

**Flambeau Mine Monitoring Well Locations
and
Graphs of Ground Water Quality Data for Select Constituents:**

**Specific Conductivity
Sulfate
Copper
Iron
Manganese
Zinc**

(measured concentrations vs. baseline vs. predictive modeling vs. relevant water quality standards)

an excerpt from:

Flambeau Mine: Water Contamination and Selective “Alternative Facts”, Robert E. Moran, Ph.D.
(Michael-Moran Associates, Golden, Colorado, U.S.A.; remwater.org),
May 2019 (posthumous), Figures 6, 7, 8 and 9a-9f.

This excerpt from Dr. Robert Moran’s work has been provided by Deer Tail Scientific
for educational purposes. For a copy of the full report, go to:
<https://deertailscientific.wordpress.com/moran-report/>



Deer Tail Scientific
Duluth, Minnesota, U.S.A.
<https://deertailscientific.wordpress.com/>

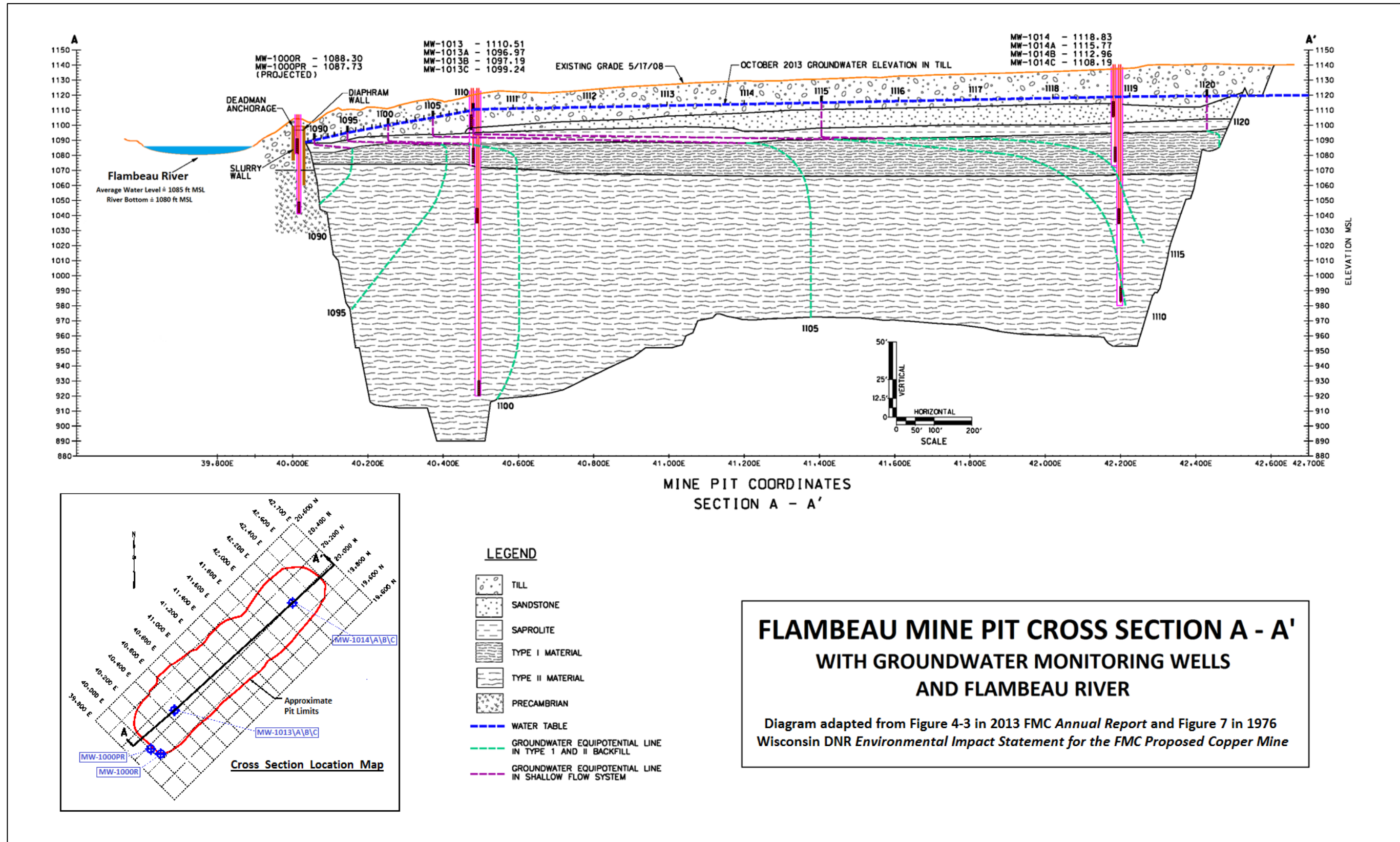


Figure 6. Flambeau Mine backfilled pit cross section with groundwater monitoring wells. Relative position and depth of Flambeau River is also shown (140 ft. from pit; approximately 5 ft. deep in vicinity of the 225-ft. deep backfilled pit). (Figure adapted from Figure 4-3 in: 2013 Annual Report, FMC, Jan 2014 and Figure 7 in: Environmental Impact Statement for the FMC Proposed Copper Mine, Wisconsin DNR, 1976).

