SUBPROJECT 2:

GEOLOGIC MAPPING OF IMPAIRED WATERSHEDS IN NORTHEAST IOWA: PHASE 2: Upper Iowa and Yellow River Watersheds

A. Introduction

This proposed subproject comprises the second phase of a multi-year program to produce digital geologic maps of impaired watersheds in northeast Iowa. The Upper Iowa River (UIR) and Yellow River (YR) have long been recognized among Iowa's premiere recreational streams, but in recent years water quality impairments from high concentrations of fecal coliform bacteria have raised public concerns about the health impacts of recreational activity (Skopec et al., 2003).

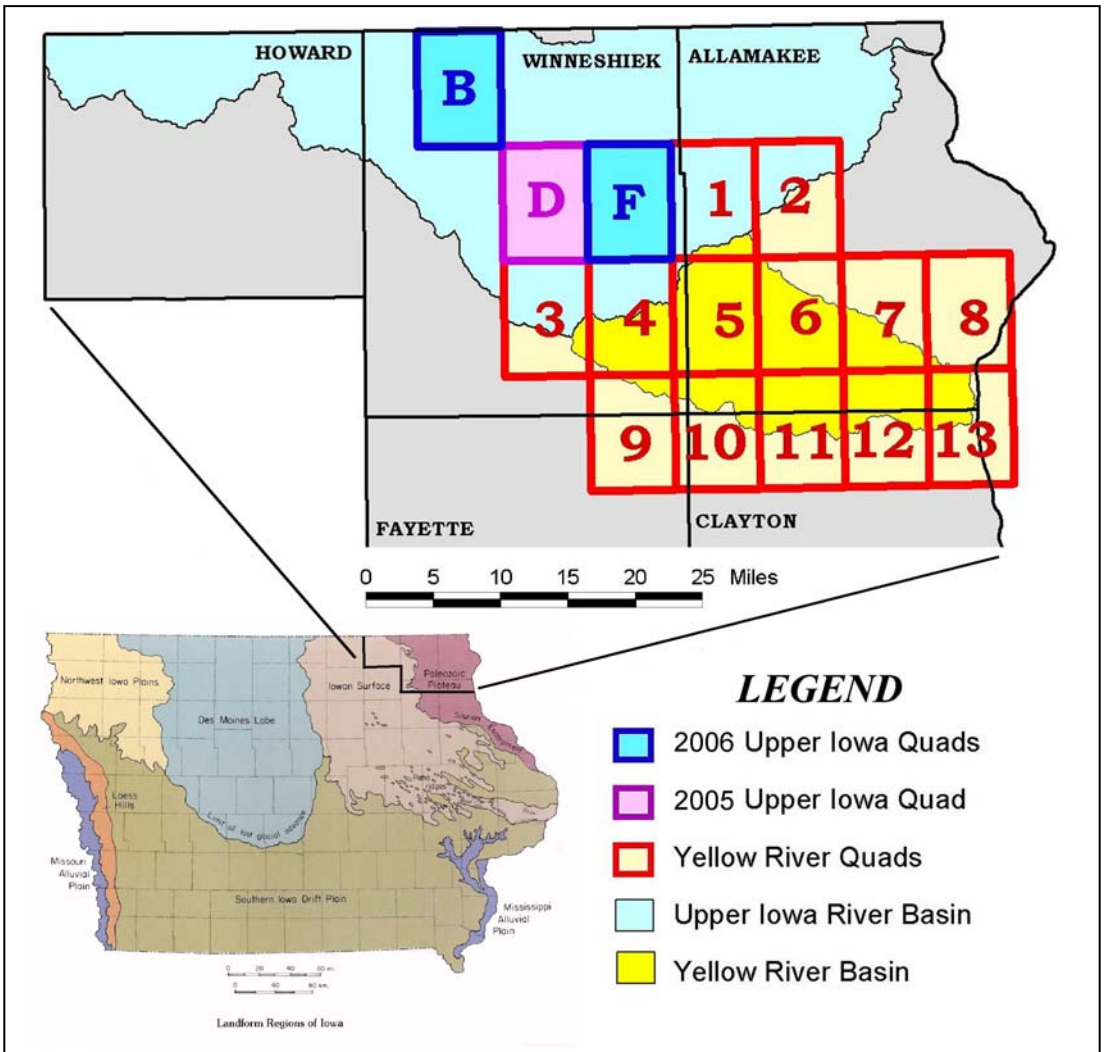

Fig. 2-1. Location of the Upper Iowa River (UIR) and Yellow River (YR) watersheds in Iowa. The Decorah (D) 7.5' Quadrangle is being mapped as part of Iowa's FFY2004 project. Surficial geologic maps of the Bluffton (B) and Freeport (F) 7.5' quadrangles are proposed for FFY2005. Bedrock geologic mapping of the YR watershed, including all of the Hanover (1), Waukon (2), Calmar (3), Postville NW (4), Frankville (5), Rossville (6), Waterville (7), Harpers Ferry (8), Castalia (9), Postville (10), Monona (11), Giard (12), and Prairie du Chien (13) 7.5' quadrangles is proposed for the FFY2005 STATEMAP Program.

Proposed surficial geologic mapping in the Bluffton (B) and Freeport (F) quadrangles in the UIR Watershed would bracket earlier FFY04 mapping in the Decorah Quadrangle, which included the City of Decorah (population 8,172), the largest community in the watershed, the seat of Winneshiek County government and a regional cultural center. Proposed bedrock geologic mapping in the YR Watershed would include the communities of Waukon (population 4,059), the seat of Allamakee County government, and Postville (population 2,244) and Monona (1,497) in Clayton County.

B. Location and Geologic Setting

The Upper Iowa River and Yellow River watersheds are located within the Paleozoic Plateau region of northeast Iowa (Fig. 2-1), a region of shallow, near-surface bedrock with karst development in Paleozoic carbonate strata (Prior, 1991). The water quality impacts of non-point source contamination of shallow groundwaters in the karsted Ordovician carbonates of the Galena Group have long been the subject of continuing hydrogeologic investigations by the Iowa Geological Survey (Hoyer et al., 1986; Hallberg et al., 1989; Libra et al., 1991; Libra et al., 1992; Rowden et al., 1993; Rowden et al., 1995; Liu et al., 1997; Liu et al., 2000)

