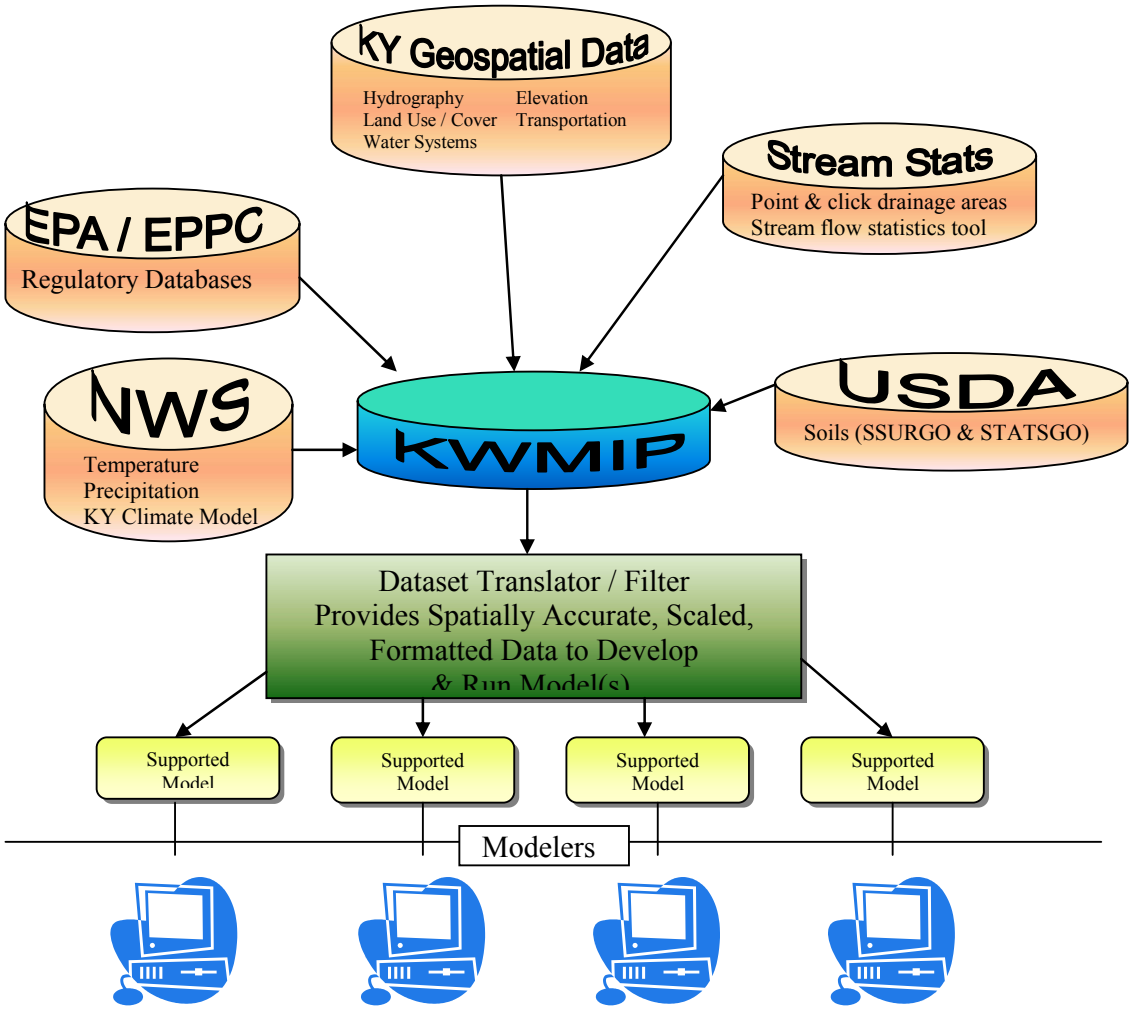
KENTUCKY WATERSHED MODELING INFORMATION PORTAL

USE CASE

March 14, 2006

FINAL



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March 14, 2006 O.1.1.LV2004107R01

Mr. Gary Harp
Director
Division of Geographic Information
1025 Capital Center
Frankfort, Kentucky 40601

Re: Final Use Case Report
Kentucky Watershed Modeling Information Portal

Dear Mr. Harp:

Enclosed please find the Final Use Case Report for the Kentucky Watershed Modeling Information Portal (KWMIP). This Report describes KWMIP provides the functional context to the KWMIP User Needs Assessment and summarizes the input from the Project Partners and Technical Advisory Group. The Use Case has highlighted the value and importance of the Kentucky GeoNet as one of the major data services for KWMIP.

The User Needs Assessment, this Use Case and the Data Matrix formed the basis for the Request for Quotations issued by the Open Geospatial Consortium on March 3, 2006. This interactive approach is well suited to ensuring that the portal meets the needs of DGI and your constituency and the larger community of Kentucky water resource managers.

Thank you for the opportunity to support the Division of Geographic Information on this important project. We are looking forward to working with you as this project continues.

Respectfully submitted,

FULLER, MOSSBARGER, SCOTT AND MAY
ENGINEERS, INC.

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/kae

Enclosures: 1

Final Use Case Report

Kentucky Watershed Modeling Information Portal

Prepared for:
Division of Geographic Information
Frankfort, Kentucky

March 14, 2006

Final Use Case Report
Kentucky Watershed Modeling Information Portal

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Appendix A TAG Meeting Participants (Dec. 2005)

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Appendix D Watershed Delineation in Karst Areas

Acronyms and Abbreviations

AnnAGNPS	Agricultural Non-Point Source Pollution Model
AquaTox	Aquatic Toxicity
BASINS	Better Assessment Science Integrating Point & Nonpoint Sources
COT	(Kentucky) Commonwealth Office of Technology
DEM	Digital Elevation Model
DOQQ	Digital Orthorectified Quarter Quadrangles
DSS	Decision Support System
EFDC	Environmental Fluid Dynamics Code
EIEN	Environmental Information Exchange Network
EPD-RIV1	(Georgia) Environmental Protection Division Dynamic One-Dimensional Model of Hydrodynamics and Water Quality
EPPC	Environmental and Public Protection Cabinet
FDI	flow duration interval
FEMA	Federal Emergency Management Agency
FMSM	Fuller, Mossbarger, Scott and May Engineers, Inc.
GeoHMS	(HEC) Geospatial Hydrologic Modeling Extension
GeoRAS	(HEC) Geographic River Analysis System
GIS	Geographic Information System
HEC	Hydrologic Engineering Center
HMS	(HEC) Hydrologic Modeling System
HSPF	Hydrological Simulation Program—Fortran
HUC	Hydrologic Unit Code
KDOW	Kentucky Division of Water
KGS	Kentucky Geologic Survey
KLC	Kentucky Landscape Census
KLS	Kentucky Landscape Snapshot
KSS	Kentucky Speleological Survey
KWMIP	Kentucky Watershed Modeling Information Portal
LA	Load Allocation (TMDL nonpoint source component)
LSPC	Loading Simulation Program in C++
MDAS	Mining Data Analysis System
MODFLOW	Modular Three-Dimensional Groundwater Flow Model
MOS	Margin of Safety
MOVEM	WASP Post-processor
NCDC	National Climatic Data Center
NHD	National Hydrography Dataset
OGC	Open Geospatial Consortium
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance Quality Control
QUAL2K	River and Stream Water Quality Model
RAS	(HEC) River Analysis System
ResSim	(HEC) Reservoir System Simulation program

Acronyms and Abbreviations

STATSGO	State Soil Geographic (NRCS 1:250,000 soils coverage and database)
SSURGO	Soil Survey Geographic (NRCS 1:24,000 soils coverage and database)
SWMM	Storm Water Management Model
TAG	Technical Advisory Group
TMDL	Total Maximum Daily Load
UNA	User Needs Analysis
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WAMView	Watershed Assessment Model (View)
WASP	Water Quality Analysis Simulation Program
WCS	Watershed Characterization System
WLA	Wasteload Allocation

Executive Summary

In September 2004, The Kentucky Commonwealth Office of Technology (COT) was awarded a $750,000 Cooperative Agreement from the US Environmental Protection Agency to develop the Kentucky Watershed Modeling Information Portal (KWMIP). KWMIP is a web-based portal that provides watershed model input data. The ultimate goal of the project is to enhance the use of watershed modeling in Kentucky's environmental decision-making. Project partners are COT, Kentucky Department of Environmental Protection's Division of Water, US Geological Survey, the Open Geospatial Consortium (OGC) and the US Environmental Protection Agency (USEPA).

In order to provide solutions that meet the needs and intent of the end users, OGC has developed a systematic process for obtaining user input and feedback. This process includes forming a user group to provide necessary input, conducting a ***User Needs Analysis*** to clearly articulate needs for the end product and a ***Use Case***, which describes the functions the system should perform. These components are integrally linked to ensure that the final system functions as initially intended. Otherwise, a collection of individual subroutines that does not operate as an integrated system may be developed. A request for proposals (RFP) will be issued by OGC to select a contractor to build and install the portal based on the criteria articulated in the User Needs Analysis and Use Case.

A Technical Advisory Group (TAG), consisting of future portal users from agencies, academia, non-profits and consultants, was formed in August, 2005. The Project Partners used an open process to identify and invite over 80 individuals to participate on the TAG. Through conferences and professional contacts, new TAG members continue to join the group.

The TAG met in August, 2005 and advised the Project Partners regarding model selection and datasets that should be accessed through KWMIP. Results of these meetings have been reviewed by the TAG and published in October 2005. The report is available on the documents page of the KWMIP website: http://kwmip.ky.gov/projectdocs.htm

This KWMIP Use Case document was drafted by the Project Partners to describe KWMIP functions, user interactions and services in more detail. This document describes user registration and login, model selection, data preview, data selection, data transformation and delivery and user community support. User community support includes the data registry, data standards, training materials and help, list serve and feedback services. The draft Use Case document was discussed with Project Partners on December 8, 2005. See **Appendix 1** TAG Participants List. Their input resulted in improvements to the Use Case document, and guides the development of KWMIP products.

This document includes the draft ***Data Matrix*** which provides an overview of approximately 80 spatial and tabular data layers that the Project Partners and TAG identified as relevant to the models that are being evaluated for inclusion in KWMIP. Although the Data Matrix needs additional discussion, review by the Project Partners has highlighted the richness of Kentucky's geospatial data and the availability of that data for viewing and downloading from the Kentucky GeoNet http://kygeonet.ky.gov/ and related sites. A recommendation to serve as many data layers as possible from the KYGeoNet is being explored. The TAG met on February 28, 2006 to discuss the Data Matrix. The meeting participants identified and prioritized additional data layers available from GeoNet that would be useful for KWMIP.

Final Use Case Report

Kentucky Watershed Modeling Information Portal

1. Introduction

In September 2004, The Kentucky Commonwealth Office of Technology (COT) was awarded a $750,000 Cooperative Agreement from the US Environmental Protection Agency to develop the Kentucky Watershed Modeling Information Portal (KWMIP). KWMIP is a web-based portal that provides watershed model input data. The ultimate goal of the project is to enhance the use of watershed modeling in Kentucky's environmental decision-making. Project partners are COT, Kentucky Department of Environmental Protection's Division of Water, US Geological Survey, the Open Geospatial Consortium (OGC) and the US Environmental Protection Agency.

The Kentucky Watershed Modeling Information Portal (KWMIP) will be designed to quickly and accurately provide clipped and formatted watershed model input data for 2 -5 supported models. KWMIP will also deliver temperature and precipitation data from the Kentucky Climate Model, developed by USGS as a component of this project. The KWMIP project includes training for water resources managers to enhance understanding of the uses of modeling in decision–making and training for modelers on the use of KWMIP. Plans to support system operation and maintenance, perhaps through user fees from non-governmental users, will be developed.

