Non-point Source Pollution: A Review of Policies, Practices and Regulations in Alberta and Selected Jurisdictions

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About the Authors

Kim Sanderson: Kim Sanderson has worked for over 25 years as a researcher and writer on a wide range of environmental topics. She worked for ten years as an Environmental Research Officer at the Environment Council of Alberta, where she authored or co-authored some 20 reports and provided support to the Alberta Round Table on Environment and Economy. Since then, Kim has done contract resarch, writing and editing work with a diversity of government, industry and not-for-profit agencies, including several multi-stakeholder organizations. She was a founding partner of Green Planet Communications, Inc. in 2002.

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Mary Griffiths: In 2009 Mary Griffiths, PhD retired from the Pembina Institute where, as Senior Policy Analyst on the Energy Solutions Team, she was engaged in efforts to reduce the environmental impact of fossil fuel energy development. She was the lead author of more than ten reports, including several which examined the use of water for energy production in Alberta. Mary served on various Alberta government committees dealing with the environmental aspects of energy development and was often invited to speak at workshops and conferences.

Mary now continues her environmental work as a part-time consultant with MG Environmental and she is a Senior Associate with Green Planet Communications, Inc. where she continues to undertake research and write reports. She continues her interest in water issues and is a member of the Board of the Water Matters Society of Alberta. She also served on the Management Advisory Board of the Alberta Water Research Institute for a year until it was disbanded in 2011.

Mary obtained her B.A. and doctorate and started her career at the University of Exeter, U.K., where she taught geography.

In 2002, Mary received a Canadian Environmental Award for her work on clean air issues, and she is also a recipient of a 2005 Alberta Centennial Medal.

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- Helen Bresler, Watershed Planning Unit Supervisor, Department of Ecology, State of Washington
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The authors have made every effort to ensure the accuracy of material in this report, but the information may not reflect the views of those acknowledged above or listed in Appendix A.

Advice and guidance from the Alberta Water Council's Non-Point Source Pollution Project Team, the client for this report, was also very much appreciated.

Note to Reader

This report contains a large number of references for those who want more information. The web links were correct at the time the research was undertaken (between October 2011 and February 2012) but web pages change and we apologize if a link is no longer active.

The report also contains a large number of abbreviations and acronyms. The phrase is written out in full the first time it is used in a chapter and generally thereafter the acronym or abbreviation is used. A full list of abbreviations, acronyms and symbols appears in the preliminary material immediately following the table of contents. This list also shows the jurisdiction to which the acronym or abbreviation applies.

Except for direct quotations, metric units are used in this report. If the original material was in Imperial units, as it often was for U.S. jurisdictions, the units were converted to metric to enable easier comparison with Canadian and European jurisdictions.

The authors have endeavoured to compile as much relevant information from Alberta and other jurisdictions as possible to ensure the team receives a comprehensive report. However, it is quite possible that some material has been overlooked and this report should not be viewed as containing reference to all the material that might be available.

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List of Acronyms, Abbreviations and Symbols

Acronym, Abbreviation or Symbol	Full Name	Relevant Jurisdiction
AAP	Accepted Agricultural Practice	Vermont
AEGP	Agri-Environmental Group Plan	Saskatchewan
AESA	Alberta Environmentally Sustainable Agriculture	Alberta
AEW	Alberta Environment and Water	Alberta
ALR	Agricultural Land Reserve	B.C.
AOC	Area of Concern	Ontario
AOPA	Agricultural Operation Practices Act	Alberta
ARD	(Alberta) Agriculture and Rural Development	Alberta
ASN	Alberta Stewardship Network	Alberta
AT	Alberta Transportation	Alberta
ATV	All-terrain Vehicle	Ontario, Saskatchewan
BMP	Best or Beneficial Management Practice	All
BRBC	Bow River Basin Council	Alberta
CA	Conservation Authority	Ontario
CAESA	Canada-Alberta Environmentally Sustainable Agriculture	Alberta
CAFO	Concentrated Animal Feeding Operation	U.S.
CFSA	Crown Forest Sustainability Act	Ontario
CREP	Conservation Reserve Enhancement Program	N. Carolina, Vermont
CSF	Catchment Sensitive Farming	England
CSO	Combined Sewer Overflow	Alberta
CWA	Clean Water Act	U.S.
CWL	Clear Water Landcare	Alberta
DEFRA	Department of Food, Agriculture and Rural Affairs	England
dS	deciSiemen	Alberta
DUC	Ducks Unlimited Canada	Alberta
EC	European Commission	Europe
EFP	Environmental Farm Plan	All provinces
EPA	Environmental Protection Agency	U.S., California
EPEA	Environmental Protection and Enhancement Act	Alberta
EQIP	Environmental Quality Incentives Program	U.S.
ERCB	Energy Resources Conservation Board	Alberta
EU	European Union	Europe
FLUZ	Forest Land Use Zone	Alberta
FMA	Forest Management Agreement	Alberta, Saskatchewan
FMP	Forest Management Plan	Alberta, Saskatchewan
FMU	Forest Management Unit	Alberta
FOM	Forest Operations Monitoring	Alberta
FREP	Forest and Range Evaluation Program	B.C.
FRPA	Forest and Range Practices Act	B.C.
FSCP	Foothills Stream Crossing Partnership	Alberta
GAEC	Good Agricultural and Environmental Condition	England
GBR	General Binding Rule	England, Scotland
GoA	Government of Alberta	Alberta

Acronym, Abbreviation or Symbol	Full Name	Relevant Jurisdiction
ha	hectare	Entire report
ILRP	Irrigated Lands Regulatory Program	California
IWMP	Integrated Watershed Management Plan	Alberta
kg	kilogram	Entire report
km	kilometre	Entire report
LID	Low Impact Development	Canada and U.S.
LTRN	Long Term River Network	Alberta
LWMP	Liquid Waste Management Plan	B.C.
m	metre	Entire report
mg	milligram	Entire report
µg	microgram	Entire report
MM	Management Measure	California
MNR	(Ontario) Ministry of Natural Resources	Ontario
NASM	Non-agricultural Source Materials	Ontario
NCWP	Nose Creek Watershed Partnership	Alberta
NMP	Nutrient Management Plan	Ontario
NMS	Nutrient Management Strategy	Ontario
NPDES	National Pollutant Discharge Elimination System	U.S.
NPS	Non-Point Source	All
NPSP	Non-Point Source Pollution	All
NR	Natural Resources	Wisconsin
NRCB	Natural Resources Conservation Board	Alberta
NRCS	Natural Resources Conservation Service	U.S.
NSR	North Saskatchewan River	Alberta
NSWA	North Saskatchewan Watershed Alliance	Alberta
OHV	Off Highway Vehicle	Alberta
OMAFRA	Ontario Ministry of Agriculture, Food and Rural Affairs	Ontario
OME	Ontario Ministry of the Environment	Ontario
ORV	Off-road vehicle	B.C.
OWC	Oldman Water Council	Alberta
OWEB	Oregon Water Enhancement Board	Oregon
SEARS	Scotland's Environmental and Rural Services	Scotland
SEPA	Scottish Environment Protection Agency	Scotland
SMR	Statutory Management Rule	England
SRD	(Alberta) Sustainable Resource Development	Alberta
SuDS	Sustainable Drainage System	England
SUDS	Sustainable Urban Drainage System	Scotland
SWA	Saskatchewan Watershed Authority	Saskatchewan
SWRCB	State Water Resources Control Board	California
t	tonne	Entire report
TLMP	Total Loading Management Plan	Alberta
TLP	Total Loadings Plan	Alberta
TMDL	Total Maximum Daily Load	U.S.
TSS	Total Suspended Solids	Alberta +
USDA	U.S. Department of Agriculture	U.S.
USFS	U.S. Forest Service	U.S.

Acronym, Abbreviation or Symbol	Full Name	Relevant Jurisdiction
USMP	Universal Stormwater Management Program	North Carolina
WDNR	Wisconsin Department of Natural Resources	Wisconsin
WDR	Waste Discharge Requirements	California
WFD	Water Framework Directive	Europe
WPAC	Watershed Planning and Advisory Council	Alberta
WPZ	Watershed Protection Zone	England
WQO	Water Quality Objective	Alberta
WSG	Watershed Stewardship Group	Alberta
WWFMP	Wet Weather Flow Master Plan	Ontario

Executive Summary

This report, *Non-point Source Pollution: A Review of Policies, Practices and Regulations in Alberta and Selected Jurisdictions,* was commissioned by the Alberta Water Council's Non-Point Source Pollution Project Team, to assist in Phase II of their work. The report reviews legislated requirements and voluntary best (or beneficial) management practices (BMPs) for addressing non-point source pollution (NPSP) in Alberta, three other Canadian provinces and selected jurisdictions in the U.S. and Europe for five major land uses: agriculture, urban, forestry, oil and gas, and recreation. The main objectives are to identify gaps and opportunities for reducing NPSP in Alberta and to learn from the experience of other jurisdictions. These jurisdictions were selected in discussion with the team and on the recommendation of people who are knowledgeable on the subject. The study objectives and methodology are outlined in Chapter 1.

Chapter 2 describes how NPSP is managed in Alberta. No single government department is responsible for NPSP in the province, so there is no systematic approach to addressing this issue. Good data, especially baseline data, are lacking in many areas and monitoring networks are generally not designed to answer questions related to loading and peak flows. Although all five major land uses were examined in this report, most attention was paid to agriculture, urban and forestry, as relatively little information was available on the extent of NPSP issues and their management for the conventional oil and gas sector (which is heavily regulated) and for recreation.

Raising producer awareness and encouraging the voluntary adoption of BMPs has been Alberta's main approach to managing NPSP from agriculture. A wide array of resources, programs and partnerships have been developed in support of this approach, including manuals and demonstration projects, cost-sharing mechanisms, and a variety of stewardship initiatives. Two studies now underway are expected to shed light on the environmental and economic effectiveness of BMPs in agricultural watersheds. Key pieces of legislation relevant to managing NPSP from agriculture include the *Agricultural Operation Practices Act,* which describes requirements for manure management, and the *Environmental Protection and Enhancement Act*, which regulates activities associated with pesticides.

NPSP management in urban areas was most closely examined for Calgary and Edmonton. A total loading management plan and a stormwater management strategy are major components of NPSP management in these cities, and both monitor stormwater quality. Municipalities typically manage stormwater using regulatory and policy tools (e.g., bylaws and formal plans) combined with a wide array of BMPs, including low impact development (LID) initiatives applied to new development and as retrofit projects. Erosion and sediment control guidelines are also essential features of urban NPSP management.

For the forest sector, the key policy tool for managing NPSP is the Timber Harvest Planning and Operating Ground Rules. These Ground Rules describe the requirements that licensees must meet as a condition of their harvest approval and include a number of mandatory requirements related to watershed protection and riparian lands, soils, habitat management and roads. The Alberta Government monitors compliance through planned and random audits and field inspections.

Like Alberta, none of the other Canadian provinces studied (British Columbia, Ontario and Saskatchewan) has a comprehensive integrated NPSP program and BMPs are used to varying degrees. Each jurisdiction has examples of instructional approaches, with both Ontario and Saskatchewan devoting considerable effort to source water protection strategies following a serious outbreak of waterborne disease in each province in 2000 and 2001 respectively. B.C., Ontario and Saskatchewan are reviewed in Chapter 3.

Of note in British Columbia, the comprehensive *Forest and Range Practices Act* governs the activities of forest and range licensees, and also enables penalties for activities (such as irresponsible off-roading) that damage sensitive sites. The Government has identified objectives and key resource values and forest companies develop strategies to meet these objectives, including objectives for soil, water and fish; the water objective, for example, includes maintaining or promoting healthy riparian and upland areas. The Government's Forest and Range Evaluation Program monitors activities on Crown land and their impacts to ensure that licensees are effectively meeting the established objectives.

Ontario's 36 Conservation Authorities play a key role in watershed management, oversee many NPSP-related initiatives in their regions, and have been actively involved in preparing watershed assessments and source protection plans. Ontario's *Nutrient Management Act* regulates what can and cannot be applied to land and describes standards and practices for management and application of nutrient-containing materials to avoid NPSP. A 2009 ban on cosmetic use of pesticides appears to have significantly reduced concentrations of three commonly used pesticides in sampled streams.

Saskatchewan's Long-Term Safe Drinking Water Strategy is the focal point for water management in that province. The Saskatchewan Watershed Authority, a Crown Corporation that was given greater responsibility after the 2001 incident in North Battleford, has a wide mandate for managing and protecting water, watersheds and related land resources. It undertakes watershed planning, conservation of wetlands, public awareness activities, and monitoring health of aquatic ecosystems. Like Alberta, Saskatchewan uses BMPs extensively to manage NPSP from agriculture. Saskatchewan is adopting a new legal framework for environmental management, including an Environmental Code that will define environmental outcomes and require the regulated community to decide how it will achieve compliance.

Chapter 4 looks at examples of NPSP management in the U.S. The federal *Clean Water Act* (CWA), which is implemented through the Environmental Protection Agency (EPA), sets regulatory requirements for NPSP (section 4.1.3). The EPA's Nonpoint Source Control Branch requires each state to comply and report on their NPSP program, including water quality monitoring and analysis. The CWA sets water quality standards for each class of designated water use (such as drinking water source, recreation use) and each state must have a water management plan to address NPSP and limit discharges to meet those standards. The Agency provides guidance on watershed planning, and the Nine Key Elements to be included in a Watershed Management Plan (Figure 4) provide a useful checklist of issues to be addressed when setting up a NPSP program. The EPA has produced manuals describing BMPs to reduce NPSP from agriculture, forestry and the built environment, as well as a toolkit on water quality trading. The U.S. Department of Agriculture also encourages the use of BMPs to reduce NPSP through its Clean Water Program, and provides some funding, but programs are voluntary (section 4.1.4).

While each state must comply with the CWA, states may also have their own legislation that augments federal requirements. In California (section 4.2), the *Porter-Cologne Water Quality Control Act* includes a discharge requirement for NPSP. Farmers can obtain a Conditional Waiver of Waste Discharge Requirements if they follow a water quality control plan, which usually includes monitoring and other enforceable requirements designed to meet water quality standards. The Irrigated Lands Regulatory Program, which is part of the State Water Resources Control Board's Nonpoint Source Control Program, is considered an effective example that uses the waiver approach. There are a number of success stories for irrigated lands and a similar approach is being considered for forestry lands in California. The State Water Resources Control Board recognizes the value of LID for reducing runoff from urban land and provides some funding for LID projects.

North Carolina's *Clean Water Responsibility and Environmentally Sound Policy Act* supplements federal legislation and sets out specific requirements for reducing nutrient levels in surface waters (section 4.3). The state's Division of Water Quality adopted basin-wide planning 20 years ago and implemented

programs to reduce nutrient levels from point and non-point sources in two major watersheds. In the Tar-Pamlico River Basin, for example, where NPSP is the most important nutrient source, the management strategy includes two agricultural rules to reduce nutrient use, three rules to protect buffer zones and a stormwater rule that applies to urban development. The nutrient management rule, which applies to agricultural land and to the commercial application of fertilizer on golf courses and lawns, requires operators to take state-sponsored nutrient management training or have a nutrient management plan. This comprehensive watershed approach, which is implemented through a Basin Oversight Committee and local advisory committees, is considered a success by the EPA, even though the nutrient levels in the estuary have not yet declined as expected, based on the implemented measures.

In Oregon, the focus is on the way in which the City of Portland implemented its highly-regarded LID program (section 4.4). The City first used BMPs to reduce stormwater runoff from municipal property, including road allowances, and extended the program to encourage private property owners to adopt LID. Brief reference is made to the Willamette Partnership, which is developing a legal framework for the trading of ecosystem services that might be applied to water quality.

In Vermont (section 4.5), the Department of Environmental Conservation implements the state's *Water Pollution Control Act* but responsibility for NPSP from agricultural sources is delegated to the Agency of Agriculture. Farmers are required to implement Accepted Agricultural Practices that include manure management and buffer zones along stream banks. Medium-sized farms that operate under a General Permit must have nutrient management plans, while large farms are individually licensed. BMPs to reduce agricultural NPSP are encouraged through federal and state funding programs. Accepted Management Practices for forestry operations include some designed to protect water quality. Vermont has a new Green Infrastructure Program and the Vermont League of Cities and Towns developed a model LID stormwater management bylaw. A watershed approach, which was first adopted to reduce phosphorus discharges to Lake Champlain, has been extended to the whole state in the recently renamed Ecosystem Restoration Program. A number of projects in small watersheds have reduced nutrient or sediment loads and feature as EPA success stories.

In the State of Washington, the Department of Ecology is responsible for implementing the *Water Pollution Control Act* but 12 state agencies are involved in the *Watershed Planning Act* (section 4.6). Responsibility for addressing NPSP is split between several departments. The Department of Agriculture manages NPSP from most agricultural sources: there are many rules relating to the use of pesticides and fertilizers, and dairy farms and concentrated animal feeding operations are required to have nutrient management plans. The Department of Natural Resources is responsible for adherence to very detailed Forest Practice Rules, including those in the Forest Practices Watershed Analysis Manual. The shared responsibilities make it difficult for the Department of Ecology to implement or enforce measures to reduce NPSP in those sectors, which may have other priorities. However, the Department has been effective in local partnerships to reduce the impacts of ranching on water quality through the fencing and riparian buffers. With respect to urban NPSP, the City of Seattle has been a leader in the implementation of LID and the Puget Sound Partnership is very active, producing a LID manual and, with the University of Washington, giving training workshops to help professionals implement LID.

Wisconsin considers its agricultural and urban NPSP programs to be among the most progressive in the U.S. (section 4.7). The state's Priority Watershed and Lake Program addressed soil erosion and manure management at critical sites over a 30-year period by helping landowners implement BMPs. The more recent state-wide Runoff Management Rule limits the amount of phosphorus that is allowed to run off cropland and pasture and requires an uncultivated buffer next to water bodies. Counties take the lead in implementing the rule through their Land and Water Resource Management Plans. The Runoff Management Rule also applies to urban development, including roads, both during and post-construction. Some towns are encouraging LID. Milwaukee, for example, requires post development runoff to be at

least 10% less than pre-development flows. Implementation of BMPs in forestry is only mandatory in certified or registered forests, but the state evaluates their effectiveness through field examination of some harvest sites and monitoring of water quality.

Chapter 5 starts with a brief summary of the European Union's regulatory requirements followed by a review of the NPSP programs in three countries. The EU's Water Framework Directive requires each member country to adopt measures to reduce diffuse water pollution (as NPSP is called in Europe), including river basin management plans (section 5.1). The Nitrates Directive applies specifically to agricultural sources and requires mandatory measures to reduce nitrogen applications to the soil in vulnerable areas.

In England, the Environment Agency is responsible for managing NPSP, but works with the department responsible for agriculture and Natural England (section 5.2). As throughout the EU, farmers must keep their land in good agricultural and economic condition if they wish to receive any funding under the EU Single Payments Scheme. The Catchment Sensitive Farming Program focuses on measures to reduce NPSP in priority watersheds, but implementation varies between areas. The National Auditor has been highly critical of the Environment Agency's efforts to address diffuse water pollution, and his criticisms and recommendations provide good advice for those who are setting up a NPSP program.

One expert considers Scotland to be 10 years ahead of England in its NPSP program (section 5.3.2). Scotland's Environmental Protection Agency started with monitoring to characterize and quantify the impacts of diffuse water pollution and, when planning their program, tried to learn from experiences elsewhere, including the U.S. In 2005, a General Binding Rule was introduced to limit diffuse pollution from the built environment (including roads) and rules that apply to agriculture and forestry were added later. As with some rules in the U.S., General Binding Rules require compliance with certain practices, but do not require any special authorization. The Scottish EPA trained staff in several rural agencies to help raise awareness and undertake compliance monitoring. Sustainable Urban Drainage Systems, which are required to manage runoff from almost all new development except for single-dwelling homes, implement LID techniques.

As a result of the impacts of its highly intensive arable and livestock production, the Netherlands has very stringent rules for managing manure, fertilizers and many other non-point sources (section 5.4). There is a comprehensive water quality monitoring program and the data are used to update plans to reduce nutrient-rich runoff. The government funds research into ways to reduce the nutrient load from agriculture, especially in areas with nutrient-leaching soils. Even though the Dutch have a long tradition of being regulated, some farmers find the rules complex and onerous.

The final chapter, Chapter 6, extracts conclusions from the report findings. It draws on the experience of other jurisdictions to outline the key components of an effective NPSP program and identifies ways in which Alberta might approach a NPSP program of its own.

1. Introduction

The Alberta Water Council is a multi-stakeholder organization with representation from governments, industry and non-government organizations. The Council and its teams and committees operate by consensus. In 2009, a Council report[1] identified several priority areas for further work, including improving the understanding and management of non-point source pollution (NPSP). The Council subsequently established the Non-Point Source Pollution Project Team to examine the issue and develop recommendations on how to better manage the total non-point source contaminant loading in Alberta's watersheds to achieve *Water for Life* goals.

Drinking water, the production of livestock and crops, recreation, and a variety of industrial uses all rely on good quality water, as do healthy aquatic ecosystems and wildlife. Pollution from both point and non-point sources can reduce overall water quality. Point source pollution, such as discharge from a wastewater treatment plant, is generally well-understood and can be relatively easily measured and managed. NPSP, which is contamination that enters a water body from diffuse points of discharge and has no single point of origin,[2] is more complex and difficult to manage.

Non-point source pollutants can reach water bodies through surface runoff, atmospheric deposition and groundwater. Several key factors, including topography, soil texture, and weather and climate patterns, affect the movement of water through the landscape and play a major role in the extent to which NPSP becomes an issue. Almost any activity on the land base can be a potential source of NPSP.

To address this issue, the NPSP project team divided its work into three phases. The Phase I report, completed in November 2011, summarized the current state of knowledge in Alberta about the contribution of NPSP to the quality of Alberta's surface water, identified the major NPS contaminants, and provided a foundation for Phases II and III.[3] Phase II produced this report: *Non-point Source Pollution: A Review of Policies, Practices and Regulations in Alberta and Selected Jurisdictions.* Phase III will see the development of a final report and recommendations from the team to the Alberta Water Council, based on the information and conclusions from Phases I and II.

1.1 Objectives

The objectives for Phase II were to:

- Review existing public policies, practices and regulations in Alberta that are or could be applied to non-point sources of pollution.
- Review policies, practices and regulations in other jurisdictions to find innovative tools to manage non-point source pollution.
- Evaluate the state of implementation of policy, practices and regulatory tools for reducing or controlling non-point source pollution with a focus on Alberta, and identify the gaps and opportunities for improvement.

1.2 Methodology and Overview

The project technical team provided initial direction to the consultants, who then developed a draft table of contents for the Phase II report. The full project team also provided input to the draft table of contents prior to approving the proposed approach, and provided some contacts and possible sources of

[1] Alberta Water Council. 2009, *Recommended Projects to Advance the Goal of Healthy Aquatic Ecosystems.*
[2] This is the working definition being used by the NPSP project team; it has not been formally published.
[3] CPP Environmental Corp. 2011, *Current state of non-point source pollution: Knowledge, data and tools.* Report prepared by T. Charette and M. Trites for the Alberta Water Council, 153 pp.

information. The consultants then built an initial list of potential resource people using leads from the team, their personal contacts and online research. The general approach involved online research, some literature searches, and phone calls and meetings with key resource people to obtain further clarification and details.

Building on the work done in Phase I and to the extent that information is available, the team agreed that five main land uses would be the focus of Phase II work: agriculture, urban, forestry, oil and gas, and recreation. To maintain a realistic scope for the project, the team agreed that research for Alberta would be limited to initiatives by the Government of Alberta and industry associations as appropriate, the two largest municipalities (Calgary and Edmonton), and selected regional watershed planning and stewardship bodies; the results appear in Chapter 2. The team also agreed that the Phase II work would examine in detail three Canadian provinces (Chapter 3), five US states[4] along with the US Environmental Protection Agency and the US Department of Agriculture (Chapter 4), and four European jurisdictions including the EU (Chapter 5). All individuals who provided information and comment to the consultants are listed in Appendix A.

Policy instruments and tools to address NPSP, include:

- "Sticks" in the form of regulation (such as land use, regulation of specific practices through permits, licences, and prohibitions),
- "Carrots" such as economic instruments in the form of subsidies, taxes and tax incentives, and
- "Sermons," which is the use of information or communication in the form of moral suasion, education and outreach.[5]

This report describes approaches and measures taken by various jurisdictions to reduce NPSP and relates success stories, where possible. It does not attempt to analyze the scientific efficacy of these measures, although such attempts can be found in the relevant literature.[6] Relevant regulatory and policy tools are noted and examples of best management practices and case studies are included, but specific management practices are not listed; rather, readers are directed to the various compilations referenced in this report.

[4] The City of Portland and Willamette Valley, Oregon were also examined.

[5] Bemelmans-Videc, M. *et al* (eds.) 1998, *Carrots, Sticks and Sermons: Policy Instruments and Their Evaluation*, London: Transaction Publishers; cited in Johns, Carolyn M. 2001. *Effective Policy Regimes for the Management of Non-point Source Water Pollution: Ontario and the US in Comparative Perspective*. This draft paper by Dr. Johns was prepared as a background document for the Walkerton Inquiry, https://ozone.scholarsportal.info/bitstream/1873/8143/1/10294253.pdf

[6] There is a large amount of literature on the effectiveness of different methods for reducing NPSP, such as buffer zones and wetlands. See, for example, references in Kay, P., A. C. Edwards and M. Foulger, "A Review of the Efficacy of Contemporary Agricultural Stewardship Measures for Ameliorating Water Pollution Problems of Key Concern to the UK Water Industry," Agricultural Systems, 2009, Vol. 99, Issues 2-3, February, pp. 67-75.

2. Managing Non-Point Source Pollution in Alberta

Alberta covers an area of 661,848 km^2, with a land base of 642,317 km^2;[7] its population of 3.8 million[8] is more than 80% urban.[9] Alberta has processes for approving, monitoring and ensuring compliance for point sources, with regulatory entities such as Alberta Environment and Water, the Natural Resources Conservation Board, and others having a clear mandate depending on the emissions source. However, like the sources themselves, mechanisms for managing non-point source pollution (NPSP) are much more dispersed; approvals are not required for many activities that could generate NPSP, and often more than one agency is involved in identifying potential problems and solutions. As a result, there is no one "home" in government or one systematic approach for dealing with NPSP. This issue stretches across many programs, legislation and regulations at different landscape levels and at different levels of policy development, all of which makes management and coordination more complex. On the other hand, sharing responsibility across several entities can lead to creative solutions that are specifically designed to address a concern.

Another challenge in managing NPSP in Alberta relates to the lack of good data in many areas, especially baseline data. The Phase I report for this project noted knowledge gaps, particularly with respect to data and the cumulative effects of NPSP from various activities. The lack of baseline data was a key observation of the Alberta Environmental Monitoring Panel in 2011[10] and was reiterated by a number of people who were interviewed for this report. Monitoring for NPSP is done on an *ad hoc* basis; as issues are identified, Government of Alberta departments tend to collaborate as required to monitor and assess the results.

Surface water is monitored in Alberta by various government, industry and stakeholder groups. To support these efforts, Alberta Environment and Water conducts water quality monitoring, reporting and evaluation throughout the province, including the 28 sites of the Long-Term River Network (LTRN), the River Water Quality Index, and lake monitoring. Monitoring networks for streams and wetlands are not as well developed. Work is also underway to develop ecological indicators and decision-support tools to assess cumulative effects in major watersheds, including the influences of point and non-point sources of contaminants. Nevertheless, controlling NPSP remains a challenge in the sense that no single agency or level of government is solely responsible for integrating land use activities into water quality protection strategies.[11] As well, most monitoring networks are not designed to answer loading questions; the LTRN, for example, takes monthly samples but may or may not catch peak flows, which is when most of the NPSP occurs.[12]

Against this backdrop, the rest of this chapter aims to "tell the story" of how NPSP is managed in Alberta.

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[7] Statistics Canada at http://www40.statcan.ca/l01/cst01/phys01-eng.htm.
[8] Statistics Canada at http://www40.statcan.gc.ca/l01/cst01/demo02a-eng.htm
[9] Statistics Canada at http://www40.statcan.gc.ca/l01/cst01/demo62j-eng.htm
[10] Alberta Environmental Monitoring Panel. June 2011, *A World Class Environmental Monitoring, Evaluation and Reporting System for Alberta*, http://environment.gov.ab.ca/info/library/8381.pdf
[11] Previous text in this paragraph is adapted from Alberta Environment and Water's online description of its Surface Water Quality Program, at http://www.environment.alberta.ca/01256.html
[12] Steph Neufeldt, Watershed Specialist, EPCOR Water Services, personal communication with Kim Sanderson, December 15, 2011.

2.1 Agriculture

Agriculture is a major land use in Alberta, with a total farm land area of just over 21 million ha, or about one-third of the total land area of the province; irrigation accounts for 675,000 ha, or 5% of the total cultivated land area.[13] [14]Alberta remains the largest beef producing province in Canada; dairy and poultry operations also contribute significantly to provincial agricultural production. In 2010, Alberta beef and dairy operations accounted for over 11 million head.[15]

As noted in the Phase I report, nutrients, pesticides and pathogens are the main constituents of NPSP from agriculture, along with sediment. These constituents enter watercourses largely as a result of erosion and runoff. Nutrients can originate with both manure and fertilizer, and excess nitrogen and phosphorus are both potential risks to surface water quality. Although Alberta does have several Acts and regulations that apply, or could apply, to potential NPSP from agriculture, the province and the industry have relied much more on Beneficial Management Practices (BMPs)[16] to address existing and potential NPSP.

2.1.1 Policy and Regulatory Tools

Most of the policy and regulatory tools that apply or could be applied to NPSP from agriculture are within provincial jurisdiction. These include the following Acts and their regulations, and Codes of Practice:

- *Agricultural Operation Practices Act*
- *Environmental Protection and Enhancement Act* (and the Environmental Code of Practice for Pesticides)
- Grazing Lease Stewardship Code of Practice
- *Animal Health Act*
- *Soil Conservation Act*
- *Water Act*

The federal *Fisheries Act* is also pertinent. It is discussed separately in section 3.1 because it applies to all internal Canadian waters inhabited by fish or with the potential to support fish.

Agricultural Operation Practices Act

The *Agricultural Operation Practices Act* (AOPA)[17] and its regulations are administered by Alberta Agriculture and Rural Development and enforced by the Natural Resources Conservation Board (NRCB). The regulations set environmental standards for the province's livestock industry. AOPA focuses particularly on confined feeding operations,[18] but applies to all livestock operations in terms of how they are required to manage manure. Such operations must follow the manure application and setback distances to protect surface water and groundwater resources. Seasonal feeding and bedding sites where livestock are fed and sheltered must also adhere to these regulations.

[13] Government of Alberta. 2011, *Agricultural Statistics Factsheet*, Agdex853, http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd12807

[14] Alberta's total area is 661,848 km^2, with a land base of 642,317 km^2. Source: Statistics Canada at http://www40.statcan.ca/l01/cst01/phys01-eng.htm.

[15] Government of Alberta. 2011, *Agricultural Statistics Factsheet*, Agdex853.

[16] The acronym BMPs can also stand for Best Management Practices. "BMPs" is used in this report to mean both "Beneficial" and "Best" Management Practices.

[17] Government of Alberta, *Agricultural Operation Practices Act*, http://www.qp.alberta.ca/570.cfm?frm_isbn=9780779751310&search_by=link

[18] Confined Feeding Operations are regulated by the NRCB and have very specific requirements that were not part of this review, except insofar as they must adhere to manure application requirements.

The manure spreading regulations include requirements for manure incorporation, soil nitrogen and salinity limits, setback distances, record keeping and soil testing. Specifically:[19]

- Manure must be incorporated within 48 hours when applied to cultivated land (except when applied to forages or direct-seeded crops, frozen or snow-covered land or unless an operation has a permit that specifies a different incorporation requirement). AOPA prohibits spreading of manure on snow-covered or frozen ground unless authorized by the NRCB on a case-by-case basis.
- The regulation sets soil nitrate-nitrogen and salinity limits according to various farming methods, soil groups, soil textures, and the depth to the water table. These limits may only be exceeded if a producer has a nutrient management plan approved by the NRCB. To ensure the salts in manure do not affect plant growth, the regulations specify that manure must not be applied to soils that have an electrical conductivity (salinity) greater than 4 deciSiemen per metre (dS/m) from the top 0 to 15 cm of soil. Manure should not be applied at levels that may increase the soil salinity (after manure is applied) by more than 1 dS/m from a soil depth of 0 to 15 cm.[20]
- Setback distances are required to reduce nuisance effects on neighbours and to minimize the risk of manure leaving the land on which it is applied and entering a common body of water. Manure must be applied at least:
    - 150 m away from a residence or other occupied building that the operator does not own if the manure will not be incorporated when spreading on forage or direct-seeded crops,
    - 30 m away from a water well,
    - 10 m away from a common body of water if subsurface injection is used,
    - 30 m away from a common body of water if manure is surface-applied,

    and incorporated within 48 hours of application, except when applied on forage, direct-seeded crops, frozen or snow-covered land. A person who applies manure on forage, direct-seeded crops, frozen or snow-covered land must meet the minimum setback distances for manure application, keeping in mind the average slope of the land near the common body of water.

The setback distances required are based on slope if the land slopes toward a common body of water, as noted in Table 1.

Table 1. Setback Distances Required for Manure Application on a Slope

Average slope within 90 metres of a common body of water	Setback distance required from the common body of water
4% or less	30 m
Greater than 4% to less than 6%	60 m
6% or greater, but less than 12 %	90 m
12% or greater	No application allowed

Producers using wintering sites are expected to minimize the risk of runoff by locating wintering sites and corrals 30 m or more from a common body of water. If the wintering sites or livestock corrals are closer than 30 m, one of the following options must be used to reduce runoff risks:

[19] The remaining text related to AOPA is adapted from three publications published by the Government of Alberta and the NRCB in 2007: *Manure Spreading Regulations*, Agdex 096-5; *Wintering Sites and Livestock Corrals*, Agdex 096-4; and *Manure Management Regulations for Cow/Calf Producers*, Agdex 096-6. All Agdex publications can be accessed via http://www.agriculture.alberta.ca/app21/infopage?start=true

[20] For details on nitrate-nitrogen limits in specific soil groups and types, see *The Standard: Manure Management Regulations for Cow/Calf Producers*, March 2007, Agdex 096-6.

- An interceptor (e.g., berm or ditch) must be constructed between the site and the water to divert runoff away from the water, or
- Manure and bedding accumulated at the site must be moved to an appropriate manure storage facility or area before runoff occurs.

If the NRCB receives a complaint, it can inspect a livestock facility. NRCB inspectors typically look at potential risks to the environment or problems related to manure handling, storage and application. If a problem is found, inspectors will work with operators to resolve the situation. When determining the appropriate enforcement response, inspectors will consider the significance of any non-compliance as well as the risk to the environment and the operator's willingness to address the issue voluntarily.

Environmental Protection and Enhancement Act

The *Environmental Protection and Enhancement Act* (EPEA)[21] is very wide-ranging and covers any activity that could adversely affect the environment. For example, if manure is applied at a rate or in a location where it could cause environmental damage, an environmental protection order could be issued by Alberta Environment and Water under EPEA. Such orders are not usually punitive; rather they require that a plan be developed and implemented to deal with the release.

EPEA also regulates the sale, use, application, handling, storage, transport and disposal of pesticides. EPEA regulations specify:

- Use of pesticides according to the directions specified on the label.
- Transportation and disposal of pesticides in a way that ensures they will not contaminate food or water.
- Storage of pesticides in their original containers or in other containers that are clearly marked.
- Responsibility of the user for cleanup and decontamination in case of accidental spills.
- Washing of pesticide-contaminated material or sprayers is prohibited within 30 m of an open water body or on a public waterworks system.
- Pesticide storage is not allowed within 30 m of an open water body.
- No person shall use, apply handle, transport, store or dispose of a pesticide or operate any equipment involving the use, handling, transportation, storage handling or disposal of pesticides in a manner that is or is likely to cause an adverse effect.[22]

A Special Use Approval permit is required from Alberta Environment and Water to apply or store pesticides or wash equipment used to apply pesticides in, on or within 30 m of an open body of water. This does not include sloughs or ponds less than 4 ha in area, providing they are completely surrounded by private land with no drainage off the land.

The Environmental Code of Practice for Pesticides[23] further notes that:

- Herbicides must not be deposited within 30 horizontal metres of an open body of water unless the herbicide application is conducted by ground application equipment only.
- Herbicides must not be deposited on areas that have slumped, been washed out or are subject to soil erosion into the water body.

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[21] Government of Alberta, *Environmental Protection and Enhancement Act*, http://www.qp.alberta.ca/570.cfm?frm_isbn=9780779755240&search_by=link

[22] Alberta Agriculture and Rural Development and Agriculture and Agri-Food Canada/Prairie Farm Rehabilitation Administration. 2004, *Beneficial Management Practices: Environmental Manual for Crop Producers in Alberta* - Alberta Legislation, Agdex 100/25-,1 http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex9450.

[23] Government of Alberta. 2010, *Environmental Code of Practice for Pesticides*, effective May 12, 2010, http://www.qp.alberta.ca/574.cfm?page=PESTICIDE.cfm&leg_type=Codes&isbncln=9780779749676

- An applicator must not locate outdoor field pesticide mixing and loading sites within 30 horizontal metres of an open body of water, unless specific conditions are met.

Alberta Environment and Water investigates potential contraventions of provincial pesticide regulations.

EPEA also empowers the government to prevent and control the release of substances into the environment, and to ensure prompt control and clean up.

Grazing Lease Stewardship Code of Practice[24]

Public rangelands play an important role in watershed functions. Riparian areas are often sources of succulent forage, water and shade and require special attention to prevent damage. The *Public Lands Act* and its regulations, administered by Alberta Sustainable Resource Development, lay out the requirements associated with grazing leases, and the Grazing Lease Stewardship Code of Practice describes the roles and responsibilities of leaseholders. Grazing leaseholders are required to apply sustainable grazing practices that flow from four key rangeland management principles, one of which is particularly relevant to preventing NPSP; that is, avoid grazing during vulnerable periods. Leaseholders are expected to consult with the rangeland agrologist and apply specific practices as required when rangelands are considered vulnerable (e.g., during early spring); these practices include:

- Manage grazing on stream banks during vulnerable periods to prevent permanent trampling damage.
- Minimize dormant season browsing (if approved for the lease) to encourage woody plant regeneration in riparian areas.
- Manage grazing on riparian sites during vulnerable periods to prevent permanent trampling damage.

Range health is monitored through a rating system that addresses five indicators of range health, one of which is site stability: Is the site maintained or is the ecological site subject to accelerated erosion? Riparian health is also assessed by rating riparian plant communities using indicators appropriate for those systems. Rangeland agrologists inspect and rate range health on leases and discuss management with leaseholders. Management agreements and tenure conditions help leaseholders meet their stewardship commitments and include a peer review process when stewardship commitments are not achieved. Grazing leaseholders are required to "invest in management practices that result in stable range and riparian health. . . Grazing leaseholders have a particularly crucial responsibility to address any riparian area management issues on their grazing lease" (p. 9).

Animal Health Act[25]

This Act is the responsibility of Alberta Agriculture and Rural Development. It includes the *Destruction and Disposal of Dead Animals Regulation,* which has requirements for distance from a water body. For natural disposal (scavenging), the site must be 500 m from wells, waterways and high water marks of lakes, and 25 m from the edge of a coulee, major cut or embankment. For burial or composting, the pit or site must be 100 m from wells, waterways and high water marks of lakes, and 25 m from the edge of a coulee, major cut or embankment. The bottom of a burial pit must be at least one metre above the seasonal high water table.

[24] The text in this section is adapted from the *Grazing Lease Stewardship Code of Practice*, published by Alberta Sustainable Resource Development, December 14, 2007; http://www.srd.alberta.ca/LandsForests/GrazingRangeManagement/GrazingLeaseStewardshipCodeOfPractice.aspx

[25] Government of Alberta, *Animal Health Act*, http://www.qp.alberta.ca/570.cfm?frm_isbn=9780779751402&search_by=link

Soil Conservation Act

The *Soil Conservation Act*[26] applies to all landholders and requires them to prevent soil loss or deterioration, or to stop it from continuing if it is already occurring. It is administered by Alberta Agriculture and Rural Development and enforced by local authorities (municipalities). When agricultural practices cause or are likely to cause soil degradation, a soil conservation officer acting on behalf of the local municipality may serve notice to the landholder advising that remedial action is required within a specified time. The landholder may appeal the notice, but if the appeal fails, the landholder must comply with the notice. "If the remedial action is not done within the specified time, the soil conservation officer and/or others under the officer's direction may enter the property and perform the required work. The cost of this work may be collected by a tax on the property. Any person obstructing the officer or failing to comply with the notice is subject to a fine of up to $5,000" (p. 150).[27]

Water Act[28]

The *Water Act* requires approval from Alberta Environment and Water for any project or activity that, among other things, could cause:

- Siltation of water,
- Erosion of any bed or shore of a water body, or
- An effect on the aquatic environment.

2.1.2 Use and Implementation of BMPs

Alberta Agriculture and Rural Development (ARD) has worked extensively with Agriculture and Agri-Food Canada, with producer organizations and with groups such as the Alberta Riparian Habitat Management Society (commonly referred to as "Cows and Fish") to develop and produce BMP manuals for the main agricultural commodity types. These agencies along with local authorities work closely with producers to identify situations where BMPs could be used to address various on-farm environmental issues, assist producers with implementation, and advise them of cost-sharing opportunities.

Raising producer awareness and encouraging the widespread voluntary adoption of BMPs has been Alberta's preferred approach for managing NPSP from agriculture for more than 20 years. This proactive approach offers strong extension support and cost-sharing mechanisms, but is backed up by enforcement if needed. However, the main barriers to BMP adoption and implementation are: the amount of time needed to put the measure in place (e.g., rotational grazing, fencing), cost of implementing change, and lack of knowledge and understanding of the issue.[29]

In developing its series of BMP manuals, ARD defined a BMP as "any management practice that reduces or eliminates an environmental risk. BMPs are site-specific practices that take into consideration legislation, practicality and operational needs for a specific operation."[30] ARD, with partnership funding

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[26] Government of Alberta. *Soil Conservation Act*, http://www.qp.alberta.ca/570.cfm?frm_isbn=9780779753468&search_by=link

[27] Text in this paragraph adapted from Alberta Agriculture and Rural Development and Agriculture and Agri-Food Canada/Prairie Farm Rehabilitation Administration. 2004, *Beneficial Management Practices: Environmental Manual for Crop Producers in Alberta*, Agdex 100/25-1, http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex9450

[28] Government of Alberta. *Water Act*, http://www.qp.alberta.ca/570.cfm?frm_isbn=9780779754366&search_by=link

[29] Dale Chrapko, Program Manager, Agri-Environmental Programs Section (Growing Forward), Alberta Agriculture and Rural Development, personal communication with Kim Sanderson, December 13, 2011.

[30] Alberta Agriculture and Rural Development. 2010, *Beneficial Management Practices – Environmental Manual for Livestock Producers in Alberta*, p. 3.

from Agriculture and Agri-Food Canada/Prairie Farm Rehabilitation Administration, produced four manuals in the BMP series that cover all aspects of environmental risk for a farm operation, including NPSP.[31] Detailed BMP environmental manuals were developed for Alberta Farmsteads (Agdex 090-1), Crop Producers (Agdex 100/25-1), Cow/Calf Producers (Agdex 420/28-2), and Livestock Producers (Agdex 400/28-2). All manuals are available by searching online at http://www.agriculture.alberta.ca/app21/infopage?start=true.

These manuals describe in detail how to manage potential sources of NPSP; for example, the manual for livestock producers devotes one chapter to surface water management, examining runon and runoff flows, their risks and various management options including catchbasins, vegetated filter strips and constructed wetlands. ARD's website provides access to factsheets and guides on diverse topics that could help prevent NPSP from agriculture, such as the use of pasture water systems for livestock, pasture pipeline design, and many others. Agriculture and Agri-Food Canada has also published a *Field Manual on Buffer Design for the Canadian Prairies.*[32] It is intended for use by agricultural practitioners and identifies appropriate BMPs, including vegetated buffers, to reduce the loss of nutrients.

A study done in 2007 for the Crop Nutrients Council examined what the economic benefit would need to be to encourage Canadian agricultural producers to adopt BMPs, specifically those related to crop nutrients.[33] The study concluded that most of the selected BMPs, including soil testing, minimum tillage, no tillage, and nutrient management planning, improved profitability for the representative farms. The profitability of farms using variable rate fertilization depended on the crop grown and the province. In all cases, the models suggested that buffer strips reduced expected net revenue. The study also found that funding was available for all the BMPs evaluated except soil testing (unless obtained through the development of a nutrient management program), but most respondents were not accessing these funding programs. Results of the survey done as part of the study suggest that the greatest barriers to adoption were cost and not understanding the need for the BMP.

The Canadian Fertilizer Institute is working with others to help improve agricultural productivity and minimize environmental impacts by encouraging adopting of the 4R Nutrient Stewardship System. The 4R system is a BMP with four pillars for fertilizer application: Right Source @ Right Rate, Right Time, Right Place®.[34] Better management and application practices can reduce NPSP by reducing the loss of nitrogen and phosphorus from fields. A research project now underway in Alberta is investigating the benefits of 4R nutrient management on barley, canola and wheat. Sites around Alberta, representing a range of soil and climate variables, are being used to evaluate the performance of nitrogen fertilizer options based on the 4R nutrient management system. Once completed, the results will be used to update provincial nitrogen fertilizer management recommendations and the Alberta Farm Fertilizer Information and Recommendations Manager software.[35]

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[31] Alberta Environmentally Sustainable Agriculture Program and the Alberta Beef Producers also contributed funding to one or more manuals.

[32] Franz, B. *et al*. 2011, *Field Manual on Buffer Design for the Canadian Prairies*, http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1308065640348&lang=eng

[33] George Morris Centre. 2007, *An Economic Evaluation of Beneficial Management Practices for Crop Nutrients in Canadian Agriculture*, prepared for the Crop Nutrients Council, http://www.georgemorris.org/aspx/Public/Utils/DbFileViewerPopup.aspx?FileID=269

[34] Canadian Fertilizer Institute website, http://www.cfi.ca/whatwedo/nutrients/. See also http://www.nutrientstewardship.com/

[35] *Agri-News*, Nov. 28, 2011, http://www1.agric.gov.ab.ca/$department/newslett.nsf/all/agnw18758

Examples of Partners

Cows and Fish

Cows and Fish is a voluntary stewardship program that works with various groups and agencies, landowners and managers on both private and public land to improve and protect the health of riparian areas. Healthy riparian areas act as filters to keep sediments and pollutants out of adjoining watercourses. Cows and Fish has produced a number of resources, including tools for assessing riparian health, tools for riparian management, and examples of good stewardship practices. Among other things, the program works with cattle producers to set up demonstration sites that provide practical, local examples of riparian management options and illustrate to other producers and communities the costs and benefits associated with certain management techniques. In 2010, Cows and Fish evaluated 151 sites for riparian health, for a total of over 2,200 sites since 1997. A significant focus of their work is workshops and training sessions to resource managers to improve extension program delivery.[36]

Ducks Unlimited Canada

Wetlands and their surrounding grasslands reduce the effects of flooding, erosion and sedimentation; recharge local groundwater and aquifers; filter nutrients, pesticides and pathogens from the water; maintain shorelines; and provide important wildlife habitat. They can thus play an important role in helping to reduce and mitigate NPSP. Wetland restoration is a recognized BMP and is a key component of the Environmental Farm Plan process. Ducks Unlimited Canada (DUC) works closely with federal and provincial agencies, private landowners, grazing leaseholders, and irrigation districts to help conserve natural and agricultural lands and restore wetlands; over 1800 projects are underway in Alberta. DUC provides producers with education, assistance and support in developing and implementing wetlands preservation and restoration projects.[37] See Figure 1 for more information on the importance of wetlands in managing NPSP.

Land Stewardship Centre

The Land Stewardship Centre (LSC) works directly with landowners and land managers to improve stewardship practices, supports grass-roots community stewardship efforts, and encourages the development of practices and policies that support sustainable resource use. The LSC has developed various programs, tools and information resources to help people become better stewards, many of which focus on the rural environment. The Centre has an extensive online resource centre with information, news and resources related to environmental stewardship, including many that pertain to water quality and NPSP.[38]

[36] Cows and Fish website, http://www.cowsandfish.org/
[37] Ducks Unlimited Canada website, http://www.ducks.ca/province/ab/index.html
[38] The LSC's online resource centre is located at http://www.landstewardship.org/resources/explore/

Figure 1. The Importance of Wetlands

Wetlands are among the Earth's most productive ecosystems, and also one of its most threatened. Many prairie wetlands have disappeared, and in some areas of Saskatchewan, this figure is over 90%. Wetlands play a major role in mitigating the impacts of NPSP by capturing and holding rainfall and snowmelt from the surrounding area. They filter sediments and nutrients contained in this runoff, removing various contaminants such as chemicals, metals and other pollutants, before slowly returning water to the hydrologic cycle, The loss of wetlands from the landscape causes larger areas to drain directly into downstream streams, rivers, lakes and possible drinking water supplies.

A recent pilot project aimed to assess the benefits that people get from wetlands in a quantifiable and comparable way, focusing on an area around Calgary. The study showed that wetlands provide substantial benefits, including water storage and flood control, but it was more difficult to assess their total contribution to water quality. The water purification model used in the study suggested that all the wetlands in the study area provide moderate water purification services, but the model does not provide information on whether particular areas or developments are currently benefiting from water purification and how wetlands affect water quality either in specific locations or at the landscape scale. As noted in the Urban sections of this report, constructed wetlands are often used to treat contaminated or nutrient-enriched water. In the study area, wetlands are being modified for nutrient management or replaced by water treatment plants and constructed wetlands and stormwater ponds. Calculating the replacement cost of constructed or modified wetlands and water treatment in plants is a method for determining the value of water purification by wetlands to humans.

A project by Ducks Unlimited Canada (DUC) assessed the impacts of prairie wetland loss and associated drainage activity in the Broughton's Creek watershed in south-western Manitoba. The project confirmed that 21% of the total wetland area in this watershed was lost between 1968 and 2005. The next phase of work involved developing a hydrologic model to evaluate environmental impacts of this loss at a watershed scale. Of relevance to managing NPSP, the research determined that wetland loss since 1968 in the Broughton's Creek watershed has resulted in:

- 31% increase in area draining downstream (3,108 ha)
- 18% increase in peak flow following rainfall
- 30% increase in water flow
- 31% increase in nitrogen and phosphorus load from the watershed
- 41% increase in sediment loading (average annual)

In Manitoba, this has implications for water quality in Lake Winnipeg, which is experiencing problems with algal blooms and high phosphorus levels.

DUC also looked at the Smith Creek watershed in east-central Saskatchewan, where 66% of total wetlands were drained or degraded between 1958 and 2000. Further, DUC's research determined that wetland loss in the Smith Creek watershed accelerated between 2000 and 2007, resulting in:

- 15% reduction in the total number of remaining wetlands (1,089 wetlands drained)
- 7% increase in the area draining downstream (9,100 ha)
- 26% increase in potential nitrogen and phosphorus loads from the watershed

Information on the Alberta Ecosystem Services Study (paragraph 2) from: Government of Alberta. 2011, *Ecosystem Services Approach Pilot for Wetlands*: *Integrated Assessment Report*, http://environment.gov.ab.ca/info/library/8493.pdf
Information in first paragraph and on DUC projects adapted from DUC fact sheets (http://www.ducks.ca): "The Impacts of Wetland Loss in Manitoba" and "The Impacts of Wetland Loss in Saskatchewan."

Funding Mechanisms and Approaches

Over the years, ARD has provided funding alone and in partnership with Agriculture and Agri-Food Canada to assist producers in identifying and implementing BMPs that can reduce NPSP.

Environmental Farm Plans

Agriculture and Agri-Food Canada supported the initial development of Environmental Farm Plans (EFPs) over a four-year period. By taking advantage of financial support to develop EFPs, producers can assess their environmental risks, including potential management issues related to NPSP, and develop mitigation plans. EFPs are now coordinated through ARD and recent data show that over 12,000 producers have participated in this initiative.[39] EFPs are meant to be regularly updated and are required for some program funding. A future driver for EFPs could emerge if commodity groups require an EFP to be in place as part of their branding and marketing initiatives.

Growing Forward

Growing Forward is a joint federal-provincial initiative that, among other things, aims to help producers more effectively manage risk. The initiative provides support in more than 20 program areas, including the development of stewardship plans. There are three Stewardship Plan programs: Integrated Crop Management, Grazing and Winter Feeding Management, and Manure Management. Producers develop a work plan that identifies mitigating actions that will address their highest environmental risks and will reduce or minimize their impact on the environment. Producers can apply for grant funding for projects that will help them achieve actions identified in their work plan. Approved projects are funded on a 50:50 cost-shared basis to a maximum amount per applicant, depending on the program.[40]

Agricultural Service Board Grant Program

This program is supported by ARD and administered by Alberta Municipal Affairs. It supports Agricultural Service Boards in developing and delivering environmental extension programming and administration of legislative requirements under the *Agricultural Service Board Act*. It enables the hiring of qualified staff directed at environmental programming and implementation of the *Agricultural Service Board Act*. The budget allocation for 2011/12 was $12.2-million.[41]

Agriculture Opportunity Fund[42]

The Agriculture Opportunity Fund is also supported by ARD and provides funding assistance to eligible organizations to enable them, through partnership with others, to promote long-term sustainability of the agricultural industry and rural communities in their areas. The focus is on growth, environment, economic development and sound extension methodology. “Environment” is one of the Fund’s three main program areas, with the intent of achieving enhanced awareness, understanding and implementation of environmentally beneficial agricultural practices and the importance of responsible stewardship of land, air, water and biodiversity. Recipients are required to submit annual reports.

Monitoring BMP Implementation and Effectiveness

It is difficult to quantify both the extent of implementation of BMPs to manage NPSP and their overall effectiveness. Many producers have taken advantage of support programs to voluntarily identify and implement BMPs and ARD does field inspections to ensure funding was used properly and the BMP was actually adopted. ARD also tracks its extension activities, but it is possible that projects may be counted in more than one program.

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[39] Alberta Environmental Farm Plan website, http://www.albertaefp.com/
[40] Growing Forward website, http://www.growingforward.alberta.ca/index.htm
[41] Agriculture Service Board Grant Program, http://www.municipalaffairs.alberta.ca/municipalgrants-ministry.cfm
[42] Agriculture Opportunity Fund, http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/webdoc7493

Every three years, ARD surveys 500 farmers in the five provincial agricultural regions to track changes in awareness of, attitudes toward and adoption of environmentally sustainable agriculture practices in Alberta. The most recent survey was done in 2010 and assessed changes since the previous survey in 2007.[43] An overall trend in the 2010 survey suggests that environmentally sustainable agriculture is increasingly becoming part of mainstream agriculture. Two key findings are relevant to the NPSP project, but it is difficult to know how these numbers actually translate to on-the-ground changes:

- There were strong gains in several water quality practices that could prevent or mitigate NPSP; these included the use of vegetative buffer strips along the edges of water bodies (13% increase), avoiding draining or filling natural wetlands (13% increase), providing off-site watering systems to keep livestock out of water bodies (12% increase), and the use of grassed waterways (10% increase).
- There was increased adoption of some manure management practices, but overall awareness and understanding of the requirements of AOPA continue to lag. Despite ongoing extension efforts, only 41% of respondents said they were aware of the management standards in AOPA that apply to their operations.

Despite documented efforts to implement BMPs, a big question remains as to how effective these efforts are at actually reducing or preventing NPSP. Intuitively, it seems that many BMPs would positively affect NPSP to water bodies, but performance measures and clear correlations between BMP implementation and improved water quality have yet to be developed. Two evaluation projects described at the end of section 2.1.3 are examining the relationship between BMPs and surface water quality, and will help strengthen the links between science and policy.

2.1.3 Monitoring NPSP and Assessing Management Outcomes

Several major surveys and studies have been done to monitor and assess the impact of agriculture on surface water quality in Alberta. Much of this work has been done in southern Alberta where agricultural activities are most intense, and some of these studies are described below. The data collection process and methodology are described in detail in the background materials for each project. ARD does not monitor water quality on an ongoing basis. If an issue is identified, partnerships are typically formed to fund the monitoring and ARD provides analysis.

The Provincial Stream Survey was conducted under the Canada-Alberta Environmentally Sustainable Agriculture (CAESA) agreement to determine if there were relationships between the agricultural intensity in the drainage basins and water quality of streams. In 1995 and 1996, water quality was monitored in 27 streams with differing levels of agricultural intensity. The study observed higher peak, median, and flow-weighted mean concentrations of total and dissolved nutrients and more frequent pesticide detections in streams draining high agricultural intensity watersheds. The Alberta Environmentally Sustainable Agriculture (AESA) Program was initiated in 1998 following cessation of CAESA. The **AESA Stream Survey** assessed temporal and spatial patterns in water quality in watersheds with agricultural activity. Data were collected in 23 diverse watersheds from 1999 to 2006 to evaluate water quality and quantity. This study confirmed the impact of agricultural activities on surface water quality in Alberta, echoing the findings of the CAESA study.[44]

[43] Alberta Agriculture and Rural Development, *2010 Environmentally Sustainable Agriculture Tracking Survey Report*, http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/aesa6467

[44] Lorenz, K., *et al*. 2008, *Assessment of Environmental Sustainability in Alberta's Agricultural Watersheds Project, Volume 3: AESA Water Quality Monitoring Project*, http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/irr12914

From 1999 to 2006, ARD and the Oldman Watershed Council monitored water quality and flows in two agricultural watersheds in southern Alberta, the **Battersea Drain and Lower Little Bow River**.[45] Water flows in these watersheds are controlled, in part, by irrigation demand. The existing network of monitoring sites was used to evaluate five BMPs established in the watersheds. Results showed that BMPs that targeted point sources of contamination were the most effective. Water quality improvements in fecal contaminant loads and concentration were measured for BMPs that limited or excluded livestock access to waterways. Nutrient reductions were more difficult to quantify, suggesting that either BMPs may not be effective at reducing nutrients or more likely, that BMPs need to be applied on the landscape more extensively or monitored for a longer period of time to detect nutrient changes.

Also in southern Alberta, the **Oldman River Basin Water Quality Initiative (ORBWQI)** saw water samples collected along the length of the Oldman River from 1998 to 2003.[46] The study is described in more detail in section 2.6.3; it showed that non-point sources play a major role in the quality of the Oldman River and its tributaries, and agriculture is not the only land use that affects water quality in the basin.

In 2006 and 2007, ARD undertook a study to assess **water quality in Alberta's irrigation districts**. Irrigation water was monitored at about 80 sites in 11 irrigation districts.[47] Sampling sites were chosen to capture water as it moved through the infrastructure of each irrigation district, from the source water to return flows. Samples were analyzed for a suite of nutrient, metal, major ion, salinity, pesticide, and bacterial indicators. The study found that water quality for irrigation was generally good or excellent and guidelines for nutrients and metals were met most of the time, but pesticides were detected in most samples and herbicide guidelines for irrigation were often exceeded. Salinity and major ions were not a concern for most districts.

In 2006, Alberta Environment (and Water) undertook a pilot study to evaluate the practicality of aquatic ecosystem monitoring in small agricultural streams in Alberta.[48] Researchers looked at three streams from the AESA network in different ecoregions that are farmed with different levels of intensity. Biological communities and sediments were sampled and field data and observations were noted for basic water quality parameters and site characteristics. The study found differences in biological communities among streams that were linked to the degree of eutrophication, physical habitat characteristics and disturbance. More work is needed to determine background or reference conditions that could be used to depict healthy conditions for each ecoregion. This would then enable health assessments of streams affected by various types of activity (agriculture, forestry, urban development, mining, etc.).

Collecting surface water quality data is a necessary first step in developing strategies to manage NPSP and determine which BMPs will give the best results. At present, there is little scientific data to demonstrate the environmental and economic effectiveness of BMPs. Two evaluation studies now underway are expected to shed some light on which BMPs are most effective at reducing or preventing NPSP.

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[45] Alberta Agriculture and Food and Oldman Watershed Council. *Beneficial Management Practice Evaluation in the Battersea Drain and Lower Little Bow River Watersheds*, 2007, http://oldmanbasin.org/pdfs/bmp_eval_2007.pdf

[46] Description of this program is adapted from Saffran, K.A. 2005, *Oldman River Basin Water Quality Initiative: Surface Water Quality Summary Report, April 1998-March 2003*, http://www.oldmanbasin.org/pdfs/orbwqi_swq_98-03.pdf

[47] For details, see Little, J. *et al*. 2010, *Assessment of Water Quality in Alberta's Irrigation Districts. Second Edition.* AARD, Lethbridge, 181 pages, http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/irr13000

[48] Anderson, A.-M. *et. al*. 2009, *Pilot Study to Evaluate the Practicality of Aquatic Ecosystem Monitoring in Small Agricultural Streams in Alberta*, Alberta Environment, http://www.environment.gov.ab.ca/info/library/8140.pdf

In 2004, Agriculture and Agri-Food Canada initiated the **Watershed Evaluation of Beneficial Management Practices** project to measure the economic and water quality impacts of selected agricultural BMPs at nine small watershed sites across Canada.[49] By assessing BMPs at the watershed scale, researchers can better understand their performance by evaluating the combined effects of soils, topography, local climate, and land use. This research is being done on working farms to ensure applicability to the agricultural landscape. The project is funded until 2013. BMPs were selected to match the unique conditions of each watershed, as well as to reflect local and regional BMP interests. The Lower Little Bow River Watershed[50] was chosen for testing in Alberta, and four BMPs are being evaluated: cattle exclusion fencing (and off-stream watering), off-stream watering without fencing, nutrient input/management (commercial fertilizer and manure), and buffer strips. To date, more than half of the BMP tests (13 of 22) reduced surface water contamination by nutrients or sediment, although in many cases, the results have yet to be quantified. Some BMPs were found to have both positive and negative environmental effects.

In 2007, ARD and its partners implemented the **Nutrient Beneficial Management Practices Evaluation Project, 2007-2012**. This six-year study is scientifically evaluating BMPs in two watersheds: Whelp Creek near Lacombe in central Alberta, and Indianfarm Creek near Pincher Creek in southwestern Alberta.[51] Two field sites are also part of the study, in the Lower Little Bow River and Battersea Drain watersheds east of Picture Butte. The selected sites will be evaluated before and after BMP implementation through the monitoring of surface water quality and quantity, soil nutrient status, riparian health, and rangeland health. Land cover, land use and economic data will also be collected and used in the overall assessment. Based on the collected data, a computer model will then be used to predict the environmental and economic effectiveness of BMPs in all agricultural watersheds in the province. The study is evaluating six nutrient management BMPs, three livestock management BMPs, and one alteration of infrastructure BMP.

2.1.4 Other Initiatives

Phosphorus is an essential plant nutrient and application of manure at appropriate rates can benefit crops. However, over-application can cause phosphorus to accumulate in soil and potentially contaminate surface water,[52] as this nutrient is known to contribute to eutrophication. AOPA has soil limits for manure application based on nitrogen, but shifting to a phosphorus-based system may be needed.

The livestock industry (Intensive Livestock Working Group) is taking the lead in developing a long-term Phosphorus Strategy to help minimize its impact on surface water quality, ensure it has the social license to continue operations, and can grow as market conditions allow. A sub watershed-scale pilot project is being proposed in support of the industry-led Phosphorus Strategy. The next steps are to establish a study watershed and finalize funding support to move forward for implementation in 2013. Partners in this industry-led project include ARD and the NRCB.[53]

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[49] Text about this project adapted from Agriculture and Agri-Food Canada's online description at http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1296246973332&lang=eng

[50] Water quality in the Lower Little Bow River had been previously monitored to determine if irrigation return flows were having a significant impact on river water quality and to examine relationships between land use and water quality in this watershed. See Little, J.L. *et al.* 2003, "Land Use and Water Quality Relationships in the Lower Little Bow River Watershed, Alberta, Canada," in *Water Qual. Res. J. Canada*. 38(4):563-584.

[51] Text about this project adapted from online description at http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/epw11955. Progress reports are also available at this site.

[52] See Olson, B.M. and B.A. Paterson. "Implications of Moving to a Phosphorus Based System for Manure Application," http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/epw9889

[53] Ron Axelson, Executive Director, Intensive Livestock Working Group, personal communication with Kim Sanderson, February 22, 2012.

NPSP from agriculture has been implicated as a significant contributor to phosphorus loadings in the Bow River. A Phosphorus Management Plan for the Bow is expected to be developed in 2012-2013 and may create regional ambient water quality objectives with limits and triggers using a cumulative effects management approach.

Private landowners play an important role in conserving natural landscapes and can help to prevent NPSP and preserve ecological integrity by managing their land with conservation goals in mind. This can be particularly important as a source water protection tool. Landowners can work with land trusts to conserve their land through land donations, land purchases, a combination of land donation and land purchase, or through a Conservation Easement. Through its Ecological Gifts Program, the Government of Canada has eliminated capital gains tax for all certified ecological gift donations.[54]

2.2 Urban

The Phase I work for this project found that "of all human activities, large urban developments in the Bow and North Saskatchewan River basins seem to have the most direct effect on mainstem water quality, primarily because urban centres typically cluster around mainstems and many stormwater outfalls directly discharge to them. Urban development, through stormwater runoff, is also affecting the water quality and ecosystem health of streams. This runoff exports relatively important NPS pollutant loads of total suspended solids (TSS), metals, nutrients, salts, pesticides, and fecal coliforms."[55]

The project team agreed that discussion of how urban NPSP is managed in Alberta would focus on the two major cities of Calgary and Edmonton. Together, these two cities comprise about 50% of Alberta's population[56] on a total of 1427 km^2, or 0.2% of the total provincial land base. Neither city has a NPSP management strategy or framework *per se*, but stormwater management is clearly a major focus.

Cities require approvals from Alberta Environment and Water (AEW) to operate their wastewater treatment plant, wastewater collection system, and stormwater drainage systems. These approvals include conditions that can affect NPSP, such as a requirement to have a **total loading management plan** (TLMP) and a stormwater management strategy. Municipalities typically use a mix of approaches to address NPSP, but the TLMPs consider non-point source releases in addition to loadings from wastewater treatment plants, with the objective of ensuring that total emissions to the river do not have significant adverse impacts on the aquatic ecosystem. As noted in Calgary's TLMP, "An overriding principle behind total loading management is that it is a planning approach, rather than a regulatory approach. As such, the total loading objectives are not regulatory limits, but are values the City will use to manage its pollutant loadings to the Bow River. In practice, the loading objectives are more idealistic than regulatory values tend to be, and include margins of safety."[57]

[54] See the Alberta Land Trust Alliance website at http://www.landtrusts-alberta.ca/guide.php?PHPSESSID=st6hjso5kcge0etl1vglb14t80 for more information.
[55] CPP Environmental Corp. 2011, *Current state of non-point source pollution: Knowledge, data, and tools,* Report prepared by T. Charette and M. Trites for the Alberta Water Council, 153 pp, p. i.
[56] Statistics Canada data from 2006 indicate the two cities comprised just over 52% of provincial population. Since then, other data from the cities and the province using differing years, suggest that percentage has declined slightly to just under 50%.
[57] City of Calgary, Water Services. *2008 Calgary Total Loading Management Plan,* p.3.

Calgary's 2008 TLMP includes total loading objectives for TSS and total phosphorus. The total loading objective adopted for TSS was an average value of 52,920 kg/day.[58] Loadings are not forecast to reach this level until about 2018 or later. However, the City will strive to ensure TSS loadings from 2015 and on will be no higher than those corresponding to 2005 levels of development, and will consider possibilities for reducing future loadings below those levels.[59] The loading objective adopted for total phosphorus is an annual average of 340 kg/day.[60] This is approximately 25% of actual loadings in the early 1980s prior to the introduction of biological nutrient removal in Calgary's wastewater treatment plants. Even with biological nutrient removal processes, the City marginally exceeded this loading objective when it was first established in 2008. The application of alum for phosphorus removal was implemented as a temporary precautionary measure in an attempt to adequately protect the Bow River. The commissioning of Pine Creek wastewater treatment plant with effluent filtration in late 2008 has significantly reduced the amount of alum usage. Further upgrades to the existing wastewater treatment plants with more advanced treatment technologies are planned in the future.[61]

Work done to prepare Edmonton's Total Loadings Plan (TLP)[62] showed that stormwater is the major source of TSS to the North Saskatchewan River. Thus, Edmonton's 2009 TLP focused on TSS, proposing to limit TSS discharges to baseline levels, defined as the long-term average TSS loading from years 2000 to 2008. This approach was taken due to high variance of annual loadings. Previous work concluded that average TSS loadings from 1994-2004 were not causing observable biological effects on the river, and that capping TSS discharges at current baseline levels (28,870 kg/day) will ensure a healthy aquatic ecosystem.[63] A caveat is that in any given year, above average precipitation can result in TSS loadings higher than the baseline level, and for this reason, multi-year moving averages will be used to assess long-term performance.[64] The concept of limiting TSS loads to the baseline level is considered attainable in the long term, as long as low impact development (LID) practices are used to curb loadings from new land development. Phosphorus is expected to be the next parameter to be addressed under Edmonton's TLP.[65]

Stormwater runoff is a major source of NPSP from urban land uses and because of this prominence, the urban land use section of this report focuses on managing stormwater and drainage. TLMPs can set management objectives but typically, diverse approaches are needed to achieve the objectives. These approaches and strategies range from constructing end-of-pipe solutions to preserving and creating wetlands and implementing LID practices.

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[58] This is based on based on average effects across the cross-section of the Bow River at the Stier's Ranch monitoring site for the annual ten month "clear flow" period from August 01 to May 31 with a frequency of conformance of 0.27% less than the background frequency of conformance upstream of Calgary (i.e., one day of non-conformance each year on average attributable to releases from Calgary).

[59] Calgary's Stormwater Strategy, discussed in section 2.2.1.2, has taken a step beyond this objective by aiming to reduce sediment loading to the 2005 level of 36,900 kg/day. See the 2010 Stormwater Management Strategy Update at http://agendaminutes.calgary.ca/sirepub/cache/0/2xnyn455bo11nv45y0f1rrrq/372171230201104491517 5.PDF

[60] Based on maintaining the surface water quality guideline of 5.0 mg/L dissolved oxygen as an instantaneous minimum with a frequency of compliance of 99.91% (one day non-conformance in three years) in regard to daily diurnal minima as an average across the full width of the river upstream of the confluence with the Highwood River.

[61] Yin Deong, Watershed Management Team Lead, City of Calgary, personal communication with Kim Sanderson, March 27, 2012.

[62] City of Edmonton, Drainage Services. 2009, *City of Edmonton Total Loadings Plan*, http://www.edmonton.ca/environmental/documents/TotalLoadingPlan.pdf

[63] City of Edmonton. Drainage Services Branch. 2010, *City Discharges to the North Saskatchewan River: Addressing the Challenge*, Discussion Paper 9 in the Edmonton Sustainability Papers. See http://www.edmonton.ca/city_government/city_vision_and_strategic_plan/the-way-we-green-discussion-papers.aspx

[64] City of Edmonton, Drainage Services. 2009, *City of Edmonton Total Loadings Plan*.

[65] Fayi Zhou, General Supervisor, Environmental Planning, Infrastructure Services, City of Edmonton, personal communication with Kim Sanderson, December 2, 2011.

2.2.1 Policy and Regulatory Tools

2.2.1.1 Government of Alberta Requirements and Guidance

AEW regulates the construction and operation of municipal waterworks, wastewater and storm drainage systems. Standards and guidelines for these systems and the approval procedures for various activities are described in the *Environmental Protection and Enhancement Act* and its regulations.[66] Also pertinent to NPSP is the **Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems**, referenced in regulation 119/1993,[67] which recommends guidelines for design and operation of storm drainage systems. It is recognized that standards and regulations cannot be expected to cover every activity in municipal water, wastewater and storm drainage programs, so the 2001 Municipal Policies and Procedures Manual[68] was developed to describe policies and procedures followed by AEW in dealing with some situations not covered by the regulations.

Policy 1-7 in the **Municipal Policies and Procedures Manual** applies to "storm drainage collection system" and "storm drainage treatment facility" as defined in the *Wastewater and Storm Drainage Regulation*, and states: "When stormwater is discharged to a water body, consideration will be given to the development of strategies or options for improving the quality of stormwater and decreasing the impact it may have on receiving water quality. In some instances, alternatives to direct discharge of stormwater into a receiving body of water will be required" (p. 1-1).

In elaborating on this policy, the Manual further describes minimum quality standards and identifies the requirement for a stormwater management plan:

> "Regions will ensure that the municipalities, in planning and implementing surface drainage, adopt an integrated approach to stormwater management, beginning at the watershed and sub-watershed levels and extending to the subdivision/site plan level with emphasis on stormwater quality and best management practices (BMPs), both structural and non-structural. All municipalities will be required to develop a Master Drainage Plan, within a span of five years from the time this policy takes effect. The plan shall incorporate stormwater management techniques to effect a minimum of 85% removal of sediments of particle size 75 μm or greater. Regions will work with the municipalities to develop a Master Drainage Plan, and this process shall be integrated into the Drainage System Approval for the municipalities.
>
> "Receiving water quality concerns and specific site conditions should be taken into account in developing the stormwater management plan, which may result in higher than 85% removal of sediments. Consideration shall be given to stormwater management measures, including stormwater lot level controls, stormwater conveyance controls and pre-release stormwater management facilities. The municipalities shall select the BMP in the context of land use and environmental planning, taking into consideration the receiving water quality concerns, site conditions, and applicability of the selected BMP under the local conditions.
>
> "Note: It should be noted that reducing the impact from existing developments is difficult and has limited effect; thus, this policy is aimed at new developments" (p. 6-3).

[66] See in particular Alberta Regulation 119/1993, the Wastewater and Storm Drainage Regulation http://www.qp.alberta.ca/574.cfm?page=1993_119.cfm&leg_type=Regs&isbncln=0779727231
[67] See http://environment.alberta.ca/01249.html
[68] Alberta Environment. 2001, *Municipal Policies and Procedures Manual*, http://environment.alberta.ca/02174.html

The **Storm Water Management Guidelines for the Province of Alberta** (1999)[69] provide information on the requirements for stormwater runoff and outfall works, as required by the *Water Act.* They are intended to be used a decision-making tool and not as a rulebook for developing stormwater management solutions, which must be governed by site-specific conditions and characteristics. "Some of the storm water considerations include:

- Minimize flooding and erosion
- Minimize effects to the aquatic environment
- Maintain the natural stream and wetlands through the property
- Develop above the 1 in 100 year flood level
- Conform with approved master drainage plans
- Minimize impact on groundwater, erosion and sediment transport to the receiving water body
- Provide runoff control to ensure:
    - A maximum release rate equal to pre-development flow unless an adequate outlet exists and the increased rate of release will not cause any adverse effect.
    - Storm water ponds capable of storing flood events up to 1 in 100 years
    - Capture sediments from runoff."[70]

The Storm Water Guidelines also include a discussion on planning, selection, design, implementation, and costs of BMPs related to stormwater management.

2.2.1.2 Municipal Bylaws, Plans and Strategies

Both Calgary and Edmonton have drainage and related bylaws and strategies to address NPSP. Many of the approaches described in this section are interconnected and complementary.

a) Drainage Bylaws and Plans

Calgary's Drainage Bylaw 37M2005, section 4(1) states that No Person shall Release, or allow to be Released, any Prohibited Material into the Storm Drainage System, except as permitted in Subsection (3). Prohibited Materials include soil, sediment, waste, cooking oils and grease, gasoline, motor oil, solvents, paint, pesticides, and many other items.[71] This bylaw operates in conjunction with the Lot Grading Bylaw (32M2004),[72] which ensures proper surface drainage between public and private lands.

Edmonton's Surface Drainage Bylaw 11501[73] regulates lot grading and surface drainage requirements within private and public lands to prevent erosion and slope instability, among other things (s. 11 and 12). The Sewers Use Bylaw 9675[74] prohibits release of stormwater runoff from private property to the North Saskatchewan River, or to any canal, ditch, reservoir or other man made surface water feature that drains into the North Saskatchewan River from the upstream City limits to 125 m downstream of the E.L. Smith Water Treatment Plant water supply intake (s. 12). Relevant to NPSP, the Drainage Master Plan 2004-2014[75] contains a principle to maximize environmental protection by, among other things, improving the

[69] See http://environment.gov.ab.ca/info/posting.asp?assetid=6786&categoryid=5
[70] Source: *Water Act: Storm Water Management Fact Sheet*, online at http://environment.alberta.ca/documents/Water-Act-Stormwater-Management.pdf
[71] See http://www.calgary.ca/UEP/Water/Pages/Water-and-wastewater-systems/Storm-drainage-system/Drainage-bylaw/Drainage-Bylaw.aspx
[72] See http://www.calgary.ca/CA/city-clerks/Documents/Legislative-services/Bylaws/32m2004-LotGradingBylaw.pdf
[73] City of Edmonton. Surface Drainage Bylaw 11501, http://www.edmonton.ca/bylaws_licences/C11501.pdf.
[74] City of Edmonton. Sewers Use Bylaw 9675, http://www.edmonton.ca/bylaws_licences/C9675.pdf
[75] City of Edmonton. Drainage Master Plan 2004-2014, http://www.edmonton.ca/environmental/documents/DrrainageMasterPlan2004-14.pdf

quality of surface water discharges. It also recognizes the importance of conserving and constructing wetlands for their stormwater management and water quality enhancement benefits.

b) Stormwater Management

Both Calgary and Edmonton have Stormwater Management Strategies and related documents that reflect the conditions and circumstances of each municipality.

Three goals in **Calgary's Stormwater Management Strategy** relate directly to NPSP: protect watershed health by reducing the rate and volume of stormwater runoff; reduce sediment loading to the Bow River to or below the 2005 level by 2015; and reduce pollutants entering Calgary's waterways. Within Calgary city limits, stormwater contributes 90% of TSS loadings. The strategy sets a more ambitious target for TSS than the one in the TLMP by aiming to reduce TSS loadings to or below the 2005 level (36,900 kg/day) by 2015.[76] As part of this strategy, Calgary has a stormwater retrofit program for older communities that drain directly to the rivers and creeks without any water quality improvements. These areas are being retrofit with wet ponds, wetlands and LID practices. New subdivision developments are required to have retention facilities that remove at least 85% of TSS.[77]

Several other documents associated with Calgary's Stormwater Management Strategy provide extensive guidance on a variety of approaches to manage stormwater:

- *Stormwater Management and Design Manual* (2011) – This is a comprehensive design manual intended to result in effective, reliable, and economically affordable systems for managing stormwater.[78]
- *Stormwater Source Control Practice Handbook* (2007) – This document was designed to serve as a toolbox of options for the City of Calgary and all local professionals involved in the management of stormwater runoff.[79]
- *Principles for Stormwater Wetland Management in the City of Calgary* (2009) – Guidance in this document aims to balance the design and management of stormwater wetlands in Calgary so they can effectively manage stormwater while serving as sustainable ecological systems with amenity value.[80]

Calgary has initiated various research and demonstration projects to gain local experience and data on the performance of stormwater source control practices and ensure these practices can be successfully implemented and sustained. Examples are bioretention projects that use vegetation to filter and reduce runoff, and porous pavement options.[81]

BMPs are used, as well, to implement Calgary's Stormwater Management Strategy and are described in section 2.2.2.

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[76] City of Calgary. 2010 Stormwater Management Strategy Update at http://agendaminutes.calgary.ca/sirepub/cache/0/2xnyn455bo11nv45y0f1rrrq/372171230201104491517 5.PDF

[77] See http://www.calgary.ca/UEP/ESM/Pages/State-of-the-Environment/Water/Water-quality-of-our-rivers.aspx

[78] City of Calgary Water Resources. 2011, *Stormwater Management and Design Manual,* http://www.calgary.ca/PDA/DBA/Documents/urban_development/bulletins/2011-stormwater-management-and-Design.pdf

[79] City of Calgary Water Resources. 2007, *Stormwater Source Control Practice Handbook,* http://www.calgary.ca/UEP/Water/Documents/Water-Documents/Stormwater%20Source%20Control%20Practices%20Handbook%20-%20November%202007.pdf

[80] City of Calgary. 2009, *Principles for Stormwater Wetland Management in the City of Calgary,* http://www.calgary.ca/UEP/Water/Documents/Water-Documents/Principles_for_Stormwater_Wetlands_Management.pdf

[81] City of Calgary Stormwater Management Report, no date, http://www.calgary.ca/UEP/Water/Documents/Water-Documents/stormwater_report.pdf

Calgary has also improved its stormwater management by integrating and aligning existing watershed management plans with major City planning documents. The key principles of the Bow, Elbow and Nose Creek Watershed management plans were integrated into the Municipal Development Plan and the Calgary Transportation Plan.[82] Runoff volume control targets, first developed for the Nose Creek plan,[83] are also being applied to the Shepard and Pine Creek watersheds, and similar targets are being developed for the Bow River, Elbow River and Fish Creek catchment areas within City limits.[84] Calgary has developed three overall watershed policy approaches that align with the long-term sustainability strategies of the Municipal Development Plan and the Calgary Transportation Plan:

- **Watershed planning** by influencing urban decision making – integrating green infrastructure, particularly LID.
- **Watershed protection** through sustainable land use – reducing imperviousness, connecting green spaces, improving riparian health, using setback policies to protect wetlands and environmental reserves. For example, a core indicator in the Municipal Development Plan is watershed health, and the metric is "percent of impervious surfaces." In 1998, 32% of land cover in the city was impervious (roads, parking, bridges), and the target is to reduce this to 10% to 20% by 2070.[85] The **Environmental Reserve Setback Policy** (2007)[86] requires base setbacks ranging from 6 to 50 m for streams and rivers, and a setback of 30 m for Class 3-6 wetlands, as defined in the Calgary Wetland Conservation Plan. Adjustments are made for slope, connectivity to groundwater and cover type.
- **Watershed valuation** by promoting the importance of the watershed – informing citizens about the impacts of human activities on the watershed and exploring alternate water sources for some uses.

Calgary's **Wetland Conservation Plan** (2004)[87] aims to ensure no net loss of Calgary's wetlands by promoting their conservation and/or mitigation in areas of future urban development and in transportation and utility corridors. Calgary also has a **Natural Area Management Plan** (1994) and an **Open Space Plan** (2003). The Natural Area Management Plan[88] establishes an overall policy direction for the protection, management, public use and enjoyment, acquisition and stewardship of Calgary's natural heritage to ensure these lands continue to provide a range of environmental, economic and social benefits. The Open Space Plan[89] identifies broad principles, policies and strategies for the acquisition and development of open space in Calgary. Detailed implementation will occur through the development of

[82] City of Calgary, Utilities & Environmental Protection Department Report to the SPC on Utilities and Environment: Watershed Policies Alignment with Plan It Implementation. November 30, 2011, http://agendaminutes.calgary.ca/sirepub/mtgviewer.aspx?meetid=306&doctype=AGENDA

[83] Section 2.6.4.1 on the Nose Creek Watershed Partnership includes a table with these targets.

[84] Yin Deong, Watershed Management Team Lead, City of Calgary, personal communication with Kim Sanderson, December 8, 2011.

[85] *The City of Calgary Municipal Development Plan*. 2009; p. 5-10, http://www.calgary.ca/PDA/LUPP/Documents/Publications/mdp-municipal-development-plan.pdf

[86] City of Calgary, Community Services and Utilities & Environmental Protection Report to the SPC on Utilities and Environment: Environmental Reserve Setbacks, April 25, 2007, http://www.calgary.ca/CSPS/Parks/Documents/Planning-and-Operations/Natural-Areas-and-Wetlands/environmental_reserve_setback_policy.pdf.

[87] City of Calgary. 2004, *Wetland Conservation Plan*, see http://www.calgary.ca/CSPS/Parks/Documents/Planning-and-Operations/Natural-Areas-and-Wetlands/wetland_conservation_plan.pdf

[88] Calgary Parks and Recreation, City of Calgary. 1994, *Natural Area Management Plan*, http://www.calgary.ca/CSPS/Parks/Documents/Planning-and-Operations/Natural-Areas-and-Wetlands/natural-area-management-plan.pdf

[89] The City of Calgary, Parks. 2003, *Open Space Plan*, http://www.calgary.ca/CSPS/Parks/Documents/Planning-and-Operations/open-space-plan.pdf

policies in more specific, related planning and management documents, such as stormwater management, urban forestry, and others.

Edmonton's **Stormwater Quality Control Strategy and Action Plan** (2008)[90] was developed to improve watershed health by reducing stormwater pollution to the North Saskatchewan River (NSR). Some stormwater from newer areas in the City does receive partial treatment as it flows through wet ponds and constructed wetlands. Stormwater from about 8,800 ha is now routed through 158 wet ponds and about 16 constructed wetlands. That still leaves about 20,600 ha of runoff that can discharge directly into tributary creeks or the NSR via 235 stormwater outfalls. The Kennedale end-of-pipe treatment facility in one of the City's four major storm basins was completed in 2009 and was Edmonton's first wetland built exclusively to improve stormwater quality before discharge to the NSR. It serves Edmonton's largest storm basin. The facility, which receives runoff from 7,250 ha, is expected to remove about 1,100 kg of TSS per day, using oil/grit separators and park space improvements.[91] The Groat Road Basin End-of-Pipe Underground Stormwater Treatment facility in Government House Park is also completed and measures are being investigated for the Quesnell and Whitemud Creek/30th Avenue storm basins. Other major facilities to help manage urban runoff include Fulton Creek Marshland, Roper Pond, Pylypow Constructed wetland, and Mill Creek Oil Removal Facility. All the Strategy components (two wetlands, two low-flow diversions, and staged LID implementation) have a combined potential TSS reduction credit of 2,440 kg/day.[92] Other measures such as BMPs and LID initiatives are described in section 2.2.2.

The **Combined Sewer Overflow (CSO) Control Strategy** (2000)[93] was a requirement in the City of Edmonton's approval to operate. It is a long-term program to improve capture and treatment of combined sewer overflows otherwise discharged to the NSR. Combined sewers transport both domestic sewage and stormwater, and result in discharges of untreated sanitary sewage into watercourses during high intensity rainfalls. Edmonton has 18 CSO outfalls. The Strategy expects to increase the average annual capture and treatment of wet weather flows in the sewer system from 56% to 86%, and reduce average annual CSO occurrences from 89 to 46. An updated CSO Control Strategy is due to be completed by June 2012.

The **Interconnection Strategy** is an ongoing program to monitor and eliminate dry weather sanitary overflows into the storm sewer system. As of 2009, only 142 of the original 390 interconnection sites remain to be addressed.[94]

Edmonton's **Natural Area Systems Policy** (Policy C531)[95] was adopted in 2007. Its primary intent is to safeguard natural areas and biodiversity, but this includes wetlands, water bodies and riparian areas. The conservation of the City's ecological network is to be considered in drainage planning and dedication of municipal reserve and environmental reserve, among other things. The document **Natural Connections:**

[90] City of Edmonton. 2008, *City of Edmonton Stormwater Quality Control Strategy & Action Plan,* http://www.edmonton.ca/environmental/documents/SWQStrategyActionPlan.pdf
[91] City of Edmonton, Drainage Services Branch. 2010, *City Discharges to the North Saskatchewan River: Addressing the Challenge.* Discussion Paper 9 in the Edmonton Sustainability Papers. See http://www.edmonton.ca/city_government/city_vision_and_strategic_plan/the-way-we-green-discussion-papers.aspx
[92] City of Edmonton, Drainage Services. 2009, *City of Edmonton Total Loadings Plan*. See http://www.edmonton.ca/environmental/documents/TotalLoadingPlan.pdf
[93] See http://www.edmonton.ca/environmental/documents/CSOReportJune2000.pdf
[94] See City of Edmonton Stormwater Quality Control Strategy & Action Plan. 2008, p. 11.
[95] See http://www.edmonton.ca/environmental/documents/Revised_Administrative_Directive_-_Policy_C531_FINAL_Mar._2009.pdf

Integrated Natural Areas Conservation Plan (2007)[96] supports this policy, taking an ecological network approach to conservation. One essential aspect of providing wildlife corridors is maintaining adequate riparian zones along major rivers and tributaries, which also serves to reduce potential NPSP.

c) Environmental Plans

Both Edmonton and Calgary have environmental plans and both cities report periodically on their environmental progress.

Calgary's **Environmental Action Plan** (2007)[97] has one goal pertaining to NPSP: Ensure and protect water quality. Under this goal, two of the five targets relate to NPSP:

- Keep TSS loading at or below the 2005 level
- Protect regional watersheds.

Edmonton recently completed a very comprehensive exercise that resulted in a number of new plans for the City, one of which is **The Way We Green** (2011),[98] the environmental strategic plan. Efforts were made to link the objectives with other municipal plans, particularly the Municipal Development Plan (*The Way We Grow*). One goal in *The Way We Green* pertains to NPSP: Water quality in the North Saskatchewan River sustains healthy people and ecosystems. Four of the five objectives under this goal relate to NPSP, and each objective has a number of strategic actions:

- 4.1: The City of Edmonton protects, maintains and continually enhances the water quality of the North Saskatchewan Watershed.
- 4.2: The North Saskatchewan River and its tributaries are protected from pollution and erosion caused by stormwater runoff from Edmonton's built areas.
- 4.3: The North Saskatchewan River and its tributaries are protected from pollution from Edmonton's combined sewer overflows.
- 4.5: Impacts on Edmonton's water resources are mitigated by ensuring that new developments in Edmonton embody an exemplary standard of ecological design.

2.2.2 Use and Implementation of BMPs

Many BMPs have been developed and applied to manage NPSP in urban areas; these are reflected in the numerous manuals and guidance documents used in both Calgary and Edmonton. Approaches such as environmental strategies and action plans also tend to focus on the use of BMPs. Outreach and education programs are considered in section 2.2.4.

a) Erosion and Sediment Control

Calgary's **Guidelines for Erosion & Sediment Control** (2001)[99] are intended to help designers and administrators of the Stormwater Management System in Calgary implement appropriate control measures to prevent sediment pollution. The aim is to encourage prevention rather than effect a cure, thus emphasis is placed on protecting exposed surfaces and controlling runoff. The manual focuses heavily on two types of BMPs: source control BMPs; and runoff, conveyance, and treatment BMPs. "Source control BMPs help prevent sediment-laden flows from running onto surfaces where pollutants can be picked up.

[96] City of Edmonton. 2007, *Natural Connections Strategic Plan*, http://www.edmonton.ca/environmental/documents/Natural_Connections_-_Strategic_Plan_JUNE_09.pdf
[97] City of Calgary. 2007, *The City of Calgary's Environmental Action Plan*, http://www.calgary.ca/UEP/ESM/Documents/ESM-Documents/environmental_action_plan.pdf
[98] City of Edmonton. 2011, *The Way We Green: The City of Edmonton's Environmental Strategic Plan*, http://www.edmonton.ca/city_government/city_vision_and_strategic_plan/the-way-we-green.aspx
[99] City of Calgary. 2001, *Guidelines for Erosion & Sediment Control*, http://www.calgary.ca/UEP/Water/Documents/Water-Documents/escguidelines2001-02-12.pdf

When contaminants are picked up, they should be routed through runoff, conveyance and treatment BMPs. BMPs also include good housekeeping practices."[100]

Similarly, **Edmonton's Erosion and Sedimentation Control Guidelines** (2005)[101] and the accompanying **Erosion and Sedimentation Control Field Manual** (2005)[102] were prepared to help owners, developers, consultants, contractors, and City departments and staff understand erosion and sedimentation control issues and provide general direction in managing those issues. The Guidelines discuss regulatory requirements as well as considerations in an erosion and sedimentation control plan and includes a chapter on BMPs. The Field Manual provides much more detail, with about half of the 100-page document devoted to a discussion of BMPs.

b) Salt Management

Both Calgary and Edmonton have strategies to manage the implications of keeping roads safe for winter driving. Environment Canada's *Code of Practice for the Environmental Management of Road Salts*[103] requires annual reporting to Environment Canada by June 30 of each year, starting in 2005. The Transportation Association of Canada has produced various materials on salt management, including *Syntheses of Best Practices: Road Salt Management, Salt Management Plans* (2003). These materials are intended to assist road authorities as they find ways to more effectively manage salt required for winter maintenance while minimizing effects on the environment.[104]

Calgary's **Road Salt Management Plan** was developed in accordance with Environment Canada's Code of Practice. Its overall goal is to improve environmental protection without compromising road safety. To that end, the Plan sets out the policy and procedural framework for ensuring that the City of Calgary continuously improves the management of road salt used in its snow and ice control operations. It addresses aspects of salt mixing and application, salt storage, equipment washing, and other activities that could lead to salts becoming a non-point source pollutant.[105] The City has also installed two large tent structures to cover its salt storage depot in south Calgary to prevent wind erosion and keep the stockpile dry. The tents are built on an impermeable surface and an emergency containment pond is located adjacent to the depot in the unlikely event of salt runoff from the site.[106]

Edmonton's **Roadway Maintenance Salt Management Plan** (2004) describes in detail the procedures for storage, use, and application of salt required for winter road maintenance. The Plan enables the City to compare its current practices to best practices, identify gaps and focus on closing the gaps. The City of Edmonton undertakes best practices in its use of salt for winter road safety.[107] Edmonton is involved in traction studies to assess when to apply sand or salt or nothing, which could lead to significant source reductions. The City is also reviewing practices at the yards where salt and sand are stored. This includes

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[100] City of Calgary. 2001, *Guidelines for Erosion & Sediment Control*, http://www.calgary.ca/UEP/Water/Documents/Water-Documents/escguidelines2001-02-12.pdf, p. 32.
[101] City of Edmonton. 2005, *Erosion and Sedimentation Control Guidelines*, http://www.edmonton.ca/city_government/documents/ControlGuide.pdf
[102] City of Edmonton. 2005, *Erosion and Sedimentation Control Field Manual*, http://www.edmonton.ca/city_government/documents/FieldManual.pdf
[103] See http://www.ec.gc.ca/nopp/roadsalt/cop/en/code.htm
[104] Transportation Association of Canada. 2003, *Syntheses of Best Practices: Road Salt Management, Salt Management Plans*, http://www.tac-atc.ca/english/resourcecentre/readingroom/pdf/roadsalt-1.pdf
[105] *Road Salt Management Plan, 2011 Snow and Ice Control Operations*. Revised November 30, 2011. The City of Calgary ROADS.
[106] City of Calgary Salt Management Plan FAQ, http://www.calgary.ca/Transportation/Roads/Pages/Road-Maintenance/Snow-and-ice-control/Salt-management-plan-FAQs.aspx
[107] City of Edmonton. 2006, *The City of Edmonton's 2006 Environmental Strategic Plan*, http://www.edmonton.ca/environmental/documents/2006_ESP.pdf

measuring salt losses from the sites, examining salt transfer technology, and methods to develop more homogeneous storage piles.[108]

c) Snow and Sand Management

In addition to managing the salt and sand used on city streets, winter cities must also deal with the snow-salt-sand mixture that is collected when snow is cleared from streets, as well as the sand that is left behind on the roads in the spring. Edmonton is transitioning its five snow storage sites to engineered facilities, which are designed and built solely for storing and managing snow. Two of these sites have a hard surface for snow storage, and all have one or two ponds and a weir system to enable the meltwater to be collected and the sediment to settle; the ponds are then cleaned out in the summer. Snow storage sites that are hard-surfaced experience much less erosion than non-engineered sites and show lower levels of TSS and other parameters such as heavy metals that attach to sediments in runoff.[109]

Both Edmonton and Calgary have procedures in place to ensure that spring street-sweeping to collect sand is done in a way that minimizes runoff. Since 2004, Edmonton has been cleaning and recycling the road sand it collects.

d) Low Impact Development

Both Edmonton and Calgary are working to incorporate LID principles, practices and technologies. Both cities have initiated research and are developing LID guidelines suitable for their soils and climate, with the expectation that such practices will be more widely implemented, particularly in new developments.[110]

LID is mentioned elsewhere in this report and includes many possible approaches. Figure 2 provides a short overview of LID and some examples.

e) Other Initiatives

Calgary's Integrated Pest Management Plan[111] and Edmonton's Integrated Pest Management Policy[112] affect NPSP insofar as they aim to reduce the amount of herbicides and pesticides applied to City property. Both cities also have emergency response measures to contain and clean up spills.

