Title: Precipitation chemistry concentrations and fluxes, HJ Andrews Experimental Forest, 1969 to present

Abstract:

Collection and analyses of precipitation chemistry were initiated in 1969 at the low-elevation Primary Met site, and in 1973 at a mid-elevation Hi-15 site. Rain collection samples accumulate from one week to three weeks in bulk and NADP type collectors and then are transported to Cooperative Chemical Analytical Laboratory (CCAL) for analysis. Analytes include nitrogen, phosphorus, carbon, and cations and anions as well as pH, conductivity, alkalinity and particulate sediment. Concentration and volume of precipitation are combined for inflow. Dry deposition chemistry concentrations began in 1989 and are analyzed 2-4 times per year at one site. The original objectives were to evaluate precipitation chemistry inputs versus chemistry outputs in streamflow from forested watersheds. The study has evolved into a general monitoring effort for precipitation chemistry that is among the least contaminated of any within the USA. This study is conducted in conjunction with Andrews streamflow chemistry (CF002) and the U.S. National Atmospheric Deposition Program (NADP).

Keywords: Chemical analysis; Hydrology/Water; Nutrients; Precipitation; Solution transport; Timber harvesting; Water chemistry; Inorganic nutrients; Hydrology; Water chemistry; precipitation; chemical properties; concentration; suspended solids; timber harvest; inorganic nutrients; nutrients; water;

Date data commenced: 1968-10-01
Date data terminated: 2019-05-22
Principal Investigator: Sherri L. Johnson

List of Entities:

1. Precipitation water sample nutrient concentrations
2. Precipitation water nutrient inflow in kg/ha
3. Precipitation water nutrient mean annual concentrations
6. Precipitation water sample log sheet: field and laboratory comments

**I. Precipitation water sample nutrient concentrations**

Precipitation samples are collected and analyzed on a 3-week basis for nutrient concentrations. Precipitation amounts for each sampling period are provided.

**Attribute List:**

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2. Precipitation water nutrient inflow in kg/ha

Derived nutrient inputs based on precipitation nutrient concentration data (Entity 1) and actual precipitation for the sampling period.

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<td>mg/l</td>
</tr>
<tr>
<td>CLCODE_YR</td>
<td>char</td>
<td>2</td>
<td>Y</td>
<td>enum</td>
<td></td>
</tr>
<tr>
<td>DOC_YR</td>
<td>numeric</td>
<td>6,2</td>
<td>Y</td>
<td>0.1000 - 1.4400</td>
<td>mg/l</td>
</tr>
<tr>
<td>DOCCODE_YR</td>
<td>char</td>
<td>2</td>
<td>Y</td>
<td>enum</td>
<td></td>
</tr>
</tbody>
</table>

### Attribute List:

- **STCODE**: N N char(5) enum
- **ENTITY**: N N numeric(1,0) range
- **SITECODE**: Y N char(6) place
- **WATERYEAR**: N N numeric(4,0) range
- **DATE_TIME**: Y N datetime range
- **LABNO**: N Y char(4) freetext
- **TYPE**: N N char(2) enum
- **QCCODE**: N N char(2) enum

---

**6. Precipitation water sample log sheet: field and laboratory comments**

---
<table>
<thead>
<tr>
<th>Attribute</th>
<th>Optional</th>
<th>Required</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>QA_SAMPLE</td>
<td>N</td>
<td>Y</td>
<td>char(6)</td>
<td>freetext</td>
</tr>
<tr>
<td>SAMPLER_TYPE</td>
<td>N</td>
<td>N</td>
<td>char(2)</td>
<td>enum</td>
</tr>
<tr>
<td>LOW_VOLUME</td>
<td>N</td>
<td>N</td>
<td>char(1)</td>
<td>enum</td>
</tr>
<tr>
<td>FIELD_COMMENTS9N</td>
<td>N</td>
<td>Y</td>
<td>char(254)</td>
<td>freetext</td>
</tr>
<tr>
<td>LAB_COMMENTS</td>
<td>N</td>
<td>Y</td>
<td>char(254)</td>
<td>freetext</td>
</tr>
<tr>
<td>SEQ_INDEX</td>
<td>N</td>
<td>N</td>
<td>numeric(5,0)</td>
<td>range 1.0000 9233.0000 number</td>
</tr>
</tbody>
</table>

Attributes Definitions:

**ALK**

Alkalinity as calcium carbonate (CaCO3); method: electrometric titration to pH 4.5; all data is converted from the formerly used units of bicarbonate carbon (HCO3-C)

**ALK_INPUT**

Alkalinity inflow as CaCO3 (units have been converted for all values from bicarbonate (HCO3-C) to calcium carbonate)

**ALK_YR**

Mean annual alkalinity concentration as CaCO3 (calcium carbonate) - all values have been converted from HCO3-C (bi-carbonate)

**ALKCODE**

Alkalinity value qualifier code

**ALKCODE_YR**

Annual alkalinity qualifier value code

**ANCA**

Anion-cation ratio: micro equivalence ratio of anions to cations by calculation - provided only as an analytical check. Requires anions: ALK, SO4S, CL, NO3N, PO4P, cations: pH, Na, K, Ca, Mg, NH4N

**ANCACODE**

Anion-cation ratio qualifier code

**CA**

Ca, dissolved calcium (filtrable) concentration; method flame atomic absorption spectroscopy

**CA_INPUT**

Calcium inflow

**CA_YR**

Mean annual calcium concentration

**CACODE**

Ca value qualifier code

**CACODE_YR**

Annual Ca value qualifier code

**CL**

Chloride (dissolved) concentration; method: ion chromatography (automated ferric thiocyanate before 1993)

