Operational Procedures for Collecting Water-Quality Samples at Monitoring Sites on Maple Creek Near Nickerson and the Platte River at Louisville, Eastern Nebraska

By Steven M. Johnson and Robert B. Swanson

U.S. GEOLOGICAL SURVEY
Open-File Report 94-121

Prepared as part of the
NATIONAL WATER-QUALITY ASSESSMENT PROGRAM

U.S. DEPARTMENT OF THE INTERIOR
MARCH 3, 1849

Lincoln, Nebraska
1994

U.S. DEPARTMENT OF THE INTERIOR

BRUCE BABBITT, Secretary

U.S. GEOLOGICAL SURVEY

Gordon P. Eaton, Director

For additional information write to:

District Chief
U.S. Geological Survey
Room 406 Federal Bldg.
100 Centennial Mall North
Lincoln, Nebraska 68508

Copies of this report can be purchased from:

U.S. Geological Survey
Earth Science Information Center
Open-File Reports Section
Box 25286, MS 517
Denver Federal Center
Denver, Colorado 80225

CONTENTS

FIGURES

TABLES

CONVERSION FACTORS

Multiply	By	To obtain
cubic foot per second (ft^3/s)	0.02832	cubic meter per second
degree Fahrenheit (°F)	(1)	degree Celsius (°C)
gallon (gal)	3.785	liter
inch (in.)	25.4	millimeter
mile (mi)	1.609	kilometer
quart (qt)	0.9464	liter
square mile (mi^2)	2.590	square kilometer

[1] °C = 5/9 (°F-32).

Operational Procedures for Collecting Water-Quality Samples at Monitoring Sites on Maple Creek Near Nickerson and the Platte River at Louisville, Eastern Nebraska

By Steven M. Johnson *and* Robert B. Swanson

Abstract

Prototype stream-monitoring sites were operated during part of 1992 in the Central Nebraska Basins and three other study areas of the National Water-Quality Assessment Program of the U.S. Geological Survey. Results from the prototype project will provide information needed to operate a network of intensive fixed-station stream-monitoring sites.

This report evaluates operating procedures for two National Water-Quality Assessment prototype sites in the Central Nebraska Basins study area at Maple Creek near Nickerson and the Platte River at Louisville, Nebraska. Each site was sampled intensively in the spring and late summer 1992, with less intensive sampling in midsummer. In addition, multiple samples were collected during two high flows at the Maple Creek site--one early and the other late in the growing season. Water-sample analyses included determination of pesticides, nutrients, major ions, suspended sediment, and measurement of physical properties. Equipment and protocols for the water-quality sampling procedures were evaluated.

High-flow stream sampling was difficult to complete because of unpredictable precipitation and its resulting storm runoff. The tracking of storms and anticipation of high flow required extra effort by personnel to collect water samples at selected stages of flow. Some equipment and procedural modifications were found to improve collection and processing of water samples.

Operation of the prototype stream-monitoring sites included development and comparison of onsite and laboratory sample-processing procedures. Onsite processing was labor intensive but allowed for immediate preservation of all sampled constituents. Laboratory processing required less field labor and decreased the risk of contamination, but allowed for no immediate preservation of the samples.

INTRODUCTION

The National Water-Quality Assessment (NAWQA) Program was established in 1986 to provide a hydrologically based, long-term method of assessing the quality of the Nation's water resources (Hirsch and others, 1988; Leahy and others, 1990). NAWQA investigations concentrate on a sampling design that is based on a multidisciplinary (physical, chemical, and biological) approach, resulting in converging lines of evidence to assess water-quality conditions. The NAWQA program includes 60 study units (hereafter referred to as study areas) that are delineated on the basis of large hydrologic systems, such as major river basins and aquifers (fig. 1). The program is based on three cycles of operation, with studies in 20 new areas beginning operation every 5 to 6 years. Each study area will be intensely investigated in cycles of 4- to 5-year duration, followed by 5 years of less-intense activity (Leahy and others, 1990).

The Central Nebraska Basins (CNBR) was one of 20 initial NAWQA study areas where operations began in October of 1990. The study area includes a drainage of about 30,000 mi^2 (fig. 2) from where the North and South Platte Rivers converge to the

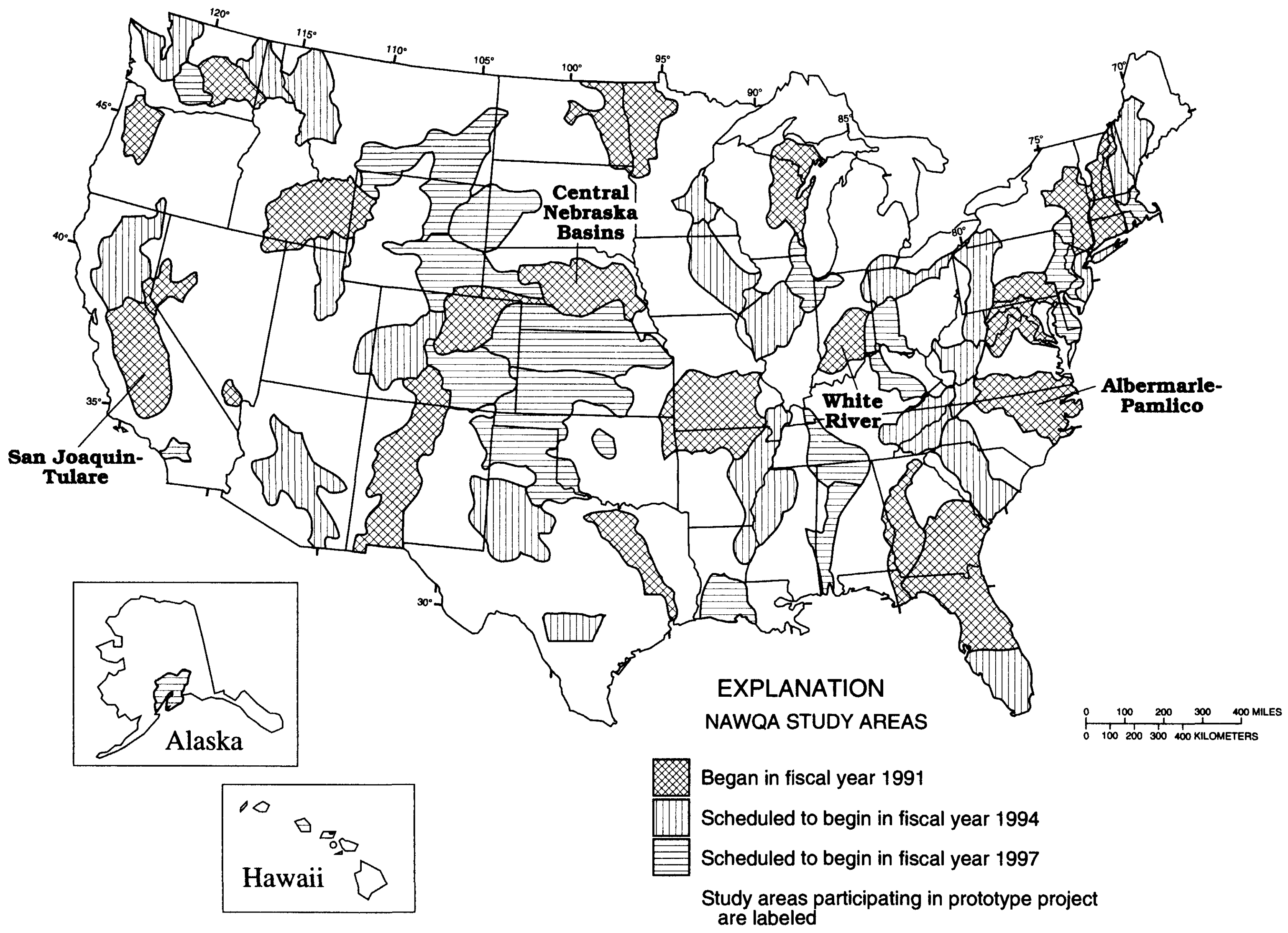


Figure 1. Location of National Water-Quality Assessment (NAWQA) study areas and study areas that are part of the Prototype Intensive Fixed-Station Stream-Monitoring Project.

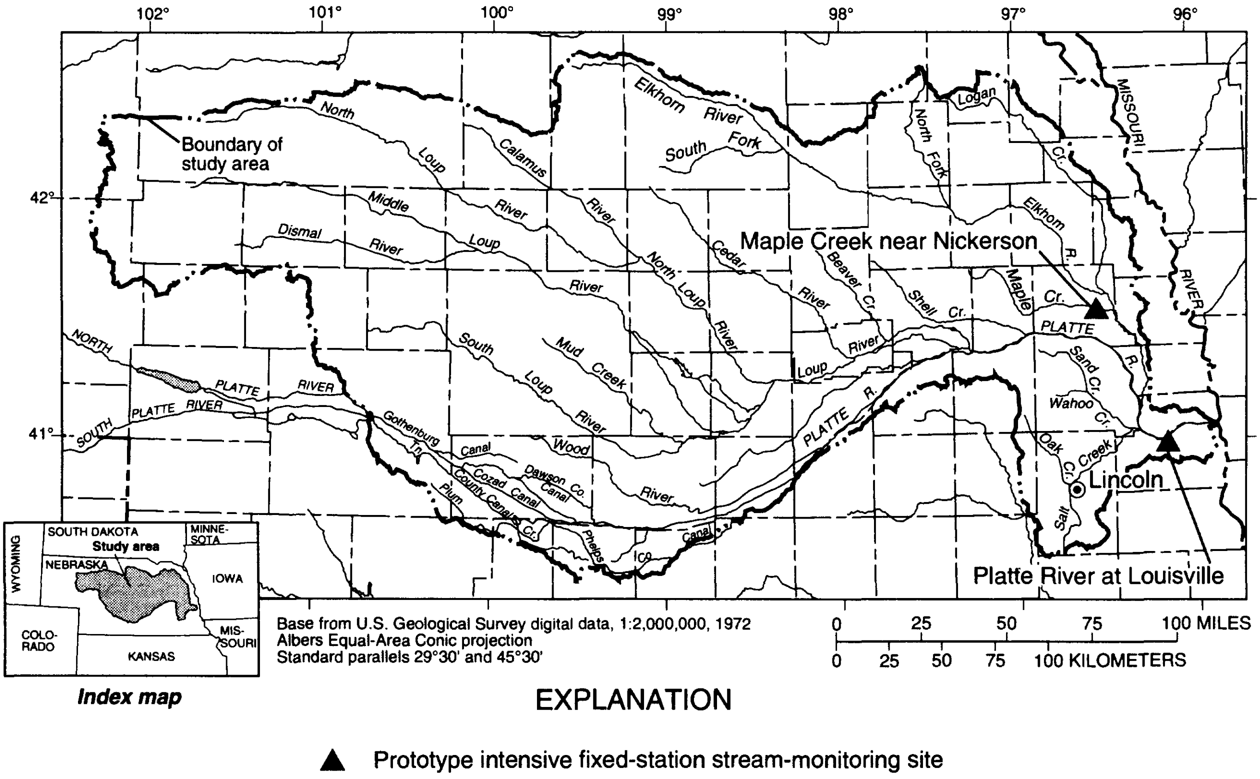


Figure 2. Location of Central Nebraska Basins study area and prototype intensive fixed-station stream-monitoring sites.

mouth of the Platte River at the Missouri River (Huntzinger, 1991).

