

BIG DRY CREEK

Biological Monitoring

Update

December 5, 2023



Aquatics Associates, Inc.
Fort Collins, CO

Biological Monitoring Sites in Big Dry Creek

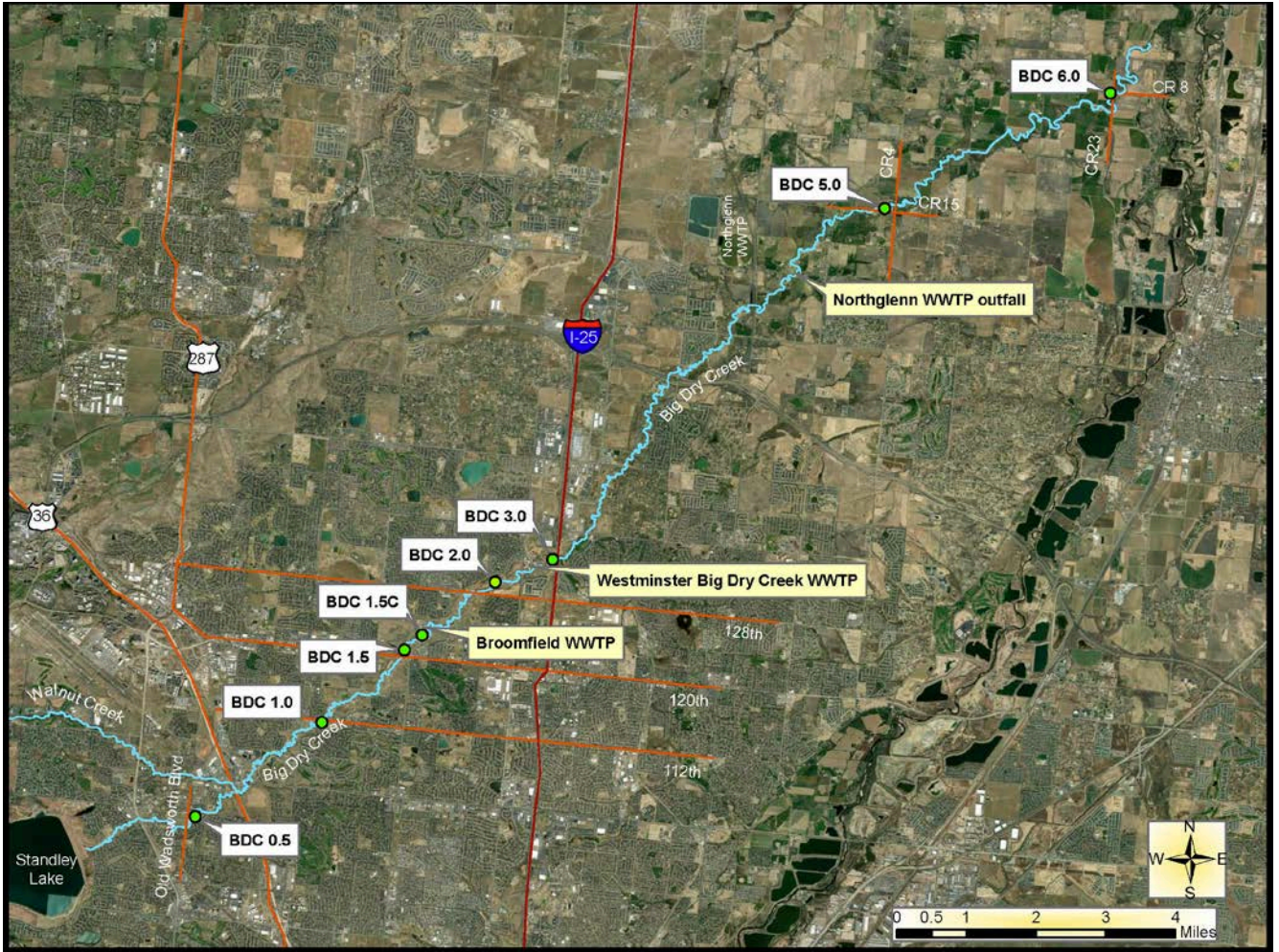


TABLE 1
BIOLOGICAL MONITORING SITES
IN BIG DRY CREEK, 2008-2022

<u>Study Site</u>	<u>Distance Between Sites</u>	<u>Cumulative Distance</u>
UPSTREAM FROM TREATMENT PLANTS		<i>Distance from Standley Lake dam</i>
bdc0.5 Church Ranch Open Space, downstream from Old Wadsworth Boulevard	1.5 mi.	1.5 mi.
bdc1.0 Upstream from 112 th Avenue	2.8 mi.	4.3 mi.
bdc1.5C Immediately upstream from Broomfield WWTP	0.4 mi.	6.2 mi.
DOWNSTREAM FROM TREATMENT PLANTS		
bdc2.0 Upstream from 128 th Avenue, downstream from Broomfield WWTP	1.5 mi.	7.7 mi.
bdc3.0 At Interstate-25, downstream from Westminster Big Dry Creek WWTP	1.0 mi.	8.7 mi.
bdc5.0 Downstream from Weld County Road 4	8.2 mi.	16.9 mi.

Sites bdc1.5 and bdc6.0 were eliminated in 2008.
Site bdc1.5C was added to the program in the spring 2000.

BDC Sampling



Macroinvertebrate sampling with kick net in the fall



Electrofishing - 2-pass removal shoreline shocking equipment

BDC Fish Sampling



BDC Fish Sampling



BDC Fish Sampling

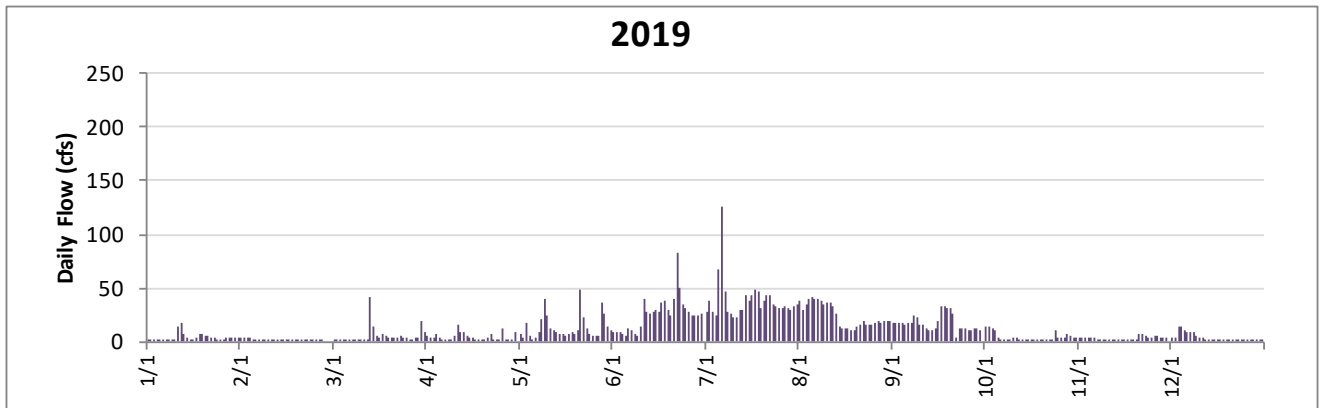
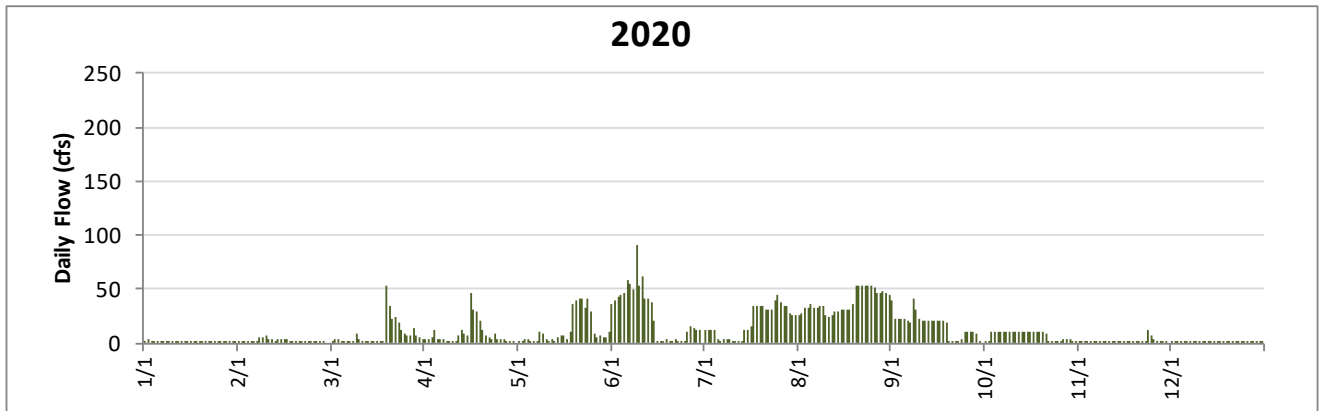
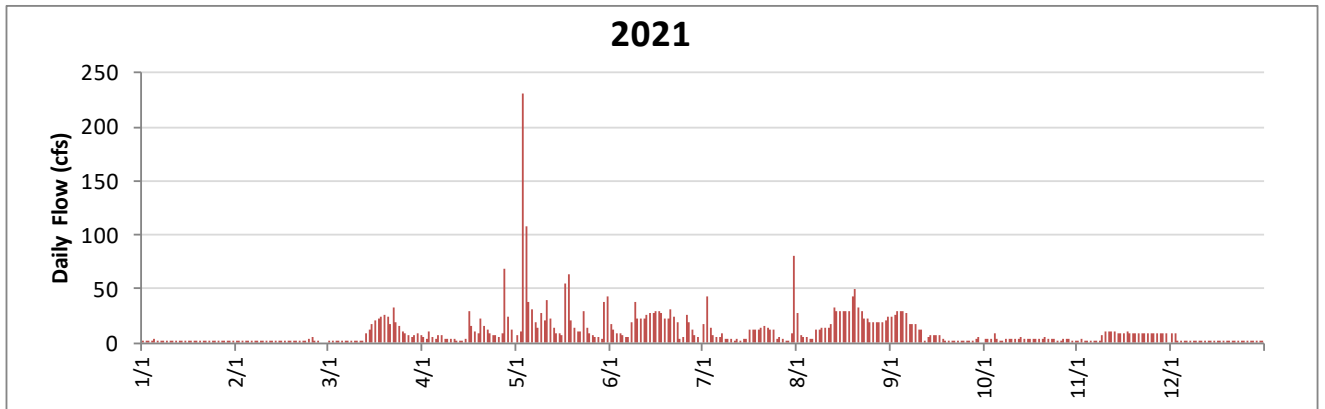
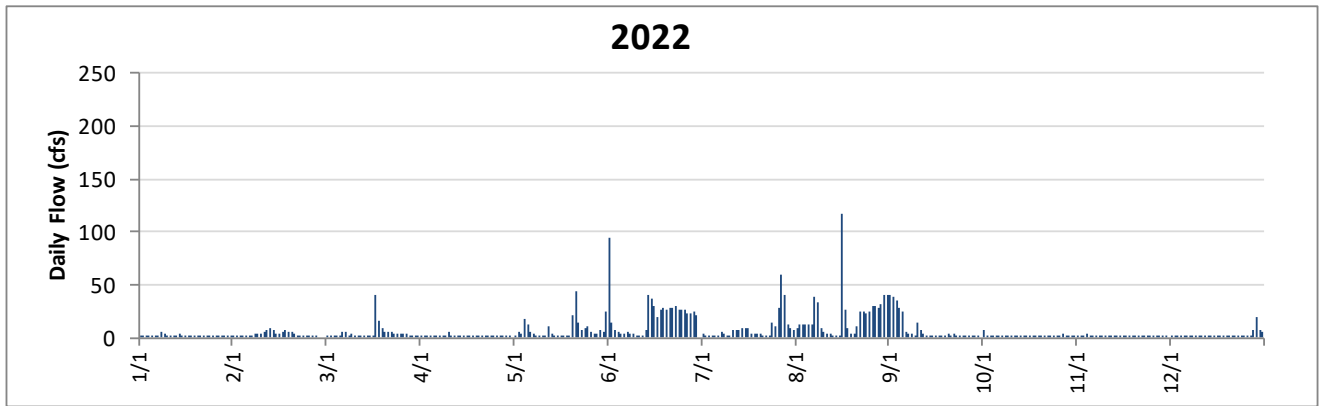


