

Technical Memorandum



To: Ms. Antonia Estevez
Water Systems Consulting, Inc.

From: Thomas Harder, P.G., CH.G.
Thomas Harder & Co.

Date: 8-Mar-23

Re: Response to Comments Regarding Potential Impacts of the Replenish Big Bear Project on the Lucerne Valley Land Discharge Location

The purpose of this Technical Memorandum (TM) is to provide supporting documentation and analysis to address comments received regarding the Replenish Big Bear Project (the Project) Notice of Preparation. Specifically, two comments are addressed herein pertaining to potential impacts of reduction in discharges from the Big Bear Area Regional Wastewater Agency (BBARWA) plant in Big Bear City to the Lucerne Valley Land Discharge Location (LVDL):

1. Have current and historical discharges to the LVDL contributed to surface or near-surface water flow in the natural wash located approximately 1-mile north of the site?
2. Have discharges to the LVDL caused higher Total Dissolved Solids (TDS) and nitrate concentrations in groundwater beneath the site than otherwise would have occurred absent the discharges?

Potential for Contributions to Surface Flow in the Wash North of the LVDL

It is assumed that the wash in question is the unnamed wash located approximately 0.8-mile northeast of the LVDL (see Figure 1). This wash is ephemeral, meaning that surface water flows in the channel only during periods of extreme above-normal precipitation. A review of historical aerial imagery (i.e. Google Earth) shows that this wash is dry in all historical images available since 1985 although its presence indicates that water has flowed in it periodically.

Based on a review of groundwater level data from wells located north of the LVDL and within or adjacent to the wash, it is not possible that groundwater recharge from surface discharges to the LVDL have caused surface and/or near-surface flow of water in the wash. Available

groundwater level records from 1994 through 2020 indicate that groundwater near the wash has never been shallower than approximately 110 feet below the land surface (see Figure 2). Records from two wells were obtained from the United States Geological Survey (USGS) National Water Information System (NWIS) online water database. Groundwater levels near the wash haven't varied more than approximately 10 feet and for the well with the longest period of record, was approximately the same elevation in 2020 as it was in 1994. As discharges to the LVDL were occurring throughout this time, and as there is no evidence groundwater levels have ever reached the ground surface at the wash, it is not possible that recharge from the LVDL has ever caused surface water flow in the wash.

