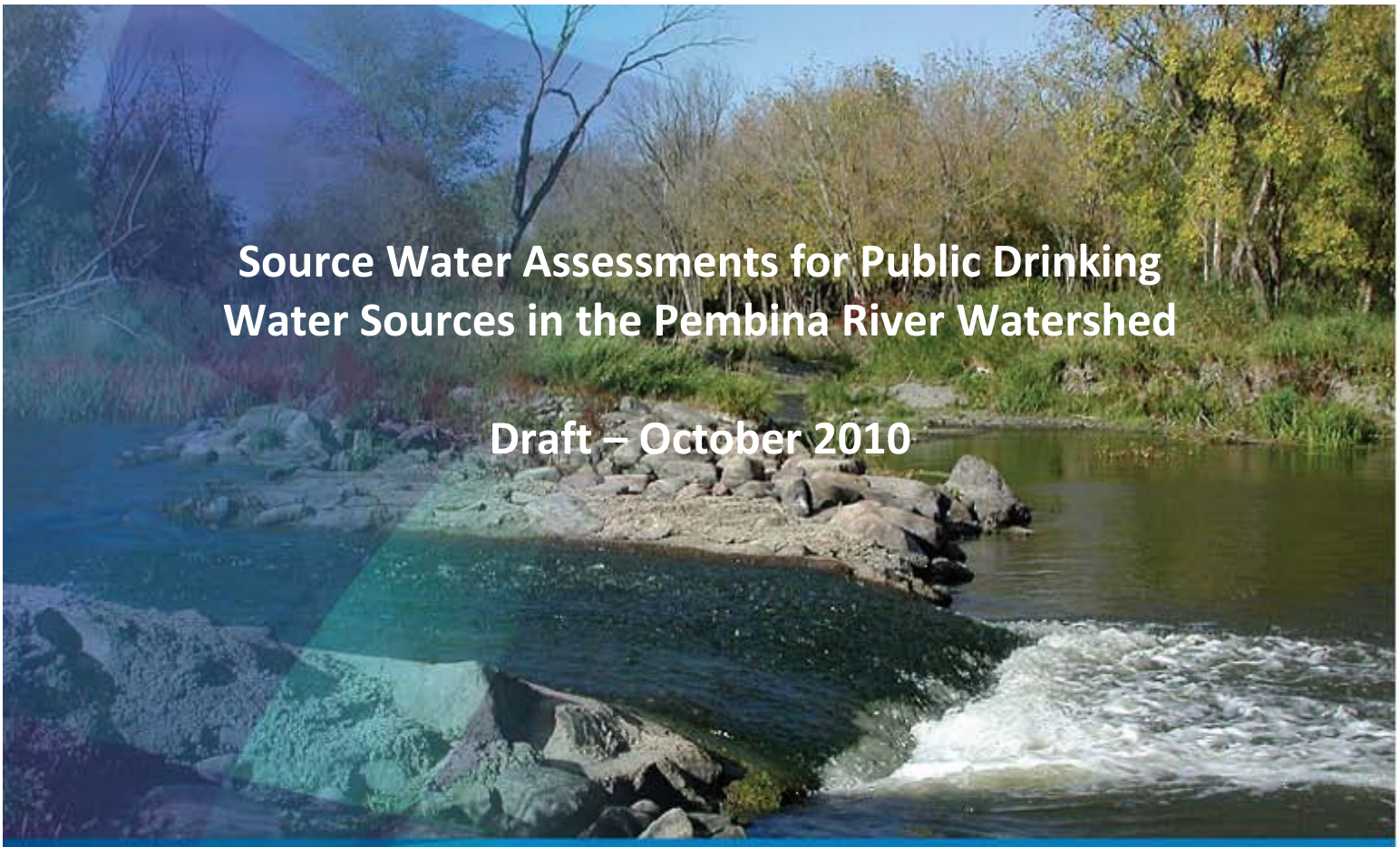

Source Water Assessments for Public Drinking Water Sources in the Pembina River Watershed

Draft – October 2010

Source Water Assessments for Public Water Sources in the Pembina River Watershed

October 2010

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Source Water Protection

Clean, potable drinking water is critical for human life and, therefore, a necessity for prosperous sustainable communities. Protecting water at its source, or before it arrives at our treatment facilities, is a preventative approach to water management. It is more ecologically responsible and may be less expensive and to prevent contamination to our source waters, than to try and remediate water quality in treatment facilities.

Source water protection provides benefits to watersheds beyond those realized at the water treatment plant. Clean water benefits aquatic ecosystems, supports recreational and wildlife values, and ensures sustainability for future generations. Source water protection fits well within the integrated watershed management framework as it pulls from a wide knowledge base spanning hydrogeology, land use planning, water quality, municipal infrastructure and industry as well as relying heavily on local knowledge for describing area conditions and implementing actions.

The approach to source water protection planning varies widely across Canada. Manitoba has adopted a 'grassroots' approach to source water protection. A source water assessment is conducted with a group of local, technical and non-technical representatives and their recommendations are placed within an integrated watershed management plan. This locally-led approach to protecting drinking water sources is inline with the shared governance model adopted for soil and water management across municipal Manitoba through the Conservation Districts program. The process is quick, easy to follow and relies primarily on the common sense of a small group of people. In this watershed, 9 sources of drinking water are from groundwater, and six are from surface water. As a result, this team was comprised of a hydrogeologist, a regional drinking water officer, a watershed planner, Conservation District representatives, and a municipal representative that changed based on which municipal system was being reviewed. This team has made recommendations based on one site visit, a relatively simple review of land activities in the area, and a follow-up discussion of potential threats to drinking water quality based on what they observed during site visits and information available in the provincial groundwater database.

The recommendations from this assessment have been included in the Pembina River integrated watershed management plan. The plan also includes more general recommendations for systems not reviewed in this assessment, such as private wells and semi-public systems such as those found in hospitals and schools.

Public Drinking Water Sources

In Manitoba, the Office of Drinking Water defines a public water system as a potable supply of drinking water with 15 or more connections. The Pembina watershed contains 15 public drinking water systems, 9 of which withdraw their water from a groundwater source, six from surface water sources, and one from both. Some of these public drinking water systems use multiple wells to withdraw water for a single community.

Source Water Assessments

The source water assessments are completed in two steps;

1. **Mapping Source Water Protection Zones**. A desk-top exercise that includes creating maps that display potential source water threats, land cover and local infrastructure. This is done within a 1.5 kilometre buffer around each public water system well, or sub watershed of a surface water source. Information to create these maps is drawn from provincial databases that may not be updated with current information. To 'groundtruth' what is identified within the source water protection zones, site visits are held.
2. **Site Visits**. Site visits are conducted by a group of local and technical experts. Information on the maps and accompanying data are considered, but a careful review of individual well conditions and land use activities at the site are the focus of this visit. Potential threats are discussed and precautionary measures that could be applied to protect wells are considered. Potential pollutant sources examined in this assessment include:
    - Roadways
    - Wastewater treatment plants
    - Manure storage areas
    - Railways
    - Oil Wells
    - Contaminated sites
    - Chemical, fuel, petro-chemical storage locations
    - Industry
    - Mining operations
    - Waste disposal sites
    - Agricultural drains
    - Population centres

Boil Water Advisories

There is a history of boil water advisories in the Pembina river watershed. Rock Lake Beach campground is currently under a long-term boil water advisory. Strathcona Park and Pilot Mound have both been under temporary boil water advisories within the last five years. The community of Ninette, which is serviced by private or semi-private wells, is also under a long- term boil water advisory.

Emergency Response Plans

Emergency preparedness is important for addressing spills, accidents, or other emergencies that may affect water, aquatic ecosystems, or a drinking water source. Owners of public water systems are required to develop Emergency Response Plans under MR 77/2003, Section 29, Water and Wastewater Facility Operators Regulation. This regulation falls under the Environment Act and is administered by Manitoba Conservation. Manitoba Water Stewardship's Office of Drinking Water has included the requirement for an Emergency Response Plan in each Water Plant Operating Licence. Deadlines for the development of an Emergency Response Plan are specified in each operating licence.

Recommendations for all public drinking water sources

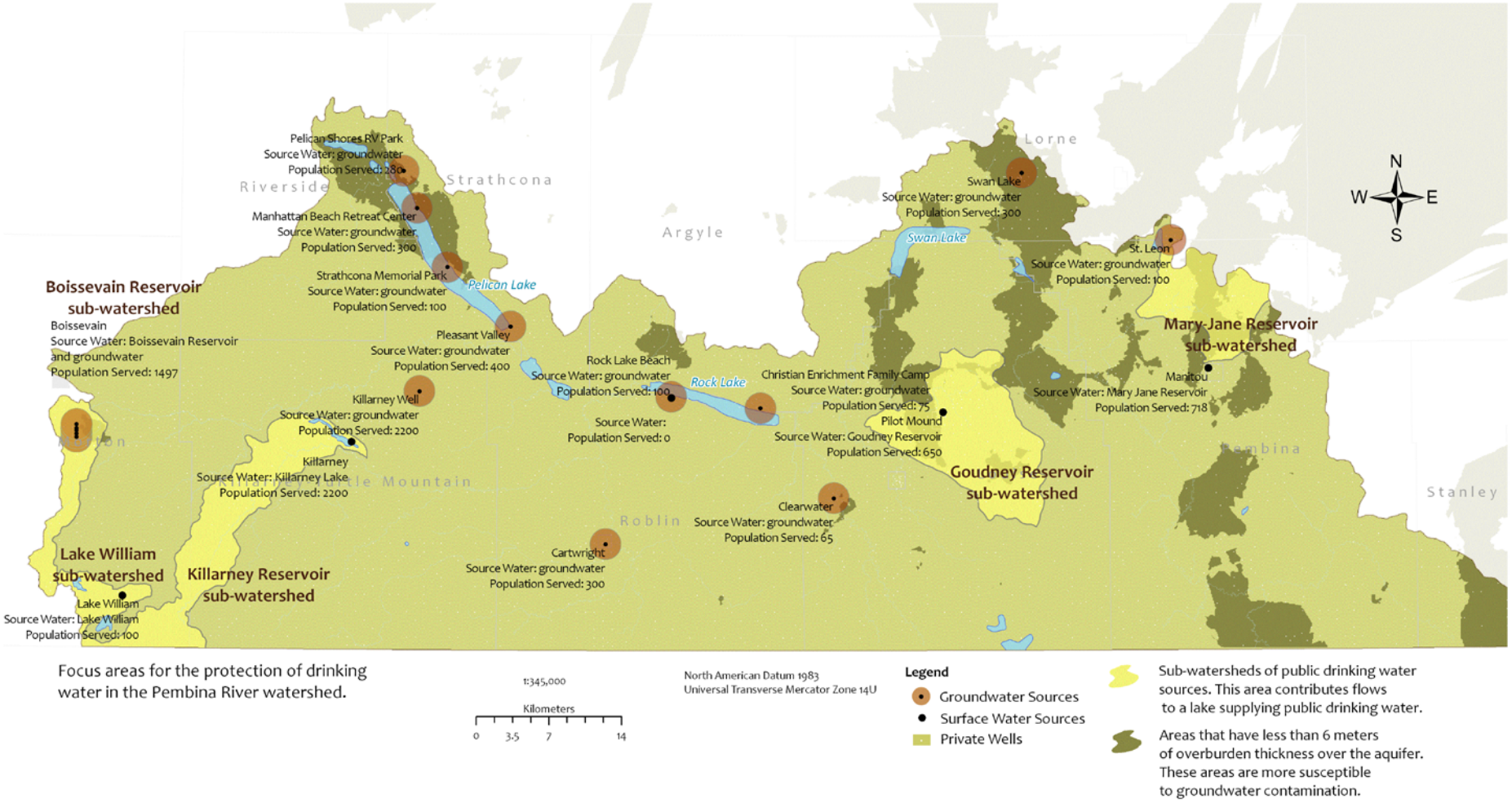
1. Intensive and high-pollution risk development activities, (land uses and structures that have a high risk of causing pollution and include, but are not limited to

chemical/ fertilizer storage facilities, disposal fields, fuel tanks, waste disposal grounds, wastewater treatment facilities) will be restricted in public drinking water source zones. Where restriction is not possible, development may be considered in public drinking water source zones provided:

- the proponent can prove by adequate engineering or hydro-geological investigation that the proposed activity will not cause pollution of the public drinking water supply or;
- appropriate precautionary measures have been taken to sufficiently mitigate the risk of endangering the quality of the water supply for public drinking water supply purposes.

2. To prevent significant surface water quality and drinking water quality deterioration, developments in or near surface waters and riparian areas will be restricted, or limited, if they:
    - lead to the contribution of nutrients, pathogenic organisms, deleterious chemicals or materials to these waters;
    - accelerate erosion and bank instability;
    - cause the removal of natural vegetative cover; and/or
    - may have an impact on in-stream flows needed to maintain healthy aquatic ecosystems.
3. Seal unused, abandoned and poorly constructed wells that are located within a source water protection zones for all public drinking water.
4. Ensure an emergency response plan is developed for each public water system.

Site-specific recommendations are found on the following pages.



Focus areas for the protection of drinking water in the Pembina River watershed.

1:345,000

Kilometers

0 3.5 7 14

North American Datum 1983
Universal Transverse Mercator Zone 14U

Legend

- Groundwater Sources
- Surface Water Sources
- Private Wells
- Sub-watersheds of public drinking water sources. This area contributes flows to a lake supplying public drinking water.
- Areas that have less than 6 meters of overburden thickness over the aquifer. These areas are more susceptible to groundwater contamination.