Upper Iowa River Watershed: The Iowa portion of the Upper Iowa River (UIR) Watershed spans through portions of Howard, Winneshiek, and Allamakee counties (Fig. 2-1). Of the two quadrangles proposed for this project, the Bluffton 7.5' Quadrangle is bounded by 43° 15' to 43° 22.5' latitude, and 91° 52.5' to 92° 00' longitude, and the Freeport 7.5' Quadrangle is bounded by 43° 15' to 43° 22.5' latitude, and 91° 37.5' to 91° 45' longitude.

Yellow River Watershed: The Yellow River (YR) Watershed spans through portions of Winneshiek, Clayton, and Allamakee counties (Fig. 2-1). The proposed project area includes all of the thirteen 7.5' quadrangles that contain portions of the YR Watershed, and is bounded by 43° 00' to 43° 22.5' latitude, and 91° 07.5' to 91° 52.5' longitude.

C. Purpose and Justification

A major goal of geologic mapping in the UIR and YR watersheds is to carry out a threefold subdivision of one of the earlier bedrock geologic mapping units (Ogp—the Galena Group and Platteville Formation) previously mapped by Witzke et al. (1998). Local interests called for the Iowa Geological Survey (IGS) to map the outcrop distribution of the Decorah Shale, for the purpose of identifying sensitive areas where overlying fens may be naturally remediating contaminated near-surface groundwaters discharging from shallow karst aquifers. The role of the Decorah Shale in the bioremediation of discharging shallow groundwaters has received attention in an analogous geomorphic situation near the City of Rochester in the Zumbro River Basin of southeastern Minnesota (Barret, Modjeski, and Lee, 2001; Lindgren, 2001). There, shallow groundwaters flowing through fens on the Decorah-Platteville outcrop belt locally recharge the Cambro-Ordovician aquifer and the Rochester municipal well field. Proposed new mapping subdivision of the Galena Group (Fig. 2-2) will help to determine the location of fens overlying the outcrop belt of the Decorah Shale in Iowa.

