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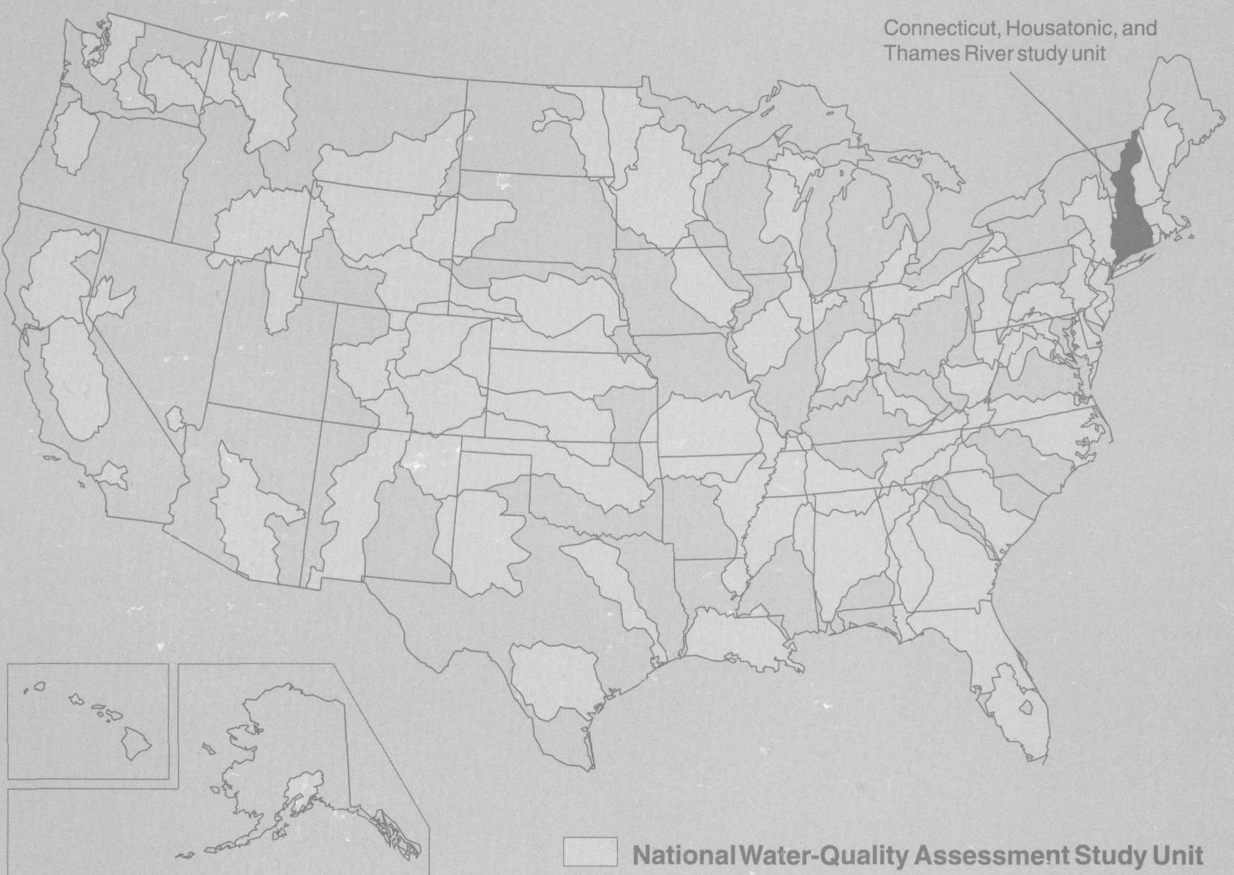
NATIONAL WATER-QUALITY ASSESSMENT PROGRAM

Pesticides in Surface Water in the Connecticut, Housatonic, and Thames River Basins, 1992–95

Water-Resources Investigations Report 98-4247



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Pesticides in Surface Water in the Connecticut, Housatonic, and Thames River Basins, 1992–95

By MARC J. ZIMMERMAN

Water-Resources Investigations Report 98-4247

NATIONAL WATER-QUALITY ASSESSMENT PROGRAM

Northborough, Massachusetts
1999

U.S. DEPARTMENT OF THE INTERIOR
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U.S. GEOLOGICAL SURVEY
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FOREWORD

The mission of the U.S. Geological Survey (USGS) is to assess the quantity and quality of the earth resources of the Nation and to provide information that will assist resource managers and policymakers at Federal, State, and local levels in making sound decisions. Assessment of water-quality conditions and trends is an important part of this overall mission.

One of the greatest challenges faced by water-resources scientists is acquiring reliable information that will guide the use and protection of the Nation's water resources. That challenge is being addressed by Federal, State, interstate, and local water-resource agencies and by many academic institutions. These organizations are collecting water-quality data for a host of purposes that include: compliance with permits and water-supply standards; development of remediation plans for specific contamination problems; operational decisions on industrial, wastewater, or water-supply facilities; and research on factors that affect water quality. An additional need for water-quality information is to provide a basis on which regional- and national-level policy decisions can be based. Wise decisions must be based on sound information. As a society we need to know whether certain types of water-quality problems are isolated or ubiquitous, whether there are significant differences in conditions among regions, whether the conditions are changing over time, and why these conditions change from place to place and over time. The information can be used to help determine the efficacy of existing water-quality policies and to help analysts determine the need for and likely consequences of new policies.

To address these needs, the U.S. Congress appropriated funds in 1986 for the USGS to begin a pilot program in seven project areas to develop and refine the National Water-Quality Assessment (NAWQA) Program. In 1991, the USGS began full implementation of the program. The NAWQA Program builds upon an existing base of water-quality studies of the USGS, as well as those of other Federal, State, and local agencies. The objectives of the NAWQA Program are to:

- Describe current water-quality conditions for a large part of the Nation's freshwater streams, rivers, and aquifers.
- Describe how water quality is changing over time.
- Improve understanding of the primary natural and human factors that affect water-quality conditions.

This information will help support the development and evaluation of management, regulatory, and monitoring decisions by other Federal, State, and local agencies to protect, use, and enhance water resources.

The goals of the NAWQA Program are being achieved through ongoing and proposed investigations of 59 of the Nation's most important river basins and aquifer systems, which are referred to as study units. These study units are distributed throughout the Nation and cover a diversity of hydrogeologic settings. More than two-thirds of the Nation's freshwater use occurs within the 60 study units and more than two-thirds of the people served by public water-supply systems live within their boundaries.

National synthesis of data analysis, based on aggregation of comparable information obtained from the study units, is a major component of the program. This effort focuses on selected water-quality topics using nationally consistent information. Comparative studies will explain differences and similarities in observed water-quality conditions among study areas and will identify changes and trends and their causes. The first topics addressed by the national synthesis are pesticides, nutrients, volatile organic compounds, and aquatic biology. Discussions on these and other water-quality topics will be published in periodic summaries of the quality of the Nation's ground and surface water as the information becomes available.

This report is an element of the comprehensive body of information developed as part of the NAWQA Program. The program depends heavily on the advice, cooperation, and information from many Federal, State, interstate, Tribal, and local agencies and the public. The assistance and suggestions of all are greatly appreciated.

Robert M. Hirsch

Robert M. Hirsch
Chief Hydrologist

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CONVERSION FACTORS, ABBREVIATED WATER-QUALITY UNITS, AND OTHER ABBREVIATIONS

CONVERSION FACTORS

Multiply	By	To obtain
acre-foot (acre-ft)	1,233	cubic meter
cubic foot per second (ft^3/s)	0.02832	cubic meter per second
foot (ft)	0.3048	meter
gallon	3.79	liter
pound (lb)	0.4536	kilogram
quart	0.947	liter
square mile (mi^2)	2.590	square kilometer
ton per year (ton/yr)	0.9072	grams per day

ABBREVIATED WATER-QUALITY UNITS

Milligram per liter (mg/L) is a unit expressing the concentration of a chemical constituent in solution as weight (milligram) per unit volume (liter) of water.

Microgram per liter (µg/L) is a unit expressing the concentration of a chemical constituent in solution as weight (microgram) of solute per unit volume (liter) of water.

Specific conductance of water is expressed in microsiemens per centimeter at 25 degrees Celsius (µS/cm). This unit is equivalent to micromhos per centimeter at 25 degrees Celsius (µmho/cm), formerly used by the U.S. Geological Survey.

OTHER ABBREVIATIONS

DCPA	Dimethyl tetrachloroterephthalate
DDE, *p,p′*-	*p,p′*-Dichlorodiphenyldichloroethylene
EPTC	S-ethyl dipropylthiocarbamate
HCH, *alpha*-	benzene hexachloride
2,4,5-T	2,4,5-Trichlorophenoxyacetic acid
2,4-D	2,4-dichlorophenoxyacetic acid
2,4-DB	4-(2,4-Dichlorophenoxy) butyric acid
DNOC	4, 6-Dinitro-o-cresol
MCPA	(4-chloro-2-methyl) phenoxyacetic acid
MCPB	4-(4-chloro-o-tolyloxy) butyric acid

Pesticides in Surface Water in the Connecticut, Housatonic, and Thames River Basins, 1992–95

By Marc J. Zimmerman

Abstract

From March 1993 through September 1995, surface-water-quality samples were collected routinely from streams in the Connecticut, Housatonic, and Thames River Basins study unit of the U.S. Geological Survey's National Water Quality Assessment Program (NAWQA). The streams sampled in this study were selected to reflect typical water-quality conditions in urban, agricultural, and forested settings. One hundred thirty-nine of these samples were analyzed for a wide array of pesticides. The length of time during which sample and data collection occurred ranged from several days for intensive studies of the interactions of ground water with surface water to several weeks for high-flow and low-flow investigations. A longer-term study was conducted at a single urban site that was sampled weekly in the spring and summer of 1993 and 1994 and less frequently in autumn and winter of those years. The relatively large number of samples collected at this single site is the likely reason for the detection there of 22 different pesticides or their metabolites, usually at low concentrations.

Although some herbicides and insecticides were found in streams draining both urban and agricultural settings, different groups of pesticides were usually associated with these settings; in particular, insecticides were more commonly detected in urban than in agricultural samples. Pesticides were rarely detected in streams draining forested settings.

The most commonly detected pesticide, atrazine, was virtually ubiquitous; it was found in samples from all land-use and basin categories. Atrazine was detected most frequently in streams draining agricultural basins. Metolachlor was also detected at more agricultural than urban sites. Most of the samples in which carbaryl, diazinon, and prometon were detected came from urban streams.

Concentrations of pesticides determined using a solid phase-extraction methodology did not exceed Maximum Contaminant Levels (MCL) or Health Advisory Levels (HAL) as defined by the U.S. Environmental Protection Agency. Commonly detected pesticides and their highest concentrations were: atrazine (1.10 micrograms per liter), carbaryl (3.2 micrograms per liter), diazinon (0.210 micrograms per liter), metolachlor (0.910 micrograms per liter), prometon (0.140 micrograms per liter), and simazine (0.690 micrograms per liter). The highest concentrations of atrazine, metolachlor, and simazine were detected in samples collected in agricultural basins and the highest concentrations of carbaryl, diazinon, and prometon were detected in samples collected in urban basins. A single atrazine concentration (4.5 micrograms per liter) exceeding the MCL was detected in a sample analyzed using an enzyme-linked immunosorbent assay (ELISA). (It should be noted that the McLand HAL are set for finished drinking water and exceeding them does not mean that a standard was violated.)

The highest estimated total daily loads of pesticides were associated with elevated streamflow in storm runoff during the late spring to early summer period, shortly following pesticide application. Some high loads, however, were also found later in the growing season. Estimated loads in excess of 4 kilograms per day

were determined for the Connecticut River at Thompsonville, Conn., and the Naugatuck River at Beacon Falls, Conn.

Detection of pesticides in streams throughout the summer months during base flow periods in urban and agricultural basins suggests a ground-water transport mechanism, although atmospheric transport may also play a role. The repeated application of pesticides (especially insecticides) during the growing season in urban areas, however, may contribute to the detection of these compounds.

Sampling focused on annual periods of normal high and low streamflow, which may have affected data interpretation; additional sampling of stormwater runoff during normal low-flow periods would provide valuable data, as would frequent or repeated sampling of more sites. Use of carefully designed, automated sampling programs accompanied by a sample screening method, such as ELISA, should result in the collection of additional important information while keeping costs down. Sampling for pesticides in rainfall also would further contribute to our understanding of pesticide distribution.

INTRODUCTION

The Connecticut, Housatonic, and Thames River NAWQA project was one of 20 NAWQA studies begun in 1991 (Gilliom and others, 1995) to help describe trends and current water-quality conditions in the Nation's streams and to improve understanding of natural and human factors affecting water quality. This report describes the occurrence and distribution of pesticides in the Connecticut, Housatonic, and Thames River Basins NAWQA study unit (CONN–NAWQA) from 1992–95.

Purpose and Scope

The primary goals of this report are:

- To document the results of field studies for pesticides in surface water in the study area during 1992–95;
- To describe the occurrence and distribution of pesticides in surface water and to relate them to land use;
- To evaluate loadings of pesticides to surface water in the study area; and
- To examine mechanisms by which pesticides are transported to surface water.

This report does not attempt to interpret the potential influence of pesticides on aquatic biota. It seems reasonable to state, however, that at sufficiently high concentrations, herbicides might be toxic to algae and aquatic plants and insecticides could kill aquatic animals. But, the effects of pesticides at low concentrations in aquatic systems are not so obvious. A recent hypothesis suggests that, even at low concentrations in the aquatic environment, pesticides may disrupt endocrine function in animals (U.S. Environmental Protection Agency, 1997). The possible effects include abnormal thyroid function, decreased reproductive capacity, and modification of secondary sexual characteristics. Thus, estimates of pesticide concentrations in receiving waters may provide valuable information about these previously unsuspected biological effects.

Previous Studies

A recent review of literature and data for the study area (Zimmerman and others, 1996) revealed little available information on pesticides in surface water during the period 1969–92. The pesticides detected most frequently were atrazine, metolachlor, 2,4-D, and silvex. Data on application rates were spotty and did not consistently reflect detection frequency.

Several recent books synthesize the state-of-the-art in the study of pesticides in the environment (Majewski and Capel, 1995; Barbash and Resek, 1996; Larson and others, 1997). By pointing out deficiencies in our understanding of pesticides in the environment, they provide much food for thought. Although the volumes focus on the separate sub-disciplines of pesticides in the atmosphere, ground water, and surface water, they each contain sections describing the movement of pesticides in and between these media. Each book compiles a large amount of data from numerous studies and contains an extensive bibliography.

Majewski and Capel's 1995 synthesis of available information on pesticides in the atmosphere includes a list of pesticides detected in air and rain (table 1). This extensive list demonstrates the potential importance of atmospheric transport in distributing pesticides far beyond the locations where they are applied. They conclude that atmospheric deposition of pesticides most likely affects water quality as a result of rainfall and consequent runoff, but the full significance or magnitude of this impact is still unknown.

Barbash and Resek (1996) state that there are relatively few studies on the contribution of pesticides from ground water to surface water. Some of these studies do indicate that ground-water discharge can sustain low concentrations of dissolved pesticides in streams during base flow periods. The authors further suggest that, in low relief areas that are intensively farmed, ground water may be the main source of pesticide load in large rivers during base flow periods. Larson and others (1997) relate concentrations of pesticides detected in surface waters to water-quality criteria for human health and aquatic organisms; they discuss the limitations inherent in interpreting the criteria for aquatic organisms.

Table 1. Pesticides detected in air and rain in national studies

[Majewski and Capel, 1995. Pesticides are listed in decreasing order of percent of sites with detectable concentrations]

Air	Rain
DDTs	Atrazine
Methidathion	Alachlor
γ-HCH	γ-HCH
α-HCH	α-HCH
Diazinon	Metolachlor
Heptachlor	DDTs
Malathion	Desethylatrazine
Dieldrin	Dieldrin
Chlorpyrifos	Simazine
Diazinon-OA	Chlordane
2,4-Ds	Cyanazine
DDEs	Toxaphene
Methyl parathion	DDEs
Toxaphene	Metrabuzin
Parathion	DIP-atrazine
Parathion-OA	Prometon
Aldrin	Propazine
Trifluralin	Terbutryn
Chlordane	Ametryn
DDDs	Prometryn
Endrin	
Phorate	
Endosulfan	
Heptachlor epoxide	
Dachthal	
DEF	
δ-HCH	
2,4,5-Ts	
beta-HCH	

Approach

Surface-water-quality monitoring networks established as part of NAWQA activities are designed to collect information for interpreting the effects of land use on water quality. Individual monitoring sites are selected to represent locations where drainage occurs from basins with relatively homogeneous characteristics, namely, agricultural, urban, and forested land-use. By selecting sites with upstream drainage areas containing a particular predominant land use, general conclusions can be drawn about the relation between land use and water quality; these are designated as indicator sites. Additional sampling takes place at sites in large drainage basins; these are designated integrator sites because water quality at these sites reflects a more heterogeneous mix of land use types.

Several different monitoring approaches were taken in the study of pesticides in surface water in the CONN–NAWQA project. Sampling regimes were designed to obtain information on the broad areal distribution of pesticides in the environment as well as to monitor temporal changes in concentrations. Thus, in addition to frequent sampling for pesticides at a single site over an extended period, pesticide samples were also collected during (1) studies lasting several weeks covering many basins and large parts of the study area, and (2) studies lasting 2–3 days in relatively small basins.

Acknowledgments

The author wishes to thank all who helped collect and process the samples which formed the basis for this report. In particular, Britt Stock, U.S. Geological Survey (USGS) hydrologic technician, not only responsibly handled the normal duties of

water-quality sampling and data checking for 2 1/2 years, but also patiently trained numerous temporary assistants and other project staff in the intricacies of sampling methodology. Jon Morrison and Tim Frick of the Connecticut District of the USGS collected most of the samples in Connecticut.

DESCRIPTION OF STUDY UNIT

Location

The CONN–NAWQA study area encompasses approximately 16,000 mi^2 in New England (and small contiguous areas of New York and Quebec), extending south from Quebec to Long Island Sound. In addition to the Connecticut, Housatonic, and Thames River Basins, the study area includes small coastal basins in Connecticut (fig. 1, table 2).

Land Use

Land use in the study area is highly mixed, with forests dominating the north and densely populated urban areas featuring prominently in the south (Zimmerman and others, 1996). Most of the land use in the study area (approximately 80 percent) can be classified as forested, that is, characterized by little urban or agricultural development and with low population density; most of the land in this category is found in New Hampshire and Vermont where agriculture, silviculture, and recreation are the principal commercial activities. However, even in the more densely populated southern regions, undeveloped land accounts for about two-thirds of the land use. Land-use data for the selection of sampling sites were derived from the USGS Geographic Information Retrieval and Analysis System (GIRAS) for handling land-use and land-cover data (Mitchell and others, 1977.)

In this report, recent satellite images were used to interpret land use. Satellite imagery data from Landsat satellites with a thematic mapper (TM) were used to improve spectral and spatial resolution for interpreting data related to land use (P.A. Steeves, U.S. Geological Survey, written commun., 1997). Satellite imagery data of the study area were categorized and compared with existing spatial data. Comparisons were also made with aerial photographs to confirm land-use classifications. When discrepancies occurred, the satellite data interpretations were modified. Where comparable land-use coverages existed for GIRAS and TM data, land-use distributions were found to be similar among land-use types.

For the entire study area, TM data analysis categorized 8.5 percent of the land use as urban, 11.7 as agricultural, 77.7 percent as forested, and the remainder as either water or barren. In basins classified as urban, which ranged in area from 2.3 to 115 mi^2, urban land use varied from 5.8 to 75.7 percent and agricultural land use constituted from 6.3 to 29.8 percent (table 3). In agricultural basins, with areas of 2.3 to 194 mi^2, agricultural land use ranged from 6.5 to 38.3 percent and urban land use ranged from 0.0 to 15.4 percent. Forested basins were most homogeneous with 78.7 to 95.9 percent of their lands classified as undeveloped. The larger, integrator basins ranged in area from about 150 mi^2 to almost 11,000 mi^2. In integrator basins, up to 17.7 percent of the area was classified as urban land use and up to 23.5 percent was agricultural.

Pesticide Use

While pesticide use is closely associated with large-scale agriculture, herbicides are also applied along automotive and railroad rights-of-way for weed control. In addition, recreational areas, such as golf courses, also may require repeated applications of pesticides over large areas (table 4). Insecticides are used in agricultural areas for seed protection in storage as well as during and after germination in the field. In urban areas, insecticides are used outdoors to protect gardens and other plantings in residential and public areas. Some of the commercially available pesticides associated with urban use may be mixtures which include pesticides also having agricultural applications (table 4).

Pesticides, commonly in solution, are applied by numerous means that generally depend on the type of use and area of application (Larson and others, 1997). For large-scale agricultural applications, aerial spraying is a typical practice. Additional means include spraying from tractors and direct application to crops. Along roadways and other transportation rights-of-way, moving trucks spray herbicides; for small areas, or along guard rails and bridges, manual spraying is often used. In urban and suburban settings, pesticides are applied to lawns, gardens, parks, cemeteries, and golf courses as liquid sprays, powders, or granules.

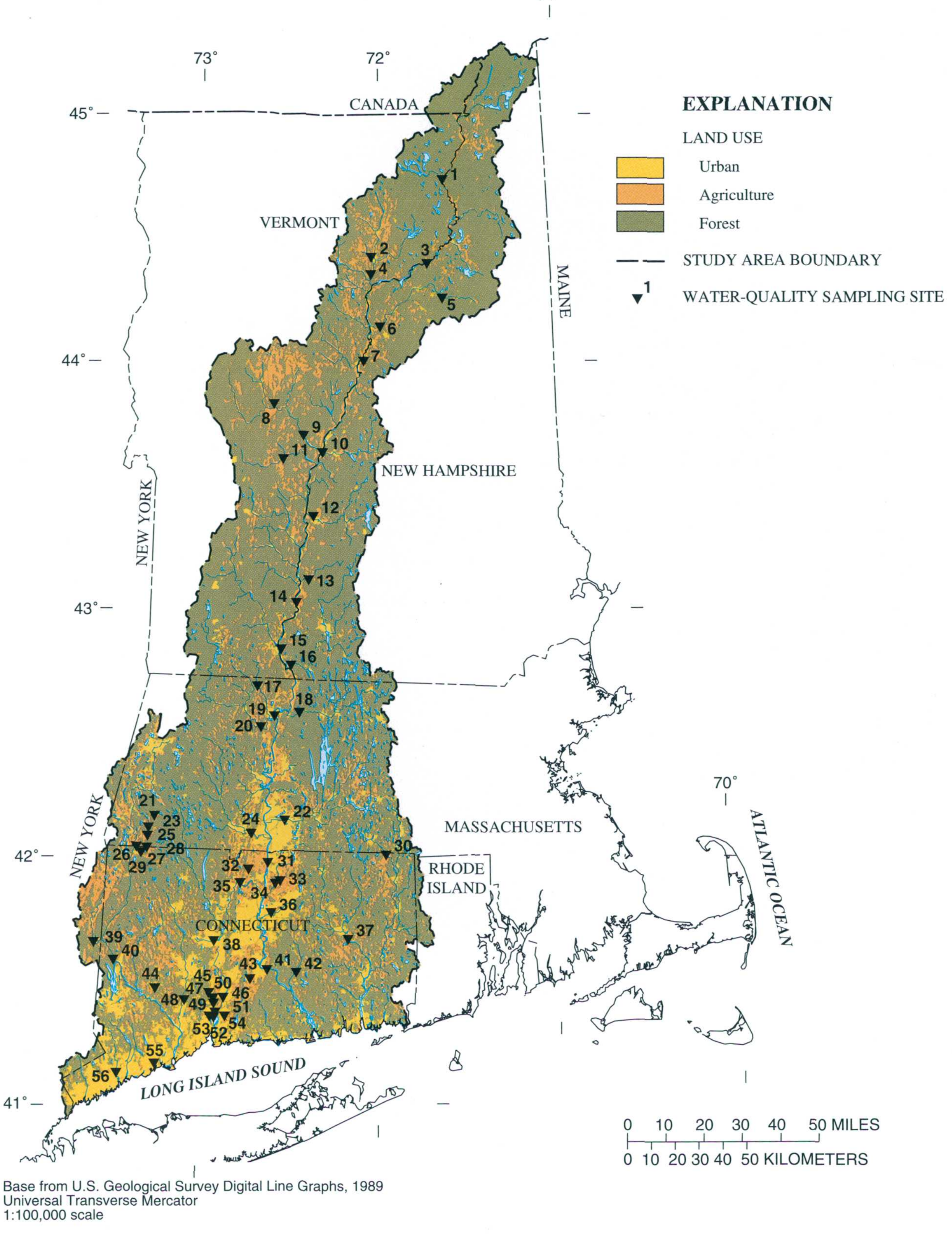

Figure 1. The Connecticut, Housatonic, and Thames River Basins study unit.

Table 2. Map numbers, station numbers, and station names of sites sampled for pesticides as part of the Connecticut, Housatonic, and Thames River Basins study, 1992–95

[Site locations are shown on figure 1. No., number]

Map No.	Station No.	Station name
1	01129500	Connecticut River at North Stratford, N.H.
2	01135300	Sleepers River near St. Johnsbury, Vt.
3	01131500	Connecticut River near Dalton, N.H.
4	01135500	Passumpsic River near St. Johnsbury, Vt.
5	01137500	Ammonoosuc River at Bethlehem Junction, N.H.
6	01138000	Ammonoosuc River near Bath, N.H.
7	440057072045201	Unnamed Tributary to Connecticut River near Haverhill, N.H.
8	435031072351101	Second Branch White River near Bethel, Vt.
9	01144000	White River at West Hartford, Vt.
10	01144500	Connecticut River at West Lebanon, N.H.
11	433709072320301	Ottauqueechee River at West Woodstock, Vt.
12	01152500	Sugar River at West Claremont, N.H.
13	01155000	Cold River at Drewsville, N.H.
14	430217072271601	Great Brook near Walpole, N.H.
15	425104072322601	Whetstone Brook at mouth at Brattleboro, Vt.
16	01161000	Ashuelot River at Hinsdale, N.H.
17	01170100	Green River near Colrain, Mass.
18	01166500	Millers River at Erving, Mass.
19	01170500	Connecticut River at Montague City, Mass.
20	01170000	Deerfield River near West Deerfield, Mass.
21	01198151	Rawson Brook–Wellman Road near Monterey, Mass.
22	01177000	Chicopee River at Indian Orchard, Mass.
23	01198158	Konkapot River at Hartsville–Mill River Road near Mill River, Mass.
24	01183500	Westfield River near Westfield, Mass.
25	01198159	Konkapot River near Mill River, Mass.
26	01198200	Konkapot River at Ashley Falls, Mass.
27	01198180	Konkapot River at Clayton, Conn.
28	01198190	Konkapot River near Canaan, Conn.
29	01198185	Konkapot River at Sodom, Conn.
30	01124000	Quinebaug River at Quinebaug, Conn.
31	01184000	Connecticut River at Thompsonville, Conn.
32	01184100	Stony Brook near West Suffield, Conn.
33	01184490	Broad Brook at Broad Brook, Conn.
34	01184500	Scantic River at Broad Brook, Conn.
35	01189995	Farmington River at Tariffville, Conn.
36	01192500	Hockanum River near East Hartford, Conn.
37	01122610	Shetucket River at South Windham, Conn.
38	01189000	Pequabuck River at Forestville, Conn.
39	01199900	Tenmile River at South Dover, N.Y.
40	01200600	Housatonic River near New Milford, Conn.
41	01193000	Connecticut River near Middletown, Conn.
42	01193500	Salmon River near East Hampton, Conn.
43	01192883	Coginchaug River at Middletown, Conn.
44	01204000	Pomperaug River at Southbury, Conn.
45	01196589	Brooksvale Stream at Mt. Sanford Road, Cheshire, Conn.
46	01196500	Quinnipiac River at Wallingford, Conn.
47	01196618	Willow Brook at Willow Street, Hamden, Conn.
48	01208500	Naugatuck River at Beacon Falls, Conn.
49	01196619	Eaton Brook at Route 10, Hamden, Conn.
50	01196620	Mill River near Hamden, Conn.
51	0119662350	Mill River at Dixwell Avenue, Hamden, Conn.
52	0119662375	Shepard Brook at Route 10, Hamden, Conn.
53	0119662380	Mill River at Skiff Street, Hamden, Conn.
54	01196580	Muddy River near North Haven, Conn.
55	01208873	Rooster River at Fairfield, Conn.
56	01209710	Norwalk River at Winnipauk, Conn.

Table 3. Drainage areas and principal land-use categories of basins sampled for pesticides in the Connecticut, Housatonic, and Thames River Basins study, 1992–95

Basin description	Drainage area (square miles)	Percent urban area	Percent agricultural area	Percent forested area
Urban	2.3–115	5.8–75.7	6.3–29.8	13.0 –83.9
Agricultural	2.3–194	0.0–15.4	6.5–38.3	45.7–91.2
Forested	1.3–100	0.1–6.2	3.8–13.6	78.7–95.9
Integrator	75.9–10,887	0.2–17.7	5.4–23.5	60.6–91.5

Table 4. Action and use of selected pesticides detected in the Connecticut, Housatonic, and Thames River Basins study, 1992–95

[Sine, 1996]

Pesticide name	Action	Pesticide use
Atrazine	Selective herbicide	Season-long weed control in corn, sorghum, and other crops. At high application rates, for nonselective weed control in non-agricultural areas.
Carbaryl	Broad spectrum insecticide	For use on fruits, vegetables, forests, field crops, lawns, nuts, ornamentals, pasture, turf, and shade trees.
Diazinon	Insecticide, nematicide	For soil insects and pests of fruits, vegetables, tobacco, forage and field crops, range, pasture, and ornamentals. For indoor household pests such as cockroaches and other insects; grubs, nematodes in turf.
Metolachlor	Selective herbicide	Pre-emergence weed control in corn, sorghum, potatoes, pod crops, and woody ornamentals.
Prometon	Nonselective herbicide	Pre- or post-emergence application. Controls annual and many perennial broadleaf weeds and grasses.
Simazine	Selective herbicide	Controls annual grasses and broadleaf weeds in corn, fruit, certain nuts, asparagus, ornamental trees and nursery stock, in turf grass sod production, fairways, lawns. At high application rates, for nonselective weed control in industrial areas.

Any type of spraying creates aerosols which may be transported away from the desired application site by wind or water. Effective pesticide use requires reducing application losses. Thus, aerial spraying is done from low altitudes and tractors apply pesticides close to the soil surface. Regardless of the means of application, pesticides can nevertheless find their way into the atmosphere through evaporation and wind-facilitated transport. Long-distance movement of pesticides is a well-documented phenomenon; for example, the cotton pesticide, toxaphene, is transported from the southern United States to the Midwest (Majewski and Capel, 1995).

In addition to the means of application and atmospheric transport, the types of surfaces on which the pesticides are applied affect movement to nearby surface water. For example, large proportions of pesticides applied to the ground, such as agricultural soil or lawns, are unlikely to move far from the application site. If, however, substantial runoff reaches impervious surfaces, such as those common in urban and roadside settings, subsequent movement of runoff to storm sewers can rapidly transport pesticides to streams. In order to minimize its transport to streams, atrazine, for example, has been designated a Restricted Use Pesticide by the U.S. Environmental Protection Agency (USEPA) which requires "buffer areas" between application sites and surface water (Sine, 1996).

STUDY METHODS

Sampling-Site Selection

Several general criteria served as guidelines for selecting indicator basins for fixed or synoptic sampling sites. Land-use maps and data, previous experience, and site reconnaissance were relied upon to implement land-use categorization and sampling-site selection. A basin was classified as urban or agricultural if a substantial fraction of its land use was in either category, especially in the immediate vicinity of the sampling site. The urban land-use category included high-population-density city areas and low-population-density residential areas. Agricultural basins had a substantial part of the land under cultivation or in pasturage. Basins with little or no substantial urban or agricultural areas were classified as forested, or undeveloped, basins which served as reference areas, to contrast with developed areas. Specific criteria for selecting indicator basins from these land-use categories were: (1) drainage areas ranging from approximately 10 to 100 mi^2; (2) minimal point sources in the immediate vicinity of monitoring stations; and (3) active streamgaging stations. In New England, meeting all these criteria proved a difficult task.

In the CONN–NAWQA study, samples were collected for pesticide analysis at 29 sites in Connecticut, 10 in Massachusetts, 10 in New Hampshire, 6 in Vermont, and 1 in New York (table 5). The distribution of land-use categories reflects the objective of the sampling and the percentage of developed land in the southern parts of the study area (tables 5, 6). Connecticut, with a large proportion of urban or agricultural land use, had many existing streamflow-gaging stations monitoring developed basins.

A major component of surface-water quality-data collection consisted of regular monitoring at 12 existing or newly established stations (table 7). Overall, four fixed stations were selected as urban, three as agricultural, two as forested, and three as integrators. Eleven of these stations were classified as basic fixed sites where monthly water-quality samples were collected. The twelfth station, the Norwalk River at Winnipauk, Conn., was classified as an urban indicator intensive fixed site, and was sampled more frequently. This intensive fixed site is located in a highly developed, typical mixed land-use area (fig. 2). A residential area lies immediately to the west; a railroad line runs adjacent to the sampling site; a bridge is about 100 ft downstream; and a major highway runs parallel to the river, occasionally adjacent to it.

Sample Collection

Obtaining information to describe temporal and spatial differences in pesticide occurrence and distribution required several approaches to sampling. Sampling frequency at individual sampling locations varied from once to many times during the study period. Some stations were sampled following storms when streamflow was greater than average, and other stations were sampled when streamflow was very low. Some stations were sampled under high and low streamflow conditions.

Intensive Fixed-Site Sampling

At the Norwalk River at Winnipauk, Conn., the intensive fixed site, water-quality samples were collected approximately weekly from March through October 1993 and March through August 1994; bimonthly in November and December 1993 and February 1994; once in January 1994; and monthly, as a basic fixed site (with no pesticide sampling), from September 1994 through September 1995.

High-Flux Sampling

In 1993 and 1994, water-quality sampling took place throughout the study area shortly after springtime application of agricultural pesticides and fertilizers. Because this sampling regime was designed to yield the highest numbers of pesticide detections and highest pesticide concentrations in stormwater runoff to streams, these periods were referred to as "high flux."

In June 1993, CONN–NAWQA participated in a National effort to examine the efficacy of using an enzyme-linked immunosorbent assay (ELISA) method to detect atrazine and 2,4-D in runoff following application in the spring. The National study tested for the occurrence and distribution of atrazine and 2,4-D. In addition to the samples collected for the National study, which were shipped to the USGS National Water Quality Laboratory (NWQL) for analysis, 62 samples from 47 sites were analyzed by CONN–NAWQA personnel using an ELISA technique; analyses were performed to detect the presence of metolachlor, another commonly applied herbicide, as well as atrazine and 2,4-D.

In late spring and early summer 1994, samples were collected to identify a broad suite of pesticides in runoff during the high-flux period—in contrast to the high-flow period of late winter and early spring, when snow-melt runoff is the primary source of stream discharge. Farmers in New England generally apply fertilizer and pesticides when the soil reaches a desired temperature. Farm chemical application typically began in early May 1994. Sampling began at sites in Connecticut, New York, and Massachusetts in May and concluded in Vermont and New Hampshire in June because the soils in the southern parts of the study unit warm up before soils in the northern parts.

