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**FINAL REPORT
GROUNDWATER NITRATE STUDY
CHICO URBAN AREA
PREPARED FOR THE
COUNTY OF BUTTE
ADMINISTRATIVE OFFICE**

EXECUTIVE SUMMARY

This Groundwater Nitrate Study Report has been prepared for the County of Butte Administrative Office (the County) and in response to the Redding office of the California Regional Water Quality Control Board (RWQCB) Order No. 90-126 (the Order). The Order was issued based on the results of previous groundwater studies in the Chico Urban Area (CUA) of Butte County (Figure 1), which suggested that the source of nitrate impacts to groundwater were from individual waste systems. The scope of work for the Nitrate Study was presented in the Groundwater Nitrate Study Work Plan (Work Plan) dated September 1993 (Dames & Moore, September 1993).

PURPOSE AND OBJECTIVES

The purpose of the study as described in the Work Plan is to further characterize the extent and severity of elevated nitrate levels reported in groundwater during previous studies in the CUA. The data generated from current and previous studies has allowed an initial correlation between elevated nitrate in groundwater to identifiable sources or source areas. Specifically, the data will support an evaluation of whether individual waste systems are contributing substantially to nitrates reported in groundwater in the CUA.

Several focused objectives were established for this study, based on discussions with the County of Butte and the RWQCB. These objectives are presented below.

1. Identify the western limit of elevated nitrate impacts along the west side of the CUA.
2. Establish the extent of nitrate in groundwater in areas where deficiencies in data exist. Filling these data gaps as necessary to identify the most significant sources of nitrate to groundwater and the extent of their impact.
3. Increase the validity of the database by obtaining a greater proportion of samples from wells with appropriate construction for chemical monitoring.
4. Quantify and evaluate the effect that above-normal precipitation this past winter had on nitrate concentrations in groundwater compared to nitrate data collected during previous drought years.
5. Determine groundwater elevations and flow directions to assist in evaluating sources and the extent of nitrate impacted groundwater around the CUA.

6. Assess and evaluate the extent of nitrate from non-septic sources in agricultural areas.

SCOPE OF WORK

Dames & Moore met with the County, the RWQCB, and the public in order to clarify the objectives and the scope of work for this study. Two tasks, database development and data review, were conducted in order to prepare the Work Plan. The results of the database development and data review tasks were presented in the Work Plan and were used to develop a sampling and analysis program for this study. Implementation of the study included monitoring well installation and monitoring well sampling by the specific tasks presented below.

Well Installation

- Four shallow monitoring wells were installed west of the CUA to assess the western extent of nitrate impacted groundwater.
- Fourteen new shallow monitoring wells were installed where there was insufficient groundwater nitrate data, particularly upgradient, downgradient, and within previously impacted areas.
- One new groundwater monitoring well was installed into the intermediate aquifer in northeastern CUA.

Well Sampling

- Groundwater samples were collected from all of the newly installed monitoring wells and from selected existing wells that are screened solely in the shallow aquifer zone.
- Groundwater samples were collected from existing wells screened in the intermediate aquifer. The existing wells selected for this study have been sampled frequently in the past.
- New data and data collected during previous studies have been used to assess whether above-normal precipitation this past winter had any effect on the nitrate concentrations in the intermediate aquifer.
- Groundwater samples were collected from wells screened at similar depths within the intermediate aquifer, to show the general impact of nitrate in the intermediate aquifer.
- One groundwater sample was collected from a newly installed shallow monitoring well located in an agricultural area outside of the currently identified high-nitrate areas.

- Water level elevations were measured in all accessible wells to determine shallow aquifer groundwater flow directions.

Hydrogeology

There are three aquifers (water-bearing zones) underlying the CUA. They are referred to as the shallow, intermediate, and deep aquifers. The aquifers are loosely correlative to the alluvial fan deposits, the fanglomerate deposits, and the Tuscan formation, respectively. Recharge to the aquifers is from direct precipitation and local recharge from Big Chico Creek and Lindo Channel. Some recharge to the deep aquifer comes from the foothills to the east (DWR, 1984).

The shallow aquifer is unconfined and ranges in thickness from 0 to about 50 feet bgs. It consists mostly of consolidated and unconsolidated alluvial sand and gravel deposits, although there are silt and clay units present. This aquifer has limited storage capabilities, and very little water is pumped from it in the eastern part of the CUA. The thickness of the aquifer increases up to 50 feet in the western part of the CUA (DWR, 1984).

