Cache la Poudre/NISP Water Quality Monitoring Program

Water Quality Department

INTRODUCTION

Northern Water began collecting data in the Cache la Poudre River in 2015 to establish a baseline dataset representative of conditions prior to the construction of the Northern Integrated Supply Project (NISP; Figure 1). The program is robust and has been adapted over the years to ensure the data collected meet evolving objectives as NISP enters the final phases of permitting and design.

The objectives of this program are to:

- Provide a consistent, high-quality data set from the North Fork of the Poudre River to its confluence with the South Platte River that provides for upstream to downstream spatial comparisons of the various water quality parameters over time;
- Monitor trends and changes in Poudre River water quality;
- Provide information to support NISP-related water quality mitigation measures and to support adaptive management efforts;
- Comply with monitoring conditions required in the Rationale for Conditional 401 Certification of the Northern Integrated Supply Project (NISP 401 Certification); and
- Assess compliance with the state water quality standards and potential inclusions on Colorado's Section 303(d) List of Impaired Waters and Monitoring and Evaluation List.

Figure 1. Sampling on the Poudre River.

MONITORING LOCATIONS

The Cache la Poudre/NISP Water Quality Monitoring Program includes monitoring locations in Larimer and Weld counties and covers approximately 50 miles of river starting upstream of the Hansen Supply Canal and ending east of Greeley at the confluence with the South Platte River. Most stations are in the mainstem of the Poudre River, with three monitoring stations in Poudre River tributaries: Spring Creek, Boxelder Creek, and Fossil Creek. Current and future station locations related to baseline Poudre River and NISP monitoring are described in Table 1 and shown in Figure 2. Station changes since the program's inception are documented in Appendix 1. Additionally, a number of NISP-related station locations were updated, which are indicated in Table 1 and described in a memorandum to CDPHE in Appendix 2.

Table 1. Poudre River Monitoring Locations

Station	Description	Station Type	Lat	Long	NISP WQ Baseline Station[1]	NISP 401 Condition Station
CLAFTCCO [4]	Poudre River at Canyon Gauge	Poudre River mainstem, continuous temp. gauge	40.6643	-105.2233		X
PR-GLDU[2]	Poudre River upstream of Glade Reservoir release	Poudre River mainstem	40.664	-105.2161		X
GLD-DAM[2]	Glade Reservoir near dam	Reservoir	TBD	TBD		X
GLDF-MID[2]	Glade Reservoir forebay at deepest location	Reservoir	TBD	TBD		X
GLD-PRU[2]	Glade Reservoir release just upstream of Poudre River	Reservoir Release	TBD	TBD		X
PR-HSCU	Poudre River upstream of Hansen Supply Canal, below Glade Reservoir Release	Poudre River mainstem	40.6601	-105.2095	X	X
PR-HSCD	Poudre River downstream of Hansen Supply Canal	Poudre River mainstem	40.6606	-105.2032	X	X
PR-LCCU[2] [4]	Poudre River upstream of Larimer County Canal	Poudre River mainstem	40.6584	-105.1915		X

Station	Description	Station Type	Lat	Long	NISP WQ Baseline Station[1]	NISP 401 Condition Station
PR-LCU[2] [3]	Poudre River upstream of Little Cache Canal	Poudre River mainstem	40.6529	-105.1517		X
PR-LION	Poudre River at Lions Park	Poudre River mainstem	40.6243	-105.1425		X
PR-LWU[2] [4]	Poudre River upstream of Larimer & Weld Canal	Poudre River mainstem	40.6122	-105.1072		X
PR-SHI	Poudre River at Shields St.	Poudre River mainstem	40.6031	-105.0958		X
PR-MWWU	Poudre River at Lincoln Ave upstream of Mulberry WWTP	Poudre River mainstem	40.5881	-105.0694	X	X
PR-TCU[2] [4]	Poudre River upstream of Timnath Canal Inlet	Poudre River mainstem	40.5761	-105.0486		X
PR-MWWD	Poudre River at Timberline Ave downstream of Mulberry WWTP	Poudre River mainstem	40.5786	-105.0355	X	
SC-PRU	Spring Creek upstream of the Poudre River	Tributary	40.5712	-105.0313	X	
PR-SCD	Poudre River at Prospect St downstream of Spring Creek	Poudre River mainstem	40.5678	-105.0271	X	X
PR-NAT [4]	Poudre River at Nature Center	Poudre River mainstem	40.5599	-105.0216		X (replaced with PR-SCD)
PR-BCU	Poudre River upstream of Boxelder Creek	Poudre River mainstem	40.5518	-105.0107		X
BC-PRU	Boxelder Creek upstream of the Poudre River	Tributary	40.5500	-105.0041	X	
PR-BCD	Poudre River downstream of Boxelder Creek	Poudre River mainstem	40.5379	-104.9998	X	

