Phase III GIS-based Sediment Quality Database for the St. Louis River Area of Concern (AOC)—Minnesota Focus

Addendum to the Phase II Technical Documentation

Final Report

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DISCLAIMER

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LIST OF ACRONYMS AND ABBREVIATIONS

AOC	Area of Concern
As	Arsenic
AVS	Acid Volatile Sulfides
CERCLIS	Comprehensive Environmental Response, Compensation and Liability Information System
CN	Cyanide
DB	Database
DL	Detection Limit
DRO	Diesel Range Organics
DSN	Data Source Name
DW	Dry Weight
FK	Foreign Key
F/P	Fluoranthene to Pyrene Ratio
FTP	File Transfer Protocol
GIS	Geographic Information System
GT	Greater Than
HCB	Hexachlorobenzene
Hg	Mercury
ID	Identification
IJC	International Joint Commission
LDepth	Lower Depth Interval of a Sediment Core
LKP	Look-up
LRM	Logistic Regression Model
LT	Less Than
MDL	Method Detection Limit
MESL	MacDonald Environmental Sciences Ltd.
MLE	Maximum Likelihood Estimation
MLSCP	Minnesota's Lake Superior Coastal Program
MN	Minnesota
MPCA	Minnesota Pollution Control Agency
MS™	Microsoft™
NA	Not Available
NAD	North American Datum
ND	Nondetect
No.	Number
NOAA	National Oceanic and Atmospheric Administration
NR	Not Reported
NT	Not Toxic
OCS	Octachlorostyrene
ODBC	Open Database Connectivity
P/A	Phenanthrene to Anthracene Ratio
PAH	Polycyclic Aromatic Hydrocarbon
Pb	Lead

LIST OF ACRONYMS AND ABBREVIATIONS

PCB	Polychlorinated Biphenyl
PEC	Probable Effect Concentration
PEC-Q	Probable Effect Concentration Quotient
PK	Primary Key
PO	Post Office
PTBL	Table
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QM	Query Manager
QRY	Query
R-EMAP	Regional Environmental Monitoring and Assessment Program
SD	Standard Deviation
SEM	Simultaneously Extractable Metals
SLRIDT	St. Louis River Interlake/Duluth Tar
Sn	Tin
SQC	Sediment Quality Criteria
SQG	Sediment Quality Guideline
SQT	Sediment Quality Target
T	Toxic
TBT	Tributyltin
TCDD	Tetrachlorodibenzo-p-dioxins
TCDF	Tetrachlorodibenzofurans
TEF	Toxic Equivalency Factor
TOC	Total Organic Carbon
UDepth	Upper Depth Interval of a Sediment Core
U.S. EPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
UTM	Universal Transverse Mercator
VOCs	Volatile Organic Compounds
WA	Washington
WW	Wet Weight

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CHAPTER 1

INTRODUCTION

The lower St. Louis River provides an important coastal resource to western Lake Superior (Figure 1). In particular, this transboundary waterway provides critical habitat to invertebrate, fish, and waterfowl species and also provides an economic venue for Great Lakes shipping and business in the Duluth-Superior Harbor. Contaminated sediments have contributed to several use impairments in the lower St. Louis River and were a factor in the International Joint Commission's (IJC) decision to designate the lower St. Louis River as one of 43 Areas of Concern (AOCs) in the Great Lakes basin (IJC 1989). Consequently, several sediment quality and fish tissue studies have been conducted in the lower St. Louis River AOC, particularly since 1990, to delineate the extent and magnitude of contaminants of potential concern and to assess the potential for ecological effects (Figure 2). Sediment quality issues in the Lower St. Louis River AOC are of interest to local and state agencies in Minnesota and Wisconsin, as well as to federal agencies, tribal groups, responsible parties, and other concerned stakeholders.

The Minnesota Pollution Control Agency (MPCA), with the contractual assistance of Exa Data & Mapping Services, Inc. and their subcontractors, have completed Phase III of a Geographic Information System (GIS)-based sediment quality database for the St. Louis River AOC (Crane 2005; Crane and Myre 2005). A diagram of the project team is provided in Figure 3. This phase of the database focused on the Minnesota side of the AOC. A history of the development of earlier phases of this sediment quality database is provided in the Phase II project reports (Smorong and Crane 2004; Smorong *et al*. 2004a,b). The purpose of this addendum report is to document technical details regarding new methods and procedures used to update the Phase II sediment quality database with new data sets to produce the Phase III sediment quality database. Database users should refer to the Phase II report documentation (Smorong and Crane 2004, Smorong *et al.* 2004a,b), in addition to the Addendum to the Phase II Help Section for Database Users (Crane and Myre 2005), when using either the Phase III Microsoft™ (MS™) Access 2000 sediment quality database or the Query Manager-compatible database files. The MS™ Access 2000 sediment quality database is also available in MS™ Access '97 format for those users lacking MS™ Access 2000 software. Instructions for obtaining the Phase III database files from the MPCA's File Transfer Protocol (FTP) site were provided in Chapter 4 of the Addendum to the Phase II Help Section for Database Users (Crane and Myre 2005). However, these files have since been moved to the following FTP site until the Phase IV database files become available during March 2006: ftp://files.pca.state.mn.us/pub/sedimentDB/ . The updated web site for obtaining a free copy of the National Oceanic and Atmospheric Administration's (NOAA's) Query Manager version 2.56 software is: http://response.restoration.noaa.gov/topic_subtopic_entry.php?RECORD_KEY%28entry_subtopic_topic%29=entry_id,subtopic_id,topic_id&entry_id(entry_subtopic_topic)=376&subtopic_id(entry_subtopic_topic)=5&topic_id(entry_subtopic_topic)=2 .

CHAPTER 2

SUMMARY OF PHASE III DATABASE UPDATES

2.1 AUDIT OF THE PHASE II DATABASE STRUCTURE

Prior to beginning work on the Phase III sediment quality database, Peggy Myre (Exa Data & Mapping Services, Inc.) conducted an audit of the Phase II MS™ Access 2000 database. The results of her audit, as well as actions taken in regards to primary key (PK) assignments and evaluating relationships (in order to look for orphan records), are provided in Appendix A. In addition, she also deleted the database field "StationID_OLD" in the AVS_SEM table.

2.2 INCLUSION OF BENTHIC INVERTEBRATE COMMUNITY DATA FIELDS

Based on input from MPCA staff and stakeholders, benthic invertebrate community data fields have been added to the Phase III MS™ Access 2000 database (Tables 1 to 3). Most of these data fields were based on a Regional Environmental Monitoring and Assessment Program (R-EMAP) project, which entailed the most comprehensive benthic invertebrate community survey that has taken place in the St. Louis River AOC (Breneman *et al.* 2000; Crane *et al.* 2005). A screening form was developed to evaluate benthic invertebrate community data sets prior to adding them to the database (Appendix B).

These benthic data fields were not included in the Query Manager compatible database files. Query Manager has a limited capacity for including summary benthic invertebrate community data (e.g., abundance or biomass of major taxa) in its sediment bioassay table.

2.3 NEW SEDIMENT QUALITY DATA SETS

The Phase III MS™ Access 2000 database includes the sediment quality and fish tissue data contained within the Phase I and II databases, as well as 25 new data sets from the Minnesota side of the St. Louis River AOC (Table 4). Thirteen of these new data sets were obtained directly from NOAA's Query Manager Watershed database for the St. Louis River. NOAA compiled this Watershed database as part of their Natural Resource Trustee activities for the St. Louis River Interlake/Duluth Tar Superfund site. New data were also added to the Phase III sediment quality database from the USS Superfund site (URS Corp. 2003), Minnesota Slip (Streitz and Johnson 2005), Kingsbury Bay (St. Louis River Natural Resource Trustees 2002; Service Engineering Group 2004), and several lakes near the St. Louis River bordering the Fond du Lac Reservation (Costa 2000, 2001, 2002, 2004). Benthic data from two large studies (Crane *et al.* 1997; Breneman *et al.* 2000, Crane *et al.* 2005) were added to the database. These data sets provided good spatial coverage of benthic invertebrate community populations along the Minnesota side of the St. Louis River AOC.

2.4 ADDITION OF QUERY OPTIONS IN THE MS™ ACCESS DATABASE

2.4.1 Overview of Query Generation

Another new feature of the Phase III MS™ Access '97 and 2000 sediment quality databases is the addition of several queries, of which the query output is recorded in the "Queries" section of each database. These queries were developed by Peggy Myre (Exa Data & Mapping Services, Inc.) as an extra feature for the benefit of a few MPCA staff (Myre 2005). As such, the queries are not very user friendly, although users with knowledge about MS™ Access will be able to adapt them for their own use. A user friendly query interface will be completed as part of the Phase IV MS™ Access 2000 sediment quality database. Several of the queries are composed of a series of queries, numbered in sequential order. Because each subsequent query calls the previous query, it is only necessary to run the final query (this results in each query being run in order). Each query step was saved so that the user could alter the criteria during each step, if desired.

All of the queries are in the database and start with the preface "Qry." Instructions on how to run each query, the nomenclature used, and the assumptions made during the formation of each query are documented in each specific query description below. Several new query lookup lists were created in support of the queries so that they run more efficiently.

All of the queries include the fields StudyID, MESL StationID, SampleID, udepth, ldepth, as well as coordinates (latitude/longitude and UTM coordinates) to enable importing the data into ArcMap. In addition, StationID was also imported since the field MESL Station ID is not unique to each station (but is unique to each sample).

In the documentation below, *query* and *table* names are noted in italics, and field names are underlined. As a reminder to users, a number of user-friendly sediment quality queries (Appendix C) are available in NOAA's Query Manager 2.56 software that can be used in conjunction with the Phase III Query Manager-compatible database files.

2.4.2 Query Descriptions

2.4.2.1 PAH Source Ratio List Sorted by Depth Interval

The polycyclic aromatic hydrocarbon (PAH) Source Ratio query series is prefaced by "QryPAHSource." To create a table of PAH source ratios sorted by depth interval, it is only necessary to run the final query "*QryPAHSource2_CalcRatios*." A description of each query and any associated assumptions is listed below.

QryPAHSource1_SelectData: This query selects all samples with the two relevant PAH source ratios [i.e., phenanthrene/anthracene (P/A) and fluoranthene/pyrene (F/P)]. A P/A ratio <10 and F/P ratio >1.0 have been shown to be indicative of pyrogenic (i.e., combustion) sources of PAHs (Budzinski *et al*. 1997). A P/A ratio >10 is indicative of petrogenic (i.e., petroleum-based) inputs (Budzinski *et al.* 1997). The chemical concentration value that is queried is the field MESL C Calc, containing the full value for data reported above detection, and one-half the

reported detection limit for data reported below detection. It restricts the selection to records with reported concentrations (no missing values), and excludes samples that do not pass the Level II sediment quality target (SQT) benchmark for data reported as below detection (MESL_EXCLUDE_HIGH ND <>"X"). In addition, it excludes samples that do not fall within one of the desired depth intervals. A lookup table was created for each unique combination of upper and lower depth in the sample table, so that depth intervals could be redefined. Currently, in the table *lkp – QryDepthBin*, the depth intervals are:

- ≥0 to ≤5 cm,
- ≥0 to ≤15 cm,
- ≥0 to ≤30 cm,
- ≥15 to ≤30 cm,
- ≥30 to ≤45 cm, and
- ≥30 cm.

Note: if samples fell outside of these definitions (e.g., 25-40 cm), the depth interval code was given an "X" and these samples were excluded from the query. A sort order was added to the lookup table so that the final results would sort by depth interval in the order provided above.

QryPAHSource1_SelectData_Crosstab: This query takes the selected data from the first query, checks to make sure that there are no missing PAHs for any particular sample, and then formats them so that the PAHs are reported across the top of the table in separate columns. The depth interval and coordinates are also carried forward.

QryPAHSource2_CalcRatios: This query is the final (and only necessary) query that is run to generate a table of PAH source ratios for each sample, sorted by depth interval. It derives the PAH values from the previous cross-tab query. The PAH source ratios are reported to three significant digits.

2.4.2.2 Select All Chemistry Sorted by Location

QrySelect ChemData: This single query simply extracts all of the sediment chemistry data, and sorts the data by the Area field (e.g., Allouez Bay, Duluth Harbor, Lower St. Louis River, Lower St. Louis River watershed, Nemadji River, St. Louis Bay, and Superior Bay). The field LOCDESC is used to describe the specific station location. The chemical concentration value that is queried is the field MESL C CALC, containing the full value for data reported above detection, and one-half the reported detection limit for data reported below detection. It restricts the selection for records with reported concentration (no missing values), and excludes records that do not pass the Level II SQT criteria for data reported as below detection (MESL_EXCLUDE_HIGH ND <> "X"). After Area, the data are sorted by StudyID, StationID, SampleID, and Chemcode.

There are two ways of editing this query:

- Edit the selected metric or unit in Design Mode: Open the query in Design Mode, and then type in the chemcode or other variable in the Criteria row.

- Using Filters: In Design Mode, remove all of the variables in the Criteria row. Then run the query so it is in DataSheet mode. This change will bring up all of the data records. Then the user can filter the data on specific fields using the "Filter by Selection" or "Filter by Form" buttons. See MS™ Access documentation on how these functions work (http://support.microsoft.com/kb/304263/EN-US/).

2.4.2.3 Benthic Invertebrate Community Data

QryBenthicData: This single query simply extracts all of the mean benthic invertebrate community data (mean, standard deviation, and sum) for a specific metric of the category "Taxonomic Group." The query is currently set-up to query the metric "Total Abundance" with the units of organisms/m^2. As with the chemistry data query, there are two ways of editing this query:

- Edit the selected metric or unit in Design Mode. Open the query in Design Mode, and edit the field directly using the specific options in the table *lkp – BENTHOSMETRICS*.
- In Design Mode, remove all of the variables in the Criteria row. Then run the query so it is in DataSheet mode. This will bring up all of the data records. Then the user can filter the data on Category or Metric using the "Filter by Selection" or "Filter by Form" buttons. See MS™ Access documentation on how these functions work (http://support.microsoft.com/kb/304263/EN-US/).

