15 Minute Stream Flow Data: USGS (FIFE)

Summary:

The Fifteen Minute Stream Flow Data from the USGS Data Set contains 15 minute stream flow data from the USGS station located 2.9 miles upstream from the mouth of Kings Creek. The record extends from April 1, 1979 through September 2, 1988. The purpose of this data set was to provide accurate measurements of the stream flow from Kings Creek so that a water budget analysis for the northwest quadrant of the FIFE study area could be performed.

The stilling pipe installed at the USGS station operates on the principle that the water level in a standpipe at a specific location within a stream bed can be converted to a volume of water in the stream bed. The tracking of the change in stream height with time then enables the calculation of stream flow.

Table of Contents:

1. Data Set Overview:

Data Set Identification:

15 Minute Stream Flow Data: USGS (FIFE).
(Fifteen Minute Stream Flow from the USGS).

Data Set Introduction:

The Fifteen Minute Stream Flow Data from the USGS Data Set contains 15 minute stream flow data from the USGS station located 2.9 miles upstream from the mouth of Kings Creek. The record extends from April 1, 1979 through September 2, 1988.

Objective/Purpose:

The purpose of this data set was to provide accurate measurements of the stream flow from Kings Creek so that a water budget analysis for the northwest quadrant of the FIFE study area could be performed.

Summary of Parameters:

Water flow.

Discussion:

This data set contains 15 minute stream flow data from the USGS station located 2.9 miles upstream from the mouth of Kings Creek. The record extends from April 1, 1979 through September 2, 1988.

Related Data Sets:

- Storm Event Stream Flow.
- Daily Stream Flow Amounts.

FIS Data Base Table Name:

STREAM_FLOW_15MIN_DATA.

2. Investigator(s):

Investigator(s) Name and Title:

Staff Science.

Title of Investigation:

Staff Science Soil Moisture and Hydrology Data Acquisition Program.

Contact Information:

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Requested Form of Acknowledgment.

The Fifteen Minute Stream Flow Rates from USGS were provided to the FIFE Information System staff courtesy of the U.S. Geological Survey, Water Resources Division, Lawrence, Kansas.

3. Theory of Measurements:

The stilling pipe installed at the USGS station operates on the principle that the water level in a standpipe at a specific location within a stream bed can be converted to a volume of water in the stream bed. The tracking of the change in stream height with time then enables the calculation of stream flow.

4. Equipment:

Sensor/Instrument Description:

The stilling well consisted of a vertical pipe connected to the stream by intake pipes. The well was placed in one side of the stream. A float was used to detect the height of the water within the well.

An analog or digital recorder was used to track the stage height of the water in the stilling well. The analog recorder (strip-chart) produces a graphic record of the rise and fall of the water surface with time, while the battery-powered, paper-punch recorder is actuated by a cam on a battery-driven mechanical clock which punchs stage height every 15 minutes. Both recorders run unattended for 60-90 days.

A manual reference gauge was also used in Kings Creek to make direct measurements of stream height.

Collection Environment:

Ground-based.

Source/Platform:

The stilling pipe intake at the USGS station is built into the bottom of the stream bed.

Source/Platform Mission Objectives:

To measure the volume of stream flow.

Key Variables:

Water flow rate.

Principles of Operation:

The water stage recorder measures height of the water surface above an established base plane for that stream. The stage is sensed by a float in a stilling well that is connected to the stream by intake pipes. The stilling well protects the float and dampens the fluctuation in the stream caused by wind and turbulence. The stilling well was placed on one side of the stream with the base of the well placed at the bottom of the stream and its top above the maximum recorded stage. The intake was designed to prevent lag during periods of rapid change in stage and to prevent velocity-head effects at its end.

The height of the water in the still is converted to stream flow using a discharge rating which was determined for Kings Creek. This discharge rating may be a simple relation between stage and discharge or a more complex relation in which discharge is a function of stage, slope, rate of change of stage or other factors such as channel shape, debris, and vegetation in the stream bed.

