Cold Spring Groundwater Study

Annual Report to the Legislature

06/30/2020

This report was prepared in response to Laws of 2016, Chapter 189, Article 3, Section 44, Part b

The commissioner must conduct necessary monitoring of stream flow and water levels and develop a groundwater model to determine the amount of water that can be sustainably pumped in the area of Cold Spring Creek for area businesses, agriculture, and city needs. Beginning July 1, 2017, the commissioner must submit an annual progress report to the chairs and ranking minority members of the House of Representatives and Senate committees and divisions with jurisdiction over environment and natural resources. The commissioner must submit a final report by January 15, 2022.

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As requested by Minnesota Statute 3.197: This report cost approximately $1,129 to prepare, including staff time, printing and mailing expenses.

Background and Overview

The 2016 Minnesota Legislature directed the Minnesota Department of Natural Resources (DNR) to "conduct necessary monitoring of stream flow and water levels and develop a groundwater model to determine the amount of water that can be sustainably pumped in the area of Cold Spring Creek for area businesses, agriculture, and city needs."

This represents the fourth annual report, as required in legislation.

Multiple scientific investigations demonstrate that groundwater pumping in and around the City of Cold Spring (the City) reduces groundwater flow into Cold Spring Creek, a designated trout stream. The glacial aquifer system, which is strongly connected to Cold Spring Creek, supplies groundwater to the City, Cold Spring Brewing Company (CSBC), and numerous private wells and agricultural irrigation wells.

The City and CSBC are actively planning for potential growth and developing strategies to meet their current and anticipated water supply needs. To support these planning efforts the DNR has built a groundwater flow model that can be used to determine current and projected effects of groundwater use on streamflow in Cold Spring Creek. The DNR built the model using all available data through 2018. The DNR convened a technical advisory group (TAG) consisting of outside groundwater experts and modeling expertise to review and advise model development.

The model calculates the average effect of groundwater use on base flow in Cold Spring Creek over a long period of time (years to decades). The model can also predict how changing pumping in the area of interest will affect base flow in the creek. The model is sufficient to approximate how much water can be sustainably pumped from the City and CSBC wells in relation to stream flow in Cold Spring Creek.

Tasks completed during fiscal year 2020 include the following:

- Continued monitoring of flow in Cold Spring Creek and water levels in observation wells;
- Refined the model based on comments from CSBC's consultant and other members of the Technical Advisory Group;
- Ran model simulations that explore how pumping affects base flow in Cold Spring Creek;
- Published modeling results and model description on project website; and
- Met with representatives of the City and CSBC to discuss the results of the model.

In-progress tasks include the following:

- Collecting streamflow and water level data;
- Continuing discussions with the City and CSBC, regarding options for meeting sustainable water supply needs.

Data Collection

The DNR continues to operate two continuous stream flow gages and three flow measurement sites along Cold Spring Creek as well as measuring groundwater levels at 12 observation wells in the study area. Monitoring is planned to continue through summer 2020, after which time the DNR will evaluate and condense the monitoring program if appropriate.

Groundwater Model Summary

The DNR completed the refined groundwater model of the Cold Spring area in December 2019. We used information about streamflow, groundwater, geology, weather, and lakes. The model includes key information about the hydrologic system so that it can calculate how pumping groundwater affects flow in Cold Spring Creek. The model results showed us that:

- In 2018, groundwater pumping within the model area, reported at 1.3 billion gallons reduced base flow in the Creek by about 20 percent.
- Groundwater pumping within ¼ mile of the Creek has the most impact on base flow in the Creek.
- Current groundwater pumping more than 2 miles from the Creek has very little impact on base flow in the Creek.
- If all wells in the model area pumped their permitted volumes, it would reduce base flow by about 23 percent (see Table 2. Scenario 8).
- If any of the current pumping volume were shifted from the city's existing well field to a well field farther from the Creek, there would be more base flow in the Creek.

What do the model results mean?

The model results showed us that pumping groundwater at 2018 volumes or at permitted volumes reduces base flow by 20 percent or more. This reduction in base flow is negatively impacting the Creek.