Fish processing setup and species sorting

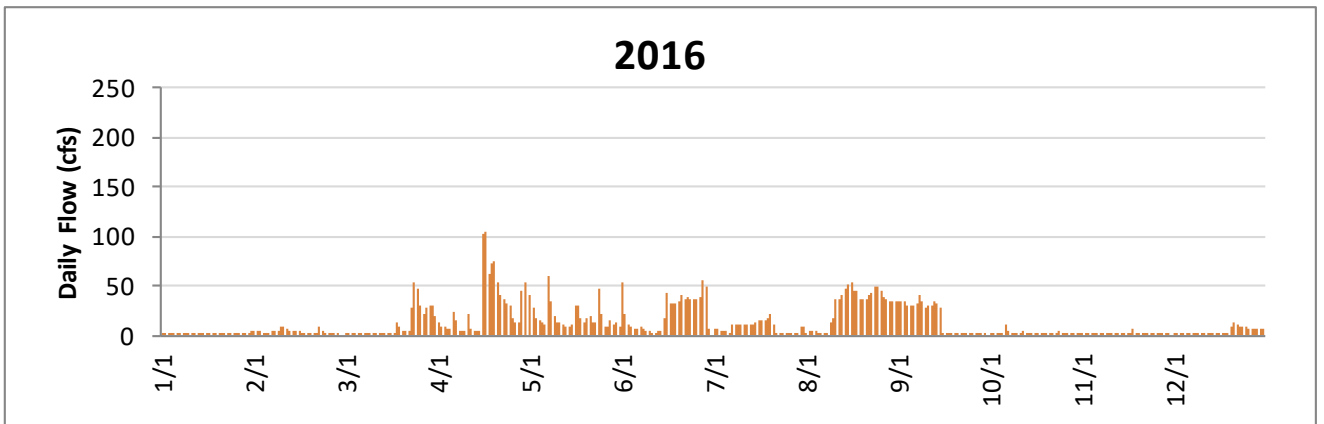
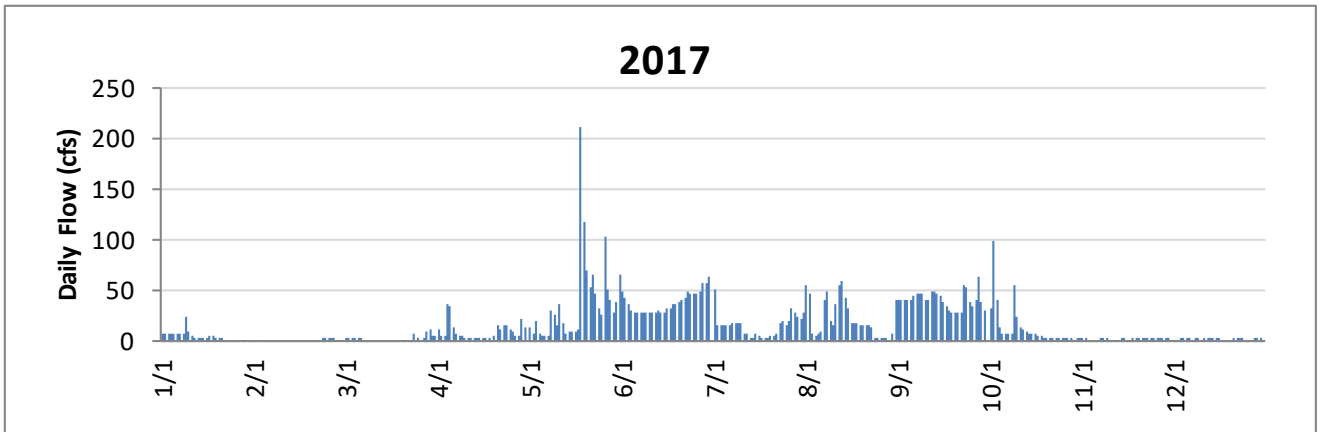
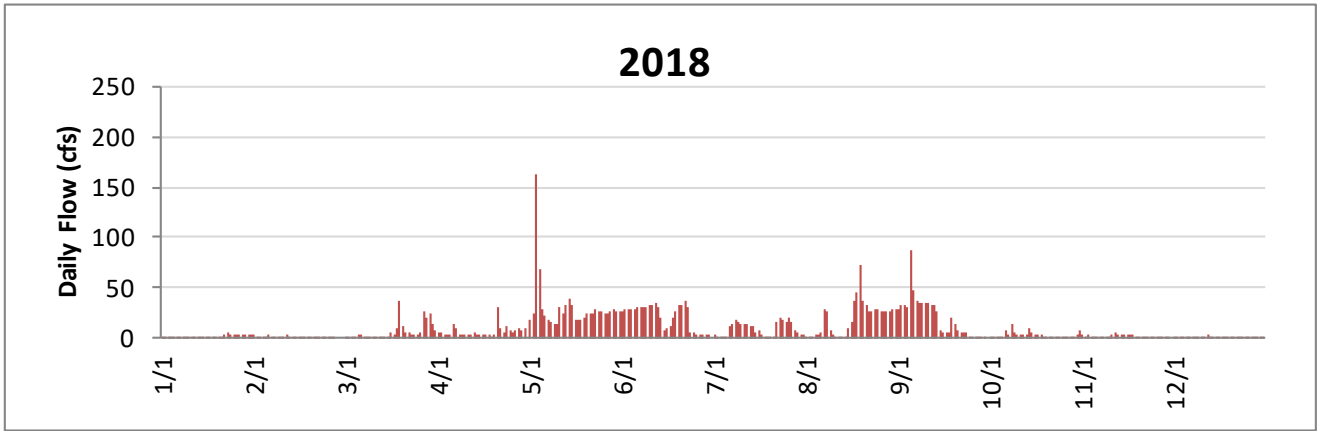


AAI teams taking fish measurements

Big Dry Creek Streamflow Data, 2019-2022



Big Dry Creek Streamflow Data, 2016-2018



Source: USGS Streamflow data for gage 06720820 Big Dry Creek at Westminster, CO. U.S. Dept. of Interior, U.S. Geological Survey.