Station	Description	Station Type	Lat	Long	NISP WQ Baseline Station[1]	NISP 401 Condition Station
FC-MID[2] [3]	Fossil Creek Reservoir at deepest location	Reservoir	40.4940	-104.9950		X
FC-PRU	Fossil Creek at County Road 34C upstream of Poudre River	Tributary	40.4976	-104.9873	X	X (surrogate for FC-MID until monitoring commences)
PR-NCD	Poudre River downstream of Fossil Creek and New Cache Ditch	Poudre River mainstem	40.5008	-104.9673	X	X
PR-WKD	Poudre River downstream of Carestream and Windsor WWTPs	Poudre River mainstem	40.4421	-104.8496	X	
PR-GRU	Poudre River at 8th St upstream of Greeley and Leprino WWTPs	Poudre River mainstem	40.4244	-1046805	X	
PR-SPU	Poudre River upstream of the South Platte River	Poudre River mainstem	40.4232	-104.6000	X	
UGT-DAM[2]	Upper Galeton Reservoir near dam	Reservoir	TBD	TBD		X
UGTF-MID[2]	Upper Galeton Reservoir forebay at deepest location	Reservoir	TBD	TBD		X

[1] *"Baseline station" means that the station has been monitored consistently since 2015.*
[2] *Station not yet in use. Placeholder for when NISP sampling commences. Any latitude/longitude information provided is from the NISP 401 Certification.*
[3] *Station change proposed and pending. Coordinates for FC-MID are approximate (Appendix 2).*
[4] *Station change proposed and implemented in 2024 (Appendix 2).*

