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Appendix A. Salt Creek watershed management plan distribution list

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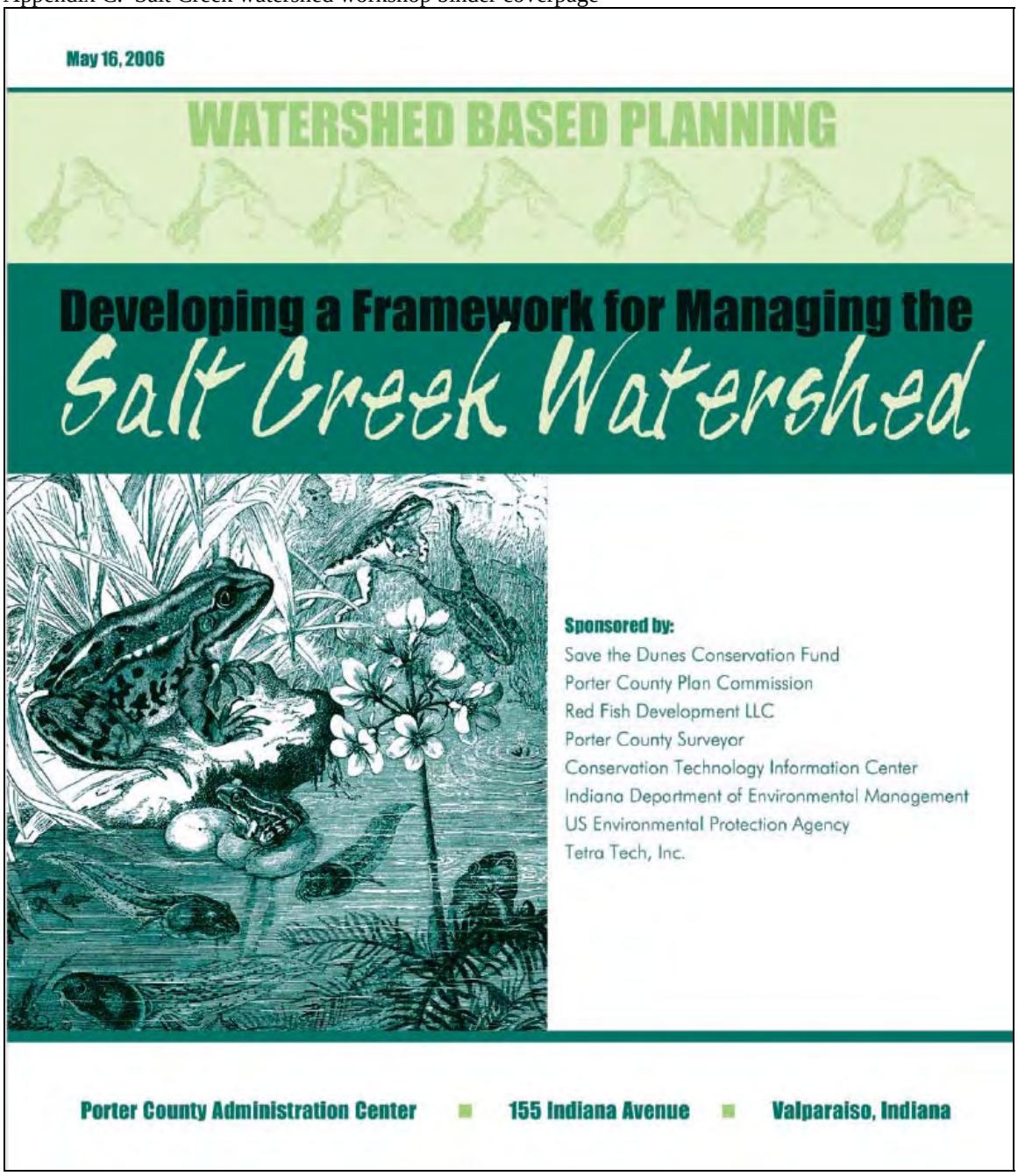
Appendix C. Salt Creek watershed workshop binder coverpage



Appendix D. Salt Creek watershed workshop agenda

Watershed Based Planning

Save the Dunes Conservation Fund

Developing a Framework for Managing the Salt Creek Watershed

This workshop seeks to build on efforts to protect and restore Salt Creek in Porter County, Indiana, through a locally lead, collaborative process to identify problems and develop and implement achievable solutions.

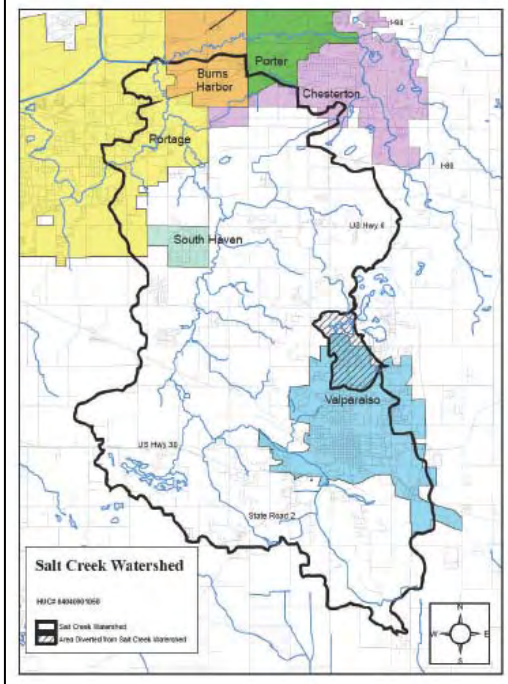
May 16, 2006 Porter County Administration Center 155 Indiana Avenue, Valparaiso, Indiana

8:30 – 9:00	**Registration**	*Save the Dunes Staff*
9:00 – 9:15	**Welcome and Introductions**	*Thomas Anderson* *SDCF Executive Director*
9:15 – 9:30	**Opening Remarks**	*Karen Tallian* *Indiana State Senator*
9:30 – 9:45	**Workshop Objectives and the Benefits of a Watershed Approach**	*Christine Livingston* *SDCF Watershed Coordinator*
9:45 – 10:45	**Watersheds: How They Work (Or Not)** • Watershed structure and function • Impacts of land use and land management on water quality	*Barry Tonning, Tetra Tech*
10:45 – 11:00	**Break**	
11:00 – 12:00	**Assessing Problems and Developing Solutions** • Measuring water quality and stream health • Management practices to address problems	*Barry Tonning, Tetra Tech*
12:00 – 1:00	**Lunch and Presentation** • Development and trends in Porter County • Potential impacts on water quality	*Robert Thompson* *Porter Co. Plan Commission*
1:00 – 1:30	**Agricultural Practices and Ongoing Efforts** • Ag management practices to protect water quality	*Bill Moran, NRCS*
1:30 – 2:30	**Salt Creek Watershed Assessment** • Review of assessment data and Salt Creek TMDL • Identification of key problems and likely source area	*Barry Tonning, Tetra Tech*
2:30 – 2:45	**Break**	
2:45 – 3:30	**Management Practices for the Salt Creek Watershed** • Linking problems, threats, and source areas • Possible solutions for particular areas • Organizing for success: public outreach, involvement, and planning	*Facilitated Discussion*
3:40 – 4:00	**Integrating and Coordinating Activities** • Summary of today's discussions • How do we integrate our efforts? • What's next – forging a cooperative planning approach	*Christine Livingston* *SDCF Watershed Coordinator*
4:00	**Workshop Adjourns**	

Final Agenda May 16, 2006

TETRA TECH

Appendix E. Salt Creek brochure



WATERSHED BASED PLANNING

Developing a Framework for Managing the Salt Creek Watershed

Mission Statement

The Salt Creek watershed group will foster improved communication, collaboration, education, and ecological understanding, and develop strategies to conserve, protect, and enhance the resources of the watershed.

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WHY DEVELOP A WATERSHED MANAGEMENT PLAN?

Watershed management is an effective way to cross traditional boundaries and bring people in a region together to make responsible land use choices. Almost every activity on the land has the potential to affect the quality of water in our communities. Effects from increases in human population and industrial, commercial, and residential development include; degraded water quality, decreased recreational and aesthetic value and loss of habitat for fish and wildlife. There is a critical need for us to improve the quality of our water and protect it from these impacts. A well developed watershed management plan is an important step in this process.

Salt Creek at Butternut Springs Outlet

THE SALT CREEK WATERSHED PROJECT

Save the Dunes Conservation Fund (SDCF) is currently funded by the Indiana Department of Environmental Management (IDEM) to coordinate the development and implementation of a watershed management plan in the Salt Creek watershed. The 49,573 acre watershed includes sections of Valparaiso, Chesterton, Portage, Burns Harbor, Porter, and South Haven (see map on reverse). The Salt Creek Watershed Management Plan will assess current water quality and identify pollutant sources. The final plan will guide the process of improving water quality in the Salt Creek watershed while accommodating important economic, social, and recreational uses.

Guest speaker Bill Moran describes agricultural practices at the Salt Creek watershed workshop.

Save the Dunes Conservation Fund

YOU CAN MAKE A DIFFERENCE!

If you drink water from Lake Michigan, enjoy the beach, own property within the Salt Creek watershed, or have concern for protection of our natural resources, you have a vested interest in improving Salt Creek water quality. Broad-based participation in the development of the Salt Creek Watershed Management Plan ensures that everyone's interests are represented. **All meetings are open to the public (see schedule below).** Listed below are simple things you can do to help.

- Get involved in the Salt Creek watershed planning process!
- Volunteer for programs, such as stream monitoring and storm drain marking.
- Minimize use of lawn fertilizers and pesticides or use low phosphorus fertilizer.
- Make sure your septic system functions properly.
- Dispose of waste properly, rather than dumping waste down storm drains.
- Keep yard waste and trash out of the streets and gutters.
- Wash your car at a carwash or on your lawn to keep runoff out of storm drains.
- Pick up after your pets.
- For more information visit www.savedunes.org/water_program/salt_creek/.

Volunteers monitor water quality to identify critical areas in the watershed.

Portage students mark storm drains to educate residents on the negative impact of stormwater runoff on Salt Creek.

Meeting Schedule

Porter County Administration Center
155 Indiana Avenue, Suite 309, Valparaiso, Indiana
The following Tuesdays:

Technical & Outreach Committees at 9am	All Committees at 3pm
August 29, 2006	November 14, 2006
February 6, 2007	May 1, 2007
August 7, 2007	November 6, 2007

Note: Meeting dates and locations are subject to change. For additional information please contact Christine Livingston at (219) 879-3564 or cll@savedunes.org.

This project has been funded in part by the United States Environmental Protection Agency under assistance agreement C97742-01 to the Indiana Department of Environmental Management. The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation.

Appendix F. Press releases

For Immediate Release

Tuesday, June 13, 2006

Contact: Christine Livingston, Watershed Coordinator
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Watershed Management to Protect Water Quality!

Salt Creek Watershed Management Planning Underway.

Tuesday, June 20, 2006, 9:00 am.
Porter County Administration Center, Suite 309

Save the Dunes Conservation Fund (SDCF) is leading an effort to develop and implement a plan for the management of the Salt Creek watershed, which occupies much of Porter County, including sections of Valparaiso, Portage, Chesterton, Porter, Burns Harbor, and South Haven. Many issues and concerns were identified by participants at the kick off meeting, which was held May 16, 2006. Involved citizens want the Salt Creek Watershed Management Plan to promote better stewardship of private and public land, identify and implement ways to improve land use management, and increase public understanding and awareness about water quality issues.

Development of the Salt Creek Watershed Management Plan is underway and will provide a framework for achieving a healthy Salt Creek watershed. Public input during this process is critical to ensure everyone's interests are represented. The public is encouraged to attend the Salt Creek Committee Meetings. Save the Dunes Conservation Fund will hold its first Planning and Technical Advisory and Volunteer/Outreach Committee Meetings on Tuesday, June 20, 2006 at 9:00 am at the Porter County Administration Center, Suite 309. Jenny Orsburn, of the Department of Natural Resources will present information on the Lake Michigan Coastal Program's watershed management efforts. The group will then develop a list of the most pressing water quality concerns for Salt Creek and will draft its vision and mission statements. Plans for this summer's water quality monitoring program will also be discussed.

Save the Dunes Conservation Fund has been funded in part by IDEM's 319 Grant Program to develop the Salt Creek Watershed Management Plan.

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For Immediate Release
Thursday, August 24, 2006

Contact: Christine Livingston, Watershed Coordinator
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Salt Creek Watershed Meeting August 29th

The public is invited to attend the upcoming Salt Creek Committee Meeting on Tuesday, August 29, 2006 at 9:00 am at the Porter County Administration Center, Suite 309. Public participation is essential to ensure that broad interests are represented. The upcoming meeting will include a presentation by Shorewood Forest Community Manager, Christian Anderson on management efforts for Lake Louise. Mary Beth Wiseman of the Northwestern Indiana Regional Plan Commission (NIRPC) will present on the *Watershed Management Plan for Lake, Porter, and LaPorte Counties* and how Salt Creek efforts fit into this regional plan. Updates on completed sections of the plan and water quality sampling location changes will follow these presentations. SDCF will welcome responses from attendees on personal observations of water quality concerns within the watershed.

Save the Dunes Conservation Fund (SDCF) is funded in part by IDEM's 319 Grant Program to develop the Salt Creek Watershed Management Plan. The Salt Creek watershed occupies much of Porter County, including sections of Valparaiso, Portage, Chesterton, Porter, Burns Harbor, and South Haven. If you live within the Salt Creek watershed, you have a vested interest in the improvement of Salt Creek water quality! The mission of the Salt Creek Watershed Group is to foster improved communication, collaboration, education, and ecological understanding and develop strategies that conserve, protect, and enhance the resources of the watershed.

A current draft of the Salt Creek Watershed Management Plan may be downloaded from Save the Dunes Conservation Fund's web page located on the Save the Dunes website at www.savedunes.net/water_program/salt_creek/.

For more information please contact Christine Livingston at cll@savedunes.org.

Save the Dunes Conservation Fund
444 Barker Road
Michigan City, IN 46360
Ph. 219-879-3564 / Fx. 219-872-4875

For Immediate Release

Tuesday November 14, 2006

Contact: Christine Livingston, Watershed Coordinator
Office: 219-879-3564 Email: cll@savedunes.org

Watershed Management to Protect Water Quality!

Salt Creek Watershed Management Planning Underway.

Tuesday, November 14, 2006, 3:00 pm.
Porter County Administration Center, Suite 309

Save the Dunes Conservation Fund (SDCF) funded by IDEM's 319 Grant Program to develop and implement a plan for the management of the Salt Creek watershed. The watershed occupies nearly 20% Porter County, including parts of Valparaiso, Portage, Chesterton, Porter, Burns Harbor, and South Haven. The Salt Creek Watershed Group continues to pursue their mission statement: *The Salt Creek watershed stakeholders will foster improved communication, collaboration, education, and scientific understanding of the watershed, and will develop strategies that conserve, protect, and enhance*

Development of the Salt Creek Watershed Management Plan is underway. The public is encouraged to attend the Salt Creek Committee Meetings. Save the Dunes Conservation Fund will hold its first Salt Creek Steering Committee Meeting jointly with the working group meeting on Tuesday, November 14, 2006 at 3:00 pm at the Porter County Administration Center, Suite 309. SDCF Water Program Director Christine Livingston will show pictures of good and bad practices throughout the watershed and discuss the current status of the draft Salt Creek Watershed Plan. Jeff Jones and Colin Highlands will discuss the Portage Parks Department's efforts to acquire and protect the Salt Creek corridor in Portage. The group will then decide on action items for the next quarter.

Save the Dunes Conservation Fund
444 Barker Road
Michigan City, IN 46360
Ph. 219-879-3564 / Fx. 219-872-4875

For Immediate Release
Wednesday January 31, 2007

Contact: Christine Livingston, Water Program Director
Office: 219-879-3564 Email: cll@savedunes.org

Protecting Salt Creek Water Quality through Watershed Management!

Tuesday, February 6th 9:00 am
Porter County Administration Center, Suite 309

Save the Dunes Conservation Fund (SDCF) is coordinating the development and implementation of a watershed management plan for the Salt Creek watershed. Salt Creek watershed planning and management is a community driven process, and partners include representatives from Porter County, Valparaiso, Portage, Chesterton, Porter, Burns Harbor, South Haven, government agencies, Valparaiso University, local developers, concerned citizens, and many others.

The Salt Creek Watershed Group continues to pursue their mission statement: *The Salt Creek watershed stakeholders will foster improved communication, collaboration, education, and scientific understanding of the watershed, and will develop strategies that conserve, protect, and enhance the resources of the watershed.*

The public is encouraged to attend the Salt Creek Committee Meetings. The next Salt Creek Technical Advisory and Outreach Committee Meeting will be held Tuesday February 6, 2007 from 9:00 to 10:30 am at the Porter County Administration Center, Suite 309. The meeting will focus on Salt Creek water quality data and will include a presentation by Charles Morris, Environmental Manager from IDEM's Biological Studies Section on Salt Creek water quality and biological data from the summer of 2006 study. Residents of the Salt Creek watershed are encouraged to share their knowledge of the Salt Creek watershed to help interpret this data. Development and implementation of the Salt Creek Watershed Management Plan is funded by IDEM's 319 Grant Program. For more information on this project or to download a current draft of the Salt Creek Watershed Management Plan, please visit www.savedunes.org/water_program/salt_creek/.

Save the Dunes Conservation Fund
444 Barker Road
Michigan City, IN 46360
Ph. 219-879-3564 / Fx. 219-872-4875

For Immediate Release
Wednesday April 25, 2007

Contact: Christine Livingston, Water Program Director
Office: 219-879-3564 Email: cll@savedunes.org

Salt Creek Watershed Committee works to protect water quality

Tuesday May 1st, 3:00 pm
Porter County Administration Center, Suite 309

Save the Dunes Conservation Fund (SDCF) is coordinating the development and implementation of a watershed management plan for the Salt Creek watershed. Watershed management is a community driven process, and partners include representatives from Porter County, Valparaiso, Portage, Chesterton, Porter, Burns Harbor, South Haven, government agencies, Valparaiso University, local developers, concerned citizens, and many others.

The Salt Creek Watershed Group continues to pursue their mission statement: *The Salt Creek watershed stakeholders will foster improved communication, collaboration, education, and scientific understanding of the watershed, and will develop strategies that conserve, protect, and enhance the resources of the watershed.*

The next Salt Creek Committee Meeting will be held Tuesday May 1st, 2007 from 3:00 to 4:30 am at the Porter County Administration Center, Suite 309. The public is encouraged to attend the Salt Creek Committee Meetings. The meeting will include a presentation by Robert Thompson, Executive Director of the Porter County Plan Commission on the proposed Porter County Unified Development Ordinance and how the watershed overlay will help protect the Salt Creek watershed. The group will also discuss potential implementation projects and potential pollutant sources throughout the watershed. Development and implementation of the Salt Creek Watershed Management Plan is funded by IDEM's 319 Grant Program. For more information on this project or to download a current draft of the Salt Creek Watershed Management Plan, please visit www.savedunes.org/water_program/salt_creek/.

Save the Dunes Conservation Fund
444 Barker Road
Michigan City, IN 46360
Ph. 219-879-3564 / Fx. 219-872-4875

For Immediate Release

Thursday August 2nd, 2007

Contact: Christine Livingston, Water Program Director
Office: 219-879-3564 Email: cll@savedunes.org

How Can We Improve Salt Creek Water Quality?
Help Decide at the Salt Creek Watershed Committee Meeting

Tuesday August 7th, 9:00 am
Porter County Administration Center, Suite 309

Results from Save the Dunes Conservation Fund (SDCF)'s Salt Creek water quality monitoring program are in, and the Salt Creek Watershed Committee is ready to interpret the data to guide the watershed management process. Water quality monitoring began in 2006 to investigate the sources of nonpoint source pollution that lead to impaired water quality in Salt Creek. With the 2007 monitoring program complete, the Committee will now incorporate the results into the Salt Creek Watershed Management Plan. The final plan will facilitate the process of improving Salt Creek water quality.

The public is encouraged to attend the Salt Creek Committee Meeting on Tuesday August 7th, 2007 from 9:00 to 10:30 am at the Porter County Administration Center, Suite 309 in Valparaiso. Watershed management is a community driven process, and broad-based participation in the development of the plan will ensure that everyone's interests are represented. The August 7th meeting will include a presentation on the Salt Creek water quality monitoring program and results. The group will discuss the data to identify potential pollutant sources and determine critical areas throughout the watershed.

The 49,573 acre Salt Creek watershed includes sections of Valparaiso, Chesterton, Portage, Burns Harbor, Porter, and South Haven. The Indiana Department of Environmental Management (IDEM) has identified sections of Salt Creek on the 303(d) list of impaired waters as impaired for excessive *Escherichia coli (E. coli)* concentrations and impaired biotic communities. SDCF is funded by IDEM's 319 Grant Program to coordinate the development and implementation of the Salt Creek Watershed Management Plan to address these water quality concerns.

The Salt Creek Watershed Committee was formed in 2006 to oversee the development of the Plan. The Committee includes representatives from Porter County, all municipalities within the watershed, government agencies, Valparaiso University, local developers, concerned citizens, and many others. The group continues to pursue their mission: *The Salt Creek watershed stakeholders will foster improved communication, collaboration, education, and scientific understanding of the watershed, and will develop strategies that conserve, protect, and enhance the resources of the watershed.*

Save the Dunes Conservation Fund

444 Barker Road
Michigan City, IN 46360
Ph. 219-879-3564 / Fx. 219-872-4875

For Immediate Release

Tuesday, November 6th, 2007 .