We also learned that pumping very close to the Creek strongly impacts flow in the Creek, but pumping farther from the Creek has much less impact. The model results show that it is possible for groundwater users to meet their current and future needs while also protecting the ecosystem by strategically managing existing appropriations near the Creek and locating new wells farther from the Creek.

Engaging Stakeholders

The DNR met with representatives from the City and CSBC on Wednesday, January 22, 2020 to discuss modifications to and findings from the groundwater model. Several groundwater use scenarios (described below) were simulated using the model and discussed at the meeting. These scenarios were not intended to be prescriptive. Rather, these scenarios were chosen to help understand how the volume of groundwater used (Table 1) and the location of groundwater pumping (Figure 1) affects base flow in the creek.

Scenarios 1 to 5 consisted of successively “turning off” wells at increments of distance away from the creek, as follows:

> **Scenario 1 (2018)**: All wells within the model area, which extends three to five miles around the creek, were pumped at 2018 pumping rates, averaged over the year.
>
> **Scenario 2 (1/4 mile)**: All wells within ¼ mile of Cold Spring Creek were turned off and the rest of the wells in the model domain were pumped at 2018 rates.
>
> **Scenario 3 (half mile)**: All wells within ½ mile of Cold Spring Creek were turned off and the rest of the wells in the model domain were pumped at 2018 rates.
>
> **Scenario 4 (one mile)**: All wells within 1 mile of Cold Spring Creek were turned off and the rest of the wells in the model domain were pumped at 2018 rates.
>
> **Scenario 5 (two miles)**: All wells within 2 mile of Cold Spring Creek were turned off and the rest of the wells in the model domain were pumped at 2018 rates.

Pumping within the first quarter mile of Cold Spring Creek has the strongest effect on streamflow, as demonstrated by the difference in baseflow depletion between scenario 1 and scenario 2.

Table 1. Simulated base flow in Cold Spring Creek for Scenarios 1 through 5.

Scenario	Simulation	Pumping volume (mgy)	Upstream reach H16011008 (cfs)	Depletion over upstream reach (cfs)	Upstream reach % difference	Downstream reach H16011007 (cfs)	Depletion over downstream reach (cfs)	Downstream reach % difference
	Measured (from field data)	***--***	***0.49***	***--***	***--***	***1.94***	***--***	***--***
1	2018	1313	0.39	0.13	21.0	1.66	0.47	19.5
2	Quarter mile	1125	0.49	0.03	5.8	2.02	0.11	5.4
3	Half mile	1121	0.49	0.03	5.8	2.02	0.11	5.4
4	One mile	811	0.49	0.03	5.8	2.03	0.1	4.9
5	Two miles	377	0.52	0	0.0	2.12	0.01	0.5

For Scenarios 1 through 4, MODFLOW reduced the specified pumping by 17.3 mgy (179.21 m^3/day). For Scenario 5, MODFLOW reduced the specified pumping by 0.9 mgy (9.16 m^3/day).

