VIII BENEFICIAL MANAGEMENT PRACTICES FOR WATER QUALITY RISK MITIGATION

Beneficial Management Practices, or BMPs, are mitigative and preventative measures that can be taken to protect watersheds from the impact of human development. BMPs protect and improve water quality and quantity, and in many cases there are provincial and federal programs designed to support the implementation of BMPs by providing both technical and financial assistance to individuals, organizations, and corporations whose activities may be impacting water resources. BMPs are focused on non-point sources of water contamination, and represent guidelines for improve overall water quality or quantity.

There are many different types of Beneficial Management Practices, and they vary depending on the sector of human activity to which they apply. For example, in natural resource extraction there are mitigative measures that can be taken during site construction, site operation, and after extraction activities have ceased. During construction, the use of sediment capturing technologies and techniques such as construction site isolation or siltation barriers can be used to reduce sediment inputs to waterways. During site operation, water conservation technologies that recycle the water used for resource extraction can reduce the impact of a project on river flow. Cleanup and restoration measures are often implemented once operations at an extraction site have ceased: these many include top soil replacement, re-vegetation, weed control, or wildlife habitat enhancement.

There are three broad categories of Beneficial Management Practices that will be discussed in this section: agricultural, urban, and riparian development. The BMPs mentioned do not represent a comprehensive list, as guidelines and regulations around the implementation of Beneficial Management Practices are constantly in development. However, a brief discussion with some examples for each category is included in the following sections, followed by some recommendations on focus area for BMPs within the Saskatchewan portion of the South Saskatchewan River.

VIII.1 Agricultural Beneficial Management Practices

Beneficial Management Practices as they relate to agricultural activities include practices that protect wetlands, conserve important wildlife habitat, and prevent waterway contamination. These are practical, non-regulatory approaches designed to effectively minimize the environmental impacts that result from agriculture. For example, fencing off riparian areas and providing indirect watering to livestock prevents cattle from accessing wetlands and damaging the riparian buffer. This directly protects water quality within the wetland, and indirectly protects the integrity of the aquatic ecosystem which also works to improve water quality through the biological uptake of nutrients and contaminants. Some of these practices have direct and obvious advantages, such as reducing fertilizer application rates by choosing better products, changing the timing of application, or alternating with other nutrient enrichment practices such as fallow fields, or planting nitrogen-fixing plants such as legumes. Other practices have an impact that is perhaps less obvious, such as the re-establishment of native plants which provide more permanent land cover compared to shallow rooting weedy species, and therefore prevent soil erosion which can contribute to the amount of sediment in waterways.

In the State of the Watershed Report of 2010 by Saskatchewan Environment, the adoption of agricultural beneficial management practices in the South Saskatchewan River was rated at moderate to high, depending on the type of program used to grant funding for BMP implementation (figures 46 to 48). In Saskatchewan there are a number of programs that promote the application of agricultural BMPs, including (taken from Saskatchewan Watershed Authority, 2010)

1) The Saskatchewan Soil Conservation Association (SSCA). The SSCA is a non-profit, producer based organization that actively promotes soil conservation in Saskatchewan through conferences, workshops, a quarterly newsletter, producer networking opportunities, and soil conservation extension materials.

2) The Saskatchewan Agriculture Applied Research Management Program. Established in 1998 in cooperation with the Saskatchewan Soil Conservation Association, Agriculture and Agri-Food

Canada and the Saskatchewan Ministry of Agriculture, the program promotes precision farming through the development of demonstration projects.

3) The Prairie Stewardship Program. The goal of the program is to promote stewardship of riparian and native prairie ecosystems. To participate in the program, landowners voluntarily conserve these areas through a verbal stewardship agreement. The Saskatchewan Watershed Authority provides stewards with technical and administrative assistance to help them adopt agricultural BMPs. BMPs completed through this program include:

- Enhancing Wildlife Habitat and Biodiversity;
- Wintering Site Management;
- Riparian Area Management;
- Land Management for Soils at Risk and Species at Risk.

