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
(Revised April 2011)
(Revised June 2012)
(Revised February 2013)
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Attachments

Note Regarding Record of Changes to Sampling Plan:

Revised April 2011 in redline-strikeout to reflect changes in sampling frequencies and locations that have occurred over time.
Revised June 2012 to reflect changes in sample handling and storage requirements.

Revised February 2013 to reflect changes to QA samples and nutrient methods.

Editorial revision April 2014 to correct substantive typographical error (biannual changed to biennial) and update to Table 2 related to frozen samples.

Revised June 2018 with sampling and editorial updates.

List of Acronyms

BDC – Big Dry Creek
BDCWA – Big Dry Creek Watershed Association
BMP – Best Management Practice
CDPHE – Colorado Department of Public Health & Environment
CDPS – Colorado Discharge Permit System
cfs – cubic feet per second
COC – Chain of Custody
DI – Deionized Water
DMR – Discharge Monitoring Report
DMRQA – Discharge Monitoring Report Quality Assurance
EPA – (US) Environmental Protection Agency
HDPE – High Density Polyethylene
LDMS – Laboratory Data Management System
MDL – Method Detection Limit (or Level)
PQL – Practical Quantitation Limit
PT – Proficiency Test
QA- Quality Assurance
QAP – Quality Assurance Plan
QC – Quality Control
SDW – Safe Drinking Water
TDS – Total Dissolved Solids
TMDL – Total Maximum Daily Load
TOC – Total Organic Carbon
Trec – Total Recoverable (synonymous with Total for metals)
TSS – Total Suspended Solids
USGS – United States Geological Survey
WQ – Water Quality
WWTP – Waste Water Treatment Plant

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 (BDC) 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 most discharge stormwater to the stream. The region has also seen significant increase in population over the last decade, with projections of continued growth. The U.S. Department of Energy also supported the monitoring program between 1997 through decommissioning and decontamination of the Rocky Flats site in 2006.

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 included 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 chemical constituents, fecal coliforms, and physical properties such as pH, temperature, conductivity, suspended and dissolved solids, and flow. However, at the federal and state level, there had been increasing recognition that the health of water bodies is reflected by the biological communities as well as more traditional chemical and physical characteristics. Therefore, in 1997, the Big Dry Creek monitoring program was broadened to include biological monitoring for fish and macroinvertebrates, and standardized assessment of habitat characteristics. A central database was created at this time.

In recent years, the water quality monitoring plan has been enhanced in response to state regulatory actions and concerns. Increased nutrients monitoring was driven by the implementation of Regulation 85 and the need to assess Big Dry Creek's contribution to pH impairment in Barr Lake. In 2016, a TMDL was assigned for *E. coli* in Big Dry Creek after considerable efforts by the cities and state personnel.

The current 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.
- 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 to identify trends and anticipate 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.
- Work cooperatively towards improvements in water quality and to resolve any TMDLs.

2. Task Descriptions

Current and stated water quality constituents, habitat measurements, macroinvertebrate sampling, artificial substrate studies, fish sampling and flow measurements data are

collected at locations on Big Dry Creek identified in Table 1 and Map 1 (photographs are taken at each sampling location at the time of the site visit):

Table 1. Big Dry Creek Sample Site Locations

Site	Location/Selection criteria	Constituents[1]
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 Broomfield's WWTP outfall.	Water Quality, Flow
Bdc2.0	Big Dry Creek at 128th Ave. Represents conditions downstream of BWWTP and upstream of the WWWTP outfall	Water Quality, Habitat, Macroinvertebrates, Fish, Flow
Bdc3.0	Big Dry Creek at I-25 Represents conditions downstream of the WWWTP outfall, but upstream of Northglenn.	Water Quality, Habitat, Macroinvertebrates, Fish, Flow
Bdc4.5	Big Dry Creek at York St. (sampling location moved downstream April 2011 for safety reasons) Represents urban development impacts, agricultural impacts, and background conditions for the Northglenn WWTP.	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, Fish
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

[1] Historical data collection objectives can be found in former versions of Monitoring Plan.

In addition to the monthly flow measurements taken by City sampling staff, the USGS, in cooperation with the cities and BDCWA, maintain two continuous flow recorders: one near Front Range Community College, between Site 1.0 and 1.5, upstream of the three municipal WWTPs (USGS #06720820), and one 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 for trending and Reg. 85, and identify trends in flows. WWTP DMR and Reg. 85 data have been used for discharge-specific data, since 2011.

