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Program Overview

Metro Wastewater Reclamation District (Metro District) applies biosolids to their properties near Deer Trail, Colorado. These biosolids applications could affect the quality of water in alluvial and bedrock aquifers, streambed sediments, soils, and crops. Water quality can be directly affected through:

- Contaminated recharge water, or
- Infiltration of water through contaminated soils or sediments (remobilization).

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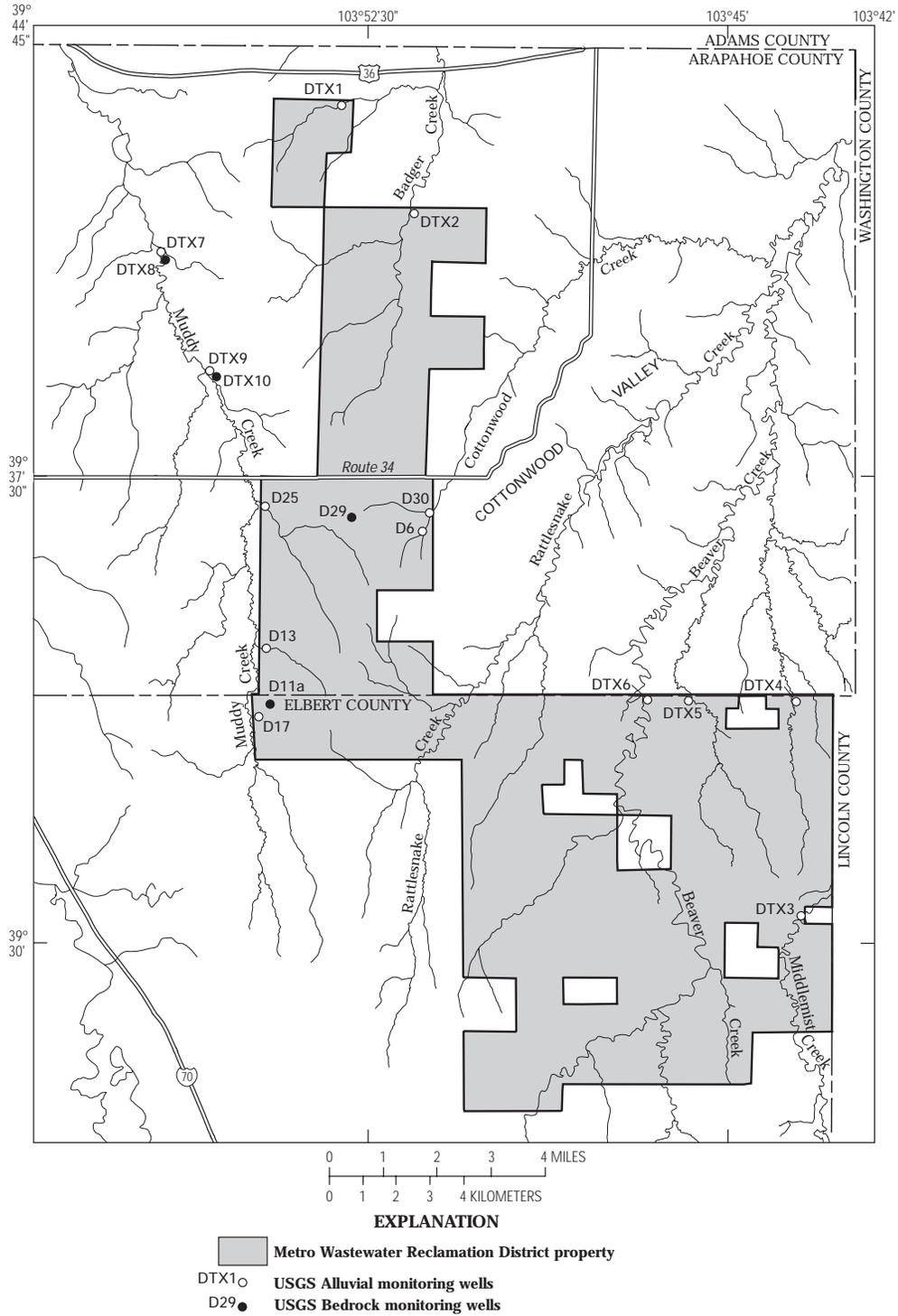
USGS

The U.S. Geological Survey is a science organization that provides the Nation with reliable, impartial information to describe and understand the Earth. The USGS home page: <http://www.usgs.gov>

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USGS ground-water sampling equipment and well



USGS Expanded Monitoring Program sites (ground water, only) and Metro District's biosolids-application properties near Deer Trail, Colorado

Program Overview

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Water quality can be indirectly affected through:

- Plowing that mobilizes or changes subsurface chemical constituents, or
- Contributions to natural processes such as nitrification.