NAWQA program personnel recognized that a network of fixed water-quality monitoring sites would be needed to describe water-quality conditions and long-term trends within and among study areas. Operation of this network was tested at prototype sites in 4 of the 20 initial study areas. The Prototype Intensive Fixed-Station Stream-Monitoring Project was designed to answer the following questions: (1) Are planned sampling protocols and related equipment operationally adequate and achievable, and (2) What sampling frequency is needed at a fixed-station monitoring site to describe adequately temporal variability in water quality? Also, the project would provide information needed to establish a national network of water-quality monitoring sites operated by similar techniques. The CNBR, White River, San Joaquin-Tulare, and Albermarle-Pamlico study areas (fig. 1) were part of the prototype project from May through August 1992. Protocols, equipment, and sampling frequency were tested at two or three sites in each of these study areas.

This report describes operational protocols and related onsite activities for two prototype intensive fixed-station stream-monitoring sites, hereinafter called prototype, in the CNBR study area. Comparisons of similar sample-processing techniques used onsite and in the laboratory also are included. Results from the prototype efforts are intended to provide information for planning personnel, equipment, laboratory, and time resources required to operate a surface-water fixed-station monitoring network.

Maple Creek near Nickerson (station no. 06800000) and the Platte River at Louisville, Nebraska (station no. 06805500), were operated as prototype sites (fig. 2) in the CNBR study area. Selection of sites was made from the existing network of U.S. Geological Survey surface-water gaging stations on the basis of their potential use as fixed-station monitoring sites for the water-quality assessment and proximity to a U.S. Geological Survey office. Existing gaging stations were used to minimize equipment purchases and to increase the amount of available historical data. Both sites were located within a 1.5-hour drive from the U.S. Geological Survey office in Lincoln, which enabled both sites to be visited during a single day. Sampling strategy included regularly scheduled and high-flow sample collection.

Monitoring activities at these sites included enhancement of instrumentation and analysis of samples collected. A U.S. Geological Survey Minimonitor and Sutron 8200[1] electronic data logger were installed at the Maple Creek site for recording specific conductance, pH, and temperature of the water four times per hour. Minimonitor data were stored and transmitted every 4 hours from a data-collection platform (DCP) by satellite to the U.S. Geological Survey office in Lincoln, Nebraska. Sampling procedures used in this project were based on standard U.S. Geological Survey methods (Edwards and Glysson, 1988; Jones and others, 1991; Grey, 1992). Samples were collected, processed, and analyzed for chemical constituents expected to be present in streams that drain agricultural lands; constituents included pesticides, nutrients, major ions, and suspended sediment. Physical properties also were determined. Lists of chemical constituents and physical properties analyzed are included in tables 1 and 2.

COLLECTION AND PROCESSING OF REGULARLY SCHEDULED STREAM-WATER SAMPLES

Both prototype sites were sampled regularly during the project period to find the most effective sampling interval needed to define water-quality variability. The sites were sampled every other day for 6 weeks from May 12 to June 22, 1992, followed by a month of weekly samples from June 23 to July 19, 1992, and ending with every-other-day sampling again for 6 weeks from July 20 to August 28, 1992.

Pre-Sampling Preparation

Prior to sampling, organization of supplies and inspection of equipment was done to ensure a complete set of materials and operational equipment, both onsite and at the U.S. Geological Survey laboratory in Lincoln. All equipment was used exclusively for NAWQA surface-water samples. A vehicle was designated specifically for NAWQA field operations. The vehicle contained NAWQA sampling equipment that not only helped operationally but minimized the possibility of sample contamination from non-NAWQA sample-collection activities.

Stainless-steel, aluminum, glass, and Teflon equipment was used for collecting and processing water samples for analysis of organic compounds to avoid their adsorption to the container (Topp and Smith, 1992). Samples for analysis of inorganic constituents were processed using additional equipment made from plastic because adsorption of these constituents to the container was not expected to be significant. All supplies met standards for sampling and were obtained from commercial suppliers or from the U.S. Geological Survey's laboratory (NWQL) in Arvada, Colorado (Pritt and Jones, 1989). Equipment and supply information is listed in tables 3 and 4.

Onsite Procedures

Sample-collection and processing procedures used at both prototype sites were similar (fig. 3), but the type of equipment and sampling methodology were dependent on streamflow and site conditions. At each site, the stream gage was inspected, and the stream stage and discharge were found by either rating or measurement. The distribution of discharge across the channel was derived from a discharge measurement or from flow-distribution profiles obtained from past measurements. Onsite measurements of specific conductance, pH, water and air temperature, dissolved oxygen, and alkalinity were made.

Equipment was inspected, and all surfaces on the sampling equipment that potentially could contact the samples were cleaned. Cleaning procedures included a wash with a nonphosphate detergent solution, followed by a rinse with copious amounts of distilled water, or stream water when supplies of distilled water were limited. Then the equipment was rinsed with laboratory-grade methanol for removal of any residual contaminants, and finally three rinses with stream water.

---

[1] The use of brand or supplier names in this report is for identification purposes only and does not constitute endorsement by the U.S. Geological Survey.

Table 1. Type of sample analysis, general sample processing, and laboratories used for the prototype intensive fixed-station stream-monitoring sites, National Water-Quality Assessment Program

Type of measurements and sample collected	Volume of sample required	Treatment	Bottle requirements	Processing location
Discharge	none[1]	none	none	none
Specific conductance	100 milliliters	do.	white polyethylene	field
pH	Do.	do.	do.	Do.
Temperature, water and air	Do.	do.	do.	Do.
Dissolved oxygen	Do.	do.	do.	Do.
Alkalinity	Do.	filtered	do.	Do.
Cations, dissolved	250 milliliters	none	do.	NWQL[2]
Cations, total	Do.	filtered, 1 milliliter nitric acid	do.	Do.
Anions, dissolved	Do.	none	do.	Do.
Anions, total	Do.	filtered	do.	Do.
Nutrients, dissolved	Do.	filtered, 1 milliliter mercuric chloride	brown polyethylene	Do.
Nutrients, total	Do.	1 milliliter mercuric chloride	brown polyethylene	Do.
Pesticides, SPE[3]	1,000 mililiters	filtered	cartridge	Do.
Suspended-sediment concentration	1 quart	none	glass	Iowa City[4]

[1] Measured in or at the stream by standard methods.

[2] NWQL, U.S. Geological Survey laboratory, Arvada, Colo.

[3] Pesticide analytes for solid-phase extraction (SPE) are listed in table 2.

[4] U.S. Geological Survey laboratory, Iowa City, Iowa.

Table 2. Pesticide analytes for solid-phase extraction (SPE), Central Nebraska Basins study area

2,6-Diethylaniline
Alachlor
Alpha hexachloride
Atrazine
Benfluralin

Butylate
Carbaryl (Sevin)
Carbofuran (Furadan)
Chlorpyrifos
Cyanazine

DCPA (Dacthal)
DDE
Deethylatrazine
Diazinon
Dieldrin

Dimethoat
Disulfoton (Di-Syston)
EPTC (Eptam)
Ethalfluralin
Ethoprop (Rovokil)

Fonofos (Dyfonate)
Lindane
Linuron
Malathion
Methyl azimphos

Methyl parathion
Metribuzin
Molinate
Nepropamide

Parathion
Pebulate
Pendimethalin (Prowl)
Permethrin (Ambush)
Phorate (Timet)

Prometon
Pronamid
Propachlor
Propanil
Propargite I & II

Simazine
Tebuthiuron
Terbacil
Terbufos

Samples were collected by wading when flows and conditions permitted. Otherwise, they were collected from a bridge by either handline or bridge crane. Sample water was collected by equal discharge-increment (EDI) methods (Edwards and Glysson, 1988; Wells and others, 1990). The Platte River at Louisville usually had two major stream channels with different properties; therefore, care was taken in selecting cross-sectional sampling points for a representative sample. A total of about 4 to 5 liters of water were collected from six points at each prototype site when the stream contained small sediment concentrations.

High flows with large sediment concentrations required more water to be collected (6 to 9 liters) because of the water lost in filtering procedures. It was not uncommon to change filters 5 to 10 times during sample processing. Each time the filter apparatus was opened, water remaining in the filter support base was lost, and additional sample water was circulated through the apparatus. All water was collected in stainless-steel milk cans or glass bottles, depending on availability of containers and collector preference.

While one person collected the sample, a second person assembled and calibrated equipment used in the onsite processing of the samples. Processing equipment included a cone splitter (with all required bottles), a peristaltic pump and filter system used in preparing samples for inorganic analysis, another pump and filter system used in preparing samples for organic analysis, a third pump system used in processing the solid-phase extraction (SPE) cartridges (fig. 4), and meters for physical-property measurements.

Both members of the collection team were needed to split the sample using a 10-port Teflon-cone splitter. The distribution ports led to tubes that can be arranged in various combinations to deliver a desired volume of subsample. Although 4 to 5 liters of sample were required, other volumes can be split easily by varying the size and number of receiving subsample bottles and the number of discharge tubes allocated to each subsample bottle. The 4 to 5 liters of sample first were split into four 1-liter Teflon bottles and a 1-quart glass jar using two discharge tubes per container, which yielded 800 to 1,000 milliliters per container. The glass quart jar was labeled for suspended-sediment analysis.

The contents of one of the 1-liter Teflon bottles were split a second time to yield three 250-milliliter subsamples in polyethylene bottles. One 250-millilitèr subsample was treated with 1-milliliter of mercuric chloride for total-phosphorous analysis, and the remaining two

Table 3. Equipment list for sample collection and sample processing at prototype intensive fixed-station stream-monitoring sites in the Central Nebraska Basins study area

Quantity	Item
Samplers	
1	DH-81, depth-integrating water and sediment sampler, rod suspension, wading.
1	D-77TM, depth-integrating water and sediment sampler, cable-reel suspension.
1	DH-76, depth-integrating water and sediment sampler, handline suspension.
1	D-77 Teflon cap, with cap-bottle adaptor and nozzles.
Sample containers	
1	Teflon 3-liter bottle for D-77TM
4	Teflon 500-milliliter wash bottles
1	Stainless-steel milk can per sample
	or
2	Glass 1-gallon jugs per sample
7-12	1-litre Teflon bottles per sample
1	3,000-milliliter bottle
Meters and balances	
1	Dissolved oxygen meter
1	pH meter
1	Specific-conductance meter
1	6,000-gram balance
Pumps and pump parts	
1	Teflon diaphragm pump
1	Low-volume ceramic head pump
1	Breaker switch and speed control
1	Peristaltic pump
Filter apparatus	
1	Aluminum 147-millimeter filter support plate
1	Acrylic 147-millimeter filter support plate
Tubing and fittings	
5 feet	1/4-inch Teflon corrugated tubing
5 feet	1/8-inch Teflon tubing
2	1/8-inch to 1/4-inch Teflon fitting
Volumetric measuring devices	
1	1-10-milliliter microdispenser
1	5-cubic-centimeter syringe
1	Microdispenser with 100-microliter glass bores
1	Value stop
1	100-milliliter pipet or graduated cylinder
1	10-milliliter graduated cylinders
1	1,000-milliliter beaker
Miscellaneous equipment	
1-2	48-quart cooler per sample
1	Rope with clip
1	Teflon-cone splitter
2	Forceps
1	Titration kit
1	Magnetic stirrer with rod

Table 4. Supply list for sample collection and sample processing at prototype intensive fixed-station stream-monitoring sites in the Central Nebraska Basins study area

Quantity	Item
Filter pads and cartridges	
2	0.7-micrometer baked glass-fiber filters pads
4	0.45-micrometer cellulose nitrate filter pads
1	Solid-phase extraction cartridge per sample
Forms	
1	Water-quality form per sample
1	Solid-phase extraction check lists per sample
Chemicals	
1	Vial of surrogate
1	Ampule nitric acid per sample
2	Ampules mercuric chloride per sample
5 milliliters	Laboratory-grade detergent
10 milliliters	Laboratory-grade distilled water per sample
4 liters	Distilled and de-ionized water per sample
Sample bottles	
2	1-quart glass jars per sample
2	Brown polyethylene bottles per sample
3	White polyethylene bottles per sample
1	Acid-washed polyethylene bottle per sample
2	125-milliliter amber glass per sample
Miscellaneous supplies	
1	Roll of aluminum foil
1	Marking pen (permanent)
2	Pair rubber gloves

250-milliliter subsamples were left untreated for total-anion and total-cation analysis.