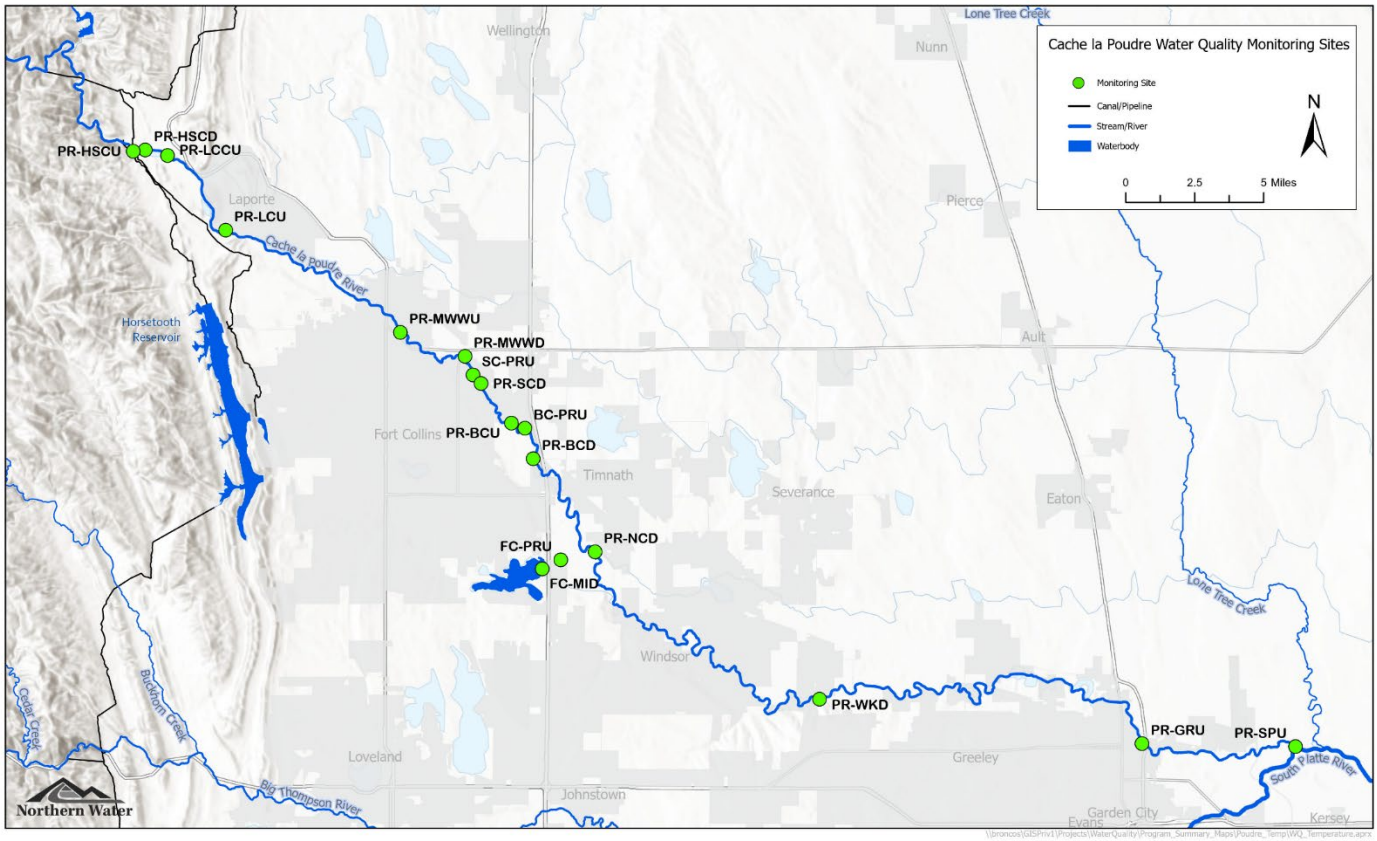

Figure 2. Map of NISP Water Quality Sites

PARAMETERS

General Water Quality

The Poudre River Water Quality Monitoring Program includes monitoring for nutrients, metals, major ions, general chemistry, and physical parameters. The parameter groups collected and the frequency of sampling at each site are objective specific: some support baseline data collection while others are specific to monitoring conditions defined in the NISP 401 Certification.

There are several parameter groups specific to objectives, location and sampling month (Table 2):

- P1 – Sampled at most sites during most sampling events and includes parameters related to existing water quality issues. This list fulfills the sampling requirements for the abbreviated list of parameters for general water quality, arsenic/copper and nutrients in the NISP 401 Certification.
- P2 – Sampled at two sites that are near the current or future (under NISP) drinking water supply diversions and focuses on parameter that are of interest for drinking water treatment (total organic carbon, alkalinity, and total dissolved solids), in addition to the parameters on the P1 list.
- P3 – Includes the same parameter as the P1 with the addition of all the major ions and a more inclusive list of metals. This allows for a comprehensive assessment of water quality. This list fulfills the sampling requirements for the long list of parameters for general water quality in the NISP 401 Certification. Samples are collected in February, June, and September.
- P4 – Includes the same parameters as the P2 with the addition of all major ions and a more inclusive list of metals. This allows for a comprehensive assessment of water quality. Samples are collected in February, June, and September.

- PAC – This list is specific to sample collection for assessment of arsenic and copper as required in the NISP 401 Certification.
- PA – This list is specific to sample collection for assessment of arsenic as required in the NISP 401 Certification.
- PN – This list is specific to sample collection for assessment of nutrients as required in the NISP 401 Certification.

