seawa

GROUNDWATER SUMMARY – SEAWA WATERSHED
SOUTH SASKATCHEWAN RIVER BASIN

SEAWA Watershed Report 2011-14
SEAWA Web-based State of the Watershed Report

Ryan Davison, AESB / Agriculture and Agri-Food Canada

Marc Dubord, M.Sc., P.Geol., Cenovus Energy

with support from hydrogeological consultants limited (HCL)

South East Alberta Watershed Alliance
721 97 Carry Drive SE
Medicine Hat, Alberta, Canada T1B 3M6

www.seawa.ca 403.488.8110

Groundwater Summary – SEAWA Watershed
Ryan Davison and Marc Dubord

Table of Contents

List of Figures

List of Tables

Introduction

Groundwater is an important resource that should be protected and sustainably managed. General references regarding the difference aspects of groundwater are readily available, and a few are provided here for completeness. Water Wells that Last for Generations (AENV and AAFC, 2010) and the Working Well Program (AENV, 2011a) are two specific references that are focused on water wells. The Alberta WaterPortal (Alberta Water Portal, 2011) is a website that provides links to many different groundwater and surface water information sources.

The SEAWA boundaries and counties comprising the basin are described in SEAWA Watershed report 2009-1 and outlined in Figure 1 (next page). The bulk of the following descriptions are taken from the groundwater reports for Cypress (hcl, 2001), 40 Mile (hcl, 2004) and Warner (Stantec, 2002) Counties in Alberta and the report for the Prelate (SRC, 2007a)[5] 72K mapsheet in Saskatchewan. More detailed information should be obtained from the relevant groundwater report for the specific area of interest.

Groundwater reports for the larger Alberta portions of the SEAWA basin include those for:

- Warner (Stantec, 2002),
- Forty Mile (hcl, 2004), and
- Cypress (hcl, 2001) Counties.

Groundwater information regarding the Saskatchewan portion of the basin is summarized in the South Saskatchewan River Watershed report (SWA, 2007), and groundwater reports by the SRC for:

- Cypress Lake (72F) (SRC, 2007b),
- Prelate (72K)(SRC, 2007a)
- Kindersley (72N) (SRC, 1990) areas, and
- specifically for the Ribstone Creek Aquifer (SRC, 2002).

Minor areas of the Basin are included in Cardston (hcl, 2003), Lethbridge, and Newell (Worley Parsons, 2008) Counties, Special Areas Nos. 2 and 3 (hcl, 200), and Taber and Acadia (hcl, 2007) Municipal Districts.

There are also more specific reports (Aquaterre, 2002; Clifton, 2002; and Sabatini, 2002) documenting local hydrogeologic conditions within the Counties. For completeness, the groundwater reports are referenced below, but information from these reports including minor portions of the basin will not be detailed in the overall discussion.

Geology

For this discussion, the sediments overlying the bedrock will be described as the surficial interval. The area is immediately underlain by glacial till with minor interbedded sands and gravels, in turn underlain by fluvial and lacustrine deposits. Pre-glacial sediments comprising sand and gravel deposits are locally distributed in the bedrock lows (Figure 2).