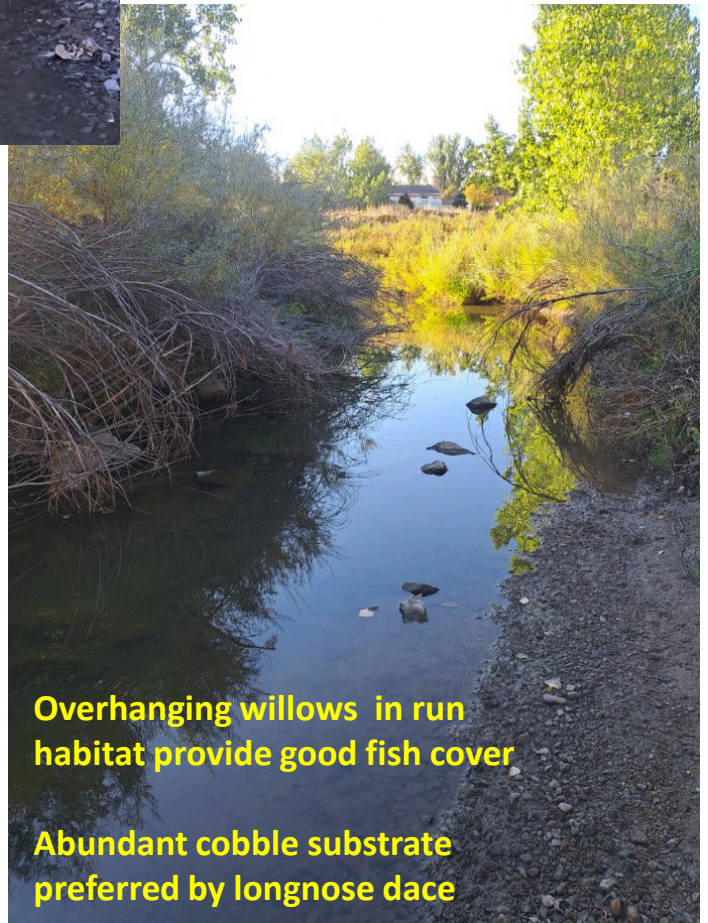
BDC 0.5



BDC 1.0



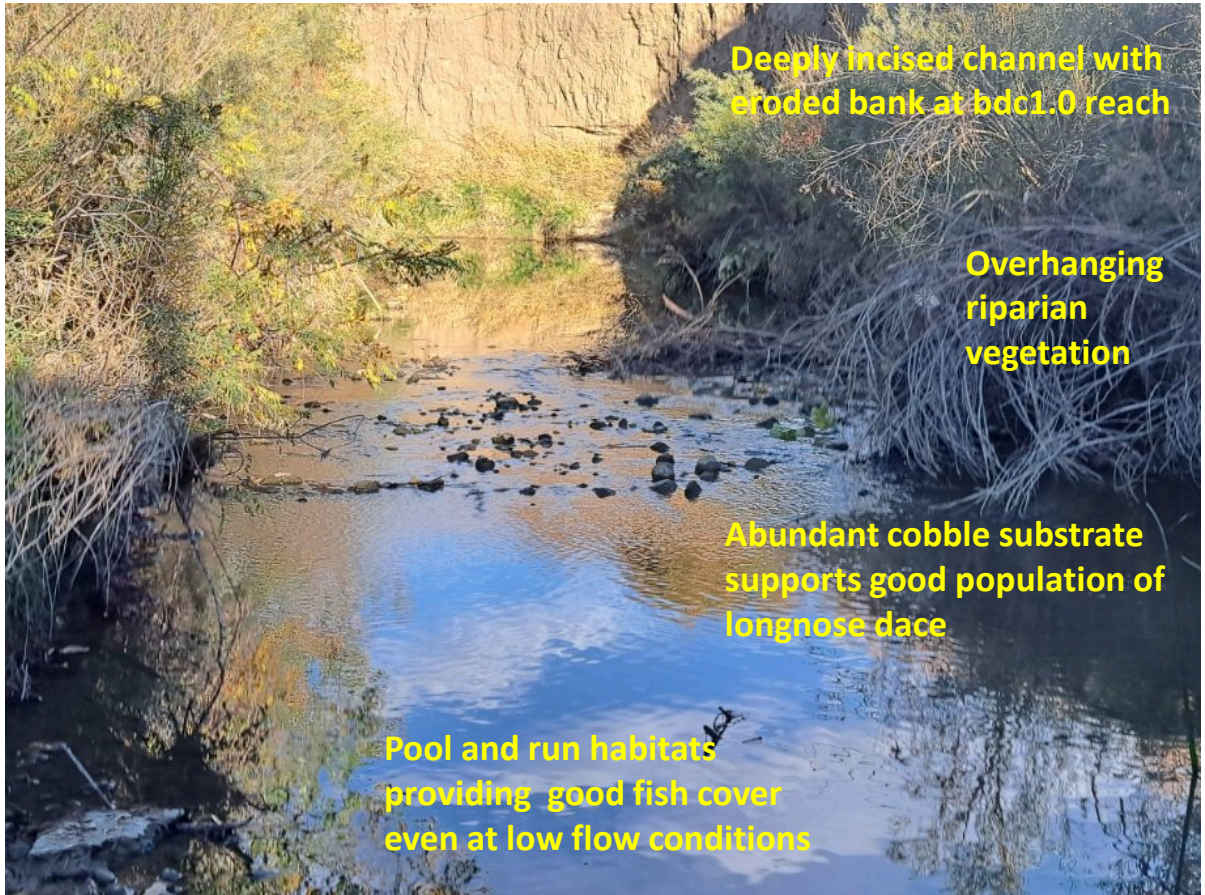
**Upstream end of bdc1.0 reach
shaded with good riparian growth**



**Overhanging willows in run
habitat provide good fish cover**

**Abundant cobble substrate
preferred by longnose dace**

BDC 1.0



BDC 1.5C



Bdc1.5C reach more channelized since 2018. Deep run habitat with sand/silty uniform bottom



Soft substrates are predominant at bdc1.5C



Only few areas with cobble and gravel substrates present

BDC 1.5C



BDC 2.0



**Sand and silt substrates
are predominant**

**Only small amounts of
periphytic algae are present**

**Few areas with gravel substrate
present in the bdc2.0 reach**

BDC 2.0

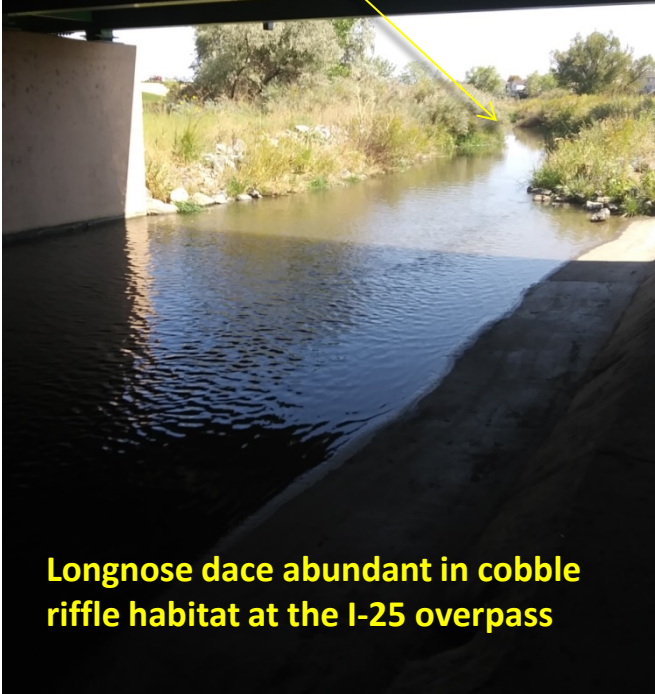


BDC 3.0



BDC 3.0

Location of Thornton's new pedestrian bridge completed in May 2022



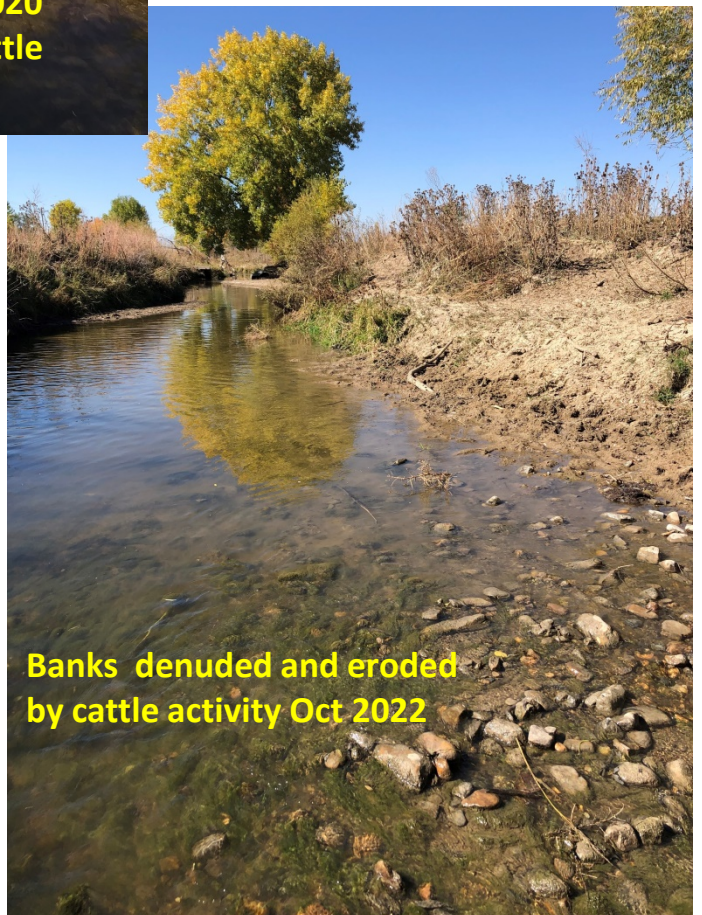
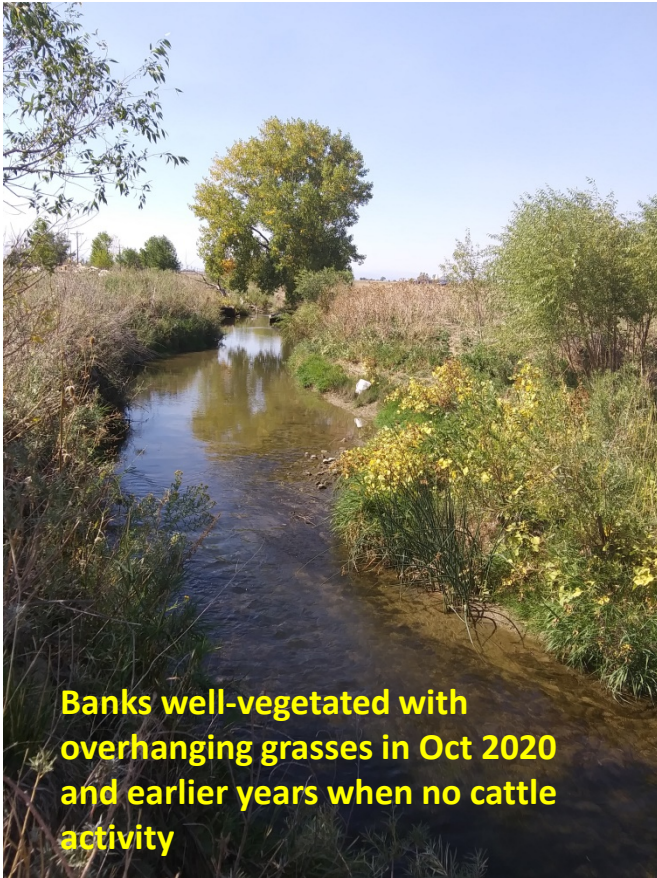
Longnose dace abundant in cobble riffle habitat at the I-25 overpass



New bridge downstream from I-25

Flooding at bdc3.0 on May 12, 2023 after 3 day rain event (~3-4 inches)

BDC 5.0



BDC 5.0



BDC 5.0

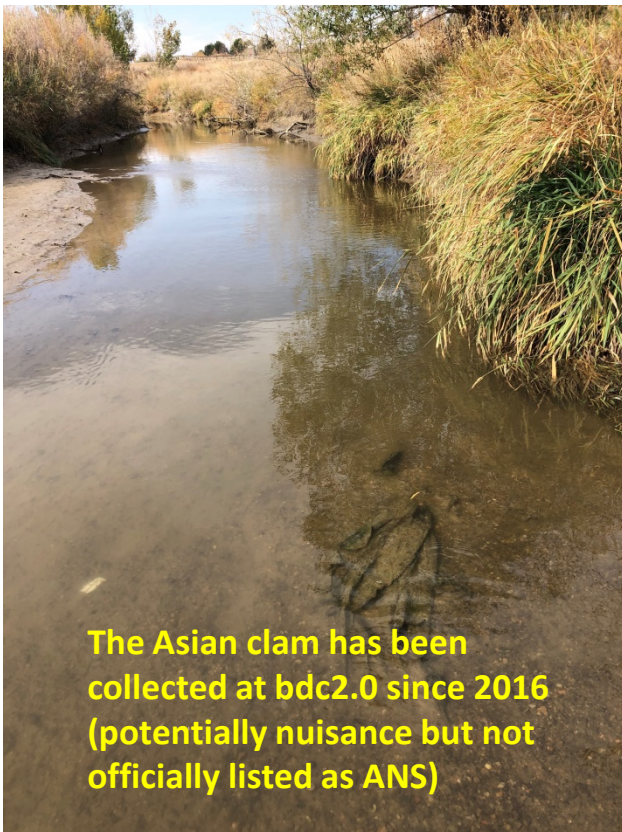


Upper pool, deepened by Sept 2013 flood event, has continued to fill in with sediment and was notably shallower in Oct 2020 and 2022



Sediment deposition evident in cobble areas resulting in less algae growth in Oct 2022 vs 2020

Important Nuisance Aquatic Species in BDC



BDC Important Native Fish Species



Johnny Darter presence is important species for water quality regulations in BDC Segment 1



