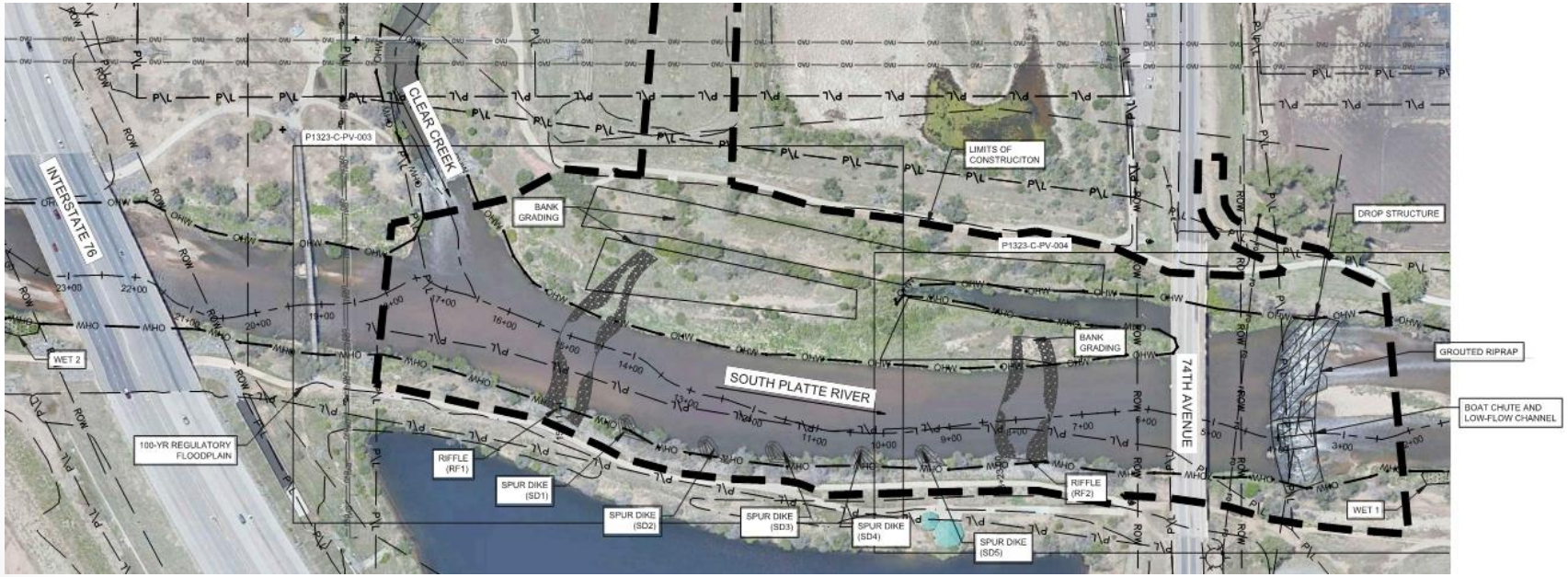
Assessment of In-Stream Channel Improvements to Promote Thermal Mixing and Diversify Native Fish Habitat in an Effluent-Dominated Segment of the South Platte River



Jordan Parman
Senior Water Quality Scientist
November 16, 2021

METRO WATER RECOVERY

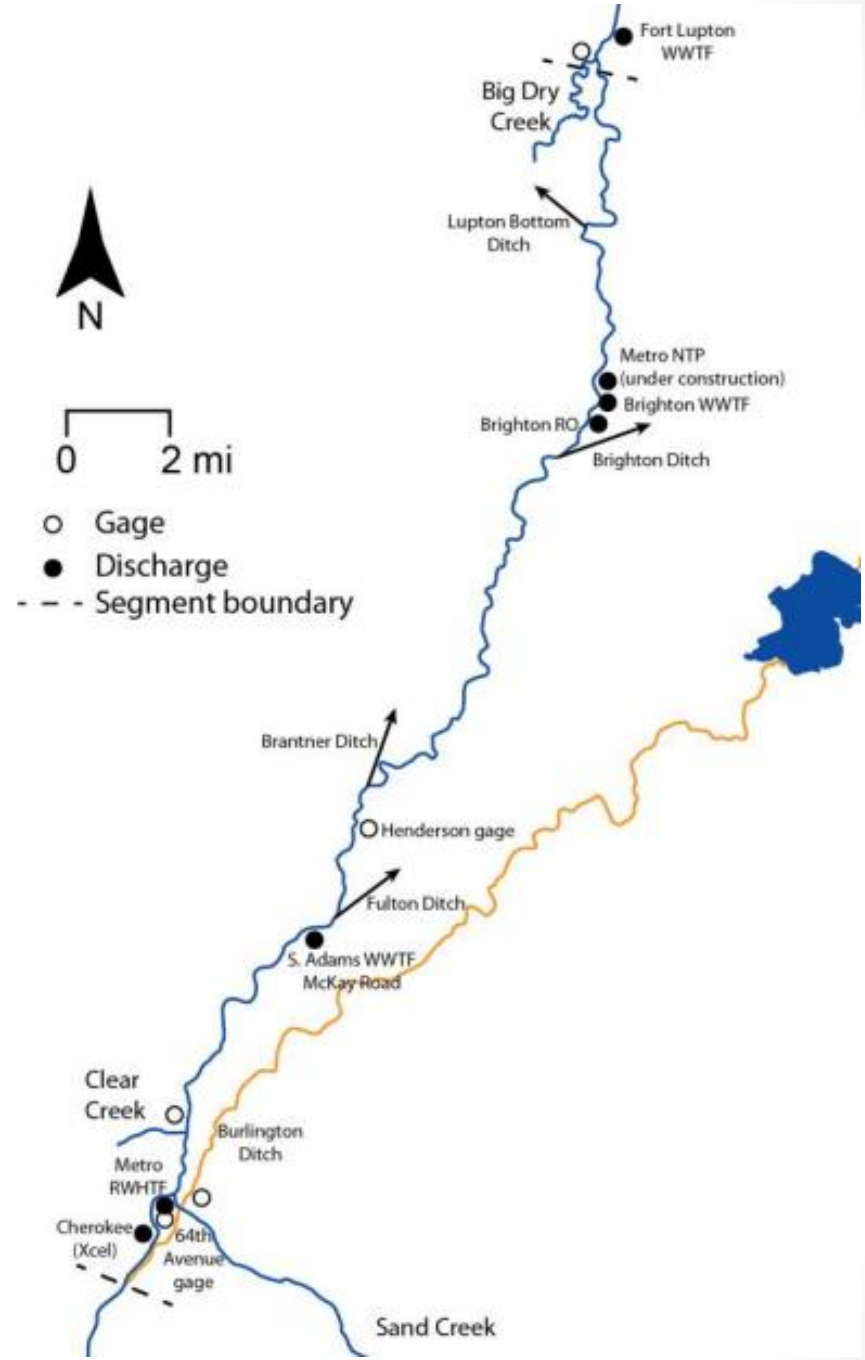
South Platte River Urban Waters Partnership Quarterly Meeting