Table 5. Distribution of basin land-use categories of pesticide sampling sites in the five states represented in the Connecticut, Housatonic, and Thames River Basins study

State	Number of sites sampled by category				Total
	Urban	Agricultural	Forested	Integrator	
Connecticut	12	8	2	7	29
Massachusetts	0	1	4	5	10
New York	0	1	0	0	1
New Hampshire	0	3	1	6	10
Vermont	1	3	0	2	6
Total	13	16	7	20	56

Table 6. Distribution of urban, agricultural, and forested land use in basins sampled for pesticides in the Connecticut, Housatonic, and Thames River Basins study, 1993–95

[Basins are sorted by decreasing percent of category's land use within each category, except for integrator basins, which are sorted by decreasing basin area. No., number; mi^2, square mile]

Station name	Map No.	Basin area (mi^2)	Percent urban	Percent agricultural	Percent forested
Urban basins					
Rooster River at Fairfield, Conn.	55	10.6	75.7	10.3	13.0
Shepard Brook at Route 10, Hamden, Conn.	52	2.56	42.1	10.3	47.1
Quinnipiac River at Wallingford, Conn.	46	115	36.6	16.2	45.7
Hockanum River near East Hartford, Conn.	36	73.4	31.0	17.1	50.0
Mill River at Skiff Street, Hamden, Conn.	53	32.2	30.0	11.6	58.1
Norwalk River at Winnipauk, Conn.	56	33.0	26.0	7.90	65.2
Pequabuck River at Forestville, Conn.	38	45.8	25.7	12.7	59.7
Mill River at Dixwell Avenue, Hamden, Conn.	51	28.4	27.2	11.7	60.8
Eaton Brook at Route 10, Hamden, Conn.	49	2.43	24.9	6.30	68.8
Willow Brook at Willow Street, Hamden, Conn.	47	13.0	24.5	8.50	66.7
Mill River near Hamden, Conn.	50	24.5	25.2	11.9	62.7
Muddy River near North Haven, Conn.	54	18.0	22.2	29.8	45.4
Whetstone Brook at mouth at Brattleboro, Vt.	15	28.5	5.80	9.80	83.9
Agricultural basins					
Broad Brook at Broad Brook, Conn.	33	15.5	15.4	38.3	45.7
Tenmile River at South Dover, N.Y.	39	194	11.3	33.8	53.5
Stony Brook near West Suffield, Conn.	32	10.4	13.0	31.3	54.9
Second Branch White River near Bethel, Vt.	8	70.9	2.3	28.0	69.4
Scantic River at Broad Brook, Conn.	34	98.2	12.9	25.8	61.0
Coginchaug River at Middletown, Conn.	43	29.8	15.2	25.2	58.2
Pomperaug River at Southbury, Conn.	44	75.1	15.1	23.5	60.6
Unnamed Tributary to Connecticut River near Haverhill, N.H.	7	2.3	.0	20.1	79.9
Sleepers River near St. Johnsbury, Vt.	2	42.9	.2	18.7	81.1
Great Brook near Walpole, N.H.	14	10.1	2.1	18.3	79.2

Table 6. Distribution of urban, agricultural, and forested land use in basins sampled for pesticides in the Connecticut, Housatonic, and Thames River Basins study, 1993–95—*Continued*

Station name	Map No.	Basin area (mi^2)	Percent urban	Percent agricultural	Percent forested
Agricultural basins--*Continued*					
Konkapot River at Ashley Falls, Mass.	26	61.1	4.6	12.9	80.4
Konkapot River near Canaan, Conn.	28	59.3	4.4	12.6	80.9
Konkapot River at Sodom, Conn.	29	56.4	4.3	12.2	81.4
Konkapot River at Clayton, Conn.	27	55.6	4.1	10.6	83.3
Ottauqueechee River at West Woodstock, Vt.	11	127.6	1.1	7.3	91.2
Cold River at Drewsville, N.H.	13	82.7	1.5	6.5	91
Forested basins					
Ammonoosuc River at Bethlehem Junction, N.H.	5	87.6	0.1	3.8	95.9
Green River near Colrain, Mass.	17	41.3	.5	4.5	94.6
Brooksvale Stream at Mt. Sanford Road, Cheshire, Conn.	45	1.52	2.6	4.0	93.3
Rawson Brook–Wellman Road near Monterey, Mass.	21	8.6	2.2	4.9	91.4
Konkapot River at Hartsville–Mill River Road near Mill River, Mass.	23	34.0	3.4	6.7	86.8
Konkapot River near Mill River, Mass.	25	48.9	3.7	8.3	85.7
Salmon River near East Hampton, Conn.	42	100.0	6.2	13.6	78.7
Integrator basins					
Connecticut River near Middletown, Conn.	41	10,900	4.9	10.8	82.3
Connecticut River at Thompsonville, Conn.	31	9,660	3.0	10.2	84.9
Connecticut River at Montague City, Mass.	19	7860	1.7	9.7	87.2
Connecticut River at West Lebanon, N.H.	10	4090	.7	10.9	87.4
Connecticut River near Dalton, N.H.	3	1510	.2	7.1	91.5
Housatonic River near New Milford, Conn.	40	1022	7.8	17.5	72.7
Connecticut River at North Stratford, N.H.	1	799	.3	7.3	91.0
Chicopee River at Indian Orchard, Mass.	22	689	4.0	9.9	78.5
White River at West Hartford, Vt.	9	690	1.5	14.5	83.7
Farmington River at Tariffville, Conn.	35	577	8.5	8.4	79.8
Deerfield River near West Deerfield, Mass.	20	557	1.2	7.8	89.3
Westfield River near Westfield, Mass.	24	497	4.0	8.4	85.9
Passumpsic River near St. Johnsbury, Vt.	4	436	.5	14.0	85.4
Ashuelot River at Hinsdale, N.H.	16	420	2.8	5.5	89.7
Shetucket River at South Windham, Conn.	37	408	5.6	11.5	80.5
Ammonoosuc River near Bath, N.H.	6	395	.32	7.2	92.2
Millers River at Erving, Mass.	18	372	4.2	5.4	87.5
Sugar River at West Claremont, N.H.	12	269	3.5	7.4	84.7
Naugatuck River at Beacon Falls, Conn.	48	260	17.7	13.2	67.2
Quinebaug River at Quinebaug, Conn.	30	155	5.5	9.0	82.1

Table 7. Fixed-site surface-water-quality monitoring stations of the Connecticut, Housatonic, and Thames River Basins study

[No., number; mi^2, square mile]

Station name	Map No.	Station type	Basin area (mi^2)
Hockanum River near East Hartford, Conn.	36	Urban indicator	73.4
Pequabuck River at Forestville, Conn.	38	Urban indicator	45.8
Rooster River at Fairfield, Conn.	55	Urban indicator	10.6
Norwalk River at Winnipauk, Conn.[1]	56	Urban indicator	33.0
Sleepers River near St. Johnsbury, Vt.	2	Agricultural indicator	42.9
Broad Brook at Broad Brook, Conn.	33	Agricultural indicator	10.4
Tenmile River at South Dover near Wingdale, N.Y.	39	Agricultural indicator	194
Ammonoosuc River at Bethlehem Junction, N.H.	5	Forested indicator	87.6
Green River near Colrain, Mass.	17	Forested indicator	41.4
White River at West Hartford, Vt.	9	Integrator	690
Connecticut River at Thompsonville, Conn.	31	Integrator	9,660
Housatonic River near New Milford, Conn.	40	Integrator	1,022

[1]Intensive fixed site

Because of the difficulty inherent in timing the collection of a single sample to detect pesticides in small, indicator basins following brief, intense storms, much of the sampling effort focused on larger, integrator basins which cumulate flows from many smaller basins. Discharge peaks attenuate which increases the period during which pesticides may be detected as a result of a single storm in these basins. To further enhance the likelihood of detecting pesticides in storm runoff, several major basins were sampled weekly. All of the study's basic fixed sites were sampled, along with an additional 17 sites. Included in these 17 additional sites were 12 integrator stations, 3 agricultural indicators, 1 urban indicator, and 1 forested indicator.

Low-Flow Sampling

Late in the summers of 1994 and 1995, water-quality samples were collected to determine the contribution that ground-water discharge makes to surface-water quality in different land-use areas. At that time of year, runoff typically diminishes and ground-water discharge constitutes the major portion of surface-water base flow. Pesticides detected under these flow conditions were likely to have entered the surface water from ground water, although atmospheric transport was also a possible source. Unlike the high-flux sampling, which emphasized integrator basins, the low-flow sampling focused on relatively small indicator basins representative of urban, agricultural, or forested (undeveloped) land use. Limited resources necessitated a two-year program to sample water quality adequately during low-flow conditions. Therefore, low-flow sampling was undertaken in New York, Connecticut, and Massachusetts in 1994, and in Vermont and New Hampshire in 1995.

Samples were collected for analysis of nutrient and pesticide concentrations at 36 locations. These locations included sites that were selected primarily for intensive studies of ground-water and surface-water interactions. The Norwalk River at Winnipauk, sampled weekly as an intensive fixed site, is the only station with multiple low-flow-period samples.

Short-Term Intensive-Study Sampling

The short-term intensive studies required collecting several samples over a short period of time, typically one to three days. This approach for studying different flow regimes yielded information about pesticide transport in small basins.

Scantic River Basin Runoff Sampling

In spring 1992, shortly after pesticide and fertilizer applications, water-quality samples were collected during a stormwater runoff event at three locations in the 114-square-mile agricultural Scantic River Basin (fig. 3) in north-central Connecticut (Mullaney and Zimmerman, 1997).

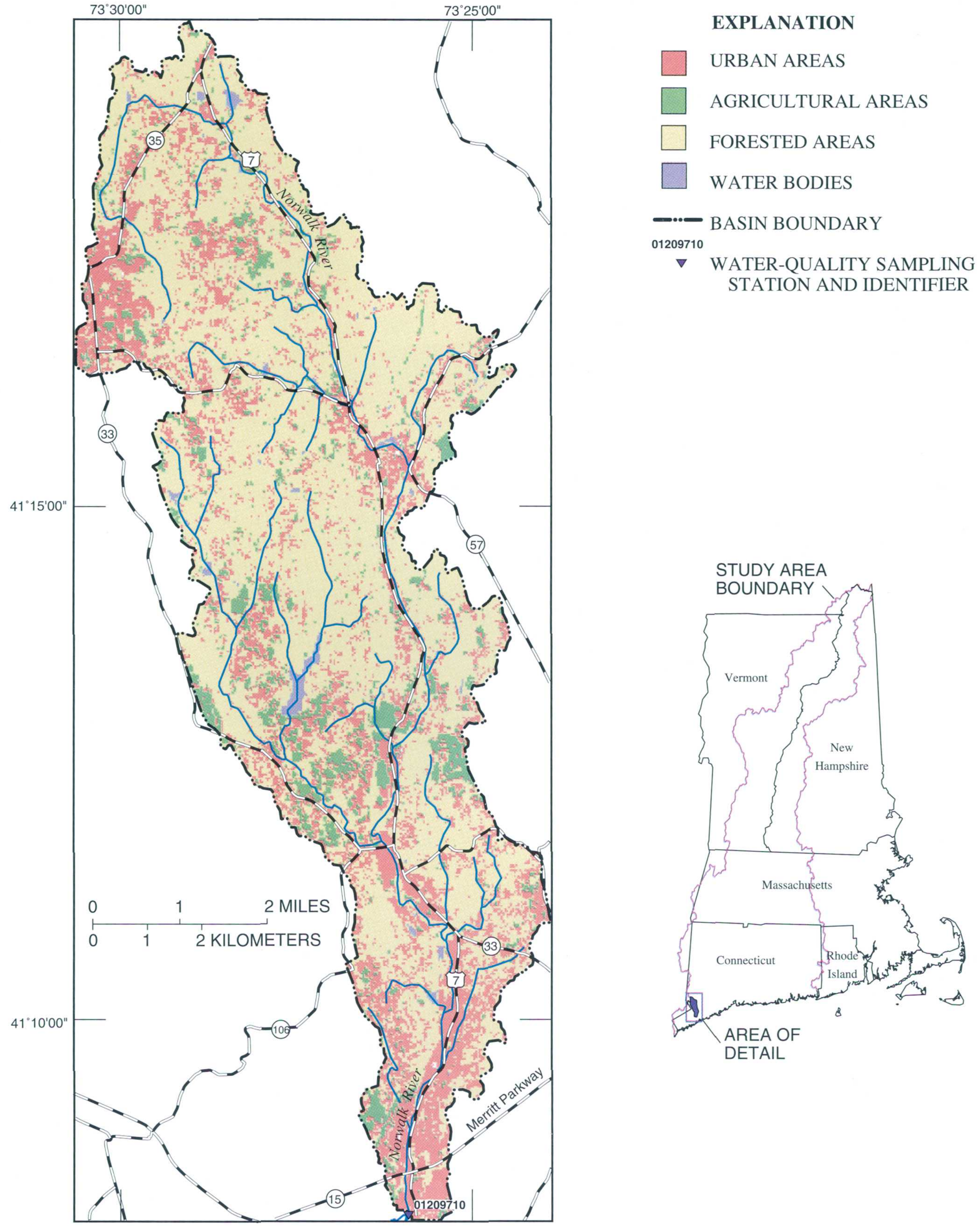

Figure 2. Land use in the basin of the Norwalk River at Winnipauk, Conn.

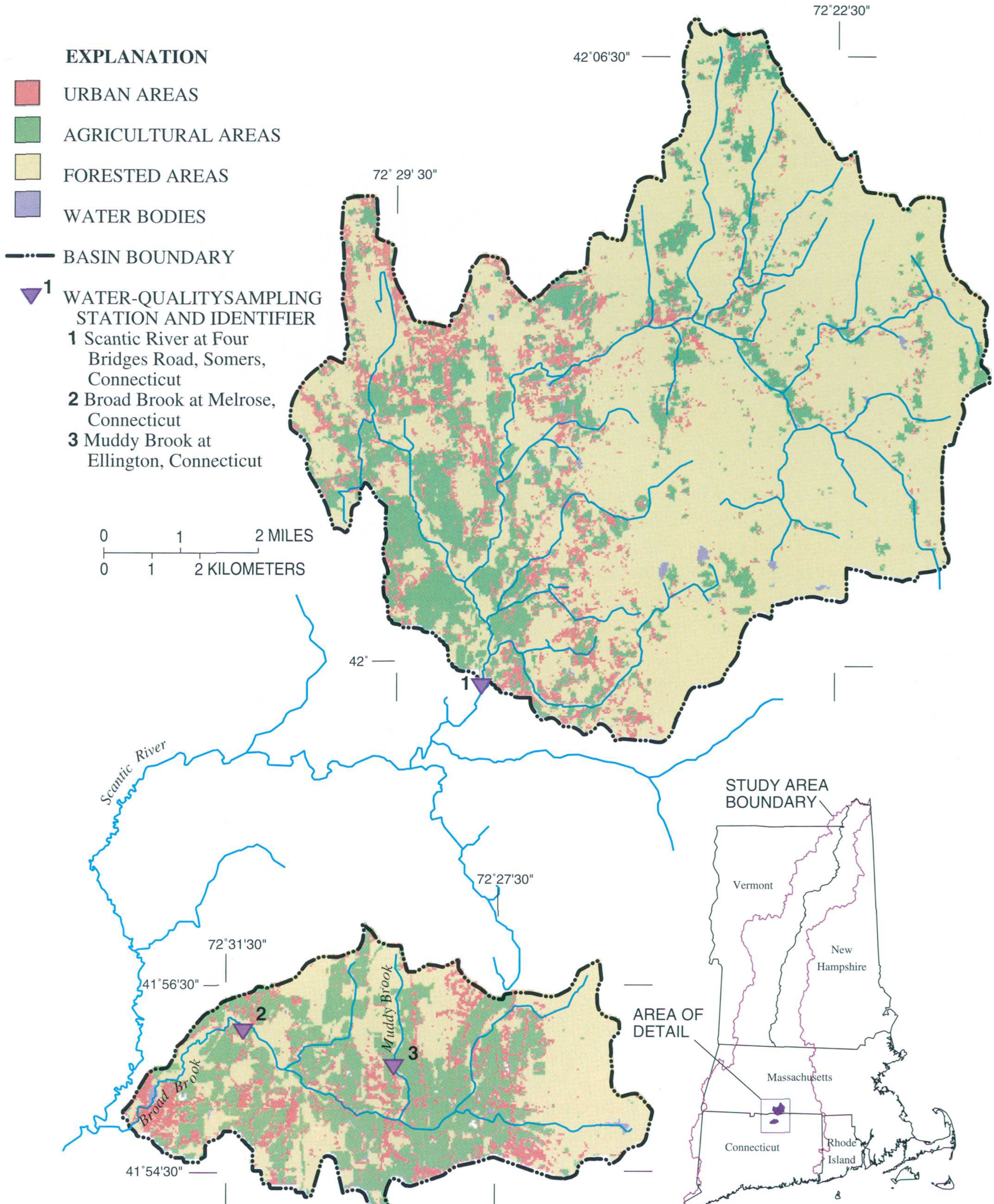

Figure 3. Surface-water-sampling sites in the Scantic River Basin, Connecticut and Massachusetts.

The purpose of this study was to examine the variation of nutrient and pesticide concentrations in stormwater. Samples were collected with automated samplers in order to obtain data over a major portion of the storm hydrograph. Samples were analyzed for selected nitrogen and phosphorus constituents, atrazine, desethylatrazine, and metolachlor.

Ground-Water/Surface-Water Interaction Sampling

Investigations took place in two relatively small river basins to link land use with the interactions between surface water and ground water. In these studies, surface-water-quality samples were collected along a river channel and its tributaries at approximately the same time as ground-water-quality samples were collected from nearby wells. This approach assumes that surface-water quality reflects the ground-water quality.

River basins desirable for study were those along which either the land-use category or intensity of development changed markedly. Hypothesizing that increasing intensity of use would be reflected in higher concentrations of chemical constituents, samples were collected from wells and streams along the land-use gradients.

Intensive, coordinated ground- and surface-water-quality investigations were undertaken during base-flow conditions in the agricultural Konkapot River Basin near Ashley Falls, Mass., in September 1994, and in the urban Mill River Basin near Hamden, Conn., in August 1995. These studies examined differences in water quality as land-use characteristics changed in these basins and provided additional information about the influence of ground water on surface-water quality under low-flow conditions.

In the Konkapot River Basin (61.1 mi^2) near Ashley Falls, Mass., ground-water samples were collected immediately adjacent to seven stream-sampling sites (fig. 4). This sampling plan was designed with the assumption that the surface water and ground water would be closely linked hydrologically during low flow and that water quality would reflect this linkage. Land use changed markedly from primarily forested to primarily agricultural between the towns of Mill River, Mass., and Clayton, Conn., increasing the likelihood that water quality differences would be evident.

In the Mill River Basin (32.2 mi^2) near Hamden, Conn. (fig. 5), transition in land use was not as clear-cut as in the Konkapot River Basin. Most of the upstream area has some residential land use—less than an ideal condition for reference (forested or undeveloped) sites. Unlike the Konkapot River study, ground-water samples were not necessarily collected adjacent to surface-water sampling sites. Ground-water sites were selected to characterize the land use in the vicinity of the stream rather than to match closely the surface-water-quality-sampling stations.

Sampling Protocols

In general, water-quality samples were collected from streams following NAWQA protocols (Shelton, 1994). Most samples were collected by wading, using the equal-width-increment (EWI) sampling method (Edwards and Glysson, 1988). At deep, swift-flowing streams, either a sample-collection bottle was lowered and raised from a bridge with a winch for EWI sampling or a grab sample was taken by wading as far into the stream as was deemed safe. In the Scantic River study, pesticide and nutrient samples were collected with an automated sampling system; some grab samples were also taken.

Sample Processing

Following collection, water samples were passed through a Teflon cone splitter—a device for dividing samples into equal aliquots for the various analyses required by NAWQA protocols (Capel and others, 1995). If the analytical suite included pesticides, the cone splitter received a thorough rinse with methanol as part of the standard cleaning procedure. Most environmental pesticide samples were processed in the field using a Solid-Phase Extraction (SPE) technique (Shelton, 1994) prior to shipping to the NWQL.

Sample Analysis and Quality Control

Surface-water-quality samples in pesticide studies were analyzed for the chemical constituents in the NAWQA laboratory schedules for field-extracted pesticides (schedules 2010 and 2051; table 8), nutrients, major inorganic ions, and dissolved and suspended organic carbon. Pesticide analysis was done by gas chromatography/mass spectrometry (GC/MS) or high-pressure liquid chromatography diode array detection (HPLC/DAD) (Zaugg and others, 1995;

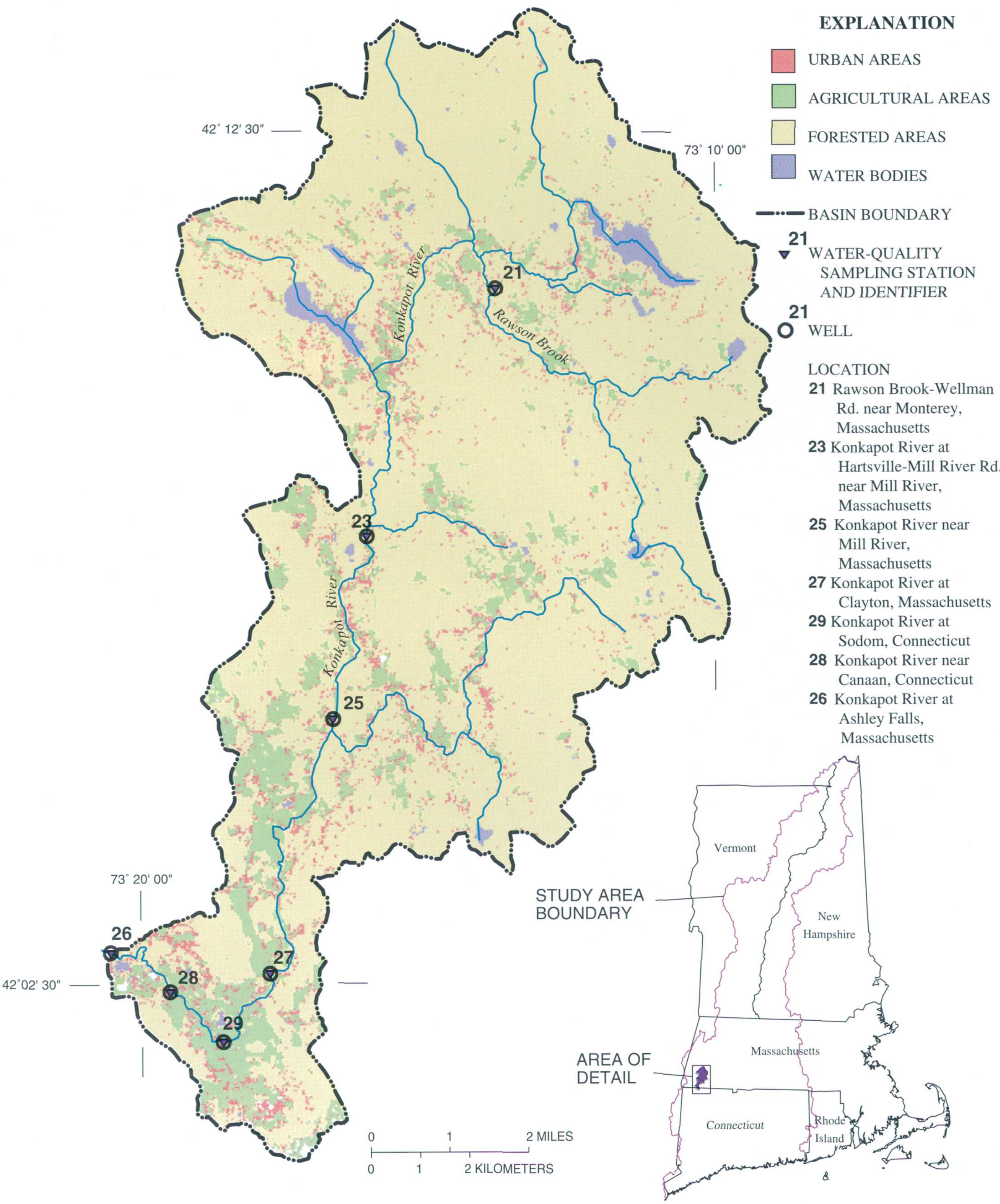

Figure 4. Surface-water- and ground-water-sampling sites in the Konkapot River Basin, Massachusetts and Connecticut.

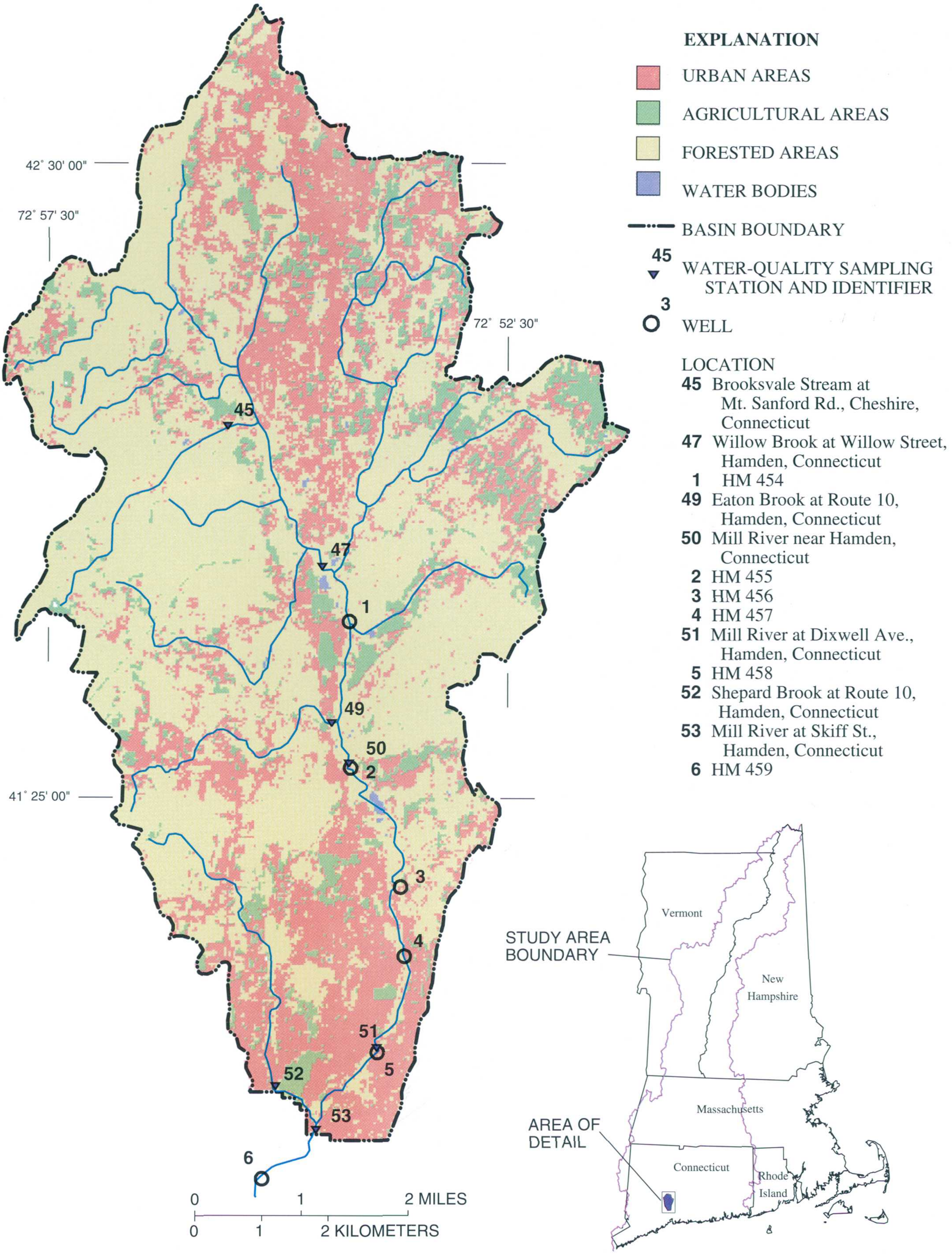

Figure 5. Surface-water- and ground-water-sampling sites in the Mill River Basin near Hamden, Conn.

Table 8. Pesticide schedules and their Method Detection Limits (MDL) using solid phase extraction methodology

[Zaugg and others, 1995; Werner and others, 1996; µg/L, microgram per liter]

Schedule 2010 pesticides			Schedule 2051 pesticides		
Parameter code	Compound name	MDL (µg/L)	Parameter code	Compound name	MDL (µg/L)
49260	Acetochlor	0.002	39742	2,4,5-T	0.035
46342	Alachlor	.002	39732	2,4-D	.035
04040	Atrazine, desethyl	.002	38746	2,4-DB	.035
39632	Atrazine	.001	49315	Acifluorfen	.035
82686	Azinphos, methyl	.001	49312	Aldicarb	.016
82673	Benfluralin	.002	49313	Aldicarb sulfone	.016
04028	Butylate	.002	49314	Aldicarb sulfoxide	.021
82680	Carbaryl	.003	38711	Bentazon	.014
82674	Carbofuran	.003	04029	Bromacil	.035
38933	Chlorpyrifos	.004	49311	Bromoxynil	.035
04041	Cyanazine	.004	49310	Carbaryl	.008
82682	DCPA	.002	49309	Carbofuran	.028
34653	DDE, p,p′-	.006	49308	3-hydroxy Carbofuran	.014
39572	Diazinon	.002	49307	Chloramben	.011
39381	Dieldrin	.001	49306	Chlorothalonil	.035
82660	Diethylaniline	.003	49305	Clopyralid	.050
82677	Disulfoton	.017	49304	Dacthal	.017
82668	EPTC	.002	38442	Dicamba	.035
82663	Ethalfluralin	.004	49303	Dichlobenil	.020
82672	Ethoprop	.003	49302	Dichlorprop	.032
04095	Fonofos	.003	49301	Dinoseb	.035
34253	HCH, α–	.002	49300	Diuron	.020
39341	HCH, γ- (Lindane)	.004	49299	DNOC	.035
82666	Linuron	.002	49298	Esfenvalerate	.019
39532	Malathion	.005	49297	Fenuron	.013
39415	Metolachlor	.002	38811	Fluometuron	.035
82630	Metribuzin	.004	38478	Linuron	.018
82671	Molinate	.004	38482	MCPA	.050
82684	Napropamide	.003	38487	MCPB	.035
39542	Parathion, ethyl	.004	38501	Methiocarb	.026
82667	Parathion, methyl	.006	49296	Methomyl	.017
82669	Pebulate	.004	49295	1-Naphthol	.007
82683	Pendimethalin	.004	49294	Neburon	.015
82687	Permethrin	.005	49293	Norflurazon	.024
82664	Phorate	.002	49292	Oryzalin	.019
04037	Prometon	.018	38866	Oxamyl	.018
82676	Pronamide	.003	49291	Picloram	.050
04024	Propachlor	.007	49236	Propham	.035
82679	Propanil	.004	38538	Propoxur	.035
82685	Propargite	.013	38762	Silvex	.021
04035	Simazine	.005	49235	Triclopyr	.050
82681	Thiobencarb	.002			
82670	Tebuthiuron	.010			
82665	Terbacil	.007			
82675	Terbufos	.013			
82678	Triallate	.001			
82661	Trifluralin	.002			

Werner and others, 1996). Parameters measured in the field at the time of sample collection include air and water temperature, specific conductance, dissolved oxygen, pH, and alkalinity.

Some samples were analyzed using an ELISA method. This assay was used to screen samples for further GC/MS analysis during the Scantic River study in 1992 and to expand the scope of the National high-flux study in 1993.

In addition to samples analyzed for the basic data collection effort, additional SPE-processed samples were collected for quality-control analysis. Several approaches were used for quality control of field-processed SPE samples. The first quality-control technique involved the determination of the efficiency of analyte recovery for the sample methodology. A 1-mL mixture containing known concentrations of several compounds (surrogates) was added to each environmental water-quality sample. The surrogates are compounds structurally similar to the targeted pesticides, but are not found in natural waters. The recovery rate, or efficiency, is calculated by comparing the theoretical concentrations of these surrogates after their addition to the sample with analytically determined concentrations. Although the mean recovery rates varied for the 3 surrogates, *alpha*-HCH-d_6, diazinon-d_{10}, and terbuthylazine, that were added to the schedule 2001/2010 environmental samples in the CONN–NAWQA study, the rates were equal to, or greater than, those described by Zaugg and others (1995) for samples with surrogate concentrations of 0.1 µg/L (table 9). During method development, the recovery surrogate selected for schedule 2050/2051 samples, BDMC, did not perform as expected and "consequently the ability to infer performance for an individual sample has been limited" (Werner and others, 1996). Furthermore, Werner and others (1996) did not report a mean recovery rate which would have enabled comparison with the results in NAWQA studies (table 9).

Overall, method development and testing indicated that results for a few pesticides (or metabolites) were too inconsistent to report with assurance of accuracy. These pesticides (desethylatrazine, carbaryl, carbofuran, azimphos-methyl, and terbacil from schedule 2001/2010; and chlorothalonil, dichlobenil, DNOC, esfenvalerate, and 1-naphthol from schedule 2050/2051), referred to as "poor performers," are all reported as qualitative, or estimated, concentrations (Zaugg and others, 1995; Werner and others, 1996). Of these, only desethylatrazine and carbaryl were detected relatively frequently in the CONN–NAWQA study. The remaining poor performers were rarely, if ever, detected.

The second quality-control procedure analyzed field blanks to ensure that equipment maintenance and sample handling precluded sample contamination. Pesticides were not detected in any of the field blank analyses, indicating that sampling methods and techniques did not introduce contamination or error into the results of the pesticide studies.

A third procedure involved adding a pesticide mixture to blank samples in the field. This mixture contained quantities of each of the targeted pesticides that would yield specific concentrations when diluted to 1 L. In general, the schedule 2001/2010 mixture was designed to yield pesticide concentrations of 0.1 µg/L for 100 percent recovery. Concentrations in the schedule 2050/2051 matrix mixture were more variable than concentrations in the 2001/2010 spikes and would have yielded approximately 1 µg/L with 100 percent recovery. Analysis of these spiked samples provided information on recovery rates for all pesticides. Recovery rates from the samples spiked in the field were comparable to, and frequently closer to 100 percent than, method development testing results (table 10). Data for the 2050/2051 methodology are not included in table 10 because: (1) method development results indicate relatively low recovery and precision versus schedule 2001/2010 results; (2) rare detection of pesticides in the 2050/2051 schedule probably due to lower sensitivity than the 2001/2010 method; and (3) low number of quality control samples. Concerns about the schedule 2050/2051 method have been thoroughly addressed elsewhere (NAWQA/NWQL Quality Assurance Committee for Schedule 2050/2051 Pesticide Method, written commun., December 1, 1995).

In general, the recovery rates for the 2001/2010 surrogate and matrix mixtures in the field and the recovery rates in laboratory method development analyses were very good, usually exceeding 80 percent. Nevertheless, the variability in the results make it difficult to draw general conclusions about the implications of the quality control results or to develop any correction factors to account for recovery rates less than or greater than 100 percent. These issues will be addressed in other NAWQA reports (R.J. Gilliom, U.S. Geological Survey, oral commun., 1997).