Sensor/Instrument Measurement Geometry:

Not available at this revision.

Manufacturer of Sensor/Instrument:

Digital stage recorder: Fischer-Porter
Analog stage recorder: Stevens A-35
Stilling Well & Weir: United States Geological Survey
Manhattan, Kansas.

Calibration:

Stage height in the stilling well is checked periodically when an engineer visits the gauge and at a minimum every (2 - 3 years). The stage height inside the still is compared with that of a direct, manual stage height measurement using a non-recording gauge.

Discharge measurements were made to define the discharge rating for Kings Creek. The measurements were initially made at various stages (stream heights) to define the relation between stage and discharge. After the initial measurements, discharge measurements were made monthly to verify the stage-discharge relationship or to define any change in the relationship.

The discharge measurements are normally made using a pygmy current meter. This meter is individually calibrated in the rating flume at the National Institute for Standards and Technology. Measurements with the current meter are made in a cross-section of the stream that is divided

into 20-30 partial sections. The area and mean velocity in each of these sections is determined separately. Indirect methods are used to determine peak flood discharges (see Carter and Davidian 1968 for details).

The stage-discharge relationship is not stable. Frequent measurement of stream discharge is required, especially when the features which control the discharge are not permanent and when various discharge measurements represent different positions of the stage-discharge curve.

Specifications:

Not available at this revision.

Tolerance:

Accuracy of the stilling well is about + or - 0.3048 E-3 meters

Frequency of Calibration:

Discharge measurements are checked monthly.

Stage height is checked when the station is visited by an engineer or at a minimum every 2 - 3 years.

Other Calibration Information:

Not available at this revision.

5. Data Acquisition Methods:

The stream flow station measurements were made in a stilling well located to the side of the open channel of Kings Creek. The data were recorded on to paper tape or a strip chart continuous recorder. It is not known which of these two standard USGS methods was used.

These data were supplied to the FIFE Information System by Eric Wood who obtained them from the Lawrence, Kansas, District Office of USGS.

6. Observations:

Data Notes:

Not available.

Field Notes:

None available at this revision.

7. Data Description:

Spatial Characteristics:

The FIFE study area, with areal extent of 15 km by 15 km, is located south of the Tuttle Reservoir and Kansas River, and about 10 km from Manhattan, Kansas, USA. The northwest corner of the area has UTM coordinates of 4,334,000 Northing and 705,000 Easting in UTM Zone 14.

Spatial Coverage:

Measurements were made at the USGS Kings Creek station (USGS ID number 06879650) located 2.9 miles from the mouth of Kings Creek.

SITEGRID_ID	STATION_ID	STATION_NAME	NORTHING	EASTING
1715-STG	650	KINGS CREEK	4330650	707973

LATITUDE	LONGITUDE
39 06 07	-96 35 42

Spatial Coverage Map:

Not available.

Spatial Resolution:

These are point data, however, they represent the total water flow from the watershed upstream from the location of the stilling well.

Projection:

Not available.

Grid Description:

Not available.

Temporal Characteristics:

Temporal Coverage:

The USGS Kings Creek stream flow data covers the period of December 25, 1984 through March 3, 1988.

Temporal Coverage Map:

Not available.

Temporal Resolution:

The USGS Kings Creek stream flow station data was recorded at 15-minute intervals when there was a flow rate greater than 2.837 E-4 [m^3][sec^-1]. When the flow rate was less, no data were reported until this rate was exceeded or 24 hours had elapsed.

Data Characteristics:

The SQL definition for this table is found in the STRM_15M.TDF file located on FIFE CD-ROM Volume 1.

