

Package ‘dataRetrieval’

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Type Package

Title Retrieval Functions for USGS and EPA Hydrologic and Water Quality Data

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Description Collection of functions to help retrieve U.S. Geological Survey (USGS) and U.S. Environmental Protection Agency (EPA) water quality and hydrology data from web services. USGS web services are discovered from the National Water Information System (NWIS) tools. Both EPA and USGS water quality data are obtained from the Water Quality Portal.

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Depends R (>= 3.0)

Imports XML, RCurl, reshape2, lubridate, plyr, stats, utils

Suggests xtable, knitr, testthat

VignetteBuilder knitr

BuildVignettes true

BugReports <https://github.com/USGS-R/dataRetrieval/issues>

URL <https://github.com/USGS-R/dataRetrieval>,
<http://pubs.usgs.gov/tm/04/a10/>

NeedsCompilation no

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dataRetrieval-package *Retrieval functions for USGS and EPA data*

Description

Package: dataRetrieval

Type: Package

License: Unlimited for this package, dependencies have more restrictive licensing.

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LazyLoad: yes

Details

Retrieval functions for USGS and EPA hydrologic and water quality data.

Please see <http://pubs.usgs.gov/tm/04/a10/> for more information.

Author(s)

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constructNWISURL	<i>Construct NWIS url for data retrieval</i>
------------------	--

Description

Imports data from NWIS web service. This function gets the data from here: <http://nwis.waterdata.usgs.gov/nwis/qwdata> A list of parameter codes can be found here: <http://nwis.waterdata.usgs.gov/nwis/pmcodes/> A list of statistic codes can be found here: http://nwis.waterdata.usgs.gov/nwis/help/?read_file=stat&format=table

Usage

```
constructNWISURL(siteNumber, parameterCd = "00060", startDate = "",
  endDate = "", service, statCd = "00003", format = "xml",
  expanded = TRUE, ratingType = "base")
```

Arguments

siteNumber	string or vector of strings USGS site number. This is usually an 8 digit number
parameterCd	string or vector of USGS parameter code. This is usually an 5 digit number.
startDate	character starting date for data retrieval in the form YYYY-MM-DD. Default is "" which indicates retrieval for the earliest possible record.
endDate	character ending date for data retrieval in the form YYYY-MM-DD. Default is "" which indicates retrieval for the latest possible record.
service	string USGS service to call. Possible values are "dv" (daily values), "uv" (unit/instantaneous values), "qw" (water quality data), "gwlevels" (groundwater), and "rating" (rating curve), "peak", "meas" (discrete streamflow measurements).
statCd	string or vector USGS statistic code only used for daily value service. This is usually 5 digits. Daily mean (00003) is the default.
format	string, can be "tsv" or "xml", and is only applicable for daily and unit value requests. "tsv" returns results faster, but there is a possibility that an incomplete file is returned without warning. XML is slower, but will offer a warning if the file was incomplete (for example, if there was a momentary problem with the internet connection). It is possible to safely use the "tsv" option, but the user must carefully check the results to see if the data returns matches what is expected. The default is therefore "xml".

expanded	logical defaults to TRUE. If TRUE, retrieves additional information, only applicable for qw data.
ratingType	can be "base", "corr", or "exsa". Only applies to rating curve data.

Value

url string

Examples

```

siteNumber <- '01594440'
startDate <- '1985-01-01'
endDate <- ''
pCode <- c("00060", "00010")
url_daily <- constructNWISURL(siteNumber, pCode,
                             startDate, endDate, 'dv', statCd=c("00003", "00001"))
url_unit <- constructNWISURL(siteNumber, pCode, "2012-06-28", "2012-06-30", 'iv')

url_qw_single <- constructNWISURL(siteNumber, "01075", startDate, endDate, 'qw')
url_qw <- constructNWISURL(siteNumber, c('01075', '00029', '00453'),
                           startDate, endDate, 'qw')
url_daily_tsv <- constructNWISURL(siteNumber, pCode, startDate, endDate, 'dv',
                                  statCd=c("00003", "00001"), format="tsv")
url_rating <- constructNWISURL(siteNumber, service="rating", ratingType="base")
url_peak <- constructNWISURL(siteNumber, service="peak")
url_meas <- constructNWISURL(siteNumber, service="meas")

```

constructWQPURL

Construct WQP url for data retrieval

Description

Imports data from WQP web service. This function gets the data from here: <http://nwis.waterdata.usgs.gov/nwis/qwdata> A list of parameter codes can be found here: <http://nwis.waterdata.usgs.gov/nwis/pmcodes/> A list of statistic codes can be found here: http://nwis.waterdata.usgs.gov/nwis/help/?read_file=stat&format=table

Usage

```
constructWQPURL(siteNumber, parameterCd, startDate, endDate)
```

Arguments

siteNumber	string or vector of strings USGS site number. This is usually an 8 digit number
parameterCd	string or vector of USGS parameter code. This is usually an 5 digit number.
startDate	character starting date for data retrieval in the form YYYY-MM-DD. Default is "" which indicates retrieval for the earliest possible record.
endDate	character ending date for data retrieval in the form YYYY-MM-DD. Default is "" which indicates retrieval for the latest possible record.

Value

url string

Examples

```
siteNumber <- '01594440'
startDate <- '1985-01-01'
endDate <- ''
pCode <- c("00060", "00010")
url_wqp <- constructWQPURL(paste("USGS", siteNumber, sep="-"),
  c('01075', '00029', '00453'),
  startDate, endDate)
```

countyCd	<i>US County Code Lookup Table</i>
----------	------------------------------------

Description

Data pulled from http://www2.census.gov/geo/docs/reference/codes/files/national_county.txt on April 1, 2015.

Value

countyCd data frame.

Name	Type	Description
STUSAB	character	State abbreviation
STATE	character	two-digit ANSI code
COUNTY	character	three-digit county code
COUNTY_NAME	character	County full name
COUNTY_ID	character	County id

Examples

```
head(countyCd)
```

getWebServiceData	<i>Function to return data from web services</i>
-------------------	--

Description

This function accepts a url parameter, and returns the raw data. The function enhances [getURI](#) with more informative error messages.

Usage

```
getWebServiceData(obs_url)
```

Arguments

obs_url character containing the url for the retrieval

Value

raw data from web services

Examples

```
siteNumber <- "02177000"
startDate <- "2012-09-01"
endDate <- "2012-10-01"
offering <- '00003'
property <- '00060'
obs_url <- constructNWISURL(siteNumber,property,startDate,endDate,'dv')
## Not run:
rawData <- getWebServiceData(obs_url)

## End(Not run)
```

importRDB1

Function to return data from the NWIS RDB 1.0 format

Description

This function accepts a url parameter that already contains the desired NWIS site, parameter code, statistic, startdate and enddate. It is not recommended to use the RDB format for importing multi-site data.

Usage

```
importRDB1(obs_url, asDateTime = FALSE, qw = FALSE, convertType = TRUE,
           tz = "")
```

Arguments

obs_url character containing the url for the retrieval

asDateTime logical, if TRUE returns date and time as POSIXct, if FALSE, Date

qw logical, if TRUE parses as water quality data (where dates/times are in start and end times)

convertType logical, defaults to TRUE. If TRUE, the function will convert the data to dates, datetimes, numerics based on a standard algorithm. If false, everything is returned as a character

`tz` character to set timezone attribute of datetime. Default is an empty quote, which converts the datetimes to UTC (properly accounting for daylight savings times based on the data's provided `tz_cd` column). Possible values to provide are "America/New_York", "America/Chicago", "America/Denver", "America/Los_Angeles", "America/Anchorage", "America/Honolulu", "America/Jamaica", "America/Managua", "America/Phoenix" and "America/Metlakatla"

Value

A data frame with the following columns:

Name	Type	Description
<code>agency_cd</code>	character	The NWIS code for the agency reporting the data
<code>site_no</code>	character	The USGS site number
<code>datetime</code>	POSIXct character	The date and time of the value converted to UTC (if <code>asDateTime = TRUE</code>), or raw character string (if <code>asDateTime = FALSE</code>)
<code>tz_cd</code>	character	The time zone code for datetime
<code>code</code>	character	Any codes that qualify the corresponding value
<code>value</code>	numeric	The numeric value for the parameter

Note that `code` and `value` are repeated for the parameters requested. The names are of the form `XD_P_S`, where `X` is literal, `D` is an option description of the parameter, `P` is the parameter code, and `S` is the statistic code (if applicable).

