In the Medicine River? Testing the Waters ledicine River Watershed Society (MRW) 2022 Water Quality Testing Program RDRWA Spring Forum 2023-03-22

Curious about the Water Cuality

Introduction to the Medicine River

- The name for the Medicine River is a "translation"
 - from the Cree words
 - muskiki and nipagwasimow,
 - which meant Sundance river.
 - It first appeared on a John Arrowsmith map in 1859
 - <u>https://www.wikiwand.com/en/Medicine_River_(Alberta)</u>
- Since the colonial authorities did not approve of the Sundance rituals, the name would have forcibly been changed ... ending up as the Medicine River
- ... not really a translation from the Cree words at all.



The Red Deer River Watershed spans across central Alberta The Medicine Sub-watershed is in the NW corner of the RDR W/S

Medicine Subwatershed



Red Deer River State of the Watershed Report



Medicine W/S

with overlay of the major highways and municipal boundaries

Figure 140. Location of the Medicine River subwatershed (AAFC-PFRA, 2008).



300 years before any geopolitical references All drainage within the M-BM sub-watershed

M.R. in Green

Map 3. The Medicine-Blindman Rivers HUC 6 watershed consists of three smaller HUC 8 subwatersheds: Medicine River, Blindman River, and the Red Deer River and Sylvan Lake subwatersheds.

9



Medicine River and Named Tributaries

Map 6. Location of the waterbodies assessed in this study, A portion of the Blindman River, as well as Sylvan and Gull Lakes and their tributaries, were previously assessed and were not included in this study.

View from the bridge

- A quick tour of the Medicine River from the 10 Paved Road Bridges
- The Bottom 2 Photos are Upstream and Downstream from the bridge
 - Note the River Water Colour in the Bottom 2 Photos

#07: 4342 H53 TR424 Prov. Hwy. 53 (w. Rimbey)









#13: 3442 H12 TR404 Prov. Hwy 12 - Gilby









#15: 3374 TR400 RCR Rainy Creek Road









#16: 39376 H766 RR32A Sec. Hwy 766 - Eckville









#19: 3224 H11 TR390 Prov. Hwy. 11









#20: 38338 RR30 5 km South of Benalto









#22: 2538 TR380 10km South of Benalto









#24: 2200 TR370 SH592 West of Penhold









#26: 2118 SH592 Markerville









#27: 1508 TR362 P.H. 54 (west of Innisfail)









Satellite Photo of Confluence



• Public Perception is typically one of

• "That Brown River"

- Rather than "that beautiful, lazy river
 - that I would love to canoe"

That Brown River



• Medicine River has the stigma of being the eighth "dirtiest" river in Canada"

 A non-authenticated, anonymous quotation, but still rather quantitative in nature

• ... and not one to be proud of

Theories and Possible Explanations

- Agricultural Practices (scapegoat)
 - Eckville Sewage Logoon outfall
 - Possible Peat Staining from
 - Peat Moss Bogs in Headwaters
 - Non flow and low flushing
 - leads to stagnation

Gosling Lake – Upper Headwaters M.R. W/S



#02: 43118 RR51









Upper Wilson Creek – Brown U/S of Civilization and Ag.



Geography of the Medicine River

- Medicine River is fed only by springs and surface runoff
- Significant flow only during Spring Runoff (Freshet) and High Rain periods
 - Medicine River is 80 km long as the crow flies,
 - Est. ~400km in length (by canoe)
 - Elevation at Medicine Lake 983 mASL
 - Elevation at R.D.R. Confluence 907 mASL
 - Slope 76m in ~ 400km is 0.00019 or 0.019% gradient
 - (BTW: Engineers design surface drainage to be 1.00% to flow)

Geography of the Medicine River

- Barely qualifies as
- Lotic flowing stream
 - Better defined as
- Lentic standing water
- In reality, it is a long, skinny lake
 - with almost no flow

Background Information

What we knew (or thought we knew) about water quality in the M.R. before we started our test program Clearwater County Stream Water Quality Monitoring Summary Report 2003-2005



Prepared for: Clearwater County 4340 – 47 Ave Box 550 Rocky Mountain House, Alberta T4T 1A4

Prepared by: Aquality Environmental Consulting Ltd. 11216-23B Avenue Edmonton, Alberta T6J 4Z6

