COOPERATIVE SAMPLING AND ANALYSIS PLAN FOR THE MAINSTEM OF BIG DRY CREEK

MONITORING CONDUCTED BY THE CITIES OF BROOMFIELD, WESTMINSTER, NORTHGLENN AND THORNTON

Prepared September 15, 2003

Table of contents

1. Project Background and Objectives 3
2. Task Description 4
3. Data Quality Objectives 5
4. Laboratory Qualifications and Analysis Methods 5
5. Measurement/Data Acquisition 9
6. Quality Assurance and Quality Control Requirements 12
7. Data Management/Handling 15
8. Reconciliation with Data Quality Objectives 15

Table of figures

Table 1. Big Dry Creek Sample Site Locations 4
Table 2. Big Dry Creek Monitoring Constituents and Methods 7
Table 3. Sample handling and storage requirements 13
Table 4. The Field Quality Control Program for 2004 is as follows: 15

List of Attachments

Attachment 1. Big Dry Creek Monitoring Program Field Sheet
Attachment 2. Allowable STORET values for Field Observations
Attachment 3. Stream Classifications and Water Quality Standards

1. Project Background and Objectives

A cooperative water quality monitoring program has been in place on the main stem (segment 1) of Big Dry Creek since 1991. The participants in the original monitoring program included the Cities of Westminster, Northglenn, and Broomfield (the Cities). The Cities all operate Wastewater Treatment Plants (WWTPs) that discharge to a 5-mile reach of Big Dry Creek. All of the municipalities have significant land area within the BDC drainage basin, and discharge stormwater to the stream.

The Rocky Flats Environmental Technology Site (RFETS) is located in the headwaters of Big Dry Creek, and also operates a WWTP that discharges to Walnut Creek, which is tributary to Big Dry Creek. Since 1997, the Department of Energy and its contractors at Rocky Flats have taken an active role in the monitoring program, and have provided technical assistance, sampling staff, and funding contributions.

Because of their shared interest in the Big Dry Creek Watershed, the Cities and Rocky Flats held discussions with the Colorado Department of Public Health and Environment, the Environmental Protection Agency, the Colorado Division of Wildlife, and other stakeholders, and formed the Big Dry Watershed Association (BDCWA) in 1997. Participants include additional federal, state and local agencies, as well as representatives of the agricultural community and interested citizens. In 2000, the City of Thornton, which does not discharge to Big Dry Creek but has significant land area in the watershed, began participating in the monitoring program, as well as contributing financially to the BDCWA.

Originally, the monitoring program was limited to analysis of consisted of chemical constituents, fecal coliforms, physical properties such as pH, temperature, conductivity, suspended and dissolved solids, and flow. However, at the Federal and State level, there has been increasing recognition that the health of water bodies is reflected by the biological communities as well as more traditional chemical and physical characteristics. In 1997, the Big Dry Creek monitoring program was broadened to include biological data, describe the habitat characteristics, improve the water quality monitoring program, and create a central database.

The objectives of the monitoring program are to:

- Cooperate in collecting relevant, timely and sufficient water quality and biological data to provide a sound scientific basis to support decision-making.
- Create and maintain a central database that all interested parties may access to obtain information about the current and historical conditions in Big Dry Creek.
- Track water quality and identify trends and potential problems.
- Identify existing and potential uses to support stream classifications and standards.
- Coordinate CDPS Permit cycles and effluent limitations among dischargers; ensure that effluent limitations accurately reflect water quality and flows in the receiving water.

- Identify impacts from specific sources or activities in the watershed, and measures to improve water quality and habitat.
- Evaluate effectiveness of BMPs or other improvements.

2. Task Description

Sample sites for water quality constituents, habitat measurements, macroinvertebrate sampling, artificial substrate studies, fish sampling and flow measurements have been established at the following locations on Big Dry Creek:

Table 1. Big Dry Creek Sample Site Locations

Site Number	Location/Selection criteria	Constituents
Bdc0.5	Big Dry Creek at Olde Wadsworth Ave. Represents background conditions upstream of the WWTP outfalls, and urbanization impacts.	Water Quality, Habitat, Macroinvertebrates, Fish, flow
Bdc1.0	Big Dry Creek at 112th Ave. Represents conditions downstream of the confluence with Walnut Creek and Rocky Flats discharge	Water Quality, Habitat, Macroinvertebrates, Fish, flow
Bdc1.5	Big Dry Creek at 120th Ave. Represents conditions immediately upstream of Broomfifeld's WWTP outfall.	Water Quality, Habitat, Macroinvertebrates, Artificial Substrates, Fish, flow
Bdc 1.5C	Big Dry Creek downstream of 120th Ave. upstream of the BWWTP. Serves as reference site representing habitat conditions prior to the Broomfield's WWTP outfall. Background for BWWTP.	Habitat, Fish, flow
Bdc10.0	Broomfield WWTP Effluent	Water Quality
Bdc2.0	Big Dry Creek at 128th Ave. Represents conditions downstream of BWWTP and upstream of the WWWTP outfall	Water Quality, Habitat, Macroinvertebrates, Artificial Substrates, Fish, flow
Bcd11.0	Westminster WWTP Effluent	Water Quality
Bdc3.0	Big Dry Creek at I-25 Represents conditions downstream of the WWWTP outfall, but upstream of Northglenn.	Water Quality, Habitat, Macroinvertebrates, Artificial Substrates, Fish, flow
Bdc4.0	Big Dry Creek at York St. Represents urban development impacts, agricultural impacts, and background conditions for the Northglenn WWTP.	Water Quality
Bdc12.0	Northglenn CDPS discharge to BDC (infrequent)	Water Quality
Bdc5.0	Big Dry Creek at Weld County Rd. 4. Represents conditions downstream of the NWWTP, and agricultural influences.	Water Quality, Habitat, Macroinvertebrates, Artificial Substrates, Fish, flow
Bdc6.0	Big Dry Creek at Weld County Rd. 23 near the confluence with the S. Platte. Represents conditions just prior to the confluence with the South Platte River (end of segment 15)	Water Quality, Habitat, Macroinvertebrates, Artificial Substrates, Fish

USGS Gaging Stations: In addition to the monthly flow measurements taken by City sampling staff, the USGS, in cooperation with Broomfield and Westminster, maintains a continuous flow recorder near Front Range Community College, between Site 1.0 and 1.5, upstream of the municipal WWTPs (USGS #06720820). An additional continuous recorder is located near the confluence of Big Dry Creek with the S. Platte River, near site 6.0 (USGS# 06720990). Data from these recorders are used to determine base flows for CDPS Permitting, characterize base and storm flows, calculate loading, and identify trends in flows.

3. Data Quality Objectives

The water quality monitoring program is reviewed and revised annually to ensure that the correct analytes are being examined at the appropriate locations and frequency. Considerations include:

1. Isolating impacts from major outfalls or diversions
2. Consistency with existing water quality standards
3. Accurately describing existing conditions
4. Characterizing the existing and potential uses
5. Impacts on CDPS effluent limitations
6. Preparing for new EPA or State standards, classifications, and goals

Data collected through this monitoring program are routinely used to

1. Establish water quality classifications and standards
2. Support appropriate effluent limitations
3. Support investigations into potential impairments
4. Evaluate impacts from various activities in the watershed.

Data are routinely used for regulatory purposes, and must be of sufficient quality to support these uses.

4. Laboratory Qualifications and Analysis Methods

Analytical laboratories are selected based on analytical capabilities and cost. City laboratories are used where possible in order to control both data quality and costs. An advantage to in-house testing is the ability to use current and historical knowledge of the watershed to evaluate data for quality and reasonableness. Results that are questionable or inconsistent with past data can be confirmed immediately, before samples are discarded or exceed holding times.

Laboratory Qualifications:

The Laboratories performing analyses in support of the Big Dry Creek monitoring program must have a quality assurance plan that assures the reliability of the data produced. Laboratory Certification is one means of documenting the quality of the laboratory program. The State of Colorado does not offer Certifications for any programs other than Drinking Water, and such Certification only applies to constituents regulated

in drinking water, and a drinking water matrix. However, acquiring SDW Certification requires a Quality Assurance Management Plan that meets the Certification requirements, and applies to the relevant analytical methods, as well sampling, sample handling, Quality Control, corrective actions, and data management. The municipal laboratories performing analyses for Big Dry Creek monitoring are Certified by the CDPHE Laboratory Services Division as follows:

Broomfield Environmental Laboratory	Microbiology, Chemistry (Metals, Nitrate/Nitrite, Fluoride, TOC), Radiochemistry
Broomfield Water Reclamation Facility	Chemistry (metals)
City of Westminster	Chemistry (TTHMs, Nitrate/Nitrite), Microbiology
City of Northglenn	Chemistry (Inorganics, Metals, TTHMs), Microbiology
City of Thornton	Chemistry (Nitrate/Nitrite, Fluoride,TOC), Microbiology,

As part of the Certification process, labs must participate successfully in Proficiency Testing (PT) studies in which unknown samples are analyzed for each constituent. Results must meet the acceptance limits established by EPA. In addition to Proficiency Testing required for drinking water Certification, the laboratories participate in PT studies, if available, for all of the analytes included in the BDC monitoring program. These may include Water Supply (drinking water) studies, Discharge Monitoring (DMR) (wastewater) studies, and USGS (ambient or groundwater) studies.

Analytical Methods:

Analytical methods used in the Big Dry Creek monitoring program are approved by EPA for use in wastewater or ambient waters and are listed in 40 CFR §136.3 (exceptions are noted in the table below). The following table lists constituents, testing frequency, analytical procedures, method detection limit, and responsible laboratory for each analyte.

Table 2. Big Dry Creek Monitoring Constituents and Methods

Constituent	Units	Frequency	Field/Lab Procedure 2002/2003	Method 2002/2003	Method Detection Limit	LabID 2002/2003
Flow	Cfs	Monthly	Manual field measurments		1 cfs	Field
pH	S.U	Monthly	Field meter/Potentiometric	EPA 150.1	N/A	Field
Dissolved Oxygen	mg/L	Monthly	Field meter/Membrane Electrode	SM 4500-O G	N/A	Field
Temperature	°C	Monthly	Field meter/Thermometric	SM 2550	N/A	Field
Conductivity	µS	Monthly	Field conductivity meter	SM 2510 B	N/A	Field
Biochemical Oxygen Demand	mg/L	Monthly	5-Day BOD	SM 5210 B	2 mg/L	Westminster (Contract)
Phosphorus, total as P	mg/L	Monthly	Ascorbic Acid (with persulfate digestion)	SM 4500-P H	0.05 mg/L	Westminster (Contract)
Orthophosphate, as P	mg/L	Monthly	Automated Ascorbic Acid	EPA 365.1	0.005 mg/L	Broomfield, Env.
Ammonia, total, as N	mg/L	Monthly	Flow Injection Analysis	SM 4500-NH_3 H	0.05 mg/L	Westminster (Contract)
Ammonia, Unionized	mg/L	Monthly	Calculation			
Nitrate + Nitrite, as N	mg/L	Monthly	Automated Cd Reduction	SM 4500-NO3- F		Westminster (Contract)
Nitrite, as N	mg/L	Monthly	Automated Cd Reduction	EPA 353.2	0.004 mg/L	Broomfield, Env.
Alkalinity, total as $CaCO_3$	mg/L	Monthly	Titration	SM 2320 B		Northglenn
Turbidity	NTU	Monthly	Nephelometric Turbidimeter	SM 2130B		Broomfield, Env.
Total Suspended Solids	mg/L	Monthly	Gravimetric	SM 2540 D	2 mg/L	Westminster (Contract)
Total Dissolved Solids	mg/L	Monthly	Gravimetric	SM 2540 C	2 (est)	Broomfield, Env.
Sulfate	mg/L	Monthly	Gravimetric	SM 4500-SO_4^{2-} D	4	Broomfield, Env.
Chloride	mg/L	Monthly	Titration	SM 4500-Cl D	1	Broomfield, Env.
Cyanide, Total	mg/L	Quarterly	Spectrophotometric	EPA 335.2	0.00064	Northglenn (Contract)
Boron	mg/L	Monthly	ICAP	EPA 200.7	0.1	Westminster (Contract)
Total Organic Carbon	mg/L	Monthly	UV-Persulfate	SM 5310 C	0.2	Broomfield, Env.
Silver, dissolved	mg/L	Quarterly	ICAP	EPA 200.7	0.003	Broomfield, WRF
Arsenic, TRec	mg/L	Monthly	GFAA	EPA 200.9	0.004	Broomfield, Env.
Cadmium, dissolved	mg/L	Quarterly	ICAP	EPA 200.7	0.0003	Broomfield, WRF