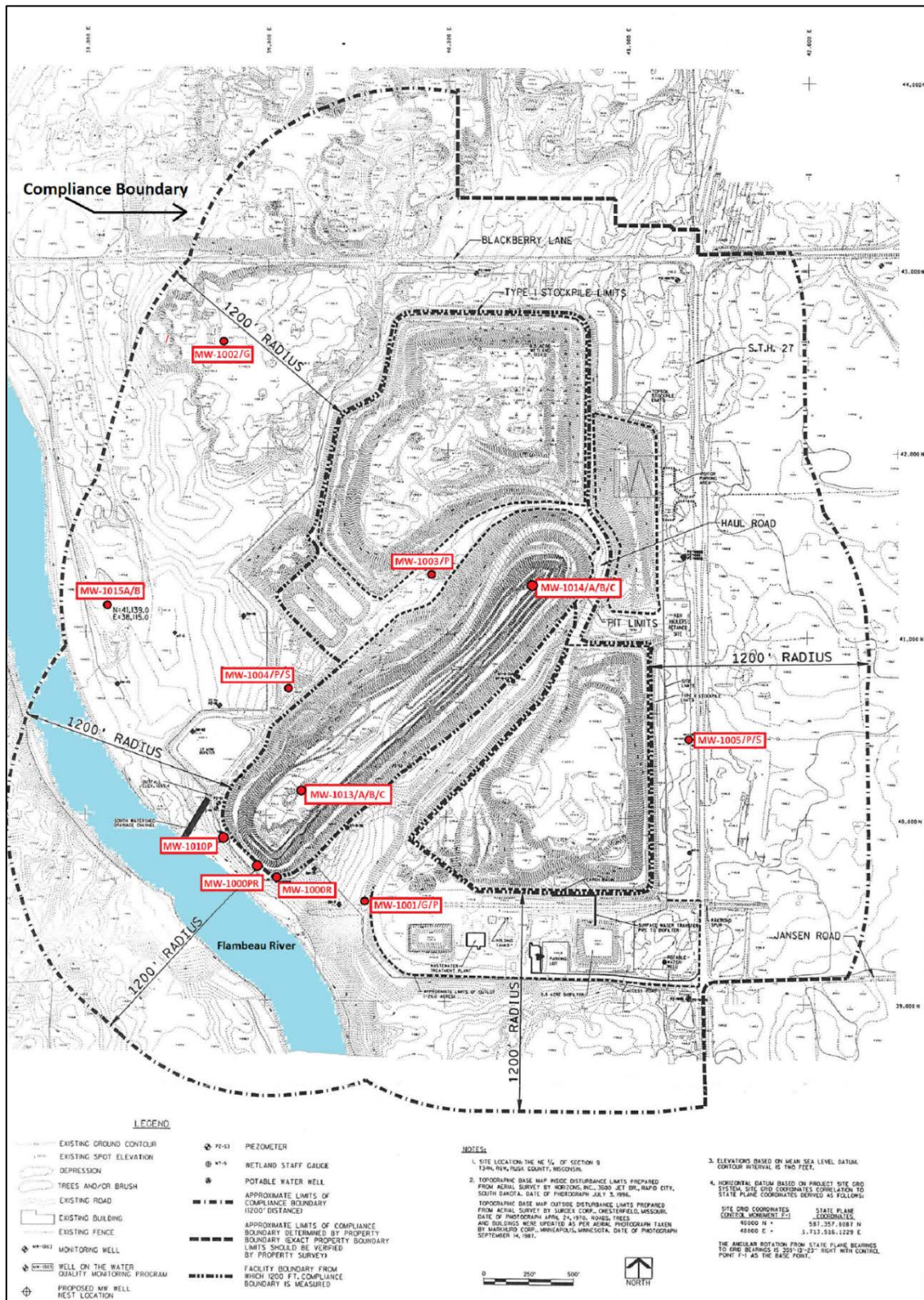
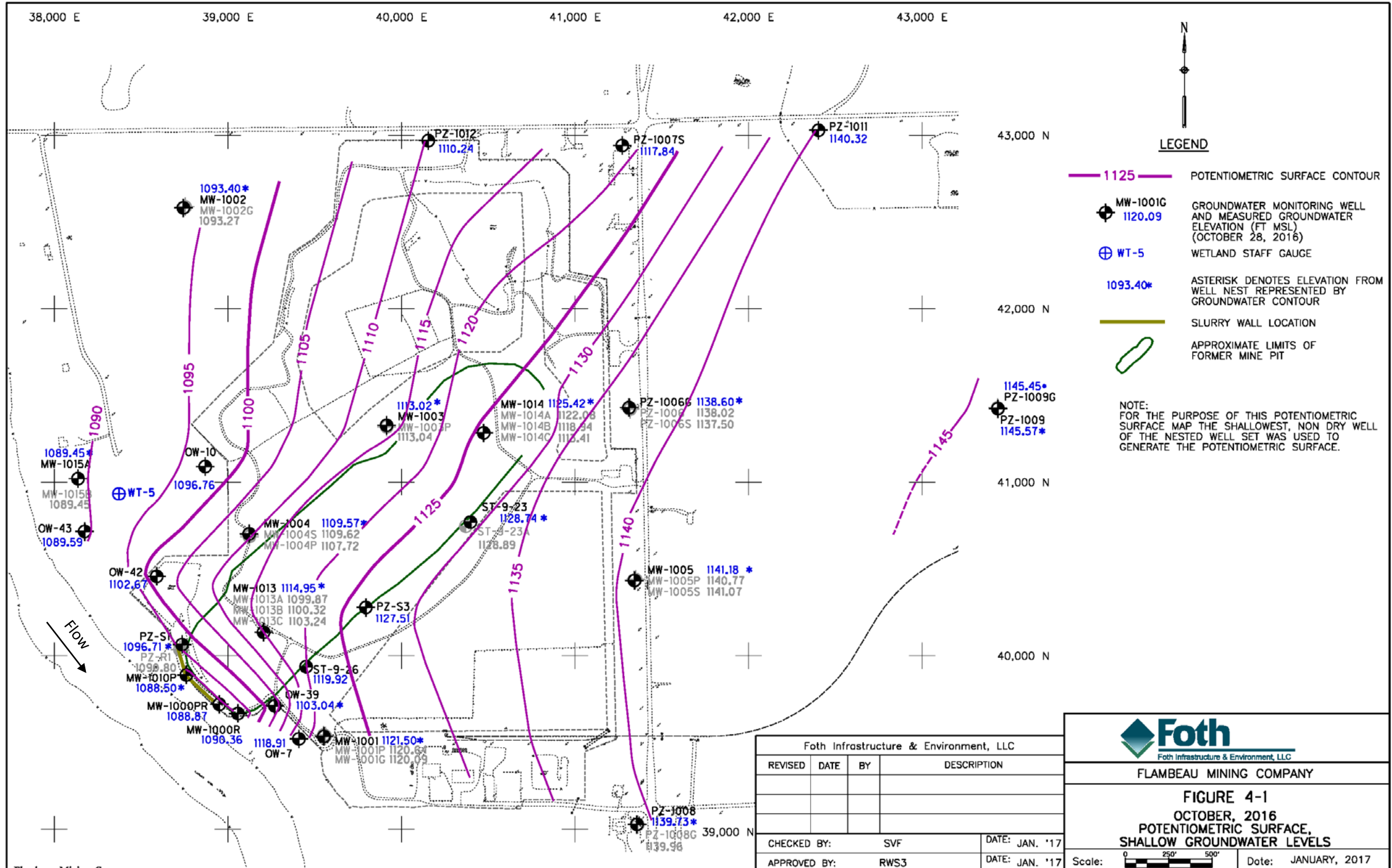