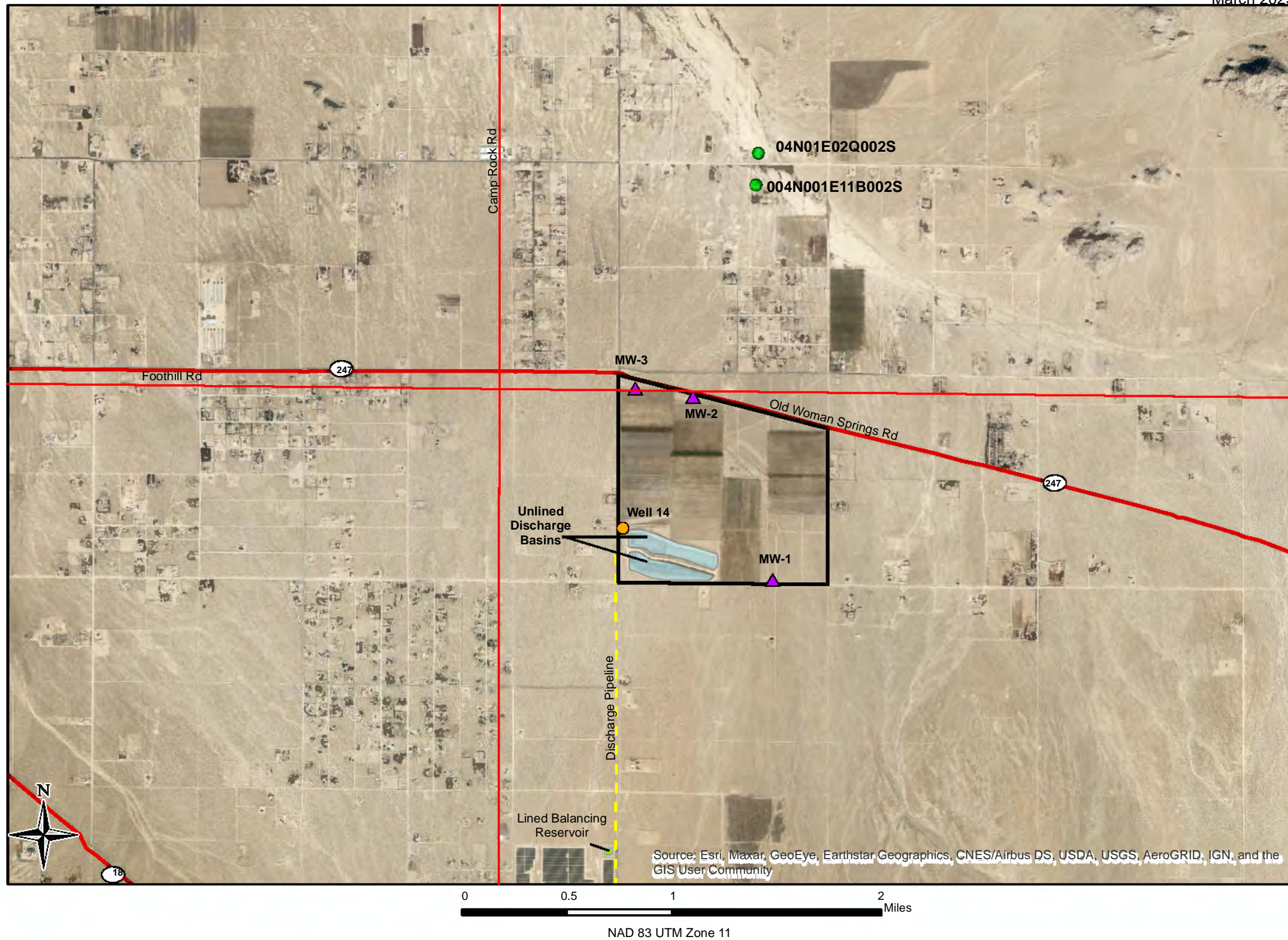
Potential for Groundwater Quality Impacts from BBARWA Discharges at the LVDL

TDS and nitrate concentrations in BBARWA effluent discharged at the LVDL have historically been lower than the TDS and nitrate concentrations detected in samples from the downgradient monitoring wells at the Site (MW-2 and MW-3).¹ Updated TDS and nitrate data in both the onsite monitoring wells and the BBARWA effluent since 2017 support the previous conclusion that the delivered water from BBARWA is not the source of the high TDS and nitrate concentrations in groundwater (see Figures 3 and 4). TDS concentrations in BBARWA effluent since 2017 show a slightly decreasing trend, while TDS concentrations in the groundwater from downgradient Monitoring Wells MW-2 and MW-3 show a slightly increasing trend (see Figure 3) suggesting the two are not correlated. Further, the downgradient concentrations are higher than the BBARWA effluent concentrations. From a mass balance standpoint, recharge of BBARWA effluent cannot be the source of the higher groundwater TDS concentrations. Similarly, nitrate concentrations in groundwater from all onsite monitoring wells are higher than concentrations in the BBARWA effluent. Thus, while the detection of low concentrations of nitrate in the BBARWA effluent contributes to nitrate in groundwater, the significantly higher nitrate concentrations detected in groundwater beneath the site indicates the BBARWA effluent is only a minor contributor and not the primary source.

¹ TH&Co, 2017. Groundwater Quality Evaluation at the Lucerne Valley Land Discharge Location. Prepared for WSC and the Big Bear Area Regional Wastewater Agency. Dated December 22, 2017.