2.4.2.4 Samples Organized by Mean PEC-Q and Depth Interval

QryPEC_Q1: This query selects all samples with a calculated mean PEC-Q (<> -99999), and retrieves them linked to both depth interval (as described in the PAH query), and by mean PEC-Q classification. A new lookup table (*lkp – QryPEC_Class*) was generated that relates a unique mean PEC-Q to a risk classification based on the intervals of <0.1 (low), ≥0.1 to ≤0.6 (moderate), and >0.6 (high). These classifications are also selected as part of this query. Note the user can change either the depth interval or the risk classification for this query by editing the lookup tables directly, and then re-running the query.

QryPEC_Q1_Crosstab: This query organizes the data selected above by depth interval, and then notes the risk classification for each sample. The actual output format will depend on the kind of map that is to be generated from the data. Coordinate information are also selected to aid in the mapping exercise.

2.4.2.5 Bioassay Data

QryBioassay: This single query simply extracts all of the sediment toxicity data, and sorts the data by Species, Endpoint, and MESL Toxicity code. Other fields selected (including the standard fields) include the Effect value (Effectval), the control-adjusted effects value (Ctrladj), the originally reported significance (Sigeffect), the TestID, and the medium of the test (e.g., sediment, elutriate, etc.). Negative control data are excluded from the query. As with the other data selection queries, there are two ways of editing this query:

- Edit the selected metric or unit in Design Mode. Open the query in Design Mode, and then type in the chemcode or other variable in the Criteria row.
- Using Filters – In Design Mode, remove all of the variables in the Criteria row. Then run the query so it is in DataSheet mode. This will bring up all of the data records. Then the user can filter the data on specific fields using the "Filter by Selection" or "Filter by Form" buttons. See MS™ Access documentation on how these functions work (http://support.microsoft.com/kb/304263/EN-US/).

2.4.2.6 Comparison to Level I and Level II SQTs

The queries that compare surficial sediment chemistry to corresponding Level I and Level II SQTs are prefaced by "QrySQT." To create a table of surficial samples and chemicals that show if the chemical is lower than (LT) or greater than (GT) the SQTs, it is only necessary to run the final query "QrySQT1&2_Union Crosstab." This query organizes the samples by depth interval; a description of each query and any associated assumptions is provided below.

QrySQT1: This query selects all surficial samples (upper depth = 0 cm) and chemicals, and compares the values with the corresponding Level I SQTs. The chemical concentration value that is queried is the field MESL C CALC, containing the full value for data reported above detection, and one-half the reported detection limit for data reported below detection. It restricts the selection for records with reported concentration (no missing values), and excludes records that do not pass the Level II SQT benchmark for data reported as below detection (MESL_EXCLUDE_HIGH ND <>"X"). The data that are retrieved are linked and sorted by depth interval, then by StudyID, StationID, SampleID, and Chemcode.

QrySQT2: This query selects all samples and chemicals, and compares the values with the Level II SQTs, in the same way as *QrySQT1*.

QrySQT1&2_Union: This is a Union query, which merges the first two queries together.

QryPEC_Q1_Crosstab: This query takes the merged data, and pivots the results (crosstab query) so that the Level I and Level II SQT exceedances are in separate columns.

2.5 UPDATED PHASE II TABLE AND FIGURE

Some documentation in the Phase II Help Section for Database Users (Smorong and Crane 2004) was updated to account for the addition of benthic invertebrate community data in the Phase III database. Figure 1 (Diagram showing the relationships between database components) and Table 1 (Detailed Description of Database Components) from the aforementioned Phase II document have been updated with similar caption titles in this Addendum document as Figure 4 and Table 5, respectively. For Figure 4, Peggy Myre (Exa Data & Mapping Services, Inc.) added primary key (PK) and foreign key (FK) designations to several fields. Since the MS™ Access sediment quality database is a relational database, the database consists of several tables that can be linked together to facilitate retrieval of the data. Every record in a table must have a primary key that differentiates it from every other record in the table. Primary keys may consist of a single attribute or multiple attributes in combination. For chemistry data, the primary key

fields are SiteID, StudyID, StationID, SampleID, Labrep, and Chemcode (Figure 4). The foreign key numbering system allows one to group the keys together into unique foreign keys. Thus, the primary key of one table is used in another table to establish a relationship. For example, for the chemistry table (ptbl – CHEM):

- FK1 describes the foreign key 'Chemcode" that relates the look-up (lkp) table CHEMDICT;
- FK2 describes the foreign key 'Qualcode' that relates to lkp – QUALIFY;
- FK3 describes the foreign key 'Chemcode' that relates to lkp – SQC; and,
- FK4 describes the foreign key group (SiteID+StudyID+StationID+SampleID+Labrep) that relates to parent table ptbl – SAMPLE.

These fields were designed to be consistent with fields used in NOAA's Query Manager 2.56 software.

CHAPTER 3

LINKAGE OF THE PHASE III DATABASE WITH ARCMAP

3.1 LINKAGE WITH ARCMAP 8.3

Users with ArcMap 8.3 should follow the directions in Section 5.3 of the Phase II Help Section for ArcView Users (Smorong *et al*. 2004a) for how to link the MS™ Access 2000 database to the Phase II ArcMap 8.3 map documents.

3.2 LINKAGE WITH ARCMAP 9

The MPCA now uses ArcMap 9 instead of ArcMap 8.3, so MPCA users will need to save the Phase II ArcMap 8.3 map documents to ArcMap 9. The directions in Section 5.3 of the Phase II Help Section for ArcView Users (Smorong *et al*. 2004a) will not work for users trying to link the MS™ Access 2000 database to the Phase II ArcMap 9 map documents. The below instructions should rectify this situation. The following directions provide step-by-step instructions for linking the MS™ Access 2000 database with the ArcMap 9 map documents.

I. Create an ODBC Connection to the Database

This section will enable the database to be connected to other programs, via a communication protocol called **ODBC** (Open Database Connectivity). The actual steps will vary somewhat depending on the Operating System in use. Instructions have been provided for users who use either Windows 2000 or Windows XP (very similar).

1. From the START menu, go to Settings/Control Panel.
2. From Control Panel, select "Switch to Classic View" (for MPCA staff) and double-click on the Administrative Tools option.
3. From Administrative Tools, double-click on the Data Sources (ODBC) tool. This step will open the ODBC Data Source Administrator dialogue box.
4. The user will now need to set up a new User Data Source Name (DSN). From the User DSN tab (should be first tab), highlight MS Access Database and then click on the **Add…** button.
5. Next, open a dialogue box called Create New Data Source and "Select a driver for which you want to set up a data source." Highlight Microsoft Access Driver (*.mdb) and then click on the button **Finish**.
6. A dialogue box called ODBC Microsoft Access Setup should now appear.
7. Next, enter a Data Source Name. This can be any name the user recognizes, like "St Louis River Database." The user can also add a Description, but this is optional.
8. After entering a Data Source Name, go to the center of the dialogue box where it says 'Database.' Click on the button labeled **Select…**.
9. This opens a dialogue box called Select Database and allows the user to browse to the location of the St Louis River database. Browse through the directories until the file is located; all *.mdb files should show up on the left window of the dialogue box.

When the correct file is located, highlight the name in the left window, and then click on the **OK** button.

10. The user should now be back to the ODBC Microsoft Access Setup dialogue box. The Data Source Name (top of the dialogue box) should be successfully related to the correct Database (middle of the dialogue box). If this is the case, click **OK**.
11. The user should now be back in ODBC Data Source Administrator, where the user's Data Source Name should appear in the list of User Data Sources. If this is correct, then click **OK**. Next, close the other Control Panel windows and continue to Step II.

***NOTE**: Users only have to do this ONCE to connect their database. Thus, every time they open their ArcMap map document, the database will already have an ODBC connection and be ready to connect to ArcMap.*

II. Make a Connection to a Phase II ArcMap Map Document

12. Open an ArcMap 9 map document of interest (e.g., ContaminatedAreas.mxd).
13. Open ArcCatalog by clicking on the ArcCatalog button on the standard toolbar. Select "Database Connections" in the left window table.
14. In ArcCatalog, in the right window under the 'Contents' tab, there should be an option called "Add OLE DB Connection." Double click on this option.
15. A dialogue box called Data Link Properties will open up (under the tab 'Provider'). Highlight Microsoft OLE DB Provider for ODBC Drivers, and then click on the button **Next>>**.
16. The 'Connection' tab will appear and the user will need to "Specify the source of the data." Click on the down arrow from the drop-down list at the top of the dialogue box to view the Data Source Name set-up in Step I. Select the data source.
17. Here it is useful to click on the **Test Connection** button. This step will ensure that the ODBC connection is working properly. If the test connection succeeds, click on **OK**. If not, the database was probably not set-up properly in Step I.
18. The user should now be back in ArcCatalog since a new "OLE DB Connection" has been created. This connection will be highlighted. The user will now be prompted for a new name (the user can edit the name OLE DB Connection). The Data Source Name the user selected before will not be automatically assigned to the OLE DB Connection name. Re-name "OLE DB Connection" to the same or similar name as was used for the Data Source Name. The user is now ready to import data into ArcMap.

***NOTE**: Once the user has set-up a database connection in ArcCatalog, he/she does not have to repeat this step; ArcCatalog will recognize the connections made previously and will re-connect each time it is opened. IF, however, the user makes new queries or tables, he/she will have to Refresh the connection by right-clicking on the connection in ArcCatalog and selecting 'Refresh.'*

19. While still in ArcCatalog, double-click on the new database connection. The contents of the database will open up, and the user will see all of the tables (with a preface of "lkp" or "ptbl") and all of the queries (with the preface of "Qry"). The user can import either tables or queries into ArcMap.

***NOTE**: The 'Type' will all be 'ACCESS Table' regardless of whether it is a table or query object in the database. ArcCatalog treats these similarly.*

20. In order to import tables into ArcMap, geopositional coordinates must be present. Therefore, only the Station table, and any queries with station locations, can be brought into the users ArcMap map document.
21. First, start with the Station table by dragging the ptbl – Station table and dropping it into the ArcMap Layers window (left window). As a result of this action, the tab will change from "Display" to "Source."
22. Right-click on the 'ptbl – STATION' table icon, and then select **Display XY Data** (this can also be done through the Tools menu).
23. Next, specify the fields for the X and Y coordinates. Under the headings for X Field and Y Field, enter "X-coord" and "Y-coord", respectively. Click **OK**. Note: if this step does not work, try specifying "Longitude" for the X Field and "Latitude" for the Y Field.
24. The station locations should now appear as points on the top layer of the ArcMap map document. Since missing coordinates are coded as –9, points that appear to be located far away from the area of interest denote stations with missing geopositional coordinates. In case this step does not work, and the user is using a version of MS™ Access newer than the 2000 version, the user will need to truncate the Field Name column in the Access table to 8 characters or less. ArcMap may also encounter problems with spaces and unique characters in Access Field Names. All spaces will be removed from the Field Names in the Phase IV MS™ Access 2000 database.
25. The user can also drag and drop a query from ArcCatalog to ArcMap, and add them following the same **Display XY Data** step as above.

***NOTE**: If the user brings a query into his/her ArcMap map document and tries to view the data, this might be a slow process considering that the queries have to be run each time they are viewed in ArcMap. There is another option to save the query data out as a separate table, so that the process of working with the data are faster. These optional steps are provided below.*

26. After importing the table or query into ArcMap, right-click on the table and select **Data/Export**. This will export the connected query into a *.dbf file, which will be directly imported (rather than linked to) to the users ArcMap map document.
27. Choose 'All records' and then either type in, or browse, to determine the location of where to store the new file. The user can re-name the file, or keep it as the same name as the query. Note that the file is automatically given the extension *.dbf. Click **OK**.
28. The user will then be prompted if he/she wants to add the new *.dbf file to his/her ArcMap map document. Click on **Yes**.
29. To add the stations to the users view, follow the same steps given above to **Display XY Data**. The points and underlying data will appear to be exactly the same as the layer linked from Access, but the data will refresh more quickly as the queries do not have to be run in the database each time the view is refreshed in ArcMap.

CHAPTER 4

TREATMENT OF NONDETECT DATA

The treatment of nondetected data was discussed in Section 5.1 of the Phase II Technical Documentation (Smorong *et al*. 2004b). The GIS-based sediment quality database was designed with four data treatment options for censoring nondetected data:

- Substitute nondetected values with one-half the detection limit;
- Delete nondetected values;
- Substitute nondetected values with the detection limit; and
- Exclude nondetected values with high detection limits.

Nondetects are also labeled as left-censored data since their values lie somewhere to the left of the detection limit threshold. Users should be aware that bias may be introduced into the results when the above data treatment options are used. Users interested in better approaches for analyzing censored data should consider using maximum likelihood estimation (MLE), imputation, or the Kaplan-Meier method (Helsel 2005a). MLE solves a "likelihood equation" to find the values for mean and standard deviation that are most likely to have produced both nondetect and detected data (Helsel 2005a). Imputation methods fill in values for censored or missing observations without assigning them all the same value (Helsel 2005a). Kaplan-Meier is a nonparametric method designed to incorporate data with multiple censoring levels and does not require specification of an assumed distribution (Helsel 2005a). Additional information about these methods is available in Helsel (2005a,b).

CHAPTER 5

PROJECT CONTACT

For further information about the Phase III MS™ Access '97/2000 or Query Manager-compatible sediment quality databases for the St. Louis River AOC—Minnesota focus, contact Judy Crane at:

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Documents from the Phase III project will be posted on the MPCA's Contaminated Sediments Web page at: http://www.pca.state.mn.us/water/sediments/studies-stlouis.html#assessment . Users will be notified when the Phase IV MS™ Access '97/2000 and Query Manager-compatible sediment quality databases for the St. Louis River AOC—Wisconsin focus, as well as the updated Phase IV ArcMap 9 map documents, have been completed by the spring of 2006.

