Technical Review Analysis - 2020
Watertown Wastewater Treatment Facility GWD 1-92
(Ground Water Quality Variance Review/Continuance)

The following is the twelfth addendum to the Technical Review Analysis written for this facility since it was originally permitted in 1992.

Site Status

The City of Watertown (City) operates a wastewater treatment facility originally constructed to discharge effluent to a 106.3 acre, fifteen (15) cell infiltration-percolation (I/P) lagoon system (see aerial site map). The eight cells at the southern end of the facility had an underdrain to collect water for discharge to Willow Creek as a point discharge. With the additional treatment added to the mechanical wastewater system, the facility has been directly discharging to the Big Sioux River as a point source since April 1998. Since April 12, 1998, the I/P lagoon system has been removed from full time service and is used on an emergency basis or when pumps are being tested. It should also be noted that I/P cells 6 and 7 (see aerial site map) of the system were converted to a soccer complex in 2002, but the exterior berms and piping are still in place so that it may be placed back into service in an emergency. (**Note:** In 2000 the berm dividing cells 6 & 7 was removed reducing the total number of cells at the facility from 15 to 14.)

In November 2014, the City informed South Dakota Department of Environment and Natural Resources (DENR) it was making changes to the land use within the wastewater treatment facility's POP Zone. The land use changes included converting approximately 35 acres of agricultural land to outdoor recreational land use including the construction of 5 softball fields, parking, concession, toilet facilities (hooked to public sewer), and two outdoor ice rinks. The complex was located in the field north of Former I/P Basins 8-15. The City's Department of Parks and Recreation was informed they are to use appropriate agronomic rates of fertilizers and pesticides to prevent further degradation of groundwater quality. Construction of the softball field and ice rink complex started during fall 2015. Additionally, construction of the softball and ice rink complex involved the removal of the I/P Basins' 8-15 berms and their underdrains. The connection from the WWTF to I/P Basins 8-15 was capped and disconnected.

Summary Technical Revisions

Issued July 13, 1992: Approved removal of monitoring well MW-12 from the permit sampling requirements. This well, which was adjacent to Williams Pipeline Terminal (now operated by Magellan Midstream Partners), contained free phase petroleum product and could not be sampled for the permit-required parameters. The product has since been removed and all release cases associated with the Magellan terminal have been placed in "No Further Action" status or closed.

Issued August 31, 1994: Approved removal of sludge from infiltration-percolation cell No. 7. This sludge was taken to the City of Watertown landfill.

Issued January 9, 1995: Approved change of location for Big Sioux River staff gauge. The new location for the staff gauge is on the bridge that crosses the Big Sioux River just north of monitoring well MW-24 (see aerial site map).

Deferred December 20, 1995: The City requested an increase in the permitted allowable limit (PAL) for nitrate at compliance point monitoring wells MW-11B and MW-23. DENR deferred its decision

on this technical revision until a review of the facility's pending ground water discharge plan renewal could be processed. When the discharge plan was renewed in July 1996, the PALs were increased as requested by the City.

Issued August 24, 2001: Approved removal of monitoring well MW-25 from the permit sampling requirements. Well MW-25 was located upgradient of I/P cell 6. This cell was converted to a soccer complex and well MW-25 was in the area where a parking lot was being constructed. This well was properly abandoned on September 14, 2001. The berms and piping are still in place at cell 6 and it can be placed back into service in an emergency. MW-25 is no longer depicted on the updated aerial site photo.

(**Note:** Wells MW-2A, MW-8A & B, MW-11A, MW-14, MW-15A, and MW-16A were abandoned under May 1994 and May 2002 permit renewals, and are no longer shown on the updated aerial site photo.)

Ground Water Monitoring Data (Biennial Review)

Overview

Based on data from the ground water monitoring wells, nitrate is the only parameter of concern that consistently exceeded ground water quality (GWQ) standards during the current biennial review period covering portions of 2018-20120 Nitrate concentration exceeded the GWQ standard of 10 ppm in well MW-16B, MW-27 and compliance point wells MW-11B and MW-23. However, monitoring wells MW-11B and MW-23 have higher permitted allowable limits (PALs) for nitrates, MW-11B (15 ppm) and MW-23 (25 ppm). Additionally, compliance point well MW-17 had sampling results that contained nitrate above the PAL.

Over the facility's monitoring history, there has been some sporadic exceedances of total dissolved solids (TDS) in several of the monitoring wells. In accordance with Table 2 in ARSD 74:54:01:04 the standard for TDS is not applicable to ground water receiving discharge from a publicly owned treatment works, so a PAL is not set for TDS. However, TDS will continue to be monitored on a semi-annual basis as part of the discharge plan. Groundwater flow direction (see aerial site map) has remained stable with flow generally to the south with east and west vectors except by the wastewater treatment plant where groundwater flows to the northeast.

Nitrate

After some initial elevated levels in the mid-1990's, well MW-11B began to again exceed the nitrate standard of 10 ppm during the September 2007 sampling event (see Figure 1). Until this review period, increases in nitrates did not appear to be significant since the mid-1990's and can likely be attributed to regular fluctuations (seasonal or otherwise). There were significant concentrations of nitrate in MW-11B from 1993-1995 up to almost 30 ppm, but levels quickly dropped and had stayed below the PAL until April 2012. Nitrates had increased further and exceeded the PAL in 2012-2013; however, during the April 1, 2014 sampling event an anomalous drop to 0.12 ppm in nitrate occurred. Nitrate concentrations have had a decreasing trend from September 2015 to the most recent sampling event (April 2020) with a concentration equal to 6.2 ppm.

