

**Ozarks Environmental and Water Resources Institute
Missouri State University**

***ANNUAL REPORT OF ACTIVITIES FOR
CALENDAR YEAR 2011***

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June 20, 2012



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EXECUTIVE SUMMARY

OEWRI activities in 2011 focused primarily on attracting external funds, formation of partnerships, student mentoring and training, and implementing applied and basic research projects to support science-based monitoring and analysis of water and sediment quality trends, watershed function and disturbance, and land use/land cover change in southwestern Missouri. In addition, our recent activities have also taken OEWRI to Jamaica to work with communities to assess water quality problems and fish, coral, and habitat conditions in local bays.

Research accomplishments include work on 11 externally funded projects totaling about \$204,000 in funds expended by OEWRI in 2010. Four peer-reviewed articles were published, four final project reports submitted to sponsors, and seventeen conference and invited presentations were delivered.

Activity records typically indicate that OEWRI staff spent about 5 to 15 percent of their time per week working on education, service, and outreach activities for the campus community and Springfield area.

Undergraduate education accomplishments include the hiring of 6 hourly workers, research project support and mentoring for 7 students, and field trip experiences for about 54 students.

Graduate education accomplishments include the hiring of 10 graduate assistants and varying levels of support for 20 thesis projects with 4 MS graduates.

OEWRI provides extensive service and outreach to the community and is involved in many planning committees, environmental events, and conferences. The number of partners involved with the Institute is extensive at all levels. In 2011 OEWRI worked with 18 MSU faculty, 5 MSU centers, and 32 other units including nine watershed groups.

OEWRI contributes to the Public Affairs mission of MSU through research, outreach, and student trips in Jamaica to address community problems, by involving students in high profile

environmental projects that challenge them to examine leadership and ethical dimensions, and maintaining strong connections with community leaders and stakeholders in the area of environmental issues and water resources management.

A benefit:cost ratio can be computed by summing the income from external grant \$ generation (217K), base leverage benefits (59K), and education (17K) and then dividing the income by the university contribution of 75K. This yields a value of return on university funding of about 3.9 times (293K/75K).

INTRODUCTION

Missouri State University's Board of Governors established the Ozarks Environmental and Water Resources Institute (OEWRI) in January 2004 to address water resource problems within the Ozarks through research, education, and outreach. Funding to start the institute included a one million dollar grant through the U.S. Environmental Protection Agency-Region 7 beginning in 2006-07 and base support by the University of \$75,000 annually. Base support allocation by CNAS will be reduced by 4K in FY 2012. Federal funding was targeted to develop the infrastructure and capacity for research in three areas identified as important to meet the needs of both environmental managers and Ozark communities: water quality and quantity, sedimentation and soil/sediment quality, and geospatial analysis of land use and natural resources. Dr. Pavlowsky was selected through a university search to be the director of OEWRI in March 2005. OEWRI is administered through the College of Natural and Applied Science. Additional information about OEWRI can be found at: <http://www.oewri.missouristate.edu/>.

This is the annual report of activities for the Ozarks Environmental and Water Resources Institute (OEWRI) in the College of Natural and Applied Sciences (CNAS) at Missouri State University (MSU). The report is organized in the following manner:

- (1) Description of the mission statement and facilities;
- (2) Description of activities for 2011
- (3) Accomplishments in research, education, outreach, partnerships, and Public Affairs
- (4) Budget Expenditures and Income for 2011
- (5) Strategic Plan for 2011
- (6) Resource Needs

MISSION STATEMENT AND FACILITIES

The mission statement for OEWRI was initially approved by the MSU Board of Governors in 2004. It was later revised and expanded to include program areas of emphasis by a committee of 14 CNAS faculty in 2007.

OEWRI's mission is to advance our scientific understanding of water resource quantity, quality, and distribution in Ozarks watersheds. Centrally located in Springfield, Missouri, OEWRI provides technical expertise, analytical capability, and student training to support environmental research, watershed monitoring programs, and watershed group activities in the Ozarks and beyond. OEWRI's mission has four major goals:

- (1) Conduct applied and basic research focusing on understanding the influence of natural processes and human activities on watershed conditions and water resources;
- (2) Establish regional partnerships, disseminate information, and provide educational and training opportunities related to scientific monitoring and management of water resources;
- (3) Provide policy alternatives to address water resource questions raised by decision-makers based on scientific sampling and analytical protocols; and
- (4) Serve as a clearinghouse for research results and publications pertaining to water supply and quality in the Ozarks.

OEWRI supports Missouri State University's mission in [public affairs](#) and its three components in ethical leadership, cultural competence, and community engagement. In addition, OEWRI programs are central to the public affairs theme in science and the environment for research and education. It directs and collaborates on basic and applied research projects aimed at solving environmental problems by working in partnership with university researchers, environmental groups, local communities, and government agencies. It involves students in all levels of its activities.

Staffing

OEWRI is staffed on campus in Temple Hall as follows:

- (1) Robert Pavlowsky, PhD., Director, half-time;
- (2) Marc Owen (M.S. Resource Planning), Research specialist II and project supervisor, Soil Quality, Geomorphology, and Field Monitoring;

(3) Heather Hoggard (M.S. Resource Planning), Research specialist II and project supervisor, Water Quality and Laboratory Director;

(4) Jennifer Andrews (M.S. Agriculture/GIS), Research Specialist I, Geospatial Technology and Conservation (Nov 2010-July 2011); and

(5) Deana Gibson, secretary and project accounts (shared with Geography, Geology, and Planning)

Facilities

OEWRI facilities are presently located in Temple Hall within office and laboratory space that is under departmental control. OEWRI space is allocated in partnership with other units as follows:

Department of Geography, Geology, and Planning

Director's office- T321;

Staff & GA offices- T326, T343, and T307;

Geomorphology Laboratory & GA office- T125 (supervised by Pavlowsky); and
Sample Preparation Laboratory, T129 (shared use area).

Department of Chemistry

Lachat Nutrient laboratory, T470 (supervised by Dr. R. Biagioni); and

Metals/ICP-AES laboratory, T437 (supervised by Dr. R. Biagioni).

