



# STATE OF THE WATERSHED

Annual Newsletter of the Big Dry Creek Watershed Association

December 2019

Volume 21

## Big Dry Creek 2018 Water Quality Monitoring Review

A key focus of the Big Dry Creek Watershed Association (BDCWA) is annual assessment of water quality conditions in Big Dry Creek. In the spring of each year, BDCWA uploads the results of the instream water quality monitoring program into a long-term water quality database and compares the results to applicable water quality standards for Big Dry Creek. Findings are documented in an annual water quality report that is presented and discussed at the March BDCWA public meeting and then posted to the BDCWA website.

Biennially, biological monitoring is also conducted at a subset of the wa-

ter quality monitoring sites. The most recent round of biological monitoring, which was conducted by Aquatics Associates, occurred during October 2018.

This brief article highlights some of the key findings of the 2018 water quality analysis, based on analysis of the data completed during 2019. (Results for 2019 sampling will be incorporated into the 2020 annual report.)

In 2018, water quality samples were collected and analyzed for a variety of constituents. Metals were monitored on a quarterly basis, with the exception of iron, which was monitored monthly. All

## Inside this

<i>Big Dry Creek 2018 Water Quality and Biological Monitoring Review</i>	1
<i>A Preview of Analyses of the Big Dry Creek Watershed using the Agricultural Ecosystems Services (AgES) Model</i>	3
<i>Big Dry Creek Biological Monitoring Results for 2018</i>	4
<i>Floodplain Restoration at Thornton's Big Dry Creek's Pilot Project Nearing Completion</i>	6
<i>BDCWA's Commitment to Water Quality Education during 2019: Colorado E. coli Symposium</i>	7
<i>What is the Big Dry Creek Watershed Association?</i>	8

All Watershed Association general membership meetings are open to the public.

Meetings are generally held on a quarterly basis in March, June, September and December.

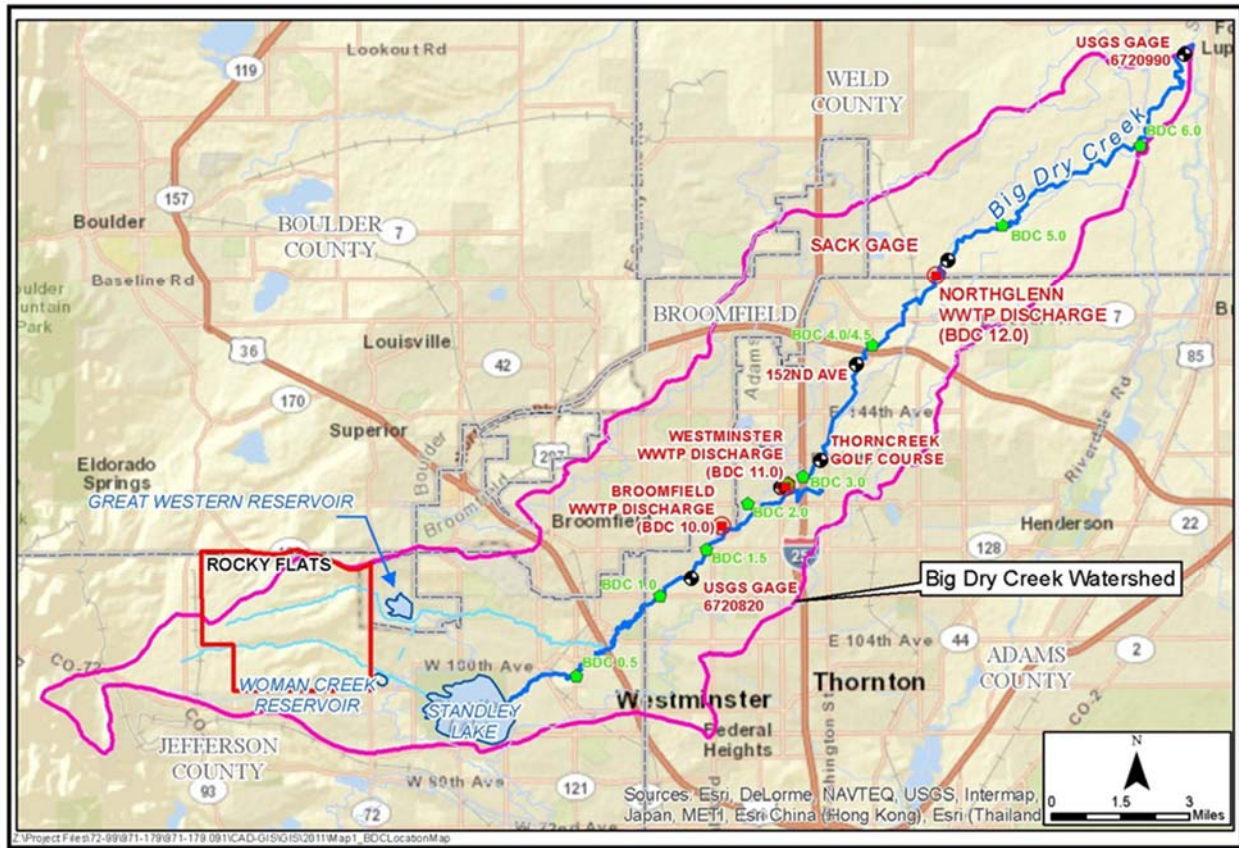
For More Information on the Next Watershed Meeting, contact Jane Clary: 303-480-1700 or visit our website:

[www.bigdrycreek.org](http://www.bigdrycreek.org)

The Big Dry Creek Watershed Association is a 501(c)(3) corporation.



Big Dry Creek during low flow conditions in Westminster in April 2019.



(Big Dry Creek 2018 Water Quality Review, Continued from page 1)

other constituents were monitored on a monthly basis. BDCWA communities also funded operation of the USGS gauging station at Westminister behind Front Range Community College.

Key findings and recommendations regarding Big Dry Creek water quality and aquatic life conditions based on analysis of the 2018 data set include:

- ◆ Water quality in Big Dry Creek attained currently applicable stream standards, with the exception of *E. coli* for the entire stream and total recoverable iron for the reach below Weld County Road 8 (bdc6.0).
- ◆ *E. coli* concentrations are elevated at multiple instream locations, with the highest concentrations present at bdc3.0 at I-25 and at bdc6.0 in the lower agricultural area. *E. coli* concentrations in the WWTP discharges are very low and meet stream standards.
- ◆ Big Dry Creek below Weld County Road 8 is listed as impaired on the 2020 303(d) List for elevated total recoverable iron concentrations, which are expected to be due to

streambank and soil erosion in the lower watershed.

- ◆ For the most recent five-year analysis period (2014-2018), Big Dry Creek attained its site-specific selenium standard. In 2016, the stream was removed from the 303(d) List of impaired waters.
- ◆ Big Dry Creek does not attain the warm water instream nitrogen and phosphorus “interim values” below WWTP discharges (from the Broomfield WWTP to the South Platte River). Although these values are not expected to be adopted as stream standards on the main stem of Big Dry Creek below WWTP discharges prior to 2027, addressing nutrient sources on Big Dry Creek is an increasing area of focus for BDCWA. Phosphorus loads to Big Dry Creek have decreased over time as a result of WWTP upgrades at the Broomfield and Westminister WWTPs, along with reuse programs that continue to be implemented at these WWTPs.

For a copy of the 2018 Annual Report, visit <http://www.bigdrycreek.org/>.



