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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 national USGS home page: <http://www.usgs.gov>

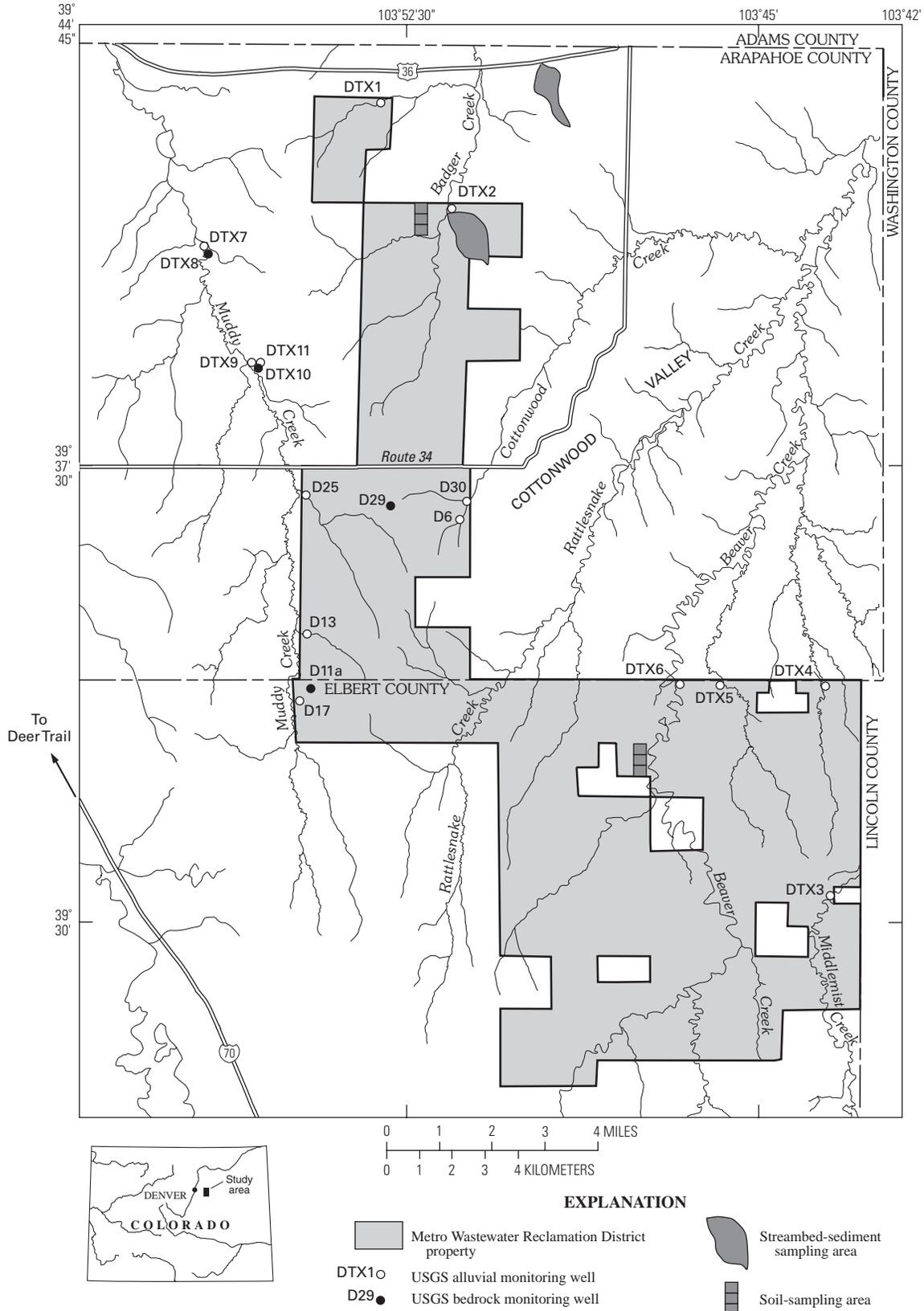
This USGS program:

The Internet address for this program, including links for data and reports, is:
<http://co.water.usgs.gov/projects/CO406/CO406.html>

The Internet address for just the data is:
<http://co.water.usgs.gov/projects/CO406/data.html>
or <http://water.usgs.gov/co/nwis>



The USGS closed two monitoring wells in August 2003 from the first USGS monitoring program (1993-99) on the Metro District central property. The depth placement and amount of well-closure materials were measured (as shown above) and recorded. These wells were closed because they had insufficient ground water for sampling.