Department of Biology

Microbiology laboratory- T239 (supervised by Dr. John Steiert).

CNAS

Field Equipment Storage and GA office, T103

Outdoor Storage

Three trucks in SW parking deck

John boat/motor and canoes in back lot of Kemper Hall.

Box trailer in Cherry Street fenced area

Program Areas

OEWRI activities at the Institute primarily focus on the following six program areas:

(1) Water and Sediment Quality Laboratory

Laboratory instrumentation and facilities to study water and sediment quality indicators of most concern to researchers, government agencies, and watershed groups in the region. The laboratory has a full-time director and training protocol and follows USEPA-approved standard methods and strict QA/QC procedures. The laboratory can analyze the following water constituents: water chemistry (temperature, pH, DO, SC, turbidity); total suspended solids and settleable solids; nutrients (N, P); metals (Cu, Pb, Zn, etc.); IDEXX bacteria counts; bacterial DNA fingerprinting and tracking using Bacteroides PCR assays; metals (Pb, Zn, Cu); total/organic carbon; suspended and benthic chlorophyll/algae; and dissolved ions by ion chromatography. The OEWRI laboratory offers the following soil/sediment analyses: particle size distribution by laser diffraction, hydrometer, and dry/wet sieving; sediment particle density; two sonic sifters; soil pH; total and inorganic carbon; available, extractable, and total trace metals, major elements, mercury, and phosphorus; gamma spectrophotometer to measure radioisotope activity (Cs-137, Pb-210); MS2 magnetic susceptibility system; and other standard soils tests.

(2) Geospatial Sciences Laboratory

The Geospatial Sciences Laboratory provides both investigative and analytical assistance to water and sediment quality related projects within the institute. The laboratory houses both field and desktop geospatial analysis equipment. Desktop instrumentation includes seven computer workstations running geospatial software including ArcGIS Desktop 9.2 suite with multiple ArcGIS Desktop extensions including Spatial Analyst, 3D Analyst, Survey Analyst, Geostatistical Analyst, Feature Analyst, and others. Workstations are also equipped with the latest version of the image processing software ENVI, as well as all of the software necessary to communicate with and integrate numerous pieces of geospatial field equipment. Field instrumentation includes three auto level with tripods and stadia rods; two Topcon electronic Total Stations; two Trimble GeoXH mapping grade GPS receivers; two Trimble Zephyr antennas; and three Garmin GPS Map 76 GPS units. In addition, OEWRI partially supports a continuous-logging GPS base station and offers on-line access to correction data. With this combination of field and desktop tools OEWRI can provide a range of cartographic products and geospatial analyses including (i) thematic map production; (ii) database development with on-line access; (iii) watershed assessments of geology, soils, stream networks, riparian lands, land use, and point and nonpoint pollution sources; (iv) topographic stream channel and floodplain surveying and mapping, (v) image interpretation and classification using aerial photography and satellite imagery, and (vi) GPS surveying and ground point control.

(3) Water Quality Monitoring

The Institute is a leader in stream sampling, trend analysis, and water quality data interpretation in southwest Missouri. Through collaboration, contracts, and grants, OEWRI provides expert advice and technical support to watershed groups, local communities, and private businesses to help plan and implement baseline and regulatory water quality monitoring programs. It is equipped to cover a wide range of monitoring services such as 319 watershed projects, TMDL monitoring programs, and catchment runoff studies. In addition, the institute supports an on-line accessible data base for publications and water quality data for the region. Data generated by monitoring efforts are used to develop rating curves to evaluate load-based pollution trends, evaluate the influence of land use on water quality, and support compliance monitoring requirements by state and federal agencies. OEWRI is equipped with three autosamplers, two propeller-type velocity meters, two acoustic velocity meters, four depth-integrated field samplers, and other field sampling supplies.

(4) Stream Stability and Sedimentation

Research on the physical characteristics of streams of all sizes is needed to develop models of channel form and behavior that can be used for management purposes to address bank erosion and sedimentation problems in the Ozarks. OEWRI focuses its physical river research efforts in three areas: channel morphology, long-term channel dynamics, and sediment contaminant dispersal. *Channel morphology* research involves the collection and evaluation of field measurements of the cross-section, longitudinal profile, and planform pattern to understand the present condition of the channel and floodplain and predict future changes. OEWRI uses a combination of quantitative and rapid assessment procedures that have been scientifically tested and developed for use in Ozarks streams. The geomorphic data collected is used to model channel form, determine causes of channel instability, and support channel restoration plans. Investigations of *long-term channel dynamics* involves the detection of changes in channel form, bank erosion, and floodplain sedimentation over periods of 10 to 1,000 years or more. Subsurface investigations and remote sensing methods are used in these studies to understand the response of watersheds and river systems to climate change and historical human disturbances. Finally, for pollution control purposes, it is important to understand processes affecting the spatial trends of *sediment contamination* in rivers. Sediment particles can bind metals and nutrients to high concentrations and often become important contributors to water quality problems. Thus, it is important to understand the role played by active channel and floodplain sediments during the storage, transformation, and remobilization of contaminants in Ozarks rivers. OEWRI is equipped with a truck-mounted Giddings coring rig, field surveying equipment, and sediment/soil sampling tools.

(5) Collaborative Environmental Programs

OEWRI collaborates with governments, consultants, agencies, environmental groups, and other universities to address water resources problem associated with urban and agricultural land management, biomonitoring, and water supply. OEWRI is involved with efforts to develop effective *soil and water conservation practices* for both urban and agricultural areas in the Ozarks. Urban projects include the evaluation of soil conditions and runoff characteristics for low impact developments, identifying causes of bed and bank erosion in urban streams, and understanding nutrient mobility in residential lawns. Local collaborators on these projects include the Watershed Committee of the Ozarks, James River Basin Partnership, City of Springfield, and Greene County, Missouri. Agricultural conservation initiatives include a pilot study on the mobility of potential contaminants after field treatments with biosolids. Collaborators on these projects include the Department of Agriculture at MSU and the City of Springfield.