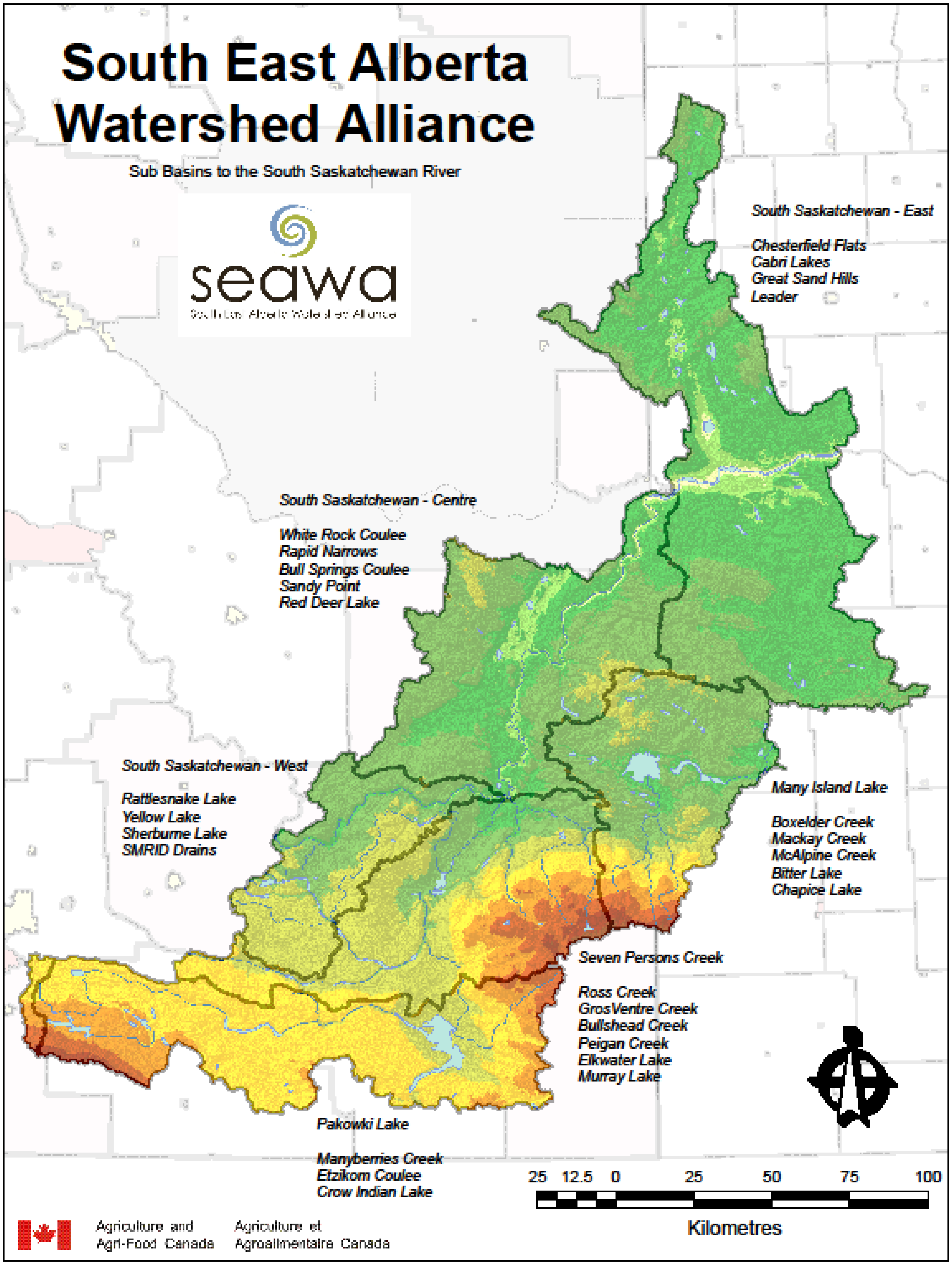

Figure 1: SEAWA Watershed Boundaries

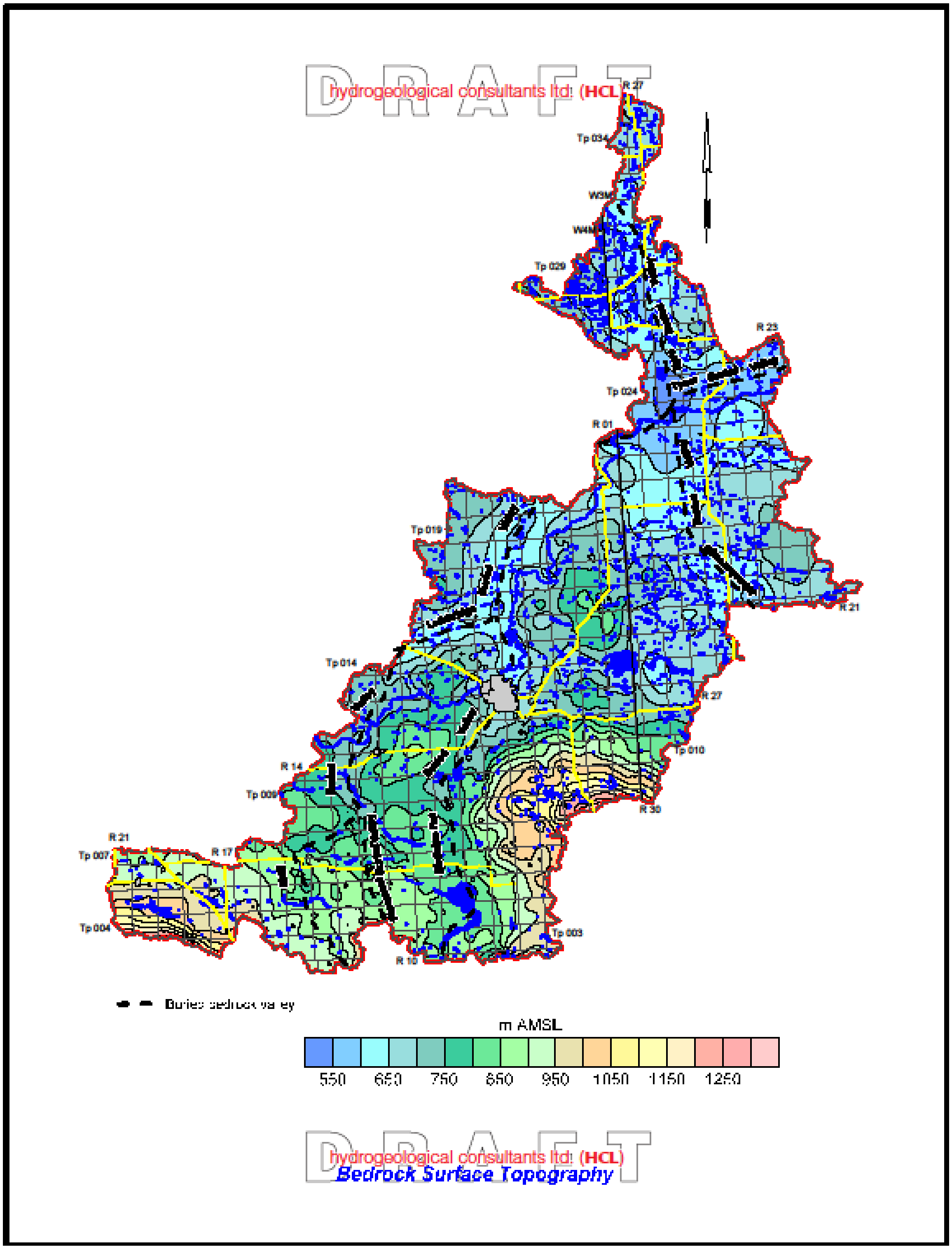

Figure 2: Bedrock Surface Topography

The thickness of the surficial interval is indicated in Figure 3.

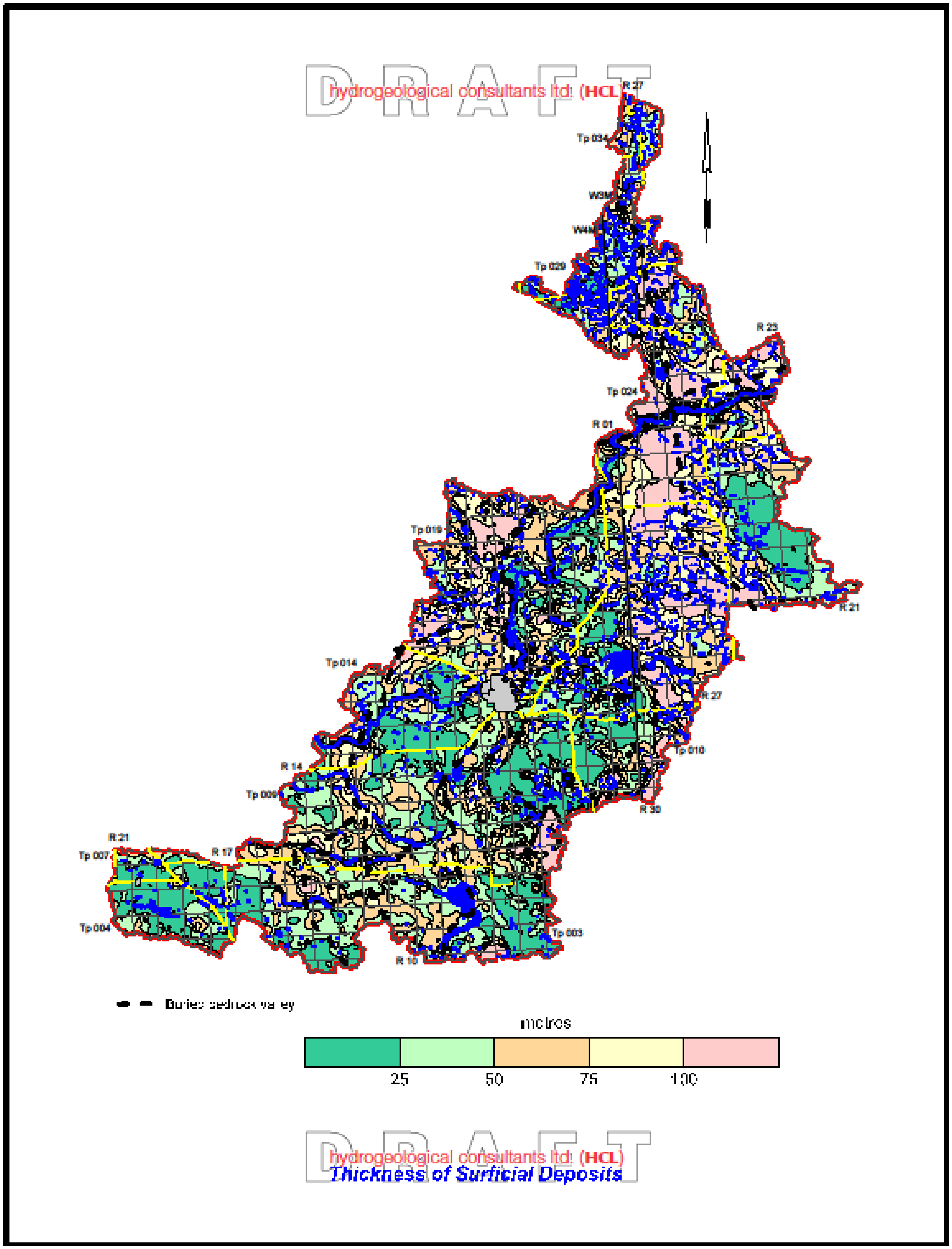

Figure 3: Thickness of Surficial Deposits

The degree of mapping and rigor of the stratigraphic nomenclature for the surficial interval varies depending on the jurisdiction. In Alberta, the units are generally described according to the depositional setting or conditions, including: unstratified glacial till (typically fine grained deposited in glacial melt conditions); stratified glacio-fluvial deposits (typically well sorted, coarser grained sediments deposited in higher energy environments, including pre-glacial channel sands located in the bedrock lows); and lacustrine deposits (typically well sorted, fine grained materials deposited in quiet conditions). In Saskatchewan the glacial till units are described, from the ground surface downwards, as the Saskatoon and Sutherland Groups. In broad terms, the pre-glacial interval overlying the bedrock is described as the Empress Group.

The bedrock surface topography is presented in Figure 2. In Alberta, the main buried bedrock channel is the east- to north-trending Lethbridge Buried Valley, which is intersected by the north-trending Skiff and Medicine Hat Valleys. In Saskatchewan, the two north-trending Johnsborough and Eyre Buried Valleys intersect the main east-trending Tyner Buried Valley in the Twp 24, Rge 27 W3M area.

A subcrop map for the Alberta portion of the basin is presented as Figure 4. The subcropping bedrock includes, from the youngest units downwards:

Bearpaw Formation – shale with occasional sandstone beds
Oldman Formation – sandstone, siltstone, shale and coals } = Belly River = Judith River
Foremost Formation – sandstone and shale }
Pakowki Formation = Lea Park equivalent - shale. (See note below)
Milk River Formation– sandstone and shale

Note: this includes the Ribstone Creek Tongue in SW Sask.

More details can be obtained from the groundwater report for the specific areas and intervals as previously described.

Base of Groundwater Protection / Base of Groundwater Exploration

The Base of Groundwater Protection (BGWP) is an Alberta specific concept developed with the intent of managing and protecting groundwater (ERCB, 2007). The BGWP hinges on the characterization of water based on mineralization expressed as total dissolved solids (TDS). Waters with less than 4,000 mg/L are described as non-saline, water with greater than 4,000 mg/L are described as saline. AENV manages non-saline water through the licencing of non-domestic groundwater use and the ERCB manages saline water through reporting requirements.

A similar approach for managing groundwater, without the stipulation of mineralization, is used in Saskatchewan. The Base of Groundwater Exploration is described (SRC, 1971) as the practical limit of groundwater exploitation for domestic or agricultural use. Groundwater from below the base of groundwater exploration is considered either too saline or at too great a depth to warrant drilling for small users.

