Scientific & Technical Report

Coalbed Methane Clearinghouse to Wyoming Energy Resources Information Clearinghouse

DOE Identification Number: DE-FG02-06ER64272
Project Dates: July 15, 2006 – December 31, 2009

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SCIENTIFIC AND TECHNICAL REPORT

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EXECUTIVE SUMMARY.

Energy development is expanding across the United States, particularly in western states like Wyoming. Federal and state land management agencies, local governments, industry and non-governmental organizations have realized the need to access spatially-referenced data and other non-spatial information to determine the geographical extent and cumulative impacts of expanding energy development. The Wyoming Energy Resources Information Clearinghouse (WERIC) is a web-based portal which centralizes access to news, data, maps, reports and other information related to the development, management and conservation of Wyoming's diverse energy resources.

WERIC was established in 2006 by the University of Wyoming's Ruckelshaus Institute of Environment and Natural Resources (ENR) and the Wyoming Geographic Information Science Center (WyGISC) with funding from the US Department of Energy (DOE) and the US Bureau of Land Management (BLM). The WERIC web portal originated in concept from a more specifically focused website, the Coalbed Methane (CBM) Clearinghouse. The CBM Clearinghouse effort focused only on coalbed methane production within the Powder River Basin of northeast Wyoming. The CBM Clearinghouse demonstrated a need to expand the effort statewide with a comprehensive energy focus, including fossil fuels and renewable and alternative energy resources produced and/or developed in Wyoming.

WERIC serves spatial data to the greater Wyoming geospatial community through the Wyoming GeoLibrary, the WyGISC Data Server and the Wyoming Energy Map. These applications are critical components that support the Wyoming Energy Resources Information Clearinghouse (WERIC). The Wyoming GeoLibrary is a tool for searching and browsing a central repository for metadata. It provides the ability to publish and maintain metadata and geospatial data in a distributed environment. The WyGISC Data Server is an internet mapping application that provides traditional GIS mapping and analysis functionality via the web. It is linked into various state and federal agency spatial data servers allowing users to visualize multiple themes, such as well locations and core sage grouse areas, in one domain. Additionally, this application gives users the ability to download any of the data being displayed within the web map. The Wyoming Energy Map is the newest mapping application developed directly from this effort. With over a 100 different layers accessible via this mapping application, it is the most comprehensive Wyoming energy mapping application available. This application also provides the public with the ability to create cultural and wildlife reports based on any location throughout Wyoming and at multiple scales. The WERIC website also allows users to access links to federal, state, and local natural resource agency websites and map servers; research documents about energy; and educational information, including information on upcoming energy-relate conferences.

The WERIC website has seen significant use by energy industry consultants, land management agencies, state and local decision-makers, non-governmental organizations and the public. Continued service to these sectors is desirable but some challenges remain in keeping the WERIC site viable. The most pressing issue is finding the human and financial resources to keep the site continually updated. Initially, the concept included offering users the ability to maintain the site themselves; however, this has proven not to be a viable option since very few people contributed. Without user contributions, the web page relied on already committed university staff to publish and link to the appropriate documents and web-pages. An option that is currently being explored to address this issue is development of a partnership

with the University of Wyoming, School of Energy Resources (SER). As part of their outreach program, SER may be able to contribute funding for a full-time position dedicated to maintenance of WERIC.

RESEARCH OBJECTIVES and ACCOMPLISHMENTS

The primary research objective of this project was to expand the scope of the CBM Clearinghouse beyond coalbed methane-related data and information to other energy resources including fossil fuels, renewable energy resources and alternative energy resources. The specific project objectives and associated accomplishments for the WERIC project are listed below. (See Appendix A-1 for a screen capture image of the WERIC website homepage.)

Web page development

- Objective: Allow users to create customized Web profiles or a personal on-line account containing data and self-generated maps based on their preferences.
- Accomplishment: The MyWyGISC Application Server was developed to allow access to web applications that have been developed by WyGISC. Several of the applications are available to all users, such as the *WyGISC Image and Raster Data Access Portal*, which allows users to access raster data and imagery for the state of Wyoming. Certain Applications within MyWyGISC have been developed in partnership with other agencies and can only be accessed by personnel from those agencies, with MyWyGISC acting as the secure access portal. MyWyGISC was developed to meet several needs, which include providing WyGISC with a method to track data use, to assist in serving our users in as efficient a manner as possible. Another function of the MyWyGISC Application Server is to provide our partners with a secure place to view, provide input, and collaborate on existing projects. (See Appendix A-2 for a screen capture image of the MyWyGISC page.)

- Objective: Develop links to federal and state agency databases for integrated up-to-date viewing of distributed, multi-source information in either tabular or spatial form.
- Accomplishment: Links to some agency electronic energy-related databases were made, which provide up-to-date viewing of distributed, multi-source information in either tabular or spatial form. The Wyoming GeoLibrary was also created to maintain a state-wide network of data providers. More details on the Wyoming GeoLibrary are given below. (See Appendix A-3 for a screen capture image of the Wyoming GeoLibrary page.) The current list of agency data-link partners and dates of partnership formation includes:
  - Wyoming State Engineer's Office, December 2007
  - Wyoming Department of Transportation, Cheyenne Wyoming. February 2008
  - Wyoming State Geological Survey, Laramie, Wyoming. July 2008
  - Wyoming Game and Fish Department, Cheyenne, Wyoming. February 2009
  - Wyoming Department of Environmental Quality, Cheyenne, Wyoming. April 2009

  WyGISC and the Wyoming GeoLibrary are also part of a variety of local, regional and national data distribution networks, including:
  - Geography Network http://www.geographynetwork.com/data/
  - National Geospatial Program - NSDI Clearinghouse http://www.usgs.gov/ngpo/
  - Wyoming Landscape Conservation Initiative http://www.wlci.gov/

- Objective: Create a collaborative Web content management system which allows users to post information or upload data to WERIC through a secure and controlled information system.

- Accomplishment: A collaborative Web content management system, which allows users to post information or upload data to WERIC through a secure and controlled information system, was created. Initially, the idea was to provide users the ability to maintain the site themselves; however, this has not proven to be a viable option since very few people contributed.

- Objective: Create a public comment page for proposed energy development actions with references to the interactive map and allow users to comment, capture comments and email these to the appropriate land management agencies.
- Accomplishment: The Wyoming Energy Map provides users with a comment email which was then used to direct any information to land management agencies.