Constituent	Units	Frequency	Field/Lab Procedure 2002/2003	Method 2002/2003	Method Detection Limit	LabID 2002/2003
Calcium, dissolved	mg/L	Monthly	EDTA Titration	SM 3500-Ca D	2 (est)	Broomfield, Env.
Chromium, dissolved	mg/L	Quarterly	ICAP	EPA 200.7	0.003	Broomfield, WRF
Copper, dissolved	mg/L	Quarterly	ICAP	EPA 200.7	0.002	Broomfield, WRF
Iron, dissolved	mg/L	Monthly	FLAA	SM 3111 B	0.01	Broomfield, Env.
Iron, Total recoverable	mg/L	Monthly	FLAA	EPA 200.2 SM 3111 B	0.1	Broomfield, Env.
Magnesium, dissolved	mg/L	Monthly	FLAA	SM 3111 B	0.4	Broomfield, Env.
Mercury, total	mg/L	Quarterly	Cold vapor	EPA 245.1	0.0002	Broomfield (Contract)
Manganese, dissolved	mg/L	Quarterly	ICAP	EPA 200.7	0.001	Broomfield, WRF
Molybdenum, dissolved	mg/L	Quarterly	ICAP	EPA 200.7	0.002	Broomfield, WRF
Nickel, dissolved	mg/L	Quarterly	ICAP	EPA 200.7	0.004	Broomfield, WRF
Lead, dissolved	mg/L	Quarterly	ICAP	EPA 200.7	0.003	Broomfield, WRF
Potassium, dissolved	mg/L	Monthly	FLAA	SM 3111 B	0.1	Broomfield, Env.
Selenium, dissolved	mg/L	Monthly	GFAA	EPA 200.9	0.0005	Broomfield, Env.
Sodium, dissolved	mg/L	Monthly	FLAA	SM 3111 B	2	Broomfield, Env.
Zinc, dissolved	mg/L	Quarterly	ICAP	EPA 200.7	0.002	Broomfield, WRF
Hardness, total as $CaCO_3$	mg/L	Monthly	Calculated	SM 2340 B	4 (est)	Broomfield, Env.
Chlorophyll a	mg/m^3	Monthly	Spectrophotometric	SM 10200 H	0.1	Northglenn
Fecal Coliform	#/100 mL	Monthly	Membrane Filtration	SM 9222 D	1	Westminster
E. coli	#/100 mL	Weekly	Colilert (Quantitray) (approved for ambient waters but not wastewater)	SM 9223 B	1	Thornton
Physical Habitat	N/A	Annual	EPA Rapid Bioassessment Protocol	RBP	N/A	Aquatics Associates
Fish Population	N/A	Annual	Electroshocking w/field ID and measuremements.	RBP/IBI	N/A	Aquatics Associates
Macroinvertebrates	N/A	Semi-Annual	Kick samples	RBP III/ICI	N/A	Aquatics Associates
Artificial Substrates	N/A	Annual	Hester-Dendy samplers	Colorado Water Quality Forum	N/A	Aquatics Associates

5. Measurement/Data Acquisition

Sample Frequency:

Water Quality: Routine water quality sampling is conducted monthly on the second Thursday of the month. Efforts are made to adhere to the sampling schedule; however, if the safety of the samplers is in question due to heavy storms, high flows, or poor road conditions, the sampling date may be adjusted.

Macroinvertebrates (kick samples): Macroinvertebrate sampling in conducted in the spring (March) prior to the beginning of the irrigation season, and in the fall (October), after peak flows.

Macroinvertebrates (Artificial Substrates): Artificial substrate sampling is conducted in the fall. The samplers are placed in September and allowed to colonize for approximately 6 weeks.

Fish: Fish sampling is conducted annually, generally in October.

Special Studies: For special studies, a sampling frequency appropriate to the purpose of the study is established. For the 2003 *E. coli* study, sampling is conducted weekly at sites 0.5, 1.0, 2.0, 3.0, and 5.0, and the WWTP outfalls.

Sampling Equipment:

Field measurements: A YSI 600XL Multiprobe field meter is used to measure pH, dissolved oxygen, temperature and conductivity *in situ* at each sample site. The meter is calibrated by Broomfield Environmental Laboratory staff according to the manufacturer's instructions and the laboratory's Quality Assurance Management Plan immediately prior to each sampling event. In the event that the multiprobe meter is not operational, temperature and dissolved measurements are taken using field D.O. and pH meters; conductivity is measured in the laboratory immediately upon receipt of samples. Field D.O and pH meters are provided by and calibrated by the Northglenn Laboratory Services staff according to the manufacturer's instructions prior to the sampling event.