[108] Wanda Goulden, City of Edmonton Transportation Services, personal communication with Kim Sanderson, December 19, 2011.
[109] Wanda Goulden, City of Edmonton Transportation Services, personal communication with Kim Sanderson, December 19, 2011
[110] For more information on LID, see the Alberta Low Impact Development Partnership at http://alidp.org/
[111] See http://www.calgary.ca/CSPS/Parks/Documents/Planning-and-Operations/Pest-Management/ipm.pdf
[112] See http://www.edmonton.ca/for_residents/integrated_pest_management_policy.pdf

Figure 2. Low Impact Development

Low Impact Development (LID) is an approach to land development (or re-development) that works with nature to manage stormwater as close to its source as possible. LID aims to increase water absorption in the urban landscape and thus reduce the amount that runs off into a stormwater system (and eventually a water body), taking sediment and pollutants with it. The use of LID principles and practices reduces the impact of built areas and promotes the natural movement of water in an ecosystem or watershed.

LID includes a wide variety of approaches and BMPs such as green roofs, rain gardens, rain barrels, porous paving materials, grassed swales (bioswales) and bioretention facilities. Selecting an appropriate LID approach means considering land use, hydrology, soil type, climate, rainfall and possibly other factors.

North Carolina State University has published a Guidebook on LID approaches. The guide contains four case studies, including one that compares the costs and benefits of low impact development with conventional development at a Piedmont site with residential lots that are approximately 0.4 ha in size. This example (section 8.4 in the guide) illustrates how LID development can be designed at a lower cost than conventional design by offsetting higher BMP costs with reduction in impervious surfaces and stormwater infrastructure. Low impact development using BMPs, which include roadway with a grass swale (instead of sidewalks and curbs), preserved natural area in front yard, and backyard draining down slope to a greenway trail (with filter strip and bioswale with underdrain) beyond the rear of a property, reduces the release of nitrogen, phosphorus and sediment to less than half the values found with conventional development.

Some text adapted from U.S. EPA website at http://www.epa.gov/owow/NPS/lid/; and North Carolina State University. 2009. *Low Impact Development: A Guidebook for North Carolina*, http://www.ces.ncsu.edu/depts/agecon/WECO/lid/documents/NC_LID_Guidebook.pdf

2.2.3 Monitoring NPSP and Assessing Management Outcomes

Calgary and Edmonton both have water quality monitoring networks in addition to the mainstem monitoring done by Alberta Environment and Water and other watershed partners. They monitor a variety of parameters in a number of locations, including stormwater outfalls. The monitoring results are incorporated into various reports to Alberta Environment and Water and to "state of environment" type reports compiled by the cities.

2.2.3.1 City of Calgary

The City of Calgary's surface water quality sampling network comprises 34 stations both upstream and downstream of the city. Sampling and analytical methods are described in detail in the *Calgary Watershed Report, 2007-2009*, which also identifies the following sampling stations: "In the Bow River watershed, seven mainstem sites are sampled routinely, two major tributaries, and three sites on Bearspaw Reservoir. In the Nose Creek watershed three sites are sampled, two in the Fish Creek watershed, and one in the Ghost River watershed. In the Elbow River watershed, the sampling network includes eight locations on the mainstem river, four major tributaries, and four sites on Glenmore Reservoir. These sites are sampled either throughout the entire year or during the open-water season, and all at least on a monthly frequency. A full complement of water quality parameters is analyzed for each site, including routine physical/chemical variables, nutrients, major ions, metals, and bacteria."[113]

In-stream monitoring for TSS is conducted in the Bow River downstream of Calgary to measure Calgary's performance relative to the total loading objective. In-stream continuous monitoring for

[113] City of Calgary Water Resources. *Calgary Watershed Report, 2007-2009: A Summary of Surface Water Quality in the Bow and Elbow River Watersheds, 2007-2009.* p. 2.

dissolved oxygen is coordinated with Alberta Environment and Water to monitor effects related to loadings of total phosphorus.[114]

Calgary has over 400 stormwater outfalls, and loadings depend on how precipitation is distributed. In developing its Total Loading Management Plan, the City monitored 18 sub-catchments from 2001-2004 to determine Event Mean Concentrations for the different pollutants of concern from representative land uses. The Event Mean Concentrations were combined with a hydrology computer model to estimate the annual pollutant loads from the city. Four major storm sewer trunks have been continuously monitored from May through August since 2007 to verify loading factors used to calculate TSS loadings. Analysis for total phosphorus was added in 2010. Two more areas will be added in 2012. As new stormwater source control practices, such as bioretention areas, are constructed, monitoring will be a key factor in determining their effectiveness and a monitoring program for these new practices is being developed to measure the effects on water quality and volume runoff.[115]

Calgary's stormwater retrofit program for older communities has completed eight projects, which have reduced the TSS loading to the Bow River by an estimated 2,600 kg per day. It is expected that the cumulative impact of all retrofit projects will allow Calgary to achieve its total loading targets for stormwater quality entering the Bow River.[116] The integrated approach that Calgary has adopted for stormwater management appears to be achieving the desired result of reducing TSS despite continued expansion of the city.

Calgary's most recent ***State of the Environment Report*** (2010)[117] provides a concise overview of the state of air, land and water in the city. It stresses the integrative nature of Calgary's strategy to protect local surface waters and address both point and non-point sources of pollution.

2.2.3.2 City of Edmonton

The City of Edmonton monitors water quality in 29 locations; of these, four are intake locations, four are storm sewer outfalls, four are combined sewer outfalls, 11 are tributaries (creeks) within the city, and six are lakes or wetlands. Storm outfall base flow is sampled twice a month and samples are also collected during every rainfall that creates significant flows to determine volume and concentrations of total loading mass. Combined sewer outfalls are sampled at every rainfall or snowfall event. Tributaries are sampled twice a year and stormwater management facilities (e.g., retention ponds) are sampled six times a year, monthly from May to October, except for the Kennedale facility which has a specific sampling protocol.[118] The City also has a quasi real-time river sampling program, which uses the raw water intake structures at the E.L. Smith Water Treatment Plant and at the Dow Chemical Facility in Fort Saskatchewan to collect samples and provide a detailed baseline assessment during spring and summer wet weather events.[119]

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[114] City of Calgary. 2010 Stormwater Management Strategy Update at http://agendaminutes.calgary.ca/sirepub/cache/0/2xnyn455bo11nv45y0f1rrrq/372171230201104491517 5.PDF

[115] Information in this paragraph adapted from the 2010 Stormwater Management Strategy Update at http://agendaminutes.calgary.ca/sirepub/cache/0/2xnyn455bo11nv45y0f1rrrq/372171230201104491517 5.PDF and from personal communication with Yin Deong, City of Calgary.

[116] City of Calgary. Agenda, SPC on Utilities and Environment Meeting, Feb. 23, 2011. UE2011-03. Stormwater Management Strategy 2010 Update, http://agendaminutes.calgary.ca/sirepub/mtgviewer.aspx?meetid=128&doctype=AGENDA&itemid=3438

[117] City of Calgary Environmental & Safety Management. *2010 State of the Environment Report,* 4th edition, http://www.calgary.ca/UEP/ESM/Pages/State-of-the-Environment/State-of-the-Environment-Report.aspx

[118] City of Edmonton Water Quality Monitoring Locations, http://www.edmonton.ca/environmental/wastewater_sewers/stormwater-quality-control-strategy.aspx

[119] City of Edmonton *Stormwater Quality Control Strategy and Action Plan*, 2008.

Other components of the City's program for tracking system performance related to stormwater management include:

- Biological diversity assessment of six constructed wetlands;
- Site monitoring of Altalink-Cumberland bioswale;
- Monitoring of Clover Bar Creek and Mill Creek Roper Pond for site risk management;
- Monitoring for stormwater retention on any porous pavement surfaces installed on demonstration sites in the Griesbach development or City-owned parking lots; and
- Annual system-wide total loadings assessment and reporting.

Monitoring of sewer outfalls to the North Saskatchewan River began in the late 1970s and evolved to become the Environmental Monitoring Program. "In 2009, 80% of storm and 95% of combined sewer discharges were monitored with a total of 379 samples collected and over 3,000 analytical laboratory tests completed."[120]

Edmonton's ***EcoVision Annual Report*** (2009) notes that Edmonton has used historical information from the Environmental Monitoring Program to develop the Edmonton Watershed Contaminant Reduction Index. The Index is "a performance measure that compares combined annual loading data and the city's population data to the established baseline and represents the progress toward reaching the ultimate target of zero loads to the North Saskatchewan River. [The Index] is calculated by combining annual loading data for three equally weighted key water quality indicators – total suspended solids, nutrients (ammonia and phosphorus), and bacteria and the City's population numbers for each year. These important watershed parameters are mathematically converted into a simple Contaminant Reduction Index score, where a maximum score of 10 equals zero loads to the river."[121] In 2009, the Index was 7.9, up from 6.8 in 2008; an Index over 7.4 is considered good.[122]

2.2.4 Building Awareness

Public support and engagement are important aspects of managing NPSP at the municipal level. Cities can also work with developers, contractors and others to share information. Some examples of activities in Calgary and Edmonton are noted in this section.

Cities have also partnered with other organizations in public education programs, such as Trout Unlimited's Yellow Fish Road™ Program, a nation-wide environmental education initiative in place since 1991. The Yellow Fish Road program's goal is to help Canadians understand that preventing pollutants from entering the stormwater system is critical to protecting and improving water quality and aquatic habitat.[123]

The City of Calgary has worked with the Alberta Low Impact Development Partnership to deliver workshops to the development industry on new techniques in stormwater management. Other efforts include a multi-year strategy to demonstrate and evaluate retrofitting LID technology such as rain gardens in existing communities.[124] Many other resources about water are on the City's website.[125]

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[120] City of Edmonton. 2009, *EcoVision Annual Report: City of Edmonton 2009;* p.66, http://www.edmonton.ca/environmental/planning/videos-booklets-annual-report-environment.aspx
[121] City of Edmonton. 2009, *EcoVision Annual Report: City of Edmonton 2009,* p.68.
[122] City of Edmonton. 2009, *EcoVision Annual Report: City of Edmonton 2009.*
[123] Trout Unlimited, Yellow Fish Road, http://www.yellowfishroad.org/
[124] City of Calgary. Agenda, SPC on Utilities and Environment Meeting, Feb. 23, 2011. UE2011-03. Stormwater Management Strategy 2010 Update, http://agendaminutes.calgary.ca/sirepub/mtgviewer.aspx?meetid=128&doctype=AGENDA&itemid=3438

Drainage Services in the City of Edmonton offers public education programs for school children and for adults. For example, the elementary school program, **Treat it Right!®** aims to teach children how their actions can have a negative impact on the stormwater and wastewater systems and ultimately on the environment. This webpage includes links to other organizations with educational resources.[126]

2.2.5 Other Municipalities

Undoubtedly many Alberta municipalities have developed bylaws, policies and practices to address NPSP. One example is the growing Town of Cochrane (15,000 population). To manage its environmental footprint, the town has introduced a number of innovative measures to improve water management and conservation. Pertinent to managing NPSP, Cochrane's land use bylaw requires the use of native plants, mulch and other pervious surfacing material (an approach often referred to as "naturescaping") to a minimum of 25% of all new residential greenspace, and in 100% of commercial greenspace.[127]

Since 2006, the City of St. Albert has been working with a consultant to monitor water quality at sites upstream and downstream from the city, as well as at several stormwater outfalls.[128] The study now has nine river sites and ten outfall sampling locations. Samples are collected four times per year: spring runoff, after major storm events in the early and late summer, and under low-flow conditions in the fall. Routine parameters (nutrients, metals, bacteria, and pesticides) are monitored throughout the year. Although the City has worked to reduce nutrients, salts and pesticides entering the river, river water quality has worsened for most parameters over the period of record, while stormwater trends have been inconsistent. Bacteria and pesticides have historically shown a modest increasing trend as the river runs through the city. The extensive park system that runs along much of the river within city limits may help explain these increases, as the parks are popular with dog walkers and have extensive areas of manicured lawns.[129]

Another example is the Riparian Setback Matrix Model (RSMM), originally developed by Aquality Environmental Consulting Ltd. for Lac La Biche County in 2007 and subsequently incorporated into the county's municipal bylaws and watershed management plan.[130] The RSMM has since been adopted by the Municipal Districts of Rockyview and Foothills, as well as Leduc and Sturgeon Counties and the Town of Turner Valley.[131] "The Riparian Setback Matrix Model creates unique, defensible Environmental Reserve setbacks based on slope, height of bank, groundwater table level, soil type and texture, and vegetation/ground cover. These development setbacks will help to protect riparian lands and maintain the ecological goods and services that healthy and functional riparian areas provide for future generations' benefit."[132] Recommended riparian setbacks for certain vegetation cover to control nutrients and sediment are noted in Table 2.

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[125] See http://www.calgary.ca/UEP/Water/Pages/Youth-education/Teacher-Resources.aspx and http://www.calgary.ca/UEP/Water/Pages/Youth-education/Other-School-and-Community-Programs.aspx

[126] See http://www.edmonton.ca/environmental/wastewater_sewers/drainage-education.aspx

[127] Cochrane example noted in the *Bow River Basin State of the Watershed Summary.* 2010, Bow River Basin Council, http://www.brbc.ab.ca/index.php?option=com_content&view=article&id=84&Itemid=1022

[128] See the annual reports prepared for the City of St. Albert, http://aquality.ca/index.php?page=technical-reports

[129] Joshua Haag, Aquality Environmental Consulting Ltd., personal communication with Kim Sanderson, January 6, 2012.

[130] Aquality Environmental Consulting Ltd. 2009, *Lac La Biche Watershed Management Plan,* http://www.laclabichecounty.com/files/labiche/watershed_management_plan.pdf

[131] Jay White, Principal, Aquality Environmental Consulting Ltd., personal communication with Kim Sanderson, April 3, 2012.

[132] *The Riparian Setback Matrix Model. June 2007. Municipal District of Foothills No. 31;* p. 6. See http://www.mdfoothills.com/media/files/upload/RSMM-MD-Foothills-Apr-1_10-2_wxm.pdf.

Table 2. Recommended Riparian Setbacks for Nitrogen, Phosphorus and Sediment Control

Parameter	Riparian Vegetation	Recommended Setback (m)	Notes
Nitrogen	Grass	50+	-Will remove ~90% of nitrate from surface and subsurface runoff
	Grass/Shrub or Forest	30+	
	Forest	30+	
Phosphorus	Grass	20+	-Will reduce soluble phosphorus by ~90% -See recommendations for sediment for the removal of total phosphorus (most phosphorus enters a buffer attached to the sediment)
	Grass/Shrub or Forest	20+	
	Forest	20+	
Sediment	Grass	30+	-Will remove ~90% of sand and silt particles -100m is required for the effective removal of clay particles -For long-term retention of sediments, the setback should be 30-100m
	Grass/Shrub or Forest	30+	
	Forest	25+	

Source: *The Riparian Setback Matrix Model. June 2007, Municipal District of Foothills No. 31;* p. 16.

2.2.6 Roads and NPSP

Roads contribute to NPSP, as noted in the phase I report for this project. In addition to urban streets, the province has thousands of kilometres of roads outside Alberta cities. Responsibility for these roads rests with the many rural and smaller urban municipalities as well as with Alberta Transportation (AT). NPSP can occur during and after road construction, near stream crossings, and as a result of highway maintenance and management.

To avoid creating NPSP when new roads are built or existing roads are expanded, AT works with Alberta Environment and Water to assess landscape drainage patterns and ensure that these patterns will not be affected by the proposed route. If there is a watercourse in the area, some channel realignment may be necessary.[133]

AT has prepared a number of guidance documents and manuals with the intent of avoiding and mitigating NPSP associated with road construction, maintenance and drainage. The Department also regularly shares information with rural municipalities to help guide their road planning, construction and management activities. AT's *Environmental Protection Plan for the Planning and Construction of Water and Transportation Projects* outlines the standard measures the Department uses to prevent or mitigate environmental impacts resulting from construction activities and identifies project-specific considerations to be implemented.[134] Other documents relevant to managing NPSP, many of which also feature BMPs, include:

- *Erosion and Sediment Control Manual* (2011);[135]
- *Field Guide for Erosion and Sediment Control* (2011);[136]

[133] Don Snider, Director, Environmental Management Services, Alberta Transportation, personal communication with Kim Sanderson, February 13, 2012.
[134] Alberta Transportation. 2009, *Environmental Protection Plan for the Planning and Construction of Water and Transportation Projects*, http://www.transportation.alberta.ca/Content/docType245/Production/AT_%20Enviro_Protect_Plan.pdf
[135] Alberta Transportation. 2011, *Erosion and Sediment Control Manual*, http://www.transportation.alberta.ca/4626.htm

- *Fish Habitat Manual* (revised 2009);[137]
- *Highway Maintenance Guidelines and Level of Service Ma*nual (2000);[138] and
- A web page with extensive guidance on the construction of bridges and structures.[139]

Salt management is another important consideration. Under Environment Canada's *Code of Practice for the Environmental Management of Road Salts*, every jurisdiction that uses more than 500 tonnes of salt per year is supposed to develop a salt management plant that addresses application, storage, and other aspects. Although voluntary, it is estimated that about 90% of Alberta's municipalities do have salt management plans in place.

Maintenance yards, which store salt and sand for winter use, are found in many locations around the province. In the 1990s, the Government of Alberta sold its 130 maintenance yards and these are now managed by the private sector although AT is still ultimately responsible for these properties and has set out Environmental Management Plan Guidelines for highway maintenance yards.[140] However, monitoring now underway around some yards is showing evidence of runoff and seepage of salts into groundwater. Additional monitoring is needed around these yards as well as around municipal facilities in rural areas to determine the extent to which salt is a problem. Monitoring along sensitive waterways, high value watercourses and source water areas is also needed to find out if contamination is occurring from road salt runoff and drainage impacts.[141]

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[136] Government of Alberta. 2011, *Field Guide for Erosion and Sediment Control*, version 2, http://www.transportation.alberta.ca/Content/docType372/Production/FieldGuideforErosionandSedimentControl-June2011.pdf

[137] Government of Alberta, Transportation. 2009, *Fish Habitat Manual: Guidelines and Procedures for Watercourse Crossings in Alberta*, http://www.transportation.alberta.ca/Content/docType245/Production/Complete_Fish_Habitiat_Manual.pdf

[138] Alberta Transportation. 2000, *Highway Maintenance Guidelines and Level of Service Manual*, http://www.transportation.alberta.ca/Content/docType34/Production/los_manual.pdf

[139] Alberta Transportation, http://www.transportation.alberta.ca/565.htm

[140] Alberta Transportation. 2010, *Contract Administration Manual*, Appendix 6: Environmental Management Plans, http://www.transportation.alberta.ca/documents/Appendix_6.pdf

[141] Don Snider, Director, Environmental Management Services, Alberta Transportation, personal communication with Kim Sanderson, February 13, 2012.

2.3 Forestry

In 1948, Alberta was divided into two main areas for the purpose of land management: the Green Area, which is public land, and the White Area, most of which is privately owned. These two areas respectively cover about 58% and 42% of the province's land base.[142] The Government of Alberta (GoA) regulates public land use for a variety of activities, including timber production. Alberta's forests cover 27,718,000 ha,[143] and forestry operations are a dominant use in the Green Area.

The GoA has sub-divided the Green Area into Forest Management Units (FMUs), which are forested public lands designated under the *Forests Act* as administrative units to manage timber. The GoA allocates the right to harvest timber in the FMUs to companies and individuals through a forest tenure system, which includes Forest Management Agreements (FMAs).[144] FMAs are the dominant form of forest tenure; they cover nearly one-third of Alberta's land base[145] and are negotiated with the company and authorized as Orders-in-Council. Between May 1, 2009 and April 30, 2010, FMUs within FMAs included about 23.1 million ha or 66% of the Green Area.

FMA holders are required to create a Forest Management Plan (FMP) for their defined forest area, and these plans must be approved by the Minister of Alberta Sustainable Resource Development (SRD). FMPs (also referred to as Detailed Forest Management Plans) are technical documents that describe forest management objectives, strategies and commitments, and identify intended methods of cutting, reforesting, and managing timber resources in the FMA. They look beyond sustained timber yield to, among other things, recognize other resource values and uses. SRD is responsible for forest management planning on the 4.3 million ha of non-FMA FMUs with timber dispositions.[146] Timber Harvest Planning and Operating Ground Rules provide direction to forest companies and government for planning, implementing and monitoring timber harvesting operations on timber dispositions.

The Phase I report for this project notes that forest harvesting and its associated activities represent important potential sources of NPSP. Runoff can potentially result from land disturbance, increased sedimentation from road construction and use, and the use of herbicides. Several policy and regulatory tools are used to manage NPSP in the forestry sector.

2.3.1 Policy and Regulatory Tools

The provincial *Forests Act* provides the legislative framework for administering forest lands (allocation of timber, annual allowable cut, etc.) and for forest management planning but is not directly relevant to NPSP. The main policy and regulatory tools that apply or could apply to NPSP from forestry include:

- Timber Harvest Planning and Operating Ground Rules
- Alberta Forest Management Planning Standard
- *Environmental Protection and Enhancement Act*

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[142] Alberta Sustainable Resource Development. Fall 2010, *Sustainable Forest Management Current Facts and Statistics,* http://www.srd.alberta.ca/LandsForests/ForestManagement/ForestManagementFactsStatistics/documents/GeneralBoundary-CurrentFactsAndStatistics-2010.pdf

[143] Statistics Canada, http://www40.statcan.gc.ca/l01/cst01/envi34a-eng.htm

[144] The other tenure types are a Timber Quota and a Timber Permit. Timber quotas and FMAs are 20-year renewable agreements.

[145] See https://www.landuse.alberta.ca/Planning/WhyLandusePlanning/UnderstandingLandUseAlberta/Pages/default.aspx

[146] Much of the text in this paragraph is adapted from *Sustainable Forest Management Current Facts and Statistics*. Fall 2010. Alberta Sustainable Resource Development. For more information on FMPs, see also http://srd.alberta.ca/LandsForests/ForestManagement/ForestManagementPlans/Default.aspx

- Herbicide Reference Manual (2004)
- *Public Lands Act*
- *Water Act* (and the Environmental Code of Practice for Watercourse Crossings)

Of these, the Timber Harvest Planning and Operating Ground Rules are the most comprehensive and relevant to managing NPSP. The federal *Fisheries Act* is also pertinent.

Timber Harvest Planning and Operating Ground Rules

Operating Ground Rules, which tenure holders must follow as a condition of their tenure document and harvest approval, provide guidance in how actions are carried out on the ground[147] and therefore greatly influence the management of NPSP. The *Alberta Timber Harvest Planning and Operating Ground Rules Framework for Renewal* (2008)[148] provides guidance in the form of a template for companies to use in developing Operating Ground Rules for their specific FMA.

The ground rule scope is noted in the Framework document: "Ground rules are the practices used in planning and conducting timber harvesting operations which constitute the methods used to implement decisions made in the FMP and other higher level plans such as Integrated Resource Plans (IRP). In the event that these strategic plans do not exist, the ground rules shall establish practices that minimize the chance of negative impacts from roads, timber harvesting and forest management operations and activities" (p. 4). The Framework envisions that ground rules will be reviewed regularly to correct any inconsistencies or problems and so that modifications can be considered that reflect the best and most current knowledge and tools available.

The Framework template includes a list of topics that must be addressed in all ground rules. It includes specific text that is mandatory and would only be changed if, in Alberta's opinion, the result is a higher standard of practice. The Framework includes a number of different ground rules to take into account the variation in landscape and timber type across the province, with the result that the Operating Ground Rules for each FMA are unique and reflect specific regional conditions and circumstances.

The sections that are most relevant to managing NPSP are Chapter 6 (Watershed Protection), Chapter 9 (Soils) and parts of Chapters 7 (Habitat Management) and 11 (Roads).

The purpose of Chapter 6 on Watershed Protection is "to manage the implications of timber operations on water quality, quantity and flow regime by:

- Minimizing the potential for sedimentation in watercourses
- Preventing soil, logging debris and deleterious substances from entering watercourses
- Maintaining aquatic and terrestrial habitat
- Complying with the *Water Act*" (p. 21).

The ground rules in Chapter 6 define operating practices to protect water quality and riparian values. This is where buffer and other requirements are noted for different watercourse classifications, as shown in Table 3.[149] This is one section where specific regional conditions are often incorporated into a company's ground rules. An example of a specific regional condition incorporated into a company's ground rules is

[147] Darren Tapp, Executive Director, Forest Management Branch, Alberta Sustainable Resource Development, personal communication with Kim Sanderson, December 22, 2011.

[148] Alberta Sustainable Resource Development. 2008, *Timber Harvest Planning and Operating Ground Rules,* http://srd.alberta.ca/LandsForests/ForestManagement/ForestManagementPlanning/documents/Annex_4_draft_Jan_15_08Final.pdf

[149] Table 3 is excerpted from *Timber Harvest Planning and Operating Ground Rules. 2008. Alberta Sustainable Resource Development,* pp. 25-27.

noted in the *Spray Lake Sawmills and C05 Timber Harvest Planning and Operating Ground Rules*, updated in January 2011.[150] The following text was added to the Watercourse Protection Area requirements for Large Permanent water bodies (see Table 3):

> "Watercourses with deeply incised **unvegetated** banks shall have the buffer start from the top of the incised valley and not the high water mark."

[150] Online at http://srd.alberta.ca/LandsForests/ForestManagement/documents/SprayLakeSawmills-OperatingGroundRules-Feb032011.pdf

Table 3. Standards and Guidelines for Operating beside Watercourses

Watercourse Classification	Roads, Landings and Bared Areas	Watercourse Protection Areas	Operating Conditions within Riparian Areas and Water Source Areas where Operations are Approved	
			Tree Felling	Equipment Operations
Class "A" Waterbodies*	Not permitted within 100m of high water mark. Any existing roads may be maintained at present classification standards. Any proposed watercourse crossings within 2 km upstream must be specifically approved in the AOP.	No disturbance of timber within 100m of the high water mark; No duff disturbance of intermittent (min 10m vegetated buffer) or ephemeral drainages (minimum 5m vegetated buffer) within 2 km upstream of Class "A" waterbody.	Not permitted without specific Alberta approval	Not allowed without specific Alberta approval
Class "B" Waterbodies*	Not permitted within 60m of high water mark. Any existing roads may be maintained at present classification standards. Any watercourse crossings within 500m upstream must be specifically approved in the AOP.	No disturbance or removal of timber within the appropriate riparian area specified by stream type unless specifically approved in the AOP. No duff disturbance of intermittent (min 10m vegetated buffer) or ephemeral drainages (minimum 5m vegetated buffer) within 500 m upstream of Class "B" waterbody.	Trees shall be felled so that they do not enter watercourse. Should slash or debris enter the watercourse immediate removal is required without a machine entering the watercourse.	Where removal of timber within 60m is approved, no machinery is permitted within 30m of the high water mark.
Large Permanent	Not permitted within 100m of the high water mark or water source area within the riparian management zone unless specifically approved in the AOP.	No disturbance or removal of timber within 60m of high water mark unless specifically approved in the AOP. No removal of timber shall be approved within 10 m of the high water mark.	Trees shall be felled so that they do not enter watercourse. Should slash or debris enter the watercourse immediate removal is required without a machine entering the watercourse.	Where removal of timber within 60m is approved, no machinery is permitted within 20m of the high water mark.
Small Permanent	Not permitted within 30m of the high water mark or water source area within the riparian management zone unless specifically approved in the AOP.	No disturbance or removal of timber within 30m of high water mark unless specifically approved in the AOP. No removal of timber shall be approved within 10 m of the high water mark. Transitional streams: Buffer of treed vegetation will be left for 10m from the high water mark or to the top of the break in slope, whichever is higher.	Trees shall be felled so that they do not enter watercourse. Should slash or debris enter the watercourse immediate removal is required without a machine entering the watercourse.	Where removal of timber within 30m is approved, no machinery is permitted within 20m of the high water mark.

Watercourse Classification	Roads, Landings and Bared Areas	Watercourse Protection Areas	Operating Conditions within Riparian Areas and Water Source Areas where Operations are Approved	
			Tree Felling	Equipment Operations
Intermittent	Not permitted within 30m of the high water mark or water source area within the riparian management zone unless specifically approved in the AOP.	Buffer of brush and lesser vegetation to be left undisturbed along the channel; Width of buffer shall vary according to soils, topographical breaks, water source areas and fisheries values.	Trees shall be felled so that they do not enter watercourse. Should slash or debris enter the watercourse immediate removal is required without a machine entering the watercourse.	Heavy equipment may operate within 20m only during frozen or dry periods. No skidding through watercourse except on snow/ice bridge or logfill. Crossings must be planned with adequate crossings to be removed on completion of operations. Where fish and spawning movements have been identified, special crossings that do not obstruct upstream fish passage or cause stream siltation may be required.
Ephemeral	Construction not permitted within a watercourse or water source area.	Buffer of undisturbed vegetation in wet gullies. Class "A" and "B" waterbody tributaries to be left undisturbed.	Accumulation of slash and debris to be removed progressively	Skidding restrictions apply on Class "A" and "B" waterbody tributaries; Skidding shall only be during dry or frozen conditions; Temporary crossings to be removed on completion of operations; On Class "A" and "B" waterbody tributaries, special crossing structures that do not cause stream siltation may be required.
Lakes (little or no recreation, waterfowl or sportfish potential)	Not permitted within 100m of high water mark unless specifically approved in the AOP.	On lakes exceeding 4 ha in area, no disturbance of timber within 100m of high water mark except where specifically approved in FHP. Where approval is granted to remove timber within the 100m zone, no timber shall be removed within 30m of the high water mark.	Trees shall be felled so that they do not enter watercourses, unless otherwise approved by Alberta. Should slash or debris enter the watercourse immediate removal is required without a machine entering the watercourse.	If timber removal is approved, no machinery to operate within 40m of the high water mark.
Lakes (with recreational, waterfowl or sport fish potential)	For shorelines not located within reserved areas, no disturbances shall be permitted within 200m of the high water mark unless specifically approved in the AOP.	On lakes exceeding 4 ha in area, no disturbance of timber within 100m of high water mark. Alberta in the FHP may require additional protection. On lakes	Trees shall be felled so that they do not enter the waterbody, unless otherwise approved. Should slash or debris enter the watercourse immediate removal	Consideration must be given to aesthetics when harvesting adjacent to lakes with recreational potential.

Watercourse Classification	Roads, Landings and Bared Areas	Watercourse Protection Areas	Operating Conditions within Riparian Areas and Water Source Areas where Operations are Approved	
			Tree Felling	Equipment Operations
		less than 4 ha, removal of timber prohibited within 30m of the high water mark and any removal within 100m requires Alberta's approval.	is required without a machine entering the watercourse.	
Water source Areas and Areas Subject to Normal Seasonal Flooding	Construction not permitted unless approved in the AOP; No log decks permitted; The number of stream crossings must be minimized; No disturbance of organic duff layers or removal of lesser vegetation.	Treed riparian management zone of at least 20m on all water source areas; No harvest of merchantable trees or disturbances of lesser vegetation unless specifically approved in the AOP; Buffer width may be altered according to its potential to produce surface water, provided it is approved in the AOP.	Heavy machinery not permitted within water source areas during unfrozen soil conditions; Minimal disturbance or removal of duff or lesser vegetation; Timber may be harvested if stream sedimentation is the only resource concern, provided there is no disturbance of the organic soils and lesser vegetation when harvesting the trees; On unstable areas subject to blowdown, merchantable trees shall be carefully harvested from water source areas to minimize root disturbances of duff layers and watercourse damming.	Road construction, timber harvest, reforestation and reclamation shall be done with equipment capable of operating without causing excessive disturbance to the soil layers; Heavy equipment is not permitted during moist or wet conditions, but may be operated during frozen periods; No soil caps or depositing of soil permitted on roads in water source areas, unless a separation layer is incorporated or the road is designed to provide adequate surface and sub-surface drainage away from the road bed; Where a separation layer is used, the soil cap shall be removed as operations are completed.
Oxbow Lake	Construction not permitted within 100m of oxbow lake unless specifically approved in the FHP.	The buffer shall encompass the area from the high water mark of the main watercourse to 20m beyond the high water mark of the oxbow lake. Oxbow lakes outside the buffer of the main watercourse shall be treated as water source areas.	Heavy equipment not permitted around oxbow lakes during unfrozen conditions. Trees shall be felled so they do not enter the waterbody, unless otherwise approved. Should slash or debris enter the watercourse, immediate removal is required without the machine entering the watercourse.	Approved activities shall be done with equipment capable of operating without causing excessive disturbance.

* Class "A" and "B" waterbodies are defined in the *Water Act.*
AOP = Annual Operating Plan FHP = Final Harvest Plan

Chapter 9 focuses on "Soils;" the purpose of this topic is "to conduct timber harvest, road construction, reforestation and reclamation operations in a way that shall:

- Minimize the potential for soil erosion;
- Prevent soil, logging debris and deleterious substances from entering watercourses;
- Ensure that the capability of the site to support healthy forest tree growth is maintained" (p. 53).

Ground rules to fulfill this purpose cover pre-harvest planning, harvesting and post-harvest reclamation and reforestation. For example:

- Areas susceptible to rutting, puddling or compaction shall be harvested during dry or frozen conditions.
- Roads within harvest areas that are no longer required shall be reclaimed and reforested.

Chapter 7.6 deals with Fisheries and the Aquatic Environment; the purpose of this topic is "to conduct timber operations in a manner that shall minimally affect:

- The health, diversity and natural distribution of aquatic biota;
- The quantity and productive capacity of the aquatic environment, including fish habitat; and
- Fisheries management objectives identified in the FMP." (p. 41)

The section notes that "the primary strategy for maintenance and protection of the aquatic environment and fish habitat is to maintain treed buffers along watercourses and water bodies and adopt rigorous watercourse crossing and erosion control measures" (p. 41). This section requires an assessment of the potential effects on fish and fish habitat for any activity that disturbs or alters the bed and banks of a fish-bearing water body, and refers to the Code of Practice for Watercourse Crossings.

Chapter 11 on "Roads" has two sub-sections relevant to NPSP. Section 11.3 on road construction, maintenance and reclamation states that "Roads shall be constructed, maintained and reclaimed in a timely manner to minimize environmental impacts" (p. 64). Section 11.3 also addresses construction, erosion control and prevention, and reclamation, and contains a total of 22 ground rules. For example:

- Water from roads, ditches and bared soil surfaces shall not be permitted to drain directly into watercourses. Where vegetated buffers alone do not retard water and sediment movement effectively, appropriate obstructions (e.g., logs, rocks, mounds) or sediment control structures shall be installed to dissipate the flow of water and capture sediment prior to entering the watercourse.

Section 11.4 deals with watercourse crossings and provides guidance "so that crossings are constructed, maintained and reclaimed in a manner that ensures negative environmental impacts are minimized and fish and fish habitat are protected. . . Watercourse crossings shall be designed, installed, maintained and deactivated in accordance with all applicable policy and legislation" (p. 67). The *Water Act Code of Practice for Watercourse Crossings* must be followed for all crossings; some situations may be exempt from the *Water Act* and *Code of Practice*, but must still have other approvals as specified in section 11.4. This section contains 27 ground rules.

Alberta Forest Management Planning Standard[151]

The Alberta Forest Management Planning Standard is not a regulation *per se*, but has been approved for use by the Minister.[152] Together with its annexes, interpretive bulletins and updates, it comprises the standard for preparing and implementing FMPs in Alberta. Alberta has adopted the CAN/CSA-Z809-

[151] See http://srd.alberta.ca/LandsForests/ForestManagement/ForestManagementManualsGuidelines.aspx

[152] Darren Tapp, Executive Director, Forest Management Branch, Alberta Sustainable Resource Development, personal communication with Kim Sanderson, December 22, 2011.

2002 *Sustainable Forest Management: Requirements and Guidance Document* (referred to as CSA Z809-02) as the forest management planning system. Section 2 in the Standard outlines the FMP process and content requirements in Alberta. The CSA Standard specifies requirements for sustainable forest management of a defined forest area, including requirements for (a) the management framework; (b) commitment; (c) public participation; (d) performance measures and targets; (e) the systematic review of actions; (f) the monitoring of effectiveness; and (g) continual improvement.[153]

Section 6 in CSA Z809-08, entitled Sustainable Forest Management Performance Requirements, includes a criterion for soil and water. Criterion 6.3.3 is "Conserve soil and water resources by maintaining their quantity and quality in forest ecosystems." Core indicators are also noted.[154]

A number of FMAs note the adherence to the Standard; for example, the FMA issued to Alpac Forest Products Incorporated in July 2011 (OC310/2011) includes General Provision 10(1):

> "The Company shall submit a forest management plan in accordance with the forest planning standards for the Minister's approval on or before May 1, 2015. . ."[155]

Environmental Protection and Enhancement Act

The *Environmental Protection and Enhancement Act* (EPEA)[156] is very wide-ranging and covers any activity that could adversely affect the environment, including activities that could cause the siltation of water or the erosion of any bed or shore of a water body. Environmental protection orders may be issued by Alberta Environment and Water under EPEA. See the description of the Code of Practice for Pesticides described in section 2.1.1.

Forest Management Herbicide Reference Manual (2004)

The Herbicide Reference Manual[157] provides information to GoA staff and forest industry personnel about Alberta's requirements and expectations as well as roles and responsibilities regarding the use of herbicides on Crown land. Herbicide application in the context of silviculture is designed to ensure rapid post-harvest re-establishment of crop tree species.

Companies must submit a detailed herbicide application proposal to SRD, requirements for which are described in the manual. This includes identifying and mapping any sensitive areas such as watercourses and buffers. A post-treatment monitoring plan for possible excursions within the project area must also be submitted (an excursion is any off-target application of herbicide).

The manual also includes guidelines for the use of herbicides for silviculture in Alberta, including one related to riparian management zones and watercourse protection buffers. This Guideline is to: "Ensure that the application of herbicides within, or adjacent to, riparian zones that are managed primarily for wildlife and biodiversity values, reflects the vegetation management priorities and objectives of those zones. Use should be made of risk management plans that address the priority habitat resource values and management objectives of riparian areas."[158]

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[153] The CSA has since updated and published CSA-Z809-08, *Sustainable Forest Management*, which supersedes earlier editions. See http://shop.csa.ca/en/canada/sustainable-forest-management/cancsa-z809-08/invt/27017442008/
[154] CSA. 2008, CAN/CSA-Z809-08 *Sustainable Forest Management*; p. 15.
[155] Alpac Forest Products Incorporated FMA, 2011, http://srd.alberta.ca/LandsForests/ForestManagement/ForestManagementAgreements/FMAHolders.aspx
[156] See http://www.qp.alberta.ca/574.cfm?page=E12.cfm&leg_type=Acts&isbncln=9780779755240
[157] Alberta Sustainable Resource Development. 2004, *Forest Management Herbicide Reference Manual*, http://www.srd.alberta.ca/LandsForests/ForestManagement/documents/Herb2004.pdf
[158] Alberta Sustainable Resource Development. 2004, *Forest Management Herbicide Reference Manual*, p. 33.

Public Lands Act

The *Public Lands Act*[159] is relevant to managing NPSP from forestry and any other activity on public land insofar as it prohibits:

- The doing of any act on public land that may injuriously affect watershed capacity,
- The disturbance of any public land in any manner that results or is likely to result in injury to the bed or shore of any river, stream, watercourse, lake or other body of water or land in the vicinity of that public land, or
- The creation of any condition on public land which is likely to result in soil erosion.

***Water Act* (and the Code of Practice for Watercourse Crossings)**

The *Water Act*[160] requires approval from Alberta Environment and Water for any project or activity that, among other things, could cause:

- Siltation of water,
- Erosion of any bed or shore of a water body, or
- An effect on the aquatic environment.

The Code of Practice for Watercourse Crossings[161] describes the requirements for watercourse crossings that are not exempt under the *Water Act* and its regulations.

2.3.2 Use and Implementation of BMPs

Although not specifically identified as BMPs, another document that provides guidance related to managing NPSP is the **Public Lands Operational Handbook (2004).**[162] This handbook applies to all industrial and commercial ventures on public land in Alberta. To help proponents minimize and manage the environmental impacts of their activities, the handbook contains:

- Objectives – an established set of environmental planning and operating targets or results the proponent is expected to achieve.
- Standards – the minimum accepted level that must be met or exceeded to ensure compliance with legislated requirements, established policy and environmental practices that are listed in the handbook.
- Guidelines – a set of suggested operating methods and practices used to achieve the objectives.

The handbook does not supersede or replace existing legislation, regulations or dispositions/approvals. Rather, it assembles a wide range of information in one place for any proponent planning activities on public land and includes in the various guidelines a range of management and operational practices. The document is organized according to the various activities that proponents might undertake, such as managing surface access; timber salvage; site disturbance and clearing; soil, vegetation, water, and waste management; and reclamation. A chapter is also devoted to fisheries and wildlife.

Several sections in the handbook are directly relevant to managing NPSP and reflect the expectation that activities will be managed to:

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[159] Government of Alberta, *Public Lands Act*, RSA 2000; s. 54(1), http://www.qp.alberta.ca/570.cfm?frm_isbn=9780779756162&search_by=link

[160] The *Water Act* is online at http://www.qp.alberta.ca/570.cfm?frm_isbn=9780779754366&search_by=link

[161] See http://www.qp.alberta.ca/documents/codes/CROSSING.pdf

[162] Sustainable Resource Management, Public Lands and Forests Division. 2004, *Public Lands Operational Handbook*, http://www.srd.alberta.ca/MapsPhotosPublications/Publications/documents/PublicLandsOperationalHandbook-Dec2004.pdf

- Prevent soil from entering a watercourse or other water body.
- Minimize the potential for soil erosion, and the amount and degree of soil disturbance.
- Protect bed and banks, and the aquatic and terrestrial habitat of any watercourse or other water body.

2.3.3 Monitoring NPSP and Assessing Management Outcomes

There do not appear to be any specific requirements for forestry companies to monitor water quality on their FMAs. Sedimentation and soil loss are the main concerns and the natural variability during periods of high rainfall or storm events can make it difficult to attribute NPSP to one particular source.

In 2008, SRD established the Forest Operations Monitoring Program to standardize how the department conducts its inspections. Forest Operations Monitoring (FOM) involves field inspections of active timber harvesting and reforestation activities to ensure they meet required provincial standards. The number of FOM inspections done is based on risk of non-compliance and is determined from key factors including volume harvested, previous enforcement actions, trends of unacceptable practices recorded and others. High priority environmental values and sensitivities are considered in the final selection of harvested areas to be inspected. In 2010, 1,757 FOM inspections were done in the province.[163]

SRD has developed a number of documents and forms that outline standard operating procedures to be used when conducting FOM inspections, including a description of the responsibilities for the inspecting officer and team leads.[164] FO-Form 4 FOM Legislative Links Table summarizes the categories (e.g., riparian, watercourse crossings, roads, soils), variance standards, measurement protocols, legal reference for each protocol, and other items.[165] Other documents have been developed for specific aspects of the inspection, such as herbicide applications (FO-SOP 19 Herbicide Application)[166] and road reclamation, which addresses erosion control, watercourse crossings and drainage.[167]

The Alberta Government monitors compliance by conducting planned and random audits of forest operations and timber production and by conducting field inspections. Forest companies and individuals also self-report.[168] Contraventions assessed over the last five years appear on the SRD website[169] and the overwhelming majority relate to violations under the *Public Lands Act*, such as unauthorized use of public land and contravention of terms and conditions.

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[163] Alberta Sustainable Resource Development. 2010, *Sustainable Forest Management, Current Facts & Statistics*, http://www.srd.alberta.ca/LandsForests/ForestManagement/ForestManagementFactsStatistics/documents/MonitoringOperations-CurrentFactsAndStatistics-2010.pdf

[164] See http://www.srd.alberta.ca/FormsOnlineServices/Directives/ForestryDirectives.aspx

[165] See http://www.srd.alberta.ca/FormsOnlineServices/Directives/documents/FO-Form04-FOMLegislationLinks-Jun2011.pdf

[166] See http://www.srd.alberta.ca/FormsOnlineServices/Directives/documents/FO-SOP19-HerbicideApplication-Jun2011.pdf

[167] See http://www.srd.alberta.ca/FormsOnlineServices/Directives/documents/FO-SOP22-RoadReclamation-Jun2011.pdf

[168] Adapted from http://www.srd.alberta.ca/LandsForests/ForestManagement/ComplianceEnforcement.aspx

[169] See http://www.srd.alberta.ca/LandsForests/ForestManagement/documents/ForestManagement-Contraventions-Jan05-2012.pdf

2.3.4 Woodlots and Agroforestry

A woodlot is any tract of land that supports naturally occurring or planted trees. Most woodlots in Alberta are family-owned and often are operated as part of an agricultural operation. These properties occupy over 1.5 million ha of forested land in Alberta's agricultural zone with an average size of 20-40 ha.[170]

Historically, forested private land was cleared for agricultural purposes or to supply wood to local communities and industries, and little thought was given to longer term sustainable forest management. But in addition to their timber value, woodlots produce other valuable ecological goods and services that are relevant to the management of NPSP. Among other things, they protect soil from wind and water erosion and contribute to cleansing, filtering and stabilizing wetlands and water bodies.

Alberta Agriculture and Rural Development has produced various resources for woodlot owners to raise awareness about the importance of sustainable woodlot management and the range of benefits that can result. The primary resources are:

- Woodlot Management Guide of Alberta[171]
- Guide and Template for Basic Woodlot Management Plan[172]

The Woodlot Management Guide describes aspects of forest ecology and timber management, but also provides information on soil characteristics, the role of wetlands, pest management, and grazing considerations, and includes lists of BMPs for each topic. The Guide for developing a woodlot management plan explains how such a plan can accomplish a number of goals, including avoiding negative environmental impacts.

2.3.5 Other Initiatives

The **Foothills Research Institute** (FRI)[173] (formerly the Foothills Model Forest) conducts applied research on the cultural, ecological, economic and social values of Alberta's forested landscape. The FRI has also worked with partners on initiatives that help address NPSP in forested areas. Two examples are the Fish and Watershed Program and the Foothills Stream Crossing Partnership.

The Fish and Watershed Program[174] develops planning tools for forest and land management that are designed to help maintain fish habitat and water quality in forests with industrial operations. Tools include watershed classification systems and riparian (wetlands) management strategies.

The Foothills Stream Crossing Partnership (FSCP), established in 2004, is a multi-industry partnership to improve the condition and performance of stream crossings on the landscape along the Eastern Slopes. The FRI is the coordinating agency for this initiative. Since its inception, the FSCP has inventoried and prioritized over 1,400 crossings belonging to more than 40 companies and government agencies. All FSCP companies with crossings in high-risk watersheds participate in the design of remediation plans, outlining the strategies, timing and justification for the order in which crossings are mitigated. To date, six watersheds have remediation plans and two more are being developed. By working with other companies in the watershed, FSCP members can plan to fix fish barriers in a sequential order up the

[170] Text in the first two paragraphs of this section adapted from Alberta Agriculture and Rural Development website, http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/apa11063
[171] Alberta Agriculture and Rural Development, *Woodlot Management Guide of Alberta*, http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/apa11063
[172] Alberta Agriculture and Rural Development, Guide for Basic Woodlot Management Plan, http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/apa7779
[173] FRI, http://foothillsresearchinstitute.ca/pages/home/default.aspx
[174] FRI, http://foothillsresearchinstitute.ca/pages/ProgramsFish_Watershed/default.aspx

watershed, and sedimentation problems from the top of the watershed down. This approach increases the efficacy of money and time spent, encourages dialogue among stakeholders, and takes an integrated approach to remediating crossings by considering other problems in the watershed, unlike traditional enforcement approaches.[175]

The FRI is now starting a new Water Program, which will include work on assessment procedures, data management, extension, BMPs and other priorities.

The **Government of Alberta** is also working on a new wetlands policy for the province, which could have implications for the management and mitigation of NPSP, particularly in the Green Area.

2.4 Oil and Gas

The conventional oil and gas sector has long been a major economic force in Alberta and although the amount of unvegetated land required for a well or facility and the associated roads may range from less than a hectare to a few hectares, the total numbers are very large. The land area covered by well sites and facilities varies, making it difficult to determine a total area occupied by such activities. Land is also disturbed for the construction of pipelines and for exploration purposes, including seismic lines.

Typically, the three phases of development activity in which the conventional oil and industry is engaged are exploration, extraction and reclamation, each of which is guided by specific policy and regulatory tools and BMPs. Oil and gas activities occur in both the White and Green Areas of the province. Potential sources of NPSP to surface waters from this industry are primarily soil erosion and spills. Data related to soil erosion and sedimentation from oil and gas activities seem to be scarce. Compared to the three land use activities previously discussed (agriculture, urban and forestry), conventional oil and gas appears to be a relatively small contributor to NPSP.

2.4.1 Policy and Regulatory Tools

The conventional oil and gas industry is governed by numerous pieces of federal and provincial legislation most of which are unrelated to NPSP. Relevant policy and regulatory tools that apply or could be applied to NPSP from conventional oil and gas activities are administered by AEW, SRD and the Energy Resources Conservation Board (ERCB). These include:

- *Environmental Protection and Enhancement Act* (including the Environmental Code of Practice for Exploration Operations, and Remediation Certificate Regulation, AR 154/2009)
- Exploration Regulation AR 284/2006 and associated Exploration and Lands Directives
- ERCB Directives 036, 055, and 071
- *Water Act*

Environmental Protection and Enhancement Act

The Environmental Protection and Enhancement Act (EPEA) prohibits activities that could affect the environment unless approval is granted. Such approvals govern water quality release and disposal of chemically influenced water, and require monitoring plans and reporting of industrial or wastewater runoff, groundwater and surface water quality.

[175] Ngaio Baril, Project Coordinator, Foothills Stream Crossing Partnership, personal communication with Kim Sanderson, January 10, 2012.

The **Environmental Code of Practice for Exploration Operations** (2005)[176] specifies soil conservation requirements in Section 5.1; with respect to NPSP, s. 5.1.9 notes:

> "The person who conducts or reclaims an exploration operation shall, until a self-sustaining vegetation cover is established, implement erosion control methods in disturbed areas that include, but are not limited to, the following:
>
> (a) slope stabilization;
> (b) cross ditching;
> (c) soil replacement; and
> (d) reseeding."

Under EPEA, reclamation certificates are required for all specified land, which includes land used for upstream oil and gas activities (well sites, batteries and pipelines). AEW issues reclamation certificates on private land and SRD issues certificates for reclamation of public land.

AEW's **Upstream Oil and Gas Reclamation and Remediation Program** is intended to ensure that land use for oil and gas development is returned to a productive state. The 2010 Reclamation Criteria (updated in 2011)[177] are divided into three land uses: Cultivated Lands, Forested Lands and Native Grasslands. The reclamation criteria that pertain to NPSP are summarized in Table 4. The full Reclamation Criteria document[178] provides more details on ensuring riparian function and managing erosion, but the focus is on restoring land to a productive state, not managing NPSP.

Table 4. Summary of the Reclamation Criteria for the Landscape for Cultivated Lands, Forested Lands and Native Grasslands

Landscape		
Drainage	·	Onsite drainage patterns must be comparable to offsite drainage patterns
Erosion	·	Onsite erosion must be comparable to offsite erosion patterns (i.e., gullies, blowouts, etc.)
Stability	·	Onsite stability must be comparable to offsite stability patterns (i.e., slope movement, slumping, subsidence, etc.)
Bare Areas	·	Onsite bare areas must be comparable to offsite bare areas
Contour	·	Contours onsite must be comparable to contours offsite

Source: Alberta Environment and Water. *2010 Reclamation Criteria – Fact Sheet*, updated June 2011; online at http://environment.alberta.ca/documents/2010-Reclamation-Criteria-Fact-Sheet.pdf

Some activities may cause releases of chemicals that can adversely affect the environment and remediation must be undertaken to avoid potential negative impacts. When a facility reaches the end of its operating life, its operating approval issued by AEW is amended to become a decommissioning and reclamation approval. This amended approval specifies what must be done, including dismantling, decommissioning and land reclamation, so that any potential impacts on the environment are resolved before the facility is deemed "reclaimed." Remediation is also required before AEW will issue a reclamation certificate for an upstream oil and gas site. Upstream sites include well sites, pipelines and batteries.[179]

[176] Environmental Code of Practice for Exploration Operations, http://www.qp.alberta.ca/documents/codes/EXPLORE.pdf
[177] Alberta Environment and Water. Reclamation Criteria, http://www.environment.alberta.ca/01884.html
[178] Alberta Environment and Water. Reclamation Criteria, http://environment.alberta.ca/03002.html
[179] Text in this paragraph is adapted from Alberta Environment and Water, http://environment.alberta.ca/01910.html

The **Remediation Certificate Regulation**, AR 154/2009,[180] defines remediation as "reducing, removing or destroying substances in soil, water or groundwater through the application of physical, chemical or biological processes." The Regulation also specifies what must be included in the application for a remediation certificate. With respect to NPSP management, the location of all surface water bodies within the remediated area or within 300 m from the edge of the remediated area must be shown as well as information on substances released and the remediation procedure.

Remediation certificates provide an incentive to clean up spills by providing closure of regulatory liability. Remediation certificates are issued for upstream oil and gas sites as well as for general contaminated sites. AEW audits approximately 10% of certified areas. The Department can refuse to issue a remediation certificate for a site if the information requirements are not met or the remediated area does not meet Alberta's remediation guidelines. A remediation certificate can be cancelled if the remediated area fails an audit or there is a substantiated complaint.[181]

In the Green Area, SRD has published *A Guide To: Reclamation Criteria for Wellsites and Associated Facilities - 2007 - Forested Lands in the Green Area Update*.[182] The document provides guidance on reclamation certification criteria for oil and gas wellsites and access roads, and associated facilities such as borrow pits, campsites and off-site sumps. The guide notes that "The goal of reclamation is to return a disturbed land to a state of equivalent capability. Equivalent capability for forested landscapes is defined as the condition in which ecosystem processes are functioning in a manner that will support the production of ecosystem goods and services consistent in quality and quantity as present prior to disturbance. This guide does not place minimums or maximums on assessment variables, rather the guide places emphasis on documenting the conditions of the wellsite and associated facilities in relation to the control conditions and ecosite characteristics. . . For the purposes of reclamation certification, equivalent capability is assumed to have been achieved where no limitations to normal ecosystem functioning are found. The presence of these limitations is determined through a systematic assessment of the reclaimed site and adjacent landscapes" (p. 4). Relevant to managing NPSP, the guide notes the need to address erosion, contouring, slumping and subsidence, among other things.

Exploration Regulation AR 284/2006[183]

This regulation is administered by SRD and requires the licensee to ensure that no shot hole or test hole is, among other things, drilled or abandoned using fluids or materials that contain harmful contaminants, nor drilled where temporary water has collected on the land surface, except with the prior approval of the Minister and in accordance with the requirements of the Exploration Directives.

Exploration Directives[184] were developed following Cabinet approval of the Exploration Regulation in 2006 and can be updated as necessary. A total of 26 exploration directives will be developed, 24 of which are in place. One of the two that remain to be completed is ED2006-16 Surface Water and Aquifers, which will likely be relevant to managing NPSP. An Environmental Field Report 2.0 must be submitted for each surface disposition application, and this report includes a question regarding fisheries, as well as questions about soil and vegetation management on the site. For soil salvage, storage, replacement and

[180] See http://www.qp.alberta.ca/574.cfm?page=2009_154.cfm&leg_type=Regs&isbncln=9780779741663
[181] See http://environment.alberta.ca/02467.html
[182] Alberta Sustainable Resource Development. 2007, *Guide To: Reclamation Criteria for Wellsites and Associated Facilities – 2007 – Forest Lands in the Green Area Update*, http://www.srd.alberta.ca/LandsForests/IndustrialActivity/IndustrialDevelopmentReclamation/documents/ReclamationCriteria-WellsitesAssociated-Facilities-ForestedLandsGreenArea-May2007.pdf
[183] Exploration Regulation AR 284/2006, http://www.qp.alberta.ca/574.cfm?page=2006_284.cfm&leg_type=Regs&isbncln=9780779738427
[184] See http://www.srd.alberta.ca/LandsForests/IndustrialActivity/SeismicExploration/ExplorationDirectives.aspx

handling, proponents are directed to follow the procedures in the Public Lands Operational Handbook (described in section 2.3.2 of this report).

External Directive ID 2002-01, Slope and Break Setback Guidelines,[185] is relevant to NPSP management. Setbacks are required for wellsites and associated infrastructure located near ravines or rivers where the slopes may be unstable. "Breaks" are the point where ground instability occurs due to slope steepness.

- For ravines and seasonal watercourses, the minimum setback is 15 m from the edge of the breaks to the edge of the wellsite.
- For permanent watercourses and immediate tributaries, the minimum setback is 45 m from the edge of breaks to the edge of the wellsite.

These distances may be modified if a geotechnical report is submitted that supports the requested change. In all cases where the minimum setback applies, the perimeter of the wellsite must be bermed with material that will ensure fluids are contained. Local conditions or factors may result in the setback being increased.

ERCB Directives

ERCB Directive 036: Drilling Blowout Prevention Requirements and Procedures (2006)[186] prohibits the use of oil-based drilling fluids (or any other potentially toxic based drilling additive) when drilling above the base of groundwater protection. All fluids used or generated must be properly contained, and any unrefined spill off-lease, or any unrefined spill over 2 m^3 on lease, must be reported to the ERCB immediately and the landowner advised.

ERCB Directive 055: Storage Requirements for the Upstream Petroleum Industry (2001)[187] directs the storage of chemicals and produced fluids, outlines requirements to prevent leaks, and specifies that leaks must be investigated and affected soil remediated. This 68-page directive establishes requirements that address "primary containment (storage) devices, secondary containment systems, leak detection systems, spill prevention and loss control systems, weather protection, and operating procedures, maintenance practices, and inspection programs to maintain the containment systems, as well as associated documentation and record retention requirements."[188]

ERCB Directive 071: Emergency Preparedness and Response Requirements for the Upstream Petroleum Industry (2003)[189] describes in detail the requirements for emergency response plans, including spills. "Consistent with the direction given in CAN/CSA Z-731, operators must assess the risk their operations pose to the environment and ensure adequate response capability in the event of a spill, particularly into moving water."[190]

[185] Alberta Sustainable Resource Development, External Directive ID 2002-01, http://www.srd.alberta.ca/FormsOnlineServices/Directives/documents/ID2002-01-SlopeBreakSetbackGuideline-Directive-Dec02.pdf
[186] Energy Resources Conservation Board Directive 036, 2006, http://www.ercb.ca/docs/Documents/directives/Directive036.pdf
[187] Energy Resources Conservation Board Directive 055, 2001, http://www.ercb.ca/docs/Documents/directives/Directive055.pdf
[188] Ibid, p 1.
[189] Energy Resources Conservation Board Directive 071, 2003, http://www.ercb.ca/docs/Documents/directives/Directive071_2005.pdf
[190] Ibid, p. 32.

Water Act

Aspects of the *Water Act* that are most pertinent to this industry concern withdrawals, volume and usage. Oil and gas companies must have approval under this Act for activities that affect or could affect a wetland or surface water or groundwater.

2.4.2 Use and Implementation of BMPs

SRD has prepared External Directive SD 2010-02 on Progressive Reclamation and Interim Clean-Up.[191] Progressive reclamation of industrial disturbances is regarded as a BMP and is a standard operating condition on all upstream oil and gas dispositions and states: The holder shall reclaim all disturbed land surfaces within two growing seasons. Interim reclamation, including site and debris cleanup, slope stabilization, re-contouring with subsoil, and spreading of topsoil shall be done progressively and concurrently with operations.

Seismic lines were historically constructed in a linear manner and were five to eight metres wide to accommodate large equipment. Lines were expected to regenerate naturally, but once they became accessible to other users, revegetation was impeded. With the advent of new technology, low impact seismic exploration is now possible. With this approach and the use of global positioning systems, lines can be opened up with smaller equipment and constructed to meander. The average seismic line width is now about two metres, reducing the surface exposed to potential erosion and runoff.[192]

The industry has implemented various BMPs and other stewardship initiatives related to managing NPSP, including:[193]

- Mitigation measures as part of water management plans for site-specific projects to minimize any effects on the watershed and other potential receptors, such as domestic use aquifers.
- Baseline studies for surface water and groundwater quality assessments.
- Extensive water monitoring programs at many sites to protect water quality in the ecosystem, beyond what is required by regulation.
- Assessing and altering projects to avoid sensitive areas such as wetlands, streams, lakes and riparian areas. In situations where avoidance is not possible, a number of mitigation tools (e.g., minimal disturbance lease and access roads, construction in frozen conditions, narrowing the width of access roads near a wetland) can be utilized.
- Mitigation measures implemented as part of the site-specific water management plan for projects to minimize effects of changes in runoff, natural drainage patterns, sediment concentrations, suspended sediment concentrations and basin sediment yield on receiving streams, lakes, ponds and wetlands.
- Locating wells to ensure that any natural drainage of fluid is in the opposite direction of any nearby water bodies.
- Conducting monthly tank inspections to reduce/minimize spills that could affect surface and groundwater.

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[191] Alberta Sustainable Resource Development External Directive SD 2010-02, http://www.srd.alberta.ca/FormsOnlineServices/Directives/documents/SD2010-02-ProgressReclamationInterimCleanUp-Directive-May10.pdf

[192] See http://www.srd.alberta.ca/LandsForests/IntegratedLandManagement/documents/ReducingtheFootprintofSeismicExploration-Aug20-2010.pdf

[193] Tara Payment, Manager, Water and Reclamation, Canadian Association of Petroleum Producers, personal communication with Kim Sanderson, December 8, 2011.

2.4.3 Monitoring NPSP and Assessing Management Outcomes

The GoA audits selected sites prior to issuing remediation or reclamation certificates, but the primary purpose is not to assess or document NPSP. The Canadian Association of Petroleum Producers' Responsible Canadian Energy™ Program[194] is an association-wide performance reporting program to demonstrate progress in environmental, health, safety, and social performance. The annual report and website note annual environmental performance, one of which is the reporting of water metrics by member companies. However, NPSP is not specifically mentioned.

The Phase I report for this project discusses a 2000-2003 study near Valleyview that examined water quality effects from oil and gas activities undertaken by NAL Resources. The study concluded that NAL activities in the Bridlebit watershed did not have any detectable impacts on water quality.[195]

2.5 Recreation

As noted in the Phase I report, recreational activity is common in Alberta and tends to be concentrated in the public land of the Green Area. Areas along the upper reaches of the Oldman, Bow and North Saskatchewan rivers are especially popular. These areas are important sources of water for drinking and many other purposes, and managing access and activities has been an ongoing challenge. As the number of people using the East Slopes for recreation grew, local municipalities became more concerned about the damage to sensitive land and water mainly from inappropriate off-highway vehicle (OHV) use and random camping. From the perspective of managing NPSP, issues included erosion, damage to riparian areas, lack of sanitary facilities for camping, and degradation of water quality.

In 2002, four Eastern Slopes rural municipalities[196] expressed concerns to the GoA that action was needed to deal with the increasing amount of activity and resulting environmental and property damage by irresponsible recreationists. The South Eastern Slopes Task Force was formed in 2003 and made 21 recommendations to the Provincial Government in its 2004 report, addressing planning and funding, roads, awareness and education, and other issues.

In 2010, the Task Force municipalities revisited the original report in light of new provincial legislation and initiatives. Despite the promise of processes and legislation such as the *Alberta Land Stewardship Act*, the Task Force concluded that "in many instances the issues and problems identified six years ago are escalating and that significant change is required to address the issues and abuse that continues due to increased recreational use along the south eastern slopes. . . For recreational use of public lands to be sustainable, a broad, overarching policy and enforcement framework is required for the entire eastern slopes area within the Province of Alberta."[197]

Alberta has a legacy of resource roads and seismic lines that were not intended for recreational use but provide easy access to remote areas. The Bighorn and the Ghost River sub-basin are two areas where NPSP issues related to heavy recreation use have been documented and management plans developed; these are discussed in more detail in section 2.5.3.

[194] CAPP Responsible Canadian Energy™ Program, http://www.capp.ca/rce/Pages/default.aspx#qvDvnPDe2dy1
[195] CPP Environmental Corp. 2011, *Current state of non-point source pollution: Knowledge, data and tools*, Report prepared by T. Charette and M. Trites for the Alberta Water Council, 153 pp, p. 113.
[196] The M.D. of Pincher Creek, M.D. of Ranchland, M.D. of Bighorn and Clearwater County
[197] South Eastern Slopes Task Force. 2010, *2010 Update, South Eastern Slopes Task Force Report*.

2.5.1 Policy and Regulatory Tools

No regulatory tools were found that relate specifically to managing NPSP from recreation. However, the new Public Lands Administration Regulation, AR 187/2011,[198] which came into effect in September 2011 following the update of the *Public Lands Act* in 2010, provides tools to better manage the long-term health of public land. This regulation has some implications for recreational use, which indirectly affects NPSP. Administered by SRD, the regulation applies to provincial land managed by SRD under the *Public Lands Act*. The new rules around recreation apply to vacant public land not held under a disposition that offers exclusive use such as grazing. It does not apply to parks and wilderness areas managed by Alberta Tourism, Parks and Recreation or to land managed by other GoA departments or to federal lands.

The regulation clarifies the rules so recreationists know where they can and can't go. For example, people don't need approval to ride OHVs on trails, but may need a permit to go off-trail or to hold an OHV rally. Access permits let staff look at what else is happening on the landscape so conditions can be set that provide enjoyment and protect the land. The regulation also allows temporary closure under certain conditions. For example, an area might be closed to OHVs to avoid ruts from spinning tires in very wet conditions, or sparks that could start a fire, but hiking might still be allowed. Recreationists who damage public land may face consequences including oral or written warnings, eviction from a campsite or area, tickets, arrests or impounded vehicles. The regulation creates authority to set disturbance standards. A company that exceeds the disturbance standard or violates approved terms or conditions can be served with an enforcement order and fined. Companies and individuals may also face penalties for failing to comply, and may be required to make restitution, conduct reclamation or take other corrective actions.[199]

2.5.2 Use and Implementation of BMPs

In 2009, the GoA published *Alberta Recreation Corridor and Trails Classification System*. The manual classifies and describes five types of trails according to the type of activity – non- motorized, motorized, mixed-use, extreme use and water use. It also provides guidance on trail design and management, noting that environmental sensitivity is a paramount consideration. Specifically: "Trails should not be developed in a manner where they can damage the environment. Special design considerations are required to locate trails through sensitive areas such as:

- wetlands;
- fragile habitats;
- nest areas;
- areas with rare or sensitive plant species; and
- soils subject to high erosion.

"Generally, stream or water crossings should be avoided wherever possible. If they are required, trail alignment and design is critical to ensure minimal impact."[200]

2.5.3 Monitoring NPSP and Assessing Management Outcomes

Two areas of Alberta are provided as examples of management approaches for recreationally-stressed systems: Bighorn Backcountry and Ghost River Forest Land Use Zone.

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[198] Public Lands Administration Regulation, AR 187/2011, http://www.qp.alberta.ca/570.cfm?frm_isbn=9780779760190&search_by=link

[199] Text in this paragraph is adapted from the SRD website at http://www.srd.alberta.ca/LandsForests/PublicLandsAdministrationRegulation/Default.aspx

[200] *Alberta Recreation Corridor and Trails Classification System.* 2009, Government of Alberta, http://www.tpr.alberta.ca/recreation/trails/pdf/RecCorridorsManual.pdf, p. 35.

Bighorn Backcountry

Bighorn Backcountry, an area of more than 5,000 km^2, borders both Jasper and Banff National Parks.[201] In the late-1990s, it was experiencing damage to trail systems, campsites and riparian areas as well as negative effects on fish and wildlife populations due to increasing recreational pressure and public access. In 2000, SRD established a multi-stakeholder group to help develop an approach to managing access, the outcome of which was the Bighorn Backcountry Access Management Plan;[202] this Plan permitted both motorized and non-motorized uses in the Bighorn.

Based on recommendations from the Bighorn Advisory Group, SRD developed a **Recreational Trail Monitoring Program** in 2003.[203] Under this program, trails would be monitored every five years, with interim surveys at any time. Trails could be closed if their condition deteriorated within or at the end of each five-year period. Selected recreational trails were to be monitored using five criteria, the first four of which are directly relevant to NPSP:

1. Frequency of erosion/rutting events
2. Intensity of erosion/rutting
3. Travelling off trails
4. Suitability and effectiveness of stream crossings
5. Presence of noxious or restricted weeds.

More detailed procedures were established to measure each criterion; for example, an erosion event was defined as ruts measuring at least 3 m long and 25 cm deep. Erosion events may run parallel as in the case of OHV tires (counts as two erosion events) or may result from a single water channel. SRD could also initiate and coordinate monitoring of sedimentation on watercourses if there was sufficient visual evidence. In 2004, SRD initiated a trail usage monitoring program using infrared trail counters to record human and animal passages, and OHV counters to record the passage of metal objects.[204]

As part of the Recreational Trail Monitoring Program, a Monitoring Group was established to provide advice and assist SRD in implementing, monitoring and developing operational plans to manage access.[205] This Group consists of:

- A multi-stakeholder standing committee representing the various user groups, which provides advice and recommendations; and
- A steering committee made up of provincial government staff responsible for implementing the Access Management Plan. Final decisions regarding management rest with the steering committee.

SRD has reviewed the recommendations made in 2002 by the Advisory Committee against the work that has been done to implement the Access Management Plan. A progress report is expected by mid-2012. The industrial footprint in the Bighorn is very small, as there are no timber commitments, no trucks are

[201] See http://www.srd.alberta.ca/RecreationPublicUse/RecreationOnPublicLand/BighornBackcountry/Default.aspx for more information on Bighorn Backcountry.
[202] Alberta Sustainable Resource Development. 2002, *Bighorn Backcountry Access Management Plan*, http://www.assembly.ab.ca/lao/library/egovdocs/alsrd/2002/138242.pdf
[203] Alberta Sustainable Resource Development. 2003, Recreational Trail Monitoring Program, http://www.srd.alberta.ca/RecreationPublicUse/RecreationOnPublicLand/BighornBackcountry/documents/recreational_trail_monitoring.pdf
[204] The monitors are still active, but data posted on the SRD website have not yet been brought up to date; see http://www.srd.alberta.ca/RecreationPublicUse/RecreationOnPublicLand/BighornBackcountry/Monitoring.aspx
[205] Mandate and terms of reference for the Monitoring Group are online at http://www.srd.alberta.ca/RecreationPublicUse/RecreationOnPublicLand/BighornBackcountry/documents/monitoring_group.pdf

permitted, and there is very little oil and gas activity. Water crossings and riparian areas are a high priority and a number of upgrades have been made, many in response to water quality concerns identified by stakeholders and Steering Committee members.[206] No water quality monitoring is being or has been done in the Bighorn to assess sedimentation rates, but if opportunities arose for such a project, it would be undertaken jointly with AEW. If erosion or other problems are identified on trails, volunteers make the necessary improvements. A plan is prepared and submitted to SRD for review and approval and SRD may supply some materials, but all rehabilitation is done by the user groups. Volunteer capacity continues to be a challenge and, on occasion, trails must be closed until the work can be completed. These closures and other access management aspects are enforced by SRD through Fish and Wildlife staff and Lands staff, as well as by RCMP and parks staff. Compliance has improved to the point where enforcement is not as significant an issue in the Bighorn as it has been, due mainly to improved signage and a growing awareness among user groups.[207]

Ghost River Forest Land Use Zone

The Ghost River sub-basin located about 60 km from Calgary has been a popular recreation destination for many years. The area's long history of use for forestry and oil and gas has left it covered with old seismic lines and resource roads. As more users were drawn to the area, random camping and motorized recreational use increased, leading to environmental damage and pressure from competing uses. Water quality impacts from erosion and sedimentation were among the impacts observed.[208]

The GoA decided to develop an access management plan for the Ghost; in 2004 and 2005, AEW did a study to gather data prior to the plan being implemented. The study was done to determine if there was a link between random camping and OHV activities and the water quality of Waiparous Creek, Fallentimber Creek, and Ghost River. Continuous measurements of turbidity and other parameters were used as a surrogate for TSS, and vehicular movement counts were taken at three sites along Waiparous Creek. Results showed that sediment loading coefficients in the lower regions of Waiparous Creek and the Ghost River were much greater than would be expected in rivers draining a similar watershed in southern Alberta, and were in fact higher than those in streams draining agricultural land at lower elevations.[209] Turbidity was high during precipitation events, and although a "weight of evidence" argument could be made to link motorized recreational activities with the large increase in sediment load, no clear scientific correlation was found between water quality and recreational use.[210] AEW will do further monitoring at two Waiparous and Ghost sites in 2012 to see if anything has changed.[211]

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[206] The Alberta Wilderness Association undertook a five-year monitoring project in one area of the Bighorn and their report also expressed concerns about inadequate protection of water bodies, among other things. See *Is the Access Management Plan Working? Monitoring Recreational Use in the Bighorn Backcountry, Final Report 2004-2008.* Alberta Wilderness Association. Online at http://albertawilderness.ca/issues/wildlands/areas-of-concern/bighorn/archive/2009-03-is-the-access-management-plan-working-final-report

[207] Text in this paragraph from personal communication of Don Livingston, Land Management/Planning Forester, Alberta Sustainable Resource Development, with Kim Sanderson, January 11, 2012.

[208] Bow River Basin Council. 2010, *State of the Watershed Summary*, http://www.brbc.ab.ca/index.php?option=com_content&view=article&id=84&Itemid=1022

[209] *Water Quality Study of Waiparous Creek, Fallentimber Creek and Ghost River*. 2006, prepared for Alberta Environment by Clearwater Environmental Consultants; presentation online at http://www.ghostwatershed.ca/GWAS/Research_%26_Data.html; full report online at http://environment.gov.ab.ca/info/library/7763.pdf

[210] Natalie Kromrey, Water Quality Specialist, Alberta Environment and Water, personal communication with Kim Sanderson, December 15, 2011.

[211] Natalie Kromrey, Water Quality Specialist, Alberta Environment and Water, personal communication with Kim Sanderson, December 15, 2011.

SRD released the *Ghost-Waiparous Operational Access Management Plan* in 2005,[212] which recommended that a Forest Land Use Zone (FLUZ)[213] be established to manage and direct recreational access on specified roads and trails in the planning area; this FLUZ was established in 2006. Recommendations also recognized the need for ongoing repairs and maintenance to enable sustained trail use (such as installation of proper stream crossings and drainage features), and for ongoing monitoring and data gathering. The plan called for the formation of a stewardship group to, among other things, ensure the sustainability of natural and aesthetic resources and make recommendations to SRD to improve the Ghost's designated trail system. The multi-stakeholder Ghost Stewardship Monitoring Group reports on progress in implementing the access management plan.[214]

2.5.4 Other Initiatives and Resources

SRD has developed a wide range of resources to inform recreational users how to reduce and manage the impacts of their recreational activities. The **Responsible Recreation** website[215] also includes information about responsible motorized recreation. SRD's website includes a section on **managing shorelands**, since private lands often border provincial water bodies.[216] One section is devoted to common lakeshore activities and how to manage their potential impacts.

The **Alberta Conservation Association** published a booklet in 1999 called *Caring for Shoreline Properties: Changing the Way We Look at Owning Lakefront Property in Alberta*.[217] It promotes the preservation and restoration of the natural state of Alberta's lakes and shorelands while maintaining the value of lakefront properties. The booklet describes the value of buffer strips, the need to manage nutrient additions to a lake, and methods to control erosion.

The **Land Stewardship Centre** is developing a Green Acreages Guide[218] for acreage, hobby farm and recreational property owners that will help them develop and implement stewardship practices to conserve and protect the valuable natural assets associated with their properties.

The **Living by Water** project[219] focuses on shorelines along all types of waterbodies and provides programs, services and materials to promote keeping shorelines healthy. The project is managed by partners in various regions of the country; in Alberta, the lead partner is the Federation of Alberta Naturalists.

Leave No Trace Canada[220] promotes responsible outdoor recreation through education, research and partnerships. Scientific research is the foundation of the Leave No Trace program and the organization's website provides access to a wide range of related research.

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[212] Alberta Sustainable Resource Development. 2005, *Ghost-Waiparous Operational Access Management Plan*, http://www.srd.alberta.ca/RecreationPublicUse/RecreationOnPublicLand/BighornBackcountry/documents/GhostWaiparousOperationalAccessManagementPlan.pdf

[213] Under the new Public Lands Administration Regulation, FLUZ will be called Public Land Use Zones.

[214] Ghost Stewardship Monitoring Group. *2009 Annual Report*, http://albertawater.com/brbc/reports/GhostStewardshipMonitoringGroup-2009AnnualReport.pdf

[215] SRD Responsible Recreation website, http://www.srd.alberta.ca/RecreationPublicUse/RecreationOnPublicLand/AboutResponsibleRecreation/Default.aspx

[216] See http://www.srd.alberta.ca/LandsForests/Shorelands/Default.aspx

[217] See http://www.srd.alberta.ca/LandsForests/Shorelands/Lakeshores/documents/Caring_For_Shoreline_Properties.pdf

[218] Land Stewardship Centre, http://www.landstewardship.org/green-acreages-guide/

[219] Living by Water, http://www.livingbywater.ca/

[220] Leave No Trace Canada, http://www.leavenotrace.ca/home

2.6 The Role of Regional Watershed Planning and Stewardship Bodies

In addition to the Alberta Water Council, the province's *Water for Life* strategy[221] established two new types of partnerships and gave them roles in stewarding the health of Alberta's watersheds. These partnerships are Watershed Planning and Advisory Councils (WPACs) and Watershed Stewardship Groups (WSGs).

The 2003 Strategy envisioned that WPACs would "lead in watershed planning, develop best management practices, foster stewardship activities within the watershed, report on the state of the watershed, and educate users of the water resource" (p.16). WPACs were subsequently designated by AEW to assess the condition of their watershed and prepare plans to address watershed issues. These 11 independent, non-profit organizations also conduct education and stewardship activities. WPACs typically include representatives of key stakeholders in the watershed, including provincial, municipal and federal governments, important industrial sectors, conservation groups, and aboriginal communities. They engage watershed residents in their work and seek consensus on solutions to watershed issues.[222]

Each WPAC develops its own bylaws, mission and objectives, and establishes priority areas of work for its region. In general, WPACs and WSGs themselves do not do monitoring, but they can encourage or recommend that their partners initiate monitoring. Each WPAC is expected to develop an Integrated Watershed Management Plan. It is important to note that watershed management plans differ from water management plans in that they focus on watershed boundaries and contemplate land use issues and water quality issues, but they are not recognized under the *Water Act*. Water management plans are defined under the *Water Act* and primarily address water quantity issues.[223]

WSGs typically comprise community, volunteer-based partnerships actively engaged in environmental stewardship of their watershed, often supported by local businesses and industries who have taken the initiative to protect their local creek, stream, stretch of river, or lake. A number of such groups already existed when the *Water for Life* Strategy was prepared and the Strategy envisioned that they would continue to play a vital role in water management.[224] Alberta now has over 140 stewardship groups undertaking a wide variety of activities across the province.

The renewed *Water for Life* Strategy (2008, p.14)[225] reiterated the important role of regional and local partnerships: "Because the people who are immediately affected by specific water issues can also more directly and effectively find solutions to address them, *Water for Life* is a shared responsibility through a network of partnerships, use of outcome-based approaches, and collaboration in delivery of services. The *Water for Life* partnerships are an important vehicle through which *Water for Life* goals are achieved."

The 2011-2014 Strategic Plan for the North Saskatchewan Watershed Alliance notes that "Collaborative planning has been adopted by the GoA as the desired approach to managing water and land in an integrated way. The current dependency on voluntary action underscores the importance of building a lasting collaborative planning and management framework to support continued stakeholder engagement in the implementation of the Integrated Watershed Management Plan."[226] This approach is fundamental to

[221] Government of Alberta. 2003, *Water for Life: Alberta's Strategy for Sustainability*, http://environment.gov.ab.ca/info/library/6190.pdf
[222] See Alberta Environment and Water, http://www.waterforlife.alberta.ca/01261.html
[223] See Water Matters, http://www.water-matters.org/topic/water-for-life/wpacs-and-wsgs
[224] Adapted from *Water for Life*, 2003, p. 16, and Alberta Environment and Water, http://www.waterforlife.alberta.ca/01316.html
[225] Government of Alberta. 2008, *Water for Life: A Renewal*, http://environment.gov.ab.ca/info/library/8035.pdf
[226] North Saskatchewan Watershed Alliance. 2011. *Strategic Plan 2011-2014*, p.5.

making progress on NPSP, as WPACs themselves have no authority to enforce their recommended approaches; rather, they rely on the voluntary commitment of partners (civic and business leaders and the general public) to ensure action. Another challenge faced by WPACs in managing NPSP and other issues is how to integrate their work with other initiatives such as the provincial Land Use Framework and its accompanying regional plans, GoA efforts to implement a Cumulative Effects Management System, and specific regional planning activities (such as municipal or regional development plans and initiatives such as the Industrial Heartland in the Edmonton area).

The NPSP project team agreed to more closely examine how three WPACs are addressing NPSP in their work:

- The Bow River Basin Council,
- The North Saskatchewan Watershed Alliance, and
- The Oldman Watershed Council.

WSGs are examined broadly and selected examples of NPSP work are highlighted.

2.6.1 The Bow River Basin Council

The Bow River Basin Council (BRBC)[227] was established in 1992 as an advisory body to the provincial Minister of Environmental Protection. In 2004, Alberta Environment designated the BRBC as the WPAC for the Bow River Basin. In 2005, the BRBC released a State of the Watershed report[228] that identified water quality concerns as one of the highest priority issues facing the basin.

The Bow watershed supports a number of diverse land uses, including a wide variety of recreational pursuits, agriculture, industry (logging, oil and gas development, hydroelectric generation) and urban development. The province's Long-Term River Network (LTRN) has four monitoring sites on the Bow River: one upstream of Calgary at Cochrane, one at the Carseland Weir, one at Cluny and one at Ronalene; there is also one station on the Elbow River at the 9th Avenue bridge in Calgary.[229]

In 2005, the BRBC, its partners and stakeholders began developing a watershed management plan to align resource and development decisions across land use sectors and jurisdictions. Phase One of the **Bow Basin Watershed Management Plan** was released in September 2008; it focused on surface water quality and was intended to serve as a decision-support tool.[230] It was developed using an environmental performance management system to achieve surface water quality outcomes with associated timelines for management actions, research, monitoring and evaluation.

The Plan contains reach-specific water quality objectives (WQOs), targets, warning levels, and baseline water quality data, acknowledging that "WQOs currently have no legal standing, but can be recognized and used as a guide for regulatory authorities, and as a means of supporting and maintaining designated water uses."[231] Reach-specific WQOs were developed for indicators in the Bow River mainstem and the Elbow River and Nose Creek sub-basins, which have implications for NPSP management.

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[227] See BRBC, http://www.brbc.ab.ca/
[228] BRBC. 2005, *BRBC State of the Watershed Report*. http://wsow.brbc.ab.ca/index.php?option=com_content&view=article&id=93&Itemid=179
[229] See http://environment.alberta.ca/01614.html for a map of all LTRN sites and more information.
[230] BRBC. 2008, *Bow Basin Watershed Management Plan, Phase One: Water Quality*, http://www.brbc.ab.ca/index.php?option=com_content&view=article&id=96&Itemid=210
[231] BRBC. 2008, *Bow Basin Watershed Management Plan, Phase One: Water Quality*, p.10

The Plan was prepared using a shared-governance approach involving key partners in the watershed. Using this shared-governance process, decision makers in the watershed "will continue to work together toward implementing the plan and achieving the plan's outcomes and goals. Government agencies will also help enforce and implement the Plan's goals through legislation and policy related to water and watershed management." [232]

The final Phase One report made 61 recommendations, 12 of which were considered the highest priority, based on science, for short-term implementation; seven of these twelve are relevant to managing NPSP, and are shown in Table 5.[233] As the table shows, implementation will rely on the efforts of BRBC partners in the basin, and some of these have already been discussed in earlier sections of this report.

[232] BRBC. 2008, *Bow Basin Watershed Management Plan, Phase One: Water Quality*. p. 3
[233] Adapted from Table 2 in the *Bow Basin Watershed Management Plan, Phase One: Water Quality*.

Table 5. Summary of Priority BRBC Watershed Management Plan Phase One Recommendations Related to NPSP

Theme	Activity	Proposed Indicator or Topic Area	River or Reach	Recommendation	Decision Makers
2b. Storm water and wastewater management	BMP Implementation	Wastewater and Stormwater Treatment	Overall Bow Basin	Municipalities must evaluate and implement the best treatment wastewater and stormwater options or technologies to protect the river water quality.	Bow Municipalities Alberta Environment (lead), Alberta Transportation
2b. Storm water and wastewater management	Monitoring and Modelling	Stormwater monitoring	Bow River Central, Elbow River Central`	Continue to conduct the water quality monitoring program for the representative storm water outfalls in Calgary in support of the Total Loading Management Plan (CoC 2005). Work on verifying and improving the storm water total suspended solid loading estimates. Expand the model to estimate loadings from the pertinent storm outfalls in the Elbow Central reach (both Elbow and Glenmore outfalls).	City of Calgary*
2b. Storm water and wastewater management	BMP Implementation	Stormwater improvements	Bow River Central, Elbow River Central	Implement significant stormwater quality upgrades / improvements within Calgary.	City of Calgary*
2c. Pesticide management	BMP Implementation	Pesticide use	Overall Bow Basin	Municipalities to uphold the principle of minimizing the quantity and/or toxicity of active ingredients when applying pesticides on the land they manage. It is recognized that the management of invasive species may require aggressive control measures.	Bow Municipalities, landowners
2d. Land use management in relation to water quality	Education	Low Impact Development Education	Overall Bow Basin	Take a lead role in helping to educate municipalities and developers on the basic principles of low impact development and encourage developers to utilize these practices in the overall design.	Alberta Low Impact Development Partnership, Bow Municipalities
2d. Land use management in relation to water quality	Education	Manure Application and Setbacks	Overall Bow Basin	Continue to educate producers on manure application and setback distances with respect to water bodies as outlined by the Agriculture Operations Practices Act. Research the effectiveness of different application techniques to reduce runoff of manure into receiving water bodies.	Alberta Agriculture and Rural Development,* Natural Resources Conservation Board,* Bow Municipalities
2d. Land use management in relation to water quality	BMP Implementation	Riparian Buffer Zone Protection	Overall Bow Basin	Adopt riparian setbacks (e.g. City of Calgary setback policy (CoC 2007); Nose Creek Watershed Management Plan (NCWP 2006) in all new developments.	Bow Municipalities

Asterisks (*) indicate that projects are either in progress or planned, subject to budgetary approval.

In 2010, the BRBC began the second phase of a watershed management plan for the Bow Basin.[234] Phase Two is focusing on land use, riparian lands, wetlands and headwaters. All of these areas are relevant to NPSP, particularly the first three. In these categories, recommendations are expected in the following areas:

- Land Use: erosion and sediment controls, low impact development, performance management, and integrated land management.
- Riparian Lands: riparian land conservation and management, riparian health inventory, identification of priority areas for inventory, and scientific tools for delineating riparian lands.
- Wetlands: wetland conservation and management, best management practices, wetland management tools, and education and awareness.
- Headwaters: headwaters conservation and management, aquatic environmentally significant areas, alluvial aquifers, headwaters runoff modelling.

A draft Phase Two report was released for review and comment in May 2011,[235] and is now being finalized. A key component is a series of environmental indicators to measure, monitor and evaluate watershed conditions as part of an iterative, adaptive environmental performance management system.[236] The draft report provides considerable detail on outcomes, objectives, indicators and thresholds, and recommends strategies and actions (including regulatory approaches, BMPs, planning and education) in each of the four focus areas; much of this content relates directly to managing NPSP but is too extensive to be included in this report.[237] When the Phase Two plan is approved by the BRBC and its partners and stakeholders, it is envisioned that an implementation committee will be formed to provide assistance and advice to all proposed implementers.

2.6.2 The North Saskatchewan Watershed Alliance

The North Saskatchewan Watershed Alliance (NSWA) was founded in 1999 and incorporated in 2000 as a non-profit society. In 2005, it was designated as the WPAC for the North Saskatchewan Basin and was given a mandate to prepare an integrated watershed management plan (IWMP). To gain more information about the watershed, the NSWA published the *State of the North Saskatchewan Watershed* report in 2005, which compiled information about current land use, water, and ecological conditions in the watershed.[238]

Land uses in the North Saskatchewan watershed include agriculture, resource exploration and extraction, recreation, urban development and country residential development. Most of the watershed's approximately 1.2 million people live in the City of Edmonton and surrounding area. The province's LTRN has three monitoring sites on the North Saskatchewan River (NSR), one upstream of Rocky Mountain House, one at Devon just upstream from Edmonton, and one at Pakan, about 100 km downstream from Edmonton.[239] AEW also undertook three synoptic surveys across the NSR basin in 2008.

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[234] *Bow River Basin Watershed Management Plan, Phase Two Terms of Reference*. 2011, http://www.brbc.ab.ca/images/stories/BBWMP-PhaseII/bbwmp_jan._13_2011_bbwmp_tor.pdf, p. 9.
[235] See http://www.brbc.ab.ca/index.php?option=com_content&view=article&id=96&Itemid=210
[236] See *Indicators for Assessing Environmental Performance of Watersheds in Southern Alberta: A Summary Document.* No date, Alberta Environment, http://environment.gov.ab.ca/info/posting.asp?assetid=7944&searchtype=asset&txtsearch=watershed%20planning%20and%20Advisory%20Councils
[237] Twenty-eight recommended strategies and actions are proposed for the Land Use area, 14 for Riparian Lands, 11 for Wetlands, and 13 for Headwaters.
[238] NSWA. 2005, *State of the North Saskatchewan Watershed Report 2005 – A Foundation for Collaborative Water Management*, http://www.nswa.ab.ca/content/state-of-the-watershed
[239] See http://environment.alberta.ca/01614.html for a map of all LTRN sites and more information.

Going downstream, water quality changes due to point and non-point inputs from natural and anthropogenic sources; NPSP includes nutrients, bacteria, sediment and pesticides.[240] A 2002 study concluded that the main source of parasites, bacteria, nutrients, organic matter and other water quality variables in the NSR is the non-point source runoff from agricultural watersheds rather than point sources such as wastewater effluent. The study noted that additional sampling should be done along streams that drain agricultural watersheds to identify areas that contribute disproportionately to parasite loads in tributary streams.[241] Sediment is another issue in the NSR watershed, particularly when flows are high, and work is underway to determine where the sediment loads originate.

Two objectives in the Terms of Reference for the IWMP[242] are relevant to NPSP:

- Identify land-use practices that could positively or negatively impact water resources and develop strategies to reduce negative impacts.
- Identify critical gaps in watershed knowledge and identify agencies or programs that will address these gaps.

The technical studies done as background to the preparation of the IWMP revealed, among other things, that many regulations, guidelines, and BMPs are in place to reduce or prevent NPSP on a site-specific basis. But less effort has been directed toward addressing the cumulative impacts resulting from numerous land-use activities. The NSWA concluded that WQOs were needed to establish limits on the cumulative effects of human activities on river water quality. WQOs were proposed for five specific monitoring sites on the NSR between the headwaters and the Alberta/Saskatchewan border.[243] Among the implications of these objectives were that new point and non-point source loads need to be minimized or offset by reducing current loads to the river, and current NPSP needs to be minimized or reduced.[244]

In 2009, the NSWA engaged the ALCES© group to do a project that simulated the effects of major land uses in the watershed on specific watershed values (including water quality) over a 100-year time span. The project report suggested that "strategies should be favoured that emphasize reductions in point and non-point pollution as well as protection and restoration of the aquatic ecosystem, including lakes, wetlands and riparian areas. . . [and] that in the future, controlling sprawl appears to be one of the most powerful means of limiting further degradation of the watershed."[245]

The *Discussion Paper for the Development of an Integrated Watershed Management Plan for the North Saskatchewan River Watershed in Alberta* proposes a number of recommendations for goals, watershed management directions and actions that are relevant to NPSP, based on the work done to date. In addition to a role for the NSWA, the paper suggests roles for key players, including the GoA, municipalities,

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[240] NSWA. 2005, *State of the North Saskatchewan Watershed Report 2005 – A Foundation for Collaborative Water Management.*

[241] Cooke, S.E. *et al*. 2002, *Relationship Between Beef Production and Waterborne Parasites (Cryptosporidium spp. and Giardia spp.) in the North Saskatchewan River Basin, Alberta, Canada,* http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/wat6400

[242] NSWA. 2005, *Terms of Reference: Integrated Watershed Management Plan for the North Saskatchewan Watershed in Alberta.*

[243] NSWA. 2010, *Proposed Site Specific Water Quality Objectives for the Mainstem of the North Saskatchewan River,* http://nswa.ab.ca/userfiles/WQO%20Final%20Report%20Mar%209%202010.pdf

[244] NSWA. 2011, *Discussion Paper for the Development of an Integrated Watershed Management Plan for the North Saskatchewan River Watershed in Alberta,* http://nswa.ab.ca/sites/default/files/IWMP%20Discussion%20Paper%20Final%20Jan%2014%202011.pdf

[245] NSWA. 2011, *Discussion Paper for the Development of an Integrated Watershed Management Plan for the North Saskatchewan River Watershed in Alberta,* p. 27. See the full report, *Cumulative Effects Assessment of the North Saskatchewan River Watershed using ALCES,* at http://www.nswa.ab.ca/cumulative_effects

industries, landowners, and land users. The Discussion Paper also notes the importance of BMPs to improve practices that do or could contribute to NPSP. The NSWA is working to prepare a draft IWMP and timeframe for implementation. Two key directions related to NPSP are to see the development and implementation of WQOs for the mainstem, and the gathering of better information for streams and tributaries to enable the establishment of WQOs for those reaches.

Earlier work by the NSWA determined that the Vermilion River watershed was experiencing substantial impacts on both water quality and quantity due to wetland drainage and modification, livestock management, tillage, and municipal and industrial development. Although comprehensive data were lacking, the 2005 *State of the North Saskatchewan Watershed* report rated the watershed as "poor." The Vermilion River Watershed Management project was established to research, assess and improve key aspects of watershed function in the Vermilion River watershed.

Two of the goals in the October 2011 *Discussion Paper for the Development of a Watershed Management Plan for the Vermilion River Watershed in Alberta*[246] pertain to the management of NPSP:

- Goal 3: Maintain or improve surface water quality in the Vermilion River watershed.
- Goal 4: Maintain or improve aquatic ecosystem health in the Vermilion River watershed.