There are also several useful attributes attached to the data frame:

Name	Type	Description
<code>url</code>	character	The url used to generate the data
<code>queryTime</code>	POSIXct	The time the data was returned
<code>comment</code>	character	Header comments from the RDB file

Examples

```
siteNumber <- "02177000"
startDate <- "2012-09-01"
endDate <- "2012-10-01"
offering <- "00003"
property <- "00060"

obs_url <- constructNWISURL(siteNumber,property,
  startDate,endDate,"dv",format="tsv")
## Not run:
data <- importRDB1(obs_url)

urlMultiPcodes <- constructNWISURL("04085427",c("00060","00010"),
  startDate,endDate,"dv",statCd=c("00003","00001"),"tsv")
multiData <- importRDB1(urlMultiPcodes)
unitDataURL <- constructNWISURL(siteNumber,property,
  "2013-11-03","2013-11-03","uv",format="tsv") #includes timezone switch
```

```

unitData <- importRDB1(unitDataURL, asDateTime=TRUE)
qwURL <- constructNWISURL(c('04024430','04024000'),
  c('34247','30234','32104','34220'),
  "2010-11-03","", "qw", format="rdb")
qwData <- importRDB1(qwURL, qw=TRUE, tz="America/Chicago")
iceSite <- '04024430'
start <- "2014-11-09"
end <- "2014-11-28"
urlIce <- constructNWISURL(iceSite,"00060",start, end,"uv",format="tsv")
ice <- importRDB1(urlIce, asDateTime=TRUE)
iceNoConvert <- importRDB1(urlIce, convertType=FALSE)

## End(Not run)
# User file:
filePath <- system.file("extdata", package="dataRetrieval")
fileName <- "RDB1Example.txt"
fullPath <- file.path(filePath, fileName)
importUserRDB <- importRDB1(fullPath)

```

importWaterML1

Function to return data from the NWISWeb WaterML1.1 service

Description

This function accepts a url parameter that already contains the desired NWIS site, parameter code, statistic, startdate and enddate.

Usage

```
importWaterML1(obs_url, asDateTime = FALSE, tz = "")
```

Arguments

obs_url	character containing the url for the retrieval
asDateTime	logical, if TRUE returns date and time as POSIXct, if FALSE, Date
tz	character to set timezone attribute of datetime. Default is an empty quote, which converts the datetimes to UTC (properly accounting for daylight savings times based on the data's provided tz_cd column). Possible values to provide are "America/New_York", "America/Chicago", "America/Denver", "America/Los_Angeles", "America/Anchorage", "America/Honolulu", "America/Jamaica", "America/Managua", "America/Phoenix" and "America/Metlakatla"

Value

A data frame with the following columns:

Name	Type	Description
agency_cd	character	The NWIS code for the agency reporting the data

site_no	character	The USGS site number
datetime	POSIXct	The date and time of the value converted to UTC (if asDateTime = TRUE), or raw character string (if asDateTime = FALSE)
tz_cd	character	The time zone code for datetime
code	character	Any codes that qualify the corresponding value
value	numeric	The numeric value for the parameter

Note that code and value are repeated for the parameters requested. The names are of the form X_D_P_S, where X is literal, D is an option description of the parameter, P is the parameter code, and S is the statistic code (if applicable).

There are also several useful attributes attached to the data frame:

Name	Type	Description
url	character	The url used to generate the data
siteInfo	data.frame	A data frame containing information on the requested sites
variableInfo	data.frame	A data frame containing information on the requested parameters
statisticInfo	data.frame	A data frame containing information on the requested statistics on the data
queryTime	POSIXct	The time the data was returned

See Also

[renameNWISColumns](#)

Examples

```
siteNumber <- "02177000"
startDate <- "2012-09-01"
endDate <- "2012-10-01"
offering <- '00003'
property <- '00060'
obs_url <- constructNWISURL(siteNumber,property,startDate,endDate,'dv')
## Not run:
data <- importWaterML1(obs_url)

groundWaterSite <- "431049071324301"
startGW <- "2013-10-01"
endGW <- "2014-06-30"
groundwaterExampleURL <- constructNWISURL(groundWaterSite, NA,
  startGW,endGW, service="gwlevels")
groundWater <- importWaterML1(groundwaterExampleURL)
groundWater2 <- importWaterML1(groundwaterExampleURL, asDateTime=TRUE)

unitDataURL <- constructNWISURL(siteNumber,property,
  "2013-11-03","2013-11-03",'uv')
unitData <- importWaterML1(unitDataURL,TRUE)

# Two sites, two pcodes, one site has two data descriptors:
siteNumber <- c('01480015','04085427')
```

```

obs_url <- constructNWISURL(siteNumber,c("00060","00010"),startDate,endDate,'dv')
data <- importWaterML1(obs_url)
data$dateTime <- as.Date(data$dateTime)
data <- renameNWISColumns(data)
names(attributes(data))
attr(data, "url")
attr(data, "disclaimer")

inactiveSite <- "05212700"
inactiveSite <- constructNWISURL(inactiveSite, "00060", "2014-01-01", "2014-01-10",'dv')
inactiveSite <- importWaterML1(inactiveSite)

inactiveAndAcitive <- c("07334200","05212700")
inactiveAndAcitive <- constructNWISURL(inactiveAndAcitive, "00060", "2014-01-01", "2014-01-10",'dv')
inactiveAndAcitive <- importWaterML1(inactiveAndAcitive)

Timezone change with specified local timezone:
tzURL <- constructNWISURL("04027000", c("00300","63680"), "2011-11-05", "2011-11-07","uv")
tzIssue <- importWaterML1(tzURL, TRUE, "America/Chicago")

## End(Not run)
filePath <- system.file("extdata", package="dataRetrieval")
fileName <- "WaterML1Example.xml"
fullPath <- file.path(filePath, fileName)
importFile <- importWaterML1(fullPath,TRUE)

```

importWaterML2 *Function to return data from the WaterML2 data*

Description

This function accepts a url parameter for a WaterML2 getObservation. This function is still under development, but the general functionality is correct.

Usage

```
importWaterML2(obs_url, asDateTime = FALSE, tz = "")
```

Arguments

obs_url	character containing the url for the retrieval
asDateTime	logical, if TRUE returns date and time as POSIXct, if FALSE, Date
tz	character to set timezone attribute of datetime. Default is an empty quote, which converts the datetimes to UTC (properly accounting for daylight savings times based on the data's provided tz_cd column). Possible values to provide are "America/New_York","America/Chicago", "America/Denver","America/Los_Angeles", "America/Anchorage", "America/Honolulu", "America/Jamaica", "America/Managua", "America/Phoenix" and "America/Metlakatla"

Value

mergedDF a data frame time, value, description, qualifier, and identifier

Examples

```
baseURL <- "http://waterservices.usgs.gov/nwis/dv/?format=waterml,2.0"
URL <- paste(baseURL, "sites=01646500",
            "startDT=2014-09-01",
            "endDT=2014-09-08",
            "statCd=00003",
            "parameterCd=00060", sep="&")
URL2 <- paste("http://cida.usgs.gov/noreast-sos/simple?request=GetObservation",
            "featureID=MD-BC-BC-05",
            "offering=RAW",
            "observedProperty=WATER", sep="&")
## Not run:
dataReturned1 <- importWaterML2(URL)
dataReturn2 <- importWaterML2(URL2, TRUE)
URLmulti <- paste(baseURL,
                "sites=04024430,04024000",
                "startDT=2014-09-01",
                "endDT=2014-09-08",
                "statCd=00003",
                "parameterCd=00060", sep="&")
dataReturnMulti <- importWaterML2(URLmulti)

## End(Not run)
filePath <- system.file("extdata", package="dataRetrieval")
fileName <- "WaterML2Example.xml"
fullPath <- file.path(filePath, fileName)
UserData <- importWaterML2(fullPath)
```

importWQP

Basic Water Quality Portal Data parser

Description

Imports data from the Water Quality Portal based on a specified url.

Usage

```
importWQP(obs_url, zip = FALSE, tz = "")
```

Arguments

obs_url	character URL to Water Quality Portal#'
zip	logical used to request the data in a zip format (TRUE)

tz character to set timezone attribute of datetime. Default is an empty quote, which converts the datetimes to UTC (properly accounting for daylight savings times based on the data's provided tz_cd column). Possible values to provide are "America/New_York", "America/Chicago", "America/Denver", "America/Los_Angeles", "America/Anchorage", "America/Honolulu", "America/Jamaica", "America/Managua", "America/Phoenix" and "America/Metlakatla"

Value

retval dataframe raw data returned from the Water Quality Portal. Additionally, a POSIXct dateTime column is supplied for start and end times, and converted to UTC. See http://www.waterqualitydata.us/portal_userguide.jsp for more information.