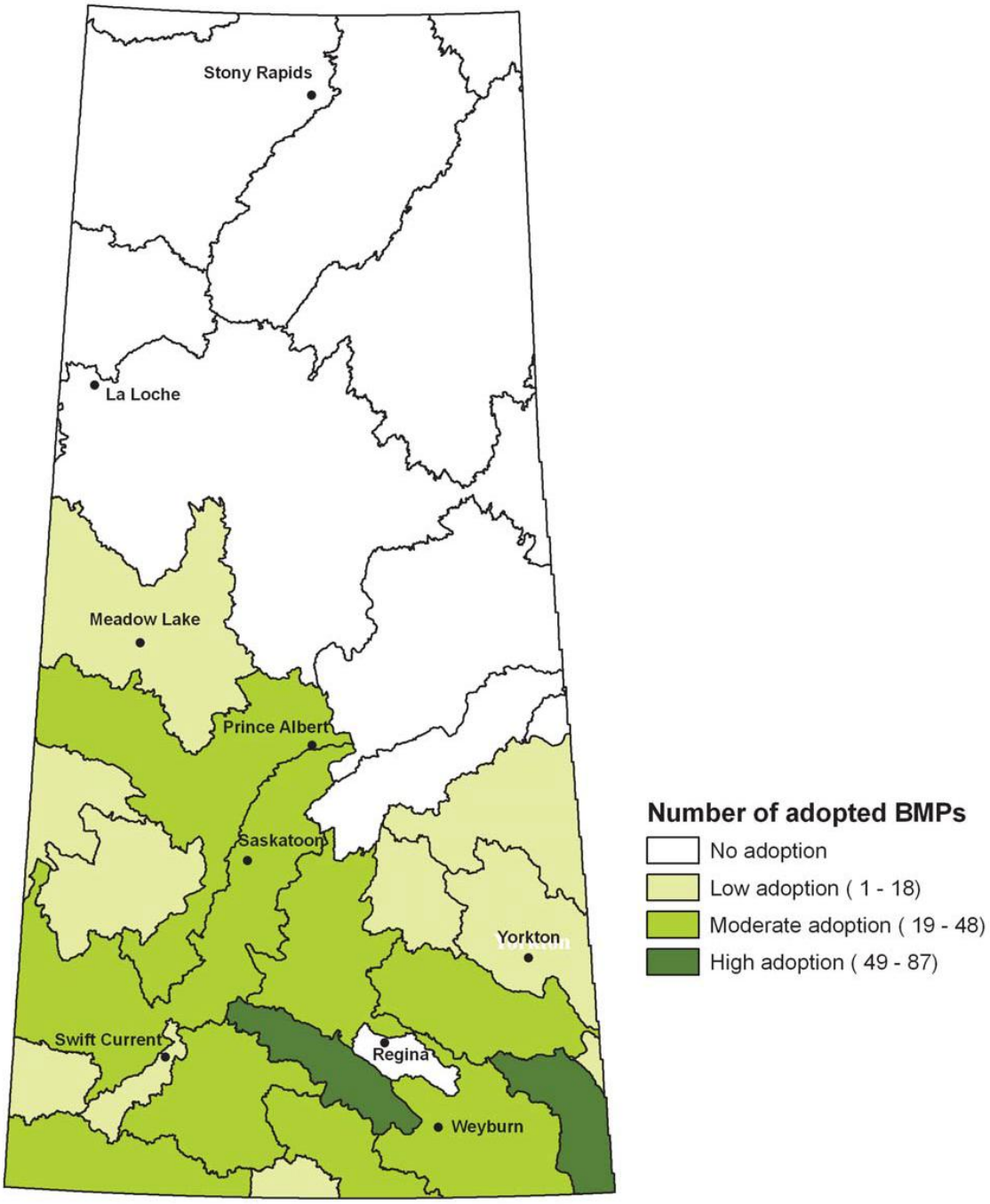

Figure 46: (Saskatchewan Watershed Authority, 2010, figure 136): Number of Go Green funded programs that promote BMPs, by watershed, between March 2006 and September 30, 2009.