A Technical Advisory Group (TAG) consisting of future portal users from agencies, academia, nonprofits and consultants, are advising the Project Partners regarding model selection, and key model input datasets, identifying portal functions and training needs. The TAG will participate in document review and beta-testing the portal. Over 80 individuals were invited to participate on the TAG and 38 participated in one or both days of User Needs Analysis (UNA) meetings held in August 2005.

The TAG identified common use of 24 models for technical analysis and water resources management decisions. A "short list" of 10 watershed models and 2 tools were identified for further consideration in KWMIP, with emphasis on components of the USEPA's Region IV Modeling Toolbox to support development of Total Maximum Daily Loads. The results of UNA meetings are discussed in detail in the *User Needs Analysis Report – Final (Oct 18, 2005).*

During the UNA meetings, the TAG began the process of identifying important portal functions and this Use Case document is intended to capture those key functions in terms of user interaction with the KWMIP system. The most recent TAG meeting was held on February 28, 2006. At this meeting the Data Matrix was discussed and TAG members identified and prioritized additional data layers available from GeoNet that would be useful for KWMIP. A copy of the entire Data Matrix (dated 02/28/06) is available on the KWMIP project website at http://kwmip.ky.gov/technical.htm

A subcommittee of the TAG is developing a "Data Matrix" that summarizes the data needs for each of the short-listed models and summarizes the capabilities of the tools. The Draft Data Matrix is provided as **Appendix B** and includes the following worksheets:

- ***Models and Contacts:*** Data Matrix Subgroup contact and web-site for each short-listed model and tool.

- ***Model Summary:*** Identifies the basic data needs for each short-listed model in a simple "yes-no" format. To date, the Model Summary has been completed for 9 of 10 short-listed models and includes 69 watershed model input datasets. The Model Summary includes the number of times each data set was used across all models. This simple summary gives insight into the relative importance of KWMIP supporting the dataset. For example, stream flow was used in 8 of 9 short listed models for which the Model Summary has been completed. By contrast, time of solar noon is used in only one of the short-listed models.

- ***KWMIP from GeoNet:*** Identifies over 80 layers from the KY GeoNet that are used directly in the watershed modeling or would provide useful supplemental information. The ability to download these pre-formatted data through KWMIP would be beneficial. Over 60 additional data layers that would also be beneficial to view (but not download) through KWMIP were also identified.

The User Needs Analysis, Use Case and Data Matrix formed the basis for a Request for Proposals (RFP). The RFP was issued by OGC in March 2006 to select a contractor to build the portal.

2. Scope and Purpose

This Use Case document and the accompanying Data Matrix provide the business and functional context to the KWMIP User Needs Assessment (UNA) report by introducing a Use Case that includes the requirements from the UNA.

The following objectives and metrics quoted from the proposal are included in this Use Case document to emphasize the objectives and metrics that the project is designed to meet. These objectives and metrics will be integrated to the extent possible into the KWMIP design. This is to ensure that the project meets its original intent and to build the necessary tracking tools for performance measure reporting into KWMIP.

Objectives:

- Increase the frequency of watershed model use to support environmental decisions
- Improve modeling efficiency and quality by serving appropriately formatted data over the web and providing a spatially distributed precipitation model
- Leverage existing and developing KY and national data by train KY water resource managers and modelers on the value of modeling, the KWIMP and supported models
- Establish mechanisms to provide technical and financial stability for KWIMP beyond this project
- Validate and extend work of OGC to define and develop vendor neutral service interfaces to water modeling component software.
- Interface to the current Environmental Information Exchange Network (EIEN) and allow for future inclusion/expansion to KY node (in development)

Performance Measures

This project will support EPA's cross-cutting environmental information strategy detailed in the USEPA Strategic Plan, which includes the following desired outcome:

By 2008: Enhanced information integrity, analysis and access strengthened by software tools and the collection of quality and appropriate data.

This project will enhance environmental results through the improved use of quality environmental information to:

- Promote environmentally beneficial action
- Improve environmental decisions
- Promote more environmentally responsible attitudes
- Improve knowledge.

The following performance measures are suggested to evaluate overall performance of this project. Additional and/or modified measures may be developed as part of the project. The results of a "user survey" will provide an information source from which these measures can be developed. In addition, specific targets may also be developed (i.e., to train a certain number of people.

- ✓ Data exchange with partners (i.e., number of agencies, firms and individuals who are trained on the KWIMP)
- ✓ Narrative estimates of data quality improvements due to KWIMP
- ✓ Narrative estimates of improved efficiency (i.e., time and cost savings) due to KWIMP availability

Over the long term, the following measures could provide additional performance evaluation of KWIMP, but data are not expected to be available by this project's conclusion.

- ✓ Frequency of data exchanges (i.e., number of KWMIP & "web-hits" over time)
- ✓ The number of environmental decisions and projects that included the use of KWIMP

3. Definitions

> *"In software engineering, a **use case** is a technique for capturing the potential requirements of a new system or software change. Each use case provides one or more **scenarios** that convey how the system should interact with the end user or another system to achieve a specific business goal. Use cases typically avoid technical jargon, preferring instead the language of the end user or domain expert. Use cases are often co-authored by software developers and end users[1]."*

In KWMIP, we will adopt the basic definition above with the following adjustments:

[1] Wikipedia, http://en.wikipedia.org/wiki/Use_case, July 2005

Master Use Case—an abstract, high-level use case that is intended to provide a business requirements context for the use cases that will be used in KWMIP. This context provides a clear connection between the business of the Commonwealth Office of Technology and the service provided by KWMIP.

Use Case—a more concrete use case that is intended to provide functional requirements context for KWMIP by looking at a hypothetical system within the Master Use Case business context.

Scenario—an element of a use case that conveys how a hypothetical system should interact with the end user or another system to achieve a specific use case sub-functional goal.

4. Master Use Case

This section provides a complete description of the Master Use Case for KWMIP. It includes background on watershed modeling and then proceeds to outline the use case in industry-standard use case fashion.

4.1. Background—Watershed Modeling

An overview of watershed modeling is provided for immediate context. The UNA participants defined watershed models as ground-water, overland and in-stream simulation of water quality and/or quantity, typically based on credible data. A model may be a computer program, a database analysis or spreadsheet. A model is used as a decision-support tool.

USEPA defines watershed models as tools for simulating the movement of precipitation and pollutants from the ground surface through pipe and channel networks, storage treatment units and finally to receiving waters. Both single-event and continuous simulation may be performed on watersheds having storm sewers and natural drainage, for prediction of flows, stages and pollutant concentrations. Each model has its own unique purpose and simulation characteristics. [2]

Watershed modeling typically includes the steps described below. It is important to note that KWMIP is intended to automate some data compilation and formatting for supported public domain models and some features will assist with data quality evaluations. The modeler will perform all other aspects of watershed modeling on their computer.

Define the Study Area: The modeler will use KWMIP to define a study area using a pre-defined watershed boundary (i.e., HUC), or a buffered HUC. KWMIP will also provide data so that the user can delineate a watershed boundary on their desktop and upload the user defined boundary to KWMIP. KWMIP will use the Study Area boundary to clip model input datasets.

Model Selection: Model selection is typically based on available data to address the question, knowledge and training of the modeler, time and resources to complete the project. KWMIP may include links to model selection tools developed by USEPA.

[2] Source: http://www.epa.gov/waterscience/wqm/

Preview Available Data: The modeler typically searches publicly available databases for spatial and numerical data to preview and evaluate available data. KWMIP will allow the user to preview and select some model input data. KWMIP will transform and format the data for use in supported models.

A Data Registry is recommended to be included in KWMIP. The Registry service will allow KWMIP users and others to register available data that is not available in large publicly available data sets. As currently envisioned, KWMIP users would contact the data owner to retrieve data. Optional templates would be available for download from the KWMIP website to facilitate standardization of these datasets. Ideally the Registry will enhance communication in the monitoring and modeling community and improve model quality as broader knowledge of local data is gained.

Compile Data: Watershed models require a variety of input datasets such as hydrography, land use, stream flow, water quality, soils, air temperature, and precipitation. These datasets are compiled by the modeler from a variety of sources, many of which are web-based. For numerical data (e.g., stream flow, water quality), the modeler may generate a coverage of monitoring stations using tabular locational data to select stations of interest. The Data Matrix includes information about data requirements for the short-listed models that KWMIP may support.

Format Data: The modeler converts the data to the format required for the model. For spatial data (e.g., hydrography, land use, soils), the modeler typically uncompresses the data, reprojects data into a single projection, merges and clips the data to the study area. For numerical data, delimited text files of relevant data are formatted for the model. One of the key goals of KWMIP is to automate the processing of geographic data so that the modeler receives a zip file of merged, clipped data in a uniform datum and projection that are ready to use. Ideally, KWMIP will also serve some numerical data in an intermediate or final form.

Quality Assure Data: A series of data checks are usually run to evaluate raw data quality and to check the quality of data transformations. For example, digital ortho quarter quadrangles (DOQ's) can be used to evaluate and update land use coverages. Stream flow and water quality data can be checked for outliers. Time series data (e.g., stream flow, precipitation) may have missing records. Interpolation methods are used to estimate missing values to complete the record. Data quality checks will be performed by the modeler on their desktop. A log of KWMIP data transformations will be downloaded in the user's data package.

Manage Data: The modeler typically uses a system of directories to manage raw and processed data, model input and output files. Data management for model input files may be dictated by the model. To the extent possible, KWMIP data retrievals should facilitate set up of model input files on the modeler's computer.

Develop the Model: The modeler inputs local data into the model and sets model parameters and assumptions. The user will perform this function.

Run the Model: The modeler runs the model to calibrate it (i.e., adjusts model parameters and assumptions so that the model simulates actual conditions as described by available data). The model is validated by conducting model runs with the calibrated model for a variety of conditions and evaluating results against available data. Once the model is

calibrated and validated, scenarios are run to simulate implications of watershed changes (e.g., new wastewater discharge, land use changes). The user will perform this function.

Report Results: Model results are typically reported using text, maps, tables and graphs. If the model was done to support a Total Maximum Daily Load, USEPA reporting requirements may be required. The user will perform this function.

4.2. Master Use Case

UNA Participants identified the following as a candidate list of automated KWMIP functions:

- **Access To Data**: Find, Preview, Select data that is needed to support a user-selected watershed model

- **Metadata**: includes data characteristics and geographic extent. Metadata should be provided by the data owner and should be accessible.

- **Provide Data**: raw, geoprocessed (i.e., orthorectified, projected, clipped to study area extent) and formatted for specific model input. Unit conversion specific to needs of model or specified by user.

- **KWMIP Data Catalog:** Catalog of data that KWMIP will access and format. Access may be real-time or from a KWMIP server. The server option is being discussed to facilitate availability of large, complex, relatively stable data through KWMIP, soils and Legacy STORET data, for example.

- **Data Registry**: A location where those who generate data that are not stored online can register their databases with KWMIP. The registry would include nonstandard datasets such as academic studies, volunteer data, and data outside the KWMIP geographic and temporal boundary. The searchable registry will include basic information about the dataset and contact information. Consider using the FEMA data capture standard to allow KWMIP to access FEMA registry and catalog.

- **Data Standards**: Data standards and standard formats so that those who generate data will be able to standardize their data acquisition, management, formatting to facilitate use by KWMIP modelers through the Data Registry. Data standards include: Environmental Data Standards, COMPASS Standards, Environmental Information Exchange Network Standards (EIEN), and Federal Geographic Data Committee (FGDC).

- **Training Materials:** Training materials used to train KWMIP users on the use of the portal and water resources managers on the use of models in decision-making will be available for on-line viewing and download.