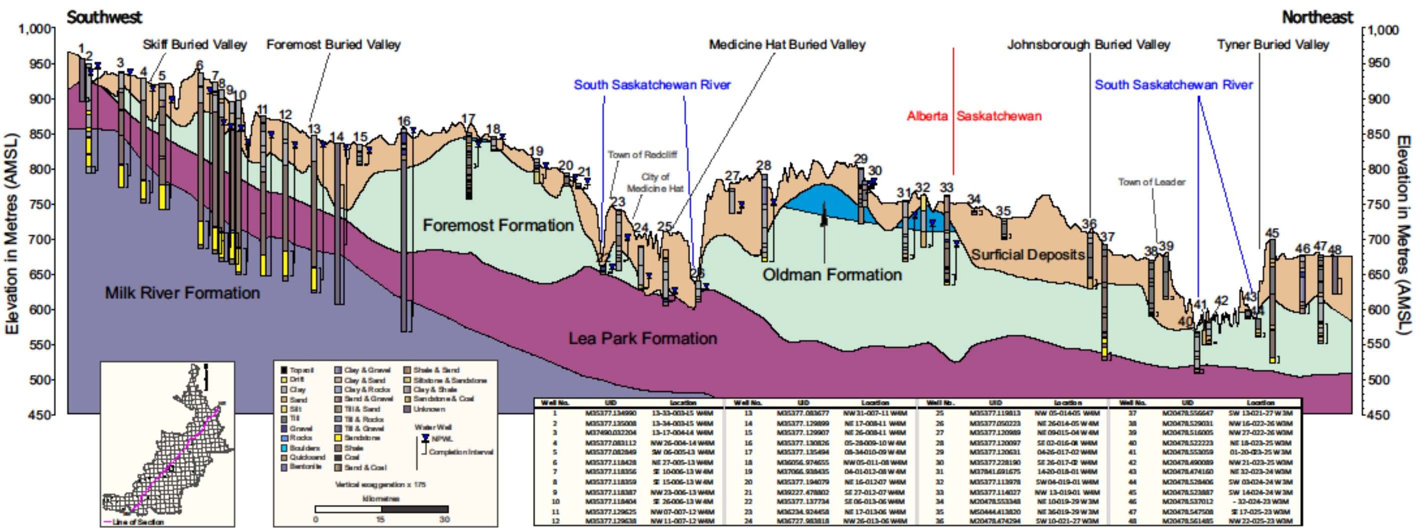

Figure 4: Subcrop Map

Groundwater Observation Well Network Monitoring

The Groundwater Observation Well Network (GOWN) (AENV, 2011b) is a system of dedicated monitoring wells located throughout Alberta. The GOWN is managed by AENV and provides information on groundwater trends and, in some cases, water quality of the monitored intervals. Information from the GOWN wells can be easily obtained on Alberta Environment's website. A similar network is operated in Saskatchewan by the Saskatchewan Watershed Authority.

There are six GOWN wells located in the SEAWA Basin. These include:

- a shallow (<30 m deep) interval well "Cypress 85-1" at 2-4-7-2-4 completed in the Upper Bearpaw;
- two intermediate (30 – 100 m deep) wells completed in the surficial aquifer - "115 Ross Creek 2288E" at 16-10-12-4-4, and "Elkwater 2294E" at 6-24-8-3-4;
- three deep wells (>100 m deep) competed in the Milk River interval – "Forty Mile Coulee 86-1" at SW 33-8-11-4, "Foremost (Town)" at 16-17-6-11-4, and "Warner 85-2 south" at 1-15-5-17-4.

Aquifers

There are aquifers both within the surficial and bedrock intervals in the Basin.

In the surficial interval, laterally discontinuous, water-bearing sands and gravels occur outside of the bedrock surface low (buried bedrock channel) areas. Coarser deposits in the bedrock channels typically form prolific, more sustainable water-bearing intervals.

Bedrock aquifers are exploited in different parts of the Basin primarily as a function of available water productivity from the overlying surficial interval. In practical terms, the shallower interval (surficial or bedrock) will be exploited initially depending on water quality and quantity requirements.

Water Wells and Springs

Water wells and spring distribution within the basin are presented in Figure 5. Apart from springs developed due to local topographic variability and geologic conditions, the majority of the documented springs in the basin are concentrated to the north and west of the Cypress Hills. Water wells are typically completed in the Oldman and Foremost Formations across most of the SEAWA Basin. Wells completed in the MilkRiver Formation are common in the southern portion of the Basin. The County groundwater reports should be referred to for further information.

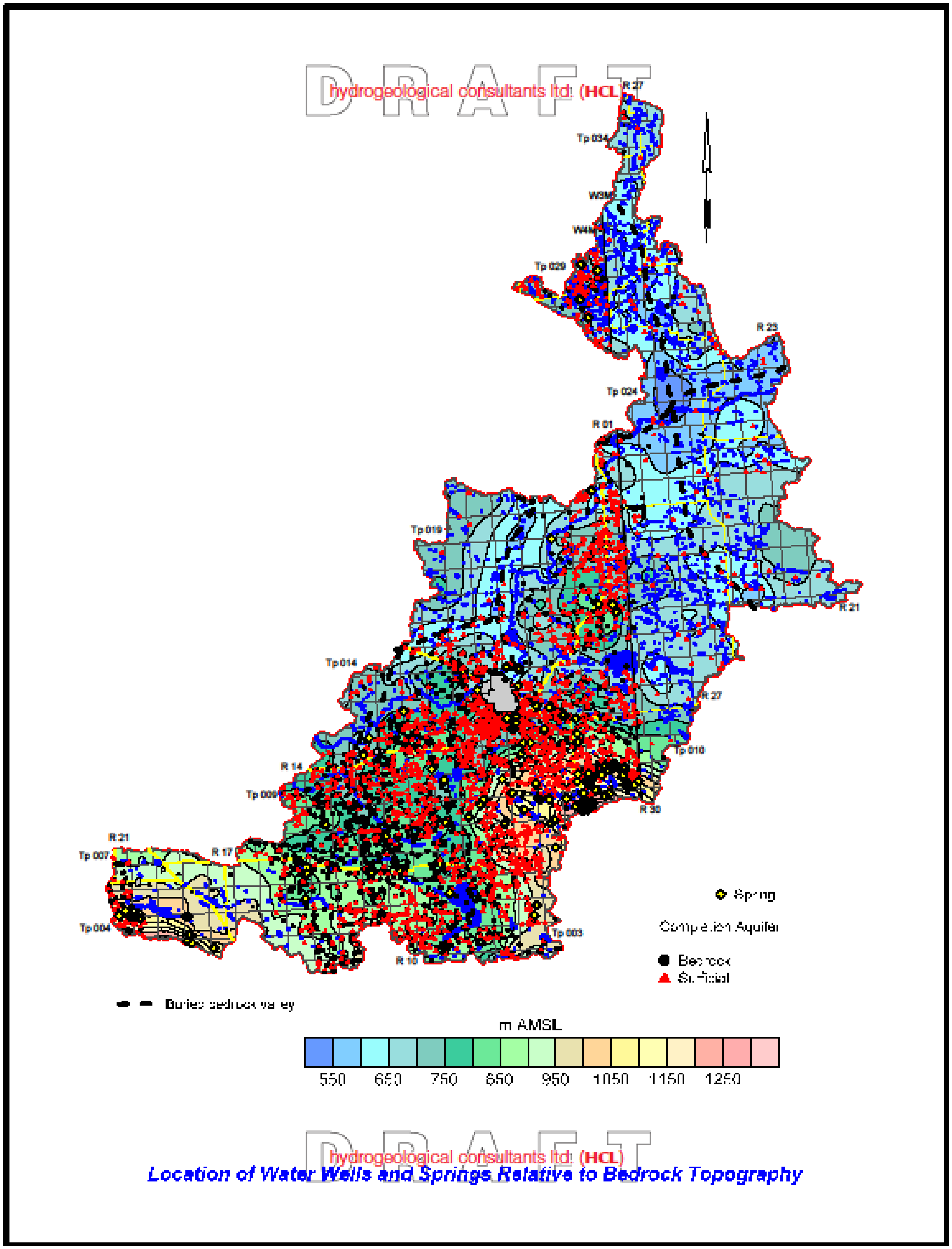

Figure 5: Location of Water Wells and Springs

Water Well Types

The surface casing types used in drilled water wells relative to the age of completion is presented in Figure 6.