Parameter/Variable Name	Parameter/Variable Description	Range	Units	Source
SITEGRID_ID	This is a FIS grid location code. Site grid codes (SSEE-III) give the south (SS) and east (EE) cell number in a 100 x 100 array of 200 m square cells. The last 3 characters (III) are an instrument identifier.			FIS
STATION_ID	The station ID designating the location of the observations.	min = 650, max = 650		FIS

OBS_DATE The date of the observations. max = 03-MAR-88	min = 25-DEC-84,		USGS
START_TIME The starting time of the observations, converted from CST.	min = 15, max = 2400	[GMT]	USGS
END_TIME The ending time of the observations, converted from CST.	min = 15, max = 2400	[GMT]	USGS
AVG_FLOW The stream flow rate between the times listed in START_TIME and END_TIME.	min = 0, max = 10.2507	[meters^3] [sec^-1]	USGS
FIFE_DATA_CRTFCN_CODE The FIFE Certification Code for the data, in the following format: CPI Certified by PI), CPI-??? (CPI - questionable data). data, CPI-???= CPI- questionable data	* CPI=checked by principal investigator, CPI-MRG=merged		FIS
LAST_REVISION_DATE data, in the format (DD-MMM-YY).	max = 29-SEP-89		

Footnote:

* Decode the FIFE_DATA_CRTFCN_CODE field as follows:

The primary certification codes are:

EXM Example or Test data (not for release) PRE Preliminary (unchecked, use at your own risk) CPI Checked by Principal Investigator (reviewed for quality) CGR Checked by a group and reconciled (data comparisons and cross checks)

The certification code modifiers are:

PRE-NFP Preliminary - Not for publication, at the request of investigator. CPI-MRG PAMS data which is "merged" from two separate receiving stations to eliminate transmission errors. CPI-??? Investigator thinks data item may be questionable.

Sample Data Record:

```
SITEGRID_ID  STATION_ID  OBS_DATE   START_TIME  END_TIME  AVG_FLOW
-----------  ----------  ---------  ----------  --------  ---------
1715-STG        650      25-DEC-84     615        2400     .00000
1715-STG        650      26-DEC-84      15        2400     .00000
1715-STG        650      27-DEC-84      15        2400     .00000
1715-STG        650      28-DEC-84      15         815     .03400
FIFE_DATA_CRTFCN_CODE  LAST_REVISION_DATE
---------------------  -----------------
CPI                    29-SEP-89
CPI                    29-SEP-89
CPI                    29-SEP-89
CPI                    29-SEP-89
```

8. Data Organization:

Data Granularity:

The USGS Kings Creek stream flow station data is point data recorded at 15-minute intervals when flow rate was greater than 2.837 E-4 [m^3][sec^-1]. When the flow rate was less, no data were reported until this rate was exceeded or 24 hours had elapsed.

A general description of data granularity as it applies to the IMS appears in the EOSDIS Glossary.

Data Format:

The CD-ROM file format consists of numerical and character fields of varying length separated by commas. The character fields are enclosed with a single apostrophe. There are no spaces between the fields. Each file begins with five header records. Header records contain the following information:

Record 1 Name of this file, its table name, number of records in this file, path and name of the document that describes the data in this file, and name of principal investigator for these data.

Record 2 Path and filename of the previous data set, and path and filename of the next data set. (Path and filenames for files that contain another set of data taken at the same site on the same day.)

Record 3 Path and filename of the previous site, and path and filename of the next site. (Path and filenames for files of the same data set taken on the same day for the previous and next sites (sequentially numbered by SITEGRID_ID)).

Record 4 Path and filename of the previous date, and path and filename of the next date. (Path and filenames for files of the same data set taken at the same site for the previous and next date.)

Record 5 Column names for the data within the file, delimited by commas.

Record 6 Data records begin.

Each field represents one of the attributes listed in the chart in the *Data Characteristics Section* and described in detail in the TDF. These fields are in the same order as in the chart.

9. Data Manipulations:

Formulae:

Derivation Techniques and Algorithms:

Section Discharge = (Mean Velocity) x (depth at vertical) x (sum ½ distance to adjacent vertical)

Total Stream Discharge = Sum of Section Discharges for the stream.

The equation used to relate stream stage to discharge is not known.