**CL_INPUT**

Chloride inflow
CL_YR
  Mean annual chloride concentration
CLCODE
  Cl value qualifier code
CLCODE_YR
  Annual Cl value qualifier code
COND
  Specific conductance; method: wheatstone bridge
COND_YR
  Mean annual specific conductivity concentration
CONDCODE
  Conductivity value qualifier code
CONDCODE_YR
  Annual conductivity value qualifier code
DATE_TIME
  Collection date and time (PST) of the precipitation sample - sample represents deposition from the previous sample date and time. Assume beginning date of first sample period for each collector is October 1st.
DOC
  DOC, dissolved organic carbon concentration; method: combustion
DOC_INPUT
  Dissolved organic carbon inflow
DOC_YR
  Mean annual dissolved organic carbon concentration
DOCCODE
  DOC value qualifier code
DOCCODE_YR
  Annual DOC value qualifier code
DON
  Dissolved organic nitrogen - not measured analytically; mathematically determined by subtracting NH3-N and NO3-N from Total dissolved nitrogen. Values before May 2005 are determined by TKN minus NH3-N.
DON_INPUT
  Dissolved organic N inflow - not measured analytically; mathematically determined by subtracting NH3-N and NO3-N from Total dissolved nitrogen. Values before May 2005 are determined by TKN minus NH3-N
DON_YR
  Mean annual dissolved organic N concentration - not measured analytically; mathematically determined by subtracting NH3-N and NO3-N from Total dissolved nitrogen. Values before May 2005 are determined by TKN minus NH3-N
DONCODE
  Dissolved organic nitrogen value qualifier code
DONCODE_YR
Annual dissolved organic N value qualifier code

ENTITY
  Entity number

FIELD_COMMENTS
  Field comments related to the collection of the water sample

K
  K, dissolved potassium (filtrable) concentration; method flame atomic absorption spectroscopy

K_INPUT
  Potassium inflow

K_YR
  Mean annual potassium concentration

KCODE
  K value qualifier code

KCODE_YR
  Annual K value qualifier code

LAB_COMMENTS
  Laboratory comments related to the handling and analyses of the sample

LABNO
  Lab number code for sample

LOW_VOLUME
  Indicator of a low volume sampler that may restrict the breadth of laboratory analyses

MG
  Mg, dissolved magnesium (filtrable) concentration; method flame atomic absorption spectroscopy

MG_INPUT
  Magnesium inflow

MG_YR
  Mean annual magnesium concentration

MGCODE
  Mg value qualifier code

MGCODE_YR
  Annual Mg value qualifier code

NA
  Na, dissolved sodium (filtrable) concentration; method flame atomic absorption spectroscopy

NA_INPUT
  Sodium inflow

NA_YR
  Mean annual sodium concentration
NACODE
   Na value qualifier code
NACODE_YR
   Annual Na value qualifier code

NH3N
   Ammonia-nitrogen (NH3-N) concentration, ammonia as nitrogen; method: automated phenate
NH3N_INPUT
   Ammonia-nitrogen (NH3-N) inflow
NH3N_YR
   Mean annual ammonia (NH3-N) concentration

NH3NCODE
   NH3-N value qualifier code
NH3NCODE_YR
   Annual NH3-N value qualifier code

NO3N
   Nitrate-nitrogen (NO3-N), nitrate + nitrite as nitrogen concentration; method: automated cadmium reduction
NO3N_INPUT
   Nitrate-nitrogen (NO3-N) inflow
NO3N_YR
   Mean annual nitrate-nitrogen (NO3-N) concentration

NO3NCODE
   NO3-N value qualifier code
NO3NCODE_YR
   Annual NO3-N value qualifier code

PARTN
   Particulate N, also known as total suspended nitrogen - not measured analytically; mathematically determined by subtraction of Total dissolved nitrogen (TDN) from Unfiltered Total nitrogen (UTN). Values before May 2005 are determined by UTKN minus TKN.

PARTN_INPUT
   Particulate N inflow - not measured analytically; mathematically determined by subtraction of Total dissolved nitrogen (TDN) from Unfiltered Total nitrogen (UTN). Values before May 2005 are determined by UTKN minus TKN.

PARTN_YR
   Mean annual particulate N concentration - not measured analytically; mathematically determined by subtraction of Total dissolved nitrogen (TDN) from Unfiltered Total nitrogen (UTN). Values before May 2005 are determined by UTKN minus TKN.

PARTNCODE
   Particulate N value qualifier code

PARTNCODE_YR
   Annual particulate N value qualifier code

PARTP
   Particulate P, also known as total suspended phosphorus - not measured analytically; mathematically determined by subtraction of Total...
Dissolved P (TDP) from Unfiltered Total P (UTP)

PARTP_INPUT

Particulate P inflow - not measured analytically; mathematically determined by subtraction of Total Dissolved P (TDP) from Unfiltered Total P (UTP)

PARTP_YR

Mean annual particulate P - not measured analytically; mathematically determined by subtraction of Total Dissolved P (TDP) from Unfiltered Total P (UTP)

PARTPCODE

Particulate P value qualifier code

PARTPCODE_YR

Annual particulate P value qualifier code

PCODE

Precipitation value qualifier code

PCODE_YR

Annual precipitation value qualifier code

PH

pH (hydrogen concentration); method: glass electrode

PH_YR

Mean annual pH

PHCODE

pH value qualifier code

PHCODE_YR

Annual pH value qualifier code

PO4P

Ortho phosphorus concentration, soluble reactive phosphorus, phosphate (PO4-P); method: ascorbic acid finish

PO4P_INPUT

Ortho phosphorus (PO4-P) inflow

PO4P_YR

Mean annual ortho phosphorus (PO4-P) concentration

PO4PCODE

Ortho phosphorus value qualifier code

PO4PCODE_YR

Annual ortho phosphorus value qualifier code

PRECIP_CM

Precipitation in centimeters for the exact sample period. Based on precipitation stations CS2MET or PRIMET (beginning WY 2003) for collector RCADMN and H15MET or CENMET (beginning WY 2006) for collectors RCHIF7, RCHIR7 and RCHI15.