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Horseguard Creek (in M.R.W/S) and Prairie Creek and Cow Creek in N.S.R.W/S

Clearwater County Water Quality Summary Report 2003-2005

• Executive Summary

Clearwater County in partnership with the Rocky Riparian Group, collected water ٠ quality samples from the Prairie, Horseguard and Cow Creeks from 2003 to 2005. Midstream flow grab samples were taken on these creeks by staff from Clearwater County and the Alberta Conservation Association. Samples were analyzed for nutrients, bacteria and physical parameters by EnviroTest in Edmonton. The creeks had a CCME Water Quality Index rating of fair (Horseguard Creek), good (Cow Creek), and excellent (Prairie Creek), which indicates that the streams are in relatively good health. Parameters of concern include high fecal coliform and *E. coli* levels in Horseguard Creek and high nutrient loading during spring runoff periods. Comparisons to AESA Stream Survey sites have shown that these creeks are similar to other low agricultural intensity streams in Alberta, although direct comparisons cannot be made without thorough consideration of land use and land cover. Future recommendations included yearly sampling starting with spring runoff and continuing into the fall, with consideration of additional parameters such as parasites and pesticides.

2006 MRWS Community Watershed Monitoring Pilot Program

Location Nutrients Bacteria

Hwy 53 Rainy Creek Rd. Range Rd. 25 Hwy 54¹



٠

¹ Hwy 54 site sampled by Alberta Environment.

Summary

Overall water quality during 2006 at the Medicine River sites sampled would be generally rated as fair. All sites had nutrient and bacteria concentrations higher than provincial or federal guidelines for the protection of aquatic life and/or drinking water for human or livestock consumption. However relative to other agricultural stream, nutrient concentrations were generally comparable or better, while bacteria levels were much higher than other agricultural streams.

2007 MRWS Community Watershed Monitoring Pilot Program

Location

Nutrients Bacteria

Hwy 53 Rainy Creek Rd. Range Rd. 25 Gabrielle L. Outflow



Summary

Overall water quality during 2007 at the Medicine River sites sampled would be generally rated as poor. All sites had nutrient and bacteria concentrations higher than provincial or federal guidelines for the protection of aquatic life and/or drinking water for human or livestock consumption. Flood conditions and sample timing may have influenced the lower water quality index scores in 2007 relative to 2006, however results from both years of sampling indicate that problems do exist throughout the watershed which will require ongoing improvements in land use practices in addition to those already in place.

RDRWA 2009 State of the Watershed

Based on the available data, the Medicine River sub-watershed receives a ۲ rating of "poor" for the condition indicators and a rating of "medium" for the risk indicators. Overall, this sub-watershed receives a ranking of "C-". There are substantial data gaps, and several of the condition rankings are based on limited data. Consequently, it is recommended to implement a detailed water quality sampling program, conduct a wetland inventory and regularly monitor riparian health conditions along the major waterbodies in the sub-watershed. Of particular concern are (1) the extensive network of linear developments (roads), primarily due to natural resource exploration and extraction activities throughout the sub-watershed, (2) TP concentrations that occasionally exceed water quality guidelines, likely due to widespread impaired riparian area health conditions and excessive agricultural runoff, municipal effluent and urban runoff that reach waterbodies throughout the sub-watershed, (3) the conversion of the landbase from its natural state to annual and perennial croplands or pastures, and (4) the loss of wetlands, which likely occurred as a result of agricultural land conversions, drainage, infilling, and the disruption of their hydrology following linear developments.
RDRWA 2009 SoW/S

Red Deer River State of the Watershed Report

Table 76. Condition and risk assessments of the Medicine River subwatershed. Indicators with a "poor" or "high" ranking are highlighted.