Table 9. Comparison among mean surrogate recovery rates for pesticide samples collected during the Connecticut, Housatonic, and Thames River Basins NAWQA study, 1993–95, and samples analyzed during method development

[Zaugg and others, 1996; N is the number of samples tested as a part of field studies; seven samples yielded the results for the method development. Values are in percent of surrogate recovered; --, results not reported]

Surrogate name	Surrogate parameter code	N	Percent recovery, field sample mean (standard deviation)	Percent recovery, method development mean (standard deviation)
Diazinon-d_{10}	91063	138	87.6(25.9)	88(3)
Terbuthylazine	91064	138	109(14.1)	100(2)
HCH-d_6, *alpha*	91065	138	101(19.5)	90(2)
BDMC	99835	124	57.3(35.8)	--

Table 10. Matrix mixture analyses in CONN–NAWQA field samples and NWQL method development samples

[The matrix mixtures were designed to yield concentrations of 0.1µg/L for all compounds except permethrin which was to yield a concentration of 0.03 µg/L. N is the number of samples analyzed for the compounds. µg/L, microgram per liter]

Compound	Parameter code	Field matrix mixture samples (N=5, except Linuron [N=4]) Mean concentration (µg/L)	Method development samples (N=6) Mean concentration, (µg/L)	Compound	Parameter code	Field matrix mixture samples (N=5, except Linuron [N=4]) Mean concentration (µg/L)	Method development samples (N=6) Mean concentration, (µg/L)
Alachlor	P46342	0.111	0.086	Malathion	P39532	0.097	0.090
Aniline, diethyl	P82660	.094	.073	Methylazinphos	P82686	.089	.078
Atrazine	P39632	.105	.089	Methylparathion	P82667	.086	.073
Benfluralin	P82673	.068	.046	Metolachlor	P39415	.116	.092
Butylate	P04028	.101	.080	Metribuzin	P82630	.041	.042
Carbaryl	P82680	.160	.151	Molinate	P82671	.106	.082
Carbofuran	P82674	.077	.108	Napropamide	P82684	.108	.083
Chlorpyrifos	P38933	.100	.083	Pebulate	P82669	.107	.079
Cyanazine	P04041	.033	.096	Pendimethalin	P82683	.067	.046
DCPA	P82682	.116	.082	Permethrin	P82687	.032	.037
DDE, *p,p'*-	P34653	.059	.048	Phorate	P82664	.074	.077
Desethylatrazine	P04040	.009	.012	Prometon	P04037	.102	.077
Diazinon	P39572	.126	.077	Pronamide	P82676	.088	.076
Dieldrin	P39381	.108	.067	Propachlor	P04024	.098	.079
Disulfoton	P82677	.064	.072	Propanil	P82679	.099	.096
EPTC	P82668	.103	.080	Propargite	P82685	.078	.059
Ethalfluralin	P82663	.077	.054	Simazine	P04035	.057	.076
Ethoprop	P82672	.111	.080	Tebuthiuron	P82670	.042	.088
Ethylparathion	P39542	.097	.083	Terbacil	P82665	.038	.075
Fonofos	P04095	.092	.075	Terbufos	P82675	.089	.074
HCH, α-	P34253	.104	.077	Thiobencarb	P82681	.116	.085
HCH, γ-	P39341	.108	.077	Triallate	P82678	.104	.075
Linuron	P82666	.107	.126	Trifluralin	P82661	.072	.047

Data Analysis

Tables containing complete listings of pesticide data are included as appendices at the rear of this report. In the body of the report, shorter tables of selected, most commonly detected pesticides are used to support graphs and relevant descriptions. Summary statistics and graphical analysis are used to examine the temporal and geographic distribution of chemical constituent concentration data. Median and maximum values describe the important concentration data; boxplots and scatterplots depict concentration distributions and temporal variations.

Comparison of numbers of detections of different pesticides in land use categories, or in samples from the same location, may not be very meaningful, because each pesticide is associated with a particular method detection limit (MDL). The USGS defines the MDL of a specific compound as the minimum concentration of the compound that can be identified, measured, and reported with 99-percent confidence that the compound's concentration is greater than zero (Wershaw and others, 1987).

The MDL is a statistically derived concentration. The actual concentration of a given pesticide may be higher than another but, because of individual differences in MDLs, the higher concentration may go unreported; that is, pesticides may be present, but will be unreported, censored, or estimated, when the concentration falls below the MDL. For example, atrazine with an MDL of 0.001 μg/L may have been detected many times, while prometon, with an MDL of 0.018 μg/L might have been present at significantly higher concentrations, but was undetectable using the existing analytical technique. Furthermore, the various pesticides have different molecular weights, making mass concentrations, rather than molarity, a further questionable basis for comparison. Thus, it is important not to infer relative significance when comparing detection frequencies among various pesticides. In other words, certain questions are inappropriate when addressing issues of pesticide occurrence and land use; for example: Why is atrazine detected more frequently than metolachlor (or prometon, or any other pesticide) in agricultural basin samples? The correct response might very well be "because its MDL is lower." The question, intended to relate cause and effect, is inappropriate for the methodology used in developing the pesticide data.

PESTICIDES IN SURFACE WATER

Field studies began in spring 1992 with the runoff study in the Scantic River Basin, expanded to the full-scale NAQWA sampling program in March 1993, and continued through August 1995 (table 11). In the course of the CONN–NAWQA studies, 31 of the 86 different pesticides or their metabolites in the NAWQA pesticide-analysis schedules (table 8) were detected in surface water (table 12). Only two pesticides, atrazine and prometon, were detected in more than 50 percent of samples collected.

Table 11. Summary of pesticide-related water-quality monitoring for the Connecticut, Housatonic, and Thames River Basins study, 1992–95

Study	Purpose	Locations sampled	Number of streams or basins sampled	Time period
Scantic Basin	Nutrients and pesticides in stormwater runoff	Scantic River Basin, north-central Connecticut	3	5/31–6/2/92
Norwalk River	Intensive fixed site	Norwalk River at Winnipauk, Connecticut	1	3/93–8/94
High flux, 1993	National ELISA test	Entire study area	47	6/93
High flux, 1994	Nutrients and pesticides in runoff	Entire study area	29	5/94–6/94
Low flow, 1994	Ground-water discharges to surface water	Connecticut, Massachusetts	21	Summer 1994
Low flow, 1995	Ground-water discharges to surface water	Vermont, New Hampshire	15	Summer 1995
Konkapot River	Ground-water/surface-water interactions	Konkapot River Basin, southwestern Massachusetts, northwestern Connecticut	1	9/6–9/8/94
Mill River	Ground-water/surface-water interactions	Mill River Basin, south-central Connecticut	1	8/21–8/23/95

Table 12. Distribution of numbers of detections of pesticides or their metabolites in surface water by land-use category and specific study in the Connecticut, Housatonic, and Thames River Basins study, 1993–95

[**Urban:** For this analysis, urban samples do not include those collected at the Norwalk River at Winnipauk, Conn. **Totals:** Totals are determined by summing all detections from Norwalk River, urban, agricultural, forested, and integrator columns. **High flux 1994:** Includes seven samples from Norwalk River at Winnipauk, Conn. **Low flow 1994–95:** Includes five samples from Norwalk River at Winnipauk, Conn. Classifications do not imply unique data sets and, hence, data in studies columns may also be included in land-use categories; NSTA, number of stations sampled; NSAM, number of samples collected; NP, number of pesticides (that is, different parameter codes) detected; Pesticide type: H, herbicide; I, insecticide; M, metabolite]

Pesticide name	Parameter code	Pesticide type	Norwalk River	Urban	Agricultural	Forested	Integrator	Totals	High Flux 1994	Low Flow 1994–95	Konkapot River	Mill River
			NSTA=1 NSAM=59 NP=25	NSTA=12 NSAM=16 NP=15	NSTA=16 NSAM=19 NP=15	NSTA=7 NSAM=9 NP=8	NSTA=20 NSAM=36 NP=18	NSTA=56 NSAM=139 NP=33	NSTA=29 NSAM=48 NP=18	NSTA=36 NSAM=41 NP=21	NSTA=7 NSAM=7 NP=4	NSTA=7 NSAM=7 NP=5
2,4-D	39732	H	1		1		1	3	1	1		
Alachlor	46342	H	1		3	1	4	9	7	1		
Atrazine	39632	H	39	9	17	3	27	94	38	25	3	5
Desethylatrazine	04040	M	16	4	13	5	15	52	17	22	6	1
Benfluralin	82673	H	2					2				
Carbaryl	49310	I	7	1	1	1		10	4	1		
Carbaryl	82680	I	19	4		2	5	30	14	6		
Carbofuran	49309	I			1			1		1		
Carbofuran	82674	I			1			1		1		
Chlorpyrifos	38933	I		1			4	5	4	1		
Cyanazine	04041	H	1	1			1	3	1	1		
DCPA	82682	H	13		3		2	18	8	2		
p,p'-DDE	34653	M	2					2		1		
Diazinon	39572	I	18	15	4	1	16	54	24	18		6
Dichlorprop	49302	H	1				1	2		1		
Dieldrin	39381	I		2				2		1		
Disulfoton	82677	I	2					2				
EPTC	82668	H					1	1				
Lindane	39341	I	1					1				
Malathion	39532	I	4	1	1		2	8	4	1		

Table 12. Distribution of numbers of detections of pesticides or their metabolites in surface water by land-use category and specific study in the Connecticut, Housatonic, and Thames River Basins NAWQA study, 1993–95—*Continued*

Pesticide name	Parameter code	Pesticide type	Norwalk River	Urban	Agricultural	Forested	Integrator	Totals	High Flux 1994	Low Flow 1994–95	Konkapot River	Mill River
			NSTA=1 NSAM=59 NP=25	NSTA=12 NSAM=16 NP=15	NSTA=16 NSAM=19 NP=15	NSTA=7 NSAM=9 NP=8	NSTA=20 NSAM=36 NP=18	NSTA=56 NSAM=139 NP=33	NSTA=29 NSAM=48 NP=18	NSTA=36 NSAM=41 NP=21	NSTA=7 NSAM=7 NP=4	NSTA=7 NSAM=7 NP=5
Metolachlor	39415	H	13	5	11	2	26	57	36	10		
Metribuzin	82630	H	3	3	2		3	11	9			
1-Naphthol	49295	I	2					2				
Napropamide	82684	H	1					1				
Pendimethalin	82683	H	1		1			2	1			
Permethrin	82687	I	1					1		1		
Prometon	04037	H	53	9	3	2	8	75	12	17	2	3
Propachlor	04024	H					1	1	1			
Propanil	82679	H	2					2				
Propargite	82685	I		1			4	5	5			
Simazine	04035	H	24	7	6		14	51	20	9		1
Terbacil	82665	H		1				1		1		
Trifluralin	82661	H	3					3				

Intensive Fixed Site

Prometon, an herbicide commonly used along highway and railroad rights-of-way for weed control, was the most frequently detected pesticide in the highly urbanized basin of the Norwalk River (table 12). Prometon was found in about 90 percent of the samples collected at this site. The Norwalk River prometon detections are likely due to the propinquity of the rail and road transportation routes. The highest prometon concentration detected was 0.140 μg/L (table 13). Prometon's Health Advisory Level (HAL) is 100 μg/L (Nowell and Resek, 1994). The other commonly detected pesticides at this site were atrazine, simazine, carbaryl, diazinon, metolachlor, and DCPA, which were each found in at least 20 percent of the samples.

Concentrations of the two most commonly detected pesticides, prometon and atrazine, did not show any clear relations with streamflow (fig. 6). In general, pesticides were detected most often during the spring-through-early-autumn growing season, which was also the most intensive sampling period. Local climate and hydrology may also have affected the results. Summer discharge patterns were markedly different during the two water years when pesticide samples were analyzed. Drought conditions characterized summer 1993 and it rained frequently during summer 1994, resulting in greater than normal discharges. In 1994, consistent, typical, low-flow conditions did not develop until September.

Pesticides were detected more often at the Norwalk site in 1993 than in 1994, although the concentration ranges were similar for both years. From March through August 1993, pesticides were detected 108 times versus 75 times during the same period in 1994 (two more samples were analyzed during the period in 1994 than in 1993). The difference in numbers of detections may be due to the drought conditions in 1993 which may have minimized the dilution of pesticides transported into the stream by runoff, groundwater discharge, or atmospheric deposition.

A total of 24 pesticides (carbaryl is not counted twice as parameter codes 49310 and 82680) and metabolites were detected at the Norwalk site; 16 were herbicides (including 1 metabolite) and 8 were insecticides (including 1 metabolite). Although 24 pesticides and metabolites were detected, the frequencies of detection and concentrations detected were generally so low that only 2 pesticides, the herbicides prometon and atrazine, had median values that exceeded their detection limits (fig. 7, table 14 and table 31, at back of report).

Carbaryl (parameter code 82680 on schedule 2001/2010), the most frequently detected insecticide, appeared in 19 of 59 samples analyzed for this compound; its highest concentration was 3.20 μg/L (fig. 7, table 13). This carbaryl concentration was among the highest pesticide concentrations detected in surface-water samples analyzed with the SPE methodology during the study period. Although a relatively high concentration, 3.20 μg/L is still less than 0.5 percent of the 700 μg/L MCL for carbaryl.

Multi-Week Synoptic Studies

In order to sample many basins throughout the study area, the NAWQA synoptic studies were usually conducted over several weeks. Thus, individual storm effects or specific climatic conditions may have varied, but overall the general conditions were as similar as possible.

High Flux—1993

In 1993, the National ELISA study detected atrazine twice—at concentrations of 0.11 μg/L at Broad Brook at Broad Brook, Conn., and 0.17 μg/L at the Hockanum River at East Hartford, Conn. Difficulties were encountered with the analysis for 2,4-D and no detections were reported.

In contrast, pesticides were detected in 15 of 62 samples in the local study (table 15). Atrazine was detected at 11 sampling sites. A comparison of the local ELISA analyses of samples that were also analyzed as part of the National program indicated that the atrazine concentrations of 0.11 μg/L at Broad Brook and 0.12 μg/L at the Hockanum River were similar to the National study's results. Metolachlor was detected at seven sites and 2,4-D at eight sites in the local study.

At two locations, the Quinebaug River at Quinebaug, Conn., and the Muddy River near North Haven, Conn., atrazine concentrations exceeded the MCL of 3.0 μg/L. Concentrations of 2,4-D and metolachlor were also relatively high at these sites but did not exceed the MCL of 70 μg/L for 2,4-D or the HAL of 100 μg/L for metolachlor.

Table 13. Concentrations of selected pesticides detected at the Norwalk River at Winnipauk, Connecticut, 1993–94

[Parameter code for carbaryl (82860) is included to distinguish its detection on schedule 2010 from carbaryl (49310) on schedule 2050. Concentrations are in micrograms per liter. E, indicates an estimated value; ft^3/s, cubic foot per second; <, actual value is less than method detection limit; --, missing data]

Sampling date	Streamflow (ft^3/s)	Atrazine	Carbaryl (82680)	Diazinon	Metolachlor	Prometon	Simazine
3/17/93	92	<0.001	<0.003	<0.002	<0.002	0.031	<0.005
3/26/93	303	<.001	<.003	.013	<.002	.028	.013
3/31/93	260	.010	E.008	.012	<.002	.021	.013
4/08/93	120	<.001	<.003	<.002	<.002	.023	<.005
4/12/93	137	--	--	--	--	--	--
4/22/93	165	.007	E.006	.020	.005	.027	.016
4/29/93	109	.007	<.003	.007	<.002	.025	.009
5/03/93	72	.010	<.003	<.002	<.002	E.012	.027
5/10/93	47	.009	<.003	<.002	<.002	E.016	.007
5/21/93	31	.011	E.014	<.002	<.002	.018	.028
5/26/93	18	.013	E.010	<.002	<.002	E.015	.022
6/02/93	38	.009	E.130	.016	.003	.027	.017
6/08/93	17	.008	E.018	<.002	.003	.026	.007
6/15/93	9.9	.011	E.013	<.002	.003	.018	.008
6/21/93	7.9	.012	E3.20	<.002	<.002	.069	.006
6/28/93	9.0	.015	E.430	.052	.007	.029	.005
7/07/93	5.2	.008	<.003	<.002	.002	.043	<.005
7/12/93	3.7	.009	<.003	<.002	<.002	E.013	.005
7/19/93	2.8	.015	<.003	<.002	<.002	.022	.005
7/26/93	2.3	.010	<.003	<.002	<.002	.025	<.005
8/10/93	2.4	.011	<.003	<.002	<.002	.024	<.005
8/26/93	2.8	.010	E.013	<.002	<.002	.039	<.005
8/31/93	2.4	<.001	<.003	<.002	<.002	<.018	<.005
9/07/93	1.8	.023	E.084	.019	E.001	.043	E.004
9/15/93	2.6	.011	E.007	<.002	<.002	.032	.007
9/20/93	4.2	.009	<.003	<.002	.002	.020	.005
9/27/93	14	.005	E.008	<.002	<.002	.027	E.003
10/4/93	E22	--	--	--	--	--	--
10/13/93	E18	<.001	<.003	.022	<.002	.035	<.005
10/19/93	7.0	.008	<.003	<.002	<.002	.021	<.005
10/25/93	16	<.001	<.003	<.002	<.002	E.011	<.005
11/08/93	22	.007	<.003	<.002	<.002	.025	.100
11/22/93	E15	<.001	<.003	<.002	<.002	E.017	.013
12/07/93	13	<.001	<.003	.013	<.002	<.018	<.005
1/13/94	E23	.009	<.003	<.002	<.002	.025	.005
2/01/94	E15	--	--	--	--	--	--
3/14/94	E195	<.001	<.003	<.002	<.002	E.016	<.005
3/21/94	E116	<.001	<.003	<.002	<.002	.018	<.005
3/29/94	--	<.001	<.003	<.002	<.002	.022	<.005
4/07/94	170	<.001	<.003	<.002	<.002	.021	<.005
4/12/94	E86	.004	<.003	<.002	<.002	.018	<.005
4/19/94	105	<.001	<.003	<.002	<.002	.022	<.005
4/25/94	E63	<.001	<.003	<.002	<.002	.019	<.005
5/04/94	E45	.005	<.003	<.002	<.002	E.017	<.005
5/10/94	63	<.001	<.003	<.002	.003	E.016	<.005

Table 13. Concentrations of selected pesticides detected at the Norwalk River at Winnipauk, Connecticut, 1993–94—*Continued*

Sampling date	Streamflow (ft^3/s)	Atrazine	Carbaryl (82680)	Diazinon	Metolachlor	Prometon	Simazine
5/17/94	181	0.004	E0.023	0.013	<0.002	<0.018	<0.005
5/25/94	E44	.010	E.022	<.002	.004	.019	E.004
5/31/94	E23	.007	<.003	<.002	<.002	<.018	<.005
6/07/94	E18	.005	<.003	<.002	<.002	<.018	<.005
6/14/94	E97	.008	E.120	.039	.006	.033	E.004
6/22/94	E21	.015	E.720	.044	.016	.021	<.005
6/28/94	E27	.006	E.016	.011	<.002	.022	<.005
7/06/94	E13	<.001	<.003	<.002	<.002	.029	<.005
7/12/94	16	.007	<.003	.006	<.002	.022	<.005
7/19/94	E10	.006	<.003	<.002	<.002	.024	<.005
7/26/94	E6.0	<.001	<.003	<.002	.005	.034	<.005
8/02/94	E33	.005	<.003	.015	<.002	.027	<.005
8/09/94	E15	.006	<.003	.010	<.002	.026	<.005
8/16/94	E16	.007	<.003	.009	<.002	.041	<.005
8/22/94	E68	<.001	E.019	.032	<.002	.140	<.005
8/30/94	E29	<.001	<.003	<.002	<.002	.029	<.005

High Flux—1994

A total of 17 different pesticides or their metabolites was detected in 48 samples collected during this period (table 12); five were insecticides and 12 were herbicides. Pesticides were detected at 27 of 29 locations sampled. Eleven pesticides were detected in urban, 11 in agricultural, 5 in forested, and 16 in integrator basin samples. At sixteen of the stations, 5 or more pesticides were detected in individual samples. The most commonly detected pesticides were atrazine, metolachlor, diazinon, simazine, carbaryl, and prometon (fig. 8, table 16). Eleven of the detections represented the highest concentrations detected using the SPE methods during the entire CONN–NAWQA study for the following pesticides: 2,4-D, alachlor, atrazine, chlorpyrifos, DCPA, malathion, metolachlor, metribuzin, pendimethalin, propachlor, and propargite.

Atrazine, metolachlor, and diazinon were found in 50 percent or more of the samples; atrazine was detected in 79 percent, metolachlor in 75 percent, and diazinon in 50 percent. Of the 12 prometon detections, 4 concentrations exceeded the MDL (all were from the Norwalk River at Winnipauk, Conn.), the remaining 8 values were estimated (that is, less than the MDL of 0.018 μg/L) (fig. 8, table 16).

A single sample, collected on June 13 from the Pomperaug River at Southbury, Conn., had the highest concentrations of seven of the pesticides or metabolites detected during the high-flux study: alachlor, atrazine, carbaryl, desethylatrazine, metribuzin, and pendimethalin (table 17). The streamflow recorded on this date was 284 cubic feet per second, a rate in the highest 10 percent for this station over the 1933–95 period of record. Eleven pesticides were detected in this sample; only two were insecticides—diazinon and carbaryl (parameter code 49310).

At the stations sampled several times during the high-flux study, relations varied among numbers of pesticides detected, peak concentrations, timing, and streamflow (fig. 9; tables 16 and 17). In general, samples collected in the middle of June had the highest numbers of pesticide detections at the multiple-sample sites, with 4 sites having their highest numbers of detections on June 10th or 14th. At the Norwalk River at Winnipauk, 9 pesticides were detected on June 14th, the date on which the discharge was second greatest during the high-flux study (fig. 6). On June 10th, highest frequencies of detection occurred at the Naugatuck River at Beacon Falls, Conn. (7 pesticides), the Farmington River at Tariffville, Conn. (4 pesticides), and the Connecticut River at

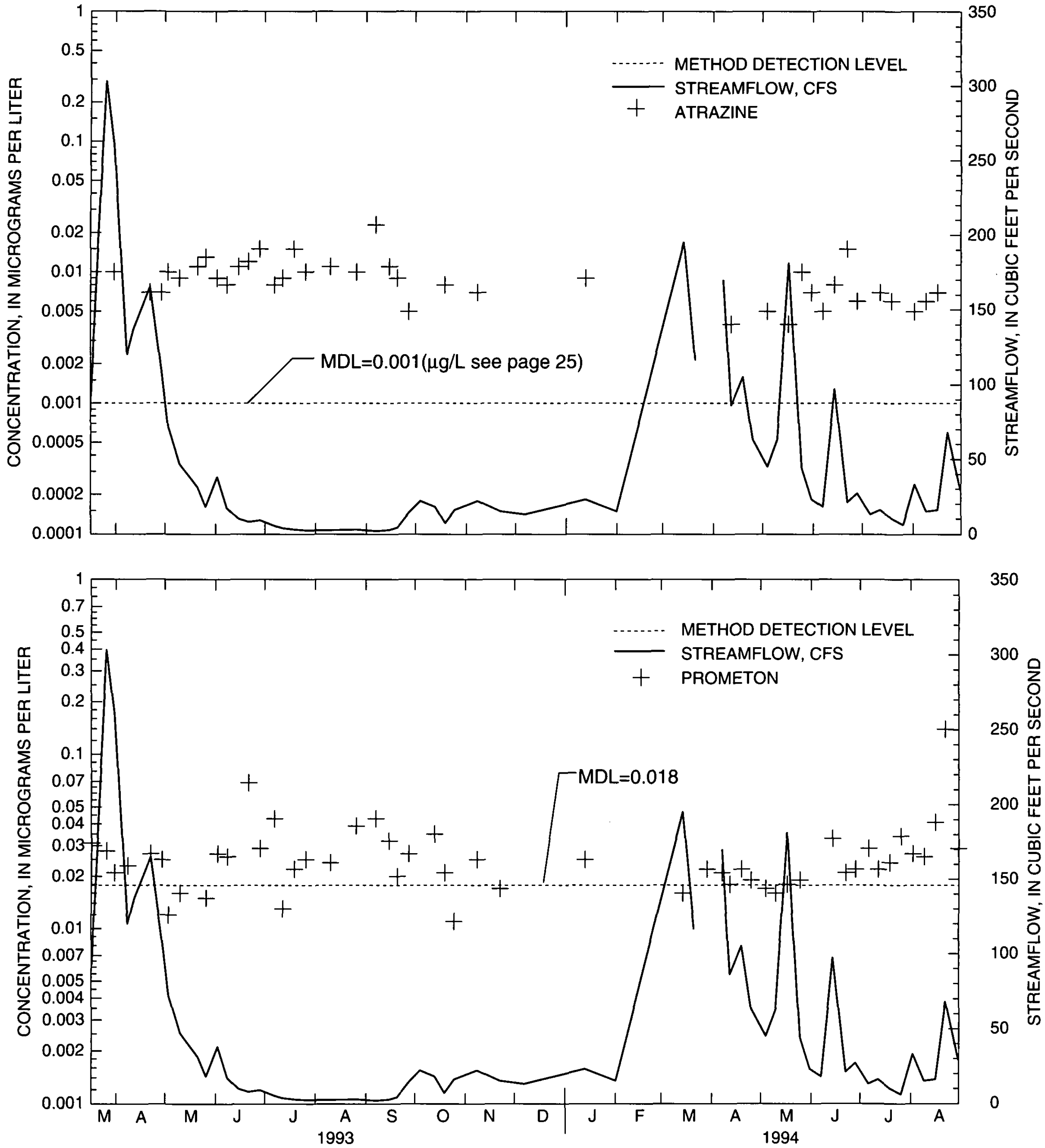

Figure 6. Atrazine and prometon concentrations and streamflow at the Norwalk River at Winnipauk, Connecticut, 1993–94.

Thompsonville, Conn. (5 pesticides); these samples were also associated with the lowest streamflows sampled during this high-flux study. These streams are affected by upstream regulation. The highest number of detections at the Housatonic River near New Milford, Conn., and the White River at West Hartford, Vt., occurred on May 26th and June 29th, respectively, when discharges were greatest among sampling dates during the high-flux study.

Peak concentrations of pesticides detected at the multiple-sample stations were not unusually high (fig. 9), with the exception of a 4.3 µg/L concentration of the insecticide malathion on May 25th at the Naugatuck River (table 17).

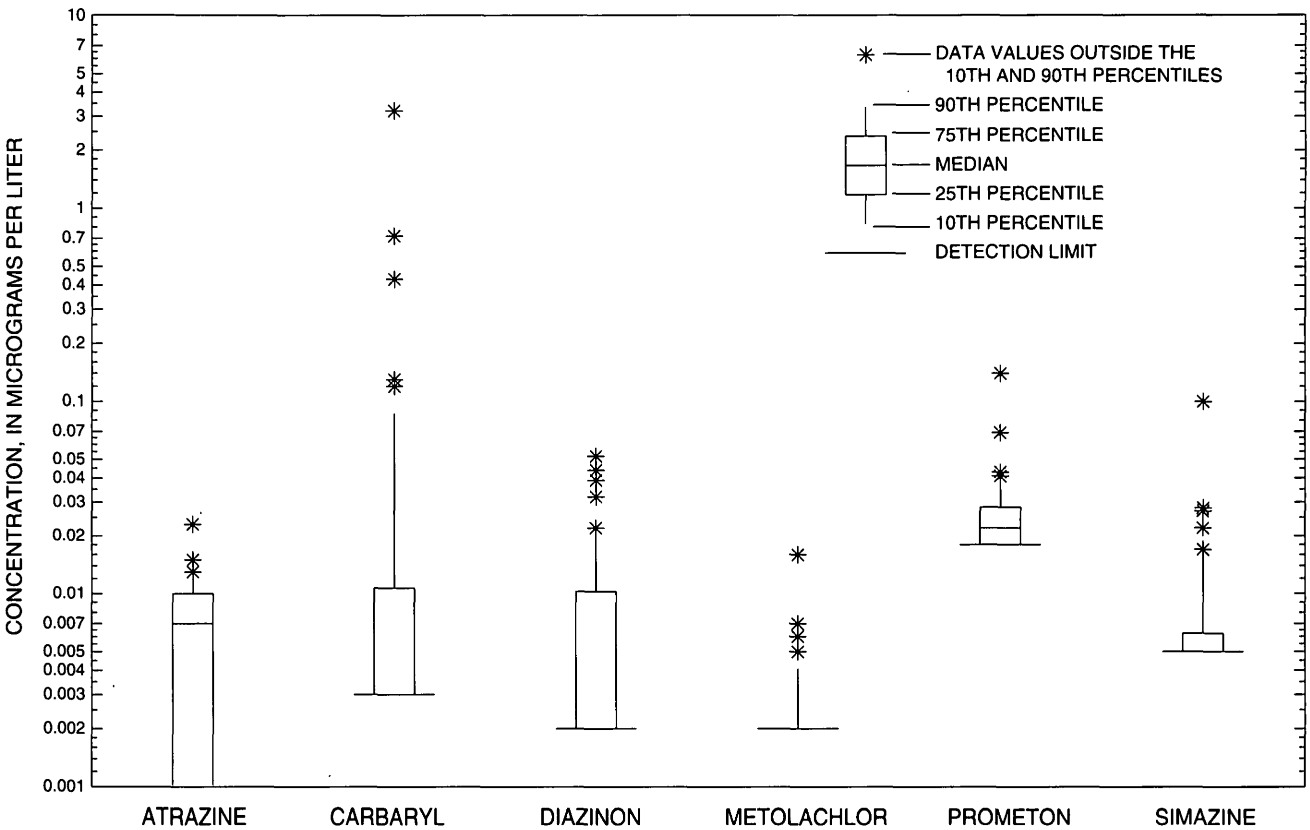

Figure 7. Most frequently detected pesticides at the Norwalk River at Winnipauk, Connecticut, 1993–94.

Table 14. Summary statistics for the most commonly detected pesticides in water-quality samples collected from March 1993 to August 1994 at the Norwalk River at Winnipauk, Connecticut

[µg/L, microgram per liter; <, actual value is less than method detection limit]

Pesticide name	Parameter code	Pesticide concentrations, (in µg/L)		Percent of samples in which values were less than or equal to those shown		
		Maximum	Minimum	75 percent	50 percent (median)	25 percent
Atrazine	39632	0.023	<0.001	0.010	0.007	<0.001
Carbaryl	82680	3.200	<.003	.010	<.003	<.003
DCPA	82682	.006	<.002	<.002	<.002	<.002
Diazinon	39572	.052	<.002	.010	<.002	<.002
Metolachlor	39415	.016	<.002	<.002	<.002	<.002
Prometon	04037	.140	<.018	.028	.022	.018
Simazine	04035	.100	<.005	.006	<.005	<.005

Table 15. Pesticides detected using ELISA methodology, June 6–28, 1993

[Concentrations are in micrograms per liter. ELISA, enxyme-linked immunosorbent assay; H, > calibration range; D, result from sample diluted to appropriate concentration for analysis; No., number; µg/L, microgram per liter; --, not detected; *, reanalyzed sample to verify high concentrations]

Site description	Station identification No.	Pesticide concentrations (µg/L)		
		Atrazine	Metolachlor	2,4-D
Halls Stream near East Hereford, Quebec, Canada	01129300	--	--	1.30
Upper Ammonoosuc River near Colebrook, N.H.	01130000	--	--	1.09
Passumpsic River at Passumpsic, Vt.	01135500	--	--	.74
West River at Newfane, Vt.	01156000	0.06	--	--
Quinebaug River at Quinebaug, Conn.	01124000	3.13 10.99* H	4.49 7.05* H	298.86 175.2* H 21.9D
Stony Brook at West Suffield, Conn.	01184100	.12	.06	--
Broad Brook at Broad Brook, Conn.	01184490	.11	.10	--
Mt. Hope River near Warrenville, Conn.	01121000	--	--	1.56 1.25
West Branch Naugatuck River at Torrington, Conn.	01205600	.06	--	.96
North Branch Park River at Hartford, Conn.	01191000	.15	.08	--
Hockanum River near East Hartford, Conn.	01192500	.12	.06	--
Tenmile River at South Dover near Wingdale, N.Y.	01199900	.24	--	--
Yantic River at Yantic, Conn.	01127500	.85	.41	3.49
Pomperaug River at Southbury, Conn.	01204000	.09	--	--
Muddy River near North Haven, Conn.	01196580	4.50	1.21	46.87

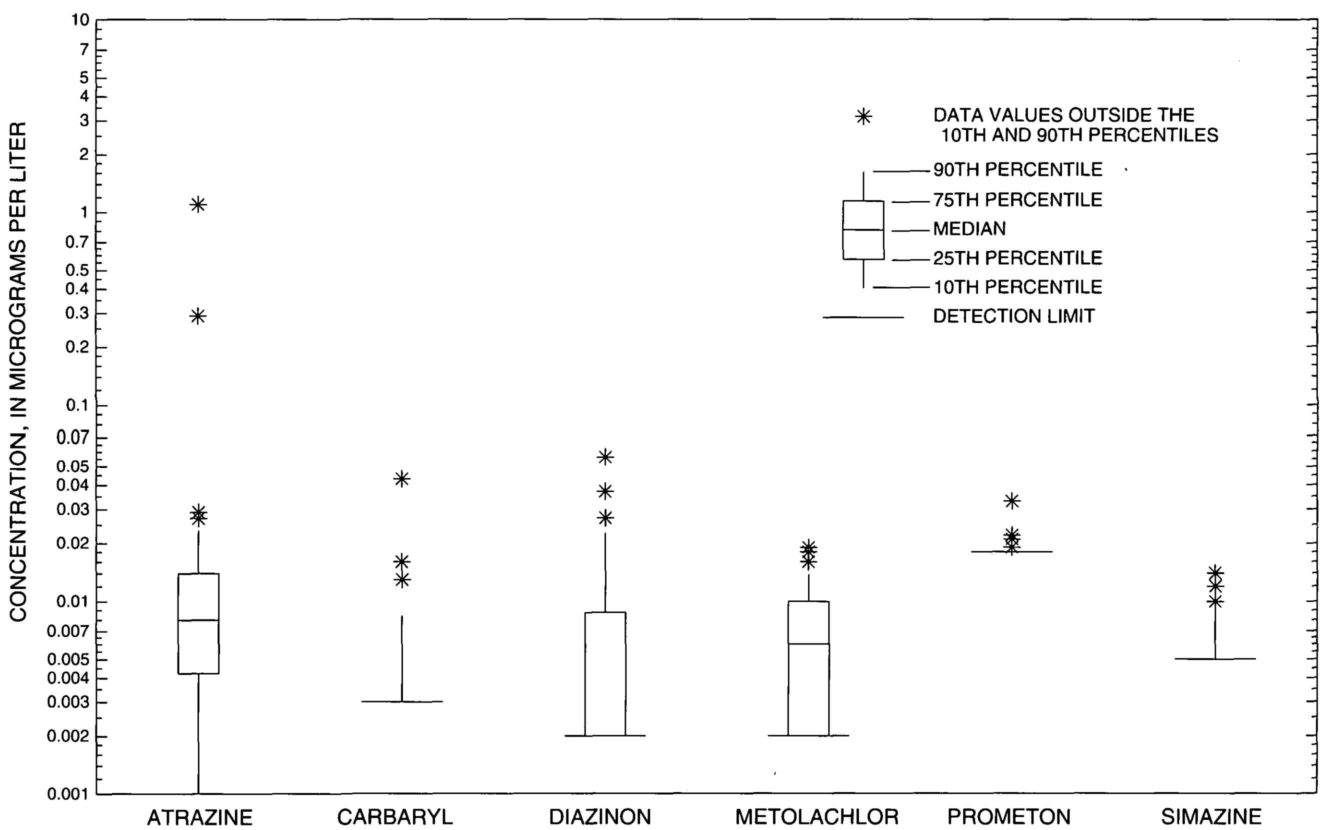

Figure 8. Concentrations of selected pesticides in streams under high-flow conditions following pesticide application in 1994. Samples from Norwalk River at Winnipauk, Connecticut, are not included.