See Also

[readWQPdata](#), [readWQPqw](#), [whatWQPsites](#)

Examples

```
# These examples require an internet connection to run

## Examples take longer than 5 seconds:
## Not run:
rawSampleURL <- constructWQPURL('USGS-01594440','01075', '', '')

rawSample <- importWQP(rawSampleURL)
url2 <- paste0(rawSampleURL, "&zip=yes")
rawSample2 <- importWQP(url2, TRUE)

STORETex <- constructWQPURL('WIDNR_WQX-10032762','Specific conductance', '', '')
STORETdata <- importWQP(STORETex)

## End(Not run)
```

readNWISdata

General Data Import from NWIS

Description

Returns data from the NWIS web service. Arguments to the function should be based on <http://waterservices.usgs.gov> service calls. See examples below for ideas of constructing queries.

Usage

```
readNWISdata(service = "dv", ...)
```

Arguments

`service` string. Possible values are "iv" (for instantaneous), "dv" (for daily values), "gwlevels" (for groundwater levels), "site" (for site service), and "qw" (water-quality). Note: "qw" calls go to: <http://nwis.waterdata.usgs.gov/usa/nwis/qwdata> for data requests, and use different call requests schemes.

... see <http://waterservices.usgs.gov/rest/Site-Service.html#Service> for a complete list of options

Value

A data frame with the following columns:

Name	Type	Description
agency	character	The NWIS code for the agency reporting the data
site	character	The USGS site number
dateTime	POSIXct	The date and time (if applicable) of the measurement, converted to UTC for unit value data. R only all
tz_cd	character	The time zone code for dateTime column
code	character	Any codes that qualify the corresponding value
value	numeric	The numeric value for the parameter

Note that code and value are repeated for the parameters requested. The names are of the form X_D_P_S, where X is literal, D is an option description of the parameter, P is the parameter code, and S is the statistic code (if applicable).

There are also several useful attributes attached to the data frame:

Name	Type	Description
url	character	The url used to generate the data
siteInfo	data.frame	A data frame containing information on the requested sites
variableInfo	data.frame	A data frame containing information on the requested parameters
statisticInfo	data.frame	A data frame containing information on the requested statistics on the data
queryTime	POSIXct	The time the data was returned

See Also

[renameNWISColumns](#), [importWaterML1](#), [importRDB1](#)

Examples

```
## Not run:
# Examples not run for time considerations
dataTemp <- readNWISdata(stateCd="OH",parameterCd="00010", service="dv")
instFlow <- readNWISdata(sites="05114000", service="iv",
                        parameterCd="00060",
                        startDate="2014-05-01T00:00Z",endDate="2014-05-01T12:00Z")

instFlowCDT <- readNWISdata(sites="05114000", service="iv",
```

```

parameterCd="00060",
startDate="2014-05-01T00:00",endDate="2014-05-01T12:00",
tz="America/Chicago")

#Empty:
multiSite <- readNWISdata(sites=c("04025000","04072150"), service="iv",
                           parameterCd="00010")

#Not empty:
multiSite <- readNWISdata(sites=c("04025500","040263491"),
                           service="iv", parameterCd="00060")
bBoxEx <- readNWISdata(bBox=c(-83,36.5,-81,38.5), parameterCd="00010")

startDate <- as.Date("2013-10-01")
endDate <- as.Date("2014-09-30")
waterYear <- readNWISdata(bBox=c(-83,36.5,-81,38.5), parameterCd="00010",
                           service="dv", startDate=startDate, endDate=endDate)
siteInfo <- readNWISdata(stateCd="WI", parameterCd="00010",
                           hasDataTypeCd="iv", service="site")
qwData <- readNWISdata(bBox=c(-82.5,41.52,-81,41),startDate=as.Date("2000-01-01"),
                           drain_area_va_min=50, qw_count_nu=50,qw_attributes="expanded",
                           qw_sample_wide="wide",list_of_search_criteria=c("lat_long_bounding_box",
                           "drain_area_va","obs_count_nu"),service="qw")
temp <- readNWISdata(bBox=c(-83,36.5,-81,38.5), parameterCd="00010", service="site",
                           seriesCatalogOutput=TRUE)
wiGWL <- readNWISdata(stateCd="WI",service="gwlevels")

## End(Not run)

```

readNWISdv

Daily Value USGS NWIS Data Retrieval

Description

Imports data from NWIS web service. This function gets the data from here: <http://waterservices.usgs.gov/>

Usage

```
readNWISdv(siteNumber, parameterCd, startDate = "", endDate = "",
            statCd = "00003")
```

Arguments

siteNumber	character USGS site number. This is usually an 8 digit number. Multiple sites can be requested with a character vector.
parameterCd	character of USGS parameter code(s). This is usually an 5 digit number.
startDate	character starting date for data retrieval in the form YYYY-MM-DD. Default is "" which indicates retrieval for the earliest possible record. Date arguments are always specified in local time.

endDate	character	ending date for data retrieval in the form YYYY-MM-DD. Default is "" which indicates retrieval for the latest possible record. Date arguments are always specified in local time.
statCd	character	USGS statistic code. This is usually 5 digits. Daily mean (00003) is the default.

Value

A data frame with the following columns:

Name	Type	Description
agency	character	The NWIS code for the agency reporting the data
site	character	The USGS site number
Date	Date	The date of the value
code	character	Any codes that qualify the corresponding value
value	numeric	The numeric value for the parameter

Note that code and value are repeated for the parameters requested. The names are of the form X_D_P_S, where X is literal, D is an option description of the parameter, P is the parameter code, and S is the statistic code (if applicable).

There are also several useful attributes attached to the data frame:

Name	Type	Description
url	character	The url used to generate the data
siteInfo	data.frame	A data frame containing information on the requested sites
variableInfo	data.frame	A data frame containing information on the requested parameters
statisticInfo	data.frame	A data frame containing information on the requested statistics on the data
queryTime	POSIXct	The time the data was returned

See Also

[renameNWISColumns](#), [importWaterML1](#)

Examples

```
siteNumber <- '04085427'
startDate <- '2012-01-01'
endDate <- '2012-06-30'
pCode <- '00060'
## Not run:
rawDailyQ <- readNWISdv(siteNumber,pCode, startDate, endDate)
rawDailyQAndTempMeanMax <- readNWISdv(siteNumber,c('00010','00060'),
  startDate, endDate, statCd=c('00001','00003'))
rawDailyQAndTempMeanMax <- renameNWISColumns(rawDailyQAndTempMeanMax)
rawDailyMultiSites<- readNWISdv(c("01491000","01645000"),c('00010','00060'),
  startDate, endDate, statCd=c('00001','00003'))
# Site with no data:
```

```
x <- readNWISdv("10258500","00060", "2014-09-08", "2014-09-14")
names(attributes(x))
attr(x, "siteInfo")
attr(x, "variableInfo")

site <- "05212700"
notActive <- readNWISdv(site, "00060", "2014-01-01","2014-01-07")

## End(Not run)
```

readNWISgw1

Groundwater level measurements retrieval from USGS (NWIS)

Description

Reads groundwater level measurements from NWISweb. Mixed date/times come back from the service depending on the year that the data was collected. See <http://waterdata.usgs.gov/usa/nwis/gw> for details about groundwater. Groundwater dates and times are returned in many different formats, therefore the date/time information is returned as a character string. Users will need to convert to a date object. See <http://waterservices.usgs.gov/rest/GW-Levels-Service.html> for more information.

Usage

```
readNWISgw1(siteNumbers, startDate = "", endDate = "")
```

Arguments

siteNumbers	character	USGS site number (or multiple sites). This is usually an 8 digit number
startDate	character	starting date for data retrieval in the form YYYY-MM-DD. Default is "" which indicates retrieval for the earliest possible record.
endDate	character	ending date for data retrieval in the form YYYY-MM-DD. Default is "" which indicates retrieval for the latest possible record.

Value

A data frame with the following columns:

Name	Type	Description
agency_cd	character	The NWIS code for the agency reporting the data
site_no	character	The USGS site number
site_tp_cd	character	Site type code
lev_dt	Date	Date level measured
lev_tm	character	Time level measured
lev_tz_cd	character	Time datum
lev_va	numeric	Water level value in feet below land surface
sl_lev_va	numeric	Water level value in feet above specific vertical datum
lev_status_cd	character	The status of the site at the time the water level was measured
lev_agency_cd	character	The agency code of the person measuring the water level

There are also several useful attributes attached to the data frame:

Name	Type	Description
url	character	The url used to generate the data
queryTime	POSIXct	The time the data was returned
comment	character	Header comments from the RDB file
siteInfo	data.frame	A data frame containing information on the requested sites

See Also

[constructNWISURL](#), [importRDB1](#)

Examples

```
siteNumber <- "434400121275801"
## Not run:
data <- readNWISgwl(siteNumber, '', '')
sites <- c("434400121275801", "375907091432201")
data2 <- readNWISgwl(sites, '', '')
data3 <- readNWISgwl("420125073193001", '', '')

## End(Not run)
```

readNWISmeas

Surface-water measurement data retrieval from USGS (NWIS)

Description

Reads surface-water measurement data from NWISweb. Data is retrieved from <http://waterdata.usgs.gov/nwis>. See <http://waterdata.usgs.gov/usa/nwis/sw> for details about surface water.