Figure 7. State of Wisconsin-established compliance boundary for enforcement of ground water quality standards at Flambeau Mine plus current monitoring well (MW) locations (Adapted from Figure 1 *in*: Groundwater Monitoring Well Nest Installation at Compliance Boundary, FMC, 2000).



Flambeau Mining Company
2016 Annual Report

\\ps1\pww\APSI\Foth.com\pww\E\Documents\Clients\Flambeau Mining\0016F777\00\CAD\Drawings\2016 Mon Rpt\2016_MonRpt_Fig 4-1.dgn
1/31/2017 jow

Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION
CHECKED BY: SVF		DATE: JAN. '17	
APPROVED BY: RWS3		DATE: JAN. '17	
APPROVED BY:		DATE:	

Foth
Foth Infrastructure & Environment, LLC

FLAMBEAU MINING COMPANY

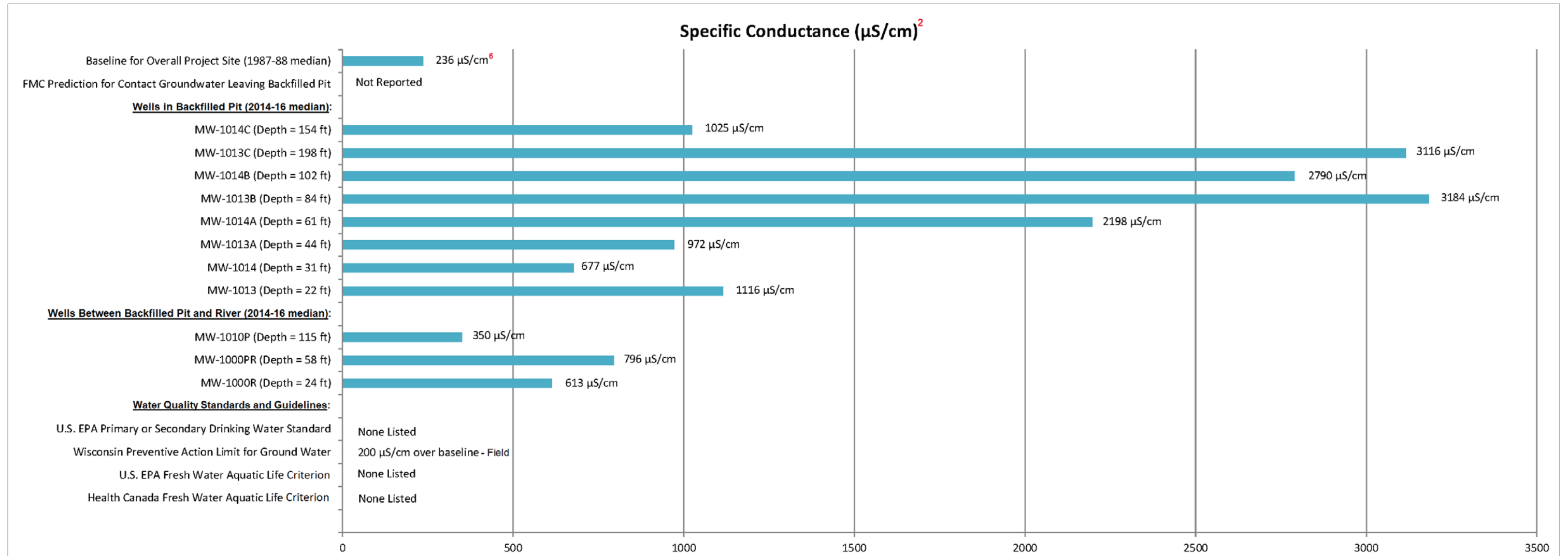
FIGURE 4-1
OCTOBER, 2016
POTENTIOMETRIC SURFACE,
SHALLOW GROUNDWATER LEVELS

Scale: 0 250' 500' Date: JANUARY, 2017

Prepared By: JOW Checked By: SVF 16F777

Figure 8. Flambeau Mine shallow potentiometric surface map showing locations of active ground water monitoring wells (Figure 4-2 in: FMC 2016 Annual Report).

