Addendum to OR98C
Last revised 9/26/97

Hydrologic Monitoring in the Johnson Creek Basin, Oregon
Water Year 2002 (Oct. 2001 to Sept. 2002)

SUMMARY

This is a continuation of a cooperative study between the U.S. Geological Survey (USGS) and municipalities in the Johnson Creek basin. The project was started in 1998 in cooperation with the City of Portland Bureau of Environmental Services (BES), and was expanded in subsequent years to include Clackamas County and the cities of Gresham and Milwaukie. In 2001, ground-water data collection was scaled back, responding to slow, steady recession in ground-water levels and spring discharge. This multi-year data collection project will continue to respond to the needs for hydrologic data and analyses, providing answers regarding surface-water, water quality, and ground-water in the basin.

Flooding resulting from direct surface runoff and increased ground-water discharge is a potential problem in residential, commercial, and public areas. Commercial and residential development in the basin has likely affected both the high-flow and low-flow hydrologic conditions in the basin. Johnson Creek is one of the region's last free-flowing urban streams and has received Federal listing for native fish. Water-quality standards will be established by the Oregon Department of Environmental Quality (ODEQ) over the next several years, and will result in Total Maximum Daily Load (TMDL) allocations for temperature, bacteria and pesticide compounds. The effects of ongoing changes in land use in the basin on magnitude and duration of high- and low-flow events, as well as water quality require further data collection and study.

The monitoring network established in the previous years will be continued with some modifications. The network of surface-water stations provides watershed managers timely flow and water-quality information in the basin. Continuation of the ground-water monitoring network will increase the understanding of the local and regional flow systems. The Internet-based distribution of data will continue to provide watershed managers with both real-time and historic data.

PROBLEM

In the last several years the Portland area has experienced extremes in terms of annual rainfall. In 1996-97 this resulted in record runoff to streams, elevated ground-water levels, and increased discharge of ground water to streams and springs. In 2001, lower than average precipitation has led to declines in streamflow and water levels in wells.

Continued surface- and ground-water monitoring is needed in the basin. The surface-water monitoring network provides watershed managers a means of warning residents in the lower part of the basin of potential flood events so that proper precautions can be taken to protect lives and property. The ground-water monitoring program provides the hydrologic data needed to improve the understanding of the hydrology of the lower basin. Specifically, a better understanding is needed of the cause and effect relation between climate (precipitation), recharge, ground-water levels, and ground-water discharge to springs and streams. Additional water-quality monitoring is needed to provide local jurisdictions with data from which TMDLs for temperature, Escherichia coli (E. coli), DDT, and Dieldrin will be established.

Previous studies and data collection currently being done by the USGS and the cooperating agencies address some, but not all the need for data and analyses regarding the TMDL allocations in the basin.

Temperature: Temperature data currently being collected by the USGS provide a basis for a temperature TMDL. Modeling proposed by ODEQ will use these data.

E. coli: Current-condition data are needed to identify the temporal and spatial distribution of E. coli. Samples collected currently by the cities of Portland and Gresham, and 10 years ago by the USGS (Edwards, 1992) indicate regular exceedence of the State of Oregon water-quality criterion of 406 colonies per 100 ml.

Pesticides: Data collected by the USGS in the Johnson Creek basin in 1989-90 (Edwards, 1992) and again in 1994 (Harrison and others, 1995) indicate the concentration of total DDT and Dieldrin can exceed the standard of 1 nanogram per liter (ng/l) and 2 ng/l, respectively. Concentration of pesticides is related to total suspended solids (TSS) in the stream. The data indicate decrease in the concentration relative to TSS over time. This trend has also been observed in the Yakima Basin, in which total DDT concentrations appear to have decreases between the initial sampling of 1987-91 and sampling done in 2000 (Joe Rinella, oral communication, 2001). These results underscore the necessity for current-condition data on pesticides in Johnson Creek.

