
**INITIAL DATA COMPILATION
FOR SETUP OF CE-QUAL-W2
VERSION 3.1
FOR THE LOWER AND MIDDLE
GREEN RIVER**

May 2003



King County

Department of Natural Resources and Parks
Water and Land Resources Division

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Alternative formats available

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Data required to set up CE-QUAL-W2 Version 3.1 for the Lower and Middle Green River (Tukwila to just below Flaming Geyser State Park) includes bathymetric, meteorologic, hydrologic, and water quality data. Topographic and riparian shade along the river channel is also needed to set up the model. These types of data are available from a variety of local, state, and federal government agencies. An attempt was made to compile all of the relevant data that are available and provide this information to Portland State University so they can develop a working water quality model of the river.

The data that have been compiled to date are identified below.

BATHYMETRY

The most readily available information regarding the topography of the basin, channel morphology, and channel cross-section geometry is available from digital elevation models (DEM - 10 m resolution), orthophotography, and Hydrologic Engineering Center (HEC) water surface profile models of the river. Based on this information, a river centerline was drawn (ArcView polyline and route) that describes as closely as possible the historical river thalweg from the downstream boundary above the confluence with the Black River near Tukwila to the upstream boundary below Flaming Geyser State Park. Based on hardcopy Federal Emergency Management Agency (FEMA) drawings of the Lower Green River HEC model cross section locations and geo-referenced electronic AutoCad drawings of the Middle Green River HEC model cross sections, sections were located on the polyline/route as closely as possible to their actual field measurement location. ArcInfo routing routines were then used to estimate the distances between each section independently of the HEC model input files (see greenrt.shp and xscts.shp). Based on comparison of a number of data sources and personal communications, it is apparent that the river channel is fairly active. The most conspicuous change in channel morphology has occurred over the last 5 years or so at a large river bend just below the confluence with Soos Creek. At this location, the main channel has cut through a large river bend and now typically flows through a channel choked with trees that previously occupied the now active channel. The historical Lower Green HEC model represents the channel condition prior to this development. The cross section measurements are in feet and it is believed that the vertical datum of the HEC model cross sections is NGVD 1929.

One problem that has yet to be resolved is the choice of Middle Green River HEC model input decks to use. The Seattle-District ACOE contracted WEST Consultants to update the HEC-2 files to HEC-RAS versions. WEST Consultants used the file **MGR.DAT** as the input deck to convert to HEC-RAS. There exists another file (**MRG.HYD**) that contains somewhat different cross section data.

With the exception of the year 2000 Emerge orthophotos of the Green River mainstem, the relevant data and image files are stored in the **Bathymetry** and **ArcView** folders. The **ArcView** folder contains the 10 m DEM and miscellaneous coverages of the stream channel and sub-basin delineations. The **Bathymetry** folder contains 3 sub-folders:

1. **HEC2** contains HEC2 input decks for the Lower and Middle Green River (**GREEN.DAT** and **MRG.DAT**, respectively). The remaining files are some sort of analyses performed with the Middle Green HEC2 model.
2. **MiddleGreenHEC** contains two more Middle Green HEC input decks. **MRG.HYD** is presumably another baseline input deck and **MRG.FWY** is another analysis. However, **MRG.HYD** and **MRG.DAT** are not identical. Major differences include: A date stamp in the **MRG.HYD** file of December 12, 1996 and “June 1995” in the **MRG.DAT** file. Cross section stations 10, 20, 3A, etc. in the **MRG.HYD** file and River Miles used as stations in the **MRG.DAT** file. **MiddleGreenHEC** also contains geo-referenced AutoCad maps that illustrate the locations of Middle Green cross section measurements, topography, and bridge locations.
3. **RAS** contains the HEC-RAS project developed from the Lower and Middle Green HEC2 input decks. The Lower Green input deck appears to be based on the MRG.DAT file. **RAS** also contains some notes prepared by the contractor that set up the HEC-RAS application (**RAS Notes.doc**) and some summary information on the HEC cross sections in **GreenHEC-RAS.xls**. The latter file contains a useful index that relates Lower Green FEMA map cross section names and Middle Green AutoCad map cross section names to the River Mile indices in the input files.