The issue of flood zoning, and its potential impact on commercial developments is also a topic of major local interest. New and proposed commercial developments along the Iowa Highway 9 corridor in Decorah and Freeport have intensified local concerns about formulating floodplain zoning by local governments. The delineation of alluvial mapping units in the UIR valley in the proposed surficial geologic mapping will inform the process of future floodplain zoning.

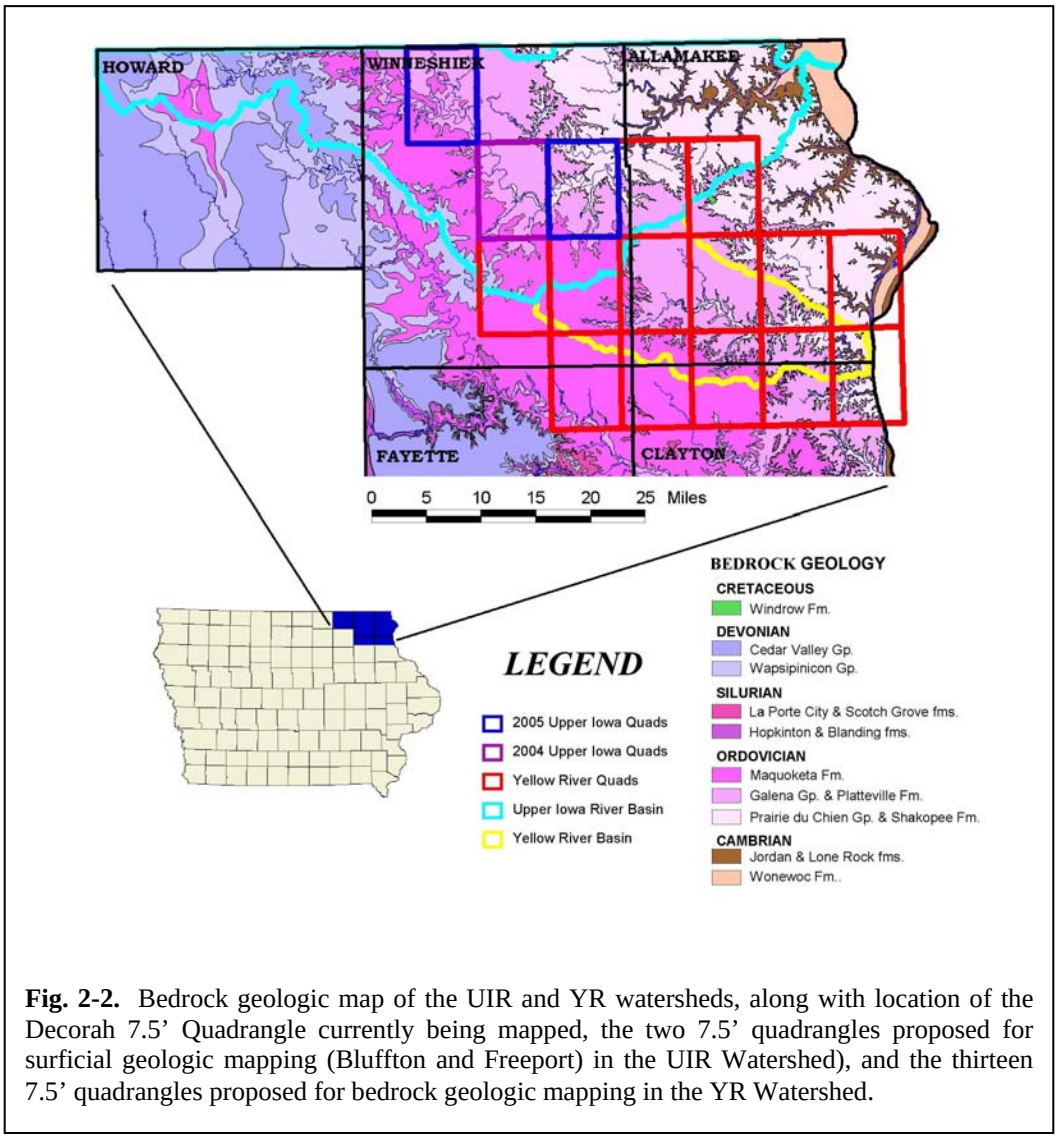

Fig. 2-2. Bedrock geologic map of the UIR and YR watersheds, along with location of the Decorah 7.5' Quadrangle currently being mapped, the two 7.5' quadrangles proposed for surficial geologic mapping (Bluffton and Freeport) in the UIR Watershed), and the thirteen 7.5' quadrangles proposed for bedrock geologic mapping in the YR Watershed.

Water Quality Impairments: Segments of both the UIR and YR are classified by the State of Iowa Administrative Rules, Chapter 61 (http://www.iowadnr.com/water/tmdlwqa/index.html) as streams in which recreational uses (swimming or canoeing; Class A1) or (fishing; ClassA2) could pose health hazards. Epidemiological studies by the U.S. Environmental Protection Agency show that the presence of *E. coli* bacteria correlates with swimming-related illnesses (USEPA, 1986). In 2003, the State of Iowa revised water quality standards for bacteria and began using *E. coli* as the indicator bacteria. As part of the new standard, a single sample tested for *E. coli* in Class A1 waters should not exceed 235 organisms/100mL; and a single sample tested for *E. coli* in Class A2 waters should not exceed 2,880 organisms/100mL (Iowa Administrative Rules Chapter 61). Water quality samples from the Yellow River, Upper Iowa River, and their tributaries, however, repeatedly exceed the State of Iowa's *E. coli* standard. Since 2003, periodic sampling of one segment of the UIR has exceeded the *E. coli* standard 7 times, including one sample of 180,000 CFU/100mL (over 700 times the state standard). Periodic sampling of a segment of the YR has exceeded the *E. coli* standard 20 times, including one sample of 130,000 CFU/100mL (over 500 times the state standard).