Metro Water Recovery

- Serve ~ 2 million people in Metro Denver area
- Treat ~ 130 MGD at Robert W. Hite Treatment Facility (RWHTF)
- Discharge into effluent-dominated segment of the South Platte River
- History of continuous treatment upgrades with immediate in-stream impact

Segment 15 of South Platte River

- Effluent-dominated
- Numerous ditch withdrawals
- Channelized
- Transition to agricultural land use downstream
- Warm water fish species



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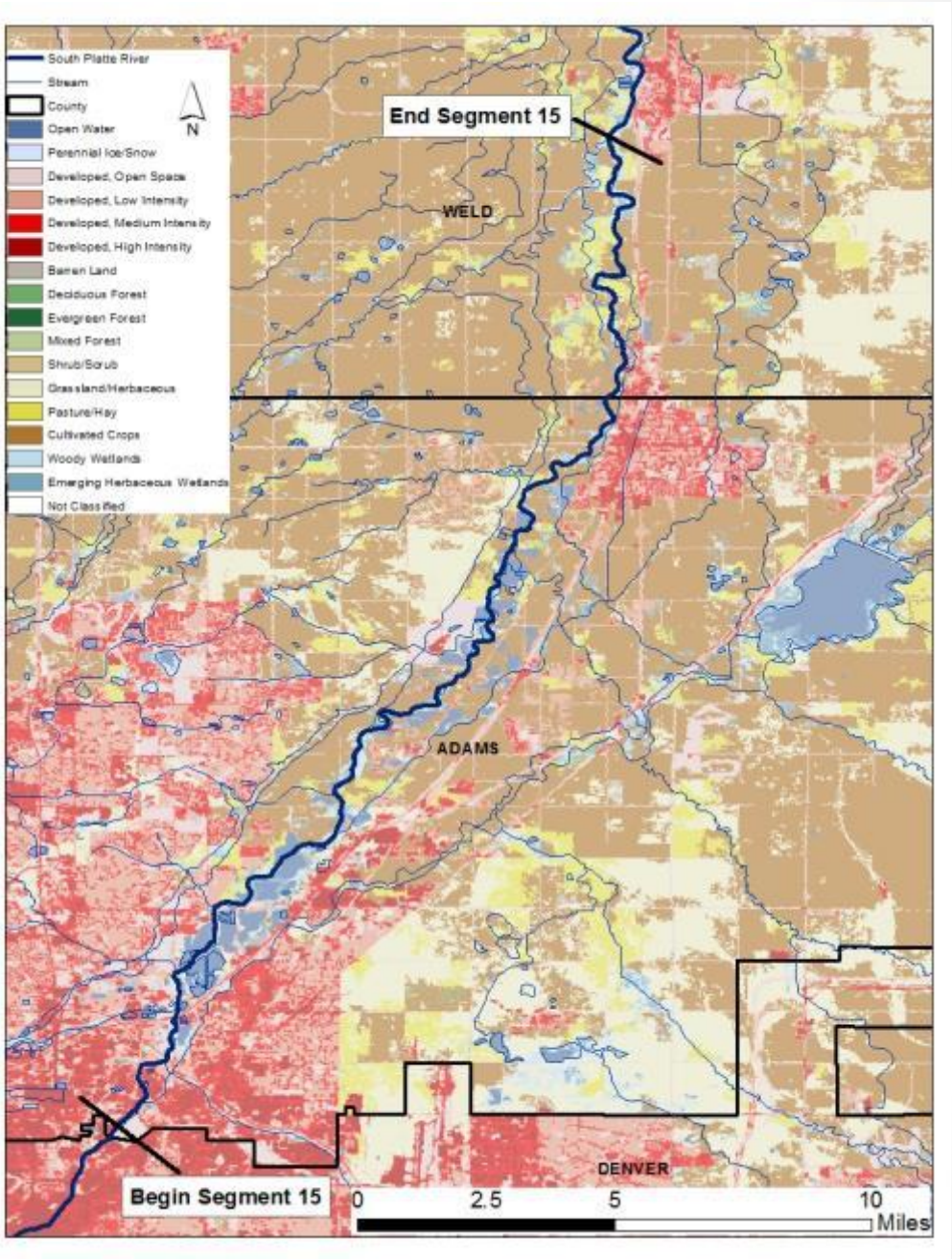

