

11 CONVERSIONS

Multiply	by	To Obtain
Length/Area		
feet	0.304 785	metres
metres	3.281 000	feet
hectares	2.471 054	acres
centimetre	0.032 808	feet
centimetre	0.393 701	inches
acres	0.404 686	hectares
inchs	25.400 000	millimetres
miles	1.609 344	kilometres
kilometer	0.621 370	miles (statute)
square feet (ft ²)	0.092 903	metres (m ²)
metres (m ²)	10.763 910	square feet (ft ²)
metres (m ²)	0.000 001	kilometres (km ²)
Concentration		
grains/gallon (UK)	14.270 050	ppm
ppm	0.998 859	mg/L
mg/L	1.001 142	ppm
Volume (capacity)		
acre feet	1233.481 838	cubic metres
cubic feet	0.028 317	cubic metres
cubic metres	35.314 667	cubic feet
cubic metres	219.969 248	gallons (UK)
cubic metres	264.172 050	gallons (US liquid)
cubic metres	1000.000 000	litres
gallons (UK)	0.004 546	cubic metres
imperial gallons	4.546 000	litres
Rate		
litres per minute	0.219 974	igpm
litres per minute	1.440 000	cubic metres/day (m ³ /day)
igpm	6.546 300	cubic metres/day (m ³ /day)
cubic metres/day (m ³ /day)	0.152 759	igpm
Pressure		
psi	6.894 757	kpa
kpa	0.145 038	psi
Miscellaneous		
Celsius	$F^{\circ} = 9/5 (C^{\circ} + 32)$	Fahrenheit
Fahrenheit	$C^{\circ} = (F^{\circ} - 32) * 5/9$	Celsius
degrees	0.017 453	radians

M.D. OF LESSER SLAVE RIVER NO. 124

Appendix B

Maps and Figures on CD-ROM

MAPS AND FIGURES ON CD-ROM

A 1) General

A01	Surface Topography
A02	Surface Casing Types used in Drilled Water Wells
A03	Location of Water Wells and Springs
A04	Minimum Depth of Existing Water Wells
A05	Maximum Depth of Existing Water Wells
A06	Difference Between the Maximum and Minimum Depth of Existing Water Wells
A07	Depth to Base of Groundwater Protection
A08	Hydrogeological Maps
A09	Generalized Cross-Section (for terminology only)
A10	Geologic Column
A11	Cross-Section A - A'
A12	Cross-Section B - B'
A13	Cross-Section C - C'
A14	Cross-Section D - D'
A15	Cross-Section E - E'
A16	Bedrock Topography
A17	Bedrock Geology
A18	Stratigraphic Section
A19	Relative Permeability
A20	Risk of Groundwater Contamination
A21	Licensed and Registered Groundwater Water Wells
A22	Estimated Water Well Use per Section
A23	Water Wells Recommended for Field Verification

B 2) Surficial Aquifers

B a) Surficial Deposits

B01	Thickness of Surficial Deposits
B02	Non-Pumping Water-Level Surface in Surficial Deposits Based on Water Wells Less than 20 Metres Deep
B03	Total Dissolved Solids in Groundwater from Surficial Deposits
B04	Sulfate in Groundwater from Surficial Deposits
B05	Nitrate + Nitrite (as N) in Groundwater from Surficial Deposits
B06	Chloride in Groundwater from Surficial Deposits
B07	Total Hardness in Groundwater from Surficial Deposits
B08	Piper Diagram - Surficial Deposits
B09	Thickness of Sand and Gravel Deposits
B10	Amount of Sand and Gravel in Surficial Deposits
B11	Thickness of Sand and Gravel Aquifer(s)
B12	Water Wells Completed in Surficial Deposits
B13	Apparent Yield for Water Wells Completed in Sand and Gravel Aquifer(s)
B14	Changes in Water Levels in Surficial Deposits

B b) First Sand and Gravel

B15	Thickness of First Sand and Gravel
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B b) Upper Sand and Gravel

B16	Thickness of Upper Surficial Deposits
B17	Thickness of Upper Sand and Gravel (not all drill holes fully penetrate surficial deposits)
B18	Apparent Yield for Water Wells Completed through Upper Sand and Gravel Aquifer