Figure 9a. MEDIAN (2014-16)¹ Flambeau Mine ground water SPECIFIC CONDUCTIVITY measurements² compared to baseline (1987-88)³, predictive modeling (1989)⁴, and relevant water quality standards⁵



1. Specific conductivity is measured in ground water by FMC on a quarterly basis. Reported measurement for each individual well is a 2014-16 median value (n = 12) determined by author using historical data presented in: 2016 Annual Report, FMC, Jan 2017. For details, see Table 6 – Ground water quality data.

2. There was no “field” or “lab” designation for baseline (1987-88) measurements of specific conductance (S.C.) reported by FMC in their 1989 Environmental Impact Report. Nor was there any such designation for later S.C. values reported in the summary table of “Historical Groundwater Results – Quarterly Parameters” found in FMC’s 2016 annual report and used for preparation of the present figure. Perusal of other FMC documents suggests reported values are “field.” Any measurements clearly designated as “field” or “lab” by U.S. EPA or other government authorities in regulatory documents have been so indicated.

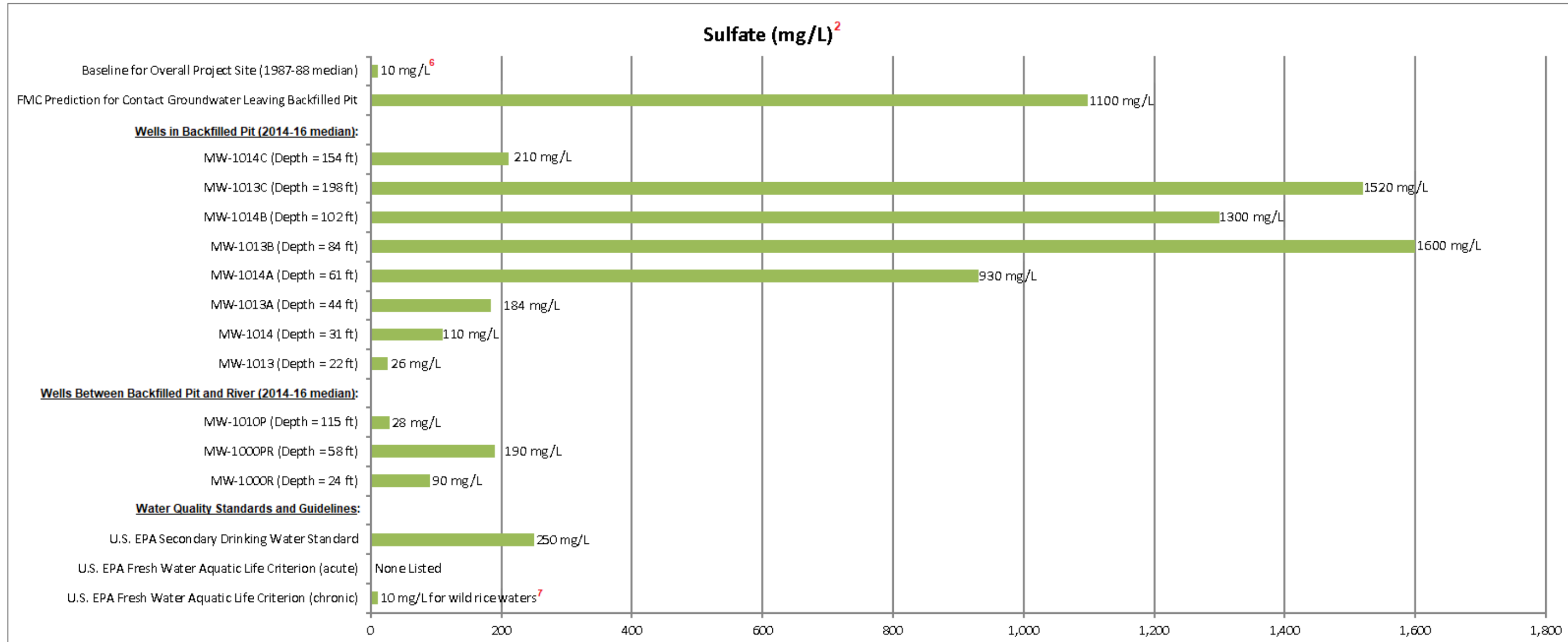
3. Baseline median determined by author using data presented in: Environmental Impact Report for the Kennecott Flambeau Project, Foth & Van Dyke, 1989. For details, see Table 6 – Ground water quality data.

4. Figures for projected ground water quality of contact water leaving the Flambeau backfilled pit were provided by Foth in: Mining Permit Application for the Flambeau Project, Volume 2, Appendix L, Dec 1989. Also see Table 8 – Projected ground water quality. For details, see Table 2 – Water quality standards.

5. For details, see Table 2 – Water quality standards.

6. Baseline Median = 236 µS/cm; Range = 84 - 954 µS/cm; n = 192; 100% detects.

Figure 9b. MEDIAN (2014-16)¹ Flambeau Mine ground water SULFATE concentrations² compared to baseline (1987-88)³, predictive modeling (1989)⁴, and relevant water quality standards⁵



1. Sulfate concentrations are measured in ground water by FMC on a quarterly basis. Reported concentration for each individual well is a 2014-16 median value (n = 12) determined by author using historical data presented in: 2016 Annual Report, FMC, Jan 2017. For details, see Table 6 - Ground water quality data.