Flow measurements: A Swoffer Model 2100 flow meter is used for flow measurements during field sampling. The flow meter is provided by Northglenn and assembled in the field prior to use.

Other Equipment: Neoprene chest waders and boots needed for collecting flow measurements and wadeabale samples are provided by Northglenn. Northglenn also supplies a five gallon bucket for conducting non-wadeable sampling.

Sample containers. Sample containers are provided to the field samplers by the laboratory responsible for analysis. All containers are of a type approved for sample collection and storage for each method. Containers provided by each city are as follows:

- Broomfield: One 2-L plastic sample container for multiple analytes and one125 mL amber glass TOC bottle for each site. For quarterly sampling, Broomfield also supplies one 1-L acid washed polypropylene bottle for metals analyses.

- Northglenn: One 1-L plastic sample container for alkalinity and Chlorophyll-A and one sterile 125 mL plastic bottle for E. coli. For quarterly samples, one 1L plastic bottle is provided for Cyanide analysis.
- Westminster: One 4L plastic sample container for multiple analytes and one sterile 125 mL plastic bottle for fecal coliforms.

Bulk samples collected in the field are further divided up and preserved as needed for various analyses by the testing laboratory. Sample handling and storage are conducted according to the protocol in Table 2.

Container preparation protocols: Sample containers are cleaned following the appropriate laboratory protocols to prevent sample contamination. The following general guidelines apply:

Primary sample collection containers and bottles for basic water quality constituents are High Density Polyethylene (HDPE) material. Only phosphate-free detergents are used for washing containers, and all containers are rinsed with tap water followed by deionized water. Any sample bottles which may be used for nutrient (nitrogen, phosphorus) determinations are either disposable or cleaned with phosphate-free detergent, and then thoroughly rinsed with tap water followed by deionized water.

TOC: Samples are collected in amber glass bottles with TFE-backed septa. At a minimum, sample bottles are washed before use with detergent, rinsed repeatedly with organic-free water, dried in a 105° oven, and stored covered, either with clean, dry TFE-backed caps or aluminum foil, until used.

Metals: Sample bottles to be used for metals analysis are cleaned according to the following procedure:

- 1:1 nitric acid wash
- tap water rinse
- 3 DI water rinses
- 1:1 hydrochloric acid wash
- tap water rinse
- 3 DI water rinses

Bacteriological Samples: Samples for fecal coliform and *E. coli* analysis are collected in sterile 120 mL HDPE bottles. Sample bottles are washed with detergent, rinsed with tap water then deionized water and then autoclaved at a temperature of 121°C for a minimum of 15 minutes. Bottles are then preserved using a 10 percent solution of sodium thiosulfate.

Sample Collection Procedure:

Big Dry Creek is a small, relatively narrow stream, and is wadeable at most sampling locations except during very high flows. Under normal conditions, maximum channel width is approximately 25 feet, and maximum depth approximately 4 feet. Because of the physical characteristics of the stream, wadeable samples collected sub-surface and approximately mid-stream are presumed to be representative of water quality in the

stream. Sampling methods and equipment for non-wadeable conditions or locations are also described below.

In order to support data interpretation and modeling, the stations are sampled in the direction of flow, from upstream to downstream, i.e. beginning with Site bdc0.5 and ending with Site bdc6.0. Added 5/6/04

Flow: Prior to sample collection, flow measurements are taken at each site using a Swoffer Model 2100 flow meter and a cross-sectional flow measurement technique. For this method of flow measurement, a tape measure is stretched across the creek. At two foot intervals, the stream depth is recorded, as well as the distance from the starting bank. Using the flow meter, the average velocity at 60% of the stream depth, is calculated and then recorded on the field measurements sheet. The stream flow in cubic feet per second is calculated using Microsoft Excel and the formula *sum of all (depth x velocity)*. This value is then recorded on the field measurements sheet.

Field measurements: Temperature, dissolved oxygen, pH, and conductivity are measured in the field using a YSI 600XL multiprobe meter or equivalent. For wadeable locations, measurements are taken directly in the water column at approximately the midpoint of each transect, upstream from the area disturbed by the flow measurement transect. For non-wadeable sites, samples are collected in a 5-gallon bucket at approximately mid-channel, and field measurements are taken in the bucket.