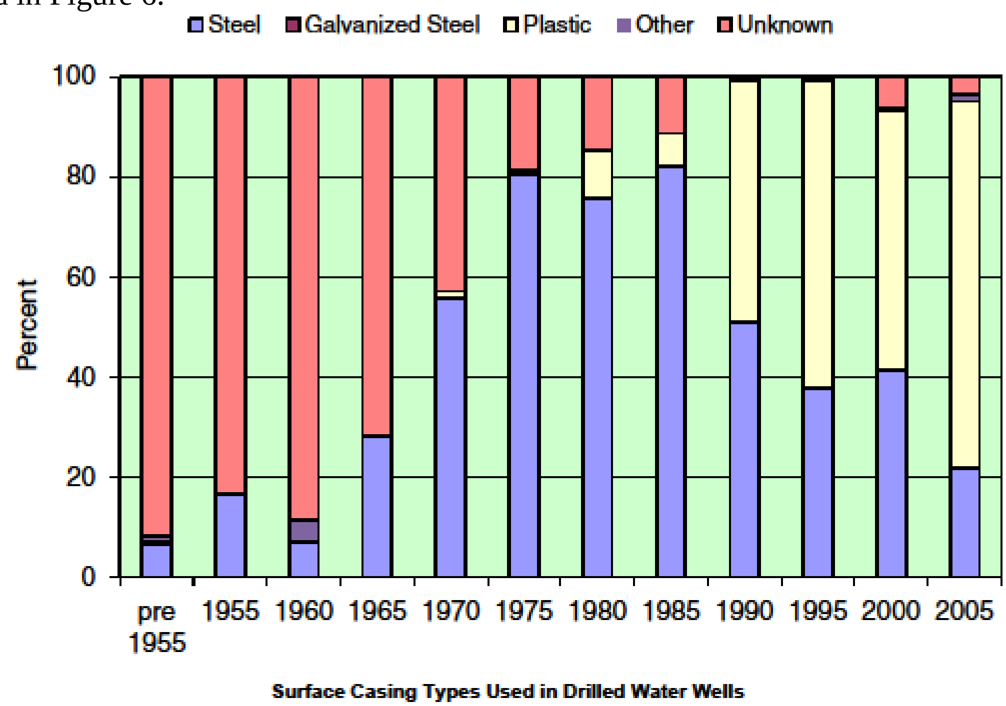

Figure 6: Surface Casing Types

Determination of the specific number of water wells, their construction methods (i.e., drilled vs. dug) and ages are outside the scope of this discussion. However, there are a number of generalizations that can be made for the basin:

- bored wells are more common in areas of low groundwater potential.
- most dug wells are expected to be comparatively older (i.e. in County of Warner, hand dug wells are pre-1960).
- steel and/or plastic casing have been the preferred casing material since the 1960's, and plastic has dominated since 2000.

Water Well Yields

Estimated water well use per section per day is presented as Figure 7. Note that this information is estimated from the anticipated daily use for a domestic water well multiplied by the density of wells in the section. One of the more dependable sources for identifying the potential for groundwater are experienced local water well drillers; however, the ultimate proof is the actual installation of a water well.

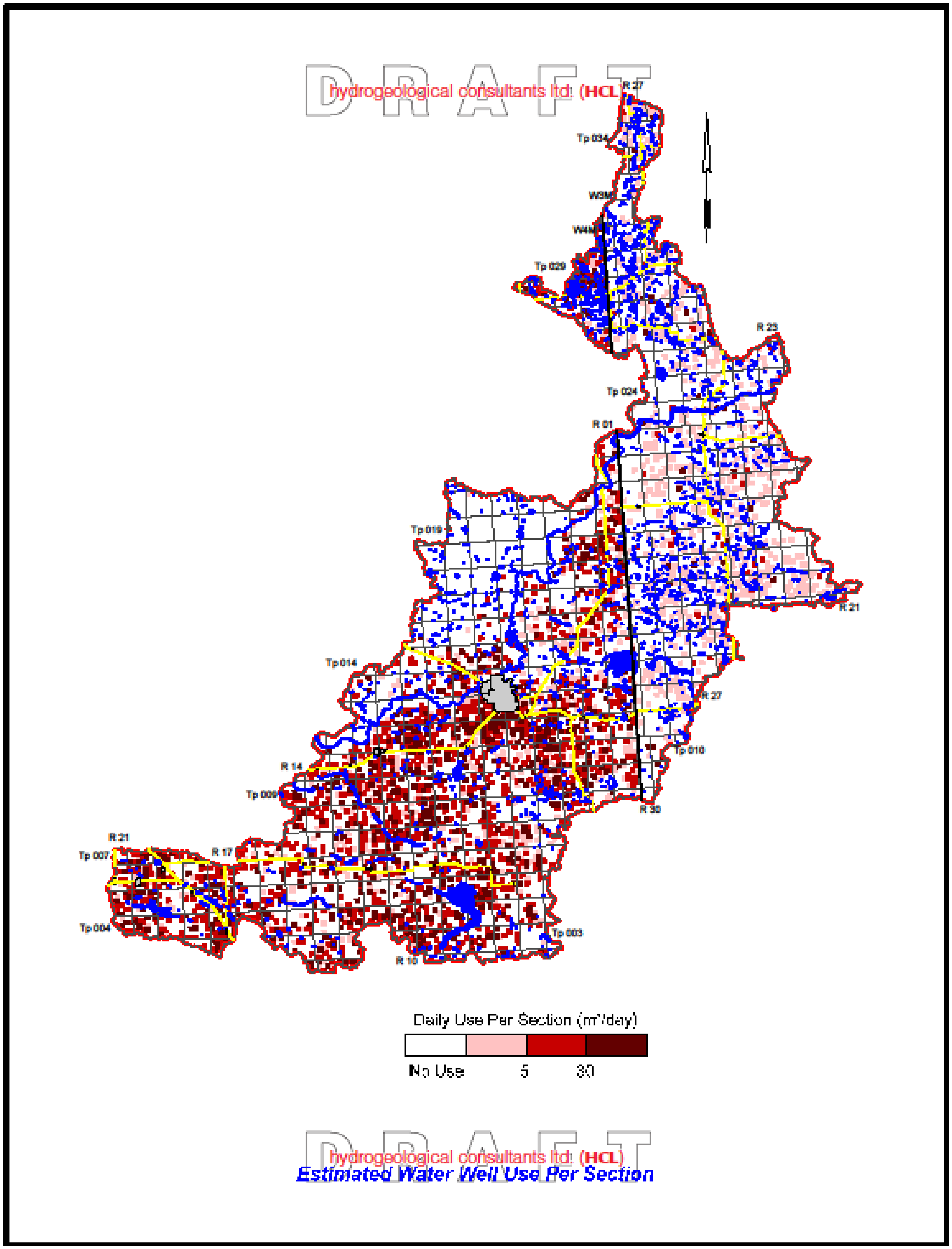

Figure 7: Estimated Water Well Use Per Section

Surficial

The apparent yield for water wells completed in sand and gravel aquifers is summarized in Figure 8.

