U.S. Geological Survey Proposal

A: Ground Water Near Deer Trail, Colorado

Option 1: Nitrogen source study

Questions:

What is the source of the steadily increasing nitrate concentrations at well D6 (section 22 of the Metro central property)? Are biosolids applications on the Metro properties near Deer Trail adversely contributing to these increasing nitrate concentrations?

Concerns:

Nitrogen sources to ground water at the study area near Deer Trail include atmospheric nitrogen, crop residue, animal waste, biosolids applied as a fertilizer, and bedrock. One alluvial-aquifer well near a Metro property boundary had steadily increasing concentrations of nitrate during 1993-2004. For land-management purposes, it would be helpful to know if ground water at this location has been affected by biosolids applications and is vulnerable to additional inputs of nitrogen from the land surface.

Objectives:

To determine the source of nitrogen in the ground-water at well D6 and other nearby shallow wells.

To evaluate the ground-water flow path of this nitrogen to well D6.

To evaluate the sustainability of various land uses in the study area based on the vulnerability of the aquifers in section 22 to nitrate contamination.

Approach:

Four USGS monitoring wells in section 22 (Metro central property) including well D6 and the 3 closest upgradient wells will be sampled for dissolved and total nutrients, including nitrate. These four wells also will be sampled for dissolved gases and isotopes of nitrogen and oxygen. All ground-water samples will be collected using appropriate USGS protocols.

Possible nitrogen sources also will be sampled for nitrogen isotopes for comparison with the ground-water results. The sources sampled will include biosolids samples, cow-manure samples, soil samples, and bedrock-core samples. The resulting isotope data will be evaluated for a possible “biosolids signature” in addition to a rock signature and a manure signature.

The data will be corrected for denitrification (known to occur at well D6), which can alter the isotopic composition of nitrate and complicate the use of isotopes for source identification. The data for the four sites, in addition to the organic wastewater compound (OWC) data collected as part of the base program, will be compared to evaluate the ground-water flow path of this nitrogen to well D6. These data and the other ground-water data collected as part of the 1993-2004 USGS monitoring studies will be used to evaluate the sustainability of various land uses in the study area based on the vulnerability of the aquifers in section 22 to nitrate contamination.

Monitoring sites:

Any sites of interest to the stakeholders could be included in this study option; however, some sites are critical for a scientifically sound study that meets the stated objectives. The highest priority sites are the wells in section 22 of the Metro central property, including wells D6, D32, D5, and D10. These sites have had significant nitrate concentrations and include well D6, which had a 1993-2004 upward trend in nitrate. In addition, age-dating results for ground-water from well D10 indicate this ground water may have been recharged since biosolids applications began in late 1993.

Benefits:

This approach will yield information useful for identifying (or at least excluding) possible sources (origins) of nitrogen causing the increasing nitrate concentrations at well D6. This approach also will yield information useful for evaluating possible flow paths (geographic sources) of nitrogen causing the increasing nitrate concentrations at well D6. The information from this approach also can be used to determine the need for and direction of future efforts to further understand nitrate concentrations at well D6.

The combination of this approach with the base program will verify and further develop the concept of biosolids signature that was introduced as a result of the 1999-2003 study.

This approach also will provide information about the sustainability of various agricultural land uses in the study, and the vulnerability of shallow aquifers in this part of the Denver Basin to nitrate contamination.

Limitations:

This approach still may not yield sufficient water-quality information to definitively prove that biosolids applications are causing the changes increasing nitrate concentrations in section 22. It is possible that the nitrogen and oxygen isotopes in biosolids are too similar to those of cow manure to be distinguished. However, this approach in combination with the base program should provide additional information that can be used to confirm or exclude sources.

Including only four USGS monitoring wells in this study option will not enable the USGS to extrapolate the findings from this study option to all parts of the study area. However,

understanding more about the nitrate in section 22 will provide some information that will apply to the broader study area.

Schedule of implementation:

This study option is planned to take place over one year only. The study option could be incorporated into any year of the study (2005 through 2010). However, staff is available during 2005 for this study option, and staff availability after 2005 is not known. Earlier implementation of this study option would provide information earlier to Metro that could be used for land-use planning, including biosolids applications.