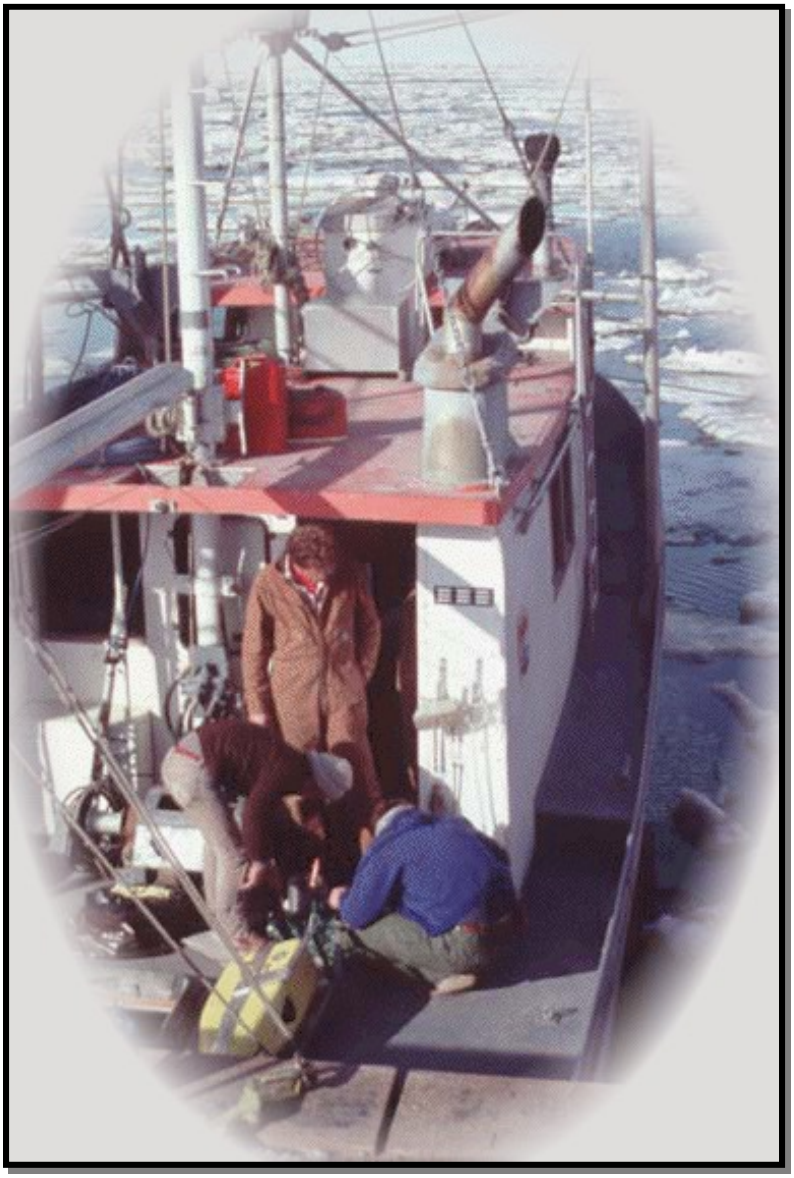
Advanced Monitoring Initiative
Arctic Coastal Integrated and Comprehensive Data Mining and Assessment Project Quality Assurance Project Plan



Evaluation of Historic Environmental Data Sets for Usability in Environmental Assessments

Prepared by
Douglas Dasher, P.E., Alaska Department of Environmental Conservation
And
Arny Blanchard, Ph.D., University of Alaska Fairbanks
August 2008

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Cover Photo: USGS R.V Karluk – Preparing gear at onset of spring ice breakup near the North Slope of Alaska in 1983. (http://walrus.wr.usgs.gov/infobank/programs/html/karluk/karluk.html)

Management Approvals

Signature indicates that the Research Plan and QAPP is approved and will be implemented in conducting the research of the project.

