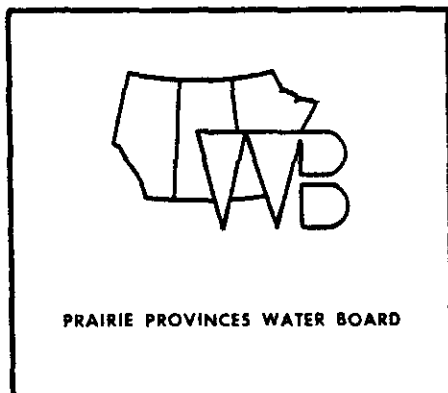


**A REVIEW OF
GROUNDWATER LEGISLATION
IN THE PRAIRIE PROVINCES**

Prepared by:

Prairie Provinces Water Board
Committee on Groundwater

February 1991
PPWB Report No. 117



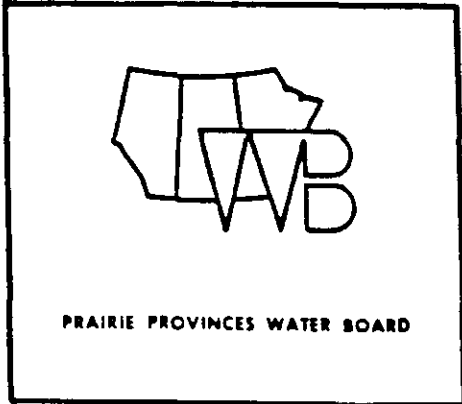
FOREWORD

The information contained in this report represents the issues and legislative base for managing groundwater in the prairies at the beginning of 1991. Because provincial groundwater legislation and policies are continuously being updated, it is important that the reader consult with the provincial government agency in his/her province to determine what changes have occurred since this report was prepared. Information can be obtained from the following:

Groundwater Section
Water Resources Branch
Manitoba Department of
Natural Resources
Dublin Building
1577 Dublin Avenue
WINNIPEG, Manitoba
R3E 3J5

Groundwater Protection Branch
Alberta Environment
5th Floor, Oxbridge Place
9820 - 106th Street
EDMONTON, Alberta
T5K 2J6

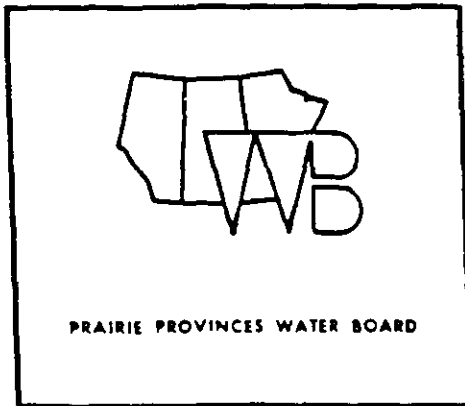
Water Management Division
Saskatchewan Water Corporation
Victoria Place
111 Fairford Street East
MOOSE JAW, Saskatchewan
S6H 7X9



ACKNOWLEDGEMENTS

The Committee on Groundwater gratefully appreciates the assistance of the people in the various provincial government departments who helped in the completion of the groundwater legislation evaluation matrices used in the preparation of this report. Their participation not only improved the information base for this report but resulted in an improved understanding of the wide range of people working in the area of groundwater.

The assistance of Mr. A.J. Chen, secretary to the committee, who helped in the report production is also acknowledged.



EXECUTIVE SUMMARY

Groundwater is a vital resource to the three prairie provinces. It is estimated that approximately 90% of the rural population in the prairie provinces rely on groundwater as their primary source of water. As much as 10% of total water use on the prairies is from groundwater.

Groundwater legislation, regulation and policies provide the framework for the protection and allocation of groundwater. Well-balanced and enabling legislation is necessary to achieve the goal of sustainable development of this valuable resource.

This report documents the results of a comprehensive review of existing provincial groundwater legislation, regulations and related policies and identifies how they deal with potential groundwater concerns at the interprovincial boundaries.

The review concluded that:

- Comprehensive legislation exists in all three provinces to address most groundwater issues.
- While the intent of most of the provincial legislation is to be proactive in dealing with groundwater in both quantity and quality matters, due to infrastructure limitations, it is normally handled in a reactive approach.

- Achieving the intent of existing groundwater legislation is constrained by the lack of comprehensive aquifer management plans (e.g., inadequate groundwater data base and monitoring networks).
- Several groundwater related issues are regulated under more than one statute.
- Most provincial statutes have accompanying regulations, standards, and/or guidelines intended to strengthen their effectiveness for dealing with specific groundwater issues.
- Allocation of groundwater in each of the three prairie provinces is not based on the same criteria nor apportioned between jurisdictions.
- There are a number of identified groundwater issues (i.e., chemigation, structure foundation boreholes and excavations, seismic boreholes, groundwater recharge area protection, and control of fluid circulation related to heat pumps) which are not presently adequately regulated by any legislation in the prairie provinces.
- The linkage of surface water, groundwater and land is not fully recognized in the existing legislation.

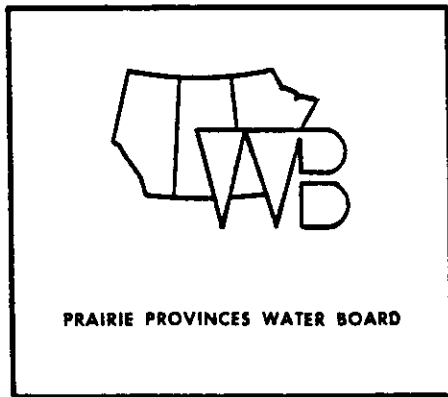


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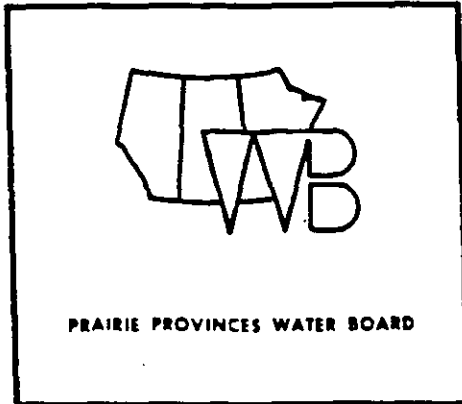
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CHAPTER 1

INTRODUCTION

Groundwater¹ is a vital resource to the economic well being of the prairie provinces. It is estimated that approximately 90% of the rural population in the prairie region rely on groundwater as their primary source of water. Groundwater also contributes significantly to surface water flow, especially during dry periods.

Because groundwater flows "out of sight", the importance of the resource and its susceptibility to pollution and overuse are frequently overlooked. Mismanagement of the resource may not be readily apparent and once polluted or depleted, it is difficult and expensive to restore the resource.

Provincial legislation and enforcement is an important element in the prevention of groundwater pollution and overuse. Because many aquifers² in the prairies cross interprovincial boundaries, the management and protection of these transboundary aquifers is directly affected by how each jurisdiction protects and regulates its aquifers.

¹ Groundwater is defined as subsurface water that occurs in fully saturated soils and geologic formations.

² Aquifer is defined as any geologic material or formation which is capable of yielding water to wells or springs.

Given the jurisdictional independence of interprovincial aquifer management, it is important that each province has a good understanding of how a neighbouring province allocates and protects its portion of transboundary aquifers. This information is important if the provinces are to work together to ensure the proper use and protection of an aquifer for all users.

In order to obtain a better understanding of interprovincial groundwater issues and management, the Prairie Provinces Water Board (PPWB) Committee on Groundwater (COG) established a three phase work program.

- Phase I: Identify potential groundwater problems at the interprovincial boundaries, including groundwater diversions and contamination.
- Phase II: Document and review existing groundwater legislation, regulations, and related policies to determine how they deal with potential groundwater problems identified in Phase I, and
- Phase III: Develop recommendations to the Board for ground rules of common procedures to ensure adequate consideration of interprovincial groundwater problems.

Phase I was completed by the COG in October 1987 with a report entitled "Potential Interprovincial Groundwater Concerns", which concluded that there were two types of groundwater management concerns that could occur at interprovincial boundaries in the future - aquifer depletion and aquifer pollution.

In order to obtain the legislative background related to groundwater, the PPWB at its October 1987 meeting requested the COG to proceed with Phase II. This included reviewing and documenting existing provincial groundwater legislation, regulations and

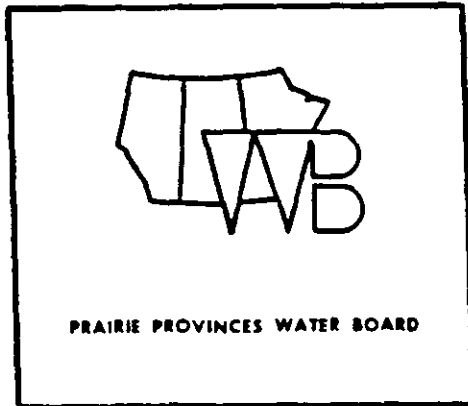
related policies, including the identification of groundwater issues in the prairie region and an assessment as to how each issue is dealt with through existing legislation.

Although the federal government has an interest in interprovincial groundwater, this review was limited to provincial legislation. Federal legislation and programs are designed primarily to support provincial management of the groundwater resource rather than taking a direct regulatory role. For example, an objective of the Prairie Farm Rehabilitation Act is to develop and promote water supply systems, among other initiatives, which provide greater economic security against drought in the prairie provinces. The Prairie Farm Rehabilitation Administration (PFRA), in close collaboration with provincial institutions, has worked toward this objective by supporting construction of dugouts, farm wells, water supply pipelines and irrigation projects in all three prairie provinces. The Canada Water Act supports the management of the water resources of Canada including research and the planning and implementation of programs relating to the conservation, development and utilization of water resources. Similar to the PFRA, programs initiated through the Canada Water Act have been undertaken in co-operation with provincial governments and any regulations or initiatives from these programs have typically been implemented through provincial statutes.

The report is divided into five chapters including this Introduction. Chapter 2 provides an overview of groundwater management concepts. Chapter 3 identifies groundwater management issues in the region; Chapter 4 provides an overview of provincial groundwater legislation. Conclusions to the report are contained in Chapter 5.

Matrices identifying existing groundwater legislation pertaining to groundwater allocation and protection for Alberta, Saskatchewan and Manitoba are provided in Appendices A, B and C respectively. The matrices contain information such as name of the act, related regulations and guidelines, agency responsible for implementation, and whether the legislation provides a proactive or reactive approach to protect and manage

groundwater. An outline of what a comprehensive groundwater data base could contain is provided in Appendix D.



CHAPTER 2

GROUNDWATER MANAGEMENT CONCEPTS

2.1 Introduction

The management of groundwater is generally divided into two functions; allocation and protection. Beginning with the transfer of natural resource jurisdiction from the federal government to the provinces in 1930, groundwater legislation has become primarily a provincial matter, with allocation and protection of groundwater administered by each province through its own legislative structure. Individual provincial legislation is dynamic in nature and continues to undergo changes in order to meet various emerging resource management needs. However, the common goal in each province is to achieve to the fullest extent possible, the sustainable use of groundwater and the protection of groundwater quality.

The need to improve our understanding of the hydrologic environment is becoming ever more important due to the increasing pressures placed on water resources by population growth and economic development. The groundwater component forms an integral part of the hydrological environment and is significant to virtually all aspects of basin management. Resource managers, working within a framework in which growth and development issues are often in conflict with those of environmental protection, must better recognize and understand the close and interactive relationship between land, groundwater and surface water. Groundwater is not a static component, but is very dynamic and subject to subsurface flow and eventual discharge. It is aquifer discharge which gives rise to the base flow component of many prairie streams, without which some would only flow intermittently, mainly at times following periods of rain or snowmelt.

Conversely, some part of the surface streamflow may replenish aquifers. Because of hydraulic continuity, polluted aquifers frequently have the potential to affect the quality of streamflow and vice versa. From a quantitative perspective, development of groundwater resources could result in reduced out-flow within groundwater discharge areas. Such change could lead to the degradation of wetlands and alteration of surface runoff characteristics, as well as the alteration of flow paths to the extent that water quality characteristics are changed (e.g., induced intrusion of salty water into a freshwater environment). Alternatively, surface water developments such as reservoirs have the potential to surcharge aquifer systems, contributing to higher water tables and the development of saline conditions beyond the immediate vicinity of these reservoirs or associated water conveyance structures, and conversely drainage may lower water tables.

In view of these relationships, the appraisal and management of transboundary groundwater resources in the prairie provinces is a formidable task given the considerable variations resulting from the individual provincial approaches. On a prairie-wide scale, the need to improve the completeness and compatibility of provincial data bases has become evident. In the context of long-term resource planning, accurate, up-to-date and consistent groundwater data must be available to facilitate decision-making for a variety of purposes including the targeting of program funding, developing water use policy and planning mutually acceptable resource development on a regional basis. Consensus is emerging among COG members and other groundwater resource managers, that existing groundwater legislation needs to be translated into more comprehensive aquifer management plans. Ideally, these plans should be consistent from one province to another and should deal with items such as a unified aquifer monitoring system and aquifer data base. Unfortunately, at the present time, all three provinces deal with adjoining components of common aquifer systems independently and manage their groundwater resources by means of provincially individual, and therefore regionally inconsistent data bases.

The need for a common prairie provinces groundwater data base was first formally identified in the 1970 Saskatchewan-Nelson Basin Board Report (Environmental Considerations - Section F - Groundwater), which provides a comprehensive description of the provincial data base situation. An example of a comprehensive data base is described in Appendix D.

2.2 Groundwater Protection

Water may be considered to be polluted whenever substances are introduced in amounts that render the water unsuitable or undesirable for specific uses. Depending on the specific use, groundwater may be locally unusable even under natural conditions (e.g., through mineralization).

The quality of water is often affected by associated land use practices. Potential sources of groundwater pollution related to urban, agricultural and industrial development are seepage from underground storage tanks, surface waste impoundments, and agricultural activities involving various substances such as fuels, fertilizers and pesticides, and wood preservatives. For example, residual seepage from chemigation may cause contamination of the water resource by movement along one or a combination of three possible pathways: 1) surface runoff to streams and lakes; 2) lateral movement of chemicals through soil to bodies of surface water; and 3) vertical percolation of chemicals to the underlying groundwater.