Based on the 2018 ground water contour map (aerial site map), this well appears to be the most downgradient well in regard to groundwater flow and is downgradient from a farmed field. Influence from the Big Sioux River may be a factor as well. Willow Creek does not appear to influence the

nitrates in MW-11B considering that the other compliance point wells, MW-19, MW-21, and MW-22, all located along the creek upstream, have not had exceedances. MW-20R, also a compliance point well, exceeded the GWQ standard in September 2011, MW-20R was resampled later that month and was at the nitrate standard (10 ppm). Since then MW-20R has been well below the standard, and prior to the September 2011 event never had an exceedance. In fact, MW-19, MW-20R, MW-21, and MW-22 have all very rarely had nitrate above 2 ppm. All wells, except MW-20R (7.8 ppm), were below 1 ppm during the last sampling event in April 2020.

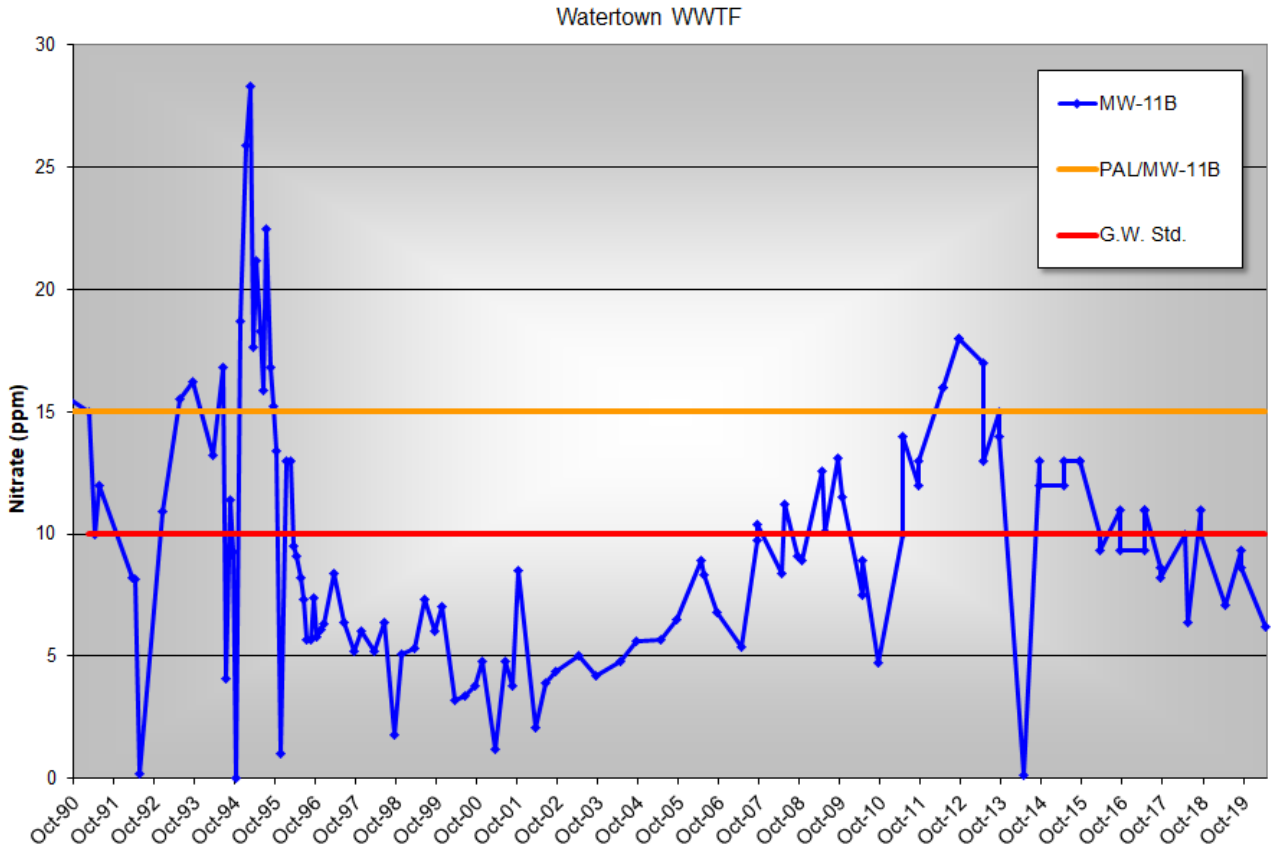


Figure 1. Nitrate concentrations in compliance point well **MW-11B**

Well MW-16B began increasing and exceeded the nitrate standard in 2002 but declined and dropped below the GWQ standard in 2010 (see Figure 2). Well MW-16B is not a compliance point well and did not start to exceed the groundwater standard until three years after the I/P lagoons were taken out of service. Due to the increased nitrate concentrations in MW-16B beginning in 2002, DENR requested that additional sampling be conducted to try and determine the source of the nitrate contamination. Note that MW-16B is located downgradient of I/P cells 6 and 7 and a farmed field (see aerial site map). In August of 2005, a water sample from this well was sent to the Environmental Isotope Laboratory at the University of Waterloo (Waterloo, Ontario) to determine if the nitrates were from commercial fertilizer or organic waste. The results of the analysis verified that the nitrate was from organic waste. Based on these results, DENR requested additional information to determine when wastewater was last discharged to I/P cells 6 and 7 and if any wastewater or sludge was applied to the field directly upgradient of the well. According to the City's records, September 9, 1997 was the last time wastewater was discharged to IP cells 6 and 7. However, sewage sludge is occasionally applied to the farm field. The sludge is applied at the agronomic rate in accordance with an approved sludge disposal permit. Since reaching a high of 40 ppm nitrate in April 2005, concentrations in well MW-16B decreased from April 2005 to September 2010. Nitrate