Potential actions under goal 3 recognize the need to establish WQOs and to identify sources and reduce NPSP through the adoption of BMPs.

2.6.3 The Oldman Watershed Council

The Oldman Watershed Council (OWC) was formed in September 2004, when the Oldman River Basin Water Quality Initiative merged with the Oldman Basin Advisory Council. The OWC is the WPAC for the Oldman River Basin, and provides leadership and guidance in watershed planning and management, monitoring water quality and promoting stewardship.[247]

The *Oldman River State of the Watershed Report Summary* (2010)[248] provides a good description of the watershed and the activities it supports. The watershed contains widely varied land uses and experiences a range of impacts from human activities. Land use activities include agriculture, forestry, mining, recreation, and oil and gas extraction. Cultivated agriculture is the main land use in 60% of the watershed, and about 20% of cultivated land is irrigated. Approximately 200,000 urban and rural residents live in the watershed, which includes the City of Lethbridge.

Southern Alberta has seen a number of water quality monitoring studies over the years. Alberta's LTRN has three monitoring sites on the Oldman River, one near Brocket in the foothills, one just upstream of Lethbridge, and one downstream of Lethbridge.[249] As noted in section 2.1.3, several studies have been carried out in the Oldman watershed. One of the most comprehensive was the **Oldman River Basin Water Quality Initiative (ORBWQI),** which saw water samples collected along the length of the

[246] NSWA. 2011, *Discussion Paper for the Development of a Watershed Management Plan for the Vermilion River Watershed in Alberta*, http://nswa.ab.ca/sites/default/files/Vermilion%20River%20Watershed%20Discussion%20Document%20Nov%2014th%202011%20for%20website.pdf

[247] See the OWC website for more information, at http://oldmanbasin.org/

[248] The description of the Oldman watershed in this paragraph is adapted from the *Oldman River State of the Watershed Report Summary*, 2010, Oldman Watershed Council, http://oldmanbasin.org/index.php/teams-and-projects/state-of-the-watershed-report/

[249] See http://environment.alberta.ca/01614.html for a map of all LTRN sites and more information.

Oldman River from 1998 to 2003.[250] This study did not focus solely on agriculture, as water flowing into the mainstem from tributaries, irrigation return flow channels, wastewater treatment plants and urban storm drains was also monitored. Water quality variables analysed included protozoan parasites, indicator bacteria, a wide range of inorganic chemicals (nutrients, ions, metals), and a suite of pesticides. The study showed that non-point sources play a major role in the quality of the Oldman River and its tributaries, and agriculture is not the only land use that affects water quality in the basin. The importance of these contributions is strengthened by the observation that in drier years, water quality appeared to improve. This pattern is complicated by the fact that even when drier conditions result in less natural runoff, irrigation and other water uses still provide a pathway for movement of material from the land to the water through return flows and storm drains.

The State of the Watershed report concluded that riparian areas across the watershed are less healthy than riparian areas in Alberta as a whole. Integrating results from the terrestrial and riparian indicators for land cover, soil erosion, riparian health and land use provides an overall ranking of "fair" for the Oldman River watershed. Integrating the results of water quality analysis for nitrogen, phosphorus, TSS and fecal coliforms gives an overall rank of "good" to "fair" for the watershed. The overall health of the Oldman watershed is rated as "fair." Across much of the watershed, land cover, riparian health, land use, water allocations, and surface water nutrient levels are the indicators of most concern.

The State of the Watershed report contained several NPSP-related recommendations for the Oldman watershed, including the need to:

- Reduce runoff and leaching to surface waters from feedlots and pastures;
- Support rural BMPs such as off-stream watering systems, riparian zone protection, manure incorporation methods, shelterbelts, reduced tillage and others;
- Support urban BMPs related to stormwater management; and
- Consider measures to reduce and prevent erosion in agricultural operations, new urban developments.

In October 2011, the OWC published *The Oldman Watershed Plan: Promoting action to maintain and improve our watershed*.[251] The plan will guide action to address priority water and land issues in the watershed. Goal 6 and its associated objectives are relevant to NPSP:

> Goal 6: Identify water quality outcomes and assess factors impacting them for adaptive watershed management.
>
> Objectives:
>
> - Assess water quality in the Oldman basin through a regular monitoring program.
> - Identify water quality objectives along the mainstem and tributaries.
> - Research and assess the causes of water quality issues from point and non-point sources.
> - Understand the cumulative impact of land activities on water quality and quantity.
> - Develop and recommend management strategies to mitigate water quality concerns.
> - Communicate research and monitoring results to watershed residents and stakeholders.

The Plan makes recommendations to the GoA and others, many of which relate to NPSP:[252]

- Expedite the cumulative effects management process.

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[250] Description of this program is adapted from Saffran, K.A. 2005, *Oldman River Basin Water Quality Initiative: Surface Water Quality Summary Report, April 1998-March 2003*, http://www.oldmanbasin.org/pdfs/orbwqi_swq_98-03.pdf

[251] OWC. 2011, *The Oldman Watershed Plan: Promoting action to maintain and improve our watershed*, http://oldmanbasin.org/. The OWC website includes other materials that were prepared as background to the Plan.

[252] The recommendations are summarized here; see the full report at http://oldmanbasin.org/ for complete wording.

- Develop a watershed-wide monitoring program for nutrients, TSS, fecal coliforms, invasive aquatic species and emerging contaminants.
- Prepare a consistent and robust set of policies to address development in or near wetlands and riparian areas.
- Review existing water conservation objectives to restore and protect the aquatic ecosystem.
- Support and maintain good stewardship practices.
- Create an erosion control monitoring and implementation program for all new developments and areas with exposed earth.

2.6.4 Watershed Stewardship Groups

WSGs have been established in every major watershed in Alberta and are eligible for financial support through the Watershed Stewardship Grant Program, administered by the Alberta Stewardship Network (ASN) and funded by AEW. Grants of up to $7,500 can be awarded to watershed stewardship groups that are working in their communities to raise awareness or improve the condition of their local watershed.[253] The number of recipients and the amount of funding available vary from year to year; 23 WSGs received funds in 2011, 25 in 2010, and 34 in 2009. Grant funds are typically leveraged at a ratio of approximately 4:1. The ASN publishes a current list of grant recipients as well as an annual report on the results of the grant program.[254] The 2010 annual report shows that over half of the funded projects were located in the Bow, North Saskatchewan and Oldman watersheds.

WSGs undertake a wide variety of projects and most are also actively involved in education and outreach to raise awareness about issues in their watershed. Selected examples pertaining specifically to NPSP are noted below. The ASN published a directory of stewardship groups, support agencies and resources involved in watershed stewardship in Alberta in 2005 which provides more details on specific WSGs.[255]

2.6.4.1 Nose Creek Watershed Partnership

Nose Creek originates near the northern boundary of Rocky View County and the Town of Crossfield north of Calgary and is fed by many intermittent streams. It flows south through the City of Airdrie and joins the Bow River in Calgary. From its headwaters to the Bow River, Nose Creek flows through many jurisdictions and land uses, including agricultural land, channelized urban settings, golf courses, industrial areas, and areas of heavy development.[256]

Riparian health and function and water quality have been compromised in the Nose Creek watershed due to elevated flows that contribute to streambank erosion, as well as encroachment by development and agricultural activity, and alteration and/or elimination of the native plant community and natural features that protect water quality. Fecal coliforms, fertilizers, herbicides, silt and sediment enter the creek through groundwater, overland runoff and stormwater outfalls. About 20% of the Nose Creek sub-basin is located within urban centres, providing for many opportunities to improve watershed management.[257]

The Nose Creek Watershed Partnership was formed in December 1998 to protect riparian areas and improve water quality in the Nose Creek Watershed. The Partnership consists of the Municipal District of Rocky View, City of Calgary, City of Airdrie, Town of Crossfield, and the Calgary Airport Authority,

[253] For more information, see http://www.landstewardship.org/watershed-stewardship-grant-program/
[254] See http://www.landstewardship.org/past-grant-recipients/.
[255] The ASN's 2005 directory, *Watershed Stewardship in Alberta*, is available online at http://www.landstewardship.org/media/uploads/Directory_of_Watershed_Stewardship_in_Alberta.pdf
[256] Nose Creek Partnership, http://nosecreekpartnership.com/the-watershed
[257] BRBC. 2010, *Bow River Basin State of the Watershed Summary*, http://www.brbc.ab.ca/index.php?option=com_content&view=article&id=84&Itemid=1022

with technical assistance provided by AEW, the BRBC, Ducks Unlimited, Fisheries and Oceans Canada and Trout Unlimited Canada. In 2002, the Partnership began discussions with AEW and in spring 2003, terms of reference were issued to guide the development of the authorized Water Management Plan. The *Nose Creek Watershed Water Management Plan*, published in 2008, has now been adopted by the Councils of Calgary, Airdrie and the Municipal District of Rocky View to be used as a guidance document and planning tool.[258]

The Plan addresses NPSP by focusing on stormwater management as well as protection of riparian areas.[259] It also includes specific NPSP-related tools to achieve the Plan's goals, including, among others:

- Staged implementation of runoff volume control targets;
- LID strategies;
- A Riparian Area Management Map defining site-specific setback criteria;
- Implementation of agricultural BMPs; and
- Cumulative effects assessment.

The runoff volume control targets in particular were viewed as an innovative approach to managing stormwater, as the Plan notes that "typical land development practices can generate 5 to 100 times more runoff compared to predevelopment conditions" (p.12). As noted earlier, the City of Calgary is now applying these targets to the Shepard and Pine Creek watersheds, and similar targets are being developed for the Bow River, Elbow River and Fish Creek catchment areas within City limits. These rates are shown in Table 6 along with a proposed implementation schedule.[260]

Table 6. Implementation Schedule for Reduction in Runoff Volume Control Targets

	Runoff Volume Control Targets			
Date of implementation	2007	Jan 2010	Jan 2013	Jan 2017
Nose Creek main stem target	90 mm (50 mm)[a]	30 mm	16 mm	11 mm
West Nose Creek target	90 mm (50 mm)	50 mm	26 mm	17 mm
% precipitation volume capture	75%-85%	85-90%	93-95%	95-97%
% increase in channel width	~100-200%	~100%	~50%	0-25%
Target impacts on creeks	High	High	Moderate	Low

[a] The 50 mm Runoff Volume Control Target should be applicable to country residential developments and low density industrial, commercial and institutional developments from 2007 to Jan 2010.

"Runoff Volume Control Targets are necessary to preserve the natural hydrological runoff volume in Nose Creek and West Nose Creek. Predevelopment runoff volumes for Nose Creek and West Nose Creek amounted to about 6.1 mm and 9.6 mm (April-October), respectively. Average precipitation at the Calgary International Airport for the period April through October is about 350 mm (based on Environment Canada's climate normals). Predevelopment runoff volumes, therefore, represented about

[258] Nose Creek Watershed Partnership. 2008, *Nose Creek Watershed Water Management Plan*, http://nosecreekpartnership.com/our-plan/nose-creek-watershed-water-management-plan

[259] The *Nose Creek Watershed Management Plan* also "1) recommends Water Conservation Objectives for Nose Creek and West Nose Creek, 2) specifies matters and factors that may be considered by Alberta Environment and Water and other decision makers in deciding whether to issue an approval, preliminary certificate or licence, or approve a transfer of an allocation of water under a licence, and 3) builds upon and/or refines the requirements specified in strategic, broad-scale planning documents." (pp.1-2)

[260] This table is excerpted from the *Nose Creek Watershed Water Management Plan*. 2008; p. 13, Table 8.1.

2% of total rainfall volumes (April-October)."[261] These targets are intended to be interpreted as annual runoff volume targets.[262]

The Partnership has several projects underway including creek rehabilitation initiatives. The group monitors riparian status, fisheries and erosion in the watershed and has initiated a basin-wide long-term water quality monitoring program at four stations in the upper Nose Creek watershed. Changes in the monitoring data will show if rehabilitation efforts are improving water quality in Nose Creek.[263]

2.6.4.2 Clear Water Landcare

Clear Water Landcare (CWL) is based in Clearwater County, which includes the Town of Rocky Mountain House. It is upstream of Edmonton in the North Saskatchewan watershed. In an earlier life, as the Rocky Riparian Group, there developed a history of working with local landowners to advise on and help them implement BMPs to protect riparian areas. The CWL is now more broadly focused on improving overall watershed health.[264]

CWL recently partnered with EPCOR to monitor water quality in a number of rivers and tributaries in the Rocky Mountain House area, and work to protect them from contaminants by promoting riparian and upland stewardship. In 2010, sampling was done initially during spring runoff and storm events when many of the contaminants that accumulate on the land over winter run into the streams. This was followed by sampling throughout the summer and fall base flow periods. Sampling included the North Saskatchewan, Clearwater, Nordegg, and Brazeau rivers, as well as streams in the more agricultural areas downstream of Rocky Mountain House (Strawberry, Modeste, Weed, Wabamun, Conjuring and Rose creeks).[265]

Data on these streams and tributaries is lacking, and this partnership is expected to yield valuable data that will enable changes in water quality to be assessed over time. It is particularly important to sample during high runoff periods since other ongoing monitoring programs in the province are generally not designed to ensure they capture these events.

[261] Nose Creek Watershed Partnership. 2008, *Nose Creek Watershed Water Management Plan*, p. 13.
[262] See Technical Memorandum dated May 10, 2010, Re: Runoff Volume Targets and Analysis Method, at http://nosecreekpartnership.com/wp-content/uploads/2011/05/Runoff-Volume-Calculation-Technical-Memo-May-2010.pdf
[263] See http://nosecreekpartnership.com/projects for more details.
[264] See http://www.county.clearwater.ab.ca/departments/section.jsp?sid=15 for more information.
[265] Neufeld, S. "Assessing the Headwater Region," in *The Ripple. A Publication of Clear Water Landcare*, Fall 2010, http://docs.clearwatercounty.ca/ckfinder/userfiles/files/Fall%20Ripple.pdf

3. Review of Selected Canadian Jurisdictions

3.1 Government of Canada

The role of the federal government in managing NPSP is relatively limited compared to the activities and approaches of the provinces. As noted in various places in this report, departments and agencies of the Government of Canada work with provincial partners to fund and deliver programs and research projects that help manage NPSP. Examples include the BMP manuals developed for agriculture in Alberta, and in Ontario, the partnership of Environment Canada with the province to manage the Great Lakes Basin Ecosystem,[266] and federal support for projects such as the Lake Simcoe Clean-up Fund.[267]

Two pieces of federal legislation are relevant to NPSP management as they pertain to the deposition or release of sediment and toxic substances:

- *Fisheries Act*, R.S.C., 1985, c. F-14
- *Canadian Environmental Protection Act*, 1999, S.C. 1999, c. 33

The *Fisheries Act*,[268] administered by the Department of Fisheries and Oceans, affects all land uses discussed in this report, as it applies to all internal waters in the country that are inhabited by fish or have the potential to support fish. Under this Act, "No person is permitted to carry on any work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat (HADD). . . Except where authorized, no person shall deposit or permit the deposit of a deleterious substance of any type in water frequented by fish. The deleterious substance cannot be deposited in a place where it would eventually enter water frequented by fish. . . A deleterious substance is any substance or water containing a substance that would degrade or alter or form part of a process of degradation or alteration of the quality of that water so that it is rendered or is likely to be rendered deleterious to fish or fish habitat or to the use by man of fish that frequent that water."[269]

It is a potentially powerful piece of legislation as offences under the Act regarding the deposit of deleterious substances are strict liability offences. "As an example, an operator commits an offence under the Act if he spreads manure on land near a stream frequented by fish and the manure gets into the stream in sufficient quantities to have a 'deleterious effect.' The offence results even if the manure does not actually cause harm to the fish. The mere fact that the manure reached water frequented by fish is an offence and may result in charges under this Act, unless the operator can prove that at all times, the water is not, has not been, and is not likely to be frequented by fish. In addition, an operator risks committing an offence if he spreads manure on land near a stream frequented by fish, even if the manure does not in fact enter the water, but had a reasonable chance of entering the water. However, if the operator can prove that at all times, the water is not, has not been and is not likely to be frequented by fish, then the operator has not committed an offence under the Act."[270]

Depending on the circumstances and whether it is a first or subsequent offence, penalties can be a fine of up to $1,000,000 or three years' imprisonment, or both.

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[266] See http://www.ec.gc.ca/grandslacs-greatlakes/default.asp?lang=En&n=70283230-1 for more information.
[267] See http://www.ec.gc.ca/default.asp?lang=En&xml=E20706E9-C4B5-48C7-A4F2-D2B37C400823 for more information.
[268] The *Fisheries Act*, R.S.C., 1985, c. F-14, http://laws-lois.justice.gc.ca/eng/acts/F-14/index.html
[269] Alberta Agriculture, Food and Rural Development. 2004, *Beneficial Management Practices: Environmental Manual for Alberta Cow/Calf Producers*, p. 93.
[270] Alberta Agriculture, Food and Rural Development. 2004, *Beneficial Management Practices: Environmental Manual for Crop Producers in Alberta*, p. 152.

The *Canadian Environmental Protection Act* (CEPA),[271] administered by Environment Canada, is relevant to NPSP in that "Where a 'toxic substance' (listed in Schedule 1 of the Act) is released into the environment, any person who owns or has the charge, management or control of a substance, or causes or contributes to the release or increases the likelihood of the release, must report the release and take measures to prevent the release and remedy/mitigate the effects."[272] This is particularly relevant to the management of stormwater.

3.2 British Columbia

3.2.1 British Columbia at a Glance

- *Efforts to implement an NPS Water Pollution Action Plan fell by the wayside in 2002. Like other provinces, B.C. does not have an integrated approach to managing NPSP, and BMPs are widely used.*
- *Some 95% of B.C. is Crown land, and the comprehensive* Forest and Range Practices Act *governs the activities of forest and range licensees. The Government has identified objectives and key resource values and forest companies develop strategies to meet them.*
- *The Forest and Range Evaluation Program (FREP) undertakes extensive monitoring of activities on Crown land and their impacts to ensure that licensees are effectively meeting the established objectives. FREP has developed a wide array of protocols and forms to use in conducting effectiveness evaluations.*
- *Some municipalities are implementing LID to better manage stormwater.*
- *The Oil and Gas Commission, a single-window regulatory agency, oversees oil and gas operations.*
- *The* Forest and Range Practices Act *has been amended to increase penalties for activities that damage sensitive sites, including irresponsible off-roading.*

3.2.2 Overview

With a total land and freshwater area of nearly 945,000 km^2,[273] B.C. occupies about 10% of Canada's land surface. About 95% of B.C. is Crown land[274] and 14% of B.C.'s total land base is protected.[275] More than half of the province's 4.6 million residents live in Vancouver and Victoria.[276] Natural resources such as fish, minerals, hydroelectricity and timber, have been the traditional backbone of B.C.'s economy,[277] and the province is Canada's second-largest natural gas producer.[278]

[271] *Canadian Environmental Protection Act*, 1999, S.C. 1999, c. 33, http://laws-lois.justice.gc.ca/eng/acts/C-15.31/index.html
[272] City of Edmonton. 2004, *Erosion and Sediment Control Field Manual*, p. 2.3.
[273] Statistics Canada, http://www40.statcan.gc.ca/l01/cst01/phys01-eng.htm
[274] Snetsinger, J. 2011, Forests and Forest Management in British Columbia, http://www.for.gov.bc.ca/ftp/HEX/external/!publish/Web/efs/Jims-Spanish-Delegation-20111004.pdf
[275] Government of B.C. website, http://www.hellobc.com/british-columbia/about-bc/geography.aspx
[276] Statistics Canada, http://www40.statcan.gc.ca/l01/cst01/demo02a-eng.htm
[277] Government of B.C. website, http://www.hellobc.com/british-columbia/about-bc/geography.aspx
[278] Government of B.C. website, http://www.gov.bc.ca/bcfacts/

In the late 1990s, B.C. developed a Non-Point Source Water Pollution Action Plan,[279] to be implemented by the then Ministry of Environment, Lands and Parks. The plan would build on actions already underway; longer-term actions that required consultation and new policy would be phased in over a five-year period. The intent at the time was that the Action Plan would be viewed as a living document, subject to review and improvement over time. The Plan identified 20 actions in six categories:

- Education and Training
- Prevention at the Site
- Land-Use Planning, Coordination and Local Action
- Assessment and Reporting
- Economic Incentives
- Legislation and Regulation.

The actions included improved legislation to better manage agricultural waste and stormwater, incorporating water resource management objectives into land-use plans, supporting development and implementation of BMPs, and promoting pollution prevention to the public and industry associations. The Action Plan recognized the complex array of federal, provincial and local agencies with a role in managing NPSP and the difficulty that flows from the fact that this is an inter-governmental and cross-jurisdictional issue.

While the NPS Action Plan was never fully implemented as envisioned, a number of the actions in the plan have been undertaken as a result of work by the Ministry of Environment's regional operations, other provincial government departments, municipal governments and non-government organizations.[280]

3.2.3 Agriculture

Only about 3% of B.C.'s land base is considered arable or potentially arable.[281] In 2006, farm holdings covered just over 2.8 million ha, with 586,000 ha in crops.[282] Most of B.C.'s ranchers depend on Crown rangelands and grazing leases; an estimated 10 million ha, of which over 8.5 million ha are Crown land, are classed as open or forested grazing land used by the ranching industry.[283] In 2006, the average census farm had an area of 143 ha,[284] but farm size varies greatly depending on the activity, with some viable operations (such as mushroom, greenhouse and poultry production) based on 5 ha or less. B.C.'s best arable land has been placed in the Agricultural Land Reserve (ALR) to be maintained for agricultural and related purposes. Slightly over 4.7 million ha of land are in the ALR.[285]

B.C.'s agriculture sector is very diverse. In 2010, the top commodities were dairy, chicken, floriculture, nursery, beef, eggs and mushrooms; the production of vegetables, grapes, berries and tree fruits is also

[279] British Columbia Ministry of Environment, Lands and Parks. 1999, *Tackling Non-Point Source Water Pollution in British Columbia: An Action Plan*, http://www.env.gov.bc.ca/wat/wq/bmps/npsaction.html
[280] Kevin Rieberger, Water Quality Science Specialist, B.C. Ministry of Environment, personal communication with Kim Sanderson, February 2, 2012.
[281] Government of British Columbia website, http://www.al.gov.bc.ca/aboutind/profile.htm
[282] Statistics Canada, http://www40.statcan.gc.ca/l01/cst01/agrc25k-eng.htm. The total farm area was higher in the 2006 census than previously due to better quality data on government land operated under a licence, permit or lease.
[283] Government of British Columbia website, http://www.al.gov.bc.ca/aboutind/profile.htm
[284] Statistics Canada, http://www40.statcan.gc.ca/l01/cst01/agrc25k-eng.htm
[285] Government of British Columbia website, http://www.al.gov.bc.ca/aboutind/profile.htm

significant.[286] Dairy is the largest single component of the agriculture industry in terms of assets and annual revenues. Beef cattle are also important and are raised throughout the province on large and small operations. In 2011, B.C. had some 650,000 head of cattle in total. Grain, oilseeds and forage seeds are also grown, mostly in the Peace River area.[287]

3.2.3.1 Policy and Regulatory Tools

Farm operators are affected by several pieces of provincial legislation but the following are most relevant to NPSP management:

- Code of Agricultural Practice for Waste Management under the *Environmental Management Act*'s Agricultural Waste Control Regulation (B.C. Reg. 131/92)[288]
- *Integrated Pest Management Act* and Regulation[289] [290]
- The *Forest and Range Practices Act*[291] and its Range Planning and Practices Regulation (B.C. Reg. 19/2004).[292]

The ***Code of Agricultural Practice for Waste Management,*** developed in 1992, describes practices for using, storing and managing agricultural waste that will result in such waste being handled in an environmentally sound manner. "Agricultural waste" includes manure, used mushroom medium and agricultural vegetation waste. The Code also describes allowable practices for on-farm disposal of dead animals, and conditions under which livestock are allowed access to watercourses. Specific requirements for storage, use and application of agricultural waste under the Code with relevance to NPSP are:

- Agricultural wastes, wood waste and mortalities must be collected, stored, handled, used and disposed of in accordance with this Code and in a manner that prevents pollution (s.3).
- Agricultural waste must not be directly discharged into a watercourse or groundwater (s.11).
- Agricultural waste must not be applied to the land if, due to meteorological, topographical or soil conditions or the rate of application, runoff or the escape of agricultural waste causes pollution of a watercourse or groundwater (s.13).
- Agricultural waste must not be applied on frozen ground, in diverting winds, on areas having standing water, on saturated soils or at rates of application that exceed the amount required for crop growth, if runoff or escape of agricultural wastes causes pollution of a watercourse or ground water, or goes beyond the farm boundary (s.14).
- Agricultural products (e.g., livestock, poultry, animal feeds, chemical fertilizers) must be managed, used and stored in a manner that prevents the escape of agricultural waste that causes pollution (s.30).

The Code also contains setback requirements for specified buildings and facilities; those that are considered to have a high risk for causing pollution must be set back 30 m from any watercourse; these

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[286] Government of British Columbia. 2011, FastStats 2010: Agriculture, Aquaculture and Food, http://www.agf.gov.bc.ca/stats/faststats/FastStats2010_R2.pdf. Farmed salmon, greenhouse tomatoes and greenhouse peppers were also in the top ten.

[287] Unless otherwise noted, text in this paragraph adapted from Government of British Columbia website, http://www.al.gov.bc.ca/aboutind/profile.htm

[288] Government of British Columbia, Code of Agricultural Practice for Waste Management, http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/10_131_92

[289] Government of British Columbia, *Integrated Pest Management Act*, http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/00_03058_01

[290] Integrated Pest Management Act Regulation B.C. Reg. 604/2004, http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/10_604_2004

[291] Government of British Columbia, *Forest and Range Practices Act*, http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/00_02069_01#section32

[292] Government of British Columbia, Range Planning and Practices Regulation, B.C. Reg. 19/2004, http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/19_19_2004

include solid agricultural waste field storage facilities with more than two weeks' storage, confined livestock areas with more than 10 agricultural units,[293] and seasonal feeding areas. Buildings and facilities with a slightly lower risk of causing pollution must be set back 15 m from any watercourse (sections 7, 8 and 29).

Under the Code, dead animals may be buried on-farm if the disposal does not cause pollution, and if the burial pits are covered, located at least 30 m from any source of water used for domestic purposes and constructed to prevent the escape of any agricultural waste that causes pollution. Mortalities may be composted on-farm if the composting site is located at least 15 m from a watercourse and 30 m from any source of water used for domestic purposes, and the composting does not cause pollution.

The Code allows for access to watercourses by livestock as follows:

- Livestock in a grazing area may have access to watercourses provided that the agricultural waste produced by that livestock does not cause pollution (s.25); and
- Livestock in a seasonal feeding area may have access to watercourses provided the access is located and maintained as necessary to prevent pollution (s.27).

With respect to seasonal feeding areas, the Code also notes that these areas must be operated in a way that does not cause pollution, and have berms where necessary to prevent agricultural waste runoff from causing pollution (s.26 (1)).

Producers who operate in compliance with this Code do not have to hold an Approval, Permit or Operational Certificate under the *Environmental Management Act* to discharge 'agricultural wastes' into the environment (i.e., it offers exemption of Sections 6(2) and 6(3) of the Act).[294] Compliance with the *Code* under the *Agricultural Waste Control Regulation* does not exempt a producer from any other part of the Act. Handling agricultural wastes in a manner not outlined in the *Code* requires an Approval, Permit or Operational Certificate under the Act.[295]

At the time this report was written, the Ministry of Environment was reviewing the Agricultural Waste Control Regulation with the intention of shifting to a code of practice to replace the current regulation.[296] In response to specific concerns about agricultural practices with potential to have significant environmental impacts, revisions are proposed in a number of areas, including, among others:[297]

- On-farm transport of agricultural wastes and by-products;
- Storage of agricultural wastes and by-products;
- Composting of agricultural wastes;
- On-farm disposal of mortalities;
- Land application of agricultural wastes and by-products; and
- Nutrient management planning.

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[293] An "agricultural unit" means a live weight of 455 kg of livestock, poultry or farmed game or any combination of them that equals 455 kg.

[294] Section 6(2) states that ". . . a person must not introduce or cause or allow waste to be introduced into the environment in the course of conducting an industry, trade or business." Section 6(3) states that ". . . a person must not introduce or cause or allow to be introduced into the environment, waste produced by a prescribed activity or operation." *Environmental Management Act*, http://www.bclaws.ca/EPLibraries/bclaws_new/document/LOC/freeside/--%20E%20--/Environmental%20Management%20Act%20SBC%202003%20c.%2053/00_Act/03053_02.xml

[295] B.C. Agricultural Research & Development Corporation. 2010, *B.C. Environmental Farm Plan: Reference Guide*, Appendices, http://www.agf.gov.bc.ca/resmgmt/EnviroFarmPlanning/EFP_Refguide/Refguide_toc.htm

[296] See http://env.gov.bc.ca/epd/codes/awcr/index.htm

[297] B.C. Ministry of Environment, *Review of the Agricultural Waste Control Regulation:* Policy Intentions Paper for Consultation, http://env.gov.bc.ca/epd/codes/awcr/intentions-paper.pdf

The Policy Intentions Paper is posted for consultation and comment until March 31, 2012.

The ***Integrated Pest Management Act*** and Regulation regulate the sale, containment, transportation, storage, preparation, mixing, application and disposal of pesticides and their containers. Under the Act, a person must not "use, handle, release, transport, store, dispose of or sell a pesticide in a manner that causes or is likely to cause an unreasonable adverse effect" (s.3 (1)(a)). Other requirements relevant to NPSP include:

- A container used to prepare, mix or apply a pesticide must not be washed or submerged in a body of water (s. 70(1)).
- Pesticide users must prevent releases of spray or runoff into natural water bodies (s.71(5)).
- In some cases, a 10 m pesticide-free zone must be maintained around bodies of water, dry streams and classified wetlands (s.73(1)).

Both the Code of Agricultural Practice for Waste Management (*Environmental Management Act*) and the Integrated Pest Management Act are administered by the B.C. Ministry of Environment.

The ***Forest and Range Practices Act*** regulates grazing on Crown rangeland and aims to protect watershed values. It generally prohibits activity that results in damage to the environment (s. 46), and with some exemptions as defined under the Regulation, requires the preparation of a range use plan and range stewardship plan (s. 32). The Range Planning and Practices Regulation (B.C. Reg. 19/2004) describes the objectives set by the government for the content of range use and stewardship plans, and includes objectives in six categories, three of which relate to NPSP management:

- Objectives for soil, including: minimize erosion and compaction (s. 6);
- Objectives for water, including: maintain or promote healthy riparian and upland areas (s. 8); and
- Objectives for fish, including: conserve fish, fish habitat and aquatic ecosystems (s. 9).

The Code of Practice for Soil Amendments (B.C. Reg. 210/2007)[298] and the Organic Matter Recycling Regulation (B.C. 18/2002),[299] also under the *Environmental Management Act*, pertain, among other things, to the land application of additional defined soil amendments and other nutrient sources. The Riparian Areas Regulation (B.C. Reg. 376/2004) under the *Fish Protection Act*[300] establishes directives to protect riparian areas from development. This regulation targets fish protection in areas zoned for residential, commercial and industrial development, but the standard for agricultural areas is complementary. The area between a watercourse and a building is set aside as a streamside protection and enhancement area for riparian vegetation that is to be planted or left to grow and is not to be used for any ancillary service uses or impervious surfaces. In addition to the setback distances noted under the Code of Agricultural Practice for Waste Management, two additional categories exist for buildings and facilities at lower risk of causing pollution. These setbacks range from 5 to 15 m.[301]

3.2.3.2 Use and Implementation of BMPs

The **B.C. Environmental Farm Plan Program** has been an important aspect of good stewardship since 2003. Many resources have been developed through this program to assist farmers in identifying and

[298] Government of British Columbia, Code of Practice for Soil Amendments, http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/210_2007
[299] Government of British Columbia, Organic Matter Recycling Regulation, http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/18_2002
[300] Government of British Columbia, Riparian Areas Regulation, http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/10_376_2004
[301] B.C. Ministry of Agriculture. 2011, Agriculture Building Setbacks from Watercourses in Farming Areas, http://www.agf.gov.bc.ca/resmgmt/publist/800Series/823400-1_Agriculture_Building_Setback_Factsheet.pdf

implementing appropriate BMPs, including the Environmental Farm Plan (EFP) Reference Guide, a Nutrient Management Reference Guide, and a Riparian Management Field Workbook.[302]

B.C. farmers are encouraged to prepare an EFP and then follow up by doing a Nutrient Management Plan if appropriate. In cases where livestock operations do not comply with nutrient management legislation, are located over vulnerable aquifers used for drinking water, or generate or use significant amounts of manure, a nutrient management plan is recommended.[303] The B.C. Department of Agriculture has also published a number of fact sheets on nutrient management and soil testing.[304] The Manure Spreading Advisory Committee, consisting of government and industry representatives, issues about five Manure Advisories each year as well as monthly updates. The advisories and updates provide timely guidance to farmers regarding activities related to the Agricultural Waste Control Regulation and the E*nvironmental Management Act*; for example, they may note if manure spreading is not advised at the time of the advisory, or stress other seasonal concerns.[305]

Many other management guides and reference documents for ranchers and farmers are available from the provincial government and describe diverse BMPs for a range of agricultural activities.[306] One of the most comprehensive is *Watershed Stewardship: A Guide for Agriculture*.[307]

The *Forest and Range Practices Act* expects that tenure holders will practice due diligence when using Crown resources and the Ministry of Forests, Lands and Natural Resource Operations has developed a number of materials that describe appropriate BMPs to fit within the due diligence context. These include a Grazing Management Guide, an overview of BMPs on Crown Range, and more detailed reports and guides on aspects such as riparian remediation and water quality.[308]

3.2.3.3 Monitoring NPSP and Assessing Management Outcomes

In 2004, a study was done to assess compliance of agricultural practices with the Agricultural Waste Control Regulation of the *Environmental Management Act* over two sensitive drinking water aquifers in the Lower Fraser Valley. These aquifers are located in an area of intense agricultural activity and there is a high risk of impact to human health and biodiversity. The study assessed 105 farms, including commercial operations and hobby farms and found that, overall, 78% were in compliance and 66% of the farms that produced or used manure or compost were in compliance. However, 76% of the farms that used manure or compost did not have a nutrient management plan.[309]

Another study in spring 2005 attempted to quantify the degree of compliance of observed manure spreading activities with the requirements of the Agricultural Waste Control Regulation and the manure

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[302] See http://www.agf.gov.bc.ca/resmgmt/EnviroFarmPlanning/index.htm

[303] B.C. Agricultural Research & Development Corporation. 2010, *B.C. Environmental Farm Plan: Reference Guide*, Chapter 6, Soil Amendments, http://www.agf.gov.bc.ca/resmgmt/EnviroFarmPlanning/EFP_Refguide/2010_Documents/06_Soil%20Amendments.pdf

[304] See http://www.agf.gov.bc.ca/resmgmt/NutrientMgmt/index.htm#nutrientguide

[305] See http://www.agf.gov.bc.ca/resmgmt/ManureAdvisory/index.htm

[306] See http://www.agf.gov.bc.ca/resmgmt/publist/Environment.htm for a full list of publications related to environmental aspects of agriculture.

[307] Governments of Canada and British Columbia. No date, *Watershed Stewardship: A Guide for Agriculture*, http://www.dfo-mpo.gc.ca/Library/216753.pdf

[308] See http://www.for.gov.bc.ca/hra/Publications/practices/RangelandWaterBMP.pdf, http://www.agf.gov.bc.ca/resmgmt/EnviroFarmPlanning/EFP_Grazing_Mgmt_Guide/Grazing_Mgmt_Guide_toc.htm, http://www.al.gov.bc.ca/range/factsheets.htm#health, http://www.for.gov.bc.ca/hra/Practices/index.htm#reports

[309] Ministry of Water, Land and Air Protection. 2005, *Compliance Assessment of Agricultural Practices over Two Sensitive Drinking Water Aquifers in the Lower Fraser Valley, British Columbia, October 2003-February 2004*, http://www.env.gov.bc.ca/epd/regions/lower_mainland/env_mgt/compliance/ag_practices/compl_assess_agr_aquifers.pdf

spreading advisories produced by the Nutrient Management Working Group in the Agassiz and Chilliwack areas of the Lower Fraser Valley.[310] The study found that about 88% of the 310 dairy farms in the areas were following the advisories. Riparian buffers were implemented 89% of the time and 90% of the spreading occurrences took place on grasslands as opposed to bare land. Light or moderate rates of manure were being spread 89% of the time. However, there were indications of much lower compliance when manure was being spread prior to February 15, which was in contravention of the advisories. Twelve ground inspections were completed as follow-up to the occurrences that were observed to pose the highest risk to the environment and were likely contraventions of the *Environmental Management Act*. Producers were informed of the legislative requirements, the availability of the advisories and the potential of various programs, such as the EFP program, to assist with remedying their non-compliance. Follow-up letters were sent to these producers requesting that Ministry of Environment staff be notified of corrective actions that had been taken to prevent future instances of non-compliance. The authors concluded that approximately 12% of producers were consistently not in compliance with legislative requirements.

A Ministry of Environment water quality monitoring program in the Coldstream watershed in the North Okanagan provides an example of concerns that have prompted the review of the Agricultural Waste Control Regulation. Coldstream Creek is the main tributary to Kalamalka Lake, supplying 80% of the flow and is used as a source of drinking and irrigation water, for recreational activities, and provides habitat for a variety of aquatic life. Nitrate levels at the upstream monitoring site in Noble Canyon, above the influence of agriculture and settlement activities were very low. For the sites below the canyon, nitrate levels were substantially higher at the sampling sites along the valley bottom through the agricultural area to the mouth, with many near or above the B.C. Water Quality Guidelines for aquatic life (3.0 mg nitrate/L). At one time, nitrate levels at one site spiked over the B.C. Drinking Water Quality Guidelines (10 mg nitrate/L). Bacteria levels also tended to increase downstream of the canyon and confirmed monitoring data from numerous other studies that indicate a chronic issue with high coliform bacteria in Coldstream Creek.[311]

The Forest and Range Evaluation Program regularly assesses sites for potential water quality impacts due to free-ranging livestock. A study published in 2011 reviewed three years of water quality effectiveness evaluation results. The study assessed potential water quality impacts associated with resource roads and timber harvesting and where free-range cattle were present, potential fecal contamination was assessed upstream of drinking water intakes. The potential for range impacts was noted at between 38 and 90% of the sites evaluated, depending on year of sampling. In other words, a drinking water intake where livestock were noted upstream had a good chance of being affected by fecal contamination. These potential impacts occurred most often where livestock had direct access to the stream. All potentially affected sites were identified to local range specialists with a recommendation for more detailed assessment.[312]

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[310] Rushworth, G. and M. Younie. 2006, *Compliance Assessment of Manure Application Practices in the Chilliwack and Agassiz Areas of the Lower Fraser Valley, British Columbia, February 7-March 4, 2005,* http://www.env.gov.bc.ca/epd/regions/lower_mainland/env_mgt/compliance/manure_chilliwack/compl_manure.pdf

[311] B.C. Ministry of Environment, *Review of the Agricultural Waste Control Regulation:* Policy Intentions Paper for Consultation, http://env.gov.bc.ca/epd/codes/awcr/intentions-paper.pdf. The full report of the Coldstream Creek Water Quality Monitoring Study: 2008-2009 is at http://a100.gov.bc.ca/pub/eirs/finishDownloadDocument.do;jsessionid=dafbb5ce601319469b4f02b33688b8d88f40cc9e319da9010842aee9c563fc9d.e3uMah8KbhmLe3iMbxmPa3uKai1ynknvrkLOlQzNp65In0?subdocumentId=7291

[312] Carson, B. and D. Maloney. 2011, *Summary of Provincial Water Quality Effectiveness Evaluation Results (2008-2010),* Forest and Range Evaluation Program, Extension Note #22, http://www.for.gov.bc.ca/hfp/frep/publications/extension_notes.htm#e22

3.2.4 Urban

B.C.'s 4.6 million residents represent just over 13% of Canada's population and are concentrated around the cities of Vancouver and Victoria; other major centres include Kelowna, Kamloops, Nanaimo, and Prince George. Like other provinces, B.C. has relied to a large extent on the adoption of BMPs to manage urban stormwater.

3.2.4.1 Policy and Regulatory Tools

Stormwater Management

The *Environmental Management Act* allows local governments to develop a **Liquid Waste Management Plan** (LWMP) for approval by the Minister of Environment. Although the primary focus of LWMPs is municipal wastewater, plans should consider issues associated with growth and development, stormwater management, drinking water supply (capacity and contamination risks), and non-point source pollution.[313]

The province has produced ***Interim Guidelines for Preparing Liquid Waste Management Plans***.[314] Two sections are relevant to stormwater and NPSP. Section 5.11 notes that the degree to which each non-point source is addressed will vary from community to community. Section 5.12 links municipal planning with stormwater management to ensure that initial stages of land use planning are integrated with local watershed hydrology and it notes the value of a watershed approach. If a municipality chooses to develop a separate stormwater management plan, that plan should be linked to other LWMP initiatives, so activities such as source control and education programs can be coordinated. The Guidelines include an Appendix with detailed Stormwater Guidance Documents.[315]

Local governments can use a range of regulatory tools to support integrated stormwater management practices. The *Local Government Act*[316] gives municipalities the authority to implement stormwater solutions such as:[317]

- bylaws that limit impervious surfaces and encourage infiltration;
- alternative low impact subdivision bylaw standards;
- bylaws that prevent the release of contaminants into stormdrains;
- watercourse setback zoning bylaws; and
- development permit areas that protect watercourses and floodplains.

Cosmetic Use of Pesticides

B.C. is examining a ban on cosmetic use of pesticides and conducted an online public consultation in late 2009-early 2010. A committee is now considering what potential legislation might look like.[318] Thirty-seven B.C. municipalities have pesticide bylaws, but they vary in the activities and chemicals covered.[319]

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[313] B.C. Ministry of Environment, *Interim Guidelines for Preparing Liquid Waste Management Plans*, section 3.1, http://www.env.gov.bc.ca/epd/mun-waste/waste-liquid/lw-mgmt-plan/section3.htm

[314] B.C. Ministry of Environment, *Interim Guidelines for Preparing Liquid Waste Management Plans*, http://www.env.gov.bc.ca/epd/mun-waste/waste-liquid/lw-mgmt-plan/index.htm

[315] B.C. Ministry of Environment, *Interim Guidelines for Preparing Liquid Waste Management Plans*, section 5.12, http://www.env.gov.bc.ca/epd/mun-waste/waste-liquid/lw-mgmt-plan/section5.htm#12.

[316] Government of British Columbia, Local Government Act, RSBC 1996, http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/96323_00

[317] Government of British Columbia, Ministry of Community, Sport and Cultural Development, Local Government Department, http://www.cscd.gov.bc.ca/lgd/environment/stormwater.htm

[318] See http://www.env.gov.bc.ca/epd/ipmp/regs/cosmetic-pesticides/consultation.htm

[319] Ministry of Environment Presentation to Special Committee on Cosmetic Pesticides, August 2011, http://www.env.gov.bc.ca/epd/ipmp/regs/cosmetic-pesticides/pdf/cosmetic-pesticides.pdf

3.2.4.2 Use and Implementation of BMPs

Two of the guidance documents in the Interim LWMP Guidelines are provincial in scope. *Stormwater Planning: A Guidebook for British Columbia*[320] provides a framework for implementing an integrated approach to stormwater management anywhere in the province. It stresses the need to consider land use practices and describes a range of approaches, including policies and site design techniques for integrating land use planning and stormwater management. The *Urban Runoff Quality Control Guidelines for British Columbia*[321] includes a variety of BMPs for source control and treatment.

The Ministry of Environment has a website with a compendium of municipal BMPs for managing water quality including stormwater.[322] The provincial government also published *Environmental Best Practices for Urban and Rural Land Development in British Columbia* in 2005; this extensive document addresses erosion and sediment control, stormwater management and pollution prevention, among other things.[323] In 1998, the province published BMPs on the use of road salt and winter maintenance for B.C. municipalities, stressing the use of alternatives where possible.[324]

Numerous other manuals, guidance documents and websites have been developed by B.C. organizations and municipalities related to managing stormwater. These include:

- *An Economic Rationale for Integrated Stormwater Management: A Resource for Urban and Rural Land Development in B.C.*,[325] which focuses on the use of LID practices.
- Capital Regional District *Model Bylaw to Regulate Discharges to the Municipal Stormwater Drainage System*,[326] plus an array of LID practices.[327]
- *Green Design Guidelines Manual*[328] which describes the importance of green infrastructure and provides several case studies from B.C. municipalities.

Metro Vancouver created a Stormwater Interagency Liaison Group to facilitate municipal stormwater management activities, and to research sustainable stormwater management practices. This group developed a stormwater planning guide that municipalities can use in developing long-term integrated stormwater management plans, stormwater source control guidelines, and other tools to assist local governments efforts in sustainable stormwater practices.[329]

Some of these resources feature examples of communities where BMPs (particularly LID) have been designed and/or implemented. One example is Cumbria Woods, a proposed 14 ha residential development on Vancouver Island. To compare costs, two alternatives were designed: a conventional North American

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[320] B.C. Ministry of Environment. 2002, *Stormwater Planning: A Guidebook for British Columbia,* http://www.env.gov.bc.ca/epd/mun-waste/waste-liquid/stormwater/index.htm

[321] B.C. Environment. 1992. *Urban Runoff Quality Control Guidelines for the Province of British Columbia,* http://www.env.gov.bc.ca/wat/wq/nps/NPS_Pollution/Stormwater_Runoff/urban_runoff_guidelines.pdf

[322] B.C. Ministry of Environment, http://www.env.gov.bc.ca/wat/wq/nps/BMP_Compendium/Municipal/Municipal_Home.htm

[323] Government of British Columbia. 2005, *Environmental Best Practices for Urban and Rural Land Development in British Columbia,* http://www.for.gov.bc.ca/hfd/library/documents/bib96812.pdf

[324] Warrington, P.D. 1998, Roadsalt and Winter Maintenance for British Columbia Municipalities: Best Management Practices to Protect Water Quality, http://www.env.gov.bc.ca/wat/wq/bmps/roadsalt.html#summary

[325] Centre for Landscape Research and the Province of British Columbia. No date. *An Economic Rationale for Integrated Stormwater Management: A Resource for Urban and Rural Land Development in* B.C., http://www.env.gov.bc.ca/epd/mun-waste/waste-liquid/stormwater/index.htm

[326] Capital Regional District. 2007, Model Bylaw: A Bylaw to Regulate Discharges to the Municipal Stormwater Drainage System, http://www.crd.bc.ca/watersheds/documents/HDM-45301-v13B-MODEL_BYLAW.pdf

[327] Capital Regional District, http://www.crd.bc.ca/watersheds/lid/index.htm

[328] The Master Municipal Construction Documents Association. 2005. *Green Design Guidelines Manual,* http://www.mmcd.net/downloads/24093-GreenDesignGuidelines-Sept1-05.pdf

[329] Metro Vancouver, http://www.metrovancouver.org/services/wastewater/sources/Pages/StormwaterManagement.aspx

suburb and a pedestrian-oriented neighbourhood with green stormwater infrastructure. The latter approach saves over $1-million in infrastructure costs.[330] Other examples have also been documented.[331]

3.2.4.3 Managing NPSP and Assessing Management Outcomes

One B.C. study looked at water quality in three urbanized watersheds in the Whistler area during stormwater (October 2007) and snowmelt (May 2008) runoff periods.[332] The goal was to determine whether land use and winter road maintenance practices in the three watersheds were affecting water quality in downstream locations as well as in a stormwater biofiltration pond that treats Whistler Village stormwater runoff. Results of the stormwater study showed that all three creeks and the pond had elevated levels of suspended sediment and turbidity, along with sediment-associated metals (copper, iron and zinc) that exceeded British Columbia Approved Water Quality Guidelines for the protection of aquatic life. The snowmelt study showed elevated levels of chloride, some metals (copper and zinc), suspended sediment, and turbidity in all four water bodies in urban areas during periods of high runoff.

Results of the biofiltration pond effectiveness study showed that, at times, the pond was receiving pollutants from urban stormwater runoff that exceeded the Approved Water Quality Guidelines. Elevated levels of suspended sediments, turbidity, *E. coli*, and metals (cadmium, copper and zinc) were observed during periods of high runoff; i.e., first flush events and early snowmelt runoff. In October 2007, the biofiltration pond was particularly effective in reducing higher levels of suspended sediments and associated metals (total copper, iron and zinc). In May 2008, total copper was effectively removed, while turbidity, total iron, nitrate and total phosphorus were only somewhat effectively removed.

The results highlighted the need for erosion and sediment source control, biofiltration pond maintenance, and improved winter road maintenance practices.

3.2.5 Forestry

Of B.C.'s total land base of nearly 95 million ha, 55 million ha are classified as forest land and, of this, 22 million ha are available for harvest; approximately 0.2 million ha are harvested annually.[333] Conifers are the dominant forest type. Forests over 140 years old cover 23 million ha.[334] In 2009, forest products accounted for 30% of the province's total exports; the forest sector as a whole accounted for 4.1% of provincial economic activity.[335]

Given the extent of forested land and activity, B.C. has many types of forest tenure, most of which are assigned under the *Forest Act*.[336] The Forest Practices and Investment Branch[337] is responsible for developing "policies and products that guide practices to achieve conservation and sustainable use of forest and range lands."

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[330] See http://www.env.gov.bc.ca/epd/mun-waste/waste-liquid/stormwater/case_studies/pdfs/52.pdf
[331] See http://www.env.gov.bc.ca/epd/mun-waste/waste-liquid/stormwater/index.htm
[332] B.C. Ministry of Environment, http://www.env.gov.bc.ca/epd/regions/lower_mainland/water_quality/reports/whistler-creek/index.htm
[333] Snetsinger, J. 2011, Forests and Forest Management in British Columbia, http://www.for.gov.bc.ca/ftp/HEX/external/!publish/Web/efs/Jims-Spanish-Delegation-20111004.pdf
[334] B.C. Ministry of Forests, Mines and Lands. 2010. *The State of British Columbia's Forests*, 3rd edition. Forest Practices and Investment Branch, http://www.for.gov.bc.ca/hfp/sof/#2010_report
[335] B.C. Ministry of Forests, Mines and Lands. 2010. *The State of British Columbia's Forests*, 3rd edition. Forest Practices and Investment Branch, http://www.for.gov.bc.ca/hfp/sof/#2010_report
[336] Government of British Columbia, *Forest Act*, RSBC 1996, http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/96157_00
[337] Forest Practices and Investment Branch, http://www.for.gov.bc.ca/hfp/index.htm

3.2.5.1 Policy and Regulatory Tools

The policy and regulatory tool most relevant to managing NPSP from forestry is the ***Forest and Range Practices Act*** (FRPA).[338] This Act and its regulations govern the activities of forest and range licensees, setting the requirements for planning, road building, logging, reforestation, and grazing.

The FRPA, described as being results-based, identifies key forest and resource values. The regulations related to FRPA further define these values by providing a goal statement for each one.[339] Through the FRPA, the government sets objectives and desired outcomes, and forest companies propose results or strategies that reflect the objectives and outcomes. The companies are then accountable for the results through a rigorous government compliance and enforcement regime. The requirements for forestry parallel those mentioned earlier for range activities, including a requirement for a forest stewardship plan (s. 3) and protection of the environment (s. 46).

Under the FRPA, forest licensees must have authorization from the government before they can harvest timber or build roads on Crown land. Licensees first submit Forest Stewardship Plans or Woodlot License Plans to the government and once the plan is approved, the licensee can apply for site level permits and authorizations. A Forest Stewardship Plan maps areas where a forest licensee may carry out forest development activities over a period of up to five years. The plan also states the results, strategies or measures that the forest licensee will achieve to be consistent with government objectives for forest values.[340] The plans must be subject to public review. "Planning measures include delineation of community watersheds, fisheries-sensitive watersheds, and riparian areas in which forest operations are prohibited or significantly limited. As of January 2010, 467 areas in B.C. had been formally designated as community watersheds, with the associated suite of legal limitations on forest practices in these areas."[341]

B.C. Reg. 14/2004, the **Forest Planning and Practices Regulation**,[342] describes objectives for Forest Stewardship Plans; of the ten categories of objectives in the regulation, two are generally relevant to NPSP:

- The objective set by government for soils is: without unduly reducing the supply of timber from British Columbia's forests, to conserve the productivity and the hydrologic function of soils (s. 5).
- The objective set by government for water, fish, wildlife and biodiversity in riparian areas is: without unduly reducing the supply of timber from British Columbia's forests, to conserve, at the landscape level, the water quality, fish habitat, wildlife habitat and biodiversity associated with those riparian areas (s. 8).

The Regulation contains requirements for:

- Maximum amount of soil disturbance permitted on the net area to be reforested (s. 35(3)).
- Maintenance of natural surface drainage patterns during and after construction of a road or access structure (s. 39(1)).
- Revegetation following road construction or deactivation if erosion could cause sediment to enter a stream, wetland or lake (s. 40).
- Designation of riparian classes for:

[338] Government of British Columbia, *Forest and Range Practices Act*, SBC 2002, http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/00_02069_01
[339] Government of British Columbian, Forest and Range Evaluation Program, http://www.for.gov.bc.ca/hfp/frep/values/index.htm
[340] Government of British Columbia website, http://www.for.gov.bc.ca/dck/Lim/dck_fsp.html
[341] B.C. Ministry of Forests, Mines and Lands. 2010, *The State of British Columbia's Forests*, 3rd edition. Forest Practices and Investment Branch, p. 99, http://www.for.gov.bc.ca/hfp/sof/#2010_report
[342] Government of British Columbia, B.C. Reg. 14/2004, Forest Planning and Practices Regulation, http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/12_14_2004

- Streams depending on whether a stream is or is not a fish stream and is or is not located in a community watershed. The classes generally reflect the width of the stream (s. 47). Section 47 also specifies minimum riparian management area widths on each side of the stream, from 20 m to 100 m, depending on the width of the stream.[343]
- Wetlands, according to size and location in specific biogeoclimatic zones or subzones; the riparian management area varies from 30 to 50 m (s. 48).
- Lakes, according to size and location in specific biogeoclimatic zones or subzones; the riparian management area varies from 0 to 30 m (s. 49).

· Prohibition of roads in a riparian management area, with some exceptions (s. 50).
· Activities that are restricted in the riparian management zone and the riparian reserve zone, such as some herbicide applications (s. 51(3)).
· Protection of the stream channel and stream bank immediately above and below a stream crossing during construction (s. 55).
· Fertilizer application rates (s. 63)

3.2.5.2 Use and Implementation of BMPs

The Forest and Range Evaluation Program notes that B.C.'s approach to effectiveness evaluation uses indicators in a different way than is done in sustainable forest management. Under the FRPA, forest agreement holders can customize forest practices and develop site-specific strategies for environmental protection as long as the government's objectives are met, and there may be no clear standard for what constitutes a BMP.[344] The Ministry of Forests, Lands and Natural Resource Operations has published a detailed Engineering Manual that describes mandatory procedures, BMPs and other information related to road and bridge design, construction, maintenance and deactivation.[345]

3.2.5.3 Monitoring NPSP and Assessing Management Effectiveness

The Forest and Range Evaluation Program (FREP) is led by the Ministry of Forests, Lands, and Natural Resource Operations in partnership with the Ministry of Environment. Among other things, FREP assesses the effectiveness of the FRPA and its regulations in achieving stewardship objectives, and determines if forest and range policies and practices are achieving the government's objectives, with a priority on environmental parameters and consideration for social and economic parameters, where appropriate.[346] Effectiveness evaluation indicators must be able to provide information on whether the policy of allowing customized or innovative forest practices is effectively meeting the government's objectives. Thus, effectiveness evaluation indicators focus on the state of the resource, such as the actual water quality in the stream, lake or wetland.[347]

The 2010 *State of the Forest* report notes that although less is known about soil and water resources than is known about timber resources, available data suggest that forest activities are conserving rather than degrading soil and water resources. The percent of harvested area taken up by roads has declined since the 1990s and now averages 3.5%, and the frequency of enforcement action for excessive soil disturbance during forest operations has sharply declined since the mid-1990s. Further, "In recent years, water quality and riparian habitats in harvested areas have been thoroughly monitored. Detailed assessments at 1,202 sites found most (94%) forest roads have low to moderate potential to deliver sediment to a stream. Detailed assessments of 1,022 streams within harvested areas found 87% in proper functioning condition.

[343] "Riparian management area" consists of a riparian management zone and a riparian reserve zone; widths for both of these zones are specified in the regulation, and together, they comprise the riparian management area.
[344] Forest and Range Evaluation Program, http://www.for.gov.bc.ca/hfp/frep/values/water.htm
[345] Ministry of Forests, Lands and Natural Resource Operations. 2011, *Engineering Manual*, http://www.for.gov.bc.ca/hth/engineering/documents/publications_guidebooks/manuals_standards/Eng-Manual.pdf
[346] Forest and Range Evaluation Program, http://www.for.gov.bc.ca/hfp/frep/about/index.htm
[347] Forest and Range Evaluation Program, http://www.for.gov.bc.ca/hfp/frep/values/water.htm

Recent examinations of forest roads have found that some stream crossings create a barrier to fish passage and remedial actions are underway."[348]

The FREP has done much of this extensive monitoring and two reports in particular are relevant to NPSP management.[349] [350] FREP has developed a wide array of protocols and forms to use in conducting effectiveness evaluations,[351] and the methodology is briefly described in each report.

3.2.6 Oil and Gas

The Ministry of Energy and Mines' Petroleum Lands Branch issues and administers provincially-owned petroleum and natural gas rights and collects the associated revenues. However, each activity carried out under agreements (such as a geophysical survey or drilling a well) must be approved by the Oil and Gas Commission.[352] The Commission is a single-window regulatory agency with responsibility for overseeing oil and gas operations in British Columbia, from the exploration and development phases, through to facilities operation and ultimately decommissioning. It is charged with balancing a broad range of environmental, economic and social considerations.[353] Regulatory responsibility is delegated to the Commission through the *Oil and Gas Activities Act*[354] and specific enactments under the *Environmental Management Act* and four other acts.

During the 2009/10 fiscal year, oil and gas operators drilled a total of 634 wells, resulting in an inventory of nearly 22,000 wells in B.C.[355]

3.2.6.1 Policy and Regulatory Tools

The following policy and regulatory tools are pertinent to managing NPSP related to conventional oil and gas activities:

- The Environmental Protection and Management Regulation under the *Oil and Gas Activities Act*
- The Oil and Gas Waste Regulation and the Spill Reporting Regulation under the *Environmental Management Act.*

The **Environmental Protection and Management Regulation** (B.C. Reg. 200/2010)[356] has some requirements for oil and gas activities that are pertinent to NPSP management:

- Operating areas to be located such that riparian values are protected and sufficient streamside vegetation is retained to protect stream temperature (s. 5).

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[348] B.C. Ministry of Forests, Mines and Lands. 2010, *The State of British Columbia's Forests*, 3rd edition. Forest Practices and Investment Branch, http://www.for.gov.bc.ca/hfp/sof/#2010_report, p. 5

[349] Carson, B. and D. Maloney. 2011, *Summary of Provincial Water Quality Effectiveness Evaluation Results (2008-2010)*, FREP Extension Note #22, http://www.for.gov.bc.ca/hfp/frep/publications/extension_notes.htm#e22

[350] Tschaplinski, P.J. 2011, *State of Stream Channels, Fish Habitats, and Adjacent Riparian Areas: Resource Stewardship Monitoring to Evaluate the Effectiveness of Riparian Management, 2005-2008*, FREP Extension Note #17, http://www.for.gov.bc.ca/hfp/frep/publications/extension_notes.htm#e17

[351] See FREP, http://www.for.gov.bc.ca/hfp/frep/indicators/table.htm

[352] B.C. Ministry of Energy and Mines, http://www.empr.gov.bc.ca/OG/oilandgas/rightsandResponsibilities/Pages/PetroleumandNaturalGas.aspx

[353] B.C. Oil and Gas Commission, http://www.bcogc.ca/about/

[354] Government of British Columbia, *Oil and Gas Activities Act*, SBC 2008, http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/00_08036_01

[355] B.C. Oil and Gas Commission. 2010, *2009/10: Field Inspection Annual Report,* http://www.bcogc.ca/document.aspx?documentID=1011&type=.pdf

[356] Government of British Columbia, Environmental Protection and Management Regulation, B.C. Reg. 200/2010, http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/21404536

- Stream, wetland and lake crossings must protect fish habitat as well as the side of the water body, and any disturbance to the stream channel and stream bank, wetland or lake bottom must be mitigated (s. 11).
- Oil and gas activity must not result in any deleterious materials being deposited into a stream, wetland or lake (s. 12).
- When activities are carried out in a wetland, the natural flow of water must be maintained, to the extent practicable (s. 13).
- Activities must not cause the soil in an operating area to become unstable, and any alteration to natural surface drainage patterns on the area must be minimized (s. 17).
- When operations end, restoration is required to de-compact soil; restore soil structure and natural surface drainage pattern; re-vegetate exposed soil and stabilize if prone to erosion; remove any structure used to cross a stream, wetland or lake and ensure the site is stable; stabilize any cut slopes or fill slopes in wellsites and facility areas (s. 19).
- Designation of riparian classes for:
    - Streams depending on whether a stream is or is not a fish stream and is or is not located in a community watershed. The classes generally reflect the width of the stream (s. 22). Section 22 also specifies minimum riparian management area widths on each side of the stream, from 20 m to 100 m, depending on the width of the stream.[357]
    - Wetlands, according to size and location in specific biogeoclimatic zones or subzones; the riparian management area varies from 0 to 50 m (s. 23).
    - Lakes, according to size and location in specific biogeoclimatic zones or subzones; the riparian management area varies from 30 to 70 m (s. 24).

When an oil and gas site is no longer productive, the site must be reclaimed in accordance with the *Oil and Gas Activities Act*.[358]

Section 7 of the **Oil and Gas Waste Regulation** (B.C. Reg. 254/2005)[359] of the *Environmental Management Act* describes conditions for discharges to land from specific operations; discharges include drilling muds, drill cuttings and other. Surface runoff from sites associated with equipment and facilities may be discharged to land as long as it meets certain discharge parameters, the water does not enter a surface watercourse or water body nor could reasonably be expected to enter one, the discharge does not cause erosion, and other requirements. The British Columbia Oil and Gas Handbook, Chapter 6 on Drilling Waste Management provides options and BMPs.[360]

The **Spill Reporting Regulation** (B.C. Reg. 263/90)[361] under the *Environmental Management Act* requires any spills to be immediately reported and all reasonable practical action taken to stop, contain and minimize the effects of the spill.

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[357] "Riparian management area" is an area adjacent to a stream, wetland, or lake in which special management is required to conserve fish or wildlife habitat, biodiversity and water values of the area. It consists of a riparian management zone and a riparian reserve zone; widths for both of these zones are specified in the regulation, and together, they comprise the riparian management area.

[358] B.C. Oil and Gas Commission Fact Sheet. 2011, Reclamation and Remediation, http://www.bcogc.ca/documents/publications/Fact%20Sheets/Reclamation_and_Remediation_FINAL.pdf

[359] Government of British Columbia, Oil and Gas Waste Regulation, B.C. Reg. 254/2005, http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/32_254_2005

[360] B.C. Oil and Gas Commission, *British Columbia Oil and Gas Handbook*, Chapter 6, http://www.bcogc.ca/document.aspx?documentID=979

[361] Government of British Columbia, Spill Reporting Regulation, B.C. Reg. 263/90, http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/46_263_90

3.2.6.2 Use and Implementation of BMPs

The Oil and Gas Commission has published several manuals and guides to assist energy companies as they undertake activities that could potentially create NPSP. These include:

- The *Environmental Protection and Management Guide*, which provides more detail on the requirements under the Environmental Protection and Management Regulation along with best practices to achieve compliance.[362]
- The Road Application and Operations Manual, which describes the application process as well as road construction, maintenance and deactivation requirements.[363]

3.2.6.1 Monitoring NPSP and Assessing Management Effectiveness

During the 2009/10 fiscal year, the Commission inspected 4,337 oil and gas operation sites, of which 2,500 were active wells.[364] Most of the tickets issued to oil and gas operators were for violations under the *Water Act* and the *Environmental Management Act*, including waste and contamination violations. Of the 18 compliance orders and 106 enforcement actions that year, some actions are relevant to NPSP management such as requirements to measure groundwater and soil contamination and submit a report; re-contour and submit report; remediate/remove soil contamination; and remediate stream crossing.

3.2.7 Recreation

On the assumption that issues related to trail use (particularly motorized use) and/or camping are the main factors affecting NPSP, this section looks at these activities and their management in B.C.

3.2.7.1 Policy and Regulatory Tools

Most of the recreation activities related to NPSP take place on Crown land. B.C. uses several policy and regulatory tools for managing potential NPSP from such activities. These include:

- *Forest and Range Practices Act* and its Forest Recreation Regulation;
- Requirements under various land use plans; and
- Off-Road Vehicle (ORV) Management Framework

Section 46 (1) of the ***Forest and Range Practices Act***[365] (FRPA) prohibits activity that results in damage to the environment, including damage to Crown land. The aim is to protect sensitive sites such as wetlands from damaging activities, including irresponsible off-roading. People found damaging sensitive areas may be issued a violation ticket of $575 or face penalties of up to $100,000, as well as other penalties.[366] Section 58 of the FRPA allows the minister to restrict or prohibit access to Crown lands in the interest of protecting a recreation or range resource or to manage public recreation use.[367]

The **Forest Recreation Regulation** (B.C. Reg. 16/2004) under the FRPA states that "a person must not, in a careless or negligent manner, damage, or cause any alterations to, a structure or natural resource on a

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[362] B.C. Oil and Gas Commission. 2011, *Environmental Protection and Management Guide, Version 1.5,* http://www.bcogc.ca/document.aspx?documentID=927&type=.pdf

[363] B.C. Oil and Gas Commission. 2011, *Road Application and Operations Manual, Version 1.7,* http://www.bcogc.ca/document.aspx?documentID=962&type=.pdf

[364] Text in this section adapted from: B.C. Oil and Gas Commission. 2010. *2009/10: Field Inspection Annual Report*, http://www.bcogc.ca/document.aspx?documentID=1011&type=.pdf

[365] Government of British Columbia, *Forest and Range Practices Act*, SBC 2002, http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/00_02069_01

[366] Government of British Columbia. March 30, 2010, News Release: Off-road vehicle users reminded to respect environment, http://www2.news.gov.bc.ca/news_releases_2009-2013/2010FOR0043-000363.htm

[367] Other legislation, including the *Wildlife Act*, the *Motor Vehicle (All Terrain) Act* and the federal *Fisheries Act*, can also be used to prosecute offenders who cause environmental damage to Crown land.

recreation site, recreation trail or interpretive forest site" (s. 17). This would apply to anyone using forested land for recreation purposes.

The Integrated Land Management Bureau leads the development of **land use plans** and agreements for B.C.'s Crown lands and natural resources and coordinates their implementation.[368] Land use plans can address access and recreational use on a seasonal or permanent basis. For example, recreation access plans were developed for three areas in the East Kootenays where recreational use of Crown land has increased substantially.[369] Three objectives from the approved Cranbrook West Recreation Management Strategy[370] are good examples of approaches to managing potential NPSP from recreation activities:

- Objective 1-1: "Manage recreation access and development to ensure that the current distribution of fish and wildlife, the sustainability of their populations and the integrity of habitats, including water quality, are not compromised."
- Objective 1-4: "Protect wetland and riparian ecosystems from degradation."
- Objective 1-9: "Manage recreation to protect water quality in surface lakes, streams and wetlands for downstream consumptive users."

Strategies under the first two objectives include measures to restrict access off hard surfaces, and a strategy for the third objective notes the need for bridge and ford stabilization, road/trail stabilization and campsite stabilization or relocation to reduce impacts on water quality from recreation activity where there is a significant impact. This plan also includes a Code of Conduct for Recreation Activity, with BMPs for both motorized and non-motorized recreation.

B.C. has developed an **Off-Road Vehicle (ORV) Management Framework,** which is being implemented in phases, starting January 1, 2012 with full implementation expected by fall 2012. Of relevance to NPSP management, the Framework includes improved tools to help compliance and enforcement officials identify irresponsible ORV riders. A provincial ORV compliance and enforcement strategy will be developed and will include an education component to help achieve voluntary compliance.[371] A 2008 brochure describes the impacts and penalties for irresponsible ORV use.[372]

In 2010, B.C. released a draft **provincial trail strategy,**[373] recognizing the already large network of trails that are under the authority of various government agencies and are used for different purposes. Under the Good Governance component is an action to improve legislation, regulations and policy to manage motorized use and enhance opportunities for motorized trail users. The strategy aims to ensure opportunities for all trail users in balance with environmental, cultural and social values.

The province also provides direction and outlines requirements for the maintenance and development of recreation sites and trails through the website **Recreation Sites and Trails B.C.,** with reference to **s**ections 56 and 57 of the *Forest and Range Practices Act.* This site links to two chapters in the Recreation Manual that deal with recreation site management and trail management.[374]

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[368] Government of British Columbia, Integrated Land Management Bureau, http://archive.ilmb.gov.bc.ca/slrp/index.html

[369] See http://www.ilmb.gov.bc.ca/content/plans/east-kootenay-recreation-access-plans

[370] Ministry of Sustainable Resource Management, Province of British Columbia. 2005. *Cranbrook West Recreation Management Strategy (Landscape Units C1-13, C27-37)*, http://archive.ilmb.gov.bc.ca/slrp/srmp/south/cwrms/pdf/final_110405.pdf

[371] Ministry of Forests, Lands and Natural Resource Operations, http://www.for.gov.bc.ca/mof/orv/

[372] Recreation Sites and Trails B.C., *Protect our Forests and Range Land*, http://www.sitesandtrailsbc.ca/documents/off-roading.pdf

[373] Province of British Columbia. 2010, *Trails Strategy for British Columbia* (draft), http://www.sitesandtrailsbc.ca/about/provincial-trail-strategy.aspx

[374] Recreation Sites and Trails B.C., http://www.sitesandtrailsbc.ca/about/site-and-trail-maintenance.aspx

3.3 Ontario

3.3.1 Ontario at a Glance

- *Ontario does not have a province-wide approach to managing NPSP and, like Alberta, relies heavily on the use of BMPs.*
- *The 36 Conservation Authorities play a key role in watershed management and oversee many NPSP-related initiatives in their regions. They operate in areas with 90% of the population, and have been actively involved in preparing watershed assessments and source protection plans.*
- *The* Nutrient Management Act *regulates what can and cannot be applied to land and lays out standards and practices for management and application of nutrient-containing materials to avoid NPSP.*
- *The* Crown Forest Sustainability Act *guides all forest management practices. Buffer zones are noted, but there is no specific standard for erosion. A* State of the Forest *report is done every five years and assesses sustainability criteria and indicators.*
- *The 2009 Ban on Cosmetic Use of Pesticides appears to have significantly reduced concentrations of three commonly used pesticides in sampled streams.*

3.3.2 Overview

Ontario is Canada's most populous province, home to more than 13 million people on a land base of 917,741 km^2; freshwater accounts for another 158,654 km^2 for a total area of 1,076,395 km^2. More than 85% of the population lives in urban centres, largely in cities on the shores of the Great Lakes.[375] The Canadian Shield separates grassy lowlands in the north from some of the country's best agricultural land in the south. In addition to the five major land uses examined in this report, mining is an important activity in Ontario, producing more than 30 different metal and non-metal products, including nickel, goal, copper and platinum.[376] The Great Lakes are a defining feature of the Ontario landscape and a major source of drinking water. Given this significance, specific research programs have been developed to protect their water quality and examples of such initiatives appear in this section.

Ontario does not have a province-wide approach to managing NPSP, but does have various policy and regulatory tools that help address this issue. As well, the province has established a network of 36 Conservation Authorities which play an important role in NPSP management. Conservation Authorities are involved in water monitoring and deliver various programs on a watershed basis across most of Ontario. For that reason they are described first, before the various land uses.

3.3.3 Conservation Authorities

Conservation Authorities (CAs) are local, community-based environmental agencies. They represent a grouping of municipalities on a watershed basis and they partner with others, including the provincial government, to manage their respective watersheds. Ontario's 36 CAs operate in watersheds in which

[375] Statistics Canada, http://www40.statcan.gc.ca/l01/cst01/phys01-eng.htm; and Government of Ontario at http://www.ontario.ca/en/communities/economy/ONT03_020921.html
[376] Government of Ontario, http://www.ontario.ca/en/about_ontario/004467.html?openNav=natural_resources

90% of the provincial population resides. Conservation Ontario[377] is the umbrella organization that represents the CAs.

CAs were established by an Act of the provincial Legislature in 1946. At the time, there were concerns that poor land, water, and forestry practices during the 1930s and 40s had led to extensive soil loss and flooding and that new approaches were needed to deal with these significant erosion and water problems. Integrated management of natural resources on a watershed basis was proposed as that new way. Municipal councils agreed to become involved and this cooperation led to the passage of the *Conservation Authorities Act*,[378] for which the Ontario Ministry of Natural Resources is responsible. The Act enabled the province and municipalities to establish a CA within a specified area (a watershed) to undertake programs for natural resource management, but overall responsibility for natural resources remained with the province.

The *Conservation Authorities Act* embodied three fundamental concepts:

- A CA is a local initiative and would only be created when residents were willing to ask the Government of Ontario to form one.
- Costs of projects must be shared by municipalities and the province.
- CAs have jurisdiction over one or more watersheds and this stewardship covers all aspects of conservation in the area.[379]

CAs are mandated to ensure the conservation, restoration and responsible management of Ontario's water, land and natural habitats through programs that balance human, environmental and economic needs. Each CA is a non-profit organization governed by a board of municipally appointed members, most of whom are also elected municipal councillors. Their funding is derived from self-generated revenues, municipal levies, provincial grants and special projects, and federal grants or contracts.[380]

CAs are active in three main areas: environmental protection, managing water resources, and education. Three of the seven areas of programs and services noted in the Conservation Ontario fact sheet[381] are relevant to NPSP management:

- **Resource Management and Watershed Stewardship**. In 2010, CAs planted 2.9 million trees with 2,000 landowners and provided landowners with $6.6-million in grants to undertake 2,129 water quality improvements, including erosion control, agricultural BMPs, and others. These programs rely on partnerships with many different organizations and agencies.[382]
- **Monitoring Watershed Health**. CAs assess the quality of water bodies by measuring water chemistry and benthic invertebrates. Some also monitor bacteria. CAs sample sites in the Provincial Surface Water Quality Monitoring Network and the Groundwater Monitoring Network, and monitor benthic biota at locations across the province (see section 3.3.9 for more details on Ontario's Provincial Water Quality Monitoring Network). Several CAs have developed watershed report cards as a means of collecting and reporting on surface water quality and other environmental indicators.
- **Source Water Protection.** The *Clean Water Act* requires communities to develop source protection plans to protect municipal drinking water. The plans will identify risks to local

[377] Conservation Ontario, http://www.conservationontario.ca/index.html
[378] *Conservation Authorities Act*, R.S.O. 1990, Chapter C.27, http://www.e-laws.gov.on.ca/html/statutes/english/elaws_statutes_90c27_e.htm
[379] These points and the history in the preceding paragraph from Conservation Ontario, http://www.conservationontario.ca/about/history.html
[380] Conservation Ontario, http://www.conservationontario.ca/about/mandate.html
[381] Conservation Ontario fact sheet, no date, http://www.conservationontario.ca/Fact_sheets/CO_Fact_Sheet.pdf
[382] Conservation Ontario, http://www.conservationontario.ca/stewardship/partners.html

drinking water sources and develop strategies to reduce or eliminate these risks. CAs have completed Watershed Assessment Reports and are working on Source Protection Plans. These plans are to be completed and submitted to the Ontario Minister of Environment by August 2012.[383] Among other things, the source protection work is expected to identify "issue contributing areas" – that is, activities that could create threats and risks to drinking water. This appears to be the first province-wide tool where water quality is associated with land uses and remedial action.[384] Source water protection plans are described in more detail in Figure 3.

To financially help landowners and businesses take voluntary action to reduce threats to local municipal drinking water sources, including threats from NPSP, the Ministry of Environment launched the Ontario Drinking Water Stewardship Program. Phase One (2007-2010) saw the allocation of $21-million for various stewardship projects including runoff and erosion control and other BMPs. An additional $7-million has been allocated to Phase Two (2011-2012), which is being delivered by CAs to landowners and businesses through an application process. It will address specific local drinking water threats identified through the Source Protection Assessment Reports. Projects include improving septic systems, managing and storing pesticides and fertilizer, and proper storage and management of fuel.[385]

CAs have authority in several areas with potential to affect NPSP. They are empowered to regulate development and activities in or adjacent to river or stream valleys, Great Lakes and large inland lake shorelines, watercourses, hazardous lands and wetlands. Development on these lands may require permission from the CA to confirm that the control of flooding, erosion, dynamic beaches, pollution or the conservation of land are not affected. CAs also regulate the straightening, changing, diverting or interfering in any way with the existing channel of a river, creek, stream, watercourse or for changing or interfering in any way with a wetland.[386] With respect to wetlands specifically, CAs regulate:

- Activities within wetland areas to ensure that these activities do not interfere with natural wetland features and hydrologic and ecological functions;
- Development within a wetland to ensure that development does not affect the control of flooding, erosion, dynamic beaches, pollution or the conservation of land; and
- Development adjacent to a wetland to ensure that the hydrologic function of the adjacent wetland is not affected.[387]

CAs have some responsibilities for managing recreational land use and, along with local municipalities, are working to regulate all-terrain vehicle (ATV) use.

The Conservation Ontario website contains a large database of watershed management projects carried out by CAs, municipalities and others, some of which undoubtedly relate to NPSP management.[388] CAs are referred to as appropriate in the Ontario chapter.

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[383] Conservation Ontario Drinking Water Source Protection Planning Fact Sheet, http://www.conservationontario.ca/source_protection/documents/DSWPPlanningProcessFactSheet_000.pdf
[384] Cathie Brown, Project Manager, Drinking Water Source Protection, Ausable Bayfield Conservation Authority personal communication with Kim Sanderson, January 20. 2012.
[385] Conservation Ontario, http://www.conservationontario.ca/source_protection/protection.html
[386] Conservation Ontario, http://www.conservationontario.ca/planning_regulations/section28.html. This authority is given through Ontario Regulations 42/06 and 146/06 to 182/06;
[387] Conservation Ontario Brochure: *Development, Interference & Alteration Regulations for All Conservation Authorities*;
http://www.conservationontario.ca/planning_regulations/CO_Section_28_Brochure_2008_08_15_final.pdf
[388] Conservation Ontario, http://www.conservationontario.ca/projects/iwmp/index.html

Figure 3. Ontario's Drinking Water Source Protection Plans

In response to recommendations from Justice O'Connor and the Walkerton inquiry, the Ontario government passed the *Clean Water Act* in 2006 to protect sources of municipal drinking water throughout the province. Under this *Act*, source protection plans are being developed on a watershed basis. The Ontario Ministry of the Environment divided the province into 19 source protection regions, covering 38 different watersheds. Under the guidance of a multi-stakeholder committee, each of the 19 regions is developing a source protection plan for the one or more watersheds in its region.

The *Clean Water Act* and its associated regulations describe the framework for developing a source protection plan. The first step was to determine where water for municipal supplies comes from, how vulnerable it is to contamination and what, if any, contaminants are present. This work was completed in 2010 with the preparation of assessment reports for each region. The assessment reports identified significant drinking water threats associated with activities in vulnerable areas through a comprehensive process that:

- identified and mapped vulnerable areas in each region (municipal wells and intakes);
- determined where drinking water threats might exist; and
- calculated the drinking water threat levels (vulnerability scores) using a standard formula developed by the Ontario Ministry of the Environment.

The *Clean Water Act* lists the 21 prescribed drinking water threat activities that could affect municipal drinking water supplies (e.g., handling, storage and application of road salt, commercial fertilizers, agriculture source material, and pesticides) but the inclusion of an activity on this list does not mean it is always a significant threat. To be a significant threat, it must be in a vulnerable area and have a high risk score as determined by the drinking water threat-specific circumstances provided by the Ontario Ministry of the Environment.

Drinking Water Source Protection Plans are now being finalized and will contain the policies to address a source protection region's significant drinking water threats in most cases. In the case of the Lake Erie Source Protection region, for example, each plan will include policies appropriate to the watershed, developed collaboratively with municipalities under the guidance of a multi-stakeholder Source Protection Steering Committee. These policies include tools such as land use planning, prescribed instruments such as permits or licences, risk management plans, restricted land uses, incentives, prohibition, education and outreach, and other approaches to meet the objects of the Source Protection Plan as outlined in the *Clean Water Act*.

The process for developing the source protection plans must generally conform to the Ministry of the Environment framework, but can vary regionally based on geography, stakeholders, and other factors. Following public consultation, source protection plans will be submitted to the Minister of Environment by August 2012 for approval. Once approved, the plans will be implemented by various agencies, including municipal governments, provincial ministries and conservation authorities. The Minister will also specify a period by which a plan must be updated. Ontario has spent about $270-million on this initiative to date, which has seen the creation of extensive databases, maps and other valuable information. It has also led to greater local and regional awareness, as well as understanding of and capacity for protecting source water.

Some material in this example was adapted from *The Source: News about the Clean Water Act*, Spring 2011, http://www.sourcewater.ca/swp_resources/TheSourceSpring2011.pdf; as well as information from Martin Keller, Source Protection Program Manager, and Emily Stahl, Hydrogeologist, both with the Grand River Conservation Authority. The Grand River is one of the four watersheds in the Lake Erie Region for which a Source Protection Plan is being developed. For more information on this region and the plan being developed, see http://www.sourcewater.ca/.

3.3.4 Agriculture

Ontario has over half of the best quality agricultural land in Canada (Class 1 soils) and even more Class 2 and Class 3 land. Over 57,000 farms in Ontario, with cash receipts of more than $10.3 billion, account for almost one-quarter of all farm revenue in Canada. Ontario has many commercial poultry, hog, dairy and beef cattle farms. Cash crops including soybeans, corn, mixed grains, forage crops, and wheat and barley are major agricultural commodities. Vegetables and fruits also account for a considerable share of Ontario's agricultural production.[389] Farmland covers about 5.4 million ha of Ontario's land base; of this, total cropland amounts to 3.7 million ha, pastures cover about 754,000 ha, and other uses including woodlands and wetlands account for the rest.[390] Dairy and beef cattle are the main forms of livestock production, with a total of nearly 1.8 million head in 2011.[391]

3.3.4.1 Policy and Regulatory Tools

Although several pieces of provincial legislation potentially affect agricultural operators, the following two Acts appear to be the most relevant to managing NPSP from this land use:

- *Nutrient Management Act*
- *Pesticides Act*

The federal *Fisheries Act* is also relevant.

The Nutrient Management Act

The *Nutrient Management Act* (2002) was designed to reduce the potential for contamination of water by some agricultural practices. Under this Act, farms must have nutrient management strategies and plans to deal with animal waste and other substances that are kept on farm properties or spread on fields.[392] The Act establishes the framework for best practices in nutrient management (particularly in managing manure) and creates standards that give BMPs the force of law. It also provides standards for how nutrients are stored and applied to farmland to reduce the likelihood of ground or surface water contamination.[393]

This Act deals with materials that are or could be applied to land by the agriculture industry as well as by municipalities and others who generate nutrient-containing materials. The regulations contain practices and standards to address:

- Application of agricultural source materials, such as manure, runoff and digestate from regulated mixed anaerobic digesters;
- Application of non-agricultural source materials (NASM), such as sewage biosolids, pulp and paper mill biosolids, food processing residuals; and
- Disposal of dead farm animals.[394]

The Act and its regulations[395] are administered by the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) and the Ontario Ministry of Environment (MOE). OMAFRA and MOE share responsibility for policy and standards development related to this Act, while OMAFRA is responsible for outreach, training, certification and approvals, and MOE has sole responsibility for compliance and

[389] Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) website, http://www.ontario.ca/en/about_ontario/004594.html?openNav=economy
[390] OMAFRA website, http://www.omafra.gov.on.ca/english/stats/agriculture_summary.htm
[391] Statistics Canada, http://www40.statcan.gc.ca/l01/cst01/prim50g-eng.htm
[392] Ontario Ministry of Environment (MOE), http://www.ene.gov.on.ca/environment/en/subject/nutrient_management/index.htm
[393] MOE, http://www.ene.gov.on.ca/environment/en/legislation/nutrient_management_act/index.htm
[394] OMAFRA, http://www.omafra.gov.on.ca/english/agops/index.html
[395] MOE, http://www.ene.gov.on.ca/environment/en/legislation/nutrient_management_act/STDPROD_081768.html

enforcement. The Act is very comprehensive, regulating, among other things, what can be applied to the land and what cannot (e.g., untreated septage, materials whose metal or pathogen content is too high).

The **Nutrient Management Act and Regulation 267/03** contain detailed and specific requirements for NASM due to potential issues with metals and pathogens in particular. These are not included in this discussion of NPSP management, but can be viewed in the legislation.

Regulation 267/03[396] addresses the production, storage and use of nutrient-containing materials that can be applied to the land. Materials generated by the operation must be managed according to a nutrient management strategy (NMS) prepared for each farm unit. Farm units that apply more than 300 nutrient units[397] of prescribed materials or apply them within 100 m of a municipal well must also develop a nutrient management plan (NMP).[398] A farm can only be required to have a NMP if it is also required to have a NMS.[399] Most provisions of the Regulation do not apply to farm units that generate five or fewer nutrient units of manure annually, but there are exceptions.[400] Farmers may prepare their own NMP as long as they have an Agricultural Operation Planning Certificate but NMS and NASM plans must be prepared by a certified consultant.

A NMS must contain information about the farm unit and operations, a list of prescribed materials generated (manure, etc.), analysis of nutrient content, destinations of nutrients generated, storage information and a contingency plan. A NMS is also required for non-agricultural operations that generate land-applied materials containing nutrients. Non-agricultural operations that need a NMS include generators of pulp and paper biosolids and sewage biosolids, among others. NMS are approved by a Director at OMAFRA for a five-year period, after which they must be renewed.

When nutrients are applied to the land described in the farm unit, a NMP must be prepared, which accounts for all nutrients including commercial fertilizers and biosolids being applied. It identifies nutrient application rates, required setbacks, cropping practices and locations, crop rotation sequences and yields, as well as soil and topographic data relevant to the plan. NMPs are not approved by OMAFRA but must be filed on the farm and reviewed, updated and summarized by the farm unit operator annually. The summary must explain any difference between the projections in the NMP and the records kept of actual events.[401]

A NASM plan fulfills the same functional role as the NMP and is required for all farms that store or land-apply Category 2 and 3 NASM[402] on a NASM plan area.[403] All such farms will eventually be required to have a NASM plan, according to the timelines in the Regulation.[404] Some farms (e.g., a cash crop farm

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[396] Ontario Regulation 267/03, http://www.e-laws.gov.on.ca/html/regs/english/elaws_regs_030267_e.htm

[397] A "nutrient unit" is defined as the amount of nutrients equivalent to a fertilizer replacement value of the lower of 43 kg of nitrogen or 55 kg of phosphorus. This unit was developed to enable comparison of different types of nutrients. See OMAFRA, http://www.omafra.gov.on.ca/english/nm/regs/nm_tabtc_09.htm for more information.

[398] Some text in this and following two paragraphs adapted from http://www.omafra.gov.on.ca/english/engineer/facts/06-025.htm and other OMAFRA web pages.

[399] OMAFRA, http://www.omafra.gov.on.ca/english/engineer/facts/10-035.htm

[400] OMAFRA, http://www.omafra.gov.on.ca/english/engineer/facts/10-035.htm

[401] OMAFRA, http://www.omafra.gov.on.ca/english/nm/regs/nmpro/nmpro07_09.htm

[402] Examples of Category 2 NASM include organic waste or washwater from a brewery or distillery. Examples of Category 3 NASM include sewage biosolids or washwater from an abattoir or dairy processing facility. http://www.omafra.gov.on.ca/english/engineer/facts/10-035.htm

[403] See http://www.omafra.gov.on.ca/english/engineer/facts/10-035.htm for specific conditions under which a NASM plan is required.

[404] Nutrient Management Protocol, http://www.omafra.gov.on.ca/english/nm/regs/nmpro/nmpro04_09.htm

receiving sewage biosolids) are only required to have a NASM plan with no requirement for a NMS or NMP.[405]

Regulation 267/03 has two protocols that provide more specific guidance:

- The Nutrient Management Protocol[406] provides technical and scientific details and standards that complement and add to those set out in the Regulation; it also provides guidance on developing and implementing NMSs, NMPs and NASM plans to ensure compliance with regulatory requirements.
- The Sampling and Analysis Protocol[407] describes the required sampling and analytical techniques to determine the nutrient content and other properties of materials applied under the *Nutrient Management Act.*

The following examples from the *Nutrient Management Act* are relevant for managing NPSP and have specific requirements for:

- Defined application rates that vary with soil, slope, runoff potential, the material being applied, and time of year, for every area where liquid NASM or liquid manure are applied within 150 m from the top of the bank of surface water. Liquid manure may not be applied to an area whose maximum sustained slope is 25% or greater (Sections 42-45).
- A vegetated buffer zone and application on snow-covered or frozen land (Section 52).
- Operation of low-density and high-density permanent outdoor confinement areas. If the number of animals in a permanent outdoor confinement area is sufficient to generate 300 or more nutrient units annually, animals are not allowed to have access to surface water. Manure must be managed in accordance with a NMS that applies to the confinement area (Section 53 ff).
- Management of milking centre washwater (Section 61).
- Permanent nutrient storage facilities, noting that a runoff management system is required that is capable of managing all runoff in compliance with the Act (Section 63ff).
- Liquid nutrients may not be stored in temporary field nutrient storage sites. If nutrients are stored in a temporary field storage site for more than 24 hours, the location of the site must meet certain requirements, including a slope of 3% or less; minimum depth of soil above the water table, under the site and within 3 m of the side of the site must be 0.9 m; the site must not be located in an area that is subject to flooding once or more every 100 years; and others (Section 82ff).
- A maximum calculated application rate: "The maximum application rate to land for the manure or the anaerobic digestion output in the sample must be such that the total plant available phosphate in the nutrients that are applied to land per hectare during any consecutive five-year period does not exceed the greater of,

  (a) the crop production requirements per hectare for that five-year period plus 85 kilograms of phosphate per hectare; and

  (b) the phosphate removed from the land per hectare in the harvested portion of the crop during that five-year period plus 390 kilograms of phosphate per hectare" (Section 92).
- Criteria for a vegetated filter strip system (Section 98).

According to **Regulation 106/09[408] of the *Nutrient Management Act,*** farm operators may dispose of dead animals on their farm by burying or composting in accordance with the Regulation. With respect to managing NPSP, Section 10 specifies that the burial pit must be at least 0.9 m above the uppermost identified bedrock layer or aquifer. There must be a flow path of at least 100 m measured from the place

[405] OMAFRA, http://www.omafra.gov.on.ca/english/engineer/facts/10-035.htm
[406] Nutrient Management Protocol, http://www.omafra.gov.on.ca/english/nm/regs/nmpro/nmprotc_09.htm
[407] Sampling and Analysis Protocol, http://www.omafra.gov.on.ca/english/nm/regs/sampro/samprotc_09.htm
[408] Ontario Regulation 106/09, http://www.e-laws.gov.on.ca/html/regs/english/elaws_regs_090106_e.htm

where it is closest to the perimeter of the burial pit to the top of the bank of the nearest surface water or tile inlet. For composting (section 17), a flow path must run for at least 50 m. For both methods, the sites must be at least six metres from a field drainage tile, and must not be located in an area that is subject to flooding once or more every 100 years, according to flood plain mapping provided by a municipality or conservation authority having jurisdiction over the area. Specified distances to various types of wells are noted for both disposal methods, but distances are less if composting is the method used.

MOE is responsible for compliance and enforcement under the *Nutrient Management Act*.[409] MOE Agricultural Environmental Officers conduct inspections and work directly with farm owners and operators to achieve compliance. When corrective action is necessary, officers can choose from a range of abatement tools, depending on the compliance history, consequences of the violation and individual circumstances. Agricultural Environmental Officers may take enforcement action if a non-compliance issue is not addressed within the agreed time.

The *Pesticides Act*

The *Pesticides Act* (1990)[410] and Regulation 63/09 provide a regulatory framework for managing pesticides in Ontario and regulate transportation, storage and disposal of pesticides. MOE monitors compliance and enforces the regulations, provides education and training on responsible pesticide use, and encourages and promotes reduced reliance on pesticides through integrated pest management practices.[411] Through Regulation 63/09,[412] the *Pesticides Act* was amended in 2009 to include the Cosmetic Pesticide Ban, which is described in more detail in section 3.3.5.3.

Other Legislation

If adverse effects occur or may occur, the *Environmental Protection Act* (1990) or the *Ontario Water Resources Act* (1990) could also apply. The *Environmental Protection Act*[413] provides for the protection and conservation of the natural environment. It forbids the discharge into the natural environment of any contaminant, but animal wastes are specifically exempted from this Act and are addressed through the *Nutrient Management Act*.

The *Ontario Water Resources Act*[414] is designed to conserve, protect and manage Ontario's water resources for efficient and sustainable use. It focuses on both groundwater and surface water. The Act regulates sewage disposal and "sewage works" and prohibits the discharge of polluting materials that may impair water quality.[415]

The *Clean Water Act* (2005)[416] is intended to protect existing and future sources of drinking water and is part of the province's multi-barrier approach. NPSP is addressed indirectly. Among other things, this Act:

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[409] Text on compliance and enforcement adapted from Compliance Tools of the *Nutrient Management Act*, 2009, at http://www.ene.gov.on.ca/environment/en/subject/nutrient_management/STDPROD_078999.html. This reference document provides more details on the tools available.

[410] *Pesticides Act*, R.S.O. 1990, CHAPTER P.11, http://www.e-laws.gov.on.ca/html/statutes/english/elaws_statutes_90p11_e.htm

[411] MOE, http://www.ene.gov.on.ca/environment/en/category/pesticides/STDPROD_079357.html

[412] Ontario Regulation 63/09, http://www.e-laws.gov.on.ca/html/regs/english/elaws_regs_090063_e.htm

[413] *Environmental Protection Act*, R.S.O. 1990, CHAPTER E.19, http://www.e-laws.gov.on.ca/html/statutes/english/elaws_statutes_90e19_e.htm

[414] *Ontario Water Resources Act*, R.S.O. 1990, CHAPTER O.40, http://www.e-laws.gov.on.ca/html/statutes/english/elaws_statutes_90o40_e.htm

[415] MOE, http://www.ene.gov.on.ca/environment/en/legislation/ontario_water_resources_act/index.htm

[416] *Clean Water Act*, S.O. 2006, CHAPTER 22, http://www.e-laws.gov.on.ca/html/statutes/english/elaws_statutes_06c22_e.htm

- requires that local communities, through local Source Protection Committees, assess existing and potential threats to their water, and that they set out and implement the actions needed to reduce or eliminate these threats;
- empowers communities to take action to prevent threats from becoming significant; and
- requires that all plans and actions are based on sound science.[417]

The *Clean Water Act* also introduces the Ontario Drinking Water Stewardship Program[418] which offers financial assistance to farmers, landowners, and small or medium-sized businesses for activities that reduce threats to local drinking water sources (see section 3.3.4.2).