Contaminated ground water or surface water could contaminate:

- Other aquifers, such as bedrock water-supply aquifers or alluvial aquifers,
- Other surface-water bodies (ponds or streams), or
- Streambed sediments.

Biosolids must meet metals and radioactivity regulations, or else agronomic loading rates will be incorrect and soils could be overloaded. Soil quality could either be improved by biosolids applications through increased nutrients and organic matter, or degraded through an overload of nutrients or metals.

The U.S. Geological Survey (USGS) has designed and begun a new monitoring program to address concerns from a stakeholder group about the biosolids and the quality of the environment in the vicinity of the biosolids-application areas. The new USGS monitoring program near Deer Trail is referred to as the "USGS Expanded Monitoring Program" and began in January 1999.

This monitoring program is distinct from, but builds on, another

USGS program that monitored shallow ground-water quality on the Metro District Central Farm from 1993-1998. The new program (1999-2005) considers environmental-quality issues for shallow and deep ground water, surface water (bed sediments), soils, crops, and the biosolids. The new expanded monitoring program includes all three Metro District properties (North, Central, and South Farms) and related private-property locations. Both programs, however, use USGS and Metro District funds. In addition, the new monitoring program also uses funds from the North Kiowa Bijou Ground Water Management District. Both programs are designed, carried out, and interpreted independently by USGS, and quality-assured USGS data and reports will be released to the public and the Metro District at the same time. By definition and design, all USGS monitoring programs are independent and unbiased.

The objectives of the new Expanded Monitoring Program are to:

- (1) Evaluate the combined effects of biosolids applications, land use, and natural processes on alluvial aquifers, the bedrock aquifer, streambed sediments, soils, and crops by comparing chemical data to

- State or Federal regulatory limits,
- Data from a site where biosolids are not applied (a control site), or

- Earlier data from the same site (trends).

(2) Monitor biosolids for metals and radioactivity, and compare the concentrations with regulatory limits.
(3) Determine the aquifer hydrology in this area.

The approach is unique for each component of the Expanded Monitoring Program. However, appropriate USGS methods and technologies will be applied to each component.

Quarterly reports such as this one will be distributed to the stakeholders and other concerned people, as well as available to the general public on the internet (<http://webserver.cr.usgs.gov>).

Each quarterly report will summarize progress from the previous quarter and plans for the current quarter; chemical data will be included every other quarter. A USGS report will be prepared annually and made available after each year of the monitoring program: the reports will include data for that year, any interpretations for that year, and statistical analysis for the data to date. A comprehensive USGS report will be prepared and available after five years of monitoring that includes complete statistical analyses and interpretations. In addition, the USGS will meet with the stakeholders once a year to discuss the Expanded Monitoring Program results and to consider possible changes to the Expanded Monitoring Program.

Questions & Answers

Q: How were the components of the Expanded Monitoring Program determined?

A: The stakeholder group identified their greatest concerns, and USGS then designed multiple monitoring-program options to address each of these concerns. The stakeholders, including the Metro District, then selected monitoring program components from these options based on benefits, limitations, and cost of each option.

Q: Why isn't air monitoring a component of this program?

A: Air monitoring could be a component of this program, but was not identified by the stakeholder group as one of the biggest concerns. USGS has contacted Colorado universities to suggest that air quality at this site might be a good thesis topic for a graduate student.

Alluvial Ground Water

Approach

Six new monitoring wells will be installed near the Metro District property boundaries in the major alluvial aquifers. These six wells plus five existing USGS monitoring wells will be sampled approximately quarterly for full inorganic chemistry and annually for radioactivity. Data will be reviewed and statistically tested for exceedance of regulations and trends.