METEOROLOGY

Long-term hourly meteorological data are available from Sea-Tac International Airport for the period 1948 – present. These data include air temperature, dew point temperature, wind speed and direction, and cloud cover in tenths. The data are provided in TD1440 format for 1948-2000. Due to the implementation of the Automated Surface Observing System (ASOS) in mid-1996, cloud cover in tenths is no longer reported in the TD1440 format. Cloud cover data for the period 1996-2000 are supplemented with data provided in space-delimited fixed-length DATSAV3 format. Hourly data for use in CE-QUAL-W2 for the period 1948-March 2000 (including cloud cover in tenths) have been compiled in an Access97 database (**met.mdb**). Example FORTRAN programs for the processing of TD1440 and DATSAV3 formatted data are also provided.

Global (diffuse and direct) short wave (solar) radiation data are available for the period 1995 – present from the National Oceanic and Atmospheric Administration’s Level 1 Integrated Surface Irradiance Study (ISIS) station in Seattle (<http://www.atdd.noaa.gov/isis/states/washington/washington.htm>). Hourly data have been downloaded and compiled in **ISIS.XLS**.

Although not compiled here, meteorological data collected at the University of Washington in Seattle, including solar radiation, are available for download (see http://www-k12.atmos.washington.edu/k12/grayskies/nw_weather.html), although some large gaps exist in the records.

The relevant data files are stored in the **Meteorology** folder. The **Meteorology** folder contains the hourly meteorological data reported at Sea-Tac (**met.mdb**), original ASCII data files (**seatac.144**, **Seattle_datsav3.txt**), and associated notes and FORTRAN data processing examples. The statistical tests of the synthesis of cloud cover in tenths from the DATSAV3 formatted file is provided in **CloudCoverEst.xls**. ISIS solar data are archived in ISIS.zip that includes the imported ASCII data in Excel worksheets (**ISIS.XLS**).

HYDROLOGY

Hydrologic data is available from King County DNR&P and the U.S. Geological Survey (USGS) for a number of mainstem and tributary locations. These data have been compiled and sampling locations are identified below.

King County: King County has recorded discharge at 15 minute intervals at the following locations relevant to setting up the model.

| Site_name | Station | MinOfDate | MaxOfDate |
|-------------------------------|----------------|------------------|------------------|
| Crisp Creek at Green River RD | 40d | 8/25/1994 | 5/29/2002 |
| Green River at 218th AV SE | 40a | 9/30/1991 | 9/30/1995 |
| Lower Green River Tributary | 32c | 9/30/1989 | 8/3/1990 |
| Mill Creek at SR 181 | 41a | 8/22/1989 | 4/6/1996 |
| O'Grady Creek near Enumclaw | 40c | 7/25/1991 | 9/30/1995 |

Note that all King County hydrologic data are recorded in Pacific Daylight Time (PDT) throughout the year.

USGS: The following daily average flow data were obtained from the USGS (including provisional data for the 2001 water year):

| ShortName | site_no | MinOfDate | MaxOfDate |
|---------------------------|----------------|------------------|------------------|
| Big Soos mouth | 12112600 | 9/1/1960 | 6/18/2002 |
| Green @ Palmer | 12106700 | 7/1/1963 | 6/18/2002 |
| Green @ Tukwila | 12113350 | 10/1/1960 | 8/11/1987 |
| Green below Howard Hanson | 12105900 | 10/1/1960 | 6/18/2002 |
| Green nr Auburn | 12113000 | 8/1/1936 | 6/18/2002 |
| Newaukum mouth | 12108500 | 7/1/1944 | 6/18/2002 |

Hourly stage (vertical datum is NGVD 1929) at the downstream boundary near Tukwila was also obtained from the USGS:

| ShortName | site_no | MinOfDate | MaxOfDate |
|-----------------|----------|-----------|-----------|
| Green @ Tukwila | 12113350 | 10/1/1987 | 6/19/2002 |

Note that the hourly data from USGS are in local time. An adjustment has been made to also provide the data in Pacific Standard Time for use in CE-QUAL-W2.