Longnose Dace is the only intolerant species in the BDC system for Fish IBIs

Other Important Fish Species Collected in BDC BDC Reg 38 – Fish Ingestion Standard



Append B-1

FISH POPULATION DATA SUMMARY FALL 2022

RELATIVE ABUNDANCE

	0.5	1.0	1.5C	2.0	3.0	5.0
Longnose Dace	6.5	14.1	-	1.8	21.2	28.2
Creek Chub	26.9	37.7	44.7	3.7	0.1	25.3
Fathead Minnow	65.8	19.5	16.7	83.4	37.1	2.2
Sand Shiner	-	16.9	-	3.4	30.6	32.6
White Sucker	0.9	11.6	31.6	2.1	2.8	10.3
Johnny Darter	-	0.4	0.9	1.8	3.6	0.1
Green Sunfish	-	-	6.1	3.8	3.3	0.2
Brook Stickleback	-	-	-	-	-	0.1
Mosquitofish	-	-	-	-	0.2	0.8
Largemouth Bass	-	-	-	-	-	0.1
Common Carp	-	-	-	-	0.1	0.1
Black Crappie	-	-	-	-	1.0	-

NUMBER COLLECTED

	0.5	1.0	1.5C	2.0	3.0	5.0	overall- all sites	
							N	%
Longnose Dace	73	156	-	20	398	446	1093	15.8
Creek Chub	304	418	51	42	2	400	1217	17.5
Fathead Minnow	743	216	19	938	697	35	2648	38.2
Sand Shiner	-	187	-	38	576	515	1316	19.0
White Sucker	10	129	36	24	53	163	415	6.0
Johnny Darter	-	4	1	20	68	1		
Green Sunfish	-	-	7	43	62	3		
Brook Stickleback	-	-	-	-	-	1		
Mosquitofish	-	-	-	-	4	13		
Largemouth Bass	-	-	-	-	-	2		
Common Carp	-	-	-	-	2	1		
Black Crappie	-	-	-	-	18	-		
Total Collected	1130	1110	114 low	1125	1880 highest	1580 high	6939	
Total Species Collected	4	6	5	7	10	11	12	
Native Species	4 fewest	6	5	7	7	8 most species	8	

Append B-2

BDC FISH SUMMARY DATA 2000-2022

Comparison of Fish Numbers

Numbers of Fish Collected						
Years	0.5	1.0	1.5C	2.0	3.0	5.0
2000	1212	360	1149	230	990	1125
2001	780	351	496	222	152	794
2002	854	883	172	59	88	2612
2003	856	831	196	9	68	1762
2004	226	531	72	38	67	674
2006	841	2171	398	336	762	2660
2008	999	1012	206	66	255	611
2010	688	374	176	129	416	3833
2012	470	797	403	1394	1118	2849
2014	1474	541	289	629	691	419
2016	648	754	319	716	225	1772
2018	2260	1525	318	1615	936	1235
2020	1254	679	38	418	1720	521
2022	1130	1110	114 lowest	1125	1880 highest	1580 high

FIGURE 4
COMPARISONS OF NUMBERS OF FISH AND SPECIES COLLECTED AT
BIG DRY CREEK SITES, 2012-2022

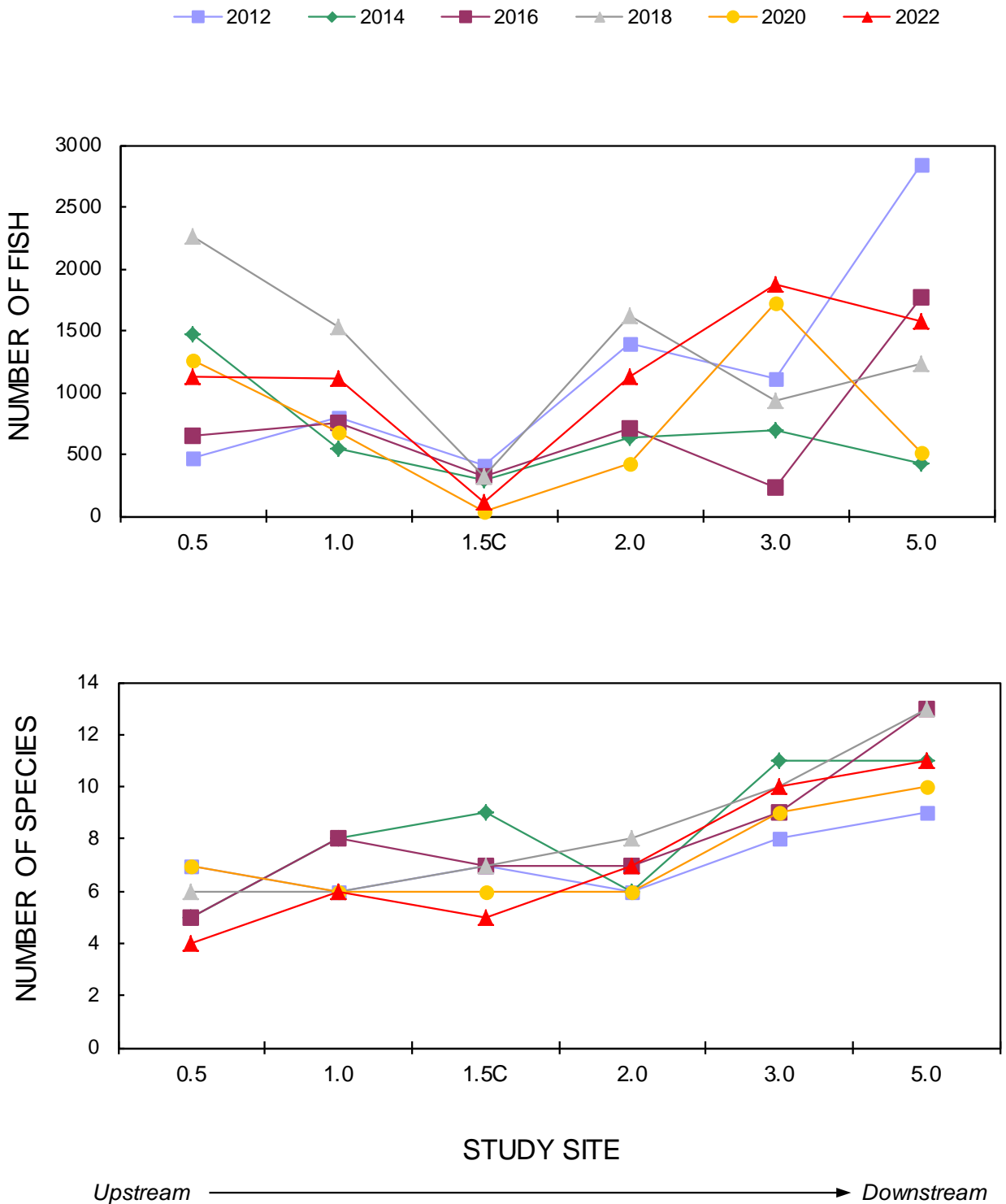
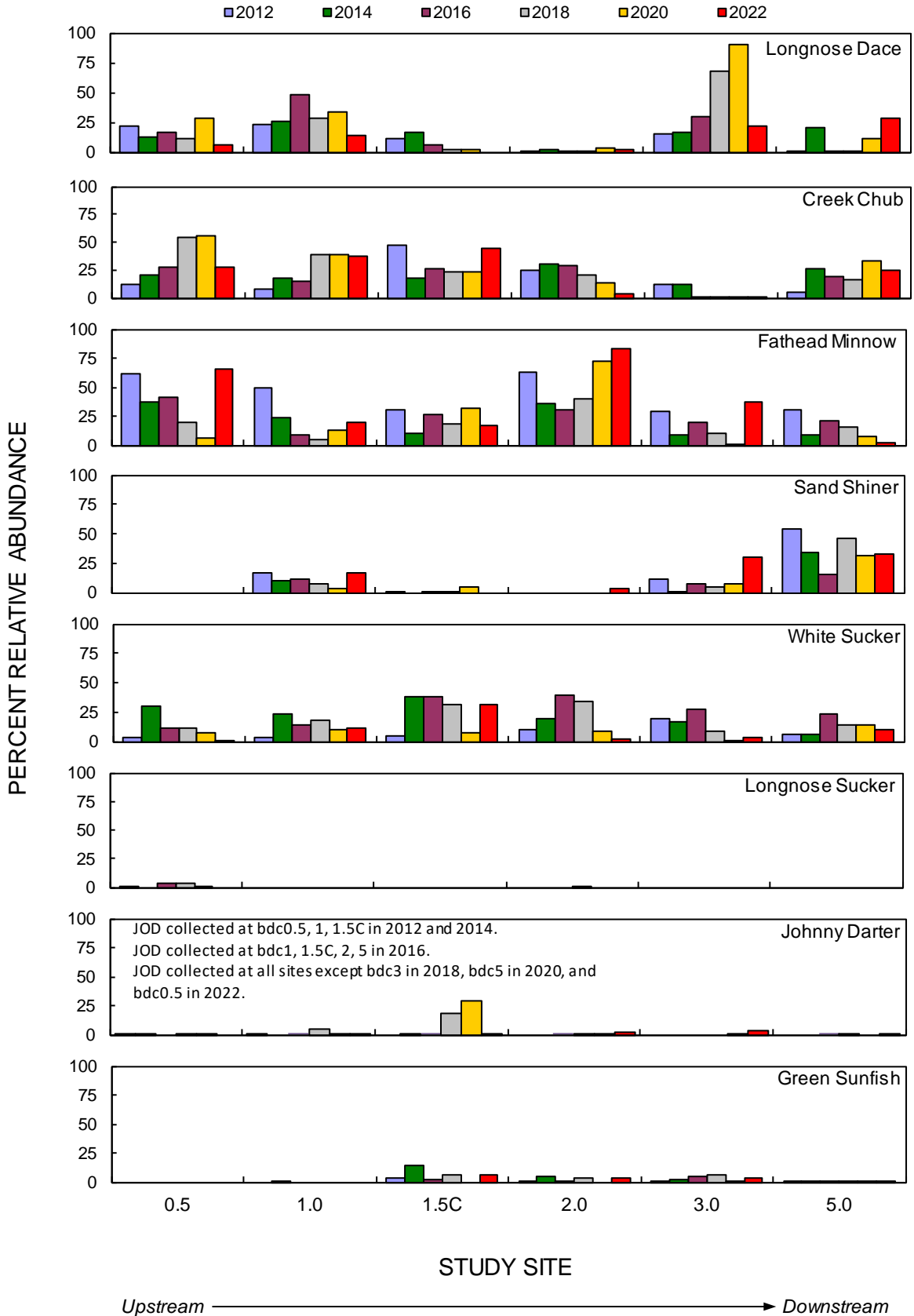