Figure 1. Focus areas for the protection of drinking water in the Pembina River watershed

Table 1. Detailed source water assessment information for groundwater sources

Assessment Questions	Boissevain PWS					Cartwright PWS		Clearwater PWS	Killarney PWS		Manhattan Beach Retreat Centre PWS	
Source	Groundwater (sandstone)					Groundwater (sand and gravel)		Groundwater (shale aquifer)	Groundwater		Groundwater (sand and gravel)	
Number of wells	5					2		1	2		2	
Well depth (m)	32.3 m (15.9 ft)	28.0 m (91.9 ft)	24.4 m (79.9 ft)	29.8 m (97.9 ft)	21.3 m (70.0 ft)	56.2 m (184.5 ft)	22.3 m (73.0 ft)	11.0 m (36 ft)	?	?	11.6 m (38 ft)	12.5 m (41 ft)
Depth to groundwater (m)	5.5 m (18.0 ft) Nov 1988	7.0 m (23.0 ft) Nov 1988	7.0 m (23.0 ft) Nov 1988	4.6 m (15.0 ft) Nov 1988	4.9 m (16.0 ft) Nov 1988	2.0 m (6.4 ft) July 1962	2.2 m (7.2 ft) July 1996	3.3 m (10.8 ft) Sept 1996	?	?	2.4 m (8 ft) in Dec 1992	2.7 m (9 ft) April 2000
Depth to top of aquifer (m)	11.3 m (37 ft)	8.5 m (28 ft)	7.6 m (25 ft)	14 m (46 ft)	4.9 m (16 ft)	16 m (54 ft)	18.9 m (62 ft)	?	?	?	2.7 m (9 ft)	3 m (10 ft)
Type of aquifer	Confined	Confined	~Confined	~Confined	Unconfined	Confined	Confined	?			Unconfined	Unconfined
Depth of casing (m)	19.7 m (64.5 ft)	17.8 m (58.5 ft)	10.4 m (34.0 ft)	17.7 m (58.0 ft)	9.1 m (30.0 ft)	50.1 m (164.5 ft)	22.3 m (73.0 ft)	4.6 m (15.0 ft)	?	?	18'	25'
Well owner	Town of Boissevain					Village of Cartwright		RM of Louise	RM of Killarney/Turtle Mountain		Manhattan Beach Retreat Centre	
Population served	~ 1500					300		~65	2200		300	
Date of well construction	1988	1988	1988	1988	1988	1962	1997	1998	2010	2010	1992	2000
Is water treated?	Yes					Yes	Yes	Yes	Yes	Yes	Yes	Yes
Is the source chlorinated?	Yes					Yes		Yes	Yes		Yes	
Direct influence from surface water?	No					No		Yes			No	
Is there permanent grass buffer at least 5 meters in circumference around the well?	Yes					In a building.	No	Yes	No	No	In a building	No
Does surface water pool around well?	No	Yes	No	No	No	No	No	Subject to flooding	No	No	No	No
The well casing extends at least 40 cm (16 inches) above mounded earth.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
The sanitary seal is secure and in good condition.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Vulnerability based on overburden thickness and composition.	Medium - Low permeability material is variable in thickness and makes up a small proportion of the sediments above the screen.					Low	Low	High	Low	Low	High - Overburden will provide very little protection	Medium - Overburden will provide some protection.
Vulnerability based on well construction.	Medium - Drill log does not indicate if there is an annular seal. Becomes unconfined during pumping.	Medium - Drill log does not indicate if there is an annular seal. Becomes unconfined during pumping.	High - Drill log does not indicate if there is an annular seal. Becomes unconfined during pumping. Less than 15 m of casing.	Medium - Drill log does not indicate if there is an annular seal. Becomes unconfined during pumping.	High - Drill log does not indicate if there is an annular seal. Less than 15 m of casing.	Low	Low	High - Well is vulnerable to changes in surface water quality.	Low	Low	High - Well has less than 15 m of casing.	High High - Well has less than 15 m of casing. No casing grout indicated on well log.

Table 1. Detailed source water assessment information for groundwater sources continued…

Assessment Questions	Pelican Shores RV Park	Pleasant Valley PWS	Rock Lake Beach PWS		St. Leon PWS		Strathcona Park PWS	Swan Lake PWS
Source	Groundwater (shale aquifer)	Groundwater (shale aquifer)	Groundwater		Groundwater (shale)		Groundwater	Groundwater (shale aquifer)
Number of wells	1	1	2		2		1	1
Well depth (m)	Unknown	11.6 m (38 ft)	Unknown	Unknown	49.3 m (161.9 ft)	52.7 m (172.9 ft)	3.7 m (12 ft)	15.2 m (50 ft)
Depth to groundwater (m)	Unknown	4.9 m (16 ft) Aug 1991	Unknown	Unknown	11.3 m (37.0 ft) 1974	13.1 m (43.0 ft) Sept 1988	Unknown	4.3 m (14.0 ft) 1977
Depth to aquifer (m)	Unknown	4.9 m (16 ft)	Unknown	Unknown	27 m (89 ft)	31.1 m (102 ft)	Unknown	4.3 m (14 ft)
Type of aquifer	Unknown	Unconfined	Unknown	Unknown	Confined	Confined	Unknown	Unconfined
Depth of casing (m)	Unknown	7.0 m (23 ft)	Unknown	Unknown	Unknown	Unknown	Unknown	7.0 m (23 ft)
Well owner	Pelican Shores	Pleasant Valley Cottage Ass.	Rock Lake Beach		RM of Lorne		RM of Strathcona	RM of Louise
Population served	280	400	100		~100		100	250
Date of well construction	Early 1900's	1991	1990	1970	1974	1988	1994	1977
Is water treated?	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Is the source chlorinated?	Yes	Yes	No		Yes		Yes	Yes
Direct influence from surface water?	No	No	No		No		Yes	No
Is there permanent grass buffer at least 5 meters in circumference around the well?	Yes	Yes	No	No	No	No	No	No
Does surface water pool around well?	No	No	No	No	No	No	Subject to flooding	No
The well casing extends at least 40 cm (16 inches) above mounded earth.	Yes	Yes	Yes	Yes	Yes	Yes	No, 28 cm (11 inches)	Yes
The sanitary seal is secure and in good condition.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Vulnerability based on overburden thickness and composition.	Low	High - Well is in a shale aquifer and is vulnerable to nearby land use activities.	Unknown	Unknown	Medium - Well may be vulnerable to changes in surface land use activity.	Medium - Well may be vulnerable to changes in surface land use activity.	High	High - Well is vulnerable to land use activity.
Vulnerability based on well construction.	High - Well is very old and may be vulnerable.	High. No indication of annular seal. Well is less than 15 m	Unknown	Unknown	High – Area adjacent to well head may benefit from a permanent grass buffer. Gravel pack within 2.5 m of ground surface.	High – Area adjacent to well head may benefit from a permanent grass buffer. No indication of casing grout on well log.	High	Medium - Area adjacent to well head may benefit from a permanent grass buffer.

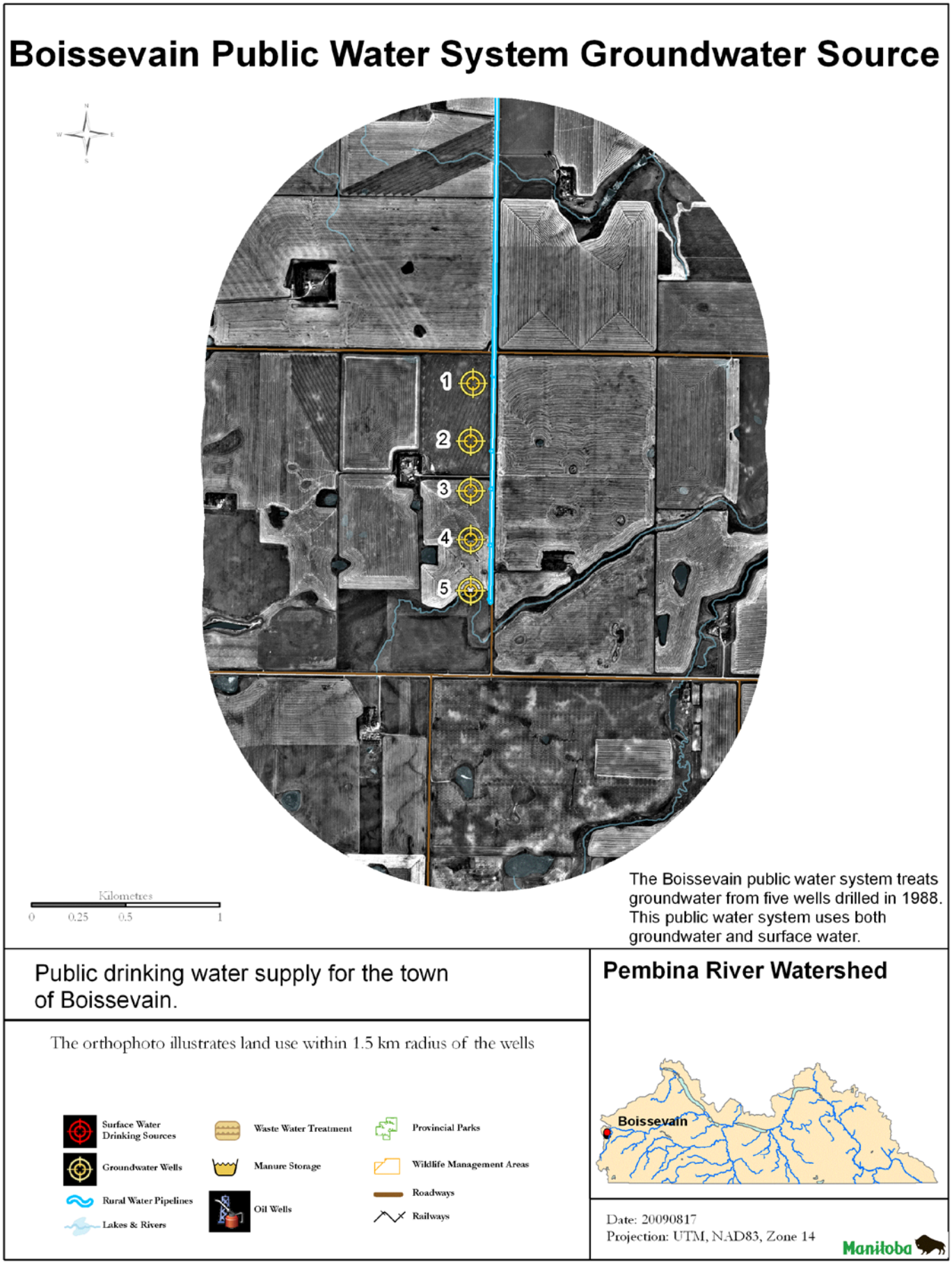


Figure 2. Town of Boissevain

Boissevain - Groundwater - Public Water System

Comments: The five groundwater wells are located along a municipal road. The wellheads are vulnerable to damage from vehicles travelling along the right-of-way, and producers harvesting hay adjacent to the road.

Table 2. Land use in the area surrounding the Boissevain public water system wells.

Potential Pollutant Source	Distance to Source Withdrawal Point	Comments	Recommended Action
Crop/Pasture land	~5 m – 1.5 km	Annual cropping, hayland and pasture land are common in this area.	Monitor any changes in land use.
Septic systems	500 m - 1.5 km	Five yard sites within 1.5 kilometers of the wells.	Provide education to yard site owners on proper septic system management.
Abandoned wells / Improperly maintained active wells	~ 30 m – 1 km	Abandoned wells may be present in the area.	Seal all abandoned wells within 1.5 km.
Transportation routes	5 m – 1.5 km	Includes paved and gravel roads. Improve drainage at well 2.	Improve drainage function to ensure that water does not pool around well heads.
Farm yards	300 m – 1.5 km	Likely includes storage of chemicals, fuel and potentially fertilizer/manure. Also, will likely include household storage of hazardous materials	Encourage landowners to attend an Environmental Farm Plan workshop to learn if they can lower threats to local groundwater.
Overland flooding	10 m	Overland flooding may infiltrate wells, or nearby abandoned wells.	Ensure that adequate drainage is maintained around wells, and abandoned wells are sealed within 1.5 km.

Recommended actions for all potential pollutant sources:

1. Improve drainage function to ensure that water does not pool around well head #2.
2. Seal all abandoned wells within 1.5 km of the well heads.
3. Provide education to yard site owners on proper septic system management.
4. Encourage landowners to attend an Environmental Farm Plan workshop to learn if they can lower threats to local groundwater.