Progress Last Quarter (January–March 1999)

The new monitoring wells were drilled and completed by USGS in February. Ground-water levels were measured the first week of March. The first ground-water samples from the new wells and the five existing wells were collected in March.

Plans for the Current Quarter (April–June 1999)

Ground-water levels will be measured the first week of each month. Ground water will be sampled in mid-April, weather permitting. The USGS is planning to have a "Sampling Open House" in April (held April 16, 1999); another "Open House" is planned for July. All interested people are welcome to come to the Open House and observe the ground-water equipment and sampling procedures and ask questions. Three instrumentation sites (including rain gages and continuous recorders) will be planned this quarter and possibly installed.

Bedrock Ground Water

Approach

A structure map of the base of the bedrock aquifer will be compiled and used to determine locations for two sets of new, paired wells (one alluvial well and one nearby dual-completion bedrock well comprise each pair). The well pairs will be installed where both the Muddy Creek alluvial aquifer and the Laramie-Fox Hills aquifer are present (along the margin of the bedrock aquifer) near the Metro District properties. Water-level data from each well pair will be used to determine aquifer hydrology and interaction at those two locations. The two new bedrock wells, along with an existing USGS bedrock well, will be sampled approxi-

mately quarterly for full inorganic chemistry and annually for radioactivity. Data will be reviewed and statistically tested for exceedance of regulations and trends.

Progress Last Quarter (January–March 1999)

The structure map of the bedrock aquifer, the Laramie-Fox Hills, was begun in January 1999; a draft was completed in February. On the basis of the draft structure map, well locations were selected along Muddy Creek. The Price family and the Weisensee family each agreed to have monitoring-well pairs installed on their property.

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***Drilling the USGS ground-water monitoring wells in
February and March 1999***

Bedrock Ground Water

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Drilling was begun in February and completed in early March. Cores from part of these two bedrock boreholes were collected by USGS, and selected parts of these cores are being analyzed for chemistry. Ground-water levels were measured the first week of March. Water-quality sampling was done in mid-March.

Plans for the Current Quarter



USGS drilling team completing a new monitoring well

(April–June 1999)

Ground-water levels will be measured the first week of each month. Ground-water sampling will take place in mid-April, weather permitting. The USGS is planning to have a "Sampling Open House" in April (held April 16, 1999); another "Open House" is planned for July. All interested people are welcome to come to the Open House and observe the ground-water equipment and sampling procedures and ask questions.



USGS staff collecting first-quarter samples from the new monitoring well, DTX6, March 1999



Stakeholders and USGS staff looking at sandstone outcrops on the Price property, June 1998

Surface-Water Sediments

Approach

Surface-water contamination is a concern for the stakeholders, but

streams flow off the Metro District properties only during runoff when surface-water sampling is impractical. Therefore, possible surface-water contamination from metals will be evaluated by sampling stream-

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Surface-Water Sediments

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bed sediments soon after storms. Two small drainage basins will be selected for similar characteristics but different land use—one drainage in a biosolids-application field and another drainage in a farmed field (not on the Metro District properties) that does not receive biosolids. A downstream location in each of the two drainage basins will be sampled after the same storms, three to four times per year for inorganic constituents (including metals, total nitrogen, and total phosphorous) and organic carbon, and one time per year for radioactive constituents. Data will be reviewed and statistically tested to determine if concentrations are significantly different between the two drainage basins.

Progress Last Quarter (January–March 1999)

None.

Plans for Current Quarter (April–June 1999)

Site locations will be evaluated and selected. Sampling may take place, depending on the weather.

Biosolids

Approach

Biosolids samples will be taken as a 24-hour composite from the Metro District plant and analyzed by USGS. Biosolids will be sampled and analyzed once each quarter during most of the program, and once each month for six months when the Lowry landfill water transfer begins. Data will be

reviewed and compared to Federal regulatory limits.

Progress Last Quarter (January–March 1999)

The first quarterly composite sample of biosolids was received from the Metro District on March 26, 1999. The sample was a 24-hour composite from the main conveyor belt and filled two one-gallon plastic bottles. These bottles had been acid rinsed and dried prior to use. The sample was picked up at the Metro facility and brought to the Lakewood laboratories of the USGS. The sample was removed from the bottles and placed into a plastic-lined cardboard box and set outside in the sun to dry.