concentrations remained low and stable from April 2011 to September 2014. From September 2014 to September 2015 nitrate concentrations had an increasing trend reaching 19 ppm in September 2015. From September 2015 to September 2017 nitrate concentrations in MW-16B have had an overall decreasing trend (4.8 ppm in 2017). From September 2017 to April 2020 nitrate concentrations have had an increasing trend with the most recent concentration equal to 26 ppm.

MW-15B is located side/downgradient of MW-16B and is also downgradient from the farmed field mentioned above. Although these wells are located near each other, their historical nitrate concentration fluctuations have not correlated with any consistency. This is consistent throughout the site, as nitrate exceedances in other wells generally appear to be localized and have not been mirrored in nearby surrounding wells. Well MW-15B had not exceeded the groundwater standard for nitrate since November 1995 until April 2009 (12 ppm) and Sept 2010 (20 ppm) – despite elevated nitrate in nearby MW-16B in 2002-2010. As shown in Figure 3, the water table elevations at the site have fluctuated, in some cases +/-5 feet from their mean value, over the sampling history. When compared side-by-side with nitrate concentrations in MW-15B and MW-16B (see Figure 2), there is no consistent correlation with water elevations in either of these wells. It appears MW-16B had higher nitrate concentrations with lower water levels, but in MW-15B concentrations went up with higher water levels.

At this time it is still unclear as to why the nitrate concentrations were high in MW-16B and, later, MW-15B. It does not appear to be from wastewater discharges to the I/P cells. One possibility has been suggested in the past that even though the sludge was applied to the farmed field to the north at the agronomic rate, crop uptake was not sufficient to keep nitrate from leaching to the ground water. The elevated nitrate concentrations in MW-16B were likely due to residual nitrate from previous sludge land application which migrated through the soil column and ground water. Neighboring MW-15B nitrate concentrations have had a decreasing trend from September 2010 to September 2019. MW-15B was damaged in late fall 2019. The casing was broken off close to the ground likely due to a vehicle hitting the well. DENR required the well to be plugged and abandoned in an email dated on December 13, 2019 and did not require the well to be replaced. The well was plugged and abandoned on December 18, 2019.