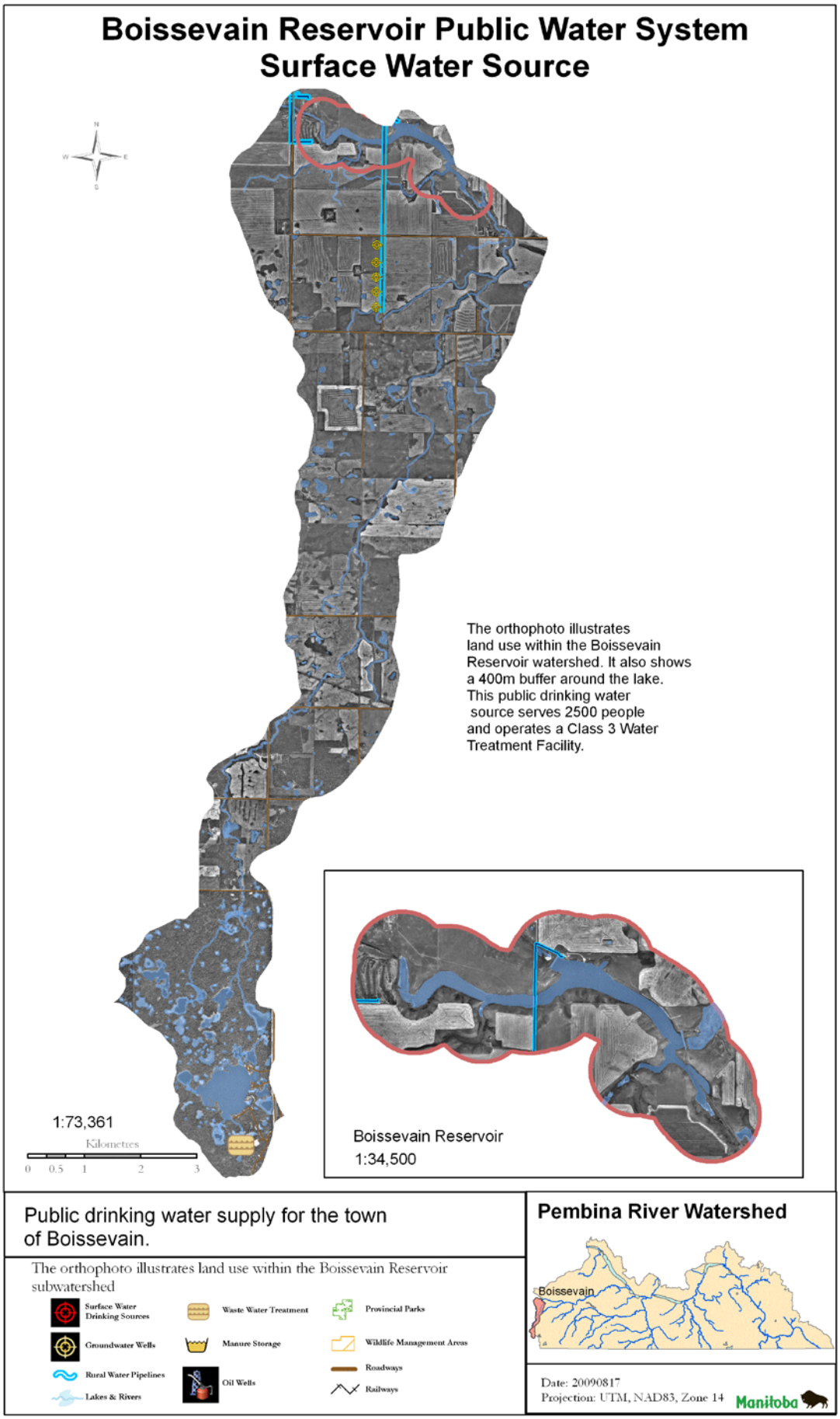


Figure 3. Town of Boissevain

Boissevain- Surface Water - Public Water System

Source: Boissevain Reservoir
Owner: Town of Boissevain
Population Served: 2500
Is the source treated?: Yes
Is the source chlorinated?: Yes

Table 3. Land use in the area surrounding the Boissevain reservoir.

Potential Pollutant Source	Distance to Source Withdrawal Point	Comments	Recommended Action
Crop/Pasture land	~5 m – 10 km	Annual cropping, hayland and pasture land are common in this area.	Reduce nutrient inputs. Ensure livestock do not have direct access to reservoir.
Septic systems	500 m - 1.5 km	Numerous yard sites in this area.	Provide education to yard site owners on proper septic system management.
Wastewater treatment plant	>10 km	Turtle Mountain Provincial Park manages a wastewater treatment lagoon in this sub watershed.	Monitor any changes.
Transportation routes	5 m – 1.5 km	Includes paved and gravel roads.	Monitor any changes.
Farm yards	300 m – 1.5 km	Likely includes storage of chemicals, fuel and potentially fertilizer/manure. Also, will likely include household storage of hazardous materials	Encourage landowners to attend an Environmental Farm Plan workshop to learn if they can lower threats to local groundwater.
Overland flooding		Overland flooding may introduce pollution into the reservoir.	Monitor any changes.

Recommended actions for all potential pollutant sources:

1. Reduce nutrient inputs from the sub watershed.
2. Provide education to yard site owners on proper septic system management.
3. Encourage landowners to attend an Environmental Farm Plan workshop to learn if they can lower threats to local groundwater.

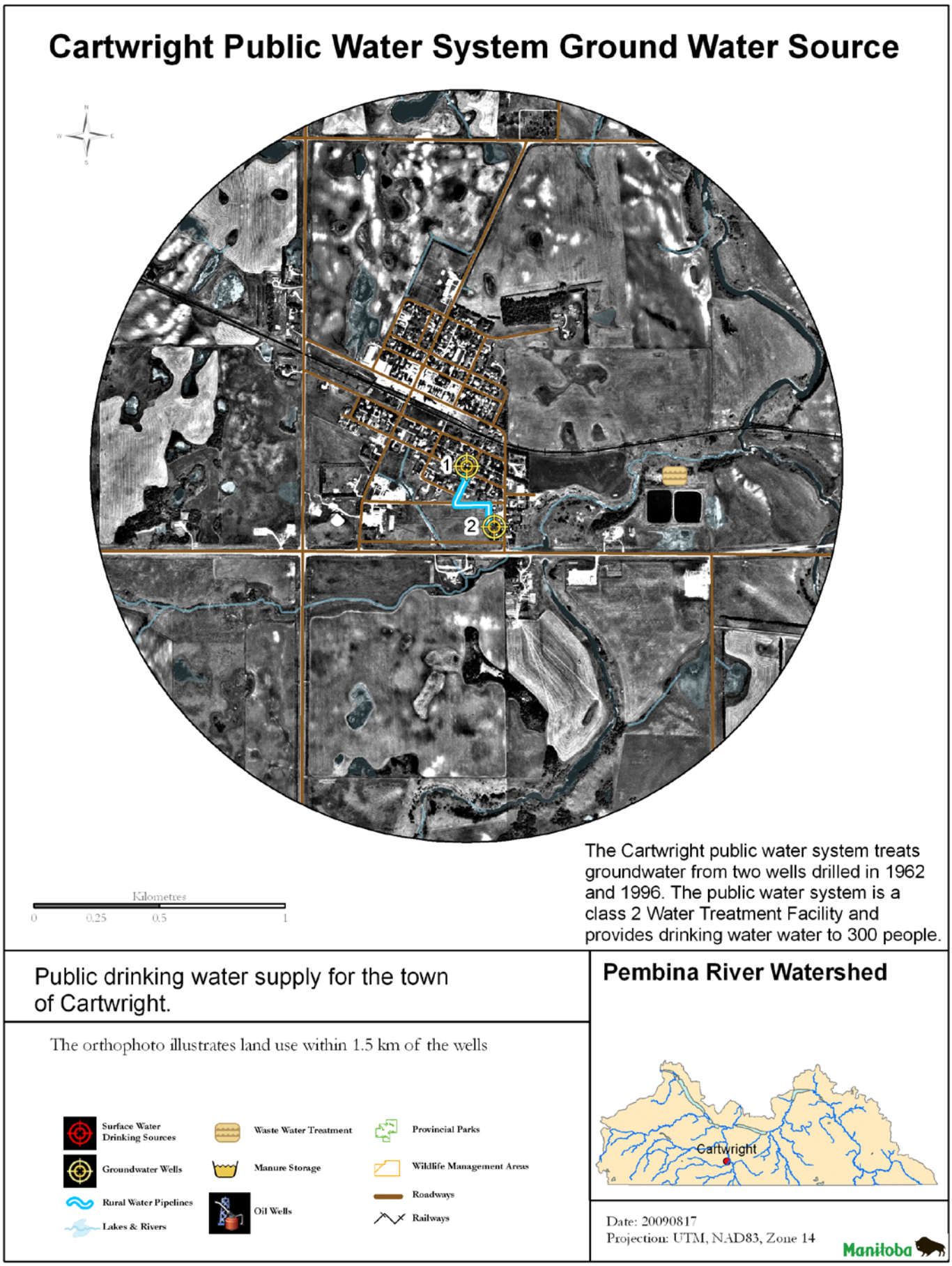


Figure 4. Village of Cartwright

Cartwright – Public Water System

Comments: Install a fence barrier to create a five meter buffer around well head #2. A vehicle service station is located approximately 100 meters from the well.

Table 4. Land use in the area surrounding the Cartwright public water system wells.

Potential Pollutant Source	Distance to Source Withdrawal Points	Comments	Recommended Action
Crop/Pasture land and livestock operations	~200 m – 1.5 km	Annual cropping, hayland and pasture land are common in this area.	Monitor any changes.
Septic systems	500 m - 1.5 km	The town of Cartwright uses a gravity sewer system directed to a lift station located on the east side of town. There a pump station takes the effluent to a lagoon located across Gimby creek. The sewer main goes underneath the waterway. A leak in the sewer main would threaten the creek and downstream ecosystem. There are a few residences on the outskirts of Cartwright that use private septic fields.	Ensure that sewer system infrastructure is kept in good repair. Encourage landowners to attend an Environmental Farm Plan workshop to learn if they can lower threats to local groundwater.
Village of Cartwright	~ 30 m – 1 km	Urban related activities –higher traffic area. Industrial activities.	Ensure all industrial wells are in good condition. Provide industrial business information on ways to prevent groundwater contamination.
Abandoned wells / Improperly maintained active wells	~ 30 m – 1 km	Abandoned wells may be present in Cartwright and surrounding area	Seal all abandoned wells within 1.5km.
Transportation routes	50 m – 1.5 km	Includes paved and gravel roads	None.
Wastewater treatment plant	600 m	A two cell waste water treatment plant is releases downstream into Gimby Creek.	Monitor any changes.

Recommended actions for all potential pollutant sources:

1. Install a fence barrier to create a five meter buffer around well head #2.

2. Encourage landowners to attend an Environmental Farm Plan workshop to learn if they can lower threats to local groundwater.
3. Ensure all industrial wells are in good condition.
4. Seal all abandoned wells within 1.5km.

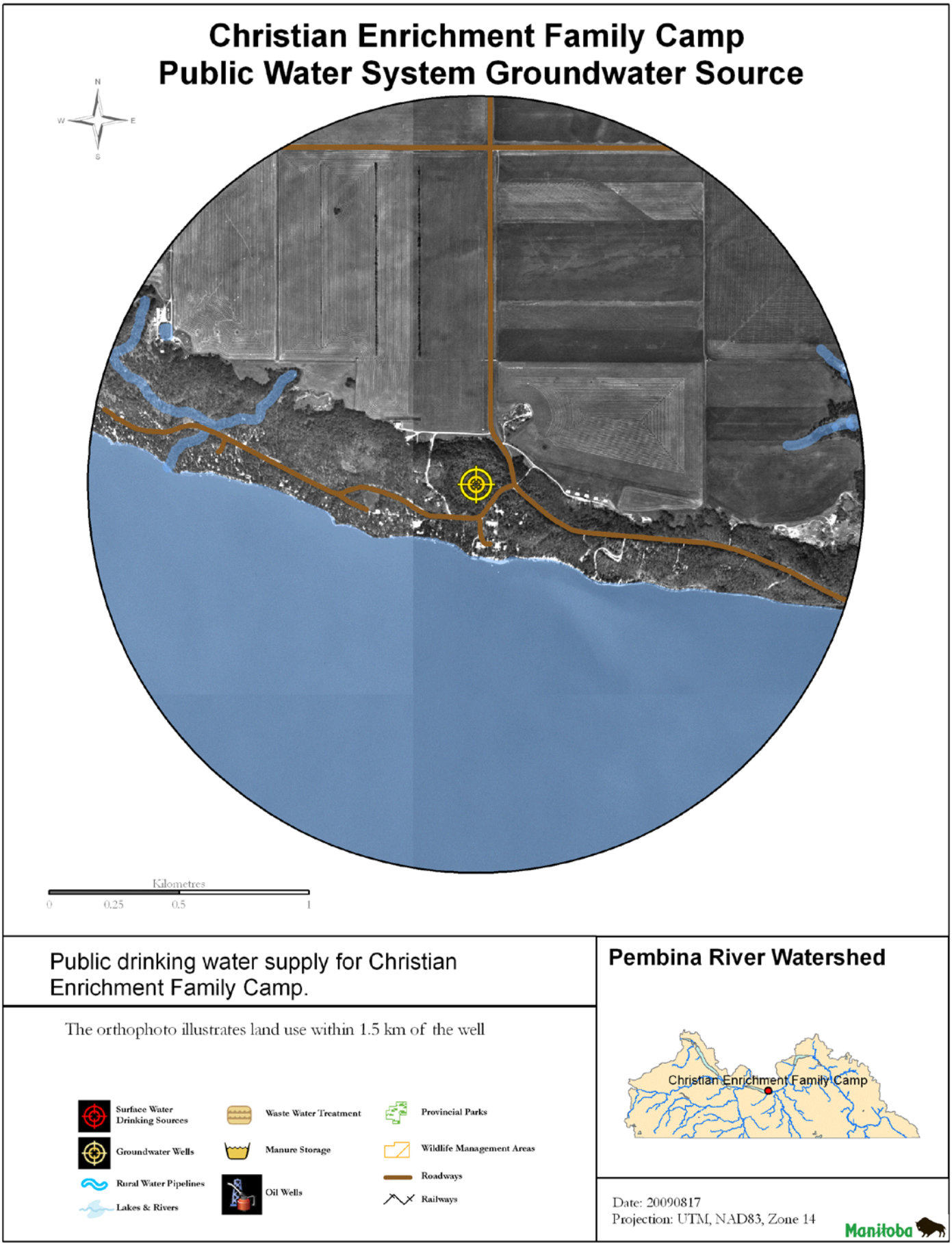


Figure 5. Christian Enrichment Family Camp

Christian Enrichment Family Camp - Public Water System

Source: Surface water (natural spring)
Well Owner: Christian Enrichment Family Camp
Population Served: ~ 75
Is the source treated?: Yes
Is the source chlorinated?: Yes

Table 5. Land use in the area surrounding the Christian Enrichment Family Camp public water system source.

Potential Pollutant Source	Distance to Source Withdrawal Point	Comments	Recommended Action
Cropland	~200 m – 1.5 km	Annual cropping is common in this area.	Monitor any changes.
Septic systems	500 m - 1.5 km	Homes in community use septic tanks for on-site waste water management.	Provide education to yard site owners on proper septic system management.
Abandoned wells / Improperly maintained active wells		Abandoned wells may be present in the surrounding area	Seal all abandoned wells within 1.5km.
Livestock process plant	500 m		Monitor any changes.
Gravel quarry	300 m		Monitor any changes.
Transportation routes	50 m – 1.5 km	Includes gravel roads.	None.