Two of the subsamples in the 1-liter Teflon bottles were filtered for dissolved inorganic-constituent analysis and laboratory alkalinity. Samples for inorganic analysis were filtered using a peristaltic pump, silicone tubing, a 147-millimeter-diameter acrylic-filter support plate, and 0.45-micrometer cellulose membrane filters. The filtrate was dispensed into four 250-milliliter polyethylene bottles. The four 250-milliliter polyethylene bottles were treated as follows: one with 1 milliliter of nitric acid for analysis of dissolved cations, another with 1 milliliter of mercuric chloride for dissolved nutrient analysis, and two remaining untreated. Of the two untreated bottles, one was required for dissolved-anion analysis and the other for determination of field alkalinity.

Organic-pesticide constituents were extracted by solid-phase extraction (SPE) at the monitoring site or upon return to the U.S. Geological Survey laboratory in Lincoln. The subsample in the 1-liter Teflon bottle of the initial split was prepared for SPE by filtration with the Teflon diaphragm pump, Teflon tubing, a 147-millimeter-diameter aluminum-filter support plate, and 0.7-micrometer baked glass-fiber filters. The subsample was filtered into a 1-liter Teflon bottle of known weight. The weight of the subsample for SPE was determined by weighing the filtrate in this bottle of known weight and subtracting the bottle weight. The volume of water filtered was calculated from the filtrate weight.

The filtered subsample was treated with methanol at a volume of 1 percent of the subsample volume plus 100 microliters of a surrogate mixture as described in a written communication from Mark Sandstrom (U.S. Geological Survey,

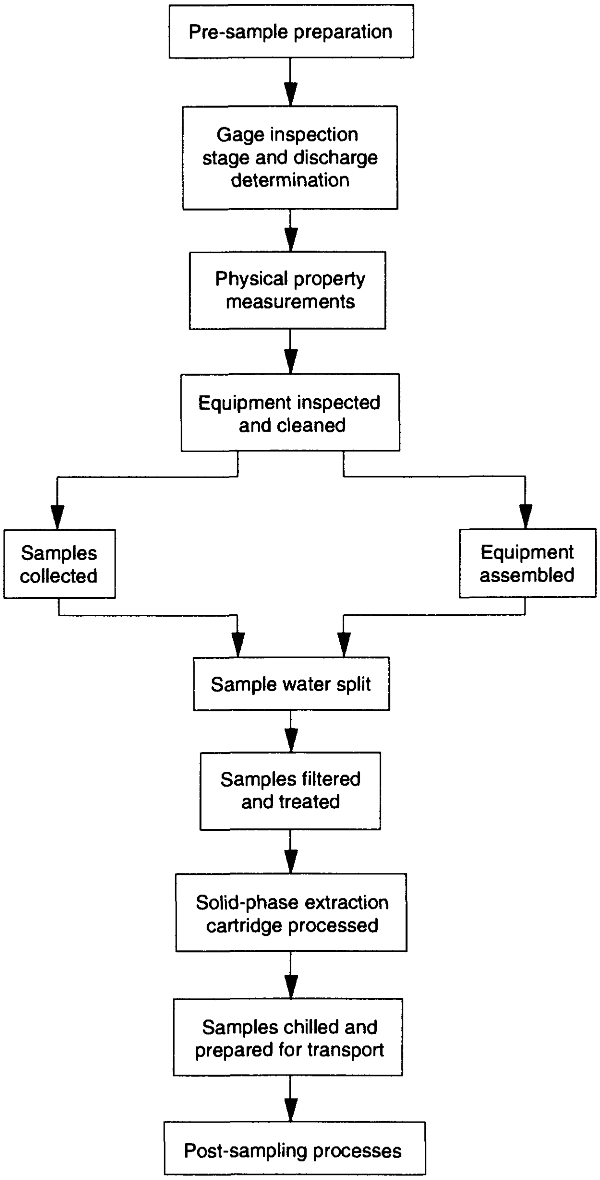


Figure 3. Operational steps in sample collection and onsite processing for prototype intensive fixed-station stream-monitoring sites, Central Nebraska Basins study area.

August 1991). A dry SPE cartridge (kind of cartridge) was conditioned with 2 milliliters of laboratory-grade methanol and 2 milliliters of organic-free distilled water. While the cartridge was being conditioned, approximately 5 milliliters of sample were circulated through the SPE-pumping system (fig. 4) to purge the system of air and residual contaminants. The SPE cartridge (and 0.45-micrometer in-line membrane filter, if needed to remove residual colloidal material) was attached, and the filtered water was pumped through the cartridge at a flow rate of 20 to 25 milliliters per minute. Discarded water was collected in a container of a known weight, and the total weight of the discarded water was determined and used to estimate the total volume of water passing through the cartridge. The cartridge was labeled and stored on ice at about 4 °C.

Quality-assurance samples were obtained during six visits to Maple Creek near Nickerson and three visits to the Platte River at Louisville. Dates, times, and type of quality-assurance samples obtained are listed in table 5. Blank and replicate samples were collected onsite as quality-assurance samples. Blank samples were processed with laboratory-grade water to detect sources of sample contamination from the equipment and handling. One-liter replicate samples were filtered through a 0.7-micrometer glass-fiber filter and sent to the NWQL for laboratory extraction to identify any inconsistency in the onsite processing of SPE cartridges. The U.S. Geological Survey Branch of Quality Assurance conducted 39 additional quality-assurance analyses on samples (consisting of regular samples, blanks, duplicates, and spikes) collected May 28, 1992, at the Platte River at Louisville.

Post-Sampling Procedures

Post-sampling procedures included equipment cleaning, data logging, and sample shipment for analysis. Equipment cleaning to remove trace amounts of constituents included a single wash with detergent (5-percent nonphosphate detergent solution), followed by a triple rinse of distilled water, and a final methanol rinse. The peristaltic pump used for inorganic and nutrient constituents was not rinsed with methanol. Equipment was air dried on a clean surface lined with aluminum foil (foil was acceptable because samples for trace metals were not being collected). Any part of the dry equipment that potentially could contact sample water was covered with clean aluminum foil. All equipment was reassembled and stored in airtight containers so airborne particulate would not contaminate a future sample.

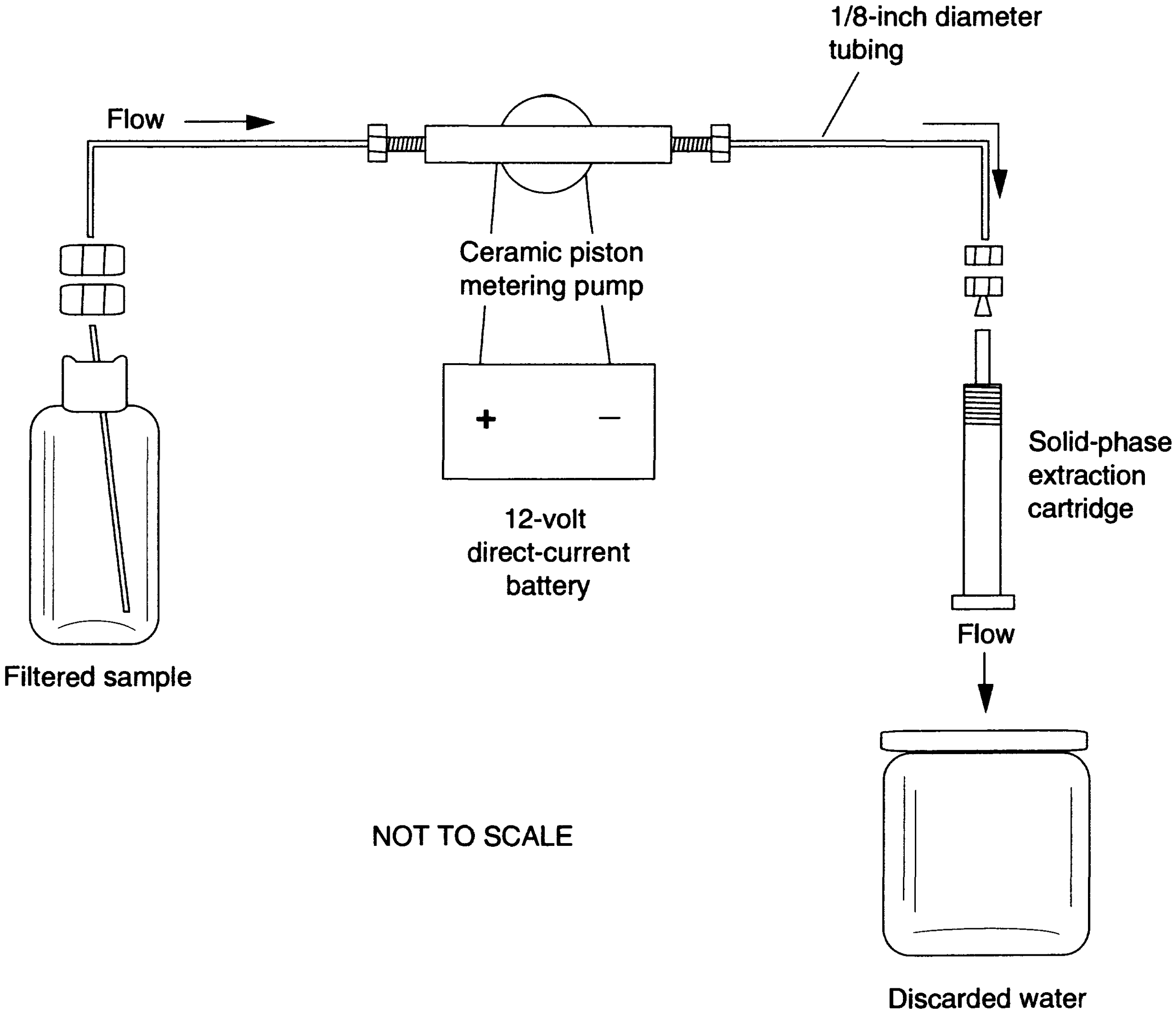


Figure 4. Solid-phase extraction pumping systems for prototype intensive fixed-station sampling.