2. There was no "Total" or "Dissolved" designation for baseline (1987-88) concentrations of sulfate reported by FMC in their 1989 Environmental Impact Report. Nor is there any such designation for later values reported in the summary tables of "Historical Groundwater Results" found in the company's annual reports. Perusal of other FMC documents suggests reported values are Dissolved. Any concentrations clearly designated as "Total" or "Dissolved" by U.S. EPA or other government authorities in regulatory documents have been so indicated.

3. Baseline median determined by author using data presented in: Environmental Impact Report for the Kennecott Flambeau Project, Foth & Van Dyke, 1989. For details, see Table 6 – Ground water quality data.

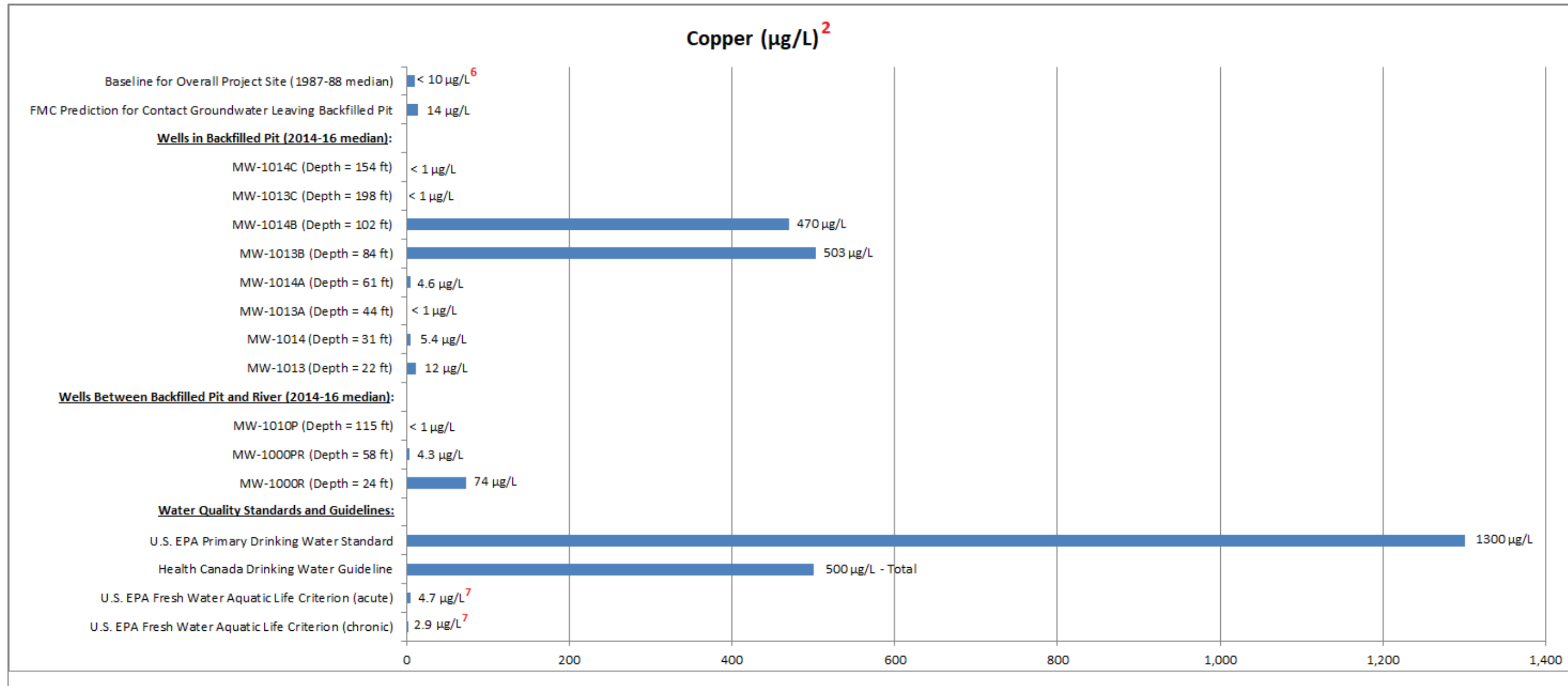
4. Figures for projected ground water quality of contact water leaving the Flambeau backfilled pit were provided by Foth in: Mining Permit Application for the Flambeau Project, Volume 2, Appendix L, Dec 1989. Also see Table 8 – Projected ground water quality.

5. For details, see Table 2 – Water quality standards.

6. Baseline Median = 10 mg/L; Range = < 5 - 48 mg/L; n = 193; 75% detects.

7. This criterion is specific for wild rice waters and was approved by U.S. EPA for the Fond du Lac Band of Lake Superior Chippewa, Grand Portage Band of Lake Superior Chippewa, and State of Minnesota. See Table 2 – Water quality standards, for more details.

Figure 9c. MEDIAN (2014-16)¹ Flambeau Mine ground water COPPER concentrations² compared to baseline (1987-88)³, predictive modeling (1989)⁴, and relevant water quality standards⁵



¹ Copper concentrations are measured in ground water by FMC on a quarterly basis. Reported concentration for each individual well is a 2014-16 median value (n = 12) determined by author using historical data presented in: 2016 Annual Report, FMC, Jan 2017. For details, see Table 6 - Ground water quality data.