Recommended actions for all potential pollutant sources:

1. Seal all abandoned wells within 1.5 km of the natural spring.
2. Install a fence to create controlled access to the surface water intake area.
3. Develop a new well to obtain water for this public water system.
4. Provide education to yard site owners on proper septic system management.

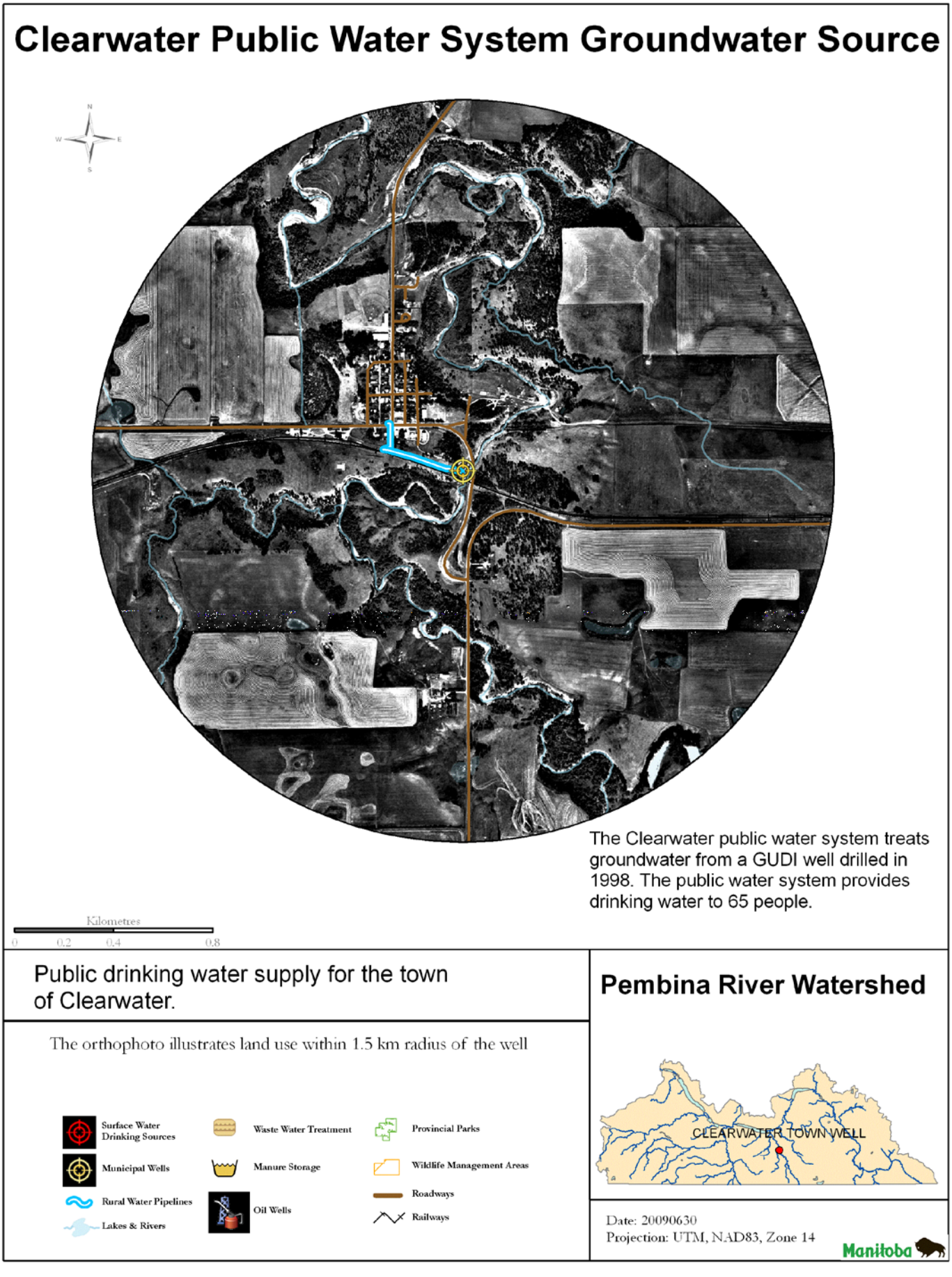


Figure 6. Town of Clearwater

Clearwater - Public Water System

Comments: Since this groundwater source is designated as GUDI (Groundwater Under Direct Influence), this well is vulnerable to contaminated surface water from Cypress Creek. The area directly upstream of the wellhead site should be monitored to ensure that a healthy riparian area is maintained. Any eroding sites should be fixed and livestock access should be managed. A new plant is scheduled to be constructed by the spring of 2011. Construction includes a new groundwater source. The RM of Louise may want to consider drilling a new well that will not be influenced by surface water

Table 6. Land use in the surrounding area of the Clearwater public water system well.

Potential Pollutant Source	Distance to Source Withdrawal Point	Comments	Recommended Action
Crop/Pasture land and Livestock Operations	Across the road ~100 m – 1.5 km	Annual cropping, hayland and pasture land are common in this area.	Monitor any changes.
Septic systems	500 m - 1.5 km	Homes in community of Clearwater used septic tanks and fields for on-site waste water management.	Provide education to yard site owners on proper septic system management.
Town of Clearwater	~ 30 m – 1 km	Urban related activities –higher traffic area	Monitor any changes.
Abandoned wells / Improperly maintained active wells	~ 30 m – 1 km	Abandoned wells are present in the Town of Clearwater and surrounding area	Seal all abandoned wells within 1.5km.
Transportation routes	50 m – 1.5 km	Includes paved and gravel roads	Monitor any changes.
Farm yards	~1.0 km	Likely includes storage of chemicals, fuel and potentially fertilizer/manure. Also, will likely include household storage of hazardous materials	Encourage landowners to attend an Environmental Farm Plan workshop to learn if they can lower threats to local groundwater.

Recommended actions for all potential pollutant sources:

1. Seal all abandoned wells within 1.5 km of the well head.
2. Create a five metre vegetated buffer around the well head.
3. Install a fence barrier to limit access to the wellhead.
4. Consider developing a new well that is not directly influenced by surface water.
5. Provide education to yard site owners on proper septic system management.
6. Encourage landowners to attend an Environmental Farm Plan workshop to learn if they can lower threats to local ground water.

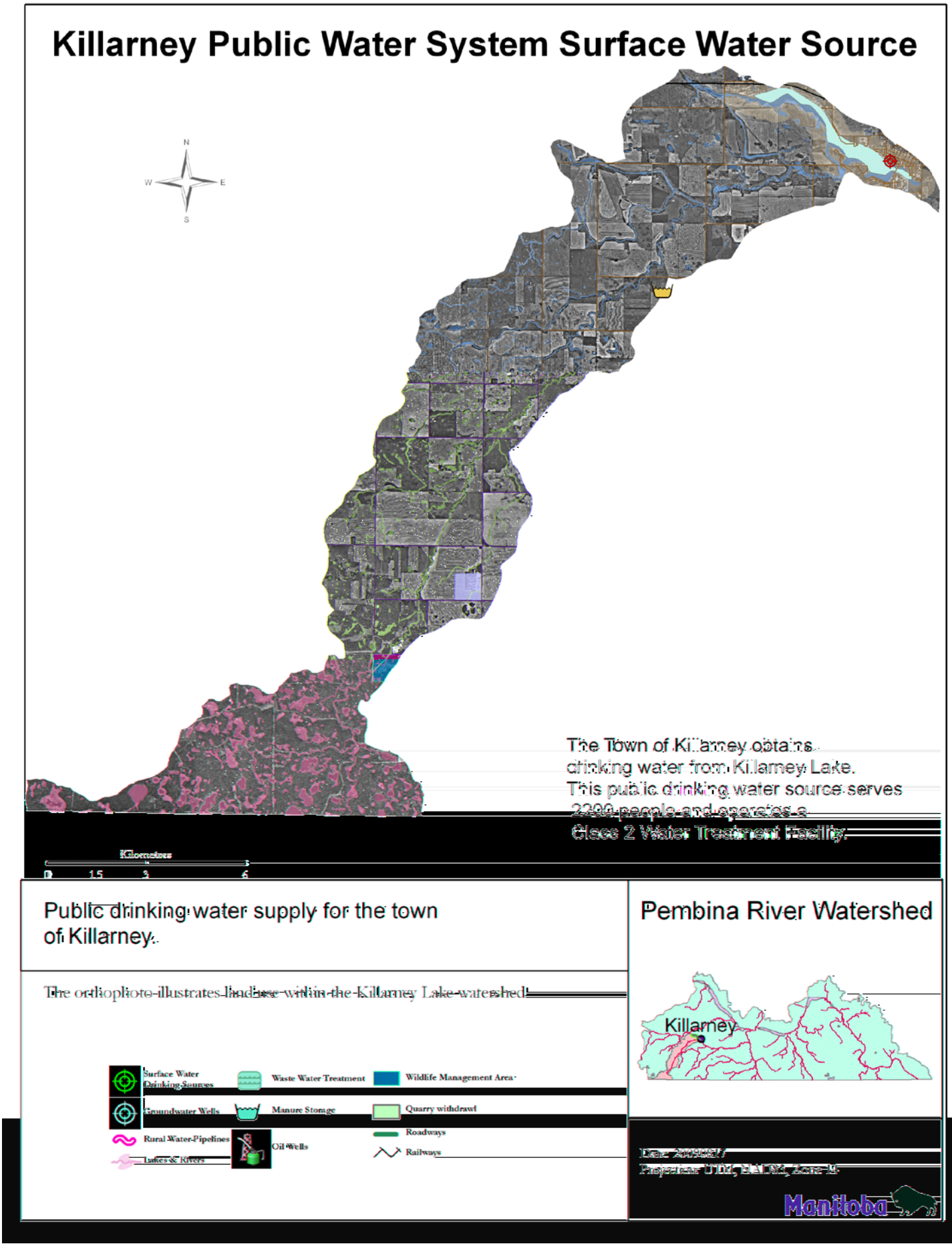


Figure 7. Town of Killarney

Killarney - Public Water System

Source: Killarney Lake
Owner: Town of Killarney
Population Served: 2200
Is the source treated?: Yes
Is the source chlorinated?: Yes

Comments: The town of Killarney will soon be sourcing drinking water from a nearby well, and will no longer be sourcing water from Killarney Lake.

Table 7. Land use in the subwatershed of Killarney Lake.

Potential Pollutant Source	Distance to Source Withdrawal Point	Comments	Recommended Action
Crop/Pasture land and livestock operations	~100 m – 20 km	Annual cropping, hayland and pasture land are common in this area. An intensive livestock operation is located <10 km upstream of Killarney lake.	Reduce nutrient inputs into this subwatershed.
Septic systems	50 m - 1.5 km	Residences in the area around Killarney Lake use septic tanks and fields for on-site waste water management.	Develop an effective septic system educational campaign. Deliver an enhanced inspection program of waste-water systems on residential properties in sensitive areas to ensure water quality is being protected.
Town of Killarney		Urban related activities –higher traffic area.	None.
Transportation routes	50 m – 1.5 km	Includes paved and gravel roads.	None.
Farm yards	1.0 km – 20.0 km upstream	Likely includes storage of chemicals, fuel and potentially fertilizer/manure. Also, will likely include household storage of hazardous materials	Encourage landowners to attend an Environmental Farm Plan workshop to learn if they can lower threats to local surface water.

Recommended actions for all potential pollutant sources:

1. Reduce nutrient inputs from the sub watershed.
2. Develop an effective septic system educational campaign. Deliver an enhanced inspection program of waste-water systems on residential properties in sensitive areas to ensure water quality is being protected.
3. Encourage landowners to attend an Environmental Farm Plan workshop to learn if they can lower threats to local surface water.

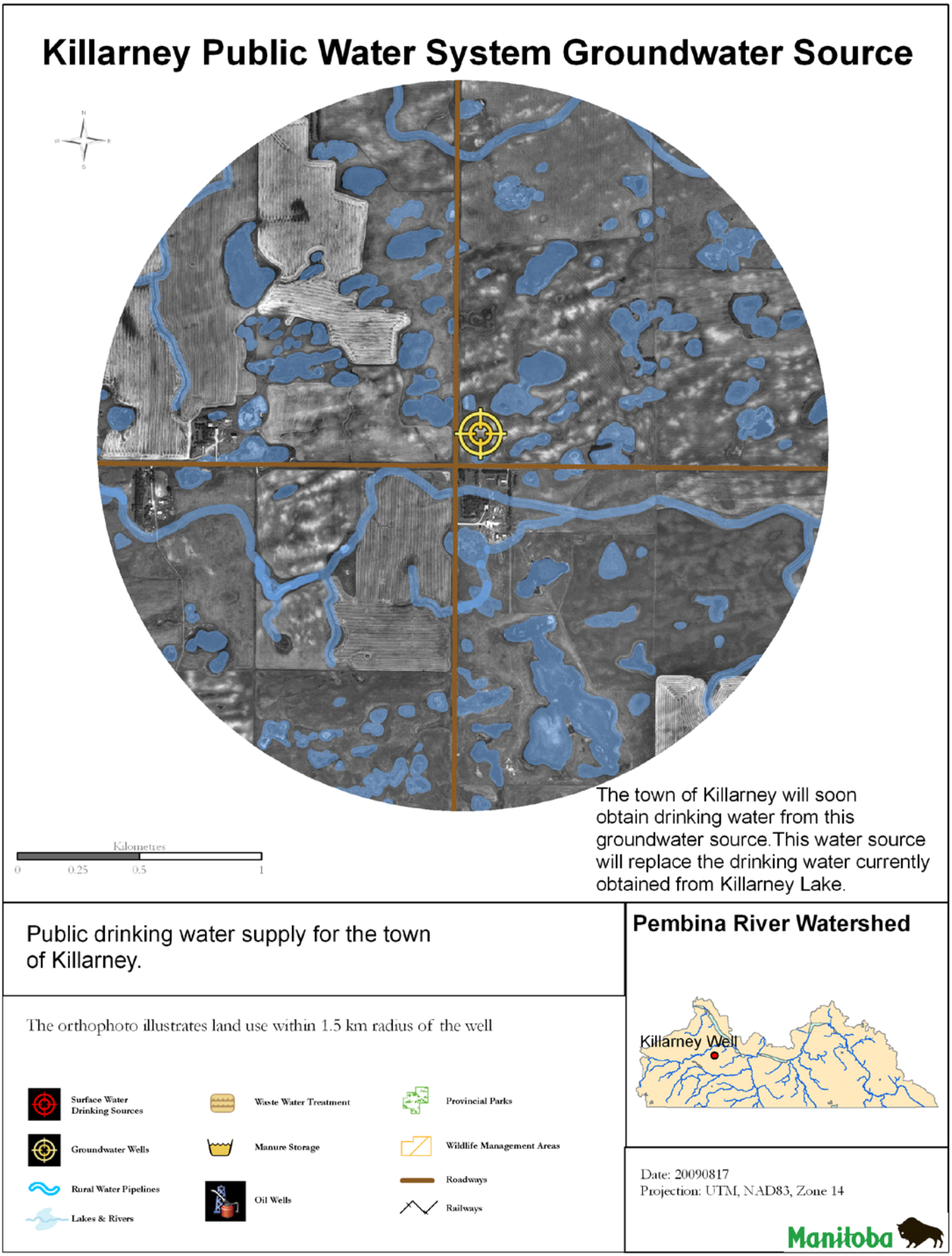


Figure 8. Town of Killarney

Killarney - Public Water System – Proposed Groundwater

Comments: This proposed well has been licensed and is expected to be operational in 2011.