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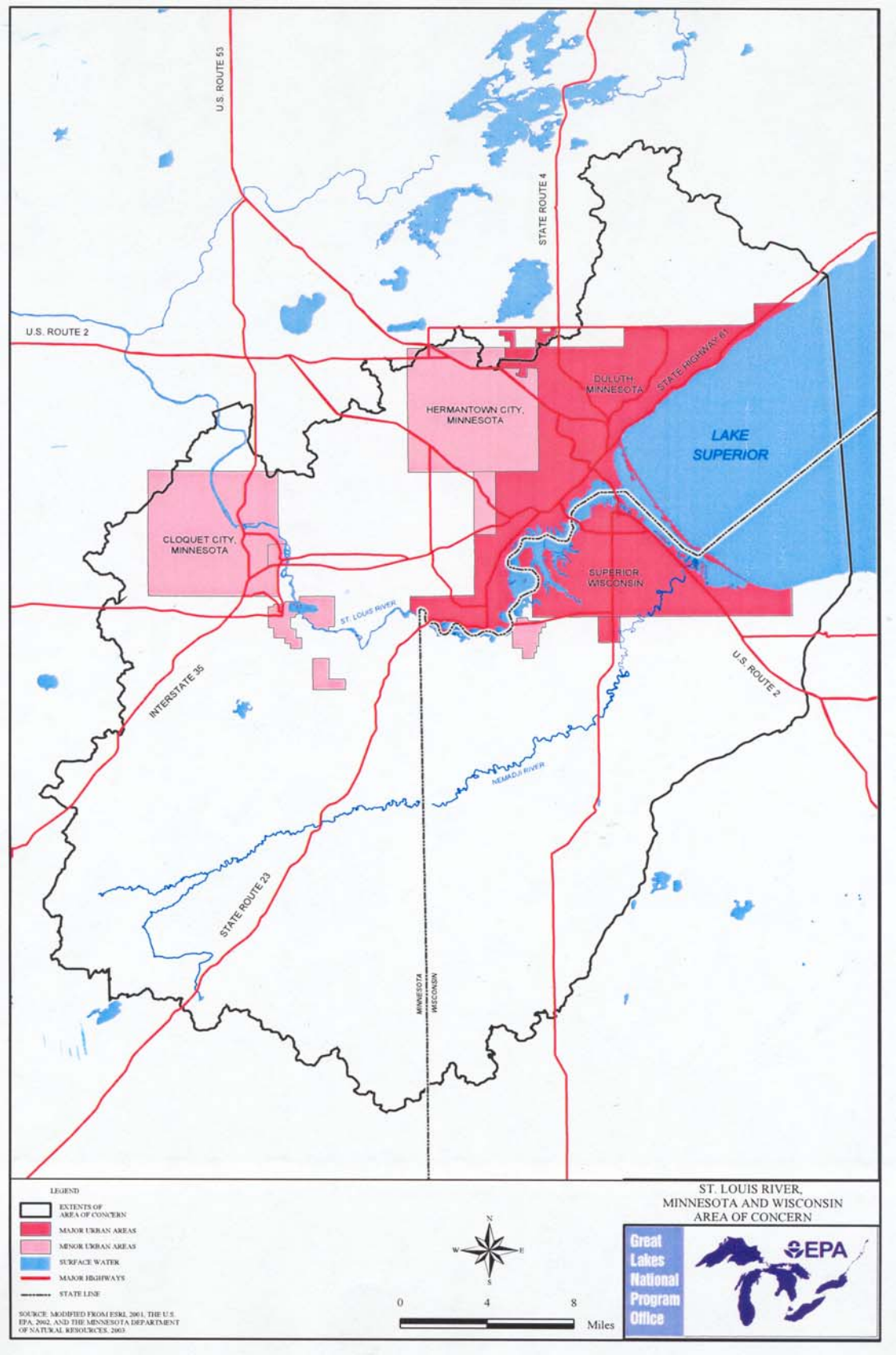

Figure 1. Map of the St. Louis River AOC.

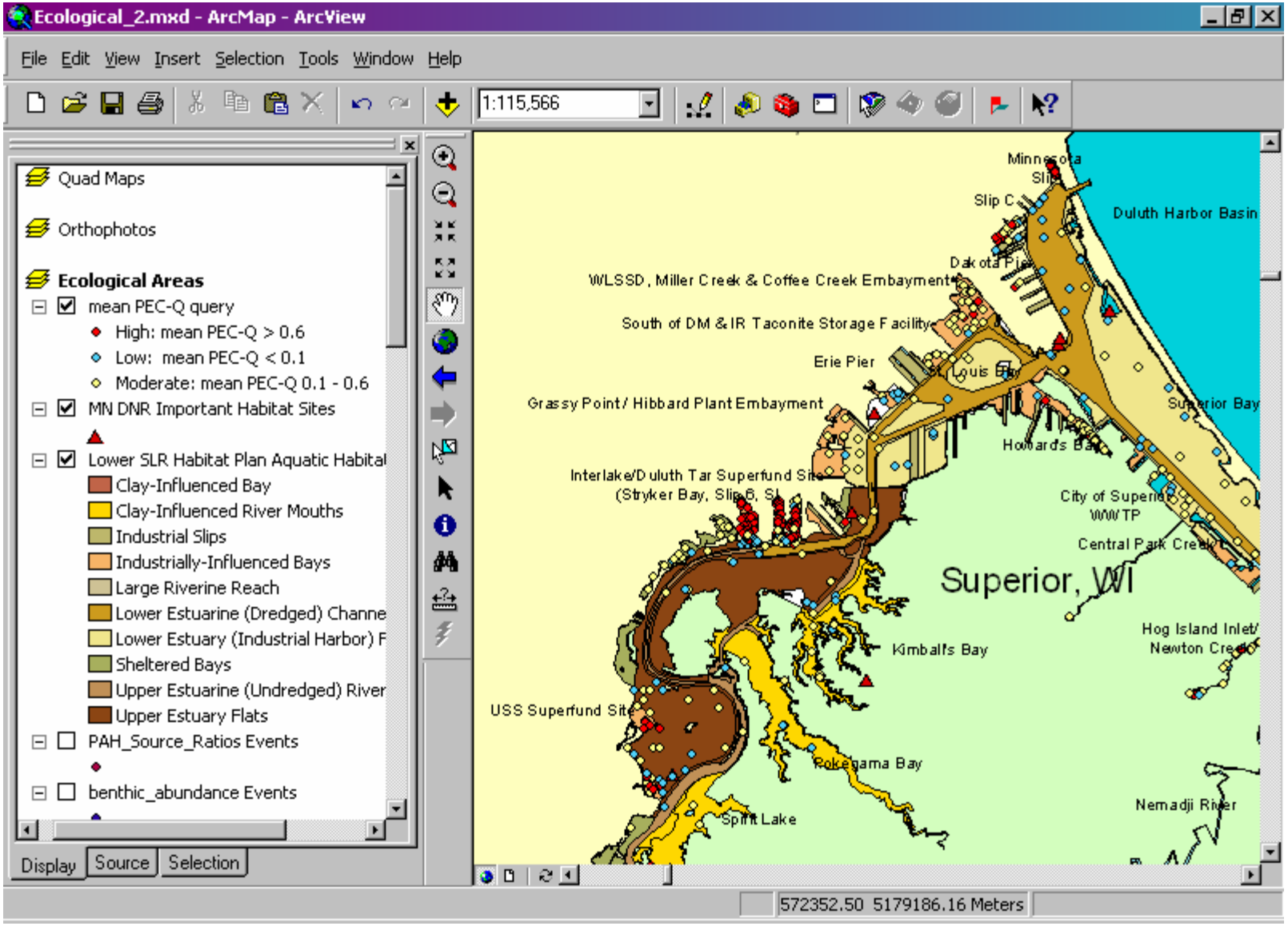

Figure 2. Example linkage of the Phase III MS™ Access 2000 database query results for mean probable effect concentration quotient (PEC-Q) ranges with the Phase II ArcMap 9 map document for Ecological Features within the lower St. Louis River AOC.

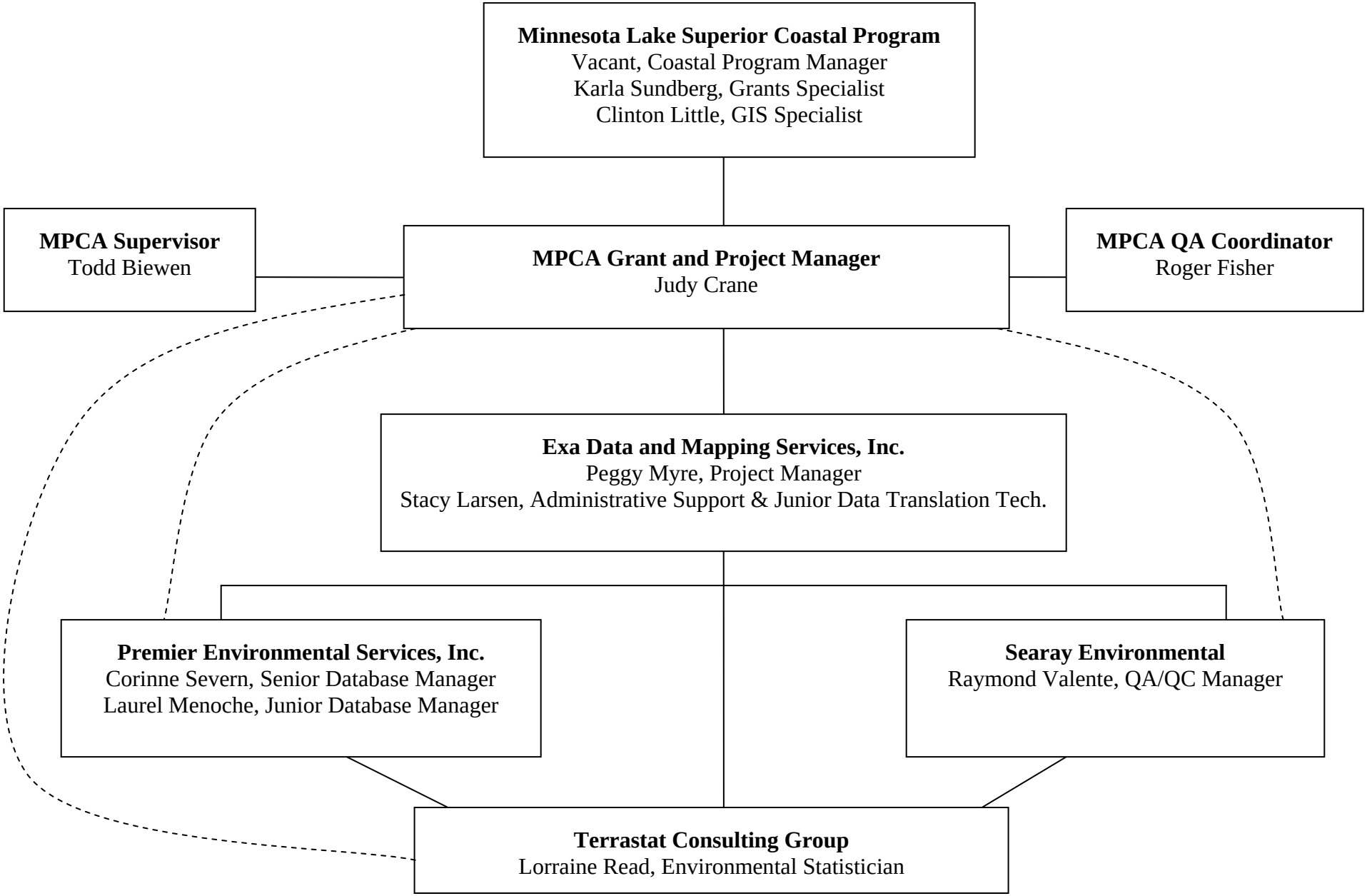

Figure 3. Project organization chart for the Phase III GIS-based sediment quality database project.

