Methodology for developing Iowa's 2002 Section 303(d) list of Impaired Waters

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Introduction

Development of a state Section 303(d) list includes 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) preparation of the state's biennial Section 305(b) report by comparing water quality information to water quality criteria 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") in the Section 305(b) report to the State's Section 303(d) list. The 303(d) list is thus a comprehensive public accounting of all impaired waterbodies. An impaired waterbody is one that does not meet water quality standards including designated uses, numeric criteria, narrative criteria, and/or anti-degradation requirements as defined in 40 CFR 131. The violations of water quality standards might be due to an individual pollutant, multiple pollutants, "pollution," or an unknown cause of impairment.

The Water 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 antidegradation 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 these impaired waterbodies is described in this document. 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).

According to current regulations, the list of impaired waterbodies must be submitted to EPA by April 1 of every even numbered year. Due to developments of a new TMDL rule in 2000, the 303(d) list was not required in 2000, but would be due April 1, 2002. Controversy over the proposed rule resulted in EPA deferring the implementation of the rule, and extended the due date for the 2002 list until October 1, 2002. This list includes waterbodies impaired by "pollutants" such as nitrate and fecal coliform bacteria, and by "pollution" such as hydromodification and habitat alteration. 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/pollution is known and regardless of whether the pollutant/pollution

source(s) can be legally controlled or acted upon by the State of Iowa. This methodology is consistent with that history.

The Iowa Section 303(d) listing process is based on, and begins with, the same guidance and data assessment procedures developed for the Iowa Section 305(b) report. Therefore, the 305(b) report and the 303(d) list are fundamentally consistent, with some minor differences that can be explained by the different purposes and perspectives of the two documents. That is, the 305(b) report attempts to characterize water quality statewide. Thus, the 305(b) report identifies 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) list, on the other hand, represents 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, that are appropriate for Section 303(d) listing.

Iowa's 303(d) listing methodology has changed significantly since the 1998 listing period. This is due to proposed changes in the federal TMDL regulations as well as the enactment of credible data legislation in 2000 by the Iowa General Assembly (Attachment 1). Where inconsistencies exist between requirements of the federal TMDL regulations and Iowa's credible data law, IDNR has noted the inconsistency and has made this methodology consistent with Iowa State law. Incorporation of requirements of the credible data law will have significant impacts on Iowa's 2002 Section 303(d) list. For example, the use of "best professional judgement," whether by IDNR staff or others, does not meet the test of "credible data" and is thus not suitable for adding waters to Iowa's Section 303(d) list. According to the credible data law, however, this type of information can, and will, be used for Section 305(b) reporting. Also, waterbodies that were included on Iowa's previous ("1998") Section 303(d) list solely on the basis of "best professional judgement" will not be included on Iowa's Section 303(d) list for 2002. These waterbodies will be addressed through requirements of the EPA consent decree for purposes of TMDL development.

Waterbodies where the assessment indicates a potential impairment, but lack credible data, will not be included on the 2002 303(d) list, but will be placed on the list of "waters in need of further investigation" as provided for by Iowa's "credible data" legislation. This list will contain three groups of waterbodies: Group 1 will include the publicly-owned lakes in Iowa that were (1) added to Iowa's 1998 list primarily on the basis of best professional judgement, (2) are currently being monitored as part of lake assessment programs, and (3) that were not assessed as "impaired" for the 2002 Section 305(b) report and added to the 2002 Section 303(d) list. Group 2 will include the publicly-owned wetlands that were placed on the 1998 list solely on the basis of best professional judgement and for which the appropriate monitoring

programs and assessment criteria have yet to be developed. Group 3 will include river and stream segments where monitoring has indicated a potential impairment, but the data is either older than five years, or does not meet data quantity or quality requirements. In these cases, follow-up monitoring is needed to verify that an impairment exists before the waterbody is placed on the 303(d) list.

This methodology is based primarily on recommendations in U.S. EPA's 1997 guidelines for Section 305(b) reporting and the existing (1992) U.S. EPA regulations regarding Section 303(d) listing. This methodology does not, however, attempt to incorporate U.S. EPA's recently-released "Integrated Assessment and Listing Methodology" or changes proposed in the forthcoming "Watershed Rule" being proposed by EPA. IDNR feels that this new approach to Section 305(b) reporting and Section 303(d) listing was hastily conceived, is currently untested, and is not yet supported by the national Section 305(b) database (U.S. EPA's *Assessment Database* (ADB)). A recent conference call indicated that approximately only one-third of the states intend to use the "integrated" methodology for their 2002 Section 303(d) lists; one-third intend to use some type of hybrid between the previous and "integrated" approaches, and one-third (including IDNR) intend to continue to provide a separate Section 305(b) report and Section 303(d) list for 2002 as in previous years. IDNR will continue to follow developments in use of "integrated" reporting and listing and will consider incorporation of the "integrated" approach for future reporting/listing cycles. Also, this methodology does not directly include recommendations from U.S. EPA's "Consolidated Assessment and Listing Methodology" (CALM). This document remained in draft form through most of the 2002 Section 305(b) reporting and Section 303(d) listing cycles. IDNR feels that guidelines in the finalized CALM report will improve the ability of states to more accurately assess the degree to which water quality goals are being met.

Methodology

The listing process

Development of the 303(d) list includes the following basic steps:

- Assemble all existing and readily available water quality-related data and information to develop the Section 305(b) report;
- 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;
- Prepare the Section 305(b) report;
- Identify impairments that are based on water quality-related data and information that meet requirements of Iowa's credible data law;
- Prepare the draft Section 303(d) list and list of waters in need of further investigation;
- Prioritize the waterbodies for TMDL development (high, medium, and low);
- Provide the draft Section 303(d) list to the public for review and comment;
- Revise and finalize the Section 303(d) list 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 July 1992 TMDL rule, sources of all 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 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 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.

The majority of information used by IDNR to develop the Section 303(d) list of impaired waters is 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 fixed station water quality monitoring networks conducted by IDNR and other agencies;
- 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;
- Data from the IDNR-sponsored lake monitoring 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.