5. Use Case

As currently written, the Use Case begins with the log-in of the KWMIP user. Significant work must be done to develop the infrastructure necessary for a functioning portal. These steps may include:

- Identification of data sources that KWMIP will access
- Obtain permission to legally access the data through KWMIP
- Develop protocols to perform the data retrievals and transformations that are specific to each dataset and model input requirements
- Develop protocols to deliver data to the user
- Develop user support interfaces
- Develop KWMIP Long Term Operation and Maintenance Plan

This use case requires the following pre-conditions:

- A National Spatial Data Infrastructure exists that includes the ability to find and access Web-available data. http://www.fgdc.gov/nsdi/nsdi.html
- A substantial collection of data specifically exists that will be useful to support watershed modeling in the Commonwealth of Kentucky. Many of these datasets are on Kentucky GeoNet. http://kygeonet.ky.gov/
- An online catalog exists, built using an open interface specification, to hold metadata about the data and services that support watershed modeling in the Commonwealth of Kentucky. http://www.opengeospatial.org/specs/?page=specs
- Third party data sites (USEPA, USGS, etc.) exist and have been registered in the online KWMIP Catalog in the previous bullet.

5.1. KWMIP User Registration and Log-In

Users may browse and access on-line links in KWMIP without registering. When the user decides to download data or other information (e.g., training materials) registration is required.

Registration includes: Name, Address, Affiliation, Email, Telephone Number, Web Connection Type (dial up, wireless/cable/ DSL, T1).

KWMIP will track web hits, registrations and data retrievals. KWMIP will create a My KWMIP file that stores date and time of the last log in, and optionally restores the user's most recent view to the browser. This feature will allow users to continue a previous session.

Web connection type information may be used to set the maximum size of download.

Users will have the option to review and update their account information.

5.2. Select a KWMIP Supported Model

KWMIP will provide some of the data that is needed to develop a particular model and will pre-format data for that model. Therefore, the user should select a model before continuing to the data services. The Model Selection step will focus the data layers that are viewed in subsequent steps. For example, if a flow model is selected, water quality-related data layers will not be visible during the Data Preview step. Users will have the option to return to this step if their preference is to preview data before selecting the model.

KWMIP Function Description	TAG Discussion and Recommendations

• Select a KWMIP-supported model from a pick list.
 	
• Select "No Model Selected, Continue Browsing"
 	
  ○ This option is provided because some users may want to utilize KWMIP's data query and download services for uses other than developing a KWMIP-supported model.
 	
  ○ If this option is selected, users will have the option to select data formats
 	
• Optional Links
 	
  ○ USEPA Model Selection Tool
 	
  ○ USEPA Region IV Modeling Toolbox
 	
  ○ Homepage for each supported model
 	
• Confirm the Model Selection or "No Model Selected, Continue Browsing"
	Discussion Topics
	
	a. Should model pre-processors be included as a model selection option? This may affect data formatting in later steps.
	
	b. If so, should options include the model AND the pre-processor?
	
	c. What model pre-processors do you recommend for KWMIP to support?
	
	d. Should model (or model pre-processor) selection influence the data layers that the KWMIP user views in subsequent steps?
	
	TAG Discussion
	
	Would user get raw data if pre-processor is selected? Avoid simple "plug and chug", user should be able to compare to raw data
	
	Users have different levels of expertise. Document data transformations (Included in **Section 5.7 Data Transformations)**
	
	If no model is selected, have options to process data anyway, to provide data for other uses
	
	Less work for KWMIP to provide data for model pre-preprocessors

KWMIP Function Description	TAG Discussion and Recommendations
	TMDL section anticipates using preprocessors for complex TMDL projects Preprocessors may not be useful depending on project timeline, available data, and watershed size (i.e., often not practical for small watersheds) MetAdapt is a tool that formats meteorological data – currently in beta-test phase by USEPA Region IV Define preprocessor and tool. This may be different for different models **TAG Recommendation:** In this version of KWMIP, generate formatted raw data. The user can then choose to use preprocessors and tools at their discretion.

5.3. Zoom to Approximate Study Area

Once the Model Selection or No Model Selected, Continue Browsing is confirmed, the user views an interactive map of Kentucky and some surrounding area. If a model has been selected, KWMIP focuses the visible data layers on those layers needed or useful for the selected model. Thus if a hydrologic model has been selected, water quality data layers will not be visible.

Data layers available at the statewide level include KY state boundary, HUC 8 watersheds, major rivers and lakes (1:100,000 scale), topography, county boundaries, interstate roads.

As the user zooms in further, additional detail and data layers become visible. Data layers could include HUC 10 watersheds, 1:24:000 hydrography, state roads, wastewater treatment plants, populated places. KWMIP will select visible data layers based on the selected model and TAG priorities.

The user first zooms to the approximate study area. The Approximate Study Area view is used to get an overview of available data in and nearby the study area. Study area selection takes place in a subsequent step.

KWMIP Function Description	TAG Discussion and Recommendations

• Zoom to the approximate study area
  ○ On-screen pan and zoom
  ○ Pick lists for Populated Place Name, County, ZIP Code, HUC 10 Name, HUC 10 Number
  ○ Use the optional look up table to crosswalk from HUC 11 to HUC 10 Name and Number
  ○ Data entry fields for waterbody name returns all possible options in KY and county, user selects appropriate choice
  ○ Data entry fields for latitude/longitude, HUC 12 Name, HUC 12 Number, HUC 14 Name, HUC 14 Number
• Graphic display zooms to selected area
• On-screen pan and zoom can be used to further zoom to the approximate study area.
	Discussion Topics
	
	e. What data layers should be visible at the statewide and smaller scales?
	
	f. What pick lists should be provided?
	
	Note: The TAG deferred discussion of e. and f. to follow a more detailed evaluation of the Data Matrix.
	
	g. What data entry fields should be provided? Google provides 1 data entry field for a variety of data types. Is this an important option? May be challenging to program.
	
	h. USGS is converting from HUC 11 and HUC 14 to HUC 10 and HUC 12, respectively. HUCs were renumbered and boundaries were changed. Currently both are available and the HUC 10 and HUC 12 boundaries have not been adopted yet. Throughout this report HUC 11 and HUC 14 are used because these are the currently official HUC boundaries. We need to work with USGS to decide whether to include both or new HUCs in KWMIP. Note that HUC 10 and HUC 12 boundaries may be larger than HUC 11 and HUC 14 boundaries, increasing the likelihood of sub-HUC modeling needs.
	
	i. After the final list of KWMIP supported data layers is developed, data layers that will be visible at for each HUC level will be identified. For example, at HUC 8 level, HUC 8 boundary, county, major rivers, climate stations may be visible. As the user zooms in, some layers may fade out and others become visible. Level of detail may also increase with zoom level. For example, climate stations may be shown at HUC 8; climate stations by type may be shown at HUC 10 and

KWMIP Function Description	TAG Discussion and Recommendations
	HUC 12 **TAG Discussion** HUC 11 and HUC10 not much difference, many more HUC14 than HUC12. HUC14 used for management **TAG Recommendation –** Provide choice – use HUC10, 12, 14; Provide a lookup tool for HUC 11

5.4. Data Preview

The Data Preview allows the user to find data that are available through KWMIP (i.e., KWMIP-supported data layer) in the Approximate Study Area. The Data Preview provides the user with an overview of available data in the study area and assists the user with deciding whether the study area is likely to have sufficient data for modeling. Users can also search the Data Registry for data that have been registered in the system. Recall that the user must contact the data owner to obtain data identified through the Data Registry.

KWMIP Function Description	TAG Discussion and Recommendations
• User selects one or more KWMIP supported data layers (i.e., data that are served by KWMIP) to preview from an on-screen menu. (See the Data Matrix for a list of relevant data layers for each model). • Data Preview may include point locations, spatial data (e.g., land use by classification) or a data mask for very complex data (e.g., SSURGO). The data mask indicates whether the selected data layer is available in the Approximate Study Area but does not preview the actual data (e.g., soil types). • Data Preview will allow the users to view the spatial coverage of their selected data layers. Currently KY GeoNet includes counties in adjacent states that share a border with Kentucky.	**Discussion Topics** j. TAG input needed on the list of priority data layers, including climate stations. Thus far, data layers to support each short-listed model have been identified by the Data Matrix Working Group. A simple prioritization was conducted to give higher priority to data layers that support the most candidate models. **Note:** The TAG deferred discussion of this item to follow a more detailed evaluation of the Data Matrix. k. Metadata are readily available for published spatial data but are not available for tabular data (e.g., stream flow, water quality). Can metadata needs for tabular data be addressed?

KWMIP Function Description	TAG Discussion and Recommendations
The KY Climate Model includes HUC 8s that are south of the Ohio River and entirely or partially in Kentucky. Spatial extent of data provided by KWMIP is discussed in more detail in **Section 5.6 Select Data for Delivery**. • For spatial data layers with more than 1 time period, KWMIP will show each as a separate dated layer. Examples include Soils (STATSGO, SSURGO) and Land Cover (1990's, 2001). Users will preview data and metadata for these layers separately. • For spatial data, user can click on "Preview Full Metadata" or "Preview Metadata Lite" for selected spatial data layers. • For tabular data, user can click on "Database Preview". Suggested information fields include: study or monitoring program name, data owners name, address, telephone number, email address, project website, study start and completion (or ongoing) dates, checklist of media sampled (water, sediment, biota), checklist of parameters sampled (conventionals, bacteria, nutrients, metals, pesticides, other organics), checklist of analytical methods (field probe, analysis kit, laboratory, KDOW approved laboratory), checkbox for report available (yes/no) • For tabular data, the user can click on Quality Assurance Project Plan (QAPP) button to retrieve document from KWMIP or to obtain data owner's contact information. • Data preview will include a "live" or "static" indicator for each data layer. Live data will be accessed in real time on the web. Static data will be accessed from a KWMIP server. For static data, the user will be notified of the data owner's update frequency and schedule, and the date of the last KWMIP update for the selected layer. • User can search the Data Registry to identify spatial and	If so, how? **TAG Discussion** KWMIP should provide information on the method for data collection, qualitative information (e.g. Student data) Link to website to get data quality information Quality Assurance Project Plan (QAPP) – either available from KWMIP or the data owner, provide a checkbox for KDOW-approved QAPP KWMIP Data Registry should provide a template for data and data quality, contacts for more information, project websites when available, a way to document protocols, and checkbox for KDOW approved QAPP The possibility of allowing users to rate data sets was discussed and dismissed because the rating may not be adequate/ accurate/ unbiased As an alternative to user ratings, KWMIP should provide an opportunity for user feedback (See **Section 5.8 KWMIP List Serve and KWMIP Feedback page**) KWMIP should track how often data are used so that maintenance is streamlined and focused on most used data. This may be a better score than rating (See **Chapter 6 Long Term Operation and Maintenance Plan**) I. TAG input needed on the list of components to be viewed when "Preview Metadata Lite" option is selected. The National Spatial Data Inventory (NSDI) clearinghouse has a model for Metadata Lite fields. Since the metadata will be in a database, it is a simple query to identify selected fields. **TAG Discussion:** Obtain and evaluate Metadata Lite fields (See **Appendix C. Minimal but Compliant Metadata**)