Segment 15 of South Platte River

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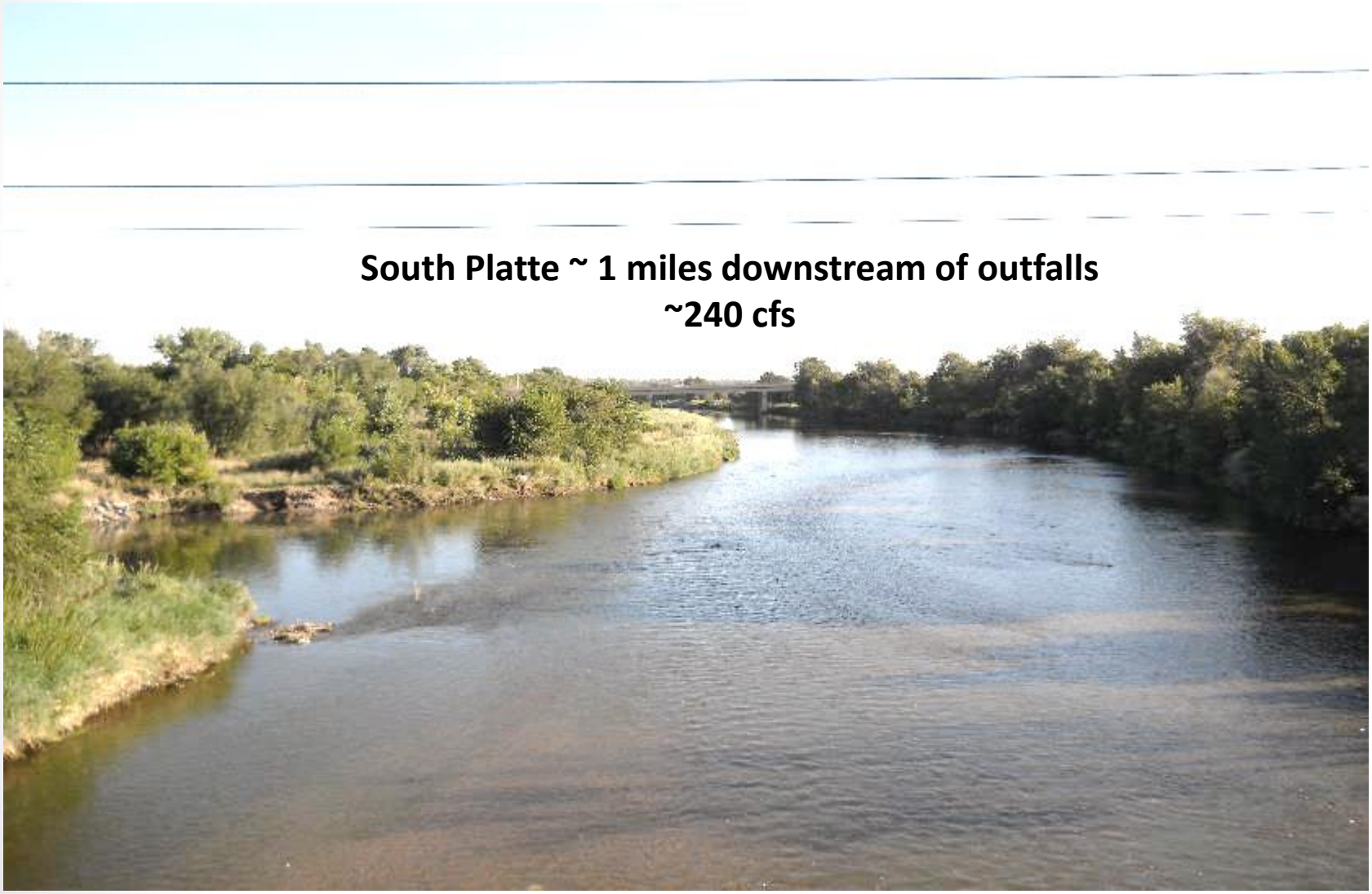
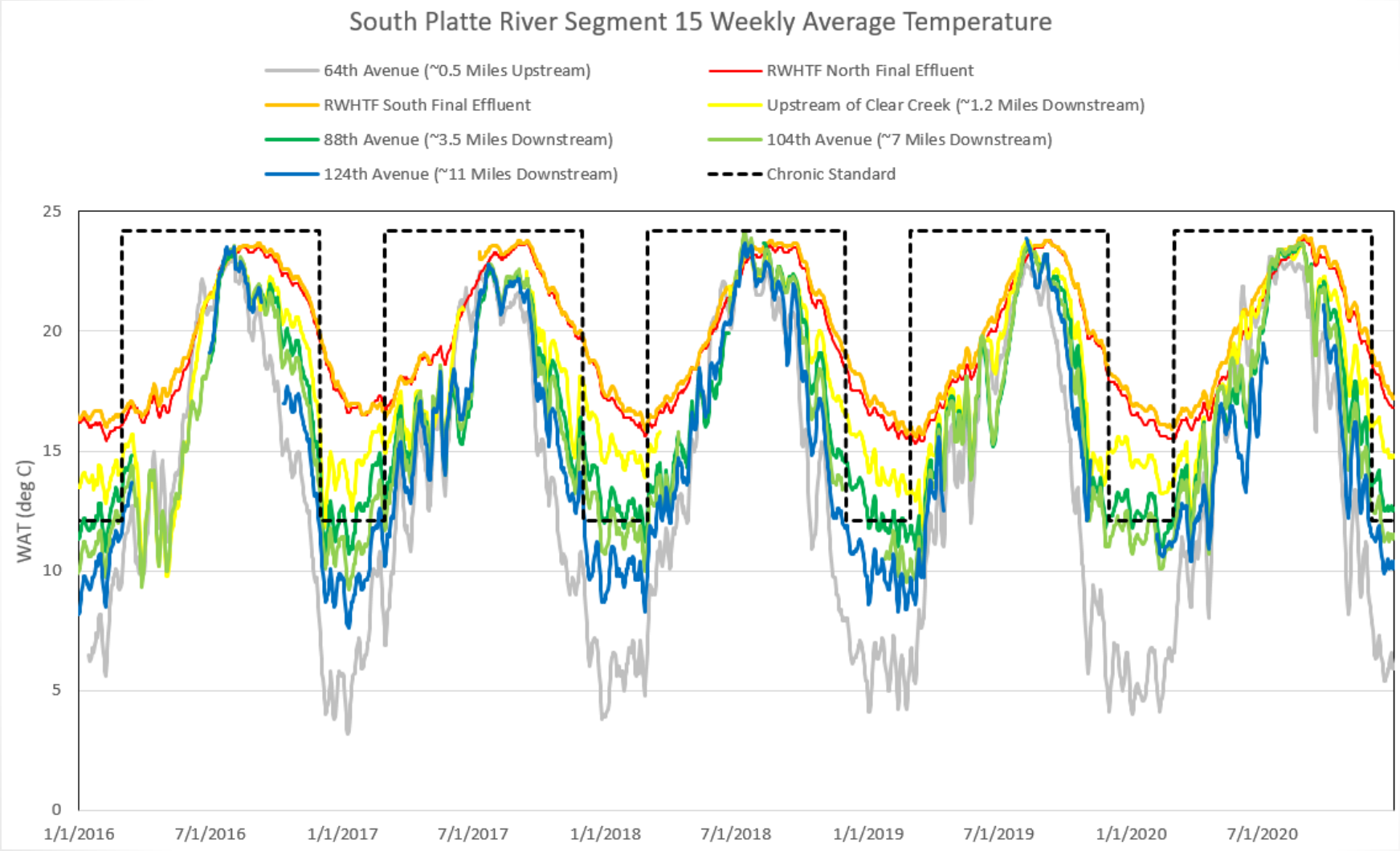
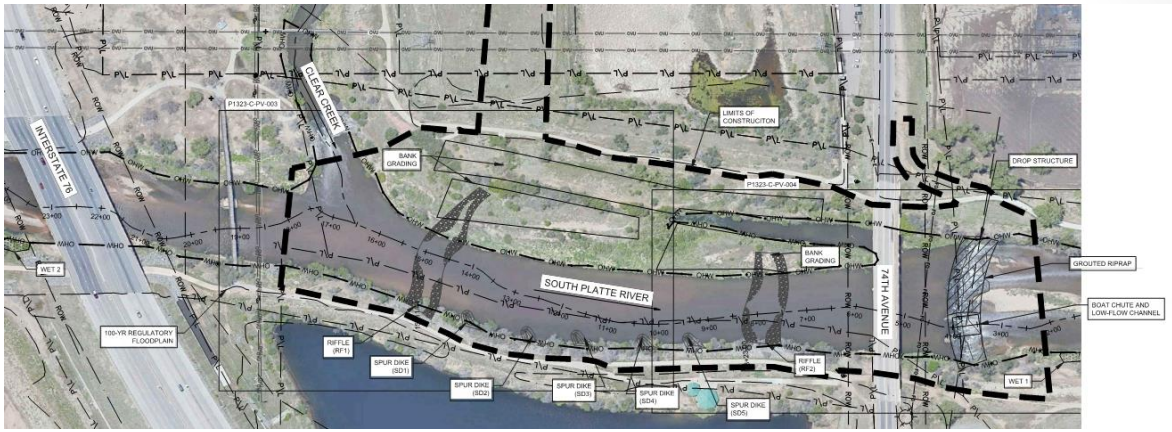