_____

Douglas Dasher, ADEC Division of Water EMAP *date*
AMI DEC Project Lead

_____

James Gendron, ADEC Division of Water, QA/QC Officer *date*
Division of Water QA/QC Officer

_____

Arny Blanchard, Ph.D., University of Alaska Fairbanks, *date*
AMI UAF Project Investigator

_____

Dixon Landers, U.S. EPA – WED, *date*
EPA Project Officer – C2000 Alaska

_____

Robert Ozretich, U.S. EPA –WED *date*
EPA QA/QC Officer – C2000 Alaska

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Distribution List

Alaska Department of Environmental Conservation

1. Douglas Dasher, Alaska Monitoring and Assessment Program
   Division of Water
   610 University Avenue, Fairbanks, AK 99709

2. James Gendron, QA/QC Officer
   Division of Water
   Juneau, AK

University of Alaska Fairbanks

1. Dr. Arny Blanchard, AMI Lead Project PI
   Institute of Marine Science
   P.O. Box 757200, Fairbanks, AK 99775

U.S. Environmental Protection Agency

1. Dr. Dixon Landers, Project Officer
   US EPA ORD Western Ecology Division
   200 SW 35th Street, Corvallis, OR 97333

2. Gretchen Hayslip
   US EPA Region X
   1200 Sixth Avenue, Mail Code: OEQ – 095
   Seattle, WA 98101

3. Robert Ozretich, EPA QA/QC Officer
   US EPA ORD Western Ecology Division
   200 SW 35th Street, Corvallis, OR 97333

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Project Management

A1 Project Task/Organization

A1.1 Purpose/Background

This pilot project assesses the usability of historic long-term environmental datasets for conducting *post hoc* Environmental Monitoring and Assessment Program (EMAP) assessments. With EMAP assessments just starting in Alaska, it will be years before resource managers can use "new" EMAP data to understand trends and changes in status over time. Can the process be "jump started" by using existing environmental datasets? Numerous marine environmental datasets have been collected over the past 30 years by various agencies in monitoring the oil and gas development activities on Alaska's North Slope. These can be used in determining the feasibility of conducting *post hoc* EMAP assessments in this region. This QAPP will define the process by which the historical datasets will be evaluated for usability in conducting post hoc assessments.

A1.2 Roles and Responsibilities

The Alaska Department of Environmental Conservation project lead, Douglas Dasher, has overall responsibility for managing the project. The lead University of Alaska Fairbanks Institute for Marine Science PI, Dr. Arny Blanchard, is responsible to the DEC project lead for managing the activities under the contract between DEC and UA, which is provided in Appendix A.

The UAF Co-PIs on this project, Drs. John Kelley, Sathy Naidu, and Stephen Jewett will because of their long history with oceanographic studies in the region of interest over the last 36 years provide expert guidance, act as sources and provide links to relevant historic data sets, help assess data quality, and provide input on the assessment and report, for which ADEC has the lead to put together.

Overall EPA, DEC, UAF and other key collaborators will be responsible to conduct QA oversight and document that the work meets this project QAPP. In the event that problems are encountered the parties will work together to resolve the problem.

A1.2.1 Collaborative Nature of the Project

DEC, UAF and EPA Office of Environmental Assessment staff in Region X, the Western Ecology Division of the National Health and Environmental Effects Research Laboratory (NHEERL), and the Environmental Sciences Division of the National Exposure Research Laboratory (NERL) will work closely together to evaluate the results of comparisons between the selected time periods from the 1970s' through 2004. For instance Dr. Tony Olsen will be working with us to help in the application of the EMAP statistical methodology to the historic dataset analysis. Dr. Dixon Landers, EPA ORD Western Ecology Division, and Gretchen Hayslip, EPA Region X, will help with our application of the data assessments and with our collaboration with the EPA Office of Environmental Information utilization of the Window to Readily Available Analytical Products (WRAP) software system. This collaborative approach utilizes the resources of the Alaska Department of Environmental Conservation, University of Alaska Fairbanks,

North Slope Borough, US Department of Interior Minerals Management, British Petroleum, and others to gather and collate the data.

A1.2.3 ADEC Lead Contact Information

Douglas Dasher, P.E.
Alaska Monitoring and Assessment Program Manager
Alaska Department of Environmental Conservation
610 University Avenue
Fairbanks, AK 99709
Ph: (907) 451-2172
Fax: (907) 451-5146
E-mail: doug.dasher@alaska.gov

A1.2.4 EPA Lead Contact Information

Dr. Dixon Landers
US EPA ORD Western Ecology Division
200 SW 35th Street
Corvallis, OR 97333
Ph: (541) 754-4427
E-mail: landers.dixon@epa.gov

And

Gretchen Hayslip
US EPA Region X
1200 Sixth Avenue
Mail Code: OEQ – 095
Seattle, WA 98101
Ph: (206) 553-1685
E-mail: hayslip.gretchen@epa.gov