Recent state regulations regarding livestock operations, wastewater plants, and their relationship to karst features have added impetus for mapping these watersheds. There is strong public interest in reducing bacteria levels in both watersheds since the UIR and YR are popular for canoeing and fishing.

Northeast Iowa
Resource Conservation and Development, Inc.
101 E Greene - P.O. Box 916 - Postville Iowa 52162-0916
Phone (563) 864-7112 - Fax (563) 864-7113

August 26, 2004

To Whom It May Concern:

On behalf of the Upper Iowa River Watershed Project I am writing to voice our support for continued geologic mapping in the Bluffton and Freeport quadrangles of Winneshiek County in Northeast Iowa. Detailed geologic mapping in these areas is crucial to understanding the complex groundwater system and to help grasp the impacts of changing development patterns in Northeast Iowa.

Recent studies of groundwater travel times and patterns have reinforced the knowledge that subsurface geology in Northeast Iowa is among the most complex in Iowa. Understanding the geologic impacts on water quality would be a valuable resource to water quality research being conducted throughout the Upper Iowa River Watershed (UIRW).

Development in the Bluffton and Freeport quadrangles is a concern for water quality professionals in Northeast Iowa. The Bluffton area has recently been the target for development of swine confinement operations. Having accurate geologic information to properly understand the confinement's impact on water quality was major concern of the Winneshiek County Supervisors. The supervisors eventually recommended the confinement's application be rejected due to the possible impact on ground water resources.