Water-quality and SPE forms (figs. 5 and 6) were completed onsite. Documentation completed in the office (such as a record of all samples, their respective physical properties, and shipping dates) was logged in a journal. All water-chemistry samples were shipped to the NWQL with their analytical request forms, and the shipper noted the date of shipping in the data journal. Samples were shipped by overnight carrier on Mondays, Tuesdays, and Wednesdays to ensure that the chilled samples would arrive at the NWQL during normal working hours.

COLLECTION AND PROCESSING OF HIGH-FLOW SAMPLES

Maple Creek was sampled throughout two storm-runoff periods, one in the early part of the growing season (June 16-19, 1992) and another later in the season (July 24-28, 1992). Maple Creek is a remote site with little road traffic. The site did not require additional personnel for traffic control during sampling from the bridge. Several samples were collected during each high-flow period--during rising stream stage, near the peak, and during the recession (figs. 7 and 8).

Table 5. Quality-assurance samples collected at the prototype intensive fixed stations, Central Nebraska Basins study area, 1992

[+, sample collected; -- no sample collected]

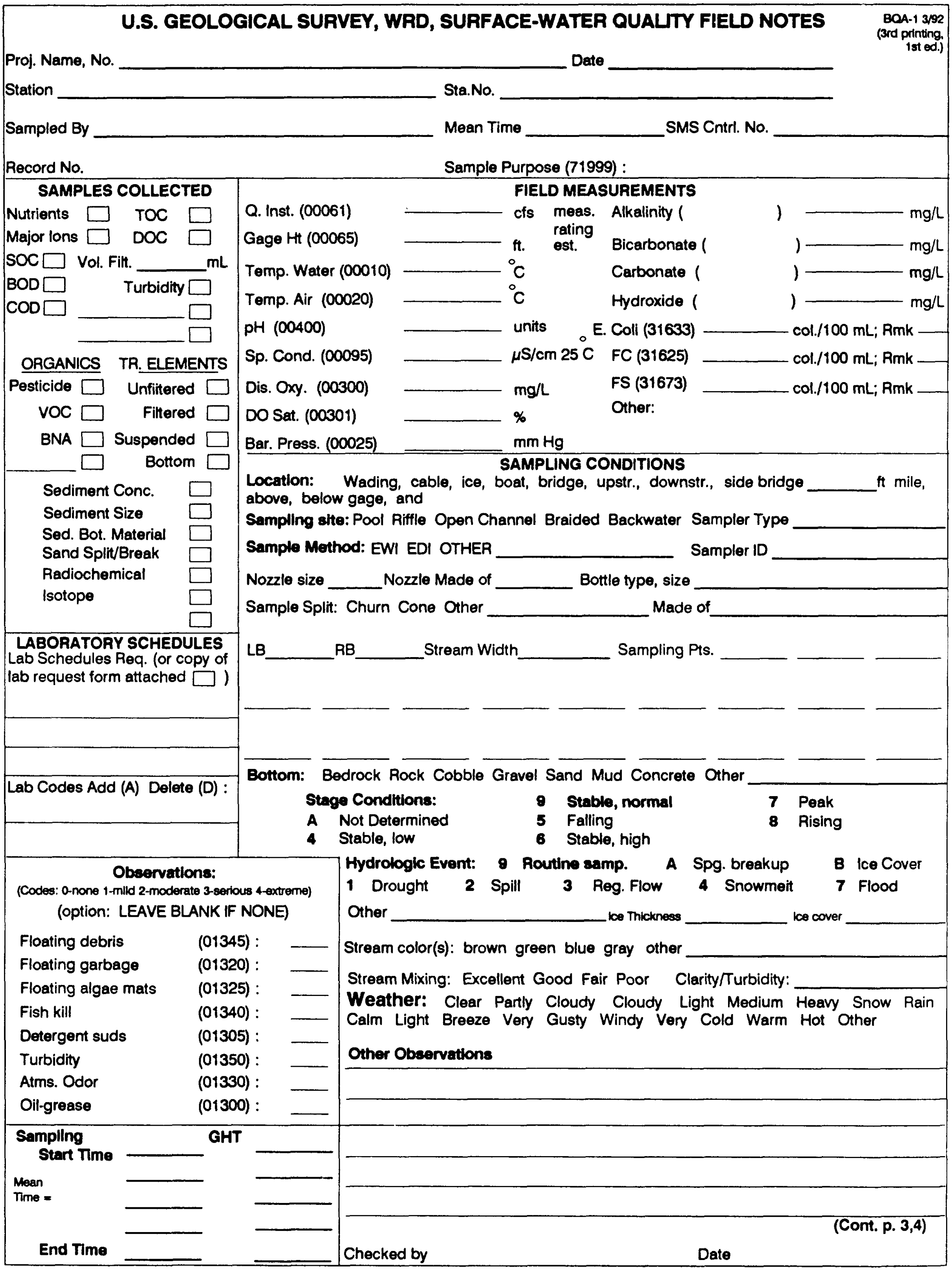
Station	Date	Time (24-hour)	Blank samples	Replicate samples
Maple Creek near Nickerson	June 1	0840	--	+
Maple Creek near Nickerson	July 30	0950	--	+
Maple Creek near Nickerson	August 3	1009	+	--
Maple Creek near Nickerson	August 19	1009	+	--
Maple Creek near Nickerson	August 21	1001	--	+
Maple Creek near Nickerson	August 27	1109	+	--
Platte River at Louisville	May 12	0901	+	--
Platte River at Louisville	May 28	1102	+	--
Platte River at Louisville	May 28	1500	--	+

Pre-Sampling Preparation

Weather forecasts and related reports were regularly monitored in anticipation of a storm. When weather information indicated a large storm near the Maple Creek watershed, a team of people was notified to collect and process the samples. Storms frequently moved through this watershed in the late evening, after normal office hours; therefore, employees were identified to be available for "off-hour" storms.

A document of the U.S. Geological Survey entitled "Emergency Flood Plan for Nebraska, 1992" was used in preparing for high-flow sample collection (U.S. Geological Survey, Lincoln, Nebr., written commun., 1992). This flood plan provided necessary information about the area's flood history, methods for communicating during a flood, and other onsite safety measures. Observers from the National Weather Service (NWS) and county sheriff offices near the Maple Creek watershed provided information when storms were in the area. The county sheriff offices provided easy access to information about storm location and intensity and road-access problems caused by flooding. Predictions of stream stage and time of streamflow peaks were obtained from the NWS. Network links to NWS radar imagery were used to help anticipate storm conditions and coverage. Information from the U.S. Geological Survey DCP at the Maple Creek stream gage provided stage information to verify rising stages. Other sources of weather information, such as local forecasts, were used as needed.

Little equipment preparation was required when a storm was anticipated because the team members already were prepared for regularly scheduled sampling. Extra bottles were stored in the gage house and the vehicle to limit the chances of missing samples during rising and falling stream stages. A second vehicle prepared for stream-discharge measurements and a crane to suspend the sampler from the bridge also were ready; this second vehicle was required to carry these items to the prototype site in order to reduce possible sample contamination by the crane and associated equipment. Therefore, the sampling team would need only to load ice and coolers for sample transportation during a storm. Equipment and supplies used during the high-flow sampling were the same as those used during the regular sampling, except some safety equipment and a cellular telephone (tables 3 and 4).



U.S. GEOLOGICAL SURVEY, WRD, SURFACE-WATER QUALITY FIELD NOTES

BQA-1 3/92
(3rd printing,
1st ed.)

Proj. Name, No. ______ Date ______

Station ______ Sta.No. ______

Sampled By ______ Mean Time ______ SMS Cntrl. No. ______

Record No. Sample Purpose (71999) :

SAMPLES COLLECTED

Nutrients ☐ TOC ☐
Major Ions ☐ DOC ☐
SOC ☐ Vol. Filt. ______mL
BOD ☐ Turbidity ☐
COD ☐ ______ ☐
______ ☐

ORGANICS TR. ELEMENTS
Pesticide ☐ Unfiltered ☐
VOC ☐ Filtered ☐
BNA ☐ Suspended ☐
______ ☐ Bottom ☐

Sediment Conc. ☐
Sediment Size ☐
Sed. Bot. Material ☐
Sand Split/Break ☐
Radiochemical ☐
Isotope ☐
☐

LABORATORY SCHEDULES
Lab Schedules Req. (or copy of lab request form attached ☐)

Lab Codes Add (A) Delete (D) :

FIELD MEASUREMENTS

Q. Inst. (00061)	______	cfs	meas.	Alkalinity ( )	______	mg/L
Gage Ht (00065)	______	ft.	rating est.	Bicarbonate ( )	______	mg/L
Temp. Water (00010)	______	°C		Carbonate ( )	______	mg/L
Temp. Air (00020)	______	°C		Hydroxide ( )	______	mg/L
pH (00400)	______	units		E. Coli (31633)	______	col./100 mL; Rmk ___
Sp. Cond. (00095)	______	µS/cm 25 C		FC (31625)	______	col./100 mL; Rmk ___
Dis. Oxy. (00300)	______	mg/L		FS (31673)	______	col./100 mL; Rmk ___
DO Sat. (00301)	______	%		Other:		
Bar. Press. (00025)	______	mm Hg				

SAMPLING CONDITIONS

Location: Wading, cable, ice, boat, bridge, upstr., downstr., side bridge ______ft mile, above, below gage, and

Sampling site: Pool Riffle Open Channel Braided Backwater Sampler Type ______

Sample Method: EWI EDI OTHER ______ Sampler ID ______

Nozzle size ______ Nozzle Made of ______ Bottle type, size ______

Sample Split: Churn Cone Other ______ Made of ______

LB______RB______Stream Width______ Sampling Pts. ______ ______ ______

______ ______ ______ ______ ______ ______ ______ ______ ______

______ ______ ______ ______ ______ ______ ______ ______ ______

Bottom: Bedrock Rock Cobble Gravel Sand Mud Concrete Other ______

Stage Conditions:

A	Not Determined	**9**	**Stable, normal**	7	Peak
4	Stable, low	5	Falling	8	Rising
		6	Stable, high		

Hydrologic Event: **9 Routine samp.** A Spg. breakup B Ice Cover
1 Drought 2 Spill 3 Reg. Flow 4 Snowmelt 7 Flood
Other ______ Ice Thickness ______ Ice cover ______

Stream color(s): brown green blue gray other ______

Stream Mixing: Excellent Good Fair Poor Clarity/Turbidity: ______

Weather: Clear Partly Cloudy Cloudy Light Medium Heavy Snow Rain
Calm Light Breeze Very Gusty Windy Very Cold Warm Hot Other

Other Observations

(Cont. p. 3,4)