Contact: Christine Livingston, Water Program Director
Office: 219-879-3564 Email: cll@savedunes.org

Salt Creek Watershed Plan in the Home Stretch

Tuesday November 13th, 3:00 pm
Porter County Administration Center, Suite 309

With development of the Salt Creek Watershed Management Plan (SCWMP) nearly complete, the Salt Creek Watershed Group is eager to put the plan into action to protect and improve Salt Creek water quality. The Group will hold its final meeting to wrap up the two-year process of developing the SCWMP on November 13th, 2007. The final plan will include goals for improving Salt Creek water quality and activities that will aid in achieving those goals. "Completing the SCWMP is not the end of the Group's work to improve Salt Creek, it's just the beginning!" explains Save the Dunes Water Program Director, Christine Livingston. "There is a lot to be done, but with the commitment from communities throughout the watershed we are already on our way to protecting water quality." Livingston further claims.

Many exciting projects and partnerships are already underway to jump start the implementation of the SCWMP. For example, Save the Dunes Conservation Fund (SDCF) is partnering with the Portage Parks Department to install a green (vegetated) roof on a concession stand at the new Imagination Glen Park soccer complex. A green roof consists of a vegetated green space on top of a human-made, impervious structure. Soil and plants in green roof systems act like a sponge and absorb excess stormwater that would normally run off the roof and into a stormdrain or nearby Salt Creek. Park Assistant Superintendent, Jeff Jones will provide the Watershed Group with an overview and update of the project at Tuesday's meeting.

SDCF is also working with the City of Valparaiso to install rain gardens at Forest Park Golf Course. A rain garden is a shallow, vegetated depression that helps clean and manage stormwater runoff on site. The bowl-shaped gardens collect run-off from impervious surfaces and allow it to infiltrate into the ground. Aesthetically-pleasing native plants help the garden absorb stormwater, while providing additional benefits such as wildlife habitat. Two rain gardens will collect stormwater from the golf course and help to store, infiltrate, and clean the water before it enters Salt Creek. City of Valparaiso Engineer, David Pilz will provide the Watershed Group with an update on the project at Tuesday's meeting and discuss future features that might be incorporated into the Golf Course.

Watershed management is a community driven process, and broad-based participation in the development of the plan will ensure that everyone's interests are represented. SDCF is funded by IDEM's 319 Grant Program to coordinate the development and implementation of the Salt Creek Watershed Management Plan to address water quality concerns. The Salt Creek Watershed Committee was formed in 2006 to oversee the development of the Plan. The Committee includes representatives from Porter County, Valparaiso, Portage, Chesterton, Porter, Burns Harbor, government agencies, Valparaiso University, local developers, concerned citizens, and many others.

The public is encouraged to attend the Salt Creek Committee Meeting on Tuesday November 13th, 2007 from 3:00 to 4:30 pm at the Porter County Administration Center, Suite 309 in Valparaiso as the group continues to pursue their mission: *The Salt Creek watershed stakeholders will foster improved communication, collaboration, education, and scientific understanding of the watershed, and will develop strategies that conserve, protect, and enhance the resources of the watershed.*

Save the Dunes Conservation Fund

444 Barker Road
Michigan City, IN 46360
Ph. 219-879-3564 / Fx. 219-872-4875

For Immediate Release: Wednesday, March 12, 2008
Contact: Christine Livingston, Water Program Director
Office: 219-879-3564 Email: cll@savedunes.org

Public Welcome at Salt Creek Committee Meeting to Finalize Plan

Wednesday, March 19th, 2008, 9:00 am
The Barker Center
444 Barker Road, Michigan City, IN 46360

The State of Indiana has reviewed the draft Salt Creek Watershed Management Plan (SCWMP) and provided feedback to Save the Dunes Conservation Fund (SDCF). The Salt Creek Watershed Committee will hold a final meeting to wrap up the two-year process of developing the SCWMP before finalizing the plan and focusing on implementation. The plan includes goals for improving Salt Creek water quality and activities toward achieving those goals.

"This meeting is the last chance for the public to provide input on the watershed plan," says SDCF Water Program Director, Christine Livingston. She continues, "We've developed many partnerships with stakeholders throughout the watershed. With all the momentum generated while developing the Plan, we're in a great position to move right into getting projects in the ground."

Demonstration projects were installed while developing the plan to get the ball rolling. For example, SDCF partnered with the Portage Parks Department to install a green (vegetated) roof on a concession stand at the new Imagination Glen Park soccer complex. A green roof consists of a vegetated green space on top of a human-made, impervious structure. Soil and plants in green roof systems act like a sponge and absorb excess stormwater that would normally run off the roof and into a stormdrain or nearby Salt Creek. SDCF is also working with the City of Valparaiso to install rain gardens at Forest Park Golf Course. A rain garden is a shallow, vegetated depression that helps clean and manage stormwater runoff on site. The bowl-shaped gardens collect runoff from impervious surfaces and allow it to infiltrate into the ground. Aesthetically-pleasing native plants help the garden absorb stormwater, while providing additional benefits such as wildlife habitat. Two rain gardens will collect stormwater from the golf course and help to store, infiltrate, and clean the water before it enters Salt Creek.

Watershed management is a community driven process, and broad-based participation in the development of the plan will ensure that everyone's interests are represented. SDCF is funded by the Indiana Department of Environmental Management (IDEM)'s 319 Grant Program to coordinate the development and implementation of the Salt Creek Watershed Management Plan to address water quality concerns. Visit http://www.savedunes.org/water_program/water_program/ to download the draft plan. The Salt Creek Watershed Committee was formed in 2006 to oversee the development of the Plan. The Committee includes representatives from Porter County, Valparaiso, Portage, Chesterton, Porter, Burns Harbor, government agencies, Valparaiso University, local developers, concerned citizens, and many others.

The public is encouraged to attend the Salt Creek Committee meeting on Wednesday March 19th from 9:00 to 10:30 am at the Barker Center in Michigan City as the Salt Creek Watershed Group continues to pursue their mission: *The Salt Creek watershed stakeholders will foster improved communication, collaboration, education, and scientific understanding of the watershed and will develop strategies that conserve, protect, and enhance the resources of the watershed.*

Save the Dunes Conservation Fund
444 Barker Road
Michigan City, IN 46360
Ph. 219-879-3564 / Fx. 219-872-4875

For Immediate Release: Tuesday, June 17th, 2008
Contact: Christine Livingston, Water Program Director
Office: 219-879-3564 Email: cll@savedunes.org

Salt Creek Watershed Plan Complete!
Tour the Exciting Projects Already Underway

Thursday, June 26th, 2008, 9:30 am
Forest Park Golf Course - 1155 Sheffield Dr, Valparaiso, IN 46385

The Salt Creek Watershed Committee will meet on June 26th to celebrate the completion of the recently approved Salt Creek Watershed Management Plan (SCWMP) and tour implementation projects. Save the Dunes Conservation Fund (SDCF) coordinated the two-year process of developing the SCWMP with funding from the Indiana Department of Environmental Management (IDEM). The 49,573 acre Salt Creek watershed includes sections of Valparaiso, Portage, Chesterton, Porter, Burns Harbor, South Haven, Shorewood Forest, and unincorporated Porter County. Salt Creek is currently impaired for high *E. coli* concentrations and impaired biotic communities. The IDEM-approved SCWMP includes goals for improving Salt Creek water quality and activities toward achieving those goals. SDCF will hold the final committee meeting under the current grant cycle on Thursday June 26th before transitioning into a newly acquired implementation grant entitled *Salt Creek Implementation Demonstration.*

Demonstration projects were installed while developing the plan to improve water quality and build momentum toward implementing the plan. SDCF has partnered with the Portage Parks Department to install a green (vegetated) roof at Imagination Glen Park and with Valparaiso University to install a vegetated swale on campus. The upcoming Salt Creek meeting will be held at Forest Park Golf Course where SDCF partnered with the Valparaiso Department of Parks and Recreation to install two rain gardens. A rain garden is a shallow, vegetated depression that helps clean and manage stormwater runoff on site. The bowl-shaped gardens collect runoff from impervious surfaces and allow it to infiltrate into the ground. Aesthetically-pleasing native plants help the garden absorb stormwater, while providing additional benefits such as wildlife habitat. The partners also planted riparian buffers to filter stormwater before it enters Salt Creek.

SDCF Water Program Director, Christine Livingston explains "it seems fitting to hold the meeting at the site of one of projects to show stakeholders the fruits of their labor. The Forest Park projects are just the beginning of the watershed group's efforts to protect and improve Salt Creek". Although the SCWMP is complete, it is never too late for the public to get involved in Salt Creek watershed management. All Salt Creek committee meetings are open to the public. The SCWMP is available for download at http://www.savedunes.org/water_program/water_program/. SDCF will continue working with watershed group to develop partnerships and identify, promote, and monitor projects that demonstrate conservation design/ low impact development (CD/LID) and reduce the impacts of nonpoint source pollution through the IDEM Section 319-funded *Salt Creek Implementation Demonstration* Project. There are many opportunities for volunteers to get involved in on the ground projects, such as planting rain gardens, monitoring water quality, and installing best management practices, such as rain barrels, on their own properties.

The public is encouraged to attend the Salt Creek Committee Meeting on Thursday June 26th, from 9:30 to 10:30 am at the Forest Park Golf Course in Valparaiso as the Salt Creek Watershed Group continues to pursue their mission: *The Salt Creek watershed stakeholders will foster improved communication, collaboration, education, and scientific understanding of the watershed and will develop strategies that conserve, protect, and enhance the resources of the watershed.*

Save the Dunes Conservation Fund

444 Barker Road
Michigan City, IN 46360
Ph. 219-879-3564 / Fx. 219-872-4875

Appendix G. Endangered threatened and rare species

Species Name	Common Name	State Status	Fed Status
	PLANTS		
Lathyrus venosus	Smooth Veiny Pea	ST	"
Vaccinium oxycoccos	Small Cranberry	ST	"
Hypericum pyramicatum	Great St. John's-wort	ST	"
Panicum leibergii	Leiberg's Witchgrass	ST	"
Drosera intermedia	Spoon-leaved Sundew	SR	"
Plantago cordata	Heart-leaved Plantain	SE	"
Myosotis laxa	Smaller Forget-me-not	ST	"
Carex leptonervia	Finely-nerved Sedge	SE	"
Carex atherodes	Awned Sedge	SE	"
Zannichellia palustris	Horned Pondweed	SR	"
Potamogeton richardsonii	Redheadgrass	SR	"
Potamogeton pusillus	Slender Pondweed	WL	"
Myriophyllum pinnatum	Cutleaf Water-milfoil	SE	"
Lemna minima	Least Duckweed	SE	"
Sorbus decora	Northern Mountain-ash	SX	"
	REPTILES		
Thamnophis butleri	Butler's Garter Snake	SE	"
Emydoidea blandingii	Blanding's Turtle	SE	"
Clemmys guttata	Spottted Turtle	SE	"
	BIRDS AND MAMMALS		
Bartramia longicauda	Upland Sandpiper	SE	"
Cistothorus platensis	Sedge Wren	SE	"
Taxidea tuxus	American Badger	"	"
Lynx rufus	Bobcat	"	"
	INSECTS		
Hadena ectypa	The Starry Campion Moth	ST	"
Euphydryas phaeton	Baltimore Checkerspot Butterfly	SR	"
Euphyes dion	Sedge Skipper Butterfly	SR	"
Poanes viator viator	Big Broad-winged Skipper Butterfly	ST	"
	HIGH QUALITY NATURAL COMMUNITY		
	Mesic Prairie	SG	"
	Fen	SG	"

Fed: LE = listed federal endangered; LT = listed federal threatened; C = federal candidate species

State: SE = stated endangered; ST = state threatened; SR = state rare; SSC = state species of special concern; SG = state significant; WL = watch list; no rank = not ranked but tracked to monitor status

Appendix H. Historic places within the Salt Creek watershed (National Register of Historic Places)

Heritage Hall, 1875.
Valparaiso
Education

Immanuel Lutheran Church, 1891.
Valparaiso
Architecture

Dr. David J. Loring Residence and Clinic, 1906.
Valparaiso
Health/Medicine, Social History

Porter County Jail (1871) and Sheriff's House (1860).
Valparaiso
Architecture, Politics/Government, Social History

Porter County Memorial Hall, 1893.
Valparaiso
Architecture, Performing Arts

Davis Garland Rose House, 1860.
Valparaiso
Architecture

Valparaiso Downtown Commercial District, 1870-1930
Valparaiso
Architecture, Commerce, Politics/Government

Appendix I. Prior studies conducted in the Salt Creek watershed.

Year	**Organization**	**Topic**	**Study/Report**
1990-2000	IDEM	Fisheries	Fish Survey Results
1990-2000	IDEM	Macroinvertebrates	Macroinvertebrate Index of Biotic Integrity
1990-2006	IDEM	Metals	Salt Creek Metal Survey
1990-2006	IDEM	Organics	Salt Creek Organics Survey
1990-2006	IDEM	Stream Chemistry	General Chemistry
1999-2006	City of Valparaiso Utilities	Stream Chemistry	Stream Sampling
2000	IDEM	Fisheries	Fish Survey Results
2000-2006	IDEM	Stream Chemistry	General Chemistry
2001	Applied Ecological Services, Inc.	Watershed Management	Watershed Diagnostic Study of the Little Calumet-Galien River Watershed
2002-2006	IDEM	Pesticides	Pesticides present in stream
2003	JFNew	Stream Chemistry	Lake Louise Water Quality Assessment
2003	Lake Michigan Interagency Task Force on *E. coli*	Pathogens	*E. coli* Sampling
2004	Wittman Hydro Planning Associates, Inc.	Pathogens	Salt Creek *E. coli* Total Maximum Daily Load
2005-2006	Valparaiso University	Stream Chemistry	General Chemistry
2005	Northwestern Indiana Regional Planning Commission	Watershed Management	Watershed Management Plan for Lake, Porter, and LaPorte Counties
2006	IDEM	Fisheries	Biotic Community Assessment/Intensive Survey

Appendix J. Hydrologic calibration and verification (from TMDL)

Calibration of the hydrologic component of the Salt Creek HSPF (Hydrologic Simulation Program-Fortran) watershed model was a stepwise process as described in the TMDL document (Approach). The four watershed characteristics were addressed sequentially. Each step involved an iterative process of executing the model, interpreting the results as described in the Approach, and adjusting input parameters accordingly. All final, calibrated input parameters were within the published, possible ranges (USEPA, 2000d). Table A 1 presents a comparison of the annual flows observed at the McCool gage with the corresponding annual flows predicted by the calibrated model. The mean annual discharge at the gage from 1947 to 1990 was 14.0 inches (35.6 centimeters). The average annual flow for the calibration period was 15 inches (38 centimeters). Flow data from 1991 was ideal for the verification period because 1991 was a wetter than average year. The average annual flow for 1991 was 19.3 inches (49 centimeters). Calibration with data from a wet year provided the opportunity to evaluate the model under conditions different than the calibration period.

Comparison of observed and simulated values for annual flow and baseflow contribution from the calibrated model were flows were less than ten percent which is considered "very good" (Figure A 1). The annual baseflow component at the McCool gage was estimated to be about 50%, based on 45 complete years of record. The simulated baseflow contribution for the calibration years averaged 52% (Table A 1). The simulated baseflow contribution for the verification period was 54%, somewhat lower than the average for the period of record. A lower portion of baseflow contribution is expected in a wetter year.

Table A 1. Comparison of simulated and observed conditions for 1988-90

Water Year	Simulated Baseflow (%)	Simulated Flow (inches)	Observed Flow (inches)	Residual (Sim-Obs)	Error (%)
Calibration Period					
1988	59	11.5	12.1	-0.6	-5.2
1989	50	16.3	15.2	1.1	6.7
1990	46	17.0	17	0	0
Average	52	15.0	14.8	0.2	1.3
Validation Period					
1991	54	21.6	19.3	1.3	6.0

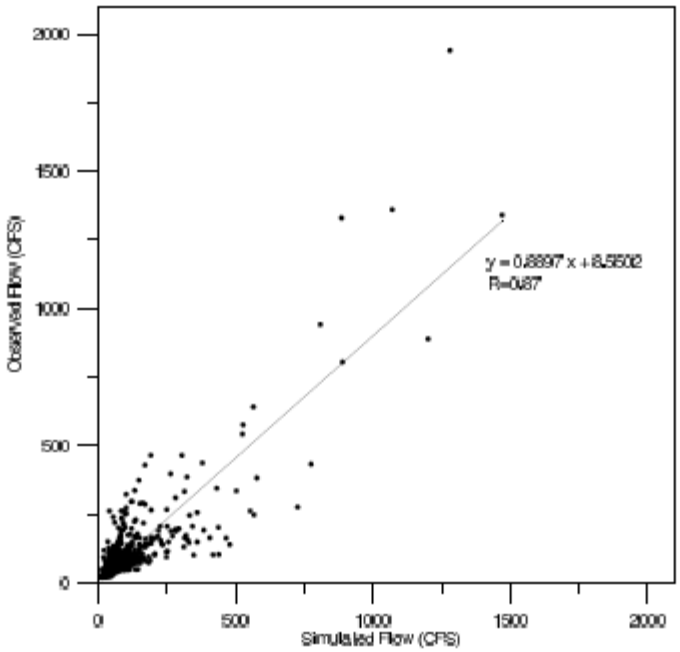
Table A 2 presents statistical results for monthly and daily flows predicted by the calibrated model. The results for the calibration and verification periods show good agreement based on monthly and daily comparisons. The correlation coefficients for the monthly and daily values for the calibration period indicate that the results are "good" as described by Donigian (2002). By the same standards, results from the verification period indicate that the predictive capacity of the model is "good" for daily flows and categorized as "very good" for monthly flows.

Table A 2. Summary statistics from flow calibration and verification

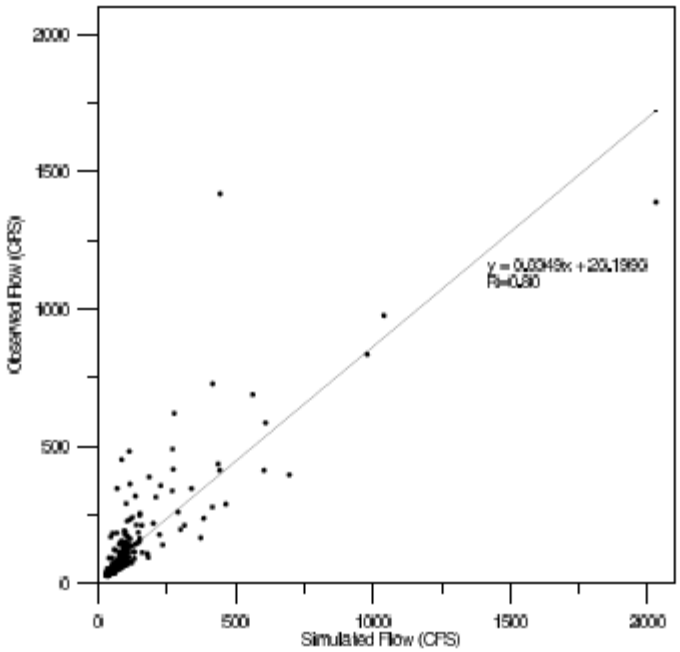
		Correlation Coefficient, R	Coefficient of Determination, R^2	NS Model Fit Efficiency
Calibration: Water Years 1988-1990	Average Monthly	0.91	0.83	0.83
	Average Daily	0.87	0.76	0.76
Verification: Water Year 1991	Average Monthly	0.93	0.86	0.80
	Average Daily	0.80	0.63	0.63

NS= Nash-Suttcliffe

Graphical comparisons of output were also employed to add weight to the evaluation of model performance. Figure A 1 shows the scatter plots of observed and predicted daily flows at McCool. The scatter plots for the daily calibration and verification results both show graphically the correlation features of the results. Figure A 2 shows observed and predicted flow-duration curves at the same site. The flow-duration curves for both calibration and verification show reasonable representation of the flow distribution. Figure A 3 shows a time series plot of simulated and observed flows at McCool. Simulated daily flows matched well with observed flows. Some difficulties were encountered in matching exactly the magnitude or timing of storm events. In many cases, the model simulates small storm events that are not reflected in the observed data. Difficulties in matching exactly the timing or magnitude of storm flows can largely be attributed to spatial and temporal uncertainties in the input climate data. Inherent approximations are introduced by using data from only one climate site to represent the entire watershed. There are numerous additional uncertainties in the measured input data and data used for calibration, including: 1) spatial variability errors in soils and land use data, 2) errors in flow measurements, and 3) errors caused by sampling strategies.