Concerns regarding the movement of pollutants within saturated media are mainly focused upon two factors: 1) rate of flow; and 2) category of groundwater flow system (i.e., local, intermediate, regional). With the exception of a few well-defined aquifers at the interprovincial boundaries (e.g., buried channel and carbonate aquifers), shallow aquifers are usually of limited areal extent, putting them in the local flow-system category. This localized connotation may incorrectly suggest that the immediate possibility of pollutants moving directly across an interprovincial boundary within shallow, relatively small aquifers

is rather remote; however, shallow transboundary aquifers are potentially at risk by virtue of their exposed position at or near the surface of the earth. Another potential pathway for interprovincial movement of polluted groundwater exists in the form of the deeper, areally extensive, regional groundwater flow systems which may transcend surface water basins.

The following categories of activities have the potential to contaminate groundwater sources and are those which are most prevalent within the provincial jurisdictions:

- underground storage tanks;
- landfills;
- surface impoundments;
- septic systems;
- land application of wastes or agricultural chemicals;
- resource exploration;
- water wells; and
- deep well injection

2.3 Groundwater Allocation

Groundwater is a renewable resource that under natural conditions is replenished. However, if the rate of withdrawal exceeds the rate of natural recharge, the volume of water stored in the aquifer will be reduced, and, if allowed to continue indefinitely, would eventually result in total depletion of the aquifer.

Several concepts are used as a basis for allocating groundwater. Generally these concepts can be divided into two major categories; sustainable yield and mining yield.

The concept of sustainable yield is generally categorized into two types - maximum and permissive. Maximum sustainable yield is the theoretical maximum rate at which water can be withdrawn, on a perennial basis, from a particular aquifer. It is determined by, and limited to, average natural recharge and is usually expressed as volume per unit time that can be maintained indefinitely. Permissive sustainable yield is the maximum rate at which water can "economically and legally" be withdrawn perennially from a particular source for beneficial purposes without bringing about some undesired results. Permissive sustainable yield is always less than natural recharge owing to physical or man-made limitations.

Mining yield is the volume of water extracted above the sustainable yield. It is a useable resource of fixed supply, somewhat similar to a mineral or petroleum deposit. It may be mined slowly or rapidly depending on the demand, but the total volume of resource is definitely limited.

A partial mining concept, Q20 (theoretical 20-year well yield) has often been used for licensing groundwater in Alberta, particularly for municipal purposes. This concept deals only with the rate of discharge from a particular source, and does not take into account the availability of natural recharge. The cumulative discharge of Q20 licences issued for withdrawing water from the same aquifer may eventually result in problems such as significant drawdowns and/or decrease in the rate of natural discharge.

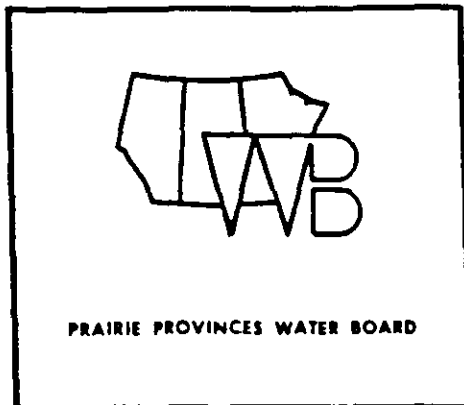
The question as to whether groundwater should be managed on a sustainable yield or mining yield basis has frequently been raised. From the viewpoint of social well-being, water has value only by virtue of demand. A socially oriented groundwater development policy would generally consider the costs and benefits associated with a particular use rate which may actually exceed the maximum sustainable yield. Alternatively, a policy which over-emphasizes the importance of natural replenishment would tend to reduce the useable value of the groundwater resource.

Resource sustainability is an important concept which has been accepted by managers of various environmental resource sectors worldwide. Groundwater in the prairies should therefore be considered as a vital and limited resource which in most cases is managed in a sustainable way to ensure that the quality and quantity of this resource is maintained for present and future generations.

2.4 Integrated Resource Management - An Emerging Concept

The quality and quantity of groundwater is influenced by both land and surface water usage and there is an emerging need to consider all three resources (groundwater, surface water and land) as interrelated factors. Integrated resource management (IRM) is a concept which attempts to optimize overall resource management by taking into account all such interrelated resources impacts within a physically functional "unit". As an example, sewage effluent irrigation may adversely affect an aquifer, which in turn can affect the drought-proofing strategy of using the same aquifer as a source of potable water. A decision in this situation may involve reconsidering the irrigation practice, altering the land use, or reviewing the drought-proofing plan to include surface water use.

For the IRM concept to be successful the cooperative efforts of both private and public sectors are required. The IRM concept has been applied and implemented by several resource management agencies, including the Tennessee Valley Authority in the USA, and the Conservation Authorities in Ontario. In all such situations the common objective has been to develop acceptable operational and management rules, strategies and policies in order to achieve the optimal utilization of each interrelated resource.



CHAPTER 3

GROUNDWATER

MANAGEMENT ISSUES

3.1 Interprovincial Concerns

In 1984, the Committee on Groundwater was directed by the PPWB to prepare a list of potential interprovincial groundwater concerns. The committee's report entitled "Report on the Existing and Future Groundwater Concerns in the Prairie Provinces," submitted to the Board in 1985, identified two broad areas of possible concern. These two areas of concern are summarized below.

1. Recognized Interprovincial Concerns

- (a) The need for development of an interprovincial groundwater monitoring network that could establish baseline water quality and water levels related to provincial boundaries.
- (b) Site specific investigations of industrial developments, coal mines, tar sand (heavy oil) developments, etc., particularly along an interprovincial boundary.

2. Other Groundwater Concerns

- (a) Concerns related to the development and use of groundwater
 - (i) Use of groundwater for large scale irrigation systems
 - (ii) Use of groundwater for thermal energy systems
 - (iii) Maintenance of water well structures

- (iv) Evaluation of aquifer recharge potential and in-situ water treatment methods for replenishment of aquifers and improvement of groundwater quality.

(b) Concerns Related to Protecting Groundwater

- (i) Groundwater contamination at or near decommissioned industrial plant sites
- (ii) Groundwater contamination at hazardous waste treatment facility sites
- (iii) Monitoring of deep well wastewater injection
- (iv) On-farm use of agricultural chemicals
- (v) Storage and handling of toxic materials
- (vi) The effect of agricultural land drainage on groundwater

The COG subsequently undertook a review of groundwater withdrawal projects in each of the three provinces within 20 km of the provincial boundaries. In its 1987 report "Potential Interprovincial Groundwater Concerns," the committee indicated while no major problems were identified with these projects, there was considerable variability in the amount of project information available as well as monitoring and enforcement of water rights legislation. The report also stated that two types of groundwater management issues will probably occur at interprovincial boundaries in the future - intensive development of interprovincial aquifers and aquifer pollution.

3.2 Legislative Framework

Having established the two broad areas of concern, quantity and quality, it was necessary to identify all relevant groundwater legislation in the three provinces. Qualitative issues are dealt with primarily through legislation related to groundwater protection, while quantitative issues are dealt with through legislation related to groundwater allocation.

There are over forty pieces of legislation in the prairie provinces dealing either directly or indirectly with protection and allocation of groundwater. Some legislation, such as the Alberta Clean Water Act, deals with more than twenty different groundwater issues; while some groundwater issues, such as foreign material deposited as a point source in a liquid storage structure (lagoon), are controlled by five different pieces of legislation in Saskatchewan. During initial discussions on the assessment of groundwater legislation in the prairie provinces, the COG realized that because of the differing approaches to groundwater protection and allocation in the provinces, legislation would best be compared by identifying specific activities which could affect either quantity and quality in transboundary aquifers. The particular groundwater legislation controlling each of these activities in the provinces can then be identified and evaluated.

Groundwater legislation matrices were constructed (Appendices A, B and C) to identify the existing legislation in each province that applies to specific activities and sub-activities that can affect groundwater quality (aquifer protection) and groundwater quantity (aquifer allocation). These matrices also identify the administrative approach to the legislation and the salient points considered by the legislation. The completed matrices were then evaluated by each provincial COG member. The results of that evaluation are summarized in Chapter 4.

3.3 Legislation Application

Generally the primary objective of legislation is to provide a legal framework to manage a particular resource for specific purposes. Two widely recognized approaches for achieving the intent of legislation can be used:

1. A proactive approach is used to prevent problems from happening. For example, the preparation of groundwater pollution hazard maps (constraint maps) which indicate the most suitable areas for landfills.

2. A reactive approach is used to monitor, investigate, and/or undertake corrective action/compensation measures as required. An example of a reactive approach is to protect and/or remediate aquifers once contaminated.

From a practical perspective, the proactive approach is more effective because it can frequently prevent problems from happening or at least minimize problems to a level which is usually easier and less costly to correct. This is particularly true with the prevention of groundwater contamination where clean-up of pollutants in aquifers is extremely difficult and expensive.

The significance of these two approaches in dealing with groundwater management issues related to groundwater protection and allocation is demonstrated in tables 3-1 and 3-2.

TABLE 3-1

A SUMMARY OF ACTIVITIES AND ISSUES
RELATED TO GROUNDWATER PROTECTION

ACTIVITY	ISSUE	PROACTIVE	REACTIVE
1. Foreign Material Deposited as a Non-Point Source at or Near the Land Surface	Non-Point source contaminants must be managed in a manner compatible with local hydrogeological conditions.	Define aquifer sensitivity to non-point source contaminants and control land use accordingly.	Investigate groundwater degradation related to non-point source contaminants and remedy as required.
2. Foreign Material Deposited as a Point Source at or Near the Land Surface	Point source contaminants must be managed in a manner compatible with hydrogeological conditions.	Site selection, design and construction of containment structures must be adequately addressed to prevent groundwater degradation.	Investigate groundwater degradation related to point source contaminants and remedy as required.
3. Foreign Material Introduced Below the Land Surface Through Drilling Activities	Drilling activities must recognize the location and characteristics of aquifers and employ methods that will prevent groundwater degradation.	The practices and procedures of both government and industries (developers) must identify aquifers and apply appropriate measures for their protection.	Investigate groundwater degradation related to drilling activities and remedy as required.
4. Foreign Material Introduced Below the Land Surface Through Mineral Extraction Activities.	Mining activities must recognize the location and characteristics of aquifers and employ methods that will prevent groundwater degradation.	The practices and procedures of both government and industries (developers) must identify aquifers and apply appropriate measures for their protection.	Investigate groundwater degradation related to mineral extraction activities and remedy as required.
5. Foreign Material Introduced Below the Land Surface Through General Construction and/or Operation Activities	General construction and/or operation activities must recognize the location and characteristics of aquifers and employ methods that will prevent groundwater degradation.	The practices and procedures of both government and industries (developers) must identify aquifers and apply appropriate measures for their protection.	Investigate groundwater degradation related to general construction and/or operation activities and remedy as required.
6. Management of Hazardous Wastes	Handling, storage and disposal of hazardous wastes must recognize the location and characteristics of aquifers and ensure that groundwater is not degraded.	Storage and disposal of hazardous wastes must not take place in hydrogeologically sensitive areas.	Investigate groundwater degradation related to the handling, storage and disposal of hazardous wastes and remedy as required.

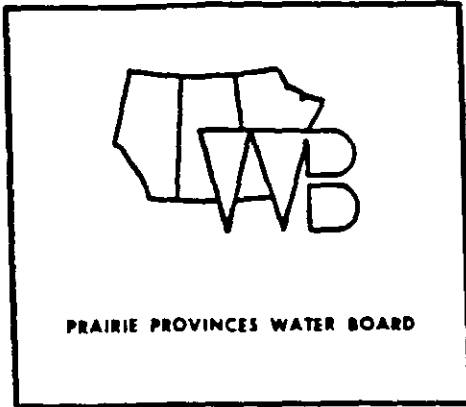
Activity #2 is considered to be the most important interprovincial concern. Point source pollutants are most commonly associated with seepage from lagoons, holding ponds, landfills and underground storage tanks.

TABLE 3-2

A SUMMARY OF ACTIVITIES AND ISSUES
RELATED TO GROUNDWATER ALLOCATION

ACTIVITY	ISSUE	PROACTIVE	REACTIVE
1. Aquifer Definition.	Aquifer definition is a prerequisite to all groundwater protection, planning, development and allocation decisions.	Determine aquifer characteristics, prepare aquifer maps and maintain aquifer data base.	Determine aquifer characteristics as required and react on a site specific basis.
2. Groundwater Allocation Plan.	Authorized groundwater withdrawals must be consistent with sustainable development.	Determine aquifer capacity and maintain active aquifer models for all allocation decisions.	Allocate water on an interactive basis using existing information.
3. Groundwater Allocation Procedures.	Groundwater withdrawals should be authorized using management practices based on scientific principle, recognizing the priority of use.	Authorized groundwater withdrawals must be consistent with aquifer allocation plan.	Authorized groundwater withdrawals are based on factors other than scientific and conflicts are resolved on a case-by-case basis.
4. Groundwater Allocation Monitoring.	Baseline monitoring, regional monitoring and site specific monitoring of approved withdrawals are necessary to achieve sustainability.	Compliance monitoring of approved withdrawals is reviewed regularly in relation to baseline and regional aquifer monitoring.	Baseline and regional monitoring networks are established concurrent with or subsequent to approved withdrawals.
5. Groundwater Allocation Enforcement.	On site verification is required to ensure all groundwater withdrawals are consistent with the approval.	Routine compliance procedures must be established and maintained to respond to immediate problems that occur.	Investigate compliance and react on a site specific basis as required.
6. Groundwater Allocation Documentation.	Complete documentation must be supplied by the proponents, and reviewed and maintained by government in a readily accessible format.	Ensure that the documentation supplied by the proponents is prepared by qualified professionals and maintained in a readily accessible format by the government.	Report accepted as submitted and only reviewed when problems occur.

Activity #1 is fundamental to all allocation and protection issues.



CHAPTER 4

GROUNDWATER LEGISLATION

4.1 Introduction

During initial discussions of this subject the COG realized that, because of the differing approaches to groundwater protection and allocation in the prairie provinces, legislation could best be compared on an activity basis. The committee decided that a detailed discussion of the adequacy of each piece of legislation was not appropriate. However, it is important to realize that proper handling of groundwater management issues within each province would minimize issues at interprovincial boundaries.