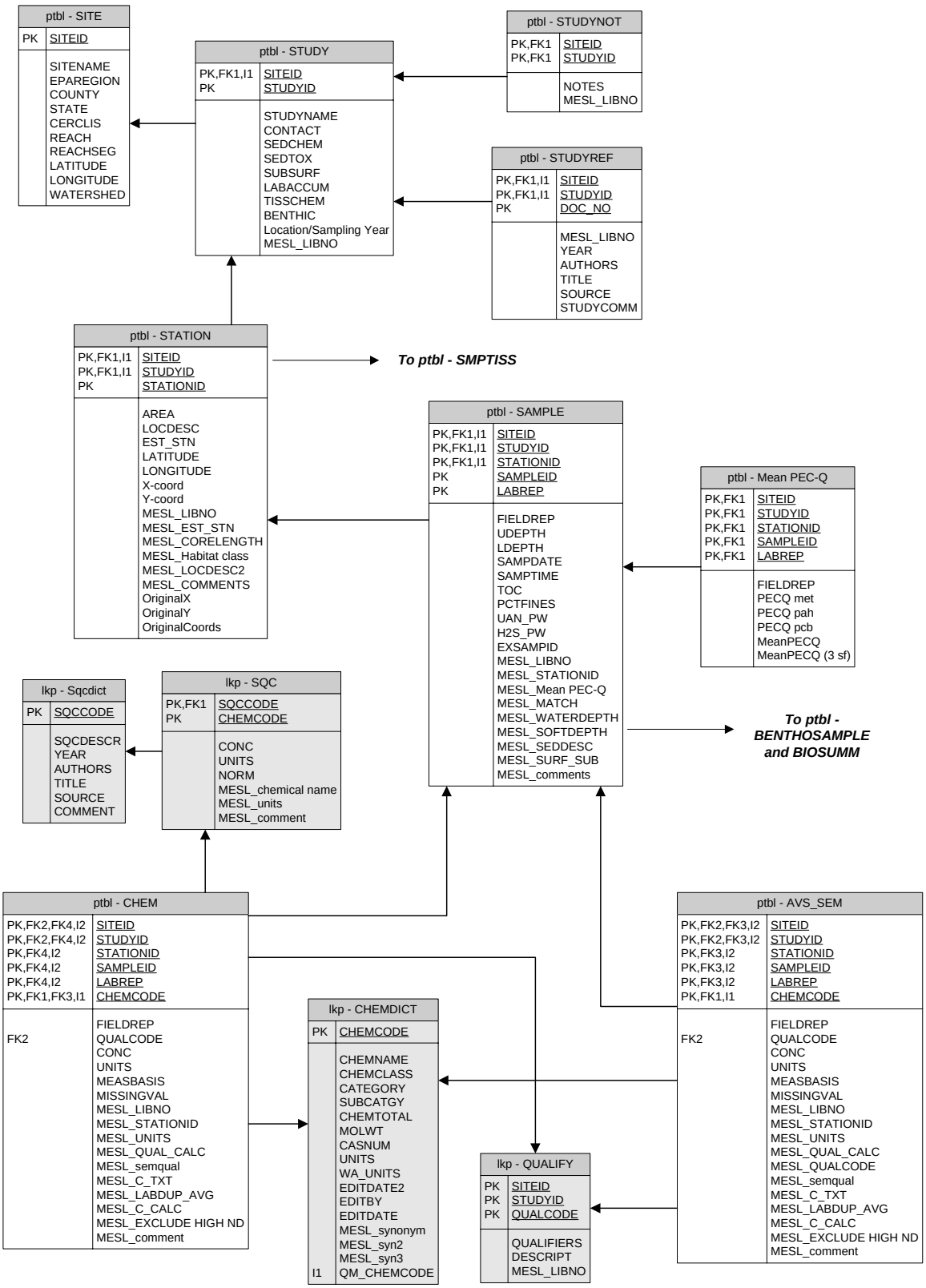

Figure 4. Diagram showing the relationships between components of the MS™ Access 2000 sediment quality database.

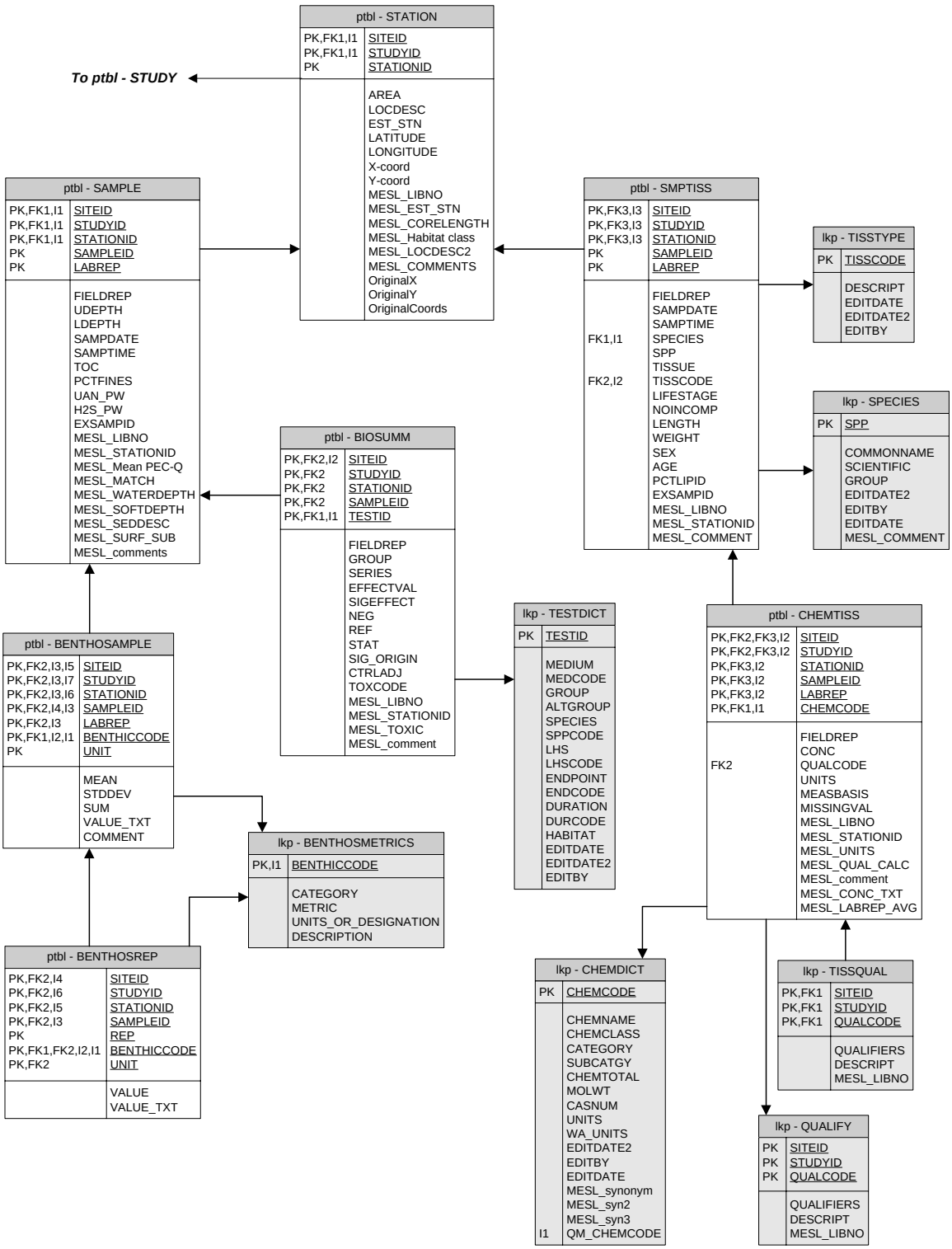

Figure 4. Continued.

Table 1. Benthic Invertebrate Community Metrics for Individual Field Replicate Samples

Benthic Metric	Units or Designation
Taxonomic Group	
Amphipoda abundance	no. of organisms/m^2 or percent
Chironomidae abundance	no. of organisms/m^2 or percent
Coenagrionidae abundance	no. of organisms/m^2 or percent
Coleoptera abundance	no. of organisms/m^2 or percent
Corixidae abundance	no. of organisms/m^2 or percent
Crustacea abundance	no. of organisms/m^2 or percent
Diptera abundance	no. of organisms/m^2 or percent
Dytiscidae abundance	no. of organisms/m^2 or percent
Ephemeroptera abundance	no. of organisms/m^2 or percent
Hemiptera abundance	no. of organisms/m^2 or percent
Mollusca abundance	no. of organisms/m^2 or percent
Odonata abundance	no. of organisms/m^2 or percent
Oligochaeta abundance	no. of organisms/m^2 or percent
Plecoptera abundance	no. of organisms/m^2 or percent
Polychaeta abundance	no. of organisms/m^2 or percent
Sphaeriidae abundance	no. of organisms/m^2 or percent
Tanytarsini abundance	no. of organisms/m^2 or percent
Trichoptera abundance	no. of organisms/m^2 or percent
Non-insect abundance	no. of organisms/m^2 or percent
total abundance	no. of organisms/m^2 or percent
total taxa	no. of taxa/m^2
Stream index abundance: Ephemeroptera, Plecoptera, and Trichoptera	no. of organisms/m^2 or percent
Wetland index abundance: Ephemeroptera, Trichoptera, Sphaeriidae, and Odonata	no. of organisms/m^2 or percent
Behavioral Group	
burrower abundance	no. of organisms/m^2 or percent
climber abundance	no. of organisms/m^2 or percent
clinger abundance	no. of organisms/m^2 or percent
Functional Group	
collector abundance	no. of organisms/m^2 or percent
grazer abundance	no. of organisms/m^2 or percent
predator abundance	no. of organisms/m^2 or percent
shredder abundance	no. of organisms/m^2 or percent

Table 1. Continued

Benthic Metric	Units or Designation
Habitat Preference*	
taxa associated with erosional habitats	percent
taxa associated with depositional habitats	percent
Mechanism	
engulfer abundance	no. of organisms/m^2 or percent
filterer abundance	no. of organisms/m^2 or percent
gatherer abundance	no. of organisms/m^2 or percent
scraper abundance	no. of organisms/m^2 or percent
Mobility	
non-mobile abundance	no. of organisms/m^2 or percent
mobile abundance	no. of organisms/m^2 or percent
Tolerance	
tolerance abundance	no. of organisms/m^2 or percent
Trophic Group	
carnivore abundance	no. of organisms/m^2 or percent
detritivore abundance	no. of organisms/m^2 or percent
herbivore abundance	no. of organisms/m^2 or percent
omnivore abundance	no. of organisms/m^2 or percent

Notes:
no. = number
* Habitat preference data are only available for the 1995 R-EMAP samples (Breneman *et al*. 2000; Crane *et al*. 2005).
Percentage abundance measurements represent a percentage of the total abundance.
Percentage taxa measurements represent a percentage of the total number of taxa.

Table 2. Benthic Invertebrate Community Metrics for the Mean and Standard Deviation (SD) of Field Replicate Data

Benthic Metric	Units or Designation
Taxonomic Group	
mean/SD Amphipoda abundance	no. of organisms/m^2 or percent
mean/SD Chironomidae abundance	no. of organisms/m^2 or percent
mean/SD Coenagrionidae abundance	no. of organisms/m^2 or percent
mean/SD Coleoptera abundance	no. of organisms/m^2 or percent
mean/SD Corixidae abundance	no. of organisms/m^2 or percent
mean/SD Crustacea abundance	no. of organisms/m^2 or percent
mean/SD Diptera abundance	no. of organisms/m^2 or percent
mean/SD Dytiscidae abundance	no. of organisms/m^2 or percent
mean/SD Ephemeroptera abundance	no. of organisms/m^2 or percent
mean/SD Hemiptera abundance	no. of organisms/m^2 or percent
mean/SD Mollusca abundance	no. of organisms/m^2 or percent
mean/SD Odonata abundance	no. of organisms/m^2 or percent
mean/SD Oligochaeta abundance	no. of organisms/m^2 or percent
mean/SD Plecoptera abundance	no. of organisms/m^2 or percent
mean/SD Polychaeta abundance	no. of organisms/m^2 or percent
mean/SD Sphaeriidae abundance	no. of organisms/m^2 or percent
mean/SD Tanytarsini abundance	no. of organisms/m^2 or percent
mean/SD Trichoptera abundance	no. of organisms/m^2 or percent
mean/SD non-insect abundance	no. of organisms/m^2 or percent
mean/SD total abundance	no. of organisms/m^2 or percent
mean/SD total taxa	no. of taxa/m^2
mean/SD Stream index abundance: Ephemeroptera, Plecoptera, and Trichoptera	no. of organisms/m^2 or percent
mean/SD Wetland index abundance: Ephemeroptera, Trichoptera, Sphaeriidae, and Odonata	no. of organisms/m^2 or percent
Behavioral Group	
mean/SD burrower abundance	no. of organisms/m^2 or percent
mean/SD climber abundance	no. of organisms/m^2 or percent
mean/SD clinger abundance	no. of organisms/m^2 or percent
Functional Group	
mean/SD collector abundance	no. of organisms/m^2 or percent
mean/SD grazer abundance	no. of organisms/m^2 or percent
mean/SD predator abundance	no. of organisms/m^2 or percent
mean/SD shredder abundance	no. of organisms/m^2 or percent

Table 2. Continued

Benthic Metric	Units or Designation
Habitat Preference*	
mean/SD taxa associated with erosional habitats	percent
mean/SD taxa associated with depositional habitats	percent
Mechanism	
mean/SD engulfer abundance	no. of organisms/m^2 or percent
mean/SD filterer abundance	no. of organisms/m^2 or percent
mean/SD gatherer abundance	no. of organisms/m^2 or percent
mean/SD scraper abundance	no. of organisms/m^2 or percent
Mobility	
mean/SD non-mobile abundance	no. of organisms/m^2 or percent
mean/SD mobile abundance	no. of organisms/m^2 or percent
Tolerance	
mean/SD tolerance abundance	no. of organisms/m^2 or percent
Trophic Group	
mean/SD carnivore abundance	no. of organisms/m^2 or percent
mean/SD detritivore abundance	no. of organisms/m^2 or percent
mean/SD herbivore abundance	no. of organisms/m^2 or percent
mean/SD omnivore abundance	no. of organisms/m^2 or percent
Benthic Classification**	
Multimetric Classification	Low Impact, Indeterminant, High Impact
Discriminant Function Analysis	Low Impact, High Impact

Notes:
SD = standard deviation
no. = number
* Habitat preference data are only available for the 1995 R-EMAP samples (Breneman *et al*. 2000; Crane *et al*. 2005).
** Benthic classification data are only available for the 1995 R-EMAP samples collected from the lower St. Louis River estuary and harbor (i.e., excludes the reservoir samples; Crane *et al*. 2005).
Percentage abundance measurements represent a percentage of the total abundance.
Percentage taxa measurements represent a percentage of the total number of taxa.