Sampling Procedure: For water quality constituents, samples are collected approximately mid-channel, sub-surface. Samples are collected immediately upstream of the flow measurement transect in order to minimize interference from disturbance of the substrate. Sample bottles are positioned with the mouth of the bottle facing upstream, and care is taken to avoid including benthic material in the sample. When there is easy access to the creek, all sample containers are taken to the creek and filled individually directly from the creek. When access to the creek is difficult, even if wadeable, and flows are collected, the largest sample container and a bucket are filled at the creek and used to fill the other, smaller sample containers. If sample bottles do not contain preservative, they are rinsed with the sample before filling. Sample bottles for cyanide are preserved with NaOH, and are not rinsed. Bacteriological sample bottles are not rinsed.

Sampling Procedure, non-wadeable samples: At site 4.0 and site 6.0 sampling is conducted from a bridge. A 5-gallon bucket is lowered from the bridge, filled and rinsed with the water to be sampled. After discarding the rinsate, the bucket is filled again, and used to fill the individual sample bottles. Field measurements are taken from the bucket after the sample bottles are filled. This procedure is also used at the WWTP outfalls, and may be used at other locations where a bridge is present if flow, ice or other conditions make sampling from the stream unsafe.

Field Records: A field data sheet (Attachment 1) is taken into the field during each sampling event. All sample documents are completed in indelible ink. Correction or revisions are made by lining out the original entry with a single line. The person making or approving the change must initial and date the change. At a minimum, Field records must include:

- Sampler(s)
- Date
- Site Identification
- Sample time at each site
- Results of field analyses
- Flow measurements
- Observations of unusual conditions at each site

Other information that should be noted includes:

Observations regarding recent precipitation, unusual flows, irrigation diversions or returns, unusual flow (or lack of flow) at stormwater or other point source outfalls, construction activities, obstructions, noteworthy growths of algae or macrophytes, and unusual color. As part of the 2003 project to upgrade the Big Dry Creek database, a list of standard Field observations with allowable STORET values relevant to Big Dry Creek was selected (Attachment 2). This record should be completed at each site.

Sample labeling:

Each sample container will be labeled and the label affixed directly to the sample bottle (not the cap). All labels must be filled out in indelible ink. If the sample bottle is to be returned to laboratory for further processing, the label must clearly specify the site identification, at a minimum. Labels for individual analyses must specify sample ID, date, analyte, and preservative.

Sample Transportation:

After collection samples are placed in coolers until they are delivered to the appropriate laboratory; bacteriological and cyanide sample coolers are chilled with "blue ice." Samples are delivered to the laboratories within 6 hours of collection.

Biological sampling:

Habitat characterization and sampling for macroinvertebrates and fish is conducted according to protocols developed by the contractor and selected with input from the regulatory community and the watershed association.

6. Quality Assurance and Quality Control Requirements

Because data for this project may be collected by 4 municipalities using as many as 6 laboratories, it is important to ensure that consistent procedures are followed. This Quality Assurance Plan has been prepared to document the procedures that all participating parties agree are necessary to produce reliable, defensible data that are of sufficient quality for the intended uses. In addition to this general plan, all of the laboratories performing testing to support the Big Dry Creek monitoring program maintain Laboratory Quality Assurance Management Plans governing laboratory and analytical activities. The laboratories' approved Quality Assurance plans will be followed when analyzing all Big Dry Creek samples. Considerations include sample custody procedures, sample preservation/storage/holding times, analyst qualifications, analysis quality control, and sampling quality control.

Sample Custody:

Chain of Custody (COC) Records are maintained for all water quality sampling conducted in conjunction with this monitoring plan. The purpose of maintaining COCs is to provide documentation that samples were collected and delivered to the laboratories within an acceptable time frame, were properly preserved, were analyzed within the allowable holding time, and to record any conditions that might help to explain anomalous results. A significant deviation from required protocols requires that results be flagged or discarded.

All sample documents are completed in indelible ink. Correction or revisions are made by lining out the original entry with a single line. The person making or approving the change must initial and date the change.