Groundwater Wells at the Lucerne Valley Land Discharge Location



Map Features

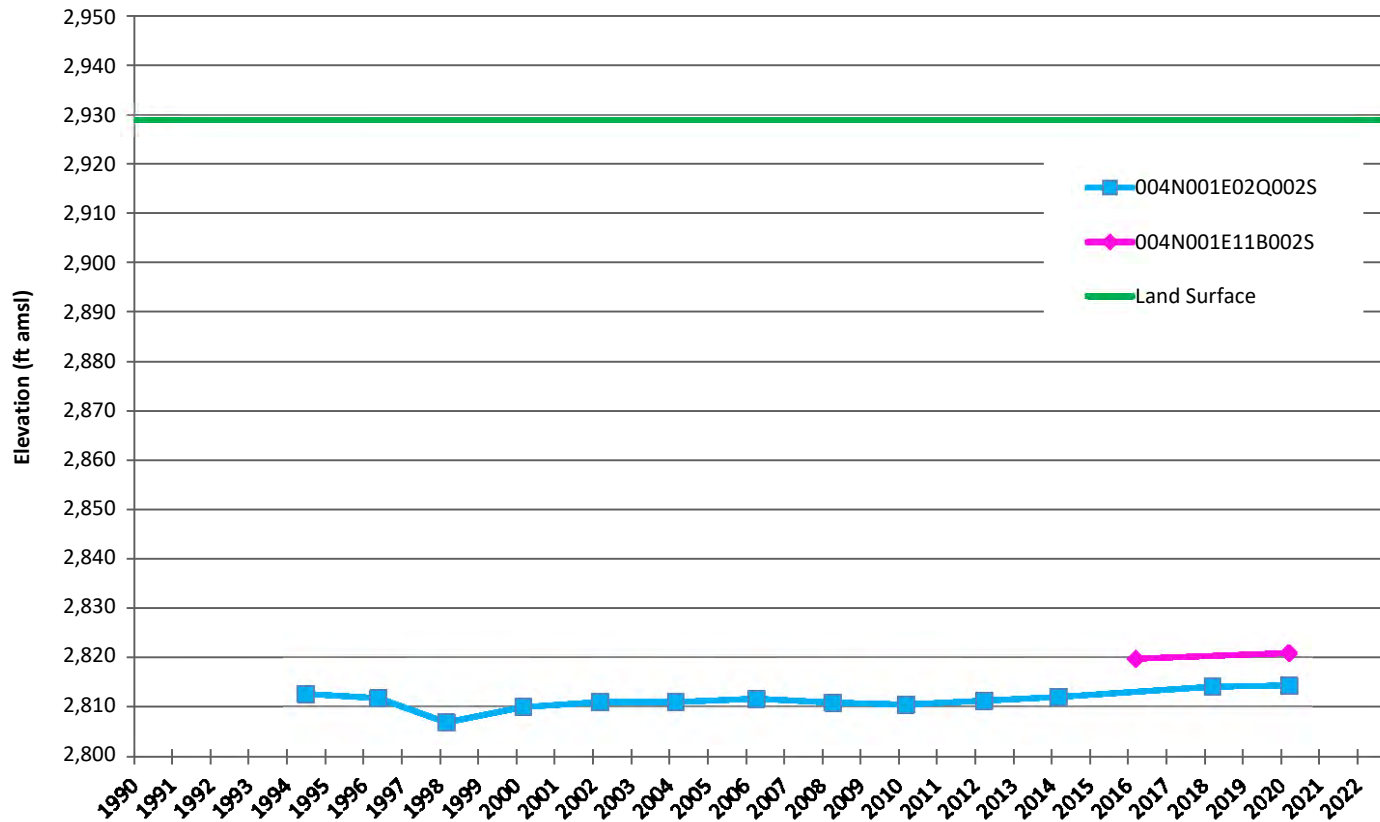
- BBARWA Monitoring Well
- Well 14
- Well with Groundwater Level
- Discharge Pipeline
- Freeway
- BBARWA Property Boundary
- Balancing Reservoir
- Unlined Discharge Basin