KWMIP Function Description	TAG Discussion and Recommendations
tabular datasets that have been registered in the system. Search fields may include HUC and data type Placeholder: can a mask be produced from the data registry to indicate watersheds where data are available to streamline this search?	m. Change in quality and spatial resolution over time (QA/QC) can be significant for some data layers. This is an issue with land use, soils and with water quality data. Metadata can be used to evaluate data quality for spatial data layers. Can this be addressed for tabular data? If so, how? **TAG Discussion** Data submitted to KWMIP should include a way to document methods changes (i.e., a management file (See **Section 5.8 Data Registry**) n. For some complex data layers (e.g., soils), pre-formatted and regularly updated data may be stored on and served to KWMIP users from a server. Smaller and less complex data layers will be provided "live". Should the user be informed of live and static data access? **TAG Recommendation:** Yes, notify the user. o. Some data layers have record level metadata (e.g., City Boundary). Each time the boundary is edited; the attribute table fields showing who edited the boundary and the date are updated. Is there a need to see this type of information at the Data Preview step? **TAG Recommendation:** This level of detail is not needed. **TAG Discussion** KWMIP is an acronym intensive project. Assistance with acronyms and abbreviations would be very helpful. Louisville Metro's MSD Hansen work flow management software allows user to click on drop down menu for abbreviations. See **Section 5.8 KWMIP Help**

5.5. Define the Study Area Boundary

Once the user previews the data available in the Approximate Study Area, the Study Area boundary can be defined. KWMIP will clip spatial and tabular data to the defined Study Area boundary. The user will have several options to define the Study Area Boundary including:

- **HUC Watershed Boundary**– the user can select one HUC 10 or one or more HUC 12 or HUC 14 watersheds

- **User Defined Study Area Boundary** – the user can upload a user delineated watershed boundary. This option may be useful to obtain data above a point of interest that does not correspond with a HUC boundary (e.g., above a wastewater treatment plant). This option may also be useful if the drainage area is influenced by karst. KWMIP can be used to download spatial data to support the user's desktop watershed delineation. [3]

The user may want to obtain data for one or more data layers from outside their Study Area boundary. For example, stream gages from adjacent watersheds may be used to estimate stream flows in ungaged streams in the study area. KWMIP will provide the option to ***buffer*** the study area boundary or to use a "***nearest neighbor***" function to obtain data from adjacent watersheds that may be relevant to their study area. The buffer function is intended to be used for relatively short distances. Nearest neighbor is intended to be used for point data (i.e., monitoring locations) that may be relatively far away from the study area.

- **Buffered Study Area Boundary**– the user can buffer the HUC watershed or a user delineated study area by a set distance to obtain data from adjacent watersheds

- **Nearest Neighbor Tool**– the Nearest Neighbor Tool can be used to locate up to 5 monitoring locations that are not located in the study area of interest.

If more than one Study Area boundary is delineated, the user will be required to assign each data layer to a boundary prior to downloading data.

5.5.1. HUC Watershed Boundary

The user will be viewing the Approximate Study Area, and viewing HUC 10 and HUC 14 and data layers of their choice including waterbodies, county or municipal boundaries, regulated facilities, gages, monitoring locations etc.

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[3] At the 12/8/05 meeting, the TAG recommended against providing an on-line watershed delineation service in KWMIP at this time. The recommendation was largely associated with concerns regarding the accuracy of these delineations in karst areas. Since a significant portion of the Kentucky landscape is karst or karst prone (65%) and tools are available through model preprocessors, WCS and GIS software, the TAG recommended that users be responsible for their own watershed delineations on the desktop.

KWMIP Function Description	TAG Discussion and Recommendations
Options for Study Area selection methods include: • Pick list for HUC Name and HUC Number • Graphic selection of HUC by minimum bounding box (rubber band) on map display that returns HUC Study Area. • Option to click on multiple HUC 12s or HUC 14s • Option to select all HUC 12s or HUC 14s above a user defined point • Manual correction if incorrect HUCs are inadvertently selected by deselecting a highlighted area on the screen or deselecting HUCs from a picklist box • Confirm selection of the HUC Study Area Boundary • User selects "Continue Defining Study Area Boundaries" or "Proceed to Select Data for Download"	p. Options for manual reselection of HUCs include deselecting a highlighted area on the screen or deselecting HUCs from a picklist box **TAG Discussion:** This is a good approach q. The maximum size of Study Area may need to be specified to control the maximum size of data requests. **TAG Discussion** If the maximum size of data requests becomes an issue, "My KWMIP" feature can reset user to the last event in their previous session and provide a record of the previous session. Get consistency on HUCs 10, 12, 14 (**Note:** This was done throughout)

5.5.2. User Defined Study Area Boundary

This option may be useful to obtain data above a point of interest that does not correspond with a HUC boundary (e.g., above a wastewater treatment plant). This option may also be useful if the drainage area is influenced by karst. KWMIP functions to download spatial data to support the user's desktop watershed delineation and upload the user defined watershed boundary are described below.

KWMIP Function Description	TAG Discussion and Recommendations

• User selects "***User Defined Study Area Boundary***"
• KWMIP identifies the following data layers to support this task:
  ○ HUC 10, HUC 12, HUC 14
  ○ NHD Waterbodies
	TAG Discussion:
	Karst Considerations: There are significant discrepancies between HUC and Karst basin boundaries. Only 30-40% of state dye traced, so this is still the data gathering phase. There is a "working" attribute field in the new HUC coverage that indicates karst, or no karst (i.e., attribute field may be incomplete).

KWMIP Function Description	TAG Discussion and Recommendations
○ 10 meter or higher resolution Digital Elevation Model (DEM) ○ Karst Potential Index Map (shows whether area of interest is likely to be karst influenced) ○ Sinkholes (closed contours, point locations), Sinkhole Drainage areas ○ Dye Traces ○ Other data layers of interest?? (Mining, aerials, sewage treatment plants, drinking water intakes) • User has the option to buffer layers for download to accommodate uncertainties associated with karst as described in **Section 5.5.3** • User selects layers for download using procedures described in **Section 5.6** • KWMIP clips and projects layers to the nearest user selected HUC, or buffered HUC as described in **Section 5.7** • Data are delivered to the user as described in **Section 5.8** KWMIP Data Transformation and Retrieval • The user delineates their watershed study area on their desktop, outside of KWMIP • The user uploads the user defined study area boundary to their My KWMIP area • KWMIP draws the user defined study area boundary on screen • User confirms the User Defined Study Area Boundary • User selects "Continue Defining Study Area Boundaries" or "Proceed to Select Data for Download"	There are two types of coverages of sinkhole drainage basins. The KGS coverage of closed contours (i.e., sinkholes) and the draft USGS coverage of sinkhole drainage areas are available. **TAG Recommendations:** The user should delineate watershed boundaries that do not coincide with HUC boundaries on their PC and upload shape file for KWMIP to use in subsequent clipping functions. Refer users to the on-line HUC guidance document by Joe Ray and Jim Currens. **See Appendix D. NOTE: link needed** Include the Groundwater Sensitivity Map and Karst Potential Map in the Data Matrix (**See Data Matrix)** GW flow in non-karst areas give direction/ suggestions for similar work in karst areas (**Placeholder – clarify this recommendation)** **NOTE:** This list of data layers necessary to support watershed delineation needs review by the TAG. **NOTE:** Clarify any projection and datum considerations for the uploaded user delineated study area boundary

5.5.3. Buffered Study Area Boundary

The user may want to obtain data for one or more data layers from outside their Study Area boundary. For example, stream gages from adjacent watersheds may be used to estimate stream flows in ungaged streams in the study area. The buffer function is intended to be used for relatively short distances. Nearest neighbor is intended to be used for point data (i.e., monitoring locations) that may be relatively distant from the study area.

KWMIP Function Description	TAG Discussion and Recommendations
• Use the pan, zoom and measure tools to estimate a buffer distance from the Study Area boundary. • Enter the selected buffer distance • If file size is an issue, a maximum buffer distance is set KWMIP prompts the user to select a smaller buffer distance if necessary. • KWMIP generates a buffered study area boundary at the selected distance • User selects "Continue Defining Study Area Boundaries" or "Proceed to Select Data for Download"	**TAG Discussion Topics** r. It may be possible to automate identification of sites near the Study Area boundary. KWMIP could identify several nearest stations for the user to select from. Would this be a more useful approach than the buffer approach described above? s. If KWMIP can identify nearby stations for selection, is the buffer tool needed? **TAG Discussion** The buffer works for spatial data- set maximum distance to avoid big downloads For point data (i.e., monitoring locations), KWMIP should allow the user to view nearest neighbor(s) up to 3-5 to see if it makes sense KWMIP should provide an option to view neighbors by distance- similar to car shopping on the web

5.5.4. Nearest Neighbor Tool

This section was added as a result of the 12/08/05 TAG meeting. The user may want to obtain data for one or more data layers from outside their Study Area boundary. For example, stream gages from adjacent watersheds may be used to estimate stream flows in

ungaged streams in the study area. The Nearest Neighbor tool is intended to be used for point data (i.e., monitoring locations) that may be relatively far away from the study area.

KWMIP Function Description	TAG Discussion and Recommendations
• Select a point data layer of interest, use "Nearest Neighbor" tool to invoke KWMIP function to identify up to 5 sites that are closest to the selected study area. • Allow the user to view nearest neighbor by distance • Use pan and zoom as needed to bring the desired monitoring locations into the view or use KWMIP to identify and highlight up to 5 nearest locations for that dataset. • User selects and confirms up to 5 point locations to include in data download. • Repeat these steps as needed for other point data layers • User selects "Continue Defining Study Area Boundaries" or "Proceed to Select Data for Download"	**TAG Discussion Topics** t. It may be possible to automate identification of sites near the Study Area boundary. KWMIP could identify several nearest stations for the user to select from. Would this be a more useful approach than the buffer approach described above? u. If KWMIP can identify nearby stations for selection, is the buffer tool needed? **TAG Discussion** The buffer works for spatial data- set maximum distance to avoid big downloads For point data (i.e., monitoring locations), KWMIP should allow the user to view nearest neighbor(s) up to 3-5 to see if it makes sense KWMIP should provide an option to view neighbors by distance- similar to car shopping on the web

5.6. Select Data for Delivery

The user will match each data layer and study area boundary to invoke KWMIP data download function.

KWMIP Function Description	TAG Discussion and Recommendations
• Select data layers to download for each boundary from a pick list • For data layers with a temporal component (e.g., stream flow, water quality, climate data), KWMIP will show the data start and stop dates that define the period of record and the user	**Discussion Topics** v. The interface to the KY Climate Model would be accessed at this step. **TAG Discussion –** work with USGS to describe this interface w. Should users be able to download station specific climate data

KWMIP Function Description	TAG Discussion and Recommendations
will select period of record or specify data start and stop dates. • KY Climate Model will allow the user to download hourly model results for precipitation and minimum and maximum temperature a user selected time period between 1/1/85 and 12/31/04. (**Note:** The Project Partners are exploring the possibility of providing other data needed for climate components of KWMIP models with the National Climatic Data Center (NCDC). Approaches to keep the KY Climate Model current will be outlined in the Long Term Operations and Maintenance Plan.) • KWMIP will generate a table of user selected data layers and user selected/generated study area boundaries (i.e., HUC, user defined study area, buffered study area, nearest neighbor). Users will click radio buttons to match each data layer to the desired boundary (Note: only 1 boundary may be selected for each data layer). • Confirm each data layer to download for each boundary	through KWMIP or only the results of the Climate Model being developed by USGS? As currently developed, the KY Climate Model does not provide outputs to support all of the climate variables needed for watershed models under consideration so access to additional climatic data would be desirable. **TAG Discussion –** USGS work on the model is nearing completion. USGS can demonstrate the model at a future KWMIP meeting, The model needs error checking, needs interface to link into. USGS needs to talk to Greg Sousa about MetAdapt and how to integrate other data needs x. Data from adjacent states may be important. There are several inter-state watersheds of importance (e.g., Cumberland River, Tennessee River, Big Sandy River). Should KWMIP access data from other states or simply provide links? The long-term maintenance considerations for accessing data from other states will influence this decision. **TAG Discussion** There is a Memorandum of Understanding (MOU) between KY Environmental and Public Protection Cabinet (EPPC) and TN Department of Environmental Conservation (TDEC), on interstate watersheds. The MOU may foster getting available information- KY contacts include Pete Goodmann, Tom VanArsdall, Ann Fredenbug, Randy Payne, Lee Colten, Kay Harker **TAG Recommendations** The level of effort required and implications on project resources needs to be considered. This is fairly important, so investigate feasibility. In terms of priorities, consider the effects of upstream states on KY water quality. Important coverages to consider include DEMs, NHD for TN, VA,