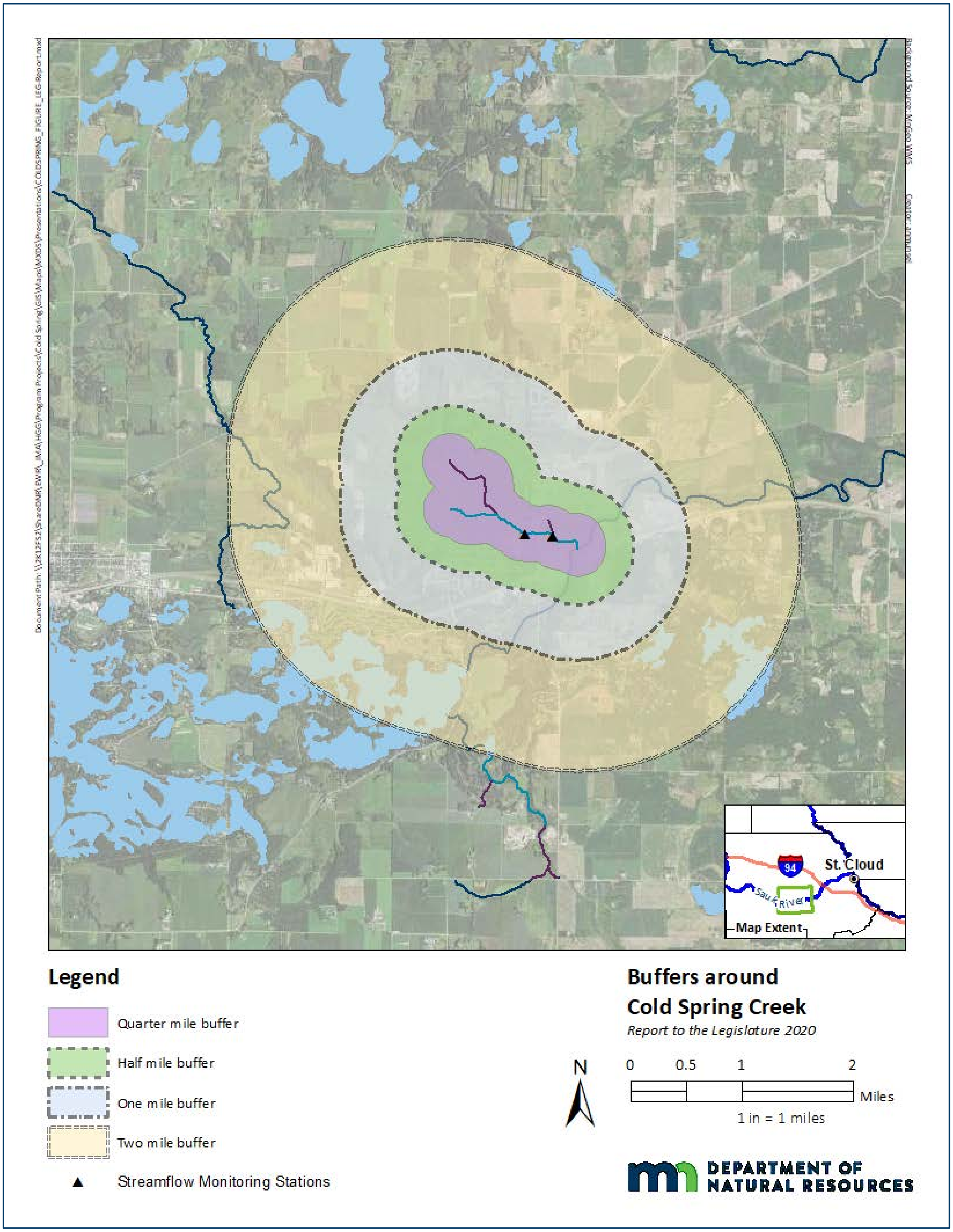

Figure 1. Map of Cold Spring Creek with associated distance buffers that were used in groundwater model analysis.

Scenarios 6 through 12, described below and on Table 2 and depicted on Figure 2, consisted of examining various hypothetical scenarios for the City and CSBC. These scenarios further explored various combinations of pumping volume and distance to meet current and potential future water supply needs. Similar to Scenarios 1 through 5 described above, these scenarios are not intended to be a specific prescription, but rather to help inform ongoing conversations about options.

Scenario 6 (2018, ¼ mile, the City's well field):

- All wells (brewery wells and city well #3) within ¼ mile of Cold Spring Creek are turned off.
- City wells 4, 5, and 6 supply the 2018 demand from the wells within ¼ mile of Cold Spring Creek split evenly among the three wells.
- The volumes and configurations simulated are not sufficient to meet the brewery and city current or future needs, however this scenario illustrates the importance of distance.

Scenario 7 (2018, ¼ mile, 20 mgy, the City's well field):

- All wells within ¼ mile of Cold Spring Creek are turned off, except 20 mgy is pumped from existing wells near the creek.
- City wells 4, 5, and 6 replace the remaining 2018 demand from the wells that would be turned off within ¼ mile of Cold Spring Creek (188 mgy minus 20 mgy).
- This scenario explores the possibility of providing up to 20 mgy for the dedicated beer line, but shifting the remaining brewery and City's demand to the City's wellfield which is located about 1 mile away from the creek

Scenario 8 (Maximum Permitted):

- All wells within the model domain pump maximum permitted volume, averaged over the year.
- This scenario examined what would happen if all permits pumped their maximum permitted volume, and it results in highest impact to streamflow.