Usage

```
readNWISmeas(siteNumbers, startDate = "", endDate = "", tz = "")
```

Arguments

siteNumbers	character USGS site number (or multiple sites). This is usually an 8 digit number
startDate	character starting date for data retrieval in the form YYYY-MM-DD. Default is "" which indicates retrieval for the earliest possible record.
endDate	character ending date for data retrieval in the form YYYY-MM-DD. Default is "" which indicates retrieval for the latest possible record.
tz	character to set timezone attribute of dateTime. Default is an empty quote, which converts the dateTimes to UTC (properly accounting for daylight savings times based on the data's provided tz_cd column). Possible values to provide are "America/New_York", "America/Chicago", "America/Denver", "America/Los_Angeles", "America/Anchorage", "America/Honolulu", "America/Jamaica", "America/Managua", "America/Phoenix" and "America/Metlakatla"

Value

A data frame with at least the following columns:

Name	Type	Description
agency_cd	character	The NWIS code for the agency reporting the data
site_no	character	The USGS site number
tz_cd	character	The time zone code for dateTime

See <http://waterdata.usgs.gov/usa/nwis/sw> for details about surface water, and http://waterdata.usgs.gov/nwis/help?output_formats_help#streamflow_measurement_data for help on the columns and codes.

There are also several useful attributes attached to the data frame:

Name	Type	Description
url	character	The url used to generate the data
queryTime	POSIXct	The time the data was returned
comment	character	Header comments from the RDB file
siteInfo	data.frame	A data frame containing information on the requested sites

See Also

[constructNWISURL](#), [importRDB1](#)

Examples

```
siteNumbers <- c('01594440','040851325')
## Not run:
data <- readNWISmeas(siteNumbers)

## End(Not run)
```

readNWISpCode

USGS Parameter Data Retrieval

Description

Imports data from NWIS about measured parameter based on user-supplied parameter code or codes. This function gets the data from here: <http://nwis.waterdata.usgs.gov/nwis/pmcodes>

Usage

```
readNWISpCode(parameterCd)
```

Arguments

parameterCd character of USGS parameter codes (or multiple parameter codes). These are 5 digit number codes, more information can be found here: <http://help.waterdata.usgs.gov/>. To get a complete list of all current parameter codes in the USGS, use "all" as the input.

Value

parameterData data frame with the following information:

Name	Type	Description
parameter_cd	character	5-digit USGS parameter code
parameter_group_nm	character	USGS parameter group name
parameter_nm	character	USGS parameter name
casrn	character	Chemical Abstracts Service (CAS) Registry Number
srsname	character	Substance Registry Services Name
parameter_units	character	Parameter units

See Also

[importRDB1](#)

Examples

```
paramINFO <- readNWISpCode(c('01075', '00060', '00931'))
```

readNWISpeak	<i>Peak flow data from USGS (NWIS)</i>
--------------	--

Description

Reads peak flow from NWISweb. Data is retrieved from <http://waterdata.usgs.gov/nwis>. In some cases, the specific date of the peak data is not know. This function will default to converting the complete dates, dropping rows with incomplete dates. If those incomplete dates are needed, set the 'asDateTime' argument to FALSE. No rows will be removed, and no dates will be converted to R Date objects.

Usage

```
readNWISpeak(siteNumbers, startDate = "", endDate = "", asDateTime = TRUE)
```

Arguments

siteNumbers character USGS site number(or multiple sites). This is usually an 8 digit number.
 startDate character starting date for data retrieval in the form YYYY-MM-DD. Default is "" which indicates retrieval for the earliest possible record.

endDate	character	ending date for data retrieval in the form YYYY-MM-DD. Default is "" which indicates retrieval for the latest possible record.
asDateTime	logical	default to TRUE. When TRUE, the peak_dt column is converted to a Date object, and incomplete dates are removed. When FALSE, no columns are removed, but no dates are converted.

Value

A data frame with the following columns:

Name	Type	Description
agency_cd	character	The NWIS code for the agency reporting the data
site_no	character	The USGS site number
peak_dt	Date	Date of peak streamflow
peak_tm	character	Time of peak streamflow as character
peak_va	numeric	Annual peak streamflow value in cfs
peak_cd	character	Peak Discharge-Qualification codes (see comment for more information)
gage_ht	numeric	Gage height for the associated peak streamflow in feet
gage_ht_cd	character	Gage height qualification codes
year_last_pk	character	Peak streamflow reported is the highest since this year
ag_dt	character	Date of maximum gage-height for water year (if not concurrent with peak)
ag_tm	character	Time of maximum gage-height for water year (if not concurrent with peak)
ag_gage_ht	character	maximum Gage height for water year in feet (if not concurrent with peak)
ag_gage_ht_cd	character	maximum Gage height code

There are also several useful attributes attached to the data frame:

Name	Type	Description
url	character	The url used to generate the data
queryTime	POSIXct	The time the data was returned
comment	character	Header comments from the RDB file
siteInfo	data.frame	A data frame containing information on the requested sites

See Also

[constructNWISURL](#), [importRDB1](#)

Examples

```
siteNumbers <- c('01594440', '040851325')
## Not run:
data <- readNWISpeak(siteNumbers)

## End(Not run)
```

readNWISqw

*Raw Data Import for USGS NWIS QW Data***Description**

Imports data from NWIS web service. This function gets the data from here: <http://nwis.waterdata.usgs.gov/nwis/qwdata> A list of parameter codes can be found here: <http://nwis.waterdata.usgs.gov/nwis/pmcodes/> A list of statistic codes can be found here: http://nwis.waterdata.usgs.gov/nwis/help/?read_file=stat&format=table

Usage

```
readNWISqw(siteNumbers, parameterCd, startDate = "", endDate = "",
  expanded = TRUE, reshape = FALSE, tz = "")
```

Arguments

siteNumbers	character of USGS site numbers. This is usually an 8 digit number
parameterCd	character that contains the code for a parameter group, or a character vector of 5-digit parameter codes. See Details .
startDate	character starting date for data retrieval in the form YYYY-MM-DD. Default is "" which indicates retrieval for the earliest possible record. Date arguments are always specified in local time.
endDate	character ending date for data retrieval in the form YYYY-MM-DD. Default is "" which indicates retrieval for the latest possible record. Date arguments are always specified in local time.
expanded	logical defaults to TRUE. If TRUE, retrieves additional information. Expanded data includes remark_cd (remark code), result_va (result value), val_qual_tx (result value qualifier code), meth_cd (method code), dqi_cd (data-quality indicator code), rpt_lev_va (reporting level), and rpt_lev_cd (reporting level type). If FALSE, only returns remark_cd (remark code) and result_va (result value). Expanded = FALSE will not give sufficient information for unbiased statistical analysis.
reshape	logical, reshape the expanded data. If TRUE, then return a wide data frame with all water-quality in a single row for each sample. If FALSE (default), then return a long data frame with each water-quality result in a single row. This argument is only applicable to expanded data. Data requested using expanded=FALSE is always returned in the wide format.
tz	character to set timezone attribute of output columns: startDateTime and endDateTime. Default is an empty quote, which converts the datetimes to UTC (properly accounting for daylight savings times). Possible values to provide are "America/New_York", "America/Chicago", "America/Denver", "America/Los_Angeles", "America/Anchorage", "America/Honolulu", "America/Jamaica", "America/Managua", "America/Phoenix" and "America/Metlakatla"

Details

Valid parameter code groups are "All," or group codes:

Code	Description
INF	Information
PHY	Physical
INM	Inorganics, Major, Metals (major cations)
INN	Inorganics, Major, Non-metals (major anions)
NUT	Nutrient
MBI	Microbiological
BIO	Biological
IMN	Inorganics, Minor, Non-metals
IMM	Inorganics, Minor, Metals
TOX	Toxicity
OPE	Organics, pesticide
OPC	Organics, PCBs
OOT	Organics, other
RAD	Radiochemical
SED	Sediment
POP	Population/community

If more than one parameter group is requested, only sites that data for all requested groups are returned.

Value

A data frame with at least the following columns:

Name	Type	Description
agency_cd	character	The NWIS code for the agency reporting the data
site_no	character	The USGS site number
sample_dt	Date	The date the sample was collected
sample_tm	character	The reported sample collection time
startDateTime	POSIXct	Combining sample_dt and sample_tm, a date/time column is created, and converted into UTC (UTC)
endDateTime	POSIXct	If any sample_end_dt and sample_end_tm exist, this column is created similar to startDateTime

Further columns will be included depending on the requested output format (expanded = TRUE or FALSE).