Table 3. Benthic Invertebrate Community Metrics for the Sum of Field Replicate Samples

Benthic Metric	Units or Designation
Taxonomic Group	
sum Amphipoda abundance	no. of organisms/m^2
sum Chironomidae abundance	no. of organisms/m^2
sum Coenagrionidae abundance	no. of organisms/m^2
sum Coleoptera abundance	no. of organisms/m^2
sum Corixidae abundance	no. of organisms/m^2
sum Crustacea abundance	no. of organisms/m^2
sum Diptera abundance	no. of organisms/m^2
sum Dytiscidae abundance	no. of organisms/m^2
sum Ephemeroptera abundance	no. of organisms/m^2
sum Hemiptera abundance	no. of organisms/m^2
sum Mollusca abundance	no. of organisms/m^2
sum Odonata abundance	no. of organisms/m^2
sum Oligochaeta abundance	no. of organisms/m^2
sum Plecoptera abundance	no. of organisms/m^2
sum Polychaeta abundance	no. of organisms/m^2
sum Sphaeriidae abundance	no. of organisms/m^2
sum Tanytarsini abundance	no. of organisms/m^2
sum Trichoptera abundance	no. of organisms/m^2
sum Non-insect abundance	no. of organisms/m^2
sum total abundance	no. of organisms/m^2
sum Stream index abundance: Ephemeroptera, Plecoptera, and Trichoptera	no. of organisms/m^2
sum Wetland index abundance: Ephemeroptera, Trichoptera, Sphaeriidae, and Odonata	no. of organisms/m^2
Behavioral Group	
sum burrower abundance	no. of organisms/m^2
sum climber abundance	no. of organisms/m^2
sum clinger abundance	no. of organisms/m^2
Functional Group	
sum collector abundance	no. of organisms/m^2
sum grazer abundance	no. of organisms/m^2
sum predator abundance	no. of organisms/m^2
sum shredder abundance	no. of organisms/m^2

Table 3. Continued

Benthic Metric	Units or Designation
Mechanism	
sum engulfer abundance	no. of organisms/m^2
sum filterer abundance	no. of organisms/m^2
sum gatherer abundance	no. of organisms/m^2
sum scraper abundance	no. of organisms/m^2
Mobility	
sum non-mobile abundance	no. of organisms/m^2
sum mobile abundance	no. of organisms/m^2
Tolerance	
sum tolerance abundance	no. of organisms/m^2
Trophic Group	
sum carnivore abundance	no. of organisms/m^2
sum detritivore abundance	no. of organisms/m^2
sum herbivore abundance	no. of organisms/m^2
sum omnivore abundance	no. of organisms/m^2

Notes:
no. = number

Table 4. Summary of Data Sets Incorporated into the Phase III GIS-based Sediment Quality Database for the St. Louis River AOC

Reference	Location	Sampling Year(s)	DESCRIPTION OF DATA AND DATA TYPES				
			Sediment Chemistry	Toxicity Test Data	Benthic Data	Bioaccumu-lation Data	Total Number of Samples
AScI Corporation (1996)	St. Louis River Interlake/Duluth Tar (SLRIDT) Superfund site	1996	Grain size, ammonia, SEM metals, AVS, metals, PAHs	Yes	No	No	16
Bay West (2001a)	SLRIDT Superfund site	2001	TOC, solids, grain size, metals, PAHs and other semi-volatiles, volatiles	No	No	No	34
Bay West (2001b)	SLRIDT Superfund site	2001	TOC, grain size, solids, cyanide, metals, PAHs and other semi-volatiles, volatiles, dioxins/furans, organo-metals, PCBs	Yes	No	Yes	47
Breneman *et al*. (2000); Crane *et al*. (2005)*	Minnesota side of the St. Louis River AOC	1995; 1996	SEM metals, AVS, Hg, PAHs, TOC, particle size	Yes	Yes	No	306
Costa (2000, 2001); AScI Corporation (2000)	Reservation lakes near St. Louis River: Big Lake, Deadfish Lake, Lost Lake, Joe Martin Lake, Pat Martin Lake, Perch Lake, Rice Portage Lake, Simian Lake, Sofie Lake, Third Lake, and West Twin Lake	2000	PCBs, Pb, Hg, total solids, total volatile solids, particle size	Yes	No	No	104
Costa *et al*. (2001) and McCann (2001)	St. Louis Bay and upper St. Louis River	2000	No	No	No	Yes	99

Table 4. Continued

Reference	Location	Sampling Year(s)	DESCRIPTION OF DATA AND DATA TYPES				
			Sediment Chemistry	Toxicity Test Data	Benthic Data	Bioaccumu-lation Data	Total Number of Samples
Costa (2002, 2004); ASci Corporation (2003)	St. Louis River and reservation lakes listed for Costa (2000, 2001)	2002	Pb, Hg, methyl Hg, PCBs, particle size, total solids, total volatile solids (methyl Hg was also analyzed on archived reservation lake samples collected in 2000 as part of Phase I study; Costa 2001)	Yes	No	No	21
Crane *et al*. (1997)*	Minnesota side of the lower St. Louis River AOC	1994	SEM metals, AVS, As, Pb, Hg, TCDDs, TCDFs, PAHs, PCBs, Ammonia, TOC, particle size	Yes	Yes	No	225
IT (1993)	SLRIDT Superfund site	1993	TOC, ammonia, cyanide, moisture, solids, metals, PAHs, volatiles	No	No	No	22
IT (1994)	SLRIDT Superfund site	1994	PAHs	No	No	No	1
IT (1996)	SLRIDT Superfund site	1996	Grain size, ammonia, cyanide, solids, sulfate, TOC, metals, PAHs, volatiles	No	No	No	56
IT (1997)	SLRIDT Superfund site	1997	Solids, ammonia, cyanide, moisture, TOC, metals, PAHs, volatiles	No	No	No	6
IT (1998)	SLRIDT Superfund site	1998	Grain size, solids, specific gravity, TOC, metals, PAHs	No	No	No	26
IT (1999)	SLRIDT Superfund site	1999	Grain size, pH, solids, specific gravity, TOC, metals, SEM metals, PAHs	No	No	No	656

Table 4. Continued

Reference	Location	Sampling Year(s)	DESCRIPTION OF DATA AND DATA TYPES				
			Sediment Chemistry	Toxicity Test Data	Benthic Data	Bioaccumu-lation Data	Total Number of Samples
MPCA (unpublished data files - 1993); Crane (1997)	USX Superfund site	1993	PAHs, phenol, metals, Hg, ammonia, CN, oil & grease, TOC (matching sediment chemistry/toxicity data were previously added to the database)	Yes	No	No	41
MPCA (unpublished data - 2001)	SLRIDT Superfund site: Reference sites	2001	TOC, moisture, metals, PAHs and other semi-volatiles, volatiles	No	No	No	20
Service Engineering Group (2000)	SLRIDT Superfund site	2000	TOC, volatiles	No	No	No	17
Service Engineering Group (2001a)	SLRIDT Superfund site	2001	Grain size, moisture	No	No	No	256
Service Engineering Group (2001b)	SLRIDT Superfund site	2001	Grain size, pH, solids, TOC, conductivity, alkalinity, sulfate, metals, PAHs and other semi-volatiles, volatiles, organo-metals	No	No	No	100
Service Engineering Group (2004) and unpublished data	SLRIDT Superfund site: Stryker Bay and Slip 7	2003; 2004	PAHs, PCBs, metals, Hg, cation exchange capacity, organic matter, pH, total Kjeldahl nitrogen, total nitrogen, phosphorus, TOC, total solids	No	No	No	52
Service Engineering Group (2004) and unpublished data	Tallas Island, Kingsbury Bay, Erie Pier, Cross Channel	2004	PAHs, PCBs, pesticides and herbicides, metals, Hg, nitrate/nitrite, phosphorus, pH, TOC, organic matter, % solids	No	No	No	31

Table 4. Continued

Reference	Location	Sampling Year(s)	DESCRIPTION OF DATA AND DATA TYPES				
			Sediment Chemistry	Toxicity Test Data	Benthic Data	Bioaccumu-lation Data	Total Number of Samples
St. Louis River Natural Resource Trustees (2002); USFWS (in preparation)	SLRIDT Superfund site (Stryker Bay, Keene Creek/Slip 7); North Bay, Kingsbury Bay	2001; 2002	No	No	No	Yes	180
Streitz and Johnson (2005); West Central Environmental Consultants (2004); Krueger (1998)	Minnesota Slip	2004	PAHs, PCBs, DROs, metals, Hg, boron, particle size, TOC, bulk density	No	No	No	14
URS Corp. (2003); report in preparation	USS Superfund site	2003	PAHs, PCBs, DROs, dioxins/furans, carbazole, dibenzofuran, OCS, HCB, VOCs, metals, Hg, AVS, SEM, CN, TOC, ammonia, particle size	No	No	No	41
URS Corp. (2003); MPCA split samples	USS Superfund site	2003	PAHs, PCBs, DROs, dioxins/furans, carbazole, dibenzofuran, OCS, HCB, VOCs, metals, Hg, AVS, SEM, CN, TOC, ammonia, particle size	No	No	No	16

As = Arsenic; AVS = acid volatile sulfides; CN = cyanide; DRO = diesel range organics; HCB = hexachlorobenzene; Hg = mercury;
OCS = octachlorostyrene; PAH = polycyclic aromatic hydrocarbons; Pb = lead, PCBs = polychlorinated biphenyls;
SEM = simultaneously extractable metals; TCDD = tetrachlorodibenzo-p-dioxins; TCDF = tetrachlorodibenzofurans; TOC = total organic carbon;
VOCs = volatile organic compounds.
* Sediment chemistry and sediment toxicity data were added to previous phases of the sediment quality database.

Table 5. Detailed Description of Database Components

Table Name	Field Name	Data Type	Field Size	Table Description / Field Description
lkp - BENTHOSMETRICS				**Lookup table for benthic data parameters.**
	BENTHICCODE	Text	4	Code for benthic parameter.
	CATEGORY	Text	25	General category or grouping for the benthic parameter.
	METRIC	Text	50	Measurement of the benthic parameter.
	UNITS_OR_DESIGNATION	Text	50	Possible units or designation for the parameter.
	DESCRIPTION	Text	200	Description of the benthic parameter.
lkp - CHEMDICT				**Lookup table with chemical dictionary.**
	CHEMCODE	Text	10	Chemical code.
	CHEMNAME	Text	45	Chemical name.
	CHEMCLASS	Text	8	Chemical class.
	CATEGORY	Text	8	Query Manager field.
	SUBCATGY	Text	10	Query Manager field.
	CHEMTOTAL	Text	10	Query Manager field.
	MOLWT	Number, Double	8	Molecular weight of chemical.
	CASNUM	Text	24	Chemical abstract services number.
	UNITS	Text	6	Units of chemical concentration.
	WA_UNITS	Text	6	Query Manager field.
	EDITDATE2	Text	8	Query Manager field.
	EDITBY	Text	15	Query Manager field.
	EDITDATE	Date/Time	8	Query Manager field.
	MESL_synonym	Text	150	Synonym for chemical name.
	MESL_syn2	Text	150	Synonym for chemical name.
	MESL_syn3	Text	150	Synonym for chemical name.
	QM_CHEMCODE	Text	50	Equivalent chemcode for Query Manager.

Table 5. Continued

Table Name	Field Name	Data Type	Field Size	Table Description / Field Description
lkp - QryDepthBin				**Lookup table used to classify data into sediment depth bins.**
	UDEPTH	Number, Single	4	Upper sampling depth (cm).
	LDEPTH	Number, Single	4	Lower sampling depth (cm).
	SORTORDER	Number, Long Integer	4	Used in queries to sort results by depth bin.
	DEPTHBIN	Text	15	Sediment depth bin category used in queries.
lkp - QryPEC_Class				**Lookup table used to classify data into risk categories.**
	MESL_Mean PEC-Q	Number, Single	4	A unique list of PEC quotients from sediment quality database, rounded to 3 significant digits.
	CLASSIFICATION	Text	20	Classification of risk.
lkp - QUALIFY				**Lookup table for sediment chemistry qualifiers (QUALCODE).**
	SITEID	Text	4	Site ID code (from Query Manager).
	STUDYID	Text	2	Study ID code.
	QUALCODE	Text	5	Qualifier code for concentration value, modified to be compatible with Query Manager (all ND data has a "U" in this field).
	QUALIFIERS	Text	30	Qualifier code for concentration value, as designated in report.
	DESCRIPT	Text	80	Description of the meaning of the qualifier, as indicated in the original report or data file.
	MESL_LIBNO	Text	50	MESL - library number.
lkp - SPECIES				**Lookup table for tissue samples species type (SPP).**
	SPP	Text	5	Species code.
	COMMONNAME	Text	25	Common name.
	SCIENTIFIC	Text	40	Scientific name.
	GROUP	Text	25	Query Manager field.
	EDITDATE2	Text	8	Query Manager field.
	EDITBY	Text	15	Query Manager field.
	EDITDATE	Date/Time	8	Query Manager field.
	MESL_COMMENT	Text	50	MESL - comments.

Table 5. Continued

Table Name	Field Name	Data Type	Field Size	Table Description / Field Description
lkp - SQC				**Sediment Quality Criteria: Level I and Level II SQTs (Crane *et al.* 2000) and SQGs (WDNR 2003).**
	SQCCODE	Text	10	Code for Sediment Quality Criteria (see lkp - Sqcdict for a description of the codes).
	CHEMCODE	Text	10	Chemical code (defined in lkp - chemdict).
	CONC	Number, Double	8	Chemical concentration.
	UNITS	Text	6	Units of SQC is reported in.
	NORM	Text	2	Indicates measurement basis SQC are reported in.
	MESL_chemical name	Text	50	MESL - chemical name.
	MESL_units	Text	50	MESL - units.
	MESL_comment	Text	100	MESL - comments.
lkp - Sqcdict				**Lookup table for Sediment Quality Criteria references (SQCCODE).**
	SQCCODE	Text	10	Code for Sediment Quality Criteria.
	SQCDESCR	Text	90	Description of the SQCCODE.
	YEAR	Text	4	Year of publishing for study reporting the sediment quality criteria.
	AUTHORS	Text	160	Authors for study reporting the sediment quality criteria.
	TITLE	Text	160	Title of the study reporting the sediment quality criteria.
	SOURCE	Text	160	Source (location) for study reporting the sediment quality criteria.
	COMMENT	Text	160	Comments.
lkp - SQCPAIRS				**Lookup table for identifying Sediment Quality Criteria pairs.**
	PAIRNAME	Text	50	High and low Sediment Quality Criteria (how Query Manager will reference the pair).
	SQCLOW	Text	10	SQCCODE of low Sediment Quality Criteria.
	SQCHIGH	Text	10	SQCCODE of high Sediment Quality Criteria.
	LOW_NAME	Text	8	Low Sediment Quality Criteria (how Query Manager will reference the SQC).
	HIGH_NAME	Text	8	High Sediment Quality Criteria (how Query Manager will reference the SQC).
	SORT_ORDER	Number, Integer	2	Query Manager field.