Table 16. Concentrations of selected pesticides detected using SPE methodology during the high-flux period in 1994 in the Connecticut, Housatonic, and Thames River Basins study

[Concentrations of pesticides are in micrograms per liter. Parameter code for carbaryl (82860) is included to distinguish its detection on schedule 2010 from carbaryl (49310) on schedule 2050. SPE, special phase extraction; E, indicates an estimated value; No., number; ft^3/s, cubic foot per second; <, actual value is less than method detection limit; --, indicates missing data]

Station No.	Station name	Sampling date	Streamflow (ft^3/s)	Atrazine	Carbaryl (82680)	Diazinon	Metolachlor	Prometon	Simazine
01135300	Sleepers River (Site W-5) near St. Johnsbury, Vt.	6/22/94	32	0.013	<0.003	<0.002	0.005	<0.018	<0.005
01184490	Broad Brook at Broad Brook, Conn.	6/01/94	20	.027	<.003	<.002	.078	<.018	<.005
01184500	Scantic River at Broad Brook, Conn.	6/02/94	--	.023	<.003	.007	.051	<.018	<.005
01192883	Coginchaug River at Middlefield, Conn.	6/13/94	19	.012	E.012	.003	.012	<.018	.005
01199900	Tenmile River at South Dover near Wingdale, N.Y.	6/13/94	339	.290	E.011	<.002	.040	E.012	.007
01131500	Connecticut River near Dalton, N.H.	6/30/94	2,530	.008	<.003	<.002	<.002	<.018	<.005
01135500	Passumpsic River at Passumpsic, Vt.	6/22/94	726	.014	<.003	<.002	.006	<.018	<.005
01144000	White River at West Hartford, Vt.	6/06/94	740	<.001	<.003	<.002	.012	<.018	<.005
01144000	White River at West Hartford, Vt.	6/16/94	608	.014	<.003	<.002	.012	<.018	.008
01144000	White River at West Hartford, Vt.	6/23/94	400	.009	<.003	<.002	.009	E.005	.012
01144000	White River at West Hartford, Vt.	6/29/94	1,080	.029	<.003	<.002	.013	<.018	.014
01144500	Connecticut River at West Lebanon, N.H.	6/30/94	1,810	.007	<.003	<.002	.005	<.018	.009
01161000	Ashuelot River at Hinsdale, N.H.	6/27/94	245	.008	E.006	.006	.008	E.004	<.005
01166500	Millers River at Erving, Mass.	6/28/94	124	.008	E.007	.016	<.002	<.018	<.005
01170000	Deerfield River near West Deerfield, Mass.	6/28/94	592	<.001	<.003	<.002	<.002	<.018	<.005
01170500	Connecticut River at Montague City, Mass.	6/27/94	9,030	.013	<.003	<.002	.010	<.018	.006
01177000	Chicopee River at Indian Orchard, Mass.	6/27/94	110	.006	<.003	.007	.006	<.018	<.005
01183500	Westfield River near Westfield, Mass.	6/27/94	235	.017	<.003	.006	.007	<.018	.010
01184000	Connecticut River at Thompsonville, Conn.	5/24/94	19,200	.005	<.003	<.002	.006	<.018	E.003
01184000	Connecticut River at Thompsonville, Conn.	6/02/94	18,500	<.001	<.003	<.002	.006	<.018	<.005
01184000	Connecticut River at Thompsonville, Conn.	6/10/94	12,000	.009	<.003	.009	.008	<.018	.005
01189995	Farmington River at Tariffville, Conn.	5/18/94	2,010	<.001	<.003	.010	.003	<.018	<.005
01189995	Farmington River at Tariffville, Conn.	5/24/94	1,200	.005	<.003	E.001	.006	<.018	E.003
01189995	Farmington River at Tariffville, Conn.	6/02/94	834	<.001	<.003	<.002	.008	<.018	<.005
01189995	Farmington River at Tariffville, Conn.	6/10/94	666	.005	<.003	.005	.006	<.018	E.003
01193000	Connecticut River at Middletown, Conn.	6/22/94	--	.019	<.003	.008	.019	<.018	.009
01200600	Housatonic River near New Milford, Conn.	5/26/94	1,400	.011	<.003	<.002	.011	E.008	E.004
01200600	Housatonic River near New Milford, Conn.	6/07/94	848	.008	<.003	<.002	.018	<.018	<.005
01200600	Housatonic River near New Milford, Conn.	6/28/94	584	.014	<.003	<.002	.013	E.010	<.005
01204000	Pomperaug River at Southbury, Conn.	6/13/94	284	1.10	<.003	.006	.910	E.012	.031

Table 16. Concentrations of selected pesticides detected using SPE methodology during the high-flux period in 1994 in the Connecticut, Housatonic, and Thames River Basins study—*Continued*

Station No.	Station name	Sampling date	Streamflow (ft³/s)	Atrazine	Carbaryl (82680)	Diazinon	Metolachlor	Prometon	Simazine
01208500	Naugatuck River at Beacon Falls, Conn.	5/17/94	1,000	<0.001	<0.003	0.037	0.004	<0.018	<0.005
01208500	Naugatuck River at Beacon Falls, Conn.	5/25/94	403	.012	<.003	.015	<.002	E.013	<.005
01208500	Naugatuck River at Beacon Falls, Conn.	6/01/94	263	.011	<.003	<.002	<.002	<.018	<.005
01208500	Naugatuck River at Beacon Falls, Conn.	6/10/94	148	<.001	E.013	.021	<.002	<.018	<.005
01209710	Norwalk River at Winnipauk, Conn.	5/17/94	181	.004	E.023	.013	<.002	<.018	<.005
01209710	Norwalk River at Winnipauk, Conn.	5/25/94	E44	.010	E.022	<.002	.004	.019	E.004
01209710	Norwalk River at Winnipauk, Conn.	5/31/94	E23	.007	<.003	<.002	<.002	<.018	<.005
01209710	Norwalk River at Winnipauk, Conn.	6/07/94	E18	.005	<.003	<.002	<.002	<.018	<.005
01209710	Norwalk River at Winnipauk, Conn.	6/14/94	E97	.008	E.120	.039	.006	.033	E.004
01209710	Norwalk River at Winnipauk, Conn.	6/22/94	E21	.015	E.720	.044	.016	.021	<.005
01209710	Norwalk River at Winnipauk, Conn.	6/28/94	E27	.006	E.016	.011	<.002	.022	<.005
01137500	Ammonoosuc River at Bethlehem Junction, N.H.	6/22/94	306	<.001	<.003	<.002	<.002	<.018	<.005
01170100	Green River near Colrain, Mass.	6/14/94	47	.004	E.011	<.002	.003	<.018	<.005
01193500	Salmon River near East Hampton, Conn.	6/13/94	161	.008	E.016	.006	.007	<.018	<.005
01189000	Pequabuck River at Forestville, Conn.	6/14/94	88	.015	E.009	.100	.015	E.012	.010
01192500	Hockanum River near East Hartford, Conn.	6/02/94	80	.018	E.019	.009	.024	<.018	.010
01196500	Quinnipiac River at Wallingford, Conn.	6/01/94	110	<.001	<.003	.018	.006	<.018	<.005
01208873	Rooster River at Fairfield, Conn.	5/31/94	7.8	<.001	<.003	.007	<.002	<.018	.037

Low Flow—1994, 1995

Atrazine, diazinon, prometon, and metolachlor were the most commonly detected pesticides during the late-summer low-flow periods; of these, only atrazine was detected in more than half of the samples (fig. 10). Pesticides and their metabolites were detected 120 times in 41 samples (table 12). Pesticides detected in surface water under low-flow conditions were characterized by having fewer high concentrations than were observed during the high-flux sampling (table 18). Among the most commonly detected pesticides (tables 16 and 19), prometon and simazine were the only ones with higher concentration ranges during low-flow periods than during the high-flux period (fig. 10). Simazine was only detected nine times during low flow and a single, relatively high concentration of 0.69 µg/L was an order of magnitude higher than the next highest concentration.

A total of 19 different pesticides or metabolites was detected during low-flow conditions: 10 were herbicides and nine were insecticides—a more even balance between these major groupings of pesticides than during the high-flux study. Many herbicides are applied early in the spring, before weeds germinate; in contrast, many insecticides are applied during the growing season to kill active insects. However, the majority of the 120 pesticide detections were herbicides and six of the insecticides were detected only once.

The continued presence of pesticides at low concentrations in surface water during low flow periods indicates that ground water is a likely source of these compounds under these conditions. The relatively high concentrations of prometon and simazine suggests that these compounds may enter streams as a result of multiple applications throughout the growing season. Wind-driven transport may also have a role in the movement of pesticides to streams.

Table 17. Sampling locations and pesticides detected using SPE methodology during the high-flux period in 1994 in the

[Concentrations are in micrograms per liter; Parameter codes for carbaryl (82860) and (49310) are included to distinguish detections on schedule 2010 from method detection limit; --, indicates missing data]

Station No.	Station name	Sampling date	Streamflow (ft³/s)	2,4-D	Alachlor	Atrazine	Carbaryl (49310)	Carbaryl (82680)	Chlorpyrifos	Cyanazine
01135300	Sleepers River (Site W-5) near. St. Johnsbury, Vt.	6/22/94	32	<0.035	<0.002	0.013	<0.008	<0.003	<0.004	<0.004
01184490	Broad Brook at Broad Brook, Conn.	6/01/94	20	<.035	<.002	.027	<.008	<.003	<.004	<.004
01184500	Scantic River at Broad Brook, Conn.	6/02/94	--	<.035	<.002	.023	<.008	<.003	<.004	<.004
01192883	Coginchaug River at Middlefield, Conn.	6/13/94	19	<.035	<.002	.012	<.008	E.012	<.004	<.004
01199900	Tenmile River at South Dover near Wingdale, N.Y.	6/13/94	339	<.035	.054	.290	<.008	E.011	<.004	<.004
01131500	Connecticut River near Dalton, N.H.	6/30/94	2,530	<.035	<.002	.008	<.008	<.003	<.004	<.004
01135500	Passumpsic River at Passumpsic, Vt.	6/22/94	726	<.035	<.002	.014	<.008	<.003	<.004	<.004
01144000	White River at West Hartford, Vt.	6/06/94	740	<.035	<.002	<.001	<.008	<.003	<.004	<.004
01144000	White River at West Hartford, Vt.	6/16/94	608	<.035	<.002	.014	<.008	<.003	<.004	<.004
01144000	White River at West Hartford, Vt.	6/23/94	400	<.035	<.002	.009	<.008	<.003	<.004	<.004
01144000	White River at West Hartford, Vt.	6/29/94	1,080	<.035	.006	.029	<.008	<.003	<.004	<.004
01144500	Connecticut River at West Lebanon, N.H.	6/30/94	1,810	<.035	<.002	.007	<.008	<.003	<.004	<.004
01161000	Ashuelot River at Hinsdale, N.H.	6/27/94	245	<.035	<.002	.008	<.008	E.006	<.004	<.004
01166500	Millers River at Erving, Mass.	6/28/94	124	E.840	<.002	.008	<.008	E.007	<.004	<.004
01170000	Deerfield River near West Deerfield, Mass.	6/28/94	592	<.035	<.002	<.001	<.008	<.003	<.004	<.004
01170500	Connecticut River at Montague City, Mass.	6/27/94	9,030	<.035	.003	.013	<.008	<.003	<.004	<.004
01177000	Chicopee River at Indian Orchard, Mass.	6/27/94	110	<.035	<.002	.006	<.008	<.003	<.004	<.004
01183500	Westfield River near Westfield, Mass.	6/27/94	235	<.035	<.002	.017	<.008	<.003	<.004	<.004
01184000	Connecticut River at Thompsonville, Conn.	6/24/94	19,200	<.035	<.002	.005	<.008	<.003	<.004	<.004
01184000	Connecticut River at Thompsonville, Conn.	6/02/94	18,500	<.035	.004	<.001	<.008	<.003	<.004	<.004
01184000	Connecticut River at Thompsonville, Conn.	6/10/94	12,000	<.035	.006	.009	<.008	<.003	<.004	<.004
01189995	Farmington River at Tariffville, Conn.	5/18/94	2,010	<.035	<.002	<.001	<.008	<.003	<.004	<.004
01189995	Farmington River at Tariffville, Conn.	5/24/94	1,200	<.035	<.002	.005	<.008	<.003	<.004	<.004
01189995	Farmington River at Tariffville, Conn.	6/02/94	834	<.035	<.002	<.001	<.008	<.003	<.004	<.004
01189995	Farmington River at Tariffville, Conn.	6/10/94	666	<.035	<.002	.005	<.008	<.003	<.004	<.004
01193000	Connecticut River at Middletown, Conn.	6/22/94	--	<.035	<.002	.019	<.008	<.003	<.004	.034
01200600	Housatonic River near New Milford, Conn.	5/26/94	1,400	<.035	<.002	.011	<.008	<.003	<.004	<.004
01200600	Housatonic River near New Milford, Conn.	6/07/94	848	<.035	<.002	.008	<.008	<.003	<.004	<.004
01200600	Housatonic River near New Milford, Conn.	6/28/94	584	<.035	<.002	.014	<.008	<.003	<.004	<.004
01204000	Pomperaug River at Southbury, Conn.	6/13/94	284	<.035	.039	1.10	E.020	<.003	<.004	<.004
01208500	Naugatuck River at Beacon Falls, Conn.	5/17/94	1,000	<.035	<.002	<.001	<.008	<.003	<.004	<.004
01208500	Naugatuck River at Beacon Falls, Conn.	5/25/94	403	<.035	<.002	.012	<.008	<.003	.005	<.004
01208500	Naugatuck River at Beacon Falls, Conn.	6/01/94	263	<.035	<.002	.011	<.008	<.003	.009	<.004
01208500	Naugatuck River at Beacon Falls, Conn.	6/10/94	148	<.035	<.002	<.001	<.008	E.013	.008	<.004
01209710	Norwalk River at Winnipauk, Conn.	5/17/94	181	<.035	<.002	.004	<.008	E.023	<.004	<.004
01209710	Norwalk River at Winnipauk, Conn.	5/25/94	E44	<.035	<.002	.010	<.008	E.022	<.004	<.004
01209710	Norwalk River at Winnipauk, Conn.	5/31/94	E23	<.035	<.002	.007	<.008	<.003	<.004	<.004
01209710	Norwalk River at Winnipauk, Conn.	6/07/94	E18	<.035	<.002	.005	<.008	<.003	<.004	<.004
01209710	Norwalk River at Winnipauk, Conn.	6/14/94	E97	<.035	<.002	.008	.060	E.120	<.004	<.004
01209710	Norwalk River at Winnipauk, Conn.	6/22/94	E21	<.035	<.002	.015	.580	E.720	<.004	<.004
01209710	Norwalk River at Winnipauk, Conn.	6/28/94	E27	<.035	<.002	.006	<.008	E.016	<.004	<.004
01137500	Ammonoosuc River at Bethlehem Junction, N.H.	6/22/94	306	<.035	<.002	<.001	<.008	<.003	<.004	<.004
01170100	Green River near Colrain, Mass.	6/14/94	47	<.035	<.002	.004	E.020	E.011	<.004	<.004
01193500	Salmon River near East Hampton, Conn.	6/13/94	161	<.035	.017	.008	<.008	E.016	<.004	<.004
01189000	Pequabuck River at Forestville, Conn.	6/14/94	88	<.035	<.002	.015	<.008	E.009	.026	<.004
01192500	Hockanum River near East Hartford, Conn.	6/02/94	80	<.035	<.002	.018	<.008	E.019	<.004	<.004
01196500	Quinnipiac River at Wallingford, Conn.	6/01/94	110	<.035	<.002	<.001	<.008	<.003	<.004	<.004
01208873	Rooster River at Fairfield, Conn.	5/31/94	7.8	<.035	<.002	<.001	<.008	<.003	<.004	<.004

Connecticut, Housatonic, and Thames River Basins study, 1993–94

detections on schedule 2050; SPE, solid phase extraction; E, indicates an estimated value; No., number; ft^3/s, foot per second; <, actual value is less than

Station No.	DCPA	Des-ethyl-atrazine	Diazi-non	Dieldrin	Mala-thion	Meto-lachlor	Metri-buzin	Pendi-methalin	Prometon	Propa-chlor	Propargite	Simazine
01135300	<0.002	<0.002	<0.002	<0.001	<0.005	0.005	<0.004	<0.004	<0.018	<0.007	<0.013	<0.005
01184490	<.002	<.002	<.002	<.001	<.005	.078	<.004	<.004	<.018	<.007	<.013	<.005
01184500	<.002	<.002	.007	<.001	<.005	.051	<.004	<.004	<.018	<.007	<.013	<.005
01192883	E.001	E.002	.003	<.001	<.005	.012	E.003	<.004	<.018	<.007	<.013	.005
01199900	<.002	E.019	<.002	<.001	.005	.040	<.004	<.004	E.012	<.007	<.013	.007
01131500	<.002	E.003	<.002	<.001	<.005	<.002	<.004	<.004	<.018	<.007	<.013	<.005
01135500	<.002	<.002	<.002	<.001	<.005	.006	<.004	<.004	<.018	<.007	<.013	<.005
01144000	<.002	<.002	<.002	<.001	<.005	.012	<.004	<.004	<.018	<.007	<.013	<.005
01144000	<.002	E.004	<.002	<.001	<.005	.012	<.004	<.004	<.018	<.007	<.013	.008
01144000	<.002	<.002	<.002	<.001	<.005	.009	<.004	<.004	E.005	<.007	<.013	.012
01144000	<.002	E.004	<.002	<.001	<.005	.013	<.004	<.004	<.018	<.007	<.013	.014
01144500	<.002	<.002	<.002	<.001	<.005	.005	<.004	<.004	<.018	<.007	<.013	.009
01161000	<.002	E.005	.006	<.001	<.005	.008	<.004	<.004	E.004	<.007	<.013	<.005
01166500	<.002	<.002	.016	<.001	<.005	<.002	<.004	<.004	<.018	<.007	<.013	<.005
01170000	<.002	<.002	<.002	<.001	<.005	<.002	<.004	<.004	<.018	<.007	<.013	<.005
01170500	<.002	E.004	<.002	<.001	<.005	.010	<.004	<.004	<.018	<.007	<.013	.006
01177000	<.002	<.002	.007	<.001	<.005	.006	<.004	<.004	<.018	<.007	<.013	<.005
01183500	.002	<.002	.006	<.001	<.005	.007	<.004	<.004	<.018	<.007	<.013	.010
01184000	<.002	<.002	<.002	<.001	<.005	.006	<.004	<.004	<.018	<.007	<.013	E.003
01184000	<.002	<.002	<.002	<.001	<.005	.006	<.004	<.004	<.018	<.007	<.013	<.005
01184000	<.002	E.002	.009	<.001	<.005	.008	<.004	<.004	<.018	<.007	<.013	.005
01189995	<.002	<.002	.010	<.001	<.005	.003	<.004	<.004	<.018	<.007	<.013	<.005
01189995	<.002	<.002	E.001	<.001	<.005	.006	<.004	<.004	<.018	<.007	<.013	E.003
01189995	<.002	<.002	<.002	<.001	<.005	.008	<.004	<.004	<.018	<.007	<.013	<.005
01189995	<.002	E.001	.005	<.001	<.005	.006	<.004	<.004	<.018	<.007	<.013	E.003
01193000	<.002	E.004	.008	<.001	<.005	.019	<.004	<.004	<.018	<.007	<.013	.009
01200600	<.002	E.007	<.002	<.001	<.005	.011	<.004	<.004	E.008	<.007	<.013	E.004
01200600	<.002	<.002	<.002	<.001	<.005	.018	<.004	<.004	<.018	<.007	<.013	<.005
01200600	<.002	<.002	<.002	<.001	<.005	.013	<.004	<.004	E.010	<.007	<.013	<.005
01204000	E.001	E.039	.006	<.001	<.005	.910	.006	.120	E.012	<.007	<.013	.031
01208500	<.002	<.002	.037	<.001	<.005	.004	.053	<.004	<.018	<.007	.300	<.005
01208500	<.002	<.002	.015	<.001	4.30	<.002	<.004	<.004	E.013	<.007	.230	<.005
01208500	<.002	<.002	<.002	<.001	<.005	<.002	.041	<.004	<.018	<.007	.400	<.005
01208500	<.002	<.002	.021	<.001	.019	<.002	.140	<.004	<.018	.008	.750	<.005
01209710	<.002	<.002	.013	<.001	<.005	<.002	<.004	<.004	<.018	<.007	<.013	<.005
01209710	<.002	<.002	<.002	<.001	<.005	.004	<.004	<.004	.019	<.007	<.013	E.004
01209710	.006	<.002	<.002	<.001	<.005	<.002	<.004	<.004	<.018	<.007	<.013	<.005
01209710	<.002	<.002	<.002	<.001	<.005	<.002	<.004	<.004	<.018	<.007	<.013	<.005
01209710	E.001	E.002	.039	<.001	<.005	.006	.005	<.004	.033	<.007	<.013	E.004
01209710	.005	E.009	.044	<.001	<.005	.016	<.004	<.004	.021	<.007	<.013	<.005
01209710	<.002	<.002	.011	<.001	<.005	<.002	<.004	<.004	.022	<.007	<.013	<.005
01137500	<.002	<.002	<.002	<.001	<.005	<.002	<.004	<.004	<.018	<.007	<.013	<.005
01170100	<.002	E.001	<.002	<.001	<.005	.003	<.004	<.004	<.018	<.007	<.013	<.005
01193500	<.002	E.002	.006	<.001	<.005	.007	<.004	<.004	<.018	<.007	<.013	<.005
01189000	.002	<.002	.100	<.001	.011	.015	.059	<.004	E.012	<.007	<.013	.010
01192500	.003	E.003	.009	<.001	<.005	.024	<.004	<.004	<.018	<.007	<.013	.010
01196500	<.002	<.002	.018	<.001	<.005	.006	.010	<.004	<.018	<.007	.028	<.005
01208873	<.002	<.002	.007	<.001	<.005	<.002	.007	<.004	<.018	<.007	<.013	.037

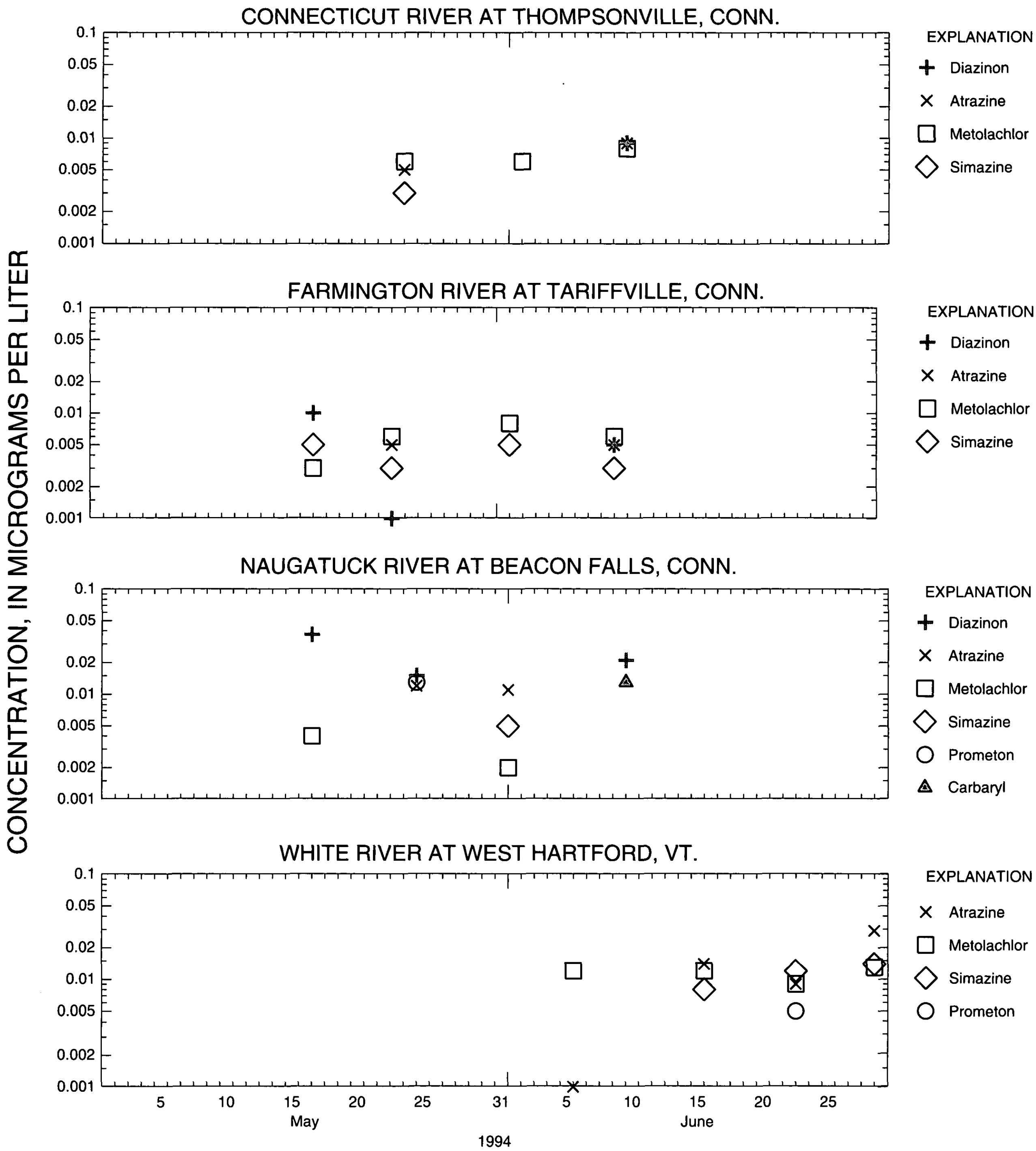

Figure 9. Detections of pesticides at stations sampled multiple times during high-flux conditions, 1994.

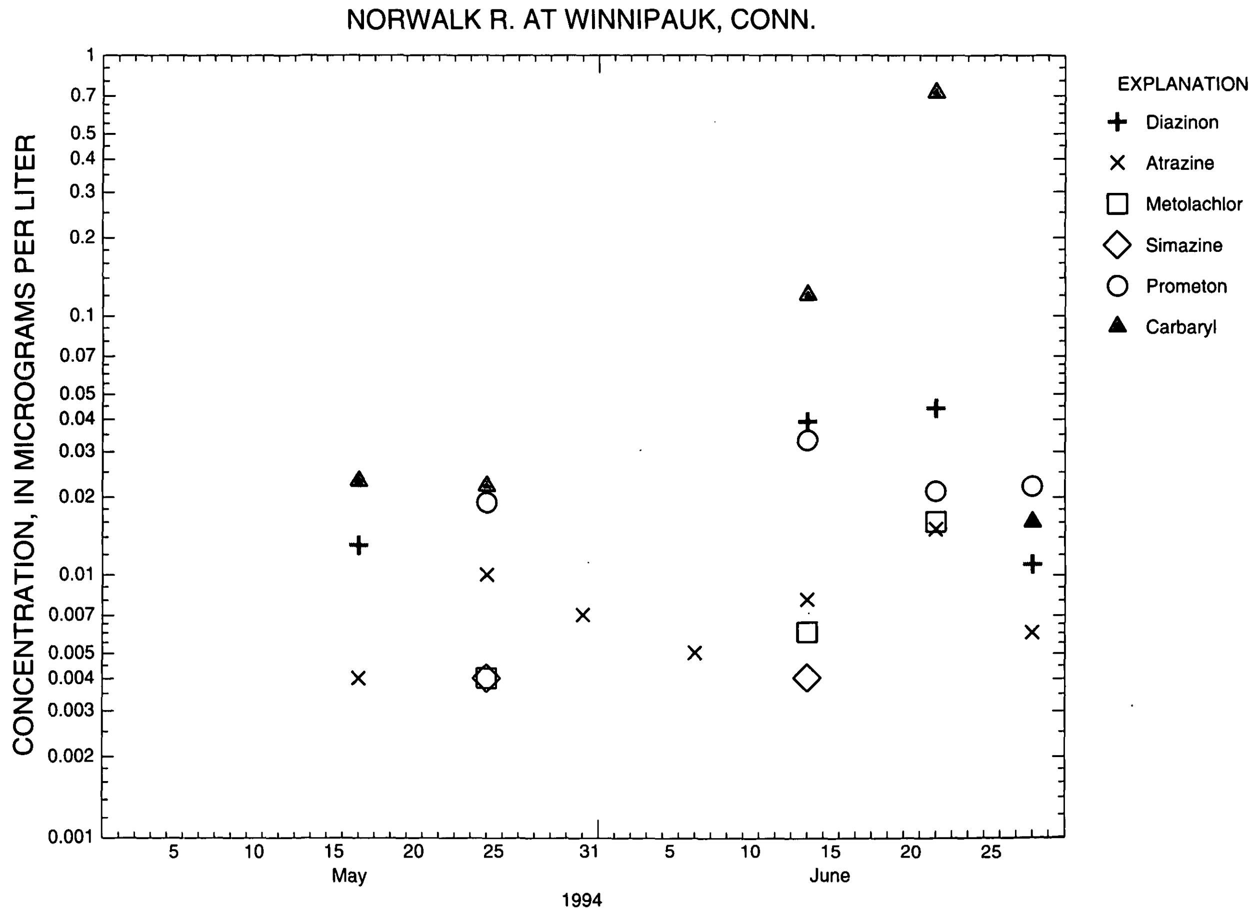

Figure 9. Detections of pesticides at stations sampled multiple times during high-flux conditions, 1994—*Continued.*

Short-Term Intensive Studies

Short-term intensive studies were valuable in obtaining information about mechanisms responsible for transporting pesticides to streams in relatively small basins. These studies generated data about pesticide transport from stormwater runoff and ground-water discharge.

Pesticides in Runoff in the Scantic River Basin

Analysis of stormwater-runoff samples collected from streams in three subbasins of the Scantic River (fig. 11, table 20) from May 31–June 2, 1992, indicates that concentrations of the herbicides atrazine and metolachlor, as well as nutrients, fluctuate with changes in streamflow (Mullaney and Zimmerman, 1997). At the Broad Brook and Muddy Brook sampling sites, atrazine and metolachlor concentrations increase and desethylatrazine concentrations generally decrease or remain low as streamflow increases (fig. 11, table 20). These compounds were detected in only one sample at the Scantic River site. These results suggest that atrazine and metolachlor were derived primarily from surface runoff and desethylatrazine, a metabolite of atrazine, entered the stream from ground water at a relatively constant rate and became diluted. Additional grab samples collected on June 6 from the Broad Brook site contained higher concentrations of atrazine, metolachlor, and desethylatrazine than the samples from the earlier storm. The concentration differences in samples from the two storms point out how difficult it may be to obtain truly representative data. These results concur with Stamer's (1996) study which found that concentrations of alachlor, atrazine, cyanazine, and metolachlor in runoff peaked following intense rains that occurred after spring pesticide application in some Nebraska streams.

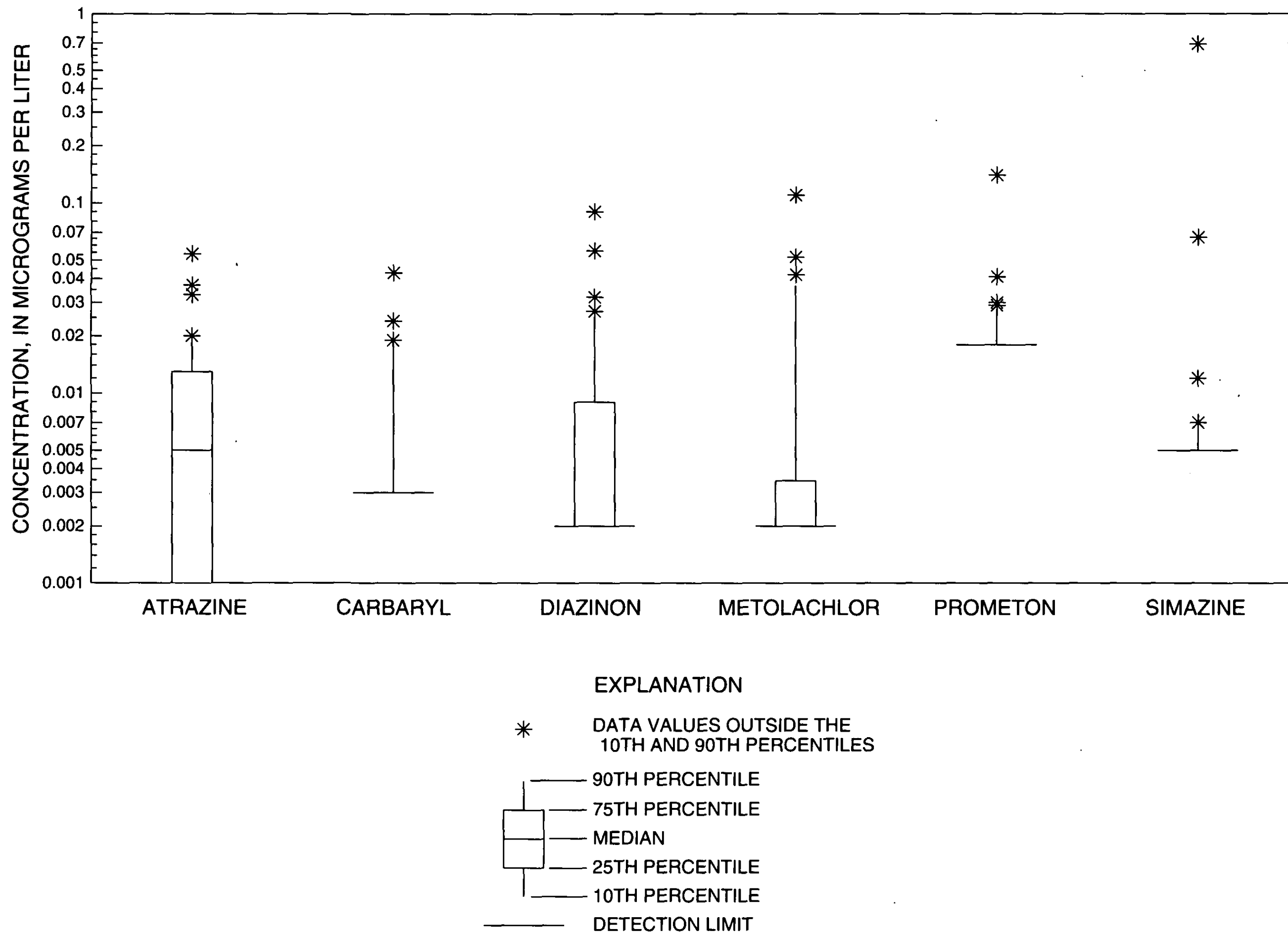

Figure 10. Concentrations of selected pesticides under low-flow conditions in 1994–95.

Interactions Between Surface Water and Ground Water

Studies of the interactions between surface water and ground water were conducted under low- or base-flow conditions, when ground water served as the major, if not exclusive, source of streamflow. This approach assumed that surface-water quality reflects ground-water-quality differences as land use changed in the downstream direction. In the Konkapot River Basin, land use changed from forested to intensively agricultural (fig. 4). In the Mill River Basin in Connecticut, the upstream land use was a mix of forested and low-density-residential use, which became highly developed and urban downstream (fig. 5).

Konkapot River

In the Konkapot River, pesticide concentrations, as well as other data, demonstrate general changes in water quality associated with increasing agricultural development downstream (fig. 4). At the farthest upstream surface-water-quality sampling station, specific conductance is 162 µS/cm and dissolved nitrite plus nitrate concentration is 0.066 mg/L (table 21). Downstream, these concentrations steadily increase, with specific conductance finally reaching 317 µS/cm and dissolved nitrite plus nitrate 0.420 mg/L at the Konkapot River at Ashley Falls, Mass., the farthest downstream station.