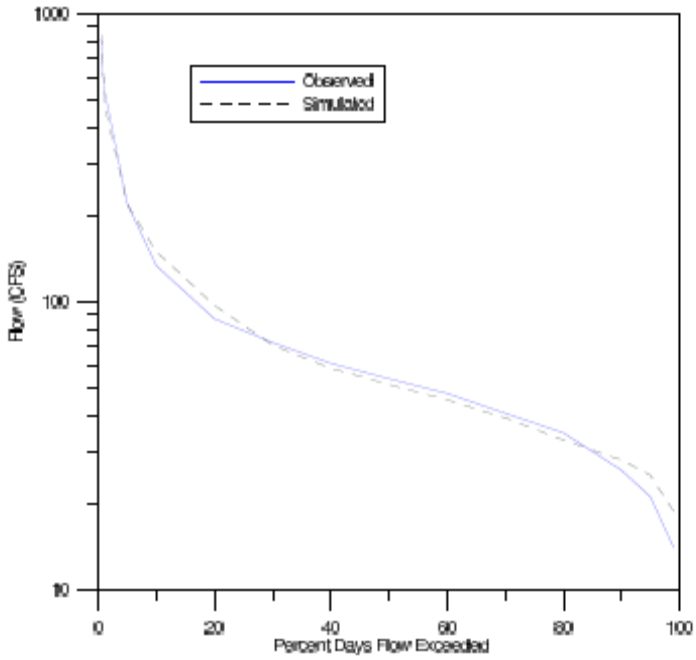


(a) Daily flow for the calibration period at McCool.

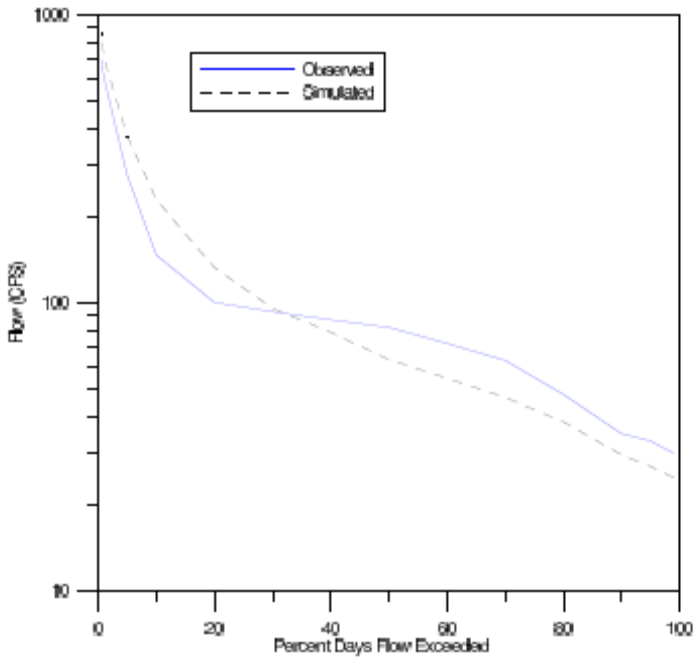


(b) Daily flow for the verification period at McCool.

Figure A 1. Relationship between daily flow values at USGS McCool gage on Salt Creek and nearby Porter gage on the Little Calumet River, 1970–1991



(a) Flow-duration curve for calibration period at McCool.



(b) Flow-duration curve for the validation period at McCool.

Figure A 2. Observed and predicted daily flows at McCool

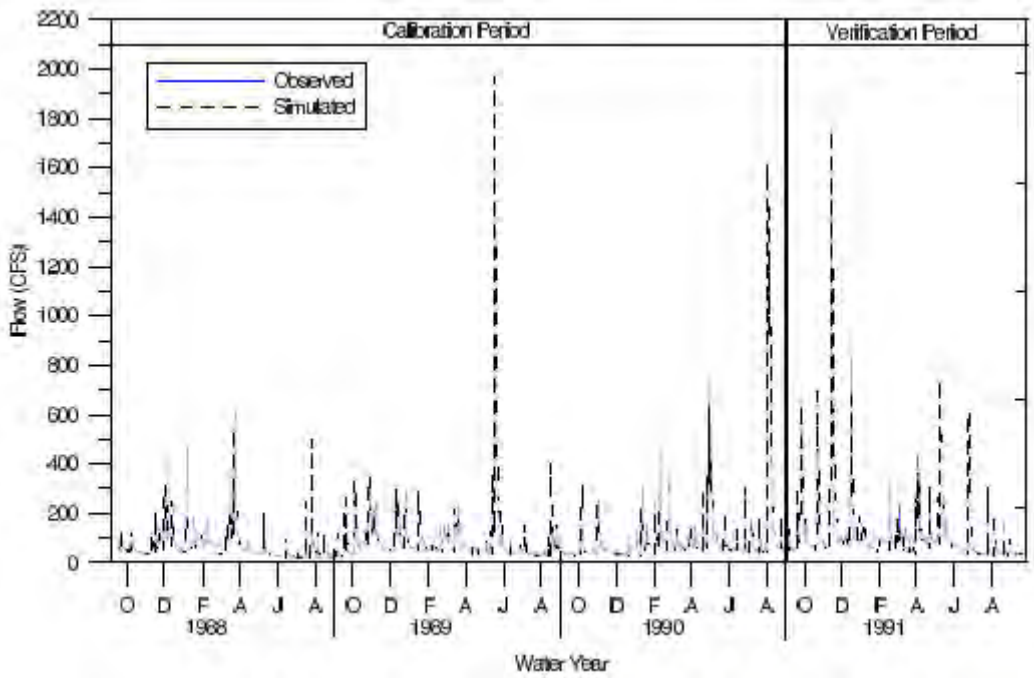


Figure A 3. Observed and simulated daily flows in Salt Creek at McCool for the calibration and verification periods

Appendix K. Salt Creek *E. coli* TMDL nonpoint source characterization (from TMDL)

The source inventory characterizes the type, magnitude, and location of potential sources of contaminant loading to a waterbody. The assessment characterizes the known and suspected sources of *E. coli* loading to Salt Creek and presents estimates that will be used as a starting point for subsequent modeling activities. The assessment of contributions from nonpoint sources was aided by use of the Bacterial Indicator Tool (herein referred to as "the Spreadsheet"). The Spreadsheet, distributed with BASINS 3.0, is a spreadsheet that estimates the bacteria contribution from multiple nonpoint sources (USEPA, 2000b). The Spreadsheet was developed to provide a scientific basis for assigning values to source-loading parameters and has been used successfully for development of TMDLs across the country. The Spreadsheet was written specifically for TMDL development for fecal coliform, but was designed for adaptation for use with nutrients and other fecal indicators. The Spreadsheet was adapted for use with *E. coli* by modifying the amount of bacteria in animal fecal matter from fecal coliform to *E. coli*. For example, the amount of fecal coliform in one gram of cow manure was changed to reflect the amount of the *E. coli* in one gram of cow manure. The Spreadsheet estimates loading rates from livestock, wildlife, and failing septics. In addition, the Spreadsheet estimates the accumulation rate and storage limits of waste buildup on four different land uses (cropland, forest, built-up, and pastureland). Output from the Spreadsheet was designed for use as input to dynamic water quality models such as the Hydrologic Simulation Program-Fortran (HSPF).

Nonpoint Sources

Nonpoint source (NPS) pollution comes from diffuse sources that cannot be identified as entering the water body at a single location. These sources generally involve land activities that contribute pollution to streams during wet weather events. Rain or snow-melt moves over and through the ground where pollutants have accumulated, transports the contaminants, and deposits them into nearby waterbodies. Bacterial NPS pollution is generated by both human and non-human (animal) sources via land use activities. Typical nonpoint sources of *E. coli* include, but are not limited to:

- Manure application to cropland
- Livestock grazing on pastureland
- Livestock with direct access to streams
- Wildlife
- Urban land activities
- Leaking / failed septic systems

Parameters for each source described above were input into the Spreadsheet. The Spreadsheet allows the watershed to be divided into a maximum of ten subwatersheds. The watershed was divided Salt Creek into five subwatersheds (Figure A 4). The subwatersheds were chosen based on the natural topographic divisions within the watershed. Typically the divisions were made at the confluence of major tributaries to Salt Creek. The subwatersheds were delineated with a Geographic Information System (GIS) that allowed for use of best professional judgment. The subwatershed data was then input into the Spreadsheet. The Spreadsheet estimates the monthly accumulation rate and storage limit of bacteria for four land use categories: built-up, cropland, forest, and pastureland (Figure A 5). The accumulation rates and storage values are determined for each subwatershed / land use combination. The accumulation rate (ACQOP) and storage limit (SQOLIM) can be used as input for the dynamic water quality model HSPF as MON-ACCUM (accumulation rate) and MON-SQOLIM (storage limit). The effects of failed septics and cattle with direct access to streams are calculated as a constant monthly load for each subwatershed (Figure A 5). The estimated loads can be used as input for modeling. Table A 3 summarizes the output sheets in the Spreadsheet.

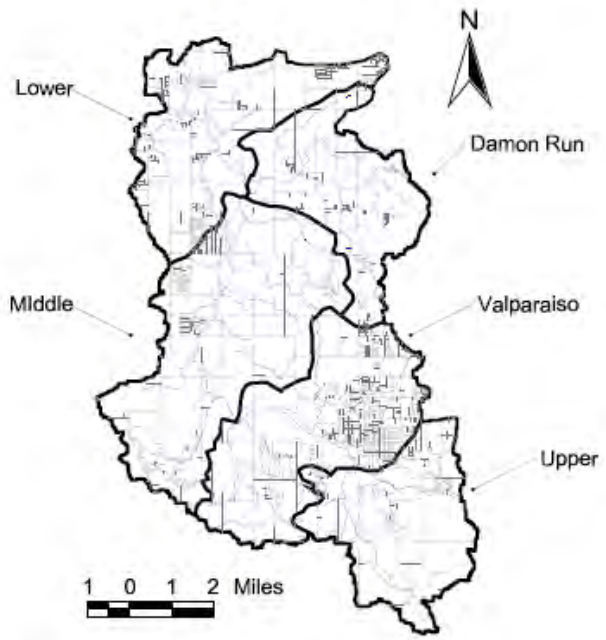


Figure A 4. The five Salt Creek subwatersheds; Upper, Valparaiso, Middle, Damon, and Lower

Subwatershed Land use

The Salt Creek watershed was divided into five subwatersheds and four land use types (Figure A 4 & Figure A 5). The geographic distribution of land use was modified from the Indiana Land Cover Dataset (USGS, 1999) presented in the Basin Characterization. The 15 land use types delineated by the Dataset were appropriately grouped according to the four general land use types recognized by the Bacterial Indicator Tool (cropland, forest, built-up, pasture). The loading for each land use is modeled to reflect the practices that occur in that area. The Spreadsheet allows for build-up and wash-off of *E. coli* in conjunction with rain events for each land use type.

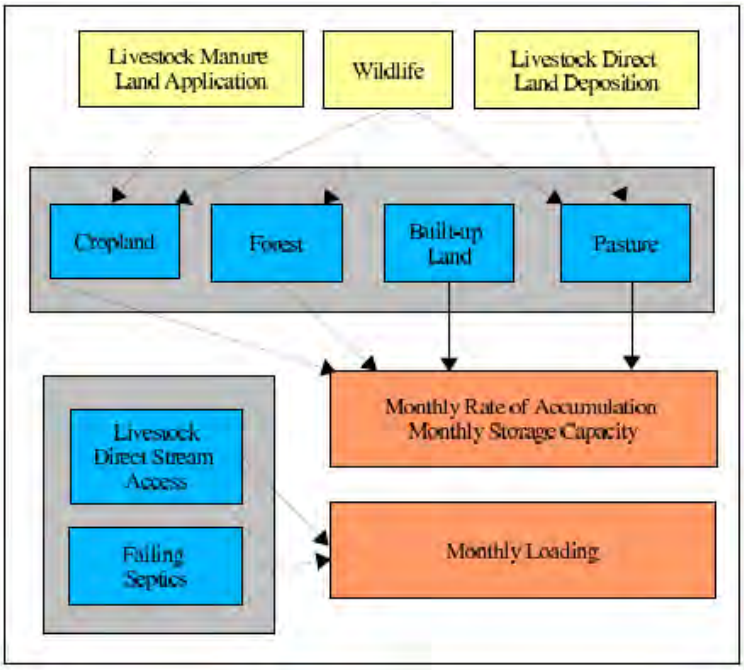


Figure A 5. Schematic of the Bacterial Indicator Tool

used to calculate *E. coli* nonpoint source accumulation rates and storage limits

Livestock

Manure from livestock is a potential source of *E. coli* to Salt Creek. The number of animals, the amount of manure produced by each animal, and the concentration of *E. coli* in the manure are used to calculate the impact of livestock on Salt Creek (Table A 5 & Table A 6). The *E. coli* concentrations in livestock feces are estimates by researchers who study *E. coli* extensively and have experience with the relevant species. The *E. coli* estimate for chickens was provided by Dr. Mike Jenkins of the Agricultural Research Service (Jenkins, 2003). The *E. coli* concentration for horse manure was provided by Dr. Robert Atwill of the University of California-Davis (Atwill, 2003). The *E. coli* concentration for cow manure was provided by a study performed by Jordan and McEwen (Jordan and McEwen, 1997).

Table A 3. Description of the output worksheets provided in the Bacterial Indicator Tool

Modified from USEPA, 2000b

Worksheet Name	Purpose
Cropland	Calculates monthly rate of accumulation and storage limit of *E. coli* on cropland from wildlife, and application of hog, cattle, and poultry manure.
Forest	Calculates monthly rate of accumulation and storage limit of *E. coli* on forestland from wildlife.
Built-up	Calculates monthly rate of accumulation and storage limit of *E. coli* on built-up land from literature values.
Pasture	Calculates monthly rate of accumulation and storage limit of *E. coli* on pastureland from wildlife, cattle, horse, sheep, and other grazing.
Cattle in Streams	Calculates the monthly loading and flow rate of *E. coli* contributed directly to the stream by beef cattle.
Septics	Calculates the monthly loading and flow rate of *E. coli* contributed by failing septics.
ACQOP & SQOLIM	Summarizes the monthly rate of accumulation and storage capacity for *E. coli* for the four land uses. Provides input parameters for HSPF (ACQOP/MON-ACCUM and SQOLIM/MON-SQOLIM)

The *E. coli* concentration number for cow was also verified by Dr. Atwill and Dr. Jeffery Karns (Atwill, 2003, Karns, 2003). Dr. John Patterson verified that all the livestock estimates for *E. coli* concentrations in fecal matter were reasonable (Patterson, 2003). The quantity of manure produced from chickens, cows, horses, pigs, and sheep are values provided by the American Society of Agricultural Engineers (ASAE) in the Spreadsheet references (USEPA, 2000b). The quantity for goats was estimated to be similar to the value provided for white-tailed deer (Virginia Department of Environmental Quality (VADEQ), 2001).

The number and location of livestock was determined by a windshield survey of the watershed. During the windshield survey observations were recorded as every road in the watershed was driven and the livestock were counted. The locations were marked with a Global Position System (GPS). The data were then overlayed on a watershed map and clipped to the watershed so as to not include observations outside of the watershed boundaries. Additional information about livestock and verification of the windshield survey data was provided from a meeting on February 6, 2003 with members of the Porter County Natural Resource Conservation Service (NRCS), the Porter County Farm Service Agency, and the Porter County Cooperative Extension Service (Table A 6) (Ames et al., 2003). Based on the survey and the subsequent meeting with local agricultural professionals, no chickens or swine were located within the watershed.

The total estimated production from livestock was calculated by multiplying the number of animals times the estimated amount of *E. coli* produced from each animal (Table A 7).

Table A 4. Land use information for the five subwatersheds in the Salt Creek watershed

Subwatersheds	Built-up (%)	Cropland (%)	Forest (%)	Pasture (%)	Total Area (% of total)
Upper Salt Creek	15	29	27	29	16
Valparaiso	44	11	28	17	22
Middle Salt Creek	13	28	33	26	28
Damon Run	12	21	41	26	15
Lower Salt Creek	25	31	29	15	19
Entire Watershed	22	24	32	22	100

Pastureland / Cropland

In the Salt Creek watershed most cattle and horse owners graze their livestock year round, but 'bed' their animals at night in a barn (Ames, 2003). While grazing, livestock deposit fecal matter directly onto pastureland and often times directly into streams. Manure deposited onto pastureland is exposed to the environment for a period of time and is available for runoff during storm events. The manure from the barn is collected and applied to croplands. Because of this variation in source type, manure from livestock is treated as three separate sources in the Spreadsheet; originating from pasture grazing, direct input into streams, and manure applied to cropland.

Table A 5. Livestock sources of *E. coli* in Salt Creek watershed

Animals	Estimated *E. coli* in fecal matter (CFU / gram feces)	Estimated amount of fecal matter (grams / day / animal)	Estimated Loading Rate of *E. coli* (CFU / day / animal)
Cattle, Beef[1,2,4,5]	10^6	2.1×10^4	2.1×10^{10}
Cattle, Dairy[1,2,4,5]	10^6	5.5×10^4	5.5×10^{10}
Chicken[1,3]	10^6	1.2×10^2	1.2×10^8
Goats[1]	10^6	7.7×10^2	7.7×10^8
Hogs[1]	10^6	5.0×10^3	5.0×10^9
Horses[1,2]	10^6	2.3×10^4	2.3×10^{10}
Sheep[1]	10^6	9.1×10^2	9.1×10^8

CFU = colony forming units; [1], E. coli concentration provided by [Patterson, 2003];[2], E. coli concentration provided by [Atwill, 2003];[3], E. coli concentration provided by [Jenkins, 2003]; [4], E. coli concentration provided by [Karns, 2003];[5], E. coli concentration provided by [Jordan and McEwen, 1997].

Table A 6. Estimated number of livestock in the Salt Creek subwatersheds

Subwatersheds	Cattle, Beef (number)	Cattle, Dairy (number)	Goats (number)	Horses (number)	Sheep (number)
Upper Salt Creek	65	0	3	4	0
Valparaiso	0	0	0	16	0
Middle Salt Creek	144	0	3	26	11
Damon Run	81	56	23	30	5
Lower Salt Creek	15	0	0	2	0
Total in Watershed	305	56	29	78	16

Table A 7. The estimated *E. coli* production from livestock in the Salt Creek subwatersheds

Subwatersheds	Cattle, Beef (CFU/year)	Cattle, Dairy (CFU/year)	Goats (CFU/year)	Horses (CFU/year)	Sheep (CFU/year)
Upper Salt Creek	5.0×10^{14}	0	8.5×10^{11}	3.3×10^{13}	0
Valparaiso	0	0	0	1.3×10^{14}	0
Middle Salt Creek	1.1×10^{15}	0	8.5×10^{11}	2.2×10^{14}	4.4×10^{12}
Damon Run	6.2×10^{14}	1.1×10^{15}	6.5×10^{12}	2.5×10^{14}	2.0×10^{12}
Lower Salt Creek	1.1×10^{14}	0	0	1.7×10^{13}	0
Total in Watershed	2.3×10^{15}	1.1×10^{15}	8.2×10^{12}	6.5×10^{14}	6.4×10^{12}

CFU = colony forming units

Land application of manure helps reduce or eliminate the need for commercial fertilizers. It can be applied in four different ways 1) surface broadcast followed by disking 2) broadcast without incorporation 3) injection under the surface, or 4) irrigation. In Porter County, Indiana animal manure is generally applied with incorporation in the spring (April - May) and fall (October - November) (Ames, 2003, Sutton, 2003). It is estimated that livestock farmers only collect and store manure from cattle and horse deposits in their barns where the animals bed at night (Ames, 2003). It is assumed that livestock usually spend 1/3 of a typical day indoors. Therefore, the amount of total manure from cattle and horses applied to land was estimated to be 1/3 of the amount produced by each animal. This fraction of the total for horse and cattle manure is distributed over the four months manure is applied to fields. The Spreadsheet assumes that cattle manure is applied to cropland, horse manure is applied to pastureland, and no manure is applied to forest or built-up areas.

The manure that is not applied by the livestock owners is assumed to all be added directly to the pasture by the animals. The manure deposited directly by the animals onto pastureland (2/3 of total) is not incorporated, but remains a source for runoff events. This fraction of the total for horse and cattle manure is distributed over twelve months because the animals are allowed to graze throughout the year. Access to streams allows livestock to input manure directly into the streams. During the meeting on February 6, 2003, the county agents indicated where livestock have stream access (Ames et al., 2003). Based on these discussions, 31% of the total cattle in the watershed have access to a stream. It was estimated that these cattle would only spend 10% of grazing time in the stream. It was assumed that most horse owners do not allow their horses access for fear of disease, so no access was input for horses (Ames et al., 2003).

Wildlife

Wildlife also contributes to *E. coli* in streams through runoff of fecal matter. The wildlife assumed to be major contributors in the watershed are coyote, deer, duck, geese, opossum, raccoon, turkey, squirrel, rabbit, and mice. IDNR surveys wildlife to establish population trends for specific species but does not survey to determine population numbers (Byer, 2003). Therefore, other resources determined the densities of the wildlife. The deer density was estimated by the Quality Deer Management Association (Table 5) ((Quality Deer management Association (QDMA, 2002). The wildlife densities for coyote were estimated by officials at the NRCS (Table 5) (Ames et al., 2003). The estimates for turkey, opossum, and squirrel were estimated from IDNR harvest numbers (IDNR, 2002b). The raccoon were estimated from a density range given on the IDNR website (IDNR, 2002b). The density of geese was estimated using Indiana state population numbers for geese, historic population data, and the windshield survey (USGS, 1999, IDNR, 2002a). The density of ducks was estimated from the U.S. Fish and Wildlife Service Adaptive Harvest Management (USFWS, 2002). The wildlife densities were assumed to be similar in all land uses, except built-up. The Spreadsheet assumes no wildlife in the built-up areas of the watershed.