USGS Expanded Monitoring Program sites and Metro District's biosolids-application properties (1999 property boundaries) near Deer Trail, Colorado

Program Overview

Continued from page 1

Water quality can be indirectly affected through:

- Tilling 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 excessive 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), biosolids, soils, and crops. 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 Groundwater 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.

Progress reports such as this one were prepared quarterly for the first 2.5 years of the program and now are prepared twice each year and distributed to the stakeholders and other concerned people, as well as available to the general public on the Internet (<http://co.water.usgs.gov>). Each progress report will summarize progress from the previous quarters and plans for the current quarters; chemical data will be included twice each year. 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: What USGS reports are available to the public for the study area near Deer Trail (page 2)?

A: The annual data report for 1999 is published and available. Also published and available is an interpretive hydrogeology report that includes the structure maps done as part of the bedrock ground-water monitoring component. Contact Tracy Yager at the USGS (see page 12) to obtain copies.

Q: Will other USGS reports be available to the public for the study area near Deer Trail?

A: Yes. Five additional USGS reports for this area are in various stages of preparation at this time (February 2004). The annual data report for 2000 is almost ready for printing; all stakeholders currently on the mailing list will receive a copy of the annual data report for 2000 by mail from the printer. The annual data report for 2001 is in preparation for final USGS approval. A data report for 2002-2003 is in preparation for first review. An interpretive water-quality report for 1993-99 has been written and is in preparation for second review. A final interpretive report for all monitoring components described in this progress report for 1999 through 2003 is in preparation for first review.

Alluvial Ground Water

Approach

Six monitoring wells were installed near the Metro District property boundaries in the major alluvial aquifers. These six wells plus five USGS monitoring wells from the previous project were sampled approximately quarterly for full inorganic chemistry and annually for radioactivity 1999-2003. Data will be reviewed and statistically tested for exceedance of regulatory limits and for trends.

Progress Last Period (July-December 2003)

Ground-water levels were measured July 2, August 1, September 8, October 8, and December 3, 2003. Ground water was sampled for chemistry in July and October 2003. Ground-water data were compiled and reviewed. The hydrogeology report for ground water 1993-99 (which includes data and interpretations for some sites included in the expanded monitoring program) was approved and prepared for printing. The annual report for 2000 was approved and prepared for the printer. All data were reviewed and compiled. Data for 2002 were presented to stakeholders in September.

Plans for the Current Period (January-June 2004)

Ground-water levels will be measured at least every other month. Ground water at selected sites will be sampled the first month of each quarter, weather permitting. Data will be compiled and reviewed. The annual reports for 2000 and possibly 2001 will be printed and distributed. A data report for 2002 through 2003 will be prepared and reviewed. Changes suggested by

review comments will be incorporated into the various draft reports. The interpretive reports will be prepared and reviewed.

Bedrock Ground Water

Approach

A structure map of the base of the bedrock aquifer was 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 were 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 hy-

drology and interaction at those two locations. The two new bedrock wells (DTX8, DTX10), along with one USGS bedrock well from the previous project (D29), were sampled approximately quarterly for full inorganic chemistry and annually for radioactivity 1999-2003. Data will be reviewed and statistically tested for exceedance of regulatory limits and for trends.

Progress Last Period (July-December 2003)

Ground-water levels were measured July 2, August 1, September 8, October 8, and December 3, 2003. Ground water was sampled for chemistry in July and October 2003. Ground-water data were compiled and reviewed. The hydrogeology report for 1993-99 (which includes the structure

Continued on page 5



This photograph shows a reclaimed area after the USGS monitoring well at this location was closed in accordance with State regulations. The monitoring well that was here was installed in 1993 but never produced any water. The well was located between wells D29 and D30 (see page 2).

Bedrock Ground Water

Continued from page 4

maps and data and interpretations for some sites included in the expanded monitoring program) was approved and prepared for printing. The annual report for 2000 was approved and prepared for the printer. All data were reviewed and compiled. Data for 2002 were presented to stakeholders in September.