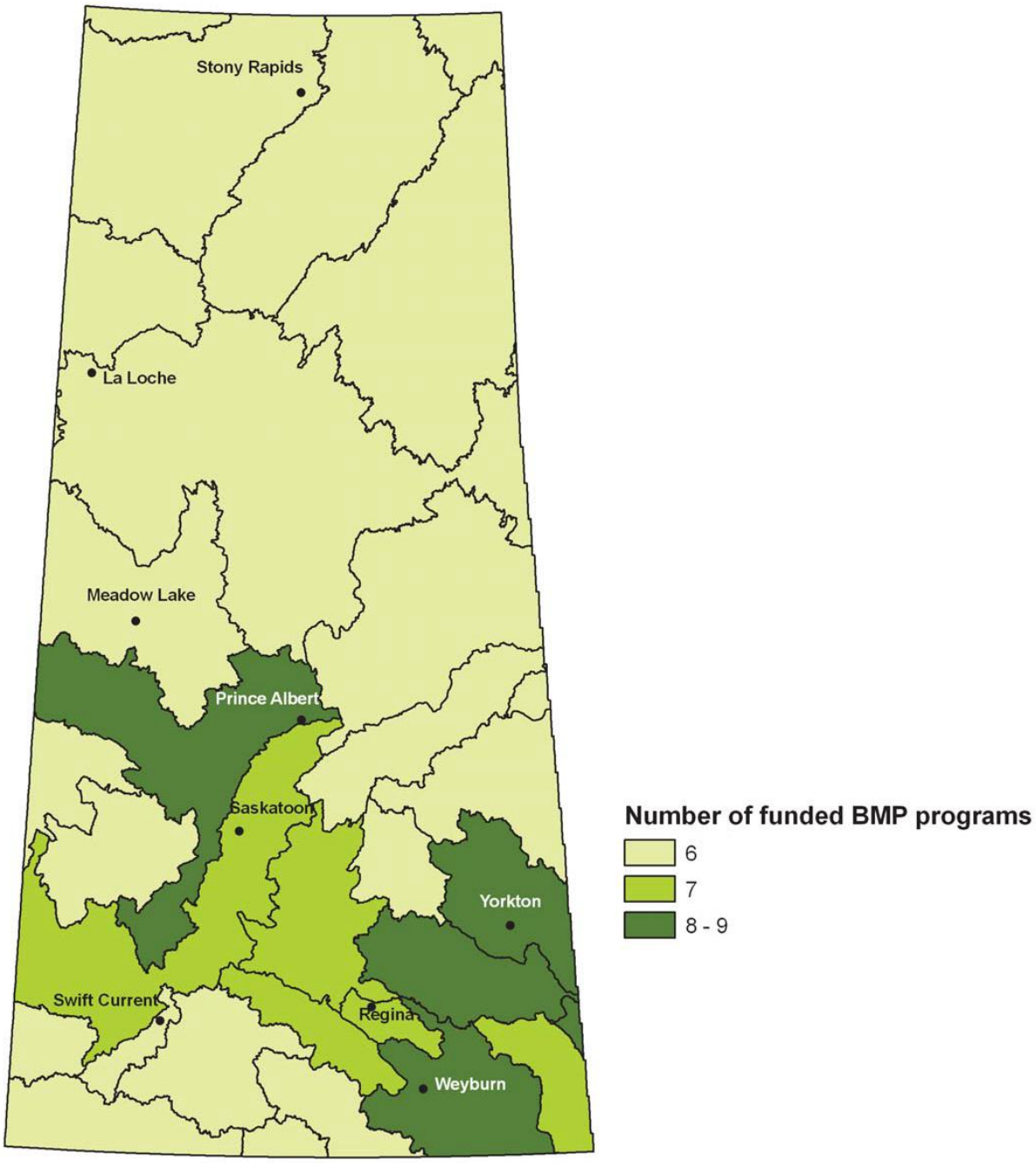

Figure 47: (Saskatchewan Watershed Authority, 2010, figure 137): number of BMPs adopted through the Prairie Stewardship Program, by watershed, between January 1, 2005 and December 31, 2008.