Data Delivery

- Objective: Expand the breadth and depth of data-holding, both thematically and geographically, through creation of a Wyoming Energy GeoLibrary.
- Accomplishment: The Wyoming Energy GeoLibrary is an important asset to all parties interested in Wyoming geospatial data as it provides the most current and accurate data for locations throughout the state. Currently there are over 800 metadata records available within the Wyoming GeoLibrary with that number continuing to grow. These include federal, state and private additions in the form of datasets on our ftp server, metadata records with links to other ftp download sites for Wyoming related data, and other geographic resources.

  The GeoLibrary is supported by a statewide network of Wyoming geospatial data producers. All producers have the ability to publish, maintain and disseminate their own metadata documents within the GeoLibrary. This offers data providers a method to disseminate their data with minimal hardware, software, and human resources while at the same time giving them full control of their contents within the GeoLibrary. From a data user's perspective, the Wyoming GeoLibrary is a website providing a variety of tools to assist in finding, evaluating and accessing geospatial information across Wyoming by giving them the ability to view metadata records associated with geospatial information.

- Objective: Develop customizable access and dissemination methods for end-user specific query functionality and stakeholder uploading of data for public distribution.
- Accomplishment: Through becoming a data provider partner, the GeoLibrary allows for stakeholder contribution. This can be accomplished by publishing metadata documents to the database for others to view and query. Currently, more than ten different agency data providers currently publish metadata records to the GeoLibrary.

- Objective: Provide mechanisms for integration of local datasets from state and federal agencies in support of assessment and permitting activities.
- Accomplishment: Established standard Internet mapping protocols for including local data. Due to limited resources by local communities mapping services were not available to include in the on-line mapping applications.

Internet Mapping Applications

- Objective: Create a more comprehensive map viewer accessing an expanded selection of relevant available mapping services.
- Accomplishment: In order to support the use of geospatial data across Wyoming, the Wyoming Geographic Information Science Center created an Internet mapping application, the WyGISC Data Server. The goal of the WyGISC Data Server is to provide easy access to both vector and raster data while giving users the basic GIS mapping and analysis capabilities. Clip and zip functionality

provides a variety of benefits to both disseminate and access data. On the data dissemination side, large datasets can be controlled by scale and allow access to download portions of a dataset. On the data access side, it allows data to be clipped to a users study area boundary, thus reducing the need to store unneeded data on a local drive.

With over 150 different geospatial layers, the WyGISC Data Server is the most complete mapping application for Wyoming. This application has the ability to overlay thematic topics such as transportation, hydrology, wildlife, energy and minerals, land management, geology and aerial photography from which users can create their own map. Additionally the user has access to all imagery and aerial photography for this area through the raster tool. This tool is especially useful for those who have their own GIS and need to perform additional analysis. (See Appendix A-4 for a screen capture image of the WyGISC Data Server page).

- Objective: Develop enhanced spatial query functionality, including buffering, proximity analysis and overlay capabilities.
- Accomplishment: The WyGISC Data Server provides users with the ability to draw point, line and polygon graphics on the map and then buffer theses features at a user specified distance. These graphics and produced buffer graphics are then available for the users to make complex spatial selections and analysis.

- Objective: Enable customized report writing capabilities for location-based analysis and reporting on energy resources, cultural features, and wildlife habitat.
- Accomplishment: The newest mapping application developed from this effort is the Wyoming Energy Map (http://sunlight.wygisc.uwyo.edu/wyenergymap/wyenergymap.html). This application provides users with the most current data about energy development in Wyoming. With over a 100 different layers accessible via this mapping application, it currently is the most comprehensive Wyoming energy mapping application available. This application also provides the public with the ability to create cultural and wildlife reports based on any location throughout Wyoming and at multiple scales. In addition to this mapping application, trained GIS professionals can connect directly to these live mapping services to use locally for their mapping purposes. (See Appendix A-5 for a screen capture image of the Wyoming Energy Map page.)

Public Outreach - Objectives

- Objective: Present live demonstrations of WERIC at conferences, meetings and to the public.
- Accomplishment: Between September 2007 and September 2009, 15 presentations of the WERIC website were given. The target audiences included federal, state, private, and university-related groups. From these outreach events, several new partners have joined us in the Wyoming GeoLibrary data provider capacity, including the Wyoming State Geological Survey, the Wyoming Bureau of Tourism, the University of Wyoming Geology Library, and the University of Wyoming Libraries System. We are excited about these partnerships, as they have provided the Wyoming GeoLibrary effort with a wide variety of new data made available to the Wyoming geospatial user community. Specific presentations are given below:
  - September 2009, Wyoming State Librarian's Conference, All Things 'Digital' Wyoming, Preconference Program, Laramie, Wyoming.
  - May 2009, Wyoming GeoLibrary in Support of the Wyoming Landscape Conservation Initiative (WLCI) Science Catalog, 2009 WLCI Science Workshop, Laramie, Wyoming.
  - October 2008, ESRI Southwest GIS Users Group Conference (SWUG), Laramie Wyoming.
  - May 2008, WyGISC Data Distribution – Past, Present and Future, GIS Summit 2008, Casper, Wyoming.
  - May 2007, Exploring the WyGISC Data Server, GIS EXPO, Casper, Wyoming.

- September 2006, BLM Minerals Conference, Cheyenne, Wyoming.

- Objective: Offer training classes to agency personnel about in-depth functionalities.
- Accomplishment: The following user short-courses and training have been offered as Wyoming GeoLibrary Outreach workshops:
  - June 2007, for WyGISC, Laramie, WY
  - April 2007, for Natrona County, Casper, WY.
  - March 2007, for Wyoming Department of Transportation, Cheyenne, WY.
  - February 2007, for Campbell County, Gillette, WY
  - February 2007, for Wyoming Game and Fish Department, Lander, WY.
  - November 2006, for WyGISC, Laramie, WY.

  Wyoming GeoLibrary Publisher trainings:
  - April 2009, for Wyoming Department of Environmental Quality, Cheyenne, WY.
  - March 2009, for City of Cheyenne/Laramie County GIS Cooperative, Cheyenne, WY.
  - February 2009, for Wyoming Game and Fish Department, Cheyenne, WY.
  - July 2008, for Wyoming State Geological Survey, Laramie, WY.
  - February 2008, for Wyoming Department of Transportation, Cheyenne, WY.