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Stakeholders and USGS staff looking at a possible Badger Creek ground- and surface-water monitoring location, June 1998. Well DTX2 was drilled at this site.

Biosolids

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The biosolids sample looked similar to black pudding and had a strong aroma that decreased as it dried. At the end of the day, the sample was mixed with a stainless steel spatula and set in a chemical hood to finish drying. This took an additional three days. After the sample was dry, it was mixed again. Visual inspection of the sample showed the sample to be relatively inhomogeneous with no single particle larger than about 1/4 inch. Aluminum foil fragments, seed casings, seeds, hair, and sand-like particles were observed in the dried material. Upon drying, the volume of the sample was reduced by at least 3-fold. The resulting biosolids



Beaver Creek, on Metro District's South Farm, is an intermittent stream. Obtaining a representative surface-water sample from intermittent streams is difficult because they have so little flow. Therefore, the Expanded Monitoring Program includes streambed-sediment samples as an indicator of surface-water quality.

were hard, irregular-shaped clinker-like particles. The entire sample was ground in a hammer mill to reduce all particles to less than 2 millimeters and then ground to a fine powder (less than 100 mesh) for further analyses. This grinding homogenizes the sample to ensure representative analysis.

Plans for Current Quarter (April–June 1999)

Analysis of the previous biosolids sample will be completed. Another biosolids sample will be received and prepared for analysis. Analysis of this sample will be started.

Soils

Approach

One "application field" will be located on the Metro District property in Arapahoe County and one "application field" will be located on the Metro District property in Elbert County. Each application field will consist of three plots of at least 20 acres and will be approximately the same size and shape. The up-gradient plot will not have biosolids applied. The middle plot will have biosolids applied in the normal fashion. The down-gradient plot will not have biosolids applied. All three plots at each application field will be farmed in the normal fashion and have crops planted and harvested. Soils from each plot of the application fields will be sampled before biosolids application and after each harvest. Samples will be analyzed for arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, zinc, plutonium, and gross alpha and beta activity. Data will be statistically analyzed after 5 years to determine how the elements of interest vary with time.

Progress Last Quarter (January–March 1999)

Dave Smith and Jim Crock of the USGS met with Metro District staff to discuss the soil sampling program. Possible locations for the two application fields were discussed.

Plans for Current Quarter (April–June 1999)

Site locations will be finalized by the end of May 1999, and soil sampling will be completed soon afterward. The first sampling will be completed prior to the application of any biosolids.

Crops

Approach

Crops from the two USGS soil application fields will be chemically analyzed after harvest. Analyses will include arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, and zinc.

Progress Last Quarter (January–March 1999)

None.

Plans for Current Quarter (April–June 1999)

Application fields will be identified. No crops will be harvested during the current quarter.

If you have questions about the Expanded Monitoring Program, please contact Tracy Yager (see page 8). Commonly asked questions will be included in each Quarterly Report.

Definitions

Alluvial aquifer—Unconsolidated (uncemented) sediments and gravels in current or historic stream channels or floodplains that contain significant amounts of ground water

Bedrock—The rock that underlies soil or other uncemented materials

Biosolids—Treated solid waste from a wastewater-treatment facility

Core—The soils and rock removed intact in a tube from the borehole when drilling a well

Dual-completion—Two separate well casings in a single borehole that receive ground water from two separate parts of an aquifer

Inorganic—Chemical elements and compounds that do not contain carbon atoms

Stakeholder—Any person or group (including the Metro District) interested or concerned about the Expanded Monitoring Program

Well casing—The rigid pipe placed in the borehole after drilling that enables the desired aquifer water to enter the well through the well screen but keeps out other aquifer water and borehole and geologic materials

Well screen—The section of well casing that enables ground water to flow into the well through thin slots

Contacts

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State Biosolids Coordinator: Lori Tucker, 303-692-3613

U.S. Environmental Protection Agency: Bob Brobst, 303-312-6129

First annual stakeholder meeting is scheduled for July 1999. Watch for a mailing that has more details about this informational meeting, or call Tracy Yager for more information.

*Prepared by Tracy Yager and Jim Crock
April 1999*