Table 18. Concentrations of pesticides detected using SPE methodology during low-flow periods in the Connecticut,

[Concentrations are in micrograms per liter; Parameter codes for carbaryl (82860) and (49310) and carbofuran (82674) and (49309) are included to ft^3/s, foot per second; <, actual value is less than method detection limit; -- missing data]

Station No.	Station name	Sampling date	Streamflow (ft^3/s)	2,4-D	Alachlor	Atrazine	Carbaryl (49310)	Carbaryl (82680)	Carbofuran (82674)	Carbofuran (49309)	Chlorpyrifos
01129500	Connecticut River at North Stratford, N.H.	8/30/95	260	--	<0.002	0.003	<0.008	<0.003	<0.003	<0.028	<0.004
01138000	Ammonoosuc River near Bath, N.H.	8/29/95	80	<0.035	<.002	<.001	<.008	<.003	<.003	<.028	<.004
01184100	Stony Brook near West Suffield, Conn.	8/10/94	2.3	.060	<.002	.019	<.008	E.010	<.003	<.028	<.004
01184490	Broad Brook at Broad Brook, Conn.	9/14/94	12	<.035	<.002	.054	<.008	<.003	<.003	<.028	<.004
01184500	Scantic River at Broad Brook, Conn.	9/14/94	36	<.035	<.002	.019	<.008	<.003	E.050	.080	<.004
01198180	Konkapot River at Clayton, Mass.	9/07/94	22	<.035	<.002	<.001	<.008	<.003	<.003	<.028	<.004
01198185	Konkapot River at Sodom, Conn.	9/07/94	23	<.035	<.002	.015	<.008	<.003	<.003	<.028	<.004
01198190	Konkapot River near Canaan, Conn.	9/07/94	27	<.035	<.002	.020	<.008	<.003	<.003	<.028	<.004
01198200	Konkapot River at Ashley Falls, Mass.	9/08/94	28	<.035	<.002	.018	<.008	<.003	<.003	<.028	<.004
01199900	Tenmile River at South Dover near Wingdale, N.Y.	8/17/94	109	<.035	.007	.033	<.008	<.003	<.003	<.028	<.004
430217072271601	Great Brook near Walpole, N.H.	8/02/95	1.8	<.035	<.002	.037	<.008	<.003	<.003	<.028	<.004
433709072320301	Ottauquechee River at West Woodstock, Vt.	8/03/95	24	<.035	<.002	<.001	<.008	<.003	<.003	<.028	<.004
435031072351101	Second Branch White River near East Bethel, Vt.	8/28/95	9.7	<.035	<.002	.006	<.008	<.003	<.003	<.028	<.004
440057072045201	Unnamed Tributary to Connecticut River near Haverhill, N.H.	8/10/95	.79	<.035	<.002	.004	<.008	<.003	<.003	<.028	<.004
01122610	Shetucket River at South Windham, Conn.	8/29/94	380	<.035	<.002	<.001	<.008	<.003	<.003	<.028	<.004
01124000	Quinebaug River at Quinebaug, Conn.	8/08/94	31	<.035	<.002	<.001	<.008	<.003	<.003	<.028	<.004
01184000	Connecticut River at Thompsonville, Conn.	8/18/94	12,600	<.035	<.002	.011	<.008	E.043	<.003	<.028	.014
01208500	Naugatuck River at Beacon Falls, Conn.	8/23/94	2,620	<.035	<.002	.018	<.008	E.016	<.003	<.028	<.004
01209710	Norwalk River at Winnipauk, Conn.	8/02/94	E33	<.035	<.002	.005	<.008	<.003	<.003	<.028	<.004
01209710	Norwalk River at Winnipauk, Conn.	8/09/94	E15	<.035	<.002	.006	<.008	<.003	<.003	<.028	<.004
01209710	Norwalk River at Winnipauk, Conn.	8/16/94	E16	<.035	<.002	.007	<.008	<.003	<.003	<.028	<.004
01209710	Norwalk River at Winnipauk, Conn.	8/22/94	E68	<.035	<.002	<.001	<.008	E.019	<.003	<.028	<.004
01209710	Norwalk River at Winnipauk, Conn.	8/30/94	E29	<.035	<.002	<.001	<.008	<.003	<.003	<.028	<.004
01170100	Green River near Colrain, Mass.	8/10/94	9.0	<.035	<.002	<.001	<.008	<.003	<.003	<.028	<.004
01193500	Salmon River near East Hampton, Conn.	8/31/94	53	<.035	<.002	.005	<.008	<.003	<.003	<.028	<.004
01196589	Brooksvale Stream at Mt. Sanford Road, Cheshire, Conn.	8/21/94	.28	<.035	<.002	<.001	<.008	<.003	<.003	<.028	<.004
01198151	Rawson Brook–Wellman Road, near Monterey, Mass.	9/06/94	2.9	<.035	<.002	<.001	<.008	<.003	<.003	<.028	<.004
01198158	Konkapot River at Hartsville–Mill River Road, near Mill River, Mass.	9/06/94	11	<.035	<.002	<.001	<.008	<.003	<.003	<.028	<.004
01198159	Konkapot River near Mill River, Mass.	9/06/94	14	<.035	<.002	<.001	<.008	<.003	<.003	<.028	<.004
01152500	Sugar River at West Claremont, N.H.	8/28/95	41	<.035	<.002	.005	<.008	<.003	<.003	<.028	<.004
01189000	Pequabuck River at Forestville, Conn.	8/31/94	82	<.035	<.002	<.001	<.010	E.024	<.003	<.028	<.004
01192500	Hockanum River near East Hartford, Conn.	8/24/94	238	<.035	<.002	.011	E.020	E.043	<.003	<.028	<.004
01196580	Muddy River near North Haven, Conn.	9/15/94	2.6	<.035	<.002	.014	<.008	<.003	<.003	<.028	<.004
01196618	Willow Brook at Willow Street, Hamden, Conn.	8/21/95	2.9	<.035	<.002	.003	<.008	<.003	<.003	<.028	<.004
01196619	Eaton Brook at Route 10, Hamden, Conn.	8/22/95	.13	<.035	<.002	<.001	<.008	<.003	<.003	<.028	<.004
01196620	Mill River near Hamden, Conn.	8/22/95	1.3	<.035	<.002	.002	<.008	<.003	<.003	<.028	<.004
0119662350	Mill River at Dixwell Avenue, Hamden, Conn.	8/22/95	3.6	<.035	<.002	.008	<.008	<.003	<.003	<.028	<.004
0119662375	Shepard Brook at Route 10, Hamden, Conn.	8/22/95	.172	<.035	<.002	.006	<.008	<.003	<.003	<.028	<.004
0119662380	Mill River at Skiff Street, Hamden, Conn.	8/23/95	2.5	<.035	<.002	.012	<.008	<.003	<.003	<.028	<.004
01208873	Rooster River at Fairfield, Conn.	8/09/94	2.0	<.035	<.002	<.001	<.008	<.003	<.003	<.028	<.004
425104072322601	Whetstone Brook at Mouth, at Brattleboro, Vt.	8/14/95	4.7	<.013	<.002	<.001	<.008	<.003	<.003	<.028	<.004

Housatonic, and Thames River Basins study, 1994–95—*Continued*

distinguish detections on schedule 2010 from detections on schedule 2050; SPE, solid phase extraction; E, indicates an estimated value; No., number;

Station No.	Cyanazine	Desethyl-atrazine	DCPA	*p,p'*-DDE	Diazinon	Dichlorprop	Dieldrin	Malathion	Metolachlor	Permethrin	Prometon	Simazine	Terbacil
01129500	<0.004	E0.004	<0.002	<0.006	<0.002	--	<0.001	<0.005	<0.002	<0.005	<0.018	<0.005	<0.007
01138000	<.004	<.002	<.002	<.006	<.002	<0.032	<.001	<.005	<.002	<.005	<.018	<.005	<.007
01184100	<.004	E.003	<.002	<.006	<.002	<.032	<.001	<.005	.052	<.005	<.018	.690	<.007
01184490	<.004	E.035	.002	<.006	.004	<.032	<.001	<.005	.110	<.005	<.018	.006	<.007
01184500	<.004	E.013	<.002	<.006	<.002	<.032	<.001	<.005	.042	<.005	<.018	<.005	<.007
01198180	<.004	E.005	<.002	<.006	<.002	<.032	<.001	<.005	<.002	<.005	<.018	<.005	<.007
01198185	<.004	E.009	<.002	<.006	<.002	<.032	<.001	<.005	<.002	<.005	<.018	<.005	<.007
01198190	<.004	E.004	<.002	<.006	<.002	<.032	<.001	<.005	.006	<.005	<.018	<.005	<.007
01198200	<.004	E.004	<.002	<.006	<.002	<.032	<.001	<.005	<.002	<.005	<.018	<.005	<.007
01199900	<.004	E.018	<.002	<.006	<.002	<.032	<.001	<.005	.042	<.005	E.016	.066	<.007
430217072271601	<.004	E.017	<.002	<.006	<.002	<.032	<.001	<.005	<.002	<.005	<.018	<.005	<.007
433709072320301	<.004	<.002	<.002	<.006	<.002	<.032	<.001	<.005	<.002	<.005	<.018	E.003	<.007
435031072351101	<.004	<.002	<.002	<.006	<.002	<.032	<.001	<.005	<.002	<.005	<.018	<.005	<.007
440057072045201	<.004	E.014	<.002	<.006	<.002	<.032	<.001	<.005	<.002	<.005	<.018	<.005	<.007
01122610	<.004	E.002	<.002	<.006	<.002	<.032	<.001	<.005	<.002	<.005	<.018	<.005	<.007
01124000	<.027	<.002	<.002	<.006	.009	.250	<.001	<.005	<.002	<.005	<.018	<.005	<.007
01184000	<.004	E.005	.002	<.006	.056	<.032	<.001	<.005	.016	<.005	E.006	.005	<.007
01208500	<.004	E.007	<.002	<.006	.027	<.032	<.001	<.005	.007	<.005	E.013	<.005	<.007
01209710	<.004	<.002	<.002	E.003	.015	<.032	<.001	<.005	<.002	E.003	.027	<.005	<.007
01209710	<.004	<.002	<.002	<.006	.010	<.032	<.001	<.005	<.002	<.005	.026	<.005	<.007
01209710	<.004	E.005	<.002	<.006	.009	<.032	<.001	<.005	<.002	<.005	.041	<.005	<.007
01209710	<.004	<.002	<.002	<.006	.032	<.032	<.001	.150	<.002	<.005	.140	<.005	<.007
01209710	<.004	.002	<.002	<.006	<.002	<.032	<.001	<.005	<.002	<.005	.029	<.005	<.007
01170100	<.004	<.002	<.002	<.006	<.002	<.032	<.001	<.005	<.002	<.005	<.018	<.005	<.007
01193500	<.004	E.003	<.002	<.006	<.002	<.032	<.001	<.005	<.002	<.005	<.018	<.005	<.007
01196589	<.004	<.002	<.002	<.006	<.002	<.032	<.001	<.005	<.002	<.005	<.018	<.005	<.007
01198151	<.004	E.003	<.002	<.006	<.002	<.032	<.001	<.005	<.002	<.005	<.018	<.005	<.007
01198158	<.004	<.002	<.002	<.006	<.002	<.032	<.001	<.005	<.002	<.005	E.008	<.005	<.007
01198159	<.004	E.003	<.002	<.006	<.002	<.032	<.001	<.005	<.002	<.005	E.007	<.005	<.007
01152500	<.004	<.002	<.002	<.006	<.002	<.032	<.001	<.005	.006	<.005	<.018	<.005	<.007
01189000	<.004	<.002	<.002	<.006	.022	<.032	<.001	<.005	<.002	<.005	E.009	<.005	<.007
01192500	.062	E.004	<.002	<.006	.090	<.032	<.001	<.005	.022	<.005	.020	.006	<.007
01196580	<.004	E.011	<.002	<.006	.011	<.032	<.001	<.005	.019	<.005	.030	E.004	E.014
01196618	<.004	E.003	<.002	<.006	.004	<.032	<.001	<.005	<.002	<.005	<.018	<.005	<.007
01196619	<.004	<.002	<.002	<.006	.006	<.032	<.001	<.005	<.002	<.005	E.008	<.005	<.007
01196620	<.004	<.002	<.002	<.006	E.002	<.032	<.001	<.005	<.002	<.005	E.005	<.005	<.007
0119662350	<.004	<.002	<.002	<.006	.005	<.032	<.001	<.005	<.002	<.005	<.018	<.005	<.007
0119662375	<.004	<.002	<.002	<.006	.005	<.032	<.001	<.005	<.002	<.005	.024	.007	<.007
0119662380	<.004	<.002	<.002	<.006	.006	<.032	<.001	<.005	<.002	<.005	<.018	<.005	<.007
01208873	<.004	<.002	<.002	<.006	.011	<.032	.004	<.005	<.002	<.005	.018	.012	<.007
425104072322601	<.004	<.002	<.002	<.006	<.002	<.032	<.001	<.005	<.002	<.005	<.018	<.005	<.007

Table 19. Concentrations of selected pesticides detected using SPE methodology during low-flow periods in the Connecticut, Housatonic,and Thames River Basins study, 1994–95

[Streamflow is in cubic foot per second; concentrations of pesticides are in micrograms per liter. Parameter code for carbaryl (82860) is included to distinguish its detection on schedule 2010 from carbaryl (49310) on schedule 2050. No., number; SPE, special phase extraction; E, indicates an estimated value; <, actual value is less than method detection limit]

Station No.	Station name	Sampling date	Stream-flow	Atrazine	Carbaryl (82680)	Diazinon	Metolachlor	Prometon	Simazine
01129500	Connecticut River at North Stratford, N.H.	8/30/95	260	0.003	<0.003	<0.002	<0.002	<0.018	<0.005
01138000	Ammonoosuc River near Bath, N.H.	8/29/95	80	<.001	<.003	<.002	<.002	<.018	<.005
01184100	Stony Brook near West Suffield, Conn.	8/10/95	2.3	.019	E.010	<.002	.052	<.018	.690
01184490	Broad Brook at Broad Brook, Conn.	9/14/94	12	.054	<.003	.004	.110	<.018	.006
01184500	Scantic River at Broad Brook, Conn.	9/14/94	36	.019	<.003	<.002	.042	<.018	<.005
01198180	Konkapot River at Clayton, Mass.	9/07/94	22	<.001	<.003	<.002	<.002	<.018	<.005
01198185	Konkapot River at Sodom, Conn.	9/07/94	23	.015	<.003	<.002	<.002	<.018	<.005
01198190	Konkapot River near Canaan, Conn.	9/07/94	27	.020	<.003	<.002	.006	<.018	<.005
01198200	Konkapot River at Ashley Falls, Mass.	9/08/94	28	.018	<.003	<.002	<.002	<.018	<.005
01199900	Tenmile River at South Dover near Wingdale, N.Y.	8/17/94	109	.033	<.003	<.002	.042	E.016	.066
430217072271601	Great Brook near Walpole, N.H.	8/02/95	1.8	.037	<.003	<.002	<.002	<.018	<.005
433709072320301	Ottauquechee River at West Woodstock, Vt.	8/03/95	24	<.001	<.003	<.002	<.002	<.018	E.003
435031072351101	Second Branch White River near East Bethel, Vt.	8/28/95	9.7	.006	<.003	<.002	<.002	<.018	<.005
440057072045201	Unnamed Tributary to Connecticut River near Haverhill, N.H.	8/10/95	.79	.004	<.003	<.002	<.002	<.018	<.005
01122610	Shetucket River at South Windham, Conn.	8/29/95	380	<.001	<.003	<.002	<.002	<.018	<.005
01124000	Quinebaug River at Quinebaug, Conn.	8/08/94	31	<.001	<.003	.009	<.002	<.018	<.005
01184000	Connecticut River at Thompsonville, Conn.	8/18/94	12,600	.011	E.043	.056	.016	E.006	.005
01208500	Naugatuck River at Beacon Falls, Conn.	8/23/94	2,620	.018	E.016	.027	.007	E.013	<.005
01209710	Norwalk River at Winnipauk, Conn.	8/02/94	E33	.005	<.003	.015	<.002	.027	<.005
01209710	Norwalk River at Winnipauk, Conn.	8/09/94	E15	.006	<.003	.010	<.002	.026	<.005
01209710	Norwalk River at Winnipauk, Conn.	8/16/94	E16	.007	<.003	.009	<.002	.041	<.005
01209710	Norwalk River at Winnipauk, Conn.	8/22/94	E68	<.001	E.019	.032	<.002	.140	<.005
01209710	Norwalk River at Winnipauk, Conn.	8/30/94	E29	<.001	<.003	<.002	<.002	.029	<.005
01170100	Green River near Colrain, Mass.	8/10/94	9.0	<.001	<.003	<.002	<.002	<.018	<.005
01193500	Salmon River near East Hampton, Conn.	8/31/94	53	.005	<.003	<.002	<.002	<.018	<.005
01196589	Brooksvale Stream at Mt Sanford Road, Cheshire, Conn.	8/21/95	.28	<.001	<.003	<.002	<.002	<.018	<.005
01198151	Rawson Brook–Wellman Road, near Monterey, Mass.	9/06/94	2.9	<.001	<.003	<.002	<.002	<.018	<.005
01198158	Konkapot River at Hartsville–Mill River Road, near Mill River, Mass.	9/06/94	11	<.001	<.003	<.002	<.002	E.008	<.005
01198159	Konkapot River near Mill River, Mass.	9/06/94	14	<.001	<.003	<.002	<.002	E.007	<.005

Table 19. Concentrations of selected pesticides detected using SPE methodology during low-flow periods in the Connecticut, Housatonic,and Thames River Basins study, 1994–95—*Continued*

Station No.	Station name	Sampling date	Stream-flow	Atrazine	Carbaryl (82680)	Diazinon	Metolachlor	Prometon	Simazine
01152500	Sugar River at West Claremont, N.H.	8/28/95	41	0.005	<0.003	<0.002	0.006	<0.018	<0.005
01189000	Pequabuck River at Forestville, Conn.	8/31/94	82	<.001	E.024	.022	<.002	E.009	<.005
01192500	Hockanum River near East Hartford, Conn.	8/24/94	238	.011	E.043	.090	.022	.020	.006
01196580	Muddy River near North Haven, Conn.	9/15/94	2.6	.014	<.003	.011	.019	.030	E.004
01196618	Willow Brook at Willow Street, Hamden, Conn.	8/21/95	2.9	.003	<.003	.004	<.002	<.018	<.005
01196619	Eaton Brook at Route 10, Hamden, Conn.	8/22/95	.13	<.001	<.003	.006	<.002	E.008	<.005
01196620	Mill River near Hamden, Conn.	8/22/95	1.3	.002	<.003	E.002	<.002	E.005	<.005
0119662350	Mill River at Dixwell Avenue, Hamden, Conn.	8/22/95	3.6	.008	<.003	.005	<.002	<.018	<.005
0119662375	Shepard Brook at Route 10, Hamden, Conn.	8/22/95	.172	.006	<.003	.005	<.002	.024	.007
0119662380	Mill River at Skiff Street, Hamden, Conn.	8/23/95	2.5	.012	<.003	.006	<.002	<.018	<.005
01208873	Rooster River at Fairfield, Conn.	8/09/94	2.0	<.001	<.003	.011	<.002	.018	.012
425104072322601	Whetstone Brook at Mouth, at Brattleboro, Vt.	8/14/95	4.7	<.001	<.003	<.002	<.002	<.018	<.005

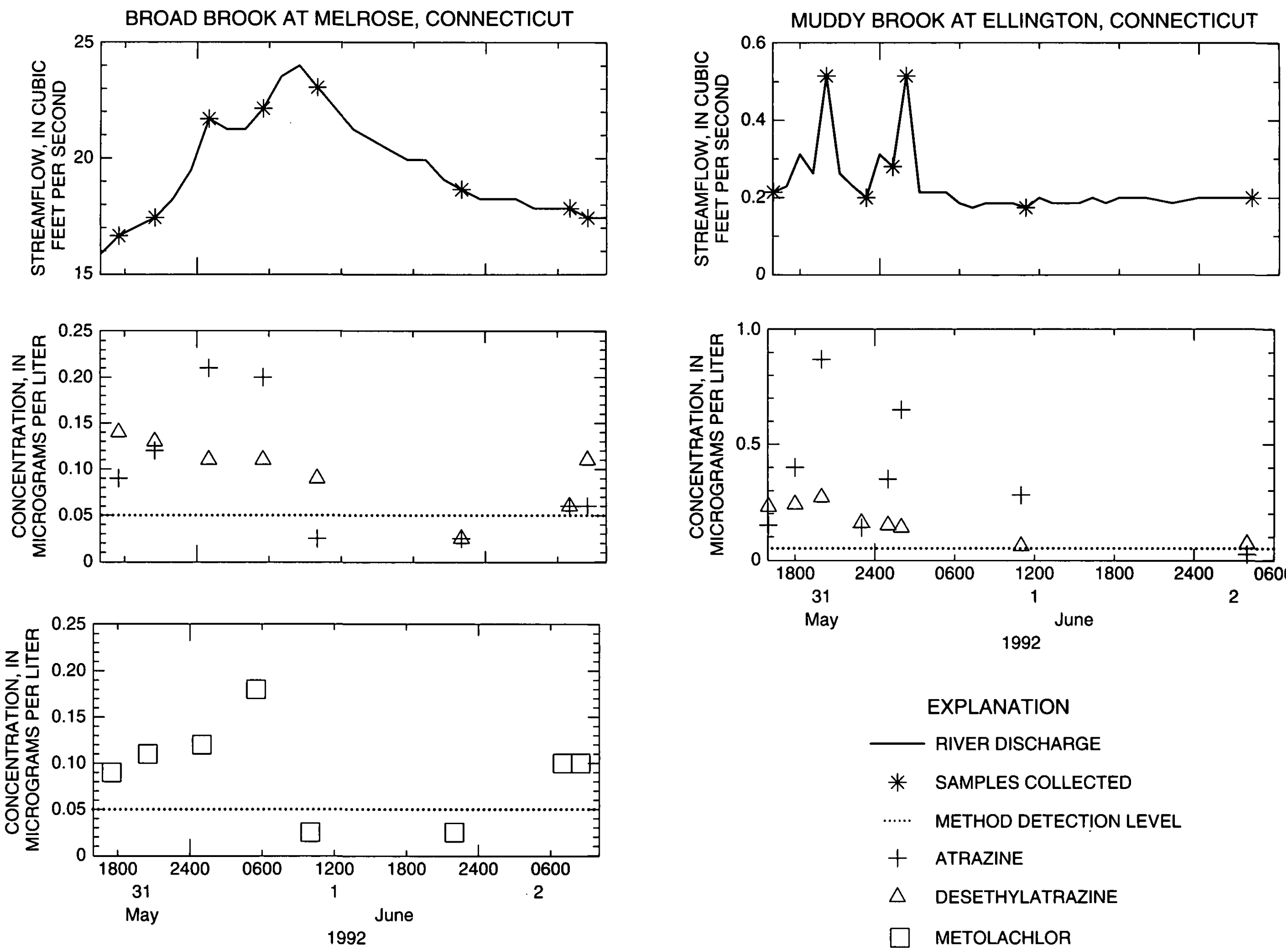

Figure 11. Streamflow and herbicide concentrations in two subbasins of the Scantic River (from Mullaney and Zimmerman, 1997).

Pesticide detections also reflect the differences between ground-water inflow from forested and agricultural land use. Atrazine—or its metabolite, desethylatrazine—was detected in surface-water and ground-water samples at all sampling locations downstream from Mill River, Mass. (table 21). These locations are in areas of intensive cultivation, with corn often planted almost to the water's edge. The surface-water stations and wells at Clayton, Mass., and Sodom, Conn., are immediately adjacent to cornfields which would explain the occurrence of atrazine in wells NKW56 and NOC39. Farther downstream, where wells NOC38 and SJW80 are not as close to cornfields, desethylatrazine, but not atrazine, was detected. This distribution of atrazine and desethylatrazine detections suggests that the occurrence of atrazine in wells was due to recent application and the occurrence of its metabolite, desethylatrazine, was a result of decay over an indeterminate time period. That atrazine was not detected in the surface water at Clayton, Mass., may be a result of a more complex ground-water flow path than hypothesized or due to dilution. Or, most simply, the surface-water quality determined at Clayton, Mass., may reflect surface water transported from upstream rather than the nearby ground-water quality.

Simazine was detected only once, in well NKW56. This well had the highest concentrations of agricultural pesticides and dissolved nitrite plus nitrate among ground-water samples taken during this study. However, the associated surface-water samples only indicated the presence of desethylatrazine. Possible explanations for the failure to detect atrazine in surface water at this location may include timing, dilution, pesticide application rate, or an undefined flow path.

Table 20. Streamflow and concentrations of pesticides detected in runoff in the Scantic River Basin, May 31 to June 6, 1992

[Concentrations of pesticides in micrograms per liter. E, indicates an estimated value; na, not available; ft^3/s, cubic foot per second; <, actual value is less than method detection limit]

Station name	Date sampled	Sampling time	Streamflow (ft^3/s)	Atrazine	Desethylatrazine	Metolachlor
Muddy Brook at Ellington, Conn.	5/31/92	1600	0.2	0.150	0.230	<0.050
	5/31/92	1800	.3	.400	.240	<.050
	5/31/92	2000	.5	.870	.270	<.050
	5/31/92	2300	.2	.140	.160	<.050
	6/01/92	0100	.3	.350	.150	<.050
	6/01/92	0200	.5	.650	.140	<.050
	6/01/92	1100	.2	.280	.060	.160
	6/02/92	0400	.2	<.050	.070	<.050
	6/06/92	0800	E78	.230	.110	<.050
Broad Brook at Melrose, Conn.	5/31/92	1730	17	.090	.140	.090
	5/31/92	2030	17	.120	.130	.110
	6/01/92	0100	22	.210	.110	.120
	6/01/92	0530	22	.200	.110	.180
	6/01/92	1000	23	<.050	.090	<.050
	6/01/92	2200	19	<.050	<.050	<.050
	6/02/92	0700	18	.060	.060	.100
	6/02/92	0830	17	.060	.110	.100
	6/06/92	0845	na	4.60	.910	.250
Scantic River at Four Bridges Road, Somers, Conn.	5/31/92	2100	40	<.050	<.050	<.050
	5/31/92	2230	41	.110	.130	.090
	6/01/92	0730	66	<.050	<.050	<.050
	6/01/92	1800	85	<.050	<.050	<.050
	6/01/92	1930	87	<.050	<.050	<.050
	6/02/92	0900	79	<.050	<.050	<.050
	6/06/92	1000	E110	<.050	<.050	<.050

Prometon was detected at station number 01198159 (Konkapot River near Mill River, Mass.) and upstream at station number 01198158 (the Konkapot River at Hartsville–Mill River Road near Mill River, Mass.). Likely sources of prometon are the main road adjacent to the downstream station and the roads in and near Hartsville, some 3 mi upstream from the Hartsville–Mill River Road station. Prometon was detected at low concentration in one well, SJW80, downstream from several roads and near a railroad right-of-way.

Mill River

Although the discontinuity in land use was not as marked in the Mill River Basin in Connecticut as in the Konkapot River Basin, ancillary surface-water-quality data for the selected reference site, Brooksvale Stream, indicated substantially lower specific conductance, 90 µS/cm, and dissolved nitrite plus nitrate concentration, 0.16 mg/L, than the other six surface-water sites; and no pesticides were detected there (table 22). The remaining specific conductance determinations for surface-water sites were all greater than 200 µS/cm and the dissolved nitrite plus nitrate concentrations were as great as 1.1 mg/L.

Pesticides were detected at low concentrations at the downstream sites. Diazinon was detected at all surface-water sampling sites, except the reference site. Each of the pesticides detected in this study of the relations between ground- and surface-water quality and land use was found at the Shepard Brook site. This site represents a very small (2.56 mi^2), highly developed basin (more than 40 percent urban land use and 10 percent agricultural land use) where the streamflow was extremely low (0.17 ft^3/s) at the time of sampling.

Table 21. Selected water-quality constituents in the Konkapot River Basin, September 6–8, 1994

[Locations are shown on figure 4. Data are presented with wells and their nearby surface-water-quality-sampling sites alternating in downstream order; ft^3/s; cubic foot per second; mg/L, milligram per liter; µg/L, microgram per liter; µS/cm, microsiemen per centimeter; <, actual value is less than method detection limit; --, indicates well discharge is not measured]

Map No.	Station name or local well name	Station identification No.	Discharge (ft^3/s)	Atrazine (µg/L)	Desethyl-atrazine (µg/L)	Prometon (µg/L)	Simazine (µg/L)	Specific conductance (µS/cm)	Dissolved nitrite + nitrate (mg/L as N)
21	M6W25	421029073140001	--	<0.001	<0.002	<0.018	<0.005	489	<0.050
21	Rawson Brook–Wellman Road near Monterey, Mass.	01198151	2.9	<.001	.003[1]	<.018	<.005	162	.066
23	NKW58	420746073155201	--	<.001	<.002	<.018	<.005	305	.180
23	Konkapot River at Hartsville–Mill River Road near Mill River, Mass.	01198158	11	<.001	<.002	.008[2]	<.005	231	.066
25	NKW57	420546073162001	--	<.001	<.002	<.018	<.005	488	.069
25	Konkapot River near Mill River, Mass.	01198159	14	<.001	.003[1]	.007[2]	<.005	270	.068
27	NKW56	420259073171301	--	.470	.160[1]	<.018	.015	450	5.10
27	Konkapot River at Clayton, Mass.	01198180	22	<.001	.005[1]	<.018	<.005	288	.140
29	NOC39	420214073175401	--	.033	.007	<.018	<.005	500	<.050
29	Konkapot River at Sodom, Conn.	01198185	23	.015	.009[1]	<.018	<.005	295	.230
28	NOC38	420246073184201	--	<.001	.015[1]	<.018	<.005	490	1.10
28	Konkapot River near Canaan, Conn.	01198190	27	.020	.004[1]	<.018	<.005	312	.380
26	SJW80	420311073193601	--	<.001	.003[1]	.008[2]	<.005	330	<.050
26	Konkapot River at Ashley Falls, Mass.	01198200	28	.018	.004[1]	<.018	<.005	317	.420

[1]Estimated value.
[2]Estimated value less than method detection limit.

Table 22. Selected water-quality constituents in the Mill River Basin, August 21–23, 1995

[Locations are shown on figure 5. Pesticide concentrations are in units of micrograms per liter; E, indicates an estimated value; No., number; ft^3/s, cubic foot per second; mg/L, milligram per liter; µS/cm, microsiemen per centimeter; <, actual value is less than method detection limit; --, indicates well discharge is not measured]

Map No.	Station or well identification No,	Station or well name	Discharge (ft^3/s)	Atrazine	Desethyl-atrazine	Diazinon	Prometon	Simazine	Specific-conductance (µS/cm)	Dissolved nitrite plus nitrate (mg/L)
45	01196589	Brooksvale Stream at Mt. Sanford Road, Cheshire, Conn.	0.28	<0.001	<0.002	<0.002	<0.018	<0.005	90	0.160
47	01196618	Willow Brook at Willow Street, Hamden, Conn.	2.9	.003	E.003	.004	<.018	<.005	239	.930
1	412622072541201	HM 454	--	<.001	E.002	<.002	E.004	<.005	242	.250
49	01196619	Eaton Brook at Route 10, Hamden, Conn.	.13	<.001	<.002	.006	E.008	<.005	202	.980
50	01196620	Mill River near Hamden, Conn.	1.3	.002	<.002	E.002	E.005	<.005	220	.680
2	412512072541001	HM 455	--	<.001	<.002	<.002	<.018	<.005	187	<.050
3	412415072533701	HM 456	--	.009	E.006	<.002	<.018	<.005	283	.760
4	412342072533401	HM 457	--	.007	E.004	<.002	E.007	E.004	252	<.050
51	0119662350	Mill River at Dixwell Avenue, Hamden, Conn.	3.6	.008	<.002	.005	<.018	<.005	282	1.00
5	412256072535101	HM 458	--	<.001	<.002	<.002	E.006	.023	408	<.050
52	0119662375	Shepard Brook at Route 10, Hamden, Conn.	.17	.006	<.002	.005	.024	.007	245	.280
53	0119662380	Mill River at Skiff Street, Hamden, Conn.	2.5	.012	<.002	.006	<.018	<.005	308	1.10
6	412155072550501	HM 459	--	<.00	E.004	<.002	<.018	<.005	565	3.50

The specific conductance in ground water generally increased downstream, as did the nitrite plus nitrate concentrations. Atrazine and its metabolite, desethylatrazine, prometon, and simazine were all detected in ground water, while diazinon, an insecticide commonly used in urban areas, was not.

The occurrence of pesticides in surface water under these low-flow conditions in this basin suggests a ground-water source. The picture is complicated by ground-water withdrawals for public water supply, which may affect streamflow. Atmospheric input cannot be ruled out as a pesticide source in this urban area where some application is likely throughout the growing season.

Land Use and Pesticide Occurrence and Distribution

Pesticides were detected in water samples throughout the study area. Only five streams sampled had no detectable pesticide concentrations: one was an urban indicator[1]; two were forested reference indicators; and two were integrators.

Pesticide Concentrations

Pesticide concentrations varied geographically and temporally. In general, the highest pesticide concentrations were found in the southern part of the study area, where the greatest amount of developed urban and agricultural land occurs and where the majority of sampling took place. In addition, most pesticides concentrations were low—close to their MDLs (tables 23, 24, 25, 26, and 27). Pesticide concentrations determined using the SPE methodology never exceeded Maximum Contaminant or Health Advisory Levels.

The most frequently detected pesticides—atrazine, carbaryl, diazinon, metolachlor, prometon, and simazine—were found in all land-use categories. This result should not be surprising considering the mechanisms that can distribute pesticides through the atmosphere, the mixture of land uses that may occur in a given basin regardless of its nominal land-use classification (tables 2, 6), and the formulation and use of pesticide mixtures. For example, basins selected for their urban character also had from about 6 to 30 percent agricultural land. Agricultural basins had as much as 15 percent urban or residential land. And, primarily forested basins may have had up to about 6 percent urban/residential land use or almost 14 percent agricultural land (table 2). As noted elsewhere (table 3), pesticides primarily used in agriculture may be applied at high rates in urban or residential settings.

The highest concentrations (using SPE methodology) of atrazine (1.10 μg/L), metolachlor (0.910 μg/L), and simazine (0.690 μg/L) were found in agricultural land-use water-quality samples; highest concentrations of carbaryl (3.20 μg/l), diazinon (0.210 μg/L), and prometon (0.140 μg/L) were found in urban land-use water-quality samples (table 28).

Pesticide Distribution and Land Use

The occurrence of specific pesticides or groups of pesticides can be associated with principal land-use categories. For example, prometon and diazinon were detected more commonly in urban than in agricultural areas (table 12). Atrazine was commonly detected in both land-use areas: in 9 of 16 urban land-use samples and 17 of 19 agricultural land-use samples; atrazine was also detected in 3 of 9 samples from primarily forested "reference" areas.

A greater variety of pesticides was detected in urban (Norwalk River at Winnipauk plus the other urban sites) than in agricultural basins, although this distribution may be skewed by the much larger number of samples collected at the Norwalk (table 12). Sixteen of the 28 pesticides and metabolites detected in urban-basin samples were not detected in agricultural-basin samples; eight of these pesticides were insecticides. Only one pesticide, carbofuran, was detected in an agricultural sample and not in any urban samples. Of the 13 pesticides or metabolites detected in both urban and agricultural samples, 10 were herbicides.

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[1]No pesticides were detected in the sample collected from Whetstone Brook at Brattleboro, Vt., a stream selected because it passed through the city's downtown section where it emptied directly into the Connecticut River. Urban land use accounted for only 5.8 percent of the basin's area, the lowest percentage for any urban-land-use site.