For most water quality parameters, data for the 305(b) report are limited to the current biennial period: the two federal fiscal years prior to the year in which the report is due. Data from the previous three federal fiscal years are used to supplement data from the current biennial period for water quality parameters with low collection frequency (e.g., toxic metals). While data older than five years are used for developing "evaluated" (low confidence) assessments for purposes of Section 305(b) reporting, these data are generally not used for Section 303(d) listing in Iowa. These sources of water quality data are discussed in more detail below.

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

  The IDNR, in cooperation with the University of Iowa Hygienic Laboratory (UHL), has conducted routine ambient monitoring of river water quality since the early 1980s. Due to resource constraints, the majority of this monitoring has been 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 79 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 79 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. Sixteen sites in the IDNR/UHL network are sampled annually for benthic macroinvertebrates. A methodology for using these macroinvertebrate data to assess support of aquatic life uses has not yet been developed. IDNR plans to investigate methods of using these data for purposes of Section 305(b) water quality assessments.

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. I.E.S. Utilities, Inc. sponsored monitoring on the Cedar River near Palo, Iowa, from 1971 to 1999 to determine potential impacts of its nuclear-powered electrical generating facility. 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.

Currently, USGS conducts routine water quality monitoring at two fixed stations in Iowa: the Mississippi River at Clinton and the Missouri River at Omaha. Both of these sites are part 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). 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.

- **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. Historically, data from these monitoring networks were available nationwide through the U.S. EPA's water quality database "STORET." The old STORET system, however, was terminated in 1999, and the "new" STORET system has, thus far, been implemented in only a few states (including Iowa). Thus, data for border waters (e.g., Mississippi River) or for waters flowing into Iowa (e.g., Shell Rock River) are obtained primarily through personal contacts with water quality monitoring staff of the adjacent states. Section 305(b) water quality assessment criteria are then applied to the data 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**

  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, 48 sites in three watersheds have been sampled. 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.

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

  Data from statewide lake surveys completed in the 1980s and 1990s by Iowa State University have served as a basis for past assessments of lake water quality. Beginning in 2000, 132 lakes throughout Iowa are now 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 115 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. In addition, concentrations of pesticides and metals in both water and bottom sediments 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, 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*. During 2001, thirty-five beaches were monitored on a weekly basis with four monitored on a more frequent, daily basis.

- **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 (RAFT) 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'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 and 4 toxic 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 10-year period 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 have been investigated by IDNR staff from either the Fisheries Bureau or Compliance & Enforcement Bureau. Information from 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 violations by public water supplies in the state. 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, that can influence their water treatment processes.

- **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, ambient” 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 these 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 1997-2000 from the U.S. Geological Survey's National Water Quality Assessment (NAWQA) Program. Recent unpublished reports produced by IDNR include investigations of the impact of a coal tar deposit on a small stream in southeast Iowa, the impact of groundwater contamination on aquatic life of Rock Creek near Clinton in eastern Iowa, and levels of nutrients and suspended sediments in the Maquoketa River and selected tributaries in northeastern Iowa. 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. Due to the historical lack of routine water quality monitoring at Iowa lakes, Section 305(b) water quality assessments of Iowa's lakes have been based primarily on observations of biologists in the IDNR Fisheries Bureau. 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 2000 by the IDNR. This program provides training, equipment and supplies to volunteers for monitoring streams throughout Iowa. There are currently two levels of training available for volunteers. Level One training includes 1) a simple habitat assessment, 2) chemical tests using field kits for nitrate, nitrite, phosphorus, pH, and dissolved oxygen along with manual measurements of stream flow, and 3) biological monitoring - noting the presence or absence of various macroinvertebrates. Level Two training includes testing methods for bacteria and chloride along with modules for standing waters (lakes, ponds, wetlands), soil, and quantitative assessment of macroinvertebrates. Guidance on preparation of quality assurance/project plans is also provided. Level Three training will possibly be available in 2003.

- **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 are evaluated by the IDNR on a case-by-case basis.

Developing Iowa's Section 303(d) list

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 is taken from Iowa's Section 305(b) report. 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 Section 303(d) listing. The process of determining whether or not data from the above data sources are appropriate for placing waterbodies on Iowa's Section 303(d) list is described below.

Data *quality* considerations

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 defines data quality objectives for the state's Section 303(d) listings (Attachment 1).

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) reports 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 for any water of the state.

"*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.

Data *quantity* considerations

For purposes of Section 305(b) reporting, the existing and readily available water quality data described above are used to make two types of water quality assessments. As described in guidelines for Section 305(b) reporting (U.S. EPA 1997), **evaluated assessments** are based on water quality information other

than current site-specific data. 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 assessments** are based on current (five years old or less) site-specific information that is believed to accurately portray water quality conditions. For many assessments, the identification as “monitored” or “evaluated” depends on the quantity of data available for the assessment. In terms of the ability of Section 305(b) assessments to characterize current water quality conditions, IDNR considers “evaluated assessments” as having relatively low confidence while “monitored” assessments are of relatively high confidence. IDNR considers “monitored” assessments as sufficiently accurate to be appropriate for both Section 305(b) reporting and Section 303(d) listing. The lower confidence “evaluated” assessments, however, are viewed as appropriate only for Section 305(b) reporting.

For purposes of Section 303(d) listing in Iowa, data quantity issues are addressed through IDNR guidelines for water quality assessments as described in the biennial Section 305(b) reports. 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. The current version of Iowa’s Section 305(b) data completeness guidelines is presented in Table 5. 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.

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

IDNR considers all existing and readily available water quality-related data and information for purposes of Section 305(b) reporting and Section 303(d) listing. 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 Section 305(b) assessments. 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 that are actually impaired to the state’s Section 303(d) list. Placing waters on the state’s Section 303(d) list on the basis of inaccurate and/or incomplete data increases the risk that resources, including staff time and monitoring dollars, will be used unwisely. Examples of water quality information that typically would not be considered appropriate 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 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 Section 303(d) waters, 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 Section 303(d) impairment actually exists and (2) 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 (end of the federal fiscal year prior to the April 1 deadline) are presumed under state law to be "not credible" unless IDNR identifies compelling reasons as to why the 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 is consistent with U.S. EPA's recommendation that data older than five years should not be used to make the type of Section 305(b) assessment ("monitored assessment") that is believed to accurately portray site-specific water quality conditions. Data older than five years are used for Section 305(b) reporting in Iowa; 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.