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

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
5. Monitor improvements from BMPs

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. However, the State of Colorado only offers certification for Safe Drinking Water (SDW) contaminants, and not wastewater. Aspects of the SDW program include a Quality Assurance Plan applicable to the relevant analytical methods, as well as sampling, sample handling, quality control, corrective actions, and data management. As part of the certification process, labs must participate successfully in Proficiency Testing (PT) in which unknown samples are analyzed for each constituent. Results must meet the acceptance limits. In addition to Proficiency Testing required for drinking water certification, the laboratories participate in annual PT studies, if available, for all of the analytes included in the BDC monitoring program. These may include Water Supply or Water Pollution studies, and Discharge Monitoring (DMRQA) studies.

Constituents and Analytical Methods:

Analytical methods used in the Big Dry Creek monitoring program are approved by EPA for use in wastewater or ambient waters as listed in 40 CFR §136.3 (exceptions are noted in the table below). Table 2a lists water quality constituents, testing frequency, analytical methods, 2018 reporting limits, 2018 method detection limits, and responsible laboratory for each analyte.

Table 2a. Analytical Methods, Limits, and Frequency

Analyte (All Locations)	Field/Lab Procedure	Method Detection Limit	Practical Quantitation Limit	Units	Sample Frequency	Laboratory
General						
ALKALINITY	SM 2320 B		1	mg/L	Monthly	City of Northglenn WTF Lab
BORON, Total	EPA 200.7	0.01	0.1	mg/L	Quarterly	Colorado Analytical
CALCIUM, Total	SM 3500-Ca B		1	mg/L	Monthly	Broomfield Env. Laboratory
CHLORIDE, D	EPA 300.0	0.08	0.5	mg/L	Monthly	Broomfield Env. Laboratory
CHLOROPHYLL-a, corr.	SM 10200 H	n/a	1	ug/L	Monthly	City of Northglenn WTF Lab
CHLOROPHYLL-a, uncorr.	SM 10200 H	n/a	1	ug/L	Monthly	City of Northglenn WTF Lab
CONDUCTIVITY	SM 2510 B		0.5	µS/cm	Monthly	Field Staff
CYANIDE, Total	EPA 335.4	0.0005	0.005	mg/L	Quarterly	Colorado Analytical
DISSOLVED OXYGEN (DO)	SM 4500-O G	Field		mg/L	Monthly	Field Staff
E. COLI	SM 9223 B Colilert	n/a	1	MPN/100 mL	Monthly	City of Thornton
HARDNESS, Total	SM 2340 B	n/a	1	mg/L	Monthly	Broomfield Env. Laboratory
MAGNESIUM, D	EPA 200.7	0.02	1	mg/L	Monthly	Broomfield Env. Laboratory
pH	SM 4500-H+ B	Field		SU	Monthly	Field Staff
POTASSIUM, D	EPA 200.7	0.03	0.5	mg/L	Monthly	Broomfield Env. Laboratory
SODIUM, D	EPA 200.7	0.1	1	mg/L	Monthly	Broomfield Env. Laboratory
SULFATE, D	EPA 300.0	0.03	1	mg/L	Monthly	Broomfield Env. Laboratory
TDS	SM 2540 C		1	mg/L	Monthly	Broomfield Env. Laboratory
TEMPERATURE	SM 2550 B	Field		°C	Monthly	Field Staff