Data Processing Sequence:

Processing Steps:

The processing steps for these data depend upon whether the data is written to a strip-chart recorder or to paper tape. Since it is not known which was used at the Kings Creek station both will be described here. If the stage height is recorded on a strip-chart all computations are performed manually in the following order:

1. Determination and application of gauge height and time corrections to the gauge height chart.
2. Computation of the mean gauge height for each 15 minute interval point.
3. Computation of discharge for each period from mean values of stage and discharge rating, including any strip chart corrections.
4. Computation of peak values of gauge height and discharge.

If the stage height is recorded to paper tape the data is read from the paper tape by a paper tape reader attached to a computer. The discharge is then computed using these data, the stage-discharge rating, the list of any corrections to the basic discharge rating, and a list of corrections to the data.

Processing Changes:

None.

Calculations:

Special Corrections/Adjustments:

None known at this revision.

Calculated Variables:

- Section discharge, and
- Total stream discharge

Graphs and Plots:

None.

10. Errors:

Sources of Error:

Errors originate from the instability of the relationship between stage height and discharge. This relationship varies temporally. It is affected by changes in the stream bed which result from the flow of water over the bed, such as scour and fill, aquatic growth, ice, debris, or bed roughness.

The intakes to the stilling well can become plugged with debris or overgrown with plant or animal material, and the float can malfunction.

Quality Assessment:

Data Validation by Source:

The discharge curves are routinely checked for accuracy. The stage height within the stilling well is routinely checked against that measured using a manual gauge.

Confidence Level/Accuracy Judgment:

The overall accuracy of these data for each year is as listed below:

Year	Accuracy Judgment
1984	Good
1985	Good
1986	Good
1987	Not available
1988	Good

Measurement Error for Parameters:

Records for 1984, 1985, 1986 and 1988 are within 5% of the reported daily discharges. The error rate for 1987 is unknown.

Additional Quality Assessments:

FIS staff applied a general Quality Assessment (QA) procedure to the data to identify inconsistencies and problems for potential users. As a general procedure, the FIS QA consisted of examining the maximum, minimum, average, and standard deviation for each numerical field in the data table. An attempt was made to find an explanation for unexpected high or low values, values outside of the normal physical range for a variable, or standard deviations that appeared inconsistent with the mean. In some cases, histograms were examined to determine whether outliers were consistent with the shape of the data distribution.

The discrepancies, which were identified, are reported as problems in the *Known Problems with the Data Section*.

Data Verification by Data Center:

The data verification performed by the ORNL DAAC deals with the quality of the data format, media, and readability. The ORNL DAAC does not make an assessment of the quality of the data itself except during the course of performing other QA procedures as described below.

The FIFE data were transferred to the ORNL DAAC via CD-ROM. These CD-ROMs are distributed by the ORNL DAAC unmodified as a set or in individual volumes, as requested. In addition, the DAAC has incorporated each of the 98 FIFE tabular datasets from the CD-ROMs into its online data holdings. Incorporation of these data involved the following steps:

- Copying the entire FIFE Volume 1, maintaining the directory structure on the CD-ROM.
- Using data files, documentation, and SQL code provided on the CD-ROM to create a database in Statistical Analysis System (SAS).
- Creating transfer files to transfer the SAS metadata database to Sybase tables.

Each distinct type of data (i.e. "data set" on the CD-ROM), is accompanied by a documentation file (i.e., .doc file) and a data format/structure definition file (i.e., .tdf file). The data format files on the CD-ROM are Oracle SQL commands (e.g., "create table") that can be used to set up a relational database table structure. This file provides column/variable names, character/numeric type, length, and format, and labels/comments. These SQL commands were converted to SAS code and were used to create SAS data sets and subsequently to input data files directly from the CD-ROM into a SAS dataset. During this process, file names and directory paths were captured and metadata was extracted to the extent possible electronically. No files were found to be corrupted or unreadable during the conversion process.