Table 5. Continued

Table Name	Field Name	Data Type	Field Size	Table Description / Field Description
lkp - TESTDICT				**Lookup table for toxicity test dictionary (TESTID).**
	TESTID	Text	12	Code describing the bioassay.
	MEDIUM	Text	15	Medium used in toxicity test (e.g., bulk sediment or pore water).
	MEDCODE	Text	2	Code used to indicate medium used in toxicity test.
	GROUP	Text	20	Group of organism used in toxicity test (e.g., bacteria or amphipod).
	ALTGROUP	Text	20	Group of organism used in toxicity test - alternate.
	SPECIES	Text	40	Species used in toxicity test.
	SPPCODE	Text	3	Code used to indicate species used in toxicity test.
	LHS	Text	10	Life stage of organism used in toxicity test.
	LHSCODE	Text	1	Code used to indicate life stage of organism used in toxicity test.
	ENDPOINT	Text	30	Endpoint of toxicity test (e.g., growth or survival).
	ENDCODE	Text	2	Code used to indicate endpoint of toxicity test.
	DURATION	Text	10	Duration of toxicity test.
	DURCODE	Text	4	Code used to indicate duration of toxicity test.
	HABITAT	Text	2	Query Manager field.
	EDITDATE	Date/Time	8	Query Manager field.
	EDITDATE2	Text	8	Query Manager field.
	EDITBY	Text	15	Query Manager field.
lkp - TISSQUAL				**Lookup table for tissue chemistry qualifiers (QUALCODE).**
	SITEID	Text	4	Site ID code (from Query Manager).
	STUDYID	Text	2	Study ID code.
	QUALCODE	Text	5	Qualifier code for concentration value, modified to be compatible with Query Manager (all ND data has a "U" in this field).
	QUALIFIERS	Text	30	Qualifier code for concentration value, as designated in report.
	DESCRIPT	Text	80	Description of the meaning of the qualifier, as indicated in the original report or data file.
	MESL_LIBNO	Text	50	MESL - library number.

Table 5. Continued

Table Name	Field Name	Data Type	Field Size	Table Description / Field Description
lkp - TISSTYPE				**Lookup table for tissue sample tissue types (TISSCODE).**
	TISSCODE	Text	6	Tissue type code.
	DESCRIPT	Text	50	Description of tissue type.
	EDITDATE	Date/Time	8	Query Manager field.
	EDITDATE2	Text	8	Query Manager field.
	EDITBY	Text	15	Query Manager field.
ptbl - AVS_SEM				**Sediment chemistry results for Acid Volatile Sulfides and Simultaneously Extracted Metals (units of µmol/g).**
	SITEID	Text	4	Site ID code (from Query Manager).
	STUDYID	Text	2	Study ID code.
	STATIONID	Text	10	Station ID code (this is the MESL_STATIONID, unless it exceeded 6 characters, then the QM_STATIONID was substituted).
	SAMPLEID	Text	6	Sample ID code.
	FIELDREP	Text	2	Identifies field replicate samples (samples collected in close proximity).
	LABREP	Text	2	This field will not be populated (lab dups will be averaged and the MESL_LABREP_AVG field identifies these averaged results).
	CHEMCODE	Text	10	Chemical code (defined in lkp - CHEMDICT).
	QUALCODE	Text	5	Qualifier code for concentration value, modified to be compatible with Query Manager (all ND data has a "U" in this field).
	CONC	Number, Double	8	Chemical concentration (dry weight basis).
	UNITS	Text	6	Units of chemical concentration.
	MEASBASIS	Text	2	Measurement basis - dry weight (DW).
	MISSINGVAL	Yes/No	1	'Yes' indicates a missing value (i.e., not reported, not sampled, lost, etc; -9 entered in CONC field).
	MESL_LIBNO	Text	20	MESL - library number.
	MESL_STATIONID	Text	50	MESL - station ID (retains the Station ID code as it appears in the original datafiles and/or reports).
	MESL_UNITS	Text	7	MESL - units of concentration value.
	MESL_QUAL_CALC	Text	10	MESL - qualifier code for concentration value - used for calculation purposes (NUM - value, U - less than detect value; X - do not include in calculations).

Table 5. Continued

Table Name	Field Name	Data Type	Field Size	Table Description / Field Description
ptbl - AVS_SEM (cont.)				**Sediment chemistry results for Acid Volatile Sulfides and Simultaneously Extracted Metals (units of µmol/g).**
	MESL_QUALCODE	Text	5	MESL - qualifier code for concentration value, as designated in report, with modifications.
	MESL_semqual	Text	50	MESL - qualifier code to indicate whether to use SEM metal conc. or total metal conc. (B entered in this field indicates that both are measured, therefore do not use the SEM result.)
	MESL_C_TXT	Text	50	MESL - concentration value represented in a text field (nondetected results include a "<").
	MESL_LABDUP_AVG	Yes/No	1	MESL - indicates if results for laboratory duplicate samples were averaged.
	MESL_C_CALC	Number, Double	8	MESL - concentration value represented in a number field (nondetected results included as 1/2 the detection limit).
	MESL_EXCLUDE HIGH ND	Text	50	MESL - X entered in this field indicates a nondetected result with a detection limit greater than the Level II SQT.
	MESL_comment	Text	250	MESL - comments.
ptbl - BENTHOSAMPLE				**Benthic infaunal data including mean, standard deviation, and summary data.**
	SITEID	Text	4	Site ID code (from Query Manager).
	STUDYID	Text	2	Study ID code.
	STATIONID	Text	10	Station ID code (this is the MESL_STATIONID, unless it exceeded 6 characters, then the QM_STATIONID was substituted).
	SAMPLEID	Text	6	Sample ID code.
	LABREP	Text	2	This field will not be populated, necessary to link to sample table.
	BENTHICCODE	Text	4	Benthic code, linked to lkp - BenthosMetrics.
	UNIT	Text	10	Unit for the benthic metric.
	MEAN	Number, Single	4	Mean value.
	STDDEV	Number, Single	4	Standard deviation of the mean value.
	SUM	Number, Single	4	Abundance sum for the sample.
	VALUE_TXT	Text	35	Text result value (if applicable).
	COMMENT	Text	35	Comment

Table 5. Continued

Table Name	Field Name	Data Type	Field Size	Table Description / Field Description
ptbl - BENTHOSREP				**Benthic infaunal replicate data.**
	SITEID	Text	4	Site ID code (from Query Manager).
	STUDYID	Text	2	Study ID code.
	STATIONID	Text	10	Station ID code (this is the MESL_STATIONID, unless it exceeded 6 characters, then the QM_STATIONID was substituted).
	SAMPLEID	Text	6	Sample ID code.
	REP	Text	2	Replicate designator.
	BENTHICCODE	Text	4	Benthic code, linked to lkp - BenthosMetrics.
	UNIT	Text	10	Unit for the benthic metric.
	VALUE	Number, Single	4	Numeric result.
	VALUE_TXT	Text	35	Text result value (if applicable).
ptbl - BIOSUMM				**Sediment toxicity test and bioaccumulation test results.**
	SITEID	Text	4	Site ID code (from Query Manager).
	STUDYID	Text	2	Study ID code.
	STATIONID	Text	10	Station ID code (this is the MESL_STATIONID, unless it exceeded 6 characters, then the QM_STATIONID was substituted).
	SAMPLEID	Text	6	Sample ID code.
	FIELDREP	Text	2	Identifies field replicate samples (samples collected in close proximity).
	TESTID	Text	12	Code describing the bioassay (see lkp - TESTDICT table for a description of the codes).
	GROUP	Text	2	Query Manager field.
	SERIES	Text	2	Associates control sample results with test results.
	EFFECTVAL	Number, Double	8	Toxicity test result (e.g., percent survival).
	SIGEFFECT	Yes/No	1	Toxic (-1) or Not toxic (0).
	NEG	Yes/No	1	Negative control sample? Yes (-1) or No (0).
	REF	Yes/No	1	Reference sample? Yes (-1) or No (0).
	STAT	Yes/No	1	Identifies sample used to determine significance (T/NT) - ND results (i.e., growth endpoint not measured because of low survival) from SQT database added as NOT TOXIC.
	SIG_ORIGIN	Text	50	Original significance designations - from Query Manager.

Table 5. Continued

Table Name	Field Name	Data Type	Field Size	Table Description / Field Description
ptbl - BIOSUMM (cont.)				**Sediment toxicity test and bioaccumulation test results.**
	CTRLADJ	Number, Double	8	Control adjusted result (test result/control result*100).
	TOXCODE	Text	1	Query Manager field.
	MESL_LIBNO	Text	50	MESL - library number.
	MESL_STATIONID	Text	50	MESL - Station ID (retains the Station ID code as it appears in the original datafiles and/or reports).
	MESL_TOXIC	Text	2	Toxic (T), Not toxic (NT), or ND (growth endpoint not measured because of low survival).
	MESL_comment	Text	250	MESL - comments.
ptbl - CHEM				**Chemistry results for sediment samples.**
	SITEID	Text	4	Site ID code (from Query Manager).
	STUDYID	Text	2	Study ID code.
	STATIONID	Text	10	Station ID code (this is the MESL_STATIONID, unless it exceeded 6 characters, then the QM_STATIONID was substituted).
	SAMPLEID	Text	6	Sample ID code.
	FIELDREP	Text	2	Identifies field replicate samples (samples collected in close proximity).
	LABREP	Text	2	This field will not be populated (lab dups will be averaged and the MESL_LABREP_AVG field identifies these averaged results).
	CHEMCODE	Text	10	Chemical code (defined in lkp - CHEMDICT).
	QUALCODE	Text	5	Qualifier code for concentration value, modified to be compatible with Query Manager (all ND data has a "U" in this field).
	CONC	Number, Double	8	Chemical concentration (dry weight basis).
	UNITS	Text	6	Units of chemical concentration.
	MEASBASIS	Text	2	Measurement basis - dry weight (DW).
	MISSINGVAL	Yes/No	1	'Yes' indicates a missing value (i.e., not reported, not sampled, lost, etc; -9 entered in CONC field).
	MESL_LIBNO	Text	20	MESL - library number.
	MESL_STATIONID	Text	50	MESL - station ID (retains the Station ID code as it appears in the original datafiles and/or reports).
	MESL_UNITS	Text	7	MESL - units of concentration value.

Table 5. Continued

Table Name	Field Name	Data Type	Field Size	Table Description / Field Description
ptbl - CHEM (cont.)				**Chemistry results for sediment samples.**
	MESL_QUAL_CALC	Text	10	MESL - qualifier code for concentration value - used for calculation purposes (NUM - value, U - less than detect value; X - do not include in calculations).
	MESL_semqual	Text	50	MESL - qualifier code to indicate whether to use SEM metal conc. or total metal conc. (B entered in this field indicates that both are measured, therefore do not use the SEM result.)
	MESL_C_TXT	Text	50	MESL - concentration value represented in a text field (nondetected results include a "<").
	MESL_LABDUP_AVG	Yes/No	1	MESL - indicates if results for laboratory duplicate samples were averaged.
	MESL_C_CALC	Number, Double	8	MESL - concentration value represented in a number field (nondetected results included as 1/2 the detection limit).
	MESL_EXCLUDE HIGH ND	Text	50	MESL - X entered in this field indicates a nondetected result with a detection limit greater than the Level II SQT.
	MESL_comment	Text	250	MESL - comments.
ptbl - CHEMTISS				**Chemistry results for tissue samples.**
	SITEID	Text	4	Site ID code (from Query Manager).
	STUDYID	Text	2	Study ID code.
	STATIONID	Text	10	Station ID code (this is the MESL_STATIONID, unless it exceeded 6 characters, then the QM_STATIONID was substituted).
	SAMPLEID	Text	6	Sample ID code.
	FIELDREP	Text	2	Identifies field replicate samples (samples collected in close proximity).
	LABREP	Text	2	Not populated (lab dups will be averaged and the MESL_LABREP_AVG field identifies these averaged results).
	CHEMCODE	Text	10	Chemical code (defined in lkp - chemdict).
	CONC	Number, Double	8	Chemical concentration (wet weight basis).
	QUALCODE	Text	5	Qualifier code for concentration value, as designated in report (see lkp_TISSQUAL table for a description of the codes).
	UNITS	Text	6	Units of chemical concentration.
	MEASBASIS	Text	2	Measurement basis - wet weight (WW).