Scenario 9 (Maximum Permitted, ¼ mile, 20 mgy, the City's well field):

- All wells within ¼ mile of Cold Spring Creek are turned off, except 20 mgy is pumped from existing wells near the creek.
- City wells 4, 5, and 6 replace the remaining permitted demand from the wells that would be turned off within ¼ mile of Cold Spring Creek (505 mgy minus 20 mgy).
- This scenario is similar to Scenario 7, except the pumping volume is greater because it simulates the maximum permitted volume rather than the amount actually used). Like Scenario 7, this scenario explores the possibility of providing 20 mgy for the dedicated beer line, but shifting the remaining brewery and City's demand to the City's wellfield. However Scenario 7 simulates the

actual use in 2018, whereas Scenario 9 simulates all permits using their maximum permitted volume. It demonstrates that shifting pumping away from the creek reduces the impact to the streamflow but does not completely offset the impact of very high pumping rates farther from the creek.

Scenario 10 (Maximum Permitted, +103 mgy):

- All wells within the model domain pump maximum permitted volume, averaged over the year. City wells 4, 5, and 6 supply an additional 103 mgy.
- Like Scenario 8, this scenario examined what would happen if all permits pumped their maximum permitted volume, but also included an additional 103 mgy of appropriation for growth or expansion. This scenario results in the highest impact to streamflow.

Scenario 11 (Maximum Permitted, ¼ mile, 20 mgy, the City's well field, +103 mgy):

- All wells within ¼ mile of Cold Spring Creek are turned off, except 20 mgy is pumped from existing wells near the creek.
- City wells 4, 5, and 6 replace the remaining permitted demand from the wells that would be turned off within ¼ mile of Cold Spring Creek and supply an additional 103 mg (505 mgy minus 20 mgy plus 103 mgy) for growth and expansion.
- This scenario explored a combination of increased volume and shifting much of the volume further away from the creek. Impacts to streamflow are considerably less than Scenario 10 but still high, leaving no margin for additional growth or expansion.

Scenario 12 (Maximum Permitted, ¼ mile, 20 mgy, +103mgy, 300 mgy Froehle):

- All wells within ¼ mile of Cold Spring Creek are turned off, except 20 mgy is pumped from existing wells near the creek.
- City wells 4, 5, and 6 replace some of the remaining permitted demand from the wells that would be turned off within ¼ mile of Cold Spring Creek but would be reduced overall by 197 mgy.
- The Froehle site (Figure 2) would replace the 197 mgy reduced from the City's wells and supply an additional 103 mgy.
- This scenario explored another approach to increasing volume by shifting part of the City and brewery's use even further away from the creek. Impacts to streamflow are considerably less than other scenarios, while also accommodating growth or expansion.

The DNR and representatives from the City and the Brewery discussed possible options going forward. The DNR is continuing to work with the City and CSBC to find sustainable options for water supply needs.

Table 2. Simulated base flow in Cold Spring Creek for Scenarios 6 through 12.

Scenario	Simulation	Pumping volume (mgy)	Upstream reach H16011008 (cfs)	Depletion over upstream reach (cfs)	Upstream reach % difference	Downstream reach H16011007 (cfs)	Depletion over downstream reach (cfs)	Downstream reach % difference
	Measured	--	*0.49*	--	--	*1.94*	--	--
6	2018, ¼ mile, the City's well field	1313	0.47	0.5	9.3	1.94	0.19	8.9
7	2018, ¼ mile, 20 mgy, the City's well field	1313	0.46	0.6	10.9	1.92	0.21	9.8
8	Permitted	2377	0.37	0.15	23.4	1.52	0.61	23.9
9	Permitted, ¼ mile, 20 mgy, the City's well field	2377	0.43	0.09	15.5	1.81	0.32	14.2
10	Permitted, +103 mgy	2480	0.35	0.17	25.8	1.48	0.65	25.1
11	Permitted, ¼ mile, 20 mgy, the City's well field, +103 mgy	2480	0.42	0.1	16.9	1.77	0.36	15.7
12	Permitted, ¼ mile, 20 mgy, +103 mgy, 300 mgy Froehle	2480	0.45	0.07	12.5	1.88	0.25	11.4

For Scenarios 8 through 11, MODFLOW reduced the specified pumping by 129 mgy (1338 m^3/day).