The *E. coli* load in fecal matter for wildlife was based on the work of Dr. Rob Atwill, researcher of *E. coli* and wildlife studies at the University of California - Davis (Atwill, 2003). The estimated amount of fecal matter produced per animal for deer, geese, and raccoon were provided from an EPA approved TMDL for fecal coliform in Virginia (VADEQ, 2001). The amount of fecal matter produced by turkey and duck was provided by the ASAE in the Spreadsheet references (USEPA, 2000b). Opossum values are assumed to be similar to that of a small dog. This value was provided by ASAE (USEPA, 2000b). The amount of fecal matter from coyote is assumed to be similar to a large dog (VADEQ, 2001; WOW, 2003).

The numbers of each type of animal in the land uses were calculated by multiplying their assumed densities with the area of each land use type (Table A 4 &Table 5). The estimated amount of *E. coli* from wildlife each year was then calculated by multiplying the number of each animal times the amount of manure produced by each (Table 5 & Table 6). As Table 6 shows, waste from raccoon, rabbit, and deer produce 86% of the total *E. coli* from wildlife in the watershed.

Urban / Industrial Lands

Runoff from urban and industrial areas can potentially contribute bacteria to streams and rivers. The bacteria can come from such sources as pet feces, urban wildlife, sanitary sewer cross-connections, and deficient solid waste collection. To assess the impact of the urban runoff, the Spreadsheet divides the built-up areas into four sub-categories and calculates the loading rates for each of these divisions based on published accumulation rates (USEPA, 2000b). Unfortunately, similar accumulation rates are not available for *E. coli*, so WHPA estimated loading rates for *E. coli* based on the published values for fecal coliform. This estimation assigns the entire built-up area one accumulation rate instead of different rates for each sub-category.

E. coli is a subset of fecal coliform, meaning measurement of fecal coliform includes all measurement of *E. coli*, along with other pathogens. The amount of *E. coli* will be lower than the amount of fecal coliform in manure. Therefore, the low-end of the range for the fecal coliform accumulation rates was used as an estimation for *E. coli*. The accumulation rates for fecal coliform range from $1.8x10^8$– $2.1x10^{10}$ count/acre/day (USEPA, 2000b). The accumulation rate for *E. coli* in urban areas was designated as $1.8x10^8$ count/acre/day.

Septic Systems

Failing septic systems contribute pathogen loads to receiving waters. However, specific information regarding the location and nature of failed systems in the watershed is unknown. The distribution of failed septics in the watershed was estimated using available information (U.S. Census Bureau, 1999, NESC, 2001). The technique used is described briefly in EPA's Protocol for Developing Pathogen TMDLs (USEPA, 2001) and in more detail in results describing a similar application to nutrient loads (Nizeyimana et al., 1996). The method uses information from the 1990 census and county level failure rates published by

the National Small Flows Clearinghouse (NSFC). Porter County population and housing information was retrieved from the U.S. Census Bureau (U.S. Census Bureau, 1999). Septic tank use is included in the housing information from the 1990 census. Unfortunately, the same information was not included in the 2000 census. Using data from 1990 may result in underestimating the impact from failing septics. The population of the county increased by about 20,000 people from 1990 to 2000. However, problems with failed or leaky septics are generally attributed to older homes. The underestimation may derive from the likelihood that some older septics failed in the 10 years that have passed since the NSFC survey.

Table A 8. Number of people on septic systems and number of failed septic systems

Subwatersheds	Estimated People with Septics (number)	Estimated People with Failed Septics (number)
Upper Salt Creek	237	3.1
Valparaiso	246	3.2
Middle Salt Creek	252	3.3
Damon Run	84	1.1
Lower Salt Creek	203	2.6

Figure 60 shows the block group distribution of houses on septic in the watershed. The number of persons per household in each tract was estimated by dividing the number of persons in the tract by the number of houses in the tract. The number of persons on septic in each tract was then estimated by multiplying the estimated number of persons per household by the number of houses on septic in the tract (Figure A 7). The population density on septic was then estimated by dividing the number of persons on septic in the tract by the tract area (Figure A 7). The population density on septic was then used with GIS software to calculate the number of persons on septic in each of the five subwatersheds (Table A 8).

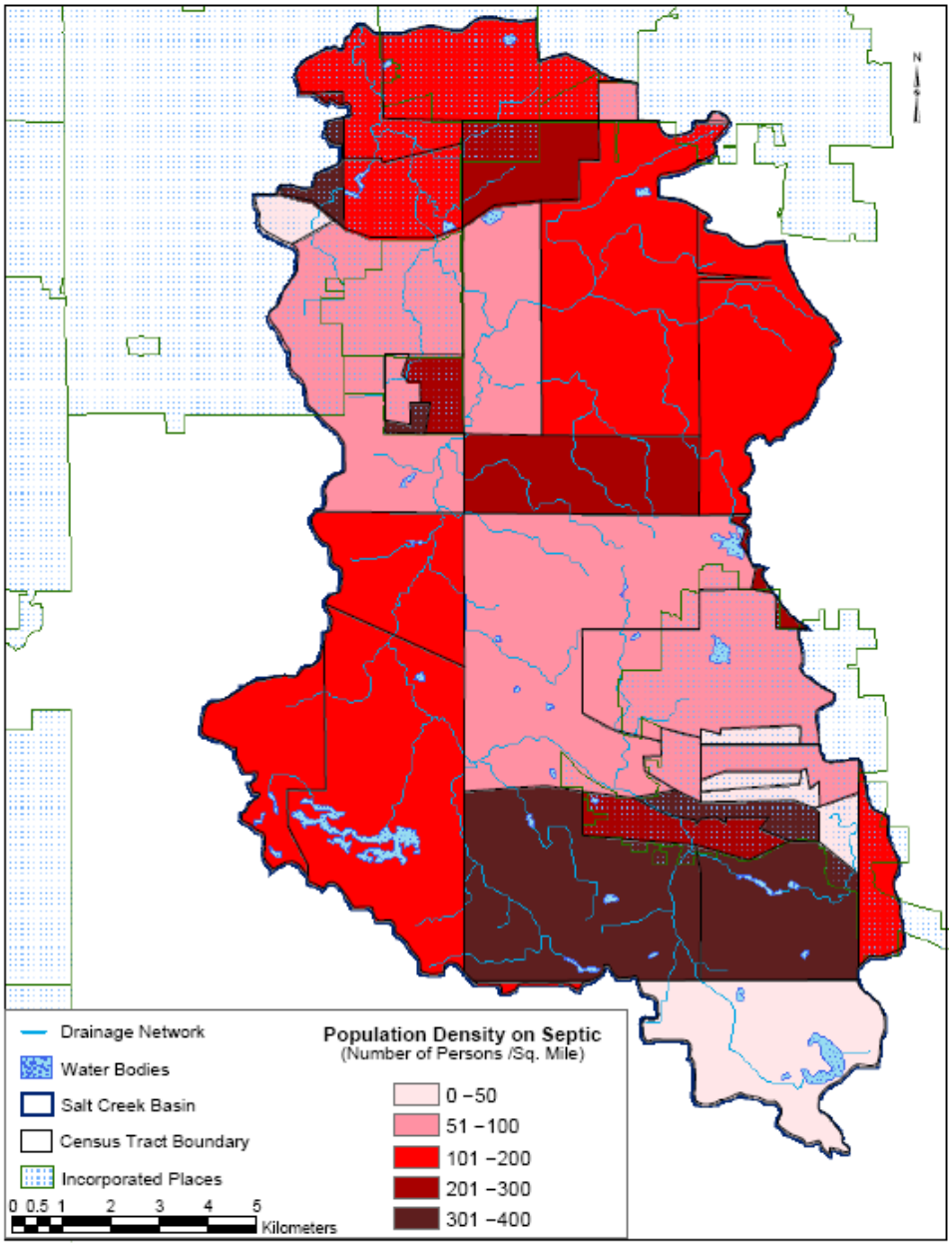


Figure A 6. Population density of septic systems in the Salt Creek watershed.

According to census data, the population of Porter County increased by approximately 20,000 people from 1990 to 2000. The highest population densities on septic system are located in the southern portion of the watershed in portions of the Clark Ditch and Sager's Lake subwatersheds (Figure A 6). Figure 60 shows the block group distribution of houses on septic in the watershed based upon the 1990 census. The number of persons per household in each tract was estimated by dividing the number of persons in the tract by the number of houses in the tract. The population density on septic was then estimated by dividing the number of persons on septic in the tract by the tract area (Figure A 6, Figure A 7).

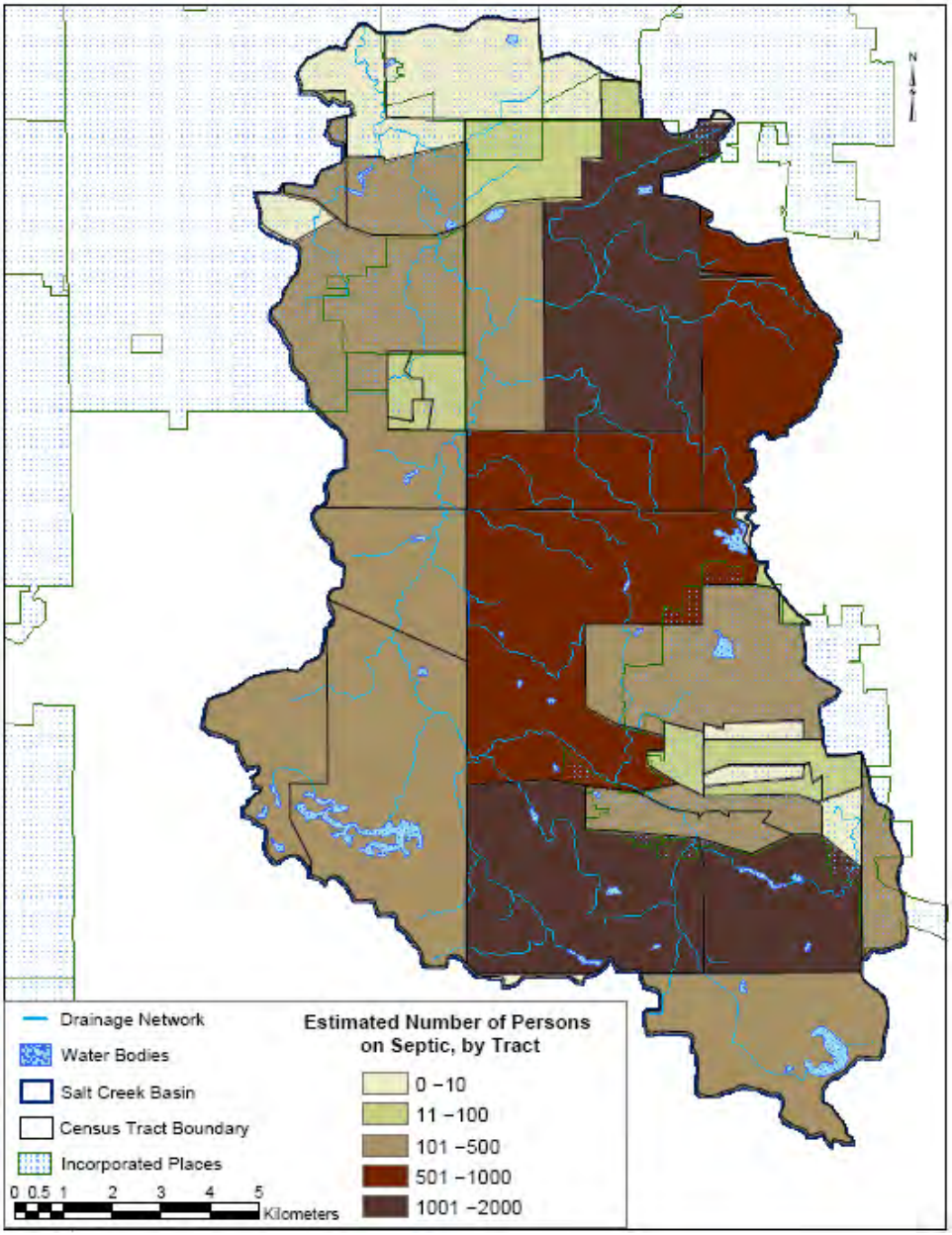


Figure A 7. Number of people with septic systems in the Salt Creek watershed

Loads from failing septics in each subwatershed were calculated with the Spreadsheet. The number of persons on septic for each subwatershed was multiplied by the septic failure rate for the area. The septic failure rate was estimated from data collected by the NSFC. The NSFC surveyed local and state public health agencies across the country in the early 1990s regarding the status of on-site systems (NESC, 2001). Unfortunately, a failure rate for Porter County was not available. We used instead the failure rate published for LaPorte County (1.3 %). The LaPorte County rate is indicative of failure rates for the counties in the region that responded to the survey. This septic failure rate was also confirmed by the Porter County Health Department's numbers of repair permits issued in Porter County in 2002 and an estimation of septic failure (Letta, 2003). The failure rate was used in conjunction with the number of people on septic systems to calculate the number of failed septics in each subwatershed (Table A 8). The subwatershed loading rates were calculated with a typical effluent discharge rate of 70 gallons/person/day (265 liters/person/day) and the average *E. coli* concentration of sewage when it reaches the stream (Horsley and Whitten, 1996). The

E. coli concentration of septic sewage at the point when it reaches the stream was not available, so the *E. coli* concentration in raw sewage was used (8.8×10^6 CFU/100mL) (Turner et al., 1997). This value is most likely an overestimation because the *E. coli* population would probably be reduced from detrimental environmental conditions as it moved from the septic tank to the stream. However, there is evidence that *E. coli* can survive and even reproduce in the natural environment given the right environmental conditions (Turco, 2002). In addition, the probable underestimation of the septic failure rate may be balanced from this overestimation in *E. coli* concentration.

Illicit Discharges

Illicit discharges usually involve an illegal or improper connection to a storm drains or a "straight pipe" to receiving waters. Illicit discharge of sewage can derive from domestic and industrial sources. Such sources are difficult to identify; often owners are not even aware of the problem. Programs to identify illicit connections can be resource intensive. However, illicit discharges can be a major source of fecal loading in a watershed. Information about existing or potential illicit discharges in the Salt Creek watershed is not available. Keith Letta of the Porter County Health Department believes that illicit discharges are not a significant problem in the watershed (Letta, 2003). Due to lack of information, potential loading rates from this source category were not estimated.

Uncertainty in Loading Estimates

The objective of the source assessment is to estimate the type, magnitude, and location of *E. coli* loading to Salt Creek. These estimates were required in order to begin modeling the effects of the combined loading on water quality in the stream. It is clear that uncertainty exists with respect to some of the loading from the identified potential sources. For instance, illicit discharges of residential sewage to streams or ditches were not identified. It is unlikely that none exist in the watershed. Similarly, there is uncertainty in the density of wildlife and urban loading rates. The estimates presented here are merely a starting point for the modeling process.

Appendix L. Total Maximum Daily Load analysis (from TMDL Chapter 6)

A TMDL represents the maximum capacity of a waterbody to assimilate a pollutant while safely meeting the respective water quality standard. The TMDL for a given waterbody and pollutant is the sum of individual wasteload allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background levels (USEPA, 2001). The sum of the allocations must not result in the exceedance of the water quality standard. In addition, a margin of safety (MOS) must be included in the analysis, either implicitly or explicitly. The MOS accounts for any uncertainty in the relationship between loads and conditions in the receiving water and helps to ensure that the water quality standard is met. These concepts can be expressed conceptually by the equation:

$$TMDL = \sum WLAs + \sum LAs + MOS$$

Developing allocations for point and nonpoint sources presents a challenge for bacteria TMDLs. TMDLs are traditionally expressed in terms of loads (mass per unit time). However, mass is not an appropriate unit for pathogens. Concentrations of indicators such as *E. coli* are usually reported in units of "colony forming units per unit volume" or "counts per unit volume." In addition, the dynamic nature of bacteria loading and the range of critical conditions presented by such diffuse sources makes assignment of fixed loads insufficient for the quantification required by a TMDL. Federal regulations allow TMDLs to be expressed in "other appropriate measures" (40 CFR 130.2 (i)). It is common for bacteria TMDLs to be expressed as a concentration or as a percent reduction required for attainment of the standard. This TMDL is expressed as a total percent reduction based on a statistical measure of the existing and target conditions. The WLA and LA are expressed as portions of the total reduction, the sum of which equals the reduction necessary to achieve the loading capacity of Salt Creek. An explicit MOS is included in the TMDL.

L.1 Critical Conditions

The goal of the TMDL program is to reduce the *E. coli* concentrations in Salt Creek to a level that meets its designated-use standard for a full body contact recreational stream. Indiana's water quality standard for recreational waters is set forth in 327 I.A.C. 2-1-6 and 2-1.5-8(e)(2) (IAC, 2008a). The standard reads "*E. coli* bacteria, using membrane filter (MF) shall not exceed one hundred twenty five (125) per one hundred (100) milliliters as a geometric mean based on no less than five (5) samples equally spaced over a thirty (30) day period nor exceed two hundred thirty five (235) per one hundred (100) milliliters in any one (1) sample in a thirty (30) day period."

The analysis of existing water quality data presented in Section 3 demonstrated that there is no single critical condition associated with violations of the dual *E. coli* standard in Salt Creek. Load-duration curve analysis revealed that exceedances of the single-sample standard occur throughout the flow regime. A higher percentage of exceedances were observed, however, in the high-to-middle range of flows (2-60 percent flow duration), indicating that concentrations above the standard are likely associated with nonpoint sources or other event-driven inputs such as storm sewer discharges and CSOs. Additional analyses presented in the Section 3 confirmed that exceedances in the creek and its tributaries were associated with precipitation events. The modeling analysis presented in Section 5 also confirmed the importance of precipitation events in contributing to elevated concentrations in the creek. The HSPF model of the watershed employed for this analysis was calibrated over an entire recreational season. The calibration period provided a good opportunity for evaluating a range of conditions in the watershed and allowed proper consideration of the critical conditions of impairment.

L.2 Technical Approach

The TMDL and respective allocations were developed in terms of the percent reductions required for attainment. The needed reductions were calculated by a statistical method that utilizes the frequency distributions of predicted *E. coli* concentrations. The method employed is modeled after concepts presented as Statistical Rollback Theory by Ott (1995). Frequency distributions of *E. coli* concentrations predicted by

the watershed model were analyzed to assess the linkage of sources with in-stream effects and set the TMDL values.

A frequency distribution is an excellent way to graphically represent hydrologic data sets. Figure 30 shows the results of the analysis. Existing conditions were defined as the distribution of concentrations predicted by the calibrated model. The distribution includes the predicted *E. coli* concentration for each day of the calibration period (the 1998 recreational season). By using the distribution of the entire recreational season, the range of conditions that represent the critical conditions is incorporated into the TMDL. The predicted distribution was approximated as lognormal. Distributions of water quality data are commonly lognormal. The lognormal regression is included on the graph with the resulting correlation coefficient.

A cumulative frequency distribution is constructed by first ranking the data from the smallest value to the largest value. The smallest value is assigned a rank of i=1 and the largest a rank of i=n, where n equals the sample size of the data set. The "plotting position" is plotted on the horizontal axis. The plotting position is a function of the rank i and the sample size n. An advantage of using frequency distributions is that all of the data are displayed and every data point has a distinct position.

Graphical analysis of *E. coli* distributions predicted by the model allows convenient comparison of scenarios with both the single-sample and geometric-mean standard. The 100th percentile of the data set represents the maximum concentration and allows direct comparison with the single-sample standard. The geometric mean of the data set is given by the 50th percentile and allows comparison with the geometric mean standard. For existing conditions, the watershed and regression models predict a 100th percentile value of 1,445 CFU/100ml (Figure 30). The WLA and LA were calculated as portions of the total reduction required to achieve the loading capacity. The loading capacity was defined as a distribution with a 100th percentile value equal to the single-sample standard of 235 CFU/100ml.

L.3 WLA

The WLA represents the portion of the TMDL assigned to point sources. A detailed description of the point sources of *E. coli* in the watershed is presented in Section 4. Ten NPDES facilities in the watershed are point sources of *E. coli*. Discharges from the ten permitted facilities include treated sanitary wastewater. All ten permittees are required to treat the waste stream and to monitor for *E. coli*, fecal coliform, or residual chlorine. Some are required to monitor for a combination of the three parameters. All of the permits are issued with the purpose of meeting the water quality standard for *E. coli* in the receiving water. It was assumed that those permittees required only to monitor for residual chlorine were meeting the single-sample standard if the permitted residual levels were met. All facilities required to monitor for only residual chlorine will be required by IDEM during the next permit cycle to monitor for *E. coli*.

In addition to treated wastewater from the permitted dischargers, point source contributions include intermittent discharges of untreated sanitary wastewater due to bypasses and CSOs. Load estimates based on 1998 data from Discharge Monitoring Reports showed that inputs due to the CSO at Valparaiso and bypasses from several of the facilities were significantly higher than the combined ambient inputs. Bypasses are defined as "the intentional diversion of waste streams from any portion of an Industrial User's treatment facility" (40 CFR122.41(m)(l)). Section 402 of the Clean Water Act prohibits bypasses from wastewater treatment facilities unless the bypass does not violate the permit or other specific extenuating circumstances are present. Indiana has in place a CSO Control Strategy to bring the State into compliance with the requirements of the Clean Water Act. The City of Valparaiso's Long Term Control Plan (LTCP) for the CSO was submitted to the State earlier in 2003 and is currently under review. The LTCP will help the City in meeting the water quality standard for *E. coli*.