All samples are documented under at least one Chain of Custody record. A copy of the field data sheet is provided to each entity conducting sampling activities, normally Northglenn and Broomfield, and serves as documentation of sample collection and receipt. Additionally, Westminster, Broomfield WRF, and Thornton provide COCs to the field samplers for analyses that they perform. Separate COCs are provided to the contract laboratories for tests that are not performed by the Cities' laboratories. Copies of all COCs are retained by the City of Northglenn with the sampling records.

All sampling documents are retained for the project record.

Sample Container, Preservation and Holding Times Criteria:

The following specifications for sample containers, preservation and maximum holding times in the laboratory are followed for the Big Dry Creek Monitoring program:

Table 3. Sample handling and storage requirements

Constituent	Container	Preservation [3]	Maximum holding time
Alkalinity	P, G [1]	None	ASAP (same day)
Ammonia, total	P, G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Biochemical Oxygen Demand	P, G	Cool, 4°C	48 hours
Boron	P, PFTE, or Quartz	HNO_3 to pH<2	6 months
Calcium	P, G	None	ASAP (same day)
Chloride	P, G	None	28 days
Chlorophyll *a*	P, G	Cool 4°C/or filter and freeze filter	8 hours/2 weeks
Cyanide	P, G	Cool 4°C, NaOH to pH>12	14 days
E. coli	P, sterile 120 mL	Cool, 4°C, 0.008% $Na_2S_2O_3$ (only if chlorinated)	6 hours
Fecal coliforms	P, G	Cool, 4°C, 0.008% $Na_2S_2O_3$ (only if chlorinated)	6 hours
Mercury	P, G	HNO_3 to pH<2	28 days
Metals, dissolved or total recoverable [2]	P, G	HNO_3 to pH <2	6 months
Nitrate/Nitrite	P, G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Nitrite	P, G	Cool 4°C	48 hours
Phosphorus, ortho	P, G	Filter immediately, Cool 4°C	48 hours
Phosphorus, Total	P, G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Sulfate	P, G	None (Note – information taken from	28 days

Constituent	Container	Preservation [3]	Maximum holding time
		drinking water regulations. 40 CFR 136.3 does not allow for holding	
Solids, Total Dissolved	P, G	None	7 days
Solids, Total Suspended	P, G	None	7 days
Total Organic Carbon	G	Cool, 4°C, H_3PO_4 to pH<2	28 days

[1] P = Polyethylene, G = Glass. All sample containers used for the Big Dry Creek project are polyethylene with the exception of bottles for Total Organic Carbon. For microbiology, plastic sample containers must be made of seterilizable materials (propropylene or other autoclavable plastic).

[2] Samples for dissolved metals are filtered through a 0.45 µm filter in the laboratory immediately after sample receipt. Total Recoverable metals are acidified without filtration. All metals samples acidified in the laboratory are held for a minimum of 24 hours prior to analysis.

[3] With the exception of Cyanide and bacteriological samples, which are collected in bottles containing the appropriate preservative, all samples are split and preserved in the laboratory immediately upon receipt.

Analyst Qualification:

All analysts performing analyses for Big Dry Creek samples must meet qualification and proficiency requirements required by the respective laboratories for the analyses they perform.

Analysis Quality Control:

Quality Control procedures and checks appropriate for each method must be followed and documented. These may include instrument calibration criteria, Instrument Performance Check standards, external quality control standards, duplicates, matrix spikes, Laboratory Fortified Blanks, Laboratory Reagent Blanks or other checks. Specific QC requirements are set forth in the individual analytical methods. City laboratories conduct Quality Control reviews for each analysis prior to accepting data. Contract laboratories submit Quality Control Reports with the analytical results.

Sampling Quality Control:

The following techniques are used to evaluate whether the sampling equipment, containers and procedures negatively affect the integrity of the sample results:

> *Field blanks* are used to provide a check on sample contamination in the field. Deionzed water, supplied by the analytical laboratory, is added to sample containers in the field. Field blanks are shipped with the samples and are analyzed for the same analytes as the water quality samples.
>
> *Field duplicates* are used to provide a check on the reproducibility of sampling and analysis. Field duplicates are prepared by collecting identical sample aliquots for the same constituents. Field duplicates should be labeled as separate samples to avoid confusion and provide a blind evaluation. [Note: The blind evaluation will only be possible for samples the city labs don't analyze – we know where we got the samples.]