4.2 Groundwater Legislation in Alberta

Groundwater issues in Alberta are dealt with by 17 different pieces of legislation. Most legislation was initially proclaimed in the 1970s and 1980s except for the Public Health Act, Water Resources Act, Agricultural Chemicals Act and Oil and Gas Conservation Act which were proclaimed prior to 1970. Table 4-1 provides a listing of Act, Agency responsible and the year in which the Act became law.

The protection of groundwater in Alberta is predominantly the responsibility of Alberta Environment; however, some groundwater protection is also handled by Alberta Labour, Alberta Health and the Energy Resources Conservation Board (ERCB). In most cases a satisfactory relationship exists between Alberta Environment and these other agencies.

TABLE 4-1
 A SUMMARY OF ACTS IN ALBERTA
 DEALING WITH GROUNDWATER
 PROTECTION AND ALLOCATION

ACT ¹	YEAR OF ENACTMENT ²	AGENCY
Public Health	1919	Alberta Health
Water Resources	1931	Alberta Environment
Agricultural Chemicals	1969	Alberta Environment
Oil & Gas Conservation	1969	Energy Resources Conservation Board
Clean Air	1971	Alberta Environment
Clean Water	1971	Alberta Environment
Department of the Environment	1971	Alberta Environment
The Surface Rights	1972	Alberta Forestry Lands and Wildlife
Coal Conservation	1973	Energy Resources Conservation Board
Land Surface Conservation & Reclamation	1973	Alberta Environment
Plumbing & Drainage	1976	Alberta Labour
Hazardous Chemicals	1978	Alberta Environment
Ground Water Development (prior to 1980 it was Groundwater Control)	1980	Alberta Environment
Transportation of Dangerous Goods	1982	Alberta Public Safety Services
Oil Sands Conservation	1983	Energy Resources Conservation Board
Water Resources Commission	1983	Alberta Environment
The Fire Prevention	1984	Alberta Labour

¹ Only those Acts that appear in the Groundwater Legislation Matrix.

² This is the year the act was first proclaimed. Note the act has, in most instances, several amendments since its initial proclamation.

Alberta Environment is a referral agency for Alberta Health on all matters related to local (not regional) landfill siting. However, in some cases Alberta Health does not follow the recommendations given by Alberta Environment. While no problems have yet occurred when the recommendations were not followed, there exists the potential for problems in the future. A problem does exist with some municipal landfills and some local landfills with regard to groundwater monitoring. Most local Boards of Health do not require monitoring and many of the monitoring reports Alberta Environment has reviewed were inadequate. This problem is being discussed with Edmonton, Calgary and other cities as time permits.

All contentious deep disposal wells and those less than 2,000 feet deep are referred to Alberta Environment by the ERCB. To date, all requests and recommendations from Alberta Environment have been followed by the ERCB; however, some of the requests or recommendations require considerable discussion with the ERCB to convince them of the needs of Alberta Environment.

Until recently the cleanup of contaminated soil around leaking underground storage tanks has been ordered by a local fire department under Alberta Labour. Due to a recent court case in Edmonton, Alberta Labour is now only directing such cleanups as are necessary to eliminate fire hazards. Additional cleanups necessary to protect the environment will be the responsibility of Alberta Environment. Alberta Environment's legislation, related to cleanup of contaminated soils, is not clearly defined in any of Alberta Environment's Acts and will probably be subject to conflicting interpretations if it comes before the courts. The legislation and procedures were reviewed by the Management of Underground Storage Tanks (M.U.S.T.) project and recommendations were made in 1990 for either strengthening the old legislation or developing new legislation. Implementation of these recommendations and the results of court cases under the Help End Landfill Pollution (H.E.L.P.) project should clarify and strengthen the legislation regarding environmental cleanup.

The approval of new subdivisions rests with local planning authorities. Most requests to subdivide agricultural land are referred to Alberta Environment for an opinion on the availability of groundwater to supply the residences and the suitability of the soils for sewage disposal. Alberta Environment cannot enforce its recommendations on the local authority and in some cases the refusal of the local authority to enforce the recommendations of Alberta Environment has resulted in the pollution of groundwater by nitrates and the depletion of groundwater in overdeveloped areas. These problems occurred a number of years ago and the present situation is predominantly in keeping with Environment's recommendations. However, problems may develop in the future if sub-divisions again become popular with Alberta home owners.

On January 9, 1990 Alberta Environment Minister, Hon. Ralph P. Klein, released a public consultation document designed to lead to comprehensive new environmental legislation for Alberta. The draft Alberta Environmental Protection and Enforcement legislation, consolidating nine existing statutes (with the exception of the Water Resources Act), was released to the public on June 21, 1990. The revised act will give the ultimate responsibility for the allocation and protection of groundwater to Alberta Environment through new and enhanced provisions including:

- establishment of a legislated Environmental Impact Assessment process including intervenor funding, early public involvement and referrals to the Natural Resources Conservation Board and the Energy Resources Conservation Board;
- the publication of an annual state of the environment report;
- statements of principle including an assurance that "the environment is essential to the well being of society" which mandates courts and decision makers to consider this when making all decisions;
- mandatory cleanup of spills by the person responsible, including managers, principals, owners, agents, receivers and trustees;
- dramatically increased penalty provision - fines of up to \$1,000,000 and six months jail terms for the most serious offenses;
- liability of corporate officers and directors for environmental offenses;

- assurances that corporations do not profit from environmental violations by imposing additional fines off-setting any monetary benefits accrued from an offense;
- twenty-five year owner/operator liability for site cleanup and reclamation costs; and
- process to allow for appeal of decisions regarding approvals.

4.3 Groundwater Legislation in Saskatchewan

In Saskatchewan, seven different government agencies are involved in administering the ten pieces of legislation (Acts) which relate to groundwater protection and allocation. One of these agencies, the Saskatchewan Research Council (SRC), does not play a direct administrative role, but its work is fundamental to management decisions made by other government agencies. The remaining six agencies along with the pertinent Acts which apply to those agencies are listed in Table 4-2. These Acts attempt to provide adequate legislation for the protection and allocation of groundwater resources. Within these Acts, the various agencies use regulations and guidelines to regulate specific activities.

TABLE 4-2

A SUMMARY OF ACTS IN SASKATCHEWAN

DEALING WITH GROUNDWATER

PROTECTION AND ALLOCATION

ACT	YEAR OF ENACTMENT	AGENCY
The Oil and Gas Conservation Act	1965	Energy and Mines
The Groundwater Conservation Act	1966	Saskatchewan Water Corporation
The Pest Control Products Act	1973	Saskatchewan Agriculture and Food
The Public Health Act	1978	Saskatchewan Health
The Environmental Assessment Act	1980	Saskatchewan Environment and Public Safety
The Environmental Management and Protection Act	1983	Saskatchewan Environment and Public Safety (SEPS)
The Pollution (by Livestock) Act	1984	Saskatchewan Agriculture and Food
The Water Corporation Act	1984	Saskatchewan Water Corporation
The Dangerous Goods Transportation Act	1985	Saskatchewan Highways and Transportation
The Mineral Resources Act	1985	Saskatchewan Energy and Mines (SEM)

Saskatchewan Environment and Public Safety (SEPS) is the primary agency responsible for groundwater protection from contamination and cleanup of contaminated aquifers. Through the Environmental Assessment Act, SEPS the Environmental Impact Statement (EIS) process. SEPS will commonly seek comments from other agencies such as Sask Water in evaluating an EIS. The EIS process is very valuable in ensuring that new projects are environmentally acceptable. The Environmental Management and Protection Act gives SEPS the authority to investigate project sites for violations and to place monitoring and/or remediation requirements on projects.

Because of the magnitude of agricultural activities in Saskatchewan, the Pest Control Products Act and Pollution by Livestock Act, which are administered by Saskatchewan Agriculture and Food are very important. These acts govern the storage, handling and

application of pesticides and herbicides, and regulate intensive livestock activities. The significance of agricultural activities has been brought home in recent years with the realization that intensive livestock and fertilization activities have, in some cases, elevated nitrate values to the point where health guidelines are exceeded.

The Oil and Gas Conservation Act gives Saskatchewan Energy and Mines (SEM) the authority to regulate oil and gas drilling activities. This involves regulating casing and abandonment procedures to ensure the protection of potable groundwater resources. The Act also governs the disposal of drilling fluids and saline waters through injection wells, and gives SEM the responsibility for cleanup of oil pipeline spills. SEM also administers the Mineral Resources Act. The primary concern of the Act in relation to groundwater is the regulation of geophysical boreholes.

The transport of all hazardous materials is governed by the Dangerous Goods Transportation Act which is administered by Saskatchewan Highways and Transportation. The Act not only regulates the transport of hazardous goods but also ensures a rapid response to spills.

Through the Public Health Act, Saskatchewan Health administers domestic sewage systems such as septic tanks and private lagoons. In addition they administer municipal sewage lagoons which receive less than 18,200 litres (4000 gallons) of waste per day.

Sask Water is involved in protecting groundwater from contamination through the Water Corporation Act. This act gives Sask Water a role in groundwater protection through issuing approvals to construct and operate works such as canals, ditches, pipelines, drainage works and lagoons. In addition it allows Sask Water to regulate effluent irrigation by way of water rights. Sask Water is also on the Environment Impact Statement review panel. This allows Sask Water to comment on new projects which may have possible detrimental effects on groundwater.

Groundwater allocation is fundamental to aquifer protection. In Saskatchewan, the majority of responsibility lies with Sask Water, with the appropriate legislation contained under the two Acts which Sask Water administers. Presently the Groundwater Regulations are being re-written. Thought should be given to incorporating The Groundwater Conservation Act into The Water Corporation Act.

In order to make more informed groundwater management decisions, the maintenance of a reliable data base is essential. To this end, the SRC and Sask Water cooperate on maintaining and expanding the driller's log data base and electric log data base. The drillers log data base contains over 98,000 entries and the electric log data base contains some 14,000 entries. The requirements for building these data bases are contained within legislation. A groundwater quality data base is also shared. However, there is no regulation governing the collection of groundwater chemistry data, thus making data collection quite inadequate. Another gap in the data base is the lack of good long term monitoring of water levels in a variety of aquifers. Currently the SRC maintains a network of observation wells, but the network needs to be expanded. Agreement should be reached between the SRC and Sask Water concerning, funding, staffing, and expansion of the monitoring system..

The recent years of drought have demonstrated the importance of informed decision making for the management of aquifers that are under high demand. In order to provide this higher level of management, Sask Water is in the process of developing aquifer management plans for major aquifers in the province. The allocation plan for the Regina aquifers was completed in 1989. In addition to Sask Water, SEPS, SRC and the City of Regina also play important roles in the development of the Regina Aquifer Management Plan. Work on the Yorkton Aquifer Management Plan is currently in process, with a proposal for the creation of a South East Aquifer Management Plan under review. The management plans involve the development of a comprehensive data base, detailed hydrogeologic studies, groundwater monitoring and a report on recommended allocations. For the Regina plan, SEPS commissioned a report on sensitivity mapping

and is currently putting together a detailed groundwater monitoring program. The aquifer allocation report for the Regina study also included a legislative review which showed the legislative mechanisms available for implementing the management plan. The aquifer management plans will greatly increase the Corporation's ability to deal with present and future groundwater issues. However, it must be realized that although the aquifer management plans can be viewed as proactive, the realization of their need was, in fact, reactive. For example, the Regina plan was initiated when it was realized that it was possible that the Regina aquifer was overallocated.

4.4 Groundwater Legislation in Manitoba

There are many elements that contribute collectively to the management of groundwater in Manitoba. Some are easily documented, others are not. All are subject to change with time.

An effort has been made to document the current (February 1991) legislation in Manitoba that deals with aquifer protection and aquifer allocation (see Appendix C). A summary of the current statutes and agencies contributing to the management of groundwater in Manitoba is provided in Table 4-3.

In the early years Manitoba's regulatory framework for water management was addressed by individual rural municipalities and provincial public health authorities and dealt mainly with protecting the potability of drinking water supplies.

The transfer of resources from the Government of Canada to Manitoba in 1930 initiated Manitoba's water allocation legislation in the form of the Water Rights Act which until 1959 dealt only with the allocation of surface water sources.

The Water Resources Administration Act of 1959 created a comprehensive water management organization primarily dedicated to quantitative water management in the

areas of land drainage, flood protection and water supply. The need for regulating water well construction in Manitoba and preserving valuable information generated from water well drilling activities was acknowledged in 1963 with the introduction of the Groundwater and Water Well Act.

The Clean Environment Act of 1968, now the Environment Act (1988) introduced quality control measures for limiting damage or degradation to Manitoba's land, water and air with a focus of ecosystem preservation. This led to the establishment in 1971 of a new department (Manitoba Environment) which inherited a portion of the existing staff and programs from Manitoba Public Health including the analytical laboratory and the public health inspection services.

Manitoba's regulatory framework for mineral exploration and development began in 1945 and soon after was faced with regulating the petroleum production industry in Southern Manitoba to ensure protection of potable water sources. More recently groundwater leakage into open pit quarries, gypsum mines etc, has demanded regulatory attention.

The environmental awareness of the 1960's heightened concern about the increasing use of chemicals in agricultural production. This led to the regulatory provisions for controlling the use of pesticides and fertilizers initiated in 1976 by Manitoba Agriculture.

TABLE 4-3
 A SUMMARY OF ACTS IN MANITOBA
 DEALING WITH GROUNDWATER
 PROTECTION AND ALLOCATION

ACT	YEAR OF ENACTMENT	AGENCY
Municipal Act	pre-1900	Manitoba Rural Development
Public Health Act	pre-1900	Manitoba Environment
Water Rights Act	1930	Manitoba Natural Resources
Mines Act	1945	Manitoba Energy & Mines
Conservation Districts Act	1959	Manitoba Rural Development
Water Resources Administration Act	1959	Manitoba Natural Resources
Groundwater and Water Well Act	1963	Manitoba Natural Resources
Environment Act	1968	Manitoba Environment
Industrial Minerals Drilling Act	1970	Manitoba Energy & Mines
Planning Act	1976	Manitoba Rural Development
Pesticides and Fertilizer Control Act	1976	Manitoba Agriculture
Dangerous Goods Handling and Transportation Act	1984	Manitoba Environment

The legislative framework in Manitoba has evolved at various times within various departments generally as a reaction to a perceived need. The effectiveness of departmental legislation is dependent to a significant degree on the resources allocated to statute administration.