The WLA was calculated as the percent reduction achievable by eliminating all bypass flows and reducing the CSO input concentrations to the geometric mean standard of 125 CFU/100ml. The geometric mean standard was used to calculate the percent reduction achievable by the point-source controls described above, the model inputs were adjusted accordingly, and the resulting distribution of predicted concentrations was fitted to a lognormal model (Figure 39) in the same way as described above for the existing conditions. The model predicts how the distribution of concentrations will change in the post-

control state. The post-control distribution is lower, as expected, and tilted more toward the right. Unlike Ott's Statistical Rollback Theory, the analysis presented here does not assume geometric scaling of post-control distributions. The tilt is represented by the lognormal model as a decrease in the slope of the regression line. The tilt is due to the reduction of CSO inputs in the model. CSO inputs are sporadic, but cause very high daily concentrations. Reducing CSO inputs in the model reduces values in the upper end of the distribution, causing the regression line to decrease and tilt more toward the right. The lognormal model of the post-control scenario predicts a distribution with a 100th percentile concentration of 1,023 CFU/100ml. The resulting reduction of 29% represents the WLA of the TMDL (Table 1). The reduction is achievable by eliminating all bypass flows and reducing the CSO input loads and does not require a reduction in limits for the permitted facilities.

L.4 LA

The LA represents the portion of the TMDL assigned to nonpoint sources. Nonpoint source pollution is derived from diffuse sources that generally involve land activities. A detailed description of the nonpoint sources of *E. coli* in the watershed is presented in Section 4 of the TMDL. The LA was calculated as the percent reduction required to reduce concentrations in addition to the WLA to the loading capacity of the creek. The loading capacity was defined as conditions that yield a 100th percentile concentration equal to the single-sample standard of 235 CFU/100ml. Specifically, the LA was calculated as the reduction required to reduce the 100th percentile concentration from conditions modeling post-control of the CSO (1,023 CFU/100ml) to the loading capacity (235 CFU/100ml) (Figure 30). The required reduction for the LA is 55%.

L.5 MOS

The MOS accounts for any uncertainty in the relationship between loads and conditions in the receiving water. Uncertainties in the source assessment and the linkage analysis were identified in Sections 4.3 and 5.3, respectively. An explicit 4% MOS was incorporated into the TMDL by reserving a portion of the loading capacity. A relatively low MOS was chosen because the overall uncertainty was minimized by use of a comprehensive watershed loading model. The loading capacity was defined as a distribution with a 100th percentile value equal to the single-sample standard of 235 CFU/100ml. The TMDL must incorporate a MOS that accounts for uncertainty in the analysis linking pollutant loads and conditions in the creek. The MOS was incorporated by defining target conditions as an additional 4 % of the TMDL. The result is a distribution with a 100th percentile equal to 170 CFU/100ml. The TMDL was calculated as the percent reduction required such that the 100th percentile of the distribution representing existing conditions is equal to that representing the target conditions. The total reduction required is 88%. The MOS portion of the TMDL is relatively low compared to the LA and the WLA. However, the MOS was determined with a 100th percentile value that is 28% lower than the single-sample standard and is considered appropriate given the robust modeling analysis used for linking sources and conditions in the creek.

L.6 Summary of TMDL Components

The TMDL was calculated by determining the total percent reduction required to reduce the 100th percentile of the distribution from existing conditions to the target conditions (Figure 30). Of the total 88% reduction required to meet the target conditions, 29% is the WLA, 55%is assigned to the LA, and 4 % is the MOS. The TMDL elements are summarized in Table 1.

H.7 Post-TMDL Distribution

The predicted post-TMDL distribution of concentrations is shown in Figure 30. The 100th percentile of the distribution was defined as necessary for achievement of the TMDL (described above). The slope of the regression was estimated as having a range. The slope was bracketed between the slope of the post-control distribution (upper bound) and the slope of the modeled distributions in the middle frequencies (30%-70% cumulative frequency). Reducing nonpoint source inputs will reduce the slope of the distribution similar to the change in slope seen by reducing CSO inputs. Like the CSO, diffuse sources are episodic, but contribute high daily concentrations. It is assumed that reducing nonpoint source inputs will not decrease

the slope of the distribution more than the slope represented by the middle range of concentrations since these concentrations should be unaffected by nonpoint source controls.

The geometric mean of the lognormal distribution is estimated by the 50th percentile. While this value represents the geometric mean of the distribution of concentrations over the entire recreational season and the geometric water quality standard applies only to a subset of the samples over any 30-day period, it is useful to compare the predicted geometric mean with the geometric standard. Given the assumptions to estimate the slope of the distribution, the geometric mean of the post-TMDL distribution was estimated to be between 30 and 70 CFU/100ml, values well below the geometric mean standard of 125 CFU/100ml.

Appendix M. Salt Creek water chemistry data tables from the current study

Site	Date	Event	Flow (cfs)	Temp (° C)	DO (mg/L)	% Sat	pH	Conductivity (mg/L)	Ammonia N (mg/L)	Nitrate + Nitrite (mg/L)	% Dissolved P	Total P (mg/L)	TSS (mg/L)	*E. coli* (CFU/100 mL)
1. Lake Louise Outlet	5/7/07	base	2.545	12.7	6.7	64.9	7.35	0.858	3.6	1.9	0.035	0.210	6.4	1000
	5/16/07	storm	1.842	13.3	6.42	61.5	7.42	812	3	2.6	0.041	0.260	7.6	19000
	5/22/07	base	1.732	12.91	7.76	74.6	7.69	846	0.2	1.2	0.027	0.120	5.2	40
	6/5/07	base	2.152	13.26	6.81	66.7	7.63	854	0.36	2.6	0.07	0.160	9.6	220
	6/19/07	storm	1.915	15.07	7.41	75.5	7.5	845	0.17	4	0.058	0.210	8.6	480
	7/5/07	base	1.811	15.05	7.1	72.3	7.52	840	0.16	2	<0.015	0.200	15	300
	7/17/07	base	2.206	14.64	7.13	72	7.54	842	0.48	1.5	<0.015	0.088	8.8	110
	7/17/07	base	2.206	14.64	7.13	72	7.54	842	0.64	1.5	<0.015	0.096	10	170
	7/24/07	base	2.257	14.32	7.53	75.6	7.58	849	0.14	2.8	<0.015	0.110	8.4	210

Site	Date	Event	Flow (cfs)	Temp (° C)	DO (mg/L)	% Sat	pH	Conductivity (mg/L)	Ammonia N (mg/L)	Nitrate + Nitrite (mg/L)	% Dissolved P	Total P (mg/L)	TSS (mg/L)	*E. coli* (CFU/100 mL)
2. Clark Ditch	5/7/07	base	2.771	12.16	8.66	82.7	7.82	0.641	0.07	0.31	0.047	0.047	13	150
	5/16/07	storm	2.969	14.4	8.78	85.9	7.82	623	0.12	0.14	0.056	0.191	12	810
	5/22/07	base	1.883	15.81	7.93	81.5	8	724	0.12	0.18	0.034	0.156	26	350
	6/5/07	base	2.62	15.83	7.13	73.8	7.99	757	0.22	0.27	0.078	0.160	32	2300
	6/19/07	storm	1.448	20.74	6.68	76.4	7.99	755	0.13	0.24	0.068	0.190	26	1100
	7/5/07	base	1.079	20.62	7.11	81.2	8.04	783	<0.042	0.44	0.054	0.082	20	1800
	7/17/07	base	0.903	19.68	7.42	83.2	8.09	830	0.12	0.43	<0.015	0.050	14	1100
	7/24/07	base	1.685	19.05	7.08	78.3	8.04	770	0.21	0.23	0.085	0.140	42	1100

Site	Date	Event	Flow (cfs)	Temp (° C)	DO (mg/L)	% Sat	pH	Conductivity (mg/L)	Ammonia N (mg/L)	Nitrate + Nitrite (mg/ L)	% Dissolved P	Total P (mg/ L)	TSS (mg/L)	*E. coli* (CFU/ 100 mL)
3. Weblos Trail Tributary	5/7/07	base	0.006	12.83	6.6	64	7.38	0.768	0.03	<0.0070	0.042	0.180	5.2	100
	5/16/07	storm	0.912	13.7	6.52	62.8	7.44	789	0.067	<0.0070	0.055	0.183	10	460
	5/22/07	base	0.397	13.91	6.5	64.1	7.61	929	0.16	0	0.03	0.131	13	760
	6/5/07	base	0.508	15.19	5.07	51.9	7.58	955	0.12	0.009	0.088	0.170	12	4700
	6/19/07	storm	0.425	19.93	5.06	57.1	7.58	1042	0.14	<0.0070	0.087	0.190	9.6	350
	7/5/07	base	0.313	18.88	5.66	62.5	7.6	1067	<0.042	<0.0070	0.055	0.100	12	410
	7/17/07	base	0.162	18.09	6.53	71	7.69	1149	0.19	<0.0070	<0.015	0.057	7.2	490
	7/24/07	base	0.217	16.85	6.61	70	7.66	1061	0.1	<0.0070	0.089	0.090	6.4	370
Site	Date	Event	Flow (cfs)	Temp (° C)	DO (mg/L)	% Sat	pH	Conductivity (mg/L)	Ammonia N (mg/L)	Nitrate + Nitrite (mg/ L)	% Dissolved P	Total P (mg/ L)	TSS (mg/L)	*E. coli* (CFU/ 100 mL)
Site 4. Block Ditch	5/7/07	base	0.4	10.73	6.75	62.5	7.49	0.934	0.18	0.22	0.023	0.120	2.6	200
	5/16/07	storm	0.595	11.3	7.06	64.4	7.41	869	0.41	0.057	0.035	0.740	120	220
	5/22/07	base	0.693	12.58	4.38	42.1	7.47	931	0.3	0.11	0.0175	0.077	6	20
	6/5/07	base	0.464	12.66	4.64	44.8	7.47	911	0.35	0.086	0.04	0.080	2.4	560
	6/19/07	storm	1.3125	16.27	4.17	43.6	7.38	899	0.27	<0.0070	<0.015	0.100	2.4	1000
	7/5/07	base	0.2712	15.99	5.27	54.8	7.38	910	<0.042	0.1	<0.015	0.034	100	170
	7/17/07	base	0.802	16	4.58	47.6	7.41	915	<0.042	<0.0070	<0.015	<0.016	1.8	90
	7/24/07	base	0.861	14.74	4.9	49.6	7.45	932	0.12	<0.0070	0.065	0.026	18	130

Site	Date	Event	Flow (cfs)	Temp (° C)	DO (mg/L)	% Sat	pH	Conductivity (mg/L)	Ammonia N (mg/L)	Nitrate + Nitrite (mg/ L)	% Dissolved P	Total P (mg/ L)	TSS (mg/L)	*E. coli* (CFU/ 100 mL)
Site 5. Salt Creek Headwaters	5/7/07	base	6.186	10.55	7.74	71.3	7.6	0.7	0.09	0.4	0.029	0.170	6	300
	5/16/07	storm	8.518	13	7.11	68	7.58	634	0.15	0.26	0.035	0.210	53	690
	5/22/07	base	4.661	14.11	6.86	67.7	7.79	699	0.12	0.32	0.023	0.129	32	260
	6/5/07	base	5.85	13.93	6.82	67.8	7.83	677	0.12	0.32	0.051	0.100	18	2800
	6/19/07	storm	5.834	20.71	5.11	58.4	7.68	645	0.22	0.26	0.053	0.320	46	4900
	7/5/07	base	3.383	19.08	5.87	64.9	7.68	652	<0.042	0.24	<0.015	0.082	43	540
	7/17/07	base	2.524	19.31	5.8	64.5	7.79	683	<0.042	0.21	0.051	0.058	31	1300
	7/24/07	base	2.991	17.07	6.35	67.5	7.8	689	<0.042	0.2	<0.015	0.050	16	940
Site	Date	Event	Flow (cfs)	Temp (° C)	DO (mg/L)	% Sat	pH	Conductivity (mg/L)	Ammonia N (mg/L)	Nitrate + Nitrite (mg/ L)	% Dissolved P	Total P (mg/ L)	TSS (mg/L)	*E. coli* (CFU/ 100 mL)
Site 6. Sagers Lake Outlet	5/7/07	base	3.455	12.93	8.07	78.5	7.8	0.868	0.06	<0.0070	0.023	0.110	6.8	60
	5/16/07	storm	4.452	15.6	8.72	87.7	7.9	266	0.11	0.043	0.035	0.137	11	500
	5/22/07	base	2.885	15.91	8.98	89.9	7.9	913	0.098	0.046	0.0186	0.097	11	100
	6/5/07	base	4.66	17.03	7.34	77.9	7.89	896	0.11	0.11	0.04	0.080	18	890
	6/19/07	storm	5.308	22	7.19	84.3	7.81	794	0.35	0.25	<0.015	0.170	35	3100
	7/5/07	base	2.562	21.05	6.96	80.2	7.8	909	<0.042	<0.0070	0.052	0.045	12	510
	7/17/07	base	1.921	20.17	7.39	83.7	7.86	947	0.11	<0.0070	<0.015	0.046	25	1100
	7/24/07	base	1.734	19.44	7.24	80.8	7.92	894	0.1	<0.0070	<0.015	0.065	18	250

Site	Date	Event	Flow (cfs)	Temp (° C)	DO (mg/L)	% Sat	pH	Conductivity (mg/L)	Ammonia N (mg/L)	Nitrate + Nitrite (mg/ L)	% Dissolved P	Total P (mg/ L)	TSS (mg/L)	*E. coli* (CFU/ 100 mL)
Site 7. Beauty Creek	5/7/07	base	2.003	14.86	8.65	87.8	7.57	0.918	0.06	0.21	0.023	0.100	1.6	40
	5/16/07	storm	1.338	15.9	8.82	85.3	7.66	801	0.052	0.19	0.035	0.114	<1.0	100
	5/22/07	base	1.07	12.53	9.09	86.9	7.81	913	0.079	0.15	0.0175	0.070	3.2	20
	5/22/07	base	1.07	12.53	9.09	86.9	7.81	913	0.079	0.14	0.0243	0.067	3.6	10
	6/5/07	base	1.587	13.24	7.67	75.1	7.55	836	0.056	0.23	0.04	0.070	5.4	1000
	6/19/07	storm	1.203	14.41	8.49	85.2	7.67	910	0.16	0.13	<0.015	0.110	3.8	240
	7/5/07	base	1.285	14.49	8.67	87.3	7.66	913	<0.042	0.13	<0.015	<0.016	3	160
	7/17/07	base	1.219	13.94	8.59	85.3	7.68	912	<0.042	0.12	<0.015	<0.016	4	200
	7/24/07	base	1.025	13.54	8.71	85.9	7.71	915	0.31	0.12	<0.015	<0.016	3.2	140
	7/24/07	base	1.025	13.54	8.71	85.9	7.71	915	0.23	0.13	0.078	0.030	2.4	170
Site	Date	Event	Flow (cfs)	Temp (° C)	DO (mg/L)	% Sat	pH	Conductivity (mg/L)	Ammonia N (mg/L)	Nitrate + Nitrite (mg/ L)	% Dissolved P	Total P (mg/ L)	TSS (mg/L)	*E. coli* (CFU/ 100 mL)
Site 8. Pepper Creek	5/7/07	base	2.582	15.4	8.3	85.2	7.82	0.824	0.083	0.15	0.027	0.181	13	90
	5/16/07	storm	3.621	14.8	8.98	88.6	7.99	728	0.052	0.26	0.035	0.140	3	660
	5/22/07	base	2.192	14.11	8.95	89.2	8.1	823	0.14	0.081	0.0175	0.083	11	80
	6/5/07	base	2.781	14.38	8.05	80.8	8.19	821	0.21	0.13	0.04	0.083	16	630
	6/19/07	storm	2.018	16.86	8.29	87.7	8.05	785	<0.042	<0.0070	<0.015	0.120	11	800
	7/5/07	base	1.9	16.78	8.39	88.6	8.06	797	<0.042	<0.0070	<0.015	<0.016	7	410
	7/5/07	base	1.9	16.78	8.39	88.6	8.06	797	<0.042	<0.0070	<0.015	<0.016	12	260
	7/17/07	base	1.751	15.89	8.59	89	8.08	776	<0.042	<0.0070	<0.015	<0.016	15	1000
	7/24/07	base	2.027	15.45	8.53	87.6	8.09	781	0.23	<0.0070	<0.015	0.034	8.8	700

Site	Date	Event	Flow (cfs)	Temp (° C)	DO (mg/L)	% Sat	pH	Conductivity (mg/L)	Ammonia N (mg/L)	Nitrate + Nitrite (mg/ L)	% Dissolved P	Total P (mg/ L)	TSS (mg/L)	*E. coli* (CFU/ 100 mL)
Site 9. Mallard's Landing Tributary	5/7/07	base	0.979	16.79	9.23	97.6	8.03	0.734	0.089	0.076	0.033	0.116	4.6	50
	5/16/07	storm	0.585	15.2	9.15	91	8.1	664	0.094	0.14	0.062	0.181	59	780
	5/22/07	base	0.842	18.09	8.67	93.7	8.17	788	0.19	0.2	0.0487	0.120	7.2	260
	6/5/07	base	0.844	15.27	7.27	74.4	8.16	776	0.12	0.29	0.069	0.120	12	1800
	6/19/07	storm	0.57	19.82	7.12	80	8.1	764	0.1	0.35	0.066	0.150	16	3100
	7/5/07	base	0.386	20.02	7.27	82	8.14	803	<0.042	0.32	0.067	0.077	6.5	470
	7/17/07	base	0.456	18.84	7.17	79	8.14	771	0.1	0.26	0.069	0.051	4.2	0
	7/24/07	base	0.55	17.49	7.68	82.4	8.16	796	0.29	0.27	0.069	0.075	5.6	430
Site	Date	Event	Flow (cfs)	Temp (° C)	DO (mg/L)	% Sat	pH	Conductivity (mg/L)	Ammonia N (mg/L)	Nitrate + Nitrite (mg/ L)	% Dissolved P	Total P (mg/ L)	TSS (mg/L)	*E. coli* (CFU/ 100 mL)
10. Butternut Springs Outlet	5/7/07	base	1.431	16.28	8.86	92.5	8.18	0.629	<0.042	0.013	0.023	0.113	7.2	150
	5/16/07	storm	2.057	15.6	9.06	91.1	8.11	528	0.052	0.095	0.035	0.118	6	1600
	5/22/07	base	0.907	16.37	8.73	91.2	8.27	651	0.081	0.049	0.022	0.067	8	120
	6/5/07	base	10.037	16.24	7.9	82.5	8.33	640	0	0.089	0.04	0.080	13	360
	6/19/07	storm	0.823	21.66	7.67	89.3	8.26	614	<0.042	<0.0070	<0.015	0.100	13	410
	7/5/07	base	0.531	21.83	7.71	90.1	8.25	609	<0.042	0.14	<0.015	<0.016	10	280
	7/17/07	base	0.936	20.11	7.69	87	8.29	608	<0.042	<0.0070	<0.015	<0.016	7.6	430
	7/24/07	base	0.955	19.44	8	89.2	8.33	621	0.18	<0.0070	0.065	0.020	7.6	300
	8/22/06	base	0.042	16.8	5.25	60.3	7.7	642	0.13	2.3		0.081	2	

Site	Date	Event	Flow (cfs)	Temp (° C)	DO (mg/L)	% Sat	pH	Conductivity (mg/L)	Ammonia N (mg/L)	Nitrate + Nitrite (mg/ L)	% Dissolved P	Total P (mg/ L)	TSS (mg/L)	*E. coli* (CFU/ 100 mL)
Site 11. Squirrel Creek	5/7/07	base	0.573	18.84	11.91	131.3	8.33	0.813	<0.042	0.74	0.023	0.126	8.4	10
	5/16/07	storm	2.058	20	9.82	108.1	8.13	819	0.052	0.41	0.035	0.240	13	3100
	5/16/07	storm	2.058	20	9.82	108.1	8.13	819	0.14	0.42	0.038	0.240	10	4400
	5/22/07	base	0.667	23.62	8.84	102.5	8.05	858	0.11	0.7	0.0476	0.128	4	30
	6/5/07	base	1.004	22.48	9.63	114.1	8.49	894	0.057	0.17	0.039	0.210	8	120
	6/19/07	storm	2.118	26.66	9.03	115.6	8.13	905	<0.042	<0.0070	0.16	0.330	11	2300
	7/5/07	base	0.12	24.12	8.48	104.7	7.98	756	<0.042	0.77	0.11	0.160	4.5	140
	7/17/07	base	0.055	16.08	5.04	52.4	7.36	715	0.21	2.8	<0.015	0.037	10	170
	7/24/07	base	0.22	16.98	7.93	84	7.55	715	<0.042	2.5	<0.015	0.041	4	130
Site	Date	Event	Flow (cfs)	Temp (° C)	DO (mg/L)	% Sat	pH	Conductivity (mg/L)	Ammonia N (mg/L)	Nitrate + Nitrite (mg/ L)	% Dissolved P	Total P (mg/ L)	TSS (mg/L)	*E. coli* (CFU/ 100 mL)
Site 12. Robbins Ditch	5/7/07	base	0.701	15.31	8.4	86.3	7.73	1.433	0.36	1.7	0.044	0.142	3.6	890
	5/16/07	storm	1.327	16.5	7.6	77.9	7.72	1112	0.11	1.8	0.061	0.170	<1.0	1300
	5/22/07	base	0.311	16.7	8.57	81.7	7.81	1480	0.2	1	0.05	0.131	4	390
	6/5/07	base	0.445	15.69	7.67	79.3	8.19	1082	0.086	0.9	0.1	0.120	2	1300
	6/5/07	base	0.445	15.69	7.67	79.3	8.19	1082	0.1	0.92	0.095	0.150	4.8	3200
	6/19/07	storm	4.287	22.51	5.77	68.3	7.64	735	0.11	1.7	0.12	0.230	16	>12000
	6/19/07	storm	4.287	22.51	5.77	68.3	7.64	735	<0.042	1.6	0.12	0.240	18	>12000
	7/5/07	base	0.137	21.64	4.8	56.5	7.57	1103	0.11	0.4	0.15	0.200	6	430
	7/17/07	base	0.041	20.9	2.45	28.1	7.55	814	0.47	0.41	0.12	0.170	9	5100
	7/24/07	base	0.135	19.17	4.11	45.7	7.82	1487	0.27	0.66	0.16	0.170	22	390