There are also several useful attributes attached to the data frame:

Name	Type	Description
url	character	The url used to generate the data
queryTime	POSIXct	The time the data was returned
comment	character	Header comments from the RDB file
siteInfo	data frame	A data frame containing information on the requested sites
variableInfo	data frame	A data frame containing information on the requested parameters

See Also

[readWQPdata](#), [whatWQPsites](#), [readWQPqw](#), [constructNWISURL](#)

Examples

```
siteNumbers <- c('04024430','04024000')
startDate <- '2010-01-01'
endDate <- ''
parameterCd <- c('34247','30234','32104','34220')
## Not run:
rawNWISqwData <- readNWISqw(siteNumbers,parameterCd,startDate,endDate)
rawNWISqwDataReshaped <- readNWISqw(siteNumbers,parameterCd,
  startDate,endDate,reshape=TRUE)
parameterCd <- "all"
rawNWISall <- readNWISqw(siteNumbers,parameterCd,
  startDate,endDate)
pgroup <- c("NUT")
rawNWISNutrients <- readNWISqw(siteNumbers,pgroup,
  startDate,endDate)
groups <- c("NUT","OPE")
rawNWISNutOpe <- readNWISqw(siteNumbers,groups,
  startDate,endDate)
rawNWISOpe <- readNWISqw(siteNumbers,"OPE",
  startDate,endDate)

## End(Not run)
```

readNWISrating	<i>Rating table for an active USGS streamgage retrieval</i>
----------------	---

Description

Reads current rating table for an active USGS streamgage from NWISweb. Data is retrieved from <http://waterdata.usgs.gov/nwis>.

Usage

```
readNWISrating(siteNumber, type = "base")
```

Arguments

siteNumber	character USGS site number. This is usually an 8 digit number
type	character can be "base", "corr", or "exsa"

Value

A data frame. If type is "base," then the columns are INDEP, typically the gage height, in feet; DEP, typically the streamflow, in cubic feet per second; and STOR, where "*" indicates that the pair are a fixed point of the rating curve. If type is "exsa," then an additional column, SHIFT, is included that indicates the current shift in the rating for that value of INDEP. If type is "corr," then the columns are INDEP, typically the gage height, in feet; CORR, the correction for that value; and CORRINDEP, the corrected value for CORR.

If type is "base," then the data frame has an attribute called "RATING" that describes the rating curve is included.

There are also several useful attributes attached to the data frame:

Name	Type	Description
url	character	The url used to generate the data
queryTime	POSIXct	The time the data was returned
comment	character	Header comments from the RDB file
siteInfo	data.frame	A data frame containing information on the requested sites
RATING	character	Rating information

Note

Not all active USGS streamgages have traditional rating curves that relate flow to stage.

See Also

[constructNWISURL](#), [importRDB1](#)

Examples

```
siteNumber <- '01594440'
## Not run:
data <- readNWISrating(siteNumber, "base")
attr(data, "RATING")

## End(Not run)
```

readNWISsite

USGS Site File Data Retrieval

Description

Imports data from USGS site file site. This function gets data from here: <http://waterservices.usgs.gov/>

Usage

```
readNWISsite(siteNumbers)
```


Arguments

siteNumbers character USGS site number (or multiple sites). This is usually an 8 digit number

Value

A data frame with at least the following columns:

Name	Type	Description
agency_cd	character	The NWIS code for the agency reporting the data
site_no	character	The USGS site number
station_nm	character	Site name
site_tp_cd	character	Site type
lat_va	numeric	DMS latitude
long_va	numeric	DMS longitude
dec_lat_va	numeric	Decimal latitude
dec_long_va	numeric	Decimal longitude
coord_meth_cd	character	Latitude-longitude method
coord_acy_cd	character	Latitude-longitude accuracy
coord_datum_cd	character	Latitude-longitude datum
dec_coord_datum_cd	character	Decimal Latitude-longitude datum
district_cd	character	District code
state_cd	character	State code
county_cd	character	County code
country_cd	character	Country code
land_net_ds	character	Land net location description
map_nm	character	Name of location map
map_scale_fc	character	Scale of location map
alt_va	numeric	Altitude of Gage/land surface
alt_meth_cd	character	Method altitude determined
alt_acy_va	numeric	Altitude accuracy
alt_datum_cd	character	Altitude datum
huc_cd	character	Hydrologic unit code
basin_cd	character	Drainage basin code
topo_cd	character	Topographic setting code
instruments_cd	character	Flags for instruments at site
construction_dt	character	Date of first construction
inventory_dt	character	Date site established or inventoried
drain_area_va	numeric	Drainage area
contrib_drain_area_va	numeric	Contributing drainage area
tz_cd	character	Time Zone abbreviation
local_time_fg	character	Site honors Daylight Savings Time
reliability_cd	character	Data reliability code
gw_file_cd	character	Data-other GW files
nat_aqfr_cd	character	National aquifer code
aqfr_cd	character	Local aquifer code
aqfr_type_cd	character	Local aquifer type code
well_depth_va	numeric	Well depth
hole_depth_va	numeric	Hole depth

depth_src_cd	character	Source of depth data
project_no	character	Project number

There are also several useful attributes attached to the data frame:

Name	Type	Description
url	character	The url used to generate the data
queryTime	POSIXct	The time the data was returned
comment	character	Header comments from the RDB file

Examples

```
## Not run:
siteINFO <- readNWISsite('05114000')
siteINFOMulti <- readNWISsite(c('05114000','09423350'))

## End(Not run)
```

readNWISuv

Instantaneous value data retrieval from USGS (NWIS)

Description

Imports data from NWIS web service. This function gets the data from here: <http://waterservices.usgs.gov/> A list of parameter codes can be found here: <http://nwis.waterdata.usgs.gov/nwis/pmcodes/> A list of statistic codes can be found here: http://nwis.waterdata.usgs.gov/nwis/help/?read_file=stat&format=table. More information on the web service can be found here: <http://waterservices.usgs.gov/rest/IV-Service.html>.

Usage

```
readNWISuv(siteNumbers, parameterCd, startDate = "", endDate = "",
           tz = "")
```

Arguments

siteNumbers	character	USGS site number (or multiple sites). This is usually an 8 digit number
parameterCd	character	USGS parameter code. This is usually a 5 digit number.
startDate	character	starting date for data retrieval in the form YYYY-MM-DD. Default is "" which indicates retrieval for the earliest possible record. Simple date arguments are specified in local time. See more information here: http://waterservices.usgs.gov/rest/IV-Service.html#Specifying .

endDate	character ending date for data retrieval in the form YYYY-MM-DD. Default is "" which indicates retrieval for the latest possible record. Simple date arguments are specified in local time. See more information here: http://waterservices.usgs.gov/rest/IV-Service.html#Specifying .
tz	character to set timezone attribute of dateTime. Default is an empty quote, which converts the dateTimes to UTC (properly accounting for daylight savings times based on the data's provided tz_cd column). Possible values to provide are "America/New_York", "America/Chicago", "America/Denver", "America/Los_Angeles", "America/Anchorage", "America/Honolulu", "America/Jamaica", "America/Managua", "America/Phoenix" and "America/Metlakatla"

Value

A data frame with the following columns:

Name	Type	Description
agency_cd	character	The NWIS code for the agency reporting the data
site_no	character	The USGS site number
dateTime	POSIXct	The date and time of the value converted to UTC
tz_cd	character	The time zone code for dateTime
code	character	Any codes that qualify the corresponding value
value	numeric	The numeric value for the parameter

Note that code and value are repeated for the parameters requested. The names are of the form: X_D_P_S, where X is literal, D is an option description of the parameter, P is the parameter code, and S is the statistic code (if applicable).

There are also several useful attributes attached to the data frame:

Name	Type	Description
url	character	The url used to generate the data
siteInfo	data.frame	A data frame containing information on the requested sites
variableInfo	data.frame	A data frame containing information on the requested parameters
statisticInfo	data.frame	A data frame containing information on the requested statistics on the data
queryTime	POSIXct	The time the data was returned

See Also

[renameNWISColumns](#), [importWaterML1](#)

Examples

```
siteNumber <- '05114000'
parameterCd <- '00060'
startDate <- "2014-10-10"
endDate <- "2014-10-10"
## Not run:
rawData <- readNWISuv(siteNumber, parameterCd, startDate, endDate)
```

```

timeZoneChange <- readNWISuv(c('04024430', '04024000'), parameterCd,
                             "2013-11-03", "2013-11-03")

centralTime <- readNWISuv(siteNumber, parameterCd,
                          "2014-10-10T12:00", "2014-10-10T23:59",
                          tz="America/Chicago")

# Adding 'Z' to the time indicates to the web service to call the data with UTC time:
GMTdata <- readNWISuv(siteNumber, parameterCd,
                      "2014-10-10T00:00Z", "2014-10-10T23:59Z")

## End(Not run)

```

readWQPdata

General Data Import from Water Quality Portal

Description

Imports data from Water Quality Portal web service. This function gets the data from here: <http://www.waterqualitydata.us>. because it allows for other agencies rather than the USGS.