A1.2.5 UAF IMS Personnel

Dr. Arny Blanchard
AMI Lead Project PI
Research Associate
University of Alaska Fairbanks
Institute of Marine Science
P.O. Box 757200
Fairbanks, AK 99775
Ph: (907) 474-1123
E-mail: fnalb@uaf.edu

A2 Problem Definition/Background

A2.1 Introduction

This QAPP establishes the criteria used to assess the quality and usability of historical data for potential use in the EPA *Advanced Monitoring Initiative Arctic Coastal Integrated and Comprehensive Data Mining and Assessment Project (AMI Project).*

Addressing this data gap and using EMAP assessment methods helps fulfill a key part of the State of Alaska's long term Water Quality Monitoring and Assessment Strategy that guides DEC's stewardship of Alaska's coastal waters. This project directly benefits the State of Alaska in its 305b reporting by filling in a significant data gap, as this historic data set has not been available for integration into past water body assessments.

A2.2 Describe the Approach

Alaska's Arctic Coastal Region has seen increased resource development with mining activity, existing oil industry development with possible expansion, and increases in populations in the coastal communities. Development of advanced observation systems are needed for a wide range of physical, biological, and chemical variables in order to evaluate the cumulative success of current environmental management policies and programs and identifying emerging problems before they become widespread or irreversible. Developing a coastal EMAP program to establish status and trends offers a powerful tool to resource managers applying the adaptive management approach to protecting environmental resources and promoting sustainability. Society as a whole has expended millions of dollars on the collection of various environmental data sets in the Alaska Arctic region and elsewhere in the United States. Yet there has been reluctance between agencies and other entities, to utilize "non-agency" datasets due to concerns with such difficulties, as inability to easily import or export information between datasets.

Before implementing new advanced observation methods or systems it is important to learn what we can from the large, sometimes uncoordinated, environmental studies that have occurred in the past in this region. First, is the existing baseline data collected since 1970 of sufficient scope and quality to conduct *post hoc* EMAP assessment of status and trends in this region? Secondly, can this historic environmental data help to focus and improve EMAP Arctic coastal survey methods?

The data recovery process will involve:

- Researching the existing datasets to establish what datasets, e.g. water chemistry, sediment metals, are complete enough to provide a time series from the 1970's to 2004.
- Selection of datasets applicable to the general EMAP sediment quality triad analysis approach, e.g., water chemistry, benthic communities, sediment chemistry.
- Review of data QA/QC to determine if the data are of sufficient quality for use in the *post hoc* EMAP status and trends assessment.
- Preparation of meta-data for these data sets to be provided with the final report and electronic distribution venues.

- Entry of selected recovered datasets into STORET, with integration into a GIS mapping system, such as Geographic Information Network of Alaska (GINA), are a final part of the data recovery process to assure long-term storage and access.

The probabilistic sampling design will be based on the generalized random tessellation survey design approach described by Stevens and Olsen (2004). The specific approach depends on the characteristics of the historical data set. One alternative is to focus only on estimating the change/trend in historical sites from 1970 to present. In this case a list of historical sites will be constructed. A subsample of the existing sites would be selected and analyzed. The subsample may be from a simple spatially-balanced survey design or a more complex design that stratifies by geographic region or other characteristics. This design provides estimates of change/trend but does not provide an estimate of current status over the study region unless assumptions are made about the representativeness of the historical sites. Historical status would be estimated by assuming the historical sites are either a representative simple random sample or a stratified random sample of the study region. Although none of the historical sites are revisited in the present, change can be estimated between the present and past in terms of difference in averages or cumulative distributions. Another alternative requires that the entire collection of historical sites provides sufficient geographic coverage of the study region to assume that the sites are a representative, although unequal probability, sample of the study region. In this case, an unequal probability sample of the historical sites would be based on the inverse of the density of the historical sites. The resulting sample would be an equal probability sample of the study region. This design would provide estimates of status at historical and present time periods, and provide estimates of change/trend. This alternative is preferred, but depends on ensuring the historical sites meet the assumption of representativeness.

Ideally, the minimum number of *post hoc* EMAP sample sites will be 30 and the maximum 50 to provide acceptable uncertainty bounds on the cumulative distribution functions generated in the statistical analysis. While dependent upon the resulting temporal and spatial data sets, we hope to conduct *post hoc* EMAP assessments within a 5 or 10 year cycle, starting in 1970. In the ideal case, data permitting, it will be possible to conduct *post hoc* EMAP assessment of status on samples collected within the same time period in a single year, with 4-6 years separating assessment periods. During this phase of the pilot project, EMAP statistical methods (Diaz-Ramos, et al., 1996), e.g. cumulative distribution estimates, will be calculated for the selected time periods of interest from the relevant data sets.