Table 23. Concentrations of selected pesticides detected in the Connecticut, Housatonic, and Thames River Basins study, 1993–95

[Concentrations are in units of micrograms per liter. Parameter code for carbaryl (82860) is included to distinguish its detection on schedule 2010 from carbaryl (49310) on schedule 2050. E, indicates an estimated value; No., number; ft^3/s, cubic foot per second; <, actual value is less than method detection limit; --, missing value]

Station No.	Station name	Sampling date	Streamflow (ft^3/s)	Atrazine	Carbaryl (82680)	Diazinon	Metolachlor	Prometon	Simazine
			Urban basins						
01189000	Pequabuck River at Forestville, Conn.	6/14/94	88	0.015	E0.009	0.100	0.015	E0.012	0.010
01189000	Pequabuck River at Forestville, Conn.	8/31/94	82	<.001	E.024	.022	<.002	E.009	<.005
01192500	Hockanum River near East Hartford, Conn.	6/02/94	80	.018	E.019	.009	.024	<.018	.010
01192500	Hockanum River near East Hartford, Conn.	8/24/94	238	.011	E.043	.090	.022	.020	.006
01196500	Quinnipiac River at Wallingford, Conn.	6/01/94	110	<.001	<.003	.018	.006	<.018	<.005
01196580	Muddy River near North Haven, Conn.	9/15/94	2.6	.014	<.003	.011	.019	.030	E.004
01196618	Willow Brook at Willow Street, Hamden, Conn.	8/21/95	2.9	.003	<.003	.004	<.002	<.018	<.005
01196619	Eaton Brook at Route 10, Hamden, Conn.	8/22/95	.13	<.001	<.003	.006	<.002	E.008	<.005
01196620	Mill River near Hamden, Conn.	8/22/95	1.3	.002	<.003	E.002	<.002	E.005	<.005
0119662350	Mill River at Dixwell Avenue, Hamden, Conn.	8/22/95	3.6	.008	<.003	.005	<.002	<.018	<.005
0119662375	Shepard Brook at Route 10, Hamden, Conn.	8/22/95	.172	.006	<.003	.005	<.002	.024	.007
0119662380	Mill River at Skiff Street, Hamden, Conn.	8/23/95	2.5	.012	<.003	.006	<.002	<.018	<.005
01208873	Rooster River at Fairfield, Conn.	4/12/94	37	<.001	<.003	.210	<.002	.029	<.005
01208873	Rooster River at Fairfield, Conn.	5/31/94	7.8	<.001	<.003	.007	<.002	<.018	.037
01208873	Rooster River at Fairfield, Conn.	8/09/94	2.0	<.001	<.003	.011	<.002	.018	.012
425104072322601	Whetstone Brook at mouth, at Brattleboro, Vt.	8/14/95	4.7	<.001	<.003	<.002	<.002	<.018	<.005
			Agricultural basins						
01135300	Sleepers River near St. Johnsbury, Vt.	6/22/94	32	0.013	<0.003	<0.002	0.005	<0.018	<0.005
01155000	Cold River at Drewsville, N.H.	8/14/95	24	.004	<.003	<.002	<.002	<.018	<.005
01184100	Stony Brook near West Suffield, Conn.	8/10/94	2.3	.019	<.003	<.002	.052	<.018	.690
01184490	Broad Brook at Broad Brook, Conn.	6/01/94	20	.027	<.003	<.002	.078	<.018	<.005
01184490	Broad Brook at Broad Brook, Conn.	9/14/94	12	.054	<.003	.004	.110	<.018	.006
01184500	Scantic River at Broad Brook, Conn.	6/02/94	--	.023	<.003	.007	.051	<.018	<.005
01184500	Scantic River at Broad Brook, Conn.	9/14/94	36	.019	<.003	<.002	.042	<.018	<.005
01192883	Coginchaug River at Middlefield, Conn.	6/13/94	19	.012	<.003	.003	.012	<.018	.005
01198180	Konkapot River at Clayton, Mass.	9/07/94	22	<.001	<.003	<.002	<.002	<.018	<.005
01198185	Konkapot River at Sodom, Conn.	9/07/94	23	.015	<.003	<.002	<.002	<.018	<.005
01198190	Konkapot River near Canaan, Conn.	9/07/94	27	.020	<.003	<.002	.006	<.018	<.005
01198200	Konkapot River at Ashley Falls, Mass.	9/08/94	28	.018	<.003	<.002	<.002	<.018	<.005
01199900	Tenmile River at South Dover near Wingdale, N.Y.	6/13/94	339	.290	<.003	<.002	.040	E.012	.007
01199900	Tenmile River at South Dover near Wingdale, N.Y.	8/17/94	109	.033	<.003	<.002	.042	E.016	.066
01204000	Pomperaug River at Southbury, Conn.	6/13/94	284	1.10	<.003	.006	.910	E.012	.031

Table 23. Concentrations of selected pesticides detected in the Connecticut, Housatonic, and Thames River Basins study, 1993–95—*Continued*

Station No.	Station name	Sampling date	Streamflow (ft^3/s)	Atrazine	Carbaryl (82680)	Diazinon	Metolachlor	Prometon	Simazine
		Agricultural basins—*Continued*							
430217072271601	Great Brook near Walpole, N.H.	8/02/95	1.8	0.037	<0.003	<0.002	<0.002	<0.018	<0.005
433709072320301	Ottauquechee River at West Woodstock, Vt.	8/03/95	24	<.001	<.003	<.002	<.002	<.018	E.003
435031072351101	Second Branch White River near East Bethel, Vt.	8/28/95	9.7	.006	<.003	<.002	<.002	<.018	<.005
440057072045201	Unnamed Tributary to Connecticut River near Haverhill, N.H.	8/10/95	.79	.004	<.003	<.002	<.002	<.018	<.005
		Forested basins							
01137500	Ammonoosuc River at Bethlehem Junction, N.H.	6/22/94	306	<0.001	<0.003	<0.002	<0.002	<0.018	<0.005
01170100	Green River near Colrain, Mass.	6/14/94	47	.004	E.011	<.002	.003	<.018	<.005
01170100	Green River near Colrain, Mass.	8/10/94	9.0	<.001	<.003	<.002	<.002	<.018	<.005
01193500	Salmon River near East Hampton, Conn.	6/13/94	161	.008	E.016	.006	.007	<.018	<.005
01193500	Salmon River near East Hampton, Conn.	8/31/94	53	.005	<.003	<.002	<.002	<.018	<.005
01196589	Brooksvale Stream at Mt. Sanford Road, Cheshire, Conn.	8/21/94	.28	<.001	<.003	<.002	<.002	<.018	<.005
01198151	Rawson Brook–Wellman Road, near Monterey, Mass.	9/06/94	2.9	<.001	<.003	<.002	<.002	<.018	<.005
01198158	Konkapot River at Hartsville–Mill River Road, near Mill River, Mass.	9/06/94	11	<.001	<.003	<.002	<.002	E.008	<.005
01198159	Konkapot River near Mill River, Mass.	9/06/94	14	<.001	<.003	<.002	<.002	E.007	<.005
		Integrator basins							
01122610	Shetucket River at South Windham, Conn.	8/29/94	380	<0.001	<0.003	<0.002	<0.002	<0.018	<0.005
01124000	Quinebaug River at Quinebaug, Conn.	8/08/94	31	<.001	<.003	.009	<.002	<.018	<.005
01129500	Connecticut River at North Stratford, N.H.	8/30/95	260	.003	<.003	<.002	<.002	<.018	<.005
01131500	Connecticut River near Dalton, N.H.	6/30/94	2,530	.008	<.003	<.002	<.002	<.018	<.005
01135500	Passumpsic River at Passumpsic, Vt.	6/22/94	726	.014	<.003	<.002	.006	<.018	<.005
01138000	Ammonoosuc River near Bath, N.H.	8/29/95	80	<.001	<.003	<.002	<.002	<.018	<.005
01144000	White River at West Hartford, Vt.	6/06/94	740	<.001	<.003	<.002	.012	<.018	<.005
01144000	White River at West Hartford, Vt.	6/16/94	608	.014	<.003	<.002	.012	<.018	.008
01144000	White River at West Hartford, Vt.	6/23/94	400	.009	<.003	<.002	.009	E.005	.012
01144000	White River at West Hartford, Vt.	6/29/94	1,080	.029	<.003	<.002	.013	<.018	.014
01144500	Connecticut River at West Lebanon, N.H.	6/30/94	1,810	.007	<.003	<.002	.005	<.018	.009
01152500	Sugar River at West Claremont, N.H.	8/28/95	41	.005	<.003	<.002	.006	<.018	<.005
01161000	Ashuelot River at Hinsdale, N.H.	6/27/94	245	.008	E.006	.006	.008	E.004	<.005
01166500	Millers River at Erving, Mass.	6/28/94	124	.008	E.007	.016	<.002	<.018	<.005
01170000	Deerfield River near West Deerfield, Mass.	6/28/94	592	<.001	<.003	<.002	<.002	<.018	<.005

Table 23. *Concentrations of selected pesticides detected in the Connecticut, Housatonic, and Thames River Basins study, 1993–95—Continued*

Station No.	Station name	Sampling date	Streamflow (ft^3/s)	Atrazine	Carbaryl (82680)	Diazinon	Metolachlor	Prometon	Simazine
		Integrator basins—*Continued*							
01170500	Connecticut River at Montague City, Mass.	6/27/94	9,030	0.013	<0.003	<0.002	0.010	<0.018	0.006
01177000	Chicopee River at Indian Orchard, Mass.	6/27/94	110	.006	<.003	.007	.006	<.018	<.005
01183500	Westfield River near Westfield, Mass.	6/27/94	235	.017	<.003	.006	.007	<.018	.010
01184000	Connecticut River at Thompsonville, Conn.	5/24/94	19,200	.005	<.003	<.002	.006	<.018	E.003
01184000	Connecticut River at Thompsonville, Conn.	6/02/94	18,500	<.001	<.003	<.002	.006	<.018	<.005
01184000	Connecticut River at Thompsonville, Conn.	6/10/94	12,000	.009	<.003	.009	.008	<.018	.005
01184000	Connecticut River at Thompsonville, Conn.	8/18/94	12,600	.011	E.043	.056	.016	E.006	.005
01189995	Farmington River at Tariffville, Conn.	5/18/94	2,010	<.001	<.003	.010	.003	<.018	<.005
01189995	Farmington River at Tariffville, Conn.	5/24/94	1,200	.005	<.003	E.001	.006	<.018	E.003
01189995	Farmington River at Tariffville, Conn.	6/02/94	834	<.001	<.003	<.002	.008	<.018	<.005
01189995	Farmington River at Tariffville, Conn.	6/10/94	666	.005	<.003	.005	.006	<.018	E.003
01193000	Connecticut River at Middletown, Conn.	6/22/94	--	.019	<.003	.008	.019	<.018	.009
01200600	Housatonic River near New Milford, Conn.	5/26/94	1400	.011	<.003	<.002	.011	E.008	E.004
01200600	Housatonic River near New Milford, Conn.	6/07/94	848	.008	<.003	<.002	.018	<.018	<.005
01200600	Housatonic River near New Milford, Conn.	6/28/94	584	.014	<.003	<.002	.013	E.010	<.005
01200600	Housatonic River near New Milford, Conn.	8/23/94	2,870	.010	<.003	.006	.010	E.008	E.004
01208500	Naugatuck River at Beacon Falls, Conn.	5/17/94	1,000	<.001	<.003	.037	.004	<.018	<.005
01208500	Naugatuck River at Beacon Falls, Conn.	5/25/94	403	.012	<.003	.015	<.002	E.013	<.005
01208500	Naugatuck River at Beacon Falls, Conn.	6/01/94	263	.011	<.003	<.002	<.002	<.018	<.005
01208500	Naugatuck River at Beacon Falls, Conn.	6/10/94	148	<.001	E.013	.021	<.002	<.018	<.005
01208500	Naugatuck River at Beacon Falls, Conn.	8/23/94	2,620	.018	E.016	.027	.007	E.013	<.005

Table 24. Concentrations of pesticides detected in urban indicator basins in the Connecticut, Housatonic, and Thames River Basins study, 1993–95

[Concentrations are in units of micrograms per liter. Parameter codes for carbaryl (82860) and (49310) are included to distinguish detections on schedule 2010 from detections on schedule 2050; E, indicates an estimated value; No., number; ft^3/s, foot per second; <, actual value is less than method detection limit; --, indicates missing data]

Station No.	Station name	Sampling date	Streamflow (ft^3/s)	Atrazine	Carbaryl (49310)	Carbaryl (82680)	Chlorpyrifos	Cyanazine	Desethyl-atrazine	Diazinon
01189000	Pequabuck River at Forestville, Conn.	6/14/94	88	0.015	<0.008	E0.009	0.026	<0.004	<0.002	0.100
01189000	Pequabuck River at Forestville, Conn.	8/31/94	82	<.001	<.010	E.024	<.004	<.004	<.002	.022
01192500	Hockanum River near East Hartford, Conn.	6/02/94	80	.018	<.008	E.019	<.004	<.004	E.003	.009
01192500	Hockanum River near East Hartford, Conn.	8/24/94	238	.011	E.020	E.043	<.004	.062	E.004	.090
01196500	Quinnipiac River at Wallingford, Conn.	6/01/94	110	<.001	<.008	<.003	<.004	<.004	<.002	.018
01196580	Muddy River near North Haven, Conn.	9/15/94	2.6	.014	<.008	<.003	<.004	<.004	E.011	.011
01196618	Willow Brook at Willow Street, Hamden, Conn.	8/21/95	2.9	.003	<.008	<.003	<.004	<.004	E.003	.004
01196619	Eaton Brook at Route 10, Hamden, Conn.	8/22/95	.13	<.001	<.008	<.003	<.004	<.004	<.002	.006
01196620	Mill River near Hamden, Conn.	8/22/95	1.3	.002	<.008	<.003	<.004	<.004	<.002	E.002
0119662350	Mill River at Dixwell Avenue, Hamden, Conn.	8/22/95	3.6	.008	<.008	<.003	<.004	<.004	<.002	.005
0119662375	Shepard Brook at Route 10, Hamden, Conn.	8/22/95	.172	.006	<.008	<.003	<.004	<.004	<.002	.005
0119662380	Mill River at Skiff Street, Hamden, Conn.	8/23/95	2.5	.012	<.008	<.003	<.004	<.004	<.002	.006
01208873	Rooster River at Fairfield, Conn.	4/12/94	37	<.001	<.008	<.003	<.004	<.004	<.002	.210
01208873	Rooster River at Fairfield, Conn.	5/31/94	7.8	<.001	<.008	<.003	<.004	<.004	<.002	.007
01208873	Rooster River at Fairfield, Conn.	8/09/94	2.0	<.001	<.008	<.003	<.004	<.004	<.002	.011
425104072322601	Whetstone Brook at mouth, at Brattleboro, Vt.	8/14/95	4.7	<.001	<.008	<.003	<.004	<.004	<.002	<.002

Table 24. Concentrations of pesticides detected in urban indicator basins in the Connecticut, Housatonic, and Thames River Basins study, 1993–95—*Continued*

Station No.	Station name	Sampling date	Dieldrin	Malathion	Metolachlor	Metribuzin	Prometon	Propargite	Simazine	Terbacil
01189000	Pequabuck River at Forestville, Conn.	6/14/94	<0.001	0.011	0.015	0.059	E0.012	<0.013	0.010	<0.007
01189000	Pequabuck River at Forestville, Conn.	8/31/94	<.001	<.005	<.002	<.004	E.009	<.013	<.005	<.007
01192500	Hockanum River near East Hartford, Conn.	6/02/94	<.001	<.005	.024	<.004	<.018	<.013	.010	<.007
01192500	Hockanum River near East Hartford, Conn.	8/24/94	<.001	<.005	.022	<.004	.020	<.013	.006	<.007
01196500	Quinnipiac River at Wallingford, Conn.	6/01/94	<.001	<.005	.006	.010	<.018	.028	<.005	--
01196580	Muddy River near North Haven, Conn.	9/15/94	<.001	<.005	.019	<.004	.030	<.013	E.004	E.014
01196618	Willow Brook at Willow Street, Hamden, Conn.	8/21/95	<.001	<.005	<.002	<.004	<.018	<.013	<.005	<.007
01196619	Eaton Brook at Route 10, Hamden, Conn.	8/22/95	<.001	<.005	<.002	<.004	E.008	<.013	<.005	<.007
01196620	Mill River near Hamden, Conn.	8/22/95	<.001	<.005	<.002	<.004	E.005	<.013	<.005	<.007
0119662350	Mill River at Dixwell Avenue, Hamden, Conn.	8/22/95	<.001	<.005	<.002	<.004	<.018	<.013	<.005	<.007
0119662375	Shepard Brook at Route 10, Hamden, Conn.	8/22/95	<.001	<.005	<.002	<.004	.024	<.013	.007	<.007
0119662380	Mill River at Skiff Street, Hamden, Conn.	8/23/95	<.001	<.005	<.002	<.004	<.018	<.013	<.005	<.007
01208873	Rooster River at Fairfield, Conn.	4/12/94	.008	<.005	<.002	<.004	.029	<.013	<.005	<.007
01208873	Rooster River at Fairfield, Conn.	5/31/94	<.001	<.005	<.002	.007	<.018	<.013	.037	--
01208873	Rooster River at Fairfield, Conn.	8/09/94	.004	<.005	<.002	<.004	.018	<.013	.012	<.007
425104072322601	Whetstone Brook at mouth, at Brattleboro, Vt.	8/14/95	<.001	<.005	<.002	<.004	<.018	<.013	<.005	<.007

Table 25. Concentrations of pesticides detected in agricultural indicator basins in the Connecticut, Housatonic, and Thames River Basins study, 1993–95

[Concentrations are in units of micrograms per liter; Parameter codes for carbaryl (49310) and carbofuran (49309) and (82674) are included to distinguish detections on schedule 2010 from detections on schedule 2050; E, indicates an estimated value; No., number; ft^3/s, foot per second; <, actual value is less than method detection limit; --, indicates missing data]

Station No.	Station name	Sampling date	Stream-flow (ft^3/s)	2,4-D	Alachlor	Atrazine	Carbaryl (49310)	Carbo-furan (49309)	Carbo-furan (82674)	DCPA
01135300	Sleepers River (Site W-5) near St. Johnsbury, Vt.	6/22/94	32	<0.035	<0.002	0.013	<0.008	<0.028	<0.003	<0.002
01155000	Cold River at Drewsville, N.H.	8/14/95	24	<.035	<.002	.004	<.008	<.028	<.003	<.002
01184100	Stony Brook near West Suffield, Conn.	8/10/95	2.3	.060	<.002	.019	<.008	<.028	<.003	<.002
01184490	Broad Brook at Broad Brook, Conn.	6/01/94	20	<.035	<.002	.027	<.008	<.028	<.003	<.002
01184490	Broad Brook at Broad Brook, Conn.	9/14/94	12	<.035	<.002	.054	<.008	<.028	<.003	.002
01184500	Scantic River at Broad Brook, Conn.	6/02/94	--	<.035	<.002	.023	<.008	<.028	<.003	<.002
01184500	Scantic River at Broad Brook, Conn.	9/14/94	36	<.035	<.002	.019	<.008	.080	E.050	<.002
01192883	Coginchaug River at Middlefield, Conn.	6/13/94	19	<.035	<.002	.012	<.008	<.028	<.003	E.001
01198180	Konkapot River at Clayton, Mass.	9/07/94	22	<.035	<.002	<.001	<.008	<.028	<.003	<.002
01198185	Konkapot River at Sodom, Conn.	9/07/94	23	<.035	<.002	.015	<.008	<.028	<.003	<.002
01198190	Konkapot River near Canaan, Conn.	9/07/94	27	<.035	<.002	.020	<.008	<.028	<.003	<.002
01198200	Konkapot River at Ashley Falls, Mass.	9/08/94	28	<.035	<.002	.018	<.008	<.028	<.003	<.002
01199900	Tenmile River at South Dover near Wingdale, N.Y.	6/13/94	339	<.035	.054	.290	<.008	<.028	<.003	<.002
01199900	Tenmile River at South Dover near Wingdale, N.Y.	8/17/94	109	<.035	.007	.033	<.008	<.028	<.003	<.002
01204000	Pomperaug River at Southbury, Conn.	6/13/94	284	<.035	.039	1.10	E.020	<.028	<.003	E.001
430217072271601	Great Brook near Walpole, N.H.	8/02/95	1.8	<.035	<.002	.037	<.008	<.028	<.003	<.002
433709072320301	Ottauquechee River at West Woodstock, Vt.	8/03/95	24	<.035	<.002	<.001	<.008	<.028	<.003	<.002
435031072351101	Second Branch White River near East Bethel, Vt.	8/28/95	9.7	<.035	<.002	.006	<.008	<.028	<.003	<.002
440057072045201	Unnamed Tributary to Connecticut River near Haverhill, N.H.	8/10/95	.79	<.035	<.002	.004	<.008	<.028	<.003	<.002

Table 25. Concentrations of pesticides detected in agricultural indicator basins in the Connecticut, Housatonic, and Thames River Basins study, 1993–95—*Continued*

Station No.	Station name	Sampling date	Desethyl-atrazine	Diazinon	Mala-thion	Meto-lachlor	Metri-buzin	Pendi-methalin	Prome-ton	Simazine
01135300	Sleepers River (Site W-5) near St. Johnsbury, Vt.	6/22/94	<0.002	<0.002	<0.005	0.005	<0.004	<0.004	<0.018	<0.005
01155000	Cold River at Drewsville, N.H.	8/14/95	<.002	<.002	<.005	<.002	<.004	<.004	<.018	<.005
01184100	Stony Brook near West Suffield, Conn.	8/10/95	E.003	<.002	<.005	.052	<.004	<.004	<.018	.690
01184490	Broad Brook at Broad Brook, Conn.	60/1/94	<.002	<.002	<.005	.078	<.004	<.004	<.018	<.005
01184490	Broad Brook at Broad Brook, Conn.	9/14/94	E.035	.004	<.005	.110	<.004	<.004	<.018	.006
01184500	Scantic River at Broad Brook, Conn.	6/02/94	<.002	.007	<.005	.051	<.004	<.004	<.018	<.005
01184500	Scantic River at Broad Brook, Conn.	9/14/94	E.013	<.002	<.005	.042	<.004	<.004	<.018	<.005
01192883	Coginchaug River at Middlefield, Conn.	6/13/94	E.002	.003	<.005	.012	E.003	<.004	<.018	.005
01198180	Konkapot River at Clayton, Mass.	9/07/94	E.005	<.002	<.005	<.002	<.004	<.004	<.018	<.005
01198185	Konkapot River at Sodom, Conn.	9/07/94	E.009	<.002	<.005	<.002	<.004	<.004	<.018	<.005
01198190	Konkapot River near Canaan, Conn.	9/07/94	E.004	<.002	<.005	.006	<.004	<.004	<.018	<.005
01198200	Konkapot River at Ashley Falls, Mass.	9/08/94	E.004	<.002	<.005	<.002	<.004	<.004	<.018	<.005
01199900	Tenmile River at South Dover near Wingdale, N.Y.	6/13/94	E.019	<.002	.005	.040	<.004	<.004	E.012	.007
01199900	Tenmile River at South Dover near Wingdale, N.Y.	8/17/94	E.018	<.002	<.005	.042	<.004	<.004	E.016	.066
01204000	Pomperaug River at Southbury, Conn.	6/13/94	E.039	.006	<.005	.910	.006	.120	E.012	.031
430217072271601	Great Brook near Walpole, N.H.	8/02/95	E.017	<.002	<.005	<.002	<.004	<.004	<.018	<.005
433709072320301	Ottauquechee River at West Woodstock, Vt.	8/03/95	<.002	<.002	<.005	<.002	<.004	<.004	<.018	E.003
435031072351101	Second Branch White River near East Bethel, Vt.	8/28/95	<.002	<.002	<.005	<.002	<.004	<.004	<.018	<.005
440057072045201	Unnamed Tributary to Connecticut River near Haverhill, N.H.	8/10/95	E.014	<.002	<.005	<.002	<.004	<.004	<.018	<.005

Table 26. Concentrations of pesticides detected in forested indicator basins in the Connecticut, Housatonic, and Thames River Basins study, 1993-95

[Concentrations are in units of micrograms per liter; Parameter codes for carbaryl (82860) and (49310) are included to distinguish detections on schedule 2010 from detections on schedule 2050; E, indicates an estimated value; No., number; ft^3/s, foot per second; <, actual value is less than method detection limit]

Station No.	Station name	Sampling date	Streamflow (ft^3/s)	Alachlor	Atrazine	Carbaryl (49310)	Carbaryl (82680)	Desethyl-atrazine	Diazinon	Metolachlor	Prometon
01137500	Ammonoosuc River at Bethlehem Junction, N.H.	6/22/94	306	<0.002	<0.001	<0.008	<0.003	<0.002	<0.002	<0.002	<0.018
01170100	Green River near Colrain, Mass.	6/14/94	47	<.002	.004	E.020	E.011	E.001	<.002	.003	<.018
01170100	Green River near Colrain, Mass.	8/10/94	9.0	<.002	<.001	<.008	<.003	<.002	<.002	<.002	<.018
01193500	Salmon River near East Hampton, Conn.	6/13/94	161	.017	.008	<.008	E.016	E.002	.006	.007	<.018
01193500	Salmon River near East Hampton, Conn.	8/31/94	53	<.002	.005	<.008	<.003	E.003	<.002	<.002	<.018
01196589	Brooksvale Stream at Mt. Sanford Road, Cheshire, Conn.	8/21/95	.28	<.002	<.001	<.008	<.003	<.002	<.002	<.002	<.018
01198151	Rawson Brook–Wellman Road, near Monterey, Mass.	9/06/94	2.9	<.002	<.001	<.008	<.003	E.003	<.002	<.002	<.018
01198158	Konkapot Road at Hartsville–Mill River Road, near Mill River, Mass.	9/06/94	11	<.002	<.001	<.008	<.003	<.002	<.002	<.002	E.008
01198159	Konkapot River near Mill River, Mass.	9/06/94	14	<.002	<.001	<.008	<.003	E.003	<.002	<.002	E.007

Table 27. Concentrations of pesticides detected in integrator basins in the Connecticut, Housatonic, and Thames River

[Units are micrograms per liter; Parameter code for carbaryl (82860) is included to distinguish its detections on schedule 2010 from detections on schedule

Station No.	Station name	Sampling date	Streamflow (ft^3/s)	2,4-D	Alachlor	Atrazine	Carbaryl (82680)	Chlorpyrifos	Cyanazine	DCPA
01122610	Shetucket River at South Windham, Conn.	8/29/94	380	<0.035	<0.002	<0.001	<0.003	<0.004	<0.004	<0.002
01124000	Quinebaug River at Quinebaug, Conn.	8/08/94	31	<.035	<.002	<.001	<.003	<.004	<.027	<.002
01129500	Connecticut River at North Stratford, N.H.	8/30/95	260	--	<.002	.003	<.003	<.004	<.004	<.002
01131500	Connecticut River near Dalton, N.H.	6/30/94	2,530	<.035	<.002	.008	<.003	<.004	<.004	<.002
01135500	Passumpsic River at Passumpsic, Vt.	6/22/94	726	<.035	<.002	.014	<.003	<.004	<.004	<.002
01138000	Ammonoosuc River near Bath, N.H.	8/29/95	80	<.035	<.002	<.001	<.003	<.004	<.004	<.002
01144000	White River at West Hartford, Vt.	6/06/94	740	<.035	<.002	<.001	<.003	<.004	<.004	<.002
01144000	White River at West Hartford, Vt.	6/16/94	608	<.035	<.002	.014	<.003	<.004	<.004	<.002
01144000	White River at West Hartford, Vt.	6/23/94	400	<.035	<.002	.009	<.003	<.004	<.004	<.002
01144000	White River at West Hartford, Vt.	6/29/94	1,080	<.035	.006	.029	<.003	<.004	<.004	<.002
01144500	Connecticut River at West Lebanon, N.H.	6/30/94	1,810	<.035	<.002	.007	<.003	<.004	<.004	<.002
01152500	Sugar River at West Claremont, N.H.	8/28/95	41	<.035	<.002	.005	<.003	<.004	<.004	<.002
01161000	Ashuelot River at Hinsdale, N.H.	6/27/94	245	<.035	<.002	.008	E.006	<.004	<.004	<.002
01166500	Millers River at Erving, Mass.	6/28/94	124	E.840	<.002	.008	E.007	<.004	<.004	<.002
01170000	Deerfield River near West Deerfield, Mass.	6/28/94	592	<.035	<.002	<.001	<.003	<.004	<.004	<.002
01170500	Connecticut River at Montague City, Mass.	6/27/94	9,030	<.035	.003	.013	<.003	<.004	<.004	<.002
01177000	Chicopee River at Indian Orchard, Mass.	6/27/94	110	<.035	<.002	.006	<.003	<.004	<.004	<.002
01183500	Westfield River near Westfield, Mass.	6/27/94	235	<.035	<.002	.017	<.003	<.004	<.004	.002
01184000	Connecticut River at Thompsonville, Conn.	5/24/94	19,200	<.035	<.002	.005	<.003	<.004	<.004	<.002
01184000	Connecticut River at Thompsonville, Conn.	6/02/94	18,500	<.035	.004	<.001	<.003	<.004	<.004	<.002
01184000	Connecticut River at Thompsonville, Conn.	6/10/94	12,000	<.035	.006	.009	<.003	<.004	<.004	<.002
01184000	Connecticut River at Thompsonville, Conn.	8/18/94	12,600	<.035	<.002	.011	E.043	.014	<.004	.002
01189995	Farmington River at Tariffville, Conn.	5/18/94	2,010	<.035	<.002	<.001	<.003	<.004	<.004	<.002
01189995	Farmington River at Tariffville, Conn.	5/24/94	1,200	<.035	<.002	.005	<.003	<.004	<.004	<.002
01189995	Farmington River at Tariffville, Conn.	6/02/94	834	<.035	<.002	<.001	<.003	<.004	<.004	<.002
01189995	Farmington River at Tariffville, Conn.	6/10/94	666	<.035	<.002	.005	<.003	<.004	<.004	<.002
01193000	Connecticut River at Middletown, Conn.	6/22/94	--	<.035	<.002	.019	<.003	<.004	.034	<.002
01200600	Housatonic River near New Milford, Conn.	5/26/94	1,400	<.035	<.002	.011	<.003	<.004	<.004	<.002
01200600	Housatonic River near New Milford, Conn.	6/07/94	848	<.035	<.002	.008	<.003	<.004	<.004	<.002
01200600	Housatonic River near New Milford, Conn.	6/28/94	584	<.035	<.002	.014	<.003	<.004	<.004	<.002
01200600	Housatonic River near New Milford, Conn.	8/23/94	2,870	<.035	<.002	.010	<.003	<.004	<.004	<.002
01208500	Naugatuck River at Beacon Falls, Conn.	5/17/94	1,000	<.035	<.002	<.001	<.003	<.004	<.004	<.002
01208500	Naugatuck River at Beacon Falls, Conn.	5/25/94	403	<.035	<.002	.012	<.003	.005	<.004	<.002
01208500	Naugatuck River at Beacon Falls, Conn.	6/01/94	263	<.035	<.002	.011	<.003	.009	<.004	<.002
01208500	Naugatuck River at Beacon Falls, Conn.	6/10/94	148	<.035	<.002	<.001	E.013	.008	<.004	<.002
01208500	Naugatuck River at Beacon Falls, Conn.	8/23/94	2,620	<.035	<.002	.018	E.016	<.004	<.004	<.002

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2050; E, indicates an estimated value; No.,number; ft^3/s, foot per second; <, actual value is less than method detection limit; --, indicates missing data]

Station No.	Des-ethyl-atrazine	Diazinon	Dichlor-prop	EPTC	Malathion	Meto-lachlor	Metribuzin	Prometon	Propachlor	Propargite	Simazine
01122610	E0.002	<0.002	<0.032	<0.002	<0.005	<0.002	<0.004	<0.018	<0.007	<0.013	<0.005
01124000	<.002	.009	.250	<.002	<.005	<.002	<.004	<.018	<.007	<.013	<.005
01129500	E.004	<.002	--	<.002	<.005	<.002	<.004	<.018	<.007	<.013	<.005
01131500	E.003	<.002	<.032	<.002	<.005	<.002	<.004	<.018	<.007	<.013	<.005
01135500	<.002	<.002	<.032	<.002	<.005	.006	<.004	<.018	<.007	<.013	<.005
01138000	<.002	<.002	<.032	<.002	<.005	<.002	<.004	<.018	<.007	<.013	<.005
01144000	<.002	<.002	<.032	<.002	<.005	.012	<.004	<.018	<.007	<.013	<.005
01144000	E.004	<.002	<.032	<.002	<.005	.012	<.004	<.018	<.007	<.013	.008
01144000	<.002	<.002	<.032	<.002	<.005	.009	<.004	E.005	<.007	<.013	.012
01144000	E.004	<.002	<.032	<.002	<.005	.013	<.004	<.018	<.007	<.013	.014
01144500	<.002	<.002	<.032	<.002	<.005	.005	<.004	<.018	<.007	<.013	.009
01152500	<.002	<.002	<.032	<.002	<.005	.006	<.004	<.018	<.007	<.013	<.005
01161000	E.005	.006	<.032	<.002	<.005	.008	<.004	E.004	<.007	<.013	<.005
01166500	<.002	.016	<.032	<.002	<.005	<.002	<.004	<.018	<.007	<.013	<.005
01170000	<.002	<.002	<.032	<.002	<.005	<.002	<.004	<.018	<.007	<.013	<.005
01170500	E.004	<.002	<.032	<.002	<.005	.010	<.004	<.018	<.007	<.013	.006
01177000	<.002	.007	<.032	<.002	<.005	.006	<.004	<.018	<.007	<.013	<.005
01183500	<.002	.006	<.032	<.002	<.005	.007	<.004	<.018	<.007	<.013	.010
01184000	<.002	<.002	<.032	.002	<.005	.006	<.004	<.018	<.007	<.013	E.003
01184000	<.002	<.002	<.032	<.002	<.005	.006	<.004	<.018	<.007	<.013	<.005
01184000	E.002	.009	<.032	<.002	<.005	.008	<.004	<.018	<.007	<.013	.005
01184000	E.005	.056	<.032	<.002	<.005	.016	<.004	E.006	<.007	<.013	.005
01189995	<.002	.010	<.032	<.002	<.005	.003	<.004	<.018	<.007	<.013	<.005
01189995	<.002	E.001	<.032	<.002	<.005	.006	<.004	<.018	<.007	<.013	E.003
01189995	<.002	<.002	<.032	<.002	<.005	.008	<.004	<.018	<.007	<.013	<.005
01189995	E.001	.005	<.032	<.002	<.005	.006	<.004	<.018	<.007	<.013	E.003
01193000	E.004	.008	<.032	<.002	<.005	.019	<.004	<.018	<.007	<.013	.009
01200600	E.007	<.002	<.032	<.002	<.005	.011	<.004	E.008	<.007	<.013	E.004
01200600	<.002	<.002	<.032	<.002	<.005	.018	<.004	<.018	<.007	<.013	<.005
01200600	<.002	<.002	<.032	<.002	<.005	.013	<.004	E.010	<.007	<.013	<.005
01200600	E.006	.006	<.032	<.002	<.005	.010	<.004	E.008	<.007	<.013	E.004
01208500	<.002	.037	<.032	<.002	<.005	.004	.053	<.018	<.007	.300	<.005
01208500	<.002	.015	<.032	<.002	4.30	<.002	<.004	E.013	<.007	.230	<.005
01208500	<.002	<.002	<.032	<.002	<.005	<.002	.041	<.018	<.007	.400	<.005
01208500	<.002	.021	<.032	<.002	.019	<.002	.140	<.018	.008	.750	<.005
01208500	E.007	.027	<.032	<.002	<.005	.007	<.004	E.013	<.007	<.013	<.005

Table 28. Maximum concentrations of the six most commonly detected pesticides in surface-water-quality samples using SPE methodology in primarily urban, agricultural, and forested basins in the Connecticut, Housatonic, and Thames River Basins study, 1993–95

[SPE, solid phase extraction; µg/L, microgram per liter]

	Basin land use		
Pesticide	Urban	Agricultural	Forested
	Concentration (µg/L)		
Atrazine	0.018	1.10	0.008
Carbaryl	3.20	.020	.020
Diazinon	.210	.007	.006
Metolachlor	.024	.910	.007
Prometon	.140	.016	.008
Simazine	.037	.690	Not detected

In samples from urban basins (not including the Norwalk River), diazinon was detected in 15 of 16 samples (94 percent), and prometon and atrazine were detected in 9 of 16 samples (56 percent). The remaining commonly detected pesticides were found in less than 50 percent of the samples. At the Norwalk site, prometon was detected in 53 of 59 samples (90 percent), atrazine in 39 of 59 samples (66 percent), simazine in 24 of 59 samples (41 percent), and the remaining pesticides in less than 33 percent of the samples.