Indicators		Rating
Condition	Wetland loss	POOR
	Riparian health	FAIR
	Linear developments	POOR
	Nutrients	
	Total phosphorus	POOR
	Total nitrogen	FAIR
	Bacteria	POOR
	Parasites	POOR
	Pesticides	GOOD
	Minimum flows to maintain ecological integrity	
	Land cover	POOR
Overall		POOR
Risk	Livestock manure production	LOW
	Urban, rural, agricultural and recreational developments	MEDIUM
	Oil/gas wells	HIGH
Overall		MEDIUM

5 of 15 Sub W/S were Rated as High Risk / Poor Condition





FINAL REPORT



2020 RDRWA Riparian Intactness Study

Project #2011 July 2020

Prepared for:



Prepared by:



AB Environment and Parks now Environment and Protected Areas

- We know there is an AEP (EPA) monitoring station on the Medicine River.
- Downstream end near Hwy. 54, between Markerville and the Confluence.
- We had not been able to find any results from testing at that station.
- We don't believe that anyone ever went looking for it (because it does exist)

Recap of Prior Testing

- Above results do not portray a healthy Medicine River
- 2006-2007 testing program was a great MRWS project for the group and community awareness
- 15 years without testing is too long
- MRWS should start a new testing program as a major project

Why should MRWS test the water?

- Dispel the scapegoat of
- Agricultural Practices being to blame
- Identify if Phosphates, Nitrates, or Sulfates
 - are the cause

- Hope to conclude brown staining is
 - natural and/or organic

RDRWA Advice: Questions to Consider

Questions to consider

- *Why:* What are the goals of the Society?
- *Who*: volunteers? County partners?
- Where: Location(s)
- What: Parameters of interest?
- When: Spring, Summer, Winter
- How:
 - Monitoring methodology
 - Data management and reporting
- Cost & Duration



MRWS 2022 Testing Program Objectives

- See if water quality has changed in 15 years
- Compare to Baseline 2006-2007 results
- See if we can find why water is still brown today
- Ag. practices have evolved is water is better or worse
- Is Ag. to blame or credit for improvements?
- Is Eckville lagoon a contributor?
- Identify location of colour change
- May find there are quality issues beyond brown colour

Pending RDRWA Testing Requirements

- AEP Requirements for the State of the Watershed (SoW/S) and Water Quality Monitoring
- RDRWA (all WPACS) are supposed to meet water quality testing requirements.
- RDRWA will probably need to monitor water quality in all the subwatersheds and tributaries very soon.
- MRWS may just be ahead of the pack by voluntarily starting before we were told to.
- Therefore, this presentation could be timely in getting other W/S groups to start thinking about their upcoming testing programs that will be required soon.

Where should we test – and Why?

Scientists

- how the water quality varies along the mainstem,
- search for the source of the differences i.e. the tributaries.
- sample along that tributary until the source or sources were narrowed down.
- Agriculture producers
 - test upstream and downstream of the grazing lease / confined feedlot
- Municipal Govt.
 - human contamination upstream and downstream of sewage handling facilities (Eckville)
- Downstream Consumers (Red Deer and Drumheller)
 - any and all sources of contamination should be eliminated.

Keep it Simple – Common Sense

- Be Realistic
- Don't bite off more than we can chew
- We are Volunteers
- Brown at headwaters, so start there
- Replicate 2006-2007 Locations
- Parallel Eckville lagoon testing program
- Prototype for expanded program in 2023

MRWS 2022 Testing Program – 3 Sites



Site 1 Rainy Ck.Rd. TR40-0 u/s Eckville



Good site access, good sample access



Site 2 TR390 d/s Eckville, u/s Horseguard



Good site access, poor sample access



Good site access, poor sample access



Site 3 Horseguard Ck U/S confluence



Good site access, poor sample access



MRWS 2022 Testing Program – 5 Sites



Site 4 TR410 Upstream of Hwy 12



Site 5 TR420 Upstream near Hwy 53



RDRWA Advice: Groups Who Support Monitoring

- RiverWatch: Interested in finding partners in central Alberta. Provide science kits, training, and data is housed in a central database. <u>Waskasoo Creek.</u>
- Water Rangers: Have developed new testkits (with great reviews). Could start small by purchasing a kit and trialing.
- DataStream: Excellent "<u>A Monitors Guide to Water Quality</u>". <u>Lake</u> <u>Winnipeg DataStream</u> provides a data hub and support to upload data.
- LakeWatch, Winter Lake Keepers & ALMS Aquakits
 Water Rangers Test Kits
- CABIN: Canadian Aquatic Biomonitoring Network
- Piper Creek have experience doing community based monitoring



Creekwatch Lab Tests

Within Creekwatch science lab they provide equipment to carry out 7 tests:

- temperature
- turbidity
- dissolved oxygen
- phosphorus
- ammonia nitrogen
- pH
- chloride

Dissolved Oxygen (mg/L)

9.6



Water Temperature (°C) 10.10

Dissolved oxygen concentrations are measured using either a YSI probe or a Hach kit with a drop-by-drop titration to show a change in water colour until totally clear. Red line indicates the Environmental Quality Guidelines for Alberta Surface Waters (2018) for exceedance is minimum 5 mg/L for instantaneous value.