The cities and counties in the Johnson Creek basin recognize the need to maintain and improve the ground- and surface-water monitoring and have requested continued cooperation and assistance from the USGS in this project. Water-quality monitoring efforts will be broadened to assist with TMDL evaluation

OBJECTIVE

The objective of this project is to provide surface- and ground-water monitoring in the basin, and continue analyses that will further the knowledge of the hydrology in the Johnson Creek basin. Data collected in this project will allow a better understanding of the relation between precipitation events and response in both the surface- and ground- water systems. Local agencies will be in an improved position in terms of land-use planning and warning capability to residences and businesses affected by extreme hydrologic events.

RELEVANCE AND BENEFITS

The project is relevant to the objectives of the USGS Federal-State Cooperative Program for several reasons.

- HYDROLOGIC HAZARDS: One focus of the study in this highly urbanized basin relates to hydrologic hazards in an area that is undergoing significant changes in land use. Flooding, both from rainfall events and from rising ground-water levels, has caused significant property damage. Real-time data from monitoring sites in the basin currently distributed on the Internet are being used by cooperating agencies to make wise decisions regarding these hazards.
- WATER QUALITY: Collection and analysis of stream temperature, E. coli, and pesticide data will aid ODEQ in development of TMDL allocations in the basin and to provide insight into the effects of land-use practices on water quality. Land-use changes, such as local stream and riparian-area restoration projects, conversion of agricultural land to urban uses, and modification of the network of urban storm-drains may have effects on water quality. Several reaches of Johnson Creek and its tributaries are critical fish habitat. Recent Federal listing under the Endangered Species Act has heightened awareness of water quality problems in the basin. In addition, cooperators have expressed concern about hazards associated with human contact with contaminated stream water.
- INTERACTION BETWEEN SURFACE WATER AND GROUND WATER: The study provides data that relate directly to the inter-related nature of the surface- and ground-water systems. Spring flows have caused flooding during the summer months in the lower part of the basin, and may be attributed to elevated ground-water levels. An ephemeral lake in the middle portion of the basin may be the expression of the local water table. Understanding the ground-water flow system is also necessary to analyze the effects of land-use change on streamflow in the basin.

APPROACH

For the 2002 water year (and Federal fiscal year), the project will include continuation of the surface water and ground water data collection network, and increased water-quality monitoring. It is anticipated that this will be an ongoing data collection and analysis program because several years of data will be required before an adequate understanding of the relation between climate and ground-water recharge, storage, and discharge can be attained. It is also anticipated that long-term monitoring will provide useful data to help identify effects of land-use change on both the quantity and quality of water in the basin. All data will continue to be posted on a public Internet web page http://oregon.usgs.gov/johnsoncreek .

Surface Water and Water Quality

The surface-water component of the study will include continuation of data collection and analysis and improvements to the data network. The stream-gage network from the previous year will be continued. This includes water level, discharge, and water temperature monitoring on Johnson Creek at Gresham (RM (river mile) 15.8), Sycamore (RM 10.2), and Milwaukie (RM 0.7) gages, and at the mouth of Kelley Creek (a tributary to Johnson Creek at RM 10.4) (figure 1). In addition to the data available on the Internet, data will be available to watershed managers directly by telephone in either a voice-synthesized or digital format.

To address the three TMDL issues described in the problem statement, the USGS will do the following:

Temperature: Data will be provided to the ODEQ for use in modeling. The continuous temperature data, in conjunction with additional continuous and reach-specific data collected by the DEQ will be inputs to the ODEQ Heat Source model. No temperature data collection will be added to the project beyond the effort in 2001

E. coli: The cities of Portland, Gresham, and Milwaukie, as well as ODEQ are currently collecting E. coli samples on a monthly basis. The jurisdictions will implement a bi-weekly sampling frequency during the winter months.

The relation of total suspended solids (TSS) to E. coli will be used to identify the flux of E. coli in Johnson Creek. Data collected in the Yakima Basin (Embrey, 1992) and in Kansas streams (Christensen, 2000) indicate a reasonable relation of E. coli to TSS, as do data collected by the City of Gresham in 2000-2001 in the Johnson Creek basin. The Gresham data, consisting of concurrent turbidity and E. coli measurements on a monthly basis indicate quite a bit of scatter at low turbidity levels, and a closer correlation at higher levels. This is consistent with the hypothesis that there are causes of high E. coli levels not associated with turbidity, but a turbidity threshold may be able to be established, above which the likelihood of high E. coli levels is high.