Well locations are from USGS National Water Information System (NWIS), 2023

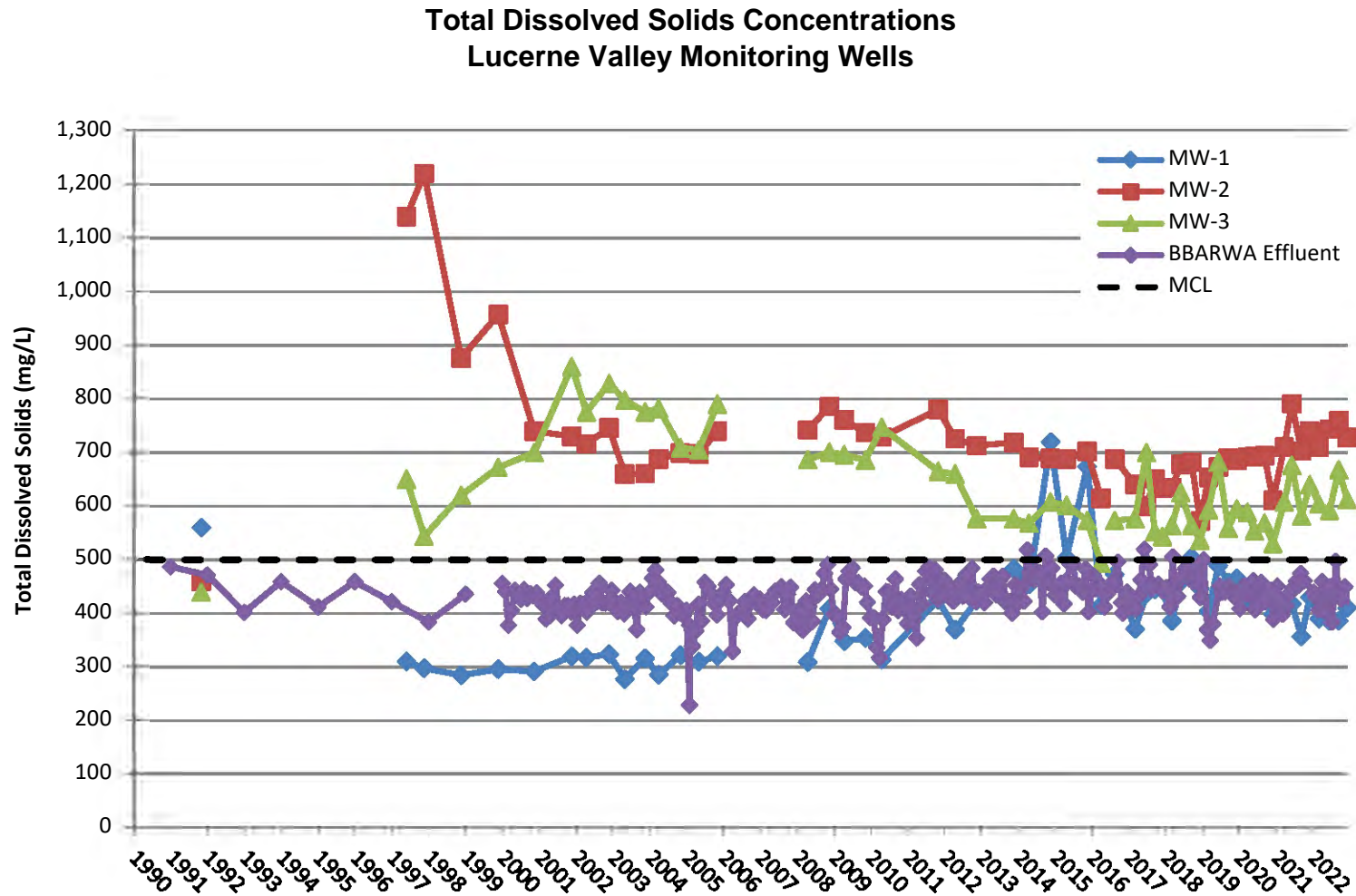
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