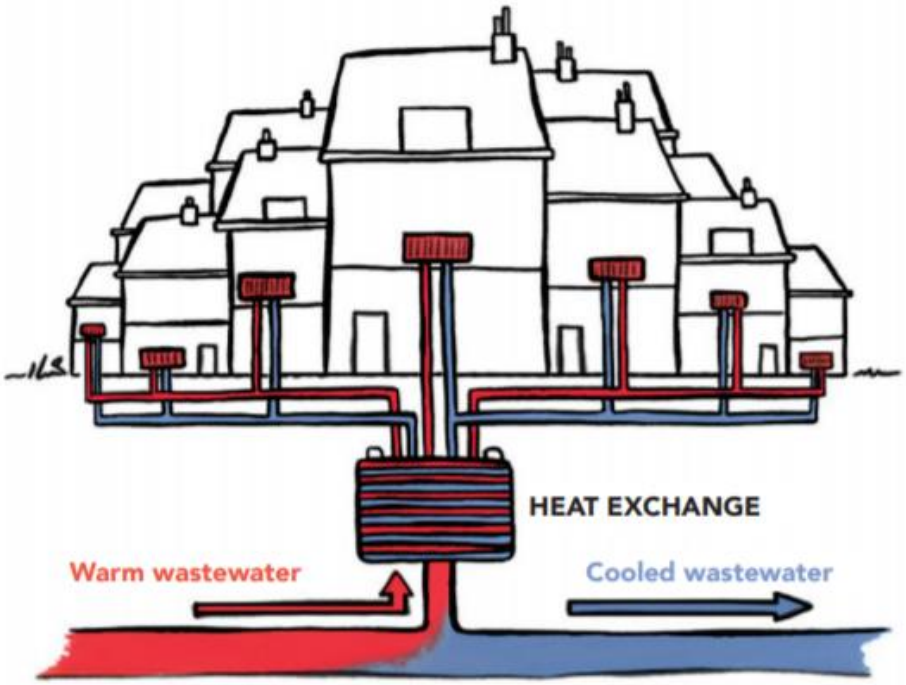
Long-Term Temperature Monitoring



Temperature Reduction Options

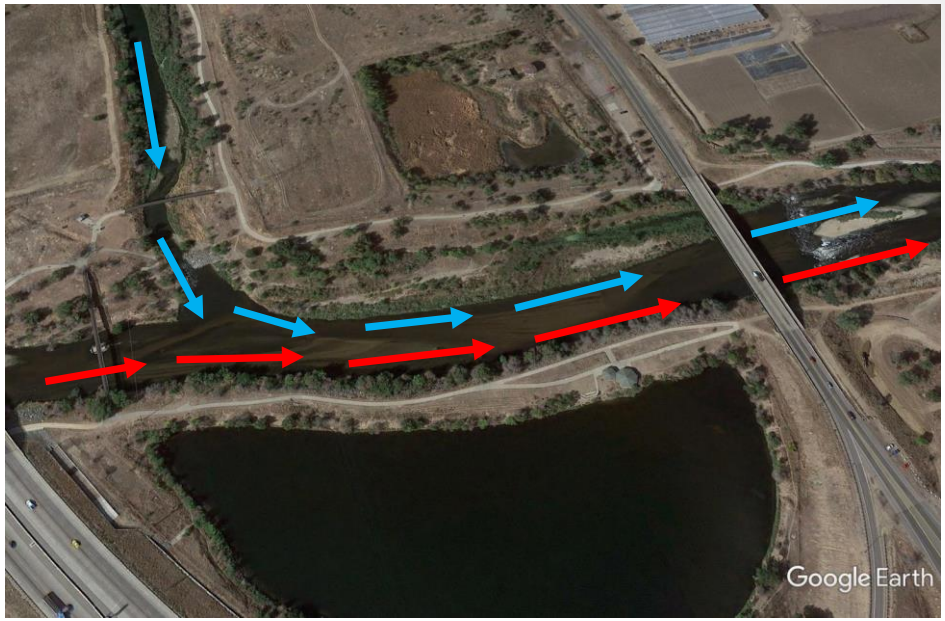
- Portfolio approach
- Environmentally friendly and sustainable
- Utilize nature to help cool the South Platte (instream projects)
- Sewer heat recovery onsite and offsite
- Incremental progress and adaptive management