KWMIP Function Description	TAG Discussion and Recommendations
	WV; Precipitation and Temperature data KYGeoNet already buffers surrounding states by 1 county KWMIP may be able to utilize BASINS to get data from outside KY y. For spatial data layers with more than 1 time period (e.g., STATSGO, SSURGO, Land Use (1990's, 2001), users will have the option download these layers separately. z. If a user is working at a relatively small scale (e.g., HUC 12 or HUC 14) should KWMIP encourage the user to select higher resolution data? aa. If data are needed for a model but not provided by KWMIP should a link or contact person be provided? For example, water quality data in COMPASS may be useful but not available through KWMIP. **TAG Discussion –** Yes, through the Data Registry bb. Should KWMIP automatically prompt users if additional data for their selected study area may be available through the Data Registry? For example, someone registered WQ data in a HUC selected by the user, should KWMIP automatically tell the user that additional WQ data are available through the Data Registry? Or should the user be responsible for checking the Data Registry without prompting? **TAG Recommendation:** Explore this option **Note:** Since Data Registry data will not be available for download through KWMIP, this recommendation is addressed in **Section 5.4. Data Preview.**

5.7. KWMIP Data Transformations

KWMIP Function Description	TAG Discussion and Recommendations
• KWMIP merges data if needed (e.g., county level data may need to be merged to generate watershed level data). • If merging is required, KWMIP will provide a general warning that there may be edge matching, data quality issues • KWMIP clips each data layer to geographic extent specified in data request (this may be a HUC 14 or HUC 10, user defined study area, buffered study area) • KWMIP transforms/processes data to conform to the file format dictated by the earlier model selection or native data format if a model was not selected. • KWMIP re-projects data to requested coordinate reference system • KWMIP builds internal processing metadata (which describes KWMIP data transformations) and sends real time to the requestor. • KWMIP sends real time response data to user • KWMIP stores ftp delivery 'data request' in outbox • KWMIP sends notification (e.g. pop-up window; e-mail) to requestor • KWMIP Query Archive – KWMIP keeps a record of requestor, internal processing metadata, placement order time and date, order extent and content, completion time and date, notification or real time send time and date, time and date of ftp closure. • KWMIP Data Retrieval Verification - ensure that the requestor and the person retrieving the data are the same	**Discussion Topics** cc. Given the complexity of data serving formats, the implementation of this general protocol may vary by data layer (e.g., access to SSURGO, land cover, STORET) requires data-specific transformation protocols. dd. Complexity of the data request may influence form of data return Options could include: ○ **Automatic** – user receives data ready to use ○ **Semi-Automatic** – user retrieves a data package from an FTP site ○ **Not Automatic** – KWMIP provides a link to data website, user retrieves data **TAG Recommendation:** Track user requests/ need for "not automatic" to prioritize for future enhancements of KWMIP. Ideally data move from "not automatic" to "semi- automatic" over time. ee. At the UNA Meetings, TAG members stated that unit conversions may be needed. These circumstances and the conversions need to be clarified and included in KWMIP functionality if possible. **TAG Discussion:** Many models give units options. • METRIC: EFDC, QUAL2K, WASP

KWMIP Function Description	TAG Discussion and Recommendations
• Simple report by request to allow review of all recorded data	• ENGLISH: LSPC • USER CHOOSES: HEC • COMPASS stores in original and standard units ff. COT preference is to provide spatial data in KY Single Zone (KY SZ). At least some pre-processors are based on ArcView which does not support KY SZ. KWMIP could provide a KY SZ tool for ArcView. **TAG Discussion** Should KWMIP provide data in single zone only? More discussion is needed Karst data are in degrees Existing data may be in other projections, don't want to convert KY N and KY S gg. The response to the user should include metadata for spatial data. In the National Map viewer, metadata is provided as an HTM file. If metadata are in a catalog, KWMIP can execute a query against database for limited or full metadata and assemble into zip file. hh. It will be easier to program the data delivery if the package consists of 1 zip file with all requested data layers. If this approach is used, a naming convention for each requested data layer is needed. ii. A naming convention for the zip file is needed. Is the file naming, zip and ship utility from national map viewer available for KWMIP?

5.8. KWMIP User Community Support

KWMIP User Community Support includes the following features:

- **Data Registry** – The Data Registry can be used for both spatial and tabular data. Data owners can register their data with KWMIP by completing a form with contact information and a brief description of the dataset.

- **Data Standards** - This service will provide data quality standards and standard formats so that those who generate data will be able to standardize their data acquisition, management, formatting to facilitate use by KWMIP modelers through the Data Registry.

- **Training Materials and HELP-** KWMIP User Guide and training presentations for modelers (use of KWMIP) and water resources managers (use of models as decision support tools) will be available for on-line viewing and download as PDF. A lookup for acronyms and abbreviations may also be provided.

- **KWMIP List Serve** - Through the KWMIP list serve, users can communicate with each other, share lessons learned and identify opportunities to share and leverage their work. Information and issues with data can also be discussed.

- **KWMIP Feedback** – an email contact for questions and recommendations

5.8.1. Data Registry

The Data Registry can be used for both spatial and tabular data. Data owners can register their data with KWMIP by completing a form with contact information and a brief description of the dataset. Those who register data will by committing to providing the data upon request to KWMIP users. The Registry will be searchable through KWMIP during the Data Preview. KWMIP users will contact data owners to discuss and retrieve data identified through the Data Registry.

KWMIP Function Description	TAG Discussion and Recommendations
Data registry components for numerical (e.g., monitoring studies) include: • Name of data collection effort (e.g., study name, monitoring program name) • Name, address, telephone number, email address, affiliation,	• Method for data collection, qualitative information (e.g. Student data) (See **Section 5.4 Data Preview**) **Note to TAG:** Student data or other qualitative information can be inferred by the user from the fields provided jj. Should the catalog have categories to group data and entries

KWMIP Function Description	TAG Discussion and Recommendations
job title, project website (if available) • Option to upload Quality Assurance Project Plan (QAPP) or check YES or NO that QAPP has been completed and YES or NO that QAPP received KDOW approval • HUC 10, 12, 14 watersheds included in registered study • Waterbodies included in registered study • Study start and completion (or ongoing) dates • Checklist for media sampled (water, sediment, biota) • Checklist for parameters sampled (conventionals, bacteria, nutrients, metals, pesticides, other organics • Checklist for analytical methods (field probe, analysis kit, laboratory, KDOW approved laboratory) • Citation for report, if available • Optional data templates can be downloaded to facilitate consistent data formats that are easily translated to model input data Data registry for spatial data include • Coverage name • Name, address, telephone number, email address, affiliation, job title, project website (if available) • Option to metadata or check YES or NO that metadata has been completed • HUC 10, 12, 14 watersheds included in coverage • Date that coverage was first registered in KWMIP	for searching? kk. Providing data for spatial extents outside KY is not difficult from a programming perspective, but has Operation and Maintenance considerations. Data sharing agreements will be needed ll. If it is feasible to access data beyond KY boundaries, what are TAG preferences for data and states? **TAG Discussion** TN, prioritize waterbodies draining into KY, rather than waterbodies that KY discharges to Data catalog should be available for all KWMIP data with ID for KWMIP available Who reviews submittals for registry? How are duplicative or junk registrations identified and addressed? Miscellaneous data such as population projections are not used by model directly but may be useful to understand watershed future. The Catalog could consider these data. **TAG Recommendations:** KWMIP should provide a flag that the data catalog is not comprehensive KWMIP should allow keyword based searches The Catalog should provide a way to identify and search raw data, this should not become a publications directory May need to set minimum criteria for data registration to avoid becoming a data dump Caution – the Data Catalog may mushroom beyond KWMIP project boundaries. Long term operation and maintenance must be considered. Encourage user maintenance.

KWMIP Function Description	TAG Discussion and Recommendations
• KWMIP provides one or more screens to search Data Registry fields identified above. • Use drop down menus and key word searches • KWMIP searches Data Catalog during Data Preview stage and highlights for the user that data may be available in the selected study area.	

5.8.2. Data Standards

This service will provide data quality standards and standard formats so that those who generate data will be able to standardize their data acquisition, management, formatting to facilitate use by KWMIP modelers through the Data Catalog. Data standards that may be included are: Environmental Data Standards, COMPASS Standards, Environmental Information Exchange Network Standards (EIEN), and Federal Geographic Data Committee (FGDC).

Discussion Topics

mm. Suggested formats that KWMIP should provide? This should be utilizing familiar data formats that can be readily transformed by the user into the necessary model input format.

TAG Discussion

Ward Wilson and Klaus Albertin of TetraTech may be able to provide sample data templates

TAG members should provide data templates to Karen Schaffer. These may be model specific

5.8.3. Calibration and Sensitivity Analysis Assistance:

An area of the portal where a modeler can obtain help with calibration and sensitivity analysis through links to papers, books, calibration checklists etc.

Discussion Topics

nn. This recommendation was received through the UNA document comment period and needs further discussion with the TAG.

oo. If this is a desired service, sources of information are needed and a mechanism to keep this updated is also needed. Can this be accomplished by linking to an academic or agency website?

TAG Discussion

This suggestion should be explored further for subsequent enhancements of KWMIP. There are long term operation and maintenance issues associated with keeping this current and ensuring that appropriate scientifically valid information is presented. Some models have sensitivity tools. This could be covered in the training and included in the on-line training materials. For now, calibration and sensitivity analysis could be addressed through the List Serve.

TAG Recommendation – This may be a good suggestion for future enhancements of KWMIP. Calibration and sensitivity analysis could be addressed through the List Serve.

5.8.4. Training Materials and HELP

KWMIP User Guide and training presentations for modelers (use of KWMIP) and water resources managers (use of models as decision support tools) will be available for on-line viewing and download as PDF. An effort will be made to avoid having too many "clicks" to get to the desired information.

KWMIP Help should include a lookup for acronyms and abbreviations similar to Louisville Metro MSD's Hansen Workflow software

5.8.5. KWMIP List Serve:

Through the KWMIP list serve, users can communicate with each other, share lessons learned and identify opportunities to share and leverage their work. Topics of interest to KWMIP users can be discussed (e.g., information and issues with data, calibration and sensitivity analysis).

5.8.6. KWMIP Feedback:

KWMIP users will have an opportunity to provide feedback on their experiences using the portal and the benefits of KWMIP. This function will be key to identifying issues and opportunities for improvement. This service directly relates to the Project Metrics discussed in Chapter 2.

6. Long Term Operation and Maintenance Plan

As KWMIP functions are finalized, a long term operations and maintenance (O&M) plan will be developed. The O&M plan will describe each O&M task, responsible entity, schedule, due date and estimated budget. The plan may also describe recommended and planned enhancements of the portal.

At this time, some key features and considerations are outlined.

- Regular updates of links to data sources and other websites
- KWMIP may access some data "live" on-line, and other data may be downloaded and pre-formatted on a server. Live data access may be implemented for data that change often and are relatively less complex to access. Static access may be utilized for data that have complex formats but do not change often. Soils data (SSURGO) are thought to be a good example of complex to access but stable data. SSURGO data are typically available at the county level which often requires merging to obtain watershed level data and once SSURGO updates are published, the data are not edited often. (Confirm this for new Soils Data Mart) Note that USEPA HQ BASINS and USEPA Region IV WCS both utilize static data access and that is outdated.
- KY Climate Model – Long term O&M considerations for the KY Climate Model include where the model will be served from and how regular updates will be performed. Possibilities for model location include USGS's Stream Stats server in Denver, USGS Kentucky District in Louisville and DGI/KWMIP server in Frankfort.