Improperly functioning septic systems can contaminate groundwater and surface water with bacteria, viruses, other pathogens and nitrates. Ontario has more than one million onsite septic systems mainly in rural and remote areas.[419] Small onsite septic systems (10,000 litres or less per day) are regulated by the *Building Code Act*[420] and associated regulations, administered by the Ministry of Municipal Affairs and Housing. Larger septic systems are regulated under the *Ontario Water Resources Act*.

3.3.4.2 Use and Implementation of BMPs

OMAFRA has produced a wide range of BMP manuals and guides to help farmers improve their stewardship.[421] A great deal of online information is also available on the OMAFRA website at http://www.omafra.gov.on.ca/english/environment/, particularly under the Environmental Stewardship category, as well as in the information sheets in the section on Environmental Farm Plans.[422] Farm owners and operators are encouraged through extension outreach to adopt BMPs as appropriate, and various cost-sharing programs are available to help with financing.

Funding Mechanisms and Approaches

A number of municipalities, conservation authorities and other organizations across Ontario offer financial incentives to farmers to support on-farm environmental improvements, including BMPs.[423] A few examples are described below.

The Environmental Farm Plan Program

Since 1992, more than 35,000 farmers in Ontario have voluntarily participated in the Environmental Farm Plan (EFP) program, about two-thirds of all the farms in the province. Similar to the Alberta initiative, operators identify actions they can take, as time and budget permit, to make environmental improvements on their farms.[424] Cost-sharing is available through the Growing Forward framework agreement between Agriculture and Agri-Food Canada and OMAFRA until March 31, 2013.[425] The Ontario Soil and Crop Improvement Association delivers workshops across the province, facilitates the creation of action plans, and helps farmers apply for funding to complete their projects.[426]

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[417] MOE, http://www.ene.gov.on.ca/environment/en/legislation/clean_water_act/index.htm
[418] MOE, http://www.ene.gov.on.ca/environment/en/subject/protection/STDPROD_080599.html
[419] Watershed Based Source Protection: Implementation Committee Report to the Minister of the Environment. 2004, http://www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@resources/documents/resource/std01_079742.pdf
[420] *Building Code Act*, S.O. 1992, CHAPTER 23, http://www.e-laws.gov.on.ca/html/statutes/english/elaws_statutes_92b23_e.htm
[421] See OMAFRA, http://www.omafra.gov.on.ca/english/environment/bmp/series.htm for a full list.
[422] OMAFRA, http://www.omafra.gov.on.ca/english/environment/farm_stew.htm#programs
[423] See OMAFRA, http://www.omafra.gov.on.ca/english/environment/water/clean_water_incentives.htm for a full list of potential funding sources.
[424] OMAFRA, http://www.omafra.gov.on.ca/english/environment/farm_stew.htm#programs
[425] This program was described previously in section 2.1.2.
[426] Ontario Soil and Crop Improvement Association, http://www.ontariosoilcrop.org/en/programs/canada_ontario_environmental_farm_plan_efp.htm

Conservation Authority Funding Programs
Many CAs offer funding and technical assistance to farmers for adoption of BMPs related to water quality, nutrient management, fish and wildlife habitat, and woodlot management.[427] CAs are also involved in the Drinking Water Stewardship Program.

Ontario Drinking Water Stewardship Program
This program is funded by MOE under the *Clean Water Act* and provides financial assistance to help Ontarians address threats to local drinking water sources. More than 2,100 projects received support between 2007 and 2011.[428] Farmers whose property meets certain criteria and who voluntarily implement BMPs to prevent runoff and erosion, manage manure and improve their barns may be eligible for financial support for a project, depending on the BMP used.[429]

Rural Water Quality Programs and Services
Rural or Clean Water Programs offered by CAs provide technical assistance and financial incentives to improve and protect water quality on rural property and farms. Local municipalities collaborate with CAs to offer cost-sharing grants to qualified landowners for BMPs that improve ground and surface water quality. For some projects, applicants must complete an Environmental Farm Plan or a project worksheet.[430]

OMAFRA Great Lakes Program
This program does not appear to provide funding to farmers, but rather focuses on identifying and evaluating tools to improve NPSP management, including BMPs. The most recent Program ran from 2007-2010.[431] Under the Canada-Ontario Agreement for the program, OMAFRA helps Ontario farmers restore, protect and conserve Great Lakes water quality and quantity through efforts such as nutrient management and environmental farm planning. In 2010, OMAFRA launched the Watershed Based Best Management Practices Evaluation Program, which supports commitments to improve the adoption and effectiveness of agricultural non-point source stewardship actions in one or two key areas in the Erie and Huron basins. The OMAFRA website lists the projects that were undertaken in the categories of Harmful Pollutants; Lake and Basin Sustainability; and Coordination of Monitoring, Research and Innovation. Virtually all of the projects funded through these programs pertain to improving the management of NPSP.

3.3.4.3 Monitoring NPSP and Assessing Management Outcomes

Ontario's Provincial Water Quality Monitoring Network is described briefly in section 3.3.9. Ontario also monitors stream quality at approximately 30 additional sites as part of special studies. One such study is monitoring water quality in 15 agricultural sub-watersheds in southern Ontario with an emphasis on nutrient concentrations in stream water, but the results have not yet been published.

Some work has been done on the costs and benefits of using BMPs to protect source water compared to costly construction projects such as a pipeline. Much of the drinking water in rural Ontario comes from groundwater and increased attention has been paid to this source following the Walkerton incident. Nevertheless, the results are relevant to managing the NPSP of surface waters.

[427] OMAFRA, http://www.omafra.gov.on.ca/english/busdev/facts/progserv.htm#section6
[428] MOE, http://www.ene.gov.on.ca/environment/en/subject/protection/STDPROD_080599.html
[429] MOE, http://www.ene.gov.on.ca/environment/en/resources/STD01_076243.html
[430] Conservation Ontario, http://www.conservationontario.ca/stewardship/programs.html
[431] OMAFRA, http://www.omafra.gov.on.ca/english/environment/coa/summary-index.htm

One such study was done in 2008 to see whether BMPs could have achieved the same results as building a pipeline from Lake Huron to the Town of Strathroy-Caradoc with lower costs.[432] The Strathroy-Caradoc area is primarily a rural municipality west of London with a population of just over 20,000 that relies on the Caradoc aquifer for its water. Iron, magnesium and nitrate levels were all elevated, and the source of the high nitrate was likely agriculture. To respond quickly to concerns about drinking water quality, a pipeline was built to bring water from Lake Huron to Strathroy in 2005, and this study was done subsequent to the pipeline being constructed.

Researchers surveyed landowners to document nitrogen management practices from 1994 to 2007, developed nitrogen budgets for relevant farm fields, estimated relative nitrogen loads from farm fields and in drinking water using different nitrogen management scenarios and a nitrogen groundwater transport model, and conducted a cost-benefit analysis of the different scenarios and the pipeline option. The two BMP scenarios were:

1. Rate Case – included practices that ensured nitrogen was available to the crop when and in the amount needed (e.g., nitrogen soil testing, sidedress application, crop consultant advice)
2. Rotation Case – included all rate case practices plus adding a cereal and cover crop to the rotation to re-distribute nitrogen needs and sources.

Using a hydrogeologic simulation, both scenarios reduced the long term potentially leachable nitrogen, but the rotation case was more successful. The study concluded, that if adopted, both the BMP Rate and Rotation Cases would have effectively reduced nitrate-N (simulated as 24 to 36% and 30 to 48%, respectively) in the drinking water obtained from the well field being studied (the Bosquart Well Field). If adopted, the BMP Rate and Rotation Cases would also have been very effective in reducing nitrate loads (estimated as 39 and 48%, respectively) leaching from cropland to groundwater in the transient-state capture zone of the Bosquart Well Field.

Although the Rotation Case reduced nitrogen concentrations and loads more than the Rate Case, costs to implement the Rate Case were lower. Both approaches would meet nitrate standards in drinking water. The study notes that if either of the BMP alternatives been implemented in the early 1990s, they would have constituted a lower cost solution than the pipeline. The results suggest that BMPs can be an effective and low-cost means of protecting groundwater and drinking water in regions that expect to see nitrogen contamination problems, provided they are implemented with adequate lead time. The study also noted that while the pipeline addressed the problem with Strathroy's drinking water, it did not affect rural households who relied on the well field being studied for their water. Managing nitrogen contamination via BMPs could produce benefits for both.

A similar study in the Regional Municipality of Waterloo in 2011 evaluated agricultural BMPs that could address contributions of nitrogen to the groundwater within a wellhead protection area. Five BMP scenarios were developed. Key results showed that all of the BMP scenarios potentially reduce nitrate leaching and maintain the drinking water standard, although their relative ranks differ for environmental effectiveness compared to economic cost. Most of the BMP scenarios can be implemented at nominal cost and some actually reduce costs, provided that manure can be easily applied elsewhere.[433]

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[432] George Morris Centre. 2009, *Cost-Benefit Analysis of Source Water Protection Beneficial Management Practices: Final Report*, prepared for the Agricultural Adaptation Council, http://www.conservationontario.ca/stewardship/pdf/SWP%20BMP%20Final%20Report%20082009.pdf. See also the fact sheet at http://www.conservationontario.ca/stewardship/pdf/SWP%20BMP%20Final%20Report%20082009.pdf

[433] Conservation Ontario Fact Sheet. 2011, *Cost-Benefit Analysis: Source Water Protection Beneficial Management Practices, Waterloo Study*, http://www.conservationontario.ca/stewardship/documents/RegionofWatFactSheetENG.PDF

3.3.5 Urban

With more than 13 million people, Ontario is home to almost 40% of Canada's population.[434] The largest concentration of people and cities is in the so-called "Golden Horseshoe" along the western end of Lake Ontario, including the Greater Toronto area, Hamilton, St. Catharines and Niagara Falls. The "Greater Golden Horseshoe" describes the metropolitan area outside the core region; it spreads inland in all directions away from Lake Ontario shoreline. Over eight million people live in this region and it is one of the fastest growing areas in North America.[435]

3.3.5.1 Policy and Regulatory Tools

Stormwater Management

Individual municipalities are responsible for managing stormwater within their jurisdictions; Ontario does not have a regulation specifically for stormwater management.[436] MOE has produced or contributed to several guides and manuals to help municipalities with this task, including the ***Stormwater Management Planning and Design Manual*** (2003). This manual provides guidance in the planning and design of stormwater management facilities and practices, stressing the value of an integrated approach. The manual emphaizes that municipal stormwater plans need to be developed in a watershed or sub-watershed context, recognizing the importance of source and non-structural controls as well as infrastructure solutions.[437] The manual includes details on infrastructure, use of wetlands, and what could be called LID approaches. This manual is also used as a baseline reference document in the review of stormwater management applications for approval under Section 53 of the *Ontario Water Resources Act* as administered by MOE.

Other ministries are also responsible for some aspects of stormwater management, including the Ministries of Municipal Affairs and Housing, Natural Resources, Infrastructure, and Transportation, depending on the issue and location.

[434] Statistics Canada, http://www40.statcan.gc.ca/l01/cst01/demo31a-eng.htm
[435] Government of Ontario, http://www.ontario.ca/en/about_ontario/ONT03_020630.html
[436] MOE, http://www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@resources/documents/resource/stdprod_082453.pdf
[437] Ontario Ministry of the Environment. 2003, *Stormwater Management Planning and Design Manual*, http://www.ene.gov.on.ca/environment/en/resources/STD01_076363.html

Stormwater Management Example: Toronto's Wet Weather Flow Master Plan[438]

Although Toronto is much larger than any city in Alberta, its approach to managing stormwater is very comprehensive and integrates many activities under one initiative. Some of the approaches are relevant for managing NPSP in Alberta.

In 2003, Toronto City Council adopted the Wet Weather Flow Master Plan (WWFMP) and a 25-Year Implementation Plan. The goal of the WWFMP is to reduce and ultimately eliminate the adverse impacts of wet weather flow; that is, runoff generated when it rains or snows. The Plan was developed with the recognition that wet weather flow will be managed on a watershed basis accompanied by a hierarchy of solutions starting with "at source", followed by "conveyance", and concluding with "end-of-pipe."[439] Council then adopted a Wet Weather Flow Management Policy,[440] which provides direction on how to manage wet weather flow on a watershed basis. Since 2003, all new developments in the City have had to comply with the policy.

Wet Weather Flow Management Guidelines were published in 2006. They provide a working aid in the review and approval of stormwater management plans for new development or redevelopment, and identify performance objectives for runoff from new development sites with respect to controls in peak flows, flood management, water quality and water balance (or annual runoff volume).[441] Table 7 (Table 3 in the *Wet Weather Flow Management Guidelines)* is shown as an example of the approach taken.

These guidelines were also incorporated into the Toronto Green Standard, released in 2007.[442] An example of a supporting initiative developed under the Green Standard is the *Design Guidelines for 'Greening' Surface Parking Lots*.[443]

Initiatives are planned under the WWFMP in a number of areas over the 25-year implementation period, including public education, source controls, municipal operations, basement flooding protection, conveyance controls, beach water quality improvements, stream and aquatic habitat restoration, and end-of-pipe facilities.[444] Various source controls will be implemented to reduce flows to the stormwater sewer system, including mandatory downspout disconnections, green roof incentive pilot program, rainwater harvesting demonstration project and tree planting. Activities will be undertaken to address erosion by restoring degraded sections of streams, revegetating various streambanks, and reforesting and creating wetlands. The plan calls for the building of 175 ponds or wetlands and other facilities.

When approved, the Implementation Plan was estimated to cost $1-billion over 25 years ($40-million per year). Implementation reports[445] track progress and the most recent report shows that $97-million was spent during the first five years.[446]

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[438] All documents prepared as part of the WWFMP process are available at http://www.toronto.ca/water/protecting_quality/wwfmmp/reports.htm

[439] City of Toronto, http://www.toronto.ca/water/protecting_quality/wwfmmp/index.htm

[440] City of Toronto. 2003, *Wet Weather Flow Management Policy*, http://www.toronto.ca/involved/projects/archived/wwfmmp_archive/pdf/wwfmmp_policy.pdf

[441] City of Toronto. 2006, *Wet Weather Flow Management Guidelines*, http://www.toronto.ca/water/protecting_quality/wwfmmp_guidelines/index.htm

[442] City of Toronto, http://www.toronto.ca/planning/environment/greendevelopment.htm

[443] City of Toronto. 2007, *Design Guidelines for 'Greening' Surface Parking Lots*, http://www.toronto.ca/planning/urbdesign/greening_parking_lots.htm

[444] City of Toronto, http://www.toronto.ca/water/protecting_quality/wwfmmp/25year_plan.htm

[445] City of Toronto, http://www.toronto.ca/water/protecting_quality/wwfmmp/annual.htm

[446] City of Toronto. 2009, *Wet Weather Flow Master Plan Five-Year Summary Report*, http://www.toronto.ca/water/protecting_quality/wwfmmp/pdf/wwfmp_5yr_implementation_report.pdf

Table 7. Examples of Water Balance (estimated annual runoff) Requirements for Various Types of Development and Soil Group Based on WWFMP (2003) Study

Connectivity Condition – No Roof Leader Connection to Storm Sewers			Estimated Allowable Annual Runoff (% of Total Annual Precipitation)
Class	**Category**	**Soil Group (HSG)**	
High Density Residential (70% imperviousness)	RHD	AB	31
	RHD	BC	38
	RHD	CD	49
Medium Density Residential (50% imperviousness)	RMD	AB	23
	RMD	BC	28
	RMD	CD	37
Low Density Residential (30% imperviousness)	RLD	AB	15
	RLD	BC	17
	RLD	CD	25
Agricultural (Tilled) (0% imperviousness)	AGT	AB	2
	AGT	BC	3
	AGT	CD	10

Code	Description
RHD	Residential lots characterized by > 60% imperviousness
RMD	Residential lots characterized by 40-60% imperviousness
RLD	Residential lots characterized by < 40% imperviousness
AGT	Agricultural lots used for crops

LEGEND

HGS – Hydrologic Soil Groups
AB – Sandy loams and gravels (very pervious)
BC – Medium textured loams (pervious)
CD – Clay loams and silty clay (impervious)

3.3.5.2 Use and Implementation of BMPs

Similar to Alberta, Ontario relies on the use of BMPs to manage stormwater. Many Conservation Authorities have addressed stormwater management in their watersheds. One example is the *Low Impact Development Stormwater Management Planning and Design Guide*, version 1.0, published by Credit Valley Conservation and the Toronto and Region Conservation Authority in 2010.[447] This comprehensive 300-page manual (plus several lengthy appendices) augments the MOE *Stormwater Management Planning and Design Manual* by focusing on sustainable stormwater planning and practices in these two watersheds (rather than end-of-pipe stormwater management practices, which are the focus of the MOE manual). The guide includes detailed BMP fact sheets, a landscape design guide for LID, and a site evaluation and soil testing protocol. Both manuals, however, note that a "treatment train" approach (that is, a combination of lot level, conveyance, and end-of-pipe stormwater management practices) is usually necessary to meet the multiple objectives of stormwater management, which include maintaining the hydrologic cycle, protecting water quality, and preventing increased erosion and flooding. Many of the LID practices could apply across a wide range of municipal situations.

[447] Credit Valley Conservation and Toronto and Region Conservation Authority. 2010, *Low Impact Development Stormwater Management Planning and Design Guide*, http://www.sustainabletechnologies.ca/portal/alias__rainbow/lang__en/tabID__578/DesktopDefault.aspx

The *Stormwater Pollution Prevention Handbook*[448] is also a practical guide for municipalities. In stormwater management terms, pollution prevention applies to activities that reduce the application of pollutants to urban surfaces, including fertilizer use and application of salt and grit to roads, as well as introduction of oil and other chemicals into drains. Many of the negative effects of urban runoff are also attributed to increased volumes of runoff, resulting in flooding and channel erosion in streams. The handbook considers both flow reduction measures and pollution source controls. It contains a series of detailed fact sheets that describe selected pollution prevention and flow reduction measures, as well as nine case studies. The case studies include sample watershed studies, municipally-based pollution prevention studies, and flow reduction programs for a range of community sizes, and could be applied to municipalities in other provinces.

3.3.5.3 Managing NPSP and Assessing Management Outcomes

Ban on Cosmetic Use of Pesticides[449]

In April 2009, the Ontario Government banned the sale and use of pesticides for cosmetic purposes, through Regulation 63/09[450] to amend the *Pesticides Act*. This regulation overrode municipal pesticide bylaws and established one set of rules for the province.[451] The regulation banned more than 180 domestic pesticide products for sale and prohibited the cosmetic uses of over 90 pesticide ingredients. Pesticides cannot be used for cosmetic purposes on lawns, vegetable and ornamental gardens, patios, driveways, cemeteries, and in parks and school yards. There are no exceptions for pest infestations in these areas and the use of biopesticides and pesticide alternatives is recommended. Exceptions to the ban are allowed for industries such as agriculture, forestry and golf courses, and consumers are still able to purchase domestic pesticide products for health or safety reasons such as controlling plants poisonous to the touch and stinging insects.

The Ontario Ministry of the Environment worked with five Conservation Authorities to monitor pesticide concentrations in ten urban Ontario streams before (July-October 2008) and after (June-October 2009) the ban took effect. A total of 168 stream water samples were collected and analyzed in a laboratory for up to 105 pesticides and pesticide breakdown products. In addition to showing if there had been any changes in concentrations, this study was also intended to provide a reference point for further work.

Concentrations of 2,4-D, dicamba, MCPP, total phenoxy herbicides and total insecticides were significantly lower in 2009 and a decrease in carbaryl concentrations approached statistical significance. Depending on the stream, median and maximum concentrations of 2,4-D, dicamba and MCPP were up to 94% (mean 67%) and 97% (mean 65%) lower in 2009, respectively. Rainfall was similar between the two study periods leading to the cautious conclusion that reductions in pesticide use after the cosmetic pesticides ban, and not changes in runoff, were responsible for the observed changes in stream water pesticide concentrations. Some of the study watersheds were potentially affected by golf courses and pre-existing municipal bylaws restricting cosmetic pesticide use. Differences in concentrations of 2,4-D, dicamba and MCPP remained statistically significant when samples from these watersheds were excluded from the analysis. Concentrations of glyphosate and its degradate, aminomethylphosphonic acid, were not

[448] Ministry of the Environment, the Government of Canada's Great Lakes Sustainability Fund, the Toronto and Region Conservation Authority, Quinte Conservation, the Cities of St. Catharines, Toronto, Waterloo, and Mississauga, and the Municipal Engineers Association. 2001, *Stormwater Pollution Prevention Handbook*, http://www.ene.gov.on.ca/environment/en/resources/STD01_076382.html

[449] Unless otherwise noted, the information on monitoring the impact of the ban on cosmetic use of pesticides is from the following source: Todd, Aaron. 2010, *Changes in Urban Stream Water Pesticide Concentrations One Year after a Cosmetic Pesticides Ban*, http://www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@resources/documents/resource/stdprod_080108.pdf

[450] Ontario Regulation 63/09, http://www.e-laws.gov.on.ca/html/regs/english/elaws_regs_090063_e.htm

[451] MOE, http://www.ene.gov.on.ca/environment/en/legislation/pesticides_act/index.htm

significantly different between 2008 and 2009, which may reflect the exceptions to the ban for certain uses of glyphosate, which is a commonly used agricultural chemical.

Stormwater Assessment
The Stormwater Assessment Monitoring and Performance (SWAMP) Program[452] was initiated in 1995 by the Government of Canada's Great Lakes Sustainability Fund, the Ontario Ministry of the Environment, the Toronto and Region Conservation Authority, and the Municipal Engineers' Association, along with host municipalities and others. The main goals of the program were to evaluate the effectiveness of stormwater technologies and disseminate study results and recommendations within the stormwater management community. Between 1995 and 2002, ten stormwater management facilities were monitored and evaluated, including four studies on wet ponds and constructed wetlands. In 2005, the results were published in a *Synthesis of Monitoring Studies Conducted under the Stormwater Assessment Monitoring and Performance Program*. Relevant to managing NPSP, the ponds and wetlands evaluated under the program exceeded their respective design targets; for example, load-based TSS removal rates for ponds and wetlands ranged between 81 and 92%, which is roughly 10-21% more than design predictions.

3.3.5.4 Other Initiatives

Innovative Stormwater Management Practices (www.iswm.ca)
Iswm.ca is an online database of innovative and LID stormwater management practices in Ontario, developed by the Toronto and Region Conservation Authority for the Ontario Ministry of the Environment. It is a free, publicly accessible archive for municipalities, developers, consultants and others to share information regarding these types of practices.

Sustainable Technologies Evaluation Program
The Sustainable Technologies Evaluation Program (STEP)[453] is a multi-agency initiative, led by the Toronto and Region Conservation Authority. This program was developed to provide the data and analytical tools necessary to support broader implementation of sustainable technologies and practices within a Canadian context. The program evaluates physical structures as well as preventative measures, implementation protocols, alternative urban site designs, and other practices. The STEP website has a plethora of case studies, BMPs, publications and other resources relevant to managing NPSP and implementing LID initiatives. Among the STEP projects are some related to evaluating LID practices in cold climates, including an evaluation of permeable pavements being done in Vaughan, Ontario.[454]

Ontario's Water Opportunities Act
The *Water Opportunities Act* (2010)[455] enables the authority to require municipalities and other water service providers to prepare municipal water sustainability plans and will help municipalities identify innovative, cost-effective solutions for drinking water, sewage and stormwater system challenges.[456] Several activities to support the goals of this Act are underway or planned, including the Showcasing Water Innovation program[457] to fund leading edge, innovative and cost-effective solutions for managing drinking water, wastewater and stormwater systems in Ontario communities. It makes $17-million available over three years for a limited number of projects.

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[452] Toronto and Region Conservation Authority. 2005, *Synthesis of Monitoring Studies Conducted under the Stormwater Assessment Monitoring and Performance Program*, http://www.sustainabletechnologies.ca/portal/alias__Rainbow/lang__en/tabID__27/DesktopDefault.aspx
[453] Sustainable Technologies Evaluation Program, http://www.sustainabletechnologies.ca/
[454] The website for this project is at http://www.sustainabletechnologies.ca/portal/alias__Rainbow/lang__en/tabID__580/DesktopDefault.aspx
[455] *Water Opportunities Act*, S.O. 2010, CHAPTER 19, Schedule 1, http://www.e-laws.gov.on.ca/html/statutes/english/elaws_statutes_10w19_e.htm
[456] MOE, http://www.ene.gov.on.ca/environment/en/legislation/water_opportunities/index.htm
[457] MOE, http://www.ene.gov.on.ca/environment/en/funding/showcasing_water_innovation/index.htm

3.3.6 Forestry

Ontario contains about two percent of the world's forests. Ontario's forested land base ranges from the deciduous forest of the Niagara Peninsula area, to the mixed forest of the Great Lakes-St. Lawrence region in central and northwestern Ontario, and the conifer-dominated boreal forest of the north.[458] About two-thirds of the province – some 71 million ha – is forested and more than 80% of these forests are on Crown land. Approximately 13% of the forested land is held in other types of ownership (private, First Nations, Federal, and protected areas.) The Government of Ontario oversees the management of Crown forests, including commercial logging on over 26 million ha. In 2008, the value of Ontario's forestry sector products was $14 billion, $8 billion of which was pulp and paper products.[459]

Access to forest resources from Crown lands is provided through a Wood Supply Commitment[460] or a Forest Resource Licence. Whenever Crown timber is harvested, licensees must pay stumpage charges for forest resources. Most of Ontario's forests are harvested by companies or individual operators that hold one of two types of licences:

- **Sustainable Forest Licences** are granted under Section 26 of the *Crown Forest Sustainability Act* (CFSA). These licences are set for periods of up to twenty years and are reviewed every five years. Sustainble Forest Licences are granted by the Minister of Northern Development, Mines and Forestry.
- **Forest Resource Licences** are granted under Section 27 of the CFSA for periods of less than five years. Licence holders may enter into agreements with the Minister of Natural Resources (MNR) for renewal and maintenance activities.[461]

The Crown forest is divided into management units, most of which are managed by individual forest companies under a Sustainable Forest Licence. The licensee is responsible for carrying out the activities of forest management planning, harvest, access road construction, forest renewal and maintenance, and monitoring and reporting, subject to CFSA regulations and MNR approvals. Before any forestry activities can take place in a management unit, an approved forest management plan must be in place. A forest management plan is prepared for a ten-year period for each forest management unit. The plans must be written in accordance with the Forest Management Planning Manual and other prescribed documents. As the plan is implemented, MNR and the forest industry routinely monitor and assess the effectiveness of forest operations to ensure that the forest management plan is being followed, reports on the results of management activities are produced, and the effectiveness of management decisions in achieving stated objectives and forest sustainability is assessed. [462]

3.3.6.1 Policy and Regulatory Tools

Ontario's forest management approach differs in a number of ways from Alberta's, due in part to the greater biodiversity in Ontario and the characteristics of the various forest types. The overall context for forest management in Ontario is the 1994 Policy Framework for Sustainable Forests.[463] The framework sets broad direction for forest policy and makes forest sustainability the primary objective of forest management. One of the five principles for sustaining forests in this provincial policy statement is "Forest

[458] MNR, http://www.ontario.ca/en/about_ontario/004464.html?openNav=natural_resources
[459] Ministry of Northern Development and Mines, http://www.mndm.gov.on.ca/forestry/forest_industry_e.asp
[460] A Wood Supply Commitment is made to a mill and obliges the holder of a forest resource licence to provide forest resources to the mill operator.
[461] Text in this section adapted from http://www.mndm.gov.on.ca/forestry/tenure_licensing_e.asp
[462] This paragraph and the previous paragraph adapted from http://www.mnr.gov.on.ca/en/Business/Forests/2ColumnSubPage/STEL02_163549.html
[463] MNR, http://www.mnr.gov.on.ca/en/Business/Forests/2ColumnSubPage/STEL02_163862.html

practices must minimize adverse effects on soil, water, remaining vegetation, fish and wildlife habitat, and other values."[464] The CFSA (1994) guides all forest management in the province.

Crown Forest Sustainability Act

The *Crown Forest Sustainability Act* (CFSA) is enabling legislation that provides for the sustainability of the Crown forest and governs forest management on Crown land to ensure long-term health of the forest. In Section 3, the CFSA notes that "The long term health and vigour of Crown forests should be provided for by using forest practices that, within the limits of silvicultural requirements, emulate natural disturbances and landscape patterns while minimizing adverse effects on plant life, animal life, water, soil, air and social and economic values, including recreational values and heritage values."[465]

The CFSA specifies the provision of four manuals to guide various aspects of forest management planning. Of these four manuals, developed by the Ontario Ministry of Natural Resources (MNR) in collaboration with non-government organizations, two are relevant to NPSP management: the Forest Management Planning Manual and the Forest Operations and Silviculture Manual.

Forest Manuals

The forest manuals are quite comprehensive and only aspects relevant to NPSP are noted here. The *Forest Management Planning Manual for Ontario's Crown Forests* (2009)[466] prescribes the requirements for Ontario's forest management planning system including a detailed description of the planning process and the products; construction and decommissioning of water crossings are noted. Part D provides direction for the scheduling of forest management operations on an annual basis, and describes requirements for various activities, including aerial herbicide and insecticide projects.

The *Forest Operations and Silviculture Manual* (2000) provides direction and guidance to resource managers responsible for managing and operating in Crown forests. "It contains provisions with respect to forest operations including standards for forest operations. Rather than give forest managers a set of strict rules that must be followed, Ontario relies on the professional judgment, within a set of broad guidelines and principles, of the people given the responsibility to manage the forest resource."[467]

Forest Management Guides

Ontario has published a series of forest management guides for forest management planning teams to use in preparing and implementing forest management plans.[468] Of most relevance to managing NPSP is the ***Forest Management Guide for Conserving Biodiversity at the Stand and Site Scales*** (2010), referred to as the "Stand and Site Guide."[469]

The Stand and Site Guide provides direction on various aspects of conserving biodiversity, including aquatic and wetland habitats and shoreline forests, special habitat features, and habitat for species at risk. Of relevance to NPSP management, it also addresses topics like road and water crossing construction and maintenance, and soil and water conservation (e.g., rutting, erosion, nutrient loss). This Guide applies to Crown forests wherever forest management occurs.

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[464] MNR, http://www.mnr.gov.on.ca/stdprodconsume/groups/lr/@mnr/@forests/documents/document/199742.pdf
[465] *Crown Forest Sustainability Act*, S.O. 1994, CHAPTER 25, http://www.e-laws.gov.on.ca/html/statutes/english/elaws_statutes_94c25_e.htm
[466] MNR. 2009, *Forest Management Planning Manual for Ontario's Crown Forests,* http://www.mnr.gov.on.ca/en/Business/Forests/Publication/MNR_E000215P.html
[467] MNR. 2000, *Forest Operations and Silviculture Manual,* p.1, http://www.mnr.gov.on.ca/en/Business/Forests/Publication/MNR_E000225P.html
[468] MNR, http://www.mnr.gov.on.ca/en/Business/Forests/2ColumnSubPage/STEL02_164533.html
[469] MNR. 2010, *Forest Management Guide for Conserving Biodiversity at the Stand and Site Scales,* http://www.mnr.gov.on.ca/en/Business/Forests/Publication/272847.html

Direction is characterized as a standard, guideline, or BMP. Standards must be followed as written. Guidelines are also mandatory and must be followed, but require professional expertise and local knowledge to be implemented. BMPs are examples of practices that forest managers may wish to use to achieve objectives associated with a standard or guideline. The list of BMPs is not intended to be exhaustive, and there is no requirement to use any of them.[470] The complementary document, *Background and Rationale for Direction,*[471] contains background information and rationale for direction in the Stand and Site Guide.

Standards, guidelines and BMPs are presented for various stand and site circumstances, including, among others:

- lakes and ponds and associated shoreline forest;
- rivers, streams, and associated shoreline forest; and
- design, location, installation, maintenance, decommissioning and rehabilitation of roads and water crossings.

The Soil and Water Conservation section of the Guide provides direction to deal with ruts and compaction, erosion, aerial spraying, and other aspects. "Due to the relatively flat topography in most of Ontario, large-scale erosion is not normally a significant concern. Localized occurrences of erosion are most often visible following localized site disturbances. It is recognized that not all indicators of site instability are visible; however, if reasonable precautions are taken, the chance of localized occurrences of erosion can be minimized."[472] Thus no specific standard is provided for erosion and the Guide refers to direction provided in the sections pertaining to roads and water crossings, rutting and compaction, and aquatic and wetland ecosystems for relevant requirements.

Selected examples of standards are listed below, and the list of standards in each category does not necessarily reflect the full list in the document.

Standards for rivers, streams, and associated shoreline forest

- For rivers and streams with high potential sensitivity to forest management operations, the area of concern (AOC)[473] must be 30-90 m based on slope, as specified. For streams with moderate sensitivity to forest management operations, the AOC must be 30 m.
- No harvest, renewal, or tending operations are permitted within the AOC that will result in damage to river or stream beds or banks and associated stabilizing vegetation, or deposition of sediment within rivers or streams. Operations specifically prohibited within the AOC include:
    - Machine travel within the inner three metres of the AOC.
    - Felling of trees into rivers or streams or the inner 3 metres of the AOC. Trees accidentally felled into rivers or streams will be left where they fall.
    - Excessive removal or damage of sapling-sized trees (<10 cm dbh[474]) and shrubs within the inner 3 metres of the AOC.

[470] Adapted from *Forest Management Guide for Conserving Biodiversity at the Stand and Site Scales*, pp. 1-2.
[471] MNR. 2010, *Forest Management Guide for Conservation Biodiversity at the Stand and Site Scales – Background and Rationale for Direction*, http://www.mnr.gov.on.ca/stdprodconsume/groups/lr/@mnr/@forests/documents/document/stdprod_068107.pdf
[472] MNR. 2010, *Forest Management Guide for Conserving Biodiversity at the Stand and Site Scales*, p. 152.
[473] An area of concern is a defined geographic area associated with an identified natural resource feature, land use or value that may be affected by forest management activities. Source: *Forest Management Planning Manual*, 2009, p. A-49.
[474] dbh is "diameter at breast height," a standard term used in the forest industry to measure tree size.

- Disturbance of the forest floor that leaves ruts or a significant area of exposed mineral soil within the inner 15 metres of the AOC. Ruts and significant patches of exposed mineral soil will be promptly rehabilitated to prevent sediment from entering a water feature. Patches of mineral soil exposed by natural events are excluded.
- Disturbance of the forest floor that disrupts hydrological function (i.e., impedes, accelerates, or diverts water movement) within recognizable ephemeral streams, springs, seeps, and other areas of groundwater discharge connected to rivers or streams.

· No contamination of rivers or streams by foreign materials is permitted. Specifically,
  - The use and storage of fuels will be carried out in accordance with the *Liquid Fuels Handling Code.*
  - No equipment maintenance (e.g., washing or changing oil) is permitted within 30 m of rivers or streams.
  - Aerial application of pesticides for renewal, tending, or protection is permitted within the AOC but will follow spray buffer zones for *significant areas* or *sensitive areas* (as appropriate) as prescribed in the *Ontario Ministry of Environment/Ontario Ministry of Natural Resources Buffer Zone Guidelines for Aerial Application of Pesticides in Crown Forests of Ontario* (1992). Machine-based ground application of herbicides (e.g., air-blast sprayers mounted on skidders) is permitted within the AOC; spray buffer zones will be 30 m for *significant areas* and 60 m for *sensitive areas*. Hand-based ground application of herbicides (e.g., back-pack sprayers) is permitted within the AOC; spray buffer zones will be 3 m. All spray buffer zones will be measured from the inner boundary of the AOC.

Standards for the design and location of water crossings[475]

· The submission, review and approval of water crossings built under authority of the CFSA will comply with the requirements of the Forest Management Planning Manual and all other applicable legislation.

· The culvert or bridge opening size shall be determined by hydrologic and hydraulic analyses, in accordance with design procedures developed for Ontario use. A water crossing structure with a single span greater than 3 m is considered to be a bridge; design of all bridges will comply with the requirements in the *Crown Land Bridge Management Guidelines*.

· Selection of the type of water crossing structure, its location and its capacity to pass water and allow for the movement of fish, will consider:

  i) possible negative effects on the form and function of the undisturbed natural channel and its floodplain;

  ii) the fish species present and the impact of the crossing structure on them, as required by the *Fisheries Act*; and

  iii) whether the water crossing is over navigable waters.

[475] Much of the past direction for forest roads came from the 1990 document *Environmental Guidelines for Access Roads and Water Crossings.* That document is now a technical supporting document for the *Forest Management Guide for Conserving Biodiversity at the Stand and Site Scales*. It provides technical advice for construction, maintenance, and abandonment of access roads and water crossings, as well as potential mitigation techniques, and is available at http://www.mnr.gov.on.ca/en/Business/Forests/Publication/MNR_E000495P.html

Standards for rutting and compaction
For all silviculture systems:

- No more than 50% of any 0.1 ha circle is permitted in ruts.[476]
- No ruts permitted that channel water into, or within 15 m of lakes, ponds, rivers, streams, woodland pools, or those portions of mapped non-forested wetlands dominated by open water or non-woody vegetation.

Ontario also has a *Fish Habitat Referral Protocol* (2009),[477] which outlines the permitting and approval roles of agencies that have a regulatory responsibility for the review of proposed development projects in and around water, where there may be impacts to fish or fish habitat. The protocol summarizes the various roles and responsibilities of these agencies, but it is not intended to address the details of permitting processes outside fish and fish habitat reviews.

3.3.6.2 Use and Implementation of BMPs

The *Forest Management Guide for Conserving Biodiversity at the Stand and Site Scales* includes many BMPs that can be used to manage NPSP from forest operations.

In 2011, the Ontario Sustainable Forestry Initiative Implementation Committee published *A Guide to Best Management Practices for Forest Operations in Northern Ontario for Private Landowners & Logging Contractors*.[478] The guide is divided into 12 sections with each section highlighting legal requirements, BMPs and special notes associated with every step of the timber harvesting and reforestation process.

3.3.6.3 Monitoring NPSP and Assessing Management Effectiveness

Forest management operations in Ontario are monitored and audited to assess compliance and evaluate progress and results. Forest management reports are prepared on an annual basis and data from the compliance assessments are used to prepare the *State of the Forest Report* described below.[479] Independent Forest Audits are done every five years on forest management units, and provide a public record of the effectiveness of forest soil protection efforts by examining overall damage trends and recommending improvements where needed.

MNR prepares a *State of the Forest Report* every five years; the most recent report was published in 2006.[480] This legally mandated report describes Ontario's forests and forest management, based on criteria and indicators of sustainable forestry. Ontario's approach to evaluating sustainable forest management is based on a framework of criteria, elements and indicators. The seven criteria are expressed as provincial forest sustainability goals. Each criterion is divided into elements; within the elements, indicators are used as measurement tools to assess progress towards a specific condition needed to achieve the goal. There are 67 indicators in total.

Criterion 3 is directly relevant to managing NPSP: "Protecting and Conserving Ontario's Forest Soil and Water Resources." This criterion is examined through two elements, and a total of five indicators. Each indicator was rated on three aspects:

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[476] A rut is defined as a continuous trench or furrow created by machine traffic that is ≥4 m long and ≥30 cm deep.
[477] Aquatic Resources Management Advisory Committee. 2009, *Fish Habitat Referral Protocol*, http://www.mnr.gov.on.ca/stdprodconsume/groups/lr/@mnr/@letsfish/documents/document/264110.pdf
[478] Ontario Sustainable Forestry Initiative Implementation Committee. 2011, *A Guide to Best Management Practices for Forest Operations in Northern Ontario for Private Landowners & Logging Contractors*, http://www.sfiontario.org/BMP_Guide_for_web_v2_Reader_Friendly.pdf
[479] MNR, http://www.mnr.gov.on.ca/en/Business/Forests/2ColumnSubPage/STDPROD_085584.html
[480] MNR. 2006, *State of the Forest Report, 2006*, http://www.mnr.gov.on.ca/en/Business/Forests/2ColumnSubPage/STEL02_179267.html

- The state – whether conditions identified by the indicator suggest good, mixed or fair, or poor progress towards sustainable forest management.
- The trend – whether those conditions are improving, mixed or showing no change, or deteriorating.
- The adequacy of data – whether the data available for the indicator is adequate, partial, or inadequate.

The results from the *2006 State of the Forest Report* for Criterion 3 are shown in Table 8; more details are available in the full report.

Table 8. Protecting and Conserving Ontario's Forest Soil and Water Resources

Element	Criterion	State	Trend	Data
Minimizing effects of forest management practices on forest soil resources	Compliance with soil protection guidelines	Good	Mixed	Partial
Minimizing effects of forest management practices on water resources	Proportion of watersheds with stand-replicating disturbance	Good	Mixed	Inadequate
	Compliance with forest management guidelines for protecting water quality	Good	Deteriorating	Inadequate
	Compliance with forest management guidelines for protecting fish habitat	Good	Deteriorating	Inadequate
	Watershed road and water crossing density	Unknown	Unknown	Unknown

"All of the data for the indicators in this criterion are indirect and most are derived from the provincial Forest Operations Information Program (i.e., compliance data). The results are generally positive, with low risk to forest sustainability identified in this area."[481]

The *Forest Management Guide for Conserving Biodiversity at the Stand and Site Scales* identifies various studies underway to investigate the effects of forest management activities on aquatic systems.[482]

3.3.6.4 Other Initiatives

Just over 10% of Ontario's forested land base (7.6 million ha) is privately owned. In the southwestern part of the province there is less than 5% forest cover and nearly all of these remnant woodlands are privately owned and have a special ecological significance. The Ontario government encourages private land stewardship through information and incentives and by providing a framework for protection of resources at the municipal level.[483] One of the mechanisms to encourage forest stewardship on private land is the Managed Forest Tax Incentive Program, which values forest land according to its current use. The program encourages forest stewardship by providing lower property taxes to participating landowners who agree to conserve and manage their forests. The program now includes over 10,000 properties covering more than 700,000 ha.[484]

[481] MNR. 2006, *State of the Forest Report, 2006, Summary*, p. 23, http://www.mnr.gov.on.ca/en/Business/Forests/2ColumnSubPage/STEL02_179267.html
[482] MNR. 2010, *Forest Management Guide for Conserving Biodiversity at the Stand and Site Scales,* http://www.mnr.gov.on.ca/en/Business/Forests/Publication/272847.html
[483] MNR, http://www.mnr.gov.on.ca/en/Business/Forests/2ColumnSubPage/STEL02_166334.html
[484] MNR, http://www.mnr.gov.on.ca/en/Business/Forests/Publication/MNR_E000245P.html

3.3.7 Oil and Gas

Oil and gas activity in Ontario occurs almost exclusively in the southwestern part of the province near Lake Erie. In most of this area, landowners own the rights to any minerals, including oil and gas, beneath their property.[485] Ontario has 1,200 active oil wells and 900 active gas wells on land.[486] Historically about 100 new oil and gas wells were drilled in southern Ontario each year, but this number has been declining; just 29 new wells were reported in 2009 and 24 in 2010.[487] Annual oil production declined 7.5% to 527,000 barrels and natural gas production dropped 2% to 234 million cubic metres from 2009 to 2010.[488]

The Ministry of Natural Resources' Petroleum Resources Centre provides governance over Ontario's oil, gas, salt and underground storage industries including policy development and field delivery of licensing, inspection, enforcement and Crown land tenure programs.[489]

3.3.7.1 Policy and Regulatory Tools

The primary legislation governing Ontario's oil and gas tenure and activities on Crown lands is Part IV of the *Mining Act* and Regulation 263/02.[490] There is no specific legislation for leasing oil and gas mineral rights or storage rights on freehold lands in Ontario, however the *Gas and Oil Leases Act*[491] provides a means to clear title of defaulted petroleum and natural gas leases. Exploration, drilling and production of crude oil and natural gas are regulated under the *Oil, Gas and Salt Resources Act*,[492] Regulation 245/97 and the Provincial Operating Standards.[493]

Provincial Operating Standards (2002)

For the purposes of this report, the requirements of Provincial Operating Standards, v 2.0[494] were the only reference that could be found related to NPSP management on the oil and gas land base. The province regards these standards as adequate under conditions normally encountered in the oil and gas industry activities involving wells and works. Requirements for abnormal or unusual conditions are not specifically provided for, nor are details of engineering or construction prescribed.

The Provincial Standards cover 13 topics, from well licence application to reporting (and include salt as well as oil and gas). No reference is made directly to NPSP, but a few of the requirements relate to management of NPSP, including:

- Drilling area setbacks from Great Lakes shorelines (100 m) and other water bodies (30 m) (s. 3.1.1).
- Waste handling (s.5.1.1).
- Fluid storage (s. 5.6).

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[485] OMAFRA. 1999, Oil and Gas Exploration, Production and Legislation on Ontario Farms Fact Sheet, http://www.ogsrlibrary.com/documents/gov_oil_gas_exploration_ontario_farms_99-029.pdf

[486] Ontario Oil, Gas and Salt Resources Library, http://www.ogsrlibrary.com/industry_statistics_ontario_petroleum

[487] Fortner, L. and T.R. Carter. *Oil and Gas Exploration and Development Activity in Ontario in 2010,* http://www.ogsrlibrary.com/documents/annual_summary_mnr_2010.pdf

[488] Fortner, L. and T.R. Carter. *Oil and Gas Exploration and Development Activity in Ontario in 2010.*

[489] MNR, http://www.mnr.gov.on.ca/en/Business/OGSR/2ColumnSubPage/STEL02_167114.html

[490] *Mining Act*, R.S.O. 1990, CHAPTER M.14, http://www.e-laws.gov.on.ca/html/statutes/english/elaws_statutes_90m14_e.htm

[491] *Gas and Oil Leases Act*, R.S.O. 1990, CHAPTER G.3, http://www.e-laws.gov.on.ca/html/statutes/english/elaws_statutes_90g03_e.htm

[492] *Oil, Gas and Salt Resources Act*, R.S.O. 1990, CHAPTER P.12, http://www.e-laws.gov.on.ca/html/statutes/english/elaws_statutes_90p12_e.htm

[493] This paragraph adapted from http://www.mnr.gov.on.ca/en/Business/OGSR/2ColumnSubPage/STEL02_167096.html

[494] MNR. 2002. *Oil, Gas and Salt Resources of Ontario: Provincial Operating Standards*, version 2.0, http://www.mnr.gov.on.ca/en/Business/OGSR/2ColumnSubPage/STEL02_167100.html

- Dikes in relation to fluid storage tanks (s. 5.6.1).
- Oil field fluid disposal wells (s. 7).
- Spill contingency plan (s. 7.12).

Suspended and Abandoned Wells

In 2004, a report to the Minister of Environment flagged suspended and abandoned oil and gas wells as a potential threat to drinking water. The main concern was that if such wells were left unplugged, "fluids such as sulphur or salt water, natural gas and oil can flow upwards, contaminating groundwater and surface waters. Similarly, contaminants originating at the surface such as pesticides, herbicides, fertilizers, manure or spills of other substances can flow down wells and contaminate groundwater. Old abandoned oil and gas production works, such as tanks, often contain oil and formation water that contaminates fresh water resources as they leak into the environment."[495]

Provincial standards under the *Oil, Gas and Salt Resources Act* do require that abandoned wells be plugged and the surface rehabilitated. To facilitate this work, Ontario established the Abandoned Works Program in 2005 to plug abandoned oil and natural gas wells. Candidate wells are ranked according to their risk to public safety and potential for environmental damage, and sites that represent immediate or significant hazards are addressed first. Most candidate wells are usually more than 50 years old, and Ministry records for these wells are often incomplete or non-existent. Thus, the program relies on landowners to help identify and locate abandoned wells on their property for which no public record exists.[496]

Compliance

The Petroleum Resources Centre is responsible for delivering an effective enforcement and inspection program to ensure the oil, gas and salt industries comply with legislation. Enforcement Officers and Petroleum Inspectors continually monitor the industry by regularly inspecting sites, auditing operations and taking appropriate actions to remedy hazards. Where appropriate, charges are laid under the *Oil, Gas and Salt Resources Act*. Public safety issues are frequently addressed to protect life, property, the environment and natural resources. This is achieved through administrative and traditional compliance, law enforcement activities, and through the education of municipalities, industry, landowners and the general public.[497]

[495] Watershed Based Source Protection: Implementation Committee Report to the Minister of the Environment. 2004, p. 36, http://www.ene.gov.on.ca/environment/en/resources/STD01_076398.html
[496] MNR, http://www.mnr.gov.on.ca/en/Business/OGSR/2ColumnSubPage/STEL02_167093.html
[497] MNR, http://www.mnr.gov.on.ca/en/Business/OGSR/2ColumnSubPage/STEL02_167094.html

3.3.8 Recreation

Very little information could be found that directly (or even indirectly) linked trail use, particularly motorized use, and/or camping to NPSP in Ontario. Regulating motorized access to trails is complicated due in part to the number of authorities involved and the fact that much of the land base for trails, especially in southern and central Ontario, is privately owned. Trail clubs can enter into agreements with landowners, and local governments also have an important role through Official Plans, bylaws and policing and controlling trail use.[498]

The 2005 *Ontario Trails Strategy*[499] cites data from the Ontario Trails Council that:

- Ontario has over 64,000 km of trails used for walking, hiking, cycling, horseback riding, snowmobiling, ATV use, dogsledding, trail biking, bird watching, and other nature-based activities.
- 525,000 people use snowmobile and ATV trails, and 800,000 people use hiking trails.

The Strategy also notes that the Ontario Federation of All Terrain Vehicle Clubs has over 2,100 km of mapped trails across Ontario.

The *Ontario Trails Strategy* is a long-term plan that establishes strategic directions for planning, managing, promoting and using trails in Ontario. It acknowledged the growing demand for ATV trails in Ontario and that pressure is increasing on the natural and cultural heritage features of trails because of growing population densities and increasing numbers of off-road vehicles, many of which are used off-trail as well.[500] It recognizes that "Trail use and off trail use can have significant environmental impacts. Both motorized and non-motorized uses can degrade sensitive landscapes and disrupt plant and animal habitats. Motorized uses can be particularly disruptive."[501] The proposed goals and strategies in response to this issue focused on the need to identify and share BMPs for environmental protection and conservation, and to take environmental and cumulative impacts (among others) into account when planning trails.[502]

In 2006, the Trails for All Ontarians Collaborative published *Ontario's Best Trails: Guidelines and Best Practices for the Design, Construction and Maintenance of Sustainable Trails for All Ontarians*.[503] This 300-page manual was developed to support the volunteers who plan, design, build and maintain most of Ontario's trails. It focuses on trails intended for human-powered use, and presents guidelines and best practices designed to apply to all trail settings. It notes: "An environmentally sustainable trail is one that will be compatible with the natural environment over the long term. Trails that experience ongoing erosion are examples of trails that are not environmentally sustainable. The choice of construction and maintenance techniques can also influence the environmental sustainability of a trail. For example, a bridge built with pressure treated wood may leach toxic chemicals into the surrounding environment if the wood is not properly treated and physically separated from the adjacent soil."[504]

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[498] Ministry of Health Promotion. 2005, *Ontario Trails Strategy*, http://www.mhp.gov.on.ca/en/active-living/recreation/trails-strategy.asp
[499] Ibid.
[500] Ibid. p. 9.
[501] Ibid. p. 16.
[502] Ibid. p. 17.
[503] Trails for All Ontarians Collaborative. 2006, *Ontario's Best Trails: Guidelines and Best Practices for the Design, Construction and Maintenance of Sustainable Trails for all Ontarians*, http://www.ontariotrails.on.ca/media/files/pdf/member-archives/reports/Ontario's%20Best%20Trails%20-%20%20Full%20Document.pdf
[504] Trails for All Ontarians Collaborative. 2006, *Ontario's Best Trails: Guidelines and Best Practices for the Design, Construction and Maintenance of Sustainable Trails for all Ontarians*, p.32.

Considerable recreation activity also takes place on Crown land, which is managed by MNR. On its website, MNR asks campers to "undertake their activities in an ecologically sound and responsible manner, accepting the risks associated with their activities. . . and to remove all litter."[505] Similarly, the use of ATVs and off-road vehicles (ORVs) is recognized as a popular outdoor activity, and "riders who wish to use Ontario's Crown land must act responsibly to help ensure that the natural environment is protected for future generations." Riders are asked to:

- Protect the natural environment and avoid sensitive features such as wetlands, streams and wildlife habitat.
- Stay on recognized trail systems.
- Pick up and pack out litter.
- Respect other users of Crown land.

To create a new trail, build a water crossing or hold an organized ATV/ORV event on Crown land, prior approval from MNR may be required.[506]

In 2007, Ontario's new *Provincial Parks and Conservation Reserves Act*[507] came into effect, replacing the 50-year old *Provincial Parks Act*. Ecological integrity will have first priority when planning and managing provincial parks and conservation reserves.[508] The Act addresses road construction, but does not reference NPSP specifically. It does note that "Except in accordance with the terms and conditions of a work permit issued under this Act, no person shall, in a provincial park or conservation reserve, cause or permit,

(a) the construction, expansion or placement of any building, structure or thing;
(b) the construction of any trail or road;
(c) the clearing of any land;
(d) the dredging or filling of any shore lands; or
(e) any activity permitted under section 17, 18, 19 or 20[509] that causes, results or is expected to result in a major disruption or impairment of the ecological integrity of a provincial park or conservation reserve" (s. 22 (1)).

The provincial government will also begin developing a non-legislative policy to address activities on Crown land adjacent to parks and conservation reserves that may negatively affect the ecological integrity of protected areas. This policy would continue to support and promote sustainable resource and community development, and would be the subject of public consultation.[510]

[505] MNR, http://www.mnr.gov.on.ca/en/Business/CrownLand/2ColumnSubPage/STEL02_170045.html
[506] Text on ATV use from MNR, http://www.mnr.gov.on.ca/en/Business/CrownLand/2ColumnSubPage/STEL02_170046.html
[507] Provincial Parks and Conservation Reserves Act, S.O. 2006, CHAPTER 12, http://www.e-laws.gov.on.ca/html/statutes/english/elaws_statutes_06p12_e.htm
[508] Ontario Parks, http://www.ontarioparks.com/english/legislation/index.html
[509] Activities in these sections include timber harvesting in Algonquin Park, oil and gas wells and aggregate pits, hydroelectricity generation, and resource access roads and utility corridors.
[510] Ontario Parks, http://www.ontarioparks.com/english/legislation/background.html

3.3.9 Provincial Water Quality Monitoring Program

Ontario's Provincial Water Quality Monitoring Network collects surface water quality information from rivers and streams at more than 400 locations across the province, although this number can vary in response to changing information needs, partnership opportunities and budgets.[511] The program is intended to gather information about the impacts of land use activities on water quality.

This program is undertaken in partnership with Conservation Authorities who collect water samples for analysis in MOE laboratories. Consistent collection methods and laboratory analysis ensure comparable test results for locations across the province. Samples from each monitoring location are tested for a consistent set of water quality indicators, including chloride, nutrients (phosphorus and nitrogen), and suspended solids. At selected locations, samples are also collected and tested for other indicators, such as metals and bacteria. Parameters including temperature and pH are measured in the field during sample collection. Data are managed by MOE and are shared by the partners and made available to the public.[512]

Recently, special studies relating to agricultural and urban watersheds have included stream-water collection and analysis. This information will support source protection planning and the management of nutrients, pesticides and road salts.[513]

[511] Aaron Todd, Coordinator, Stream Water Quality Monitoring, Environmental Monitoring and Reporting Branch. Ontario Ministry of the Environment, personal communication with Kim Sanderson, January 16, 2012.
[512] Stream monitoring locations and recent water quality monitoring results (from 2002 onward) can be downloaded from http://www.ene.gov.on.ca/environment/en/resources/collection/data_downloads/index.htm
[513] Unless otherwise noted, text in this section is adapted from MOE, http://www.ene.gov.on.ca/environment/en/monitoring_and_reporting/provincial_water_quality_monitoring_network/index.htm

3.4 Saskatchewan

3.4.1 Saskatchewan at a Glance

- *Saskatchewan's Long-Term Safe Drinking Water Strategy is the focal point for water management in the province.*
- *The Saskatchewan Watershed Authority, a Crown Corporation, has a wide mandate for managing and protecting water, watersheds and related land resources. It undertakes watershed planning, conservation of wetlands, public awareness activities, and monitoring ecological health of aquatic ecosystems.*
- *Environmental Farm Plans and Agri-Environmental Group Plans are a major focus of NPSP management for agriculture.*
- *Saskatchewan is adopting a new legal framework for managing and protecting its environment, including an Environmental Code that will define required environmental outcomes and leave it up to the regulated community to decide how it will achieve compliance.*

3.4.2 Overview

Saskatchewan covers an area of 651,000 km^2, about 9% of which is water.[514] The land is divided between the Precambrian Shield in the northern third of the province and the sedimentary rocks of the south. In 2008, approximately 25% of Saskatchewan's gross domestic product was derived from primary industries such as agriculture, mining (including uranium and potash) and petroleum.[515] The province is home to one million people,[516] nearly half of whom live in the Saskatoon and Regina census metropolitan areas;[517] it has the smallest population of the four provinces examined in this report.

Saskatchewan does not have a province-wide approach to managing NPSP although it has implemented numerous source water protection initiatives in response to a waterborne disease outbreak in the North Battleford area in 2001. In 2002, the Government of Saskatchewan released its Long-Term Safe Drinking Water Strategy.[518] The Strategy has become the focal point for future water management in Saskatchewan and has been the strategic driver for changes to legislation, regulations, departments, agencies and activities since it was announced.[519]

Another response in light of the North Battleford incident was the consolidation of watershed planning, protection and management activities of three agencies (SaskWater, Sask Environment, and Sask Wetland Conservation Corporation) into the Saskatchewan Watershed Authority (SWA) to oversee watershed and source water protection.

[514] Statistics Canada, http://www40.statcan.gc.ca/l01/cst01/phys01-eng.htm
[515] Government of Saskatchewan, http://www.gov.sk.ca/Default.aspx?DN=f80c0ebb-f1c6-497e-8bc0-30c215a5441f
[516] Statistics Canada, http://www40.statcan.gc.ca/l01/cst01/demo02a-eng.htm
[517] Statistics Canada, http://www40.statcan.gc.ca/l01/cst01/demo05a-eng.htm
[518] Government of Saskatchewan. 2002, *Saskatchewan's Safe Drinking Water Strategy*, http://www.saskh2o.ca/PDF/LTSDWS_report2003.pdf
[519] SaskH_2O, http://www.saskh2o.ca/about.asp

3.4.3 Saskatchewan Watershed Authority

The SWA is a Crown Corporation, now under the *Saskatchewan Watershed Authority Act* (2005),[520] with a wide mandate for managing and protecting water, watersheds and related land resources (s. 5). It "leads management of the province's water resources to ensure safe drinking water sources and reliable water supplies for economic, environmental and social benefits for Saskatchewan people."[521] Among other things, the SWA is responsible for watershed planning, reduction and elimination of contaminants, conservation of wetlands, public awareness, and monitoring the ecological health of aquatic ecosystems.[522] The SWA expenditures for 2010-2011 amounted to just over $39 million.[523]

The Minister of Environment is responsible for the SWA. In addition to other legislation and policy, the SWA administers the *Watershed Associations Act*[524] and the Saskatchewan Wetland Policy.[525] It coordinates North American Waterfowl Plan activities in Saskatchewan, including preservation, management and development of breeding habitat[526] and works with other departments and agencies such as Ducks Unlimited Canada to protect and restore wetlands. The SWA website lists a number of publications related to stewardship and wetlands and riparian management.[527]

The SWA works with communities to identify potential water threats and ensure protection of water resources. In response to the Government of Saskatchewan's Safe Drinking Water Strategy (2002),[528] the SWA has led the development of nine Source Water Protection Plans. Over 80% of Saskatchewan's population is now covered by such a plan. To date, eight watershed stewardship organizations have been established to implement the objectives identified in these plans. SWA staff provide technical assistance and support to these organizations, including working with land managers on BMPs.[529]

The SWA also oversees state of the watershed reporting, based on the *State of the Watershed Reporting Framework* published in 2006. The Framework provides a mechanism for consistent reporting of a standardized set of indicators, combined with a rating system to assess overall source water conditions. The system allows watershed health to be compared among watersheds and within a watershed over time. It provides information about human activities and the health of the watershed, and reports on the effectiveness of management activities to address change within the watershed.[530] The SWA has prepared two *State of the Watershed* reports, one in 2007 and one in 2010.[531]

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[520] Government of Saskatchewan. *Saskatchewan Watershed Authority Act* (2005), http://www.qp.gov.sk.ca/documents/English/Statutes/Statutes/S35-03.pdf
[521] SWA, http://www.swa.ca/AboutUs/WhatWeDo.asp
[522] Government of Saskatchewan. *Safe Drinking Water Strategy*, http://www.environment.gov.sk.ca/adx/aspx/adxGetMedia.aspx?DocID=764,758,253,94,88,Documents&MediaID=329&Filename=Sask.+Safe+Drinking+Water+Strategy.pdf&l=English
[523] Saskatchewan Watershed Authority. 2011. *Annual Report Highlights from 2010-2011*, http://www.swa.ca/Publications/Documents/SwaAnnualReport20102011Highlights.pdf
[524] Government of Saskatchewan. *Watershed Associations Act*, http://www.qp.gov.sk.ca/documents/English/Statutes/Statutes/W11.pdf
[525] See http://www.swa.ca/AboutUs/Documents/SaskatchewanWetlandPolicy.pdf
[526] SWA, http://www.swa.ca/Stewardship/NorthAmericanWaterfowlManagementPlan/Default.asp
[527] SWA, http://www.swa.ca/Publications/Default.asp?type=Stewardship
[528] Government of Saskatchewan. 2002. *Safe Drinking Water Strategy*, http://www.environment.gov.sk.ca/adx/aspx/adxGetMedia.aspx?DocID=764,758,253,94,88,Documents&MediaID=329&Filename=Sask.+Safe+Drinking+Water+Strategy.pdf&l=English
[529] SWA, http://www.swa.ca/Stewardship/PartnersPlanImplementation/Default.asp?type=SourceWaterProtectionPlan
[530] Saskatchewan Watershed Authority. 2006. *State of the Watershed Reporting Framework*, http://www.swa.ca/Publications/Documents/SOWReportFramework.pdf
[531] SWA, http://www.swa.ca/StateOfTheWatershed/Default.asp

Other major activities of the SWA related to managing NPSP include maintaining an inventory of the quality of ground and surface water, managing watersheds to meet aquatic ecosystem and fish habitat needs, and providing assistance for erosion control, maintenance of channels, and maintenance of water control works.[532]

3.4.4 Agriculture

Agriculture is a key sector of Saskatchewan's economy and accounts for over one-third of total provincial exports. Saskatchewan has over 40% of Canada's cultivated farmland, totalling more than 24 million ha. Just over 13 million ha of agricultural land are used for crop production each year, with the province producing a substantial percentage of Canada's grains, oilseeds, and pulses. With over 6 million ha of pastureland, Saskatchewan is second to Alberta in beef production, with 1.3 million beef cows. Hogs and bison are also important sectors of the livestock industry.[533] Speciality crops including wild rice, herbs and spices are a growing component of agricultural production, as is production for organic markets.[534]

3.4.4.1 Policy and Regulatory Tools

Saskatchewan does not appear to make extensive use of policy and regulatory tools to manage NPSP specifically related to agriculture, focusing instead on BMPs.

The Ministry of Agriculture administers pest control products legislation and the *Soil Drifting Control Act*. The *Pest Control Products (Saskatchewan) Act*[535] and its regulations[536] control the use, distribution and handling of pesticides, with requirements for safe storage and transport, disposal of pesticide containers, and cleaning of pesticide apparatus. The *Soil Drifting Control Act*[537] empowers the council of a rural municipality to pass a bylaw to regulate and control tillage practices which, in the opinion of the council, are liable to cause rapid soil deterioration by wind erosion (s. 2). The Act describes the sorts of practices that could be required, such as strip farming, cultivation of cover crops, prohibition of stubble burning and tree cutting, and others (s. 3). Such bylaws must be approved by both the Minister of Agriculture and by 60% of voters in the municipality.

The *Environmental Management and Protection Act* (2002),[538] under the purview of the Environment Ministry, includes a general prohibition on unauthorized discharges of substances that may cause an adverse effect to the environment or human health. It prescribes a duty to report any such discharge and it requires the person responsible for a discharge (or who allows a discharge) to take all reasonable measures to minimize damage and restore the environment.[539] Part IV of this Act deals with the protection of water and regulation of water quality, including the requirement to have a valid permit before discharging any substance in surface water or along the banks or shore of surface water to kill or

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[532] SWA, http://www.swa.ca/AboutUs/WhatWeDo.asp?type=MajorActivities

[533] Data from Government of Saskatchewan, http://www.agriculture.gov.sk.ca/Default.aspx?DN=7b598e42-c53c-485d-b0dd-e15a36e2785b

[534] Government of Saskatchewan, http://www.agriculture.gov.sk.ca/Saskatchewan_Picture

[535] Government of Saskatchewan. *Pest Control Products (Saskatchewan) Act,* http://www.qp.gov.sk.ca/documents/English/Statutes/Statutes/P8.pdf

[536] Government of Saskatchewan, Pest Control Products Regulations (1995), http://www.qp.gov.sk.ca/documents/English/Regulations/Regulations/P8R3.pdf

[537] Government of Saskatchewan, *Soil Drifting Control Act,* http://www.qp.gov.sk.ca/documents/English/Statutes/Statutes/S54.pdf

[538] Government of Saskatchewan. *Environmental Management and Protection Act (2002),* http://www.qp.gov.sk.ca/documents/english/Statutes/Statutes/e10-21.pdf

[539] Government of Saskatchewan, http://www.environment.gov.sk.ca/adx/aspx/adxGetMedia.aspx?DocID=2206,236,94,88,Documents&MediaID=1240&Filename=Environmental+Management+and+Protection+Act.pdf&l=English

control weeds, algae or other organisms (s. 35(1(b))). The 2002 Act was updated and passed by the Legislature in 2010, but the new Act has not yet been proclaimed. A new Environmental Code is being developed, which will affect some pieces of legislation when it is complete.

Saskatchewan's Fisheries Management Plan (2010)[540] is also relevant to NPSP management for most land uses. The Plan's first outcome is "sustainable management" and one of the challenges identified is "minimizing the effects of human activities and developments on aquatic habitats while promoting economic growth." A key action to meet this challenge is the preparation of standards that guide developments affecting aquatic habitats for incorporation into the Saskatchewan Environmental Code; particular attention is being paid to the sensitive ecosystems of northern Saskatchewan (p. 4).

Livestock grazing on Provincial Forest lands is governed by the *Forest Resources Management Act* and regulations.[541] Grazing permit holders must have an approved range management plan before grazing their livestock on the permit area. Ministry of Environment staff assess permit areas, check rangeland health and inspect for compliance to permit and plan conditions.[542]

3.4.4.2 Use and Implementation of BMPs

Saskatchewan has produced a great variety and number of guidelines, fact sheets, and other materials that address many aspects of managing potential NPSP from agriculture. These describe and encourage the implementation of BMPs for many activities, including manure management[543] (with guidelines for application and testing),[544] handling animal mortalities,[545] use of herbicides,[546] and selection and management of livestock overwintering sites near riparian areas.[547]

The province has also supported many partnerships to identify and implement BMPs.[548] These efforts include Environmental Farm Planning and Agri-Environmental Group Plans (AEGPs). As in other provinces, environmental farm plans are voluntary, confidential self-assessment tools producers can use to increase understanding of environmental risks and opportunities in their operations. Saskatchewan facilitated the development of AEGPs when producer groups indicated an interest in making watershed improvements in their area. "These plans are intended to mitigate or minimize negative impacts to the environment and to maintain soil, water or air quality and biodiversity to ensure the health and sustainability of land used for agricultural purposes."[549]

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[540] Saskatchewan Ministry of Environment. 2010, *Fisheries Management Plan*, http://www.environment.gov.sk.ca/adx/aspx/adxGetMedia.aspx?DocID=44c1e4e5-c717-42d3-bef7-75f0d398b55d&MediaID=3729&Filename=Fisheries+Management+Plan+2010.pdf&l=English

[541] Government of Saskatchewan, *Forest Resources Management Act*, http://www.publications.gov.sk.ca/details.cfm?p=525

[542] Saskatchewan Ministry of Environment. 2009, *Saskatchewan's 2009 State of the Environment Report, State of Saskatchewan's Provincial Forests*, http://www.environment.gov.sk.ca/soereport

[543] Saskatchewan Ministry of Agriculture, Manure Handling Guide, http://www.agriculture.gov.sk.ca/Manure_Handling_Guide

[544] Saskatchewan Ministry of Agriculture, Manure Guidelines, http://www.agriculture.gov.sk.ca/Default.aspx?DN=84596c25-26e1-40fa-aca5-b9f9b15548fc

[545] Saskatchewan Ministry of Agriculture, Mortalities Handling Guide, http://www.agriculture.gov.sk.ca/Default.aspx?DN=3b9968af-ba69-41a1-9d2a-9f122d6cedb8

[546] Saskatchewan Ministry of Agriculture, Guide to Crop Protection, http://www.agriculture.gov.sk.ca/Crop-Protection

[547] Saskatchewan Agriculture, Food and Rural Revitalization, and Saskatchewan Watershed Authority. *Stewardship and Economics of Cattle Wintering Sites*, http://www.agriculture.gov.sk.ca/Default.aspx?DN=c2eb0d6d-c071-437d-b301-17b57e642c8a

[548] See Saskatchewan Ministry of Agriculture website, http://www.agriculture.gov.sk.ca/Default.aspx?DN=e2e3f0ec-6913-4012-80d5-64c7eaea6e44

[549] Saskatchewan Watershed Authority. *2010-2011 Annual Report*, http://www.swa.ca/Publications/Documents/SwaAnnualReport20102011.pdf, pp. 19-20.

Producer groups can obtain funds through Canada-Saskatchewan Farm Stewardship Program (now Growing Forward) to address the issues identified in their watershed through the adoption of BMPs. The program is administered by the Provincial Council of Agriculture Development and Diversification Boards[550] through its Watershed Awareness Initiative. Examples of BMPs that will be funded include relocation of livestock facilities away from stream banks and lakeshores; planting forages for buffer establishment to protect stream banks and lake shores; equipment modification for improved pesticide application (Drift Reduction Technology); improved water systems and watering site management to protect high risk marginal soils, stream banks and lakeshores; and water well management (capping old wells, protecting existing wells from contamination).[551]

Saskatchewan now has 22 AEGPs in place, and the SWA coordinates implementation of the AEGPs in partnership with watershed groups and the Ministry of Agriculture. In 2010-11, the AEGPs resulted in over 1500 applications from land users for a range of BMPs.[552]

The SWA also administers the Erosion Control Assistance Program, which encourages erosion control and gully stabilization by individuals and organized groups of landowners through technical and financial assistance.[553]

NPSP from agriculture could be reduced through research and development financed through the Agriculture Development Fund[554] to identify agricultural technologies for improving management and reducing environmental risks related to pesticides, fertilizers and livestock manure.[555]

Saskatchewan is participating in the Watershed Evaluation of Best Agricultural Management Practices (WEBs) being undertaken in partnership with Agriculture and Agri-Food Canada in the Pipestone Creek basin. As well, some monitoring of Saskatchewan's surface water quality has been done in relation to intensive livestock operations, and that work concluded there was no evidence or apparent trend indicating that surface water is being compromised by the monitored operation.[556] For areas with livestock wintering on a river system, little sampling has been done to determine if there are any major water quality impacts.

[550] See PCAB website, http://saskpcab.com/
[551] Saskatchewan Ministry of Agriculture, http://www.agriculture.gov.sk.ca/Default.aspx?DN=e2e3f0ec-6913-4012-80d5-64c7eaea6e44
[552] Saskatchewan Watershed Authority. *2010-2011 Annual Report*, http://www.swa.ca/Publications/Documents/SwaAnnualReport20102011.pdf
[553] SWA, http://www.swa.ca/Publications/Documents/PR-205.pdf
[554] See Agriculture Development Fund, http://www.agriculture.gov.sk.ca/ADF
[555] Saskatchewan Ministry of Environment, Annual Report Highlights 2010-2011, http://www.saskh2o.ca/PDF/EPB418ADW1011AnnualReportHighlights.pdf
[556] Saskatchewan Agriculture, Food and Rural Revitalization. 2003, *Surface Water Quality Monitoring for Intensive Livestock Operations*, http://www.agriculture.gov.sk.ca/Default.aspx?DN=ab517097-0749-4293-b98e-dbe1935deefa

3.4.5 Urban

About two-thirds of Saskatchewan's population of one million is urban,[557] with the two major metropolitan areas of Saskatoon and Regina having about 265,000 and 215,000 residents respectively.[558] Saskatchewan has 13 other cities scattered across the province.

3.4.5.1 Policy and Regulatory Tools

The Environment Ministry regulates and monitors shoreline alterations through the *Environmental Management and Protection Act*. This is relevant to managing NPSP as development along Saskatchewan's shorelines increases. The Act "provides for the protection of aquatic habitat and states that a permit is required:

- to alter the bed, bank or boundary of any water body or water course;
- to remove or add any material to the bed, bank or boundary of any water body or watercourse; or
- to remove vegetation from the bed, bank or boundary or any water body or water course."[559]

Stormwater quality and most aspects of its management do not appear to be specifically regulated under provincial legislation in Saskatchewan. Neither the *Environmental Management and Protection Act* (2002) nor the Water Regulations presently requires a permit for the construction or operation of dedicated stormwater works. However, the Act does provide authority for creating regulations governing stormwater (s. 81(1)(bbb). As well, s. 4(2) of the Act also prohibits discharges that may cause or are causing an adverse effect.[560]

In 2006, Saskatchewan Environment produced Stormwater Guidelines[561] to provide high-level technical guidance to municipal authorities, individuals and consultants who plan to develop and implement drainage systems for stormwater in urban, commercial and industrial areas. The Guidelines note that stormwater management solutions are site specific; designers must determine if a single practice or a combination of practices is needed to meet the stormwater objectives and goals for any given site, and are responsible for the design and decisions made with respect to stormwater management. Innovation and use of best available technologies are encouraged and Saskatchewan Environment notes that the guidelines, when used as a "Code of Practice" will help minimize the impacts on receiving waters due to stormwater discharges and may serve as a "diligent" approach to improved stormwater management in the province. The Guidelines also specify that the owners and designers of stormwater management systems who plan to discharge the treated stormwater into receiving waters should consider the province's Surface Water Quality Objectives during planning, designing and implementation of stormwater drainage systems. The Guidelines focus on source controls, on-site and conveyance system controls, and end-of-pipe controls, with specifications for lot grading, infiltration systems, catchbasin and swale design, wet and dry ponds, constructed wetlands and others.

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[557] Statistics Canada, http://www40.statcan.gc.ca/l01/cst01/demo62i-eng.htm
[558] Statistics Canada, http://www40.statcan.gc.ca/l01/cst01/demo05a-eng.htm
[559] Saskatchewan Environment. *Waterfront Living in Saskatchewan*, http://www.environment.gov.sk.ca/adx/aspx/adxGetMedia.aspx?DocID=781,760,253,94,88,Documents&MediaID=336&Filename=Aquatic+Habitat+Shoreline+Protection.pdf&l=English
[560] Government of Saskatchewan. *Environmental Management and Protection Act (2002)*, http://www.qp.gov.sk.ca/documents/english/Statutes/Statutes/e10-21.pdf. As noted earlier, this Act has been updated but not yet proclaimed.
[561] Saskatchewan Environment, Environmental Protection Branch. 2006, *Stormwater Guidelines*, EPB 322, http://www.saskh2o.ca/DWBinder/EPB322StormwaterGuidelines.pdf

3.4.5.2 Use and Implementation of BMPs

Saskatoon has a series of Water and Sewage Standard Operating Procedures. The Storm Sewer Hazardous Material Spill standard operating procedure describes the response procedure to be used in the event of a hazardous materials spill into the storm sewer collection system.[562]

One section in the City's New Neighbourhood Design and Development Standards Manual (2008) describes the requirements for the stormwater drainage system, including standards for the design of grassed swales, wet ponds, dry ponds and constructed wetlands.[563]

No specific guidelines were found for erosion and sediment control, but one document related to the preparation of an environmental protection plan in conjunction with construction activities in parks notes that erosion and sedimentation control measures are to be specific to the site and conform to United States Environmental Protection Agency Document No. EPA 832/R-92-005 (September 1992), Storm Water Management for Construction Activities, Chapter 3.[564]

Saskatoon uses an Integrated Pest Management system and the least toxic methods for controlling urban pests. Chemical pesticides are used minimally, only when no other effective alternatives are available.[565] Similarly, an integrated weed control program uses a combination of methods, and herbicides are no longer applied to parks and sports fields to control broadleaf weeds.[566]

The City of Regina has in place a document called Standard Construction Specifications Manual 2011, which contains information about the requirements and standards for sewer, water, drainage, grading, paving and landscaping for streets, roads and sidewalks for developments, some of which pertain to managing NPSP (e.g., erosion).[567]

Regina's Winter Maintenance Plan makes reference to a Salt Management Plan developed in accordance with Environment Canada's "Code of Practice for the Environmental Management of Road Salts."[568] Regina also uses an Integrated Pest Management approach to control weeds and pests in its parks, athletic fields and other green spaces, and provides advice on its website on non-chemical pest control alternatives.[569]

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[562] City of Saskatoon, http://www.saskatoon.ca/DEPARTMENTS/Infrastructure%20Services/Public%20Works/Water%20and%20Sewer/Standard%20Operating%20Procedures%20Documents/Pages/default.aspx

[563] City of Saskatoon. 2008, City of Saskatoon New Neighbourhood Design and Development Standards Manual, http://www.saskatoon.ca/DEPARTMENTS/Infrastructure%20Services/StrategicServices/Documents/Design%20and%20Development%20Standards%20-%20SECTION%20SIX_Rev.pdf

[564] City of Saskatoon, http://www.saskatoon.ca/DEPARTMENTS/Infrastructure%20Services/Parks/Documents/Construction%20Standards/2011-01560%20Environmental%20Protection.pdf

[565] City of Saskatoon, http://www.saskatoon.ca/DEPARTMENTS/Infrastructure%20Services/Parks/PestManagement/Pages/default.aspx

[566] City of Saskatoon, http://www.saskatoon.ca/DEPARTMENTS/Infrastructure%20Services/Parks/WeedControl/Pages/default.aspx

[567] City of Regina, Standard Construction Specifications Manual 2011, http://www.regina.ca/residents/roads-traffic/road-bylaws-manuals-report/standard_construction_specifications/index.htm

[568] City of Regina Winter Maintenance Plan, http://www.regina.ca/opencms/export/sites/regina.ca/residents/bylaw/.media/pdf/winter_mntnce_policy_may2011.pdf

[569] City of Regina website, http://www.regina.ca/residents/tree-yard/control-pests/

3.4.6 Forestry

Saskatchewan's forests cover 33.9 million ha, mostly in the northern part of the province; this is 52% of the total land base. More than 90% of this land is in provincial Crown forests, managed by the Ministry of Environment. Of the total forested land base, 12.7 million ha are commercial forests. The forest sector contributes over $1 billion a year to the provincial economy.[570]

Saskatchewan allocates forest harvesting rights for a specific volume of timber from a defined area through the use of 20-year Forest Management Agreements (FMAs). Such agreements also confer responsibilities for long-term sustainable forest management. Twenty-year Forest Management Plans (FMPs), renewable every ten years, describe how the licensee proposes to manage the forest. FMPs include long-term strategies for inventory, harvesting, renewal and access, and describe consultation undertaken and plans to mitigate concerns raised. Five-year operating plans, updated annually, describe in detail how the licensee plans to implement the FMP.[571] Term Supply Licences are another type of tenure, These are issued for up to ten years, conferring rights to harvest specified forest products, as well as responsibilities for forest management.[572] The Ministry of Environment has an ISO 14001 certified Environmental Management System in place to manage the environmental impacts of activities under its forestry program.[573]

3.4.6.1 Policy and Regulatory Tools

Several existing policy and regulatory tools pertain in varying degrees to NPSP management:

- Forest Environmental Policy
- *Forest Resources Management Act* and regulations
- FMA Area Standards and Guidelines
- Fisheries Management Plan
- *Environmental Management and Protection Act.*

The Ministry of Environment has a Forest Environmental Policy, which notes, among other things, that "We will minimize undesired environmental impacts and prevent pollution to forest ecosystems from activities authorized, regulated and conducted by our organization."[574]

The *Forest Resources Management Act*[575] and regulations[576] are the framework for administering and managing forest lands and protecting forest health; they relate to NPSP largely because of other documents they require to be prepared. Section 9(1) of the Act requires that every ten years the Ministry of Environment prepare a report on the state of Saskatchewan's provincial forests; this report is referenced in more detail in section 3.4.6.2. Four manuals have also been legislated and are being developed by the Ministry to cover Forest Planning, Forest Operations, Compliance and Scaling. These

[570] Government of Saskatchewan, http://www.er.gov.sk.ca/Forestry
[571] Saskatchewan Ministry of Environment, http://www.environment.gov.sk.ca/Default.aspx?DN=b9517035-a2a4-4803-8d01-675215e38849
[572] Saskatchewan Ministry of Environment, http://www.environment.gov.sk.ca/Default.aspx?DN=0b632a2c-862a-4bee-8dd2-0099e594361c
[573] Saskatchewan Ministry of Environment, http://www.environment.gov.sk.ca/Default.aspx?DN=c1f06eca-55e0-4f9c-bad1-9d7540328bb4
[574] Saskatchewan Ministry of Environment. 2010, Forest Environmental Policy, http://www.environment.gov.sk.ca/adx/aspx/adxGetMedia.aspx?DocID=1102,865,244,94,88,Documents&MediaID=85d024db-3a92-48b4-8e53-049fae865089&Filename=Forest+Enviromental+Policy+Jan+2010.pdf&l=English
[575] Government of Saskatchewan, *Forest Resources Management Act*, http://www.publications.gov.sk.ca/details.cfm?p=525
[576] Government of Saskatchewan, Forest Resources Management Regulations, http://www.publications.gov.sk.ca/details.cfm?p=1124

will contain details on applicable objectives, procedures, standards and guidelines to be followed by a licensee when undertaking forest operations.[577]

In addition to these manuals, standards and guidelines specific to each FMA Area have also been developed with industry and are reviewed annually or biannually. An objective is specified for each activity along with standards and guidelines. A standard is a specific measurable activity, result or unit of measure. The Ministry of Environment will enforce a licensee's adherence to the standards and can modify standards when the monitoring of results or new knowledge indicate a change is required. Guidelines are recommended practices and are options for achieving standards and objectives given expected conditions. A licensee may deviate from the guideline when unforeseen or site-specific circumstances require an alternate approach. Although the Ministry will not enforce guidelines, their effectiveness or use of alternate practices will be considered in audits.[578]

The 2011 FMA Area Standards and Guidelines, not unlike Alberta's Timber Harvest Planning and Operating Ground Rules, describe how activities are to be carried out on the ground and thus have the potential to influence NPSP. They address roads, stream crossings, reclamation, riparian management, and spills, with reference to requirements in the Federal *Fisheries Act* and Saskatchewan's *Environmental Management and Protection Act* as appropriate. For example, the Standards and Guidelines specify:

- Road construction standards including slopes and width of right-of-way
- Riparian reservation of 0 to 90 m, depending on the ability of the adjacent lake or stream to support fish populations and its connection to a recognizable stream system
- Requirements for locating, establishing and closing work camps
- Procedures for handling spills
- No fueling of vehicles or machinery within 100 m of the high water mark of a water body
- Permitted harvest block soil disturbance (e.g., no ruts more than 15 cm deep and 5 m long).[579]

These standards will be replaced with chapters of the Saskatchewan Environmental Code (see below) as these chapters are developed.

The *Environmental Management and Protection Act* (2002)[580] is also relevant to NPSP management, as noted in section 3.4.4.1.

The Environment Ministry, including the Forest Service, is implementing a new results-based approach that will focus on desired environmental and resource management outcomes. This represents a significant shift away from prescriptive legislation and regulations to holding proponents accountable for achieving desired environmental outcomes.[581] This approach appears to be similar to that in B.C. for forest and range management.

To support the new approach, four key pieces of enabling legislation were modernized, introduced in 2009, and passed by the legislature in spring 2010, but are not yet proclaimed; the two Acts related to NPSP management for forestry are the *Forest Resources Management Act* and the *Environmental Management and Protection Act.* The new Saskatchewan Environmental Code is a key feature of the

[577] Saskatchewan Ministry of Environment, http://www.environment.gov.sk.ca/Default.aspx?DN=903599a5-ccce-47ac-9355-c17650a1e263
[578] Text in this paragraph is common to the Standards and Guidelines for all four FMA Areas; documents can be downloaded at http://www.environment.gov.sk.ca/Default.aspx?DN=903599a5-ccce-47ac-9355-c17650a1e263
[579] See the Standards and Guidelines for the four FMA Areas at http://www.environment.gov.sk.ca/Default.aspx?DN=903599a5-ccce-47ac-9355-c17650a1e263
[580] Government of Saskatchewan. *Environmental Management and Protection Act (2002),* http://www.qp.gov.sk.ca/documents/english/Statutes/Statutes/e10-21.pdf
[581] Government of Saskatchewan, http://www.environment.gov.sk.ca/Regulations

results-based model. “It is a clear, concise statement of objectives, recommended practices and alternatives that will govern the management and protection of Saskatchewan’s environment and natural resources while promoting economic growth. This Code will provide clear directions and guidelines for projects, allowing operators in many situations to proceed without waiting for a ministerial approval.”[582] Initial sections of the Code are expected to be completed in 2012, at which time the new legislative framework will be brought into effect.[583]

3.4.6.2 Monitoring NPSP and Assessing Management Effectiveness

The *2009 State of Saskatchewan Provincial Forests* report examined 23 indicators; for each indicator the report assesses the state, notes the general trend associated with its condition and evaluates the adequacy of the information available to assess the indicator. Three indicators are relevant to NPSP management, and their assessment in the 2009 report is summarized as follows:

- **Soil disturbance monitoring trends**. Following timber harvest and forest renewal activities, about 80% of the area is free from soil disturbance. Other than machine traffic compaction, surface disturbances are minor, except for rutting; up to 15% of harvest blocks may contain rutting in excess of provincial standards. Overall, the condition of this indicator was rated as fair with an improving trend and adequate information.
- **Aquatic habitat change.** Stream-dwelling insect larvae were sampled at sites where a stream may be affected by disturbance on the surrounding land from forest fire, timber harvest and road crossings. However, there were significant difficulties in sampling and finding appropriate stream conditions for this type of testing, making it impossible to determine results. The condition and trend of this indicator were rated as uncertain and the information base was inadequate.
- **Watershed health within the provincial forest.** Most watersheds within the Provincial Forest boundary are in a healthy state, based on the watershed health indicators prepared and reported by the Saskatchewan Watershed Authority in 2007. The condition of this indicator was rated as fair with an uncertain trend and partial information.[584]

Large forest companies are also required under the *Forest Resources Management Act* and regulations to have periodic independent audits to assess how well they are achieving the objectives set out in their FMP. The Independent Sustainable Forest Management Audit Manual describes the protocols for such audits. For example, one question is: Has the licensee met its obligations, commitments and objectives at the stand level in its implementation of harvesting practices on the ground? The Field component of the audit methodology to answer this question is as follows:

> “For a sample of harvest blocks identified in stand level plans, prescriptions, assessments and maps, assess during the site visit that descriptions, assessments and activities and measures identified in the documents match conditions and implemented actions on the ground. Ensure that specifications and standards have been adhered to (including those specified in operating procedures) and objectives met by the licensee in its carrying out of harvesting activities, including. . . provisions pertaining to. . . in-block roads and landings specifications, riparian zone protection, protection of other identified resources, etc.”[585]

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[582] Government of Saskatchewan, http://www.environment.gov.sk.ca/adx/aspx/adxGetMedia.aspx?DocID=303d5883-af87-41e5-bab2-2a0a20291c93&MediaID=4051&Filename=Qs++As.pdf&l=English

[583] Government of Saskatchewan, http://www.environment.gov.sk.ca/Regulations

[584] Saskatchewan Ministry of Environment. 2009, *Saskatchewan’s 2009 State of the Environment Report, State of Saskatchewan’s Provincial Forests*, http://www.environment.gov.sk.ca/soereport

[585] Saskatchewan Environment. 2003, *Independent Sustainable Forest Management Audit Manual,* http://www.environment.gov.sk.ca/adx/aspx/adxGetMedia.aspx?DocID=905,904,879,862,244,94,88,Documents&MediaID=388&Filename=Independent+Sustainable+Management+Manual.pdf&l=English

Following the audit, the Ministry and the company work together to prepare a Co-ordinated Action Plan articulating how the issues identified will be addressed. Progress on implementing the action plan is reviewed and reported annually, with updates posted on the Ministry website.[586]

3.4.7 Oil and Gas

The conventional oil and gas sector is an important contributor to Saskatchewan's economy. The province produces about 17% of Canada's crude oil; in 2010, some 27,000 oil wells yielded 154 million barrels (24.5 million m^3) and sales of $10.2 billion. Remaining recoverable reserves are estimated to be 1.2 billion barrels (183.8 million m^3). Approximately 20,000 gas wells were productive in 2010.[587] Like Alberta, Saskatchewan also has heavy oil resources and coal; other major mineral resources in Saskatchewan include potash and uranium.

The Ministry of Energy and Resources is responsible for all areas related to provincial jurisdiction over oil and gas resources, including regulation, conservation, licensing, technical and environmental standards, public safety, data collection and distribution, Crown land sales, and other aspects.[588]

3.4.7.1 Policy and Regulatory Tools

The *Oil and Gas Conservation Act* and its regulations[589] allow for the orderly exploration for and development of oil and gas, and optimization of recovery of these resources. The Act empowers the Minister of Energy and Resources to suspend operations or order various activities to be abandoned, restored, remediated or reclaimed to protect the environment (s.17.01(1)).

The Oil and Gas Conservation Regulations require operators to take immediate steps to contain and clean up spilled upstream petroleum product (crude oil, salt water, emulsions, condensates and/or natural gas liquids generated during exploration and production activities) and to notify the appropriate authorities of a spill.[590]

The Environment Ministry is involved in approving oil and gas proposals. Saskatchewan's *Environmental Assessment Act*[591] describes a process for assessing proposals for oil and gas exploration and development. The environmental screening process is outlined in the Environmental Review Guidelines for Oil and Gas Activities.[592] These Guidelines address NPSP by describing what must be included in an oil and gas proposal which is then submitted to the Environment Ministry for review; such proposals must describe, among other things:

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[586] Saskatchewan Ministry of Environment, http://www.environment.gov.sk.ca/Default.aspx?DN=3d3817dc-cd21-47c5-a395-d9511b1b6338

[587] Data in this paragraph from Government of Saskatchewan, http://www.er.gov.sk.ca/Oil-and-Gas-Facts

[588] Saskatchewan Ministry of Energy and Resources. 2011, *2010-11 Annual Report*, http://www.finance.gov.sk.ca/PlanningAndReporting/2010-11/201011ERAnnualReport.pdf

[589] Government of Saskatchewan. *Oil and Gas Conservation Act*, http://www.publications.gov.sk.ca/details.cfm?p=745; Oil and Gas Conservation regulations, http://www.publications.gov.sk.ca/details.cfm?p=679

[590] SaskSpills, http://www.saskspills.ca/about.asp

[591] Government of Saskatchewan. *Environmental Assessment Act*, http://www.publications.gov.sk.ca/details.cfm?p=488&cl=5

[592] Saskatchewan Ministry of Environment. 2011, *Environmental Review Guidelines for Oil and Gas Activities*, http://www.environment.gov.sk.ca/EnvironmentalReviewGuidelinesForOilAndGasActivities. Additional details on the environmental evaluation and screening process for oil and gas projects are noted at http://www.environment.gov.sk.ca/Default.aspx?DN=ac9f7e7e-badc-4ec6-bde1-c705853ae939

- Sensitive aspects of the proposed project area (e.g., steep slopes, water bodies, wetlands, riparian areas) and soils directly affected by the project, and measures that will be taken to avoid or mitigate identified potential impacts.
- Potential impacts of each project phase addressed in the proposal (exploration, construction, operation, decommissioning), as appropriate, and how these may be affected by existing or known future projects and activities in the project area.
- How wastes and by-products will be managed, stored, transported, reused and disposed of.
- Plans for monitoring during construction, operation and decommissioning. Monitoring plans should consider the project's impact management and protection measures and the residual impacts described in the proposal.

Projects that have potential to trigger a full Environmental Impact Assessment under the Act require a detailed Environmental Protection Plan.[593] As noted in section 3.4.6 on Forestry, Saskatchewan has updated four key pieces of enabling legislation, one of which is the *Environmental Assessment Act.* Although passed by the legislature, it has not yet been proclaimed, and is awaiting completion of initial sections of the new Saskatchewan Environmental Code, expected later in 2012.

The Oil and Gas Development Survey Guidelines for Crown Agricultural and Resource Land include some requirements pertinent to NPSP; for example, "No clearing for well sites, access routes, compressor stations, battery sites, etc. is permitted within 90 m of any water body or watercourse with known fish populations or fish bearing potential, 45 m of those with no fish bearing potential."[594]

3.4.7.2 Use and Implementation of BMPs

Saskatchewan has a number of Environmental Guidelines for the oil and gas sector, many of which have been developed by the Saskatchewan Petroleum Industry/ Government Environment Committee (SPIGEC). SPIGEC was formed in 1992 to enable government and industry to work together to resolve provincial environmental management issues. Its overriding goal is "to ensure the continued growth of the oil and natural gas industry, with development proceeding in a manner which minimizes adverse environmental effects."[595]

Many of these environmental guidelines include reference to relevant legislation, but they also suggest BMPs to address a particular issue.[596] The following guidelines vary in their level of detail but are directly or potentially relevant to NPSP management:

- Waste Management Guidelines for the Saskatchewan Upstream Oil and Gas Industry[597]
- Restoration of Spill Sites on Saskatchewan Agriculture and Pasture Lands[598]

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[593] Saskatchewan Environment and Resource Management. 2000, *Guidelines for Preparation of an Environmental Protection Plan (EPP) for Oil and Gas Projects*, http://www.environment.gov.sk.ca/adx/aspx/adxGetMedia.aspx?DocID=1241,1167,1162,1161,240,94,88,Documents&MediaID=602&Filename=EPP_Guidelines.pdf&l=English

[594] Saskatchewan Ministry of Environment. 1999, *Oil and Gas Development Survey Guidelines – Saskatchewan Crown Agriculture and Resource Land*, http://www.environment.gov.sk.ca/adx/aspx/adxGetMedia.aspx?DocID=a014ce72-cdcc-403e-93f2-36daeecbbf64&MediaID=600&Filename=Oil_and_Gas_Development_Survey_Guidelines.pdf&l=English

[595] Saskatchewan Ministry of Environment, http://www.environment.gov.sk.ca/Default.aspx?DN=13724c22-f8df-42d2-8da4-524e924164cb

[596] All guidelines can be viewed at http://www.er.gov.sk.ca/environmentalguidelines

[597] SPIGEC. 1996, *Waste Management Guidelines for the Saskatchewan Upstream Oil and Gas Industry*, http://www.er.gov.sk.ca/adx/aspx/adxGetMedia.aspx?DocID=3891,3620,3384,5460,2936,Documents&MediaID=5003&Filename=PDB+ENV+04+-+SPIGEC1+Waste+Management+Guidelines.pdf

Environmental monitors are often used during upstream oil and natural gas exploration and development projects. Government may require the presence of a monitor when the project is planned for an environmentally sensitive location. Monitors may be required to oversee or supervise activities such as clearing of vegetation, installing stream crossings or implementing erosion control programs. SPIGEC has prepared a guideline describing the required qualifications for field environmental monitors to ensure they have the necessary combination of education, experience and skills to fulfil the specific needs of the project and to meet the expectations of government and industry.[599]

3.4.8 Recreation

To be consistent with other provinces examined in this report, an effort was made to determine how NPSP associated with off-highway vehicle use is managed in Saskatchewan. However, very little information appears to be available regarding motorized recreation apart from snowmobiles, and nothing was found on access management or specific issues related to NPSP management for this land use.