PRECIP_CM

Precipitation in centimeters for the exact sample period. Based on CS2MET (RCADMN) or H15MET (RCHIR7, RCHI15) meteorological station precipitation.
PRECIP_YR
Total annual precipitation for the wateryear

PVOL
Sample volume from precipitation collector; for dry deposition sample - includes any precipitation collected and DI water added to sample for analysis

PVOLCODE
Sample volume qualifier code

QA_SAMPLE
Quality assurance sample number assigned if sample water is further analyzed for internal laboratory purposes

QCCODE
Quality control sample codes are assigned to samples collected for examining integrity of proportional sample analysis

SAMPLER_TYPE
Type of water sampler or method used to collect water

SEQ_INDEX
Sequential index generated primarily by the temporal order in which samples are collected

SI
Silica as silicon concentration; method: automated molybdenum blue

SI_INPUT
Silica inflow

SI_YR
Mean annual silica concentration

SICODE
Silica value qualifier code

SICODE_YR
Annual silica value qualifier code

SITECODE
Precipitation or dry deposition collector site code

SO4S
SO4-S (dissolved) concentration, sulfate as sulfur; method ion chromatography (automated barium sulfate before 1993)

SO4S_INPUT
SO4-S (sulfate-sulfur) inflow

SO4S_YR
Mean annual SO4-S (sulfate-sulfur) concentration

SO4SCODE
SO4-S value qualifier code

SO4SCODE_YR
Annual SO4-S value qualifier code

SSED
Suspended sediment concentration; method: nonfiltrable residue, gravimetric

**SSED_INPUT**
Suspended sediment inflow

**SSED_YR**
Mean annual suspended sediment concentration

**SSEDCODE**
Suspended sediment value qualifier code

**SSEDCODE_YR**
Annual suspended sediment value qualifier code

**STCODE**
Study code

**TDN**
Total dissolved nitrogen concentration (filtered sample); method: persulfate digestion and analysis by automated colorimetric analysis; instrument: Technicon Auto-Analyzer II

**TDN_INPUT**
Total dissolved nitrogen inflow (filtered sample)

**TDN_YR**
Mean annual total dissolved nitrogen concentration

**TDNCODE**
Total dissolved nitrogen value qualifier code

**TDNCODE_YR**
Annual total dissolved nitrogen value qualifier code

**TDP**
Total dissolved phosphorus concentration; method: persulfate/H2SO4 digestion, ascorbic acid finish

**TDP_INPUT**
Total dissolved phosphorus inflow

**TDP_YR**
Mean annual total dissolved phosphorus concentration

**TDPCODE**
Total dissolved phosphorus value qualifier code

**TDPCODE_YR**
Annual total dissolved phosphorus value qualifier code

**TKN**
Total Kjeldahl nitrogen concentration on filtered sample (dissolved); method: Kjeldahl digestion H2SO4, CuSO4/KCl, nessler finish

**TKN_INPUT**
Total Kjeldahl nitrogen (dissolved) inflow

**TKN_YR**
Mean annual total Kjeldahl nitrogen concentration (dissolved)
TKNCODE
    Total Kjeldahl nitrogen value qualifier code

TKNCODE_YR
    Annual total Kjeldahl nitrogen value qualifier code

TYPE
    Sample type indicator - indicates dry deposition samples and other qualifying information

UTKN
    Total Kjeldahl nitrogen concentration on unfiltered sample; method: Kjeldahl digestion H2SO4, CuSO4/KCl, nessler finish

UTKN_INPUT
    Unfiltered total Kjeldahl nitrogen inflow

UTKN_YR
    Mean annual unfiltered total Kjeldahl nitrogen concentration

UTKNCODE
    Unfiltered total Kjeldahl nitrogen value qualifier code

UTKNCODE_YR
    Annual unfiltered total Kjeldahl nitrogen value qualifier code

UTN
    Total nitrogen concentration (unfiltered sample); method: persulfate digestion and analysis by automated colorimetric analysis; instrument: Technicon Auto-Analyzer II

UTN_INPUT
    Total nitrogen inflow (unfiltered sample)

UTN_YR
    Mean annual total nitrogen concentration (unfiltered samples)

UTNCODE
    Unfiltered total nitrogen value qualifier code

UTNCODE_YR
    Annual unfiltered total nitrogen value qualifier code

UTP
    Unfiltered total phosphorus concentration; method: persulfate/H2SO4 digestion, ascorbic acid finish

UTP_INPUT
    Unfiltered total phosphorus inflow

UTP_YR
    Mean annual unfiltered total phosphorus concentration

UTPCODE
    Unfiltered total phosphorus value qualifier code

UTPCODE_YR
    Annual unfiltered total phosphorus value qualifier code

WATERYEAR
Water year of sample or annual summary (October-September)

Enumerated Domains:

Enumerated Domain for Attribute: ALKCODE
- A: Accepted value
- E: Estimated value
- N: No analytical measurement
- *: Value is below detection limit for analysis (used beginning in 1991)
- Q: Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: ANCACODE
- N: No anion-cation ratio calculation determined due to missing analytical components
- D: Derived anion-cation ratio value is based on the full set of anions and cations
- D*: Derived value - mathematically determined from other analytical measurements, one or more of which were below the detection limit
- DE: Derived value - mathematically determined from other analytical measurements, one or more of which were estimated values
- DQ: Derived value - mathematically determined from other analytical measurements, one or more of which were questionable values