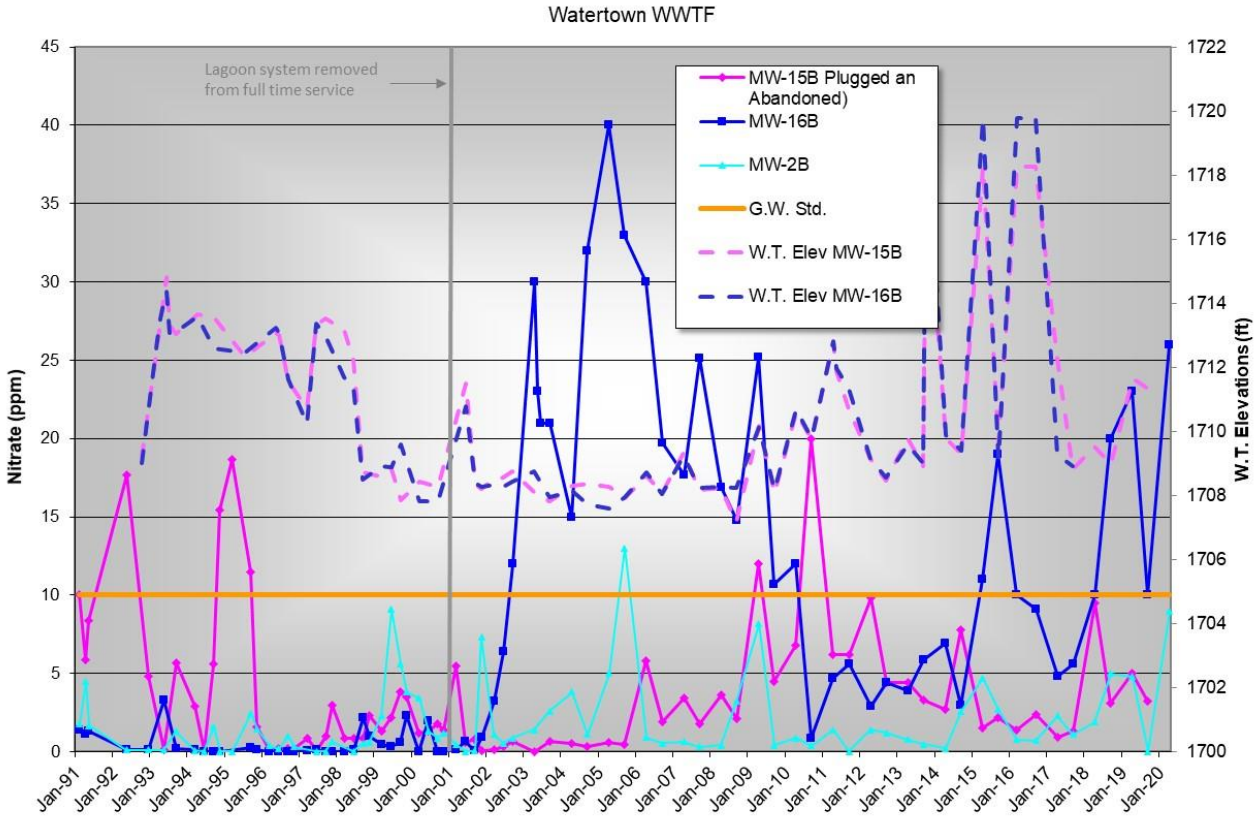


Figure 2. Nitrate concentrations in wells **MW-2B, MW-15B** and **MW-16B**

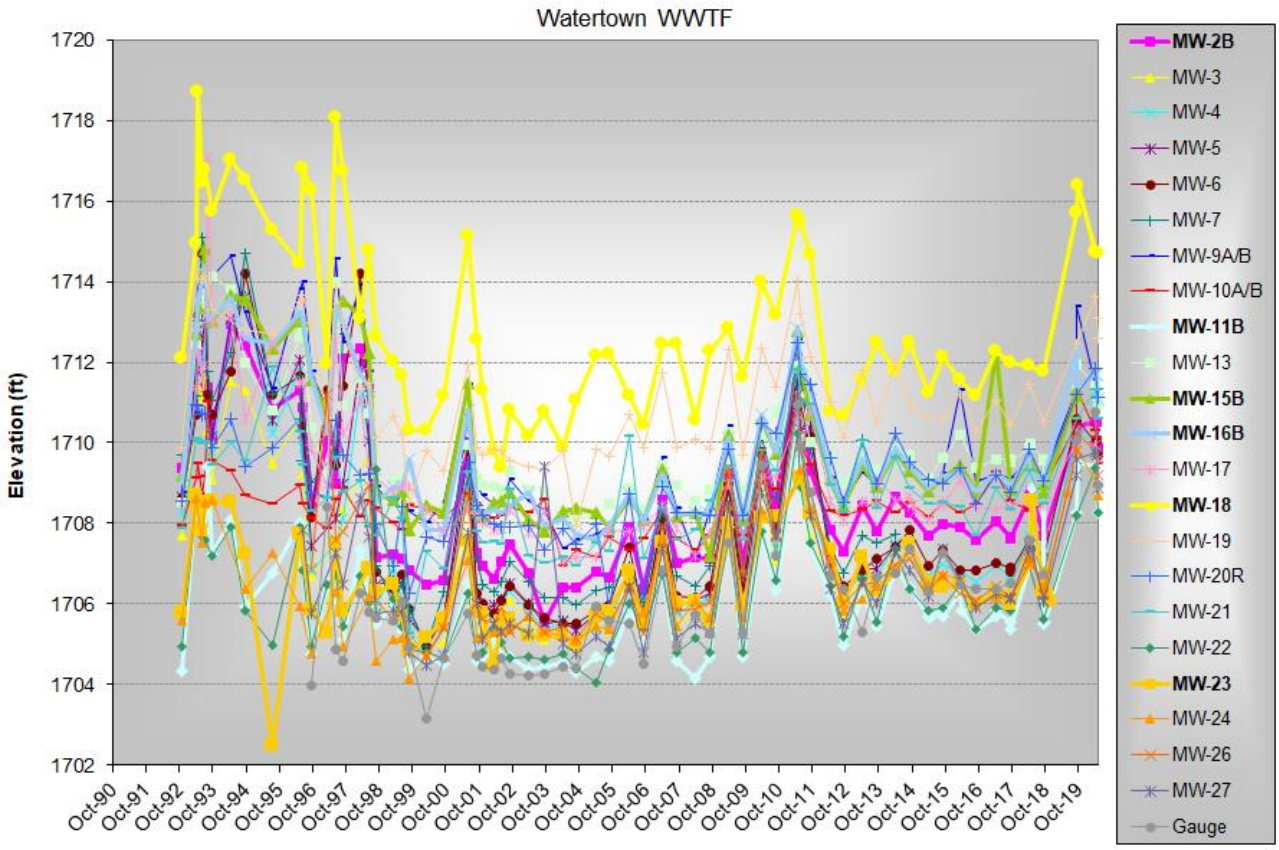


Figure 3. Water table elevations for wells of significance within this report.