Saskatchewan has an *All Terrain Vehicles Act* and regulations,[600] but this legislation deals primarily with safety, insurance and similar considerations. One regulation does prohibit the operation of an ATV on specific Crown lands.[601] The 2011 Saskatchewan Hunters' and Trappers' Guide also notes areas where ATVs may not be used.[602]

The Saskatchewan Parks website notes that "Two parks have areas set aside and designated as ATV trails. Moose Mountain and Narrow Hills provincial parks offer designated and authorized ATV trails with traffic signs and devices. While some park visitors would like to use their ATVs on other provincial park lands, uncontrolled ATV use can cause serious environmental damage such as soil erosion and compaction and damage to vegetation. ATVs can also open up previously inaccessible park areas and create unwanted trails."[603]

The Draft Carrot River Watershed Source Water Protection Plan has as one of its planning objectives, to "Minimize environmental damage from all-terrain vehicles (ATVs) by enhancing the level of awareness of ATV users and the general public on the impacts of ATV use." Located in east central Saskatchewan, the Carrot River Watershed Association proposes to "seek local partners and investigate opportunities to coordinate awareness efforts through the implementation of the Saskatchewan Ministry of Environment's Pasquia/Porcupine Integrated Forest Land Use Plan."[604]

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[598] SPIGEC. 1999, *Restoration of Spill Sites on Saskatchewan Agriculture and Pasture Lands*, http://www.er.gov.sk.ca/adx/aspx/adxGetMedia.aspx?DocID=3891,3620,3384,5460,2936,Documents&MediaID=5005&Filename=PDB+ENV+06+-+SPIGEC3+Spill+Reclamation.pdf

[599] SPIGEC. 2002, Required Qualifications: Field Environmental Monitors for Oil and Natural Gas Exploration and Development Projects, http://www.environment.gov.sk.ca/adx/aspx/adxGetMedia.aspx?DocID=1240,1167,1162,1161,240,94,88,Documents&MediaID=601&Filename=Qualification_Requirements_for_Environmental_Monitors.pdf

[600] Government of Saskatchewan, *All Terrain Vehicles Act*, http://www.publications.gov.sk.ca/details.cfm?p=369&cl=5

[601] Government of Saskatchewan, The Operation of All Terrain Vehicles on Crown Land Prohibition Regulations, http://www.qp.gov.sk.ca/documents/English/Regulations/Regulations/A18-02R2.pdf

[602] Saskatchewan Ministry of Environment. 2011, *2011 Saskatchewan Hunters' and Trappers' Guide*, http://www.environment.gov.sk.ca/adx/aspx/adxGetMedia.aspx?DocID=3222bfc9-1f52-4a80-be7f-e8066cf9f09e

[603] Saskatchewan Parks, http://www.saskparks.net/trails

[604] Saskatchewan Watershed Authority. 2012, *Draft Carrot River Watershed Source Water Protection Plan*, http://www.swa.ca/Stewardship/WatershedPlanning/pdfs/DraftCarrotRiverWatershedSourceWaterProtectionPlan-09January2012.pdf

4. Review of Selected U.S. Jurisdictions

In the chapters on the U.S., American terminology is used. Thus "statute" and "act" refer to legislation, while Administrative Code and "rule" refer to regulations.

4.1 Federal Government

4.1.1 The Federal Government at a Glance

- *Under the* Clean Water Act*, the Environmental Protection Agency (EPA) manages regulatory requirements which must be implemented by each state.*
- *Section 303 of the* Clean Water Act *sets separate water quality standards for each class of designated water use, e.g., drinking water source, recreational use. States are required to calculate the total maximum daily load for each river, lake, etc. that does not meet its specific water quality standards. The total maximum daily load sets the maximum pollutant load that would enable the water to meet the standards for its designated use and allocates a specific pollutant wasteload to point and non-point sources of pollution.*
- Clean Water Act *Section 319 requires water management plans to address NPSP and enables the EPA to provide some funding to states for selected projects.*
- *The EPA Health Watershed Initiative aims to protect good quality waters.*
- *The EPA encourages the voluntary implementation of BMPs through education, including manuals for agriculture, forestry and municipal stormwater, as well as water quality trading to meet regulatory requirements.*
- *The U.S. Department of Agriculture has a Clean Water Program which encourages the use of BMPs to reduce agricultural NPSP and provides some funding; e.g., through the Environmental Quality Incentives Program.*

4.1.2 Overview

NPSP is now the leading remaining cause of water quality problems in the U.S.[605] with polluted runoff from agricultural and urban areas being the most important sources.[606] The federal government, through the EPA has considerable influence on the programs operated by the individual states, not only setting standards, but supplying grants for some purposes. The EPA also offers detailed guidance on ways to reduce NPSP in agriculture, forestry and urban areas. While there are many success stories for small watersheds, which are documented on the EPA website,[607] there is often little data available.[608]

The U.S. Department of Agriculture (USDA) has several programs that help reduce water pollution from agricultural lands; implementation usually occurs through voluntary approaches.[609] Measures to reduce NPSP are in some cases undertaken on a watershed basis and may be initiated by conservation districts, which are quasi public/quasi government groups. These groups include elected officials but they also

[605] EPA. Polluted Runoff (Nonpoint Source Pollution), Basic Information, http://www.epa.gov/owow_keep/NPS/whatis.html
[606] EPA. Region 8, Water, Nonpoint Source Pollution webpage, http://www.epa.gov/region8/water/nps/
[607] EPA. Section 319 Success Stories, http://water.epa.gov/polwaste/nps/success319/
[608] Dov Weitman, Chief, Nonpoint Source Control Branch, EPA, personal communication with Mary Griffiths, November 2, 2011. He has since retired.
[609] Ibid. Dov Weitman provided the information summarized in this paragraph, as well as recommending states and towns that provide good examples of NPS management.

have professional staff paid by the USDA. Even states that have regulatory authority to reduce agricultural pollution try to rely on voluntary measures, encouraging the use of good management practices through funding support. States with good programs to manage agricultural NPSP include California, North Carolina, Vermont, Washington and Wisconsin. Municipalities that have been pro-active in addressing urban NPSP include Portland, Oregon; Philadelphia, Pennsylvania; and Seattle, Washington. North Carolina and Vermont also have good programs to manage stormwater runoff. California has done some work to address NPSP from forestry using both regulatory and non-regulatory methods.

4.1.3 Environmental Protection Agency

4.1.3.1 Legislation

The *Clean Water Act* (CWA) sets out the federal requirements for the protection of water quality.[610] It is implemented jointly by the federal government, through the EPA, and by the states, interstate agencies, and area-wide, local and regional planning organizations (although states may also have their own legislation and regulations to ensure that water quality standards are met). There are two main elements to the federal requirements: water quality standards[611] and surface water classifications.[612]

The CWA, Section 303(c), requires each state to set **water quality standards**, which are the goals for individual water bodies.[613] They may include specific standards for physical, chemical and biological water properties and limits on various pollutants. These standards are specific to each water body's use classification. "Under the Clean Water Act, each waterbody is classified according to its **Designated Uses**. Assigning a use designation, such as Fish and Aquatic Life, is one of the first steps in managing water quality. Designation is a scientific process that involves evaluation of the resource and its natural characteristics. Each Use Designation category carries with it a set of goals with expectations for a water body's performance. For some designations, such as Fish and Aquatic Life, detailed sub-categorization occurs to classify the water according to its specific potential."[614] The aim is to protect high quality waters, nutrient sensitive waters and outstanding water resources, as well as identify those that are impaired.

As the EPA explains in more detail: "Appropriate uses are identified by taking into consideration the use and value of the water body for public water supply, for protection of fish, shellfish, and wildlife, and for recreational, agricultural, industrial, and navigational purposes. In designating uses for a water body, States and Tribes examine the suitability of a water body for the uses based on the physical, chemical, and biological characteristics of the water body, its geographical setting and scenic qualities, and economic

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[610] U.S. Federal Register. *Title 40 – Protection of Environment*, Chapter I—Environmental Protection Agency, Subchapter D—Water Programs, Part 130—Water Quality Planning and Management, http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&sid=35956fca5f9c25dc1cfb35a038aebc8e&rgn=div5&view=text&node=40:22.0.1.1.17&idno=40#40:22.0.1.1.17.0.16.1. For more information on the *Clean Water Act,* see http://www.epa.gov/lawsregs/laws/cwa.html

[611] EPA. Water Quality Handbook, Introduction, http://water.epa.gov/scitech/swguidance/standards/handbook/intro.cfm#overview The introduction provides an overview of water quality standards.

[612] EPA. Water Quality Handbook, Chapter 2: Designated Uses, http://water.epa.gov/scitech/swguidance/standards/handbook/chapter02.cfm

[613] EPA. CWA, section 303, Water Quality Standards and Implementation Plans, http://water.epa.gov/lawsregs/guidance/303.cfm

[614] Wisconsin Department of Natural Resources, *2010 Wisconsin Water Quality Report to Congress,* p. 44, http://www.dnr.state.wi.us/org/water/condition/2010_IR/Attachment_A_2010_WQ_RptToCongress_FINAL_3-30-2010.pdf

considerations. Each water body does not necessarily require a unique set of uses. Instead, the characteristics necessary to support a use can be identified so that water bodies having those characteristics can be grouped together as supporting particular uses."[615]

Under CWA Section 303(d) all states are required to identify all **impaired waters,**[616] which includes impaired lakes, ponds, rivers and streams that do not meet Water Quality Standards. The impairment may come from point source and NPS pollution. If a water body is too polluted to meet the water quality standards, the state (or territories or authorized tribes) must establish a Total Maximum Daily Load (TMDL) for that stretch or body of water.[617] The TMDL is "a calculation of the maximum amount of a pollutant that a waterbody can receive and still safely meet water quality standards."[618]

The calculation of a TMDL is explained in an EPA training course as follows:

A TMDL is expressed as TMDL = ΣWLA_{i+} LA_i + MOS

- "Waste load allocation (WLA). Total amount of pollutant from existing point sources (e.g., sewage treatment plant, industrial facility, stormwater).
- Load allocation (LA). Total amount of pollutant from existing non-point sources and natural background (e.g., farm runoff, atmospheric mercury).
- Margin of safety (MOS). This is used to take into account lack of knowledge concerning the relationship between effluent limitations and water quality. It can be expressed as an explicit factor (e.g., percent of total, such as 10%) or an implicit factor (e.g., conservative assumption in modeling)."[619]

Thus, the calculation of a TMDL involves several activities:

- "Selection of the pollutant to consider.
- Estimation of the water body's assimilative capacity (i.e., loading capacity).
- Estimation of the pollutant loading from all sources to the water body.
- Analysis of current pollutant load and determination of needed reductions to meet assimilative capacity.
- Allocation (with a margin of safety) of the allowable pollutant load among the different pollutant sources in a manner that water quality standards are achieved."[620]

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[615] EPA. *Water Quality Standards, Designated Uses,* http://water.epa.gov/scitech/swguidance/standards/uses.cfm The text also states: "A use attainability analysis must be conducted for any water body with designated uses that do not include the 'fishable/swimmable' goal uses identified in the section 101(a)(2) of the Act. Such water bodies must be reexamined every three years to determine if new information has become available that would warrant a revision of the standard. If new information indicates that 'fishable/swimmable' uses can be attained, such uses must be designated."

[616] EPA. CWA, section 303, http://water.epa.gov/lawsregs/guidance/303.cfm The text for 303(d) starts as follows: "(d)(1)(A) Each State shall identify those waters within its boundaries for which the effluent limitations required by section 301(b)(l)(A) and section 301(b)(l)(B) are not stringent enough to implement any water quality standard applicable to such waters. The State shall establish a priority ranking for such waters. The State shall establish a priority ranking for such waters [sic.], taking into account the severity of the pollution and the uses to be made of such waters."

[617] EPA. CWA, section 303, Water Quality Standards and Implementation Plans, http://water.epa.gov/lawsregs/guidance/303.cfm See especially section 303(d). Section 303 does not specifically mention NPS pollution. This link also has hyperlink to a Summary of the CWA.

[618] EPA. Impaired Waters and Total Maximum Daily Loads, http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/. See section 303(d) of the CWA.

[619] EPA. Water Quality Standards Academy, Basic Course: Supplemental Topics – TMDL Development: The Basic Calculation, http://water.epa.gov/learn/training/standardsacademy/page9.cfm

[620] EPA. Water Quality Standards Academy, Basic Course: Supplemental Topics – TMDL Development.

The full process for developing TMDLs, including public engagement is carried out by the state, but the TMDLs must be approved by the EPA.[621]

Once a TMDL is developed, the CWA requires wasteload allocations to be implemented through the National Pollutant Discharge Elimination System (NPDES).[622] The TMDL allocates a pollutant wasteload to specific point sources and to non-point sources.[623] The primary method for controlling stormwater is through BMPs, but stormwater discharges are considered point sources and require a NPDES permit.[624] Examples of TMDLs in different jurisdictions shows how they are developed for various designated uses and for various pollutants, using a number of different models.[625] These examples also show how allocations are made and how the wasteload allocations are implemented. The pollutant selected depends on the designated use of the water. Thus in water intended for contact recreation the key indicator might be *E. coli*. If the designated use is aquatic life, where the impairment is based on biological indices, the instream target might be expressed as a measure of the hydrologic conditions necessary for a healthy aquatic ecosystem.

Congress enacted Section 319 of the CWA to set up a national program to control NPSP.[626] The state must have a Water Management Plan which identifies priority water quality problems from both point source and NPSP and is regularly updated. The Water Management Plan must describe both regulatory and non-regulatory programs as well as BMPs for reducing NPSP. The BMPs must address residual waste, the disposal of pollutants on land (or in subsurface excavations), agriculture, silviculture, mine and construction waste, salt water intrusions and urban stormwater.[627] Economic, institutional, and technical factors must be considered when determining the need for BMPs to achieve water quality goals and when evaluating them.

4.1.3.2 Funding

The CWA authorizes the EPA to provide partial funding for various programs and, in its selection process, the EPA can determine which projects receive federal money. A major source of funding is available through the Section 319 NPS management program.[628] States can apply for money for a wide

[621] EPA. Water, Total Maximum Daily Loads (303(d)), http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/overviewoftmdl.cfm This website explains the whole process.
[622] EPA. National Pollutant Discharge Elimination System, homepage, http://cfpub.epa.gov/npdes/index.cfm The system focuses on the use of permits to limit discharges.
[623] EPA. Watershed Branch (4503T), Office of Wetlands, Oceans and Watersheds, *Total Maximum Daily Loads with Stormwater Sources: A Summary of 17 TMDLs*, July 2007, EPA 841-R-07-002, http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/upload/17_TMDLs_Stormwater_Sources.pdf
[624] EPA. National Pollutant Discharge Elimination System, Stormwater Program, http://cfpub.epa.gov/npdes/home.cfm?program_id=6
[625] EPA. Watershed Branch (4503T), Office of Wetlands, Oceans and Watersheds, *Total Maximum Daily Loads with Stormwater Sources: A Summary of 17 TMDLs*. The examples given in the report cover a range of pollutants, models, and different allocation and implementation methods that may help others in the development of stormwater TMDLs.
[626] EPA. CWA, section 319, http://www.epa.gov/owow_keep/NPS/cwact.html. This is the main webpage for the CWA, section 319, with a lot of hyperlinks. See also CWA, section 319, 33 USC Sec. 1329, Nonpoint source management programs, Statute, http://www.epa.gov/owow/NPS/sec319cwa.html
[627] U.S. Federal Register. *Title 40 – Protection Of Environment*, Chapter I—Environmental Protection Agency, Subchapter D –Water Programs, Part 130—Water Quality Planning and Management, section 130.6.
[628] EPA. Polluted Runoff (Nonpoint Source Pollution), CWA, section 319(h) funding, http://www.epa.gov/owow_keep/NPS/cwact.html. For the text of the CWA, section 319 that addresses NPS pollution, see http://www.epa.gov/owow/NPS/sec319cwa.html and Federal Register, Title 33, Chapter 26 Water Pollution Prevention and Control, Subtitle III, Standards and Enforcement, section 1329, Nonpoint Source Management Programs. CWA, section 319, Grant Program, states that the federal government may fund not more

variety of activities including education, training, technology transfer, demonstration projects and monitoring to assess the success of specific NPSP projects. Applications for Section 319 funding must show how a proposed project: "(1) conforms to USEPA's 'Nine (9) Minimum Elements to be Included in a Watershed Plan for Impaired Waters Funded Using Incremental CWA Section 319 Funds' (Nine Key Elements); (2) coordinates with other related water quality improvement efforts in the watershed; and (3) implements actions that achieve the water quality goals of the TMDLs in the watershed."[629] The Nine Key Elements of an Effective State Program[630] are shown in Figure 4 (though without the explanatory text), as they are referred to in some current state reports and provide useful criteria that could be relevant for Alberta.

The funding for implementing CWA Section 319, having peaked in 2003, is now approximately $200 million per year.[631] In addition, the EPA has a number of other funding mechanisms for addressing NPSP including the Clean Water State Revolving Fund.[632] This fund is the largest source of financing for water quality improvements and has funded over 600 NPSP projects a year, with financing of $240 million in 2002.[633] The federal government provides most of the capital, with 20% matching funds from the state. Each state decides which NPSP projects receive funding and the money can be loaned to farmers, communities, businesses, non-profit groups and watershed groups at very low interest rates and repayment terms of up to 20 years. The repayments, which may come from user fees, a dedicated portion of local tax revenue, fees paid by developers, and business revenues, go back into the fund to finance further projects.

Funding is also available for water quality management planning under section 205(j) of the CWA. Groups at the state level can apply for projects that gather and map information on NPSP, increase community involvement in watershed planning and implement watershed management plans.[634]

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than 60% of the cost of a management plan funded by a state in a fiscal year, http://www.epa.gov/owow/NPS/sec319cwa.html#4

[629] SWRCB (California). CWA, section 319(h) Non-Point Source Grant Program, http://www.swrcb.ca.gov/water_issues/programs/nps/grant_program.shtml

[630] EPA. *Nonpoint Source Program and Grants Guidance for Fiscal Year 1997 and Future Years*, U.S. Environmental Protection Agency, Office of Water, Washington, D.C, Chapter 3, Nonpoint Source Management Programs, http://water.epa.gov/polwaste/nps/npsguid1.cfm

[631] EPA. CWA section 319(h) Grant Funds History, http://water.epa.gov/polwaste/nps/319hhistory.cfm

[632] EPA. Nonpoint Source-Related Funding Opportunities, http://www.epa.gov/owow_keep/NPS/funding.html See also EPA. State-EPA NPS Partnership webpage, http://www.epa.gov/owow_keep/NPS/partnership.html and the EPA Grants Reporting and Tracking System, http://iaspub.epa.gov/pls/grts/f?p=110:199:2563148358291728

[633] EPA. Clean Water State Revolving Fund, 2003, http://www.epa.gov/owm/cwfinance/cwsrf/final.pdf

[634] State of Indiana. Watersheds and Nonpoint Source Water Pollution, http://www.in.gov/idem/nps/2525.htm

Figure 4. Nine Key Elements to be Included in a Watershed Management Plan

U.S. Environmental Protection Agency
Nine Key Elements to be included in a Watershed Management Plan[635]

1. The State program contains explicit short- and long-term goals, objectives and strategies to protect surface and ground water.

2. The State strengthens its working partnerships and linkages to appropriate State, interstate, Tribal, regional, and local entities (including conservation districts), private sector groups, citizens groups, and Federal agencies.

3. The State uses a balanced approach that emphasizes both State-wide nonpoint source programs and on-the-ground management of individual watersheds where waters are impaired or threatened.

4. The State program (a) abates known water quality impairments from nonpoint source pollution and (b) prevents significant threats to water quality from present and future nonpoint source activities.

5. The State program identifies waters and their watersheds impaired by nonpoint source pollution and identifies important unimpaired waters that are threatened or otherwise at risk. Further, the State establishes a process to progressively address these identified waters by conducting more detailed watershed assessments and developing watershed implementation plans, and then by implementing the plans.

6. The State reviews, upgrades, and implements all program components required by section 319(b) of the CWA, and establishes flexible, targeted, and iterative approaches to achieve and maintain beneficial uses of water as expeditiously as practicable. The State programs include:

> A mix of water quality-based and/or technology-based programs designed to achieve and maintain beneficial uses of water; and
>
> A mix of regulatory, non-regulatory, financial and technical assistance as needed to achieve and maintain beneficial uses of water as expeditiously as practicable.

7. The State identifies Federal lands and activities which are not managed consistently with State nonpoint source program objectives. Where appropriate, the State seeks EPA assistance to help resolve issues.

8. The State manages and implements its nonpoint source program efficiently and effectively, including necessary financial management.

9. The State periodically reviews and evaluates its nonpoint source management program using environmental and functional measures of success, and revises its nonpoint source assessment and its management program at least every five years.

4.1.3.3 Data Collection

The federal government requires each state to set up a monitoring program and compile and analyze data on the quality of surface water and, as far as practical, groundwater.[636] Data may be used for modelling to help establish links between water quality and the various contaminant sources and to help determine appropriate reduction strategies across a watershed or region.[637]

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[635] EPA. Nonpoint Source Program and Grants Guidance for Fiscal Year 1997 and Future Years, U.S. Environmental Protection Agency, Office of Water, Washington, D.C, Chapter 3, Nonpoint Source Management Programs, http://water.epa.gov/polwaste/nps/npsguid1.cfm The headings are copied verbatim.

[636] U.S. Federal Register. *Title 40 – Protection of Environment*, Chapter I – Environmental Protection Agency, Subchapter D – Water Programs, Part 130 – Water Quality Planning and Management, section 130.4, http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&sid=35956fca5f9c25dc1cfb35a038aebc8e&rgn=div5&view=text&node=40:22.0.1.1.17&idno=40#40:22.0.1.1.17.0.16.1

[637] See, for example, the U.S. Geological Survey, SPARROW Surface Water-Quality Monitoring, http://water.usgs.gov/nawqa/sparrow/index.html and Preston, S.D., *et al*. 2009, *SPARROW Modeling—Enhancing*

4.1.3.4 Reporting

States are required to report annually to the EPA on the status of NPSP projects.[638] States must also submit a biennial water quality report that includes "[A] description of the nature and extent of nonpoint source pollution and recommendations of programs needed to control each category of nonpoint sources, including an estimate of implementation costs."[639]

The EPA has a website that provides links to the NPSP programs in each state,[640] which enables the public to access information on program implementation. The EPA has regional offices and a person in each state who is responsible for the NPSP program. The program management and collaboration seems to be somewhat different in each sector: agriculture, forestry and urban areas.

4.1.3.5 Agriculture

"Agriculture is listed as a source of pollution for 48% of the impaired river miles reported in the United States."[641] The EPA provides guidance on methods for reducing NPSP from agricultural sources in a manual that contains comprehensive information on "the best available, economically achievable means of reducing pollution of surface and ground water from agriculture."[642] It covers nutrient and pesticide management, erosion and sediment control, animal feeding operations, grazing management and irrigation water management. There is guidance on monitoring and tracking and techniques for estimating load. Chapter 5, entitled "Using Management Methods to Prevent and Solve Nonpoint Source Problems in Watersheds," refers to both technology-based and water quality-based implementation.

Animal Feeding Operations are a potential source of NPSP as well as point source pollution.[643] There are complex rules to distinguish between an animal feeding operation and a confined animal feeding operation, with confined operations always requiring a permit under the NPDES. However, the aim is to protect overall water quality by establishing the TMDL for a water body, which includes both source and NPS pollution, as explained above. Additional programs for addressing NPSP from agriculture are managed by the USDA (see section 4.1.4).

Understanding of the Nation's Water Quality, U.S. Geological Survey Fact Sheet 2009–3019, 6 pages, http://pubs.usgs.gov/fs/2009/3019/pdf/fs_2009_3019.pdf

[638] EPA. Applying for and Administering CWA section 319 Grants, United States Environmental Protection Agency State – EPA NPS Partnership Grants Management Work Group, March 2003, Chapter 3, Reporting Specifications, Nonpoint Source Progress Reports, http://water.epa.gov/grants_funding/cwa319/319Guide.cfm#Reporting3. "The CWA requires states to submit annual nonpoint source progress reports, which address milestone progress, resulting decreases in pollutant loadings, and other water quality improvements contained in not only the grant work plan but also the state's Nonpoint Source Management Program (CWA section 319(h)(11)). EPA suggests the following components: (1) brief summary of progress meeting milestones and objectives; (2) milestone matrix with the applicable project, completion date, and percent completed; (3) discussion of federal agency activities to support the state in reaching its milestones; and (4) summary of loading reductions, water quality improvement, and measures of environmental progress (USEPA, 1996). EPA may periodically provide updated guidance for the annual report." It seems that the annual report may be formal (as in the case of California) or informal.

[639] U.S. Federal Register. *Title 40 – Protection of Environment*, Chapter I – Environmental Protection Agency, Subchapter D – Water Programs, Part 130 – Water Quality Planning and Management, section 130.8 (b)(4). The report is in compliance with section 305(b).

[640] EPA. Polluted Runoff (Nonpoint Source Pollution), Where You Live, http://www.epa.gov/owow_keep/NPS/where.html. Where a state does not have an NPS pollution webpage, the link is to a state's water website.

[641] EPA. *National Management Measures to Control Nonpoint Source Pollution from Agriculture*, EPA 841-B-03-004, July 2003, p. 1-1, http://water.epa.gov/polwaste/nps/agriculture/upload/2003_09_24_NPS_agmm_chap1.pdf

[642] EPA. *National Management Measures to Control Nonpoint Source Pollution from Agriculture*, EPA 841-B-03-004, July 2003, http://water.epa.gov/polwaste/nps/agriculture/agmm_index.cfm.

[643] EPA. Animal Feeding Operations Virtual Website, http://cfpub.epa.gov/npdes/afo/virtualcenter.cfm

The EPA recognizes that wetlands can help reduce NPSP and has issued a guidance manual that describes management methods to protect and restore wetlands and riparian areas.[644] It also gives technical advice on the creation of vegetated filter systems and constructed wetlands. Funding may be available through the Clean Water State Revolving Fund program but the guidance manual lists various non-governmental funding sources.

4.1.3.6 Forestry

Best practices for reducing NPSP from forestry are found in the EPA's manual "National Management Measures to Control Nonpoint Source Pollution from Forestry."[645] In addition to addressing specific issues such as road construction, timber harvesting and revegetation of disturbed areas, the manual provides guidance on using management measures to reduce cumulative effects at the watershed level. An example from a national forest located in Washington and Oregon describes BMPs, water remediation and monitoring. The EPA does not have mandatory requirements to reduce NPSP from forestry, but such requirements may be set by individual states. The EPA also has an online training module on "Forestry Best Management Practices in Watersheds."[646]

4.1.3.7 Municipal Stormwater

The EPA provides information to educate the public about the impact that stormwater discharge can have on water quality,[647] as well as comprehensive technical guidance for managing NPSP from urban areas.[648] The technical manual offers detailed advice on watershed assessment and protection, site development, new development runoff treatment, new and existing on-site wastewater treatment systems, construction site erosion and chemical control, pollution prevention, and how to evaluate the effectiveness of programs. Although there is no requirement to implement these practices, they may help compliance under the NPDES (through the Storm Water Permit Program).

The EPA has examined the costs and benefits of LID in reducing stormwater discharge.[649] A study of 17 cases indicated that LID reduced runoff volumes and pollutant loadings to downstream waters, and reduced incidences of combined sewer overflows. In most cases the total capital costs of stormwater management were reduced by 15-80% when LID methods were used. Other benefits included an increase in property values due to the desirability of the lots and their proximity to open spaces and an increase in the total number of units developed.

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[644] EPA. *National Management Measures to Protect and Restore Wetlands and Riparian Areas for the Abatement of Nonpoint Source Pollution*, EPA 841-B-05-003, July, 2005, http://water.epa.gov/polwaste/nps/wetmeasures/upload/wetmeasures_guidance.pdf

[645] EPA. *National Management Measures to Control Nonpoint Source Pollution from Forestry*, EPA 841-B-05-001, May 2005, http://water.epa.gov/polwaste/nps/forestry/forestrymgmt_index.cfm

[646] EPA. Watershed Academy Web, Forestry Best Management, http://www.epa.gov/owow/watershed/wacademy/acad2000/forestry/

[647] EPA. *Protecting Water Quality from Urban Runoff*, EPA 841-F-03-003, February 2003, http://www.epa.gov/owow_keep/NPS/urban_facts.html

[648] EPA. *National Management Measures to Control Nonpoint Source Pollution from Urban Areas*, EPA 841-B-05-004, November 2005, http://water.epa.gov/polwaste/nps/urban/index.cfm#08

[649] EPA. *Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices*, EPA 841-F-07-006, December 2007, http://www.epa.gov/owow/NPS/lid/costs07/documents/reducingstormwatercosts.pdf

4.1.3.8 Watersheds

The EPA's extensive training program through its Watershed Academy has various segments that address NPSP.[650] The EPA has also issued a handbook on watershed management for NPSP, which can be used by watershed associations and state regulatory bodies.[651] It explains how to gather and analyze data to characterize pollution sources in a watershed. Goals, management strategies, program design and implementation are all addressed. Several of the EPA guidance documents provide advice for non-regulatory measures, although individual states may have regulatory requirements. The ways in which the non-regulatory approach works are shown in examples from various states, below.

In addition to programs that aim to reduce contamination of polluted waters, the EPA also has a Healthy Watersheds Initiative.

Healthy Watersheds Initiative

The EPA recognized that it is not only important to reduce pollution in contaminated waters, but to protect aquatic ecosystems and prevent contamination in the first place. "The Healthy Watersheds Initiative includes both assessment and management approaches that encourage states, local governments, watershed organizations, and others to take a strategic, systems approach to conserve healthy components of watersheds, and, therefore, avoid additional water quality impairments in the future."[652]

The program aims to protect both surface waters and aquifer recharge zones. Often the costs of drinking water treatment are related to source water protection. One study showed that for every 10% increase in forest cover of the source area, chemical and treatment costs decrease by 20%.[653] The EPA website provides information on various programs undertaken under this initiative.

Funding for programs involves partnerships, sometimes with the private sector; the private sector may obtain federal funding to help with its initiatives. For example, one of the programs listed on the Healthy Watersheds website is delivered by the Conservation Fund.[654] "The Conservation Fund's Green Infrastructure Leadership Program was created in 1999 to build the capacity of land conservation professionals and their partners to undertake strategic conservation activities that are proactive, systematic, well integrated and applied at multiple scales. The program is a cooperative effort of the Fund and multiple public and private partners."[655] Some of the funding for the Leadership Program comes from the USDA Forestry Cooperative, but "Support also was provided by the Green Infrastructure Work Group, a collection of local, state and federal government agencies and non-governmental organizations that originally came together in August 1999 to begin developing a training program that would help communities and their partners make green infrastructure an integral part of local and regional plans and community decisions."[656]

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[650] EPA. Watershed Academy, http://water.epa.gov/learn/training/wacademy/wsamap.cfm
[651] EPA. *Handbook for Developing Watershed Plans to Restore and Protect Our Waters,* EOA 841-B-08-002, March 2008, http://www.epa.gov/owow_keep/nps/watershed_handbook/index.html
[652] EPA. Polluted (Nonpoint Source Pollution) Healthy Watersheds, http://www.epa.gov/owow_keep/nps/healthywatersheds/index.html
[653] EPA. Polluted (Nonpoint Source Pollution) Healthy Watersheds Concept, Approaches and Benefits, http://www.epa.gov/owow_keep/nps/healthywatersheds/concept.html.
[654] EPA. Polluted (Nonpoint Source Pollution) Healthy Watersheds, Conservation Approaches and Tools, http://www.epa.gov/owow_keep/nps/healthywatersheds/conservation.html#green
[655] The Conservation Fund. Green Infrastructure Program, http://www.greeninfrastructure.net/who_we_are .
[656] The Conservation Fund. Green Infrastructure, http://www.greeninfrastructure.net/

4.1.3.9 Water Quality Trading

Despite the EPA's NPDES permit program, the water quality in 40% of rivers and half of the lakes in the U.S. did not meet the quality required for their designated uses, so in 2003 the EPA developed its water quality trading policy as an additional, cost-effective way to address water pollution.[657]

Water quality trading involves a voluntary exchange of pollutant reduction credits and is most effective where a facility with a higher pollutant control cost can buy a pollutant reduction credit from a source with a lower cost of control, thus reducing the cost of compliance.[658] However, trading need not be restricted to trading between facilities; it can be between point and non-point sources or between non-point sources.[659]

The EPA policy sets out the conditions that must be met to enable trading, starting with a baseline for pollution reduction credits. This means that some pollutant sources must be able to reduce pollutant levels by more than the amount necessary under a regulatory requirement such as a TMDL. In addition to explaining the policy on its website, the EPA has developed a water quality trading toolkit for permit writers, which explains how water trading can apply to NPSP.[660] "A point source may purchase nonpoint source credits in one of two ways: (1) directly from nonpoint source(s) by coordinating with a nonpoint source or a program administered by an entity responsible for a group of nonpoint sources dischargers; or (2) from a nonpoint source credit exchange that contains pollutant reduction credits contributed by numerous nonpoint sources through implementation of approved BMPs."[661] The second approach, using a NPSP credit exchange has the advantage that point sources do not have to deal directly with non-point sources.[662]

It is relatively easy to quantify a point source mass load of a pollutant, but the discharge of pollutants from NPSP is highly variable and depends on many factors. In agriculture, for example, it depends on crop type, fertilizer use, soil type, buffer zones, and the degree of slope, as well as the amount and type of precipitation and the season (which may affect the infiltration and speed of runoff), both of which vary from year to year. NPSP reductions usually depend on the implementation of BMPs and "typically use the best available performance information to estimate load reductions for a particular BMP and then discount these estimated values using uncertainty ratios to account for the technical challenges in determining BMP effectiveness."[663] The EPA Toolkit examines all the factors that need to be considered when setting a baseline for NPSP, using either a TMDL or one set at a minimum level of BMP implementation. Ongoing water quality monitoring and reporting is necessary to ensure the desired results are being obtained. In addition to ambient monitoring, uncertainty about the effectiveness of BMPs in reducing pollution can be gauged by edge of field monitoring, or modelling. If modelling is used, some

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[657] EPA. Final Water Quality Trading Policy, http://water.epa.gov/type/watersheds/trading/finalpolicy2003.cfm and EPA, Water Quality Trading, http://water.epa.gov/type/watersheds/trading.cfm

[658] EPA. Frequently Asked Questions about Water Quality Trading, http://water.epa.gov/type/watersheds/trading/tradingfaq.cfm#1

[659] Breetz, H.L., *et al. Water Quality Trading and Offset Initiatives in the U.S.: A Comprehensive Survey*, 2004, p. 8-9, http://www.dep.state.fl.us/water/watersheds/docs/ptpac/DartmouthCompTradingSurvey.pdf

[660] EPA. Water Quality Trading Toolkit for Permit Writers, http://water.epa.gov/type/watersheds/trading/WQTToolkit.cfm

[661] EPA. Water Quality Trading Toolkit, Water Quality Trading Scenario: Point Source – Nonpoint Source Trading, p.1, http://www.epa.gov/npdes/pubs/wqtradingtoolkit_ps-nps.pdf

[662] EPA. Water Quality Trading Scenario: Nonpoint Source Credit Exchange, http://www.epa.gov/npdes/pubs/wqtradingtoolkit_nps-credit-exchange.pdf

[663] EPA. Water Quality Trading Toolkit, Water Quality Trading Scenario: Point Source – Nonpoint Source Trading, p.1, http://www.epa.gov/npdes/pubs/wqtradingtoolkit_ps-nps.pdf

field testing is necessary to verify the model.[664] Although the EPA has produced a Toolkit on water quality trading, which might take place between a point and non-point source of pollution, the EPA is legally bound by the CWA to ensure that regulated point sources comply with water use standards prescribed pursuant to the statute.[665] The Toolkit refers to a number of case studies, including one in the Neuse River Basin in North Carolina and one in Wisconsin, which are described in sections 4.3.7.3 and 4.7.7.1 of this report.[666]

The USDA is also facilitating a market-based approach to improve water quality through nutrient credit trading.[667]

4.1.3.10 Progress and Effectiveness

The EPA requirement for monitoring and reporting progress ensures those conducting programs under the CWA are assessing their performance. Since the federal programs are implemented through the states, there is some variation between states in the amount of activity undertaken under the NPSP program. The EPA asks states to submit NPSP reduction success stories which the EPA profiles on a website.[668] They show that NPSP programs can be effective at the local level. However, efforts to reduce NPSP also depend on legislation and policies in individual states. The implementation of NPSP projects may rely on the initiative and commitment of conservation districts as well as other community groups that can apply for funding, including watershed councils, soil conservation districts, resource conservation councils, farmers and environmental groups.

Shortcomings in the EPA's powers are very clear when tackling NPSP in a large watershed. Under the CWA the EPA has only limited ability to achieve set goals, as seen in the difficulties in reducing the nutrient and sediment loads within the Mississippi River Basin.[669] In this huge watershed the high nutrient loadings of nitrogen and phosphorus come largely from agricultural non-point sources, especially fertilizers and runoff from concentrated livestock feeding operations. The findings from several reports indicate that to effectively address the problem the EPA needs to:

- Help with project evaluation by identifying measures of progress, gauging the cost-effectiveness of various nutrient-control actions; and establishing water-quality monitoring projects;
- Establish numeric criteria for nutrients at the end-point of the watershed;
- Develop a more action-oriented basin-wide strategy; and

[664] EPA. Frequently Asked Questions about Water Quality Trading, http://water.epa.gov/type/watersheds/trading/tradingfaq.cfm#12
[665] Joseph Britt, Agriculture Incentives Director, Sand County Foundation, personal communication with Mary Griffiths, January 29, 2012.
[666] EPA. Water Quality Trading Toolkit for Permit Writers, Appendix A, Water Quality Trading Program Fact Sheets, http://www.epa.gov/npdes/pubs/wqtradingtoolkit_app_a_case_studies.pdf
[667] USDA. Natural Resources Conservation Service, Market-Based Approaches, http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/water/quality/?cid=nrcs143_010929%20
This webpage has a link to a paper entitled "Nutrient Credit Trading – a Market-based Approach for Improving Water Quality" by Harbans, L., WNTSC/ NRCS/USDA, Portland, Oregon, undated but later than August, 2007.
[668] EPA. Section 319 Nonpoint Source Success Stories, http://water.epa.gov/polwaste/nps/success319/.
[669] National Research Council. *Improving Water Quality in the Mississippi River Basin and Northern Gulf of Mexico: Strategies and Priorities*, Committee on CWA Implementation Across the Mississippi River Basin, Water Sciences and Technology Board, Division of Earth and Life Studies, National Research Council of the National Academies. National Academic Press, prepublication copy.

- Work with other federal agencies and states to "provide a stronger, more coordinated commitment in order to develop long-term, adaptive, collaborative actions for effectively addressing water quality problems . . ."[670]

These proposals indicate the need for the EPA to work more closely with the USDA since that department is responsible for administering programs that aim to reduce the environmental impact (including NPSP) of agricultural operations.

4.1.4 U.S. Department of Agriculture

4.1.4.1 Legislation, Funding, Data Collection and Reporting

The USDA has a Clean Water Program, which aims to "restore and maintain the integrity of the Nation's waters by reducing or eliminating the discharge of pollutants into lakes, rivers, streams, wetlands, and other navigable waters. . ."[671] The Department provides funding to encourage farmers to implement BMPs to reduce or eliminate NPSP from the construction of USDA-approved facilities and roads, as well as for implementing BMPs and conservation practices to limit pollution from lands. The Conservation Reserve Enhancement Program is a voluntary program that helps farmers remove sensitive lands from production, and this may include lands that are important for protecting surface waters.[672]

The Natural Resources Conservation Service (NRCS) is the main federal agency for restoring watershed health on private land,[673] and a number of the activities through its Watershed Program that reduce soil erosion or protect land through wetland and floodplain conservation easements also help reduce NPSP.

A major NRCS funding source is the Environmental Quality Incentives Program (EQIP).[674] This voluntary program can provide funding and technical assistance for a project for up to ten years. EQIP funding can be used for conservation activities that cover a wide range of BMPs, including nutrient management, grazing management, forest management and drainage water management plans. Although the government provides funding it does not evaluate to what extent the BMPs have reduced NPSP.

4.1.4.2 USDA Progress and Effectiveness

The USDA can play an important role in reducing NPSP through conservation programs that, for example, reduce the runoff of nutrients and sediment. However, as USDA programs are mainly voluntary, their effectiveness depends on the initiative of states, conservation bodies, and others to apply for funding. The USDA also appears to be weak in assessing progress, gauging the cost-effectiveness of its actions and monitoring the impact on water quality. This is evident from several assessment studies of the Mississippi Basin and was the reason the National Academy of Sciences recommended a partnership between the EPA and USDA. Despite this, the USDA acted alone in setting up the Mississippi River Basin Healthy Watersheds Initiative to "voluntarily implement conservation practices that avoid, control,

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[670] National Research Council. *Improving Water Quality in the Mississippi River Basin and Northern Gulf of Mexico: Strategies and Priorities* (pre-publication edition, p. 3). See also p. 8, Box 1-2, for a summary of findings from other reports.

[671] USDA. *Environmental Pollution Prevention, Abatement and Control Manual,* DM 5600-001 November 18, 2004, http://www.dm.usda.gov/hmmd/hmmgguidance.pdf

[672] USDA. Conservation Reserve Enhancement Program, http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=cep

[673] USDA. Natural Resources Conservation Service, Water, http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/water

[674] USDA. Environmental Quality Incentives Program, see link at http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial. In 2011 this program had nearly 25,000 active contracts covering 7.5 million acres, with a total value of over $514 million.

and trap nutrient runoff; improve wildlife habitat; and maintain agricultural productivity."[675] Thus, in 2011 the National Academy of Sciences urged the EPA to coordinate with the USDA to provide the measuring and assessment tools for the program.[676]

The USDA has a process, the Conservation Effects Assessment Project, to evaluate the effects of conservation programs; four components assess croplands, wetlands, grazing lands and wildlife,[677] but they examine the total conservation benefits, not only the impact on water quality. The National Assessment is supplemented by small watershed studies that focus on water and soil quality on both rain-fed and irrigated land.[678]

4.2 California

4.2.1 California at a Glance

- *Water quality is regulated not only by the federal CWA but by the Porter-Cologne Water Quality Control Act, which allows for the regulation of any activity that affects water quality, not just the discharge.*
- *The Act enables a Conditional Waiver of Waste Discharge Requirements, which can apply to NPSP. A waiver must be consistent with a water quality control plan and usually includes monitoring and other enforceable requirements designed to meet water quality standards.*
- *The Irrigated Lands Regulatory Program, which uses the waiver system in the start-up phase of program development, is a good example of this innovative approach.*
- *A similar waiver system may be developed for National Forest Service lands in California.*
- *In 2008, the State Water Resources Control Board (SWRCB) recognized the value of LID and said climate-related and LID projects should receive priority for grants.*
- *California has several success stories for rivers that were formerly classed as impaired under CWA Section 303.*

4.2.2 Overview

California has about 60% of the area of Alberta, covering more than 403,000 km^2, but is much more densely populated. In 2010, its population was more than 37 million.[679] Much of the state has a Mediterranean climate, although there are important regional differences, such as between the cool, moist coastal mountains and the long dry Central Valley, which is irrigated by water from the Sacramento and San Joaquin Rivers that flow from the Sierra Nevada.

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[675] National Research Council. *Improving Water Quality in the Mississippi River Basin and Northern Gulf of Mexico: Strategies and Priorities* (pre-publication edition, p.10, citing from USDA Mississippi River Basin Healthy Watersheds Initiative, 2010). The USDA website for the Initiative is at http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/programs/farmbill/initiatives/?&cid=nrcsdev11_024120

[676] National Research Council. *Improving Water Quality in the Mississippi River Basin and Northern Gulf of Mexico: Strategies and Priorities*, pre-publication edition, p. 2.

[677] USDA. Conservation Effects Assessment Project, National Assessment, http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/nra/ceap/na

[678] USDA. Conservation Effects Assessment Project, National Assessment, Watershed Studies, http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/nra/ceap/na/?&cid=nrcs143_014156

[679] U.S. Census Bureau. Quick Facts, California, http://quickfacts.census.gov/qfd/states/06000.htm l

California is the top state in terms of cash receipts from agriculture, producing 20% of the U.S. milk supply, and nearly half of U.S.-grown nuts, fruits and vegetables.[680] About 43% of California's total area is used for agriculture. Some is for grazing, but more than one-quarter of the state is in cropland (approximately 110,000 km^2).[681] About one-third of the cropland is irrigated (more than 37,000 km^2).[682] Non-point sources are the leading cause of water pollution in the state.[683]

4.2.3 Legislation, Funding, Data Collection, Reporting

4.2.3.1 Legislation

The main piece of legislation governing water pollution in California is the *Porter-Cologne Water Quality Control Act.* Under this Act, the State Water Resources Control Board (SWRCB) is responsible for water rights and water policy, including the state's NPS Control Program. The state board operates through nine regional water quality control boards, which are also responsible for implementing federal requirements, including Sections 303 and 319 of the CWA.

The *Porter-Cologne Water Quality Control Act* and Waste Discharge Regulation (California Water Code) can control point source discharges and NPSP through:

- A Waste Discharge Permit which sets specific requirements;
- A Conditional Waiver of Waste Discharge Requirements (referred to as a waiver); and
- Prohibition of Discharge.

Under the Porter Cologne Act, the term "discharge of waste" includes all discharges, point and non-point, including agricultural return flows and stormwater discharges. In this respect it differs from the federal CWA. [684] The Porter-Cologne Act, through the Water Code, allows the Water Board to waive the requirements to submit a Report of Waste Discharge and to obtain Waste Discharge Requirements (WDRs) for a specific discharge or specific type of discharge, if the Water Board determines that the waiver is consistent with any applicable water quality control plan and is in the public interest. The Water Code further provides that any such waiver of WDRs has to be conditional, must include monitoring requirements (unless waived), may not exceed five years in duration, and may be terminated at any time by the Water Board.[685] Implementation of the Porter-Cologne Act is complex and staff at the SWRCB NPS Control Program provided a comprehensive written explanation. The material is too detailed to be

[680] USDA. California Agriculture Production Statistics, http://www.cdfa.ca.gov/statistics/, Agricultural Overview, http://www.nass.usda.gov/Statistics_by_State/California/Publications/California_Ag_Statistics/2010cas-ovw.pdf
[681] American Farmland Trust. California Agricultural Land Loss and Conservation: the Basic Facts, see map, http://www.farmland.org/documents/AFT-CA-Agricultural-Land-Loss-Basic-Facts_11-23-09.pdf
[682] Government of California. *California Water Plan Update*, 2009, http://www.waterplan.water.ca.gov/docs/meeting_materials/plenary/09.18-19.08/day2/irrigated_land_area_charts.pdf
[683] California EPA, SWRCB. *A Plan for California's Nonpoint Source Pollution Control Program*, Volume 1: Nonpoint Source Program Strategy and Implementation Plan, 1998-2013, January 2000, p. iii, http://www.waterboards.ca.gov/water_issues/programs/nps/docs/planvol1.pdf
[684] In this, the *Porter-Cologne Water Quality Control Act* differs from the federal CWA. Although the CWA distinguishes between point and nonpoint sources of pollution, it defines a point source as a discernible, confined and discrete conveyance, such as a pipe, ditch, or channel. Irrigated agricultural return flows and agricultural storm water runoff are excluded. Nonpoint pollution sources generally are sources of water pollution that do not meet the definition of a point source as defined by the CWA. This explanation is based on information from staff at the SWRCB, Division of Water Quality, Nonpoint Source Pollution Control Program.
[685] California Water Code, section 13269, http://law.onecle.com/california/water/13269.html

included in this report, but was transmitted to the Water Council's NPSP project team for its review and consideration as it develops its final report and recommendations.

Put as simply as possible, the "waiver" approach enables landowners to get exemption from the Waste Discharge Requirement for NPS runoff, if they conduct and report on water quality monitoring and meet any other specified requirements. Monitoring may be done individually, collectively (in "coalition groups") or through third party non-grower groups. Where monitoring has indicated that water quality objectives or standards have been exceeded, the requirements include (among other things) the development and implementation of management plans. A management plan must include the implementation of management practices or other treatments and monitoring/reporting to ensure effectiveness.

The waiver system under the Porter-Cologne Act can be used for NPSP management in each sector, but in addition to that legislation California has a Nonpoint Source Pollution Control Program. The first plan was introduced in 1988 and was revised in 1999.[686] The program, which addresses both surface and groundwater quality, has three parts:

> Tier 1: Nonregulatory (self-determined) implementation of BMPs.
> Tier 2: Regulatory-based incentives for BMPs (i.e., through the waiver system).
> Tier 3: The adoption and enforcement of waste discharge requirements that stipulate the implementation of BMPs.[687.688]

The State made a commitment to implement 61 NPS management measures for six NPS categories (agriculture, forestry, urban areas, marinas and recreational boating, hydromodification, and wetlands/riparian areas/vegetated treatment systems). The management measures are primarily performance standards, stating what is to be achieved, but not prescribing exactly how it is to be achieved. The strategy was to be implemented in three phases over 15 years, with a target date of 2013 for completion. The plan makes provision for: "(a) coordination among agencies; (b) participation by the public; (c) assistance technically and financially; (d) adoption of additional MMs [management measures] as goals, if needed; and (e) monitoring and reporting of program effectiveness."[689]

Thus, in addition to using the Porter-Cologne Act's planning, permitting, and enforcement authority to prevent and control NPSP, the State and Regional Water Resource Control Boards have implemented a broad program of outreach, education, technical assistance and financial incentives. This program is supplemented by collaborative efforts with other agencies and non-governmental organizations to help implement and coordinate programs that contribute to NPSP control. The goal is to provide an integrated statewide approach to controlling nonpoint sources of pollution.[690] Further details and plans for California's NPSP Control Program can be found online.[691] In large part the NPSP program is implemented through the Watershed Management Initiative (see section 4.2.7).

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[686] California EPA, SWRCB. A Plan for California's Nonpoint Source Pollution Control Program, January 2000, http://www.waterboards.ca.gov/water_issues/programs/nps/protecting.shtml

[687] *Porter-Cologne Water Quality Control Act*, California Water Code, Division 7. Water Quality, Chapter 5.4, Nonpoint Source Pollution Control Program, §13369. Implementation of the nonpoint source management plan, section (a)2(A), http://www.swrcb.ca.gov/laws_regulations/docs/portercologne.pdf

[688] SWRCB. Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program, Fact Sheet, undated, http://www.swrcb.ca.gov/water_issues/programs/nps/docs/npsfactsheet.pdf

[689] SWRCB. *Nonpoint Source Program Strategy and Implementation Plan, 1998-2013,* Volume 1, January 2000, p. iv, http://www.waterboards.ca.gov/water_issues/programs/nps/docs/planvol1.pdf

[690] This paragraph is based on information provided by staff at the SWRCB, February 15, 2012. More information is provided in the detailed explanation, which was provided separately to the Alberta Water Council's NPSP team.

[691] SWRCB. Nonpoint Source (NPS) Pollution Control Program, California Management Measures for Polluted Runoff Review Document, http://www.waterboards.ca.gov/water_issues/programs/nps/cammpr.shtml

4.2.3.2 Funding

The California NPS Program allocates approximately $4.5 million each year to implement projects to improve water quality in surface and groundwater under the federal CWA, Section 319.[692] This money, together with additional money from California bond funds, is issued through grants to support:

- Development and implementation of watershed management and TMDL plans;
- Implementation of management measures; and
- Education and technical assistance on NPSP solutions.[693]

The Agricultural Water Quality Grant Program has provided funding for projects that reduce or eliminate NPSP discharge to surface waters from agricultural lands. Funding may also be available through the EQIP program and other federal or state programs.[694]

Some funding for NPSP in California comes from the *Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act.*[695] This Act, known as Proposition 84, was approved by voters in 2006, and enables the State to issue bonds to raise money for purposes defined in the Act. Proposition 84 provides the State Water Board with $82 million (net) for matching grants to local public agencies for the reduction and prevention of stormwater contamination of rivers, lakes, and streams.[696]

In additional to central funding, some money comes from permit fees. In September 2011, the SWRCB decided to increase the permit charges to meet the budget shortfall by shifting the cost of regulatory programs, such as the Irrigated Lands Regulatory Program (see section 4.2.4), from taxpayers to permit fee payers.[697]

4.2.3.3 Data Collection

Monitoring of water quality in impaired waters is carried out routinely and the State and Regional Water Boards assess water quality every two years, as required by the federal CWA, Section 303(d), to determine if they contain pollutants at levels that exceed protective water quality criteria and standards.

One of the NPS Program priorities is to improve monitoring (to provide better data to guide decision making) and to improve the use of state regulatory authorities to better control the most challenging NPSP problems.[698]

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[692] SWRCB. CWA, section 319(h) Non-Point Source Grant Program, http://www.swrcb.ca.gov/water_issues/programs/nps/grant_program.shtml

[693] SWRCB. How the NPS Program Works, poster http://www.waterboards.ca.gov/water_issues/programs/nps/docs/marketing/nps_program_poster.pdf

[694] SWRCB. Financial Assistance Programs – Grants and Loans, http://www.waterboards.ca.gov/water_issues/programs/grants_loans/index.shtml#currentlyaccepting. The website indicates which funds are currently accepting applications.

[695] California Code, Safe Drinking Water, Water Quality and Supply, *Flood Control, River and Coastal Protection Bond Act* of 2006, http://codes.lp.findlaw.com/cacode/PRC/1/d43

[696] California Code, *Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act* (Proposition 84). Once the money was authorized the California Water Boards prepared the *Proposition 84 Storm Water Grant Program Guidelines,* adopted February 17, 2009. The first goal in the Guideline is to "Protect and Restore Surface Water Quality" and while the first objective under this goal is to "Implement a statewide strategy to efficiently prepare, adopt, and implement TMDLs . . ." the second one is to "Manage urban runoff volume to reduce pollutant loadings", with the LID as one of its actions.

[697] "Irrigate [sic] Land Permit Fees are Climbing", *California Farmer*, November 7, 2011, http://farmprogress.com/california-farmer-story-nl5_5nl-irrigate-lands-permit-fees-are-climbing-9-54538. For example, in the Central Valley fees will increase from 12 cents to 56 cents per acre.

[698] EPA. Nonpoint Source Pollution, California, http://www.epa.gov/region9/water/nonpoint/california.html

4.2.3.4 Reporting

The State Water Resources Control Board, the nine regional water boards and the California Coastal Commission compile a series of reports that are submitted annually to the EPA and the State Legislature.[699] The Annual Accomplishments Report on the NPS program summarizes progress and problems in watersheds in each region and the upcoming priorities.[700] There is a semi-annual report on the implementation of the federal CWA section 319 funding.[701] The 2010 Integrated Report on Water Quality, which reports on CWA section 303(d) funding,[702] also has a dedicated website that allows users to access water quality data.[703] The Porter-Cologne Act requires the state and regional water boards to make all reports on NPSP required under the federal CWA available to the public.[704]

4.2.4 Agriculture

The Californian waiver system, outlined in section 4.2.3.1, provides an innovative approach under which farmers are encouraged to take action to reduce NPSP, but if they fail to comply, there are enforceable regulatory requirements. This process is being used in the Irrigated Lands Regulatory Program.

4.2.4.1 Irrigated Lands Regulatory Program

Approximately 15,000 km of California's rivers and streams as well as some 2000 km^2 of lakes and reservoirs are on the CWA section 303(d) list due to impairment caused by irrigation agriculture. About 28% of these rivers and streams have been impaired by pesticides.[705]

The Irrigated Lands Regulatory Program[706] is considered a good example of a regulatory program for reducing NPSP.[707] The program is designed to prevent agricultural discharges from impairing the receiving waters and includes planning, assessment, monitoring, reporting, implementation and enforcement. The regional board can develop a local approach, in consultation with landowners, for addressing problems, but individual farmers can determine which BMPs they will implement. If monitoring shows that water quality is unsatisfactory, a regional water board issues a Conditional Waiver of Waste Discharge Requirements (under the Porter-Cologne Act). The waiver requires growers to monitor the quality of the receiving waters and take corrective action until water quality meets requirements. The program works because if individual operators do not join the waiver program, there

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[699] SWRCB. Reports 1 to 6, for fiscal year 2009-2010 are at http://www.waterboards.ca.gov/water_issues/programs/nps/planning_implementation.shtml

[700] California Water Boards and California Coastal Commission, *California Nonpoint Source Control Program, 2009-2010 Annual Accomplishments Report*, http://www.waterboards.ca.gov/water_issues/programs/nps/docs/rpt5_1011.pdf

[701] SWRCB/Regional Water Quality Control Boards, *Nonpoint Source (NPS) Implementation Workplan Progress Report Summary for July 1, 2010 through December 31, 2010*, April 2011, http://www.waterboards.ca.gov/water_issues/programs/nps/docs/rpt6_1011.pdf

[702] SWRCB. 2010 Integrated Report (CWA section 303(d) List/305(b) Report, http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml

[703] California Water Boards, 2010 Integrated Report on Water Quality with Web-Based Interactive Map, April 2010, http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010/ir2010_factsheet.pdf

[704] *Porter-Cologne Water Quality Control Act*, California Water Code, Division 7. Water Quality, Chapter 5.4, Nonpoint Source Pollution Control Program, §13369, Implementation of the nonpoint source management plan, section (b)(1) and (b)(2), http://www.swrcb.ca.gov/laws_regulations/docs/portercologne.pdf. The reports must also be submitted to the State Legislature.

[705] SWRCB. Irrigated Lands Regulatory Program, undated, http://www.swrcb.ca.gov/water_issues/programs/agriculture/docs/about_agwaivers.pdf

[706] SWRCB. Irrigated Lands Regulatory Program, http://www.swrcb.ca.gov/water_issues/programs/agriculture/index.shtml

[707] SWRCB, NPS staff communication with Mary Griffiths, November 3, 2011.

may be mandatory regulatory action (the imposition of a waste discharge requirement). Anyone who fails to comply can be served with a notice of violation and administrative penalty.

One advantage of this approach is that regional board staff do not have to routinely monitor the implementation of the BMPs as monitoring shows whether water quality objectives have been achieved. If water quality does not improve sufficiently, the regional board will require further monitoring to identify hotspots, and may instruct farmers to implement additional BMPs in the area. Various agricultural water quality issues are being addressed in this way. Monitoring reports for some regional boards are available online.[708]

As each regional board is responsible for implementing the waiver program, the details may vary in different regions. The Central Coast Regional Water Quality Control Board, for example, formed an advisory group with local farm bureaus and environmental groups to design their agricultural waiver program. In this region, farmers joining the waiver program were required to attend classes for 15 hours, create a farm plan and implement BMPs, which they selected.[709] Those completing the education program obtained a Tier 1 waiver and only had to update their management plan half-way through the five-year waiver. Those who did not complete the education plan had to submit an annual report on progress and a checklist showing the implemented BMPs. Those who failed to complete the educational program after three years were considered not to be in compliance with the waiver requirements and could be issued a Waste Discharge Requirement, which treats a farm like a point source discharger.

As it is expensive for individual farmers to undertake monitoring required by the waiver, they often join together with other farmers to work as a group. Coalitions are viewed by many as the most economical way to comply with the regulations. In the Central Valley, for example, some coalitions have been set up under the Coalition for Urban/Rural Stewardship (CURES). CURES, which is a non-profit organization, tries to encourage broad-based coalitions that represent the interests of agricultural, environmental, crop protection and water associations, government agencies, academia and public interest groups.[710] A coalition's goal is to represent farmers with irrigated cropland within a regional watershed so they do not need to maintain individual discharge permits with the Regional Board. "The coalitions conduct monthly and seasonal surface-water water quality monitoring and water and sediment toxicity analyses. Results are reported to the Regional Board on a quarterly basis. The occurrence of two or more exceedances of Basin Plan water quality and/or toxicity parameters results in the mandatory production of a management plan to address the issues. In addition, data on crops, irrigation types and scheduling, management practices implemented to protect water quality, fertilizer use, and other data are collected by coalitions through grower surveys, and reported to the Regional Board. Coalitions are also responsible for providing educational materials and outreach opportunities for growers."[711]

One of the challenges for the ILRP program has been identifying all the growers who should be members of a coalition group. Membership requirements have effectively been addressed through the use of GIS mapping, County Assessment records and §13267 letters (under the Porter-Cologne Act). A §13267 letter

[708] SWRCB. Irrigated Lands Regulatory Program, http://www.swrcb.ca.gov/water_issues/programs/agriculture/index.shtml. See, for example, Water Quality Conditions in the Central Coastal Region Related to Agricultural Discharges, Central Coastal Region Water Quality Control Board, March 2011, http://www.waterboards.ca.gov/centralcoast/board_info/agendas/2011/march/Item_14/14_att7.pdf.

[709] Dowd, B.M., D. Press and M.L. Huertos, Agricultural Nonpoint Source Water Pollution Policy: The Case of California's Central Coast; Agriculture, *Ecosystems and Environment*, 2008, vol. 128, Issue 3, p. 151-161. This paper provides an assessment of the waiver system in one region, but the findings are relevant for the state and were the basis for this section.

[710] CURES, Education for Environmental Responsibility, http://www.curesworks.org/home.asp

[711] CURES, Watershed Coalitions, http://www.curesworks.org/coalitions.asp

requires a grower to provide information, such as monitoring reports, to a regional board,[712] and if he or she fails to comply, the board can issue a Notice of Violation and may impose an Administrative Civil Liability which carries financial penalties. Many Notices of Violation, Administrative Civil Liabilities and fines have been levied and collected in the implementation and enforcement of this program.[713]

The ILRP is a multi-agency, multi-program effort and there is close coordination between the ILRP and other agencies that have authority over various aspects of agriculture. These include but are not limited to, the California Department of Pesticide Regulation, California Department of Food and Agriculture, Department of Fish and Game, National Resource Conservation Districts, commodity groups and other programs under the State Water Resource Control Board.[714]

The regional water boards are at various stages in the implementation process and are actively updating, improving and implementing their ILRPs.[715]

Success story: Reduction of Pesticide Discharge to Sacramento and Feather Rivers

One of the EPA Success Stories describes how in 1994, the Sacramento and Feather Rivers and their tributaries, which flow through the Central Valley, had approximately 130 km of their length added to the CWA Section 303(d) list of impaired waters due to high levels of organophosphate pesticides (chlorpyrifos and diazinon) in the water.[716] In 2001, the Sacramento River Watershed Program implemented a water quality management strategy for the two rivers. The strategy included both regulatory measures and BMPs.

As the EPA website explains: "An Agricultural Implementation Group composed of commodity boards, pesticide registrants, and farm organizations worked to implement the Strategy and install various structural and management BMPs. For example, landowners replaced flood irrigation in orchards with piped sprinkler systems, installed filter strips, planted cover crops, and transitioned to pest management practices that limit diazinon use." In addition, in 2003, the Central Valley Water Board enabled a regulatory approach by establishing TMDL water quality objectives for diazinon and allocating reductions. Development of the TMDL was important in motivating the agricultural community to implement BMPs. There were various funding sources to help community agricultural organizations implement the program, including federal funds under the CWA Section 319 and a USDA Water Enhancement Grant. Some of the work to reduce pesticide use is carried out by watershed coalitions.

The EPA asks its regional offices to report on the effectiveness of the watershed approach to reducing pollution through a Watershed Improvement Measure (or Measure W).[717] The reductions in diazinon levels in the Sacramento and Feather watersheds have been reported as a success under this measure.[718]

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[712] *Porter-Cologne Water Quality Control Act*, California Water Code, Division 7. Water Quality, Chapter 5.4, Nonpoint Source Pollution Control Program, §13267, http://www.swrcb.ca.gov/laws_regulations/docs/portercologne.pdf

[713] SWRCB, NPS staff communication with Mary Griffiths, November 3, 2011.

[714] Ibid.

[715] Ibid.

[716] EPA. Nonpoint Source Success Stories, California Sacramento and Feather Rivers, Stakeholders Cooperate to Reduce Diazinon in Runoff from Dormant Season Spray, http://water.epa.gov/polwaste/nps/success319/ca_sac.cfm. Unless otherwise stated, this is the source for this section.

[717] EPA. Pacific Southwest, Watershed Priorities, Measure "W" Watersheds, http://earth1.epa.gov/region9/water/watershed/measurew.html See also, EPA, Guidance for Reporting Watershed Improvement under Measure SP-12, Fyn 2009, http://www.epa.gov/region9/water/watershed/docs/SP-12_Guidance_12-05-08.pdf

[718] EPA. Pacific Southwest, Region 9, Feather and Sacramento River Watersheds, http://earth1.epa.gov/region9/water/watershed/measurew/feather-sac/index.html

Nine individual watersheds have shown improvement and "The success of the watershed approach in reducing diazinon impairments in Central Valley water bodies is a model for future water quality restoration efforts. Continuing watershed-based pollution control activities can successfully address ongoing water quality challenges in the Lower Sacramento Basin by combining community-based watershed activities with regulation."[719]

Success story: Reductions in Selenium and Pesticides in San Joaquin Basin

Selenium was reduced in the San Joaquin Basin, where irrigation led to naturally high levels of selenium and salts leaching into subsurface drainage in the Grasslands Watershed area of the basin.[720] This was achieved through implementation of BMPs and area-wide measures to reroute drainage. The effectiveness of coalitions is seen in the fact that "For the second year in a row, two water-ways under management plans in the East San Joaquin Water Quality Coalition region have shown no toxicity to test organisms or exceedances of pesticide standards for chlorpyrifos."[721]

Success Story: Watershed Restoration Efforts Improve Dissolved Oxygen Levels

Excess nutrients from urban and agricultural discharges led to an increase in algae growth (and concomitant reduction in dissolved oxygen levels), so a 22-mile stretch of Chorro Creek was put on the CWA Section 303(d) impaired waters list for dissolved oxygen.[722] Public and private landowners implemented a variety of water quality restoration efforts to reduce nutrients, addressing both point and NPS pollution. Measures to address NPSP included restoring wetlands and stream channels, removing livestock grazing from riparian areas, and controlling erosion. Monitoring showed improvements in water quality starting in 2002 and, in 2008, the Central Coast Regional Water Quality Control Board proposed removing Chorro Creek from the state's section 303(d) list. Many partners were involved in the project and over a 15-year period, funds came from local, state and federal sources.

4.2.4.2 Grazing

While irrigated lands have been a focus for the water boards, they are developing a Statewide Grazing Regulatory Action Project.[723] Although this project has not yet started, the Section 303(d) impaired waters listing has been used to encourage measures to reduce the impact of grazing.

4.2.5 Forestry

California has more than 160,000 km^2 of forest, with nearly 60% on public land.[724] The *Forest Practices Act* authorizes Forest Practice Rules, which include several measures that reduce NPSP. The rules require a Watercourse and Lake Protection Zone where additional practices may be required to protect the

[719] EPA. Region 9, Diazinon Reduction in the Sacramento and Feather Rivers, Reporting Watershed Improvement (SP12), http://earth1.epa.gov/region9/water/watershed/measurew/feather-sac/2010SacFeatherRiverSP12final-Rpt.pdf

[720] EPA. California San Joaquin Basin, Grasslands Bypass Project Reduces Selenium in the San Joaquin Basin, http://water.epa.gov/polwaste/nps/success319/ca_san.cfm

[721] "Irrigate [sic] Land Permit Fees are Climbing", *California Farmer*, November 7, 2011, http://farmprogress.com/california-farmer-story-nl5_5nl-irrigate-lands-permit-fees-are-climbing-9-54538

[722] EPA. California: Chorro Creek, Watershed Restoration Efforts Improve Dissolved Oxygen Levels, http://water.epa.gov/polwaste/nps/success319/ca_chorro.cfm

[723] SWRCB. Statewide Policies/Significant General Permits, September 7, 2011, http://www.swrcb.ca.gov/board_reference/2011fall/sb_policies_general_permits_table_1.pdf

[724] Ice, G. *et al*. Programs Assessing Implementation and Effectiveness of State Forest Practice Rules and BMPs in the West, *Water, Air and Soil Pollution:* Focus 4: 2004, p. 146, ftp://frap.cdf.ca.gov/pub/incoming/IMMP/Meaningful%20Monitoring%20Papers,%20Meeting%20Summaries,%20PPTs,%20etc/Ice,%20Dent,%20Robben,%20Cafferata%20et%20al.%202004%20Monitoring%20Forestry%20BMPs.PDF

water.[725] The width of the buffer depends on the class of the water and the degree of slope. For Class I and II waters, which include all those with aquatic life, the buffer varies from 15 m (Class II water with slope class < 30%) to 46 m (Class I water with slope class >50%).[726] Other relevant rules relate to site preparation, harvest and erosion control and logging roads.[727]

Over the years, monitoring has been conducted to assess the effectiveness of forest practice rules in protecting water quality, including a long-term monitoring program,[728] but more needs to be done. "Silviculture contributes pollutants to 17% of the polluted rivers and 21% of the polluted lakes in California."[729]

A state-wide Conditional Waiver (of Waste Discharge Requirements) may be adopted for many NPS discharges from National Forest System lands.[730] This is seen as a "very substantial strengthening of the U.S. Forest Service (USFS) Water Quality Management Plan, which will be adopted in the USFS Water Quality Management Handbook."[731] There were opportunities for public input into the plan and at the time of writing, the public was being invited to comment on the Revised Draft Statewide Waiver.[732]

As in the ILRP, the USFS Conditional Waiver requires the implementation of BMPs. It will address impacts from a wide range of activities on National Forest System lands, including timber management, road construction, range management, recreational use (including off-highway vehicles), and fire suppression.[733] The draft USFS Water Quality Management Handbook[734] is a comprehensive document that sets out BMPs for the full range of activities that could affect water quality, and administrative processes to ensure that they are implemented. As an example, the BMPs for off-highway vehicles in recreation areas include trail construction methods and monitoring to identify watercourse crossings and trail segments that need maintenance to minimize sediment delivery to water or riparian areas. Water quality monitoring is a critical component and, if necessary, monitoring results will lead to modification of management practices. Each national forest is to establish a network of baseline in-channel and hill

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[725] California Department of Forestry and Fire Protection. *California Forest Practice Rules 2010,* Article 6, http://www.fire.ca.gov/resource_mgt/downloads/2010_FP_Rulebook_w-Diagrams_wo-TechRule_No1.pdf

[726] California Department of Forestry and Fire Protection. *California Forest Practice Rules 2010,* section 916.5, 936.5, 956.5, Table 1), http://www.fire.ca.gov/resource_mgt/downloads/2010_FP_Rulebook_w-Diagrams_wo-TechRule_No1.pdf

[727] National Council for Air and Stream Improvement. *Compendium of Forestry Best Management Practices for Controlling Nonpoint Source Pollution in North America,* Technical Bulletin 966, September 2009 http://www.ncasi.org/Publications/Detail.aspx?id=3204

[728] Ice, G. *et al*. Programs Assessing Implementation and Effectiveness of State Forest Practice Rules and BMPs in the West, *Water, Air and Soil Pollution:* Focus 4: 2004, p. 146. See, for example, US Forest Service, Pacific Southwest Research Station, Caspar Creek Watershed Study, which has been operating since 1962, http://www.fs.fed.us/psw/topics/water/caspar/

[729] SWRCB. How the NPS Program Works, poster, http://www.waterboards.ca.gov/water_issues/programs/nps/docs/marketing/nps_program_poster.pdf

[730] SWRCB. Nonpoint Source Pollution Control Program, Water Quality Management Plan for National Forest System Lands in California, http://www.waterboards.ca.gov/water_issues/programs/nps/wqmp_forests.shtml

[731] SWRCB, NPS staff communication with Mary Griffiths, November 3, 2011.

[732] SWRCB. NPS Pollution Control Program, Water Quality Management Plan for National Forest System Lands in California, Relevant Documents, http://www.waterboards.ca.gov/water_issues/programs/nps/wqmp_forests.shtml#revdocs

[733] State Water Resources Control Board. Waiver of Waste Discharge Requirements for Nonpoint Source Discharges Related to Certain Activities on National Forest System Lands in California, http://www.waterboards.ca.gov/water_issues/programs/nps/docs/wqmp_frsts/wvr_pckge/waiv_%20110311.pdf. This is the draft plan, so does not yet have an Order Number.

[734] USDA Forest Service. Pacific Southwest Region, *Draft Water Quality Management Handbook,* 2011, 233 pages, http://www.swrcb.ca.gov/water_issues/programs/nps/docs/wqmp_frsts/usfs.pdf

slope monitoring sites at the watershed scale, but if there is no baseline monitoring, then project-level monitoring will be required. As with other waivers, the proposed conditional waiver will be subject to enforcement.

4.2.6 Municipal Stormwater

In California much of the drainage from developments was based on the traditional flood control principle of capturing and conveying water away from people and property, and using end-of-pipe controls. Over the past 10 to 20 years, LID has emerged as an alternate management approach in California.[735] The State Water Resources Control Board's Construction General Permit (1999) for stormwater sets minimum requirements to control runoff after construction, and requires LID techniques that are the Best Available Technology economically achievable/ Best Conventional pollutant control Technology (BAT/BCT).[736] The general permit is a NPDES requirement (so could include point and non-point sources), but it was difficult to enforce a standard that applied to land disturbance. In 2005 the SWRCB added sustainability as a core value for all water board programs and in 2006 released a draft revised General Permit that included performance standards for post-construction stormwater control. A General Permit sets standards and a project developer who applies for a General Permit and meets its requirements does not need an individual permit.

The new General Permit, which came into force in 2010, "requires dischargers to maintain pre-development drainage densities and times of concentration in order to protect channels and encourages dischargers to implement setbacks to reduce channel slope and velocity changes that can lead to aquatic habitat degradation. . ." and ". . . emphasizes runoff reduction through on-site storm water reuse, interception, evapo-transpiration and infiltration through non-structural controls and conservation design measures (e.g., downspout disconnection, soil quality preservation/enhancement, interceptor trees). Employing these measures close to the source of runoff generation is the easiest and most cost-effective way to comply with the pre-construction water balance standard."[737]

The General Permit applies in all areas unless there is a Standard Urban Storm Water Mitigation Plan or other post-construction requirement that requires even higher protection. Thus Los Angeles County has its own Standard Urban Stormwater Mitigation Plan which requires that "Post-development peak stormwater runoff discharge rates shall not exceed the estimated pre-development rate for developments where the increased peak stormwater discharge rate will result in increased potential for downstream erosion."[738]

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[735] SWRCB, Division of Financial Assistance, staff personal communication with Mary Griffiths, January 19, 2011. For example, Los Angeles collects some stormwater to use for irrigation.

[736] Low Impact Development Center Inc. Maryland. *A Review of Low Impact Development Policies: Removing Institutional Barriers to Adoption,* December, 2007; report commissioned by California SWRCB Stormwater Program and The Water Board Academy, http://www.waterboards.ca.gov/water_issues/programs/low_impact_development/docs/ca_lid_policy_review.pdf

[737] SWRCB. Construction General Permit Fact Sheet, as modified November 2010, http://www.waterboards.ca.gov/water_issues/programs/stormwater/docs/constpermits/wqo_2009_0009_factsheet.pdf

[738] Cited in Low Impact Development Center Inc. Maryland. *A Review of Low Impact Development Policies: Removing Institutional Barriers to Adoption,* December, 2007, p. 4, http://www.waterboards.ca.gov/water_issues/programs/low_impact_development/docs/ca_lid_policy_review.pdf See also, Los Angeles Regional Water Quality Control Board, Standard Urban Stormwater Mitigation Plan, http://www.swrcb.ca.gov/rwqcb4/water_issues/programs/stormwater/susmp/susmp_details.shtml

The Local Government Commission is working with agencies and organizations in Ventura County, northwest of Los Angeles, to develop a watershed-based approach.[739] The County, which has a population of approximately 800,000 and an area of less than 6,000 km^2, [740] has developed a comprehensive land use and planning strategy.[741] The strategy appears to be pro-active, aimed at responsible development for future growth, as two of the main rivers are in a relatively good state (although sensitive ecosystems have been lost in a third river, Callegulas Creek watershed, in part due to drainage from agricultural lands). The strategy describes how the Los Angeles Regional Water Quality Control Board issued a draft stormwater permit for the county that linked land development and stormwater management, including LID, control of impervious surfaces and alternative approaches to redevelopment. The guide shows that existing rules and codes may need to be revised to facilitate the objectives of a water-based approach to land use planning, and that future water quality monitoring results may require further modification of policies. The guide may provide a useful checklist for any community that plans to adopt a similar approach, but it is too early to evaluate the outcomes from the new strategy.

The SWRCB commissioned a report by the Low Impact Development Center,[742] and in Storm Water Grant Program Guidelines acknowledged LID as an "innovative approach [that] helps meet water quality and water supply objectives and maintain healthy, sustainable watersheds."[743] State Water Board staff were directed "to assign a higher grant priority to climate-related and LID projects, particularly those that are supported by local policies or ordinances."[744] It was recognized that there may be barriers to the implementation of LID, so the Guidelines indicated that some funding could be available to eliminate barriers from existing municipal regulations or standards that prevent or hinder implementation of LID practices. Funding could also be available to enable local jurisdictions to implement LID/green infrastructure techniques as well as to to encourage engineers and developers to use LID principles.

Funding for LID has been available from two bonds authorized by voters in 2002 (Proposition 40) and 2006 (Proposition 84), and from the 2009 federal stimulus bill through the Clean Water State Revolving Fund (CWSRF).[745, 746] One of the action items in the Proposition was to "Develop and adopt incentives and standard requirements . . . that encourage or require local jurisdictions to implement Low Impact Development (LID)/Green Infrastructure techniques that promote the infiltration, capture, and treatment

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[739] SWRCB. Low Impact Development (LID) Projects, http://www.waterboards.ca.gov/water_issues/programs/grants_loans/low_impact_development/index.shtml Scroll down to Local Government Commission. The project has its own website at http://water.lgc.org/ventura

[740] Wikipedia. Ventura County, California, http://en.wikipedia.org/wiki/Ventura_County,_California

[741] Local Government Commission. *Water Resources and Land Use Planning: Watershed-based Strategies for Ventura County*, December 2008, 204 pages, http://water.lgc.org/ventura/ventura%20watershed%20plan%201.pdf

[742] Low Impact Development Center Inc. Maryland. *A Review of Low Impact Development Policies: Removing Institutional Barriers to Adoption*, December, 2007, http://www.waterboards.ca.gov/water_issues/programs/low_impact_development/docs/ca_lid_policy_review.pdf

[743] California Water Boards. *Proposition 84 Storm Water Grant Program Guidelines*, adopted February 17, 2009, p. 3. The State Water Board set out these requirements in Resolution No. 2008-0030, Requiring Sustainable Water Resources Management, see http://www.waterboards.ca.gov/water_issues/programs/grants_loans/prop84/docs/prop84_swgp_guidelines_adopted.pdf

[744] California Water Boards. *Proposition 84 Storm Water Grant Program Guidelines*, p. 3.

[745] SWRCB, Division of Financial Assistance, staff personal communication with Mary Griffiths, January 19, 2011.

[746] California Code. Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act (Proposition 84). Once the money was authorized the California Water Boards prepared the *Proposition 84 Storm Water Grant Program Guidelines*, adopted February 17, 2009.
Additional financial assistance may be available through EPA section 319 funds. See SWRCB, Low Impact Development – Sustainable Storm Water Management, http://www.waterboards.ca.gov/water_issues/programs/low_impact_development/index.shtml

of storm water for reuse."[747] The request for proposals was issued in 2011 and projects will be selected in 2012. Projects from previous bond funds, which include some NPS projects, are listed online.[748] Recent projects include funding for green streets,[749] supplying citizens with rain barrels at reduced cost,[750] and capturing, treating and storing urban runoff for reuse as park irrigation water.[751]

Efforts to adopt LID are helped by the fact that the Porter-Cologne Act makes it possible for water boards ". . . to implement innovative natural resource protection programs because it allows the regulation of any activity or factor that affects water quality and is not narrowly focused on end-of-pipe treatment."[752]

Implementation of LID is encouraged by the California Water and Land Use Partnership, a group that includes staff from government agencies (such as State Water Boards, the California Environmental Protection Agency, EPA Region 9, Local Government Commission), non-profit organizations and academia.[753] It provides technical and other tools to help inform land use decisions at the local level.

4.2.7 Watershed Management

Implementation of California's NPSP program is primarily through the Watershed Management Initiative, under which the Regional Water Quality Management Boards use an integrated planning approach to create solutions specific to each watershed.[754] The plans are reviewed annually. The regional boards often implement the program through agricultural and grazing waivers of waste discharge requirements, described above. The boards tend to:

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[747] SWRCB. *Proposition 84 Storm Water Grant Program Guidelines,* adopted February 17, 2009, p. 3, Objective 1.2 and Action 1.2.1, http://www.waterboards.ca.gov/water_issues/programs/grants_loans/prop84/docs/prop84_swgp_guidelines_adopted.pdf. When the Concept Solicitation Notice was issued in November 2011, LID projects were the first on the list, see California Water Boards Concept Proposal Solicitation Notice, Proposition 84, Storm Water Grant Program, November 15, 2011. Supplied by staff at SWRCB, Division of Water Quality, Nonpoint Source Pollution Control Program, November 3, 2011.

[748] SWRCB. Low Impact Development (LID) Projects, http://www.waterboards.ca.gov/water_issues/programs/grants_loans/low_impact_development/index.shtml

[749] San Francisco Estuary Partnership. *Green Streets, Cleaner Stormwater: A Primer*, http://www.sfestuary.org/userfiles/green%20streets%20Insert_10_10_6_web.pdf. The community of El Cerrito received $392,000 for its Green Streets Project. SWRCB, Division of Financial Assistance staff, personal communication with Mary Griffiths, November 18, 2011.

[750] City of Oakland. Rain Barrel Program, http://www2.oaklandnet.com/Government/o/PWA/o/FE/s/ID/OAK025822 The City recently received $1.3 million for this project. SWRCB, Division of Financial Assistance staff, personal communication with Mary Griffiths, November 18, 2011.

[751] "Alta Vista Drainage System Shores Up Stormwater," *Redondo Beach Patch*, February 11, 2011, http://redondobeach.patch.com/articles/alta-vista-drainage-system-shores-up-stormwater. Alta Vista Diversion and Reuse Project diverts water from a park's 100 acre watershed, to prevent it entering the ocean, storing the water in an underground cistern until needed. The total project cost $2.4 million, with most of the money coming from the SWRCB. SWRCB, Division of Financial Assistance staff, personal communication with Mary Griffiths, November 18, 2011.

[752] Low Impact Development Center Inc. Maryland. *A Review of Low Impact Development Policies: Removing Institutional Barriers to Adoption,* December, 2007, http://www.waterboards.ca.gov/water_issues/programs/low_impact_development/docs/ca_lid_policy_review.pdf

[753] California Water and Land Use Partnership, http://cawalup.urbanocean.org/index.php?title=Main_Page

[754] SWRCB and California Coastal Commission. *Nonpoint Source Program Strategy and Implementation Plan, 1998-2013*, Volume 1, January 2000, p. ii, http://www.waterboards.ca.gov/water_issues/programs/nps/docs/planvol1.pdf

- Concentrate NPSP cleanup resources on reducing the TMDL for waters on the CWA 303(d) impaired waters list;
- Focus on high priority watersheds and problems, as defined by priority TMDLs and other region-specific problems; and
- Acknowledge "the balancing act required by programs to both clean up waters polluted by nonpoint sources, and preserve clean waters."[755]

4.2.8 Progress and Effectiveness

The waiver system used in the ILRP and being proposed to improve water quality in forest lands combines the voluntary adoption of BMPs to reduce polluted runoff, with an enforceable regulatory backstop. There have been some successes, but it takes time to improve water quality. Based on experience in the first few years of the system, it seems that the approach relies on several key assumptions: ". . . (1) design standards using BMPs will have a measurable and positive impact on pollution runoff; (2) monitoring efforts will be able to detect discharge "hot spots" as well as any improvements in ambient water quality; (3) government funding opportunities will defray farmer costs for monitoring and BMP implementation, which, in turn, will assure their continued cooperation in regulatory efforts; and (4) political support for improving agriculture-related water quality efforts will remain high, even in the face of competing demands on farm income, regulatory compliance efforts and attention."[756]

So far, however, the ILRP is regarded as a good example which will probably be emulated in the forest sector in California.

[755] SWRCB and California Coastal Commission. *California Nonpoint Source Control Program, 2009-2010 Annual Accomplishments Report*, http://www.waterboards.ca.gov/water_issues/programs/nps/docs/rpt5_1011.pdf

[756] Dowd, B.M., D. Press and M.L. Huertos. 2008, Agricultural Nonpoint Source Water Pollution Policy: The Case of California's Central Coast, *Agriculture, Ecosystems and Environment*, Vol. 128, Issue 3, pp. 151-161. Citation is from p. 156. This paper provides an assessment of the waiver system in one region, but the findings are relevant for the state.

4.3 North Carolina

4.3.1 North Carolina at a Glance

- *The Clean Water Responsibility and Environmentally Sound Policy Act sets out specific requirements for the reduction of nutrients in surface waters.*
- *The state has used watershed planning for almost two decades to reduce nutrient loading in two major river basins, the Tar-Pamlico and the Neuse, and is extending the approach to other basins.*
- *Water quality trading is permitted, including point to non-point source trading. A nutrient offset fee may be paid to the North Carolina Ecosystem Enhancement Program, which finances wetland and riparian restoration.*
- *Some municipalities are using LID to reduce urban runoff.*
- *The EPA cites both the Tar-Pamlico and the Neuse River Basins as success stories, but despite reductions in actual and estimated nutrient levels, water quality in the river estuaries has not yet improved. There are several possible reasons, but the examples show that it can take a long time to attain environmental improvements in large river basins.*

4.3.2 Overview

North Carolina has a population of 9.5 million people and an area of almost 126,000 km^2,[757] which is slightly larger than the entire South Saskatchewan River Basin in Alberta. The state extends from the Appalachian Mountains in the west, through a plateau region about 320 km wide, to the coastal plain and the Atlantic Ocean.[758] The climate is humid subtropical.[759]

Livestock products and crops each contribute about 50% of North Carolina's agricultural income. The top five agricultural products (based on revenue) are hogs, broilers (young chickens), greenhouse and nursery products, tobacco, and turkeys. Tobacco is the most important field crop, followed by cotton.[760]

North Carolina has had a NPSP program since 1989, which is implemented through detailed river basin action plans.[761] The plans use a mix of voluntary and regulatory approaches and are revised every five years. Sedimentation is the largest source of water pollution by volume in the state, but nutrients are also a major concern.

[757] U.S. Census Bureau. Quick Facts North Carolina, http://quickfacts.census.gov/qfd/states/37000.html
[758] Netstate. North Carolina, Geography, http://www.netstate.com/states/geography/nc_geography.htm
[759] Wikipedia. Charlotte, North Carolina, http://en.wikipedia.org/wiki/Charlotte,_North_Carolina .
[760] Netstate. North Carolina, Economy, http://www.netstate.com/economy/nc_economy.htm
[761] North Carolina Department of Environment and Natural Resources, Division of Water Quality. *North Carolina Nonpoint Source Program 2010 Annual Progress Report*, October 2009 – September 2010, p. 5, http://portal.ncdenr.org/c/document_library/get_file?uuid=81dcfb7a-95f5-4f82-a5f8-44a340bc6451&groupId=38364

4.3.3 Legislation, Funding, Data Collection, Reporting

4.3.3.1 Legislation

In addition to implementing federal requirements under the CWA, North Carolina has its own *Clean Water Responsibility and Environmentally Sound Policy Act* (1997). This requires the Environmental Management Commission to establish improvement goals for nutrient-impaired waters.[762] The Commission must obtain data on water quality, classify the waters and identify any substances that need more stringent control.[763] The Commission may allow projects to achieve nutrient reduction by paying offset fees when nutrient levels in a stretch of water are too high.[764] The funds are paid to the North Carolina Ecosystem Enhancement Program, and the scheme is more like an exceedance tax than a direct trading program.[765] This approach can be used in the four basins that have nutrient management strategies (see section 4.3.7, below), although the rules vary by watershed.[766]

The State Administrative Code also requires action at the local level. "Local governments shall, as the existing laws allow, develop, implement, and enforce comprehensive nonpoint source and stormwater discharge control programs to reduce water pollution from activities within water supply watersheds."[767]

While much work is being done to improve the quality of impaired waters, the Environmental Management Commission also takes measures to maintain the quality of "Outstanding Resource Waters."[768] The North Carolina Administrative Code lists those waters that were classified when the Code was updated in 2009 and identifies the general or specific requirements to protect them. While these requirements predominantly address stormwater discharges, they may require low density for new development. Any person may petition the Commission to classify a surface water body as Outstanding Resource Waters.

The North Carolina Department of Environment and Natural Resources has two divisions that are involved in water quality management. The Division of Water Quality is responsible for maintaining

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[762] General Assembly of North Carolina. 1997 Session, *The Clean Water Responsibility and Environmentally Sound Policy Act*, Part VI, p. 26 in the Division of Water Quality Compendium, http://portal.ncdenr.org/c/document_library/get_file?folderId=285750&name=DLFE-8508.pdf
Another source is http://www.ncga.state.nc.us/sessions/1997/bills/house/html/h515v6.html

[763] North Carolina Administrative Code. Title 15A - Environment and Natural Resources, Chapter 2: Environmental Management, 2b - Surface Water and Wetland Standards, section .0100 – Procedures for Assignment of Water Quality Standards, sections (b) and (g), http://portal.ncdenr.org/c/document_library/get_file?uuid=f12e8078-b128-44cc-b55b-fc5e7d876f3c&groupId=38364

[764] North Carolina Administrative Code. Title 15A, 02b .0240 Nutrient Offset Payments, http://portal.ncdenr.org/c/document_library/get_file?uuid=349044bb-95ed-4186-b2f2-bb64633c1513&groupId=38364

[765] Rutgers, State University of New Jersey. Water Resources Program, Case Studies, 2008, http://www.water.rutgers.edu/Projects/trading/CaseStudies.htm See Further Details of Four Successful Water Quality Trading Projects, Neuse River Basin program – Nitrogen Trading, or http://www.water.rutgers.edu/Projects/trading/FurtherDetails.pdf
See also the links to Pros and Cons of Four Successful Water Quality Trading Projects.

[766] North Carolina Division of Water Quality. Nutrient Offset Information, Introduction, http://portal.ncdenr.org/web/wq/ps/nps/nutrientoffsetintro

[767] North Carolina Administrative Code. Title 15A - Environment and Natural Resources, Chapter 2: Environmental Management, 2b - Surface Water and Wetland Standards, section .0100 - Procedures For Assignment Of Water Quality Standards, section (w), http://portal.ncdenr.org/c/document_library/get_file?uuid=f12e8078-b128-44cc-b55b-fc5e7d876f3c&groupId=38364

[768] North Carolina Administrative Code. Title 15A, 02B.0225, Classifications and Water Quality Standards Applicable to Surface Waters and Wetlands in North Carolina, Outstanding Resource Waters, http://portal.ncdenr.org/c/document_library/get_file?folderId=285750&name=DLFE-14959.pdf

water quality and uses basin-wide water quality planning to restore and protect surface water quality. Originally a voluntary program, it became a legislated requirement in 1997.[769] The Division of Soil and Water Conservation has several programs that address NPSP from agricultural sources.[770]

4.3.3.2 Funding

U.S. EPA funding in North Carolina under CWA Section 319(h) is approximately $4.5 million each year, of which about 60% is for a competitive grant program that funds innovative NPSP demonstration and restoration projects.[771] Twenty-five percent of the funds are awarded for agricultural projects, 20% for watershed protection and 16% for urban stormwater projects.[772] There are plans to allocate an average of $100,000 each year for the next 15 years for public education on NPSP. State funding is available for some cost-shared programs, which are described in section 4.3.4, below.

4.3.3.3 Data Collection

Water quality monitoring is conducted by the Division of Water Quality but only about 30% of the state's 60,000 km of rivers and streams are actually monitored.[773] In addition to 323 stations in the Ambient Monitoring System,[774] there is a Random Ambient Monitoring System, which is "a probabilistic monitoring initiative where sampling locations are randomly located on freshwater streams throughout the state."[775] Monitoring data are used to set TMDLs,[776] and the list of rivers and streams in the state with a TMDL under the federal CWA Section 303(d) is published in an annual report.[777] The public has an opportunity to provide comment on the draft list before it is submitted to the EPA for approval.[778]

In addition to data collection, the NPSP program developed and applied watershed-scale models to evaluate the effects of land use and management practices on the nitrogen loading of watersheds.[779]

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[769] North Carolina Division of Water Quality. What is Basinwide Planning? http://portal.ncdenr.org/web/wq/ps/bpu/about

[770] North Carolina Department of Environment and Natural Resources, What is Nonpoint Source Pollution? http://portal.ncdenr.org/c/journal/view_article_content?groupId=38358&articleId=1089391&version=1.0

[771] *North Carolina Nonpoint Source Program 2010 Annual Progress Report*, p. 6.

[772] Ibid.

[773] Jolley, J. *Nonpoint Source Pollution Prevention and Control through Land Use Planning and Management: An Introduction & Resource Guide for Protecting Coastal North Carolina Waters*, Watershed Education for Communities and Local Officials, NC Cooperative Extension, North Carolina State University, Raleigh, North Carolina, March 2003, p. 67, http://digital.ncdcr.gov/u?/p249901coll22,15904

[774] North Carolina Division of Water Quality. Ambient Monitoring System, http://portal.ncdenr.org/web/wq/ess/eco/ams

[775] North Carolina Division of Water Quality. Random Ambient Monitoring System, http://portal.ncdenr.org/web/wq/ess/eco/rams

[776] *North Carolina Nonpoint Source Program 2010 Annual Progress Report*, p. 11.

[777] North Carolina Department of Environment and Natural Resources. NC 2010 Integrated Report, Category 5-303(d) List Approved by EPA August 31, 2010, http://portal.ncdenr.org/c/document_library/get_file?uuid=7820714e-d00c-4ef0-85d0-047a097e9c43&groupId=38364

[778] North Carolina Department of Environment and Natural Resources. Responsiveness Summary on NC draft 2010 303(d), submitted March 29, 2010, http://portal.ncdenr.org/c/document_library/get_file?uuid=46e1ccac-a2d0-47c3-83a0-0a937c0adc0a&groupId=38364

[779] North Carolina Department of Environment and Natural Resources, Division of Water Quality. Nonpoint Source Management Program. Development and Evaluation of Export Coefficient Methods and the Evaluation of the Nutrient Loss Evaluation Worksheet (NLEW) for Lower Coastal Plain Watersheds, 1998, http://h2o.enr.state.nc.us/nps/nlew98.pdf

4.3.3.4 Reporting

The NPS Annual Progress Report estimates the reductions in nitrogen, phosphorus and sediment that resulted from the Section 319 funding in the previous year.[780] It also reports on the number of river stretches for which TMDLs have been established and the most recent report states that "Many of these have been successfully implemented to achieve water quality standards."[781]

4.3.3.5 Partnerships

At the government level, there is a partnership between the Division of Water Quality and the Division of Soil and Water Conservation. At the watershed level there are many partnerships to implement nutrient management plans. In addition, the North Carolina Division of Environmental Health is responsible for the NPS Program that deals with on-site waste disposal systems, in a state where more than half the new housing units have septic tanks or other on-site systems.[782] The program focuses on education and technology transfer.