Table 8. Land use in the area surrounding the proposed Killarney public water system well.

Potential Pollutant Source	Distance to Source Withdrawal Point	Comments	Recommended Action
Crop/Pasture land	~100 m – 1.5 km	Annual cropping, hayland and pasture land are common in this area.	Monitor any changes.
Septic systems	200 m - 1.5 km	3 yard sites within 1.5 km of the well head.	Provide education to yard site owners on proper septic system management.
Abandoned wells / Improperly maintained active wells	~ 30 m – 1 km	Abandoned wells may be present in the surrounding area.	Seal all abandoned wells within 1.5km.
Transportation routes	50 m – 1.5 km	Includes gravel roads	Monitor any changes.
Farm yards	200 m - 1.5 km	Likely includes storage of chemicals, fuel and potentially fertilizer/manure. Also, will likely include household storage of hazardous materials	Encourage landowners to attend an Environmental Farm Plan workshop to learn if they can lower threats to local groundwater.

Recommended actions for all potential pollutant sources:

1. Seal all abandoned wells within 1.5 km.
2. Provide education to yard site owners on proper septic system management.
3. Encourage landowners to attend an Environmental Farm Plan workshop to learn if they can lower threats to local groundwater.

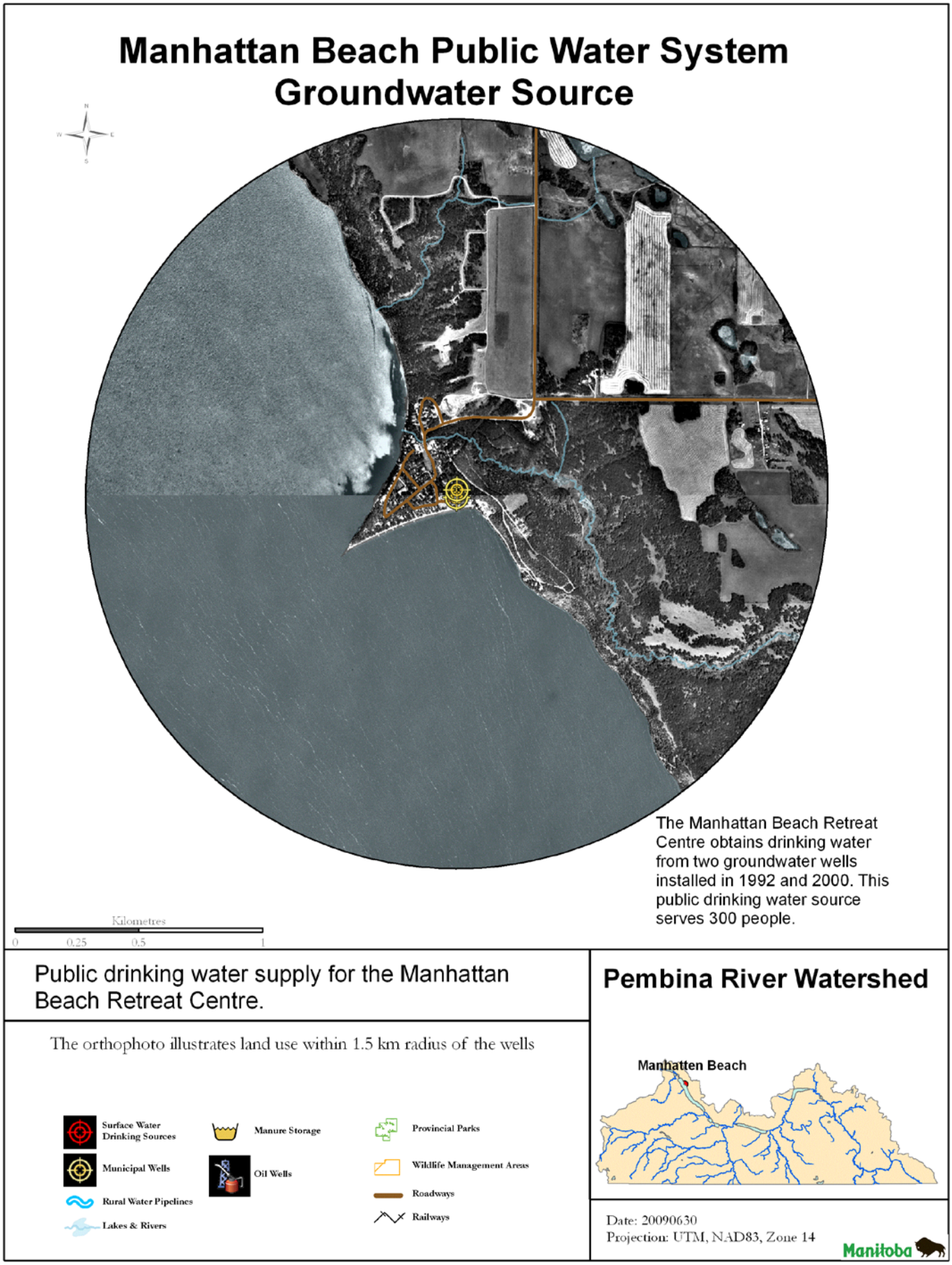


Figure 9. Manhattan Beach Retreat Centre

Manhattan Beach Retreat Centre - Public Water System

Comments: A large septic holding tank is located within 10 m of both well heads. Efforts should be make to ensure the tank does not develop a leak.

Table 9. Land use in the area surrounding the Manhattan Beach Retreat Centre public water system wells.

Potential Pollutant Source	Distance to Source Withdrawal Points	Comments	Recommended Action
Crop/Pasture land	~500 m – 1.5 km	Annual cropping, hayland and pasture land are common in this area.	Monitor any changes.
Septic systems	10 m - 1.5 km	Cottages and buildings in the community of Manhattan Beach use septic tanks for on-site waste water management.	Consider relocating nearby septic tank further from the well heads. Provide education to yard site owners on proper septic system management.
Abandoned wells / Improperly maintained active wells	~ 30 m – 1 km	Abandoned wells may be present in the Manhattan Beach Retreat Centre and surrounding area	Seal all abandoned wells within 1.5km.
Transportation routes	50 m – 1.5 km	Includes paved and gravel roads.	None.
Farm yards	~1.0 km	Likely includes storage of chemicals, fuel and potentially fertilizer/manure. Also, will likely include household storage of hazardous materials	Encourage landowners to attend an Environmental Farm Plan workshop to learn if they can lower threats to local groundwater.
Pelican Lake	50 m	Overland flooding – may infiltrate well, or nearby abandoned wells	Monitor any changes.

Recommended actions for all potential pollutant sources:

1. Consider relocating nearby septic tank further from the well heads.
2. Provide education to yard site owners on proper septic system management.
3. Seal all abandoned wells within 1.5 km of the well head.
4. Encourage landowners to attend an Environmental Farm Plan workshop to learn if they can lower threats to local groundwater.

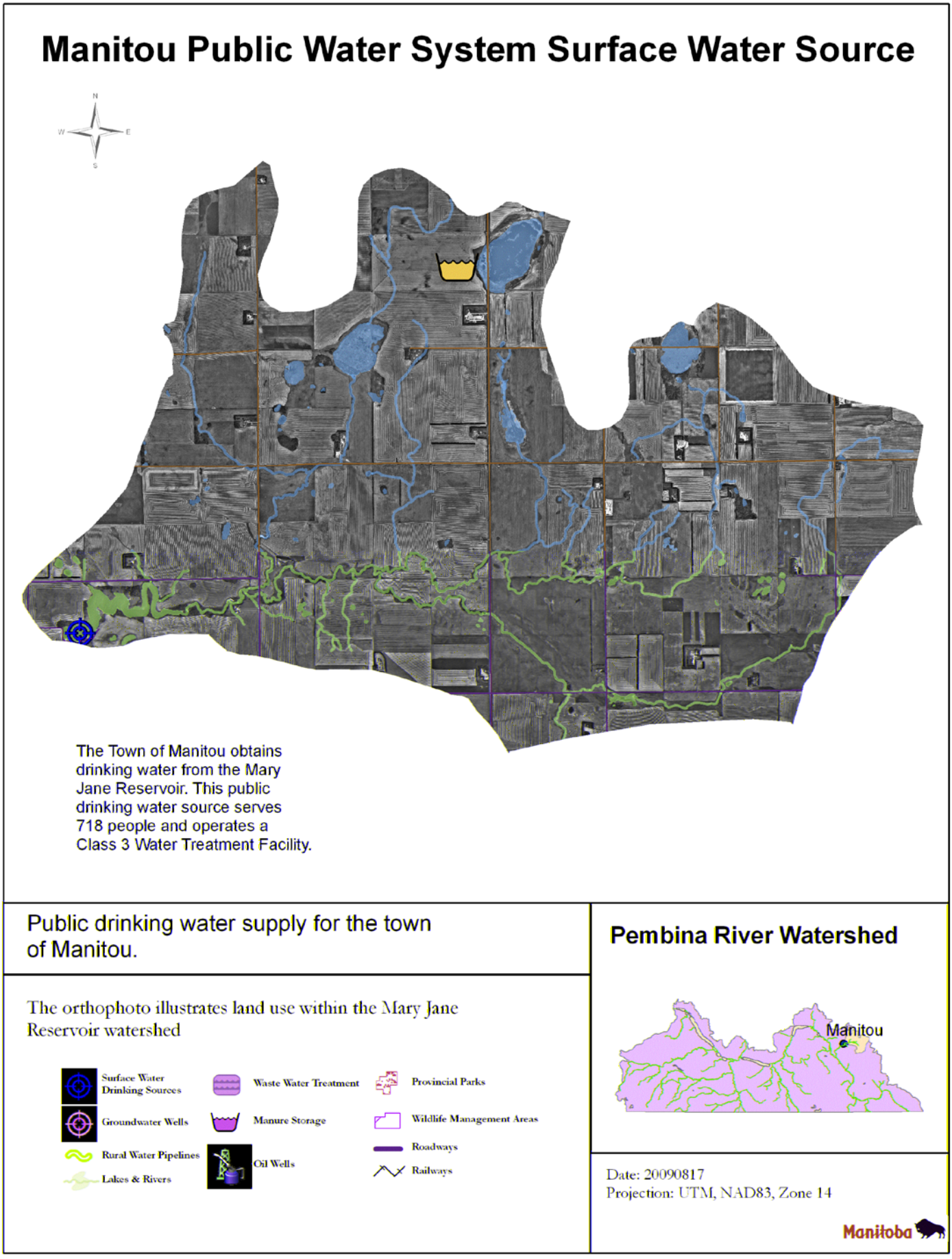


Figure 10. Town of Manitou

Manitou - Public Water System

Source: Mary Jane Reservoir
Owner: Town of Manitou
Population Served: 718
Is the source treated?: Yes
Is the source chlorinated?: Yes

Table 10. Land use in the sub watershed of the Mary Jane Reservoir.

Potential Pollutant Source	Distance to Source Withdrawal Point	Comments	Recommended Action
Crop/Pasture land and livestock operations	Across the road ~100 m – 1.5 km	Annual cropping, hayland and pasture land are common in this area. One intensive livestock operation is found in this watershed.	Reduce nutrient inputs in this subwatershed.
Septic systems	500 m - 1.5 km	Residences in this subwatershed use septic tanks, fields, sewage ejectors for on-site waste water management.	Provide education to yard site owners on proper septic system management.
Transportation routes	50 m – 1.5 km	Includes paved and gravel roads	None.
Farm yards	~1.0 km – 10 km	Likely includes storage of chemicals, fuel and potentially fertilizer/manure. Also, will likely include household storage of hazardous materials	Encourage landowners to attend an Environmental Farm Plan workshop to learn if they can lower threats to local surface water.

Recommended actions for all potential pollutant sources:

1. Reduce nutrient inputs from this sub watershed.
2. Encourage landowners to attend an Environmental Farm Plan workshop to learn if they can lower threats to local surface water.
3. Provide education to yard site owners on proper septic system management.