Usage

```
readWQPdata(...)
```

Arguments

... see www.waterqualitydata.us/webservices_documentation.jsp for a complete list of options

Value

A data frame with at least the following columns:

Name	Type	Description
OrganizationIdentifier	character	A designator used to uniquely identify a unique business.
OrganizationFormalName	character	The legal designator (i.e. formal name) of an organization.
ActivityIdentifier	character	Designator that uniquely identifies an activity within an organization.
ActivityTypeCode	character	The text describing the type of activity.
ActivityMediaName	character	Name or code indicating the environmental medium within which the activity is reported.
ActivityMediaSubdivisionName	character	Name or code indicating the environmental matrix as a subdivision of the medium.
ActivityStartDate	character	The calendar date on which the field activity is started.
ActivityStartTime/Time	character	The time of day that is reported when the field activity is started.
ActivityStartTime/TimeZoneCode	character	The time zone for which the time of day is reported.
ActivityEndDate	character	The calendar date when the field activity is completed.
ActivityEndTime/Time	character	The time of day that is reported when the field activity is completed.
ActivityEndTime/TimeZoneCode	character	The time zone for which the time of day is reported.

ActivityDepthHeightMeasure/MeasureValue	character	A measurement of the vertical location (measured from
ActivityDepthHeightMeasure/MeasureUnitCode	character	The code that represents the unit for measuring the item
ActivityDepthAltitudeReferencePointText	character	The reference used to indicate the datum or reference u
ActivityTopDepthHeightMeasure/MeasureValue	character	A measurement of the upper vertical location of a verti
ActivityTopDepthHeightMeasure/MeasureUnitCode	character	The code that represents the unit for measuring the item
ActivityBottomDepthHeightMeasure/MeasureValue	character	A measurement of the lower vertical location of a verti
ActivityBottomDepthHeightMeasure/MeasureUnitCode	character	The code that represents the unit for measuring the item
ProjectIdentifier	character	A designator used to uniquely identify a data collection
ActivityConductingOrganizationText	character	A name of the Organization conducting an activity.
MonitoringLocationIdentifier	character	A designator used to describe the unique name, number
ActivityCommentText	character	General comments concerning the activity.
SampleAquifer *	character	A code that designates the aquifer associated with grou
HydrologicCondition *	character	Hydrologic condition is the hydrologic condition that is
HydrologicEvent *	character	A hydrologic event that is represented by the sample co
SampleCollectionMethod/MethodIdentifier	character	The identification number or code assigned by the meth
SampleCollectionMethod/MethodIdentifierContext	character	Identifies the source or data system that created or def
SampleCollectionMethod/MethodName	character	The title that appears on the method from the method p
SampleCollectionEquipmentName	character	The name for the equipment used in collecting the sam
ResultDetectionConditionText	character	The textual descriptor of a result.
CharacteristicName	character	The object, property, or substance which is evaluated o
ResultSampleFractionText	character	The text name of the portion of the sample associated w
ResultMeasureValue	numeric	The reportable measure of the result for the chemical, m
MeasureQualifierCode	character	A code used to identify any qualifying issues that affect
ResultMeasure/MeasureUnitCode	character	The code that represents the unit for measuring the item
ResultStatusIdentifier	character	Indicates the acceptability of the result with respect to
StatisticalBaseCode	character	The code for the method used to calculate derived resul
ResultValueTypeName	character	A name that qualifies the process which was used in the
ResultWeightBasisText	character	The name that represents the form of the sample or por
ResultTimeBasisText	character	The period of time (in days) over which a measurement
ResultTemperatureBasisText	character	The name that represents the controlled temperature at
ResultParticleSizeBasisText	character	User defined free text describing the particle size class
PrecisionValue	character	A measure of mutual agreement among individual mea
ResultCommentText	character	Free text with general comments concerning the result.
USGSPCode *	character	5-digit number used in the US Geological Survey comp
ResultDepthHeightMeasure/MeasureValue +	character	A measurement of the vertical location (measured from
ResultDepthHeightMeasure/MeasureUnitCode +	character	The code that represents the unit for measuring the item
ResultDepthAltitudeReferencePointText +	character	The reference used to indicate the datum or reference u
SubjectTaxonomicName	character	The name of the organism from which a tissue sample
SampleTissueAnatomyName *	character	The name of the anatomy from which a tissue sample v
ResultAnalyticalMethod/MethodIdentifier	character	The identification number or code assigned by the meth
ResultAnalyticalMethod/MethodIdentifierContext	character	Identifies the source or data system that created or def
ResultAnalyticalMethod/MethodName	character	The title that appears on the method from the method p
MethodDescriptionText *	character	A brief summary that provides general information abo
LaboratoryName	character	The name of Lab responsible for the result.
AnalysisStartDate	character	The calendar date on which the analysis began.
ResultLaboratoryCommentText	character	Remarks which further describe the laboratory procedu
DetectionQuantitationLimitTypeName	character	Text describing the type of detection or quantitation lev
DetectionQuantitationLimitMeasure/MeasureValue	numeric	Constituent concentration that, when processed throug

DetectionQuantitationLimitMeasure/MeasureUnitCode	character	The code that represents the unit for measuring the item
PreparationStartDate	character	The calendar date when the preparation/extraction of the sample
ActivityStartDateTime	POSIXct	Activity start date and time converted to POSIXct UTC
ActivityEndDateTime	POSIXct	Activity end date and time converted to POSIXct UTC

* = elements only in NWIS + = elements only in STORET

There are also several useful attributes attached to the data frame:

Name	Type	Description
url	character	The url used to generate the data
siteInfo	data.frame	A data frame containing information on the requested sites
variableInfo	data.frame	A data frame containing information on the requested parameters
queryTime	POSIXct	The time the data was returned

Examples

```
## Not run:
nameToUse <- "pH"
pHData <- readWQPdata(siteid="USGS-04024315",characteristicName=nameToUse)
pHDataExpanded2 <- readWQPdata(bBox=c(-90.10,42.67,-88.64,43.35),characteristicName=nameToUse)
startDate <- as.Date("2013-01-01")
nutrientDaneCounty <- readWQPdata(countycode="US:55:025",startDate=startDate,
                                characteristicType="Nutrient")
nutrientDaneCounty <- readWQPdata(countycode="US:55:025",startDate="",
                                characteristicType="Nutrient")

## End(Not run)
```

readWQPqw

Raw Data Import for Water Quality Portal

Description

Imports data from the Water Quality Portal. This function gets the data from here: <http://www.waterqualitydata.us>. There are four required input arguments: siteNumber, parameterCd, startDate, and endDate. parameterCd can either be a USGS 5-digit code, or a characteristic name. The sites can be either USGS, or other Water Quality Portal offered sites. It is required to use the 'full' site name, such as 'USGS-01234567'.

Usage

```
readWQPqw(siteNumbers, parameterCd, startDate = "", endDate = "", tz = "")
```

Arguments

siteNumbers	character site number. This needs to include the full agency code prefix.
parameterCd	vector of USGS 5-digit parameter code or characteristicNames. Leaving this blank will return all of the measured values during the specified time period.
startDate	character starting date for data retrieval in the form YYYY-MM-DD. Default is "" which indicates retrieval for the earliest possible record. Date arguments are always specified in local time.
endDate	character ending date for data retrieval in the form YYYY-MM-DD. Default is "" which indicates retrieval for the latest possible record. Date arguments are always specified in local time.
tz	character to set timezone attribute of datetime. Default is an empty quote, which converts the datetimes to UTC (properly accounting for daylight savings times based on the data's provided tz_cd column). Possible values to provide are "America/New_York", "America/Chicago", "America/Denver", "America/Los_Angeles", "America/Anchorage", "America/Honolulu", "America/Jamaica", "America/Managua", "America/Phoenix" and "America/Metlakatla"

Value

A data frame with at least the following columns:

Name	Type	Description
OrganizationIdentifier	character	A designator used to uniquely identify a unique business.
OrganizationFormalName	character	The legal designator (i.e. formal name) of an organization.
ActivityIdentifier	character	Designator that uniquely identifies an activity within an organization.
ActivityTypeCode	character	The text describing the type of activity.
ActivityMediaName	character	Name or code indicating the environmental medium where the activity is conducted.
ActivityMediaSubdivisionName	character	Name or code indicating the environmental matrix as a subdivision of the medium.
ActivityStartDate	character	The calendar date on which the field activity is started.
ActivityStartTime/Time	character	The time of day that is reported when the field activity is started.
ActivityStartTime/TimeZoneCode	character	The time zone for which the time of day is reported. A time zone code is required.
ActivityEndDate	character	The calendar date when the field activity is completed.
ActivityEndTime/Time	character	The time of day that is reported when the field activity is completed.
ActivityEndTime/TimeZoneCode	character	The time zone for which the time of day is reported. A time zone code is required.
ActivityDepthHeightMeasure/MeasureValue	character	A measurement of the vertical location (measured from the datum or reference point).
ActivityDepthHeightMeasure/MeasureUnitCode	character	The code that represents the unit for measuring the item.
ActivityDepthAltitudeReferencePointText	character	The reference used to indicate the datum or reference point.
ActivityTopDepthHeightMeasure/MeasureValue	character	A measurement of the upper vertical location of a vertical measurement.
ActivityTopDepthHeightMeasure/MeasureUnitCode	character	The code that represents the unit for measuring the item.
ActivityBottomDepthHeightMeasure/MeasureValue	character	A measurement of the lower vertical location of a vertical measurement.
ActivityBottomDepthHeightMeasure/MeasureUnitCode	character	The code that represents the unit for measuring the item.
ProjectIdentifier	character	A designator used to uniquely identify a data collection project.
ActivityConductingOrganizationText	character	A name of the Organization conducting an activity.
MonitoringLocationIdentifier	character	A designator used to describe the unique name, number, or code of a monitoring location.
ActivityCommentText	character	General comments concerning the activity.
SampleAquifer *	character	A code that designates the aquifer associated with groundwater.
HydrologicCondition *	character	Hydrologic condition is the hydrologic condition that is associated with the activity.

HydrologicEvent *	character	A hydrologic event that is represented by the sample co
SampleCollectionMethod/MethodIdentifier	character	The identification number or code assigned by the meth
SampleCollectionMethod/MethodIdentifierContext	character	Identifies the source or data system that created or def
SampleCollectionMethod/MethodName	character	The title that appears on the method from the method p
SampleCollectionEquipmentName	character	The name for the equipment used in collecting the sam
ResultDetectionConditionText	character	The textual descriptor of a result.
CharacteristicName	character	The object, property, or substance which is evaluated o
ResultSampleFractionText	character	The text name of the portion of the sample associated w
ResultMeasureValue	numeric	The reportable measure of the result for the chemical, m
MeasureQualifierCode	character	A code used to identify any qualifying issues that affect
ResultMeasure/MeasureUnitCode	character	The code that represents the unit for measuring the item
ResultStatusIdentifier	character	Indicates the acceptability of the result with respect to
StatisticalBaseCode	character	The code for the method used to calculate derived resul
ResultValueTypeName	character	A name that qualifies the process which was used in the
ResultWeightBasisText	character	The name that represents the form of the sample or por
ResultTimeBasisText	character	The period of time (in days) over which a measurement
ResultTemperatureBasisText	character	The name that represents the controlled temperature at
ResultParticleSizeBasisText	character	User defined free text describing the particle size class
PrecisionValue	character	A measure of mutual agreement among individual mea
ResultCommentText	character	Free text with general comments concerning the result.
USGSPCode *	character	5-digit number used in the US Geological Survey comp
ResultDepthHeightMeasure/MeasureValue +	character	A measurement of the vertical location (measured from
ResultDepthHeightMeasure/MeasureUnitCode +	character	The code that represents the unit for measuring the item
ResultDepthAltitudeReferencePointText +	character	The reference used to indicate the datum or reference u
SubjectTaxonomicName	character	The name of the organism from which a tissue sample
SampleTissueAnatomyName *	character	The name of the anatomy from which a tissue sample v
ResultAnalyticalMethod/MethodIdentifier	character	The identification number or code assigned by the meth
ResultAnalyticalMethod/MethodIdentifierContext	character	Identifies the source or data system that created or def
ResultAnalyticalMethod/MethodName	character	The title that appears on the method from the method p
MethodDescriptionText *	character	A brief summary that provides general information abo
LaboratoryName	character	The name of Lab responsible for the result.
AnalysisStartDate	character	The calendar date on which the analysis began.
ResultLaboratoryCommentText	character	Remarks which further describe the laboratory procedu
DetectionQuantitationLimitTypeName	character	Text describing the type of detection or quantitation lev
DetectionQuantitationLimitMeasure/MeasureValue	numeric	Constituent concentration that, when processed throug
DetectionQuantitationLimitMeasure/MeasureUnitCode	character	The code that represents the unit for measuring the item
PreparationStartDate	character	The calendar date when the preparation/extraction of th
ActivityStartDateTime	POSIXct	Activity start date and time converted to POSIXct UTC
ActivityEndDateTime	POSIXct	Activity end date and time converted to POSIXct UTC

* = elements only in NWIS + = elements only in STORET

There are also several useful attributes attached to the data frame:

Name	Type	Description
url	character	The url used to generate the data
siteInfo	data.frame	A data frame containing information on the requested sites
variableInfo	data.frame	A data frame containing information on the requested parameters

queryTime POSIXct The time the data was returned

See Also

[readWQPdata](#), [whatWQPsites](#), [readNWISqw](#), and [importWQP](#)

Examples

```
## Not run:
rawPcode <- readWQPqw('USGS-01594440','01075', '', '')
rawCharacteristicName <- readWQPqw('WIDNR_WQX-10032762','Specific conductance', '', '')
rawPHsites <- readWQPqw(c('USGS-05406450', 'USGS-05427949','WIDNR_WQX-133040'), 'pH','','')
nwisEx <- readWQPqw('USGS-04024000',c('34247','30234','32104','34220'),'','2012-12-20')

## End(Not run)
```

renameNWISColumns	<i>renameColumns</i>
-------------------	----------------------

Description

Rename columns coming back from NWIS data retrievals. Daily and unit value columns have names derived from their data descriptor, parameter, and statistic codes. This function reads information from the header and the arguments in the call to to rename those columns.

Usage

```
renameNWISColumns(rawData, p00010 = "Wtemp", p00045 = "Precip",
  p00060 = "Flow", p00065 = "GH", p00095 = "SpecCond", p00300 = "DO",
  p00400 = "pH", p62611 = "GWL", p63680 = "Turb", p72019 = "WLBLS", ...)
```

Arguments

rawData	the daily- or unit-values dataset retrieved from NWISweb.
p00010	the base name for parameter code 00010.
p00045	the base name for parameter code 00045.
p00060	the base name for parameter code 00060.
p00065	the base name for parameter code 00065.
p00095	the base name for parameter code 00095.
p00300	the base name for parameter code 00300.
p00400	the base name for parameter code 00400.
p62611	the base name for parameter code 62611.
p63680	the base name for parameter code 63680.
p72019	the base name for parameter code 72019.
...	named arguments for the base name for any other parameter code. The form of the name must be like pXXXXX, where XXXXX is the parameter code.

Value

A dataset like data with selected columns renamed.

Note

The following statistics codes are converted by `renameNWISColumns`.

- 00001** Maximum value, suffix: Max
- 00002** Minimum value, suffix: Min
- 00003** Mean value, no suffix
- 00006** Sum of values, suffix: Sum
- 00007** Modal value, suffix: Mode
- 00008** Median value, suffix: Median
- 00011** Instantaneous Value, suffix: Inst
- 00012** Equivalent mean value, suffix: EqMean
- 00021** Tidal high-high value, suffix: HiHiTide
- 00022** Tidal low-high value, suffix: LoHiTide
- 00023** Tidal high-low value, suffix: HiLoTide
- 00024** Tidal low-low value, suffix: LoLoTide

See Also

[readNWISdv](#), [readNWISuv](#)

Examples

```
siteWithTwo <- '01480015'
startDate <- "2012-09-01"
endDate <- "2012-10-01"
## Not run:
url2 <- constructNWISURL(siteWithTwo, "00060",startDate,endDate,'dv')
twoResults <- importWaterML1(url2,TRUE)
twoResults <- renameNWISColumns(twoResults)

## End(Not run)
```

stateCd

US State Code Lookup Table

Description

Data pulled from <http://www2.census.gov/geo/docs/reference/state.txt> on April 1, 2015.

Value

stateCd data frame.

Name	Type	Description
STATE	character	two-digit ANSI code
STUSAB	character	State abbreviation
STATE_NAME	character	State full name
STATENS	character	State id

Examples

```
head(stateCd)
```

```
stateCdLookup      State code look up
```

Description

Function to simplify finding state and state code definitions. Used in readNWISdata and readWQPdata.