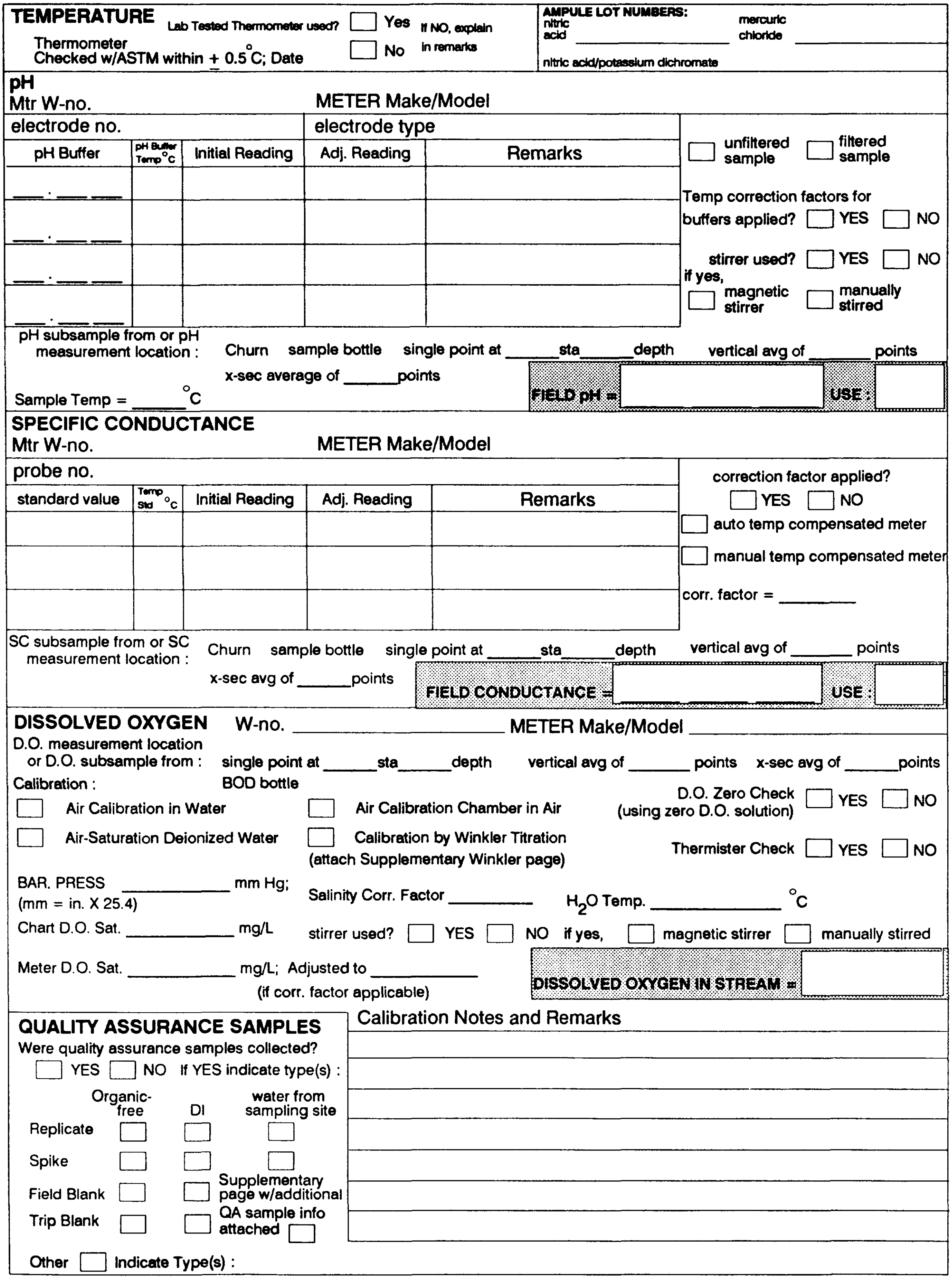
Checked by Date

Observations:
(Codes: 0-none 1-mild 2-moderate 3-serious 4-extreme)
(option: LEAVE BLANK IF NONE)

Floating debris	(01345) :	____
Floating garbage	(01320) :	____
Floating algae mats	(01325) :	____
Fish kill	(01340) :	____
Detergent suds	(01305) :	____
Turbidity	(01350) :	____
Atms. Odor	(01330) :	____
Oil-grease	(01300) :	____

Sampling		**GHT**
Start Time	______	______
Mean Time =	______	______
	______	______
	______	______
End Time	______	______

Figure 5. Example of water-quality form for prototype intensive fixed-station sampling.



TEMPERATURE Lab Tested Thermometer used? ☐ Yes ☐ No If NO, explain in remarks

Thermometer Checked w/ASTM within ± 0.5 °C; Date

AMPULE LOT NUMBERS:

nitric acid ______ mercuric chloride ______

nitric acid/potassium dichromate

pH

Mtr W-no. METER Make/Model

electrode no.			electrode type	
pH Buffer	pH Buffer Temp °C	Initial Reading	Adj. Reading	Remarks
___ . ___ ___				
___ . ___ ___				
___ . ___ ___				
___ . ___ ___				

☐ unfiltered sample ☐ filtered sample

Temp correction factors for buffers applied? ☐ YES ☐ NO

stirrer used? ☐ YES ☐ NO

if yes, ☐ magnetic stirrer ☐ manually stirred

pH subsample from or pH measurement location : Churn sample bottle single point at ______ sta ______ depth vertical avg of _______ points

x-sec average of ______ points

Sample Temp = ______ °C

FIELD pH = **USE :**

SPECIFIC CONDUCTANCE

Mtr W-no. METER Make/Model

probe no.				
standard value	Temp Std °C	Initial Reading	Adj. Reading	Remarks

correction factor applied?

☐ YES ☐ NO

☐ auto temp compensated meter

☐ manual temp compensated meter

corr. factor = _________

SC subsample from or SC measurement location : Churn sample bottle single point at ______ sta ______ depth vertical avg of _______ points

x-sec avg of ______ points

FIELD CONDUCTANCE = ______ ______ ______ **USE :**

DISSOLVED OXYGEN W-no. ________________ METER Make/Model ________

D.O. measurement location or D.O. subsample from : single point at ______ sta ______ depth vertical avg of _______ points x-sec avg of ______ points BOD bottle

Calibration :

☐ Air Calibration in Water ☐ Air Calibration Chamber in Air

☐ Air-Saturation Deionized Water ☐ Calibration by Winkler Titration (attach Supplementary Winkler page)

D.O. Zero Check (using zero D.O. solution) ☐ YES ☐ NO

Thermister Check ☐ YES ☐ NO

BAR. PRESS ___________ mm Hg; (mm = in. X 25.4)

Salinity Corr. Factor _________ H_2O Temp. ____________ °C

Chart D.O. Sat. ___________ mg/L

stirrer used? ☐ YES ☐ NO if yes, ☐ magnetic stirrer ☐ manually stirred

Meter D.O. Sat. ___________ mg/L; Adjusted to ___________ (if corr. factor applicable)

DISSOLVED OXYGEN IN STREAM =

QUALITY ASSURANCE SAMPLES

Were quality assurance samples collected?

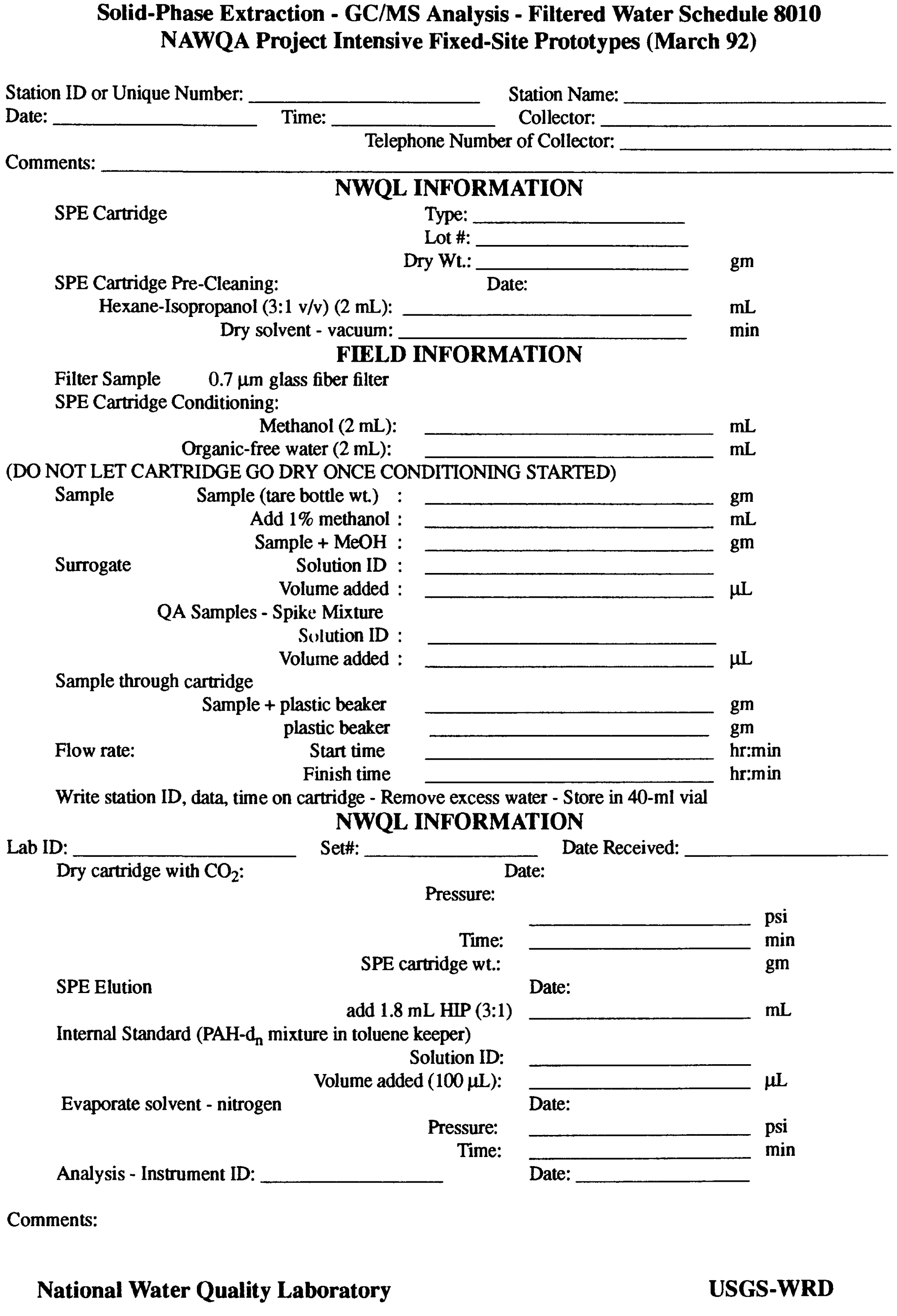
☐ YES ☐ NO If YES indicate type(s) :

	Organic-free	DI	water from sampling site
Replicate	☐	☐	☐
Spike	☐	☐	☐
Field Blank	☐	☐	Supplementary page w/additional QA sample info attached ☐
Trip Blank	☐	☐	

Other ☐ Indicate Type(s) :

Calibration Notes and Remarks

Figure 5. Example of water-quality form for prototype intensive fixed-station sampling--Continued.