Enumerated Domain for Attribute: CACODE
- A: Accepted value
- E: Estimated value
- N: No analytical measurement
- *: Value is below detection limit for analysis (used beginning in 1991)
- Q: Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: CLCODE
- A: Accepted value
- E: Estimated value
- N: No analytical measurement
- *: Value is below detection limit for analysis (used beginning in 1991)
- Q: Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: CONDCODE
- A: Accepted value
- E: Estimated value
- N: No analytical measurement
- *: Value is below detection limit for analysis (used beginning in 1991)
- Q: Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: DOCCODE
- A: Accepted value
- E: Estimated value
N  No analytical measurement
*  Value is below detection limit for analysis (used beginning in 1991)
Q  Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: KCODE
A  Accepted value
E  Estimated value
N  No analytical measurement
*  Value is below detection limit for analysis (used beginning in 1991)
Q  Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: MGCODE
A  Accepted value
E  Estimated value
N  No analytical measurement
*  Value is below detection limit for analysis (used beginning in 1991)
Q  Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: NACODE
A  Accepted value
E  Estimated value
N  No analytical measurement
*  Value is below detection limit for analysis (used beginning in 1991)
Q  Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: NH3NCODE
A  Accepted value
E  Estimated value
N  No analytical measurement
*  Value is below detection limit for analysis (used beginning in 1991)
Q  Value is questionable (used beginning in 1991)
C  Value confirmed, contamination suspected (code use begins May 2007)

Enumerated Domain for Attribute: NO3NCODE
A  Accepted value
E  Estimated value
N  No analytical measurement
*  Value is below detection limit for analysis (used beginning in 1991)
Q  Value is questionable (used beginning in 1991)
C Value confirmed, contamination suspected (code use begins May 2007)

Enumerated Domain for Attribute: PO4PCODE
A Accepted value
E Estimated value
N No analytical measurement
* Value is below detection limit for analysis (used beginning in 1991)
Q Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: PCODE
N No precipitation recorded for period. For saved sample (type='S'), precipitation for this period is included in the following period.
E Estimated precipitation
A Accepted value for precipitation
Q Precipitation value is questionable
M Missing value

Enumerated Domain for Attribute: PHCODE
A Accepted value
E Estimated value
N No analytical measurement
Q Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: PVOLCODE
Q Sample volume value is questionable - typically implies volume is measured correctly, but volume does not represent the entire collection period
N No sample volume value available
A Accepted value
K Volume is precipitation plus added DIW (usually 250 ml). Concentration values are based on this volume.
L Volume of lab water (DIW) added to dry bucket (usually 250 ml). Concentration values are based on this volume.
M Volume is precipitation in dry bucket (liters). Concentration values are based on this volume. No DIW added to the precipitation water.

Enumerated Domain for Attribute: SICODE
A Accepted value
E Estimated value
N No analytical measurement
* Value is below detection limit for analysis (used beginning in 1991)
Q Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: SO4SCODE
A Accepted value
E Estimated value
N No analytical measurement
*  Value is below detection limit for analysis (used beginning in 1991)
Q  Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: SSEDCODE
A  Accepted value
E  Estimated value
N  No analytical measurement
Q  Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: STCODE
CP002  Study code CP002

Enumerated Domain for Attribute: TKNCODE
A  Accepted value
E  Estimated value
N  No analytical measurement
*  Value is below detection limit for analysis (used beginning in 1991)
Q  Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: TDPCODE
A  Accepted value
E  Estimated value
N  No analytical measurement
*  Value is below detection limit for analysis (used beginning in 1991)
Q  Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: TYPE
S  Sample saved and combined with the following collection due to insufficient water for analyses - samples were no longer saved and combined after 1981 period (includes problems with NADP-style collector motor or samples that may have overflowed)
P  Partial sample - precipitation was not collected successfully over the entire period
YE  Year end marker allows summary by water year - this is not a sample. Flux values are calculated from precip ending Sep 30 and use analyte concentrations from the following sample. ‘YE’ markers are inserted every Sep 30.
C  Sample is combined with preceeding saved sample(s) for analysis. Combined samples of this type are not used after 1981.
DW  Dry deposition sample - dry bucket contains rain water
F  Sample is successfully collected over the entire period - a “Full” sample.
N  No sample is collected - generally indicates periods of little or no rain, but can be a lost sample.
DF  Dry deposition sample - sample is dry and not contaminated with precipitation water
B  Biased sample - Lid on NADP sampler malfunctions and sample includes dry deposition
DC  Dry deposition sample - dry bucket contains rain water and other insects/contaminants

Enumerated Domain for Attribute: UTKNCODE
A  Accepted value
E  Estimated value
N  No analytical measurement
*  Value is below detection limit for analysis (used beginning in 1991)
Q  Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: UTPCODE
  A  Accepted value
  E  Estimated value
  N  No analytical measurement
  *  Value is below detection limit for analysis (used beginning in 1991)
  Q  Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: PARTPCODE
  N  No derived value is calculated due to missing analytical components
  D  Derived value - mathematically determined from other analytical measurements
  D* Derived value - mathematically determined from other analytical measurements, one or more of which were below the detection limit
  DE Derived value - mathematically determined from other analytical measurements, one or more of which were estimated values
  DQ Derived value - mathematically determined from other analytical measurements, one or more of which were questionable values

Enumerated Domain for Attribute: UTNCODE
  A  Accepted value
  E  Estimated value
  *  Value is below detection limit for analysis (used beginning in 1991)
  Q  Value is questionable (used beginning in 1991)
  D  Derived value - mathematically determined from other analytical measurements
  D* Derived value - mathematically determined from other analytical measurements, one or more of which were below the detection limit
  DE Derived value - mathematically determined from other analytical measurements, one or more of which were estimated values
  DQ Derived value - mathematically determined from other analytical measurements, one or more of which were questionable values
  N  No analytical measurement or no derived value calculated due to missing analytical components

Enumerated Domain for Attribute: TDNCODE
  A  Accepted value
  E  Estimated value
  *  Value is below detection limit for analysis (used beginning in 1991)
  Q  Value is questionable (used beginning in 1991)
  D  Derived value - mathematically determined from other analytical measurements
  D* Derived value - mathematically determined from other analytical measurements, one or more of which were below the detection limit
DE Derived value - mathematically determined from other analytical measurements, one or more of which were estimated values.
DQ Derived value - mathematically determined from other analytical measurements, one or more of which were questionable values.
N No analytical measurement or no derived value calculated due to missing analytical components.