Plans for the Current Period (January-June 2004)

Ground-water levels will be measured at least every other month. Ground water at selected sites will be sampled the first month of each quarter, weather permitting. Data will be compiled and reviewed. The annual reports for 2000 and possibly 2001 will be printed and distributed. A data report for 2002 through 2003 will be prepared and reviewed. Changes suggested by review comments will be incorporated into the various draft reports. The interpretive reports will be prepared and reviewed.



Runoff was sufficient for streambed-sediment sampling only twice in 2003; samples were collected by the USGS June 1st and August 8th.



The USGS sampled surface-water sediments only from fresh deposits after runoff, and only in the areas shown on page 2. The study area received more rain in 2003 than in 2002. However, fewer runoff deposits were observed in 2003 than in 2002.



Streambed-sediment samples are sieved and bottled in the USGS laboratory facility in the Denver area before delivery to the various contract laboratories for analyses.

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 sur-

face-water sampling is impractical. Therefore, possible surface-water contamination from metals were evaluated by sampling streambed sediments soon after storms. Two small drainage basins were selected for similar charac-

Continued on page 6

Surface-Water Sediments

Continued from page 5

teristics 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 part of each of the two drainage basins was sampled after the same storms, as many as 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 Period (July–December 2003)

The site was carefully monitored for runoff-producing rainfall. Runoff was sufficient to enable streambed-sediment sampling only once in the designated basins during July–December 2003: August 8, 2003. The annual report for 2000 was approved and prepared for the printer. All data were reviewed and compiled. Data for 2002 were presented to stakeholders in September.

Plans for the Current Period (January–June 2004)

The site will be monitored for runoff-producing rainfall. Sampling may take place, depending on the weather. Data will be compiled and reviewed. The annual reports for 2000 and possibly 2001 will be printed and distribut-

ed. A data report for 2002 through 2003 will be prepared and reviewed. Changes suggested by review comments will be incorporated into the various draft reports. The interpretive report for 1999–2003 will be prepared and reviewed.

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 6 months when the Lowry Landfill Superfund Site water transfer begins. Data will be reviewed and compared to Federal regulatory limits.

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For the first time since well DTX5 was installed in 1999, the adjacent stream channel (a Beaver Creek tributary) contained ponded water during much of June. Corresponding increased ground-water levels at well DTX5 in June and July 2003 indicate ground-water recharge associated with this ponded surface water.

Biosolids

Continued from page 6

Progress Last Period (July–December 2003)

Biosolids samples were collected on August 22, September 13, October 13, November 18, and December 20. Each sample was a 24-hour composite from the conveyor belt at the Metro District facility. The material was placed in two acid-washed, one-gallon plastic or glass bottles and transported to the USGS in Denver. There, the samples were air-dried then ground to less than 150 micrometers. Chemical analyses were completed and compiled for all biosolids samples collected from November 2001 through March 2003. The annual report for 2000 was approved and prepared for the printer. Available data for 2002 were presented to stakeholders in September.



Runoff in the vicinity of well D6 between August 1 and September 8, 2003, deposited tumbleweeds and other vegetation debris in the stream channel and against the well cover and dislodged the wood frame around this concrete pad.

Plans for the Current Period (January–June 2004)

Quarterly biosolids samples will be collected. The remainder of the biosolids samples collected during 2003 will be submitted to the laboratories. Data will be compiled and reviewed. The annual reports for 2000 and possibly 2001 will be printed and distributed. A data report for 2002 through 2003 will be prepared and reviewed. The interpretive report for 1999–2003 will be prepared and reviewed.

Soils

Approach

One site was selected for characterizing and monitoring the chemical composition of soil on the Metro District property in Arapahoe County, and one site was selected on the Metro District property in Elbert County. Each site consists of three 20-acre (933 feet by 933 feet) fields separated by 100-foot buffer zones. The center 20-acre field at each site will have biosolids applied after the initial soil sampling. The other two 20-acre fields at each site will not have biosolids applied and will be used as “control” fields to monitor the natural variability of soil composition for the duration of the study. All three 20-acre fields at each site will be farmed in the normal fashion and have crops planted and harvested. Soils from each of the six fields will be sampled before biosolids are applied to the two center fields and then again after each harvest 1999–2003. Samples will be analyzed for arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, zinc, plutonium, and gross alpha and beta activity. Data will be examined after 5 years to determine if concentration has changed with time.