² There was no "Total" or "Dissolved" designation for baseline (1987-88) concentrations of copper reported by FMC in their 1989 Environmental Impact Report. Nor is there any such designation for later values reported in the summary tables of "Historical Groundwater Results" found in the company's annual reports. Perusal of other FMC documents suggests reported values are Dissolved. Any concentrations clearly designated as "Total" or "Dissolved" by U.S. EPA or other government authorities in regulatory documents have been so indicated.

³ Baseline median determined by author using data presented in: Environmental Impact Report for the Kennecott Flambeau Project, Foth & Van Dyke, 1989. For details, see Table 6 – Ground water quality data.

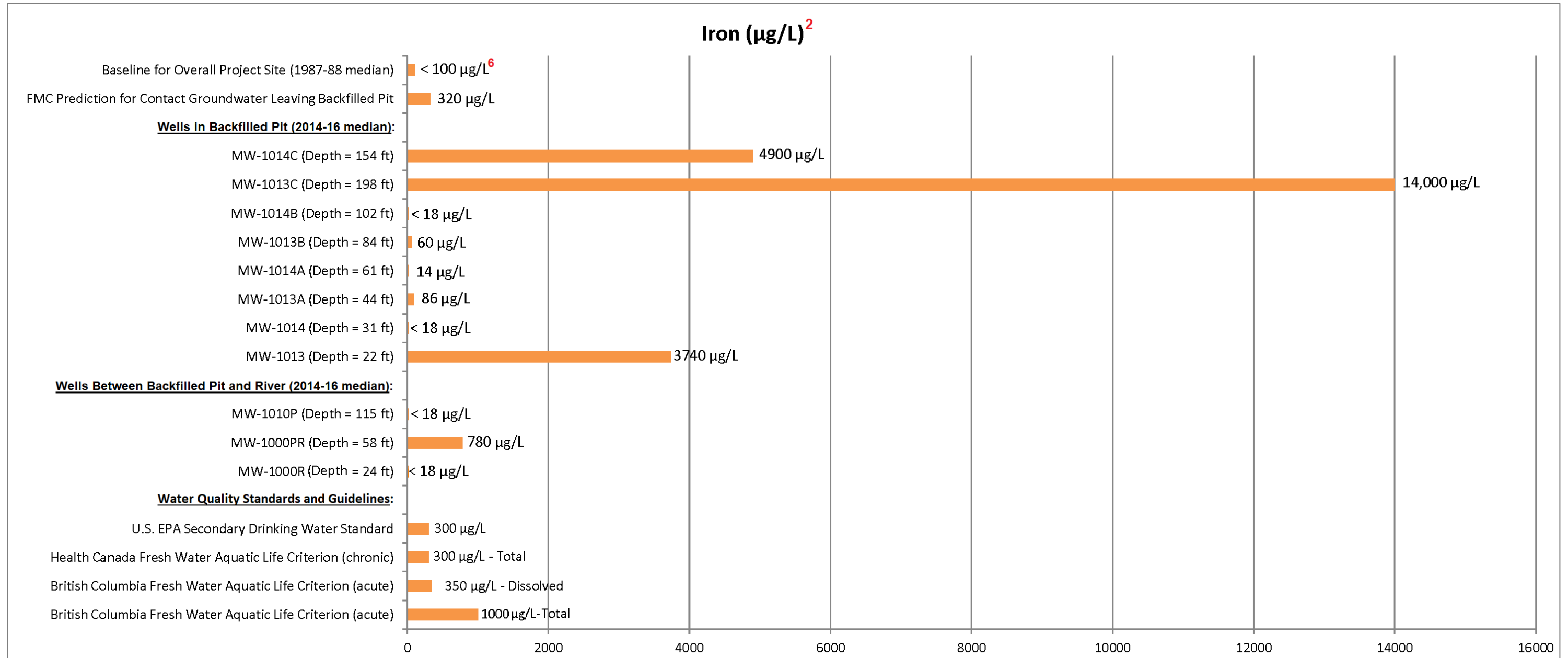
⁴ Figures for projected ground water quality of contact water leaving the Flambeau backfilled pit were provided by Foth in: Mining Permit Application for the Flambeau Project, Volume 2, Appendix L, Dec 1989. Also see Table 8 – Projected ground water quality.

⁵ For details, see Table 2 – Water quality standards.

⁶ Reported baseline median was a non-detect (< 10 µg/L); Range = < 5 - 85 µg/L; n = 193; 39% detects.

⁷ Values shown here were calculated for the Flambeau River, in the vicinity of the Flambeau Mine site, using EPA's Biotic Ligand Model (BLM). For details, see Table 2 – Water quality standards.

Figure 9d. MEDIAN (2014-16)¹ Flambeau Mine ground water IRON concentrations² compared to baseline (1987-88)³, predictive modeling (1989)⁴, and relevant water quality standards⁵



1. Iron concentrations are measured in ground water by FMC on a quarterly basis. Reported concentration for each individual well is a 2014-16 median value (n = 12) determined by author using historical data presented in: 2016 Annual Report, FMC, Jan 2017. For details, see Table 6 - Ground water quality data.

2. There was no "Total" or "Dissolved" designation for baseline (1987-88) concentrations of iron reported by FMC in their 1989 Environmental Impact Report. Nor is there any such designation for later values reported in the summary tables of "Historical Groundwater Results" found in the company's annual reports. Perusal of other FMC documents suggests reported values are Dissolved. Any concentrations clearly designated as "Total" or "Dissolved" by U.S. EPA or other government authorities in regulatory documents have been so indicated.