A2.3 Region Description

The region of interest for this pilot project covers estuaries and coastal waters of the Beaufort Sea from Point Barrow eastward to Demarcation Point, including both State and Federal waters. The area of interest covers approximately 24,000 km^2 or an area the size of Vermont. Figure 1 shows the region of interest.

A2.2.3 Historic Data Sources

Datasets will come from numerous marine environmental datasets that have been collected over the past 30 years by various agencies in monitoring the oil and gas development activities on Alaska's North Slope. The purposes of these investigations varied, ranging from general baseline characterization to preliminary trend assessments focused on anthropogenic contaminants related to oil and gas development. These datasets were collected by various agencies and universities with various objectives, field sampling and analytical methods may vary, and sampling time periods may reflect different seasons and years, for these reasons the analytical data may not be of comparable or equivalent quality for data evaluation purposes.

A2.2.4 Intended Data Usages

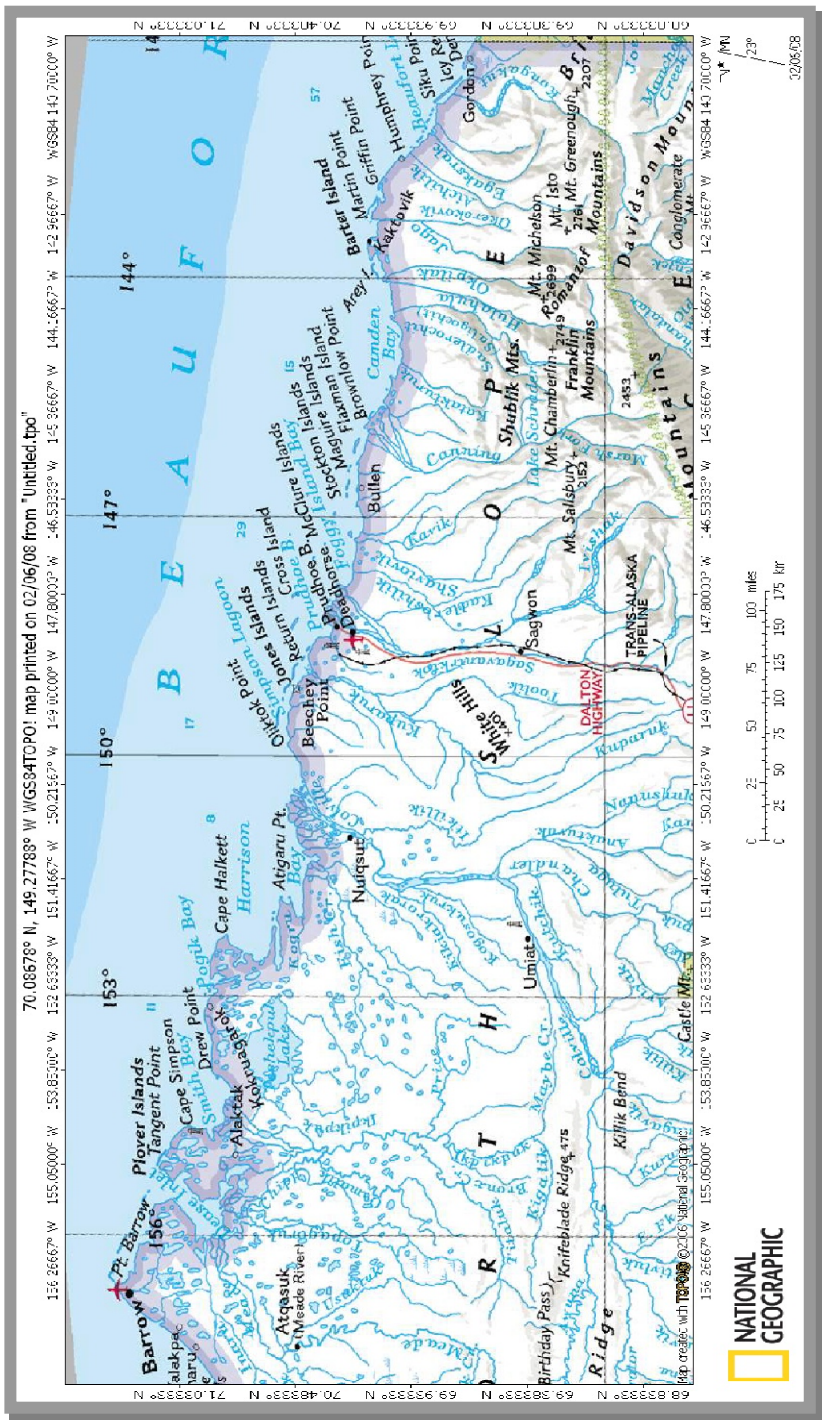
Primary application of these data sets will be to:

- Locate, reference, and standardize marine coastal data sets from 1970 through 2005 so that they are comparable and can be combined for data analysis implementation.
- Use select data sets meeting the QAPP to assess status and trends in spatial area % for indicators or stressors through retrospective data integration.
- Make available data sets along with data qualifiers for agencies and stakeholder use.
- Provide the opportunity to view the data spatially in GIS format.

A3 Data Collection

Our approach for this pilot project will systematically data mine the long-term (30 + years) marine environmental inventory, monitoring and research study datasets for the region of interest utilizing the resources of the University of Alaska Fairbanks, Alaska Department of Environmental Conservation, North Slope Borough, U.S. Department of Interior Minerals Management, British Petroleum, USEPA Region X and Office of Research and Development, and others to help gather and collate the data.

Figure 1 – AMI Region from Point Barrow to Canadian Border and Approximately 25 miles off-shore



B1 Data Quality Objectives and Data Usability Evaluation

B1.1 Data Qualitative Objectives and Criteria for Measurement Data

This section provides qualitative statements intended to help clarify the intended use of the data, define the type of data needed to support the project, and conditions under which the datasets are to be collected.

1. State the Problem: *Assess the quality and usability of historical data for possible use in the* EPA *Advanced Monitoring Initiative Arctic Coastal Integrated and Comprehensive Data Mining and Assessment Project (AMI Project).*

2. Identify the Decision: *Identify historical environmental datasets that will meet a minimum level of usability assessment of status and trends in the marine environment of the Beaufort Sea Shelf within the stated region of interest.*

3. Identify inputs to the decision: *All, within reasonable limits, historic environmental data collected within the study boundary will be screened and data sets meeting usability criteria will be used in the testing of spatial and temporal analysis methods to assess status and trends.*

4. Define the study boundaries: *Spatially it is the region bounded by 71.3 N to 71.4 N latitude and 156.68 W longitude to 69.24 N to 70.34N latitude and 141 W longitude. Temporally it covers the period from 1970 through 2005.*

5. Develop a decision rule: *Results of the spatial and temporal analysis will be assessed for statistical significance between regions or time periods. Data sets will also be evaluated against Alaska Department of Environmental Conservation, US EPA and others, NOAA, water quality criteria.*

6. Specify limits on decision errors: None for this pilot project.

B2 Data Usability Evaluation

First, for this effort the difference between data usability and data validity as used in this assessment needs to be clearly defined (Spreizer et al., 1992). Data validity points to the accuracy and precision of an individual data point, which is only, known if the field and laboratory methods are backed by a rigorous and documented QA/QC effort. The usability of historic data sets rests with the ability of the dataset as a whole to be indicative of the overall status or condition and to suggest potential trends in temporal or spatial data. In this view nothing can be said about the validity of individual data point.

Our objectives with this assessment of historic data is to use the data sets to depict both on a temporal and spatial scale, estimates of gross changes or trends, which include a linking with a probabilistic selection of historical data collections within a target population to estimate percentage area versus a sampled quantity, such as arsenic in sediments over the Beaufort Sea Shelf. Comparisons in this regards will be between the overall datasets qualitative pattern and not attempting to validate a particular data point. A consistent documented process will be employed to assess the overall quality of the historical data sets and to gauge their usability for this project. As this project is focused on usability of the datasets, it is important to keep in mind those differences or lack of

supporting data may only be of minor importance and that a degree of professional judgment by the project team must be allowed in the final acceptance of data sets.

B2.1 Data Screening for Usability

At this step the AMI project will prioritize data sets for completeness, comparability of methods and distribution within in geographical area of interests and through time period of interest for usability in our assessments.

B2.1.1 General Dataset Acceptability

This step of the data set usability assessment considers the level of historical documentation, standard practices, analytical method comparability, and quality assurance/quality control characteristics of the entire analytical data set associated with a data source (Smorong, et al., 2004). It is not a detailed QA/QC screening or validation of individual data points. The primary parameters used to review the quality of the data and establish categories of data usability are listed below.