  User Trainings:
  - April 2009, Advanced GIS Class, Guest Lecture, University of Wyoming, Laramie, WY.
  - February 2009, Eco-Informatics, Guest Lecture, University of Wyoming, Laramie, WY.
  - November 2008, DoE Carbon Sequestration Science Teams, University of Wyoming, Laramie, WY.
  - August 2008, University Libraries: Brinkerhoff Geology Library, University of Wyoming, Laramie, WY.
  - September 2007, WyGISC Geospatial Forum: Wyoming GeoLibrary. University of Wyoming, Laramie, WY.

  Professional Poster Presentations
  - October 2009, Western States Energy and Environmental Symposium, Jackson, WY.
  - November 2007, GIS Day. *GeoLibrary Portal*. University of Wyoming, Laramie, WY.
  - October 2007, ESRI Southwest GIS Users Group Conference (SWUG), Santa Fe, NM.

  Other outreach:
  Three written documents were created for the Wyoming GeoLibrary. These include a general information document, a user guide, and a data publisher guide.
  - A general user information sheet was developed to provide potential users with a general overview of the Wyoming GeoLibrary. (See Appendix B-1 to view the Wyoming GeoLibrary user information document.)
  - The user guide was developed as an informational document for Wyoming GeoLibrary users. (See Appendix B-2 to view the Wyoming GeoLibrary user guide.)
  - The publisher guide was developed to assist data publisher partners with the metadata publishing processs. (See Appendix B-3 to view the Wyoming GeoLibrary publisher guide.)

- Objective: Meet with government representatives of other western states to allow them to contribute to WERIC or assist other states with design of their own energy clearinghouse based on the WERIC model.

- Accomplishment: Attended the Western States Energy and Environmental Symposium, October 2009 in Jackson, WY. This conference was a meeting of government and legislative representatives from 13 western states to discuss regional energy policy issues. ENR and WyGISC hosted a demonstration booth showcasing the WERIC website where we had the opportunity to speak with many government leaders from other western states.

- Objective: Conduct a needs assessment or interview process with state and federal government agency personnel, industry and NGO representatives and decision-makers to determine how WERIC could be most useful to them.
- Accomplishment: Based on results from a needs assessment that was conducted in 2004 and through personal conversations with state and federal agency personnel, industry and NGO representatives, and decision-makers, it was felt an another formal needs assessment was not necessary for this project.

PROBLEMS, DELAYS, RESOLUTION

WERIC

Two issues are currently apparent with regard to WERIC. Probably the most pressing issue is maintaining the non-spatial content web pages and finding the appropriate dollars to do so. Initially the idea was to provide users the ability to maintain the site themselves however this has proven not to be a viable option since very few people contributed. Without these contributions, the web page relied on ENR and WyGISC staff to publish and link to the appropriate documents and web-pages. Unfortunately, WyGISC currently does not have the necessary thematic knowledge with regard to energy related issues or concepts which is required to maintain future links. Current efforts are underway to try to work with the School of Energy at UW to obtain this knowledge and work together to maintain this site.

Wyoming GeoLibrary

Two significant drawbacks face the Wyoming GeoLibrary, including the long-term maintenance and continued support of users. The Wyoming GeoLibrary requires maintenance in several operational environments, including technical support for the server, data provider partners, and metadata and data updates. WyGISC has provided user assistance for the Wyoming GeoLibrary throughout the development and completion of the project. There has been a significant amount of Wyoming geospatial data networking opportunities through this process. The response to the GeoLibrary from the user community has been overwhelmingly positive, and has consisted of users from a variety of states, including Wyoming, Colorado, Montana, Utah, South Dakota, North Dakota, Texas, Virginia, Pennsylvania, and Illinois, among others. The user base consists of state and local government, federal government, private industry, nongovernmental organizations, and academia.

WyGISC Data Server

The most pressing issue with regard to the WyGISC Data Server is its need to be upgraded to faster web mapping technology. Currently it is utilizing ESRI's ArcIMS technology which is being phased-out and replaced by ArcGIS Server. Efforts are currently being done by WyGISC to make this migration; however, these efforts are unfunded and thus a low priority. The newer Wyoming Energy Map does not have these issues however it does not provide the same data access and higher level analysis tools of the WyGISC Data Server. Therefore, it will be necessary to utilize the Wyoming Energy Map as a foundation in this migration effort.

PROJECT RESEARCH PRODUCTS, COLLABORATIONS AND TECHNOLOGY TRANSFER

Project Research Technologies/Techniques/Other Products
Application Server for both GeoLibrary and Data Server: ESRI's ArcIMS 9.2
Database Server: ESRI's SDE 9.2 with Microsoft SQLServer
Desktop tools: Customized tools created using Visual Basic 6.0 with ArcObjects associated with ArcCatalog

Wyoming GeoLibrary: WyGISC Metadata Toolbar
The WyGISC Metadata Toolbar is a customized ArcGIS toolbar specifically built to aid in the creation and editing of metadata. All tools will work with any object found in ArcCatalog, for which the user has write permissions. All but one of the tools was copied directly from ESRI sample scripts. These tools were found useful by WyGISC for editing and maintaining metadata and were therefore included. One button, the Wyoming GeoLibrary Preparatory button, was created specifically for assisting users in publishing their metadata into the Wyoming GeoLibrary. All customization was developed using ESRI ArcObjects within VB 6.0 to produce the WyGISC Metadata ArcCatalog toolbar. The toolbar was created by WyGISC and ESRI (sample metadata tools) in June 2006. The toolbar was updated in February 2008.

WEBSITES

WERIC
WERIC has ten main web pages associated with the portal: Home, Project Info, Interactive Maps, Research, Documents, Links, Data, Events, Education and Contributors. All ten of these pages link to an extensive network of other pages either inside or out of the WERIC portal.
Web address: http://www.weric.info

Wyoming GeoLibrary
The Wyoming GeoLibrary web page provides three main functions for users:
1. Methods for searching for metadata.
2. The ability to view and assess metadata records.
3. The ability to access geospatial data.