Coordination of administrative activities between departments has been achieved generally through informal liaison at the program delivery level. With the advent of the Environment Act 1988 certain water allocation projects require licenses under both the Environment Act and the Water Rights Act. Ministerial agreements have been considered as a means of coordinating interdepartmental administrative activities.

Modifications to the existing legislative framework are relatively tedious and time consuming to achieve. This disincentive may be beneficial to program delivery as it promotes innovative measures to achieve the intent of the legislation.

During the formative years of groundwater management in Manitoba the main concern was related to the development and maintenance of drinking water supplies. Governments traditionally have been involved in both direct service activities (water supply development) and regulatory activities (water allocation). In some cases the same agency has been involved in both activities serving as both the proponent and the regulator.

The advent of the Environment Act and the Environment Department in the 1960's reflected the need to separate development activities from regulatory activities. However, this recognition has not resulted in a major transformation of water management functions within the province.

Recent activities within the province have seen the development of regional resource management agencies in the form of Planning Districts and Conservation Districts. The strategy behind this movement appears to reflect the need to bring more people into the management process and place more emphasis on achieving resource management goals through education and incentives.

4.5 Summary

A review of the matrices (see Appendices A, B and C) indicates that there are provisions to respond to most groundwater issues through existing legislation. However, there are a number of identified groundwater issues not presently adequately regulated by any legislation in the prairie provinces:

- 1) chemigation,
- 2) structure foundation boreholes and excavations,

- 3) seismic boreholes,
- 4) groundwater recharge area protection, and
- 5) control of fluid circulation related to heat pumps.

Of these issues the most important to interprovincial waters is groundwater recharge area protection.

Present resource legislation tends to regard groundwater as a single isolated resource and, as a consequence, groundwater is vulnerable to contradictory management decisions in situations which involve other resource sectors. In fact, in some provinces, conflicting departmental or agency interest in groundwater can cause problems concerning co-ordinated management of even this single resource.

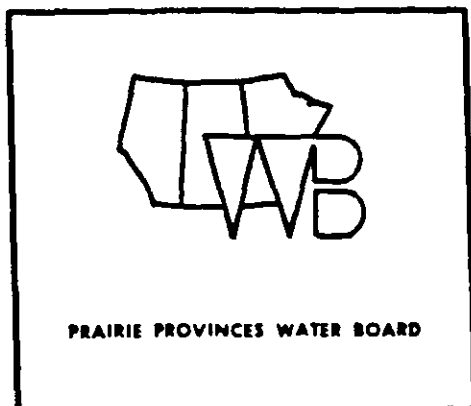
Currently, a detailed assessment concerning the possible impact(s) of any major project with the potential to influence groundwater quality is a prerequisite to the issuance of a development permit in all provincial jurisdictions. There is also generally, at present, a commensurate requirement to monitor the rate and direction of groundwater flow and to identify and quantify the contaminants involved.

As a result of the committee's review, a number of groundwater related programs were identified which have contributed significantly to the conservation and protection of the resource. Examples of these programs include:

- 1) Groundwater definition for local planning and conservation districts (Manitoba);
- 2) Saskatchewan Research Council groundwater maps (Saskatchewan);
- 3) Hydrogeologic mapping (Alberta);
- 4) Groundwater monitoring network (Manitoba);
- 5) E-Log Program (Saskatchewan);
- 6) Driller Certification Program (Alberta);
- 7) Aquifer Management Plans (Saskatchewan);

- 8) Cold Lake Monitoring (Alberta);
- 9) PFRA Rural Water Development Program (Canada);
- 10) Base of groundwater protection identification (Alberta);
- 11) Groundwater Pollution Hazard Maps (Manitoba).

It is also important to note that most of the existing provincial groundwater legislation is proactive, but because of staff limitations and organization structure, the actual application is generally reactive. Increasing demands for groundwater and increasing public awareness about the environment will make it less acceptable for provincial governments to continue to take a reactive approach to the management of this valuable resource.



CHAPTER 5

CONCLUSIONS

As a result of reviewing the potential groundwater issues and the provincial groundwater legislation dealing with these issues, the Committee on Groundwater concluded:

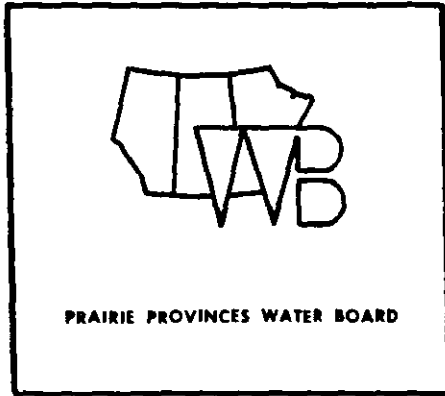
1. Comprehensive legislation exists in all three provinces to address most groundwater issues.
2. While the intent of most of the provincial legislation is to be proactive in dealing with groundwater in both quantity and quality matters, due to infrastructure limitations, it is normally handled in a reactive approach. There are some notable exceptions, such as the groundwater observation well network in Manitoba, the geologic mapping and electric log subsidy in Saskatchewan, and the groundwater data base and hydrogeological cross-sections in Alberta.
3. Achieving the intent of existing groundwater legislation is constrained by the lack of comprehensive aquifer management plans (e.g., inadequate groundwater data base and monitoring networks).
4. Several groundwater related issues are regulated under more than one statute. A review of the legislation matrices for each province shows there are a number of agencies in each province involved with groundwater. Ideally, all matters

related to groundwater quality and/or quantity should be handled by one department for greatest efficiency.

5. Most provincial statutes have accompanying regulations, standards, and/or guidelines intended to strengthen their effectiveness for dealing with specific groundwater issues. The Committee on Groundwater strongly supports the use of guidelines to administer the various issues dealing with groundwater. Changes in public demands and technology have shown that the flexibility of guidelines service the legislation much better than the more rigid standards or regulations.
6. Allocation of groundwater in each of the three prairie provinces is not based on the same criteria nor apportioned between jurisdictions. The allocation of groundwater is based, at least in the border areas, on point withdrawals with no provision for maximum or permissive sustainable yield.
7. There are a number of identified groundwater issues (i.e., chemigation, structure foundation boreholes and excavations, seismic boreholes, groundwater recharge area protection, and control of fluid circulation related to heat pumps) which are not presently adequately regulated by legislation in the prairie provinces. To date, only very local problems have occurred with any of these issues. However, some of them could cause significant future problems if due care is not taken.
8. The linkage of surface water, groundwater and land is not fully recognized in the existing legislation. The most serious deficiency in this area is the lack of recognition of the impact of development in the recharge areas of local and intermediate flow systems which can have a direct and immediate effect on groundwater supplies, water quality and river flow.

APPENDICES

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APPENDIX A
GROUNDWATER LEGISLATION
MATRIX - ALBERTA

GROUNDWATER LEGISLATION MATRIX - PART A
AQUIFER PROTECTION

Alberta
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Activity	*Act	Regulations	Standards or Guidelines	Agency	Proactive /Reactive	Notes
1. ¹ * Foreign Material Deposited as a non-point source at or near the Land Surface:						
a. Aerial Spraying of Pesticides and Fertilizers and b. Ground Spraying of Pesticides and Fertilizers and c. Soil Incorporation of Pesticides and Fertilizers	* Agricultural Chemicals	Pesticide Sales, Use and Handling	Several Available	Environment	Proactive /Reactive	Under the Act control measures to ensure the safe, informed, effective application of pesticide chemicals include: i) permits ii) licences iii) examinations iv) scheduling of pesticide to various classes v) monitoring and inspections. Conditions are routinely put in permits, for example, forest production, requiring the applicant to monitor groundwater.
d. Chemigation	None	None	None			
e. Effluent Irrigation and f. Ground Spraying of Effluent	Clean Water	General Municipal Plants Industrial Plants	A Practical Guide to Municipal Waste Water Irrigation.	Environment	Proactive /Reactive	Letter of Permission must be obtained prior to application of waste water. Several Waste Water Effluent Guidelines have been prepared for: i) Petroleum refineries ii) Fertilizer Plants iii) Brine Storage Reservoirs iv) Sand and Gravel Washing Operations v) Coal Mining Groundwater monitoring is recommended.
g. Roadway Application of Salt and Other Chemicals	None	None	None			<u>Does not appear to be a problem in Alberta</u>

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¹ * Foreign Material means one which is released into the environment (land, air, soil, waters, or biota) from an anthropogenic source, which would not be present in significant quantities in the pristine environment. A foreign substance does not have to be hazardous, but most hazardous substances are classifiable as foreign.
* Act - indicates there is a specific groundwater requirement, if an * appears in front of Act.

GROUNDWATER LEGISLATION MATRIX - PART A
AQUIFER PROTECTION

Alberta
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Activity	*Act	Regulations	Standards or Guidelines	Agency	Proactive /Reactive	Notes
h. Acid Rain	Clean Air	Clean Air (Maximum Levels)	In regulations	Environment	Proactive	Emissions controlled under the Act.
	Oil and Gas Conservation	Oil and Gas Conservation	None	ERCB	Proactive	Involved in study funding. Report by Acid Deposition Research Program states Alberta doesn't have a problem with Acid Rain.
i. Hazardous dust (radio-active, lead)	Clean Air	Clean Air (Maximum Levels)	In regulations see Dust.	Environment	Proactive	Total dustfall controlled in Act. Does not specify what type.
j. Other Landfarming	Clean Water	None	Guidelines for the Disposal of Sulphur Containing Solid Wastes. Sewage as a Resource.	Environment	Proactive	Often tied into operations involving effluent irrigation or ground spraying of effluent.
2.* Foreign Material Deposited as a point source at or near the Land Surface:						
a. Above Ground Storage Facilities:	Hazardous Chemicals	None	Hazardous Waste Storage Guidelines.	Environment	Reactive	Guidelines discuss environmental protection measures for Storage Facilities using Tanks and Containers for hazardous material.
	1. Gasoline	Clean Water	Industrial Plants	Environment	Proactive	Reporting of accidental spills is required. Licence for storage not required.
	2. Pesticides and Fertilizer	Agricultural Chemicals	Pesticides, Sales, Use and Handling	Pesticide Fire and Spill Guidelines	Environment	Proactive /Reactive
b. Spill from Storage Tank, Gasoline, Fertilizer, etc.	*Clean Water Oil and Gas Conservation Hazardous Chemicals	All Oil and Gas Conservation None	None	Environment ERCB	Reactive Proactive	Reporting required. ERCB involved if related to oil or salt water spill. If related to hazardous waste spill.

GROUNDWATER LEGISLATION MATRIX - PART A
AQUIFER PROTECTION

Alberta
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Activity	*Act	Regulations	Standards or Guidelines	Agency	Proactive /Reactive	Notes
c. Spill From Transport Vehicles	Clean Water	General		Environment	Reactive	PERT - In event of spill, Alberta Environment will respond.
	Hazardous Chemicals Transportation of Dangerous Goods	Hazardous Waste None	None	Environment APSS	Reactive Proactive	If spill involves hazardous waste.** Waste Manifest System in place, a tracking system for hazardous waste.
d. Cesspools	Plumbing and Drainage	Plumbing and Drainage	Private Sewage Disposal System Infrm. for Installers-1982	Alberta Labour	Proactive	Act deals with private ownership.
e. Liquid Storage Structures (Lagoons)	*Clean Water	General Municipal Plants	Several - see Notes	Environment	Proactive	1) Recommended Guidelines for the Design, Approval and Operation of Sewage Lagoons for Small Municipal Developments. 2) Design and Construction of Liners for Municipal Waste-water Stabilization Ponds. (GW monitoring a specific requirement)
f. Liquid Spill Containment Structures (Dyked Retention Areas)	*Clean Water	General	See above 2e-Note 2 for Dyke Design.	Environment	Proactive	
	Oil and Gas Conservation	Oil and Gas Conservation		ERCB	Proactive	ERCB involved if dealing with matters related to the energy sector (Oil and Salt Water Retention Areas).
g. Solids Storage Structures (Landfills)	*Clean Water Land Surface	None	Guidelines for Industrial Landfills.			Guidelines available for Municipal Landfills as well (unpublished).