1. Datasets must be collected within the region of interest and be georeferenced by documented latitude and longitude or qualitatively described as to water body and general location from a map source.
2. Documentation is provided on group or agency, and personnel collecting the datasets. This documentation must describe the time frame and general conditions of the dataset collection.
3. Documentation on procedures used for collecting, handling and storing the samples. While standard procedures (ASTM, USEPA, USGS, NOAA) are preferred, alternative procedures may be evaluated using best professional judgment. Decisions for accepting alternative procedures will be documented.
4. The chemical, tissue or physical analytical methods must be reported along with any QA/QC methods used. If the report author has stated and specified what QA/QC procedures were used and that they were met, the dataset will be accepted without additional data quality evaluation in B.
5. Documentation must be available on the analytical procedures/methods and detection limits used. One critical question will be the comparability of analayte results between different analytical methods. This will be assessed by looking for the presence of the following items:
    a. Units in which variables are measured are convertible to common metrics;
    b. Similar analytical and QA/QC procedures have been used for the datasets;
    c. In some cases, period of sampling, when seasonality is important, should be similar periods.
6. As the datasets are being screened for consistency over time and space the qualitative and quantitative evaluations conducted will likely benefit from larger datasets. A minimum database size of 20 data points has been established as a cut-off for the initial screening.

For guidance in assessing the analytical data quality using established USEPA criteria and guidelines for data quality, such as the *U.S. EPA National Coastal Assessment Quality Assurance Project Plan 2001-2004* (US EPA, 2001) and/or EPA's Contract Laboratory Program National Functional Guidelines for data review.

The results of this initial data acceptability screening will be documented and entered into an Excel spreadsheet. In the event that a need for professional judgment is necessary the, DEC project manager and the UAF PI, will jointly decide to accept or reject the data set for retention for further evaluation.

B2.1.2 Procedures for Final Screening of Datasets for Usability

In this step the datasets will undergo a more thorough screening using general statistical exploratory data assessment for quantitative analytical datasets, e.g. sediment trace metals, to help judge if the datasets as a whole present consistent patterns in the context of the region. Critical to this data set evaluation phase will be the use of common data exploration techniques (Sparks, 2000), such as descriptive statistics, e.g. mean, histograms, box and whisker plots, and scatter plots to evaluate patterns in the data sets This process while not meant to "validate" individual data points will assess outlier data points in regards to number and implications to the complete dataset under consideration.

B3 Acceptable Database Listing

All data sets evaluated will be listed in a table detailing the investigating agency, associated report titles, media types, analytical parameters, georeference parameters, timeline, and number of associated samples, as well as the QA/QC information that was used in the assessment process. Each data set will be assigned a usability category in the last column of the table. These categories are summarized below:

• **Category 1 – Data of Known Quality.** These data sets are fully supported by documented QA/QC protocols, sampling procedures, and do not have excessive outliers or non-detects and described are suitable for unrestricted use in this project. Data sets in this category will have adequate data supporting efforts at validating individual data points, which is beyond the scope of this project.

• **Category 2 – Data of Partially Known Quality**. These data sets are associated with more limited body of supporting information, but are considered useable for the scope of this project. The data set information at this level, though, is not considered adequate for validation of individual data points.

• **Category 3 – Data of Unknown Quality.** These data sets lack adequate level of supporting information or may have been rejected due to anomalous unexplainable patterns, lack of comparable seasonality with temporal data sets, inadequate QA/QC information, or other documented problem. While these data sets are not considered suitable directly for this projects use they may, depending on the reputability of the data sources, provide qualitative information that may be valuable when attempting to understand any spatial and temporal comparisons conducted under this project from the Category 1 and 2 data.

C1 Data Set Reduction and Processing Quality Checks

C1.1. Purpose/Background

Those data sets that are determined to meet either Category 1 or 2, and are determined to be the most representative for this pilot project, will either have the data translated electronically to the AMI project data set or will be entered manually from paper copies. The following describes the methods used to check both the electronically translated and manually entered data sets.

C1.2 Electronic Translated Data Sets

At least 10% of the translated electronic data, for example importing a comma delimited data set into Microsoft Access, will be checked using a random number generator to select stations. One person will read the data set stations results from a copy of the original untranslated data set, and the other person will verify the information on a hardcopy of the electronically entered data set, documenting any necessary changes.

C1.3 Manually Translated Data Sets

A 100% of the manually entered data will be checked, with one person reading the information from a hardcopy of the original data and the other person checking against a print out of the manually entered data set.