The hydrologic information is arranged by data source in the folder **Data**. The King County hydrologic data are stored in **Data\KingCounty\GageData\KCGageData.mdb**. The original station text export files from the King County SQL Server database are also included with ancillary documentation. King County has also developed hydrologic models of a number of Green River sub-basins using HSPF. These modeled basins and ungaged basins are described in documentation and ArcView shape files in **Data\KingCounty\BasinBoundaries**.

The USGS hydrologic data are stored in **Data\USGS\ USGSHydrology.mdb**. Original ASCII text files provided by USGS are also provided along with ancillary documentation. Tab-delimited text files and ArcView shape files are also provided in the **ArcView** folder that facilitate the determination of station locations in relation to the Green River mainstem.

WATER QUALITY

Temperature

Ecology: The Washington State Department of Ecology (Ecology) has recorded stream temperature on the Green River mainstem at Kanasket. Data were recorded on a half-hour interval and the times are reported in PDT.

| StationName | StationID | MinOfDate | MaxOfDate |
|--------------------|-----------|-----------|-----------|
| Green R @ Kanasket | 09A190 | 7/23/2001 | 9/17/2001 |

King County: King County has recorded water temperatures at 15 minute intervals at the following relevant locations:

| Site_name | StationID | MinOfDate | MaxOfDate |
|----------------------------|-----------|------------|-----------|
| Crisp Creek at Green River | 40d | 10/10/1997 | 8/6/2002 |
| Mill Creek at SR 181 | 41a | 10/1/1999 | 8/1/2002 |
| Soos Creek at Mouth | 54a | 10/1/1994 | 8/1/2002 |

Note that all temperature data recorded by the King County hydrologists are in PDT.

A special temperature study was also conducted by King County hydrologists during 1995 and 1996 at a number of stations in the mainstem, side-channels, and tributaries of the Green River. These data were not stored in the King County hydrologic database, but James Ebbert, Hydrologist, USGS, Tacoma, WA provided raw data files that were originally sent from the County for use in the National Water Quality Assessment. I processed the available data files from the following relevant locations:

| StationName | Locator | MinOfTime | MaxOfTime |
|--|---------|-----------|------------|
| Green River above Black River at Tukwila (Bicentennial Park) | BIC | 5/24/1995 | 11/20/1996 |
| Green River above Soos Creek near Auburn (Neely Bridge) | NEE | 5/25/1995 | 10/29/1996 |
| Green River at Kent (Van Doren's) | VAN | 5/24/1995 | 11/2/1995 |
| Green River at North Green River Park | NOR | 5/24/1995 | 11/20/1996 |
| Green River at S 212th Street (near Van Doren's Landing) | 212 | 6/7/1996 | 9/5/1996 |
| Green River below Big Soos Creek near Auburn (104th Pl SE) | AUB | 7/21/1995 | 9/5/1996 |
| Green River below Big Soos Creek near Auburn (NE 2nd St) | 2ND | 5/25/1995 | 7/20/1995 |
| Green River near Black Diamond (Whitney Bridge) | WHI | 5/25/1995 | 11/20/1996 |
| Green River near Kanaskat | KAN | 5/25/1995 | 7/25/1996 |
| Mullen Slough at S 277th St | 277 | 7/10/1996 | 10/29/1996 |
| Mullen Slough Mouth (Frager Rd) | FRA | 7/10/1996 | 10/25/1996 |
| O'Grady Creek | GRA | 7/2/1996 | 11/20/1996 |

Note that these temperature data were probably recorded in PDT.