Table 5. Continued

Table Name	Field Name	Data Type	Field Size	Table Description / Field Description
ptbl - CHEMTISS (cont.)				**Chemistry results for tissue samples.**
	MISSINGVAL	Yes/No	1	'Yes' indicates a missing value (i.e., not reported, not sampled, lost, etc; -9 entered in CONC field).
	MESL_LIBNO	Text	20	MESL- library number.
	MESL_STATIONID	Text	50	MESL- Station ID (retains the Station ID code as it appears in the original datafiles and/or reports).
	MESL_UNITS	Text	7	MESL - units of concentration value.
	MESL_QUAL_CALC	Text	10	MESL - qualifier code for concentration value - used for calculation purposes (NUM - value, U - less than detect value; X - do not include in calculations; UX - less than MDL, DL unknown).
	MESL_comment	Text	250	MESL - comments.
	MESL_CONC_TXT	Text	50	MESL - concentration value represented in a text field (nondetected results include a "<").
	MESL_LABREP_AVG	Yes/No	1	MESL - indicates if results for laboratory duplicate samples were averaged.
ptbl - Mean PEC-Q				**Mean Probable Effect Concentration-Quotients (Mean PEC-Q).**
	SITEID	Text	4	Site ID code (from Query Manager).
	STUDYID	Text	2	Study ID code.
	STATIONID	Text	10	Station ID code (this is the MESL_STATIONID, unless it exceeded 6 characters, then the QM_STATIONID was substituted).
	SAMPLEID	Text	6	Sample ID code.
	FIELDREP	Text	2	Identifies field replicate samples (samples collected in close proximity).
	LABREP	Text	2	This field will not be populated (lab dups will be averaged and the MESL_LABREP_AVG field identifies these averaged results).
	PECQ met	Number, Double	8	PEC quotient for metals.
	PECQ pah	Number, Double	8	PEC quotient for PAHs.
	PECQ pcb	Number, Double	8	PEC quotient for PCBs.
	MeanPECQ	Number, Double	8	Mean PEC quotient (as calculated).
	MeanPECQ (3 sf)	Number, Double	8	Mean PEC quotient (3 significant figures).

Table 5. Continued

Table Name	Field Name	Data Type	Field Size	Table Description / Field Description
ptbl - SAMPLE				**Sediment sample information.**
	SITEID	Text	4	Site ID code (from Query Manager).
	STUDYID	Text	2	Study ID code.
	STATIONID	Text	10	Station ID code (this is the MESL_STATIONID, unless it exceeded 6 characters, then the QM_STATIONID was substituted).
	SAMPLEID	Text	6	Sample ID code.
	FIELDREP	Text	2	Identifies field replicate samples (samples collected in close proximity).
	LABREP	Text	2	This field will not be populated (lab dups will be averaged and the MESL_LABREP_AVG field identifies these averaged results).
	UDEPTH	Number, Single	4	Upper sampling depth (cm).
	LDEPTH	Number, Single	4	Lower sampling depth (cm).
	SAMPDATE	Text	8	Sample date (YYYYMMDD).
	SAMPTIME	Text	5	Sample time.
	TOC	Number, Single	4	Total organic carbon (%).
	PCTFINES	Number, Single	4	Percent fines (sand + clay), the micron diameter used to define PCTFINES is <53 µm, unless otherwise noted in the MESL_comments field.
	UAN_PW	Number, Single	4	Unionized ammonia in pore water.
	H2S_PW	Number, Single	4	Hydrogen sulfide in pore water.
	EXSAMPID	Text	30	Original station ID reported in study or data file.
	MESL_LIBNO	Text	50	MESL - library number.
	MESL_STATIONID	Text	50	MESL - station ID (retains the Station ID code as it appears in the original datafiles and/or reports).
	MESL_Mean PEC-Q	Number, Single	4	MESL - Mean PEC-Q (3 significant figures).
	MESL_MATCH	Text	50	MESL - indicates if the sample has matching sediment chemistry and toxicity data.
	MESL_WATERDEPTH	Text	50	MESL - water depth at the point of sediment sampling (m). NR = not reported.
	MESL_SOFTDEPTH	Text	50	MESL - soft sediment depth (m). NR = not reported.
	MESL_SEDDESC	Text	255	MESL - sediment description (have included the sediment description if this data was available electronically). NA = not available.
	MESL_SURF_SUB	Text	50	MESL - indicates if the sample is designated as surficial or sub-surface, according to NOAA's Query Manager rules. NA indicates that the sampling depth was not specified.
	MESL_comments	Text	255	MESL - comments.

Table 5. Continued

Table Name	Field Name	Data Type	Field Size	Table Description / Field Description
ptbl - SITE				**Site Identification (Query Manager table).**
	SITEID	Text	4	Site ID code (from Query Manager).
	SITENAME	Text	40	Descriptive name for site (from Query Manager).
	EPAREGION	Number, Integer	2	Region for site location; 11 for Canada (from Query Manager).
	COUNTY	Text	25	County where site is located (from Query Manager).
	STATE	Text	2	State where site is located (from Query Manager).
	CERCLIS	Text	12	CERCLIS number for site (from Query Manager).
	REACH	Text	8	Reach number for site (from Query Manager).
	REACHSEG	Text	11	Reach segment number for site (from Query Manager).
	LATITUDE	Number, Double	8	General latitude for site location (from Query Manager).
	LONGITUDE	Number, Double	8	General longitude for site location (from Query Manager).
	WATERSHED	Text	20	Watershed name for site location (from Query Manager).
ptbl - SMPTISS				**Tissue sample information.**
	SITEID	Text	4	Site ID code (from Query Manager).
	STUDYID	Text	2	Study ID code.
	STATIONID	Text	10	Station ID code (this is the MESL_STATIONID, unless it exceeded 6 characters, then the QM_STATIONID was substituted).
	SAMPLEID	Text	6	Sample ID code.
	FIELDREP	Text	2	Identifies field replicate samples (samples collected in close proximity).
	LABREP	Text	2	Not populated (lab dups will be averaged and the MESL_LABREP_AVG field identifies these averaged results).
	SAMPDATE	Text	8	Date sample collected (YYYYMMDD).
	SAMPTIME	Text	5	Time sample collected.
	SPECIES	Text	5	Species from which the tissue sample was collected (see the lkp_SPECIES table for a description of the codes).
	SPP	Text	5	Species code (see the lkp_SPECIES table for a description of the codes).
	TISSUE	Text	30	Tissue type analyzed (see the lkp_TISSTYPE table for a description of the codes).
	TISSCODE	Text	6	Tissue type code (see the lkp_TISSTYPE table for a description of the codes).

Table 5. Continued

Table Name	Field Name	Data Type	Field Size	Table Description / Field Description
ptbl - SMPTISS (cont.)				**Tissue sample information.**
	LIFESTAGE	Text	1	Lifestage of the organism at the time of sampling.
	NOINCOMP	Number, Integer	2	Number of individuals in a composite sample.
	LENGTH	Number, Single	4	Length (cm) of individual organisms collected for tissue analysis.
	WEIGHT	Number, Single	4	Weight of individual organisms collected for tissue analysis.
	SEX	Text	1	Sex of individual organisms collected for tissue analysis.
	AGE	Number, Integer	2	Age of individual organisms collected for tissue analysis.
	PCTLIPID	Number, Single	4	Percent lipids (%).
	EXSAMPID	Text	15	Query Manager field.
	MESL_LIBNO	Text	50	MESL- library number.
	MESL_STATIONID	Text	50	MESL- Station ID (retains the Station ID code as it appears in the original datafiles and/or reports).
	MESL_COMMENT	Text	255	MESL - comments.
ptbl - STATION				**Station information (sediment and tissue samples).**
	SITEID	Text	4	Site ID code (from Query Manager).
	STUDYID	Text	2	Study ID code.
	STATIONID	Text	10	Station ID code (this is the MESL_STATIONID, unless it exceeded 6 characters, then the QM_STATIONID was substituted).
	AREA	Text	50	Waterbody (corresponds with 'DB_AREA' theme in GIS projects).
	LOCDESC	Text	50	Reach (corresponds with 'Location Description' theme in GIS projects).
	EST_STN	Text	50	Code indicating how the geographic coordinates were obtained (R = reported; P = plotted in GIS based on a map from the report; E = estimated using site descriptions from report; U = unknown).
	LATITUDE	Number, Double	8	Geographical coordinates (decimal degrees).
	LONGITUDE	Number, Double	8	Geographical coordinates (decimal degrees).
	X-coord	Number, Double	8	Geographical coordinates (UTM Zone 15 NAD83 datum).
	Y-coord	Number, Double	8	Geographical coordinates (UTM Zone 15 NAD83 datum).
	MESL_LIBNO	Text	50	MESL - library number.
	MESL_EST_STN	Text	50	MESL - description of how the geographic coordinates were obtained.

Table 5. Continued

Table Name	Field Name	Data Type	Field Size	Table Description / Field Description
ptbl - STATION (cont.)				**Station information (sediment and tissue samples).**
	MESL_CORELENGTH	Text	50	MESL - core length (units are in meters). Note that this field has only been populated when the information has been readily available (electronic format).
	MESL_Habitat class	Text	50	MESL - relevant to R-EMAP studies only (STUDYID 04 & 06). Codes: 1 = Shallow area; 2 = Channel; 3 = Reservoir.
	MESL_LOCDESC2	Text	50	MESL - additional station location descriptions.
	MESL_COMMENTS	Text	150	MESL - comments.
	ORIGINALX	Number, Single	4	Draft: Originally reported X coordinate.
	ORIGINALY	Number, Single	4	Draft: Originally reported Y coordinate.
	ORIGINALCOORDS	Text	50	Draft: Original coordinate system.
ptbl - STUDY				**Study names and the types of data associated with each study.**
	SITEID	Text	4	Site ID code (from Query Manager).
	STUDYID	Text	2	Study ID code.
	STUDYNAME	Text	40	Study name.
	CONTACT	Text	40	Contact person/agency.
	SEDCHEM	Yes/No	1	Indicates if the study has surficial sediment chemistry data incorporated in the database.
	SEDTOX	Yes/No	1	Indicates if the study has sediment toxicity data incorporated in the database.
	SUBSURF	Yes/No	1	Indicates if the study has sub-surface sediment chemistry data incorporated in the database.
	LABACCUM	Yes/No	1	Indicates if the study has bioaccumulation test data incorporated in the database.
	TISSCHEM	Yes/No	1	Indicates if the study has tissue chemistry data incorporated in the database.
	BENTHIC	Yes/No	1	Indicates if the study has benthic infaunal data incorporated in the database.
	Location/Sampling Year	Text	40	Location and sampling year.
	MESL_LIBNO	Text	50	MESL - library number.

Table 5. Continued

Table Name	Field Name	Data Type	Field Size	Table Description / Field Description
ptbl - STUDYNOT				**Study notes.**
	SITEID	Text	4	Site ID code (from Query Manager).
	STUDYID	Text	2	Study ID code.
	NOTES	Memo	0	Notes.
	MESL_LIBNO	Text	50	MESL - library number.
ptbl - STUDYREF				**Bibliographic references for each study.**
	SITEID	Text	4	Site ID code (from Query Manager).
	STUDYID	Text	2	Study ID code.
	DOC_NO	Text	50	Unique document number.
	MESL_LIBNO	Text	50	MESL - library number.
	YEAR	Text	4	Publish year for report.
	AUTHORS	Text	160	Authors of the report.
	TITLE	Text	180	Title of the report.
	SOURCE	Text	160	Source (locations).
	STUDYCOMM	Text	160	Comments.

APPENDIX A

QUALITY ASSURANCE COMMENTS OF THE PHASE II GIS-BASED SEDIMENT QUALITY DATABASE FOR THE ST. LOUIS RIVER AOC

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QUALITY ASSURANCE COMMENTS OF THE PHASE II GIS-BASED SEDIMENT QUALITY DATABASE FOR THE ST. LOUIS RIVER AOC

BY PEGGY MYRE, EXA DATA & MAPPING SERVICES, INC., MARCH 9, 2005

I. Primary Key (PK) Assignments

1. Added PK to ptbl – STUDY (SiteID+StudyID) – OK.
2. Attempted to add PK to ptbl – STUDYNOT, but there were 2 notes w/out StudyIDs (general notes on summed fields), and also multiple note records (duplicates) for StudyID 15 (2), 16 (2), and 32 (3). Assume these notes can be concatenated into final single studynot for each study? See table Dup-StudyNot

RESOLUTION: Concatenated duplicate notes into one memo field for 3 studies (15, 16, 32). I did not delete the documentation-style notes, but added artificial StudyIDs (XX and YY). I assigned a primary key (SiteID+StudyID).

3. Attempted to add PK to ptbl – STUDYREF, but there are duplicates which should be addressed. Possibly there are multiple references grouped into one StudyID? See table Dup-StudyRef.

RESOLUTION: The MESL_LIB_NO was also not a unique Document Number. Added a Document Number so could start tracking the unique documents in relation to each Study. Assigned Document Numbers for existing studies by modifying current MESL_LIB_NO (e.g., SED/1398-1, SED/1398-2, etc.). Assigned a primary key (SiteID+StudyID+Doc_No) and related it to tblStudy.

4. Added PK to ptbl – STATION successfully (SiteID+StudyID+StationID).
5. Added PK to ptbl – SAMPLE and ptbl – SMPTISS successfully (SiteID+StudyID+StationID+SampleID+LabRep).
6. Copied duplicate CHEM records to table Dup-Chem for discussion (TBT – Sn).

RESOLUTION: Added TBT_SN to lkp – CHEMDICT. Was able to create primary key in ptbl – CHEM (SiteID+StudyID+StationID+LabRep+Chemcode). NOTE: Consider that eventually this project should have compatible dictionaries with NOAA QM (note empty fields in lkp – CHEMDICT that could be populated from QM's Chemdict file).

7. Added PK to ptbl – CHEMTISS successfully (SiteID+StudyID+StationID+SampleID+LabRep+ChemCode).
8. Added PK to ptbl – AVS_SEM successfully (SiteID+StudyID+StationID+SampleID+LabRep+ChemCode).
9. Added PK to ptbl – Mean PEC-Q successfully (SiteID+StudyID+StationID+SampleID+LabRep).
10. Attempted to add PK to ptbl – BIOSUMM using QM key fields (SiteID+StudyID+SampleID+TestID), but there are duplicates - see table Dup-Biosumm. These are probably the classic bioassay duplicate problem of multiple batches (therefore multiple negative control samples) for one study and TestID. SampleIDs for these

control samples should be modified for uniqueness. It is possible that the intended structure is to include the Series field, but I could not find the key field description for the Biosumm table in the Technical documentation or the User Guide.