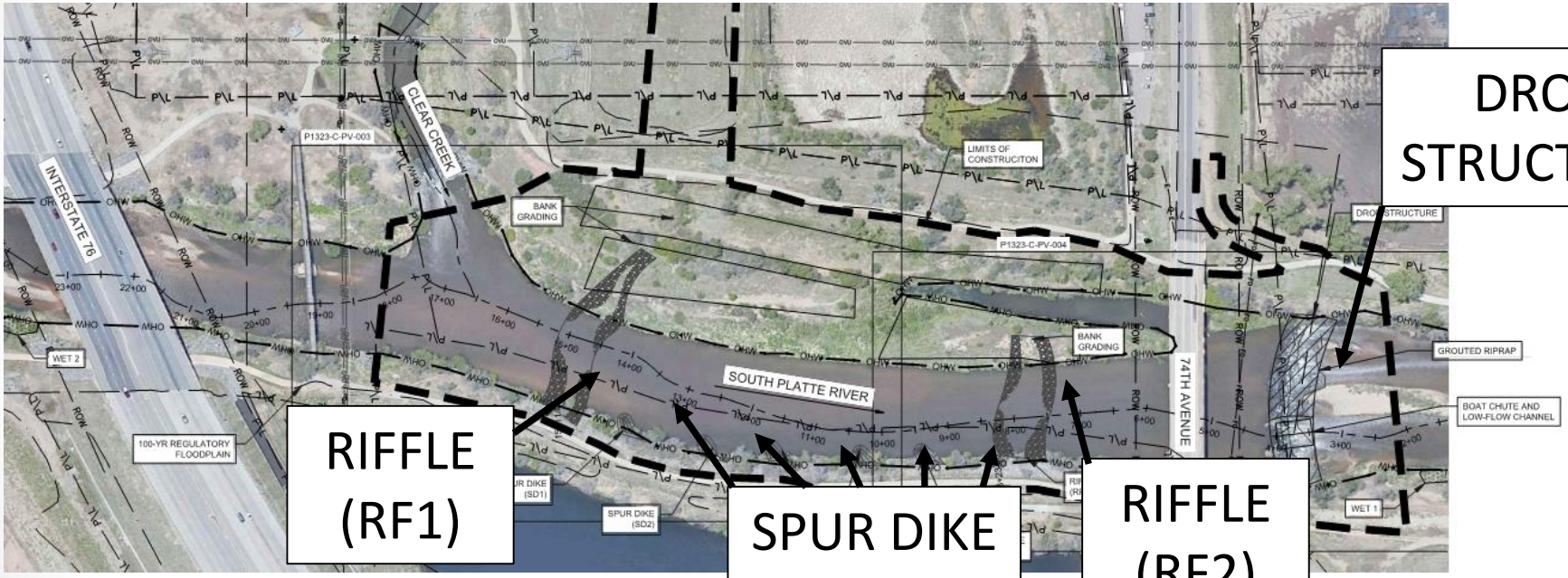


Instream Mixing Project Goals

- Improve thermal mixing and heat dissipation to reduce wintertime temperatures and create more consistent thermal conditions for aquatic life
- Incorporate aquatic life habitat enhancements