Urban growth in the Freeport quadrangle is beginning to gain speed; understanding the geology of this area will only help better plan for future expansion in this sensitive area. UIRW Project staff have begun a karst survey of portions of this quadrangle; the survey has already identified and taken GPS locations of over 200 sinkholes and nearly 30 coldwater springs in just a 10 square mile area in southern portions of the quadrangle. A detailed geologic map of this area would be very useful in understanding the sinkhole and spring relationships to subsurface geology.

A detailed geologic map of the Bluffton and Freeport quadrangles would a valuable tool and I urge steps be taken to move this project forward.

Sincerely,

Adam Kiel
GIS Specialist & Acting Coordinator for the Upper Iowa River Watershed Project

AN EQUAL OPPORTUNITY EMPLOYER

Fig. 2-3A. Letter of support for geologic mapping in the Upper Iowa River Watershed from Northeast Iowa Resource Conservation and Development, Inc.

ALLAMAKEE COUNTY SOIL AND WATER CONSERVATION DISTRICT
635 9th Street NW, Waukon, IA 52172
Phone (563) 568-2246

September 7, 2004

To Whom It May Concern:

We are writing to support an effort by the Iowa Department of Natural Resources, DNR, to create a bedrock geology map of the Yellow River Watershed. We are collaborating with the University of Iowa Hygienic Lab, UHL, National Park Service, NPS, Natural Resources Conservation Service, NRCS and several local groups to collect data on the Yellow River and its' tributaries. We hope to use this information to design a watershed treatment plan that targets funds to try to improve water quality of this stream.

Since the Yellow River is located in karst topography, containing over 2000 sinkholes and many disappearing, decreasing and increasing stream segments, defining sources of impairments is extremely difficult. We feel a dye tracing would be an essential component of the assessment in this watershed. We have been in contact with Greg Nalley, United States Geological Survey, USGS, to discuss the requirements for a dye tracing. While we have many of the necessary components, including GIS maps of sinkholes, springs and disappearing streams, plus all soils and land-use information. Greg indicated that we need an updated, comprehensive bedrock geology map of this watershed. Once funding becomes available, we would like to begin dye tracing the watershed.

Please consider this valuable project. It is essential to our plan for treating and improvin water quality in the Yellow River Watershed.

Sincerely,

John Schultz

John Schultz, Chairman
Allamakee Soil and Water Conservation District

Fig. 2-3B. Letter of support for geologic mapping in the Yellow River Watershed from Allamakee County Soil and Water Conservation District.

Coalitions of federal, state, and local agencies have formed to assess and, ultimately, to reduce the sources of bacteria in the watersheds. The UIR coalition has conducted dye-tracing and DNA source tracking projects to determine bacteria sources. The YR coalition is trying to secure funding for a dye-tracing project to determine bacteria sources. These coalitions are actively working with the public to make decisions that reduce *E. coli* levels below water-quality standards, and have requested the assistance of IGS to carry out detailed geologic mapping to support these efforts (Fig. 2-3). We have submitted a proposal to the IDNR's nonpoint (USEPA. Section 319) program that would also support the development of applied derivative environmental maps of these watersheds from detailed geologic maps.

D. Strategy for Performing the Geologic Mapping

As noted, the IGS has a grant proposal pending to the USEPA Section 319 Program that would support efforts to map the bedrock geology of the whole UIR Watershed at 1:24,000 scale, an effort that would dovetail with STATEMAP-supported surficial geologic mapping at 1:24,000 scale in the watershed. This proposal includes the surficial geologic mapping of two 7.5' quadrangles in the UIR Watershed, and bedrock geologic mapping of the whole YR Watershed, both at 1:24,000 scale.