Table 2. CLP NISP Analyte Parameter Lists

Type	Constituent	P1	P2	P3	P4	PAC	PA	PN
Field Parameters	Temperature	x	x	x	x	x	x	x
	Dissolved Oxygen	x	x	x	x	x	x	x
	Specific Conductance	x	x	x	x	x	x	x
	pH	x	x	x	x	x	x	x
	Turbidity	x	x	x	x	x	x	x
	Flow	x	x	x	x			x
Major Ions, carbon, misc.	Calcium	x	x	x	x	x	x	
	Magnesium	x	x	x	x	x	x	
	Potassium	x	x	x	x			
	Sodium	x	x	x	x			
	Chloride	x	x	x	x			
	Sulfate	x	x	x	x			
	Total Organic Carbon	x	x	x	x			
	Total Alkalinity	x	x	x	x			
	Total Suspended Solids	x		x	x			
	Total Dissolved Solids	x	x		x			
Metals	Arsenic, total	x	x	x	x	x	x	
	Cadmium, total			x	x			
	Chromium, total			x	x			
	Iron, total	x	x	x	x			
	Lead, total			x	x			
	Manganese, total	x	x	x	x			
	Molybdenum, total			x	x			
	Nickel, total			x	x			
	Copper, dissolved	x	x	x	x	x		
	Iron, dissolved	x	x	x	x			
	Manganese, dissolved	x	x	x	x			
	Arsenic, dissolved	x	x	x	x			
	Cadmium, dissolved			x	x			
	Chromium, dissolved			x	x			
	Lead, dissolved			x	x			
	Nickel, dissolved			x	x			

Type	Constituent	P1	P2	P3	P4	PAC	PA	PN
	Selenium, dissolved	x	x	x	x			
	Silver, dissolved			x	x			
	Zinc, dissolved	x	x	x	x			
Nutrients	Total Kjeldahl Nitrogen	x	x	x	x			x
	Ammonia as N	x	x	x	x			x
	Nitrate + Nitrite as N	x	x	x	x			x
	Orthophosphate as P	x	x	x	x			x
	Total Phosphorus	x	x	x	x			x

E. coli

E. coli monitoring is conducted at three sites on the Poudre River (PR-MWWU, PR-BCU, and PR-NCD). Monitoring at these sites must be performed at a frequency that fulfills the most recent minimum data requirements for the 303(d) listing of *E. coli*. To meet this requirement, five samples are collected at each site during set two-month periods, with at least seven days between each sample.

For this monitoring, Northern Water works in cooperation with the City of Fort Collins through an "in-kind" agreement. Northern Water staff collect three samples per month and deliver these to the Fort Collins Water Treatment Laboratory for analysis. The remaining sample is collected by the City of Fort Collins staff and analyzed at the Fort Collins Water Treatment Laboratory.

Discharge

Flow measurements are an important part of the program because flow is needed to calculate loads for mass balance modeling. Automated flow measurement stations (State Division of Water Resources and USGS) are located at or near several of the monitoring sites (Table 3). Where flow gaging is not available, manual flow measurements are taken when possible during sampling events (Figure 3). Discharge measurements are not required at the sites where monitoring is solely done for copper and arsenic since the purpose of this monitoring is to track changes in concentration, not calculate loads.

Figure 3. Manual flow measurement in the Poudre River

Table 3. Flow Measurement Source

Station	Flow Data Source
PR-HSCU	CLAFTCO – Bellview Diversion
PR-LCCU	401 Copper and Arsenic site, flow measurement not required
PR-LCU	401 Copper and Arsenic site, flow measurement not required
PR-LWU	401 Copper and Arsenic site, flow measurement not required
PR-MWWU	USGS 06752260
PR-TCU	401 Copper and Arsenic site, flow measurement not required
PR-MWWD	Manual measurement
PR-SCD	Manual measurement
SC-PRU	Manual measurement
PR-BCU	USGS 06752280
BC-PRU	Manual measurement or Boxelder Gage Reading + Boxelder Sanitation Effluent Flow
PR-BCD	USGS 06752280 + the flow measurement taken at BC-PRU
FC-PRU	Manual measurement or District 3 River Commissioner Mark Simpson
PR-NCD	CLARIVCO
PR-WKD	Manual Measurement
PR-GRU	CLAWASCO
PR-SPU	CLAGRECO

MONITORING FREQUENCY AND SAMPLE COLLECTION

Sampling frequency (Table 4) varies depending on the site and monitoring objectives. Monthly samples are collected at all sites during the same week, typically the first full week of the month. Each sampling event takes several days to complete. Effort is made to collect the samples from upstream to downstream in the same order as the sites listed in Table 1. At sites where samples are collected twice per month, the second event of the month is scheduled for two weeks after the first sampling event.