The software used for creation includes:
- Application Server: ESRI's ArcIMS 9.2 – Metadata Server
- Database Server: SDE 9.2 with Microsoft SQLServer
- Desktop tools: Customized tools created using Visual Basic 6.0 with ArcObjects associated with ArcCatalog
- GeoLibrary Landing WyGISC Landing Page: http://uwyo.edu/wygisc/info.asp?p=12891
- Data portal web address: http://partners.wygisc.uwyo.edu/wygeolibrary/

WyGISC Data Server
The WyGISC Data Server has one main mapping page with the ability to link to additional metadata documents via html pages. The software used for creation includes:
- Application Server: ESRI's ArcIMS 9.2 – Image Mapping Services
- Database Server: SDE 9.2 with Microsoft SQLServer
- Customized JavaScript code used for application
- WyGISC Data Server: http://partners.wygisc.uwyo.edu/website/dataserver/

Wyoming Energy Map
http://sunlight.wygisc.uwyo.edu/wyenergymap/wyenergymap.html

CONCLUSIONS & RECOMMENDATIONS

This grant provided us with the opportunity to work closely with several state agencies to create new partnerships, as well as strengthen and expand existing ones. These partnerships represent the intended use of the Wyoming GeoLibrary, with partners providing their data independently, and thus providing users with the most up-to-date data they have available. This funding has added greatly to this effort, and provided a solid foundation of partnerships and data that is now available to the Geospatial community.

The future of WERIC is very much dependent on ENR and WyGISC's ability to obtain additional funds to support this web portal. Additionally, it will be necessary to find collaborators who can assist in maintaining the web content and prioritizing enhancements to the site. Future work has been limited to just keeping the site available for users until these maintenance issues can be resolved.

Investment needs to be made in updating the WyGISC Data Server application to the newest mapping technology. With the display speeds currently seen with other applications like Google Maps, they are becoming accustomed to rapid display and expect all internet mapping applications to be similar. Right now the WyGISC Data Server cannot perform at this level due to the technology being employed. Current efforts are underway for migrating this application however lack of funding has lowered the priority of this activity. Although newer technology is available and should be employed, WyGISC believes the stability and functionality of the Data Server is still unmatched for Wyoming and provides a substantial service to the geospatial community.

GENERAL PROJECT REFERENCES & BIBLIOGRAPHY

Wyoming GeoLibrary Publisher Guide, WyGISC, 2007 (updated 2008, 2009).
Wyoming GeoLibrary User Guide, WyGISC, 2007 (updated 2008, 2009).
Wyoming GeoLibrary/MyWyGISC Information Sheet, WyGISC 2008 (updated 2009).
WyGISC Newsletter, Fall 2008.
Wyoming GeoLibrary Information Sheet, WyGISC 2007.

LIST OF PROJECT PARTICIPANTS

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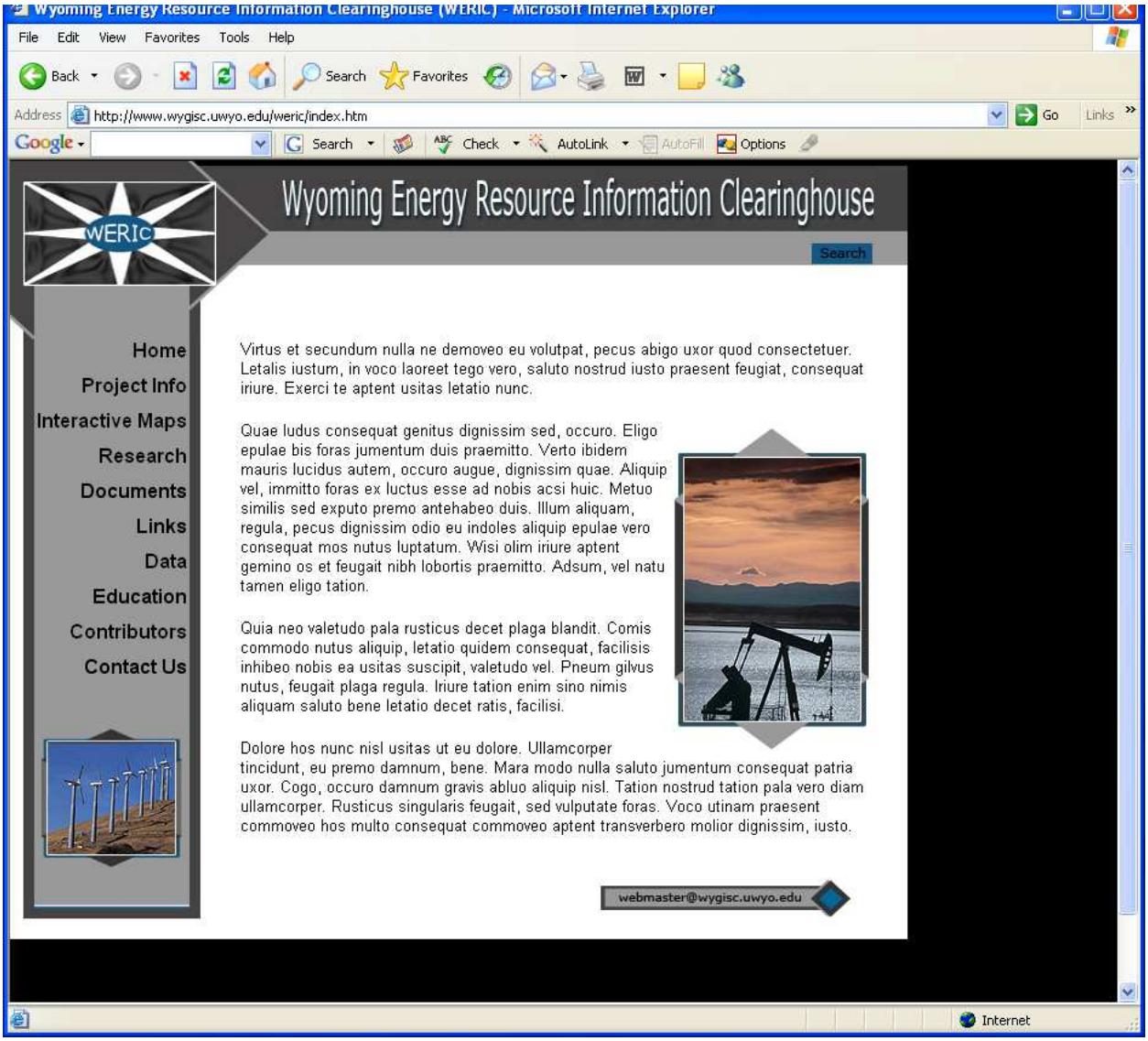
James R. Oakleaf, WyGISC Technical Coordinator
Philip L. Polzer, WyGISC GIS Analyst
Teal B. Wyckoff, WyGISC Research Scientist