11 Median

Water temperatures are measured using a non-mercury glass thermometer or YSI probe placed in flowing, shallow water near shore. Red line indicates the Water Quality Objective identified as an ideal value according to the Bow Basin Watershed Management Plan. Values should not exceed a maximum 18". Higher values may cause stress on aquatic life.



Median

Median

Turbidity is measured by slowly pouring water into a type of graduated cylinder marked with "Nephelometric Turbidity Units" or NTU's.

Median

8.2

Phosphorus (mg/L)

Creek pH is measured using either a YSI probe or a Hach kit that compare a change in water colour. The Environmental Quality Guidelines for Alberta Surface Waters (2018) for exceedance is a pH value outside the range of 6.5 - 9.

Ammonia Nitrogen (mg/L)



Median

noting the colour change. Red line indicates the Environmental Quality Guidelines for Alberta kit that compare a change in water colour. Surface Waters (2018) for exceedance is maximum 1.0 mg/L at pH 8.0, 10°C.

Chloride (mg/L)



0.02

Median

Ammonia nitrogen concentrations are measured by dipping Hach test strips into water and Orthophosphate concentrations are measured with either a LaMotte colorimeter or a Hach

To review our data reports, visit creekwatch.ca/creekwatch-reports

Creekwatch Analysis of **Test Results**

Creekwatch Training Video Note: Excellent Access to Creek



Creekwatch Onsite Training



Lessons Learned During Training

- First sample is 1.5 hours, second and third may decrease to 1.0 hours. With commute time to, between, and from 3 sites that fills a whole day
 - For comfort and safety of volunteers we prefer to grab sample from bridge railing
 - Need a remote sample grab pail or pitcher on a rope
 - A pole to ensure we collect from the middle of the creek

Sample Collection Difficult and Unsafe





Sample Collection Difficult and Unsafe



Sample Collection Difficult and Unsafe



Citizen Science – Uncomfortable Ergonomics



Centerline of Stream from Bridge Railing





Considerations of our Compromise

- However we must not contaminate sample
 - by pouring between containers
 - disturbing dissolved oxygen
 - disturbing turbidity

Creekwatch Lab – Supplementary Equipment


Centerline Sample Grab with Pitcher and Rope



Pour into pail, Test Samples from last Pitcher



Creekwatch Lab – 7 Tests



Creekwatch Lab - [1] - Temperature

• Air Temperature:

•

• Take in Shade – for reference for Water Temperature.

- Water Temperature: Cooler temp is more healthy
- Take Immediately if sample is remote from river i.e. sample pail on rope
- Manual / Analog Thermometer, take reading in Celsius, Hold submerged for 1 minute, Read after one minute, record

Squiggles at bottom of Tube





Turbidity Test – Fill Tube until lines disappear





Faint Squiggles at bottom of tube

Qualitative – Unscientific Test #1



Qualitative – Unscientific Test #2



Qualitative – Unscientific Test #3



Dissolved Oxygen Test Kit









Phosphorus:

• Orthophosphates lead to algae blooms

- Healthy 0.01-0.05mg/l
- Borderline 0.05-0.10 mg/l
- Unhealthy >0.10 mg/l

Ammonia Nitrogen

• Ammonia Nitrogen:

Animal waste and fertilizers

- Compare colour on strip to chart on bottle
- <1 mg/l is healthy,
- 1-3 mg/l is borderline healthy,
- 3-5 mg/l is unhealthy,
- >5 mg/l is very unhealthy

pH Test Kit





pH – match colour wheel



Chloride Test Kit



Creekwatch Lab - [7] - Chloride

- Extremely Healthy < 15mg/l,
- Healthy 15-120 mg/l;
- Unhealthy 120 640 mg/l,
- Extremely unhealthy >640 mg/l