Progress Last Period (July–December 2003)

Chemical analyses were completed for soil samples collected on September 19, 2002, from the Elbert County site and on October 17, 2002, from the

Arapahoe County site. Available data at the time were presented to stakeholders in September.

Plans for the Current Period (January–June 2004)

A data report for 2002 through 2003 will be prepared and reviewed. The interpretive report for 1999–2003 will be prepared and reviewed.

Crops

Approach

Crops from each of the six 20-acre soil-monitoring fields will be chemically analyzed after harvest. Analyses will include arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, and zinc.

Progress Last Period (July–December 2003)

Chemical analyses were completed for samples of wheat grain collected from both the Arapahoe County and Elbert County sites in July 2002.

Plans for the Current Period (January–June 2004)

A data report for 2002 through 2003 will be prepared and reviewed. The interpretive report for 1999–2003 will be prepared and reviewed.

If you have changes to the mailing list, please contact the Elbert County Environmental Health Officer (see page 12) or Tracy Yager (see page 12). Elbert County maintains the mailing list for these reports and for all meeting notices.

If you have questions about the Expanded Monitoring Program, please contact Tracy Yager (see page 12). Commonly asked questions will be included in each Progress Report.

USGS ground-water data, July–December 2003

[Data are preliminary and subject to revision. Standards from Colorado Department of Public Health and Environment, 1997, Basic standards for ground water, 5CCR 1002-41: July 14, 1997, 56 p. All data from filtered samples; mg/L, milligrams per liter; µg/L, micrograms per liter; <, less than; E, value estimated by laboratory; *, value is in review at the laboratory]

Well (page 2)	Sample date	Time	Nitrate plus nitrite as nitrogen, mg/L	Arsenic, µg/L	Cadmium, µg/L	Chromium, µg/L	Copper, µg/L	Lead, µg/L	Mercury, µg/L	Molybdenum, µg/L	Nickel, µg/L	Selenium, µg/L	Zinc, µg/L
D13	07/07/2003	1350	<0.05	E1	<0.04	<0.8	2.4	<0.08	<0.02	1.1	6.53	<3	3
D17	07/07/2003	1225	1.01	E2	<.04	<.8	.8	<.08	<.02	5.8	2.18	8	0.7
D25	07/10/2003	1415	2.75	2	.29	E.4	10.2	<.16	<.02	11.8	18.6	<3	7
D25	10/02/2003	1325	.58	2.3	.21	<.8	23.6	<.16	<.02	8.7	12.5	2.2	10
D29	07/07/2003	1010	<.05	<2	E.05	<.8	8.6	E.11	<.02	1.1	24.1	<3	12
D29	10/02/2003	1100	E.03	E.4	<.08	1.0	22.8	<.16	<.02	1.5	14.6	1.3	12
D30	07/10/2003	1250	<.05	<2	.08	<.8	11.7	<.16	<.02	2.2	12.2	<3	9
D6	07/10/2003	1035	20.3	<5.7	E.22	<1.6	36.9	<.56	<.02	3.4	20.5	10.5	30
D6	10/03/2003	1505	21.6	5.4	<.28	<1.6	29.5	E.32	<.02	3.8	16.6	*42.9	28
DTX1	07/10/2003	1550	1.76	E1	.19	<.8	8.4	<.16	<.02	6.8	20.4	<3	6
DTX10A	07/09/2003	1115	<.05	<2	<.07	1.1	4.4	<.16	<.02	1.4	10.3	<3	4
DTX10A	10/03/2003	1100	<.04	E.3	<.08	E.4	4.6	<.16	<.02	1.4	6.65	.9	3
DTX11	07/09/2003	1315	<.05	E1	.08	<.8	5.1	<.16	<.02	2.8	14.7	<3	11
DTX2	07/15/2003	1055	<.05	E1	E.04	<.8	6.2	<.16	<.02	1.9	20.3	E1	5
DTX2	10/06/2003	1430	<.04	1.1	E.04	<.8	6.2	<.16	E.01	1.8	10.4	1.9	5
DTX3	07/08/2003	0945	3.98	<2	<.04	<.8	2.6	<.08	<.02	.6	6.08	11	2
DTX3	10/03/2003	1330	4.08	1.3	<.04	<.8	3.0	<.08	<.02	.7	3.04	17.2	1
DTX4	07/08/2003	1140	.15	<2	E.03	<.8	3.8	<.08	<.02	.7	9.23	5	3
DTX5	07/09/2003	1555	.75	<2	.08	<.8	2.7	E.05	<.02	1.0	6.94	<3	2
DTX6	07/08/2003	1425	.49	<2	<.07	<.8	7.1	<.16	<.02	E.6	11.0	E2	6
DTX6	10/06/2003	1030	.52	.6	<.08	<.8	6.9	E.09	<.02	.9	5.79	4.8	5
DTX8A	07/11/2003	1055	<.05	<2	<.04	<.8	2.0	<.08	<.02	.5	4.21	<3	2
DTX8A	10/06/2003	1245	<.04	.3	<.04	<.8	1.9	<.08	<.02	.6	1.60	.5	1
DTX9	07/15/2003	1330	<.05	<2	.09	<.8	5.5	<.16	<.02	2.3	17.6	<3	12
Human Health Standard			10	10	5	100	1,000	50	2	None	100	50	5,000
Agricultural Standard			100	100	10	100	200	100	10	None	200	20	2,000