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GROUNDWATER LEGISLATION MATRIX - PART A
AQUIFER PROTECTION

Alberta
February 1991
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Activity	*Act	Regulations	Standards or Guidelines	Agency	Proactive /Reactive	Notes
g. Solid Storage Structures (Landfills) Continued	Conservation and Reclamation	Several	Guidelines for the Disposal of Sulphur containing Solid Wastes.	Environment	Proactive	Design for a Sanitary Landfill. Groundwater monitoring is a requirement. <u>No effective legislation to ensure cleanup of contaminated groundwater unless the landfill continues to operate; however, serious groundwater contamination from landfills is rare in Alberta.</u>
	Public Health	Waste Management		Health		
	Hazardous Chemicals	None	Hazardous Waste Storage Guidelines.			Act applies when Hazardous wastes (liquid) disposed in a landfill.
h. Intensive Livestock Enterprises (feed lots)	Clean Water	None	Code of Practice Recommendations only	Environment	Proactive /Reactive	Lieutenant Governor in Council may make regulations regarding intensive livestock Operations. Sect. 21(y).
i. Sewage Sludge	Clean Water	General Municipal Plants	Sewage as a Resource. Guidelines for the Application of Municipal Waste water	Environment	Proactive	Clean Water issues approvals for Municipal Facilities. Letter of permission required prior to application of sludge on land. Guidelines available in Land Treatment of Industrial Waste.
	Plumbing and Drainage	Plumbing and Drainage	Sludges to Agricultural lands.	Labour	Proactive	Plumbing and Drainage Act ensures adequate private disposal. <u>Act is deficient in the use of materials in individual well construction, eg. no restrictions on material type used in well construction where plastic casing with lead additives could be used.</u>
j. Septic Fields	Clean Water	General	No (pending)	Environment	Proactive	Only applies to septic tanks used to service municipal developments.
	Plumbing and Drainage	Plumbing and Drainage	Private Sewage Disposal Systems Infm. for Installers-1982	Labour	Proactive	Individual private septic fields do not require a licence under Clean Water Act. <u>There is a problem with potential nitrate contamination in subdivisions. No effective legislation to control use of septic systems.</u>

GROUNDWATER LEGISLATION MATRIX - PART A
AQUIFER PROTECTION

Alberta
February 1991
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Activity	*Act	Regulations	Standards or Guidelines	Agency	Proactive /Reactive	Notes
k. Buried Storage Tanks (gasoline, etc.)	*The Fire Prevention Clean Water	Alberta Fire Code None	Environmental Code of Practice for Underground Storage Tank Systems Containing Petroleum Products	Labour Environment	Proactive /Reactive	Alberta Environment in close co-operation with Alberta Labour (The Fire Prevention Act). Controls imposed are a safeguard against contamination. Clean Water applies only when a spill occurs. <u>Present system of enforcement through Fire Prevention act is working satisfactory but if challenged would probably be inadequate. Presently being reviewed under M.U.S.T.</u>
l. Holding Tanks	Plumbing and Drainage	Plumbing and Drainage	None	Labour	Proactive	Applies to private sewage disposal.
m. Pipelines and Lift Stations	Land Surface Conservation & Reclamation Clean Water	Several General Municipal Plants	Information Requirements for Regulated Pipelines	Environment	Proactive	Clean Water Act would apply when dealing with municipal water facilities.
	Oil and Gas Conservation	Oil and Gas Conservation		ERCB	Proactive	Pipeline breaks related to energy production are acted upon by the ERCB.
n. Other i) Oily Wastes Storage Facilities ii) Pesticide Container Collection Sites iii) Sulphur Storage Sites	*Oil and Gas Conservation	Oil and Gas Conservation	See Note	ERCB	Proactive	Defines requirements for permanent/temporary storage facilities in Information Letter IL 85-16. Leakage Monitoring System is required with sampling.
	*Agricultural Chemicals		Design Guidelines and Specifications Available.	Environment	Proactive	<u>Problems handled through funding from Alberta Environment. Expect a deposit on all containers to be instigated by private industry and then all sites will be supervised by private industry.</u> Groundwater Monitoring is a requirement.
	*Clean Water	None		Environment	Proactive	Alberta Environment is responsible for overseeing monitoring requirements which include groundwater systems. Refer to ERCB IL 84-11 entitled Approval, Monitoring and Control of Sulphur Storage Sites.

GROUNDWATER LEGISLATION MATRIX - PART A
AQUIFER PROTECTION

Alberta
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Activity	*Act	Regulations	Standards or Guidelines	Agency	Proactive /Reactive	Notes
iv) Drilling Fluids	Oil and Gas Conservation	Oil and Gas Conservation	See Note	ERCB	Proactive	Describes acceptable measures for surface disposal of non-toxic drilling wastes in Interim Directive ID-OG 75-2. <u>Potential problem with oil well sumps and groundwater contamination. Our input is through ERCB. Could be a problem in the future.</u>
v) Oil Wastes	*Oil and Gas Conservation *Clean Water	Oil and Gas Conservation None	See Note	ERCB Environment	Proactive Proactive	See Appendix B of Informational Letter IL85-16: Land Treatment of Oil Wastes - Guidelines for Application and monitoring.
vi) Bottom/Fly Ash	Land Surface Conservation & Reclamation	None		Environment	Proactive	Allows for incorporation of ash as a soil amendment within mined areas.
3. *Foreign Material Introduced Below the Land Surface Through Drilling Activity:						
a. Water Well (production, injection, unused)	Oil and Gas Conservation	Oil and Gas Conservation	None	ERCB		Sect. 21(o) of the Clean Water Act addresses drilling of water wells.
	*GW Dev. *Clean Water Public Health	Water Well Drilling & Construction None Nuisance and General Sanitation	None See Note	Environment Environment Health	Proactive	Guidelines for the Design and Approval of Water Supply Systems for Small Municipal Development.
b. Oil and Gas Well (production, injection, unused) and c. Mineral Exploration Borehole	Oil and Gas Conservation	Oil and Gas Conservation	See Notes	ERCB	Proactive	1) Surface Casing Minimum Requirements 2) Casing cementing Minimum Requirements 3) Guide to Minimum Casing Design Req. The above requirements by ERCB aid in the protection of aquifers but they were not specifically developed for that purpose. <u>Alberta Environment only reviews wells shallower than 600 m or waste disposal wells. We have no input on the balance but this has not been a problem.</u>
d. Structure Foundation Borehole	None	None	None			
e. Waste Disposal Well (injection, unused)	*Clean Water	None	In Terms & Conditions of Licence	Environment	Reactive	

GROUNDWATER LEGISLATION MATRIX - PART A
AQUIFER PROTECTION

Alberta
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Activity	*Act	Regulations	Standards or Guidelines	Agency	Proactive /Reactive	Notes
e. Waste Disposal Well (injection, unused) Continued	*Oil and Gas Conservation	Oil and Gas Conservation		ERCB	Proactive	ERCB described acceptable disposal criteria for drilling fluids by deep well injection in Interim Directive ID 81-1. Also see Informational Letter IL 84-12: Surface Casing and Logging Requirements New Disposal and Injection wells.
f. Geophysical Boreholes	Oil and Gas Conservation	Oil and Gas Conservation	Unpublished	ERCB	Proactive	
	*GW Dev.	General	Abandonment Procedures Available	Environment	Proactive	GW Development applies to when water well drillers are drilling test holes for geophysical logging purposes. <u>Deficiencies in abandonment of coal and mineral exploration test holes. A potential concern but only minor problems have occurred.</u>
g. Other						
4. *Foreign Material Introduced Below the Land Surface Through Mineral Extraction Activity:						
a. Open Pit Quarries and	Oil and Gas Conservation	Oil and Gas Conservation	Several - See Notes	ERCB		1) Coal Conservation Act applies when dealing with coal schemes.
	*Land Surface Conservation & Reclamation	Regulated Coal Surface Operations Regulations. Regulated Oil Sands		Environment	Proactive	2) Oil Sands Conservation Act applies when dealing with oil sand schemes.
	*Clean Water	Surface Operations Regulations.		Environment		3) For sand, gravel, clay and marl refer to Waste Water Effluent Guidelines for Alberta Sand & Gravel Washing Operations.
b. Underground Mine Workings and	Coal Conservation	General				4) Oil Sands Guidelines - ERCB Application 1985.
	Oil Sands Conservation	Oil Sands				5) Guidelines Respecting an Applic. for a Commercial Crude Bitumen Recovery & Upgrading Project ERCB Guide G-23.

GROUNDWATER LEGISLATION MATRIX - PART A
AQUIFER PROTECTION

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Activity	*Act	Regulations	Standards or Guidelines	Agency	Proactive /Reactive	Notes
c. Solution Mining (production maintenance, and potash mining)						6) Alberta Coal Mining Waste Water Effluent Guidelines. 7) Basis for Approval of Industrial Plants in Alberta, July 1983. When projects are announced groundwater studies are normally undertaken which address the protection aspect. Monitoring is often a requirement under the Clean Water Act's terms and conditions.
5. *Foreign Material Introduced Below the Land Surface Through General Construction and/or Operation:						
a. Canals, Locks, etc.	*Water Resources Clean Water	None	Available	Environment	Proactive	W.R. Act highlights resource protection. Definition of water in Act includes groundwater. Clean Water Act requires permit to construct under waterworks system, Sec. 21(f,f.1).
b. Pipelines and Tunnels	Clean Water	General Municipal Plants		Environment		Clean Water Act may apply when dealing with waterworks systems.
	Oil and Gas Conservation	Oil and Gas Conservation	Pipeline Applic. to the ERCB	ERCB	Proactive	ERCB has responsibility over cleaning of biodegradable pipeline spills.
	Land Surface Conservation & Reclamation	Regulated Oil & Gas Pipeline Surface Operations	Info. Req. for Regulated Pipelines	Environment		Abandonment of regulated pipelines requires approval. Groundwater protection is not specially mentioned in Guidelines only inferred.
c. Structure Foundation Excavations	None	None	None	None		

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GROUNDWATER LEGISLATION MATRIX - PART A
AQUIFER PROTECTION

Alberta
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Activity	*Act	Regulations	Standards or Guidelines	Agency	Proactive /Reactive	Notes
d. Drainage Wells (Surface Water)	*Water Resources	General	Licence is required. Guidelines available	Environment		W.R. Act highlights resource protection. Alberta Agriculture provides Agri-fax on subject of drainage. Water quality implications of drainage have not been highlighted in Clean Water Act. <u>However, adequate control through Water Resources Act.</u>
6. ² **Hazardous Wastes:						
a. Deposited on the Land Surface	*Hazardous Chemicals Clean Water	Hazardous Waste None	Hazardous Waste Storage Guidelines. Guidelines for Industrial landfills.	Environment	Proactive	In addition, a report by ECA, 1980 titled: The Management and Disposal of Hazardous Waste, discusses the Administration and Regulation of Hazardous Waste.
b. Deposited in Containment Structures at the Land Surface	*Hazardous Chemicals Clean Water	Hazardous waste	Hazardous Waste Storage Guidelines	Environment	Proactive	Guidelines discuss environmental protection measures for Storage Facilities using Tanks and Containers.
c. Deposited in the Soil Zone	*Hazardous Chemicals Clean Water	Hazardous waste	As above	Environment	Proactive	Sec. 21(o) of Clean Water Act.
d. Introduced Below Land Surface Through Drilling Activity	Hazardous Chemicals Clean Water Oil and Gas Conservation	Hazardous waste Oil and Gas Conservation		ERCB	Proactive	

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² **Hazardous waste means one which owing to its physical, chemical, or toxicological properties, will when released in sufficient quantities into the environment, cause degradation of the environment, and pose a risk to groundwater.

Responsibility for hazardous wastes associated with old or abandoned industrial sites is not clear. A number of test cases are expected to be in court during the next year. Alberta Environment will assume responsibility where cleanup is not undertaken by the private sector.

GROUNDWATER LEGISLATION MATRIX - PART A
 AQUIFER PROTECTION

Alberta
 February 1991
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Activity	*Act	Regulations	Standards or Guidelines	Agency	Proactive /Reactive	Notes
e. Deposited In Containment Structures Below the Land Surface	Hazardous Chemicals *Clean Water Oil and Gas Conservation	Oil and Gas Conservation	Guidelines for Industrial Landfills	Environment ERCB	Proactive	Under provisions of Clean Water Act groundwater monitoring is a requirement. Approvals require i) Permits to Construct; ii) Licence to Operate; iii) Letters of Permission. Site chosen to minimize potential for groundwater damage.

GROUNDWATER LEGISLATION MATRIX - PART B
AQUIFER ALLOCATION

Alberta
February 1991
(1 of 3)

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Activity	*Act	Regulations	Standards or Guidelines	Agency	Proactive /Reactive	Notes
1. Aquifer Inventory:						
a. Drilling Records	*Ground Water Development	Ground Water Development General Water Well Drilling and Construction Form	Found in Form Regulations	Environment	Proactive	All drilling records are required. About 90% submission. E-logs submitted on a voluntary basis.
b. Chemistry Records	None	None	None	Environmental Centre	Proactive	Copies of all chemical analysis are forwarded to Environment.
c. Groundwater Reports	Ground Water Development *Water Resources	Ground Water Development General The Water Resources	Several Yes (see note)	Environment Environment	Proactive Proactive /Reactive	Reports are required for Impact Assessments, industrial operations, subdivision requests with all been made public. Terms and conditions of exploration permit require reports.
d. Geologic Definition	Dept. of Environment	None	None	Environment Alberta Research Council	Proactive	Hydrogeological Cross-Sections and Base of Ground Water Protection Maps by Environment. Hydrogeological maps by Alberta Research Council.
e. Aquifer Evaluation	*Water Resources	None	None	Environment	Proactive /Reactive	Ongoing program in support of applications for licence; in response to allegations of unreasonable interference.
f. Formal Mapping and Reporting	Dept. of Environment	None	None	Environment Alberta Research Council	Proactive	See Geologic Definition Notes.
g. Data Base: i) Manual File ii) Computer File	*Ground Water Development	Ground Water Development General.	Unpublished Guidelines Available	Environment	Proactive	Consists of paper file & microfiche. Partial computer file, for example listing. Full computer file being contemplated.
2. Aquifer Allocation Plan	*Water Resources	None	Guidelines offered in long term planning studies	Environment	Proactive /Reactive	Ground water usage became regulated in 1962 under the Act. The Act allocates the right to appropriate water by means of licences. Long term planning of aquifer allocation is studied for example in projects like the Cold Lake/Beaver River Long Term Water Management Plan.

GROUNDWATER LEGISLATION MATRIX - PART B
AQUIFER ALLOCATION

Alberta
February 1991
(2 of 3)

Activity	*Act	Regulations	Standards or Guidelines	Agency	Proactive /Reactive	Notes
2. Aquifer Allocation Plan Continued	Water Resources Commission	None	None	Environment	Proactive	A function of the Commission is to review and assess long term water resource planning by the Province in relation to several identified factors.
3. Aquifer Allocation Procedure	*Water Resources	The Water Resources General	Ground Water Projects How to Obtain a Licence or Permit. Guidelines to aquifer allocations available.	Environment	Proactive	Detailed Guidelines as to obtaining a licence or permit are available. Require filling of application forms. Applications reviewed by Ground Water Rights Branch. Any public concerns are addressed. If approved, licences are issued setting out certain terms and conditions.
4. Aquifer Allocation Monitoring:						
a. Water Level Monitoring By User (Project)	*Water Resources	None	Under Terms & Conditions of Licence	Environment	Proactive /Reactive	Monitoring required by licensee or permittee as outlined in terms and conditions of approval.
b. Water Level Monitoring By Province (Project)	Water Resources Dept. of Environment (2A)	None	None	Environment	Reactive Proactive	In response to allegations of unreasonable interference. Environment through its Provincial Ground Water Observation Well Network monitors water levels, both on a Provincial and Regional basis.
c. Water Level Monitoring (Regional)	Dept. of Environment (2A)	None	None	Environment	Proactive	More than 250 wells are located throughout the Province. Data is used to assist in the orderly utilization of ground water resources.
d. Water Chemistry Monitoring By User (Project)	*Water Resources Clean Water	None General	Under Terms & Conditions	Environment	Proactive /Reactive Proactive	As above under 4(a) Notes. Under Clean Water Act Drinking Water Quality is enforced through the Licencing Program.

