved solids / salinity / chlorides / sulfates	no	yes	"Total dissolved solids" refers to the concentration of inorganic salts, small amounts of organic material, and other dissolved materials. The principal inorganic anions dissolved in water are carbonates, chlorides, sulfates, and nitrates; the principal cations are calcium, magnesium, sodium, and potassium.
1400	thermal modifications	yes	yes	A manmade deviation from natural seasonal water temperatures such that aquatic biota may be adversely affected. This deviation can include (1) addition of heat above physiological optimum levels of resident aquatic life, (2) the addition of heat such that state water quality standards are violated, or (3) the abrupt cessation of heated effluents during cooler seasons such that aquatic life cannot acclimate to the sudden change in ambient water temperature. Scenarios that can lead to impairments due to "thermal modifications" include the following: (1) discharge of heated effluent from power generating facilities such that ambient water temperatures violate water quality standards and (2) a fish kill caused by summer storm runoff with elevated temperatures due to flow over super-heated impervious surfaces (streets, parking lots, etc) in urban areas.
1500	flow alterations	yes	no	"Flow alterations" refer to human-related deviations from natural seasonal flow regimes that can adversely affect native biota. Flow alterations can result from several activities including water withdrawal for irrigation or water supplies and regulation of stream flow at dams.
1600	habitat alterations (other than flow)	yes	no	"Habitat alterations" refer to manmade changes in the physical habitats of surface waters such that native aquatic biota may be adversely affected. When assessing impairments to Iowa surface waters for Section 305(b) reporting, "habitat alterations" refers primarily to impacts from (1) stream channelization (i.e., channel straightening), (2) removal of riparian vegetation, (3) pasturing of the riparian zone, and/or (4) streambank destabilization. All of these alterations tend to decrease the value of streams and rivers as high quality habitats for use by aquatic life through removal of

Cause Code	Cause Category	Historically Used?	Numeric Criteria?	Description
				important naturally-occurring habitat types (e.g., pools, riffles, sand bars, and snags). In addition, the alteration of aquatic habitat tends to increase the severity of impacts from other sources of pollution on aquatic life, especially the effects of siltation during low-flow periods.
1700	pathogens (pathogen indicators)	yes	yes	"Pathogens," in the context of Section 305(b) reporting, actually refers to concentrations of indicator bacteria (e.g., fecal coliforms or *E. coli*) in surface water samples. Iowa surface waters that support swimming, water skiing, and other primary body contact recreation that involves considerable risk of ingesting surface water are designated for Class A (swimmable) uses in the *Iowa Water Quality Standards*. Levels of fecal coliform bacteria and *E. coli* are monitored by DNR in rivers and lakes designated for Class A uses to *indicate* the health risks to persons using these waters for water-based recreation. Although typically not pathogenic, pathogen indicators such as fecal coliforms and *E. coli* are present in the intestines of warm-blooded animals and are commonly monitored by state environmental agencies to indicate the degree to which surface waters may contain waterborne pathogens (e.g., *Salmonella* and *Shigella*) that can cause disease in humans.
1800	radiation	no	yes	Radiation is the energy emitted spontaneously in the process of decay of unstable atoms of radioisotopes. Sources of radiation include (1) the natural decay of primordial radioisotopes and their decay products and (2) manmade radioisotopes released into the environment beginning with testing and use of the atomic bomb in World War II. Radiation absorbed by plant and animal tissue may cause cellular and molecular damage that can adversely affect aquatic biota.
1900	oil and grease	no	no	"Oil and grease" refers to adverse impacts to public water supplies or aquatic biota due to the presence of oils of petroleum or non-petroleum origin. Scenarios that can lead to impairments due to "oil and grease" include the following: (1) a fish kill caused by a spill of fuel oil and (2) adverse impacts to aquatic life resulting from contact of surface waters with coal tar waste.
2000	taste and odor	no	no	"Taste and odor" refer to the acceptability of drinking water to the user. Most taste and odor problems are related to the presence of phenolic compounds or to the presence of odor-producing organic substances produced by microorganisms or by human and industrial wastes.
2100	suspended solids	yes	no	"Suspended solids" refers to the organic and inorganic particulate matter in the water column. Such material can originate from detritus carried by streams and rivers, atmospheric fallout, biological activity, chemical reactions, and re-suspension from bottom sediments as a result of current, wind/wave action, or movements of bottom-dwelling fish.
2200	noxious aquatic plants**	yes	no	"Noxious aquatic plants" refers to excessive growths of aquatic macrophytes or algae (e.g., bluegreen algae) that are known to be potentially harmful to human health as well as to the health of aquatic biota. Scenarios that can lead to impairments due to "noxious aquatic plants" include the following: dominance of a lakes' phytoplankton community by bluegreen algae.
2210	excessive algal growth / chlorophyll-a	yes	no	"Excessive algal growth" refers to an unusually large concentration of algal organisms (planktonic or benthic) that can adversely affect either the aesthetic quality of the surface water for water-based recreation or the ability of the waterbody to support the expected types and numbers of aquatic biota (see explanation for cause code 2500 (Turbidity) below). Scenarios that can lead to impairments due to "excessive algal growth" include the following: (1) occurrence of a trophic state index value (TSI) for chlorophyll-a of greater than 65 and (2) excessive growth of attached algae (periphyton) on coarse substrates in stream riffle areas.
2400	total toxics	no	no	"Total toxics" refers to the cumulative adverse impact of toxic parameters from multiple groupings on