- **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 5). These guidelines identify the numbers of samples needed for Section 305(b) assessments that can support Section 303(d) listings (i.e., a Section 305(b) *monitored* assessment). 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. Information on preparing these plans, along with requirements for complying with Iowa's "credible data" law, are provided as part of training in the DNR-sponsored IOWATER volunteer water quality monitoring program.

- **Results of habitat assessment:** Although detailed information on the quality of aquatic habitats is collected as part of the IDNR/UHL biocriteria project, 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.

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 Section 303(d) listing (Table 5). The following are instances where overwhelming evidence of an impairment justifies addition of an Iowa waterbody to Iowa's 2002 Section 303(d) list.

- 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 impair one or more designated uses.

- Trophic State Index (Carlson 1977, 1991) values for total phosphorus, chlorophyll-a, or secchi depth that are based on less than three years of data but are at least 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).

List of waters in need of further investigation

Although not used for Section 303(d) listing, the above types of water-related information are used for Section 305(b) reporting 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 2002 list of waters in need of further investigation will consist of three groups:

Group 1 includes the publicly-owned lakes in Iowa that were added to Iowa's 1998 list primarily on the basis of best professional judgement and that are currently being monitored as part of lake assessment programs. These programs include (1) the five-year IDNR/Iowa State University study of water quality at 132 Iowa lakes, (2) the fish population studies of the IDNR Fisheries Bureau, and (3) other special studies of lake water quality. These monitoring programs are designed to generate sufficient credible data that can be used to demonstrate whether beneficial uses (e.g., aquatic life use) are supported and whether the lake should be added to Iowa's future Section 303(d) lists.

Group 2 includes the publicly-owned wetlands that were placed on the 1998 list solely on the basis of best professional judgement and for which the appropriate monitoring programs and assessment criteria have yet to be developed. These wetlands were added to Iowa's 1998 Section 303(d) list without adequate consideration of data quality. That is, no water quality monitoring is, or has been, conducted on Iowa's wetlands. In addition, the *Iowa Water Quality Standards* do not contain criteria that are useful for determining wetland quality. Thus, IDNR feels that the assessments that were used to place these wetlands on Iowa's 1998 Section 303(d) list were flawed, and these wetlands should be removed from the 303(d) list until more accurate assessments can be completed. The need for this action is supported by follow-up conversations

with several biologists that have indicated that they did not fully understand the Section 305(b) assessment process and thus may have provided an incorrect assessment of wetland water quality. IDNR recognizes the need to develop methods for assessing the quality of Iowa's wetlands. Thus, IDNR plans to conduct the following activities related to assessing wetland quality: (1) evaluate and report on the ability of existing functional models to provide information on the relative quality of individual (specific) wetlands; (2) evaluate and report on the methods used by other states to assess whether wetlands meet water quality standards and the relevance of these methods to assessing Iowa's wetlands.

Group 3 includes those stream and river segments where monitoring indicates a potential impairment, but the data does not show overwhelming evidence of an impairment, is older than five years, and/or the data does not meet the data quantity or quality restrictions as defined in the section entitled "Developing Iowa's Section 303(d) list." In these cases, follow-up monitoring is needed to verify that the impairment exists before the water can be placed on the 303(d) list.

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 1 through 5). In general, the U.S. EPA (1997) 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." For toxic parameters (for example, 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) 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 (see Table 4). IDNR has modified U.S. EPA's (1997) Section 305(b) guidelines for assessing drinking water uses with data for nitrate in surface water sources. 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 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 developed for the 1998-1999 Section 305(b) reporting cycle and 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. 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, average water quality values from a three to five-year period will be compared to existing state water quality standards to determine the existence of an impairment.

  Because only two years of lake data from this program were available during preparation of the 2002 Section 303(d) list, this information was not sufficient for adding lakes to Iowa's 2002 Section 303(d) list. Carlson's (1977, 1991) trophic state index, however, was used to identify Iowa lakes that demonstrate overwhelming evidence of an impairment (see Attachment 3). Thus, based on occurrence of this overwhelming evidence, these lakes were added to the 2002 Section 303(d) list. For future Section 303(d) lists, sufficient

data will likely be available for a more comprehensive assessment of lake water quality and for adding lakes to Iowa's list.

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

  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) 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 the 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: (1) the geometric mean of at least ten samples collected preferably during one or both recreational seasons (April 1 to

October 31) of the current biennial period 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 (1997), 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 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).

Lake beaches: the geometric mean of at least five samples collected over a 30-day period should not exceed the Iowa water quality criterion of 200 organisms per 100 ml for fecal coliform bacteria. In addition, no swimming area closures can have been issued during the two-year assessment period. According to the IDNR beach closing policy used during the 2000 and 2001 summer seasons, warnings that swimming was not recommended were posted at beaches where single sample maximum values for any one of three indicator bacteria (fecal coliforms, *E. coli*, or enterococci) were exceeded. Because warnings may have been based on indicator bacteria for which state water quality criteria do not exist (i.e., *E. coli* and enterococci), and because this portion of IDNR's beach closure policy was not entirely consistent with U.S. EPA's Section 305(b) assessment guidelines, warnings posted at Iowa swimming beaches, regardless of the length of time posted, were not used in developing Section 305(b) assessments or Section 303(d) listings. Due to sampling frequency, the use of single-sample maximum values to assess beaches, however, is problematic. With less than 10 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 4 and 5.