MRWS Test Results

• Preliminary Results to Date

• Field Data Interpretation Only

MRWS 2022 Testing Program – Results 1/2

Site	Air	Water	Turbidity	Dissolved	Ammonia	Phosporus	рН	Chloride
	Temp	Temp		Oxygen	Nitrogen			
	°C	°C	NTU	mg/L	mg/L	mg/L		mg/L
		Cooler	0-400	Support Life				
1	21.5	20	11	6	0.25	0.05	8	15
			Very Clear	Borderline	Healthy	Healthy	Healthy	Borderline
1	24	13	10	9	0.25	0	8.2	15
			Very Clear	Exc. Healthy	Healthy	Healthy	Healthy	Borderline
2	26	22	12	8	0.5	0.06	8	20
			Very Clear	Exc. Healthy	Healthy	Borderline	Healthy	Borderline
2	23	14	13	8 - 9	0.25	0.4	8.2	15
			Very Clear	Exc. Healthy	Healthy	Healthy	Healthy	Borderline

MRWS 2022 Testing Program – Results 2/2

Site	Air	Water	Turbidity	Dissolved	Ammonia	Phosporus	рН	Chloride
	Temp	Temp		Oxygen	Nitrogen			
	°C	°C	NTU	mg/L	mg/L	mg/L		mg/L
		Cooler	0-400	Support Life				
3		17.5	< 10	3	0.01	0.02	8.1	20
			Very Clear	Unhealthy	Healthy	Healthy	Healthy	Borderline
3	25	22	18	7	0.75	0.02	8	30
			Very Good	Exc. Healthy	Healthy	Healthy	Healthy	Borderline
3	23	14	10	8	0.25	0.8	8 - 8	20
			Very Clear	Exc. Healthy	Healthy	Borderline	Healthy	Borderline
4	20		< 10	8	0.25	0.06	7.4	5
			Very Clear	Exc. Healthy	Healthy	Borderline	Healthy	Healthy
5			20	7	0.25	0.02	7.4	5
			Very Good	Exc. Healthy	Healthy	Healthy	Healthy	Healthy

Meanwhile...

• While we have been doing our own Lab Tests

• We have located a lot of test results of prior tests by others that we had not found before

• Historic Data to compare to our 2022 data

AEP Water Quality 1974-2022

- AEP is collecting water quality data
- from the rivers and major tributaries
- through the Long Term River Network (LTRN)
 - and Tributary Monitoring Network (TMN) programs.
 - Station information that can be retrieved
- from the <u>Surface Water Quality Data Portal</u>.