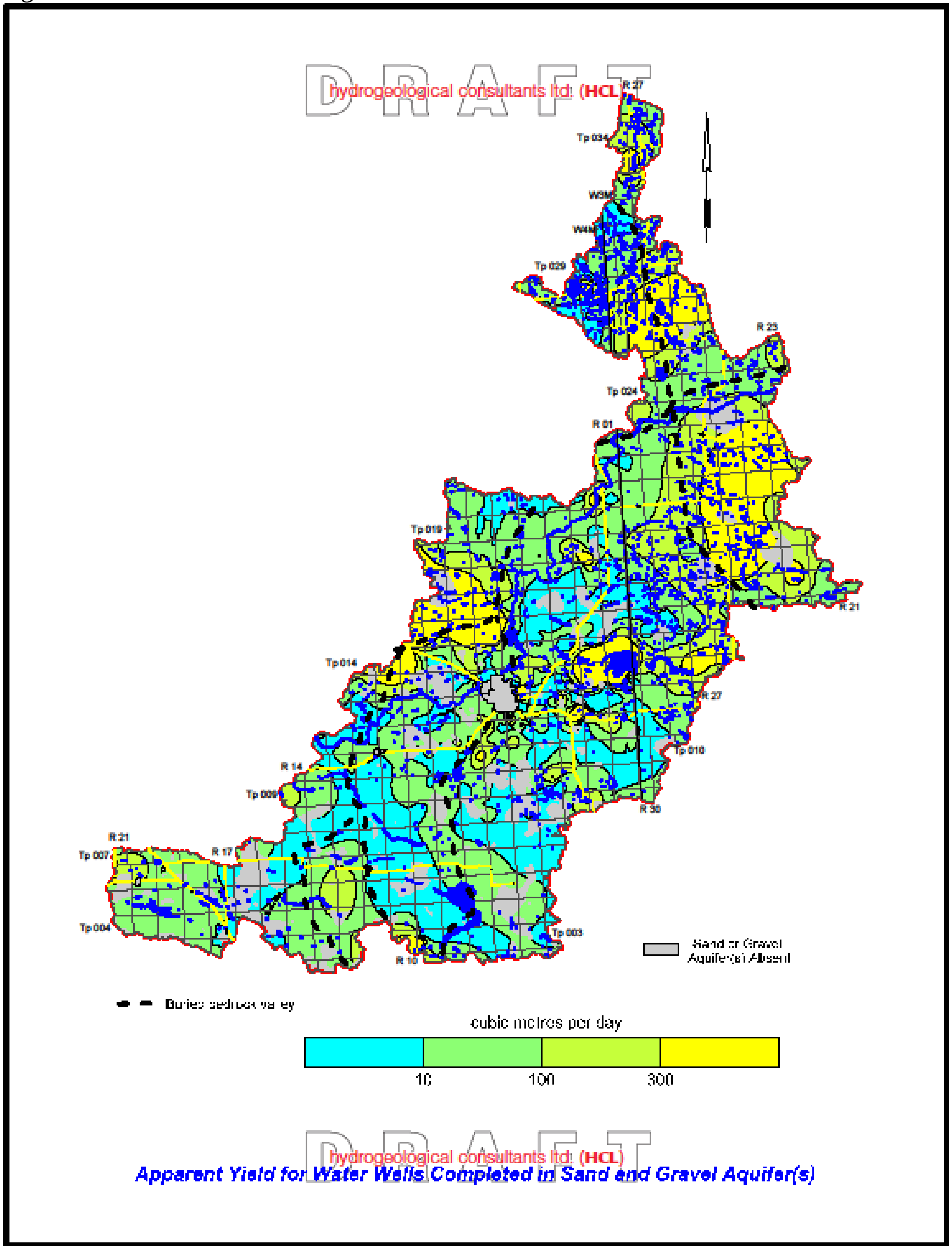

Figure 8: Apparent Yield for Water Wells in Sand and Gravel Aquifers

Bedrock

The apparent yield for water wells completed in upper bedrock aquifers is summarized in Figure 9.

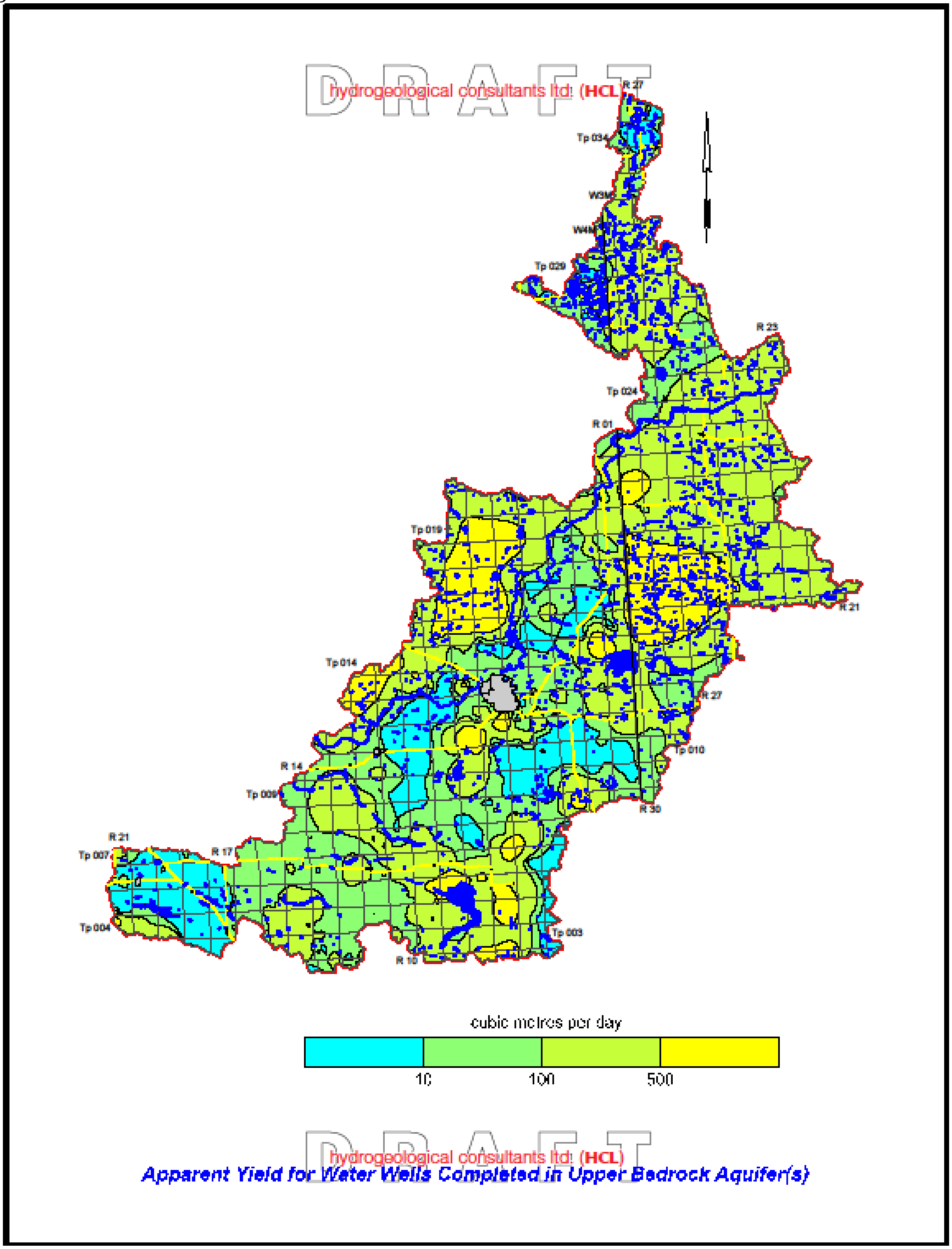

Figure 9: Apparent Yield for Water Wells in Upper Bedrock Aquifer

Groundwater Quality

The variation in the groundwater quality can provide a clue as to the origin of the water. In shallow surficial aquifers, water enters the flow system through infiltration and flows to discharge in a relatively short time. In general the water is hard and predominately calcium bicarbonate or calcium sulfate type with varying concentrations of iron, manganese and sulfates. Total Dissolved Solids (TDS) concentrations typically range from 500 mg/l to 1500 mg/l depending on depth, residency time, and lithology of the aquifer. Shallow groundwater quality is vulnerable to contamination from surface sources, and elevated nitrates have been found in areas built over with septic fields or various commercial operations. (Bel-MK Eng. 1998) TDS concentration of surficial deposits is summarized in Figure 10.

Water from bedrock is resident for a longer time in the formation and is influenced by different surrounding materials. Total Dissolved Solids (TDS) of water from bedrock is generally over 1500mg/l and is predominately sodium-sulfate type. The water is usually soft, and from a greater depth. In the north and eastern parts of the watershed, wells are developed in the sandstone of the Oldman and Foremost (Belly River, SK) Formations. Water is predominantly the sodium sulfate type in the 2500-4000 mg/L range with concentrations of sodium, manganese and sulfates exceeding the Aesthetic Objectives (AO) of the Guidelines for Canadian Drinking Water Quality (GCDWQ) (Clifton Assoc 2002). In the south and west of the watershed, bedrock wells are more commonly completed in sandstone of the Milk River Formation. Wells are deeper, and mineralization is higher in the Piegan Creek area and decreasing to the south west. (AGRA 1998) . Sodium, chloride and fluoride concentrations may exceed GCDWQ guidelines for Aesthetic Objectives. TDS concentration of bedrock deposits is summarized in Figure 11

In addition to providing a safe secure water source for rural residents, groundwater plays an important role in providing base flow for creeks and rivers. In the winter months, mineral concentrations increase, and the influence of the groundwater can be noticed in the City of Medicine Hat as the river water becomes harder.