- **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 4). Due to the variability in fish contaminant levels, 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 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 indicates an impairment of the aquatic life uses. The "once in three-year" frequency of criteria violation 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. Due to the absence of an ongoing source of a pollutant, TMDLs will not be developed for kills caused by a one-time illegal or unauthorized release of manure or other toxic substance. Impacts from this type of fish kill are addressed through IDNR's enforcement procedures. Fish kills attributed to authorized discharges (i.e., a discharge meeting permit limits) are considered for Section 303(d) listing as the existing, required pollution control measures are not adequate to address this impairment.

- **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 4. Impairments related to the quality of finished (treated) water will be determined through review of annual IDNR public drinking water program compliance reports. 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 4 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 2002 Section 303(d) list

According to U.S. EPA guidelines (40 CFR 130.7), "impaired" waterbodies not included on a state's 303(d) list must demonstrate "good cause" for their exclusion. "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 5).
- **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.

Each waterbody that is not included on the 303(d) list will be accompanied by documentation that describes the rationale for not being included on the list. This rationale will be incorporated into waterbody-specific information in the U.S. EPA's Section 305(b) Assessment Database.

In addition, Iowa's credible data law states, in part, that (1) credible data shall be used when determining whether any water of the state is to be placed on or removed from any Section 303(d) list and (2) the data quality for removal of a water from the state Section 303(d) list shall be the same as the data quality for adding that water to the list. These provisions in state law have the following consequences for this methodology and Iowa's 2002 Section 303(d) list.

- The placement of all waterbodies on Iowa's 2002 and subsequent Section 303(d) lists must be supported by credible data. If the original assessment of a water quality as "impaired" was made without credible data, the likelihood of flaws in the assessment is increased; thus, the waterbody will not be included on the 2002 303(d) list. Based on the existing non-credible information, the waterbody would then be placed on the state list of waters in need of further investigation as previously described (see above section on *List of Waters in Need of Further Investigation*).

- If a waterbody was added to Iowa's 1998 303(d) list without the use of credible data, credible data are not required for omitting that waterbody from the 2002 303(d) list.

Waterbodies added to the list with credible data will remain on the list 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.

Placement of waters within the 303(d) list categories

In their July 2000 TMDL rule, U.S. EPA proposed that the section 303(d) lists include all impaired waterbodies, sorted into four parts. While the implementation of this rule has been deferred, and will most likely not take effect in its current form, the IDNR believes the multi-part list described in the rule has merit. The forthcoming "Watershed Rule", which will replace the proposed July 2000 rule, also emphasizes separating the waterbodies into different categories based on assessments, but only the waters needing a TMDL developed would be included on the 303(d) list. The IDNR has modified the four part list proposed in July 2000 to include a fifth section that was not in EPA's July 2000 rule. Part One of the list would include impaired waterbodies for which TMDLs would be required to be established within 10-15 years. Part Two of the list would include waterbodies impaired by pollution that is not caused by a pollutant. TMDLs would not be required for these waterbodies. Part Three of the list would include waterbodies for which TMDLs had been established but water quality standards not yet attained. Part Four would include waterbodies for which technology-based controls or other enforceable controls would attain water quality standards by the next listing cycle. Part Five of the list includes waterbodies that are biologically impaired, but no source or cause of impairment has been identified. These five parts are further explained below.

Part One waterbodies: Waterbodies impaired by one or more pollutant(s).

TMDL development is required for waterbodies on Part One of the list. A "pollutant," as defined in 40 CFR Section 130.2, could be any of the following: dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock,

sand, cellar dirt; also, sediments, pathogens, nutrients, metals, low dissolved oxygen, temperature, pH, pesticides, mercury, organics, ammonia, and industrial, municipal, and agricultural waste discharged into water.

For example, the designated drinking water uses of the reach of the Raccoon River in Polk and Dallas counties is impaired by nitrate. During the Section 305(b) assessment period of October 1999 to September 2001, 53 of 187 samples collected from the Raccoon River by the Des Moines Water Works exceeded the nitrate maximum contaminant level (MCL) of 10 mg/l. Based on the percentage of samples that exceeded the MCL (28%), this river reach was assessed as "not supporting" its designated Class C use as a source of water for a potable water supply. Thus, this river reach was added to Iowa's 2002 Section 303(d) list.

Part Two waterbodies: Waterbodies impaired by "pollution," but not impaired by one or more "pollutant."

A TMDL is not required for waterbodies in Part Two. "Pollution" is defined in 40 CFR Section 130.2 as "the man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of the water." Examples of "pollution" include habitat alterations, impaired biologic communities and flow alterations.

For example, a number of wetlands in the floodplain of the Missouri River in western Iowa have been assessed as "impaired" due to flow alterations of the Missouri River (for example, Blencoe Lake in Monona County). The flow alterations that are believed to impair these wetlands resulted from development of the Missouri River for commercial navigation uses in the mid-Twentieth Century. Navigation-related alterations to the river, including channelization of the river and control of river flow at Gavins Point Dam—resulted in degradation of the river bed such that the water table of the floodplain was also lowered. This lowering tended to de-water these riparian wetlands and has led to water level problems that have adversely affect the quality of wetland habitat.

Part Three waterbodies: Waterbodies for which EPA has approved or established a TMDL and water quality standards have not yet been attained.

For example, Rock Creek in Clinton County has a history of high levels of ammonia due to discharge of groundwater contaminated by a now-abandoned fertilizer plant (PCS Nitrogen). In addition, the high nutrient levels in this stream were believed to contribute to nuisance blooms of algae in an important backwater formed at the confluence of Rock