Analyte (All Locations)	Field/Lab Procedure	Method Detection Limit	Practical Quantitation Limit	Units	Sample Frequency	Laboratory
TOTAL ORGANIC CARBON	SM 5310 C	0.16	0.25	mg/L	Monthly	Broomfield Env. Laboratory
TSS	SM 2540 D	1	2	mg/L	Monthly	West. BDC WWTF Lab
TURBIDITY	EPA 180.1 Rev.2	Field		NTU	Monthly	Field Staff
Nutrients						
NITROGEN, NH3	TMA-001	0.02	0.05	mg/L	Monthly	West. BDC WWTF Lab
NITROGEN, NO2	EPA 353.2	0.004	0.01	mg/L	Monthly	Broomfield Env. Laboratory
NITROGEN, NO3+NO2	Calculated	n/a	0.05	mg/L	Monthly	West. BDC WWTF Lab
NITROGEN, TKN	Calculated	n/a	0.1	mg/L	Monthly	West. BDC WWTF Lab
NITROGEN, TIN	SM 4500-N D	0.02	0.05	mg/L	Monthly	West. BDC WWTF Lab
NITROGEN, TOTAL	SM 4500-N C	0.03	0.1	mg/L	Monthly	West. BDC WWTF Lab
PHOSPHORUS, TOTAL	Lachat 10-115-01-4-B	0.01	0.02	mg/L	Monthly	West. BDC WWTF Lab
PHOSPHORUS, ORTHO AS P	EPA 365.1	0.003	0.01	mg/L	Monthly	Broomfield Env. Laboratory
Metals						
ARSENIC, Trec	EPA 200.8	0.0007	0.001	mg/L	Quarterly	Broomfield WRF Lab
CADMIUM, D	EPA 200.8	0.0005	0.001	mg/L	Quarterly	Broomfield WRF Lab
CHROMIUM, D	EPA 200.8	0.0005	0.001	mg/L	Quarterly	Broomfield WRF Lab
COPPER, D	EPA 200.8	0.0008	0.002	mg/L	Quarterly	Broomfield WRF Lab
IRON, Trec	EPA 200.7	0.05	0.5	mg/L	Monthly	Broomfield Env. Laboratory
LEAD, D	EPA 200.8	0.0004	0.001	mg/L	Quarterly	Broomfield WRF Lab
MANGANESE, D	EPA 200.8	0.0005	0.001	mg/L	Quarterly	Broomfield WRF Lab
NICKEL, D	EPA 200.8	0.001	0.003	mg/L	Quarterly	Broomfield WRF Lab
SELENIUM, D	EPA 200.8	0.0004	0.001	mg/L	Quarterly	Broomfield WRF Lab
SILVER, D	EPA 200.8	0.0003	0.001	mg/L	Quarterly	Broomfield WRF Lab
ZINC, D	EPA 200.8	0.001	0.003	mg/L	Quarterly	Broomfield WRF Lab
120th & BDC Only[1]						
MERCURY, Trec	EPA 1631e	0.0002	0.0005	µg/L	Monthly	Broomfield WRF Lab
Selected Locations Only						
FLOW	VENDOR	Field		cfs	Monthly	Field

[1] Broomfield collects Mercury data separately and shares with BDCWA.

In addition to the water quality constituents listed above, fish, habitat, and macroinvertebrate data is collected biennially by Aquatics Associates. These procedures (Table 2b) and findings are documented in detail in biennial Aquatics Associates reports, and are included in the annual BDC WQ Reports.

Table 2b. Big Dry Creek Sampling Parameters, Procedures and Frequencies

Constituent	Frequency	Field/Lab Procedure	Method	Contractor
Physical Habitat	Biennial, Fall	EPA Rapid Bioassessment Protocol	RBP	Aquatics Associates
Fish Population	Biennial, Fall	Electroshocking w/field ID and measurements.	RBP/IBI	Aquatics Associates
Macro-invertebrates	Biennial, Fall	Kick samples	RBP III/ICI	Aquatics Associates

5. Sample Methodology

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. Cities will do their best to adhere to this schedule in order to not disrupt other cities' schedules.

Macroinvertebrates (kick samples): Macroinvertebrate sampling is conducted biennially in the fall (October), after peak flows, by Aquatics Associates.

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

Special Studies: For special studies, a sampling frequency appropriate to the purpose of the study is established. For example, the 2003 *E. coli* study was 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 multiprobe field meter is used to measure pH, dissolved oxygen, temperature and conductivity *in situ* at each sample site. In the event that the multiprobe meter is not operational, temperature and dissolved measurements are taken using Northglenn's DO and pH meter and conductivity is measured in the laboratory immediately upon receipt of samples. Field meters are calibrated by city staff according to the manufacturer's instructions immediately prior to each sampling event.

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

Other equipment: Neoprene chest waders and boots needed for collecting flow measurements and wadeable samples are provided by Northglenn. Northglenn also supplies a five-gallon bucket and rope 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 for each site are as follows:

- Broomfield: One 2-L plastic sample container for multiple analytes and one 125 mL amber glass TOC bottle. For quarterly sampling, Broomfield also supplies one 1-L acid washed plastic bottle for metals and other additional bottles as needed.