Enumerated Domain for Attribute: DONCODE
N No derived value is calculated due to missing analytical components.
D Derived value - mathematically determined from other analytical measurements.
D* Derived value - mathematically determined from other analytical measurements, one or more of which were below the detection limit.
DE Derived value - mathematically determined from other analytical measurements, one or more of which were estimated values.
DQ Derived value - mathematically determined from other analytical measurements, one or more of which were questionable values.

Enumerated Domain for Attribute: PARTNCODE
N No derived value is calculated due to missing analytical components.
D Derived value - mathematically determined from other analytical measurements.
D* Derived value - mathematically determined from other analytical measurements, one or more of which were below the detection limit.
DE Derived value - mathematically determined from other analytical measurements, one or more of which were estimated values.
DQ Derived value - mathematically determined from other analytical measurements, one or more of which were questionable values.

Enumerated Domain for Attribute: ALKCODE
A Accepted value.
E Estimated value.
N No analytical measurement.
* Value is below detection limit for analysis (used beginning in 1991).
Q Value is questionable (used beginning in 1991).

Enumerated Domain for Attribute: CACODE
A Accepted value.
E Estimated value.
N No analytical measurement.
* Value is below detection limit for analysis (used beginning in 1991).
Q Value is questionable (used beginning in 1991).

Enumerated Domain for Attribute: CLCODE
A Accepted value.
E Estimated value.
N No analytical measurement.
* Value is below detection limit for analysis (used beginning in 1991).
Q Value is questionable (used beginning in 1991).

Enumerated Domain for Attribute: DOCCODE
A Accepted value.
E Estimated value
N No analytical measurement
* Value is below detection limit for analysis (used beginning in 1991)
Q Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: KCODE
A Accepted value
E Estimated value
N No analytical measurement
* Value is below detection limit for analysis (used beginning in 1991)
Q Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: MGCODE
A Accepted value
E Estimated value
N No analytical measurement
* Value is below detection limit for analysis (used beginning in 1991)
Q Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: NACODE
A Accepted value
E Estimated value
N No analytical measurement
* Value is below detection limit for analysis (used beginning in 1991)
Q Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: NH3NCODE
A Accepted value
E Estimated value
N No analytical measurement
* Value is below detection limit for analysis (used beginning in 1991)
Q Value is questionable (used beginning in 1991)
C Value confirmed, contamination suspected (code use begins May 2007)

Enumerated Domain for Attribute: NO3NCODE
A Accepted value
E Estimated value
N No analytical measurement
* Value is below detection limit for analysis (used beginning in 1991)
Q Value is questionable (used beginning in 1991)
C Value confirmed, contamination suspected (code use begins May 2007)

Enumerated Domain for Attribute: PO4PCODE
A Accepted value
E Estimated value
N No analytical measurement
* Value is below detection limit for analysis (used beginning in 1991)
Q Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: PCODE
N No precipitation recorded for period. For saved sample (type='S'), precipitation for this period is included in the following period.
E Estimated precipitation
A Accepted value for precipitation
Q Precipitation value is questionable
M Missing value

Enumerated Domain for Attribute: SICODE
A Accepted value
E Estimated value
N No analytical measurement
* Value is below detection limit for analysis (used beginning in 1991)
Q Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: SO4SCODE
A Accepted value
E Estimated value
N No analytical measurement
* Value is below detection limit for analysis (used beginning in 1991)
Q Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: SSEDCODE
A Accepted value
E Estimated value
N No analytical measurement
* Value is below detection limit for analysis (used beginning in 1991)
Q Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: STCODE
CP002 Study code CP002

Enumerated Domain for Attribute: TKNCODE
A Accepted value
E Estimated value
N No analytical measurement
* Value is below detection limit for analysis (used beginning in 1991)
Q Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: TDPCODE
A Accepted value
E Estimated value
N No analytical measurement
* Value is below detection limit for analysis (used beginning in 1991)
Q Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: TYPE
S Sample saved and combined with the following collection due to insufficient water for analyses - samples were no longer saved and combined after 1981
P Partial sample - precipitation was not collected successfully over the entire period (includes problems with NADP-style collector motor or samples that may have overflowed)
YE Year end marker allows summary by water year - this is not a sample. Flux values are calculated from precip ending Sep 30 and use analyte concentrations from the following sample. ‘YE’ markers are inserted every Sep 30.
C Sample is combined with preceding saved sample(s) for analysis. Combined samples of this type are not used after 1981.
DW Dry deposition sample - dry bucket contains rain water
F Sample is successfully collected over the entire period - a “Full” sample.
N No sample is collected - generally indicates periods of little or no rain, but can be a lost sample.
DF Dry deposition sample - sample is dry and not contaminated with precipitation water
B Biased sample - Lid on NADP sampler malfunctions and sample includes dry deposition
DC Dry deposition sample - dry bucket contains rain water and other insects/contaminants