USGS streambed-sediment data for radioactivity, 2003

[Data are preliminary and subject to revision. Sampling sites are shown on page 2. pCi/g, picocuries per gram; ssMDC, minimum detectable concentration calculated for that sample; Pu, plutonium; +/-, plus or minus the analytical uncertainty]

Site	Sample date	Gross Alpha, pCi/g	Gross Alpha, ssMDC, pCi/g	Gross Beta, pCi/g	Gross Beta, ssMDC, pCi/g	Pu238, pCi/g	Pu238, ssMDC, pCi/g	Pu239+240, pCi/g	Pu239+240, ssMDC, pCi/g
No biosolids	06/01/2003	20.5 +/- 2.8	3.2	30.2 +/- 3.4	3.4	0.0036 +/- 0.0036	0.026	0.0071 +/- 0.0036	0.026
Biosolids applied	06/01/2003	16.0 +/- 2.3	2.7	24.8 +/- 2.9	4.2	.0075 +/- .0038	.028	.0075 +/- .0038	.028

USGS streambed-sediment data for samples collected July-December 2003

[Data are preliminary and subject to revision. Sampling sites are shown on page 2. mg/kg, milligrams per kilogram; g/kg, grams per kilogram; µg/g, micrograms per gram; E, value estimated by laboratory because less than reporting limit; <, less than]

Site	Sample date	Total nitrogen, mg/kg	Phosphorous, mg/kg	Carbon, inorganic, g/kg	Carbon, total, g/kg	Carbon, organic, g/kg	Aluminum, µg/g	Arsenic, µg/g	Cadmium, µg/g
Biosolids applied	08/08/2003	1,500	200	16	8.3	7.8	28,000	8	E0.2
No biosolids	08/08/2003	530	520	12	6.6	5.4	22,000	7	E.1

Site	Sample date	Chromium, µg/g	Copper, µg/g	Lead, µg/g	Mercury, µg/g	Molybdenum, µg/g	Nickel, µg/g	Selenium, µg/g	Zinc, µg/g
Biosolids applied	08/08/2003	29	15	18	E0.03	E0.5	17	E0.87	77
No biosolids	08/08/2003	25	13	15	E.01	E.3	16	E.60	65

USGS biosolids data for samples collected November 2001 through March 2003

[Data are preliminary and subject to revision. Standards from Colorado Department of Public Health and Environment, 1993, Biosolids regulation, 5CCR 1002-64: April 14, 2003. ppm, parts per million; %, percent; <, less than; pCi/g, picocuries per gram; Pu, plutonium; N.D., not determined; +/-, plus or minus the analytical uncertainty]