Table 4. The Field Quality Control Program for 2004 is as follows:

Month	QC Test	Site
March	Field blanks (complete set)	6.0 (represents max equipment use)
June	Field duplicates for Constituents of Concern (Represents high flows)	1.5 – Selenium 2.0 – *E. coli* 3.0 – NH_3 5.0 – Fe (TRec)
September	Field duplicates, full set	5.0 –most constituents detected at this site.
December	Field duplicates for Constituents of Concern (Represents low flows)	1.5 – Selenium 2.0 – *E. coli* 3.0 – NH_3 5.0 – Fe (TRec)

7. Data Management/Handling

Data Review: All data generated for the project will be evaluated against the appropriate quality control criteria contained in the referenced methods and the laboratory's Quality Assurance Plan. Data failing to meet the method specifications will be rejected or qualified as appropriate. Data meeting the method specifications will be evaluated by the Big Dry Creek Watershed Association steering committee at least annually. During this review, data are checked for reasonableness and consistency with past measurements, as well as obvious errors. Data are not considered final until the joint review has been completed.

Method Detection Limits: Method Detection Limits (MDL) will be reviewed and updated as needed, but at least annually. The current MDL for each analysis must be associated with the result. All results below the applicable MDL will be flagged with a "U" Qualifier.

Data storage: All data generated by/for each City laboratory are entered into the city's Laboratory Data Management System (LDMS). All of the participating laboratories are currently using the Tribal LDMS software. At least annually, all data are transferred to the Watershed Coordinator, and are entered into the master database maintained and managed by Wright Water Engineers

Recordkeeping: All analysis records are maintained for at least 5 years by the laboratory performing the analysis.

Sampling records are maintained by the City of Northglenn for at least 5 years.

8. Reconciliation with Data Quality Objectives

Data are examined for trends, correlations, consistency with the applicable standards, or other concerns, and a report is produced by the watershed coordinator at least annually. Data are compared with the current Stream Classifications and Water Quality Standards

table, Attachment 3). The conclusions are reported in an annual presentation to the BDCWA. Recommendations for changes to the monitoring plan are developed with consideration given to the input provided by all parties, and the sampling and analysis plan is modified accordingly.

Data for the previous 5 years, or more if necessary, are provided to the CDPHE Water Quality Control Division to support the Stream Classifications and Standards Triennial Review process, the 303(d) listing process, CDPS permit activities, and other uses as needed.

Water quality data are also correlated with biological data periodically to help identify the relative effects of water quality and habitat on the aquatic community.

Big Dry Creek Monitoring Program
Field Visit Record

Station Visit Start Date: _____
Activity Start Time: _____
Field Personnel: _____

Field Measurements

Station ID	BDC 0.5	BDC 1.0	BDC 1.5	BDC BROOM	BDC 2.0	BCD WESTY	BDC 3.0	BDC 4.0	BDC NORTH	BDC 5.0	BDC 6.0
Time Sampled											
pH											
D.O.											
Temperature											
Conductivity											

Site Characteristics (Record allowed STORET value for each characteristic at each site)

Station ID	BDC 0.5	BDC 1.0	BDC 1.5
Weather Condition			
Ice - Severity			
Flow, Stream Class			
Hydrograph Limb			
Bank Erosion Stability			
RBP2, Water Quality, Water Odors			
RBP2, Water Quality, Water Surface Oilds			
RBPS, Water Quality, Turbidity			
RBP2, Watershed, Local NPS Pollution			
RBP2, Watershed, Local Erosion			

Flow, Measured	width	depth	flow	width	depth	flow	width	depth	flow

Big Dry Creek Monitoring Program
Field Visit Record

Site Characteristics (Record allowed STORET value for each characteristic at each site)

Station ID	BDC 2.0				BDC 3.0				BDC 4.0				BDC 5.0				BDC 6.0		
Weather Condition																			
Ice - Severity																			
Flow, Stream Class																			
Hydrograph Limb																			
Bank Erosion Stability																			
RBP2, Water Quality, Water Odors																			
RBP2, Water Quality, Water Surface Oilds																			
RBPS, Water Quality, Turbidity																			
RBP2, Watershed, Local NPS Pollution																			
RBP2, Watershed, Local Erosion																			
Flow, Measured	width	depth	flow		width	depth	flow		width	depth	flow		width	depth	flow		width	depth	flow

Additional comments (e.g. unusual algal growth, construction activities, ditch diversions, Standley Lake releases, or other conditions)