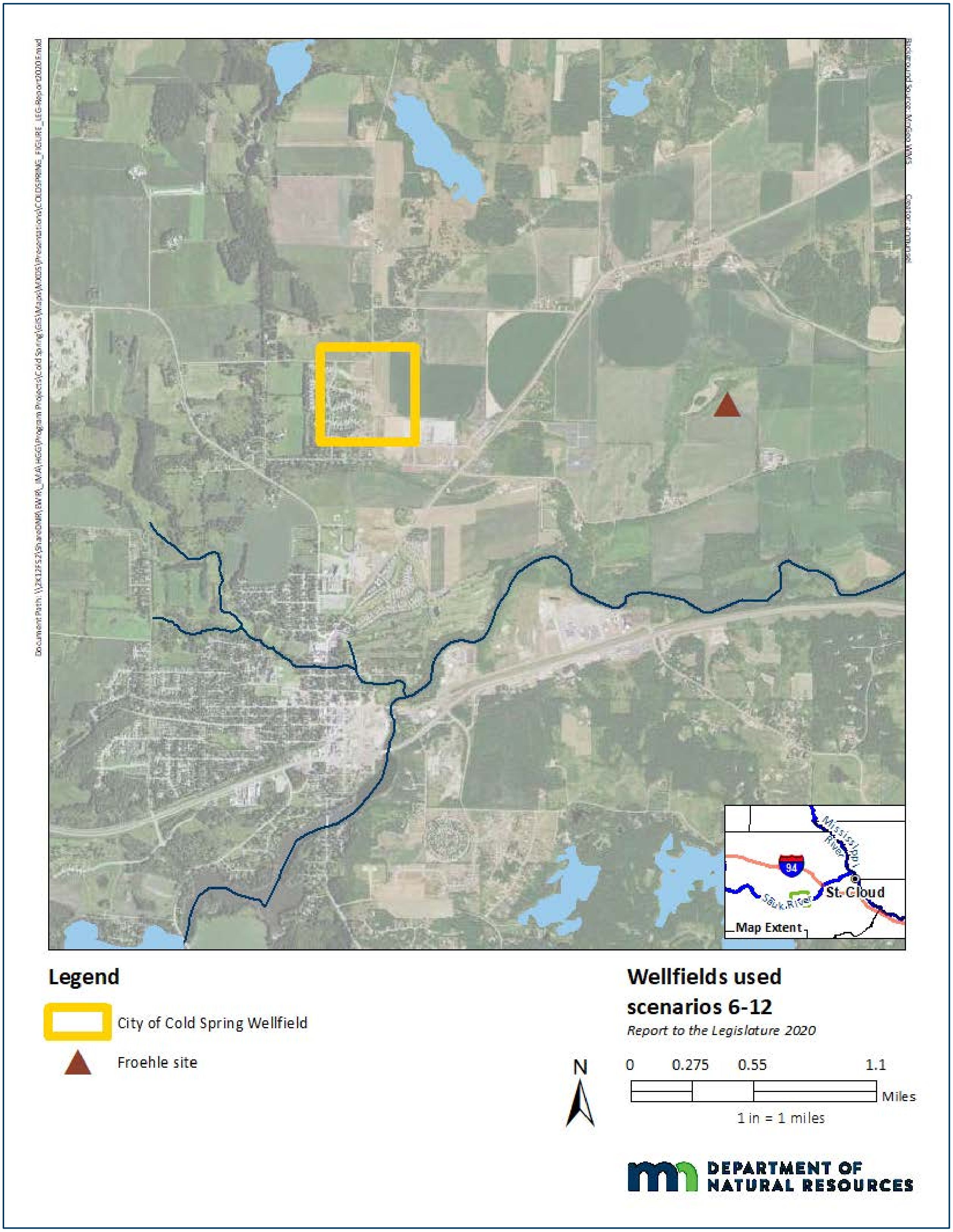

Figure 2. Map showing location of City's current wellfield and the Froehle site relative to Cold Spring Creek