Sample date	Arsenic, ppm	Cadmium, ppm	Copper, ppm	Lead, ppm	Mercury, ppm	Molybdenum, ppm	Nickel, ppm	Selenium, ppm	Zinc, ppm	Total Sulfur, %	Gross Alpha, pCi/g	Gross Beta, pCi/g	Pu238, pCi/g	Pu239+240, pCi/g
November 2001	1.7	2.5	620	60.0	1.8	32.0	24.0	11.0	650	1.51	N.D.	N.D.	N.D.	N.D.
December 2001	1.5	2.6	570	60.0	1.5	29.0	22.0	9.6	600	1.42	N.D.	N.D.	N.D.	N.D.
January 2002	1.6	2.9	600	58.0	1.6	29.0	23.0	9.4	630	1.49	37+/-9	27+/-5	0+/-0.02	0+/-0.02
February 2002	1.1	3.0	590	71.0	1.1	31.0	23.0	8.3	610	1.45	N.D.	N.D.	N.D.	N.D.
March 2002	1.1	2.9	560	67.0	1.3	30.0	22.0	8.3	580	1.51	N.D.	N.D.	N.D.	N.D.
April 2002	1.2	3.0	570	63.0	1.5	35.0	21.0	8.3	580	1.47	40+/-11	22+/-4	0+/- .02	0+/- .02
May 2002	2.2	2.7	689	58.3	1.5	37.7	24.7	9.9	717	1.54	N.D.	N.D.	N.D.	N.D.
June 2002	2.2	2.6	735	61.2	1.7	39.4	30.4	11.0	754	1.59	N.D.	N.D.	N.D.	N.D.
July 2002	2.2	2.2	722	62.7	2.2	47.6	26.2	10.0	778	1.62	18+/-2	23+/-3	0+/- .00	0+/- .00
August 2002	2.1	2.3	731	77.6	1.6	60.6	25.2	10.0	796	1.58	N.D.	N.D.	N.D.	N.D.
September 2002	2.2	2.2	709	64.1	1.7	50.3	23.0	9.7	747	1.46	N.D.	N.D.	N.D.	N.D.
October 2002	2.0	2.2	736	58.4	1.2	43.0	24.7	9.8	749	1.45	16+/-2	19+/-2	0+/- .00	0+/- .00
November 2002	1.7	2.2	710	56.0	1.5	34.2	23.4	9.1	702	1.39	N.D.	N.D.	N.D.	N.D.
December 2002	1.6	2.4	705	53.5	1.5	40.0	25.5	9.5	705	1.40	N.D.	N.D.	N.D.	N.D.
January 2003	1.6	2.3	701	55.0	1.2	41.3	23.9	9.2	675	1.45	19+/-2	19+/-2	0+/- .00	0+/- .00
February 2003	1.4	2.2	648	46.2	1.2	43.7	25.2	7.7	657	1.36	N.D.	N.D.	N.D.	N.D.
March 2003	1.3	2.4	619	47.0	1.2	40.9	23.1	7.4	627	1.30	N.D.	N.D.	N.D.	N.D.
Maximum Allowable for Grade I	41	39	1500	200	17.0	75 (Grade II)	420	100	2800	No standard set	¹ 40	No standard set	No standard set	No standard set

¹ The Colorado regulatory limit on gross alpha activity of 40 pCi/g was removed from the regulation effective June 30, 2003.

USGS soil data for samples collected October 17, 2002, at the Arapahoe County site and September 19, 2002, at the Elbert County site

[Data are preliminary and subject to revision. Sampling sites are shown on page 2. mg/kg, milligrams per kilogram; <, less than; pCi/g, picocuries per gram; Pu, plutonium; +/-, plus or minus the analytical uncertainty]

Field Sampled	Arsenic, mg/kg	Cad-mium, mg/kg	Copper, mg/kg	Lead, mg/kg	Mercury, mg/kg	Molyb-denum, mg/kg	Nickel, mg/kg	Sele-nium, mg/kg	Zinc, mg/kg	Gross Alpha, pCi/g	Gross Beta, pCi/g	Pu238, pCi/g	Pu239+ 240, pCi/g
Arapahoe County North Field (Control)	7.4	0.205	12.1	18.3	0.11	0.70	14.1	0.43	54.8	5.5 +/- 1.0	20.8 +/- 2.3	0 +/- 0.0042	0.0040 +/- 0.0040
Arapahoe County Middle Field (Biosolids applied)	7.0	.236	15.5	18.8	.02	.79	15.8	.33	59.2	18.9 +/- 2.4	28.4 +/- 3.0	0 +/- .0042	.0041 +/- .0080
Arapahoe County South Field (Control)	6.5	.208	12.2	18.0	.02	.71	14.2	.37	54.0	11.6 +/- 1.6	23.3 +/- 2.5	-.0037 +/- .0037	0 +/- .0027
Elbert County North Field (Control)	12.8	.192	20.0	25.5	.03	1.30	24.3	.9	90.8	14.7 +/- 1.9	25.7 +/- 2.7	0 +/- .0018	-.0018 +/- .0027
Elbert County Middle Field (Biosolids applied)	15.7	.214	22.6	27.7	.04	1.65	23.1	1.0	92.1	15.6 +/- 2.0	27.4 +/- 2.9	0 +/- .0010	.0018 +/- .0028
Elbert County South Field (Control)	12.5	.213	17.2	24.3	.03	1.40	19.8	.8	78.1	18.6 +/- 2.3	24.3 +/- 2.6	0 +/- .0036	.0106 +/- .0070