Table 4. Sample Parameter Group by Site and Month[1].

Station	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
PR-HSCU[1]	P2	P2			P4	P2	P2	P2	P4	P2	P2	P4
PR-LCCU	PAC	PAC	PAC	PAC	PAC	PAC	PAC	PAC	PAC	PAC	PAC	PAC
PR-LCU	PAC	PAC	PAC	PAC	PAC	PAC	PAC	PAC	PAC	PAC	PAC	PAC
PR-LWU	PAC	PAC	PAC	PAC	PAC	PAC	PAC	PAC	PAC	PAC	PAC	PAC
PR-MWWU	P2	P2	P1	P2	P4	P2	P2/P2	P2/P2	P4/P2	P2/P2	P2/P2	P4/P2
PR-TCU	P2	P2	PA	P2	P4	P2	P2/P2	P2/P2	P4/P2	P2/P2	P2/P2	P4/P2
TC-LCR42							P2/P2	P2/P2	P4/P2			
PR-MWWD												
SC-PRU	P1	P1			P3	P1	P1	P1	P3	P1	P1	P3
PR-SCD	P1	P1	PN	PN	P3	P1	P1	P1	P3	P1	P1	P3
BC-PRU	P1	P1			P3	P1	P1	P1	P3	P1	P1	P3
PR-BCD	P1	P1			P3	P1	P1	P1	P3	P1	P1	P3
FC-MID1	PN	PN	PN	PN	PN	PN	PN	PN	PN	PN	PN	PN

Station	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
FC-PRU[4]	PN	PN	PN	PN	PN	PN	PN	PN	PN	PN	PN	PN
PR-NCD	P1	P1			P3	P1	P1	P1	P3	P1	P1	P3
PR-WKD	P1	P1			P3	P1	P1	P1	P3	P1	P1	P3
SP-KER	P2	P2		P2	P4	P2	P2	P2	P4	P2	P2	P4
PR-GRU	P1	P1			P3	P1	P1	P1	P3	P1	P1	P3
PR-SPU	P1	P1			P3	P1	P1	P1	P3	P1	P1	P3

[1] Where sampling is conducted two times per month, parameter groups listed accordingly
[2] Surrogate site for PR-GLDU. Sampling will begin at PR-GLDU once Glade begins operating
[3] PR-TCU sampled only when Timnath Canal is running
[4] Samples collected at FC-PRU until access to Fossil Creek Reservoir is obtained

Samples are collected at PR-MWWD to see the effect of discharge from the Mulberry Wastewater Treatment Plan (WWTP). If there is no discharge from the WWTP at the time of sample collection, samples are not collected at this site. In these instances, the water quality at PR-MWWU is representative of the water quality at PR-MWWD.

All samples are collected by Northern Water Field Services following protocols documented in Northern Water's Standard Operating Procedure (SOP), Standard Operating Procedures for Northern Water's Water Quality Monitoring Programs.

Sample Analysis and Data Processing

Samples for nutrients and TDS are analyzed at High Sierra Water Lab, a USGS-certified private laboratory with low-level detection analytical capabilities. Samples for metals, major ions, and general chemistry are analyzed at Huffman Laboratories; a USGS certified private laboratory with low-level detection analytical capabilities.

Data collected in the field and received from laboratories are subject to thorough QA/QC following protocols documented in Northern Water's SOP, Standard Operating Procedures for Northern Water's Water Quality Monitoring Programs. Final data are accessible on Northern Water's Database Interface.

APPENDIX 1 – HISTORY OF PROGRAM CHANGES

The three tables below outline changes to the Poudre River/NISP Water Quality Monitoring Program since it began in 2015. Note that these changes are outlined by calendar year, not water year.