The flux of E. coli over a storm event is also needed. The USGS will sample one storm event for E. coli. and TSS. All samples will be analyzed by the City of Portland laboratory. Six sites will be sampled. Assuming a storm event of 48 hours in duration, the following four sites will be sampled at 0, 8, 16, 24, 36, and 48 hours:

Johnson Creek at Palmblad Rd. (RM 17.2)

Johnson Creek at Sycamore (RM 10.2)

Storm water outfall at SE Umatilla St. (RM 3.1)

Johnson Creek at Milwaukie (RM 0.7)

Two sites will be sampled less frequently. Samples will be taken at 0, 8, 24, and 48 hours at:

Storm water outfall at Gresham City Park (RM 15.0, approximately)

Johnson Creek at 45th Ave. (RM 3.2)

In addition, a series of blank and duplicate samples will be taken through the storm event for quality assurance.

Discharge will be determined at the six locations during the storm event. Discharge at the stream-gage locations will be determined from the stage-discharge rating. Discharge at the non-gaged stream locations will be measured, and the City of Portland will use pipe metering equipment to determine discharge at the storm water outfall pipe locations.

Modeling will be done by the ODEQ using the Soil Water Assessment Tool (SWAT) developed by Dr. Jeff Arnold for the U.S. Department of Agriculture Research Service. This model predicts TSS, and therefore a relation must be established between TSS and E. coli.

Pesticides: Sampling for DDT (and breakdown products DDD and DDE) and Dieldrin will be done through the same storm event discussed above. Sampling will be done at the same locations and times. Samples will be analyzed by the USGS lab in Denver, Colorado. In addition, six quality-control samples will be taken consisting of two each of blank, duplicate, and spike samples.

As with bacteria, understanding of the flux of TSS is critical to the understanding of movement of pesticides in Johnson Creek. Data from the Yakima basin (Rinella and others, 1999 and Washington Dept. of Ecology, 1997) indicate a fairly strong relation between DDT and TSS. Limited data on Johnson Creek (Harrison and others, 1995) also indicate a relation between DDT and TSS. The Oregon DEQ will be establishing the TMDL for total DDT and Dieldrin based on the SWAT model.

Ground Water

Data collection and analysis in this study will build upon the work done in the Portland Basin Ground-Water Study (McFarland and Morgan, 1996), allowing a better understanding of the interaction between the aquifer system, springs, and Johnson Creek. The ground-water component of the study will include the following tasks:

1. Monitoring well water-level measurements-

   Water levels in 19 wells will be measured on a bi-monthly schedule. This frequency of measurement is adequate to provide detailed water-level hydrographs that represent seasonal climatic changes. The water-level data will be useful in predicting the timing of inundation of the low-lying Holgate Lake area and increased flow of Crystal Springs Creek due to a rising water table.

   In addition, five wells are instrumented with continuous water-level recorders. Of these, one well is equipped with telemetry, with the data available on the Internet. Continuous recording will allow detection of water-level changes that occur in response to specific precipitation (recharge) events and that may result in increased discharge to springs.

   Monitoring in the Holgate lake area will be scaled back. The lake did not emerge during the 2001 water year, in contrast to the 10 foot lake depth during the 1998 water year. The ground-water level adjacent to Holgate Lake dropped several feet below the elevation of the lakebed during the past year. The continuous water-level gage at Holgate Lake will be reactivated if the real-time continuous ground-water monitor near the lake indicates emergence of the lake, and associated hazards to the surrounding area is likely.

2. Data analysis-

   Data collected from observation wells will be plotted both in hydrographs (change in water level with time) and as aerial water-level maps. The hydrographs will be helpful in studying trends related to climatic events and the aerial water-level maps will allow an understanding of changes of ground-water gradients and flow directions as a result of changes in recharge. This recharge includes infiltration of precipitation, septic systems, discharge to drywells, and seepage from streams.

REPORTING AND PRODUCTS

Progress will be relayed to the cooperators through quarterly meetings. Updates and consultation will occur informally as needed throughout the project.