Enumerated Domain for Attribute: UTKNCODE
A Accepted value
E Estimated value
N No analytical measurement
* Value is below detection limit for analysis (used beginning in 1991)
Q Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: UTPCODE
A Accepted value
E Estimated value
N No analytical measurement
* Value is below detection limit for analysis (used beginning in 1991)
Q Value is questionable (used beginning in 1991)
Enumerated Domain for Attribute: PARTPCODE
N  No derived value is calculated due to missing analytical components
D  Derived value - mathematically determined from other analytical measurements
D* Derived value - mathematically determined from other analytical measurements, one or more of which were below the detection limit
DE Derived value - mathematically determined from other analytical measurements, one or more of which were estimated values
DQ Derived value - mathematically determined from other analytical measurements, one or more of which were questionable values

Enumerated Domain for Attribute: UTNCODE
A  Accepted value
E  Estimated value
*  Value is below detection limit for analysis (used beginning in 1991)
Q  Value is questionable (used beginning in 1991)
D  Derived value - mathematically determined from other analytical measurements
D* Derived value - mathematically determined from other analytical measurements, one or more of which were below the detection limit
DE Derived value - mathematically determined from other analytical measurements, one or more of which were estimated values
DQ Derived value - mathematically determined from other analytical measurements, one or more of which were questionable values
N  No analytical measurement or no derived value calculated due to missing analytical components

Enumerated Domain for Attribute: TDNCODE
A  Accepted value
E  Estimated value
*  Value is below detection limit for analysis (used beginning in 1991)
Q  Value is questionable (used beginning in 1991)
D  Derived value - mathematically determined from other analytical measurements
D* Derived value - mathematically determined from other analytical measurements, one or more of which were below the detection limit
DE Derived value - mathematically determined from other analytical measurements, one or more of which were estimated values
DQ Derived value - mathematically determined from other analytical measurements, one or more of which were questionable values
N  No analytical measurement or no derived value calculated due to missing analytical components

Enumerated Domain for Attribute: DONCODE
N  No derived value is calculated due to missing analytical components
D  Derived value - mathematically determined from other analytical measurements
D* Derived value - mathematically determined from other analytical measurements, one or more of which were below the detection limit
DE Derived value - mathematically determined from other analytical measurements, one or more of which were estimated values
DQ Derived value - mathematically determined from other analytical measurements, one or more of which were questionable values

Enumerated Domain for Attribute: PARTNCODE
N  No derived value is calculated due to missing analytical components
### Derived Values:

- **D**: Derived value - mathematically determined from other analytical measurements.
- **D***: Derived value - mathematically determined from other analytical measurements, one or more of which were below the detection limit.
- **DE**: Derived value - mathematically determined from other analytical measurements, one or more of which were estimated values.
- **DQ**: Derived value - mathematically determined from other analytical measurements, one or more of which were questionable values.

### Enumerated Domain for Attribute: ALKCODE_YR

- **Q**: Annual value includes questionable values.
- **N**: No analyses conducted in water year.
- **A**: Annual value is accepted.
- **E**: Annual value includes estimated values.
- **I**: Annual value incomplete; one or more values are missing for part of the year.
- **I***: Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit.
- **IE**: Annual value incomplete; one or more values are missing for part of the year; one or more values estimated.
- **IQ**: Annual value incomplete; one or more values are missing for part of the year; one or more values questionable.
- *****: Annual value includes one or more values measured below the detection limit.

### Enumerated Domain for Attribute: CACODE_YR

- **Q**: Annual value includes questionable values.
- **N**: No analyses conducted in water year.
- **A**: Annual value is accepted.
- **E**: Annual value includes estimated values.
- **I**: Annual value incomplete; one or more values are missing for part of the year.
- **I***: Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit.
- **IE**: Annual value incomplete; one or more values are missing for part of the year; one or more values estimated.
- **IQ**: Annual value incomplete; one or more values are missing for part of the year; one or more values questionable.
- *****: Annual value includes one or more values measured below the detection limit.

### Enumerated Domain for Attribute: CLCODE_YR

- **Q**: Annual value includes questionable values.
- **N**: No analyses conducted in water year.
- **A**: Annual value is accepted.
- **E**: Annual value includes estimated values.
- **I**: Annual value incomplete; one or more values are missing for part of the year.
- **I***: Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit.
- **IE**: Annual value incomplete; one or more values are missing for part of the year; one or more values estimated.
- **IQ**: Annual value incomplete; one or more values are missing for part of the year; one or more values questionable.
- *****: Annual value includes one or more values measured below the detection limit.
Enumerated Domain for Attribute: CONDCODE_YR
Q  Annual value includes questionable values
N  No analyses conducted in water year
A  Annual value is accepted
E  Annual value includes estimated values
I  Annual value incomplete; one or more values are missing for part of the year
I* Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit
IE Annual value incomplete; one or more values are missing for part of the year; one or more values estimated
IQ Annual value incomplete; one or more values are missing for part of the year; one or more values questionable
* Annual value includes one or more values measured below the detection limit

Enumerated Domain for Attribute: DOCCODE_YR
Q  Annual value includes questionable values
N  No analyses conducted in water year
A  Annual value is accepted
E  Annual value includes estimated values
I  Annual value incomplete; one or more values are missing for part of the year
I* Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit
IE Annual value incomplete; one or more values are missing for part of the year; one or more values estimated
IQ Annual value incomplete; one or more values are missing for part of the year; one or more values questionable
* Annual value includes one or more values measured below the detection limit

Enumerated Domain for Attribute: KCODE_YR
Q  Annual value includes questionable values
N  No analyses conducted in water year
A  Annual value is accepted
E  Annual value includes estimated values
I  Annual value incomplete; one or more values are missing for part of the year
I* Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit
IE Annual value incomplete; one or more values are missing for part of the year; one or more values estimated
IQ Annual value incomplete; one or more values are missing for part of the year; one or more values questionable
* Annual value includes one or more values measured below the detection limit