Site	Date	Event	Flow (cfs)	Temp (° C)	DO (mg/L)	% Sat	pH	Conductivity (mg/L)	Ammonia N (mg/L)	Nitrate + Nitrite (mg/L)	% Dissolved P	Total P (mg/L)	TSS (mg/L)	*E. coli* (CFU/100 mL)
Site 13. Damon Run	5/7/07	base	8.411	17.08	11.15	118.5	7.96	0.714	0.072	0.25	0.032	0.141	4	90
	5/7/07	base	8.411	17.08	11.15	118.5	7.96	0.714	0.071	0.25	0.033	0.152	4.6	110
	5/16/07	storm	12.523	16.4	9.89	101.2	7.86	704	0.085	0.66	0.05	0.210	8	590
	5/22/07	base	5.271	18.18	10.01	109.2	8.04	799	0.17	0.39	0.031	0.120	4.8	210
	6/5/07	base	5.628	16.58	7.68	80.8	8	778	0.13	0.43	0.074	0.100	20	500
	6/19/07	storm	6.64	21.82	7.11	83.1	7.81	715	0.31	0.55	0.072	0.180	26	4100
	7/5/07	base	2.966	21.11	7.47	86.1	7.97	810	<0.042	0.54	<0.015	0.066	8.5	580
	7/17/07	base	2.013	19.01	6.51	72.1	7.85	699	0.11	0.71	<0.015	0.056	10	4500
	7/24/07	base	3.742	18.19	7.77	84.6	7.98	838	0.21	0.62	0.061	0.078	9.6	410
Site	Date	Event	Flow (cfs)	Temp (° C)	DO (mg/L)	% Sat	pH	Conductivity (mg/L)	Ammonia N (mg/L)	Nitrate + Nitrite (mg/L)	% Dissolved P	Total P (mg/L)	TSS (mg/L)	*E. coli* (CFU/100 mL)
Site 14. Mainstem at Lenburg Road	5/7/07	base		16.54	8.56	90	7.94	0.851	0.069	1.8	0.048	0.196	14	100
	5/16/07	storm		16.8	7.37	76.1	7.91	758	0.084	2.8	0.069	0.260	32	1500
	5/22/07	base		16.49	7.73	80.9	8.09	885	0.081	2.1	0.065	0.168	21	240
	6/5/07	base	56.657	17.64	7.03	75.6	8.17	864	0.097	1.9	0.15	0.260	57	1400
	6/19/07	storm	44.865	23.58	6.74	81.5	7.96	843	0.24	2.7	0.11	0.300	49	4500
	7/5/07	base	33.651	22.74	7.26	86.4	8.01	1028	0.12	6.2	0.17	0.230	22	350
	7/17/07	base	26.337	20.82	7.56	86.8	8.18	975	<0.042	4.1	0.12	0.130	18	430
	7/24/07	base	35.06	19.86	7.54	84.8	8.2	958	<0.042	3.8	0.13	0.180	20	380

Site	Date	Event	Flow (cfs)	Temp (deg C)	DO (mg/L)	% Sat	pH	Conductivity (mg/L)	Ammonia N (mg/L)	Nitrate + Nitrite (mg/ L)	% Dissolved P	Total P (mg/ L)	TSS (mg/L)	E. coli (CFU/ 100 mL)
Site 15. Salt Creek at SR 130	5/15/06			12.5	9.3		7.8	843	<0.1	2.8		0.200	42	
	6/26/06			19.9	8.7		8.1	1031	<0.1	5		0.360	19	
	7/25/06			24.9	7.3		8.3	947	<0.1	3.5		0.160	23	
	8/28/06			20.9	7.9		7.9	902	<0.1	4		0.220	24	
	9/14/06			18	7.3		7.7	618	<0.1	1.3		0.260	68	
	5/7/07	base	28.157	19.2	8.4		8	992	<0.1	4		0.180	14	
	5/16/07	storm	42.057											
	5/22/07	base												
	6/5/07	base	24.943	20.26	8.64		8.05	1068	<0.1	5.3		0.200	24	
	6/19/07	storm	30.698											
	7/5/07	base	20.343	19.93	9.65		8.19	1023	<0.1	5.3		0.230	14	

Site	Date	Event	Flow (cfs)	Temp (° C)	DO (mg/L)	% Sat	pH	Conductivity (mg/L)	Ammonia N (mg/L)	Nitrate + Nitrite (mg/ L)	% Dissolved P	Total P (mg/ L)	TSS (mg/L)	*E. coli* (CFU/ 100 mL)
Site 16. Salt Creek at US 20	5/15/06			12.2	9.5		7.9	791	<0.1	1.8		0.180	49	
	6/26/06			20.4	8.5		8.1	980	<0.1	3.9		0.260	36	
	7/25/06			25.1	7.1		8.3	872	<0.1	2.4		0.170	37	
	8/28/06			21.1	7.5		7.8	851	<0.1	2.2		0.190	48	
	9/14/06			17.8	7.2		7.7	532	<0.1	1.4		0.360	121	
	5/7/07	base		21.8	7.9		8	930	<0.1	2.8		0.140	20	
	5/16/07	storm												
	5/22/07	base												
	6/5/07	base		21.85	8.18		8.04	973	<0.1	3.3		0.140	30	
	6/19/07	storm												
	7/5/07	base		20.67	9.29		8.18	965	<0.1	3.8		0.120	14	

Appendix N. Macroinvertebrate results from the current study.

Table A 9. Macroinvertebrates collected from the Salt Creek watershed streams in 2006

Taxa (Scientific Name)		**Site 2**	**Site 5**	**Site 7**	**Site 8**	**Site 9**	**Site 10**	**Site 13**	**Site 14**
Order	**Family**	**Count**	**Count**	**Count**	**Count**	**Count**	**Count**	**Count**	**Count**
Amphipoda	Gammaridae		12	91	70	13	58	63	4
Coleoptera	Elmidae	2	2				4		
Coleoptera	Gyrinidae	2							
Coleoptera	Helodidae					2			
Decopoda	Astacidae	1							
Diptera	Chironomidae	2				3	18		1
Diptera	Ephydridae			12					
Ephemeroptera	Baetidae	6						6	
Ephemeroptera	Heptageniidae	3							
Arthropoda	Ascellidae	2							
Gastropoda	Lymnaeidae							2	
Gastropoda	Physidae					2		3	
Gastropoda	Planorbidae					2			
Gastropoda	Hydrobiidae					2			
Hemiptera	Corixidae							7	
Hemiptera	Gerridae	2							
Hemiptera	Mesoveliidae		1						
Hirudinea		1							
Hirudinea	Glossiphoniidae								1
Isopoda	Asillidae	2	4		8	4		7	
Megaloptera	Sialidae							5	
Platyhelminthes	Turbellaria	4							
Odonata	Coenagrionidae	2							
Odonata	Calopterygidae		6						
Arthropoda	Ascellidae	2							
Pelecypoda	Sphaeriidae							10	
Platyhelminthes	Turbellaria	2				8			
Trichoptera	Hydropsychidae	85			2		2	8	
TOTAL		**118**	**25**	**103**	**80**	**36**	**82**	**111**	**6**

Table A 10. Salt Creek watershed streams mIBI metrics, August 22, 2006

mIBI Metric	**S2**	**S5**	**S7**	**S8**	**S9**	**S10**	**S13**	**S14**
HBI	6	4	6	6	6	6	2	4
No. Taxa (family)	6	0	0	0	2	0	2	0
Total Count (# individuals)	2	0	2	2	0	2	2	0
% Dominant Taxa	0	4	0	0	4	0	2	0
EPT Index (# families)	6	0	0	0	0	0	0	0
EPT Count (# individuals)	6	0	0	0	0	0	0	0
EPT Count/Total Count	8	0	0	0	0	0	0	0
EPT Abun./Chir. Abun.	8	3	3	2	3	3	6	3
Chironomid Count	8	8	8	8	8	8	8	8
mIBI Score	5.60	2.10	2.10	2.00	2.50	2.10	2.40	1.60
Ranking	Slight	Mod	Mod	Mod	Mod	Mod	Mod	Sev

Table A 11. Clark Ditch (site 2) multi-habitat macroinvertebrate results, August 22, 2006

Order	**Family**	**#**	**EPT**	**# w/t**	**Tolerance (t)**	**# x t**	**%**
Coleoptera	Elmidae	2	2	2	4	8	1.69
Coleoptera	Gyrinidae	2	2	2	5	10	1.69
Decopoda	Astacidae	1		1	8	8	0.85
Diptera	Chironomidae	2	2	2	6	12	1.69
Ephemeroptera	Baetidae	6	6	6	4	24	5.08
Ephemeroptera	Heptageniidae	3	3	3	4	12	2.54
Arthropoda	Ascellidae	2		2	8	16	1.69
Hemiptera	Gerridae	2		2	5	10	1.69
Hirudinea		1		1	0	0	0.85
Isopoda	Asillidae	2		2	8	16	1.69
Platyhelminthes	Turbellaria	4		4	4	16	3.39
Odonata	Coenagrionidae	2		2	6.1	12.2	1.69
Arthropoda	Ascellidae	2		2	8	16	1.69
Platyhelminthes	Turbellaria	2		2	4	8	1.69
Trichoptera	Hydropsychidae	85	85	85	4	340	72.03
TOTALS		**118**	**100**	**118**		**508.2**	100.00

Table A 12. Salt Creek Headwaters (site 5) multi-habitat macroinvertebrate results, August 22, 2006

Order	**Family**	**#**	**EPT**	**# w/t**	**Tolerance (t)**	**# x t**	**%**
Amphipoda	Gammaridae	12		12	4	48	41.38
Coleoptera	Elmidae	5		5	4	20	17.24
Diptera	Chironomidae	1			6	6	3.45
Hemiptera	Mesoveliidae	1		1		0	3.45
Isopoda	Asillidae	4		4	8	32	13.79
Odonata	Calopterygidae	6		6	5	30	20.69
TOTALS		**29**	**0**	**28**		**136.0**	100.00

Table A 13. Beauty Creek (site 7) multi-habitat macroinvertebrate results, August 22, 2006

Order	Family	#	EPT	# w/t	Tolerance (t)	# x t	%
Amphipoda	Gammaridae	91		91	4	364	87.50
Diptera	Chironomidae	1			6	6	0.96
Diptera	Ephydridae	12		12	6	72	11.54
TOTALS		**104**	**0**	**103**		**442.0**	100.00

Table A 14. Pepper Creek (site 8) multi-habitat macroinvertebrate results, August 22, 2006

Order	Family	#	EPT	# w/t	Tolerance (t)	# x t	%
Amphipoda	Gammaridae	70		70	4	280	86.42
Diptera	Chironomidae	1			6	6	1.23
Isopoda	Asillidae	8		8	8	64	9.88
Trichoptera	Hydropsychidae	2	2	2	4	8	2.47
TOTALS		**81**	**2**	**80**		**358.0**	100.00

Table A 15. Mallard's Landing (site 9) multi-habitat macroinvertebrate results, August 22, 2006

Order	Family	#	EPT	# w/t	Tolerance (t)	# x t	%
Amphipoda	Gammaridae	13		13	4	52	36.11
Coleoptera	Helodidae	2		2		0	5.56
Diptera	Chironomidae	3		3	6	18	8.33
Gastropoda	Physidae	2		2	8	16	5.56
Gastropoda	Planorbidae	2		2		0	5.56
Gastropoda	Hydrobiidae	2		2		0	5.56
Isopoda	Asillidae	4		4	8	32	11.11
Platyhelminthes	Turbellaria	8		8	4	32	22.22
TOTALS		**36**	**0**	**36**		**150.0**	100.00

Table A 16. Butternut Springs (site 10) multi-habitat macroinvertebrate results, August 22, 2006

Order	Family	#	EPT	# w/t	Tolerance (t)	# x t	%
Amphipoda	Gammaridae	58		58	4	232	70.73
Coleoptera	Elmidae	4		4	4	16	4.88
Diptera	Chironomidae	18		18	6	108	21.95
Trichoptera	Hydropsychidae	2		2	4	8	2.44
TOTALS		**82**	**0**	**82**		**364.0**	100.00

Table A 17. Damon Run (site 13) multi-habitat macroinvertebrate results, August 22, 2006

Order	Family	#	EPT	# w/t	Tolerance (t)	# x t	%
Amphipoda	Gammaridae	63		63	4	252	56.25
Diptera	Chironomidae	1			6	6	0.89
Ephemeroptera	Baetidae	6	6	6	4	24	5.36
Gastropoda	Lymnaeidae	2		2	6.9	13.8	1.79
Gastropoda	Physidae	3		3	8	24	2.68
Hemiptera	Corixidae	7		7	10	70	6.25
Isopoda	Asillidae	7		7	8	56	6.25
Megaloptera	Sialidae	5		5	4	20	4.46
Pelecypoda	Sphaeriidae	10		10	8	80	8.93
Trichoptera	Hydropsychidae	8		8	4	32	7.14
TOTALS		**112**	**6**	**111**		**577.8**	100.00

Table A 18. Salt Creek (site 14) multi-habitat macroinvertebrate results, August 22, 2006

Order	Family	#	EPT	# w/t	Tolerance (t)	# x t	%
Amphipoda	Gammaridae	4		4	4	16	66.67
Diptera	Chironomidae	1		1	6	6	16.67
Isopoda	Asillidae	1		1	8	8	16.67
TOTALS		**6**	**0**	**6**		**30.0**	100.00

Table A 19. Macroinvertebrates collected from the Salt Creek watershed streams in 2007

Order	Family	Site 2	Site 5	Site 7	Site 8	Site 9	Site 10	Site 13	Site 14
Amphipoda	Gammaridae	11	18	53	59	95	52	42	7
Bivalvia	*Corbicula fluminea*	2				3	4	3	
Bivalvia	Sphaeriidae						1		
Coleoptera	Dytiscidae			5					
Coleoptera	Elmidae	15			1		7		
Coleoptera	Haliplidae		1						
Coleoptera	Hydrophilidae		4		9		1	1	4
Decopoda	Astacidae	3	1						
Diptera	Chironomidae	2							
Diptera	Ephydridae			1					
Diptera	Stratiomyidae		1						
Diptera	Syrphidae		2						
Diptera	Tipulidae			1			1		
Ephemeroptera	Baetidae		3	1	1	1			
Ephemeroptera	Heptageniidae		1			1			
Ephemeroptera	Siphlonuridae								11
Gastropoda	Physidae	2			4			1	
Gastropoda	Planorbidae						1		
Gastropoda	Viviparidae	2						1	
Hemiptera	Belostomatidae				1				
Hemiptera	Gerridae	3		1			4		3
Hemiptera	Notonectidae								3
Hemiptera	Pleidae	2							
Hemiptera	Veliidae	1							
Isopoda	Asillidae	19	38		10	4	1	23	
Lepidoptera	Langessa		1	2					
Megaloptera	Sialidae	4							2
Odonata	Aeshnidae	1			1		7		
Odonata	Agrionidae	12			2	1	12	12	4
Odonata	Coenagrionidae	16	4			1			4
Odonata	Libellulidae		1						
Plecoptera	Perlidae	1	14					10	10
Plecoptera	Perlodidae				2				
Trichoptera	Brachycentridae			6	1		1		
Trichoptera	Hydropsychidae	3	11		16			1	1
Trichoptera	Limnephilidae	2	1		2		4	2	
Trichoptera	Odontoceridae		1				3	1	
TOTAL		101	102	70	109	106	99	97	49

Table A 20. Clark Ditch (site 2) mIBI metrics, May 29, 2007

mIBI Metric	**S2**	**S5**	**S7**	**S8**	**S9**	**S10**	**S13**	**S14**
HBI	2	2	8	6	6	6	4	6
No. Taxa (family)	8	6	2	4	0	4	4	2
Total Count (# individuals)	2	2	0	2	2	2	2	0
% Dominant Taxa	8	4	0	2	0	2	4	6
EPT Index (# families)	2	6	0	4	0	2	4	2
EPT Count (# individuals)	0	2	0	2	0	0	0	2
EPT Count/Total Count	0	4	0	2	0	0	2	4
EPT Abun./Chir. Abun.	4	8	8	8	8	8	8	8
Chironomid Count	8	8	8	8	8	8	8	8
mIBI Score	3.80	4.70	2.90	4.20	2.70	3.60	4.00	4.20
Ranking	Mod	Slight	Mod	Slight	Mod	Mod	Slight	Slight

Table A 21. Clark Ditch (site 2) multi-habitat macroinvertebrate results, May 29, 2007

Order	**Family**	**#**	**EPT**	**# w/t**	**Tolerance (t)**	**# x t**	**%**
Amphipoda	Gammaridae	11		11	4	44	10.89
Bivalvia	*Corbicula fluminea*	2		2	3.2	6.4	1.98
Coleoptera	Elmidae	15		15	4	60	14.85
Decopoda	Astacidae	3		3	8	24	2.97
Diptera	Chironomidae	2		2	6	12	1.98
Gastropoda	Physidae	2		2	8	16	1.98
Gastropoda	Viviparidae	2		2	6	12	1.98
Hemiptera	Gerridae	3		3	5	15	2.97
Hemiptera	Pleidae	2		0		0	1.98
Hemiptera	Veliidae	1		0		0	0.99
Isopoda	Asillidae	19		19	8	152	18.81
Megaloptera	Sialidae	4		4	4	16	3.96
Odonata	Aeshnidae	1		1	3	3	0.99
Odonata	Agrionidae	12		12	5	60	11.88
Odonata	Coenagrionidae	16		16	6.1	97.6	15.84
Plecoptera	Perlidae	1	1	1	1	1	0.99
Trichoptera	Hydropsychidae	3	3	3	4	12	2.97
Trichoptera	Limnephilidae	2	2	2	4	8	1.98
TOTALS		**101**	**6**	**98**		**539.0**	100.00

Table A 22. Salt Creek Headwaters (site 5) multi-habitat macroinvertebrate results, May 29, 2007

Order	Family	#	EPT	# w/t	Tolerance (t)	# x t	%
Amphipoda	Gammaridae	18		18	4	72	17.65
Coleoptera	Haliplidae	1		1	7	7	0.98
Coleoptera	Hydrophilidae	4		4	5	20	3.92
Decopoda	Astacidae	1		1	8	8	0.98
Diptera	Stratiomyidae	1		0		0	0.98
Diptera	Syrphidae	2		2	10	20	1.96
Ephemeroptera	Baetidae	3	3	3	4	12	2.94
Ephemeroptera	Heptageniidae	1	1	1	4	4	0.98
Isopoda	Asillidae	38		38	8	304	37.25
Lepidoptera	Langessa	1		0		0	0.98
Odonata	Libellulidae	1		1	9	9	0.98
Plecoptera	Perlidae	14	14	14	1	14	13.73
Trichoptera	Hydropsychidae	11	11	11	4	44	10.78
Trichoptera	Hydroptilidae			0	4	0	0.00
Trichoptera	Limnephilidae	1	1	1	4	4	0.98
Trichoptera	Odontoceridae	1	1	0	0	0	0.98
TOTALS		**102**	**31**	**99**		**542.4**	100.00

Table A 23. Beauty Creek (site 7) multi-habitat macroinvertebrate results, May 29, 2007

Order	Family	#	EPT	# w/t	Tolerance (t)	# x t	%
Amphipoda	Gammaridae	53		53	4	212	75.71
Coleoptera	Dytiscidae	5		5	5	25	7.14
Diptera	Ephydridae	1		1	6	6	1.43
Diptera	Tipulidae	1		1	3	3	1.43
Ephemeroptera	Baetidae	1	1	1	4	4	1.43
Hemiptera	Gerridae	1		1	5	5	1.43
Lepidoptera	Langessa	2		0		0	2.86
Trichoptera	Brachycentridae	6	6	6	1	6	8.57
TOTALS		**70**	**7**	**68**		**261.0**	100.00

Table A 24. Pepper Creek (site 8) multi-habitat macroinvertebrate results, May 29, 2007