It should also be noted that wells downgradient from MW-16B did not have consistent results, suggesting they have been impacted by the upgradient farmed field (see Figure 4). Monitoring wells MW-1, MW-3, MW-5, and MW-7 were abandoned during the 2014 Ground Water Discharge Plan Permit Renewal. The closest downgradient well to MW-16B, MW-1, had not been above 1 ppm for over 18 years. However, wells MW-2B, MW-3, and MW-27 are also downgradient and have shown unexplained fluctuations in nitrate concentrations (see Figure 4). Nitrate concentrations in monitoring well MW-2B was stable from 2009 to 2012 then had a decreasing trend from 2012 to 2014. Nitrate concentrations increased from April 2014 to April 2015 reaching a concentration equal to 3 ppm. From 2015 to 2016 nitrate decreased to 0.78 ppm. From March 2016 to September 2017 nitrate concentrations remained relatively stable with nitrate concentrations remaining below 5 ppm with the most recent concentration equal to 1.1 ppm. In MW-27, with the exception of two sampling event on September 2014 (14 ppm) and September 2018 (12 ppm), nitrate concentrations have remained stable and below 10 ppm. During the most recent sampling event in April 2020 having a concentration equal to 0.94 ppm.

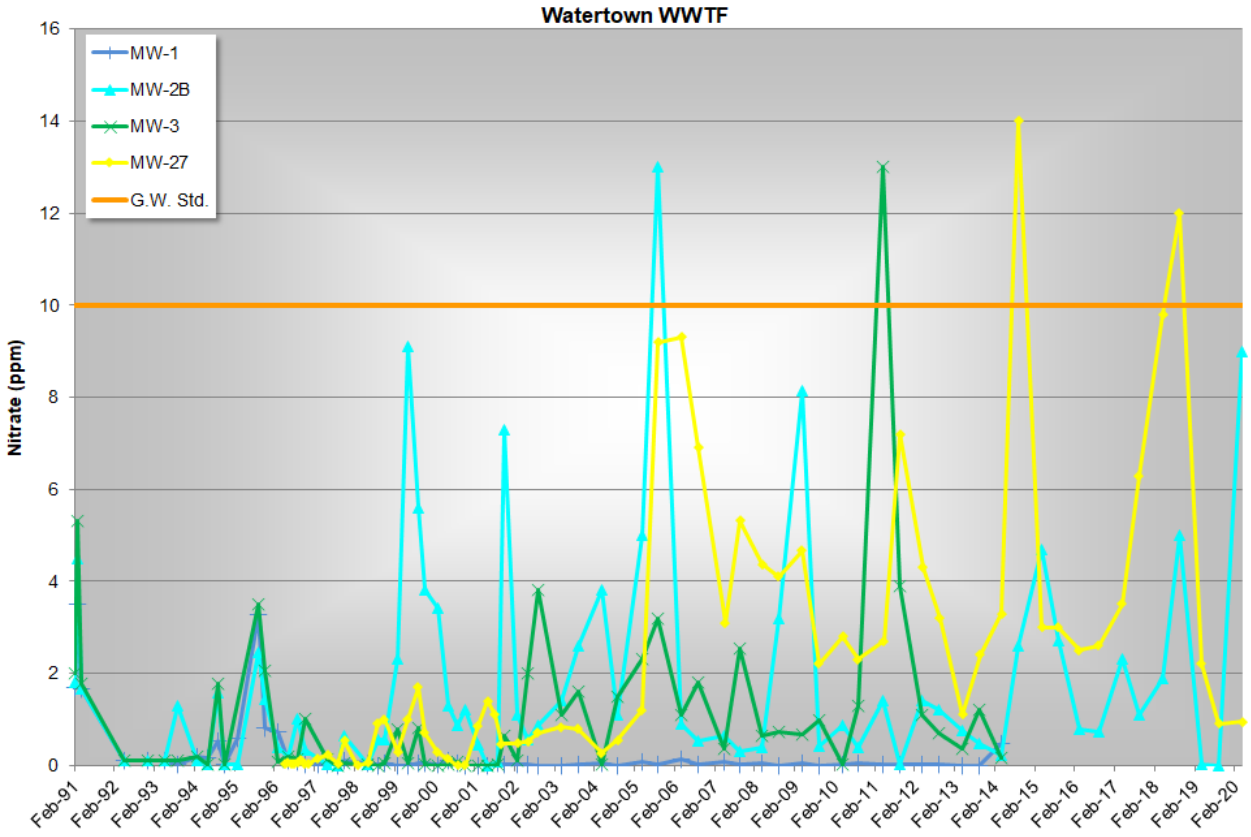


Figure 4. Nitrate concentrations for wells **MW-1, MW-2B, MW-3**, and **MW-27**

Well MW-18, an upgradient well, has had fluctuating nitrate concentrations over the years, with two 2010 sampling events and two 2011 events above 10 ppm – the only exceedances since 1998 (see Figure 5). The facility management noted that the 2010-2011 exceedances are "likely due to the application of commercial fertilizer on this property, rather than an effect of wastewater treatment facility operations" (see May 12, 2010 email from Mike Boerger to Tom Brandner). From 2011 to 2017 nitrate concentrations had decreasing/ stable trend (April 2017; 2.4 ppm). From April 2017 to September 2019 nitrate concentration had an increasing trend with a concentration equal to 5.1 ppm. The most recent sampling event show a sharp decrease in nitrate concentrations with a concentration equal to 0.86 ppm.