A major part of the mapping effort would be devoted to fully exploiting water well records currently held by the IGS. Within the Bluffton and Freeport quadrangles in the UIR Watershed, only 18 % of the sample sets currently have been logged. The 82 unstudied wells in this area have a cumulative depth of 10,178'. In the YR Watershed, only 26% of the sample sets have currently been logged. The 219 unstudied wells have a cumulative depth of 136,095'. IGS proposes to continue a highly successful program of hiring and training a part-time workforce of University of Iowa geology students to study well samples, and to prepare and digitize well logs in support of the mapping effort.

Digital soil surveys from NRCS are already available from the NRGIS library, and a portrayal of areas of bedrock exposure in the UIR Watershed and the remainder of Howard, Winneshiek, and Allamakee Counties is shown in Figure 2-4. Initial work on the project will involve a systematic review of digital soil survey databases to assure that all useful geologic data have been extracted from these coverages. These data will be digitally integrated in ArcView® 3.3 with other published and unpublished geologic data in paper archives held by IGS, or retrieved from other sources.

Field investigations would be assisted by consulting geologists Jean Young and Michael Vermace of Luther College in Decorah, who would provide GPS locations of well sites, and supervise local geologic reconnaissance by students at Luther College and their development of ArcView®3.3 coverages of these site data. Quaternary mapping units will be developed using a combination of existing geologic information (IGS well logs, materials data from local agencies and consultants, and digital soil surveys), aerial photography, and new field work to characterize and delineate deposits. New geologic information from continuous core drilling and outcrop descriptions will be collected for areas with limited data. This will test confidence levels in the use of existing data sources to reliably delineate mapping units. Drilling transects in alluvial settings will be particularly important to establish a stratigraphic framework for the Upper Iowa River.

E. Summary of Prior Work

The most recently-published bedrock geologic map in Iowa (Hershey, 1969) is now out of print, but the bedrock geology of the area of the UIR and YR watersheds in Iowa was more recently mapped by Witzke et al. (1998; http://gsbdata.igsb.uiowa.edu/gsbpubs/pdf/OFM-1998-7.pdf). The one-year duration of that regional STATEMAP project required that a number of bedrock units were lumped into larger mapping units in order to meet production deadlines. Now, with a specific request from local organizations to delineate the outcrop extent of the Decorah Shale and Platteville Formations to better understand their water quality impacts, the IGS proposes to subdivide the Ordovician Ogp (Galena Group and Platteville Formation; Fig. 2) into three units: (1) Galena Group carbonates (Dubuque, Wise Lake,

and Dunleith Formations); (2) Decorah Formation; and (3) Platteville Formation. This work would be carried out throughout the UIR and YR watersheds during this multi-year mapping program, but would be completed in the Bluffton and Freeport quadrangles and the YR Watershed for this proposed project.