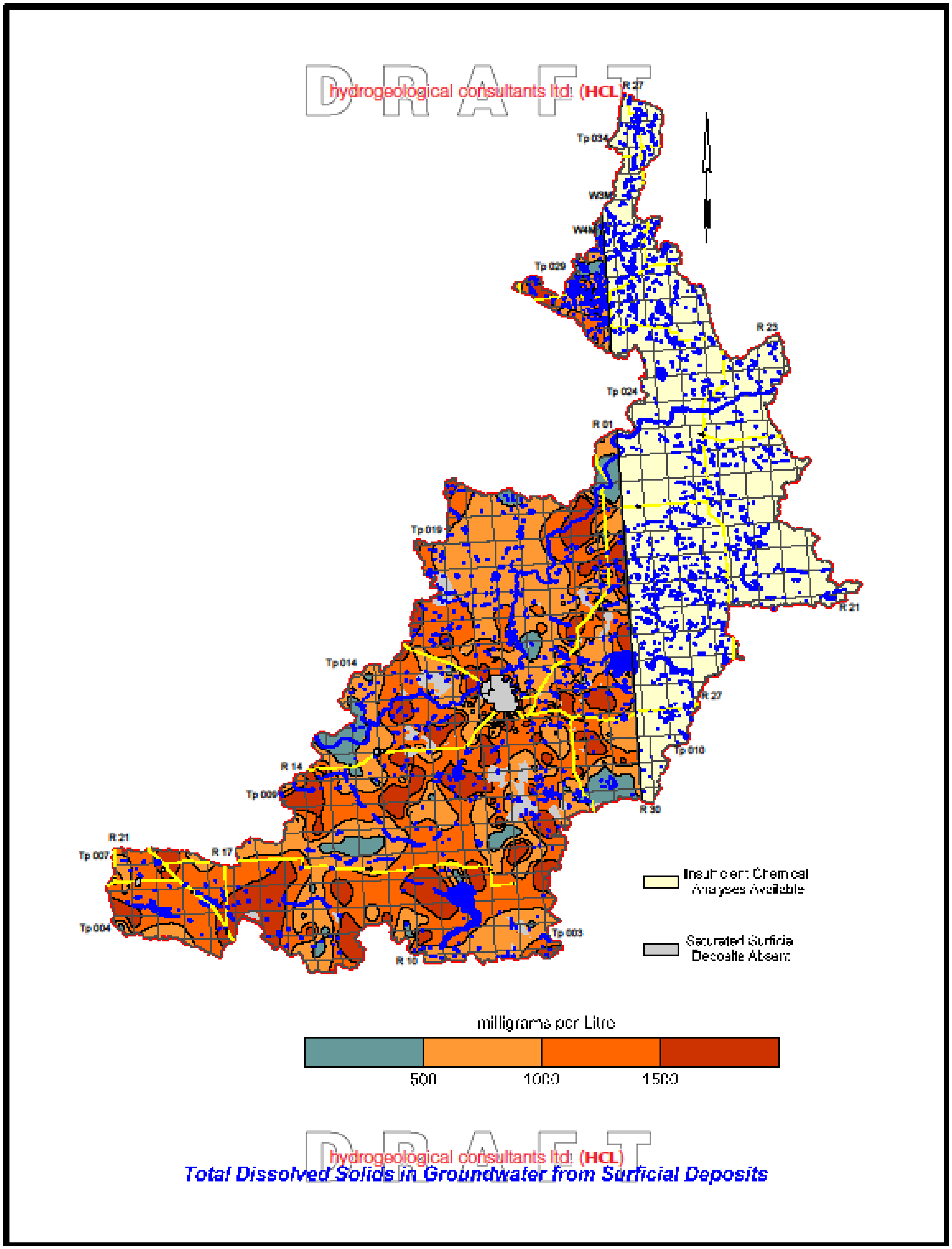

Figure 10: Total Dissolved Solids in Groundwater from Surficial Deposits

Surficial

Total dissolved solids distribution in groundwater from surficial aquifers is presented as Figure 10 and summarized in Table 1, below.

Aquifer	Water Type(s)	TDS range	Typical TDS range or single value	Source	Comments
Quaternary	$Ca/Mg/Na \pm SO_4/HCO_3$	225 – 151,000	200 – 2,000	72K	Saline waters related to discharge areas
Surfical (40 Mile)	Mixed cation-HCO_3/SO_4	130 – 10,704	1,455	hcl	SO_4 rich waters with higher TDS
Surficial (Cypress)	$Ca\text{-}Mg\text{-}HCO_3/SO_4$	84 – 12,610	1302	hcl	
Surficial (this study)	$Ca\text{-}Mg\text{-}HCO_3/SO_4$ (interpreted)	84 – 21736	1267	hcl (this study)	
Surfical (Warner)	$Ca\text{-}Na\text{-}HCO_3/SO_4$ (interpreted)	86 – 16,800	1,317	Stantec (2002)	

Table 1: Concentrations of Constituents from Surficial Deposits

Bedrock

Total dissolved solids distribution in groundwater from upper bedrock aquifers is presented as Figure 11 and summarized in Table 2, below.

Aquifer	Water Type(s)	TDS range	Typical TDS range or single value	Source	Comments
Judith River	$Na \pm SO_4 \pm Cl \pm HCO_3$	820 -12,200	1,00 – 3,000	72K	
BearPaw	$Na \pm SO_4 \pm HCO_3$	200 – 5,600	500 – 2,500	72K	
Eastend-Cypress Hills	$Ca/Mg \pm SO_4/HCO_3$ and $Na\text{-}HCO_3$	300 – 2,400	300 – 2,400	72K	
Upper BR (40 Mile)	Na-Cl (North part) $Na\text{-}HCO_3/SO_4$ (south part)	115 – 12,557	1,402	hcl	
Upper BR (this study)	$Na\text{-}HCO_3\text{-}SO_4$ (interpreted)	5 – 26,646	1,470	hcl (this study)	
Bedrock (Warner)	$Na\text{-}HCO_3\text{-}SO_4$ (interpreted)	2 – 22,268	2,128	Stantec (2002)	

Table 2: Concentrations of Constituents in Groundwater from Upper Bedrock Aquifers(s)

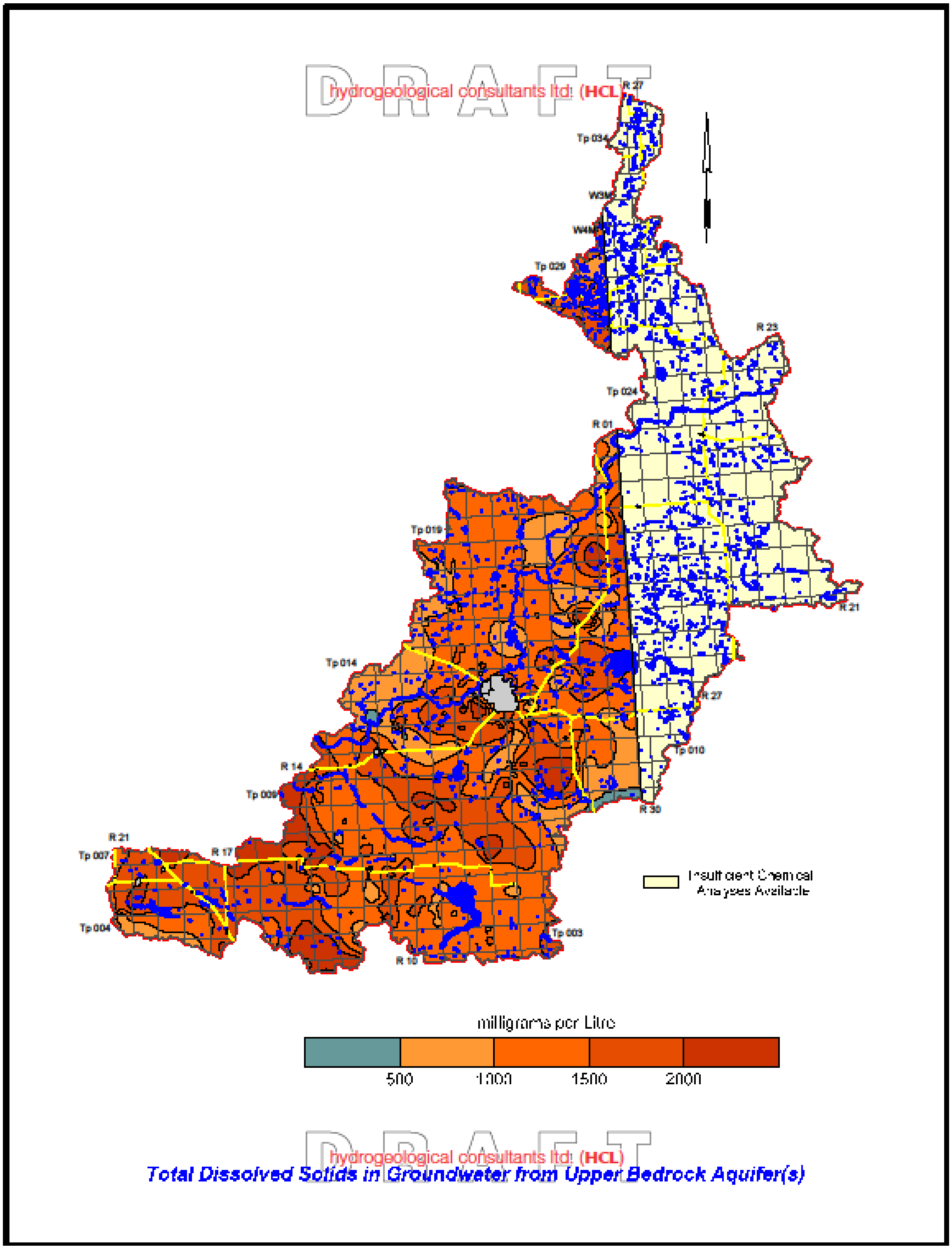

Figure 11: Total Dissolved Solids in Groundwater from Upper Bedrock Aquifer(s)