USGS wheat-grain data for samples collected in 2002

[Data are preliminary and subject to revision. Samples were collected from soil sites shown on page 2. mg/kg, milligrams per kilogram; <, less than; N.D., not determined; pCi/g, picocuries per gram; Pu, plutonium; +/-, plus or minus the analytical uncertainty]

Field Sampled	Arsenic, mg/kg	Cad-mium, mg/kg	Copper, mg/kg	Lead, mg/kg	Mercury, mg/kg	Molyb-denum, mg/kg	Nickel, mg/kg	Sele-nium, mg/kg	Zinc, mg/kg	Gross Alpha, pCi/g	Gross Beta, pCi/g	Pu238, pCi/g	Pu239 + 240, pCi/g
Arapahoe County North Field (Control)	<0.05	0.03	5.1	0.01	<0.02	0.8	1.6	0.26	24.3	N.D.	N.D.	N.D.	N.D.
Arapahoe County Middle Field (Biosolids applied)	.05	.02	7.5	.01	<.02	1.0	3.4	1.1	22.9	0.6 +/- 0.5	3.5 +/- 0.8	0.0036 +/- 0.0070	-0.0035 +/- 0.0035
Arapahoe County South Field (Control)	<.05	.03	6.7	.02	<.02	.9	3.0	.83	21.4	N.D.	N.D.	N.D.	N.D.
Elbert County North Field (Control)	<.05	.01	6.1	.01	<.02	1.2	1.7	2.6	28.5	N.D.	N.D.	N.D.	N.D.
Elbert County Middle Field (Biosolids applied)	.07	.01	6.1	.07	<.02	1.7	8.7	.37	34.7	1.1 +/- .5	5.0 +/- .9	0 +/- .0040	0 +/- .0039
Elbert County South Field (Control)	<.05	.01	4.9	.03	<.02	1.0	3.6	.36	23.5	N.D.	N.D.	N.D.	N.D.

Definitions

Analytical uncertainty—The possible range of the true value or error term contributed by bias and variability of the laboratory measurement technique. All laboratory data have associated uncertainty. Each sample value should be thought of as a range in concentration defined by the reported value plus or minus the analytical uncertainty. The true concentration usually is somewhere in this range, but not a precisely known point. For most analyses, the analytical uncertainty is not calculated for each sample but is estimated from bias and variability data derived from analyses of quality-assurance samples like blanks and replicates. For radioactivity data, the analytical uncertainty is calculated individually for each sample for each analyte based on analytical and statistical variables.

Biosolids—Solid organic matter recovered from a sewage-treatment process that meets regulatory criteria for beneficial use, such as for fertilizer. Metro District applies Grade I, Class B biosolids at Deer Trail. Regulations require that land-applied biosolids must meet or exceed Grade II, Class B. Grade I exceeds Grade II.

Composited sample—A sample made by combining individual subsamples into a single sample. Each streambed-sediment sample from this program usually is a field-composited sample because the sample contains sediments from more than one depositional area of the streambed.

Less than (<)—A designation for analytical results to indicate that a constituent was not present or was present at very low levels that the laboratory could not reliably determine. Note that the actual amount of this constituent in that sample is unknown and could be any amount between zero and the “less than” value.

Runoff—The rain that hits the ground and flows over the land surface into valleys instead of infiltrating into the soil. Runoff can wash particles of soil, rock, plants, and biosolids from the land surface into the streambeds of the valleys.

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

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***Fifth annual stakeholder meeting:
was held 9/30/03 at the Metro Wastewater Reclamation District property near Deer Trail, Colorado***

Prepared by Tracy Yager, Dave Smith, and Jim Crock (USGS) in cooperation with Metro Wastewater Reclamation District, February 2004

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