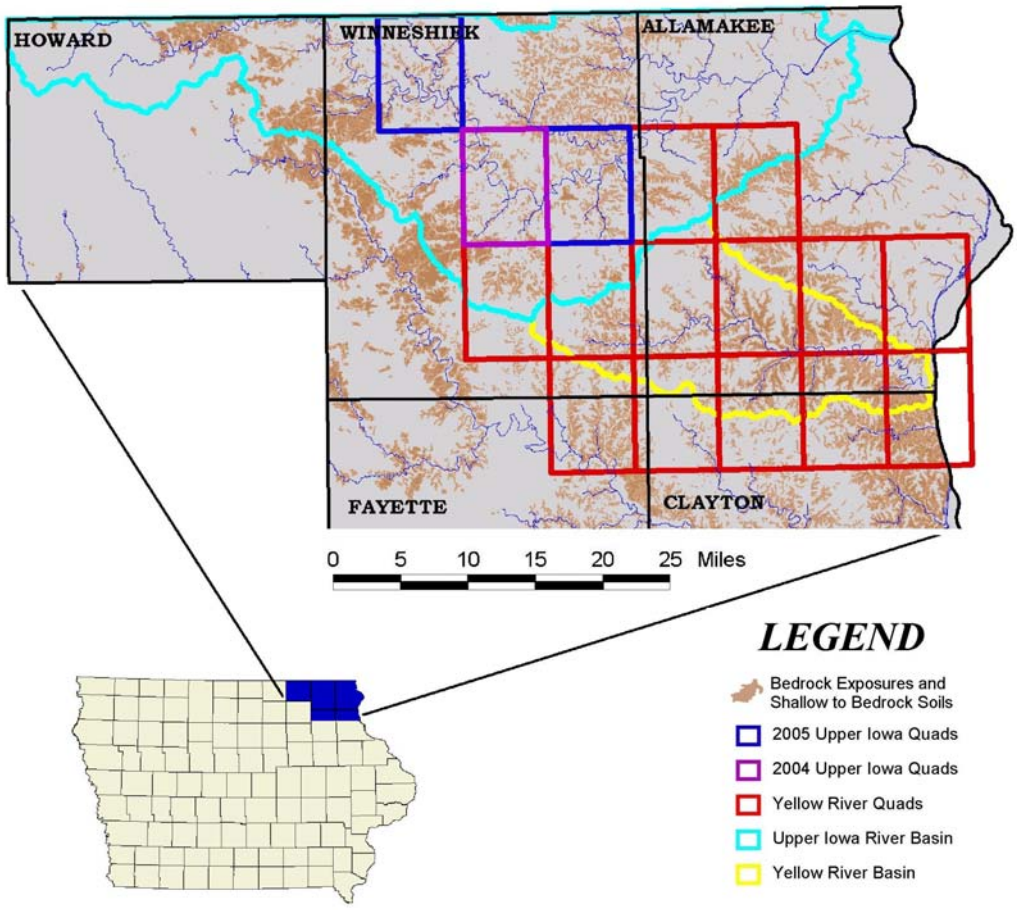

Fig. 2-4. Locations of areas of bedrock exposure in Howard, Winneshiek, Allamakee, Fayette, and Clayton counties in Iowa, extracted from NRCS digital soil survey data in the NRGIS library, along with USGS 7.5' topographic quadrangle areas proposed for geologic mapping in Fig. 1.

Quaternary deposits in the area of the UIR Watershed include pre-Illinoian till deposits and loess deposits in upland areas, and alluvial fills in the valleys of the Mississippi River and its tributary streams. Regional summaries of the late Quaternary and Holocene alluvial stratigraphy in Iowa can be found in Bettis (1990a and 1990b) and Bettis et al. (1992). In recent years, Quaternary studies in northeast Iowa have focused on paleoclimate archives in speleothems from cave systems, and Holocene sedimentary records sampled from alluvial fills (Denniston et al., 1999; Baker et al., 2001; Baker et al., 2002).

F. Deliverable Geologic Maps

Upon completion of this project, paper copies of the Bluffton and Freeport 7.5' quadrangles at 1:24,000 scale, and a paper copy of the YR watershed at 1:100,000 scale, would be delivered to the STATEMAP Program Officer. The maps would be entitled (1) ***Surficial Geologic Map of the Bluffton 7.5' Quadrangle***, (2) ***Surficial Geologic Map of the Freeport 7.5' Quadrangle***, and (3) ***Bedrock Geologic Map of the Yellow River Watershed***. All would be printed using IGS's HP DesignJet 2500CP inkjet plotter. All paper copies and reports would be delivered to the U.S. Geological Survey Program Officer upon completion of the project on or before June 30, 2006.

G. Project Personnel

Greg A. Ludvigson (Project Leader) Ph.D. '88; M.S. '76; B.S. '72; University of Iowa; Senior Research Geologist. Thirty years experience at Iowa Geological Survey; geologic field mapping has been a significant component of professional work experience and graduate thesis research. Dr. Ludvigson will be responsible for supervision of student well loggers, and coordinating the mapping of areas of exposed bedrock.