Groundwater Allocation and Use

In Alberta, there is an important distinction made between how much water is allocated to a particular licence as opposed to how much is actually used. In 2005 Alberta Environment commissioned AMEC to report on allocation and use in Alberta. While the main focus of the study was on surface water, the 734 pg report also contains a quantity of useful information related to groundwater that has been compiled in Table 3.

By 2003, under the new Water Act, 658 water wells had been registered in the basin. For the most part, these are located on farms and used for traditional **agricultural** purposes. This number is a good measure of the relative importance of the groundwater in the basin as indicated by the well owner's interest in acquiring a priority date through the registration process. Overall, agricultural use of groundwater is forecasted to steadily increase into 2025.

Urban **municipal** groundwater licences are held by the respective counties, for the villages of Hilda, Schuler, Irvine, Elkwater, Irvine, Manyberries, Etzikom, Foremost, Skiff and Wrentham. There are 19 of these "urban" groundwater licences held, with the annual use estimated to be 525 dam3. In addition, there are 31 rural municipal licences held by groups such as water co-ops, colonies, community halls, farmsteads, and subdivisions. While the development of water pipelines into some areas replace groundwater sources, this demand on the resource is predicted to increase based on population growth trends.

Groundwater Allocation and Use in the SEAWA Basin				
PURPOSE	USE / ACTIVITY	NUMBER OF LICENCES OR REGISTRATIONS	ALLOCATION (dam3)	USE (dam3)
Agricultural	Registration	658	525.5	525.5
	Stockwater	44	234.1	234.1
	Feedlots	2	40.4	40.4
	Irrigation	2	153	153
Municipal	Urban	19	1,982	525
	Rural	31	127	126
Commercial	Parks and Recreation	3	69.1	12.8
	Other	1	49.6	49.6
Petroleum	Injection	1	1.2	1.2
	Gas Plants	1	10	10
Industrial	Manufacturing	2	909.1	909.1
Other		0	0	0
TOTAL		764	4101	2586.7
1. Current and Future Water Use in Alberta - AMEC Earth and Environmental , for Alberta Environment, March 2007				

Table 3: Groundwater Use and Allocation in the SEAWA Basin.

There are 3 **commercial** licences for groundwater for Parks and Recreation and 1 for an undefined activity. Other possible activities designated as commercial may include aggregate washing, construction, or golf courses. Groundwater use is not forecasted to increase significantly for this sector

The **petroleum** sector may use groundwater for injection to stimulate production. EUB data indicates there is only 1 such licence in the basin issued in the 1970’s. Estimates of water used for injection activities as prepared by Genowa found that 178 dam3 of saline water was injected in 2005. No source was specified. One licence for 10 dam3 is also issued for one of the gas plants. It is forecasted that water requirements for the sector will decline as production from existing fields decreases.

Two licences have been issued **manufacturing** activities in the basin allowing withdrawls of up to 909 dam3. They were issued in the1960s and have remained unchanged and it is forecast to continue at this rate into the future.

Aquifer Vulnerability Index (AAFRD 2005) and Risk of Groundwater Contamination

The risk of groundwater contamination, as estimated by hydrogeologic consultants ltd (HCL). is presented as Figure 12, and the criteria used to generate the risk rating is summarized in Table 4, below. The following paragraph, as provided by HCL, described the risk process.

> *The main source of groundwater contamination involves activities on or near the land surface. The risk of groundwater contamination is high when the near-surface materials are porous and permeable and low when the materials are less porous and less permeable. The two sources of data for the risk analysis include (a) a determination of when sand and gravel is or is not present within one metre of the ground surface, and (b) the surficial geology map. The presence or absence of sand and gravel within one metre of the land surface is based on a geological surface prepared from the data supplied on the water well drilling reports. The information available on the surficial geology map is categorized based on relative permeability. The information from these two sources is combined to form the risk assessment map.*

Surface Permeability	Sand or Gravel Present – Top Within One metre of Ground Surface	Groundwater Contamination Risk
Low	No	Low
Moderate	No	Moderate
High	No	High
Low	Yes	High
Moderate	Yes	High
High	Yes	Very High

Table 4: Risk of Groundwater Contamination Criteria (from HCL)

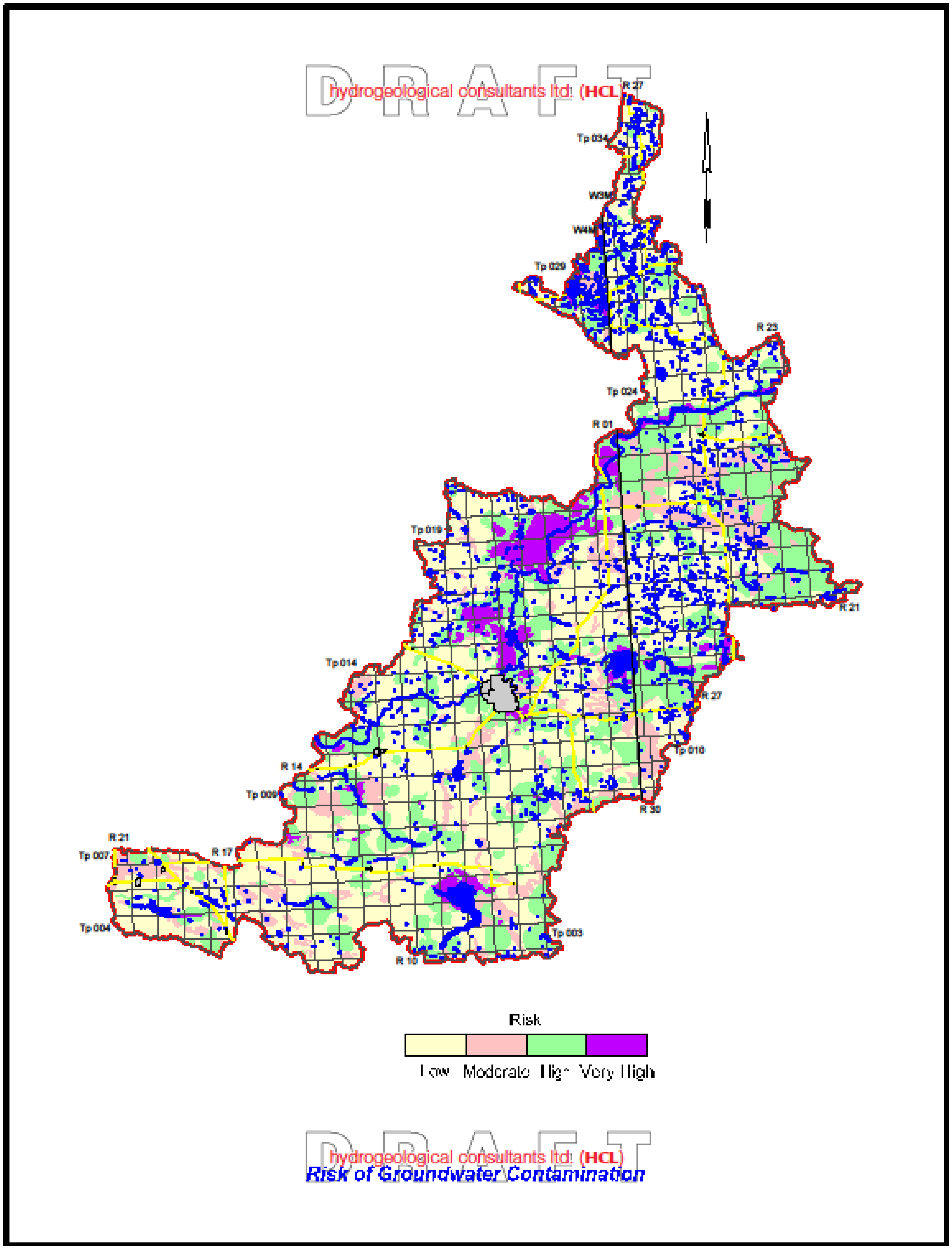

Figure 12: Risk of Groundwater Contamination

References

AENV and AAFC (Alberta Environment, and Agriculture and Agri-Food Canada), 2010. Water Wells that last for Generations (7th ed.). Available on-line at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/wwg404.