Additional Quality Assurance procedures were performed as follows:

- Statistical operations were performed to calculate minimum and maximum values for all numeric fields and to create a listing of all values of the character fields. During this process, it was determined that various conventions were used to represent missing values. (Note: no modifications were made to any data by the DAAC). In most cases, missing value identification conventions were discussed in the accompanying .doc file. Based on a visual check of the minimum and maximum values, no glaring errors or holes were identified that might indicate errors introduced during CD-ROM mastering by the FIFE project or data ingest by the DAAC.
- Some minor inconsistencies and typographical errors were identified in some of the character fields and column labels, however, no modifications were made to the data by the DAAC.
- Some conversions of ASCII data were necessary to move the data from a DOS platform to a UNIX platform. Standard operating system conversion utilities were used (e.g., dos2unix).
- Much of the metadata required for archival is imbedded in the narrative documentation accompanying the data sets and extracted manually by DAAC staff who have read the .doc files provided on the CD-ROM and have hand entered this information into the metadata database maintained by the DAAC. QA procedures have been performed on these metadata to identify and eliminate typographical errors and inconsistencies in naming conventions, to ensure that all required metadata is present, and to ensure the accuracy of file names and paths for retrieval.
- Data requested for distribution to users are checked to verify that files copied from disk to other media remain uncorrupted.

As errors are discovered in the online tabular data by investigators, users, or DAAC staff, corrections are made in cooperation with the principal investigators. These corrections are then distributed to users. CD-ROM data are corrected when re-mastering occurs for replenishment of CD-ROM stock.

11. Notes:

Limitations of the Data:

Not available.

Known Problems with the Data:

The mean flow values for July 6, 1987 through July 11, 1987 are questionable. An independent comparison of the data here and these same data acquired directly from USGS by another group shows a discrepancy between the mean flow values for these dates. The data here shows a mean flow of zero for these dates while the same USGS data set acquired by the second group shows the mean flow rates for these dates to be .08211 [m^3][sec^-1] for July 6, 1987 and to range from .05390 to .05958 [m^3][sec^-1] for July 10, 1987. The USGS regional office in Lawrence, Kansas, should be contacted if you wish to resolve this discrepancy.

Unusually high mean flow values were recorded on the days, listed below:

Mean Flow

Date	Description [m^3][sec^-1]
April 27, 1985	5 values greater than 6.0
June 22, 1985	3 values greater than 6.0
October 9, 1985	3 values greater than 6.0
May 17, 1986	3 values greater than 6.0
October 4, 1986	3 values greater than 6.0
April 14, 1987	3 values greater than 6.0

Usage Guidance:

None available at this revision.

Any Other Relevant Information about the Study:

None.

12. Application of the Data Set:

This data set can be used to perform water budget analysis for the northwest quadrant of the FIFE study area.

13. Future Modifications and Plans:

The FIFE field campaigns were held in 1987 and 1989 and there are no plans for new data collection. Field work continues near the FIFE site at the Long-Term Ecological Research (LTER) Network Konza research site (i.e., LTER continues to monitor the site). The FIFE investigators are continuing to analyze and model the data from the field campaigns to produce new data products.

14. Software:

Software to access the data set is available on the all volumes of the FIFE CD-ROM set. For a detailed description of the available software see the *Software Description Document*.

15. Data Access:

Contact Information:

ORNL DAAC User Services
Oak Ridge National Laboratory

Telephone: (865) 241-3952
FAX: (865) 574-4665

Email: ornldaac@ornl.gov

Data Center Identification:

ORNL Distributed Active Archive Center
Oak Ridge National Laboratory
USA

Telephone: (865) 241-3952
FAX: (865) 574-4665
Email: ornldaac@ornl.gov

Procedures for Obtaining Data:

Users may place requests by telephone, electronic mail, or FAX. Data is also available via the World Wide Web at http://daac.ornl.gov.

Data Center Status/Plans:

FIFE data are available from the ORNL DAAC. Please contact the ORNL DAAC User Services Office for the most current information about these data.