Creek with the Upper Mississippi River (Shrickers Slough). Thus, due to its failure to meet the designated aquatic life uses, and due to its contribution to nuisance algal blooms, this stream was added to Iowa's 1998 Section 303(d) list. Iowa DNR prepared a TMDL for ammonia and nitrate-nitrite in Rock Creek in 2000, which was approved by U.S. EPA Region VII in January 2001. As part of this TMDL, the following corrective measures have been taken. Beginning in 1999, hybrid poplar trees were planted along an unnamed tributary of Rock Creek known as "Ammonia Creek" that flows through the property and delivers high levels of ammonia to Rock Creek. These trees have dense root masses that penetrate deep into the soil profile; research has demonstrated the ability of these trees to remove nitrogen compounds from contaminated groundwater. Also, a containment trench with a sump system was constructed in April 1999 to collect and remove the top ten feet of ammonia-rich groundwater feeding Ammonia Creek. There are also plans to convert approximately 120 acres of cropland to native prairie plantings. Through the cooperative efforts of DNR, a private landowner, and PCS Nitrogen, an 80-acre wetland was created in early 2000 through the impoundment of Rock Creek downstream from the abandoned plant. This wetland is expected to help process and assimilate high levels of nitrogen compounds leaving the site and improve the water quality in lower Rock Creek and in Shrickers Slough. Water quality monitoring of Rock Creek is being conducted by the IDNR and PCS Nitrogen. Water quality monitoring of Shrickers Slough and Rock Creek is continuing as part of the Upper Mississippi River Long-Term Resources Monitoring Program in order to determine the effectiveness of these corrective measures and to determine whether Rock Creek now meets its water quality standards for aquatic life uses.

Part Four waterbodies: Waterbodies that are impaired, for which the state demonstrates that water quality standards will be attained prior to the submission of the State's next 303(d) list as a result of implementation of technology-based effluent limitations required by the CWA or other controls enforceable by State law or regulation.

TMDLs are not required for waterbodies included in Part Four of the list. However, waterbodies included in Part Four that do not achieve water quality standards by the next listing period may be moved to Part One and a TMDL required, unless the failure to obtain water quality standards is due to noncompliance with a NPDES permit. The listing of waterbodies on Part 4 of the 303(d) list is in conflict with State's credible data law (2001 Iowa Code, Section 455B.194, subsection 1). Therefore, no waterbodies will be placed on Part 4 of Iowa's list.

Part Five waterbodies: Biologically impaired waterbodies with no identified cause of impairment.

These biological impairments are typically identified through (1) biological monitoring of streams and rivers conducted by the IDNR Water Quality Bureau in cooperation with UHL and (2) standardized assessments of lake recreational fisheries as conducted by the IDNR Fisheries Bureau. Depending on consistency with Iowa's "credible data" law, other types of biological monitoring may result in identification of a biological impairment without identifying a cause of the impairment. Identification of the cause(s) of impairment will precede movement of these waters to Parts One and Two of the list. Prior to submittal of Iowa's next Section 303(d) list, data collection and analysis will be performed in an attempt to determine a cause of impairment.

For example as part of the 1998 Section 305(b) report, the results from three November 1990 DNR stream use assessments on Camp Creek in Polk County were used to assess support of the Class B(LR) aquatic life uses as "impaired" due to (1) very low diversity of the fish communities at the three locations sampled and (2) presence of less than a majority of the expected fish taxa for streams in this subecoregion. Thus, this stream reach was added to Iowa's 1998 Section 303(d) list. Given the average to above average aquatic habitats present in this stream reach, the relatively poor results of biological sampling suggest a potential, but as yet unknown, water quality problem. Before a TMDL can be developed, follow-up monitoring is needed to update this assessment, to better determine the status of the aquatic communities of this stream, and to more accurately determine the causes and sources of any impairments of the Class B(LR) uses.

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 identified as "impaired" in IDNR's Part 1 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 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), Illinois and Wisconsin (Mississippi River)). IDNR will also provide its draft 303(d) list to TMDL coordinators of these states and to the water quality project coordinator of 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 Water 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 Water 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 was provided to the public for review and comment. The draft methodology was available in hard copy by contacting the IDNR, the draft was also available at the IDNR Total Maximum Daily Load Program website at http://www.state.ia.us/dnr/organiza/epd/wtresrce/303dnotc. Comments on the draft methodology were received for a period of over sixty days. IDNR will continue to accept and consider comments in order to approve future versions of this methodology.

References

GAO. 2002. Water quality: inconsistent state approaches complicate Nation's efforts to identify its most polluted waters. Report GAO-02-186. United States General Accounting Office. 40 pp.

Smith, E.P., K. Ye, C. Hughes, and L. Shabman. 2001. Statistical assessment of violations of water quality standards under Section 303(d) of the Clean Water Act. Environmental Science & Technology 35:606-612.

U.S. EPA. 1994. Water Quality Standards Handbook: Second Edition. Report EPA-823-B-94-005a. Water Quality Standards Branch, Office of Science and Technology, U.S. Environmental Protection Agency, 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.

Table 1. Summary of Iowa water quality criteria used to make assessments of support of beneficial designated uses of Iowa surface waters for purposes of Section 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.state.ia.us/dnr/organiza/epd/wtresrce/wquality/index.htm).

	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 1990) 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 1 (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 1 (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 2. 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 3. Methods for determining support of **AQUATIC LIFE USES** for general use and designated use surface waters in Iowa for Section 305(b) reporting.

		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 biennial 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.	Criteria for conventional pollutants exceeded in 11-25% of samples.	> one violation of acute / chronic criteria if samples collected quarterly or more often; criteria for conventionals exceeded in > 25% of samples.
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

Table 4. 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.

		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 is 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 4. (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 15% of samples violate the MCL for nitrate. Or, trend analysis shows a significant increase in contaminant levels.*	From 15-25% 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

*Considered as candidates for Section 303(d) listing.