Order	Family	#	EPT	# w/t	Tolerance (t)	# x t	%
Amphipoda	Gammaridae	59		59	4	236	54.13
Coleoptera	Elmidae	1		1	4	4	0.92
Coleoptera	Hydrophilidae	9		9	5	45	8.26
Ephemeroptera	Baetidae	1	1	1	4	4	0.92
Gastropoda	Physidae	4		4	8	32	3.67
Hemiptera	Belostomatidae	1		0		0	0.92
Isopoda	Asillidae	10		10	8	80	9.17
Odonata	Aeshnidae	1		1	3	3	0.92
Odonata	Agrionidae	2		2	5	10	1.83
Plecoptera	Perlodidae	2	2	2	2	4	1.83
Trichoptera	Brachycentridae	1	1	1	1	1	0.92
Trichoptera	Hydropsychidae	16	16	16	4	64	14.68
Trichoptera	Limnephilidae	2	2	2	4	8	1.83
TOTALS		**109**	**22**	**108**		**491.0**	100.00

Table A 25. Mallard's Landing (site 9) multi-habitat macroinvertebrate results, May 29, 2007

Order	Family	#	EPT	# w/t	Tolerance (t)	# x t	%
Amphipoda	Gammaridae	95		95	4	380	89.62
Bivalvia	*Corbicula fluminea*	3		3	3.2	9.6	2.83
Ephemeroptera	Baetidae	1	1	1	4	4	0.94
Ephemeroptera	Heptageniidae	1	1	1	4	4	0.94
Isopoda	Asillidae	4		4	8	32	3.77
Odonata	Agrionidae	1		1	5	5	0.94
Odonata	Coenagrionidae	1		1	6.1	6.1	0.94
TOTALS		**106**	**2**	**106**		**440.7**	100.00

Table A 26. Butternut Springs (site 10) multi-habitat macroinvertebrate results, May 29, 2007

Order	Family	#	EPT	# w/t	Tolerance (t)	# x t	%
Amphipoda	Gammaridae	52		52	4	208	52.53
Bivalvia	*Corbicula fluminea*	4		4	3.2	12.8	4.04
Bivalvia	Sphaeriidae	1		1	8	8	1.01
Coleoptera	Elmidae	7		7	4	28	7.07
Coleoptera	Hydrophilidae	1		1	5	5	1.01
Diptera	Tipulidae	1		1	3	3	1.01
Gastropoda	Planorbidae	1		1	7	7	1.01
Hemiptera	Gerridae	4		4	5	20	4.04
Isopoda	Asillidae	1		1	8	8	1.01
Odonata	Aeshnidae	7		7	3	21	7.07
Odonata	Agrionidae	12		12	5	60	12.12
Trichoptera	Brachycentridae	1	1	1	1	1	1.01
Trichoptera	Limnephilidae	4	4	4	4	16	4.04
Trichoptera	Odontoceridae	3	3	0	0	0	3.03
TOTALS		**99**	**8**	**96**		**397.8**	100.00

Table A 27. Damon Run (site 13) multi-habitat macroinvertebrate results, May 29, 2007

Order	Family	#	EPT	# w/t	Tolerance (t)	# x t	%
Amphipoda	Gammaridae	42		42	4	168	43.30
Bivalvia	*Corbicula fluminea*	3		3	3.2	9.6	3.09
Coleoptera	Hydrophilidae	1		1	5	5	1.03
Gastropoda	Physidae	1		1	8	8	1.03
Gastropoda	Viviparidae	1		1	6	6	1.03
Isopoda	Asillidae	23		23	8	184	23.71
Odonata	Agrionidae	12		12	5	60	12.37
Plecoptera	Perlidae	10	10	10	1	10	10.31
Trichoptera	Hydropsychidae	1	1	1	4	4	1.03
Trichoptera	Limnephilidae	2	2	2	4	8	2.06
Trichoptera	Odontoceridae	1	1	0	0	0	1.03
TOTALS		**97**	**14**	**96**		**462.6**	100.00

Table A 28. Salt Creek (site 14) multi-habitat macroinvertebrate results, May 29, 2007

Order	Family	#	EPT	# w/t	Tolerance (t)	# x t	%
Amphipoda	Gammaridae	7		7	4	28	14.29
Coleoptera	Hydrophilidae	4		4	5	20	8.16
Ephemeroptera	Siphlonuridae	11	11	11	7	77	22.45
Hemiptera	Gerridae	3		3	5	15	6.12
Hemiptera	Notonectidae	3		0		0	6.12
Megaloptera	Sialidae	2		2	4	8	4.08
Odonata	Agrionidae	4		4	5	20	8.16
Odonata	Coenagrionidae	4		4	6.1	24.4	8.16
Plecoptera	Perlidae	10	10	10	1	10	20.41
Trichoptera	Hydropsychidae	1	1	1	4	4	2.04
TOTALS		**49**	**22**	**46**		**206.4**	100.00

Appendix O. QHEI Results from the current study

Table A 29. Salt Creek QHEI scores from August 22, 2006.

Stream Name	Site Number	Substrate Score	Cover Score	Channel Score	Riparian Score	Pool Score	Riffle Score	Gradient Score	Total Score	
Maximum Possible Score		**20**	**20**	**20**	**10**	**12**	**8**	**10**	**100.00**	
Lake Louise Outlet	S1	13	6	8	4.5	4	0	10	**45.50**	Non-supporting
Clark Ditch	S2	1	6	11	5.5	5	0	8	**36.50**	Non-supporting
Weblos Trail Tributary	S3	13	8	8	5	0	0	4	**38.00**	Non-supporting
Block Ditch	S4	5	6	8	7.5	0	0	4	**30.50**	Non-supporting
Headwaters	S5	7	9	11	4	3	7	4	**45.00**	Non-supporting
Sager's Lake Outlet	S6	8	11	9	6.25	6	1	8	**49.25**	Non-supporting
Beauty Creek	S7	16	14	15	5.25	10	4	10	**74.25**	Fully supporting
Pepper Creek	S8	5	9	11	7.5	4	0	10	**46.50**	Non-supporting
Mallard's Landing Tributary	S9	3	14	12	10	9	2	8	**58.00**	Partially supporting
Butternut Springs Outlet	S10	1	6	8	7	4	0	10	**36.00**	Non-supporting
Squirrel Creek	S11	11	5	8	3	0	0	8	**35.00**	Non-supporting
Robbin's Ditch	S12	1	3	4	5	0	0	10	**23.00**	Non-supporting
Damon Run	S13	4	8	9	10	4	0	4	**39.00**	Non-supporting
Salt Creek (Lenburg Road)	S14	3	7	9	10	5	0	10	**44.00**	Non-supporting
Salt Creek (SR 130)	S15	14	5	12	9.75	0	0	10	**50.75**	Non-supporting
Salt Creek (US 20)	S16	13	13	10	6.75	9	0	10	**61.75**	Partially supporting

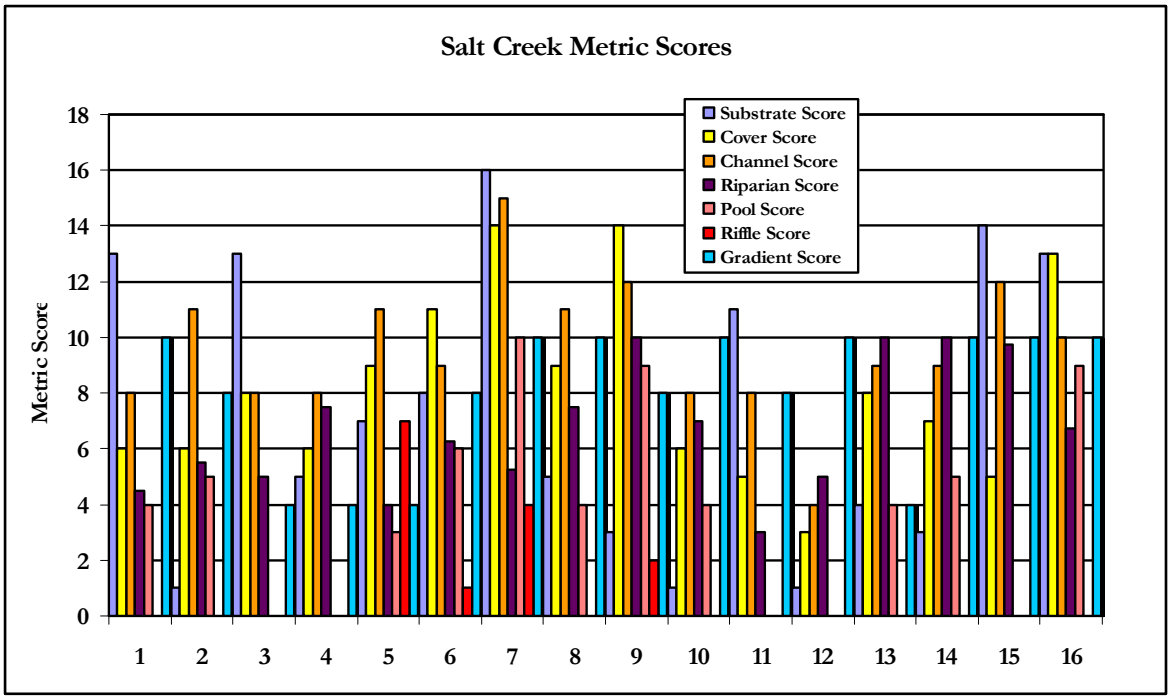


Figure A 8. Salt Creek metric scores from August 22, 2006

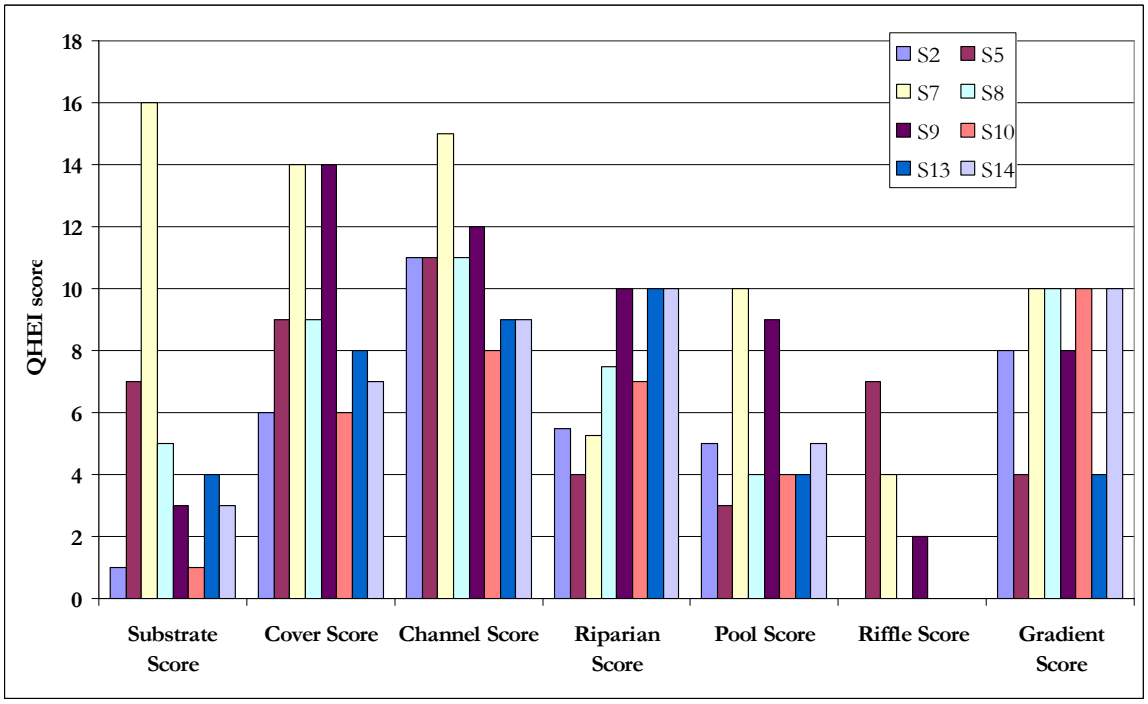


Figure A 9. QHEI metric comparison for sites where macroinvertebrate sampling occurred in 2006.

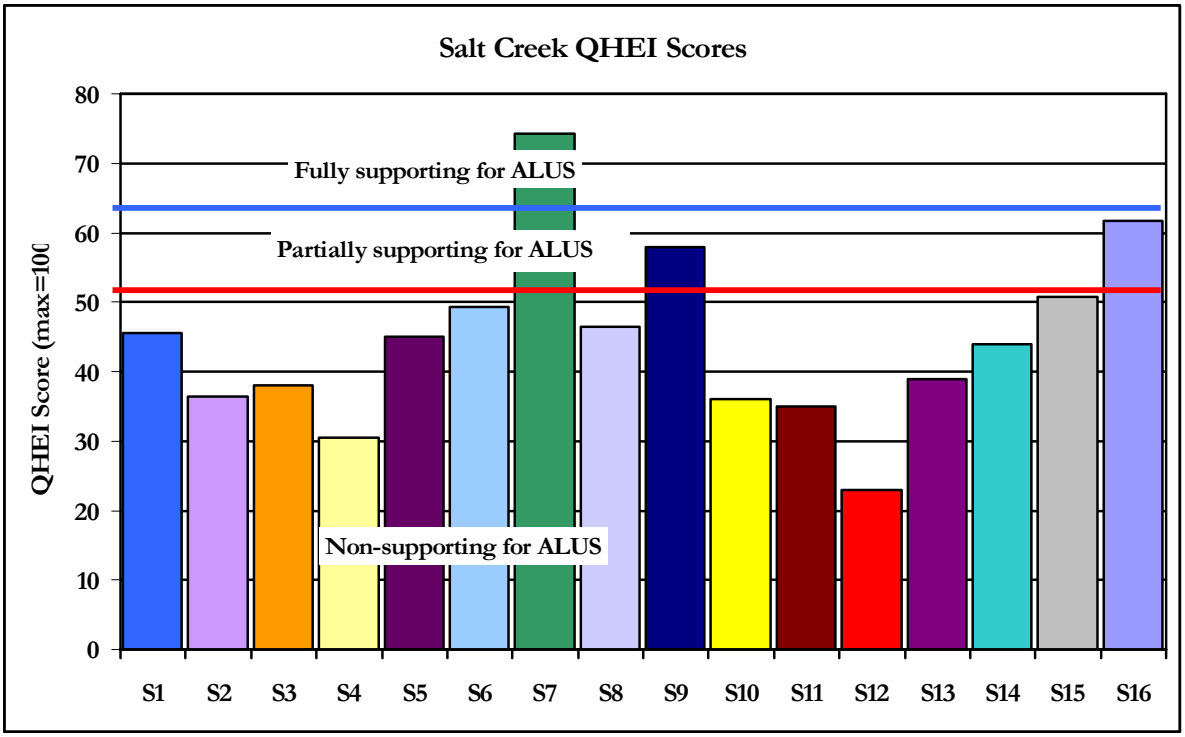


Figure A 10. Salt Creek QHEI scores from August 22, 2006

Appendix P. Salt Creek watershed BMP list

BMP removal efficiencies were taken from the "BMPList" worksheet in STEPL unless otherwise noted. The acres to meet the N, P, and TSS goals were estimated for selected practices by determining the pollutant reduction associated with implementing the BMP on one acre within the Salt Creek watershed using the USEPA Region 5 model. The total reduction necessary to meet the goal was then divided by the reduction per acre to obtain an estimate of the acres of the BMP necessary to achieve the goal. The acres of each BMP needed to meet the goal were calculated assuming the goal would be met using only that BMP. Removal efficiencies, acres necessary to meet goals, and approximate costs are estimates and are for planning purposes only. The actual number and types of BMPs implemented and associated removal efficiencies and costs will depend upon several factors including site specific conditions (soil, hydrology, etc.), identification of willing partners, and available resources.

Table A 30. Salt Creek watershed agricultural best management practices

Agricultural Best Management Practice (BMP)	Goals/Activities	N % removal efficiency	Acres to meet N goal	P % removal efficiency	Acres to meet P goal	TSS % removal efficiency	Acres to meet TSS goal	Approximate Cost	Hydro-logic benefit
Conservation Crop Rotation	1.3								No
Contour Farming	1.3, 2.1	49%	239	55%	32	41%	1.3	$12/acre	Yes
Cover (Crops) and Green Manure	1.3, 2.1							$14/acre	No
Filter Strip (Buffer Strip)	1.3, 2.1	Up to 70%	119.5	75-85%	16	Up to 65%	1.3	$190/acre	Yes
Nutrient/Pest Management Planning	1.3, 2.1							$9/acre	No
Residue Management, Reduced tillage systems	1.3	55%	119.5	45%	16	75%	0.7	$10/acre	Yes
Strip Cropping	1.3, 2.1		119.5		16		0.7	$12/acre	Yes
Terrace	1.3, 2.1	20-55%		70-85%		up to 85%			Yes
Alternative Watering System	1.3, 2.1								Yes
Animal Trails and Walkways	1.3, 2.1								No
Streambank Fencing (Livestock Exclusion)	2.1, 4.1	75%		75%		75%		$1.60/foot	Yes
Runoff Management System	1.3, 2.1	ND		83%		ND			Yes
Waste Management Systems	2.1	80%		90%		ND			No
Waste Storage Facility	2.1	65%		60%		ND			No

Table A 31. Salt Creek watershed urban best management practices

Urban Best Management Practice (BMP)	Goals/Activities	N % removal efficiency	Acres to meet N goal	P % removal efficiency	Acres to meet P goal	TSS % removal efficiency	Acres to meet TSS goal	Approximate Cost	Hydro-logic benefit
Bioretention Facility	1.1, 1.2	63%		80%		ND		$5-$40/sq ft	Yes
Concrete (Grid) Pavement	1.1, 1.2, 3.2	90%		90%		90%			Yes
Extended Wet Detention	1.1, 1.2	55%		69%		86%		$35,000 to $110,000	Yes
Filter Strip	1.1, 1.2	53%	108.6	61%	64	65%	3.9	$190/acre	Yes
Grass Swale	1.1, 1.2	10%		25%		65%		$2-$3/ ft	Yes
Green Roof	1.1, 1.2							$12-$24/ sq ft	Yes
Infiltration Basin	1.1, 1.2	60%		65%		75%			Yes
Level Spreaders	1.1, 1.2								Yes
Cistern	1.1, 1.2, 1.6	0%		0%		0%			Yes
Rain Barrel	1.1, 1.2, 1.6	0%		0%		0%		$75-$200	Yes
Delaware Sand Filter	1.1, 1.2	ND		38%		83%			No
Vegetated Infiltration Swale	1.1, 1.2, 1.6	50%		65%		90%			Yes
Wet Swale	1.1, 1.2, 1.6	40%		20%		80%			Yes
Porous Pavement	1.1, 1.2, 3.2	85%	50.3	65%	45.7	90%	3.3	$1-$5/sq ft	Yes
Rain Garden	1.1, 1.2, 1.6							$5-$40/sq foot	Yes
Seasonal (weekly) Street Sweeping	1.1	ND		6%		16%			No
Settling Basin	1.1, 1.2	ND		52%		82%			Yes
Wet Pond	1.1, 1.2	35%		45%		60%			Yes

Table A 32. Salt Creek watershed best management practices

Best Management Practice (BMP)	Goals/Activities	N % removal efficiency	Acres to meet N goal	P % removal efficiency	Acres to meet P goal	TSS % removal efficiency	Acres to meet TSS goal	Approximate Cost	Hydro-logic benefit
Wetland Detention	1.1, 1.2, 1.3, 1.4, 2.1, 4.2	20%	217.3	44%	64	78%	3.9	$1,500-$2,500/acre	Yes
Wetland Restoration	1.1, 1.2, 1.3, 1.4, 4.1, 4.2, 4.3							$1,000-$2,000/acre	Yes
Stream in a Ditch	1.1, 1.2, 1.3, 1.4, 4.1, 4.2, 4.3								Yes
Stream Channel (Bank) Stabilization	2.1, 4.1	75%		75%		75%			Yes
Critical Area Planting	1.3							$1,300/acre	Yes
Daylighting	1.1, 1.2, 1.3, 1.4, 4.1, 4.2, 4.3								Yes
Riparian Vegetion Establishment (Herbaceous)	1.1, 1.2, 1.3, 1.4, 2.1, 4.1, 4.3							$225/acre	No
Riparian Vegetion Establishment (Forested)	1.1, 1.2, 1.3, 1.4, 2.1, 4.1, 4.3							$500/acre	Yes

BMP Descriptions

BMP descriptions for the practices listed above are taken from the BMP Descriptions for STEPL and Region 5 Model (available for download at http://bering.tetratech-ffx.com/stepl/STEPLmain_files/BestManagementPracticesDefinitions.pdf). BMPs not described in the STEPL/Region 5 Model definitions are described below.

Alternative Watering System- Alternative gravity flow or pressure livestock watering system designed to reduce uncontrolled stream access.

Nutrient/Pest Management Planning- Development of nutrient and/or pest management plans according to FOTG specifications 590 and 595. According to FOTG specifications, nutrient management is managing the amount, source, placement, form, and timing of the application of nutrients and soil amendments. Pest management is utilizing environmentally sensitive prevention, avoidance, monitoring, and suppression strategies to manage weeds, insects, diseases, animals and other organisms (including invasiveand non-invasive species), that directly or indirectly cause damage or annoyance.

Green Roof- A roof consiting of vegetation and soil or a growing medium planted over a waterproofing membrane to absorb and evapotranspire rainwater. Additional layers, such as a root barrier and drainage and irrigation systems, may also be included.

Level Spreader- A device used to disperse concentrated runoff uniformly over the ground surface as sheet flow (FOTG code 580).

Cistern- A system that collects and stores stormwater from a roof or other impervious surface for reuse that can be located either above or below ground. Distinguishable from a rain barrel by its larger size.