Solid-Phase Extraction - GC/MS Analysis - Filtered Water Schedule 8010
NAWQA Project Intensive Fixed-Site Prototypes (March 92)

Station ID or Unique Number: Station Name:
Date: Time: Collector:
Telephone Number of Collector:
Comments:

NWQL INFORMATION

SPE Cartridge
Type:
Lot #:
Dry Wt.: gm
SPE Cartridge Pre-Cleaning: Date:
Hexane-Isopropanol (3:1 v/v) (2 mL): mL
Dry solvent - vacuum: min

FIELD INFORMATION

Filter Sample 0.7 µm glass fiber filter
SPE Cartridge Conditioning:
Methanol (2 mL): mL
Organic-free water (2 mL): mL
(DO NOT LET CARTRIDGE GO DRY ONCE CONDITIONING STARTED)
Sample Sample (tare bottle wt.) : gm
Add 1% methanol : mL
Sample + MeOH : gm
Surrogate Solution ID :
Volume added : µL
QA Samples - Spike Mixture
Solution ID :
Volume added : µL
Sample through cartridge
Sample + plastic beaker gm
plastic beaker gm
Flow rate: Start time hr:min
Finish time hr:min
Write station ID, data, time on cartridge - Remove excess water - Store in 40-ml vial

NWQL INFORMATION

Lab ID: Set#: Date Received:
Dry cartridge with CO_2: Date:
Pressure:
psi
Time: min
SPE cartridge wt.: gm
SPE Elution Date:
add 1.8 mL HIP (3:1) mL
Internal Standard (PAH-d_n mixture in toluene keeper)
Solution ID:
Volume added (100 µL): µL
Evaporate solvent - nitrogen Date:
Pressure: psi
Time: min
Analysis - Instrument ID: Date:

Comments:

National Water Quality Laboratory **USGS-WRD**

Figure 6. Example of solid-phase extraction form for prototype intensive fixed-station sampling.

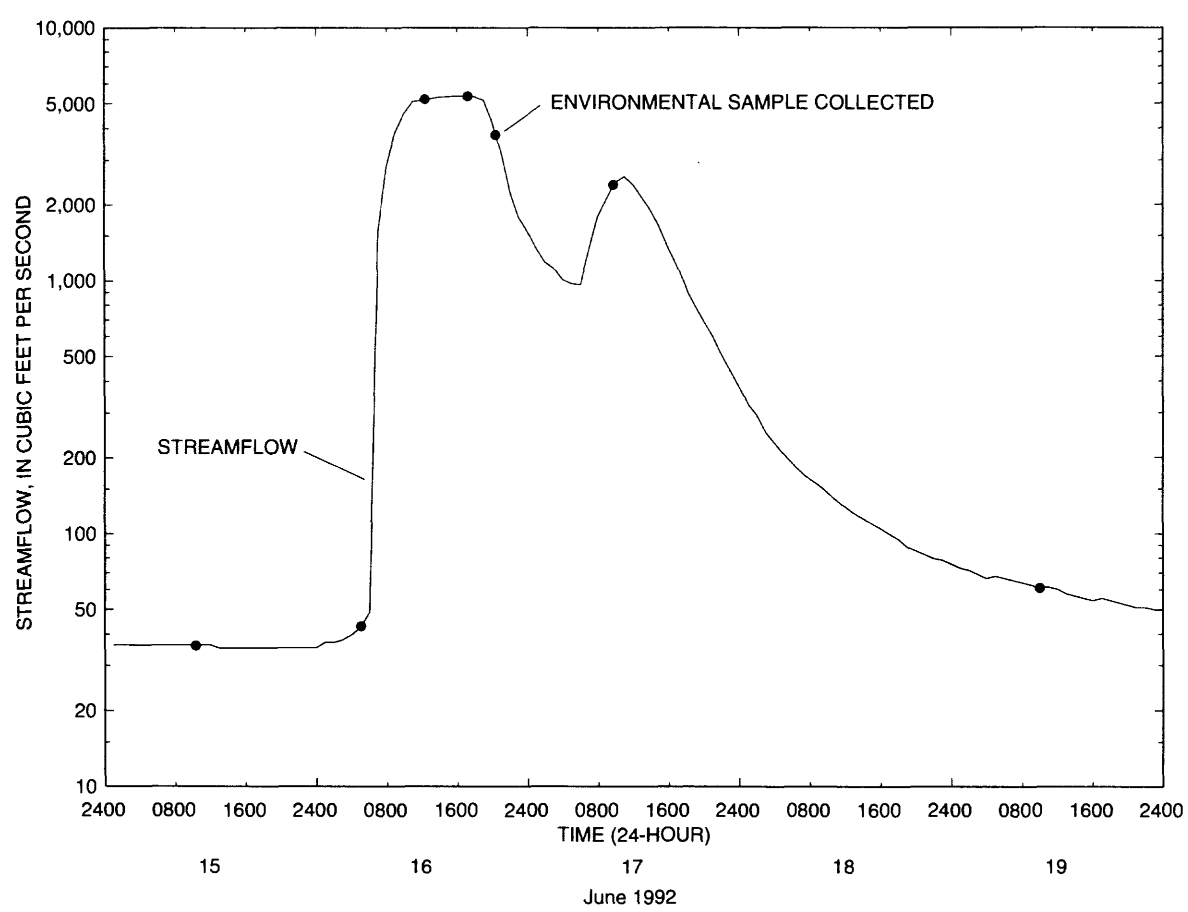


Figure 7. Streamflow discharge and sampling times during early season high flow at Maple Creek near Nickerson, Nebraska, June 15-19, 1992.

Onsite, Laboratory, and Post-Sampling Procedures

Sample-collection and processing procedures for high flows were the same as the regularly scheduled sample collection. Identical physical properties were measured and samples collected; however, the higher velocities and deeper water required larger sample-collection equipment and the use of a crane.

All high-flow samples were collected by the same EDI methods used when collecting regularly scheduled stream-water samples. The raw samples then were stored on ice at a temperature near 4 °C for transport to the U.S. Geological Survey laboratory in Lincoln. Many samples were processed in the laboratory in Lincoln, rather than onsite, to allow field personnel enough time to collect all necessary samples. All samples were processed within an 8-hour workday, when possible, to minimize the amount of time the samples were held and to improve sample integrity. One person collected samples and brought them back to the laboratory, where a second person would help in processing samples. Two people working in the laboratory minimized the time required for processing the samples because they could do multiple tasks. For example, nutrients could be filtered while the samples for organic analysis also were being filtered. Samples then were prepared and shipped for analysis.

RESULTS OF STREAM WATER-QUALITY SAMPLING PROCEDURE

Tasks were completed successfully for the sampling season except for samples during the rising stage and at the peak of an early season storm in the Maple Creek watershed. Another early season (May 17, 1992) storm was sampled

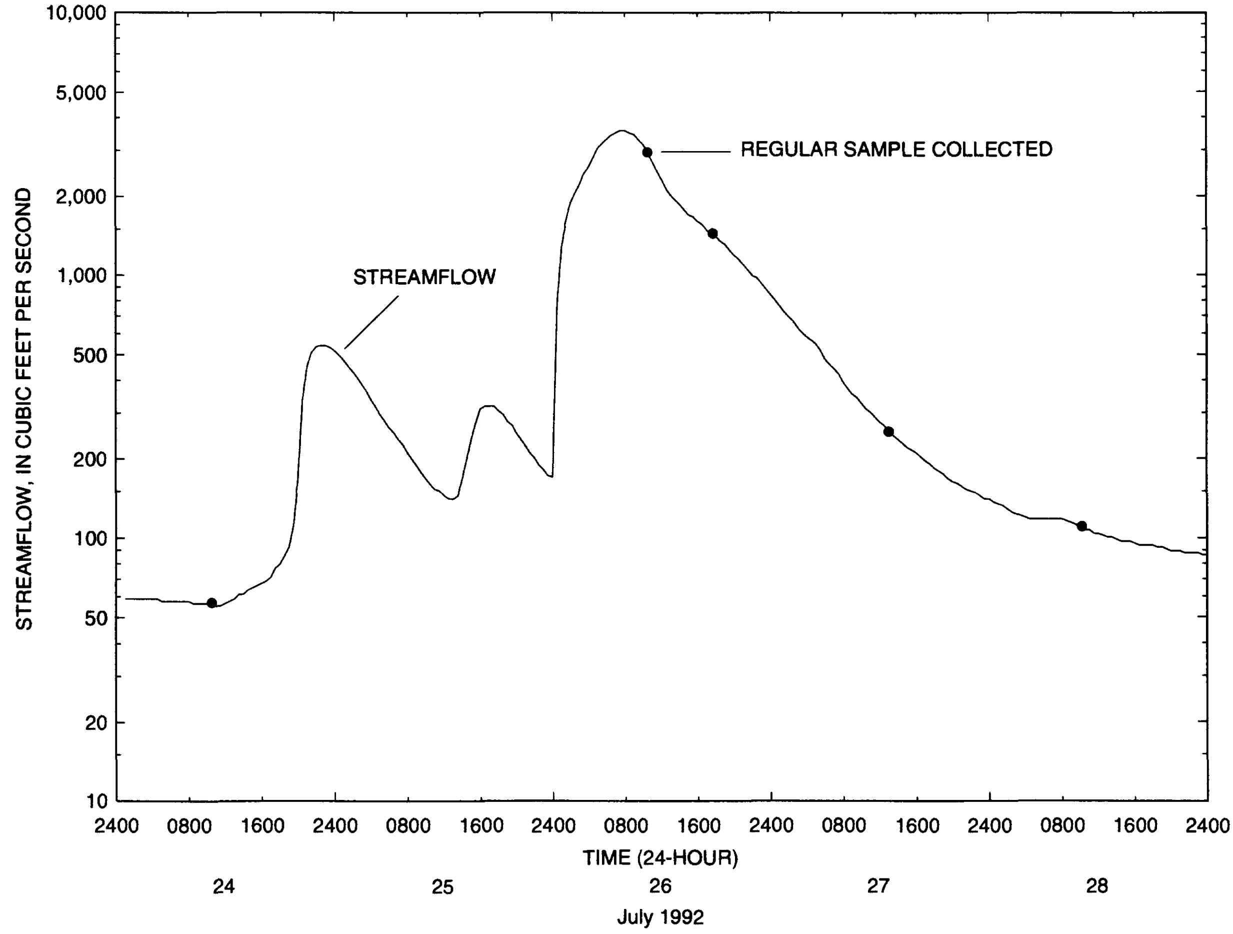


Figure 8. Streamflow discharge and sampling times during late season high flow at Maple Creek near Nickerson, Nebraska, July 24-28, 1992.

successfully a few weeks later. Regularly scheduled sampling was completed for all days planned at both Maple Creek near Nickerson and the Platte River at Louisville. Sampling times are plotted on discharge hydrographs for the two sites in figures 9 and 10. Detailed storm hydrographs and sampling times for an early season storm and a late season storm at Maple Creek near Nickerson are shown in figures 7 and 8. Tabulation of these data and the dates samples were shipped to the NWQL are included in table 6.

Much was learned about the organizational demands of high-flow sample collection through both the successful and missed sampling opportunities. Precipitation that would produce an adequate runoff was difficult to anticipate. Rises in stream stage in response to storm runoff did not occur as soon as expected. For example, attempts to sample high flow were made very early in the season, but when the sampling team reached the site, only a slight rise in stage had occurred. It was found that large storms in the Maple Creek watershed did not produce a substantial rise in stage at the sampling site for nearly 12 hours after the rain fell.