D1 Documentations and Records

All electronic and paper copies of data reports, screening summaries, and other work products will be archived for a period of six years at the Alaska Department of Environmental Conservation, Fairbanks, Alaska, and office. After six years, DEC will determine if this material needs to be archived for a longer period of time.

Matching datasets of all paper and electronic data sources that are acquired or generated during the project, whether or not they contributed to the project reports and/or manuscripts, will be sent to the EPA project manager for EPA use and archiving.

E References

Diaz-Ramos, S., Stevens, D.L., Jr and Olsen, A.R. 1996. *EMAP Statistical Methods Manual. Rep. EPA/620/R-96/002*, U.S. Environmental Protection Agency, Office of Research and Development, NHEERL-WED, Corvallis, Oregon. http://www.epa.gov/nheerl/arm/documents/intro.pdf

Smorong, D.E., Mackenzie, C.L., Crane, J.L., MacDonald, D.D., Fisher, L.J., and Huntington, C.A. 2004. Phase II GIS-Based sediment quality database for the St. Louis River Area of Concern (AOC). MacDonald Environmental Sciences Ltd., Nanamio, BC and Minnesota Pollution Control Agency, St. Paul, MN. (http://www.pca.state.mn.us/publicaitons/tdr-fg04-03.pdf)

Sparks, T. (Ed) 2000. Statistics in Ecotoxicology. Ecological & Environmental Toxicology Series, John Wiley and Sons, England.

Spreizer, G.M., Calbrese, T.J., and Weidner, R.S. 1992. Assessing the Usability of Historical Water Quality Data for Current and Future Applications. Current Practices in Ground Water and Vadose Zone Investigations, ASTM STP 1118, David M. Nielsen and Martin N. Sara, Eds., American Society for Testing Materials, Philadelphia.

Stevens, D. L., Jr. and A. R. Olsen 2000. "Spatially-balanced sampling of natural resources." Journal of American Statistical Association 99(465): 262-278.

US EPA. 2001. Environmental Monitoring and Assessment Program (EMAP): National Coastal Assessment Quality Assurance Project Plan 2001 – 2004. United States Environmental Protection Agency, Office of Research and Development, National Health and Environmental Effects Research Laboratory, Gulf Ecology Division, Gulf Breeze, FL. EPA/620/R-010/002.

Appendix A - Data Set Screening Check Sheet for Historic Data Sets Usability Evaluation

Data Set Screening Check Sheet for Historic Data Sets Usability Evaluation

The following criteria provide guidelines for the screening of potential data sets to assure general consistency in the information that will be reviewed and, if judged acceptable for specific purposes will be included in the final database.

General Criteria for Evaluating Data Set Acceptability

1. Samples must be located within a region covering the estuaries and coastal waters of the Beaufort Sea from Point Barrow eastward to Demarcation Point, including both State and Federal waters. See Figure 1 in the preceding section of the QAPP.

2. All sample locations must be georeferenced. Ideally, the sampling locations should be referenced by GPS or Loran information providing latitude and longitude or other suitable georeferenced coordinate, such as UTM. The method of obtaining coordinates should be detailed, along with all applicable information available, such as geographic datum and GPS or Loran instrument details. For data sets where locations are referenced by maps the coordinates should be checked and estimated using GIS software. Appropriate notes should be placed in the data base in regards to the methods used to obtain the sample site coordinates.

3. Documentation must sufficient to determine the types of acceptable procedures that were used for collecting, handling and storing samples. Acceptable procedures [ASTM, NOAA, USGS, EPA or other specific to the sampling project] must be described and current for the time frame that the sampling occurred within. The reviewer must use best professional judgment and clearly document decisions when accepting data sets with minimal descriptions of procedures.

4. The chemical analytical methods used for sample analysis must be reported. For data sets within the period from 1995 to today, detection limits must be reported, and the report must at least state that QA/QC procedures were followed and met. Older data sets will require data quality to be evaluated as described earlier in this QAPP using various protocols and best professional judgment. In the event that best professional judgment must be used the rational for the decisions regarding acceptability of the data set must be documented.