Enumerated Domain for Attribute: MGCODE_YR
Q  Annual value includes questionable values
N  No analyses conducted in water year
A  Annual value is accepted
E  Annual value includes estimated values
I  Annual value incomplete; one or more values are missing for part of the year
I* Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit
IE Annual value incomplete; one or more values are missing for part of the year; one or more values estimated
IQ Annual value incomplete; one or more values are missing for part of the year; one or more values questionable
*  Annual value includes one or more values measured below the detection limit

Enumerated Domain for Attribute: NACODE_YR
Q  Annual value includes questionable values
N  No analyses conducted in water year
A  Annual value is accepted
E  Annual value includes estimated values
I  Annual value incomplete; one or more values are missing for part of the year
I* Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit
IE Annual value incomplete; one or more values are missing for part of the year; one or more values estimated
IQ Annual value incomplete; one or more values are missing for part of the year; one or more values questionable
*  Annual value includes one or more values measured below the detection limit

Enumerated Domain for Attribute: NH3NCODE_YR
Q  Annual value includes questionable values
N  No analyses conducted in water year
A  Annual value is accepted
E  Annual value includes estimated values
I  Annual value incomplete; one or more values are missing for part of the year
I* Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit
IE Annual value incomplete; one or more values are missing for part of the year; one or more values estimated
IQ Annual value incomplete; one or more values are missing for part of the year; one or more values questionable
*  Annual value includes one or more values measured below the detection limit

Enumerated Domain for Attribute: NO3NCODE_YR
Q  Annual value includes questionable values
N  No analyses conducted in water year
A  Annual value is accepted
E  Annual value includes estimated values
I  Annual value incomplete; one or more values are missing for part of the year
I* Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit
IE Annual value incomplete; one or more values are missing for part of the year; one or more values estimated
IQ
Annual value incomplete; one or more values are missing for part of the year; one or more values questionable

* Annual value includes one or more values measured below the detection limit

Enumerated Domain for Attribute: PO4PCODE_YR
- Q Annual value includes questionable values
- N No analyses conducted in water year
- A Annual value is accepted
- E Annual value includes estimated values
- I Annual value incomplete; one or more values are missing for part of the year
- I* Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit
- IE Annual value incomplete; one or more values are missing for part of the year; one or more values estimated
- IQ Annual value incomplete; one or more values are missing for part of the year; one or more values questionable
- * Annual value includes one or more values measured below the detection limit

Enumerated Domain for Attribute: DONCODE_YR
- N No derived values are calculated for the entire water year
- D Annual value based on derived values
- D* Annual value based on derived values; one or more values measured below the detection limit
- DE Annual value based on derived values; one or more values estimated
- DQ Annual value based on derived values; one or more values questionable
- ID Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values
- ID* Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values of which one or more values measured below the detection limit
- IDE Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values of which one or more values are estimated
- IDQ Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values of which one or more values are questionable

Enumerated Domain for Attribute: PCODE_YR
- I Incomplete, parts of year missing from annual summary
- A All precipitation is included and not estimated for the water year
- E Total includes estimated precipitation values
- Q Precipitation total may be questionable for some periods of the water year

Enumerated Domain for Attribute: PHCODE_YR
- Q Annual value includes questionable values
- N No analyses conducted in water year
- A Annual value is accepted
- E Annual value includes estimated values
- I Annual value incomplete; one or more values are missing for part of the year
IE  Annual value incomplete; one or more values are missing for part of the year; one or more values estimated
IQ  Annual value incomplete; one or more values are missing for part of the year; one or more values questionable

Enumerated Domain for Attribute: PARTNCODE_YR
N  No derived values are calculated for the entire water year
D  Annual value based on derived values
D* Annual value based on derived values; one or more values measured below the detection limit
DE Annual value based on derived values; one or more values estimated
DQ Annual value based on derived values; one or more values questionable
ID Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values
ID* Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values of which one or more values measured below the detection limit
IDE Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values of which one or more values are estimated
IDQ Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values of which one or more values are questionable

Enumerated Domain for Attribute: PARTPCODE_YR
N  No derived values are calculated for the entire water year
D  Annual value based on derived values
D* Annual value based on derived values; one or more values measured below the detection limit
DE Annual value based on derived values; one or more values estimated
DQ Annual value based on derived values; one or more values questionable
ID Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values
ID* Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values of which one or more values measured below the detection limit
IDE Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values of which one or more values are estimated
IDQ Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values of which one or more values are questionable

Enumerated Domain for Attribute: SICODE_YR
Q  Annual value includes questionable values
N  No analyses conducted in water year
A  Annual value is accepted
E  Annual value includes estimated values
I  Annual value incomplete; one or more values are missing for part of the year
I* Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit
IE Annual value incomplete; one or more values are missing for part of the year; one or more values estimated
IQ Annual value incomplete; one or more values are missing for part of the year; one or more values questionable
* Annual value includes one or more values measured below the detection limit

Enumerated Domain for Attribute: SO4SCODE_YR
Q Annual value includes questionable values
N No analyses conducted in water year
A Annual value is accepted
E Annual value includes estimated values
I Annual value incomplete; one or more values are missing for part of the year
I* Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit
IE Annual value incomplete; one or more values are missing for part of the year; one or more values estimated
IQ Annual value incomplete; one or more values are missing for part of the year; one or more values questionable
*

Enumerated Domain for Attribute: SSEDCODE_YR
Q Annual value includes questionable values
N No analyses conducted in water year
A Annual value is accepted
E Annual value includes estimated values
I Annual value incomplete; one or more values are missing for part of the year
IE Annual value incomplete; one or more values are missing for part of the year; one or more values estimated
IQ Annual value incomplete; one or more values are missing for part of the year; one or more values questionable
*