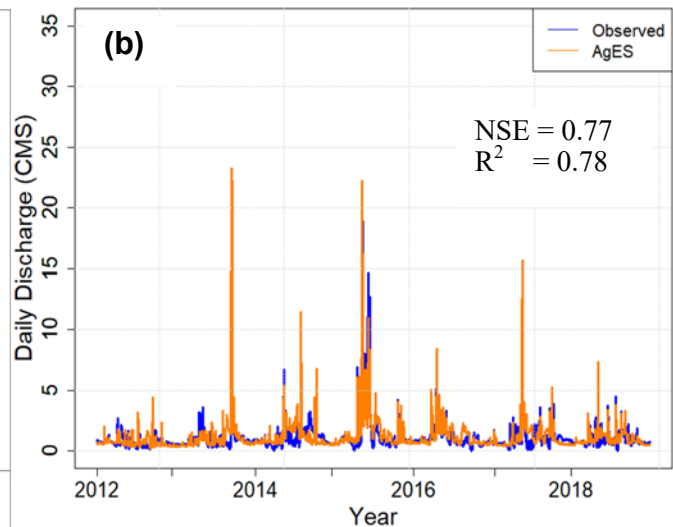
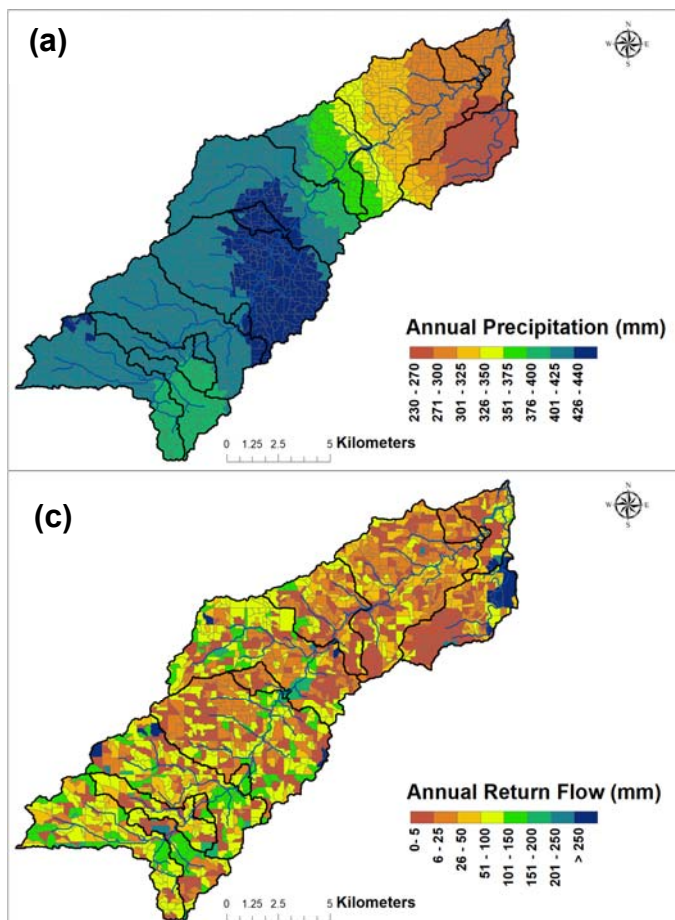
## A Preview of Analyses of the Big Dry Creek Watershed using the Agricultural Ecosystems Services (AgES) Model

Agricultural conservation practices are widely used to combat the negative impacts on ecosystem services. Issues include water quality improvement, flow regulation, and soil erosion control. However, the effective mitigation of non-point sources of pollution is challenging because of the variability in space and time of pollutant sources and their routing. Physically distributed watershed models can be used to evaluate the benefits of agricultural conservation practices at different scales. A team led by Dr. Tim Green of USDA-Agricultural Research Service and Dr. Anoop Valiya Veetil at Colorado State University are using the Agricultural Ecosystem Services (AgES) model to simulate the Big Dry Creek watershed and each irrigated field. AgES is continuous in time (daily time step), fully distributed in space, and capable of routing water, nutrients, and sediments among the smallest spatial units (hydrologic response units or HRUs). The over-

all objectives of this research are to evaluate transport of water and nitrogen, and to explore how the landscape positions of agricultural conservation practices might influence their performance in irrigated agricultural systems.

Currently, the developed model has been calibrated to the observed streamflow (USGS: 06720990) at a daily time scale for 7 years (2012-2018), and initial results are illustrated below. The model performance was evaluated by using goodness-of-fit criteria, such as coefficient of determination ( $R^2$ ) and Nash-Sutcliffe Efficiency (NSE). Additionally, the annual return flow (surface and sub-surface) is being quantified over the watershed. The spatial pattern shows the HRU-level contribution and variation of return flow within each sub-catchment.

A final modeling report is anticipated in mid-2020.



**Figures (a)** Spatial distribution of annual average precipitation across the Big Dry Creek Watershed; **(b)** Time series plot of AgES model simulated and observed stream flow at a daily time step. Here the unit of discharge is cubic meters per second (CMS); and **(c)** Spatial distribution of annual average return flow in the watershed. (Note: Black lines show the boundaries of 16 sub-catchments over the watershed).

## Big Dry Creek Biological Monitoring Results for 2018

BDCWA conducts a biennial macroinvertebrate and fish monitoring program during the month of October in even years. The most recent sampling was completed in October 2018. Biological monitoring in the Big Dry Creek Watershed has now been conducted for over 20 years, with the next round of sampling scheduled for 2020. The fall 2018 event was completed approximately five years after the September 2013 flood event, which altered some channel characteristics.