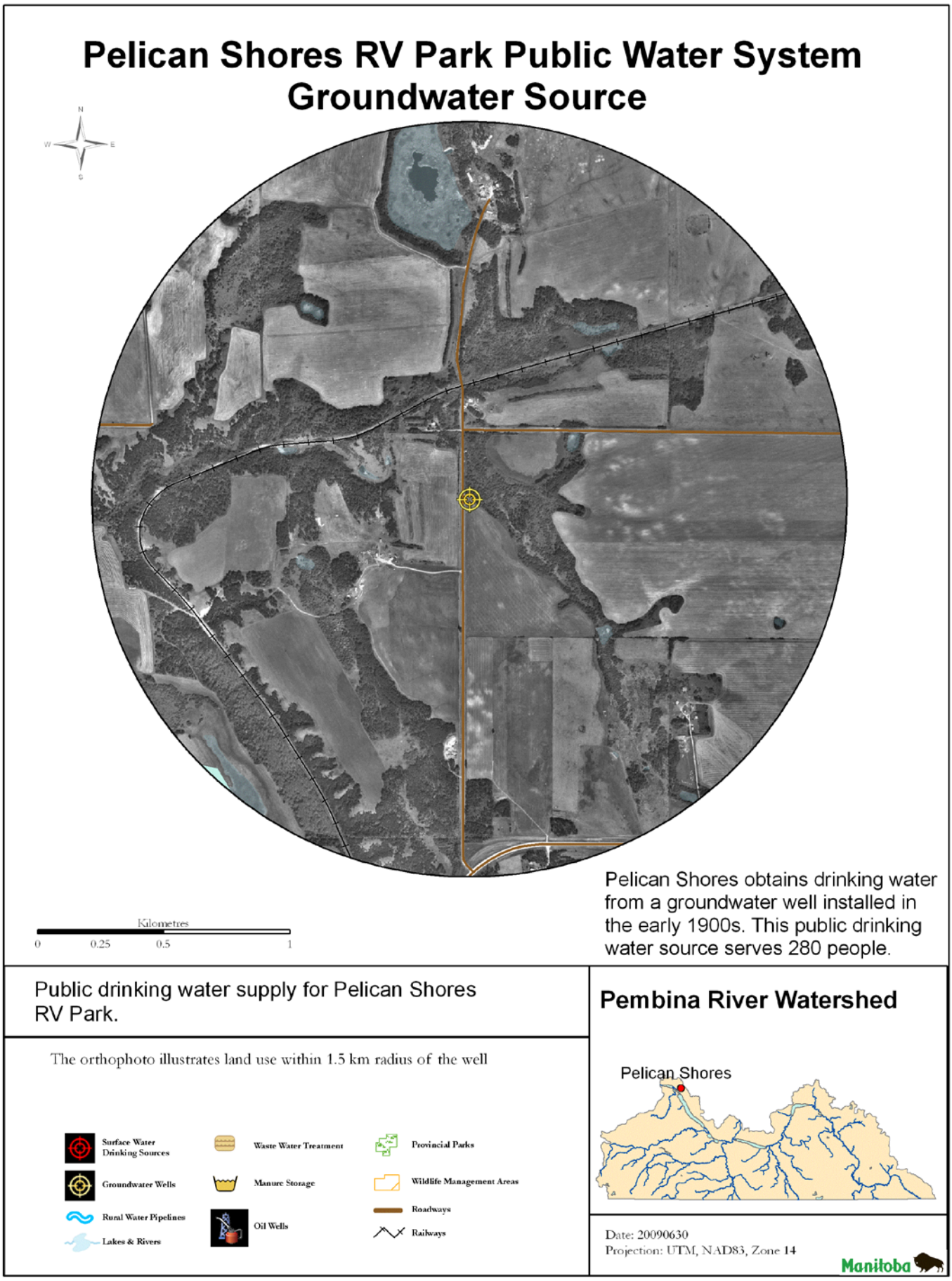


Figure 11. Pelican Shores RV Park

Pelican Shores RV Park - Public Water System

Comments: Beaver activity on a nearby stream may cause flooding and surface water contamination of the well head.

Table 11. Land use in the area surrounding the Pelican Shores RV Park public water system well.

Potential Pollutant Source	Distance to Source Withdrawal Point	Comments	Recommended Action
Crop/Pasture land and livestock operations	Across the road ~200 m – 1.5 km	Annual cropping, hayland and pasture land are common in this area.	Monitor any changes.
Abandoned wells / Improperly maintained active wells		Abandoned wells may be present in the surrounding area	Seal all abandoned wells within 1.5km.
Transportation routes	50 m – 1.5 km	Includes gravel roads and a railway.	None.
Farm yards	~1.0 km	Likely includes storage of chemicals, fuel and potentially fertilizer/manure. Also, will likely include household storage of hazardous materials	Encourage landowners to attend an Environmental Farm Plan workshop to learn if they can lower threats to local groundwater.
Creek – overland flooding	10 m	Overland flooding – may infiltrate well, or nearby abandoned wells	Control beaver activity on adjacent waterway to prevent flooding of the well head.

Recommended actions for all potential pollutant sources:

1. Control beaver activity on adjacent waterway to prevent flooding of the well head.
2. Consider developing a new well that is not directly beside a creek.
3. Seal all abandoned wells within 1.5 km of the well head.
4. Encourage landowners to attend an Environmental Farm Plan workshop to learn if they can lower threats to local groundwater.

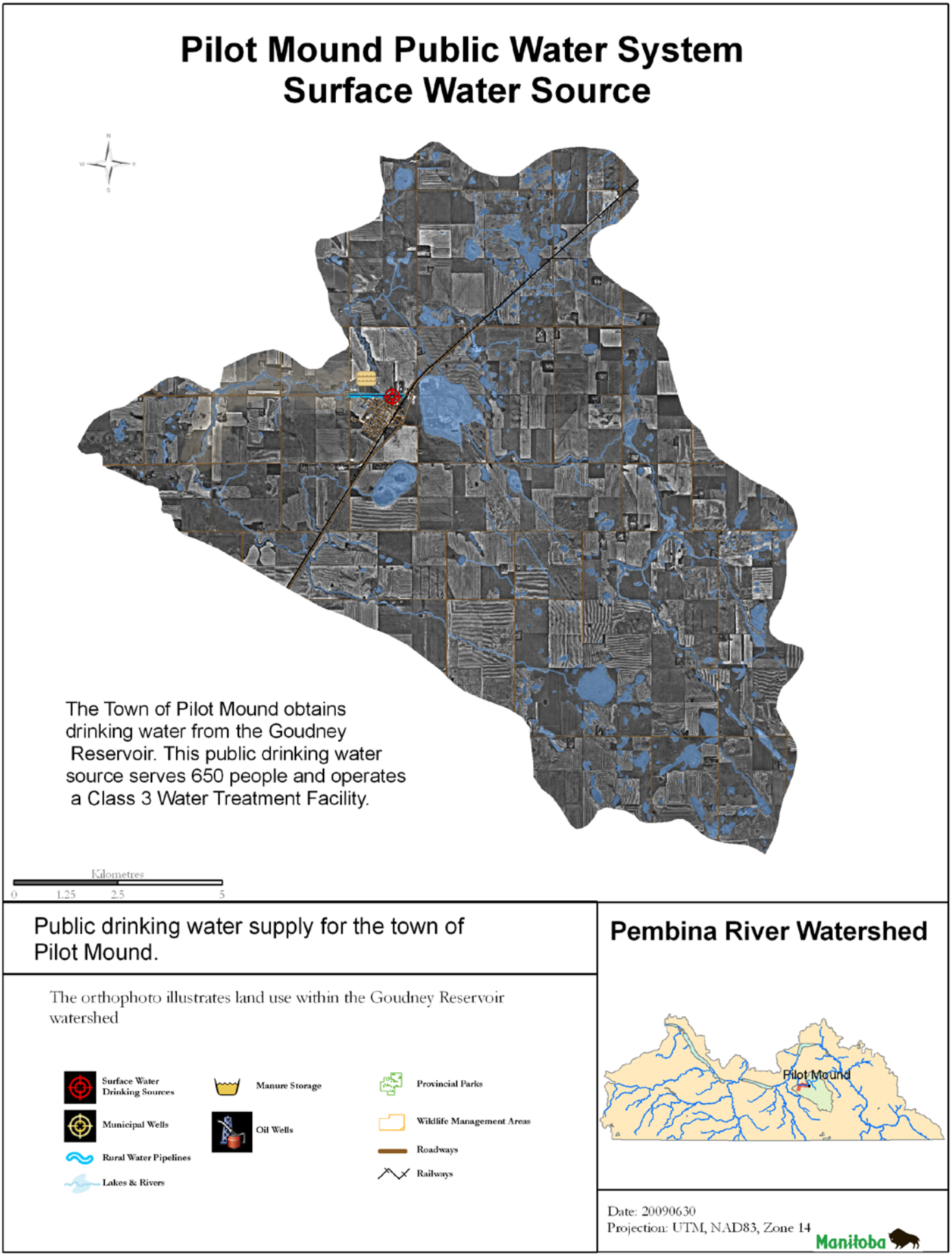


Figure 12. Town of Pilot Mound

Pilot Mound - Public Water System

Source: Goudney Reservoir
Owner: Town of Pilot Mound
Population Served: 650
Is the source treated?: Yes
Is the source chlorinated?: Yes

Comments: The Goudney Reservoir Action provides a very detailed description of the Goudney Reservoir and watershed.

Table 12. Land use in the sub watershed of the Goudney Reservoir.

Potential Pollutant Source	Distance to Source Withdrawal Point	Comments	Recommended Action
Crop/Pasture land and livestock operations	~100 m – 1.5 km	Annual cropping, hayland and pasture land are common in this area.	Reduce nutrient inputs from sub-watershed.
Septic systems	500 m - 1.5 km	Homes in community of Pilot Mound use septic tanks and fields for on-site waste water management.	Provide education to yard site owners on proper septic system management.
Town of Pilot Mound	~ 30 m – 1 km	Urban related activities –higher traffic area.	Monitor any changes.
Wastewater treatment plant	~ 30 m – 1 km	Wastewater treatment plant is located northwest of Goudney reservoir.	Reduce nutrient inputs from sub-watershed.
Transportation routes	50 m – 1.5 km	Includes paved and gravel roads.	Monitor any changes.
Farm yards	~1.0 km	Likely includes storage of chemicals, fuel and potentially fertilizer/manure. Also, will likely include household storage of hazardous materials	Encourage landowners to attend an Environmental Farm Plan workshop to learn if they can lower threats to local surface water.

Recommended actions for all potential pollutant sources:

1. Reduce nutrient inputs from sub-watershed.
2. Provide education to yard site owners on proper septic system management.
3. Encourage landowners to attend an Environmental Farm Plan workshop to learn if they can lower threats to local surface water.

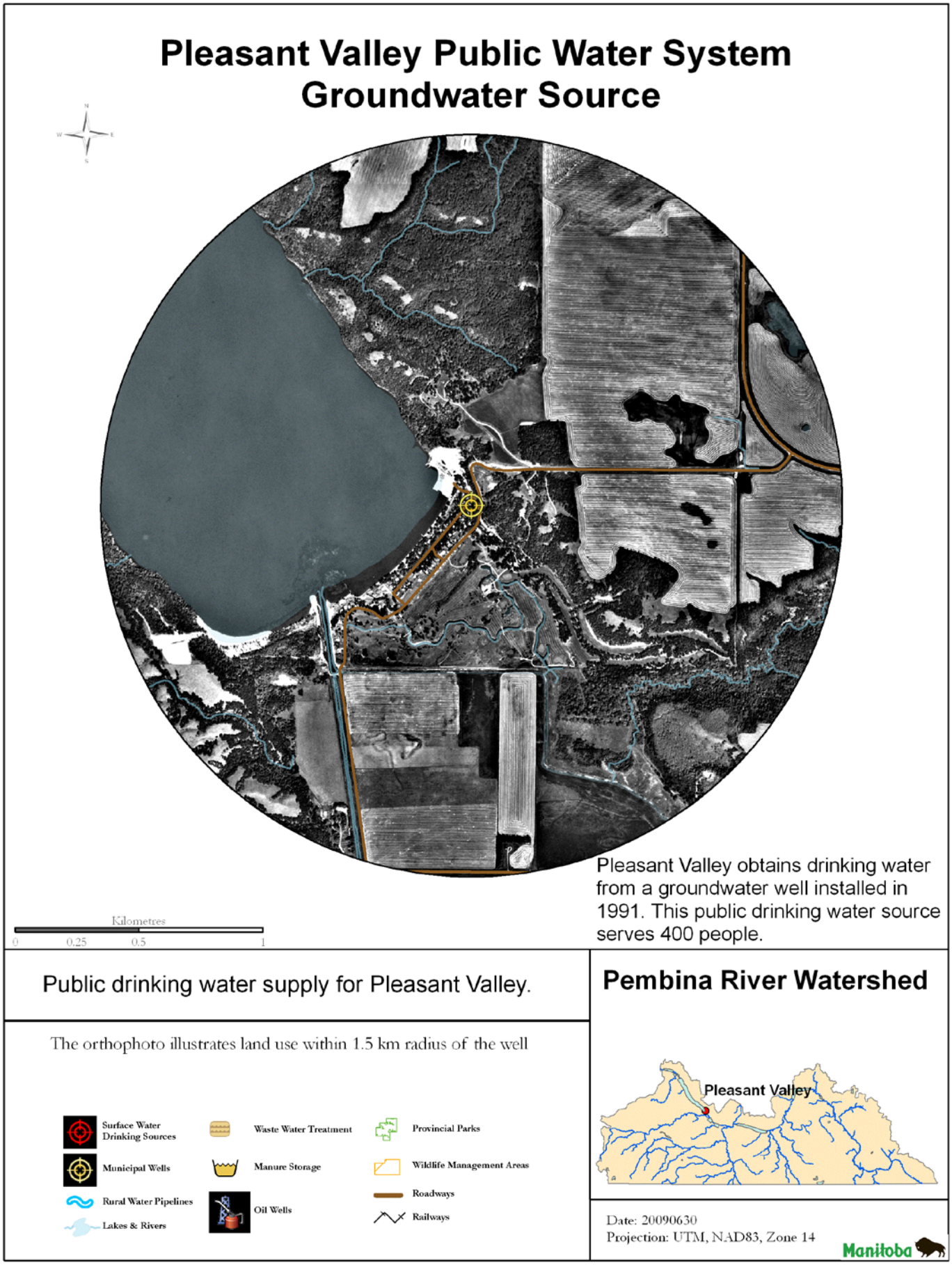


Figure 13. Pleasant Valley Cottage Association

Pleasant Valley - Public Water System

Table 13. Land use in the surrounding area the Pleasant Valley public water system well.