Project Components



Project Photos

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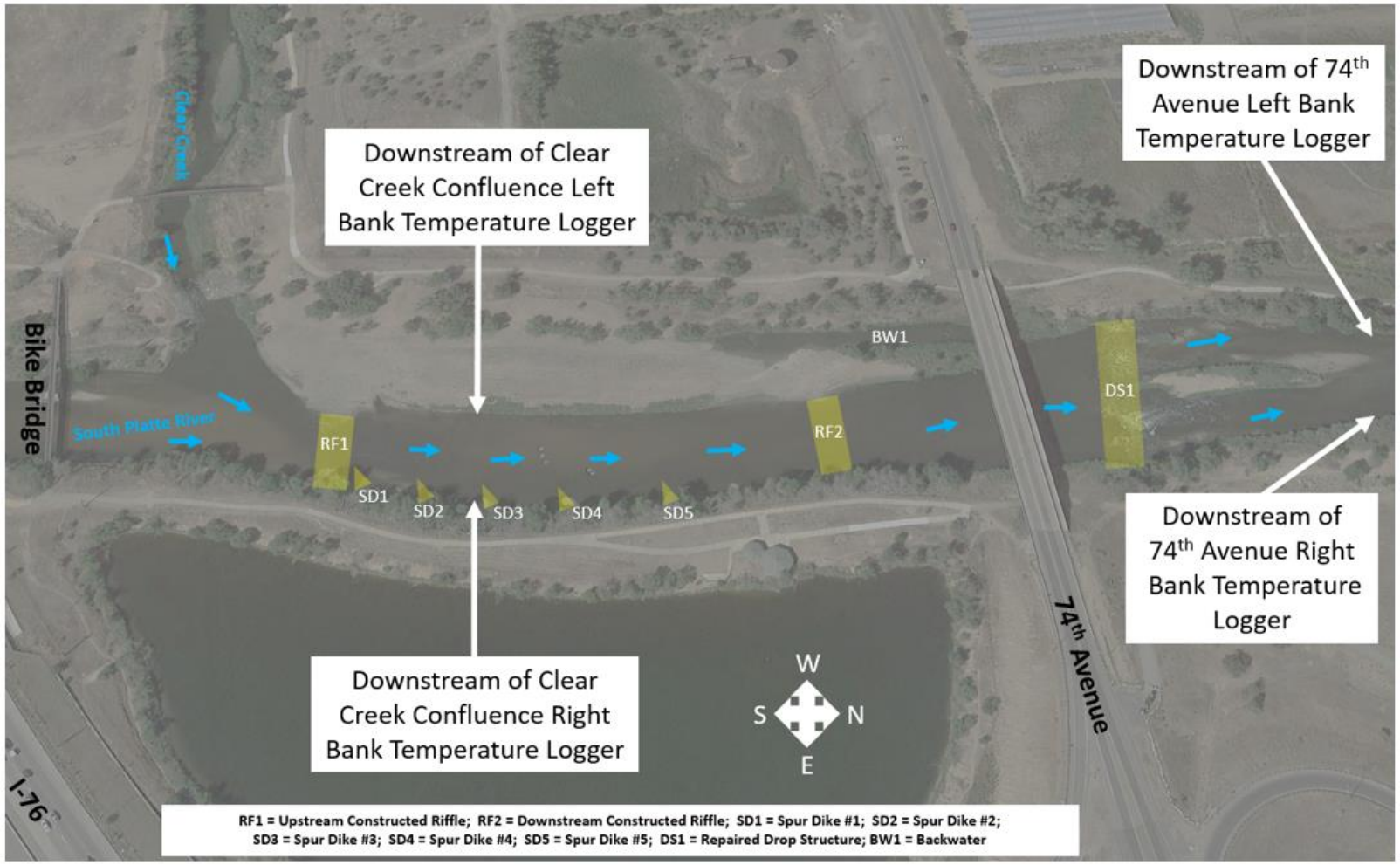