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GROUNDWATER LEGISLATION MATRIX - PART B
AQUIFER ALLOCATION

Alberta
February 1991
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Activity	*Act	Regulations	Standards or Guidelines	Agency	Proactive /Reactive	Notes
e. Water Chemistry Monitoring By Province (Project) and f. Water Chemistry Monitoring (Regional)	Dept. of Environment (2A)	None	None	Environment	Proactive	Two Department Programs are ongoing. 1) High Quality Sampling. Province wide ground water quality project initiated to provide specific information for reviewing, evaluating and defining natural background conditions. 2) Provincial Ground Water Observation Well Network - monitors water quality through periodic water sampling of newly completed observation wells. Data obtained used to assist in the protection of ground water resource.
5. Aquifer Allocation Enforcement	*Water Resources	The Water Resources	Ground Water Projects - How To Obtain a Licence or Permit	Environment	Proactive /Reactive	Licences or temporary permits are required to divert and use ground water for a number of purposes. Licence stipulates location, source of supply, quantity and rate of withdrawal. It is an offence under the legislation for any person to use, other than for domestic purposes, any ground water except under authority of the Act. Penalties in the form of fines and/or imprisonment may be taken.
6. Aquifer Allocation Documentation	*Water Resources	The Water Resources	Ground Water Projects - How To Obtain a Licence or Permit	Environment	Proactive	To maintain a licence or temporary permit, it may be necessary to submit an annual report containing information on water levels and volumes of water pumped over the years. Licences generally consist of operational guidelines and monitoring requirements.



PRAIRIE PROVINCES WATER BOARD

APPENDIX B
GROUNDWATER LEGISLATION
MATRIX - SASKATCHEWAN

GROUNDWATER LEGISLATION MATRIX - PART A
AQUIFER PROTECTION

Saskatchewan
February 1991
(1 of 9)

Activity	*Act	Regulations	Standards or Guidelines	Agency	Proactive /Reactive	Notes
1. ¹ * Foreign Material Deposited as a non-point source at or near the Land Surface:						
a. Aerial Spraying of Pesticides and Fertilizers	* The Pest Control Products (Saskatchewan)	Pesticide Sales, Use and Handling	Standards and Guidelines	Sask Agriculture and Food	Proactive /Reactive	This ensures users are protected, informed and effectively apply pesticides under this Act. Control measures include: permits, licences, examination, storage, inspection and monitoring.
b. Ground Spraying of Pesticides and Fertilizers	The Pest Control Products (Saskatchewan)	Pesticide Sales, Use and Handling	Standards and Guidelines	Sask Agriculture and Food	Proactive /Reactive	
c. Soil Incorporation of Pesticides and Fertilizers						
d. Chemigation	None	None	None			
e. Effluent Irrigation	The Environmental Management and Protection The Water Corporation	Water Pollution Control and Waterworks Water Rights	Sewage Effluent Irrigation Guidelines and Design Legislation for Approvals to Construct and Operate Works	Sask Environment and Public Safety Sask Water	Proactive /Reactive Proactive	Issues permits for the application of waste water for irrigation. Issues approvals to construct and operate works.
f. Ground Spraying of Effluent						
g. Roadway Application of Salt and Other Chemicals						
h. Acid Rain						

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¹ * Foreign Material means one which is released into the environment (land, air, soil, waters, or biota) from an anthropogenic source, which would not be present in significant quantities in the pristine environment. A foreign substance does not have to be hazardous, but most hazardous substances are classifiable as foreign.

* Act - indicates there is a specific groundwater requirement, if an * appears in front of Act.

GROUNDWATER LEGISLATION MATRIX - PART A
AQUIFER PROTECTION

Saskatchewan
February 1991
(2 of 9)

Activity	*Act	Regulations	Standards or Guidelines	Agency	Proactive /Reactive	Notes
i. Hazardous dust (radioactive, lead)						
j. Other						
Road Application of Oily Wastes	Oil and Gas Conservation	Oil and Gas Conservation	Guidelines for Oily Waste Disposal on Municipal Roads	Sask Energy and Mines	Proactive	Sask Energy and Mines approval required prior to disposal.
Land Application of Waste Drilling Fluids	Oil and Gas Conservation	Oil and Gas Conservation	Guidelines for On and Off Lease Application of Drilling Fluids	Sask Energy and Mines	Proactive	Guidelines apply to freshwater mud systems only.
2.* Foreign Material Deposited as a point source at or near the Land Surface:						
a. Surface Storage Tanks for Gasoline, Fertilizer, etc.	The Environmental Management and Protection	Mineral Industry Pollution Prevention	Guidelines	Sask Environment and Public Safety	Proactive	Mines Pollution Control Branch requires (by licence) that all storage tanks of reagents or fuel be in a lined dyke area.
b. Spill from Surface Storage	The Environmental Management and Protection	Spill Control	None	Sask Environment and Public Safety	Proactive /Reactive	Requirements for reporting clean up and monitoring spills.
	The Oil and Gas Conservation	Oil and Gas Conservation	None	Sask Energy and Mines	Proactive	Is related to oil or salt water spills.
c. Spill From Transport Vehicles	The Dangerous Goods Transportation	Dangerous Goods Transportation	None	Sask Highways and Transportation	Proactive	Applies to time that vehicles are on public highways (travelling). Dangerous goods manifest systems in place - can react to incidents rapidly.

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GROUNDWATER LEGISLATION MATRIX - PART A
AQUIFER PROTECTION

Saskatchewan
February 1991
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Activity	*Act	Regulations	Standards or Guidelines	Agency	Proactive /Reactive	Notes
d. Cesspools	The Public Health	Plumbing and Drainage	Private Sewage Disposal Systems, 1980	Sask Health	Proactive	All private sewage disposal systems are required to be permitted through Sask Health.
e. Liquid Storage Structures (Lagoons)	The Public Health	Plumbing and Drainage	Private Sewage Disposal Systems, 1980	Sask Health	Proactive	Sask Health is involved in sewage lagoon systems that receive less than 4000 gallons of waste per day.
	The Environmental Management and Protection	Mineral Industry Pollution Prevention	Guidelines	Sask Environment and Public Safety	Proactive	Mines Pollution Control Branch requires that all waste water storage and treatment ponds be free from seepage.
	The Environmental Management and Protection	Water Pollution Control and Waterworks	A Guide to Sewage Works Design and Lagoon Operation and Maintenance	Sask Environment and Public Safety	Proactive /Reactive	Design, application and operation Guidelines exist. Some types of operations are exempt from The Environmental Management and Protection Act.
	The Water Corporation	None	Legislation for Approvals to Construct and Operate Works.	Sask Water	Proactive	Issues approval to construct and operate works.
	The Oil and Gas Conservation Act	Oil and Gas Conservation	None	Sask Energy and Mines	Proactive	Provides for emergency storage of salt water in lined pits. Brine pits at liquid propane gas storage facilities fall under the Act.
	The Pollution (By Livestock) Control Act, 1984	Facility Siting, Design and Management	Code of Recommended Practice	Sask Agriculture and Food	Proactive /Reactive	Controls the counteract, operation relocation of facilities.

GROUNDWATER LEGISLATION MATRIX - PART A
AQUIFER PROTECTION

Saskatchewan
February 1991
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Activity	*Act	Regulations	Standards or Guidelines	Agency	Proactive /Reactive	Notes
f. Liquid Spill Containment Structures (dyked retention areas)	The Environmental Management and Protection	Spill Control and Hazardous Substance	None	Sask Environment and Public Safety	Proactive	Some spill control structures exist at industrial effluent facilities that are licensed under The Environmental Management and Protection Act. Mines Pollution Control Branch requires (by licence) that all storage tanks of reagents or fuel be in a lined dyke area.
g. Solids Storage Structures (Landfills)						
h. Intensive Livestock Enterprises (feed lots)	The Pollution (By Livestock) Control Act, 1984 The Public Health	Facility Siting, Design and Management Sanitation	Code of Recommended Practice None	Sask Agriculture and Food Sask Health	Proactive /Reactive Proactive /Reactive	Controls the counteract, operation relation of facilities. No person shall locate a feed lot so that drainage therefrom will pollute any municipal or private water supply.
i. Sewage Sludge	The Environmental Management and Protection	Water Pollution Control and Waterworks	Sewage Works Design Guidelines	Sask Environment and Public Safety	Proactive /Reactive	Construction and operation approvals required.
j. Septic Fields	The Public Health	Plumbing and Drainage	Private Sewage Disposal Systems, 1980	Sask Health	Proactive	All private sewage disposal systems are required to be permitted through Sask Health
k. Buried Storage Tanks (gasoline, etc.)						
l. Holding Tanks	The Public Health	Plumbing and Drainage	Private Sewage Disposal Systems, 1980	Sask Health	Proactive	All holding tanks require a permit from Sask Health.

GROUNDWATER LEGISLATION MATRIX - PART A
AQUIFER PROTECTION

Saskatchewan
February 1991
(5 of 9)

Activity	*Act	Regulations	Standards or Guidelines	Agency	Proactive /Reactive	Notes
m. Pipelines and Lift Stations	The Environmental Management and Protection	Water Pollution Control and Waterworks	A Guide to Sewage Works Design	Sask Environment and Public Safety	Proactive	Requirements for sewage pipes and lift stations.
	The Water Corporation	None	Legislation for Approvals to Construct and Operate Works	Sask Water	Proactive	Issues approvals to construct and operate works.
n. Other Tailings Management Areas	The Environmental Management and Protection Act	Mineral Industry Pollution Prevention	None	Sask Environment and Public Safety	Proactive /Reactive	Issues licences to construct and operate. Requirements for containment monitoring, effluent treatment and reclamation (long term stabilization).
Oily Wastes	The Oil and Gas Conservation	Oil and Gas Conservation	Guidelines for the Construction and Monitoring of Ecology Pits in Saskatchewan's Heavy Oil Area	Sask Energy and Mines	Proactive	Provides for temporary storage of oily wastes and oil and salt water spill materials.
Drilling Fluids	The Oil and Gas Conservation	Oil and Gas Conservation	Guidelines for On and Off Lease Application of Drilling Fluids	Sask Energy and Mines	Proactive	Guidelines apply to freshwater mud systems only.
Set Systems	The Public Health	Plumbing and Drainage	Private Sewage Disposal Systems, 1980	Sask Health	Proactive	All systems must be permitted by Sask Health.

GROUNDWATER LEGISLATION MATRIX - PART A
AQUIFER PROTECTION

Saskatchewan
February 1991
(6 of 9)

Activity	*Act	Regulations	Standards or Guidelines	Agency	Proactive /Reactive	Notes
Livestock Manure Disposal	The Pollution (By Livestock) Control Act, 1984	Facility Siting, Design and Management	Code of Recommended Practice	Sask Agriculture and Food	Proactive /Reactive	Controls the counteract, operation relocation of facilities.
Agricultural Chemicals (pesticides and fertilizers)	The Pest Control Products (Saskatchewan)	Pesticide Sales, Use and Handling	Standards and Guidelines	Sask Agriculture and Food	Proactive /Reactive	This ensures users are protected, informed and effectively apply pesticides under this Act. Control measures include: permits, licences, examination, storage, inspection and monitoring.
3. *Foreign Material Introduced Below the Land Surface Through Drilling Activity:						
a. Water Well (production, injection, unused)	The Water Corporation	Ground Water Conservation	Legislation for Approvals to Construct and Operate Works	Sask Water	Proactive	Issues approvals to construct and operate producing water wells.
	The Oil and Gas Conservation	Oil and Gas Conservation	None	Sask Energy and Mines	Proactive	Water source wells for oil field use and water injection wells are covered under the Act. Casing and cementing programs to protect groundwater are specified.
b. Oil and Gas Well (production, injection, unused)	The Oil and Gas Conservation	Oil and Gas Conservation	None	Sask Energy and Mines	Proactive	Water source wells for oil field use and water injection wells are covered under the Act.
	The Oil and Gas Conservation	Oil and Gas Conservation	None	Sask Energy and Mines	Proactive	Casing and cementing programs to protect groundwater are specified.
c. Mineral Exploration Borehole	None	None	Mineral Exploration Guidelines	Sask Environment and Public Safety	Proactive	
d. Structure Foundation Borehole	None	None	None			

GROUNDWATER LEGISLATION MATRIX - PART A
AQUIFER PROTECTION

Saskatchewan
February 1991
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Activity	*Act	Regulations	Standards or Guidelines	Agency	Proactive /Reactive	Notes
e. Waste Disposal Well (injection, unused)	The Oil and Gas Conservation	Oil and Gas Conservation	None	Sask Energy and Mines	Proactive	Salt water disposal wells and other waste disposal wells are covered under the Act.
f. Geophysical Boreholes	The Mineral Resources Act, 1985	Sedimentary Basin Geophysical Exploration	None	Sask Energy and Mines	Proactive	
g. Other						
4. *Foreign Material Introduced Below the Land Surface Through Mineral Extraction Activity:						
a. Open Pit Quarries	The Environmental Management and Protection Act	Mineral Industry Pollution Prevention	None	Sask Environment and Public Safety	Proactive /Reactive	Requirements to control, handle and treat water (where necessary groundwater monitoring is required). Reclamation required.
b. Underground Mine Workings	The Environmental Management and Protection	Mineral Industry Pollution Prevention	None	Sask Environment and Public Safety	Proactive /Reactive	Requirements to control, handle and treat water (where necessary groundwater monitoring is required). Reclamation required.
c. Solution Mining (production maintenance, and potash mining)	The Environmental Management and Protection	Mineral Industry Pollution Prevention	None	Sask Environment and Public Safety	Proactive /Reactive	Requirements to control, handle and treat water (where necessary groundwater monitoring is required). Reclamation required.
	The Oil and Gas Conservation	The Oil and Gas Conservation	None	Sask Energy and Mines	Proactive	

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GROUNDWATER LEGISLATION MATRIX - PART A
AQUIFER PROTECTION

Saskatchewan
February 1991
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Activity	*Act	Regulations	Standards or Guidelines	Agency	Proactive /Reactive	Notes
5. *Foreign Material Introduced Below the Land Surface Through General Construction and/or Operation:						
a. Canals, Locks, etc.	The Water Corporation	Water Rights	Legislation for Approvals to Construct and Operate Works	Sask Water	Proactive	Issues approvals to construct and operate canals, ditches, pipelines and other water conveyance works.
b. Pipelines and Tunnels	The Oil and Gas Conservation	Oil and Gas Conservation	None	Sask Energy and Mines	Proactive	Sask Energy and Mines has responsibility for seeing that pipeline spills are cleaned up.
	The Water Corporation	Water Rights	Legislation for Approvals to Construct and Operate Works	Sask Water	Proactive	Issues approvals to construct and operate canals, ditches, pipelines and other water conveyance works.
c. Structure Foundation Excavations						
d. Drainage Wells (Surface Water)	The Water Corporation	Drainage Control	Legislation for Approvals to Construct and Operate Works	Sask Water	Proactive	Issues approvals to construct and operate drainage works (wells).