4.3.4 Agriculture

The Division of Soil and Water Conservation has a NPS Programs section that focuses on agriculture. It supports 96 soil and water conservation districts across the state in identifying and assessing water quality areas of concern. The division works with the Division of Water Quality, which supplies monitoring data, to develop plans to address agricultural runoff at the watershed and sub-watershed scale.[783] This work is described in section 4.3.7.

North Carolina has several cost-shared programs:

- The **North Carolina Agriculture Cost Share Program** has provided financial stimulus to farmers who implement BMPs to reduce agricultural NPS input to critical watersheds. The program has resulted in considerable reduction in the runoff of soil, nitrogen, and phosphorus. In fiscal year 2010, the program approved contracts with farmers covering over 32,000 ha. It was estimated that the BMPs would annually save more than 110,000 tonnes of soil, nearly 170,000 kg of nitrogen and 40,000 kg of phosphorus.
- The **Community Conservation Assistance Program** is designed to improve water quality through the voluntary installation of various BMPs on developed lands not directly involved in agricultural production. This includes rain gardens, stream restoration projects, riparian buffers, and treating impervious surfaces to reduce runoff.
- The **Conservation Reserve Enhancement Program** provides federal funds for conservation easements. In North Carolina some soil and water conservation districts have encouraged those enrolled in the program to upgrade to permanent conservation easements. The Annual Report shows the estimated benefits in terms of reduced runoff of nitrogen, phosphorus and soil.

[780] *North Carolina Nonpoint Source Program 2010 Annual Progress Report.*
[781] Ibid. p. 9.
[782] Ibid. p. 26.
[783] *North Carolina Nonpoint Source Program 2010 Annual Progress Report,* pp. 45-56.

4.3.5 Forestry

The forest products industry is the largest business in North Carolina and three-quarters of the forests are owned by private landowners.[784] The North Carolina Forest Service has a separate unit to manage its Forestry NPS Program.[785] Operators are expected to follow Forest Practices Guidelines Related to Water Quality and if these are followed, operators are exempt from permitting requirements under the *Sedimentation Pollution Control Act.*[786] Chapter 2 of the North Carolina Forestry Best Management Practices Manual sets out practices that can help ensure compliance with the water quality guidelines.[787] Although implementation of BMPs is voluntary, any forest operator wanting to obtain forest certification for the produced timber, must follow BMP requirements. Also, the Forest Service inspects post-harvesting sites to assess how well the Forest Practices Guidelines have been implemented and may issue charges if water quality is affected by sediment.[788] In addition to Forest Service inspections, the Division of Water Quality may undertake independent monitoring and if water quality standards are violated, the Division can issue a Notice of Violation and/or impose a civil penalty. The North Carolina Forestry Association Prologger program provides training to encourage BMP implementation. A survey found: "In 2005, BMP implementation on sites managed by certified ProLoggers was 84% while implementation was lower (78%) on sites harvested with no ProLogger-trained forester."[789]

4.3.6 Municipal Stormwater

The traditional approach was for local (city and county) government to have rules for the discharge of stormwater and to issue a permit to a developer specifying stormwater requirements. North Carolina now offers an alternative: the Universal Stormwater Management Program. Not only will this voluntary program be administratively simpler, it should give greater protection to surface waters.[790] The program has two basic components, a design standard for stormwater and a setback requirement. It may include LID, but this is not actually stipulated.

With the exception of the coastal counties, the design standards for North Carolina are as follows:

- All residential development disturbing 0.4 ha or more and all commercial development disturbing 0.2 ha or more must have stormwater control and treatment measures to handle runoff generated by a 2.5 cm rain event.
- At a minimum, these measures must be capable of removing 85% of the TSS and must have a volume drawdown of at least 48 hours (but not more than 120 hours).
- Any stored stormwater must be discharged at a rate equal to or less than the pre-development discharge rate for the 1-year, 24-hour storm.

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[784] North Carolina Forest Service. About N.C. Forest Service, http://ncforestservice.gov/about_ncdfr.htm

[785] North Carolina Department of Environment and Natural Resources, Division of Water Quality. Nonpoint Source Management Program: Forestry, http://portal.ncdenr.org/c/document_library/get_file?uuid=7c190a65-5766-42c3-a145-2d21056dfdd1&groupId=38364 See also *North Carolina Nonpoint Source Program 2010 Annual Progress Report*, p. 31.

[786] North Carolina Forest Service, *Water Quality, Best Management Practices Manual,* pp. 22 -23, http://ncforestservice.gov/water_quality/bmp_manual.htm

[787] North Carolina Forest Service, Water Quality, Summarizing Forestry BMPs, http://ncforestservice.gov/water_quality/what_are_bmps.htm

[788] North Carolina Forest Service, Water Quality, *Best Management Practices Manual,* pp. 22, 24.

[789] National Council for Air and Stream Improvement. *Compendium of Forestry Best Management Practices for Controlling Nonpoint Source Pollution in North America,* Technical Bulletin 966, September 2009 http://www.ncasi.org/Publications/Detail.aspx?id=3204

[790] North Carolina, Division of Water Quality. Universal Stormwater Management Program, http://portal.ncdenr.org/web/wq/ws/su/usmp

- The impervious surface must not exceed 36% of the area in new developments within critical areas of water supply watersheds.
- No new impervious surfaces are allowed within the 100-year floodplain, except for roads, paths and water dependent structures. If a 100-year floodplain has not been delineated, no new impervious development is allowed within 9 m of a water body.[791]

The Division of Water Quality has produced a manual of low impact best practices for stormwater management.[792]

Huntersville, which lies within commuting distance of Charlotte, is a good example of the new approach. In 2010 the town had a population of 47,000.[793] Very rapid urban growth (400% in ten years) led to increasing sedimentation and pollutant loading in the local creek. It was listed as a CWA Section 303 Impaired Water and action was necessary, especially as the creek lies upstream of a drinking water intake.[794] In 2003 the town adopted a Water Quality Ordinance to encourage the use of LID and in 2007 it passed the Post-Construction Storm Water Ordinance.[795] The town has a produced a water quality design manual and a Site Evaluation Tool, which is used to assess and compare pre- and post-development runoff, to help site design and evaluate BMPs.

The North Carolina State University Water Quality Group has paid considerable attention to reducing polluted runoff from urban areas and set up a LID group to help practitioners find information. North Carolina has streamlined the principles of LID to five key strategies:

- Conserve natural areas;
- Minimize development impacts through design and techniques;
- Maintain time of concentration;
- Storage, detention and filtration of integrated management practices; and
- Pollution prevention and education.[796]

The group has developed a comprehensive LID guide[797] and provides training for municipal officials.

Swannanoa River Success Story

The Swannanoa River, located in the mountainous region of western North Carolina, was receiving so much sediment from residential and commercial runoff that the water quality was rated "poor" on the biological integrity standard.[798] Two stream segments with a total length of 22 km were added to the state's 303(d) list for impaired biological integrity. The non-profit RiverLink and other project partners

[791] North Carolina, Division of Water Quality. Universal Stormwater Management Program, Specifications, http://portal.ncdenr.org/web/wq/ws/su/usmp
[792] North Carolina, Division of Water Quality. Stormwater Best Practices Manual, 2007 and updates, http://portal.ncdenr.org/web/wq/ws/su/bmp-manual
[793] Wikipedia. Huntersville, North Carolina, http://en.wikipedia.org/wiki/Huntersville,_North_Carolina
[794] Charlotte-Mecklenburg Stormwater Services. Huntersville's Water Quality Ordinance, Power Point Presentation, http://www.charmeck.org/stormwater/regulations/Documents/Huntersville%20LID%20Documents/HuntersvilleLIDBackground.pdf. This town was recommended as an example by Rich Gannon, Supervisor, NPS Unit, Division of Water Quality, personal communication with Mary Griffiths, December 5, 2011.
[795] Charlotte-Mecklenburg Stormwater Services. Huntersville LID, http://www.charmeck.org/stormwater/regulations/Pages/LIDHuntersville.aspx
[796] North Carolina State University. What is the NC LID Group? http://www.bae.ncsu.edu/topic/lid/about.html
[797] North Carolina State University. *Low Impact Development: A Guidebook for North Carolina*, North Carolina Cooperative Extension, June 2009, 310 pages, http://www.ces.ncsu.edu/depts/agecon/WECO/lid/documents/NC_LID_Guidebook.pdf
[798] U.S. EPA. Nonpoint Source Success Stories, North Carolina Swannanoa River: Implementing Urban Best Management Practices Improves Water Quality, http://water.epa.gov/polwaste/nps/success319/nc_swan.cfm

obtained funding from an EPA Section 319 grant and another source totalling about $900,000, which enabled them to implement BMPs to minimize the amount of sediment reaching the river. These included riparian planting and stream bank restoration, conservation easements that provided a 90 m buffer along 2 km of stream, as well as bioretention cells and rain gardens, to slow discharge. By 2010 both segments had been delisted due to significant improvements in water quality.[799]

4.3.7 Watershed Management

The Division of Water Quality adopted basin-wide planning 20 years ago. The responsibility for watershed protection was delegated to local government,[800] so watershed-specific plans could be developed to focus on the local issues.[801] The Division of Water Quality provided information about the Clean Water Management Trust Fund and CWA Sections 319 and 205(j) Grants to assist with targeting restoration and protection activities to Impaired and High Quality Waters.[802] This has resulted in different management requirements in different watersheds. For example, the Goose Creek Watershed requires undisturbed riparian buffers that are 60 m wide for water bodies within the 100-year floodplain and 30 m wide for water bodies beyond the 100-year floodplain.[803] In contrast, the Neuse River Basin management strategy for nutrient sensitive waters sets the minimum buffer width at 15 m, divided into two zones.[804]

4.3.7.1 Water Quality Trading

Water quality trading has been adopted in several watersheds in North Carolina to cost-effectively reduce water pollution. The trading is supported by state regulation that gives polluters the option of paying a nutrient offset fee to the North Carolina Ecosystem Enhancement Program (NCEEP) or other bodies that operate an offset scheme.[805] The NCEEP uses the money to restore riparian areas in watersheds targeted under the program, actively seeking landowners that have sites that need restoration.[806] A sister program may also be used to mitigate unavoidable stream, buffer and wetland habitat impacts from transportation infrastructure improvements.[807] The legislation has separate sections that specify the rules for water

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[799] *North Carolina Nonpoint Source Program 2010 Annual Progress Report*, p. 4.
[800] North Carolina, Division of Water Quality. Water Supply Watershed Protection Plan, Model Watershed Protection Ordinance, http://portal.ncdenr.org/web/wq/swp/ws/wswp/modelordinance
[801] North Carolina Division of Water Quality. Basinwide Water Quality Plans, http://portal.ncdenr.org/web/wq/ps/bpu/basin
[802] *North Carolina Nonpoint Source Program 2010 Annual Progress Report*, p. 60.
[803] North Carolina Administrative Code. Title 15A, 02b .0605 Site Specific Water Quality Management Plan for the Goose Creek Watershed (Yadkin Pee-Dee River Basin): Riparian Buffer Widths, http://reports.oah.state.nc.us/ncac/title%2015a%20-%20environment%20and%20natural%20resources/chapter%2002%20-%20environmental%20management/subchapter%20b/15a%20ncac%2002b%20.0605.html
[804] North Carolina Administrative Code. Title 15A, 02B .0233 Neuse River Basin: Nutrient Sensitive Waters Management Strategy: Protection and Maintenance of Existing Riparian Buffers, http://reports.oah.state.nc.us/ncac/title%2015a%20-%20environment%20and%20natural%20resources/chapter%2002%20-%20environmental%20management/subchapter%20b/15a%20ncac%2002b%20.0233.html
[805] North Carolina Administrative Code, 15A NCAC 02B .0240 Nutrient Offset Payments, http://portal.ncdenr.org/c/document_library/get_file?uuid=349044bb-95ed-4186-b2f2-bb64633c1513&groupId=38364
[806] North Carolina, Division of Water Quality. *Neuse River Basinwide Water Quality Plan*, 2009, p. 437, http://portal.ncdenr.org/c/document_library/get_file?uuid=e438d6bc-d147-4d7b-8224-08e5a7c74b86&groupId=38364 This report has the most up-to-date information, as the Neuse Nutrient Strategy website is outdated, according to Rich Gannon, Supervisor, NPS Unit, Division of Water Quality, personal communication with Mary Griffiths, December 5, 2011. Thus, although the Neuse Basin is the "trendsetter," information about it must be gleaned from this plan for the fourth cycle of operation.
[807] North Carolina, Division of Water Quality. *Neuse River Basinwide Water Quality Plan*, 2009, p. 437.

quality trading in specific watersheds, including the Tar-Pamlico River Basin and the Neuse River Basin (see sections 4.3.7.2 and 4.3.7.3). The experience in these basins has led to the development of nutrient management strategies in other basins, including those for Jordan Lake (initiated in 2002, with new rules effective in 2009)[808, 809] and Falls Lake (approved December 2010).[810] These two basins have rules for agriculture and stormwater (with separate requirements for existing development that predated stormwater controls, and for new development) as well as for wastewater discharge. The plans allow trading with anyone within the basin to meet on-site requirements.[811] Starting with a model ordinance that will be implemented in 2012, new development will also be able to pay fees for off-site offsets.

4.3.7.2 Tar-Pamlico River Basin Nutrient Strategy

The Tar-Pamlico Nutrient Strategy features as one of the EPA's success stories, so is described in some detail.[812] However, it also provides insight into the difficulties in reducing NPSP and achieving tangible improvements in water quality.

The 15,500 km^2 Tar-Pamlico River Basin covers about one-eighth of the state of North Carolina and is slightly larger than the Beaver River Basin in Alberta. In the mid-1980s, high levels of nutrients from row crops and confined animal feeding operations were causing harmful algae blooms, low oxygen levels and fish kills and severely affecting the Albemarle-Pamlico Sound.[813, 814] It was estimated that approximately 85% of the nutrients came from NPSP or forest land.[815] Modelling of the estuary was completed in 1993 and this was used to develop a water quality management plan.[816] The voluntary strategy for reducing NPSP was too slow, so the Environmental Management Commission called for regulatory requirements,[817] which were set out in the 2001 Tar-Pamlico Nutrient Strategy.

The strategy has two **agricultural rules**. The first requires farmers in the basin to implement land management practices that achieve a 30% reduction in nitrogen loading from 1991 levels and keep

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[808] North Carolina, Division of Water Quality. Jordan Lake Nutrient Management Strategy, Fact Sheet, http://portal.ncdenr.org/c/document_library/get_file?uuid=fd6c684b-2c8e-4617-a890-551ad77cd680&groupId=235275

[809] North Carolina, Division of Water Quality. Nonpoint Source Management Program, http://portal.ncdenr.org/web/wq/ps/nps See links at left of page for information on the basin-specific nutrient strategies.

[810] North Carolina, Division of Water Quality. Falls Lake Nutrient Management Strategy, http://portal.ncdenr.org/web/wq/ps/nps/fallslake

[811] Rich Gannon, Supervisor, NPS Unit, Division of Water Quality, personal communication with Mary Griffiths, December 5, 2011.

[812] North Carolina Department of Environmental Management. Tar-Pamlico River Basinwide Water Quality Management Plan, December 1994, http://h2o.enr.state.nc.us/basinwide/documents/Tar-PamlicoRiverBasinwideWQMgmtPlan1994.pdf

[813] North Carolina Division of Water Quality. Tar-Pamlico Nutrient Strategy – Introduction, http://portal.ncdenr.org/web/wq/ps/nps/tarpamlico. See also North Carolina Division of Water Quality, Tar-Pamlico River Nutrient Strategy, Fact Sheet, undated http://portal.ncdenr.org/c/document_library/get_file?uuid=156c787b-8904-4c98-9fa3-daa86de64124&groupId=38364

[814] EPA. North Carolina: Tar-Pamlico Basin - Agricultural Management Strategy Reduces Instream Nutrients, http://www.epa.gov/owow/NPS/success/state/nc_tar.htm

[815] Rich Gannon, Supervisor, NPS Unit, Division of Water Quality, personal communication with Mary Griffiths, December 5, 2011.

[816] North Carolina Department of Environmental Management. Tar-Pamlico River Basinwide Water Quality Management Plan, December 1994, http://h2o.enr.state.nc.us/basinwide/documents/Tar-PamlicoRiverBasinwideWQMgmtPlan1994.pdf The basinwide plan is updated every five years. The most recent is Tar-Pamlico Basinwide Water Quality Plan, 2010, http://portal.ncdenr.org/web/wq/ps/bpu/basin/tarpamlico/2010

[817] North Carolina, Division of Water Quality. Tar-Pamlico Nutrient Strategy Rules, http://portal.ncdenr.org/web/wq/ps/nps/test/tarrule The page includes links to the rules for different sectors.

phosphorus at or below 1991 levels. The second rule sets out the process for achieving these goals. "Farmers, who are involved in the commercial production of crops or horticultural products, or whose livestock or poultry holdings exceed specified numbers, are subject to the rule and required to register with their local advisory committee. Registration helps farmers get details on rule options and technical and cost share assistance."[818] Two organizations have the task of overseeing the implementation of the agricultural rules: the Basin Oversight Committee and 14 local advisory committees. The Basin Oversight Committee comprises representatives from governmental, environmental, farming and scientific communities, and the local advisory committees include farmers and local agricultural representatives who develop the local strategy and submit annual progress reports to the Basin Oversight Committee.

Progress is tracked using a nutrient accounting software model.[819] In 2009, "[A]griculture collectively achieved an estimated 50% reduction in nitrogen loss compared to the 1991 baseline, continuing to exceed the rule-mandated 30% reduction,"[820] and each local advisory committee attained the minimum 30% reduction. The most significant cause of the reduction is better fertilizer management, but BMPs (which includes buffer zones from 7 to 30 m wide) and cropping shifts also help reduce nutrient runoff.

The strategy has a **nutrient management rule** that requires all those who apply fertilizer in the basin (including those who grow crops, manage golf courses, or manage lawns and gardens) to "either take state-sponsored nutrient management training or have a nutrient management plan in place for the lands to which they apply fertilizer."[821] The only exempted group is residential landowners, and the Division of Water Quality requires local governments to conduct outreach to educate them on domestic fertilizer use and other activities that can affect water quality. Although this training process worked for agricultural producers, it was not so successful for turf managers, as insufficient resources were available to conduct full outreach and ensure compliance.[822]

There are three **rules to protect buffers** in the strategy:

- The buffer protection rule says that the buffer zone must be maintained at a minimum 15 m, with the inner 9 m being most strongly protected.[823]
- The buffer mitigation rule makes it possible to get approval to undertake some activities in a buffer zone if the required mitigation measures are followed.
- The buffer delegation rule enables local governments to obtain authority to implement buffer rules within their jurisdiction.

Legislation sets out separate specifications for forest buffers and for local governments to prevent runoff from new development.[824]

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[818] North Carolina, Division of Water Quality. Tar-Pamlico Agriculture Rule, http://portal.ncdenr.org/web/wq/ps/nps/tarpamlicoagriculture

[819] The Nutrient Loss Estimation Worksheet tracking results and annual reports are available online at http://portal.ncdenr.org/web/wq/ps/nps/tarpamlicoprogress

[820] Tar-Pamlico Basin Oversight Committee. Annual Progress Report on the Tar-Pamlico Agricultural Rule (15 A NCAC 02B.0256) A Report to the NC Environmental Management Commission, Crop Year 2009, http://portal.ncdenr.org/c/document_library/get_file?uuid=0d97569c-8b7d-4227-a923-c4b207f95313&groupId=38364

[821] North Carolina, Division of Water Quality. Tar-Pamlico Nutrient Management Rule, http://portal.ncdenr.org/web/wq/ps/nps/tarpamliconutmanrule See also the link to the rule itself.

[822] Rich Gannon, Supervisor, NPS Unit, Division of Water Quality, personal communication with Mary Griffiths, December 5, 2011.

[823] North Carolina, Division of Water Quality. Tar-Pamlico Buffer Protection Rules, http://portal.ncdenr.org/web/wq/ps/nps/tarpamlicobuffer

[824] North Carolina Administrative Code. 15A NCAC 02B .0259 Tar-Pamlico River Basin: Nutrient Sensitive Waters Management Strategy: Protection and Maintenance Of Existing Riparian Buffers,

The **stormwater rule** requires a number of cities and counties in the Tar-Pamlico basin to adopt stormwater management. "Local stormwater programs are to include the permitting of new development to prevent erosion, reduce nitrogen runoff by 30 percent compared to pre-development levels, and to keep phosphorus inputs from increasing from predevelopment levels."[825] If the computed nitrogen export from the land will exceed certain thresholds, a new developer must implement BMPs or take part in a regional management strategy. The Nutrient Offset option means paying the third party to offset their nutrient releases by undertaking a nutrient-reduction program somewhere else within the hydrologic area, either through the Ecosystem Enhancement Program or other third party provider, as described in section 4.3.7.1, above.[826]

Although point source pollution is a relatively small part of the load in the Tar-Pamlico Basin, **point-to-non-point source trading** was introduced in Phase 1 (1990-1994) of the Tar-Pamlico Nutrient Strategy as a cost-effective way for point-source dischargers to meet their collective loading cap and to help fund agricultural BMPs to reduce NPSP in the basin. The Tar-Pamlico Basin Association, which represented the largest point source wastewater dischargers in the basin, agreed to either reduce their nutrient loading or, if they exceeded an annual collective loading cap, to fund agricultural BMPs through the state's existing Agriculture Cost Share Program.[827] Farmers do not get any credits toward agriculture rule requirements for implementing BMPs financed through this offset plan, as the credits accrue to the dischargers' association.[828] "Thus, the Tar-Pamlico program establishes responsibility at the group level as opposed to the individual level and there is no individual polluter-level transaction. An advantage is that those individual transaction and tracking costs are spared by using an existing program (cost share) combined with minor additional administrative costs of tracking the point source loads annually."[829]

In Phase 2 (1994-2004), TMDL requirements were used to set nitrogen and phosphorus caps from both point and non-point sources. So far in Phase 3 (2005-2014), the Basin Association continues to stay below the caps and there has been no trading, but the caps have served as a "stick" to encourage members of the Association to make improvements cost-effectively, as they otherwise need to make plant improvements to expand or renovate;[830] the provisions remain in place to allow for cost-effective nutrient reductions.

Reductions have been achieved in point sources (which can be monitored) and the required accounting shows that agricultural operations are implementing BMPs as they are supposed to. However, the Supervisor of the NPS program has pointed out that the estuary has not recovered because the loading has

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http://reports.oah.state.nc.us/ncac/title%2015a%20-%20environment%20and%20natural%20resources/chapter%2002%20-%20environmental%20management/subchapter%20b/15a%20ncac%2002b%20.0259.html

[825] North Carolina, Division of Water Quality. Tar-Pamlico Stormwater Rule, http://portal.ncdenr.org/web/wq/ps/nps/tarpamstorm

[826] North Carolina, Division of Water Quality. Nutrient Offset Program, Introduction, http://portal.ncdenr.org/web/wq/ps/nps/nutrientoffsetintro

[827] North Carolina, Division of Water Quality. Tar-Pamlico Basin, Point Source Agreements, http://portal.ncdenr.org/web/wq/ps/nps/tarpampointsource

[828] Rich Gannon, Supervisor, NPS Unit, Division of Water Quality, North Carolina, personal communication with Mary Griffiths, December 1, 20l1.

[829] North Carolina, Division of Water Quality. Frequently Asked Questions about the Tar-Pamlico Nutrient Trading Program, August 2001, http://portal.ncdenr.org/c/document_library/get_file?uuid=f56812be-a5bc-46ac-be4a-752057e73c1a&groupId=38364

[830] Rich Gannon, Supervisor, NPS Unit, Division of Water Quality, North Carolina, personal communication with Mary Griffiths, December 1, 20l1.

not been substantially reduced.[831] This might be due to the ongoing release of nutrients from river sediments or deficiencies in the accounting methods. The agricultural NPSP reductions are based on the expected reduction in nitrogen from the implementation of agricultural BMPs as determined from empirically-based spread sheets which give the nitrogen loss at the edge of the field. This is different from the loading to the stream, which may also come via groundwater, airborne ammonia pollution from Concentrated Animal Feeding Operations (CAFOs) that is re-deposited near the field, and from historic nutrients released from sediments. A research project using paired watersheds has been designed to assess the relationship between field-edge values and water quality. Another problem has been to get golf course managers and homeowners to reduce the rates of fertilizer use and keep nutrients off impervious surfaces or to apply fertilizer according to a plan.

The Tar-Pamlico example shows the importance of addressing all sources of NPSP and of carefully evaluating the effectiveness of BMPs. It also shows that visible improvements in water quality can take a long time to achieve.

4.3.7.3 Neuse River Basin Nutrient Management Strategy

The Neuse nutrient management strategy – similar in many respects to the Tar-Pamlico – is another EPA Success Story[832] and has been described as the "trendsetter."[833] There is more urban development in the Neuse River Basin than in the Tar-Pamlico and in 2009 an estimated 1,600 km of river in the basin were affected by urban NPSP, compared with approximately 1,100 km affected by agriculture and forestry.[834] It seems that the strategy has reduced nitrogen loading to the rivers, although this has not yet resulted in improvements in the estuary.

The Neuse River Basin nutrient management strategy was adopted in 1997.[835] The agricultural community adopted various BMPs including buffers, contour planting, no-till planting, and creek fencing which resulted in a decrease in nitrogen loading to the estuary that exceeded the 30% reduction goal called for in the TMDL.

As in the Tar-Pamlico, the Neuse River Basin nutrient management strategy includes provision for nitrogen trading between point and non-point sources.[836] The Neuse Stormwater Rule requires 15 of the largest and fastest-growing local government districts in the basin to develop a local stormwater program that includes stormwater plans for new developments, protection of riparian buffers and public education action plans.[837] New urban developments are required to implement BMPs to lower nitrogen export as far as possible, but can also offset part of the nitrogen off-site release by making payments to the North

[831] Rich Gannon, Supervisor, NPS Unit, Division of Water Quality, personal communication with Mary Griffiths, December 5, 2011. Most of this paragraph is based on his evaluation.
[832] EPA. Success Stories, North Carolina: Neuse River Basin, Basin-wide Cleanup Effort Reduces Instream Nitrogen, http://www.epa.gov/owow/NPS/success/state/nc_neu.htm
[833] Rich Gannon, Supervisor, NPS Unit, Division of Water Quality, personal communication with Mary Griffiths, December 5, 2011. Unfortunately, the Neuse Nutrient Management Strategy website is outdated, so the only recent information about the program is in the 2009 Basinwide Water Quality Plan.
[834] North Carolina, Division of Water Quality. Neuse River Basinwide Water Quality Plan, 2009, p. 5, http://portal.ncdenr.org/c/document_library/get_file?uuid=e438d6bc-d147-4d7b-8224-08e5a7c74b86&groupId=38364
[835] North Carolina, Division of Water Quality. Neuse Nutrient Strategy, http://portal.ncdenr.org/web/wq/ps/nps/neuse
[836] EPA. Water Quality Trading Toolkit, Appendix A, Neuse River Basin Nutrient Sensitive Waters Management Strategy, pp. A-73 to A-80, http://www.epa.gov/npdes/pubs/wqtradingtoolkit_app_a_case_studies.pdf
[837] North Carolina, Division of Water Quality. Neuse River Basinwide Water Quality Plan, 2009, p. 462.

Carolina Ecosystem Enhancement Program nutrient offset program. [838] Under this system, approximately 13,600 kg of nitrogen are offset annually in the basin.[839] Some water quality improvements were noted during the 2008 reporting period. The 2009 report states that "Since full implementation of the nutrient reduction strategy, nitrogen loads from point sources have been reduced by 65 percent and the agriculture community has reduced their estimated nitrogen loss from cropland and pastureland by approximately 45 percent. Over 1,850 fertilizer applicators have received nutrient management training and the 15 local governments covered under the Neuse Stormwater Rule have adopted and implemented local stormwater programs to limit nitrogen inputs from stormwater runoff resulting from new development."[840] These results suggest the strategy has been a success, but the data do not show the required 30% reduction in total nitrogen loading at the estuary. This failure may be due to the year-to-year variability in precipitation and flow, and it seems from trends that there is more than a five-year time lag in achieving the expected reduction at the end of the river.

4.3.8 Progress and Effectiveness

Over 200 TMDLs were established in North Carolina and in many cases water quality standards have now been achieved.[841] The basin-wide approach has shown that it is possible to impose caps, reduce point source discharges and encourage the implementation of BMPs for NPSP. However, even when there is apparent success in the estimated reduction of NPSP, as in the Tar-Pamlico and Neuse Basins, it may not result in an immediate improvement in the environment. NPSP is a complex problem and, according to the Supervisor of the NPS Program, is "woefully underfunded"[842] compared with point source pollution for which the EPA has traditionally provided far more money. He points out that "If you want real success stories for NPS strategies, you need to get down to small watersheds," where success has often been the result of voluntary restoration initiatives, which get access to funding and drive the projects forward.

There continue to be ongoing challenges to municipal efforts to reduce NPSP:

- Local municipalities have to take the initiative to introduce LID.
- State permitting process may be an impediment to change, as it is necessary to remove requirements in local ordinances.
- LID practices may not compete cost-wise with a standard "pipe and pond" approach. It is difficult to quantify the effect of, for example, disconnecting downspouts.
- There are concerns about the cost of long-term maintenance costs of LID.
- It is difficult for the local government to monitor the implemented changes, to ensure they are still in place and being effective. [843]

[838] Ibid. p. 437. The reference refers to the Wetlands Restoration Fund, but it seems from p. 49 of this report that the Fund is now part of the North Carolina Ecosystem Enhancement Program.
[839] Ibid. p. 462.
[840] Ibid. p. 7.
[841] North Carolina Division of Water Quality, *North Carolina Nonpoint Source Program 2010 Annual Progress Report*, October 2009 – September 2010, p. 9, http://portal.ncdenr.org/c/document_library/get_file?uuid=81dcfb7a-95f5-4f82-a5f8-44a340bc6451&groupId=38364
[842] Rich Gannon, Supervisor, NPS Unit, Division of Water Quality, personal communication with Mary Griffiths, December 5, 2011.
[843] Ibid. All points in the list were mentioned by Rich Gannon.

4.4 Oregon

As the NPSP project team directed, the scope of work for Oregon was limited to Portland and the Willamette River Basin.

4.4.1 Oregon at a Glance

- *Portland first implemented BMPs to reduce stormwater runoff from municipal property, including road allowances, and extended the program to encourage private property owners to adopt LID practices.*
- *The Willamette Partnership, a coalition of conservation, business, agricultural and scientific leaders has developed a market-based approach to ecosystem services. The trading system, which includes wetlands and riparian habitat, might be adapted to apply to NPSP.*

4.4.2 Overview

Oregon has an area of approximately 250,000 km^2, so is about two-fifths the size of Alberta, but the population of 3.8 million is comparable to Alberta's.[844] The landscape is diverse, with a large variation in elevation from sea level to Mount Hood, over 3,400 m high.[845] Oregon has approximately 15 main river basins.[846] Some rivers flow north into the Columbia River, which forms much of the divide with the State of Washington, some flow east to Idaho and some short ones flow west to the Pacific Ocean. Oregon has a generally temperate climate, with two broad climatic zones on either side of the Cascade Range, the western portion having more precipitation and more moderate temperatures.[847] The average annual precipitation in Portland is 94 cm, nearly all of which falls as rain; this is about twice the precipitation of Edmonton or Calgary (48 and 41 cm, respectively).

The state is the largest lumber producer in the U.S. and is a leader in clean technologies, including renewable energy and high-tech manufacturing.[848] The Willamette River Basin has an area of nearly 30,000 km^2, around 2.5 million people and about 75% of Oregon's economic activity.[849] At its northern end where the Willamette River joins the Columbia, lies Portland, with a population of nearly 600,000.[850]

The Department of Environmental Quality estimates that 75% of the sub-basins in Oregon are primarily affected by forestry and/or agricultural NPSP, with the remainder affected by point and non-point sources.[851] Oregon's NPS program has been broadened to protect groundwater as well as surface water. In 2010 the Department of Environmental Quality started implementing a watershed approach to water quality management. More than 40 local, state, and federal regulatory and non-regulatory programs address NPSP.[852]

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[844] U.S. Bureau of Census. Quick Facts, http://quickfacts.census.gov/qfd/states/41000.html
[845] Wikipedia. Mount Hood, http://en.wikipedia.org/wiki/Mount_Hood
[846] Oregon Department of Environmental Quality. *Oregon Nonpoint Source Pollution Program 2010 Annual Report,* April 2011, p. 69, http://www.deq.state.or.us/wq/nonpoint/docs/annualrpts/rpt10.pdf
[847] Oregon – Climate, http://www.city-data.com/states/Oregon-Climate.html
[848] Business Oregon. Oregon's Industries, http://www.oregon4biz.com/The-Oregon-Advantage/Industry/
[849] The Willamette Partnership. http://willamettepartnership.org/about-the-willamette-basin
[850] U.S. Census Bureau. Quick Facts, http://quickfacts.census.gov/qfd/states/41/4159000.html
[851] Bureau of Land Management, Forest Service and Oregon Departmental Quality. *5 Year Progress Report,* March 2010, Appendix, p. 30, http://www.deq.state.or.us/wq/nonpoint/docs/5YearProgRepFinal201003.pdf
[852] Oregon Department of Environmental Quality. NPS Program Implementation, http://www.deq.state.or.us/wq/nonpoint/implementation.htm

4.4.3 Legislation, Funding, Data Collection and Reporting

4.4.3.1 Legislation

Oregon's NPSP program is designed to meet the federal requirements of the CWA.[853] The Oregon Water Enhancement Board (OWEB) has broad authority to carry out watershed enhancement and restoration, conduct education and outreach and provide funding for a range of activities.[854] The agency is led by a citizen board drawn from the public at large, tribes, and federal and state natural resource agency boards and commissions.

4.4.3.2 Funding

As in all states, funding is available under provisions in the federal CWA, Section 319, and the Clean Water State Revolving Fund also gives loans for NPSP projects.[855] In 2010 nearly $1.4 million was provided in grants and more than $11 million in loans.[856] The OWEB provides grants for local projects designed to improve streams and wetlands, including support for local watershed councils.[857] Its funds come from the Oregon Lottery, federal dollars, and salmon license plate revenue.[858]

4.4.3.3 Data Collection

Oregon gathers data to establish TMDLs for streams that are listed as impaired under the federal CWA, Section 303(d). The Department of Environmental Quality uses volunteers for water quality monitoring on smaller streams and in addition to basic water quality sampling, has "initiated conversations about incorporating volunteer organizations into stratified basin wide probabilistic sampling of biological water quality indicators to assess TMDL and local program effectiveness."[859]

4.4.3.4 Reporting

Oregon's Annual Report to the EPA on its NPSP program provides a comprehensive review of all activities undertaken, the most recent report being for fiscal year 2010.[860] Efforts are made to report on environmental outcomes, rather than administrative measures of success such as dollars spent or projects approved.[861] The OWEB also has a monitoring and reporting program, which focuses on watershed health.[862]

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[853] Oregon Department of Environmental Quality. *Oregon Nonpoint Source Pollution Program 2010 Annual Report,* April 2011, p. E-3, http://www.deq.state.or.us/wq/nonpoint/docs/annualrpts/rpt10.pdf

[854] Oregon State Archives. Oregon Watershed Enhancement Board, http://arcweb.sos.state.or.us/pages/rules/oars_600/oar_695/695_tofc.html

[855] Oregon Department of Environmental Quality. NPS Program Implementation, http://www.deq.state.or.us/wq/nonpoint/implementation.htm. See also *Oregon Nonpoint Source Pollution Program 2010 Annual Report,* p. 23.

[856] *Oregon Nonpoint Source Pollution Program 2010 Annual Report,* p. E-2.

[857] Oregon State Archives. Oregon Watershed Enhancement Board. Support for watershed councils is set out in Division 40.

[858] Oregon Watershed Enhancement Board. About Us, http://www.oregon.gov/OWEB/about_us.shtml

[859] *Oregon Nonpoint Source Pollution Program 2010 Annual Report,* p. 37 and 80.

[860] *Oregon Nonpoint Source Pollution Program 2010 Annual Report.*

[861] Ibid. p. 49.This work is being done through the Conservation Effectiveness Partnership, which is a three-way partnership between the USDA Natural Resource Conservation Service, the Oregon Watershed Enhancement Board, and the Oregon Department of Environmental Quality.

[862] Oregon Watershed Enhancement Board. http://www.oregon.gov/OWEB/

4.4.4 Municipal Stormwater

The City of Portland has a combined sewer system and in the early 1990s, in response to its NPDES permit, decided to develop sustainable stormwater management.[863] Although the primary aim of the Stormwater Management Plan is to reduce flows through the combined sewer system,[864] many of the best practices are relevant to NPSP. Portland's municipal program is highly regarded worldwide and several BMP projects have won awards.[865]

"The city's code requires on-site stormwater management for new development and redevelopment, and encourages the use of green infrastructure techniques to meet this objective. In addition, new city-owned buildings are required to have a green roof covering 70% of the roof area. As an incentive for other buildings, a zoning bonus that allows additional square footage is available for those that install a green roof." [866]

The "Grey to Green" BMPs for the City's urban water management include a comprehensive suite of LID methods, such as ecoroofs on city property, green streets with vegetated curb extensions or streetside planters, construction of swales, tree planting and the acquisition of natural areas to protect them from development and preserve floodplain function. The city's Bureau of Environmental Services conducted project and program-specific monitoring to assess the benefits of specific BMPs. They found, for example, that:

- Ecoroofs retain more than 50% of annual stormwater.
- Vegetated infiltration facilities (green streets) provide at least a 70% reduction in peak flows during intense storm events, and reduce annual flow volumes by 80%.
- These measures not only reduce flows to the combined and separated sewer systems, they also reduce erosion and pollutant runoff in areas where stormwater flows directly into streams and rivers.[867]
- There are other environmental benefits relating to health, energy and community liveability.[868]

Funding for the City's Green Program activities comes from the city's construction budget. "The 1% for Green Program collects one percent of the construction budget of City of Portland projects within the right-of-way that are not subject to the requirements of Portland's Stormwater Management Manual. These funds support green street projects that manage stormwater as well as providing other

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[863] Portland Bureau of Environmental Services. A Sustainable Approach to Stormwater Management, http://www.ci.portland.or.us/bes/index.cfm?c=34598

[864] City of Portland Bureau of Environmental Services. 2005 Portland Watershed Management Plan, March 2006, http://www.portlandonline.com/BES/index.cfm?c=38965&a=107808

[865] Water Environmental Research Foundation, Case Studies, Portland, Oregon, http://www.werf.org/livablecommunities/studies_port_or.htm

[866] Low Impact Development Center Inc. Maryland. *A Review of Low Impact Development Policies: Removing Institutional Barriers to Adoption,* December, 2007; report commissioned by California SWRCB Stormwater Program and The Water Board Academy, p. 19, http://www.waterboards.ca.gov/water_issues/programs/low_impact_development/docs/ca_lid_policy_review.pdf The cited text was based on Portland City Code Chapter 17.38, Policy Framework, Appeals, and Update Process, and C. Kloss and C. Calarusse, Rooftops to Rivers: Green Strategies for Controlling Stormwater and Combined Sewer Overflows, Natural Resources Defense Council, June 2006.

[867] City of Portland Environmental Services. Portland Watershed Management Plan, Report 2008 – 2010, p. 28, http://www.portlandonline.com/bes/index.cfm?c=38965&a=338860

[868] City of Portland Bureau of Environmental Services. Portland's Green Infrastructure: Quantifying the Health, Energy and Community Liveability Benefits, February 2010, http://www.portlandonline.com/BES/index.cfm?c=52055&a=298042

environmental and community benefits."[869] Some of the projects funded are in response to community requests.

The City also wanted private property owners to reduce runoff. "To ensure that private property owners implemented the BMP requirements, the City needed to amend codes governing new and redevelopment. Because there were a number of possible approaches that could be adopted to require BMPs, in 1996 the City created a Stormwater Policy Advisory Committee . . ., which included a diverse group of stakeholders from landscape architecture, architecture, engineering, institutional organizations, and the stormwater treatment industry, to provide input to the City on stormwater matters."[870] This committee's work led to the policy behind the city's Stormwater Management Manual.[871] It explains, for example, that stormwater must be managed on-site as far as possible, before it is discharged either to a piped system or surface drainage runoff. This is to be achieved by limiting the impervious area and directing stormwater to vegetated areas that are designed to handle it.

The City provides a financial incentive for ratepayers to prevent runoff from their property. The Clean River Rewards program, which was introduced in 2006, allows residents to save up to 100% of their on-site stormwater management charges if they adopt sufficient measures to avoid any runoff.[872] There is also an opportunity for sewer customers to help fund improvements in water quality and watersheds. "GreenBucks allows customers to contribute $1, $3, or $5 per billing period to help public schools maintain green stormwater management facilities on school property."[873] The money may be used for creating rain gardens, swales and ecoroofs in schools. The schools not only improve stormwater management, but have an educational role in displaying LID BMPs.

4.4.5 Watershed Management

In 2010 the Department of Environmental Quality initiated watershed management. "The Watershed Approach is a coordinating framework for management that focuses public, private, and non-profit sector efforts to address the highest priority problems within watersheds taking into consideration both ground and surface water flow. This approach provides a broad assessment of the status of water quality and other environmental indicators within a basin, greater opportunities for stakeholder involvement and interagency cooperation, and addresses some of the limitations of the TMDL process."[874] It will not replace the TMDL (which is required by the federal government), but "[U]nlike a TMDL, the Watershed Approach process is not limited to addressing 303(d) listings using available water quality data. It addresses surface water status for both 303(d) listings and other surface water related concerns, groundwater and upland conditions, and provides an evaluation of the environmental status of the basin as a whole."[875] As the next section shows, work at a watershed level started more than a decade ago.

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[869] City of Portland Environmental Services. Portland Watershed Management Plan, Report 2008 – 2010, p. 36, http://www.portlandonline.com/bes/index.cfm?c=38965&a=338860

[870] Water Environmental Research Foundation. Case Studies, Portland, Oregon, http://www.werf.org/livablecommunities/studies_port_or.htm

[871] City of Portland Environmental Services. Stormwater Management Manual, 2008, http://www.portlandonline.com/BES/index.cfm?c=47952& The manual contains detailed requirements to be addressed before someone applies for a NPDES discharge permit.

[872] Portland Bureau of Environmental Services. Clean River Rewards – Contain the Rain, http://www.portlandonline.com/bes/index.cfm?c=41976

[873] Portland Bureau of Environmental Services. GreenBucks: Supporting Schools, Investing in Clean Rivers, http://www.portlandonline.com/BES/index.cfm?c=52708

[874] Oregon Department of Environmental Quality. *Oregon Nonpoint Source Pollution Program 2010 Annual Report*, April 2011, p. 69, http://www.deq.state.or.us/wq/nonpoint/docs/annualrpts/rpt10.pdf

[875] Ibid.

4.4.5.1 Willamette River Basin

Monitoring by the Department of Environmental Quality showed that a range of issues needed to be addressed in the Willamette River, including sediment, dissolved oxygen, nutrients, biological criteria and water temperature. In 1996 the state governor established the Willamette River Basin Task Force,[876] which led in 2004 to the Willamette Partnership.[877] The "coalition of conservation, city, business, farm, and scientific leaders was founded to develop innovative, market-based tools that can combine with regulatory controls to deliver broad conservation benefits, at lower costs and with reduced conflict, in the Willamette River Basin."[878] Through an EPA Targeted Watershed Grant, the partnership was able to develop the technical and legal framework to establish markets for ecosystem services.[879] The initial system was to allow trading in water temperature, but the approach shows how a trading system can be established. The Ecosystem Credit Accounting System includes a General Crediting Protocol which sets out what must be done on the land to obtain credits, how credits are verified and how they can be sold and bought.[880] The initial four "currencies" are wetlands, salmonid habitat, prairie habitat and riparian habitat. Since two of these (wetlands and riparian habitat) address NPSP, a modified version of the trading system may be applicable for reducing NPSP. The system is explained in a pilot project entitled Ecosystem Credit Accounting.[881]

4.4.6 Progress and Effectiveness

Portland's implementation of BMPs is exemplary, not only in areas of government responsibility such as streets, public buildings and schools, but in the incentive given to the private sector to implement LID. The water quality trading pilot developed in the Willamette River Basin, might be a useful example for addressing NPSP.

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[876] Oregon Department of Environmental Quality. *Oregon Nonpoint Source Control Program Plan*, 2000 update, p. 5-30, http://www.deq.state.or.us/wq/nonpoint/docs/plan/plan.pdf

[877] Willamette Partnership. History of the Willamette Partnership, http://willamettepartnership.org/history

[878] Ibid.

[879] Willamette Partnership. EPA Targeted Watershed Grant, http://willamettepartnership.org/ongoing-projects-and-activities/epa-targeted-watershed-grant-1

[880] Willamette Partnership. Counting on the Environment, http://willamettepartnership.org/ongoing-projects-and-activities/nrcs-conservation-innovations-grant-1/counting-on-the-environment

[881] Willamette Partnership. *Ecosystem Credit Accounting, Pilot General Crediting Protocol: Willamette Basin*, Version 1.1, 2009, http://willamettepartnership.org/General%20Crediting%20Protocol%201.1.pdf

4.5 Vermont

4.5.1 Vermont at a Glance

- *The Agency of Agriculture is responsible for the reduction of agricultural NPSP. Farmers are required to implement Accepted Agricultural Practices that include manure management and application, and buffer zones along stream banks.*
- *Medium-sized farms operate under a General Permit that requires farmers to have a nutrient management plan; large farms are individually licensed.*
- *Agricultural BMPs may get funding through the Conservation Reserve Enhancement Program.*
- *The State has a Green Infrastructure Program and some municipalities impose restrictions on stormwater runoff that encourage LID.*
- *The Ecosystem Restoration Program has recently replaced the Clean and Clear Action Plan to implement watershed management, through a partnership of several state agencies and watershed coordinators.*

4.5.2 Overview

Vermont is a small state with a population of only 626,000 and an area of less than 24,000 km^2,[882] which is slightly smaller than the Bow River Basin. It has a humid continental climate with moderate precipitation in all seasons. Snowfall varies with topography and location, from 1.5 m to 3 m.[883] Forests (most of which are privately owned) cover 80% of the state, often growing on hillsides that were once farmed.[884] Cropland and pasture now cover only 14% of the state, with dairy farming being the main source of revenue, followed by beef cattle and calves and greenhouse and nursery products.[885] Agriculture is a major source of surface and groundwater pollution. About 90% of the phosphorus pollution affecting state waters comes from NPSP, including runoff from farms, streambanks, roadways, parking lots, construction sites and lawns;[886] poor manure handling and soil erosion are the most important causes.[887]

4.5.3 Legislation, Funding, Data Collection, Reporting

4.5.3.1 Legislation

The State's Water Pollution Control Statute addresses both point source and NPSP. The lead agency is the Department of Environmental Conservation, which carries out obligations under the federal CWA,

[882] U.S. Census Bureau. Quick Facts, http://quickfacts.census.gov/qfd/states/50000.html
[883] The Weather and Climate of Vermont, http://academics.smcvt.edu/vtgeographic/textbook/weather/weather_and_climate_of_vermont.htm
[884] Wharton, Eric H. *et al*. *Forests of the Green Mountain State*, U.S. Department of Agriculture Forest Service, Resource Bulletin, NE-158, November 2003, http://www.vtfpr.org/util/NERB158.pdf
[885] Netstate. Vermont Economy, http://www.netstate.com/economy/vt_economy.htm Agriculture in Vermont, http://academics.smcvt.edu/vtgeographic/textbook/agriculture/agriculture_in_vermont.htm. Information from a 1986 study and phosphorus TMDL for Lake Champlain.
[886] Vermont Agency of Natural Resources and Vermont Agency of Agriculture, Food and Markets. *Vermont Clean and Clear Action Plan: 2009 Annual Report*, February 2010, p. 67, http://www.leg.state.vt.us/reports/2010ExternalReports/253565.pdf
[887] Vermont Agency of Agriculture. Accepted Agricultural Practice Regulations, http://www.vermontagriculture.com/ARMES/awq/AAPs.htm

undertakes water quality monitoring and determines if water meets the required standards.[888] There are requirements to reduce stormwater runoff, not only through the federal CWA but through the state program to limit stormwater runoff from impervious surfaces, and to limit the use of phosphorus and nitrogen fertilizer.[889]

In the 1990s, the Vermont Legislature required the Department of Environmental Conservation to delegate its authority for the management of water pollution from agricultural non-point sources to the Agency of Agriculture.[890] This Agency is responsible for the planning, implementation and regulation of the Agricultural NPSP Reduction Program.[891] The Agency has a Memorandum of Understanding with respect to cooperation with the Vermont Agency of Natural Resources, which is the State water quality agency responsible for the management and enforcement of all other laws and regulations concerning water quality and wetland protection.

The Natural Resources Board's Water Resources Panel advised on Water Quality Standards that set policies for water quality, water conservation, riparian vegetation, basin planning hydrology and the classification of waters.[892] Basin planning must include strategies to protect riparian zones and requires stormwater management. The policy on NPSP authorizes the use of Accepted Agricultural Practices in agriculture and Acceptable Management Practices in forestry. The Panel developed Vermont's Wetland Rules, which include a 30 m buffer zone around Class 1 wetlands and a 15 m buffer around Class II wetlands, unless otherwise designated.[893] The Water Resources Panel "provides a forum for meaningful citizen involvement in the development of water resources management and wetlands protection policies for the State of Vermont."[894]

Act 250, which was the outcome of concern about environmental issues arising from development in the 1960s and 1970s,[895] established nine District Environmental Commissions to review all large-scale developments, subdivisions and industrial developments according to ten criteria.[896] Their work has implications for NPSP control, as their decisions and conditions may relate to soil erosion and water pollution.[897]

4.5.3.2 Funding

Funding comes from a variety of state and federal programs, as described in sections 4.5.4.2 and 4.5.7, below.

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[888] Rick Hopkins, Department of Environmental Conservation, personal communication with Mary Griffiths, November 9, 2011.
[889] Vermont Statutes. *Title 10 V.S.A. Chapter 47: Water Pollution Control*, section 1264 and 1266b, http://www.leg.state.vt.us/statutes/sections.cfm?Title=10&Chapter=047
[890] Rick Hopkins, Department of Environmental Conservation, personal communication with Mary Griffiths, November 9, 2011 and January 24, 2012. DEC still retains its authority for managing water pollution from agricultural point sources.
[891] Vermont Agency of Agriculture. Accepted Agricultural Practice Regulations, 2006, http://www.vermontagriculture.com/ARMES/awq/AAPs.htm
[892] State of Vermont, Natural Resources Board, Water Resources Panel. Water Quality Standards, 2008, http://www.nrb.state.vt.us/wrp/publications/wqs.pdf
[893] Natural Resources Board, Water Resources Panel. Vermont's Wetland Rules, 2010, http://www.nrb.state.vt.us/wrp/publications/VWR%207-16-10.pdf
[894] Natural Resources Board. Water Resources Panel, http://nrb.state.vt.us/wrp/index.htm
[895] Rick Hopkins, Department of Environmental Conservation, personal communication with Mary Griffiths, November 9, 2011.
[896] Natural Resources Board – District Commissions, Act 250, http://nrb.state.vt.us/lup/publications/nrb1.pdf
[897] Natural Resources Board. District Environmental Commissions, http://nrb.state.vt.us/lup/index.htm See links at bottom of the webpage for more information and also the Natural Resources Board homepage, http://nrb.state.vt.us/

4.5.3.3 Data Collection

The Vermont Department of Environmental Conservation undertakes water quality monitoring.[898] Its Monitoring, Assessment and Planning Program measures water quality indicators such as the biological integrity index, and evaluates them against standards or thresholds. This water quality information is used to develop watershed plans that target waters for protection or remediation.[899]

As required by the federal CWA, streams and those water bodies that do not meet the water quality standards for aquatic life are put on the state's "303(d) list" of impaired waters. TMDLs have been established for about 15 rivers.[900] Stormwater is the source of most problems, with sediment and phosphorus being problematic in a few water bodies.

4.5.3.4 Reporting

Reporting is carried out under the individual programs referred to below, especially through the former Clean and Clear Annual Report.[901] Vermont prepares semi-annual progress reports and submits those to the New England regional office of EPA. The state reports on progress under its Performance Partnership [Grant] Agreement and with respect to the listing of agreed upon Priorities and Commitments, as well as on 319 related activities through EPA's Grants Reporting and Tracking System (GRTS).[902] There is also an annual summary of the forestry Acceptable Management Best Practices Program.

4.5.4 Agriculture

4.5.4.1 Regulatory: Accepted Agricultural Practices and the Non-Point Source Pollution Reduction Program

The Vermont Agency of Agriculture has created a comprehensive program to reduce agricultural NPSP.[903] Farmers are required to follow Accepted Agricultural Practices; these are statewide rules to protect surface water quality and they affect all farms regardless of size, type and location. They were designed to be technically feasible and cost-effective for farmers to implement without government financial assistance. Practices designed to reduce rather than eliminate pollutants include:

- "Management of barnyards, manure storage structures and sites to prevent the discharge of manure or other wastes
- Standards for manure stacking including buffers to neighbors' wells and prohibitions on manure stacking on land subject to overflow from adjacent waters
- A prohibition on manure application between December 15th and April 1st
- Buffers of perennial vegetation 3 metres from the top of the streambank on cropland and 7.5 metres from the top of the bank at points of runoff."[904]

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[898] Vermont Department of Environmental Conservation, Water Quality Division. Water Quality Monitoring, http://www.vtwaterquality.org/mapp/htm/mp_monitoring.htm

[899] Vermont Department of Environmental Conservation, Water Quality Division. Monitoring, Assessment and Planning Program, http://www.vtwaterquality.org/mapp.htm

[900] Vermont Department of Environmental Conservation, Water Quality Division. TMDL Information, http://www.vtwaterquality.org/mapp/htm/mp_tmdl.htm

[901] The Clean and Clear Program has become the Ecosystem Restoration Program, and the new website is under construction at http://www.anr.state.vt.us/dec/waterq/erp.htm

[902] Rick Hopkins, Department of Environmental Conservation, January 24, 2012.

[903] Department of Environmental Conservation, Agency of Natural Resources and Agency of Agriculture. Clean and Clear Action Plan. New website at http://www.anr.state.vt.us/dec/waterq/erp.htm

[904] A full list of Accepted Agricultural Practices can be found at www.vermontagriculture.com/ARMES/awq/AAP.html

These Accepted Agricultural Practices are enforced through a complaint-driven system. Consistent with an enforcement procedure contained in a 1993 Memorandum of Understanding between the Department of Environmental Conservation and the Vermont Agency of Agriculture, the Agency of Agriculture is required to to follow up and conduct a site investigation. Complaints received by the Department of an agricultural non-point source nature are referred to the Agency of Agriculture.[905]

If farmers implement the Accepted Agricultural Practices it is presumed that they will be in compliance with the state's Water Quality Standards and Wetland Rules. However, this presumption does not exempt farmers from the requirement to comply with those standards and rules. Thus, the presumption is "rebuttable" if water quality data or the results of a water quality study show conclusive evidence that the state or federal water quality standards are not being met.[906]

The government can enforce the implementation of the Accepted Agricultural Practices through a hierarchy of measures: corrective action letters, cease and desist orders, administrative penalties and court injunctions.[907] "Over the past 5 years, from 2005 to December 2009, 85 to 91% of the farms investigated were successful in meeting the AAP requirements. This success rate includes farms that may have been found in violation of the AAPs, but made immediate corrections in response to assistance from Agency field agents."[908]

In addition to the Accepted Agricultural Practices, the Agency of Agriculture has regulatory requirements for medium and large farm operations; these requirements ensure responsible manure management and nutrient management plans that may also help reduce NPSP.[909] All medium-sized farm operations (e.g., all dairy farms with 200 to 699 mature animals) operate under a General Permit,[910] which requires that farms generating animal waste "do not have a direct discharge of waste to the waters of the state and operate in accordance with a nutrient management plan."[911] Farm operators must complete a two-page form that indicates the size and nature of their farm, whether it has a nutrient management plan, how manure is stored, whether there is a silage leachate system, etc., and sign that they will comply with all the conditions in the Medium Farm Operation General Permit.[912]

Large farm operations have to be licensed individually and the law prohibits the discharge of wastes from the production area to water bodies.[913]

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[905] Rick Hopkins, Department of Environmental Conservation, personal communication with Mary Griffiths, November 9, 2011.
[906] Division of Agricultural Resource Management and Environmental Stewardship, Vermont Agency of Agriculture. Accepted Agricultural Practice Regulations, 2006, http://www.vermontagriculture.com/ARMES/awq/AAPs.htm
[907] Ibid.
[908] Vermont Agency of Natural Resources, Vermont Agency of Agriculture, Food and Markets. *Vermont Clean and Clear Action Plan: 2009 Annual Report*, February 2010, p.72, http://www.leg.state.vt.us/reports/2010ExternalReports/253565.pdf
[909] Agency of Agriculture. Agricultural Water Quality, http://www.vermontagriculture.com/ARMES/awq/presentations.html
[910] Agency of Agriculture. Medium Farm Operations (MFO) Program, http://www.vermontagriculture.com/ARMES/awq/MFO.html
[911] Agency of Agriculture. General Permit for Medium Farm Operations, http://www.vermontagriculture.com/ARMES/awq/documents/GP_for_MFOs.pdf
[912] Agency of Agriculture. Notice of Intent to Comply, http://www.vermontagriculture.com/ARMES/awq/documents/NOIC.pdf
[913] Agency of Agriculture. Large Farm Operations Program, http://www.vermontagriculture.com/ARMES/awq/LFO.html

4.5.4.2 Best Management Practices

Vermont also encourages BMPs by providing funding, which may cover up to 80% of the cost of BMPs that are approved by the Natural Resources Conservation Service for productive land and 50% for non-production areas.[914] Funding may be available under the following programs:

- Nutrient Management Incentive Grant towards the creation of a nutrient management plan;
- Farm Agronomic Practices Program for cover cropping, no-till, ridge till, and rotation implementation;
- Alternative Manure Management Program;
- Vermont Agricultural Buffer Program; and
- Conservation Reserve Enhancement Program to help cover the cost of installing and maintaining grass or wooded buffers along state waterways.

The **Conservation Reserve Enhancement Program** (CREP) is an enhanced version of the federal Conservation Reserve Program.[915] In Vermont landowners are compensated for the loss of agricultural land that is converted to dedicated forest buffers (minimum width 10 m) or vegetated filter strips (minimum width 7.5 m) to filter runoff and trap sediments, fertilizers and pesticides.[916] The landowner or renter must maintain the buffer for either 15 or 30 years, as specified in a contract, and receives an annual rental payment, based on the area of the buffer zone. The program is a partnership between the Vermont Agency of Agriculture, the U.S. Department of Agriculture Farm Service Agency, the Natural Resources Conservation Service, and Partners for Fish and Wildlife. The federal cost-share and incentive program pays up to 90% of the cost of establishing vegetative buffers and installing permanent fencing, alternative water systems and animal stream crossings.

The CREP aims to reduce phosphorus losses from the edge of fields, but it is very difficult to determine the exact amount of phosphorus reductions that are being achieved. The program started in 2002 and by 2009 a total of about 875 ha had been enrolled in the program, covering 575 km of stream bank.[917] University of Vermont Extension collected data and, based on some very general assumptions, estimated that since the beginning of CREP, about 770 kg of phosphorus may have been trapped by CREP buffers. This may seem very little given the total cost of $1.2 million to the state (with funds matched 4:1 by Federal funds), but some of the lands had only recently been added to the program and they should continue to trap phosphorus over a long period.

4.5.5 Forestry

The Vermont Division of Forestry has a Forest Watershed Program.[918] As in agriculture, forestry uses Acceptable Management Practices to protect water quality from forestry operations. Although the law requires a permit for discharges to water, this is not necessary if operators follow the Acceptable Management Practices for Maintaining Water Quality on Logging Jobs in Vermont.[919] The practices are designed to prevent mud and logging slash from entering waterways and cover such things as truck roads,

[914] Vermont Agency of Agriculture. Agricultural Water Quality, http://www.vermontagriculture.com/ARMES/awq/AWQ.html
[915] Vermont Agency of Agriculture. Conservation Reserve Enhancement Program, http://www.vermontagriculture.com/ARMES/CREPwebsite/Home/Home.htm
[916] *Vermont Clean and Clear Action Plan: 2009 Annual Report*, p. 87, http://www.leg.state.vt.us/reports/2010ExternalReports/253565.pdf
[917] *Vermont Clean and Clear Action Plan: 2009 Annual Report*, pp. 87 and 89, http://www.leg.state.vt.us/reports/2010ExternalReports/253565.pdf
[918] Vermont Division of Forestry. Forest Watershed Program, http://www.vtfpr.org/watershed/index.cfm
[919] Department of Forests, Parks, and Recreation. Acceptable Management Practices for Maintaining Water Quality on Logging Jobs in Vermont, 1987, http://www.vtfpr.org/watershed/documents/Amp2009pdf.pdf

skid trails, surface water and stream crossings, protective strips and log landings, addressing not only the logging phase but practices to be applied after logging. For example, a protective strip which is a minimum of 7.5 m wide must be left along a stream or water body, with a larger distance between a road and stream, the distance depending on the degree of slope of the land.[920] The minimum size of the protective buffer for Heavy Cutting (that is, clearing areas of 16 ha or more on private land, for which a permit is required)[921] is the same as for small-scale operations.[922]

Unlike agriculture, the Acceptable Management Practices for Forestry are not mandatory for small-scale operations, but if there is a discharge to waters and the practices have not been followed, the operator will face fines and penalties.[923] Enforcement is conducted by the Agency of Natural Resources, but it seems there is a high level of voluntary cooperation to meet water quality laws.[924]

The Department of Forestry provides training to loggers and foresters on Acceptable Management Practices. In addition, the Portable Skidder Bridge Initiative provides education and loans to encourage the use of these bridges for temporary stream crossing.[925]

4.5.6 Municipal Stormwater

4.5.6.1 Regulatory

Stormwater runoff from urban areas is recognized as a water quality problem in Vermont,[926] and the State aims to reduce runoff through a permit system. The Department of Environmental Conservation's Water Quality Division issues separate permits for runoff from construction sites, impervious surfaces and industrial/manufacturing facilities; a development may require all three.[927]A construction permit is needed if a project disturbs more than 0.4 ha, and this requires measures to control erosion and sediment.[928] An operational permit is needed if a project will result in new impervious surfaces of 464 m^2 or more, and

[920] Acceptable Best Management Practice #14 states that: "Except for the necessary construction of stream crossings, a protective strip shall be left along streams and other bodies of water in which only light thinning or selection harvesting can occur so that breaks made in the canopy are minimal and a continuous cover is maintained. Log transport machinery must remain outside a 25 foot margin along the stream or waterbody." A table sets out the minimum distances according to the degree of slope.

[921] Vermont Division of Forestry. Heavy Cutting, http://www.vtfpr.org/watershed/heavycut.cfm and Title 10, Conservation and Development, Chapter 83, Department of Forests, section2625, Regulation of heavy cutting, http://www.vtfpr.org/watershed/reghevcut.pdf. If an application to cut is denied, appeal may be made to the Commissioner of Forests, Parks and Recreation.

[922] Gary Sabourin, Watershed Forester, Vermont Department of Forests, Parks and Recreation, personal communication with Mary Griffiths, November 10, 2011.

[923] Rick Hopkins, Department of Environmental Conservation, personal communication with Mary Griffiths, November 9, 2011.

[924] Vermont Division of Forestry. Forest Watershed Program. Vermont's Acceptable Management Best Practices Program, Annual Statewide Summary, 2010, http://www.vtfpr.org/watershed/documents/AMP%202010%20State%20Report%20(2).pdf

[925] Vermont Division of Forestry, Portable Skidder Bridge Initiative, http://www.vtfpr.org/watershed/initiative.cfm

[926] Rick Hopkins, Department of Environmental Conservation, personal communication with Mary Griffiths, November 9, 2011.

[927] Department of Environmental Conservation. *Stormwater 101, An Introduction to the Vermont Stormwater Program*, http://www.vtwaterquality.org/stormwater/docs/sw_Stormwater_101.pdf

[928] Vermont League of Cities and Towns. *Managing Stormwater through Low Impact Development (LID) Techniques*, Municipal Assistance Center Technical Paper #5, May, 2008, http://www.anr.state.vt.us/dec/waterq/stormwater/docs/sw_VLCTmodelordinance.pdf

this requires showing how it will meet the State's stormwater treatment standards with respect to water quality, channel protection, groundwater recharge and flood protection.[929]

In 2002, 25 streams were impaired primarily due to urban stormwater. The Department of Environmental Conservation knew that a large amount of work was needed to address the backlog of outdated permits and establish TMDLs. The Department decided to issue Watershed Improvement Permits instead of using the classic TMDL approach.[930]

One municipality in Vermont, South Burlington, where a lot of work was needed to address stormwater discharges, set up a Stormwater Services utility. The utility is authorized to charge a Stormwater Utility User Fee, which is assessed through an analysis of impervious surface area on properties.[931] Similar stormwater utility fees are becoming increasingly common in the U.S.[932]

There is a federal requirement for metropolitan areas with fewer than 100,000 people that have separate storm sewer systems. Since 1999 they have to apply for a General Permit for Small Municipal Separate Storm Sewer Systems (known as the MS4 permit).[933] These municipalities must undertake six measures to reduce stormwater impact: "(1) Public Education and Outreach, (2) Public Participation/Involvement, (3) Illicit Discharge Detection and Elimination, (4) Construction Site Runoff Control, (5) Post-Construction Runoff Control, and (6) Pollution Prevention/Good Housekeeping."[934] Municipalities have to inform the government what actions they are taking to comply.

Some small municipalities have decided to adopt rules to encourage LID.[935] For example, Fayston land use regulations state that: "Control of storm water runoff flows from all impervious surfaces shall be accomplished by limiting the post-development peak discharge rate from the subdivision so that it does not exceed the pre-development peak discharge rate from the site."[936]

4.5.6.2 Best Management Practices

Municipalities may undertake voluntary measures to reduce NPSP pollution by implementing LID. In addition to the usual range of BMPs,[937] measures may include standards for the protection of natural

[929] Natural Resources Board, Water Resources Panel. Water Quality Standards, 2008, http://www.nrb.state.vt.us/wrp/publications/wqs.pdf See also http://www.nrb.state.vt.us/wrp/rules.htm
[930] Department of Environmental Conservation. Urban Stormwater in Vermont, http://www.anr.state.vt.us/dec/waterq/stormwater/docs/sw_urbanswmgt.pdf
[931] South Burlington Stormwater Services. About Our Utility, http://www.sburlstormwater.com/about_us/about_us.shtml
[932] Tom DiPietro, Stormwater Superintendent, South Burlington Stormwater Utility, personal communication with Mary Griffiths, November 14, 2011.
[933] Department of Environmental Conservation, Water Quality Division. General Permit for Small Municipal Separate Storm Sewer Systems, http://www.anr.state.vt.us/dec/waterq/stormwater/htm/sw_ms4.htm
[934] Ibid. See also http://www.anr.state.vt.us/dec/waterq/cfm/ref/Ref_Stormwater.cfm
[935] Milly Archer, Water Resources Coordinator, Vermont League of Cities and Towns, personal communication with Mary Griffiths, November 16, 2011. Examples include Fayston, Woodstock, Calais and Charlotte, but some of the towns are so small that they have little information on their websites.
[936] Town of Fayston, Vermont. Land Use Regulations, December 2011, section 3.4(D), pp. 32-35, http://faystonvt.com/Permits/FaystonLandUseRegsDec2011.pdf
[937] Department of Environmental Conservation, Water Quality Division. Green Infrastructure, http://www.vtwaterquality.org/stormwater/htm/sw_green_infrastructure.htm; Best Management Practices, http://www.vtwaterquality.org/stormwater/htm/sw_LID.htm

areas, river corridors and vegetated buffers as well as restrictions on development on steep slopes to limit stormwater runoff and erosion.[938]

A Green Infrastructure Program was recently developed as an initiative of the Agency of Natural Resources with support from the Department of Environmental Conservation, the Ecosystem Restoration Program and the Department of Forests, Parks and Recreation.[939] The draft plan focuses on education and tools to implement green infrastructure. It has four objectives:

- Train professionals in Vermont in green infrastructure practices
- Help municipalities understand the impacts of stormwater runoff and work to mitigate the effects
- Inform and enable property owners to advocate for green infrastructure, by giving them access to information and training (including a plan to provide funding and feature success stories)
- Ensure that state agencies secure and commit funding for green infrastructure initiatives.

An Executive Order is in preparation, which will provide the appropriate state agencies with funds and the ability to undertake projects on state property and examine opportunities to integrate green stormwater infrastructure systems and practices into existing state programs.[940]

The Vermont League of Cities and Towns developed a model bylaw that outlines the measures that a municipality may wish to integrate in its own zoning or subdivision regulations.[941] The Department of Environmental Conservation has developed LID guidance for residential development.[942]

4.5.7 Watershed Management

Vermont requires the development of basin-specific watershed management plans[943] that address point and NPS stressors and pollution. The Ecosystem Restoration Program (formerly the Clean and Clear Action Plan) combines a regulatory approach with a non-regulatory partnership between several state agencies to improve water quality.[944] The Clean and Clear program was established in 2003 to adopt a comprehensive watershed approach to improving water quality in Lake Champlain, especially to reduce point source and NPS phosphorus loadings.[945] It aimed to help farmers reduce agricultural sources of phosphorus, protect and restore critical wetlands, reduce stream erosion, improve urban development and road construction, and reduce various point source discharges. The basis for the plan was the regulatory requirement that set a TMDL for the lake (which was approved by US EPA) and allocates an allowable load to Quebec, Vermont and New York. As the website explains:

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[938] Jenna Calvi, Green Infrastructure Coordinator, State of Vermont Stormwater Section. Green Infrastructure and Low Impact Development, presentation, June 15, 2011, http://www.vtwaterquality.org/stormwater/docs/sw_LIDwkshp_6-15JC.pdf

[939] Vermont Agency of Natural Resources. Green Infrastructure Strategic Plan, 2011-2013 (draft).

[940] Executive Order, State of Vermont. Leadership in the Use of Green Stormwater Infrastructure Practices for Managing Stormwater Runoff (draft).

[941] Vermont League of Cities and Towns. Model Low Impact Development Stormwater Management Bylaw, May 2008, available at Resource Library at www.vlct.org.

[942] Department of Environmental Conservation. *Vermont Low Impact Development Guide for Residential and Small Sites*, http://www.anr.state.vt.us/dec/waterq/planning/docs/pl_LID%20Guide.pdf

[943] Department of Environmental Conservation. Vermont Surface Water Management Strategy, Chapter 1, A Comprehensive Ambient Surface Water Monitoring Strategy, http://www.vtwaterquality.org/wqd_mgtplan/swms_ch1.htm

[944] Department of Environmental Conservation, Water Quality Division. Ecosystem Restoration Program, http://www.vtwaterquality.org/erp.htm. As this is a recent change, the Ecosystem Restoration Program website is still under construction, so some Clean and Clear Action Plan links are not available (February 15, 2012).

[945] Vermont Clean and Clear Action Plan. As of February 15, 2012, the plan was not available on the new website, http://www.anr.state.vt.us/dec/waterq/erp.htm

> "The river basin planning process will pull together and keep on track many of the complex and interrelated projects prescribed by the Lake Champlain Phosphorus TMDL for each major tributary to Lake Champlain. Watershed plans that have been developed with the public will be used as a guide for reducing phosphorus sources. In order to be successful, we will hire a watershed coordinator for each of the seven major basins draining to Lake Champlain."[946]

Watershed coordinators have an important role as they lead the development of individual basin water quality management plans, including public involvement in plan development. They also link the various state and federal agencies and local organizations that are working to improve water quality and helping to educate landowners and business owners to prevent or reduce NPSP from their property.[947] These include the Agency of Agriculture and Agency of Transportation and, within the Agency of Natural Resources, the Departments of Environmental Conservation (Water Quality Division), Forests, Parks and Recreation, and Fish and Wildlife. In the first six years of the Clean and Clear program, Vermont invested more than $50 million to improve water quality in Lake Champlain and leveraged an additional $52 million in federal funding.[948]

Although the focus was initially on the Lake Champlain watershed, the Clean and Clear Action Plan was expanded to the whole of Vermont.[949, 950] The Water Quality Division developed integrated watershed management in phases. The first phase was to integrate the monitoring, assessment and planning sections, to ensure that plans are based on scientific information. The second step was to develop the Statewide Surface Water Strategy and the third phase, which is being proposed, is tactical basin planning.[951] The strategy recognizes that basin planning involves a number of partners and that it is important not only to set attainable targets and objectives, but to define clear roles, track outcomes and monitor the commitments of participants. The planning focus is on both polluted water and on protecting areas where the quality is excellent. Also, the plans will be routinely evaluated and updated. "Every five years, in conjunction with the preparation of a Basin Plan, the regional and municipal plans associated with the basin will be reviewed to determine their consistency with 'essential water protection elements' and to identify any potential conflicts or deficiencies with regard to proposed basin planning recommendations."[952]

The most recent annual report indicates progress, including an increase in the wetland area protected and restored under the Wetland Reserve Program (which uses federal funding for voluntary efforts) and a decline in the nitrate exceedances in drinking water supplies, based on five-year rolling averages since 2002-2005. However, the phosphorus monitoring results show that the total phosphorus loading for Lake Champlain is still about double the TMDL and most of this comes from NPSP. "While overall progress in reducing phosphorus in Lake Champlain has been disappointing, there were some positive signs in the results. Phosphorus loads and flow-weighted mean phosphorus concentrations in the inflows to most

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[946] Vermont Clean and Clear, River Basin Planning. As of February 15, 2012, the plan was not available on the new website, http://www.anr.state.vt.us/dec/waterq/erp.htm

[947] Vermont Agency of Natural Resources, Vermont Agency of Agriculture, Food and Markets, *Vermont Clean and Clear Action Plan: 2009 Annual Report,* February 2010, p. 67, http://www.leg.state.vt.us/reports/2010ExternalReports/253565.pdf

[948] Ibid. p. 10.

[949] Neil Kamman, Monitoring, Assessment and Planning Program, Vermont Department of Environmental Conservation, Water Quality Division, personal communication with Mary Griffiths, November 7, 2011.

[950] *Vermont Clean and Clear Action Plan: 2009 Annual Report,* p. 68.

[951] Department of Environmental Conservation. Vermont Surface Water Management Strategy, Chapter 4, Tactical Basin Planning, http://www.vtwaterquality.org/wqd_mgtplan/swms_ch4.htm

[952] Department of Environmental Conservation, Water Quality Division. Basin Planning Process, Key Elements, http://www.vtwaterquality.org/planning/htm/pl_basinplan.htm

regions of the lake were stable or decreasing during 1991-2008 in spite of ongoing land use conversion and development in the watershed."[953]

4.5.8 Progress and Effectiveness

The EPA has nine success stories for Vermont, involving action by both federal and state agencies. One story involved the restoration of a stream (Adams Brook) through improved agricultural practices and erosion control work.[954] Monitoring showed that the biological integrity index had more than halved (i.e., improved) between 1998 and 2002. Another case, South Bay on Lake Memphremagog, was listed as an impaired water under CWA Section 303(d) in 1992 due to high phosphorus levels.[955] With federal funding under the EQIP program and some funding from the Vermont Agency of Agriculture, conservation measures were undertaken on 90 of 140 farms in two watersheds draining to the bay. Water quality standards for South Bay were met in 2005, but the challenge of reducing phosphorus levels in Lake Champlain remains.

Most success stories are for relatively small watersheds. Several involve efforts to reduce erosion from forestry on streams that were placed on the CWA Section 303(d) list, due to excessive sediment from poor logging practices.[956]

[953] *Vermont Clean and Clear Action Plan: 2009 Annual Report,* p.63.
[954] EPA. Nonpoint Source Success Stories, Vermont: Stream Restored Through Improved Agricultural Practices and Erosion Control Work, http://water.epa.gov/polwaste/nps/success319/vt_adams.cfm
[955] EPA. Nonpoint Source Success Stories, Vermont: South Bay of Lake Memphremagog, Local Farmers Help Restore Bay by Reducing Phosphorus in Runoff, http://water.epa.gov/polwaste/nps/success319/vt_south.cfm
[956] EPA. Nonpoint Source Success Stories Vermont: Logging Management Restores Dowsville Brook Tributary, http://water.epa.gov/polwaste/nps/success319/vt_dow.cfm; Logging Management Restores Joiner Brook Segment, http://water.epa.gov/polwaste/nps/success319/vt_joiner.cfm

4.6 Washington

4.6.1 Washington at a Glance

- *Partnerships with landowners effectively keeping livestock out of streams. Dairy farms and CAFOs must have nutrient management plans.*
- *Forests cover approximately half the state and there is a highly regulated forest management system with specific requirements to protect water bodies in different locations and sites.*
- *The City of Seattle has been a leader in implementing LID for a decade; the Puget Sound Partnership manual on LID has been in use for six years and the University of Washington provides LID training workshops to a large number of professionals.*
- *Shared responsibilities make it difficult for the Department of Ecology to implement or enforce measures to reduce NPSP from agriculture and forestry.*

4.6.2 Overview

Washington State's population is 6.7 million,[957] almost twice that of Alberta. The state covers 172,000 km^2, which is about one quarter of Alberta's area.[958] The Columbia River flows south from British Columbia, and much of the Columbia Plateau drains to the river, which forms part of the state's southern border with Oregon. To the west of the Plateau lie the Cascade Mountains, which are separated from the Coast Range and Olympic Mountains by the lowlands around Puget Sound. High parts of the Coast Range receive more than 350 cm of rain a year; parts of the western slopes of the Cascade Mountains receive up to 500 cm of snow while in the immediate rain shadow of the range, precipitation is only 15 cm a year.[959] About half the lands in the state are forested,[960] but agriculture is also important. About 70% of agricultural land is in crops (including apples, wheat and potatoes), with dairy products and beef cattle providing about one-quarter of agricultural revenue.[961, 962]

About one-third of the rivers and streams fail to meet state water quality standards.[963] Point sources (industry and wastewater treatment plants) are the source of about half the phosphorus, with the rest coming from NPSP sources such as stormwater runoff, septic tanks and agriculture.[964] The Department of Ecology has a Nonpoint Pollution program that addresses forestry, urban areas and working near water.[965]

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[957] U.S. Census Bureau. Washington, Quick Facts, 2010, http://quickfacts.census.gov/qfd/states/53000.html
[958] Municipal Research and Services Center, Washington. Forest Lands in Washington Counties, http://www.mrsc.org/subjects/environment/forest/timber.aspx
[959] Netstate. The Geography of Washington, http://www.netstate.com/states/geography/wa_geography.htm
[960] Municipal Research and Services Center, Washington. Forest Lands in Washington Counties, http://www.mrsc.org/subjects/environment/forest/timber.aspx and
Washington State, Department of Ecology. Land Use and Nonpoint Pollution, http://www.ecy.wa.gov/programs/wq/nonpoint/sources.html
[961] Netstate. Washington Economy, http://www.netstate.com/economy/wa_economy.htm
[962] Department of Agriculture. Agriculture: A Cornerstone of Washington's Economy, http://agr.wa.gov/AgInWA/
[963] Department of Ecology. Washington Waters, http://www.ecy.wa.gov/washington_waters/
[964] Washington State, Department of Ecology. Water Quality, Reducing Phosphorus, http://www.ecy.wa.gov/programs/wq/nonpoint/phosphorus/PhosphorusBan.html Septic tank systems serve approximately 1.4 million suburban and rural homes. Nonpoint Pollution from Urban Living, http://www.ecy.wa.gov/programs/wq/nonpoint/urban.html
[965] Washington State, Department of Ecology. Water Quality: Nonpoint Pollution, http://www.ecy.wa.gov/programs/wq/nonpoint/

4.6.3 Legislation, Funding, Data Collection, Reporting

4.6.3.1 Legislation

The *Water Pollution Control Act* authorizes the Department of Ecology to address pollution, including the power to issue enforcement orders for violations relating to NPSP.[966]

The *Watershed Planning Act* sets the requirements for watershed planning.[967] Twelve state agencies, including the Departments of Agriculture, Ecology and Natural Resources signed a Memorandum of Understanding to identify roles and responsibilities with respect to watershed planning.[968]

The Department of Agriculture has responsibility for the *Dairy Nutrient Management Act* and regulations relating to the use of pesticides and fertilizers, which are described in section 4.6.4.

The Department of Natural Resources has a lead role with respect to forestry. One objective of the *Forest Practices Act* is to "Achieve compliance with all applicable requirements of federal and state law with respect to nonpoint sources of water pollution from forest practices"[969] and to "Develop a watershed analysis system that addresses the cumulative effect of forest practices . . ."[970] It authorizes the Forest Practices Rules,[971] which address issues related to NPSP, including watershed analysis.[972] More details are given in section 4.6.5.

4.6.3.2 Funding

The Department of Ecology provides information on grants available for addressing NPSP[973] and watershed planning.[974] Funds may be available not only from the federal CWA Section 319 NPS and Conservation Reserve Enhancement Program grants, but through the Centennial Clean Water Fund, the State Revolving Loan Fund and various other sources.[975] The Small Forest Landowner Office has information on assistance available for forestry riparian easements, etc.[976] The State Stormwater Grant Program makes funding available for LID developments as well as for conventional infrastructure.[977] In 2006, the Department of Ecology received a budget of $2.5 million to help implement LID projects in the

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[966] Washington State Legislature. Chapter 90-48-037 RCW Water Pollution Control, http://apps.leg.wa.gov/rcw/default.aspx?cite=90.48.037 RCW refers to the Revised Code of Washington.
[967] Washington State Legislature, Chapter 90.82 RCW Watershed Planning, http://apps.leg.wa.gov/rcw/default.aspx?cite=90.82
[968] Department of Ecology. *Watershed Planning Act,* http://www.ecy.wa.gov/watershed/misc/background.html
[969] *Forest Practices Act,* 2011, Chapter 76.09 RCW, RCW 76.09.010(2)(g), http://www.dnr.wa.gov/Publications/fp_rules_76.09.pdf
[970] *Forest Practices Act,* 2011, Chapter 76.09 RCW, RCW 76.09.010(2)(j), http://www.dnr.wa.gov/Publications/fp_rules_76.09.pdf
[971] *Forest Practices Act,* 2011, Chapter 76.09 RCW, RCW 76.09.50, http://www.dnr.wa.gov/Publications/fp_rules_76.09.pdf
[972] Department of Natural Resources. Chapter 222-22 WAC, Watershed Analysis, http://www.dnr.wa.gov/Publications/fp_rules_ch222-22wac.pdf
[973] Department of Ecology. Financial Assistance for Nonpoint Pollution Projects, http://www.ecy.wa.gov/programs/wq/nonpoint/financial.html
[974] Department of Ecology. Watershed Management, http://www.ecy.wa.gov/watershed/
[975] Department of Ecology. *Year 2010 Report on Activities to Implement Washington State's Water Quality Plan to Control Nonpoint Source Pollution,* May 2011, pp. 2-4, unpublished.
[976] Department of Natural Resources. Small Forest Landowner Office, http://www.dnr.wa.gov/BusinessPermits/Topics/SmallForestLandownerOffice/Pages/fp_sflo_overview.aspx
See Forest Landowners Assistance Programs, p.8, http://www.dnr.wa.gov/Publications/fp_sflo_resourcesforsflo.pdf
[977] Department of Ecology. FY2012 Statewide Stormwater Grant Program: Funding Guidelines, p.1, http://www.ecy.wa.gov/pubs/1110071.pdf

Puget Sound area and funded 10 projects.[978] The *Watershed Planning Act* includes provision for a specific amount of funding for each phase in the development of watershed management plans.[979]

4.6.3.3 Data Collection

The Department of Ecology monitors surface water and conducts studies of groundwater.[980] Monthly data are collected at 100 stream stations, and 68 long-term stations are monitored annually to show trends.[981] The Department of Ecology works with the Department of Agriculture and other agencies to monitor waters for pesticide residues and to assess the effects of pesticides on surface and groundwater.[982] In spring and summer, pesticides are monitored weekly in selected salmonid-bearing streams.[983] In 2003, the Department of Agriculture started an assessment of groundwater vulnerability to pesticide contamination, which is updated annually.[984]

4.6.3.4 Reporting

The results of water quality monitoring are summarized in an annual report, which draws conclusions and makes recommendations.[985] Results that exceed water quality criteria or the usual range of data are reported once a month.[986]As in other states, the federal CWA requires the identification of water bodies that fail to meet water quality standards and the results are published in the Water Quality Assessment.[987] The Annual Report to the EPA on spending under CWA Section 319 gives estimates of the pollutant load reductions for each project.[988]

The Department of Ecology reports to the public on success stories through its website, which provides links to statewide stories and those within a given locality, as well as to EPA Success Stories.[989] A 2005 report features stories about water quality improvements in the state.[990] Many success stories are the outcome of partnerships between local government, businesses, non-profit groups, First Nations and private citizens.

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[978] Department of Ecology. Implementing Low Impact Development Projects, http://www.ecy.wa.gov/programs/wq/funding/FundingPrograms/OtherFundingPrograms/LID2007/lidprojects.html
[979] Department of Ecology. *Watershed Planning Act*, http://www.ecy.wa.gov/watershed/misc/background.html
[980] Department of Ecology. Water Quality Monitoring Information, http://www.ecy.wa.gov/programs/wq/wqmonitor.html
[981] Department of Ecology. River and Stream Water Quality Monitoring, http://www.ecy.wa.gov/programs/eap/fw_riv/rv_main.html
[982] Department of Agriculture. Water Resources Protection, http://agr.wa.gov/PestFert/natresources/WaterResourcesProtection.aspx
[983] Department of Agriculture. Surface Water Monitoring Program for Pesticides in Salmonid-bearing Streams, http://agr.wa.gov/PestFert/natresources/SWM/
[984] Department of Agriculture. Groundwater Quality Protection, Aquifer Vulnerability Assessment Project, http://agr.wa.gov/PestFert/NatResources/Groundwater.aspx
[985] Department of Ecology. River and Stream Water Quality Monitoring Report, Water Year 2010, p.37, http://www.ecy.wa.gov/pubs/1103037.pdf
[986] Department of Ecology. River and Stream Water Quality Monitoring, http://www.ecy.wa.gov/programs/eap/fw_riv/rv_main.html
[987] Department of Ecology. Overview of the Water Quality Program, http://www.ecy.wa.gov/programs/wq/overview.html
[988] Department of Ecology. *Year 2010 Report on Activities to Implement Washington State's Water Quality Plan to Control Nonpoint Source Pollution*, May 2011, unpublished.
[989] Department of Ecology. Statewide Stories, http://www.ecy.wa.gov/programs/wq/wqstories/storiesStatewide.html
[990] Department of Ecology. Getting Results: Stories of Water Quality Improvements in Washington State, 2005, http://www.ecy.wa.gov/pubs/0410070.pdf

4.6.4 Agriculture

The Department of Ecology has overall responsibility for water quality and partners with local conservation districts to implement BMPs,[991] but the Department of Agriculture manages NPSP from many agricultural sources.

The *Dairy Nutrient Management Act* requires milk producers to have a licence and to reregister with the Department of Agriculture every two years, providing information on the size of their herd and the amount of land.[992, 993] Each dairy farm must have a nutrient management plan, to prevent discharge of nutrients to state waters, which must be certified.[994] Inspections are carried out by the Department of Agriculture, with priority for inspections in areas with impaired waters and areas close to other waters in the state.[995] If a dairy farm is found to be releasing pollutants to surface water or groundwater, a copy of the inspection report and enforcement actions taken must be provided to the local conservation district, as well as the farmer. However, for a first offence violation of water quality laws, the penalty may be waived to give the farmer time to come into compliance.[996]

A Concentrated Animal Feeding Operation (CAFO) is required to have a NPDES permit under the federal CWA, which is issued by the Department of Ecology. It is a no-discharge permit that prohibits discharges except under certain conditions and sets requirements to protect water quality.[997] A CAFO must have a comprehensive certified nutrient management plan which must include, among other things, a description of the liquid and solid manure production, storage areas and leak detection systems, as well as a BMP implementation schedule.[998] The plan must indicate how application of manure to the land meets the CAFO permit conditions and must address the transport or export of manure. Maps to accompany the management plan must show the location of manure storage areas, sensitive environmental features (such as wells and drinking water sources) and buffers, as well as soil survey and topographical maps. Some information must be reported annually. Although the CAFO permit is issued by the Department of Ecology, the Department of Agriculture conducts the inspections.

Washington State has a wide range of rules affecting the permitted use, application and management of fertilizers and pesticides.[999] The Department of Agriculture has developed a fact sheet to provide advice

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[991] Department of Ecology. *Focus on Livestock and Water Quality*, http://www.ecy.wa.gov/pubs/1110015.pdf

[992] RCW 90.64.017, Registration of Dairy Producers, http://apps.leg.wa.gov/RCW/default.aspx?cite=90.64.017

[993] In the past, dairy farms were regulated by the Department of Ecology and required to have permits, but the authority was transferred to the Department of Agriculture, which does not have water quality as a priority in the same way as the Department of Ecology. In the Nooksack Basin, for example, water quality has declined since the transfer. Helen Bresler, Watershed Planning Unit Supervisor, Department of Ecology, personal communication with Mary Griffiths, January 27, 2012.

[994] Department of Agriculture. Dairy Nutrient Management, http://agr.wa.gov/FoodAnimal/Livestock-Nutrient/. See also *Dairy Nutrient Management Statute*, RCW Title 90, Chapter 90.64, http://apps.leg.wa.gov/RCW/default.aspx?cite=90.64, including RCW 90.64.026, Dairy Nutrient Management Plans, http://apps.leg.wa.gov/RCW/default.aspx?cite=90.64.026

[995] Washington State, Laws and Rules. RCW Title 90, Chapter 90.64.023, Inspection Program, http://apps.leg.wa.gov/RCW/default.aspx?cite=90.64E. Under the Nutrient Management Program, each cow dairy is inspected at least once every 22 months, http://agr.wa.gov/FoodAnimal/Livestock-Nutrient/Inspections.aspx

[996] Washington State, Laws and Rules. RCW 90.64.030, Investigation of Dairy Farms, http://apps.leg.wa.gov/RCW/default.aspx?cite=90.64.030

[997] Department of Agriculture. NPDES CAFO Permit, http://agr.wa.gov/FoodAnimal/Livestock-Nutrient/NPDESCAFOPermit.aspx

[998] Department of Agriculture. Minimum Elements of a CAFO NMP, http://agr.wa.gov/FoodAnimal/Livestock-Nutrient/CAFONutrientMgmtPlans.aspx

[999] Department of Agriculture. Pesticides and Fertilizers, http://agr.wa.gov/Portals/PF/. The Washington Administrative Code, Title 16, Chapters 200 and 230, respectively, http://agr.wa.gov/PestFert/Pesticides/LawsRules.aspx .

on the protection of groundwater during the use of pesticides.[1000] The Department's Water Protection section works with the Department of Ecology to monitor for pesticides and fertilizers[1001] and to assess the vulnerability of groundwater to pesticide contamination.[1002] The Department's Natural Resources Assessment section focuses on the impacts of agricultural chemicals on natural resources, including water.[1003]

The Department of Ecology has taken the lead in working with conservation districts, local governments and landowners to reduce the impacts of ranching on water quality. For example, in one area more than 30 km of riparian buffers are planned to keep cattle from drinking from a creek.[1004] This involves installing fences, planting native trees and shrubs and providing another source of drinking water. The work is still in progress but monitoring in the creek twice a month shows that water quality is improving. In another area, more than 50 km of riparian buffer have been installed.[1005]

While preferring to work proactively, the Department of Ecology may need to take corrective action. It recently issued an enforcement order, requiring livestock to be removed from a stream and the creation of a minimum 10.5 m buffer.[1006]

4.6.5 Forestry

Washington has one of the most highly regulated forest management systems in the U.S.[1007] As in California, approximately 60% of the forested lands are public. Over half the private forest land is owned by landowners with less than 2,000 ha.[1008] Much of the privately held forest land is operated by Small Forest Landowners, but that description can cover quite large landholdings.[1009]

The Department of Natural Resources is the main agency for implementing and enforcing the Forest Practices statute and Forest Practices Rules. Rules relating to water quality protection must be approved

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[1000] Department of Agriculture. Groundwater Protection: Pesticide Use and Leachability, Fact Sheet, 2008, http://agr.wa.gov/PestFert/natresources/docs/GW_FactSheet_05-08.pdf

[1001] Department of Agriculture. Surface Water Monitoring Program for Pesticides in Salmonid-bearing Streams, http://agr.wa.gov/PestFert/NatResources/SWM/

[1002] Department of Agriculture. Water Resources Protection, http://agr.wa.gov/PestFert/natresources/WaterResourcesProtection.aspx, and Groundwater Quality Protection, http://agr.wa.gov/PestFert/NatResources/Groundwater.aspx

[1003] Department of Agriculture. Natural Resources Assessment, http://agr.wa.gov/PestFert/natresources/

[1004] Department of Ecology. Transforming Watersheds, Upper Cow Creek – Adams County, http://www.ecy.wa.gov/pubs/0610051.pdf

[1005] Department of Ecology. *Year 2010 Report on Activities to Implement Washington State's Water Quality Plan to Control Nonpoint Source Pollution*, May 2011, pp. 40-42, unpublished. The project is the Palouse River Partnership.

[1006] Helen Bresler, Watershed Planning Unit Supervisor, Department of Ecology, personal communication with Mary Griffiths, January 27, 2012. The case is currently before the Court of Appeal.