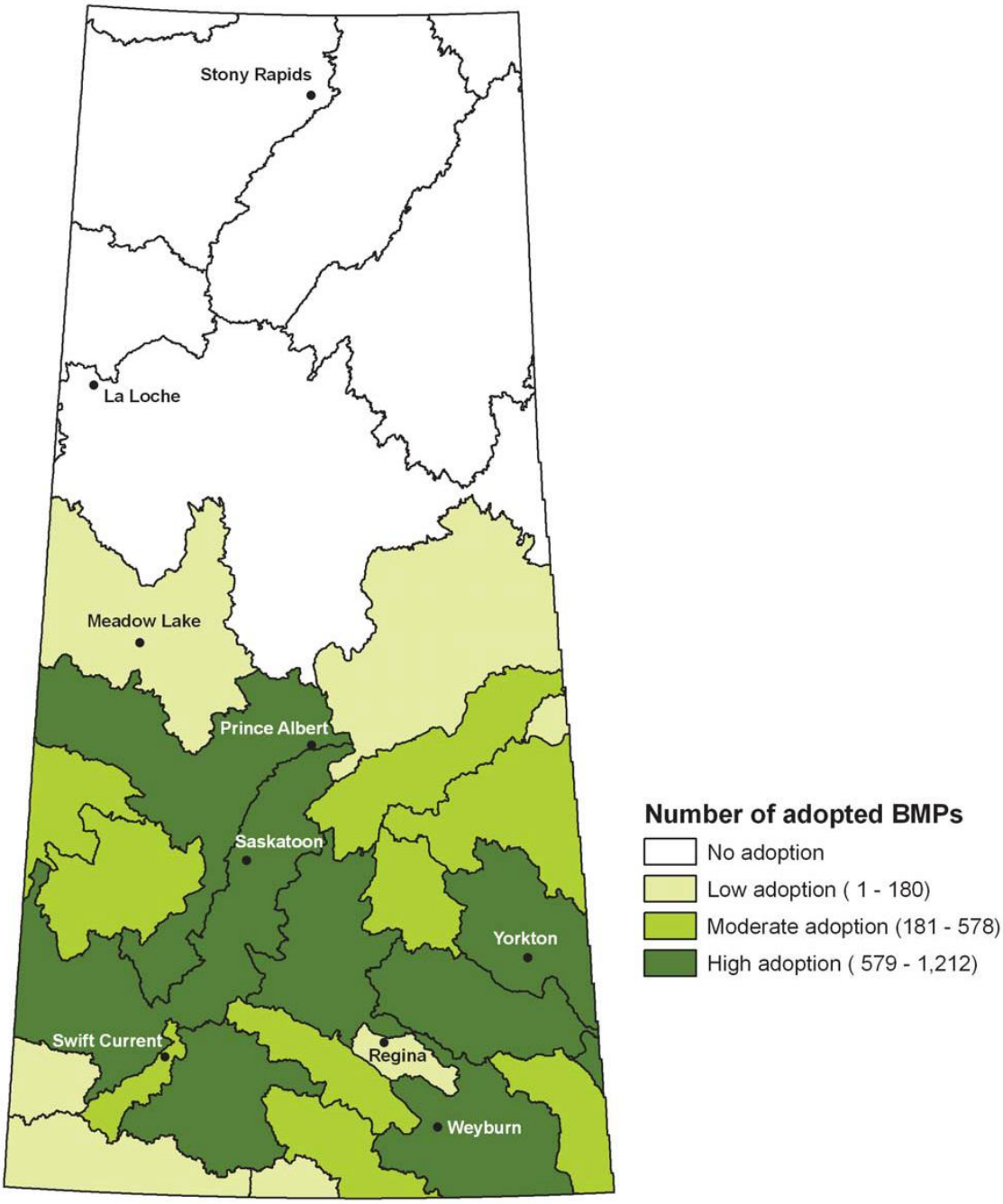

Figure 48 (Saskatchewan Watershed Authority, 2010, figure 138): number of BMPs adopted through the Canada-Saskatchewan Farm Stewardship Program, by watershed, between March 2005 and January 22, 2009.