Stephanie Tassier-Surine (Principle Mapping Geologist) MS Geology, University of Massachusetts; Quaternary research geologist. Six years of experience at Iowa Geological Survey; maps completed include "Surficial Geologic Materials of the Ely and Swisher Quadrangles, Iowa", and "Surficial Geologic Materials of the Tiffin and Iowa City West 7.5' quadrangles" and "Surficial Geologic Materials of Johnson County, Iowa". Ms. Surine will be responsible for mapping Quaternary units.

Robert A. McKay (Project Geologist) M.S. University of Iowa; Senior Research Geologist. Twenty-six years of experience at the Iowa Geological Survey. He has special expertise in Cambro-Ordovician stratigraphy.

Paul Liu (Project Geologist) PhD, University of Nebraska; Ten years experience at the Iowa Geological Survey. Dr. Liu has research experience on Cretaceous nanofossil biostratigraphy in North America, and Cambro-Ordovician stratigraphy in China. He has worked on hydrogeologic research in northeast Iowa at the Iowa Geological Survey.

Raymond R. Anderson (Project Geologist) Ph.D. '92, M.S. '75, B.S. '70; University of Iowa; Senior Research and Extension Geologist.; Thirty-four years experience at the Iowa Geological Survey; work in cartography, remote sensing and as a research geologist; supervision of all bedrock and subsurface geologic mapping activities. Principal Investigater on 11 previous STATEMAP Cooperative Agreements. Dr. Anderson will be responsible for the construction of geologic databases, and digital cartography.

Brian J. Witzke (Project Geologist) Ph.D. '81; M.S. '76; University of Iowa, B.S. '72; University of Wisconsin, Milwaukee; Senior Research Geologist. Twenty-six years experience at Iowa Geological Survey; broad interests in sedimentary geology and paleontology, primarily focused in Paleozoic and Cretaceous strata of the North American Midcontinent; has been a key participant in most recent Survey mapping programs.

Bill J. Bunker (Project Geologist) B.S. '69, Iowa State University, Senior Research Geologist. Thirty-three years experience at Iowa Geological Survey, working primarily on geologic mapping projects in northeast and northwest Iowa, and principal author of the DNAG volume article on sedimentary rocks of mid-continent North America. For the last 10 years his primary responsibilities have been development of data base programs for storage and retrieval of geologic data.

Jean Young and Michael Vermace (Consulting Geologists) Jean Young (M.S. '64 University of Iowa), Curator of Geology at Luther College in Decorah, Iowa for over 30 years. Ms Young will be responsible for GPS location of well sites, and the supervision of Luther College students in local geologic reconnaissance in support of the mapping effort. Mike Vermace (Ph.D. 1996 University of Iowa), Visiting Assistant Professor of Environmental Science, will supervise student data entry of site observations into GIS databases.

BUDGET SUMMARY

Budget for cash award from USGS. The budget for the Decorah Quadrangle geologic mapping project includes a request for a $128,887 cash award from the USGS. The request includes $82,378 for salary/benefits for the part-time employment of six (6) IGS staff geologists; and $19,200 for the part-time employment of four (4) student employees (10-12 hrs/week for 48 weeks) whose principal duties would be to examine well cutting samples under the supervision of IGS staff geologists, to perform computer data entry from well logs and driller's logs, and to assist staff geologists in preparation of the geologic map. Requested contract drilling expenses sum to $8,800 (Aquadrill, Inc.; 800 feet of coring at $22/ft).

Requested funds of $2,000 for analytical services would support particle size analyses of unconsolidated sediments, and C-14 dating of Quaternary deposits. Also included are $4,500 for a contract for local assistance by consulting geologists Jean Young and Michael Vermace of Luther College in Decorah, $8,800 for contract drilling in support of the mapping effort, and $2,000 for field expenses.

Budget contribution match from IGS. The IGS will contribute a total of $128,887 to this mapping project. This contribution will be a 50% match on each line item in the budget, precisely matching the proposed amount requested from the USGS.

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