16. Output Products and Availability:

The Daily Stream Flow Amounts are available on FIFE CD-ROM Volume 1. The CD_ROM filename is as follows:

\DATA\HYDROLGY\STRM_15M\Yyyyy\ydddgrid.S15

Where *yyyy* are the four digits of the century and year (e.g., Y1987 = 1987). Note: capital letters indicate fixed values that appear on the CD-ROM exactly as shown here, lower case indicates characters (values) that change for each path and file.

The format used for the filenames is: *ydddgrid.sfx,* where *grid* is the four number code for the location within the FIFE site grid, *y* is the last digit of the year (e.g., 7 = 1987), and *ddd* is the day of the year (e.g., 061 = sixty-first day of the year). The filename extension (*.sfx*), identifies the data set content for the file (see the *Data Characteristics Section*) and is equal to .S15 for this data set.

17. References:

Satellite/Instrument/Data Processing Documentation.

Beven, K.J. 1986. Hillslope runoff processes and flood frequency characteristics. In: Hillslope Processes. A.D. Abrahams (ed.). George Allen and Unwin.

Anonymous. 1980. U.S Geological Survey Water-Data Report KS-79-1 Through KS-89-1. Water Resources Data Kansas. Water Year 1979-. Prepared in cooperation with the State of Kansas and with other agencies.

Carter, R.W., and J. Davidian. 1968. Techniques of Water-Resources Investigations of the United States Geological Survey. Book 3:

Applications of Hydraulics. Chapter A6: General Procedure for Gaging Streams. 13 pgs.

Journal Articles and Study Reports.

Wood, E.F. 1990. Water balance model for Kings Creek. AMS Symposium on the First ISLSCP Field Experiment (FIFE). Anaheim, California. pp. 163-167.

Wood, E.F., M. Sivapalan, K.J. Beven, and L. Band. 1989. Effects of spatial variability and scale with implications to hydrologic modeling. J. Hydrol. 102:29-47.

Sivapalan, M., K.J. Beven, and E.F. Wood. 1987. On hydrological similarity: 2. A scaled model of storm runoff production. Water Resources Res. 23:2266-2278.

Famiglietti, J.S., E.F. Wood, M. Sivapalan, and D.J. Thongs. 1992. A catchment Scale Water Balance for FIFE. J. Geophysical Res.

Famiglietti, J.S. 1991. Aggregation and scaling of spatially-variable hydrological processes: local, catchment-scale and macroscale models of water and energy balance. PhD Dissertation. Dept. of Civil Engineering. Princeton University. Princeton, NJ.

Archive/DBMS Usage Documentation.

Contact the EOS Distributed Active Archive Center (DAAC) at Oak Ridge National Laboratory (ORNL), Oak Ridge, Tennessee (see the *Data Center Identification Section*). Documentation about using the archive and/or online access to the data at the ORNL DAAC is not available at this revision.

18. Glossary of Terms:

A general glossary for the DAAC is located at Glossary

19. List of Acronyms:

CD-ROM Compact Disk-Read Only Memory DAAC Distributed Active Archive Center EOSDIS Earth Observing System Data and Information System FIFE First ISLSCP Field

Experiment FIS FIFE Information System ISLSCP International Satellite Land Surface Climatology Project ORNL Oak Ridge National Laboratory URL Uniform Resource Locator USGS United States Geological Survey UTM Universal Transverse Mercator

A general list of acronyms for the DAAC is available at Acronyms.

20. Document Information:

May 11, 1994 (citation revised on October 14, 2002).

Warning: This document has not been checked for technical or editorial accuracy by the FIFE Information Scientist. There may be inconsistencies with other documents, technical or editorial errors that were inadvertently introduced when the document was compiled or references to preliminary data that were not included on the final CD-ROM.

Previous versions of this document have been reviewed by the Principal Investigator, the person who transmitted the data to FIS, a FIS staff member, or a FIFE scientist generally familiar with the data.

Document Review Date:
September 17, 1996.

Document ID:
ORNL-FIFE_STRM_15M.

Citation:
Cite this data set as follows:

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