Comparing data for the Norwalk (fig. 7) to the rest of the urban sites (fig. 12), reveals similar ranges of concentrations for the pesticides detected. The primary differences between the two groups of data are (1) the high frequency of prometon detections at the Norwalk River; (2) the less frequent occurrence of diazinon at the Norwalk River than at the other urban sites; and (3) the 13 detections of DCPA at the Norwalk River versus none at the other urban sites (table 12).

The appearance of the prometon boxplot for urban stations (fig. 12) can be misleading: a number of the samples had detectable concentrations of prometon, but the concentrations were less than the MDL of 0.018 µg/L and, therefore, were reported as estimated values (table 24) and were censored in the boxplot. Prometon was detected in 9 of 16 (56 percent) urban-land-use samples (table 12).

One explanation for differences in frequency of diazinon detection between the Norwalk River and other urban sites is related to the number of samples taken at the Norwalk during non-growing seasons, when this pesticide would not likely be applied. Another possible explanation is that the urban samples were collected from basins with a greater proportion of residential land use than that found in the Norwalk Basin, which is highly commercialized. Larson and others (1997) report that more or less continual residential applications accounted for elevated concentrations of pesticides determined in urban runoff during spring, summer, and autumn.

Most of the DCPA detections in the Norwalk River occurred in spring and early summer, primarily in 1993, and most sampling in other urban basins took place in late summer. DCPA is used on golf courses, as is simazine, and there is a golf course not far from the Norwalk River sampling location which could account for the presence of DCPA in the samples.

Atrazine was detected in 89 percent (17 of 19 samples) and metolachlor was detected in 58 percent (11 of 19) of the samples collected in agricultural basins (table 12). The remaining pesticides were found in less than one-third of the samples. Although atrazine, too, was commonly detected in urban-water-quality samples its median concentration in these samples was about an order of magnitude lower than in agricultural-basin samples (fig. 12). The median atrazine concentration from agricultural samples was approximately equal to the highest concentration detected in urban samples and was greater than twice the highest concentration in undeveloped-basin samples (fig. 12). The median concentration of metolachlor, the second most commonly detected pesticide in agricultural samples, was approximately 0.006 µg/L in agricultural samples (fig. 12) and was less than the MDL in urban samples (fig. 12). Simazine, a non-selective herbicide used in urban and agricultural settings, was detected more frequently in urban than agricultural samples, but the concentrations ranges were higher in the agricultural samples.

Seven different pesticides or metabolites were detected at forested reference sites (table 12). Desethylatrazine was the most commonly detected compound. Of the 17 total detections, 11 were from 2 samples collected during the high-flux study in June 1994. Six of these detections were at the Salmon River near East Hampton, Conn., a basin with a substantial amount of developed land (13.6 percent agricultural and 6.2 percent urban or residential). The other high-flux sample, collected from the Green River near Colrain, Mass., a basic fixed site, had detectable concentrations of 5 pesticide compounds. There is only 4.5 percent agricultural and 0.5 percent urban land use

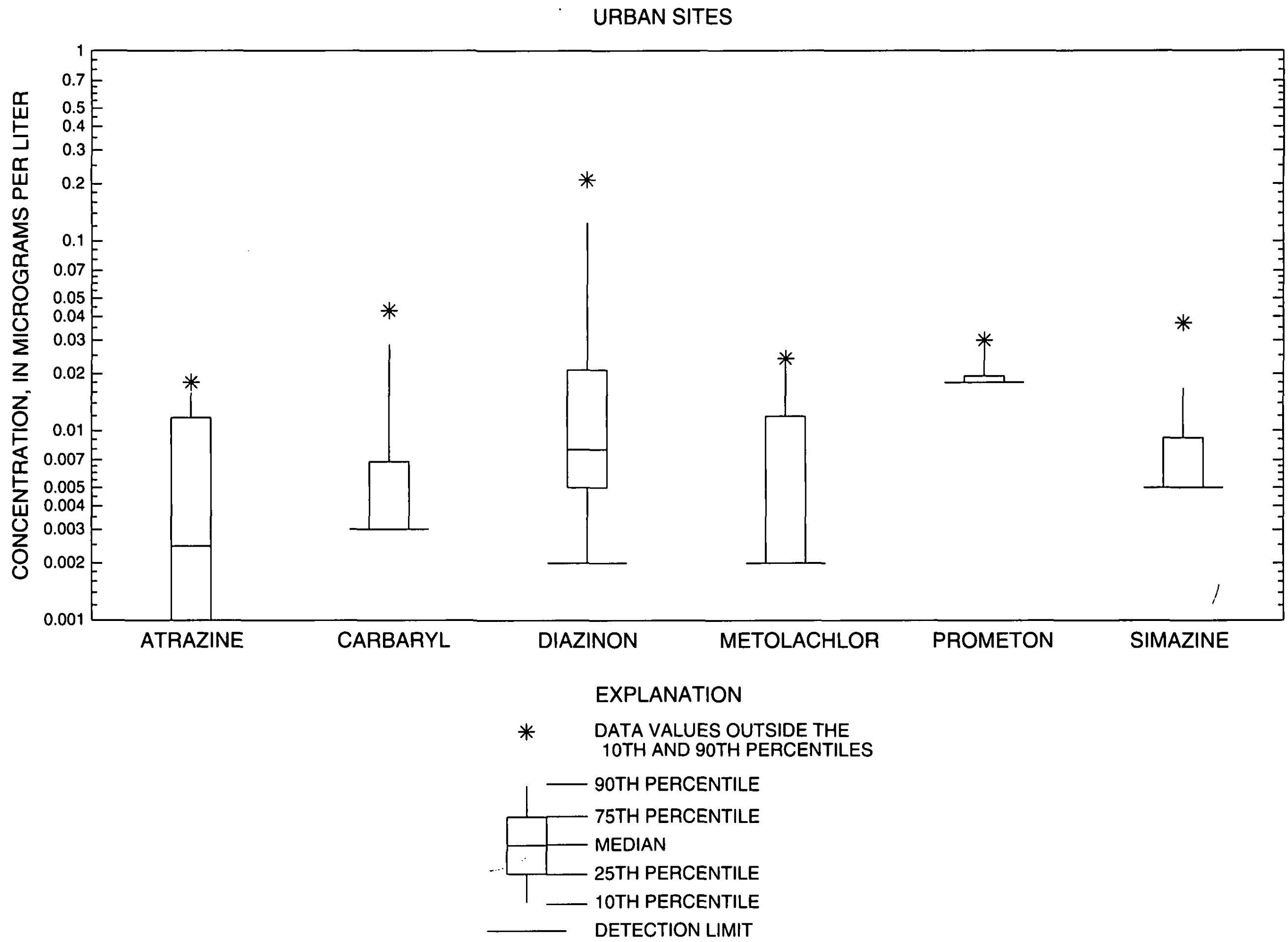

Figure 12. Concentrations of selected pesticides in streams in urban, agricultural, and forested land-use basins in the Connecticut, Housatonic, and Thames River Basins study, 1993–95.

in the basin upstream from the Green River site (table 6). During low-flow sampling at these two sites, the only detections were atrazine and desethylatrazine at the Salmon River. The rare occurrence of detectable pesticides during low-flow sampling at reference sites suggests that atmospheric transport may be responsible for pesticide occurrence. Still, the inclusion of residential and agricultural land use in reference settings may have a direct effect.

Although generally selected for their large basin areas and non-predominating land use, some of the integrator basins have substantial areas of urban or agricultural land use (tables 2, 6). The pesticides detected in samples from of these basins may reflect the effect of land use. For example, several pesticides detected in samples from the Naugatuck River at Beacon Falls, Conn., may be closely, but not necessarily exclusively, associated with urban settings; these include the insecticides, carbaryl, chlorpyrifos, diazinon, malathion, and propargite, and the herbicides, metribuzin and prometon (table 27). Nearly 18 percent of this basin's land use is classified as urban. Similarly, several samples from the White River at West Hartford, Vt., a basin with nearly 15 percent agricultural land use, contained detectable concentrations of the commonly used agricultural herbicides atrazine, metolachlor, and simazine, but no insecticides.

Pesticide Transport and Loading to Surface Water

Estimating annual loads of pesticides transported without continuous or frequent, regular sampling over long time periods limits this analysis to daily loads (tables 29 and 30, and tables 32 and 33 at back of report) extrapolated from instantaneous concentrations and discharges. Such an analysis yields conservative

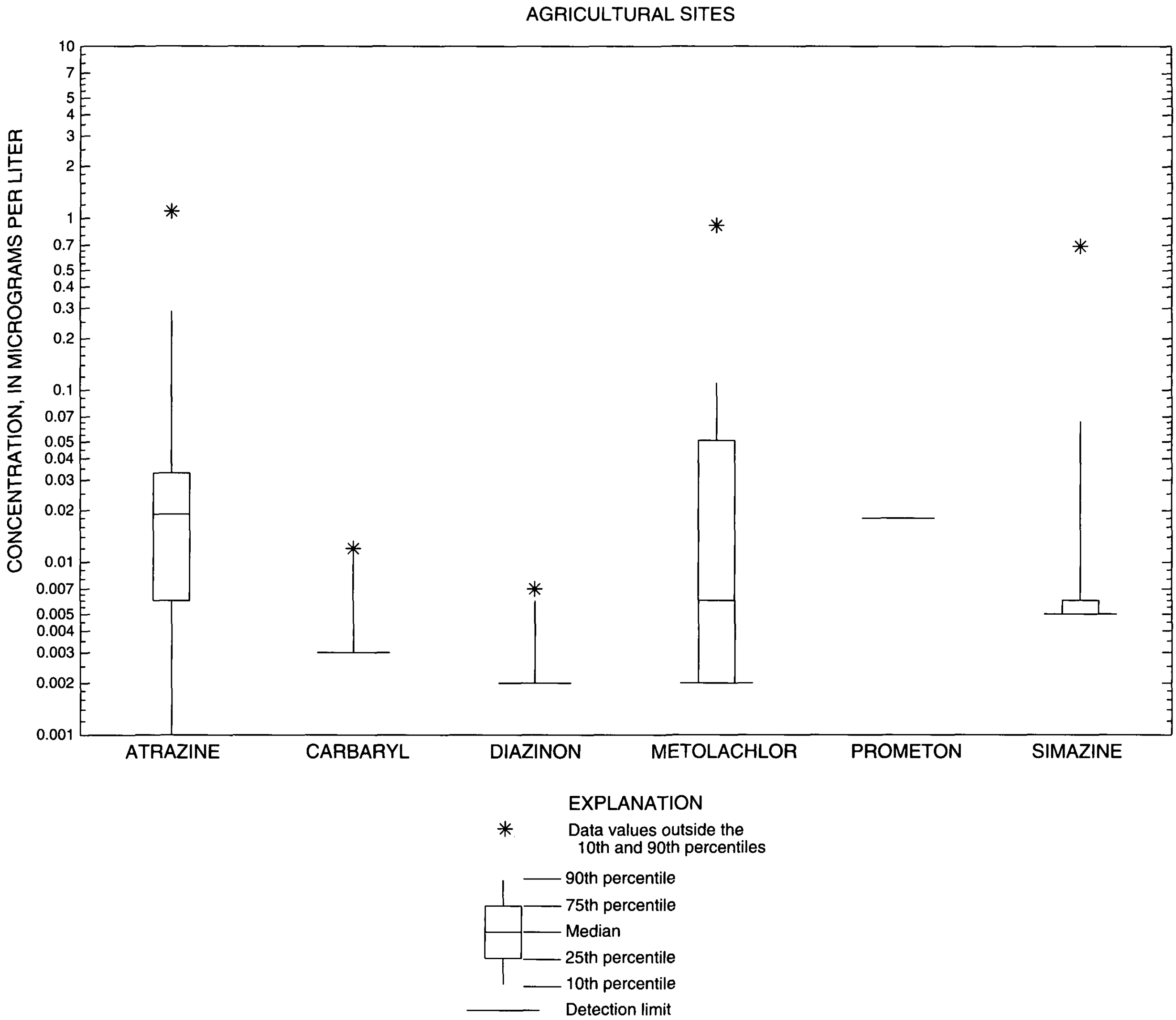

Figure 12. Concentrations of selected pesticides in streams in urban, agricultural, and forested land-use basins in the Connecticut, Housatonic, and Thames River Basins study, 1993–95—*Continued.*

(low) estimates of the mass of pesticides transported to urban and agriculturally dominated streams in the study area because sampling did not take place over complete hydrographs and likely missed peak concentrations.

In general, the greatest instantaneous pesticide loads are associated with relatively high discharges that occurred in the spring and early summer after application. It should be noted, however, that this period was targeted for sampling and such an interpretation is subject to further testing through storm-water sampling at other times of the year.

In the Norwalk River at Winnipauk, estimated total and individual pesticide loads vary considerably with streamflow (tables 29 and 32). There is a general association of increased loads with elevated streamflow, but sampling frequency and logistics undoubtedly caused peak flows and greatest loads to go unsampled. The variability in the streamflow-pesticide

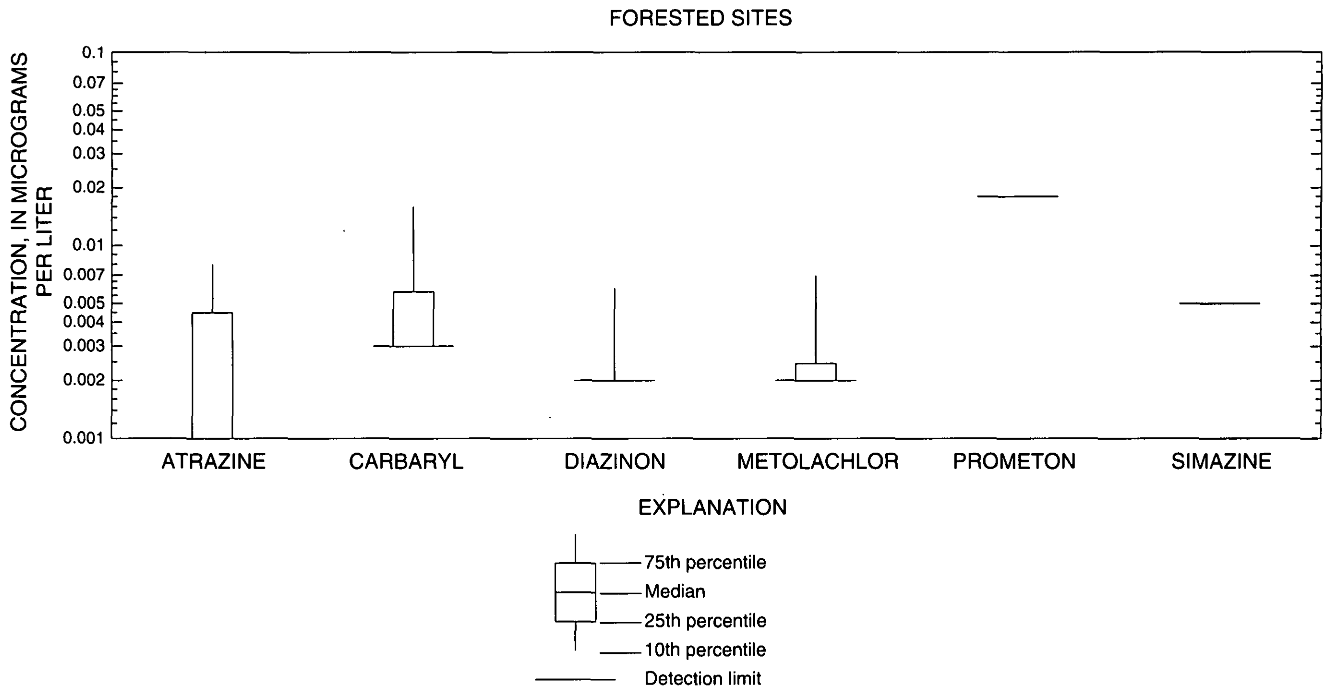

Figure 12. Concentrations of selected pesticides in streams in urban, agricultural, and forested land-use basins in the Connecticut, Housatonic, and Thames River Basins study, 1993–95—*Continued.*

load relation probably further reflects the somewhat arbitrary application of pesticides during the growing season in urban areas.

Although the estimated daily pesticide loads generally increase at the Norwalk River when streamflow is high, the pesticide concentrations appear relatively constant (fig. 6). This phenomenon suggests that increased masses of pesticides are transported to the stream, but the volume of the streamflow dilutes the concentrations, a phenomenon typifying nonpoint-source runoff.

Generally, 2 to 4 pesticides constitute the majority of the estimated total load at the Norwalk River. On several occasions, carbaryl dominated the pesticide load. However, Zaugg and others (1995) note that carbaryl concentrations should only be considered estimates because of the variable results for the SPE method. This uncertainty adds to the difficulty in interpreting pesticide load estimation.

In samples from other urban basins, highest instantaneous loads of individual pesticides are associated with elevated streamflow which generally occur in the aftermath of storms (table 33). The highest estimated total daily load, 150 grams per day, based on instantaneous streamflow, occurred at the Hockanum River near East Hartford (table 30). This sample was collected in August 1994, approximately 2 days after mean daily streamflow peaked, during what is normally the low-flow season. The primary components of the pesticide ensemble were diazinon, cyanazine, and carbaryl; five other pesticides or metabolites were detected. This relatively high estimated pesticide load would seem to contradict the assumption that late spring and early summer are the periods when high pesticide loads should be expected. However, urban areas, in general, are less predictable with respect to seasonal patterns of application than agricultural areas. Application periods are less well-defined because major commercial crops are not the focus of pesticide application. Additional pesticide sampling of stormwater which may interrupt the low-flow period would help to reevaluate the assumption. Other samples with total pesticide loads greater than 10 g/d were collected during the high-flux sampling period. Remaining total pesticide loads for low-flow periods were less than 1 g/d.

Table 29. Estimates of total daily loads of pesticides detected at the Norwalk River at Winnipauk, Connecticut, 1993–94

[Units are grams per day. Load values represent sums of individual pesticide loads. ft^3/s, cubic foot per second]

Sampling date	Streamflow (ft^3/s)	Total pesticide load	Sampling date	Streamflow (ft^3/s)	Total pesticide load
3/17/93	92	7.0	10/25/93	16	0.86
3/26/93	303	40.	11/08/93	22	5.3
3/31/93	260	41	11/22/93	E15	1.1
4/08/93	120	7.7	12/07/93	13	.41
4/12/93	137	[1]0	1/13/94	E23	2.2
4/22/93	165	53	3/14/94	E195	7.6
4/29/93	109	14	3/21/94	E116	5.1
5/03/93	72	20.	3/29/94	E340	18.
5/10/93	47	3.7	4/07/94	170	20.
5/21/93	31	5.7	4/12/94	E86	4.6
5/26/93	18	3.1	4/19/94	105	5.7
6/02/93	38	20.	4/25/94	E63	2.9
6/08/93	17	2.6	5/04/94	E45	7.4
6/15/93	9.9	1.4	5/10/94	63	2.9
6/21/93	7.9	75	5/17/94	181	18
6/28/93	9.0	12	5/25/94	E44	6.4
7/07/93	5.2	1.3	5/31/94	E23	.73
7/12/93	3.7	.24	6/07/94	E18	.22
7/19/93	2.8	.32	6/14/94	E97	52
7/26/93	2.3	.21	6/22/94	E21	53
8/10/93	2.4	.24	6/28/94	E27	2.9
8/26/93	2.8	.42	7/06/94	E13	1.1
8/31/93	2.4	.0	7/12/94	16	1.4
9/07/93	1.8	.80	7/19/94	E10	1.0
9/15/93	2.6	.40	7/26/94	E6.0	.85
9/20/93	4.2	.44	8/02/94	E33	4.3
9/27/93	14	1.7	8/09/94	E15	1.5
10/04/93	E22	[1]0	8/16/94	E16	2.4
10/13/93	E18	2.5	8/22/94	E68	57
10/19/93	7.0	.50	8/30/94	E29	2.1

[1]Schedule 2010 pesticide data are missing.

Table 30. Estimates of total daily loads of pesticides detected in surface-water samples in the Connecticut, Housatonic, and Thames River Basins study, 1993–95

[Units are grams per day. Total loads represent sums of individual pesticide loads. No., number; ft^3/s, cubic feet per second; --, no pesticides detected]

Station No.	Station name	Sampling date	Discharge (ft^3/s)	Total pesticide load
	Urban basins			
01189000	Pequabuck River at Forestville, Conn.	6/14/94	88	55.3
01189000	Pequabuck River at Forestville, Conn.	8/31/94	82	11
01192500	Hockanum River near East Hartford, Conn.	6/02/94	80	16
01192500	Hockanum River near East Hartford, Conn.	8/24/94	238	150
01196500	Quinnipiac River at Wallingford, Conn.	6/01/94	110	17
01196580	Muddy River near North Haven, Conn.	9/15/94	2.6	.72
01196618	Willow Brook at Willow Street, Hamden, Conn.	8/21/95	2.9	.070
01196619	Eaton Brook at Route 10, Hamden, Conn.	8/22/95	.13	.14
01196620	Mill River near Hamden, Conn.	8/22/95	1.3	.208
0119662350	Mill River at Dixwell Avenue, Hamden, Conn.	8/22/95	3.6	.11
0119662375	Shepard Brook at Route 10, Hamden, Conn.	8/22/95	.172	.018
0119662380	Mill River at Skiff Street, Hamden, Conn.	8/23/95	2.5	.11
01208873	Rooster River at Fairfield, Conn.	4/12/94	37	22
01208873	Rooster River at Fairfield, Conn.	5/31/94	7.8	.97
01208873	Rooster River at Fairfield, Conn.	8/09/94	2.0	.22
	Agricultural basins			
01135300	Sleepers River (Site W-5) near St. Johnsbury, Vt.	6/22/94	32	1.4
01184100	Stony Brook near West Suffield, Conn.	8/10/94	2.3	4.7
01184490	Broad Brook at Broad Brook, Conn.	6/01/94	20	5.1
01184490	Broad Brook at Broad Brook, Conn.	9/14/94	12	5.1
01184500	Scantic River at Broad Brook, Conn.	9/14/94	36	18
01192883	Coginchaug River at Middlefield, Conn.	6/13/94	19	1.6
01198180	Konkapot River at Clayton, Mass.	9/07/94	22	.27
01198185	Konkapot River at Sodom, Conn.	9/07/94	23	1.4
01198190	Konkapot River near Canaan, Conn.	9/07/94	27	2.0
01198200	Konkapot River at Ashley Falls, Mass.	9/08/94	28	1.5
01199900	Tenmile River at South Dover near Wingdale, N.Y.	6/13/94	339	350
01199900	Tenmile River at South Dover near Wingdale, N.Y.	8/17/94	109	31
01204000	Pomperaug River at Southbury, Conn.	6/13/94	284	1,000
430217072271601	Great Brook near Walpole, N.H.	8/02/95	1.8	.24
433709072320301	Ottauquechee River at West Woodstock, Vt.	8/03/95	2.4	.18
435031072351101	Second Branch White River near East Bethel, Vt.	8/28/95	9.7	.14
440057072045201	Unnamed Tributary to Connecticut River near Haverhill, N.H.	8/10/95	.79	.035
	Forested basins			
01137500	Ammonoosuc River at Bethlehem Junction, N.H.	6/22/94	306	
01170100	Green River near Colrain, Mass.	6/14/94	47	2.2
01170100	Green River near Colrain, Mass.	8/10/94	9.0	
01193500	Salmon R near East Hampton, Conn.	6/13/94	161	22

Table 30. Estimates of total daily loads of pesticides detected in surface-water samples in the Connecticut, Housatonic, and Thames River Basins study, 1993–95—*Continued*

Station No.	Station name	Sampling date	Discharge (ft^3/s)	Total pesticide load
	Forested basins—*Continued*			
01193500	Salmon River near East Hampton, Conn.	8/31/94	53	1.0
01196589	Brooksvale Stream at Mt. Sanford Road, Cheshire, Conn.	8/21/95	.28	--
01198151	Rawson Brook–Wellman Road, near Monterey, Mass.	9/06/94	29	.21
01198158	Konkapot River at Hartsville–Mill River Road, near Mill River, Mass.	9/06/94	11	.22
01198159	Konkapot River near Mill River, Mass.	9/06/94	14	.34
	Integrator basins			
01122610	Shetucket River at South Windham, Conn.	8/29/94	380	1.9
01124000	Quinebaug River at Quinebaug, Conn.	8/08/94	31	20.
01129500	Connecticut River at North Stratford, N.H.	8/30/95	260	4.4
01131500	Connecticut River near Dalton, N.H.	6/30/94	2,530	68
01135500	Passumpsic River at Passumpsic, Vt.	6/22/94	726	36
01144000	White River at West Hartford, Vt.	6/06/94	740	22
01144000	White River at West Hartford, Vt.	6/16/94	608	57
01144000	White River at West Hartford, Vt.	6/23/94	400	34
01144000	White River at West Hartford, Vt.	6/29/94	1,080	170
01144500	Connecticut River at West Lebanon, N.H.	6/30/94	1,810	93
01152500	Sugar River at West Lebanon, N.H.	8/28/95	41	1.1
01161000	Ashuelot River at Hinsdale, N.H.	6/27/94	245	17
01166500	Millers River at Erving, Mass.	6/28/94	124	260
01170500	Connecticut River at Montague City, Mass.	6/27/94	9,030	800
01177000	Chicopee River at Indian Orchard, Mass.	6/27/94	110	5.1
01183500	Westfield River near Westfield, Mass.	6/27/94	235	660
01184000	Connecticut River at Thompsonville, Conn.	5/24/94	19,200	530
01184000	Connecticut River at Thompsonville, Conn.	6/02/94	18,500	453
01184000	Connecticut River at Thompsonville, Conn.	6/10/94	12,000	1,200
01184000	Connecticut River at Thompsonville, Conn.	8/18/94	12,600	4,400
01189995	Farmington River at Tariffville, Conn.	5/18/94	2,010	64
01189995	Farmington River at Tariffville, Conn.	5/24/94	1,200	4.2
01189995	Farmington River at Tariffville, Conn.	6/02/94	834	16
01189995	Farmington River at Tariffville, Conn.	6/10/94	666	33
01200600	Housatonic River near New Milford, Conn.	5/26/94	1,420	140
01200600	Housatonic River near New Milford, Conn.	6/07/94	848	54
01200600	Housatonic River near New Milford, Conn.	6/28/94	584	53
01200600	Housatonic River near New Milford, Conn.	8/23/94	2,870	310
01208500	Naugatuck River at Beacon Falls, Conn.	5/17/94	1,000	960
01208500	Naugatuck River at Beacon Falls, Conn.	5/25/94	403	4,300
01208500	Naugatuck River at Beacon Falls, Conn.	6/01/94	263	270
01208500	Naugatuck River at Beacon Falls, Conn.	6/10/94	148	350
01208500	Naugatuck River at Beacon Falls, Conn.	8/23/94	2,620	560

The highest estimated total daily pesticide load in agricultural indicator basin samples (table 30), 1,000 g/d, was determined from a sample from the Pomperaug River at Southbury, Conn., noted previously for its numerous high individual pesticide concentrations (table 17). The next highest calculated total pesticide load was 350 g/d from a sample from the Tenmile River at South Dover near Wingdale, N.Y. Atrazine accounted for more than two-thirds of the pesticide load in both samples. These two samples were collected during the high-flux sampling period in 1994. Remaining pesticide load calculations resulted in much lower estimates than were determined for these two samples.

The highest estimated total load from a reference site, 22 g/d, came from a sample from the Salmon River near East Hampton, Conn. (table 30). This sample was collected during the high-flux period in 1994. Of the 6 pesticides detected in this sample, alachlor and carbaryl accounted for more the 50 percent of the calculated daily load. Other reference sites had low or undetectable concentrations of pesticides resulting in very small calculated loads.

Total pesticide loads at integrator stations that were sampled on several occasions, for the most part during the 1994 high-flux study, generally demonstrate that greatest total loads were transported with highest discharges (table 30). With some exceptions, this relation was also true for daily loads calculated for the White River at West Hartford, Vt., the Farmington River at Tariffville, Conn., the Naugatuck River at Beacon Falls, Conn., and the Housatonic River near New Milford, Conn.

The Connecticut River at Thompsonville, Conn., and Housatonic River near New Milford, Conn., also carry high pesticide loads in late August, well after the primary spring application period (table 30). The streamflows associated with these high summer loads are relatively high in comparison with streamflow earlier in the month. At Thompsonville, Conn., estimates indicate that the Connecticut River transported greater loads of all pesticides, except alachlor, during the summer than during the spring. Loads of two insecticides, carbaryl and diazinon, were particularly high in the summer sample. These pesticides probably originate from the Springfield, Mass., metropolitan area.

The data for Housatonic River indicate that the proportions of pesticides contributing to the total load are about the same in the highest spring streamflow and summer streamflow. The major qualitative difference is the inclusion of the insecticide diazinon in the summer; diazinon was not detected in the spring high-flux samples.

The largest estimated total pesticide loads determined in the CONN–NAWQA study may be substantially lower than those reported elsewhere. For example, in comparably sized tributaries to Chesapeake Bay (Hainly and Kahn, 1996), loads of atrazine alone were determined to be of similar magnitude to CONN–NAWQA total pesticide loads.

Data on instantaneous concentrations of pesticides which exceed environmental standards can indicate locations where additional regulation or improved management are needed. Instantaneous load estimates serve as starting points for understanding the potential cumulative effects of these compounds in downstream surface waters. That is, a high concentration with a very low streamflow (small load) in a small tributary may not be nearly as significant as a lower concentration with a higher streamflow (large load) in a larger stream. The variability in loads from stations with more than one sample may be caused by a number of factors, including land use, hydrologic setting, streamflow, and agricultural practices.

CONCLUSIONS

The results of the studies reported here indicate that different groups of pesticides occur in streams draining urban and agricultural areas. Insecticides are more commonly detected in urban streams than in agricultural streams; urban insecticide use is likely associated with control of visible lawn, flower, fruit, and vegetable pests in residential areas as well as pests in recreational locations, such as parks and golf courses. Concentrations of pesticides detected vary greatly and likely depend on a complex set of variables associated with hydrologic conditions, timing and method of application, and distance from field application to stream. Differences in MDLs affect the relative frequency of detection of pesticides and may affect interpretation of pesticide use and comparisons of concentrations among different pesticides.

In general, higher concentrations of pesticides were detected in storm runoff following spring agricultural applications than at other times; for example, atrazine (1.10 µg/L), and metolachlor (0.910 µg/L). This observation is supported by observations in agricultural basins, such as the Scantic River, as well as in larger integrator basins. Substantial pesticide loads were also delivered from urban streams (350 g/d in the Hockanum River). In urban areas, however, as exemplified by the Norwalk River at Winnipauk, Conn., pesticide applications probably continue throughout the growing season, which results in detections of some pesticides from drifting spray and atmospheric deposition, irrespective of time of year or rainfall runoff.

The 48 samples collected during the high-flux period in May and June of 1994 accounted for more than 40 percent of pesticide detections during the entire CONN–NAWQA study period from March 1993 through September 1995. Finding increases in pesticide concentrations shortly after application, in conjunction with increasing streamflow, is consistent with runoff transport to streams. Atmospheric input may provide yet another pesticide source, especially at this time of year.

In spite of its classification as a restricted-use pesticide, which should minimize its transport to streams, atrazine was the most commonly detected pesticide in this study. Used primarily in agriculture, atrazine is also a component of some residential lawn-care products, which probably contributes to its widespread detection. The MDL for atrazine is very low (0.001 µg/L), which also affects its frequency of detection. The heterogeneous land-use characteristics of the basins studied is another factor in the appearance of agricultural pesticides in urban settings. The timing and purpose of pesticide applications in most basins also make it difficult to identify and relate specific causes and effects, other than pre-emergence cropland herbicide application.

Rainfall and other dispersion mechanisms carry pesticides to streams and into ground water following their application to cropland. Pesticides may break down in ground water or be transported to streams. The length of time required for pesticide movement through the subterranean environment depends on the environmental chemistry of pesticide compounds and hydrogeological factors that affect transport.These phenomena are most likely reflected in the distribution of pesticides observed in the study of interactions between ground water and surface water in the Konkapot River Basin.

Data about instantaneous pesticide concentrations is particularly important in determining whether regulatory standards are being violated at specific locations. Load calculations also provide valuable information on the efficiency of agricultural practices in retaining chemicals where they have been applied and on potential impacts on aquatic biota in the downstream environment. Infrequent surface-water sampling that yields instantaneous estimates of pesticide loads, however, does not capture the dynamic nature of hydrologic transport of material. More frequent sampling over the period of storm hydrographs would aid in detailing mechanisms responsible for transport of pesticides to surface water. Sampling for atmospheric sources of pesticides in urban and rural areas would further enhance our understanding of pesticide transport.

Immunoassay techniques allow for very rapid screening of large numbers of samples in a field or laboratory setting. Samples in which a target pesticide is detected can be further analyzed for a broad range of pesticides. The results of the local study indicate that use of the ELISA can be a very cost-effective, accurate method for analyzing for the presence of pesticides, assuming that manufacturers develop sufficiently sensitive test kits for target pesticides. At the time these analyses were performed, the ELISA detection levels were comparable to USGS SPE methods. More recently developed MDLs for the SPE methodology are substantially lower than the ELISA detection levels in 1993. Use of automated samplers in conjunction with immunoassay screening of samples for target pesticides would greatly enhance our ability to more accurately quantify pesticide loads transported to streams.