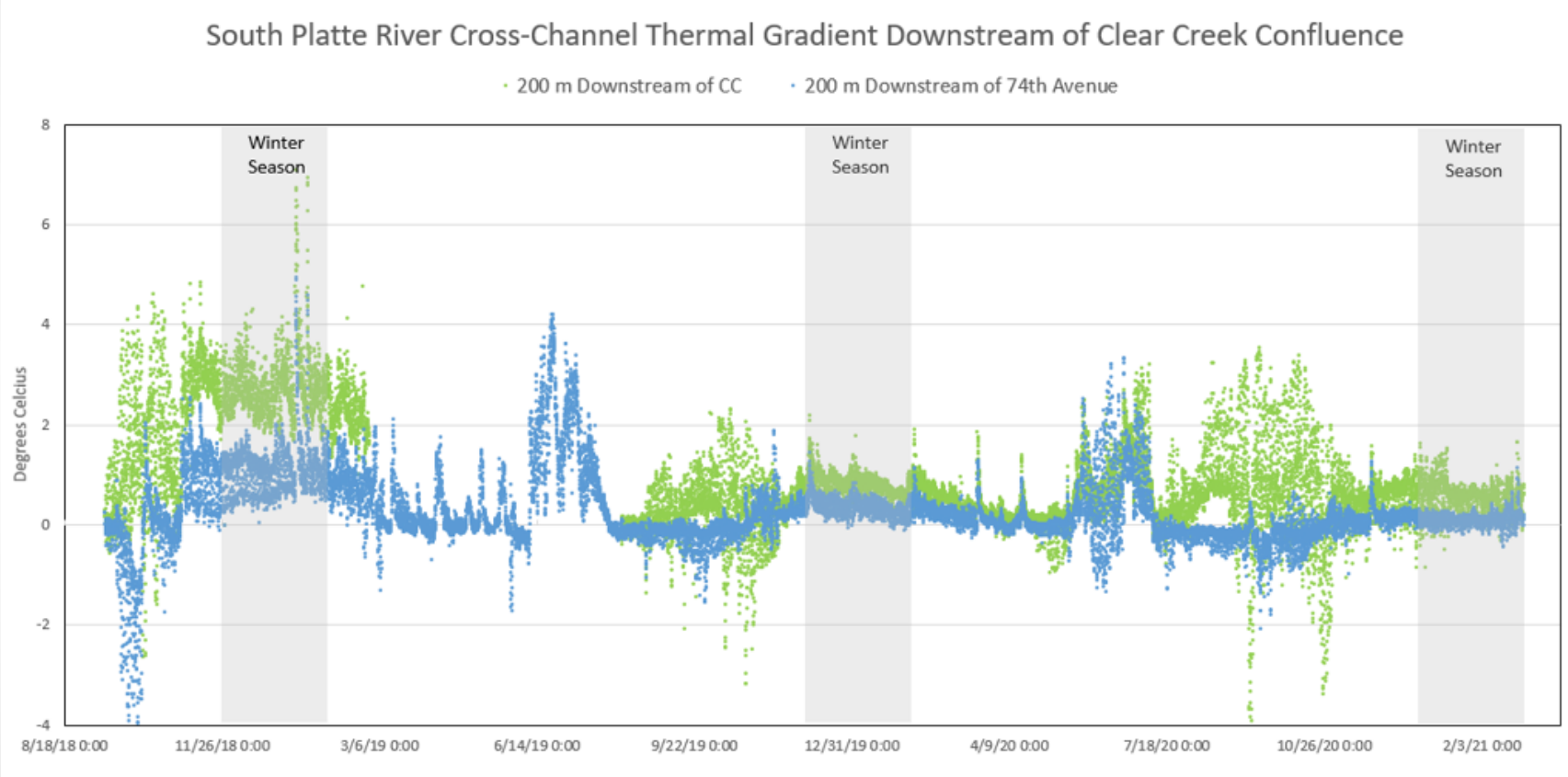
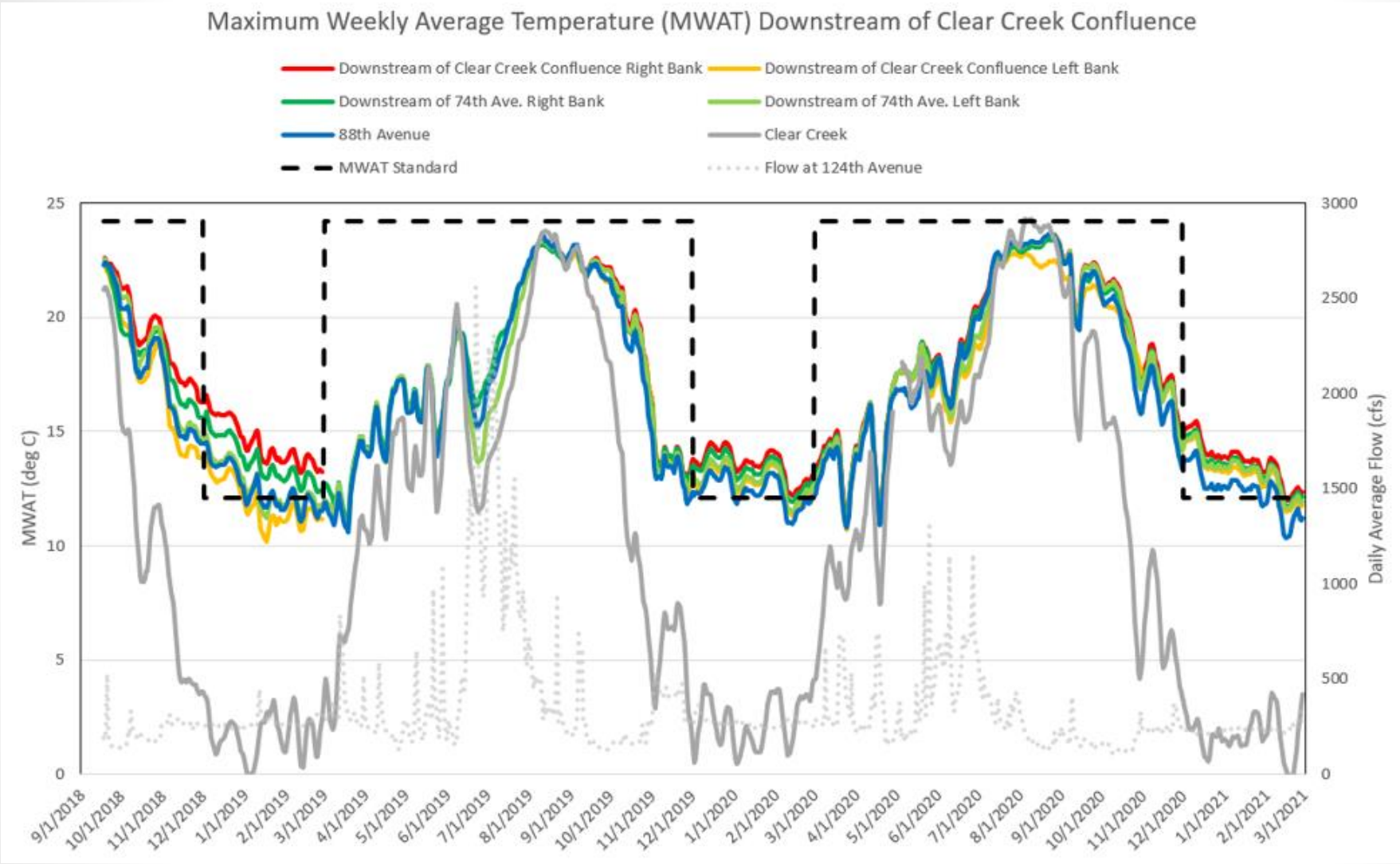
Monitoring Cross-Channel Thermal Gradient