Rain Barrel- A small (approximately 55 gallon) barrel that collects and stores stormwater from a roof or other impervious surface for reuse.

Delaware Sand Filter- See STEPL-Sand Filter. The Delaware sand filter utilizes underground concrete vaults with a sedimentation chamber and a filtration chamber to filter stormwater.

Vegetated Infiltration Swale- A broad, shallow swale with vegetated side slopes and bottom to remove stormwater pollutants though filtration, soil absorption, and uptake by vegetation.

Wet Swale- A broad open channel used to temporarily store stormwater. It is constructed with existing soils and has no underlying filtering bed.

Rain Garden- A shallow, attractively-landscaped depression that helps to manage stormwater runoff on site. The bowl-shaped gardens create “bioretention areas” by collecting stormwater runoff from impervious surfaces and allowing it to be slowly absorbed and filtered by soil and plants.

Wetland Restoration- The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions, such as water storage and filtration, to former or degraded wetland.

Stream in a Ditch- Stream design intended to modify a traditional drainage ditch to mimic a natural stream by incorporating a primary channel to accommodate bank-full flows and a wider vegetated bench to accommodate larger flows. The primary channel meanders within the wider channel, which functions as a miniature floodplain. Stream in a ditch design slows water velocities, stabilizes banks, provides habitat, and filters pollutants.

Daylighting- Removing a stream from underground pipe or culvert to restore its natural form and function. Daylighting exposes the stream to sunlight, improving water quality and habitat.

Herbaceous Riparian Buffer Establishment/Enhancement- Establishing or enhancing a riparian herbaceous buffer according to FOTG specification 390. Riparian areas are ecosystems that occur along water courses or at the fring of water bodies. Buffers filter stormwater pollutants, reduce erosion, and provide habitat. Riparian herbaceous cover consistes of gresses, grass-like plants and forbs.

Forested Riparian Buffer Establishment/Enhancement - Establishing or enhancing a riparian forest buffer according to FOTG specification 391. A riparian forest buffer is an area of predominantly trees and/or shrubs located adjacent to and up-gradient from water courses or water bodies. Buffers filter stormwater pollutants, reduce erosion, and provide habitat.

Appendix Q. City of Valparaiso and Unincorporated Porter County zoning maps

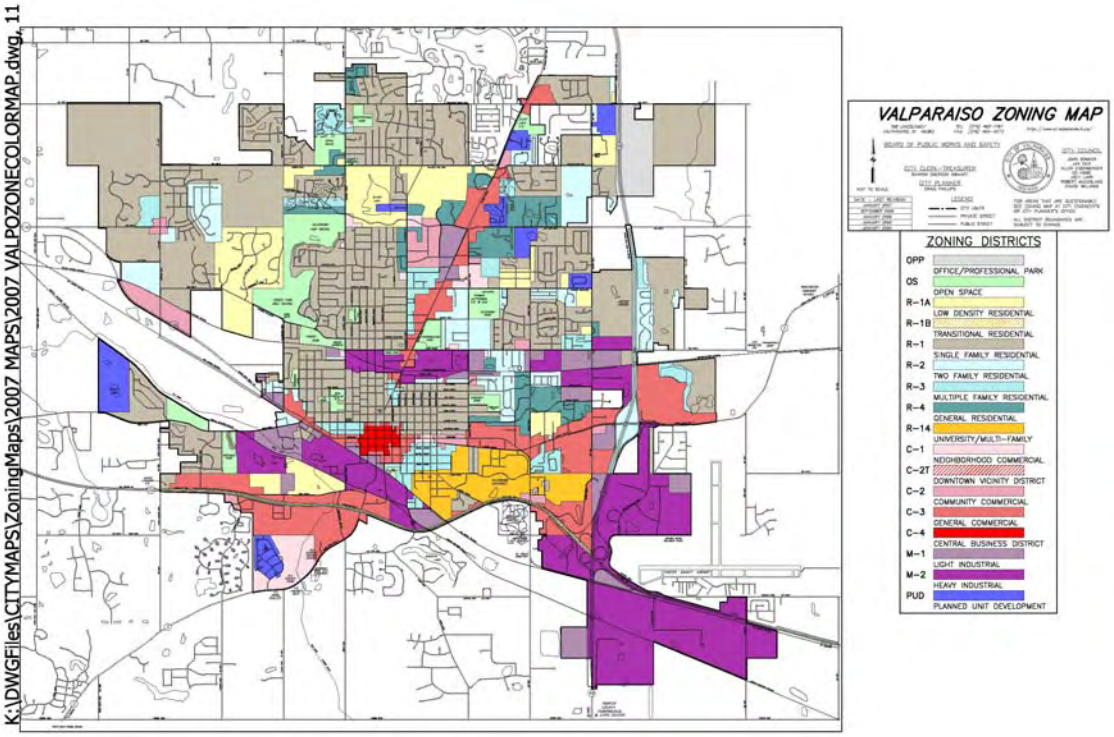


Figure A 11. City of Valparaiso Zoning Map (Valparaiso, 2004)

To view a full sized map see the Appendix CD included with this plan or visit http://www.ci.valparaiso.in.us/Government/citymaps/ZoningMap/ValpoZoningMap.pdf.

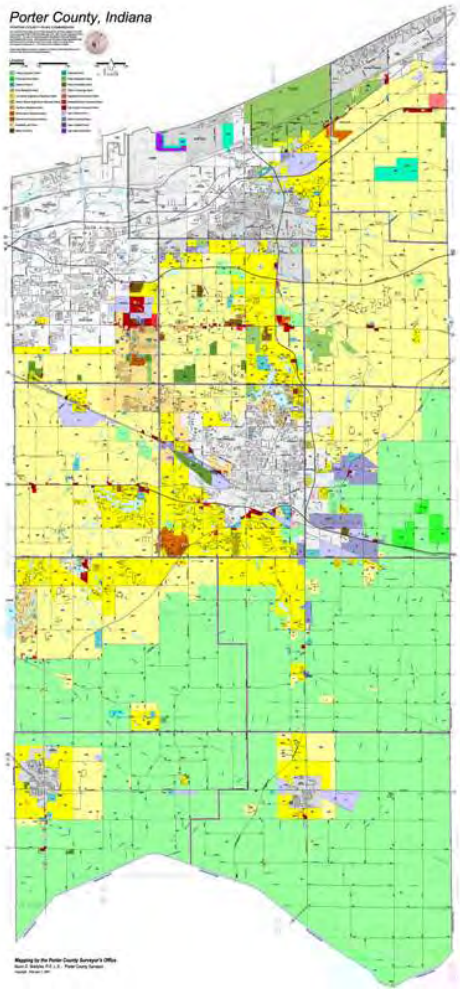


Figure A 12. Porter County Zoning Map (Porter County Surveyor's Office, 2007)

To view a full sized map see the Appendix CD included with this plan or visit http://www.porterco.org/assets/files/pdf/plcm/UDO_Zoning_Map.pdf.

Appendix R. GIS data sources

The following geographic information systems (GIS) data sources were used to create one or more of the maps in the Salt Creek Watershed Management Plan as listed below:

(VLACD, 2006). Valparaiso Lakes Area Conservancy District. The watershed boundary for the Valparaiso Chain of Lakes Watershed was provided by the Valparaiso Lakes Area Conservancy District. This layer was clipped to the Salt Creek watershed boundary to display the area diverted from the watershed.

(Choi, 2005) Choi, J.Y., B. Engel and L. Theller. 2005. Online Watershed Delineation. http://pasture.ecn.purdue.edu/~watergen/

(IDEM, 2007a) Indiana Department of Environmental Management, Office of Land Quality, Compliance and Response Branch, Solid Waste Compliance Section. 2007. CONFINED_FEEDING_OPERATIONS_IDEM_IN: Confined Feeding Operation Facilities in Indiana(Indiana Department of Environmental Management, Point Shapefile)

(IDEM, 2007b) Indiana Department of Environmental Management, Office of Land Quality, Compliance and Response Branch, Solid Waste Compliance Section. 2007. OPEN_DUMPS_IDEM_IN: Open Dump Sites in Indiana (Indiana Department of Environmental Management, Point Shapefile).

(IDEM, 2007c) Indiana Department of Environmental Management, Office of Land Quality, Compliance and Response Branch, Solid Waste Compliance Section. 2007. WASTE_SEPTAGE_SITES_IDEM_IN:Septage Waste Sites in Indiana (Indiana Department of Environmental Management, Point Shapefile).

(IDEM, 2007d) Indiana Department of Environmental Management, Office of Land Quality, Compliance and Response Branch, Industrial Waste Section. 2007. WASTE_INDUSTRIAL_IDEM_IN: Industrial Waste Sites in Indiana (Indiana Department of Environmental Management, Point Shapefile).

(IDEM, 2007e) Indiana Department of Environmental Management, Office of Land Quality, Remediation Service Branch, Leaking Underground Storage Tank Section. 2007. LUST_IDEM_IN: Leaking Underground Storage Tanks in Indiana (Indiana Department of Environmental Management, Point Shapefile).

(IDEM, 2006) Indiana Department of Environmental Management, Office of Water Quality. 2006. IMPAIRED_STREAMS_IDEM_IN: Impaired Streams in Indiana on the 303(d) List of 2006 (Indiana Department of Environmental Management, Line Shapefile).

(IDEM, 2002) Indiana Department of Environmental Management, Office of Water Quality, Data Management Section. 2002. NPDES_FACILITY_IDEM_IN: Facilities in the National Pollutant Discharge Elimination System with Assigned UTM Coordinates in Indiana (Indiana Department of Environmental Management, Point Shapefile).

(IDNR, 2006) Indiana Department of Natural Resources. 2006. Dams_IDNR_IN: Dams in Indiana under the Jurisdiction of the Indiana Department of Natural Resources (Indiana Department of Natural Resources, Point Shapefile).

(IDNR, 1992) Indiana Dept. of Natural Resources, Division of Fish and Wildlife. 1992. Known salmonid streams as defined and revealed by the Division of Fish and Wildlife. Obtained from Linda Lambert, Indiana Dept. of Natural Resources.

(INDOT, 2001) Indiana Department of Transportation, Graphics and Engineering. 2001. INCORPORATED_AREAS_INDOT_IN: Incorporated Boundaries in Indiana (Indiana Department of Transportation, Polygon Shapefile).

(INHDC, 2007) Indiana Natural Heritage Data Center. MANAGED_LANDS_IDNR_IN: Lands owned and managed by the IDNR (Indiana Department of Natural Resources, 1:24,000, Polygon Shapefile)

(INDOT, 2004) Indiana Department of Transportation. 2004. HIGHWAYS_INDOTMODEL_IN: Highways in Indiana (Indiana Department of Transportation, 1:24,000 Line Shapefile).

(IGS, 2004) Indiana Geological Survey. 2004. CENSUS_MCD_POPCHANGE_IN: Population Densities and Changes of Densities of Minor Civil Divisions in Indiana from 1890 to 2000 (United States Census Bureau, 1:500,000, Polygon Shapefile), digital representation by Denver Harper, 2004.

(IGS, 2003) Indiana Geological Survey. 2003. ECOREGIONS_USGS_IN: Ecoregions, Levels III and IV, Indiana (U.S. Geological Survey, 1:250,000, Polygon Shapefile).

(IGS, 2007a) Indiana Geological Survey. 2007. IS2001USGS_IN: Estimated Percentages of Impervious Surfaces in Indiana in 2001, Derived from the National Land Cover Database (NLCD 2001) (United States Geological Survey, 30-Meter Grid), digital representation by Chris Dintaman, 2007.

(IGS, 2007b) Indiana Geological Survey. 2007. LC2001USGS_IN: 2001 Land Cover in Indiana, Derived from the National Land Cover Database (NLCD 2001) (United States Geological Survey, 30-Meter Grid), digital representation by Chris Dintaman.

(IGS, 2007c) Indiana Geological Survey. 2007. TC2001USGS_IN: Estimated Percentage of Tree Canopy in Indiana in 2001, Derived from the National Land Cover Database (NLCD 2001) (United States Geological Survey, 30-Meter Grid), digital representation by Chris Dintaman.

(US Census Bureau, 2005) U.S. Census Bureau, Indiana Department of Transportation. 2005. ROADS_2005_INDOT_IN: Indiana Roads from INDOT and TIGER Files, 2005 (INDOT, 1:100,000, Line Shapefile).

(USDS, 2004) U. S. Department of Agriculture, National Agricultural Statistics Service

CULTIVATED_AREAS_USDA_IN: Cultivated Areas in Indiana in 2004 (United States Department of Agriculture, 1:100,000, Polygon Shapefile)

(USDA, 1994) U. S. Department of Agriculture, Natural Resources Conservation Service. 1994. SOILS_STATSGO_IN: Soil Associations in Indiana (U.S. Dept. of Agriculture, 1:250,000, Polygon Shapefile).

(USDA, 2005) U. S. Department of Agriculture, Natural Resources Conservation Service. 2005. SOILS_SSURGO_TABLES_NRCS_IN: Soil Survey Geographic (SSURGO) database for Porter County, Indiana.

(USDA, 2002a) U.S. Department of Agriculture, Natural Resources Conservation Service, Indiana Department of Environmental Management, Indiana Department of Natural Resources, Division of Water. 2002. WATERSHEDS_HUC11__USGS_IN: Watersheds, 11-digit Hydrologic Units, in Indiana, (Derived from US Geological Survey, Polygon Shapefile).

(USDA, 2002b) U.S. Department of Agriculture, Natural Resources Conservation Service, Indiana Department of Environmental Management, Indiana Department of Natural Resources, Division of Water. 2002. WATERSHEDS_HUC14_SUBWATERSHEDS_USGS_IN: Subwatersheds, 14-digit, Hydrologic Units, in Indiana, (US Geological Survey, 1:24000 Polygon Shapefile).

(USFWS, 1992) U.S. Fish and Wildlife Service, National Wetland Inventory. 1992. WETLANDS_NWI_POLY_IN: National Wetland Inventory Polygons by County in Indiana (US Fish and Wildlife Service, 1:2M, Polygon Shapefile).

(USGS, 2001) U.S. Geological Survey and U.S. Environmental Protection Agency. 2001. HYDROGRAPHY_LINE_NHD_IN: Streams, Rivers, Canals, and Ditches in Indiana (United States Geological Survey, 1:100,000, Polygon Shapefile).

Salt Creek watershed map sources by Figure:

Figure 1. Actual and official boundaries of the Salt Creek watershed- Area diverted from watershed (City of Valparaiso); Incorporated Areas (INDOT, 2001); Hydrography (USGS, 2001); 11 Digit HUC Watersheds (USDA, 2002a); Roads (US Census Bureau, 2005)

Figures 2-6. Salt Creek subwatersheds- These maps were generously produced by Craig Shillinglaw in March and April of 2006 as a volunteer contribution for Save the Dunes.

Figures 7- 9 were taken from the Salt Creek *E. coli* TMDL (WHPA, 2003)

Figure 10-11. Salt Creek watershed highly erodible land and dominant soil hydrologic groups- SURGO (USDA, 2005); Hydrography (USGS, 2001); 14 Digit HUC Watersheds (USDA, 2002b); Highways (INDOT, 2004)

Figures 12-15 were taken from the Salt Creek *E. coli* TMDL (WHPA, 2003)

Figures 16, 18-22- National Wetland Inventory (USFWS, 1992); Area diverted from watershed (City of Valparaiso); Incorporated Areas (INDOT, 2001); Hydrography (USGS, 2001); 14 Digit HUC Watersheds (USDA, 2002b)

Figure 17. Salt Creek watershed soil hydric ratings- SURGO (USDA, 2005); Area diverted from watershed (City of Valparaiso); Hydrography (USGS, 2001); 11 Digit HUC Watersheds (USDA, 2002a)

Figure 23. Salt Creek Ecoregions- Ecoregions (IGS, 2003); Area diverted from watershed (City of Valparaiso); Hydrography (USGS, 2001); 11 Digit HUC Watersheds (USDA, 2002a)

Figures 24-25. Land cover in the Salt Creek watershed- Land Cover (IGS, 2007b); 11 Digit HUC Watersheds (USDA, 2002a)

Figure 26 was taken from the Salt Creek *E. coli* TMDL (WHPA, 2003)

Figure 27. Change in population density, 1990-2000- Census Population Change (IGS, 2004); SURGO (USDA, 2005); Hydrography (USGS, 2001); 14 Digit HUC Watersheds (USDA, 2002b); Highways (INDOT, 2004)

Figure 28. National Park Service property within the Salt Creek watershed- Managed Lands (INHDC, 2007); Hydrography (USGS, 2001); 11 Digit HUC Watersheds (USDA, 2002a); Roads (US Census Bureau, 2005); Incorporated Areas (INDOT, 2001)

Figure 29. 303(d) impaired streams in the Salt Creek watershed- Impaired streams (IDEM, 2006); Hydrography (USGS, 2001); 11 Digit HUC Watersheds (USDA, 2002a)

Figure 30 was taken from the Salt Creek *E. coli* TMDL (WHPA, 2003)

Figure 31. IDEM 2006 biotic community assessment/intensive survey sampling was provided by IDEM in 2006.

Figure 32. Map of stream sampling sites- GPS locations of stream sampling sites were collected by JFNew. Hydrography (USGS, 2001); 11 Digit HUC Watersheds (USDA, 2002a); area diverted from watershed (City of Valparaiso);

Figure 33-34. Sampling site subwatersheds- Subwatersheds generated using Purdue's Online Watershed Delineator (OWL) (Choi, 2005); GPS locations of stream sampling sites were collected by JFNew. Hydrography (USGS, 2001); 11 Digit HUC Watersheds (USDA, 2002a); area diverted from watershed (City of Valparaiso); Highways (INDOT, 2004)

Figures 35-50 are photographs taken by SDCF in June 2006

Figure 51. Salt Creek watershed cultivated areas- Cultivated areas (USDA, 2004); Hydrography (USGS, 2001); 14 Digit HUC Watersheds (USDA, 2002b)

Figure 52 was taken from the Indiana State Department of Agriculture website (ISDA, 2007)

Figure 53. Salt Creek watershed estimated percent impervious surfaces- Estimated percentage impervious surfaces (IGS, 2007a) Hydrography (USGS, 2001); 14 Digit HUC Watersheds (USDA, 2002b); area diverted from watershed (City of Valparaiso);

Figures 54-58 are photographs taken by SDCF and watershed stakeholders in 2006

Figure 59. Salt Creek watershed soil suitability for septic systems- Porter County Soil Survey (USDA, 1976); 11 Digit HUC Watersheds (USDA, 2002a); SURGO (USDA, 2005)

Figure 60 was taken from the Salt Creek *E. coli* TMDL (WHPA, 2003)

Figure 61. Septage waste sites within the Salt Creek watershed- Septage waste sites (IDEM, 2007c); Hydrography (USGS, 2001); 11 Digit HUC Watersheds (USDA, 2002a); area diverted from watershed (City of Valparaiso); Incorporated Areas (INDOT, 2001); Highways (INDOT, 2004)

Figure 62 was provided by the Valparaiso Water Reclamation Department (2007)

Figure 63. NPDES facilities in the Salt Creek watershed- NPDES facilities (IDEM, 2002), Hydrography (USGS, 2001); 11 Digit HUC Watersheds (USDA, 2002a); area diverted from watershed (City of Valparaiso); Incorporated Areas (INDOT, 2001); Highways (INDOT, 2004)

Figures 64, 65, and 67 are photographs taken by SDCF and watershed stakeholders in 2006

Figure 66. Dams in the Salt Creek watershed- Dams (IDNR, 2006); Hydrography (USGS, 2001); 11 Digit HUC Watersheds (USDA, 2002a); area diverted from watershed (City of Valparaiso); Incorporated Areas (INDOT, 2001); Highways (INDOT, 2004)

Figure 68. Salmonid streams in the Salt Creek watershed- Salmonid streams (IDNR, 1992); Hydrography (USGS, 2001); 11 Digit HUC Watersheds (USDA, 2002a); area diverted from watershed (City of Valparaiso); Incorporated Areas (INDOT, 2001); Highways (INDOT, 2004)

Figure 69. Open dump sites in the Salt Creek watershed- Open dump sites (IDEM, 2007b); Hydrography (USGS, 2001); 11 Digit HUC Watersheds (USDA, 2002a); area diverted from watershed (City of Valparaiso); Incorporated Areas (INDOT, 2001); Highways (INDOT, 2004)

Figure 70. Leaking underground storage tanks in the Salt Creek watershed- LUSTs (IDEM, 2007e); Hydrography (USGS, 2001); 11 Digit HUC Watersheds (USDA, 2002a); area diverted from watershed (City of Valparaiso); Incorporated Areas (INDOT, 2001); Highways (INDOT, 2004)

Figure 71. Industrial waste sites in the Salt Creek watershed- Industrial waste sites (IDEM, 2007d); Hydrography (USGS, 2001); 11 Digit HUC Watersheds (USDA, 2002a); area diverted from watershed (City of Valparaiso); Incorporated Areas (INDOT, 2001); Highways (INDOT, 2004)

Figure 72. Salt Creek watershed critical and priority areas- GPS locations of stream sampling sites were collected by JFNew and critical and priority subwatersheds were generated by JFNew. 2005 statewide aerial photos; Highways (INDOT, 2004); Hydrography (USGS, 2001); 11 Digit HUC Watersheds (USDA, 2002a); area diverted from watershed (City of Valparaiso); Incorporated Areas (INDOT, 2001)