### Benthic Macroinvertebrate (“bug”) Results

For benthic macroinvertebrate monitoring, several types of evaluation are completed, including calculation of the invertebrate community index (ICI) and Colorado’s multi-metric index (MMI), along with other metrics. For purposes of evaluating compliance with Colorado’s Aquatic Life Use Attainment Policy 10-1, MMI scores are the primary focus. The table below provides a summary of MMI results for macroinvertebrate data collected in the fall of 2012, 2014, 2016 and 2018 for the aquatic monitoring program on Big Dry Creek.

All 2018 sites met use attainment in 2018 (MMI >29). Sites bdc0.5 and bdc1.0 had the



*Aquatics Associates staff and volunteers conduct fish shocking as part of biological monitoring on the creek during 2018.*

highest MMI scores with these in the High Scoring Waters category (MMI >51 for biotype 3). The lowest MMI score in 2018 was at site bdc3.0.

For the more recent four sampling years over the past seven years, only bdc5.0 in 2016 did not meet use attainment. However, the most recent MMI data for this site demonstrated attainment. The cause for the unusual 2016 scores at this

Site	Location	MMI Score				4-Year Mean
		2012	2014	2016	2018	
<b>BDC 0.5</b>	d/s from Old Wadsworth Ave., at Church Ranch Open Space	<b>60.2</b>	50.9	<b>52.9</b>	<b>55.2</b>	54.8
<b>BDC 1.0</b>	u/s from 112th Ave.	47.5	50.0	41.4	<b>55.9</b>	48.7
<b>BDC 1.5C</b>	d/s from 120th Ave., u/s Broomfield WWTP	<b>59.5</b>	<b>58.3</b>	43.4	46.3	51.9
<b>BDC 2.0</b>	u/s from 128th Ave., d/s from Broomfield WWTP	37.2	<b>52.4</b>	46.7	44.8	45.3
<b>BDC 3.0</b>	at I-25, d/s from Westminster WWTP	45.5	41.7	42.0	39.3	42.1
<b>BDC 5.0</b>	d/s from Weld County Rd. 4	<b>58.2</b>	41.1	24.9	43.8	42.0
<b>Annual Mean</b>		51.4	49.1	41.9	47.6	

*Big Dry Creek MMI scores calculated using EDAS V. 4 for Biotype 3. Values in bold are high-scoring waters. Values below 29 are considered impaired.*

Site	Location	Johnny Darter Count				
		2010	2012	2014	2016	2018
<b>BDC 0.5</b>	d/s from Old Wadsworth Ave., at Church Ranch Open Space	40	3	2	0	1
<b>BDC 1.0</b>	u/s from 112th Ave.	2	1	0	9	63
<b>BDC 1.5C</b>	d/s from 120th Ave., u/s Broomfield WWTP	0	0	1	4	60
<b>BDC 2.0</b>	u/s from 128th Ave., d/s from Broomfield WWTP	0	0	0	1	19
<b>BDC 3.0</b>	at I-25, d/s from Westminster WWTP	0	0	0	0	0
<b>BDC 5.0</b>	d/s from Weld County Rd. 4	0	0	0	11	1

site are not known; however, this site is located below a substantial ditch diversion, so BDCWA intends to explore whether there could have been a flow-related cause for these results.

Fish Results

In 2018 good numbers of fish (e.g., 1,000 or more fish) were collected at all sites except bdc1.5c, where only about 300 fish were collected. The most fish (over 2,200) were collected at bdc0.5. Also notable in 2018 was high fish numbers at bdc2.0 (below the Broomfield WWTP) occurring for the fourth consecutive sampling event. The abundant fish population in 2018 was also generally in good health as indicated by the low mean disease rating for “black spot” disease.

Fathead minnows are the most abundant species system-wide with white suckers, creek chubs, longnose dace, and sand shiners relatively abundant as well. Johnny darters appear to have had resurgence in numbers (see table above). This species is important because of Regulation 31 temperature standards for Big Dry Creek Segment 1. In 2018, Johnny darter numbers increased notably, especially at sites bdc1.0 and bdc1.5c where 63 and 60 individuals were collected, respectively. In 2016, only 9 and 4 individuals, respectively, were collected at these sites, which in that year was notable because so few individuals had been collect-

ed in previous years. At site bdc0.5 in 2018, where they historically have been most abundant, only one individual was collected. In contrast, during 2018, 19 Johnny darters were collected at bdc2.0, where only one was collected in 2016 and none were collected since 2001. At site bdc5.0 in 2016, 11 individuals were collected for the first time over the study period, but in 2018, only one individual was collected. Hypotheses related to sources of year-to-year variation will be included in the 2018 biological monitoring report.