Usage

```
stateCdLookup(input, outputType = "postal")
```

Arguments

input could be character (full name, abbreviation, id), or numeric (id)
outputType character can be "postal","fullName","tableIndex", or "id".

Examples

```
fullName <- stateCdLookup("wi", "fullName")
abbrev <- stateCdLookup("Wisconsin", "postal")
id <- stateCdLookup("WI", "id")
name <- stateCdLookup(55, "fullName")
index <- stateCdLookup("WI", "tableIndex")
stateCd[index,]
```

 whatNWISdata

USGS data availability

Description

Imports a table of available parameters, period of record, and count. See <http://waterservices.usgs.gov/rest/Site-Service.html> for more information.

Usage

```
whatNWISdata(siteNumbers, service = "all", parameterCd = "all",
  statCd = "all")
```

Arguments

siteNumbers	character	USGS site number or multiple sites.
service	character	Options are "all", or one or many of "dv"(daily values), "uv","rt", or "iv"(unit values), "qw"(water-quality),"sv"(sites visits),"pk"(peak measurements), "gw"(groundwater levels), "ad" (sites included in USGS Annual Water Data Reports External Link), "aw" (sites monitored by the USGS Active Groundwater Level Network External Link), "id" (historical instantaneous values)
parameterCd	character vector	of valid parameter codes to return. Defaults to "all" which will not perform a filter.
statCd	character vector	of all statistic codes to return. Defaults to "all" which will not perform a filter.

Value

A data frame with the following columns:

Name	Type	Description
agency_cd	character	The NWIS code for the agency reporting the data
site_no	character	The USGS site number
station_nm	character	Site name
site_tp_cd	character	Site type
dec_lat_va	numeric	Decimal latitude
dec_long_va	numeric	Decimal longitude
coord_acy_cd	character	Latitude-longitude accuracy
dec_coord_datum_cd	character	Decimal Latitude-longitude datum
alt_va	character	Altitude of Gage or land surface
alt_acy_va	character	Altitude accuracy
alt_datum_cd	character	Altitude datum
huc_cd	character	Hydrologic unit code
data_type_cd	character	Data type
parm_cd	character	Parameter code

stat_cd	character	Statistical code
dd_nu	character	Internal database key
loc_web_ds	character	Additional measurement description
medium_grp_cd	character	Medium group code
parm_grp_cd	character	Parameter group code
srs_id	character	SRS ID
access_cd	character	Access code
begin_date	Date	Begin date
end_date	Date	End date
count_nu	integer	Record count
parameter_group_nm	character	Parameter group name
parameter_nm	character	Parameter name
casrn	character	Chemical Abstracts Service (CAS) Registry Number
srsname	character	Substance Registry Services
parameter_units	character	Parameter units

There are also several useful attributes attached to the data frame:

Name	Type	Description
url	character	The url used to generate the data
comment	character	Header comments from the RDB file
queryTime	POSIXct	The time the data was returned

Examples

```
## Not run:
availableData <- whatNWISdata('05114000')
# To find just unit value ('instantaneous') data:
uvData <- whatNWISdata('05114000',service="uv")
uvDataMulti <- whatNWISdata(c('05114000','09423350'),service=c("uv","dv"))
siteNumbers <- c("01491000","01645000")
flowAndTemp <- whatNWISdata(siteNumbers, parameterCd=c("00060","00010"))

## End(Not run)
```

whatNWISsites

Site Data Import from NWIS

Description

Returns a list of sites from the NWIS web service. This function gets the data from: <http://waterservices.usgs.gov/rest/Site-Test-Tool.html>. Arguments to the function should be based on <http://waterservices.usgs.gov/rest/Site-Service.html#Service> Mapper format is used

Usage

```
whatNWISsites(...)
```

Arguments

... see <http://waterservices.usgs.gov/rest/Site-Service.html#Service> for a complete list of options

Value

A data frame with at least the following columns:

Name	Type	Description
agency_cd	character	The NWIS code for the agency reporting the data
site_no	character	The USGS site number
station_nm	character	Station name
site_tp_cd	character	Site type code
dec_lat_va	numeric	Decimal latitude
dec_long_va	numeric	Decimal longitude
queryTime	POSIXct	Query time

There are also several useful attributes attached to the data frame:

Name	Type	Description
url	character	The url used to generate the data
queryTime	POSIXct	The time the data was returned

Examples

```
## Not run:
siteListPhos <- whatNWISsites(stateCd="OH",parameterCd="00665")

## End(Not run)
```

whatWQPsites

Site Data Import from Water Quality Portal

Description

Returns a list of sites from the Water Quality Portal web service. This function gets the data from: <http://www.waterqualitydata.us>. Arguments to the function should be based on www.waterqualitydata.us/webservices_documentation.jsp

Usage

```
whatWQPsites(...)
```

Arguments

... see www.waterqualitydata.us/webservices_documentation.jsp for a complete list of options

Value

A data frame with at least the following columns:

Name	Type	Description
OrganizationIdentifier	character	A designator used to uniquely identify a unique business
OrganizationFormalName	character	The legal designator (i.e. formal name) of an organization
MonitoringLocationIdentifier	character	A designator used to describe the unique name, number, or letter
MonitoringLocationName	character	The designator specified by the sampling organization
MonitoringLocationTypeName	character	The descriptive name for a type of monitoring location
MonitoringLocationDescriptionText	character	Text description of the monitoring location.
HUCEightDigitCode	character	The 8 digit federal code used to identify the hydrologic unit
DrainageAreaMeasure/MeasureValue *	character	The drainage basin of a lake, stream, wetland, or estuary
DrainageAreaMeasure/MeasureUnitCode *	character	The code that represents the unit for measuring the item
ContributingDrainageAreaMeasure/MeasureValue *	character	The contributing drainage area of a lake, stream, wetland, or estuary
ContributingDrainageAreaMeasure/MeasureUnitCode *	character	The code that represents the unit for measuring the item
LatitudeMeasure	numeric	The measure of the angular distance on a meridian north or south
LongitudeMeasure	numeric	The measure of the angular distance on a meridian east or west
SourceMapScaleNumeric	character	The number that represents the proportional distance of the map
HorizontalAccuracyMeasure/MeasureValue *	character	The horizontal measure of the relative accuracy of the item
HorizontalAccuracyMeasure/MeasureUnitCode *	character	The code that represents the unit for measuring the item
HorizontalCollectionMethodName	character	The name that identifies the method used to determine the location
HorizontalCoordinateReferenceSystemDatumName	character	The name that describes the reference datum used in determining the location
VerticalMeasure/MeasureValue	character	The measure of elevation (i.e., the altitude), above or below a datum
VerticalMeasure/MeasureUnitCode	character	The code that represents the unit for measuring the item
VerticalAccuracyMeasure/MeasureValue *	character	The vertical measure of the relative accuracy of the latitude
VerticalAccuracyMeasure/MeasureUnitCode *	character	The code that represents the unit for measuring the item
VerticalCollectionMethodName	character	The name that identifies the method used to collect the item
VerticalCoordinateReferenceSystemDatumName	character	The name of the reference datum used to determine the location
CountryCode	character	A code designator used to identify a primary geopolitical entity
StateCode	character	A code designator used to identify a principal administrative area
CountyCode	character	A code designator used to identify a U.S. county or county equivalent
AquiferName *	character	Name of the aquifer in which the well is completed.
FormationTypeText *	character	Name of the primary formation or soils unit, in which the well is completed.
AquiferTypeName *	character	The type of aquifer, such as confined or unconfined.
ConstructionDateText *	character	Date of construction when well was completed. May be null.
WellDepthMeasure/MeasureValue *	character	Depth below land surface datum (LSD) to the bottom of the well
WellDepthMeasure/MeasureUnitCode *	character	The code that represents the unit for measuring the item
WellHoleDepthMeasure/MeasureValue *	character	Depth below land surface datum (LSD) to the bottom of the well
WellHoleDepthMeasure/MeasureUnitCode *	character	The code that represents the unit for measuring the item
queryTime	POSIXct	Query time

* element is only in NWIS

Examples

```
## Not run:
site1 <- whatWQPsites(siteid="USGS-01594440")

type <- "Stream"
sites <- whatWQPsites(countycode="US:55:025",siteType=type)

## End(Not run)
```

zeroPad

Pad string with leading zeros

Description

Function to pad a string with leading zeros. Useful for parameter codes and USGS site IDs.

Usage

```
zeroPad(x, padTo)
```

Arguments

x	character
padTo	number Final desired length of the character

Value

x character returned with leading zeros

Examples

```
pCode <- '10'
correctPCode <- zeroPad(pCode,5)
pCodes <- c('100','1000','0','12345','1565465465465465')
correctPCodes <- zeroPad(pCodes,5)
```


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