  This model relies on climate data from the National Climatic Data Center (NCDC), who provide data via web access or on CD for a fee. Data must then be processed and integrated into the model. Data network updates such as changes in station locations

must be accommodated. USGS has developed the model and interfaces to accomplish these updates efficiently.

Interest in expanding the KY Climate Model interface to support additional climate variables has been expressed by project partners. Approaches to providing these enhancements will be discussed with NCDC. Recommended and planned interface expansions will be incorporated into the O&M Plan.

TAG Discussion

If possible, KWMIP could provide data for direct input into WCS and BASINS.

Important to note that some models use vector data but new land use data are raster.

- Updates of data that are stored in pre-formatted form on the KWMIP server that is concurrent with updates done by the data owner.
- KWMIP efficiency (i.e., time to return data to the user) may be improved by storing the results of data transformations on a server. This may also be useful for data sharing among users. This gain in efficiency must consider data update frequencies so that the user is provided the most current data.

Track frequency of data downloads so that maintenance and updating can be prioritized.

Appendix A

TAG Meeting Participants (Dec. 2005)

Karla Andrew, Western Kentucky University
Mark Ayers, US Geological Survey
Sam Backarach, Open Geospatial Consortium
Lee Colten, KY Division of Water
Elizabeth Coyle, Louisville Metro Metropolitan Sewer District
Jim Currens, KY Geological Survey
Jim Dinger, KY Geological Survey
Ann Fredenburg, KY Division of Water
Gary Harp, Division of Geographic Information
Dr. Alice Jones, Eastern Kentucky University
Ray Rush, FMSM Engineers
Karen Schaffer, FMSM Engineers
Greg Sousa, Tetra Tech
Demetrio Zourarakis, Division of Geographic Information

Appendix B

Data Matrix

Data Matrix Revised 02/28/06

The Data Matrix was discussed and revised during the most recent TAG meeting, held on February 28, 2006. TAG members identified and prioritized additional data layers available from GeoNet that would be useful for KWMIP.

Attached are two key spreadsheets included in the Data Matrix:

Model Summary
Identifies the basic data needs for each short-listed model in a simple "yes-no" format. To date, the Model Summary has been completed for 9 of 10 short-listed models and includes 69 watershed model input datasets. The Model Summary includes the number of times each data set was used across all models. This simple summary gives insight into the relative importance of KWMIP supporting the dataset. This summary was built on 1st TAG meeting feedback.

GeoNet
The 02/28/09 TAG meeting focused on identifying additional supporting layers that would be useful for KWMIP. It was determined that any layer with a **1** was identified directly as model input data, layers with a **2** are datasets that need to be supported by KWMIP, layers with a **3** are datasets that need to be viewable – what is viewable will be defined in the portal.

A copy of the complete, revised Data Matrix (dated 03/09/06) will be posted to the KWMIP project website at http://kwmip.ky.gov/technical.htm.

Models and Contacts: Data Matrix Subgroup contact and web-site for each candidate model and tool

Model/ Tool	Name	Contact	Email	Model Type	Status/ Notes	Model/Tool Website
Model	AnnAGNPS	Mark Ayers	mayers@usgs.gov	Watershed	Interest in simulation of in-stream sediment processes, AnnAgNPS was dropped from the list b/c the KDOW has not decided what model they will use for sediment TMDLs	http://www.earthit.com/services/agnps.html http://www.ars.usda.gov/Research/docs.htm?docid=5222
Model	EFDC	Greg Sousa	gregory.sousa@tetratech-ffx.com	Hydrodynamic	Drafted	http://www.epa.gov/athens/wwqtsc/html/efdc.html
Model	HEC	Bill Caldwell, Steve Cummings	bill.caldwell@ky.gov steve_cummings@gspnet.com	Hydrodynamic	Drafted- Refers to HEC series: HEC-DSSVue 1.2; HEC-RAS 3.1.3; HEC-GeoHMS 1.1; DSS Excel Add-In; HEC-ResSim 2.0; HEC-GeoRAS 3.1.1; HEC-HMS 2.2.2	http://www.hec.usace.army.mil/
Model	HSPF	Greg Sousa	gregory.sousa@tetratech-ffx.com	All	Drafted	http://www.epa.gov/ceampubl/swater/hspf/index.htm http://water.usgs.gov/cgi-bin/man_wrdapp?hspf
Model	Load Duration Curves	Ann Fredenburg	Andrea.Fredenburg@ky.gov	Water Quality	Drafted	http://rd.tetratech.com/epa/
Model	LSPC	Greg Sousa	gregory.sousa@tetratech-ffx.com	Watershed	Drafted	http://www.epa.gov/athens/wwqtsc/html/lspc.html
Model	ModFlow	Mark Ayers	mayers@usgs.gov	Groundwater	Drafted	http://www.modflow.com/modflow/modflow.html
Model	QUAL-2E	Ann Fredenburg	Andrea.Fredenburg@ky.gov	Water Quality	Dropped Ann does not have access to this model, no longer supported by USEPA	NA
Model	QUAL2K	Ann Fredenburg	Andrea.Fredenburg@ky.gov	Water Quality	Drafted	http://www.epa.gov/ATHENS/wwqtsc/html/qual2k.html
Model	SWMM	Karen Schaffer Ward Wilson	kschaffer@fmsm.com ward.wilson@tetratech.com	Watershed	Drafted	http://www.epa.gov/ednnrmrl/swmm/#A
Model	WASP	Greg Sousa	gregory.sousa@tetratech-ffx.com	Water Quality	Drafted	http://www.epa.gov/athens/wwqtsc/html/wasp.html

Model/ Tool	Name	Contact	Email	Model Type	Status/ Notes	Model/Tool Website
Tool	BASINS	Karen Schaffer	kschaffer@fmsm.com	All	Drafted list of Models, Tools Data	http://www.epa.gov/waterscience/basins/basinsv3.htm
Tool	MetAdapt	Greg Sousa	gregory.sousa@tetratech-ffx.com	Data Input tool	Drafted	NA - tool is under development by USEPA R4 and TetraTech
Tool	WCS	Karen Schaffer	kschaffer@fmsm.com	Data Input tool	Drafted	http://www.epa.gov/athens/wwqtsc/html/wcs.html

KWMIP Data Matrix
Data Summary

Data	Numeric/ Geo-graphic	QUAL2K	EFDC	HEC	HSPF	LDC	LSPC	Mod Flow	SWMM	WASP	Total	Notes
Agricultural Census	N				1		1				**2**	
Air Deposition Loads	N		1		1		1			1	**4**	
Air Temperature	N	1	1		1		1		1	1	**6**	
Ambient Water Quality	N	1	1		1	1	1		1	1	**7**	
Ambient Water Quality Sites	G	1	1		1	1	1		1	1	**7**	
Barometric Pressure	N		1								**1**	
Basin Area	N			1					1		**2**	watershed boundary?
basin loss rate	N			1					1		**2**	definition needed
Bathymetry (stream/lake)	G		1						1	1	**3**	channel geometry?
Cloud Cover	N	1	1		1		1			1	**5**	
Decentralized Wastewater Treatment	G	1	1		1		1			1	**5**	location, density of septics & straight pipes
Dew point temperature	N	1	1		1		1			1	**5**	
Digital Ortho Quarter Quad	G			1	1		1				**3**	
Effluent Quality	N	1	1		1		1		1	1	**6**	
Elevation (DEM)	G		1		1		1		1	1	**5**	Digital elevation model
Evapotranspiration	N		1		1		1		1	1	**5**	evaporation vs. evapotranspiration
flow routing	G			1					1		**2**	hydrography?
Geology	G		1		1		1	1		1	**5**	
Groundwater Flow	N		1		1		1		1	1	**5**	interflow vs. deep GW
Groundwater Level	N		1		1		1	1	1	1	**6**	
Groundwater Quality	N	1	1		1		1		1	1	**6**	
Groundwater Sensitivity	G										**NA**	drainage delineations in Karst Areas
Hydraulic Conductivity	N								1		**1**	
Hydrography (NHD)	G		1		1		1		1	1	**5**	flow routing?
Impervious Area	G			1	1		1		1		**4**	
Impoundment outflow	N		1		1	1	1		1	1	**6**	
Impoundment stage	N		1		1		1		1	1	**5**	
Impoundment storage	N		1		1		1		1	1	**5**	
Infiltration Rate	N								1		**1**	
Karst Basin Boundaries	G		1		1		1			1	**4**	

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Karst Flow Routes	G		1		1		1			1	**4**	
Karst Potential Index Map	G		1		1		1			1	**4**	
Land Use/Land Cover	G		1	1	1	1	1		1	1	**7**	
Latitude	G		1						1	1	**3**	
Longitude	G		1						1	1	**3**	
Photoperiod	N	1								1	**2**	
Point Source Locations	G	1	1		1	1	1		1	1	**7**	
Population	N				1	1	1				**3**	
Precipitation	N		1	1	1	1	1		1	1	**7**	
Relative Humidity	N		1							1	**2**	
Return Flows	N		1		1	1	1		1	1	**6**	Any water that "returns" back to the stream/lake
Runoff Water Quality	N	1	1		1	1	1		1	1	**7**	
Sediment Load	N		1		1	1	1			1	**5**	
sediment quality	N		1		1		1			1	**4**	
Septic System Suitability Map	G				1		1				**2**	
Shade	N	1								1	**2**	
Sinkhole Drainage Boundaries	G		1		1		1			1	**4**	
Sinkhole Locations	G		1		1		1			1	**4**	
Soils	G				1		1		1		**3**	ABCD Classification
Solar radiation	N	1	1		1		1			1	**5**	
Spring Water Quality	N	1	1		1		1			1	**5**	
Stage	N			1					1		**2**	
stream cross section	G		1	1	1		1		1	1	**6**	channel geometry/ bathymetery?
Stream flow	N	1	1	1	1	1	1		1	1	**8**	
Stream flow gage location	G		1		1	1	1		1	1	**6**	
Time of solar noon	N	1									**1**	
Time of sunrise	N	1									**1**	
Time of sunset	N	1									**1**	
Topography	G		1		1		1		1	1	**5**	
unit hydrograph	N			1					1		**2**	flow?