Cause Code	Cause Category	Historically Used?	Numeric Criteria?	Description
				water quality and aquatic biota.
2500	turbidity	yes	no	In the context of IDNR Section 305(b) reporting, and given the existence of cause code 22120 (excessive algal growth / chlorophyll-a), turbidity refers to non-algal materials suspended in the water column, especially soil particles (silt or clay), that give the water a brown, cloudy appearance. Turbidity-related impairments due to planktonic algae (i.e., "green" water) are included in cause category 2210 (excessive algal growth / chlorophyll-a)). High levels of turbidity may suggest a water quality impairment. High levels of turbidity in surface waters, whether due to suspended algae or non-algal materials, can interfere with the growth and reproduction of sight-feeding game fish (e.g., bluegill (*Lepomis macrochirus*), largemouth bass (*Micropterus salmoides*), and walleye (*Stizostedion vitreum*)), and excessive turbidity reduces the aesthetic appeal of surface waters for primary contact recreation such as swimming and water skiing. The primary sources of high turbidity in Iowa surface waters are (1) the resuspension of bottom sediments in shallow lakes through wind/wave action, (2) delivery of high amounts of silt and clay particles to the surface waters during precipitation runoff from agricultural areas, (3) contributions of silt and clay particles from erosion of stream banks or lake shorelines, or (4) bottom feeding fish (e.g., common carp (*Cyprinus carpio*) and bullheads (*Ameiurus* spp.) that increase turbidity through resuspension of sediment and nutrients during feeding and spawning activities. Surface waters that drain watersheds with certain types of clay-dominated soils may have chronic problems with turbidity regardless of the level of agricultural activity in the watershed. Historical evidence suggests that streams and rivers in the Missouri River drainage of southern and western Iowa had high levels of turbidity even during pre-settlement times. The presence of a turbidity tolerant fish fauna in these streams and rivers supports this assertion. Iowa surface waters with water quality problems due to high levels of turbidity are generally of three types: (1) man-made lakes in southern Iowa with relatively large watersheds having high rates of soil erosion (e.g., Bob White, Rock Creek, and Manteno lakes) and (2) shallow natural lakes of northern Iowa with high turbidities related to resuspension of silt and nutrients by bottom-feeding fish and/or wind/wave action (e.g., Ingham, Lower Gar, and North Twin lakes) and (3) streams and rivers with chronically high turbidities that may contribute to reduced aquatic diversity.
2600	exotic species	yes	no	For purposes of Section 305(B) water quality assessments in Iowa, "exotic species" refers to a form "introduced into an area or ecosystem outside its historic or native geographic range; this includes both foreign (i.e., exotic) and transplanted species, and is used synonymously with "alien," "nonnative," and "introduced." Examples of exotic species in Iowa include common carp, grass carp, and the plant purple loosestrife. Scenarios that can lead to impairments due to "exotic species" include the following: (1) re-suspension of sediment and nutrients in a shallow lake by a large population of common carp; (2) elimination of aquatic macrophytes from the littoral zone of a lake by grass carp such that the lake shifts from a clear-water to a phytoplankton-dominated (green) lake; and (3) the replacement of native wetland vegetation with purple loosestrife, thus degrading the quality of the wetland.

* aldrin, dieldrin, chlordane, alpha-endosulfan, beta-endosulfan, endoslufan sulfate, endrin, endrin aldehyde, heptachlor, heptachlor epoxide, alpha BHC, beta BHC, gamma-BHC (lindane), delta-BHC, and toxaphene.

** Bluegreen algae is considered a "noxious aquatic plant" by IDNR