- Northglenn: One 1-L plastic sample container for alkalinity and Chlorophyll-a and one sterile 125 mL plastic bottle for *E. coli*. For quarterly sampling, one 500-mL plastic bottle is provided by the contract lab for cyanide analysis.
- Westminster: One 2-L plastic sample container for multiple analytes. For quarterly sampling, Westminster also supplies one 1-L plastic container for boron analysis.

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. Additional bottles may be needed for field duplicates and blanks per Table 4.

Container preparation protocols: Sample containers are cleaned following the appropriate laboratory protocols to prevent sample contamination. Sample bottles are checked prior to sampling to ensure they are in good condition. The following general guidelines apply:

- Water quality: High Density Polyethylene (HDPE) bottles are used for primary sample collection containers. Only phosphate-free detergents are used for washing containers, and all containers are rinsed with tap water followed by deionized water.
- TOC: Samples are collected in 125 mL amber glass bottles with TFE-lined septa. Sample bottles are washed before use in the laboratory dishwasher.
- Metals: Bottles to be used for metals analysis are cleaned with nitric acid and hydrochloric acid, and rinsed well with tap water then DI.
- Bacteriological Samples: Samples for *E. coli* analysis are collected in sterile 125 mL plastic bottles. Sample bottles are washed with detergent, rinsed with tap water and deionized water, preserved with sodium thiosulfate, then autoclaved at a temperature of 121°C for a minimum of 15 minutes.

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.

Flow: Prior to sample collection, flow measurements are taken at selected sites 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

recorded on the field measurements sheet. The stream flow in cubic feet per second (cfs) is calculated using Microsoft Excel and the formula *sum of all (depth x velocity)*. This value is then recorded on the field data 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, wadeable sites: 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. 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 also not rinsed.

Sampling Procedure, non-wadeable sites: At site 4.5, site 5.0, and site 6.0 sampling is conducted from a bridge. A 5-gallon bucket is lowered from the bridge on the downstream side, filled and rinsed with the water to be sampled. After discarding the rinsate to the side, 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 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 and initialing. 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
- Relevant STORET observations (Attachment 2)

Other information that should be noted includes:

Observations regarding recent precipitation, unusual flows, irrigation diversions or returns, Standley Lake releases, 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. This record should be completed at each site.

Sample labeling:

Each sample container will be labeled and the label affixed or written directly on 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 and date, 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 municipal laboratories immediately after sample event. Cyanide samples may be delivered within four days.

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 four municipalities using as many as six laboratories, it is important to ensure that consistent procedures are followed. This Monitoring 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 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 properly preserved, collected, and delivered. 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 municipal laboratories. Copies of all

COCs are retained by the City of Northglenn with the sampling records, for at least 10 years.

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[1]	Preservation [3]	Req. Maximum Holding Time
Alkalinity	P, FP, G	Cool, ± 6ºC	14 days
Boron	P, FP	HNO_3 to pH<2	6 months
Calcium	P, FP, G	None	24 hours
Chloride	P, FP, G	None required	28 days
Chlorophyll *a*	P, G	Filter within 24 hours, freeze filter, keep dark	28 days
Cyanide	P, FP, G	Cool, ± 6ºC, NaOH to pH >10, reducing agent if oxidizer present	14 days
E. coli	PA, G, sterile	Cool, <10°C, 10% $Na_2S_2O_3$	8 hours
Mercury	G	5 mL/L BrCl	90 days
Metals, dissolved or total recoverable [2]	P, FG, G	HNO_3 to pH <2	6 months
Nitrogen, Ammonia	P, FP, G	Cool, ± 6ºC, H_2SO_4 to pH<2	28 days
Nitrogen, Nitrate/Nitrite	P, FP, G	Cool, ± 6ºC, H_2SO_4 to pH<2	28 days
Nitrogen, Nitrite	P, FP, G	Filter immediately, Cool, ± 6ºC	48 hours
Nitrogen, Total	P, FP, G	Cool, ± 6ºC, H_2SO_4 to pH<2	Digest within 48 hours, then 7 days
Phosphorus, ortho	P, G	Filter immediately, Cool ± 6ºC	48 hours
Phosphorus, Total	P, FP, G	Cool, ± 6ºC, H_2SO_4 to pH<2	28 days
Sulfate	P, FP, G	Cool, ± 6ºC	28 days
Solids, Total Dissolved	P, FP, G	None	7 days
Solids, Total Suspended	P, FP, G	None	7 days
Total Organic Carbon	G	Cool, ± 6ºC, H_3PO_4 to pH<2	28 days

[1] P = Polyethylene, FP = Fluoropolymer, G = Glass. All sample containers used for the Big Dry Creek project are polyethylene with the exception of bottles for Total Organic Carbon and mercury. For microbiology, PA is any plastic that is made of sterilizable materials (polypropylene 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 Qualifications:

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 (QC) 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. Deionized 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 in separate bottles 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 brought to contract laboratories.]