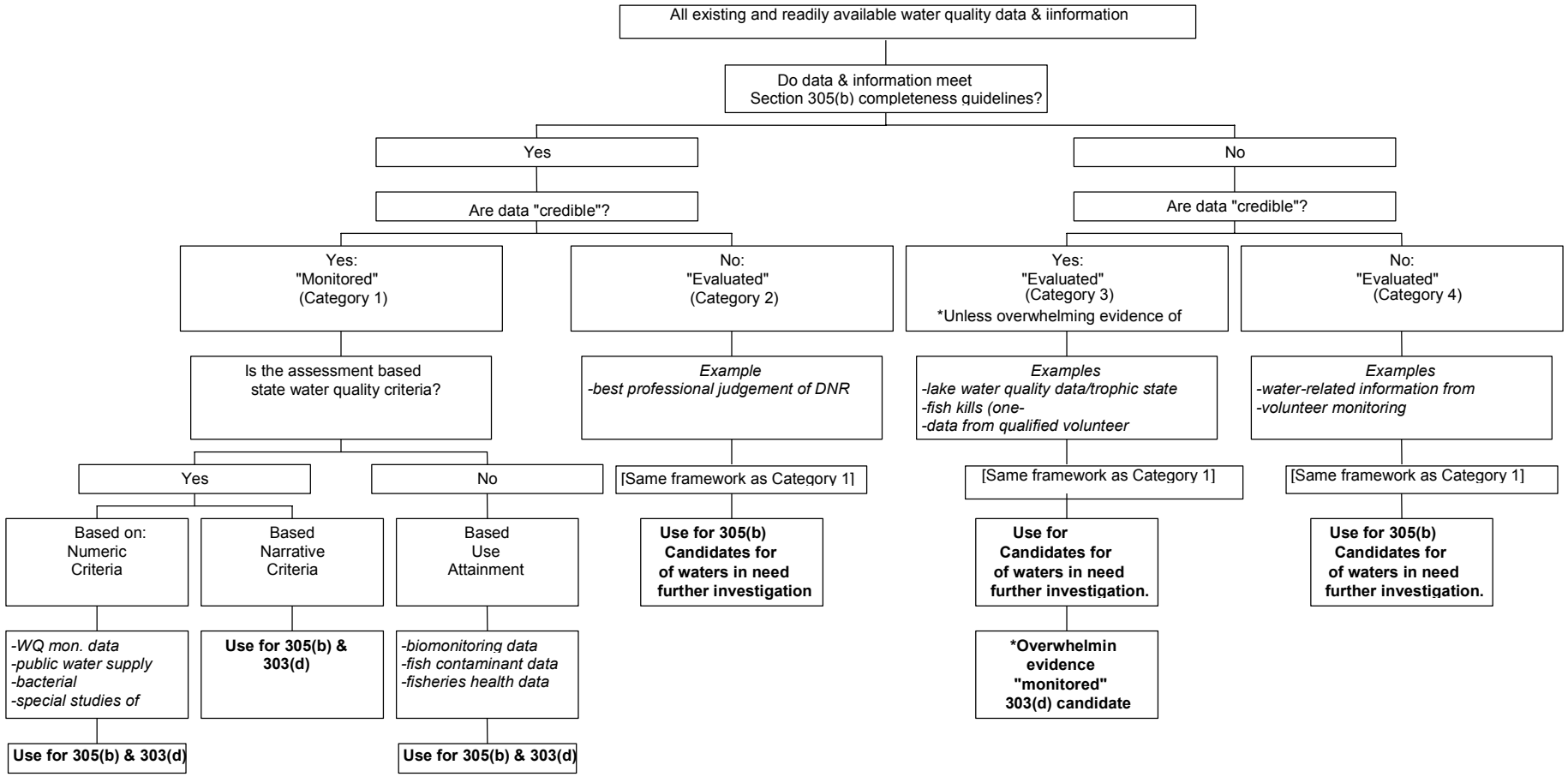
Table 5. Data completeness guidelines for using results of routine ambient monitoring to make "monitored" assessments of beneficial uses for Section 305(b) assessments that are used for Section 303(d) listing in Iowa.*

DESIGNATED BENEFICIAL 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 the most recent 3 complete federal fiscal years (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 one or both years of the current biennial period (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.
	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
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 current biennial period; 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 the current biennial period.
Drinking Water	Data for levels of toxics from waterbodies designated for drinking water (Class C) uses.	Data collected quarterly or more frequently during the most recent 3 compete federal fiscal years (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 the current biennial period (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 Section 305(b) reporting; these "evaluated" assessments, however, are of generally low confidence and are not appropriate for Section 303(d) listing.

**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 2002 Section 305(b) report and



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 the general assembly not later than January 15, 2001.

Sec. 14. **APPLICABILITY OF SECTION 303(d) LISTS**. This Act takes effect July 1, 2000. However, any requirements under

this Act which apply to a section 303(d) list shall not apply for the section 303(d) list for the year 2000, but any requirements shall take effect for all section 303(d) lists created after the year 2000 list.

MARY E. KRAMER
President of the Senate

BRENT SIEGRIST
Speaker of the House

I hereby certify that this bill originated in the Senate and is known as Senate File 2371, Seventy-eighth General Assembly.

MICHAEL E. MARSHALL
Secretary of the Senate

Approved , 2000

THOMAS J. VILSACK
Governor

Attachment 2.

Guidelines for Determining Section 305(b) Aquatic Life Use Support (ALUS)
Using 1997 – 2001 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 current (1999-2000) Section 305(b) reporting cycle (see also Part III, Chapter Two (*Assessment Methodology*) of this report). 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 1990, 1996); definitions of designated uses [e.g., Class B(WW), Class B(LR), and Class B(CW)] are presented in Table 2-3 of this report as well as in the *Iowa Water Quality Standards* (IAC 1990, 1996).

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

Benthic macroinvertebrate and fish sampling data from 1997 – 2001 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 ≤ 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 305b 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 the 2002 305(b) report using 1997-2001 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 1997b), *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 Water Resources 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 flood plain land uses, buffer strip width and vegetation, channel

sinuosity and morphometry, bank conditions, sediment composition, stream flow, and instream habitat.

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.

Attachment 3

THE USE OF THE TROPHIC STATE INDEX TO IDENTIFY WATER QUALITY IMPAIRMENTS IN IOWA LAKES FOR THE 2002 SECTION 305(b) REPORT AND SECTION 303(d) LIST

Iowa DNR

Water Quality Bureau

December 2002

INTRODUCTION

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 the 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, and turbidity). Previous assessments based on best professional judgement have been supplemented with lake monitoring data as this information has been available (e.g., Bachmann et al. 1982, Bachmann et al. 1994). Previous statewide surveys of Iowa lakes (e.g., Bachmann et al. 1980, Bachmann et al. 1994), however, have involved monitoring in summers of only one year at approximately 10-year intervals. 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. 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.