The intermediate aquifer ranges from 0 to 600 feet thick. The top of the unit ranges from 0 to 50 feet bgs in the CUA. It is composed mostly of cemented older alluvial deposits (fanglomerates), unconsolidated sand and gravel beds, and thick clayey layers. Groundwater occurs mainly in the uncemented sand and gravel beds under semiconfined conditions. Recharge to this zone is from streams incised into the overlying alluvial deposits, through vertical leakage from the overlying saturated alluvium, and possibly from inflow from the underlying Tuscan formation. The intermediate aquifer has limited vertical permeability because of the relatively impermeable cemented and clayey layers (DWR, 1984).

CONCLUSIONS

The current groundwater study increased the understanding of shallow aquifer hydrology, and the horizontal and vertical distribution of nitrate throughout the CUA. We believe the study has generated data needed to describe current water quality in the uppermost groundwater body. This data will support further characterization of nitrate sources, allowing more focused studies designed to evaluate and mitigate continued loading to soil and groundwater.

Previous studies have been based on data from wells of variable construction. Current results in this study are based on wells constructed specifically for groundwater quality assessment or using

existing wells of equivalent construction quality standards. These wells supply depth-discrete groundwater quality data. These data are of a higher confidence than previous data. Groundwater quality information from discrete hydrologic aquifers can be used to better evaluate transport mechanisms and correlate impacts to potential source areas.

The areas of relatively high nitrate concentrations in the northwestern portion of the CUA reported from previous studies were confirmed in this study and supply more depth-discrete definition. In the shallow aquifer, there is a distinct area of elevated nitrate from wells between West Sacramento Avenue and the Esplanade that is also seen in the intermediate aquifer. This distribution of nitrate suggests hydraulic communication, and nitrate transport from the shallow into the intermediate aquifer.

Between Lindo Channel and Big Chico Creek another area appears to be impacted by nitrate in the intermediate aquifer; however in this same area, the shallow aquifer appears to be less impacted, as shown in Figure 7. Nitrate impacts in the vicinity of the Esplanade are most likely from a surface source, whereas nitrate impacts in the second area between Lindo Channel and Big Chico Creek may be due to a more complex, or possibly a historic source of nitrate.

There are wells installed and/or sampled in other areas of the CUA that have reported concentrations of nitrate that could be elevated compared to background. In the shallow aquifer wells DMW-5 and FAMW-2 in the northeastern portion of the CUA and DMW-14 and NGS-1 in the southwestern portion of the CUA are elevated above the current background concentration. In the intermediate aquifer well 13G4 in the northeastern portion of the CUA and wells 33J1 and 9G4 in the southwestern portion of the CUA are elevated above the current background concentration. The source of these impacts is currently unknown, but based on current knowledge, the impacts reported in these specific wells do not appear to be due to individual waste systems.

One well (DMW-20) was installed and sampled in order to assess the contribution of an agricultural area to nitrates in groundwater. Results from this well had a reported value of 6.7 mg/L. Though this reported value is slightly lower than from DMW-4, it is difficult to make a conclusion on impacts from agriculture in other portions of the CUA from the results received from this one well.

Precipitation levels for the CUA were compiled in order to evaluate any detectable changes in nitrate levels that could be correlated to the above-average precipitation during the winter months

of 1992/1993. Shallow aquifer data shows no significant variations between nitrate levels from these two events. Nitrate levels in the intermediate aquifer show some variation between the two sampling events, with the most significant being higher nitrate values prior to the high precipitation period, especially in wells that had higher nitrate levels.

RECOMMENDATIONS

Information is needed to assess the contribution of specific source areas of nitrate, and the time and manner they may have been discharged. Subsequent studies will need to further characterize soils and groundwater in certain areas where the source and transport mechanism has not been identified. Current and historic land use and current septic system discharge rates will also need to be considered. An overview of the types of studies that may need to be conducted is presented below followed by some more specific actions currently recommended for implementation.

As discussed with the County and the public, it is appropriate to initiate some additional activities which are recommended to be conducted as soon as possible. These activities will confirm and further utilize existing data, and when completed, will greatly improve the accuracy of identifying current and perhaps historic sources of nitrate within the CUA. Only after sources of nitrate have been identified accurately can corrective action be undertaken.