King County has also initiated a special temperature study as part of the Green-Duwamish Water Quality Assessment. Continuous temperature recording (15 minute intervals during summer and 1 hour during winter) was initiated at the following stations in July 2001.

| StationName | Locator | MinOfDate | MaxOfDate |
|--------------------------------|---------|-----------|-----------|
| Duwamish River at South Park | GRT01 | 7/27/2001 | 2/22/2002 |
| Black River | GRT02 | 7/23/2001 | 2/28/2002 |
| Olsen Creek | GRT03 | 7/27/2001 | 2/22/2002 |
| Green River at Porter Levee | GRT04 | 7/27/2001 | 2/28/2002 |
| Mill Creek at Peasely Canyon W | GRT04b | 7/23/2001 | 2/22/2002 |
| Mill Creek Dead Zone | GRT05 | 7/23/2001 | 2/22/2002 |
| Burns Creek | GRT06 | 7/24/2001 | 2/22/2002 |
| O'Grady Creek | GRT07 | 7/27/2001 | 2/22/2002 |

| | | | |
|---------------------------------|---------|------------|------------|
| Newaukum Creek at 212 Ave SE | GRT09 | 7/23/2001 | 10/25/2001 |
| Green River at Whitney Bridge | GRT10 | 7/24/2001 | 9/6/2001 |
| Green River at Whitney Bridge | GRT10_2 | 11/16/2001 | 2/22/2002 |
| not Watercress Creek | GRT11 | 7/27/2001 | 2/22/2002 |
| Newaukum Creek forested site | GRT12 | 7/27/2001 | 2/22/2002 |
| Icy Creek | GRT13 | 7/24/2001 | 2/22/2002 |
| Green River - Coal Downstream | GRT14 | 10/25/2001 | 2/22/2002 |
| Green River at Palmer Bridge | GRT16 | 7/24/2001 | 2/20/2002 |
| Green River below Howard Hanson | GRT17 | 7/24/2001 | 2/20/2002 |

Note that the time records for these data are in Pacific Daylight Time (PDT). Additional stations were added in the summer of 2002. Data from these stations are not yet available.

University of Washington: University of Washington researchers have collected temperature data at 15 minute intervals at number of locations in the Soos Creek basin and along the Green River mainstem during the summer of 2001. Data were recorded at 15 minute intervals in Coordinated Universal Time (UTC). The most relevant stations are:

| Station | Description | MinOfdate | MaxOfdate |
|---------|-----------------|-----------|------------|
| BS4 | Soos Creek near | 7/8/2000 | 9/12/2002 |
| GR1 | Green River | 8/22/2000 | 9/12/2002 |
| GR2 | Green River | 7/8/2000 | 1/18/2001 |
| GR3-4 | Green River | 3/30/2001 | 9/12/2002 |
| GR5 | Green River | 7/24/2001 | 10/17/2001 |
| GR6 | Green River | 7/24/2001 | 9/12/2002 |
| GR7 | Green River | 7/24/2001 | 9/12/2002 |

Note that the time records for these data are in UTC.

USGS: Hourly temperature data were recorded by the USGS at five locations in the basin.

| Station_Name | GaugeID | MinOfDate | MaxOfDate |
|--|----------|-----------|-----------|
| BIG SOOS CREEK ABV HATCHERY, NR AUBURN, WA | 12112600 | 3/1/1996 | 10/1/1998 |
| DUWAMISH R AT GOLF COURSE AT TUKWILA, WA | 12113390 | 1/22/1996 | 1/6/2000 |
| GREEN RIVER ABV TWIN CAMP CREEK NR | 12103380 | 4/10/1996 | 5/19/1998 |

| | | | |
|--|----------|-----------|-----------|
| LESTER, WA | | | |
| GREEN RIVER NEAR AUBURN | 12113000 | 7/6/1998 | 9/14/1998 |
| NEWAUKUM CREEK NEAR BLACK DIAMOND, WASH. | 12108500 | 6/29/1996 | 10/1/1998 |
| SPRINGBROOK CREEK AT TUKWILA, WA | 12113375 | 1/17/1996 | 5/12/1998 |

Note that the time standard these data were recorded in has not been confirmed. Most likely the time record represents PDT. The 1998 data from Station 1211300 were apparently recorded by King County and transferred to the USGS.