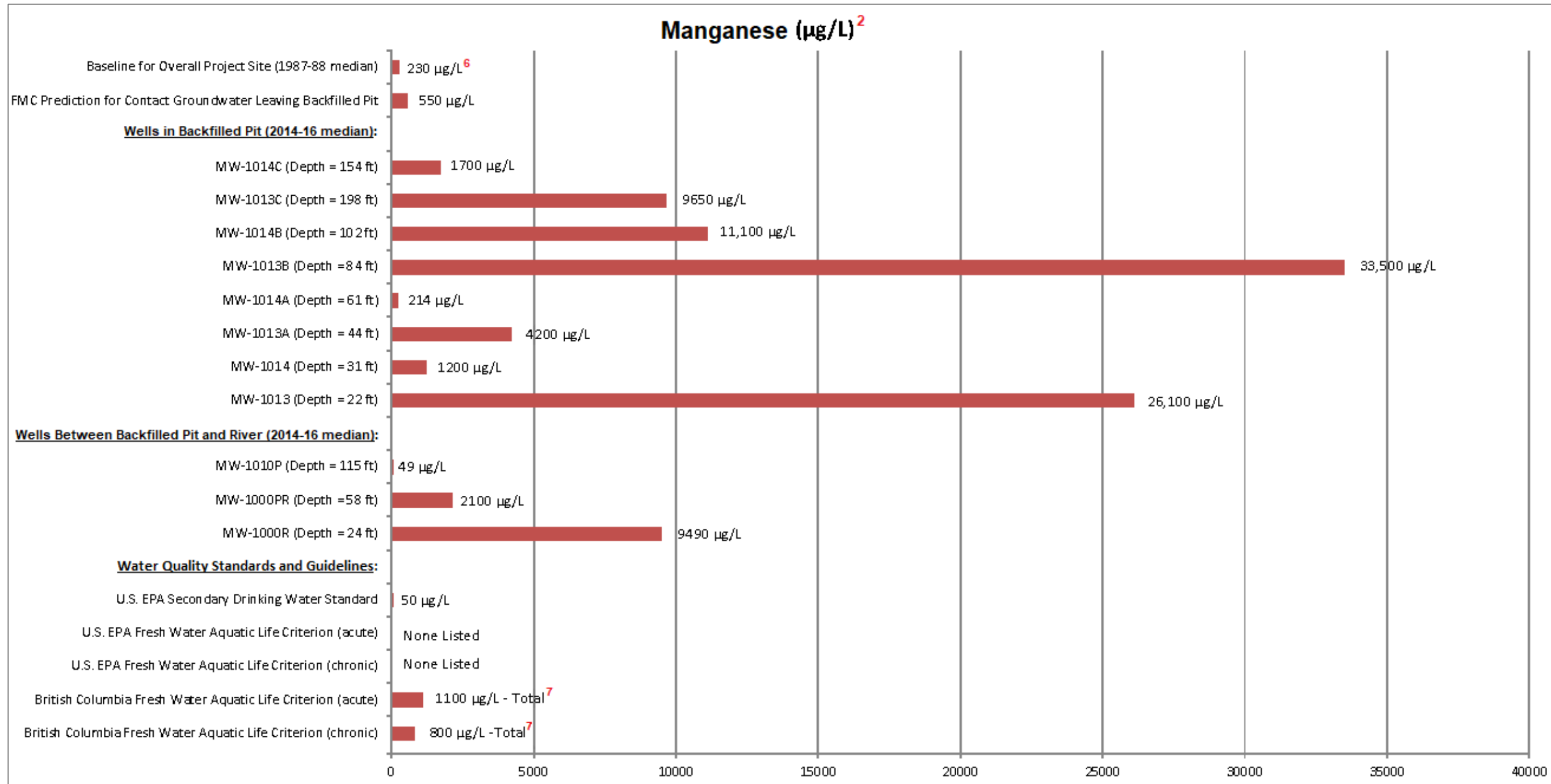
3. Baseline median determined by author using data presented in: Environmental Impact Report for the Kennecott Flambeau Project, Foth & Van Dyke, 1989. For details, see Table 6 - Ground water quality data.

4. Figures for projected ground water quality of contact water leaving the Flambeau backfilled pit were provided by Foth in: Mining Permit Application for the Flambeau Project, Volume 2, Appendix L, Dec 1989. Also see Table 8 - Projected ground water quality.

5. For details, see Table 2 - Water quality standards.

6. Reported baseline median was a non-detect (< 100 µg/L); Range = < 60 - 21,000 µg/L; n = 193; 46% detects.

Figure 9e. MEDIAN (2014-16)¹ Flambeau Mine ground water MANGANESE concentrations² compared to baseline (1987-88)³, predictive modeling (1989)⁴, and relevant water quality standards⁵



1. Manganese concentrations are measured in ground water by FMC on a quarterly basis. Reported concentration for each individual well is a 2014-16 median value (n = 12) determined by author using historical data presented in: 2016 Annual Report, FMC, Jan 2017. For details, see Table 6 - Ground water quality data.

2. There was no "Total" or "Dissolved" designation for baseline (1987-88) concentrations of manganese reported by FMC in their 1989 Environmental Impact Report. Nor is there any such designation for later values reported in the summary tables of "Historical Groundwater Results" found in the company's annual reports. Perusal of other FMC documents suggests reported values are Dissolved. Any concentrations clearly designated as "Total" or "Dissolved" by U.S. EPA or other government authorities in regulatory documents have been so indicated.

3. Baseline median determined by author using data presented in: Environmental Impact Report for the Kennecott Flambeau Project, Foth & Van Dyke, 1989. For details, see Table 6 - Ground water quality data.