Table 4. Field Quality Control Program

Month	Analyte	Type[1]/Site	Lab
March	All WQ (incl CN-)	FB @ bdc6.0	All
	Nutrients	FB/FD @ bdc2.0	Westminster
June	Se and Fe(Trec)	FD @ bdc1.5	Broomfield WW
	E. coli	FD @ bdc2.0	Thornton
	Nutrients	FD @ bdc2.0	Westminster
September	All WQ (incl CN-)	FD @ bdc5.0	All
	Nutrients	FB/FD @ bdc2.0	Westminster
December	Se and Fe(Trec)	FD @ bdc1.5	Broomfield WW
	E. coli	FD @ bdc2.0	Thornton
	Nutrients	FD @ bdc2.0	Westminster

[1] FB = Field Blank, FD = Field Duplicate

7. Data Management/Handling

Data Review: All data generated for the program will be evaluated against the appropriate quality control criteria contained in the referenced methods and each

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.

Practical Quantitation Limits: Practical Quantitation Limits (PQL), used here as synonymous with reporting limits, are each laboratory's lowest reportable level of a given analyte. Analyte results lower than a PQL without an applicable MDL are shown as < (less than). See Table 2a for each PQL.

Method Detection Limits: Method Detection Limits (MDL) are statistically derived values that state with 99.5% confidence that the value is not zero. These will be reviewed and updated by each laboratory as needed, but at least annually. The current MDL for each applicable analysis must be associated with the result (see Table 2a). All results below the MDL will be flagged with a "U" Qualifier. Values between an MDL and the PQL will be flagged with a "J" Qualifier.

Data storage: All data generated by/for each City laboratory are entered into the city's Laboratory Data Management System (LDMS) or Excel. All of the participating laboratories are using various 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 ten 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.