The continuous temperature data are arranged by data source in the folder **Data**. The Ecology data is stored in **Data\Ecology\Ecology.mdb**. The King County temperature data collected in conjunction with the hydrologic data are stored in **Data\KingCounty\GageData\KCGageData.mdb**. The selected data collected as part of the King County 1995-96 temperature study are provided in **Data\KingCounty\1995TemperatureData\KC1995-96TemperatureData.mdb**. The initial data collected as part of the Green-Duwamish WQA is provided in **Data\KingCounty\GDWQATemperature\GreenWQATemperature.mdb**. The USGS temperature data are stored in **Data\USGS\USGSTemperature.mdb**. Tab-delimited text files and ArcView shape files are also provided in the **ArcView** folder that facilitate the determination of station locations in relation to the Green River mainstem.

Constituents

Ecology: Ecology has monitored a number of locations on an intermittent-monthly basis in the Green River basin. Data from the following stations have been compiled from Ecology's web data server

(<http://www.ecy.wa.gov/apps/watersheds/riv/stationlistbywria.asp?wria=09>).

| StationName | Station | MinOfDate | MaxOfDate |
|---------------------------|---------|------------|------------|
| Big Soos Cr nr Auburn | 09B090 | 10/20/1993 | 9/22/1999 |
| Black R @ Renton | 09H090 | 10/20/1993 | 9/21/1994 |
| Duwamish R @ Allentown Br | 09A060 | 10/18/1989 | 11/19/1990 |
| Green Abv Big Soos/Auburn | 09A130 | 10/20/1993 | 9/21/1994 |

| | | | |
|-----------------------------------|--------|------------|-----------|
| Soos/Auburn | | | |
| Green R @ 212th St nr Kent | 09A090 | 10/18/1989 | 9/21/1994 |
| Green R @ Kanaskat | 09A190 | 10/16/1989 | 3/20/2002 |
| Green R @ Tukwila | 09A080 | 12/12/1990 | 3/19/2002 |
| Mill Creek - Kent on W Valley Hwy | 09E090 | 10/18/1989 | 6/20/1990 |
| Mill Creek @ Orillia | 09E070 | 10/18/1989 | 9/21/1994 |
| Newaukum Creek nr Enumclaw | 09F150 | 10/21/1998 | 9/22/1999 |

King County: King County has monitored a number of locations in the Green River basin on a routine (monthly) basis. Data from the following most relevant locations have been compiled from the King County data management system.

| Location | LOCATOR | MinDATE | MaxDATE |
|-----------------------------------|---------|------------|------------|
| 16th Avenue South | 0307 | 2/21/1990 | 12/19/2001 |
| 68th South and South 261st | A315 | 2/21/1990 | 12/11/2001 |
| above Newaukum Creek | B319 | 1/4/1990 | 12/11/2001 |
| Auburn-Black Diamond Road | A319 | 2/21/1990 | 12/11/2001 |
| Black River pump station pool | A317 | 11/14/2001 | 11/28/2001 |
| East Marginal Way | 0309 | 2/21/1990 | 12/11/2001 |
| Fort Dent Park | 3106 | 2/21/1990 | 12/11/2001 |
| Green River blw Howard Hanson Dam | E319 | 11/28/2001 | 11/28/2001 |
| Interurban Avenue | 0311 | 2/21/1990 | 12/11/2001 |
| Longacres | 0317 | 1/4/1990 | 12/11/2001 |
| Mullen Slough nr mouth | MULLEN1 | 2/27/2001 | 12/12/2001 |

| | | | |
|---------------------------------|------|-----------|------------|
| SE Green Valley Road | 0321 | 1/12/1993 | 12/11/2001 |
| Spokane Street | 0305 | 2/21/1990 | 12/19/2001 |
| USGS Gaging Station 12108500 | 0322 | 2/21/1990 | 12/15/2001 |
| USGS Gaging Station 12112600 | A320 | 1/4/1990 | 12/11/2001 |