Enumerated Domain for Attribute: STCODE
CP002 Study code CP002

Enumerated Domain for Attribute: TKNCODE_YR
Q Annual value includes questionable values
N No analyses conducted in water year
A Annual value is accepted
E Annual value includes estimated values
I Annual value incomplete; one or more values are missing for part of the year
I* Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit
IE Annual value incomplete; one or more values are missing for part of the year; one or more values estimated
IQ Annual value incomplete; one or more values are missing for part of the year; one or more values questionable
*

Enumerated Domain for Attribute: TDPCODE_YR
Q Annual value includes questionable values
N No analyses conducted in water year
A     Annual value is accepted
E     Annual value includes estimated values
I     Annual value incomplete; one or more values are missing for part of the year
I*    Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit
IE    Annual value incomplete; one or more values are missing for part of the year; one or more values estimated
IQ    Annual value incomplete; one or more values are missing for part of the year; one or more values questionable
*     Annual value includes one or more values measured below the detection limit

Enumerated Domain for Attribute: UTKNCODE_YR
Q     Annual value includes questionable values
N     No analyses conducted in water year
A     Annual value is accepted
E     Annual value includes estimated values
I     Annual value incomplete; one or more values are missing for part of the year
I*    Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit
IE    Annual value incomplete; one or more values are missing for part of the year; one or more values estimated
IQ    Annual value incomplete; one or more values are missing for part of the year; one or more values questionable
*     Annual value includes one or more values measured below the detection limit

Enumerated Domain for Attribute: UTPCODE_YR
Q     Annual value includes questionable values
N     No analyses conducted in water year
A     Annual value is accepted
E     Annual value includes estimated values
I     Annual value incomplete; one or more values are missing for part of the year
I*    Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit
IE    Annual value incomplete; one or more values are missing for part of the year; one or more values estimated
IQ    Annual value incomplete; one or more values are missing for part of the year; one or more values questionable
*     Annual value includes one or more values measured below the detection limit

Enumerated Domain for Attribute: UTNCODE_YR
Q     Annual value includes questionable values
N     No analyses conducted in water year
A     Annual value is accepted
E     Annual value includes estimated values
I     Annual value incomplete; one or more values are missing for part of the year
I*    Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IE</td>
<td>Annual value incomplete; one or more values are missing for part of the year; one or more values estimated</td>
</tr>
<tr>
<td>IQ</td>
<td>Annual value incomplete; one or more values are missing for part of the year; one or more values questionable</td>
</tr>
<tr>
<td>*</td>
<td>Annual value includes one or more values measured below the detection limit</td>
</tr>
<tr>
<td>D</td>
<td>Annual value based on derived values</td>
</tr>
<tr>
<td>D*</td>
<td>Annual value based on derived values; one or more values measured below the detection limit</td>
</tr>
<tr>
<td>DE</td>
<td>Annual value based on derived values; one or more values estimated</td>
</tr>
<tr>
<td>DQ</td>
<td>Annual value based on derived values; one or more values questionable</td>
</tr>
<tr>
<td>ID</td>
<td>Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values</td>
</tr>
<tr>
<td>ID*</td>
<td>Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values of which one or more values measured below the detection limit</td>
</tr>
<tr>
<td>IDE</td>
<td>Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values of which one or more values are estimated</td>
</tr>
<tr>
<td>IDQ</td>
<td>Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values of which one or more values are questionable</td>
</tr>
</tbody>
</table>

Enumerated Domain for Attribute: **TDNCODE_YR**

- **Q**: Annual value includes questionable values
- **N**: No analyses conducted in water year
- **A**: Annual value is accepted
- **E**: Annual value includes estimated values
- **I**: Annual value incomplete; one or more values are missing for part of the year
- **I***: Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit
- **IE**: Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values
- **ID**: Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values of which one or more values measured below the detection limit
- **IDE**: Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values of which one or more values are estimated
- **IDQ**: Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values of which one or more values are questionable

Enumerated Domain for Attribute: **STCODE**

- **CP002**: Study code CP002
Enumerated Domain for Attribute: TYPE
S Sample saved and combined with the following collection due to insufficient water for analyses - samples were no longer saved and combined after 1981
P Partial sample - precipitation was not collected successfully over the entire period (includes problems with NADP-style collector motor or samples that may have overflowed)
YE Year end marker allows summary by water year - this is not a sample. Flux values are calculated from precip ending Sep 30 and use analyte concentrations from the following sample. ‘YE’ markers are inserted every Sep 30.
C Sample is combined with preceeding saved sample(s) for analysis. Combined samples of this type are not used after 1981.
DW Dry deposition sample - dry bucket contains rain water
F Sample is successfully collected over the entire period - a “Full” sample.
N No sample is collected - generally indicates periods of little or no rain, but can be a lost sample.
DF Dry deposition sample - sample is dry and not contaminated with precipitation water
B Biased sample - Lid on NADP sampler malfunctions and sample includes dry deposition
DC Dry deposition sample - dry bucket contains rain water and other insects/contaminants

Enumerated Domain for Attribute: QCCODE
NA Water sample is not a quality control sample
QZ Miscellaneous quality control water sample

Enumerated Domain for Attribute: SAMPLER_TYPE
BC Bulk collection includes both wet and dry deposition
NP NADP-type sampler that separates wet deposition from dry deposition
RC Bulk samples from original, locally-designed rain collectors that includes both wet and dry deposition

Enumerated Domain for Attribute: LOW_VOLUME
N Sample is of sufficient volume for laboratory analyses
Y Sample is low volume and laboratory analyses may be limited