FIGURE 3
PERCENT ABUNDANCE OF NUMERICALLY DOMINANT AND IMPORTANT
NATIVE FISH SPECIES AT BDC SITES, FALL 2012-2022



Append B-3

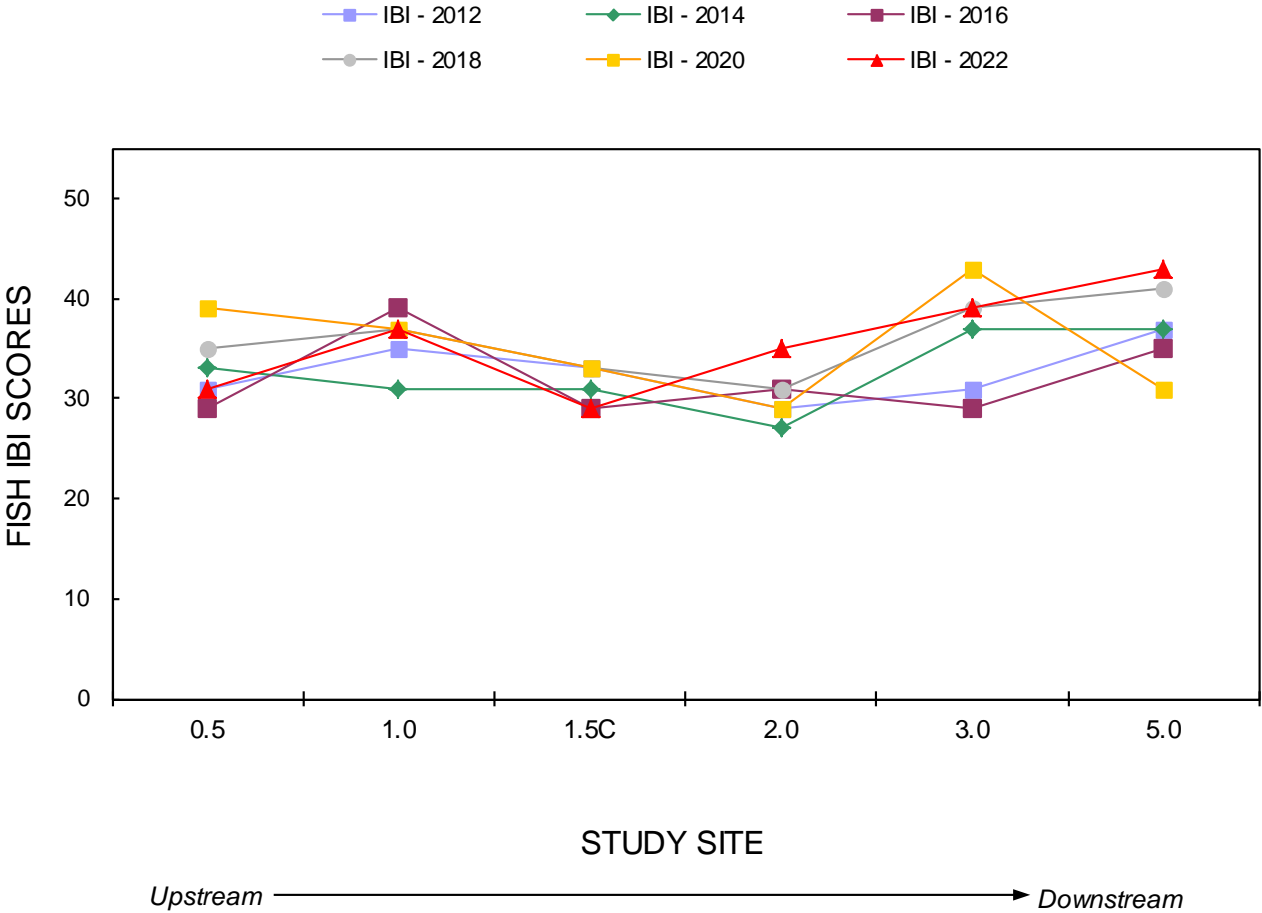
JOHNNY DARTER COLLECTIONS 1997-2022

Dates Sampled *	Numbers Collected					
	0.5	1.0	1.5C	2.0	3.0	5.0
1997 spring	10	5	ns	2	0	0
1997 fall	28	13	ns	0	0	0
1998	20	6	ns	4	0	0
1999	27	0	ns	0	0	0
2000	11	2	0	2	0	0
2001	15	0	0	1	0	0
2002	0	1	0	0	0	0
2003	0	0	0	0	0	0
2004	0	0	0	0	0	0
2006	0	0	0	0	0	0
2008	5	1	0	0	0	0
2010	40	2	0	0	0	0
2012	3	1	0	0	0	0
2014	2	0	1	0	0	0
2016	0	9	4	1	0	11
2018	1	63	60	19	0	1
2020	4	4	11	5	3	0
2022	0	4	1	20	68	1
No. of Years Collected 1997-2022	11	11	5	8	2	3
Total Individuals (when collected)	1-40	1-63	1-60	1-20	3, 68	1-11

* Fish sampling includes only Fall collections for 1998-2022 period.

ns = not sampled

FIGURE 5
COMPARISONS OF FISH INDEX OF BIOTIC INTEGRITY (IBI) SCORES
FOR BIG DRY CREEK, 2012-2022



Append B-4

FISH IBI SCORES

BIG DRY CREEK 2012-2022

IBI Score	0.5	1.0	1.5C	2.0	3.0	5.0
2012	31	35	33	29	31	37
2014	33	31	31	27	37	37
2016	29	39	29	31	29	35
2018	35	37	33	31	39	41
2020	39	37	33	29	43	31
2022	31	37	29	35	39	43
			lowest			highest
6-yr Mean IBI 2012-2022	33.0	36.0	31.3	30.3	36.3	37.3
		high		lowest	high	highest
mean up/down	33.4	upstream sites		34.7	downstream sites	

Condition Category	Score Range
Excellent	53 - 55
Good	44 - 52
Fair	37 - 43
Poor	29 - 36
Very Poor	11 - 28

Fish IBI Calculations

BDC 2022

IBI Metric	BDC-0.5		BDC-1		BDC-1.5C		BDC-2		BDC-3		BDC-5	
	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score
1 Total Number of Native Species	4	3	6	3	5	3	7	3	7	3	8	3
2 Number of Darter Species 1/	0	1	1	3	1	3	1	3	1	3	1	3
3 Number of Sunfish Species 1/	0	1	0	1	1	3	1	3	2	5	1	3
4 Number of Minnow Species 1/	3	5	4	5	2	3	4	5	4	5	5	5
5 Number of Intolerant Species 1/	1	3	1	3	1	3	1	3	1	3	1	3
6 % White Suckers 2/	0.9	5	11.6	5	31.6	5	2.1	5	2.8	5	10.3	5
7 % Omnivores 1/	66.6	1	31.1	3	48.3	1	85.5	1	40.0	3	12.6	5
8 % Specialized Insectivores 1/ 4	6.5	1	31.3	3	7.0	1	10.8	1	58.9	5	62.0	5
9 Numbers of Individuals (CPU)	1130	5	1110	5	114	1	1125	5	1880	5	1580	5
10 % Introduced Species 2/	0.0	5	0.0	5	0.0	5	0.0	5	1.3	1	1.0	3
11 % Diseased Individuals 1/	95.5	1	78.5	1	65.8	1	63.2	1	47.7	1	2.7	3
Total Score		31		37		29		35		39		43
Category		Poor		Fair		Poor		Poor		Fair		Fair

metrics where differences among sites

bdc5 (followed by bdc3, then bdc1) had highest scores in 2022- all "fair"

bdc5 had best score due to:

- fewer % omnivores (whs, fmw)
- more % insectiv (vs. other sites)
- lower % disease (vs. other sites)

bdc3 had better score due to:

- more sunfish species, more insectivores, fewer introduced species

bdc1.5C had poorest score due to:

- low fish nos., fewer minnow species
- lower % insectiv (vs. other sites)
- more % omnivores (whs, fmw)

BLACK SPOT DISEASE



Heavily infected Longnose Dace



Healthy Longnose Dace

BLACK SPOT DISEASE



Heavily infected White Sucker



Moderately infected White Sucker

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FIGURE 6
FISH DISEASE OCCURRENCE AT
BIG DRY CREEK SITES, 2000-2022

■ Number Diseased □ Total Fish Collected

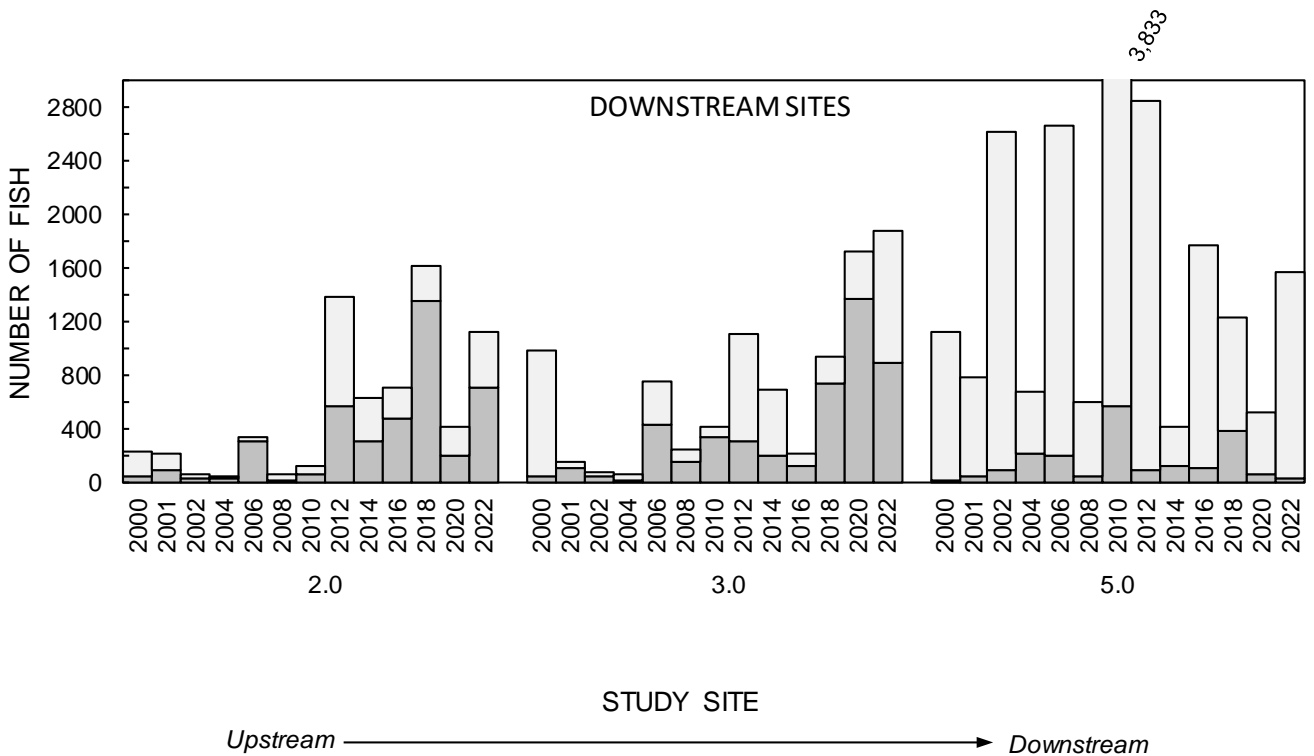
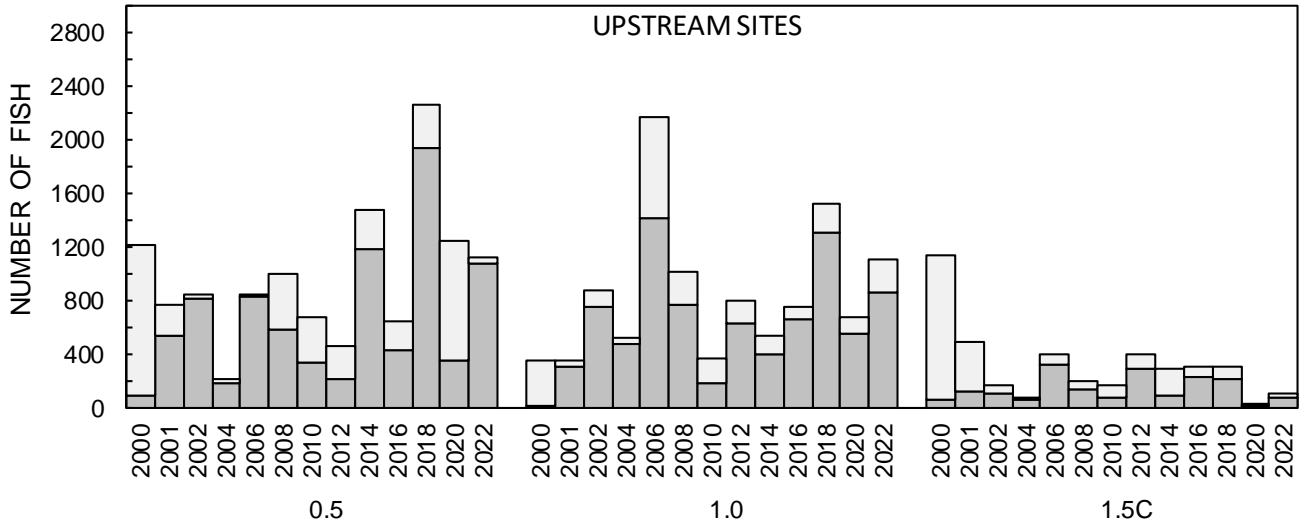