Potential Pollutant Source	Distance to Source Withdrawal Point	Comments	Recommended Action
Crop/Pasture land and	~400 m – 1.5 km	Annual cropping, hayland and pasture land are common in this area.	Monitor any changes.
Septic systems	500 m - 1.5 km	Homes in community of Pleasant Valley use septic tanks and for on-site waste water management.	Develop an effective septic system educational campaign. Deliver an enhanced inspection program of waste-water systems on residential properties in sensitive areas to ensure water quality is being protected.
Pleasant Valley	~ 30 m – 1 km	Urban related activities –higher traffic area	None.
Abandoned wells / Improperly maintained active wells		Abandoned wells may be present in the surrounding area	Seal all abandoned wells within 1.5km.
Transportation routes	50 m – 1.5 km	Includes paved and gravel roads	None.
Golf Course	~ 500 m	Likely includes storage of chemicals, fuel and potentially fertilizer.	Monitor any changes.
Pelican Lake – overland flooding	50 m	Overland flooding – may infiltrate well, or nearby abandoned wells	Monitor any changes.

Recommended actions for all potential pollutant sources:

1. Seal all abandoned wells within 1.5 km of the well head.
2. Develop an effective septic system educational campaign. Deliver an enhanced inspection program of waste-water systems on residential properties in sensitive areas to ensure water quality is being protected.

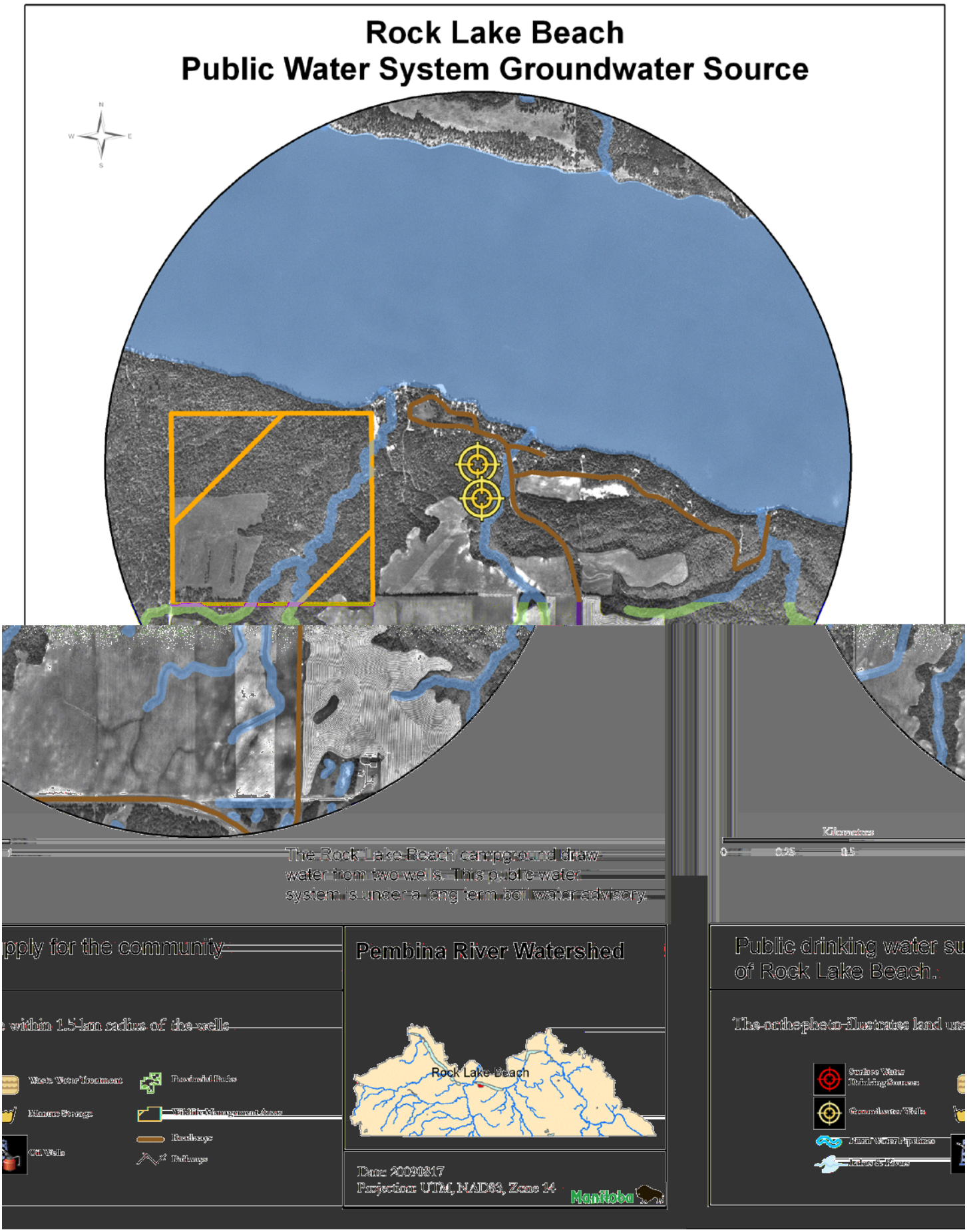


Figure 14. Rock Lake Beach

Rock Lake Beach - Public Water System

Comments: This public water system is under a long-term boil water advisory.

Table 14. Land use in the area surrounding the Rock Lake Beach public water system wells.

Potential Pollutant Source	Distance to Source Withdrawal Point	Comments	Recommended Action
Crop/Pasture land and livestock operations	~200 m – 1.5 km	Annual cropping, hayland and pasture land are common in this area.	Monitor any changes.
Septic systems	500 m - 1.5 km	Residences in the community of Rock Lake Beach use septic tanks for on-site waste water management.	Develop an effective septic system educational campaign. Deliver an enhanced inspection program of waste-water systems on residential properties in sensitive areas to ensure water quality is being protected.
Abandoned wells / Improperly maintained active wells	~ 30 m – 1 km	Abandoned wells may be present in the surrounding area.	Seal all abandoned wells within 1.5km.
Transportation routes	50 m – 1.5 km	Includes paved and gravel roads	None.
Farm yards	~1.5 km	Likely includes storage of chemicals, fuel and potentially fertilizer/manure. Also, will likely include household storage of hazardous materials	Encourage landowners to attend an Environmental Farm Plan workshop to learn if they can lower threats to local surface water.

Recommended actions for all potential pollutant sources:

1. Consider developing a new well.
2. Seal all abandoned wells within 1.5 km of the well head.
3. Develop an effective septic system educational campaign.
4. Encourage landowners to attend an Environmental Farm Plan workshop to learn if they can lower threats to local surface water.

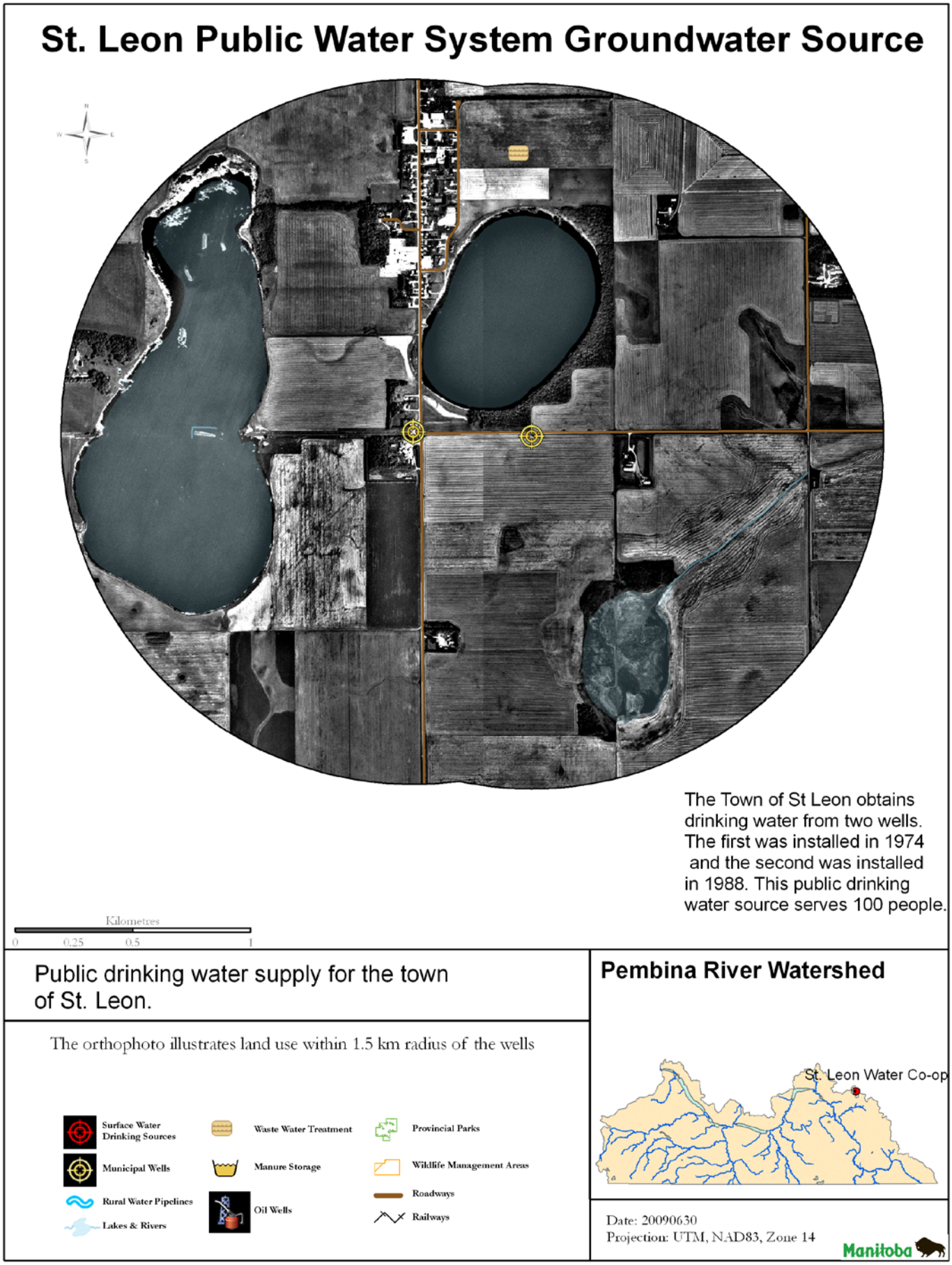


Figure 15. Town of St. Leon

St. Leon - Public Water System

Comments: Upgrade both well head sites with a new casing and fencing. Create a five meter vegetated buffer around the well 2.

Table 15. Land use in the area surrounding the St. Leon public water system wells.

Potential Pollutant Source	Distance to Source Withdrawal Point	Comments	Recommended Action
Crop/Pasture land and Livestock Operations	~5 m – 1.5 km	Annual cropping, hayland and pasture land are common in this area.	Monitor any changes.
Septic systems	500 m - 1.5 km	Homes in community of St. Leon use septic tanks and fields for on-site waste water management.	Provide education to yard site owners on proper septic system management.
Town of St Leon	~ 30 m – 1 km	Urban related activities –higher traffic area	Monitor any changes.
Abandoned wells / Improperly maintained active wells	~ 30 m – 1 km	Abandoned wells may be present in St Leon and surrounding area.	Seal all abandoned wells within 1.5km.
Transportation routes	50 m – 1.5 km	Includes paved and gravel roads	Monitor any changes.
Farm yards	~1.0 km	Likely includes storage of chemicals, fuel and potentially fertilizer/manure. Also, will likely include household storage of hazardous materials	Encourage landowners to attend an Environmental Farm Plan workshop to learn if they can lower threats to local groundwater.
Wastewater treatment plant	~1.0 km		Monitor any changes.

Recommended actions for all potential pollutant sources:

1. Upgrade both well head sites with a new casing and fencing. Create a five metre vegetated buffer around the well 2.
2. Seal all abandoned wells within 1.5 km of the well heads.
3. Provide education to yard site owners on proper septic system management.
4. Encourage landowners to attend an Environmental Farm Plan workshop to learn if they can lower threats to local groundwater.