High-flow sampling required more than two people to collect and process samples. There were problems in coordinating the number of people and the times that they would be called for high-flow sampling. Personnel had to be on call in every instance that adverse weather developed, and enough supplies to take multiple samples had to be on hand. The urgency to collect samples several times during intense, short-duration high flows made it impossible to immediately process the samples; therefore, they were chilled and brought

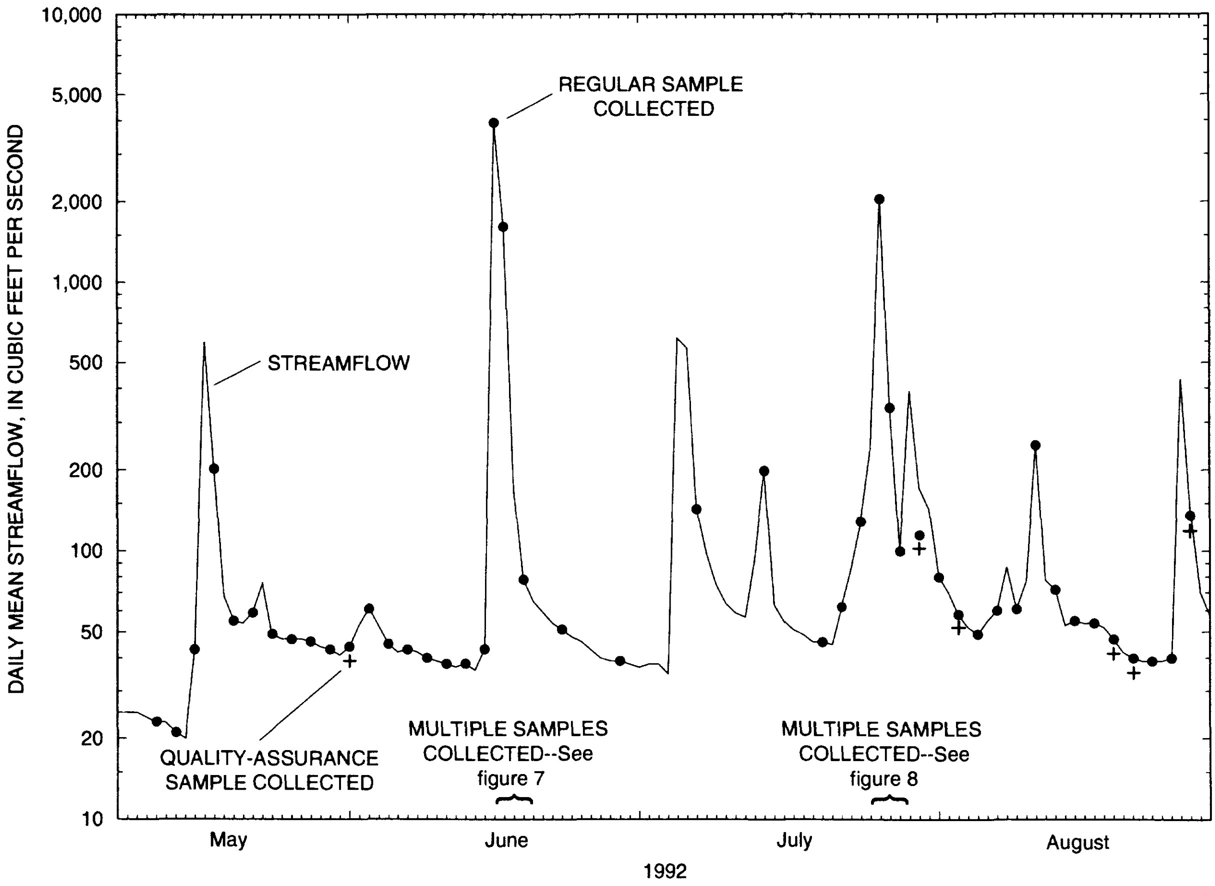


Figure 9. Streamflow discharge and sampling times for Maple Creek near Nickerson, Nebraska, May 8-August 28,1992.

to the U.S. Geological Survey laboratory in Lincoln to be processed as personnel were available. The nature of the sampling required a substantial commitment of personnel when other activities also were underway. Due to time and personnel constraints, a few samples from the spring high flow were not processed until as much as 2 days after collection and shipped to the laboratory as much as 8 days after collection, although most were processed within 8-24 hours of collection. The late season high-flow sampling was conducted more efficiently because the personnel better understood the storm-runoff characteristics, so all samples were processed within 24 hours of their collection. Most high-flow samples were shipped to the laboratory for analysis 4-8 days after processing.

As previously mentioned, typical weather patterns in the Maple Creek watershed resulted in storms that occur in the evening and late hours of the night. Coupled with this were storms on weekends that required extensive overtime to track and sample high flows. A thorough knowledge of the precipitation in the watershed upstream from the site and the resulting rise in stream stage would have decreased the time and expense of sampling trips that missed all or part of the high flow. Information about the site should include the amount, intensity, and location of rainfall that would produce a significant amount of runoff, and a characteristic timing of the rise and fall of the stream stage.

Some equipment and procedural modifications were useful. The D-77TM crane-suspended water sampler and portable four-wheel crane required time to set up and take down. There was insufficient room in the sampling vehicle for the crane. Also, risk of sample contamination existed from the lubricants and composition of the crane. Therefore, the D-77TM was used only during high-

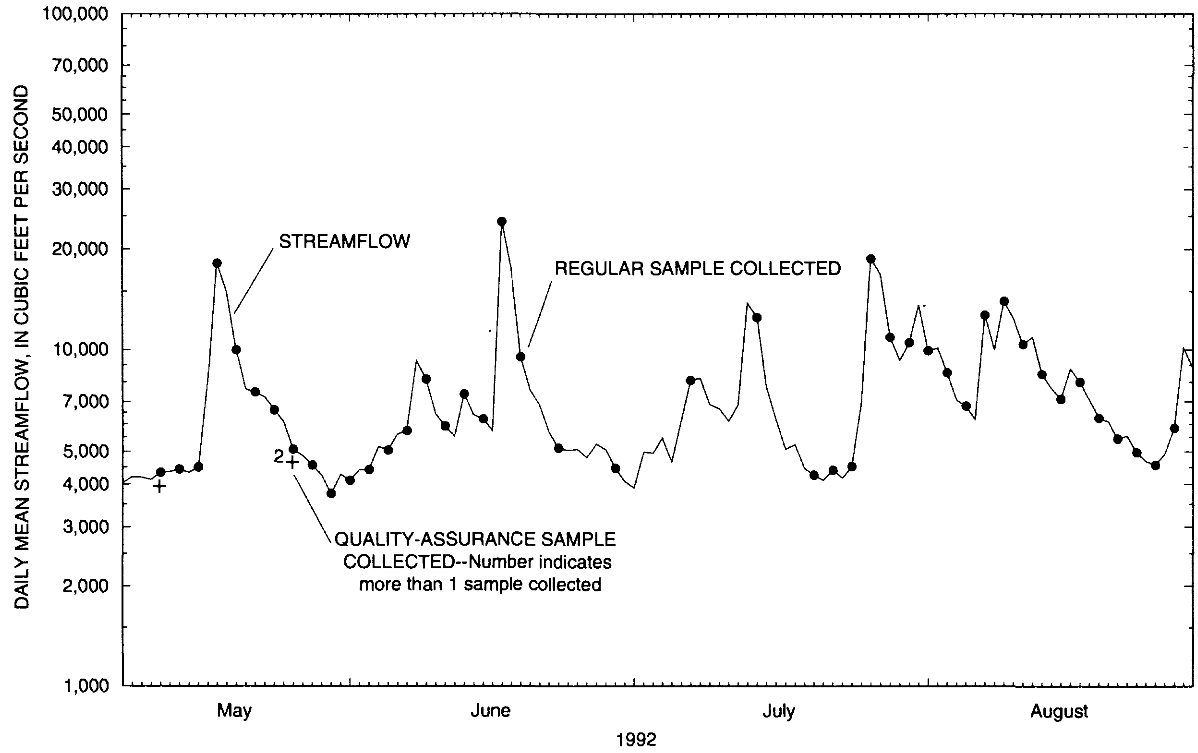


Figure 10. Streamflow discharge and sampling times for Platte River at Louisville, Nebraska, May 8-August 28, 1992.

flow sample collection, and the DH-76 handline sampler was chosen for use when flow conditions exceeded the ability to collect samples by wading the stream. A DH-81 rod-suspension sampler was used when wading low flows, and a DH-76 handline sampler was used during the intermediate flow conditions. A more practical use of the D-77TM sampler would be to mount it permanently on a trailer for ease of operation when frequent and rapid responses to high flows are required. Also, the trailer would assure minimal contamination of the sampling vehicle.

Base flow at Maple Creek near Nickerson is shallow and slow, making is so difficult that a depth-integrated sample with the DH-81 rod-suspension sampler could not be obtained. Therefore, narrow-mouth glass bottles were dipped directly into the stream at EDI points during low flow to collect what usually would have been depth-integrated samples.

The Teflon-cone splitter accumulated coarse organic matter in the bottom and caused the distribution tubes to clog, and some bottles overflowed. If not watched closely, this problem could lead to some sample loss and an unrepresentative split. Also, accumulation of organic matter was a source of contamination for subsequent samples that were split before the cone splitter was thoroughly cleaned. Cleaning the cone splitter was difficult and time consuming because it required dismantling the entire piece of equipment into more than 25 parts. Frequent dismantling for cleaning also caused wear on the soft Teflon surfaces. Forcing water backwards through the splitter helped clean the equipment but could not remove all of the organic debris.

Large concentrations (greater than 500 milligrams per liter) of fine sediment in many samples required modifications to the filtering process. The filtering systems often leaked and filter pads had to be replaced many times, which required that additional water be collected. Often very fine sediment could not be removed by multiple 0.7-micrometer filters. This fine sediment collected in the SPE cartridge and caused blockage before the entire sample volume could pass through the system. A 0.45-micrometer in-line filter was used as a secondary filter. This second filter increased

Table 6. Sample-collection dates and times, and dates samples were shipped to laboratory in Arvada, Colorado

Date of collection	Time of collection (24-hour)	Date shipped to laboratory	Date of collection	Time of collection (24-hour)	Date shipped to laboratory
Maple Creek near Nickerson, Nebraska					
5-12-92	1245	5-13-92	6-29-92	1030	6-30-92
5-14-92	1200	5-19-92	7-7-92	1330	7-8-92
5-16-92	0930	5-20-92	7-14-92	1030	7-15-92
5-18-92	1000	5-20-92	7-20-92	1200	7-21-92
5-20-92	0955	5-21-92	7-22-92	0950	7-29-92
5-22-92	1145	5-27-92	7-24-92	1030	7-29-92
5-24-92	0945	5-27-92	7-26-92	1030	7-29-92
5-26-92	1020	5-27-92	7-26-92	1740	7-29-92
5-28-92	0915	5-28-92	7-27-92	1300	7-29-92
5-30-92	0950	6-2-92	7-28-92	1010	7-29-92
6-1-92	0840	6-2-92	7-30-92	0940	8-3-92
6-3-92	1020	6-8-92	8-1-92	1120	8-3-92
6-5-92	1030	6-8-92	8-3-92	1015	8-5-92
6-7-92	0930	6-8-92	8-5-92	1110	8-10-92
6-9-92	0940	6-15-92	8-7-92	1020	8-10-92
6-11-92	1050	6-15-92	8-9-92	1045	8-10-92
6-13-92	0915	6-15-92	8-11-92	1110	8-17-92
6-15-92	1020	6-22-92	8-13-92	1110	8-17-92
6-16-92	0500	6-22-92	8-15-92	1145	8-17-92
6-16-92	1220	6-22-92	8-17-92	1035	8-17-92
6-16-92	1715	6-22-92	8-19-92	1050	8-24-92
6-16-92	2030	6-22-92	8-21-92	1020	8-24-92
6-17-92	0945	6-22-92	8-23-92	1345	8-31-92
6-19-92	1000	6-22-92	8-25-92	1150	8-31-92
6-23-92	1045	6-23-92	8-27-92	1145	8-31-92
Platte River at Louisville, Nebraska					
5-12-92	0900	5-13-92	7-7-92	1330	7-8-92
5-14-92	0845	5-19-92	7-14-92	1300	7-15-92
5-16-92	1245	5-20-92	7-20-92	1000	7-21-92
5-18-92	1210	5-20-92	7-22-92	0800	7-29-92
5-20-92	0745	5-21-92	7-24-92	0845	7-29-92