Appendix B - Data Quality Check Sheet for Entered Data Sets

Data Quality Check Sheet for AMI Project Database

STUDY NAME/STUDY ID: _____

DATA ENTRY/TRANSLATION DATE: _____

QA/QC DATE: _____

MS™ EXCEL FILE NAME: _____

MS™ ACCESS FILE NAME: _____

STEP #2 QA/QC CHECKS FOR TRANSLATED DATA COMPLETED:
Name of Reviewer #1 (print): _____ Initials/Date:_____
Name of Reviewer #2 (print): _____ Initials/Date:_____

STEP #3 QA/QC CHECKS FOR MANUALLY-ENTERED DATA COMPLETED:
Name of Reviewer #1 (print): _____ Initials/Date:_____
Name of Reviewer #2 (print): _____ Initials/Date:_____
Initial and date to verify that changes incorporated: _____

Step #1: DOCUMENTATION

The following information must be verified and documented prior to entering data into the final project database.

Metadata description of Study _____
PDF copy of any report the accompanied the data sets _____
Hard copy of any dataset report for file or library _____
Name of Reviewer (print): _____ Initials/Date: _____

Step #2: QA/QC PROCEDURES FOR VERIFYING TRANSLATED DATA

For data sets that are received electronically and then processed into Excel, Access or similar data base the following steps are required as part of the QA/QC check of the data translation process, once the data has been translated.

1. Using a random number generator, such as that provided in Excel, select a number of stations and chemicals to check, ensuring that at least 10% of the data are checked.

2. One reviewer reads the following data from a printed copy of the original data file or hardcopy: site number, chemical name, analysis result, units, and qualifiers.

3. Upon verification the translation reviewer places a checkmark in the translated electronic data base and the reviewer with the original data file also checks their hardcopy to confirm that the data was verified.

4. Upon encountering errors, the reason for the error is investigated. Methods to correct the error must be documented.

5. The signed and dated original data checking sheets are retained on file for the time period required in this QAPP.

6. Future errors and subsequent changes for each dataset will be noted in attachments to the original data checking sheets.

Step #3: QA/QC PROCEDURES FOR VERIFYING MANUALLY ENTERED DATA

All data entered manually from hardcopies must be 100% verified using the following steps after the data is entered into a spreadsheet or other database. Manually entered data will be 100% verified.

1. One person will, using a printed copy of the original data set that includes, at a minimum: site number, chemical name, analysis result, units, and qualifiers, read the data while another person with a hardcopy of the electronically entered data set verifies the information by putting a checkmark on the hardcopy.

2. Errors encountered must be investigated, corrected and documented. In the event that the error is systemic in the electronically entered dataset the error is first corrected and another hardcopy created before resuming data checking.

4. One person will incorporate any corrections into the electronic data file.

5. Another person will check that the corrections have been correctly incorporated by indicating this with a different colored checkmark on the hardcopy and this person signs and date the hardcopy (indicating changes have been incorporated).

6. The signed and dated original data checking sheets are retained on file for the time period required in this QAPP.

7. Future errors and subsequent changes for each dataset will be noted in attachments to the original data checking sheets.

Appendix D - Example of Table used to Log Data Set Information

Example of Table used to Log Data Set Information

Project #	Project name	Primary Investigator	Group or Agency	Sample Type	Years	Locations	Gear	Methods	QA/QC	References	Data file
0001	Aspects of Size Distributions, Clay Mineralogy and Geochemistry of Sediments of the Beaufort Sea and Adjacent Deltas, North Arctic Alaska	Sathy Naidu	IMS	sediment size, carbonate, heavy metals, clay minerals	1971-1982	Harrison Bay, Stephanson Sound, Beaufort Sea, Simpson Lagoon	grab, core, vibrocore	sieve-pipette technique; dispersion/settling technique, glycolation expansion followed by semi-quantitative estimation; manometrical determination of carbonates, LECO TC-12 automatic carbon determinator; atomic absorption spectroscopy, graphite furnace		Naidu 1982 references.pdf	Beaufort Sea 1971-1980 raw data spreadsheet.xls
0002	Sources, transport pathways, depositional sites and dynamics of sediments in the lagoon and adjacent shallow marine regions, northern arctic Alaska	Sathy Naidu	IMS	sediment size, mineralogy, organic carbon, nitrogent, carbonate, metals	1980-1981	inner continental margin of Alaskan Beaufort Sea especially Simpson Lagoon and Beaufort Lagoon	LANDSAT II & III, gravity core, grab, sediment traps	filter water samples for determining volume of particulates, partitioning of Mn by neutron activation, 210Pb analysis, dispersion/settling technique, glycolation expansion followed by semi-quantitative estimation		Naidu 1981 references	Beaufort Sea 1971-1980 raw data spreadsheet.xls