OEWRI also collaborates with aquatic biologists, limnologists, and microbiologists to use *biomonitoring methods* to evaluate the impacts of natural disturbance and human activities on river and lake biota. The projects involve surveys of macroinvertebrates, mussels, plankton, chlorophyll, and algae in streams and lakes. Biomonitoring surveys are used to compliment water quality studies if information on ecological impacts is required. In addition, OEWRI supports total-coliform and *E. coli* monitoring activities and microbial source tracking using a Bacteroides PCR assays in Ozark watersheds.

OEWRI is involved with regional committees and research initiatives to better understand *water supply vulnerability* in the Ozarks. Population growth and land use change in the region are straining water resources due to water shortages, nonpoint pollution, waste water and septic field releases, and water rights issues. OEWRI is presently involved with several community and regional initiatives to evaluate water supply problems in the southwest Missouri including the role that new infrastructure, conservation, and climate change may play on future supplies and economic growth. In the past, OEWRI has been included on emergency evaluation teams for sinkhole collapse and flood damage in Greene and Christian Counties, Missouri.

(6) Student Training and Research

An important outcome of OEWRI activities is the training and research experience provided to undergraduates and graduate students at MSU. In 2011 OEWRI supported 6 undergraduate hourly workers and 8 undergraduate research projects. Further, the Institute supported 10 graduate assistants and 20 master thesis projects. In addition, OEWRI staff provided an important “on call” educational resource to the University because they are accessible to students, have applicable technical expertise, and overlap project involvement with student

activities. All students that work on OEWRI projects must complete a structured training program and monitored field or laboratory probationary period prior to the collection or analysis of data for OEWRI projects. Several OEWRI graduate assistants have gone on to jobs in the environmental management field in the Ozarks after graduation.

OEWRI “Start-Up” Projects

From 2006 to 2010, the primary objective of OEWRI was to implement a start-up plan supported by two federal grants from the USEPA.-Region 7 totaling \$984,000. In October 2010, U.S.E.P.A.-Region 7 notified MSU that OEWRI had fulfilled its contract obligations for the start-up grant in full and closed the project.

The Start-up Plan had the following objectives:

- (i) Provide infrastructure and develop office and laboratory space;
- (ii) Develop facilities, instrumentation, and capacity for scientific water and soil/sediment monitoring and analysis including acquisition of equipment and supplies for water and sediment quality activities;
- (iii) Develop EPA-approved Quality Assurance Program Plans (QAPPs) and Standard Operating Procedures (SOPs) for all laboratory/analytical, field monitoring, and geospatial techniques;
- (iv) Inventory and network university-wide resources to provide water and soil/sediment quality monitoring and analytical services for contract work and to support collaborative efforts or matching funds for grants;
- (v) Develop and support environmental and water resource website services including data delivery and communication systems;
- (vi) Develop active partnerships with environmental groups, government agencies, or other universities to develop and implement monitoring activities, research projects, or management plans aimed at improving watersheds in the Ozarks;
- (vii) Host and sponsor water research and resources conferences for the Ozarks; and
- (viii) Plan and implement four water and sediment quality research projects that address regional water quality concerns as determined by government agencies, watershed stakeholders, and published TMDLs. These four projects were: (i) Water quality assessment of the Pearson Creek Watershed; (ii) Measurement of suspended sediment, inorganic and organic carbon, nutrient, and dissolved chemical loads in the James River Basin; (iii) Historical and present-day channel

stability and gravel bar occurrence within Finley Creek; and (iv) History of mining sediment contamination and channel/floodplain sedimentation in the Middle James River Valley.

INSTITUTE ACTIVITIES FOR 2011

OEWRI activities in 2011 focused on attracting external funds, formation of partnerships, student mentoring and training, and implementing applied and basic research projects to support science-based monitoring and analysis of water and sediment quality trends, watershed function and disturbance, and land use/land cover change in southwestern Missouri. In addition, OEWRI has been working in partnership with the Bluefields Bay Friendly Fisherman's Society to assess the marine fishery, habitat characteristics, and environmental threats in the Bluefields Bay Fish Sanctuary in Jamaica.

RESEARCH ACCOMPLISHMENTS

OEWRI's research accomplishments include work on externally funded projects, publications, and presentations. Specific accomplishments for 2011 are listed below

External Grants

OEWRI worked on 9 externally funded projects in 2011. Six were continuing from previous years and three were new in 2011. The total multi-year value of the active grants in 2011 was approximately \$789,000. The value of external funds spent by OEWRI in the 2011 single year period totaled \$217,000. This amount included an indirect cost contribution from OEWRI to the university and college of about \$20,000.

OEWRI submitted two proposals in 2011 that was not funded. One proposal was to the National Science Foundation's low temperature geochemistry program with Missouri S & T Geology faculty entitled "Geochemical phases, mobility, and isotopic signature of lead in road dust from Missouri's lead producing regions." OEWRI's funding level was \$64,000 over two years. The proposal was resubmitted for 2012. The other proposal was to the USDA's Conservation Innovation Grant program entitled "Enhancing Soil Quality to Achieve Sustainable Pasture Systems" in cooperation with SW Missouri Resource Conservation and Development and Darr School of Agriculture. OEWRI's funding level was \$180,000 over three years. The 9 active grants for 2011 are briefly described below:

- (1) Stormwater Runoff Quality to the James River 319 project
Sponsor: James River Basin Partnership (through MoDNR and USEPA)
Budget No. I02060-152013-022 Total: \$69,916 2011: \$5,000
Period: 08-01-06 to -01-31-11 IC rate: 13% S&F