Table 6. Sample-collection dates and times, and dates samples were shipped to laboratory in Arvada, Colorado--Continued

Date of collection	Time of collection (24-hour)	Date shipped to laboratory	Date of collection	Time of collection (24-hour)	Date shipped to laboratory
Platte River at Louisville, Nebraska--Continued					
5-22-92	0930	5-27-92	7-26-92	1655	7-29-92
5-24-92	0815	5-27-92	7-28-92	1140	7-29-92
5-26-92	1230	5-27-92	7-30-92	1115	8-3-92
5-28-92	0930	5-28-92	8-1-92	0915	8-3-92
5-30-92	0830	6-2-92	8-3-92	0815	8-4-92
6-1-92	1045	6-2-92	8-5-92	0920	8-10-92
6-3-92	1220	6-8-92	8-7-92	0820	8-10-92
6-5-92	1200	6-8-92	8-9-92	0915	8-10-92
6-7-92	1115	6-8-92	8-11-92	0910	8-18-92
6-9-92	1140	6-10-92	8-13-92	0900	8-18-92
6-11-92	0930	6-15-92	8-15-92	0945	8-18-92
6-13-92	1100	6-15-92	8-17-92	0835	8-18-92
6-15-92	1220	6-22-92	8-19-92	0900	8-24-92
6-17-92	1200	6-22-92	8-21-92	0820	8-24-92
6-19-92	1130	6-22-92	8-23-92	1210	8-24-92
6-23-92	1130	6-24-92	8-25-92	0950	8-31-92
6-29-92	1230	6-30-92	8-27-92	0945	8-31-92

the amount of sample that could pass through the SPE cartridge before blockage, but sometimes the filter would require replacement part way through the process. In extreme cases, it helped to allow time for the sediment to settle out.

Corrugated Teflon tubing used in filtering samples for organic analysis occasionally trapped sediment in the folds. This residue was not removed by the normal cleaning procedures and could be a source for contamination of subsequent samples. Large volumes of detergent and water were needed to dislodge sediment residue from corrugated tubing before applying the three-step cleaning procedure. The tubing was replaced when the cost of cleaning soiled tubing was considered to exceed replacement cost. Spiraled Teflon tubing, if available, may be better for this application.

All required samples never were collected, following onsite protocols, within an 8-hour day. This was particularly true when samples contained large concentrations of fine sediment and during high flow when sampling time was critical. Samples with large concentrations of sediment were transported to the laboratory in Lincoln to process them successfully because the onsite protocol under these conditions was not practical. In general, laboratory conditions were needed to process samples in a timely and proper manner. Road dust in agricultural areas, which includes most of the CNBR study unit, was a constant concern because of probable airborne contamination. Cleaning equipment and sample processing required large amounts of distilled water, but transport of distilled water was a limiting factor. Rationing of distilled water resulted in residual detergent in equipment after cleaning, and in a few cases during high-flow sampling, distilled water had to be reserved for detergent solutions and stream water used as a rinse. Also, the methanol used in the cleaning process is a hazardous substance, which makes it difficult to store, transport, and maintain sufficient quantities in vehicles; however, laboratories can routinely store methanol in sufficient quantities. Confined onsite conditions led to spills and marginally functional equipment layout. Additional vehicles were required to transport stream-gaging equipment separate from sample-processing equipment because of space constraints, and the logistics related to sampling high flows were challenging enough without extra vehicles to manage.

A minimonitor was selected to log data on specific conductance, pH, and water temperature four times per hour at the prototype site on Maple Creek near Nickerson. Many attempts were made to operate this monitor, but it would not store any usable data. Data stored from the minimonitor for all three physical properties were unreasonably large or small with no variability over time. There are other instruments available that are designed for the same functions as the minimonitor that might be candidates for testing.

Resources for onsite processing of selected pesticides by solid-phase extraction and laboratory processing were compared. Time of completion and the personnel requirements for the tasks related to each method are listed in tables 7 and 8. Time requirements discussed here and listed in table 7 are minimum required times and do not reflect secondary sampling activities such as shipping and resupply. Time logs were kept during a period of base flow at a common level of personnel experience. Requirements for high-flow sampling and at different levels of personnel experience would vary from those documented.

Laboratory processing required 32 percent fewer person hours than onsite processing for the two prototype sites in the CNBR study unit. Onsite processing required two people for an entire work day, but laboratory processing required one person for one-half day onsite and two people for one-half day in the laboratory. Also, adaptation of processing equipment to multiple power sources, 12-volt direct-current battery and 120-volt alternating current, was necessary to use essential instruments and equipment both onsite and in the laboratory. Laboratory processing has operational advantages. However, information on sample degradation during transit is not available at this time. Such data are needed to determine the extent of sample compromise compared with the operational drawbacks and contamination aspects of onsite processing.

SUMMARY

The Prototype Intensive Fixed-Station Stream-Monitoring Project was designed to test protocols, equipment, and sampling frequency for a national intensive fixed-station water-quality network. Monitoring sites on Maple Creek near Nickerson, Nebraska, and the Platte River at Louisville, Nebraska, were operated as intensive fixed stations from May 12, 1992, to August 28, 1992. The two sites were sampled every other day during 6 weeks in the spring and 6 weeks in late summer, separated by a month of weekly samples. Maple Creek near Nickerson also was sampled repeatedly during two high-flow periods--one early and another late in the growing season. Both sites were sampled for the analysis of pesticides, nutrients, major ions, suspended sediment, and measurement of physical properties.

Field procedures and equipment components of an intensive fixed-station monitoring site were evaluated to determine if they were achievable and adequate. Water and sediment samplers, pumps, and sample-splitting equipment were obtained, and proposed protocols for collecting samples were tested. A U.S. Geological Survey Minimonitor was connected to a data-collection platform for real-time acquisition of water-quality data. Water-sampling and processing equipment were constructed of materials that would not interfere with the detection of selected analytes. Water and sediment were collected by documented U.S. Geological Survey methods.

Procedural and logistical differences between isolating selected pesticides onsite by solid-phase extraction and processing the samples at a nearby U.S. Geological Survey laboratory were described. Comparisons of onsite to laboratory solid-phase extraction for selected pesticide analyses show that laboratory processing required 32 percent fewer person hours to complete with less probability of sample and equipment contamination. Onsite

Table 7. Minimum time and personnel requirements for onsite processing of prototype intensive fixed-station samples collected during base-flow conditions

[SPE, solid-phase extraction]

Clock time (minutes)	Tasks and procedures	Number of workers	Person hours required for task
45	Drive from Lincoln to Louisville, Nebraska, site.	2	1.5
30	Check in, set up equipment, and collect sample.	2	1.0
30	Split sample, filter sample for pesticide process.	2	1.0
50	Process SPE cartridge, determine alkalinity, and filter sample for nonpesticide samples.	2	1.7
10	Clean up and check out.	2	.33
75	Drive from Louisville to Nickerson, Nebraska, site.	2	2.5
25	Check in, set up equipment, and collect sample.	2	.84
30	Split sample, filter sample for pesticide process.	2	1.0
50	Process SPE cartridge, determine alkalinity, and filter sample for nonpesticide samples.	2	1.7
10	Clean up and check out.	2	.33
75	Return trip from Nickerson to Lincoln, Nebraska	2	2.5
430	Total		14.4

Table 8. Minimum time and personnel requirements for laboratory processing of prototype intensive fixed-station samples collected during base-flow conditions[1]

Clock time (minutes)	Tasks and procedures	Number of workers	Person hours required for task
45	Drive from Lincoln to Louisville, Nebraska, site.	1	0.75
45	Check in and collect samples.	1	.75
75	Drive from Louisville to Nickerson, Nebraska, site.	1	1.25
30	Check in and collect samples.	1	.50
75	Return trip from Nickerson to Lincoln, Nebraska.	1	1.25
50	Set up laboratory and split samples, filter sample for pesticide processing.	2	1.67
45	Process SPE cartridge, determine alkalinity, and filter sample for nonpesticide samples.	2	1.50
45	Process SPE cartridge, determine alkalinity, and filter sample for nonpesticide samples.	2	1.50
10	Clean up	2	.33
420	Total		9.50

[1] Time requirements listed here and in table 7 are minimum required times and do not reflect secondary sampling activities such as shipping and resupply. Time logs listed here and in table 7 were collected during a period of base flow at a common level of personnel experience. Requirements for high-flow sampling and at different levels of personnel experience would vary from those documented.

processing has the advantage of immediate preservation of samples to protect constituents from degradation.

Most of the challenges associated with high-flow sampling were related to logistics and personnel. Adequate prior knowledge of the drainage basin's response to precipitation is necessary. Accurate and rapid assessment of precipitation location and intensity also are required. More than two people were required to collect and process multiple samples during high flow, and most stream rises occurred outside of normal working hours. Backlogs of samples were accumulated during high-flow sampling. Problems with filter clogging and residual colloidal materials in the filtrate were encountered with filtering samples with large concentrations of sediment in storm-runoff water. Permanent installation of certain sampling equipment on a trailer would help rapid response to high-flow occurrences.

REFERENCES CITED

Edwards, T.K., and Glysson, G.D., 1988, Field methods for measurement of fluvial sediment: U.S. Geological Survey Open-File Report 86-531, 118 p.

Grey, D.W., 1992, Operation of the Sutron 8200 with a USGS Minimonitor: U.S. Geological Survey, WRD Instrument News, issue 59, p. 20-22.

Hirsch, R.M., Alley, W.M., and Wilber, W.G., 1988, Concepts for a National Water-Quality Assessment Program: U.S. Geological Survey Circular 1021, 42 p.

Huntzinger, T.L., 1991, National Water-Quality Assessment Program--the Central Nebraska Basins: U.S. Geological Survey Water Fact Sheet, Open-File Report 91-97, 2 p.

Jones, J.C., Tracey, D.C., and Sorensen, F.W., 1991, Operating manual for the U.S. Geological Survey's Data-Collection System with the Geostationary Operational Environmental Satellite: U.S. Geological Survey Open-File Report 91-99, 237 p.

Leahy, P.P., Rosenshein, J.S., and Knopman, D.S., 1990, Implementation plan for National Water-Quality Assessment Program: U.S. Geological Survey Open-File Report 90-174, 10 p.

Pritt, J.W., and Jones, B.E., 1989, 1990 National Water-Quality Laboratory services catalog: U.S. Geological Survey Open-File Report 89-386, 133 p.

Topp, Edward, and Smith, Ward, 1992, Sorption of the herbicides atrazine and metolachlor to selected plastics and silicone rubber: Journal of Environmental Quality, v. 21, no. 3, p. 316-317.

Wells, F.C., Gibbons, W.J., and Dorsey, M.E., 1990, Guidelines for collection and field analysis of water-quality samples from streams in Texas: U.S. Geological Survey Open-File Report 90-127, 79 p.

☆U.S. GOVERNMENT PRINTING OFFICE: 1994 - 558-630/00028