The methodology for Iowa's 2002 Section 303(d) list requires that the combined credible data from at least three years of monitoring from this type of lake survey be used to identify water quality impairments appropriate for addition to Iowa's list. During preparation of Iowa's 2002 list, however, data from only two years of the ISU lake study—2000 and 2001—were available and appropriate for Section 305(b) reporting and/or Section 303(d) listing. In order to make use of these data, and in order to maintain some continuity with previous Section 303(d) listings for Iowa lakes, a conservative approach was used to identify Iowa lakes as candidates for Section 303(d) listing. This approach is based on use of relatively high TSI thresholds to (1) account for the lack of sufficient data to accurately characterize current lake quality and (2) provide a reasonable level of confidence that the lakes are, in fact, impaired. In other words, the goal was to set the TSI thresholds sufficiently high such that the group of candidate lakes for Section 303(d) listing in 2002 would likely also be added to Iowa's subsequent Section 303(d) lists regardless of the variability expected in results of subsequent lake monitoring. Results from ongoing lake monitoring in 2002, 2003, and 2004 will provide the data needed to better determine the existence of any impairments at these lakes and to either sufficiently justify their addition to the state's Section 303(d) list or to move them to the category of "fully supported / threatened" lakes.

TROPHIC STATE and the TROPHIC STATE INDEX

For purposes of developing water quality assessments for the 2002 Section 305(b) reporting cycle, Carlson's (1977, 1984, 1991) "trophic state index" (TSI) was used with data generated for 130 Iowa lakes as part of the Iowa State University surveys in 2000 and 2001 (Downing and Ramstack 2001, 2002).

"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 to 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 1 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).

ASSESSMENT RATIONALE

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.

Thus, the use of Carlson's TSI for assessing support of Class A (primary contact recreation) uses at Iowa lakes is based primarily on the response variables of chlorophyll-a and secchi depth. TSI values for secchi depth will be used as surrogate measures not only for chlorophyll-a but for turbidity caused by other organic and inorganic materials suspended in the water column that can be interpreted as an "aesthetically objectionable" condition. Use of TSI values for secchi depth, along with data for inorganic suspended solids from Downing and Ramstack (2000, 2001), will allow identification of problems at several of Iowa's natural and manmade lakes that suffer from high turbidities caused re-suspension of sediment due to either wind/wave action, bottom-feeding fish (e.g., common carp), and/or sediment delivered to the lake in runoff events. While using secchi depth as a surrogate measure of non-algal turbidity deviates from the typical interpretation of "trophic state index," this usage is appropriate for identifying water quality problems at many of Iowa's shallow lakes. Levels of chlorophyll-a and secchi depth are believed to more directly measure the water quality impacts at Iowa lakes that primarily affect the swimming-type uses than are levels of total phosphorus. The indicator variable total phosphorus is used primarily for purposes of interpretation of discrepancies between TSI values for chlorophyll-a and secchi depth.

For purposes of assessing support of the Class A and Class B uses at Iowa lakes, median values from lake monitoring in 2000 and 2001 (Downing and Ramstack 2001, 2002) were used to calculate TSI values for total phosphorus, chlorophyll-a, and Secchi depth. Assessment decisions were based primarily on TSI values for chlorophyll-a and Secchi depth (water transparency); the TSI values for total phosphorus were used primarily to interpret inconsistencies between TSI values for chlorophyll and Secchi depth. Levels of total phosphorus in Iowa lakes appear to be a poor predictor of algal biomass and water transparency. Data from Downing and Ramstack (2001, 2002) suggest that, in general, the levels of chlorophyll-a in Iowa's lakes are much less than the levels suggested by concentrations of total phosphorus. This pattern is suggested by the generally higher TSI values for total phosphorus compared to those for chlorophyll- and secchi depth (Table 2). Reasons for this difference include (1) high levels of

non-algal turbidity that limit light penetration into the water column and thus inhibit growth of algae, (2) grazing of phytoplankton by zooplankton and (3) limitations on algal production due to low levels of nitrogen relative to phosphorus.

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 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. Thus, while these lakes have very high levels of total phosphorus that would suggest impairment of designated uses, the levels chlorophyll-a and Secchi depth are relatively low and do not suggest impairment. 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 at Iowa lakes.

DATA REQUIREMENTS FOR SECTION 303(d) LISTING

Due to the lack of sufficient data to accurately characterize lake water quality for the 2002 Section 305(b) and 303(d) cycles, (i.e., three to five years of sampling with a frequency of from three to five samplings per year), assessment thresholds for identifying "impaired" lakes were set in the hypereutrophic range (TSI values for chlorophyll-a and/or Secchi depth greater than 70). Using these thresholds provides overwhelming evidence of water quality impacts and provides good confidence that lakes assessed as "impaired" based on data from 2000 and 2001 would likely be assessed as "impaired" given the more complete dataset that will result from the combination of current data with results of additional years of lake monitoring. Data for inorganic suspended solids from the ISU surveys, as well as information on lake plankton communities in Downing et al. (2002) were also used to interpret TSI values and to provide a more complete assessment of lake water quality.

Table 1. 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 2. Ranges of TSI values for Iowa lakes based on median values from the 2000 and 2001 statewide surveys of 130 Iowa lakes by Iowa State University (Downing and Ramstack 2001, 2002). Lakes were samples approximately three times in the summers of 2000 and 2001.

	TSI Values:		
	total phosphorus	**chlorophyll-a**	**secchi depth**
minimum	53	34	34
10th percentile	62	47	50
25th percentile	66	52	56
median	***73***	***57***	***60***
75th percentile	78	64	70
90th percentile	84	71	80
maximum	97	84	80
mean	72	58	62
standard deviation	8.6	9.2	10.3

According to Carlson (1977), TSI values from about 50 to 60 represent "eutrophic" conditions, and TSI levels above 70 suggest hyper-eutrophic conditions at lakes. The range between TSI values of 60 to 70 represent a transition from the eutrophic to hyper-eutrophic conditions.