- (2) James River Urban Stream MS-4 & TMDL Monitoring Program
 Sponsor: Greene County and local governments
 Budget No. M02025-1520123-021 Total: \$200,000 2011: \$40,000
 Period: 08-01-08 to 07-31-13 IC rate: 38.5% DC
- (3) Biosolids Runoff Study
 Sponsor: City of Springfield
 Budget No. K02192-152013 Total: \$128,408 2011: \$42,000
 Period: 08-15-08 to 12-15-11 IC rate: 38.5% DC
- (4) Big River Mining Sediment Storage Assessment
 Sponsor: U.S. Fish and Wildlife Service, Columbia, MO
 Budget No. I02172-152013-021 Total: \$151,279 2011: \$30,000
 Period: 01-09-09 to 09-30-13 IC rate: \$17.5% DC
- (5) Springfield Urban Stream MS4 Monitoring (annual continuation)
 Sponsor: City of Springfield
 Budget No. M02029-152013-021 Total: \$28,000 2011: \$22,000
 Period: 08-31-10 to 08-31-11 IC rate: 38.5% DC
- (6) Baseline Study of PAH Sources in Springfield
 Sponsor: City of Springfield
 Budget No. M02038-152013-021 Total: \$32,846 2011: \$25,000
 Period: 11-01-10 to 1-31-12 IC rate: 38.5% DC
- (7) Urban Watershed Stewardship 319 Project
 Sponsor: Watershed Committee of the Ozarks (through MoDNR and USEPA)
 Budget No. O02244-152013-021 Total: \$150,240 2011: \$35,000
 Period: 04-30-11 to 03-01-15 IC rate: 13% DC
- (8) Taum Sauk Lower Reservoir Stream Discharge Assessment,
 Sponsor: Olsson Associates, Springfield, Mo.
 Invoice contract, summer 2011 Total: \$8,000 2011: \$8,000
- (9) James River Urban Stream MS-4 & TMDL Monitoring Program (cost increase add-on)
 Sponsor: Greene County and local governments
 Budget No. M02025-1520123-021 Total: \$20,000 2011: \$10,000
 Period: 08-01-11 to 07-31-13 IC rate: 38.5% DC

Journal Articles (4)

M.R. Owen and R.T. Pavlowsky, 2011. *Base flow hydrology and water quality of an Ozarks spring and associated recharge area, southern Missouri, USA*. Environmental Earth Sciences 64:169-183.

M.R. Owen, R.T. Pavlowsky, and P.J. Womble, 2011. Historical disturbance and contemporary floodplain development along an Ozark river, southwest Missouri. Physical Geography 32(5):423-444.

D.J. Martin and R.T. Pavlowsky, 2011. Spatial patterns of channel instability along an Ozark river, southwest Missouri. Physical Geography 32(5):445-468.

S.A. Lecce, R.T. Pavlowsky, G.S. Bassett, and D.J. Martin, 2011. Metal contamination from gold mining in the Cid District, North Carolina. Physical Geography 32(5):469-495.

Project Final Reports (4)

Owen, M.R. and R.T. Pavlowsky, 2011. Final Technical Report for: Water Quality Monitoring and Load Reduction Evaluation from Residential Developments in Christian County, Missouri. Completed for: James River Basin Partnership “Sources and Reductions of Storm Water Runoff in the James River Basin” EPA FY 2006 319.

Owen, M.R., R.T. Pavlowsky, and D.J. Martin, 2011. Big River Mining Sediment Assessment Project Big River Borrow Pit Monitoring Project. Funded by: U.S. Fish and Wildlife Service Cooperative Ecosystems Studies Unit.

Hoggard, H., and R.T. Pavlowsky, 2011. Approved Quality Assurance Project Plan (QAPP) for the “Springfield/Greene County Urban Watershed Stewardship 319 Project”

Hoggard, H., and R.T. Pavlowsky, 2011. Approved Quality Assurance Project Plan (QAPP) for Pearson Creek Watershed Show-Me Yards, Neighborhoods, Farms, and Ranches 319 Project (Finalized in early 2012).

Presentations (17)

Owen, M.R., and R.T. Pavlowsky, 2011. *Water quality and runoff characteristics from agricultural fields applied with biosolids and mineral fertilizers, Lawrence County, Missouri*. Workshop on Environmental Stewardship of Biosolids Land Application: Implications regarding soil health, nutrient cycling, storm water runoff, and agricultural production, Missouri Natural Resources Conference 2011, Tan-Tar-A, Osage Beach, Missouri, February 2-4, 2011. (session moderator too)

DeWitt, A.R., and R.T. Pavlowsky, 2011. *Runoff water quality assessment for forage crop fields applied with biosolids and mineral fertilizers, Southwest Missouri*. Upper Midwest Stream Restoration Symposium, Oconomowoc, WI, Feb 27-Mar 2.

Owen, M.R., and R.T. Pavlowsky, 2011. *Assessment of nutrient and suspended sediment contributions from subdivision developments in Christian County, Missouri*. Upper Midwest Stream Restoration Symposium, Oconomowoc, WI, Feb 27-Mar 2.

Pavlowsky, R.T., and S.A. Lecce, 2011. *Geomorphic disturbance, mining contamination, and restoration of the Big River, eastern Missouri*. Upper Midwest Stream Restoration Symposium, Oconomowoc, WI, Feb 27-Mar 2.

Young, B.M., and R.T. Pavlowsky, 2011. *Remobilization of mining contaminated sediment within disturbance zones along the lower Big River, eastern Missouri*. Upper Midwest Stream Restoration Symposium, Oconomowoc, WI, Feb 27-Mar 2.

Pavlowsky, R.T., and W.P. Dryer, 2011. *Debris flows and coastal sedimentation caused by catastrophic flooding, Bluefields River, southwestern Jamaica*. Association of American Geographers annual meeting, Seattle, WA, April 12-16.

Young, B.M., and R.T. Pavlowsky, 2011. *Channel disturbance and sediment-Pb mobilization in the lower Big River, eastern Missouri*. Association of American Geographers annual meeting, Seattle, WA, April 12-16.

Lecce, S.A., R.T. Pavlowsky, M.R. Owen, and D.J. Martin, 2011. *Storage of Lead-contaminated mining sediment in the floodplain of the Big River, Missouri*. Association of American Geographers annual meeting, Seattle, WA, April 12-16.

Mbuh, M.J., R.T. Pavlowsky, M. Baddock, J.A. Lee, and T. Gill, 2011. *Soil influence and geomorphology of dust sources on the Southern High Plains using MODIS imagery for 2001 to 2009*. Association of American Geographers annual meeting, Seattle, WA, April 12-16.