[1007] Ice, G. *et al*. Programs Assessing Implementation and Effectiveness of State Forest Practice Rules and BMPs, *Water, Air and Soil Pollution: Focus* 4: 2004, p.158, ftp://frap.cdf.ca.gov/pub/incoming/IMMP/Meaningful%20Monitoring%20Papers,%20Meeting%20Summaries,%20PPTs,%20etc/Ice,%20Dent,%20Robben,%20Cafferata%20et%20al.%202004%20Monitoring%20Forestry%20BMPs.PDF

[1008] *Small Forest Landowner Statute*, 2008, Chapter 76.13.005 RCW, http://www.dnr.wa.gov/Publications/fp_rules_76.13.pdf

[1009] The definition of a Small Forest Landowner is complex, relating to the volume of timber harvested over a period of up to 10 years, see Chapter 76.13.120(2)(c) RCW and WAC 222-21-010(13). According to tax rules, anyone harvesting less than two million board feet of timber a year is a small harvester and this is the definition which may also be used to classify "small" forest landowners. See Understanding Washington's Timber Excise Tax, 2010, http://dor.wa.gov/Docs/Pubs/ForestTax/TimberExciseTax.pdf

by the Department of Ecology before they are adopted by the Forest Practices Board.[1010] If the Department of Natural Resources fails to enforce compliance with required forest practices relating to water quality, the Department of Ecology can petition the chairman of the appeals board, who can require action,[1011] but this has not yet been done.[1012]

Current Forest Practices Rules relating to water quality are very detailed[1013] and are based on the 1999 Forests and Fish Report.[1014] This objective of the report was to protect and improve riparian habitat on non-federal forest lands in the state; this included meeting the CWA requirements and protecting fish habitat, as well as keeping the timber industry economically viable.[1015] Classifications and measurements to determine the required practices are very specific and complex and the appendices provide a lot of detail but, in broad terms, the practices were to include:

- Typing and mapping of streams, based on three categories, Type S (shorelines of the state, which include the shorelines of rivers[1016] and lakes as well as coastal shorelines), Type F (which are above a minimum size and contain fish habitat or are diverted for use) and N (which are subdivided into Np, perennial nonfish habitat streams and Ns, seasonal nonfish habitat streams that flow into an S, F or Np stream) (Appendix B, p. 18).[1017]
- Measures to restore and maintain riparian functions (Appendix B), with separate strategies for Westside forests (where the objective is mature riparian stands with average age of 120 years and the attainment of resource objectives) and Eastside forests (where stand conditions vary over time but maintain general forest health) (Appendix B, p. 18). There are specified riparian management requirements based on a classification of water bodies (Types S, F and N) and the distance from water. A distinction is made between the core zone (e.g., 9-15 m from water edge) and the inner zone (e.g., on the Westside, where the outer boundary is related to potential tree height or 24-40 m from the water edge, depending on the site class of land, or on the Eastside forests 22.5 or 30 m from the water edge).
- Management of unstable slopes (Appendix C).
- Road construction restrictions (Appendix D).
- Buffers to protect riparian habitat and wetlands from pesticide use (Appendix E).
- Protection of wetlands near water bodies and a no-net loss replacement policy for other forest wetlands (Appendix F).
- Watershed analysis, on a voluntary basis, to address cumulative impacts, and the development of basin-specific BMPs to protect water quality and fish habitat (Appendix G).
- Alternative plans (Appendix H).

[1010] Department of Natural Resources. Forest Practices Rules, Rules Overview, http://www.dnr.wa.gov/BusinessPermits/Topics/ForestPracticesRules/Pages/fp_rules.aspx

[1011] *Forest Practices Act*, 2011, Chapter 76.09 RCW, in particular, RCW 76.09.100, http://www.dnr.wa.gov/Publications/fp_rules_76.09.pdf

[1012] Helen Bresler, Watershed Planning Unit Supervisor, Department of Ecology, personal communication with Mary Griffiths, January 27, 2012.

[1013] Department of Natural Resources. Title 222 WAC, Forest Practices Rules, http://www.dnr.wa.gov/BusinessPermits/Topics/ForestPracticesRules/Pages/fp_rules.aspx

[1014] Department of Ecology. Nonpoint Pollution from Forestry, http://www.ecy.wa.gov/programs/wq/nonpoint/ForestRules.html

[1015] Several federal agencies (US Fish and Wildlife Service, US EPA, etc.) and state agencies (Washington State Department of Natural Resources, Department of Fish and Wildlife and Department of Ecology). *Forests and Fish Report*, 1999, p. 2, http://www.dnr.wa.gov/Publications/fp_rules_forestsandfish.pdf

[1016] See *Shoreline Management Act*, Chapter 90.58RCW, 1971, http://apps.leg.wa.gov/rcw/default.aspx?cite=90.58 Shorelines are defined where the flow exceeds twenty cubic feet per second, see Definitions and Concepts, 2(e), http://apps.leg.wa.gov/rcw/default.aspx?cite=90.58.030

[1017] The typing, which came into effect in 2006, is set out in Chapter 222-16-030, WAC, Definitions, http://www.dnr.wa.gov/Publications/fp_rules_ch222-16wac.pdf

- Small landowners (Appendix I).
- An adaptive management approach to develop BMPs (Appendix L).

These requirements are now reflected in the Forest Practices Board Manual, which provides comprehensive technical advice on the implementation of the Forest Practices Rules.[1018] Section 7 has Guidelines for Riparian Management Zones, with separate sections for the forests in Western and Eastern Washington.[1019] A chapter identifies practices for sensitive sites, such as the headwaters of a spring, for which a 15 m buffer is required (in Eastern Washington, and slightly larger in the Western area).[1020] There are Guidelines for Wetland Delineation,[1021] and separate Guidelines for Wetland Replacement by Substitution or Enhancement.[1022] One section of the manual provides guidance on acquiring easements[1023] and another is entitled Guidelines for Adaptive Management.[1024] Section 11, Standard Methodology for Conducting Watershed Analysis,[1025] is a separate comprehensive Forest Practices Watershed Analysis Manual, which is described in the following paragraph.

The Forest Practices Watershed Analysis Manual[1026] addresses cumulative impacts rather than individual forest activities. The state is divided into 800 watersheds, ranging in size from 4,000 to 20,000 ha, which are referred to as Watershed Administrative Units (WAUs). "Watershed analysis is a structured approach to developing a forest practices plan for a WAU based on a biological and physical inventory. It is a collaborative process involving resource scientists and managers representing landowners, agencies, tribes and other interested public. Once initiated, the team conducts the assessment within a specific time-frame . . . The forest practices rules provide a policy structure to the process by encoding the steps, operating rules, key linkages and decision requirements for the team."[1027] The watershed plans identify sensitive areas within a watershed and specify how they are to be managed unless an alternative plan is approved with compliance regulated by the Department of Natural Resources. There are provisions for monitoring by those interested in the watershed, with opportunities for feedback and adaptive management. "By encoding into regulations a science-based assessment process rather than a one-size-fits-all set of 'Best Management Practices (BMPs)', the watershed analysis process represents a departure from conventional approaches to forest land regulation. The new system not only requires local scientific assessments but relies upon diligent revision as monitoring provides feedback on whether resources are improving or degrading. It also relies on stakeholders within each watershed to make it work."[1028] Unfortunately, the reliance on local initiatives has meant that little progress has been made in developing

[1018] Department of Natural Resources. *Forest Practices Board Manual*, http://www.dnr.wa.gov/BusinessPermits/Topics/ForestPracticesRules/Pages/fp_board_manual.aspx
[1019] *Forest Practices Board Manual*, 2010, section 7, Guidelines for Riparian Management Zones, http://www.dnr.wa.gov/Publications/fp_board_manual_section07.pdf
[1020] *Forest Practices Board Manual*, 2010, section 7, Guidelines for Riparian Management Zones, p. M7-7, http://www.dnr.wa.gov/Publications/fp_board_manual_section07.pdf
[1021] *Forest Practices Board Manual*, 2000, section 8, Guidelines for Wetland Delineation, http://www.dnr.wa.gov/Publications/fp_board_manual_section08.pdf
[1022] *Forest Practices Board Manual*, 2000, section 9, Guidelines for Wetland Replacement by Substitution or Enhancement, http://www.dnr.wa.gov/Publications/fp_board_manual_section09.pdf
[1023] *Forest Practices Board Manual*, 2011, section 18, Rivers and Habitat Open Space Program, http://www.dnr.wa.gov/Publications/fp_board_manual_section18.pdf
[1024] *Forest Practices Board Manual*, 2005, section 22, Guidelines for Adaptive Management, http://www.dnr.wa.gov/Publications/fp_board_manual_section22.pdf
[1025] *Forest Practices Board Manual*, 2011, section 11, Standard Methodology for Conducting Watershed Analysis, http://www.dnr.wa.gov/Publications/fp_board_manual_section11.pdf. This site provides a link to the manual.
[1026] Department of Natural Resources. Standard Methodology for Conducting Watershed Analysis, Washington Forest Practices Board, 2011, 125 pp. plus 11 Appendices, including http://www.dnr.wa.gov/ResearchScience/Topics/WatershedAnalysis/Pages/fp_watershed_analysis_manual.aspx
[1027] Ibid. pp. 5-6.
[1028] Ibid. p. 7.

watershed plans for forestry. Moreover, it is not practical or workable to have special rules for so many different areas.[1029]

Starting in 2006, the Forest and Fish Compliance Monitoring Program has been evaluating whether forestry activities on both state and private lands are meeting forest practice rules.[1030] The Department of Natural Resources reports to the Forest Practices Board every two years. In 2008 and 2009, inspections focused on riparian and road-related activities, and determined the severity of non-compliance actions.[1031] Nearly 4/5th of road and riparian/wetland related activities were compliant, although sampling showed that compliance was lower on small parcels of land (less than 8 ha), where just over 3/5th were in compliance.

The expectation was that the prescribed forest management practices and adaptive management set out in the Forests and Fish report would result in forest streams and rivers meeting water quality standards.[1032] However, when the Department of Ecology reviewed progress in 2009 (as required when the 10-year CWA assurances expired[1033]) it was found that "the forest practices and adaptive management have not fully met the expectations of research and program performance that underlie the basis for providing the CWA assurances. The adaptive management program has not provided the information needed to validate the effectiveness of the rules in protecting water quality. In fact, no field studies or assessments have been completed that test the ability of the rules to meet state water quality standards."[1034]

Despite the problems, the Department of Ecology determined that "Taken in total, the forest practices program provides a substantial framework for bringing the forest practices rules and activities into full compliance with the water quality standards. Ecology has concluded it is in the best interests of water quality, and is consistent with legislative intent, to work with the other participants to make needed improvements to the existing program. Ecology is therefore conditionally extending the CWA assurances with the intent to stimulate the needed improvements to the forest practices and adaptive management programs."[1035] The report set out new timelines, often for actions by the Department of Natural Resources. It provided a list of tasks that the Cooperative Monitoring, Evaluation and Research Committee must address (p. 10) and indicated that there must be consistent compliance and enforcement of the Forest Practices Rules.

Measures are now underway to address operational issues and compliance monitoring, and "Ecology's highest concern going forward is with the adaptive management program. These concerns are greatest regarding the ability to fund the needed studies and assessments at a rate that creates a viable science-based program. Scientific studies and assessments need to be designed to provide Policy and the Forest Practices Board . . . with information sufficient to enable these policy makers to make informed science-

[1029] Helen Bresler, Watershed Planning Unit Supervisor, Department of Ecology, personal communication with Mary Griffiths, January 27, 2012.
[1030] Department of Ecology. Forest and Fish Monitoring Program, 2010, http://www.ecy.wa.gov/pubs/1010031.pdf See also, http://www.ecy.wa.gov/biblio/1010031.html
[1031] Department of Natural Resources, *Forest Practices Compliance Monitoring Report, 20008/2009,* January 2011, pp. 7-10, http://www.dnr.wa.gov/Publications/fp_cm_biennial_report_08-09.pdf See also media release, February 8, 2011, http://www.dnr.wa.gov/BusinessPermits/News/Pages/2011_02_08_forest_practices_nr.aspx
[1032] Department of Ecology. *2009 Clean Water Act Assurances Review of Washington's Forest Practices Program,* p. 4, http://www.ecy.wa.gov/programs/wq/nonpoint/ForestPractices/CWAassurances-FinalRevPaper071509-W97.pdf
[1033] The Department of Ecology had given an undertaking to the EPA that the proposed approach would address water quality problems, and be a satisfactory alternative to the conventional EPA approach under the CWA.
[1034] *2009 Clean Water Act Assurances Review of Washington's Forest Practices Program,* p. 4,
[1035] Ibid. p. 5.

based policy decisions. Just as importantly, policy makers must be committed to using science to fairly and efficiently revise the forest practices rules and programs as needed."[1036]

Ten years was probably too short a time to see measurable improvements in water quality, given the fact that watersheds needed to recover from earlier forest practices. Also, enforcement is the primary responsibility of the Department of Natural Resources, which does not place the same priority on water quality as the Department of Ecology and may not take enforcement action against a water quality violation. Despite enforcement issues, the use of Forest Practice Rules is preferable to a TMDL approach for reducing the impacts of forestry on water quality.[1037]

4.6.6 Municipal Stormwater

The Department of Ecology is developing LID standards.[1038] At present there is a requirement for on-site stormwater management for all new development and redevelopments above a certain size.[1039] There are exemptions for oil and gas field activities as well as for forestry and agriculture.[1040]

The Puget Sound area is described as an ecologically delicate area and the government has given the Puget Sound Partnership (which includes government, business, First Nations and scientists) the task of restoring its health.[1041] The Puget Sound Partnership, with a leadership council appointed by the state governor and professional staff, has taken the lead in fostering LID. The Partnership's LID Technical Guidance Manual was first published in 2005.[1042] Before developing the 2012 edition, a survey was conducted of 500 professionals in the Puget Sound area who had been involved in LID, so their feedback could be incorporated. This is approximately the number of people who attended the 2009 and 2010 LID technical workshops held by Washington State University Extension in conjunction with the Puget Sound Partnership.[1043] The draft 2012 LID Manual will be a comprehensive document, covering design, construction, maintenance and performance of a large range of LID measures.[1044] The draft includes references to research that shows the need for LID and provides case studies.[1045] The Partnership's resource centre also has a large amount of information on LID.[1046]

[1036] Department of Ecology. *Year 2010 Report on Activities to Implement Washington State's Water Quality Plan to Control Nonpoint Source Pollution*, May 2011, p. 38, unpublished.
[1037] Helen Bresler, Watershed Planning Unit Supervisor, Department of Ecology, personal communication with Mary Griffiths, January 27, 2012.
[1038] Department of Ecology. Developing Low Impact Development (LID) Standards, http://www.ecy.wa.gov/programs/wq/stormwater/municipal/LIDstandards.html
[1039] Department of Ecology. Phase I Municipal Stormwater Permit, p. 18-19, Minimum Requirement #5, http://www.ecy.wa.gov/programs/wq/stormwater/municipal/phaseIpermit/phipermit.html See Minimum requirement #5.
[1040] Department of Ecology. Phase I Municipal Stormwater Permit, Appendix 1 – Minimum Technical Requirements for New Development and Redevelopment, p. 1, http://www.ecy.wa.gov/programs/wq/stormwater/municipal/phaseIpermit/MODIFIEDpermitDOCS/Appendix1.pdf
[1041] Puget Sound Partnership. About the Partnership, http://www.psp.wa.gov/aboutthepartnership.php
[1042] Puget Sound Partnership. Development of LID Technical Guidance Manual for Puget Sound, http://www.psp.wa.gov/LID_manual.php
[1043] Washington State University/Puget Sound Partnership LID Technical Workshop Series, http://www.capps.wsu.edu/conferences/lidworkshops/
[1044] Puget Sound Partnership. Draft LID Manual. See Table of Contents at http://www.psp.wa.gov/downloads/LID/TableofContents.pdf. The draft manual has more than 250 pages, without appendices.
[1045] Puget Sound Partnership. Draft LID Manual, http://www.psp.wa.gov/downloads/LID/draft_2012/LID_Letter-Email-1-6.pdf
[1046] Puget Sound Partnership. Stormwater Resources, http://www.psparchives.com/our_work/stormwater/stormwater_resources.htm

As the previous paragraph shows, many people are involved in LID in the Puget Sound area. Seattle, which is situated on Puget Sound, has a Green Stormwater Infrastructure program that mandates LID wherever possible.[1047] "To be considered Green Stormwater Infrastructure, it must provide a function in addition to stormwater management such as water reuse, providing greenspace and/or habitat in the City. . . Green Stormwater Infrastructure can be used to comply with the Minimum Requirements for Flow Control, Minimum Requirements for Treatment, or both, depending on how they are designed and constructed. All projects are required to implement Green Stormwater Infrastructure to the Maximum Extent Feasible for flow control. This means that Green Stormwater Infrastructure must be incorporated throughout the project site wherever feasible, constrained only by the physical limitations of the site, practical considerations of engineering design and necessary business practices, and reasonable financial considerations of costs and benefits."[1048]

To aid construction of green stormwater infrastructure, the City lists not only the specifications but pre-approved materials for porous pavement, stormwater planters and green roofs.[1049] There are also inspection and verification procedures.

In addition to requiring green infrastructure on private land, the City has implemented Natural Drainage Systems on city streets. The first street using a natural drainage approach was implemented in 2001 and the City has been become a prize-winning leader for its adoption of this approach.[1050] The University of Washington monitored some projects, showing how the systems reduce storm flow and pollutants.[1051] The Natural Drainage Projects website provides guidelines, an overview of costs and benefits and case studies of projects, including a virtual tour of several streets where projects have been implemented.[1052]

4.6.7 Watershed Management

The Department of Ecology adopted the watershed approach to water management in the 1990s.[1053] The state is divided into 23 Water Quality Management Areas, which address both point and non-point sources of pollution. There is a five-year cycle of scoping, data collection, data analysis, technical reporting and implementation, with each activity taking about one year and four or five management areas starting at year one in a given year. Each cycle targets certain areas to address. Funding is available from various programs.[1054]

[1047] Seattle Public Utilities. Green Stormwater Infrastructure, http://www.seattle.gov/util/About_SPU/Drainage_&_Sewer_System/GreenStormwaterInfrastructure/index.htm

[1048] Seattle Public Utilities. Green Stormwater Infrastructure, Stormwater Code Compliance, http://www.seattle.gov/util/About_SPU/Drainage_&_Sewer_System/GreenStormwaterInfrastructure/StormwaterCodeCompliance/index.htm

[1049] Seattle Public Utilities. Green Stormwater Infrastructure, Stormwater Code Compliance, Specifications and Pre-approved Materials, http://www.seattle.gov/util/About_SPU/Drainage_&_Sewer_System/GreenStormwaterInfrastructure/StormwaterCodeCompliance/SpecificationsPre-approvedMaterials/index.htm

[1050] City of Seattle. *Seattle's Natural Drainage Systems*, pp. 2 and 18, http://www.seattle.gov/util/groups/public/@spu/@usm/documents/webcontent/spu02_019984.pdf. The booklet outlines the key requirements for project success, p. 7.

[1051] City of Seattle. *Seattle's Natural Drainage Systems*, p. 10.

[1052] Seattle Public Utilities. Green Stormwater Infrastructure, Natural Drainage Projects, http://www.seattle.gov/util/About_SPU/Drainage_&_Sewer_System/GreenStormwaterInfrastructure/NaturalDrainageProjects/index.htm

[1053] Department of Ecology. An Overview of Washington State's Watershed Approach to Water Quality Management, http://www.ecy.wa.gov/programs/wq/watershed/overview.html

[1054] Department of Ecology. Watershed Management, http://www.ecy.wa.gov/watershed/

"At the watershed scale, regional staff. . . have been working closely with local conservation districts to provide focused and innovative outreach, and attractive BMP incentives to increase participation in stream restoration."[1055] Details are provided in the most recent report to the EPA.

However, at the local level, watershed planning is optional[1056] and the watershed approach has received most attention in areas where there are concerns about water quantity and supply rather than about water quality.[1057]

4.6.8 Progress and Effectiveness

Washington has several EPA success stories, including changes to irrigation practices to reduce sediment,[1058] implementation of BMPs in agriculture (such as riparian buffers, providing alternative water sources for livestock, building manure containment structures),[1059] and reducing bacteria levels through nutrient management planning, upgrading septic systems and keeping livestock out of streams.[1060] The Department of Ecology has been successful in reducing toxic substances in the Spokane River without using a TMDL approach, by working at the state level and with local groups to clean up contaminated sites.[1061] Work included removing heavy metal-contaminated materials that washed downstream from Idaho's historic Coeur d'Alene mining area and were deposited in beaches along the river.

There are still problems to address in agriculture and the state's comprehensive scheme to reduce forestry impacts on watercourses has not been as effective as expected. It seems that the division of responsibility between different state departments and also the implementation of federal requirements can cause stumbling blocks in the Department of Ecology's efforts to reduce NPSP. "While Ecology has achieved many successes, walking the path toward clean water has also proven to be fraught with difficulties. This year we faced opposition in the legislative forum, dealt with some poor coordination between our agency and EPA, and had difficulties with other state agencies."[1062] However, "Reflecting on this year's successes and difficulties, we have learned that clarifying roles and responsibilities among the complex regulatory landscape is essential to ensure efficient and effective implementation."[1063] This is an important lesson that may be relevant for Alberta.

With respect to the implementation of LID, it appears that partnerships are working. The City of Seattle and the Puget Sound Partnership are actively implementing LID and, with the University of Wisconsin, are providing education on how to plan, construct and maintain LID measures, which are now often required rather than optional.

[1055] Department of Ecology. *Year 2010 Report on Activities to Implement Washington State's Water Quality Plan to Control Nonpoint Source Pollution,* May 2011, p. 28, unpublished.
[1056] Municipal Research and Services Center of Washington, MRSC Inquiries, Environment and Natural Resources, http://www.mrsc.org/askmrsc/pastinqsubject.aspx?sid=7
[1057] Helen Bresler, Watershed Planning Unit Supervisor, Department of Ecology, personal communication with Mary Griffiths, January 27, 2012.
[1058] EPA. Success Stories, Washington: Lower Yakima River, Changes in Irrigation Practices Reduce Turbidity, http://water.epa.gov/polwaste/nps/success319/wa_yakima.cfm
[1059] EPA. Success Stories, Washington: Willapa River, Implementing Best Management Practices Reduces Bacteria Levels, http://water.epa.gov/polwaste/nps/success319/wa_willapa.cfm
[1060] EPA. Success Stories, Washington: Lower Nooksack River, Watershed-scale Efforts Reduce Bacteria Levels, http://water.epa.gov/polwaste/nps/success319/wa_nooksack.cfm
[1061] Department of Ecology. Spokane River Toxics Reduction Strategy, 2011, http://www.ecy.wa.gov/pubs/1110038.pdf
[1062] Department of Ecology. *Year 2010 Report on Activities to Implement Washington State's Water Quality Plan to Control Nonpoint Source Pollution,* May 2011, p. 1, unpublished.
[1063] Ibid. p. 43.

4.7 Wisconsin

4.7.1 Wisconsin at a Glance

- *The Runoff Management Rule addresses NPSP in agricultural and urban areas.*
- *It sets performance standards for manure, nutrient management and to reduce soil loss to waterways, but they are not usually mandatory for existing operations unless the government offers 70% cost-sharing for compliance measures.*
- *Counties must take the lead in implementing and enforcing state NPSP requirements, but government and non-governmental partnerships are important.*
- *Wisconsin Department of Natural Resources ranks watersheds according to NPSP problems and in 30 years the Priority Watershed and Lake Program resolved the issues at more than 90% of critical sites, with measurable results.*
- *Wisconsin considers its agricultural and urban NPSP program to be among the most progressive in the U.S.*

4.7.2 Overview

Wisconsin lies between Lake Superior, Lake Michigan and the Mississippi River (on its western border).[1064] The state is about one-fifth the size of Alberta, with an area of 140,000 km^2.[1065] Its population is almost 5.7 million, which is nearly twice that of Alberta. Wisconsin has a humid continental climate with average snowfall between 0.75 m and 2.5 m.[1066] Approximately two-thirds of Wisconsin drains into the Mississippi River, with the eastern part of the state draining to Lake Michigan and a smaller area draining north to Lake Superior. Wisconsin has more than 15,000 lakes and over two million ha of wetlands.[1067]

Over 99% of the farms are family-owned and with 1.25 million dairy cows, dairy farming is the source of over half the agricultural income.[1068]

The main source of impairment for both lakes and impoundments is polluted runoff from non-point sources.[1069] The state has been active in efforts to reduce NPSP and has strict rules for phosphorus entering the water, especially to help reduce the level of nutrients flowing via the Mississippi River into the Gulf of Mexico.[1070]

[1064] Wisconsin Department of Natural Resources (WDNR). *2010 Wisconsin Water Quality Report to Congress,* p. 14, Figure 3, http://www.dnr.state.wi.us/org/water/condition/2010_IR/Attachment_A_2010_WQ_RptToCongress_FINAL_3-30-2010.pdf

[1065] U.S. Census Bureau. Quick Facts, Wisconsin, http://quickfacts.census.gov/qfd/states/55000.html

[1066] Wisconsin – Topography, http://www.city-data.com/states/Wisconsin-Topography.html.

[1067] WDNR. 2010 Wisconsin Water Quality Report to Congress, p. 12, http://www.dnr.state.wi.us/org/water/condition/2010_IR/Attachment_A_2010_WQ_RptToCongress_FINAL_3-30-2010.pdf

[1068] Netstate. Wisconsin Agriculture, http://www.agclassroom.org/kids/stats/wisconsin.pdf and Wisconsin Economy, http://www.netstate.com/economy/wi_economy.htm

[1069] WDNR. *2010 Wisconsin Water Quality Report to Congress*, p. 108,

[1070] WDNR. *2010 Water Division Report*, p. 25, http://dnr.wi.gov/org/water/success/2010Report.pdf

4.7.3 Legislation, Funding, Data Collection, Reporting

4.7.3.1 Legislation

Wisconsin has two pieces of legislation that set out how the Wisconsin Department of Natural Resources (WDNR) must manage NPSP; these relate to Water and Sewage,[1071] and Pollution Discharge Elimination.[1072]

The Water and Sewage Statute states that "The department shall, by rule, prescribe performance standards for nonpoint sources that are not agricultural facilities or agricultural practices. The performance standards shall be designed to achieve water quality standards by limiting nonpoint source water pollution."[1073] For agricultural sources, the WDNR must work with the Department of Agriculture, Trade and Consumer Protection.[1074] The Nonpoint Source Pollution Financial Abatement Program provides technical and financial assistance where NPS problems are most severe, including, in the past, to priority watersheds and priority lakes.[1075] A separate program provides grants to address urban NPSP.[1076]

The Pollution Discharge Elimination Statute sets conditions for issuing permits for discharges and applies primarily to point source discharges. However, it makes provision for trading of water pollution credits, requiring the WDNR to set up at least one pilot project to evaluate the trading of water pollution credits.[1077] One condition for selection of the pilot location was that "[T]he area includes both agricultural and municipal sources of water pollution and both point sources and nonpoint sources."[1078] (See Water Quality Trading, section 4.7.7.1)

The statutes are implemented through the Wisconsin Administrative Code and the Runoff Management Rules. The basic Runoff Management Rule (NR 151)[1079] dates from 2002 and "establishes runoff pollution performance standards for both agricultural and non-agricultural practices and manure management prohibitions for agricultural facilities and practices."[1080]

[1071] Wisconsin Statutes. *Chapter 281, Water and Sewage*, https://docs.legis.wisconsin.gov/statutes/statutes/281
[1072] Wisconsin Statutes. *Chapter 283, Pollution Discharge Elimination*, https://docs.legis.wisconsin.gov/statutes/statutes/283
[1073] Wisconsin Statutes. *Chapter 281, Water and Sewage*, section 281.16(2)(a), https://docs.legis.wisconsin.gov/statutes/statutes/281
[1074] Wisconsin Statutes. *Chapter 281, Water and Sewage*, section 281.16(3)(a), https://docs.legis.wisconsin.gov/statutes/statutes/281. The rule also gives the Department of Natural Resources, in consultation with the Department of Agriculture, power to address nonpoint source pollution from agricultural lands (unless it comes from animal wastes other agricultural waste in a priority watershed or priority lake area, in which case the Department can only take action if it is designated a critical site). See Statutes, Chapter 281, Water and Sewage, section 281.20.
[1075] Wisconsin Statutes. *Chapter 281, Water and Sewage*, section 281.65, Financial assistance; nonpoint source water pollution abatement, https://docs.legis.wisconsin.gov/statutes/statutes/281. This is a long section, with a lot of detail.
[1076] Wisconsin Statutes. *Chapter 281, Water and Sewage*, section 281.66, Urban nonpoint source water pollution abatement and storm water management program, https://docs.legis.wisconsin.gov/statutes/statutes/281
[1077] Wisconsin Statutes. *Chapter 283, Trading of Water Pollution Credits*, section 283.84, https://docs.legis.wisconsin.gov/statutes/statutes/283/V/84/2/b
[1078] Ibid. section 283.84(2)(b).
[1079] WDNR. Unofficial Text, *Chapter NR151, Runoff Management*, http://legis.wisconsin.gov/rsb/code/nr/nr151.pdf
[1080] WDNR. Non-Agricultural Revisions to Chapter NR 151, Runoff Management Rule, http://dnr.wi.gov/runoff/pdf/rules/Final_NR151_non-ag_FS_Oct_2011.pdf

All the rules are clearly summarized for the public in a number of fact sheets.[1081] Detailed regulatory requirements for agricultural and municipal NPSP are described in Sections 4.7.4 and 4.7.6, respectively.

In 2009, nearly 19% of the length of Wisconsin's streams and rivers were designated as Outstanding Resource Waters or Exceptional Resource Waters, meeting the federal CWA requirements for adoption of an "antidegradation" policy.[1082]

4.7.3.2 Funding

Between 1978 and 2008, the WDNR administered the Priority Watershed and Lake Program, allocating $211 million in cost-share grants.[1083] After 30 years the Priority Watershed and Lake Program has been discontinued, but to address NPSP:[1084]

- The Targeted Runoff Management Grant Program is a new program that focuses primarily on farm sites. It can also help farmers meet Notice of Discharge requirements if they are not in compliance with required standards.
- The Urban Nonpoint Source and Storm Water Grant Program funds BMPs in existing and planned urban areas, as well as stormwater planning, information and education. These programs record the number of projects and expenditures, but most BMPs implemented through the programs are not tracked to determine the resulting pollutant load reductions.[1085]
- The Nonpoint Source Pollution Abatement Program provides funding for WDNR easements to reduce polluted runoff. By 2009 this program had spent approximately $3.3 million to purchase 78 easements totaling nearly 700 ha.[1086]

Some federal funding for projects that reduce NPSP comes from the Mississippi River Basin Initiative, which focuses on conservation practices through contracts with farmers, and the Great Lakes Restoration Initiative.[1087]

4.7.3.3 Data Collection

Wisconsin's Water Quality Monitoring Strategy has three tiers:

1. Statewide baseline monitoring
2. Targeted evaluation monitoring (when environmental problems require closer study)
3. Follow-up studies to determine the success of management actions.[1088]

The state's Surface Water Data Viewer makes it possible to view surface water resources online.[1089]

One targeted project was a multi-year study to monitor phosphorus levels in over 240 streams and 42 rivers, which led to the development of upper limit phosphorus criteria.[1090] In 2010, as part of the efforts

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[1081] WDNR. Runoff Management Administrative Rules, http://www.dnr.state.wi.us/runoff/rules/, see "Current Rules" tab, for links to the rules and fact sheets. For an overview of all the original rules, see Wisconsin's Runoff Rules, 2002, http://www.dnr.wi.gov/runoff/pdf/rules/GeneralRulesPub.pdf.
[1082] WDNR. *2010 Wisconsin Water Quality Report to Congress*, p. 46, http://www.dnr.state.wi.us/org/water/condition/2010_IR/Attachment_A_2010_WQ_RptToCongress_FINAL_3-30-2010.pdf
[1083] Ibid. p. 23.
[1084] WDNR. *2010 Water Division Report*, p. 23, http://dnr.wi.gov/org/water/success/2010Report.pdf
[1085] WDNR. *2010 Wisconsin Water Quality Report to Congress*, p. 22.
[1086] Ibid, p. 54.
[1087] Joseph Britt, Agriculture Incentives Director, Sand County Foundation, personal communication with Mary Griffiths, December 7, 2011.
[1088] WDNR. Water Monitoring Strategy, http://www.dnr.state.wi.us/org/water/monitoring/strategy.htm For the full strategy, see http://www.dnr.state.wi.us/org/water/monitoring/MonitoringStrategyV2.pdf
[1089] WDNR. Surface Water Data Viewer, http://dnr.wi.gov/org/water/data_viewer.htm

to reduce phosphorus levels in the Mississippi River, WDNR established statewide water quality standards for phosphorus and agricultural performance standards to reduce phosphorus in stormwater runoff from farms and urban areas.[1091]

Another special project was conducted to assess 200 wadeable streams and the data collected were used to help characterize other streams.[1092] While these studies are not directly related to runoff management, the knowledge of stream quality could help identify where measures are needed.

In addition to monitoring by Department of Natural Resources staff, citizen water monitoring is a key part of the monitoring effort, for both streams and lakes.[1093] Citizens are involved at one of three levels and, depending on the level, data are used for screening, determining status and trends, or management decisions.

4.7.3.4 Reporting

Like other states Wisconsin has to submit an "Impaired Waters List" to the EPA every two years to comply with CWA Section 303(d).[1094] At present several large basins are being assessed to determine what reductions are needed in phosphorus loadings. The 2010 Water Quality Report, a biennial report of progress, includes details on the implementation of BMPs to reduce runoff.[1095]

4.7.3.5 Partnerships

The Wisconsin Lakes Partnership has been recognized as a national model of collaboration for reducing the environmental impact on lakes.[1096] The WDNR supplies technical expertise, financial support and regulatory authority; the University of Wisconsin-Extension assists the formation of lake organizations, helps to link stakeholders and provides educational materials and programs; and the Wisconsin Association of Lakes and local citizens undertake advocacy and actions to restore their lakes. An example of a research partnership is given at the end of the next section on agriculture.

4.7.4 Agriculture

Wisconsin's performance standards to protect water quality by minimizing erosion reducing runoff include:

- manure management prohibitions
- nutrient management
- manure storage
- soil loss from fields next to lakes and rivers.[1097]

WDNR administers regulations relating to the storage and use of manure. These regulations cover discharges from small operations, which can get a Notice of Discharge under NR 243 requiring them to

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[1090] WDNR. *2010 Water Division Report*, p. 24.
[1091] Ibid. p. 63.
[1092] Ibid. p. 27.
[1093] WDNR. *2010 Wisconsin Water Quality Report to Congress*, p. 80.
[1094] WDNR. *2010 Water Division Report*, p. 31.
[1095] WDNR. *2010 Wisconsin Water Quality Report to Congress.* See p. 17 for Runoff Management and p. 23 for Best Management Practices.
[1096] WDNR. *2010 Water Division Report*, p. 32.
[1097] WDNR. Agricultural Runoff Management, http://www.dnr.state.wi.us/runoff/ag/

comply,[1098] and also include criteria for Concentrated Animal Feeding Operations, which are operations with more than 1,000 animal units and must be permitted.[1099]

The Runoff Rules for Farmers[1100] include requirements in NR 151, the Runoff Management Rule, and in ATCP 50, the Soil and Water Resource Management Program.[1101] The Runoff Management Rule (NR 151) requires nearly all farms to:

- Use the Wisconsin Phosphorus Index (PI) on all fields. The PI evaluates both phosphorus source and transport factors and sets limits on the amount of phosphorus that may run off croplands and pastures over a crop rotation and on an annual basis.
- Provide a buffer between agricultural fields and water bodies where no tillage is allowed, to avoid soil deposits and reduce phosphorus loading.[1102]

The rule sets performance standards, but in many cases standards do not apply to existing operations unless the government offers 70% cost-sharing for measures to ensure compliance.[1103] Farmers are eligible for a farmland preservation tax credit if they can certify on their tax return that they comply with Wisconsin's conservation standards. These include complying with NR 151 agricultural performance standards and prohibitions incorporated into ATCP 50, or have a schedule of compliance designed to meet those standards by the end of 2015, at the latest.[1104]

Although the Department of Agriculture, Trade and Consumer Protection educates farmers on the measures required to manage manure and nutrients,[1105] and cooperation is required between different agencies,[1106] the counties take the lead in the Implementation Strategy for NR 151 for agricultural lands through their Land and Water Resource Management Plans. These plans identify the strategies that the counties will implement to promote compliance with NR 151.[1107] The local County Land Conservation Department provides farmers with information and advice on implementing the agricultural runoff standards including soil erosion control, manure and nutrient management. Nutrient management rules apply to more than agricultural land: property owners who apply fertilizer to 2 ha or more (e.g., lawns or turf) are required to follow a nutrient management plan, which includes an application schedule based on soil tests. [1108]

[1098] WDNR. *2010 Wisconsin Water Quality Report to Congress*, p. 19.
[1099] WDNR. Runoff Management Section, Permits for Concentrated Animal Feeding Operations (CAFOs): What You Need to Know, http://dnr.wi.gov/runoff/pdf/ag/cafo/CAFO2brochure.pdf
[1100] WDNR. Wisconsin's Runoff Rules: What Farmers Need to Know, 2004, http://datcp.wi.gov/uploads/Environment/pdf/FarmersNeed.pdf
[1101] ATCP refers to the fact that the rule is the responsibility of the Department of Agriculture, Trade and Consumer Protection.
[1102] WDNR. *2010 Water Division Report*, p. 24.
[1103] WDNR. Agricultural Performance Standards and Prohibitions, http://www.dnr.state.wi.us/runoff/pdf/rules/NR151SubIIAgFactSheet.pdf
[1104] Wisconsin Department of Agriculture, Trade and Consumer Protection. Working Lands Initiative, Soil and Water Conservation Compliance, http://datcp.wi.gov/Environment/Working_Lands_Initiative/Soil_Water_Compliance/index.aspx
[1105] Wisconsin Department of Agriculture, Trade and Consumer Protection. Nutrient Management, http://datcp.wi.gov/Farms/Nutrient_Management/index.aspx
[1106] WDNR. Runoff Management Outreach Activities, http://www.dnr.state.wi.us/runoff/outreach.htm This webpage gives links to various agencies that may be involved in reducing nonpoint source pollution
[1107] WDNR. Implementation Strategy for NR 151 – Agricultural Nonpoint Performance Standards and Prohibitions, http://www.dnr.state.wi.us/runoff/rules/NR151strategy.htm See also Implementation Strategy for NR 151 – Agricultural and Nonpoint Performance Standards and Prohibitions, http://www.dnr.state.wi.us/runoff/pdf/ag/strategy151.pdf, for the full text of the strategy.
[1108] WDNR. *Wisconsin's Runoff Rules*, 2002, p. 6, http://www.dnr.wi.gov/runoff/pdf/rules/GeneralRulesPub.pdf

In 2008 and 2009, around 75% of counties inventoried farms for compliance, and 50-75% of counties reported seeing medium to high levels of compliance with agricultural performance standards and prohibitions.[1109]

The Department of Agriculture, Trade and Consumer Protection and WDNR report annually to the Wisconsin Land and Water Conservation Board.[1110] The 2009 report provides insight into the costs of the various programs. For example, through the Soil and Water Resource Management Program county staff were responsible for the installation of about $5.2 million in cost-share practices in that year, including $1.8 million to cost-share on 31,000 ha in nutrient management plans; $0.52 million for nearly 9,600 m of streambank protection; $0.5 million for 73 ha of waterways; and $0.49 million for 26 manure storage structures.[1111] Under the federal/state Conservation Reserve Enhancement Program approximately 3,500 landowners received about $5 million in rent for enrolling their lands to protect water quality. Targeted Runoff Management Grants provided funding for 55 agricultural and one urban project in 2009, while Urban Nonpoint Source and Stormwater Grants covered up to 50% of the cost for BMPs for 18 projects.[1112]

Partnerships are also important in Wisconsin. Non-profit and grower organizations and academia are working to improve agricultural practices and reduce NPSP. The Wisconsin Buffer Initiative is a cooperative effort between farmers, University of Wisconsin scientists, public agencies and the Nature Conservancy.[1113] They have initiated a paired watershed pilot project on two sub-watersheds of the Pecatonica River in southwest Wisconsin. Changes in management are being introduced in one sub-basin where a high level of sediment or phosphorus is being added to the stream and the other watershed is a control. Phosphorus delivery from the edge-of-field to a point of interest is complex due to storage in sediment in the channel.[1114] The pilot will try to identify the key processes governing phosphorus delivery through measurement and modelling. Monitoring started three years before the project was implemented in 2009, to provide a baseline. It is too early to see results but the research is of interest for determining the extent to which targeted strategies are effective.

Sand County Foundation, which is based in Wisconsin, is trying to develop a model for reducing NPSP through market-based target incentives.[1115] The Foundation helps to educate farmers and monitors outcomes, using federal grants as well as private money.[1116] In their experience, conservation and nutrient management projects are most often initiated by non-profit organizations, local government and local

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[1109] WDNR. *2010 Wisconsin Water Quality Report to Congress*, p. 22, http://www.dnr.state.wi.us/org/water/condition/2010_IR/Attachment_A_2010_WQ_RptToCongress_FINAL_3-30-2010.pdf

[1110] Wisconsin Department of Agriculture, Trade and Consumer Protection. Land and Water Conservation, http://datcp.wi.gov/Environment/Land_and_Water_Conservation/Annual_Reporting/index.aspx

[1111] Department of Agriculture, Trade and Consumer Protection and Department of Natural Resources. *Wisconsin Land and Water Conservation, Annual Progress Report, 2009 Program Highlights*, p. 3, http://datcp.wi.gov/uploads/Environment/pdf/2009AnnualReport.pdf

[1112] Ibid. pp. 3- 4. The report provides details on more programs.

[1113] The Nature Conservancy. Pectonia River: Wisconsin Buffer Initiative Pilot Project, http://www.farmland.org/documents/WI_Pecatonica_Final_071210.pdf
See also US Geological Survey, Pectonia River: Wisconsin Buffer Initiative Pilot Project, http://www.farmland.org/documents/USGS_FieldTrip_Handout_092010.pdf

[1114] The findings from this project could be relevant to understanding why the levels of phosphorus and nitrogen from the Tar-Pamlico Basin in North Carolina, which are based on edge-of-field modelling, do not correspond with the levels found at the mouth of the basin. Mary Griffiths' comment.

[1115] Sand County Foundation. Agricultural Incentives Program, http://www.sandcounty.net/initiatives/agincentives/

[1116] Joseph Britt, Agriculture Incentives Director, Sand County Foundation, personal communication with Mary Griffiths, December 7, 2011.

offices of federal agencies. In addition to working with farmers at the field scale on conservation practices that reduce NPSP, they also try to determine what motivates farmers to apply and sustain BMPs. The Foundation recognizes that it would be impossible to compensate all farmers for adopting conservation practices, so it is important to motivate them because it is the right thing to do. It may not be possible to use improvements in water quality as an immediate motivation, as it can take time for improved practices to show their impact on water quality. Also, water quality may be confounded by other events. For example, an increase in high precipitation events as a result of climate change leads to more runoff, more sedimentation and more pollutants; a change in commodity prices may lead to a change in crops which may affect nutrient use or runoff.

The **Priority Watershed and Lake Program** (NR120), which ran from 1978 to 2008, seems to have been quite successful. Over that time, 86 of the state's lakes and watersheds were designated as priorities.[1117] The program inventoried sources of soil erosion and all barnyards and feedlots in priority project areas. Phosphorus from livestock manure was found to be a key water quality problem. Owners of critical sites were required to either participate voluntarily or be subject to legal orders to abate pollution. Local project managers helped landowners install BMPs or change management practices, and NPS grants were available to cover 70% of the cost of approved projects.[1118] It was estimated that over the last five years of the program, cropland erosion was reduced by more than 450,000 t/yr; streambank erosion was reduced by more than 135,000 t/yr and farm phosphorus was reduced by 100,000 kg/yr. At the end of 2008, 93% of all types of critical sites were resolved.[1119] [1120]

4.7.5 Forestry

In Wisconsin, the Division of Forestry comes under the jurisdiction of the WDNR. The state introduced BMPs to minimize NPSP to meet federal requirements in CWA Section 319. [1121] The Best Management Practices Manual was published in 1995; although compliance is generally voluntary, the practices are mandatory for forest lands that have enrolled under the Managed Forest Law, as well as those that are certified as sustainable forests.[1122]

BMPs cover, for example, riparian setbacks, road construction, stream crossings and wetlands.[1123] The recommended riparian management (or buffer) zone for lakes, designated trout streams and streams is 30 m for those that are 0.9 m and wider, and 10.5 m for those that are narrower.

The state has monitored the implementation of BMPs by a field examination of timber sale sites. During the first 10 years, there was 83% compliance at the 500 monitored sites. This monitoring also showed that where BMPs were implemented, there was no adverse impact on water quality 99% of the time, whereas

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[1117] WDNR. *2010 Wisconsin Water Quality Report to Congress*, p. 24, http://www.dnr.state.wi.us/org/water/condition/2010_IR/Attachment_A_2010_WQ_RptToCongress_FINAL_3-30-2010.pdf

[1118] WDNR. *NR 120 – Priority Watershed and Lake Program*, http://www.dnr.state.wi.us/runoff/pdf/rules/NR120FactSheet.pdf

[1119] WDNR. *2010 Wisconsin Water Quality Report to Congress*, p. 25, http://www.dnr.state.wi.us/org/water/condition/2010_IR/Attachment_A_2010_WQ_RptToCongress_FINAL_3-30-2010.pdf

[1120] Ibid. p. 24.

[1121] Division of Forestry. Best Management Practices for Water Quality, http://dnr.wi.gov/forestry/Usesof/bmp/index_water.htm

[1122] Division of Forestry. *Wisconsin's Forestry Best Management Practices for Water Quality 1995-2005*, p. 2, http://dnr.wi.gov/forestry/publications/pdf/FR-349.pdf

[1123] Division of Forestry. *Best Management Practices for Water Quality Field Manual*, Chapter 7, http://dnr.wi.gov/forestry/publications/pdf/FR-093.pdf

there were adverse impacts 73% of the time if BMPs were not observed.[1124] "In 2006, BMP evaluations were conducted on 28 federal and 33 industrial timber sales. Overall implementation scores for federal and industrial lands were 95% and 94%, respectively."[1125]

WDNR continues to examine the impact of BMPs and has initiated a project to evaluate the effectiveness of riparian management zones through direct measurements of in-stream flow and water quality to determine whether modifications are needed in zone width and management activities within the zone.[1126]

4.7.6 Municipal Stormwater

In addition to having rules that apply to agriculture, the Runoff Management Rule (NR 151)[1127] also addresses NPSP from stormwater and construction sites.[1128]

Construction sites that are 0.4 ha or more in size are required to implement BMPs so they "reduce to the **m**aximum **e**xtent **p**racticable (MEP) 80 percent of the sediment load on an average annual basis."[1129] This requirement is implemented and enforced through stormwater construction permits. A plan must be developed for post-construction stormwater control. There is a MEP performance standard for water infiltration to ensure that a considerable amount of the water can infiltrate. In residential districts infiltration must meet 90% of the pre-development level (or equivalent to 25% of the 2-year 24-hour design storm[1130]), and in commercial districts infiltration must be at least 60% of the pre-development level (or 10% of the 2-year 24-hour design storm). Up to 1% of the area of residential sites and up to 2% of commercial sites must be used for this infiltration. Fifteen-metre, permanently vegetated buffers are required for most lakes, streams and wetlands; while this increases to 22.5 m for outstanding and exceptional water resources and high quality wetlands,[1131] it may be between 3 m and 9 m for less susceptible wetlands.

Another rule under NR 151 relates to measures to control erosion from transportation construction sites and has very detailed specifications, covering not only construction but post-construction performance standards, including infiltration swales.[1132]

[1124] Division of Forestry. *Wisconsin's Forestry Best Management Practices for Water Quality 1995-2005*, p. 11.
[1125] National Council for Air and Stream Improvement. *Compendium of Forestry Best Management Practices for Controlling Nonpoint Source Pollution in North America*, Technical Bulletin 966, September 2009, p. 139, http://www.ncasi.org/Publications/Detail.aspx?id=3204. The source for the statement is Shy, K. and C. Wagner. 2007. *Wisconsin's forestry best management practices for water quality 2006 BMP monitoring report*. PUB-FR-391-2007. Madison, WI: Wisconsin Department of Natural Resources – Division of Forestry.
[1126] WDNR. *2010 Wisconsin Water Quality Report to Congress*, p. 47, http://www.dnr.state.wi.us/org/water/condition/2010_IR/Attachment_A_2010_WQ_RptToCongress_FINAL_3-30-2010.pdf
[1127] WDNR. Unofficial Text, *Chapter NR151, Runoff Management*, http://legis.wisconsin.gov/rsb/code/nr/nr151.pdf
[1128] WDNR. *Non-Agricultural Performance Standards for Construction Erosion Control and Storm Water Management*, NR 151, Subchapter III, Fact Sheet, http://www.dnr.state.wi.us/runoff/pdf/rules/NR151SubchapterIIIFactSheet.pdf
[1129] Ibid. p. 1.
[1130] This is an accepted rate that represents the largest amount of rainfall expected over a 24-hour period during a 2-year interval, which is used as the basis for designing stormwater management, LEEDuser, http://www.leeduser.com/glossary/term/4636
[1131] WDNR. *Non-Agricultural Revisions to Chapter NR 151, Runoff Management Rule*, p. 5, for wetlands, http://dnr.wi.gov/runoff/pdf/rules/Final_NR151_non-ag_FS_Oct_2011.pdf
[1132] WDNR. *Transportation Facilities Performance Standards*, NR 151 Subchapter IV, Fact Sheet, http://www.dnr.state.wi.us/runoff/pdf/rules/NR151TransFactSheet.pdf. As this fact sheet is undated, it is uncertain whether it contains the most recent information. There were revisions to NR151 in 2011, see WDNR. *Non-Agricultural Revisions to Chapter NR 151, Runoff Management Rule.*

In addition to NR 151, there are several administrative rules including Model Ordinances for Construction Site Erosion Control and Stormwater Management (NR 152), the Targeted Management Grant Program (NR 153), Best Management Practices, Technical Standards and Cost Share Conditions (NR 154, which applies to projects in NR 153, 155, etc.), and Urban Nonpoint Source Water Pollution Abatement and Stormwater Grant Management Program (NR 155, which provides 50-70% cost-sharing to plan and install management practices).[1133, 1134]

Wisconsin recognizes the importance of wetlands and with many organizations has developed a strategy to reverse the loss of wetlands, 75% of which are on private lands.[1135] When a local municipality issues a building permit, it is required by law to include a notice about the consequences of failing to comply with wetland laws and laws relating to construction near wetlands, streams and lakes.

"Municipalities usually directly fund BMP construction and stormwater planning within their boundaries."[1136] However, most of the BMPs are not tracked to determine how much pollution was reduced as a result of the measures.

4.7.6.1 Milwaukee

Milwaukee has a comprehensive Storm Water Management Program for reducing NPSP, to help reduce pollution entering Lake Michigan.[1137] Action is encouraged by support at the political level: "Mayor Barrett has directed city departments to reduce by 15% the amount of stormwater runoff from city properties and encourages businesses and residents to do the same." There are mandatory requirements for private developments. Project proponents are required to submit a stormwater management plan for any development or redevelopment of 0.4 ha or more, or if the development increases the impervious area by 0.2 ha or more.[1138] If development or redevelopment that requires a stormwater management plan does not increase the impervious area by more than 0.2 ha, the plan must "limit the post-development peak runoff rates to at least 10% less than pre-development peak runoff rates for the 2-year and 100-year storm events."[1139] These requirements are in addition to the Storm Water Pollution Prevention Plan required by the state. The municipality also has an educational program for the public,[1140] and is making efforts to increase green roofs and plant native species that absorb more rainfall in boulevards.[1141] A case study suggests that the success of the program is due to support from the top, and to citizen and stakeholder involvement and the careful selection of methods that address the specific water quality issue.[1142]

[1133] WDNR. Runoff Management Administrative Rules, http://www.dnr.state.wi.us/runoff/rules/
[1134] WDNR. *2010 Wisconsin Water Quality Report to Congress*, p. 22.
[1135] WDNR. *2010 Water Division Report*, p. 40, 42, http://dnr.wi.gov/org/water/success/2010Report.pdf
[1136] WDNR. *2010 Wisconsin Water Quality Report to Congress*, p. 22.
[1137] City of Milwaukee. Stormwater Management Program, http://city.milwaukee.gov/stormwatermanagement
[1138] City of Milwaukee. Stormwater Management Program, Frequently Asked Questions about Stormwater Management Plans, When is a Stormwater Management Plan Required? http://city.milwaukee.gov/FrequentlyAskedQuest12932.htm
[1139] Ibid.
[1140] City of Milwaukee. Stormwater Management Program, What Can You Do, http://city.milwaukee.gov/WhatCanyouDo12906.htm; see also http://city.milwaukee.gov/StormWaterPollutionP12929.htm
[1141] City of Milwaukee. Office of Sustainability, Managing Your Stormwater, http://city.milwaukee.gov/ManagingYourStormwater This includes reducing the flow into sewers by downspout disconnections in targeted neighbourhoods and foundation drain disconnections in public housing.
[1142] Water Environmental Research Foundation. Using Rainwater to Grow Livable Communities, Case Studies, http://www.werf.org/livablecommunities/studies_list.htm

4.7.7 Watershed Approach

Wisconsin has ranked watersheds according to NPSP problems for more than two decades. This ranking, which is shown on an interactive map, identifies priority watersheds, guides funding decisions and helps counties identify where BMPs are most needed.[1143] The watershed approach in agriculture was described in section 4.7.4. This section looks at the work that has been done on water quality trading in Wisconsin.

4.7.7.1 Water Quality Trading

Wisconsin has been examining the potential of water quality trading since 1998. Although it was studied in three areas, only one trading program occurred between a point source and agricultural non-point sources.[1144] This pilot program operated for a while in the Red Cedar Creek River Basin and reduced the NPS phosphorus runoff to the river from agricultural sources to offset the phosphorus discharges from the City of Cumberland sewage treatment plant, which helped the City to limit expensive upgrading of its plant.[1145] More than 60 trades were completed in the 3-year pilot, but the program ceased and the evaluation concluded that a 1 mg/litre phosphorus limit was insufficient to drive trades in most areas.[1146]

At the request of the Natural Resources Board, the subject was reviewed by WDNR, with input from many stakeholders. The review showed that most wastewater treatment plants in Wisconsin can reduce phosphorus loads more economically by upgrading their plant than by trading.[1147] Nevertheless, the WDNR recommended legislative changes to facilitate trading.[1148] Complex technical and regulatory issues make water quality trading a less attractive option than it might at first appear. Efforts are now underway in Wisconsin to implement the central idea behind trading − reduced compliance costs for regulated point sources through the purchase of phosphorus pollution reduction by non-point sources − by attempting to enlist all pollution sources in specific watersheds in multi-year watershed-scale phosphorus reduction efforts.[1149]

4.7.8 Progress and Effectiveness

Wisconsin has been diligent and exemplary in implementing, monitoring, measuring and reporting on the various programs to reduce runoff. The Priority Watershed and Lake Program addressed more than 90% of critical sites over the 30 years of the program and it has been replaced with new targeted programs. WDNR has removed 129 water/pollutant listings from the impaired list due to restoration and water quality improvements.[1150] Despite success, the state continues to review its progress. The 2010 report to Congress stated that "Wisconsin is poised to revise both urban and agricultural nonpoint source performance standards – already among the most progressive in the entire nation – to help address the runoff of sediment and nutrients to our waterways."[1151]

[1143] WDNR. Nonpoint Source Rankings in Basin Plans, http://dnr.wi.gov/org/water/wm/glwsp/npsrank/

[1144] WDNR. *A Water Quality Trading Framework for Wisconsin*, July 2011, p. 6, http://fyi.uwex.edu/wqtrading/files/2011/07/WQT-Framework-Final.pdf. The report, Appendix B, provides a useful evaluation of trading in other states (including California, N. Carolina, Oregon and Vermont).

[1145] EPA. Water Quality Trading Toolkit, Appendix A, Red Cedar River Nutrient Trading Pilot Program, pp. A-115 – A118, http://www.epa.gov/npdes/pubs/wqtradingtoolkit_app_a_case_studies.pdf

[1146] Water Quality Trading and Offset Initiatives in the U.S.: A Comprehensive Survey, 2004, p. 316, http://www.dep.state.fl.us/water/watersheds/docs/ptpac/dartmouthcomptradingsurvey.pdf

[1147] WDNR. *A Water Quality Trading Framework for Wisconsin*, July 2011, p. 6.

[1148] Ibid. p. 33.

[1149] Joseph Britt, Agriculture Incentives Director, Sand County Foundation, personal communication with Mary Griffiths, January 19, 2011.

[1150] WDNR. *2010 Water Division Report*, p. 33, http://dnr.wi.gov/org/water/success/2010Report.pdf. The report does not indicate to what extent the impairment was due to NPSP, but this seems to be the major source of pollution in rural areas.

[1151] WDNR. *2010 Wisconsin Water Quality Report to Congress*, p. 151, http://www.dnr.state.wi.us/org/water/condition/2010_IR/Attachment_A_2010_WQ_RptToCongress_FINAL_3-30-2010.pdf

5. Review of Selected Jurisdictions in Europe

5.1 The European Union

5.1.1 The European Union at a Glance

- *European Union (EU) legislation directs what must be done in each of the member states, and each state passes its own legislation in order to comply with EU requirements.*
- *The Water Framework Directive requires states to adopt a comprehensive, watershed approach to point and diffuse (non-point source) water pollution.*
- *The Nitrates Directive aims to prevent nitrogen from agricultural sources from polluting ground and surface waters through the implementation of good farming practices.*

5.1.2 European Union Regulatory Requirements

In 2000 the EU authorized the Water Framework Directive (WFD) to address diffuse water pollution, which is the term commonly used for NPSP in Europe.[1152] The WFD adopts a water management approach based on river basins and covers urban wastewater treatment and integrated pollution prevention and control; these are now regarded as the minimum requirements and must be integrated into river basin management planning.[1153]

The Directive sets standards for surface and groundwater and requires member states to:

- Adopt a combined approach for point and diffuse sources and implement controls or BMPs that relate to diffuse pollution (Article 10(2)(c)).
- Adopt measures to prevent or control the input of pollutants from diffuse sources, including prior regulation (prohibiting entry into water) or prior authorization or registration, based on binding rules (Article 11(3)(h)).
- Adopt strategies against pollution, including the priority substances that the European Commission identifies (Article 16(6)).
- Identify and estimate significant diffuse source pollution, in particular by substances listed in Annex VIII, from urban, industrial, agricultural and other installations and activities (Annex II, Section 1.4).
- Select monitoring sites for water bodies that are at risk of significant diffuse pollution, at a representative selection of water bodies, to assess the magnitude and impact of the diffuse source pressures. (Annex V, Surface Water Status, Section 1.3.2).
- Establish river basin management plans that contain a summary of the significant pressures and impacts of human activity, with an estimation of diffuse source pollution, including a summary of land use (Annex VII, Section 2).[1154]

[1152] European Commission: Environment. The EU Water Framework Directive – Integrated River Basin Management for Europe, http://ec.europa.eu/environment/water/water-framework/index_en.html
[1153] EU. Wise Water Note 9, Integrating Water Policy: Linking all EU Water Legislation within a Single Framework, http://ec.europa.eu/environment/water/participation/pdf/waternotes/water_note9_other_water_legislation.pdf
[1154] European Commission. *Directive 2000/60/EC of the European Parliament and of the Council of 23 October, 2000, establishing a Framework for Community Action in the Field of Water Policy*, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:327:0001:0072:EN:PDF

The WFD recognizes the value of public participation in its implementation, especially in the production, review and updating of river basin management plans (Article 14). It also adopts economic approaches, including recovery of the cost of water services.[1155]

The EU estimates that farming is responsible for over 50% of nitrogen discharge into surface waters.[1156] "The **Nitrates Directive** (91/676/EEC) aims to prevent nitrates from agricultural sources from affecting ground and surface waters. It requires Member States to (1) detect waters that are already affected or likely to be affected by nitrate pollution, (2) designate all those areas that drain into waters that are polluted as 'vulnerable zones,' (3) develop action programmes within the vulnerable zones, and (4) monitor and assess the action programmes and revise them as needed to achieve the directive's goals."[emphasis in original][1157] The Nitrates Directive requires countries to develop codes of good agricultural practice, which farmers are expected to implement on a voluntary basis. In vulnerable zones, in addition to the code, measures must be taken to limit the application of nitrogen fertilizer to the soil, which might require investing in livestock manure storage facilities. It seems this approach has been effective, as nitrate concentrations were stable or fell at 70% of monitored sites between 2004 and 2007.[1158]

The way in which the requirements of the WFD and the Nitrates Directive are implemented, depends on the legislation and policy in the individual EU countries.

[1155] EU. *A Common Task, Public Participation in River Basin Management Planning*, WISE Water Note 12, http://ec.europa.eu/environment/water/participation/pdf/waternotes/water_note12_public_participation_plans.pdf
[1156] EC. *The EU Nitrates Directive*, 2010, http://ec.europa.eu/environment/pubs/pdf/factsheets/nitrates.pdf
[1157] EU. *Integrating Water Policy: Linking all EU Water Legislation within a Single Framework*, Wise Water Note 9, http://ec.europa.eu/environment/water/participation/pdf/waternotes/water_note9_other_water_legislation.pdf
[1158] EC. *The EU Nitrates Directive*, 2010, p. 1, http://ec.europa.eu/environment/pubs/pdf/factsheets/nitrates.pdf

5.2 England

5.2.1 England at a Glance

- *A Statutory Management Requirement (SMR 4) implements the EU Nitrates Directive by setting nutrient management rules for farmers in nitrate vulnerable zones.*
- *To receive funding under the EU Single Payments Scheme, farmers must comply not only with SMR 4 but keep the land in Good Agricultural and Economic Condition, which from 2012 includes buffer zones for fertilizer and manure applications.*
- *The Catchment Sensitive Farming program focuses on priority watersheds, but the implementation varies considerably between areas.*
- *The National Auditor has been highly critical of the Environment Agency's management of diffuse water pollution.*

5.2.2 Overview

England lies at approximately the same latitude as southern Alberta; the latitude of London is similar to that of Calgary, but the Gulf Stream gives it a mild, humid climate. The average winter temperature is above freezing and precipitation varies from less than 80 cm per year in the south to double that in the north.[1159] England's population is about 50 million on a total land area of almost 130,000 km^2 (one-fifth the area of Alberta).[1160] Urban development covers approximately one-fifth of the country; about 30% of the land is cultivated, about 35% is used for grazing and rough grazing, and 8% for forestry.

Risk assessments conducted as a basis for compliance under the WFD showed that diffuse pollution is a greater source of pollution than point sources.[1161] "Up to 82 per cent of rivers, 53 per cent of lakes and 75 per cent of groundwater bodies are at risk of not achieving good ecological and chemical status by 2015 (as required by the WFD) because of diffuse water pollution."[1162] In 2007 the Environment Agency indicated that it aimed "to complete over 8,500 investigations into the reasons for water bodies failing to meet the required ecological standard by December 2012." This is to help it target its actions to improve water quality.[1163]

[1159] Weather Online. England and Scotland, http://www.weatheronline.co.uk/reports/climate/England-and-Scotland.htm

[1160] Wikipedia. The Geography of England, http://en.wikipedia.org/wiki/Geography_of_England. This is the source of information in this paragraph.

[1161] Environment Agency. *The Unseen Threat to Water Quality*, Diffuse Water Pollution in England and Wales Report, May 2007, p. 6, http://www.environment-agency.gov.uk/static/documents/Research/geho0207bzlvee_1773088.pdf

[1162] Environment Agency. Water Protection Zones, Briefing Note, October 2009, http://www.environment-agency.gov.uk/static/documents/Business/WPZ_Oct_2009_key_messages.pdf It is apparent that the EU Directive is more stringent that the former English standards, as "Under the Agency's previous system for classifying water quality, 79 per cent of English rivers achieved good or very good status in 2008, up from 55 per cent in 1990." National Audit Office, *Environment Agency: Tackling Diffuse Water Pollution in England*, Report by the Comptroller and Auditor General, July 2010, p. 4. See link to the report at: http://www.nao.org.uk/publications/1011/water_quality.aspx

[1163] Environment Agency. *The Unseen Threat to Water Quality*, p.5.

5.2.3 Legislation, Funding, Data Collection, Reporting

5.2.3.1 Legislation

When the Environment Agency reviewed diffuse pollution to meet the requirements of the EU's WFD, it determined that "To reduce urban and rural diffuse pollution further, we are likely to need new or improved legislative powers, for example to improve land management practices, and a combination of voluntary, regulatory and economic measures."[1164] General Binding Rules are seen as a way to address diffuse water pollution (as has been done in Scotland, see section 5.4), but at the time of writing they are not ready.[1165]

The *Water Resources Act* makes it possible for the Environment Agency to prosecute for various offences if surface waters or groundwater are knowingly polluted.[1166] The Act also gives the Environmental Agency powers to establish water protection zones (WPZ) for addressing both point source and diffuse pollution.[1167] WPZs are a mechanism for addressing water pollution from urban and rural sources where voluntary measures are insufficient to meet the requirements of the WFD.[1168] A WPZ can be applied over any scale and target almost any pollutant or polluting activity, but can only be created following consultation and secondary legislation.[1169] The Water Protection Zones Statutory Instrument was to come into force in December 2009.[1170] The Environmental Agency recognized that "WPZs are a relatively untried mechanism. Hence, we will start with a small number of candidate sites in this project, prior to any widespread use. This is to refine our understanding and 'establish the concept' for WPZs prior to any wider use of them."[1171]

A very specific statutory instrument is the Nitrate Pollution Prevention Regulation.[1172] This regulation applies to agriculture, and the Nitrates Action Programme is summarized in section 5.2.4.

[1164] Ibid. p.4.
[1165] DEFRA and Environment Agency. *Water for Life and Livelihoods*, River Basin Management Plan: Thames River Basin District, 2009, p. 84, http://publications.environment-agency.gov.uk/PDF/GETH0910BSWA-E-E.pdf
[1166] *Water Resources Act*, 1991, section 85, with amendments, http://www.legislation.gov.uk/ukpga/1991/57/section/85
[1167] *Water Resources Act*, 1991, section 93, with amendments, http://www.legislation.gov.uk/ukpga/1991/57/section/93. Because it is difficult to follow all the amendments in the legislation, the summary of the sections is taken from Environment Agency, *Water for Life and Livelihoods*, River Basin Management Plan: Thames River Basin District, 2009, Annex F, pp. 36-37 and pp. 39-40, http://publications.environment-agency.gov.uk/PDF/GETH0910BSWG-E-E.pdf. See also: Environment Agency, Thames River Basin Management Plan, http://www.environment-agency.gov.uk/research/planning/125035.aspx This page has links to the plan and all the annexes.http://publications.environment-agency.gov.uk/PDF/GETH0910BSWA-E-E.pdf
[1168] Environment Agency. Water Protection Zones, http://www.environment-agency.gov.uk/business/topics/pollution/111261.aspx
[1169] Farmers Guardian. Water Framework Directive a Threat to Crop Protection, May 15, 2009, http://www.farmersguardian.com/water-framework-directive-a-threat-to-crop-protection/25108.article
[1170] DEFRA and Environment Agency. *Water for Life and Livelihoods*, p. 84.
[1171] Environment Agency. Water Protection Zones, Briefing Note, October 2009, http://www.environment-agency.gov.uk/static/documents/Business/WPZ_Oct_2009_key_messages.pdf
[1172] Statutory Instruments, 2008, No. 2349, Agriculture, England; Water, England, The Nitrate Pollution Prevention Regulations 2008, http://www.legislation.gov.uk/uksi/2008/2349/pdfs/uksi_20082349_en.pdf

5.2.3.2 Funding

"In 2008-09 the [Environment] Agency spent over £140 million on its water quality work in England, including an estimated £8 million directly on diffuse pollution. Other environmental schemes, such as the England Catchment Sensitive Farming Initiative, also help to tackle diffuse pollution."[1173] Given the fact that diffuse pollution is now a greater problem than point source pollution, it seems that a different allocation of funding may be required.

With respect to agriculture, "The latest reform of the EU Common Agricultural Policy (CAP) in 2003 broke the link between financial support and production. CAP support is now tied to compliance with EU standards for the environment, public and animal health. Farmers will also have to maintain land in good agricultural and environmental condition."[1174] Farmers who comply with good agricultural practices are eligible for assistance under the "Single Payment Scheme"[1175] and payments are made by the Rural Payments Agency, which also carries out inspections.[1176] "The new scheme will break the link between production and support. Instead, farmers will be asked to demonstrate that they are keeping their land in good agricultural and environmental condition and complying with a number of specified legal requirements relating to the environment, public and plant health and animal health and welfare. Meeting these requirements is described in the regulations as 'cross-compliance'."[1177]

Under the Catchment Sensitive Farming program the Department of Food, Agriculture and Rural Affairs (DEFRA) "funds a £10.5 million Capital Grants Scheme in 2011-12 to support land managers in priority catchments in England, which help farmers to install facilities that benefit water quality by reducing diffuse pollution."[1178] In fiscal year 2011-12 funding is available in 50 priority catchment areas.[1179] Farmers are expected to pay up to 50% of the capital costs for items such as watercourse fencing, roofing for manure stores, and pesticide loading and wash down areas, and the payment rate is fixed for specific projects.[1180]

5.2.3.3 Data Collection

The Environmental Agency is responsible for water monitoring and reporting, in accordance with the WFD.[1181] In addition to routine monitoring, the Agency manages the Harmonized Monitoring Scheme, which monitors and reports on long-term trends and the loads of some nutrients. "The sampling network

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[1173] National Audit Office, *Environment Agency: Tackling Diffuse Water Pollution in England*, Report by the Comptroller and Auditor General, July 2010, p. 4. See link to the report at: http://www.nao.org.uk/publications/1011/water_quality.aspx

[1174] Environment Agency. *The Unseen Threat to Water Quality*, p.15.

[1175] Rural Payments Agency. Single Payment Scheme, http://rpa.defra.gov.uk/rpa/index.nsf/vDocView/FFFDD11D4803F7D580256F72003DD33D?OpenDocument

[1176] Rural Payments Agency. What We Do, http://rpa.defra.gov.uk/rpa/index.nsf/home. The Agency works with the Department for Environment, Food and Rural Affairs and makes Common Agricultural Policy support payments and carries out inspections.

[1177] Rural Payments Agency. Single Payment Scheme – Introduction, http://rpa.defra.gov.uk/rpa/index.nsf/vContentByTaxonomy/RPA%20Schemes**Single%20Payment%20Scheme**Introduction**?OpenDocument

[1178] DEFRA. Catchment Sensitive Farming, http://www.defra.gov.uk/food-farm/land-manage/nitrates-watercourses/csf/

[1179] Natural England. Capital Grants Scheme, http://www.naturalengland.org.uk/ourwork/farming/csf/cgs/default.aspx

[1180] Ibid.

[1181] Environment Agency. Monitoring Emissions to Water, http://www.environment-agency.gov.uk/business/regulation/31833.aspx

includes 230 sites, which are mainly located at the tidal limits of major rivers or at the points of confluence of significant tributaries."[1182]

5.2.3.4 Reporting

The Environment Agency issues occasional subject-specific reports and an annual report on its activities. A 2007 report on the impacts of diffuse water pollution provides background information to underpin the development of regulatory and voluntary measures to comply with the EU's WFD.[1183]

There is only one reference to diffuse water pollution in the Environment Agency's most recent annual report, which explains that the Agency is shifting its focus "to tackling pollution from agricultural land, highways and urban areas (known as 'diffuse' pollution) which is now a major cause of poor water quality."[1184]

Reporting is required for the Catchment Sensitive Farming program and the results are described in section 5.2.4, below.

5.2.3.5 Partnerships

The Environment Agency works with Natural England and DEFRA to implement actions to reduce diffuse water pollution.[1185] Natural England is the government's advisor on the natural environment and as well as conserving biodiversity and habitat, manages the country's green farming schemes.

5.2.4 Agriculture

The Environment Agency recognizes the contribution that agriculture makes to diffuse water pollution. A 2007 report found that losses from agricultural land account for:

- An estimated 61% of nitrate that enters surface waters in England and Wales, with nitrate concentrations linked to the proportion of arable land in the catchment upstream, and intensive livestock production being another significant source.
- Up to 40% of the phosphate load in rivers, although this varies between catchments.[1186]
- About 75% of the sediment load in "at risk" rivers (e.g., for bathing).[1187]

Several programs aim to reduce pollution from agricultural sources. DEFRA requires farmers to comply with the Nitrates Action Programme, promotes Good Agricultural Practice,[1188] and encourages participation in the Catchment Sensitive Farming program.

As mentioned in section 5.2.3.2, financial support for agriculture within the EU is tied to adoption of good agricultural practices, through the Single Payment Scheme or other direct farm payments.[1189]

[1182] DEFRA. SMR 4 Nutrient Status of Rivers, http://www.defra.gov.uk/statistics/foodfarm/enviro/observatory/cross-compliance/smr4-nutrient-status-of-rivers/
[1183] Environment Agency. *The Unseen Threat to Water Quality*.
[1184] Environment Agency. *Annual Report and Accounts 2010-2011*, July 2011, p. 5, http://www.official-documents.gov.uk/document/hc1012/hc12/1269/1269.pdf
[1185] Ibid.
[1186] Environment Agency. *The Unseen Threat to Water Quality*, p. 8.
[1187] Natural England, A Guide to England Catchment Sensitive Farming Delivery Initiative, leaflet, http://archive.defra.gov.uk/foodfarm/landmanage/water/csf/documents/leaflet.pdf
[1188] DEFRA. Good Agricultural Practices, Nutrients and Fertilizers, http://www.defra.gov.uk/food-farm/land-manage/nutrients/

Payment requires not only compliance with Statutory Management Requirements (SMR) but with good management practices, which specify actions a farmer must undertake to keep the land in Good Agricultural and Environmental Condition (GAEC).[1190] There is an inspection program to check compliance with SMR and GAEC requirements.[1191]

The Nitrates Action Programme is a mandatory program required under the EU Nitrates Directive. SMR 4 applies to those who farm in nitrate vulnerable zones.[1192, 1193] Nitrate Vulnerable Zones are areas where surface water or groundwater contains (or could contain, if no action is taken) nitrate concentrations greater than 50 mg/l. They cover much of England.[1194] Farmers in a Nitrate Vulnerable Zone must comply with a series of rules that cover nitrogen fertilizer application rates, manure management (including closed periods when no manure may be spread), and record-keeping.[1195,1196] There is an online self-assessment tool.[1197] In cases where at least 80% of the farm is in grassland, farmers may apply for a waiver of the rules, to allow them to spread up to 250 kg of livestock nitrogen manure per hectare, which exceeds the 170 kg limit set by the EU Nitrates Directive.[1198]

The EU requires member states to review the effectiveness of actions taken to comply with the Nitrate Directive at least every four years.[1199] DEFRA uses monthly readings to monitor the nitrate levels at 7,000 monitoring stations and published data show, for example, the length of rivers where nitrate levels exceed the EU Nitrates Directive.[1200]

In January 2012, a new GAEC standard set out buffer zones and stipulates that a farmer must not apply:

- manufactured nitrogen (inorganic) fertilizer within 2 m of surface water;
- organic manure within 10 m of surface water (with some exemptions);

[1189] Business Link. Managing Environmental Resources, Nitrate Vulnerable Zones, NVZ and Cross-Compliance, http://www.businesslink.gov.uk/bdotg/action/detail?itemId=1097363009&r.l1=1081597476&r.l2=1082184851&r.l3=1083731949&r.l4=1083659199&r.s=sc&type=RESOURCES

[1190] DEFRA. Inspection Data, http://www.defra.gov.uk/statistics/foodfarm/enviro/observatory/cross-compliance/inspection-data/ The majority of the standards of Good Agricultural and Environmental Condition (GAEC) relate to pre-existing legal requirements.

[1191] Rural Payments Agency. Single Payment Scheme, Inspection Process, http://rpa.gov.uk/rpa/index.nsf/UIMenu/3A99D4AFFE35CADE802570C700466AED?Opendocument

[1192] DEFRA. SMR 4 Nitrate Vulnerable Zones, http://www.defra.gov.uk/statistics/foodfarm/enviro/observatory/cross-compliance/smr4-nvzs/

[1193] DEFRA. Nitrate Vulnerable Zones, http://www.defra.gov.uk/food-farm/land-manage/nitrates-watercourses/nitrates/

[1194] DEFRA. Nitrate Vulnerable Zones in England, map, http://archive.defra.gov.uk/environment/quality/water/waterquality/diffuse/nitrate/documents/nvz-england-new-map.pdf

[1195] Rural Payments Agency. Nitrate Vulnerable Zones, Standard Management Requirement, http://rpa.gov.uk/rpa/index.nsf/293a8949ec0ba26d80256f65003bc4f7/12eac3896620097b802573aa00553363!OpenDocument

[1196] Business Link. Nitrate Vulnerable Zones, How to Comply with NVZ Rules, http://www.businesslink.gov.uk/bdotg/action/detail?itemId=1083660854&r.l1=1081597476&r.l2=1082184851&r.l3=1083731949&r.l4=1083659199&r.s=sc&type=RESOURCES

[1197] DEFRA. Nitrate Vulnerable Zones, http://www.defra.gov.uk/food-farm/land-manage/nitrates-watercourses/nitrates/

[1198] Ibid.

[1199] Ibid.

[1200] DEFRA. SMR 4 Nutrient Status of Rivers, http://www.defra.gov.uk/statistics/foodfarm/enviro/observatory/cross-compliance/smr4-nutrient-status-of-rivers/ .

- organic manure within 50 m of a spring, well or borehole.[1201]

A farmer who spreads organic manure must also maintain a map identifying the buffer zones.

In addition to mandatory requirements, the Code of Good Agricultural Practice provides advice on manure and nutrient management plans, the application of manure and fertilizers, the handling and use of pesticides and livestock management.[1202] There are very few references to diffuse pollution, but many references to buffer zones, including a recommendation that "[W]ider buffers are advisable and conservation headlands and buffer strips in excess of any cross compliance obligation may be eligible for payment under an agri-environment agreement."

Sixty-four priority catchments have been identified under the Catchment Sensitive Farming (CSF) program.[1203] Training, advice and capital grants are targeted to specific areas within these catchments.[1204] CSF officers provide practical advice to farmers and land managers, offering workshops, farm events and individual appraisals.[1205] In some cases there are partnerships with other bodies.[1206]

As explained in section 5.2.3.2, some funding is available for CSF under its Capital Grant Scheme,[1207] which is tailored to the priority needs within each area. Each catchment has its own Funding Priority Statement which identifies catchment-specific priorities and target areas.[1208] For example, in the River Exe catchment in southwest England, there are three priority sub-catchments and the focus is to:

- separate clean and dirty water in yards;
- limit run-off from farm and cattle tracks;
- reduce rainwater entering slurry or silage stores;
- reduce amount of sediment entering watercourses; and
- exclude or limit impact of livestock on watercourses.[1209]

In the southeast of England, in the River Stour catchment, some of the priorities are similar, but the first one is to improve treatment of pesticide washings to reduce losses to groundwater or watercourses.[1210]

[1201] Rural Payments Agency. No Spread Zones (GAEC 19), http://rpa.gov.uk/rpa/index.nsf/contentdocs/08E50CD0B067E37BE802573A6003E1E6F. Organic manure refers to any nitrogen fertiliser or phosphate fertiliser derived from animal, plant or human sources and includes livestock manure.

[1202] DEFRA. *Protecting Our Water, Soil and Air: A Code of Good Agricultural Practice for Farmers, Growers and Land Managers*,2009, http://www.defra.gov.uk/publications/files/pb13558-cogap-090202.pdf

[1203] DEFRA. Catchment Sensitive Farming, http://www.defra.gov.uk/food-farm/land-manage/nitrates-watercourses/csf/

[1204] Natural England. Catchment Sensitive Farming (CSF) Catchments, map, http://www.naturalengland.org.uk/Images/catchment-map_tcm6-26030.pdf

[1205] Natural England. *A Guide to England Catchment Sensitive Farming Delivery Initiative*, leaflet, http://archive.defra.gov.uk/foodfarm/landmanage/water/csf/documents/leaflet.pdf

[1206] See, for example, the Loddon Farm Advice Project. DEFRA and Environment Agency, *Water for Life and Livelihoods*, River Basin Management Plan: Thames River Basin District, 2009, p. 21, http://publications.environment-agency.gov.uk/PDF/GETH0910BSWA-E-E.pdf

[1207] Natural England. Catchment Sensitive Farming: Summary of Phase 1 and 2 Evaluation Report, http://www.naturalengland.org.uk/Images/csf-evaluation-summary_tcm6-27150.pdf

[1208] Natural England. Capital Grants Scheme, Priority Catchments, http://www.naturalengland.org.uk/ourwork/farming/csf/cgs/catchments.aspx

[1209] Natural England. Capital Grants Scheme – Funding Priority Statement 2001/12, Catchment 18: River Exe, http://www.naturalengland.org.uk/Images/CSF5-18_tcm6-26174.pdf

[1210] Natural England. Capital Grants Scheme – Funding Priority Statement 2001/12, Catchment 37: The Stour. http://www.naturalengland.org.uk/Images/CSF5-37_tcm6-26193.pdf

The CSF funding priorities do not appear to include fertilizer use, presumably because this is being addressed through the Nitrates Action Programme.

The first five-year evaluation report found that:

- CSF advice has been delivered to over 9,000 farms covering an area of 1.3 million ha; this represents 17% of all farm holdings within priority catchments (38% by area) and 45% within targeted sub-catchments (62% by area).[1211]
- 64% of farms have implemented more than half the specific recommendations to reduce water pollution.[1212]
- More than 93,000 farm-specific recommendations were made.[1213]
- The uptake rate for advice was more than 50%.
- Monitored pollutant levels declined by up to 30% in targeted sub-catchments.
- It is too early to see a response in ecological monitoring data.

The evaluation report also surveyed the farmers' views on the initiative. It was found that:

- 80% of farmers had increased knowledge of water pollution.
- Over 90% thought that the initiative was the best way to learn about water pollution.
- There is still only limited recognition that agriculture makes a significant contribution to water pollution.[1214]

Key drivers for farmer participation have been financial incentives through:

- Free advice;
- Reduced costs (such as more accurate calculation of fertilizer application rates); and
- Grants.[1215]

5.2.5 Forestry

Forestry Commission England is the government department responsible for forest management. The "Forests and Water" guide sets out the standards and guidance for BMPs.[1216] The guide describes legal requirements to prevent hazardous substances from entering watercourses, as well as minimum buffer distances.[1217] Narrow buffers of only 10 m are required along streams less than 2 m wide, and 20 m is the minimum for wider streams. Only around water abstraction points are wider buffers mandatory. In addition to the regulatory requirements there are sustainable forest management guidelines. They include measures to reduce erosion by avoiding the use of equipment in watercourses, the direct discharge of forest drains and runoff, and the use of fords.[1218] A number of the guidelines are General Binding Rules in Scotland (see section 5.4.5), but not in England. The UK Woodland Assurance Standard, which is an

[1211] Natural England. Catchment Sensitive Farming: Summary of Phase 1 and 2 Evaluation Report, http://www.naturalengland.org.uk/Images/csf-evaluation-summary_tcm6-27150.pdf
[1212] Natural England. Catchment Sensitive Farming Evaluation, http://www.naturalengland.org.uk/ourwork/farming/csf/evaluation.aspx
[1213] Natural England. Catchment Sensitive Farming: Summary of Phase 1 and 2 Evaluation Report. This report is also the basis for the following four bullets in the list.
[1214] Ibid.
[1215] Ibid.
[1216] Forestry Commission. UKFS Guidelines on Forests and Water, http://www.forestry.gov.uk/forestry/INFD-8BVGX9
[1217] Forestry Commission. *Forests and Water*, UK Forestry Standard Guidelines, 5th edition, 2011, Chapter 5, especially p.19-23, http://www.forestry.gov.uk/pdf/FCGL007.pdf/$FILE/FCGL007.pdf
[1218] Forestry Commission. *Forests and Water*, Chapter 6.

independent body for certifying sustainable woodland management, also sets out similar requirements in its standard, distinguishing between regulatory requirements and guidance.[1219]

In Water Protection Zones (see section 5.2.3.1), the Environment Agency has additional powers to address diffuse water pollution and damage that might cause the water bodies to fail WFD objectives.[1220] Such measures could also apply to forestry activities.

5.2.6 Municipal Stormwater

The Environment Agency recognizes that runoff from the urban environment can be a threat to water quality, and ". . . want sustainable drainage systems (SuDS) that intercept pollutants and reduce flood risk to become a common feature of urban design."[1221] SuDS include rainwater re-use, soakaways, permeable surfaces, ponds and wetlands,[1222] so are similar to some LID measures in North America.

The National SuDS Working Group, which includes members from various government departments as well as non-governmental bodies, developed an Interim Code of Practice for SuDS.[1223] "It provides a set of agreements between those public organisations with statutory or regulatory responsibilities relating to SuDS and could be used in lieu of commencement of schedule 3 of the *Flood and Water Management Act 2010.*"[1224] Schedule 3 requires the minister to publish national standards for the implementation of sustainable drainage.[1225, 1226] Local initiatives may be underway, where local water quality has necessitated action.[1227] In 2012, the government intends to consult on a national strategy on urban diffuse pollution.[1228]

5.2.7 Mining

The Environment Agency and Coal Authority are working on a program to deal with waste water from mines.[1229] Many of the discharges can be treated as point sources, but diffuse pollution can occur from groundwater seeps and from tailings and waste disposal. A study found that "For many mine-impacted catchments, remediation of the point sources alone may not improve river water quality sufficiently to

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[1219] UK Woodland Assurance Standard, http://ukwas.org.uk/
[1220] Forestry Commission. *Forests and Water*, p. 14.
[1221] Environment Agency. *The Unseen Threat to Water Quality*, Diffuse Water Pollution in England and Wales Report, May 2007, p.3, http://www.environment-agency.gov.uk/static/documents/Research/geho0207bzlvee_1773088.pdf
[1222] Environment Agency. *The Unseen Threat to Water Quality*, p. 15.
[1223] Construction Industry Research and Information Association (CIRIA), Sustainable Drainage Systems, Interim Code of Practice for SuDS, http://www.ciria.org.uk/suds/interim_code.htm
[1224] Ibid.
[1225] *Flood and Water Management Act 2010*, Schedule 3, section 5, http://www.legislation.gov.uk/ukpga/2010/29/schedule/3/paragraph/5. Schedule 3 does not yet seem to have been implemented, according to this website.
[1226] DEFRA. *Flood and Water Management Act 2010*, Implementation Approach, http://www.defra.gov.uk/environment/flooding/legislation/implementation-approach/
[1227] Environment Agency. *The Unseen Threat to Water Quality*, p.15.
[1228] HM Government. *Water for Life*, December 2011, pp. 28 and 38, http://www.official-documents.gov.uk/document/cm82/8230/8230.pdf
[1229] Ibid. p. 37.

achieve the WFD objectives of good ecological and chemical status by 2015,"[1230] and that in some catchments diffuse sources can be a significant source of pollution, especially during high runoff.[1231]

The WFD has also focused attention on abandoned non-coal mines. There is "limited understanding of the significance of diffuse mine water pollution in river catchments affected by mine water pollution."[1232] Diffuse water pollution has been identified as significant at some sites, where it may be an important source of contaminant load in rivers and DEFRA has initiated research into the problem. Unlike coal mines, it seems there is no agency responsible for tackling diffuse pollution from other mines.[1233]

At present, the problem is being studied but no success stories were found on the treatment of diffuse water pollution from mining activities in England.

5.2.8 Watershed Management

In compliance with the WFD, England has adopted River Basin Management Plans for the country's 11 basins.[1234] These plans address many issues, including diffuse pollution. The plan for the Thames River Basin,[1235] for example, identifies diffuse pollution from agriculture and urban sources as two of the five key issues that need to be addressed in the basin.[1236] One part of the plan is the Catchment Sensitive Farming program, described in section 5.2.4, above. Water Protection Zones (Environment Agency and DEFRA) will provide a regulatory tool to address issues in high risk areas where existing frameworks will not meet the WFD.[1237]

The government thinks that voluntary measures and the right advice based on local knowledge can achieve much in river basin management, supplemented with regulation where needed.[1238]

5.2.9 Progress and Effectiveness

The National Auditor has written a critical report on the Environment Agency's management of diffuse water pollution.[1239] The Auditor found, for example, that:

[1230] Environment Agency. *Abandoned Mines and the Water Environment,* 2008, http://publications.environment-agency.gov.uk/PDF/SCHO0508BNZS-E-E.pdf

[1231] Mayes, W.M. *et al*., Quantifying the Importance of Diffuse Minewater Pollution in a Historically Heavily Coal Mined Catchment, *Environmental Pollution,* Vol. 151, Issue 1, Jan. 2008, p. 165 (abstract), http://www.sciencedirect.com/science/article/pii/S0269749107001133

[1232] Jarvis, A. *et al*. Prospects for Effective National Management of Abandoned Metal Mine Water Pollution in the UK, IMWA Symposium 2007: Water in Mining Environments, http://www.imwa.info/docs/imwa_2007/IMWA2007_Jarvis.pdf

[1233] Hetherington, G., MP Urges Action over Mine Water Pollution, *The Northern Echo,* 9th February, 2011, http://www.thenorthernecho.co.uk/news/8840428.MP_urges_action_over_mine_water_pollution/

[1234] Environment Agency. *Water for Life and Livelihoods:* River Basin Management Plans, http://www.environment-agency.gov.uk/research/planning/33106.aspx One of the 11 basins, Solway-Tweed, overlaps with Scotland.

[1235] Environment Agency. Thames River Basin Management Plan, http://www.environment-agency.gov.uk/research/planning/125035.aspx This page has links to the plan and all the annexes.

[1236] DEFRA and Environment Agency. *Water for Life and Livelihoods,* River Basin Management Plan: Thames River Basin District, 2009, p. 5, http://publications.environment-agency.gov.uk/PDF/GETH0910BSWA-E-E.pdf

[1237] Ibid. p. 20.

[1238] Environment Agency. *The Unseen Threat to Water Quality*, Diffuse Water Pollution in England and Wales Report, May 2007, p.17, http://www.environment-agency.gov.uk/static/documents/Research/geho0207bzlvee_1773088.pdf

- The first requirement is sound knowledge. The Environmental Agency has very limited information on why some rivers are failing quality standards, the extent to which failure to meet standards is due to diffuse pollution, which agricultural sources (such as fertilizer spreading or livestock management) contribute most to this failure, and which changes to farming practices are likely to have the greatest impact.
- The Catchment Sensitive Farming Delivery Initiative has led some farmers to change their farming practices, but the number of farms engaged varies greatly between areas. It is not known if this is due to the targeted nature of the program, different farm types and sizes, or the variety of methods used to engage with farmers in different areas.
- Farmers who cause diffuse pollution are not adequately aware of the need to change, which undermines the effectiveness of the Agency's voluntary initiatives to change behaviours. "[W]ithout the widespread commitment of farmers to tackling diffuse pollution or sufficient access to financial incentives, the impact of voluntary initiatives has been piecemeal."[1240]
- Partnerships can be important, but they must work well. There are some good partnerships at the local level, but coordination and greater clarity around the roles and responsibilities is needed at the national level.
- Funding to reduce diffuse water pollution should be allocated where it can be most effective. "A lack of flexibility in the allocation of capital grants under the England Catchment Sensitive Farming Delivery Initiative means that, in certain cases, the funding is not being spent on those measures which would deliver the maximum reductions in diffuse pollution at an individual farm level."[1241]
- There was limited evidence of the effectiveness of inspection activity and ". . . the Agency has been slow to recognise the ineffectiveness of some of the existing sanctions and regulations to tackle diffuse pollution."[1242]

Much of the critique relates to agricultural pollution, as this is where the Environment Agency has done the most work. The Auditor noted that the Agency has less knowledge about diffuse pollution from urban sources. The critique is cited here to help Alberta identify potential pitfalls in designing measures to address NPSP; the Auditor's recommendations provide a useful checklist.[1243]

[1239] National Audit Office. *Environment Agency: Tackling Diffuse Water Pollution in England*, Summary Report, Report by the Comptroller and Auditor General, July 2010, pp. 4-9. See http://www.nao.org.uk/publications/1011/water_quality.aspx

[1240] Ibid. p. 6.

[1241] Ibid. p. 6.

[1242] Ibid. p. 7.

[1243] Ibid. pp. 8-9.

5.3 Scotland

5.3.1 Scotland at a Glance

- *Scotland is far ahead of England in addressing diffuse pollution.*
- *Diffuse pollution is regulated by General Binding Rules that apply to agriculture, forestry and the built environment.*
- *The Diffuse Pollution Management Advisory Group guides implementation of the Scottish Environment Protection Agency's plans, which focus on priority catchment areas where the pollution is greatest.*
- *Staff with several rural government agencies receive training to help raise public awareness and undertake compliance monitoring.*
- *Sustainable Urban Drainage Systems are required to manage runoff from almost all new development, except for single-dwelling homes.*

5.3.2 Overview

Scotland's population is around 5.2 million[1244] and its area is almost 79,000 km^2,[1245] which makes it about 12% the size of Alberta. As in Alberta, about 80% of the population is urban.[1246] The Scottish Highlands lie to the north and west with the main lowland and agricultural area to the south. Scotland has a humid climate, with measurable precipitation on about 175 days each year, although this increases to 250 days in parts of the Highlands.[1247] The amount of precipitation varies from as much as 300 cm in the western Highlands to 80 cm in the east. Snowfall occurs on fewer than 20 days a year on the west coast but up to 100 days per year in some mountains in the interior.

Overall water quality in Scotland is good, but there is a wide range of problems at the local level due to agriculture, forestry and urban development.[1248] One expert considers Scotland to be 10 years ahead of England with respect to the management of diffuse water pollution.[1249] For this reason, and because the Scottish example shows how diffuse water pollution was approached from the start, the next paragraph provides a short history of how the Scottish program was developed.