GROUNDWATER LEGISLATION MATRIX - PART A
AQUIFER PROTECTION

Saskatchewan
February 1991
(9 of 9)

Activity	*Act	Regulations	Standards or Guidelines	Agency	Proactive /Reactive	Notes
6. ² Hazardous Wastes:						
a. Deposited on the Land Surface						
b. Deposited in Containment Structures at the Land Surface						
c. Deposited in the Soil Zone						
d. Introduced Below Land Surface Through Drilling Activity	The Oil and Gas Conservation	Oil and Gas	None	Sask Energy and Mines	Proactive	
e. Deposited in Containment Structures Below the Land Surface	The Oil and Gas Conservation	Oil and Gas Conservation	None	Sask Energy and Mines	Proactive	Waste disposal wells.
f. Canister Repositories (hazardous waste)						
g. Other Liquid Propane Gas and Natural Gas Cavern Storage Projects	The Oil and Gas Conservation	Oil and Gas Conservation	None	Sask Energy and Mines	Proactive	Approval is required to develop and operate storage projects.

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² Hazardous waste means one which owing to its physical, chemical, or toxicological properties, will when released in sufficient quantities into the environment, cause degradation of the environment, and pose a risk to groundwater.

Responsibility for hazardous wastes associated with old or abandoned industrial sites is not clear. A number of test cases are expected to be in court during the next year. Alberta Environment will assume responsibility where cleanup is not undertaken by the private sector.

GROUNDWATER LEGISLATION MATRIX - PART B
AQUIFER ALLOCATION

Saskatchewan
February 1991
(1 of 4)

Activity	*Act	Regulations	Standards or Guidelines	Agency	Proactive /Reactive	Notes
1. Aquifer Inventory:						
a. Drilling Records	The Ground Water Conservation	Ground Water Conservation	None	Sask Water	Proactive	Legislation requires that all registered water well drillers submit drilling reports.
	N/A	N/A	Test Drilling Program	Sask Water	Proactive /Reactive	Sask Water purchases E-logs for domestic and municipal wells.
	N/A	N/A	None	Sask Research Council	Proactive	Sask Research Council maintains drilling records for research purposes.
b. Chemistry Records	N/A	N/A	None	Sask Environment and Public Safety	Proactive	Sask Environment and Public Safety maintains copies of all chemical analyses that are provided.
	N/A	N/A	None	Sask Research Council	Proactive	Sask Research Council maintains chemistry records for research purposes.
c. Groundwater Reports	N/A	N/A	None	Sask Environment and Public Safety	Proactive	Sask Environment and Public Safety maintains a library of groundwater reports that may be used for such things as environmental impact statements, licensed industrial and/or municipal waste water works, spill events, etc.
	The Water Corporation The Ground Water Conservation	Ground Water Conservation	None	Sask Water	Proactive	Requires the submission of groundwater reports for all municipal and industrial uses of groundwater before an approval to operate and the right to use groundwater is issued.
	N/A	N/A	None	Sask Research Council	Proactive	Sask Research Council has a library of groundwater reports used for research purposes.
d. Geologic Definition	N/A	N/A	None	Sask Research Council	Proactive	Sask Research Council develops and prepared hydrogeological maps and cross-sections and reports.
e. Aquifer Evaluation	N/A	N/A	None	Sask Research Council	Proactive	Sask Research Council may undertake aquifer evaluations for agencies under contact.

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GROUNDWATER LEGISLATION MATRIX - PART B
AQUIFER ALLOCATION

Saskatchewan
February 1991
(2 of 4)

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Activity	*Act	Regulations	Standards or Guidelines	Agency	Proactive /Reactive	Notes
f. Formal Mapping and Reporting	N/A	N/A	Informal Guidelines that Allow for Mapping and Reporting of Ground Water Resources	Sask Water	Proactive /Reactive	Ongoing programs to develop hydrogeological cross-sections using CAD, maintain potentiometric maps and reporting and identifying flowing artesian wells.
	N/A	N/A	None	Sask Research Council	Proactive	Sask Research Council develops and prepares hydrogeological maps and cross-sections.
g. Data Base: i) Manual ii) EDP	The Environmental Management and Protection	N/A	None	Sask Environment and Public Safety	Proactive	Maintains a water quality data base for the province (Esquadat). A new microcomputer data base for groundwater is being implemented.
	N/A	N/A	None	Sask Research Council	Proactive	Sask Research Council maintains a data base (paper, microfiche and electronic) on aquifer inventory items a. to f. inclusive.
				Sask Water	Proactive	Sask Water maintains a data base on aquifer inventory items a. to f. inclusive.
2. Aquifer Allocation Plan	The Water Corporation Act and The Ground Water Conservation Act.	Ground Water Conservation	None	Sask Water	Proactive /Reactive	In 1959, the province initiated the registration of water well drilling equipment requiring drillers to file drillers reports on every well or test hole completed, the purpose of which was to create a groundwater data base. In 1966, the Ground Water Conservation Act and Regulations were passed for the licensing of groundwater use. In accordance with the Act, logs of wells drilled and information on the formation and materials encountered during drilling operations is submitted to Sask Water.

GROUNDWATER LEGISLATION MATRIX - PART B
AQUIFER ALLOCATION

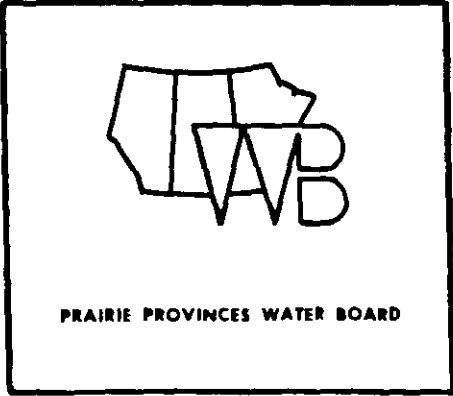
Saskatchewan
February 1991
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Activity	*Act	Regulations	Standards or Guidelines	Agency	Proactive /Reactive	Notes
3. Aquifer Allocation Procedure	The Water Corporation	Ground Water Conservation	Ground Water Investigation Permits and Legislation for Approvals to Construct and Operate Works	Sask Water	Proactive	Issues groundwater investigation permits. Issues approval for construction and operation and right to use groundwater for all uses except domestic uses. Approvals usually contain terms and conditions with respect to operation, use and monitoring, etc.
4. Aquifer Allocation Monitoring:	(Sask Research Council undertakes monitoring of water levels and chemistry at various scales. This work is done to satisfy a need for the information and is not done directly at a regulatory function.)					
a. Water Level Monitoring By User (Project)	The Water Corporation	Ground Water Conservation	None	Sask Water	Proactive /Reactive	Most industrial and municipal projects have conditions included on the approval to operate and use groundwater that requires monitoring of the producing well and any surrounding monitoring wells and/or piezometers.
b. Water Level Monitoring By Province (Project)						
c. Water Level Monitoring (Regional)						
d. Water Chemistry Monitoring By User (Project)	The Environmental Management and Protection	Water Pollution Control and Waterworks	Conditions Stipulated in Permits and Orders	Sask Environment and Public Safety	Proactive /Reactive	Monitoring includes drinking water.
e. Water Chemistry Monitoring By Province (Project)	The Environmental Management and Protection	None	Department Procedures Manual	Sask Environment and Public Safety	Proactive /Reactive	The department is developing a groundwater monitoring protocol document for use by all agencies and clientele involved in groundwater monitoring. The purpose of this document is to standardise data collection and report procedures.
f. Water Chemistry Monitoring (Regional)						

GROUNDWATER LEGISLATION MATRIX - PART B
AQUIFER ALLOCATION

Saskatchewan
February 1991
(4 of 4)

Activity	*Act	Regulations	Standards or Guidelines	Agency	Proactive /Reactive	Notes
5. Aquifer Allocation Enforcement	The Water Corporation Act and The Ground Water Conservation Act	Ground Water Conservation	Legislation for Ground Water Investigation Permits and Approvals to Construct, Operate and Right to Use Ground Water	Sask Water	Proactive /Reactive	<p>Anyone contemplating the use of groundwater must first obtain a groundwater investigation permit to conduct a groundwater investigation. The development of a well (except for domestic uses) requires an approval to construct and an approval to operate which includes the right to use groundwater. Most Corporation Act.contain terms and conditions under which a proponent can operate.</p> <p>Anyone contravening the legislation or terms and conditions of an approval are subject to penalties under The Water Corporation Act.</p>
6. Aquifer Allocation Documentation	The Water Corporation Act and The Ground Water Conservation Act	Ground Water Conservation	Legislation and Informal Guidelines	Sask Water	Proactive	<p>Sask Water maintains a computer data base of all approved users and hydrogeologic data on the developed wells.</p> <p>Sask Water maintains 90,000 well records on domestic wells.</p> <p>Industrial and municipal users are required to submit consumptive use data on an annual basis.</p>



APPENDIX C
GROUNDWATER LEGISLATION
MATRIX - MANITOBA

GROUNDWATER LEGISLATION MATRIX - PART A
AQUIFER PROTECTION

Manitoba
February 1991
(1 of 6)

Activity	*Act	Regulations	Standards or Guidelines	Agency	Proactive /Reactive	Notes
1. ¹ * Foreign Material Deposited as a non-point source at or near the Land Surface:						
a. Aerial Spraying of Pesticides and Fertilizers	Environment Pesticides & Fertilizer Control	Pesticides	Yearly Guidebook	Environment Manitoba Agriculture	Proactive Proactive	Departmental approval on external water bodies Regulation of commercial operators.
b. Ground Spraying of Pesticides and Fertilizers	Environment Pesticides & Fertilizer Control	Pesticides	Yearly Guidebook	Environment Manitoba Agriculture	Proactive Proactive	Regulation of commercial operators.
c. Soil Incorporation of Pesticides and Fertilizers	Pesticides & Fertilizer Control		Yearly Guidebook	Manitoba Agriculture	Proactive	Regulation of commercial operators.
d. Chemigation	None					
e. Effluent Irrigation	Environment	General		Environment	Proactive	
f. Ground spraying of effluent	Environment	Livestock production operation Private sewage disposal system		Environment	Proactive	
g. Roadway Application of Salt and Other Chemicals						
h. Acid Rain	Environment	INCO & HBM&S SO ₂ regulation		Environment	Proactive	Standards for SO ₂ emissions.

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¹ * Foreign Material means one which is released into the environment (land, air, soil, waters, or biota) from an anthropogenic source, which would not be present in significant quantities in the pristine environment. A foreign substance does not have to be hazardous, but most hazardous substances are classifiable as foreign.

* Act - indicates there is a specific groundwater requirement, if an * appears in front of Act.

GROUNDWATER LEGISLATION MATRIX - PART A
AQUIFER PROTECTION

Manitoba
February 1991
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Activity	*Act	Regulations	Standards or Guidelines	Agency	Proactive /Reactive	Notes
i. Hazardous dust (radio-active, lead)	Environment Dangerous Goods Handling and Transporta- tion	General Env. Accident Reporting Regulation		Environment	Reactive	
j. Other						
2.* Foreign Material Deposited as a point source at or near the Land Surface:						
a. Above Ground Storage Facilities:						
1. Gasoline	Environment Dangerous Goods Handling and Transporta- tion	Storage and handling of gasoline General		Environment Environment	Proactive Proactive	Departmental approval.
2. Pesticides and Fertilizer						
b. Spill from Storage Tank, Gasoline, Fertilizer, etc.	Dangerous Goods Handling and Transporta- tion Environment	Accident reporting regulation Storage and handling of gasoline		Environment Environment	Reactive Reactive	Department may set conditions. Department may set conditions.
c. Spill From Transport Vehicles	Dangerous Goods Handling and Transporta- tion Environment	Accident reporting regulation Storage and handling of gasoline		Environment Environment	Reactive Reactive	Department may set conditions. Department may set conditions.
d. Cesspools	Environment	General		Environment	Proactive	Departmental approval.

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GROUNDWATER LEGISLATION MATRIX - PART A
AQUIFER PROTECTION

Manitoba
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Activity	*Act	Regulations	Standards or Guidelines	Agency	Proactive /Reactive	Notes
e. Liquid Storage Structures (Lagoons)	Environment	General	Design criteria	Environment	Proactive	Departmental approval.
f. Liquid Spill Containment Structures (Dyked Retention Areas)	Environment	Storage and handling of gasoline	Design criteria	Environment	Proactive	Departmental approval.
g. Solids Storage Structures (Landfills)	Environment	Waste disposal grounds	Operational rules	Environment	Proactive	
h. Intensive Livestock Enterprises (feed lots)	Environment	Livestock production	General		Proactive	Large operations must register with Minister.
i. Sewage Sludge	Environment	General		Environment	Proactive	
j. Septic Fields	Environment	Private sewage disposal systems	Detailed	Environment	Proactive	
k. Buried Storage Tanks (gasoline, etc.)	Environment	Storage and handling of gasoline and associated products		Environment	Proactive	Designation of areas affected by gasoline spills as critical or sensitive. Mandatory testing of storage tanks.
l. Holding Tanks	Environment	Private sewage disposal systems		Environment	Proactive	Holding tanks required in designated sensitive areas.
m. Pipelines and Lift Stations	Public Health	Waterworks, sewage and sewage disposal		Environment	Proactive	Lift stations require departmental approval.
n. Other						
3. *Foreign Material Introduced Below the Land Surface Through Drilling Activity:						
a. Water Well (production, injection, unused)	Groundwater and Water Well Public Health	General protection of water sources	General	Manitoba Natural Resources Environment	Proactive Proactive	Drillers report required. Department approval for injection well.