AEP Monitor Station M.R. Hwy 54 – 87 observations

SUM OF CATIONS	11 meq/L	COLOUR TRUE	18 rel unit	S VANADIUM TOTAL RECOVERABLE	0.28 ug/L
SUM OF ANIONS	10 meq/L	CARBON TOTAL ORGANIC (TOC)	10 mg/L	ZINC TOTAL RECOVERABLE	1.8 ug/L
TOTAL DISSOLVED SOLIDS (CALCD.)	540 mg/L	RHENIUM TOTAL RECOVERABLE	0.006 ug/L	OXYGEN DISSOLVED (FIELD METER)	1.4 mg/L
ALKALINITY TOTAL CACO3	480 mg/L	IONIC BALANCE DIFFERENCE ABSOLUTE	3.7 %	3.7 % TEMPERATURE AIR	
ALKALINITY PHENOLPHTHALEIN CACO3	1 mg/L	ARSENIC TOTAL RECOVERABLE	4.05 ug/L	SAMPLING DISTANCE FROM LEFT BANK	50%
BICARBONATE (CALCD.)	580 mg/L	BORON TOTAL RECOVERABLE	64.7 ug/L	CLOUD COVER	100 %
CARBONATE (CALCD.)	1 mg/L	BARIUM TOTAL RECOVERABLE	211 ug/L	COLIFORMS FECAL	31 No/100 mL
HYDROXIDE (CALCD.)	1 mg/L	BERYLLIUM TOTAL RECOVERABLE	0.005 ug/L	ESCHERICHIA COLI	20 No/100 mL
SULPHATE DISSOLVED	26 mg/L	BISMUTH TOTAL RECOVERABLE	0.003 ug/L	PH (FIELD)	7.74 pH units
TURBIDITY	35 NTU	CALCIUM TOTAL RECOVERABLE	81.2 mg/L	SPECIFIC CONDUCTANCE (FIELD)	921 uS/cm
CHLORIDE DISSOLVED	9.8 mg/L	CADMIUM TOTAL RECOVERABLE	0.01 ug/L	TEMPERATURE WATER	-0.03 deg C
RESIDUE FILTERABLE	560 mg/L	COBALT TOTAL RECOVERABLE	0.956 ug/L	MANGANESE DISSOLVED	1.8 mg/L
RESIDUE NONFILTERABLE	12 mg/L	CHROMIUM TOTAL RECOVERABLE	0.1 ug/L	IRON DISSOLVED	0.11 mg/L
AMMONIA TOTAL	0.73 mg/L	COPPER TOTAL RECOVERABLE	0.36 ug/L	NITROGEN, NITRATE	0.0061 mg/L
NITROGEN DISSOLVED KJELDAHL	1.1 mg/L	IRON TOTAL RECOVERABLE	2980 ug/L	NITROGEN NITRITE	0.0062 mg/L
NITROGEN TOTAL KJELDAHL (TKN)	1.5 mg/L	LITHIUM TOTAL RECOVERABLE	23.7 ug/L	NITROGEN NO3 & NO2	0.012 mg/L
PHOSPHORUS TOTAL DISSOLVED	0.0039 mg/L	MANGANESE TOTAL RECOVERABLE	1660 ug/L	SILVER TOTAL RECOVERABLE	0.001 ug/L
PHOSPHORUS TOTAL (P)	0.25 mg/L	MOLYBDENUM TOTAL RECOVERABLE	0.919 ug/L	ALUMINUM TOTAL RECOVERABLE	5.9 ug/L
PHOSPHATE DISSOLVED ORTHO	0.0034 mg/L	NICKEL TOTAL RECOVERABLE	2.03 ug/L	COLOUR (VISUAL) AT SITE	1 N/A
SPECIFIC CONDUCTANCE (LAB)	910 uS/cm	LEAD TOTAL RECOVERABLE - PB	0.037 ug/L	FOAM(VISUAL) AT SITE	0 N/A
CARBON DISSOLVED ORGANIC	8.7 mg/L	ANTIMONY TOTAL RECOVERABLE	0.083 ug/L	TURBIDITY (VISUAL) AT SITE	1 N/A
NITROGEN TOTAL (CALCD.)	1.5 mg/L	SELENIUM TOTAL RECOVERABLE	0.4 ug/L	ODOUR APPARENT IN SAMPLE	1 N/A
PH (LAB)	7.8 pH units	TIN TOTAL RECOVERABLE	0.06 ug/L	ICE COVER	100%
HARDNESS TOTAL (CALCD.) CACO3	380 mg/L	STRONTIUM TOTAL RECOVERABLE	844 ug/L	SNOW COVER ON ICE	100 %
SODIUM DISSOLVED/FILTERED	78 mg/L	THORIUM TOTAL RECOVERABLE	0.006 ug/L	SNOW COVER IN IMMEDIATE AREA	100 %
MAGNESIUM DISSOLVED/FILTERED	35 mg/L	TITANIUM TOTAL RECOVERABLE	1.64 ug/L	ICE THICKNESS, ESTIMATE	0.65 m
POTASSIUM DISSOLVED/FILTERED	4.4 mg/L	THALLIUM TOTAL RECOVERABLE	0.002 ug/L	SNOW DEPTH ON ICE, ESTIMATE	0.2 m
CALCIUM DISSOLVED/FILTERED	93 mg/L	URANIUM TOTAL RECOVERABLE	1.42 ug/L	WATER DEPTH, ESTIMATE	0.4 m

MERCURY TOTAL

3.63 ng/L

M.R. Turbidity Variance 1982-2022

Turbidity Value



M.R. Turbidity Variance – on Scale 0-400 NTU

Turbidity Value per NTU 0-400



AEP Sample Sites on M.R. 1974-2022



RDRWA Advice: Options

- Explore formal partnership model with local counties and/or City of Red Deer (more formal).
- Take a citizen science approach (less formal; higher engagement).
- Seek funding to hire someone to desi or explore options (or a volunteer).
- Start with a pilot in 2022; seek fundir a pilot.



Critters in the Creek

 However, regardless of what our water quality testing results indicate or prove, one of the main objectives of the MRWS remains to encourage agricultural producers to keep their livestock away from the river and off the ice.

• There is still work to be done on that front.







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