In the 1990s in the UK diffuse pollution was not recognized as a concept. Groundwater concerns associated with nitrate from agriculture and solvents from urban areas were the first issues to be recognized (although not initially considered as diffuse pollution, with its associated control implications). In 1994 a Scottish Environment Protection Agency (SEPA) predecessor organization, the Forth River Purification Board, sought to address outstanding issues relating to water pollution control

[1244] Scotland: The Official Gateway to Scotland. Population of Scotland, http://www.scotland.org/facts/population/
[1245] Wikipedia. The Geography of Scotland, http://en.wikipedia.org/wiki/Geography_of_Scotland
[1246] Scottish Government, Office of the Chief Statistician. Scottish Government Urban Rural Classification, 2009-2010, August 2010, http://www.scotland.gov.uk/Resource/Doc/933/0103167.pdf
[1247] Scotland Info Home. Weather and Climate, http://www.scotlandinfo.eu/weather-climate
[1248] SEPA. Significant Water Management Issues in the Scotland River Basin District, 2007, p. 3. Link at http://www.sepa.org.uk/water/water_regulation/regimes/pollution_control/diffuse_pollution.aspx. This report provides an interim overview of the situation and was written in compliance with the EU Directive. Appendix E provides an inventory showing the results (by sub-basin) of applying the heavily modified water bodies screening tool, and the source of the impact. The report was prepared as a step in the development of a river basin management plan for Scotland and formed the basis for public consultation.
[1249] Professor Chris Jefferies, Division of Environment, University of Abertay, Dundee, personal communication with Mary Griffiths, December 15, 2011.

and, in consultation with the US EPA (e.g., Dov Weitman, Chief, Nonpoint Source Control Branch, EPA) identified diffuse pollution as a major issue hitherto barely considered in the UK. In the mid-1990s, the Forth River Purification Board initiated a series of investigations to characterize and quantify diffuse pollution impacts,[1250] and to identify remedial or management actions.[1251,1252] Thus diffuse pollution in Scotland was already getting attention in the 1990s,[1253] and the EU WFD merely provided the foundation for implementing a national program.[1254]

5.3.3 Legislation, Funding, Data Collection, Reporting

5.3.3.1 Legislation

The Scottish Environment Protection Agency (SEPA) was established in 1996 and is responsible for managing water pollution. It is a non-department public body governed by a board of ministers that reports to the Scottish Parliament.[1255]

Diffuse pollution in Scotland is regulated under the *Water Environment and Water Services (Scotland) Act 2003,*[1256] including the Water Environment (Controlled Activities) (Scotland) Regulations 2011,[1257] and the Water Environment (Diffuse Pollution) (Scotland) Regulations 2008.[1258] Controlled Activities are

[1250] D'Arcy, B.J. *et al*. "Diffuse Pollution and Agriculture in the Forth Catchment", in A. Petchey, B.J. D'Arcy and C.A. Frost (eds), *Diffuse Pollution and Agriculture*. Scottish Agricultural College, Aberdeen, 1996.
[1251] D'Arcy B.J., *et al*. "Initiatives to tackle diffuse pollution in the UK", *Water Science & Technology*, 1998, Vol. 38, No.10, p. 131-138.
[1252] D'Arcy B.J. and A. Frost, The role of best management practices in alleviating water quality problems associated with diffuse pollution, *The Science of the Total Environment*, 2001, Vol. 265, Elsevier, p. 359-367.
[1253] The work was initiated by Brian D'Arcy, Environmental Consultant and formerly Diffuse Pollution Project Manager at SEPA, under the direction of the then Chief Executive Patricia Henton, from 2001-2004. Personal communication with Mary Griffiths, December 16, 2011. Brian D'Arcy's role in this work was identified by Dov Weitman, former Head of the Nonpoint Source Pollution program with the US EPA, and Professor Chris Jefferies, University of Abertay.
[1254] Brian D'Arcy explained as follows: Ahead of the EU WFD, the international diffuse pollution video, *Nature's Way* provided a launch for diffuse pollution issues and remedial measures in Scotland and elsewhere. This film was made under the guidance of the founder of the international diffuse pollution specialist group and co-developer of the concept of diffuse pollution, Prof Vladimir Novotny (see Novotny, V. and Olem, *Water Quality: Prevention, Identification and Management of Diffuse Pollution.* Van Nostrand Reinhold, New York, 1994, reprinted and distributed by John Wiley & Sons, New York; and Novotny, V., *Water Quality: Diffuse Pollution and Watershed Management*, John Wiley & Sons Inc. New York, 2003). The *Nature's Way* video was launched in 1996 in SEPA, establishing the subject as an important issue well ahead of the WFD and probably influencing the development of the scope of issues to be subsequently addressed by the WFD. Another key driver for diffuse pollution work in the UK, prior to the WFD, was the EU Bathing Water Directive (see Kay, D., *et al*, Reducing fluxes of faecal indicator compliance parameters to bathing waters from diffuse agricultural sources, the Brighouse Bay study, Scotland. *Environmental Pollution*, 2007, Vol. 147 (1), p. 138-149). Prof. David Kay and his team were ahead of most others in the UK in characterizing, quantifying and thus properly recognizing that the wet weather patterns of bathing water failures indicated that diffuse sources were important.
[1255] SEPA. About Us, http://www.sepa.org.uk/about_us.aspx
[1256] *Water Environment and Water Services (Scotland) Act*, 2003, section 20, http://www.legislation.gov.uk/asp/2003/3/contents
[1257] Water Environment (Controlled Activities) (Scotland) Regulations 2011, http://www.legislation.gov.uk/ssi/2011/209/pdfs/ssi_20110209_en.pdf This is the most recent version of regulations introduced in 2005. General Binding Rules are set out in Schedule 3. See also NetRegs, Scottish Water Legislation, http://www.environment-agency.gov.uk/netregs/legislation/current/63590.aspx and SEPA, Water, Diffuse Pollution, http://www.sepa.org.uk/water/diffuse_pollution.aspx
[1258] Water Environment (Diffuse Pollution) (Scotland) Regulations 2008, http://www.legislation.gov.uk/ssi/2008/54/pdfs/ssi_20080054_en.pdf

governed by general binding rules (GBRs), registrations and licences, as explained in a guide.[1259] Diffuse water pollution is regulated by GBRs.[1260] The Diffuse Pollution GBRs provide a statutory baseline of good practices, and those undertaking activities that fall under this rule must follow these practices, but the activities do not require any special authorization. GBRs relate to surface water drainage from the built environment, activities such as construction near watercourses and handling harmful substances, such as fuel close to surface water. The first GBRs for diffuse pollution were introduced in 2005,[1261] but new binding rules relating to diffuse water pollution from agricultural sources were introduced in 2008.[1262] These rules and the mandatory regulations to comply with the EU Nitrates Directive are described in the section on agriculture.

Under the provisions of the *Water Environment and Water Services Act*, which implemented the EU Water Framework Directive in Scotland,[1263] SEPA set up the Diffuse Pollution Management Advisory Group. This group provides a formal consultation mechanism for SEPA to guide the implementation of the department's plans.[1264] Its purpose is to help create "a robust governance, decision-making and coordination framework" to ensure effective actions to address rural diffuse pollution in river basin management planning in Scotland. Members of the advisory group, who are selected to represent "a cross section of rural, environmental and biodiversity interests,"[1265] include government agencies (including the Forestry Commission of Scotland), farmer and tenant organizations, district salmon fishery boards and the Scottish Golf Environment Group.[1266]

The Diffuse Pollution Management Advisory Group identified three types of water body:

- "water bodies currently at good or high status where no deterioration in status is allowed;
- water bodies currently less than good status but where the scale of improvement in the status is relatively small and can be reached with compliance with the Diffuse Pollution GBRs. . .;

[1259] The Water Environment (Controlled Activities) (Scotland) Regulations 2011, August, 2011, p. 7. See hyperlink to the CAR Practical Guide to the regulations at http://www.sepa.org.uk/water/water_regulation/regimes/pollution_control/diffuse_pollution.aspx.
[1260] SEPA. Pollution Control, Diffuse Pollution, http://www.sepa.org.uk/water/water_regulation/regimes/pollution_control/diffuse_pollution.aspx
[1261] The first 17 GBRs, which date from 2005, were added to in 2008. See Water Environment (Controlled Activities) (Scotland) Regulations, Schedule 3, http://www.legislation.gov.uk/ssi/2008/54/pdfs/ssi_20080054_en.pdf
[1262] Scottish Statutory Instruments, 2008, No. 54, Environmental Protection Water, Water Environment (Diffuse Pollution) (Scotland) Regulations 2008, http://www.legislation.gov.uk/ssi/2008/54/pdfs/ssi_20080054_en.pdf For the reason why General Binding Rules were selected rather than other measures, see Executive Note to The Water Environment (Diffuse Pollution)(Scotland) Regulations 2008, SSI/2008/54, http://www.legislation.gov.uk/ssi/2008/54/pdfs/ssien_20080054_en.pdf
[1263] Her Majesty's Stationery Office. *Water Environment and Water Services (Scotland) Act 2003*, section 17, http://www.hmso.gov.uk/legislation/scotland/acts2003/30003--c.htm#17
[1264] The Advisory Group was developed in accordance with the EU WFD, which institutionalized the public consultation process, and came after SEPA had prepared its basic program. Brian D'Arcy, Consultant on Diffuse Water Pollution and formerly responsible for the Diffuse Pollution Programme at SEPA, personal communication with Mary Griffiths, December 16, 2011.
[1265] SEPA. Diffuse Pollution Management Advisory Group, http://www.sepa.org.uk/water/river_basin_planning/diffuse_pollution_mag.aspx#membership
[1266] This advisory body was designed to have strong representation from the farming community, as many of the diffuse problems are in rural areas, but by including reports on other sectors, it enabled them to see that the problem was also being addressed by others, and they were not a special target. Brian D'Arcy, personal communication with Mary Griffiths, December 16, 2011.

- water bodies currently less than good and where the status is not expected to reach good status without significant change in land management practices."[1267]

They proposed a two-tiered strategy:

- A national campaign to prevent further deterioration of water quality and deliver moderate improvements in water quality.[1268] This will include a series of guidance documents, and training for land managers, as well as a communications campaign to raise national awareness. SEPA will train Scotland's Environment and Rural Services staff,[1269] who will be able to conduct site inspections to determine whether statutory requirements are being adopted.
- A targeted approach in those catchments where the impact of diffuse pollution on the water environment requires a more focused approach.[1270] "Catchments have been selected using a risk based approach where water bodies or protected areas are significantly failing standards due to rural diffuse pollution. High priority has been given to those areas affecting human health (i.e., drinking water protected areas and catchments draining to bathing waters)."[1271] The process will include identification of the issues, a catchment characterization report (based on surveys and modelling), raising awareness, one-on-one engagement and audit, and specific advice on land management. There will also be a monitoring process.[1272]

The group developed an implementation plan[1273] and the new program to address rural diffuse pollution started in 2010[1274] with the identification of 14 priority catchments (from a total of 133).[1275]

The *Water Environment and Water Services Act* requires Scotland to implement river basin planning.[1276] SEPA set up River Basin District Advisory Groups and considers their advice when undertaking river basin planning or any other aspect of water management within the district.[1277] There are eight area advisory groups, overseen by the National Advisory Group. The advisory groups, not unlike the WPACs in Alberta, include representatives from:

- the main responsible authorities;
- those providing water management measures (deliverers); and

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[1267] SEPA. Diffuse Pollution Management Advisory Group. The Strategy, http://www.sepa.org.uk/water/river_basin_planning/diffuse_pollution_mag/overview_of_the_strategy.aspx#StrategySummary

[1268] SEPA. Diffuse Pollution Management Advisory Group. The National Campaign, http://www.sepa.org.uk/water/river_basin_planning/diffuse_pollution_mag/the_national_campaign.aspx

[1269] Scottish Government. Scotland's Environment and Rural Services, http://www.sears.scotland.gov.uk/ Partners include SEPA, the Animal Health and Veterinary Laboratories Agency, Forestry Commission of Scotland and the Scottish Government Rural Payments and Inspections Directorate, as well as the Crofters Association and National Park authorities.

[1270] SEPA. Diffuse Pollution Management Advisory Group. Priority Catchments, http://www.sepa.org.uk/water/river_basin_planning/diffuse_pollution_mag/priority_catchments.aspx

[1271] Ibid.

[1272] SEPA. Diffuse Pollution Management Advisory Group. Overall Monitoring and Reporting, http://www.sepa.org.uk/water/river_basin_planning/diffuse_pollution_mag/monitoring_and_reporting.aspx

[1273] SEPA. Diffuse Pollution Management Advisory Group, http://www.sepa.org.uk/water/river_basin_planning/diffuse_pollution_mag.aspx#membership This page includes hyperlinks to the chapters in the plan.

[1274] SEPA. Diffuse Pollution Priority Catchments, http://www.sepa.org.uk/water/river_basin_planning/dp_priority_catchments.aspx

[1275] SEPA. Diffuse Pollution Management Advisory Group, Priority Catchments, http://www.sepa.org.uk/water/river_basin_planning/diffuse_pollution_mag/priority_catchments.aspx

[1276] Her Majesty's Stationery Office, *Water Environment and Water Services (Scotland) Act* 2003, Chapter 2, River Basin Management Planning, http://www.hmso.gov.uk/legislation/scotland/acts2003/30003--c.htm#17

[1277] Ibid. section 17.

- organizations or activities causing pressures and impacts within the water environment.[1278]

5.3.3.2 Funding

Some measures to reduce diffuse pollution may be funded by the Scottish Rural Development Programme.[1279, 1280] Scotland's Environmental and Rural Services (SEARS) provides money for SEPA's Water Environment Restoration Fund.[1281] This fund is for a wide range of restoration work but could potentially be used to limit runoff.[1282] SEARS may also provide funding to reduce diffuse pollution under the Rural Development Contracts – Land Managers Options, or under Rural Development Contracts – Rural Priorities, which is a competitive program to fund projects best able to meet a range of key objectives in an area.[1283]

5.3.3.3 Data Collection

The outcome of monitoring is shown in detailed water body data sheets, which provide information on the current status, future targets, pressures on the water body, mitigation measures and a complete classification based on a number of water quality parameters, for each stretch of a river or lake. To see the information it is only necessary to select a water body name and records are displayed for different segments of that water (e.g., Leven brings up Loch Leven, six river stretches and two groundwater assessments).[1284] Water classification reports are available for each area.[1285]

In addition, water quality monitoring is conducted in 56 rivers in Scotland as part of the harmonized monitoring scheme.[1286] It includes phosphorus and ammoniacal nitrogen, as well as flows, which are increasing as a result of climate change; this means that total loads may increase, even if the concentration of a substance is declining.[1287]

5.3.3.4 Reporting

Diffuse pollution was highlighted as a major impact on the Scottish water environment in characterization reports of the river basins in 2005,[1288] and in a report identifying significant water management issues in

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[1278] SEPA. River Basin Planning, Scotland, http://www.sepa.org.uk/water/river_basin_planning/scotland.aspx

[1279] SEPA. Diffuse Pollution Management Advisory Group. Overall Monitoring and Reporting, http://www.sepa.org.uk/water/river_basin_planning/diffuse_pollution_mag/monitoring_and_reporting.aspx

[1280] Scottish Government. Scotland Rural Development Programme, 2007- 2013, http://scotland.gov.uk/Topics/farmingrural/SRDP. Money in this fund comes from the Scottish Government and from the European Agricultural Fund for Rural Development. Individuals and groups can seek funding to help meet the government's strategic objectives in rural Scotland.

[1281] Scotland's Environmental and Rural Services (SEARS). Water Environment Restoration Fund, http://www.sears.scotland.gov.uk/ViewService.aspx?id=309

[1282] SEPA. SEPA's Water Environment Restoration Fund, http://www.sepa.org.uk/water/restoration_fund.aspx

[1283] SEPA. Pollution Control, Questions and Answers, Is Funding Available to Help Reduce Diffuse Pollution Risks? http://www.sepa.org.uk/water/water_regulation/regimes/pollution_control/diffuse_pollution/questions_and_answers.aspx

[1284] SEPA. Water Bodies Data Sheets, http://www.sepa.org.uk/water/river_basin_planning/waterbody_data_sheets.aspx

[1285] SEPA. River Basin Planning, Water Classification Reports, 2009, http://www.sepa.org.uk/water/river_basin_planning/classification_results_2009.aspx

[1286] SEPA. Trends in Scottish River Water Quality, http://www.sepa.org.uk/science_and_research/data_and_reports/water/scottish_river_water_quality.aspx

[1287] Ibid.

[1288] SEPA. River Basin Planning, http://www.sepa.org.uk/water/river_basin_planning.aspx

2007.[1289] The latter report indicates the area and number of water bodies where diffuse pollution specifically from agriculture, forestry or urban development is an issue. A water body is included in the table if diffuse pollution affects more than 15% of the length or 20% of the area of "at risk" water bodies. This identification of water at risk provides a basis for action.

The most recent SEPA Annual Report has many references to diffuse pollution. Enforcement actions are summarized in section 5.3.4, below, on agriculture.[1290]

SEPA also produces an Annual Review of Performance.[1291] The most recent review stated "In 2010-2011 we have:. . . made significant progress in mitigating rural diffuse pollution, concentrating on evidence gathering and awareness raising in priority catchments, fully supported by the relevant sectors."[1292]

5.3.3.5 Partnerships

SEPA recognizes the need for partnerships to implement river basin planning.[1293] They have provided training on diffuse pollution to more than 100 staff in agencies that partner with SEARS, as well as to some national parks staff.[1294] These people are thus able to raise public awareness and also help in compliance monitoring.

5.3.4 Agriculture

SEPA found it important to explain the GBRs for agriculture, some of which address diffuse water pollution, before the rules were introduced in 2008. SEPA also aimed to educate farmers directly via a network of SEPA catchment officers. SEPA worked with SEARS to explain the BMPs for each of the rules.[1295] Leaflets and web pages provide information on Practices Affecting Phosphorus,[1296] Practices Affecting Suspended Solids,[1297] and on BMPs for different types of farming, including arable,[1298] livestock,[1299] and riparian lands.[1300]

GBR18 relates to the storage and application of fertilizer. For example:

[1289] SEPA. Significant Water Management Issues in the Scotland River Basin District, 2007, p. 24. Link at http://www.sepa.org.uk/water/water_regulation/regimes/pollution_control/diffuse_pollution.aspx
[1290] SEPA. SEPA's Annual Report and Accounts, 2010-2011, p. 14. See link at http://www.sepa.org.uk/about_us/publications/annual_review_of_performance.aspx
[1291] SEPA. Annual Review of Performance, 2010-2011. http://www.sepa.org.uk/about_us/publications/annual_review_of_performance.aspx
[1292] Ibid. p.25.
[1293] SEPA. How We Work with Others, http://www.sepa.org.uk/water/river_basin_planning/how_we_work_with_others.aspx
[1294] SEPA. SEPA's Annual Report and Accounts, 2010-2011, pp. 28 and 32. See link at http://www.sepa.org.uk/about_us/publications/annual_review_of_performance.aspx
[1295] SEPA. Agricultural Best Management Practices, http://apps.sepa.org.uk/bmp/. See hyperlinks at bottom of web page.
[1296] SEPA. Best Management Practices, Practices Affecting Phosphorus, http://apps.sepa.org.uk/bmp/ByPollutant.aspx?pollutant=2
[1297] SEPA. Best Management Practices, Practices Affecting Suspended Solids, http://apps.sepa.org.uk/bmp/ByPollutant.aspx?pollutant=1
[1298] SEPA. Best Management Practices, Practices by Application: Arable, http://apps.sepa.org.uk/bmp/ByApplication.aspx?application=2
[1299] SEPA. Best Management Practices, Practices by Application: Livestock, http://apps.sepa.org.uk/bmp/ByApplication.aspx?application=3
[1300] SEPA. Best Management Practices, Practices by Application: Riparian, http://apps.sepa.org.uk/bmp/ByApplication.aspx?application=5

"Fertiliser must not be stored on land that:

- is within 10 m of any surface water or wetland;
- is within 50 m of any spring that supplies water for human consumption, or any well or borehole that is not capped to prevent the ingress of water;
- is waterlogged; or
- has an average soil depth of less than 30 cm and overlies gravel or fissured rock, except where the fertiliser is stored in an impermeable container."[1301]

There are separate specifications for the application of organic and inorganic fertilizer.

GBR 19, on the keeping of livestock, says that "Significant erosion or poaching of any land that is within 5 m of surface water or wetland must be prevented."

GBR 20 about the cultivation of land states, for example, that:

"Land must not be cultivated for crops if it is:

- within 2 m of any surface water or wetland;
- within 5 m of any spring that supplies water for human consumption or any well or borehole that is not capped to prevent water ingress; or
- waterlogged."

Other general binding rules related to diffuse water pollution cover pesticide applications, runoff from agricultural buildings and yards, and the handling of oil, paints, disinfectants and other pollutants.[1302]

Inspections of rural sources to ensure compliance are carried out by both SEPA and the SEARS partnership, which involves nine organizations that provide rural services.[1303] SEPA employs Catchment Officers and SEPA trains SEARS staff to check for compliance with the GBRs when they are carrying out their other duties in rural areas.[1304] Inspections are conducted on a random basis and inspectors are most stringent in cases where lack of compliance causes risks to downstream users. For example, fencing to keep livestock out of a water body will be required in a fish spawning location or if there are recreational waters downstream. The SEPA catchment specialists undertake more detailed investigations in targeted priority catchments as part of a systematic program to assess and improve catchments identified as particularly at risk from diffuse pollution.

To enable SEPA to assess the main causes of diffuse pollution, in 2010 officers walked through priority catchment areas identifying breaches of the Diffuse Pollution General Binding Rules within the first 5 m on either side of a water body.[1305] This special effort identified 2,630 breaches, with the most important problems caused by the storage and application of fertilizer, the keeping of livestock and cultivation of land.

[1301] The Water Environment (Controlled Activities) (Scotland) Regulations 2011, August 2011, pp. 12-13. For General Binding Rules 18 - 20, see hyperlink to the CAR Practical Guide at http://www.sepa.org.uk/water/water_regulation/regimes/pollution_control/diffuse_pollution.aspx

[1302] SEPA. General Binding Rules 10 and 11, http://www.sepa.org.uk/water/water_regulation/regimes/pollution_control/suds/gbrs.aspx

[1303] SEPA. Pollution Control, Questions and Answers, How Will Compliance with Diffuse Pollution GBRs be Assessed, http://www.sepa.org.uk/water/water_regulation/regimes/pollution_control/diffuse_pollution/questions_and_answers.aspx

[1304] Brian D'Arcy, personal communication with Mary Griffiths, December 16, 2011.

[1305] SEPA. *SEPA's Annual Report and Accounts, 2010-2011*, p. 10 – 11, 14. See link at http://www.sepa.org.uk/about_us/publications/annual_review_of_performance.aspx

Citizens can also report suspected cases of non-compliance. SEPA staff will then visit the site (with a witness if a subsequent visit is required) and the problem will be explained and ideally resolved.

In addition to the GBRs, there are other mandatory requirements. The Protection of Water Against Agricultural Nitrate Pollution (Scotland) Regulations 1996 requires the identification of nitrate vulnerable zones, where surface or groundwater contains more than 50 mg/l nitrates, or would contain that level if actions are not taken.[1306] A groundwater monitoring scheme is used to identify Nitrate Vulnerable Zones (of which there are four in Scotland).[1307] Farmers in these zones are required to take special measures, which include preparing a fertilizer and manure management plan, calculating and recording the storage capacity required for livestock manure, calculating and recording the 170kg/N/ha loading limit for livestock manure and the maximum nitrogen limit for each crop grown and for grassland.[1308] In addition to the regulatory requirements, there are many BMPs, which are explained in Practices Affecting Nitrate.[1309]

5.3.5 Forestry

The GBRs under the Water Environment (Diffuse Pollution) (Scotland) Regulations 2008, described in section 5.3.4 on Agriculture, also apply to forestry and are summarized in a leaflet for the forest industry.[1310]

Rules and BMPs for forestry in Scotland are set out in the UK Forestry Standard Guidelines. The "Forests and Water" guideline recommends rules that are legally binding in Scotland as good practices for the rest of the U.K.[1311] GBRs that apply to forestry stipulate that

- Work must not be carried out when fish are spawning or the juvenile fish are in the stream (GBR9f).
- The operator must not operate machinery in water courses during forestry operations (GBR9h).
- No land shall be cultivated that is: within 2 m of any surface water or wetland, 5 m of any spring, well or borehole, or is waterlogged (GBR20a).[1312]
- Land must not be mole-drained where the gradient exceeds 8% (GBR20b) and the discharge from drains must not destabilize the bank or cause erosion on the stream bed (GBR21b).
- Land must be cultivated in such a way as to minimize the risk of pollution to the water environment (GBR 20c).
- Runoff must be discharged in such a way that it minimizes the risk of pollution to the water environment (GBR21a).

[1306] SEPA. Nitrate Monitoring Network, http://www.sepa.org.uk/water/protected_areas/nitrates_monitoring/nitrate_monitoring.aspx

[1307] SEPA. *Nitrate Vulnerable Zones in Scotland: Review of Designations,* 2009, http://www.scotland.gov.uk/Resource/Doc/278281/0100701.pdf

[1308] The Scottish Government, Nitrate Vulnerable Zones, Key Requirements of the NVZ Action Programmes, http://www.scotland.gov.uk/Topics/farmingrural/Agriculture/Environment/NVZintro/KeyRequirements

[1309] SEPA. Best Management Practices, Practices Affecting Nitrate, http://apps.sepa.org.uk/bmp/ByPollutant.aspx?pollutant=11

[1310] Scotland's Environmental and Rural Services. Reducing the Risk of Water Pollution: Diffuse Pollution General Binding Rules (DPGBRs): Forestry. See link on SEPA website at http://www.sepa.org.uk/water/river_basin_planning/dp_priority_catchments.aspx

[1311] Forestry Commission. Forests and Water, UK Forestry Standard Guidelines, 5th edition, 2011, p.27, http://www.forestry.gov.uk/pdf/FCGL007.pdf/$FILE/FCGL007.pdf

[1312] The Guideline expands on the rule, explaining that width of a buffer depends on circumstances and that the recommended minimum width is 10 m along streams less than 2 m wide. Along channels more than 2 m wide, and around lakes and wetlands, the recommended minimum buffer is 20 m.

There are additional binding rules with respect to the construction of minor and temporary bridges, small-scale bank reinforcement and the removal of sediment from culverts, which may be relevant to forestry operations. The Scottish Forestry Commission assesses compliance with GBRs, not only on private woodlands but also on Forestry Commission land.[1313]

Using data from SEPA, the Commission has identified where forestry is classed as a primary pressure on rivers, and plans to use this information in future forest design plans.[1314] SEPA also provides information on BMPs for woodlands,[1315] including practices for the riparian zone.[1316] Because the focus in the past was on planting, the rules for harvesting have not been as well developed in Scotland, in comparison with the American BMPs for harvesting. Policy is focused more on size (limited) of plot that may be clear-felled in a given area of mature forest in any one period, rather than on detailed BMPs to minimize impacts.[1317]

5.3.6 Municipal Stormwater

Sustainable urban drainage systems (SUDS) are mandatory in Scotland. GBR 10 requires runoff from any development (including buildings and roads) built after 2007 to have a SUDS (both during and after construction), unless the runoff is from a single dwelling.[1318] The system may include permeable surfaces, filter strips, infiltration trenches, swales, detention basins, underground storage, wetlands and ponds.[1319]

SEPA explains SUDS for the public[1320] and provides training on SUDS for it staff.[1321] It has been suggested that at some time in the future, urban environment wardens who deal with issues such as litter, dog fouling, illegal tipping of waste and vehicle emissions,[1322] might be trained to also identify violation of GBRs relating to SUDS.[1323]

The Scottish SUDS Working Party was established in 1997 to promote the use of SUDS.[1324] Members include government agencies and other national stakeholder organizations: Scottish Government (WFD,

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[1313] Brian D'Arcy, personal communication with Mary Griffiths, December 16, 2011.
[1314] Forestry Commission Scotland. Review of the Year 10/11, p. 30, http://www.forestry.gov.uk/pdf/FCSAnnualReview1011web.pdf/$FILE/FCSAnnualReview1011web.pdf
[1315] SEPA. Best Management Practices, Practices by Application: Woodlands, http://apps.sepa.org.uk/bmp/ByApplication.aspx?application=4
[1316] SEPA. Best Management Practices, BMP 138: Woodland Management in the Riparian Zone, http://apps.sepa.org.uk/bmp/ShowPractice.aspx?bmpNumber=138
[1317] Brian D'Arcy, personal communication with Mary Griffiths, December 16, 2011.
[1318] SEPA. General Binding Rules 10 and 11, http://www.sepa.org.uk/water/water_regulation/regimes/pollution_control/suds/gbrs.aspx See also hyperlink to the CAR Practical Guide at http://www.sepa.org.uk/water/water_regulation/regimes/pollution_control/diffuse_pollution.aspx
[1319] SEPA. Sustainable Urban Drainage Systems (SUDS), http://www.sepa.org.uk/water/water_regulation/regimes/pollution_control/suds.aspx
[1320] SEPA. SUDS Explained, http://www.sepa.org.uk/water/water_regulation/regimes/pollution_control/suds/suds_explained.aspx
[1321] SEPA. SUDS, Training, Research and Guidance, http://www.sepa.org.uk/water/water_regulation/regimes/pollution_control/suds/training,_research__guidance.aspx
[1322] The City of Edinburgh Council, Environment Wardens, http://www.edinburgh.gov.uk/a_to_z/service/940606/environmental_wardens
[1323] Brian D'Arcy, personal communication with Mary Griffiths, December 16, 2011.
[1324] SEPA. SUDS Working Party, http://www.sepa.org.uk/water/water_regulation/regimes/pollution_control/suds/suds_working_party.aspx Early efforts to introduce innovative drainage technology to the UK were led by Prof. Chris Pratt at Coventry University, who staged regular seminars as "The Standing Conference on Stormwater Source Control (e.g., Pratt, C. (ed.) Proceedings of the XIII Standing Conference on Stormwater Source Control. School of the Built Environment,

Planning and Transportation functions for example), SEPA, Scottish Enterprise and Scottish Water, plus professional bodies representing architects and landscape architects. In parallel, a research and monitoring program was established with a cluster of Scottish universities, led by the Urban Water Technology Centre at the University of Abertay. This was later superceded by a UK SUDS Network, established with Environment Agency and SEPA encouragement, and led by Abertay and Coventry Universities.[1325] This UK-based network aims to promote research and best practice in SUDS and to advance the work of the Scottish Universities' SUDS Monitoring Group. This group identifies problems, explains to stakeholders what specific control is required, encourages the universities to measure the impact of a proposed change, and then promotes implementation.[1326]

Dunfermline is a town where an extensive SUDS scheme is being developed for a mixture of industrial, commercial, residential and recreational areas.[1327] The City of Glasgow sets out specific requirements for SUDS.[1328]

5.3.7 Watershed Management

The legislative basis for watershed planning is summarized in section 5.3.3.1 above. River basin management plans are quite new and the first plans run from 2009 to 2015.[1329] Most of the country is included in the Scotland River Basin Plan while the rest of the country is in the Solway Tweed river basin district, draining the south of the southern uplands and part of northeast England.[1330] "The river basin management plans for the Scotland and the Solway Tweed river basin districts set out our ambition to improve from 63% of water bodies in Scotland at good status to 97% by 2027. This plan will contribute by enabling stakeholders from a range of sectors and organisations to co-ordinate activities and resources to tackle diffuse pollution."[1331]

5.3.8 Progress and Effectiveness

Scotland's experience with GBRs first led to development of rules for the design of drainage systems for buildings and roads and, after evaluation and consultation, to agriculture. In agriculture, the first infringement may be used as an opportunity to provide education on an issue, and then the possibility of a penalty is likely to encourage compliance. Training government staff who work in rural areas to watch for infringements of the rules minimizes the cost of inspections. It is too early to determine the overall effectiveness of the GBRs for agriculture and SUDS, but the country's approach appears to be worth considering.

Coventry University, Coventry, 1996). Urban diffuse pollution was highlighted in 1995 at one such seminar: D'Arcy B.J. and C.D. Bayes. Industrial Estates: a Problem. In C. Pratt (ed.) Proceedings of the Tenth Meeting of the Standing Conference on Stormwater Source Control. School of the Built Environment, Coventry University, Coventry, 1995, and the SUDS concept was also promoted via those annual events.

[1325] SEPA. SUDS Training, Research and Guidance, http://www.sepa.org.uk/water/water_regulation/regimes/pollution_control/suds/training,_research__guidance.aspx See also the SUDSnet website, coordinated by the Urban Water Technology Centre at the University of Abertay Dundee and Coventry University, http://www.sudsnet.abertay.ac.uk/

[1326] Brian D'Arcy, personal communication with Mary Griffiths, December 16, 2011.

[1327] Construction Industry Research and Information Association. SuDS, Dunfermline East Expansion, http://www.ciria.org.uk/suds/cs_dunfermline_eastern_expansion.htm

[1328] Glasgow City Council. Sustainable Drainage Systems (SUDS), http://www.glasgow.gov.uk/en/Business/CityPlan/Part3_DevPol_DesGuide/Environment/ENV04

[1329] SEPA. River Basin Planning, http://www.sepa.org.uk/water/river_basin_planning.aspx

[1330] Scottish Government. The River Basin Management Plan for the Scotland River Basin District 2009-2015. See links at http://www.sepa.org.uk/water/river_basin_planning.aspx

[1331] SEPA. Environmental Objectives for Rural Diffuse Pollution, http://www.sepa.org.uk/water/river_basin_planning/diffuse_pollution_mag/environmental_objectives.aspx

5.4 The Netherlands

5.4.1 The Netherlands at a Glance

- *As a result of its highly intensive arable and livestock production, the Netherlands has very stringent rules for managing manure and fertilizers as well as many activities.*
- *Despite some reductions in phosphate and nitrogen levels, monitoring shows even stricter requirements are needed, especially in areas with sand and loess soils.*
- *The 4th Action Plan to comply with the EU Nitrates Directive and the latest version of the Fertilizer Act set crop, soil and timing limitations on the use of manure and fertilizers.*
- *The Outdoor Cultivation and Livestock Discharge Order prohibits the use of pesticides and manure immediately adjacent to waterways.*
- *While recognizing the need for regulation, farmers find measures to reduce diffuse water pollution complex and onerous.*

5.4.2 Overview

The Netherlands has an area of 41,500 km^2, including 7,750 km^2 of open water.[1332] Although the country is considerably smaller than the Red Deer River Basin (which is nearly 50,000 km^2), it has a population of 16.5 million – more than four times that of Alberta. The highest point in the country is 323 m and a considerable area of the polders lies below sea level.[1333] The country has a temperate climate with annual average precipitation of 75 cm.[1334] Despite being so densely populated, agriculture is very important. Agriculture and horticulture account for 10% of the Dutch economy and employment.[1335] Arable production (cereals, fodder crops, potatoes, vegetables and flowers), dairy farming, and the raising of pigs and poultry are the main activities.[1336] Intensive livestock activities lead to greater manure production than required to maintain soil fertility, causing high nitrogen and phosphorus levels, while the use of pesticides and other agricultural chemicals also pose threats to water quality. Diffuse sources are the main cause of water pollution.[1337] In addition to agriculture, industry, transportation, the built environment and shipping are sources of diffuse pollution.[1338]

Much of the information about the Netherlands is from Dutch-language publications. Titles in the footnotes are translated into English, with the Dutch title added after the hyperlink.

[1332] United Nations. National Information, *Agriculture and Sustainable Development in the Netherlands*, p. 7, http://www.un.org/esa/agenda21/natlinfo/countr/nether/agriculture.pdf

[1333] Frank Lamé, Senior Project Manager, Deltares. "Into Dutch Soils", presentation in New Delhi, India, February 2010.

[1334] United Nations. National Information, *Agriculture and Sustainable Development in the Netherlands*, p. 7,

[1335] Dutch Ministry of Economic Affairs, Agriculture and Innovation; Agriculture and Horticulture, http://english.minlnv.nl/portal/page?_pageid=116,1640381&_dad=portal&_schema=PORTAL

[1336] United Nations, National Information, *Agriculture and Sustainable Development in the Netherlands*, p. 7-8,

[1337] Dutch Government. *River Basin Management Plans, 2009-2013, Summary for Eems, Maas, Rhine Delta and Schelde*, December 2009, p. 20, http://www.rijksoverheid.nl/documenten-en-publicaties/brochures/2011/03/28/stroomgebiedbeheerplannen.html (in Dutch, Stroomgebiedbeheerplannen, 2009-2013)

[1338] Warmer, H. and R. van Dokkum. *Water Pollution Control in the Netherlands: Policy and Practice*, 2001, RIZA (Rijksinstituut voor Integraal Zoetwaterbeheer en Afvalwaterbehandeling), Report 2002.009, pp. 43-44.

5.4.3 Legislation, Funding, Data Collection, Reporting

5.4.3.1 Legislation

As in other countries in the EU, Dutch management of diffuse sources of water pollution is now determined by the EU Nitrates Directive and WFD, although the Dutch had some stringent rules before these EU requirements.

The 2009 *Water Act*, which replaced a number of different pieces of legislation, governs the management of water in the Netherlands, including the permitting process for discharges.[1339] Another document gives the minister power to make rules to comply with international laws.[1340] Water quality monitoring is required under a separate regulation,[1341] and a government order sets maximum permitted levels for a wide range of substances, including nitrates (maximum 50 mg/litre) and the active substances in pesticides (0.1µg/l; or a maximum of 0.5µg/l, including degradation products).[1342]

The *Fertiliser Act* limits the application of manure to the land (see section 5.4.4).[1343] If the total Dutch production of manure from livestock (expressed in nitrogen and phosphate) exceeds a specified level, the government can order a percentage reduction in the number of animals or birds being produced.[1344]

The Outdoor Cultivation and Livestock Discharge Order applies to the use of pesticides near open bodies of water.[1345] Its provisions are summarized in section 5.4.4, below.

The Implementation Program for Diffuse Water Pollution came into force in January 2008.[1346] The program recognizes that the main pollutants are from agriculture (fertilizers, manure, pesticides, copper and zinc from animal feedstuffs, and veterinary medicines) and from traffic and transport, including atmospheric deposition of polycyclic aromatic hydrocarbons (from combustion and car tires) and metals (e.g., copper from brake lining), although various other substances, including human medicines, are addressed in the program.[1347] In this report, attention focuses on the requirements for agriculture.

[1339] Dutch Government. Improving Water Quality, http://www.rijksoverheid.nl/onderwerpen/waterkwaliteit/naar-een-betere-waterkwaliteit (in Dutch, Naar een Betere Waterqualiteit) *Water Act*, http://wetten.overheid.nl/BWBR0025458/Opschrift/geldigheidsdatum_03-01-2012

[1340] Dutch Government. Water Order, Chapter 6, Articles 6.2 and 6.3, http://wetten.overheid.nl/BWBR0026872/geldigheidsdatum_03-01-2012#Hoofdstuk6 (in Dutch, Waterbesluit)

[1341] Dutch Government. Water Framework Directive Monitoring Regulation, http://wetten.overheid.nl/BWBR0027502/geldigheidsdatum_29-12-2011 (in Dutch, Regeling Monitoring Kaderrichtlijn Water)

[1342] Dutch Government. Water Quality and Monitoring Order 2009, http://wetten.overheid.nl/BWBR0027061/geldigheidsdatum_29-12-2011#Opschrift (in Dutch, Besluit Kwaliteitseisen en Monitoring Water 2009) Maximum permitted quantities are given in the Appendices.

[1343] *Fertiliser Act*, http://wetten.overheid.nl/BWBR0004054/geldigheidsdatum_30-12-2011 (in Dutch, Meststoffen Wet)

[1344] Between 1992 and 2002, cattle numbers decreased by 17%, pigs by 14%, and sheep and goats by 21%, and the nitrogen and phosphate surpluses declined. European Union, 2010/65/: Commission Decision of 5 February 2010 . . . granting a derogation . . . concerning the protection of waters against pollution caused by nitrates from agricultural sources, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:035:0018:01:EN:HTML

[1345] Dutch Government. Outdoor Cultivation and Livestock Discharge Order, http://wetten.overheid.nl/BWBR0011133/geldigheidsdatum_03-01-2012 (in Dutch, Losingenbesluit Open Teelt en Veehouderij)

[1346] Dutch Government. *Diffuse Water Pollution Implementation Program*, January 2008, http://www.rijksoverheid.nl/documenten-en-publicaties/brochures/2008/03/04/uitvoeringsprogramma-diffuse-bronnen-waterverontreiniging.html (in Dutch, Uitvoeringsprogramma Diffuse Bronnen Waterverontreiniging**)**

[1347] Ibid. p. 8.

To comply with the WFD, the Dutch developed a National Water Plan and watershed plans for each of the four major river basins.[1348] When the WFD was introduced, it was evident that the Netherlands could not immediately comply with its requirements. Despite ongoing efforts under the *Fertiliser Act*, the levels of nitrogen and phosphate were still too high. The Dutch government requested a waiver from the EC in 2005 and 2010. Based on the progress shown in 2006-2009, and the further restrictions imposed in the 4th Action Plan (see section 5.4.4, below), the waiver was extended to 2013.[1349]

5.4.3.2 Data Collection

Water boards and the national government monitor at about 500 surface locations across the country, while national and provincial governments monitor groundwater at 5-15 m subsurface.[1350] Results show that water quality is strongly influenced by agriculture at approximately 175 of the surface monitoring sites.

A separate monitoring program evaluates how well the National Fertilizer Policy is reducing diffuse agricultural water pollution. Monitoring is conducted up to four times a year in drainage ditches and groundwater at more than 500 selected agricultural operations. The results are analyzed with respect to soil type for various operations, including horticulture, arable and dairy farming.[1351] Exceedances in sand, loess, clay and peat areas can be compared. Phosphate levels in the ground are also monitored and mapped to show the percentage of the land that is saturated with phosphates.

5.4.3.3 Reporting

A brief update on the Implementation Program for Diffuse Water Pollution was provided to Parliament in September 2009, with the promise of a more detailed update in 2013.[1352]

5.4.3.4 Funding

The Dutch government gave €75 million ($100 million) to the WFD Innovation Program which funded approximately 65 projects between 2008 and 2012.[1353] Of this, approximately €13 million was for projects to reduce the nutrient load from agriculture. Most was to be used to research practical solutions, with 10% allocated for outreach.

5.4.3.5 Partnerships

Various national and regional governments and agencies (water boards) have responsibility for water quality and work to achieve national goals.

[1348] Dutch Government. Improving Water Quality, http://www.rijksoverheid.nl/onderwerpen/waterkwaliteit/naar-een-betere-waterkwaliteit (in Dutch, Naar een Betere Waterqualiteit)

[1349] European Commission. 2010/65/: Commission Decision of 5 February 2010 . . . granting a derogation. . . concerning the protection of waters against pollution caused by nitrates from agricultural sources, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:035:0018:01:EN:HTML

[1350] Dutch Government. Parliamentary Papers, *4th Dutch Action Plan for the Nitrates Directive*, p. 38, http://www.rijksoverheid.nl/onderwerpen/waterkwaliteit/documenten-en-publicaties/kamerstukken/2009/03/26/4e-actieprogramma.html (in Dutch, Vierde Nederlandse Actieprogramma betreffende de Nitraatrichtlijn)

[1351] Ibid. pp. 9, 13 and 38.

[1352] Minister of Housing, Planning and Environment. Letter to the Chair of the Second Chamber, 30 September, 2009, Brief Progress Report on the Diffuse Water Pollution Implementation Program, p. 4, http://www.rijksoverheid.nl/documenten-en-publicaties/kamerstukken/2009/09/30/beknopte-voortgangsrapportage-uitvoeringsprogramma-diffuse-bronnen-waterverontreiniging-inclusief-geneesmiddelen-stand-van-zaken.html (in Dutch, Beknopte Voortgangsrapportage Uitvoeringsprogramma Diffuse Bronnen Waterverontreiniging)

[1353] Dutch Government. Improving Water Quality, WFD Innovation Program, http://www.rijksoverheid.nl/onderwerpen/waterkwaliteit/naar-een-betere-waterkwaliteit (in Dutch, Innovatieprogramma KRW) See also the *4th Action Plan for the Nitrates Directive*, pp. 7 and 34, and Minister of Housing, Planning and Environment, Letter to the Chair of the Second Chamber, 30 September 2009, p. 4.

5.4.4 Agriculture

The Netherlands has been trying to reduce the environmental impact of nutrients in manure since 1986 when the *Fertiliser Act* was first passed. As a result of high levels of animal nutrients, the Dutch government introduced the MINeral Accounting System (MINAS) in the early 1990s, which required farmers to record the nitrogen and phosphorus inputs and outputs from their land.[1354] If a farmer exceeded a recognized acceptable level, which depended on crop and soil type, he or she had to pay a financial levy per kilogram of exceedance. The European Court of Justice determined in 2003 that the Dutch program did not meet the requirements of the EU Nitrates Directive, since it did not limit the application rate of nitrogen to a maximum of 170 kg in the form of animal manure per hectare per year. The new Dutch nitrates policy, introduced in 2006, was developed after extensive calculations concerning the relationship between animal feeding, excretion and gaseous losses from housing and storage, and the nitrogen fertilizer replacement value of manure; the relationship between the input of manure and fertilizers and the actual output in, for example, harvested crops; and the relationships between soil surpluses and the quality of groundwater and surface water. Based on this information, application standards were calculated for a wide range of crops and soil types. The 2006 program sets application standards, the nitrogen replacement values of various organic manures, and periods of the year in which the use of fertilizers and manures is forbidden.

The most recent plan is based on an evaluation of the program between 2006 and 2009 and the plan fine-tunes earlier requirements to reflect the outcome of environmental monitoring and agricultural needs. Monitoring results showed that the use of phosphate and, to a lesser extent, nitrogen fertilizers had decreased, including the amount in groundwater.[1355] However, the nitrate levels in groundwater in sand and loess areas needed to be further reduced, and to a lesser extent on clay soils. It was also found that some crop yields had declined as a result of too little manure or fertilizer.

In the latest version of the *Fertiliser Act* the maximum permitted application of manure must not exceed 170 kg/ha over the area of the farm (Article 9).[1356] This amount may be reduced as far as zero if it appears necessary to prevent nitrogen levels exceeding the permitted maximum for surface water (11.3 mg/litre) or groundwater (50 mg/litre)(Article 10). The maximum phosphate application permitted depends on the phosphate level in the soil and whether the land is used for arable agriculture or grass (Article 11). The Act limits the number of pigs, chicken and turkeys that are permitted on a farm (Articles 18-33). Even if the phosphate level in the soil is neutral, the amount used on arable land has to be reduced by 5 kg/ha for each year 2010-2013. If the soil is already saturated with phosphate, the permitted application is lower. The Act requires an independent assessment of the policy every five years.

The overall aim of the current manure management requirements is to reduce the nitrate levels in water to 50 mg/l by 2015 and achieve equilibrium in phosphate levels.[1357] The Nitrates Directive 4th Action Plan sets out the most recent requirements; it came into force in 2010 and applies until 2013.[1358] These requirements include:

- Stricter rules on the application of manure for leaching-sensitive crops in sand and loess areas, which will become legally binding in the 5th Action Plan, giving farmers time to adjust their farm operations.

[1354] Schröder, J.J. and J.J. Neeteson. Nutrient Management Regulations in the Netherlands, *Geoderma*, Vol. 144, 2008, pp. 418-425.
[1355] Dutch Government. Parliamentary Papers, *4th Dutch Action Plan for the Nitrates Directive*, pp. 6-8.
[1356] *Fertiliser Act*, http://wetten.overheid.nl/BWBR0004054/geldigheidsdatum_30-12-2011 (in Dutch, Meststoffen Wet). The Act defines phosphate as phosphorus in any form or compound, multiplied by a factor of 2.29.
[1357] Dutch Government. *Diffuse Water Pollution Implementation Program*, 2008, p. 41.
[1358] Dutch Government. Parliamentary Papers, *4th Dutch Action Plan for the Nitrates Directive.*

- The option for farmers producing high yields of sugar beet and chip potatoes on clay soils to slightly increase their nitrate use, compared with the 3rd Action Plan, in recognition of the fact that yield had been harmed by the previous requirements.
- Phosphate application amounts that are aligned with both land use (grassland and arable) and with the phosphate content of the soil (low, normal or saturated phosphate levels). Farmers will have to carry out soil tests to determine the phosphate level of their ground, or by default, adhere to the phosphate applications for phosphate-saturated soil.
- A reduction in the period of the year when manure may be spread and when nitrogen fertilizers can be applied to the land, and an increase in the storage capacity for manure to seven months.
- Maintenance of rules to ensure that the total manure production (in terms of nitrogen and phosphate) does not exceed the 2002 level. This requires farmers to adjust the number of livestock or to export manure for use elsewhere.

The Dutch government recognizes the importance of innovation for reducing the harmful impact of manure. This can be done not only by improving the timing of application, selecting the most appropriate type of application (such as row spreading), testing drainage recycling schemes and optimizing the cultivation of catch crops, but by ensuring that the improved techniques are adopted by farmers.[1359] Innovation pilots for agriculture thus play an important role in the Implementation Program for Diffuse Water Pollution. The pilot projects aim to improve knowledge, examine the cost-effectiveness of various measures and encourage voluntary implementation of BMPs. The pilots focus on areas with phosphate-leaching soils, that is, areas where the Nitrates Directive maximum of 50 mg/l nitrate is insufficient to protect water quality.

Another requirement, the Outdoor Cultivation and Livestock Discharge Order,[1360] prohibits the use of pesticides and manure along waterways; the cultivation-free buffer zone varies from as little as 25 cm for grain and grass to between 50 and 150 cm for other crops, and up to 9 m for orchards, depending on the spray mechanism used (Article 13). Buffers must be at least 5 m wide along about 2,000 km of steams in ecologically vulnerable streams in High Netherlands.[1361] As a result of rules to better manage pesticide use, the estimated environmental load was reduced by 85% between 1998 and 2007, although this was not yet fully evident in water quality.[1362] Additional measures were needed with respect to the use of herbicides on hard surfaces and from the greenhouse industry. New rules were introduced to limit the use of glyphosate; from a monitoring study in the Maas River, it appears the rules have been effective in reducing the exceedances of glyphosate between 2008 and 2010.[1363]

5.4.5 Forestry

To reduce the contamination of water, the use of herbicides must be limited in government-owned forests (as well as on land administered by the Ministry of Defense and around government buildings).[1364]

[1359] Ibid. pp. 18, 49.
[1360] Dutch Government. Outdoor Cultivation and Livestock Discharge Order, http://wetten.overheid.nl/BWBR0011133/geldigheidsdatum_03-01-2012 (in Dutch, Lozingenbesluit Open Teelt en Veehouderij)
[1361] Dutch Government. Parliamentary Papers, *4th Dutch Action Plan for the Nitrates Directive*, pp. 6 and 32.
[1362] Dutch Government. *Diffuse Water Pollution Implementation Program*, 2008, pp. 25-26.
[1363] RIWA-Maas. Glyphosate and AMPA in the Maas River Basin: Results of a 2010 International Monitoring Campaign (in Dutch, Glyfosaat en AMPA in het Stroomgebied van de Maas). AMPA results from the degradation of glyphosate.
[1364] Dutch Government. *Diffuse Water Pollution Implementation Program*, 2008, p. 47.

5.4.6 Municipal Stormwater

Many municipalities are taking steps to keep runoff from flowing into the combined sewer system.[1365] In 2009 the Association of Dutch Municipalities developed a model bylaw, which could require the separation of the surface and sewage water systems. The Dutch have examined the proportion of contaminants (phosphorus, nitrogen, zinc and copper) that come from different sources, including agriculture, traffic, construction and sewage treatment systems. Runoff seems to make a relatively small contribution.[1366] In this densely populated country, diffuse pollution from traffic has been researched. Contaminants (heavy metals, polycyclic aromatic hydrocarbons and oil) come from the wear of tires and the road surface, the corrosion of street infrastructure, and vehicle exhaust.[1367] Studies showed, for example, that along motorways, 20-40% of the contamination of groundwater and surface water came from runoff and 60-80% from atmospheric deposition. Deposition is close to the road (groundwater concentrations at 10 m from the road are similar to control points at 200 m), so contaminated runoff can be reduced through use of very porous asphalt on the emergency strip along motorways.

In the Netherlands, large urban areas that are often paved with brick and mild winter temperatures have led in the past to extensive use of herbicides (including those based on glyphosate) to reduce weeds. There has been concern about the health effects of glyphosate.[1368] Recent research has shown that it is technically and economically possible to remove weeds on paved surfaces without, or with very limited use of, herbicides; individuals are no longer permitted to use glyphosate on paved surfaces and professionals are only allowed to use it under special conditions with a permit, as set out in Sustainable Weed Control of Paved Surfaces system.[1369]

5.4.7 Watershed Management

Diffuse water pollution is addressed in River Basin Management Plans, which cover all aspects of pollution and hydrology. The plans set out how needed reductions in both point and diffuse pollution sources are to be achieved in each basin over the period 2010-2016, and sometimes for the period 2017-2025, together with estimated costs.[1370] Municipalities are responsible for the point source sewerage systems, disconnecting hard surfaces (e.g., parking lots) from stormwater sewage systems, the use of non-leaching building materials, and the reduction in the use of herbicides. They can do this by example or by municipal regulations.

[1365] Ministry of Transport and Water. *Water in Pictures: Progress Report on Water Management in the Netherlands*, 2010, p. 32, http://www.rijksoverheid.nl/documenten-en-publicaties/rapporten/2010/01/01/water-in-beeld-2010-voortgangsrapportage-over-het-waterbeheer-in-nederland.html (In Dutch, Water in Beeld, Voorgangsrapportage over het Waterbeheer in Nederland)

[1366] Ibid. pp. 45-46. The author does not know if this is because much of the runoff currently flows through the sewer system.

[1367] Commission on Integrated Water Resources Management, Workgroup 4. Water and Environment, Road Runoff, 2002, http://books.google.ca/books/about/Afstromend_wegwater.html?id=P7bzGwAACAAJ&redir_esc=y (in Dutch, Commissie Integraal Waterbeheer: Afstromend Wegwater) Available online by doing search on Dutch author and title.

[1368] See, for example, Paganelli, A. *et al*. Glyphosate-Based Herbicides Produce Teratogenic Effects on Vertebrates by Impairing Retinoic Acid Signaling, *Chemical Research in Toxicology*, Vol. 23(10), 2010, pp. 1586-1595, http://uneamfagro.org/phocadownload/taller-glifosato_docs/anexo%201%20martinez.pdf

[1369] Dutch Government. *Diffuse Water Pollution Implementation Program*, 2007, p. 28, http://www.rijksoverheid.nl/onderwerpen/waterkwaliteit/documenten-en-publicaties/brochures/2008/03/04/uitvoeringsprogramma-diffuse-bronnen-waterverontreiniging.html

[1370] Dutch Government. *River Basin Management Plans, 2009-2013, Summary for the Eems, Maas, Rhine Delta and Schelde*, December 2009, pp. 29, 33 and 39, http://www.rijksoverheid.nl/documenten-en-publicaties/brochures/2011/03/28/stroomgebiedbeheerplannen.html (in Dutch, Stroomgebiedbeheerplannen, 2009-2013)

5.4.8 Progress and Effectiveness

Because of the dense population, the high water table in much of the land and the intensive land use for agriculture and urban development, the Dutch government has needed strict regulations to reduce the discharge of pollutants, including manure, fertilizers and pesticides. Even though the Dutch have a long tradition of being regulated, the rules and regulations are onerous. Many farmers recognize the need for strict regulation to prevent dumping of manure, but some find the current system too complex and a heavy administrative burden.[1371] However, these stringent requirements are needed if the country is to attain the outcomes required by the EU Nitrates Directive and the WFD.

[1371] Dutch Government. Parliamentary Papers, *4th Dutch Action Plan for the Nitrates Directive*, p. 15.

6. Implementing a Non-Point Source Pollution Program

This chapter summarizes the research findings and presents conclusions, drawing on the experience of jurisdictions that have a specific NPSP program in place for protecting water quality. Key features that appear to be important to the success of a NPSP program are identified and illustrated with examples. Alberta's approach is evaluated in the context of the key components, and gaps are noted where appropriate. The section concludes with an example to consider if a NPSP program were to be developed.

6.1 Components of an Effective NPSP Program

Although none of the Canadian provinces examined for this report has an integrated NPSP program, all U.S. and European jurisdictions studied do have such programs. The experience of these jurisdictions is used to outline some of the key components for an effective NPSP program. Each component is accompanied by an explanation and examples. Where there is an example of the component from B.C., Ontario or Saskatchewan, it is noted even though the example is not in the context of a formal NPSP program. Much of the Canadian work mentioned in the examples is in the early stages and it is too soon to effectively assess how well these initiatives are managing NPSP. The examples, which include both favourable and unfavourable experiences, are listed in the same order as in this report, with the section number in brackets. The components, described in more detail in the following sections, are:

- Clear lead agency
- Good baseline data
- Careful development of NPSP plan
- Sound regulatory framework
- Partnerships with other regulatory agencies
- Partnerships with non-regulatory bodies
- Awareness and education
- Adequate funding
- Implementation and enforcement
- Ongoing monitoring and assessment
- Watershed approach
- Measures to address municipal NPSP

6.1.1 Clear Lead Agency

One government department or agency should have overall responsibility for the NPSP program in a jurisdiction. One department needs to drive the NPSP initiative and this is usually the department responsible for water quality. This department conducts the basic monitoring, has an overall view of the issue and is not attached to any one sector of the economy. It also undertakes ongoing monitoring and assessment of the program. If responsibilities are delegated to or shared with another department, the lead department should retain some role in enforcement, as another department will have different priorities and be less focused on protecting water quality.

Examples:

- The Saskatchewan Watershed Authority is the lead agency in that province for many activities related to NPSP, with a focus on watershed management and source protection. Although its activities are not formally structured as a NPSP program, SWA led the development of nine source water protection plans and oversees state of the watershed reporting (s. 3.4.3).
- The California State Water Resources Control Board (which operates through nine regional boards) is the lead agency in that state (s. 4.2.3.1) and has successfully implemented the effective Irrigated Lands Regulatory Program (s. 4.2.4.1).

- In North Carolina, the Department of Environment and Natural Resources is the lead agency, but the NPSP program is implemented by two divisions within the department, the Division of Water Quality and the Division of Soil and Water Conservation (s. 4.3.3.1).
- In the State of Washington, shared responsibilities make it difficult for the Department of Ecology to enforce measures to reduce NPSP in agriculture and forestry. In its 2010 report on NPSP, the Department emphasized the importance of clarifying roles and responsibilities to ensure efficient and effective implementation of the program (s. 4.6.8).

6.1.2 Good Baseline Data

Good baseline water quality monitoring data are essential to understanding the contribution that NPSP makes to water pollution in any location. A comprehensive stream monitoring network is the first requirement but further insight into pollution sources can be obtained through random ambient monitoring. In addition to monitoring on a planned schedule, event monitoring (during spring runoff or after a major summer precipitation event, for example) will indicate the load of sediment and other pollutants that enter the water from diffuse sources. Monitoring results can be used to identify the major pollutants, such as sediment, specific nutrients, and pesticides, and to estimate the loads. Government water quality monitoring can be supplemented with monitoring by trained volunteers. Depending on their level of training and experience, data may be used for screening, determining river status and water quality trends, or even for management decisions. Government regulations may also require those who generate NPSP to monitor water quality.

Baseline monitoring makes it possible to identify and classify:

- Water bodies that are of good quality, where no deterioration should be allowed;
- Water bodies where the status is less than good, but where improvements can be expected using mandatory requirements (such as accepted practices or rules); and
- Water bodies where water quality is poor and improvement cannot be expected without significant changes in land management practices.[1372]

Examples:

- Ontario's Provincial Water Quality Monitoring Program collects surface water quality information from rivers and streams at more than 400 locations across the province. The program is undertaken in partnership with Conservation Authorities, which collect samples for analysis in Ministry of Environment laboratories (s. 3.3.9).
- The US EPA requires each state to monitor water quality and classify rivers based on monitoring results and to estimate pollutant loading from all sources relative to a water body's assimilative capacity for the selected pollutants (s. 4.1.3.1).
- North Carolina undertakes random ambient monitoring in addition to monitoring on about 30% of the state's rivers (s. 4.3.3.3).
- Wisconsin uses citizen monitoring as a key part of its monitoring of lakes and streams (4.7.3.3).
- The EU Water Framework Directive requires monitoring sites at a representative selection of water bodies that are at risk of NPSP, to assess the magnitude and impact of the diffuse source pressures (s. 5.1.2).

[1372] These three bullets are based on the work of the Diffuse Pollution Management Advisory Group in Scotland.

6.1.3 Careful Development of a Plan

The detailed plan and long-term goals for reducing NPSP will depend on its sources. A good plan should be even-handed across different sectors, should not be too complex and will work best if it has support at the political level. The plan should identify goals, set targets and be reviewed at regular intervals (e.g., every five years) so that it can be adjusted, based on monitoring results. It should include measures to keep clean waters clean. As noted in s. 6.1.10, it can take some time to see results.

Examples:

Identify the problems and sources of NPSP:

- Ontario's source water protection plans address both point source and NPSP. Regulations describe a detailed framework for developing these plans; they identify 21 activities that could threaten drinking water supplies and many of these activities are non-point sources (s. 3.3.3, particularly Figure 3).
- The US EPA requires all states to develop plans to reduce the total maximum daily load (TMDL) of pollutants for NPSP, as well as the load from point sources in impaired waters (s. 4.1.3.1). This complex system, which is the foundation of the federal US approach to all water pollution, is different from the approaches seen in Canada. However, some form of classification of rivers and lakes can identify priority areas and provide focus for an implementation plan.
- Scotland prepared characterization reports for river basins which identify priority catchments where water quality needs to improve to be fit for specific uses, such as drinking water (s. 5.3.3.1 and s. 5.3.3.4).

Be even-handed across different sectors:

- California is planning to extend use of the conditional waiver system from agricultural lands to forest lands, including recreation areas (s. 4.2.5).
- Wisconsin has Runoff Rules that apply to agriculture, to property owners who apply fertilizer to two hectares or more and to NPSP from stormwater and construction sites (s. 4.7.4 and s. 4.7.6).
- Scotland's General Binding Rules apply to the built environment (buildings and roads, with the exception of single residential buildings), agriculture and forestry and do not select a single sector. Scotland's EPA set up the Diffuse Pollution Management Advisory Group, with members from a cross-section of rural, environmental and biodiversity interests, to help gain support for the NPSP program and show that agriculture was not a special target (s. 5.3.3.1).

Avoid complexity:

- Although Ontario's process to develop source water protection plans is very thorough and has resulted in a great deal of valuable analysis, it is also complex (s. 3.3.3, particularly Figure 3).
- Washington's Forest Watershed Analysis Manual is very detailed and relies on local initiatives to address cumulative effects in each small watershed, so has not been widely implemented (s. 4.6.5).
- The NPSP requirements in the Netherlands are extremely complex and onerous on the agricultural community (s. 5.4.4).

Set goals and targets

- California's NPSP plan was to meet objectives by 2013, in three phases (s. 4.2.3.1).
- The Tar-Pamlico River Basin Nutrient Strategy in North Carolina set targets for nitrogen and phosphorus relative to 1991 levels. The plan is implemented in phases, with a review and adjustments to the strategy at each phase (s. 4.3.7.2).

Protect clean waters:

- The US EPA requires the identification and protection of Outstanding Resource Waters. It also has a Healthy Watersheds Initiative with funding for partnerships to keep clean water clean (s. 4.1.3.8).
- Wisconsin has identified one-fifth of its rivers as Outstanding Resource Waters, and requires wider buffers to protect them in urban areas (s. 4.7.3.1 and s. 4.7.6).

Obtain support at the political level

- Political support is evident in several pieces of state legislation to protect water quality.
- Milwaukee, Wisconsin has a successful Low Impact Development (LID) program that was initiated under direction from the city's mayor (s. 4.7.6.1).

6.1.4 Sound Regulatory Framework

There are three basic approaches to the management of NPSP:

1. **Non-regulatory best (beneficial) management practices (BMPs)**
2. **Regulatory-based incentives for BMPs**
3. **Waste discharge laws and regulations, such as those that apply to Concentrated Animal Feeding Operations (CAFOs).**

There is a role for each approach but an effective NPSP program needs a regulatory basis. Legislation to mandate the implementation of measures to reduce NPSP means the requirements can be enforced when necessary. The basic requirements may be called General Binding Rules (GBRs) or may require adoption of Accepted Agricultural Practices or Accepted Forestry Practices. Compliance with GBRs or Accepted Practices means that those who undertake activities that create NPSP are required to follow the rules, but no registration or permit is required to operate. However, if inspection shows an activity is affecting water quality, enforcement may follow. The legislated requirements can be supplemented by programs that encourage adoption of BMPs through education and funding. BMPs usually aim to reduce the impact of substances of concern, whether sediment, nutrients or other pollutants, rather than managing the natural hydrology. They are frequently encouraged in agriculture and forestry and are part of some urban LID programs.

Examples:

- Under Ontario's *Nutrient Management Act*, farms must have nutrient management strategies and plans to deal with animal waste and other substances that are kept on farm properties or spread on fields. The Act establishes the framework for best practices in nutrient management and creates standards that give BMPs the force of law. It also provides standards for how nutrients are stored and applied to farmland to reduce the likelihood of groundwater or surface water contamination (s. 3.3.4.1).
- Ontario has banned the cosmetic use of pesticides, overriding municipal pesticide bylaws and establishing one set of rules for the province (s. 3.3.5.3). B.C. is considering such a ban (s. 3.2.4.1).
- California uses the conditional waiver system set out under the *Porter-Cologne Act*, which requires farmers to take certain actions to reduce NPSP discharges (e.g., attend a training course, prepare a nutrient management plan, conduct monitoring). Farmers who fail to comply with the waiver requirements may have to meet much more stringent water permit conditions (s. 4.2.3.1). The conditional waiver system may be extended to forestry, including recreational use of forest lands.

- Vermont requires farmers to follow Accepted Agricultural Practices relating to manure management and other activities. Permits are required for medium and large farm operations (s. 4.5.4.1), and additional programs encourage adoption of BMPs (s. 4.5.4.2). Accepted management practices for logging are not mandatory, but if water quality is affected, the operator can be fined (s. 4.5.5).
- Wisconsin's Runoff Management Rule sets performance standards for agriculture and for stormwater flowing from new construction and roads (s. 4.7.4 and s. 4.7.6).
- The EU Water Framework Directive requires measures to prevent or control the input of NPSP (prohibiting entry into water) or prior authorization or registration, based on binding rules. The Nitrates Directive addresses NPSP from fertilizer and manure and requires special measures in nitrate-vulnerable zones (s. 5.1.2).
- NPSP in Scotland is regulated through GBRs (s. 5.3.3.1). GBRs for agriculture set buffer zones that apply to fertilizer application, livestock and cultivation close to water and wetlands (s. 5.3.4). A GBR requires sustainable urban drainage systems for runoff from all new buildings and roads, except from single residential buildings (s. 5.3.6). There are also mandatory GBRs for forestry (s. 5.3.5).

6.1.5 Partnerships with other Regulatory Agencies

NPSP is created from many types of land use, so the lead department should seek partnerships with other government departments or agencies to implement a program. The departments responsible for agriculture, forestry and public lands will be essential partners in designing and implementing a program for those sectors, while those representing municipal governments and transportation will need to be involved in developing plans for the built environment. It may be appropriate to have a formal Memorandum of Understanding (MOU) with other agencies, so that roles and responsibilities are clearly defined.

Examples:

- B.C.'s ministries of Environment, and Forests, Lands and Natural Resource Operations have collaborated to develop and implement the Forest and Range Evaluation Program to evaluate how effectively licensees are meeting government objectives and desired outcomes (s. 3.2.5.3).
- In Vermont, the Agency of Natural Resources is responsible for water quality management but the Legislature delegated responsibility for reducing NPSP from agriculture to the Agency of Agriculture and there is an MOU between the two agencies (s. 4.5.3.1). Partnerships with various government agencies are essential for reducing the NPSP loads flowing into Lake Champlain (s. 4.5.7).
- In England, the National Auditor noted that partnerships can be important but coordination and greater clarity of roles and responsibilities were needed at the national level (s. 5.2.9).
- Scotland's EPA provided training for staff in Scotland's Environmental and Rural Services and the national parks so they could help implement and enforce the NPSP program (s. 5.3.3.5). It has been pointed out that co-training with field staff of stakeholder organizations is the most effective mechanism to develop a common understanding of the issues.[1373]

6.1.6 Partnerships with Non-regulatory Bodies

Partnerships with non-governmental organizations, including those representing agricultural and other sector interests, and with academic bodies are very important for effective implementation of NPSP programs. In fact, "Engagement with the polluting sectors is a pre-requisite for effective pollution

[1373] Ibid.

control and prevention."[1374] Many successful NPSP projects in the U.S. have been implemented through bodies responsible for conservancy or wetlands. At the regional or local level there have been constructive partnerships between government and local groups who are keen to protect specific watersheds. Academic organizations have played an important role in education on NPSP and in research to determine changes achieved through NPSP implementation. Several academic bodies have focused on research and education on LID.

Examples:

- Ontario's Conservation Authorities have some regulatory responsibilities but they also initiate voluntary partnerships with federal, provincial and municipal governments and various non-government and other organizations at the community level, focusing on environmental protection, water resource management and education (s. 3.3.3).
- In Saskatchewan, eight watershed stewardship organizations have been established to implement source water protection plans developed for their regions (s. 3.4.3). Saskatchewan's Agri-Environmental Group Plans were developed on a partnership basis with producers to make watershed improvements in their area (s. 3.4.4.2).
- The Willamette Partnership in Oregon is trying to combine a regulatory approach and market-based tools to address watershed issues (s. 4.4.5.1).
- In Washington many success stories are the result of partnerships between local government, business, non-profit groups, First Nations and citizens (s. 4.6.3.4). The Puget Sound Partnership has taken a lead in encouraging LID and, in partnership with Washington State University Extension, has developed comprehensive manuals and trained several hundred professionals in LID (s. 4.6.6).
- The Wisconsin Lakes Partnership which includes the Wisconsin Department of Natural Resources, the University of Wisconsin Extension and other bodies, is recognized as a model for collaboration (s. 4.7.3.5). The Wisconsin Buffer Initiative is a partnership between farmers, University of Wisconsin scientists, public agencies and the Nature Conservancy (s. 4.7.4).

6.1.7 Awareness and Education

It is important to raise awareness about NPSP and ensure the various sectors that contribute to or are affected by NPSP are informed, both before a reduction program is introduced and during its implementation. In a jurisdiction that has previously paid relatively little attention to NPSP, it may be necessary to raise awareness in government and the relevant sectors through conferences and meetings before a NPSP plan is developed. Well-informed sectors can participate more effectively in the planning process and advise how best to raise public awareness in their sectors before a plan is implemented. Once a plan is in place, it may be possible to use first-time infringements as an opportunity for education, rather than impose a penalty. Education may be included as part of the NPSP plan, as seen in California.

Examples:

- The US EPA provides grants for education, training, technology transfer and demonstration projects under the *Clean Water Act* (CWA), Section 319 funding for NPSP programs (s. 4.1.3.2).
- In California the Central Coast Water Quality Control Board required irrigators to take a 15-hour course on NPSP, as part of the conditional waiver requirement under the Irrigated Lands Regulatory Program in that region. The waiver conditions were developed in partnership with local bodies (s. 4.2.4.1).

[1374] D'Arcy, B.J. *A Strategy for the Control of Diffuse Pollution of Water in Scotland*, Diffuse Pollution Initiative Report No. 20, 5th draft 2004.

- In England, many farmers surveyed in the Catchment Sensitive Farming Delivery Initiative were not convinced that their actions contributed to NPSP, so the National Auditor emphasized the need to increase awareness and demonstrate the benefit of mitigation measures (s. 5.2.4).

6.1.8 Adequate Funding

Any effective NPSP program needs sufficient long-term funding to cover the costs of staff for planning, education, implementation, monitoring and enforcement. Funding will also be needed if the plans include cost share programs that encourage implementation of BMPs. Government can determine whether some form of cost-recovery is desirable (as in California's Irrigated Lands Regulatory Program monitoring requirements) or whether the program will allow offset fees (as in North Carolina). Some costs associated with inspections may be reduced if there is cross-training with field staff who are involved in other existing programs (as in Scotland).

Examples:

Funding for regulatory programs

- The US EPA provides funding for NPSP projects under the CWA Section 319, and for water quality management planning under the CWA Section 205(j), which is in addition to funds provided by various state governments (s. 4.1.3.2).
- In California's Irrigated Lands Regulatory Program, farmers are required to conduct monitoring to determine whether measures are effectively reducing water pollution, thus reducing the total cost of monitoring paid by government (s. 4.2.4.1).
- In North Carolina it was pointed out that NPSP programs tend to be chronically underfunded compared to point source programs (s. 4.3.8).

Funding for BMPs

- The USDA provides funds for the Conservation Reserve Enhancement Program and others that encourage adoption of agricultural BMPs, some of which may reduce NPSP (s. 4.1.4.1).
- California has a special fund to encourage local jurisdictions to implement LID projects (s. 4.2.6).
- In England, the National Auditor criticized the lack of flexibility in a grant program, which meant that funding was not being spent on measures that would deliver the maximum value at the farm level (s. 5.2.9).

6.1.9 Implementation and Enforcement

Once a NPSP management plan is developed, it should be implemented and enforced fairly across all sectors. As mentioned earlier, if responsibility for program implementation has been delegated to a different government agency, it is important for the lead agency to retain powers to enforce compliance. If a program requires compliance with certain conditions it is important that all those affected are required to comply, or it may place an unfair burden on those who are meeting the rules. A jurisdiction should have a clear system that enables the public to provide confidential information about infractions, which can then be investigated.

Examples:

- The California Irrigated Lands Regulatory Program issues notices and fines to irrigators who fail to join the regional monitoring coalition and fail to meet the conditional waiver requirements (s. 4.2.4.1).
- The North Carolina Division of Water Quality has power to issue a notice of violation for NPSP resulting from forestry even though the Forest Service is responsible for inspecting sites after harvesting (s. 4.3.5).

- In Vermont, if the Department of Environmental Conservation receives a complaint about agricultural NPSP, it is referred to the Agency of Agriculture, which is required to investigate (s. 4.5.4.1).
- The National Auditor in England criticized the Environment Agency for not consistently following up on inspections or using the information to show the ineffectiveness of some measures (s. 5.2.9).
- In Scotland, if citizens report non-compliance with GBRs, Scottish EPA staff are required to visit the site and address the issue (s. 5.3.4).

6.1.10 Ongoing Monitoring and Assessment

Ongoing monitoring is essential to assess the success of a NPSP program; monitoring programs should be reviewed at regular intervals and adjusted as necessary. This monitoring and assessment should form the basis for a public report on the program's achievements. The effectiveness of individual projects or methods may be assessed in various ways, including through a research project conducted by a local academic institution or by a government agency with that type of mandate. Since NPSP varies with runoff, it is advisable to use running averages to determine trends. There may also be a time lag between the implementation of measures to reduce NPSP and improvements in water quality, which needs to be considered during the evaluation process.

Examples:

Monitoring and assessment

- The US EPA requires annual reports on the implementation of NPSP programs that it funds (s. 4.1.3.4).
- The USDA funds use of BMPs but programs are voluntary and the department does not effectively monitor and assess their effectiveness (s. 4.1.4).
- To make efficient use of resources, Washington uses a five-year cycle of scoping, data collection, data analysis, technical reporting and implementation for Water Quality Management Areas, with about one-fifth of the watershed regions starting at year one of the cycle each year (s. 4.6.7).
- Wisconsin monitors the implementation of BMPs in forestry, through monitoring of timber harvest sites (s. 4.7.5).
- The Netherlands undertakes a large amount of monitoring, including at 500 selected agricultural operations, to evaluate NPSP reduction measures (s. 5.4.3.2).

Research

- The University of Washington has monitored some LID projects to show how they reduce storm flow and pollutants (s. 4.6.6).
- The Wisconsin Department of Natural Resources is evaluating the effectiveness of riparian management zones on water quality (s. 4.7.5) and the University of Wisconsin is conducting a paired watershed study (s. 4.7.4).
- In the Netherlands, research monitoring has been conducted to determine the impacts of roads on NPSP (s. 5.4.6).

Time lag

- In the Tar-Pamlico Basin in North Carolina, the expected improvement in water quality, based on the implementation of measures to reduce NPSP, has not been achieved. This may be due to historic pollutants seeping from groundwater or being released from sediments. It may also be because the model used to estimate the benefit of certain measures (e.g., buffer strips) is not accounting for all factors (s. 4.3.7.2).

6.1.11 Watershed Approach

A watershed approach is an effective way to implement a NPSP program at the regional and local levels. It enables those living and working in the area to implement or adapt a program to focus on the needs of a specific watershed. Partnerships between different sectors may be easier to set up at a watershed level, especially partnerships involving non-government organizations working at the local level. In some EPA success stories, projects were initiated by funding applications from local organizations that were well-informed and passionate about addressing local issues.

Examples:

- Ontario's source protection plans will cover 38 different watersheds (s. 3.3.3, particularly Figure 3).
- Saskatchewan is similarly developing its source water protection plans on a watershed basis, and the Saskatchewan Watershed Authority reports on the state of the province's watersheds (s. 3.4.3).
- Most EPA success stories are for watersheds. Some watershed projects may be quite large, such as the reduction of pesticide discharges in the Sacramento and Feather Rivers in California (s. 4.2.4.1), but many are smaller.
- California's NPSP program is implemented primarily through its Watershed Management Initiative, using an integrated planning approach specific to each watershed and focusing on high priority watersheds (s. 4.2.7).
- Vermont's Ecosystem Restoration Program uses a watershed approach that combines regulatory requirements with non-regulatory partnerships (s. 4.5.7) and there are several success stories for small watersheds (s. 4.5.8).
- Washington's Department of Ecology has worked effectively with conservation districts, local governments and landowners to reduce the impacts of ranching on water quality (s. 4.6.4).
- Wisconsin's Priority Watershed and Lake Program was effective in meeting targets in more than 90% of critical sites over a 30-year period (s. 4.7.4).
- The EU Water Framework Directive requires river basin management plans that contain a summary of the significant pressures and impacts of human activity with an estimation of diffuse source pollution (s. 5.1.2).

6.1.12 Measures to Address Municipal NPSP

Even if LID requirements are not part of a jurisdiction's NPSP plan, individual municipalities may take initiatives to implement LID. However, if a jurisdiction does not include requirements for LID, it may still be necessary to alter legislation to allow municipalities more powers to manage stormwater in new, sustainable ways. Implementation of LIDs is often achieved through regional or local partnerships.

Examples:

- Toronto has implemented a comprehensive Wet Weather Flow Master Plan, which integrates many activities under one initiative, including LID approaches (s. 3.3.5.1).
- California has amended its Construction General Permit to require LID techniques where economically achievable (s. 4.2.6). LID in California is encouraged by the California Water and Land Use Partnership, which includes not only government agencies, but non-profit organizations and academia (s. 4.2.6).
- The North Carolina State University Water Quality Group has set up a LID group to help practitioners implement LID in the state and provides training (s. 4.3.6).
- The City of Portland's "Grey to Green" BMPs include a comprehensive suite of LID measures and the program is highly regarded world-wide. In addition to city projects funded from its construction budget, there are incentives to private property owners (s. 4.4.4).

- The Agency of Natural Resources in Vermont has initiated a Green Infrastructure Program to stimulate the development of LID practices and the Vermont League of Cities and Towns has developed a model bylaw that municipalities can adopt (s. 4.5.6).
- Seattle, Washington has a comprehensive Green Stormwater Infrastructure program that mandates LID for new development wherever possible. In addition, Natural Stormwater Drainage Systems are implemented on city streets (s. 4.6.6).

6.2 How Alberta Compares

Like the other provinces examined in this report, Alberta does not have a formal NPSP program. It has processes to approve, monitor and ensure compliance for point sources, but its approach for managing NPSP has been much more fragmented. Management mechanisms and responsibilities are dispersed and various activities that could generate NPSP do not require approvals or any interaction with a regulatory authority. NPSP monitoring has generally been on an *ad hoc* basis, with short-term projects undertaken as needs are identified. Implementation of BMPs is similarly *ad hoc* and voluntary, and assessing the actual impacts or quantifying the benefits of their adoption has been challenging.

As this section will show, Alberta already has some of the elements common to successful NPSP programs in other jurisdictions but, for the most part, they are not coordinated or enabled through any binding or non-binding framework. Although there are gaps, a foundation does exist on which to build a NPSP program in this province.

6.2.1 Clear Lead Agency

No clear lead agency in Alberta is responsible for managing NPSP although Alberta Environment and Water (AEW) is involved with many aspects of NPSP and works with other departments as needs are identified. Among other things, AEW administers the *Environmental Protection and Enhancement Act*, and monitors and manages water quality, but cannot be said to be the lead agency on the NPSP issue. NPSP from various land uses is generally addressed in Alberta, through policy and regulatory tools or BMPs, by the department or agency whose mandate relates most closely to that sector; e.g., Alberta Agriculture and Rural Development plays a lead role in working with the agriculture sector; Alberta Sustainable Resource Development has a lead role in managing NPSP related to forestry and other activities on Crown land. However, the focus of these other departments is not necessarily on protecting water quality, as it is for AEW. AEW recognizes this situation, noting that, "Non-point source pollution control remains a challenge in the sense that no single agency or level of government has sole responsibility for the integration of land use activities into water quality protection strategies."[1375]

6.2.2 Good Baseline Data

Baseline monitoring describes the state of the environment and its natural variability, which is particularly important for assessing NPSP. AEW does water quality monitoring, reporting and evaluation throughout the province, including the Long-Term River Network (LTRN), which at only 28 sites seems limited given the size of the province. Monitoring networks for wetlands and smaller streams and tributaries are much less well developed, although as noted in s. 2.1.3 work is underway in some areas of Alberta to monitor water quality in smaller watercourses. Crucial to monitoring NPSP is the fact that most of the networks are not designed to answer the loading questions associated with heavy precipitation and runoff events, which is very important in establishing baselines. S. 6.4.2 notes some work being done in the upper reaches of the North Saskatchewan River to sample during spring runoff and storm events.

[1375] Alberta Environment and Water website, http://www.environment.alberta.ca/01256.html

As the Alberta Environmental Monitoring Panel noted in its June 2011 final report, "Alberta has a long history of extensive compliance monitoring, but. . . like many jurisdictions, baseline monitoring is often overlooked in spite of its importance."[1376] The Panel called on the Government of Alberta to implement a comprehensive environmental monitoring, evaluation and reporting system for Alberta, including a greater focus on baseline data.

6.2.3 Careful Development of NPSP Plan

Alberta's landscape is experiencing more activity and more intensive land uses. Population growth, much of it on the outskirts of cities, in small urban areas and acreages, is a factor; so are the conversion of land to cultivated or more intensive agriculture, the ongoing efforts to find and extract conventional oil and gas resources, and the province's ever-expanding network of roads. If a provincial NPSP plan is developed, all sources would need to be considered and projected into the future to determine appropriate goals and targets. Especially in areas where water bodies are already compromised, both point and non-point source loadings would need to be considered. An example is the phosphorus plan being developed for the Bow River (s. 2.1.4), which recognized the need to more closely examine NPS on a total loading basis after the City of Calgary invested substantially in its wastewater treatment plant to reduce phosphorus from that point source. Alberta already has several other initiatives underway that would need to be considered in any formal plan to address NPSP; these include the regional plans being prepared under the Land-use Framework and its enabling legislation, and the notion of thresholds and limits in the Cumulative Effects Management System (CEMS). Elements of these initiatives could conceivably be applied to managing NPSP on a regional or "place" basis, or a NPSP program might be implemented through these initiatives on a watershed basis, but neither of these approaches would result in one integrated provincial NPSP plan. The additional specific aspects identified in s. 6.1.3 (even-handedness, goals and targets, protect clean waters, political support) also need careful consideration in developing a comprehensive plan.

6.2.4 Sound Regulatory Framework

Alberta uses a mix of regulatory and non-regulatory approaches to manage NPSP. For example, agricultural operators are expected to follow the manure application requirements in the *Agricultural Operation Practices Act* (s. 2.1.1). Cities require approvals from AEW to operate their wastewater treatment plant, wastewater collection system and stormwater drainage system, and before an approval is granted, a total loading management plan and a stormwater management strategy must be prepared (s. 2.2). Both Edmonton and Calgary also have their own bylaws and other policy tools in place to address NPSP (s. 2.2.1.2). Strong riparian and source water protection requirements for forestry operations are set out in the Timber Harvest Planning and Operating Ground Rules that forest operations must follow as a condition of their tenure agreement and harvest approval (s. 2.3.1). However, Alberta has also relied extensively on the voluntary adoption of BMPs to manage NPSP, particularly in the agriculture sector (s. 2.1.2). If Alberta were to develop a NPSP plan, the *Alberta Environmental Protection and Enhancement Act* or the *Water Act* could potentially be amended to provide the necessary regulatory framework, although the amendments might depend on the direction taken through CEMS and/or regional plans. Changes to municipal legislation might also be needed.

6.2.5 Partnerships with other Regulatory Agencies

Partnerships among regulatory agencies are evident in collaborative efforts to encourage the adoption of BMPs and in monitoring projects, such as those undertaken with respect to NPSP and agriculture (s. 2.1.2 and 2.1.3). Alberta Agriculture and Rural Development regularly collaborates with Agriculture and Agri-Food Canada in developing and delivering initiatives, and AEW has partnered with other regulatory agencies to monitor NPSP in both urban and rural areas. The Alberta Environmental Monitoring Panel

[1376] Alberta Environmental Monitoring Panel. June 2011. *A World Class Environmental Monitoring, Evaluation and Reporting System for Alberta*, p. 12, http://environment.gov.ab.ca/info/library/8381.pdf

also recommended that federal and provincial environmental coordination and cooperation be improved when it comes to environmental monitoring, evaluation and reporting, noting successful precedents.[1377] Based on experience in other jurisdictions, partnerships would probably be needed between AEW and provincial government departments responsible for municipalities, transportation, agriculture and forestry, and perhaps the Energy Resources Conservation Board and the Natural Resources Conservation Board. There are also likely to be roles for certain federal government departments (e.g., Agriculture and Agri-Food Canada, Environment Canada, Fisheries and Oceans Canada) and, as seen in the development of source protection plans in other provinces, municipal governments also need to participate actively.

6.2.6 Partnerships with Non-regulatory Bodies

Agricultural initiatives to address NPSP have made especially good use of partnerships with non-regulatory bodies to develop and deliver on-the-ground programs (s. 2.1.2). Alberta also has a long track record of partnerships involving non-regulatory bodies. For example, provincial advisory organizations such as the Alberta Water Council and the Clean Air Strategic Alliance, as well as regional bodies such as Watershed Planning and Advisory Councils (WPACs) all have government, industry and NGO members. This experience offers a good basis for partnerships needed to design and implement a NPSP program.

6.2.7 Awareness and Education

Alberta has devoted substantial resources to raising awareness about NPSP, and has also relied on partnerships with other organizations to get the message out, as noted throughout section 2. But it can be hard to measure the success of education and outreach initiatives, especially in the absence of requirements for implementation and enforcement. As well, people may understand why a particular measure is important to prevent NPSP, but if there is an economic cost or if there are not perceived to be any economic benefits or other incentives, the enhanced awareness may not translate to action. However, if Alberta were to develop a formal NPSP program, these existing initiatives and proven partnerships provide a solid foundation on which to build, and the roles of some of the organizations already involved in education and outreach could potentially be expanded.

6.2.8 Adequate Funding

In the absence of a formal NPSP program, it would be difficult to determine how much money is actually being spent on NPSP-related management in Alberta. The province now supports joint initiatives such as agriculture's Growing Forward, WPACs and Watershed Stewardship Groups, *ad hoc* monitoring projects, and undoubtedly many other activities. Developing a formal integrated NPSP program would require a major shift in how funds are coordinated and assigned and possibly in where the funds come from. For example, point source emitters have traditionally been expected to fund monitoring and mitigation, but a different approach would be needed for NPSP.

6.2.9 Implementation and Enforcement

The current approach means that different agencies have responsibilities for enforcing the NPSP requirements that do exist in Alberta for different land uses. This is reasonable in the absence of an integrated NPSP program, but it does mean that within a given sector, several different authorities are responsible for ensuring compliance, as noted in s. 2.1.1 for agriculture. In the case of forestry, Alberta Sustainable Resource Development is largely responsible for monitoring forestry operations for compliance (s. 2.3.3). In the case of back country recreation, enforcement is a challenge in Alberta, as it is in other provinces. Implementing and enforcing a comprehensive NPSP program would need to be integrated with or incorporate what is now being done under existing programs. If a new program were developed under AEW, cross-training of staff in other departments would make it possible to build on

[1377] Alberta Environmental Monitoring Panel. June 2011. *A World Class Environmental Monitoring, Evaluation and Reporting System for Alberta*, http://environment.gov.ab.ca/info/library/8381.pdf

existing programs and limit the need for dedicated AEW staff to conduct field inspections. This is the approach taken in Scotland, and B.C.'s Forest and Range Evaluation Program also trains people in a variety of positions to do routine field evaluations.

6.2.10 Ongoing Monitoring and Assessment

Alberta's Long-Term River Network has been the primary ongoing focus for provincial surface water quality monitoring, and additional monitoring is done upstream and downstream of major cities. If the recommendations of the Alberta Environmental Monitoring Panel are fully implemented, the result would be a much more comprehensive monitoring, evaluation and reporting system for the entire province, responding to the needs of each geographic region based on the Land-use Framework boundaries. This would eventually provide much of the information needed for the ongoing evaluation and assessment of a provincial NPSP program.

6.2.11 Watershed Approach

Through the *Water for Life* partnerships, Alberta recognized the importance of taking a watershed approach. Eleven WPACs have been established to assess the condition of their watershed, prepare plans to address watershed issues, and undertake education and stewardship activities (s. 2.6). Although a great deal of collaborative work has gone into developing integrated watershed management plans, WPACs have no authority to enforce the plans, and rely instead on the voluntary commitment of partners, some of which may have regulatory authority and others that do not. Alberta can probably learn from the way in which NPSP and source protection programs have been implemented on a watershed basis in some other jurisdictions.

6.2.12 Measures to Address Municipal NPSP

The two major Alberta cities appear to have a great deal of diverse and relatively integrated activity underway to manage NPSP. Some of these activities are required by the provincial government (such as total loading plans) and some are in response to federal government requirements (e.g., salt management plans). Strides have been made to improve stormwater management, even as populations have grown, and interest is now turning to LID initiatives for both new developments and as retrofits in established urban areas. While larger urban centres generally have greater capacity to identify potential opportunities for managing NPSP, rural municipalities need more attention whether a provincial NPSP program is developed or not.

6.3 Scotland: An example to consider

The key components of NPSP management are found in Scotland's program and it may be helpful to look at the Scottish experience if Alberta decides to develop a NPSP program. The importance of addressing NPSP was recognized in Scotland in the mid-1990s and staff at the Scottish EPA tried to learn from experiences elsewhere. Conferences were held and invited speakers included the Chief of the Nonpoint Source Control Branch at the US EPA. The extent of diffuse pollution in Scotland was studied,[1378] and in 2001, the Diffuse Pollution Initiative was set up as a three-year program to:

1. Characterize and quantify the extent of NPSP and its impacts on the environment;
2. Provide information for developing new regulatory and other controls on NPSP; and
3. Raise awareness and understanding.[1379]

Scotland passed legislation in 2003 under which regulations were developed for controlled activities, including those that cause diffuse pollution. The strategy was developed to address three key sectors: agriculture, forestry and urban areas.[1380] The selected approach was to use General Binding Rules (GBRs), as described in section 5.3, which apply to almost all new construction and roads, to livestock and cultivation practices, and to forestry. The GBRs require the adoption of certain practices, but do not require registration or permits. They have been described as a "light touch" form of control,[1381] but there are powers to enforce compliance if the GBRs are not implemented. If desired, the first infringement may be used as an opportunity to raise awareness and resolve an issue, rather than immediately impose a penalty. GBRs can be an effective way to implement measures to reduce NPSP while minimizing regulation but, if necessary, can be combined with more stringent requirements, such as those relating to nitrates in Scotland. However, if GBRs are to be most effective, it is essential to incorporate all key components in the strategy, including monitoring, education and enforcement, as outlined in Section 6.1.

[1378] Petchey, A.M., B.J. D'Arcy and C.A. Frost, editors. *Diffuse Pollution and Agriculture,* Proceedings of a Conference held in Edinburgh, 12-14 April, 1995. See also, D'Arcy, B. J., *et al*. "Initiatives to Tackle Diffuse Pollution in the UK", *Water, Science and Technology*, Vol. 38, No. 10, pp. 131-138, 1998.
[1379] D'Arcy, B. J. *A Strategy for the Control of Diffuse Pollution of Water in Scotland*, Diffuse Pollution Initiative Report No. 20, 5th draft 2004.
[1380] Initially, abandoned mines and atmospheric pollution were considered but the problems from these sources were addressed elsewhere in the Scottish EPA.
[1381] Executive Note to the Water Environment (Diffuse Pollution)(Scotland) Regulations 2008, SSI/2008/54, Introduction, http://www.legislation.gov.uk/ssi/2008/54/pdfs/ssien_20080054_en.pdf

Appendix A: Resource People

The authors are very grateful to the individuals listed below who generously provided information, insight and additional sources for this project. The authors have made every effort to ensure the accuracy of material in this report but the content may not reflect the views of those listed here.

Name	Title and/or organization	Jurisdiction
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Ron Axelson	Executive Director, Intensive Livestock Working Group	Alberta
Ngaio Baril	Project Coordinator, Foothills Stream Crossing Partnership	Alberta
Mark Bennett	Executive Director, Bow River Basin Council	Alberta
Helen Bresler	Watershed Planning Unit Supervisor, Department of Ecology	Washington
Joe Britt	Agricultural Incentives Director, Sand County Foundation	Wisconsin
Cathie Brown	Project Manager, Drinking Water Source Protection, Ausable Bayfield Conservation Authority	Ontario
Jenna Calvi	Environmental Analyst, Green Infrastructure Coordinator, Vermont Department of Environmental Conservation, Stormwater Program	Vermont
Dale Chrapko	Program Manager, Agri-Environmental Programs Section, Alberta Agriculture and Rural Development	Alberta
Brian D'Arcy	Consultant, formerly responsible for the NPSP program at the Scottish EPA	Scotland
Yin Deong	Watershed Management Team Lead, City of Calgary	Alberta
Tom DiPietro	Stormwater Superintendent, South Burlington Stormwater Utility	Vermont
Simon Dyer	Policy Director, Pembina Institute	Alberta
John Englert	Manager, Environmental Regulation, Alberta Transportation	Alberta
Shane Gabor	Research Biologist, Ducks Unlimited Canada	Alberta
Rich Gannon	Supervisor, Nonpoint Source Planning Program, North Carolina Division of Water Quality	North Carolina
Wanda Goulden	General Supervisor, Geo-Environmental Engineering/ Engineering Services, Transportation Services, City of Edmonton	Alberta
Joshua Haag	Aquality Environmental Consulting Ltd.	Alberta
David Hill	Executive Director, Water Resources, Alberta Innovates: Energy and Environment Solutions	Alberta
Brian Hills	Team Lead, Science and Technical Support, Alberta Environment and Water	Alberta
Rick Hopkins	Department of Environmental Conservation	Vermont
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Martin Keller	Source Protection Program Manager, Grand River Conservation Authority	Ontario
Natalie Kromrey	Water Quality Specialist, Science and Technical Support, Alberta Environment and Water	Alberta
Ron Leaf	Municipal Manager, Clearwater County	Alberta
Don Livingston	Land Management/Planning Forester, Alberta Sustainable Resource Development	Alberta
Dave Maloney	Forest Water Management Officer, B.C. Ministry of Forests, Lands and Natural Resources Operations	B.C.
G. Tracy Mehan III	Principal (Drinking Water and Water Quality Group), The Cadmus Group Inc.	U.S.

Name	Title and/or organization	Jurisdiction
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Steph Neufeld	Watershed Specialist, EPCOR Water Services	Alberta
Tara Payment	Manager, Water and Reclamation, Canadian Association of Petroleum Producers	Alberta
Kevin Rieberger	Water Quality Science Specialist, B.C. Ministry of Environment	B.C.
Gary Sabourin	Watershed Forester, Vermont Department of Forests, Parks and Recreation	Vermont
Tracy Scott	Head, Industry and Government Relations – Alberta, Ducks Unlimited Canada	Alberta
Don Snider	Director, Environmental Management Services, Alberta Transportation	Alberta
Al Sosiak	President of North American Lake Management Society	U.S.
Bill Stack	Centre for Watershed Protection	U.S.
Emily Stahl	Hydrogeologist, Grand River Conservation Authority	Ontario
Clarence Stuart	Environmental Scientist, Transportation Operations, Transportation Services, City of Edmonton	Alberta
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Aaron Todd	Coordinator, Stream Water Quality Monitoring, Environmental Monitoring and Reporting Branch, Ontario Ministry of the Environment	Ontario
Dave Trew	Executive Director, North Saskatchewan Watershed Alliance	Alberta
Arno van Breemen	Inspector, Water Management	The Netherlands
Hans van Duijne	Netherlands Soil Partnership, Cluster Manager Canada, Deltares	The Netherlands
Henry Vaux	Professor of Resource Economics and Resource Economist, Emeritus; and Chair, Rosenberg International Forum on Water Policy	U.S.
Dov Weitman	Chief, Nonpoint Source Control Branch, EPA (until retirement, December 31, 2011)	U.S.
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