Products from the study in water year 2002 will include:

1. Operation of streamflow gage on Johnson Creek at Gresham, Sycamore, and Milwaukie and on Kelley Creek.
2. Operation of temperature gages at the streamflow gage sites. In addition, the water-temperature monitor on Crystal Springs Creek will be continued.
3. E. coli, pesticide, and TSS samples will be taken over a single storm event at six sites.
4. Bi-monthly water-level measurements at 19 wells.
5. Continuous (hourly) water-level measurements at 5 wells, of which one is transmitted real-time and displayed on the Internet.
6. Hydrographs and annual change maps for ground-water levels. Interpretive water-level maps and change maps will be presented for discussion at meetings; however, they cannot be released to the cooperators. Release of these materials to the cooperators or to the public requires they first be approved through the USGS review process. If publication of these data is desired, the content and timing of such report will be decided through discussions with the cooperators in a future agreement.
7. Continuation of the Johnson Creek basin hydrologic monitoring Internet web page. The web page includes both real-time and historic stream flow, ground water, water quality, and precipitation data.
8. Publication of collected data in the USGS Annual Data Report for Oregon.
9. A work plan and amendment to the proposal for subsequent-year activities.

BUDGET

* Operation of gaging stations at Johnson Creek at Gresham, Sycamore and Milwaukie, and Kelley Creek, including Stage, discharge, and temperature	$50,400
* Operation of water-temperature gage on Crystal Springs	$2,000
* Operation of ground-water monitoring network, including Continuous recorders	$21,000
* Salary for storm sampling for pesticides, E. coli and TSS	$10,000
* Pesticide analysis of storm samples	$24,400
* Salary for data analysis and project management	$34,400
Total	$142,200

Funding Distribution

USGS	$71,100
City of Portland BES	$40,350
City of Gresham	$12,250
City of Milwaukie	$3,750
Clackamas County	$9,600
Multnomah County	$5,150
Total	$142,200

REFERENCES

Christensen, V.G., Juan, X., and Xiegler, A.C., 2000, Regression analysis and real-time water quality monitoring to estimate constituent concentrations, loads, and yields in the Little Arkansas River, south-central Kansas, 1995-99, U.S. Geological Survey Water-Resources Investigations Report 00-4126, 36 p.

Edwards, T.K., 1992, Water-quality and flow data for the Johnson Creek Basin, Oregon, April 1988 to January 1990: U.S. Geological Survey Open-File Report 92-73, 29 p.

Embrey, S.S., 1992, Surface-water-quality assessment of the Yakima River Basin, Washington: Areal distribution of fecal-indicator bacteria, July 1988: U.S. Geological Survey Water-Resources Investigations Report 91-4073, 34 p.

Harrison, H.E., Anderson, C.W., Rinella, F.A., Gasser, T.M., and Pogue, T.R., Jr., 1995, Analytical data from Phases I and II of the Willamette River Basin Water Quality Study, Oregon, 1992-94: U.S. Geological Survey Open-File Report 95-373, 171 p.

McFarland, W.D., and Morgan, D.S., 1996, Description of the ground-water flow system in the Portland Basin, Oregon and Washington: U.S. Geological Survey Water-Supply Paper 2470-A, 58 p.

Rinella, J.F., McKenzie, S.W., Crawford, J.K., Foreman, W.T., Fuhrer, G.J., and Morace, J.L., 1999, Surface-water-quality assessment of the Yakima River Basin, Washington: Distribution of pesticides and other organic compounds in water, sediment, and aquatic biota, 1987-91, U.S. Geological Survey Water-Supply Paper 2354-B, 180 p.