B c) Lower Sand and Gravel

B19	Structure-Contour Map - Top of Lower Sand and Gravel Deposits
B20	Depth to Top of Lower Sand and Gravel Deposits
B21	Thickness of Lower Sand and Gravel Deposits
B22	Apparent Yield for Water Wells Completed through Lower Sand and Gravel Aquifer
B23	Non-Pumping Water-Level Surface in Lower Sand and Gravel Aquifer

3) Bedrock Aquifers

C

a) General

- C01 Apparent Yield for Water Wells Completed in Upper Bedrock Aquifer(s)
- C02 Total Dissolved Solids in Groundwater from Upper Bedrock Aquifer(s)
- C03 Sulfate in Groundwater from Upper Bedrock Aquifer(s)
- C04 Chloride in Groundwater from Upper Bedrock Aquifer(s)
- C05 Fluoride in Groundwater from Upper Bedrock Aquifer(s)
- C06 Total Hardness of Groundwater from Upper Bedrock Aquifer(s)
- C07 Piper Diagram - Bedrock Aquifer(s)
- C08 Recharge/Discharge Areas between Surficial Deposits and Upper Bedrock Aquifer(s)
- C09 Non-Pumping Water-Level Surface in Upper Bedrock Aquifer(s)
- C10 Areas of Potential Groundwater Depletion - Upper Bedrock Aquifer(s)

k) Bearpaw Formation

- C11 Depth to Top of Bearpaw Formation
- C12 Structure-Contour Map - Bearpaw Formation

l) Oldman Formation

- C13 Depth to Top of Oldman Formation
- C14 Structure-Contour Map - Oldman Formation
- C15 Non-Pumping Water-Level Surface - Oldman Aquifer
- C16 Apparent Yield for Water Wells Completed through Oldman Aquifer
- C17 Total Dissolved Solids in Groundwater from Oldman Aquifer
- C18 Sulfate in Groundwater from Oldman Aquifer
- C19 Chloride in Groundwater from Oldman Aquifer
- C20 Fluoride in Groundwater from Oldman Aquifer

d) Foremost Formation

- C21 Depth to Top of Foremost Formation
- C22 Structure-Contour Map - Foremost Formation
- C23 Non-Pumping Water-Level Surface - Foremost Aquifer
- C24 Apparent Yield for Water Wells Completed through Foremost Aquifer
- C25 Total Dissolved Solids in Groundwater from Foremost Aquifer
- C26 Sulfate in Groundwater from Foremost Aquifer
- C27 Chloride in Groundwater from Foremost Aquifer
- C28 Fluoride in Groundwater from Foremost Aquifer
- C29 Piper Diagram - Foremost Aquifer

e) Lea Park Formation

- C30 Depth to Top of Lea Park Formation
- C31 Structure-Contour Map - Lea Park Formation

e) Milk River Formation

- C32 Depth to Top of Milk River Formation
- C33 Structure-Contour Map - Milk River Formation

f) Mannville Group

- Norwich Resources Water Source Well - Annual Groundwater Production

4) Hydrographs and Observation Water Wells

D

Hydrographs

- D01 Hydrograph - AENV Obs Water Well: Smith 86 - 1
- D02 Annual Precipitation vs Water Levels in AENV Obs WW No. 86-1

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Appendix C

General Water Well Information

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Domestic Water Well Testing

Purpose and Requirements

The purpose of the testing of domestic water wells is to obtain background data related to:

- 1) the non-pumping water level for the aquifer - Has there been any lowering of the level since the last measurement?
- 2) the specific capacity of the water well, which indicates the type of contact the water well has with the aquifer;
- 3) the transmissivity of the aquifer and hence an estimate of the projected long-term yield for the water well;
- 4) the chemical, bacteriological and physical quality of the groundwater from the water well.

The testing procedure involves conducting an aquifer test and collecting of groundwater samples for analysis by an accredited laboratory. The date and time of the testing are to be recorded on all data collection sheets. A sketch showing the location of the water well relative to surrounding features is required. The sketch should answer the question, "If this water well is tested in the future, how will the person doing the testing know this is the water well I tested?"