RESOLUTION: I added unique control samples for multiple series for StudyID 06, created PK for Biosumm and was able to relate it to ptbl – SAMPLE.

11. Attempted to add PK to lkp – QUALIFY (see dup-Qualcode table). It looks like there was both U and < that were noted as U, probably should be merged into 1 records (Qualifiers = "U, <"). No problem with PK for any other lookup tables.

RESOLUTION: I was able to concatenate the two duplicate records and then make PK.

II. Check/Enforce Relationships (looking for orphan records)

1. Relationships between Study and StudyNot/StudyDup not 1:1 for duplicate reasons cited above.
2. No relationship in database between Study and Station? I added one and enforced relationship – everything OK.
3. Relationship between Station and Sample OK.
4. Temporarily made a unique key including units in Chem. Was able to create and enforce relationship between Sample and Chem, so no problems.
5. All ChemCodes in Chem table are represented in ChemDict.
6. Oddly, the Smptiss table was related to the Sample table rather than to the Station table. Two studies have both sed chem and tiss chem data, but the SampleIDS are clearly different so this is an error. I changed this relationship and enforce the relationship (no problems).
7. Able to create and enforce relationship between Smptiss and Chemtiss – all OK.
8. All species and tisscodes are represented in lookup tables from Smptiss – all OK.
9. All chemcodes in chemtiss represented in Chemdict – all OK.
10. One sediment chemistry qualifier definition missing (see Table MissQual).

RESOLUTION: Added qualifier to table.

11. Sample – Biosumm relationship OK.
12. All TestIDs in Biosumm represented in TestDict.
13. Relationship between Sample and AVS_SEM is OK.
14. All Chemcodes in AVS_SEM table are represented in ChemDict.
15. Relationship between Sample and PEC-Q table is OK.

APPENDIX B

SCREENING CRITERIA FOR EVALUATING BENTHIC INVERTEBRATE COMMUNITY DATA SETS FOR THE PHASE III GIS-BASED SEDIMENT QUALITY DATABASE FOR THE ST. LOUIS RIVER AOC

APPENDIX B

SCREENING CRITERIA FOR EVALUATING CANDIDATE BENTHIC INVERTEBRATE COMMUNITY DATA SETS FOR THE PHASE III GIS-BASED SEDIMENT QUALTIY DATABASE FOR THE ST. LOUIS RIVER AOC

BENTHIC INVERTEBRATE COMMUNITY CRITERIA:

MESL Library #: Date Printed:

First or Second Screener (or Combined):

Names of Screeners if the benthic invertebrate community data were evaluated during a different time period than the rest of the data set:

Phase III Database Screeners:

First Screener's Name: Date of First Screen:

Second Screener's Name: Date of Second Screen:

Phase IV Database Screeners:

First Screener's Name: Date of First Screen:

Second Screener's Name: Date of Second Screen:

1. Were standard operating procedures, documented guidance, or references used to collect, sort, preserve, and identify benthic invertebrates?
   Page reference:

2a. What QA/QC procedures were followed (e.g., list number of replicates/site)?
   Page reference:

2b. Were minimum data quality objectives met (i.e., stated in report)? Provide details.
   Page reference:

2c. If there are any indications that QA/QC procedures were insufficient and/or the data quality objectives were not met, indicate decisions made relative to these deficiencies. Note: for details regarding rationale/decisions, see the DECISION-MAKING SUMMARY worksheet.

Ancillary information

1. Did the study design include one or more reference and/or training sites (i.e., low/high impacted sites)?
   Page reference:

2. Were benthic invertebrates sampled in close proximity to sites where sediment samples were collected for sediment chemistry, physical measurements, toxicity tests, and/or bioaccumulation studies?
   Page reference:

3. What sampling device was used to collect benthic invertebrate samples and what was the surface area of it?
   Page reference:

4. Were water depth, sediment particle size, and TOC measured?
   Page reference:

5. What was the taxonomic resolution for identifying benthic invertebrates?
   Page reference:

6. Were deformities in Chironomid larvae observed (i.e., deformities in mouthpart structures)?
   Page reference:

7. What kind of benthic metrics were determined from the study (e.g., taxonomic categories, trophic level associations, functional feeding groups, behavioral mechanisms)?
   Page reference:

8. Were the data statistically analyzed to determine benthic community impairment (or lack of it)?
   Page reference:

APPENDIX C

LIST OF QUERY OPTIONS IN QUERY MANAGER VERSION 2.56

APPENDIX C

LIST OF QUERY OPTIONS IN QUERY MANAGER VERSION 2.56

The following information on available sediment query options in Query Manager version 2.56 was obtained from NOAA's web site at: http://response.restoration.noaa.gov/topic_subtopic_entry.php?RECORD_KEY%28entry_subtopic_topic%29=entry_id,subtopic_id,topic_id&entry_id(entry_subtopic_topic)=101&subtopic_id(entry_subtopic_topic)=5&topic_id(entry_subtopic_topic)=2). The type of query options are defined for all data types, sediment bioassay data, surficial sediment chemistry data, subsurface sediment chemistry data, and tissue chemistry data. Note that the MPCA's Query Manager-compatible database files are set-up so that users can chose to perform some of the queries with either the MPCA's sediment quality targets (SQTs; Crane *et al*. 2000, 2002) or the Wisconsin Department of Natural Resources sediment quality guidelines (SQGs; WDNR 2003). In contrast, these values are not expressly set-up in NOAA's Query Manager St. Louis River Watershed database that is available from their web site; instead, the consensus-based sediment quality guidelines (MacDonald *et al*. 2000) are provided, in addition to several marine/estuarine guideline values. Thus, users wanting to make comparisons to the Minnesota SQTs and Wisconsin SQGs should use the MPCA's Query Manager-compatible database files.

ALL DATA TYPES

- **Station Location by Study**: Shows station locations for selected studies.
- **Study Notes**: Brings up notes on the selected studies.
- **Study Reference**: Lists the reference citation for each study, if available.

SEDIMENT BIOASSAY

- **Station Location by Study**: Shows station locations for selected studies for sediment bioassay data.
- **Test Endpoints, Toxic/ Non-toxic Sample**: Shows toxic and non-toxic samples for selected endpoint or all endpoints.
- **Test Response Value Ranges**: Shows toxic and non-toxic samples and test response values in three user-defined ranges for the selected test endpoint.
- **Control-normalized Response Value Ranges**: Shows toxic and non-toxic samples and control-normalized test response values (ratio of test sample response to control response) in three user-defined ranges for the selected test endpoint.

SEDIMENT CHEMISTRY (SURFACE)

[upper depth = 0 and lower depth < 30.5 cm or 12 inches]

- **Station Location by Study**: Shows station locations for selected studies for sediment chemistry data
- **Concentration Ranges**: Identifies samples in three user-defined concentration ranges for selected studies for a selected chemical.

- **Sediment Quality Guideline (SQG) Pair: One Chemical**: The user selects from a list of 11 paired sediment quality guidelines and selects an individual chemical from the list of chemicals available for the selected guideline pair. Each sample is classified into one of three ranges defined by the guideline pair concentrations for the selected chemical.
- **SQG Pair: All Chemicals**: Determines the number of chemicals that exceed a user-selected SQG pair of low and high concentrations. The column with the lower concentration SQG represents the number of chemicals that exceeded the lower SQG but not the higher SQG. The column with the higher concentration SQG represents the number of chemicals that exceeded the higher SQG.
- **Compare to Selected Sediment Quality Guidelines**: Identifies samples in two ranges defined by the selected SQG concentration for a selected chemical.
- **Number of Chemicals in a Sample Exceeding Selected Guideline**: The user selects one SQG from the library of SQGs in the database and the results show the number of chemicals measured in a sample for the selected SQG and the number of those chemicals that exceeded the SQG.
- **Mean/Maximum SQG Quotients by Sample for Selected Guideline**: Determines the number of chemicals measured in a sample for the selected SQG or and the mean and maximum SQG quotient (ratio of the chemical concentration to the SQG concentration) for each sample for selected studies. The sum of SQG ratios and the standard deviation of SQG ratios for each sample are also calculated.
- **Select Multiple Chemical**s: Provides the user with data for selected chemicals and studies in a spreadsheet format, with columns for each chemical selected. User may select individual chemicals from the entire list of chemicals measured in selected studies, by chemical class, or by chemicals for a selected SQG. The user may also create or use a chemical list.
- **MultiChem SQG Quotients for selected SQG**: Provides the user with data for selected chemicals and studies in a spreadsheet format, with columns for each chemical selected. Instead of concentrations, however, the output table displays the ratio of the chemical concentration to its respective SQG concentration.
- **Sum PAH toxic unit model**: Calculates PAH toxic unit values according to three models: the U.S. EPA PAH toxic unit model Final Chronic Value (Di Toro *et al*. 2000) U.S. EPA PAH toxic unit model Final Acute value (Di Toro *et al*. 2000), and the Sum PAH model (Swartz *et al.* 1995). The user selects which model result to plot in MARPLOT and low and high ranges for the model chosen. The values for all three models are calculated and included in the output table.
- **Logistic regression model (LRM) probability of toxicity**: Logistic regression model (LRM) estimates the probability of toxicity for each sample based on the maximum (Pr_Max1) or the average (Pr_Avg1) probability from 37 individual chemical logistic regression models for marine amphipod 10-d survival endpoints (Field et al 2002). ***Note: this query only applies to marine and estuarine data sets.***

SEDIMENT CHEMISTRY (SUBSURFACE)

Subsurface sediment chemistry query output includes all sediment core samples (including the surface core segment) and also any sample that has an upper depth below the surface or has a

core length greater than 30.5 cm (12 inches). The user is also given the option to include all surface and subsurface sediment samples.

The subsurface queries are identical to their surface sediment query counterpart, except for the Maximum Concentration Ranges query. This query shows the maximum concentration for each station over all core segments in three user-defined ranges for the selected chemical.

- **Station Location by Study**: Shows station locations for selected studies for sediment chemistry data
- **Concentration Ranges**: Identifies samples in three user-defined concentration ranges for selected studies for a selected chemical.
- **SQG Pair: One Chemical**: The user selects from a list of 11 paired sediment quality guidelines and selects an individual chemical from the list of chemicals available for the selected guideline pair. Each sample is classified into one of three ranges defined by the guideline pair concentrations for the selected chemical.
- **SQG Pair: All Chemicals**: Determines the number of chemicals that exceed a user-selected SQG pair low and high concentrations. The column with the lower concentration SQG represents the number of chemicals that exceeded the lower SQG but not the higher SQG. The column with the higher concentration SQG represents the number of chemicals that exceeded the higher SQG.
- **Maximum Concentration Ranges**: Identifies samples in three user-defined concentration ranges for selected studies for a selected chemical. The range classification is based on the maximum concentration for the core if the core contains more than one sample. The output column, "Maxconc," is the highest concentration of all the samples taken at a given station.
- **Mean/Maximum SQG Quotients by Sample for Selected Guideline**: Determines the number of chemicals measured in a sample for the selected SQG and/or the mean and maximum SQG quotient (ratio of the chemical concentration to the SQG concentration) for each sample for selected studies. The sum of SQG ratios and the standard deviation of SQG ratios for each sample are also calculated.
- **Select Multiple Chemicals**: Provides the user with data for selected chemicals and studies in a spreadsheet format, with columns for each chemical selected. User may select individual chemicals from the entire list of chemicals measured in selected studies, by chemical class, or by chemicals for a selected SQG. The user may also create or use a chemical list.
- **MultiChem SQG Quotients for selected SQG**: Provides the user with data for selected chemicals and studies in a spreadsheet format, with columns for each chemical selected. Instead of concentrations, however, the output table displays the ratio of the chemical concentration to its respective SQG concentration.
- **Sum PAH toxic unit model**: Calculates PAH toxic unit values according to three models: the U.S. EPA PAH toxic unit model Final Chronic Value (Di Toro *et al*. 2000) U.S. EPA PAH toxic unit model Final Acute value (Di Toro *et al*. 2000), and the Sum PAH model (Swartz *et al.* 1995). The user selects which model result to plot in MARPLOT and low and high ranges for the model chosen. The values for all three models are calculated and included in the output table.

- **Logistic regression model (LRM) probability of toxicity**: Estimates the probability of toxicity for each sample based on the maximum (Pr_Max1) or the average (Pr_Avg1) probability from 37 individual chemical logistic regression models for marine amphipod 10-d survival endpoints (Field *et al*. 2002). ***Note: this query is not applicable to freshwater sediments.***

TISSUE CHEMISTRY

- **Station Location by Study**: Shows station locations for selected studies for tissue chemistry data
- **Concentration Ranges for all Samples for a Chemical**: Identifies samples in three user-defined concentration ranges for all tissue samples for a selected chemical. Allows for specification by taxonomic group or species and tissue type.
- **Select Multiple Chemicals**: Provides the user with data for selected chemicals and studies in a spreadsheet format, with columns for each chemical selected. User may select individual chemicals from the entire list of chemicals measured in selected studies, by chemical class, or by chemicals for a selected SQG. The user may also create or use a chemical list.
- **Mean Concentration by Location**: Calculates the mean tissue concentration for all samples of the selected species (or taxonomic group) and tissue type collected from the same location on the same date. Lipid-normalized concentrations are also calculated.
- **Tissue Residue Risk to Human Health:** Determines cancer risk or non-cancer risk to human health based on EPA or FDA guidelines.
- **Dioxin Toxic Equivalency**: Calculates the 2,3,7,8-TCDD (dioxin) toxic equivalency concentration for dioxin, furan, and PCB congeners based on the selected set of toxic equivalency factors (TEFs) for fish, birds, or mammals (van den Berg *et al*. 1998).