South Platte River Cross-Channel Thermal Gradient Downstream of Clear Creek Confluence
200 m Downstream of CC
200 m Downstream of 74th Avenue
Winter Season
Winter Season
Winter Season
Degrees Celcius
8
6
4
2
0
-2
-4
8/18/18 0:00
11/26/18 0:00
3/6/19 0:00
6/14/19 0:00
9/22/19 0:00
12/31/19 0:00
4/9/20 0:00
7/18/20 0:00
10/26/20 0:00
2/3/21 0:00

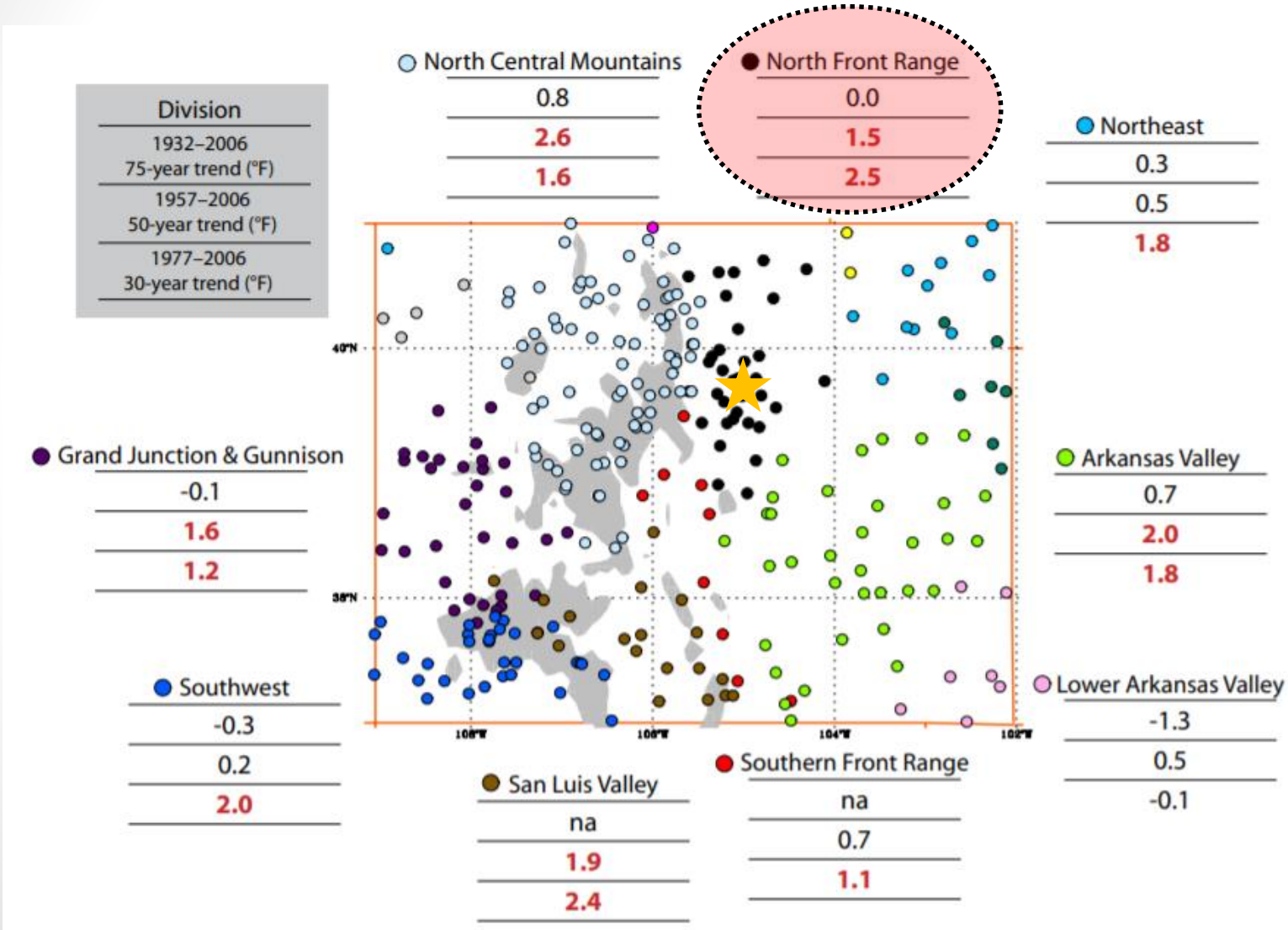

Maximum Weekly Average Temperature (MWAT) Downstream of Clear Creek Confluence
Downstream of Clear Creek Confluence Right Bank
Downstream of Clear Creek Confluence Left Bank
Downstream of 74th Ave. Right Bank
Downstream of 74th Ave. Left Bank
88th Avenue
Clear Creek
MWAT Standard
Flow at 124th Avenue
MWAT (deg C)
Daily Average Flow (cfs)
0
5
10
15
20
25
0
500
1000
1500
2000
2500
3000
9/1/2018
10/1/2018
11/1/2018
12/1/2018
1/1/2019
2/1/2019
3/1/2019
4/1/2019
5/1/2019
6/1/2019
7/1/2019
8/1/2019
9/1/2019
10/1/2019
11/1/2019
12/1/2019
1/1/2020
2/1/2020
3/1/2020
4/1/2020
5/1/2020
6/1/2020
7/1/2020
8/1/2020
9/1/2020
10/1/2020
11/1/2020
12/1/2020
1/1/2021
2/1/2021
3/1/2021

Historical Streamflow

- Recent low flows upstream of RWHTF
- Availability of cool Clear Creek water in winter months
- Future flow projections?

Season	Clear Creek at York Street Average Discharge (cfs)	South Platte at 64th Avenue Average Discharge (cfs)	South Platte at 88th Avenue Average Stream Temperature (deg C)
Winter 2011-2012	23.6	11.1	Data Gap
Winter 2012-2013	9.1	5.9	13.1
Winter 2013-2014	37.1	19.8	11.8
Winter 2014-2015	45.6	35.3	Data Gap
Winter 2015-2016	31.3	33.3	11.9
Winter 2016-2017	21.9	24.3	12.6
Winter 2017-2018	21.8	3.7	13.0
Winter 2018-2019	20.9	5.4	12.5
Winter 2019-2020	22.7	4.7	12.4
Winter 2020-2021	19.3	5.1	12.4

Climate Change Impacts?



Adapted from "Climate Change in Colorado: A Synthesis to Support Water Resources Management and Adaptation"

Target Fish Species Habitat Preference

Common Name – Species Name	Preferred Microhabitat	Current/ Depth	Substrate	Guild	Vegetation/ Cover	Spawning Habits
White Sucker *Catostomus commersonii*	Pools, runs and riffles, riprap banks, bridge abutments, undercut banks, are all preferred locations	Low to moderate flows	Rock, gravel, and sand	Pool	Prefers shade and cover from large woody debris or bank vegetation	Spring. Migrates to moving water w/gravel substrates, eggs adhere to substrate in pools and eddies; spawn in moving water at velocities between 0.5-3 ft/sec
Green Sunfish *Lepomis cyanellus*	Pools and backwaters w/abundant instream cover	Adults prefer low velocity 0.32 ft/sec, juveniles less than 0.26 ft/sec	Sand	Pool	Often occur near vegetation	Spring to summer. Nests are built in gravel or sand between 1.6-13" deep
Sand Shiner *Notropis stramineus*	School in riffles, downstream of submerged sand bars, or in sandy backwaters	Adults use depths between 0.3-0.6 ft w/velocities between 0.1-1 ft/sec	Silt and sand, gravel and cobble	Riffle	Will use vegetation as instream cover	Summer. Eggs are laid over sand or deposited on gravel
Longnose Dace *Rhinichthys cataractae*	Narrow riffles, runs, and pools	Depths ranging from less than 1 ft to 2 ft.	Rubble, gravel 5-8" in diameter or sand, directly above or spaces between substrate	Riffle	Abundance was positively correlated w/aquatic vegetation	Spring through summer. Spawn over pits in riffles w/loose gravel and sand; spawns in currents between 1.5 and 2 ft/sec

Target Fish Species

White Sucker

Sand Shiner

Longnose Dace

Green Sunfish

Fish Data

Before and After Construction

- Fish assemblage dominated by native minnows
- Constructed habitat designed for native species, but preferred habitat for introduced species as well
- High species diversity including darters

	Before			After		
Common Name	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Native						
Fathead Minnow	186	5180	1280	864	5770	6641
Sand Shiner	86	507	57	61	59	5
White Sucker	111	1	25	46	20	47
Green Sunfish	4	7	2	69	10	21
Iowa Darter		1		6	20	30
Longnose Dace		7	18	6	7	
Johnny Darter	5				2	3
Longnose Sucker			3		2	
Creek Chub		1	3			
Brook Stickleback			1			
Introduced						
Common Carp	7	2	32	58	9	13
Largemouth Bass	29		2	28	4	25
Western Mosquitofish	20	5	10	1	33	5
Smallmouth Bass	1			3	9	5
Yellow Perch	6			9		3
Black Crappie		3		3		4
Bluegill						2
Golden Shiner			1			
Rainbow Trout	1					
Total Individuals	**456**	**5714**	**1434**	**1154**	**5945**	**6804**
Species Richness	**11**	**10**	**12**	**12**	**12**	**13**

Conclusions and Future Plans

- Habitat improvements are improving thermal mixing
- Impact on overall temperature reductions is less certain and will heavily depend on future air temperature and streamflow
- Evidence of healthy, diverse and predominantly native fish assemblage in project reach
- Continue to evaluate impact of instream habitat improvements in combination with other temperature reduction projects
- Monitor, monitor, monitor….

Questions…

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CDM Smith

METRO WATER RECOVERY

GEI Consultants