As of April 2009, the Beneficial Management Practices that are eligible for funding under the Canada-Saskatchewan Farm Stewardship Program include:

- Integrated Pest Management Planning
- Integrated Pest Management for Insects, Vertebrates and Non-vertebrate Pests
- Integrated Pest Management for Invasive Species
- Native Plant Re-establishment
- Irrigation Management Planning
- Irrigation Equipment Modification
- Low Disturbance Placement of Seed and Fertilizer
- Chaff Collectors and Chaff Spreaders
- Precision Farming Applications – GPS
- Protecting Marginal High-Risk Soils
- Shelterbelt Establishment
- Decommissioning Abandoned Wells
- Protecting Existing Wells
- Agricultural Products Safe Storage and Handling
- Pesticide Application Systems (drift reduction technology)
- Information Collection and Monitoring
- Manure Nutrient Planning
- Manure Storage Improvements
- Manure Storage Increases
- Manure Application Equipment and Technologies
- Modifying and Re-vegetating Waterways
- Planting Vegetation to Protect Streambank and Shoreline Areas
- Improved Stream and Creek Crossings
- Relocation of Livestock Confinement Facilities
- Fencing to Protect the Environment
- Fencing to Prevent Damage by Big Game Wildlife
- Utilizing Portable Windbreaks and Shelters
- Remote Water Systems
- Farmyard Runoff Control

The agricultural Beneficial Management Practices adopted by producers through the Canada-Saskatchewan Farm Stewardship Program, by watershed, between March 2005 and January 22, 2009 (figure 48) included:

- Improved Manure Storage and Handling
- Manure Treatment
- Manure Land Application
- In-Barn Improvements
- Runoff Control
- Enhancing Wildlife Habitat and Biodiversity
- Wintering Site Management
- Product and Waste Management
- Water Well Management
- Riparian Area Management
- Erosion Control Structures (Riparian)
- Erosion Control Structures (Non-Riparian)
- Land Management for Soils at Risk
- Improved Cropping Systems
- Cover Crops
- Relocation of Livestock Confinement and Horticultural Facilities
- Improved Pest Management
- Nutrient Recovery from Waste Water
- Irrigation Management
- Shelterbelt Establishment
- Invasive Alien Plant Species Control
- Habitat Conservation/Enhancement for Species at Risk
- Preventing Wildlife Damage
- Nutrient Management Planning
- Integrated Pest Management Planning
- Grazing Management Planning
- Soil Erosion Control Planning

- Biodiversity Enhancement Planning
- Irrigation Management Planning
- Riparian Health Assessment

These two lists represent most of the agricultural BMPs that improve or protect water quality by improving the health of uplands and riparian areas, preventing soil erosion, preventing direct and indirect water contamination, improving soil moisture, retaining permanent cover, and protecting and retaining wetlands. More information on agricultural beneficial management practices is available from Saskatchewan Agriculture, Alberta Agriculture and Rural Development, and Agriculture Canada in the following reports:

Beneficial Management Practices: Environmental Manual for Crop Producers in Alberta. (2004). Produced in Partnership with Agriculture and Agri-Food Canada. Published by Alberta Agriculture, Food and Rural Development. (Available online at http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex9483)

Guide to the Canada-Saskatchewan Farm Stewardship Program (CSFSP). (2011). Provincial Council of Agricultural Development and Diversification Boards (PCAB). (Available online at http://saskpcab.com/)

VIII.2 Urban Beneficial Management Practices

Urban beneficial management practices protect waterways from point sources of water contamination such as stormwater outfall flows, sewage effluent releases, and wastewater treatment plant discharges, but also non-point sources of contamination such as the melting of plowed road snow containing road salts and sand, or pesticides and fertilizers washing from gold courses adjacent to waterways. Highway runoff, for example, may contain trace metals,

hydrocarbons, and nitrates (figure 49) while stormwater runoff may contain phosphorus, nitrogen, pesticides, fertilizers, industrial solvents, hydrocarbons, trace metals, and even fecal coliforms.