Table A1. Changes to sampling schedule and monitoring frequency for sonde/grab samples (not continuous temperature)

Year	Description of Change
2015	Program Start
	4 sampling events total, monthly June-Sept
	Pinyon Environmental conducted sampling following Northern Water's protocols
2016	16 sampling events total except for at G3-PRU which had bi-monthly July, Aug, Sept (6 events)
	Monthly sampling in Feb, Mar, Oct, Nov; Bimonthly sampling April-Sept
	Oct-April conducted by Northern Water Field Services (FS), May-Sept hybrid of FS and LT Environmental Inc.
2017	Same as in 2016 except split with FS/LT April-Sept
2018	Same at 2017. Program summary says that PR-MWWD is only sampled if Mulberry WWTP is discharging but have data at PR-MWWD for nearly all sample dates. Constituents with largest differences between sites include TOC, TDS, and Total Alk.
2019	Same as 2018.
	Oct-April sampling carried out by FS, April-Sept split between FS & LT.
	Sampling exceptions: (1) PR-NFU not sampled second time in July for park maintenance; (2) BC-PRU not sampled second time in Sept. for construction; and (3) ED-PRU not sampled Feb and early June sample – no flow.
2020	Sampling dates were variable due to COVID-19 pandemic.
	Most stations went to monthly sampling Jun/Jul/Aug/Sept except for PR-HSCU, PR-MWWU, PR-MWWD, PR-GRU, PR-SPU which still had bimonthly sampling
	All sampling conducted by FS
	Sampling **exceptions**; (1) PR-NFU ***only*** sampled Feb; (2) PR-HSCU not sampled in Sept; (3) PR-EDU ***only*** sampled Feb/Aug; (4) ED-PRU ***only*** sampled Aug; (5) PR-TCU sampled in July, Aug, Sept, Oct, Nov, Dec, monthly; (6) BC-PRU not sampled early June – backflow from CLP
2021	January: PR-MWWU, PR-SCD, PR-NCD only
	All stations Feb – Sept monthly except in June (PR-HSCU, PR-MWWU, PR-MWWD, PR-GRU, PR-SPU only)
	Bimonthly sampling April – Sept added for PR-HSCU, PR-MWWU, PR-MWWD, PR-GRU, PR-SPU
	Sampling exceptions: FC-PRU not sampled April – July due to construction and BC-PRU not sampled in May due to backflow from PR
2022	Monthly Sampling in Feb, Mar, Oct, Nov;
	Bimonthly April-Sept for a subset of stations: PR-HSCU, PR-MWWU, PR-MWWD, PR-GRU, PR-SPU
2025	Bimonthly sampling at PR-GRU and PR-SPU discontinued; monthly only
	Dec/Jan sampling added to PR-MWWU, PR-SCD, FC-MID