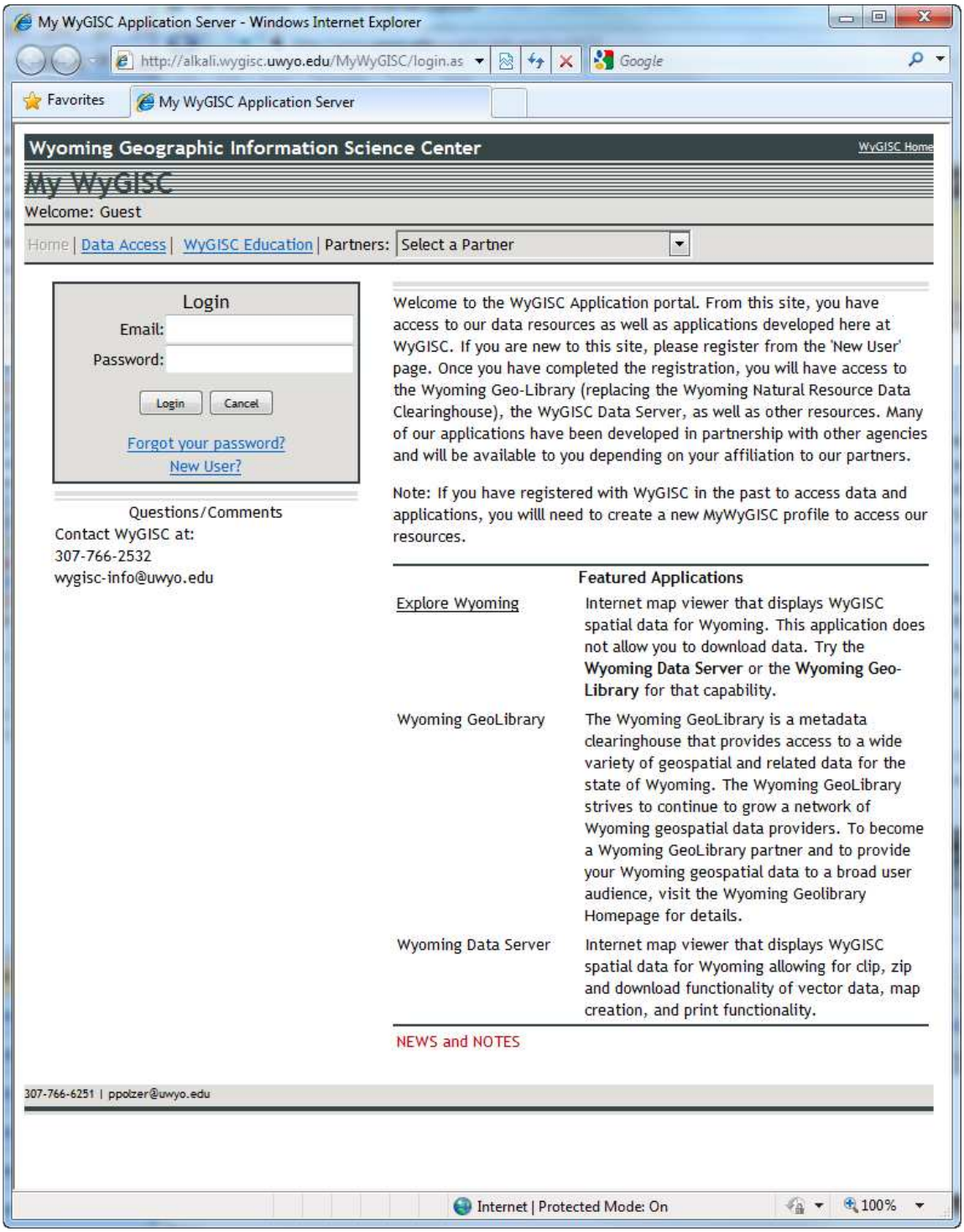
APPENDIX A

Wyoming Energy Resource Information Clearinghouse Website Images

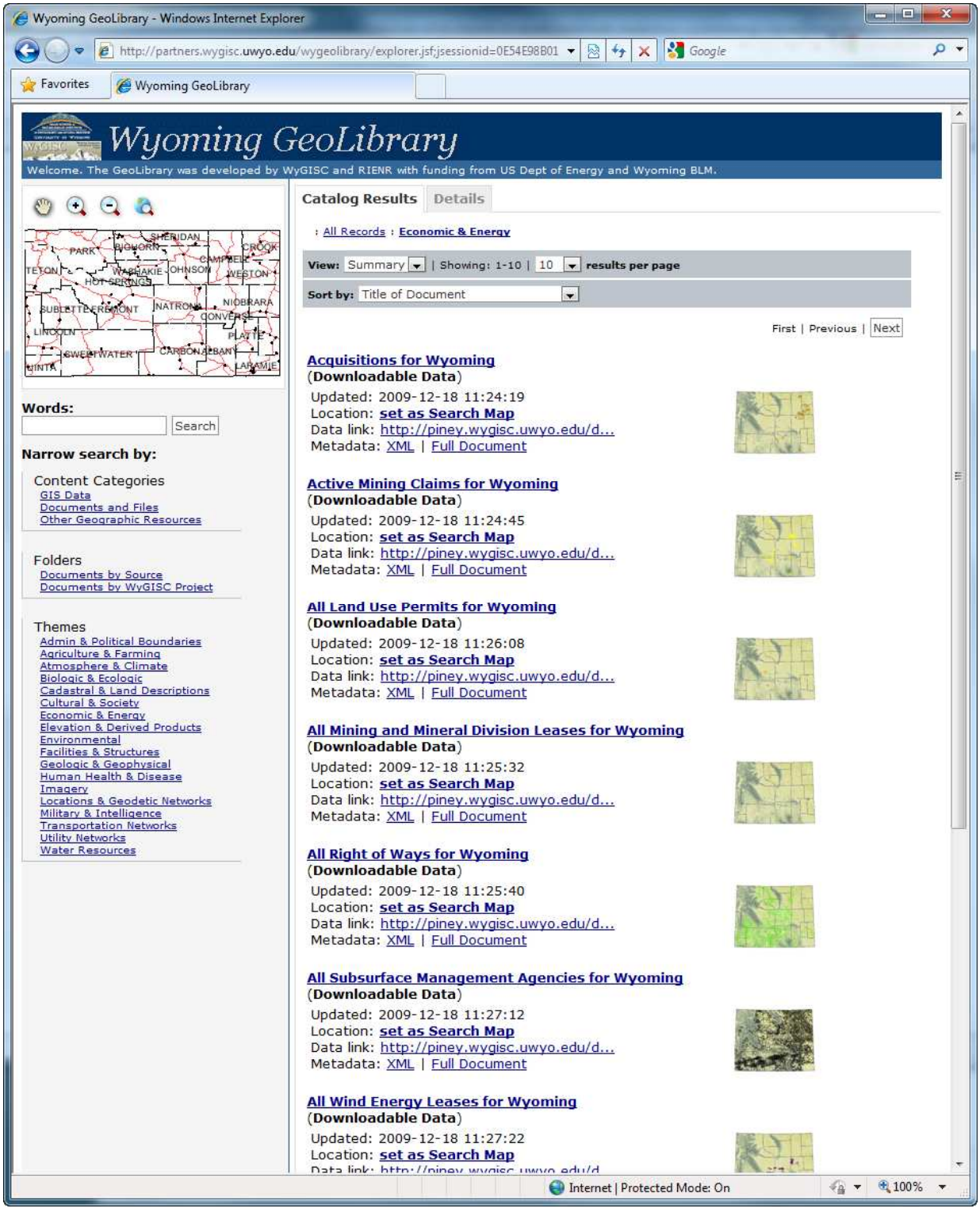
A-1
WERIC Home Page



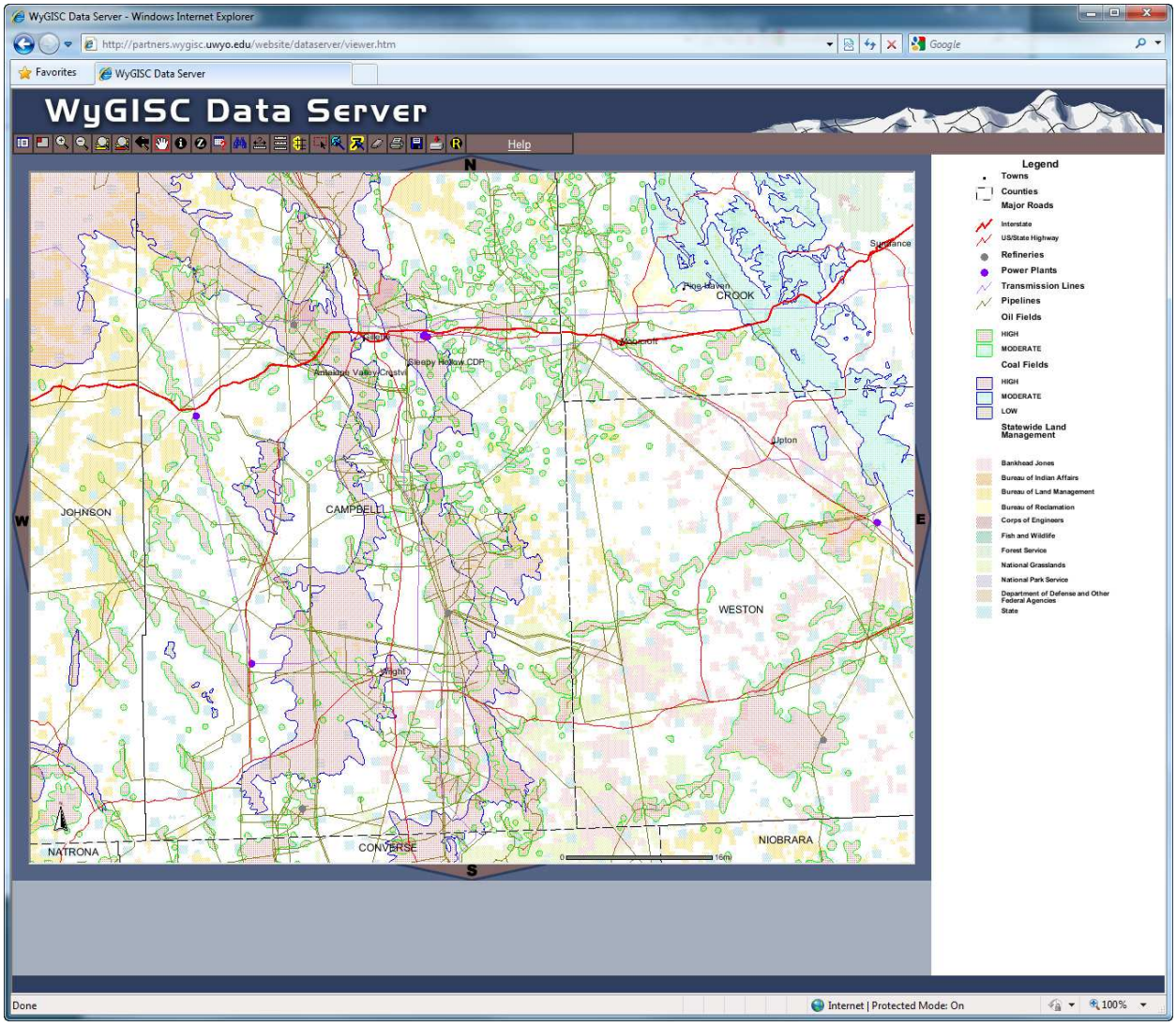
A-2
MyWyGISC



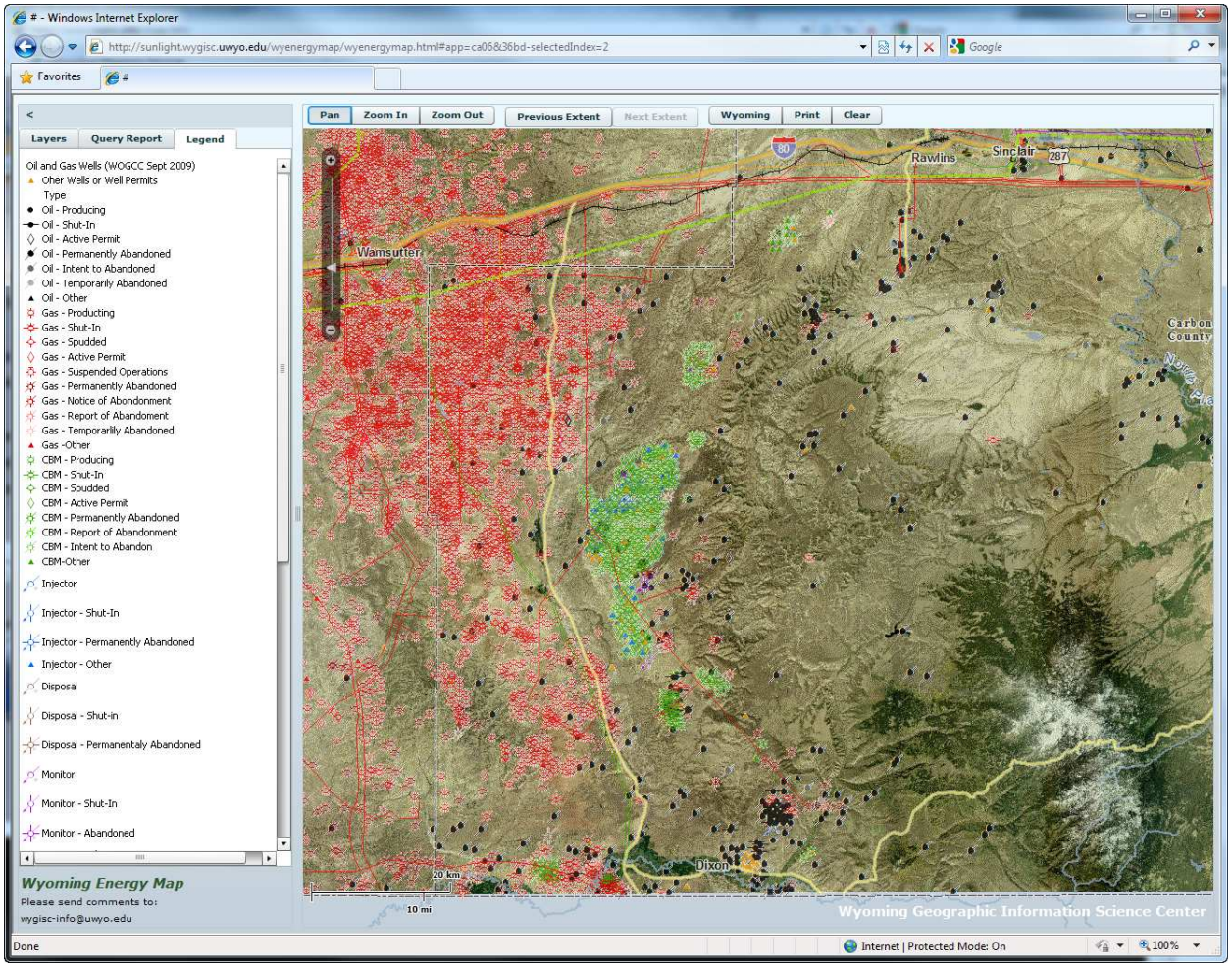
A-3
Wyoming GeoLibrary



A-4
WyGISC Data Server



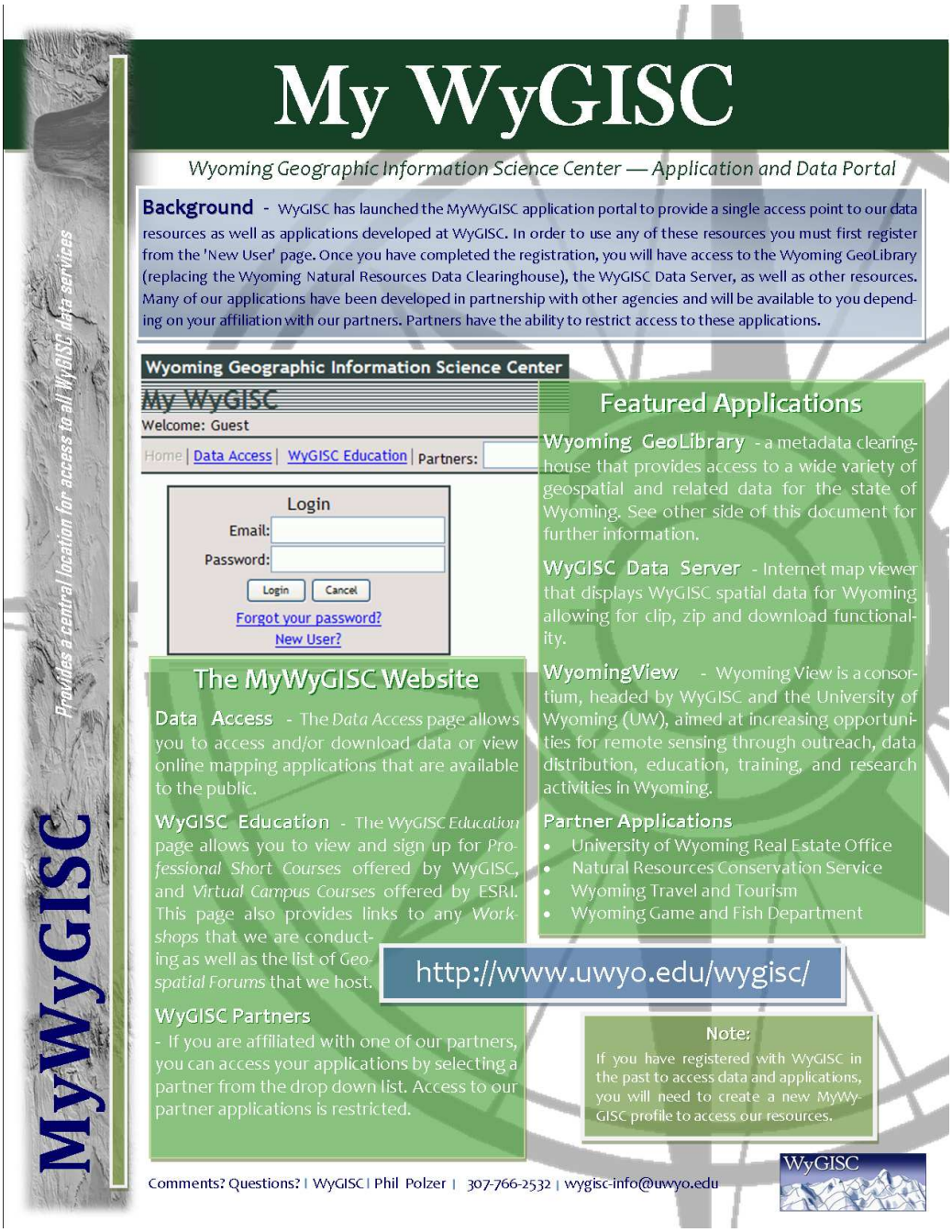
A-5
Wyoming Energy Map



APPENDIX B

Outreach and User Documents

B-1
Wyoming GeoLibrary
Information Sheet (page 1)



B-1
Wyoming GeoLibrary
Information Sheet (page 2)

Wyoming GeoLibrary

Metadata Clearinghouse for Wyoming geospatial data

Wyoming GeoLibrary

Wyoming Geographic Information Science Center — Metadata Clearinghouse

Background - The Wyoming GeoLibrary provides the Wyoming geospatial community the ability to access and disseminate spatial data. The goal of the GeoLibrary is to create a data clearinghouse that is supported by a statewide network of geospatial data producers. All producers have the ability to publish and maintain their own metadata documents within the GeoLibrary. This offers data providers a method to disseminate data with minimal hardware, software and human resources while giving them full control of their contents within the GeoLibrary.