In 2020, BDCWA will continue its biological monitoring program with sampling in October.



*Johnny darter collected on Big Dry Creek during 2018. Johnny darters are a key fish species driving temperature standards on Big Dry Creek.*



### Channel Degradation on Big Dry Creek Near 152nd Parkway and E-470 Prior to Restoration Project



### Floodplain Restoration at Thornton's Big Dry Creek's Pilot Project Nearing Completion

The Big Dry Creek Floodplain Restoration Project at the city of Thornton's open space between 152nd Parkway and E-470 west of York Street, is almost complete. Mile High Flood District's contractor hopes to finish the channel reconstruction by the end of January 2020, with wildlife habitat and stream riparian plantings completed in May of 2020.

The project's goal is to reconnect Big Dry Creek to its historic floodplain—to improve channel stability, water quality, wildlife habitat and ecosystem health. With the South Platte River on Thornton's eastern edge and Niver Creek and its tributaries in the city's southwest area, Big Dry Creek provides outstanding opportunities for preservation and enhancement as a wildlife habitat, open space area and year-round passive recreation area. Design of a missing link of the Big Dry Creek Regional Trail originating at Standley Lake, from approximately 148th Avenue to 156th Avenue in Thornton, is also underway.

For more information about this project, contact Paula Schulte at [Paula.Schulte@cityofthornton.net](mailto:Paula.Schulte@cityofthornton.net).



Channel restoration in progress,  
December 2019

### Open Space Preservation in Thornton and Adams County

Almost 300 acres of open land in the Big Dry Creek corridor have been preserved by Thornton and Adams County, providing continuity with the upstream Westminster Open Space along the Big Dry Creek Corridor. Stream restoration projects such as this one are expected to improve habitat and provide recreational opportunities.

## BDCWA’s Commitment to Water Quality Education during 2019: Colorado *E. coli* Symposium

As a 501(c)(3), the goals of BDCWA include three broad categories: (1) public education and involvement, (2) monitoring and study, and (3) protecting, preserving and restoring water quality, aquatic life, and habitat.

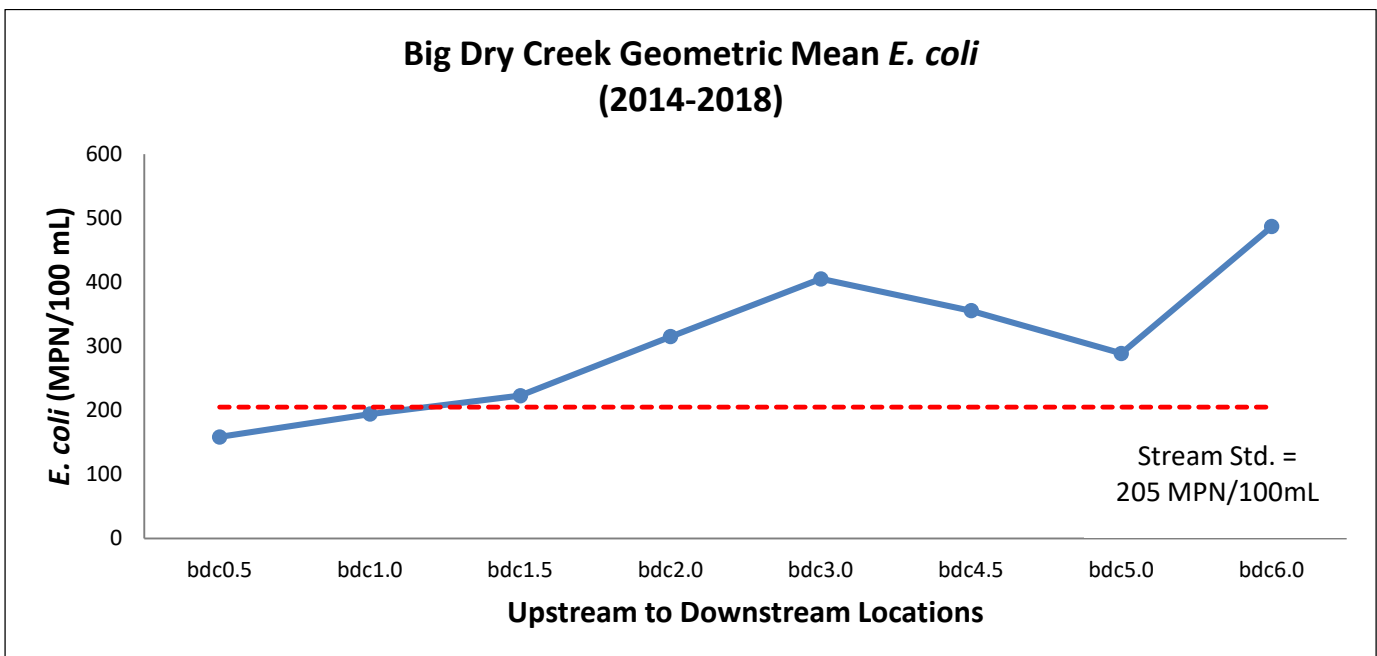
Consistent with its public education and involvement goals, during 2019, BDCWA served as a co-sponsor of Colorado’s first *E. coli* Symposium, which was held at the Arvada Center in March 2019. BDCWA worked with co-sponsors including the Colorado Department of Public Health and Environment, the Colorado Stormwater Council, and the Urban Drainage and Flood Control District. The one-day symposium focused on approaches to address water quality impairments in Colorado due to elevated levels of *E. coli*. Speakers included representatives from the Colorado Water Quality Control Division, EPA Region 8, local governments and consultants. The keynote speaker was Dr. Orin Shanks of EPA Office of Research Development who presented the most current information on microbial source tracking and provided some example applications from around the U.S.