TABLE 5

COMPARISONS OF PERCENT DISEASE BY SITE AND UPSTREAM VS. DOWNSTREAM AT SITES IN BIG DRY CREEK, 2000-2022

Percent Disease by site	Big Dry Creek					
	upstream sites			downstream sites		
	<u>bdc0.5</u>	<u>bdc1.0</u>	<u>bdc1.5C</u>	<u>bdc2.0</u>	<u>bdc3.0</u>	<u>bdc5.0</u>
2000	7.8	6.4	6.2	19.6	5.3	2.1
2001	69.4	90.3	26.8	46.4	70.4	6.8
2002	95.2	85.6	68.0	71.2	56.8	3.8
2003	66.6	75.6	94.4	66.7	50.0	5.2
2004	85.8	91.0	91.7	92.1	38.8	31.5
2006	99.8	65.4	81.5	92.9	57.4	7.5
2008	59.2	75.7	70.9	39.4	63.0	8.0
2010	50.0	48.6	44.7	48.8	83.0	14.8
2012	45.5	80.3	71.9	41.0	28.1	3.6
2014	80.9	76.0	32.9	49.0	29.2	29.9
2016	66.4	89.0	74.2	67.6	57.1	6.0
2018	86.1	86.4	70.8	83.6	79.6	31.8
2020	28.9	82.0	52.6	47.9	79.8	12.1
2022	95.5	78.5	65.8	63.2	47.7	2.7
13-yr Mean 2001-2022	71.5	78.8	65.1	62.3	57.0	12.6

Annual Mean Percent Disease

	<u>all sites</u>	<u>upstream sites</u>	<u>downstream sites</u>
2000	7.0	5.6	8.4
2001	52.2	66.4	38.0
2002	56.4	76.6	36.2
2003	59.0	78.3	39.8
2004	66.9	88.2	45.7
2006	63.3	81.8	44.7
2008	52.7	68.6	36.8
2010	48.3	47.8	48.9
2012	45.1	65.9	24.2
2014	49.7	63.3	36.0
2016	60.1	76.5	43.6
2018	73.1	81.1	65.0
2020	50.6	54.5	46.6
2022	58.9	79.9	37.9
13-yr Mean 2001-2022	57.9	71.8	44.0
			59.6 when bdc2 and bdc3 only

TABLE 6

**MEAN DISEASE RATINGS AND PERCENT OF HEAVY INFECTED FISH COLLECTED
AT BIG DRY CREEK SITES, FALL 2012-2022**

<u>Year Sampled</u>	<u>upstream sites</u>			<u>downstream sites</u>		
	<u>bdc0.5</u>	<u>bdc1.0</u>	<u>bdc1.5C</u>	<u>bdc2.0</u>	<u>bdc3.0</u>	<u>bdc5.0</u>
Fall 2012						
Mean Disease Rating	0.5	1.1	0.7	0.6	0.3	0.1
upstream sites	0.8					
downstream sites	0.3					
Percent Heavy	0.4	9.3	0.7	0.4	0.0	0.0
upstream sites	3.5					
downstream sites	0.1					
Fall 2014						
Mean Disease Rating	0.8	0.8	0.3	0.4	0.4	0.3
upstream sites	0.6					
downstream sites	0.4					
Percent Heavy	1.2	2.1	0.0	0.0	0.0	0.0
upstream sites	1.1					
downstream sites	0.0					
Fall 2016						
Mean Disease Rating	0.7	1.0	0.7	0.6	0.6	<0.1
upstream sites	0.8					
downstream sites	0.4					
Percent Heavy	0.5	1.8	0.0	0.0	0.0	0.0
upstream sites	0.8					
downstream sites	0.0					
Fall 2018						
Mean Disease Rating	0.8	1.1	0.8	0.4	0.6	0.1
upstream sites	0.9					
downstream sites	0.4					
Percent Heavy	1.2	2.8	2.4	0.0	0.0	0.0
upstream sites	2.1					
downstream sites	0.0					
Fall 2020						
Mean Disease Rating	0.2	0.8	0.5	0.6	0.4	0.1
upstream sites	0.5					
downstream sites	0.4					
Percent Heavy	0.0	1.7	0.0	0.0	0.0	0.0
upstream sites	0.6					
downstream sites	0.0					
Fall 2022						
Mean Disease Rating	1.0	0.8	0.7	0.5	0.3	0.0
upstream sites	0.8					
downstream sites	0.3					
Percent Heavy	2.7	0.4	0.0	0.0	0.0	0.0
upstream sites	1.0					
downstream sites	0.0					

Append B-5
BDC Snail Population Fall 2000-2022

Numbers When Collected

year	upstream sites			downstream sites		
	0.5	1.0	1.5C	2.0	3.0	5.0
2000	73	--	--	--	--	--
2001	98	73	--	--	254	36
2002	4774	388	413	167	358	248
2003	551	413	55	--	110	55
2004	496	55	110	--	96	--
2006	78	248	83	--	55	18
2008	--	--	--	--	2	--
2010	83	469	165	--	55	717
2012	165	276	--	--	28	28
2014	386	33	--	110	55	--
2016	331	--	1323	55	--	--
2018	--	1544	303	165	224	--
2020	110	441	55	221	4	110
2022	7	276	221	4	331	--

Mean Numbers 511 301 195 52 112 87
2000-2022

Upstream sites 336
Downstream sites 83

2022 vs. 2020 Changes

snails	down	down	up	down	up	down
disease	up	down	up	up	down	down

FIGURE 7
PERCENT ABUNDANCE OF MACROINVERTEBRATE TAXONOMIC GROUPS IN KICK SAMPLES FROM BIG DRY CREEK, FALL 2016-2022

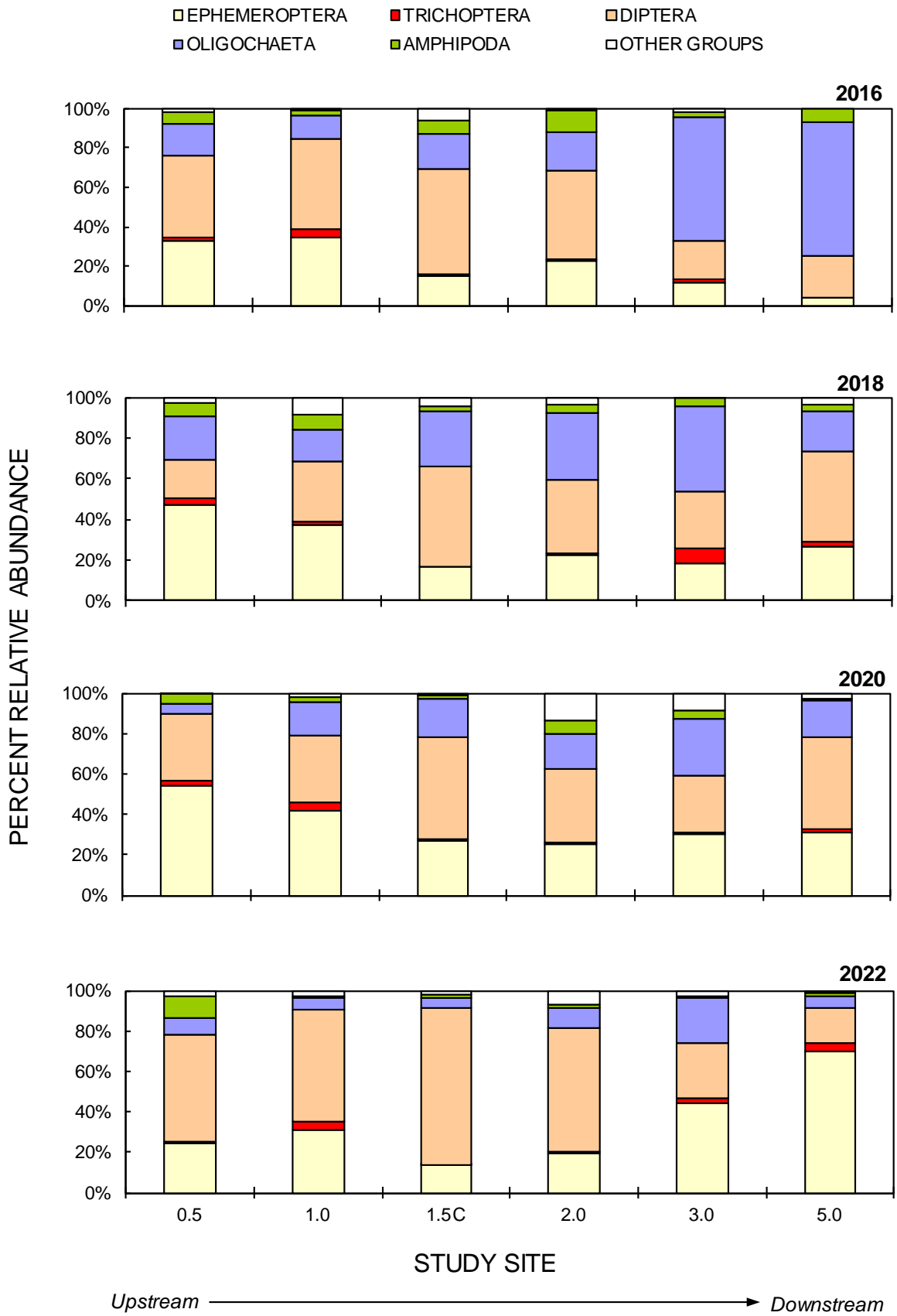


TABLE 7
MEAN PERCENT RELATIVE ABUNDANCE FOR PREDOMINANT AND IMPORTANT
MACROINVERTEBRATE SPECIES COLLECTED AT BIG DRY CREEK SITES
UPSTREAM AND DOWSTREAM FROM WWTPs, FALL 2022 VS. 2016-2020