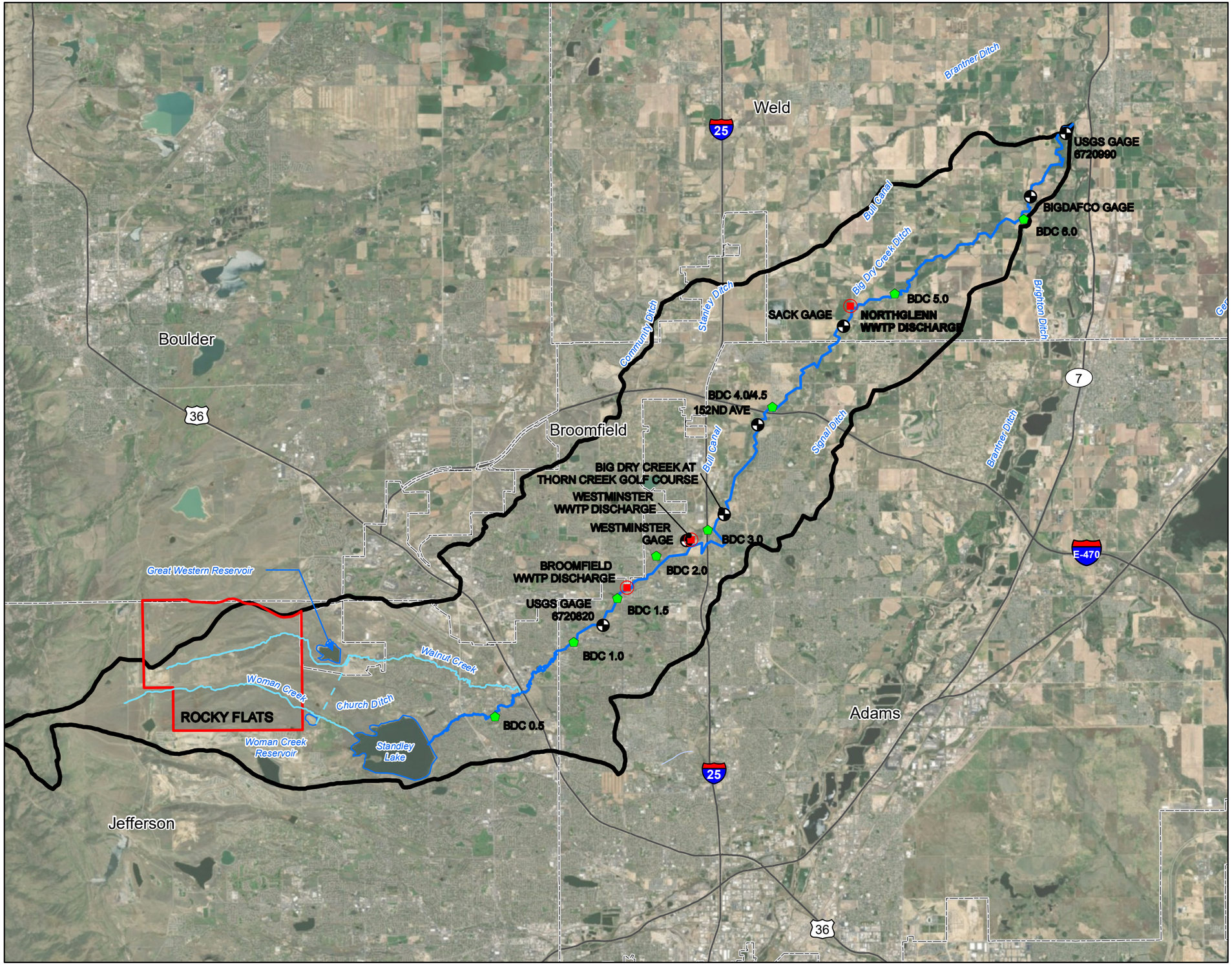
Attachments

Map 1. Big Dry Creek Monitoring Locations

Map 1

BIG DRY CREEK WATERSHED

KEY FEATURES AND MONITORING LOCATIONS



Legend

- Wastewater Discharge
- Monitoring Location
- Stream Gage
- Big Dry Creek
- Big Dry Creek Watershed

N
W E
S

0 6,000 12,000 24,000 FEET

PROJECT NO. 971-179.091

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Attachment 1. Big Dry Creek Monitoring Program Field Sheet

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)