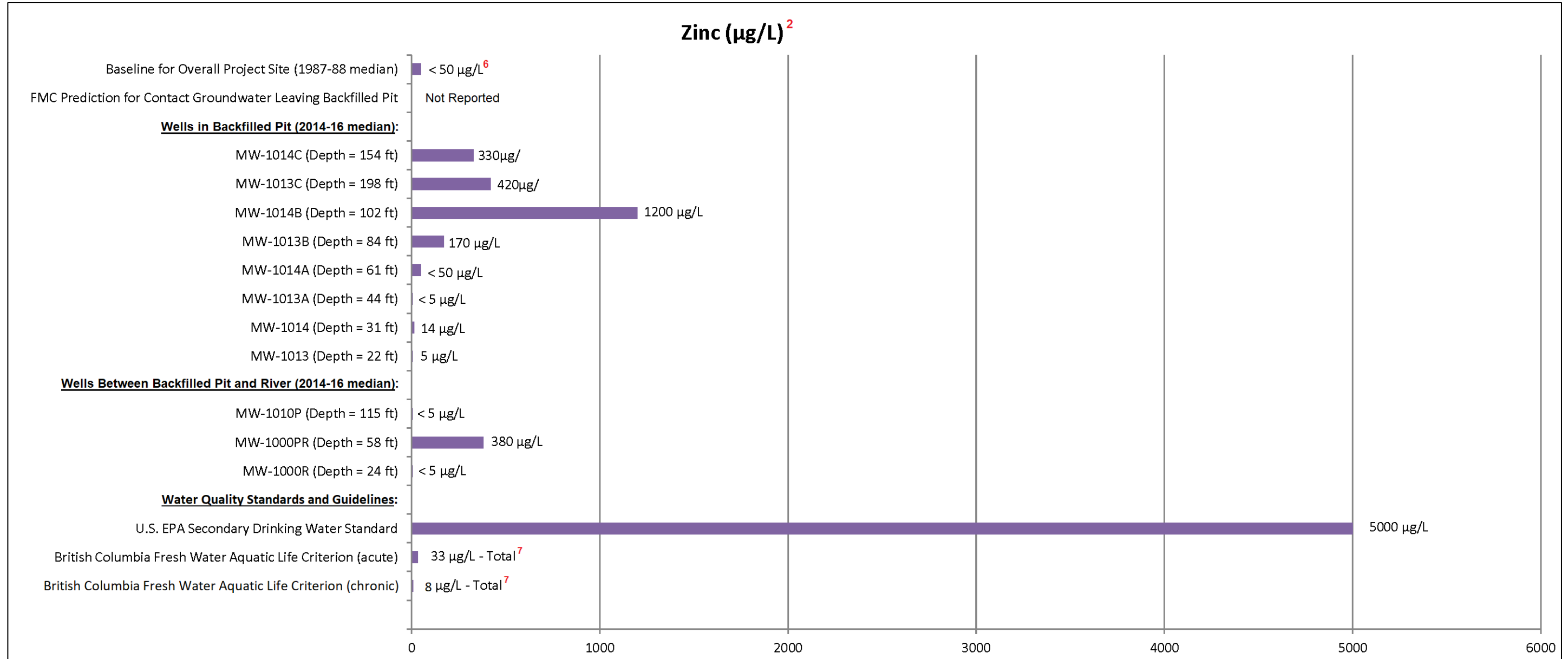
4. Figures for projected ground water quality of contact water leaving the Flambeau backfilled pit were provided by Foth in: Mining Permit Application for the Flambeau Project, Volume 2, Appendix L, Dec 1989. Also see Table 8 - Projected ground water quality.

5. For details, see Table 2 - Water quality standards.

6. Baseline Median = 230 µg/L; Range = < 50 - 1400 µg/L; n = 193; 72% detects.

7. Hardness-dependent toxicity; reported value is for a hardness of 50 mg/l.

Figure 9f. MEDIAN¹ (2014-16) Flambeau Mine ground water ZINC concentrations² compared to baseline (1987-88)³, predictive modeling (1989)⁴, and relevant water quality standards⁵



1. Zinc concentrations are measured in ground water by FMC on a quarterly basis. Reported concentration for each individual well is a 2014-16 median value (n = 12) determined by author using historical data presented in: *2016 Annual Report*, FMC, Jan 2017. For details, see Table 6 - Ground water quality data.

2. There was no "Total" or "Dissolved" designation for baseline (1987-88) concentrations of zinc reported by FMC in their 1989 Environmental Impact Report. Nor is there any such designation for later values reported in the summary tables of "Historical Groundwater Results" found in the company's annual reports. Perusal of other FMC documents suggests reported values are Dissolved. Any concentrations clearly designated as "Total" or "Dissolved" by U.S. EPA or other government authorities in regulatory documents have been so indicated.

3. Baseline median determined by author using data presented in: *Environmental Impact Report for the Kennecott Flambeau Project*, Foth & Van Dyke, 1989. For details, see Table 6 – Ground water quality data.

4. Figures for projected ground water quality of contact water leaving the Flambeau backfilled pit were provided by Foth in: *Mining Permit Application for the Flambeau Project*, Volume 2, Appendix L, Dec 1989. Also see Table 8 – Projected ground water quality.

5. For details, see Table 2 – Water quality standards.

6. Reported baseline median was a non-detect (< 50 µg/L); Range = < 10 - 1800 µg/L; n = 193; 23% detects.

7. Hardness-dependent toxicity; reported value is for a hardness ≤ 90 mg/l.