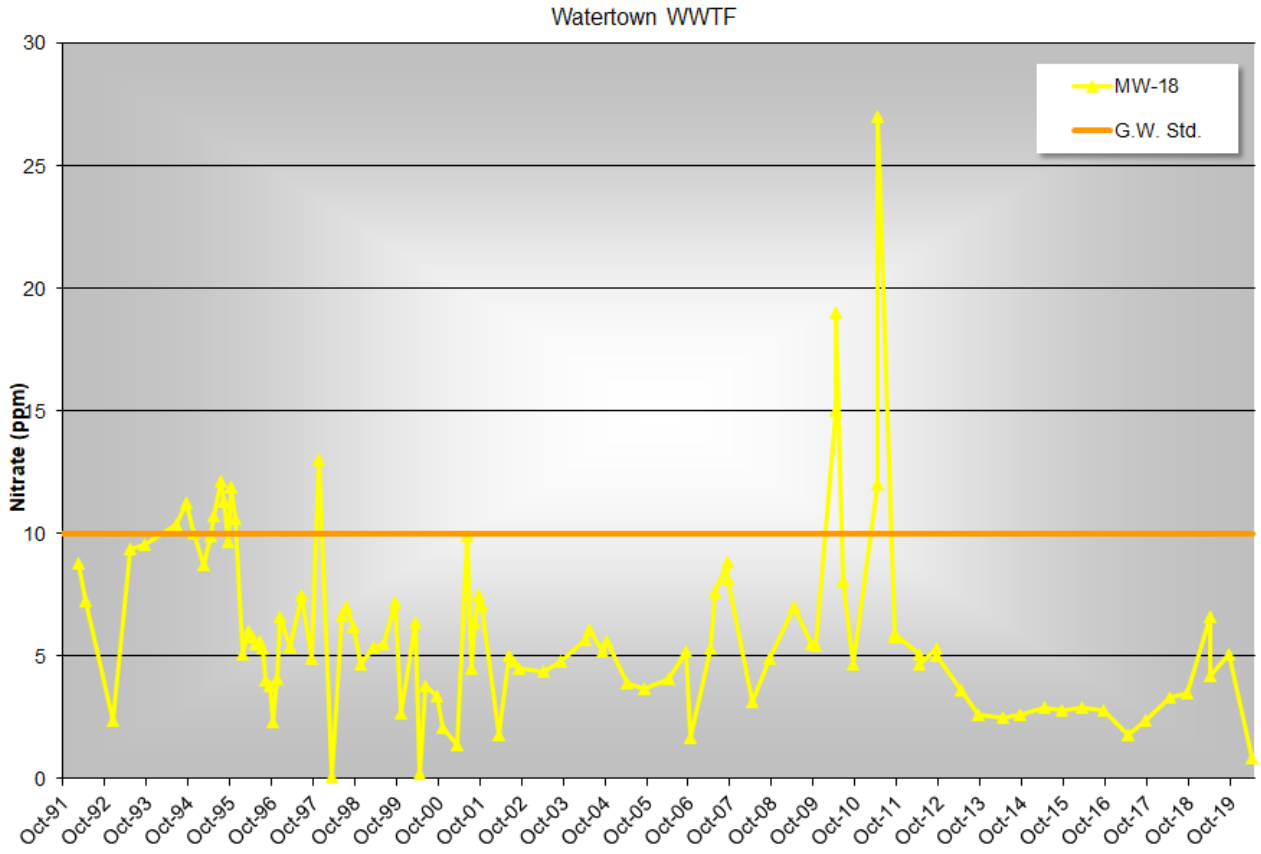


Figure 5. Nitrate concentrations in compliance point well **MW-18**

Well MW-23 has generally exceeded the nitrate GWQ standard over its monitoring history (see Figure 6). The highest exceedance occurred in September 2006 and was 29.3 ppm. However, nitrate concentrations in well MW-23 exceeded the GWQ standard prior to any discharge from the wastewater treatment facility. Based on this information, a PAL for nitrate was set at 25 ppm in well MW-23.

Except for monitoring well MW-17, nitrate concentrations in wells upgradient from MW-23 have been below the GWQ standard since 2002. Based on this data, it appears the higher nitrate concentrations in well MW-23 are localized. Monitoring well MW-17 exceeded the groundwater quality standard in September 2013 with nitrate concentration of 14 ppm and again during the required accelerated monitoring with a nitrate concentration of 11 ppm (first exceedances in the well since 1995). However, the sampling event in April 2014 yielded a nitrate concentration of 0.34 ppm. MW-17 exceeded the nitrate standard again during the September 2014 sampling event (24 ppm) and during the required accelerated monitoring (12 ppm). From September 2014 to April 2020 nitrate concentrations in MW-17 have had an overall decreasing concentration. The most recent sampling event had a nitrate concentration equal to 4.5 ppm.

In an email from the City dated November 5, 2018, DENR was informed MW-23 and MW-26R casings had experienced an elevation change. In a letter dated November 15, 2018, DENR agreed with trimming the top of MW-23 and continuing accelerated monitoring. DENR also required MW-23 to be replaced by the end of 2018 and have MW-26R replaced by March 2019. The wells were replaced and renamed MW-23R and MW-26R (R18) according to an email from the City dated January 7, 2019.