AENV (Alberta Environment), 2011a. Working Well Program. Available on-line at: http://environment.alberta.ca/02207.html

AENV (Alberta Environment), 2011b. Groundwater Observation Well Network. Available on-line at: http://www.environment.alberta.ca/apps/GOWN/

Alberta Water Portal, 2011. Website available on-line at: http://www.albertawater.com/.

Aquaterre Solutions Inc., 2002. Groundwater Assessment for the County of Forty Mile, Peigan Creek Area, Southern Alberta. Prepared for AAFC-PFRA.

Christiansen, E., 1971. Geology and Groundwater Resources of the Regina Area (72I) Saskatchewan. Saskatchewan Research Council Geology Division, Map No. 13.

Clifton Associates Ltd, 2002. Potable Groundwater Investigation, Test drilling and evaluation of the Foremost Aquifer, Schuler-Hilda Area, Cypress County Alberta. Prepared for Cypress County and the AACF-PFRA.

ERCB (Alberta Energy and Utilities Board), 2007. ST55-2008: Alberta's Base of Groundwater Protection (BGWP) Information. Bulletin 2007-10, April 19, 2007.

Hydrogeological consultants ltd. (hcl), 2000. Special Areas 2,3 and 4, and M.D. of Acadia, Part of the Red Deer, and the South and North Saskatchewan River Basins, Parts of Tp 019 to 037, R 01 to 18, W4M, Regional Groundwater Assessment, Prepared for Special Areas 2,3 and 4, and M.D. of Acadia in conjunction with AAFC and PFRA. hcl File No. 99-101.

Hydrogeological consultants ltd. (hcl), 2001. Cypress County, Part of the South Saskatchewan and Missouri River Basins, Tp 001 to 021, R 01 to 13, W4M, Regional Groundwater Assessment. Prepared for Cypress County in conjunction with AAFC and PFRA. hcl File No. 01-149.

Hydrogeological consultants ltd. (hcl), 2003. Cardston County, Part of the South Saskatchewan and Missouri River Basins, Tp 001 to 007, R 19 to 29, W4M, Regional Groundwater Assessment. Prepared for Cardston County in conjunction with Agriculture and Agri-Food Canada (AAFC) and Prairie Farm Rehabilitation Administration (PFRA). hcl File No. 02-100.

Hydrogeological consultants ltd. (hcl), 2004. County of Forty Mile No. 8, Part of the South Saskatchewan and Missouri River Basins, Tp 001 to 013, R 05 to 14, W4M, Regional Groundwater Assessment. Prepared for County of Forty Mile no. 8 in conjunction with AAFC and PFRA. hcl File No. 03-215.

Hydrogeological consultants ltd. (hcl), 2007. Regional Groundwater Assessment, part of the South Saskatchewan River Basin Parts of Tp 007 to 015, R 12 to 20, W4M. Prepared for M.D. of Taber in conjunction with AAFC and PFRA. hcl File No. 07-322.03.

Sabatini Earth Technologies, 2002. Gros Ventre Groundwater Assessment, Parts of Twp 8-9, Rge3-4W4M. Prepared for Cypress County and the AACF-PFRA.

SRC (Saskatchewan Research Council Geology Division (author E. Christiansen.)), 1971. Geology and Groundwater Resources of the Regina Area (72I) SRC Geology Division, Map No. 13.

SRC (Saskatchewan Research Council (author M.J. Millard)), 1990. Geology and Groundwater Resources of the Kindersley Area (72N), Saskatchewan. SRC Pub. No. R-1210-9-E-90.

SRC (Saskatchewan Research Council, (authors H. Maathuis and M. Simpson)), 2002. Hydrogeology of the Ribstone Creek Aquifer in Western Canada, by. Prepared for AAFC and PFRA. SRC Pub. No. 11500-1E02.

SRC (Saskatchewan Research Council, (authors H. Maathuis and M. Simpson)), 2007a. Groundwater Resources of the Prelate (72K) area, Saskatchewan. Prepared for SWA, SRC Pub. No. 11975-1E07.

SRC (Saskatchewan Research Council (authors H. Maathuis and M. Simpson)), 2007b. Groundwater Resources of the Cypress Lake (72F) area, Saskatchewan. Prepared for the Saskatchewan Watershed Authority (SWA). SRC Pub. No. 11974-1E07

SWA (Saskatchewan Watershed Authority), 2007. Background Report, South Saskatchewan River Watershed, 108 pp.

Stantec Consulting Ltd., 2002. Regional Groundwater Assessment of Potable Groundwater in County of Warner No. 5, Alberta. Prepared for County of Warner. File. No. 1-02-15277.

WorleyParsons Komex, 2008. Regional Groundwater Resource Assessment for the County of Newell No.4. Prepared for County of Newell and AAFC-PFRA..File No. E00025059.

seawa
South East Alberta Watershed Alliance

South East Alberta Watershed Alliance
721 97 Carry Drive SE
Medicine Hat, Alberta, Canada T1B 3M6

www.seawa.ca 403.488.8110

The **South East Alberta Watershed Alliance (SEAWA)** was formed in 2007, incorporated as a non-profit society in 2008, and designated as the WPAC (Watershed Policy and Advisory Council) for the South Saskatchewan River sub-basin.

SEAWA Vision: *A healthy watershed that provides balance between social, environmental and economic benefits.*

SEAWA Mission: *South East Alberta Watershed Alliance brings together diverse partners to plan and facilitate the sustainable use of the South Saskatchewan River Watershed for present and future needs.*

SEAWA Members include interested individuals throughout the watershed along with our communities, ranchers, farmers, industries, companies, governments, conservation groups and educational institutions. We are proud to include the following among our founding members:

Government Sector: Alberta Government, City of Medicine Hat, Government of Canada, Cypress County, Palliser Health Region, Town of Redcliff, Town of Bow Island, and Special Areas Board.

Land Resource - Industry and Agriculture Sectors: St Mary River Irrigation District, Murray Lake Ranching, GG Bruins Farms, Short Grass Ranches, Canadian Fertilizers Limited, Redcliff Technology Enterprise Centre, Box Springs Business Park, and Canadian Centre for Unmanned Vehicles.

Academic, Research and Non-Governmental Organizations Sectors: Medicine Hat College, Alberta Research Institute, Red Deer River Watershed Alliance, and Hyperion Research.

Tourism and Conservation Sectors: Grasslands Naturalists, Canadian Badlands, and Medicine Hat Interpretive Program.

SEAWA Web-based State of the Watershed Report is managed by the *SEAWA State of the Watershed Committee (members - 2010)*:

Dr Peter Wallis, SoW Chair, *Dean of Science Medicine Hat College*
Gary Bierback, SEAWA Vice-Chair, *St Mary River Irrigation District*
Grayson Mauch, *City of Medicine Hat* Water and Wastewater
Herb Scott, *Cypress County*
Stuart Murray, *Murray Lake Ranching*
Mike Maxwell, *Métis* member
Jennifer Nitschelm, *Alberta Agriculture and Rural Development*
Major Dan Davies OMM CD (Canadian Forces retired)
Russ Golonowski, *Canadian Fertilizers Limited*
Ryan Davison, *Agriculture and Agri-Food Canada* PFRA
Marc Dubord, *Cenovus Energy*
Nivea de Oliveira, *Alberta Environment*
Monique Dietrich, *Alberta Environment*
Audrey Goodwin, *Alberta Environment*
Bob Kaufman, *AESA, Cypress County and County of 40 Mile*
Gerard Klotz, *Medicine Hat College*
Maggie Romuld, *SEAWA Watershed Coordinator*
Bob Phillips, *SEAWA Executive Director*

SEAWA Watershed Reports are part of our Web-based State of the Watershed Report.

Funding for this series of SEAWA Watershed Reports was provided by:

Government of Alberta