Attachment 2. Allowable STORET values for Field Observations

Big Dry Creek Field Visit Record

Station Visit Start Date _____

Activity Start Time _____

Station ID _____

Field Personnel _____

Characteristic *(Circle appropriate allowed value)*	**Allowed Value**	**Description**
WEATHER CONDITION (WMO 4501 CODE LIST)	0	Cloudless.
	1	Cloudy or partly cloudy.
	2	Overcast.
	3	Drifting snow, or dust/sand storm. Visibility l.t. 1000 M.
	4	Fog or dust. Visibility l.t. 1000 M.
	5	Drizzle or light rain.
	6	Rain.
	7	Snow, sleet, or hail.
	8	Rain showers.
	9	Thunderstorms. Squalls. Rain, sleet, snow, or hail.
ICE - SEVERITY (CHOICE LIST)	NONE	None. Old STORET Code 0.
	MILD	Mild. Old STORET Code 1.
	MODERATE	Moderate. Old STORET Code 2.
	SERIOUS	Serious. Old STORET Code 3.
	EXTREME	Extreme. Old STORET Code 4
FLOW, STREAM CLASS (CHOICE LIST)	1	Flow less than 1.0 CFS.
	2	Flow between 1 and 5 CFS.
	3	Flow between 5 and 10 CFS.
	4	Flow between 10 and 25 CFS.
	5	Flow between 25 and 50 CFS.
	6	Flow between 50 and 100 CFS.
	7	Flow between 100 and 250 CFS.
	8	Flow between 250 and 500 CFS.
	9	Flow above 500 CFS.
	DRY	Dry. Old STORET Code 1.
	LOW	Low. Old STORET Code 2.
	NORMAL	Normal. Old STORET Code 3.
	FLOOD	Flood. Old STORET Code 4.
	ABOVE NORMAL	Above Normal. Old STORET Code 5.
HYDROGRAPH LIMB (CHOICE LIST)	BASE	Base. Old STORET Code 1.
	RISING	Rising. Old STORET Code 2.
	PEAK	Peak. Old STORET Code 3.
	FALLING	Falling. Old STORET Code 4.
BANK EROSION STABILITY (CHOICE LIST)	STAB	Stable. No evidence of erosion or bank failure.
	MDST	Moderately stable. Small areas of erosion.
	MDUS	Moderately unstable. Eroded areas of moderate frequency.
	UNST	Unstable. Many eroded areas. Frequent 'raw' areas.
BANK VEGETATIVE STABILITY (CHOICE LIST)	E	Excellent. Over 80 % of streambank covered by vegetation.
	G	Good. 50 to 79 % of streambank covered by vegetation.
	F	Fair. 25 to 49 % of streambank covered by vegetation.
	P	Poor. Less than 25 % of streambank covered by vegetation.
RBP2, WATER QUALITY, WATER ODORS	NONE	Normal/none
	PETROLEUM	Petroleum
	FISHY	Fishy
	SEWAGE	Sewage
	CHEMICAL	Chemical
	OTHER	Other (use "Result Comment" for description)
RBP2, WATER QUALITY, WATER SURFACE OILS	SLICK	Slick
	NONE	None
	SHEEN	Sheen
	GLOBS	Globs
	FLECKS	Flecks
	OTHER	Other (use "Result Comment" for description)
RBP2, WATER QUALITY, TURBIDITY	CLEAR	Clear
	OPAQUE	Opaque
	SLIGHTLY TUR	Slightly turbid
	STAINED	Stained
	TURBID	Turbid
	OTHER	Other (use "Result Comment" for description)
RBP2, WATERSHED, LOCAL NPS POLLUTION	NONE	No evidence of Non-point source pollution
	SOME	Some potential sources of Non-point source pollution
	OBVIOUS	Obvious sources of Non-point source pollution
RBP2, WATERSHED, LOCAL EROSION	NONE	No local watershed erosion
	MODERATE	Moderate local watershed erosion
	HEAVY	Heavy local watershed erosion

Visit Comments (text): (e.g., algae, construction activities, ditch diversions, Standley Lake releases, other conditions)

Attachment 3. Regulation 38 Stream Standards for Big Dry Creek

1. Mainstem of Big Dry Creek, including all tributaries and wetlands, from the source to the confluence with the South Platte River, except for specific listing in Segments 4a, 4b, 5 and 6.

COSPBD01	Classifications
Designation	Agriculture
UP	Aq Life Warm 2
	Recreation P

Qualifiers:

Other:

*chlorophyll a (mg/m^2)(chronic) = applies only above the facilities listed at 38.5(4).
*Phosphorus(chronic) = applies only above the facilities listed at 38.5(4).
*Selenium(acute) = 19.1 ug/L from 11/1 - 3/31
TVS from 4/1 - 10/31.
Refer to Section 38.6(4)(d).
*Selenium(chronic) = 15 ug/L from 11/1 - 3/31
7.4 ug/L from 4/1 - 10/31.
Refer to Section 38.6(4)(d).

Physical and Biological

	DM	MWAT
Temperature °C	WS-I	WS-I
	acute	**chronic**
D.O. (mg/L)	---	5.0
pH	6.5 - 9.0	---
chlorophyll a (mg/m^2)	---	150*
E. Coli (per 100 mL)	---	205

Inorganic (mg/L)

	acute	chronic
Ammonia	TVS	TVS
Boron	---	0.75
Chloride	---	---
Chlorine	0.019	0.011
Cyanide	0.005	---
Nitrate	100	---
Nitrite	---	4.5
Phosphorus	---	0.17*
Sulfate	---	---
Sulfide	---	0.002

Metals (ug/L)

	acute	chronic
Aluminum	---	---
Arsenic	340	100(T)
Beryllium	---	100(T)
Cadmium	TVS	TVS
Chromium III	TVS	TVS
Chromium III	---	100(T)
Chromium VI	TVS	TVS
Copper	TVS	TVS
Iron	---	1000(T)
Lead	TVS	TVS
Manganese	TVS	TVS
Mercury	---	0.01(t)
Molybdenum	---	150(T)
Nickel	TVS	TVS
Selenium	---	varies*
Selenium	varies*	---
Silver	TVS	TVS
Uranium	---	---
Zinc	TVS	TVS