The symposium provided practical information for local governments and others working to identify and reduce *E. coli* sources as a result of existing or future Total Maximum Daily Loads (TMDLs).

Several local examples of communities addressing *E. coli* issues in Colorado were part of the symposium, including Denver, Boulder and Big Dry Creek.

Because Big Dry Creek has a Total Maximum Daily Load (TMDL) for *E. coli*, BDCWA stakeholders, and particularly municipal separate storm sewer (MS4) discharge permittees, are interested in understanding sources of *E. coli* in Big Dry Creek and determining control measures that may be able to help reduce *E. coli* loading to the creek. BDDWA’s long-term monitoring program includes *E. coli*, and several special studies have been conducted to better understand this issue.

As discussed in the [Colorado \*E. coli\* Toolbox](#), the highest priority of local governments in urban areas is identifying human sources of bacteria loading to streams and reducing this loading. Recent work on Big Dry Creek suggests that there are likely natural sources such as birds that contribute *E. coli* to the creek. The downstream portion of the watershed in the agricultural area has areas where cattle access water in the creek, which is hypothesized to contribute to *E. coli* in the lower watershed. More work on is planned in 2020 to better understand and target controllable sources in the watershed.



## What is the Big Dry Creek Watershed Association?

The Big Dry Creek Watershed Association (BDCWA) is a non-profit corporation consisting of individuals and entities who dedicate time and resources to developing a sound scientific understanding of water quality, flow, aquatic life and habitat conditions in the Big Dry Creek watershed and act to improve these conditions.

The Big Dry Creek Partnership, which included the City and County of Broomfield, the Cities of Northglenn and Westminster, and Rocky Flats Environmental Technology Site (RFETS), founded the BDCWA in 1997. These entities have been heavily involved in monitoring stream conditions for many years. Since 1997, the Association has expanded to include representatives from other cities, counties, farmers, ditch companies, citizens and regulatory and resource agencies. The BDCWA is open to those interested in cooperatively working towards understanding and prioritizing efforts to improve basin conditions.

In 2004, the BDCWA formed a non-profit corporation with a Board of Directors currently consisting of representatives of the Cities of Westminster, Northglenn and Thornton, the City and County of Broomfield, Weld County and Adams County. Activities of the BDCWA during the last twenty years have been funded through the contributions from these entities, as well as the U.S. Department of Energy, the Woman Creek Reservoir Authority, the Colorado Water Conservation Board, the U.S. Environmental Protection Agency's 319 program (as administered by the Colorado Department of Public Health and Environment) and the Regional Geographic Initiative grant program.

For more information on the Big Dry Creek Watershed Association, please visit the BDCWA's website at [www.bigdrycreek.org](http://www.bigdrycreek.org) or contact Jane Clary, Watershed Coordinator, Wright Water Engineers, Inc., 303-480-1700 or [clary@wrightwater.com](mailto:clary@wrightwater.com).



Big Dry Creek Watershed Association  
c/o Wright Water Engineers, Inc.  
2490 W. 26th Ave., Suite 100A  
Denver, CO 80211