Beneficial management practices for urban areas include direct and indirect practices that reduce, prevent, or compensate for the impact of urban areas on local waterways. Direct management practices include (adapted from Water Quality Division, 1999):

- Stormwater Extended Detention Ponds
- Wet Ponds
- Storm Water Wetlands
- Multiple Pond Systems
- Infiltration Interception (Trenches, Basins)
- Porous Pavement
- Concrete Grid Pavement
- Sand Filters
- Constructed Grassland/Wetland Swales
- Sediment Traps
- Wind Erosion Controls
- Steep Slope Terraces
- Streambank Stabilization

Indirect management practices include:

- Direct Runoff Away From Natural Channels
- Proper Disposal of Accumulated Sediment
- Proper Snow Removal and Storage
- Herbicide/Pesticide/Fertilizer Management
- Protect Natural Vegetation and Riparian Vegetation
- Redirection from Landfills
- Litter Removal
- Street Cleaning

Generally speaking, the purpose of urban BMPs are to either intercept runoff before it reaches the waterway, or improve the quality of runoff so that it has less of an impact on overall water quality. In addition to these general BMPs, there are numerous BMPs related to construction that are outside of the scope of this document to enumerate, but many guidelines are available to discuss these techniques in detail.

Highway Runoff Constituents and Their Primary Sources

Constituents	Primary Sources
Particulates	Pavement wear, vehicles, atmosphere, maintenance
Nitrogen, Phosphorus	Atmosphere, roadside fertilizer application
Lead	Leaded gasoline (auto exhaust), tire wear (lead oxide filler material, lubricating oil and grease, bearing wear)
Zinc	Tire wear (filler material), motor oil (stabilizing additive), grease
Iron	Auto body rust, steel highway structures (guard rails, bridges, etc.), moving engine parts
Copper	Metal plating, bearing and brush wear, moving engine parts, brake lining wear, fungicides and insecticides
Cadmium	Tire wear (filler material), insecticide application
Chromium	Metal plating, moving engine parts, brake lining wear
Nickel	Diesel fuel and gasoline (exhaust), lubricating oil, metal plating, bushing wear, brake lining wear, asphalt paving
Manganese	Moving engine parts
Cyanide	Anti-cake compounds (ferric ferrocyanide, sodium ferrocyanide, yellow prussiate of soda) used to keep deicing salt granular
Sodium, Calcium, Chloride	Deicing salts
Sulphate	Roadway beds, fuel, deicing salts
Petroleum	Spills, leaks or blow-by of motor lubricants, antifreeze and hydraulic fluids, asphalt surface leachate

Figure 49: Highway runoff constituents and their primary sources (taken directly from Water Quality Division, 1999, table 2).

For example, additional information on urban BMPS and Beneficial Management Practices for development in riparian areas can be found in:

Stepping Back from the Water: A Beneficial Management Practices Guide for New Development Near Water Bodies in Alberta's Settled Region. (2012). Alberta Environment and Sustainable Resource Development. (Available online at http://environment.gov.ab.ca/info/library/8554.pdf).

Urban Best Management Practices for Nonpoint Source Pollution. (1999). Produced by the Point and Nonpoint Source programs Water Quality Division. Wyoming Department of Environmental Quality. (Available online at http://deq.state.wy.us/wqd/watershed/Downloads/NPS%20Program/92171.pdf).