Taxa	2016		2018		2020		2022	
	Up	Down	Up	Down	Up	Down	Up	Down
TURBELLARIA (flatworms)								
<i>Dugesia sp.</i>	0.1	0.5	0.6	0.5	0.2	2.3	0.6	0.1
OLIGOCHAETA (aquatic worms)								
<i>Nais spp.</i>	5.0	31.5	2.3	15.8	6.6	6.6	0.6	9.8
Tubificidae	9.5	18.2	17.7	14.0	6.8	13.9	5.7	1.7
AMPHIPODS (scuds)								
<i>Crangonyx sp.</i>	4.2	4.4	2.8	2.0	1.9	3.5	2.4	0.7
<i>Hyalella azteca</i>	1.2	2.6	2.7	1.6	1.1	0.5	1.8	0.7
EPHEMEROPTERA (mayflies)								
<i>Acentrella insignificans</i>	nc	0.2	1.1	4.3	1.9	0.7	0.3	0.7
<i>Baetis tricaudatus</i>	7.0	0.6	0.8	0.1	9.0	0.3	0.3	nc
<i>Callibaetis sp.</i>	0.1	nc	0.2	nc	nc	0.1	1.8	0.2
<i>Fallceon quilleri</i>	7.8	3.4	8.7	3.5	7.2	3.6	5.8	8.6
<i>Tricorythodes explicatus</i>	12.2	7.5	22.8	13.7	22.1	23.6	14.5	34.5
TRICHOPTERA (caddisflies)								
<i>Cheumatopsyche sp.</i>	1.4	0.4	1.3	1.9	1.5	0.4	1.7	2.3
<i>Hydropsyche sp.</i>	0.6	0.2	0.1	1.1	0.2	nc	nc	0.2
<i>Hydroptila sp.</i>	0.4	0.3	nc	0.3	0.5	0.3	0.1	<0.1
DIPTERA								
Chironomidae (midges)								
<i>Chironomus sp.</i>	2.2	3.0	1.2	0.8	1.0	0.9	1.8	1.2
<i>Cricotopus sp.</i>	12.2	11.9	2.5	17.0	12.2	16.8	10.5	14.6
<i>Cryptochironomus sp.</i>	2.9	0.5	1.4	0.6	1.0	1.2	0.7	0.8
<i>Hydrobaenus sp.</i>	0.6	0.1	4.4	0.5	3.1	0.9	0.7	0.1
<i>Micropsectra sp.</i>	1.6	3.1	2.6	3.4	1.7	0.9	0.6	2.4
<i>Stictochironomus sp.</i>	10.0	2.0	13.1	5.1	11.1	11.4	33.3	6.0
Simuliidae (black flies)								
<i>Simulium vittatum</i> complex	1.1	3.4	1.4	3.9	2.8	1.0	7.9	1.8
GASTROPODA (snails)								
<i>Ferrissia sp.</i>	1.6	0.1	1.6	0.1	0.4	0.4	0.3	nc
Physidae	0.1	nc	0.1	nc	0.1	<0.1	0.1	0.2
BIVALVIA (clams)								
<i>Corbicula sp.</i>	nc	<0.1	0.1	0.3	nc	4.8	nc	2.5

Asian Clams
Big Dry Creek 2016-2022

Year	Numbers Collected					
	0.5	1.0	1.5C	2.0	3.0	5.0
2016	--	--	--	22	--	--
2018	--	110	--	276	51	--
2020	--	--	--	3142	276	496
2022	--	--	--	3197	772	110

The Asian clam, *Corbicula* sp. was first collected in 2016 at bdc2.0.

FIGURE 8
MACROINVERTEBRATE DENSITY AND TOTAL NUMBER OF TAXA
COLLECTED IN KICK SAMPLES FROM BIG DRY CREEK, FALL 2016-2022

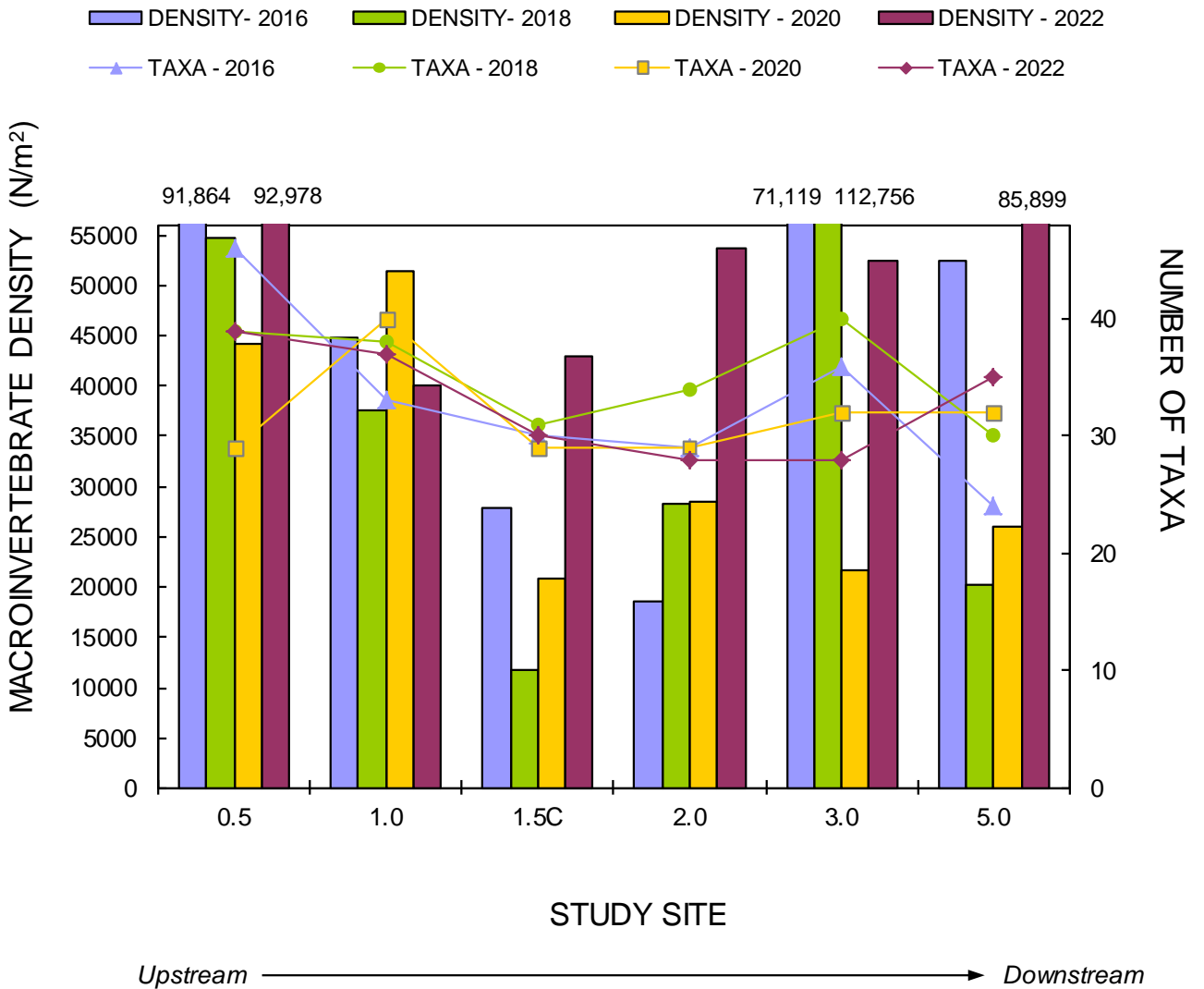
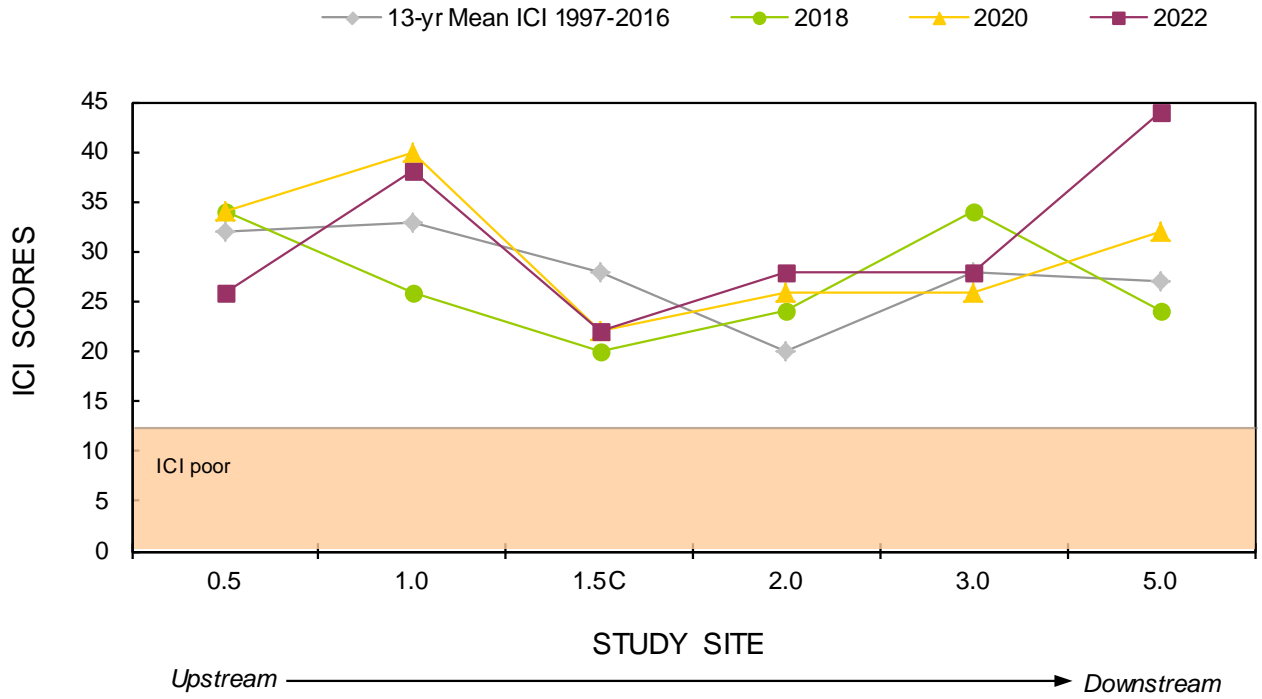