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Wastewater/Stormwater Infrastructure	G		1		1		1		1	1	**5**	
Water Surface Elevation	N		1	1					1	1	**4**	espcially in large rivers
Water Withdrawal Amounts	N		1		1		1		1	1	**5**	
Water Withdrawal Location	G		1		1		1		1	1	**5**	
Watershed Boundary	G		1		1		1		1	1	**5**	Basin area?
Well Competency	N				1		1	1			**3**	
Well Construction	N				1		1	1			**3**	
Well Depth	N				1		1	1			**3**	
Wind Direction	N		1							1	**2**	
Wind speed	N	1	1		1		1		1	1	**6**	
Total		**19**	**48**	**12**	**50**	**12**	**50**	**5**	**40**	**49**		

KWMIP DATA MATRIX
GEONET SUMMARY

GeoNet - this sheet was provided by KY GeoNet staff and shows the 360+ datasets, static map images and standards

KWMIP Dataset	Dataset Name	Service Type	Onlink
1	11 Digit Hydrologic Units	DD	ftp://ftp.kymartian.ky.gov/dgi/huc11.zip
1	14 Digit Hydrologic Units	DD	http://www.uky.edu/KGS/gis/hucfinder.htm
1	7.5-minute Geologic Quadrangle Map Images in MrSid Format (KY Single Zone)	DD	http://kymartian.ky.gov/gqmaps1z/index.html
1	A GIS Sinkhole Coverage for the Karst Areas of Kentucky	DD	http://www.uky.edu/KGS/gis/sinkpick.htm
1	Areas Unsuitable for Conventional Septic Systems	SMI	http://wris.ky.gov/wris/mapgis/othermaps.htm
1	Census Block Groups, 1990	DD	ftp://kygeonet.ky.gov/kygeodata/ky/dgi/kyblkgrp1990.zip
1	Census Block Groups, 2000	DD	http://kgsweb.uky.edu/download/state/kyblkgrp2000.zip
1	Census Blocks, 1990	DD	http://kgsweb.uky.edu/download/state/CENTRACT.ZIP
1	Census Blocks, 2000 (by County)	DD	http://www.uky.edu/KGS/gis/census2000.htm
1	Census Blocks, 2000 (Statewide)	DD	ftp://ftp.kymartian.ky.gov/dgi/kyblock2000.zip
1	Census Tracts, 1990	DD	ftp://kygeonet.ky.gov/kygeodata/ky/dgi/kytract1990.zip
1	Census Tracts, 2000	DD	http://kgsweb.uky.edu/download/state/kytracts2000.zip
1	Digital Ortho Images in JPEG Format (Kentucky Single Zone)	DD	ftp://ftp.kymartian.ky.gov/doq1z/
1	Digital Ortho Quarter Quad Index	DD	ftp://ftp.kymartian.ky.gov/dgi/doqq1z.zip
1	Digital Ortho Quarter Quad Index, 16ths	DD	ftp://ftp.kymartian.ky.gov/dgi/doqq16.zip
1	Digital Ortho Quarter Quad Index, 64ths	DD	ftp://ftp.kymartian.ky.gov/dgi/doqq64.zip
1	FSA NAIP Digital Ortho Photo Imagery for Kentucky (2004)	DD	ftp://ftp.kymartian.ky.gov/fsa/
1	Groundwater Sensitivity Regions of Kentucky	DD	http://kgsweb.uky.edu/download/rivers/sensitivity.ZIP
1	Karst Dye Traces	DD	http://kgsweb.uky.edu/download/rivers/karstdye.ZIP
1	Karst Occurrence in Kentucky	DD	http://kgsweb.uky.edu/download/geology/karst500k.zip
1	Kentucky Inter-municpal Operating Permit points (KIMOP systems)	DD	http://wris.ky.gov/wris/mapgis/wrisdata.htm
1	Kentucky NLCD92	DD	ftp://ftp.kymartian.ky.gov/kls/kls_nlcd92.zip
1	Kentucky Single Zone 30ft DEM	DD	http://kymartian.ky.gov/demwebusgs/
1	Kentucky Single Zone 30ft DEM	DD	http://kymartian.ky.gov/demweb/
1	Kentucky Sinkhole Drainage Areas	DD	ftp://ftp.kymartian.ky.gov/usgs/kysinksheds.zip
1	Lift Stations	DD	http://wris.ky.gov/wris/mapgis/wrisdata.htm
1	McLean Co., KY, High Resolution Land Cover Data Set	DD	ftp://ftp.kymartian.ky.gov/kls/mcleanco_hireslc.zip
1	NHD 24k Streams of Kentucky (Statewide)	DD	ftp://kygeonet.ky.gov/kygeodata/ky/nhd/kynhd24k_1z.zip
1	Package Treatment Plants (PTPs)	DD	http://wris.ky.gov/wris/mapgis/wrisdata.htm
1	Pump Stations	DD	http://wris.ky.gov/wris/mapgis/wrisdata.htm
1	Regulated Dams of Kentucky	DD	http://kgsweb.uky.edu/download/rivers/dowdams.ZIP
1	Sewer Lines	DD	http://wris.ky.gov/wris/mapgis/wrisdata.htm

1	Simplified Geology of Kentucky	DD	http://kgsweb.uky.edu/download/state/kygeol.ZIP
1	Spring and Surface Sources	DD	http://wris.ky.gov/wris/mapgis/wrisdata.htm
1	Springs in Kentucky	DD	http://kgsweb.uky.edu/download/rivers/springs.ZIP
1	Surface Water Monitoring Stations	DD	http://kgsweb.uky.edu/download/rivers/usgsgage.ZIP
1	The 8, 10, and 12 digit hydrologic unit boundaries for Kentucky	DD	ftp://ftp.kymartian.ky.gov/usgs/kyhu12sz.zip
1	Wastewater Treatment Plant Outfalls	DD	http://wris.ky.gov/wris/mapgis/wrisdata.htm
1	Wastewater Treatment Plants (WWTPs)	DD	http://wris.ky.gov/wris/mapgis/wrisdata.htm
1	Water Wells in Kentucky	DD	http://kgsweb.uky.edu/download/rivers/WWELLS.ZIP
1 or 2?	Kentucky Stream Reach Drainage Polygons	DD	ftp://ftp.kymartian.ky.gov/usgs/kyhydropolys.zip
1?	7.5 Minute Topographic Maps of Kentucky (DRGs)	DD	http://kymartian.ky.gov/drgmaps/
1?	Kentucky Raster Graphics (KRGs)	DD	http://kymartian.ky.gov/krgmaps/index.html
2	026 Designated Use Lakes	DD	ftp://kygeonet.ky.gov/kygeodata/ky/nrepc/026_designated_uses_lakes.zip
2	026 Designated Use Waters	DD	ftp://kygeonet.ky.gov/kygeodata/ky/nrepc/026_designated_uses.zip
2	030 Exceptional Use Waters	DD	ftp://kygeonet.ky.gov/kygeodata/ky/nrepc/030_exceptional_use.zip
2	030 Exceptional Waters - Lakes	DD	ftp://kygeonet.ky.gov/kygeodata/ky/nrepc/030_exceptional_use_lake.zip
2	2004 303(d) Statewide Approved TMDLs - Lakes	DD	ftp://kygeonet.ky.gov/kygeodata/ky/nrepc/2004_303d_approved_tmdls_lakes.zip
2	2004 303(d) Statewide Approved TMDLs - Streams	DD	ftp://kygeonet.ky.gov/kygeodata/ky/nrepc/2004_303d_approved_tmdls_streams.zip
2	2004 303(d) Statewide Delistings - Lakes	DD	ftp://kygeonet.ky.gov/kygeodata/ky/nrepc/2004_303d_delistings_lakes.zip
2	2004 303(d) Statewide Delistings - Streams	DD	ftp://kygeonet.ky.gov/kygeodata/ky/nrepc/2004_303d_delistings_streams.zip
2	2004 303(d) Statewide Required TMDLs - Lakes	DD	ftp://kygeonet.ky.gov/kygeodata/ky/nrepc/2004_303d_required_tmdls_lakes.zip
2	2004 303(d) Statewide Required TMDLs - Streams	DD	ftp://kygeonet.ky.gov/kygeodata/ky/nrepc/2004_303d_required_tmdls_streams.zip
2	Green River Peak Flows	DD	ftp://ftp.kymartian.ky.gov/usgs/greenpf6.zip
2	Kentucky River Peak Flows	DD	ftp://ftp.kymartian.ky.gov/usgs/ky6pf.zip
2	Kentucky Statewide 305(b) - Aquatic Life	DD	ftp://kygeonet.ky.gov/kygeodata/ky/nrepc/statewide_305b_aqlife.zip
2	Kentucky Statewide 305(b) - Drinking Water	DD	ftp://kygeonet.ky.gov/kygeodata/ky/nrepc/statewide_305b_drink.zip
2	Kentucky Statewide 305(b) - Fish Tissue Consumption	DD	ftp://kygeonet.ky.gov/kygeodata/ky/nrepc/statewide_305b_fc.zip
2	Kentucky Statewide 305(b) - Overall Use Support	DD	ftp://kygeonet.ky.gov/kygeodata/ky/nrepc/statewide_305b_overall.zip
2	Kentucky Statewide 305(b) - Swimming	DD	ftp://kygeonet.ky.gov/kygeodata/ky/nrepc/statewide_305b_swim.zip
2	Kentucky Statewide 305(b) Lakes - Aquatic Life	DD	ftp://kygeonet.ky.gov/kygeodata/ky/nrepc/statewide_305b_lakes_aqlife.zip
2	Kentucky Statewide 305(b) Lakes - Drinking Water	DD	ftp://kygeonet.ky.gov/kygeodata/ky/nrepc/statewide_305b_lakes_dw.zip

2	Kentucky Statewide 305(b) Lakes - Fish Tissue Consumption	DD	ftp://kygeonet.ky.gov/kygeodata/ky/nrepc/statewide_305b_lakes_fc.zip
2	Kentucky Statewide 305(b) Lakes - Overall Use Support	DD	ftp://kygeonet.ky.gov/kygeodata/ky/nrepc/statewide_305b_lakes_overall.zip
2	Kentucky Statewide 305(b) Lakes - Swimming	DD	ftp://kygeonet.ky.gov/kygeodata/ky/nrepc/statewide_305b_lakes_swim.zip
2	Lower Cumberland River Peak Flows	DD	ftp://ftp.kymartian.ky.gov/usgs/locu6pf.zip
2	Lower Mississippi River Peak Flows	DD	ftp://ftp.kymartian.ky.gov/usgs/lomi6pf.zip
2	Lower Ohio Peak Flows	DD	ftp://ftp.kymartian.ky.gov/usgs/looh6pf.zip
2	Lower Tennessee River Peak Flows	DD	ftp://ftp.kymartian.ky.gov/usgs/lotn6pf.zip
2	Miami Ohio Racoon River Peak Flows	DD	ftp://ftp.kymartian.ky.gov/usgs/racoon6pf.zip
2	Middle Ohio Little Miami River Peak Flows	DD	ftp://ftp.kymartian.ky.gov/usgs/molm6pf.zip
2	Nitrate-Nitrogen Concentrations in Wells and Springs in Kentucky	SMI	http://kgsweb.uky.edu/download/wrs/lc60.pdf
2	Salt River Peak Flows	DD	ftp://ftp.kymartian.ky.gov/usgs/salt6pf.zip
2	Source Water Assessment and Protection Program (SWAPP) Zone 1	DD	ftp://kygeonet.ky.gov/kygeodata/ky/nrepc/kyswapp_zone1.zip
2	Source Water Assessment and Protection Program (SWAPP) Zone 2	DD	ftp://kygeonet.ky.gov/kygeodata/ky/nrepc/kyswapp_zone2.zip
2	Source Water Assessment and Protection Program (SWAPP) Zone 3	DD	ftp://kygeonet.ky.gov/kygeodata/ky/nrepc/kyswapp_zone3.zip
2	Upper Cumberland Peak Flows	DD	ftp://ftp.kymartian.ky.gov/usgs/ucum6pf.zip
2?	Big Sandy River Peak Flows	DD	ftp://ftp.kymartian.ky.gov/usgs/bsan6pf.zip
2?	Licking River Peak Flows	DD	ftp://ftp.kymartian.ky.gov/usgs/lick6pf.zip
2?	Well Sources	DD	http://wris.ky.gov/wris/mapgis/wrisdata.htm
3	7.5-minute Quadrangle Index	DD	http://kgsweb.uky.edu/download/state/QUADSKY.ZIP
3	7.5-minute Quadrangle Index - Line	DD	ftp://kygeonet.ky.gov/kygeodata/ky/dgi/Quad_Line1z.zip
3	7.5-minute Wetlands Quadrangle Map Images in MrSid Format	DD	http://kymartian.ky.gov/wetlands1z/index.html
3	8 Digit Hydrologic Units	DD	ftp://ftp.kymartian.ky.gov/dgi/huc8.zip
3	City Point Locations in Kentucky	DD	ftp://ftp.kymartian.ky.gov/dgi/city_incpts.zip
3	Corporate Boundary Polygons of Kentucky	DD	ftp://ftp.kymartian.ky.gov/dlgbnd/
3	County Boundary Polygons of Kentucky	DD	ftp://ftp.kymartian.ky.gov/county/
3	Draft Level III and IV Ecoregions of Kentucky	DD	http://kgsweb.uky.edu/download/geology/kyeco.zip
3	Generalized geologic bedrock conditions as related to solid-waste landfills in Kentucky	SMI	http://kgsweb.uky.edu/PubsSearching/MoreInfo.asp?titleInput=1078&map=0
3	Generalized geologic map for land-use planning: Anderson County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc74_12.pdf
3	Generalized geologic map for land-use planning: Ballard County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc70_12.pdf
3	Generalized geologic map for land-use planning: Bullitt County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc90_12.pdf
3	Generalized geologic map for land-use planning: Butler County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc61_12.pdf
3	Generalized geologic map for land-use planning: Calloway County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc73_12.pdf
3	Generalized geologic map for land-use planning: Carlisle County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc78_12.pdf
3	Generalized geologic map for land-use planning: Christian County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc105_12.pdf