The water well should be taken out of service as long as possible before the start of the aquifer test, preferably not less than 30 minutes before the start of pumping. The non-pumping water level is to be measured 30, 10, and 5 minutes before the start of pumping and immediately before the start of pumping which is to be designated as time 0 for the test. All water levels must be from the same designated reference, usually the top of the casing. Water levels are to be measured during the pumping interval and during the recovery interval after the pump has been turned off; all water measurements are to be with an accuracy of ± 0.01 metres.

During the pumping and recovery intervals, the water level is to be measured at the appropriate times. An example of the time schedule for a four-hour test is as follows, measured in minutes after the pump is turned on and again after the pump is turned off:

1,2,3,4,6,8,10,13,16,20,25,32,40,50,64,80,100,120.

For a four-hour test, the reading after 120 minutes of pumping will be the same as the 0 minutes of recovery. Under no circumstance will the recovery interval be less than the pumping interval.

Flow rate during the aquifer test should be measured and recorded with the maximum accuracy possible. Ideally, a water meter with an accuracy of better than $\pm 1\%$ displaying instantaneous and total flow should be used. If a water meter is not available, then the time required to completely fill a container of known volume should be recorded, noting the time to the nearest 0.5 seconds or better. Flow rate should be determined and recorded often to ensure a constant pumping rate.

Groundwater samples should be collected as soon as possible after the start of pumping and within 10 minutes of the end of pumping. Initially only the groundwater samples collected near the end of the pumping interval need to be submitted to the accredited laboratory for analysis. All samples must be properly stored for transportation to the laboratory and, in the case of the bacteriological analysis, there is a maximum time allowed between the time the sample is collected and the time the sample is delivered to the laboratory. The first samples collected are only analyzed if there is a problem or a concern with the first samples submitted to the laboratory.

Procedure

Site Diagrams

These diagrams are a map showing the distance to nearby significant features. This would include things like a corner of a building (house, barn, garage etc.) or the distance to the half-mile or mile fence. The description should allow anyone not familiar with the site to be able to unequivocally identify the water well that was tested. In lieu of a map, UTM coordinates accurate to within five metres would be acceptable. If a hand-held GPS is used, the post-processing correction details must be provided.

Surface Details

The type of surface completion must be noted. This will include such things as a pitless adapter, well pit, pump house, in basement, etc. Also, the reference point used for measuring water levels needs to be noted. This would include top of casing (TOC) XX metres above ground level; well pit lid, XX metres above TOC; TOC in well pit XX metres below ground level.

Groundwater Discharge Point

Where was the flow of groundwater discharge regulated? For example was the discharge through a hydrant downstream from the pressure tank; discharged directly to ground either by connecting directly above the well seal or by pulling the pump up out of the pitless adapter; from a tap on the house downstream from the pressure tank? Also note must be made if any action was taken to ensure the pump would operate continuously during the pumping interval and whether the groundwater was passing through any water-treatment equipment before the discharge point.

Water-Level Measurements

How were the water-level measurements obtained? If obtained using a contact gauge, what type of cable was on the tape, graduated tape or a tape with tags? If a tape with tags, when was the last time the tags were calibrated? If a graduated tape, what is the serial number of the tape and is the tape shorter than its original length (i.e. is any tape missing)?

If water levels are obtained using a transducer and data logger, the serial numbers of both transducer and data logger are needed and a copy of the calibration sheet. The additional information required is the depth the transducer was set and the length of time between when the transducer was installed and when the calibration water level was measured, plus the length of time between the installation of the transducer and the start of the aquifer test. All water levels must be measured at least to the nearest 0.01 metres.

Discharge Measurements

Type of water meter used. This could include such things as a turbine or positive displacement meter. How were the readings obtained from the meter? Were the readings visually noted and recorded or were they recorded using a data logger?

Water Samples

A water sample must be collected between the 4- and 6-minute water-level measurements, whenever there is an observed physical change in the groundwater being pumped, and 10 minutes before the end of the planned pumping interval. Additional water samples must be collected if it is expected that pumping will be terminated before the planned pumping interval.