USGS: A number of locations in the Green River basin have been monitored for varying periods of time by the USGS. Three locations include data that have been collected through 1998: Big Soos Creek (12112600), Green River near Kanasket (12103380), and Newaukum Creek (12108500). The ASCII text files containing these and other data sets have been downloaded using the USGS web data and have been processed into an Access database.

| Description | site_no | MinOfDate | MaxOfDate |
|---|----------|------------|-----------|
| GREEN RIVER ABV TWIN CAMP CREEK NR I FSTER WA | 12103380 | 9/25/1995 | 4/9/1998 |
| GREEN RIVER AT KANASKAT, WA | 12107000 | 10/15/1975 | 9/18/1978 |
| GREEN R AT FLAMING GEYSER BR NR BLACK DIAMOND WA | 12107498 | 10/15/1975 | 9/28/1976 |
| GREEN RIVER NR BLACK DIAMOND, WASH | 12107500 | 8/3/1977 | 8/4/1977 |
| NEWAUKUM CREEK NEAR BLACK DIAMOND WASH | 12108500 | 12/11/1977 | 4/13/1998 |
| GREEN R AT AUBURN ACADEMY NR AUBURN WASH | 12109010 | 12/1/1970 | 9/27/1971 |
| BIG SOOS CREEK ABV HATCHERY, NR AUBURN WA | 12112600 | 10/4/1962 | 4/13/1998 |
| GREEN RIVER NR AUBURN, WA | 12113000 | 2/9/1955 | 9/8/1970 |
| GREEN R AT 212 ST. NR KENT, WASH. | 12113340 | 12/1/1970 | 8/4/1977 |
| GREEN RIVER AT TUKWILA, WASH. | 12113350 | 10/8/1962 | 9/8/1970 |

The water quality data are arranged by data source in the folder **Data**. The Ecology data is stored in **Data\Ecology\Ecology.mdb**. The King County data are stored in **Data\KingCounty\WaterQuality\GreenWQ.mdb**. A summary of the King County data of primary interest is provided in **DataSummary.xls**. The USGS water quality data are stored in **Data\USGS\USGSWQ.mdb**. Tab-delimited text files and ArcView shape files are also provided in the **ArcView** folder that facilitate the determination of station locations in relation to the Green River mainstem.

RIPARIAN AND TOPOGRAPHIC SHADE

An analysis of riparian and topographic shade was initiated using the ArcView Ttools extension provided by the Oregon Department of Environmental Quality

(<http://www.deq.state.or.us/wq/TMDLs/WQAnalTools.htm>). The mainstem green centerline coverage was used to create sampling points at 100-ft intervals along the river and Ttools was used to calculate stream aspect, elevation, slope, and topographic shade using a 10 m Digital Elevation Model (DEM). King County is currently digitizing land cover types over a 300-ft buffer width (from each side of the centerline) to provide riparian shade data for input to Ttools. The analysis results to date are provided in the folder **Shade**. Supporting files (e.g., 10 m DEM) are provided in the **ArcView** folder.

A regional consortium is currently developing high resolution DEMs (1 m) using **L**ight **D**istance **A**nd **R**anging (LIDAR) technology. It is hoped that this technology will provide ground topography (including structures) and canopy elevation and density for use in the HSPF and CE-QUAL-W2 topographic and vegetation shade models. Program information and available data can be viewed at <http://duff.geology.washington.edu/data/raster/lidar/>