VIII.3 BMP Focus Areas for the South Saskatchewan River Basin

According to the analysis of threats to water quality in the South Saskatchewan River Basin described in sections III.3 (Threats to Water Quality) and VII.4.i-A (Human Activity in the South Saskatchewan River Basin), there are three main areas where the application of Beneficial Management Practices would best serve to protection water quality in the South Saskatchewan River Basin:

- Nutrient Runoff from Agricultural Activity
- Contamination from Stormwater Discharge
- Wetland Retention

VIII.3.i Nutrient Runoff from Agricultural Activity

Nutrient runoff from agricultural activity poses a significant threat to water quality in the South Saskatchewan River Basin. Nutrients such as nitrogen and phosphorus often exceed the optimal thresholds established for aquatic ecosystem protection discussed in section V.2, more so than any other potential agricultural contaminant, including sedimentation from soil erosion. Beneficial

Management Practices that focus in the interception of nutrients in surface and groundwater runoff have the potential to reduce the impact of agriculture on water quality in the Saskatchewan portion of the South Saskatchewan River Basin. These practices would include:

Manure Management

- Manure Storage Increases
- Manure Storage Improvements
- Manure Nutrient Planning
- Wintering Site Management

Improving Permanent Cover and Soil Quality

- Protecting Marginal High-Risk Soils
- Native Plant Re-establishment
- Improved Cropping Systems
- Soil Erosion Control Planning

Protecting Riparian Areas

- Planting Vegetation to Protect Streambank and Shoreline Area
- Modifying and Re-vegetating Waterways
- Riparian Area Management
- Remote Water Systems
- Fencing to Protect the Environment, Including Waterways
- Riparian Health Assessment
- Relocation of Livestock Confinement and Horticultural Facilities Away From Waterways

Nutrient Runoff Prevention

- Farmyard Runoff Control
- Erosion Control Structures (Riparian)
- Cover Crops
- Nutrient Recovery from Waste Water
- Nutrient Management Planning

VIII.3.ii Contamination from Stormwater Discharge

Stormwater runoff from urban areas poses a significant risk to water quality in the South Saskatchewan River because of two factors: 1) The lack of runoff interception in most urban centers in Saskatchewan, including the City of Saskatoon, means that stormwater is discharged directly into the river system without the benefit of oxidation and biological processing that would take place in wetlands and riparian areas and reduce the impact of stormwater on biochemical oxygen demand and dissolved oxygen levels, and 2) many outdated stormwater systems include combined sewer systems that discharge household and industrial wastes directly into the river without treatment (and may contain industrial solvents, pharmaceuticals, heavy metals, pesticides, and other chemicals in addition to nutrient inputs).

Urban Beneficial Management Practices that would reduce the impact of stormwater runoff on water quality in the South Saskatchewan River include:

- Stormwater Extended Detention Ponds
- Storm Water Wetlands
- Constructed Grassland/Wetland Swales
- Multiple Pond Systems
- Wet Ponds

VIII.3.ii Wetland Retention

Perhaps one of the most concerning large-scale impact on water quality arising from human activity in the South Saskatchewan River Basin is the long history of wetland drainage in the Prairie Provinces. While wetland drainage has the potential to affect water quality in a multitude of ways, the greatest risk lies in the fact that the rate of wetland drainage in the province is largely untracked and unknown. Estimations of the total portion of wetlands that have been drained across Alberta, Saskatchewan, and Manitoba range from 65% to 90%, with the cumulative impact difficult to quantify given the indirect relationship wetlands have to overall water quality and quantity protection. However, the services that wetland provide both for water quality protection, and flood mitigation, have been well studied, and it is likely that any program or Beneficial

Management Practices that value wetlands for those services and work to protect and restore them will also have a long term beneficial impact on the Province of Saskatchewan as a whole: not only because of the important habitat that wetlands provide, but also because they are part of a larger drainage system that sustains the lifeblood of the South Saskatchewan River Basin, and thus, sustains the human activities that take place therein.

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