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GROUNDWATER LEGISLATION MATRIX - PART A
AQUIFER PROTECTION

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Activity	*Act	Regulations	Standards or Guidelines	Agency	Proactive /Reactive	Notes
b. Oil and Gas Well (production, injection, unused) and	Municipal Mines Industrial Minerals Drilling	Bylaws petroleum products	Casing & sealing	Municipal Manitoba Energy & Mines	Reactive Proactive	May make bylaws as required.
c. Mineral Exploration Borehole	Mines Industrial Minerals Drilling	General	Permit restrictions	Manitoba Energy & Mines Manitoba Energy & Mines	Proactive	No control on base metal boreholes. Non-metallic minerals only.
d. Structure Foundation Borehole	None					
e. Waste Disposal Well (injection, unused)	Mines Public Health	Petroleum prod. protection of water sources		Manitoba Energy & Mines Manitoba Energy & Mines	Proactive Proactive	Departmental approval required. Department approval required.
f. Geophysical Boreholes	Mines	Petroleum prod.	General	Manitoba Energy & Mines	Proactive	
g. Other						
4. *Foreign Material Introduced Below the Land Surface Through Mineral Extraction Activity:						
a. Open Pit Quarries	Mines Environment	Quarrying materials General		Manitoba Energy and Mines Environment	Proactive Proactive	Rehabilitation plan required. Environmental assessment.
b. Underground Mine Workings	Mines	General		Manitoba Energy and Mines	Proactive	Departmental approval.

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GROUNDWATER LEGISLATION MATRIX - PART A
AQUIFER PROTECTION

Manitoba
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Activity	*Act	Regulations	Standards or Guidelines	Agency	Proactive /Reactive	Notes
c. Solution Mining (production maintenance, and potash mining)	Mines	General		Manitoba Energy and Mines	Proactive	Departmental approval.
	Environment	General		Environment	Proactive	Environmental assessment.
5. *Foreign Material Introduced Below the Land Surface Through General Construction and/or Operation:						
a. Canals, Locks, etc.	Water Rights	General		Manitoba Natural Resources	Proactive	License required.
	Environment			Environment	Proactive	Environmental assessment.
b. Pipelines and Tunnels	Mines	Petroleum products		Manitoba Energy and Mines	Proactive	Approval of petroleum product pipelines.
	Environment			Environment	Proactive	Environmental assessment.
c. Structure Foundation Excavations	None					
d. Drainage Wells (Surface Water)	Water Rights	General		Water Rights	Proactive	License required.
	Public Health	Protection of water sources		Environment	Proactive	No replenishment of well water except from approved source.
6. ² Hazardous Wastes:						
a. Deposited on the Land Surface	Dangerous Goods Handling and Transportation	General		Environment	Proactive	Registration of all hazardous goods required.

² Hazardous waste means one which owing to its physical, chemical, or toxicological properties, will when released in sufficient quantities into the environment, cause degradation of the environment, and pose a risk to groundwater.

Responsibility for hazardous wastes associated with old or abandoned industrial sites is not clear. A number of test cases are expected to be in court during the next year. Alberta Environment will assume responsibility where cleanup is not undertaken by the private sector.

GROUNDWATER LEGISLATION MATRIX - PART A
AQUIFER PROTECTION

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Activity	*Act	Regulations	Standards or Guidelines	Agency	Proactive /Reactive	Notes
b. Deposited in Containment Structures at the Land Surface	Dangerous Goods Handling and Transportation	General		Environment	Proactive	Licensing of handlers.
c. Deposited in the Soil Zone	Dangerous Goods Handling and Transportation	General		Environment	Proactive	Licensing of all disposal sites (under development).
d. Introduced Below Land Surface Through Drilling Activity	Dangerous Goods Handling and Transportation	General		Environment	Proactive	
e. Deposited in Containment Structures Below the Land Surface	Dangerous Goods Handling and Transportation	General		Environment	Proactive	Licensing of all disposal sites (under development).

GROUNDWATER LEGISLATION MATRIX - PART B
AQUIFER ALLOCATION

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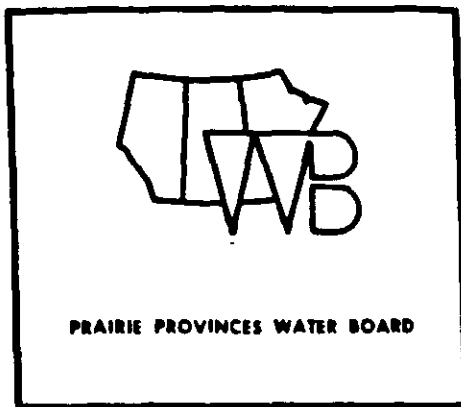
Activity	*Act	Regulations	Standards or Guidelines	Agency	Proactive /Reactive	Notes
1. Aquifer Inventory:						
a. Drilling Records	*Groundwater and Water Well	General	Drillers Report	Manitoba Natural Resources	Proactive	Drillers report format provided by Department.
b. Chemistry Records	Water Resources Administration		Program	Manitoba Natural Resources	Proactive	Individual well, as reported.
c. Groundwater Reports	Water Resources Administration		Program	Manitoba Natural Resources	Proactive	Basins, watershed, planning districts.
d. Geologic Definition	Water Resources Administration		Program	Manitoba Natural Resources	Proactive	1:250,000 availability maps. Hydrogeology reports.
e. Aquifer Evaluation	Water Resources Administration		Program	Manitoba Natural Resources	Proactive	Aquifer capacity (sustainable).
f. Formal Mapping and Reporting	Water Resources Administration		Program	Manitoba Natural Resources	Proactive	1:250,000 availability maps.
g. Data Base: i) Manual File ii) Computer File	Water Resources Administration		Program	Manitoba Natural Resources	Proactive	Majority of data stored on magnetic tape.
2. Aquifer Allocation Plan	Water Rights		Program	Manitoba Natural Resources	Proactive	All licences are within sustainable capacity of the aquifer.
3. Aquifer Allocation Procedure	Water Rights	General		Manitoba Natural Resources	Proactive	1st in time, first in right. Order of priority of use. Reservation of potable water aquifers by ministerial order.

GROUNDWATER LEGISLATION MATRIX - PART B
AQUIFER ALLOCATION

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Activity	*Act	Regulations	Standards or Guidelines	Agency	Proactive /Reactive	Notes
4. Aquifer Allocation Monitoring:						
a. Water Level Monitoring By User (Project)	Water Rights	General	Condition of license	Manitoba Natural Resources	Proactive or Reactive	Generally not enforced.
b. Water Level Monitoring By Province (Project)	Water Rights Administration		Program	Manitoba Natural Resources	Proactive	Annual review.
c. Water Level Monitoring (Regional)	Water Rights Administration		Program	Manitoba Natural Resources	Proactive	
d. Water Chemistry Monitoring By User (Project)	Water Rights	General	Condition of license	Manitoba Natural Resources	Proactive or Reactive	Generally not required.
e. Water Chemistry Monitoring By Province (Project)	Water Rights Administration		Program	Manitoba Natural Resources	Proactive	
f. Water Chemistry Monitoring (Regional)	Water Rights Administration		Program	Manitoba Natural Resources	Proactive	Annual review.
5. Aquifer Allocation Enforcement	Water Rights	General	Program	Manitoba Natural Resources	Reactive	Response to violations.
6. Aquifer Allocation Documentation	Water Rights	General	Permanent file of licenses	Manitoba Natural Resources	Proactive	

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APPENDIX D

**A SUMMARY OF A
COMPREHENSIVE GROUNDWATER
DATA BASE FOR THE
PRAIRIE PROVINCES**

A comprehensive groundwater data base should embody as a minimum the following points:

- 1) It must be as complete as possible to enable correct resource assessments and facilitate decision making.
- 2) It should be established in such a way that the data can be easily collected and quickly updated to ensure timely availability of information.
- 3) It should be easy to access and to transfer, on demand, from collection points to the locations of various end users to meet their needs as they arise.
- 4) Data bases should be standardized and should contain information pertinent to the following principal data base types:
 - Aquifer Data
 - Aquifer Definition
 - Aquifer Capacity
 - Aquifer Allocation
 - Aquifer Protection

It seems reasonable from the foregoing that data management needs can best be met if the information were to be collected and stored by computer in a digital format. Since the ability to cross-reference data in a spatial-relationship framework is extremely important, strong consideration should be given to a GIS (Geographical Information System). Data management possibilities, as an example, would include data sorted according to township and range or according to UTM (Universal Transverse Mercator) coordinates, and cross referenced to existing reports. The latter could include original drillers' reports or consultants' reports available in library files as hard copy or microfiche. The main advantage of this system and format is that it would enable a data overview across the entire prairie region in a comprehensive 'land-tie' fashion, thus permitting a large number of single point report and map data to be integrated and examined within a common, spatially-related picture across the Prairie Provinces.

It is encouraging that individual provincial data bases are already handled in such a way as to facilitate the collection of data on an ongoing basis according to the five previously- mentioned data base types.

Aquifer Data - is collected in the form of hydrography data, relating natural and human influences on the behaviour of groundwater levels. A variety of essential well, test hole and aquifer information such as lithology, aquifer and well yield parameters and quality parameters are also collected and archived.

Aquifer Definition - represents the sorting of aquifer data into a data file to establish aquifer parameters (thickness, depth) and aquifer boundaries, along with patterns of groundwater recharge and discharge and flow directions. Closely linked to this is Aquifer Capacity representing the establishment of aquifer properties such as transmissivity, storage, safe yields, recharge and discharge rates, and other factors affecting assessment of groundwater quantity.

Aquifer Allocation - represents the complete range of aquifer management functions, including aspects pertaining to legislation, licenses, permits, enforcement and monitoring. Aquifer allocation logically integrates knowledge of matters concerning land use, interaction with surface water and other resource management factors from the preceding data bases.

Aquifer Protection - consists of data or report information delineating areas requiring special protection such as recharge areas and aquifer windows. These and other aquifer circumstances are particularly vulnerable to construction, forest clearing, use of agri-chemicals and other activities which could affect groundwater quality and hence its utilization on a sustainable basis.

A SUMMARY OF A COMPREHENSIVE GROUNDWATER DATA BASE FOR THE PRAIRIE PROVINCES

DATA BASE TYPE	MAIN DATA BASE INFORMATION	IDEAL DATA BASE SITUATION
Aquifer Data	<ul style="list-style-type: none"> - Hydrograph data - Well/Test hole data (location, log, etc.) - Data Collection - Stratigraphic "picks" - hydrogeologic parameters <ul style="list-style-type: none"> - T, S, - K, Q₂₀; others - hydrogeochem.; water quality information 	<ul style="list-style-type: none"> - Hydrograph data includes both natural and man-made situations established according to Aquifer Resource Management Units with installation environment well-defined. A monitoring commitment is a minimum of 10 years for any meaningful interpretation. Should have digital input/output for efficient transfer of information to users. - Well and test hole data should be centrally located in each province and be digitally encoded for all significant attributes, preferably in standard format for all three provinces. Full GIS systems compatibility should be ensured for easy access by users through remote micro terminals. Updates should be a quick and easy process for users to receive. - Data summaries available in cross reference to well/test hole data to show geophysical logs, pump test details and data, water quality, etc. - Arrangements made to collect data from all contributing agencies in same format.

<p>Aquifer Definition (where possible)</p>	<ul style="list-style-type: none"> - Aquifer boundaries, and depth and thickness - Identification of recharge and discharge patters and directions of flow, etc. - Note: this information presupposes very detailed analysis and information gathering. This is not always the case across the prairies. 	<ul style="list-style-type: none"> - Attempts should be made to identify system relationships, such as surface water, groundwater interactions and other aquifer units to set out aquifer systems into complete groundwater resource management units. Standardized approach amongst provinces, particularly across provincial boundaries, are required to reach decisions and make joint plans concerning water and land use. - Map formats - input digitally into compatible GIS format standard for provinces, to allow for quick updates of interpretive maps as new information becomes available.
<p>Aquifer Capacity</p>	<ul style="list-style-type: none"> - Aquifer transmissivity, storage and texture - point specific yields (Q_{20}) - long-term aquifer yields 	<ul style="list-style-type: none"> - Standard aquifer capacity appraisal procedures and reporting are highly desirable to identify development potential (across provincial boundaries in particular). - Map format in standard GIS format in compatible linkage to other aquifer data for accessibility.
<p>Aquifer Allocation</p>	<ul style="list-style-type: none"> - licenses and permits - enforcement/ monitoring - legislation 	<ul style="list-style-type: none"> - Priorization of allocation carried out in accordance with knowledge of matters such as land use, water use, interaction with surface water and environmental aspects of general concern to public and concepts of sustainable resource management. - licenses and permits issued in conformance to management plan with enforcement, monitoring and dispute solving mechanism which is objectively dealt with on basis of this plan. - public informed and advised on aquifer allocation issue well ahead of development.
<p>Aquifer Protection</p>	<ul style="list-style-type: none"> - special protection areas - such as restricted zones overlying recharge areas. - zones subject to prevention of development, including construction, forest clearing, use of agri-chemicals, or other activities which could affect groundwater quality or quantity. 	<ul style="list-style-type: none"> - information available from data base; protected area defined in any reports requested from that area. - degree of protection legislated [total ban on activity (pristine)] (partial ban on activity, etc.). - "sunset" date of restrictions; permanent, or for some fixed time, then reinstated? - reasons for area's protected status. - areas where groundwater has been degraded by contaminants.