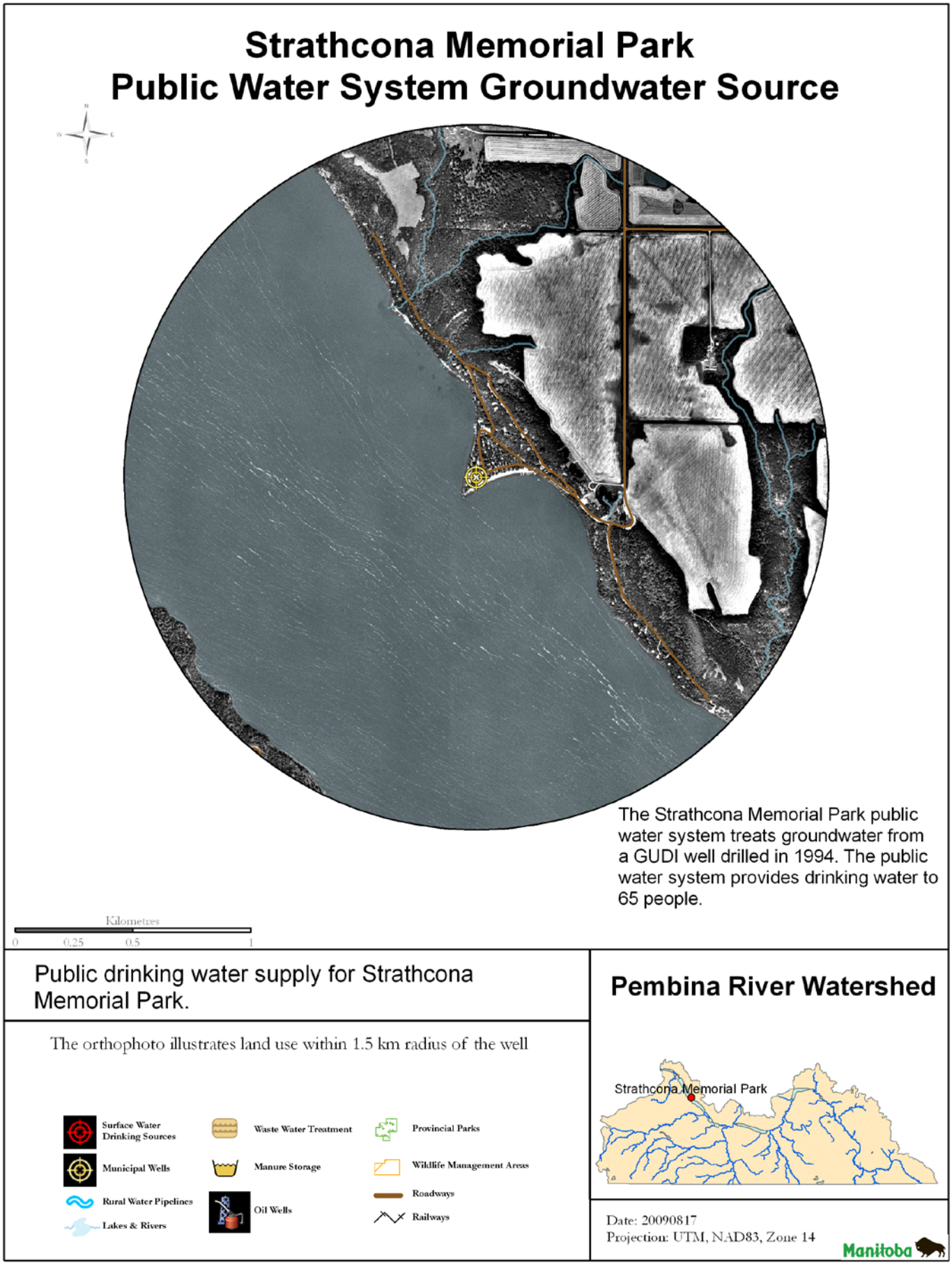


Figure 16. Town of St. Leon

Strathcona Memorial Park - Public Water System

Comments: Upgrade both well head sites with a new casing and fencing. Create a five meter vegetated buffer around the well 2.

Table 16. Land use in the area surrounding the Strathcona Memorial Park public water system well.

Potential Pollutant Source	Distance to Source Withdrawal Point	Comments	Recommended Action
Crop/Pasture land and Livestock Operations	~5 m – 1.5 km	Annual cropping, hayland and pasture land are common in this area.	Monitor any changes.
Septic systems	5 m - 1.5 km	Homes in community of Strathcona Park use septic tanks for on-site waste water management.	Remove large septic tank, which is located five meters north of well. Develop an effective septic system educational campaign. Deliver an enhanced inspection program of waste-water systems on residential properties in sensitive areas to ensure water quality is being protected
Abandoned wells / Improperly maintained active wells	~ 30 m – 1 km	Abandoned wells may be present in Strathcona Park and surrounding area.	Seal all abandoned wells within 1.5 km.
Transportation routes	2 m	Includes gravel roads and parking lot.	Monitor any changes.

Recommended actions for all potential pollutant sources:

1. Consider developing a new well that is not directly influenced by surface water.
2. Upgrade well head site with a new casing and fencing. Create a five meter vegetated buffer around the well head.
3. Remove large septic tank, which is located five meters north of well.
4. Develop an effective septic system educational campaign. Deliver an enhanced inspection program of waste-water systems on residential properties in sensitive areas to ensure water quality is being protected
5. Seal all abandoned wells within 1.5 km.

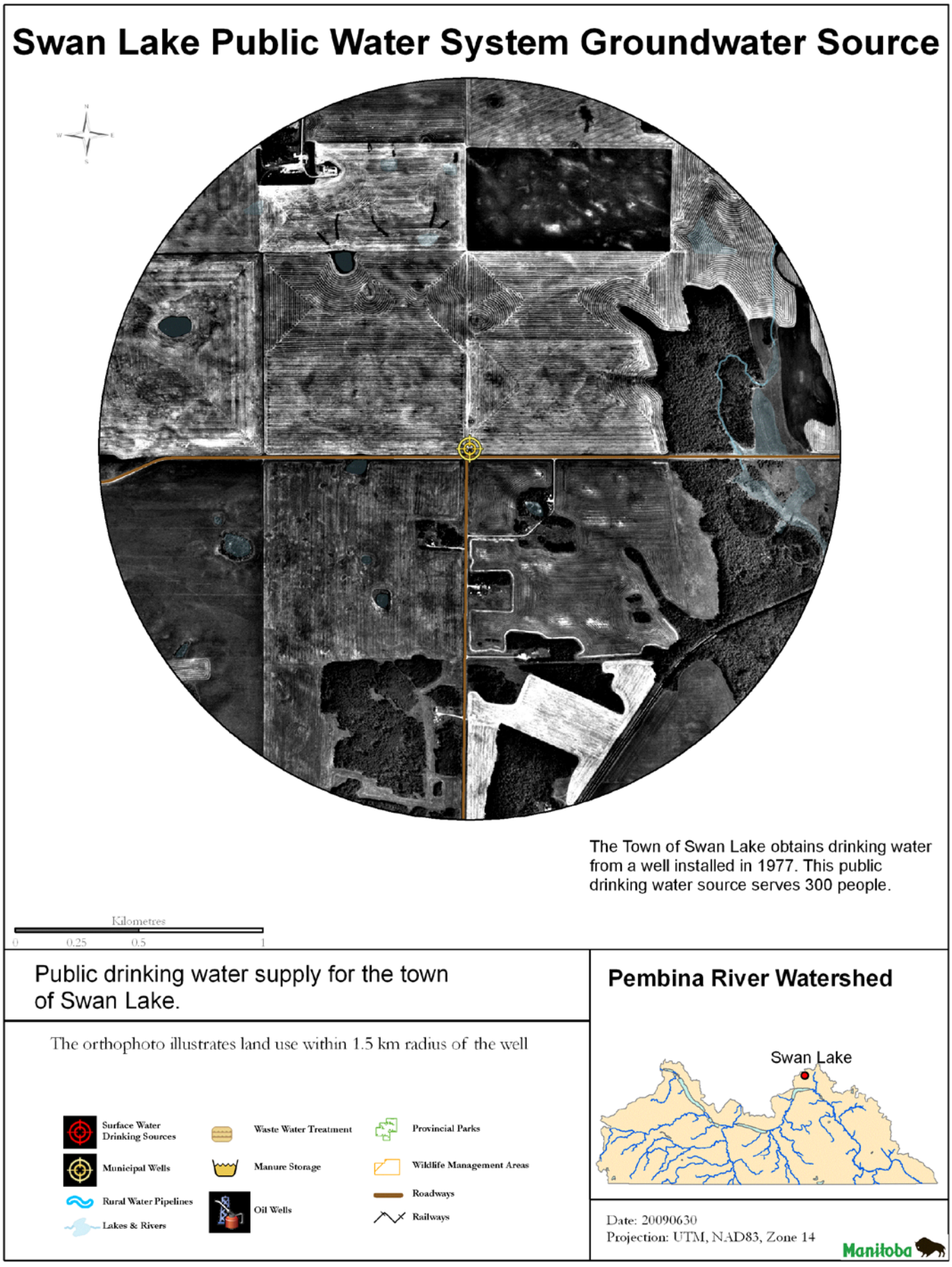


Figure 17. Town of Swan Lake

Swan Lake - Public Water System

Comments: The road allowance directly adjacent to the roadway can be used for pesticides and fertilizer mixing, which may make the well head susceptible to contamination.

Table 17. Land use in the surrounding area the Swan Lake public water system well.

Potential Pollutant Source	Distance to Source Withdrawal Point	Comments	Recommended Action
Crop/Pasture land	~5 m – 1.5 km	Annual cropping, hayland and pasture land are common in this area.	Monitor any changes.
Septic systems	500 m - 1.5 km	Homes south of the well head.	Provide education to yard site owners on proper septic system management.
Abandoned wells / Improperly maintained active wells	~ 30 m – 1 km	Abandoned wells may be present the surrounding area.	Seal all abandoned wells within 1.5km.
Transportation routes	50 m – 1.5 km	Includes paved and gravel roads. Road allowance adjacent to well head may make well head susceptible to contamination.	Install a fence barrier to create a five meter buffer around well head.
Farm yards	~1.0 km	Likely includes storage of chemicals, fuel and potentially fertilizer/manure. Also, will likely include household storage of hazardous materials	Encourage landowners to attend an Environmental Farm Plan workshop to learn if they can lower threats to local groundwater.
Intensive livestock operation (hogs)	~1.4 km	Appears to be decommissioned.	Monitor any changes.

Recommended actions for all potential pollutant sources:

1. Install fence barrier to create a five metre buffer around well head.
2. Seal all abandoned wells within 1.5 km of the well head.
3. Encourage landowners to attend an Environmental Farm Plan workshop to learn if they can lower threats to local groundwater.
4. Provide education to yard site owners on proper septic system management.

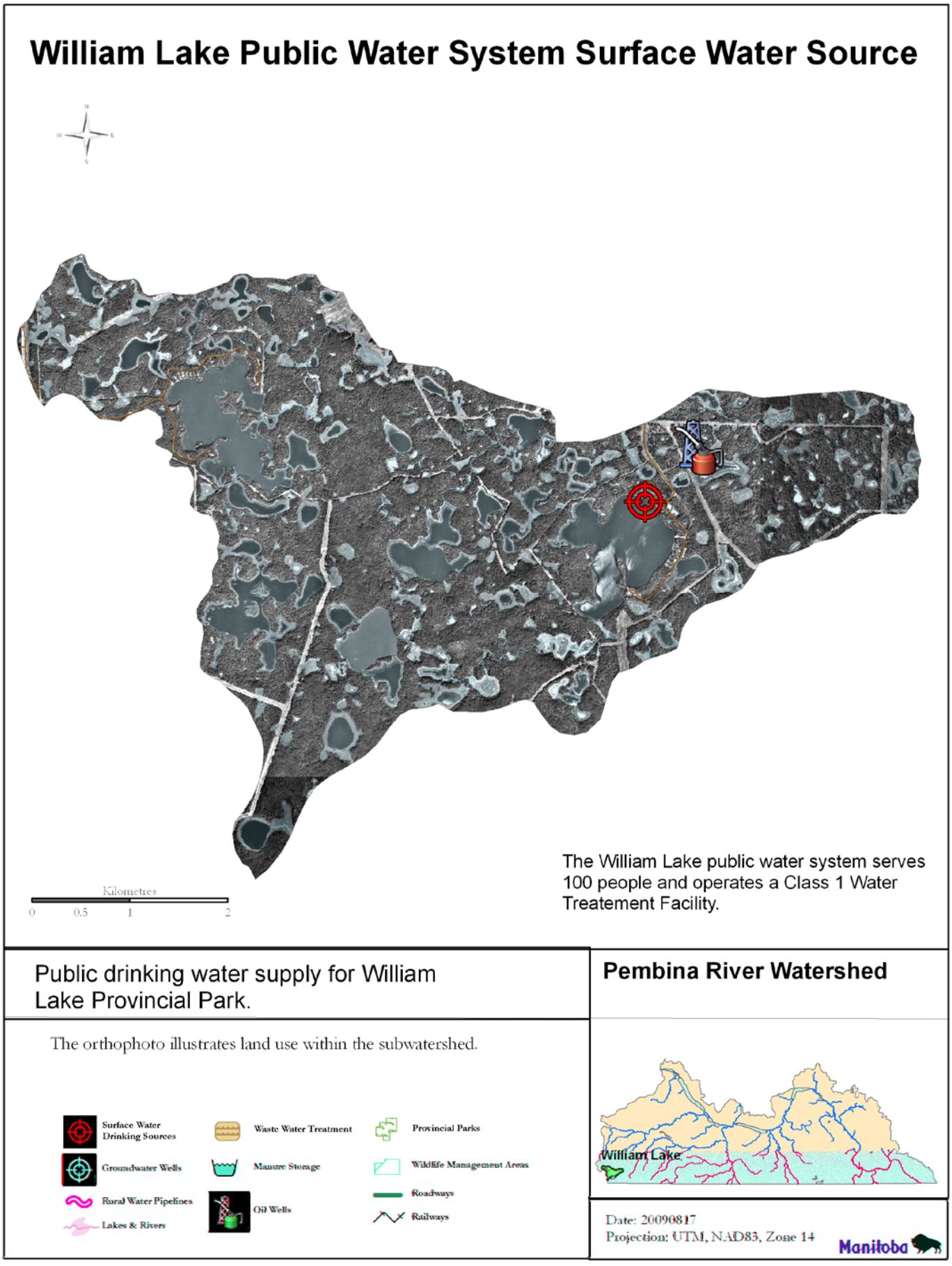


Figure 18. William Lake Provincial Park

William Lake - Public Water System

Source: Surface water
Owner: Manitoba Conservation – Parks Branch
Population Served: 100
Is the source treated?: Yes
What type of treatment is used?: Chlorinated
Is the source chlorinated?: Yes

Comments: An oil well is located ~ 500 m northeast of William Lake.

Table 18. Land use in the subwatershed of William Lake.

Potential Pollutant Source	Distance to Source Withdrawal Point	Comments	Recommended Action
Pasture	~100 m – 1.5 km	Community pasture land surrounds this area.	Monitor any changes.
Septic systems	500 m - 1.5 km	William Lake campground uses septic tanks to hold waste water.	None.
Oil well	500 m north east		Monitor any changes.

Recommended actions for all potential pollutant sources:

1. None identified.