DeWitt, A.R., M.R. Owen, and R.T. Pavlowsky, 2011. *Downstream changes in channel morphology and flood capacity in an Ozarks watershed, Southwest Missouri*. Association of American Geographers annual meeting, Seattle, WA, April 12-16.

DeWitt, A.R., R.T. Pavlowsky, and M. Harrington, 2010. *Drainage area-regime equations to quantify channel morphology of an Ozarks River, southwest Missouri*. Geological Society of America annual meeting, Minneapolis, MN, October 9-12.

Schiller, A., and R.T. Pavlowsky, 2011. *Trap efficiency and suspended sediment levels of Ozarks Mill Pond, Ozark, MO*. Geological Society of America annual meeting, Minneapolis, MN, October 9-12.

Pavlowsky, R.T., and S.A. Lecce, 2011, *Downstream changes in historical floodplain sedimentation along the Big River, Meramec Basin, Missouri Ozarks*. Geological Society of America annual meeting, Minneapolis, MN, October 9-12.

Pavlowsky, J.M., D.J. Wronkiewicz, and R.T. Pavlowsky, 2011. *Accuracy and precision of geochemical analyses of contaminated and background sediments using a portable X-ray fluorescence analyzer*. Geological Society of America annual meeting, Minneapolis, MN, October 9-12.

Pavlowsky, R.T., 2011. *Climate change science: physics, chemistry, and biology*. Panel presentation and discussion of the science of climate change. Sponsored by Environmental Focus Committee and Office of Public Affairs, Missouri State University. March 3, 2011.

Pavlowsky, R.T., 2011. *Lead contamination in Big River floodplains in Jefferson County, MO*, Big River Watershed Group Meeting, Hillsboro Civic Center, August 23, 2011

EDUCATION ACCOMPLISHMENTS

OEWRI dedicates a significant amount of effort to training and research support for undergraduate and graduate students. Since staff offices are located on the third floor of Temple Hall in close proximity to CNAS departments, it is only reasonable to expect that OEWRI supports curriculum and teaching activities through technical assistance, research methodologies, and environmental database access. Activity logs show that OEWRI staff spend from 5 to 15 percent of their time per week training and mentoring students and assisting faculty in CNAS and other colleges at MSU. In 2011, OEWRI staff and facilities provided technical and educational resources for undergraduate and graduate students in several CNAS departments including GGP, BIO, CHM, and AGR (now its own “school” unit) and the Department of Sociology, Anthropology, and Criminology in the College of Humanities and Public Affairs. A list of student training and education accomplishments supported by OEWRI follows below.

Undergraduate Hourly Workers (6 students)

Daniel Williams (GRY), GIS analysis
Susan Helwig (GLG), Sediment analysis, Big River mining contamination project
Stephanie Prevedel (CHM), Urban stream quality & carbon transport, laboratory worker
Terry Phillips (CHM), Urban stream quality & carbon transport, laboratory worker
Aaron Pavlowsky (GGP), Sediment analysis and GPS/GIS support in Jamaica
Erin Murray (BIO), Sediment analysis, Big River mining contamination project

Undergraduate Student Research Projects (7 students)

(1) Research projects in GRY 348-Geomorphology (Fall 2011) (5)

Brandon Ives- Rainwater hydrology on the lot scale: a Springfield test study
Ezekiel Kuehn- In-channel water loss and grain in Crane Creek, Missouri
Annalee Hoy- Did construction at Cherokee Middle School cause a floodplain problem?
Mark Urbanek- Analysis of the effects of slope on sinkholes
Justin Foss- Assessment of Galloway Branch Waterway improvements, Sequiota Park, Springfield, Missouri

(2) Intern Research Projects (*CNAS undergrad research showcase participants*) (2)

- (a) Erin Murray (BIO), Mining lead contamination in Big River sediments
- (b) Aaron Pavlowsky (GGP), Bluefields Bay Fish and Habitat Assessment Project

Undergraduate Field Trips

GRY 348- Fall: Ward Branch channel assessment (1/2 day x 18 students)
GRY 348-Fall: Soil Coring at Pearson Creek (1/2 day x 18)
AGA 345-Fall: Soil Judging, use of coring truck and crew (1/2 day x 8)
AGA 545- Spring: Soil Appraisal, use of coring truck and crew (1/2 day x 10)

Graduate Thesis Research (20)

OEWRI supports various levels of graduate student research at Missouri State University. The Institute entirely or partially supported 18 MS thesis projects in three programs: Geospatial Science (17), MNAS (2), and Biology (1) (see below). In addition, external funds for OEWRI projects provided graduate assistantships for 7 students and hourly work positions for 0 graduate students in 2011. These students and their programs are listed below.

Graduated

Ben Young (GSS)
Joseph Mbongowo (GSS)
Emily Sturnfield (GSS)
Nick Vail (GSS)

2nd Year

Kyle Kosovich (MNAS)
Matt Grootens (GSS)
Tyler Suda (GSS)
Megan Harrington (GSS)
Anna Larkin (GSS)
Nicole Daugherty (GSS)
Andrew DeWitt (GSS)
Andrew Schiller (GSS)
Malissa Nowack (GSS)

1st Year

Jennifer Carroll (GSS)
Kris Breckenridge (GSS)
Andrea Mayus (GSS)
David Dickson (MNAS)
Josh Rudolph (BIO)
Lindsay Olson (GSS)
Tylene Coonts (GSS)

Graduate Assistantships (10)

Ben Young (GSS), Big River Project, Spring, Summer, & Fall
Emily Sturnfield (GSS), Water quality laboratory, Spring
Andrew DeWitt (GSS), James River Runoff-319, Spring, Summer, & Fall
Anna Larkin (GSS), Urban Stream MS-4, Spring, Summer, & Fall
Andrea Mayus (GSS), Pearson Creek 319 project and water quality laboratory, Fall
Lindsay Olson (GSS), Big River project, Summer & Fall
Megan Harrington (GSS), James River geomorphology project, Summer
Nicole Daugherty (GSS), Water quality laboratory, Summer & Fall
Kyle Kosovich (MNAS), Sediment Laboratory, Spring, Summer, & Fall
Josh Rudolph (BIO), Hydrologic monitoring and Jamaica project, Fall