Figure 8 data
BDC Macroinvertebrate Density and Taxa FALL 2016-2022

	STUDY SITE						Annual Mean
	0.5	1.0	1.5C	2.0	3.0	5.0	
DENSITY (N/m²)							
2016	91,864	44,762	27,893	18,511	71,119	52,369	51,086
2018	54,629	37,492	11,674	28,224	112,756	20,121	44,149
2020	44,107	51,388	20,742	28,389	21,671	25,927	32,037
2022	92,978	39,973	42,902	53,585	52,479	85,899	61,303
	highest	low est				high	
4-yr Mean	70,894	43,404	25,803	32,177	64,506	46,079	47,144
	highest		low est		high		
TAXA							
2016	46	33	30	29	36	24	33
2018	39	38	31	34	40	30	35
2020	29	40	29	29	32	32	32
2022	39	37	30	28	28	35	33
	highest			low est	low est		
4-yr Mean	38	37	30	30	34	30	33
	highest	high					

FIGURE 9
COMPARISON OF MACROINVERTEBRATE ICI SCORES
FOR BIG DC SITES IN FALL,
1997-2016 MEAN VS. 2018, 2020 AND 2022



Append C-2

ANNUAL ICI RESULTS, 2000-2022

	STUDY SITE					
	0.5	1.0	1.5C	2.0	3.0	5.0
2000	38	36	30	30	36	14
2001	30	38	38	14	32	32
2002	24	22	28	16	22	28
2003	24	36	34	14	22	22
2004	36	20	28	20	30	36
2006	28	22	28	10	30	28
2008	22	34	16	20	22	32
2010	36	42	30	20	28	24
2012	38	32	26	16	32	26
2014	32	34	24	26	28	36
2016	42	34	26	26	24	12
2018	34	26	20	24	34	24
2020	34	40	22	26	26	32
2022	26	38	22 min	28	28	44 max
14-yr mean ICI 2000-2022	31.7	32.4 max	26.6	20.7 min	28.1	27.9
4-yr mean ICI 2016-2022	34.0	34.5 max	22.5 min	26.0	28.0	28.0

Poor 0-12

Good 36-45

TABLE 8
SUMMARY OF KEY COMMUNITY PARAMETERS AND INDICES
BIG DRY CREEK SITES, FALL 2022 VS. 2016-2020

Site	Total Taxa	EPT Taxa	Metric			
			Species Diversity	ICI	HBI	% Chironomidae
2016						
<u>Upstream Sites</u>						
bdc0.5	46	6	3.76	42	6.21	40.2
bdc1.0	33	7	4.11	34	6.17	43.4
bdc1.5C	30	6	3.71	26	6.75	53.6
Mean	36	6	3.86	34.0	6.38	45.7
<u>Downstream Sites</u>						
bdc2.0	29	6	3.62	26	6.74	37.5
bdc3.0	36	6	3.13	24	8.10	17.2
bdc5.0	24	4	2.27	12	8.47	19.2
Mean	30	5	3.01	20.7	7.77	24.6
2018						
<u>Upstream Sites</u>						
bdc0.5	39	6	3.58	34	6.02	15.1
bdc1.0	38	5	4.10	26	6.21	27.4
bdc1.5C	31	5	3.44	20	7.14	48.6
Mean	36	5	3.71	26.7	6.46	30.4
<u>Downstream Sites</u>						
bdc2.0	34	6	3.74	24	7.07	31.5
bdc3.0	40	8	3.73	34	7.20	26.6
bdc5.0	30	5	3.56	24	6.52	38.6
Mean	35	6	3.68	27.3	6.93	32.2
2020						
<u>Upstream Sites</u>						
bdc0.5	29	7	3.29	34	5.57	27.3
bdc1.0	40	8	4.07	40	6.07	29.8
bdc1.5C	29	5	3.38	22	6.51	50.0
Mean	33	7	3.58	32.0	6.05	35.7
<u>Downstream Sites</u>						
bdc2.0	29	6	3.66	26	6.42	34.6
bdc3.0	32	6	3.34	26	6.54	27.7
bdc5.0	32	8	3.03	32	6.39	45.5
Mean	31	7	3.34	28.0	6.45	35.9
2022						
<u>Upstream Sites</u>						
bdc0.5	39	5	3.28	26	6.01	47.6
bdc1.0	37	8	3.59	38	5.98	36.4
bdc1.5C	30	4	2.41	22	6.53	76.8
Mean	35	6	3.09	28.7	6.17	53.6
<u>Downstream Sites</u>						
bdc2.0	28	5	3.54	28	6.40	57.8
bdc3.0	28	6	3.31	28	6.05	26.5
bdc5.0	35	8	2.46	44	4.92	16.7
Mean	30	6	3.10	33.3	5.79	33.7

MMI Interpretation Criteria - EDAS version 4

BDC Segment 1 - Biotype 3, Class 1 Waters (Reg #38 change, June 2020)

Aquatic Life Use Thresholds			Auxillary Metric Thresholds Class 1 Waters ONLY (MMI between Attainment and Impairment)		Auxillary Metric Thresholds Class 2 Waters (MMI between Attainment and Impairment)	
Biotype	Attainment Threshold	Impairment Threshold	Hilsenhoff Bioitic Index (HBI)	Shannon Diversity Index (shan_base_2)	no metrics needed	
3	Plains & Xeric	42	29	<7.6	>2.4	in support of use

Criteria for Protection of High Scoring Waters

Biotype	High Scoring Water (MMI)	Allowable MMI decline	
3	Plains & Xeric	>51	-22

Reference:

WQCC 2017. Policy Statement 10-1. Aquatic Life use Attainment, Methodology to Determine Use Attainment for Rivers and Streams, Approved August 7, 2017; Expires December 31, 2020. Colorado Department of Public Health and Environment, Colorado Water Quality Control Commission, Denver, CO.

MMI SCORES FOR BIG DRY CREEK SITES, FALL 2016, 2018, 2020 AND 2022

MMI Sores

Site	Location	Biotype	2016	2018	2020	2022	4-yr mean
BDC 0.5	d/s from Old Wadsworth Ave., at Church Ranch Open Space	3	52.9	55.2	49.9	55.8	53.5
BDC 1.0	u/s from 112th Ave.	3	41.4	55.9	50.8	54.6	50.7
BDC 1.5C	d/s from 120th Ave., immediately u/s Broomfield WWTP	3	43.4	46.3	40.2	46.3	44.1
BDC 2.0	u/s from 128th Ave., d/s from Broomfield WWTP	3	46.7	44.8	43.2	36.3	42.8
BDC 3.0	at I-25, d/s from Westminster WWTP	3	42.0	39.3	50.0	44.7	44.0
BDC 5.0	d/s from Weld County Rd. 4	3	24.9	43.8	48.7	46.3	40.9
Annual Mean			41.9	47.6	47.1	47.3	

MMIs per EDAS v4 and Policy Statement 10-1 (CWQCC 2017).

Bold indicates High Scoring Water (MMI >51 for Biotype 3).

All analyses performed by Aquatics Associates, Inc.

impaired

in grey zone, but use attainment with auxillary metrics

Thresholds for Biotypte 3 (Plains & Xeric):

High Scoring Water: >51

Attainment Threshold: 42

Impairment Threshold: 29

Auxillary Metrics thresholds for Class 1 streams (apply when scores are in between attainment and impairment thresholds):

HBI Threshold: <7.6

Shannon Diversity Index Threshold: >2.4

Scores between the Attainment and Impairment thresholds which met use attainment using the auxillary metrics.

Comments for 2022

MMI values for 2022 met use attainment all six sites on Big Dry Creek (MMIs >29 threshold for Class 1 streams).

Lowest score in 2022 was at site bdc2.0 (MMI 36.3). While this score was below the Attainment Threshold of 42 (in "gray zone"

between Attainment and Impairment thresholds), site bdc2.0 met use attainment for Class I streams using the auxillary metrics HBI and Shannon Diversity thresholds.

Sites bdc0.5 and bdc1.0 were High Scoring Waters (HSW) in 2022.

USEFULNESS OF DATA SET FOR BDC SEGMENT 1 WQ REGS

- **Reg 93- 303(d) Monitoring & Evaluation List**

MMI results for BDC Seg 1 affect the 303(d) listing status.

- **Reg 31**

Temperature standard driven by presence of the Johnny darter in BDC Seg 1.

- **Reg 38 - Fish Ingestion Qualifier**

The fish ingestion standards do not apply to BDC Seg 1 per the States's final ruling for Reg 38 in June 2020, based on facts submitted by BDCWA for the Rule Making Hearing. The issue was "whether BDC Seg 1 has fish of catchable size and which are normally consumed and where there is evidence that fishing occurs on a recurring basis".

- **Future New Ammonia Criteria**

Basis on presence of Unionid Mussels and Non-Pulmonate Snails (cited as ammonia-sensitive). Our review of BDC macroinvert data set 1997-2022 indicates none ever collected in BDC.

RECOMMENDATIONS FOR FUTURE MONITORING

- Keep future monitoring program intact (six sites, fish & bugs fall season only, continue MMI) with monitoring in even years. Next event is Oct 2024.

These data have been crucial for supporting the Cities various compliance issues with the State's stream classification regulations (i.e., 303(d) M&E listing [MMIs], Reg 38 fish ingestion [fish data], Reg 31 temperature standards [Johnny darter], etc.).

Cities lab staff continue to document fishing activity concurrent with their regular water sampling visits to address State's future re-visit of Reg 38 Fish Ingestion Qualifier as "evidence that fishing does not occur on a recurring basis."

- If MMIs do not meet use-attainment, consider an additional macroinvertebrate collection in odd years (in between year) at sites not meeting use attainment to have supporting data for WQCD's 303(d) Monitoring & Evaluation De-Listing.
- As always, savings can be realized if Cities provide assistance (4-6 people) for the 3-day fish sampling event.

**THANKS TO ALL OF OUR VOLUNTEERS FOR
A SUCCESSFUL 2022 SAMPLING SEASON!**