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. TSI values are based on data from the Iowa State University statewide survey of 130 Iowa lakes in 2000 and 2001 (N approximately equal to 6); 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 2002 305(b) report
Coralville Reservoir	Johnson	82.2	**49.4**	63.9	FST
Red Rock Reservoir	Marion	81.0	**40.4**	60.5	FST
Saylorville Reservoir	Polk	79.3	**46.6**	62.1	FST
Meadow Lake	Adair	79.3	**64.4**	60.5	FST
West Osceola	Clarke	79.2	**55.1**	57.7	FST
Union Grove Lake	Tama	78.9	**61.5**	63.7	FST
Lake Keomah	Mahaska	78.3	**53.3**	59.6	FST
Lake Pahoja	Lyon	76.5	**64.5**	57.7	FST
Roberts Creek Lake	Marion	76.4	**55.8**	61.5	FST
Briggs Woods Lake	Hamilton	74.5	**54.0**	50.2	FS
Lake Cornelia	Wright	74.5	**57.6**	59.0	FST
Center Lake	Dickinson	74.0	**58.4**	58.5	FST
Beeds Lake	Franklin	73.9	**53.5**	57.1	FST
Lower Pine Lake	Hardin	73.7	**59.4**	64.4	FST
Hannen Lake	Benton	73.5	**51.8**	49.4	FS
Upper Gar Lake	Dickinson	73.1	**53.1**	59.6	FST
Badger Lake	Webster	73.1	**49.4**	60.5	FST
Manteno Lake	Shelby	72.8	**49.6**	52.2	FS
Hooper Area Pond	Warren	72.7	**62.6**	61.3	FST
Arrowhead Lake	Sac	72.6	**53.6**	48.8	FS
Eldred Sherwood Lake	Hancock	72.6	**54.8**	56.2	FST
Mill Creek Lake	O'Brien	71.7	**61.2**	59.6	FST
Diamond Lake	Poweshiek	71.3	**55.1**	56.5	FST

Lake Name	County	TSI for total phosphorus	TSI for chlorophyll-a	TSI for Secchi depth	Use Support for 2002 305(b) report
Rathbun Reservoir	Appanoose	70.9	**44.6**	60.4	FST
Rodgers Park Lake	Benton	70.8	**48.3**	59.6	FST
Arrowhead Lake	Pottawattamie	70.7	**56.3**	59.2	FST
Little River	Decatur	70.5	**48.6**	60.0	FST
Easter Lake	Polk	70.2	**59.8**	63.7	FST

USING TSI VALUES TO ASSESS SUPPORT OF AQUATIC LIFE USES:

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.

Threshold TSI Values:

As summarized in Table 4, to be considered for Section 303(d) listing, the TSI value for chlorophyll-a or secchi depth must be greater than 70. These lakes are likely to have nutrient or sediment-related water quality problems that contribute to excessive turbidity that impairs either the Class A or Class B uses and are thus potential candidates for Section 303(d) listing. Because these lakes are also known to have generally poor water quality, the recommendation for Section 303(d) listing is made with a relatively high level of confidence; thus, the Section 305(b) assessment category is “monitored.”

Relevant State Water Quality Criteria:

The current (September 2001) *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;

IDNR is aware that some of the *aesthetically objectionable conditions* (e.g., algal blooms) and/or *undesirable or nuisance aquatic life* (bluegreen algae) 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.

Assessment Categories:

In terms of Section 305(b) reporting, "evaluated assessments" are 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 have relatively low confidence. IDNR does not consider waterbodies identified as "impaired" based on "evaluated" assessments as candidates for the state's Section 303(d) list. In contrast, "monitored assessments" are based primarily on recent, site-specific ambient monitoring data and thus have relatively high confidence. IDNR considers waterbodies identified as "impaired" based on "monitored assessments" as candidates for the state's Section 303(d) list. For purposes of preparing the 2002 Section 305(b) report and Section 303(d) list, 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" and "fully supported" contain lakes with good to very good water quality that, even with the variability present in lake monitoring data, will likely not have TSI values that justify addition to future Section 303(d) lists.

Table 4. 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 2002 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 → 56*	*0.7 → 0.5*
partially supported (monitored: candidates for Section 303(d) listing)	70-75	*56 → 92*	*0.5 → 0.35*
not supported (monitored: candidates for Section 303(d) listing)	>75	*>92*	*<0.35*

Use Support Categories:

The following are detailed descriptions of the use support categories used for Section 305(b) lake assessments for the 2002 reporting cycle.

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 75. 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) constitutes 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 values for chlorophyll-a and/or secchi depth are well-above (worse than) the lower limit that identifies "hyper-eutrophic" lakes. Thus, these threshold values provide overwhelming 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 of between 70 and 75. 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 values for chlorophyll-a and secchi depth are at the lower limit that identifies "hyper-eutrophic" lakes. Both these ranges are above (worse than) TSI values typically used to identify lakes as "impaired." The use of these high TSI thresholds is justified, in part, by the current lack of sufficient data to characterize lake water quality and (2) the need for a high level of confidence to add waters to Iowa's Section 303(d) list in the absence of sufficient data.

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

Lakes with TSI values for chlorophyll-a or Secchi depth of between 65 and 70 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 interfere with designated uses for primary contact recreation and/or aquatic life. These TSI threshold values are in the middle to upper range of 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.

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

Lakes with TSI values for chlorophyll-a or secchi depth of between 60 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 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 to upper range between eutrophic and hyper-eutrophic lakes. The lower TSI value for these parameters (60) is the at the upper boundary of eutrophic lakes. Lakes with TSI values in this range appear to have relatively good water quality.

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

Lakes with TSI values for chlorophyll-a and secchi depth of less than 60 have good to excellent water transparency and do not typically have turbidities 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.

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 rely on qualitative characterizations of TSI values; Table 5 summarizes these characterizations.

Table 5. Characterization 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	relatively poor	0.71 – 0.5	relatively 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

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