Completed MS Theses (3)

Sturnfield, E., Aug 2011. Water quality and bacteria trends in South Dry Sac Watershed (GSS)

Mbuh, M., Dec 2011 Spatiotemporal characteristics of dust sources on the Southern High Plains and Eastern New Mexico using MODIS Imagery from 2001 to 2009 (GSS)

Young, B.M., May 2011. Historical channel change and mining-contaminated sediment remobilization in the Lower Big River, eastern Missouri. (GSS)

National Student Awards (2)

DeWitt, A.R., M.R.Owen, and R.T. Pavlowsky, 2011. *Downstream changes in channel morphology and flood capacity in an Ozarks watershed, Southwest Missouri*. Association of American Geographers annual meeting, Seattle, WA, April 12-16. Winner of the Reds Wolman Research Award of the Geomorphology specialty group.

Young, B.M., and R.T. Pavlowsky, 2011. *Remobilization of mining contaminated sediment within disturbance zones along the lower Big River, eastern Missouri*. Upper Midwest Stream

Restoration Symposium, Oconomowoc, WI, Feb 27-Mar 2. Second place student poster award for the conference.

Graduate-level Field Trips

BIO 609- Spring (John Havel): Measurement of channel properties and flow (1/2 day x 8)

GEO 770-Summer (Pavlovsky): James River channel assessment (6 days x 12)

SERVICE AND OUTREACH ACCOMPLISHMENTS

Service and community outreach is an important component of OEWRI's mission. The Institute is an "on-call" campus resource for technical advice and support and overall this type of service accounts for about 10% of staff workload. Examples of these types of activities include OEWRI loaning field equipment to Drs. Black (GGP) and Barnhart (BIO), providing research topic presentations in Dr. Pavlovsky's GRY 348 and Dr. Meyer's GEO 700 courses, and generating water analyses to support Dr. Biagioni's laboratory projects. Examples of other types of service and outreach activities by OEWRI are described below:

Environmental Events

Sponsored a booth at the annual Missouri Natural Resources Conference at Tan-Tar-A.

Sponsored a booth at the 2011 Sustainability Conference at MSU with five posters.

Attended the Sequoia Park Ribbon Cutting Ceremony on October 27, 2011.

Attended the Watershed Committee of the Ozark's Media Day event, April 13, 2011.

Attended the Watershed Management Conference, Lake of the Ozarks, MO., October 21-22, 2011.

Attended the Watershed Committee of the Ozarks Watershed Center ribbon cutting ceremony July 22, 2011.

Participated in the Meramec River Conservation Action Plan Workshop: The Upper Meramec. Ozark Outdoors Riverfront Resort, Leasburg, MO. April 19-20, 2011.

Staffed OEWRI booth at MSU's 3rd Annual Sustainability Conference and Exhibition, October 19, 2011.

Management of urban stream water quality monitoring activities for communities in the Springfield area.

Participated in 319 Monitoring Workshop sponsored by Missouri DNR at Lake of the Ozarks

OEWRI staff volunteered at Envirothon (Lake Springfield Park).

Staff helped faculty involved in Expanding Your Horizons (MSU)

Staff volunteered at JRBP Children's Workshops

Staff helped to plan and support the annual Water Future Conference held in Springfield.

Teaching Support at MSU

Operated truck-mounted Giddings soil probe for a field trip in GRY 348 *Geomorphology* (Pavlowsky), Fall 2011.

Staff taught lab session on stream discharge and channel capacity in GRY 348 *Geomorphology* (Pavlowsky), Fall 2011.

Staff trained students how to survey stream channels in GRY 348 *Geomorphology* (Pavlowsky), Fall 2011.

Staff gave presentation to GEO 700 *Introduction to Graduate Study in Geospatial Science* (Meyer) in GGP, Fall 2011

Staff trained students how to survey stream channels in GEO 770 *Advanced Field and Laboratory Methods* (Pavlowsky), Summer 2011.

Recorded and reported mileage records and coordinated maintenance on OEWRI and GGP vehicles.

Provided technical assistance and water quality analyses for Project Wet summer program.

Provide technical support to Drs. Black (GGP), Dr Biagioni (CHM), Mantei (GGP), and Gouzie

Geospatial Technology Support

GPS base station data access: OEWRI provides server space and public access through our website for Global Positioning Systems (GPS) differential correction data generated from the GGP base station receiver on top of Sunvilla Towers.

Geospatial database access: OEWRI provides access to geospatial data stored on OEWRI servers to GGP graduate students and faculty to support class projects and research

GGP GIS Support: OEWRI provides GPS receivers and related equipment for several courses offered by the department.

Student and Faculty Help: OEWRI provides "walk-in" assistance to students and faculty on a daily basis to help with GIS/GPS/Remote Sensing related tasks and environmental research needs.

Environmental Group Assistance (selected examples)

Watershed Committee of the Ozarks, Loring Bullard: OEWRI staff regularly attend monthly Watershed Committee meetings to participate and give updates on OEWRI projects and website postings. OEWRI is working with the Watershed Committee on a new urban water quality 319 grant with the City of Springfield. In addition, OEWRI is providing water and channel monitoring data for the South Dry Sac River and pond in the area around the Watershed Center at Valley Water Mill. Both undergraduate and graduate students are working on this.

James River Basin Partnership, Joseph Pitts: OEWRI is working with the JRBP to complete a water quality study of Pearson Creek watershed and determine the effect of bank erosion and riparian land runoff on water quality in the James River.

Southwest Missouri Resource Conservation and Development Council, Rita Mueller: OEWRI is provided technical assistance upon which to apply for a federal Conservation Innovation Grant totaling almost 800K over three years. The project aimed to determine the soil improvements and water quality effects associated with different grazing and biosolids application treatments. MSU's School of Agriculture is also a partner on the project. The grant was not funded in 2011, but the group will try to resubmit the proposal to another funding agency.