3	Generalized geologic map for land-use planning: Clinton County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc98_12.pdf
3	Generalized geologic map for land-use planning: Daviess County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc87_12.pdf
3	Generalized geologic map for land-use planning: Edmonson County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc60_12.pdf
3	Generalized geologic map for land-use planning: Estill County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc89_12.pdf
3	Generalized geologic map for land-use planning: Franklin County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc104_12.pdf
3	Generalized geologic map for land-use planning: Fulton County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc69_12.pdf
3	Generalized geologic map for land-use planning: Graves County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc50_12.pdf
3	Generalized geologic map for land-use planning: Hancock County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc88_12.pdf
3	Generalized geologic map for land-use planning: Hardin County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc82_12.pdf
3	Generalized geologic map for land-use planning: Henderson County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc75_12.pdf
3	Generalized geologic map for land-use planning: Hickman County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc79_12.pdf
3	Generalized geologic map for land-use planning: Hopkins County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc91_12.pdf
3	Generalized geologic map for land-use planning: Jefferson County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc81_12.pdf
3	Generalized geologic map for land-use planning: Jessamine County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc37_12.pdf
3	Generalized geologic map for land-use planning: Livingston County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc68_12.pdf
3	Generalized geologic map for land-use planning: Logan County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc108_12.pdf
3	Generalized geologic map for land-use planning: Lyon County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc51_12.pdf
3	Generalized geologic map for land-use planning: Madison County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc72_12.pdf
3	Generalized geologic map for land-use planning: Marshall County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc76_12.pdf
3	Generalized geologic map for land-use planning: McCracken County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc71_12.pdf
3	Generalized geologic map for land-use planning: Mclean County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc85_12.pdf
3	Generalized geologic map for land-use planning: Nelson County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc97_12.pdf
3	Generalized geologic map for land-use planning: Oldham County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc106_12.pdf
3	Generalized geologic map for land-use planning: Pulaski County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc80_12.pdf
3	Generalized geologic map for land-use planning: Russell County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc94_12.pdf
3	Generalized geologic map for land-use planning: Scott County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc48_12.pdf
3	Generalized geologic map for land-use planning: Simpson County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc107_12.pdf

3	Generalized geologic map for land-use planning: Todd County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc109_12.pdf
3	Generalized geologic map for land-use planning: Trigg County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc83_12.pdf
3	Generalized geologic map for land-use planning: Union County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc84_12.pdf
3	Generalized geologic map for land-use planning: Warren County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc59_12.pdf
3	Generalized geologic map for land-use planning: Wayne County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc93_12.pdf
3	Generalized geologic map for land-use planning: Webster County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc86_12.pdf
3	Generalized geologic map for land-use planning: Wolfe County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc103_12.pdf
3	Generalized geologic map for land-use planning: Woodford County, Kentucky (pdf)	SMI	http://kgsweb.uky.edu/olops/pub/kgs/mc49_12.pdf
3	Hillshade	DD	http://kymartian.ky.gov/hillshade1z/index.html
3	Hydrology of Kentucky	LDM	http://kygeonet.ky.gov/kyhydro/viewer.htm
3	Kentucky's Proposed Water & Wastewater Infrastructure Projects (JPEG)	SMI	http://kygeonet.ky.gov/kygeodata/ky/wris/kywaterprojects.jpg
3	Kentucky's Proposed Water Infrastructure Projects	LDM	http://kygeonet.ky.gov/watprop/viewer.htm
3	Kentucky's Water Wells	LDM	http://kgsmap.uky.edu/website/kgsgw/viewer.htm
3	Kentucky's Wetland Polygon Features	DD	ftp://ftp.kymartian.ky.gov/nrepc/wetlands.zip
3	KY SSURGO Soils Status Map 092705	DD	http://www.ky.nrcs.usda.gov/technical/GIS
3	Lakes of Kentucky	DD	http://kgsweb.uky.edu/download/rivers/kylakes.ZIP
3	Land-Use Planning: Soils and Geology	LDM	http://kgsmap.uky.edu/website/kyluplan/viewer.htm
3	Mapped Ground-Water Basins in the Beaver Dam 30 x 60 Minute Quadrangle	SMI	http://kgsweb.uky.edu/download/wrs/Mc19.pdf
3	Mapped Ground-Water Basins in the Bowling Green 30 x 60 Minute Quadrangle	SMI	http://kgsweb.uky.edu/download/wrs/Mc22.pdf
3	Mapped Ground-Water Basins in the Campbellsville 30 x 60 Minute Quadrangle	SMI	http://kgsweb.uky.edu/download/wrs/Mc17.pdf
3	Mapped Ground-Water Basins in the Harrodsburg 30 x 60 Minute Quadrangle	SMI	http://kgsweb.uky.edu/download/wrs/Mc16.pdf
3	Mapped Ground-Water Basins in the Somerset 30 x 60 Minute Quadrangle	SMI	http://kgsweb.uky.edu/download/wrs/Mc18.pdf
3	Physiographic Regions of Kentucky	DD	http://kgsweb.uky.edu/download/state/REGIONS.ZIP
3?	LOJIC Products Catalog	SMI	http://www.lojic.org/apps/products/cart/index.cfm

Appendix C

Minimal but Compliant Data

Metadata elements included in the Metadata Entry System

Source: http://www.fgdc.gov/clearinghouse/metadataesystem/mes_description.html

Accessed December 29, 2005

There is abundant interest in exactly what elements need to be filled in in order to build **minimal but compliant FGDC-style metadata** as produced by the Metadata Entry System. These are a few more than the mandatory list but constitute a minimal adequate set for general "catalog" use. Here is a list of those elements, valid for Version 1.0 of the Content Standard for Digital Geospatial Metadata:

Repeating "Profile" Elements

The following elements are collected once for a given metadata entry person and are embedded in every subsequent metadata entry they make, saving data entry time for this information.

Metadata organization:

Metadata contact position/person:

Address type:

Address:

City:

State or province:

Postal code:

Country:

Phone:

Fax:

E-mail address

Metadata Elements for Each Entry

General Identification Information

Identity of this entry (for future update):

Originator:

Publication date (YYYYMMDD):

Title of data set:

Edition:

Presentation Form:

Publication place:

Publisher:

Online linkage (URL):

Abstract:

Purpose:

Supplemental Information:

Beginning date: (YYYYMMDD):

Ending date: (YYYYMMDD):

Currentness reference:

Progress:

Intended data set maintenance and update frequency:

West bounding coordinate (-DDD.XXX):

East bounding coordinate (-DDD.XXX):

North bounding coordinate (DD.XXX):

South bounding coordinate (DD.XXX):

Theme keywords:

Theme Reference:

Place keywords:

Place Reference:

Limits on data accessibility:

Limits on use of data:

Browse graphic URL:

Browse graphic caption:

Browse graphic file type:

Spatial data type: (vector, raster, point)

Distribution Information

Distribution organization:

Distribution contact position/person:

Address type:

Address:

City:

State or province:

Postal code:

Country:

Phone:

Fax:

E-mail:

Dataset name as known by Distributor:

Liability held by distributor:

Date of last metadata entry or update (YYYYMMDD):

Appendix D

Watershed Delineation in Karst Areas

Inaccurate Sub-Division of Hydrologic Units

IN KENTUCKY'S KARST WATERSHEDS

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Kentucky Division of Water

Frankfort, Kentucky

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Available at: http://www.uky.edu/WaterResources/SYMP00-POST.HTML
Accessed December 29, 2005

ABSTRACT

Hydrologic Unit Code (HUC) watershed maps in karst areas of Kentucky have been delineated by the US Geologic Survey and cooperating agencies based on uniform topographic criteria without verification with groundwater-tracer data. In order to represent true hydrologic units, a region's groundwater must be considered. The fact that groundwater divides in soluble rock terrains do not always coincide with topographic divides, has not been adequately evaluated in the production of these important maps.

A comparison of tracer-delineated groundwater basins with these maps reveals that a significant percentage of the HUC topographic basins in karst regions fail to coincide with hydrologic basins on two levels: 1) The HUC boundaries are wrong where they attribute drainage (both base flow and high flow) of an area to the incorrect watershed. 2) They are inaccurate when they attribute base flow drainage to an incorrect basin even though some portion of high-flow discharge does follow surface channels or overflow springs to the correctly attributed basin. Clearly, karst watershed data cannot be reliably obtained from topographic maps or elevation models.

A large karst watershed, located in Barren and Edmonson counties of the Green River basin, is mismapped where an 8-digit Cataloging Unit boundary incorrectly attributes about 100 mi2 of the Green River basin to the Barren River. Base-flow and high-flow drainage has been traced to springs on the Green River rather than the Barren River.

These traced groundwater basins were originally published in 1981 (Quinlan and Ray) and have been republished at scale of 1:100,000 (Ray and Currens, 1998).

Additionally, in Christian and Trigg counties within the Cumberland River basin an 11-digit Hydrologic Unit boundary inaccurately attributes about 25 mi2 of the Little River basin to the Sinking Fork basin. The Sinking Fork watershed does receive a portion of this basin's high-flow drainage via overflow springs and channels, but its base flow supplies the largest spring on the Little River. Similar inaccuracies involving four karst drainage basins have been determined for about 25 mi2 in Meade and Breckinridge counties.

A basic principle of karst watersheds has been disregarded since the HUC maps imply more than mere topograpic divisions. If environmental-protection work, land and water-resource management activities, or hydrologic balance calculations in karst terrain were based on existing HUC maps, serious errors could result. Although topographic divides are often used when estimating karst-basin boundaries, an important practice is the depiction of these hypothetical karst divides with broken lines, which more accurately reflects their imprecise nature. At a minimum, topographic divides in karst terrain should be depicted on HUC maps with dashed or dotted lines where the true nature of stream flow and groundwater drainage is unknown. Groundwater-basin delineations should be utilized where available. Also, a caveat, alerting the user to the potential variation between topographic surfaces and karst watersheds, should be prominently displayed in the karst regions of these maps.

When the actual flow pattern of a karst watershed is required, hypothetical groundwater boundaries must be tested with field investigations. The verifiable procedure for mapping a karst watershed boundary is a series of groundwater tracer tests. Two additional field methods, although less definitive than groundwater tracing, is to map the potentiometric surface and to calculate the hydrologic balance of springs and streams. One must recognize, and advise the user of HUC maps, that topographic divides are unreliable when mapping hydrologic units in karst terrain.