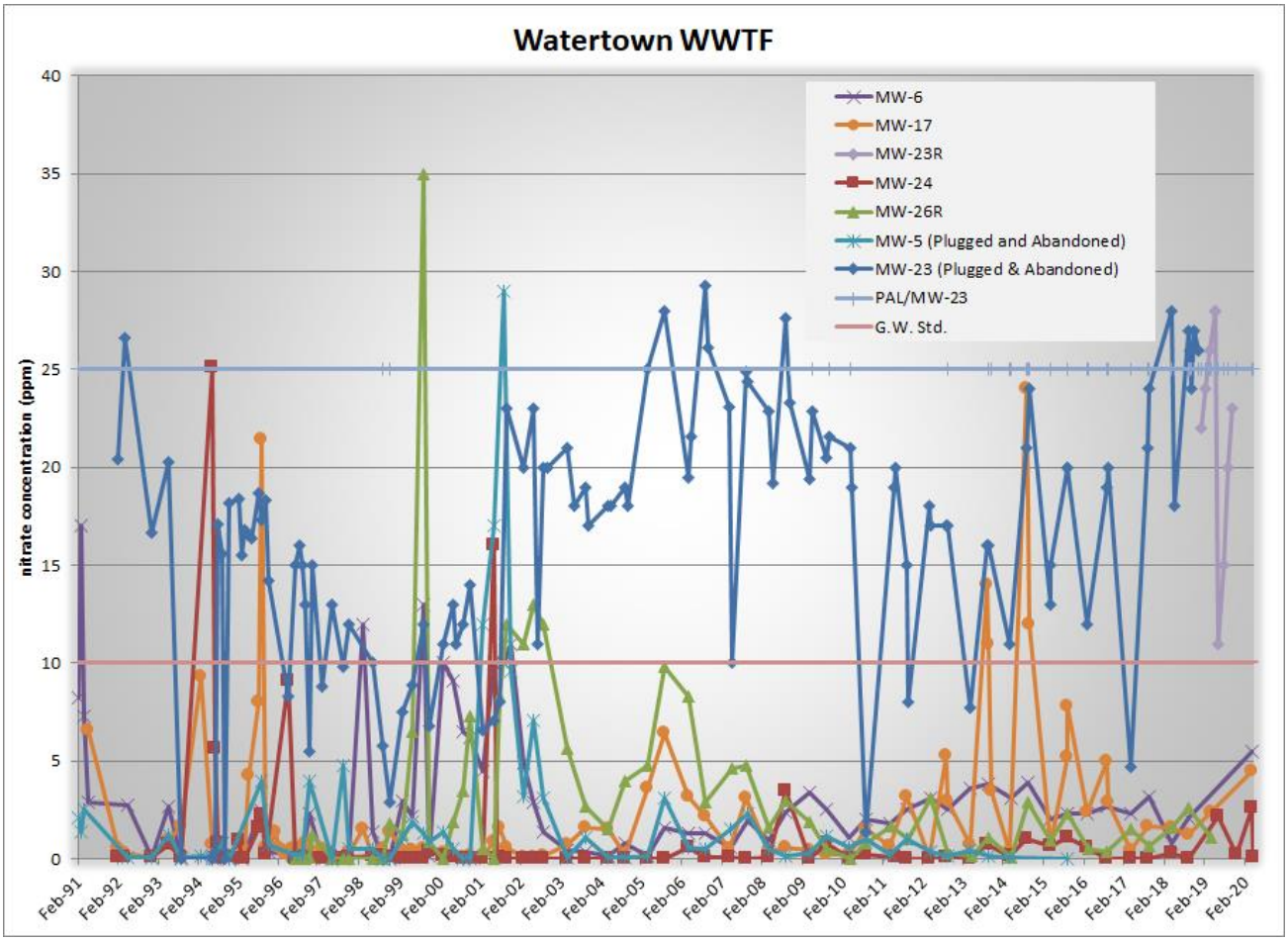


Figure 6. Nitrate concentrations in compliance point wells **MW-23, MW-23R** and **MW-17** as well as nearby **MW-24**, **MW-26R**, **MW-5**, and **MW-6.**

Ground Water Monitoring Summary

The site-wide exceedances of the GWQ standard for nitrate have been sporadic with some concern surrounding the nitrate concentrations in well MW-16B, but mainly with compliance points MW-11B, MW-17, MW-18 and MW-23 (replaced by MW-23R). During this biennial review period these wells show a generally steady or slightly decreasing concentration. Up-stream/-gradient compliance point wells (MW-24 near the Big Sioux River, and MW-19, MW-20R, MW-21, and MW-22 along Willow Creek) have all shown low nitrate concentrations with relative consistency, aside from MW-23. Although nitrate in MW-23 has shown a recent slow, overall decreasing trend (since approximately 2007), during the facility's sampling history it has had the highest sustained concentrations of nitrate. From the aerial photo and ground water contours, it appears the source may be agricultural from a field to the west (private property), which would explain why upgradient wells have not shown any impact.

Emergency Discharges

Due to the previous renovation of the wastewater treatment facility, discharges to the I/P system will only be necessary on an emergency basis or when treated effluent is discharged when pumps in the effluent pump building are being tested. The table below provides information about the reported discharges since June 2018.