Regional Outreach

Examples of community outreach and related committee work include the following:

Director is a member of the Midwest Science Advisory Network; U.S. Fish and Wildlife Service, National Fish Habitat Action Plan

Director is a member of the Future of Water Committee, a subcommittee of the Good Community Committee for the City of Springfield

Director is a member of the Conservation Planning Advisory group for the upper Meramec River watershed. Sponsored by The Nature Conservancy.

Director presented on "*Lead contamination in Big River floodplains in Jefferson County, MO*" at a meeting of the Big River Watershed Group, Hillsboro Civic Center, August 23, 2011

Director was a member of the Ozark Summit planning committee for a regional conference on ecological restoration to be held on campus.

Director lead an effort to bring MSU students and provide community assistance and technical support for fish sanctuary and watershed assessments in Bluefields Bay, Jamaica in partnership with Dan Beckman in Biology.

Director and Linnea Iantria (GGP) provided community assistance and technical support to develop a tourism masterplan for Bluefields Bay and Treasure Beach communities in Jamaica.

Director participated in panel presentation and discussion of the science of “*Climate change science: physics, chemistry, and biology.*” Sponsored by Environmental Focus Committee and Office of Public Affairs, Missouri State University. March 3, 2011. MSU put it out as on-line video.

PARTNERSHIPS

One of the major goals for OEWRI is to develop and sustain partnerships across a wide range of environmental interests in the Ozarks and beyond through communication, resource sharing, and projects. In 2011, OEWRI worked with the following agencies and groups:

Regional Environmental Groups (9)

Watershed Committee of the Ozarks, Loring Bullard
James River Basin Partnership, Joseph Pitts
Upper White River Basin Foundation, John Moore/David Casaletto
Table Rock Lake Water Quality, Inc., Gopala Borchelt
Southwest Missouri Resource C & D Council, Rita Mueller
Elk River Watershed Improvement Association, Drew Holt
The Nature Conservancy, Kristen Blann
Ozark Regional Land Trust, Abigail Lambert
Big River Watershed Group, Michael Andresini

Government Agencies (8)

Environmental Protection Agency, Region 7
Missouri Department of Natural Resources
Missouri Department of Conservation
National Resources Conservation Service
Southern Missouri Water Quality Project
Greene County County Soil and Water District
USGS-Water Resources Program (Rolla. MO)
U.S. Fish and Wildlife Service

Universities (7)

University of Missouri-Columbia
Missouri University of Science and Technology
East Carolina University
Drury University

Local Governments (7)

Greene County
Christian County
City of Springfield

City of Nixa
City of Ozark
City of Battlefield
City Utilities of Springfield

Private Companies (1)

Olsson Associates

Missouri State University Centers (5)

Center for Archaeological Research
Center for Resources Planning and Management
Bull Shoals Field Station
Darr Agricultural Center
Center for Biomedical and Life Sciences

Faculty at MSU (18)

Tom Dewitt, Agriculture/NRCS
Gary Webb, Agriculture
Chris Barnhart, Biology
Dan Beckman, Biology
Paul Durham, Biology
Janice Greene, Biology
John Havel, Biology
Jack Steiert, Biology
Rich Biagioni, Chemistry
Tom Plymate, Head Geography, Geology, and Planning
Jill Black, Geography
Doug Gouzie, Geology
Kevin Mickus, Geology
Diane May, Planning
William Wedenoja, Anthropology
David Byers, Anthropology
Adam Coulter, Geography
Jack Dill, Geography

PUBLIC AFFAIRS ACTIVITIES

OEWRI supports the Public Affairs Mission of MSU. Below are several examples of Public Affairs accomplishments for 2011.

Cultural Competence. OEWRI has extended its outreach and research program to the southwest coast of Jamaica on Bluefields Bay. MSU faculty, graduate students, and undergraduate students are working within local communities alongside citizen groups to address economic and environmental problems. The goal is to develop a sustainable economy that combines natural resource use with conservation activities including environmental education. Critical to the sustainable goal is the development of geotourism opportunities, better water treatment facilities, improved marine fishery stocks, and soil and water conservation practices that result in both sufficient crop production and reduced soil erosion and runoff problems.

MSU faculty Bill Wedenoja (ANT), Dan Beckman (BIO), and Linnea Iantria (GGP) are working with OEWRI to assist Bluefields Bay community groups in their goal of developing a better future for their community and children. OEWRI is providing water quality, soil management, and mapping expertise to the partnership. In 2011, Pavlowsky lead one study-away student group and two graduate/undergraduate research trips to address marine conservation, water quality, and geotourism in Jamaica. With the financial support of the Latin American, Caribbean, and Hispanic Studies program and faculty research grants at MSU, OEWRI, GGP, and the Biology Department has been working on a pilot study to determine the baseline condition of the fishery and habitat quality in Bluefields Bay Fish Sanctuary. Two GSS MS theses have previously been completed in support of these efforts in 2010. Two more thesis projects in the GSS and BIO MS degree programs were begun in 2011 in Jamaica (Carroll and Rudolph).

Ethical Leadership. OEWRI gives students a chance to work in the field of environmental management and research along side of faculty and government managers. They get to work on projects in support of environmental leadership goals and ethical decision-making. There are two projects that showcase this element in the Institute's accomplishments.

First, the MS-4 urban stream water quality monitoring program allows OEWRI to take a leadership role in addressing water management regulations for the City of Springfield and other urban areas in Greene County. We operate and report on a 32 site water quality monitoring network aimed at sampling nutrient, sediment, and chloride concentrations in storm runoff. The results of student run field monitoring and laboratory analyses are used to guide water quality management plans where students get to interact with state and local environmental managers. In addition, the data collected is being stored and evaluated by OEWRI to get as much scientific knowledge from the data as possible, rather than let it become buried in regulatory agency files. The collaborative aspect of this project helps our students to get hands-on experience in water

quality monitoring, reduces the cost for regulatory compliance to the communities, and expands the utility of the data with research for the public good.