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TABLES 31–33

Table 31. Concentrations of pesticides detected at the Norwalk River at Winnipauk, Connecticut, 1993–94

[Concentrations are in micrograms per liter. Parameter codes for carbaryl (82860) and (49310) are included to distinguish detections on schedule 2010 from detections on schedule 2050. E, indicates an estimated value; ft^3/s, foot per second; <, actual value is less than method detection limit; --, missing data]

Sampling date	Streamflow (ft^3/s)	2,4-D	Alachlor	Desethyl-atrazine	Atrazine	Benfluralin	Carbaryl (49310)	Carbaryl (82680)	DCPA	*p,p′*-DDE	Diazinon	Disulfoton
3/17/93	92	<0.035	<0.002	<0.002	<0.001	<0.002	<0.008	<0.003	<0.002	<0.006	<0.002	<0.017
3/26/93	303	<.035	<.002	<.002	<.001	<.002	<.050	<.003	<.002	<.006	.013	<.017
3/31/93	260	<.035	<.002	<.002	.010	<.002	<.008	E.008	<.002	<.006	.012	<.017
4/08/93	120	<.035	<.002	E.003	<.001	<.002	<.008	<.003	<.002	<.006	<.002	<.017
4/12/93	137	<.035	--	--	--	--	<.008	--	--	--	--	--
4/22/93	165	E.030	<.002	<.002	.007	.010	<.008	E.006	.002	<.006	.020	<.017
4/29/93	109	<.035	<.002	<.002	.007	<.002	<.008	<.003	.002	<.006	.007	<.017
5/03/93	72	<.035	<.002	<.002	.010	.006	<.008	<.003	.004	<.006	<.002	<.017
5/10/93	47	--	<.002	<.002	.009	<.002	--	<.003	<.002	<.006	<.002	<.017
5/21/93	31	<.035	<.002	E.004	.011	<.002	<.008	E.014	<.002	<.006	<.002	<.017
5/26/93	18	<.035	<.002	E.004	.013	<.002	<.008	E.010	<.002	<.006	<.002	E.007
6/02/93	38	<.035	<.002	<.002	.009	<.002	.460	E.130	.002	<.006	.016	<.017
6/08/93	17	<.035	<.002	<.002	.008	<.002	E.009	E.018	<.002	<.006	<.002	<.017
6/15/93	9.9	<.035	<.002	E.006	.011	<.002	<.008	E.013	<.002	<.006	<.002	<.017
6/21/93	7.9	<.035	<.002	E.004	.012	<.002	2.90	E3.20	.002	<.006	<.002	<.017
6/28/93	9.0	<.035	.011	E.003	.015	<.002	<.008	E.430	.002	<.006	.052	<.017
7/07/93	5.2	<.035	<.002	<.002	.008	<.002	<.008	<.003	.002	<.006	<.002	E.006
7/12/93	3.7	<.035	<.002	<.002	.009	<.002	<.008	<.003	<.002	<.006	<.002	<.017
7/19/93	2.8	<.035	<.002	E.004	.015	<.002	<.008	<.003	<.002	<.006	<.002	<.017
7/26/93	2.3	<.035	<.002	E.003	.010	<.002	<.008	<.003	<.002	<.006	<.002	<.017
8/10/93	2.4	<.035	<.002	E.006	.011	<.002	<.008	<.003	<.002	<.006	<.002	<.017
8/26/93	2.8	<.035	<.002	<.002	.010	<.002	<.008	E.013	<.002	<.006	<.002	<.017
8/31/93	2.4	<.035	<.002	<.002	<.001	<.002	<.008	<.003	<.002	<.006	<.002	<.017
9/07/93	1.8	<.035	<.002	E.008	.023	<.002	.070	E.084	E.001	<.006	.019	<.017
9/15/93	2.6	<.035	<.002	E.004	.011	<.002	<.008	E.007	E.001	<.006	<.002	<.017
9/20/93	4.2	<.035	<.002	<.002	.009	<.002	<.008	<.003	<.002	.007	<.002	<.017
9/27/93	14	<.035	<.002	E.003	.005	<.002	E.010	E.008	.002	<.006	<.002	<.017
10/04/93	E22	<.035	--	--	--	--	<.008	--	--	--	--	--
10/13/93	E18	<.035	<.002	<.002	<.001	<.002	<.008	<.003	<.002	<.006	.022	<.017
10/19/93	7.0	<.035	<.002	<.002	.008	<.002	<.008	<.003	<.002	<.006	<.002	<.017

Table 31. Concentrations of pesticides detected at the Norwalk River at Winnipauk, Connecticut, 1993–94—*Continued*

Sampling date	Streamflow (ft^3/s)	2,4-D	Alachlor	Desethyl-atrazine	Atrazine	Benfluralin	Carbaryl (49310)	Carbaryl (82680)	DCPA	*p,p'*-DDE	Diazinon	Disulfoton
10/25/93	16	<0.035	<0.002	<0.002	<0.001	<0.002	<0.008	<0.003	<0.002	<0.006	<0.002	<0.017
11/08/93	22	<.035	<.002	<.002	.007	<.002	<.008	<.003	<.002	<.006	<.002	<.017
11/22/93	E15	<.035	<.002	<.002	<.001	<.002	<.008	<.003	<.002	<.006	<.002	<.017
12/07/93	13	<.035	<.002	<.002	<.001	<.002	<.008	<.003	<.002	<.006	.013	<.017
1/13/94	E23	<.035	<.002	<.002	.009	<.002	<.008	<.003	<.002	<.006	<.002	<.017
2/01/94	E15	--	--	--	--	--	--	--	--	--	--	--
3/14/94	E195	<.035	<.002	<.002	<.001	<.002	<.008	<.003	<.002	<.006	<.002	<.017
3/21/94	E116	<.035	<.002	<.002	<.001	<.002	<.008	<.003	<.002	<.006	<.002	<.017
3/29/94	--	<.035	<.002	<.002	<.001	<.002	<.008	<.003	<.002	<.006	<.002	<.017
4/07/94	170	<.035	<.002	<.002	<.001	<.002	<.008	<.003	<.002	<.006	<.002	<.017
4/12/94	E86	<.035	<.002	<.002	.004	<.002	<.008	<.003	<.002	<.006	<.002	<.017
4/19/94	105	<.035	<.002	<.002	<.001	<.002	<.008	<.003	<.002	<.006	<.002	<.017
4/25/94	E63	<.035	<.002	<.002	<.001	<.002	<.008	<.003	<.002	<.006	<.002	<.017
5/04/94	E45	<.035	<.002	<.002	.005	<.002	<.008	<.003	<.002	<.006	<.002	<.017
5/10/94	63	<.035	<.002	<.002	<.001	<.002	<.008	<.003	<.002	<.006	<.002	<.017
5/17/94	181	<.035	<.002	<.002	.004	<.002	<.008	E.023	<.002	<.006	.013	<.017
5/25/94	E44	<.035	<.002	<.002	.010	<.002	<.008	E.022	<.002	<.006	<.002	<.017
5/31/94	E23	<.035	<.002	<.002	.007	<.002	<.008	<.003	.006	<.006	<.002	<.017
6/07/94	E18	<.035	<.002	<.002	.005	<.002	<.008	<.003	<.002	<.006	<.002	<.017
6/14/94	E97	<.035	<.002	E.002	.008	<.002	.060	E.120	E.001	<.006	.039	<.017
6/22/94	E21	<.035	<.002	E.009	.015	<.002	.580	E.720	.005	<.006	.044	<.017
6/28/94	E27	<.035	<.002	<.002	.006	<.002	<.008	E.016	<.002	<.006	.011	<.017
7/06/94	E13	<.035	<.002	E.005	<.001	<.002	<.008	<.003	<.002	<.006	<.002	<.017
7/12/94	16	<.035	<.002	<.002	.007	<.002	<.008	<.003	<.002	<.006	.006	<.017
7/19/94	E10	<.035	<.002	<.002	.006	<.002	<.008	<.003	<.002	<.006	<.002	<.017
7/26/94	E6.0	<.035	<.002	<.002	<.001	<.002	<.008	<.003	<.002	<.006	<.002	<.017
8/02/94	E33	<.035	<.002	<.002	.005	<.002	<.008	<.003	<.002	E.003	.015	<.017
8/09/94	E15	<.035	<.002	<.002	.006	<.002	<.008	<.003	<.002	<.006	.010	<.017
8/16/94	E16	<.035	<.002	E.005	.007	<.002	<.008	<.003	<.002	<.006	.009	<.017
8/22/94	E68	<.035	<.002	<.002	<.001	<.002	<.008	E.019	<.002	<.006	.032	<.017
8/30/94	E29	<.035	<.002	<.002	<.001	<.002	<.008	<.003	<.002	<.006	<.002	<.017

Table 31. Concentrations of pesticides detected at the Norwalk River at Winnipauk, Connecticut, 1993–94—*Continued*

Sampling date	Streamflow (ft^3/s)	Lindane	Malathion	Metola-chlor	Metri-buzin	1-Naphthol	Napro-pamide	Pendime-thalin	Perme-thrin	Prometon	Propanil	Simazine	Trifluralin
3/17/93	92	<0.004	<0.005	<0.002	<0.004	<0.007	<0.003	<0.004	<0.005	0.031	<0.004	<0.005	<0.002
3/26/93	303	<.004	<.005	<.002	<.004	<.050	<.003	<.004	<.005	.028	<.004	.013	<.002
3/31/93	260	<.004	<.005	<.002	<.004	<.007	<.003	<.004	<.005	.021	<.004	.013	<.002
4/08/93	120	<.004	<.005	<.002	<.004	<.007	<.003	<.004	<.005	.023	<.004	<.005	<.002
4/12/93	137	--	--	--	--	<.007	--	--	--	--	--	--	--
4/22/93	165	<.004	<.005	.005	<.004	<.007	<.003	.009	<.005	.027	<.004	.016	.011
4/29/93	109	E.003	<.005	<.002	<.004	<.007	<.003	<.004	<.005	.025	<.004	.009	<.002
5/03/93	72	<.004	<.005	<.002	<.004	<.007	.012	<.004	<.005	E.012	<.004	.027	.006
5/10/93	47	<.004	<.005	<.002	<.004	--	<.003	<.004	<.005	E.016	<.004	.007	<.002
5/21/93	31	<.004	<.005	<.002	<.004	<.007	<.003	<.004	<.005	.018	<.004	.028	<.002
5/26/93	18	<.004	<.005	<.002	<.004	<.007	<.003	<.004	<.005	E.015	<.004	.022	<.002
6/02/93	38	<.004	<.005	.003	<.004	<.007	<.003	<.004	<.005	.027	<.004	.017	.007
6/08/93	17	<.004	<.005	.003	<.004	<.007	<.003	<.004	<.005	.026	<.004	.007	<.002
6/15/93	9.9	<.004	<.005	.003	<.004	<.007	<.003	<.004	<.005	.018	<.004	.008	<.002
6/21/93	7.9	<.004	<.005	<.002	<.004	E.580	<.003	<.004	<.005	.069	<.004	.006	<.002
6/28/93	9.0	<.004	<.005	.007	<.004	<.007	<.003	<.004	<.005	.029	<.004	.005	<.002
7/07/93	5.2	<.004	<.005	.002	.009	<.007	<.003	<.004	<.005	.043	.008	<.005	<.002
7/12/93	3.7	<.004	<.005	<.002	<.004	<.007	<.003	<.004	<.005	E.013	<.004	.005	<.002
7/19/93	2.8	<.004	<.005	<.002	<.004	<.007	<.003	<.004	<.005	.022	<.004	.005	<.002
7/26/93	2.3	<.004	<.005	<.002	<.004	<.007	<.003	<.004	<.005	.025	<.004	<.005	<.002
8/10/93	2.4	<.004	<.005	<.002	<.004	<.007	<.003	<.004	<.005	.024	<.004	<.005	<.002
8/26/93	2.8	<.004	<.005	<.002	<.004	<.007	<.003	<.004	<.005	.039	<.004	<.005	<.002
8/31/93	2.4	<.004	<.005	<.002	<.004	<.007	<.003	<.004	<.005	<.018	<.004	<.005	<.002
9/07/93	1.8	<.004	<.005	E.001	<.004	<.007	<.003	<.004	<.005	.043	E.003	E.004	<.002
9/15/93	2.6	<.004	<.005	<.002	<.004	<.007	<.003	<.004	<.005	.032	<.004	.007	<.002
9/20/93	4.2	<.004	<.005	.002	<.004	<.007	<.003	<.004	<.005	.020	<.004	.005	<.002
9/27/93	14	<.004	<.005	<.002	<.004	<.007	<.003	<.004	<.005	.027	<.004	E.003	<.002
10/04/93	E22	--	--	--	--	<.007	--	--	--	--	--	--	--
10/13/93	E18	<.004	<.005	<.002	<.004	<.007	<.003	<.004	<.005	.035	<.004	<.005	<.002
10/19/93	7.0	<.004	<.005	<.002	<.004	<.007	<.003	<.004	<.005	.021	<.004	<.005	<.002
10/25/93	16	<.004	.011	<.002	<.004	<.007	<.003	<.004	<.005	E.011	<.004	<.005	<.002
11/08/93	22	<.004	<.005	<.002	<.004	<.007	<.003	<.004	<.005	.025	<.004	.100	<.002
11/22/93	E15	<.004	<.005	<.002	<.004	<.007	<.003	<.004	<.005	E.017	<.004	.013	<.002
12/07/93	13	<.004	<.005	<.002	<.004	<.007	<.003	<.004	<.005	<.018	<.004	<.005	<.002
1/13/94	E23	<.004	<.005	<.002	<.004	<.007	<.003	<.004	<.005	.025	<.004	.005	<.002

Table 31. Concentrations of pesticides detected at the Norwalk River at Winnipauk, Connecticut, 1993–94—*Continued*

Sampling date	Streamflow (ft^3/s)	Lindane	Malathion	Metola-chlor	Metri-buzin	1-Naphthol	Napro-pamide	Pendime-thalin	Perme-thrin	Prometon	Propanil	Simazine	Trifluralin
2/01/94	E15	--	--	--	--	--	--	--	--	--	--	--	--
3/14/94	E195	<0.004	<0.005	<0.002	<0.004	<0.007	<0.003	<0.004	<0.005	E0.016	<0.004	<0.005	<0.002
3/21/94	E116	<.004	<.005	<.002	<.004	<.007	<.003	<.004	<.005	.018	<.004	<.005	<.002
3/29/94	--	<.004	<.005	<.002	<.004	<.007	<.003	<.004	<.005	.022	<.004	<.005	<.002
4/07/94	170	<.004	.026	<.002	<.004	<.007	<.003	<.004	<.005	.021	<.004	<.005	<.002
4/12/94	E86	<.004	<.005	<.002	<.004	<.007	<.003	<.004	<.005	.018	<.004	<.005	<.002
4/19/94	105	<.004	<.005	<.002	<.004	<.007	<.003	<.004	<.005	.022	<.004	<.005	<.002
4/25/94	E63	<.004	<.005	<.002	<.004	<.007	<.003	<.004	<.005	.019	<.004	<.005	<.002
5/04/94	E45	<.004	<.005	<.002	<.004	<.007	<.003	<.004	<.005	E.017	<.004	<.005	<.002
5/10/94	63	<.004	<.005	.003	<.004	<.007	<.003	<.004	<.005	E.016	<.004	<.005	<.002
5/17/94	181	<.004	<.005	<.002	<.004	<.007	<.003	<.004	<.005	<.018	<.004	<.005	<.002
5/25/94	E44	<.004	<.005	.004	<.004	<.007	<.003	<.004	<.005	.019	<.004	E.004	<.002
5/31/94	E23	<.004	<.005	<.002	<.004	<.007	<.003	<.004	<.005	<.018	<.004	<.005	<.002
6/07/94	E18	<.004	<.005	<.002	<.004	<.007	<.003	<.004	<.005	<.018	<.004	<.005	<.002
6/14/94	E97	<.004	<.005	.006	.005	<.007	<.003	<.004	<.005	.033	<.004	E.004	<.002
6/22/94	E21	<.004	<.005	.016	<.004	E.200	<.003	<.004	<.005	.021	<.004	<.005	<.002
6/28/94	E27	<.004	<.005	<.002	<.004	<.007	<.003	<.004	<.005	.022	<.004	<.005	<.002
7/06/94	E13	<.004	<.005	<.002	<.004	<.007	<.003	<.004	<.005	.029	<.004	<.005	<.002
7/12/94	16	<.004	<.005	<.002	<.004	<.007	<.003	<.004	<.005	.022	<.004	<.005	<.002
7/19/94	E10	<.004	.009	<.002	<.004	<.007	<.003	<.004	<.005	.024	<.004	<.005	<.002
7/26/94	E6.0	<.004	<.005	.005	.019	<.007	<.003	<.004	<.005	.034	<.004	<.005	<.002
8/02/94	E33	<.004	<.005	<.002	<.004	<.007	<.003	<.004	E.003	.027	<.004	<.005	<.002
8/09/94	E15	<.004	<.005	<.002	<.004	<.007	<.003	<.004	<.005	.026	<.004	<.005	<.002
8/16/94	E16	<.004	<.005	<.002	<.004	<.007	<.003	<.004	<.005	.041	<.004	<.005	<.002
8/22/94	E68	<.004	.150	<.002	<.004	<.007	<.003	<.004	<.005	.140	<.004	<.005	<.002
8/30/94	E29	<.004	<.005	<.002	<.004	<.007	<.003	<.004	<.005	.029	<.004	<.005	<.002

Table 32. Estimated daily loads of pesticides detected at the Norwalk River at Winnipauk, Connecticut, 1993–94

[Units are grams per day and are estimates based on sample concentrations and instantaneous streamflow measurements made at the time of sampling. Parameter codes for carbaryl (82860) and (49310) are included to distinguish detections on schedule 2010 from detections on schedule 2050; E, indicates an estimated value; ft^3/s, cubic foot per second; Blanks indicate pesticide concentrations less than MDL in sample]

Sampling date	Stream-flow (ft^3/s)	2,4-D	Alachlor	Des-ethyl-atrazine	Atrazine	Benflur-alin	Carbaryl (49310)	Carbaryl (82680)	DCPA	*p,p'*-DDE	Diazi-non	Disulfoton
3/17/93	92											
3/26/93	303										9.64	
3/31/93	260				6.37			5.09			7.64	
4/08/93	120			0.881								
4/12/93	137											
4/22/93	165	12.1			2.83	4.04		2.42	0.808		.808	
4/29/93	109				1.87				.53		1.87	
5/03/93	72				11.8	1.60			1.07			
5/10/93	47				1.04							
5/21/93	31			.304	.835			1.06				
5/26/93	18			.176	.573			.441				0.309
6/02/93	38				.837		42.8	12.1	.186		1.49	
6/08/93	17				.332		.375	.749				
6/15/93	9.9			.145	2.67			.315				
6/21/93	7.9			.077	.232		56.1	61.9	.039			
6/28/93	9.0		0.242	.066	.331			9.48	.044		1.15	
7/07/93	5.2				.102				.025			.076
7/12/93	3.7				.082							
7/19/93	2.8			.027	.103							
7/26/93	2.3			.017	.056							
8/10/93	2.4			.035	.065							
8/26/93	2.8				.069			.089				
8/31/93	2.4											
9/07/93	1.8			.035	.101		.309	.370	.004		.084	
9/15/93	2.6			.025	.070			.045	.006			
9/20/93	4.2				.093					0.072		
9/27/93	14			.103	.171		.343	.274	.069			
10/04/93	E22											
10/13/93	E18										.970	
10/19/93	7.0				.137							
10/25/93	16											
11/08/93	22				.377							
11/22/93	E15											
12/07/93	13										.414	
1/13/94	E23				0.507							
2/01/94	E15											
3/14/94	E195											
3/21/94	E116											
3/29/94	E340											
4/07/94	170											

Table 32. Estimated daily loads of pesticides detected at the Norwalk River at Winnipauk, Connecticut, 1993–94—*Continued*

Sampling date	Streamflow (ft^3/s)	2,4-D	Alachlor	Desethylatrazine	Atrazine	Benfluralin	Carbaryl (49310)	Carbaryl (82680)	DCPA	*p,p′*-DDE	Diazinon	Disulfoton
4/12/94	E86				0.842							
4/19/94	105											
4/25/94	E63											
5/34/94	E45				.551							
5/10/94	63											
5/17/94	181				1.77			10.2			5.76	
5/25/94	E44				1.08			2.37				
5/31/94	E23				.394				0.338			
6/07/94	E18				.220							
6/14/94	E97			0.475	1.90		14.3	28.5	.238		9.26	
6/22/94	E21			.463	.771		29.8	37.0	.257		2.26	
6/28/94	E27							.823			.566	
7/06/94	E13			.159								
7/12/94	16				.274						.235	
7/19/94	E10				.147							
7/26/94	E6.0											
8/02/94	E33				.404					0.242	1.21	
8/09/94	E15				.220						.367	
8/16/94	E16			.196	.274						.353	
8/22/94	E68							3.16			5.33	
8/30/94	E29											

Table 32. Estimated daily loads of pesticides detected at the Norwalk River at Winnipauk, Connecticut, 1993–94—*Continued*

Sampling date	Lindane	Malathion	Metolachlor	Metribuzin	1-Naphthol	Napropamide	Pendimethalin	Permethrin	Prometon	Propanil	Simazine	Trifluralin
3/17/93									6.98			
3/26/93									20.8		9.64	
3/31/93									13.4		8.28	
4/08/93									6.78			
4/12/93												
4/22/93			2.02				3.64		10.9		6.46	4.44
4/29/93	0.801								6.67		2.40	
5/03/93						3.20			3.20		7.21	1.60
5/10/93									1.84		.806	
5/21/93									1.37		2.13	
5/26/93									.661		.970	
6/02/93			.279						2.51		1.58	.651
6/08/93			.125						1.08		.291	
6/15/93			.073						.436		.194	
6/21/93					11.2				1.33		.116	
6/28/93			.154						.639		.110	
7/07/93			.025	0.115					.832	0.155		
7/12/93									.118		.045	
7/19/93									.151		.034	
7/26/93									.141			
8/10/93									.141			
8/26/93									.267			
8/31/93												
9/07/93			.004						.170	.013	.018	
9/15/93									.204		.045	
9/20/93			.021						.206		.051	
9/27/93									.926		.103	
10/04/93												
10/13/93									1.54			
10/19/93									.360			
10/25/93		0.431							.431			
11/08/93									.979		3.92	
11/22/93									.624		.477	
12/7/93												
1/13/94									1.41		.282	
2/01/94												
3/14/94									7.64			
3/21/94									5.11			
3/29/94									18.3			
4/07/94		10.8							8.74			
4/12/94									3.79			
4/19/94									5.66			
4/25/94									2.93			
5/34/94									1.87			
5/10/94			.463						2.47			

Table 32. Estimated daily loads of pesticides detected at the Norwalk River at Winnipauk, Connecticut, 1993–94—*Continued*

Sampling date	Lindane	Malathion	Metolachlor	Metribuzin	1-Naphthol	Napropamide	Pendimethalin	Permethrin	Prometon	Propanil	Simazine	Trifluralin
5/17/94												
5/25/94			0.431						2.05		0.431	
5/31/94												
6/07/94												
6/14/94			1.43	1.19					7.84		.950	
6/22/94			.823		10.3				1.08			
6/28/94									1.13			
7/06/94									.923			
7/12/94									.862			
7/19/94		0.220							.588			
7/26/94			.073	.279					.499			
8/02/94								0.242	2.18			
8/09/94									.955			
8/16/94									1.61			
8/22/94		25.0							23.3			
8/30/94									2.06			

Table 33. Estimated daily loads of pesticides detected in surface-water samples in the Connecticut, Housatonic, and Thames River Basins study, 1993–95

[Units are grams per day and are estimates based on sample concentrations and instantaneous streamflow measurements made at the time of sampling. Parameter codes for carbaryl (82860) and (49310) are included to distinguish detections on schedule 2010 from detections on schedule 2050. Blanks indicate pesticide concentrations less than MDL in sample. No., number; ft^3/s, cubic foot per second]

Station No.	Station name	Sampling date	Discharge	Atrazine	Carbaryl (49310)	Carbaryl (82680)	Chlorpyrifos	Cyanazine	Desethylatrazine	Diazinon	Dieldrin	Malathion	Metolachlor	Metribuzin	Prometon	Propargite	Simazine	Terbacil
	Urban basins																	
01189000	Pequabuck River at Forestville, Conn.	6/14/94	88	3.23		1.94	5.60			21.5		2.37	3.23	12.7	2.58		2.15	
01189000	Pequabuck River at Forestville, Conn.	8/31/94	82			4.82				4.41					1.81			
01192500	Hockanum River near East Hartford, Conn.	6/02/94	80	3.52		3.72			0.59	1.76			4.70				1.96	
01192500	Hockanum River near East Hartford, Conn.	8/24/94	238	6.41	11.6	25.0		36.1	2.33	52.4			12.8		11.6		3.49	
01196500	Quinnipiac River at Wallingford, Conn.	6/01/94	110							4.84			1.61	2.69		7.54		
01196580	Muddy River near North Haven, Conn.	9/15/94	2.6	.089						.070			.12		.191		.25	0.089
01196618	Willow Brook at Willow Street, Hamden, Conn.	8/21/95	2.9	.021					.021	.028								
01196619	Eaton Brook at Route 10, Hamden, Conn.	8/22/95	.13							.002					.003			
01196620	Mill River near Hamden, Conn.	8/22/95	1.3	.006						.006					.016			
0119662350	Mill River at Dixwell Avenue, Hamden, Conn.	8/22/95	3.6	.070						.044								
0119662375	Shepard Brook at Route 10, Hamden, Conn.	8/22/95	.172	.003						.002					.010		.003	
0119662380	Mill River at Skiff Street, Hamden, Conn.	8/23/95	2.5	.073						.037								
01208873	Rooster River at Fairfield, Conn.	4/12/94	37							19.0	0.724				2.63			
01208873	Rooster River at Fairfield, Conn.	5/31/94	7.8							.134				.134			.706	
01208873	Rooster River at Fairfield, Conn.	8/09/94	2.0							.054					.088		.059	.020

Table 33. Estimated daily loads of pesticides detected in surface-water samples in the Connecticut, Housatonic, and Thames River Basins study, 1993–95—*Continued*

Station No.	Station name	Sampling date	Discharge	2,4-D	Alachlor	Atrazine	Carbaryl (49310)	Carbofuran (49309)	Carbofuran (82674)	DCPA	Desethylatrazine	Diazinon	Malathion	Metolachlor	Metribuzin	Pendimethalin	Prometon	Simazine
							Agricultural basins											
01135300	Sleepers River (Site W-5) near St. Johnsbury, Vt.	6/22/94	32			1.02								0.391				
01184100	Stony Brook near West Suffield, Conn.	8/10/94	2.3	0.338		.107					0.017			.292				3.88
01184490	Broad Brook at Broad Brook, Conn.	6/01/94	20			1.32							3.82					
01184490	Broad Brook at Broad Brook, Conn.	9/14/94	12			1.59						0.117		3.23				.176
01184500	Scantic River at Broad Brook, Conn.	9/14/94	36			1.67		7.05	4.40		1.15			3.70				
01192883	Coginchaug River at Middlefield, Conn.	6/13/94	19			.558				0.046	.093	.139		.558				.232
01198180	Konkapot River at Clayton, Mass.	9/07/94	22								.269							
01198185	Konkapot River at Sodom, Conn.	9/07/94	23			.844					.506							
01198190	Konkapot River near Canaan, Conn.	9/07/94	27			1.32					.264			.396				
01198200	Konkapot River at Ashley Falls, Mass.	9/08/94	28			1.23					.274							
01199900	Tenmile River at South Dover near Wingdale, N.Y.	6/13/94	339		44.8	241					15.8		4.15	33.2			9.95	5.81
01199900	Tenmile River at South Dover near Wingdale, N.Y.	8/17/94	109		1.87	8.80					4.80			11.2			4.27	17.6
01204000	Pomperaug River at Southbury, Conn.	6/13/94	284		27.1	764	13.9			.695	27.1	4.17		63.2	4.17	83.4	8.34	21.5
430217072271601	Great Brook near Walpole, N.H.	8/02/95	1.8			.163					.075							
433709072320301	Ottauquechee River at West Woodstock, Vt.	8/03/95	2.4															.176
435031072351101	Second Branch White River near East Bethel, Vt.	8/28/95	9.7			.142												
440057072045201	Unnamed Tributary to Connecticut River near Haverhill, N.H.	8/10/95	.79			.008					.027							

Table 33. Estimated daily loads of pesticides detected in surface-water samples in the Connecticut, Housatonic, and Thames River Basins study, 1993–95—*Continued*

Station No.	Station name	Sampling date	Discharge	Alachlor	Atrazine	Carbaryl (49310)	Carbaryl (82680)	Desethyl-atrazine	Diazinon	Meto-lachlor	Prometon
				Forested basins							
01137500	Ammonoosuc River at Bethlehem Junction, N.H.	6/22/94	306								
01170100	Green River near Colrain, Mass.	6/14/94	47		0.46	2.30	1.26	0.11		0.34	
01170100	Green River near Colrain, Mass.	8/10/94	9.0								
01193500	Salmon River near East Hampton, Conn.	6/13/94	161	6.70	3.15		6.30	.79	2.36	2.78	
01193500	Salmon River near East Hampton, Conn.	8/31/94	53		.65			.39			
01196589	Brooksvale Stream at Mt. Sanford Road, Cheshire, Conn.	8/21/95	.28								
01198151	Rawson Brook–Wellman Road, near Monterey, Mass.	9/06/94	29					.21			
01198158	Konkapot River at Hartsville–Mill River Road, near Mill River, Mass.	9/06/94	11								0.22
01198159	Konkapot River near Mill River, Mass.	9/06/94	14					.10			.24

Table 33. Estimated daily loads of pesticides detected in surface-water samples in the Connecticut, Housatonic, and Thames River Basins study, 1993–95—*Continued*

Station No.	Station name	Sampling date	Streamflow (ft^3/s)	Alachlor	Atrazine	Carbaryl (82680)	Chlor-pyrifos	Cyana-zine	DCPA	Desethyl-atrazine	Diazinon	Dichlor-prop
				Integrator basins								
01122610	Shetucket River at South Windham, Conn.	8/29/94	380							1.86		
01124000	Quinebaug River at Quinebaug, Conn.	8/08/94	31								0.683	19.0
01129500	Connecticut River at North Stratford, N.H.	8/30/95	260		1.91					2.54		
01131500	Connecticut River near Dalton, N.H.	6/30/94	2,530		49.5					18.6		
01135500	Passumpsic River at Passumpsic, Vt.	6/22/94	726		24.9							
01144000	White River at West Hartford, Vt.	6/06/94	740									
01144000	White River at West Hartford, Vt.	6/16/94	608		20.8					5.95		
01144000	White River at West Hartford, Vt.	6/23/94	400		8.81							
01144000	White River at West Hartford, Vt.	6/29/94	1,080	15.9	76.6					10.6		
01144500	Connecticut River at West Lebanon, N.H.	6/30/94	1,810		31.0							
01152500	Sugar River at West Lebanon, N.H.	8/28/95	41		0.50							
01161000	Ashuelot River at Hinsdale, N.H.	6/27/94	245		4.80	3.60					3.60	
01166500	Millers River at Erving, Mass.	6/28/94	124		2.43	2.12					4.85	
01170500	Connecticut River at Montague City, Mass.	6/27/94	9,030	66.3	287					88.4		
01177000	Chicopee River at Indian Orchard, Mass.	6/27/94	110		1.61						1.88	
01183500	Westfield River near Westfield, Mass.	6/27/94	235		235							
01184000	Connecticut River at Thompsonville, Conn.	5/24/94	19,200		235							
01184000	Connecticut River at Thompsonville, Conn.	6/02/94	18,500	181								
01184000	Connecticut River at Thompsonville, Conn.	6/10/94	12,000	176	264					58.7	264	
01184000	Connecticut River at Thompsonville, Conn.	8/18/94	12,600		339	1,330			61.7	154	1,730	
01189995	Farmington River at Tariffville, Conn.	5/18/94	2,010								49.2	
01189995	Farmington River at Tariffville, Conn.	5/24/94	1,200		1.22						.245	
01189995	Farmington River at Tariffville, Conn.	6/02/94	834									
01189995	Farmington River at Tariffville, Conn.	6/10/94	666		8.15					1.63	8.15	
01200600	Housatonic River near New Milford, Conn.	5/26/94	1,420		38.2					24.3		
01200600	Housatonic River near New Milford, Conn.	6/07/94	848		16.6							
01200600	Housatonic River near New Milford, Conn.	6/28/94	584		20.0							
01200600	Housatonic River near New Milford, Conn.	8/23/94	2,870		70.2					42.1	42.1	
01208500	Naugatuck River at Beacon Falls, Conn.	5/17/94	1,000								90.5	
01208500	Naugatuck River at Beacon Falls, Conn.	5/25/94	403		11.8		4.93				14.8	
01208500	Naugatuck River at Beacon Falls, Conn.	6/01/94	263		7.08		5.79					
01208500	Naugatuck River at Beacon Falls, Conn.	6/10/94	148			4.71	2.90				7.60	
01208500	Naugatuck River at Beacon Falls, Conn.	8/23/94	2,620		115	103				44.9	173	

Table 33. Estimated daily loads of pesticides detected in surface-water samples in the Connecticut, Housatonic, and Thames River Basins study, 1993–95—*Continued*

Station No.	Station.name	Sampling date	Dis-charge	EPTC	Malathion	Metola-chlor	Metri-buzin	Pendi-methalin	Prome-ton	Pro-pachlor	Pro-pargite	2,4-D	Simazine
					Integrator basins—*Continued*								
01122610	Shetucket River at South Windham, Conn.	8/29/94	380										
01124000	Quinebaug River at Quinebaug, Conn.	8/08/94	31										
01129500	Connecticut River at North Stratford, N.H.	8/30/95	260										
01131500	Connecticut River near Dalton, N.H.	6/30/94	2,530										
01135500	Passumpsic River at Passumpsic, Vt.	6/22/94	726			10.7							
01144000	White River at West Hartford, Vt.	6/06/94	740			21.7							
01144000	White River at West Hartford, Vt.	6/16/94	608			17.9							11.9
01144000	White River at West Hartford, Vt.	6/23/94	400			8.81			4.89				11.7
01144000	White River at West Hartford, Vt.	6/29/94	1,080			34.4							37.0
01144500	Connecticut River at West Lebanon, N.H.	6/30/94	1,810			22.1							39.9
01152500	Sugar River at West Lebanon, N.H.	8/28/95	41			.60							
01161000	Ashuelot River at Hinsdale, N.H.	6/27/94	245			4.80							
01166500	Millers River at Erving, Mass.	6/28/94	124									255	
01170500	Connecticut River at Montague City, Mass.	6/27/94	9,030			221							133
01177000	Chicopee River at Indian Orchard, Mass.	6/27/94	110			1.61							
01183500	Westfield River near Westfield, Mass.	6/27/94	235			282							141
01184000	Connecticut River at Thompsonville, Conn.	5/24/94	19,200			282							14.1
01184000	Connecticut River at Thompsonville, Conn.	6/02/94	18,500			272							
01184000	Connecticut River at Thompsonville, Conn.	6/10/94	12,000			235							147
01184000	Connecticut River at Thompsonville, Conn.	8/18/94	12,600			493			185				154
01189995	Farmington River at Tariffville, Conn.	5/18/94	2,010			14.8							
01189995	Farmington River at Tariffville, Conn.	5/24/94	1,200	0.489		1.47							.734
01189995	Farmington River at Tariffville, Conn.	6/02/94	834			16.3							
01189995	Farmington River at Tariffville, Conn.	6/10/94	666			9.78							489
01200600	Housatonic River near New Milford, Conn.	5/26/94	1,420			38.2			27.8				13.9
01200600	Housatonic River near New Milford, Conn.	6/07/94	848			37.3							
01200600	Housatonic River near New Milford, Conn.	6/28/94	584			18.6			14.2				
01200600	Housatonic River near New Milford, Conn.	8/23/94	2,870			70.2			56.2				28.1
01208500	Naugatuck River at Beacon Falls, Conn.	5/17/94	1,000			9.79	130				734		
01208500	Naugatuck River at Beacon Falls, Conn.	5/25/94	403		4,240				12.8				
01208500	Naugatuck River at Beacon Falls, Conn.	6/01/94	263				26.4				257		
01208500	Naugatuck River at Beacon Falls, Conn.	6/10/94	148		6.88		50.7			2.90	272		
01208500	Naugatuck River at Beacon Falls, Conn.	8/23/94	2,620			44.9			83.3				

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