Discharge Type (No. of events)	Average Time (min)	Average Gallons Pumped	Gallons Pumped
Test Run Pumps (3)	83	117,633.3	NA
Test New Screw Press (2)	886	3,080,800	NA
High Flow Through Facility (2)	218.50	431,060	NA
Biosolids Dewatering Testing (1)	436	NA	4,877,000
Test Run Efficiency Pumps (1)	78	NA	253,600

Table 1: Watertown Wastewater Treatment Facility discharge events from June 7, 2018 to December 11, 2019.

Recommendations

It is recommended that the ground water quality variance be continued for a period of two (2) years. The ground water quality variance will be schedule for review on May 3, 2022.

Prepared By: Georgina Smith, Environmental Scientist II

Date Amended (after internal review): _____September 21, 2020_____

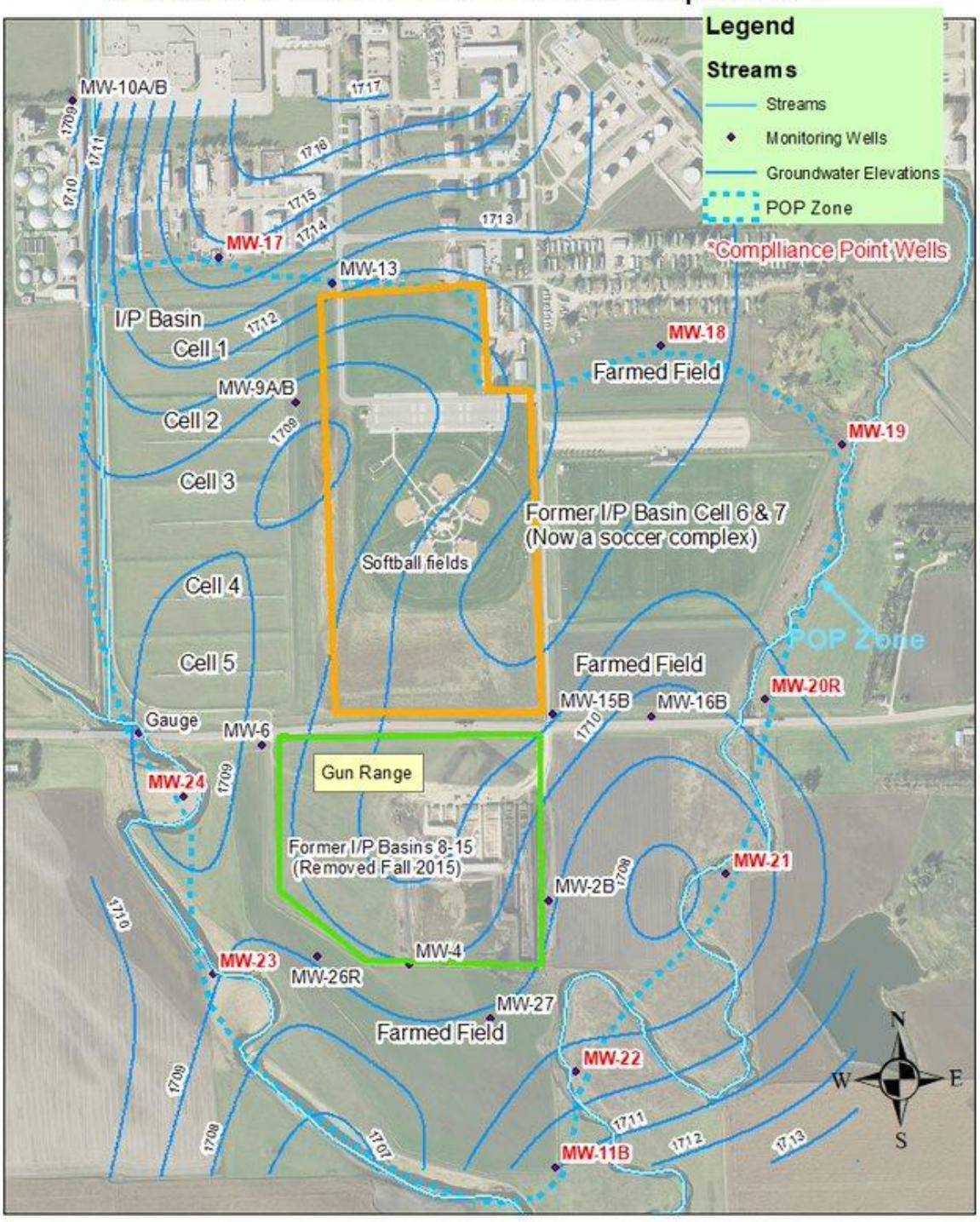
Reviewed By: Brian Walsh, Public Affairs Director

Attachments

Monitoring Wells and Sampling Parameters

COMPLIANCE POINTS	INTERMEDIATE WELLS	SAMPLING PARAMETERS
MW-11B, 17, 18, 19, 20R, 21, 22, 23, and 24	MW-2B, 4, 6, 9A, 9B, 10A, 10B, 13, 15B, 16B, 26R, & 27	Ammonia-Nitrogen, Chloride, Fluoride, Nitrate-Nitrogen, Nitrite, pH, Sulfate, & Total Dissolved Solids

Watertown WWTF GW Contours April 2020



Note: Aerial photo date 2018