Second, the Big River sediment contamination study addresses questions about the degree and spatial extent of lead contamination in sediments from the Big River in eastern Missouri due to mine tailings inputs from the Old Lead Belt mining area which closed in 1972. OEWRI has become the leader on mining contamination problems in association within one of the largest Superfund sites in nation. Our students get opportunities to attend meetings with Federal environmental officials and managers where the results of our studies are being showcased to affect the decision-making process involved with management plans for the Big River. These plans address the toxic risks of contaminated sediment and water to aquatic life and human health. This work will be expanded to include the Viburnum Trend mining area in SE Missouri in 2012.

Community Engagement. OEWRI is constantly out in the community working with partners and responding to new environmental challenges. Recall the long list of partners involved with OEWRI described above. Due to training and networking on projects, several OEWRI graduates have been hired by local watershed groups and local and state environmental agencies.

UNIVERSITY BUDGET EXPENDITURES AND INCOMES

In addition to external grant funding, OEWRI is allocated about \$75,000 annually by the University to support staff and operations. The university dedicated these funds to OEWRI to provide match support for federal start-up funding and to add long-term stability to the operation of the Institute. The budgeting of these funds is generally distributed as follows: (i) full-time staff person, 67%; (ii) supplemental salary for the director, 13%; (iii) administrative and laboratory supplies, 15%; and (iv) emergency reserve, vehicle maintenance, and instrumentation operations, 5%.

The university budget allocation to OEWRI is leveraged to produce benefits beyond base funding in three ways: (i) salary match for federal grants; (ii) additional service time; and (iii) equivalent credit hour generation. An approximate accounting of additional cost benefits is provided below.

Match. State funds can be used to provide salary match on some environmental grants, the Federal 319 nonpoint source grants in particular require a 40% match in the total budget. OEWRI matches at least 25K annually to these types of grants.

Service Time. Activity logs for OEWRI staff indicate that 10% of the weekly workload is related to service to MSU. If a 10% return on staff time and annual staff salary of 34K is assumed, then three full-time staff generate about 13K in service benefits beyond project funding.

Credit Hour Generation. OEWRI staff are precluded from teaching courses at MSU under present funding line conditions. However, they contribute significantly to credit hour generation through mentoring, research projects, and field trips for undergraduate and graduate students. Given the educational accomplishments described above, the dollar value of these benefits can be estimated. Thesis research support is valued at 0.5 to 2 credits per year on a 3 graduate credit base, variable upon the level of support involved (e.g., 6 students x 2 credits; 6 x 1; 8 x 0.5). At \$224 per graduate credit and 22 credits, the value is 5K for thesis mentoring and support. Graduate field trip contributions are valued at 0.5 credits per student trip day at 76 students per unit day for a benefit of 38 graduate credits or 9K per year. Undergraduate credit generation is valued the same way, but at \$186 per credit. If undergraduate research support is valued at 1 credit per student x 7 students, then the benefit is 2K. Field trip generation is 27 students per day x 0.5 credits each totaling a benefit of 2.6K.

Benefit:Cost Comparison for 2010. A benefit:cost ratio can be computed by summing the income from external grant \$ generation (217K), base leverage benefits (59K), and education (17K) and then dividing the income by the university contribution of 75K. This yields a value of return on university funding of about 3.9 times (293K/75K).

GOALS AND STRATEGIC PLAN FOR 2012

OEWRI plan's is to continue on its present course of action and schedule of activities. The following six goals will help further support the mission of OEWRI:

- (1) Continue to attract externally-funded projects.
- (2) Continue to support and mentor undergraduate and graduate research.
- (3) This summer OEWRI will lose its space in Temple 129 (soil and sediment preparation laboratory) to provide space for the new animal facility. New space needs to be found to replace this loss and continue operations on funded projects.
- (4) Continue to focus on peer-reviewed publication as an outlet for research project results. Through publication, OEWRI's reputation in the field can grow and it can be more competitive for basic research grant funding in the future.

(5) Maintain and regularly update the OEWRI website as a major communication and data outlet.

(6) Try to find ways to get more faculty into principal investigator roles in OEWRI. Research analysis and writing is a bottleneck for productivity.

(7) Expand partnerships with centers and research groups at MSU. OEWRI will work Dr. Chris Barnhart (Biology) to develop restoration partnership on campus and regionally to attract federal funding for endangered species and aquatic habitat projects. In addition, OEWRI will work with Paul Durham (Center for Biological and Life Sciences) to develop the capacity for analysis and research in the area of biological contaminants in surface water systems in the Ozarks.

SPACE AND STAFFING NEEDS

Given the level of productivity of OEWRI and its lack of sufficient space to house staff, students, laboratories, and field equipment, three additional types of spaces are needed by OEWRI to improve productivity, working conditions, and safety:

(1) Sediment laboratory space (15' x 20') is needed for sediment sample preparation and analysis to support recent instrumentation acquisitions and funded research activities. It does not need a hood, but a running hot and cold sink would be very useful ("dirty lab").

(2) Water quality laboratory space (15' x 20') is needed that has a fume hood and sink. Present facilities are not adequately ventilated for the number of staff and students working in the present laboratory. In addition, presently there is not enough space to house the activities required to adequately support the instrumentation and externally funded research projects for OEWRI ("clean lab").

(3) Field equipment and supplies space (20' x 20') is needed to have access to the outside so that field monitoring activities effectively organized and outfitted. Presently, water quality laboratory, sediment quality laboratory, and field activities are run out of one laboratory. Ideally, this space may be part of a larger double-bay garage so that the truck mounted coring rig for which OEWRI presently operates can be shielded from the weather and vandalism ("Field monitoring garage").

(4) Full- or half-time faculty position (PhD) with expertise in hydrology and water quality modeling. This position is justified based on: (1) contract statement by the university to provide a replacement to GGP for the time Pavlowsky is directing the Institute (presently unfilled); (2) In the establishment proposal approved by the MSU Board of Governors, a full-time research position was planned to be included in OEWRI; (3) President's Futures Task Force identified the

hiring of a hydrologist to be a high priority in order to support the environmental research goals of the university; (4) The Dean of CNAS has supported and filled similar requests for staffing resources in other centers; (5) this expertise is particularly needed to address water quality needs in the region and attract more external funds; and (6) a recent external review of GGP and OEWRI recognized that OEWRI is understaffed relative to its productivity.