**Lucerne Valley
Land Discharge Location**
Figure 1

USGS Wells Groundwater Elevations

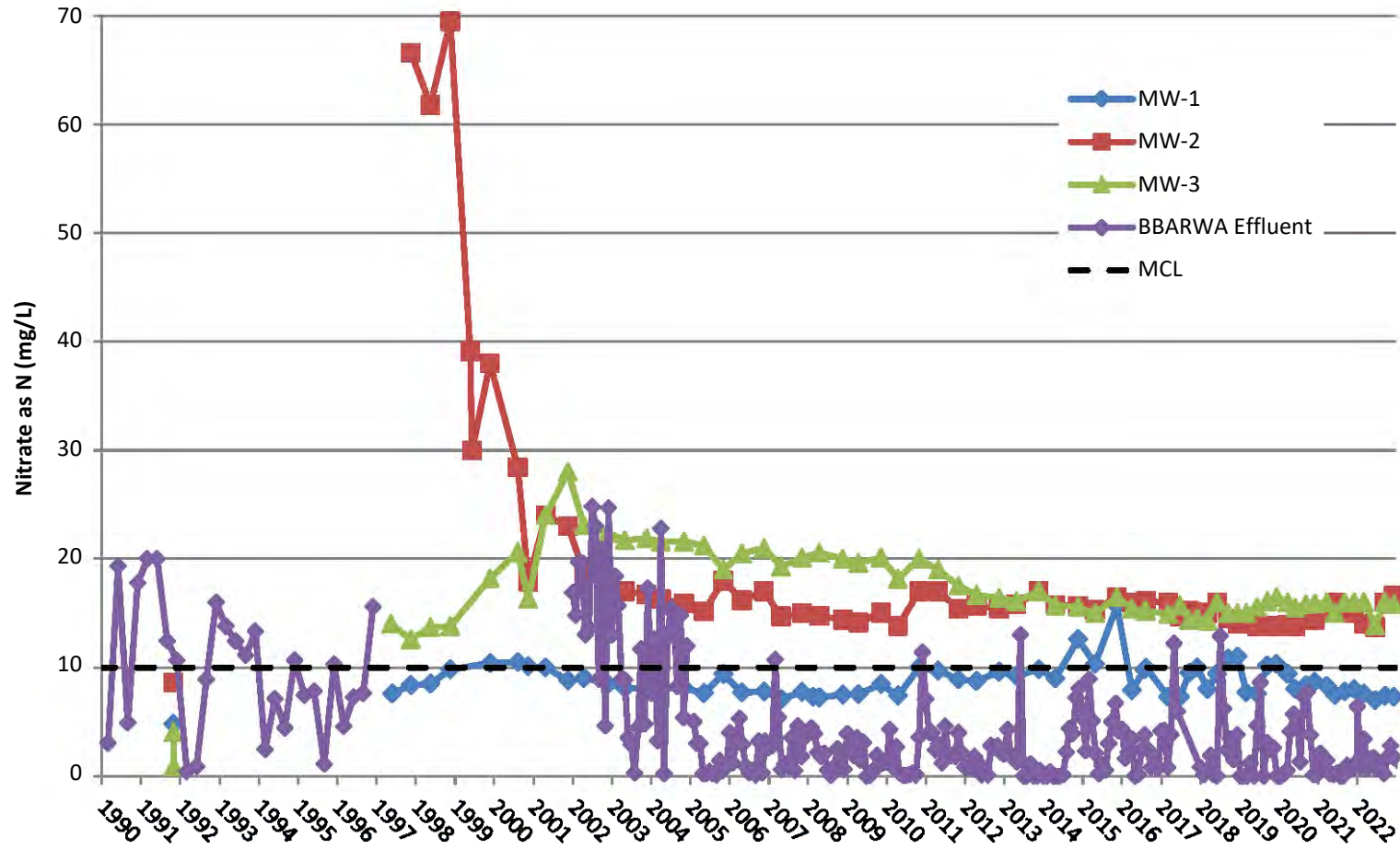


Notes: ft amsl = feet above mean sea level
Data from USGS National Water Information System (NWIS), 2023.
https://nwis.waterdata.usgs.gov/nwis/gwlevels?search_station_nm=004N001E



Note: mg/L = milligrams per liter

Nitrate (as N) Concentrations Lucerne Valley Monitoring Wells



Note: mg/L = milligrams per liter