Data User

The Wyoming GeoLibrary is a website that provides tools to assist in finding, evaluating and accessing geospatial information for Wyoming. The foundation of the Wyoming GeoLibrary is based on giving users the ability to view metadata records associated with geospatial information. The tools within the Wyoming GeoLibrary help users locate metadata documents that meet their search criteria. The users can limit results by using one or all of the following methods: defining an area of interest using an interactive map, selecting a specific data type (e.g., downloadable data) or category (e.g., Inland Water Resources) and by typing in a keyword (e.g., river). Users can also browse metadata documents based on who created the data, or by subject matter. The result is a list of available metadata. The user can view the full metadata document, see the extent of the data described by the metadata, download or, in the case of Internet mapping services, directly link to these data with their desktop GIS software.

Data Provider

The Wyoming GeoLibrary is an ESRI ArcIMS Metadata Server providing a mechanism to disseminate Wyoming geospatial information. With the appropriate permissions and ESRI's desktop data-browser application, ArcCatalog, data providers can connect via the Internet and publish metadata documents directly to the Wyoming GeoLibrary. With a basic set of metadata requirements, the process is straight forward and easy to use. WyGISC provides a custom desktop application: the Wyoming GeoLibrary Preparatory Tool. This application works with any selectable object within ArcCatalog producing and/or editing the local metadata content through an easy-to-use dialog box. Once the metadata is properly formatted, the document can be transferred by the data provider through a simple copy/paste command using ArcCatalog. Only the data provider and the site administrator have access to modify and/or delete the metadata record. These changes are automatically reflected in the Wyoming GeoLibrary.

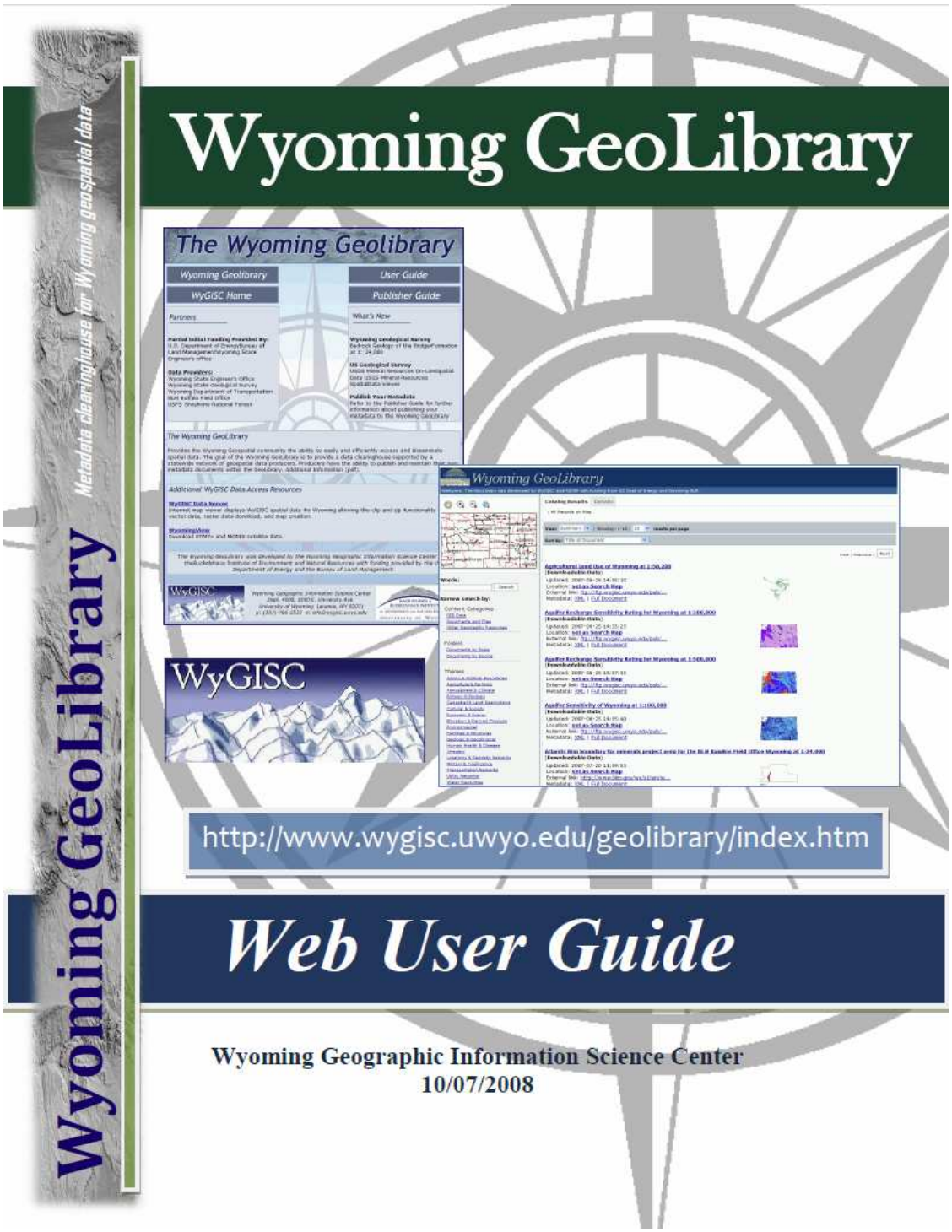
http://partners.wygisc.uwyo.edu/wygeolibrary/

Funding for this project has been provided by the Wyoming State Engineer's Office, Wyoming Bureau of Land Management and US Department of Energy in cooperation with WyGISC and the Ruckelshaus Institute and Haub School of Environment and Natural Resources

Comments? Questions? | WyGISC | Data Manager | 307-766-2532 | wygisc-info@uwyo.edu
Want to become a data provider? | JOakleaf@uwyo.edu | or | Wyckoff@uwyo.edu

WyGISC

B-2
Wyoming GeoLibrary
User Guide



B-3
Wyoming GeoLibrary
Publisher Guide