Table A2. Changes to the Program parameter lists and analysis

Year	Description of Change
2015	Program start: (1) DO, pH, SpCond, temp, turbidity, water level (for wells), flow, Ca, Mg, Cl, SO4, TP, ortho-P, NOx, NH3, TKN, Cu dis, Fe dis, Fe Tot Rec, Mn dis, Mn Tot Rec, Se dis (2) High Sierra Water Lab – Nutrients and TSS (3) Huffman (now Hazen) Labs – metals and gen chemistry
2016	Separated parameters into two lists, PR1, PR2, and added As, Zn, TOC, Alk, TDS (1) PR1: DO, pH, SpCond, temp, turbidity, flow, Ca, Mg, Cl, SO4, TP, ortho-P, NOx, NH3, TKN, **As dis**, Cu dis, Fe dis, Fe Tot Rec, Mn dis, Mn Tot Rec, Se dis, **Zn dis** (2) PR2: DO, pH, SpCond, temp, turbidity, flow, Ca, Mg, Cl, SO4, **TOC, Alk, TDS**, TP, ortho-P, NOx, NH3, TKN, **As dis**, Cu dis, Fe dis, Fe Tot Rec, Mn dis, Mn Tot Rec, Se dis, **Zn dis** (3) High Sierra Water Lab – Nutrients, TDS (4) Hazen Labs – metals & gen chem
2017	No changes from 2016
2018	TSS added only at PR-MWWU May-Aug and As Tot Rec added to program in May 2018
2019	Separated parameters into four lists, PR1, PR2, PR3, PR4. PR3 and PR4 sampled in Feb, June, Sept. Added noted constituents (see below): (1) PR1: DO, pH, SpCond, temp, turbidity, flow, Ca, Mg, Cl, SO4, TP, ortho-P, NOx, NH3, TKN, As dis, Cu dis, Fe dis, Fe Tot Rec, Mn dis, Mn Tot Rec, Se dis, Zn dis (2) PR2: PR1 *plus* TOC, Total Alkalinity, TDS (3) PR3: PR2 *plus* **K, Na, Cd dis, Cd Tot Rec, Cr dis, Cr Tot Rec, Pb dis, Pb Tot Rec, Mo Tot Rec, Ni dis, Ni Tot Rec, Ag dis** and *minus* TDS, TSS at all locations (4) PR4: PR3 *plus* TDS (all constituents) (5) High Sierra Water Lab – Nutrients, TDS (6) Hazen Labs – metals, major ions, and gen chem
2020	Added PAC, PA, and PN sample parameter lists, which began in Oct/Nov/Dec: (1) PAC (As/Cu): DO, pH, SpCond, temp, turbidity, Ca, Mg, As Tot Rec, Cu dis (2) PA (As-Cu): DO, pH, SpCond, temp, turbidity, Ca, Mg, As Tot Rec (3) PN (nutrients): DO, pH, SpCond, temp, turbidity, flow, TP, ortho-P, NOx, NH3, TKN (4) High Sierra Water Lab – Nutrients, TDS (5) Hazen Labs – metals, major ions, gen chem (6) Tri-State Energy requested additional parameters at PR-HSCU and PR-MWWU for one year: Al Tot Rec, Ba Tot, Si Tot, Sr Tot, F
2021	Same sample parameter lists as in 2020. Used PN/PA in Jan, otherwise used P1-P4.
2022	Same sample parameter lists. Used P1-P4
2025	Add K & Na to P2 analytical suite to capture additional Major Ions.

Table A3. Changes to program monitoring locations

Year	Description of Change
2015	Program start. 14 stations total. 8 mainstem: PR-MWWU, PR-MWWD, PR-SCD, PR-BCD, PR-NCD, PR-WKD, PR-GRU, PR-KOU. 4 tributaries: SC-PRU, BC-PRU, FC-PRU, ED-PRU. 2 groundwater wells: 2D-ARC3, 2D-GRE4.
2016	18 stations total. 10 mainstem: Added PR-NFU, HSC-PRU, PR-SPU; discontinued PR-KOU. 5 tributaries: Added DC-PRU. 2 South Platte: SP-PRU, SP-KER. 1 ag ditch: G3-PRU. Discontinued the 2 groundwater wells (2D-ARC3, 2D-GRE4).
2017	18 stations total. 11 mainstem: Added PR-EDU. 4 tributaries: Discontinued DC-PRU due to consistently low flows and site access during high flows; ED-PRU moved slightly downstream beginning in April 2017. 2 South Platte: (same). 1 ag ditch: (same).
2018	18 stations total. No changes from 2017. PR-SPU moved upstream ~1 river mile beginning Sept 2017.
2019	15 stations total. 11 mainstem: (same). 4 tributaries: (same). Discontinued South Platte (SP-PRU, SP-KER). Discontinued ag ditch (G3-PRU).
2020	16 stations total. 12 mainstem: Added PR-TCU July/Aug/Sept/Oct; updated name of HSC-PRU to PR-HSCU; PR-NFU stopped after Feb (City of Fort Collins & Greeley have established long-term monitoring at this location). 4 tributaries (same). Updated station table to include NISP-Required stations (though many TBD) but did not sample PR-LCCU, PR-LCU, PR-LWU, PR-BCU.
2021	12 stations total. 9 mainstem: PR-HSCU, PR-MWWU, PR-MWWD, PR-SCD, PR-BCD, PR-NCD, PR-WKD, PR-GRU, PR-SPU; Discontinued PR-EDU, PR-TIU. 3 tributaries: SC-PRU, BC-PRU, FC-PRU; discontinued ED-PRU.
2022	Same as 2021
2025	Discontinued PR-MWWD, initiated FC-MID, reinitiated SP-KER

APPENDIX 2 – MEMORANDUM TO CDPHE REQUESTING NISP 401 CERTIFICATION STATION CHANGES

Available upon request from the Water Quality Department.


Northern Water