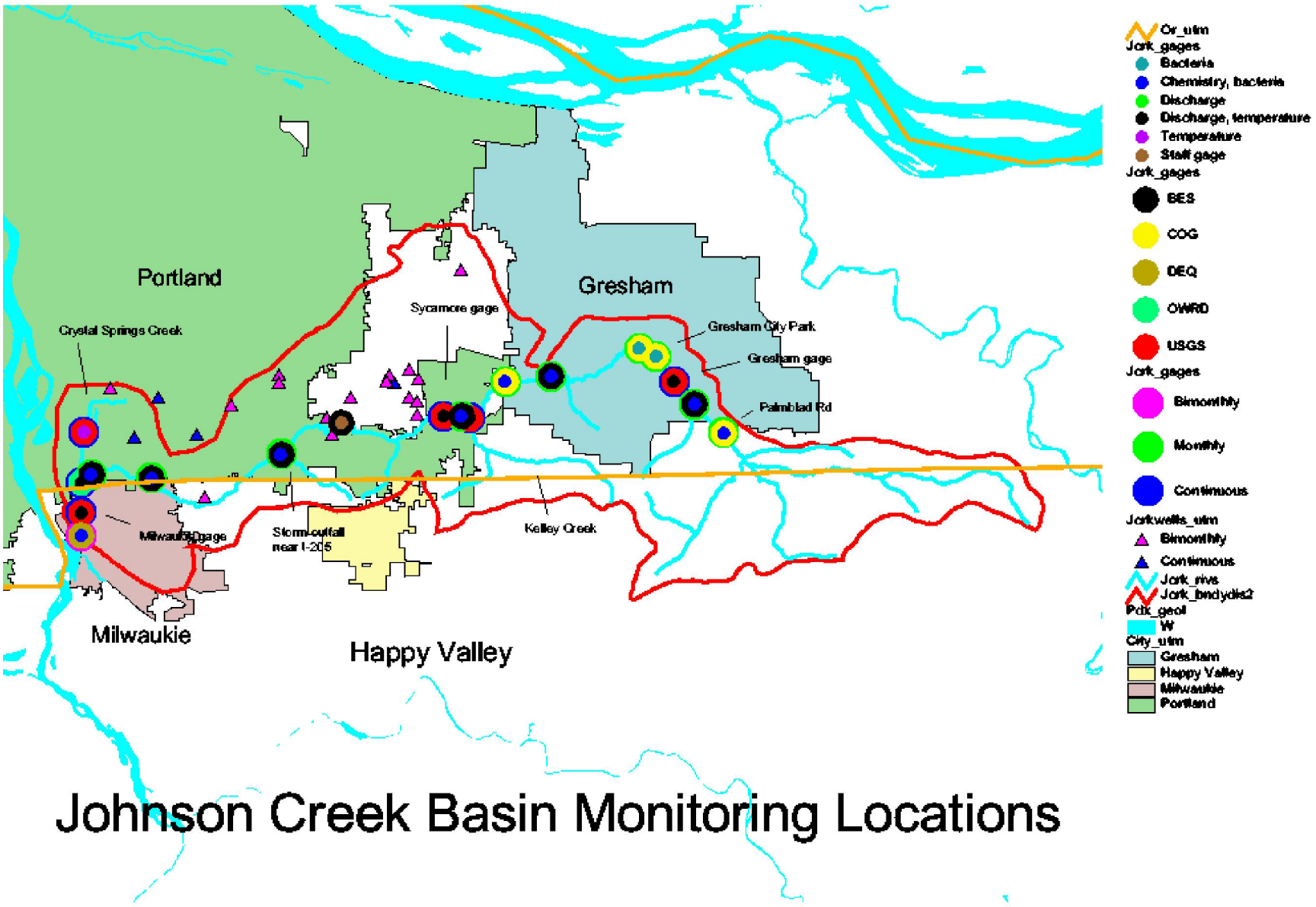
Washington State Department of Ecology, 1997, A suspended and DDT total maximum daily load evaluation report for the Yakima River, Publication No. 97-321.

WORK PLAN

Work Plan for Johnson Creek Hydrologic Monitoring for Federal Fiscal Year 2002

Task	2001			2002								
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept
Operation of gages on Johnson Creek and Kelley Creek												
Sample storm for pesticides, E. coli, TSS												
Ground-water level observation network												
Ground-water well recorder network												
Hydrographs and maps of ground-water levels												
Maintain web page												
Evaluate network, develop work plan for next year												

file /jcrk/admin/proposal2002



Johnson Creek Basin Monitoring Locations